Bharat Bijlee make crane and hoist duty motors are ideally suitable for short time and intermittent duties. These motors are specially designed for frequent starts/stops and reversals.

Major Application

These motors are widely used in following applications:

- Crane duty and Hoist duty application including LT & CT drives
- Material Handling
- Weirs and Sluices
- Lift Duty
- Auxiliary motors in rolling mills

Product Range

Frame Size	kW Range
71 to 355L	0.37 to 400

Standards

In general these motors conform to following standards

IS/IEC 60034-1 "Rotating Electrical Machines - Part 1 Rating & Performance"	Three Phase Induction Motors specification
IS : 1231	Dimensions of foot mounted A.C induction motors
IS : 2223	Dimensions of flange mounted A.C Induction motors

CE Marks

All motors have CE marking on the nameplate.

ELECTRICAL FEATURES

Operating Conditions

Supply conditions (Voltage & Frequency)

Voltage : 415V ± 10%

Frequency : 50Hz ± 5%

Combined Variation : ± 10%

*Other voltage / Frequency on request.

Ambient

Motors are designed for ambient temperature of 45°C.

Altitude

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

Re-rating Factors

The re-rating applicable under different conditions of ambient and altitude are obtained by multiplying following factors.

Variation in Ambient & Altitude

Table 1

Amb. Temp. (°C)	Permissible output as % of rated value	Altitude above sea level (meters)	Permissible output as % of rated value
⩽ 30	107	1000	100
30-45	100	1500	97
50	96	2000	94
55	92	2500	90
60	87	3000	86
		3500	82
		4000	77

Insulation

The motors are provided with class F insulation scheme with temperature rise limited to class B limits.

Winding

The stators are wound with modified polyester enamel covered (Temp class 155°C) copper wires as per IS 13730:3 and impregnated with class F varnish. However motors wound with dual coated copper wires and VPI can be provided on request.

All Motors in 315S frame & above are wound with dual coated winding wire (thermal class 200°C) as per IS 13730:13 and are impregnated with VPI process.

Thermal Protection (for Winding & Bearing)

PTC thermistors / thermostats/ RTDs etc. can be embedded in stator winding on request.

In case of frame sizes 250M & above bearing temperature detectors (BTD) can be supplied on request.

Earthing Terminals

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

Anti- condensation Method

In order to avoid condensation of water inside the motors they can be heated up by connecting 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 method as indicated in IS: 900 for heating the stator winding could be adopted. Motors can also be offered with built in space heaters in frame sizes 90S and above.

MECHANICAL FEATURES

Enclosures: (Material & T Box Location)

Table 2

Frame Size	Enclosure Materials	Terminal Box Location	
		Standard	Option available
71-80	Aluminum	TOP	----
90S-112M	Aluminum	TOP	----
	Cast Iron	RHS	TOP & LHS
132S-132M	Aluminum	TOP	-
132S-225M	Cast Iron	RHS	TOP & LHS
250M-355L	Cast Iron	TOP	RHS & LHS

Degree of Protection

All motors have IP55 degree of protection as per IS:4691. Higher degree of protection such as IP56, IP66 can be offered 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.

Cooling

All motors are totally enclosed Fan Cooled (TEFC). The cooling is effected by self driven, bi-directional centrifugal fan protected by fan cover. The Type of cooling is IC411 as per IS: 6362. Motors with natural ventilation(TENV) or with forced cooing arrangement can be offered on request.
Minimum cooling distance as indicated in GA Drawing has to be provided for effective cooling of the motor.

Note: For more details, refer to annexure I.

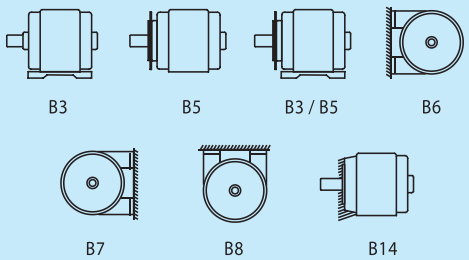
Type of Construction

Standards 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.

