EMERSON
Industrial Automation

3-phase TEFV induction motors - Slip-ring rotor
FLSB - FLSLB

37 kW to 300 kW

Technical catalogue

1239 en - 2012.05 / i

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Quality commitment

Emerson Industrial Automation's quality management system is based on:

- Control of procedures right from the initial sales offering until delivery to the customer, including design, manufacturing start-up and production
- A total quality policy based on making continuous progress in improving operational procedures, involving all departments in the company in order to give customer satisfaction as regards delivery times, conformity and cost
- Indicators used to monitor procedure performance
- Corrective actions and advancements with tools such as FMECA, QFD, MAVP, MSP/MSQ and Hoshin type improvement workshops on flows, process re-engineering, plus Lean Manufacturing and Lean Office
- Annual surveys, opinion polls and regular visits to customers in order to ascertain and detect their expectations

Personnel are trained and take part in analyses and actions for continuous improvement of our procedures.

- The motors in this catalogue have been specially designed to limit the impact of their construction on the environment. This eco-design has resulted in the creation of a “Product Environmental Profile” (reference 4592).

Emerson Industrial Automation has entrusted the certification of its expertise to various international organisations.
Certification is granted by independent professional auditors, and recognises the high standards of the **company's quality assurance procedures.** All activities resulting in the final version of the machine have therefore received official certification **ISO 9001: 2008 from the DNV**. Similarly, our environmental approach has enabled us to obtain certification ISO 14001: 2004.
Products for particular applications or those designed to operate in specific environments are also approved or certified by the following organisations: LCIE, DNV, INERIS, EFECTIS, UL, BSRIA, TUV, GOST, which check their technical performance against the various standards or recommendations.

SYSTÈME DE MANAGEMENT ENVIRONNEMENTAL CERTIFIÉ ISO 14001 : 2004 DNV

ISO 9001 : 2008

CE

DNV DET NORSKE VERITAS

UL

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LCIE

CSA

BUREAU VERITAS 1828

PCT

INERIS

Definition of “Index of Protection” (IP)

Indices of protection of electrical equipment enclosures
In accordance with IEC 60034-5 - EN 60034-5 (IP) - IEC 62262 (IK)

1st number: Protection against solid objects			2nd number: Protection against liquids			3rd number: Mechanical protection		
IP	**Tests**	**Definition**	**IP**	**Tests**	**Definition**	**IK**	**Tests**	**Definition**
0		No protection	0		No protection	00		No protection
1	Ø 50 mm	Protected against solid objects larger than 50 mm (e.g. accidental contact with the hand)	1		Protected against water drops falling vertically (condensation)	01	150 g, 10 cm	Impact energy: 0.15 J
2	Ø 12 mm	Protected against solid objects larger than 12 mm (e.g. a finger)	2	15°	Protected against water drops falling at up to 15° from the vertical	02	200 g, 10 cm	Impact energy: 0.20 J
3	Ø 2.5 mm	Protected against solid objects larger than 2.5 mm (e.g. tools, wires)	3	60°	Protected against rain falling at up to 60° from the vertical	03	250 g, 15 cm	Impact energy: 0.37 J
4	Ø 1 mm	Protected against solid objects larger than 1 mm (e.g. thin tools, small wires)	4		Protected against projected water from all directions	04	250 g, 20 cm	Impact energy: 0.50 J
5		Protected against dust (no deposits of harmful material)	5		Projected against jets of water from all directions from a hose	05	350 g, 20 cm	Impact energy: 0.70 J
6		Protected against any dust penetration	6		Protected against projected water comparable to big waves	06	250 g, 40 cm	Impact energy: 1 J
			7	0.15 m, 1 m	Protected against the effects of immersion between 0.15 and 1 m	07	0.5 kg, 40 cm	Impact energy: 2 J
			8 ..m	..m	Protected against prolonged effects of immersion under pressure	08	1.25 kg, 40 cm	Impact energy: 5 J
						09	2.5 kg, 40 cm	Impact energy: 10 J
						10	5 kg, 40 cm	Impact energy: 20 J

Example:

Example of an IP 55 machine

IP : Index of protection

5. : Machine protected against dust and accidental contact.
Test result: no dust enters in harmful quantities, no risk of direct contact with rotating parts. The test will last for 2 hours.

.5 : Machine protected against jets of water from all directions from hoses at 3 m distance with a flow rate of 12.5 l/min at 0.3 bar.
The test will last for 3 minutes.
Test result: no damage from water projected onto the machine.

Interference suppression and protection of people

AIRBORNE INTERFERENCE

EMISSION

For standard motors, the housing acts as an electromagnetic screening, reducing electromagnetic emissions measured at 0.25 metres from the motor to approximately 5 gauss (5 x 10–4 T).
However, electromagnetic emissions may be noticeably reduced by a special construction of aluminium alloy end shields and a stainless steel shaft.

IMMUNITY

The construction of motor housings (especially finned aluminium alloy frames) isolates external electromagnetic sources to the extent that any field penetrating the casing and magnetic circuit will be too weak to interfere with the operation of the motor.

POWER SUPPLY INTERFERENCE

The use of electronic systems for starting, speed control or power supply can create harmonics on the supply lines which may interfere with the operation of machines. These phenomena are taken into account in determining the machine dimensions, which act as quenching chokes in this respect.
The IEC 61000 standard, currently in preparation, will define permissible rejection and immunity rates: only then will machines for general distribution (especially single-phase motors and commutator motors) have to be fitted with suppression systems.
Three-phase squirrel cage machines do not in themselves produce interference of this type. Mains connection equipment (contactors) may, however, need interference protection.

APPLICATION OF DIRECTIVE 2004/108/EC CONCERNING ELECTROMAGNETIC COMPATIBILITY (EMC)

a - for motors only
According to amendment 1 of IEC 60034-1, induction motors are not transmitters and do not produce interference (via carried or airborne signals) and therefore conform inherently to the essential requirements of the EMC directives.

b - for motors supplied by inverters (at fixed or variable frequency)
In this case, the motor is only a sub-assembly of a device which the system builder must ensure conforms to the essential requirements of the EMC directives.

APPLICATION OF LOW VOLTAGE DIRECTIVE 2006/95/EC

All motors have been subject to this directive. The main requirements concern the protection of people, animals and property against risks caused by operation of the motors (see the commissioning and maintenance manual for precautions to be taken).

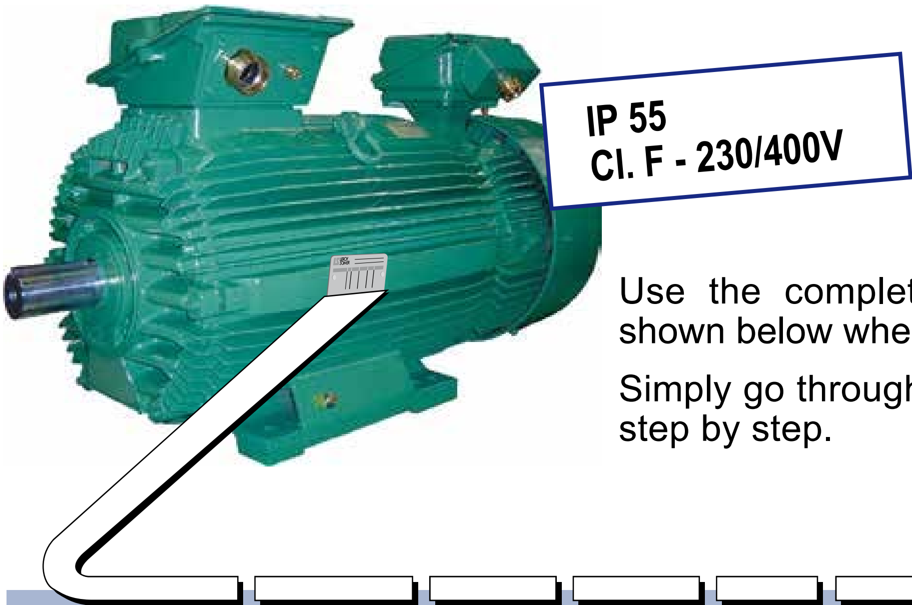
APPLICATION OF MACHINERY DIRECTIVE 2006/42/EC

All motors are designed to be integrated in a device subject to the machinery directive.

CE PRODUCT MARKING

The fact that motors conform to the essential requirements of the Directives is shown by the **CE** mark on their nameplates and/or packaging and documentation.

Designation



Use the complete motor **designation** as shown below when placing your **order**.

Simply go through the complete designation step by step.

4P 1500 min^{-1}	FLSB	180	M	17 kW	IM 1001 IM B3	230 / 400 V	50 Hz	IP 55
No. of poles Speed(s)	Range identification	Frame size IEC 60072	Frame type	Rated power	Mounting arrangements IEC 60034-7	Supply voltage	Mains frequency	Protection IEC 60034-5

Components

DESCRIPTION

Components	Materials	Remarks
Housing with cooling fins	Cast iron	- with integral feet, or without feet • 4, 6 or 8 fixing holes for foot mounting • lifting rings - earth terminal on foot or fin
Stator		- class F insulation - impregnation under vacuum and pressure with polyester varnish
Wound rotor		- winding in enamel covered wire, shrunk fibreglass on steel ring - rotor balanced dynamically, class A, 1/2 key
Shaft	Steel	- tapped centre hole - open keyway
Commutator	Bronze	- located at the non-drive end - 3 helically fluted bronze rings for easy removal of carbon dust
Brushes	Selected according to rotor and environmental characteristics	- inserted in double brush holders - access possible at the back of the motor via two inspection doors
End shields	Cast iron	- shields fitted with drain holes for removing old grease
Bearings and lubrication		- regreasable bearings on the whole range
Labyrinth seal	Steel or cast iron	- DE and NDE labyrinth seal
Fan	Metal	- 2 directions of rotation: straight blades
Fan cover	Steel	- fitted, on request, with a drip cover for operation in vertical position, shaft end facing down
Stator terminal box	Cast iron	- IP 55 - fitted with a terminal block with 6 or 9 terminals - mounting plate fitted with brass cable gland - 1 earth terminal in each terminal box
Rotor terminal box	Cast iron	- connection to slip-rings : in an additional terminal box located on the NDE shield

EXCEPTIONS FOR FLSLB MOTORS FOR HOISTING APPLICATIONS

Mechanical design

The standard design of hoisting type motors (FLSLB) is mechanically identical to that of FLSB motors for general applications. On request, they can be fitted with 2 shaft extensions and/or with dimensions conforming to French standard NF C 51-157 (see section «Optional features»).

