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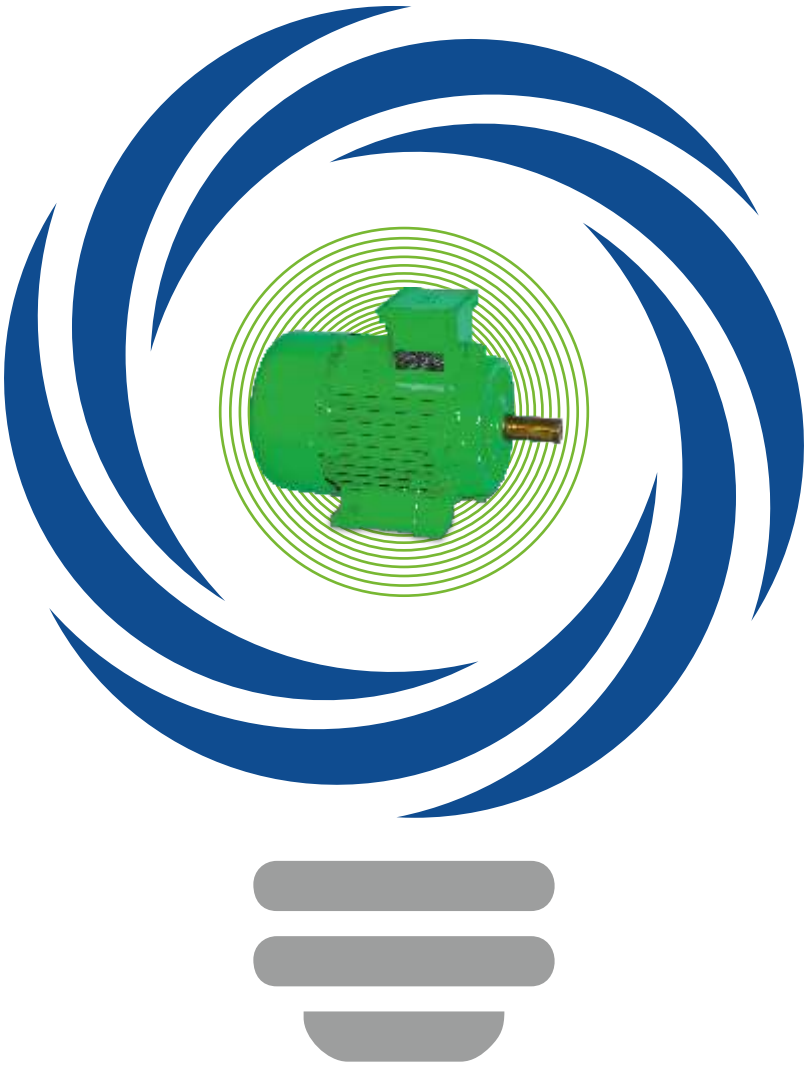
Bharat Bijlee

SynchroVERT™

IE4 Super Premium Efficiency Motors



Bharat Bijlee has always been a front-runner in providing energy efficient motors and automation solutions that help our customers reduce the life-cycle energy costs of their motor-driven systems.

To complement our portfolio of IE2 and IE3 motors, we now introduce - for the first time in India - our new range of **SynchroVERT™** motors that conforms to the Super Premium IE4 class of efficiency. With a remarkably short payback period, they offer significant savings over IE2 and IE3 motors along with a host of technologically superior features.

SUPER PREMIUM EFFICIENCY INDUCTION MOTORS

Global warming and its impact on the environment is an ever-growing concern. Governments and companies across the world are actively seeking solutions to a problem that has the potential to profoundly alter the future of our planet. The ever increasing cost of fuel and electricity adds to the complexity, and directly affects not just industries but entire economies. Renewable energy is only part of the solution.