Mounting

Horizontal Mounting



Vertical Mounting

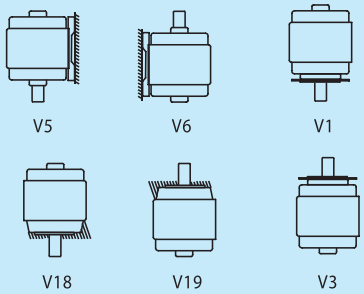


Table 3

Frame Size		Bearing Nos. C3 clearance		Termin-al Box Type/ Location	Terminal		No. & size of Cable entries	Max cond. Cross Sec. area (mm^2)
		DE	NDE		No.	Size		
71		6202 2Z	6202 2Z	gk030/ Top	3	M4	1×3/4"	4
80		6004 2Z	6004 2Z					
90S, 90L		6205 2Z	6205 2Z	gk130/ TOP	3*			6
100L		6206 2Z	6205 2Z	gk230/ TOP	3*		2 × 1"	10
112M		6206 2Z	6205 2Z		6			
132S, 132M		6208 2Z	6208 2Z	gk330/ TOP	6	M5		
160M, 160L		6309 2Z	6209 2Z	gk330/ RHS				16
180M, 180L		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		150
280 S/M	2P	6316	6316					
	4,6 & 8P	6317	6316					
315S, 315M		6319	6319	TB315/ Top	6	M12	2 × 2"	240
315L							2 × 2 1/2"	
355L		6322	6322	TB355/ Top	6	M16	2 × 3"	300

*3 Terminals up to and including 1.5kW & 6 terminals for higher outputs

Special Design Features

- Increased air gap between stator and rotor
- Special rotor design

Types of Duties

The various operating cycles of driven machines can be classified into nine basic duties, ranging from S1 to S8 They are as follows:

Table 4

S1	Continuous duty
S2	Short time duty
S3	Intermittent periodic duty
S4	Intermittent periodic duty with starting
S5	Intermittent periodic duty with starting and electric braking
S6	Continuous duty with Intermittent periodic loading
S7	Continuous duty with starting and electric braking
S8	Continuous duty with periodic speed changes

Duties S2, S3, S4 and S5 explained with graphs

A) S2-Short Time Duty

This includes a period of operation at constant load which are too short to attain thermal equilibrium, followed by rest period of sufficient duration to re-establish equality of temperature with cooling medium in one cycle.

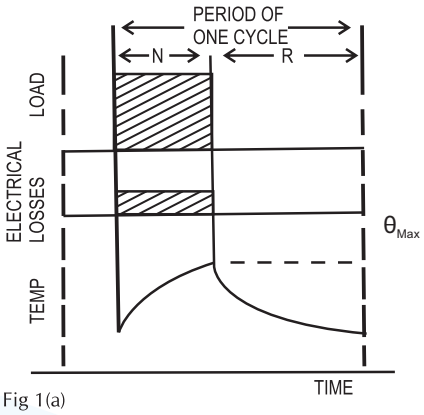


Fig 1(a)

N = Operation under rated conditions.

R = At rest de-energized

θ_{Max} = Maximum temperature attained during the duty cycle.

B) S3- Intermittent Periodic Duty

This includes a period of operation at constant load and a de-energized period, which are too short to attain thermal equilibrium during one cycle. The starting current does not significantly affect the temperature rise for this type of duty.

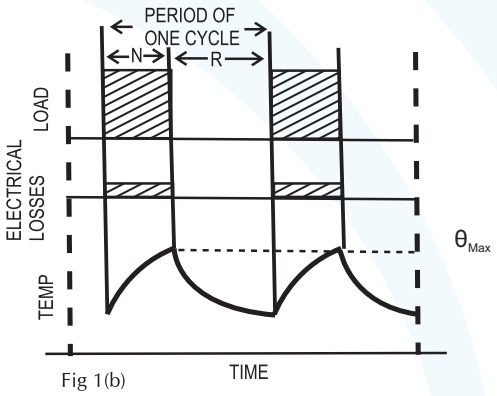


Fig 1(b)

$$\text{Cyclic duration factor} = \frac{N}{N + R}$$

C) S4- Intermittent Periodic Duty with Starting

This includes a period of starting, a period of operation at constant load and a de-energized period, which is too short to attain thermal equilibrium during one cycle. The starting affects temperature rise, as load GD^2 is higher than rotor GD^2 and/ or no. of start/hour is high, for this type of duty. The motor is stopped after switching off either by natural deceleration, or by a mechanical Brake, without additional heating of the windings

