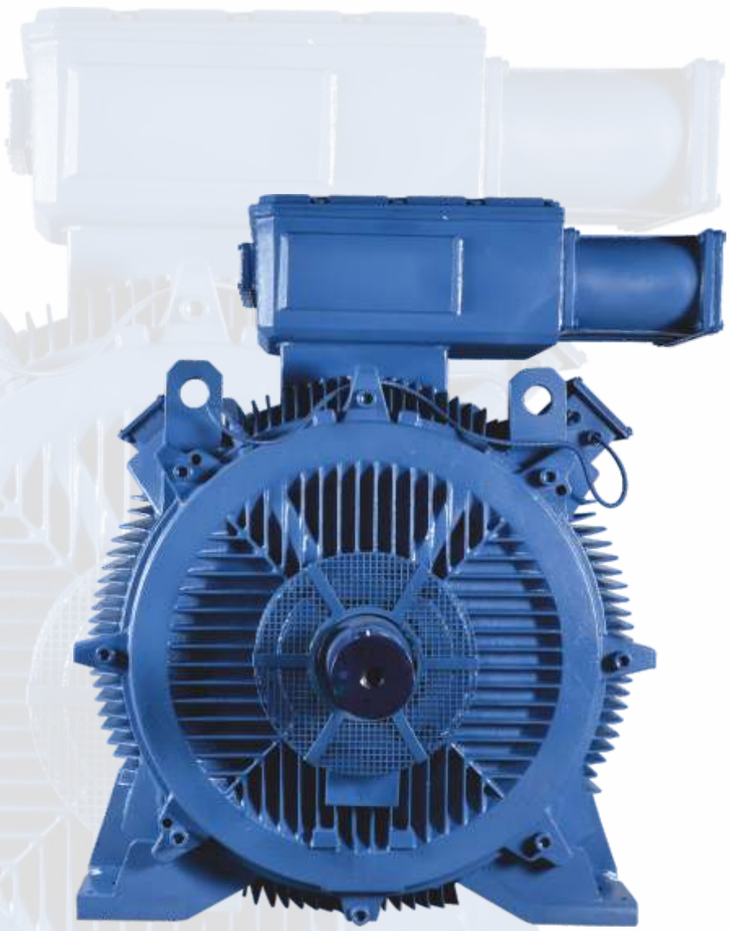
Powered by Trust™

Bharat Bijlee

LOW VOLTAGE MOTORS

0.12kW to 1250kW



Industrial Motors

Over the last 67 years, we have become a reflection of the strength and purpose that today represent Indian Industry and its growing power internationally. Bharat Bijlee has evolved from a pioneer of electrical engineering in India to one of the most trusted names in the industry. Our portfolio of products and services includes Power Transformers, Projects, Motors, Drives and Elevator Systems and caters to a spectrum of industries and the builders of the nation's infrastructure: Power, Refineries, Steel, Cement, Railways, Machinery, Construction and Textiles.

Our products must perform faultlessly and we must fulfill the most demanding delivery schedules. We value innovation and are proud of the customer - centric outlook that enables us to develop specialised solutions for a wide range of utility and industrial markets. Our plant near Mumbai & our extensive network of Sales and Service offices are integrated by enterprise - wise management and information systems. Technology and innovation coverage to offer our customers integrated solutions that meet their specific needs. We are growing; expanding both our manufacturing range and capacities, venturing into related diversifications and exploring new markets with new partners.

Transformers

Projects

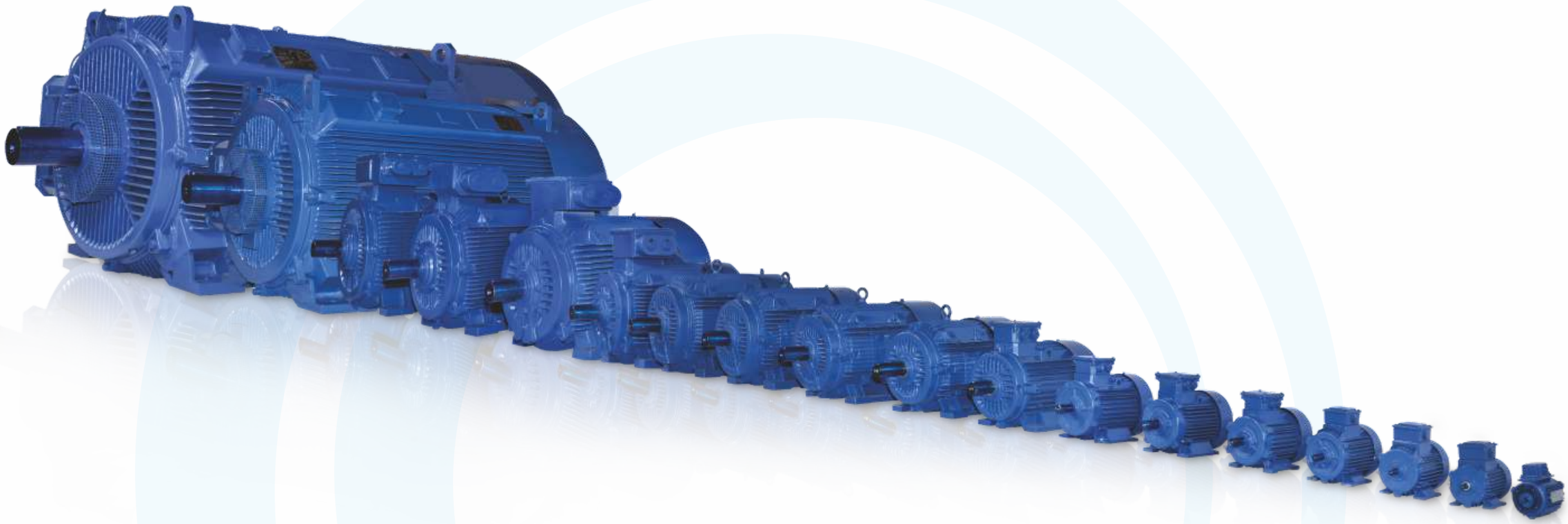
LT Motors
0.12kW to 1250 kW, up to 690V

MV Motors
160kW to 1000kW, up to 6.6kV

Drives

Elevator Systems

Complete range of BBL motors from frame 56 to 450
(0.12kW to 1250kW) suitable for all applications across industries.



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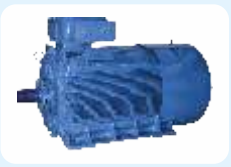
PRODUCT RANGE

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	
Large LT Motors(DCCA)	355 to 450	280 to 1250	2, 4, 6, 8	
Standard Flame Proof Motors	80 to 280	0.37 to 90	2, 4, 6, 8	
IE2 Flame Proof Motors	80 to 315	0.37 to 200	2, 4, 6	
Non - Sparking Motors	63 to 400	0.12 to 560	2, 4, 6, 8	
Increased Safety Motors (For details, please contact our Sales Office)	63 to 450		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	
Textile Motors - Ring Frame	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	355 to 450	160 to 1000	2,4,6,8	

Product Range

Type	Series	Frame Size	kW Range	Poles
Standard TEFC SCR Motors	MA	63 to 355L	0.12 to 355	2P, 4P, 6P, 8P
High Efficiency IE2 Series Motors	2H	71 to 355L	0.37 to 355	2P, 4P, 6P
High Efficiency Motors	MH	90 to 355L	0.37 to 200	8P
Large Motors with DCCA	2H/ MH	355LK to 450L	250 to 1250	2P, 4P, 6P, 8P

Reference Standards

Motors comply with following Indian & International standards as applicable.

IS : 325	Three Phase Induction motor specifications (For Standard TEFC SCR Motors)
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 flange mounted A.C induction motors
IS : 4029	Guide for testing three phase induction motors (For Standard TEFC SCR Motors)
IS : 4889	Methods of determination of efficiency of rotating electric machines (For Standard TEFC SCR Motors)
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 method of cooling for Rotating Electrical Machines / Method of cooling (IC code)
IS:12065/ IEC 60034-9	Permissible limits of noise level for Rotating Electric Machines
IS:12075 : 2008	Mechanical Vibration of Rotating Electrical Machines
IS:12615: 2011	Energy Efficient Induction Motors Three phase Squirrel Cage (For IE2 Series Motors)
IEC 60034-1	Rotating Electrical Machines - Rating & Performance
IEC 60072-1	Dimension & Output rating of Rotating Electrical machines
IS:15999 - (Part2/Sec 1): 2011	Standard Methods for determining Losses and Efficiency from Tests (For IE2 Series Motors)

CE MARK

All motors have CE mark on the nameplate

ELECTRICAL FEATURES

Standard Operating Conditions

Supply Conditions (Voltage & Frequency)

Voltage : 415 V ± 10%
Frequency : 50Hz ± 5%
Combined variation : ± 10%
(Absolute sum with max frequency variation 5%)

For motors above 710kW the standard supply voltage is 690V ± 10%.
690V motors wire wound or strip wound can be offered on request.

Ambient

Motors are designed for ambient temperature as mentioned in the performance tables. Higher ambient temperature motors can be offered on request.

Altitude

Motors are designed for an altitude up to 1000m above mean sea level. Motors can be offered for higher altitudes on request.

Re-rating Factors

The re-rating applicable under different conditions of variations in 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 for all Motors

For motors with Ambient 40° C		For motors with Ambient 50° C	
Amb. Temp. (°C)	Permissible output as % of rated value	Amb. Temp. (°C)	Permissible output as % of rated value
20	107	30	107
21-35	103	30-45	103
40	100	50	100
45	95	55	96
50	91	60	92

Altitude above sea level (m)	Permissible output as % of rated value
1000	100
1500	97
2000	94
2500	90
3000	86
3500	82
4000	77

Method of Starting

Bharat Bijlee motors are suitable for direct on line (DOL) or star/delta starting as shown below. All IE2 series motors and Large LT motors are suitable for inverter duty starting.

kW Rating	Method of Starting	No. of Leads
Up to & including 1.5 kW (for MA series motors)	DOL	3 (Internal Star connection), for MA series motors
		6 (for 2H series motors)
Up to & including 1.5 kW	DOL 415V – Star 240V - Delta	6
Above 1.5 kW	DOL or Star/Delta	6

Starting current measurement of BBL Motors

Induction motor starting current is generally 6 to 7 times the full load current of the motor. This is a characteristic feature of the motor and though undesirable, it is inevitable in the design of the motor. Measurement of this starting current at rated voltage becomes difficult since it demands higher capacity of the supply system as well as use of appropriate CTs in the circuit of meters. Generally a fraction of rated starting current is passed in the motor due to capacity constraints. This current is extrapolated to rated voltage. If this measurement is done at higher voltage then the estimated starting current is more accurate. At Bharat Bijlee, starting current measurement is done as per below table

kW Range	Measurement at % of voltage to rated voltage
0.12kW to 90kW	70%
90kW to 200kW	60%
200kW to 355kW	35%
355kW to 560kW	25%
560kW and above (with rated voltage 690V or higher)	25%

Duty, Starting Time & Number of Consecutive Starts

Motors are designed for continuous (S1) Duty. Other types of duty (S2 to S9) can be offered on request. For load $GD^2 \leq$ Motor GD^2, the motors can safely withstand 3 consecutive starts from cold condition & 2 consecutive starts from hot condition. In application where more severe starting conditions are encountered, a special enquiry should be made to our Sales Office. 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/ hour
- Speed-Torque diagram of driven equipment
- Method of braking (Electrical or Mechanical)
- Method of starting
- Method of coupling

Insulation and Endurance

The motors are provided with Class F insulation scheme with temperature rise limited to Class B. These motors can be overloaded continuously by 10% (service factor = 1.1). The temperature rise will be still within limits of Class F.

All insulation materials used are adequately resistant to the action of microbes and fungi.

Standard Winding

The stators are wound with modified polyester enamel covered (IS 13730: Part 3, thermal class 155) copper wires and are flood impregnated.

Insulation Scheme for Inverter Duty Motors

- The stators are wound with polysteremide coated with polyamide-imide top coat, (dual coated) wires as per IS 13730: part 13, thermal class 200 copper wires
- Vacuum Pressure Impregnation (VPI) is provided to windings on request
- Depending on the voltage wave rise time (dv/dt) and the maximum peak to peak voltage at the motor terminals, suitable insulation schemes are provided on request
- On customer's demand, insulated bearings are offered from frame size 160 and onwards on the non driving end side of the motor

Options (On request)

- Class 'H' insulation
- VPI for frames 63 to 280
- Winding with dual coated wires

Thermal Protection (for Winding & Bearing)

PTC thermisters / thermostats etc. can be embedded in stator winding on request. All Large Motors with DCCA are provided with 3 numbers of simplex PT 100 platinum RTD's for winding temperature detection. In case of frame sizes 250 & above, Resistance Temperature Detectors (RTD) & Bearing Temperature Detectors (BTD) can be supplied on request.

Earthing Terminals

Two earthing terminals are provided on the body and one earthing 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 can be adopted.

Motors can also be offered with built in space heaters in frame size 90 and above. Built in space heaters are provided as a standard feature for all Large Motors with DCCA.

Frame Size	Enclosure Materials	Terminals Box Location	
		Standard	Option Available
63-80	Aluminum	TOP	---------
90S-132M	Aluminum	TOP	---------
	Cast Iron (on request)	RHS	TOP & LHS
160M-225M	Cast Iron	RHS	TOP & LHS
250M-355L	Cast Iron	TOP	RHS & LHS
355 L/K	Cast Iron	RHS	LHS/TOP
400L/450M/ 450L	Fabricated MS with CI E/s	TOP	RHS & LHS

MECHANICAL FEATURES

Enclosures: (Material and Terminal Box Location)

Motors are offered with following enclosure

All foot mounted motors are with integral feet construction. All motors up to 280 frame are with integral bearing covers, and motors in frame 315 & above are with separate bearing covers.

Type of Construction

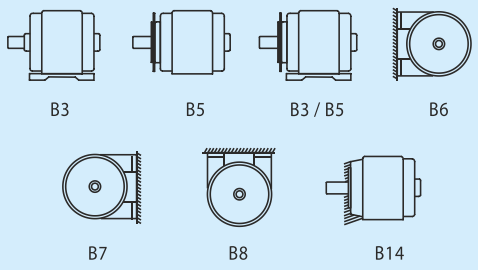
Standard motors are designed for foot mounting (B3). Motors up to frame 355 are also suitable for B6, B7, B8, V5 and V6 mounting.

Motors can be supplied in flange mounting (B5). Flange mounted motors up to frame 355 are also suitable for V1 and V3 mounting.

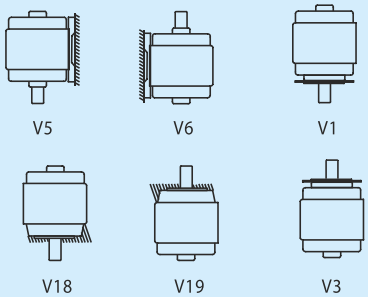
Large Motors with DCCA can be supplied in B3, V1 and B35 construction with dimensions as per IEC 60072-1 and IEC 60072-2.

Mounting

Horizontal Mounting



Vertical Mounting



Cooling

All motors are Totally Enclosed Fan Cooled (TEFC-IC411 as per IS: 6362, IC4A1A1 as per IEC 60034-6). The cooling is effected by self driven, bi-directional centrifugal fan protected by fan cover. Following cooling types can be provided on request.

- Natural ventilation [TESC or TENV (Ic410)]
- Forced cooling for frame sizes 132 and above. (IC 416) Minimum cooling distance, as indicated in the GA drawing has to be provided for effective cooling of the motor.

  For Large Motors with DCCA special bearing cooling fan is provided at driving end to reduce bearing temperature and increase bearing life. Minimum cooling distance, as indicated in the GA drawing has to be provided for effective cooling of the motor.

Note: For more details, refer to annexure I on page no. 120.

Bearing and Terminal Box Details

Frame Size		Bearing Nos. C3 clearance		Terminal Box Type/ Location	Terminal		No. & size of Cable entries	Max cond. Cross Sec. area mm2
		DE	NDE		No.	Size		
63		6201 2Z	6201 2Z	gk030/ TOP	3	M4	1×3/4”	4
71		6202 2Z	6202 2Z					
80		6004 2Z	6004 2Z					
90S, 90L		6205 2Z	6205 2Z	gk130/TOP	3*			
100L		6206 2Z	62052Z	gk230/TOP			2 × 1”	10
112M		6206 2Z	6205 2Z					
132S, 132M		6208 2Z	6208 2Z	gk330/TOP	6	M5		
160M, 160L		6309 2Z	6209 2Z	gk330/RHS				16
180M, 180L(IE2 4 P)		6310 2Z	6309 2Z	gk430/RHS	6	M6	2 × 1-1/2”	50
180M, 180L (Standard 2P, 4P, 6P, 8P & IE2 2P,6P)		6310 2Z	6210 2Z	gk430/RHS	6	M6	2 × 1-1/2”	50
200L		6312 2Z	6212 2Z	TB225/RHS	6	M8	2 × 2”	70
225S, 225M		6313	6213					
250M		6315	6215	TB280/ TOP	6	M10		
280 S/M	2P	6316	6316					150
	4,6 & 8P	6317	6316					
315S/M		6319	6319	TB315/ TOP	6	M12	2x2”	185
315L							2x2 ½ “	240
355 L		6322	6322	TB 355/ TOP	6	M16	2 X 3”	300
355L/K	2P	6319	6319	TB400/RHS	6	M20	2x3”	400
	4P	6322	6322					
	6P							
	8P							
400M/L	2P	6324	6322	TB400/ TOP				
	4P							
	6P							
	8P							
450M/L	4P	6326	6326	TB400/ TOP				
	6P							
	8P							

*3 Terminals up to and including 1.5kW & 6 terminals for higher kW outputs, except IE2 motors.
Note: L10 bearing life is 50,000 hours for directly coupled loads through flexible couplings only.

Roller Bearing and Insulated Bearing

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

Bearing Lubrication

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

On line Greasing

On line greasing arrangement is provided in frame sizes 225 and above. For frame sizes 180 and 200 it can be provided on request.

Bearing	Pole	Re-lubrication	
		Quantity (gm)	Interval (Hrs)
6313	2	120	3200
	4		9000
	6		15000
	8		21000
6315	2	150	2800
	4		8200
	6		10000
	8		18000
6316	2	180	2000
6317	4	180	7500
	6		13000
	8		17500
6319	2	220	2000
	4		5000
	6		7500
	8		10000
6322	2	40	1000
	4, 6		3000
	8		6000
6324	2	40	1000
	4, 6		2500
	8		5000
6326	4, 6	40	2000
	8		4000

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 mounted motors are additionally provided with oil tight shaft protection on driving end side.

Note: For more details, refer to annexure II on page no. 121.

Rotor

Entire range of motors is fitted with dynamically balanced aluminum die cast squirrel cage rotors.

Shaft

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

Large Motors with DCCA are provided with single shaft extension in accordance with IS: 8223. Shafts material is EN8 for 355 & 400 frames, and EN19 for 450 frames. Shafts of these frames are ultrasonically tested.

Balancing & Vibration

The balancing grade is G2.5 as per ISO: 1940. Rotors are dynamically balanced with a half key in the shaft extension. All motors have vibration grade A as per IEC 60034 - 14. Other grades as per IEC 60034 - 14 or IS 12075 - 2008 can be offered on request.

Note: For more details, refer to annexure VIII on page no. 131.

Direction of Rotation

All motors are suitable for bi - directional rotation.

Lifting Arrangement

All motors with frame size 100 and above are provided with lifting hooks. When two or more hooks are provided, all hooks to be used simultaneously for lifting the motor.

Noise Level

Motors are designed for noise level well below the limits specified in IS: 12065 and IEC 60034 - 9.

Note: For more details, refer to annexure IV on page no. 123

Paint

All motors are painted with acrylic base paint shade RAL 5000. 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.

Packing

Motors up to 132 frame are packed in thermocol /corrugated boxes. Wooden packing boxes or wooden pallets are provided for higher frame size. sea worthy / Export packing case for home market (without fumigation certificate) is also available on request.

Shipping Dimensions

FRAME	TYPE REF	PACKING BOX DIMENSIONS			MOTOR GROSS WEIGHT IN Kg
		LENGTH	WIDTH	HEIGHT	
63	MA063433G	260	180	240	5.5
71	MA071433G	300	200	260	8
80	2H080453G	320	240	290	13
90S	2H09S423G	390	280	320	16
90L	2H09L473G	390	280	320	20
100L	2H10L473G	455	320	370	28
112M	2H11M473G	555	470	380	38
132S (TOP TB)	2H13S2N3G	600	430	490	70
132S (Side TB)	2H13S2N3G	570	500	400	70
132M	2H13M4T3G	690	410	410	77
160M	2H16M4K3G	660	440	390	155
160L	2H16L4T3G	820	540	440	167
180M	2H18M473G	820	540	440	235
180L	2H18L483G	820	540	440	248
200L	2H20L453G	890	610	560	364
225S	2H22S433G	970	660	610	452
225M	2H22M453G	970	660	610	467
250M	2H25M233G	1050	610	790	646
280SM	2H28M453G	1100	660	820	885
315SM	2H31M653G	1300	720	940	1,179
315L	2H31L693G	1500	720	940	1,400
355L	2H35L453G	1680	840	1050	2,194
400M	MH40M453G	2110	1100	1400	2,915
400L	MH40L6A3G	2110	1100	1400	3,500
450L	MH45L893G	2290	1200	1430	6,350

EFFECT OF CONVERTER (VFD) SUPPLY VOLTAGE ON MOTOR PERFORMANCE

Motor Terminal Voltage Transients

Modem controls use power transistors that switch at very high rates. To achieve this, the devices have very fast turn on times that result in voltage pulses with high dv/dt. When such a drive is used with a squirrel cage induction motor, the pulses, in combination with the cable and motor impedence, generate high peak voltages at motor terminals. These peak voltages are repetitive. They occur continuously and can reduce motor insulation system life.

Due to space & surface charge creation within the insulation components, the electric stress is not only defined by the instantaneous voltage itself but also by the peak voltages that have been stressing the insulation previously. Generally, it has been shown by experience that, within certain limits valid for drive systems, the stressing parameter is the peak/ peak voltage.

In order to guarantee a normal service life, one must be sure that these peak voltages do not exceed the maximum repetitive voltage rating of the motor.

As per NEMA MG1 Part 31, definite purpose, inverter fed motors are designed to withstand maximum repetitive voltage peaks at motor terminals equal to 3.1 times the motor's rated RMS voltage with a rise time not less than 0.1 µs. For 415 volt motor, these peaks will be of the order of 415 × 3.1 = 1286.5 volts.

Fundamental Contributors to Peak Voltages Stressing Motor Insulation

It is difficult to determine if a particular drive & cable will cause peak voltage in excess of the motor's insulation capability. There are six fundamental issues that determine the amount of peak voltage that will exist at the motor's terminals: pulse rise time, cable length, minimum time between pulse, minimum pulse duration, transition type (single or double), & the use of multiple motors.

1. Pulse Rise Time

A certain amount of time is required for the voltage at the drive terminals for transition from low to high. This is called the rise time. A shorter rise time will cause the peak voltage at the motor's terminals to reach a higher value for a given cable length between the motor and the drive.

2. Cable Length

In general, longer cable will increase the value of the peak voltage at the motor's terminals. With modern IGBT drives, the peak voltage begins to occur with a cable length of a few meters and can reach 2 times the control DC bus voltage at a length less than 20 meters. In some cases, however, very long cables (in excess of 130 meters, for example) can result in a situation where the peak voltage does not decay quickly enough. In this case, the peak voltage can be more than 2 times the control DC bus voltage.

3. Minimum Time between Pulses and Minimum Pulse Duration

An adjustable frequency drive creates average voltage changes by varying the width of the pulses it produces and the time between them. The peak voltage is potentially at its worst when time between pulses is at the minimum for drive and the length of the pulse duration is at the minimum. The minimum time between pulses is most likely to occur at high output voltage and during transient conditions, such as acceleration & deceleration. Minimum pulse width is most likely to occur at low output voltages. If the time between pulses or the minimum pulse duration is less than three times the resonant period of the cable (0.2 to 2 µs for industrial cable), higher peak voltage will occur. The only way to be sure this condition does not exist in any particular drive is by measuring the pulses directly or by contacting the manufacturer of the drive.

4. Transition Type

Each of a drive's three output phases is capable of being switched. Generally, only one of the three phases is switched at any given instant. This situation is called a single transition. Some drives will switch two phases simultaneously. This is referred to, as a double transition. The result is a line-to-line polarity reversal with twice the voltage excursion as that of single transition. This causes higher peak voltage at the motor's terminals. Some drives perform double transitions only during transient conditions such as acceleration and deceleration. Double transitions are generally found in old drives and are not widely used today. The only way to be sure a drive does not perform double transitions is by measuring the pulses directly or by contacting the manufacturer of the drive.

5. Multiple Motors

If more than one motor is connected to a drive, there can be higher peak voltage due to reflections from each motor. The situation is made worse when there is a long length of cable between the drive and the common connection of motor. This length of lead acts to decouple the motor from the drive. As a result, reflection which would normally be absorbed by the drive's low impedence can be carried to another motor and add to the peak voltage at its terminals.

6. Switching Frequency

Many PWM drives provide for convenient user adjustment of the switching frequency. This frequency can be adjusted over a range as broad as 500 Hz to 20 kHz. The choice of switching frequency is significant because it defines the number of peak voltages that will be occurring at the motor in a certain amount of time. The higher the switching frequency, the greater the number of peak voltage and their magnitude that will be stressing the motor's insulation system.

(Reference: From NEMA - Application guide for AC adjustable Speed Drive Systems**)**

Proper care must be taken to limit the peak voltages to the limits of insulation scheme used in the motor.

This includes provision of suitable chokes / filters at converter output voltage.

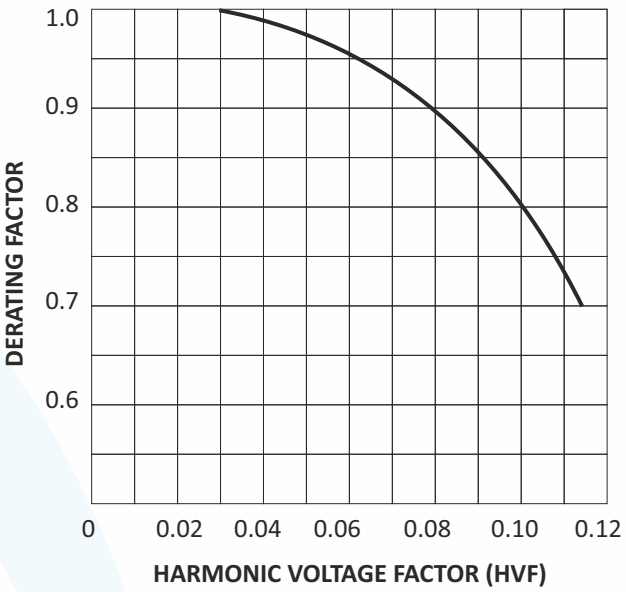
Temperature Rise of the Motor

Converter output voltage is not sinusoidal, but it contains higher order harmonics. These harmonics create additional losses in core, stator winding and rotor of the motor. This in turn, results in higher temperature rise of the motor, crossing the normal class B limits at rated load. The increase in temperature rise is of the order 15 to 20^{0}C

In order to keep the temperature rise of the motor within acceptable limits, torque de-rating of the motor is essential.

NEMA MG1 - Part 30 considers a de-rating factor (torque de-ration) to avoid excessive overheating of a general purpose motor fed by converter, compensating for the circulation of harmonic currents and the additional heat generated due to the PWM voltage harmonic content.