Rotor constants

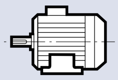
The standard rotor characteristics of hoisting type FLSLB motors conform to French standard NF C 51-157 and may or may not differ from the FLSB motor for general applications (see section «Selection data»).

Mounting arrangements

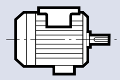
MOUNTINGS AND POSITIONS (IEC standard 60034-7)

Foot mounted motors

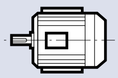
IM 1001 (IM B3)
- Horizontal shaft
- Feet on floor



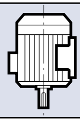
IM 1071 (IM B8)
- Horizontal shaft
- Feet on ceiling



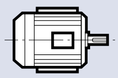
IM 1051 (IM B6)
- Horizontal shaft
- Wall mounted with feet on LHS when viewed from drive end



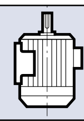
IM 1011 (IM V5)
- Vertical shaft facing down
- Feet on wall



IM 1061 (IM B7)
- Horizontal shaft
- Wall mounted with feet on RHS when viewed from drive end

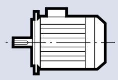


IM 1031 (IM V6)
- Vertical shaft facing up
- Feet on wall

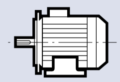


(FF) flange mounted motors

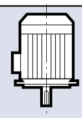
IM 3001 (IM B5)
- Horizontal shaft



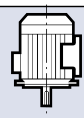
IM 2001 (IM B35)
- Horizontal shaft
- Feet on floor



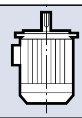
IM 3011 (IM V1)
- Vertical shaft facing down



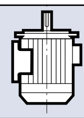
IM 2011 (IM V15)
- Vertical shaft facing down
- Feet on wall



IM 3031 (IM V3)
- Vertical shaft facing up



IM 2031 (IM V36)
- Vertical shaft facing up
- Feet on wall



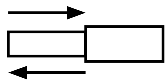
Code I	IM B3	IM B5	IM B6	IM B7	IM B8	IM B35	IM V1	IM V3	IM V5	IM V6	IM V15	IM V36
Code II	**IM 1001**	**IM 3001**	**IM 1051**	**IM 1061**	**IM 1071**	**IM 2001**	**IM 3011**	**IM 3031**	**IM 1011**	**IM 1031**	**IM 2011**	**IM 2031**
Frame size												
280	●	□	■	■	■	●	●	●	■	■	■	■
315	●	□	■	■	■	●	●	■	■	■	■	■
355	●	□	■	■	■	●	●	■	■	■	■	■

● : possible positions
□ : positions not available
■ : please consult Emerson Industrial Automation, specifying the coupling method and the axial and radial loads if applicable

Bearings

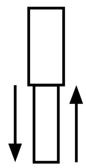
TYPE OF BEARING - AXIAL LOADS

Permissible axial loads in daN on main shaft extension for standard bearing assembly
3-phase induction motors - Slip-ring rotor - Horizontal motor - Calculated lifetime L_{10h} = 25,000 hours

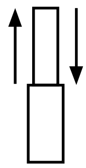


Type	Type of bearing		Permissible axial loads: horizontal motor					
	DE bearing	NDE bearing	1 500 min⁻¹		1 000 min⁻¹		750 min⁻¹	
			→	←	→	←	→	←
280 S/M	NU 219	6219 C3	371	371	461	461	536	536
315 S/M/L	22220 C3	6220 C3	495	495	602	602	690	690
355 L	22222 C3	NU 2222	1222	1222	1757	1757	2000	2000

Permissible axial loads in daN on main shaft extension for standard bearing assembly
3-phase induction motors - Slip-ring rotor - Vertical motors IM 3011 (IM V1) and IM 3031 (IM V3)
Calculated lifetime L_{10h} = 25,000 hours



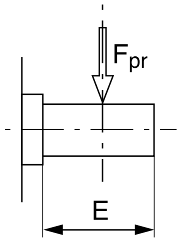
Type	Type of bearing		Permissible axial loads: vertical motor IM 3011 (IM V1)					
	DE bearing	NDE bearing	1 500 min⁻¹		1 000 min⁻¹		750 min⁻¹	
			↓	↑	↓	↑	↓	↑
280 S/M	NU 219	7219 B	275	682	378	784	463	869
315 S/M/L	NU 2220	7220 B	388	710	500	822	592	914
355 L	NU 2222	7222 B	496	869	631	1004	743	1115



Type	Type of bearing		Permissible axial loads: vertical motor IM 3031 (IM V3)					
	DE bearing	NDE bearing	1 500 min⁻¹		1 000 min⁻¹		750 min⁻¹	
			↓	↑	↓	↑	↓	↑
280 S/M	NU 219	7219 B	275	682	378	784	463	869
315 S/M/L	NU 2220	7220 B	388	710	500	822	592	914
355 L	NU 2222	7222 B	496	869	631	1004	743	1115

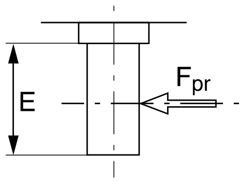
Bearings

RADIAL LOADS AT E/2



Permissible radial loads in daN on main shaft extension at E/2 for standard bearing assembly
3-phase induction motors - Slip-ring rotor - Horizontal motor - Calculated lifetime L_{10h} = 25,000 hours

Type	Type of bearing		Permissible radial loads: horizontal motor		
	DE bearing	NDE bearing	1 500 min⁻¹	1 000 min⁻¹	750 min⁻¹
280 S/M	NU 219	6219 C3	1670	1925	1912
315 S/M/L	22220 C3	6220 C3	1650	1900	2150
355 L	22222 C3	NU 2222	2234	2234	2234



Permissible radial loads in daN on main shaft extension at E/2 for standard bearing assembly
3-phase induction motors - Slip-ring rotor - Vertical motor - Calculated lifetime L_{10h} = 25,000 hours

Type	Type of bearing		Permissible radial loads: vertical motor		
	DE bearing	NDE bearing	1 500 min⁻¹	1 000 min⁻¹	750 min⁻¹
280 S/M	NU 219	7219 B	1800	2052	2253
315 S/M/L	NU 2220	7220 B	1240	1240	1240
355 L	NU 2222	7222 B	2497	2497	2494

Bearings

GREASING INTERVALS

Greasing intervals on nameplate for 3-phase TEFV induction motors - Slip-ring rotor - 40°C ambient T°
Standard bearing assembly

Type of bearing	Greasing interval in hours						Quantity of grease per bearing in cm^3
	1 800 min^{-1}	1 500 min^{-1}	1 200 min^{-1}	1 000 min^{-1}	900 min^{-1}	750 min^{-1}	
22220	380	540	760	1000	1150	1470	42
22222	300	460	660	900	1050	1350	53
7219 B	4200	5800	8000	10500	12000	15500	28
7220 B	3800	5400	7600	10000	11500	14500	31
7222 B	3000	4500	6600	9000	10500	13500	38
NU 219	2100	2900	4000	5200	6000	7700	27
NU 2220	1900	2700	3800	5000	5750	7300	41
NU 2222	1500	2300	3300	4500	5250	6750	53

BRUSHES AND BRUSH-HOLDER

Type	Type of brush-holder			Type of brush		
	Number	Designation	Dimensions in mm	Number	Designation	Dimensions in mm
280 S/M	3	A2 BG	40 x 20	6	CM 5H	40 x 20 x 32
315 S	3	A2 BG	40 x 20	6	CM 5H	40 x 20 x 32
315 M/L	3	A2 BG	40 x 20	6	CM 5H	40 x 20 x 32
355 L	3	A2 BG JF	50 x 20	12	CM 5H	25 x 20 x 40
355 L*	3	A2 BG JF	50 x 20	12	CM 1S	25 x 20 x 40

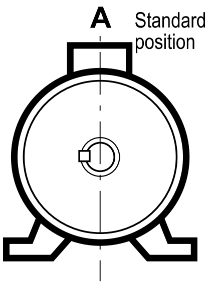
* 4-pole motors from 250 kW at catalogue rotor voltages.
6-pole motors from 160 kW at catalogue rotor voltages.

Mains connection

STATOR AND ROTOR TERMINAL BOXES

Placed as standard on the top of the motor near the drive end, the terminal box has IP 55 protection.
The standard position of the cable gland is on the right, seen from the drive end, but owing to the symmetrical construction of the box it can be placed in any of the 4 directions (except position **2** for flange mounted motors).
There is a second IP 55 terminal box called the rotor terminal box.

Position of the terminal box in relation to the drive end (position motor IM 1001)



Positions of the cable gland in relation to the drive end

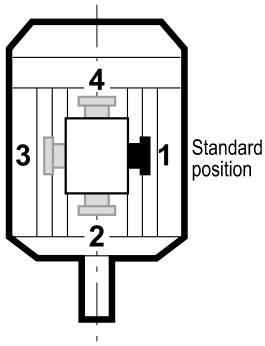


TABLE OF CABLE GLANDS

Unless specifically requested on your order, our slip-ring motors are supplied with brass cable glands.

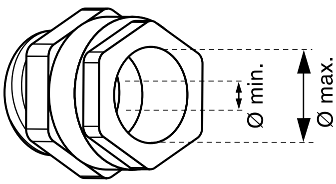
Stator terminal box

Frame size	Cable gland	Cable gland for PTU/PTF accessories, etc.
280	1 x PE 48	PE 11
315	1 x PE 48	PE 11
355	1 x PE 3"	PE 11

Rotor cable gland

Frame size	PE
280	1 x PE 36 on rotor box
315/355	1 x PE 48 on rotor box

Cable gland tightening capacity



Type of cable gland	Cable size	
	min. cable Ø (mm)	max. cable Ø (mm)
PE 11	6.5	11
PE 36	22	32.5
PE 48	31	42
3"	40	62

Mains connection

TERMINAL BLOCKS - DIRECTION OF ROTATION

The motors are fitted with a block of 6 terminals complying with standard NF C 51-120, with the terminal markings complying with IEC 34-8 (or NF C51-118).
When the motor is running in U1, V1, W1 or 1U, 1V, 1W from a 3-phase mains supply L1, L2, L3, it turns clockwise when seen from the drive shaft end.
If any two of the phases are changed over, the motor will run in an anti-clockwise direction. (Make sure the motor has been designed to run in both directions).

