ABOUT JYOTI LTD: COMPANY PROFILE

Jyoti Ltd., a leading engineering company, is offering high quality products and services to clients in India and in the international market. Established in 1943, today Jyoti Ltd. is serving the vital fields of national and international economy such as:

- Power (Thermal, Hydel & Nuclear) Generation, Transmission and Distribution,
- Agriculture, helping irrigation through pumping systems,
- Water supply & Sewerage schemes,
- Defence-particularly Naval & Marine Establishments,
- Railways,
- Core industries like Steel, Cement, Paper, Sugar, Fertilizers, and Chemicals & Petrochemicals.

Jyoti offers a wide range of quality products and services conforming to Indian and International standards.

Jyoti has received ISO-9001 Certification for establishing and applying Quality Systems for design, development, manufacture and servicing of its Pumps, Switchgears, Generators, Motors and Hydro Turbines.

The products and Services we offer include:

- Medium & Large pumps,
- Hydro-Electric Generating Systems,
- L.T. & H.T. Alternators
- L.T. & H.T. Motors
- Special Rotating Electrical Machines like Arno Convertors, Sugar Centrifuge Motors, Frequency Convertors etc.,
- Medium voltage Switchboards & Switchgear,
- Electronics & Control Systems,
- Jyoti assumes single-source responsibility for implementing Turn-Key Projects.
- Jyoti Pro/ENGINEER Design Service Centre offers CAD/ CAM / CAE solution to improve engineering processes.

The wide range of products and services offered are engineered by different product and service groups manned by competent professional specialising in their respective fields. Jyoti has a countrywide marketing network of Zonal & Branch offices and System Houses. System Houses serve, as an extended arm of the network catering to the complete technical and commercial needs of customers. They draw on all the strengths of Jyoti brand image, technical expertise and engineering support. They all are backed up by well-equipped customer services available at authorised service centres as well as at Zonal & Branch Offices. With opening up economy, the Export Division has intensified its operations in the international market. In order to meet the growing demand of ‘Jyoti Switchboards in Gulf countries, a unit to manufacture medium voltage switchboards has been set up at Sohar, in Oman. This unit, Jyoti Sohar Switchgear LLC is a joint venture between Jyoti Ltd. and OMZEST Group of Muscat.

‘Jyoti’ Products, which meet stringent requirements of Core Sectors of Indian and Global economy, have been developed at Jyoti R&D Centre through market-oriented research. First of its kind to be set up in Private Sector in 1964, the R&D Centre has produced a capability to cater to changing market needs through a planned, focused and cost effective Research and Development. The basic philosophy is to preserve and enhance. ‘Core competence’ in technology development to maintain competitiveness in Global Market. The company has received several National awards for Imports Substitution from Government of India. The company has also received prestigious awards from Institutions like Associated Chambers of Commerce and Industry of India (ASSOCHAM), Federation of Indian Chambers of Commerce and Industry (FICCI) and Confederation of India Industry (CII), for its pioneering efforts in developing indigenous technology.

Jyoti has won the Award from International Association for Small Hydro for its outstanding contribution as equipment manufacturer for development of Small Hydro Power (SIP) in India recognition from IREDA for outstanding contribution to renewable energy sector.

Jyoti has set up a Pro/ENGINEER Design Service Centre, the first of its kind in the Western region of the country. The Centre aims at Virtual Engineering by providing CAD / CAM / CAE solutions i.e. to improve designs, manufacturing processes and enhance the product quality on the one hand and reduce cost and time on the other.

Though Jyoti’s corporate philosophy is to develop indigenous technology, Jyoti Imports technical know-how on a selective basis with a view to update its own technological base and remain competitive. Jyoti has entered into technical collaboration with leading foreign firms for manufacturing of various products. At present, it has technical collaboration with Toshiba Corporation, Japan for manufacture of Vacuum Circuit Breakers. Jyoti has entered into technical collaboration with Jeumont Industries, France to manufacture High Voltage Alternators for Steam / Gas Turbine duty. In co-operation with Turbo-Institute, Slovenia, Jyoti aims to offer a wide range of runners and improved designs of Small Hydel Sets.

Being an integral part of the society, Jyoti is deeply conscious of its obligations and responsibility towards society. Jyoti has played a major role in rehabilitating the handicapped by providing training and assisting various voluntary organisations and encouraging own employees to participate in areas like promotion of renewable sources of energy, preservation of environment, voluntary blood donation programmes, vocational training for rural and urban youth and integrated rural development programmes. Jyoti has received prestigious awards for these efforts from Government of India and FICCI.

QUALITY & COMPLIANCE

GENERAL:

Quality Assurance of L.T. motors designed, manufactured, marketed and serviced by Jyoti Ltd. is broadly divided into three categories:-

a) Design Quality
b) Conformance Quality
c) Performance Quality

d) **DESIGN QUALITY :**

The final design released from design department to manufacturing department is based on valuable inputs from the experienced engineers from various departments viz. Standard Dept., Quality Dept., Manufacturing Dept., Customer Service Dept., Marketing Dept., as indicated below:-

a) Standard Department ensures that materials, standards & tolerances for components and the products are as per work standard, national or international standards.
b) R & D Department specifies quality standards based on performance requirements and information on past field complaint. The criticalities of various components are also taken into account.
c) Manufacturing Department examines the design in terms of capabilities of the existing machine tools and other manufacturing processes to achieve the dimensions and tolerances indicated.
d) Customer Services Department examines the design from the viewpoint of ease of erection, maintenance and servicing.
e) Marketing Department examines the design from the viewpoint of market feedback and customer's existing requirements.

➢ **CONFORMANCE QUALITY :**

Planning for conformance quality by manufacturing involves the following stages.

a) Vendor selection and development for supply of raw materials, components and fabrication to meet the standards laid down in the bill of materials, drawings, etc. is done by Purchase Department with the help of engineers in Manufacturing, Quality & R&D personnel.
b) Product engineering group does preparation of process charts. The information on the process sheets is transferred on job cards for each component in order to manufacture components as per the process sequence and methods indicated on the job cards.

Verification of the conformance quality is done at various stage of manufacturing as indicated below:

I. Inspection of incoming material
II. Stage Wise in-process inspection
III. Sub-assembly & assembly inspection viz. stator assembly, rotor assembly and complete assembly etc.

The real quality of any machine can be seen in its performance, that is why we pay close attention to customer's comments. From the moment you place your order until the motor is up and running, we keep you informed and involved. Our own Procedures are constantly under review. All our staff are involved in continuous training programs to help them to serve you better, and increased skills bring

Increased motivation. At JYOTI, we think that it is vital for our customers to know the importance we attach to quality. It is a reality that inspires each employee to give his best.

MILE STONE

→ First motor manufactured at Jyoti ltd.	- 1948
→ vertical motors for V.T.pumps	- 1955
→ TEFC motors	- 1955
→ First slipring motors (168kW/12P)	- 1955
→ Arno convertor (120 KVA) for Railways	- 1965
→ PAM motor was introduced under collaboration of BTG UK	- 1986
→ L.T. CACA motor for Chanderpur	- 1986
→ Standard motors with Class 'F' insulation	- 1995
→ Windmill generator up to 400 kw (Single / Dual speed)	- 1996
→ Vertical TEFC series motors up to frame size 355	- 1998
→ Auxiliary motors for Railways (WAG - 9)	- 1999
→ TEFC - 2 pole & 8 pole series motors	- 2000
→ TEFC Slip Ring Motor	- 2000
→ Electric motor for Transport Bus Vehicle (Inverter Fed)	- 2001
→ *Flange Mounted Dual Speed Generator*	- 2001
→ *Dual Speed (8P/16P) Motor for Defence*	- 2006
→ 750/200kW Dual Speed Generator	- 2009
→ 10 Pole TEFC series Motors	- 2010
→ Efficiency - 1 Motors	-2010

REFERENCE STANDARDS

NATIONAL STANDARDS & EQUIVALENT INTERNATIONAL STANDARDS

	National	International	British
Three phase Induction motors	IS:325	IEC 34-1	BS 5000
Rotating Electrical Machines	IS:4722	IEC 34	BS 4999
Type of duty & classes of rating assigned to rotating electrical Machines	IS:12824	IEC 34-1	BS 4999
Method of determination of efficiency of rotating electrical Machines	IS:4889	IEC 34-2	BS 4999
Degree of protection provided by enclosure for rotating Electrical machines	IS:4691	IEC 34-5	BS 4999
Designation of methods of cooling of rotating Electrical machines	IS:6362	IEC 34-6	BS 4999
Designation for types of construction and mounting Arrangements of rotating electrical machines	IS:2253	IEC 34-7	BS 4999
Terminal marking & Direction of rotation for rotating Electrical machines	IS:4728	IEC 34-8	BS 4999
Permissible limits of Noise levels for rotating electrical Machines	IS:12065	IEC 34-9	BS 4999
Mechanical vibration of rotating electrical machines with Shaft height 56 mm & higher-measurement, evaluation & limits of vibration severity.	IS:12075	IEC 34-14	BS 4999
Dimensions of foot mounted Induction motors	IS:1231	IEC 72	BS 5000
Dimensions of Flange mounted Induction motors	IS:2223	IEC 72-1	BS 4999
Dimensions and output ratings for foot mounted electrical Machines with frame 355 and above	IS:8223	IEC 72-1	BS 4999
Thermal evaluation and classification of electrical insulation.	IS:1271	IEC 85	BS 5000
Dimensions of vertical shaft motors for pumps	IS:2254	----	----
Guide for testing three phase induction motors	IS:4029	IEC 34	----
Guide for testing insulation resistance of rotating machines	IS:7816	----	----
Temp. Rise measurement of rotating electrical machines	IS:12802	----	----
Classification of degree of protection provided by enclosure Of electrical equipment.	IS:12063	----	----
Guide on effects of unbalanced voltage on the performance Of 3 phase squirrel cage motors	IS: 13529	IEC892	----
Induction motor -Energy efficient 3 phase, squirrel cage	IS:12615	----	----
Three phase squirrel cage Induction motors for centrifugal Pumps for agricultural applications	IS:7538	----	----
Values of performance characteristics for 3 phase Induction Motors.	IS:8789	----	----
Recommendations for the dimensions and output rating of Electric motors- Flange mounting	IS:14568	IEC 72-2	----
Code of practice for installation and maintenance of Induction Motors	IS:900	----	----
Motors for Submersible pump sets	IS:9283	----	----
Increased Safety Motors (Type 'e' Motor)	IS:6381	----	----
Impulse withstand load of REM with form wound Stator coil	IS:4222	----	----

NOMENCLATURE OF JYOTI L.T. INDUCTION MOTORS

1	2	3	4	5	6	7	8	9	10	11
	C		T	F	G	2	8	0	L	
	C		T	F		3	1	5	M	
F	C	V	T	F		3	5	5	S	

- 11 → Special machine
- 10 → L = Large length, M = Medium length, S = Small length
- 7, 8, 9 → Frame size as per IS-1231 & IS-8223 ie. Shaft centre height From base for horizontal foot mounted motor.
- 6 → G = Induction generator
- 5 → F = Fan cooled, S =Surface cooled
- 4 → T= Totally enclosed, D = Drip proof
- 3 → V = Vertical hollow shaft Flange Mounted, U = Vertical solid shaft as per IS 2254 Flange Mounted
- 2 → C = Squirrel cage rotor, W = Wound rotor
- 1 → F = Flange mounted, S = Single phase (As per IS: 2223)

TOLERANCE ON MAIN PERFORMANCE PARAMETERS

TOLERANCES FOR ELECTROMECHANICAL CHARACTERISTICS

IEC 34-1 or BS 4999 or IS 325 specifies standard tolerances for electromechanical characteristics

Parameters	Tolerances
Efficiency { Machines P≤ 50 kW Machines P > 50 kW	-15%(1-η) -10%(1-η)
Total losses above 50 kW Motor	+10%
Power factor (CosΦ)	-1/6(1- cosΦ) (Min. 0.02-max. 0.07)
Slip	±20% of guaranteed value
Locked rotor torque (Break away torque)	-15%,+25% of guaranteed value
Locked rotor current (Break away current)	+20% of guaranteed value
Pull out torque	-10% of guaranteed value
Rotor voltage	± 10% of guaranteed value
Moment of Inertia (also $GD^{2)}$	±10% of guaranteed value

Note: Tolerances on following parameters are as per Jyoti standard

Vibration	+10% of guaranteed classification
Noise	+3 dB (A) over guaranteed value

- **Mechanical Tolerances:**

The standard tolerances shown below are applicable to the drawing dimensions given in our catalogues. They fully comply with IEC standard 72-1/IS-1231 & IS-2223.

Dimensions	Tolerances
Frame size H ≤ 250 ≥ 280 Diameter ϕ of shaft extension: 11 to 28 mm 32 to 48 mm 55 mm and over	0 - 0.5 mm 0 - 1.0 mm j6 k6 m6
Diameter N of flange spigot:	j6 up to F500B
Key width:	h9
Width of drive shaft key way (Normal keying)	N9
Key depth: -rectangular section	h11
Concentricity of spigot diameter and perpendicularity of mating surface of flange in relation to shaft F55 to F115 F130 to F265 F300 to F500	 0.08 mm 0.10 mm 0.125 mm
Eccentricity of shaft in flanged motors (Standard class) - diameter > 10 up to 18 mm - diameter > 18 up to 30 mm - diameter > 30 up to 50 mm - diameter > 50 up to 80 mm - diameter > 80 up to 120 mm	 0.035 mm 0.040 mm 0.050 mm 0.060 mm 0.070 mm

ENVIRONMENT

➢ NORMAL OPERATING CONDITIONS:

Under IEC 34-1, BS 4999 or IS 325 standard motors must be able to operate under the following conditions:

- Ambient temperature between - 15°C and +50°C inclusive
- Altitude under 1000M
- Atmospheric pressure 1050 mbar

➢ DERATING FACTORS:

For different operating conditions other than those mentioned above, apply the following derating factors.

Ambient temperature °C	Approx. derating factor
50	1.00
55	0.88
60	0.83

Altitude above MSL (M)	Approx. derating factor
1000	1.00
1500	0.95
2000	0.91
2500	0.87
3000	0.83
3500	0.79
4000	0.74

Variation in voltage	Variation in frequency	Combined variation	Derating factor
±10 %	±5 %	±10 %	1.0
+10%, -15%	±5 %	+10%,-15%	0.90
±15%	±5 %	±15%	0.85

➢ RELATIVE HUMIDITY :

Above 50% relative humidity either TEFC motors are to be used or open type motors with proper protective coating to be used. If relative humidity is 90% & above then TEFC motors with tropical coating over winding are provided against condensation of moisture.

➢ DRAIN HOLES :

Holes are provided in motors of frame size 225 and above at the lowest points of the Totally Enclosed Fan Cooled machine enclosure to drain off any moisture condensation that may have accumulated inside. After draining the moisture the plugs must be refitted, in order to maintain IP55 protection.

➢ DRIP COVER (CANOPY COVER) :

For machines operating vertically outdoors, with the drive shaft downwards, canopies are used.

SUPPLY CONDITIONS

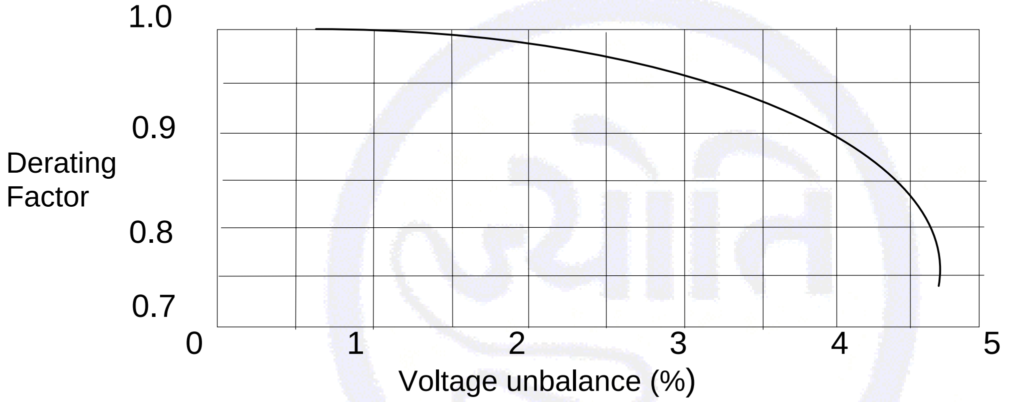
➢ VOLTAGE & FREQUENCY RATING :

Our standard motors are designed for operation at 415 Volt, 50 Hz, 3 phase AC supply. Motors for other voltages and frequencies will be available on request. Jyoti motors are suitable for a voltage variation of ±10% and frequency variation of ±5%. In case of continuous operation at extreme voltage limits, the temperature rise limit can exceed by 10°C. Motors when operated under the extreme condition of voltage and frequency variation may not necessarily have their performance in accordance with above standards.

➢ UNBALANCE VOLTAGE :

Standard motors are capable of operating under condition of supply voltage unbalance not exceeding 1% for long period or 2% for short period. Motors required operating at voltages and frequency variations other than specified by above standard can be supplied on request. A motor user from the voltage readings of the three phases can determine the percentage voltage unbalances.

$$\text{Percentage voltage unbalances.} = \frac{\text{Maximum voltage deviation from average voltage}}{\text{Average voltage}} \times 100$$



TYPICAL DERATING FACTOR DUE TO UNBALANCED VOLTAGES

In some applications, greater unbalance than that permitted by IS may be unavoidable, and some derating of the motor might be necessary to reduce the possibility of damage due to overheating. Typical values of derating of single speed three-phase cage Induction motors, rated up to 650V are shown in the fig. above.

EFFECT OF VARIATION OF VOLTAGE & FREQUENCY ON THE CHARACTERISTICS OF MOTOR:

CHARACTERISTICS	VOLTAGE		FREQUENCY	
	110%	90%	105%	95%
TORQUE				
Starting & Maximum	+21%	-19%	-10%	+11%
SPEED				
Synchronous	No change	No change	+5%	-5%
Full load	+1%	-1.5%	+5%	-5%
CURRENT				
No- load	+(10 to 15) %	-(10 to 12)%	-(5 to 6)%	+(5 to 6)%
Starting	+(10 to 12)%	-(10 to 12)%	-(5 to 6)%	+(5 to 6)%
Full-load	-7 %	+11%	No major change	
Temperature rise	-3 to 4 °C	+6 to 7 °C	No major change	
Over load capacity	+21 %	-19 %	No major change	
Magnetic Noise	No major change		No major change	
FL. Efficiency (%)	+0.5 to 1%	-2%	No major change	
FL. Power factor (%)	-3 %	+1%	No major change	

Note: The data given above are for general guidance only.

ELECTRICAL FEATURES

➢ RATED SPEED/SLIP :

The rated speed corresponds to the speed at which the motor runs with rated load. The speed of an a.c . Motor depends on mains frequency and number of poles of stator windings.

Where speed Ns $= \frac{2 \times F \times 60}{P}$ rpm. This is the synchronous speed.

F = Frequency of the supply system and P = No. of poles.

The synchronous speed can never be reached by squirrel cage or slip ring Induction motors. At no-load, however, the speed is practically equal to the synchronous speed; at rated output speed (N) is slightly lower. The slip is the difference between the synchronous speed and the rated speed of the motor expressed as a percentage of the synchronous speed. Normally for partial loads, slip varies proportionally with the output.

$$\% \text{ slip} = \frac{Ns - N}{Ns} \times 100$$

➢ RATED CURRENT :

It is the current drawn by the motor when running with rated load and at rated supply conditions. The rated current given in performance data is for 415V supply. For motors designed to suit other voltages like 440V, 400V, 380V, the rated current is given by

$$I = \frac{Vr}{V} \times Ir$$

Where Ir = rated current at rated voltage Vr (Vr = 415 V)

I = rated current at required voltage V

The current drawn by a motor varies with load, though no linear relationship exists.

➢ DIRECTION OF ROTATION :

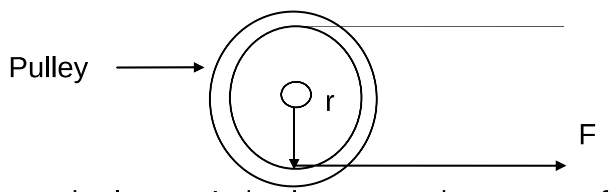
If the mains supply is connected to the stator terminals marked U, V & W of a three-phase motor, and the phase sequence of the mains is L1, L2, L3, the motor will rotate clockwise as viewed from the drive end. For opposite direction of rotation, interchange two of the three wires connected to the stator switch or the motor.

➢ OVERLOAD :

Standard motors are designed to withstand overload up to 1.6 times of their rated torque for 15 seconds without stalling or abrupt change in speed at rated supply conditions. Standard Motors are not suitable for continuous overload.

➢ MOTOR TORQUE :

The torque of a motor is a measure of its turning ability. If the power and the speed are known it is easy to calculate the torque. At the periphery of a pulley there is a certain force in the belt is generated in running motor see figure .The product of force F and the radius of the pulley r is the torque T of the motor.

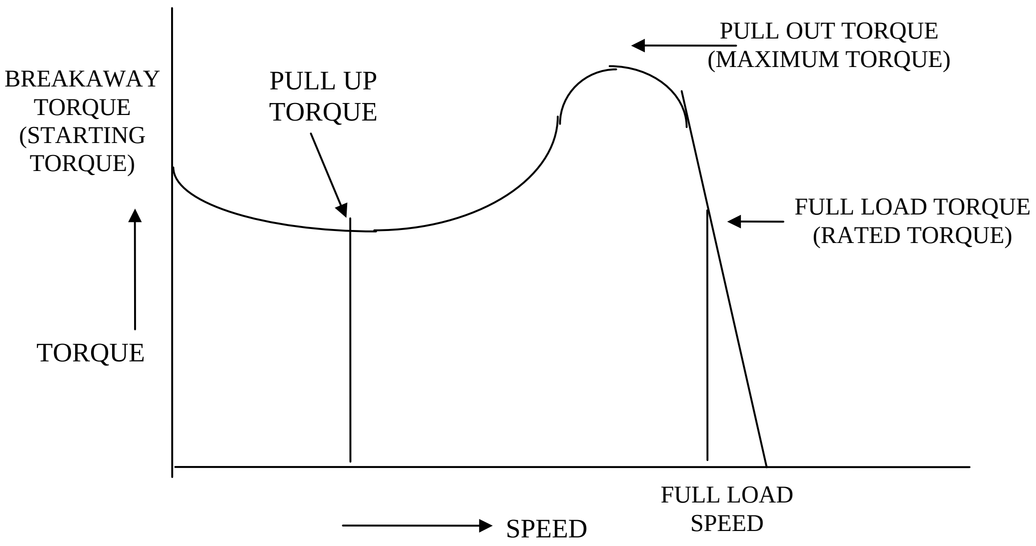


During the acceleration of a squirrel cage Induction motor the torque of the motor first droops slightly ($T_{\text{pull-up}}$) but then rises to its maximum (T_{pullout}). In normal motors the maximum torque occurs at 85 to 90% of full load speed. At synchronous speed zero torque is developed.

Jyoti standard squirrel cage induction motors are designed to develop high starting torque at reasonable starting current. For DOL starting method, starting torque and starting current values are mentioned in data sheets.

To achieve high starting torque and lower starting current for squirrel cage induction motors, multi cage aluminium diecast rotor construction is used up to 280 frame size and deep bar single cage or double cage rotor construction is used for motors in frame size above 280. In case of wound rotor induction motor, starting torque and starting current depends on external resistance connected in rotor circuit. If the voltage varies from its rated value within the permissible limits, the starting, pull up and pull out torque vary as the square of the voltage.

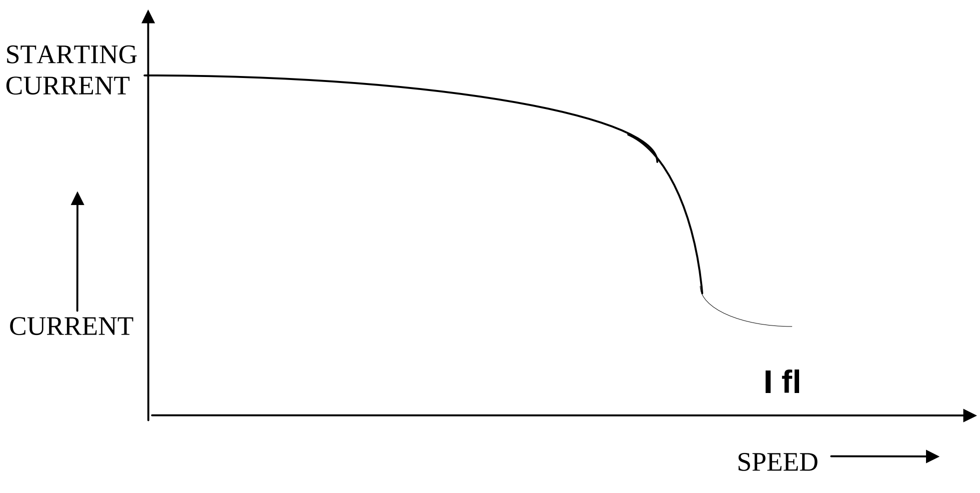
➢ TYPICAL SPEED-TORQUE AND STARTING CURRENT CHARACTERISTICS:



➢ LOCKED ROTOR CURRENT (STARTING CURRENT) :

This is the current drawn by the motor at the time of starting when started on DOL. In data it is expressed as percentage of the rated current of the motor.

The starting current varies proportionately with voltage from its rated value within the permissible limits.



➢ LOCKED ROTOR WITHSTAND TIME

It is the time taken by the motor windings or rotor to reach the maximum limiting temperature, during rotor locked condition, depending upon class of insulation, from either ambient temperature, or rated service temperature.

CALCULATION OF LOCKED ROTOR WITHSTAND TIME

➢ STATOR:

Limiting Temperature **T1**		Maximum permissible Temperature **T2**	
Class **B** insulation	185 °C	Class **B** insulation	120 °C
Class **F** insulation	210 °C	Class **F** insulation	145 °C
Class **H** insulation	235 °C	Class **H** insulation	165 °C
Aluminium rotor	450 °C		
Copper rotor	350 °C	Ambient Temperature	**Tamb**

$$\text{Locked rotor withstands time (Cold)} = \frac{(T1 - Tamb) \times w1 \times k1}{3 \times Ist^2\, R \text{ at permissible temperature}}$$

$$\text{Locked rotor withstands time (Hot)} = \frac{(T1 - T2) \times w1 \times k1}{3 \times Ist^2\, R \text{ at permissible temp.}}$$

➢ ROTOR :

$$\text{Locked rotor withstands time (Cold)} = \frac{(T1 - Tamb) \times w2 \times k2}{3 \times Ist^2\, R \text{ at permissible temp.} \times 0.85}$$

$$\text{Locked rotor withstands time (Hot)} = \frac{(T1 - T2) \times w2 \times k2}{3 \times Ist^2\, R \text{ at perm. temp.} \times 0.85}$$

w1 = Weight of stator active material. Specific heat of copper ($\nu 1$) = 0.385 J/kg/°C
w2 = Weight of rotor active material Specific heat of aluminium ($\nu 2$) = 0.925 J/kg/°C
k1 = Specific heat of stator active material. (Copper)
k2 = Specific heat of rotor active material. (Copper or Aluminium)

❖ STARTING TIME :

It is the time taken by a motor to come to its rated speed
Starting time depends on the following factors;

1. GD^2 of load referred to motor shaft plus motor GD^2
2. Torque speed curve of the motor
3. Torque speed curve of the load

Starting time should be lower than the locked rotor withstand time for a safe motor

➢ CALCULATION OF STARTING TIME:

The starting time or the acceleration time can be calculated approximately by the following formulae

$$\mathbf{Ta} = \frac{N \times \text{Total } GD^2}{375 \times Ta}$$

Where;

- N = Full load speed of motor in rpm
- Total GD^2 = GD2 of motor + GD^2 of load in Kg-m^2
- Ta = (K_1 - K_2) x Full load torque of motor in Kg-m.
- K_1 = Break away toque of motor / Full load torque of motor
- K_2 = Load torque /Full load torque of motor

❖ STATOR THERMAL - WITHSTAND TIME FOR 4 POLE SPDP MOTOR.