Following figure provides the de-ration factor based on the Harmonic Voltage Factor (HVF).



Another way of keeping the temperature rise within limit is to provide independent cooling system (separate ventilation) to the motor.

If one uses sine wave filter after converter, the additional temperature rise gets reduced to about 5^{0}C, but, usually, the user avoids to put the filter for cost considerations.

Temperature Rise of the Windings for Variable Torque Applications

When motor speed is reduced in variable torque application (generally parabolic torque speed curve characteristic), ventilation due to fan reduces. But motor losses also reduce drastically.
To limit the winding temperature rise to class B limits at rated output with converter supply, permissible rated output must be reduced to 85% of the motor nameplate output on sinusoidal supply.

Temperature Rise of the Windings for Constant Torque Applications

When motor speed is reduced in constant torque application, ventilation due to fan reduces. Motor losses remain practically constant in this application but ventilation reduces considerably. Hence, in addition to harmonics effect, the temperature rise is additionally increased due to reduced speed of the cooling fan. Providing independent cooling system (separate ventilation) to the motor in this case is very effective in keeping the temperature rise within acceptable limits.

Bearing Currents

Voltage is generated at shaft ends due to high switching frequency of converter and the excess length of cable between converter and motor. This results in currents flowing through bearings and results in bearing failure. One remedy is to use the insulated bearing on non drive end side.

Accoustic Noise

In case of motors fed by converter supply, the electromagnetically excited noise can be significantly higher owing to the harmonic contents of the converter supply voltage.

Higher switching frequencies tend to reduce the magnetically excited noise of the motor.

Motor Applications for VFD

- Constant Torque - Crane, Hoist, Reciprocating Compressor etc.
- Variable Torque - Centrifugal Pump, Fan, Blowers etc.
- Constant Power - Metal cutting, Lathes, Coiler / Decoiler Machines etc.
- Custom built to suit customer's specific requirements.

Motors for Constant Torque application suitable for speed range of 1:10, 1:5, 1:2 etc can be provided. Depending on the speed range, motors can be offered with forced cooling (IC 416) or in higher frame sizes. Please check with our Sales Office for motors to be operated beyond the speed given in Table I.

Table I

Frame	2 Pole	4 Pole	6 Pole
112	5200	3600	2400
132	4500	2700	2400
160	4500	2700	2400
180	4500	2700	2400
200	4500	2300	2400
225	3600	2300	1800
250	3600	2300	1800
280	3600	2300	1800
315	3600	2300	1800

These are maximum safe operating speeds of a direct coupled motor, as per IS 15880:2009.

Special Features of Bharat Bijlee Motors for Running on Converter Supply

Bharat Bijlee motors are provided with special impregnation system / Vacuum Pressure Impregnation, special slot insulation paper, special phase insulation paper and dual coated winding wire to take care of the stresses. This insulation scheme is as per the requirement of IEC 60034-18-41. For voltages higher than 500V, please refer to our sales office.

Shaft induced voltage occurs due to the use of VFD. This causes flow of currents through bearing which can lead to premature bearing failure. Insulated bearings can be provided in frames from 132 onwards on request. In closed loop system operations, speed feedback is obtained through encoder mounted on the shaft of the motor. We provide encoder mounting arrangements on non drive end side shaft of the motor on request. We require Encoder Mounting Details to check the suitability of mounting the same on our motor (Hollow Shaft Type Encoder recommended).

Conclusion:

As explained above, motors which are required to operate with VFD supply need special design considerations. Please refer such requirements to our sales office with load details and speed range.

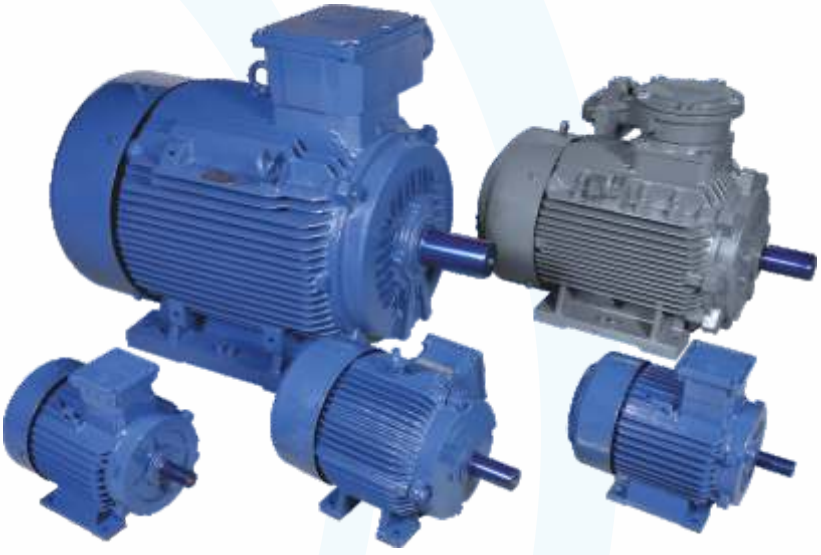
We are giving herewith standard service conditions for BBL motors working on VFD supply. If the properties /characteristics of VFD are different than those specified here, please contact sales office for necessary selection at our end.

Checklist For Motors To Be Run On VFD Supply

Motor Parameters	BBL Standard	Customer Specification
Base voltage and kW rating at 50Hz	Base Voltage: 415V kW Rating: As per Customer requirement	Customer to specify
Four point rating as per IS 15881	As per customer requirement	Customer to specify
Duty Details (Torque at different speeds and time d uration)	As per customer requirement	Customer to specify
Time duration for which motor is running at minimum speed	As per customer requirement	Customer to specify
Application: Constant Torque	Forced cooling arrangement for speeds 30% or below	Customer to specify
	For other speeds, refer to works	
Application: Variable Torque (Pump or Fan)	10% to 100% speed variation with temperature rise F to F For temperature rise to be limited to Class B, refer to Sales Office	Customer to specify
Base Speed (Polarity of motor)	As per customer requirement	Customer to specify
Speed Range (frequency variation)	10% to 100% with forced cooling arrangement for constant torque application	Customer to specify
Maximum safe operating speed	As per IS 15880 : 2009 (Table 1)	–
Operation above base speed	Constant Power	Customer to agree
Insulation class / Temperature rise (F to F / F to B)	F to F at 100% load (VFD supply)	Customer to agree
	F to B at 85% load (VFD supply)	
	F to B at 100% load (grid supply)	
Hazardous area zone 1 or zone 2	Combined testing at rated torque is a statutory requirement to determine temperature class	Customer to pay extra charges
Accessories		
Encoder	NDE side extension for enco der mounting on request	Customer to specify
Thermisters /RTD/ BTD	On request	Customer to specify
Bearing insulation	On request, recommended from 315 frame	Customer to agree
VFD parameters		
THD of the drive output voltage	Up to 3% THD, de ra-tion not required For 5% THD, de-ration factor is 0.95 For 10% THD de-ration factor is 0.80 For THD higher than 10%, contact sales office	Customer to specify
Voltage boost	Required for speed below 33% of rated speed (for constant torque application)	Customer to note
Carrier or switching frequency	Max 5.0kHz	Customer to specify
Rise time	0.1µsec or more	Customer to specify
Individual drive or multi motor drive	Individual drive	Customer to specify
Voltage at motor terminals from drive (if less than permissible variation of rated voltage, then de-ration factor to be considered while arriving at motor kW)	Rated voltage required at motor terminals	Customer to specify

Minimum time between pulses	6 µsec or more	Customer to agree
Minimum pulse duration	6 µsec or more	Customer to agree
Installation requirements		
Earthing	Special high frequency earthing (at customer's end)	Customer to provide
Type of power cable	Shielded cables recommended	Customer to provide
Cable length between drive and motor, along with peak voltage limit for motor insulation	Safe up to 5 meters For higher length, customer or his system integrator has to ensure by using sine filters / dv/dt filters / chokes/ lower switching frequencies such that: a) For VFD motors having rated voltage up to 500V, the peak to peak phase voltage is not exceeding 1.56 kV at motor terminals b) For VFD motors with rated voltage up to 690V, peak to peak phase voltage is not exceeding 2.15 kV at motor terminals. Above voltage values are as per IEC 60034-25 c) For standard motor the peak voltage at motor terminals should not exceed 800V	Customer to agree
dv/dt filters or sine wave filter	Mandatory for high switching frequency (5kHz or more) and higher cable lengths (>5m)	Customer to agree
Motor power factor correction capacitors	Not to be used	Customer to note

Note:
1) Efficiency class is not applicable for VFD driven motors. For further information refer to sales office.
2) For rated voltage above 500 volts, please refer enquiry to sales office.



Performance Table for 2 Pole Motors

TEFC 3 Phase Squirrel Cage Induction Motors - Frame size 63 to 355L

Applicable standard for testing: IS 4029
Applicable standard for efficiency determination: IS 4889

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

Ambient : 50° C
Duty : S1(Continuous)
3000 rpm (2-Pole)

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

Rated Output		Frame size IEC	Type ref. B3 construction	Operating characteristics at rated output									With DOL starting		Pullout Torque to Rated Torque Ratio	Rotor GD^2 kgm^2	Net Weight B3 constr. kg
				Rated Speed RPM	Rated Current Amps.	Rated Torque kg-m	Power Factor			% Efficiency			Starting Current to Rated Current Ratio	Starting Torque to rated torque ratio			
kW	HP						FL	3/4L	1/2L	FL	3/4L	1/2L					
0.18	0.25	63	MA063213	2720	0.57	0.064	0.76	0.66	0.52	58.0	57.0	52.0	3.2	2.7	3.0	0.00085	5
0.25	0.35	63	MA063233	2720	0.65	0.090	0.82	0.75	0.63	65.0	60.0	54.0	3.5	2.4	2.6	0.00099	5
0.37	0.5	71	MA071213	2790	0.91	0.129	0.80	0.72	0.60	71.0	68.0	62.0	4.0	2.3	2.8	0.0015	6
0.55	0.75	71	MA071233	2805	1.31	0.191	0.79	0.72	0.58	74.0	74.0	71.0	5.0	2.7	3.0	0.0019	7
0.75	1	80	MA080213	2830	1.65	0.258	0.82	0.74	0.62	77.0	76.0	72.0	5.0	2.5	2.8	0.0037	10
1.1	1.5	80	MA080233	2840	2.36	0.377	0.82	0.75	0.63	79.0	79.0	76.0	5.9	2.7	3.0	0.0051	11
1.5	2	90S	MA09S233	2825	3.01	0.517	0.86	0.83	0.76	80.6	78.0	74.0	5.5	2.7	3.0	0.0071	15
2.2	3	90L	MA09L253	2830	4.36	0.757	0.85	0.82	0.74	82.5	80.0	76.0	6.0	3.0	3.0	0.0093	18
3.7	5	100L	MA10L213	2900	7.12	1.24	0.85	0.80	0.70	85.0	83.0	78.0	6.5	2.8	3.0	0.0188	24
5.5	7.5	132S	MA13S2B3	2920	10.1	1.83	0.88	0.85	0.77	85.7	85.0	80.0	6.5	2.3	3.0	0.0630	52
7.5	10	132S	MA13S2E3	2920	13.6	2.50	0.88	0.84	0.76	87.0	86.0	82.0	6.5	2.3	3.0	0.0760	55
9.3	12.5	132M	MA13M2N3	2920	16.5	3.10	0.89	0.85	0.76	88.0	86.0	83.0	6.5	2.4	2.9	0.0980	67
11	15	160M	MA16M213	2920	19.3	3.67	0.89	0.87	0.83	89.0	88.0	86.0	5.8	2.0	3.0	0.134	95
15	20	160M	MA16M253	2920	26.2	5.00	0.89	0.88	0.82	89.5	89.0	87.0	6.0	2.0	3.0	0.171	112
18.5	25	160L	MA16L273	2920	31.6	6.17	0.90	0.88	0.86	90.5	90.0	88.0	6.5	2.0	3.0	0.225	123
22	30	180M	MA18M213	2930	37.6	7.31	0.89	0.87	0.80	91.5	90.5	88.0	6.5	2.2	2.7	0.30	168
30	40	200L	MA20L233	2950	51.2	9.91	0.88	0.85	0.79	92.6	92.0	89.5	6.5	2.5	2.5	0.52	253
37	50	200L	MA20L253	2945	62.9	12.2	0.88	0.85	0.79	93.0	92.5	91.0	6.5	2.5	2.5	0.61	274
45	60	225M	MA22M233	2960	74.4	14.8	0.90	0.87	0.83	93.5	93.0	91.0	6.0	2.5	2.5	1.04	348
55	75	250M	MA25M213	2960	89.1	18.1	0.92	0.91	0.86	93.3	92.8	91.5	6.0	2.1	2.6	2.11	523
75	100	280S	MA28S213	2970	122	24.6	0.91	0.89	0.84	93.7	92.5	90.0	6.0	1.8	2.7	2.63	626
90	120	280M	MA28M233	2970	146	29.5	0.91	0.89	0.84	94.0	93.0	91.0	6.0	1.8	2.7	3.01	669
110	150	315S	MA31S233	2982	180	35.9	0.90	0.86	0.78	94.5	94.0	91.5	7.0	2.0	2.5	5.0	898
125	170	315M	MA31M2A3	2982	206	40.8	0.89	0.85	0.76	94.7	93.5	91.5	7.0	2.2	2.6	5.0	940
132	180	315M	MA31M233	2982	215	43.1	0.90	0.86	0.78	95.0	94.0	92.0	7.0	2.0	2.5	5.0	940
150	200	315L	MA31L2A3	2982	247	49.0	0.89	0.84	0.76	95.1	94.2	92.2	7.0	2.0	2.5	6.2	1100
160	215	315L	MA31L253	2982	260	52.3	0.90	0.85	0.77	95.2	94.6	92.7	7.0	2.0	2.5	6.2	1100
180	240	315L	MA31L2B3	2982	299	58.8	0.88	0.82	0.75	95.3	94.7	92.7	7.0	2.0	2.5	7.7	1390
*200	270	315L	MA31L273	2982	324	65.3	0.90	0.85	0.77	95.5	95.0	93.0	7.0	2.0	2.5	7.7	1390
*250	335	355L	MA35L213	2985	404	81.6	0.90	0.88	0.84	95.7	95.2	93.7	7.0	1.6	2.4	12.0	1680
*315	425	355L	MA35L233	2985	508	102.8	0.90	0.88	0.84	95.8	95.3	93.8	7.0	1.6	2.4	14.7	1870

Notes: •All performance values are subject to tolerance as per IS 325.
• For ratings above 0.37kW & up to 355kW, motors are avaialble with efficiency class IE2. For details, please refer the section of IE2 series motors in this catalogue.
(*)These ratings are suitable for ambient temperature of 45°C

Performance table for 4 Pole motors

TEFC 3 Phase Squirrel Cage Induction Motors - Frame size 63 to 355L

Applicable standard for testing: IS 4029
Applicable standard for efficiency determination: IS 4889

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

Ambient : 50°C
Duty : S1(Continuous)
1500 rpm (4-Pole)

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

Rated Output		Frame size IEC	Type ref. B3 construction	Operating characteristics at rated output									With DOL starting		Pullout Torque to Rated Torque Ratio	Rotor GD^2 kgm^2	Net Weight B3 constr. kg
				Rated Speed RPM	Rated Current Amps.	Rated Torque kg-m	Power Factor			% Efficiency			Starting Current to Rated Current Ratio	Starting Torque to rated torque ratio			
kW	HP						FL	3/4L	1/2L	FL	3/4L	1/2L					
0.12	0.16	63	MA063413	1330	0.41	0.088	0.75	0.65	0.50	54.0	48.0	40.0	2.4	1.9	2.3	0.00140	5
0.18	0.25	63	MA063433	1350	0.56	0.130	0.75	0.65	0.50	60.0	56.0	50.0	3.0	2.0	2.3	0.00160	5
0.25	0.35	71	MA071413	1370	0.68	0.178	0.76	0.63	0.51	67.0	64.0	58.0	3.0	2.0	2.5	0.0024	6
0.37	0.5	71	MA071433	1360	1.02	0.265	0.71	0.62	0.50	71.0	70.0	64.0	3.4	2.3	2.5	0.0033	7
0.55	0.75	80	MA080413	1405	1.28	0.381	0.81	0.70	0.56	74.0	71.0	67.0	4.0	2.4	2.6	0.0061	10
0.75	1	80	MA080433	1405	1.74	0.520	0.78	0.70	0.58	77.0	76.0	72.0	4.5	2.8	3.0	0.0072	11
1.1	1.5	90S	MA09S433	1410	2.45	0.760	0.80	0.73	0.61	78.0	77.0	72.0	4.2	2.3	2.7	0.0120	14
1.5	2	90L	MA09L453	1410	3.26	1.04	0.80	0.72	0.58	80.0	79.0	75.0	5.0	2.5	3.0	0.0160	17
2.2	3	100L	MA10L433	1420	4.55	1.51	0.82	0.69	0.53	82.0	80.0	76.0	5.5	2.5	3.0	0.0210	22
3.7	5	112M	MA11M433	1430	7.3	2.52	0.83	0.76	0.65	85.0	85.0	82.0	6.0	2.6	3.0	0.0530	32
5.5	7.5	132S	MA13S4B3	1450	10.3	3.69	0.86	0.81	0.70	86.5	86.0	84.0	6.0	2.4	3.0	0.1040	50
7.5	10	132M	MA13M4K3	1450	13.7	5.04	0.87	0.82	0.72	87.5	87.0	85.0	6.0	2.3	3.0	0.1260	64
9.3	12.5	160M	MA16M4A3	1450	17.4	6.25	0.84	0.80	0.72	88.5	88.0	87.0	6.0	2.0	2.5	0.141	93
11	15	160M	MA16M4C3	1450	20.5	7.39	0.84	0.81	0.76	89.0	89.0	86.0	6.0	2.1	2.5	0.177	97
15	20	160L	MA16L4K3	1450	27.5	10.1	0.84	0.83	0.79	90.2	90.5	90.0	6.0	2.1	2.5	0.235	113
18.5	25	180M	MA18M433	1460	33.2	12.3	0.85	0.82	0.72	91.2	91.2	90.0	6.0	2.4	2.5	0.460	160
22	30	180L	MA18L473	1460	39.2	14.7	0.85	0.82	0.72	91.8	91.5	90.0	6.0	2.4	2.5	0.540	188
30	40	200L	MA20L433	1465	51.6	19.9	0.88	0.84	0.77	92.0	92.0	90.0	6.0	2.6	2.5	0.860	270
37	50	225S	MA22S413	1470	63.6	24.5	0.87	0.83	0.75	93.0	93.0	91.0	6.0	2.5	2.5	1.32	328
45	60	225M	MA22M433	1470	76.3	29.8	0.88	0.84	0.75	93.2	93.2	91.0	6.0	2.5	2.5	1.60	362
55	75	250M	MA25M413	1475	93.8	36.3	0.87	0.85	0.78	93.8	93.3	91.5	6.0	2.5	2.6	2.83	475
75	100	280S	MA28S413	1480	126	49.4	0.88	0.87	0.81	94.2	94.0	93.0	6.0	2.1	2.5	5.00	653
90	120	280M	MA28M433	1480	150	59.2	0.88	0.87	0.81	94.7	94.3	93.2	6.0	2.1	2.5	6.00	713
110	150	315S	MA31S413	1485	188	72.1	0.86	0.83	0.76	94.7	94.5	93.2	6.5	2.5	3.0	9.97	862
125	170	315M	MA31M4A3	1486	216	81.9	0.85	0.81	0.74	94.8	94.5	93.3	6.5	2.5	3.0	11.7	965
132	180	315M	MA31M433	1487	225	86.5	0.86	0.83	0.76	95.0	94.8	93.8	6.5	2.5	3.0	11.7	965
150	200	315L	MA31L4A3	1488	261	98.2	0.84	0.80	0.72	95.2	95.0	93.9	6.5	2.5	3.0	14.0	1145
160	215	315L	MA31L453	1488	271	104.7	0.86	0.83	0.76	95.4	95.2	94.0	6.5	2.5	3.0	14.0	1145
180	240	315L	MA31L463	1488	305	117.8	0.86	0.83	0.76	95.5	95.3	94.0	6.5	2.5	3.0	15.6	1225
200	270	315L	MA31L473	1488	338	130.9	0.86	0.83	0.76	95.6	95.4	94.0	6.5	2.5	3.0	17.8	1290
250	335	355L	MA35L413	1488	413	163.6	0.88	0.85	0.75	95.8	95.5	94.0	6.5	2.2	2.5	23.3	1680
315	422	355L	MA35L433	1488	519	206.2	0.88	0.85	0.75	96.0	95.6	94.2	6.5	2.2	2.5	32.7	1855
355	475	355L	MA35L453	1488	585	232.4	0.88	0.85	0.75	96.0	95.6	94.2	6.5	2.2	2.5	37.9	2025

Notes: •All performance values are subject to tolerance as per IS 325.
• For ratings above 0.37kW & up to 355kW, motors are available with efficiency class IE2. For details, please refer the section of IE2 series motors in this catalogue.
Efficiency measurements are without seals.
(*) This rating is suitable ambient temperature for 45°C

Performance table for 6 Pole motors

Applicable standard for testing: IS 4029
Applicable standard for efficiency determination: IS 4889

TEFC 3 Phase Squirrel Cage Induction Motors - Frame size 71 to 355L

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

Ambient : 50°C
Duty : S1(Continuous)

1000 rpm (6-Pole)

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

Rated Output		Frame size IEC	Type ref. B3 construction	Operating characteristics at rated output									With DOL starting		Pullout Torque to Rated Torque Ratio	Rotor GD^2 kgm^2	Net Weight B3 constr. kg
				Rated Speed RPM	Rated Current Amps.	Rated Torque kg-m	Power Factor			% Efficiency			Starting Current to Rated Current Ratio	Starting Torque to rated torque ratio			
kW	HP						FL	3/4L	1/2L	FL	3/4L	1/2L					
0.25	0.35	71	MA071633	875	0.8	0.278	0.70	0.60	0.48	62.0	62.0	55.0	2.6	2.0	2.3	0.00380	7
0.37	0.5	80	MA080613	910	1.08	0.396	0.70	0.60	0.48	68.0	66.0	61.0	3.0	2.1	2.3	0.00600	10
0.55	0.75	80	MA080633	915	1.56	0.585	0.71	0.62	0.48	69.0	70.0	64.0	4.0	2.2	2.5	0.0084	11
0.75	1	90S	MA09S633	925	1.99	0.790	0.72	0.61	0.50	73.0	70.0	69.0	3.4	2.0	2.5	0.0122	14
1.1	1.5	90L	MA09L653	930	2.8	1.15	0.72	0.61	0.50	76.0	74.0	72.0	4.0	2.1	2.6	0.0160	17
1.5	2	100L	MA10L633	935	3.72	1.56	0.72	0.64	0.52	78.0	75.0	72.0	4.0	2.0	2.5	0.0250	22
2.2	3	112M	MA11M633	935	4.97	2.29	0.77	0.68	0.55	80.0	80.0	74.0	5.0	2.0	2.5	0.0500	29
3.7	5	132S	MA13S6B3	950	8.05	3.79	0.77	0.72	0.60	83.0	83.0	82.0	5.0	2.2	2.8	0.118	50
5.5	7.5	132M	MA13M6N3	950	11.6	5.64	0.78	0.74	0.64	84.5	84.5	83.0	5.5	2.5	3.0	0.172	66
7.5	10	160M	MA16M633	960	14.8	7.61	0.80	0.74	0.64	88.0	88.0	86.0	5.4	2.0	2.5	0.276	103
9.3	12.5	160L	MA16L663	960	18.4	9.44	0.80	0.74	0.64	88.0	88.0	87.0	5.5	2.1	2.5	0.340	113
11	15	160L	MA16L673	965	21.6	11.1	0.80	0.77	0.70	88.5	88.0	87.0	6.0	2.0	2.5	0.400	123
15	20	180L	MA18L613	965	29	15.1	0.80	0.75	0.62	90.0	90.0	87.0	5.5	2.6	2.3	0.680	175
18.5	25	200L	MA20L613	975	34	18.5	0.83	0.78	0.70	91.1	91.0	88.0	5.8	2.6	2.3	1.00	241
22	30	200L	MA20L633	975	40.3	22.0	0.83	0.77	0.68	91.5	91.0	88.0	5.8	2.6	2.3	1.20	254
30	40	225M	MA22M623	975	52.1	30.0	0.87	0.84	0.76	92.0	91.0	88.0	6.0	2.3	2.2	2.10	336
37	50	250M	MA25M603	975	63.2	37.0	0.88	0.85	0.82	92.5	92.5	91.0	6.0	2.5	2.3	3.51	458
45	60	280S	MA28S613	980	81.1	44.7	0.83	0.80	0.70	93.0	92.5	92.0	6.0	2.5	2.3	5.11	573
55	75	280M	MA28M633	980	96.3	54.7	0.85	0.81	0.72	93.5	93.0	92.0	6.0	2.3	2.3	6.16	620
75	100	315S	MA31S613	985	131	74.2	0.85	0.82	0.75	94.0	94.0	92.2	6.0	2.4	2.5	10.7	830
90	120	315M	MA31M633	987	158	88.8	0.84	0.81	0.72	94.2	94.2	92.5	6.0	2.3	2.5	12.4	912
110	150	315M	MA31M653	988	191	108.4	0.85	0.82	0.73	94.5	94.5	92.5	6.0	2.3	2.5	15.5	1010
125	170	315L	MA31L6A3	988	219	123.2	0.84	0.80	0.71	94.7	94.6	92.6	6.0	2.3	2.5	18.0	1175
132	180	315L	MA31L673	988	227	130.1	0.85	0.82	0.73	95.0	94.9	93.0	6.0	2.3	2.5	18.0	1175
150	200	315L	MA31L6B3	988	265	147.9	0.83	0.80	0.70	95.0	94.3	92.8	6.0	2.3	2.5	21.5	1231
160	215	315L	MA31L693	988	276	157.7	0.85	0.82	0.73	95.0	94.5	93.0	6.0	2.3	2.5	21.5	1231
180	240	355L	MA35L6A3	990	321	177.1	0.82	0.77	0.65	95.1	94.6	93.0	6.0	2.0	2.5	28.7	1670
200	270	355L	MA35L613	990	348	196.8	0.84	0.80	0.7	95.2	95	93.3	6.0	2.0	2.5	28.7	1670
250	335	355L	MA35L633	990	434	246.0	0.84	0.80	0.7	95.5	95	93.5	6.0	2.0	2.5	35.5	1780

Notes:
- All performance values are subject to tolerance as per IS 325.
- For ratings above 0.37kW & up to 355kW, motors are avaialble with efficiency class IE2. For details, please refer the section of IE2 series motors in this catalogue.

Efficiency measurements are without seals.