Electric motors are estimated to consume about 65% of the electrical energy consumed by industry. Moreover, energy costs over the typical life cycle of a motor can be as high as twenty times the original capital cost of the motor. Energy efficient motors thus offer an opportunity to significantly reduce energy costs and their collateral environmental effects. Increasingly, there is a strong economic-and environmental-case for choosing high efficiency motors over conventional ones. Instead of repairing or rewinding a failed motor, organizations may profitably consider replacing them with energy efficient motors or motor driven systems that can bring about significant reduction in energy consumption.

Energy Efficient Motors conform to the following standards defined by IEC 60034-30-1:2014

- Efficiency Class IE1: Standard efficiency
- Efficiency Class IE2: High efficiency
- Efficiency Class IE3: Premium efficiency
- Efficiency Class IE4: Super Premium efficiency

CII NATIONAL
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MOST INNOVATIVE ENERGY
SAVING PRODUCT

Bharat Bijlee's **SynchroVERT™** is a range of Super Premium IE4 class Line Start Permanent Magnet Synchronous Motors (LSPMSM)*. These motors do not need a VFD for operation, unlike most PMSMs, and can easily replace existing squirrel cage induction motors. They offer significant savings over IE2 motors.

ADVANTAGES OF SynchroVERT™

Key benefits of our IE4 LSPMS motor include:

- Online starting
- Can operate without a VFD
- Lossless excitation
- High efficiency
- High power factor at all loads
- No rotor losses
- Runs at synchronous speed
- Suitable for applications with constant torque below synchronous speed and constant HP above synchronous speed
- Multiple motors run at exactly the same speed without VFDs: this eliminates speed encoders for feedback control
- Starting currents are lower than in IE2 motors; starting torque values are similar to IE2 motors

As these are synchronous motors, the rated speed is synchronous i.e. 1500 RPM. With this motor, a pump or fan will run at about 3% higher speed and it will give much higher discharge/air delivery. Hence if the pump or fan is already fully loading the motor, it cannot be used unless the impellor is redesigned or it is used along with a VFD drive.

In other applications, the higher speed results in more output of the product, eg, spinning frames, textile machines, etc.

Product Range

Type	Frame Size	kW range
IE4 Super Premium Efficiency-4H	112M to 180L	2.2 to 22

Our new SynchroVERT™ range of IE4 motors combines high efficiency with a host of technologically superior features

- Super Premium IE4 class of efficiency as per IEC 60034-30-1:2014
- Remarkably short payback periods
- Operates without a VFD
- Line Start Permanent Magnet Synchronous Motor (LSPMSM) technology*

*Patent Pending

Standards

All motors comply with following Indian and International standards

IS/IEC 60034-1	Rotating electric machines: Part 1 Rating and Performance
IS 900	Code of practice for installation & maintenance of induction motors
IS 1231	Dimensions of foot mounted A.C Induction motors
IS 2223	Dimensions of foot Flange mounted A.C Induction motors
IS 15999 part 2 section 1 /IEC 60034-2-1	Rotating Electrical Machines - Standard Methods for determining losses and efficiency from tests
IS /IEC 60034-5	Degree of protection provided by the integral design of Rotating Electrical Machines (IP code) : classification
IS 6362/ IEC 60034-6	Designation of methods of cooling for Rotating Electrical Machines
IS 12065/ IEC 60034-9	Permissible Limits of noise level for Rotating Electrical Machines
IEC 60034-14	Mechanical Vibration of Rotating Electrical Machines
IS 12615:2011	Efficiency classes of line operated AC motors (IE code)
IEC 60072-1	Dimension & Output rating of Rotating Electrical machines

ELECTRICAL FEATURES

Standard Operating Condition

Supply Conditions (Voltage & Frequency)

Voltage : 415 V ± 10%
Frequency : 50 Hz ± 5%
Combined variation : ± 10%

Ambient

Motors are designed for ambient temperature of 50 °C.

Altitude

Motors are designed for an altitude up to 1000 m above mean sea level.

Re-rating factors

The re-rating applicable under different conditions of supply voltage, frequency, ambient & altitude are obtained by multiplying following factors.