➢ FORMULA :

$$\textbf{TIME} = \frac{\text{Wt. of Copper x Specific heat of copper x Temp. difference x 1000}}{(Ipu^2-1) \times Ifl^2 \times \text{Resistance at reference temp.}}$$

FRAME	KW	Tcold	Thot
CD-280S	110	12.0	7.0
CD-280M	132	12.0	7.0
CD-280M	150	12.0	7.0
CVD-280	160	12.0	7.0
CD-315M	180	14.0	8.0
CD-315L	200	14.0	8.0
CD-315L	220	14.0	8.0
CD-315L	250	14.0	8.0
CD-315L	280	14.0	8.0
CD-355L	370	16.0	10.0
CD-400L	450	16.0	10.0

❖ STATOR THERMAL - WITHSTAND TIME FOR 6 POLE SPDP MOTOR :

FRAME	KW	Tcold	Thot
CVD-280	67	12.0	6.0
CVD-280	75	12.0	6.0
CVD-280	90	12.0	6.0
CD-315S	110	14.0	8.0
CD-315M	132	14.0	8.0
CD-315L	150	14.0	8.0
CD-315L	160	15.0	9.0
CD-355S	180 / 187	15.0	9.0
CD-355M	200	16.0	10.0
CD-355L	220	16.0	10.0
CD-355L	250	16.0	10.0

❖ STATOR THERMAL - WITHSTAND TIME FOR 4 POLE TEFC MOTOR.

➢ **FORMULA:**

TIME = $\frac{\text{Wt. of Copper x Specific heat of copper x Temp. difference x 1000}}{(Ipu^2\text{-}1) \text{ x } Ifl^2 \text{ x Resistance at reference temp.}}$

FRAME	KW	Tcold	Thot
CTF-225S	37	12.0	8.0
CTF-225M	45	12.0	8.0
CTF-250M	55	16.0	10.0
CTF-280S	67	16.0	10.0
CTF-280S	75	16.0	10.0
CTF-280M	90	16.0	10.0
CTF-315M	110	16.0	10.0
CTF-315M	125	16.0	10.0
CTF-315M	132	16.0	10.0
CTF-315L	150 /160	16.0	10.0
CTF-355S	187	18.0	12.0
CTF-355M	220	18.0	12.0
CTF-355M	250	18.0	12.0
CVTF-355	280	18.0	12.0
CVTF-355	315	18.0	12.0
CTF-400L	370	20.0	14.0

❖ STATOR THERMAL - WITHSTAND TIME FOR 6 POLE TEFC MOTOR:

FRAME	KW	Tcold	Thot
CTF-280S	45	12.0	8.0
CTF-280M	55	12.0	8.0
CTF-315S	67	16.0	10.0
CTF-315M	75	16.0	10.0
CTF-315M	90	16.0	10.0
CTF-315L	110	16.0	10.0
CTF-315L	132	16.0	10.0
CTF-355M	160	18.0	12.0
CTF-355M	180	18.0	12.0
CTF-355M	200	18.0	12.0
CVTF-355	220	18.0	12.0
CVTF-355	250	18.0	12.0

❖ STATOR THERMAL - WITHSTAND TIME FOR 8 POLE TEFC MOTOR:

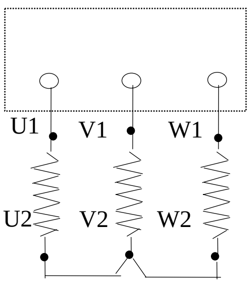
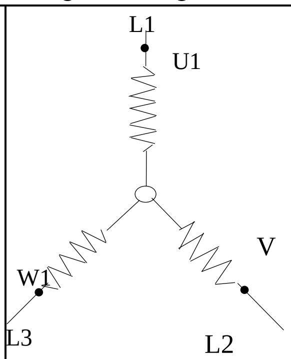
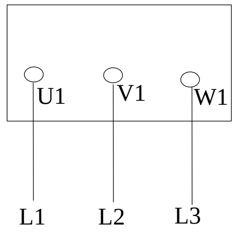
FRAME	KW	Tcold	Thot
CTF-315M	55	16.0	10.0
CTF-315M	75	16.0	10.0
CTF-315L	90	16.0	10.0
CTF-315L	110	16.0	10.0
CTF-355M	125 / 132	18.0	12.0

MOTOR CONNECTIONS

➢ SINGLE SPEED MOTORS:

<table>
<tr><th rowspan="2">Voltages and connections</th><th rowspan="2">Internal connection diagrams</th><th rowspan="2">Outline diagrams</th><th colspan="2">External connection diagrams</th></tr>
<tr><th>DOL starting</th><th>Y/Δ starting</th></tr>
<tr><td></td><td colspan="4">Single Voltage Motors (3 Terminals)</td></tr>
<tr><td>

- Voltage **U**
- Connection
- Y internal

eg. 415 V-Y</td><td>
</td><td>
</td><td>
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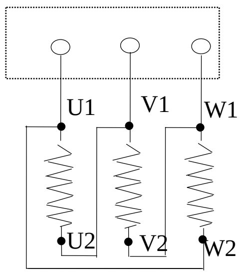
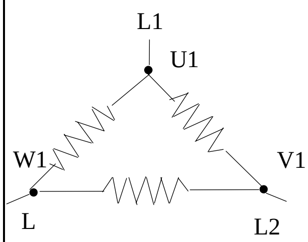
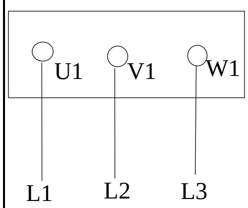
<tr><td>

- Voltage: U
- Connection:
- Δ internal

Eg. 415 V-Δ</td><td>
</td><td>
</td><td>
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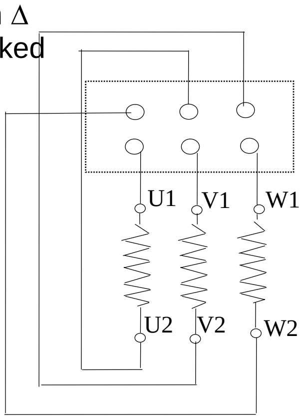
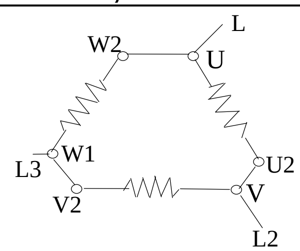
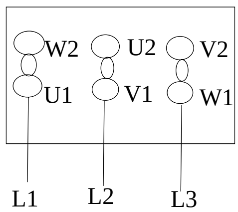
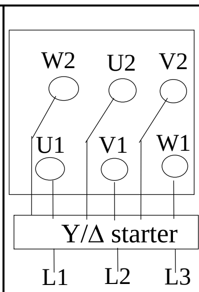
<tr><td colspan="5"></td></tr>
<tr><td colspan="5">Dual voltage motor with Y,Δ connections (6 terminals)</td></tr>
<tr><td rowspan="2" colspan="2">

- Voltage: U
- Connection Δ

(At lower marked voltage)
Eg. 240 V-Δ



- Voltage

Connection Y(At higher marked)</td><td>
</td><td>
</td><td>
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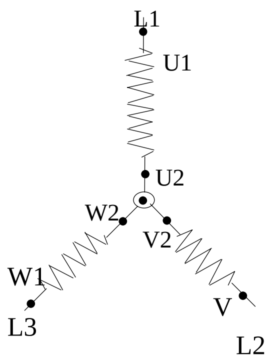
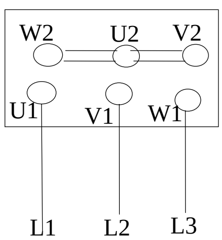
<tr><td>
</td><td>
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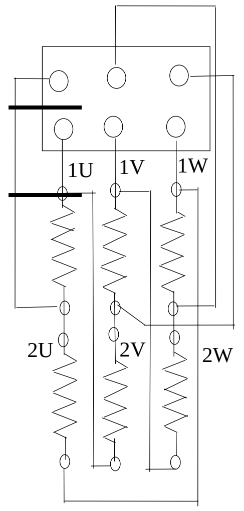
TWO SPEED MOTORS

<table>
<tr><th rowspan="2">Voltages and Connections</th><th rowspan="2">Internal connection Diagrams</th><th rowspan="2">Outline diagrams</th><th colspan="2">External connection diagrams</th></tr>
<tr><th>Manually operated</th><th>switch operated</th></tr>
<tr><td>Dahlander-PAM centrifuges machines for quadratically decreasing torque.
6 terminals
(Y internal)
Y-Y Y</td>
<td>
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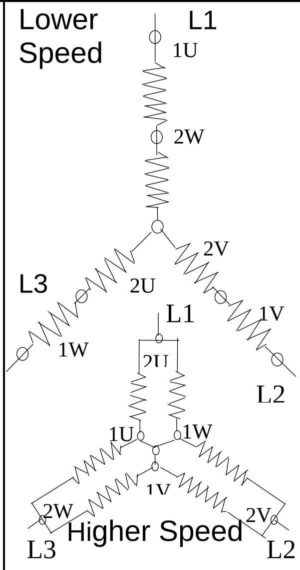
<td>
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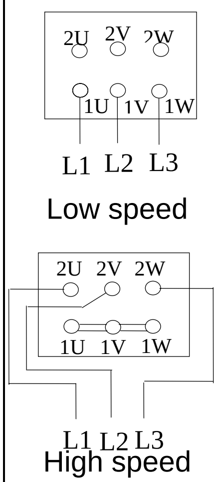
<td>
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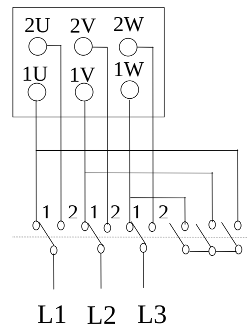
<td>
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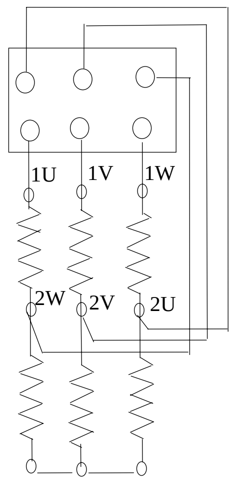
<tr><td>Dahlander-Constant torque
6 terminals
(Δ Internal)
Δ-Y Y</td>
<td>
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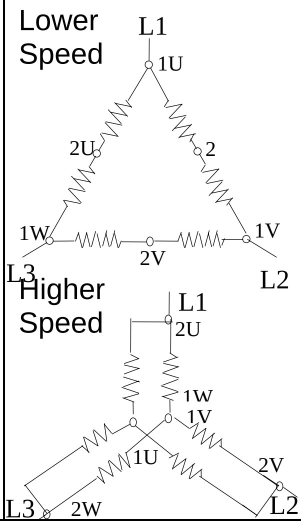
<td>
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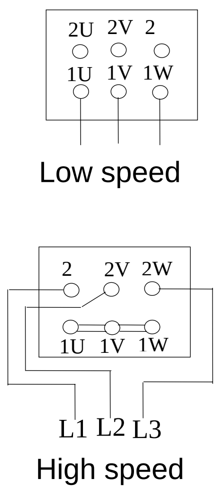
<td>
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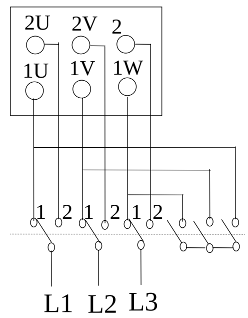
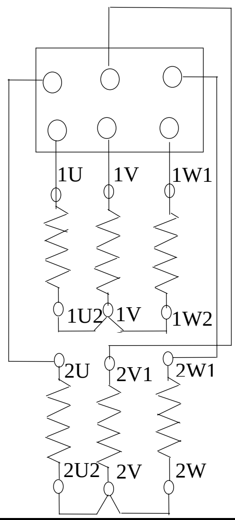
<td>
</td></tr>
<tr><td>Two separate windings
2 x 3 terminals
(Y internal)</td>
<td>
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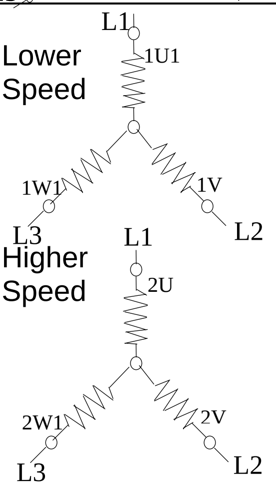
<td>
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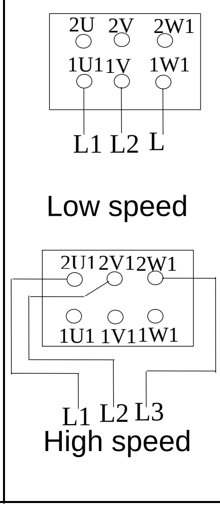
<td>
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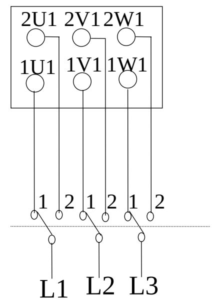
<td>
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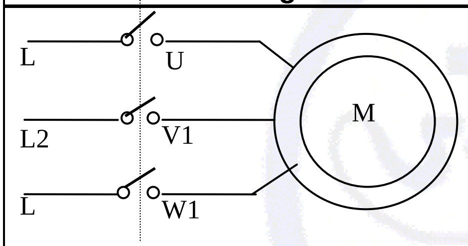
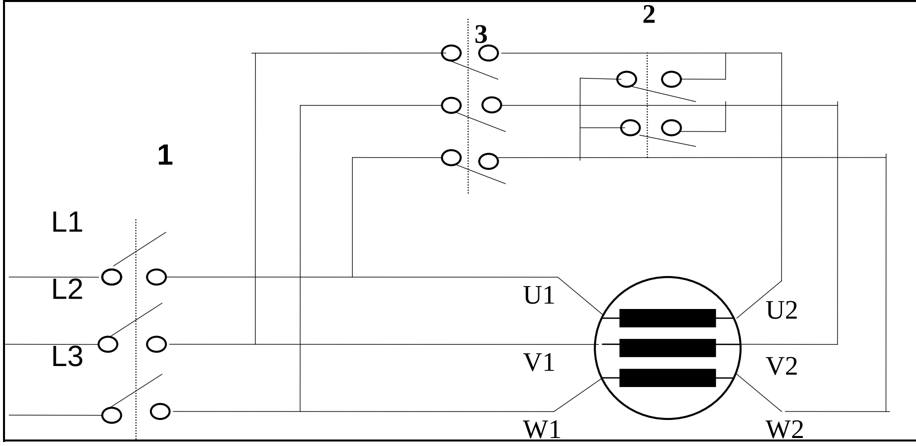
<table>
<tr><th>Outline Diagram</th><th>Features</th></tr>
<tr><td>



</td><td>

- Simple equipment
- High Starting Torque
- Minimum Starting Time
- High Starting Current

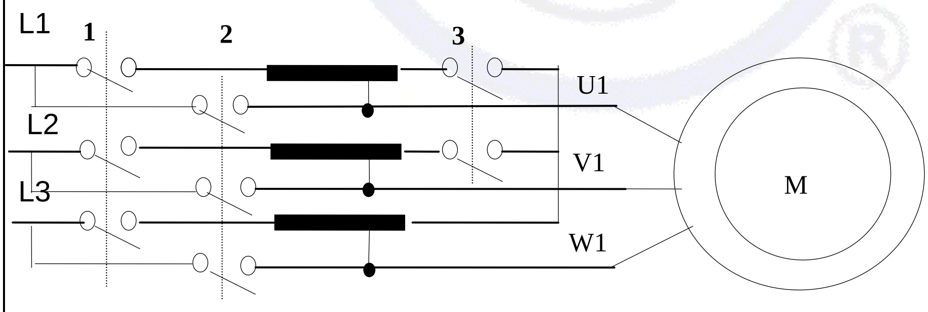
</td></tr>
</table>

Outline Diagram	Features
	• Starting current will be reduced to 1/3 value • Starting torque will be reduced to 1/3 value • 3 switches provided for the equipment

The first step in deciding whether star-delta starting can be used is to check that the starting torque of the motor is sufficient for the application. The load torque must not exceed the motor torque., nor must it be so high that the current at the moment of change over to Δ is unacceptably high. If the change over takes place at the maximum torque of the motor, the current will be about 50 to 80% of the starting current with direct-on-line starting.

- **<u>Auto-transformer Starting :</u>**

In case of Autotransformer starting, starting current reduces in proportion of voltage applied to motor terminals.

Outline diagram	Features
	• Reduction in torque is proportional to square of tapping. • Reduction of current proportional to reduction in torque • Current is not cut off

- **<u>Resistance Starting :</u>**

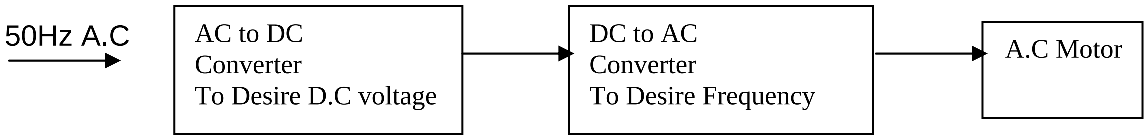
In case of wound rotor induction motor rotor winding is star connected and three winding leads are terminated in a separate terminal box through a connection with suitable sliprings and brush gear.

VFD (VARIABLE FREQUENCY DRIVE) SUITABLE MOTORS:

The most Effective and Energy efficient way to change the motor speed is to change the

Frequency of supplied voltage. VFDs are use for this purpose. VFD converts the fixed frequency supply voltage to a continuously variable frequency, there by allowing adjustable motor speed.

The basic steps for this process are shown in below fig.



The modern strategy for controlling the A.C O/P (Voltage & Frequency) of such a power Electronic

A converter is the technique known as Pulse Width Modulation using BJT or IGBT Transistors.

Currently PWM with IGBT Transistors are widely in use.

There are some undesirable Characteristics of IGBT Transistors as below.

1) Large Voltage spikes due to high switching Frequency of relatively high voltage

   As e.g. for a 415V System it will be 3times Over voltage.

   - Due to this High voltage spikes there will be Premature failure occur in the motor

     Insulation System. Basically Turn-to-Turn failures in start & end coils.

   - High voltage spikes causes capacitive coupled voltage to ground across the motor Bearings. The grease having partial insulation effects give rise to accumulation of Electric charge. Which causes bearing current flow through shaft & Grooves on bearing raceways.

To Overcome These Problems additional features required are as below

FEATURES REQUIRED FOR VFD SUITABLE MOTORS:

Additional features required

1) Insulated Bearing at either side of motor.

2) Dual Coated copper wire.

3) Double Impregnation Process.

➢ VOLTAGE DROP ALONG THE CABLE:

Induction motors draw heavy currents during starting, resulting in considerable voltage drop along the cable. If other loads are connected in parallel to the motors, the voltage drop along the common feeder causes operational problems to these associated loads. Larger the starting current and longer the common feeder, larger will be the voltage drop. In view of this while specifying motors or cables, it is required to estimate the right combination of starting current and cable size, alternatively, it is important to know voltage drop for an installation when starting / locking of motors occurs such that the maximum voltage drop is less than 3%. The relative voltage drop, Δu is estimated as

$$\Delta u = \frac{u}{U} 100$$

Where U is the rated voltage of the motor,

u is the voltage drop given as

$$u = b \left(\rho \frac{L}{S} \cos\phi + \lambda L \sin\phi \right) I_s$$

Where

u	=	Voltage drop
B	=	Factor equal to 1 for three-phase circuits and equal to 2 for Single-phase circuits.
ρ	=	Resistivity of conductors in normal duty taken as being equal to the Resistivity at the normal duty temperature, i.e. 1.25 times the resistivity at 20°Cm giving 0.0225 Ω mm² / m for aluminium copper and 0.036 Ω mm² / m for aluminum.
L	=	Length of cabling in meters
S	=	Cross section of conductors in mm²
$\cos\phi$	=	Power factor, if exact figure is not available it is equal to 0.8 and $\sin\phi = 0.6$
λ	=	Linear reactance of conductors, taken as being equal to 0.08 mΩ/m if the exact figure is not available
I_s	=	Current in use.

➢ NEGATIVE SEQUENCE WITHSTAND CHARACTERISTICS

Negative sequence withstand characteristics are used to obtain capability of the motor to withstand the overloading caused by negative sequence currents that occur due to unbalance in supply voltage.
While % unbalance in voltage is given by the ratio

$$\frac{\text{Max. Deviation (phase value) from average value x 100}}{\text{Average value}}$$

The negative sequence voltage, V_N for any degree of unbalance can be calculated by

$V_N = 1/3\ (V_a + \alpha^2 V_a + \alpha V_c)$
Where $\alpha = 1\ \angle 120°$ and $\alpha^2 = 1\ \angle 240°$

➢ Estimation of negative sequence current

Once negative sequence voltage is known amount of negative sequence current that is ultimately responsible for overloading can be estimated from the following equivalent circuit of the motor. The value of circuit parameters can be obtained from design or from test results.

Determination of withstand capability :

Since the negative sequence currents result in overloading, the amount of negative sequence current carried by the winding, as a percentage of rated current can be used as a measure of overloading due to unbalance. The thermal withstand characteristics of the machine available for different overload conditions can be used to represent the capacity of the machine to withstand negative sequence voltage and current. The negative sequence withstand characteristics are design specific and will vary from motor to motor. A sample method for obtaining negative sequence withstand characteristics of the motor is given hereunder.

Sample Calculation :

Let nominal voltage be 415 V and rated current be 60 A. Under unbalance condition let the voltage be

$V_a = 385 \angle 0°$ V
$V_b = 410 \angle 120°$ V
$V_c = 425 \angle 240°$ V

$$\text{Average voltage} = \frac{385 + 410 + 425}{3}$$

$$= 407 \text{ V}$$

$$\text{Unbalance voltage} = \frac{425 - 407}{407} \times 100$$

$$= 4.42\%$$

➢ **NEGATIVE SEQUENCE VOLTAGE**

$$V_N = \frac{385 \angle 0° + \alpha^2 410 \angle 120° + \alpha 425 \angle 240°}{3}$$

$$= 11.66 \angle 158° V$$

% Negative sequence voltage = 11.66 / 407

= 2.86% (approx. 3%)

Now, if the parameters of the machine are as given below:

R1 = 0.052
R2 = 0.071
X1 = 0.51
X2 = 0.53
s = 0.0123
Then s_1 = 2 – 0.0123 = 1.9877

From the equivalent circuit diagram

$$I_N = \frac{V_N}{(R1 + R2 / s_1) + j(X1+X2)}$$

$$= \frac{11.66 \angle 158°}{(0.052 + 0.071/ 1.9877) + j(0.51+0.53)}$$

$$= 11.17 \angle -243.4°$$

This corresponds to 18.6% (approx. 20%) of the rated current for the case considered here. This condition can be equated to an overload of 20%. Now the thermal withstand characteristics of the motor can be used to obtain the thermal withstand time for this particular motor. Similarly, thermal withstand time for different negative sequence voltage of voltage unbalance can be calculated.

The following table gives the thermal withstand time of this sample motor for different negative sequence voltage.

% Negative sequence voltage	% Negative sequence current	Withstand time Sec.	
		Cold	Hot
1	6	Continuous	Continuous
2	10	Continuous	Continuous
3	20	3500	1800
6	40	1600	600
9	60	1100	400

DUTY

The various operating cycles of driven machines can be classified into nine basic duties, ranging from **S1** to **S9** separately indicated below. Suitable motors can be offered to match the duty cycles of the driven machines.

- **CLASSES OF DUTY:**

The following are the duty types:

S1 Continuous duty
S2 Short time duty
S3 Intermittent periodic duty
S4 Intermittent periodic duty with starting.
S5 Intermittent periodic duty with starting and braking.
S6 Continuous duty with intermittent periodic loading.
S7 Continuous duty with starting and braking.
S8 Continuous duty with periodic speed charges
S9 Duty with Non-periodic load & speed variations.

1) Continuous Duty (Duty Type S1)

Operation at constant load of sufficient duration for thermal equilibrium to be reached. (Fig. 1)

2) Short Time Duty (Duty Type S2)

Operation at constant load during a given time, less than that required to reach thermal equilibrium, followed by a rest and de-energized period of sufficient duration to re-establish equality of temperature with the cooling medium. The recommended values for this type duty are 10,30,60 and 90 minutes. (Fig. 2)

3) Intermittent Periodic Duty (Duty Type S3)

A sequence of identical duty cycles, each consisting of a period of operation at constant load and a rest and a de-energized period, these periods being too short to attain thermal equilibrium during one duty cycle. In this duty, the cycle is such that the starting current does not significantly affect the temperature rise for this duty cycle. The duration of the duty cycle is 10 minutes if not otherwise specified. (Fig. 3)

4) Intermittent Periodic Duty with Starting (Duty Type S4)

A sequence of identical duty cycles each consisting of a period of starting, a period of operation at constant load and a rest period, the operating and rest and de-energized being too short to attain thermal equilibrium during one duty cycle. The stopping of the motor is obtained either by natural deceleration after disconnection of the electricity supply or by means of mechanical braking which does not cause additional heating of the windings. (Fig. 4)

5) Intermittent Periodic Duty with Starting and Braking (Duty Type S5)

A sequence of identical duty cycles each consisting of a period of starting, a period of operation at constant load, a period of rapid electric braking and a rest and de-energized period. The operating and rest and de-energized periods being too short to attain thermal equilibrium during one duty cycle. In this duty braking is rapid and is carried out electrically. (Fig. 5)

6) Continuous Duty with Intermittent Periodic Loading (Duty Type S6)

A sequence of identical duty cycles each consisting of a period of operation at constant load and a period of operation at no-load, machines with excited windings having normal no-load rated voltage excitation. Unless otherwise specified the duration of the duty cycle is 10 minutes. The recommended values of cyclic duration factor are 15,25,40 and 60 per cent. (Fig. 6)

7) Continuous Duty with Starting And Braking (Duty Type S7)

A sequence of identical duty cycles each consisting of a period of starting, a period of operation at constant load and a period of electrical braking. There is no rest and de-energized period, these periods being too short to attain thermal equilibrium during one duty cycle. (Fig. 7)

8) Continuous Duty with Periodic Speed Changes (Duty Type S8)

A sequence of identical duty cycles each consisting of a period of operation at constant load corresponding to a determined speed of rotation, followed immediately by a period of operation at other constant loads corresponding to different speeds of rotation. There is no rest and de-energized period. These periods being too short to attain thermal equilibrium during one duty cycle. (Fig. 8)

9) Duty with Non-Periodic Load And Speed Variations (Duty Type S9)

A duty in which generally load and speed are varying non-periodically within the permissible operating range. This duty includes frequently applied overloads that may exceed the full loads. For this duty, suitable load values should be taken as the basis of the overload concept. (Fig. 9)

➢ DESIGNATION:

A duty type is designated by means of the abbreviation given below. For the duty type **S2** the abbreviation is followed by an indication of the duration of the duty. For type **S3** and **S6** the abbreviations are followed by an indication of the cyclic duration factor. For types **S4** and **S5** the abbreviations are followed by the indication of the cyclic duration factor, the number of duty cycles per hour (c/h) and the factor of inertia (FI). For type **S7** the abbreviation is followed by the indication of the number of cycles per hour and the factor of inertia. For the type **S8** and **S9** the abbreviation is followed by the indication of the number of duty cycles per hour and the factor of inertia together with the load. In addition, the cyclic duration factor should be indicated for each speed. The ratings shall be assigned in accordance with the requirements of this standard and be marked on the rating plate of the machine.

