EMERSON
Industrial Automation

LS2

High-efficiency three-phase induction motors
LSES - FLSES - PLSES

0.75 to 900 kW

Technical catalogue

4608 en - 2013.07 / h

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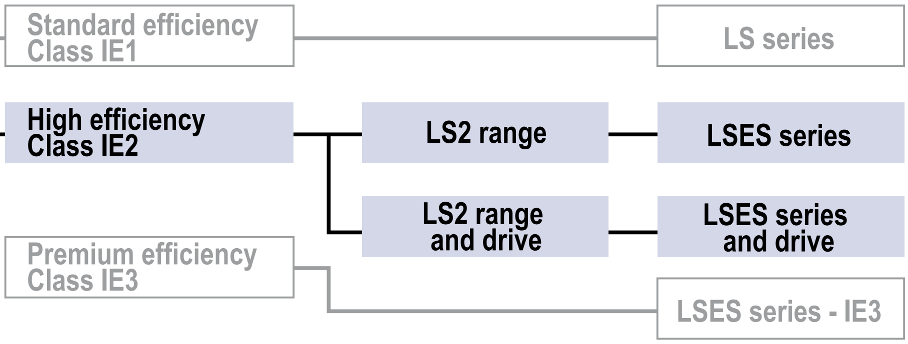
Introduction

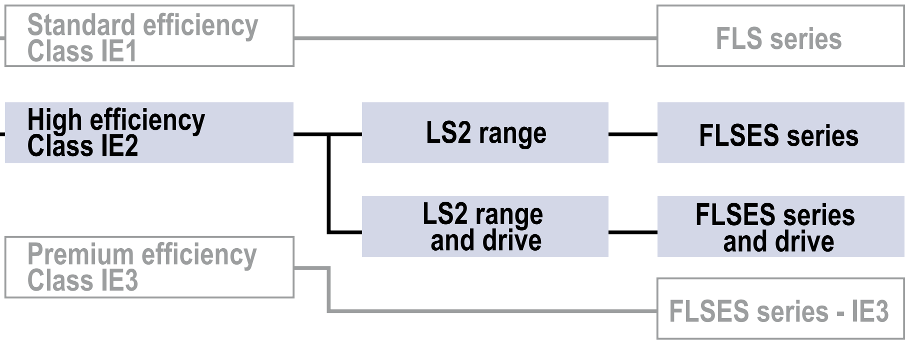
In this catalogue, Emerson Industrial Automation describes the LS2 high-efficiency induction motors.
These motors have been designed to incorporate the latest European standards, and can satisfy most of industry's demands.
They are par excellence the leading products in the Emerson Industrial Automation range.

Other motors, ranging in power from **0.045 to 2200 kW** and special construction types are included in the Emerson Industrial Automation motor programme.

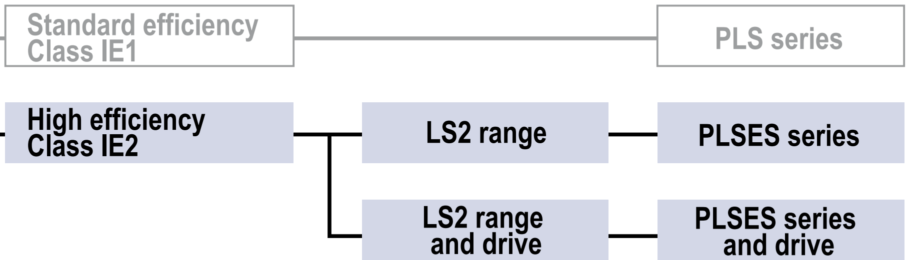
Motors with IP55 aluminium alloy frame for general applications: pumps, fans, air compressors, etc



Motors with IP55 cast iron frame for heavy industrial processes, etc



Motors with IP23 aluminium or steel frame for general applications and especially drip-proof refrigeration compressors, etc



For more information, see the "Directives and standards relating to motor efficiency" section.

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 life cycle on the environment. This eco-design approach has resulted in the creation of “Product Environmental Profile” (references 4592/4950/4951).

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.

ISO 9001 : 2008

Directive and standards relating to motor efficiency

There have been a number of changes to the standards and new standards created in recent years. They mainly concern motor efficiency and their scope includes measurement methods and motor classification.

Regulations are gradually being implemented, both nationally and internationally, in many countries in order to promote the use of high-efficiency motors (Europe, USA, Canada, Brazil, Australia, New Zealand, Korea, China, Israel, etc).

The new generation of LS2 high-efficiency three-phase induction motors responds to changes in the standards as well as the latest demands of system integrators and users.

A - Standard IEC 60034-30
(September 2008) defines the principle to be adopted and brings global harmonisation to energy efficiency classes for electric motors throughout the world.

Motors concerned
single speed three-phase cage induction motors
- Un ≤ 1000 V
- Pn from 0.75 to 375 kW
- 2, 4 and 6 poles
- S1 or S3 duty with operating factor ≥ 80%
- 50 and 60 Hz frequency
- On the mains
- All types of fixing, shaft extension, accessories
- All protection indices IP 1x to 6x and cooling method IC 0x to 4x

Motors not concerned
- Magnet motors
- Motors specifically designed for variable speed in accordance with IEC 60034-25
- Motors which are fully integrated in a machine and cannot be tested separately (such as rotor/stator).

B - New standard for measuring the efficiency of electric motors: IEC 60034-2-1 (September 2007)
Standard IEC 60034-2-1 concerns asynchronous induction motors:

- Single-phase and Three-phase with power ratings of 1 kW or less
  The preferred method is the D.O.L. method
- Three-phase motors with power ratings above 1 kW
  The preferred method is the method which adds the losses to the total measured additional losses

Comments:
- The new standard for efficiency measurement is very similar to the IEEE 112-B method used in North America.
- Since the measurement method is different, this means that for the same motor, the rated value will be different (usually lower) with IEC 60034-2-1 than with IEC 60034-2.

Example of a 22 kW 4P LSES motor:
- according to IEC 60034-2, the efficiency is 92.6%
- according to IEC 60034-2-1, the efficiency is 92.3%

C - Directive 2009/125/EC (21 October 2009) from the European Parliament has established a framework for setting the eco-design requirements to be applied to “energy-using products”. These products are grouped in lots. Motors come under lot 11 of the eco-design programme, as do pumps, fans and circulating pumps.

D - Decree implementing European directive ErP (Energy related Product) - EC/640/2009 - lot 11 (July 2009)
This is based on standard IEC 60034-30 and will define the efficiency classes whose use will be mandatory in the future. It specifies the efficiency levels to be attained for machines sold in the European market and outlines the timetable for their implementation.

This standard only defines efficiency classes and their conditions. It is then up to each country to define the efficiency classes and the exact scope of application.

ERP EUROPEAN DIRECTIVE

Motors concerned: Motors defined under standard IEC 60034-30.
Obligation to place high-efficiency motors on the market:
- IE2 class from 16 June 2011
- Class IE3[1] from 1 January 2015 for power ratings from 7.5 to 375 kW
- Class IE3[1] from 1 January 2017 for power ratings from 0.75 to 375 kW

The European Commission is currently working to define minimum efficiency values for drives.

[1] or IE2 motor + drive

Motors not concerned:
- Motors designed to operate when fully submerged in liquid
- Motors which are fully integrated in another product (rotor/stator)
- Motors with duty other than S1
- Motors designed to operate in the following conditions:
  - altitude > 1000 m
  - ambient air temperature > 40°C
  - maximum operating temperature > 400°C
  - ambient air temperature < -15°C or < 0°C for air-cooled motors
  - cooling water temperature at product entry < 5°C or > 25°C
- Safety motors conforming to directive ATEX 94/9/EC
- Brake motors
- Onboard motors

Efficiency classes	Efficiency level	Definition
IE1	Standard	Comparable to eff2
IE2	High	Comparable to eff1 and EPAct'92
IE3	Premium	Comparable to EISA Premium
IE4 *	Super Premium	

* Draft.

Standards and approvals

LIST OF STANDARDS QUOTED IN THIS DOCUMENT

LS2 motors comply with the standards quoted in this catalogue

Reference		International standards
IEC 60034-1	EN 60034-1	Electrical rotating machines: ratings and operating characteristics.
IEC 60034-2		Electrical rotating machines: methods for determining losses and efficiency from tests (additional losses added as a fixed percentage)
IEC 60034-2-1		Electrical rotating machines: methods for determining losses and efficiency from tests (measured additional losses)
IEC 60034-5	EN 60034-5	Electrical rotating machines: classification of degrees of protection provided by casings of rotating machines
IEC 60034-6	EN 60034-6	Electrical rotating machines (except traction): cooling methods.
IEC 60034-7	EN 60034-7	Electrical rotating machines (except traction): symbols for mounting positions and assembly layouts
IEC 60034-8		Electrical rotating machines: terminal markings and direction of rotation.
IEC 60034-9	EN 60034-9	Electrical rotating machines: noise limits.
IEC 60034-12	EN 60034-12	Starting characteristics for single-speed 3-phase cage induction motors for supply voltages less than or equal to 660V
IEC 60034-14	EN 60034-14	Electrical rotating machines: mechanical vibrations of certain machines with a frame size above or equal to 56 mm. Measurement, evaluation and limits of vibrational intensity.
IEC 60034-17		Cage induction motors supplied by inverters - Application guide
IEC 60034-30		Electrical rotating machines: efficiency classes for single-speed three-phase cage induction motors (Code IE)
IEC 60038		IEC standard voltages.
IEC 60072-1		Dimensions and power series for electrical rotating machines: designation of casings between 56 and 400 and flanges between 55 and 1080
IEC 60085		Evaluation and thermal classification of electrical insulation
IEC 60721-2-1		Classification of natural environment conditions. Temperature and humidity.
IEC 60892		Effects of an imbalance in the voltage system on the characteristics of three-phase squirrel-cage induction motors
IEC 61000-2-10/11 and 2-2		Electromagnetic compatibility (EMC): environment.
IEC guide 106		Guidelines on the specification of environmental conditions for the determination of operating characteristics of equipment
ISO 281		Bearings - Dynamic load ratings and nominal bearing life.
ISO 1680	EN 21680	Acoustics - Test code for measuring airborne noise emitted by electrical rotating machines: a method for establishing an expert opinion for free field conditions over a reflective surface
ISO 8821		Mechanical vibration - Balancing. Conventions on shaft keys and related parts
	EN 50102	Degree of protection provided by electrical enclosures against extreme mechanical impacts.
ISO 12944-2		Corrosivity category

Standards and approvals

APPROVALS

Certain countries recommend or insist on approval from national organizations.
Approved products must carry the recognized mark on their nameplates.

Country	Initials	Organization
USA / CANADA	**UL**	Underwriters Laboratories
CANADA	**CSA**	Canadian Standards Association
etc.		

Approvals for EMERSON motors (versions derived from standard construction):

Country	Initials	Certification No.	Application
CANADA	**CSA**	LR 57 008	Adapted standard range (see chapter «Supply voltage»)
USA	**UL or** ЯU	E 68554 SA 6704 E 206450	Impregnation systems Stator/rotor assemblies for sealed units Complete motors up to 160 size
SAUDI ARABIA	**SASO**		Standard range
FRANCE	**LCIE** **INERIS**	Various n^{os}	Sealing, shocks, safety

For specific approved products, see the relevant documents.

International and national standard equivalents

International reference standards		National standards				
IEC	**Title** (summary)	**FRANCE**	**GERMANY**	**U.K.**	**ITALY**	**SWITZERLAND**
60034-1	Ratings and operating characteristics	NFEN 60034-1 NFC 51-120 NFC 51-200	DIN/VDE O530	BS 4999	CEI 2.3.VI.	SEV ASE 3009
60034-5	Classification of degrees of protection	NFEN 60034-5	DIN/EN 60034-5	BS EN 60034-5	UNEL B 1781	
60034-6	Cooling methods	NFEN 60034-6	DIN/EN 60034-6	BS EN 60034-6		
60034-7	Mounting arrangements and assembly layouts	NFEN 60034-7	DIN/EN 60034-7	BS EN 60034-7		
60034-8	Terminal markings and direction of rotation	NFC 51 118	DIN/VDE 0530 Teil 8	BS 4999-108		
60034-9	Noise limits	NFEN 60034-9	DIN/EN 60034-9	BS EN 60034-9		
60034-12	Starting characteristics for single-speed motors for supply voltages ≤ 660 V	NFEN 60034-12	DIN/EN 60034-12	BS EN 60034-12		SEV ASE 3009-12
60034-14	Mechanical vibrations of machines with frame size ≥ 56 mm	NFEN 60034-14	DIN/EN 60034-14	BS EN 60034-14		
60072-1	Dimensions and output powers for machines of between 56 and 400 frame size and flanges of between 55 and 1080.	NFC 51 104 NFC 51 105	DIN 748 (~) DIN 42672 DIN 42673 DIN 42631 DIN 42676 DIN 42677	BS 4999		
60085	Evaluation and thermal classification of electrical insulation	NFC 26206	DIN/EN 60085	BS 2757		SEV ASE 3584

Note: DIN 748 tolerances do not conform to IEC 60072-1.

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.

Environmental limitations

NORMAL OPERATING CONDITIONS

ACCORDING TO IEC 60034-1, MOTORS CAN OPERATE IN THE FOLLOWING NORMAL CONDITIONS:

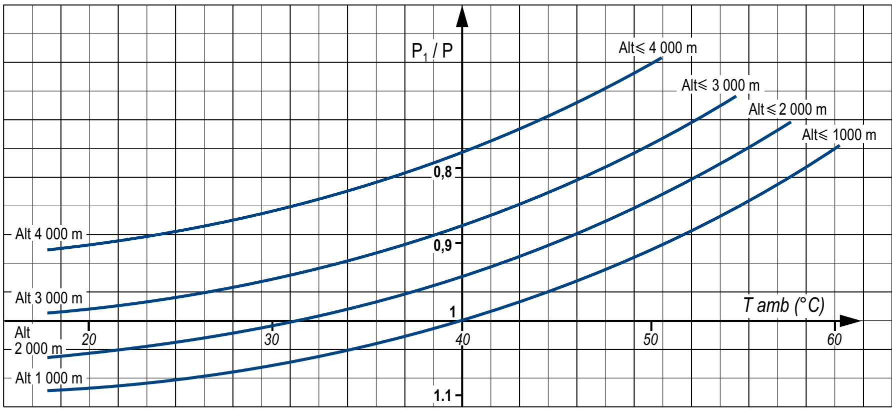
• ambient temperature within the range 16 to 40°C
• altitude less than 1000 m
• atmospheric pressure: 1050 hPa (mbar) = (750 mm Hg)

POWER CORRECTION FACTOR:

For operating conditions outside these limits, apply the power correction coefficient shown in the chart on the right which maintains the thermal reserve, as a function of the altitude and ambient temperature.

Correction coefficient table

Note: the output power can only be corrected upwards once the ability of the motor to start the load has been checked.



NORMAL STORAGE CONDITIONS

Machines should be stored in the horizontal position at an ambient temperature between -16 and + 80°C for aluminium motors, between -40 and + 80°C for cast iron motors, and in relative humidity of less than 90%.

For restarting, see commissioning manual.

RELATIVE AND ABSOLUTE HUMIDITY

MEASURING THE HUMIDITY:

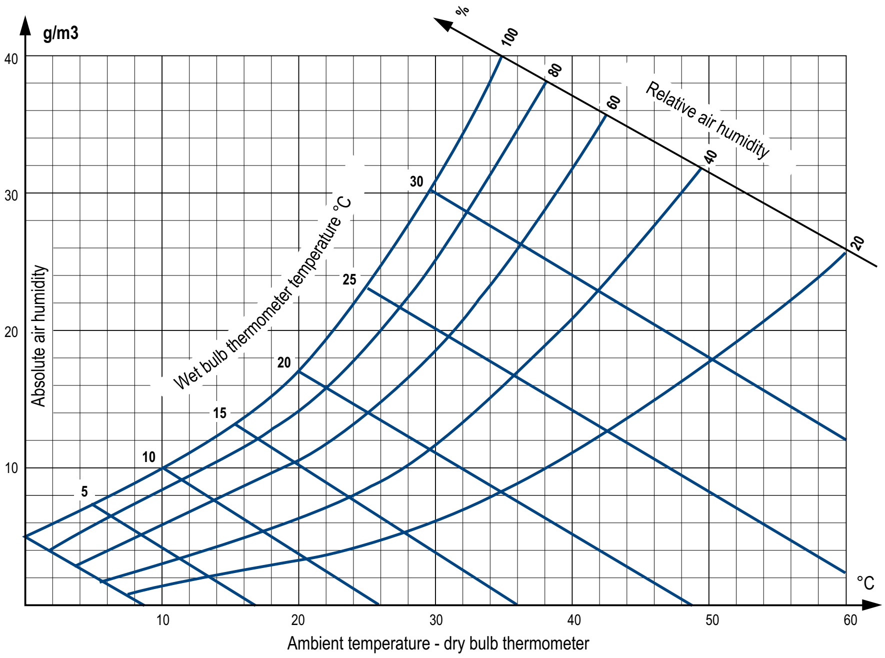
Humidity is usually measured by the "wet and dry bulb thermometer" method.

Absolute humidity, calculated from the readings taken on the two thermometers, can be determined using the chart on the right. The chart also provides relative humidity figures.

To determine the humidity correctly, a good air flow is required for stable readings, and accurate readings must be taken on the thermometers.

During the construction of aluminium motors, the materials of the various components which are in contact with one another are selected so as to minimise deterioration by galvanic effect. The voltages in the metal combinations used (cast iron-steel; cast iron-aluminium; steel-aluminium; steel-tin) are too low to cause deterioration.

In temperate climates, relative humidity is generally between 50 and 70%. For the relationship between relative humidity and motor impregnation, especially where humidity and temperature are high, see table on next page.



DRAIN HOLES

Holes are provided at the lowest points of the enclosure, depending on the operating position (IM etc) to drain off any moisture that may have accumulated inside during cooling of the machine.

The holes may be sealed in various ways:
- standard: with plastic plugs
- on request: with screws, siphon or plastic ventilator

Under certain special conditions, it is advisable to leave the drain holes permanently open (operating in environments with high levels of condensation).

Opening the holes periodically should be part of the regular maintenance procedure.

DRIP COVERS

For machines operating outdoors, with the drive shaft downwards, drip covers are recommended.

This is an option and should be specified on the order if required.

Impregnation and enhanced protection

NORMAL ATMOSPHERIC PRESSURE (750 MM HG)

The selection table below can be used to find the method of manufacture best suited to particular environments in which temperature and relative humidity show large degrees of variation (see relative and absolute humidity calculation method, on preceding page).
The symbols used refer to permutations of components, materials, impregnation methods and finishes (varnish or paint).
The protection of the winding is generally described by the term "tropicalization".

For high humidity environments, we recommend that the windings are pre-heated (see next page).

INFLUENCE OF ATMOSPHERIC PRESSURE

As atmospheric pressure decreases, air particles rarefy and the environment becomes increasingly conductive.
- P > 550 mm Hg:
Standard impregnation according to previous table - Possible derating or forced ventilation.
- P > 200 mm Hg:
Coating of bearings - Flying leads up to a zone at P ~ 750 mm Hg - Derating to take account of insufficient ventilation - Forced ventilation.
- P < 200 mm Hg: Special manufacture based on specification.

In all cases, these problems should be resolved by a special contract worked out on the basis of a specification.

Ambient temperature / Relative humidity	RH ≤ 95%	RH > 95%*	Influence on construction
θ < - 40°C	ask for estimate (quotation)	ask for estimate (quotation)	Increasing derating
- 20 to + 40 °C**	T Standard or T0	TC Standard or TC0	
- 40 to + 40°C	T1	TC1	
- 16 to + 65°C	T2	TC2	
+ 65 to + 90°C	ask for estimate (quotation)	ask for estimate (quotation)	
θ > + 90°C	ask for estimate (quotation)	ask for estimate (quotation)	
Plate mark	T	TC	
Influence on construction	Increased protection of windings		

* *Atmosphere without high levels of condensation*
** *-16 to +40 °C for LSES Alu motors frame size 80 to 112*

Standard impregnation

Heaters

SPACE HEATERS

Severe climatic conditions, e.g. T amb < - 40°C, RH > 95% etc, may require the use of space heaters (fitted to the motor windings) which serve to maintain the average temperature of the motor, provide trouble-free starting, and eliminate problems caused by condensation (loss of insulation).

The heater supply wires are brought out to a terminal block in the motor terminal box.

The heaters must be switched off while the motor is running.

D.C. INJECTION HEATING

An alternative to the use of space 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. This method can only be used on motors rated less than 10 kW.

This is easily calculated: if R is the resistance of the windings in series, the D.C. voltage will be given by the equation (Ohm's law):

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

Resistance should be measured with a micro-ohmmeter.

A.C. INJECTION HEATING

A single-phase A.C. voltage (from 10 to 15% of rated voltage), can be used between 2 phases placed in series.
This method can be used on the whole motor range.

External finish

Emerson Industrial Automation motors are protected with a range of surface finishes.
The surfaces receive appropriate special treatments, as shown below.

Preparation of surfaces

SURFACE	PARTS	TREATMENT
Cast iron	End shields	Shot blasting + Primer
Steel	Accessories	Phosphatization + Primer
	Terminal boxes - Fan covers	Electrostatic painting or Epoxy powder
Aluminium alloy	Housings - Terminal boxes	Shot blasting
Polymer	Fan covers - Terminal boxes Ventilation grilles	None, but must be free from grease, casting-mould coatings, and dust which would affect paint adhesion

DEFINITION OF ATMOSPHERES

An atmosphere is said to be harsh when components are attacked by bases, acids or salts. It is said to be corrosive when components are attacked by oxygen.

Paint systems

SERIES	ATMOSPHERE	SYSTEM	APPLICATIONS	CORROSIVITY CATEGORY * ACC. TO ISO 12944-2
LSES Aluminium frame PLSES/PLS Steel frame	Non-harsh and not very harsh (indoors, rural, industrial)	**Ia** LSES - PLSES standard	1 polyurethane top coat 20/30 µm	**C3L**
	Substantial chemical attack: frequent contact with bases, acids, alkalis **Surroundings - neutral environment** (not in contact with chlorinated or sulphurous products)	**IIIb****	1 Epoxy base coat 30/40 µm 1 Epoxy intermediate coat 30/40 µm 1 Epoxy top coat 25/35 µm	**C4H**
LSES Aluminium frame PLSES/PLS Steel frame FLSES/FLS Cast iron frame	Moderately corrosive: humid, and outdoors (temperate climate)	**IIa** FLSES standard	1 Epoxy base coat 30/40 µm 1 polyurethane top coat 20/30 µm	**C3M**
	Corrosive: maritime, very humid (tropical climate)	**IIIa** FLSES standard with Corrobloc finish	1 Epoxy base coat 30/40 µm 1 Epoxy intermediate coat 30/40 µm 1 polyurethane top coat 20/30 µm	**C4M**
	Special conditions Very harsh, polluted with chlorinated or sulphurous products	**Ve****	1 Epoxy base coat 20/30 µm 2 Epoxy intermediate coats, each 35/40 µm 1 polyurethane top coat 35/40 µm	**C5I-M**
		161b**	1 base coat 50 µm 2 Epoxy intermediate coats 80 µm 1 Epoxy top coat 50 µm	**C5M-M**

System **I**a is for moderate climates and System **II**a is for general climates as defined in standard IEC 60721.2.1.

* Values given for information only since the substrates vary in nature whereas the standard only takes account of steel substrates.
* * Assessment of the degree of rusting in accordance with standard ISO 4628 (rusted area between 1 and 0.5%)

Emerson Industrial Automation standard paint colour reference:

RAL 6000

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.

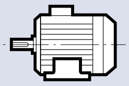
Mounting arrangements

MOUNTINGS AND POSITIONS (IEC STANDARD 60034-7)

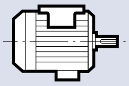
Foot mounted motors

• all frame sizes

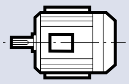
IM 1001 (IM B3)
- Horizontal shaft
- Feet on floor



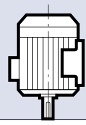
IM 1071 (IM B8)
- Horizontal shaft
- Feet on top



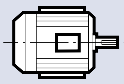
IM 1051 (IM B6)
- Horizontal shaft
- Wall mounted with feet on left when viewed from drive end



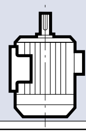
IM 1011 (IM V5)
- Vertical shaft facing down
- Feet on wall



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



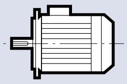
IM 1031 (IM V6)
- Vertical shaft facing up
- Feet on wall



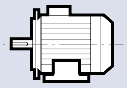
(FF) flange mounted motors

• all frame sizes
(except IM 3001, which is limited to frame size 225 mm)

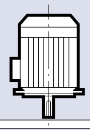
IM 3001 (IM B5)
- Horizontal shaft



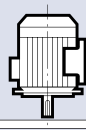
IM 2001 (IM B35)
- Horizontal shaft
- Feet on floor



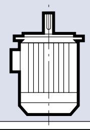
IM 3011 (IM V1)
- Vertical shaft facing down



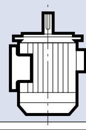
IM 2011 (IM V15)
- Vertical shaft facing down
- Feet on wall



IM 3031 (IM V3)
- Vertical shaft facing up



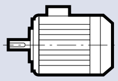
IM 2031 (IM V36)
- Vertical shaft facing up
- Feet on wall



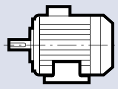
(FT) face mounted motors

• all frame sizes ≤ 132 mm

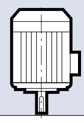
IM 3601 (IM B14)
- Horizontal shaft



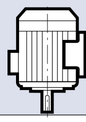
IM 2101 (IM B34)
- Horizontal shaft
- Feet on floor



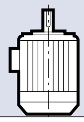
IM 3611 (IM V18)
- Vertical shaft facing down



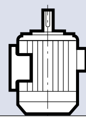
IM 2111 (IM V58)
- Vertical shaft facing down
- Feet on wall



IM 3631 (IM V19)
- Vertical shaft facing up



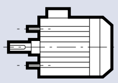
IM 2131 (IM V69)
- Vertical shaft facing up
- Feet on wall



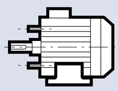
Motors without drive end shield

Warning: the protection (IP) specified on the IM B9 and IM B15 motor nameplates is provided by the customer when the motor is assembled.

IM 9101 (IM B9)
- Threaded tie rods
- Horizontal shaft



IM 1201 (IM B15)
- Foot mounted with threaded tie rods
- Horizontal shaft



Frame size (mm)	Mounting positions											
	IM 1001	IM 1051	IM 1061	IM 1071	IM 1011	IM 1031	IM 3001	IM 3011	IM 3031	IM 2001	IM 2011	IM 2031
≤ 200	●	●	●	●	●	●	●	●	●	●	●	●
225 and 250	●	●	●	●	●	●	■	●	●	●	●	●
≥ 280	●	■	■	■	■	■	■	●	●	●	●	■

●: possible positions
■: please consult Emerson Industrial Automation specifying the coupling method and the axial and radial loads if applicable

Mains connection

TERMINAL BOX

Placed as standard on the top of the motor near the drive end, it is IP 55 protection and fitted with threaded plugs or a removable undrilled support plate.
The standard position of the plug is on the right, seen from the drive end but, owing to the symmetrical construction of the box, it can usually be placed in any of the 4 directions, as shown in the table below:
If required, the terminal box may be fitted in a different position (on the left or right as seen from the drive end, and at the DE or NDE of the motor housing).

FLYING LEADS

According to specification, motors can be supplied with flying leads using single-core cables (as an option, the cables can be protected by a sheath) or multicore cables.
Please state cable characteristics (cross-section, length, number of conductors), connection method (flying leads or on a terminal block) and the drill hole position.

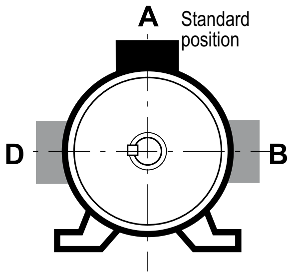
WIRING DIAGRAMS

All standard motors are supplied with a wiring diagram in the terminal box.
The diagrams normally used are shown opposite.
On the following pages are outline diagrams with internal and external connections.

EARTH TERMINAL

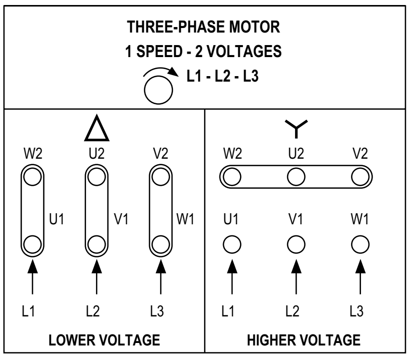
This is situated inside the terminal box. Consisting of a threaded stud with a hexagonal nut, it is used to connect cables with cross-sections at least as large as the cross-section of the phase conductors.
It is indicated by the sign: ⏚ in the terminal box moulding.
On request, a second earth terminal can be fitted on one of the feet or on one of the cooling fins.

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

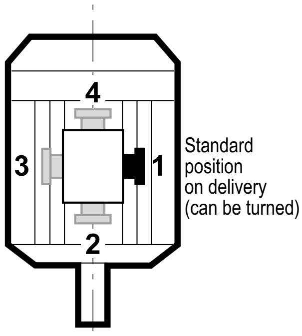


Terminal box position	A	B	D
LSES	●	■	■
FLSES 80 to 225 SR/MR	●	-	-
FLSES/FLS 225M to 450	●	■	■
PLSES/PLS	●	■	■

● : standard
■ : please consult Emerson Industrial Automation
- : not available



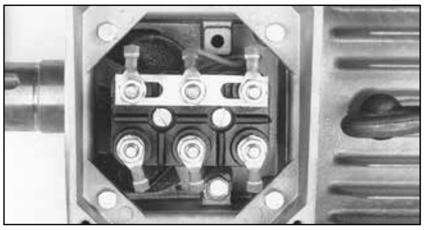
Positions of the threaded plug in relation to the drive end

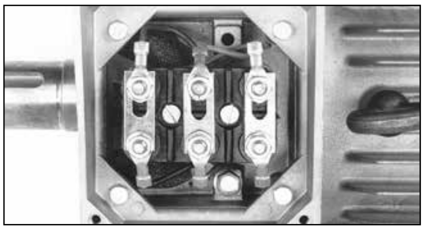


Position 2 not recommended (impossible on standard (FF) flange mounted motor)

Cable gland position	1	2*	3	4
LSES - FLSES - PLSES 80 to 315	◆	✶	✶	✶
PLSES/PLS 315 LG/MGU/VLG/VLGU PLS 355/400	◆	-	✶	-

* not recommended (impossible on (FF) flange mounted motors and on the FLSES/FLS 355LK/400/450)
◆ : standard
✶ : possible by simply turning round the terminal box
- : not available





Radial loads

PERMISSIBLE RADIAL LOAD ON THE MAIN SHAFT EXTENSION

In pulley and belt couplings, the drive shaft carrying the pulley is subjected to a radial force Fpr applied at a distance X (mm) from the shoulder of the shaft extension (length E).

Radial force acting on the drive shaft: Fpr
The radial force Fpr expressed in daN applied to the drive shaft is found by the formula.

$$\mathbf{Fpr = 1.91\ 10^6 \frac{P_N \cdot k}{D \cdot N_N} \pm P_P}$$

where:
PN = rated motor power (kW)
D = external diameter of the drive pulley (mm)
N_N = rated motor speed (min^{-1})
k = factor depending on the type of transmission
PP = weight of the pulley (daN)

The weight of the pulley is positive when it acts in the same direction as the tension force in the belt (and negative when it acts in the opposite direction).

Range of values for factor k(*)
- toothed belts: k = 1 to 1.5
- V-belts: k = 2 to 2.5
- flat belts
  • with tensioner: k = 2.5 to 3
  • without tensioner: k = 3 to 4

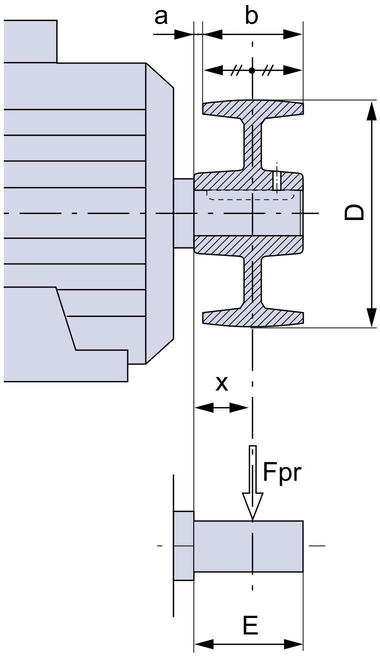
(*) A more accurate figure for factor k can be obtained from the transmission suppliers.

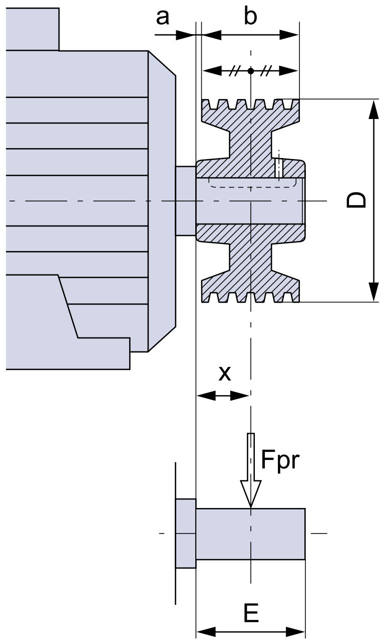
Permissible radial force on the drive shaft:
The charts on the following pages indicate, for each type of motor, the radial force FR at a distance X permissible on the drive end shaft extension, for a bearing life L10h of 25,000 hours.

Note: For frame sizes ≥ 315 M, the selection charts are applicable for a motor installed with the shaft horizontal.