Variation in Supply Voltage & Frequency

Voltage Variation %	Frequency Variation %	Combined Voltage & Frequency Variation %	Permissible output as % of rated value
± 10	± 5	± 10	100
± 12.5	± 5	± 12.5	95
± 15	± 5	± 15	90

Variation in Ambient & Altitude

Amb. Temp. °C	Permissible output as % of rated value
30	107
30-50	103
50	100
55	96
60	92

Method of starting

BBL motors are suitable for following method of starting

kW rating	Method of starting	No. of leads
2.2 to 22 kW	DOL or Star/Delta or VFD	6

Starting Time and Duty Cycle

Motors are designed for continuous (S1) Duty. Other types of duty (S2 to S9) can be offered on request. The motors can safely withstand 3 consecutive starts from cold condition & 2 consecutive starts from hot conditions. In applications where more severe starting conditions are encountered, a special enquiry should be made e.g.

- Drives with high inertia e.g flywheel drives, eccentric presses, large fans etc.
- Drives involving intermittent duty of motors with frequent starts e.g. rolling mills, centrifuges and conveyor motors, etc.

The enquiry should be accompanied with following information.

- GD^2 and relevant speed of driven equipment
- Duty cycle/sequence of operation/no. starts/hours
- Speed-Torque diagram of driven equipment
- Method of braking (Electrical or Mechanical)

Insulation and Endurance

The Motors are provided with class F insulation scheme with temperature rise limited to class B. These motors can be used either at ambient temperature of 55 ^{0}C or overloaded continuously by 10% (service factor = 1.1). The temperature rise will be still within limits of class F.

The slot insulation consists of Nomex-polyester-Nomex (NPN). All insulation materials used are adequately resistant to the action of microbes and fungi.

Winding & Insulation Suitable for Inverter Duty Motors

- The stators are wound with polyesteramide base coat with polyamide-imide top coat wires as per IS 13730 - part 13, thermal class 200 copper wires.
- Vacuum Pressure Impregnation (VPI) with Class H (thermal class 180) solvent less resin is provided to windings.

All BBL motors are suitable for inverter duty application. No special software is required for these LSPMSM and any brand of VFD suitable for 3 phase induction motors can be used.

On customer's demand, insulated bearings are offered from frame size 132 and onwards on the NDE side of the motor.

Options

Motors with class 'H' insulation can be offered on request.

Thermal Protection (for Winding & Bearing)

PTC Thermisters/thermostats/RTD etc. can be embedded in stator winding on request.

Earthing Terminals

Two earthing terminals are provided on the body and one terminal is provided in the terminal box.

Anti-condensation Method

In order to avoid condensation of water inside the motors, they can be heated up by connecting a voltage 4 to 10% of rated voltage to the motor terminals. Adequate heating is obtained with current equal to 20-25% of rated motor current. Alternatively any of the methods indicated in IS 900 for heating stator winding could be adopted. Motors can also be offered with built in space heaters.

MECHANICAL FEATURES

Enclosures (Material & T box location)

Motors are offered with following enclosure

Frame Size	Enclosure Materials	Terminals Box Location	
		Standards	Option Available
112M	Aluminum	TOP	LHS
	Cast Iron	RHS	TOP & LHS
132S & 132M	Aluminum	TOP	-
132S-180L	Cast Iron	RHS	TOP & LHS

All foot mounted motors are with integral feet construction.

Cooling

All motors are totally enclosed Fan Cooled (TEFC) The cooling is effected by self driven, bi-directional centrifugal fan protected by fan cover. The Type of cooling is as per IS 6362 / IEC 60034-6.

Forced cooling arrangement can be provided for frame 132S and above.

Cooling Type	Cooling Code	
TEFC	IC 411	Standard
TENV	IC 410	On Demand
FORCED COOLED	IC 416	On Demand

Degree of Protection

All motors have IP55 degree of protection as per IS/IEC 60034-5. Higher degree of protection such as IP56, IP66 can be provided on request. **All flange motors are additionally provided with oil tight shaft protection on driving end side.**

Roller Bearing and Insulated Bearing

- Alternatively motors with insulated bearing on NDE side can be offered from frame size 132 & above on request at extra price.
- Motors can also be offered with cylindrical roller bearing (NU) on DE side for frame sizes 132 and above at extra price.