Examples:

S2 60 minutes
S3 25 percent
S6 40 percent
S4 25 percent 120 c/h FI

S7 500 c/h FI

S8, S9 } 30 c/h FI 1.0kW 740 rpm 40 percent

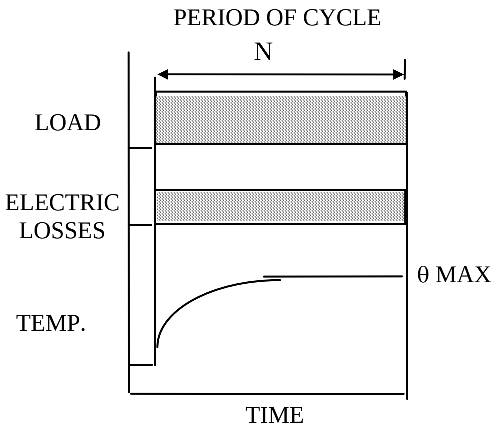
Where FI = Factor of Inertia

$$= \frac{GD^2 \text{ of motor} + GD^2 \text{ of load}}{GD^2 \text{ of motor}}$$

❖ APPLICATION OF DUTY TYPE RATED MOTORS :

Duty	Application
S1	Pumps, Blowers, Fans, Compressors
S2	Operation of gates of Dams, Sirens, Capstan.
S3	Valve actuators, Wire Drawing machines
S4	Hoist, Cranes, Lifts
S5	Hoists, Cranes, Rolling mills
S6	Conveyors, Machines tools
S7	Machine Tools
S8 S9	Special applications where the motor is required to run at different speeds and different loads

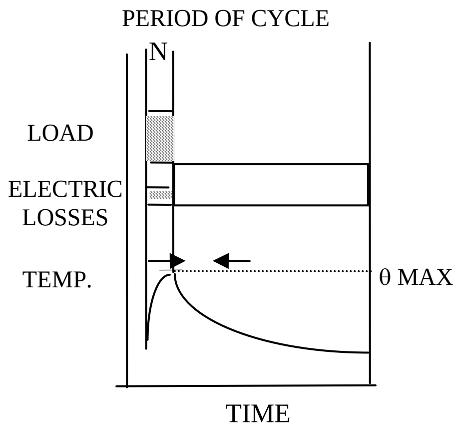
DIAGRAMS OF DUTY



θ MAX = MAX. TEMPERATURE ATTAINED DURING DUTY CYCLE
N = OPERATION UNDER RATED CONDITION(CONSTANT LOAD)

CONTINUOUS RUNNING DUTY, DUTY TYPE S1

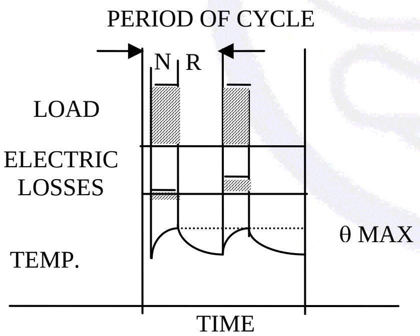
FIG.1



θ MAX = MAX. TEMPERATURE ATTAINED DURING DUTY CYCLE
N = OPERATION UNDER RATED CONDITION (CONSTANT LOAD)

SHORT TIME DUTY, DUTY TYPE S2

FIG.2

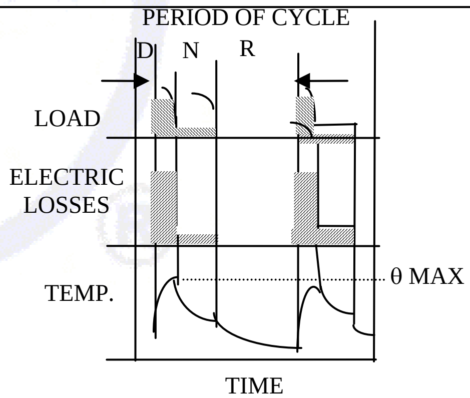


θ MAX = MAX.TEMPERATURE ATTAINED DURING THE DUTY CYCLE
N = OPERATION UNDER RATED CONDITION(CONSTANT LOAD)
R = AT REST & DE-ENERGIZED

CYCLIC DURATION FACTOR = $\frac{N}{N+R}$ X100 %

INTERMITTENT PERIODIC DUTY, DUTY TYPE S3

FIG 3.

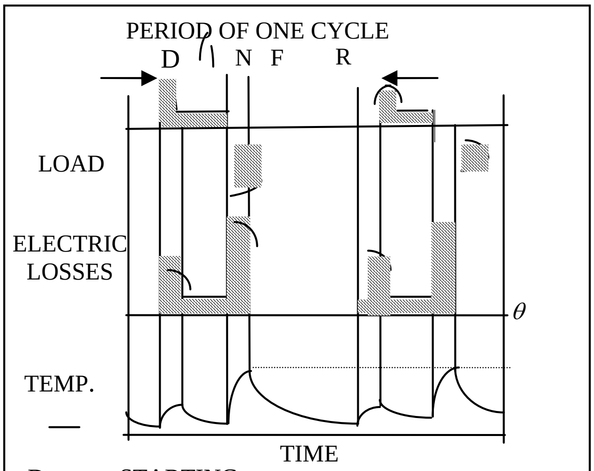


θ MAX= MAX.TEMPERATURE ATTAINED DURING THE DUTY CYCLE
N = OPERATION UNDER RATED CONDITION(CONSTANT LOAD)
D = STARTING
R = AT REST & DE-ENERGIZED
CYCLIC DURATION FACTOR
= (D+N)/(D+N+R) X 100 %

INTERMITTENT PERIODIC DUTY WITH STARTING, DUTY TYPE S4

FIG 4.

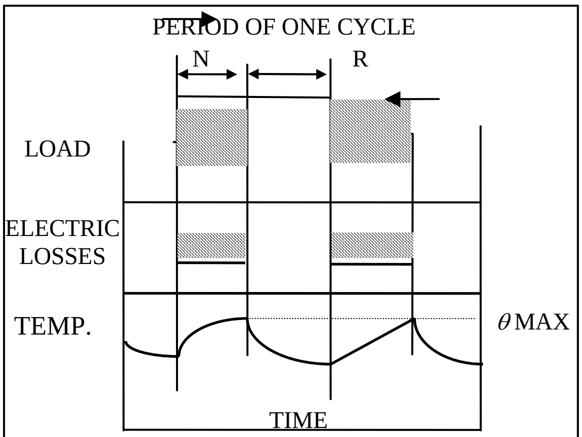
DIAGRAMS OF DUTY CYCLE



D = STARTING
N = OPERATION UNDER RATED CONDITION
F = ELECTRIC BRAKING
R = AT REST & DE-ENERGIZED
θ MAX = MAX. TEMP. ATTAINED DURING THE DUTY CYCLE
CYCLIC DURATION FACTOR = $\frac{D + N + F}{D + N + F + R}$ X 100 %

INTERMITTENT PERIODIC DUTY WITH STARTING AND ELECTRIC BRAKING, DUTY TYPE S5

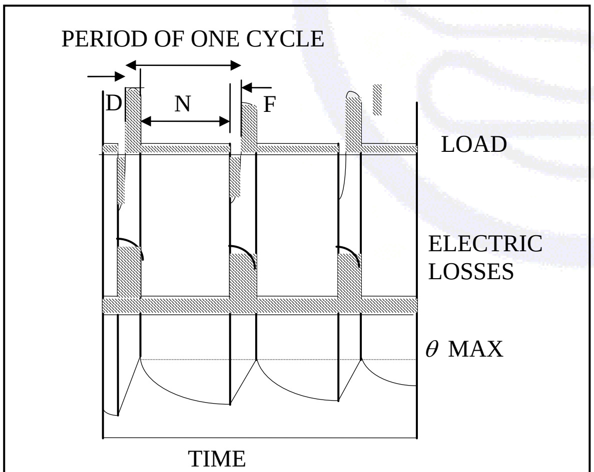
FIG.5



θ MAX = MAX.TEMP. ATTAINED DURING THE DUTY CYCLE
N = OPERATION UNDER RATED CONDITION
R = OPERATION ON NO - LOAD
CYCLIC DURATION FACTOR = $\frac{N}{N+R}$ X 100 %

CONTINUOUS DUTY WITH INTERMITTENT PERIODIC LOADING, DUTY TYPE S6

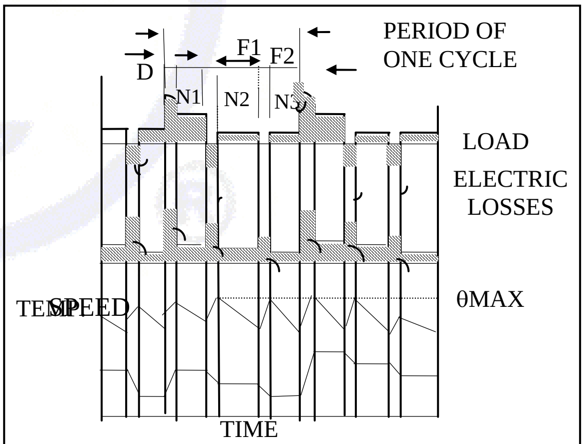
FIG.6



D = STARTING
N = OPERATION UNDER RATED CONDITION(CONSTANT LOAD)
F = ELECTRIC BRAKING
θ MAX = MAX. TEMP. ATTAINED DURING THE DUTY CYCLE
CYCLIC DURATION FACTOR = 100 %

CONTINUOUS DUTY WITH STARTING AND ELECTRIC BRAKING, DUTY TYPE S7

FIG 7

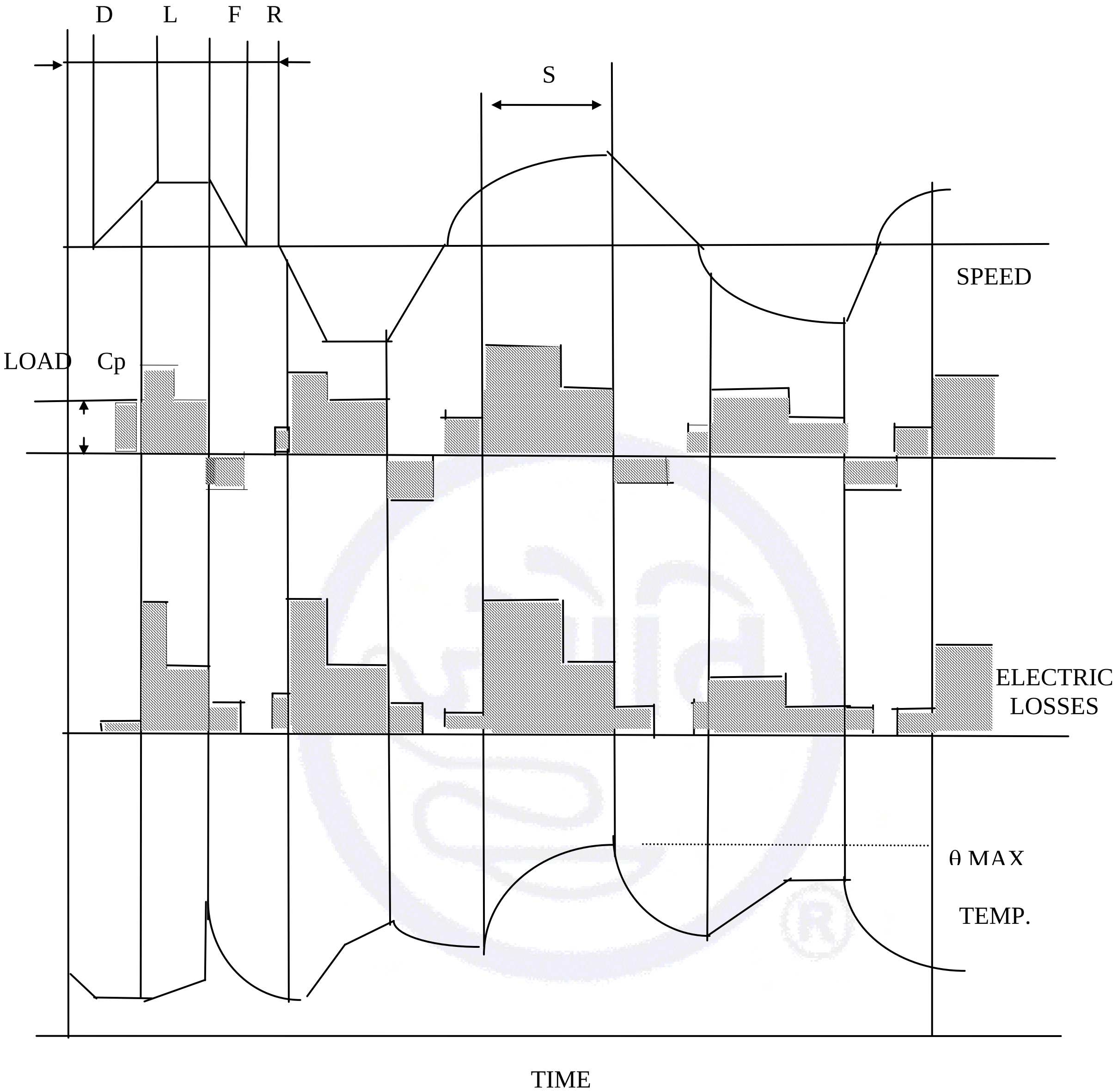


D = ACCELERATION
F1, F2 = ELECTRIC BRAKING
N1,N2,N3 = OPERATION AT RATED CONDITION
θ MAX = MAX.TEMP. ATTAINED DURING THE DUTY CYCLE
S = D+N1+F1+N2+F2+N3
CYCLIC DURATION FACTOR = (D+N1) X 100/S %
= (F1+N2) X 100/S %
= (F2+N3) X 100/S %

CONTINUOUS DUTY WITH PERIODIC SPEED CHANGES DUTY TYPE S8

FIG.8

DIAGRAMS OF DUTY CYCLE



D = STARTING
F = ELECTRIC BRAKING
S = OPERATION UNDER OVERLOAD
θMAX = MAXIMUM TEMP. ATTAINED DURING DUTY CYCLE
L = OPERATION UNDER VARIOUS LOADS
R = AT REST AND DE-ENERGIZED
Cp = FULL LOAD

DUTY WITH NON-PERIODIC LOAD AND SPEED VARIATIONS TYPE S9

FIG.9

METHODS OF COOLING

➢ DESIGNATION SYSTEM:

The cooling system designation consists of,

⇒ The letter IC.

⇒ A letter designating the cooling circuit arrangement.

⇒ Two sets of designation numbers, one set each for primary & secondary cooling.

The designation system is made up as follows,

Complete designation----------------------	***IC***	***4***	***A***	***1***	***A***	***1***
Simplified designation----------------------	***IC***	***4***		***1***		***1***

CODE LETTERS
(International Cooling)

CIRCUIT ARRANGEMENT
Designated by a characteristic numeral
In accordance with Table-1

PRIMARY COOLANT
Designated by a characteristic letter
In accordance with Table-2

METHOD OF MOVEMENT OF PRIMARY COOLANT
(Higher temperature)
Designated by a characteristic letter
In accordance with Table-3

SECONDARY COOLANT
If applicable, designated by a characteristic letter
In accordance with Table-2
Omitted for simplified designation if it is A for air

METHOD OF MOVEMENT OF SECONDARY COOLANT
(Lower temperature)
Designated by a characteristic letter
In accordance with Table-3

NOTE: The following rule may be applied to distinguish between complete & Simplified designations.

- A complete designation can be recognized by the presence (after the letters IC) of three or five numbers & letters in the regular sequence = numeral,(letter, numeral). Examples: IC3A1, IC4A1A1 or IC7A1W7.

- A simplified designation has two or three consecutive numerals, or a letter in the final position Examples: IC31, IC411 or IC71W.

➢ **Table 1 - Circuit arrangement :**

CHAR. NUMERAL	BRIEF DESCRIPTION	DEFINITION
0	Free circulation	The coolant is freely drawn directly from the surrounding medium, cools the machine, & then freely returns directly to the surrounding medium (open circuit).
1	Inlet pipe or inlet duct circulated	The coolant is drawn from a medium remote from the machine, is guided to the machine through an inlet pipe or duct, passes through the machine & returns directly to the surrounding medium (open circuit).
2	Outlet pipe or outlet duct circulated	The coolant is freely drawn directly from the surrounding medium, passes through the machine & is then discharged from the machine through an outlet pipe or duct to a medium remote from the machine (open circuit).
3	Inlet & outlet pipe or duct circulated	The coolant is drawn from a medium remote from the machine, is guided to the machine through an inlet pipe or duct, passes through the machine & is then discharged from the machine through an outlet pipe or duct to a medium remote from the machine (open circuit).
4	Frame surface cooled	The primary coolant is circulated in a closed circuit in the machine & gives its heat through the external surface of the machine (Im addition to the heat transfer via the stator core & other heat conducting parts) to the final coolant, which is the surrounding medium. The surface may be plain or ribbed, with or without an outer shell to improve the heat transfer.
5	Integral heat exchanger (using surrounding medium)	The primary coolant is circulated in a closed circuit & gives its heat via a heat exchanger, which is built into & forms an integral part of the machine, to the final coolant to the surrounding medium.
6	Machine-mounted heat exchanger (using surrounding medium)	The primary coolant is circulated in a closed circuit & gives its heat via a heat exchanger, which is mounted directly on the machine, to the final coolant to the surrounding medium.
7	Integral heat exchanger (using remote medium)	The primary coolant is circulated in a closed circuit & gives its heat via a heat exchanger, which is built into & forms an integral part of the machine, to the secondary coolant to the remote medium.
8	Machine-mounted heat exchanger (using remote medium)	The primary coolant is circulated in a closed circuit & gives its heat via a heat exchanger, which is mounted directly on the machine, to the secondary coolant, which is the remote medium.
9	Separate heat exchanger (using surrounding or remote medium)	The primary coolant is circulated in a closed circuit & gives its heat via a heat exchanger, which is separate from the machine, to the secondary coolant, which is either the surrounding or the remote medium.

➢ **Table 2 – Coolant :**

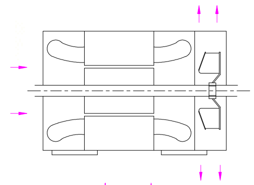
Characteristic letter	Coolant
A	Air
F	Freon
H	Hydrogen
N	Nitrogen
C	Carbon dioxide
W	Water
U	Oil
S	Any other coolant
Y	Coolant not yet selected

❖ Table 3 - Method of Movement

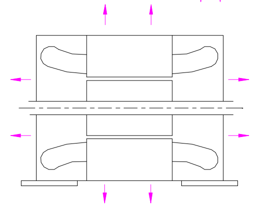
CHARACTE-RISTIC NUMERAL	BRIEF DESCRIPTION	DEFINITION
0	Free circulation	The coolant is moved by temperature differences. The fanning action of rotor is negligible.
1	Self-circulation	The coolant is moved dependent on the rotational speed of the main machine, either by the action of the rotor alone or by means of a component designed for this purpose & mounted directly on the rotor of the main machine, or by a fan or pump unit mechanically driven by the rotor of the main machine.
2,3,4	-----	Not yet defined
5	Integral independent component	The coolant is moved by an Integral component, the power of which is obtained in such a way that it is independent of the rotational speed of the main machine, e.g. a machine mounted fan unit driven by its own electric motor.
6	Machine-mounted independent component	The coolant is moved by a component mounted on the machine, the power of which is obtained in such a way that it is independent of the rotational speed of the main machine, e.g. a machine mounted fan unit or pump unit driven by its own electric motor.
7	Separate & independent component or coolant system pressure	The coolant is moved by a separate electrical or mechanical component not mounted on the machine & independent of it or is produced by the pressure in the coolant circulating system, e.g. supplied from a water distribution system, or a gas main under pressure.
8	Relative displacement	The movement of the coolant results from relative movement between the machine & the coolant, either by moving the machine through the coolant or by flow of the surrounding coolant (air or liquid)
9	All other components	The movement of the coolant is produced by a method other than defined above & shall be fully described.

Table 4 - STANDARD CODES

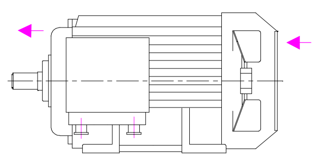
IC 01 — Self cooling open machine, fan mounted on the Shaft. Screen protected Drip Proof (SPDP)



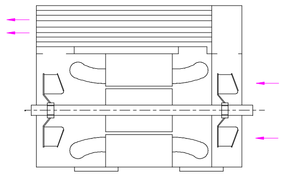
IC 410 — Enclosed machine, surface cooled by natural Convection & radiation. No external fan. Totally Enclosed (TE)



IC 411 — Enclosed machine, smooth & finned ventilated Casting. Fan mounted on the shaft. Totally Enclosed Fan Cooled (TEFC)



IC 611 — Closed air circuit cooled by air. Fan mounted on the shaft. Closed Air Circuit Air Cooled (CACA)



DETERMINATION OF IP NUMBERS

REFERENCE IS: 4691

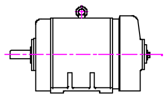
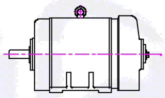
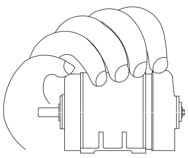
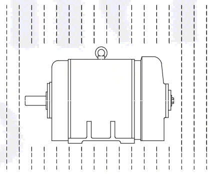
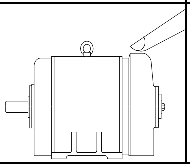
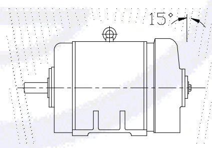
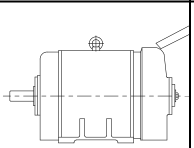
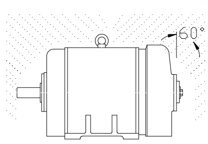
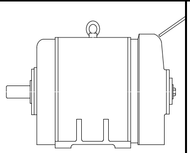
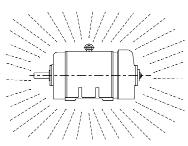
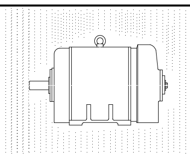
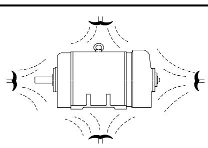
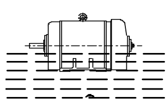
IP 5 5 W

Code letters
International Protection — **IP**

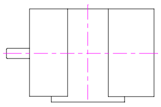
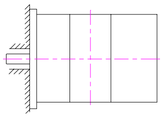
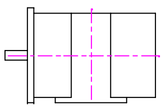
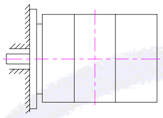
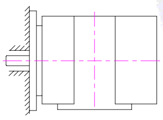
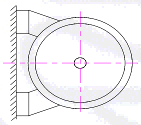
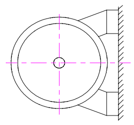
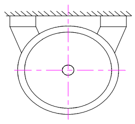
First Characteristic numeral
(Dust protection / Solid Object, numerical 0-5 or letter X) — **5**

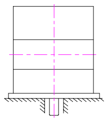
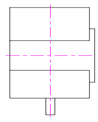
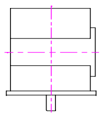
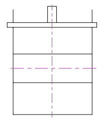
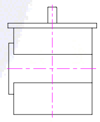
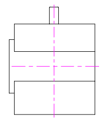
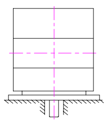
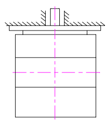
Second Characteristic numeral
(Liquid protection, numerical 0-6 or letter X) — **5**

Optional letter for application in specified weather conditions (normally agreed Between user and manufacturer, example: rain hood — **W**

FIRST NUMBER (PROTECTION AGAINST SOLID OBJECT)			**SECOND NUMBER (PROTECTION AGAINST LIQUIDS)**		
IP		TESTS	IP		TESTS
0		No Protection	0		No Protection
1		Protected against solid objects up to 50 mm, e.g. accidental touch by hands	1		Protected against vertically falling drops of water (e.g. condensation)
2		Protected against solid objects up to 12 mm, e.g. fingers.	2		Protected against direct spray of water up to 15° from vertical
3		Protected against solid objects over 2.5 mm, e.g. tools & wires.	3		Protected against spray of water up to 60° from vertical
4		Protected against solid objects over 1 mm, e.g. thin wires.	4		Protected against water splashes from all direction
5		Protected against dust - limited ingress permitted (no harmful deposit).	5		Protected against low-pressure jets of water from all direction.
			6		Water from Heavy Seas shall not harm

MOUNTING ARRANGEMENT

HORIZONTAL		
FIGURE		
REF	IM 1001 (B3)	IM 3001 (B5)
FRAME	WITH FEET	WITHOUT FEET
SHAFT	HORIZONTAL	HORIZONTAL
MTNG	BASE OR RAIL	FLANGE TYPE B
FIGURE		
REF	IM 2001 (B35)	IM 3601 (B14)
FRAME	WITH FEET	WITHOUT FEET
SHAFT	HORIZONTAL	HORIZONTAL
MTNG	BASE OR FLANGE TYPE B	FLANGE TYPE C
FIGURE		
REF	IM 2101 (B34)	IM 1051 (B6)
FRAME	WITH FEET	WITH FEET
SHAFT	HORIZONTAL	HORIZONTAL
MTNG	BASE OR FLANGE TYPE C	WALL
FIGURE		
REF	IM 1061 (B7)	IM 1071 (B8)
FRAME	WITH FEET	WITH FEET
SHAFT	HORIZONTAL	HORIZONTAL
MTNG	WALL	CEILING

VERTICAL		
FIGURE		
REF	IM 3011 (V1)	IM 1011 (V5)
FRAME	WITHOUT FEET	WITH FEET
SHAFT	FACE VERT.DOWN	FACE VERT.DOWN
MTNG	FLANGE TYPE B	BASE OR RAIL
FIGURE		
REF	IM 2011 (V15)	IM 3031 (V3)
FRAME	WITH FEET	WITHOUT FEET
SHAFT	FACE VERT DOWN	FACE VERT UPWARD
MTNG	WALL OR FLANGE TYPE B	FLANGE TYPE B
FIGURE		
REF	IM 2031 (V36)	IM 1031 (V6)
FRAME	WITH FEET	WITH FEET
SHAFT	FACE VERT UP	FACE VERT UP
MTNG	WALL OR FLANGE TYPE B	WALL
FIGURE		
REF	IM 3611 (V18)	IM 3631 (V19)
FRAME	WITHOUT FEET	WITHOUT FEET
SHAFT	FACE VERTICAL DOWN	FACE VERTICAL UPWARD
MTNG	FLANGE TYPE C	FLANGE TYPE C

For installation of foot mounted motor on the wall
Additional wall support should be required.

REFERENCE IS 2253

CONSTRUCTIONAL DETAILS

❖ ENCLOSURE:

All foot-mounted motors have integral feet. TEFC & TE motors have integral longitudinal fins/ribs for effective heat transfer. The stator and end shields are machined to close tolerances for providing perfect alignment and fits. Motors with drain holes at their lowest position and drain plugs can be provided on request.

❖ BODY AND END SHIELDS:

Stator frame and end shields of motor are of rigid cast iron of grade FG-200 as per IS-210. Large sized motor frames are of fabricated construction using FE-410 WA (ST-42) steel as per IS-226.

❖ CORE:

Both stator and rotor cores are made of high quality low loss silicon steel laminations. These are insulated on both sides. In larger machines thick end plates are used to give additional mechanical rigidity.

❖ WINDINGS;

Stator and rotor windings (Slip ring motors) consist of modified polyester enamel covered copper wire conforming to IS: 13730 part 3 / IS: 4800 part V. As per requirement of the client we can provide dual coated copper wires as per IS: 13730 part 13 can be provided.

❖ INSULATION:

Standard motors are provided with windings having Class "F" Insulation with maximum permissible temperature limited to class "B" Insulation level as specified in IS - 12802. When required, motors can be provided with Class "H" Insulation. Vacuum and pressure impregnation using thermosetting type impregnation varnish makes winding more resistant to effect of oil, moisture and other contamination. It also gives additional mechanical strength. On special request, windings can be given tropic proofing and antifungal treatment by epoxy coating. Winding overhangs are given epoxy coating for protection against moisture and polluted atmosphere.

Table showing maximum temperature rise of winding by resistance method for different ambient temperature and the *Hot spot temperature for the insulation system is given below: (As per IS 12802)

Class of insulation	Max. Permissible Temp. Limit (°C)	*Hot spot allowance (°C)	Max. Permissible Temp. above an ambient temp. of (°C)				
			40	45	50	55	60
B	130	10	80	75	70	65	60
F	155	10	105	100	95	90	85
H	180	15	125	120	115	110	105

- Hot spot allowance is an empirical value expressed in °C, by which hottest spot of winding can exceed the mean temperature rise of the winding. The temperature rise is calculated by the following formula:

$$t_2 - t_a = (R_2 - R_1) / R_1 \times (\text{constant} + t_1) + t_1 - t_a$$

Where

t_2 = temperature of winding at the end of temperature rise test.

t_1 = temperature of winding before temperature rise test.

t_a = temperature of cooling medium at end of temperature rise test.

R_2 = resistance of winding at the end of temperature rise test.

R_1 = resistance of winding at temperature t_1, Constant = 234.5 for copper conductor

❖ EARTHING:

Two numbers of M8 screws and washers are provided for earthing frame up to 250. For frames 280 and above M12 screws are provided. Additional earthing bolts are provided inside the terminal box.

❖ ROTOR:

The rotor of Squirrel cage motor is made of diecast aluminium up to 280-frame size (or alloy in case of special machines). Rotors of higher frames are made of electrolytic copper/copper alloys bars and short circuit rings connected by high quality silver containing brazing alloy. The rotors of SR (slip ring) motors are wound with copper wire or strip. All rotors are dynamically balanced to grade 6.3 as per ISO-1940 using half key to required accuracy. Coupling halves, pulleys or pinions belonging to the motor have to be balanced with half key.