Change in bearing life depending on the
radial load factor
For a radial load Fpr (Fpr ≠ FR), applied at distance X, the bearing life L10h changes, as a rough estimate, in the ratio kR, (kR = Fpr/FR) as shown in the chart below, for standard fitting arrangements.

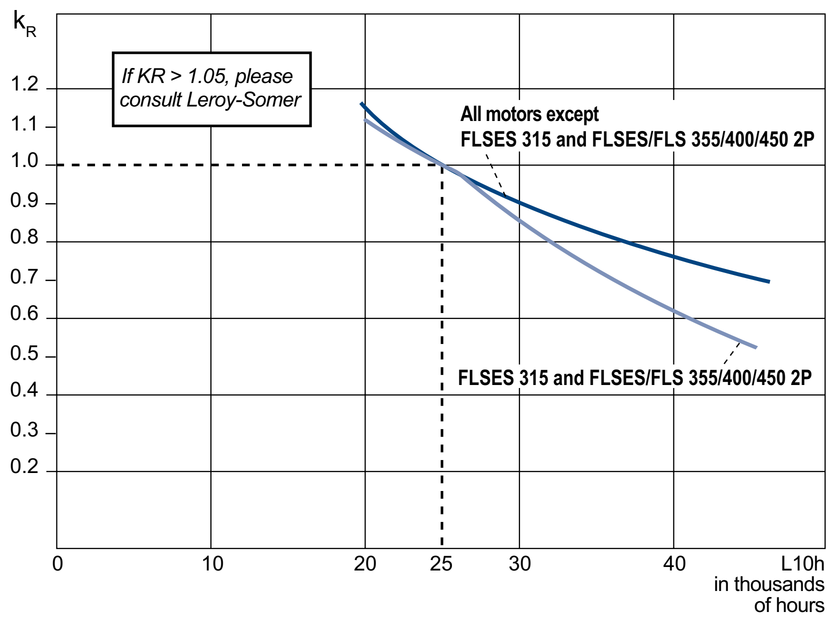
If the load factor kR is greater than 1.05, you should consult our technical department, stating mounting position and direction of force before opting for a special fitting arrangement.





$$\left\{ \begin{array}{l} x = a + \frac{b}{2} \\ \text{where} \\ x \leq E \end{array} \right. \qquad \left\{ \begin{array}{l} x = a + \frac{b}{2} \\ \text{where} \\ x \leq E \end{array} \right.$$

Change in bearing life L_{10h} depending on the radial load factor k_R for standard fitting arrangements.



Cooling

New designation for the IC (International Cooling) coded cooling method in the IEC 60034-6 standard.
The standard allows for two designations (general formula and simplified formula) as shown in the example opposite.

IC 4 A 1 A 1

- 1 → Secondary fluid circulation method (1: self-circulating)
- A → Secondary fluid (A: air)
- 1 → Primary fluid circulation method (1: self-circulating)
- A → Primary fluid (A: air)
- 4 → Circuit layout (4: surface-cooled machine)

Note: The letter A may be omitted if this will not lead to confusion. This contracted formula becomes the simplified formula.
Simplified form: ***IC 411.***

Circuit layout

Characteristic number	Abbreviated designation	Description
0(1)	Free circulation	The coolant enters and leaves the machine freely. It is taken from and returned to the fluid round the machine.
1(1)	Machine with one intake pipe	The coolant is taken up elsewhere than from the fluid round the machine, brought into the machine through an intake pipe and emptied into the fluid round the machine.
2(1)	Machine with one outlet pipe	The coolant is taken up from the fluid round the machine, brought away from the machine by an outlet pipe and does not go back into the fluid round the machine.
3(1)	Machine with two pipes (intake and outlet)	The coolant is taken up elsewhere than from the fluid round the machine, brought to the machine through an intake pipe, then taken away from the machine through an outlet pipe and does not go back into the fluid round the machine.
4	Surface cooled machine using the fluid round the machine	The primary coolant circulates in a closed circuit, transferring its heat to a secondary coolant (the one surrounding the machine) through the machine casing. The casing surface is either smooth or finned to improve heat transmission.
5(2)	Built-in heat exchanger (using the surrounding environment)	The primary coolant circulates in a closed circuit, transferring its heat to a secondary coolant (the one surrounding the machine) in an integral heat exchanger inside the machine.
6(2)	Machine-mounted heat exchanger (using the surrounding environment)	The primary coolant circulates in a closed circuit, transferring its heat to a secondary coolant (the one surrounding the machine) in a heat exchanger that forms an independent unit, mounted on the machine.
7(2)	Built-in heat exchanger (not using the surrounding environment)	The primary coolant circulates in a closed circuit, transferring its heat to a secondary coolant (which is not the one round the machine) in an integral heat exchanger inside the machine.
8(2)	Machine-mounted heat exchanger (not using the surrounding environment)	The primary coolant circulates in a closed circuit, transferring its heat to a secondary coolant (which is not the one round the machine) in a heat exchanger that forms an independent unit, mounted on the machine.
9(2)(3)	Separate heat exchanger (using the surrounding environment or not)	The primary coolant circulates in a closed circuit, transferring its heat to the secondary fluid in a heat exchanger that forms an independent unit, away from the machine.

Coolant

Characteristic letter	Type of fluid
A	Air
F	Freon
H	Hydrogen
N	Nitrogen
C	Carbon dioxide
W	Water
U	Oil
S	Any other fluid (must be identified separately)
Y	The fluid has not yet been selected (used temporarily)

Circulation method

Characteristic number	Abbreviated designation	Description
0	Free circulation	The circulation of the coolant is due only to differences in temperature. Ventilation caused by the rotor is negligible.
1	Self-circulating	The circulation of the coolant depends on the rotational speed of the main machine, and is caused by the action of the rotor alone, or a device mounted directly on it.
2, 3, 4		Not yet defined.
5(4)	Built-in, independent device	The coolant is circulated by a built-in device which is powered independently of the rotational speed of the main machine.
6(4)	Independent device, mounted on the machine	The coolant is circulated by a device mounted on the machine which is powered independently of the rotational speed of the main machine.
7(4)	Entirely separate independent device or using the pressure of the coolant circulation system	The coolant is circulated by a separate electrical or mechanical device, independent and not mounted on the machine, or by the pressure in the coolant circulation system.
8(4)	Relative displacement	The circulation of the coolant is produced by the relative movement between the machine and the coolant, either by displacement of the machine in relation to the coolant, or by the flow of the surrounding coolant.
9	Any other devices	The coolant is circulated using a method other than those defined above: it must be described in full.

(1) Filters or labyrinth seals for dust removal or noise protection can be fitted inside the casing or in the ducting. The first characteristic numbers 0 to 3 also apply to machines in which the coolant is taken up at the outlet of a water-cooler designed to lower the temperature of the ambient air or recirculated through a water-cooler so as not to increase the ambient temperature.
(2) The nature of the heat exchanger elements is not specified (smooth or finned tubes, corrugated surfaces, etc).
(3) A separate heat exchanger can be installed near to or at a distance from the machine. A secondary gas coolant may or may not be the surrounding medium.
(4) Use of such a device does not exclude the ventilating action of the rotor or the existence of an additional fan mounted directly on the rotor.

Cooling

MOTOR VENTILATION

In compliance with IEC 60034-6, the motors in this catalogue are cooled using method IC 411, ie. "surface-cooled machine using the ambient air circulating round the machine".

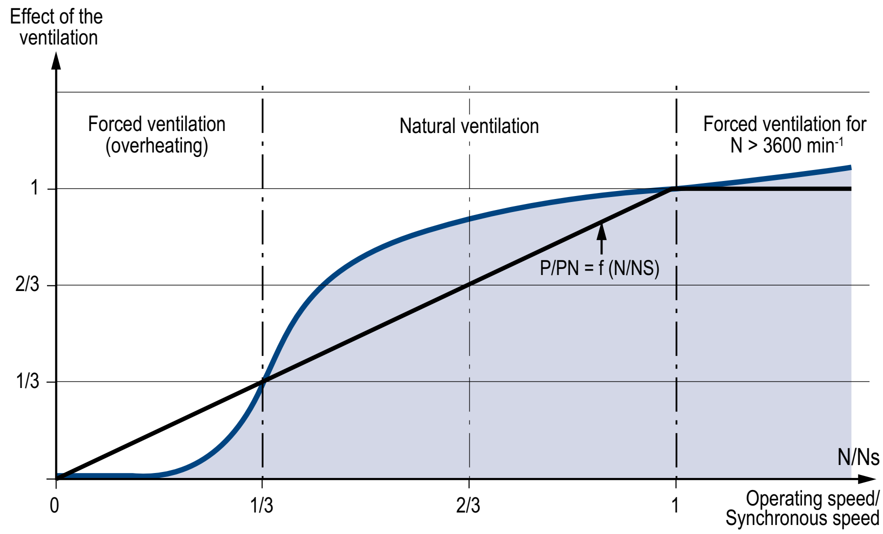
Cooling is achieved by a fan mounted at the non-drive end of the motor, inside a fan cover which acts as a safety guard (check according to IEC 600 34-5). The fan draws the air through the grille in the cover and blows it along the housing fins, giving an identical heat balance in either direction of rotation (except for LSES 2-pole motors of frame size 315 mm).

Note: Obstruction, even accidental, of the fan cover grille (grille clogged or placed against a wall) seriously impairs motor cooling.

We recommend a minimum distance of 1/3 of the frame size between the end of the cover and any possible obstacle (wall, machine, etc).

Cooling of variable speed motors

Special precautions need to be taken when standard induction motors are being used with variable speed, powered by an inverter or voltage controller.
During prolonged operation at low speed, cooling efficiency is greatly diminished. It is therefore advisable to install a forced ventilation unit that will produce a constant flow of air independently of the motor speed.
In prolonged operation at high speed, the fan may make excessive noise. It is again advisable to install a forced ventilation system.



NON-VENTILATED APPLICATIONS IN CONTINUOUS OPERATION

Motors can be supplied without fans. Dimensions will depend on the application.

IC 418 cooling system

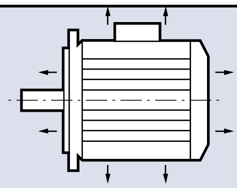
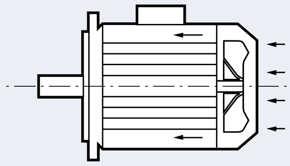
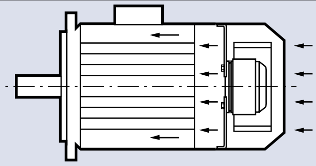
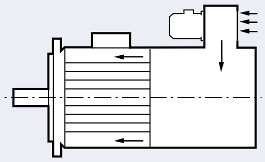
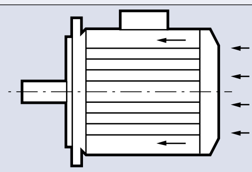
If they are placed in the air flow from a fan, these motors are capable of supplying their rated power if the speed of the air between the housing fins and the overall flow rate of the air between the fins comply with the data in the table below.

Type LSES/FLSES/FLS	2 poles		4 poles		6 poles	
	flow rate m3/hr	speed m/s	flow rate m3/hr	speed m/s	flow rate m3/hr	speed m/s
80	120	7.5	60	4	40	2.5
90	200	11.5	75	5.5	60	3.5
100	300	15	130	7.5	95	5
112	460	18	200	9	140	6
132	570	21	300	10.5	220	7
160	1000	21	600	12.5	420	9
180	1200	21	900	16	600	10
200	1800	23	1200	16	750	10
225	2000	24	1500	18	1700	13
250	3000	25	2600	20	1700	13
280	3000	25	2600	20	2000	15
315	5000	25	2600	20	2000	15
355	5200	25	2800	20	2200	15
400	5500	25	3000	20	2600	15
450	6000	25	3200	20	2600	15

These air flows are valid for normal operating conditions as described in the “Environmental limitations” section.

Cooling for LSES / FLSES / FLS motors

Standard codes

IC 410	Enclosed machine, surface-cooled by natural convection and radiation. No external fan.	
IC 411	Enclosed machine. Smooth or finned ventilated casing. External shaft-mounted fan.	
IC 416 A*	Enclosed machine. Smooth or finned enclosed casing. External motorized axial (A) fan supplied with the machine.	
IC 416 R*	Enclosed machine. Smooth or finned enclosed casing. External motorized radial (R) fan supplied with the machine.	
IC 418	Enclosed machine. Smooth or finned casing. No external fan. Ventilation provided by air flow coming from the driven system.	

** Features not within manufacturer's standard range.*

Application of cooling systems to the Emerson Industrial Automation range

LSES/FLSES/FLS type	IC 410 IC 418	IC 411	IC 416 A	IC 416 R
80	●	■	●	◆
≥ 90	●	■	●	●

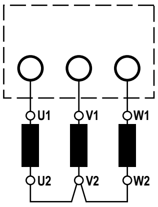
■ : standard construction
● : possible (ask for estimate)
◆ : not available

Other cooling systems may be fitted, such as liquid cooling.

Motor connections

Single speed motors

<table>
<tr><th rowspan="2">Voltages and connections</th><th rowspan="2">Internal wiring diagrams</th><th rowspan="2">Winding outline diagrams</th><th colspan="2">External connection diagrams</th></tr>
<tr><th>D.O.L. starting</th><th>Y/Δ starting</th></tr>
<tr><td colspan="5">Single voltage motors (3 TERMINALS)</td></tr>
<tr><td>- Voltage: U
- Connection:
Y internal

Eg: 400 V/Y</td>
<td>
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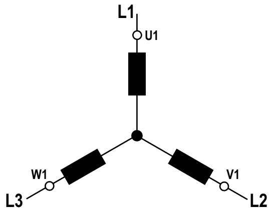
<td>
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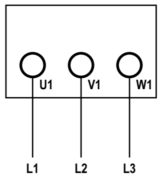
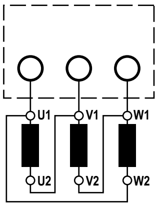
<td>
</td>
<td>——</td></tr>
<tr><td>- Voltage: U
- Connection:
Δ internal

Eg: 400 V/Δ</td>
<td>
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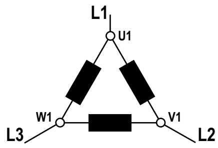
<td>
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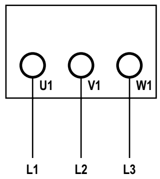
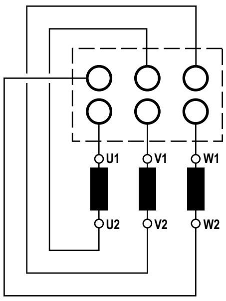
<td>
</td>
<td>——</td></tr>
<tr><td colspan="5">Dual-voltage motors with Y, Δ connections (6 TERMINALS)</td></tr>
<tr><td>- Voltage: U
- Connection: Δ
(at lower voltage)

Eg: 230 V/Δ</td>
<td rowspan="2">
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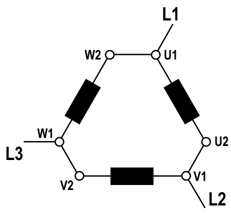
<td>
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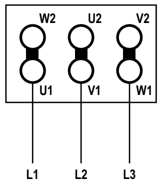
<td>
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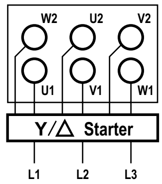
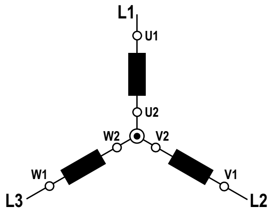
<td>
</td></tr>
<tr><td>- Voltage: U √3
- Connection: Y
(at higher voltage)

Eg: 400 V/Y</td>
<td>
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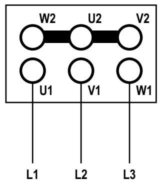
<td>
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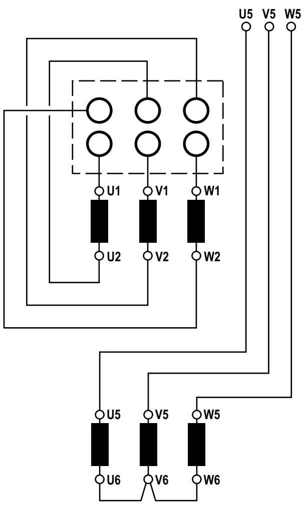
<tr><td colspan="5">Dual-voltage motors with series-parallel connections (9 TERMINALS)</td></tr>
<tr><td>- Voltage: U
- Connection: Y Y
(at lower voltage)

Eg: 230 V/ Y Y</td>
<td rowspan="2">
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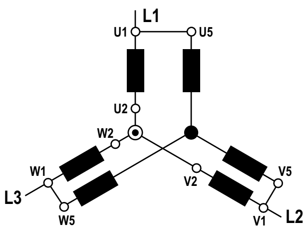
<td>
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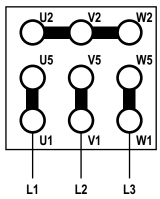
<td>
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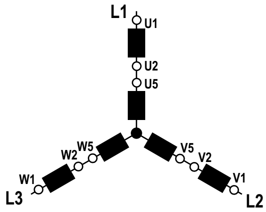
<td>——</td></tr>
<tr><td>- Voltage: 2 U
- Connection: Y
(series-star
at higher
voltage)

Eg: 460 V/Y</td>
<td>
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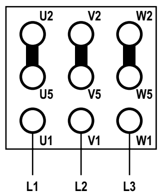
<td>
</td>
<td>——</td></tr>
</table>

Bearings and bearing life

DEFINITIONS

LOAD RATINGS

Static load rating Co:
This is the load for which permanent deformation at point of contact between a bearing race and the ball (or roller) with the heaviest load reaches 0.01% of the diameter of the ball (or roller).

Dynamic load rating C:
This is the load (constant in intensity and direction) for which the nominal lifetime of the bearing will reach 1 million revolutions.
The static load rating C_o and dynamic load rating C are obtained for each bearing by following the method in ISO 281.

LIFETIME

The lifetime of a bearing is the number of revolutions (or number of operating hours at a constant speed) that the bearing can accomplish before the first signs of fatigue (spalling) begin to appear on a ring, ball or roller.

Nominal lifetime L10h
According to the ISO recommendations, the nominal lifetime is the length of time completed or exceeded by 90% of apparently identical bearings operating under the conditions specified by the manufacturer.

Note: The majority of bearings last much longer than the nominal lifetime; the average lifetime achieved or exceeded by 50% of bearings is around 5 times longer than the nominal lifetime.

DETERMINATION OF NOMINAL LIFETIME

Constant load and speed of rotation
The nominal lifetime of a bearing expressed in operating hours L_{10h}, the dynamic load rating C expressed in daN and the applied loads (radial load F_r and axial load F_a) are related by the following equation:

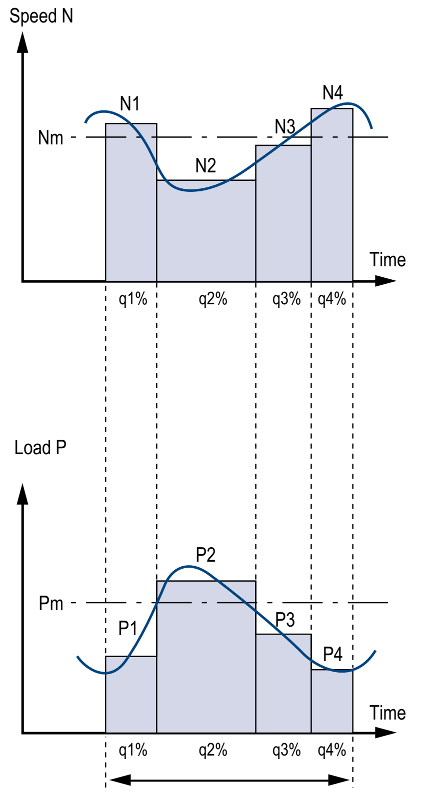
$$L_{10h} = \frac{1000000}{60 \cdot N} \cdot \left(\frac{C}{P}\right)^p$$

where N = speed of rotation (min^{-1})
P ($P = X F_r + Y F_a$): equivalent dynamic load (F_r, F_a, P in daN)
p: exponent which is a function of the contact between the races and balls (or rollers)
p = 3 for ball bearings
p = 10/3 for roller bearings

The formulae that give Equivalent Dynamic Load (values of factors X and Y) for different types of bearing may be obtained from their respective manufacturers.

Variable load and speed of rotation
For bearings with periodically variable load and speed, the nominal lifetime is established using the equation:

$$L_{10h} = \frac{1000000}{60 \cdot N_m} \cdot \left(\frac{C}{P_m}\right)^p$$



N_m: average speed of rotation

$$N_m = N_1 \cdot \frac{q_1}{100} + N_2 \cdot \frac{q_2}{100} + \dots (min^{-1})$$

P_m: average equivalent dynamic load

$$P_m = \sqrt[p]{P_1^p \cdot \left(\frac{N_1}{N_m}\right) \cdot \frac{q_1}{100} + P_2^p \cdot \left(\frac{N_2}{N_m}\right) \cdot \frac{q_2}{100} + \dots} \; (daN)$$

with q_1, q_2, etc as a %

Nominal lifetime L_{10h} is applicable to bearings made of bearing steel and normal operating conditions (lubricating film present, no contamination, correctly fitted, etc).
Situations and data differing from these conditions will lead to either a reduction or an increase in lifetime compared to the nominal lifetime.

Corrected nominal lifetime
If the ISO recommendations (DIN ISO 281) are used, improvements to bearing steel, manufacturing processes and the effects of operating conditions may be integrated in the nominal lifetime calculation.

The theoretical pre-fatigue lifetime L_{nah} is thus calculated using the formula:
$L_{nah} = a_1 \, a_2 \, a_3 \, L_{10h}$
where:
a_1: failure probability factor
a_2: factor for the characteristics and tempering of the steel
a3: factor for the operating conditions (lubricant quality, temperature, speed of rotation, etc).

Lubrication and maintenance of bearings

ROLE OF THE LUBRICANT

The principal role of the lubricant is to avoid direct contact between the metal parts in motion: balls or rollers, slip-rings, cages, etc. It also protects the bearing against wear and corrosion.

The quantity of lubricant needed by a bearing is normally quite small. There should be enough to provide good lubrication without undesirable overheating. As well as lubrication itself and the operating temperature, the amount of lubricant should be judged by considerations such as sealing and heat dissipation.

The lubricating power of a grease or an oil lessens with time owing to mechanical constraints and straightforward ageing. Used or contaminated lubricants should therefore be replaced or topped up with new lubricant at regular intervals.

Bearings can be lubricated with grease, oil or, in certain cases, with a solid lubricant.

GREASING

A lubricating grease can be defined as a product of semi-fluid consistency obtained by the dispersion of a thickening agent in a lubricating fluid and which may contain several additives to give it particular properties.

Composition of a grease
Base oil: 85 to 97%
Thickener: 3 to 15%
Additives: 0 to 12%

The base oil lubricates

The oil making up the grease **is of prime importance.** It is the oil that lubricates the moving parts by coating them with a protective film which prevents direct contact. The thickness of the lubricating film is directly linked to the viscosity of the oil, and the viscosity itself depends on temperature. The two main types used to make grease are mineral oils and synthetic oils. Mineral oils are suitable for normal applications in a range of temperatures from -30°C to +150°C.
Synthetic oils have the advantage of being effective in severe conditions (extreme variations of temperature, harsh chemical environments, etc).

The thickener gives the grease consistency

The more thickener a grease contains, the "harder" it will be. Grease consistency varies with the temperature. In falling temperatures, the grease hardens progressively, and the opposite happens when temperatures rise.

The consistency of a grease can be quantified using the NLGI (National Lubricating Grease Institute) classification. There are 9 NLGI grades, from 000 for the softest greases up to 6 for the hardest. Consistency is expressed by the depth to which a cone may be driven into a grease maintained at 25°C.

If we only consider the chemical nature of the thickener, lubricating greases fall into three major categories:

• **conventional greases with a metallic soap base** (calcium, sodium, aluminium, lithium). Lithium soaps have several advantages over other metallic soaps: a high melting point (180° to 200°), good mechanical stability and good water resistant properties.

• **greases with a complex soap base** The main advantage of this type of soap is a very high melting point (over 250°C).

• **soapless greases.** The thickener is an inorganic compound, such as clay. Their main property is the absence of a melting point, which makes them practically non-liquefying.

Additives improve some properties of greases

Additives fall into two types, depending on whether or not they are soluble in the base oil.

The most common insoluble additives - graphite, molybdenum disulphide, talc, mica, etc, improve the friction characteristics between metal surfaces. They are therefore used in applications where heavy pressure occurs.

The soluble additives are the same as those used in lubricating oils: antioxidants, anti-rust agents, etc.

LUBRICATION TYPE

The bearings are lubricated with a polyurea soap-based grease.

Duty cycle - Definitions

DUTY CYCLES

(IEC 60034-1)

The typical duty cycles are described below:

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 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, each 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 - Periodic continuous duty with related changes of load and speed - Type S8
A sequence of identical duty cycles, each consisting of a period of operation at 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).

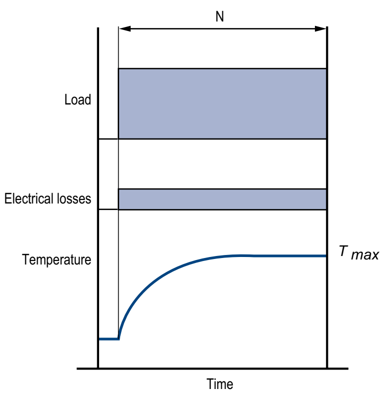
9 - Duty with non-periodic variations in load and speed - Type S9
This is a duty in which the load and speed generally vary non-periodically within the permissible operating range. This duty frequently includes applied overloads which may be much higher than the full load or loads (see figure 9).

Note - For this type of duty, the appropriate full load values must be used as the basis for calculating overload.

10 - Operation at discrete constant loads - Type S10
This duty consists of a maximum of 4 discrete 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: Only S1 and S3 duty types with a duty factor of 80% or more are affected by IEC 60034-30

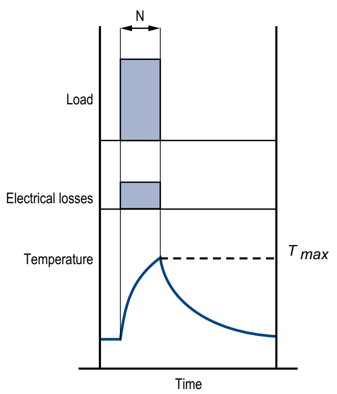
Fig. 1. - Continuous duty. Type S1.



N = operation at constant load

T_{max} = maximum temperature attained

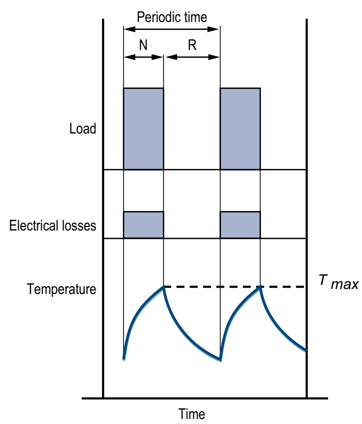
Fig. 2. - Short-time duty. Type S2.



N = operation at constant load

T_{max} = maximum temperature attained

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



N = operation at constant load

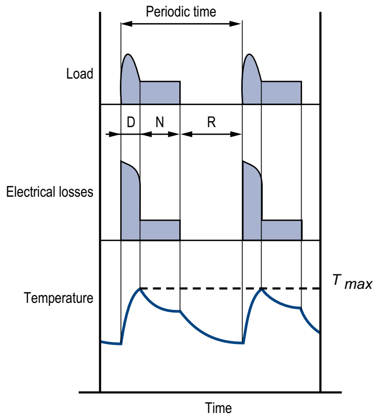
R = off-delay

T_{max} = maximum temperature attained

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

Duty cycle - Definitions

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



D = starting

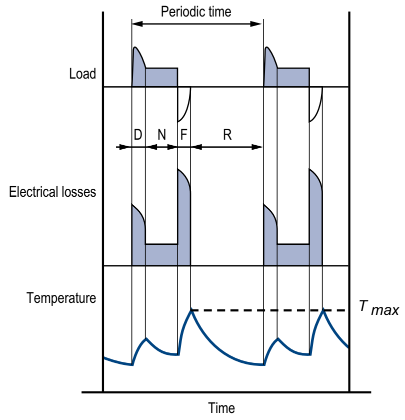
N = operation at constant load

R = off-delay

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

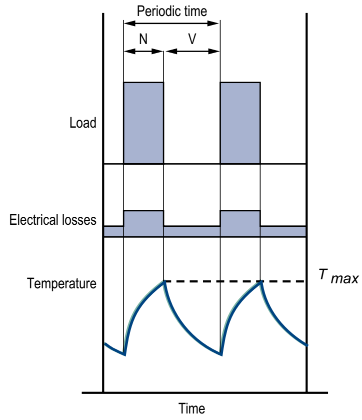
F = electrical braking

R = off-delay

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.



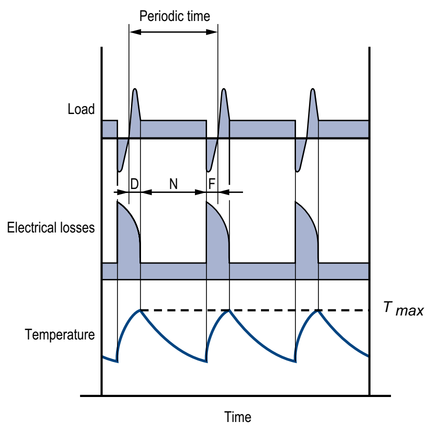
N = operation at constant load

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

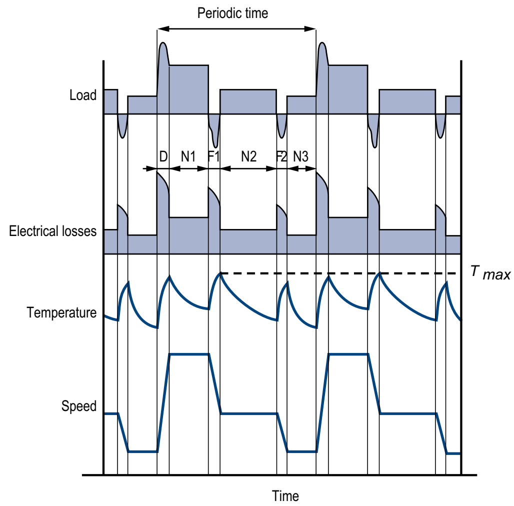
N = operation at constant load

F = electrical braking

T_{max} = maximum temperature attained during cycle

Operating factor = 1

Fig. 8. - Periodic continuous 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

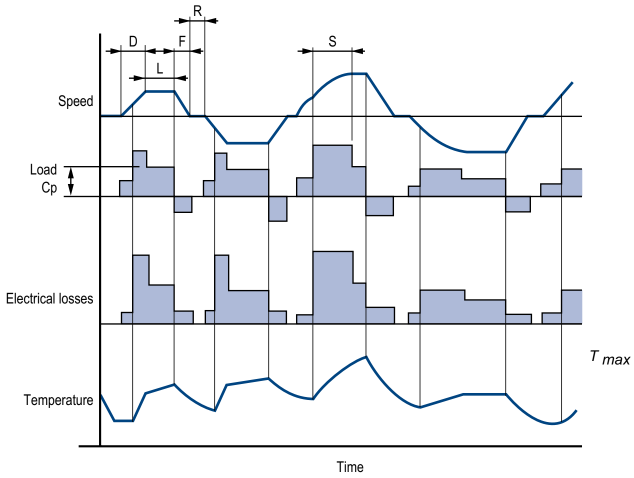
Operating factor = $\frac{D + N_1}{D + N_1 + F_1 + N_2 + F_2 + N_3}$ 100 %

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

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

Duty cycle - Definitions

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



D = starting

L = operation at variable loads

F = electrical braking

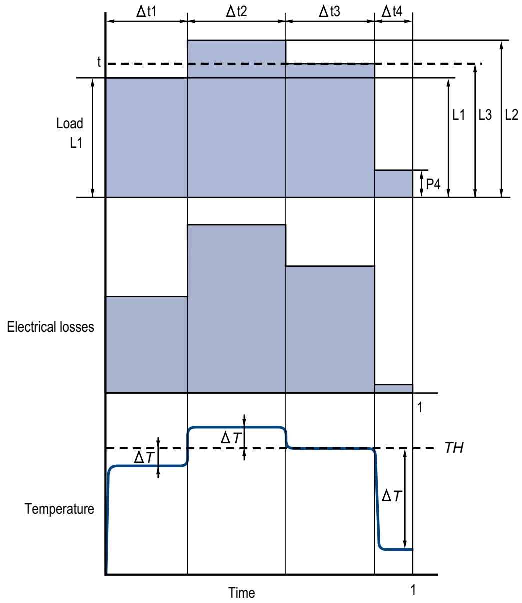
R = off-delay

S = operation at overload

C_p = full load

T_{max} = maximum temperature attained

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



L = load

N = rated power for type S1 duty

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 type S1 duty

ΔH_i = increase or decrease in temperature rise during the ith period of the cycle

Power is determined according to duty cycle. See "Operation" section, "Power - Torque - Efficiency - Power Factor (Cos φ)" paragraph.

Supply voltage

REGULATIONS AND STANDARDS

The IEC 60038 standard gives the European reference voltage as 230/400 V three-phase and 230 V single-phase, with a tolerance of ±10%. The tolerances usually permitted for power supply sources are indicated below:
• Maximum line drop between customer delivery point and customer usage point: 4%.
• Variation in frequency around the rated frequency:
- continuous operation: ±1%
- transient state: ±2%
• Three-phase mains phase voltage imbalance:
- zero-sequence component and/or negative phase sequence component compared to positive phase sequence component: < 2%

The motors in this catalogue are designed for use on the European power supply of 230/400 V ±10% - 50 Hz.

All other voltages and frequencies are available on request.

