

# **KARNATAKA POWER TRANSMISSION CORPORATION LIMITED**

## **SECTION-INDUCTION MOTORS**

## **CONTENTS**

1.0	SCOPE .....	3
2.0	CODES AND STANDARDS .....	3
3.0	DRIVEN EQUIPMENT .....	3
4.0	PERFORMANCE AND CHARACTERISTICS .....	3
5.0	INSULATION .....	4
6.0	TEMPERATURE RISE .....	5
7.0	CONSTRUCTIONAL FEATURES .....	5
8.0	BEARINGS.....	5
9.0	TERMINAL BOX.....	5
10.0	PAINT AND FINISH .....	6
11.0	HEATING DURING IDLE PERIODS.....	7
12.0	ACCESSORIES .....	7
13.0	TESTS .....	7

## **1.0 SCOPE**

- 1.1 The specification covers the design, material, constructional features, manufacture, inspection and testing at the VENDOR'S/his SUB-VENDOR'S works, delivery to site and performance testing of Low Voltage induction motors rated up to 1000V.

## **2.0 CODES AND STANDARDS**

- 2.1 The design, material, construction, manufacture, inspection, testing and performance of induction motors shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the applicable standards specified in data sheet A1 latest revision as on the date of offer. Nothing in this specification shall be construed to relieve the VENDOR of this responsibility. In case of conflict between the standards and this specification, this specification shall govern.

## **3.0 DRIVEN EQUIPMENT**

- 3.1 When this specification forms part of the driven equipment specification, information not given in the Data Sheet-A will be governed by the driven equipment specification.
- 3.2 Motors shall be capable of satisfactory operation for the application and duty as specified in the motor Data Sheet-A and as specified for the driven equipment.

## **4.0 PERFORMANCE AND CHARACTERISTICS**

- 4.1 Motors shall be capable of giving rated output without reduction in the expected life span when operated continuously under either of the following supply conditions as specified in Data Sheet-A.

<u>Supply Condition</u>		
	<b>I</b>	<b>II</b>
(a) Variation in supply voltage from rated voltage	$\pm 6\%$	$\pm 10\%$
(b) Variation in supply frequency from rated frequency	$\pm 3\%$	$\pm 5\%$

(c)	Combined voltage and frequency variation	9%	10%
-----	--	----	-----

- 4.2 Motors shall be suitable for the method of starting specified in the Data Sheet-A.
- 4.3 The minimum permissible voltage shall be 85% of the rated voltage during motor starting
  - 4.3.1 Motors shall be capable of starting and accelerating the load with the applicable method of starting, without winding temperatures reaching injurious levels, when the supply voltage is in the range of 85% of the rated motor voltage to maximum permissible voltage specified in Data Sheet-A.
- 4.4 The locked rotor current of the motor shall not exceed 600% of full load current (subject to tolerances as per the applicable standard) unless otherwise specified.
- 4.5 Motors shall be capable of developing the rated full load torque even if the supply voltage drops to 70% of the rated voltage. The pull out torque of the motor shall be atleast 205% of full load torque.
- 4.6 Motors when started with the driven equipment coupled shall be capable of withstanding at least two successive starts from cold conditions & one start from hot condition without injurious heating of windings. The motors shall also be suitable for three equally spread starts per hour under the above referred supply conditions.
- 4.7 Motors shall be of Energy Efficient type if specified in Data sheet-A1. Category of Energy efficiency shall be as mentioned in data sheet-A1

## **5.0 INSULATION**

- 5.1 The insulation shall be given tropical and fungicidal treatment for successful operation of the motor in hot, humid and tropical climate.
- 5.2 Insulation of VFD controlled Motors shall be designed to withstand a dv/dt of 0.1 micro sec rise from 10 % to 90 % of steady voltage

and a maximum peak of 1600 volts as per NEMA standard MG1 Part 31.40.4.2

## **6.0 TEMPERATURE RISE**

- 6.1 The temperature rises shall not exceed the values given in IS 12802. Under extremes of supply condition (clause 4.1 above), the temperature rise shall not exceed the value indicated in IS by 10°C.
- 6.2 For motors specified for outdoor installation heating due to direct exposure to solar radiation shall be considered.