❖ SLIPRING AND BRUSHGEAR:

SR motors are provided with slipring and brush gear arrangement. The sliprings are moulded in epoxy-based insulation and have excellent stability at high temperature and have very good anti-tracking property. Fabricated sliprings as per steel plants specification are also supplied on request. The brush holder made of brass along with metal graphite carbon brushes are provided - one on each ring phase. The grade of carbon brush is M15E of Assam carbon or equivalent. The adjustable device for brush tension with the help of adjustable nuts is provided on the brush arm on request.

❖ TERMINAL BOX:

Motors rated up to and including 2.2 kW (3 HP), are provided with 3 stud type terminals and motors above 2.2kW (3HP) are provided with 6 terminals. The terminal blocks for star connection are provided with markings U, V and W. The terminal blocks for delta connection are provided with markings U1, V1, and W1. And U2, V2, W2. Clearance and creep age distances in the terminal box are as per IS: 6381. Terminal box of all motors are rotatable to 360 °C in steps of 90 °C. This feature has been incorporated in order to facilitate cable entry from any direction. The terminal box provided for standard motors is of cast aluminium alloy or cast iron or fabricated sheet metal. The detailed dimensions of the terminal box are given in the drawings at the end of the catalogue. As of standard practice, the terminal box is provided on the right hand side, when viewed from driving end. On special requirement, terminal box can be provided on the left hand side, when viewed from driving end. The terminal box in frame size 225 and above is suitable for withstanding short circuit fault of 35 MVA (i.e., 50KA for 0.25 Sec. at 415 volts). Separate terminal can be provided on request

❖ CABLE GLANDS:

Standard TEFC/SPDP motors are provided with cable entry hole in cast iron / fabricated terminal box. These cable entry holes are suitable for cable gland as per the customer's cable. On request single or double compression glands can be provided with terminal box. However for selection of single or double compression glands type, the type of cable and its size is required to be mentioned at the inquiry/tender/purchase stage itself. Terminal boxes are suitable to accommodate aluminium cable sizes as mentioned in the table enclosed.

❖ SHAFT:

Shafts are liberally designed to take care of the weight of rotating parts and the unbalance magnetic pull, ensuring that critical speed is more than 130 % of rated speed. The shaft is made of 40C8 steel. Shaft made of special steel are also available on demand to suit the requirement of application.

❖ BEARINGS AND LUBRICATION:

Antifriction bearings are used at driving and non-driving ends. Bearings are liberally designed for L_{10} life of more than 20 000 hours. **Lithium base grease of Grade-3 as per IS-7623** having drop point 160 °C is provided and recommended for replenishment. Motor having oil lubricated bearing is provided with oil bath, level gauge, oil filling plug and oil drainage plug. After end of relubrication interval as marked on separate nameplate, oil should be changed using recommended quality of oil as per IS-1012. Regreasing arrangement is provided for all motors above 225 frames. Regreasing interval, quantity etc, are indicated on separate nameplate. In case of pulley drive, it is preferable that data of belt tension, type and size of pulley etc. should be furnished by the customer. List of maximum axial/radial load allowed due to driven equipment for bearings are attached

BEARING CHARTS

FRAME	POLE	BEARING TYPE													
		HORIZONTAL MOTOR						VERTICAL MOTOR							
		SQUIRREL CAGE				SLIPRING		HOLLOW SHAFT				SOLID SHAFT			
		TEFC (CTF)		SPDP (DP)		SPDP (WD)		TEFC (CVTF)		SPDP (CVD)		CUTF		CUD	
		DE	NDE	DE	NDE	DE	NDE	TOP	BTM	TOP	BTM	TOP	BTM	TOP	BTM
	*														
280	4,6,8	NU 316	6316	NU 318	6316	NU 318	6316	2X7322	6316	2X7322	6318	6316	6316	6318	6318
315	4,6,8	NU 318	6318	NU 320	6320	NU 320	6320	29324	6318	29326	6320	6318	6318	6320	6320
355	4,6,8	NU 322	6322	NU 322	6320	NU 322	6320	29326	6322	29326	6320	6322	6322	6322	6320
400	4,6,8	NU 324	6324	NU 322	6320	NU 322	6320	-	-	-	-	6324	6324	-	-
450	6,8,10	NU 324	6324	-	-	-	-	-	-	-	-	7322	NU324	-	-

*** Note:** At present the above bearings data should be taken for 2 Pole motors also

BEARING & LUBRICATION

(A) HORIZONTAL MOTOR:

BEARING TYPE		REGREASING QUANTITY in gms.		RELUBRICATION INTERVAL in working hours	
DE	**NDE**	**DE**	**NDE**	**1500 rpm**	**1000 rpm**
6316	6314	35	30	7,000	12,000
NU 316	6316	35	35	3,500	6,000
NU 318	6316	40	35	3,000	5,500
NU 320	6318	50	40	2,600	5,000
NU 322	6320	60	50	2,250	4,400
NU 322	6322	60	60	2,250	4400
NU 324	6324	75	75	1,850	3,800

(B) VERTICAL MOTOR:

BEARING TYPE		REGREASING QUANTITY in gms.		RELUBRICATION INTERVAL in working hours	
TOP	**BOTTOM**	**TOP**	**BOTTOM**	**1500 rpm**	**1000 rpm**
6316	6216	35	20	7,000	12,000
6316	6316	35	35	7,000	12,000
6318	6318	40	40	6,000	11,000
6322	6320	60	50	4,500	8,500
6322	6322	60	60	4,500	8,500
7316	6211	35	10	7,000	12,000
2X7316	6211	70	10	7,000	12,000
7316	6320	35	50	5,250	10,000
7317	6312	40	20	6,500	11,500
7320	6212	50	15	5,250	10,000
2X7320	6216	100	20	5,250	10,000
7322	6316	60	35	4,500	8,500
2X7322	6316	120	35	4,500	8,500
2X7322	6318	120	40	4,500	8,500

NOTE: Relubrication given above is for general guidelines. Care has to be taken during maintenance schedule that foreign particles do not enter in the bearings & grease

PERMISSIBLE RADIAL PULLEY LOADS & RECOMMENDED PULLEY SIZES

FRAME SIZE	PERMISSIBLE RADIAL LOAD (kg)		PERMISSIBLE PULLEY SIZE	
	4 POLE	6 POLE	Diameter (mm)	Width (mm)
CTF - 280	800	910	450	225
CTF - 315	1250	1400	500	250
CTF - 355	1650	1950	560	280
CTF - 400	1850	2050	600	310
CD - 280	1200	1320	450	225
CD - 315	1450	1650	500	250
CD - 355	1650	1950	560	280
CD - 400	1850	2050	600	310

Note: The above pulley dimension ensures that the radial load at the shaft end remains within the permissible limits & at the centre of shaft extension.

- **PULLEY DIAMETER:**

When the desired bearing life has been determined, the minimum permissible pulley diameter can be calculated using F_R as follows :

$$D = \frac{1.9 \times 10^7 \times K \times P}{n \times F_R}$$

where D = diameter of pulley, mm
P = Power requirement, kW
n = Motor speed, rpm
K = Belt tension factor, dependent on belt type and type of duty. A common value for V-belt is 2.5
F_R = Permissible radial force.

MAXIMUM PERMISSIBLE AXIAL THRUST LOAD

SR. NO	FRAME SIZE	kW RATING	POLE	TOP BEARING	MAXIMUM PUMP THRUST LOAD ALLOWED WITH BEARING LIFE ATLEAST, In Kg		
					20,000 Hrs.	40,000 Hrs.	1,00,000 Hrs.
1.	CVD-280	168	4	2 X 7322 BG	2850	2200	1500
2.	CVD-315	280	4	29326 E	7350	5850	4250
3.	CVD-315	150	6	29326 E	8350	6650	4850
4.	CVD-355	355	4	29326 E	7200	5650	4100
5.	CVTF-280	100	4	2 X 7322 BG	3000	2300	1650
6.	CVTF-315	160	4	29324 E	4200	3300	2300
7.	CVTF-315	132	6	29324 E	7550	6050	4500
8.	CVTF-355	250	4	29326 E	7150	5600	4050

❖ SLIP RING MOTORS:

If direct on line starting is not permitted, and the starting torque with star-delta starting is too low, a slip ring motor may be used.
A slip ring motor is started with the aid of an external resistance, which is connected to the rotor circuit via a slip ring mechanism. Connecting in the extra rotor resistance during the start gives a lower starting current and a higher starting torque. The resistance of the rheostat (variable resistor) can be chosen so that the starting torque has the desired value right up to the maximum torque.
During the start the rheostat is gradually removed from the circuit as the speed of the motor increases. When the entire rheostat is out of the circuit, rated speed can be achieved. The rotor winding is short-circuited and the motor is working equivalent to a squirrel cage motor.
The size of the rheostat is chosen on the basis of the mean torque required during the start. The rated data of the motor can be used to calculate the resistance that will give rated current and rated torque on starting. The resistance R_2 is worked out with the formula:

$$R_2 = \frac{U_2}{\sqrt{3} \times I_2} \text{ ohm/phase}$$

Where U_2 = Rotor voltage at standstill
I_2 = Rotor current at rated power.

To reduce brush and slipring wear, motors can be fitted with brush-lifting gear. This is mainly used for large motors and when the motor runs continuously for long periods. The brush lifting device is designed so that a simple manual operation simultaneously lifts the brushes and short circuit the sliprings. This is done when the motor has reached rated speed.

❖ POWER FACTOR IMPROVEMENT CAPACITORS:

A motor consumes not only active power, which it converts into mechanical work, but also reactive power, which is needed for magnetization but does not perform any work

The active and reactive power together give the apparent power. The ratio between the active power measured in kW, and the apparent power measured in KVA, is known as the power factor. The power factor is usually between 0.7 and 0.9 designated by $\cos\phi$. It is lower for small motors and higher for larger ones.

If there are many motors in an installation it will consume a lot of reactive power and will therefore have a lower power factor. Power supply utilities sometimes require the power factor of an installation to be raised. This is done by connecting capacitors to the supply, these generate reactive power and thus raise the power factor.
With phase compensation the capacitors are usually connected in parallel with the motor or group of motors. The capacitors must not be connected in parallel with single phases of the winding; such an arrangement may make the motor difficult or impossible to start with star delta starting. The formula for calculating the size of a capacitor for a mains frequency of 50Hz is as follows:

$$C = 3.2 \times 10^6 \times Q/U_2$$

Where;
C = Capacitance, μF
U = Capacitor voltage, V
Q = Reactive power, kvar

The reactive power is obtained by the following formula;

$$Q = K \times P / \eta$$

Where;
K = Constant from table on right
P = Rated power of motor, kW
η = Efficiency of motor

❖ POWER FACTOR IMPROVEMENT CHART

Ratings of capacitors in KVAR required for given degree of power factor correction per kW of load.

INITIAL POWERFACTOR VS KVAR OF CAPACITORS

INITIAL POWER FACTOR	CORRECTION TO				
	0.85	0.90	0.95	0.98	Unity
0.50	1.112	1.248	1.403	1.529	1.732
0.51	1.066	1.202	1.357	1.483	1.686
0.52	1.024	1.160	1.315	1.441	1.644
0.53	0.980	1.116	1.271	1.397	1.600
0.54	0.939	1.075	1.230	1.356	1.559
0.55	0.899	1.035	1.190	1.316	1.519
0.56	0.860	0.996	1.151	1.277	1.480
0.57	0.822	0.958	1.113	1.239	1.442
0.58	0.785	0.921	1.076	1.202	1.405
0.59	0.748	0.884	1.039	1.165	1.368
0.60	0.714	0.849	1.005	1.131	1.334
0.61	0.679	0.815	0.970	1.096	1.299
0.62	0.645	0.781	0.936	1.062	1.265
0.63	0.613	0.749	0.904	1.030	1.233
0.64	0.580	0.716	0.871	0.997	1.200
0.65	0.549	0.685	0.840	0.966	1.169
0.66	0.518	0.654	0.809	0.935	1.138
0.67	0.488	0.624	0.779	0.905	1.108
0.68	0.459	0.595	0.750	0.876	1.079
0.69	0.429	0.565	0.720	0.840	1.049
0.70	0.400	0.536	0.691	0.811	1.020
0.71	0.372	0.508	0.663	0.783	0.992
0.72	0.343	0.479	0.634	0.754	0.963
0.73	0.316	0.452	0.607	0.727	0.936
0.74	0.289	0.425	0.580	0.700	0.909
0.75	0.262	0.398	0.553	0.673	0.882
0.76	0.235	0.371	0.526	0.652	0.855
0.77	0.209	0.345	0.500	0.620	0.829
0.78	0.183	0.319	0.473	0.594	0.803
0.79	0.156	0.292	0.447	0.567	0.776
0.80	0.130	0.266	0.421	0.541`	0.750
0.81	0.104	0.240	0.395	0.515	0.724
0.82	0.078	0.214	0.369	0.489	0.698
0.83	0.052	0.188	0.343	0.463	0.672
0.84	0.026	0.162	0.317	0.437	0.645
0.85	-	0.136	0.291	0.417	0.620
0.86	-	0.109	0.264	0.390	0.593
0.87	-	0.083	0.238	0.364	0.567
0.88	-	0.054	0.209	0.335	0.538
0.89	-	0.028	0.183	0.309	0.512
0.90	-	-	0.155	0.281	0.484

The reactive power (KVAR) Q **= K** x Rated power / Efficiency. Where K is the constant from the chart.

Example: Initial power factor = 0.80, Correction desired = 0.98, Capacitor KVAR required per kW load from chart = 0.541, load of motor = 125 kW, Capacitor KVAR required = 0.541x125/0.935 = 72.326 = 75 KVAR

TERMINAL BOXES FOR STANDARD MOTORS

FRAME	MAXIMUM RATING (kW)	STUD SIZE (Qty- 6NOS)	LUG SIZE (Dowell's or equivalent make)		CABLE SIZE ALLUMINIUM OR COPPER	TERMINAL BOX SIZE
			CRIMPING TYPE	SOLDER-ING TYPE	Nos X COREX AREA (mm^2)	L X B X H (mm)
280	132	M 12 (B)	CUS 27	13 EL	2 X 3C X 200	320 X 320 X 200
280	168	M 12 (B)	CUS 27	13 EL	2 X 3C X 200	320 X 320 X 200
315	250	M 16 (B)	CUS 33	14 EL	2 X 3C X 400	320 X 320 X 200
315	280	M 20 (B)	CUS 33	14 EL	2 X 3C X 400	320 X 320 X 200
355	370	M 20 (C)	CUS 33	18 EL	2 X 3C X 400	400 X 400 X 200
355	370	M 24 (B)	CUS 34	20 EL	2 X 3C X 400	400 X 400 X 220
400	370	M 20 (C)	CUS 33	18 EL	2 X 3C X 400	400 X 400 X 200
400	370	M 24 (B)	CUS 34	20 EL	2 X 3C X 400	400 X 400 X 220

(B) - BRASS MATERIAL, (C) - COPPER MATERIAL.

NOTE: Frame size 225 & above suitable for single & double compression type. Cable gland can be provided on request. For detail dimensions of terminal box refer drawing No: 4EK-3118.

ACCESSORIES

The accessories that can be provided along with a motor, when required are thermistors, space heaters, sockets for customers cable, compression glands, RTD, BTD & Dial type thermometer for bigger frames.

1. THERMISTORS:

These are semiconductor devices, which have a property of suddenly changing their resistance at a definite temperature known as 'Curie Point'. Thermistors that may be provided on the motors are those having 'Positive Temperature Coefficient' (PTC). Where the resistance suddenly increases at 'Curie Point'.

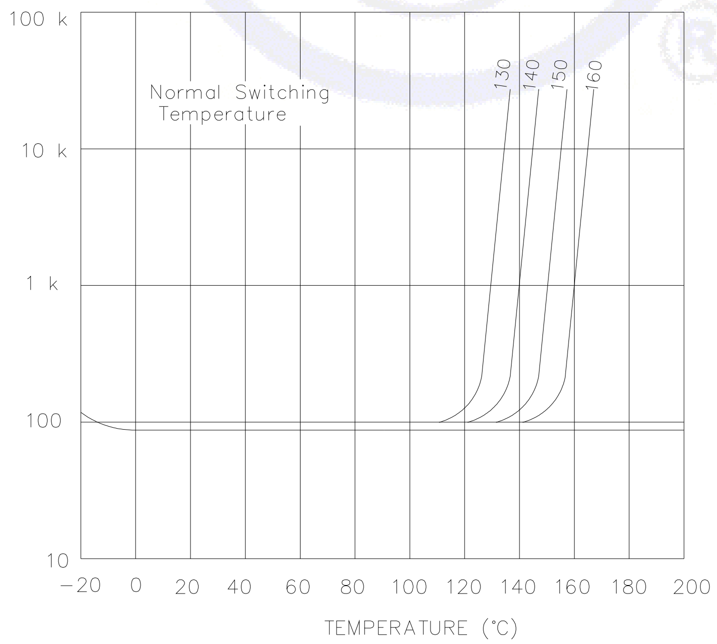
A combination of different ratings of thermistors can be provided in same motor for 'Alarm & trip' facilities for frame 160 and above only.

DISC TEMPERATURE (°C)	RESISTANCE (Ω)
25	250 (MAX.)
TR-5	550 (MAX.)
TR	1000 (MAX.)
TR+5	1330 (MIN.)
TR+15	4000 (MIN.)

THERMISTOR TYPE TO INSULATION CLASS BS 4999 Pt-72

CLASS OF INSULATION	THERMISTOR TYPE	
	EARLY WARNING	TRIP
A	90 OR 100	110
E	110	130
B	120	140
F	140	160
H	170	190

Typical Resistance v/s Temperature Characteristics for each switching temperature.



The thermistors generally provided are rated for 160°C (PTC 160) for class F motors. The motor having class F insulation with class B rise are provided as follows

Thermistor	3 Nos PTC-160 for trip	+3 Nos additional or 3 Nos PTC-150 for alarm.

- ## MODE OF OPERATION:

The thermistors connected in series are placed inside of each of the phase windings of the motor. This gives protection against single phasing and/or overheating due to excess load on the motor. During normal operation the thermistors carry a current of few mA. Which is sufficient to actuate a relay in control unit. This in turn allows the contactor-operating coil to hold the starter in the 'Run' position. If the winding of the motor heats up to such an extent so as to bring the temperature of the thermistor up to the 'Curie Point'. The increase in the resistance causes the relay to open and the contactor to disconnect the motor supply. The leads of thermistors are brought to a terminals fitted inside the terminal box for motors up to frame 180. For frame 200 and above separate auxiliary terminal box is provided.

2. **THERMOCOUPLE:** Copper - Constantant thermocouple - 1 No / per phase

3. **RESISTANCE TEMPERATURE DETECTOR (RTD):** (For frame size 280 & above)
   It can provide protection as well as temperature indication.
   Platinum type wire / strip / stem type. For winding, - 1 No / phase
   RTD - PT 100 i.e. 100 Ω at 0 °C For Bearings - 1 No / Bearing

4. **DIAL TYPE THERMOMETER:**

   Mercury in steel stem type thermometer with dial type read out & NC/NO contact.-1 No / Bearing

5. **SPACE HEATER:**

   Severe climatic condition like very low temperature & high humidity may develop moisture or dew setting inside the motor over the winding, & there by reducing insulating resistance. The space heaters mounted on the overhang of the winding, maintain average temperature of the motor during idle condition or kept for storage for a long duration.
   The motors are provided with anti-condensation heater above 90 frame.

FRAME SIZE	POWER (W)
280	150 or 160 watts
315 & 355	225 or 240 watts
400 & 450	300 or 320 watts

The anti-condensation heaters need 240 V, single phase, 50 Hz supply.

- **CAUTION**:-Supply to the heaters must be switched off before switching on the motor.

- **D.C. INJECTION**: (This method can only be used on motors of less than 30 kW)

An alternative to the use of anti-condensation heaters is to inject direct current into two of the phases wired in series from a D.C. Voltage source, which can give the total power, indicated in the table above.
To calculate the d.c.voltage, use the following relationship:

$$U_{(V)} = \sqrt{P_{(W)} * R_{(W)}}$$

Where R is the resistance of the windings in series.
Resistance should be measured with a suitable ohmmeter.

TESTS TO BE CONDUCTED ON INDUCTION MOTORS

ROUTINE TESTS

The following routine tests as per IS-325 are conducted on all motors;

1. Insulation resistance test
2. Measurement of resistance of windings of stator and wound rotor with corresponding ambient temperature.
3. No-Load test
4. Locked rotor readings of voltage, current and power input at suitable reduced voltage.
5. Reduced voltage running up test (for squirrel cage motors)
6. Open circuit voltage ratio of stator and rotor windings (for slip ring motors)
7. High voltage test

TYPE TESTS

The following Type tests as per IS-325 are carried out;

1. Measurement of resistance of windings of stator and wound rotor with corresponding ambient temperature.
2. No load test at rated voltage to determine input current, power and speed.
3. Open circuit voltage ratio of wound rotor motors
4. Reduced voltage running up test at no load (for squirrel cage motors up to 37 kW only)
5. Locked rotor readings of voltage, current and power input at a suitable reduced voltage.
6. Full load test to determine efficiency, power factor and slip
7. Temperature rise test
8. Momentary overload test
9. Insulation resistance test.
10. High voltage test

ADDITIONAL TESTS

The following additional tests can also be carried out on request;

*11.Test for vibration severity of motor on no-load.
*12. Test for noise levels of motor on no-load.
*13. Test for degree of protection by enclosure (For second numeral only).
*14. Temperature rise test at limiting values of voltages.
*15. Over speed test.

Note:

* Type test on vertical motors up to 30 kW will be conducted vertically on loading device and above 30 kW motors are tested with its respective/suitable pump coupled. Load test and temperature rise test will be conducted at maximum available load.

NOISE LEVEL:

The noise level of motors is restricted to the levels specified in IS 12065. Table below gives the noise level as per IS 12065.

Protective Enclosure		IP 22	IP 44	IP 22	IP 44	IP 22	IP 44	IP 22	IP 44	IP 22	IP 44	IP 22	IP 44
Rating kW (or kVA)		Rated speed (rev/min)											
		960 & 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

- IP 22 corresponds generally to drip-proof, open ventilated & similar enclosures.
  IP 44 corresponds generally to totally enclosed fan-cooled, closed air circuit air-cooled, & similar Enclosures (see IS 4691).
  - The position of measurement points should be at intervals of not more than one meter from machine.

❖ VIBRATION:

The motor is said to be in state of free vibration if any part of it experiences displacement in any direction. Standard motors comply with normal class of vibration depend ending on severity as per IS 12075.

Vibration levels: Limits of vibration severity in rotating electrical machines measured in state of free suspension.

Shaft Height H, mm	56 to 132		160 to 225		225 & above	
Range of speed (RPM)	600 to 1500	Above 1500 & upto 3000	600 to 1500	Above 1500 & upto 3000	600 to 1500	Above 1500 & upto 3000
Class of Vibration severity	RMS Value of Vibration Velocity, mm/sec					
Normal	1.8	1.8	1.8	2.8	2.8	4.5
Precision A	0.71	0.71	0.71	1.12	---	---
Precision B	0.45	0.45	0.45	0.71	---	---
Precision C	0.28	0.28	0.28	0.45	---	---

The vibration may be determined in rigid mounting condition but the value of Vibration severity shall be agreed by a special agreement between manufacturer & user. The double amplitude of vibration displacement, $a = \frac{0.45\ V_{rms}}{f}$ where, f = frequency of vibration in RPS.Fe.g. 25 H_Z for 1500 RPM

PERFORMANCE DATA OF JYOTI CTF HORIZONTAL 2 POLE SQ.CAGE TEFC MOTORS

VOLTAGE	: 415 VOLTS ± 10 %	DUTY	: S1	DEG. OF PROTECTION	: IP-55
FREQUENCY	: 50 Hzs. ± 5 %	INSULATION	: F	MOUNTING	: B3
PHASE	: 3	AMB. TEMP.	: 45°C	COOLING	: IC-411
COMB. VARIT.	: ± 10 %	TEMP. RISE	: 75°C		

KW	Motor Type CTF	FL Speed RPM	EFFICIENCY % LOAD			POWER FACTOR % LOAD			FL Current AMP	IST % of FLC	TST % of FLT	TMX % of FLT	WEIGHT Kg.	GD^2 $KG-M^2$	T-N GRP .NO.	I-N GRP .NO.	T-W GRP .NO.
			100	75	50	100	75	50									
75	280S	2965	92.5	92.0	90.0	0.90	0.85	0.75	125	650	180	230	670	11.0	104	204	306
90	280M	2970	92.5	92.0	90.0	0.90	0.86	0.75	150	650	180	230	750	12.0	104	204	306
110	315M	2975	93.0	92.5	90.5	0.90	0.86	0.78	183	700	180	230	980	21.0	104	205	308
132	315M	2975	93.0	92.5	90.0	0.90	0.86	0.78	219	700	180	230	1160	25.0	104	205	308
160	315L	2980	93.0	92.5	90.0	0.90	0.86	0.78	266	700	180	230	1280	30.0	104	205	308
180	355S	2980	93.5	93.0	91.0	0.90	0.87	0.78	297	700	180	230	1350	40.0.	104	205	316
200	355M	2980	93.5	93.0	91.0	0.91	0.87	0.78	327	700	160	250	1450	46.0	107	205	316
220	355M	2980	93.5	93.0	91.0	0.91	0.87	0.78	359	700	160	250	1450	46.0	107	205	316
250	355M	2980	93.5	93.0	91.0	0.91	0.87	0.78	408	700	150	200	1500	48.0	109	205	316
280	400M	2980	94.0	93.5	91.5	0.91	0.87	0.78	455	700	150	200	2300	50.0	109	205	316
300	400M	2980	94.0	93.5	91.5	0.90	0.87	0.78	493	700	150	200	2350	50.0	109	205	316
335	400M	2980	94.5	94.0	92.0	0.90	0.87	0.78	548	700	150	200	2400	52.0	109	205	316
355	400L	2985	94.5	94.0	92.0	0.90	0.88	0.80	580	700	150	200	2400	54.0	109	205	316
370	400L	2985	94.5	94.0	92.0	0.90	0.88	0.80	605	700	150	200	2450	56.0	109	205	316

NOTE: THE ABOVE PERFORMANCES ARE SUBJECTED TO TOLERANCES GIVEN IN IS: 325.

PERFORMANCE DATA OF JYOTI CTF HORIZONTAL 4 POLE SQ.CAGE TEFC MOTORS(EFF-1)

VOLTAGE	: 415 VOLTS ± 10 %	DUTY	: S1	DEG. OF PROTECTION	: IP-55
FREQUENCY	: 50 Hzs. ± 5 %	INSULATION	: F	MOUNTING	: B3
PHASE	: 3	AMB. TEMP.	: 50°C	COOLING	: IC-411
COMB. VARIT.	: ± 10 %	TEMP. RISE	: 70°C	REF. STANDARD	: IS:325 , IS:12615

KW	Motor Type CTF/CUTF	FL Speed RPM	EFFICIENCY % LOAD			POWER FACTOR % LOAD			FL Current AMP	IST % of FLC	TST % of FLT	TMX % of FLT	WEIGHT Kg.	GD^2 KG-M^2	T-N GRP. NO.	I-N GRP .NO.	T-W GRP .NO.
			100	75	50	100	75	50									
67	280S	1475	94.5	93.5	92.5	0.88	0.84	0.74	113	700	200	275	670	11.0	102	205	308
75	280S	1480	94.7	93.2	91.0	0.89	0.85	0.75	125	700	200	275	670	11.0	102	205	308
90	280M	1480	95.0	93.5	91.5	0.90	0.86	0.78	148	700	200	275	750	12.0	102	205	308
110	315M	1480	95.2	94.0	92.0	0.90	0.86	0.78	178	700	200	275	980	21.0	102	205	308
125	315M	1485	95.5	95.0	93.5	0.90	0.86	0.78	202	600	200	275	1160	25.0.	102	203	302
132	315M	1485	95.5	95.0	93.5	0.90	0.86	0.78	214	600	200	275	1160	25.0	102	203	302
150	315L	1485	95.5	95.0	93.5	0.90	0.88	0.80	245	650	200	300	1250	28.0	111	204	305
160	315L	1485	95.8	95.0	93.5	0.90	0.88	0.80	260	650	200	300	1280	30.0	111	204	305
180	355S	1485	95.8	95.2	94.0	0.90	0.87	0.78	290	650	180	300	1350	40.0	105	204	306
200	355M	1485	95.8	95.0	94.0	0.90	0.87	0.78	324	650	180	300	1450	46.0	105	204	306
220	355M	1485	95.8	95.2	94.0	0.90	0.87	0.78	356	650	180	300	1450	46.0	105	204	306
250	355M	1485	95.8	95.2	94.0	0.90	0.87	0.78	404	650	180	300	1500	48.0	105	204	306
280	355L	1485	95.8	95.2	94.0	0.90	0.88	0.82	452	650	200	300	2000	45.0	114	204	306
300	355L	1485	96.0	95.5	94.0	0.90	0.88	0.82	484	650	200	300	2075	48.0	114	204	306
315	355L	1485	96.0	95.5	94.0	0.90	0.88	0.82	508	650	200	300	2075	48.0	114	204	306
335	400M	1485	96.0	95.5	94.0	0.90	0.87	0.78	540	650	180	250	2400	52.0	106	204	307
355	400L	1490	96.0	95.5	94.5	0.90	0.88	0.80	572	650	150	275	2400	54.0	110	204	307
370	400L	1490	96.0	95.5	94.5	0.90	0.88	0.80	596	650	150	275	2450	56.0	110	204	307
400	400L	1490	96.0	95.5	94.5	0.90	0.88	0.80	644	650	150	275	2450	60.0	110	204	307
450	400L	1490	96.0	95.5	94.5	0.90	0.88	0.80	725	650	150	275	2500	65.0	110	204	307

NOTE: THE ABOVE PERFORMANCES ARE SUBJECTED TO TOLERANCES GIVEN IN IS: 325.

