INTER PLANT STANDARD – STEEL INDUSTRY		
IPSS	**SPECIFICATION FOR ac ROLLER TABLE MOTORS** (*Second Revision*)	**IPSS:1-03-007-14**
	Corresponding IS does not exist	Formerly : IPSS:1-03-007-03

0. FOREWORD

0.1 This Inter Plant 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 ac Roller Table 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 sub-assemblies used in steel plant equipment and accessories and provide guidance in indenting stores or equipment for existing or new installations by individual steel plants. For exercising effective control on inventories, it is advisable to select 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 Inter Plant Standard should be read in conjunction with IPSS:1-03-016-14 `Standard information for enquiry and order for electric motors (*second revision*).

0.4 This second revision has been carried out because of the following :

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

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

1. SCOPE

1.1 This Inter Plant Standard covers the requirements of three phase squirrel cage induction motors (including roller table motors of geared motor design) operating on DOL starting or VVVF source with large rate of switching operations used for roller table drives in rolling mills in the steel plants.

1.2 **Class of Insulation** – The ac roller table motors shall have windings of class `H' insulation (with enamel coating) unless otherwise specified [see IS 1271:1985 Thermal evaluation and classification of electrical insulation *(first revision*)]'. Temperature rise limited to class B with class F insulation.

1.3 Motor shall be suitable for required no. of switching operations / reversals per hour either with DOL starting or with VVVF operation.

2. SITE CONDITIONS

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

2.1 **Ambient Temperature** – The reference ambient temperature shall be 40ºC.

NOTE: For using motors at higher ambient temperature the guidance given in 7.3 shall be followed.

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

2.3 **Ambient Air** – Ambient air may contain fair amount of conductive dust.

2.4 **Altitude** – The altitude shall not exceed 1000 m.

2.5 **Form and Symmetry of Currents and Voltages of supply** – These shall conform to 3.2 of IS 325:1996 `Specification for three phase induction motors (*fourth revision*)' except when the motors are fed from static frequency convertors.

NOTE : Limits for wave form distortion for operation of motors from static frequency convertors are under consideration.

3. **TERMINOLOGY** - For the purpose of this standard, the following definition shall apply :

3.1 **Acceleration Torque –** The acceleration value `B' is a measure of the amount of acceleration work the motor is capable of doing during one hour. Its value is determined as the product of total inertia (expressed in GD^2) to be accelerated and the maximum number of starts per hour of the motor without exceeding the permissible temperature limit. The unit of `B' is kgm^2/h.

NOTE 1 : For duty cycles involving electric braking, recommended equivalent number of starts are given below for guidance:

Jogging/inching operation is equivalent to 0.25 starts

One plug reversal is equivalent to 4 starts.

One dc Dynamic braking stop is equivalent to 2 starts.

One plug stop is equivalent to 3 starts.

NOTE 2 : For computation of the required acceleration value B, a recommended method is given below:

$B = KZ\ GD^2$, where
K = 0.25 for jogging/inching operation.
K = 1 for start (from `0' to 0.9 n_o to 0 rev/min)
K = 2 for dynamic braking (from 0.9 n_o to 0 rev/min)
K = 4 for plug reversal (from 0.9 n_o to 0.9 n_o rev/min)
Z = Required number of operations/hour,
GD^2 = Total GD^2 referred to the motor shaft, and
n_o = synchronous speed.

4. TYPE OF ENCLOSURE

4.1 The degree of protection to be provided by the enclosure shall be IP 55 of IS/IEC 60034-5(2000) [IS 4691:1985 is withdrawn] or better as required by the purchaser.

5. METHOD OF COOLING

5.1 The method of cooling used shall be IC 410 in accordance with IS 6362:1995 `Designation of methods of cooling of rotating electrical machines'. For operation between 1–50 Hz, the motor cooling shall be as per IC 416. IC 401 for non ventilated motors, fins if required on the motor body shall be circular. Space heaters to be provided if specified.

6. MOUNTING

6.1 The mounting shall conform to any one of the designations IMB 3 or IMB 5 specified in IS 2253:1974 `Designations for types of construction and mounting arrangement of rotating electrical machines (*first revision*)'. If specified, hollow shaft extension may be provided according to the drawing provided by the purchaser.

7. RATED VOLTAGE, FREQUENCY AND PERFORMANCE VALUES

7.1 **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%, -10% in general cases but in special cases if desired by the purchaser.