## **7.0 CONSTRUCTIONAL FEATURES**

- 7.1 All windings shall be of Copper
- 7.2 Motors weighing more than 25 kg. shall be provided with eyebolts, lugs or other means to facilitate safe lifting.

## **8.0 BEARINGS**

- 8.1 Unless otherwise specified in data sheet-A, motor bearings shall not be subjected to any external thrust load.
- 8.2 Unless otherwise specified, motor bearings shall have an estimated life of at least 40,000 hrs.
- 8.3 The bearings shall permit running of the motor in either direction of rotation.
- 8.4 When forced oil lubrication or water cooling is required, prior approval from the purchaser shall be obtained.
- 8.5 It shall be possible to lubricate the bearings without dismantling any part of the motor.
- 8.6 VFD controlled Motors shall have their bearings insulated to prevent motor shaft currents from entering the bearing race.

## **9.0 TERMINAL BOX**

- 9.1 Terminal boxes shall have a degree of protection of atleast IP 55 for out door applicable

- 9.2 Unless otherwise approved, the terminal box shall be capable of being turned through 360° in steps of 90°.
- 9.3 Terminals shall be of stud type & the terminal box shall be complete with necessary lugs, nuts, washers.
- 9.4 When single core cables are to be used the gland plates shall be of non magnetic material.
- 9.5 Sizes of terminal boxes and lugs shall be as given in Table-I, unless specified otherwise in data sheet A or Section C.

**TABLE-I**

**415 V MOTORS - SIZES OF CABLES, STUDS, TERMINAL LUGS & TERMINAL BOXES (TO BE PROVIDED ON MOTORS BY VENDOR)**

Sl No.	Motor Rating (kW)	1100V Al. Conductor, armoured PVC/XLPE Cable Cores x mm <sup>2</sup>
1.	Upto 3	3x4
2.	3.1 - 7.5	3x6
3.	7.6 - 15	3x16
4.	16 - 25	3x35
5.	26 - 40	3x70
6.	41 - 55	3x120
7.	56 - 70	3x185
8.	71 - 85	3x240
9.	86 - 110	3x400
10.	111 - 200	3x1Cx500

**10.0 PAINT AND FINISH**

- 10.1 All motor parts exposed directly to atmosphere shall be finished and painted to produce a neat and durable surface which would prevent rusting and corrosion. The equipment shall be thoroughly degreased, all rust, sharp edges and scale removed and treated with one coat of primer and finished with two coats of grey enamel paint.

## **11.0 HEATING DURING IDLE PERIODS**

- 11.1 Motors rated above 30 kW shall have space heaters suitable for 240V, single phase, 50 Hz, AC supply. Space heaters shall have adequate capacity to maintain motor internal temperature above dew point to prevent moisture condensation during idle period. The space heaters shall be placed in easily accessible positions in the lowest part of the motor frame.

## **12.0 ACCESSORIES**

- 12.1 Two independent earthing points shall be provided on opposite sides of the motor, for bolted connection of the PURCHASER'S earthing conductors as specified in data sheet-A. These earthing points shall be in addition to earthing stud provided in the terminal box.
- 12.2 Except when otherwise specified, the motors shall be provided with a bare shaft extension having a key slot and a key at the driving end.

## **13.0 TESTS**

- 13.1 Motor shall be subjected to all the routine tests as per applicable standard in the presence of the PURCHASER'S representative. Copies of test certificates of type and routine tests, shall be furnished as specified in the distribution schedule, for the PURCHASER'S approval. The VENDOR shall ensure to use calibrated test equipment/instruments having valid calibration test certificates from standard laboratories traceable to national/international standards.
- 13.2 If type tests have not been carried out on similar Motors, or if the type test reports submitted are not found in order, then VENDOR shall carry out these tests without any extra cost to the Purchaser.