PERFORMANCE DATA OF JYOTI CTF HORIZONTAL 4 POLE SQ.CAGE TEFC MOTORS(EFF-2)

VOLTAGE	: 415 VOLTS ± 10 %	DUTY	: S1	DEG. OF PROTECTION	: IP-55
FREQUENCY	: 50 Hzs. ± 5 %	INSULATION	: F	MOUNTING	: B3
PHASE	: 3	AMB. TEMP.	: 50°C	COOLING	: IC-411
COMB. VARIT.	: ± 10 %	TEMP. RISE	: 70°C	REF STANDARD	: IS:325 , IS:12615

KW	Motor Type CTF/CUTF	FL Speed RPM	EFFICIENCY % LOAD			POWER FACTOR % LOAD			FL Current AMP	IST % of FLC	TST % of FLT	TMX % of FLT	WEIGHT Kg.	GD² KG-M²	T-N GRP. NO.	I-N GRP .NO.	T-W GRP .NO.
			100	75	50	100	75	50									
67	280S	1475	93.5	93.0	92.0	0.88	0.84	0.74	114	700	200	275	670	11.0	102	205	308
75	280S	1480	94.0	92.5	90.5	0.89	0.85	0.75	125	700	200	275	670	11.0	102	205	308
90	280M	1480	94.5	93.0	91.0	0.90	0.86	0.78	148	700	200	275	750	12.0	102	205	308
110	315M	1480	94.5	93.5	91.5	0.90	0.86	0.78	180	700	200	275	980	21.0	102	205	308
125	315M	1485	95.0	94.5	93.0	0.90	0.86	0.78	204	600	200	275	1160	25.0.	102	203	302
132	315M	1485	95.0	94.5	93.0	0.90	0.86	0.78	215	600	200	275	1160	25.0	102	203	302
150	315L	1485	95.0	94.5	93.5	0.90	0.88	0.80	245	650	200	300	1250	28.0	111	204	305
160	315L	1485	95.0	94.5	93.5	0.90	0.88	0.80	260	650	200	300	1280	30.0	111	204	305
180	355S	1485	95.0	94.5	93.5	0.90	0.87	0.78	294	650	180	300	1350	40.0	105	204	306
200	355M	1485	95.5	95.0	94.0	0.90	0.87	0.78	324	650	180	300	1450	46.0	105	204	306
220	355M	1485	95.5	95.0	94.0	0.90	0.87	0.78	356	650	180	300	1450	46.0	105	204	306
250	355M	1485	95.5	95.0	94.0	0.90	0.87	0.78	405	650	180	300	1500	48.0	105	204	306
280	355L	1485	95.5	95.0	94.0	0.90	0.88	0.82	454	650	180	300	2000	45.0	114	204	306
300	355L	1485	96.0	95.5	94.0	0.90	0.88	0.82	484	650	180	300	2075	48.0	114	204	306
315	355L	1485	96.0	95.5	94.0	0.90	0.88	0.82	508	650	180	300	2075	48.0	114	204	306
335	400M	1485	96.0	95.5	94.0	0.90	0.87	0.78	540	650	180	250	2400	52.0	106	204	307
355	400L	1490	96.0	95.5	94.5	0.90	0.88	0.80	572	650	150	275	2400	54.0	110	204	307
370	400L	1490	96.0	95.5	94.5	0.90	0.88	0.80	596	650	150	275	2450	56.0	110	204	307
400	400L	1490	96.0	95.5	94.5	0.90	0.88	0.80	644	650	150	275	2450	60.0	110	204	307
450	400L	1490	96.0	95.5	94.5	0.90	0.88	0.80	725	650	150	275	2500	65.0	110	204	307

NOTE: THE ABOVE PERFORMANCES ARE SUBJECTED TO TOLERANCES GIVEN IN IS : 325.

PERFORMANCE DATA OF JYOTI CTF HORIZONTAL 6 POLE SQ.CAGE TEFC MOTORS (EFF-1)

VOLTAGE	: 415 VOLTS ± 10 %	DUTY	: S1	DEG. OF PROTECTION	: IP-55
FREQUENCY	: 50 Hzs. ± 5 %	INSULATION	: F	MOUNTING	: B3
PHASE	: 3	AMB. TEMP.	: 50°C	COOLING	: IC-411
COMB. VARIT.	: ± 10 %	TEMP. RISE	: 70°C	REF. STANDARD	: IS:325 , IS:12615

KW	Motor Type CTF/CUTF	FL Speed RPM	EFFICIENCY % LOAD			POWER FACTOR % LOAD			FL Current AMP	IST % of FLC	TST % of FLT	TMX % of FLT	WEIGHT Kg.	GD^2 $KG\text{-}M^2$	T-N GRP .NO.	I-N GRP .NO.	T-W GRP .NO.
			100	75	50	100	75	50									
45	280S	980	93.4	92.8	90.0	0.85	0.80	0.70	80	600	200	300	600	10.5	102	203	301
55	280M	980	93.8	93.0	91.5	0.85	0.80	0.70	96	600	200	300	690	15.0	102	203	301
67	315M	985	93.8	93.0	91.5	0.85	0.80	0.72	118	600	180	250	930	21.0	106	203	302
75	315M	985	94.2	93.5	92.0	0.85	0.80	0.72	132	600	180	250	930	21.0	106	203	302
90	315M	985	94.5	94.0	91.5	0.84	0.80	0.68	158	600	180	250	950	25.0.	106	203	302
110	315L	985	94.6	94.0	92.0	0.84	0.80	0.68	194	600	200	275	980	28.0	102	203	302
125	315L	985	95.0	94.5	92.5	0.84	0.80	0.68	218	600	200	275	1020	32.0	102	203	302
132	315L	985	95.0	94.5	92.5	0.84	0.80	0.68	230	600	200	275	1020	32.0	102	203	302
150	355M	985	95.0	94.5	92.6	0.84	0.78	0.67	262	600	200	300	1460	40.0	102	203	303
160	355M	985	95.0	94.5	92.6	0.84	0.78	0.67	280	600	200	300	1460	40.0	102	203	303
180	355M	985	95.0	94.5	93.5	0.84	0.78	0.67	314	600	200	300	1550	44.0	102	203	303
200	355M	990	95.5	95.0	94.0	0.85	0.80	0.70	342	600	200	300	1600	48.0	102	203	303
220	355L	990	95.5	95.0	94.0	0.85	0.81	0.75	378	600	180	280	2125	62.0	115	203	303
250	355L	990	95.5	95.0	93.5	0.85	0.81	0.75	428	600	180	280	2200	65.0	115	203	303
280	400L	990	95.5	95.0	93.5	0.85	0.80	0.70	483	600	180	250	2350	60.0	106	203	303
300	400L	990	95.5	95.0	93.5	0.85	0.80	0.70	514	600	180	250	2450	65.0	106	203	303
315	400L	990	95.5	95.0	93.5	0.85	0.80	0.70	540	600	180	250	2450	65.0	106	203	303
335	400L	990	95.5	95.0	93.5	0.85	0.80	0.70	575	600	180	250	2550	70.0	106	203	303
355	400L	990	95.6	95.0	93.5	0.85	0.80	0.70	608	600	180	250	2550	70.0	106	203	303
370	400L	990	95.6	95.0	93.5	0.85	0.80	0.70	634	600	180	250	2550	70.0	106	203	303

NOTE : THE ABOVE PERFORMANCES ARE SUBJECTED TO TOLERANCES GIVEN IN IS : 325.

PERFORMANCE DATA OF JYOTI CTF HORIZONTAL 8 POLE SQ.CAGE TEFC MOTORS (EFF-1)

VOLTAGE	: 415 VOLTS ± 10 %	DUTY	: S1	DEG. OF PROTECTION	: IP-55
FREQUENCY	: 50 Hzs. ± 5 %	INSULATION	: F	MOUNTING	: B3
PHASE	: 3	AMB. TEMP.	: 50°C	COOLING	: IC-411
COMB. VARIT.	: ± 10 %	TEMP. RISE	: 70°C	REF. STANDARD	: IS:325 , IS:12615

KW	Motor Type CTF/CUTF	FL Speed RPM	EFFICIENCY % LOAD 100	75	50	POWER FACTOR % LOAD 100	75	50	FL Current AMP	IST % of FLC	TST % of FLT	TMX % of FLT	WEIGHT Kg.	GD² KG-M²	T-N GRP .NO.	I-N GRP .NO.	T-W GRP .NO.
37	280S	730	91.9	91.5	89.5	0.77	0.72	0.60	73	600	200	250	670	9.0	103	203	301
45	280M	735	92.4	91.5	89.5	0.78	0.73	0.60	87	600	200	250	750	12.0	103	203	301
55	315M	740	92.8	92.0	89.0	0.73	0.70	0.55	114	550	180	250	980	20.0	106	202	312
67	315M	740	92.8	92.0	89.0	0.73	0.70	0.55	138	550	180	250	1050	23.0	106	202	312
75	315M	740	93.5	92.5	89.5	0.73	0.70	0.55	154	550	180	250	1160	26.0 .	106	202	312
90	315L	740	93.9	93.5	91.0	0.73	0.70	0.56	182	550	160	250	1250	37.0	106	202	312
110	315L	740	94.3	93.5	92.0	0.74	0.70	0.56	220	500	160	250	1280	60.0	106	201	313
125	355S	740	94.7	94.0	90.8	0.74	0.70	0.56	245	600	180	250	1350	72.0	106	203	303
132	355S	740	94.7	94.0	90.8	0.74	0.70	0.56	260	600	180	250	1450	72.0	106	203	303
160	355M	740	94.8	94.5	92.5	0.82	0.78	0.70	286	500	160	250	1450	80.0	107	201	314
180	355L	740	94.8	94.5	92.5	0.82	0.78	0.72	322	600	160	260	2150	62.0	116	116	303
200	355L	743	95.0	94.5	92.5	0.82	0.78	0.72	358	600	160	260	2165	66.0	116	116	303
220	355L	743	95.0	94.5	92.5	0.82	0.78	0.72	394	600	160	260	2275	72.0	116	116	303
250	400L	745	95.0	94.5	92.5	0.84	0.80	0.75	436	600	160	250	2400	90.0	107	203	303

NOTE: THE ABOVE PERFORMANCES ARE SUBJECTED TO TOLERANCES GIVEN IN IS: 325.

PERFORMANCE DATA OF JYOTI CTF HORIZONTAL 8 POLE SQ.CAGE TEFC MOTORS (EFF-2)

VOLTAGE	: 415 VOLTS ± 10 %	DUTY	: S1	DEG. OF PROTECTION	: IP-55
FREQUENCY	: 50 Hzs. ± 5 %	INSULATION	: F	MOUNTING	: B3
PHASE	: 3	AMB. TEMP.	: 50°C	COOLING	: IC-411
COMB. VARIT.	: ± 10 %	TEMP. RISE	: 70°C	REF. STANDARD	: IS:325 , IS:12615

KW	Motor Type CTF/CUTF	FL Speed RPM	EFFICIENCY % LOAD			POWER FACTOR % LOAD			FL Current AMP	IST % of FLC	TST % of FLT	TMX % of FLT	WEIGHT Kg.	GD² KG-M²	T-N GRP .NO.	I-N GRP .NO.	T-W GRP .NO.
			100	75	50	100	75	50									
37	280S	730	91.5	91.0	89.0	0.77	0.72	0.60	73	600	200	250	670	9.0	103	203	301
45	280M	735	92.0	91.0	89.0	0.78	0.73	0.60	87	600	200	250	750	12.0	103	203	301
55	315M	740	92.5	91.5	88.5	0.73	0.70	0.55	114	550	160	250	980	20.0	106	202	312
67	315M	740	92.5	91.5	88.5	0.73	0.70	0.55	138	550	160	250	1050	23.0	106	202	312
75	315M	740	92.5	91.5	88.5	0.73	0.70	0.55	155	550	180	250	1160	26.0.	106	202	312
90	315L	740	93.0	92.5	90.0	0.73	0.70	0.56	180	550	160	250	1250	37.0	106	202	312
110	315L	740	93.5	93.0	91.5	0.74	0.70	0.56	220	500	160	250	1280	60.0	106	201	313
125	355S	740	94.0	93.2	90.0	0.74	0.70	0.56	248	600	160	250	1350	72.0	106	203	303
132	355S	740	94.0	93.2	90.0	0.74	0.70	0.56	262	600	160	250	1450	72.0	106	203	303
160	355M	740	94.5	94.0	92.0	0.82	0.78	0.70	288	500	160	250	1450	80.0	107	201	314
180	355L	740	94.5	94.0	92.0	0.82	0.78	0.72	324	600	160	260	2150	62.0	116	116	303
200	355L	743	94.5	94.0	92.0	0.82	0.78	0.72	360	600	160	260	2165	66.0	116	116	303
220	355L	743	94.5	94.0	92.0	0.82	0.78	0.72	395	600	160	260	2275	72.0	116	116	303
250	400L	745	95.0	94.5	92.5	0.84	0.80	0.75	436	600	160	250	2400	90.0	107	203	303

NOTE: THE ABOVE PERFORMANCES ARE SUBJECTED TO TOLERANCES GIVEN IN IS: 325.

PERFORMANCE DATA OF JYOTI CVTF VERTICAL 4 POLE SQ.CAGE TEFC MOTORS

VOLTAGE : 415 VOLTS ± 10 % DUTY : S1 DEG. OF PROTECTION : IP-55
FREQUENCY : 50 Hzs. ± 5 % INSULATION : F MOUNTING : V1
PHASE : 3 AMB. TEMP. : 45°C COOLING : IC-411
COMB. VARIT. : ± 10 % TEMP. RISE : 75°C

KW	Motor Type CVTF	FL Speed RPM	EFFICIENCY % LOAD			POWER FACTOR % LOAD			FL Current AMP	IST % of FLC	TST % of FLT	TMX % of FLT	WEIGHT Kg.	GD² KG-M²	T-N GRP. NO.	I-N GRP. NO.	T-W GRP .NO.
			100	75	50	100	75	50									
75	280	1480	92.0	91.0	89.0	0.88	0.81	0.74	128	650	200	275	750	11.0	102	204	305
90	280	1480	92.0	91.0	89.0	0.88	0.84	0.74	155	600	200	275	780	12.0	102	203	302
110	315	1480	93.0	92.0	90.5	0.90	0.86	0.78	183	700	200	275	1250	20.0	102	205	308
125	315	1485	93.0	92.0	90.5	0.90	0.86	0.78	207	650	220	275	1300	23.0	101	204	305
132	315	1485	93.0	92.0	91.0	0.90	0.86	0.78	220	650	200	275	1300	23.0	102	204	305
150	315	1480	93.0	92.0	91.0	0.90	0.86	0.78	250	600	200	275	1350	25.0	102	203	302
160	315	1480	93.0	92.0	90.0	0.90	0.85	0.78	265	600	200	275	1350	25.0	102	203	302
180	355	1480	93.5	92.5	90.0	0.90	0.86	0.78	300	700	200	275	1600	65.0	102	205	316
200	355	1480	93.5	92.5	90.0	0.90	0.85	0.80	332	600	200	275	1650	68.0	102	203	303
220	355	1485	94.0	93.0	92.0	0.90	0.86	0.80	362	650	220	275	1650	68.0	101	204	306
250	355	1480	94.0	93.5	92.5	0.90	0.86	0.82	411	600	200	275	1750	76.0	102	203	303
280	355	1485	95.0	94.5	93.5	0.90	0.88	0.82	456	600	200	275	1800	85.0	102	203	303
300	355	1485	95.0	94.5	93.5	0.89	0.87	0.82	495	600	200	275	1850	85.0	102	203	303
315	355	1485	95.5	95.0	93.5	0.90	0.88	0.82	510	600	180	300	1850	90.0	105	203	303

NOTE : THE ABOVE PERFORMANCES ARE SUBJECTED TO TOLERANCES GIVEN IN IS : 325.

PERFORMANCE DATA OF JYOTI CVTF VERTICAL 6 POLE SQ.CAGE TEFC MOTORS

VOLTAGE	: 415 VOLTS ± 10 %	DUTY	: S1	DEG. OF PROTECTION	: IP-55
FREQUENCY	: 50 Hzs. ± 5 %	INSULATION	: F	MOUNTING	: V1
PHASE	: 3	AMB. TEMP.	: 45°C	COOLING	: IC-411
COMB. VARIT.	: ± 10 %	TEMP. RISE	: 75°C		

KW	Motor Type CVTF	FL Speed RPM	EFFICIENCY % LOAD			POWER FACTOR % LOAD			FL Current AMP	IST % of FLC	TST % of FLT	TMX % of FLT	WEIGHT Kg.	GD² KG-M²	T-N GRP .NO.	I-N GRP .NO.	T-W GRP .NO.
			100	75	50	100	75	50									
45	280	985	91.0	90.5	88.0	0.84	0.80	0.70	82	500	180	230	525	8.0	104	201	309
55	280	985	91.0	90.5	88.0	0.84	0.80	0.75	100	500	180	230	985	16.0	104	201	309
67	315	985	91.0	90.5	88.5	0.84	0.80	0.75	122	550	180	230	1050	20.0	104	202	312
75	315	985	92.0	91.0	89.0	0.85	0.80	0.74	133	550	200	250	1275	23.0	103	202	312
90	315	985	92.5	92.0	91.0	0.84	0.82	0.76	161	600	180	230	1350	26.0	104	203	302
110	315	985	93.5	93.0	91.0	0.84	0.80	0.68	195	600	200	275	1350	28.0	102	203	302
125	315	985	93.5	93.0	91.0	0.84	0.80	0.68	222	600	200	275	1350	32.0	102	203	302
132	315	985	93.5	93.0	91.0	0.84	0.80	0.68	234	600	200	275	1400	32.0	102	203	302
150	355	985	93.0	92.5	91.0	0.84	0.79	0.74	267	600	200	275	1500	50.0	102	203	303
160	355	985	93.0	93.5	92.0	0.84	0.79	0.74	285	600	200	275	1500	60.0	102	203	303
180	355	985	94.0	93.5	92.0	0.84	0.79	0.74	317	600	200	275	1570	60.0	102	203	303
200	355	985	94.5	94.0	92.5	0.85	0.80	0.75	348	650	220	275	1650	85.0	101	204	306
220	355	990	95.0	94.5	93.0	0.87	0.83	0.78	370	750	250	300	1700	85.0	111	206	317
250	355	990	95.0	94.5	93.0	0.88	0.84	0.79	418	700	200	275	1750	90.0	102	205	316

NOTE: THE ABOVE PERFORMANCES ARE SUBJECTED TO TOLERANCES GIVEN IN IS: 325.

PERFORMANCE DATA OF JYOTI CD HORIZONTAL 4 POLE SQ.CAGE SPDP MOTORS

VOLTAGE	: 415 VOLTS ± 10 %	DUTY	: S1	DEG. OF PROTECTION	: IP-23
FREQUENCY	: 50 Hzs. ± 5 %	INSULATION	: F	MOUNTING	: B3
PHASE	: 3	AMB. TEMP.	: 45°C	COOLING	: IC-01
COMB. VARIT.	: ± 10 %	TEMP. RISE	: 75°C		

KW	Motor Type CD/ CUD	FL Speed RPM	EFFICIENCY % LOAD			POWER FACTOR % LOAD			FL Current AMP	IST % of FLC	TST % of FLT	TMX % of FLT	WEIGHT Kg.	GD² KG-M²	T-N GRP. NO.	I-N GRP. NO.	T-W GRP. NO.
			100	75	50	100	75	50									
110	280S	1470	92.0	91.5	89.5	0.88	0.85	0.74	185	600	180	250	720	7.0	106	203	301
125	280M	1470	93.0	92.5	90.0	0.88	0.85	0.73	212	600	200	275	780	7.5	102	203	301
132	280M	1470	93.0	92.5	90.0	0.88	0.85	0.73	224	600	180	250	780	7.5	106	203	301
150	280M	1475	93.0	92.5	90.0	0.88	0.85	0.73	255	600	180	250	850	9.0	106	203	301
160	315S	1480	93.0	92.5	90.0	0.88	0.85	0.73	272	600	180	300	900	14.0	105	203	301
180	315M	1475	93.0	92.5	90.0	0.88	0.85	0.73	306	600	180	300	950	14.5	105	203	302
200	315M	1480	93.5	92.5	90.5	0.88	0.85	0.75	338	600	180	300	1040	17.0	105	203	302
220	315L	1480	93.5	92.5	90.5	0.88	0.85	0.75	372	600	180	300	1100	20.0	105	203	302
250	315L	1480	93.5	92.5	90.5	0.88	0.85	0.75	423	600	180	300	1180	25.0	105	203	302
280	315L	1480	93.5	92.5	90.5	0.88	0.85	0.75	474	600	180	300	1350	30.0	105	203	302
300	355S	1480	94.0	93.0	92.0	0.90	0.88	0.85	493	600	150	275	1750	32.0	110	203	302
315	355S	1480	94.0	93.0	92.0	0.90	0.88	0.85	518	600	150	275	1750	32.0	110	203	302
335	355M	1480	94.0	93.0	92.0	0.90	0.88	0.85	551	600	150	275	1900	38.0	110	203	302
355	355L	1480	94.0	93.5	92.5	0.90	0.88	0.85	584	600	160	300	2000	59.0	108	203	302
370	355L	1480	94.0	93.5	92.5	0.90	0.88	0.85	605	600	160	300	2000	59.0	108	203	302

NOTE: THE ABOVE PERFORMANCES ARE SUBJECTED TO TOLERANCES GIVEN IN IS: 325.

PERFORMANCE DATA OF JYOTI CD HORIZONTAL 6 POLE SQ.CAGE SPDP MOTORS

VOLTAGE	: 415 VOLTS ± 10 %	DUTY	: S1	DEG. OF PROTECTION	: IP-23
FREQUENCY	: 50 Hzs. ± 5 %	INSULATION	: F	MOUNTING	: B3
PHASE	: 3	AMB. TEMP.	: 45°C	COOLING	: IC-01
COMB. VARIT.	: ± 10 %	TEMP. RISE	: 75°C		

KW	Motor Type CD/CUD	FL Speed RPM	EFFICIENCY % LOAD			POWER FACTOR % LOAD			FL Current AMP	IST % of FLC	TST % of FLT	TMX % of FLT	WEIGHT Kg.	GD² KG-M²	T-N GRP .NO.	I-N GRP .NO.	T-W GRP .NO.
			100	75	50	100	75	50									
67	280S	980	91.5	90.5	89.0	0.85	0.80	0.68	115	500	200	250	625	12.8	103	201	310
75	280S	980	91.0	90.5	89.0	0.82	0.78	0.68	140	500	200	250	650	13.3	103	201	310
90	280M	980	92.5	92.0	90.5	0.82	0.78	0.68	165	500	200	250	720	15.5	103	201	310
110	315S	980	92.5	92.0	90.0	0.84	0.80	0.70	197	500	180	300	900	32.0	105	201	318
125	315M	980	92.5	92.0	90.0	0.84	0.80	0.70	224	500	180	300	1150	41.0.	105	201	318
132	315M	980	92.5	92.0	90.0	0.84	0.80	0.70	236	500	180	300	1150	41.0	105	201	318
150	315L	980	92.5	92.0	90.0	0.84	0.80	0.70	269	500	180	300	1200	44.0	105	201	318
160	315L	980	92.5	92.0	90.0	0.84	0.80	0.70	286	500	180	300	1200	44.0	105	201	318
180	355S	990	93.0	92.5	91.0	0.85	0.82	0.72	317	600	160	300	1400	48.0	108	203	302
200	355M	990	93.0	92.5	91.0	0.85	0.82	0.72	352	600	160	300	1450	50.0	108	203	302
220	355L	990	93.5	92.5	91.0	0.85	0.82	0.72	385	600	160	300	1500	56.0	108	203	302
250	355L	990	93.5	93.0	91.5	0.85	0.82	0.72	438	600	160	300	1550	64.0	108	203	302

NOTE: THE ABOVE PERFORMANCES ARE SUBJECTED TO TOLERANCES GIVEN IN IS: 325.

PERFORMANCE DATA OF JYOTI CVD VERTICAL 4 POLE SQ.CAGE SPDP MOTORS

VOLTAGE	: 415 VOLTS ± 10 %	DUTY	: S1	DEG. OF PROTECTION	: IP-23
FREQUENCY	: 50 Hzs. ± 5 %	INSULATION	: F	MOUNTING	: V1
PHASE	: 3	AMB. TEMP.	: 45°C	COOLING	: IC-01
COMB. VARIT.	: ± 10 %	TEMP. RISE	: 75°C		

KW	Motor Type CVD	FL Speed RPM	EFFICIENCY % LOAD			POWER FACTOR % LOAD			FL Current AMP	IST % of FLC	TST % of FLT	TMX % of FLT	WEIGHT Kg.	GD^2 KG-M^2	T-N GRP. NO.	I-N GRP. NO.	T-W GRP. NO.
			100	75	50	100	75	50									
110	280	1465	93.0	91.5	90.0	0.88	0.86	0.80	187	600	180	250	700	7.0	106	203	301
125	280	1465	93.0	91.5	90.0	0.90	0.88	0.82	208	600	180	250	740	7.4	106	203	301
132	280	1465	93.0	91.5	90.0	0.90	0.88	0.82	220	600	180	250	760	7.8	106	203	301
150	280	1475	93.0	92.5	91.0	0.90	0.88	0.82	250	600	180	250	800	8.5	106	203	301
160	280	1475	93.0	92.5	91.0	0.90	0.88	0.82	268	600	160	250	1000	15.0	107	203	301
180	315	1475	93.0	92.5	91.0	0.88	0.85	0.75	306	600	150	275	1250	17.5	110	203	302
200	315	1480	93.5	92.5	91.0	0.88	0.85	0.75	340	600	150	275	1360	22.0	110	203	302
220	315	1480	93.5	93.0	91.0	0.88	0.85	0.75	374	600	150	275	1400	24.0	110	203	302
250	315	1480	93.5	93.0	91.0	0.88	0.85	0.75	422	600	150	275	1450	25.0	110	203	302
280	315	1480	93.5	92.5	91.0	0.88	0.85	0.75	474	600	150	275	1600	30.0	110	203	302
300	355	1480	94.0	93.5	92.0	0.90	0.88	0.80	496	600	150	275	1750	32.0	110	203	302
315	355	1480	94.0	93.5	91.5	0.88	0.85	0.75	533	600	150	275	1800	32.0	110	203	302
335	355	1485	94.0	93.5	92.0	0.90	0.88	0.80	550	600	150	275	1900	38.0	110	203	302
355	355	1480	94.0	93.5	92.5	0.90	0.88	0.82	587	600	150	275	2000	59.0	110	203	302
370	355	1480	94.0	93.5	92.5	0.90	0.88	0.85	605	600	150	275	2000	59.0	110	203	302

NOTE: THE ABOVE PERFORMANCES ARE SUBJECTED TO TOLERANCES GIVEN IN IS: 325.