Motor type	Terminals
280 to 355	M12

Tightening torque for the nuts on the terminal blocks

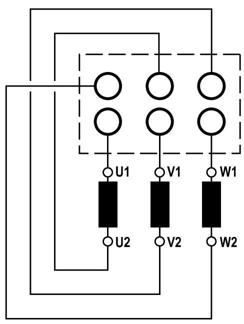
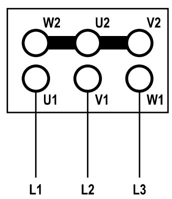
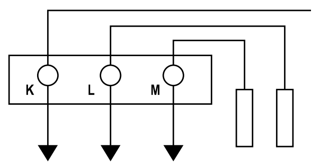
Terminal	M12
Torque N.m	35

If the motor is fitted with thermal protection or space heaters, these are connected and labelled in the main terminal box.

The rotor terminal box located at the back of the motor contains three M12 terminals.

WIRING DIAGRAMS

All standard motors are supplied with a wiring diagram in the terminal box.

Voltages and connection	Diagrams of internal connections	External connection diagrams	
		Stator connection	Connection to slip-rings
- Voltage: U - Δ connection (at lower voltage) eg 230 V / Δ			
- Voltage : U √3 - Y connection (at higher voltage) eg 400 V / Y			280, 315 and 355 : terminal block in auxiliary terminal box, called the rotor terminal box. 

EARTH TERMINAL

This is located inside the terminal box and is indicated by the sign ⏚ in the terminal box moulding.

A second earth terminal is always fitted on a foot (left or right) on the housing.

Consisting of a threaded stud with a hexagonal nut, it is used to connect cables with a cross-section no less than that of the phase conductors.

STARTING

Polystart LBs are electrolytic starters for 3-phase slip-ring induction motors where they are being used as starter rheostats.

Applications

Cement works, paper-mills, quarries, mines, timber industries, agro-food industries, etc.

Definition of duty cycles

DUTY CYCLES
(according to IEC 60034-1)

Duty cycles are as follows :

1 - Continuous duty - Type S1
Operation at constant load of sufficient duration for thermal equilibrium to be reached (see figure 1).

2 - Short-time duty - Type S2
Operation at constant load during a given time, less than that required for thermal equilibrium to be reached, followed by a rest and de-energized period of sufficient duration to re-establish machine temperatures to within 2 K of the coolant (see figure 2).

3 - Intermittent periodic duty - Type S3
A sequence of identical duty cycles, each consisting of a period of operation at constant load and a rest and de-energized period (see figure 3). Here, the cycle is such that the starting current does not significantly affect the temperature rise (see figure 3).

4 - Intermittent periodic duty with starting - Type S4
A sequence of identical duty cycles consisting of a significant starting period, a period of operation at constant load and a rest and de-energized period (see figure 4).

5 - Intermittent periodic duty with electrical braking - Type S5
A sequence of periodic duty cycles, each consisting of a starting period, a period of operation at constant load, a period of rapid electrical braking and a rest and de-energized period (see figure 5).

6 - Periodic continuous duty with intermittent load - 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. There is no rest and de-energized period (see figure 6).

7 - Periodic continuous duty with electrical braking - Type S7
A sequence of identical duty cycles, each consisting of a starting period, a period of operation at constant load and a period of electrical braking. There is no rest and de-energized period (see figure 7).

8 - Continuous-operation periodic duty with related changes of load and speed - Type S8
A sequence of identical duty cycles, each consisting of a period of operation at a constant load corresponding to a predetermined rotation speed, followed by one or more periods of operation at other constant loads corresponding to different rotation speeds (in induction motors, this can be done by changing the number of poles). There is no rest and de-energized period (see figure 8).

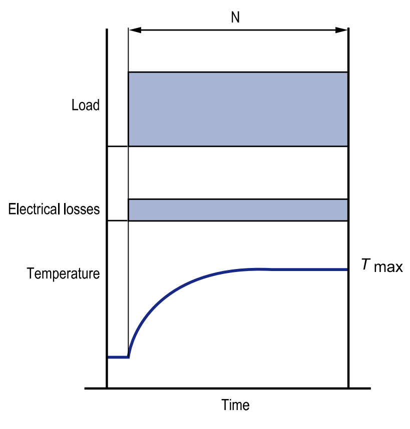
9 - Duty with non-periodic variations in load and speed - Type S9
This is a duty in which the load and speed generally vary non-periodically within the permissible operating range. This duty frequently includes applied overloads which may be much higher than the full load or loads (see figure 9).
Note - For this type of duty, the appropriate full load values must be used as the basis for calculating overload.

10 - Operation at distinct constant loads - Type S10
This duty consists of a maximum of 4 distinct load values (or equivalent loads), each value being applied for sufficient time for the machine to reach thermal equilibrium. The minimum load during a load cycle may be zero (no-load operation or rest and de-energized period) (see figure 10).

Note : On page 19, there is a method for specifying machines for intermittent duty.

Note: Only S1 and S3 duty types with a duty factor of 80% or more are affected by IEC 60034-30.

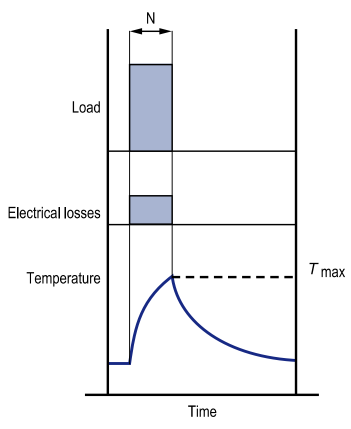
Fig. 1. - Continuous duty. Type S1.



N = operation at constant load

T_{max} = maximum temperature attained

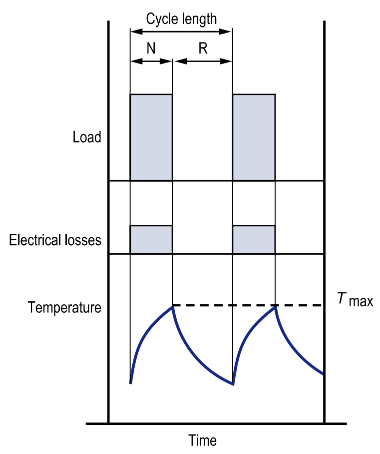
Fig. 2. - Short-time duty. Type S2.



N = operation at constant load

T_{max} = maximum temperature attained

Fig. 3. - Intermittent periodic duty. Type S3.



N = operation at constant load

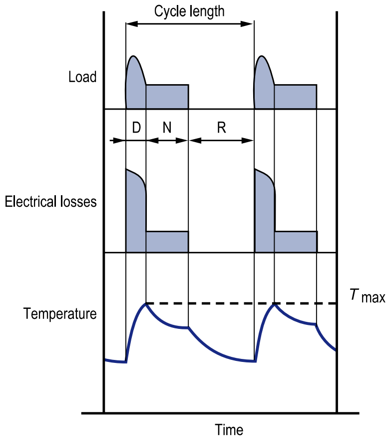
R = rest

T_{max} = maximum temperature attained

$$\text{Operating factor (\%)} = \frac{N}{N + R} \cdot 100$$

Definition of duty cycles

Fig. 4. - Intermittent periodic duty with starting. Type S4.



D = starting

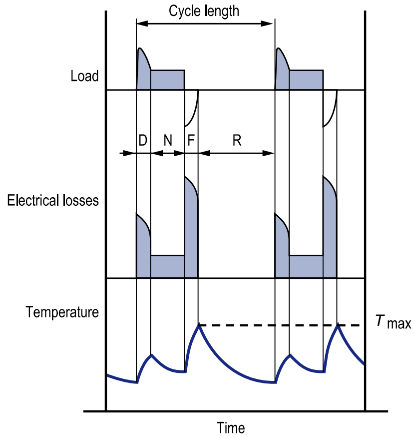
N = operation at constant load

R = rest

T_{max} = maximum temperature attained during cycle

Operating factor (%) = $\frac{D + N}{N + R + D} \cdot 100$

Fig. 5. - Intermittent periodic duty with electrical braking. Type S5.



D = starting

N = operation at constant load

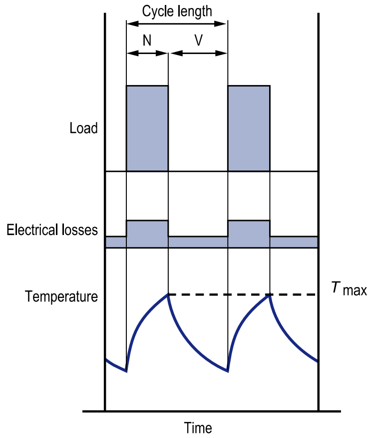
F = electrical braking

R = rest

T_{max} = maximum temperature attained during cycle

Operating factor (%) = $\frac{D + N + F}{D + N + F + R} \cdot 100$

Fig. 6. - Periodic continuous duty with intermittent load. Type S6.



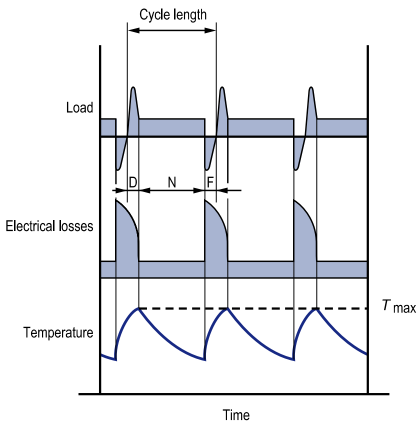
N = operation at constant load

V = no-load operation

T_{max} = maximum temperature attained during cycle

Operating factor (%) = $\frac{N}{N + V} \cdot 100$

Fig. 7. - Periodic continuous duty with electrical braking. Type S7.



D = starting

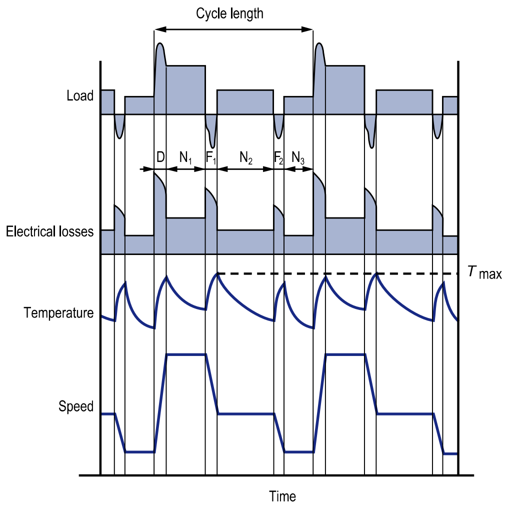
N = operation at constant load

F = electrical braking

T_{max} = maximum temperature attained during cycle

Operating factor = 1

Fig. 8. - Continuous-operation periodic duty with related changes of load and speed. Type S8.