Grease

Sealed for life bearing (2Z) are filled with grease Unirex N3-ESSO. Other bearings are filled with SKF LGMT3 of SKF make. Special high temperature grease can be provided on request.

Packing

Motors up to 132M frame are packed in thermacol / corrugated boxes. Wooden packing boxes are provided for higher frame size. Export worthy packing is also available on request.

On line re-greasing

On line re-greasing arrangement for frame size 180M and 180L can be provided on request.

Noise Level

Motors are designed for noise level well below the limits specified in IS 12065.

Rotor

Entire range of motors is fitted with dynamically balanced aluminum die cast squirrel cage rotors. These rotors have specially embedded rare earth neodymium magnets.

Shaft

All motors are provided with single shaft extension in accordance with IS 1231. The Shaft material is C40 (EN8) Steel. However any special shaft extension and /or special shaft material e.g. EN24 or stainless steel grades are also provided on request.

Balancing & Vibration

Rotors are dynamically balanced with a half key in the shaft extension. Vibration grade is 'reduced grade' conforming to IS 12075. Other grades as per IS 12075 can be provided on request. Vibration grades conforming to IEC 60034-14 can be provided on request.

Paint

All motors are painted with acrylic paint in Pure Green colour, RAL shade No. 6037. Motors used in corrosive atmosphere are painted with Epoxy base paint. Any other shade or material (e.g. polyurethane paint) can be offered on request.

ENERGY SAVINGS

	Permanent Magnet Synchronous Motors (self starting)					Savings using IE4 PMSM over IE2	
S.No.	Frame	kW	Pole	BBL SynchroVERT LSPM Motor % Eff	BBL IE2 %Eff	Energy (kWh) saving/year based on 6000 Hrs running	Rs. Saving/year based on power rate Rs.9 per kWh
1	112M	2.2	4	89.5	84.3	910	8188
2	112M	3.0	4	90.4	85.5	1141	10270
3	112M	3.7	4	90.9	86.3	1302	11716
4	132S	3.7	4	90.9	86.3	1302	11716
5	132S	5.5	4	91.9	87.7	1720	15477
6	132M	7.5	4	92.6	88.7	2137	19230
7	160M	11.0	4	93.3	89.8	2757	24814
8	160L	15.0	4	93.9	90.6	3491	31420
9	180M	18.5	4	94.2	91.2	3876	34885
10	180L	22.0	4	94.5	91.6	4422	39800

(Refer performance table for details)

BEARING & TERMINALS BOX DETAILS

Frame Size	Bearing nos. C3 Clearance		Terminals Box Type / Location	Terminals		No. & size of cable entries	Max. Cond. Cross Sec. area mm
	DE	NDE		No.	Size		
112M	6206 2Z	6205 2Z	gk230/ TOP	6	M4	2×1''	10
132S,132M	6208 2Z	6208 2Z	gk330/ TOP	6	M5		
160M,160L	6309 2Z	6209 2Z					16
180M,180L	6310 2Z	6309 2Z	gk430/ TOP	6	M6	2×1-1/2''	50

Note: L10 bearing life is 50,000 hours for directly coupled loads through flexible couplings only.