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.

7.1.1 The motor shall be suitable for operating in the frequency range of 5-50 Hz with corresponding voltage variation for obtaining rated torque when used for variable speed application. For motor operation between 1-50 Hz, the motor cooling shall be as per IC 416. Maximum frequency shall be non VVVF and ≥ 75%.

7.1.2 The motor shall be suitable for direct-on-line starting for non-VVVF application.

7.2 **Performance Values** - The performance values shall be as given in **Table-1**.

7.3 **Correction Factors for Ambient Temperature** - The rated acceleration value as specified in **Table-1**, correspond to the standard ambient temperature of 40°C. For higher ambient temperature, the following correction factors for acceleration values shall be applied for selection of desired kW rating accordingly:

45°C - 93% of the rated acceleration value at 40°C

50°C - 85% of the rated acceleration value at 40°C

55°C - 80% of the rated acceleration value at 40°C

60°C - 75% of the rated acceleration value at 40°C

7.4 The motors shall also be suitable for operation on static frequency convertors.

NOTE: Limits for waveform distortion for operation of motors from static frequency convertors are under consideration.

7.5 The motors shall be suitable for type of duty S_4, S_5, S_6 and S_7 [IS 12824:1989 is withdrawn]. While the units are driven through VVVF. However for DOL, the detailed number of switching cycles shall be considered to check the capacity of motor and its value.

7.6 **Stalled Rotor Withstand Time** - Motors shall be suitable for a stalled rotor withstand time of 1 to 3 minutes as specified by the purchaser when starting from cold under rated voltage conditions (see NOTE under **Table-1**).

8. DIMENSIONS

8.1 The basic dimensions of foot-mounted and flange mounted ac roller table motors and their shaft extensions shall correspond to IS 1231:1974 `Dimensions of three-phase foot-mounted induction motors (*third revision*)' and IS 2223:1983 `Dimension of flange-mounted ac induction motors (*first revision*)' respectively.

9. SPECIAL CONSTRUCTIONAL FEATURES

9.1 **Material of Body** - Material of the motor body shall be cast iron grade FG-260 conforming to IS 210:2009 `Specification for grey iron castings (*fourth revision*)', or SG iron conforming to IS 1865:1991 `Specification for iron castings with spheroidal or nodular graphite (*second revision*)' or fabricated steel conforming to IS 2062:2011 `Steel for general structural purposes (*superseding IS 226:1975*)'.

9.2 For foot-mounted motors with cast iron/SG iron body, the feet shall be integrally cast with the body.

9.3 IC-401 shall be for non-ventilated motors. Fins, if provided on the motor body, shall be circular.

9.4 Separately screwed eyebolts or lifting lugs of suitable sizes shall be provided on the motor for the purpose of lifting. Eyebolts conforming to IS 4190:1984 `Specification for eyebolts with collars' shall be used.

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

9.6 **Bearings** - All bearings shall have an L_{10} life of at least 40000 h [IS 3824 (part 1 to 4):1983 are withdrawn] or minimum medium duty (C_3) 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.

9.7 **Lubrication of Bearings** - Regreasing facility through a grease nipple conforming to IS 4009(Parts 1 & 2):1981 `Specification for grease nipples (*first revision*)', along with facility for excess grease removal shall be provided for motors of frame sizes 160 and larger and for above160 frame as per suppliers practice.

9.8 **Fixing Bolts for End Shields** - The minimum size of end shield fixing bolts shall be M8. The bolts shall have hexagonal heads.

9.9 **Terminals and Terminal Box** - Unless otherwise specified, the motor shall be star connected and only 3 terminals of the motor windings shall be brought out in the terminal box. Terminal box shall be as per detailed engineering requirements. Separate auxiliary terminal box for thermistor shall be provided.

9.9.1 The provisions of the terminal box shall be in accordance with clause 5 of IS 1231:1974. It shall be possible to turn the terminal box to any of the four positions at 90^{o} intervals to permit cable entry from any of these four positions / or at rear end as specified. Separate auxiliary terminal to be provided for thermistor.

9.9.2 Use of space heaters if specified by the purchaser.

9.10 **Interchangeability of Parts** - The motors of identical rating supplied in a lot by the same supplier shall have the interchangeability in the following parts:

a) Rotors,

b) End shield,

c) Bearing capsules

d) Bearing cups

e) Self cooling fans.