- For motors of frame size ≤ 160 mm, maximum operating voltage: 700 V
- For motors of frame size ≥ 180 mm, maximum operating voltage: 1000 V

EFFECTS ON MOTOR PERFORMANCE

VOLTAGE RANGE

The characteristics of motors will of course vary with a corresponding variation in voltage of ±10% around the rated value.

An approximation of these variations is given in the table opposite.

	Voltage variation as a %				
	UN-10%	UN-5%	UN	UN+5%	UN+10%
Torque curve	0.81	0.90	1	1.10	1.21
Slip	1.23	1.11	1	0.91	0.83
Rated current	1.10	1.05	1	0.98	0.98
Rated efficiency	0.97	0.98	1	1.00	0.98
Rated power factor (cos φ)	1.03	1.02	1	0.97	0.94
Starting current	0.90	0.95	1	1.05	1.10
Nominal temperature rise	1.18	1.05*	1	1*	1.10
P (Watt) no-load	0.85	0.92	1	1.12	1.25
Q (reactive V A) no-load	0.81	0.9	1	1.1	1.21

* According to standard IEC 60034-1, the additional temperature rise must not exceed 10 K within ±5% of U_N.

Supply voltage

Simultaneous variation of voltage and frequency

Within the tolerances defined in IEC guide 106, machine input and performance are unaffected if the variations are of the same polarity and the voltage/frequency ratio U/f remains constant.

If this is not the case, variations in performance are significant and require the machine specification to be changed.

Variation in main motor parameters (approx.) within the limits defined in IEC Guide 106.

$U_{/f}$	Pu	M	N	Cos φ	Efficiency
Constant	$Pu\ \frac{f'}{f}$	M	$N\ \frac{f'}{f}$	cosφ unchanged	Efficiency unchanged
Variable	$Pu\left(\frac{u'/u}{f/f'}\right)^2$	$M\left(\frac{u'/u}{f/f'}\right)^2$	$N\ \frac{f'}{f}$	Dependent on the machine saturation state	

M = minimum and maximum values of starting torque.

Use of 400 V - 50 Hz motors on 460 V - 60 Hz supplies

For a rated power at 60 Hz equal to the rated power at 50 Hz, the main characteristics are modified according to the following variations:

- Efficiency increases by 0.5 - 1.5%
- Power factor increases by 0.5 to 1.5%
- Rated current decreases by 0 to 5%
- IS/IN increases by around 10%
- Slip and rated torque MN, MD/MN, MM/MN remain more or less constant.

Comment:
For the North American markets, a different type of construction is needed to comply with the regulatory requirements.

Use on supplies with U' voltages different from the voltages in the characteristics tables

In this case, the machine windings should be adjusted.
As a result, only the current values will be changed and become:

$$I' = I_{400V} \times \frac{400}{U'}$$

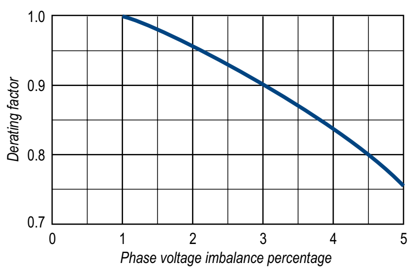
Phase voltage imbalance

The phase imbalance for voltage is calculated as follows:

$$\text{Phase voltage imbalance as a \%} = 100 \times \frac{\text{maximum difference in voltage compared to the average voltage value}}{\text{average voltage value}}$$

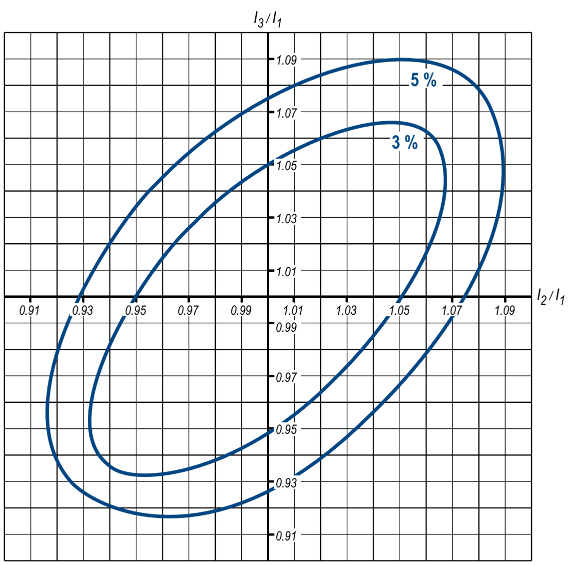
The effect on motor performance is summarized in the table opposite.
If this imbalance is known before the motor is purchased, it is advisable, in order to establish the type of motor required, to apply the derating specified in standard IEC 60892, illustrated on the graph opposite.

Percentage imbalance	0	2	3.5	5
Stator current	100	101	104	107.5
Increase in losses %	0	4	12.5	25
Temperature rise	1	1.05	1.14	1.28



Phase current imbalance

Voltage imbalances induce current imbalances. Natural lack of symmetry due to manufacture also induces current imbalances.
The chart opposite shows the ratios in which the negative phase component is equal to 5% (and 3%) of the positive phase components in three-phase current supplies without zero components (neutral absent or not connected).
Inside the curve, the negative phase component is lower than 5% (and 3%).



Insulation class - Temperature rise and thermal reserve

INSULATION CLASS

The machines in this catalogue have been designed with a class F insulation system for the windings.
Class F allows for temperature rises of 105 K (measured by the resistance variation method) and maximum temperatures at the hot spots in the machine of 155°C (Ref. IEC 60085 and IEC 60034-1).
Complete impregnation with tropicalized varnish of thermal class 180°C gives protection against attacks from the environment, such as: 90% relative humidity, interference, etc.
For special constructions, the winding is class H and impregnated with special varnishes which enable it to operate in conditions of high temperatures with relative air humidity of up to 100%.

The insulation of the windings is monitored in two ways:
a - Dielectric inspection which involves checking the leakage current, at an applied voltage of (2U + 1000) V, in conditions complying with standard IEC 60034-1 (systematic test).
b - Monitoring the insulation resistance between the windings and between the windings and the earth (sampling test) at a D.C. voltage of 500 V or 1000 V.

TEMPERATURE RISE AND THERMAL RESERVE

Emerson Industrial Automation motors are built to have a maximum winding temperature rise of 80 K under normal operating conditions (ambient temperature 40°C, altitude below 1000 m, rated voltage and frequency, rated load).

The result is a thermal reserve linked to the following factors:
- a difference of 25 K between the nominal temperature rise (U_n, F_n, P_n) and the permissible temperature rise (105 K) for class F insulation.
- a difference of 10°C minimum at the voltage limits.

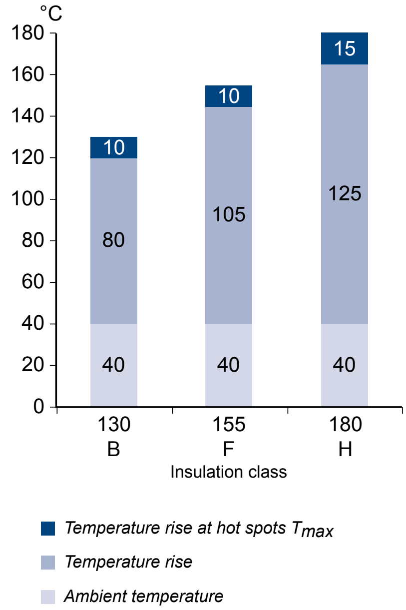
In IEC 60034-1 and 60034-2, temperature rise ($\Delta\theta$), is calculated using the winding resistance variation method, with the formula:

$$\Delta T = \frac{R_2 - R_1}{R_1}(235 + T_1) + (T_1 - T_2)$$

R_1: cold resistance measured at ambient temperature T_1

R_2: stabilized hot resistance measured at ambient temperature T_2
235: coefficient for a copper winding (for an aluminium winding, the coefficient is 225)

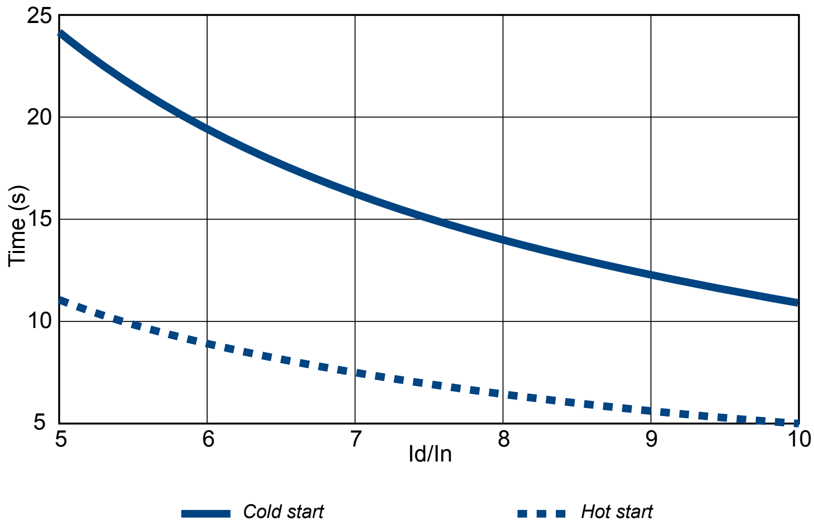
Temperature rise (ΔT) and maximum temperatures at hot spots (Tmax) for insulation classes (IEC 60034-1).*



Starting times and starting current

PERMISSIBLE STARTING TIMES AND LOCKED ROTOR TIMES

The starting times calculated must remain within the limits of the graph opposite which defines maximum starting times in relation to the starting current.
Three successive cold starts and two consecutive warm starts are allowed with a stop between each start.
Permissible motor starting time as a function of the ratio I_D/I_N.



Note : For IP55 models and frame sizes ≥ 355 LD, two consecutive cold starts and one warm start is allowed (after thermal stabilisation at rated power). A stop of at least 15 minutes is necessary between each consecutive start.

Power - Torque - Efficiency - Power Factor (Cos φ)

DEFINITIONS

The output power (Pu) at the motor shaft is linked to the torque (M) by the equation:

$$Pu = M.\omega$$

where Pu is in W, M is in N.m, ω is in rad/s and where ω is expressed as a function of the speed of rotation in min-1 by the equation:

$$\omega = 2\pi.N/60$$

The active power (P) drawn from the mains is expressed as a function of the apparent power (S) and the reactive power (Q) by the equation:

$$S = \sqrt{P^2 + Q^2}$$

(S in VA, P in W and Q in VAR)

The power P is linked to the output power Pu by the equation:

$$P = \frac{Pu}{\eta}$$

where η is the efficiency of the machine.

The output power Pu at the motor shaft is expressed as a function of the phase-to-phase mains voltage (U in Volts), of the line current absorbed (I in Amps) by the equation:

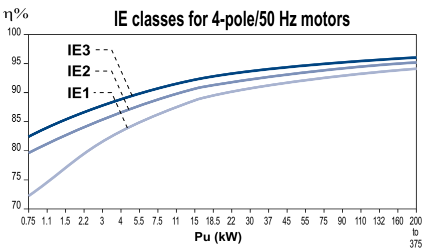
$$Pu = U.I.\ \sqrt{3}\ .\cos\varphi\ .\ \eta$$

where cosφ is the power factor found from the ratio:

$$\cos\varphi = \frac{P}{S}$$

EFFICIENCY

In accordance with the agreements signed at the Rio and Buenos Aires international conferences, **the new generation of motors with aluminium or cast iron frame** has been designed to improve efficiency by reducing atmospheric pollution (carbon dioxide).
The improved efficiency of low voltage industrial motors (representing around 50% of installed power in industry) has had a large impact on energy consumption.



3 IE efficiency levels have been defined for 2, 4 and 6-pole motors in classification IEC 60034-30 from 0.75 to 375 kW and this catalogue presents the reference range of IE2 motors.
IE3 and super Premium level ranges are available on request.

Advantages of improvement in efficiency:

Motor characteristics	Effects on the motor	Customer benefits
Increase in efficiency and in power factor.	Increase in specific output power.	Lower operating costs. Longer service life (x2 or 3). Better return on investment.
Noise reduction.	-	Improved working conditions.
Vibration reduction.	-	Quiet operation and longer service life of equipment being driven.
Temperature reduction.	Longer service life of fragile components (insulation system components, greased bearings).	Reduced number of operating incidents and reduced maintenance costs.
	Increased capability of instantaneous or extended overloads.	Wider field of applications (voltages, altitude, ambient temperature, etc)

INFLUENCE OF LOAD ON EFFICIENCY AND THE COS φ

See the selection data.
Overrating motors in a number of applications causes them to operate at about 3/4 load, resulting in optimum motor efficiency.

Power - Torque - Efficiency - Power Factor (Cos φ)

RATED POWER PN IN RELATION TO DUTY CYCLE

GENERAL RULES FOR STANDARD MOTORS

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

Iterative calculation where:

t_d(s)	starting time achieved with motor rated P(w)
n	number of (equivalent) starts per hour
fdm (OF)	operating factor (decimal)
I_D/I_n	current demand for motor rated P
P_u (w)	motor output power during the duty cycle using OF (in decimal), operating factor
P (w)	motor rated power selected for the calculation

Note: n and OF are defined in section D4.6.2.
Sp = specification

S1	OF = 1; n ≤ 6
S2	; n = 1 operating life determined by specification
S3	OF according to Sp ; n ~ 0 (no effect of starting on temperature rise)
S4	OF according to Sp ; n according to Sp; t_d, P_u, P according to Sp (replace n with 4n in the above formula)
S5	OF according to Sp ; n = n starts + 3 n braking operations = 4 n; t_d, P_u, P acc. to Sp (replace n with 4n in the above formula)
S6	$P = \sqrt{\frac{\Sigma(P^2_i \cdot t_i)}{\Sigma t_i}}$
S7	same formula as S5 but OF = 1
S8	at high speed, same formula as S1 at low speed, same formula as S5
S9	S8 duty formula after complete description of cycle with OF on each speed
S10	same formula as S6

In addition, see the warning regarding precautions to be taken. Variations in voltage and/or frequency greater than standard should also be taken into account. The application should also be taken into account (general at constant torque, centrifugal at quadratic torque, etc).

DETERMINATION OF THE POWER IN INTERMITTENT DUTY CYCLES FOR ADAPTED MOTORS

RMS POWER IN INTERMITTENT DUTY

This is the rated power absorbed by the driven machine, usually defined by the manufacturer.
If the power absorbed by the machine varies during a cycle, the rms power P is calculated using the equation:

$$P = \sqrt{\frac{\Sigma^n{}_1(P^2{}_i \cdot t_i)}{\Sigma^n{}_1 t_i}} = \sqrt{\frac{P^2{}_1 \cdot t_1 + P^2{}_2 \cdot t_2 \cdots + P^2{}_n \cdot t_n}{t_1 + t_2 + \cdots t_n}}$$

if, during the working time the absorbed power is:

P1 for period t1
P2 for period t2

Pn for period tn

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

Additionally, it is also necessary to check that for a particular motor of power PN:

- the actual starting time is at most equal to 5 seconds
- 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 operating time with a load during the cycle to the total duration of the cycle where the motor is energized.

Operating factor (OF)
Expressed as a percentage, this is the ratio of the motor power-up time during the cycle to the total cycle time, provided that the total cycle time is less than 10 minutes.

Starting class
Class: n = nD + k.nF + k'.ni
nD: number of complete starts per hour
nF: number of electrical braking operations per hour

"Electrical braking" means any braking directly involving the stator winding or the rotor winding:

- Regenerative braking (with frequency controller, multipole motor, etc).
- Reverse-current braking (the most commonly used)
- D.C. injection braking

ni: number of pulses (incomplete starts up to a third of maximum speed) per hour

k and k' are constants determined as follows:

	k	k'
Cage induction motors	3	0.5

- Reversing the direction of rotation involves braking (usually electrical) and starting.
- Braking with Emerson Industrial Automation electromechanical brakes, as with any other brakes that are independent of the motor, does not constitute electrical braking in the sense described above.

Power - Torque - Efficiency - Power Factor (Cos φ)

Calculating derating

• Input criteria (load)
- rms power during the cycle = P
- Moment of inertia related to the speed of the motor: Je
- Operating factor = OF (fdm)
- Class of starts per hour = n
- Resistive torque during starting = Mr

• Selection in catalogue
- Motor rated power = PN
- Starting current Id, cosφD
- Moment of rotor inertia Jr
- Average starting torque Mmot
- Efficiency at PN(ηPN) and at P(ηP)

Calculations

- Starting time:

$$t_d = \frac{\pi}{30} \cdot N \cdot \frac{(J_e + J_r)}{M_{mot} - M_r}$$

- Cumulative starting time per hour:

n x td

- Energy to be dissipated per hour during starts = sum of the energy dissipated in the rotor (= inertia acceleration energy) and the energy dissipated in the stator during the cumulative starting time per hour:

$$E_d = \frac{1}{2}(J_e + J_r)\left(\frac{\pi \cdot N}{30}\right)^2 \text{ x n + n x } t_d\sqrt{3}UI_d\cos\varphi_d$$

- Energy to be dissipated during operation

Ef = P. (1 - ηP) . [(fdm) x 3600 - n x td]

- Energy that the motor can dissipate at rated power with the Operating Factor for Intermittent Duty.

Em = (fdm) 3600 . PN(1 - ηPN)

(The heat dissipated when the motor is at rest can be ignored).

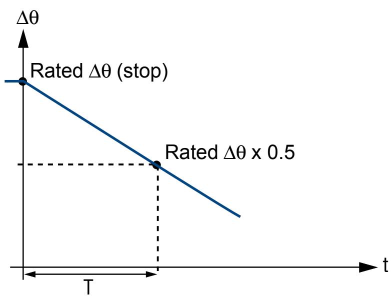
Dimensioning is correct if the following relationship is verified =

$$E_m \geq E_d + E_f$$

If the sum of Ed + Ef is lower than 0.75 Em, check whether a motor with the next lowest power would be more suitable.

EQUIVALENT THERMAL CONSTANT

The equivalent thermal constant enables the machine cooling time to be predetermined.



$$\text{Thermal constant} = \frac{T}{\ln 2} = 1.44\ T$$

Cooling curve Δθ = f(t)
where:

Δθ = temperature rise in S1 duty

T = time taken to go from the nominal temperature rise to half its value

t= time

ln= natural logarithm

TRANSIENT OVERLOAD AFTER OPERATION IN TYPE S1 DUTY CYCLE

At rated voltage and frequency, the motors can withstand an overload of:
1.20 for an OF = 50%
1.40 for an OF = 10%

However, it is necessary to ensure that the maximum torque is much greater than 1.5 times the rated torque corresponding to the overload.

Speed of rotation

MOTORS USED WITH VARIABLE SPEED DRIVE

GENERAL

Drive control by a frequency inverter can in fact result in an increase in the machine temperature rise, due to a significantly lower supply voltage than on the mains, additional losses related to the wave form produced by the drive (PWM) and the reduction in speed of the cooling fan. Standard IEC 60034-17 describes numerous good practices for all types of electric motor, however since this is Emerson Industrial Automation's area of specialist expertise, we describe the best ways to deal with variable speed in the section below.

DERATING THE POWER WHEN THE LSES, FLSES AND PLSES RANGES ARE USED AT VARIABLE SPEED

Reminder: Emerson Industrial Automation recommends the use of PTC sensors, monitored by the drive, to protect the motor as much as possible.

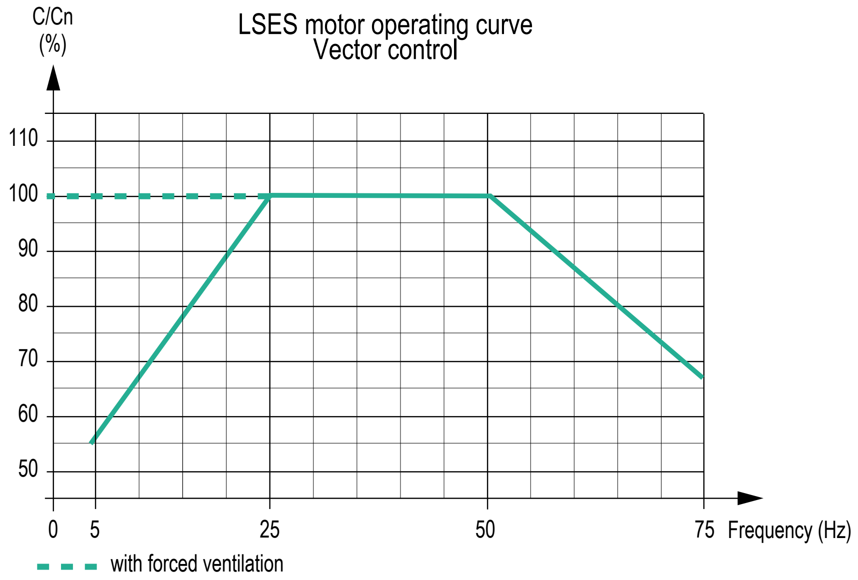
The choice of temperature class B for the mains power supply means that LSES, FLSES or PLSES motors can be used on a drive without derating the power in centrifugal applications.

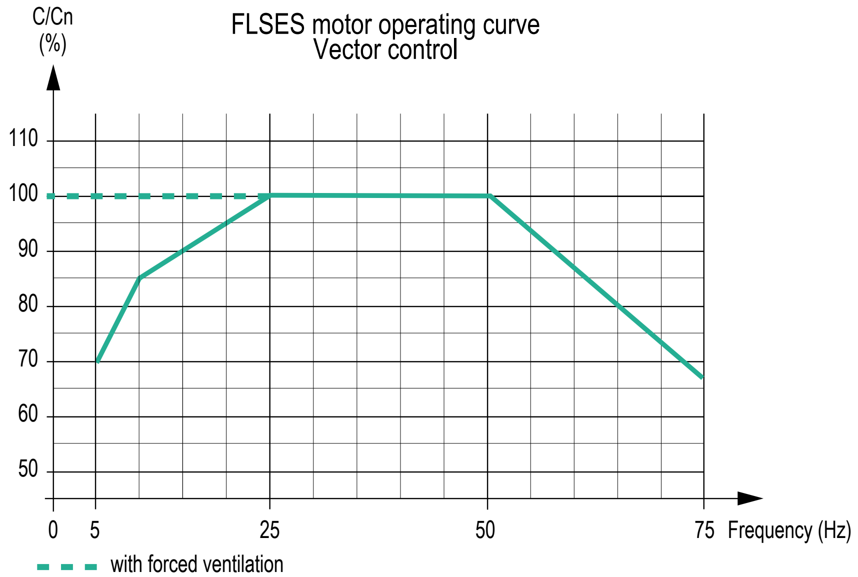
As far as constant torque applications are concerned, derating depends on the speed range: please refer to the graphs below.

In constant torque applications which can operate below the rated frequency and to avoid derating the power, it may prove necessary to use a forced ventilation unit, depending on the operating cycle.

Note 1: The thermal reserve, a Emerson Industrial Automation special feature, should be used to keep the motor in its temperature class. However in certain cases, the temperature class will change from B to F ie. between 80 k and 105 k.

Note 2: To avoid changes in frame size due to derating within the standard ranges, Emerson Industrial Automation has developed a range of LSMV adapted motors with standardized dimensions.





Speed of rotation

INSULATION SYSTEM FOR VARIABLE SPEED APPLICATIONS

The insulation system for the LSES, FLSES or PLSES motor ranges means they can be used on a drive without modification, regardless of the size of the machine or the application, at a supply voltage ≤ 480 V 50/60 Hz and can tolerate voltage peaks up to 1500 V and variations of 3500V/µs at the motor terminals.

These values are guaranteed without using a filter at the motor terminals.

For any voltage > 480 V, Emerson Industrial Automation's reinforced insulation system must be used unless otherwise agreed by Leroy- Somer or a sine filter is used (only compatible with a U/f control mode).

RECOMMENDATIONS CONCERNING THE MECHANISM OF ROTATION FOR VARIABLE SPEED APPLICATIONS

The voltage wave form at the drive output (PWM) can generate high-frequency leakage currents which can, in certain situations, damage the motor bearings.

This phenomenon is amplified with:

- High mains supply voltages
- Increased motor size
- Incorrectly earthed motor-drive system
- Long cable length between the drive and the motor
- Motor incorrectly aligned with the driven machine

Emerson Industrial Automation machines which have been earthed in accordance with good practice need no special options except in the situations listed below:

- For voltage ≤ 480 V 50/60 Hz, and frame size ≥ 315 mm, we recommend using an insulated NDE bearing.

- For voltage > 480 V 50/60 Hz, and frame size ≥ 315 mm, we recommend using 2 insulated bearings. Another solution could be to only use one insulated NDE bearing, accompanied by a filter at the drive output (dV/dt type or common mode filter).

GOOD WIRING PRACTICE

It is the responsibility of the user and/or the installer to connect the motor-drive system in accordance with the current legislation and regulations in the country of use. This is particularly important as concerns cable size and connection of earths and grounds.

The following information is given for guidance only, and should never be used as a substitute for the current standards, nor does it relieve the installer of his responsibility.

A motor-drive system which has been earthed in accordance with good practice will contribute significantly to reducing the voltage on the shaft and the motor casing, resulting in fewer high-frequency leakage currents. Premature breakage of bearings and auxiliary equipment such as encoders, should also be avoided wherever possible.

To ensure the safety of personnel, the size of the earthing cables should be determined individually in accordance with local regulations.

To ensure the safety of motors with frame size 315 mm or above, we recommend installing grounding strips between the terminal box and the feet and/or the motor and the driven machine.

For motors with a power rating of 30 kW or higher, the use of shielded single-core cables is strongly recommended. The motor-drive wiring must be symmetrical (U,V,W at the motor end must correspond to U,V,W at the drive end) with the cable shielding earthed both at the motor end and at the drive end.

For high-powered motors, unshielded single-core cables can be used as long as they are installed together in a metal cable duct earthed on both sides with a grounding strip.

Cables must be kept as short as possible.

Typically, shielded cables up to 20 m long can be used without additional precautions. Beyond this length, special measures such as adding filters at the drive output should be considered.

OPERATION AT SPEEDS HIGHER THAN THOSE ASSIGNED BY THE MAINS FREQUENCIES

Using induction motors at high speeds (speed higher than 3600 min^{-1}) can be risky:

- The cage may be damaged
- Bearing life may be impaired
- There may be increased vibration
- Etc

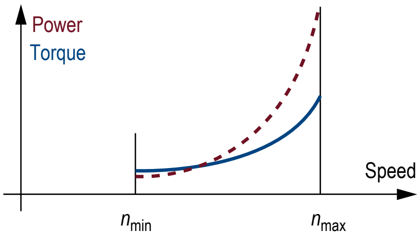
When high-speed motors are used, they often need to be adapted, **and an in-depth mechanical and electrical design exercise is needed**.

Speed of rotation

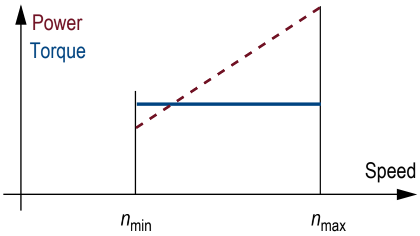
APPLICATIONS AND CHOICE OF SOLUTIONS

There are three main typical load types. The speed range and torque (or power) must be determined for the application to be able to select the correct drive system:

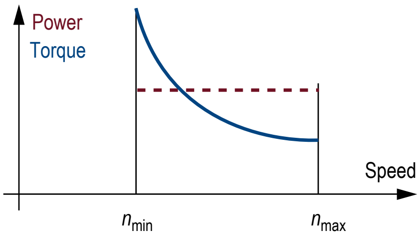
Centrifugal machines
The torque varies as the square of the speed (power cubed). The torque required for acceleration is low (about 20% of rated torque). The starting torque is low.
• Sizing: according to the power or torque at maximum speed.
• Select a drive for reduced overload operation.
Typical applications: ventilation, pumping, etc.



Applications with constant torque
The torque remains constant throughout the speed range. The torque required for acceleration may be high, depending on the machine (higher than the rated torque).
• Sizing: according to the torque required over the entire speed range.
• Select a drive for maximum overload operation.
Typical machines: extruders, grinders, travelling cranes, presses, etc.

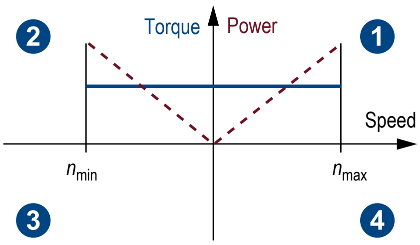


Applications with constant power
The torque decreases as the speed increases. The torque required for acceleration is at most equal to the rated torque. The starting torque is at the maximum.
• Sizing: according to the torque required at minimum speed and the operating speed range.
• Select a drive for maximum overload operation.
• Encoder feedback is recommended for enhanced regulation.
Typical machines: winders, machine tool spindles, etc.



4-QUADRANT MACHINES

The torque/speed relationship for these applications is shown opposite, but the load becomes a driving load in certain stages of the cycle.
• Sizing: see above according to the type of load.
• An RIS (reinforced insulation system) is required for repetitive braking operations.
• Drive selection: A braking resistor can be used to dissipate the energy in a driving load. Alternatively, the energy can be fed back to the grid. In this latter case, a regenerative drive or a 4-quadrant drive is required.
Typical machines: centrifuges, travelling cranes, presses, machine tool spindles, etc.

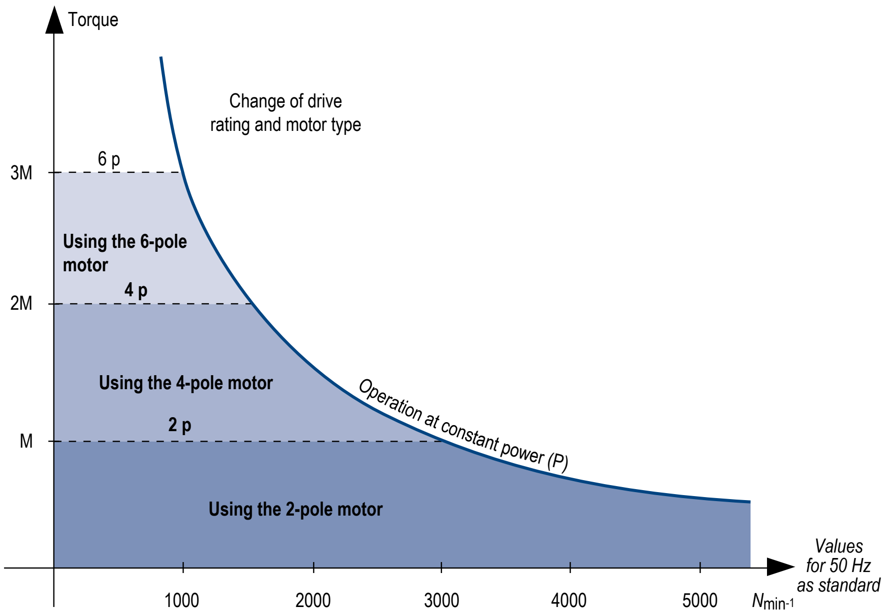


CHOICE OF DRIVE/MOTOR COMBINATION

The curve below expresses the output torque of a 50 Hz motor (2, 4 or 6 poles) supplied by a drive.
For a frequency inverter with power PN operating at constant power P within a determined range of speeds, it is possible to optimize the choice of motor and its number of poles to give a maximum amount of torque.

Example: the Unidrive SP- 3.5 T drive can supply the following motors:
LSES 90 - 2 p - 2.2 kW - 7.1 N.m
LSES 100 - 4 p - 2.2 kW - 14.6 N.m
LSES 112 - 6 p - 2.2 kW - 21.9 N.m

The choice of the motor /drive combination will therefore depend on the application.



Speed of rotation

EXTREME OPERATING CONDITIONS AND OTHER POINTS

MOTOR CONNECTIONS

For use on a variable speed drive, Emerson Industrial Automation recommends star connection for the windings whenever possible.

TRANSIENT OVERLOADS

Drives are designed to withstand transient overload peaks of 180% or overloads of 150% for 60 seconds (maximum once every ten minutes). If the overload is greater, the system will automatically shut down. Emerson Industrial Automation motors are designed to withstand these overloads, however in the event of very repetitive operation we still recommend use of a temperature sensor at the heart of the motor.

STARTING TORQUE AND CURRENT

Thanks to advances in control electronics, the torque available when the motor is switched on can be adjusted to a value between the rated torque and the variable speed drive breakdown torque. The starting current will be directly related to the torque (120 or 180%).

ADJUSTING THE SWITCHING FREQUENCY

The variable speed drive switching frequency has an impact on losses in the motor and the drive, on the acoustic noise and the torque ripple.

A low switching frequency has an unfavourable impact on temperature rise in motors.

For motors of frame size ≥ 315mm, Emerson Industrial Automation recommends a drive switching frequency of 3 kHz minimum.

In addition, a high switching frequency optimizes the acoustic noise and torque ripple level.

CHOICE OF MOTOR

There are two possibilities:

a - The frequency inverter is not supplied by Emerson Industrial Automation

All the motors in this catalogue can be used with a frequency inverter. Depending on the application, motors will need to be derated by around 10% compared to the motor operating curves in order to guarantee that motors will not be damaged.

b - The frequency inverter is supplied by Emerson Industrial Automation

As these two ranges have been specifically designed for use in combination, excellent performance is guaranteed, in accordance with the curves on the previous page.

Use of motors in the LSMV range, especially in constant torque applications, can achieve unrivalled performance levels.

Noise level

NOISE EMITTED BY ROTATING MACHINES

In a compressible medium, the mechanical vibrations of an elastic body create pressure waves which are characterized by their amplitude and frequency. The pressure waves constitute an audible noise if they have a frequency of between 16 Hz and 16,000 Hz.