PERFORMANCE DATA OF JYOTI CVD VERTICAL 6 POLE SQ.CAGE SPDP MOTORS

VOLTAGE : 415 VOLTS ± 10 % DUTY : S1 DEG. OF PROTECTION : IP-23
FREQUENCY : 50 Hzs. ± 5 % INSULATION : F MOUNTING : V1
PHASE : 3 AMB. TEMP. : 45°C COOLING : IC-01
COMB. VARIT. : ± 10 % TEMP. RISE : 75°C

KW	Motor Type CVD	FL Speed RPM	EFFICIENCY % LOAD			POWER FACTOR % LOAD			FL Current AMP	IST % of FLC	TST % of FLT	TMX % of FLT	WEIGHT Kg.	GD^2 $KG\text{-}M^2$	T-N GRP. NO.	I-N GRP .NO.	T-W GRP .NO.
			100	75	50	100	75	50									
67	280	980	92.0	91.5	89.5	0.82	0.78	0.67	125	500	180	250	720	12.8	106	201	310
75	280	980	92.0	91.5	89.5	0.86	0.82	0.70	128	500	180	250	760	14.5	106	201	310
90	280	980	93.0	92.5	91.0	0.86	0.82	0.70	156	500	180	250	780	15.5	106	201	310
110	315	980	93.0	92.5	91.0	0.84	0.80	0.70	196	500	180	300	940	20.0	105	201	318
125	315	980	92.5	92.0	90.0	0.84	0.80	0.70	224	500	180	300	1050	23.0	105	201	318
132	315	980	92.5	92.0	90.0	0.84	0.80	0.70	236	500	180	300	1050	23.0	105	201	318
150	315	980	93.0	92.5	90.0	0.85	0.80	0.70	262	600	180	300	1200	29.0	105	203	302
160	355	985	93.0	92.5	91.0	0.85	0.82	0.72	282	600	160	300	1350	41.0	108	203	302
180	355	990	93.0	92.5	91.0	0.85	0.82	0.72	317	600	160	300	1400	48.0	108	203	302
200	355	990	93.5	93.0	92.0	0.85	0.82	0.72	350	600	160	300	1450	50.0	108	203	302
220	355	990	93.5	93.0	92.0	0.85	0.82	0.72	387	600	160	300	1500	56.0	108	203	302
250	355	990	93.5	93.0	92.0	0.86	0.82	0.72	438	600	160	300	1550	64.0	108	203	302

NOTE: THE ABOVE PERFORMANCES ARE SUBJECTED TO TOLERANCES GIVEN IN IS: 325.

PERFORMANCE DATA OF JYOTI WD HORIZONTAL 4 POLE SLIP-RING MOTORS

VOLTAGE	: 415 VOLTS ± 10 %	DUTY	: S1	DEG. OF PROTECTION	: IP23
FREQUENCY	: 50 Hzs. ± 5 %	INSULATION	: F	MOUNTING	: B3
PHASE	: 3	AMB. TEMP.	: 45°C	COOLING	: IC-01
COMB. VARIT.	: ± 10 %	TEMP. RISE	: 75°C		

KW	Motor Type WD	FL Speed RPM	EFFICIENCY (%) LOAD 100	75	50	POWER FACTOR % LOAD 100	75	50	FL Current AMP	ROTOR VOLTAGE VOLTS	ROTOR CURRENT AMP.	WEIGHT Kg.	GD² KG-M²	T-N GRP .NO.	I-N GRP .NO.	T-W GRP .NO.
110	280S	1470	91.0	90.5	88.5	0.86	0.82	0.72	196	415	160	760	15.0	113	203	302
125	280M	1470	91.5	91.0	89.0	0.86	0.82	0.72	221	230	327	810	20.0	113	203	302
132	280M	1470	91.5	91.0	89.0	0.86	0.82	0.72	234	230	346	810	20.0	113	203	302
150	280M	1470	92.0	91.5	90.5	0.90	0.88	0.80	252	270	334	850	21.0	113	203	302
160	315S/M	1475	92.0	91.5	91.0	0.90	0.88	0.80	269	260	370	890	23.0	113	203	302
180	315M	1480	92.5	92.0	91.0	0.88	0.84	0.76	308	290	372	1050	24.0	113	203	302
200	315M	1480	92.5	92.0	91.0	0.88	0.84	0.76	342	310	386	1100	25.0	113	203	302
220	315L	1480	93.0	92.0	91.0	0.88	0.84	0.76	374	335	392	1100	26.0	113	203	302
250	315L	1480	93.0	92.0	91.0	0.88	0.84	0.76	425	360	415	1180	26.0	113	203	302
280	355S	1480	93.5	93.0	91.0	0.88	0.84	0.76	473	440	380	1350	30.0	113	203	302
300	355S	1480	93.5	93.0	91.0	0.88	0.84	0.76	507	475	378	1400	32.0	113	203	302
315	355M	1480	93.5	93.0	91.0	0.88	0.84	0.76	533	475	395	1400	32.0	113	203	302
335	355M	1485	94.0	93.5	91.5	0.88	0.84	0.76	563	475	420	1800	52.0	113	203	302
355	355L	1485	94.0	93.5	91.5	0.90	0.86	0.78	584	535	395	2100	95.5	113	203	302
370	355L	1480	94.0	93.5	91.5	0.90	0.86	0.78	608	535	411	2100	95.5	113	203	302

NOTE : THE ABOVE PERFORMANCES ARE SUBJECTED TO TOLERANCES GIVEN IN IS : 325.

PERFORMANCE DATA OF JYOTI WD HORIZONTAL 6 POLE SLIP-RING MOTORS

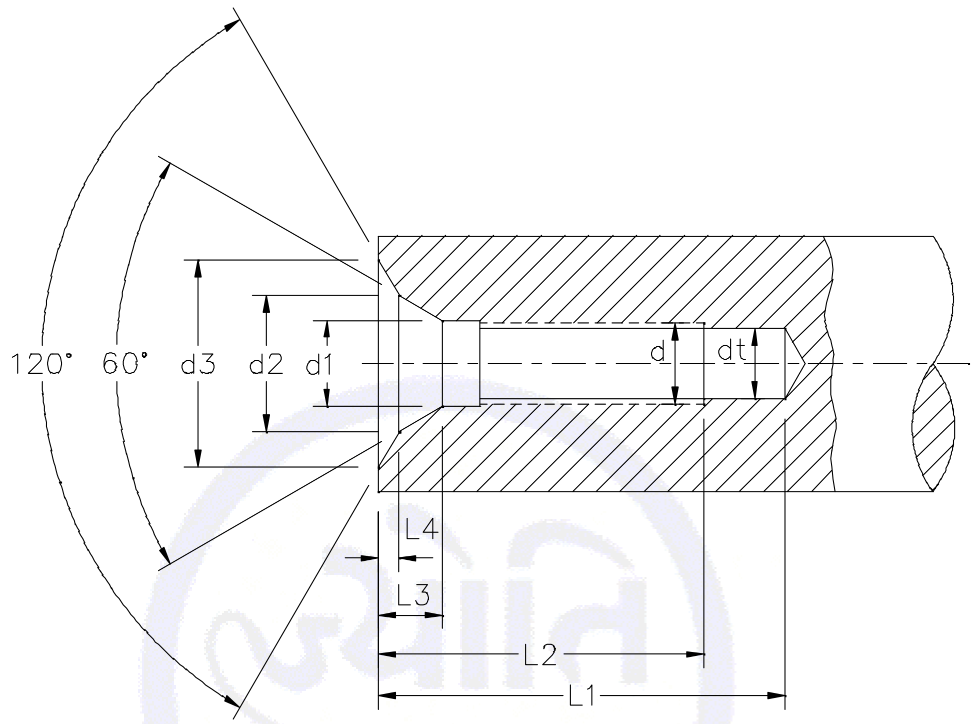
VOLTAGE	: 415 VOLTS ± 10 %	DUTY	: S1	DEG. OF PROTECTION	: IP-23
FREQUENCY	: 50 Hzs. ± 5 %	INSULATION	: F	MOUNTING	: B3
PHASE	: 3	AMB. TEMP.	: 45°C	COOLING	: IC-01
COMB. VARIT.	: ± 10 %	TEMP. RISE	: 75°C		

KW	Motor Type WD	FL Speed RPM	EFFICIENCY (%) LOAD 100	75	50	POWER FACTOR % LOAD 100	75	50	FL Current AMP	ROTOR VOLTAGE VOLTS	ROTOR CURRENT AMP.	WEIGHT Kg.	GD² KG-M²	T-N GRP .NO.	I-N GRP. NO.	T-W GRP. NO.
67	280S	975	91.0	90.5	89.0	0.80	0.76	0.70	128	400	101	780	13.8	112	203	301
75	280M	970	91.0	90.5	89.0	0.80	0.76	0.70	143	400	113	780	13.8	112	203	301
90	280M	975	92.0	91.5	90.0	0.84	0.82	0.72	160	361	150	820	15.0	112	203	301
110	315S/M	975	92.5	92.0	90.5	0.84	0.80	0.70	197	240	275	1000	20.0	113	203	302
125	315M	980	92.5	92.0	90.5	0.84	0.80	0.70	224	250	300	1180	24.0	113	203	302
132	315M	980	93.0	92.5	91.0	0.84	0.80	0.70	235	250	316	1180	24.0	113	203	302
150	315L	980	93.5	93.0	91.5	0.85	0.80	0.70	267	280	320	1250	27.0	113	203	302
160	315L	980	93.0	92.5	91.0	0.84	0.80	0.70	285	280	341	1250	27.0	113	203	302
180	355S	985	93.0	92.5	91.0	0.86	0.82	0.72	313	325	331	1850	50.0	113	203	302
200	355M	985	93.0	92.5	91.0	0.86	0.82	0.72	348	330	362	1950	60.0	113	203	302
220	355L	985	93.5	93.0	91.5	0.86	0.82	0.72	381	330	397	2000	64.0	113	203	302
250	355L	985	93.5	93.0	91.5	0.86	0.82	0.72	430	350	426	2150	68.0	113	203	302
280	400S	985	94.0	93.5	91.5	0.86	0.82	0.72	484	370	451	2200	72.0	113	203	302
300	400M	985	94.0	93.5	91.5	0.86	0.82	0.72	519	400	447	2400	75.0	113	203	302
315	400M	985	93.5	93.0	91.5	0.86	0.82	0.72	544	400	469	2400	79.0	113	203	302
335	400M	985	93.5	93.0	91.5	0.86	0.82	0.72	580	425	470	2450	79.0	113	203	302
355	400L	985	93.5	93.0	91.5	0.86	0.82	0.72	614	440	481	2600	85.0	113	203	302
370	400L	985	93.5	93.0	91.5	0.86	0.82	0.72	640	455	485	2600	85.0	113	203	302

NOTE: THE ABOVE PERFORMANCES ARE SUBJECTED TO TOLERANCES GIVEN IN IS: 325.

THREADED CENTER HOLES - WITH PROTECTED EDGES

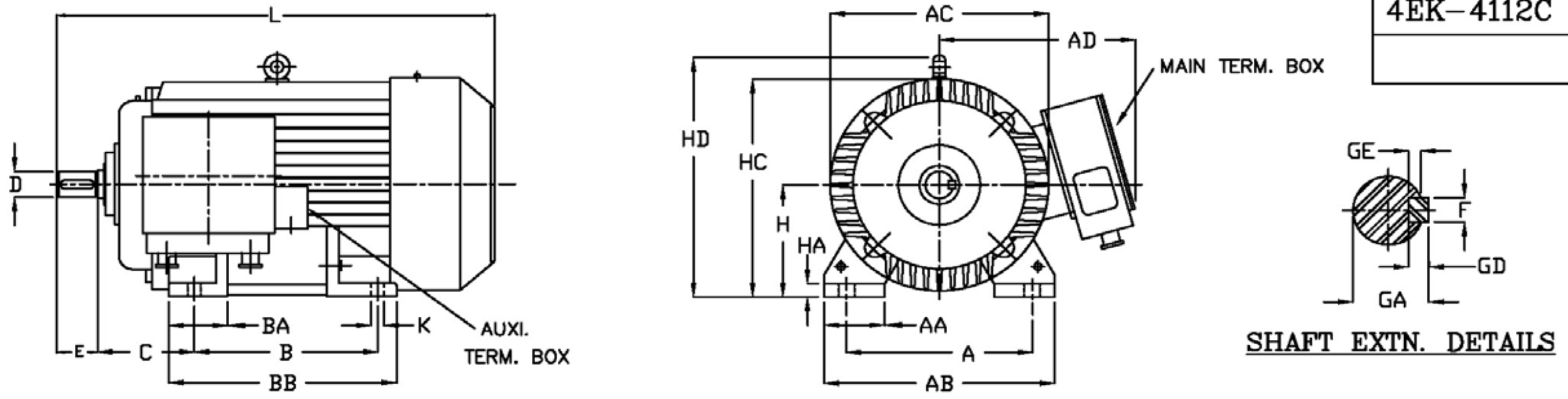
BASIS: - IS: 2540 - 1963
(COMPANY STANDARD NO : W25302)



Minimum Shaft Dia D	Nominal Size d	Tapping Drill Size dt	d1	d2	d3	L1	L2	L3	L4
10	M5	4.20	5.3	7.4	9.00	16	12	4.0	0.5
14	M6	5.00	6.4	9.4	11.00	20	16	4.5	0.5
17	M8	6.75	8.4	10.8	14.50	25	20	5.5	1.0
22	M10	8.50	10.5	13.8	17.50	30	24	7.0	1.0
30	M12	10.25	13.0	16.8	20.50	36	28	8.0	1.0
38	M16	14.00	17.0	21.7	28.50	40	32	10.0	2.0
50	M20	17.50	21.0	26.7	33.50	50	40	12.0	2.0
85	M24	21.00	25.0	32.7	39.50	63	50	14.0	2.0
130	M30	26.50	31.0	41.7	48.50	80	65	18.0	2.0

EXAMPLE FOR DESIGNATION: - PROTECTED CENTER HOLE M24 AS PER IS : 2540 - 1963.
Instruction for Machine shop: - These threaded center hole can be made by using ordinary twist drill of diameter. d1, d2 & d3 with flat 60° & 120° point respectively.

4EK−4112C



SHAFT EXTN. DETAILS

DASH NO.	FRAME	* A	* B	* C	H	K	L	+ AA	+ AB	+ AC	+ AD	+ BA	+ BB	+ HA	+ HC	+ HD	DØ	* E	F	GA	GD	GE
−1	CTF−280S	457	368	190	$280.0_{-1.0}$	24	1115	120	560	595	615	140	490	35	576	687	65m6	140	18	69.00	11.00	7.00
−2	CTF−280M	457	419	190	$280.0_{-1.0}$	24	1115	120	560	595	615	140	490	35	576	687	65m6	140	18	69.00	11.00	7.00
−3	CTF−315M	508	457	216	$315.0_{-1.0}$	28	1310	120	628	652	750	160	600	40	640	750	65m6	140	18	69.00	11.00	7.00
−4	CTF−315L	508	508	216	$315.0_{-1.0}$	28	1310	120	628	652	750	160	600	40	640	750	65m6	140	18	69.00	11.00	7.00
−5	CTF−355S	610	500	254	$355.0_{-1.0}$	28	1415	120	730	720	780	150	660	44	715	820	75m6	140	20	79.50	12.00	7.50
−6	CTF−355M	610	560	254	$355.0_{-1.0}$	28	1415	120	730	720	780	150	660	44	715	820	75m6	140	20	79.50	12.00	7.50
−7	CTF−400M	686	630	280	$400.0_{-1.0}$	36	1660	160	820	812	670	150	850	40	810	932	90m6	170	25	95.00	14.00	9.00
−8	CTF−400L	686	710	280	$400.0_{-1.0}$	36	1660	160	820	812	670	150	850	40	810	932	90m6	170	25	95.00	14.00	9.00

NOTES: −

(1) ALL DIMENSIONS ARE IN MILLIMETER EXCEPT OTHERWISE STATED.

\+ (2) THESE DIMENSIONS MAY VARY BY 5mm. DUE TO VARIATION IN FABRICATION/CASTING.

* (3) THESE DIMENSIONS MAY VARY BY ±0.75mm.

(4) NOS. & SIZE OF CABLE GLANDS WILL BE GIVEN AS PER CUSTOMER'S REQUIREMENT.

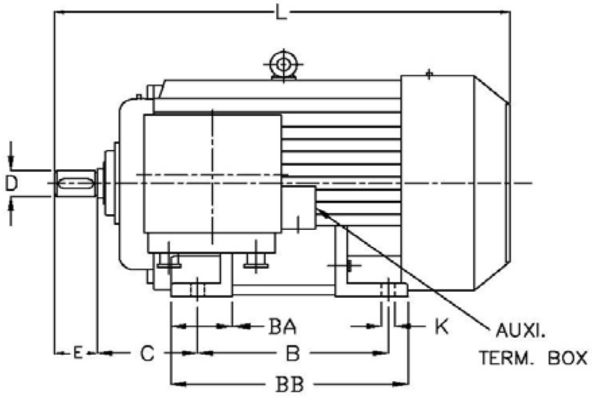
(5) THE CABLE ENTRY CAN BE TURNED TO ANY ONE OF FOUR POSITIONS AT 90° INTERVALS.

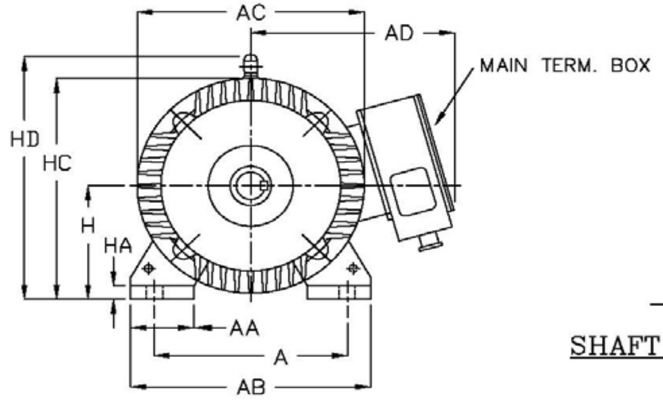
FOR 2 POLE ONLY.

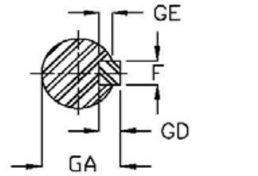
GENERAL DIMENSIONAL DRAWING OF JYOTI TEFC HORIZONTAL INDUCTION MOTOR.	APPD.BY	J.D.K.P.	Jyoti Ltd. VADODARA − INDIA
	DRN.BY	VBD	
	DATE:	20/4/11	No.:4EK−4112C

This drawing is the property of Jyoti Ltd. and any unauthorised use thereof by copying or otherwise by any party what soever is strictly prohibited.

4EK–3521E







SHAFT EXTN. DETAILS

DASH NO.	FRAME	*A	*B	*C	H	K	+L	+AA	+AB	+AC	+AD	+BA	+BB	+HA	+HC	+HD	DØ	*E	F	GA	GD	GE
–1	CTF–280S	457	368	190	$280.0_{-1.0}$	24	1115	120	560	595	615	140	490	35	576	687	75m6	140	20	79.50	12.00	7.50
–2	CTF–280M	457	419	190	$280.0_{-1.0}$	24	1115	120	560	595	615	140	490	35	576	687	75m6	140	20	79.50	12.00	7.50
–3	CTF–315M	508	457	216	$315.0_{-1.0}$	28	1310	120	628	652	750	160	600	40	640	750	80m6	170	22	85.00	14.00	9.00
–4	CTF–315L	508	508	216	$315.0_{-1.0}$	28	1310	120	628	652	750	160	600	40	640	750	80m6	170	22	85.00	14.00	9.00
–5	CTF–355S	610	500	254	$355.0_{-1.0}$	28	1415	120	730	720	780	150	660	44	715	820	100m6	210	28	106.00	16.00	10.00
–6	CTF–355M	610	560	254	$355.0_{-1.0}$	28	1415	120	730	720	780	150	660	44	715	820	100m6	210	28	106.00	16.00	10.00
–7	CTF–400M	686	630	280	$400.0_{-1.0}$	36	1660	160	820	812	670	150	850	40	810	932	100m6	210	28	106.00	16.00	10.00
–8	CTF–400L	686	710	280	$400.0_{-1.0}$	36	1660	160	820	812	670	150	850	40	810	932	100m6	210	28	106.00	16.00	10.00

NOTES: –

+ (1) ALL DIMENSIONS ARE IN MILLIMETER EXCEPT OTHERWISE STATED. THESE DIMENSIONS MAY VARY BY 5mm. DUE TO VARIATION IN FABRICATION/CASTING.

* (2) THESE DIMENSIONS MAY VARY BY ± 0.75mm.

(3) NOS. & SIZE OF CABLE GLANDS WILL BE GIVEN AS PER CUSTOMER'S REQUIREMENT.

(4) THE CABLE ENTRY CAN BE TURNED TO ANY ONE OF FOUR POSITIONS AT 90° INTERVALS.

FOR 4 POLE & MORE

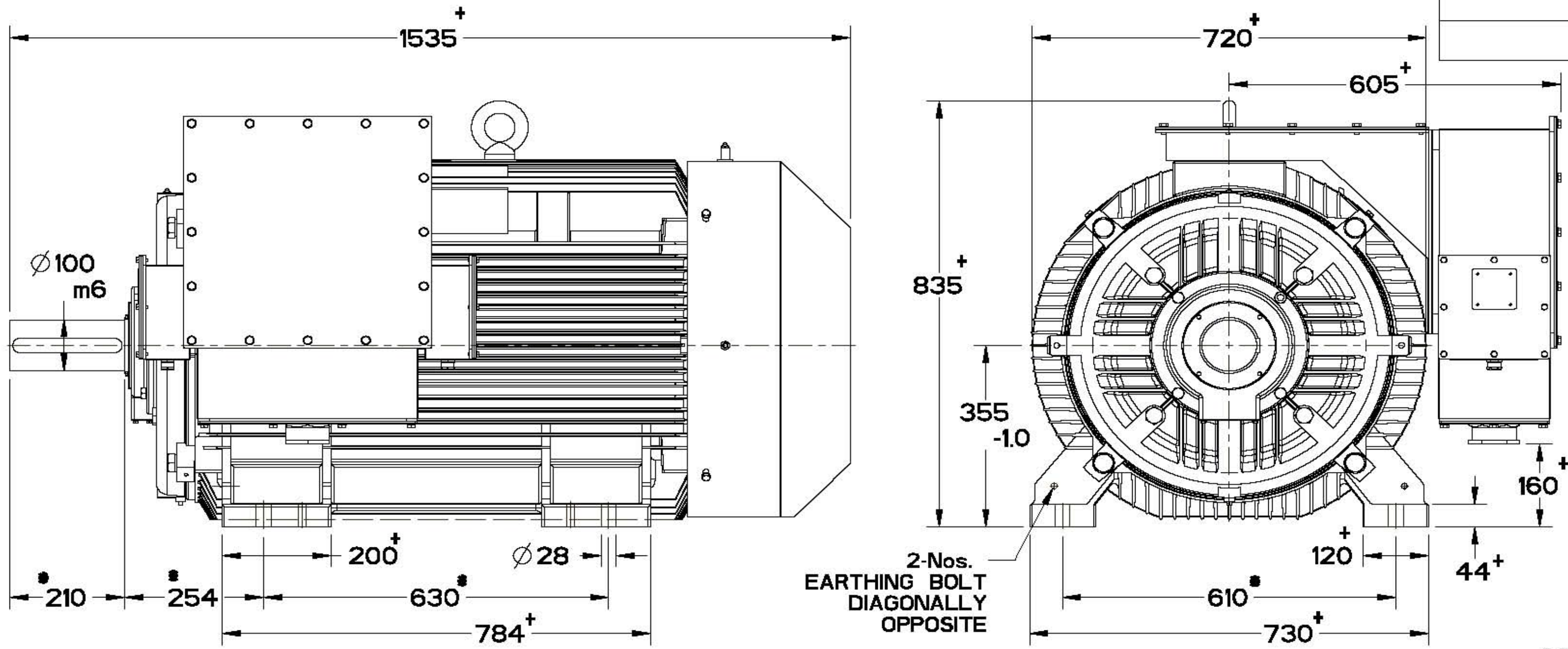
GENERAL DIMENSIONAL DRAWING OF JYOTI TEFC HORIZONTAL INDUCTION MOTOR.

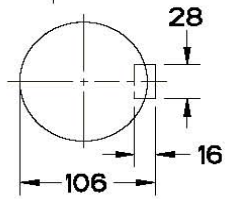
APPD.BY	J.D.K.P.
DRN.BY	VBD
DATE:	21/4/11

Jyoti Ltd. VADODARA – INDIA

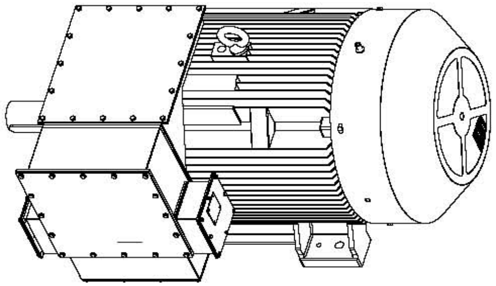
No.:4EK–3521E

4EK-5488





SHAFT EXT. DETAILS



Notes:-
* 1) These dimensions may vary by ±0.75mm.
+ 2) These dimensions may vary by ±5.0mm. due to variation in fabrication/casting.
3) All dimensions are in mm.
4) Nos. & size of cable glands will be given as per customer's requirement.

GENERAL DIMENSION DRAWING OF CTF-355L MOTOR	APPD.BY	JDKP	Jyoti Ltd. VADODARA - INDIA
	DRN.BY	VBD	
	DATE:	02-Mar-10	No. 4EK-5488

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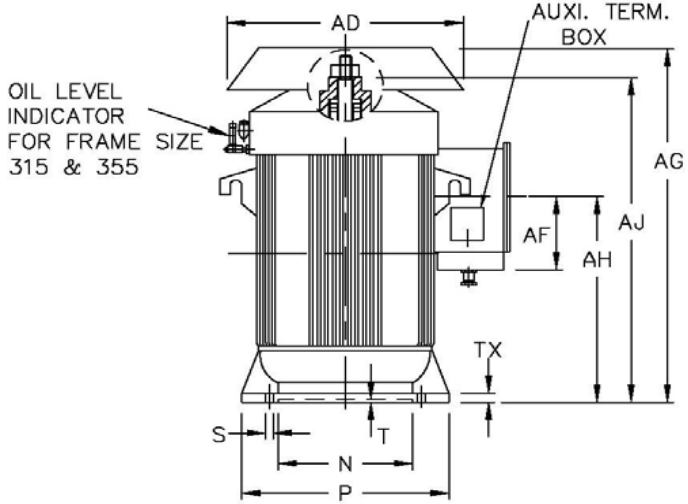
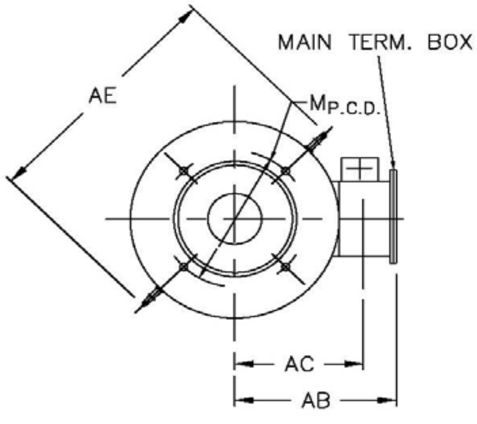
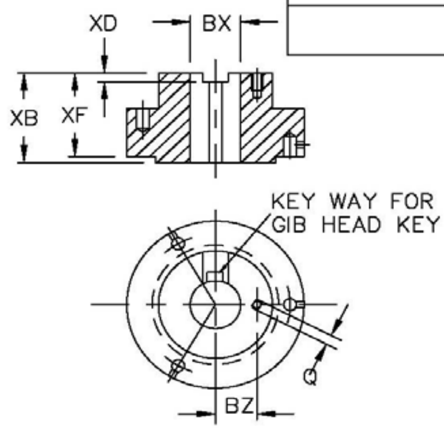
4EK–3641D





BOTTOM VIEW OF MOTOR



SAFETY CLUTCH TOP HALF

DASH NO.	FRAME	+P	M P.C.D.	N H8	S	T	+TX	+AB	+AC	+AD	+AE	+AF	+AG	+AH	AJ	⊗BX	GIB HEAD KEY SIZE	Q	XB	XF	XD	BZ
–1	CVTF–280	510	375	342.9	18	6	20	545	430	554	640	285	1235	595	1160	50 H8	14 X 9	M8	108	100	8	35
–2	CVTF–315	625	375	342.9	18	8	25	570	455	610	680	285	1415	756	1333	60 H8	18 X 11	M8	116	109	7	40
–3	CVTF–355	775	661	558.8	22	8	25	615	490	666	765	375	1590	933	1538	60 H8	18 X 11	M8	175	169	6	40

NOTES: –

(1) ALL DIMENSIONS ARE IN MILLIMETER EXCEPT OTHERWISE STATED.