F_1F_2 = electrical braking

D = starting

$N_1N_2N_3$ = operation at constant loads.

T_{max} = maximum temperature attained during cycle

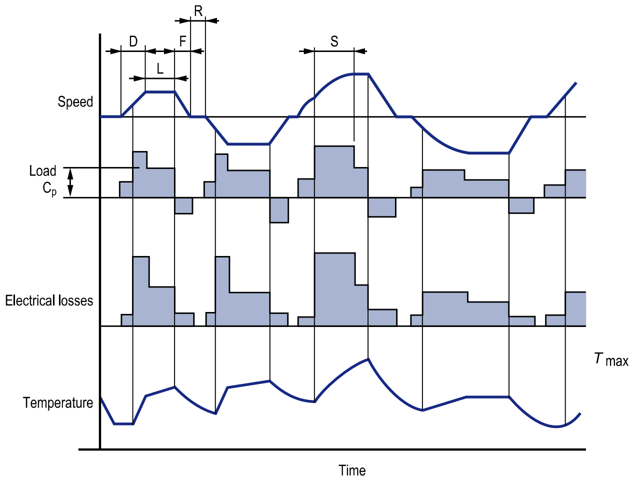
Operating factor = $\frac{D + N_1}{D + N_1 + F_1 + N_2 + F_2 + N_3}$ 100 %

$\frac{F_1 + N_2}{D + N_1 + F_1 + N_2 + F_2 + N_3}$ 100 %

$\frac{F_2 + N_3}{D + N_1 + F_1 + N_2 + F_2 + N_3}$ 100 %

Definition of duty cycles

Fig. 9. - Duty with non-periodic variations in load and speed. Type S9.



D = starting

L = operation at variable loads

F = electrical braking

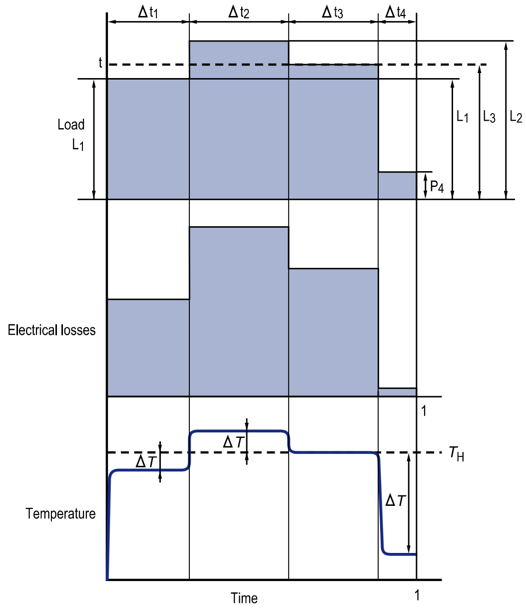
R = rest

S = operation at overload

C_p = full load

T_{max} = maximum temperature attained

Fig. 10. - Duty at distinct constant loads. Type S10.



L = load

N = rated power for duty type S1

p = p / $\frac{L}{N}$ = reduced load

t = time

T_p = total cycle time

t_i = discrete period within a cycle

Δt_i = t_i / T_p = relative duration of period within a cycle

Pu = electrical losses

H_N = temperature at rated power for duty type S1

ΔH_i = increase or decrease in temperature rise at the i^{th} period of a cycle

Supply voltage

REGULATIONS AND STANDARDS

The statement by the Electricity Consultative Committee dated 25 June 1982, and the 6th edition (1983) of publication No. 38 of the International Electrotechnical Committee (IEC), have laid down timescales for the harmonisation of standard voltages in Europe.

Since 1996, voltages at the point of delivery have had to be maintained between the following extreme values:

- ***Single phase current: 207 to 244 V***
- ***3-phase current: 358 to 423 V***

The IEC 38 standard gives the European reference voltage as 230/400 V 3-phase and 230 V single phase with a tolerance of + 6 % to – 10 % until 2003 and ± 10 % thereafter.
IEC guide 106 also gives tolerances for power supplies:

• Maximum line drop between customer delivery point and customer usage point: 4 %.

• Variation in frequency around rated frequency:
- continuous operation : ± 1 %,
- transient states : ± 2 %.

• 3-phase mains phase-balance error
- zero-sequence component and/or negative phase sequence component compared to positive phase sequence component: < 2 %

• Harmonics
- relative harmonic content: < 10 %,
- individual harmonic voltages: to be established.

• Surges and transient power cuts: to be established.

USING 400 V - 50 HZ MOTORS ON 460 V - 60 HZ MAINS SUPPLIES

The electrical characteristics are modified as follows:

$P_{60\ Hz} = P_{50\ Hz} \times 1{,}15$

$U_{Rotor} = U_{Rotor\ 50\ Hz} \times \frac{U_{supply}}{400}$

The rotor and stator current remain the same.

Eg. :
FLSB 280 M4 motor - 75 kW - 1 500 min^{-1}
where U_{Supply} = 400 V - 50 Hz I_{Stator} = 140 A
U_{Rotor} = 500 V I_{Rotor} = 91 A

Characteristics of this motor at 440 V - 60 Hz :
$P_N = 75 \times 1{,}15 = 86$ kW

$U_{Rotor} = 500 \times \frac{460}{400} = 552$ V

I_{Rotor} = 104 A I_{Stator} = 161 A

60 Hz supply: voltage outside the 440 - 460V range
Only available on special request, as the windings have to be redefined.

Determining the power for intermittent duty cycles

RMS POWER IN INTERMITTENT DUTY

This is the rated power drawn by the machine and is generally determined by the manufacturer.
If the power drawn by the machine varies during a cycle, the rms power P is calculated using the equation:

$$P_n = \sqrt{\frac{n + t_d \times [I_D/I_n \times P]^2 + (3600 - n \times t_d)P^2u \times fdm}{3600}}$$

if, during the working time, the power drawn is:

P_1 for period t_1
P_2 for period t_2
— —
P_n for period t_n

Power values less than 0.5 P_N are replaced by 0.5 P_N in the calculation of rms power P (no-load operation is a special case).

In addition, it is also necessary to check that, for a particular motor of power P_N:
• the starting system (Polystart or rheostat) can tolerate the number of starts/hr
• the maximum output of the cycle does not exceed twice the rated output power P
• there is still sufficient accelerating torque during the starting period.

Load factor (LF)
Expressed as a percentage, this is the ratio of the period of actual operating time with a load during the cycle to the total duration of the cycle where the motor is energised.

Operating factor (OF)
Expressed as a percentage, this is the ratio of the period of actual operating time to the total duration of the cycle, provided that the total cycle is shorter than 10 minutes.

Starting class
Class : $n = n_D + k \cdot n_F + k' \cdot n_i$

n_D number of complete starts per hour;

n_F the number of times electrical braking is applied in the hour;
«Electrical braking» means any braking directly involving the stator winding or the rotor winding:
• regenerative braking (with frequency controller, multi-pole motor, etc)
• reverse-current braking (the most commonly used)
• D.C. injection braking

n_i is the number of impulses (incomplete starts of up to one-third of maximum speed) per hour.

k and k’ are constants determined as follows:

	k	k'
Slip-ring motors	0,8	0,25

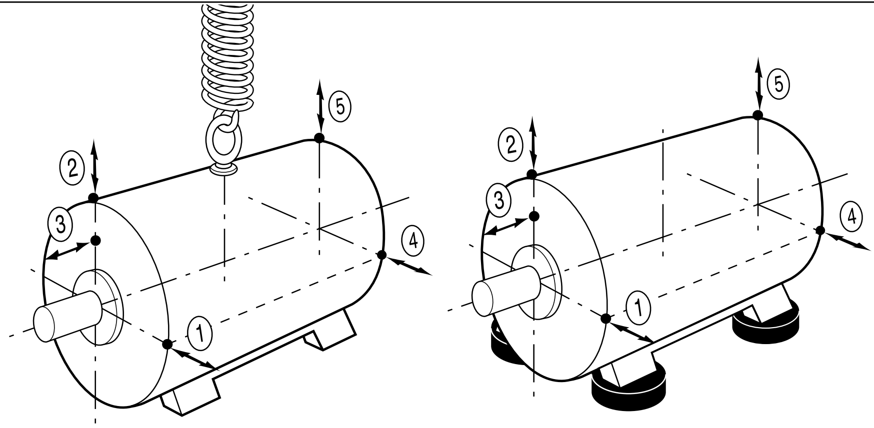
NOTE: For electrical braking on slip-ring motors, the rotor is connected to a special position on the rheostat (initial start position for D.C. injection and a position with a higher resistance value for reverse-current braking). The rotor must NEVER remain in the short-circuit position during braking.
- Reversing the direction of rotation involves braking (generally electrical) and starting.
- Braking with Emerson Industrial Automation electro-mechanical brakes, as with any other brakes that are independent of the motor, does not constitute electrical braking in the sense intended above.

Vibrations and balancing

VIBRATION LEVELS - BALANCING

Inaccuracies due to construction (magnetic, mechanical and air-flow) lead to sinusoidal or pseudo-sinusoidal vibrations over a wide range of frequencies. Other sources of vibration can also affect motor operation, such as poor mounting, incorrect drive coupling, end shield misalignment, etc.
We shall first of all look at the vibrations emitted at the operating frequency, corresponding to an unbalanced load whose amplitude swamps all other frequencies and on which the dynamic balancing of the mass in rotation has a decisive effect.
Under standard ISO 8821, rotating machines can be balanced with or without a key or with a half-key on the shaft extension.
ISO 8821 requires the balancing method to be marked on the shaft extension as follows:
- half-key balancing: letter H
- full key balancing: letter F
- no-key balancing: letter N.

The machines in this catalogue are in vibration class level A - level B is available on request.



Measuring system for suspended machines

Measuring system for machines on flexible mountings

The measurement points quoted in the standards are the ones indicated in the drawings above.
At each point, the results should be lower than those given in the tables below for each balancing class, and only the highest value is to be taken as the «vibration level».

Measured parameters

The vibration speed can be chosen as the variable to be measured. This is the speed at which the machine moves either side of its static position. It is measured in mm/s.

As the vibratory movements are complex and non-harmonic, it is the quadratic average (rms value) of the speed of vibration which is used to express the vibration level.