Performance table for 8 Pole motors

TEFC 3 Phase Squirrel Cage Induction Motors - Frame size 90S to 355L

Applicable standard for testing: IS 4029
Applicable standard for efficiency determination: IS 4889

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

Ambient :50°C
Duty : S1(Continuous)

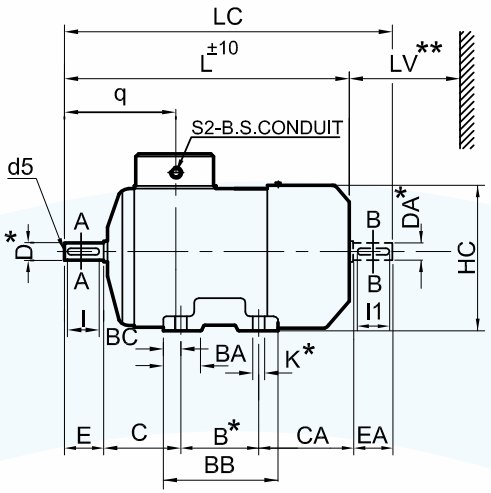
750 rpm (8-Pole)

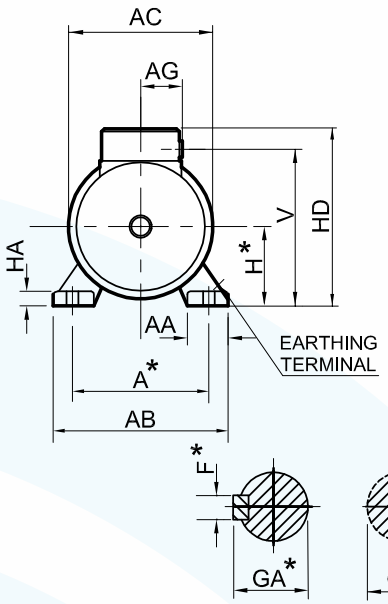
Ins. Class : F
Temp. Rise : B
Protection : IP55

Rated Output		Frame size IEC	Type ref. B3 construction	Rated Speed RPM	Operating characteristics at rated output								With DOL starting		Pullout Torque to Rated Torque Ratio	Rotor GD² kgm²	Net Weight B3 constr. kg
					Rated Current Amps.	Rated Torque kg-m	Power Factor			% Efficiency			Starting Current to Rated	Starting Torque to rated			
kW	HP						FL	3/4L	1/2L	FL	3/4L	1/2L					
0.37	0.5	90S	MA09S813	700	1.32	0.515	0.63	0.52	0.41	62.0	55.0	48.0	2.7	1.8	2.1	0.01100	11
0.55	0.75	90L	MA09L853	690	1.81	0.776	0.63	0.55	0.43	67.0	62.0	58.0	2.9	2.0	2.4	0.01400	14
0.75	1	100L	MA10L813	685	2.04	1.07	0.73	0.63	0.50	70.0	70.0	64.0	3.0	1.6	1.8	0.0230	18
1.1	1.5	100L	MA10L833	690	2.91	1.55	0.71	0.62	0.48	74.0	73.0	71.0	3.3	1.9	2.3	0.0270	21
1.5	2	112M	MA11M813	705	3.87	2.07	0.70	0.62	0.50	77.0	77.0	75.0	3.8	1.7	2.2	0.0510	25
2.2	3	132S	MA13S8B3	705	5.03	3.04	0.78	0.74	0.64	78.0	78.0	75.0	3.5	1.8	2.3	0.0990	44
3.7	5	160M	MA16M813	720	8.05	5.01	0.78	0.74	0.65	82.0	82.0	78.0	4.4	1.8	2.0	0.217	88
5.5	7.5	160M	MA16M833	715	11.6	7.49	0.78	0.74	0.65	84.5	84.5	82.0	4.8	1.9	2.2	0.299	101
7.5	10	160L	MA16L873	710	15.6	10.3	0.78	0.74	0.65	86.0	84.0	82.0	5.5	2.1	2.2	0.400	119
9.3	12.5	180M	MA18M813	715	18.9	12.7	0.79	0.74	0.64	86.5	86.5	85.0	4.5	2.1	2.2	0.620	177
11	15	180L	MA18L833	720	22.1	14.9	0.79	0.74	0.64	87.5	87.5	86.0	4.5	2.1	2.2	0.720	182
15	20	200L	MA20L833	720	28.8	20.3	0.82	0.79	0.71	88.5	88.5	87.0	5.5	2.5	2.3	1.32	282
18.5	25	225S	MA22S813	725	36.6	24.9	0.79	0.77	0.69	89.0	88.0	87.0	5.3	2.1	2.2	1.950	329
22	30	225M	MA22M833	725	43	29.6	0.79	0.77	0.69	90.0	89.0	87.0	5.3	2.1	2.2	2.410	369
30	40	250M	MA25M813	730	55.9	40.0	0.82	0.78	0.68	91.0	90.5	89.0	5.5	2.5	2.2	3.720	472
37	50	280S	MA28S823	730	70.8	49.4	0.79	0.75	0.65	92.0	92.0	90.0	5.5	2.2	2.2	5.83	615
45	60	280M	MA28M853	730	86.1	60.0	0.79	0.75	0.65	92.0	92.0	91.0	5.5	2.2	2.2	6.86	665
55	75	315S	MA31S813	740	105	72.4	0.78	0.73	0.62	93.0	92.5	90.5	5.5	2.1	2.4	10.7	833
75	100	315M	MA31M833	740	143	98.7	0.78	0.73	0.62	93.5	93.0	92.0	5.5	2.1	2.4	12.4	912
90	120	315M	MA31M853	740	171	118.5	0.78	0.73	0.62	94.0	93.5	92.5	5.5	2.1	2.4	15.5	1010
110	150	315L	MA31L873	740	208	144.8	0.78	0.73	0.62	94.2	93.7	92.5	5.5	2.1	2.4	18.0	1170
125	170	315L	MA31L8A3	740	236	164.5	0.78	0.73	0.64	94.3	93.7	92.5	5.5	2.1	2.4	21.5	1340
132	180	315L	MA31L893	740	249	173.7	0.78	0.73	0.64	94.5	94.0	92.8	5.5	2.1	2.4	21.5	1340
150	200	355L	MA35L8A3	740	283	197.4	0.78	0.70	0.60	94.6	94.0	92.5	5.5	1.8	2.2	28.7	1670
160	215	355L	MA35L813	740	300	210.6	0.78	0.70	0.60	95.0	94.5	92.5	5.5	1.8	2.2	28.7	1670
180	240	355L	MA35L8B3	740	338	236.9	0.78	0.70	0.60	95.0	94.3	92.3	5.5	1.8	2.2	35.5	1780
200	270	355L	MA35L833	740	376	263.2	0.78	0.70	0.60	95.0	94.5	92.5	5.5	1.8	2.2	35.5	1780

Notes:
- All performance values are subject to toleance as per IS 325.
- Ratings above 200kW up to 630kW are available in 355, 400 & 450 frames with Dual Circuit Cooling Arrangement (DCCA). Efficiency measurements are without seals.

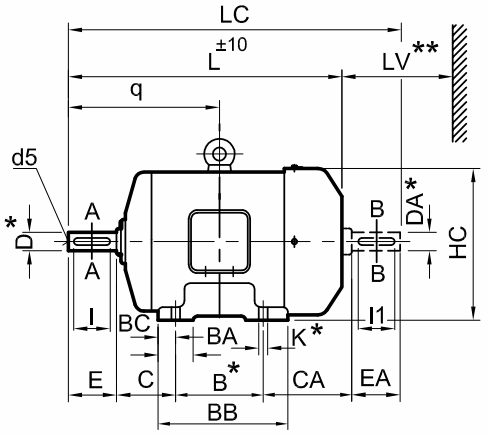
Dimensional Drawing: Industrial Motors Type MA Foot Mounted (B3) TEFC series Frame 63-355L

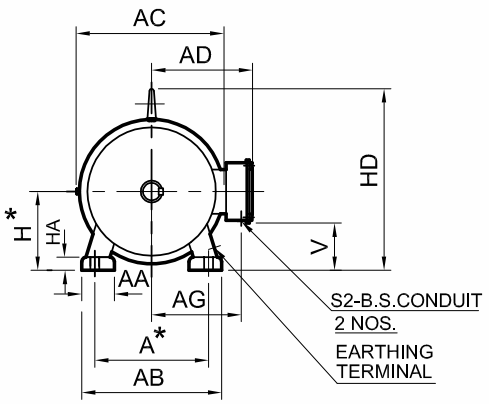




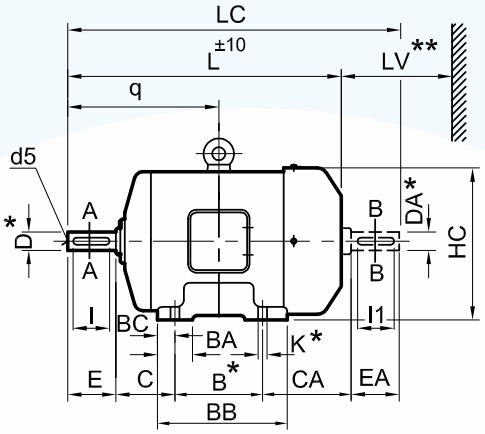
FRAME SIZE 63 TO 80

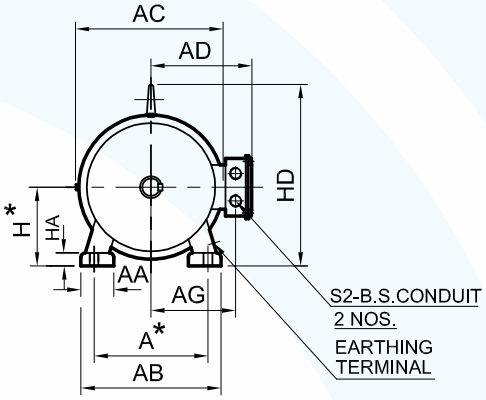
SECTION A-A SECTION B-B





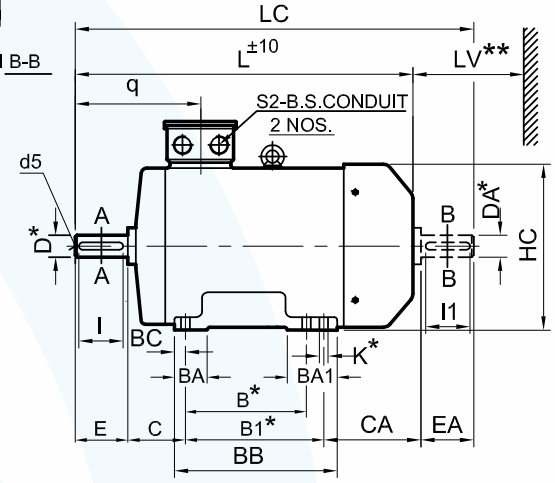
FRAME SIZE 160M TO 180L

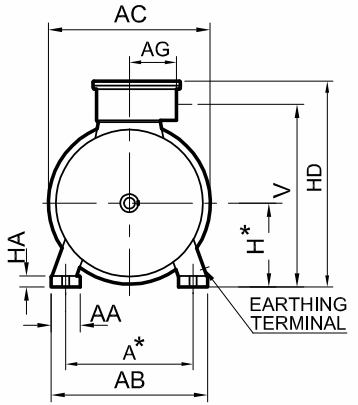




FRAME SIZE 200L TO 225M

* Refer TABLE A for tolerances





FRAME SIZE 90S TO 132M
FRAME SIZE 250M TO 355L

CAT-C-6335-3-1

Dimensional Details: Industrial Motors Type MA Foot Mounted (B3) TEFC series Frame 63-355L

		FIXING						GENERAL														TERMINAL BOX				SHAFT					
IEC Fr. size	Pole	A*	B*	B1*	C	H*	K*	AB	BB	AA	BA	BA1	BC	HA	HC	HD	AD	L	LC	CA	AC	LV**	V	q	AG	S2 B.S.C.	D,DA*	E EA	F* FA*	GA* GC*	I I1	d5
63	2 & 4	100	80	—	40	63	7	126	100	28	30	—	13	7	125	179	—	206	241	75	124	30	149	104	40	3/4"	11	23	4	12.5	18	M4
71	2,4 & 6	112	90	—	45	71	7	135	110	31	30	—	13	7	141	195	—	234	278	83	140	30	166	102	40	3/4"	14	30	5	16	25	M5
80	2,4 & 6	125	100	—	50	80	10	150	124	31	35	—	15	9	159	214	—	267	324	94	157	30	185	112	40	3/4"	19	40	6	21.5	35	M6
90S	2,4,6 & 8	140	100	—	56	90	10	168	125	34	31.5	—	18	12	177	230	-	302	374	118	174	35	199	139	52	3/4"	24	50	8	27	45	M8
90L	2,4,6 & 8		125						150									327	399					153								
100L	2,4,6 & 8	160	140	—	63	100	12	190	174	43.5	36	—	21	12	198	257	-	366	448	125	192	40	225	152	56	1"	28	60	8	31	55	M10
112M	4,6 & 8	190	140	—	70	112	12	220	174	47	36	—	21	12	222	282	-	388	471	141	220	45	249	157	56	1"	28	60	8	31	55	M10
132S	2	216	140	—	89	132	12	256	180	64	50	—	23	17	262	338	-	475	578	189	260	50	299	196	63	1"	38	80	10	41	70	M12
	4,6 & 8																	459	561	172											
132M	2		178						218		54							556	659	232				215								
	4,6																	497	599	172											
160M	2	254	210	—	108	160	15	310	250	58	70	—	23	20	318	366	226	605	741	203	316	60	98	323	186	1"	42	110	12	45	105	M16
	4,6 & 8																	585	721	183											
160L	2		254						294									649	785	203				345							
	4,6 & 8																	629	765	183											
180M	2,4,6 & 8	279	241	—	121	180	15	344	281	65	70	—	23	26	357	412	265	679	799	217	354	70	83	352	216	1 1/2"	48	110	14	51.5	100	M16
180L	2,4,6 & 8		279						319									717	838	218				371							
200L	2	318	305	—	133	200	19	398	355	85	85	—	28	32	397	462	319	795	920	262	394	80	—	396	249	2"	55	110	16	59	100	M20
	4,6 & 8																	772	897	239											
225S	4,6 & 8	356	286	—	149	225	19	436	336	85	85	—	28	34	450	509	344	827	976	231	450	90	—	432.5	273	2"	60	140	18	64	130	M20
225M	2		311						361									837	956	276				415			55	110	16	59	100	
	4,6 & 8																	852	1001	231				445			60	140	18	64	130	
250M	2	406	349	—	168	250	24	506	425	100	115	—	49	42	495	665	—	914	1065	268	489	100	578	352	243	2"	60	140	18	64	130	M20
	4,6 & 8																										65	140	18	69	130	
280S/M	2	457	368	419	190	280	24	540	490	100	110	149	40	42	552	725	—	1010	1160	271	544	115	638	360	243	2"	65	140	18	69	130	M20
	4,6 & 8																										75	140	20	79.5	130	
315S/M	2	508	406	457	216	315	28	625	540	120	120	155	46	45	615	830	—	1137	1293	240	600	130	728	386	278	2"	65	140	18	69	130	M20
	4,6 & 8																	1167	1353					416			80	170	22	85	160	
315L	2		508	—					593	120	120	—	46					1302	1458	454				386		2 1/2"	65	140	18	69	130	
	4,6 & 8																	1332	1518					416			80	170	22	85	160	
355L	2	610	630	—	254	355	28	710	770	110	170	—	73	45	693	939	—	1461	1622	458	685	145	850	434	403	3"	75	140	20	79.5	130	M24
	4,6 & 8																	1491	1682					464			95	170	25	100	160	

TABLE A

Dimension	Tolerance		Specification
A,B	±0.75		
H	-0.5	UPTO 280	IS : 1231
	-1	OVER 280	
K	+0.360	7,10Ø	
	+0.430	12,15Ø	
	+0.520	19,24,28Ø	

Dimension	Tolerance		Specification
D,DA	j6	11,14,19,24,28Ø	IS : 1231
	k6	38,42,48Ø	
	m6	55,60,65,75,80,95Ø	
GA,GC,F,FA			IS : 2048
d5(centering)			IS : 2540

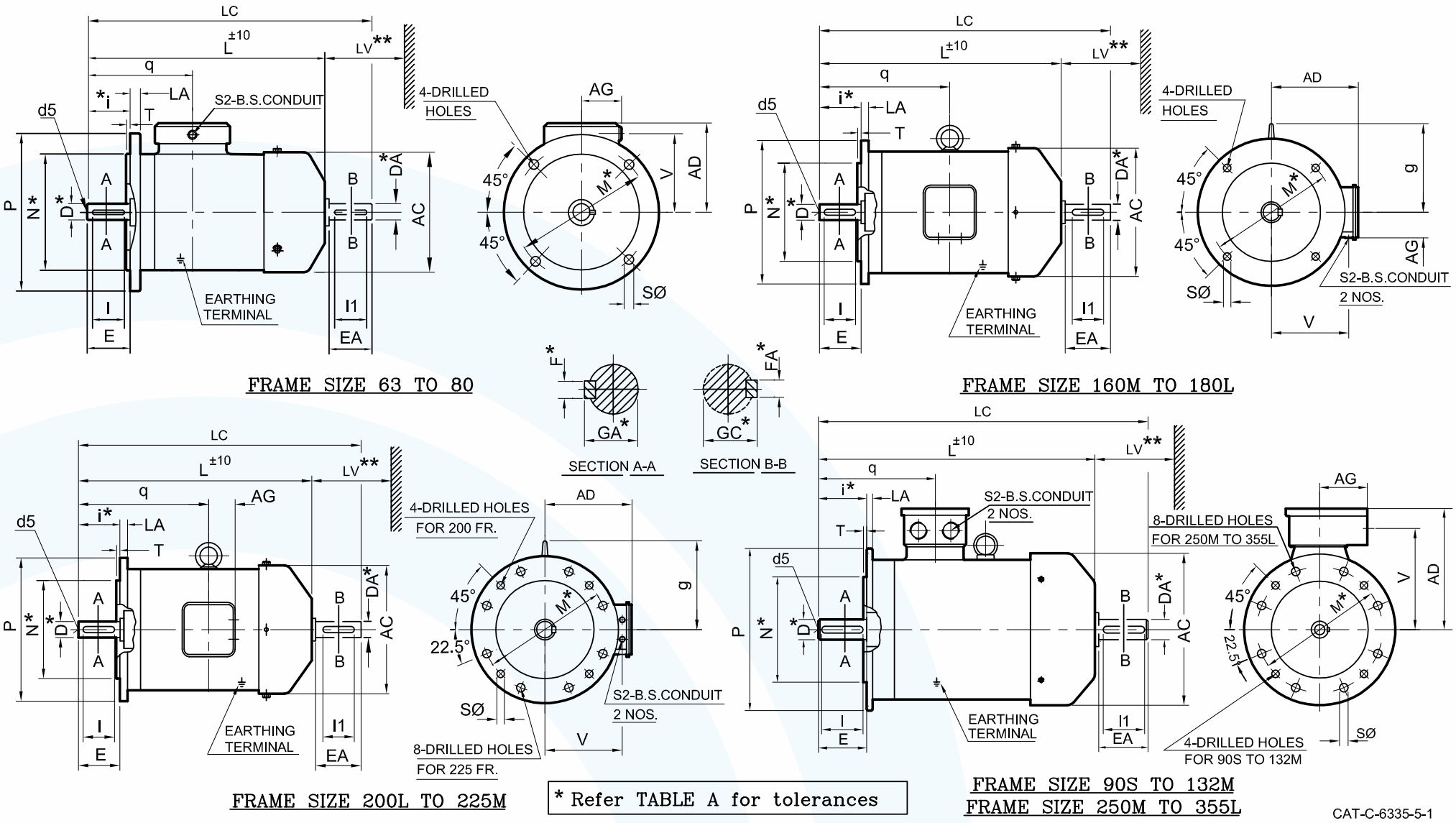
① Without Eye bolt

- Key / key way fit : h9 / N9
- Double shaft extension can be provided with shaft dimension identical to DE shaft.
- Also suitable for B6,B7,B8,V5 & V6 mounting as per IS 2253.

** Minimum distance for efficient cooling of motor to be maintained by user

All Dimensions are in mm unless otherwise specified.

Dimensional Drawing: Industrial Motors Type MA Flange Mounted (B5) TEFC series Frame 63-355L



* Refer TABLE A for tolerances

CAT-C-6335-5-1

Dimensional Details: Industrial Motors Type MA Flange Mounted (B5) TEFC series Frame 63-355L

		FIXING					GENERAL								TERMINAL BOX				SHAFT					
IEC Fr. size	Pole	P	N*	M*	i*	S	T	LA	AD	AC	L	LC	LV**	g	V	q	AG	S2 B.S.C.	D,DA**	E EA	F* FA*	GA* GC*	I I1	d5
63	2 & 4	140	95	115	23	10	3	9	116	124	225	260	30	—	86	109	40	3/4"	11	23	4	12.5	18	M4
71	2,4 & 6	160	110	130	30	10	3.5	9	124	140	261	305	30	—	95	127	40	3/4"	14	30	5	16	25	M5
80	2,4 & 6	200	130	165	40	12	3.5	10	134	157	267	324	30	—	105	112	40	3/4"	19	40	6	21.5	35	M6
90S	2,4,6 & 8	200	130	165	50	12	3.5	10	140	174	302	374	35	①	109	139	52	3/4"	24	50	8	27	45	M8
90L	2,4,6 & 8										327	399				153								
100L	2,4,6 & 8	250	180	215	60	15	4	11	157	195	366	448	40	-	125	152	56	1"	28	60	8	31	55	M10
112M	4,6 & 8	250	180	215	60	15	4	11	170	220	388	471	45	-	137	157	56	1"	28	60	8	31	55	M10
132S	2	300	230	265	80	15	4	12	206	260	475	578	50	-	167	196	63	1"	38	80	10	41	70	M12
	4,6 & 8										459	561												
132M	2										556	659				215								
	4&6										497	599												
160M	2	350	250	300	110	19	5	13	226	316	605	741	60	206	186	323	63	1"	42	110	12	45	105	M16
	4,6 & 8										585	721												
160L	2										649	785				345								
	4,6 & 8										629	765												
180M	2,4,6 & 8	350	250	300	110	19	5	13	265	354	679	799	70	232	216	352	97	1 1/2"	48	110	14	51.5	100	M16
180L	2,4,6 & 8										717	838				371								
200L	2	400	300	350	110	19	5	15	319	394	795	920	80	262	249	396	172	2"	55	110	16	59	100	M20
	4,6 & 8										772	897												
225S	4,6 & 8	450	350	400	140	19	5	16	344	450	827	976	90	284	273	432.5	172	2"	60	140	18	64	130	M20
225M	2				110						837	956				415			55	110	16	59	100	
	4,6 & 8				140						852	1001				445			60	140	18	64	130	
250M	2	550	450	500	140	19	5	18	415	489	914	1065	100	—	328	352	243	2"	60	140	18	64	130	M20
	4,6 & 8																		65	140	18	69	130	
280S/M	2	550	450	500	140	19	5	18	445	544	1010	1160	115	—	358	360	243	2"	65	140	18	69	130	M20
	4,6 & 8																		75	140	20	79.5	130	
315S/M	2	660	550	600	140	24	6	22	515	615	1137	1293	130	—	413	386	278	2"	65	140	18	69	130	M20
	4,6 & 8				170						1167	1353				416			80	170	22	85	160	
315L	2				140						1302	1458				386		2 1/2"	65	140	18	69	130	
	4,6 & 8				170						1332	1518				416			80	170	22	85	160	
355L	2	800	680	740	140	24	6	25	584	690	1461	1622	145	—	495	434	403	3"	75	140	20	79.5	130	M24
	4,6 & 8				170						1491	1682				464			95	170	25	100	160	M24

TABLE A

Dimension	Tolerance		Specification
N	j6	UPTO 450	IS : 2223
	js6	OVER 450	
M	±0.3	UPTO 265	
	±0.5	OVER 265	
i	±1	UPTO 85	
	±1.5	OVER 85	

Dimension	Tolerance		Specification
D,DA	j6	11,14,19,24,28Ø	IS : 1231
	k6	38,42,48Ø	
	m6	55,60,65,75,80,95Ø	
GA,GC,F,FA			IS : 2048
d5(centering)			IS : 2540

① Without Eye bolt

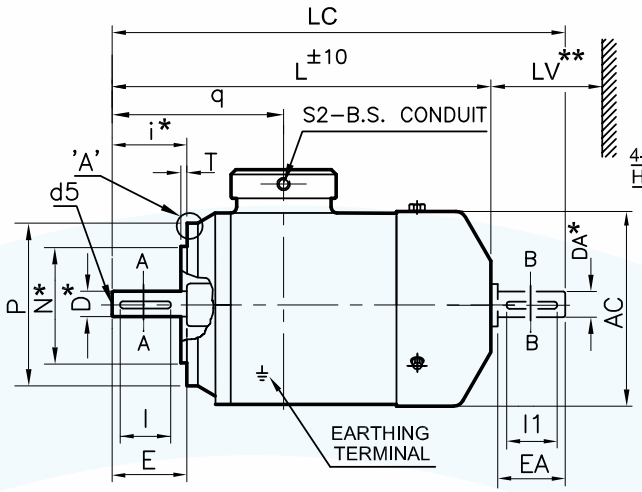
- Key / key way fit : h9 / N9
- 8 Nos. Fixing Holes from 225S/M frame onwards
- Double shaft extension can be provided with shaft dimension identical to D.E.shaft
- Also suitable for V1 & V3 mounting as per IS 2253

** Minimum distance for efficient cooling of motor to be maintained by user

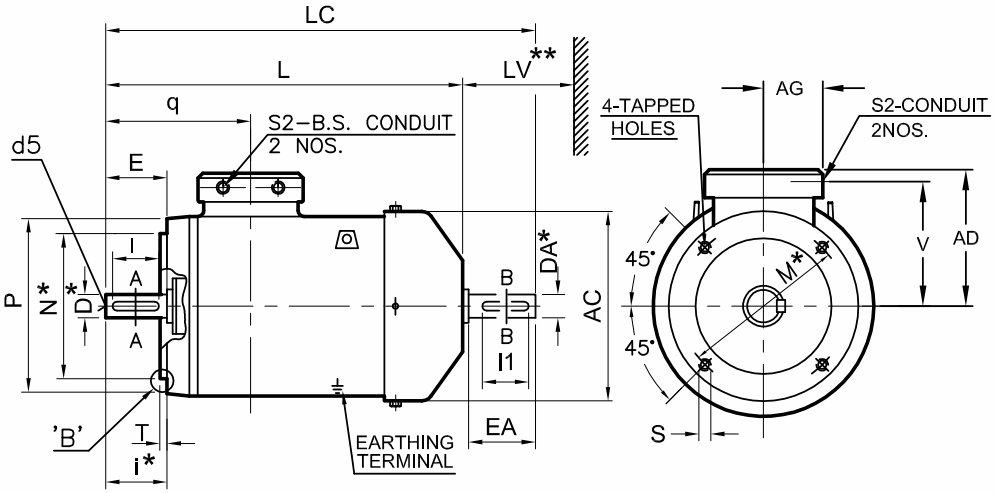
All Dimensions are in mm unless otherwise specified.