Noise is measured by a microphone linked to a frequency analyser. Measurements are taken in an anechoic chamber on machines at no-load, and a sound pressure level Lp or a sound power level Lw can then be established. Measurement can also be carried out in situ on machines which may be on-load, using an acoustic intensity meter which can differentiate between sound sources and identify the sound emissions from the machine.

The concept of noise is linked to hearing. The auditory sensation is determined by integrating weighted frequency components with isosonic curves (giving a sensation of constant sound level) according to their intensity.

The weighting is carried out on sound meters using filters whose bandwidth takes into account, to a certain extent, the physiology of the human ear:

Filter A: used for low and medium noise levels. High attenuation, narrow bandwidth.

Filter B: used for very high noise levels. Wide bandwidth.

Filter C: very low attenuation over the whole of the audible frequency range.

Filter A is used most frequently for sound levels emitted by rotating machinery. It is this filter which has been used to establish the standardized characteristics.

A few basic definitions:
The unit of reference is the bel, and the sub-multiple decibel dB is used here.

Sound pressure level in dB

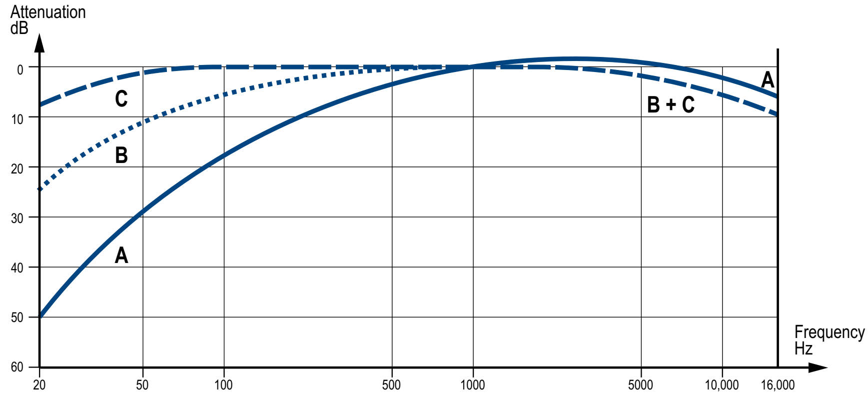
$$L_p = 20\log_{10}\left(\frac{P}{P_0}\right) \text{ avec } p_0 = 2.10^{-5} \text{ Pa}$$

Sound power level in dB

$$L_W = 10\log_{10}\left(\frac{P}{P_0}\right) \text{ avec } p_0 = 10^{-12} \text{ W}$$

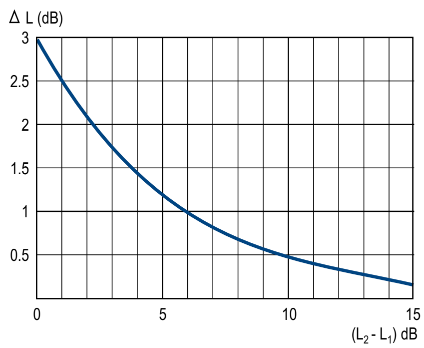
Sound intensity level in dB

$$L_W = 10\log_{10}\left(\frac{I}{I_0}\right) \text{ avec } I_0 = 10^{-12} \text{ W/m}^2$$



Correction of measurements

For differences of less than 10 dB between 2 sound sources or where there is background noise, corrections can be made by addition or subtraction using the rules below.

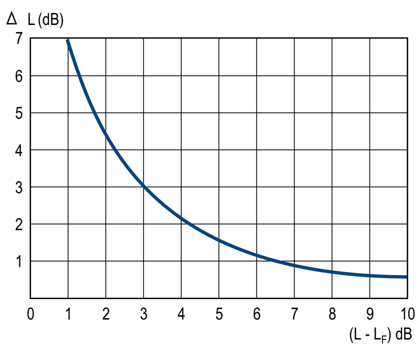


Addition of levels

If L1 and L2 are the separately measured levels (L2 ≥ L1), the resulting sound level LR will be obtained by the formula:

$$LR = L2 + \Delta L$$

ΔL is found by using the curve above.



Subtraction of levels*

This is most commonly used to eliminate background noise from measurements taken in a "noisy" environment.

If L is the measured level and LF the background noise level, the actual sound level LR will be obtained by the calculation:

$$LR = L - \Delta L$$

ΔL is found by using the curve above.

**This method is the one normally used for measuring sound power and pressure levels. It is also an integral part of sound intensity measurement.*

Weighted sound level [dB(A)]

Under IEC 60034-9, the guaranteed values are given for a machine operating at no-load under normal supply conditions (IEC 60034-1), in the actual operating position, or sometimes in the direction of rotation as specified in the design.
This being the case, standardized sound power level limits are shown for the values obtained for the machines described in this catalogue.
(Measurements were taken in conformity with standard ISO 1680).
Expressed as sound power level (Lw) according to the standard, the level of sound is also shown as sound pressure level (Lp) in the selection data.
The maximum standard tolerance for all these values is + 3 dB(A).

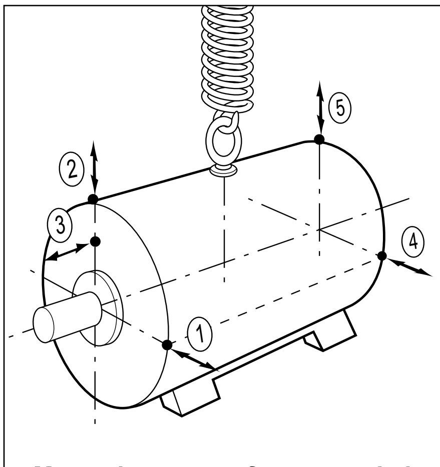
The noise levels of the motors in this catalogue are indicated in the selection tables.

Vibration

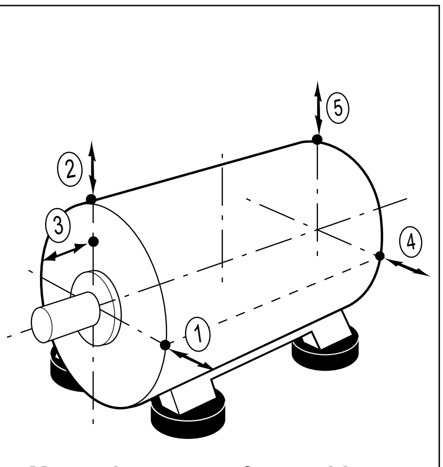
VIBRATION LEVELS - BALANCING

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.
Standard 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

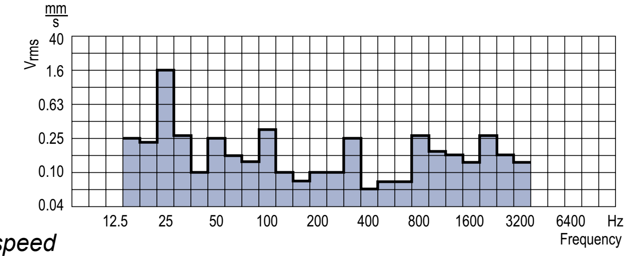


Measuring system for machines on flexible mountings

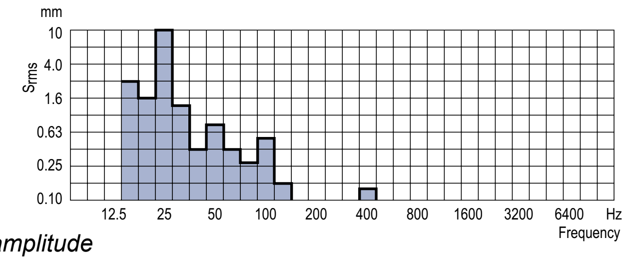
The measurement points quoted in the standards are indicated in the drawings above.
At each point, the results should be lower than those given in the tables below for each balancing class and only the highest value is to be taken as the " vibration level".

MEASURED PARAMETERS

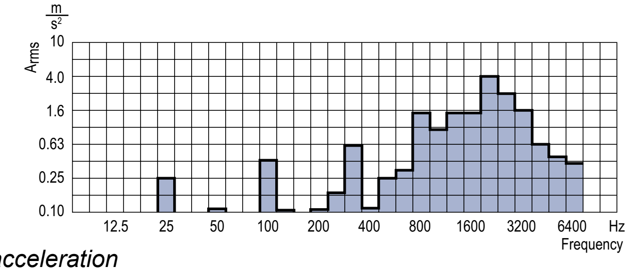
The vibration speed can be chosen as the variable to be measured. This is the speed at which the machine moves either side of its static position. It is measured in mm/s.
As the vibratory movements are complex and non-harmonic, it is the root mean square (rms) value of the speed of vibration which is used to express the vibration level.
Other variables that could also be measured are the vibratory displacement amplitude (in µm) or vibratory acceleration (in m/s^2).
If the vibratory displacement is measured against frequency, the measured value decreases with the frequency: high-frequency vibrations cannot be measured.
If the vibratory acceleration is measured, the measured value increases with the frequency: low-frequency vibrations (unbalanced loads) cannot be measured here.
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).



Vibration speed



Vibration amplitude



Vibration acceleration

Vibration

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

Vibration level	Frame size *H* (mm)								
	56 ≤ *H* ≤ 132			132 < *H* ≤ 280			*H* > 280		
	Displacement µm	Speed mm/s	Acceleration m/s^2	Displacement µm	Speed mm/s	Acceleration m/s^2	Displacement µm	Speed mm/s	Acceleration m/s^2
A	25	1.6	2.5	35	2.2	3.5	45	2.8	4.4
B	11	0.7	1.1	18	1.1	1.7	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 necessary addition of balancing disks mounted on the shaft extensions.

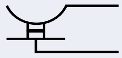
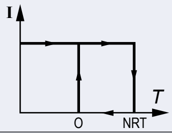
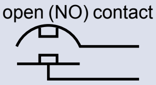
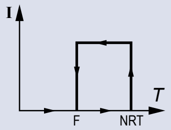
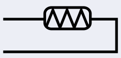
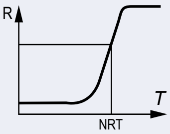
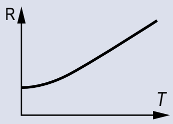
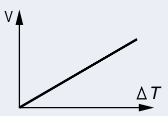
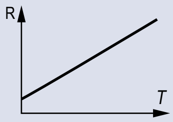
Performance

THERMAL PROTECTION

Motors are protected by a manual or automatic overcurrent relay, placed between the isolating switch and the motor. This relay may in turn be protected by fuses.

These protection devices provide total protection of the motor against non-transient overloads. If a shorter reaction time is required, if you want to detect transient overloads, or if you wish to 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 at sensitive points. The various types are shown in the table below, with a description of each. It must be emphasized that under no circumstances can these sensors be used to carry out direct regulation of the motor operating cycles.

Built-in indirect thermal protection

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 series
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 **CTP**	Non-linear variable resistance, indirectly heated 		0	General monitoring for transient overloads	Mounted with associated relay in control circuit 3 in series
Temperature sensor **KTY**	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	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.
- **KTY** 84/130 as standard
* 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 panel of the installation for continuous surveillance

Alarm and early warning

All protective equipment can be backed up by another type of protection (with different NRTs): the first device will then act as an early warning (light or sound signals given without shutting down the power circuits), and the second device will be the 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.

Starting methods for induction motors

The two essential parameters for starting cage induction motors are:
- starting torque
- starting current

These two parameters and the resistive torque determine the starting time.
These three characteristics arise from the construction of cage induction motors. Depending on the driven load, it may be necessary to adjust these values to avoid torque surges on the load or current surges in the supply. There are essentially five different types of supply, which are:
- D.O.L. starting
- star/delta starting
- soft starting with auto-transformer
- soft starting with resistors
- electronic starting

The tables on the next few pages give the electrical outline diagrams, the effect on the characteristic curves, and a comparison of the respective advantages of each mode.

MOTORS WITH ASSOCIATED ELECTRONICS

Electronic starting modes control the voltage at the motor terminals throughout the entire starting phase, giving very gradual smooth starting.

DIGISTART D2 ELECTRONIC STARTER

This simple, compact electronic starter enables three-phase induction motors to be started smoothly by controlling their acceleration. It incorporates motor protection.

- **18 to 200 A range**
- **Integrated by-pass**: ease of wiring
- Simplicity and speed of setup

All settings configured with just seven selector switches
- **Flexibility**
- Mains supply voltages 200-440 VAC & 200-575 VAC
- **Starting and stopping modes:**
- Current limit
- Current ramp
- Deceleration control
- Communication
- Modbus, DeviceNet, Profibus, USB, display console
- Management of pumping functions

DIGISTART D3 ELECTRONIC STARTER

Using the latest electronic control technologies to manage transient phases, the DIGISTART D3 range combines simplicity and user-friendliness while offering the user a high-performance, communicating electronic starter, and can achieve substantial energy savings.

- Range from 23 to 1600 A/400 V or 690 V
- Integrated bypass up to 1000 A:
- Compact design: up to 60% space saving
- Energy saving
- Reduced installation costs
- **Advanced control**
- Starting and stopping adapt to the load automatically
- Automatic parameter optimisation by gradually learning the types of start
- Special deceleration curve for pumping applications which derives from more than 15 years of Emerson Industrial Automation's experience and expertise
- **High availability**
- Able to operate with only two power components operational
- Protection devices can be disabled to implement forced run mode (smoke extraction, fire pump, etc.)
- **Total protection**
- Continuous thermal modelling for maximum motor protection (even in the event of a power cut)
- Trips on configurable power thresholds
- Control of phase current imbalance
- Monitoring of motor temperatures and the environment with PTC or PT 100
- **Optional**
- Installation trips in the event of an earth fault
- Protection against mains over- and undervoltages
- Connection to "Δ" motor (6-wire)
- Starter size at least one rating lower
- Automatic detection of motor connection
- Ideal for replacing Y/Δ starters
- **Communication**
  Modbus RTU, DeviceNet, Profibus, USB
- **Simplicity of setup**
- 3 parameter-setting levels
- Preset configurations for pumps, fans, compressors, etc
- Standard: access to the main parameters
- Advanced menu: access to all data
- Storage
- Time-stamped log of trips
- Energy consumption and operating conditions
- Latest modifications
- Simulate operation by forcing control
- Display the state of the inputs/outputs
- Counters: running time, number of starts, etc

VARIABLE SPEED MOTOR

These motors (VARMECA type) are designed and developed with built-in electronics.

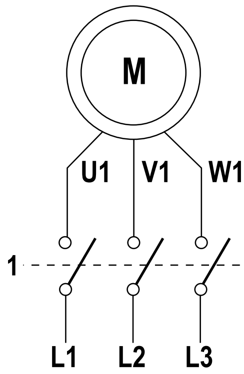
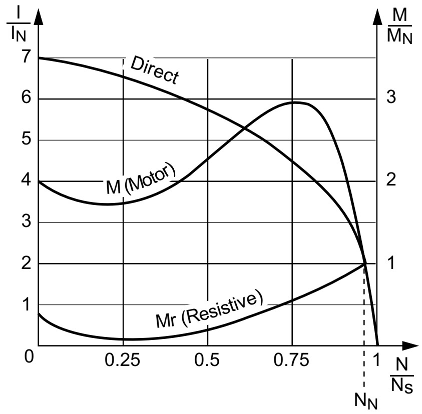
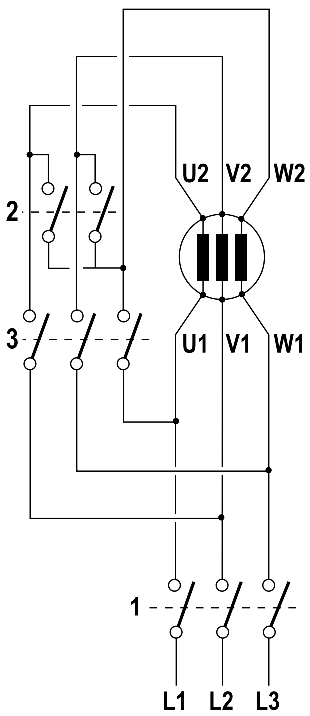
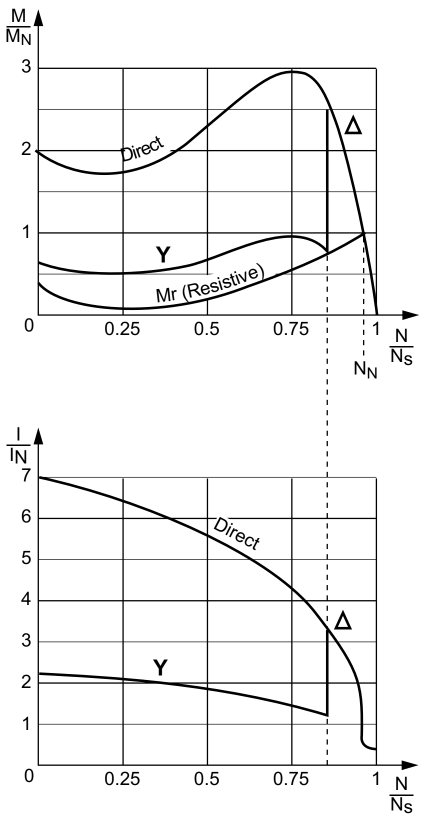
Characteristics:
- 0.75 < P ≤ 7.5 kW*
- 50/60 Hz
- 360 < speed < 2400 min^{-1} (4-pole motors)
- Power factor = 1
- Constant torque

** other power ratings on request*

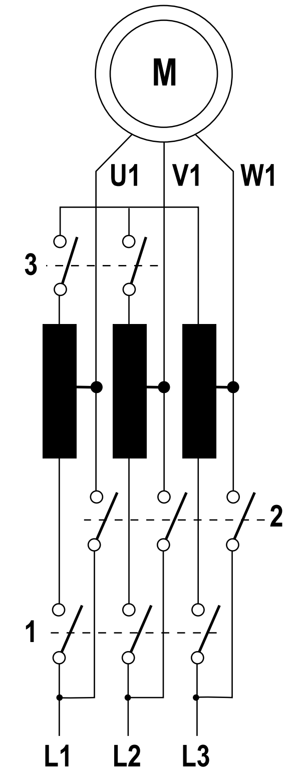
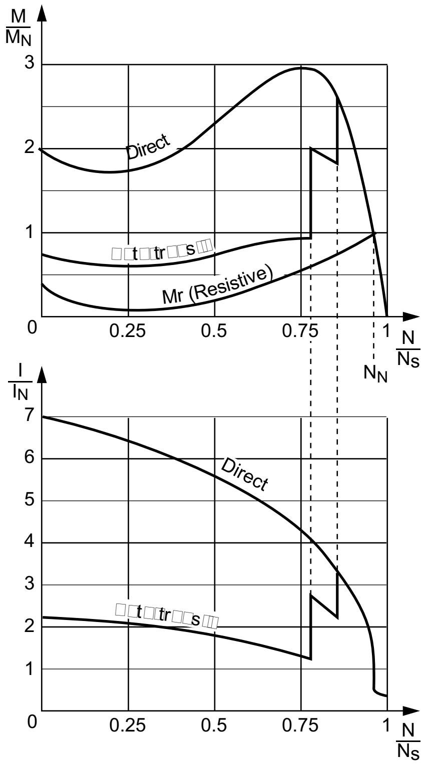
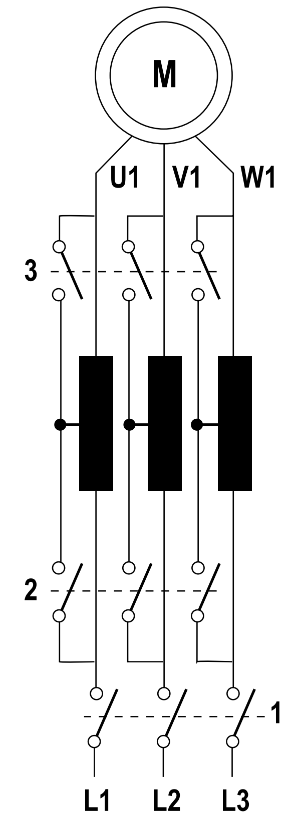
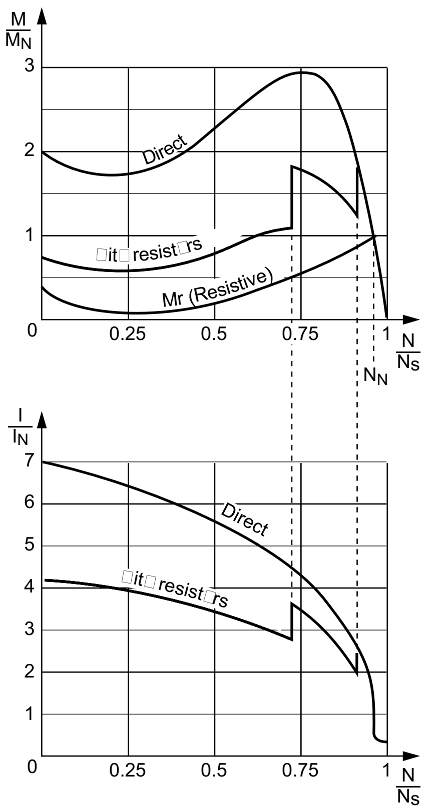
- **Starting on variable speed drive**

One of the advantages of variable speed drives is that loads can be started without a current surge on the mains supply, since starting is always performed with no voltage or frequency at the motor terminals.

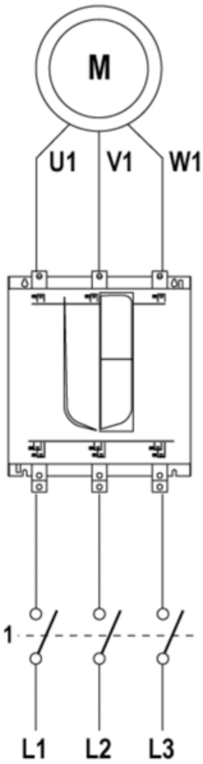
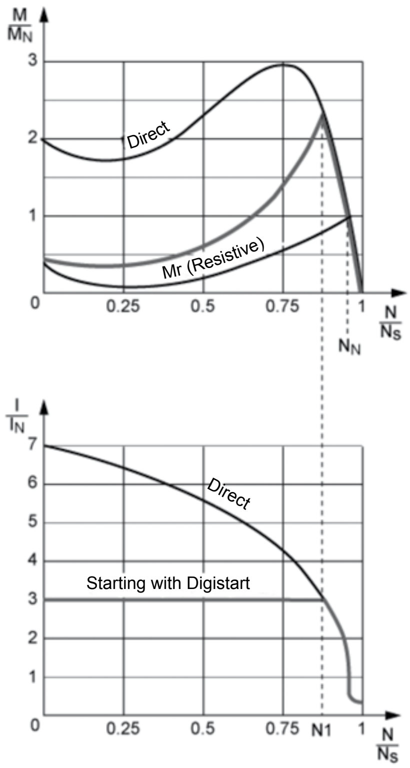
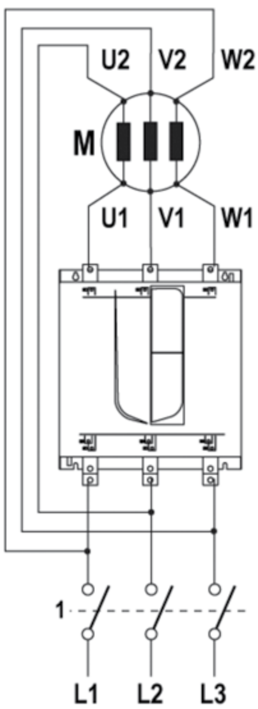
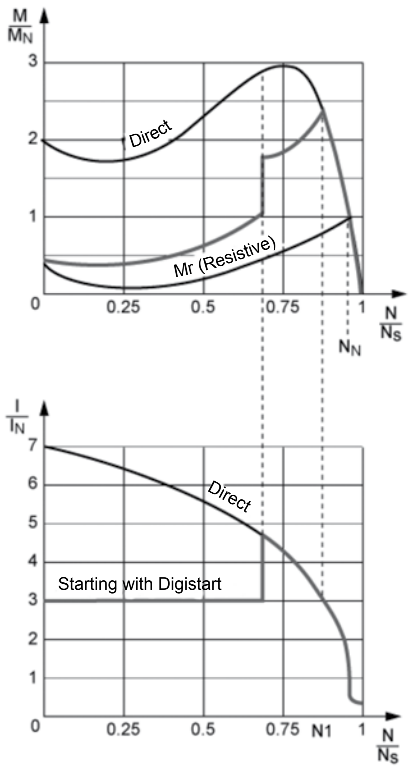
Starting methods for induction motors

Mode	Outline diagram	Characteristic curves	Number of steps	Starting torque	Starting current	Advantages
D.O.L.			1	M_D	I_D	Simplicity of the equipment High torque Minimum starting time
Star-delta			2	$M_D/3$	$I_D/3$	Starting current divided by 3 Simple equipment 3 contactors including 1 two-pole

Starting methods for induction motors

Mode	Outline diagram	Characteristic curves	Number of steps	Starting torque	Starting current	Advantages
Soft starting with autotransformer			$n \geq 3$	$K^2.M_D$ $K = \frac{U_{starting}}{U_n}$	$K^2.I_D$	Can be used to select the torque Current reduction proportional to that for the torque No power cut-off
Soft starting with resistors			n	$K^2.M_D$ $K = \frac{U_{starting}}{U_n}$	$K.I_D$	Can be used to select the torque or the current No power cut-off Modest additional cost (1 contactor per step)

Starting methods for induction motors

Mode	Outline diagram	Characteristic curves	Number of steps	Starting torque	Starting current	Advantages
DIGISTART D2 & D3				K^2M_D $K = \frac{U_{starting}}{U_n}$	KI_D	Adjustable on site Choice of torque and current No power cut-off Smooth starting Compact size No maintenance High number of starts Digital Integrated motor and machine protection Serial link
DIGISTART D3 mode "6-wire"				K^2M_D $K = \frac{U_{starting}}{U_n}$	KI_D	Same advantages as the above DIGISTART Current reduced by 35% Suitable for retrofitting on Y - Δ installations With or without bypass

Braking

GENERAL

The braking torque is equal to the torque produced by the motor, increased by the resistive torque of the driven machine.

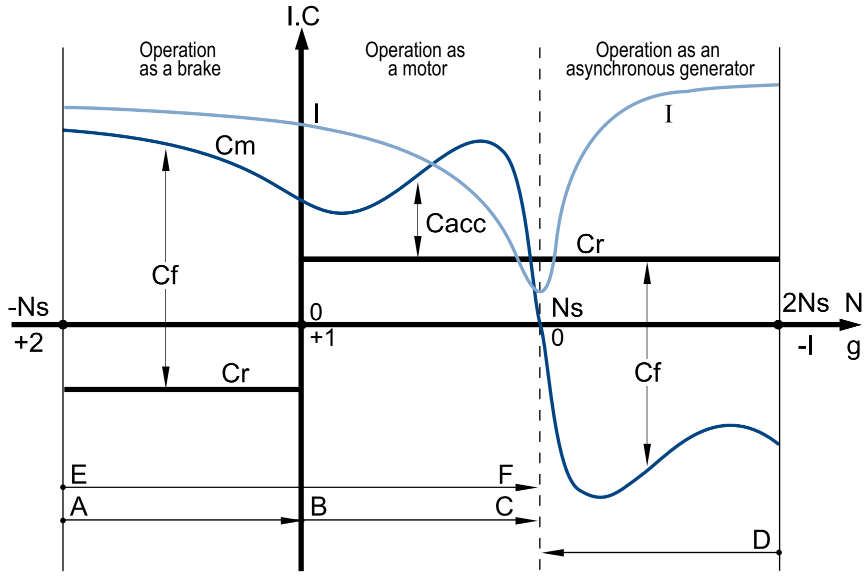
$$C_f = C_m + C_r$$

C_f= braking torque
C_m= motor torque
C_r= resistive torque

Braking time, i.e. the time required for an induction motor to change from speed N to stop, is calculated by the formula:

$$T_f = \frac{\Pi \cdot J \cdot N}{30 \cdot C_f(moy)}$$

T_f (in s) = braking time
J (in kgm^2) = moment of inertia
N (in min^{-1}) = speed of rotation
C_f (av) (in N.m) = average braking torque during the time period



Curves I = f(N), C_m = f (N), C_r = f(N), in the motor starting and braking zones.

I = *current absorbed*
C = *torque value*
C_f = *braking torque*
C_r = *resistive torque*
C_m = *motor torque*
N = *speed of rotation*
g = *slip*
N_s = *synchronous speed*
AB = *reverse current braking*
BC = *starting, acceleration*
DC = *regenerative braking*
EF = *reversal*

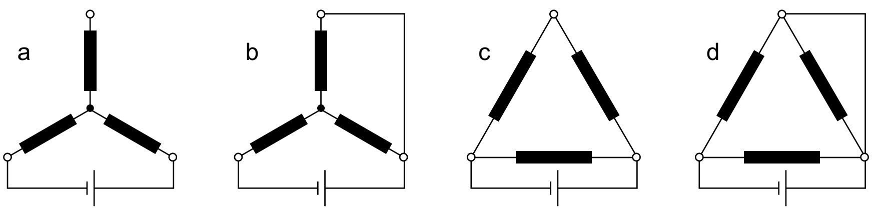
REVERSE-CURRENT BRAKING

This method of braking is obtained by reversing two of the phases.
In general, an isolator disconnects the motor from the supply at the time the speed changes to N=0.
In cage induction motors, the average braking torque is usually greater than the starting torque.
Braking torque varies in different types of machine, as it depends on the rotor cage construction.
This method of braking involves a large amount of absorbed current, more or less constant and slightly higher than the starting current.
Thermal stresses during braking are three times higher than during acceleration.
Accurate calculations are required for repetitive braking.
Note: The direction of rotation of a motor is changed by reverse-current braking and restarting.
Thermally, one reversal is the equivalent of 4 starts. Care must therefore be taken when choosing a machine.

D.C. INJECTION BRAKING

Operating stability can be a problem when reverse-current braking is used, due to the flattening out of the braking torque curve in the speed interval (O, — N_S).
There is no such problem with D.C. injection braking: this can be used on both cage induction and slip-ring motors.
With this braking method, the induction motor is connected to the mains and braking occurs when the A.C. voltage is cut off and D.C. voltage is applied to the stator.
There are four different ways of connecting the windings to the D.C. voltage.
The D.C. voltage applied to the stator is usually supplied by a rectifier plugged into the mains.

Thermal stresses are approximately three times lower than for reverse-current braking.
The shape of the braking torque curve in the speed interval (0, — N_S) is similar to that of the curve Tm = f (N) and is obtained by changing the abscissa variable to N_f = N_S — N.



Motor winding connections for D.C. voltage

Braking

The braking current is calculated using the formula:

$$I_f = k1_i \times I_d \sqrt{\frac{C_f - C_{fe}}{k_2 - Cd}}$$

The values of k1 for each of the four connections are:

$k1_a = 1.225$ $k1_c = 2.12$
$k1_b = 1.41$ $k1_d = 2.45$

The braking torque can be found by:

$$C_f = \frac{\Pi \cdot J \cdot N}{30 \cdot T_f}$$

formulae where:

If (in A) = braking direct current
Id (in A = starting current in phase $= \frac{1}{\sqrt{3}}$ Id as per catalogue (for Δ connection)
Cf (in N.m) = average braking torque during the time period (Ns , N)
Cfe (in N.m) = external braking torque
Cd (in N.m) = starting torque
J (in kgm2) = total moment of inertia on the drive shaft
N (in min-1) = speed of rotation
Tf (in s) = braking time
k1i = numerical factors for connections a, b, c and d (see diagram)
k2 = numerical factors taking into account the average braking torque (k2 = 1.7)

The D.C. voltage to be applied to the windings is calculated by:
Uf = k3i . k4 . If . R1

k3 values for the four diagrams are as follows:

$k3_a = 2$ $k3_b = 1.5$
$k3_c = 0.66$ $k3_d = 0.5$

Uf (in V) = D.C. voltage for braking
If (in A) = direct current for braking
R1 (in Ω) = stator phase resistance at 20°C
k3i = numerical factors for diagrams a, b, c and d
k4 = numerical factor taking account of the temperature rise in the motor (k4 = 1.3)

MECHANICAL BRAKING
Electromechanical brakes (D.C. or A.C field excitation) can be fitted at the non-drive end of the motor.

For further details, see our "Brake motors" catalogue.

ASYNCHRONOUS REGENERATIVE BRAKING
This is the braking method applied to multi-speed motors when changing down to lower speeds. This procedure cannot be used to stop the motor.

Thermal stresses are approximately equal to those occurring when motors with Dahlander connections are started at the lower rated speed (speed ratio 1 : 2).

With the motor at the lower speed, working as an asynchronous generator, it develops very high braking torque in the speed interval (2Ns, Ns).

The maximum braking torque is markedly higher than the motor starting torque at the lower speed.

DECELERATION BRAKES
For safety reasons, deceleration brakes are fitted at the non-drive end of motors used on hazardous machines (for example, where cutting tools may come into contact with the operator).

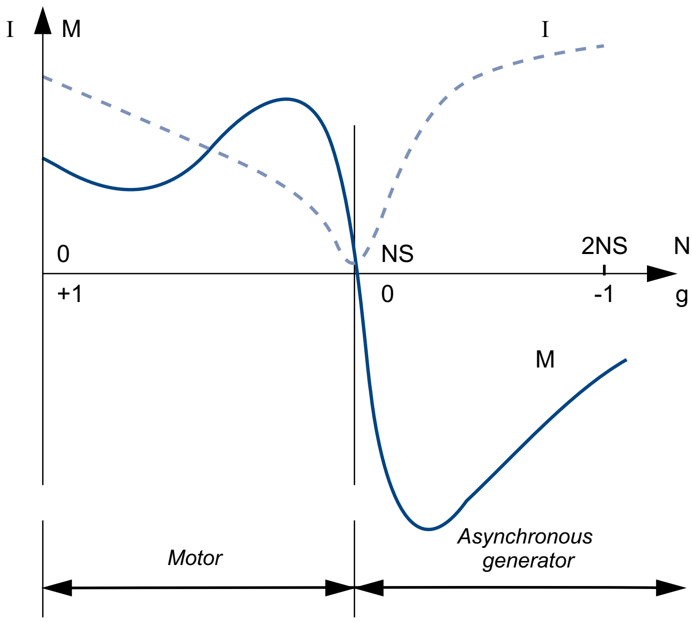
The range of brakes is determined by the braking torques:
2.5 - 4 - 8 - 16 - 32 - 60 Nm

The appropriate brake is selected in the factory according to the number of motor poles, the driven inertia, the number of brakings per hour and the required braking time.