**INFORMATION TO BE SUBMITTED BY THE VENDOR**  
**AFTER AWARD OF CONTRACT**

- 1.0 Technical particulars as per data sheet B of tender specification. (Based on motor manufacturer)
- 2.0 Type and frame size :
- 3.0 Starting time (Secs)
  - 3.1 With 100% voltage at terminals
  - 3.2 With minimum voltage at terminals (at \_\_\_\_ % Rated voltage)
  - 3.3 With 110% voltage at terminals
- 4.0 Safe stall time at 100/110% rated voltage under hot/cold condition.
- 5.0 Type and size of cable for which gland is provided in the terminal box :
- 6.0 Type of bearings and expected life.
- 7.0 Total weight of motor (kg)
  - 7.1 Weight of Stator (kg)
  - 7.2 Weight of Rotor (kg)
- 8.0 Motor  $GD^2$  :
- 9.0 Efficiency (%)
  - 9.1 Full Load Efficiency
  - 9.2 75% Load Efficiency
  - 9.3 50% Load Efficiency
  - 9.4 25% Load Efficiency
- 10.0 Power Factor



- 10.1 Full Load Power Factor
- 10.2 75% Load Power Factor
- 10.3 50% Load Power Factor
- 10.4 25% Load Power Factor
- 11.0 Torque (% FLT)
- 11.1 Starting
- 11.2 Maximum (Pullout torque)
- 11.3 Pull up torque
- 12.0 Type of Enclosure
- 13.0 Cooling designation
- 14.0 Space heaters
- 14.1 Rated voltage/number
- 14.2 Rating total
- 14.3 Separate terminal box provided
- 15.0 Motor reactances (Pu)
- 15.1 Subtransient reactance
- 15.2 Transient reactance
- 15.3 Steady state reactance
- 16.0 Guaranteed losses (kW)
- 16.1 Iron loss
- 16.2 Copper loss
- 16.3 Friction, Windage & Stray losses.

- 17.0 Motor outline dimension drawing  
(Number of copies as per distribution schedule)
- 18.0 Type test certificates (Number of copies as per distribution schedule)
- 19.0 Speed torque curve at rated & minimum starting voltage with  
Speed/Torque curve of the driven equipment superimposed.
- 20.0 Current - speed curve.
- 21.0 Current - time curve.
- 22.0 Efficiency, power factor, slip, current against output curve.
- 23.0 Thermal withstand characteristic for motors of 100 kW & above - Hot  
& Cold.
- 24.0 Negative sequence current Vs time curve for motor of 100 kW & above.
- 25.0 Rotor voltage/Rotor current (for wound motors).

### **DATA SHEET A1**

SL.NO.	DESCRIPTION	UNIT	TECHNICAL PARTICULARS
1.0	GENERAL		
1.1	APPLICATION		
1.2	NUMBERS REQUIRED		
1.3	TYPE OF MOTOR		SQUIRREL CAGE / WOUND ROTOR
1.4	SUPPLY SYSTEM FAULT LEVEL	MVA	
1.5	TYPE OF EARTHING OF SUPPLY SYSTEM NEUTRAL		
2.0	RATING		
2.1	RATED OUTPUT :	kW	
2.2	RATED VOLTAGE :	V	
2.3	NUMBER OF PHASES & FREQUENCY		
2.4	SUPPLY CONDITION (REF. CL.NO.4.1 OF TCE.M4-203-01)		I/II
2.5	SYNCHRONOUS SPEED	RPM	
3.0	DUTY		
3.1	TYPE OF DUTY (CLAUSE 9.2 OF IS:325 OR EQUIVALENT)		
3.2	POWER REQUIRED BY LOAD	kW	
3.3	ENERGY EFFICIENCY CLASS AS PER IS-12615		EFF1/EFF2
4.0	METHOD OF STARTING		D.O.L./STAR DELTA/ SOFT START/OTHER
5.0	INSULATION		
5.1	CLASS OF INSULATION		F