CAT-C-6335-5-2

Dimensional Details: Industrial Motors Type MA Face Mounted (B14) TEFC series Frame 63-132M

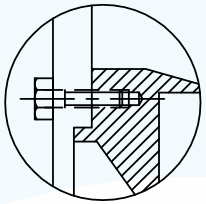


FRAME SIZE 63 TO 80

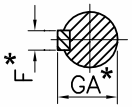


FRAME SIZE 90S TO 132M

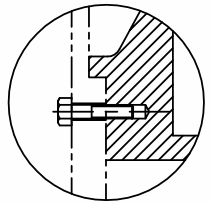
IEC Fr. size	Pole	FIXING P	N*	M*	i*	S	GENERAL T	AD	AC	L	LC	LV**	g	TERMINAL BOX V	q	AG	S2 B.S.C.	SHAFT D* DA*	E EA	F* FA*	GA* GC*	I I1	d5
63	2 & 4	90	60	75	23	M5X10	2.5	116	124	206	241	30	—	86	104	40	3/4"	11	23	4	12.5	18	M4
71	2,4 & 6	105	70	85	30	M6X10	2.5	124	140	234	278	30	—	95	102	40	3/4"	14	30	5	16	25	M5
80	2,4 & 6	120	80	100	40	M6X13	3	134	157	267	324	30	—	105	112	40	3/4"	19	40	6	21.5	35	M6
90S	2,4,6 & 8	140	95	115	50	M8X12	3	140	174	302	374	35	①	109	139	52	3/4"	24	50	8	27	45	M8
90L	2,4,6 & 8									327	399				153								
100L	2,4,6 & 8	160	110	130	60	M8X12	3.5	157	195	366	448	40	-	125	152	56	1"	28	60	8	31	55	M10
112M	2,4,6 & 8	160	110	130	60	M8X12	3.5	170	220	388	471	45	-	137	157	56	1"	28	60	8	31	55	M10
132S	2	250	180	215	80	M12X20	4	206	260	475	578	50	-	167	196	63	1"	38	80	10	41	70	M12
	4,6 & 8									459	561												
132M	2									556	659				215								
	4 & 6									497	599												



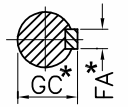
ENLARGEMENT OF CIRCLE 'A'



SECTION A–A



ENLARGEMENT OF CIRCLE 'B'



SECTION B–B

TABLE A

Dimension	Tolerance	Specification
N	j6	IS : 2223
M	±0.3	
i	±1	

Dimension	Tolerance		Specification
D,DA	j6	11,14,19,24,28Ø	IS : 1231
	k6	38Ø	
GA,GC,F,FA			IS : 2048
d5(centering)			IS : 2540

*Refer TABLE A for tolerances

① Without Eye bolt

- Also suitable for V19 & V18 mounting as per IS 2253
- Key / key way fit : h9 / N9
- Double shaft extension can be provided with shaft dimension identical to D.E. shaft

** Minimum distance for efficient cooling of motor to be maintained by user

All Dimensions are in mm unless otherwise specified.

Global warming is a reality and world over people are working towards reduction in carbon foot print. Electric motor applications, in Indian industry, consume about seventy percent of the generated electrical energy in India. Improving efficiency of the motor is therefore a major concern in energy-efficiency efforts. Electric motors with improved efficiency, in combination with frequency converters can save about 7% of the total worldwide electrical energy. Roughly one quarter to one third of these savings come from the improved efficiency of the motor. A need was felt amongst users, consultants and manufacturers in India to revise existing BIS standard IS 12615:2004 to harmonize with the international standards. This will lead us to be in line with international code of standards and practices. This will also result in having uniform test procedures to facilitate the end user to compare the performance and energy efficiency of motors manufactured by different manufacturers.

Motors from 0.37kW to 375kW make up the vast majority (approximately 90%) of installed motor population and are covered by the standard IS12615:2011. This fulfils the need of the manufacturers to design motor for a global market. This standard defines three efficiency classes and corresponding efficiency values for motors operating at 50Hz frequency.

Salient features of BIS standard IS 12615:2011 (second revision)

This standard is primarily based on IEC 60034-30:2008 issued by the International Electrotechnical Commission except that additional performance parameters other than efficiency values have also been included such as starting current, starting torque and full load speed.

The efficiency levels in IS 12615:2011 are based on test methods specified in IS 15999 (Part 2/sec 1): 2011 /IEC 60034-2-1:2007. The standard specifies methods used to determine losses and efficiency, with the objective to calculate efficiency values more accurately.

The standard specifies rated voltage as 415V, and rated frequency as 50Hz. Also the permissible variations in voltage and frequency are as below

- Voltage: ±10%
- Frequency: ±5%
- Combined variation: ±10%

The standard specifies output kW rating and frame relationship up to 160kW for 2P & 4P ratings and up to 132kW for 6P ratings. Above these ratings, the

New IE Efficiency Classes are as given below

Efficiency Class	Description	
IE1	Standard efficiency	Comparable to eff2
IE2	High efficiency	Comparable to eff1
IE3	Premium	Premium

The standard covers low voltage, AC three phase squirrel cage, single speed induction motors for

- Rated voltage $\leq$ 1000V
- Rated frequency 50Hz
- Rated output between 0.37kW to 375kW
- 2, 4 & 6 Pole motors
- Rated on the basis of continuous duty (S1) or intermittent periodic duty (S3) with 80% or higher cyclic duration factor
- Capable of operating direct on line
- Rated for ambient temperature of 40^{0}C & altitude not exceeding 1000m
- Degree of protection IP44 or superior
- Method of cooling IC 411
- Fixing dimensions as per IS 1231 & IS 2223
- Determination of total losses with stray load loss determination from residual losses

This standard does not cover

- 8P & higher polarity motors
- Pole changing motors (multispeed motors)
- Motors made exclusively for converter duty application
- Motors completely integrated into the machine. (for example, pumps, compressors that cannot be tested separately from the machine)
- Crane & hoist duty motors

Highlight

- Efficiency values of different manufacturers are comparable only if they are measured by the same method as per IS 15999 (Part 2/sec 1):2011 / IEC 60034-2-1:2007.
- IE Class efficiencies are subject to tolerance as per IS/IEC 60034-1.
- For conditions of limitations on grid supply (e.g. limiting starting current, high tolerances of voltage and/or frequency), it may not be possible to achieve the same IE efficiency class.
- Energy efficient cage-induction motors are typically built with more active material to achieve higher efficiency and hence the starting performance of these motors differ somewhat

from motors with a lower efficiency. The locked rotor current increases approximately by 10 to 15 percent for increase in each level of efficiency for the same output power. For replacing existing motors, this should be checked by the user with manufacturer for proper sizing of the protective devices.

Old efficiency levels were eff2 and eff1 (as per CEMEP). For calculation of these efficiencies, fixed stray load losses (0.5% of motor input) were assumed and not measured. Hence efficiency values were with high uncertainty. Now IS : 12615:2011 refers to IS : 15999 (Part 2/sec 1):2011 / IEC 60034-2-1:2007 for calculation of efficiency. This calculation is based on the new methods of stray load loss measurement specified in the standard. The effect is in reduction of efficiency value than the earlier values.

Bharat Bijlee's IE2 Motors Product Range

Type	Frame Size	kW Range
IE2 High efficiency-2H	71 TO 355L	0.37 TO 355

Bharat Bijlee IE2 motors are readily suitable for inverter duty -

Features:

- All motors with dual coat winding wires
- Special Impregnation to suit inverter duty
- 6 terminals in the terminal box for all motors

Stray Load Loss Measurement and Efficiency Determination of IE2 Motor

The most significant difference in the efficiency determination method of standard motors (as per IS : 325) and IE2 motors (as per IS : 12615-2011) is in the measurement of stray load losses.

Effect of additional stray load losses for efficiency determination as per IS : 12615-2011.

The new standard follows IS : 15999 / IEC 60034-2-1 for arriving at the stray load losses. These losses can vary from 2.5% in small motors to 0.5% in higher ratings up to 10MW. (reference - graph. In figure 11 of standard IS : 15999).

The earlier standard IS : 12615-2004 used for eff1 motors assumed stray load losses as 0.5% of output. Hence the efficiency values tested by the earlier standard would be 0% to 2.0% higher than the new standard for the same motor.

Example is given below

Rating 4 Pole	eff1 specified in IS : 12615-2004 (%)	IE2 specified in IS : 12615-2011 (%)	Reduction in efficiency from eff1 due to additional stray load losses (%)
0.75kW	82.5	79.6	2.9
55kW	94.2	93.5	0.7

When comparing eff1/eff2 motor & IE2 motor, it is necessary to note the difference in testing methods. The standard has reduced the efficiency value to take care of this. At first glance, a customer would feel that an IE2 motor is inferior to an eff1 motor though both might be identical.

Hence for any comparison, it is necessary to use the same method of loss calculation.

The worked out example shown below gives the energy savings per year (for 8000 hours running) of a BBL IE2 motor (normalized for 0.5% stray load loss) over a BBL standard motor. Stray load losses are taken from figure 11 of IS : 15999.

Efficiency comparison and energy saving of standard motor and IE2 motor

Rating kW	Bharat Bijlee Standard Motor Catalogue (η %)	Bharat Bijlee IE2 Catalogue (η %)	Input Power (kW) for IE2 motor as per catalogue	Additional Stray load losses (kW) over Standard motor	Normalized IE2 % η with 0.5% Stray losses assumed	Standard Motor losses (kW)	IE2 Motors losses Normalized (kW)	Saving (kW)	Saving (kW) Saving in energy kWH @8000 Hrs running per year
11	89.0	89.8	11.0 / 0.898 =12.249	(0.2424-0.0550) = 0.187	11.0 / (12.249 - 0.187) =91.2	(11.0 / 0.89) - 11.0 =1.36	(11.0/ 0.912) - 11.0 =1.062	1.36-1.062 =0.298	2380
55	93.8	93.5	55.0/ 0.935 =58. 824	(0.959-0.275) =0.684	55.0/ (58.824-0.684) =94.6	(55.0/ 0.938) -55.0 =3.636	(55.0/ 0.95) -55.0= 2.894	3.636-2.894= 0.742	5936

For Standard motor, stray load loss is 0.5% of output
Stray load loss for 11kW motor is 0.055 kW
Stray load loss for 55kW motor is 0.275 kW

For IE2 motor, as per nomogram (figure 11 of IS 15999)
Stray load loss for 11kW motor is 0.2424 kW
Stray load loss for 55kW motor is 0.959 kW

Table shown below gives the Energy Savings Per Year (for 8000 hours running) of a BBL IE2 Motor (normalized for 0.5% stray load loss) over a standard eff2 motor as per IS 12615-2004

	2 Pole				4 Pole				6 Pole			
Rating kW	Standard eff2 Motor (η%)	BBL IE2 Motor (η%)	Normalized IE2 η with 0.5% Stray load losses	Saving in kWh/Year @8000 Hrs running	Standard eff2 Motor (η%)	BBL IE2 Motor(η%)	Normalized IE2 η with 0.5% Stray load losses	Saving in kWh/Year @8000 Hrs running	Standard eff2 Motor (η%)	BBL IE2 Motor(η %)	Normalized IE2 η with 0.5% Stray load losses	Saving in kWh/Year @8000 Hrs running
0.37	66.0	72.2	73.78	472.8	66.0	70.1	71.64	353.1	65.0	69	70.52	356.4
0.55	70.0	74.8	76.42	528.4	70.0	75.1	76.73	551.3	68.0	72.9	74.49	563.8
0.75	73.0	77.4	79.07	631.0	73.0	79.6	81.31	839.9	71.0	75.9	77.54	713.2
1.1	76.2	79.6	81.29	723.4	76.2	81.4	83.12	961.8	74.0	78.1	79.77	859.6
1.5	78.5	81.3	82.96	822.5	78.5	82.8	84.49	1083.4	76.0	79.8	81.44	1054.6
2.2	81.0	83.2	84.82	979.2	81.0	84.3	85.94	1248.8	79.0	81.8	83.40	1175.6
3.7	84.0	85.5	87.06	1237.4	84.0	86.3	87.87	1551.2	82.5	84.3	85.84	1396.2
5.5	85.7	87.0	88.50	1624.3	85.7	87.7	89.21	2018.2	84.5	86	87.49	1777.9
7.5	87.0	88.1	89.55	1965.7	87.0	88.7	90.16	2416.9	86.0	87.2	88.64	2079.2
9.3	87.7	88.8	90.22	2367.8	87.7	89.3	90.72	2827.4	87.0	88	89.41	2304.0
11	88.4	89.4	90.79	2621.8	88.4	89.8	91.20	3051.6	87.5	88.7	90.08	2884.3
15	89.4	90.3	91.64	3278.6	89.4	90.6	91.94	3710.2	88.5	89.7	91.03	3771.8
18.5	90.0	90.9	92.20	3927.0	90.0	91.2	92.50	4452.6	89.5	90.4	91.70	3961.9
22	90.5	91.3	92.57	4349.4	90.5	91.6	92.87	4969.2	90.0	90.9	92.17	4597.1
30	91.4	92.0	93.21	5107.6	91.4	92.3	93.52	5940.5	91.0	91.7	92.91	5423.3
37	92.0	92.5	93.67	5750.0	92.0	92.7	93.88	6428.6	91.5	92.2	93.37	6484.8
45	92.5	92.9	94.04	6360.4	92.5	93.1	94.24	7178.9	92.0	92.7	93.84	7653.4
55	93.0	93.2	94.30	6509.7	93.0	93.5	94.60	7999.8	92.5	93.1	94.20	8568.3
75	93.6	93.8	94.84	8361.3	93.6	94	95.04	9701.0	93.0	93.7	94.74	11824.9
90	93.9	94.1	95.10	9681.9	93.9	94.2	95.20	10481.8	93.3	94.0	95.00	13811.3
110	94.0	94.3	95.26	12383.0	94.4	94.5	95.46	10362.0	93.5	94.3	95.26	17389.3
125	94.5	94.5	95.43	10360.3	94.7	94.6	95.53	9227.8	93.6	94.4	95.33	19430.6
132	94.5	94.6	95.52	11972.5	94.7	94.7	95.62	10774.2	93.8	94.6	95.52	20311.7
150	94.6	94.7	95.60	13231.2	94.8	94.7	95.60	10555.0				
160	94.8	94.8	95.68	12475.1	95.0	94.9	95.78	11035.5				

Testing Facility To Meet Global Standards

Bharat Bijlee has made a proactive initiative towards producing energy efficient motors with our technologically advanced in-house test facility for complete range of IE motors as per latest International Standards and 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: 60034-2-1:2007 and IS:15999 (part 2/sec 1):2011
- Loading as per full load torque and stray load loss determination from residual loss method 2-1-1B (In line with future revision of IEC: 60034-2-1:201X)
- Five test stations for IE2/IE3 efficiency determination
- Efficiency calculation through special software in line with future revision of IEC: 60034-2-1:201X
- Combined testing of Motor + Drive for Safe and Hazardous Area Motors
- Data measurement up to 22kW through SCADA is established and higher ratings under upgradation

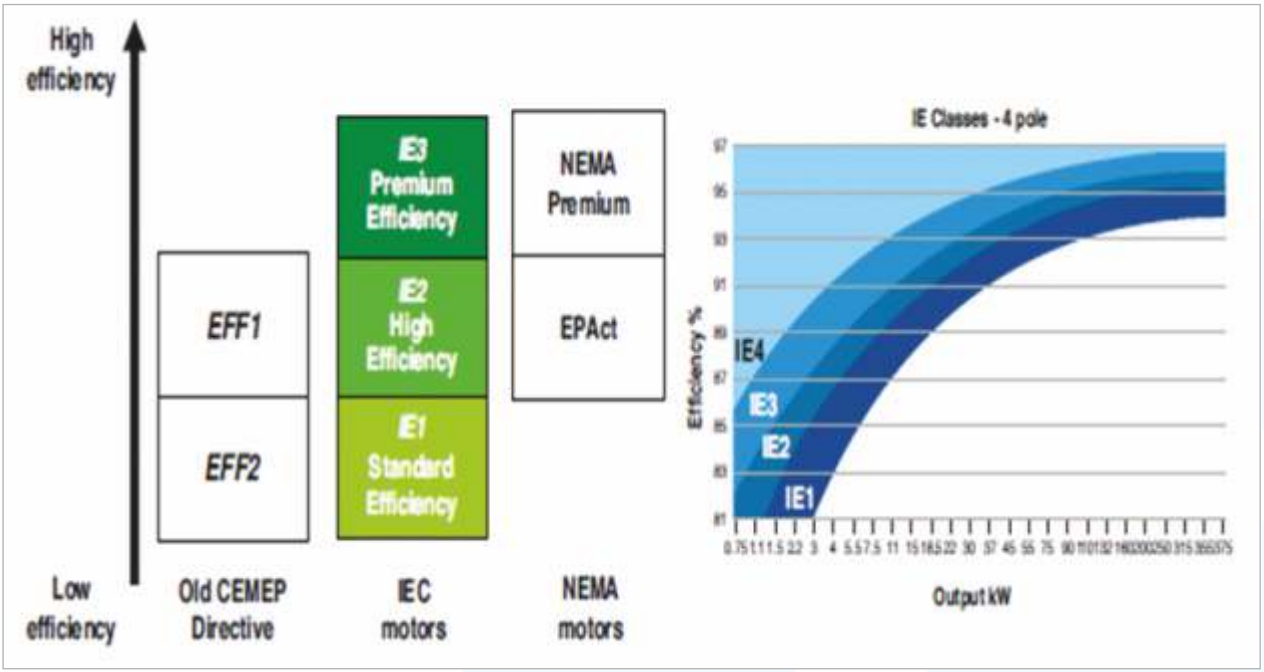
Common Queries

IE Class Efficiency

IE is International Efficiency - IE1, IE2, IE3 & IE4. Efficiency of the class increases from IE1 to IE4. IS 12615:2011 is referring to these classes and is identical to IEC 60034-30:2008. This IEC standard is accepted globally. IS 12615 refers to IS 15999 (Part 2/ Sec1):2011 / IEC 60034-2-1:2007 for calculation of efficiency. This calculation is based on the new methods of stray load loss measurement specified in the standard.

Comparision of New IE Efficiency Classes & Old Efficiency Classes

Old efficiency levels were eff2 and eff1 (as per CEMEP). For calculation of these efficiencies, fixed stray load losses (0.5% of motor output) were assumed. Now IS 12615: 2011 refers to IS 15999 (Part 2/ Sec1): 2011/ IEC 60034 - 2 -1: 2007 for calculation of efficiency. This calculation is based on the new methods of stray load loss measurement specified in the standard. The effect is in reduction of efficiency value than the earlier ones.



Can eff1 motors simply be relabeled as IE2 without retesting?

No - IE and eff ratings are not the same or equivalent. Motors that have been given an eff rating will have to be retested before being given an IE rating.

When Should I Consider Buying Energy Efficient Motor?

- For all new installations
- When purchasing equipment packages, such as compressors, HVAC systems and Pump
- When measure modifications are made to facilities or processes
- Instead of rewinding older, standard efficiency units
- To replace oversized and under loaded motors
- As part of a preventive maintenance or energy conservation programmes

Extending IE Class Performance to Motors used in Hazardous Area

Bharat Bijlee continues the practice of extending the advantage of higher efficiency series for hazardous area also.

- Ex - d Flameproof
- Ex - e Increased Safety
- Ex - n Non Sparking

Performance Table for 2-Pole Motors

TEFC 3 Phase Squirrel Cage Induction Motors - Frame size 71 to 355L

Applicable standard for testing &efficiency determination: IS 15999
Voltage : 415V ±10%
Frequency : 50Hz ±5%
Combined Variation : ±10%

Ambient : 50°C
Duty : S1(Continuous)
3000 rpm (2-Pole)

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

IE2

Rated Output		Frame size	Type Ref.	Operating Characteristics at Rated output									With DOL Starting		Pullout Torque to Rated Torque Ratio	Rotor GD^2 kgm^2	Net Weight B3 constr. kg
				Rated Speed RPM	Rated Current Amps.	Rated Torque Kg.m	Power Factor			% Efficiency			Starting Current to Rated Current Ratio	Starting Torque to Rated Torque Ratio			
kW	HP	IEC	B3 Construction				FL	3/4L	1/2L	FL	3/4L	1/2L					
0.37	0.50	71	2H0712A3	2800	0.96	0.129	0.74	0.68	0.60	72.2	72.2	66.0	5.0	2.6	3.0	0.0019	7
0.55	0.75	71	2H071233	2805	1.29	0.191	0.79	0.72	0.58	74.8	74.0	70.0	5.0	2.7	3.0	0.0019	7
0.75	1	80	2H080213	2830	1.64	0.258	0.82	0.74	0.62	77.4	76.5	73.5	5.0	2.5	2.8	0.0037	10
1.1	1.5	80	2H080233	2830	2.34	0.379	0.82	0.75	0.63	79.6	79.6	75.5	6.0	2.7	3.0	0.0051	11
1.5	2	90S	2H09S243	2840	3.13	0.514	0.82	0.78	0.68	81.3	81.3	78.0	6.5	3.3	3.5	0.0091	17
2.2	3	90L	2H09L273	2840	4.49	0.755	0.82	0.78	0.68	83.2	83.2	81.7	6.5	3.3	3.5	0.0113	20
3.7	5	100L	2H10L233	2890	6.92	1.25	0.87	0.83	0.75	85.5	85.5	84.0	6.5	3.0	3.3	0.0212	26
5.5	7.5	132S	2H13S2G3	2935	9.9	1.83	0.90	0.88	0.83	87.0	86.0	82.0	7.0	2.6	3.0	0.0820	55
7.5	10	132S	2H13S2N3	2935	13.2	2.49	0.90	0.87	0.82	88.1	87.5	85.0	7.0	2.6	3.0	0.0980	67
9.3	12.5	160M	2H16M233	2935	16.4	3.09	0.89	0.86	0.82	88.8	88.6	85.0	6.5	2.0	2.5	0.1500	105
11	15	160M	2H16M253	2935	19.2	3.65	0.89	0.84	0.76	89.4	89.4	87.0	6.5	2.3	3.0	0.171	112
15	20	160M	2H16M263	2930	26	4.99	0.89	0.88	0.82	90.3	90.0	88.0	6.5	2.0	2.5	0.203	120
18.5	25	160L	2H16L293	2930	31.5	6.15	0.90	0.89	0.86	90.9	90.7	89.0	6.5	2.0	2.5	0.268	137
22	30	180M	2H18M233	2935	37.7	7.30	0.89	0.87	0.82	91.3	91.0	88.8	7.0	2.4	2.7	0.34	117
30	40	200L	2H20L2A3	2955	51	9.89	0.89	0.86	0.80	92.0	92.0	90.0	7.0	2.6	3.0	0.61	274
37	50	200L	2H20L253	2945	62.5	12.2	0.89	0.86	0.80	92.5	92.0	90.0	7.0	2.4	2.5	0.61	274
45	60	225M	2H22M253	2965	76.6	14.8	0.88	0.85	0.78	92.9	92.7	91.0	7.0	2.5	2.5	1.13	353
55	75	250M	2H25M233	2965	89.2	18.1	0.92	0.91	0.86	93.2	92.7	90.0	7.0	2.3	2.7	2.60	550
75	100	280S	2H28S233	2970	124	24.6	0.90	0.88	0.83	93.8	93.6	92.0	7.0	2.2	2.8	3.01	669
90	120	280M	2H28M253	2970	146	29.5	0.91	0.89	0.87	94.1	93.9	90.9	7.0	2.2	2.8	3.42	750
110	150	315S	2H31S233	2982	180	35.9	0.90	0.86	0.78	94.3	94.1	91.5	7.0	2.0	2.5	5.0	898
125	170	315M	2H31M2A3	2982	207	40.8	0.89	0.85	0.76	94.5	93.5	91.5	7.0	2.2	2.6	5.0	940
132	180	315M	2H31M233	2982	216	43.1	0.90	0.86	0.78	94.6	93.6	91.3	7.0	2.0	2.5	5.0	940
150	200	315L	2H31L2A3	2982	248	49.0	0.89	0.84	0.76	94.7	93.7	92.2	7.0	2.0	2.5	6.2	1100
160	215	315L	2H31L253	2982	261	52.3	0.90	0.85	0.77	94.8	94.1	93.0	7.0	2.0	2.5	6.2	1100
180	240	315L	2H31L2B3	2982	300	58.8	0.88	0.82	0.75	94.9	94.1	93.0	7.0	2.0	2.5	7.7	1390
*200	270	315L	2H31L273	2982	325	65.3	0.90	0.85	0.77	95	94.5	93.3	7.0	2.0	2.5	7.7	1390
*250	335	355L	2H35L213	2985	407	81.6	0.90	0.88	0.84	95.0	94.5	92.8	7.0	1.6	2.4	12.0	1680
*315	425	355L	2H35L233	2985	512	102.8	0.90	0.88	0.84	95	94.5	93.0	7.0	1.6	2.4	14.7	1870

Note : Efficiency class 'IE2' will be punched on the nameplates as per IS : 12615-2011 for ratings from 0.37kW to 375kW.
All performance values are subject to tolerance as per IS/IEC 60034-1
Efficiency measurements are without seals.
(*) These ratings are suitable for ambient temperature of 45°C

Performance Table for 4-Pole Motors

TEFC 3 Phase Squirrel Cage Induction Motors - Frame size 71 to 355L

Applicable standard for testing & efficiency determination: IS 15999

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

Ambient: : 50° C
Duty : S1(Continuous)

1500 rpm (4-Pole)

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

IE2

Rated Output		Frame size	Type Ref.	Operating Characteristics at Rated output									With DOL Starting		Pullout Torque to Rated Torque Ratio	Rotor GD^2 kgm^2	Net Weight B3 constr. kg
				Rated Speed	Rated Current	Rated Torque	Power Factor			% Efficiency			Starting Current to Rated Current Ratio	Starting Torque to Rated Torque Ratio			
kW	HP	IEC	B3 Construction	RPM	Amps.	Kg.m	FL	3/4L	1/2L	FL	3/4L	1/2L					
0.37	0.5	71	2H071433	1380	1.03	0.26	0.71	0.62	0.50	70.1	70.1	65.0	3.4	2.3	2.5	0.0033	7
0.55	0.75	80	2H080433	1420	1.38	0.38	0.74	0.64	0.50	75.1	75.1	68.0	5.0	2.8	3.0	0.0072	11
0.75	1	80	2H080453	1410	1.75	0.52	0.75	0.66	0.53	79.6	79.6	74.0	5.0	2.8	3.0	0.0082	12
1.1	1.5	90S	2H09S423	1430	2.44	0.75	0.77	0.70	0.57	81.4	81.4	77.5	6.0	2.4	2.8	0.015	15
1.5	2	90L	2H09L473	1435	3.23	1.02	0.78	0.70	0.57	82.8	82.8	80.0	5.5	2.7	3.0	0.019	19
2.2	3	100L	2H10L473	1435	4.48	1.49	0.81	0.74	0.60	84.3	84.3	82.0	6.0	2.6	3.0	0.028	26
3.7	5	112M	2H11M473	1450	7.46	2.49	0.80	0.76	0.62	86.3	86.3	84.0	6.5	2.7	3.0	0.066	36
5.5	7.5	132S	2H13S4K3	1450	10.2	3.69	0.85	0.82	0.74	87.7	87.7	86.0	6.5	2.2	2.8	0.126	64
7.5	10	132M	2H13M4T3	1450	13.8	5.04	0.85	0.82	0.74	88.7	88.7	87.0	6.5	2.2	2.8	0.163	74
9.3	12.5	160M	2H16M4C3	1460	17.7	6.20	0.82	0.76	0.68	89.3	89.3	87.0	6.5	2.5	2.8	0.177	105
11	15	160M	2H16M4K3	1465	20.3	7.31	0.84	0.80	0.70	89.8	89.8	88.0	6.5	2.5	2.8	0.229	115
15	20	160L	2H16L4T3	1465	27.1	9.97	0.85	0.82	0.72	90.6	90.6	89.5	6.5	2.5	2.7	0.300	128
18.5	25	180M	2H18M473	1465	33.6	12.3	0.84	0.81	0.72	91.2	91.2	89.5	7.0	2.7	2.9	0.540	188
22	30	180L	2H18L483	1470	39.5	14.6	0.84	0.78	0.69	91.6	91.6	89.8	7.0	2.8	3.0	0.61	200
30	40	200L	2H20L453	1470	52.6	19.9	0.86	0.82	0.72	92.3	92.0	90.0	7.0	2.6	2.6	0.93	275
37	50	225S	2H22S433	1470	63.8	24.5	0.87	0.85	0.77	92.7	92.5	90.5	7.0	2.6	2.6	1.60	362
45	60	225M	2H22M453	1470	77.3	29.8	0.87	0.85	0.77	93.1	92.8	91.0	7.0	2.6	2.6	1.85	377
55	75	250M	2H25M433	1480	95.2	36.2	0.86	0.84	0.76	93.5	93.0	91.0	7.0	2.5	2.6	3.06	500
75	100	280S	2H28S423	1480	126	49.4	0.88	0.86	0.80	94.0	93.5	92.0	7.0	2.2	2.5	5.53	670
90	120	280M	2H28M453	1480	151	59.2	0.88	0.86	0.80	94.2	94.0	92.0	7.0	2.2	2.5	6.36	735
110	150	315S	2H31S413	1485	188	72.1	0.86	0.83	0.76	94.5	94.3	92.3	6.5	2.5	3.0	9.97	862
125	170	315M	2H31M4A3	1486	216	81.9	0.85	0.81	0.74	94.6	94.3	92.7	6.5	2.5	3.0	11.7	965
132	180	315M	2H31M433	1487	225	86.5	0.86	0.83	0.76	94.7	94.5	93.0	6.5	2.5	3.0	11.7	965
150	200	315L	2H31L4A3	1488	262	98.2	0.84	0.80	0.72	94.7	94.4	92.8	6.5	2.5	3.0	14.0	1145
160	215	315L	2H31L453	1488	273	104.7	0.86	0.83	0.76	94.9	94.6	93.1	6.5	2.5	3.0	14.0	1145
180	240	315L	2H31L463	1488	307	117.8	0.86	0.83	0.76	95.0	94.7	93.2	6.5	2.5	3.0	15.6	1225
200	270	315L	2H31L473	1488	340	130.9	0.86	0.83	0.76	95.1	94.8	93.3	6.5	2.5	3.0	17.8	1290
250	335	355L	2H35L413	1488	416	163.6	0.88	0.85	0.75	95.1	94.9	93.5	6.5	2.2	2.5	23.3	1680
315	422	355L	2H35L433	1488	524	206.2	0.88	0.85	0.75	95.1	94.8	93.5	6.5	2.2	2.5	32.7	1855
355	475	355L	2H35L453	1488	590	232.4	0.88	0.85	0.75	95.1	94.9	93.5	6.5	2.2	2.5	37.9	2025

Note : Efficiency class 'IE2' will be punched on the nameplates as per IS : 12615-2011 for ratings from 0.37kW to 375kW.
All performance values are subject to tolerance as per IS/IEC 60034-1 Efficiency measurements are without seals.