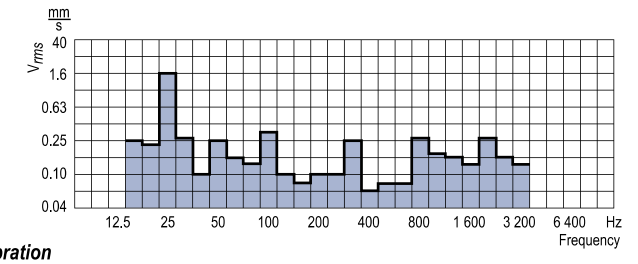
Other variables that could be measured are the vibratory displacement amplitude (in µm) or the vibratory acceleration (in m/s²).

If the vibratory displacement is measured against frequency, the measured value decreases with the frequency: high-frequency vibrations are not taken into account.

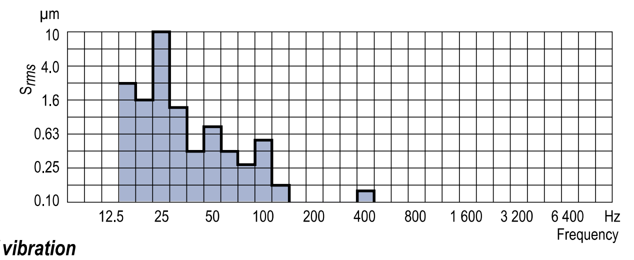
If the vibratory acceleration is measured against frequency, the measured value increases with the frequency: low-frequency vibrations (unbalanced loads) cannot be measured.

The rms speed of vibration is the variable chosen by the standards.

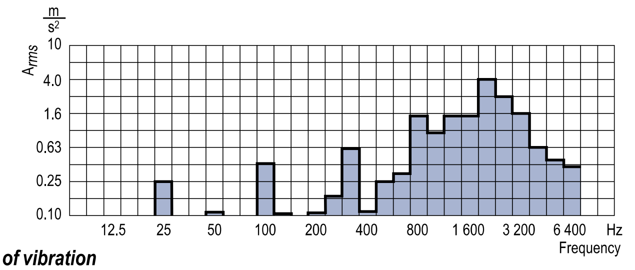
However, if preferred, the table of vibration amplitudes may still be used (for measuring sinusoidal and similar vibrations).



Speed of vibration



Amplitude of vibration



Acceleration of vibration

Vibrations and balancing

Maximum vibration magnitude limits, for displacement, speed and acceleration in rms values for frame size H (IEC 60034-14)

Vibration level	Frame size H (mm)		
	H > 280		
	Displacement µm	Speed mm/s	Acceleration m/s²
A	45	2.8	4.4
B	29	1.8	2.8

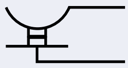
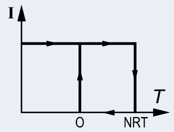
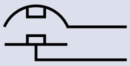
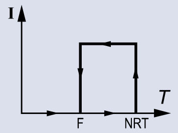
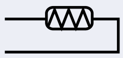
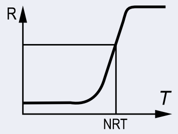
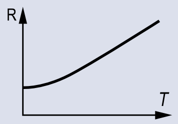
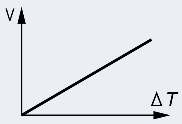
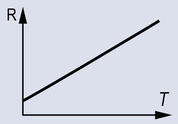
For large machines and special requirements with regard to vibration, balancing can be carried out *in situ* (finished assembly).
Prior consultation is essential, as the machine dimensions may be modified by the addition to the drive ends of the balancing disks required in this situation.

Performance

THERMAL PROTECTION

Motors are protected by a manual or automatic overcurrent relay, sited between the isolating switch and the motor. This relay may in turn be protected by fuses.
These features provide total protection against non-transient overloads. If a shorter reaction time is required, or if you want to detect transient overloads, or monitor temperature rises at «hot spots» in the motor or at strategic points in the installation for maintenance purposes, it would be advisable to install heat sensors. The various types are shown in the table below, with a description of each. It must be emphasized that sensors cannot be used to carry out direct adjustments to the motor operating cycle.

Indirect thermal protection, built-in

Type	Operating principle	Operating curve	Breaking capacity (A)	Protection provided	Mounting Number of devices*
Normally closed thermal protection **PTO**	Bimetallic strip, indirectly heated, with normally closed (NC) contact 		2.5 A at 250 V with cos φ 0.4	General monitoring for non-transient overloads	Mounting in control circuit 2 or 3 in range
Normally open thermal protection **PTF**	Bimetallic strip, indirectly heated, with normally open (NO) contact 		2.5 A at 250 V with cos φ 0.4	General monitoring for non-transient overloads	Mounting in control circuit 2 or 3 in parallel
Positive temperature coefficient thermistor **PTC**	Non-linear variable resistance, indirectly heated 		0	General monitoring for transient overloads	Mounted with associated relay in control circuit 3 in range
Temperature sensor **KT** Y	Resistance depends on the temperature of the winding		0	Continuous monitoring with high accuracy at key hot spots	Mounted in control boards with associated reading equipment (or recorder) 1 per hot spot
Thermocouples ***T*** (*T* < 150 °C) Constantan copper ***K*** (*T* < 1000 °C) Copper/Copper-Nickel	Peltier effect		0	Continuous monitoring at regular intervals at hot spots	Mounted in control boards with associated reading equipment (or recorder) 1 per hot spot
Platinum temperature sensor **PT 100**	Linear variable resistance, indirectly heated		0	0 Continuous monitoring with high accuracy at key hot spots	Mounted in control boards with associated reading equipment (or recorder) 1 per hot spot

- NRT: Nominal running temperature
- The NRTs are chosen according to the position of the sensor in the motor and the temperature rise class.
* The number of devices relates to the winding protection.

Fitting thermal protection

- PTO or PTF, in the control circuits
- PTC, with relay, in the control circuits
- PT 100 or thermocouples, with reading equipment or recorder, in the control board of the installation for continuous surveillance.

Alarm and Early Warning

All protective equipment may be backed up by another type of protection (with different N.R.T.s). The first device will then act as an «early warning» system (light or sound signals given without shutting down the power circuits), and the second device will be the actual alarm, shutting down the power circuits.

Built-in direct thermal protection

For low rated currents, bimetallic strip-type protection may be used. The line current passes through the strip, which shuts down or restores the supply circuit as necessary. The design of this type of protection allows for manual or automatic reset.

Selection data

For dimensions, see page 30.

4 poles - 1500 min^{-1}

IP55 - CLASS F - GENERAL APPLICATIONS

S3 duty - 6 starts/h - Operating factor 100%

	MAINS SUPPLY : Δ 230 / Y 400 V 50 Hz									
	Rated power	Rated speed	Motor torque	Current at 400 V		Rotor voltage	Efficiency	Power factor	Moment of inertia	Weight
				Stator	Rotor				Rotor	
Type	P_N kW	N_N min^{-1}	M_M/M_N	I_N A	I_R A	U_R V	η %	cos φ	J kg.m^2	IM B3 kg
FLSB 280 S	55	1 468	4.4	109	82	410	91.2	0.80	1.4	850
FLSB 280 M	75	1 475	3.7	140	91	500	90	0.86	1.675	900
FLSB 315 S	90	1 470	3.4	171	106	516	91.6	0.83	2.275	1 120
FLSB 315 M	110	1 480	5	213	106	632	92.2	0.81	2.8	1 220
FLSB 315 L	132	1 480	5	241	110	726	93.1	0.85	3.2	1 270
FLSB 355 L	160	1 480	3.7	295	188	505	93.2	0.84	6.25	1 550
FLSB 355 L	220	1 478	4	375	201	630	93	0.91	7.875	1 680
FLSB 355 L	250	1 480	4	451	310	490	93	0.86	9.4	1 830
FLSB 355 L	300	1 480	4	518	325	560	95	0.88	9.4	1 830

4 poles - 1500 min^{-1}

IP55 - CLASS F - HOISTING AND MATERIALS HANDLING

S4 intermittent periodic duty or S5 with starting and braking - Selection by class of starts per hour

	MAINS SUPPLY : Δ 230 / Y 400 V 50 Hz														
	Operating factor	Class 150 (starts/hr)			Class 300 (starts/hr)			Class 600 (starts/hr)			Rotor voltage	Moment of inertia			Weight
		Rated power	Current at 400 V		Rated power	Current at 400 V		Rated power	Current at 400 V						
			Stator	Rotor		Stator	Rotor		Stator	Rotor		Rotor	Driven	Total	
Type	%	P_N kW	I_N A	I_R A	P_N kW	I_N A	I_R A	P_N kW	I_N A	I_R A	U_R V	J kg.m²			IM B3 kg
	25	70	139	181	-	-	-	-	-	-					
FLSLB 280 S	40	60	119	155	54	125	139	-	-	-	235	1.4	1.1	2.5	850
	60	55	109	142	48	111	124	39	90	101					
	25	94	175	196	-	-	-	-	-	-					
FLSLB 280 M	40	85	159	178	74	138	155	-	-	-	290	1.675	1.45	3.125	900
	60	75	140	157	68	148	142	51	111	107					
	25	112	213	223	-	-	-	-	-	-					
FLSLB 315 S	40	100	190	199	86	191	172	-	-	-	305	2.275	1.475	3.75	1 120
	60	90	171	179	78	173	155	59	131	117					
	25	137	265	231	-	-	-	-	-	-					
FLSLB 315 M	40	122	236	205	103	233	173	-	-	-	360	2.8	1.7	4.5	1 220
	60	110	213	185	94	212	158	70	158	118					
	25	166	303	237	-	-	-	-	-	-					
FLSLB 315 L	40	143	261	204	124	264	177	-	-	-	425	3.2	2.25	5.45	1 270
	60	132	241	188	115	245	164	87	185	124					
	25	202	372	242	-	-	-	-	-	-					
FLSLB 355 L	40	174	321	209	150	323	180	-	-	-	505	6.25	0.45	6.7	1 550
	60	160	295	192	139	299	167	105	226	126					
	25	277	472	267	-	-	-	-	-	-					
FLSLB 355 L	40	239	407	230	207	412	199	-	-	-	630	7.875	1.375	9.25	1 680
	60	220	375	212	191	380	184	145	288	140					
	25	-	-	-	-	-	-	-	-	-					
FLSLB 355 L	40	270	487	334	-	-	-	-	-	-	490	9.4	1.45	10.85	1 830
	60	250	451	309	216	455	267	-	-	-					
	25	-	-	-	-	-	-	-	-	-					
FLSLB 355 L	40	325	561	352	-	-	-	-	-	-	560	9.4	1.6	11	1 830
	60	300	518	325	260	524	281	-	-	-					