Operation as an asynchronous generator

GENERAL

The motor operates as an asynchronous generator each time the load becomes a driving load and the rotor speed exceeds the synchronous speed (Ns).
This can be induced either voluntarily, as in the case of electric power stations (water or wind power, etc) or involuntarily, caused by factors linked to the application (downward movement of crane hooks or blocks, inclined conveyors, etc).



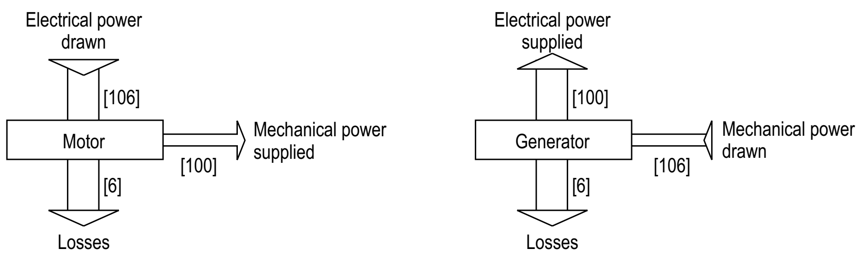
OPERATING CHARACTERISTICS

The diagram opposite shows the various operations of an asynchronous machine in relation to its slip (g) or its speed (N).

Example: Let us consider an induction motor of 45 kW, 4 poles, 50 Hz at 400 V. As a rough estimate, its characteristics as an asynchronous generator can be deduced from its rated characteristics as a motor, by applying the rules of symmetry.
If more precise values are required, the manufacturer should be consulted.

In practice, it can be checked that the same machine, operating as a motor and as a generator with the same slip, has approximately the same losses in both cases, and therefore virtually the same efficiency. It can be deduced from this that the rated electrical power supplied by the asynchronous generator will be virtually the same as the motor output power.

Characteristics	Motor	AG
Synchronous speed (min^{-1})	1500	1500
Rated speed (min^{-1})	1465	1535
Rated torque(m.N)	+ 287	- 287
Rated current at 400 (A)	87 A (absorbed)	87 A (supplied)



Operation as an asynchronous generator

CONNECTION TO A POWERFUL MAINS SUPPLY

It is assumed that the machine stator is connected to a powerful electrical mains supply (usually the national grid), ie. a mains supply provided by a generator which regulates the power to at least twice that of the asynchronous generator. Under these conditions, the mains supply imposes its own voltage and frequency on the asynchronous generator. Furthermore, it supplies it automatically with the reactive energy necessary for all its operating conditions.

CONNECTION - DISCONNECTION

Before connecting the asynchronous generator to the mains supply, it is necessary to ensure that the direction of phase rotation of the asynchronous generator and the mains supply are in the same order.

• To connect an asynchronous generator to the mains supply, it should be accelerated gradually until it reaches its synchronous speed Ns. At this speed, the machine torque is zero and the current is minimal.

This is an important advantage of asynchronous generators: as the rotor is not polarised until the stator is powered up, it is not necessary to synchronise the mains supply and the machine when they are connected.

However, there is a phenomenon affecting the connection of asynchronous generators which, in some cases, can be a nuisance: the asynchronous generator rotor, although not energised, still has some residual magnetism.
On connection, when the magnetic flux created by the mains supply and that caused by the rotor residual magnetism are not in phase, the stator experiences a very brief current peak (one or two half-waves), combined with an instantaneous overtorque of the same duration.
It is advisable to use connecting stator resistances to limit this phenomenon.

• Disconnecting the asynchronous generator from the mains supply does not pose any particular problem.
As soon as the machine is disconnected, it becomes electrically inert since it is no longer energised by the mains supply. It no longer brakes the driving machine, which should therefore be stopped to avoid reaching overspeed.

Reactive power compensation

To limit the current in the lines and the transformer, the asynchronous generator can be compensated by restoring the power factor of the installation to the unit, using a bank of capacitors.
In this case, the capacitors are only inserted at the terminals of the asynchronous generator once it has been connected, to avoid self-energisation of the machine due to the residual magnetism during speed pick-up. For a three-phase low voltage asynchronous generator, three-phase or single-phase capacitors in delta connection are used.

Electrical protection and safety

There are two protection and safety categories:
- those which relate to the mains
- those which relate to the set and its generator

The major mains protection devices monitor:
- maximum-minimum voltage
- maximum-minimum frequency
- minimum power or energy feedback (operating as a motor)
- generator connection fault

The protection devices for the set monitor:
- stop on detection of racing start
- lubrication faults
- thermal magnetic protection of the generator, usually with probes in the winding

POWER SUPPLY FOR AN ISOLATED NETWORK

This concerns supplying a consuming network which does not have another generator of sufficient power to impose its voltage and frequency on the asynchronous generator.

REACTIVE POWER COMPENSATION

In the most common case, reactive energy must be supplied:
- to the asynchronous generator
- to the user loads which consume it

To supply both of these consumption types with reactive energy, a reactive energy source of suitable power is connected in parallel on the circuit. This is usually a bank of capacitors with one or more stages which may be fixed, manually adjusted (using notches) or automatically adjusted. Synchronous capacitors are now rarely used.
Example: In an isolated network with power consumption of 50 kW where cos $\varphi = 0.9$ (and tan $\varphi = 0.49$), supplied by an asynchronous generator with cos φ of 0.8 at 50 kW (and tan φ = 0.75), it is necessary to use a bank of capacitors which supplies: (50 x 0.49) + (50 x 0.75) = 62 kvar.

Designation

The complete motor **reference** described below will enable you to order the desired **equipment**.

The selection method consists of following the terms in the designation.

4P 1500 min⁻¹	LSES	180	MT	18.5 kW	LS2/IE2	IM 1001 IM B3	230 / 400 V	50 Hz	IP 55
No. of poles speed(s)	Series designation	Frame size IEC 60072	Housing designation and manufacturer code	Rated output power	Range/ Efficiency class	Mounting arrangement IEC 60034-7	Mains voltage	Mains frequency	Protection IEC 60034-5

Description

Component	Materials	Remarks
Housing with cooling fins	Aluminium alloy	- with integral or screw-on feet, or without feet - 4 or 6 fixing holes for housings with feet - lifting rings for frame size ≥ 100 - earth terminal with an optional jumper screw
Stator	Insulated low-carbon magnetic steel laminations Electroplated copper	- low carbon content guarantees long-term lamination pack stability - semi-enclosed slots - class F insulation
Rotor	Insulated low-carbon magnetic steel laminations Aluminium	- inclined cage bars - rotor cage pressure die-cast in aluminium (or alloy for special applications) - shrink-fitted to shaft - rotor balanced dynamically, 1/2 key
Shaft	Steel	• for frame size ≤ 160 MP - LR: - tapped centre hole - closed keyway • for frame size ≥ 160 M - L: - tapped centre hole - open keyway
End shields	Aluminium alloy	- 80 - 90 non drive end shield
	Cast iron	- 80 - 90 drive end shield (except for 6-pole version and optional for 80 and 90 at non drive end shield) - 100 to 315 drive end and non drive end shields
Bearings and lubrication		- permanently greased bearings frame size 80 to 225 - regreasable bearings frame size 250 to 315 - bearings preloaded at non drive end
Labyrinth seal **Lipseals**	Plastic or steel Synthetic rubber	- lipseal or deflector at drive end for all flange mounted motors - lipseal, deflector or labyrinth seal for foot mounted motors
Fan	Composite material or aluminium alloy	- 2 directions of rotation: straight blades
Fan cover	Composite material or pressed steel	- fitted, on request, with a drip cover for operation in vertical position, shaft end facing down (steel cover)
Terminal box	Composite material or aluminium alloy	- IP 55 - can be turned, opposite the feet - fitted with a terminal block with 6 steel terminals as standard (brass as an option) - terminal box fitted with threaded plugs, supplied without cable glands (cable glands as an option) - 1 earth terminal in each terminal box - fixing system consisting of a cover with captive screws

Bearings and lubrication

PERMANENTLY GREASED BEARINGS

Under normal operating conditions, the service life in hours of the lubricant is indicated in the table below for ambient temperatures less than 55°C.

Series	Type	No. of poles	Types of permanently greased bearing		Grease life according to speed of rotation								
					3000 rpm			1500 rpm			1000 rpm		
			N.D.E.	D.E.	25°C	40°C	55°C	25°C	40°C	55°C	25°C	40°C	55°C
LSES	80 L	2	6203 CN	6204 C3	≥40000	≥40000	25000	-	-	-	-	-	-
	80LG	2 ; 4	6204 C3	6205 C3	≥40000	≥40000	24000	≥40000	≥40000	31000	-	-	-
	90 S - L	2 ; 4 ; 6									≥40000	≥40000	34000
	90 LU	4	6205 C3	6205 C3	-	-	-	≥40000	≥40000	30000	-	-	-
	100 L	2 ; 4 ; 6	6205 C3	6206 C3	≥40000	≥40000	22000	≥40000	≥40000	30000	≥40000	≥40000	33000
	100 LR	4			-	-	-				-	-	-
	112 MR	2	6205 C3	6206 C3	≥40000	≥40000	22000	-	-	-	-	-	-
	112 MG	2 ; 6						-	-	-	≥40000	≥40000	33000
	112 MU	4	6206 C3	6206 C3	-	-	-	≥40000	≥40000	30000	-	-	-
	132 S	2 ; 6	6206 C3	6208 C3	≥40000	≥40000	19000	-	-	-	≥40000	≥40000	30000
	132 SU	2 ; 4						≥40000	≥40000	25000	-	-	-
	132 M	2 ; 4 ; 6	6207 C3	6308 C3	≥40000	≥40000	19000	≥40000	≥40000	25000	≥40000	≥40000	30000
	132 MU	4 ; 6	6307 C3	6308 C3	-	-	-	≥40000	≥40000	25000	≥40000	≥40000	30000
	160 MR	2 ; 4	6308 C3	6309 C3	≥40000	35000	15000	≥40000	≥40000	24000	-	-	-
	160 MP	2 ; 4	6208 C3	6309 C3	≥40000	35000	18000	≥40000	≥40000	24000	-	-	-
	160 M	6	6210 C3	6309 C3	-	-	-	-	-	-	≥40000	≥40000	27000
	160 LU	4 ; 6			-	-	-	≥40000	≥40000	23000			
	160 L	2 ; 4			≥40000	30000	15000				-	-	-
	180 MT	2 ; 4	6210 C3	6310 C3	≥40000	30000	15000	≥40000	≥40000	23000	-	-	-
	180 LR	4			-	-	-				-	-	-
	180 LUR	4 ; 6	6312 C3	6310 C3	-	-	-	≥40000	≥40000	22000	≥40000	≥40000	27000
	180 L	6	6212 C3	6310 C3	-	-	-	-	-	-	≥40000	≥40000	28000
	200 LR	2 ; 4 ; 6	6312 C3	6312 C3	≥40000	25000	12500	≥40000	≥40000	22000	≥40000	≥40000	27000
	200 L	2 ; 6	6214 C3	6312 C3	≥40000	25000	12500	-	-	-	≥40000	≥40000	27000
	200 LU	2 ; 6	6312 C3	6312 C3	≥40000	25000	12500	-	-	-	≥40000	≥40000	27000
	225 ST	4	6214 C3	6313 C3	-	-	-	≥40000	≥40000	21000	-	-	-
	225 MT	2			≥40000	22000	11000	-	-	-	-	-	-
	225 MR	2 ; 4 ; 6	6312 C3	6313 C3	≥40000	22000	11000	≥40000	≥40000	21000	≥40000	≥40000	26000
	225 MG	2 ; 4 ; 6	6216 C3	6314 C3	36000	18000	9000	40000	40000	20000	≥40000	≥40000	25000

Note: on request, all motors can be fitted with grease nipples except the 132 S/SU.

Bearings and lubrication

BEARINGS WITH GREASE NIPPLES

The chart opposite shows the greasing intervals, depending on the type of motor, for standard bearing assemblies of frame size ≥ 160 mm fitted with grease nipples, operating at an ambient temperature of 25°C, 40°C and 55°C on a horizontal shaft machine.

The chart below is valid for LSES motors lubricated with Polyrex EM103 grease, which is used as standard.

SPECIAL CONSTRUCTION AND ENVIRONMENT

For vertical shaft machines, the greasing intervals will be approximately 80% of the values stated in the table below.

Note: The quality and quantity of grease and the greasing interval are shown on the machine nameplate.

For special assemblies (motors fitted with DE roller bearings or other types), machines of frame size ≥ 160 mm have bearings with grease nipples.

Instructions for bearing maintenance are given on the nameplates on these machines.

Series	Type	No. of poles	Type of bearing for bearings with grease nipples		Quantity of grease	Greasing intervals in hours								
						3000 rpm			1500 rpm			1000 rpm		
			N.D.E.	D.E.	g	25°C	40°C	55°C	25°C	40°C	55°C	25°C	40°C	55°C
LSES	160 M*	6	6210 C3	6309 C3	13	-	-	-	-	-	-	31600	15800	7900
	160 LU*	4 ; 6				-	-	-	25800	12900	6450	31600	15800	7900
	160 L*	2 ; 4				17600	8800	4400	25800	12900	6450	-	-	-
	180 MT*	2 ; 4	6210 C3	6310 C3	15	15600	7800	3900	24200	12100	6050	-	-	-
	180 LR*	4				-	-	-	24200	12100	6050	-	-	-
	180 LUR*	4 ; 6	6312 C3	6310 C3	20	-	-	-	21400	10700	5350	28000	14000	7000
	180 L*	6	6212 C3	6310 C3	15	-	-	-	-	-	-	28000	14000	7000
	200 LR*	2 ; 4 ; 6	6312 C3	6312 C3	20	12000	6000	3000	21400	10700	5350	28000	14000	7000
	200 L*	2 ; 6	6214 C3	6312 C3	20	11600	5800	2900	-	-	-	27600	13800	6900
	200 LU*	2 ; 6	6312 C3	6312 C3	20	12000	6000	3000	-	-	-	28000	14000	7000
	225 ST*	4	6214 C3	6313 C3	25	-	-	-	20000	10000	5000	-	-	-
	225 MT*	2				10600	5300	2650	-	-	-	-	-	-
	225 MR*	2 ; 4 ; 6	6312 C3	6313 C3	25	10600	5300	2650	20000	10000	5000	26800	13400	6700
	225 MG*	2 ; 4 ; 6	6216 C3	6314 C3	25	9400	4700	2350	18800	9400	4700	25600	12800	6400
	250 MZ	2	6312 C3	6313 C3	25	10600	5300	2650	-	-	-	-	-	-
	250 ME	4 ; 6	6216 C3	6314 C3	25	-	-	-	22000	11000	5500	30000	16000	8000
	250 MF	2				11000	5500	2750	-	-	-	-	-	-
	280 SC - MC	2							-	-	-	-	-	-
	280 SC	4 ; 6	6216 C3	6316 C3	35	-	-	-	20000	10000	5000	28000	14000	7000
	280 MC	6				-	-	-	-	-	-			
	280 MD	4	6218 C3	6316 C3	35	-	-	-	20000	10000	5000	-	-	-
	280 SU	2 ; 4 ; 6	6317 C3	6317 C3	40	8000	4000	2250	18000	9000	4500	24000	12000	6000
	280 SK	6				-	-	-	-	-	-	24000	12000	6000
	315 SN	2	6216 C3	6316 C3	35	9000	4500	2250	-	-	-	-	-	-
	315 SN	6	6218 C3	6317 C3	40	-	-	-	-	-	-	24000	12000	6000
	315 MP - MR	2	6317 C3	6317 C3	40	8000	4000	2250	-	-	-	-	-	-
	315 SP	4	6317 C3	6320 C3	50	-	-	-	15000	7500	3750	-	-	-
	315 MP - MR	4 ; 6										24000	12000	6000

** bearing with grease nipple available to order*

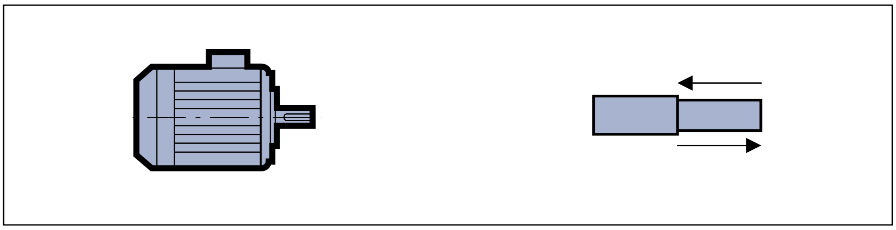
STANDARD BEARING FITTING ARRANGEMENTS

LSES series		Horizontal shaft	Vertical shaft	
			Shaft facing down	Shaft facing up
Foot mounted motors	Mounting arrangement	B3	V5	V6
	standard mounting	The DE bearing is: - located at DE for frame ≤ 180 - locked for frame ≥ 200	The DE bearing is: - located at DE for frame ≤ 180 - locked for frame ≥ 200	The DE bearing is: - locked for frame ≥ 100
	on request	DE bearing locked for frame < 132	The DE bearing is locked	
Flange mounted motors (or foot and flange)	Mounting arrangement	B5 / B35 / B14 / B34	V1 / V15 / V18 / V58	V3 / V36 / V19 / V69
	standard mounting	The DE bearing is locked	The DE bearing is locked	The DE bearing is locked

Axial loads

Horizontal motor

For a bearing life L_{10h} of 25,000 hours and 40,000 hours

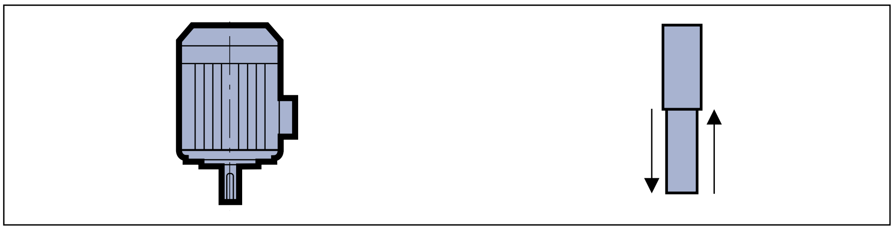


Series	Type	No. of poles	Permissible axial load (in daN) on main shaft extension for standard bearing assembly IM B3/B6 IM B7/B8 IM B5/B35 IM B14/B34											
			3000 rpm				1500 rpm				1000 rpm			
			→		←		→		←		→		←	
			25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours
LSES	80 L	2	32	23	62	53	-	-	-	-	-	-	-	-
	80 LG	2 ; 4	32	22	72	62	47	34	87	74	-	-	-	-
	90 S - L	2 ; 4 ; 6	29	20	69	59	45	32	85	72	60	44	100	84
	90 LU	4	-	-	-	-	42	28	92	78	-	-	-	-
	100 L	2 ; 4 ; 6	43	30	93	80	65	47	115	97	85	63	135	113
	100 LR	4	-	-	-	-	63	45	113	95	-	-	-	-
	112 MR	2	42	29	92	79	-	-	-	-	-	-	-	-
	112 MG	2 ; 6	46	32	96	82	-	-	-	-	81	60	131	110
	112 MU	4	-	-	-	-	56	39	116	98	-	-	-	-
	132 S	2 ; 6	74	54	134	114	-	-	-	-	131	99	191	159
	132 SU	2 ; 4	74	54	134	114	101	74	161	134	-	-	-	-
	132 M	2 ; 4 ; 6	110	82	180	152	157	120	227	190	190	146	260	216
	132 MU	4 ; 6	-	-	-	-	150	113	230	193	180	136	260	216
	160 MP	2 ; 4	149	113	229	193	211	163	291	243	-	-	-	-
	160 MR/LR	2 ; 4	144	108	234	198	204	156	294	246	-	-	-	-
	160 M	6	-	-	-	-	-	-	-	-	240	183	340	283
	160 L	2 ; 4	126	91	226	191	179	132	279	232	-	-	-	-
	160 LU	4 ; 6	-	-	-	-	185	138	285	238	217	161	317	261
	180 MT	2 ; 4	158	117	258	217	207	153	307	253	-	-	-	-
	180 LR	4	-	-	-	-	193	140	293	240	-	-	-	-
	180 L	6	-	-	-	-	-	-	-	-	277	213	325	261
	180 LUR	4 ; 6	-	-	-	-	199	147	262	210	224	162	287	225
	200 LR	2 ; 4 ; 6	237	184	300	247	294	224	357	287	337	254	400	317
	200 L	2 ; 6	249	195	315	261	-	-	-	-	367	283	433	349
	200 LU	2 ; 6	232	179	295	242	-	-	-	-	320	238	383	301
	225 ST	4	-	-	-	-	363	283	429	349	-	-	-	-
	225 MT	2	279	219	345	285	-	-	-	-	-	-	-	-
	225 MR	2 ; 4 ; 6	270	210	333	273	339	261	402	324	407	256	470	319
	225 MG	2 ; 4 ; 6	295	228	365	298	378	290	448	360	458	353	528	423
	250 MZ	2	277	217	340	280	-	-	-	-	-	-	-	-
	250 ME	4 ; 6	-	-	-	-	392	303	462	373	478	372	548	442
	250 MF	2	291	224	361	294	-	-	-	-	-	-	-	-
	280 SC	2 ; 4 ; 6	298	231	368	301	465	361	535	431	574	449	644	519
	280 SU	2 ; 4	480	398	300	218	577	469	397	289	-	-	-	-
	280 SK	6	-	-	-	-	-	-	-	-	705	574	525	394
	280 MC	2 ; 6	295	228	365	298	-	-	-	-	559	435	629	505
	280 MD	4	-	-	-	-	429	246	517	246	-	-	-	-
	315 SN	2 ; 6	349	271	419	341	-	-	-	-	553	423	641	511
	315 SP	4	-	-	-	-	792	650	612	470	-	-	-	-
	315 MP	2 ; 4 ; 6	492	409	312	229	764	623	584	443	884	717	704	537
	315 MR	2 ; 4 ; 6	467	386	287	206	753	613	573	433	856	613	676	433

Axial loads

Vertical motor
Shaft facing down

For a bearing life L_{10h}
of 25,000 hours
and 40,000 hours

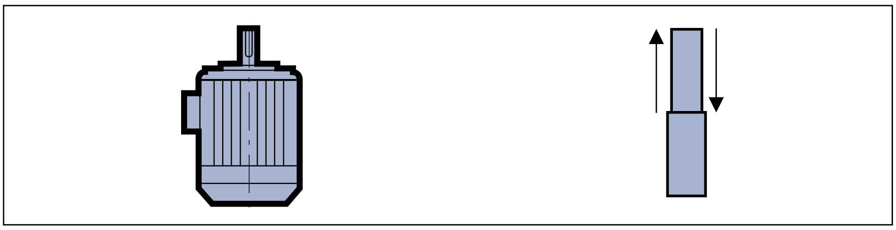


Series	Type	No. of poles	Permissible axial load (in daN) on main shaft extension for standard bearing assembly IM V5 / IM V1 / V15 / IM V18 / V58											
			3000 rpm ↓		3000 rpm ↑		1500 rpm ↓		1500 rpm ↑		1000 rpm ↓		1000 rpm ↑	
			25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours
LSES	80 L	2	30	21	64	55	-	-	-	-	-	-	-	-
	80 LG	2 ; 4	30	20	75	65	45	32	92	78	-	-	-	-
	90 S - L	2 ; 4 ; 6	27	17	74	64	42	29	91	78	56	41	106	90
	90 LU	4	-	-	-	-	38	24	85	98	-	-	-	-
	100 L	2 ; 4 ; 6	40	26	99	86	60	42	123	104	80	58	143	121
	100 LR	4	-	-	-	-	57	39	122	104	-	-	-	-
	112 MR	2	38	25	99	86	-	-	-	-	-	-	-	-
	112 MG	2 ; 6	40	26	106	92	-	-	-	-	75	53	143	121
	112 MU	4	-	-	-	-	49	31	129	111	-	-	-	-
	132 S	2 ; 6	67	47	145	125	-	-	-	-	122	90	207	175
	132 SU	2 ; 4	65	45	147	127	91	64	177	150	-	-	-	-
	132 M	2 ; 4 ; 6	101	73	196	168	145	108	247	210	179	134	279	235
	132 MU	4 ; 6	-	-	-	-	136	98	253	215	165	121	286	242
	160 MP	2	137	101	249	212	197	148	316	268	-	-	-	-
	160 MR/LR	2 ; 4	129	93	257	221	187	138	323	274	-	-	-	-
	160 M	6	-	-	-	-	-	-	-	-	215	158	379	322
	160 L	2 ; 4	104	69	262	226	156	109	317	270	-	-	-	-
	160 LU	4 ; 6	-	-	-	-	160	112	329	281	187	131	372	316
	180 MT	2 ; 4	134	93	196	255	182	128	352	298	-	-	-	-
	180 LR	4	-	-	-	-	167	113	345	291	-	-	-	-
	180 L	6	-	-	-	-	-	-	-	-	239	175	391	326
	180 LUR	4 ; 6	-	-	-	-	163	110	334	280	183	120	377	314
	200 LR	2 ; 4 ; 6	202	148	358	304	258	187	431	360	296	212	492	408
	200 L	2 ; 6	211	156	370	316	-	-	-	-	315	230	523	438
	200 LU	2 ; 6	186	132	369	315	-	-	-	-	262	179	497	414
	225 ST	4	-	-	-	-	314	233	511	430	-	-	-	-
	225 MT	2	238	177	408	347	-	-	-	-	-	-	-	-
	225 MR	2 ; 4 ; 6	222	162	408	248	284	204	503	423	351	197	593	440
	225 MG	2 ; 4 ; 6	222	154	485	417	276	186	419	529	360	253	706	599
	250 MZ	2	229	168	415	354	-	-	-	-	-	-	-	-
	250 ME	4 ; 6	-	-	-	-	299	208	626	535	401	293	695	587
	250 MF	2	201	133	500	432	-	-	-	-	-	-	-	-
	280 SC	2 ; 4 ; 6	233	165	478	410	361	255	710	604	487	360	806	679
	280 SU	2 ; 4	294	210	585	501	358	246	760	648	-	-	-	-
	280 SK	6	-	-	-	-	-	-	-	-	502	368	850	716
	280 MD	4	-	-	-	-	310	125	726	453				
	315 SN	2 ; 6	259	180	567	458	-	-	-	-	419	286	886	753
	315 SP	4	-	-	-	-	607	463	892	748	-	-	-	-
	315 MP	2 ; 4 ; 6	326	242	560	476	559	416	912	769	661	491	1070	900
	315 MR	2 ; 4 ; 6	275	191	586	502	521	378	952	808	604	378	1109	808

Axial loads

Vertical motor
Shaft facing up

For a bearing life L_{10h}
of 25,000 hours
and 40,000 hours

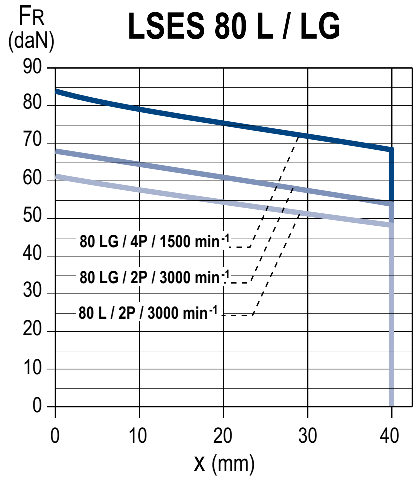


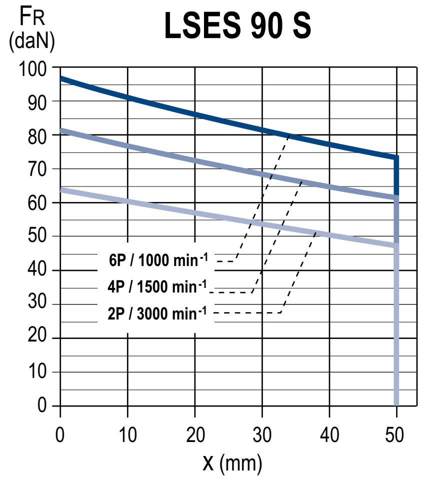
Series	Type	No. of poles	Permissible axial load (in daN) on main shaft extension for standard bearing assembly IM V6 IM V3 / V36 IM V19 / V69											
			3000 rpm ↓		3000 rpm ↑		1500 rpm ↓		1500 rpm ↑		1000 rpm ↓		1000 rpm ↑	
			25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours
LSES	80 L	2	60	51	34	25	-	-	-	-	-	-	-	-
	80 LG	2 ; 4	69	59	35	25	85	72	52	38	-	-	-	-
	90 S - L	2 ; 4 ; 6	67	57	34	24	82	69	51	38	96	81	66	50
	90 LU	4	-	-	-	-	87	74	48	35	-	-	-	-
	100 L	2 ; 4 ; 6	90	76	49	36	110	92	73	54	130	108	93	72
	100 LR	4	-	-	-	-	107	89	72	54	-	-	-	-
	112 MR	2	88	75	49	36	-	-	-	-	-	-	-	-
	112 MG	2 ; 6	89	76	56	42	-	-	-	-	125	103	93	71
	112 MU	4 ; 6	-	-	-	-	109	91	69	51	-	-	-	-
	132 S	2 ; 6	127	107	86	66	-	-	-	-	182	150	147	115
	132 SU	2 ; 4	125	105	87	67	151	90	116	124	-	-	-	-
	132 M	2 ; 4 ; 6	171	143	126	98	215	178	177	140	249	205	209	165
	132 MU	4 ; 6	-	-	-	-	216	179	173	135	245	201	206	162
	160 MP	2	217	181	169	132	276	228	236	188	-	-	-	-
	160 MR/LR	2 ; 4	219	183	167	131	277	228	233	184	-	-	-	-
	160 M	6	-	-	-	-	-	-	-	-	315	258	279	222
	160 L	2 ; 4	204	169	162	126	256	209	217	170	-	-	-	-
	160 LU	4 ; 6	-	-	-	-	260	212	229	181	287	231	272	216
	180 MT	2 ; 4	234	193	196	155	282	228	252	198	-	-	-	-
	180 LR	4	-	-	-	-	267	213	245	191	-	-	-	-
	180 L	6	-	-	-	-	-	-	-	-	287	223	343	278
	180 LUR	4 ; 6	-	-	-	-	226	173	271	217	246	183	314	251
	200 LR	2 ; 4 ; 6	265	211	295	241	321	250	368	297	359	275	429	345
	200 L	2 ; 6	277	222	304	250	-	-	-	-	381	296	457	376
	200 LU	2 ; 6	249	195	306	252	-	-	-	-	325	242	434	351
	225 ST	4	-	-	-	-	380	299	445	364	-	-	-	-
	225 MT	2	304	243	342	281	-	-	-	-	-	-	-	-
	225 MR	2 ; 4 ; 6	285	225	345	285	347	267	440	360	414	260	530	377
	225 MG	2 ; 4 ; 6	292	224	415	347	346	256	549	459	430	323	636	529
	250 MZ	2	292	231	352	291	-	-	-	-	-	-	-	-
	250 ME	4 ; 6	-	-	-	-	369	278	556	465	471	363	625	517
	250 MF	2	271	203	430	363	-	-	-	-	-	-	-	-
	280 SC	2 ; 4 ; 6	303	235	408	340	431	325	640	534	557	430	736	609
	280 SU	2 ; 4	114	30	765	681	178	66	940	828	-	-	-	-
	280 SK	6	-	-	-	-	-	-	-	-	322	188	1030	896
	280 MD	4	-	-	-	-	398	125	638	453	-	-	-	-
	315 SN	2 ; 6	329	250	497	418	-	-	-	-	507	374	798	665
	315 SP	4	-	-	-	-	427	283	1072	928	-	-	-	-
	315 MP	2 ; 4 ; 6	146	62	740	656	379	236	1092	949	481	311	1250	1080
	315 MR	2 ; 4 ; 6	95	11	766	682	341	198	1132	988	341	198	1132	988

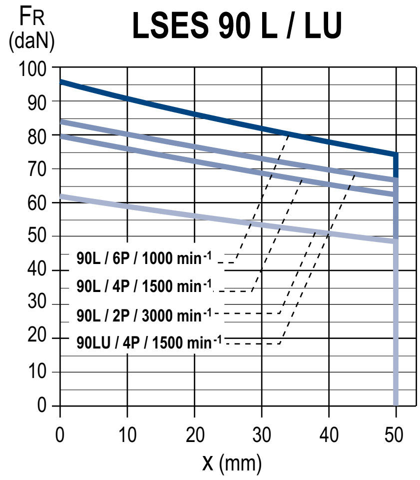
Radial loads

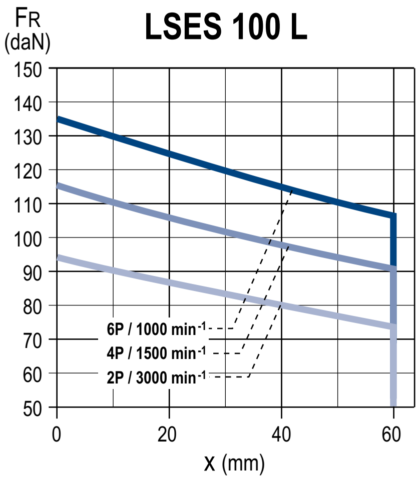
STANDARD FITTING ARRANGEMENT

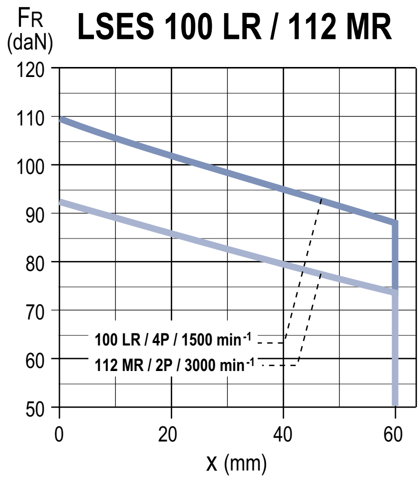
Permissible radial load on main shaft extension with a bearing life L10h of 25,000 hours.
FR: Radial Force
X : distance with respect to the shaft shoulder