10. EARTHING

10.1 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 clause 12.2.2.2 of IS 3043 : 1987 `Code of practice for earthing (*first revision*)'.

11. TEMPERATURE-RISE TEST

11.1 The temperature-rise test shall be carried out at full load in accordance with 22 of IS 325:1996 as per class 1.2 by subjecting the motor to the rated acceleration value (B). The permissible limits of temperature-rise shall not exceed the relevant values given in Table-1 of IS 325:1996 as per clause 1.2.

11.2 **Temperature Rise Test Under Stalled Rotor Condition** – The temperature shall be measured by applying rated voltage to the motor with rotor locked. The temperature-rise shall not exceed the permissible value for the relevant insulation class.

12. LIMITS OF VIBRATION

12.1 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.

13. LIMITS OF NOISE LEVEL

13.1 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.

14. TERMINAL MARKING

14.1 Terminals shall be marked in accordance with IS/IEC 60034-8(2002) [IS 4728:1975 is withdrawn]. Identical markings shall be provided both on the leads and the terminal blocks.

15. RATING PLATE

15.1 Rating plate made of stainless steel stating the following particulars shall be fixed on the body of the motor:

a) Reference to this interplant standard, i.e. IPSS:1-03-007-14;

b) Rated output in kW,

c) Name of the manufacturer and trade mark,

d) Manufacturer's serial number and frame reference,

e) Rated voltage and winding connection of the motor,

f) Rated current in A at rated voltage,

g) Speed in rev/min at rated output,

h) Rated frequency,

i) Class of insulation,

j) Type of duty,

k) Bearing designation,

l) Type of enclosure,

m) Mass of motor in kg,

n) Stalled rotor withstand time, and

o) Year of manufacture.

NOTE: An additional name plate may be used to indicate the designation of bearings, lubrication details (type, quantity and frequency).

16. TESTS

16.1 The tests applicable to the motors covered by this standard shall be in accordance with **Table-2**. A certificate indicating the routine tests conducted on each motor including thermal withstand capability shall be supplied with the motors. A proforma given in **Appendix-A** may be used to indicate the results of type tests specified in **Table-2**. The manufacturer shall supply type test certificate with each order whenever required by the user. The manufacturer will supply the air gap figure.

TABLE – 2

TESTS ON ac ROLLER TABLE MOTORS

SL No.	Test	Clause Ref. In ISs	Classification of Test
1.	Measurement of winding resistance at ambient temperature	21.3.1 of IS 325:1996	Routine and type test
2.	Insulation resistance test (both before and after the high voltage test)	24 of IS 325:1996	Routine and type test
3.	High voltage test	23 of IS 325:1996	Routine and type test
4.	No Load Test	21.3.1 of IS 325:1996	Routine and type test
5.	Locked rotor test (for breakaway torque and breakaway starting current)	21.3.1 of IS 325:1996	Routine and type test
6.	Performance at the lowest and at the highest frequency	--	Routine and type test
7.	Temperature-rise test (see 11.1)	22 of IS 325:1996	Type test
8.	Load test at rated voltage (for verification of efficiency, power factor and slip as declared by manufacturer)	21.3.1 of IS 325:1996	Type test
9.	Speed torque test (pull-up, pull-out and breakaway torque) over the entire range of 10 to 75 Hz with an interval of 5 Hz.	--	Type test
10.	Over speed test (120% of the speed corresponding to maximum frequency for two minutes)	25 of IS 325:1996	Type test
11.	Mechanical inspection a) Dimensional checking (including checking of air gap) b) Dismantle/Inspection/Reassembly c) Balancing of the rotor d) Mass of the motor	--	Type test
12.	Stalled rotor withstand time test (for 3 minutes or 10 minutes as specified under rated voltage condition)	--	Type test
13.	Test for verification of acceleration value (dynamic constant) of the motor. The acceleration value (in kgm^2/h) may be verified by subjecting the motor to continuous plug reversals with a pure inertia load coupled to the motor. The rate of plug reversals to be adjusted depending on the acceleration value specified and the inertia of load. The steady state temperature-rise should be within the limits specified for the insulation class.	--	Type test

Note: Speed type test shall be for rated load and peak load in case of VFD motors. Break away and pull out torque for DOL motors.