PERFORMANCE TABLE - SUPER PREMIUM EFFICIENCY SynchroVERT LSPM MOTORS - TYPE 4H

TEFC 3 Phase Squirrel Cage LSPM induction Motors - Frame size 112M to 180L

Applicable standards for testing: IEC 60034-2-1:2014
Applicable Efficiency classes of Line operated AC Motors: IEC 60034-30-1:2014

Voltage: 415 V +/- 10%
Frequency: 50 Hz +/- 5%
Combined Variation: +/-10%

Ambient: 50 °C
Duty: S1 (Continuous)
1500 rpm (4-Pole)
Operating Characteristics at Rated Output

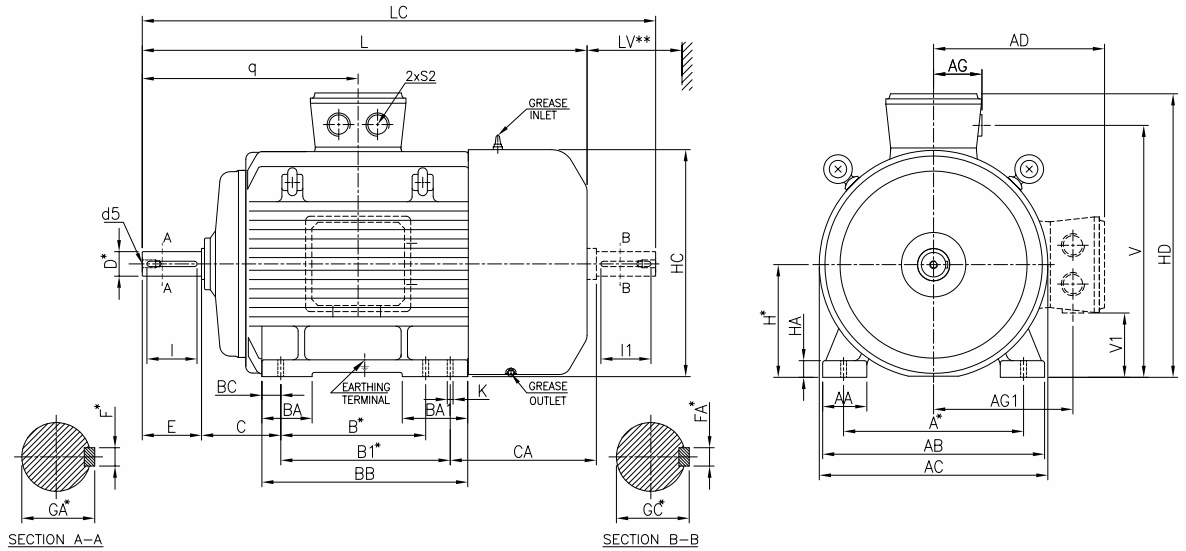
IE4

Ins. Class: F
Temp.Rise: B
Protection: IP55

Rated Output		Frame Size	Type reference - B3 Mounting	Rated Speed	Rated Current	Rated Torque	Power Factor			% Efficiency			With DOL Starting		Pullout Torque to Rated Torque Ratio	Rotor GD^2 kgm^2
kW	HP			RPM	Amps.	Kg.m	FL	3/4FL	1/2FL	FL	3/4FL	1/2FL	Starting Current to Rated Current Ratio	Starting Torque to Rated Torque Ratio		
2.2	3.0	112M	4H11M4S3	1500	4.0	1.4	0.86	0.81	0.71	89.5	89.4	88.6	6.7	2.20	2.7	0.055
3.0	4.0	112M	4H11M4R3	1500	5.4	1.9	0.86	0.81	0.71	90.4	90.4	89.6	6.7	2.20	2.7	0.060
3.7	5.0	112M	4H11M4T3	1500	6.6	2.4	0.86	0.81	0.71	90.9	90.9	90.1	6.7	2.20	2.7	0.060
3.7	5.0	132S	4H13S4W3	1500	6.7	2.4	0.85	0.81	0.69	90.9	90.6	88.8	6.7	2.30	2.5	0.070
5.5	7.5	132S	4H13S4F3	1500	9.8	3.6	0.85	0.81	0.69	91.9	91.7	90.0	6.7	2.30	2.5	0.080
7.5	10.0	132M	4H13M4M3	1500	13.3	4.9	0.85	0.81	0.69	92.6	92.4	90.7	6.7	2.30	2.5	0.120
11.0	15.0	160M	4H16M4N3	1500	19.1	7.1	0.86	0.85	0.76	93.3	92.3	90.3	6.0	2.00	2.2	0.300
15.0	20.0	160L	4H16L4B3	1500	25.8	9.7	0.86	0.85	0.76	93.9	92.9	90.9	6.0	2.00	2.2	0.480
18.5	25.0	180M	4H18M4R3	1500	31.8	12.0	0.86	0.85	0.76	94.2	93.4	91.7	6.0	2.00	2.2	0.560
22.0	30.0	180L	4H18L4T3	1500	37.7	14.3	0.86	0.85	0.76	94.5	93.7	92.0	6.0	2.00	2.2	0.610