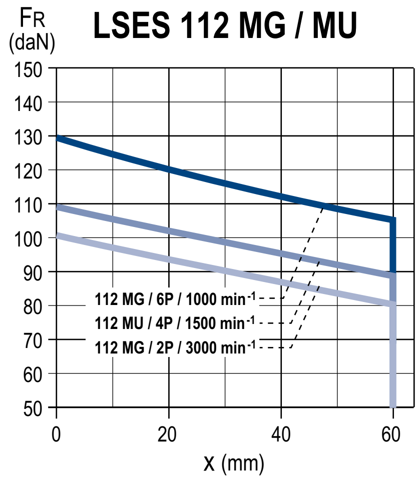


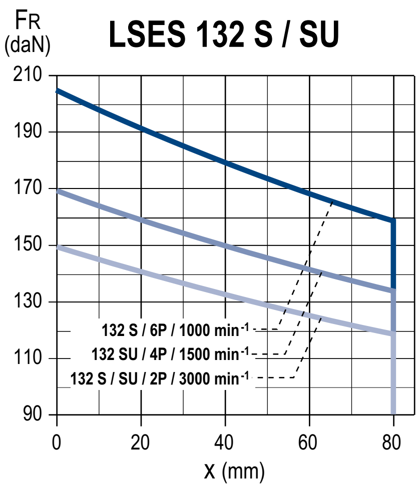


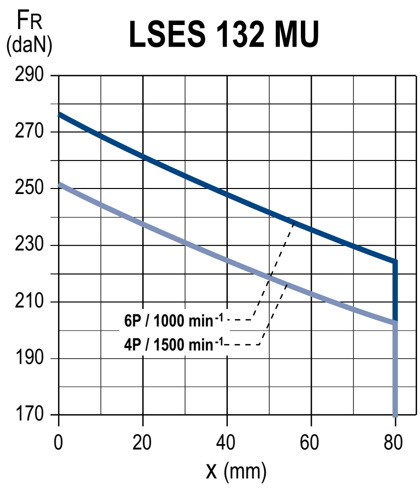


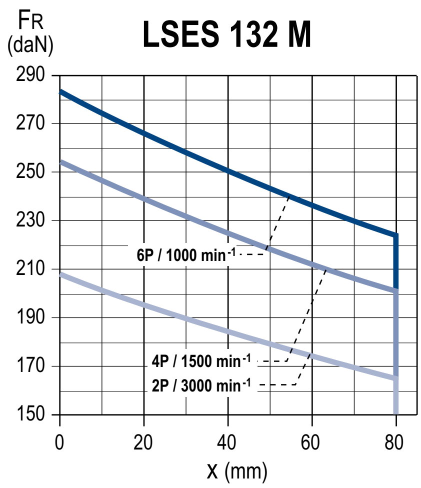








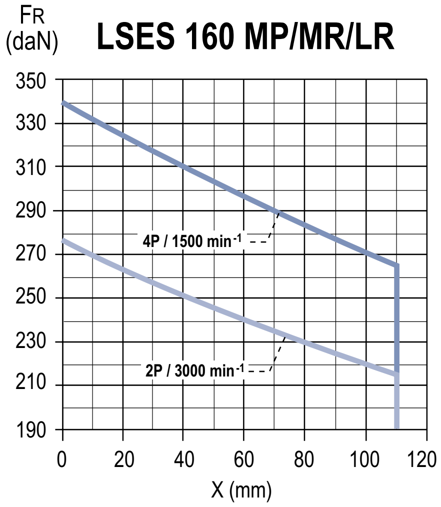


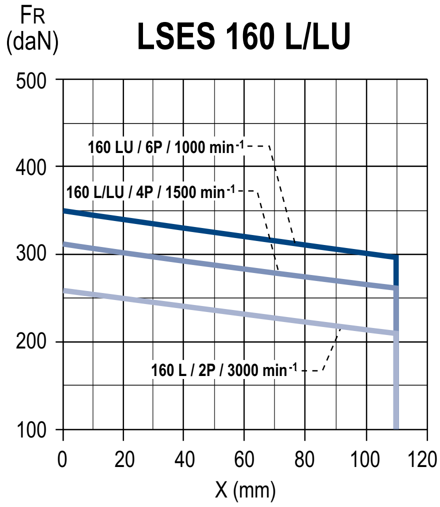


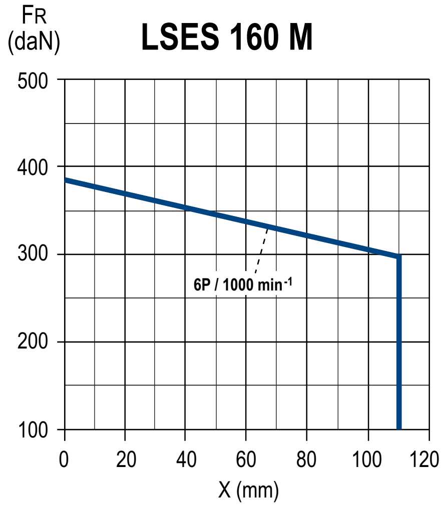
Radial loads

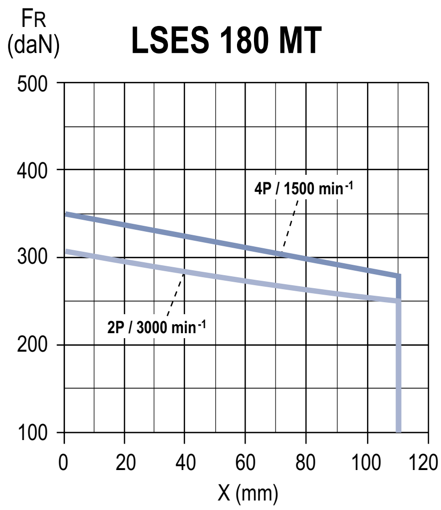
STANDARD FITTING ARRANGEMENT

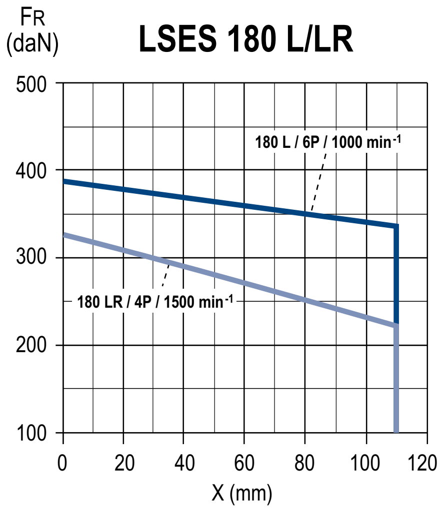
Permissible radial load on main shaft extension with a bearing life L10h of 25,000 hours.
FR: Radial Force
X : distance with respect to the shaft shoulder

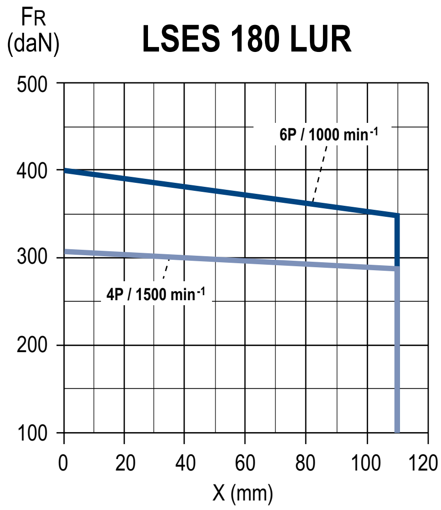


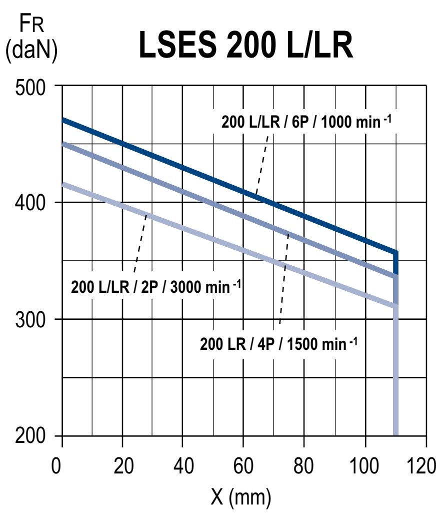


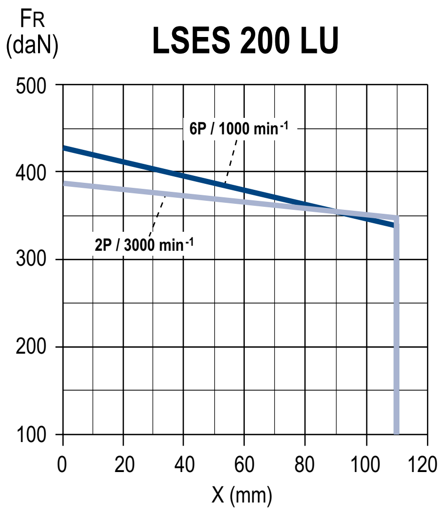


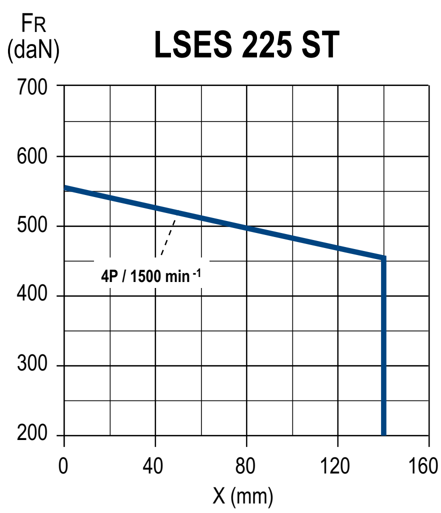








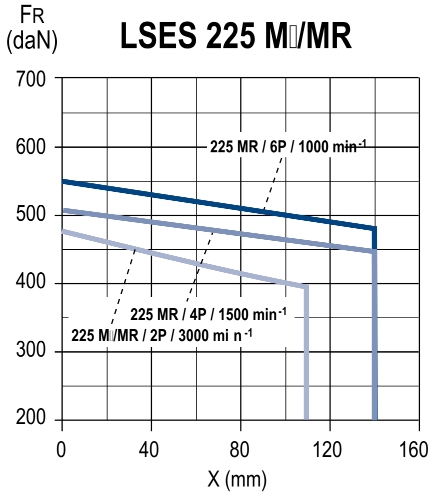


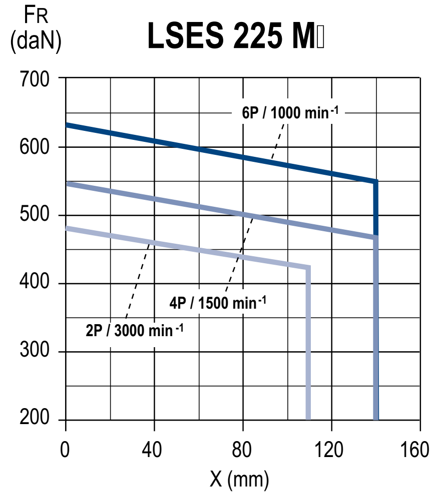


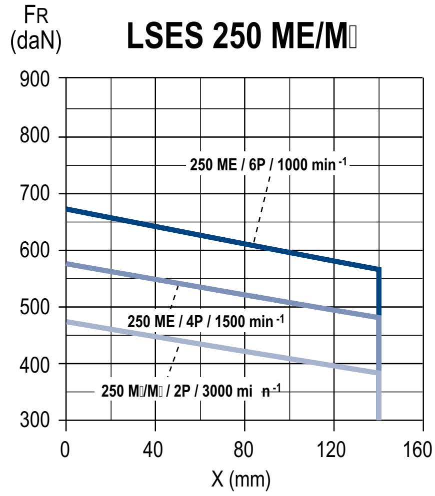
Radial loads

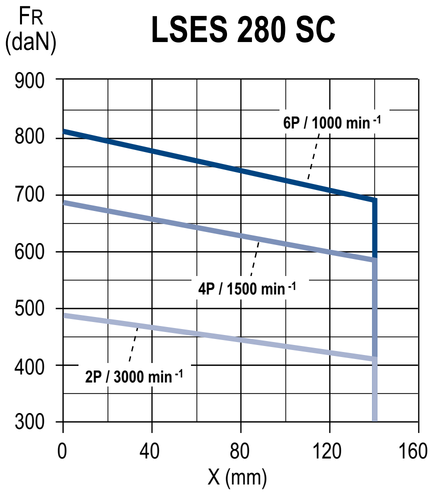
STANDARD FITTING ARRANGEMENT

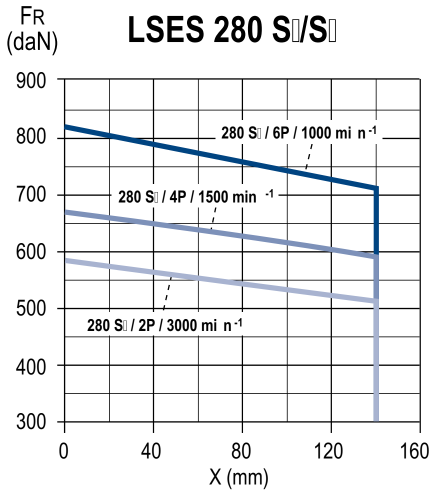
Permissible radial load on main shaft extension with a bearing life L10h of 25,000 hours.
FR: Radial Force
X : distance with respect to the shaft shoulder

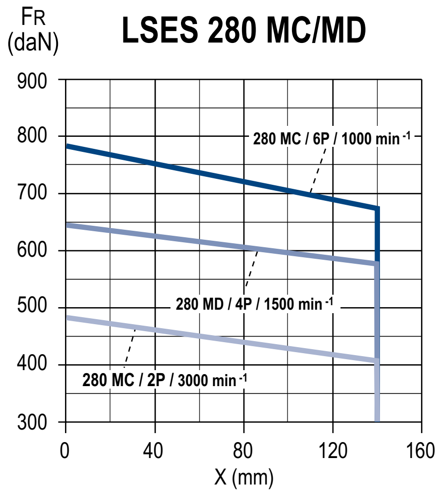


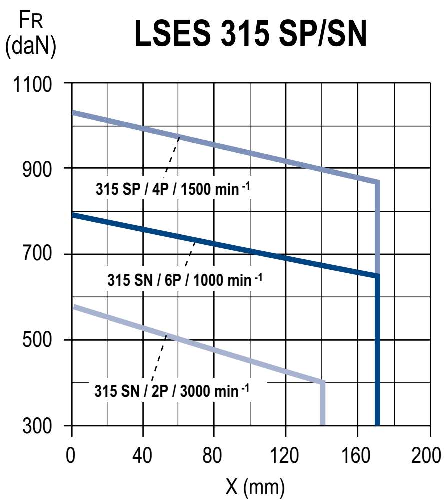


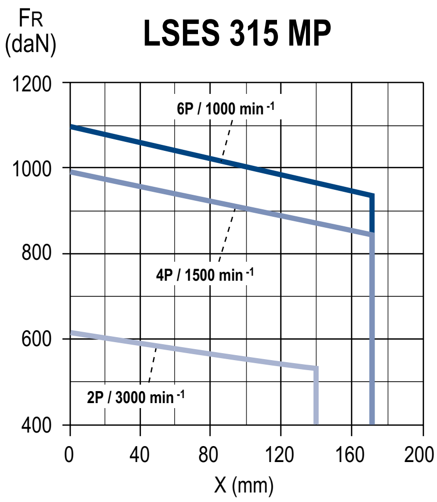


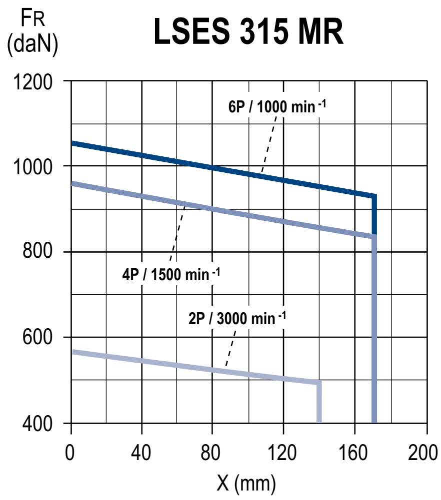












Radial loads

SPECIAL FITTING ARRANGEMENTS

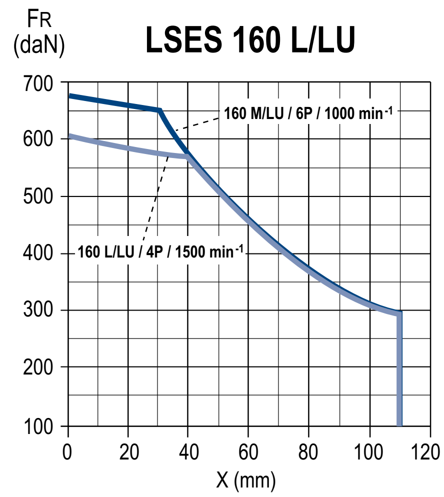
Type of drive end roller bearings

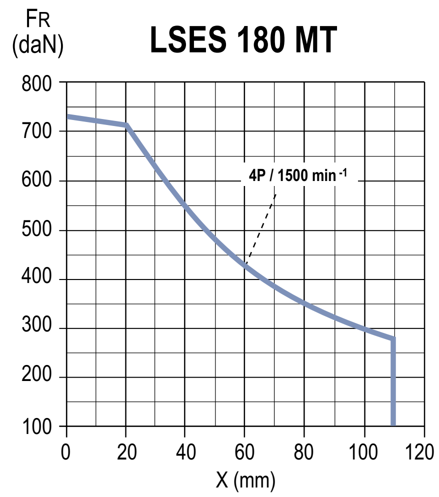
Series	Type	No. of poles	Non-drive end bearing (N.D.E.)	Drive end bearing (D.E.)
LSES	160 M	6	6210 C3	NU 309
	160 L/LU	4; 6		
	180 MT	4	6210 C3	NU 310
	180 LR	4		
	180 L	6	6212 C3	NU 310
	200 LR	4; 6	6312 C3	NU 312
	200 L	6	6214 C3	NU 312
	225 ST	4	6214 C3	NU 313
	225 MR	4; 6	6312 C3	NU 313
	250 ME	4; 6	6216 C3	NU 314
	280 SC	4; 6	6216 C3	NU 316
	280 MC	6		
	280 MD	4	6218 C3	NU 316
	315 SN	6	6218 C3	NU 317
	315 SP	4	6317 C3	NU 320
	315 MP/MR	4; 6	6317 C3	NU 320

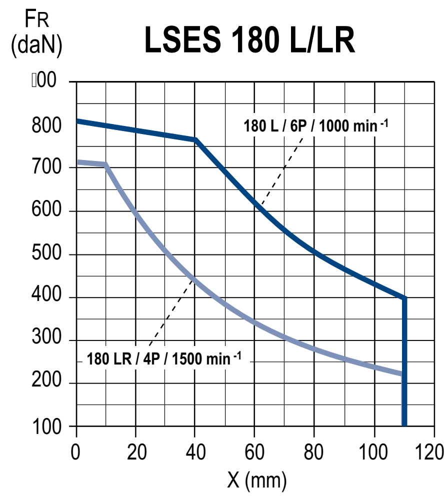
Radial loads

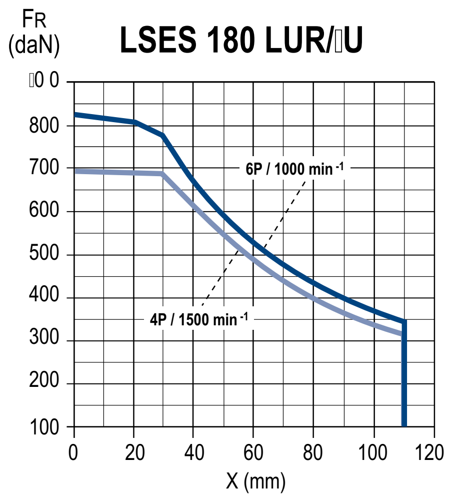
SPECIAL FITTING ARRANGEMENTS

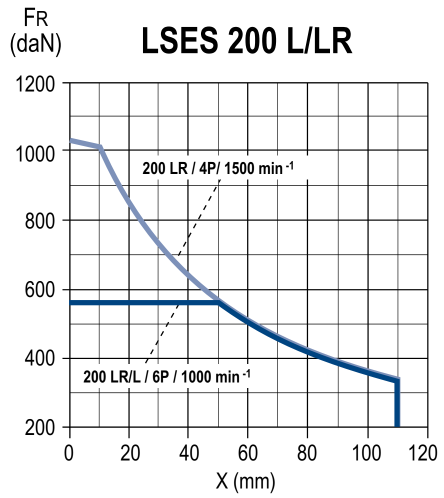
Permissible radial load on main shaft extension with a bearing life L10h of 25,000 hours.
FR: Radial Force
X : distance with respect to the shaft shoulder

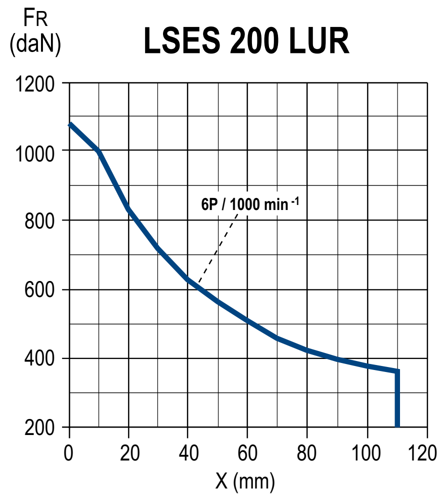


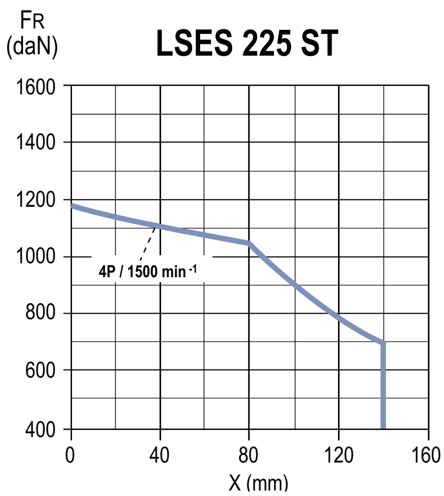


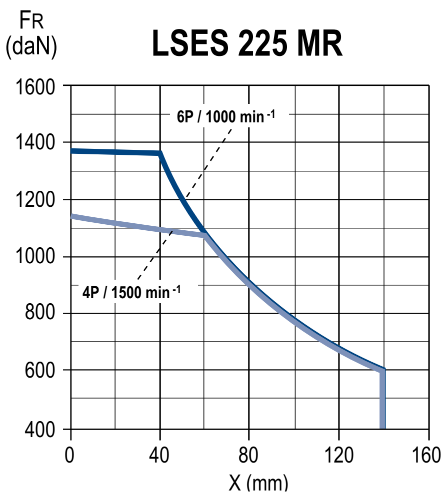


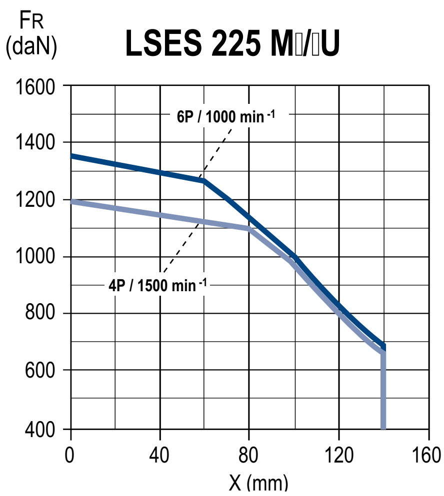








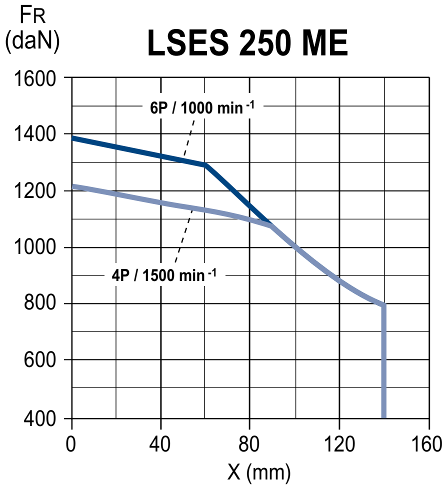


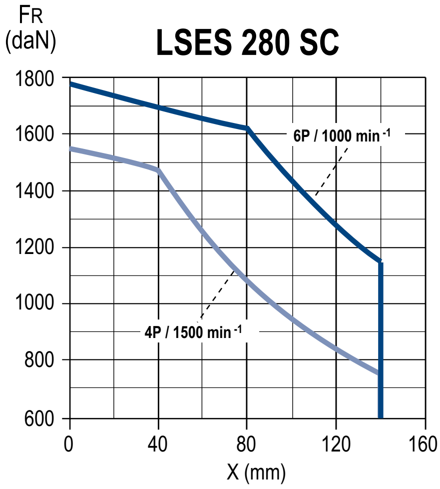


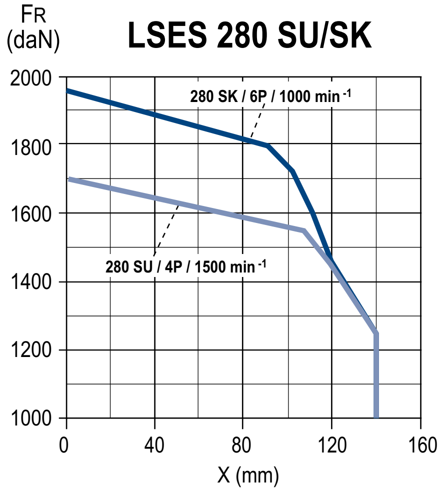
Radial loads

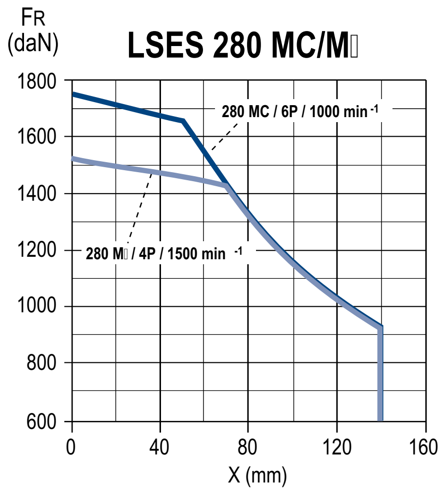
SPECIAL FITTING ARRANGEMENTS

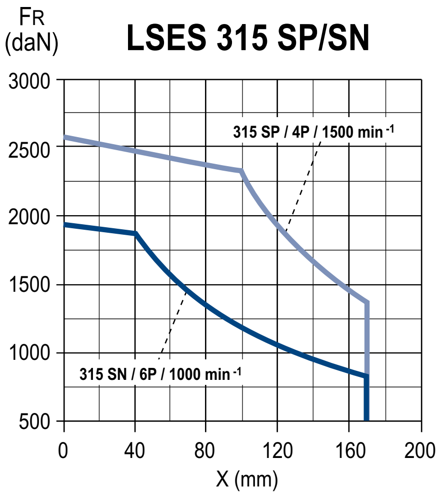
Permissible radial load on main shaft extension with a bearing life L10h of 25,000 hours.
FR: Radial Force
X : distance with respect to the shaft shoulder

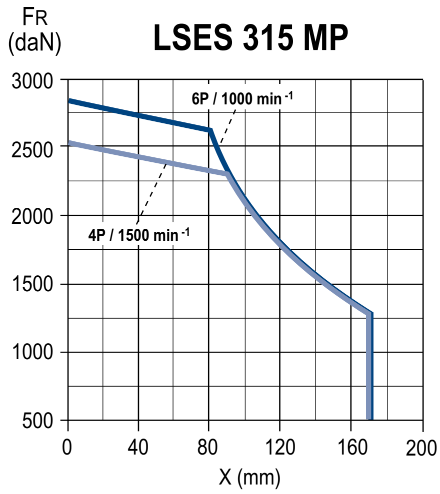


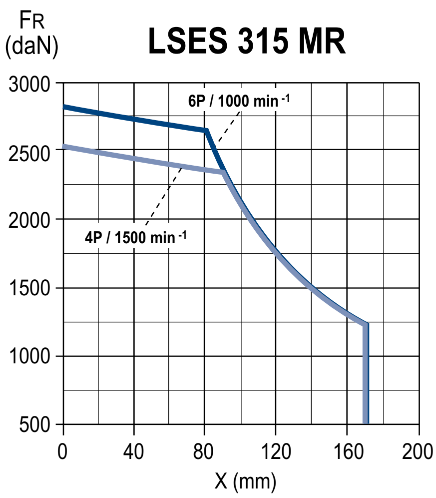












Mains connection

Descriptive table of terminal boxes for rated supply voltage of 400 V (According to EN 50262)

Series	Type	No. of poles	Terminal box material	Power + auxiliaries	
				Number of drill holes	Drill hole diameter
LSES	80	2; 4; 6	Plastic	1 + 1 protective cap (number of drill holes)	ISO M20 x 1.5
	90	2; 4; 6			
	100	2; 4; 6			
	112	2; 4; 6			
	132*	2; 4; 6	Aluminium alloy	2	ISO M25 x 1.5
	160*	2; 4; 6			
	180	2; 4; 6		3	2 ISO x M40 + 1 ISO x M16
	200	2; 4; 6			
	225	2; 4; 6			2 ISO x M50 + 1 ISO x M16
	250 MZ	2			
	250 ME / 225 MG	2; 4; 6			2 ISO x M63 + 1 ISO x M16
	280	2; 4; 6			
	315	2; 4; 6		0	Removable undrilled mounting plate

** As an option, both ISO M25 cable glands may be replaced by 1 ISO x M25 and 1 ISO x M32 (to comply with standard DIN 42925).*

TERMINAL BLOCKS
DIRECTION OF ROTATION

Standard motors are fitted with a block of six 6 terminals complying with standard NFC 51 120, with the terminal markings complying with IEC 60034-8 (or NFEN 60034-8).
When the motor is running in U1, V1, W1 or 1U, 1V, 1W from a direct mains supply L1, L2, L3, it turns clockwise when seen from the drive end.
If any two of the phases are changed over, the motor will run in an anti-clockwise direction (make sure that the motor has been designed to run in both directions).
If the motor is fitted with accessories (thermal protection or space heater), these must be connected on screw dominos with labelled wires.