TABLE - 1

PERFORMANCE VALUES OF ac ROLLER TABLE MOTORS

(Clause 7.1, 7.2, 7.3 and 7.6)

Sl. No.	Nearest Frame Size as per IS	Synchron-ous speed at 50 Hz, rpm	Breakaway Torque in kgm at 415 V, 50 Hz	Breakaway Starting Current at 415 V, 50 Hz	Acceleration Value (B) in kgm^2/h at				Maximum GD^2 of Rotor in kgm^2
					25% CDF	40% CDF	60% CDF	100% CDF	
1	2	3	4	5	6	7	8	9	10
				FOOT MOUNTED MOTORS					
1	132 M	1000	2.4	nil	1200	nil	nil	nil	0.063
2	180 L	750	7	nil	3900	nil	nil	nil	0.32
3	180 L	600	7	nil	5700	nil	nil	nil	0.32
4	200 L	600	14	nil	8900	nil	nil	nil	2
5	225 S			Under Consideratlon					
6	250 M	375	20	nil	22800	nil	nil	nil	3.2
				FLANGE MOUNTED MOTORS					
	Flange Designation & Frame Size								

1	F 265 B & 132 M	1000	2.4	nil	1200	nil	nil	nil	0.063
2	F 265 B & 132 M	600	2.4	nil	2600	nil	nil	nil	0.063
3	F 350 B & 200 L	600	14	nil	8900	nil	nil	nil	2

NOTE 1 : The values given in this Table are applicable for 10 minutes stalling time; relevant values for 3 minutes stalling time under consideration.

NOTE 2: The value of rotor GD^2as given in column 10 is for general guidance only.

APPENDIX - A

(Clause 16)

PROFORMA FOR TYPE TEST REPORT OF ac ROLLER TABLE MOTORS CONFORMING TO IPSS:1-03-007-14

Name and Address of the Manufacturer

Purchaser

Certificate No.

Purchaser's Order No.

Order Acceptance No.

NAME PLATE DATA

Breakaway Torque in kgm	Rated Voltage in Volts	Winding Connection	Breakaway Starting Current in A	Rated Frequency Range of Frequency in Hz	Speed in rpm at Rated Output	Frame Size/ Flange Designation	Enclosure	Method of Cooling	Accelera-tion value in kgm^2/h	GD^2 of Rotor in kgm^2
1	2	3	4	5	6	7	8	9	10	11

APPENDIX - A (Contd/-)

NAME PLATE DATA (Contd/-)

Stalled Rotor Withstand Time	Locked Rotor Current	Type of Duty	Mass in kg	Rated Output in kW	Rated Current in A at Rated Voltage	Class of Insulation	Bearing Designation	Year of Manufac-ture	Lubrication Details
12	13	14	15	16	17	18	19	20	21

APPENDIX - A (Contd/-)

TESTS

Stator Winding Resistance per phase	Insulation Resistance		High Voltage Test	Overspeed Test	Stalled Rotor Withstand Time
	Before HV Test	After HV Test			
…ohms at ^{o}C	…M-ohm	…M-ohm	Withstand kV for …… minutes	Tested at ..… rev/min for ….. minutes	Rotor stalled for …..... minutes, Temperature-rise at the end of the Test …^{o}C
1	2	3	4	5	6

APPENDIX - A (Contd/-)

8. LOAD TESTS

Loading Condition	Volts	Amperes	Watts	% Slip	Load	Power Factors Guaranteed Test	Efficiency Guaranteed Test
No Load 1/2 Load 3/4 Load Full Load							

9. TEMPERATURE-RISE TEST

Condition of Test				Temperature-Rise ^{o}C Stator	
Hours Run	Line Volts	Line Amperes	Cooling Air ^{o}C	Core by Thermometer	Windings by Resistance or Thermometer

Breakaway Torque in kgm with…….Volts Applied

Breakaway Starting Current (Locked Rotor) with…….volts applied

APPENDIX - A (Contd/-)

10. Performance at the lowest and at the Highest Frequency

SPEED TORQUE TEST

	Lowest Frequency	Highest Frequency
Speed in rev/min		
Current in amperes		

Torque in kgm

11. Verification of Acceleration Value

Acceleration Value computed as per clause 3 and as per test carried out as specified in Sl.No.13 of Table-2 of IPSS:1-03-007-
00(R_1D_3).....kgm^2/h 14(F)

Steady state temperature-rise.....^oC