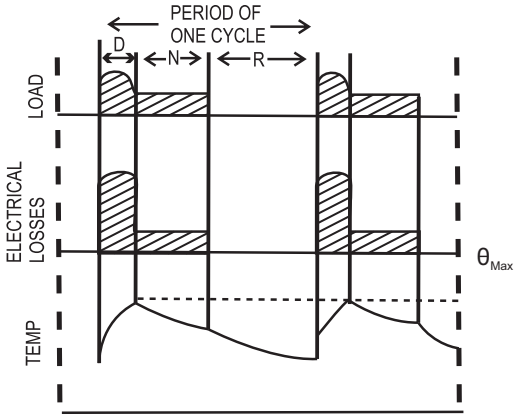


Fig 1(c)

$$\text{Cyclic duration factor} = \frac{D + N}{D + N + R}$$

Where D = Starting

D) S5- Intermittent Periodic Duty with Starting and Electrical Braking

This includes a period of starting, a period of operation at constant load, a period of electrical braking, and de-energized period which are too short to attain thermal equilibrium during one duty cycle. It is understood that the starting affect temperature rise, as in (c) above, and the stopping also affects temperature rise as braking is carried out electrically.

We also supply motors for special types of duties, on enquiry including multi-speed motors with squirrel cage rotors.

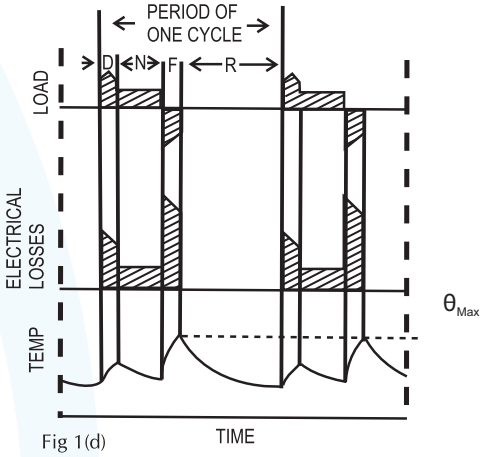


Fig 1(d)

$$\text{Cyclic duration factor} = \frac{D + N + F}{D + N + F + R}$$

Where F = Electric breaking

The common Cyclic Duration Factors (CDF) for the above duties are 25%, 40% and 60%. We also supply, on enquiry, motors for other CDF's. The CDF calculations are shown in figures 1(a), 1(b), 1(c), 1(d).

Examples of typical Starting Duties

Table 5

Starting Duties					Starting Class
Duty Cycle	St/hr	Jogs/hr	Breaking to Stop/hr	Complete plug reversal/hr	No. of Starts/hr thermal Equivalent
S3	60	0	0	0	60
	40	80	0	0	
	20	80	20	0	
S4	150	0	0	0	150
	100	200	0	0	
S5	80	0	80	0	150
	65	130	65	0	
	30	160	30	30	
S4	300	0	0	0	300
	200	400	0	0	
S5	160	0	180	0	300
	130	260	130	0	
	60	320	60	60	

Refer above table for example of typical starting duties and selection of starting class. Table given here are for load $GD^2 \leq$ rotor GD^2. For cases where load GD^2 >rotor GD^2 the motor should be selected from the table with a higher no. of starts/hr. as per the formula.

No. of starts allowed =No. of starts as per table $\times 2 \times GD^2$ of rotor/ (GD^2 of rotor + GD^2 of load).