5.2	REF. AMBIENT TEMPERATURE	deg.C			
5.3	TEMPERATURE RISE OF WINDINGBY WDG RESISTANCE METHOD	deg.C	Corresponding to Class B Insulation		
6.0	INSTALLATION				
6.1	LOCATION		Indoor/Outdoor		
6.2	HAZARDOUS AREA DIVISION (IS:5572 OR EQUIVALENT)				
6.3	ATMOSPHERE		CHEMICAL/DUSTY/SALT LADEN		
7.0	ENCLOSURE				
7.1	TYPE OF COOLING (IS 6362)				
7.2	DESIGNATION FOR DEGREE OF PROTECTION (IS 4691)				
8.0	MAIN TERMINAL BOX				
8.1	LOCATION AS SEEN FROM NON- DRIVE END: RATINGS		TOP/RIGHT/LEFT		
8.2	(a) SHORT TIME	kA(RMS) SECS.	0.25		
	i. CURRENT :				
	ii. DURATION :				
	(b) DYNAMIC :	kA(PEAK)			
8.3	EXTERNAL CABLE DETAILS				
8.3.1	TYPE				
8.3.2	SIZE & NO OF CORES				
8.4	EARTHING CONDUCTORS				
8.4.1	MATERIAL				
8.4.2	SIZE				
Spec. of Induction Motor					
Page 12 of 20					

9.0	MISCELLANEOUS REQUIREMENTS		<b><u>TO BE FILLED IF MOTORS ARE BOUGHT SEPERATELY</u></b>
9.1	SHAFT ORIENTATION		HORIZONTAL/VERTICAL/HOLLOW VERTICAL
9.2	MOUNTING SYMBOL (IS:2253OR EQUIVALENT)		
9.3	ROTATION AS SEEN FROM NON-DRIVE END		CLOCKWISE/ANTI-CLOCKWISE
9.4	TYPE OF BEARING		
9.4.1	DRIVE END		
9.4.2	NON DRIVE END		
9.5	WHETHER BED PLATE REQUIRED		YES/NO
9.6	MOTOR SHALL MATCH THE FOLLOWING TORQUE REQUIREMENTS OF THE DRIVEN EQUIPMENT: a) STARTING TORUE b) FULL LOAD (RATED) TORQUE c) PULL OUT TORQUE d) PULL UP TORQUE		
9.7	COUPLING BY MOTOR SUPPLIER		YES/NO
9.8	IF YES, TYPE OF COUPLING		
9.9	GD <sup>2</sup> of LOAD		
10.0	COLOUR SHADES OF PAINT		
11	a) WHETHER VIBRATION PADS REQUIRED b) IF REQUIRED SIZE OF THE PAD		YES/NO
12	TEMPERATURE DETECTORS/INDICATORS		

--	--	--	--	--

12.1	EMBEDDED TEMPERATURE DETECTORS FOR WINDING REQUIRED		YES/NO	
12.2	EMBEDDED TEMPERATURE DETECTORS FOR BEARINGS REQUIRED		YES/NO	
12.3	BEARING THERMOMETERS FOR DRIVING END & NON DRIVING ENDS REQUIRED		YES/NO	
13	SPACE HEATERS FORMOTORS REQUIRED		YES/NO	