Performance Table for 6-Pole Motors

TEFC 3 Phase Squirrel Cage Induction Motors - Frame size 80 to 355L

Applicable standard for testing & efficiency determination: IS 15999

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

Ambient: : 50°C
Duty : S1(Continuous)

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

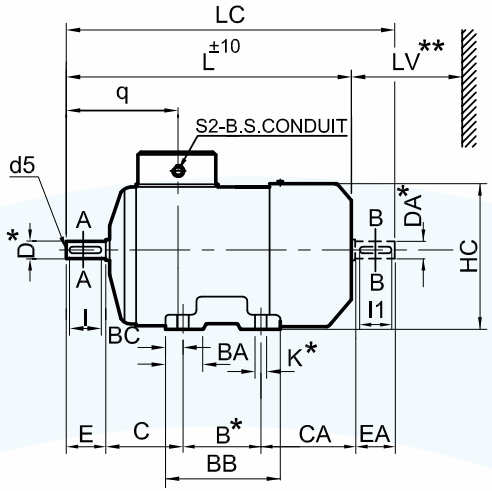
IE2

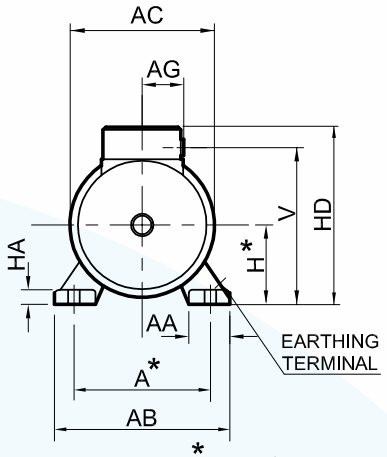
1000 rpm (6-Pole)

Rated Output		Frame size	Type Ref.	Operating Characteristics at Rated output									With DOL Starting		Pullout Torque to Rated Torque Ratio	Rotor GD^2 kgm^2	Net Weight B3 constr. kg
				Rated Speed	Rated Current	Rated Torque	Power Factor			% Efficiency			Starting Current to Rated Current Ratio	Starting Torque to Rated Torque Ratio			
kW	HP	IEC	B3 Construction	RPM	Amps.	Kg.m	FL	3/4L	1/2L	FL	3/4L	1/2L					
0.37	0.5	80	2H080613	910	1.07	0.396	0.70	0.60	0.48	69.0	69.0	67.0	3.0	2.1	2.3	0.0060	10
0.55	0.75	80	2H080633	915	1.48	0.585	0.71	0.62	0.48	72.9	72.9	68.5	4.0	2.2	2.5	0.0084	11
0.75	1	90S	2H09S633	925	1.91	0.790	0.72	0.61	0.50	75.9	75.9	72.3	4.0	2.0	2.5	0.0122	14
1.1	1.5	90L	2H09L653	930	2.72	1.15	0.72	0.61	0.50	78.1	78.1	74.0	4.0	2.0	2.6	0.0160	17
1.5	2.0	100L	2H10L633	935	3.63	1.56	0.72	0.60	0.52	79.8	79.6	75.0	4.5	2.0	2.5	0.0250	22
2.2	3.0	112M	2H11M653	940	4.99	2.28	0.75	0.65	0.58	81.8	81.8	79.8	5.0	2.1	2.5	0.065	33
3.7	5	132S	2H13S6G3	960	8	3.75	0.74	0.70	0.60	84.3	83.5	82.0	5.5	2.0	2.5	0.130	52
5.5	7.5	132M	2H13M6T3	960	11.4	5.58	0.74	0.70	0.60	86.0	84.5	82.0	6.0	2.0	2.5	0.193	71
7.5	10	160M	2H16M633	960	15	7.61	0.80	0.74	0.64	87.2	87.2	85.2	5.5	2.0	2.5	0.276	103
9.3	12.5	160L	2H16L663	960	18.4	9.44	0.80	0.74	0.64	88.0	88.0	86.7	5.5	2.1	2.5	0.34	113
11	15	160L	2H16L673	965	21.6	11.1	0.80	0.77	0.66	88.7	88.7	87.0	6.0	2.0	2.5	0.40	123
15	20	180L	2H18L633	965	29.1	15.1	0.80	0.75	0.62	89.7	89.7	87.2	5.5	2.6	2.3	0.82	200
18.5	25	200L	2H20L633	975	34.7	18.5	0.82	0.77	0.69	90.4	90.4	88.3	5.5	2.6	2.3	1.20	254
22	30	200L	2H20L653	975	41.1	22.0	0.82	0.77	0.69	90.9	90.9	88.8	6.0	2.6	2.3	1.37	270
30	40	225M	2H22M643	975	52.9	30.0	0.86	0.84	0.76	91.7	91.2	88.7	7.0	2.5	2.2	2.41	358
37	50	250M	2H25M633	980	63.4	36.8	0.88	0.85	0.82	92.2	92.2	91.0	6.0	2.5	2.3	3.72	528
45	60	280S	2H28S613	980	81.4	44.7	0.83	0.80	0.70	92.7	92.7	91.2	6.0	2.5	2.4	5.11	573
55	75	280M	2H28M633	980	96.7	54.7	0.85	0.83	0.73	93.1	93.1	91.0	6.0	2.4	2.4	6.16	620
75	100	315S	2H31S613	985	131	74.2	0.85	0.82	0.75	93.7	93.7	92.5	6.0	2.4	2.5	10.7	830
90	120	315M	2H31M633	987	159	88.8	0.84	0.81	0.72	94.0	93.9	92.5	6.0	2.3	2.5	12.4	912
110	150	315M	2H31M653	988	191	108.4	0.85	0.82	0.74	94.3	94.3	93.3	6.0	2.3	2.5	15.5	1010
125	170	315L	2H31L6A3	988	219	123.2	0.84	0.80	0.71	94.4	94.4	93.0	6.0	2.3	2.5	18.0	1175
132	180	315L	2H31L673	988	228	130.1	0.85	0.82	0.73	94.6	94.3	92.8	6.0	2.3	2.5	18.0	1175
150	200	315L	2H31L6B3	988	265	147.9	0.83	0.80	0.70	94.7	94.4	92.8	6.0	2.3	2.5	21.5	1231
160	215	315L	2H31L693	988	276	157.7	0.85	0.82	0.73	94.8	94.6	93.0	6.0	2.3	2.5	21.5	1231
180	240	355L	2H35L6A3	990	322	177.1	0.82	0.77	0.65	94.9	94.6	93.3	6.0	2.0	2.5	28.7	1670
200	270	355L	2H35L613	990	349	196.8	0.84	0.80	0.7	95.0	94.7	93.5	6.0	2.0	2.5	28.7	1670
250	335	355L	2H35L633	990	436	246.0	0.84	0.80	0.7	95.0	94.7	93.4	6.0	2.0	2.5	35.5	1780

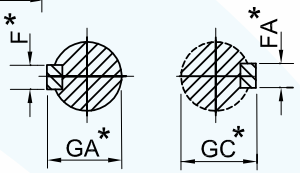
Note : Efficiency class 'IE2' will be punched on the nameplates as per IS : 12615-2011 for ratings from 0.37kW to 375kW.
All performance values are subject to tolerance as per IS/IEC 60034-1 Efficiency measurements are without seals.

Dimensional Drawing: Industrial Motors Type 2H Foot Mounted (B3) TEFC (IE2) series Frame 63-355L

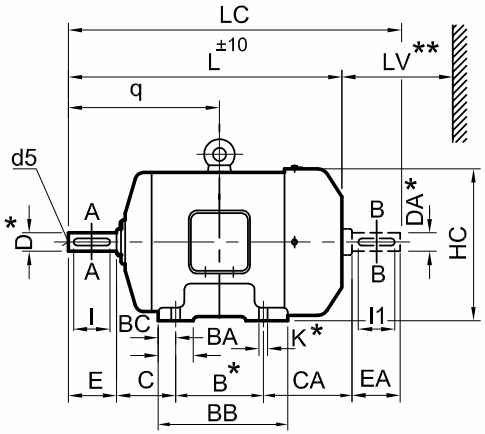


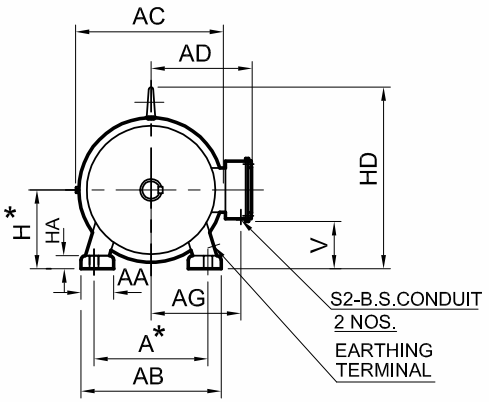


FRAME SIZE 63 TO 80

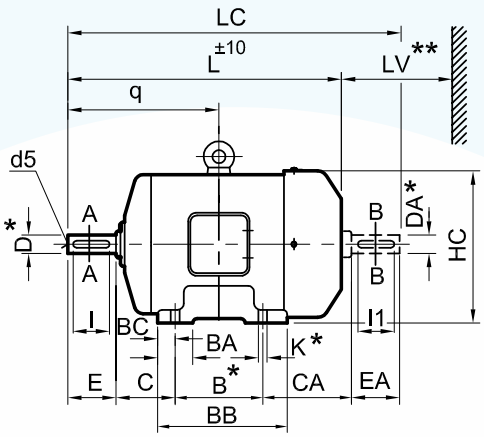


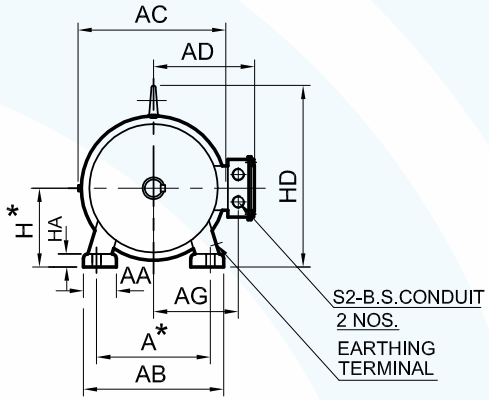
SECTION A-A SECTION B-B



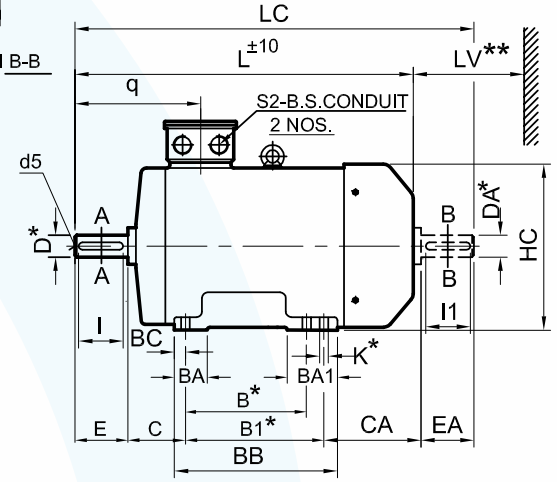


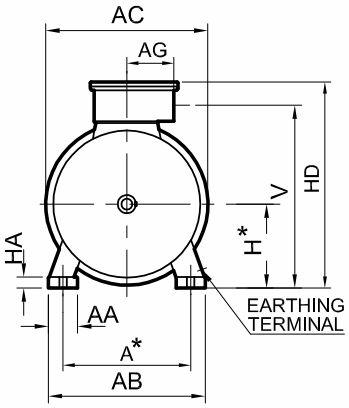
FRAME SIZE 160M TO 180L





FRAME SIZE 200L TO 225M





FRAME SIZE 90S TO 132M
FRAME SIZE 250M TO 355L

* Refer TABLE A for tolerances

CAT-C-6335-3-1

Dimensional Details: Industrial Motors Type 2H Foot Mounted (B3) TEFC IE2 series Frame 63-355L

		FIXING						GENERAL										TERMINAL BOX					SHAFT						
IEC Fr. size	Pole	A*	B*	B1*	C	H*	K*	AB	BB	AA	BA	BA1	BC	HA	HC	HD	AD	L	LC	CA	AC	LV**	V	q	AG	S2 B.S.C.	D,DA*	E EA	F* FA*	GA* GC*	I I1	d5
63	2 & 4	100	80	—	40	63	7	126	100	28	30	—	13	7	125	179	—	206	241	75	124	30	149	104	40	3/4"	11	23	4	12.5	18	M4
71	2,4 & 6	112	90	—	45	71	7	135	110	31	30	—	13	7	141	195	—	234	278	83	140	30	166	102	40	3/4"	14	30	5	16	25	M5
80	2,4 & 6	125	100	—	50	80	10	150	124	31	35	—	15	9	159	214	—	267	324	94	157	30	185	112	40	3/4"	19	40	6	21.5	35	M6
90S	6 & 8	140	100	—	56	90	10	168	125	34	31.5	—	18	12	177	230	-	302	374	118	174	35	199	139	52	3/4"	24	50	8	27	45	M8
90L	6 & 8		125						150									327	399					153								
100L	6 & 8	160	140	—	63	100	12	190	174	43.5	36	—	21	12	198	257	-	366	448	125	192	40	225	152	56	1"	28	60	8	31	55	M10
112M	6 & 8	190	140	—	70	112	12	220	174	47	36	—	21	12	222	282	-	388	471	141	220	45	249	157	56	1"	28	60	8	31	55	M10
132S	6 & 8	216	140	—	89	132	12	256	180	64	50	—	23	17	262	338	-	459	561	172	260	50	299	196	63	1"	38	80	10	41	70	M12
132M	6		178						218		54							497	599	172				215								
160M	2 & 4	254	210	—	108	160	15	310	250	58	70	—	23	20	318	366	226	605	741	203	316	60	98	323	186	1"	42	110	12	45	105	M16
	6 & 8																	585	721	183											
160L	6 & 8		254						294									629	765	183				345							
180M	2,6 & 8	279	241	—	121	180	15	344	281	65	70	—	23	26	357	412	265	679	799	217	354	70	83	352	216	1 1/2"	48	110	14	51.5	100	M16
180L	6 & 8		279						319									717	838	218				371							
200L	2	318	305	—	133	200	19	398	355	85	85	—	28	32	397	462	319	795	920	262	394	80	—	396	249	2"	55	110	16	59	100	M20
	6 & 8																	772	897	239											
225S	4	356	286	—	149	225	19	436	336	85	85	—	28	34	450	509	344	877	1026	281	450	90	—	432.5	273	2"	60	140	18	64	130	M20
225M	2		311						361									837	956	276				415			55	110	16	59	100	
	6 & 8																	852	1001	231				445			60	140	18	64	130	
250M	2	406	349	—	168	250	24	506	425	100	115	—	49	42	495	665	—	983	1134	337	489	100	578	352	243	2"	60	140	18	64	130	M20
	4,6 & 8																	914	1065	268							65	140	18	69	130	
280S/M	2	457	368	419	190	280	24	540	490	100	110	149	40	42	552	725	—	1010	1160	271	544	115	638	360	243	2"	65	140	18	69	130	M20
	4,6 & 8																										75	140	20	79.5	130	
315S/M	2	508	406	457	216	315	28	625	540	120	120	155	46	45	615	830	—	1137	1293	240	600	130	728	386	278	2"	65	140	18	69	130	M20
	4,6 & 8																	1167	1353					416			80	170	22	85	160	
315L	2		508	—					593	120	120	—	46					1302	1458	454				386		2 1/2"	65	140	18	69	130	
	4,6 & 8																	1332	1518					416			80	170	22	85	160	
355L	2	610	630	—	254	355	28	710	770	110	170	—	73	45	693	939	—	1461	1622	458	685	145	850	434	403	3"	75	140	20	79.5	130	M24
	4,6 & 8																	1491	1682					464			95	170	25	100	160	

TABLE B

Pole	L	LC	CA
—	—	—	—
—	—	—	—
—	—	—	—
2 & 4	336	408	152
2 & 4	361	433	152
2 & 4	387	469	146
4	419	502	172
2 & 4	518	617	228
—	—	—	—
4	556	659	232
—	—	—	—
2 & 4	635	771	233
—	—	—	—
2 & 4	679	815	233
4	698	802	220
4	737	841	221
—	—	—	—
4	795	920	262
—	—	—	—
—	—	—	—
4	902	1051	281
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—

TABLE A

Dimension	Tolerance		Specification
A,B	±0.75		
H	-0.5	UPTO 280	IS : 1231
	-1	OVER 280	
K	+0.360	7,10Ø	
	+0.430	12,15Ø	
	+0.520	19,24,28Ø	

Dimension	Tolerance		Specification
D,DA	j6	11,14,19,24,28Ø	IS : 1231
	k6	38,42,48Ø	
	m6	55,60,65,75,80,95Ø	
GA,GC,F,FA			IS : 2048
d5(centering)			IS : 2540

*Refer TABLE A for tolerances

Special Remarks

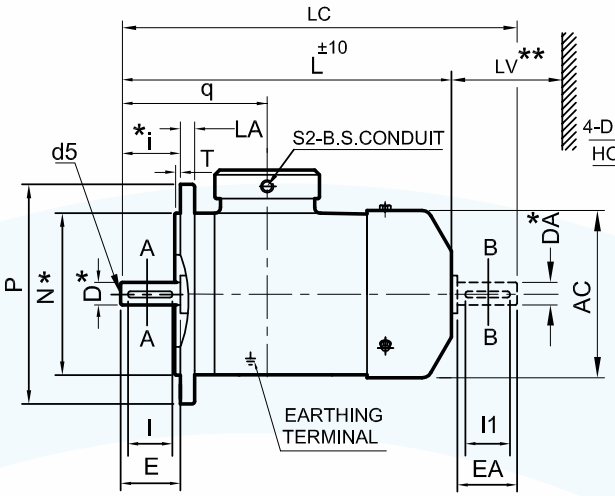
15kW/2P & 11kW/4P in 160M will have dimensions "L","LC" & "CA" as Indicated in table "B"

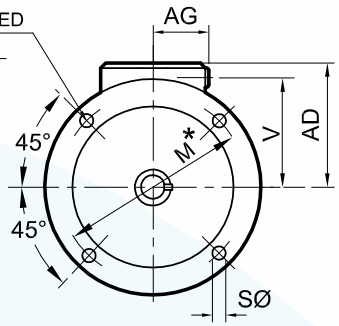
- Double shaft extension can be provided with shaft dimension identical to DE shaft.
- Also suitable for B6,B7,B8,V5 & V6 mounting as per IS 2253.
- ** Minimum distance for efficient cooling of motor to be maintained by user
- (1) Without Eye bolt
- Key / key way fit : h9 / N9

All Dimensions are in mm unless otherwise specified.

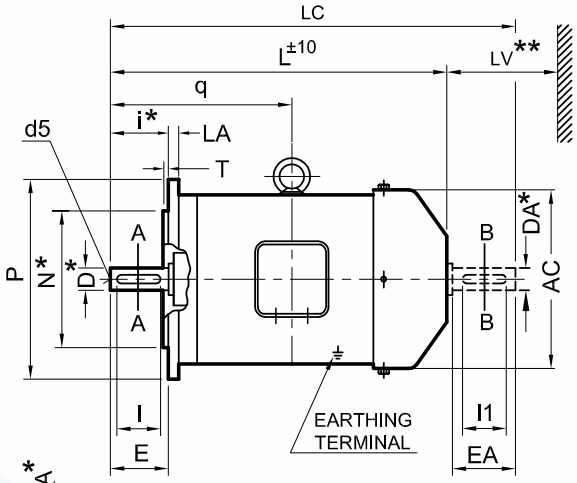
CAT-A-6335-3-2

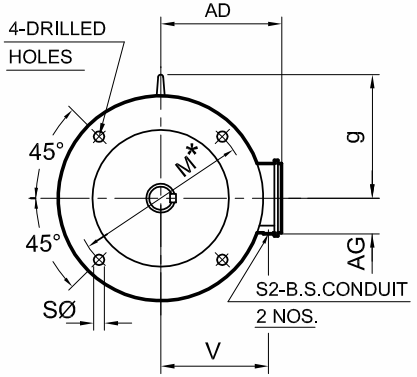
Dimensional Drawing: Industrial Motors Type 2H Flange Mounted (B5) TEFC (IE2) series Frame 63-355L



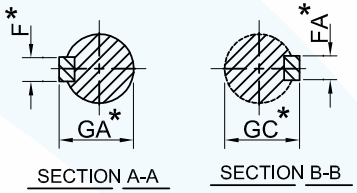


FRAME SIZE 63 TO 80



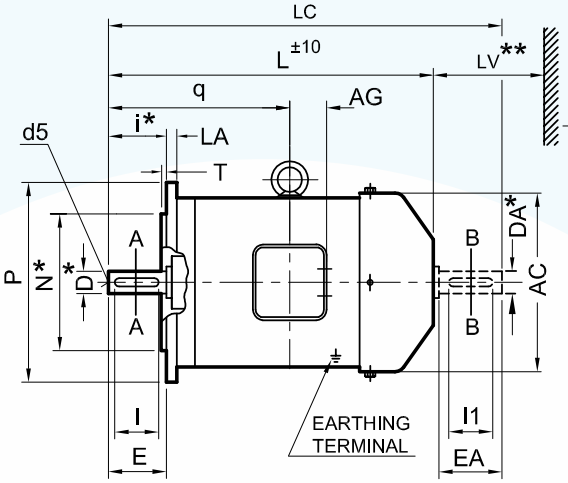


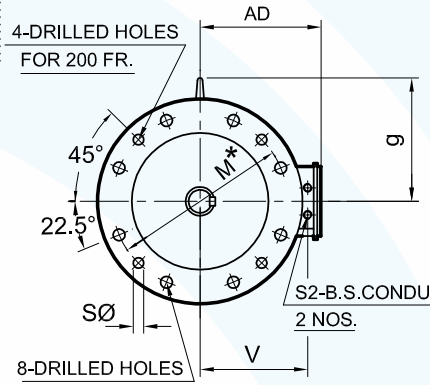
FRAME SIZE 160M TO 180L



SECTION A-A

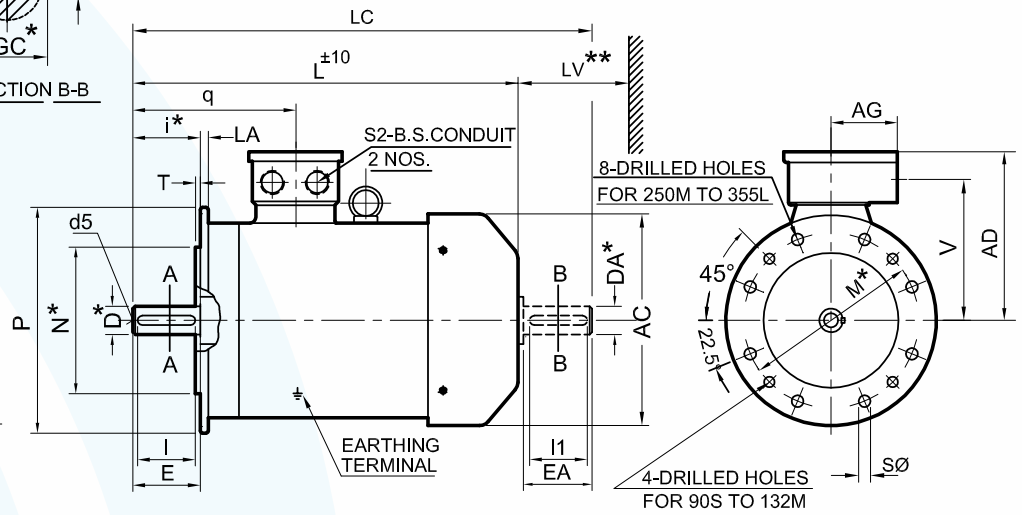
SECTION B-B





FRAME SIZE 200L TO 225M

* Refer TABLE A for tolerances



FRAME SIZE 90S TO 132M
FRAME SIZE 250M TO 355L

CAT-C-6335-5-1

Dimensional Details: Industrial Motors Type 2H Flange Mounted (B5) TEFC (IE2) series Frame 63-355L