\+ (2) THESE DIMENSIONS MAY VARY BY 5mm. DUE TO VARIATION IN FABRICATION/CASTING.

* (3) THESE DIMENSIONS MAY VARY BY ± 0.75mm.

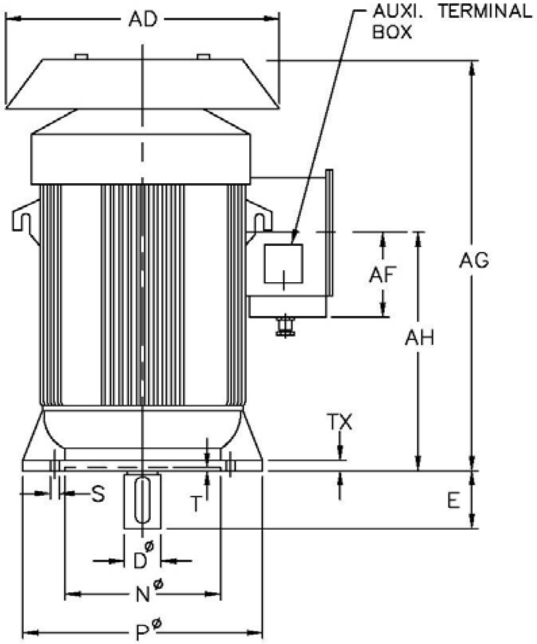
(4) NOS. & SIZE OF CABLE GLANDS WILL BE GIVEN AS PER CUSTOMER'S REQUIREMENT.

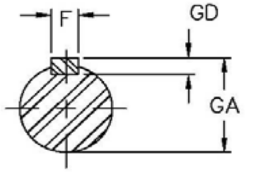
(5) THE CABLE ENTRY CAN BE TURNED TO ANY ONE OF FOUR POSITIONS AT 90° INTERVALS.

⊗ DIMENSION BX INDICATE THE MAXIMUM HEAD SHAFT DIA. PERMITTED FOR EACH FRAME.

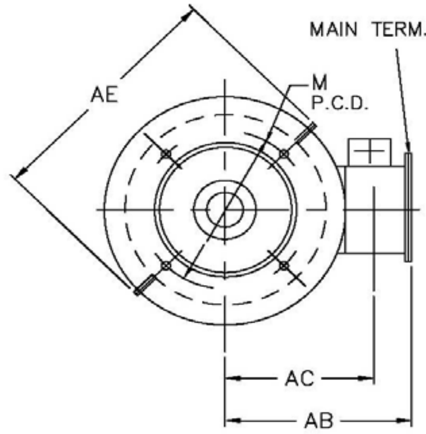
GENERAL DIMENSIONAL DRAWING OF JYOTI TEFC VERTICAL HOLLOW SHAFT MOTOR	APPD.BY	J.D.K.P.	Jyoti Ltd. VADODARA – INDIA
	DRN.BY	VBD	
	DATE:	21/4/11	No.: 4EK–3641D

4EK-3779E





END VIEW OF SHAFT



BOTTOM VIEW OF MOTOR

DASH NO.	FRAME	+P	M P.C.D.	N H8	S$^{\varnothing}$	T	+TX	+AB	+AC	+AD	+AE	+AF	AH	+AG	D$^{\varnothing}$	E	F	GA	GD
-1	CUTF-280	510	375	342.9	18	6	20	545	430	555	640	285	595	1135	75 m6	140	20	79.50	12.00
-2	CUTF-315	625	375	342.9	18	8	25	570	455	610	720	285	755	1335	80 m6	170	22	85.00	14.00
-3	CUTF-355	775	661	558.8	22	8	25	610	490	755	805	375	835	1405	100 m6	210	28	106.00	16.00

NOTES: -

(1) ALL DIMENSIONS ARE IN MILLIMETER EXCEPT OTHERWISE STATED.

+ (2) THESE DIMENSIONS MAY VARY BY ±5mm. DUE TO VARIATION IN FABRI./CASTING

* (3) THESE DIMENSIONS MAY VARY BY ± 0.75mm.

(4) NOS. & SIZE OF CABLE GLANDS WILL BE GIVEN AS PER CUSTOMER'S REQUIREMENT.

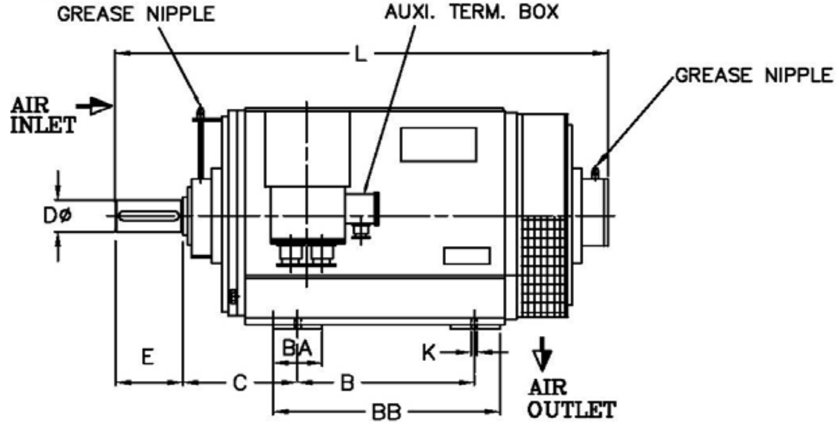
(5) THE CABLE ENTRY CAN BE TURNED TO ANY ONE OF FOUR POSITIONS AT 90° INTERVALS.

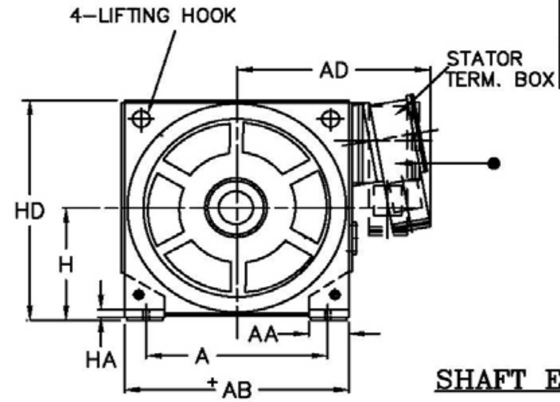
FOR 4 POLE & MORE

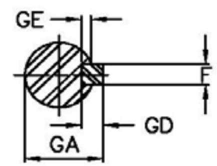
GENERAL DIMENSIONAL DRAWING OF JYOTI TEFC VERTICAL SOLID SHAFT MOTOR.	APPD.BY	J.D.K.P.	Jyoti Ltd. VADODARA - INDIA
	DRN.BY	VBD	
	DATE:	21/4/11	No.: 4EK-3779E

4EK-3105C

COM.M577-018







SHAFT EXTN. DETAILS

DASH NO.	FRAME	*A	+B	+C	+H	*K	+L	+AA	+AB	+AD	+BA	+BB	HA	+HD	D	*E	F_{h9}	GA	GD^{h11}	GE
-1	CD-280S	457	368	190	$280_{-1.0}$	24	1150	120	584	645	200	674	20	575	80_{m6}	170	22	85	14	9
-2	CD-280M	457	419	190	$280_{-1.0}$	24	1150	120	584	645	200	674	20	575	80_{m6}	170	22	85	14	9
-3	CD-315S	508	406	216	$315_{-1.0}$	28	1185	130	640	635	200	627	20	640	90_{m6}	170	25	95	14	9
-4	CD-315M	508	457	216	$315_{-1.0}$	28	1320	150	640	635	200	700	20	640	90_{m6}	170	25	95	14	9
-5	CD-315L	508	508	216	$315_{-1.0}$	28	1320	150	640	635	200	700	20	640	90_{m6}	170	25	95	14	9
-6	CD-355S	610	500	250	$355_{-1.0}$	28	1475	120	720	615	200	764	20	718	100_{m6}	210	28	106	16	10
-7	CD-355M	610	560	250	$355_{-1.0}$	28	1475	120	720	615	200	764	20	718	100_{m6}	210	28	106	16	10
-8	CD-355L	610	630	250	$355_{-1.0}$	28	1475	120	720	615	200	764	20	718	100_{m6}	210	28	106	16	10

NOTES: -

(1) ALL DIMENSIONS ARE IN MILLIMETER EXCEPT OTHERWISE STATED.

+ (2) THESE DIMENSIONS MAY VARY BY 5mm. DUE TO VARIATION IN FABRICATION/CASTING.

* (3) THESE DIMENSIONS MAY VARY BY ±0.75mm.

(4) NOS. & SIZE OF CABLE GLANDS WILL BE GIVEN AS PER CUSTOMER'S REQUIREMENT.

(5) THE CABLE ENTRY CAN BE TURNED TO ANY ONE OF FOUR POSITIONS AT 90° INTERVALS.

● FOR FRAME SIZE 355 THE TERM. BOX POSITION WILL BE STRAIGHT AS SHOWN.

FOR 4 POLE & MORE

GENERAL DIMENSIONAL DRAWING OF JYOTI DRIP PROOF HORIZONTAL INDUCTION MOTOR.

APPD.BY J.D.K.P.
DRN.BY VBD
DATE: 31/08/09

Jyoti Ltd. VADODARA - INDIA

No.:4EK-3105C

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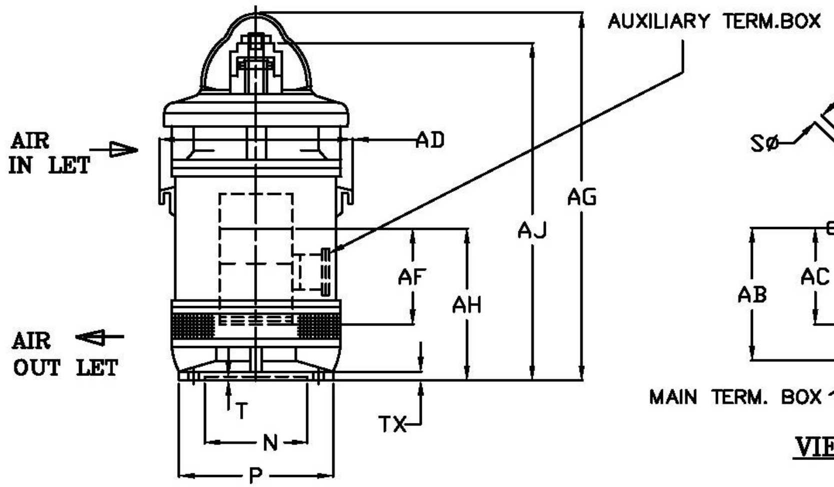
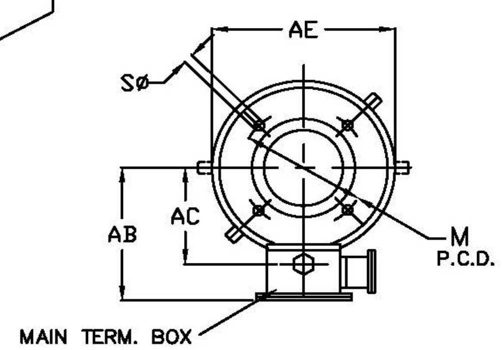
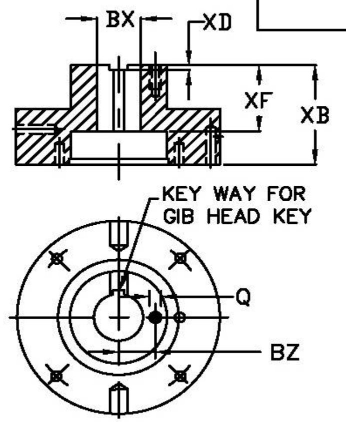
4EK-3112D





VIEW FROM BOTTOM



SAFETY CLUTCH TOP HALF

DASH NO.	FRAME	+ P	M P.C.D.	N H8	S	T	+TX	+AB	+AC	+AD	+AE	+AF	AH	AJ	+AG	⊗BX	KEY	Q	XB	XF	XD	BZ
-1	CVD-280	510	375.00	342.90	18	8	20	544	420	700	615	285	520	1166	1262	50 H8	14x9	M8	110	75	6	35

NOTES:-

(1) ALL DIMENSIONS ARE IN MILLIMETER EXCEPT OTHERWISE STATED.

+ (2) THESE DIMENSIONS MAY VARY BY 5mm. DUE TO VARIATION IN FABRICATION/CASTING.

* (3) THESE DIMENSIONS MAY VARY BY ± 0.75mm.

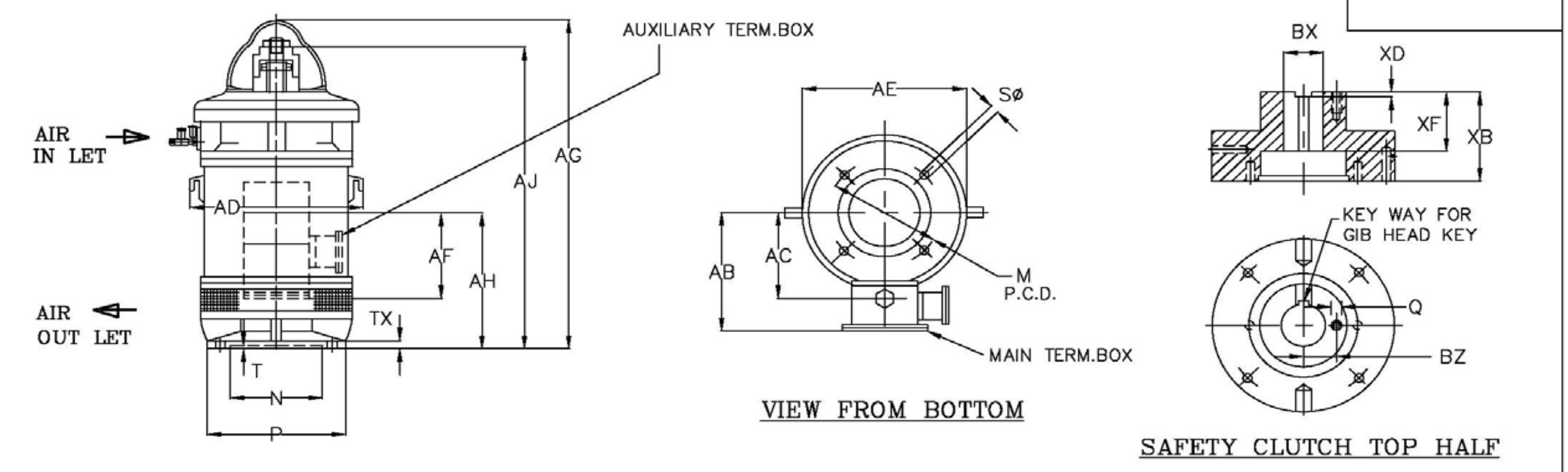
(4) NOS. & SIZE OF CABLE GLANDS WILL BE GIVEN AS PER CUSTOMER'S REQUIREMENT.

(5) THE CABLE ENTRY CAN BE TURNED TO ANY ONE OF FOUR POSITIONS AT 90° INTERVALS.

⊗ DIMENSION BX INDICATE THE MAXIMUM HEAD SHAFT DIA. PERMITED FOR EACH FRAME.

GENERAL DIMENSIONAL DRAWING OF JYOTI DRIP PROOF VERTICAL HOLLOW SHAFT MOTOR.	APPD.BY	J.D.K.P.	Jyoti Ltd. VADODARA - INDIA
	DRN.BY	VBD	
	DATE:	21/4/11	No.:4EK-3112D

4EK-3111C



DASH NO.	FRAME	+P	M P.C.D.	N H8	S	T	+TX	+AB	+AC	+AD	+AE	+AF	+AH	+AJ	+AG	⊗BX	KEY	Q	XB	XF	XD	BZ
−1	CVD−315	625	375.00	342.90	18	8	25	605	490	815	780	285	790	1402	1566	60 H8	18X11	M8	175	125	6	40
−2	CVD−355	775	661.00	558.80	22	8	30	660	553	960	920	370	810	1599	1731	60 H8	18X11	M8	187	130	6	40

NOTES: −

(1) ALL DIMENSIONS ARE IN MILLIMETER EXCEPT OTHERWISE STATED.

\+ (2) THESE DIMENSIONS MAY VARY BY 5mm. DUE TO VARIATION IN FABRICATION/CASTING.

* (3) THESE DIMENSIONS MAY VARY BY ±0.75mm.

(4) NOS. & SIZE OF CABLE GLANDS WILL BE GIVEN AS PER CUSTOMER'S REQUIREMENT.

(5) THE CABLE ENTRY CAN BE TURNED TO ANY ONE OF FOUR POSITIONS AT 90° INTERVALS.

⊗ DIMENSION BX INDICATE THE MAXIMUM HEAD SHAFT DIA. PERMITTED FOR EACH FRAME.

GENERAL DIMENSIONAL DRAWING OF JYOTI DRIP PROOF VERTICAL HOLLOW SHAFT MOTOR.

APPD.BY	J.D.K.P.	Jyoti Ltd. VADODARA − INDIA
DRN.BY	VBD	
DATE:	31/08/09	NO.: 4EK-3111C

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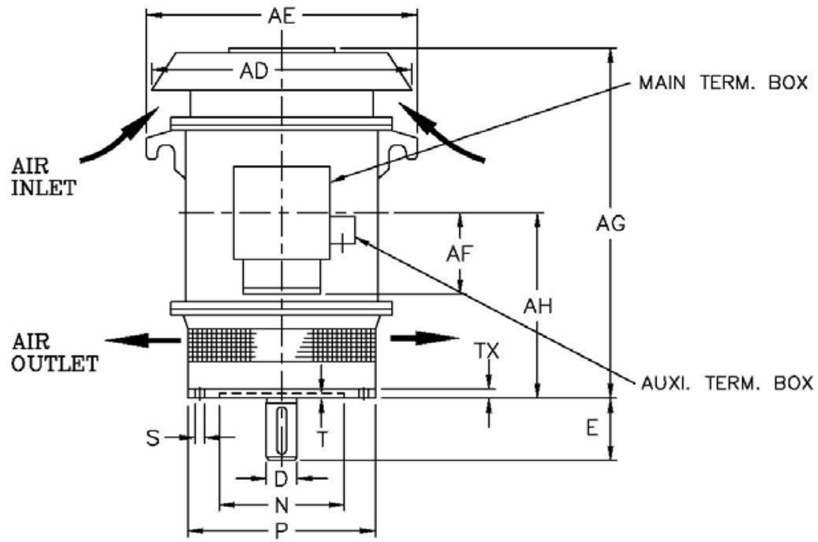
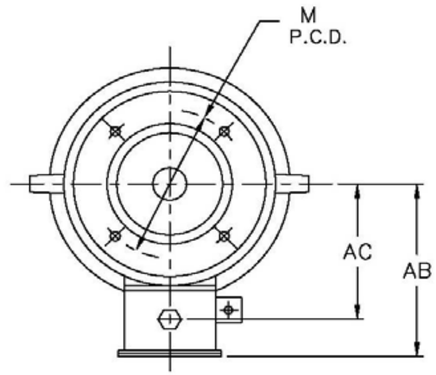
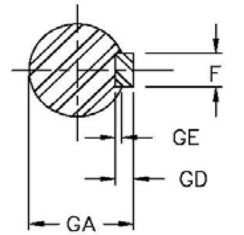
4EK–2565D





BOTTOM VIEW OF MOTOR



END VIEW OF SHAFT

DASH NO.	FRAME	+P	M P.C.D.	N H8	SØ	T	+TX	+AB	+AC	+AD	+AE	+AF	+AH	+AG	DØ	E	F	GA	GD	GE
–1	CUD–280	510	375	342.90	18	8	20	545	420	690	700	285	520	989	80_{m6}	170	22	85.00	14.00	9.00
–2	CUD–315	625	375	342.90	18	8	25	593	470	720	784	285	790	1210	90_{m6}	170	25	95.00	14.00	9.00
–3	CUD–355	775	661	558.80	22	8	30	660	535	890	960	375	810	1354	90_{m6}	170	25	95.00	14.00	9.00

NOTES: –

(1) ALL DIMENSIONS ARE IN MILLIMETER EXCEPT OTHERWISE STATED.

\+ (2) THESE DIMENSIONS MAY VARY BY 5mm. DUE TO VARIATION IN FABRICATION/CASTING.

* (3) THESE DIMENSIONS MAY VARY BY ±0.75mm.

(4) NOS. & SIZE OF CABLE GLANDS WILL BE GIVEN AS PER CUSTOMER'S REQUIREMENT.

(5) THE CABLE ENTRY CAN BE TURNED TO ANY ONE OF FOUR POSITIONS AT 90° INTERVALS.

FOR 4 POLE & MORE

GENERAL DIMENSIONAL DRAWING OF JYOTI DRIP PROOF VERTICAL SOLID SHAFT MOTOR.	APPD.BY	J.D.K.P.	Jyoti Ltd. VADODARA – INDIA
	DRN.BY	VBD	
	DATE:	21/4/11	No.:4EK–2565D

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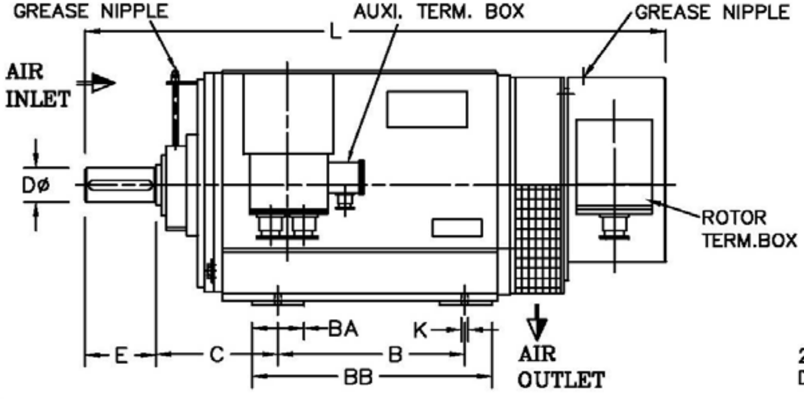
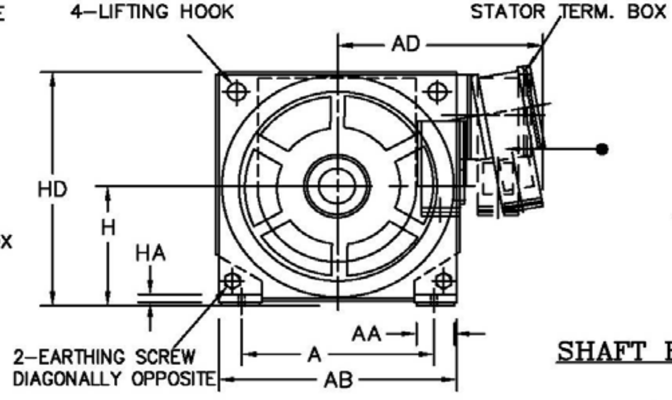
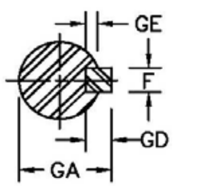
4EK–3110B
COM.M255–013







SHAFT EXTN. DETAILS

DASH NO.	FRAME	* A	+AA	+AB	+AD	* B	+ BB	+ BA	* C	D	* E	F h9	GA	GD h11	GE	H	+ HA	+ HD +	K	+ L
–1	WD–280S	457	150	584	645	368	674	200	190	80_{m6}	170	22	85	14	9.00	$280_{-1.0}$	20	575	24	1425
–2	WD–280M	457	150	584	645	419	674	200	190	80_{m6}	170	22	85	14	9.00	$280_{-1.0}$	20	575	24	1425
–3	WD–315S	508	150	640	640	406	700	200	216	90_{m6}	170	25	95	14	9.00	$315_{-1.0}$	20	640	28	1675
–4	WD–315M	508	150	640	640	457	700	200	216	90_{m6}	170	25	95	14	9.00	$315_{-1.0}$	20	640	28	1675
–5	WD–315L	508	150	640	640	508	700	200	216	90_{m6}	170	25	95	14	9.00	$315_{-1.0}$	20	640	28	1675
–6	WD–355S	610	135	720	604	500	764	200	250	100_{m6}	210	28	106	16	10.00	$355_{-1.0}$	20	718	28	1790
–7	WD–355M	610	135	720	604	560	764	200	250	100_{m6}	210	28	106	16	10.00	$355_{-1.0}$	20	710	28	1790
–8	WD–355L	610	135	720	604	630	764	200	250	100_{m6}	210	28	106	16	10.00	$355_{-1.0}$	20	710	28	1790
–9	WD–400S	686	135	750	765	560	656	200	280	100_{m6}	210	28	106	16	10.00	$400_{-1.0}$	20	778	28	1820
–10	WD–400M	686	135	750	765	630	726	200	280	100_{m6}	210	28	106	16	10.00	$400_{-1.0}$	20	778	28	1885

NOTES: –

(1) ALL DIMENSIONS ARE IN MILLIMETER EXCEPT OTHERWISE STATED.

\+ (2) THESE DIMENSIONS MAY VARY BY 5mm. DUE TO VARIATION IN FABRICATION/CASTING.

* (3) THESE DIMENSIONS MAY VARY BY ±0.75mm.

(4) NOS. & SIZE OF CABLE GLANDS WILL BE GIVEN AS PER CUSTOMER'S REQUIREMENT.

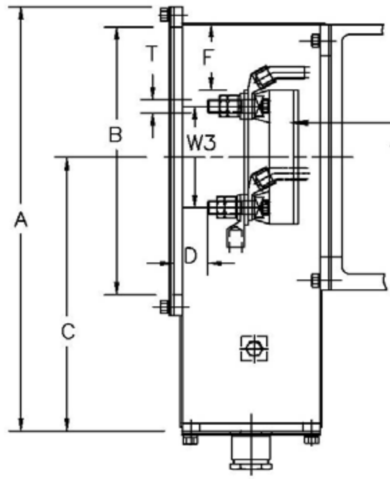
(5) THE CABLE ENTRY CAN BE TURNED TO ANY ONE OF FOUR POSITIONS AT 90° INTERVALS.

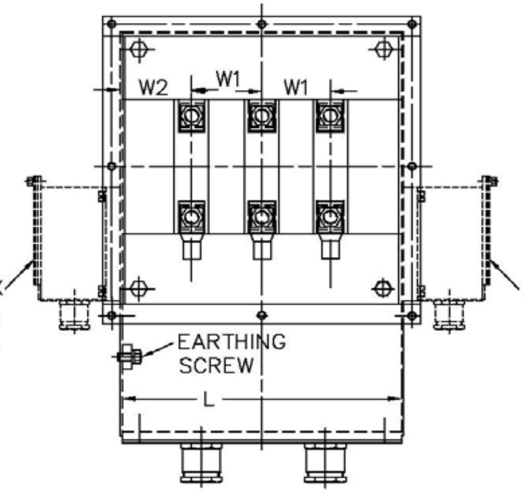
● FOR FRAME SIZE 355 THE TERM. BOX POSITION WILL BE STRAIGHT AS SHOWN.