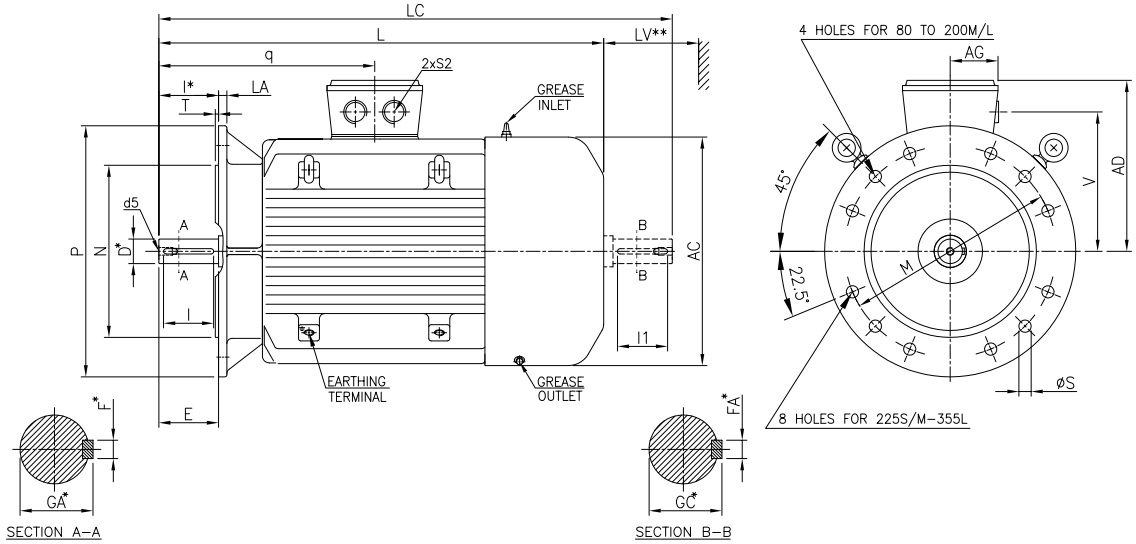
Note: Efficiency class 'IE4' will be printed on the name plate.
All performance values are subjected to tolerance as per IS/IEC 60034-1

SUPER PREMIUM EFFICIENCY IE4 SERIES MOTORS - TYPE 4H, B3, TEFC, FRAME 112M - 180L



		FIXING						GENERAL												TERMINAL BOX				SHAFT					
IEC Fr. Size	Pole	A*	B*	B1*	C	H*	K*	AB	BB	AA	BA	BA1	BC	HA	HC	HD	L	AC	LV**	V	q	AG	S2 BSC	D*	E	F*	GA*	I	d5
112M	4	190	140	--	70	112	12	220	174	47	36	--	21	12	222	282	419	220	45	249	157	56	1"	28	60	8	31	55	M10
132S	4	216	140	--	89	132	12	256	180	54	50	--	20	16	260	328	480	260	50	299	197	63	1"	38	80	10	41	70	M12
132M	4	216	178	--	89	132	12	256	218	56	54	--	20	17	260	328	566	260	50	299	197	63	1"	38	80	10	41	70	M12
160M/L	4	254	210	254	108	160	15	310	294	58	70	105	20	20	334	398	673	348	60	363	345	63	1"	42	110	12	45	105	M16
180M	4	279	241	--	121	180	15	344	281	65	70	--	23	26	354	443	698	354	70	396	343	87	1 1/2"	48	110	14	51.5	100	M16
180L	4	279	279	--	121	180	15	344	319	65	70	--	23	26	354	443	737	354	70	396	377	87	1 1/2"	48	110	14	51.5	100	M16