Selection of motors for hoist motions

For hoisting motor, the power required shall not be less than that computed from the following:

$$kW = \frac{MVC_vCDF}{6.12E} X \frac{1}{C_{amb}}$$

Where, derating factor will be taken as 12%,

kW = One hour power rating for DC motors & power rating at (S-40%) cyclic duration factor for AC motors

M = Mass of rated load on hook plus weight of hook block & wire ropes in tones

V = Specified hoisting speed in m/min

E = Combined efficiency of gears & sheaves
= (0.93)n × (0.98)m for sleeve bearings
= (0.95)n × (0.99)m for antifriction bearings
= (0.985)n × (0.99)m for hardened profile ground & oil splashed lubricator, where

n = Number of pairs of gears

m = Total number rotating sheaves passed over by each part of the moving rope attached to the drum

C_v = Service factor for vertical motion depending on type of motors,
= 0.67 for AC motors,
= 0.5 for DC motors

CDF = Cyclic duration factor

C_{amb} = Derating factor for ambient temperature as per table 1.

For an AC hoist motor, the specified full load hoist speed must be obtained at not more than rated torque, therefore, the calculated full load kW must be multiplied by: $\frac{(100 - \text{rated slip\%})}{(100 \text{ total ohms at full speed\%})}$

Where sufficient information is not available values given in table 6 below for duty cycles, cyclic duration factor & starting corresponding to mechanism class shall be used. The values given are based on the following formula:

$$CDF = \frac{\text{Operating time X 100}}{\text{Operating time + Idle time}}$$

Recommended Cyclic Duration Factor & starting class:

Table 6

Mechanism Class	Duty cycle No. of cyclic class (c) Cycles/hr (%)	Recommended CDF (%)	Starting class (c) Equivalent starts/hr
M1	Up to 5 Cycles 25	25	90
M2	Up to 5 Cycles 25	25	90
M3	10 to 15 Cycles 40	40	150
M4	16 to 20 Cycles 40	40	150
M5	21 to 30 Cycles 60	60	300
M6	31 to 40 Cycles 60	60	300
M7	41 to 50 Cycles 100	100	600
M8	51 to 60 Cycles 100	100	600

Selection of Motors for Crane Travel or Trolley Traverse

It is assumed that the drive mechanism from the motor to the track wheels will use enclosed gearings mounted on anti-friction bearings. The actual efficiency of the drive will be adopted in making calculations. Where actual efficiency values are not available, the efficiency of the drive shall be taken in the range of 0.85 to 0.9.

For the track wheel with anti-friction bearings the rolling friction at these bearings plus the friction between the track wheels with an average drive efficiency of 0.875 will give an overall friction factor of 8.0 kgf per tonne of the mass moved for calculation of the motor horse power or torque. In the case of wheels with the plain bearings an overall friction of 13.0 kgf per tonne of the mass moved may be used.

Selection of Motors for Crane Travel or Trolley Traverse:

For bridge travel or trolley traverse the power of the motor required shall not be less than that computed from the following:

For indoor cranes

$$kW = \frac{MVSCDF}{6117T} \times \frac{(F+1100a)}{981N}$$

For outdoor cranes

$$kW = \frac{MVSCDF}{6117T} \times \frac{(F+1100a)}{981N} + \frac{R_w V}{6117T}$$

where,

kW = One hour power rating for DC motors & power rating at 40 percent cyclic duration factor for AC motors.

M = Mass of crane or trolley plus mass of max rated load in tonnes.

V = Specified free running speed m/min.

N = Mechanical efficiency of gearing. For spur & helical gears it can be taken as 0.95 per reduction.

T = Factor introduced by the permissible motor torque during acceleration exceeding the motor rated torque. As a general guidance value of T may be taken as 1.7 for motor having pull out torque of 275 percent full load torque. Lower value of T should be taken for corresponding lower value of pull out torque.

= 1.3 of d.c motor pull out torque *100

= 1.6 for a.c motor 160*full load torque

F = Overall friction factor

= 8kgf per tonne for wheel on anti friction bearing.

= 13 kgf per tonne for wheels on plane bearings

CDF = Cyclic duration factor

R_w = Load due to service wind acting horizontally, which can be obtained by multiplying the horizontal exposed area by the service wind by taking drag co-efficient into consideration.