### **DATA SHEET A2**

<b>SL.N O.</b>	<b>BRIEF TITLE</b>	<b>REFERENCE STANDARDS</b>	<b>NUMBER</b>	<b>OF</b>
1.	THREE PHASE INDUCTION MOTORS	<input type="checkbox"/> IS-325	<input type="checkbox"/> BS-4999	<input type="checkbox"/> IEC-34
2.	ROTATING ELECTRICAL MACHINES	<input type="checkbox"/> IS-4722	<input type="checkbox"/> BSEN60034- 1	<input type="checkbox"/> IEC-34-1
3.	SINGLE PHASE INDUCTION MOTORS	<input type="checkbox"/> IS-996	<input type="checkbox"/> BS	<input type="checkbox"/> IEC
4.	CODE OF PRACTICE FOR CLIMATE PROOFING	<input type="checkbox"/> IS	<input type="checkbox"/> BS-6751	<input type="checkbox"/> IEC
5.	DESIGNATIONS FOR TYPES OF CONSTRUCTION AND MOUNTING OF ARRANGEMENT OF ROTATING ELECTRICAL MACHINES	<input type="checkbox"/> IS-2253	<input type="checkbox"/> BSEN60034- 7	<input type="checkbox"/> IEC-34-7
6.	TERMINAL MARKING & DIRECTION OF ROTATION FOR ROTATING ELECTRICAL MACHINERY	<input type="checkbox"/> IS-4728	<input type="checkbox"/> BS-4999- 108	<input type="checkbox"/> IEC-34-8
7.	DESIGNATION OF METHODS OF COOLING FOR ROTATING ELECTRICAL MACHINES	<input type="checkbox"/> IS-6362	<input type="checkbox"/> BSEN 60034-6- 1994	<input type="checkbox"/> IEC-34-6
8.	DEGREES OF PROTECTION PROVIDED BY ENCLOSURE FOR ROTATING ELECTRICAL MACHINERY	<input type="checkbox"/> IS-4691	<input type="checkbox"/> BS- EN60529	<input type="checkbox"/> IEC-529
9.	GUIDE FOR TESTING THREE PHASE	<input type="checkbox"/> IS-4029	<input type="checkbox"/> BSEN60034-	<input type="checkbox"/> IEC-34-2



SL.N O.	BRIEF TITLE	REFERENCE STANDARDS	NUMBER	OF
	INDUCTION MOTORS		2	
10.	MEASUREMENT AND EVALUATION OF VIBRATION OF ROTATING ELECTRICAL MACHINES	<input type="checkbox"/> IS-12075	<input type="checkbox"/> BS- 4999142	<input type="checkbox"/> IEC-34- 14
11.	CLASSIFICATION OF HAZARDOUS AREAS FOR ELECTRICAL INSTALLATION	<input type="checkbox"/> IS-5572	<input type="checkbox"/> BS	<input type="checkbox"/> IEC-79
12.	DIMENSIONS OF SLIDE RAILS FOR ELECTRIC MOTORS	<input type="checkbox"/> IS-2968	<input type="checkbox"/> BS-4999- 141	<input type="checkbox"/> IEC
13.	PERMISSIBLE LIMITS OF NOISE LEVEL FOR ROTATING ELECTRICAL MACHINES	<input type="checkbox"/> IS-12065	<input type="checkbox"/> BSEN 60034-9- 1994	<input type="checkbox"/> IEC
14.	GUIDE FOR TESTING INSULATION RESISTANCE OF ROTATING MACHINES	<input type="checkbox"/> IS-7816	<input type="checkbox"/> BS	<input type="checkbox"/> IEC
15.	INDUCTION MOTORS- ENERGY EFFICIENT THREE PHASE SQUIRREL CAGE- SPECIFICATION	<input type="checkbox"/> IS-12615		<input type="checkbox"/> IEC- 60034-3
16.	FLAME PROOF A C MOTORS FOR USE IN MINES.	<input type="checkbox"/> IS- 3682		
17.	FLAME PROOF ENCLOSURES OF ELECTRICAL APPARATUS	<input type="checkbox"/> IS-2148		
18.	STARTING PERFORMANCE OF SINGLE SPEED THREE	<input type="checkbox"/> IS-8789	<input type="checkbox"/> BSEN- 60034-12	<input type="checkbox"/> IEC-34- 12