6 poles - 1000 min^{-1}

IP55 - CLASS F - GENERAL APPLICATIONS

S3 duty - 6 starts/h - Operating factor 100%

	MAINS SUPPLY : Δ 230 / Y 400 V 50 Hz									
	Rated power	Rated speed	Motor torque	Current at 400 V		Rotor voltage	Efficiency	Power factor	Moment of inertia	Weight
				Stator	Rotor				Rotor	
Type	P_N kW	N_N min^{-1}	M_M/M_N	I_N A	I_R A	U_R V	η %	cos φ	J kg.m^2	IM B3 kg
FLSB 280 S	45	975	4.9	86	79	345	91	0.83	1.875	820
FLSB 280 M	55	980	5	105	77	435	92	0.82	2.325	890
FLSB 315 M	75	976	4	139	93	490	92.4	0.84	3.5	1 120
FLSB 315 M	90	978	4	170	88	620	92	0.83	4.125	1 220
FLSB 355 L	110	988	4.3	202	171	390	92.6	0.85	8.5	1 550
FLSB 355 L	132	985	5.1	256	168	475	92	0.81	11.075	1 660
FLSB 355 L	160	985	5	304	176	550	93.8	0.81	13.2	1 750
FLSB 355 L	200	985	4	415	269	450	94	0.74	15.7	1 830

6 poles - 1000 min^{-1}

IP55 - CLASS F - HOISTING AND MATERIALS HANDLING

S4 intermittent periodic duty or S5 with starting and braking - Selection by class of starts per hour

MAINS SUPPLY : Δ 230 / Y 400 V 50 Hz															
	Operating factor	Class 150 (starts/hr)			Class 300 (starts/hr)			Class 600 (starts/hr)			Rotor voltage	Moment of inertia			Weight
		Rated power	Current at 400 V		Rated power	Current at 400 V		Rated power	Current at 400 V						
			Stator	Rotor		Stator	Rotor		Stator	Rotor		Rotor	Driven	Total	
Type	%	P_N kW	I_N A	I_R A	P_N kW	I_N A	I_R A	P_N kW	I_N A	I_R A	U_R V	J kg.m^2			IM B3 kg
	25	57	109	173	-	-	-	-	-	-					
FLSLB 280 S	40	50	96	152	43	86	130	-	-	-	200	1.875	2.75	4.625	820
	60	45	86	136	38	85	115	30	67	91					
	25	70	134	170	-	-	-	-	-	-					
FLSLB 280 M	40	62	118	150	52	116	126	-	-	-	250	2.325	3.175	5.5	890
	60	55	105	133	47	105	114	37	82	90					
	25	95	176	206	-	-	-	-	-	-					
FLSLB 315 M	40	84	156	182	72	156	156	-	-	-	280	3.5	4.325	7.825	1 120
	60	75	139	162	64	138	139	50	108	108					
	25	113	213	208	-	-	-	-	-	-					
FLSLB 315 M	40	100	189	184	85	187	156	-	-	-	330	4.125	5.125	9.25	1 220
	60	90	170	165	77	170	141	60	132	110					
	25	138	253	215	-	-	-	-	-	-					
FLSLB 355 L	40	122	224	190	105	225	164	-	-	-	390	8.5	3	11.5	1 550
	60	110	202	171	94	201	146	72	154	112					
	25	165	320	211	-	-	-	-	-	-					
FLSLB 355 L	40	147	285	188	125	283	160	-	-	-	475	11.075	2.675	13.75	1 660
	60	132	256	169	112	253	143	87	197	111					
	25	200	380	219	-	-	-	-	-	-					
FLSLB 355 L	40	178	338	195	155	344	169	-	-	-	555	13.2	2.9	16.1	1 750
	60	160	304	175	140	310	153	106	235	116					
	25	-	-	-	-	-	-	-	-	-					
FLSLB 355 L	40	220	457	296	-	-	-	-	-	-	450	15.7	3.3	19	1 830
	60	200	415	269	175	365	236	-	-	-					

8 poles - 750 min^{-1}

IP55 - CLASS F - GENERAL APPLICATIONS

S3 duty - 6 starts/h - Operating factor 100%

	MAINS SUPPLY : Δ 230 / Y 400 V 50 Hz									
	Rated power	Rated speed	Motor torque	Current at 400 V		Rotor voltage	Efficiency	Power factor	Moment of inertia	Weight
				Stator	Rotor				Rotor	
Type	P_N kW	N_N min^{-1}	M_M/M_N	I_N A	I_R A	U_R V	η %	cos φ	J kg.m^2	IM B3 kg
FLSB 280 S	37	735	4.2	78	63	355	90	0.76	2.45	820
FLSB 280 M	47	735	4.5	98	62	455	91	0.76	3	890
FLSB 315 M	60	736	4	124	77	474	93	0.75	5.1	1 120
FLSB 315 M	75	738	4.3	147	77	589	93	0.79	6.25	1 220
FLSB 355 L	95	730	4.2	181	85	675	93.5	0.81	10.5	1 550
FLSB 355 L	120	732	3.8	244	161	440	92	0.77	12	1 660
FLSB 355 L	132	742	3.4	265	235	340	93.6	0.77	15	1 970

8 poles - 750 min^{-1}

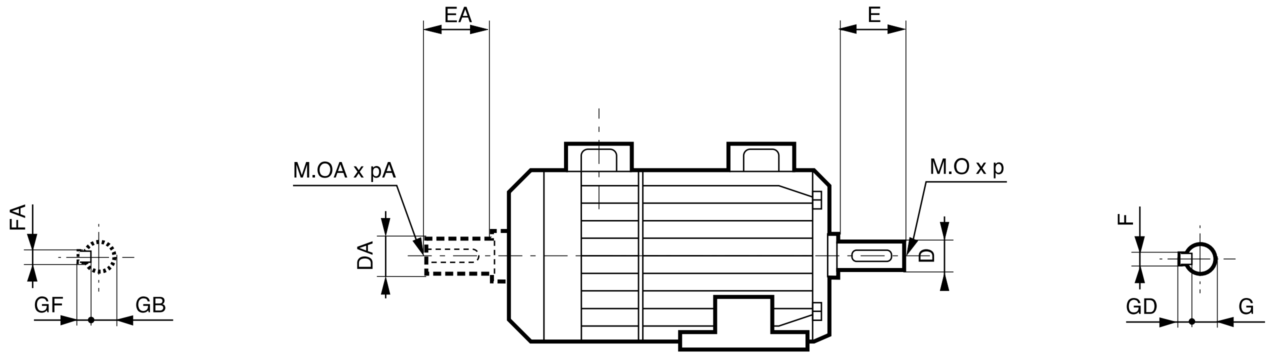
IP55 - CLASS F - HOISTING AND MATERIALS HANDLING

S4 intermittent periodic duty or S5 with starting and braking - Selection by class of starts per hour

	MAINS SUPPLY : Δ 230 / Y 400 V 50 Hz													
		Class 150 (starts/hr)			Class 300 (starts/hr)			Class 600 (starts/hr)						
	Operating factor	Rated power	Current at 400 V		Rated power	Current at 400 V		Rated power	Current at 400 V		Rotor voltage	Moment of inertia		
			Stator	Rotor		Stator	Rotor		Stator	Rotor		Rotor	Driven	Total	Weight
Type	%	P_N kW	I_N A	I_R A	P_N kW	I_N A	I_R A	P_N kW	I_N A	I_R A	U_R V	J kg.m^2			IM B3 kg
FLSLB 280 S	25	47	104	139	-	-	-	-	-	-	205	2.45	5.05	7.5	820
	40	41	91	121	35	86	104	-	-	-					
	60	37	82	109	32	79	95	25	61	74					
FLSLB 280 M	25	60	124	137	-	-	-	-	-	-	265	3	6.5	9.5	890
	40	52	107	119	45	108	103	-	-	-					
	60	47	97	108	41	99	94	32	77	73					
FLSLB 315 M	25	75	155	165	-	-	-	-	-	-	275	5.1	7.15	12.25	1 120
	40	66	136	145	57	137	126	-	-	-					
	60	60	124	132	52	125	115	40	96	88					
FLSLB 315 M	25	95	186	172	-	-	-	-	-	-	335	6.25	8.75	15	1 220
	40	83	163	150	72	150	130	-	-	-					
	60	75	147	136	65	149	118	50	114	90					
FLSLB 355 L	25	120	229	187	-	-	-	-	-	-	390	10.5	9	19.5	1 550
	40	105	200	163	90	200	140	-	-	-					
	60	95	181	148	82	182	127	65	144	101					
FLSLB 355 L	25	150	305	207	-	-	-	-	-	-	440	12	11.75	23.75	1 660
	40	132	268	182	115	273	158	-	-	-					
	60	120	244	165	105	249	145	80	190	110					

Shaft extensions

Dimensions in millimetres

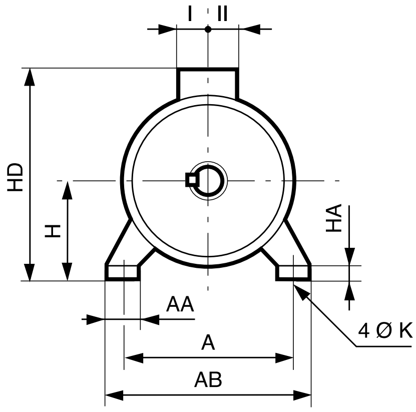


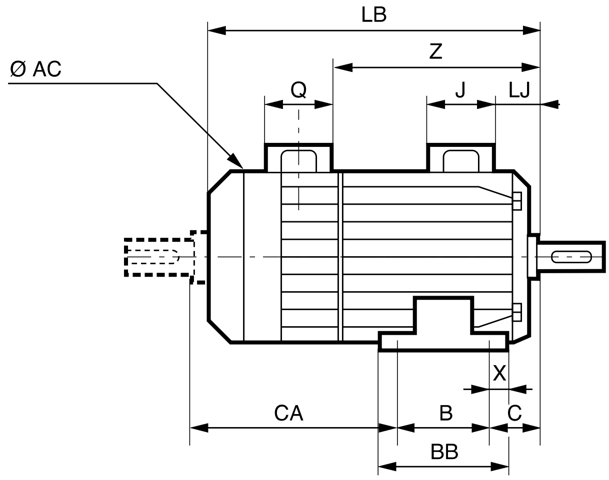
Type	Shaft extensions						
	4 Poles and more						
	F	GD	D	G	E	O	p
	FA	GF	DA	GB	EA	OA	pA
FLSB-FLSLB 280 S/M	20	12	75 m6	67.5	140 h13	20	42
FLSB-FLSLB 315 S/M	22	14	80 m6	71	170 h13	20	42
FLSB-FLSLB 315 L	25	14	90 m6	81	170 h13	24	50
FLSB-FLSLB 355 L	28	16	100 m6	90	210 h13	24	50

IMPORTANT NOTE: The standard design of hoisting type motors (FLSLB) is mechanically identical to that of motors for general applications. Optional conformity with NF C 51-157: see section «Optional features».