A = Average linear acceleration of the crane of the trolley in cm/s^2 till the mechanism reaches 90% of free running speed for the value of average linear acceleration refer table 7

S = Service factor aimed at providing adequate motor heat dissipation capacity as given in table 7

Acceleration values

Table 7

Speed to be reached m/min	Acceleration in cm/s^2 Low & Moderate speed with Long Travel	Acceleration in cm/s^2 for Moderate & High speed (Normal Application)	Acceleration in cm/s^2 for High speed with High Acceleration
240	-	50	67
190	-	44	58
150	-	39	52
120	22	35	47
100	19	32	43
60	15	25	33
40	12	19	-
25	10	16	-
15	8	-	-
10	7	-	-

VFD Crane Duty Motors

The growing need for energy saving and accurate control has resulted in increased demand for VFD operated Crane Duty Motors. It has advantage over traditional Slipring Motor on speed range with low maintenance leading to reduced Life Cycle Cost. Current control of VFD Driven motors are better than Standard TEFC SCR Motors. Crane / Hoist Duty Motors call for the Constant Torque application and the speed range varies from 10% to 100% of the synchronous speed.

Bharat Bijlee Inverter Duty Crane and Hoist Motors are provided with special insulation system suitable to withstand voltage spikes when run on VFD. The selection of frame size for various duty type and starts shall be as per the selection table enclosed. These motors have following special features:

- Dual Coated Winding Wire
- Vacuum Pressure Impregnation

For selection of motors suitable to work with VFD supply, please contact works.

Note: For more details, refer to page 6, 7, 8, 9, 10 and 11 of Industrial Motors Technical Information section.

Standard Features:

Voltage: 220 to 690 Volts
Frequency: 50 / 60 Hz
Ambient: 45°C
Altitude: 1000 meters above mean sea level.
Insulation: Class F / H (Temperature rise limited to class B or F as per demand)
Bharat Bijlee Motors are suitable for the following IGBT Drive output

- High Frequency in the range of 3kHz – 6kHz
- Voltage rise time > 0.1 sec
- Voltage spikes up to 1600V and rise time of 0.1 sec
- THD < 3%

Bharat Bijlee motors from 315 frame and above are inherently suitable for VFD operation.

Optional: Insulated bearing (Recommended for 250 Frame onwards) Thermister /RTD / BTD.

Motors with Integral Brakes

These motors can be supplied with integral fail safe D.C. brake in frame sizes up to 132, with built in rectifiers (so that no separate DC supply is required for brake part).For more details refer brake motors section of the catalogue.

Flame-proof Crane Duty Motors

Motors suitable for intermittent duty operation can be offered in frame sizes MJ80, MJ 90, MJ 100, MJ 112 and MJ 132. for enquiry please refer to our sales office.

Enquiries

When making an enquiry or placing an order for crane duty motor, please furnish the following information. This will enable us to supply most suitable motor for your cranes and hoists.

1. Details of Crane:

a. Class of crane
b. Type of crane
c. Tonnage of crane
d. Operating speed
e. Type of motion: Hoisting, Travelling or Traversing

2. Electrical Features:

a. Motor Outpt (kW) and Polarity
b. Supply voltage and frequency with variations
c. Type of Rotor: Squirrel Cage / Slipring
d. Class of Insulation and ambient temperature
e. Method of starting
f. Requirement of starting torque, pull out torque, starting current
g. Load torque of the driven equipment
h. In case of Slipring motors rotor voltage and rotor current is to be specified

3. Operational Details:

a. Duty type : S2,S3,S4 or S5
b. Duty cycle details preferably with a sketch if different from S2, S3, S4 or S5.
c. No. of starts per hour
d. Method of braking: plugging, DC injection/ mechanical brake
e. No. of reversals per hour
f. Cyclic duration factor (CDF)
g. Load inertia referred to motor speed (GD^2)

4. Mechanical Features:

a. Enclosure
b. Degree of protection
c. Mounting
d. Fixing dimensions

(If Bharat Bijlee standard motor fixing dimensions are not applicable, please let us know your specific requirements, preferably with a drawing)

e. Shaft extension: Requirement of shaft extension if any, needs to be mentioned
f. Any other relevant data