Tightening torque for the nuts on the terminal blocks

Terminal	M4	M5	M6	M8	M10	M12	M16
Torque N.m	2	3.2	5	10	20	35	65

LSES series	400 V Mains Power Supply		
	230/400 V connections		400 VD connections
	No. of poles	Terminals	Terminals
80 to 112	2 ; 4 ; 6	M5	M5
132 S/SU	2 ; 4 ; 6	M5	M5
132 M/MP/MU	2 ; 4 ; 6	M6	M6
160	2 ; 4 ; 6	M6	M6
180 MT/L	2 ; 4 ; 6	M6	M6
180 LR	4	M8	M6
200 LR	2 ; 4 ; 6	M8	M6
200 L	2 ; 6	M8	M8
225 ST	4	M10	M8
225 MR	4	M10	M8
	6	M8	M8
250 ME	4 ; 6	M10	M8
250 MZ	2	M10	M8
280 SC	2	M12	M10
	4	M12	M8
	6	M10	M8
280 MC	2	M12	M10
	6	M10	M8
280 MD	4	M12	M10
315 SN	2	M16	M12
	6	M12	M10
315 SP	4	M16	M12
315 MP	2 ; 4 ; 6 (110 kW)	M16	M12
	6 (90 kW)	M12	M10
315 MR	2 ; 4 (160 kW)	M16	M12
	2 ; 4 (200 kW)	M16	M16
	6	M16	M12

2 poles - 3000 min^{-1}

IP55 - CLASS F - ΔT80K - S1 - CLASS IE2

MAINS SUPPLY 400 V 50 Hz

Type	Rated power	Rated speed	Rated torque	Rated current	Power factor			Efficiency IEC 60034-2-1 2007			Starting current/ Rated current	Starting torque/ Rated torque	Maximum torque/ Rated torque	Moment of inertia	Weight	Noise
	P_N	N_N	M_N	$I_{N (400V)}$	Cos φ			η			Is/In	Ms/Mn	M_M/Mn	J	IM B3	LP
	kW	min^{-1}	N.m	A	4/4	3/4	2/4	4/4	3/4	2/4				$kg.m^2$	kg	db(A)
LSES 80 L	0.75	2860	2.5	1.7	0.85	0.77	0.66	78.6	78.8	77.2	6.0	2.4	3.0	0.00073	9.5	61
LSES 80 L	1.1	2845	3.7	2.3	0.85	0.78	0.64	79.7	80.9	79.2	7.0	2.8	3.4	0.00095	10.7	61
LSES 90 S	1.5	2860	5.0	3.2	0.84	0.76	0.62	81.7	82.3	80.6	7.8	3.4	4.5	0.00149	12.9	64
LSES 90 L	2.2	2870	7.2	4.5	0.84	0.76	0.63	83.7	83.7	81.6	8.7	4.0	4.1	0.00197	16.1	64
LSES 100 L	3	2870	10.0	5.9	0.87	0.81	0.69	84.8	85.5	84.4	8.5	4.0	4.0	0.00267	22.2	66
LSES 112 MR	4	2864	13.4	7.9	0.85	0.79	0.66	86.2	86.9	86.0	8.6	4.2	3.7	0.00323	26.5	66
LSES 132 S	5.5	2923	17.9	10.0	0.90	0.86	0.76	88.1	88.9	88.4	8.3	2.5	3.5	0.00881	35	72
LSES 132 SU	7.5	2923	24.1	13.3	0.91	0.88	0.79	88.1	88.9	88.9	8.6	2.7	3.1	0.01096	41	72
LSES 160 MP	11	2927	35.9	21.2	0.84	0.77	0.66	89.6	90.1	89.4	8.3	3.6	4.6	0.01940	63	72
LSES 160 MR	15	2928	49.2	27.2	0.89	0.84	0.75	90.4	91.4	91.3	9.0	2.7	3.8	0.02560	75	72
LSES 160 L	18.5	2944	60.1	32.9	0.89	0.86	0.79	91.5	91.9	91.4	8.4	2.9	3.0	0.05000	101	72
LSES 180 MT	22	2938	71.9	38.9	0.89	0.87	0.80	91.8	92.3	91.9	8.4	2.7	3.2	0.06000	105	69
LSES 200 LR	30	2952	97.3	51.2	0.92	0.90	0.85	92.3	92.7	92.1	8.6	3.0	3.5	0.10000	155	77
LSES 200 L	37	2943	119	64.8	0.89	0.87	0.81	92.6	93.1	92.7	7.1	2.2	2.5	0.12000	182	73
LSES 225 MT	45	2953	145	79.5	0.88	0.85	0.78	93.1	93.4	92.8	7.9	3.0	3.4	0.14000	203	73
LSES 250MZ	55	2950	179	95.7	0.89	0.86	0.80	93.5	93.8	93.4	7.9	3.0	3.3	0.17000	238	76
LSES 280 SC	75	2967	241	128	0.90	0.88	0.82	94.3	94.5	93.9	8.2	2.7	3.0	0.36000	340	81
LSES 280 MC	90	2969	287	153	0.90	0.88	0.82	94.6	94.8	94.3	8.4	2.8	3.4	0.43000	370	80
LSES 315 SN	110	2964	353	185	0.91	0.90	0.86	94.4	94.9	94.7	8.3	2.8	3.3	0.55000	447	80
LSES 315 MP	132	2976	425	223	0.89	0.88	0.83	94.9	94.7	93.7	7.6	2.8	3.0	1.67000	718	84
LSES 315 MR	160	2975	512	270	0.90	0.89	0.85	94.9	94.8	94.0	7.6	2.9	3.1	1.97000	823	83
LSES 315 MR	200	2982	641	348	0.88	0.83	0.75	95.3	94.8	93.4	8.7	3.8	3.9	2.05000	849	85

POWER RATINGS NOT CONFORMING TO THE STANDARDS

Type	Rated power	Rated speed	Rated torque	Rated current	Power factor			Efficiency IEC 60034-2-1 2007			Starting current/ Rated current	Starting torque/ Rated torque	Maximum torque/ Rated torque	Moment of inertia	Weight	Noise
	P_N	N_N	M_N	$I_{N (400V)}$	Cos φ			η			Id/In	Md/Mn	M_M/Mn	J	IM B3	LP
	kW	min^{-1}	N.m	A	4/4	3/4	2/4	4/4	3/4	2/4				$kg.m^2$	kg	db(A)
LSES 71 LG	0.75	2825	2.5	1.7	0.83	0.76	0.64	77.7	77.7	74.8	6.4	3.4	3.4	0.000692	7.5	62
LSES 80 LG	1.5	2860	5.0	3.2	0.87	0.76	0.62	81.7	82.3	80.6	7.8	3.4	4.5	0.00150	13	64
LSES 90 L	1.8	2874	6	3.6	0.87	0.81	0.69	83.3	83.5	81.9	8.6	4.3	4.3	0.00169	14.5	64
LSES 100 L	3.7	2867	12	7.5	0.83	0.76	0.65	85.7	85.8	84.4	8.8	4.2	3.6	0.00291	24	66
LSES 112 MG	5.5	2922	17.9	8.3	0.91	0.87	0.79	87.4	88.2	87.6	8.3	2.5	3.5	0.00855	33	72
LSES 132 M	9	2925	29.2	17.7	0.82	0.75	0.63	89.5	89.8	89.2	8.0	3.5	3.6	0.0164	50	72
LSES 132 M	11	2927	35.9	21.2	0.84	0.77	0.66	89.6	90.1	89.4	8.3	3.6	4.6	0.0194	55	72
LSES 200 LR	40	2963	129.0	72.6	0.86	0.81	0.70	92.6	92.2	90.7	10.7	3.9	4.6	0.10	170	73
LSES 200 LU	55	2963	179	95.7	0.89	0.86	0.80	93.5	93.8	93.4	7.9	3.0	3.3	0.17	225	73
LSES 225 MR	55	2950	179	95.7	0.89	0.86	0.80	93.5	93.8	93.4	7.9	3.0	3.3	0.17	230	73
LSES 225 MG	90	2968	287	153	0.90	0.88	0.82	94.6	94.8	94.3	8.4	2.8	3.4	0.43	355	73
LSES 250 MF	105	2965	338.0	175.0	0.92	0.90	0.85	94.6	95.0	94.7	8.6	2.8	3.2	0.45	430	76
LSES 280 SU	160	2975	512	270	0.90	0.89	0.85	94.9	94.8	94.0	7.6	2.9	3.1	1.97	805	81

4 poles - 1500 min^{-1}

IP55 - CLASS F - ΔT80K - S1 - CLASS IE2

Type	MAINS SUPPLY 400 V 50 Hz															
	Rated power	Rated speed	Rated torque	Rated current	Power factor			Efficiency IEC 60034-2-1 2007			Starting current/ Rated current	Starting torque/ Rated torque	Maximum torque/ Rated torque	Moment of inertia	Weight	Noise
	P_N	N_N	M_N	$I_{N\,(400V)}$	Cos φ			η			Id/In	Md/Mn	M_M/Mn	J	IM B3	LP
	kW	min^{-1}	N.m	A	4/4	3/4	2/4	4/4	3/4	2/4				kg.m^2	kg	db(A)
LSES 80 LG	0.75	1445	5.0	1.7	0.77	0.69	0.55	80.1	80.8	79.0	5.6	1.8	2.6	0.00261	11.7	47
LSES 90 S	1.1	1435	7.5	2.4	0.82	0.75	0.62	81.5	83.3	83.0	5.4	1.9	2.5	0.00298	12.2	48
LSES 90 L	1.5	1445	9.9	3.2	0.80	0.71	0.55	83.0	83.9	82.4	5.5	1.9	2.4	0.00374	14.6	48
LSES 100 L	2.2	1440	14.6	4.6	0.82	0.74	0.63	84.7	85.9	86.1	6.3	2.3	2.2	0.00531	21.3	48
LSES 100 LR	3	1439	19.9	6.5	0.78	0.72	0.58	85.5	86.7	86.4	7.1	3.0	4.1	0.00665	25.7	48
LSES 112 MU	4	1455	26.3	8.4	0.79	0.71	0.57	87.0	87.9	87.5	7.2	2.5	3.2	0.0129	35	49
LSES 132 SU	5.5	1455	35.9	11.9	0.76	0.67	0.53	87.7	88.4	87.5	7.2	2.6	3.7	0.0157	42	49
LSES 132 M	7.5	1458	48.6	14.6	0.83	0.76	0.63	88.9	89.8	89.3	8.0	2.9	3.9	0.0252	57	62
LSES 160 MR	11	1459	72.2	21.2	0.83	0.78	0.66	90.1	90.9	90.5	8.2	3.3	4.0	0.035	77	62
LSES 160 L	15	1457	97.9	28.2	0.84	0.80	0.69	90.8	91.8	92.1	7.4	2.2	3.1	0.07	91	62
LSES 180 MT	18.5	1458	121	35.1	0.83	0.78	0.66	91.4	92.1	92.1	7.6	2.9	3.6	0.08	103	64
LSES 180 LR	22	1458	144	41.0	0.84	0.79	0.67	91.8	92.5	92.5	7.8	2.8	3.3	0.09	115	64
LSES 200 LR	30	1463	196	56.5	0.83	0.78	0.67	92.4	92.9	92.5	7.0	2.8	2.8	0.16	164	69
LSES 225 ST	37	1469	240	69.7	0.82	0.78	0.68	92.9	93.7	93.8	6.3	2.7	2.7	0.23	205	64
LSES 225 MR	45	1471	292	84.1	0.83	0.79	0.68	93.3	93.9	93.8	6.9	2.3	2.4	0.29	235	64
LSES 250 ME	55	1482	355	102	0.84	0.79	0.69	94.1	94.4	93.9	7.4	2.6	2.7	0.65	328	69
LSES 280 SC	75	1482	483	139	0.83	0.78	0.67	94.5	94.6	94.0	8.8	2.4	2.9	0.86	392	70
LSES 280 MD	90	1481	582	166	0.83	0.78	0.68	94.6	94.8	94.3	7.9	3.4	3.7	1.03	455	69
LSES 315 SP	110	1488	706	204	0.82	0.78	0.67	94.5	94.1	92.8	7.9	3.1	3.4	2.32	670	76
LSES 315 MP	132	1486	855	238	0.85	0.81	0.72	95.4	95.2	94.3	7.9	3.1	3.4	2.79	758	70
LSES 315 MR	160	1484	1027	288	0.84	0.80	0.72	95.2	95.2	94.5	7.5	2.8	2.9	3.25	850	77
LSES 315 MR*	200	1484	1295	361	0.84	0.79	0.68	95.7	95.8	95.2	7.6	2.8	3.0	3.25	850	77

* Class F temperature rise

POWER RATINGS NOT CONFORMING TO THE STANDARDS

Type	Rated power	Rated speed	Rated torque	Rated current	Power factor			Efficiency IEC 60034-2-1 2007			Starting current/ Rated current	Starting torque/ Rated torque	Maximum torque/ Rated torque	Moment of inertia	Weight	Noise
	P_N	N_N	M_N	$I_{N\,(400V)}$	Cos φ			η			Id/In	Md/Mn	M_M/Mn	J	IM B3	LP
	kW	min^{-1}	N.m	A	4/4	3/4	2/4	4/4	3/4	2/4				kg.m^2	kg	db(A)
LSES 80 LG	0.9	1437	6.0	2.1	0.83	0.74	0.60	80.0	81.7	80.0	5.5	1.9	2.5	0.00374	12.5	47
LSES 80 LG	1.1	1435	7.5	2.4	0.82	0.75	0.62	81.5	83.3	83.0	6.2	2.4	2.8	0.00374	12.7	47
LSES 90 LU	1.8	1442	12.4	3.8	0.81	0.72	0.57	83.9	84.4	82.8	6.6	2.6	2.3	0.0043	19	48
LSES 132 MU	9	1462	58.9	17.4	0.83	0.77	0.66	89.8	90.5	89.9	8.0	3.3	3.7	0.0293	68	62
LSES 160LU	18.5	1458	121	35.1	0.83	0.78	0.66	91.4	92.1	92.1	7.6	2.9	3.6	0.08	98	62
LSES 180LUR	30	1463	196	56.5	0.83	0.78	0.67	92.4	92.9	92.5	7.0	2.8	2.8	0.16	160	69
LSES 225 MG	70	1482	451	127	0.84	0.79	0.68	94.4	94.4	93.6	8.8	2.0	2.9	0.85	380	69
LSES 280 SU	145	1487	937	261	0.84	0.79	0.69	95.4	95.1	93.9	9.0	3.3	3.4	3.11	800	70

6 poles - 1000 min^{-1}

IP55 - CLASS F - ΔT80K - S1 - CLASS IE2

MAINS SUPPLY 400 V 50 Hz

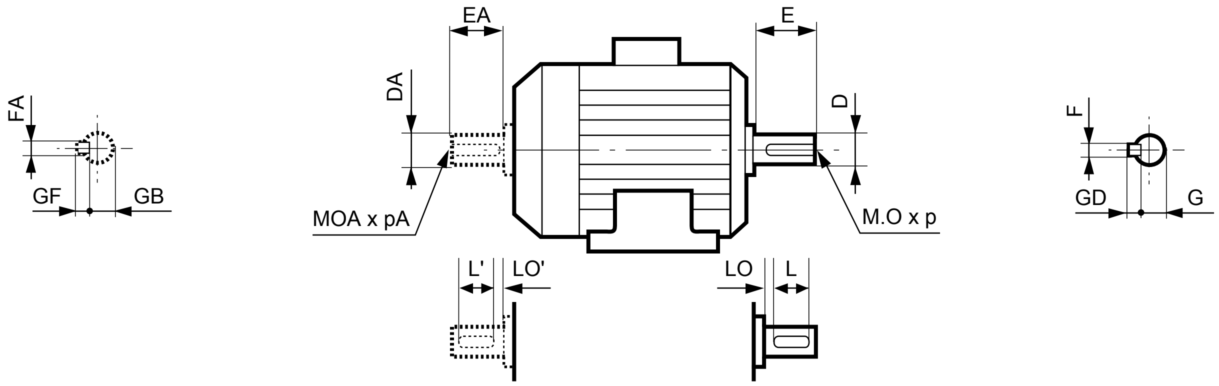
Type	Rated power	Rated speed	Rated torque	Rated current	Power factor			Efficiency IEC 60034-2-1 2007			Starting current/ Rated current	Starting torque/ Rated torque	Maximum torque/ Rated torque	Moment of inertia	Weight	Noise
	P_N	N_N	M_N	$I_{N\ (400V)}$	Cos φ			η			Id/In	Md/Mn	M_M/Mn	J	IM B3	LP
	kW	min^{-1}	N.m	A	4/4	3/4	2/4	4/4	3/4	2/4				kg.m^2	kg	db(A)
LSES 90 S	0.75	955	7.5	2.1	0.69	0.59	0.46	76.6	77.1	74.4	4.1	1.6	2.1	0.00319	14	51
LSES 90 L	1.1	955	11.0	3.0	0.67	0.58	0.45	79.1	79.5	77.4	4.8	2.0	3.1	0.0044	16.6	51
LSES 100 L	1.5	957	14.9	4.0	0.66	0.58	0.45	80.5	81.1	79.0	4.7	2.0	2.2	0.00587	22.1	50
LSES 112 MG	2.2	957	20.9	5.0	0.73	0.65	0.51	82.2	83.3	82.0	5.3	1.6	2.4	0.011	28	51
LSES 132 S	3	962	29.1	7.0	0.72	0.64	0.50	83.8	84.5	83.1	6.2	2.2	3.1	0.0154	38	55
LSES 132 M	4	963	39.4	9.0	0.75	0.68	0.56	85.2	86.7	86.4	5.7	2.0	2.6	0.0249	48	55
LSES 132 MU	5.5	963	55.0	12.9	0.72	0.66	0.54	86.4	87.4	86.9	5.6	2.5	2.8	0.0364	63	55
LSES 160 M	7.5	970	73.30	15.5	0.80	0.76	0.65	87.2	88.3	88.3	5.0	1.4	2.1	0.09	82	56
LSES 160 LU	11	970	108	23.0	0.79	0.74	0.62	88.7	89.3	88.9	5.4	1.7	2.5	0.13	98	56
LSES 180 L	15	973	148	30.1	0.80	0.74	0.63	90.0	90.9	90.7	6.9	2.5	3.1	0.19	134	60
LSES 200 LR	18.5	973	182	36.6	0.81	0.76	0.66	90.5	91.5	91.6	6.9	2.4	2.8	0.25	165	63
LSES 200 L	22	975	215	43.6	0.80	0.75	0.65	91.3	92.0	91.9	6.8	2.3	2.9	0.3	187	62
LSES 225 MR	30	977	293	62.5	0.75	0.70	0.59	91.8	92.2	91.6	7.2	2.8	3.1	0.4	234	63
LSES 250 ME	37	983	358	67.8	0.85	0.81	0.72	92.7	93.1	92.6	6.0	2.0	2.3	0.72	286	65
LSES 280 SC	45	982	439	85.5	0.82	0.78	0.67	93.0	93.5	93.3	6.1	2.0	2.5	0.83	312	65
LSES 280 MC	55	982	536	103	0.82	0.78	0.67	93.4	93.7	93.1	6.5	2.4	2.8	1.03	354	65
LSES 315 SN	75	982	729	136	0.85	0.82	0.74	93.7	94.3	94.1	6.5	2.4	2.5	1.4	460	65
LSES 315 MP	90	986	872	168	0.82	0.79	0.71	94.1	94.5	94.2	6.0	1.8	2.4	2.93	642	69
LSES 315 MP	110	988	1062	209	0.80	0.76	0.66	94.6	94.8	94.1	6.5	2.4	2.6	3.54	718	74
LSES 315 MR	132	987	1278	248	0.81	0.77	0.67	94.7	95.0	94.7	6.6	2.5	2.5	4.2	840	68

POWER RATINGS NOT CONFORMING TO THE STANDARDS

Type	Rated power	Rated speed	Rated torque	Rated current	Power factor			Efficiency IEC 60034-2-1 2007			Starting current/ Rated current	Starting torque/ Rated torque	Maximum torque/ Rated torque	Moment of inertia	Weight	Noise
	P_N	N_N	M_N	$I_{N\ (400V)}$	Cos φ			η			Id/In	Md/Mn	M_M/Mn	J	IM B3	LP
	kW	min^{-1}	N.m	A	4/4	3/4	2/4	4/4	3/4	2/4				kg.m^2	kg	db(A)
LSES 180 LUR	18.5	973	182	36.6	0.81	0.76	0.66	90.5	91.5	91.6	6.9	2.4	2.8	0.25	162	60
LSES 200 LU	27	978	263.0	55.0	0.77	0.76	0.60	91.6	91.6	90.7	6.7	2.6	2.8	0.39	220	63
LSES 225 MG	45	982	439	85.5	0.82	0.78	0.67	93.0	93.5	93.3	6.1	2.0	2.5	0.83	300	63
LSES 280 SK	100	988	966.0	195.0	0.79	0.73	0.60	94.5	94.4	93.5	6.6	2.4	2.8	3.27	650	65

Shaft extensions

Dimensions in millimetres

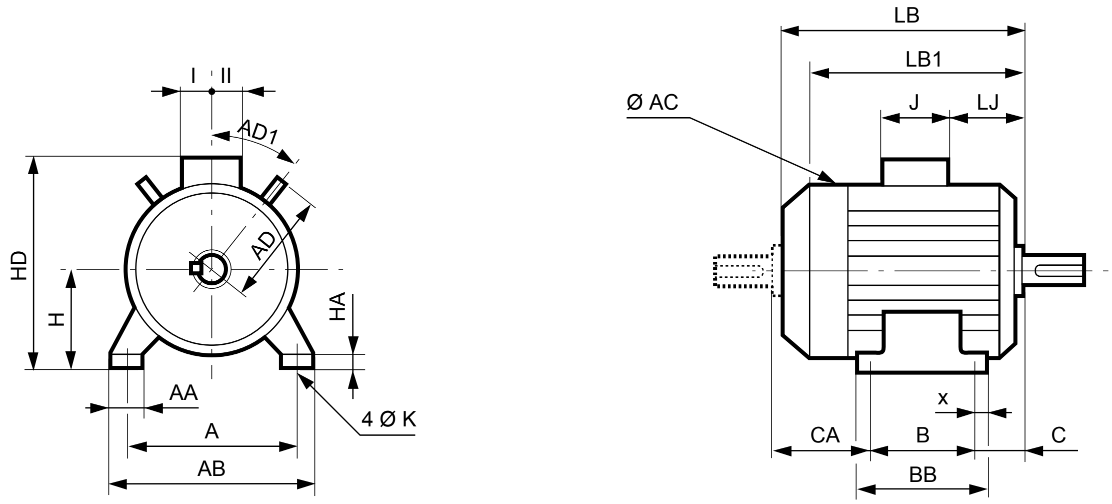


Type	Main shaft extensions																	
	4 and 6 poles									2 poles								
	F	GD	D	G	E	O	p	L	LO	F	GD	D	G	E	O	p	L	LO
LSES 80 L/LG	6	6	19j6	15.5	40	6	16	30	6	6	6	19j6	15.5	40	6	16	30	6
LSES 90 S/L	8	7	24j6	20	50	8	19	40	6	8	7	24j6	20	50	8	19	40	6
LSES 100 L/LR	8	7	28j6	24	60	10	22	50	6	8	7	28j6	24	60	10	22	50	6
LSES 112 MR/MG/MU	8	7	28j6	24	60	10	22	50	6	8	7	28j6	24	60	10	22	50	6
LSES 132 S/SU/M/MU	10	8	38k6	33	80	12	28	63	10	10	8	38k6	33	80	12	28	63	10
LSES 160 MP/MR/LR/M/L/LU	12	8	42k6	37	110	16	36	100	6	12	8	42k6	37	110	16	36	100	6
LSES 180 MT/L/LR	14	9	48k6	42.5	110	16	36	98	12	14	9	48k6	42.5	110	16	36	98	12
LSES 200 L/LR/LU	16	10	55m6	49	110	20	42	97	13	16	10	55m6	49	110	20	42	97	13
LSES 225 ST/MR/MT/MG	18	11	60m6	53	140	20	42	126	14	16	10	55m6	49	110	20	42	97	13
LSES 250 ME/MZ	18	11	65m6	58	140	20	42	126	14	18	11	60m6	53	140	20	42	126	14
LSES 280 SC/MF/MC/MD/SU/SK	20	12	75m6	67.5	140	20	42	125	15	18	11	65m6	58	140	20	42	125	14
LSES 315 SN/SP/MP/MR	22	14	80m6	71	170	20	42	155	15	18	11	65m6	58	140	20	42	126	14

Type	Secondary shaft extensions																	
	4 and 6 poles									2 poles								
	FA	GF	DA	GB	EA	OA	pA	L'	LO'	FA	GF	DA	GB	EA	OA	pA	L'	LO'
LSES 80 L/LG	5	5	14j6	11	30	5	15	25	3.5	5	5	14j6	11	30	5	15	25	3.5
LSES 90 S/L	6	6	19j6	15.5	40	6	16	30	6	6	6	19j6	15.5	40	6	16	30	6
LSES 100 L/LR	8	7	24j6	20	50	8	19	40	6	8	7	24j6	20	50	8	19	40	6
LSES 112 MR/MG/MU	8	7	24j6	20	50	8	19	40	6	8	7	24j6	20	50	8	19	40	6
LSES 132 S/SU/M/MU	8	7	28k6	24	60	10	22	50	6	8	7	28k6	24	60	10	22	50	6
LSES 160 MP/MR/LR	12	8	38k6	37	80	16	36	100	6	12	8	38k6	37	80	16	36	100	6
LSES 160 M/L/LU	12	8	42k6	37	110	16	36	100	6	12	8	42k6	37	110	16	36	100	6
LSES 180 MT/L/LR	14	9	48k6	42.5	110	16	36	98	12	14	9	48k6	42.5	110	16	36	98	12
LSES 200 L/LR/LU	16	10	55m6	49	110	20	42	97	13	16	10	55m6	49	110	20	42	97	13
LSES 225 ST/MR/MT/MG	18	11	60m6	53	140	20	42	126	14	16	10	55m6	49	110	20	42	97	13
LSES 250 ME/MZ	18	11	60m6	53	140	20	42	126	14	18	11	60m6	53	140	20	42	126	14
LSES 280 SC/MF/MC/MD/SU/SK	18	11	65m6	58	140	20	42	126	14	18	11	65m6	58	140	20	42	126	14
LSES 315 SN	20	12	75m6	67.5	140	20	42	125	15	18	11	65m6	58	140	20	42	125	14
LSES 315 SP/MP/MR	22	14	80m6	71	170	24	42	155	15	18	11	65m6	58	140	20	42	126	14

Foot mounted IM 1001 (IM B3)

Dimensions in millimetres

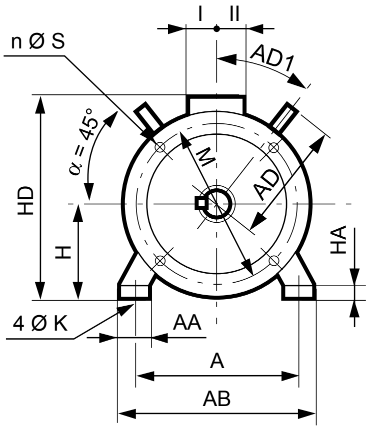


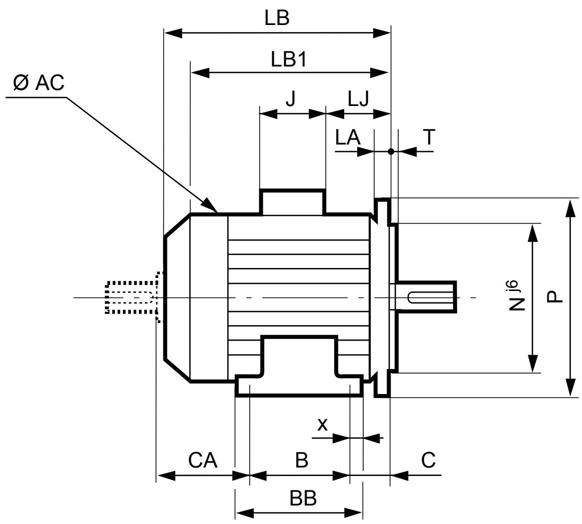
Type	Main dimensions																			
	A	AB	B	BB	C	X	AA	K	HA	H	AC*	HD	LB	LB1**	LJ	J	I	II	AD	AD1	CA
LSES 80 L	125	157	100	120	50	10	29	10	10	80	170	205	215	177	25.5	86	43	43	-	-	68
LSES 80 LG	125	157	100	125	50	14	31	10	10	80	185	215	247	204	25.5	86	43	43	-	-	99
LSES 90 S	140	172	100	120	56	10	37	10	11	90	190	225	217.5	177	25.5	86	43	43	-	-	66
LSES 90 L	140	172	125	162	56	28	39	10	11	90	190	225	244.5	204	25.5	86	43	43	-	-	68
LSES 100 L	160	196	140	165	63	12	40	12	13	100	200	240	290	250	26.5	86	43	43	118	45	93
LSES 100 LR	160	196	140	165	63	12	40	12	13	100	200	240	309	264	26.5	86	43	43	118	45	111
LSES 112 MR	190	220	140	165	70	13	45	12	14	112	200	252	309	264	26.5	86	43	43	118	45	104
LSES 112 MU	190	220	140	165	70	12	52	12	14	112	235	261	333	288	35.5	86	43	43	-	-	130
LSES 112 MG	190	220	140	165	70	12	52	12	14	112	235	261	315	265	35.5	86	43	43	-	-	110
LSES 132 S	216	250	140	170	89	16	42	12	16	132	220	304	350	306	32.5	126	63	63	130	45	128
LSES 132 SU	216	250	140	170	89	16	42	12	16	132	220	304	377	329	32.5	126	63	63	130	45	152
LSES 132 M	216	250	178	208	89	15	50	12	15	132	265	322	385	327	17	126	63	63	140	45	126
LSES 132 MU	216	250	178	208	89	15	50	12	15	132	265	322	412	351	17	126	63	63	140	45	148
LSES 160 MP	254	294	210	294	108	20	64	14.5	25	160	264	350	468	407	58.5	126	63	63	155	45	154
LSES 160 MR	254	294	210	294	108	20	64	14.5	25	160	264	350	495	440	58.5	126	63	63	155	45	138
LSES 160 M	254	294	254	294	108	20	60	14.5	25	160	312	395	495	435	42.75	135	88	64	-	-	182
LSES 160 L	254	294	254	294	108	20	60	14.5	25	160	312	395	495	435	42.75	135	88	64	-	-	138
LSES 160 LU	254	294	254	294	108	20	60	14.5	25	160	312	395	510	450	42.75	135	88	64	-	-	153
LSES 180 MT	279	324	241	316	121	20	79	14.5	28	180	312	428	495	435	54.75	186	112	98	-	-	138
LSES 180 LR	279	324	279	316	121	20	79	14.5	28	180	312	428	520	450	54.75	186	112	98	-	-	125
LSES 180 L	279	339	279	329	121	25	86	14.5	25	180	350	436	552	481	63.5	186	112	98	-	-	159
LSES 200 LR	318	378	305	365	133	30	108	18.5	30	200	350	456	620	539	69.5	186	112	98	-	-	194
LSES 200 L	318	388	305	375	133	35	103	18.5	36	200	390	476	621	539	77	186	112	98	-	-	194
LSES 200 LU	318	388	305	375	133	35	103	18.5	36	200	390	476	669	587	77	186	112	98	-	-	194
LSES 225 ST	356	431	286	386	149	50	127	18.5	36	225	390	535	627.5	545	61	231	119	142	-	-	203
LSES 225 MT	356	431	311	386	149	50	127	18.5	36	225	390	535	627.5	545	61	231	119	142	-	-	178
LSES 225 MR	356	431	311	386	149	50	127	18.5	36	225	390	535	675.5	593	61	231	119	142	-	-	228
LSES 225 MG	356	420	311	375	142	30	65	18.5	30	225	479	630	810	727.5	68	292	151	181	-	-	360
LSES 250 MZ	406	470	349	449	167.5	70	150	24	47	250	390	560	675.5	593	61	231	119	142	-	-	171
LSES 250 ME	406	470	349	420	168	35	90	24	36	250	479	656	810	716	67.5	292	151	181	-	-	303
LSES 250 MF	406	470	349	420	168	35	90	24	36	250	479	656	870	776	67.5	292	151	181	-	-	353
LSES 280 MC	457	520	419	478	190	35	90	24	35	280	479	686	810	716	67.5	292	151	181	-	-	211
LSES 280 SC	457	520	368	478	190	35	90	24	35	280	479	686	810	716	67.5	292	151	181	-	-	262
LSES 280 SK	457	533	368	495	190	40	85	24	35	280	586	746	921	827	99	292	151	181	-	-	312
LSES 280 SU	457	533	368	495	190	40	85	24	35	280	586	746	991	897	99	292	151	181	-	-	382
LSES 280 MD	457	520	419	478	190	35	90	24	35	280	479	686	870	776	67.5	292	151	181	-	-	271
LSES 315 SN	508	594	406	537	216	40	140	28	50	315	479	805	870	776	4.5	418	180	236	-	-	248
LSES 315 MP	508	594	457	537	216	40	114	28	70	315	586	865	947	845	61.5	418	180	236	-	-	290
LSES 315 MR	508	594	457	537	216	40	114	28	70	315	586	865	1017	947	61.5	418	180	236	-	-	360
LSES 315 SP	508	594	406	537	216	40	114	28	70	315	586	865	947	845	61.5	418	180	236	-	-	341

* AC: housing diameter without lifting rings
** LB1: non-ventilated motor.