Foot mounted IM B3 (IM 1001)

Dimensions in millimetres





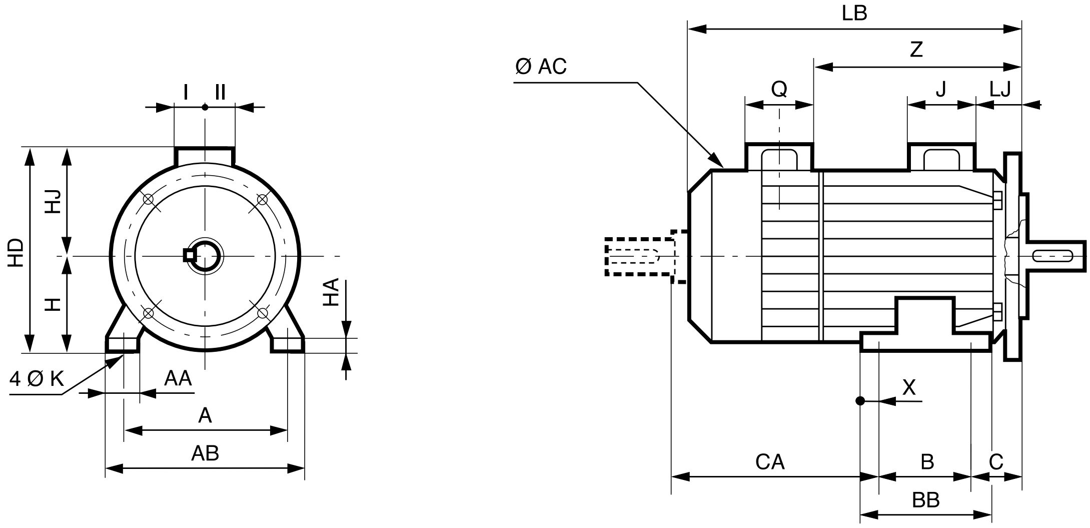
Type	Main dimensions																		
	A	AB	B	BB	C	X	AA	K	HA	H	AC	HD	LB	LJ	J	I	II	Z	Q	CA
FLSB-FLSLB 280 S	457	537	368	499	190	40	80	22	40	280	556	730	1 280	68	352	173	210	787	230	725
FLSB-FLSLB 280 M	457	537	419	499	190	40	80	22	40	280	556	730	1 280	68	352	173	210	787	230	674
FLSB-FLSLB 315 S	508	600	406	598	216	45	100	27	40	315	624	833	1 420	68	352	173	210	878	230	804
FLSB-FLSLB 315 M	508	600	457	598	216	45	100	27	40	315	624	835	1 420	70	452	217	269	878	230	753
FLSB-FLSLB 315 L	508	600	508	598	216	45	100	27	40	315	624	835	1 420	70	452	217	269	878	230	702
FLSB-FLSLB 355 L	610	710	630	710	254	40	110	27	35	355	700	910	1 560	61	452	217	269	1 093	230	678
FLSB-FLSLB 355 L[1]	610	710	630	710	254	40	110	27	35	355	700	910	1 685	61	452	217	269	1 218	230	803

1. 4-pole motors from 250 kW upwards at catalogue rotor voltages and 6 and 8-pole motors from 160 kW upwards at catalogue rotor voltages.

Tolerance on frame size: 0/-1
Tolerance on dimensions B - A: js14
Tolerance on dimension C: js16

Foot and flange mounted IM B35 (IM 2001)

Dimensions in millimetres



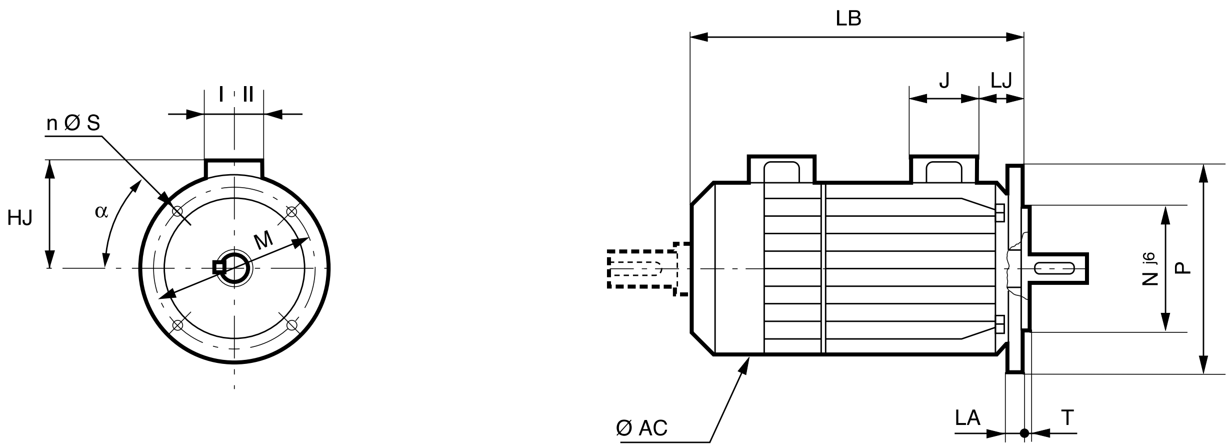
Type	Main dimensions																					
	A	AB	B	BB	C	X	AA	K	HA	H	AC	HD	HJ	LB	LJ	J	I	II	Z	Q	CA	Symb.
FLSB-FLSLB 280 S	457	537	368	499	190	40	80	22	40	280	556	730	450	1 280	68	352	173	210	787	230	725	FF 500
FLSB-FLSLB 280 M	457	537	419	499	190	40	80	22	40	280	556	730	450	1 280	68	352	173	210	787	230	674	FF 500
FLSB-FLSLB 315 S	508	600	406	598	216	45	100	27	40	315	624	833	518	1 420	68	352	173	210	878	230	804	FF 600
FLSB-FLSLB 315 M	508	600	457	598	216	45	100	27	40	315	624	835	520	1 420	70	452	217	269	878	230	753	FF 600
FLSB-FLSLB 315 L	508	600	508	598	216	45	100	27	40	315	624	835	520	1 420	70	452	217	269	878	230	702	FF 600
FLSB-FLSLB 355 L	610	710	630	710	254	40	110	27	35	355	700	910	555	1 560	61	452	217	269	1 093	230	678	FF 740
FLSB-FLSLB 355 L[1]	610	710	630	710	254	40	110	27	35	355	700	910	555	1 685	61	452	217	269	1 218	230	803	FF 740

1. 4-pole motors from 250 kW upwards at catalogue rotor voltages and 6 and 8-pole motors from 160 kW upwards at catalogue rotor voltages.

Tolerance on frame size: 0/-1
Tolerance on dimensions B - A: js14
Tolerance on dimension C: js16

Flange mounted IM B5 (IM 3001)

Dimensions in millimetres



IEC symbol	Flange dimensions							
	M	N	P	T	n	s	LA	α
FF 500	500	450	550	5	8	18	18	22° 30
FF 600	600	550	660	6	8	22	25	22° 30
FF 740	740	680	800	6	8	22	25	22° 30

Type	Main dimensions						
	AC	LB	HJ	LJ	J	I	II
FLSB-FLSLB 280 S	556	1 280	450	68	352	173	210
FLSB-FLSLB 280 M	556	1 280	450	68	352	173	210
FLSB-FLSLB 315 S	624	1 420	518	68	352	173	210
FLSB-FLSLB 315 M	624	1 420	520	70	452	217	269
FLSB-FLSLB 315 L	624	1 420	520	70	452	217	269
FLSB-FLSLB 355 L	700	1 560	555	61	452	217	269
FLSB-FLSLB 355 L[1]	700	1 685	555	61	452	217	269

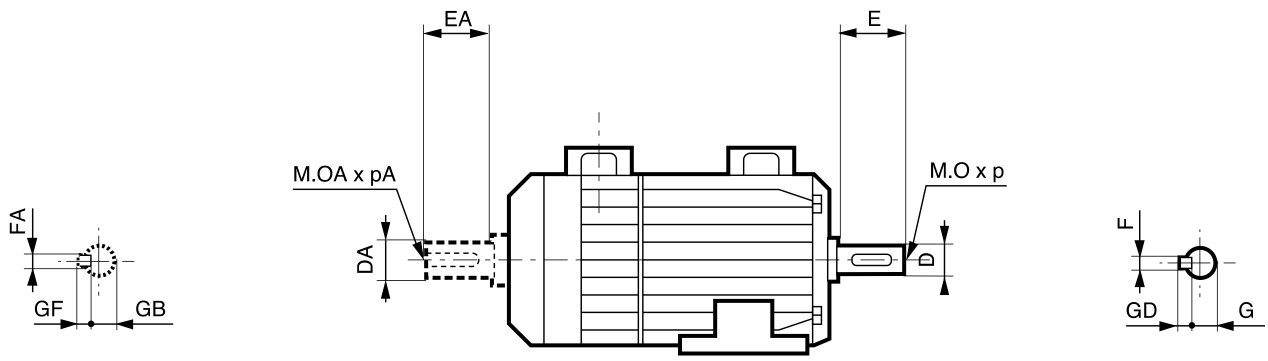
1. 4-pole motors from 250 kW upwards at catalogue rotor voltages and 6 and 8-pole motors from 160 kW upwards at catalogue rotor voltages.

Note: the mating surface of the flange is in the same plane as the shoulder of the shaft: dimension R = 0 ± 1.45

NOTE : IM 3001 - IMB5 position not available (see page 12).