		FIXING					GENERAL								TERMINAL BOX				SHAFT						
IEC Fr. size	Pole	P	N*	M*	i*	S	T	LA	AD	AC	L	LC	LV**	g	V	q	AG	S2 B.S.C.	* * D,DA	E EA	F* FA*	GA* GC*	I I1	d5
63	2 & 4	140	95	115	23	10	3	9	116	124	225	260	30	—	86	109	40	3/4"	11	23	4	12.5	18	M4
71	2,4 & 6	160	110	130	30	10	3.5	9	124	140	261	305	30	—	95	127	40	3/4"	14	30	5	16	25	M5
80	2,4 & 6	200	130	165	40	12	3.5	10	134	157	267	324	30	—	105	112	40	3/4"	19	40	6	21.5	35	M6
90S	6 & 8	200	130	165	50	12	3.5	10	140	174	302	374	35	①	109	139	52	3/4"	24	50	8	27	45	M8
90L	6 & 8										327	399				153								
100L	6 & 8	250	180	215	60	15	4	11	157	195	366	448	40	-	125	152	56	1"	28	60	8	31	55	M10
112M	6 & 8	250	180	215	60	15	4	11	170	220	388	471	45	-	137	157	56	1"	28	60	8	31	55	M10
132S	6 & 8	300	230	265	80	15	4	12	206	260	459	561	50	-	167	196	63	1"	38	80	10	41	70	M12
132M	6										497	599				215								
160M	2 & 4	350	250	300	110	19	5	13	226	316	605	741	60	206	186	323	63	1"	42	110	12	45	105	M16
	6 & 8										585	721												
160L	6 & 8										629	765				345								
180M	2,6 & 8	350	250	300	110	19	5	13	265	354	679	799	70	232	216	352	97	1 1/2"	48	110	14	51.5	100	M16
180L	6 & 8										717	838				371								
200L	2	400	300	350	110	19	5	15	319	394	795	920	80	262	249	396	172	2"	55	110	16	59	100	M20
	6 & 8										772	897												
225S	4	450	350	400	140	19	5	16	344	450	877	1026	90	284	273	432.5	172	2"	60	140	18	64	130	M20
225M	2				110						837	956				415			55	110	16	59	100	
	6 & 8				140						852	1001				445			60	140	18	64	130	
250M	2	550	450	500	140	19	5	18	415	489	983	1134	100	—	328	352	243	2"	60	140	18	64	130	M20
	4,6 & 8										914	1065							65	140	18	69	130	
280S/M	2	550	450	500	140	19	5	18	445	544	1010	1160	115	—	358	360	243	2"	65	140	18	69	130	M20
	4,6 & 8																		75	140	20	79.5	130	
315S/M	2	660	550	600	140	24	6	22	515	615	1137	1293	130	—	413	386	278	2"	65	140	18	69	130	M20
	4,6 & 8				170						1167	1353				416			80	170	22	85	160	
315L	2				140						1302	1458				386		2 1/2"	65	140	18	69	130	
	4,6 & 8				170						1332	1518				416			80	170	22	85	160	
355L	2	800	680	740	140	24	6	25	584	690	1461	1622	145	—	495	434	403	3"	75	140	20	79.5	130	M24
	4,6 & 8				170						1491	1682				464			95	170	25	100	160	M24

TABLE B

Pole	L	LC
—	—	—
—	—	—
—	—	—
2 & 4	336	408
2 & 4	361	433
2 & 4	387	469
4	419	502
2 & 4	518	617
—	—	—
4	556	659
—	—	—
2 & 4	635	771
—	—	—
2 & 4	679	815
4	698	802
4	737	841
—	—	—
4	795	920
—	—	—
—	—	—
4	902	1051
—	—	—
—	—	—
—	—	—
—	—	—
—	—	—
—	—	—
—	—	—
—	—	—

TABLE A

Dimension	Tolerance		Specification
N	j6	UPTO 450	IS : 2223
	js6	OVER 450	
M	±0.3	UPTO 265	
	±0.5	OVER 265	
i	±1	UPTO 85	
	±1.5	OVER 85	

Dimension	Tolerance		Specification
D,DA	j6	11,14,19,24,28Ø	IS : 1231
	k6	38,42,48Ø	
	m6	55,60,65,75,80,95Ø	
GA,GC,F,FA			IS : 2048
d5(centering)			IS : 2540

*Refer TABLE A for tolerances

① Without Eye bolt

** Minimum distance for efficient cooling of motor to be maintained by user

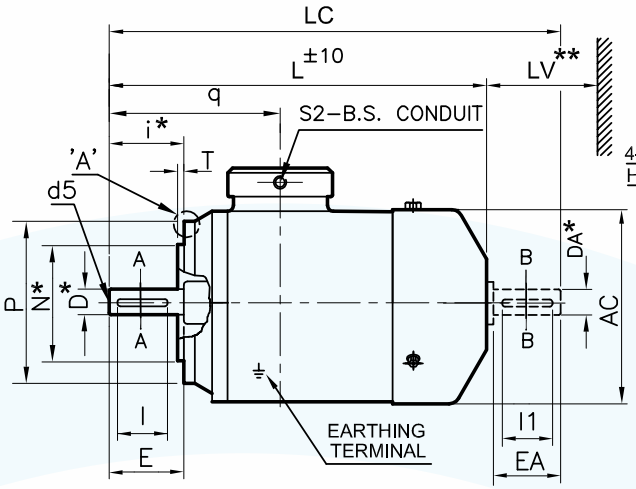
Special Remarks

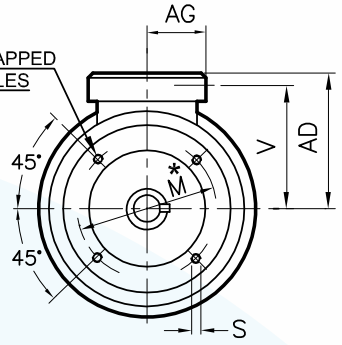
15kW/2P & 11kW/4P in 160M will have dimensions "L" & "LC" as Indicated in table "B"

- Double shaft extension can be provided with shaft dimension identical to D.E.shaft
- Also suitable for V1 & V3 mounting as per IS 2253
- Key / key way fit : h9 / N9
- 8 Nos. Fixing Holes from 225S/M frame onwards

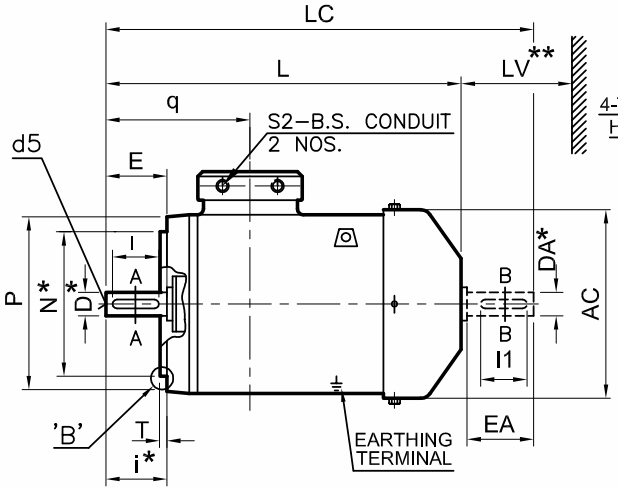
All Dimensions are in mm unless otherwise specified.

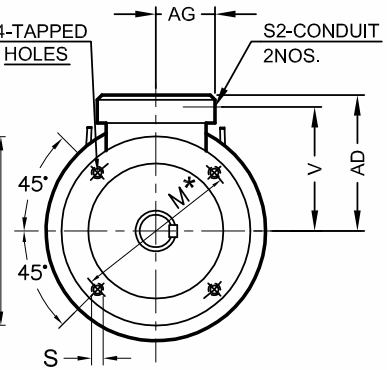
Dimensional Details: Industrial Motors Type 2H Face Mounted (B14) TEFC (IE2) series Frame 63-132M





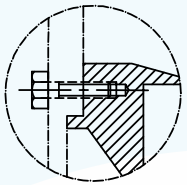
FRAME SIZE 63 TO 80



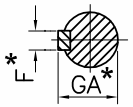


FRAME SIZE 90S TO 132M

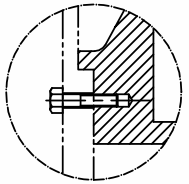
		FIXING					GENERAL						TERMINAL BOX			SHAFT							TABLE B		
IEC Fr. size	Pole	P	N*	M*	i*	S	T	AD	AC	L	LC	LV**	g	V	q	AG	S2 B.S.C.	D* DA*	E EA	F* FA*	GA* GC*	I I1	d5	Pole	L	LC
63	2 & 4	90	60	75	23	M5X10	2.5	116	124	206	241	30	—	86	104	40	3/4"	11	23	4	12.5	18	M4	—	—	—
71	2,4 & 6	105	70	85	30	M6X10	2.5	124	140	234	278	30	—	95	102	40	3/4"	14	30	5	16	25	M5	—	—	—
80	2,4 & 6	120	80	100	40	M6X13	3	134	157	267	324	30	—	105	112	40	3/4"	19	40	6	21.5	35	M6	—	—	—
90S	6 & 8	140	95	115	50	M8X12	3	140	174	302	374	35	①	109	139	52	3/4"	24	50	8	27	45	M8	2 & 4	336	408
90L	6 & 8									327	399				153									2 & 4	361	433
100L	6 & 8	160	110	130	60	M8X12	3.5	157	195	366	448	40	-	125	152	56	1"	28	60	8	31	55	M10	2 & 4	387	469
112M	6 & 8	160	110	130	60	M8X12	3.5	170	220	388	471	45	-	137	157	56	1"	28	60	8	31	55	M10	4	419	502
132S	6 & 8	250	180	215	80	M12X20	4	206	260	459	561	50	-	167	196	63	1"	38	80	10	41	70	M12	2&4	518	617
132M	6									497	599				215									—	—	—
																								4	556	659



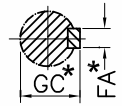
ENLARGEMENT OF CIRCLE 'A'



SECTION A–A



ENLARGEMENT OF CIRCLE 'B'



SECTION B–B

TABLE A

Dimension	Tolerance	Specification
N	j6	IS : 2223
M	±0.3	
i	±1	

Dimension	Tolerance		Specification
D,DA	j6	11,14,19,24,28Ø	IS : 1231
	k6	38Ø	
GA,GC,F,FA			IS : 2048
d5(centering)			IS : 2540

① Without Eye bolt
- Also suitable for V19 & V18 mounting as per IS 2253
- Key / key way fit : h9 / N9
- Double shaft extension can be provided with shaft dimension identical to D.E. shaft

** Minimum distance for efficient cooling of motor to be maintained by user

*Refer TABLE A for tolerances

All Dimensions are in mm unless otherwise specified.

Performance Table for 8-Pole Motors

Standard TEFC 3 Phase Squirrel Cage Induction Motors - Frame size 90s to 355L

Applicable standard for testing: IS 4029
Applicable standard for efficiency determination: IS 4889

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

Ambient: : 45°C
Duty : S1(Continuous)

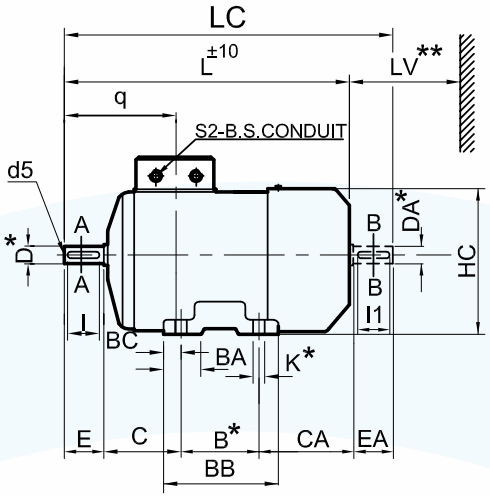
750 rpm (8-Pole)

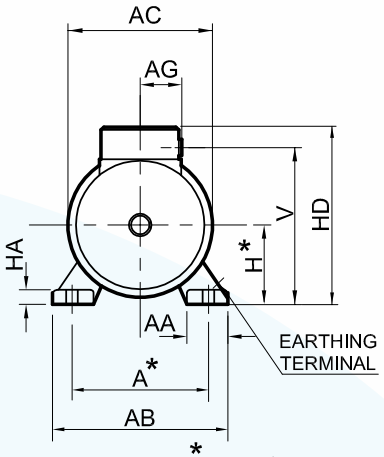
Ins. Class : F
Temp. Rise : B
Protection : IP55

Rated Output		Frame size	Type ref	Rated Speed RPM	Rated Current Amps	Rated Torque Kg.m	Operating Characteristics at Rated output						With DOL Starting		Pullout Torque to Rated Torque Ratio	Rotor GD^2 kgm^2	Net Weight B3 constr. kg
							Power Factor			% Efficiency			Starting Current to Rated Current Ratio	Starting Torque to Rated Torque Ratio			
kW	HP						FL	3/4L	1/2L	FL	3/4L	1/2L					
0.37	0.5	90S	MH09S813	700	1.22	0.515	0.63	0.52	0.41	66.8	60.0	52.0	2.7	1.8	2.1	0.0110	11
0.55	0.75	90L	MH09L853	690	1.71	0.776	0.63	0.53	0.43	71.1	67.0	62.0	2.9	2.0	2.4	0.0140	14
0.75	1	100L	MH10L813	685	1.94	1.07	0.73	0.63	0.50	73.8	73.8	67.0	3.0	1.7	2.0	0.0230	18
1.1	1.5	100L	MH10L833	690	2.83	1.55	0.71	0.62	0.48	76.2	76.2	73.0	3.3	1.9	2.3	0.0270	21
1.5	2	112M	MH11M813	705	3.83	2.07	0.70	0.62	0.50	77.9	77.9	75.0	3.8	1.7	2.2	0.0510	25
2.2	3	132S	MH13S8B3	705	4.87	3.04	0.78	0.74	0.64	80.5	80.0	76.0	3.5	1.8	2.3	0.0990	44
3.7	5	160M	MH16M813	720	7.95	5.01	0.78	0.74	0.65	83.0	83.0	78.0	4.4	1.8	2.0	0.217	88
5.5	7.5	160M	MH16M833	720	11.5	7.44	0.78	0.74	0.65	85.1	85.1	82.0	4.8	1.9	2.2	0.299	101
7.5	10	160L	MH16L873	715	15.5	10.2	0.78	0.74	0.65	86.4	86.4	84.0	5.5	2.1	2.2	0.400	119
9.3	12.5	180M	MH18M813	720	18.8	12.6	0.79	0.74	0.64	87.3	87.3	85.0	5.0	2.1	2.2	0.620	177
11	15	180L	MH18L833	720	22	14.9	0.79	0.74	0.64	88.1	88.1	87.0	5.0	2.1	2.2	0.720	182
15	20	200L	MH20L833	720	28.6	20.3	0.82	0.79	0.71	89.0	89.0	88.0	6.0	2.5	2.3	1.32	282
18.5	25	225S	MH22S823	725	36.3	24.9	0.79	0.77	0.69	89.8	89.8	88.0	5.5	2.1	2.2	2.10	334
22	30	225M	MH22M833	725	43	29.6	0.79	0.77	0.69	90.2	90.2	88.0	5.5	2.1	2.2	2.41	369
30	40	250M	MH25M813	730	55.6	40.0	0.82	0.78	0.68	91.5	91.5	89.0	6.0	2.5	2.2	3.72	472
37	50	280S	MH28S823	730	70.8	49.4	0.79	0.75	0.65	92.0	92.0	90.0	5.5	2.2	2.2	5.83	615
45	60	280M	MH28M853	730	85.8	60.0	0.79	0.75	0.65	92.4	92.4	90.0	5.5	2.2	2.2	6.86	665
55	75	315S	MH31S813	740	105	72.4	0.78	0.73	0.64	93.0	92.5	90.5	5.5	2.1	2.4	10.7	833
75	100	315M	MH31M833	740	143	98.7	0.78	0.73	0.64	93.5	93.5	92.0	5.5	2.1	2.4	12.4	912
90	120	315M	MH31M853	740	171	118.5	0.78	0.73	0.65	94.0	94.0	93.0	5.5	2.1	2.4	15.5	1010
110	150	315L	MH31L873	740	208	144.8	0.78	0.73	0.64	94.3	94.0	93.0	5.5	2.1	2.4	18.0	1170
125	170	315L	MH31L8A3	740	236	164.5	0.78	0.73	0.64	94.6	94.4	93.6	5.5	2.1	2.4	21.5	1340
132	180	315L	MH31L893	740	248	173.7	0.78	0.73	0.64	94.8	94.7	94.0	5.5	2.1	2.4	21.5	1340
150	200	355L	MH35L8A3	740	282	197.4	0.78	0.70	0.60	95.0	95.0	93.0	5.5	1.8	2.2	28.7	1670
160	215	355L	MH35L813	740	300	210.6	0.78	0.70	0.60	95.0	95.0	93.0	5.5	1.8	2.2	28.7	1670
180	240	355L	MH35L8B3	740	337	236.9	0.78	0.70	0.60	95.2	95.2	93.2	5.5	1.8	2.2	35.5	1780
200	270	355L	MH35L833	740	374	263.2	0.78	0.70	0.60	95.3	95.3	93.3	5.5	1.8	2.2	35.5	1780

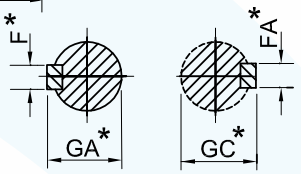
Note : All performance values are subject to tolerance as per IS: 325. Efficiency measurements are without seals.
Ratings above 200kW/8P up to 630kW/8P are available in Frame 400 & 450. For details refer to the DCCA section of this catalogue.

Dimensional Drawing: Industrial Motors Type MH Foot Mounted (B3) TEFC series Frame 90S-355L

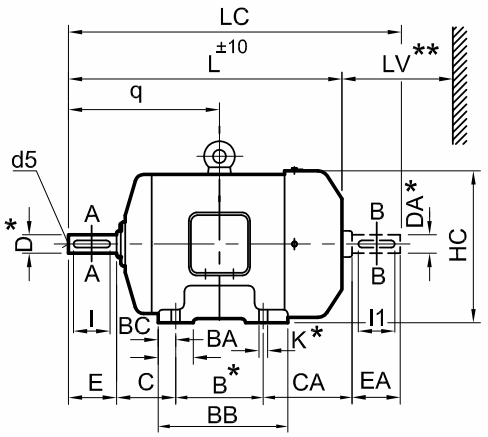


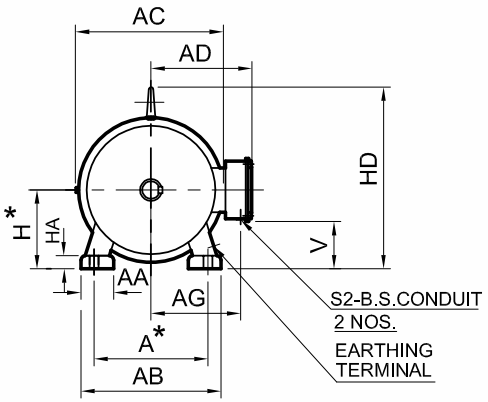


FRAME SIZE 90S TO 132S

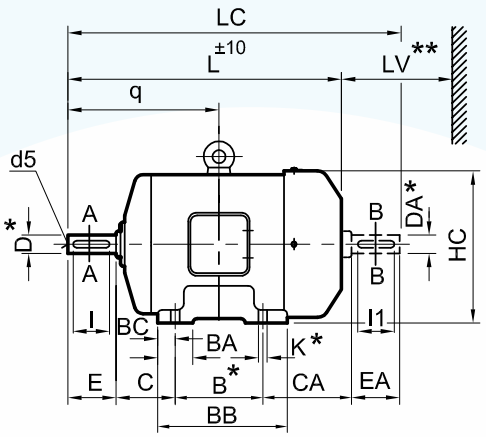


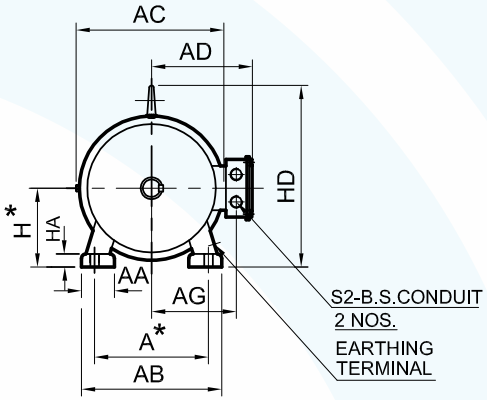
SECTION A-A SECTION B-B





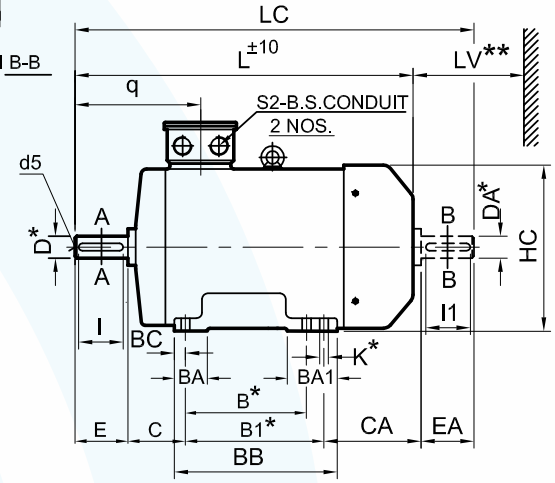
FRAME SIZE 160M TO 180L

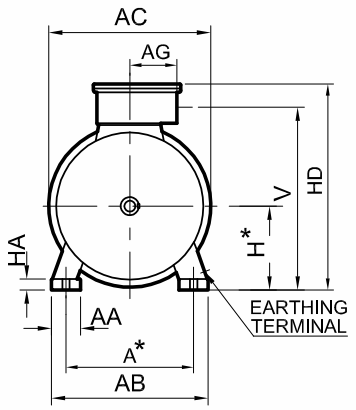




FRAME SIZE 200L TO 225M

* Refer TABLE A for tolerances





FRAME SIZE 250M TO 355L

CAT-C-9035-3-1

Dimensional Details: Industrial Motors Type MH Foot Mounted (B3) TEFC series Frame 90S-355L

		FIXING						GENERAL													TERMINAL BOX				SHAFT					
IEC Fr. size	Pole	A*	B*	B1*	C	H*	K*	AB	BB	AA	BA	BA1	BC	HA	HC	HD	AD	L	LC	CA	AC	LV**	V	q	AG	S2 B.S.C.	D,DA*	E EA	F* FA*	GA* GC*	I I1	d5
90S	8	140	100	—	56	90	10	168	125	34	31.5	—	18	12	177	230	-	302	374	118	174	35	199	139	52	3/4"	24	50	8	27	45	M8
90L	8		125						150									327	399					153								
100L	8	160	140	—	63	100	12	190	174	43.5	36	—	21	12	198	257	-	366	448	125	192	40	225	152	56	1"	28	60	8	31	55	M10
112M	8	190	140	—	70	112	12	220	174	47	36	—	21	12	222	282	-	388	471	141	220	45	249	157	56	1"	28	60	8	31	55	M10
132S	8	216	140	—	89	132	12	256	180	64	50	—	23	17	262	338	-	459	561	172	260	50	299	196	63	1"	38	80	10	41	70	M12
160M	8	254	254	—	108	160	15	310	294	58	70	—	23	20	318	366	226	585	721	183	316	60	98	323	186	1"	42	110	12	45	105	M16
160L	8																	629	765	183				345								
180M	8	279	241	—	121	180	15	344	281	65	70	—	23	26	357	412	265	679	799	217	354	70	83	352	216	1 1/2"	48	110	14	51.5	100	M16
180L	8		279						319									717	838	218				371								
200L	8	318	305	—	133	200	19	398	355	85	85	—	28	32	397	462	319	772	897	239	394	80	—	396	249	2"	55	110	16	59	100	M20
225M	8	356	311	—	149	225	19	436	361	85	85	—	28	34	450	509	344	852	1001	231	450	90	—	445	273	2"	60	140	18	64	130	M20
250M	8	406	349	—	168	250	24	506	425	100	115	—	49	42	495	665	—	914	1065	268	489	100	578	352	243	2"	65	140	18	69	130	M20
280S/M	8	457	368	419	190	280	24	540	490	100	110	149	40	42	552	725	—	1010	1160	271	544	115	638	360	243	2"	75	140	20	79.5	130	M20
315S/M	8	508	406	457	216	315	28	625	540	120	120	155	46	45	615	830	—	1167	1353	240	600	130	728	416	278	2"	80	170	22	85	160	M20
315L	8		508	—					593	120	120	—	46					1332	1518	454				416		2 1/2"	80	170	22	85	160	
355L	8	610	630	—	254	355	28	710	770	110	170	—	73	45	693	939	—	1491	1682	458	685	145	850	464	403	3"	95	170	25	100	160	M24

TABLE A

Dimension	Tolerance		Specification
A,B	±0.75		
H	-0.5	UPTO 280	IS : 1231
	-1	OVER 280	
K	+0.360	10Ø	
	+0.430	12,15Ø	
	+0.520	19,24,28Ø	

Dimension	Tolerance		Specification
D,DA	j6	24,28Ø	IS : 1231
	k6	38,42,48Ø	
	m6	55,60,65,75,80,95Ø	
GA,GC,F,FA			IS : 2048
d5(centering)			IS : 2540

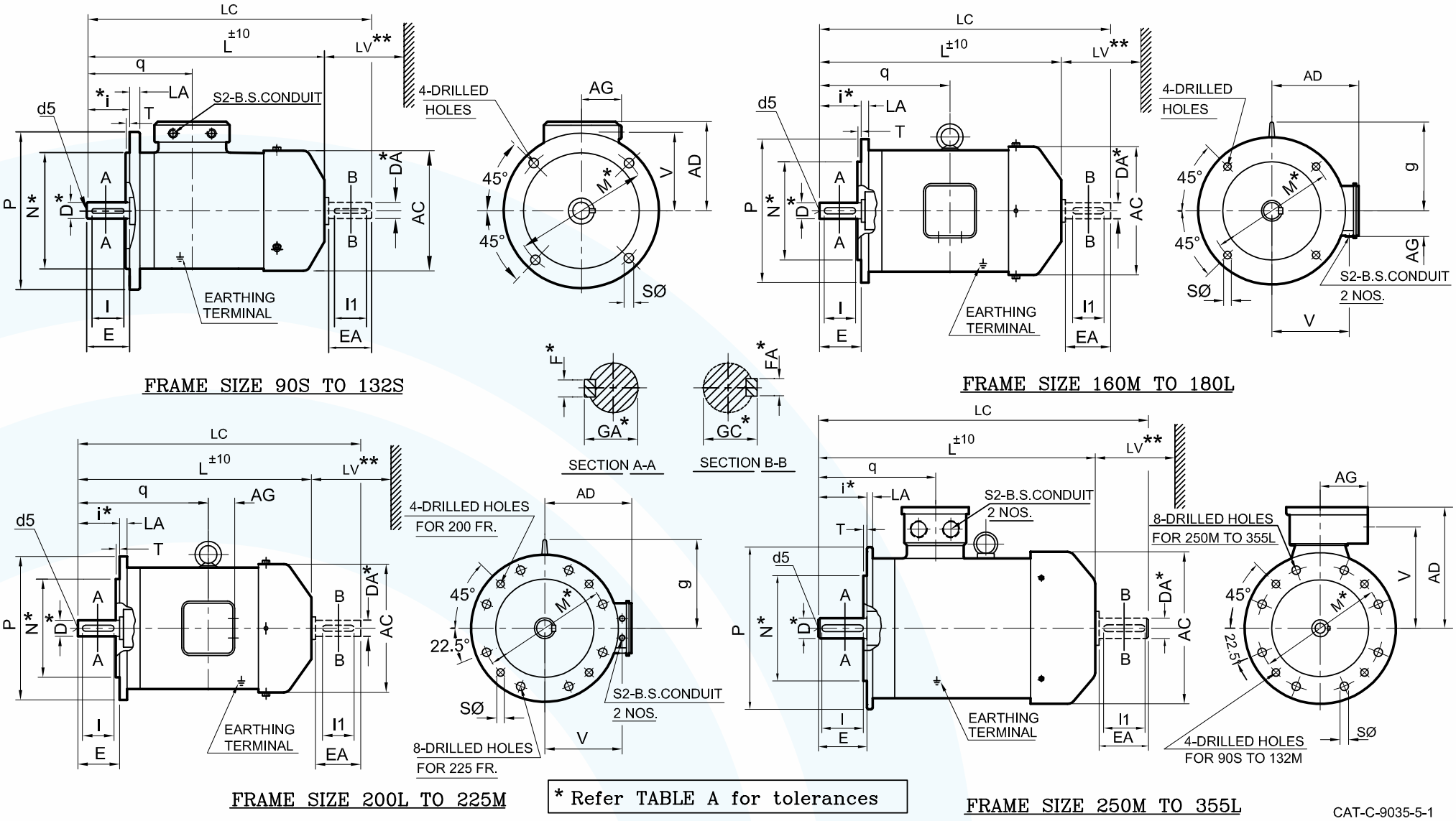
- Double shaft extension can be provided with shaft dimension identical to DE shaft.
- Also suitable for B6,B7,B8,V5 & V6 mounting as per IS 2253.
- ** Minimum distance for efficient cooling of motor to be maintained by user
- ① Without Eye bolt
- Key / key way fit : h9 / N9

*Refer TABLE A for tolerances

All Dimensions are in mm unless otherwise specified.