FOR 4 POLE & MORE

GENERAL DIMENSIONAL DRAWING OF JYOTI DRIP PROOF HORIZONTAL SLIP RING MOTOR.	APPD.BY	J.D.K.P.	Jyoti Ltd. VADODARA – INDIA
	DRN.BY	VBD	
	DATE:	31/08/09	No.:4EK–3110B

4EK–4879B





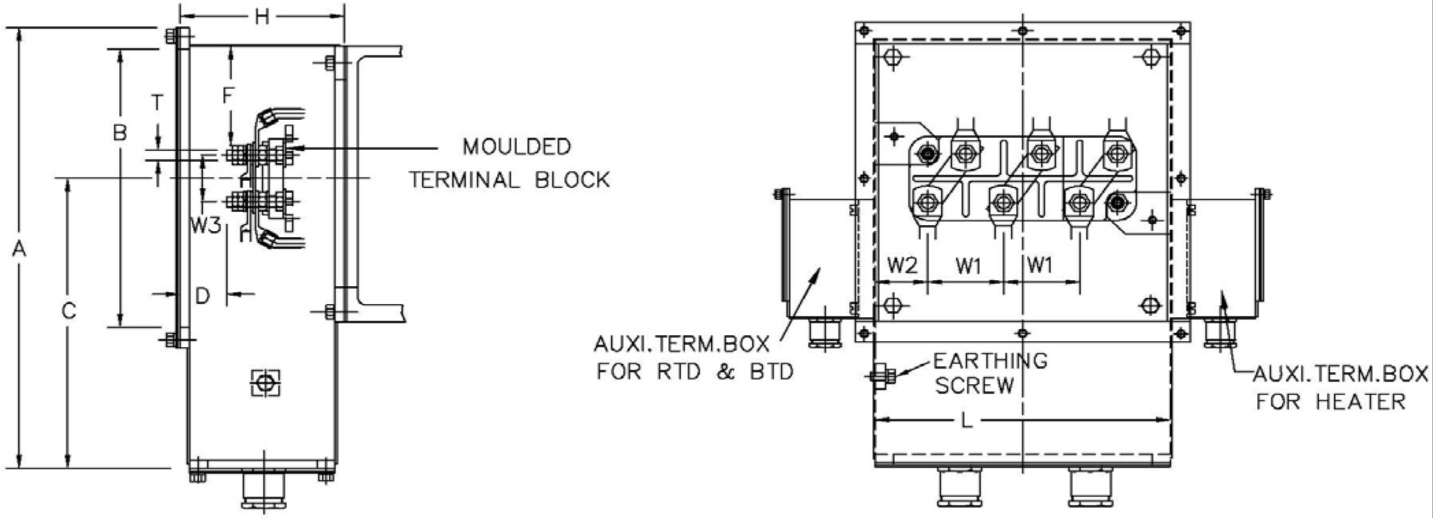
DASH NO.	FRAME	TERM.BOX SUITABLE FOR CABLE	L	B	H +	INTERNAL DIMENSIONS			A +	C	D	F	T
						W1	W2	W3					
–1	280	2 X 3C X 240 SQ.MM.	320	315	220	65	95	70	467	280	40	125	M16
–2	315	2 X 3C X 300 SQ.MM.	320	315	220	65	95	70	467	280	40	125	M16

NOTES: –

+ (1) THESE DIMENSIONS MAY VARY BY 5mm. DUE TO VARIATIONS IN FABRICATION/CASTING.
* (2) CABLE ENTRY HOLES AND CABLE GLANDS CAN BE PROVIDED TO SUIT SPECIFIC REQUIREMENT OF CUSTOMER ON REQUEST.
(3) AUX. TERM. BOXES MAY BE GIVEN AGAINST ACCESSORIES REQUIREMENT

GENERAL ARRAGEMENTS FOR INDUCTION MOTOR'S TERMINAL BOX	APPD.BY J.D.K.PATEL	Jyoti Ltd. VADODARA – INDIA
	DRN.BY VBD	
	DATE: 19/4/11	No.:4EK–4879B

4EK-5774



DASH NO.	FRAME	TERM.BOX SUITABLE FOR CABLE	L	B	H +	INTERNAL DIMENSIONS			A +	C	D	F	T
						W1	W2	W3					
–1	355	2 X 3C X 400 SQ.MM.	400	395	220	102	70	70	595	390	60	125	M16
–2	400	2 X 3C X 400 SQ.MM.	400	395	220	102	70	70	595	390	60	125	M16

NOTES: –

\+ (1) THESE DIMENSIONS MAY VARY BY 5mm. DUE TO VARIATIONS IN FABRICATION/CASTING.

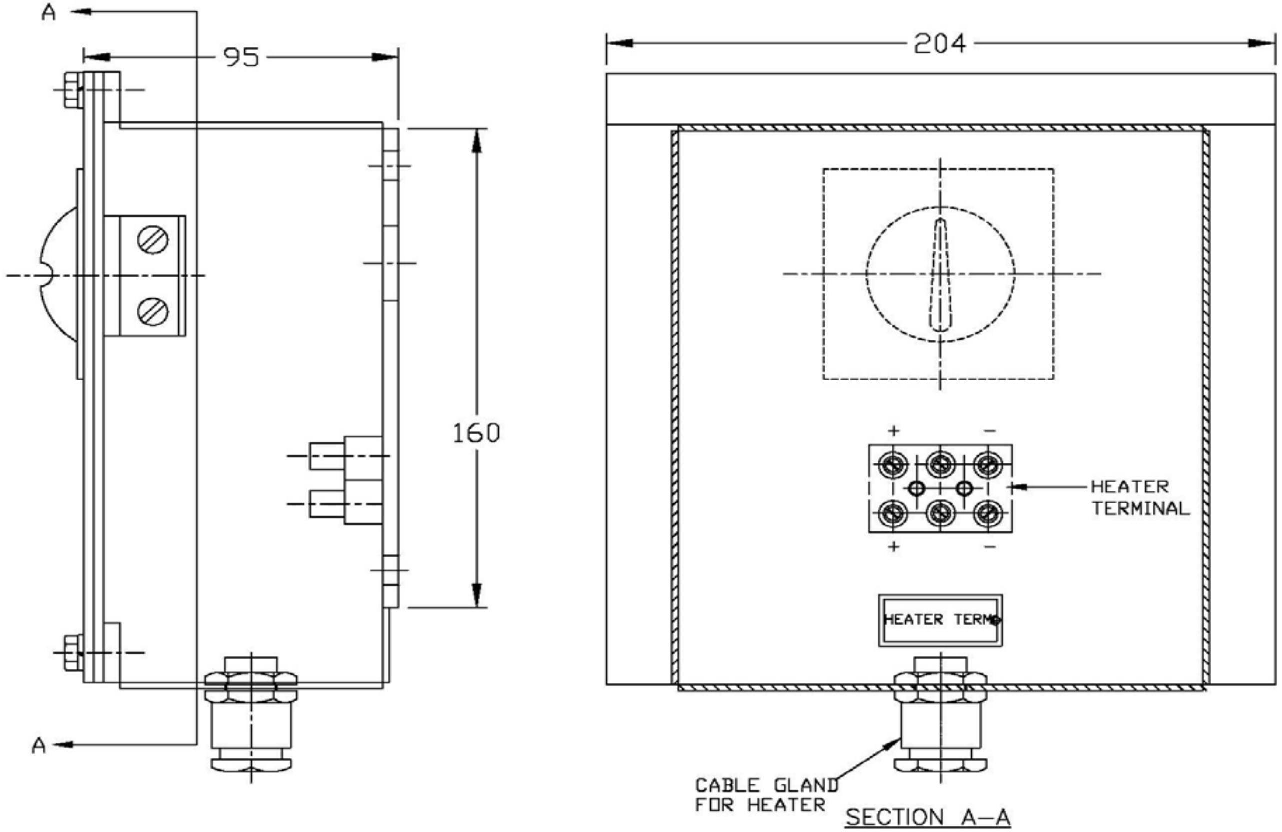
* (2) CABLE ENTRY HOLES AND CABLE GLANDS CAN BE PROVIDED TO SUIT SPECIFIC REQUIREMENT OF CUSTOMER ON REQUEST.

(3) DEGREE OF PROTECTION : IP55

GENERAL ARRAGEMENTS FOR INDUCTION MOTOR'S TERMINAL BOX

APPD.BY	JDKP	Jyoti Ltd. VADODARA – INDIA
DRN.BY	VBD	
DATE:	19/4/11	No.4EK-5774

4EK-4687A



ACCESSORIES :– SPACE HEATER

AUXI. TERMINAL BOX ARRANGEMENT FOR ACCESSORIES.	APPD.BY	JDKP	Jyoti Ltd. VADODARA – INDIA
	DRN.BY	VBD	
	DATE:	19/4/11	No.4EK-4687A

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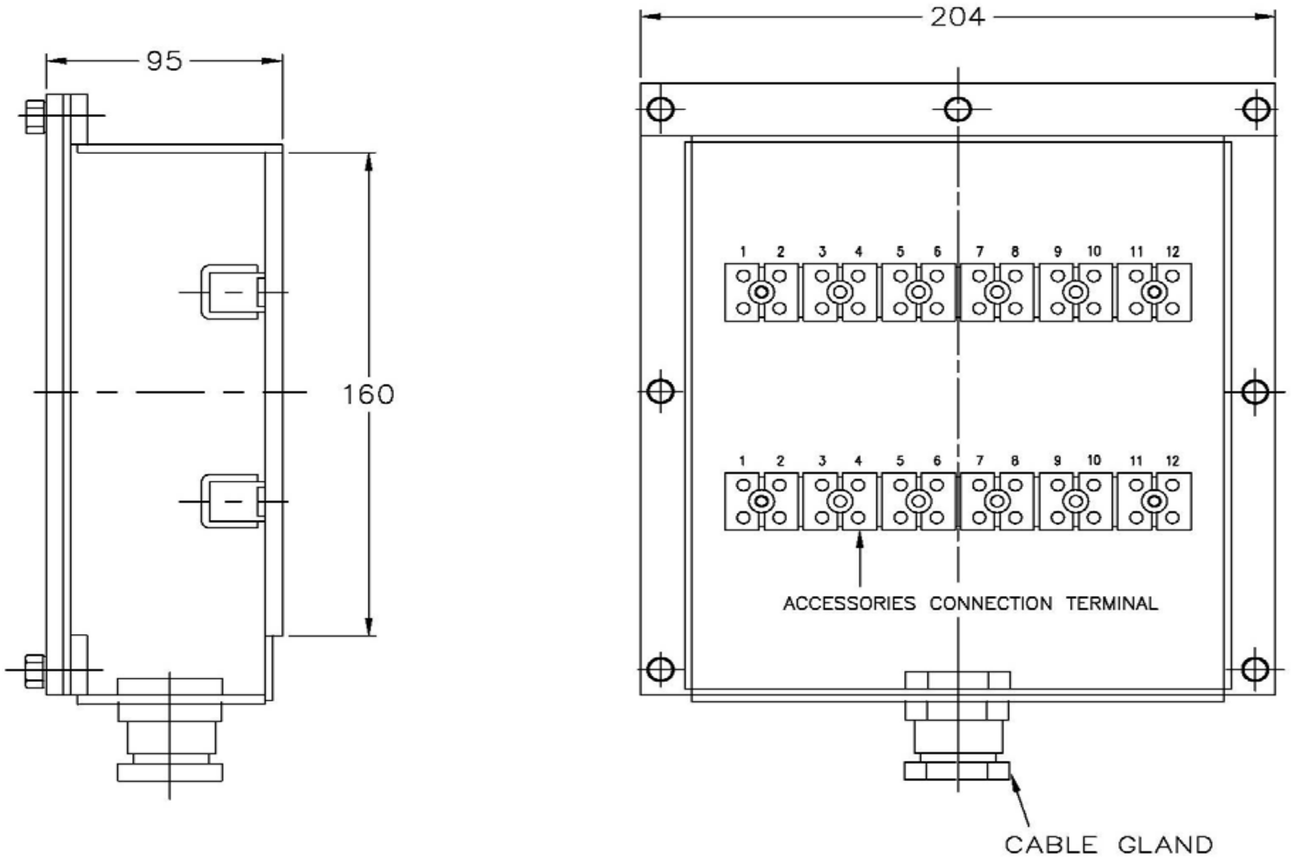
4EK-5775



ACCESSORIES :- RTD,BTD & THERMISTER

AUXI. TERMINAL BOX
ARRANGEMENT FOR ACCESSORIES.

APPD.BY	JDKP
DRN.BY	VBD
DATE:	19/4/11

Jyoti Ltd.
VADODARA - INDIA
No. 4EK-5775

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4EK–3835A

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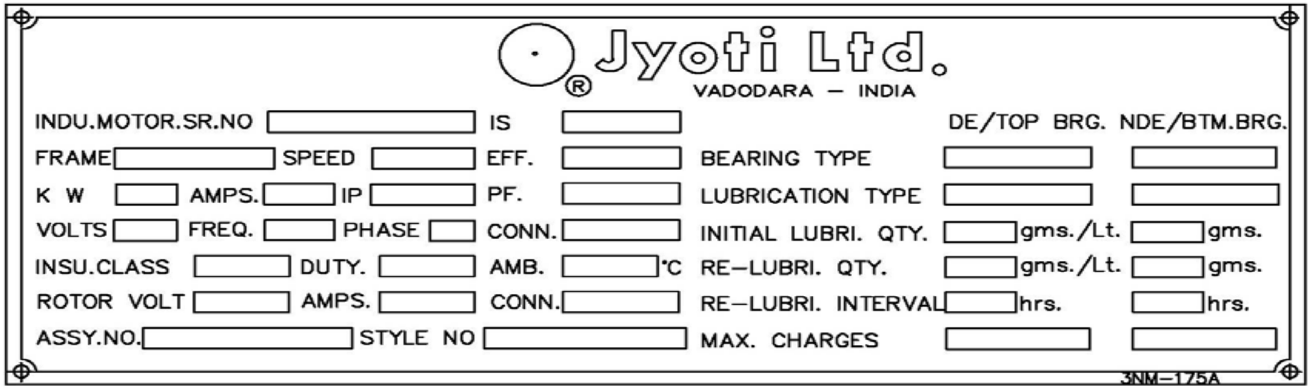

NAME PLATE FOR INDUCTION MOTOR.	APPD.BY J.D.K.P.	Jyoti Ltd. VADODARA – INDIA
	DRN.BY S.C.P.	
	DATE: 10/08/99	No.:4EK–3835A

10/08/99

RECOMMENDED SPARES

DESCRIPTION OF PARTS	RECOMMENDED MINIMUM STOCK		
	NUMBER OF UNITS IN OPERATION		
	1 to 4	5 to 9	10 to 20
Bearings	1 set	2 set	4 set
Space heaters	1 set	2 set	4 set
Thermistors / RTD / BTD	1 set	2 set	4 set
Sliprings *	1 set	1 set	2 set
Brushes *	1 set	2 set	4 set
Brushes holders *	1 set	2 set	4 set
Oil seals / Leap seal	1 set	2 set	4 set
Dial type thermometer	1 set	2 set	4 set

*** As applicable to slipring motors only.**

SHIPPING DIMENSIONS & WEIGHTS

FRAME SIZE	L (cm)	B (cm)	H (cm)	WEIGHT (kg)
CTF - 280 S	122	102	74	850
CTF - 280 M	122	102	74	900
CTF - 315 S	129	116	80	1140
CTF - 315 M	141	115	81	1250
CTF - 315 L	141	115	81	1400
CTF - 355 S	150	125	84	1750
CTF - 355 M	150	125	84	1800
CTF - 400 L	180	128	100	2700
CVTF - 280	88	75	130	880
CVTF - 315	97	81	147	1450
CVTF - 355	115	93	167	2500
CUTF - 280	107	82	162	1500
CUTF - 315	115	93	190	2650
CUTF - 355	128	105	182	2750
CD - 280 S	125	105	68	830
CD - 280 M	125	105	68	970
CD - 315 S	143	114	70	1050
CD - 315 M	143	114	70	1200
CD - 315 L	143	114	70	1500
CD - 355 S	160	114	79	1950
CD - 355 M	160	114	79	2150
CD - 355 L	160	114	79	2250

CVD - 280	110	83	133	1100
CVD - 315	114	110	161	1750
CVD - 355	129	116	181	2300
CUD - 280	99	83	132	1150
CUD - 315	112	91	140	1800
CUD - 355	121	111	157	2400
WD - 280 S	153	107	65	880
WD - 280 M	153	107	65	950
WD - 315 S	174	110	76	1200
WD - 315 M	174	110	76	1400
WD - 315 L	174	110	76	1500
WD - 355 S	190	111	76	2100
WD - 355 M	190	111	76	2250
WD - 355 L	190	111	76	2400
WD - 400 S	194	115	85	2400
WD - 400 M	194	115	85	2600
WD - 400 L	194	115	85	2850

DEFINITIONS AND FORMULAS

➢ DEFINITIONS :

1) Continuous Max. Rating (S1):- It is the shaft load in kW which motor can carry continuously Without or CMR exceeding temperature rise limit.

2) Efficiency (η):- It is the ratio of output (kW) to input (kW) for a given loading condition.

Power factor (PF): - It is the ratio of input (kW) to input (kVA) for a given loading condition.

3) Rotor voltage of slipring motor (RV):- It is the open circuit voltage at standstill, measured across the with rated voltage applied to stator winding.

4) Rotor current of rated slipring motor (RA):- It is the current flowing through rotor winding and slipring at load with slipring shorted.

5) Starting torque (Tst):- It is the torque (% of full load torque) which motor will develop at rest with rated voltage and frequency applied to stator winding.

6) Starting current (Ist):- It is the steady state current (% of full load current) which Motor will draw at rest with rated voltage and frequency applied to stator winding.

7) Pull out torque (Tmax):- It is the maximum torque (% of full load torque) which motor will develop, without an abrupt drop in speed with rated voltage and frequency applied to stator winding.

8) Full load torque (FLT):- It is the torque (Kg-M) developed by the motor delivering Rated load with rated voltage and frequency applied to stator winding.

9) Full load current (FLC):- It is the current (Amp) drawn by the motor delivering rated Load with rated voltage and frequency applied to stator Winding.

10) Full load speed (FLS): - It is the speed (RPM) of rotation of the motor delivering Rated load at rated voltage and frequency.

11) Moment of inertia (GD^2):- It is the mass moment of inertia (in Kg -m^2) of rotating parts of the motor.

Note:
For definition of other terminologies please refer IS-1885 pt.35

FORMULAS

1) Full load current IFL = $\frac{kW \times 1000}{1.732 \times VOLT \times PF \times \eta}$

2) % Efficiency (η) = $\frac{kW (Output) \times 100}{kW (Input)}$

3) Power factor PF(pu) = $\frac{kW(Input) \times 1000}{1.732 \times VOLT \times IFL}$

4) Synch. speed Ns(RPM) = $\frac{120 \times Frequency}{No.\ of\ poles}$

5) Full load speed N (RPM) = $\frac{Ns \times (1 - S)}{100}$

6) Full load slip S(%) = $\frac{(Ns - N) \times 100}{Ns}$

7) Full load torque FLT (KGM) = $\frac{kW \times 974}{N}$

8) Horse power HP = $\frac{kW}{0.746}$

9) Power output of motor

a) For linear displacement is found from

P (HP) = $\frac{F \times V}{75 \times \eta}$ or (kW) = $\frac{F \times V}{102 \times \eta}$

F = Load (kg)
V = Vel (M/Sec)
η = Efficiency

b) For angular displacement from

P (HP) = $\frac{T \times S}{716 \times \eta}$ or (kW) = $\frac{T \times S}{974 \times \eta}$

T = Torque (kgm)
S = Speed (rpm)

c) For pump drives the required power output of the motor is determined by substituting the product of the pump capacity and the manometric lifting head for the product F.V giving

P(kW) = $\frac{1000 \times Q \times \nu \times H}{102 \times \eta}$

Q = Capacity of the pump (m^3 s)
ν = Sp.Wt. of the liquid kg/m^3)
H = Total head of liquid(m)

d) With lifts the weight of the cage & half of the useful load are balanced by counter-weight.

P (kW) = $\frac{F \times V}{2 \times 102 \times \eta}$

V = Velocity in (m/s)

e) In case of fans P (kW) = $\frac{Q \times p}{102 \times \eta}$

p = Air back - pressure at the outlet in mm of a column of water (kg/m^2 = 0.00142 PSI)

SPECIFICATION OF INDUCTION MOTORS

A) GENERAL:

1)	Type of rotor	Squirrel cage / Slip ring
2)	Rated Power Output (kW)	0.55 kW to 5000 kW
3)	Synchronous speed (RPM)	3000 / 1500 / 1000 / 750 etc.
4)	Type of Enclosure	Drip proof / TEFC / CACA / CACW
5)	Degree of Protection	IP-23, IP -44 & IP-55
6)	Method of Cooling	IC -01/IC-411/IC-161 etc.
7)	Method of Mounting	B3 - Horizontal foot mounted V1 - Vertical flange mounted etc.
8)	Frame size	71 to 1100
9)	Class of Insulation	F / H
10)	Type of Duty	S1- Continuous.
11)	No. of phases	3
12)	Rated Voltage (Volts)	415 / 3300 / 6600 / 11000
13)	Rated Frequency (Hz)	50
14)	Variation in Voltage	± 6 % or ±10 % or + 6 %, -15 %
15)	% Variation in Frequency	± 3 % or ± 5 %
16)	% Combined Voltage & Frequency Variation	± 6 % or ± 10 %
17)	Winding Connection - stator & rotor	Star or Delta
18)	Terminals	Three or Six
19)	Power cable Type / Run / Size	As per client requirement
20)	Method of Earthing	2 nos. diagonally opposite
21)	Permissible Temperature Rise	Limited to B
22)	Minimum Starting Voltage across the terminal	85 % of rated voltage
23)	Method of Starting	DOL / Star - Delta / Auto Trans. etc.
24)	Direction of Rotation	Clockwise / Anti clockwise looking from shaft side / Both direction
25)	Type of Coupling	Flexible for solid shaft motor rigid for hollow shaft motor.
26)	Shaft orientation	Horizontal / Vertical etc.
27)	Noise level at one meter distance	As per is : 12065.
28)	Vibration Level	As per is : 12075
29)	Terminal box position	Right hand side looking from coupling end
30)	Fault withstand capability of terminal box	45 MVA / 250 MVA / 350 MVA etc.
31)	Duration of fault	0.25 Second

32)	Type of slip ring gear		Fixed
33)	No. Of starts per hour		
	a)	Equally spread starts	3
	b)	Hot starts	1
	c)	Cold starts	2
34)	Bearing		
	a)	Drive End side / Top side	Ball or Rollar bearing or Thrust Bearing
	b)	Non drive end/ Bottom side	Ball or Rollar bearing
35)	Lubrication		
	a)	Drive End side / Top side	Lithium base Grease or Oil
	b)	Non drive end/ Bottom side	Lithium Base Grease or Oil
36)	Reference standard		IS: 325 / IEC 34 -1

C) <u>SITE CONDITIONS:</u>

1)	Ambient Temperature (°C)	45 °C
2)	Altitude (Meters)	Up to 1000 m
3)	Maximum Humidity (%)	50 % for drip proof machine 100 % for TEFC & CACA, CACW
4)	Installation	Location - Outdoor / Indoor
5)	Atmospheric Condition	Non Hazardous
6)	Paints & Treatments	Colour - Shade no. 621 of IS 5

F) <u>ACCESSORIES:</u>

1)	Space Heaters	Optional
2)	Thermistors	Optional
For Motors above 280 Frame		
3)	Winding - RTD	Optional - 100 Ω at 0 °C Simplex
4)	Bearing - RTD	Optional - 100 Ω at 0 °C Simplex
5)	Dial type Thermometer for Bearing	Optional for Vertical Hollow shaft motor
6)	Breather plug	Optional for Totally enclosed motor
7)	Terminal Box for accessories	Optional
8)	If any Special Requirements	Optional

OUESTIONNAIRE FOR 3 PHASE INDUCTION MOTORS

(FOR ENQUIRY / TENDER / ORDER)

A) GENERAL:

1) Project Name
2) No. Of Motor required
3) Type of Motor (Squirrel Cage / Slipring)
4) Rated Power Output (kW)
5) Speed (RPM) / No. of Poles
6) Type of Enclosure
7) Degree of Protection
8) Method of Cooling
9) Method of Mounting
10) Class of Insulation
11) Type of Duty
12) Noise level at one metre distance
13) Vibration Level
14) Power cable Type / Run / Size

B) SUPPLY CONDITIONS :

1) Rated Voltage (Volts)
2) Rated Frequency (Hz)
3) Variation in Voltage (%)
4) Variation in Frequency (%)
5) Combined Voltage & Frequency Variation (%)
6) Minimum Starting Voltage across the terminal
7) Method of Starting

C) SITE CONDITIONS:

1) Ambient Temperature (°C)
2) Altitude (Meters)
3) Maximum Humidity (%)
4) Installation (Location- Outdoor/Indoor)
5) Atmospheric Condition
6) Permissible Temperature Rise

D) DRIVEN EQUIPMENT DETAILS:

1) Type of given Equipment
2) Torque Speed characteristic of Driven Equipment
3) Moment of Inertia (GD^2) Driven Equipment / Reference Speed
4) Direction of Rotation
5) Crank Angle / Torque Diagram for compressor application
6) Current Pulsation allowed for compressor application
7) Type of Coupling (Flexible / Rigid)
8) Thrust load applicable on motor bearing
9) Pulley / Belt detail

E) ACCESSORIES:

1) Space Heaters
2) Thermistors
3) RTD - Winding / Bearing (Simplex / Duplex)
4) If any Special Requirements

OUESTIONNAIRE REFERANCE FOR INDUCTION MOTORS

(DURING ENQUIRY / ORDER)

A) GENERAL:

1)	Project Name	
2)	No. Of Motor required (Qty.)	
3)	Type of Motors	LT Motor / HT Motor
4)	Type of rotor	Squirrel cage / Slip ring
5)	Rated Power Output (KW)	
6)	Synchronous speed (RPM)	3000 / 1500 / 1000 / 750
7)	Type of Enclosure	Drip proof / TEFC / CACA / CACW
8)	Degree of Protection	IP-21/ IP -22 / IP - 23 / IP -44/ IP-55
9)	Method of Cooling	IC -01/IC-411/IC-161 etc.
10)	Method of Mounting	B3 - Horizontal foot mounted V1 - Vertical flange mounted etc.
11)	Class of Insulation	B / F / H
12)	Type of Duty	S1- Continuous / S2 - Short time/ S3
13)	Noise level at one metre distance	As per is : 12065. ----- db(A) AT 1 M.
14)	Vibration Level	As per is : 12075
15)	Power cable Type / Run / Size	
16)	Method of Earthing	2 nos. Bolts / Flats
16)	Reference standard	IS: 325 / IEC 34 -1 / NEMA

B) SUPPLY CONDITIONS :

1)	No. of phases	3
2)	Rated Voltage (Volts)	415 / 3300 / 6600 / 11000
3)	Rated Frequency (Hz)	50 / 60
4)	Variation in Voltage	± 6 % / ±10 % / + 6 %, -15 %
5)	% Variation in Frequency	± 3 % / ± 5 %
6)	% Combined Voltage & Frequency Variation	± 6 % / ± 10 %
7)	Minimum Starting Voltage across the terminal	80 % / 85 %
8)	Method of Starting	DOL /Star-Delta /Auto Trans./ Soft start

C) SITE CONDITIONS:

1)	Ambient Temperature (°C)	40 °C / 45 °C / 50 °C / 55 °C
2)	Altitude (Metres)	below 1000 m / 2000 m / 3000 m etc.
3)	Maximum Humidity (%)	80 % / 90 % / 100 %
4)	Installation	Location- Outdoor/Indoor
5)	Atmospheric Condition	Non Hazardous / Hazardous
6)	Permissible Temperature Rise	Limited to B / F

D) DRIVEN EQUIPMENT DETAILS:

1)	Type of driven Equipment	
2)	Torque Speed characteristic of Driven Equipment	Starting Torque, Pull out Torque Pull up Torque etc.
3)	Moment of Inertia (GD^2) of Driven Equipment at Reference Speed	
4)	Direction of Rotation	Clockwise / Anti clockwise looking from shaft side / both direction
5)	Crank Angle / Torque Diagram for compressor duty	
6)	Current Pulsation allowed for compressor application	
7)	Type of Coupling	Flexible / Rigid / Fluid / Belt etc.
8)	Pulley / Belt details	Diameter, width
9)	Force acting at the point where applied.	Axial Force & Radial force (kg)
10)	Thrust load applicable on motor bearing	Upward & downward thrust (kg)
11)	Shaft orientation	Horizontal / Vertical etc.

E) SPECIAL FEATURES:

1)	Winding Connection	Star / Delta
2)	Terminals	Three / Six
3)	Type of slip ring gear	Fixed / Brush lifting arrangement
4)	Terminal box position	Left / Right hand side looking from Coupling end
5)	Fault withstand capability of terminal box	45 MVA / 250 MVA / 350 MVA etc.
6)	Duration of fault	0.25 Second
7)	Shaft extension details	Diameter & length / Tapered/Threaded
8)	Paints & Treatments	Colour - Shade no. 621 of IS 5 Normal / Epoxy / Special paint

F) ACCESSORIES:

1)	Space Heaters	
2)	Thermistors	
3)	Winding - RTD	PT-100 / 100 Ω at 0 °C Simplex/Duplex
4)	Bearing - RTD	PT-100 / 100 Ω at 0 °C Simplex/Duplex
5)	Dial type Thermometer for Bearing	
6)	Breather plug	
7)	Terminal Box for accessories	
8)	If any Special Requirements	