FLSLB motors for hoisting applications

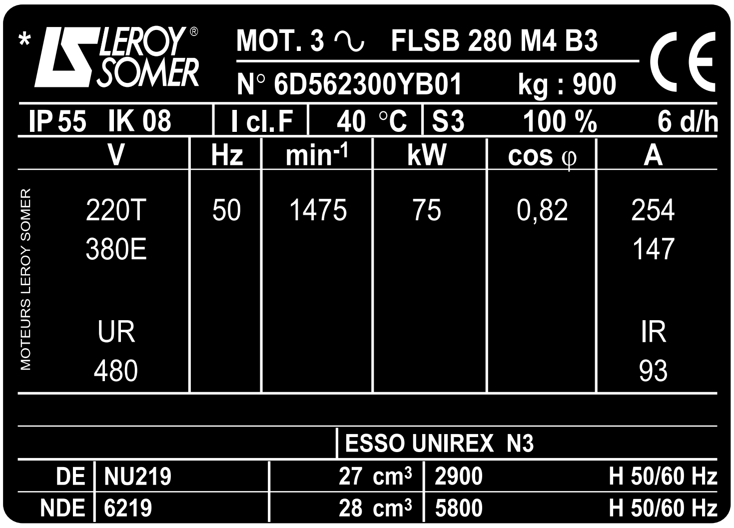
On request, these motors can be fitted with 2 shaft extensions (standard dimensions section «Shaft extensions»).
On request, FLSLB motors can be fitted with main or secondary shaft extensions conforming to French standard NF C 51-157 with the dimensions indicated below for frame sizes 280 and 315S. The dimensions given in section «Shaft extensions» already conform for frame sizes 315L and 355L.



Type	Shaft extensions - Option						
	F	GD	D	G	E	O	p
	FA	GF	DA	GB	EA	OA	pA
FLSLB 280 S/M	22	14	80 m6	71	140 h13	20	42
FLSLB 315 S/M	25	14	90 m6	81	170 h13	24	50

Identification

NAMEPLATE



* Other logos may be used as an option, but only by agreement before ordering.

DEFINITION OF SYMBOLS USED ON NAMEPLATE

CE **Legal mark of conformity product to the requirements of European Directives**

MOT 3 ~ : 3-phase A.C. motor
FLSB : FLSB range
280 : Frame size
M4 B3 : Housing symbol

Motor no.

N° : Motor batch number

kg : Weight
IP55 IK08 : Protection index
I cl. F : Insulation class F
40 °C : Maximum ambient temperature for operation, according to IEC 34-1
S...% : Duty - Operating factor
...d/h : Number of cycles per hour
V : Supply voltage
Hz : Supply frequency
min^{-1} : Revolutions per minute
kW : Rated output power
cos φ : Power factor
A : Rated current
T : Delta connection
E : Star connection
IR : Rotor current
UR : Rotor voltage

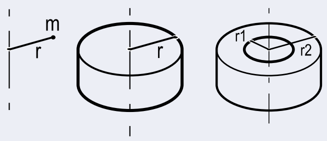
Bearings

DE : Drive end bearing
NDE : Non drive end bearing
27 cm^3 : Amount of grease at each regreasing (in cm^3)
2 900 h : Regreasing interval (in hours)
ESSO UNIREX N3 : Type of grease

Please quote when ordering spare parts

Standard formulae used in electrical engineering

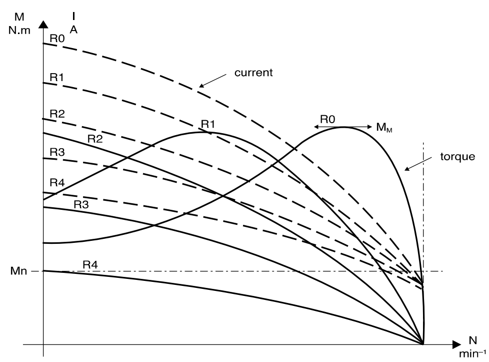
MECHANICAL FORMULAE

Title	Formula	Unit	Definitions / notes
Force	$F = m \cdot \gamma$	F in N m in kg γ in m/s²	A force F is the product of a mass m by an acceleration γ
Weight	$G = m \cdot g$	G in N m in kg g = 9.81 m/s²	
Moment	$M = F \cdot r$	M in N.m F in N r in m	The moment M of a force in relation to an axis is the product of that force multiplied by the r of the point of application of F in relation to the axis.
Power - rotating	$P = M \cdot \omega$	P in W M in N.m ω in rad/s	Power P is the quantity of work yielded per unit of time $\omega = 2\pi N/60$ where N is the speed of rotation in min^{-1}
- linear	$P = F \cdot V$	P in W F in N V in m/s	V = linear velocity
Acceleration time	$t = J \cdot \frac{\omega}{M_a}$	t in s J in kg.m² ω in rad/s M_a in Nm	J is the moment of inertia of the system M_a is the moment of acceleration Note: All the calculations refer to a single rotational speed ω where the inertias at speed ω" are corrected to speed ω by the following calculation: $J_\omega = J_{\omega'} \cdot \left(\frac{\omega'}{\omega}\right)^2$
Moment of inertia Centre of gravity	$J = m \cdot r^2$		
Solid cylinder around its axis	$J = m \cdot \frac{r^2}{2}$	J in kg.m² m in kg r in m	
Hollow cylinder around its axis	$J = m \cdot \frac{r_1^2 + r_2^2}{2}$		
Inertia of a mass in linear motion	$J = m \cdot \left(\frac{v}{\omega}\right)^2$	J in kg.m² m in kg v in m/s ω in rad/s	The moment of inertia of a mass in linear motion transformed to a rotating motion.

Standard formulae used in electrical engineering

ELECTRICAL FORMULAE

Title	Formula	Unit	Definitions / notes
Accelerating torque	$M_a = \frac{M_D + 2M_A + 2M_M + M_N}{6} - M_r$ *General formula:* $M_a = \frac{1}{N_N}\int_0^{N_N}(M_{mot} - M_r)dN$	*Nm*	Moment of acceleration M_A is the difference between the motor torque M_{mot} (estimated), and the resistive torque M_r. (M_D, M_A, M_M, M_N, see curve below) N = instantaneous speed N_N = rated speed
Power required by the machine	$P = \frac{M \cdot \omega}{\eta_A}$	*P* in W *M* in N.m ω in rad/s η_A no units	η_A expresses the efficiency of the driven machine. *M* is the torque required by the driven machine.
Power drawn by the 3-phase motor	$P = \sqrt{3} \cdot U \cdot I \cdot \cos\varphi$	*P* in W *U* in V *I* in A	φ phase angle by which the current lags or leads the voltage. *U* armature voltage. *I* line current.
Reactive power drawn by the motor	$Q = \sqrt{3} \cdot U \cdot I \cdot \sin\varphi$	Q in VAR	
Reactive power supplied by a bank of capacitors	$Q = \sqrt{3} \cdot U^2 \cdot C \cdot \omega$	*U* in V *C* in µ F ω in rad/s	*U* = voltage at the capacitor terminals *C* = capacitor capacitance ω = rotational frequency of supply phases (ω = 2πf)
Apparent power	$S = \sqrt{3} \cdot U \cdot I$ $S = \sqrt{P^2 + Q^2}$	S in VA	
Power supplied by the 3-phase motor	$P = \sqrt{3} \cdot U \cdot I \cdot \cos\varphi \cdot \eta$		η expresses motor efficiency at the point of operation under consideration.
Slip	$g = \frac{N_S - N}{N_S}$		Slip is the difference between the actual motor speed *N* and the synchronous speed N_S
Synchronous speed	$N_S = \frac{120 \cdot f}{p}$	N_S in min^{-1} *f* in Hz	*p* = number of poles *f* = frequency of the power supply
Rotor constants on starting	U_R = Cte $I_R = k\frac{U_R}{R}$ $I_R = \frac{P \times 1.05}{\sqrt{3} \cdot U_R}$	I_R in A U_R in V *R* in Ω *P* in W	*R* = starting resistance connected to the rotor.

Parameters	Symbol	Unit	Torque and current curve as a function of speed
Starting current **Rated current** **No-load current**	I_D I_N I_O	A	
Starting torque* **Run up torque** **Breakdown torque** **Rated torque**	M_D M_A M_M M_N	Nm	
Rated speed **Synchronous speed**	N_N N_S	min^{-1}	

* Torque is the usual term for expressing the moment of a force.

Tolerance on main performance parameters

TOLERANCES ON ELECTROMECHANICAL CHARACTERISTICS

IEC 60034-1 specifies standard tolerances for electromechanical characteristics.

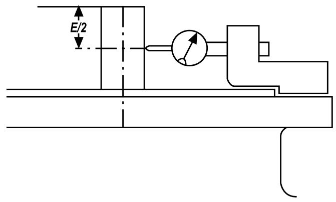
Parameters		Tolerances
Efficiency	machines P ≤ 150 kW machines P > 150 kW	**– 15% of (1 – η)** **– 10% of (1 – η)**
Cos φ		**– 1/6 (1 – cos φ)** **(min 0.02 - max 0.07)**
Slip	machines P < 1 kW machines P ≥ 1 kW	**± 30%** **± 20%**
Locked rotor torque		**– 15%, + 25% of rated torque**
Starting current		**+ 20%**
Run-up torque		**– 15 % of rated torque**
Breakdown torque		**– 10% of rated torque** **> 1.5 M_N**
Moment of inertia		**± 10%**
Noise		**+ 3 dB (A)**
Vibration		**+ 10% of the guaranteed class**

Note: IEC 60034-1 - does not specify tolerances for current
- the tolerance is ± 10% in NEMA-MG1

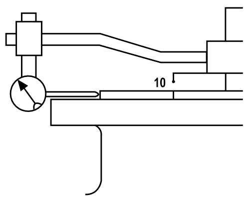
TOLERANCES AND ADJUSTMENTS

The standard tolerances shown below are applicable to the mechanical characteristics given in our catalogues. They comply fully with the requirements of IEC standard 60072-1.

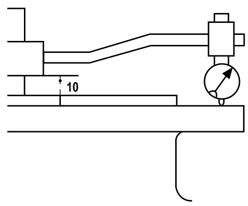
Characteristics	Tolerances
Frame size H ≤ 250 ≥ 280 Diameter ∅ of the shaft extension: - 11 to 28 mm - 32 to 48 mm - 55 mm and over	**0, — 0.5 mm** **0, — 1 mm** **j6** **k6** **m6**
Diameter N of flange spigots	**j6 up to FF 500,** **js6 for FF 600 and over**
Key width	**h9**
Width of drive shaft keyway (normal keying)	**N9**
Key depth: - square section - rectangular section	 **h9** **h11**
① ***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**
② ***Concentricity of spigot diameter*** and ③ ***perpendicularity of mating surface of flange in relation to shaft*** (standard class) Flange (FF) or Faceplate (FT): - F 55 to F 115 - F 130 to F 265 - FF 300 to FF 500 - FF 600 to FF 740 - FF 940 to FF 1080	 **0.08 mm** **0.10 mm** **0.125 mm** **0.16 mm** **0.20 mm**



① ***Eccentricity of shaft in flanged motors***



② ***Concentricity of spigot diameter***



③ ***Perpendicularity of mating surface of flange in relation to shaft***

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