CAT-A-9035-3-2

Dimensional Drawing: Industrial Motors Type MH Flange Mounted (B5) TEFC series Frame 90S-355L



* Refer TABLE A for tolerances

CAT-C-9035-5-1

Dimensional Details: Industrial Motors Type MH Flange Mounted (B5) TEFC series Frame 90S-355L

		FIXING					GENERAL								TERMINAL BOX				SHAFT					
IEC Fr. size	Pole	P	N*	M*	i*	S	T	LA	AD	AC	L	LC	LV**	g	V	q	AG	S2 B.S.C.	* * D,DA	E EA	F* FA*	GA* GC*	I I1	d5
90S	8	200	130	165	50	12	3.5	10	140	174	302	374	35	①	109	139	52	3/4"	24	50	8	27	45	M8
90L	8										327	399				153								
100L	8	250	180	215	60	15	4	11	157	195	366	448	40	-	125	152	56	1"	28	60	8	31	55	M10
112M	8	250	180	215	60	15	4	11	170	220	388	471	45	-	137	157	56	1"	28	60	8	31	55	M10
132S	8	300	230	265	80	15	4	12	206	260	459	561	50	-	167	196	63	1"	38	80	10	41	70	M12
160M	8	350	250	300	110	19	5	13	226	316	585	721	60	206	186	323	63	1"	42	110	12	45	105	M16
160L	8										629	765				345								
180M	8	350	250	300	110	19	5	13	265	354	679	799	70	232	216	352	97	1 1/2"	48	110	14	51.5	100	M16
180L	8										717	838				371								
200L	8	400	300	350	110	19	5	15	319	394	772	897	80	262	249	396	172	2"	55	110	16	59	100	M20
225M	8	450	350	400	140	19	5	16	344	450	852	1001	90	284	273	445	172	2"	60	140	18	64	130	M20
250M	8	550	450	500	140	19	5	18	415	489	914	1065	100	—	328	352	243	2"	65	140	18	69	130	M20
280S/M	8	550	450	500	140	19	5	18	445	544	1010	1160	115	—	358	360	243	2"	75	140	20	79.5	130	M20
315S/M	8	660	550	600	170	24	6	22	515	615	1167	1353	130	—	413	416	278	2"	80	170	22	85	160	M20
315L	8				170						1332	1518				416		2 1/2"	80	170	22	85	160	
355L	8	800	680	740	170	24	6	25	584	690	1491	1682	145	—	495	464	403	3"	95	170	25	100	160	M24

TABLE A

Dimension	Tolerance		Specification
N	j6	UPTO 450	IS : 2223
	js6	OVER 450	
M	±0.3	UPTO 265	
	±0.5	OVER 265	
i	±1	UPTO 85	
	±1.5	OVER 85	

Dimension	Tolerance		Specification
D,DA	j6	24,28Ø	IS : 1231
	k6	38,42,48Ø	
	m6	55,60,65,75,80,95Ø	
GA,GC,F,FA			IS : 2048
d5(centering)			IS : 2540

*Refer TABLE A for tolerances

① Without Eye bolt

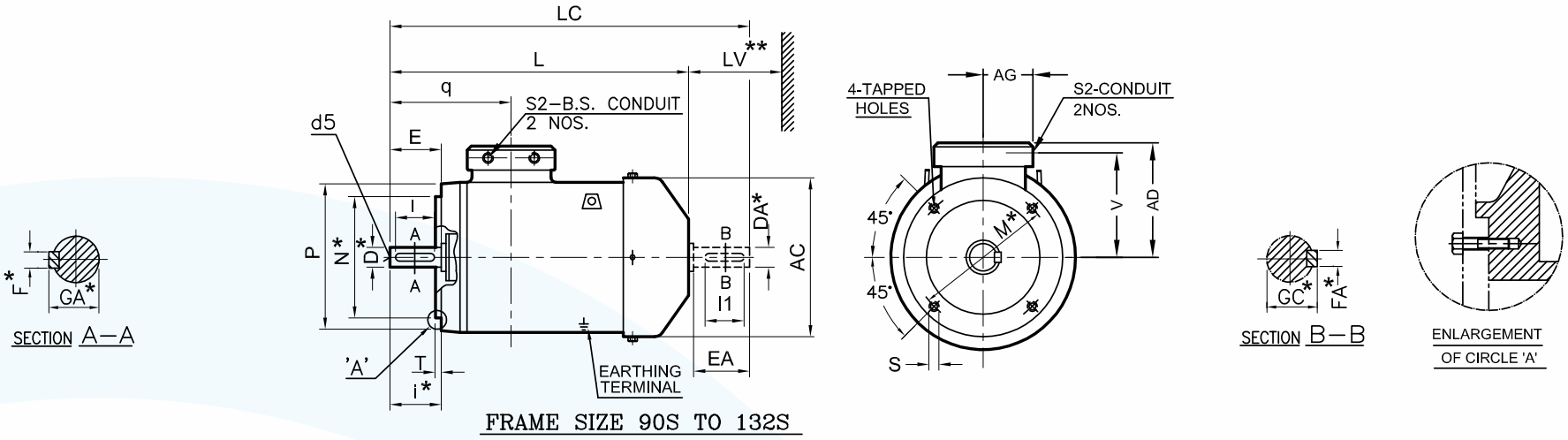
** Minimum distance for efficient cooling of motor to be maintained by user

- Double shaft extension can be provided with shaft dimension identical to D.E.shaft
- Also suitable for V1 & V3 mounting as per IS 2253
- Key / key way fit : h9 / N9
- 8 Nos. Fixing Holes from 225S/M frame onwards

All Dimensions are in mm unless otherwise specified.

CAT-A-9035-5-2

Dimensional Details: Industrial Motors Type MH Face Mounted (B14) TEFC series Frame 90S-132S



FRAME SIZE 90S TO 132S

		FIXING					GENERAL						TERMINAL BOX				SHAFT					
IEC Fr. size	Pole	P	N*	M*	i*	S	T	AD	AC	L	LC	LV**	g	V	q	AG	S2 B.S.C.	D* DA*	E EA	F* FA*	GA* GC*	I I1	d5
90S	8	140	95	115	50	M8X12	3	140	174	302	374	35	①	109	139	52	3/4"	24	50	8	27	45	M8
90L	8									327	399				153								
100L	8	160	110	130	60	M8X12	3.5	157	195	366	448	40	-	125	152	56	1"	28	60	8	31	55	M10
112M	8	160	110	130	60	M8X12	3.5	170	220	388	471	45	-	137	157	56	1"	28	60	8	31	55	M10
132S	8	250	180	215	80	M12X20	4	206	260	459	561	50	-	167	196	63	1"	38	80	10	41	70	M12

TABLE A

Dimension	Tolerance	Specification
N	j6	IS : 2223
M	±0.3	
i	±1	

Dimension	Tolerance		Specification
D,DA	j6	24,28Ø	IS : 1231
	k6	38Ø	
GA,GC,F,FA			IS : 2048
d5(centering)			IS : 2540

*Refer TABLE A for tolerances

① Without Eye bolt
- Also suitable for V19 & V18 mounting as per IS 2253
- Key / key way fit : h9 / N9
- Double shaft extension can be provided with shaft dimension identical to D.E. shaft

** Minimum distance for efficient cooling of motor to be maintained by user

All Dimensions are in mm unless otherwise specified.

Large Motors with DCCA are manufactured using dual circuit cooling technology, offering high power and better reliability. The outputs which are normally available in HT range are now offered in low voltage range with this new technology.

These motors are suitable for use in various industrial sectors such as power generation, petrochemical, cement, steel, paper and pulp, waste water treatment, chemical industries, sugar etc.

The motors can serve various applications such as pump, compressor, conveyor, fan, blower, etc.

Technology

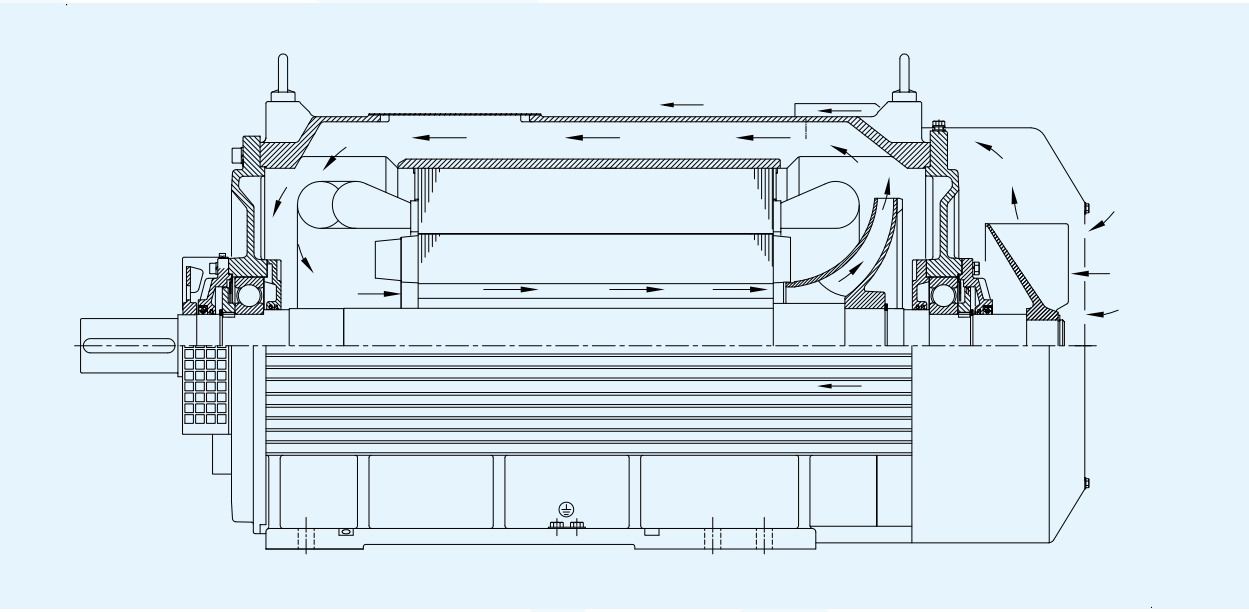
The Dual Circuit Cooling Arrangement (DCCA) is new efficient cooling system used by Bharat Bijlee for High Efficiency Large LT Motors. This technology consists of two independent cooling systems which improves the overall cooling of the motor.

The primary cooling circuit is the regular stator body fin cooling in which the shaft mounted external fan blows air over the stator body fins and cools the motor by forced convection and radiation.

The secondary internal cooling circuit consists of rotor with vent holes, an aluminum impeller and four ventilating ducts on the inside of the stator body. The air inside the motor is circulated by the impeller which passes through the ventilating ducts where it gets cooled on its way from non driving end to the driving end by the primary circuit. This cool air then passes over the DE overhangs and through the rotor vents to the non driving end and on its way absorbing heat from the overhangs and from the rotor. This heated air again passes through the impeller to the ventilating ducts and the cycle repeats.

The advantages of this technology are:

- Lower temperature rise of the winding
- Reduced temperature gradient between DE and NDE sides of the winding on account of uniform distribution of heat
- Enhanced insulation life
- Increased motor reliability
- Reduction in motor size and as a result, higher outputs can be drawn from the same motor.



Dual Circuit Cooling Arrangement

Performance Table for 2-Pole & 4-Pole Motors

TEFC 3 Phase Squirrel Cage Induction Motors - DCCA Series - Frame size 355L/K to 450L

Voltage : 415V± 10% (up to 630kW)
: 690V± 10% (710kW & above)
Frequency : 50Hz± 5%
Combined Variation : ± 10%

Ambient: 40°C
Duty : S1(Continuous)

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

3000 rpm (2-Pole)

Rated Output		Frame size IEC	Type Ref. B3 Construction	Operating Characteristics at Rated output									With DOL Starting		Pullout Torque to Rated Torque Ratio	Rotor GD² kgm²	Net Weight B3 Constn. kg
				Speed RPM	Current Amps.	Rated Torque kg.m	Power Factor			% Efficiency			Starting Current to Rated Current Ratio	Starting Torque to Rated Torque Ratio			
kW	HP						FL	3/4L	1/2L	FL	3/4L	1/2L					
355	475	355L/K	2H35K2M3	2980	584	116	0.89	0.87	0.82	95.0	94.6	93.6	6.5	1.7	2.5	23.30	2040
400	536	355L/K	MH35K2P3	2980	651	131	0.89	0.87	0.82	96.0	95.6	94.6	6.5	1.7	2.5	26.00	2160
450	603	355L/K	MH35K2T3	2981	723	147	0.90	0.88	0.83	96.2	95.8	94.8	6.5	1.7	2.5	28.60	2280
475	636	355L/K	MH35K2A3	2982	762	155	0.90	0.88	0.83	96.4	96.0	95.0	6.5	1.8	2.5	31.30	2380
500	670	355L/K	MH35K2W3	2982	802	163	0.90	0.88	0.83	96.4	96.0	95.0	6.5	1.8	2.5	31.30	2380
560	750	400L	MH40L293	2985	930	183	0.88	0.85	0.79	95.2	94.2	92.2	7.0	1.7	2.5	51.30	2880
* 630	845	400L	MH40L2A3	2985	1044	206	0.88	0.85	0.79	95.4	94.4	92.4	7.0	1.7	2.5	57.30	3260

1500 rpm (4-Pole)

Rated Output		Frame size IEC	Type Ref. B3 Construction	Operating Characteristics at Rated output									With DOL Starting		Pullout Torque to Rated Torque Ratio	Rotor GD² kgm²	Net Weight B3 Constn. kg
				Speed RPM	Current Amps.	Rated Torque kg.m	Power Factor			% Efficiency			Starting Current to Rated Current Ratio	Starting Torque to Rated Torque Ratio			
kW	HP						FL	3/4L	1/2L	FL	3/4L	1/2L					
400	536	355L/K	MH35K4P3	1488	673	262	0.86	0.83	0.73	96.2	96.0	95.2	6.5	2.1	2.5	30.60	2160
450	603	355L/K	MH35K4T3	1488	755	295	0.86	0.83	0.73	96.4	96.2	95.4	6.5	2.1	2.5	33.70	2270
500	670	355L/K	MH35K4W3	1488	828	327	0.87	0.84	0.74	96.6	96.4	95.6	6.5	2.1	2.4	36.80	2380
560	750	400L	MH40L493	1492	917	366	0.88	0.85	0.78	96.5	96.1	95.1	6.8	2.0	2.5	63.00	2810
630	845	400L	MH40L4A3	1492	1031	411	0.88	0.85	0.78	96.6	96.2	95.2	6.8	2.0	2.5	70.50	3000
* 710	952	400L	MH40L4B3	1492	697	463	0.88	0.85	0.78	96.8	96.4	95.4	6.8	2.0	2.5	70.50	3000
800	1072	450M	MH45M433	1492	789	522	0.88	0.84	0.76	96.4	96.2	95.4	6.8	2.1	2.5	120.0	4300
900	1206	450M	MH45M453	1492	886	588	0.88	0.84	0.76	96.6	96.4	95.6	6.8	2.1	2.5	132.0	4500
1000	1340	450L	MH45L473	1492	982	653	0.88	0.84	0.76	96.8	96.6	95.7	6.8	2.1	2.5	160.0	5650

Note : 1. Efficiency class 'IE2' will be punched on the nameplates as per IS : 12615-2011 for ratings up to 375kw for 2,4 & 6 Pole ratings.
2. All performance values are subject to tolerance as per IS:325/ IEC 60034-1
3. Higher ratings can be offered on request in 4, 6 and 8 polarity.
* Temperature rise limited to class "F"

Performance Table for 6-Pole & 8-Pole Motors

TEFC 3 Phase Squirrel Cage Induction Motors - DCCA Series - Frame size 355L/K to 450L

Voltage : 415V± 10% (up to 630kW)
: 690V± 10% (710kW & above)
Frequency : 50Hz±-5%
Combined Variation : ± 10%

Ambient : 40°C
Duty : S1(Continuous)

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

1000 rpm (6-Pole)

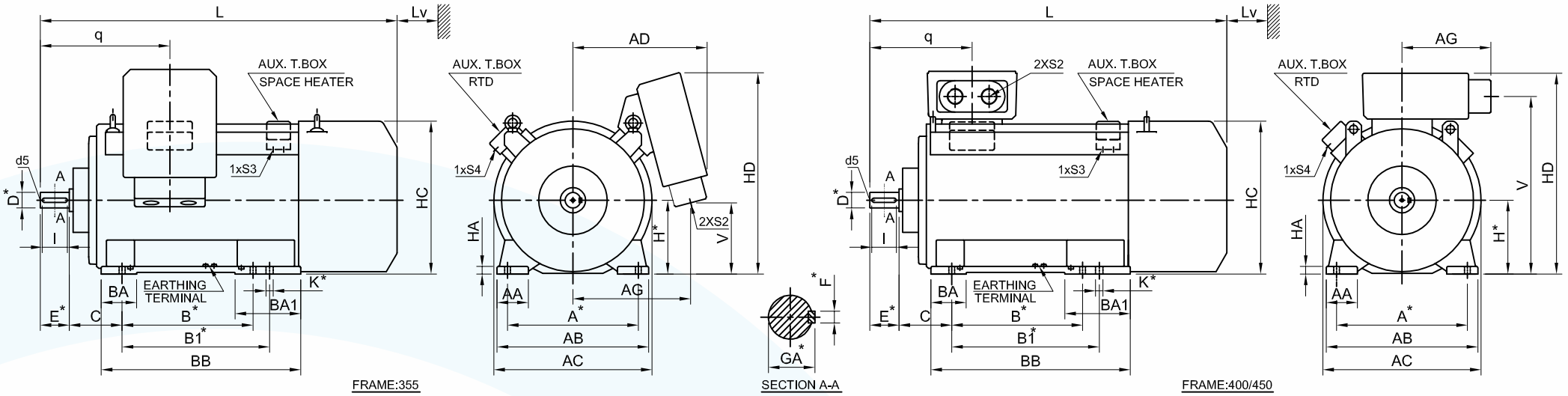
Rated Output		Frame size	Type Ref.	Operating Characteristics at Rated output									With DOL Starting		Pullout Torque to Rated Torque Ratio	Rotor GD² kgm²	Net Weight B3 Constn. kg
				Speed RPM	Current Amps.	Rated Torque kg.m	Power Factor			% Efficiency			Starting Current to Rated Current Ratio	Starting Torque to Rated Torque Ratio			
kW	HP	IEC	B3 Construction				FL	3/4L	1/2L	FL	3/4L	1/2L					
315	422	355L/K	2H35K6M3	992	549	309	0.84	0.80	0.70	95.0	95.0	94.2	6.5	2.0	2.5	56.90	1980
355	475	355L/K	2H35K6P3	992	619	349	0.84	0.80	0.70	95.0	95.0	94.2	6.5	2.0	2.5	66.00	2280
400	536	355L/K	MH35K6T3	992	690	393	0.84	0.80	0.70	96.0	96.0	95.4	6.5	2.0	2.5	69.70	2410
450	603	400L	MH40L693	991	762	442	0.85	0.80	0.70	96.6	96.4	95.8	6.5	1.9	2.5	77.00	2810
500	670	400L	MH40L6A3	991	847	491	0.85	0.80	0.70	96.6	96.4	95.8	6.5	1.9	2.5	86.00	3000
*560	750	400L	MH40L6B3	991	947	550	0.85	0.80	0.70	96.8	96.6	96.0	6.5	1.9	2.5	86.00	3000
630	845	450M	MH45M633	992	1080	619	0.84	0.79	0.70	96.6	96.5	96.0	6.5	1.9	2.5	180.0	4300
710	952	450M	MH45M653	992	731	697	0.84	0.79	0.70	96.7	96.6	96.1	6.5	1.9	2.5	200.0	4400
800	1072	450L	MH45L673	993	823	785	0.84	0.79	0.70	96.8	96.7	96.2	6.5	1.9	2.5	236.0	5600

750 rpm (8-Pole)

Rated Output		Frame size	Type Ref.	Operating Characteristics at Rated output									With DOL Starting		Pullout Torque to Rated Torque Ratio	Rotor GD² kgm²	Net Weight B3 Constn. kg
				Speed RPM	Current Amps.	Rated Torque kg.m	Power Factor			% Efficiency			Starting Current to Rated Current Ratio	Starting Torque to Rated Torque Ratio			
kW	HP	IEC	B3 Construction				FL	3/4L	1/2L	FL	3/4L	1/2L					
** 250	335	355L/K	MH35K8P3	741	457	329	0.80	0.75	0.68	95.2	95.0	94.5	6.1	1.8	2.2	66.00	2280
** 315	422	355L/K	MH35K8T3	741	574	414	0.80	0.75	0.68	95.5	95.3	94.8	6.1	1.8	2.2	69.70	2410
355	475	400L	MH40L893	740	660	467	0.78	0.74	0.68	95.9	95.7	95.3	5.5	1.8	2.2	77.00	2810
400	536	400L	MH40L8A3	740	743	526	0.78	0.74	0.68	96.0	95.8	95.4	5.5	1.8	2.2	86.00	3000
*450	603	400L	MH40L8B3	740	835	592	0.78	0.74	0.68	96.1	95.9	95.5	5.5	1.8	2.2	86.00	3000
500	670	450M	MH45M833	742	929	656	0.78	0.76	0.70	96.0	95.8	95.4	6.5	1.8	2.5	180.0	4300
560	750	450M	MH45M853	742	1039	735	0.78	0.76	0.70	96.1	95.9	95.5	6.5	1.8	2.5	200.0	4400
630	845	450L	MH45L873	742	1168	827	0.78	0.76	0.70	96.2	96.0	95.6	6.5	1.8	2.5	236.0	5600

Note : 1. Efficiency class 'IE2' will be punched on the nameplates as per IS : 12615-2011 for ratings up to 375kw for 2,4 & 6 Pole ratings.
2. All performance values are subject to tolerance as per IS:325 / IEC 60034-1
3. Higher ratings can be offered on request in 4, 6 and 8 polarity.
* Temperature rise limited to class "
** Temperature rise limited to 90°C

Dimensional Drawing: Industrial Motors Type - 2H Foot Mounted (B3) TEFC DCCA - Series Frame 355/400/450



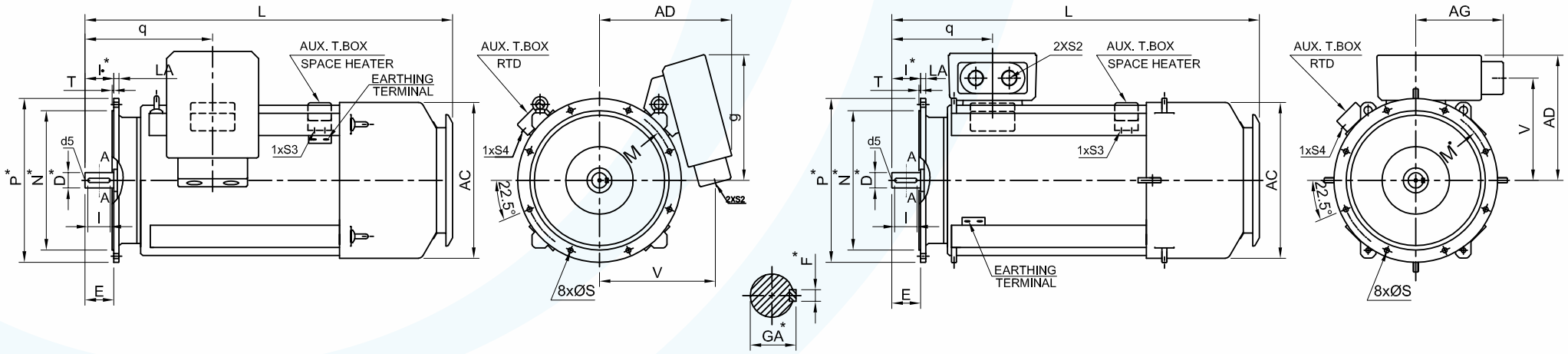
FRAME:355 SECTION A-A FRAME:400/450

IEC Fr. Size	Pole	FIXING						GENERAL											
		A*	B*	B1*	C	H*	K*	AB	BB	AA	BA	BA1	HA	HC	HD	AD	L	AC	Lv
355L/K	2	610	630	710	254	355	28	730	960	150	170	315	36	736	985	685	1735	765	200
355L/K	4/6/8	610	630	710	254	355	28	730	960	150	170	315	36	736	985	685	1765	765	130
400M/L	2	686	710	800	280	400	35	820	940	140	170	260	35	824	1076	-	1835	852	250
400M/L	4/6/8	686	710	800	280	400	35	820	940	140	170	260	35	824	1076	-	1875	852	200
450M	4/6/8	800	1000	-	250	450	42	940	1180	180	260	-	42	935	1210	-	2025	972	200
450L	4/6/8	800	1250	-	250	450	42	940	1430	180	260	390	42	935	1210	-	2147	972	200

IEC Fr. Size	Pole	TERMINAL BOX						SHAFT					
		V	q	AG	S2 B.S.C.	S3 B.S.C.	S4 B.S.C.	D*	E	F*	GA*	I	d5
355L/K	2	345	625	595	3"	3/4"	1"	75	140	20	79.5	130	M20
355L/K	4/6/8	345	655	595	3"	3/4"	1"	95	170	25	100	160	M24
400M/L	2	952	560	590	3"	3/4"	1"	80	170	22	85	160	M20
400M/L	4/6/8	952	600	590	3"	3/4"	1"	110	210	28	116	180	M24
450M	4/6/8	1086	600	590	3"	3/4"	1"	120	210	32	127	180	M24
450L	4/6/8	1086	605	590	3"	3/4"	1"	120	210	32	127	180	M24

TABLE A									
Dimension	A	B	H	K	D	GA	F	d5 (Centering)	L
Tolerance	±0.75	±0.75	-1	-	m6	-	h9		±50
Specification	IS:1231	IS:1231	IS:1231	IS:1231	IS:1231	IS:2048	IS:2048	IS:2540	-

Dimensional Drawing: Industrial Motors Type-2H Flange Mounted (V1) TEFC DCCA- Series Frame 355 / 400 / 450