SUPER PREMIUM EFFICIENCY IE4 SERIES MOTORS - TYPE 4H, B5, TEFC, FRAME 112M - 180L



		FIXING					GENERAL						TERMINAL BOX				SHAFT					
IEC Fr. Size	Pole	P*	N*	M*	i*	S	T	LA	AD	L	LV**	AC	V	q	AG	S2 BSC	D*	E	F*	GA*	I	d5
112M	4	250	180	215	60	15	4	11	170	419	45	220	137	157	56	1"	28	60	8	31	55	M10
132S	4	300	230	265	80	15	4	12	196	480	50	260	167	197	63	1"	38	80	10	41	70	M12
132M	4	300	230	265	80	15	4	12	196	556	50	260	167	197	63	1"	38	80	10	41	70	M12
160M/L	4	350	250	300	110	19	5	13	238	673	60	348	203	345	63	1"	42	110	12	45	105	M16
180M	4	350	250	300	110	19	5	13	265	679	70	354	216	352	97	1 1/2"	48	110	14	51.5	100	M16
180L	4	350	250	300	110	19	5	13	265	717	70	354	216	371	97	1 1/2"	48	110	14	51.5	100	M16

PRODUCT RANGE

Bharat Bijlee manufactures a complete range of three phase squirrel cage induction motors.

Motor Type	Frame	Power (kW)	Polarity	
Standard Motors	63 to 355	0.18 to 315	2, 4, 6, 8	
IE2 Motors	71 to 355	0.37 to 375	2, 4, 6	
IE3 Motors	80 to 355	0.75 to 315	2, 4, 6	
Large LT Motors(DCCA)	355 to 450	280 to 1250	2, 4, 6, 8	
Standard Flame Proof Motors	80 to 315	0.37 to 200	2, 4, 6, 8	
IE2 Flame Proof Motors	80 to 315	0.37 to 200	2, 4, 6	
IE3 Flame Proof Motors	80 to 315	0.75 to 180	2, 4, 6	
Non - Sparking Motors	63 to 400	0.12 to 560	2, 4, 6, 8	
Increased Safety Motors	63 to 355	0.12 to 400	2, 4, 6, 8	
Crane & Hoist Duty Motors	71 to 355	0.37 to 400	4, 6, 8	
Brake Motors	71 to 132	0.25 to 9.3	2, 4, 6, 8	
Slip ring Motors	100 to 160	1.1 to 10	4, 6	
Ring Frame Textile Motors	100 to 160	1.1 to 15	4	
Cane Unloader Motors	160 to 225	11 to 30	6	
Marine Duty Motors	63 to 450	----	----	
Roller Table Motors	As per requirement	----	----	
Railway Auxilliary Motors	As per requirement	----	----	
Medium Voltage Motors	315 to 450	160 to 1000	2, 4, 6, 8	

TESTING FACILITY TO MEET GLOBAL STANDARDS

Bharat Bijlee has proactively produced energy efficient motors for the complete range of IE motors, using our state-of-the-art in-house test facility. Our in-house test facility meets the latest International Standards and is in line with future revision.

Salient Features

- Direct Load Test up to 560 kW (380V to 6600V, 50/60 Hz)
- Mixed Frequency Testing Facility up to 1250 kW
- Test set up for efficiency determination as per IEC 60034-2-1:2014 and IS 15999 (Part 2/Sec 1):2011
- Five test stations for IE2/IE3/IE4 efficiency determination
- Efficiency calculation through special software in line with IEC 60034-2-1:2014
- Combined testing of Motor + Drive for Safe and Hazardous Area Motors
- Data measurement up to 22 kW through SCADA is established and higher ratings under upgradation

IE4 motors installed and running on TFO textile machines

State-of-art type test field

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