SL.N O.	BRIEF TITLE	REFERENCE STANDARDS	NUMBER	OF
	PHASE CAGE INDUCTION MOTORS FOR VOLTAGE UP TO 600 V			
19.	CAGE INDUCTION MOTORS WHEN FED FROM CONVERTERS – APPLICATION GUIDE			<input type="checkbox"/> IEC-34- 17
20.	ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEM- EMC REQUIREMENTS AND SPECIFIC TEST METHODS.		<input type="checkbox"/> BS-EN- 61800	<input type="checkbox"/> IEC- 61800
21.	DIMENSIONS AND OUTPUT SERIES FOR ROTATING ELECTRICAL MACHINES.	<input type="checkbox"/> IS-1231	<input type="checkbox"/> BS-4999- 141	<input type="checkbox"/> IEC- 72- 1
22.	ELECTRICAL APPARATUS FOR EXPLOSIVE GAS ATMOSPHERE – CLASSIFICATION OF HAZARDOUS AREA.	<input type="checkbox"/> IS-5571	<input type="checkbox"/> BSEn- 60079	<input type="checkbox"/> IEC-79- 10
23.	TEMPERATURE RISE MEASUREMENT OF ROTATING ELECTRICAL MACHINES	<input type="checkbox"/> IS-12802	<input type="checkbox"/> BS	<input type="checkbox"/> IEC
24.	TYPE OF DUTY AND CLASSES OF RATING ASSIGNED TO ROTATING ELECTRICAL MACHINES	<input type="checkbox"/> IS 12824	<input type="checkbox"/> BS	<input type="checkbox"/> IEC
25.	CBIP RECOMMENDATION FOR MOTORS			

## NOTES

1. EQUIPMENT, ASSOCIATED ACCESSORIES, COMPONENTS / PARTS, RAW MATERIAL AND TESTS SHALL IN GENERAL CONFORM TO ☐ IS ☐ BS ☐ IEC
2. OFFERS CONFORMING TO OTHER AUTHORITATIVE STANDARDS MAY ALSO BE CONSIDERED/MAY NOT BE CONSIDERED.

### **DATA SHEET B (TO BE FILLED BY BIDDER)**

1.0	Application				
2.0	Manufacturer				
3.0	Country of Origin				
4.0	Applicable Standards				
5.0	Efficiency Category( For Energy Efficient Motors only)				
6.0	Rated				
	(a)	Output		kW	
	(b)	Speed		RPM	
	(c)	Frame size			
7.0	Type of Duty (IS 325 or equivalent)				
8.0	(a)	Supply Conditions			
		i)	Rated Voltage		
		ii)	No. of Phases	V	
		iii)	Frequency	Hz	
	(b)	Allowable Variations in			

		i)	Voltage	%	
		ii)	Frequency	%	
		iii)	Combined	%	
9.0	Current				
	(a)	Full Load Amps			
	(b)	Starting		% FL	
10.0	Method of Starting				
11.0	Insulation				
11.1	Class of Insulation				
11.2	Whether Tropicalised		Yes/No		
12.0	(a)	Ref. Ambient Temp.		deg.C	
	(b)	Temp. rise of windings by Res. Method			
	i)	Stator		deg.C	
	ii)	Rotor		deg.C	
	(c)	Temp. rise of bearings		deg.C	
13.0	Degree of Protection (IS 4691 or equivalent)				
14.0	Suitable for Outdoor Operation		Yes/No		
15.0	Normal winding connection		Star/D elta		
	(i)	Stator			
	(ii)	Rotor			
16.0	Space heater Rating Terminal box		Watts		

	(i)	Type & No. of Terminals brought Out		
	(ii)	Fault withstand capacity at rated voltage & duration		
	(iii)	Maximum size of Aluminium armoured cable that can be Terminated	cores X Sq mm	
17.0		Dimensional Dwg. Enclosed	Yes/No	
18.0		Torque		
	a)	Full load torque	kg-m	
	b)	Starting torque	% FLT	
	c)	Pull out Torque	% FLT	
	d)	Pull up Torque	% FLT	