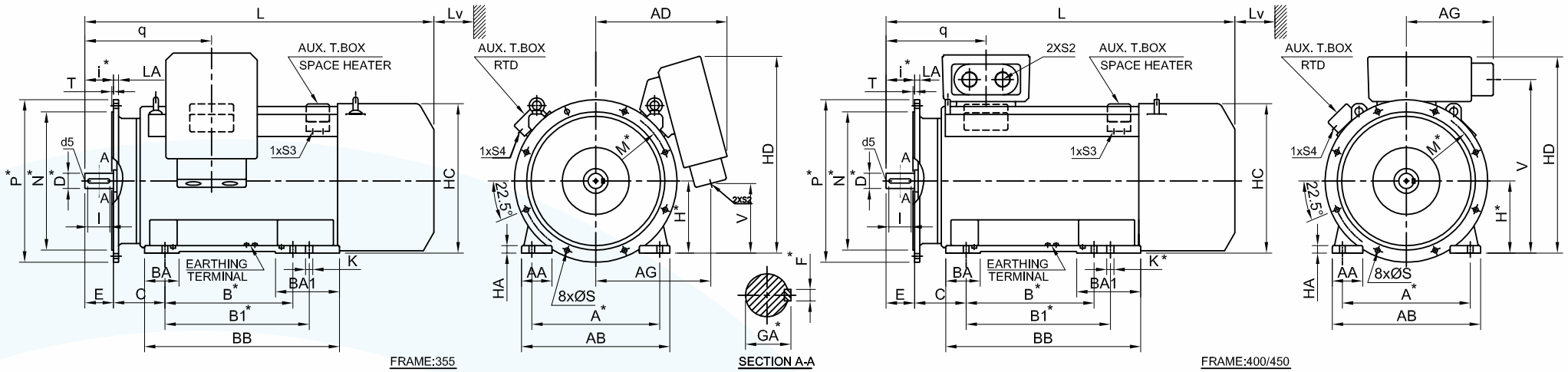
FRAME:355 SECTION A-A FRAME:400/450

		FIXING					GENERAL								TERMINAL BOX			
IEC Fr. Size	Pole	P	N*	M*	i*	S	T	LA	AD	AC	L	g	V	q	AG	S2 B.S.C.	S3 B.S.C.	S4 B.S.C.
355L/K	2	800	680	740	140	24	6	25	685	765	1835	630	570	625	-	3"	3/4"	1"
355L/K	4/6/8	800	680	740	170	24	6	25	685	765	1865	630	570	655	-	3"	3/4"	1"
400M/L	2	800	680	740	170	24	6	25	-	852	1935	-	552	560	590	3"	3/4"	1"
400M/L	4/6/8	800	680	740	210	24	6	25	-	852	1975	-	552	600	590	3"	3/4"	1"
450M	4/6/8	1150	1000	1080	210	28	6	30	-	972	2125	-	636	600	590	3"	3/4"	1"
450L	4/6/8	1150	1000	1080	210	28	6	30	-	972	2447	-	636	605	590	3"	3/4"	1"

		SHAFT					
IEC Fr. Size	Pole	D*	E	F*	GA*	I	dS
355L/K	2	75	140	20	79.5	130	M20
355L/K	4/6/8	95	170	25	100	160	M24
400M/L	2	80	170	22	85	160	M20
400M/L	4/6/8	110	210	28	116	180	M24
450M	4/6/8	120	210	32	127	180	M24
450L	4/6/8	120	210	32	127	180	M24

TABLE A								
Dimension	N	M	i	D	GA	F	d5 (Centering)	L
Tolerance	js6	±0.5	±1.5	m6	-	h9	-	±50
Specification	IS:2223	IS:2223	-	IS:1231	IS:2048	IS:2048	IS:2540	-

Dimensional Drawing: Industrial Motors Type - 2H Foot cum Flange Mounted (B35) TEFC DCCA - Series Frame 355/400/450



IEC Fr. Size	Pole	FIXING											SHAFT					
		A*	B*	B1*	C	H*	K*	P	N*	M*	I*	S	D*	E	F*	GA*	I	d5
355L/K	2	610	630	710	254	355	28	800	680	740	140	24	75	140	20	79.5	130	M20
355L/K	4/6/8	610	630	710	254	355	28	800	680	740	170	24	95	170	25	100	160	M24
400M/L	2	686	710	800	280	400	35	800	680	740	170	24	80	170	22	85	160	M20
400M/L	4/6/8	686	710	800	280	400	35	800	680	740	210	24	110	210	28	116	180	M24
450M	4/6/8	800	1000	-	250	450	42	1150	1000	1080	210	28	120	210	32	127	180	M24
450L	4/6/8	800	1250	-	250	450	42	1150	1000	1080	210	28	120	210	32	127	180	M24

IEC Fr. Size	Pole	GENERAL														TERMINAL BOX					
		T	LA	AB	BB	AA	BA	BA1	HA	HC	HD	AD	L	AC	Lv	V	q	AG	S2 B.S.C.	S3 B.S.C.	S4 B.S.C.
355L/K	2	6	25	730	960	150	170	315	36	736	985	685	1735	765	200	345	625	595	3"	3/4"	1"
355L/K	4/6/8	6	25	730	960	150	170	315	36	736	985	685	1765	765	130	345	655	595	3"	3/4"	1"
400M/L	2	6	25	820	940	140	170	260	35	824	1076		1835	852	250	952	560	590	3"	3/4"	1"
400M/L	4/6/8	6	25	820	940	140	170	260	35	824	1076		1875	852	200	952	600	590	3"	3/4"	1"
450M	4/6/8	6	30	940	1180	180	260	-	42	935	1210	-	2025	972	200	1086	600	590	3"	3/4"	1"
450L	4/6/8	6	30	940	1430	180	260	390	42	935	1210	-	2347	972	200	1086	605	590	3"	3/4"	1"

TABLE A

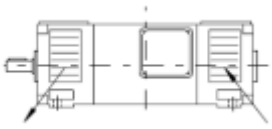
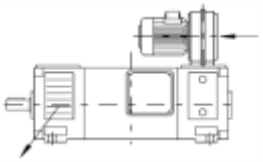
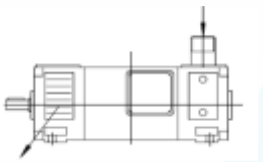
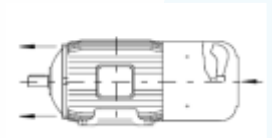
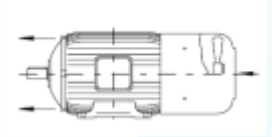
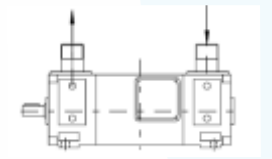
Dimension	A	B	H	K	N	M	i	D	GA	F	d5 (Centering)	I
Tolerance	±0.75	±0.75	1		js6	±0.5	±1.5	mG		h9	-	±50
Specification	IS:1231	IS:1231	IS:1231	IS:1231	IS:2223	IS:2223		IS:1231	IS:2048	IS:2048	IS:2510	

Methods of Cooling

Designation system concerning methods of cooling refers to standard IEC 60034-6.

Explanation of the product code

International Cooling	Circuit arrangement	Primary coolant	Method of movement of primary coolant	Secondary coolant	Method of movement of secondary coolant
(IC)	4	(A)	1	(A)	6
	1	2	3	4	5
Position 1			Position 4		
0 :	Free circulation (open circuit)		A:	For air (omitted for simplified designation)	
4 :	Frame surface cooled		W:	For water	
Position 2			Position 5		
A:	For air (omitted for simplified designation)		0	Free convection	
Position 3			1	Self-circulation	
0 :	Free convection		6	Machine-mounted independent component	
1 :	Self-circulation		8	Relative displacement	
6 :	Machine-mounted independent component				

IC 01		Enclosure IP 21 - IP 23 (type G...) **Self-ventilated with integral fan cooling (DP)** Cooling air is blown through the motor by a fan mounted on the shaft.
IC 06		Enclosure IP 21 - IP 23 (type G...I) **Separate ventilation with radial fitted fan unit (FV)** Cooling air is blown through the motor by a separately excited fan motor. The inlet side may be equipped with an air filter.
IC 17		Enclosure IP 21 - IP 23 (type G..) **Single pipe ventilated (FV)** Cooling air is blown across the motor through the pipe connection with a separate customer provided external blower fan and discharges on the other side to open space.
IC 410		Enclosure IP 44 - IP 55 (type G..Z) **Totally-enclosed non ventilated (TENV)** Cooling without using a fan, only by nature ventilation and radiation on the totally enclosed motor surface.
IC 411		Enclosure IP 44 - IP 55 (type G..ZE) **Totally-enclosed fan-cooled (TEFC)** Cooling air is blown over the totally enclosed motor surface by a fan mounted an the shaft.
IC 416		Enclosure IP 44 - IP 55 (type G..ZO) **External surface cooling (TEFV)** Cooling air is blown over the totally enclosed motor surface by an separately excited fan motor.
IC 37		Enclosure IP 44 - IP 55 (type G..Z) **Double pipe ventilated (TEPV)** Cooling air is blown across the motor through a pipe connecting by means of a separate customer provided external blower fan and discharges on the other side's pipe connecting.

Degree of Protection

Degree of protection for rotating machines are indicated according to IS/IEC 60034-5 using the characteristic letters 'IP' followed by two characteristic numerals for the degree of protection.

The first numeral indicates protection against contact and ingress of foreign bodies.

The second numeral indicates protection against ingress of water.

First characteristic numeral

IP2X Protected against solid objects greater than 12mm

IP5X Dust protected motors, Ingress of dust is not fully protected ,but dust can not enter in an amount sufficient to interface with satisfactory operations of the motor.

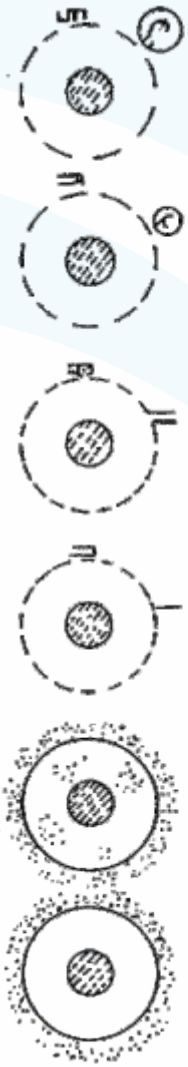
Second characteristic numeral

IPX3 Protected against spraying water, sprayed up to angle of 60^{o} from vertical shall have no harmful effect.

IPX5 Protected against water, jets by a nozzle from any direction shall have no harmful effect.

IPX6 Protected against heavy seas, powerful jets from all direction shall have no harmful effect.

Degree of protection Schematic

1st Numeric		
	0	No protection
	1	Protected against solid objects greater that 50mm (e.g. hand)
	2	Protected against solid objects greater that 12mm (e.g. fingers)
	3	Protected against solid objects greater that 2.5mm (e.g. tools, wires)
	4	Protected against solid objects greater that 1mm (e.g. wire or strips)
	5	Ingress of dust is not totally protected, but does not enter in sufficient quantities to harm equipment
	6	No ingress of dust

2nd Numeric		
	0	No protection
	1	Dripping water shall have no harmful effect.
	2	Protected against dripping water when enclosure is titled 15^{0}
	3	Protected against spraying water up to 60^{0}
	4	Water splashed from any direction shall have no harmful effect
	5	Water hosed against the enclosure shall have no harmful effect (water jets)
	6	Water from powerful jets of heavy seas shall have no harmful effects

Tolerances (Reference IS/IEC 60034-1)

Unless stated otherwise, tolerances on declared values are applicable as given in the table below:

Schedule of tolerances on values of quantities

Quantity	Tolerance
Efficiency ŋ -Machines up to and including 150 kW (or kVA) -Machines above 150 kW (or kVA)	 -15 % of (1 - ŋ) -10 % of (1 - ŋ)
Power-factor, cosΦ, for induction machines	-1/6 (1 -cosΦ) Minimum absolute value 0.02 Maximum absolute value 0.07
Slip of induction motors (at full load and at working temperature) *PN* < 1 kW *PN* 1 kW	 ± 30 % of the slip ± 20 % of the slip
Locked rotor current of cage induction motors with any specified starting apparatus	+20 % of the current
Locked rotor torque of cage induction motors	+25 -15 % of the torque. (+25 % may be exceeded by agreement)
Breakdown torque of induction motors	-10% of the torque except that after allowing for this tolerance the torque shall be not less than 1.6 or 1.5 times the rated torque

Note: When tolerance is stated in only direction, the value is not limited in the other direction.

Limiting Mean Sound Power Level Lw in dB(A) for Airborne Noise Emitted by Rotating Electrical Machines

IS: 12065 - 1987

Protective Enclosure		IP22	IP44	IP22	IP44	IP22	IP44	IP22	IP44	IP22	IP44	IP22	IP44
Rating kV(or kVA)		Rated Speed (rpm)											
		960 and below		961 to 1320		1321 to 1900		1901 to 2360		2361 to 3150		3151 to 3750	
Above	Up to	Sound Power Level dB(A)											
-	1.1	-	76	-	79	-	80	-	83	-	84	-	88
1.1	2.2	-	79	-	80	-	83	-	87	-	89	-	91
2.2	5.5	-	82	-	84	-	87	-	92	-	93	-	95
5.5	11	82	85	85	88	88	91	91	96	94	97	97	100
11	22	86	89	89	93	92	96	94	98	97	101	100	103
22	37	89	91	92	95	94	97	96	100	99	103	102	105
37	55	90	92	94	97	97	99	99	103	101	105	104	107
55	110	94	96	97	101	100	104	102	105	104	107	106	109
110	220	98	100	100	104	103	106	105	108	107	110	108	112
220	630	100	102	104	106	106	109	107	111	108	112	110	114
660	1100	102	104	106	107	107	111	108	111	108	112	110	114
1100	2500	105	107	109	110	109	113	109	113	109	113	110	114
2500	6300	106	108	110	112	111	115	111	115	111	115	111	115
6300	16000	108	110	111	113	113	116	113	116	113	116	113	116

Note 1: IP22 corresponds generally to drip-proof, ventilated and similar enclosures.

IP44 corresponds generally to totally enclosed fan-cooled, closed air circuit air-cooled, and similar enclosures (See IS: 4691-1985*).

Note 2: No positive tolerance is allowed on the above sound power levels.

Storage and Handling Instructions for Motors

Introduction

The purpose of this write-up is to offer some short, easy to follow recommendations to our customers, users and dealers for the proper care of electric motors in storage.

For practical purposes, such equipment is considered to be in storage not only when it is in the store room but also when:

It has been delivered to the jobsite and is awaiting installation;
or, It has been installed but regular operation is delayed / pending completion of plant construction;
or, there are 3 months or more, idle periods between operating cycles;
or, the plant or department is shut down.

The recommendations given here apply to conditions commonly found in indoor storage. Personnel responsible for care of the equipment should use good discretion in adapting these recommendations to the particular situation. Common sense and sound safety rules need to be followed.

SAFETY PROCEDURE

WARNING

Dangerous voltages are present in the motor components which can cause serious injury, electrocution and equipment damage. To avoid serious injury and/or equipment damage before any adjustments, servicing, wiring, parts replacement or any other act requiring physical contact with the electrical or mechanical working components of this equipment is performed, all equipment must be de-energized, disconnected and isolated to prevent accidental contact with live or rotating parts.

The success and safe operation of motors is dependent upon proper handling, installation, operation and maintenance, as well as upon proper design and manufacture. Failure to follow certain fundamental installation and maintenance requirements may lead to personal injury and the failure and loss of the motor as well as damage to other property.

Only qualified personnel should be involved in the inspection, maintenance and repair procedure and all plant safety procedures must be observed.

A qualified person is one who is familiar with the installation, construction and operation of the equipment, and the hazards involved. In addition, he has the following qualifications:

- Is trained and authorized to energize, de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.

- Is trained in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing etc. in accordance with established safety practices.

- Is trained in rendering first aid.

Motor should be installed and grounded as per local and national codes.

Storage Instructions For Motors

Indoor storage

Wholly controlled atmosphere or partially controlled atmosphere

- Storage room must be clean, dust free and dry
- Maintain temperature in the range 20 deg to 50 deg in the storage room
- Maintain uniform temperature throughout the room
- Relative humidity to be 50% or less
- Ensure absence of harmful fumes
- Vibration free area
- Space heater must be energized if temperature falls below 10 deg.C or humidity is more than 50% to prevent harmful effects of moisture condensation.
- Ensure that no water drips on motor and no water accumulates under the motor.
- Ensure that all plugs originally provided are in place. (e.g. cable entry hole plugs, drain plugs and plug in fan cowl for greasing. If plugs are missing, all the openings to be covered with an adhesive plastic cloth.
- The enclosing structure should be designed to protect the motor from flying debris or other damage from high winds.

Cover the motor completely in a strong, transparent plastic bag to exclude dirt, dust, moisture, and other foreign materials. Before sealing this bag, small bags of silica-gel desiccant should be put inside the bag, around the motor.

Rodents and other animals like to house inside motors in search of warm surroundings or food. Some of them attack the insulating materials. Their access to the motor should be restricted.

Outdoor storage

Dry climate (Conditions usually found) - Dust, sand, heat from the sun, and occasional rain or snow.

Humid climate (Conditions usually found) - Dust, rain and snow, organic (fungus) growth

Salty and industrial atmospheres (Conditions usually found) - Moisture impregnated with salts or other acidic / alkaline chemicals, salty dust, sand, rain or snow, fungus growth, fumes, coal and chemical dust soot. All precautions indicated in indoor storage to be taken.

In addition, after the unit is covered as explained in these instructions, a shed should be erected to protect it from direct rain, snow, and excessive direct sun heat. At a bare minimum, a heavy water-proofed cover should be slipped over it.

Bearings:
Special precautions need to be taken when the machine is idle for a period of 3 moths or more to avoid corrosion of the bearings and loss of grease. It is advisable to rotate the shaft periodically (once in a week @ 30 rpm for minimum 15 sec.) as the grease tends to settle at the bottom of the housings. Before a machine is started after a long idle period, the bearing covers should be removed and grease in the housing pressed with thumbs between the races of the bearing. If any deterioration of grease is apparent, the old grease should be removed and new grease pressed in the bearing housings.

If the machine is idle for four months or more, change the grease completely.

Shaft extensions, machines surfaces or flanges:
The machined parts have a protective coat of anti-rust preservative which should not be taken off during normal storage periods. In case of long storage, periodic examination should be carried out and fresh preservation should be applied, if required, after any rust or moisture has been removed. Preservation can be easily taken off by using paraffin or other petroleum solvents.

Complete motor:
When storage may last over one year, repaint all surfaces previously painted, before putting motor into service.

Handling instructions for motors

- For lifting the motor, only the lifting hook provided with motor, are to be used.
- Use all lifting hooks that are provided simultaneously. (If motor is provided with two hooks, use both hooks and not one)
- Do not use any other part of the motor for lifting.
- Do not use shaft projections for dragging the motor.
- Do not roll or drag the motor on the floor.
- Motors must not be kept in vertical position with external fan cowls as base.
- Jerks and jolts must be avoided to increase the bearing life.
- In vertical lifting, uncontrolled rotation of the motor must be prevented.
- Do not lift other equipments with motor lifting points only.

Recommended Maintenance Schedule

1. DAILY MAINTENANCE

1.1 Examine visually earth connections. Check motor leads and cable connections are fully tight and not loose.
1.2 Check motor windings for overheating (the permissible maximum temperature is above that which can be comfortably felt by hand).
1.3 Examine control equipments.
1.4 Check body and bearing temperature
1.5 Check voltage and current in all three phases. Check voltage variation and unbalance.
1.6 Check vibrations at bearings.
1.7 Check if motor rotation is free and measure speed.
1.8 Check for any abnormal noise.

Note: In order to avoid opening up motors, a good indication is to observe the shell temperature under normal working conditions. Any increase not accounted for, for example by seasonal increase in ambient temperature, should be suspected.

2. WEEKLY MAINTENANCE

2.1 Check belt tension. In cases where this is excessive, it should immediately be reduced. Check motor pulley seat location. Pulley has to rest on shaft shoulder.
2.2 Check coupling condition.
2.3 Blow out windings of protected type motors situated in dusty locations. Check for any accumulation of dirt, sand or fine dust.
2.4 Examine starting equipment for burnt contacts where motor is started and stopped frequently.
2.5 For outdoor motors, check if canopy is at proper place.

3. MONTHLY MAINTENANCE

3.1 Overhaul Controllers.
3.2 Inspect and clean oil circuit breakers.
3.3 Wipe brush holders and check bedding of brushes of slip-ring motors.

4. HALF YEARLY MAINTENANCE

4.1 Clean windings of motors subjected to corrosive or other elements; also bake and varnish, if necessary.
4.2 In the case of slip-ring motors, check sliprings for grooving or unusual wear.
4.3 Check grease in ball and roller bearings and make it up where necessary taking care to avoid overfilling.

5. ANNUAL MAINTENANCE

5.1 Check all high speed bearings and renew, if necessary.
5.2 Blow out all motor winding thoroughly with clean dry air. Make sure that the pressure is not so high as to damage the insulation.
5.3 Clean and varnish dirty and oily windings.
5.4 Overhaul motors which have been subjected to severe operating conditions.
5.5 Renew switch and fuse contacts, if damaged. Check oil.
5.6 There can be cement dust / saw dust / rock dust / coal dust / grain dust on motor body. Blow out compressed air over motor body to clean this accumulated dust at the time of monthly maintenance. See to it that all ventilation paths are absolutely free.
5.7 Paint the motor if required.
5.8 Check insulation resistance to earth and between phases of motor winding, control gear and wiring.
5.9 Check resistance of earth connections.
5.10 Check air gaps.
5.11 Test the motor overload relays and breakers.

6. RECORDS

6.1 Maintain a register giving one or more pages for each motor and record therein all important inspection and maintenance works carried out from time to time. These records should show past performance, normal insulation resistance level, air gap measurements, nature of repairs and time between previous repairs and other important information which would be of help for good performance and maintenance. Sample format is attached.

Trouble Shooting Chart

TROUBLE	CAUSE	WHAT TO DO
Motor fails to start	Blown fuses	Replace fuses with proper type and rating.
	Overload trips	Check and reset overload in starter
	Improper power supply	Check to see that power supply agrees with Motor name plate and load factor
	Improper line connection	Check connections with diagram supplied with motor
	Open circuit in winding or control switch	Indicated by humming sound when switch is closed. Check for loose wiring connections. Also, ensure that all control contacts are closing
	Mechanical failure	Check to see if motor and drive turn freely. Check bearings and lubrication
	Short circuited stator	Indicated by blown fuses. Motor must be rewound
	Poor stator coil connection	Remove end shields, locate with test lamps
	Rotor defective	Look for broken bar sand/or end rings
	Motors may be over loaded	Reduce Load
Motor stalls	One phase may be open	Check lines for open phase
	Wrong application	Change type or size. Consult manufacturer
	Over Load	Reduce Load
	Low Voltage	Ensure the name plate voltage is maintained. Check connection
	Open circuit	Fuses blown, check overload relay, stator and push buttons
Motor runs and then dies down	Power failure	Check for loose connections to line, fuses and control
Motor does not come up to speed	Voltage too low at motor terminals because of line drop	Use higher voltage or transformer terminals or reduce load. Check connections. Check conductors for proper size
	Starting load too high	Check load motor is supposed to carry at start
	Broken rotor bars or loose rotor	Look for cracks near the rings. A new rotor may be required, as repairs are usually temporary
	Open primary circuit	Locate fault with testing device and repair

Motor takes too long to accelerate and/or draws high amp	Excessive load	Reduce load
	Low voltage during start	Check for high resistance. Adequate wire size
	Defective squirrel cage rotor	Replace with new rotor
	Applied voltage too low	Increase power tap
Wrong rotation	Wrong sequence of phases	Reverse connections at motor or at switchboard
Motor overheats while running under load	Overload	Reduce Load
	Frame vents may be clogged with dirt and prevent proper ventilation of motor	Open vent holes and check for a continuous stream of air from the motor
	Motor may have one phase open	Check to make sure that all leads are well connected
	Grounded coil	Locate and repair
	Unbalanced terminal voltage	Check for faulty leads, connections and transformers
Motor vibrates	Motor misaligned	Realign
	Weak support	Strengthen base
	Coupling out of balance	Balance coupling
	Driven equipment unbalanced	Rebalance driven equipment
	Defective bearings	Replace bearings
	Bearings not in line	Line up properly
	Balancing weights shifted	Rebalance motor.
	Contradiction between balancing of rotor and coupling (half key - full key)	Rebalance coupling or motor
	Polyphase motor running single phase	Check for open circuit
	Excessive end play	Adjust bearing or add shim
Scraping noise	Fan rubbing fan cover	Remove interference
	Fan striking insulation	Clear fan
	Loose on bed plate	Tighten holding bolts

Noisy operation	Rotor unbalance	Rebalance
Hot bearings general	Bent or sprung shaft	Straighten shaft
	Excessive belt pull	Decrease belt tension.
	Pulleys too far away	Move pulley closer to motor bearing
	Pulley diameter too small	Use larger pulleys
	Misalignment	Correct by realignment of drive
Hot bearings ball	Insufficient grease	Maintain proper quality of grease in bearing
	Deterioration of grease of lubricant contaminated	Remove old grease, wash bearings thoroughly in kerosene and replace with new grease
	Excess lubricant	Reduce quantity of grease, bearing should not be more than 1/2 filled
	Overload bearing	Check alignment, side and end thrust.
	Broken ball or rough races	Replace bearing, first clean housing thoroughly

MOTOR SERVICE RECORD

Serial No. _____ kW _____ Type _____

Speed _____ Volts _____ Amperes _____ Phase _____ Frequency _____

Insulation Class _____ Temperature Rise _____ °C Frame Size _____

Connection Diagram-Rotor _____ Stator _____

Owner Order No. _____ Item No. _____ Date Purchased _____

MACHINE TYPE	WEATHER PROTECTED	LUBRICATION
- Horizontal - Vertical - Totally-Enclosed - Explosion-Proof	**Bearings** - Ball - Roller -Sleeve Size : Drive End _____ Non Drive End _____	**Shaft Extension** Length _____

Date Installed	Location	Application	Dist. kept for cooling

Date Repaired or Replaced	Repairs or Parts Replaced	Fault	Repaired by	Total Cost

Name of Part	No. Per Machine	Manufacturer's No.	Date	Qty. Repl.	Cost	Date	Qty. Repl.	Cost	Date	Qty. Repl.	Cost
Rotor											
Stator Coils											
Bearing, DE											
NDE											
Cooling fan											
Others											

INSPECTION													
Date													
Bearings													
Lubrication													
Excess Heat													
Excess Noise													
Speed													
Voltage in 3 ph													
Voltage Variation													
Voltage Unbalance													
Current in 3 ph													
Current Variation													
Current Unbalance													
Insulation Resistance													
Clean & clear air passages													
Alignment													
Vibration													
Body Temp.													
Abnormal noise													

Table 1 Derived Values of Limits of Vibration Severity in Rotating Electrical Machines measured in State of Free suspension (Velocity Mode)

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Sl.No	Shaft Height mm	56 < H ≤132		132 < H ≤225		225 < H ≤400		H > 400	
i	Range of Speed, rpm	500 to 1500	> 1500 and up to 3000	500 to 1500	> 1500 and up to 3000	500 to 1500	> 1500 and up to 3000	500 to 1500	> 1500 and up to 3000
rms value of vibration velocity in mm/s for the shaft height H in mm									
ii	N(Normal)	1.8	18	1.8	2.8	2.8	4.5	2.8	4.5
iii	R(Reduced)	0.71	0.71	0.71	1.12	1.8	2.8	----	----
iv	S(Special)	0.45	0.45	0.45	0.71	1.12	1.8	----	----

Table 2 Derived Values of Limits of Vibration Severity in Rotating Electrical Machines measured in State of Free suspension (Displacement Mode)

Shaft Height	56 < H ≤132						132 < H ≤225						225 < H ≤400						H > 400					
Speed, rpm	500	600	750	1000	1500	3000	500	600	750	1000	1500	3000	500	600	750	1000	1500	3000	500	600	750	1000	1500	3000
Vibration limit in maximum displacement amplitude, in µm																								
N(Normal)	96	80	64	48	32	16	96	80	64	48	32	25	150	125	100	75	50	42	150	125	100	75	50	40
R(Reduced)	36	30	24	18	12	6	36	30	24	18	12	10	96	80	64	48	32	26	---	---	---	---	---	---
S(Special)	24	20	16	12	8	4	24	20	16	12	8	6	50	60	40	30	20	17	---	---	---	---	---	---

Note: For the purpose of Table 2 f is assumed as frequency corresponding to rotor rpm. But for evaluation the dominant frequency should be determined by spectrum analysis and only that frequency should be used for calculation.

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