Foot and flange mounted IM 2001 (IM B35)

Dimensions in millimetres



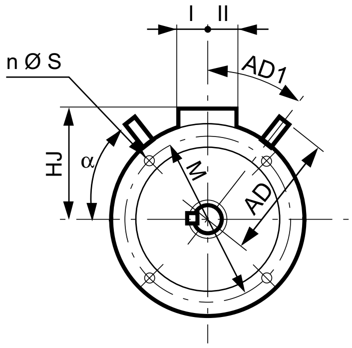


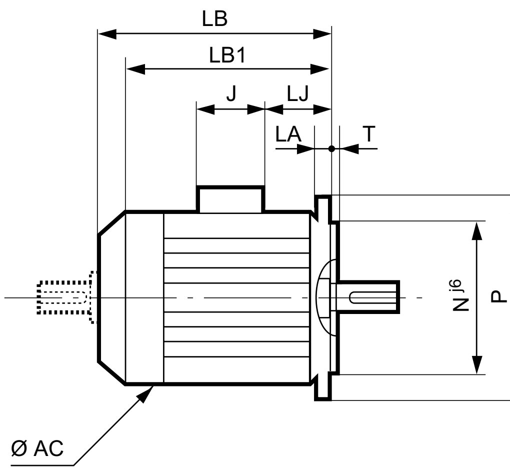
Type	Main dimensions																					
	A	AB	B	BB	C	X	AA	K	HA	H	AC*	HD	LB	LB1**	LJ	J	I	II	AD	AD1	CA	Symbol
LSES 80 L	125	157	100	120	50	10	29	10	10	80	170	205	215	177	25.5	86	43	43	-	-	68	FF 165
LSES 80 LG	125	157	100	125	70	14	31	10	10	80	185	215	267	224	46	86	43	43	-	-	99	FF 165
LSES 90 S	140	172	100	120	76	10	37	10	11	90	190	225	237	196.5	46	86	43	43	-	-	66	FF 165
LSES 90 L	140	172	125	162	76	28	39	10	11	90	190	225	265	224.5	46	86	43	43	-	-	68	FF 165
LSES 100 L	160	196	140	165	63	12	40	12	13	100	200	240	290	250	26.5	86	43	43	118	45	93	FF 215
LSES 100 LR	160	196	140	165	63	12	40	12	13	100	200	240	309	264	26.5	86	43	43	118	45	111	FF 215
LSES 112 MR	190	220	140	165	70	13	45	12	14	112	200	252	309	264	26.5	86	43	43	118	45	104	FF 215
LSES 112 MU	190	220	140	165	70	12	52	12	14	112	235	261	333	288	35.5	86	43	43	-	-	130	FF 215
LSES 112 MG	190	220	140	165	70	12	52	12	14	112	235	261	315	265	35.5	86	43	43	-	-	110	FF 215
LSES 132 S	216	250	140	170	89	16	42	12	16	132	220	304	350	306	32.5	126	63	63	130	45	128	FF 265
LSES 132 SU	216	250	140	170	89	16	42	12	16	132	220	304	377	329	32.5	126	63	63	130	45	152	FF 265
LSES 132 M	216	250	178	208	89	15	50	12	15	132	265	322	385	327	17	126	63	63	140	45	126	FF 265
LSES 132 MU	216	250	178	208	89	15	50	12	15	132	265	322	412	351	17	126	63	63	140	45	148	FF 265
LSES 160 MP	254	294	210	294	108	20	64	14.5	25	160	264	350	468	407	58.5	126	63	63	155	45	154	FF 300
LSES 160 MR	254	294	210	294	108	20	64	14.5	25	160	264	350	495	440	58.5	126	63	63	155	45	138	FF 300
LSES 160 M	254	294	254	294	108	20	60	14.5	25	160	312	395	495	435	42.75	135	88	64	-	-	182	FF 300
LSES 160 L	254	294	254	294	108	20	60	14.5	25	160	312	395	495	435	42.75	135	88	64	-	-	138	FF 300
LSES 160 LU	254	294	254	294	108	20	60	14.5	25	160	312	395	510	450	42.75	135	88	64	-	-	153	FF 300
LSES 180 MT	279	324	241	316	121	20	79	14.5	28	180	312	428	495	435	54.75	186	112	98	-	-	138	FF 300
LSES 180 LR	279	324	279	316	121	20	79	14.5	28	180	312	428	520	450	54.75	186	112	98	-	-	125	FF 300
LSES 180 L	279	339	279	329	121	25	86	14.5	25	180	350	436	552	481	63.5	186	112	98	-	-	159	FF 300
LSES 200 LR	318	378	305	365	133	30	108	18.5	30	200	350	456	620	539	69.5	186	112	98	-	-	194	FF 350
LSES 200 L	318	388	305	375	133	35	103	18.5	36	200	390	476	621	539	77	186	112	98	-	-	194	FF 350
LSES 200 LU	318	388	305	375	133	35	103	18.5	36	200	390	476	669	587	77	186	112	98	-	-	194	FF 350
LSES 225 ST	356	431	286	386	149	50	127	18.5	36	225	390	535	627.5	545	61	231	119	142	-	-	203	FF 400
LSES 225 MT	356	431	311	386	149	50	127	18.5	36	225	390	535	627.5	545	61	231	119	142	-	-	178	FF 400
LSES 225 MR	356	431	311	386	149	50	127	18.5	36	225	390	535	675.5	593	61	231	119	142	-	-	228	FF 400
LSES 225 MG	356	420	311	375	142	30	65	18.5	30	225	479	630	810	727.5	68	292	151	181	-	-	360	FF 400
LSES 250 MZ	406	470	349	449	167.5	70	150	24	47	250	390	560	675.5	593	61	231	119	142	-	-	171	FF 500
LSES 250 ME	406	470	349	420	168	35	90	24	36	250	479	656	810	716	67.5	292	151	181	-	-	303	FF 500
LSES 250 MF	406	470	349	420	168	35	90	24	36	250	479	656	870	776	67.5	292	151	181	-	-	353	FF 500
LSES 280 MC	457	520	419	478	190	35	90	24	35	280	479	686	810	716	67.5	292	151	181	-	-	211	FF 500
LSES 280 SC	457	520	368	478	190	35	90	24	35	280	479	686	810	716	67.5	292	151	181	-	-	262	FF 500
LSES 280 SK	457	533	368	495	190	40	85	24	35	280	586	746	921	827	99	292	151	181	-	-	312	FF 500
LSES 280 SU	457	533	368	495	190	40	85	24	35	280	586	746	991	897	99	292	151	181	-	-	382	FF 500
LSES 280 MD	457	520	419	478	190	35	90	24	35	280	479	686	870	776	67.5	292	151	181	-	-	271	FF 500
LSES 315 SN	508	594	406	537	216	40	140	28	50	315	479	805	870	776	4.5	418	180	236	-	-	248	FF 600
LSES 315 MP	508	594	457	537	216	40	114	28	70	315	586	865	947	845	61.5	418	180	236	-	-	290	FF 600
LSES 315 MR	508	594	457	537	216	40	114	28	70	315	586	865	1017	947	61.5	418	180	236	-	-	360	FF 600
LSES 315 SP	508	594	406	537	216	40	114	28	70	315	586	865	947	845	61.5	418	180	236	-	-	341	FF 600

* AC: housing diameter without lifting rings
** LB1: non-ventilated motor.

Flange mounted IM 3001 (IM B5) IM 3011 (IM V1)

Dimensions in millimetres





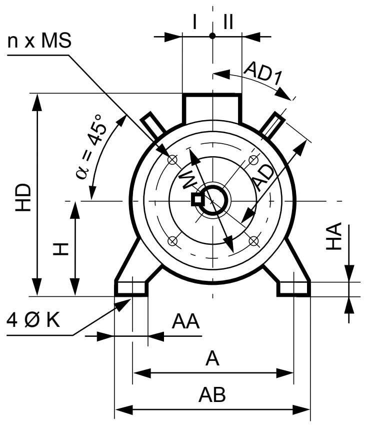
IEC symbol	Flange dimensions							
	M	N	P	T	n	α°	S	LA
FF 165	165	130	200	3.5	4	45	12	10
FF 165	165	130	200	3.5	4	45	12	10
FF 165	165	130	200	3.5	4	45	12	10
FF 165	165	130	200	3.5	4	45	12	10
FF 215	215	180	250	4	4	45	14.5	12
FF 215	215	180	250	4	4	45	14.5	12
FF 215	215	180	250	4	4	45	14.5	11
FF 215	215	180	250	4	4	45	14.5	11
FF 215	215	180	250	4	4	45	14.5	11
FF 265	265	230	300	4	4	45	14.5	12
FF 265	265	230	300	4	4	45	14.5	12
FF 265	265	230	300	4	4	45	14.5	12
FF 265	265	230	300	4	4	45	14.5	12
FF 300	300	250	350	5	4	45	18.5	14
FF 300	300	250	350	5	4	45	18.5	14
FF 300	300	250	350	5	4	45	18.5	14
FF 300	300	250	350	5	4	45	18.5	14
FF 300	300	250	350	5	4	45	18.5	14
FF 300	300	250	350	5	4	45	18.5	14
FF 300	300	250	350	5	4	45	18.5	14
FF 300	300	250	350	5	4	45	18.5	14
FF 350	350	300	400	5	4	45	18.5	15
FF 350	350	300	400	5	4	45	18.5	15
FF 350	350	300	400	5	4	45	18.5	15
FF 400	400	350	450	5	8	22.5	18.5	16
FF 400	400	350	450	5	8	22.5	18.5	16
FF 400	400	350	450	5	8	22.5	18.5	16
FF 400	400	350	450	5	8	22.5	18.5	16
FF 500	500	450	550	5	8	22.5	18.5	18
FF 500	500	450	550	5	8	22.5	18.5	18
FF 500	500	450	550	5	8	22.5	18.5	18
FF 500	500	450	550	5	8	22.5	18.5	18
FF 500	500	450	550	5	8	22.5	18.5	18
FF 500	500	450	550	5	8	22.5	18.5	18
FF 500	500	450	550	5	8	22.5	18.5	18
FF 500	500	450	550	5	8	22.5	18.5	18
FF 600	600	550	660	6	8	22.5	24	22
FF 600	600	550	660	6	8	22.5	24	22
FF 600	600	550	660	6	8	22.5	24	22
FF 600	600	550	660	6	8	22.5	24	22

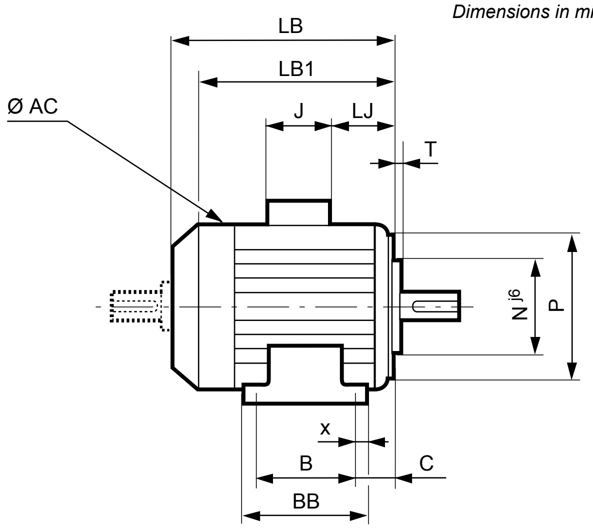
Type	Main dimensions									
	AC*	LB	LB1**	HJ	LJ	J	I	II	AD	AD1
LSES 80 L	170	215	177	125	25.5	86	43	43	-	-
LSES 80 LG	185	267	224	135	46	86	43	43	-	-
LSES 90 S	190	237	196.5	135	46	86	43	43	-	-
LSES 90 L	190	265	224.5	135	46	86	43	43	-	-
LSES 100 L	200	290	250	140	26.5	86	43	43	118	45
LSES 100 LR	200	309	264	140	26.5	86	43	43	118	45
LSES 112 MR	200	309	264	140	26.5	86	43	43	118	45
LSES 112 MU	235	333	288	149	35.5	86	43	43	-	-
LSES 112 MG	235	315	265	149	35.5	86	43	43	-	-
LSES 132 S	220	350	306	172	32.5	126	63	63	130	45
LSES 132 SU	220	377	329	172	32.5	126	63	63	130	45
LSES 132 M	265	385	327	190	17	126	63	63	140	45
LSES 132 MU	265	412	351	190	17	126	63	63	140	45
LSES 160 MP	264	468	407	190	58.5	126	63	63	155	45
LSES 160 MR	264	495	440	190	58.5	126	63	63	155	45
LSES 160 M	312	495	435	235	42.75	135	88	64	-	-
LSES 160 L	312	495	435	235	42.75	135	88	64	-	-
LSES 160 LU	312	510	450	235	42.75	135	88	64	-	-
LSES 180 MT	312	495	435	248	54.75	186	112	98	-	-
LSES 180 LR	312	520	450	248	54.75	186	112	98	-	-
LSES 180 L	350	552	481	256	63.5	186	112	98	-	-
LSES 200 LR	350	620	539	256	69.5	186	112	98	-	-
LSES 200 L	390	621	539	276	77	186	112	98	-	-
LSES 200 LU	390	669	587	276	77	186	112	98	-	-
LSES 225 ST	390	627.5	545	310	61	231	119	142	-	-
LSES 225 MT	390	627.5	545	310	61	231	119	142	-	-
LSES 225 MR	390	675.5	593	310	61	231	119	142	-	-
LSES 225 MG	479	810	727.5	405	68	292	151	181	-	-
LSES 250 MZ	390	675.5	593	310	61	231	119	142	-	-
LSES 250 ME	479	810	716	406	67.5	292	151	181	-	-
LSES 250 MF	479	870	776	406	67.5	292	151	181	-	-
LSES 280 MC	479	810	716	406	67.5	292	151	181	-	-
LSES 280 SC	479	810	716	406	67.5	292	151	181	-	-
LSES 280 SK	586	921	827	466	99	292	151	181	-	-
LSES 280 SU	586	991	897	466	99	292	151	181	-	-
LSES 280 MD	479	870	776	406	67.5	292	151	181	-	-
LSES 315 SN	479	870	776	490	4.5	418	180	236	-	-
LSES 315 MP	586	947	845	550	61.5	418	180	236	-	-
LSES 315 MR	586	1017	947	550	61.5	418	180	236	-	-
LSES 315 SP	586	947	845	550	61.5	418	180	236	-	-

* AC: housing diameter without lifting rings
** LB1: non-ventilated motor
For a frame size ≥ 250mm for IM 3001 use, please consult Emerson Industrial Automation.
Dimensions of shaft extensions identical to those for foot mounted motors.

Foot and face mounted IM 2101 (IM B34)

Dimensions in millimetres



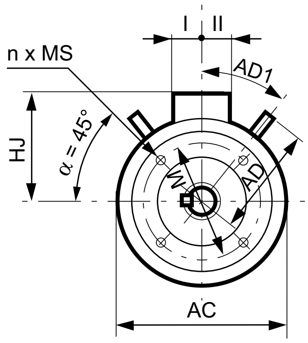


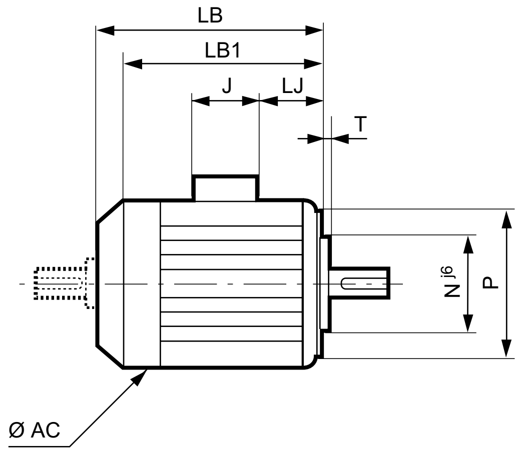
Type	Main dimensions																					
	A	AB	B	BB	C	X	AA	K	HA	H	AC*	HD	LB	LB1**	LJ	J	I	II	AD	AD1	CA	Symbol
LSES 80 L	125	157	100	120	50	10	29	10	10	80	170	205	215	177	25.5	86	43	43	-	-	68	FT 100
LSES 80 LG	125	157	100	125	50	14	31	10	10	80	185	215	247	204	25.5	86	43	43	-	-	99	FT 100
LSES 90 S	140	172	100	120	56	10	37	10	11	90	190	225	217.5	177	25.5	86	43	43	-	-	66	FT 115
LSES 90 L	140	172	125	162	56	28	39	10	11	90	190	225	244.5	204	25.5	86	43	43	-	-	68	FT 115
LSES 100 L	160	196	140	165	63	12	40	12	13	100	200	240	290	250	26.5	86	43	43	118	45	93	FT 130
LSES 100 LR	160	196	140	165	63	12	40	12	13	100	200	240	309	264	26.5	86	43	43	118	45	111	FT 130
LSES 112 MR	190	220	140	165	70	13	45	12	14	112	200	252	309	264	26.5	86	43	43	118	45	104	FT 130
LSES 112 MU	190	220	140	165	70	12	52	12	14	112	235	261	333	288	35.5	86	43	43	-	-	130	FT 130
LSES 112 MG	190	220	140	165	70	12	52	12	14	112	235	261	315	265	35.5	86	43	43	-	-	110	FT 130
LSES 132 S	216	250	140	170	89	16	42	12	16	132	220	304	350	306	32.5	126	63	63	130	45	128	FT 215
LSES 132 SU	216	250	140	170	89	16	42	12	16	132	220	304	377	329	32.5	126	63	63	130	45	152	FT 215
LSES 132 M	216	250	178	208	89	15	50	12	15	132	265	322	385	327	17	126	63	63	140	45	126	FT 215
LSES 132 MU	216	250	178	208	89	15	50	12	15	132	265	322	412	351	17	126	63	63	140	45	148	FT 215
LSES 160 MP	254	294	210	294	108	20	64	14.5	25	160	264	350	468	407	58.5	126	63	63	155	45	154	FT 215
LSES 160 MR	254	294	210	294	108	20	64	14.5	25	160	264	350	495	440	58.5	126	63	63	155	45	138	FT 215

* AC: housing diameter without lifting rings
** LB1: non-ventilated motor.

Face mounted IM 3601 (IM B14)

Dimensions in millimetres





IEC symbol	Faceplate dimensions					
	M	N	P	T	n	MS
FT 100	100	80	120	3	4	M6
FT 100	100	80	120	3	4	M6
FT 115	115	95	140	3	4	M8
FT 115	115	95	140	3	4	M8
FT 130	130	110	160	3.5	4	M8
FT 130	130	110	160	3.5	4	M8
FT 130	130	110	160	3.5	4	M8
FT 130	130	110	160	3.5	4	M8
FT 130	130	110	160	3.5	4	M8
FT 215	215	180	250	4	4	M12
FT 215	215	180	250	4	4	M12
FT 215	215	180	250	4	4	M12
FT 215	215	180	250	4	4	M12
FT 215	215	180	250	4	4	M12
FT 215	215	180	250	4	4	M12

Type	Main dimensions									
	AC*	LB	LB1**	HJ	LJ	J	I	II	AD	AD1
LSES 80 L	170	215	177	125	25.5	86	43	43	-	-
LSES 80 LG	185	247	204	135	25.5	86	43	43	-	-
LSES 90 S	190	217.5	177	135	25.5	86	43	43	-	-
LSES 90 L	190	244.5	204	135	25.5	86	43	43	-	-
LSES 100 L	200	290	250	140	26.5	86	43	43	118	45
LSES 100 LR	200	309	264	140	26.5	86	43	43	118	45
LSES 112 MR	200	309	264	140	26.5	86	43	43	118	45
LSES 112 MU	235	333	288	149	35.5	86	43	43	-	-
LSES 112 MG	235	315	265	149	35.5	86	43	43	-	-
LSES 132 S	220	350	306	172	32.5	126	63	63	130	45
LSES 132 SU	220	377	329	172	32.5	126	63	63	130	45
LSES 132 M	265	385	327	190	17	126	63	63	140	45
LSES 132 MU	265	412	351	190	17	126	63	63	140	45
LSES 160 MP	264	468	407	190	58.5	126	63	63	155	45
LSES 160 MR	264	495	440	190	58.5	126	63	63	155	45

* AC: housing diameter without lifting rings
** LB1: non-ventilated motor

Non-standard flanges

Optionally, Emerson Industrial Automation motors can be fitted with flanges and faceplates that are larger or smaller than standard. This means that motors can be adapted to all types of situation without the need for costly and time-consuming modifications.

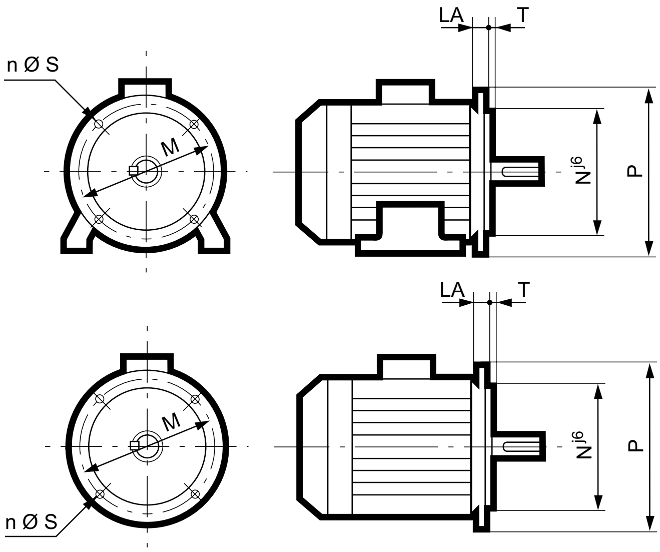
The tables below give the flange and faceplate dimensions and also indicate flange/motor compatibility.
The bearing and shaft extension for each frame size remain standard.

Dimensions in millimetres

(FF) Flange mounted

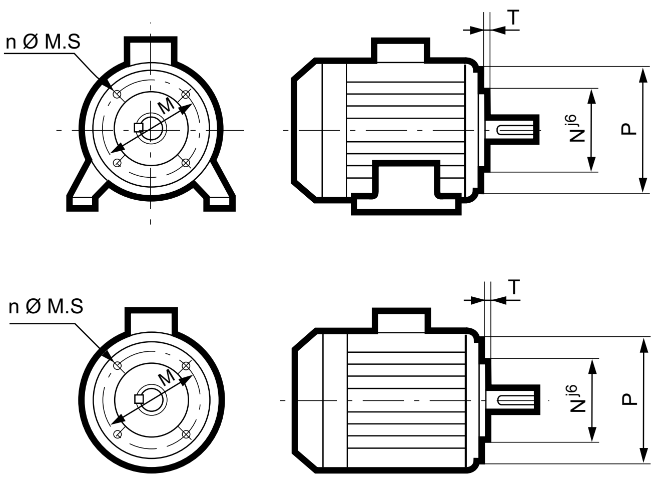
IEC symbol	Flange dimensions						
	M	N	P	T	n	S	LA
FF 100	100	80	120	2.5	4	7	5
FF 115	115	95	140	3	4	10	10
FF 130	130	110	160	3.5	4	10	10
FF 165	165	130	200	3.5	4	12	10
FF 215	215	180	250	4	4	15	12
FF 265	265	230	300	4	4	15	14
FF 300	300	250	350	5	4	18.5	14
FF 350	350	300	400	5	4	18.5	15
FF 400	400	350	450	5	8	18.5	16
FF 500	500	450	550	5	8	18.5	18
FF 600*	600	550	660	6	8	24	22

* Tolerance Njs^6



(FT) Face mounted

IEC symbol	Faceplate dimensions					
	M	N	P	T	n	M.S
FT 65	65	50	80	2.5	4	M5
FT 75	75	60	90	2.5	4	M5
FT 85	85	70	105	2.5	4	M6
FT 100	100	80	120	3	4	M6
FT 115	115	95	140	3	4	M8
FT 130	130	110	160	3.5	4	M8
FT 165	165	130	200	3.5	4	M10
FT 215	215	180	250	4	4	M12
FT 265	265	230	300	4	4	M12



Mechanical options

Modified flanges

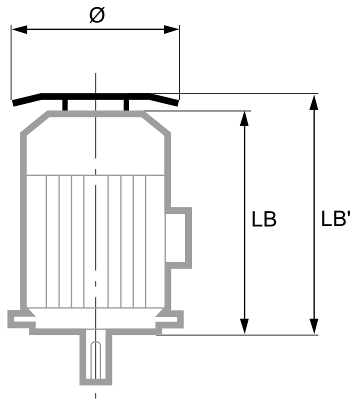
Motor type	Mounting forms \ Flange type	(FF) Flange mounted														(FT) Face mounted								
		FF 85	FF 100	FF 115	FF 130	FF 165	FF 215	FF 265	FF 300	FF 350	FF 400	FF 500	FF 600	FF 740	FF 940	FT 65	FT 75	FT 85	FT 100	FT 115	FT 130	FT 165	FT 215	FT 265
80 L	all	■	■	■	■	●	◆									◆	◆	◆	●	◆	◆			
80 LG / 90	B5/B35 (1)	◆	◆	◆	◆	●	■	■										◆	◆	■	■	◆		
80 LG / 90	B3/B14/B34	■	■	■	■	■	■	■										◆	◆	●	◆	◆		
100 L/LR	all	■	■	■	■	■	●	■										◆	◆	◆	●	◆	◆	
100 LG	all				■	■	●	◆												◆	●	◆	◆	
112 MU/MG	all				■	■	●	◆												◆	●	◆	◆	
132 S/SU	all					■	◆	●													◆	◆	●	
132 SM/M/MU	all					■	■	●	◆												■	■	●	
160 MR/LR/MP	all							■	●	■													●	
160 M/L/LU/LUR	all						◆	◆	●	◆														
180	all							●	●	◆	◆ (1)													
200	all									●	◆													
225	all										●	◆												
250	all										◆	●												
280	all										◆	●	◆											
315	all											◆ (1)	●											

● Standard ■ Modified bearing location ◆ Adaptable without modification (1) dimension C need not comply with IEC 60072

Drip cover for operation in vertical position, shaft end facing down

Dimensions in millimetres

Motor type	LB'	Ø
LSES 80	LB + 20	145
LSES 90	LB + 20	185
LSES 100	LB + 20	185
LSES 112 MR	LB + 20	185
LSES 112 MG/MU	LB + 25	210
LSES 132 S/SU	LB + 25	210
LSES 132 M/MU	LB + 30	240
LSES 160 MP/LR	LB + 30	240
LSES 160 M/L/LU	LB + 36.5	265
LSES 180 MT/LR	LB + 36.5	265
LSES 180 L	LB + 36.5	305
LSES 200 LR	LB + 36.5	305
LSES 200 L	LB + 36.5	350
LSES 225	LB + 36.5	350
LSES 250 MZ	LB + 36.5	350
LSES 250 ME	LB + 55	420
LSES 280	LB + 55	420
LSES 315 SN	LB + 55	420
LSES 315 SP/MP/MR	LB + 76.5	505



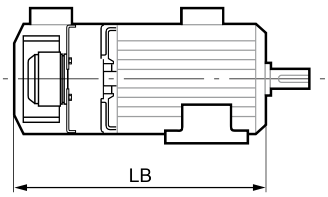
Mechanical and electric options

MOTORS WITH BRAKE, FORCED VENTILATION

The integration of high-efficiency motors within a process often requires accessories to make operation easier:

- Forced ventilation for motors used at high or low speeds.
- Holding brakes for maintaining the rotor in the stop position without needing to leave the motor switched on.
- Emergency stop brakes to immobilise loads in case of failure of the motor torque control or loss of power supply.

Notes:
- Without forced ventilation, there is a possibility of overspeed with optional class B balancing.
- The motor temperature is monitored by sensors built into the windings.



Series LSES	LB dimensions with Forced Ventilation	
	Foot or face mounted motors	Flange mounted motor
80 L	317	
80 LG	331	351
90 S	304	324
90 L	331	351
100 L	373	
100 LR		
112 MR		
112 MG	412	
112 MU		
132 S	453	
132 SU		
132 M	458	
132 MU		
160 MP	709	
160 MR	730	
160 L	687	
160 M		
180 MT		
180 LR	702	
180 L	741	
200 LR	796	
200 L	802	
225 MR	853.5	
225 ST	808.5	
225 MT		
250 ME	1012	
250 MZ	853.5	
280 MD	1072	
280 SC	1012	
280 MC		
315 SN	1072	
315 SP	1181	
315 MP		
315 MR	1251	

MOTORS WITH SPACE HEATERS

Type	Power (W)
LSES 80 L	16
LSES 80 LG to 160 MP/LR	25
LSES 160 M/L to 225 ST/MT/MR	52
LSES 250 MZ	
LSES 250 ME/MF	84
LSES 280 SC/MC/MD	
LSES 315 SN	
LSES 315 MP/MR	108

The space heaters use 200/240 V, single-phase, 50 or 60 Hz.

MOTORS WITH CONNECTABLE PLUG

The connectable plug option allows a simple, fast and secured motor connection.

It can be used in a number of processes (automobile, food industries...) where machinery replacement time must be minimised.

The male part of the connector is mounted in place of or on the motor terminal box, depending on the other selected options.

The connector plug is connected to the stator coil.

The female part of the connector is attached to the supply network.

Up to 10 contacts can be mounted on the connectors, covering powers up to 11 kW to the acceptable maximum current limit of 40 A.

For higher powers please consult.

MOTORS WITH INTEGRATED VARIABLE SPEED: VARMECA

The Varmeca is a frequency invertor with flux vector control operating on all of the supply networks (200 V to 480 V 50/60Hz).

Mechanically it is mounted in place of the terminal box.

The assembly enables operation at constant torque, at low speed and at constant power at high speed (forced ventilation option obligatory).

In all cases the Varmeca enables the management of the CTP and PTO motor sensors.

The motor-inverter offers a decentralised solution on the machine, the product being designed to operate in an industrial environment (electronics encapsulated in resin).

A number of options may be integrated: local speed control, forward and reverse drive, display, braking resistance; field bus.

Varmeca conforms to the European standards CE mark as well as North America, UL for the USA and c(UL)us for Canada.

Position of the lifting rings

LIFTING THE MOTOR ONLY

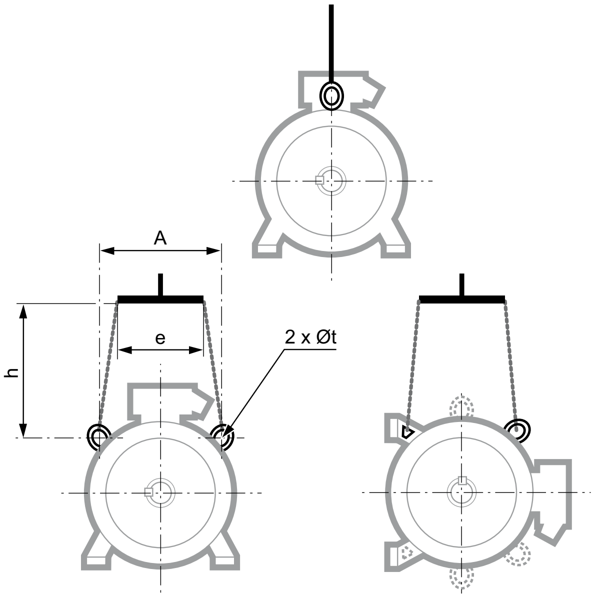
(not coupled to the machine)

The regulations stipulate that over 25 kg, suitable handling equipment must be used.

All our motors are fitted with grab handles, making them easier to handle without risk. A diagram of the sling hoisting method appears below with the required dimensions.

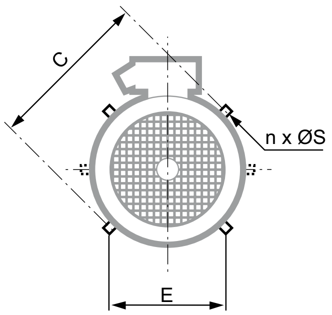
To prevent any damage to the motor during handling (for example: switching the motor from horizontal to vertical), it is essential to follow these instructions.

HORIZONTAL POSITION

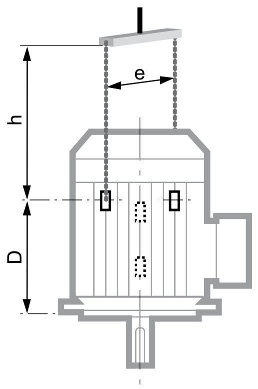


Type	Horizontal position			
	A	e min.	h min.	Øt
LSES 100 L/LR	165	165	150	9
LSES 112 M/MR	165	165	150	9
LSES 112 MG/MU	-	-	-	9
LSES 132 S/SU	180	180	150	9
LSES 132 M/MU	200	180	150	14
LSES 160 MP/MR/LR	200	180	110	14
LSES 160 L/LU	200	180	110	14
LSES 180 L	200	260	150	14
LSES 200 L/LR	270	260	165	14
LSES 225 ST/MT	270	260	150	14
LSES 250 ME	400	400	500	30
LSES 280 SC/MC/MD	400	400	500	30
LSES 315 SN	400	400	500	30
LSES 315 SP/MP/MR	360	380	500	17

VERTICAL POSITION



View from above**



Side view

Type	Vertical position						
	C	E	D	n**	ØS	e min.*	h min.
LSES 160 M/L/LU	320	200	230	2	14	320	350
LSES 180 MR	320	200	230	2	14	320	270
LSES 180 L	390	265	290	2	14	390	320
LSES 200 L/LR	410	300	295	2	14	410	450
LSES 225 ST/MT/MR	410	300	295	2	14	410	450
LSES 250 MZ	410	300	295	2	14	410	450
LSES 250 ME	500	400	502	4	30	500	500
LSES 280 SC/SD/MC/MD	500	400	502	4	30	500	500
LSES 315 SN	500	400	502	4	30	500	500
LSES 315 SP/MP/MR	630	-	570	2	30	630	550

** if the motor is fitted with a drip cover, allow an additional 50 to 100 mm to avoid damaging it when the load is swung.*

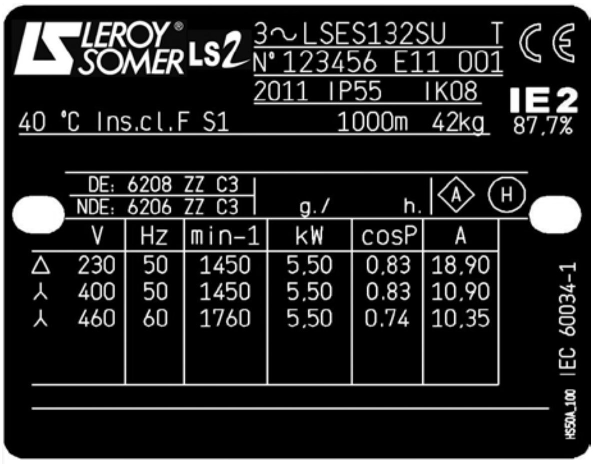
*** if n = 2, the lifting rings form an angle of 90° with respect to the terminal box axis.*
if n = 4, this angle becomes 45°.

Separate ring ≤ 25 kg
Built-in ring > 25 kg

Identification

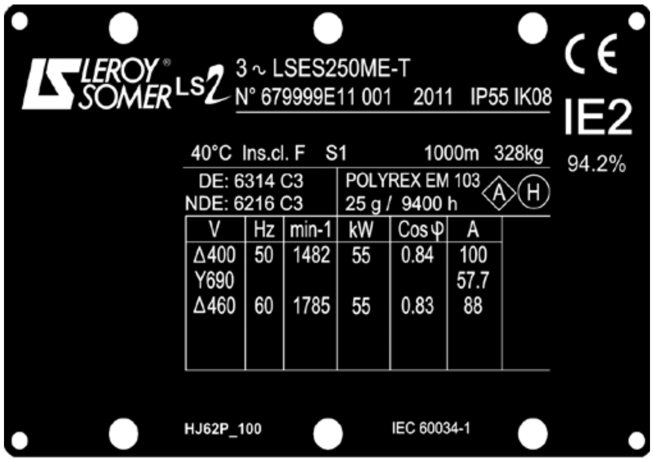
NAMEPLATES

LSES 80 to LSES 160 MP/MR



* Other logos can optionally be provided: agreement prior to ordering is essential.

LSES 160 M/L to LSES 315



DEFINITION OF SYMBOLS USED ON NAMEPLATES

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

MOT 3 ~ : Three-phase A.C. motor
LSES : Series
132 : Frame size
S : Housing symbol
T : Impregnation index

Motor no.

123456 : Serial number
E : Month of production
11 : Year of production
001 : Batch number
IE2 : Efficiency class
83.8% : Efficiency at 4/4 load

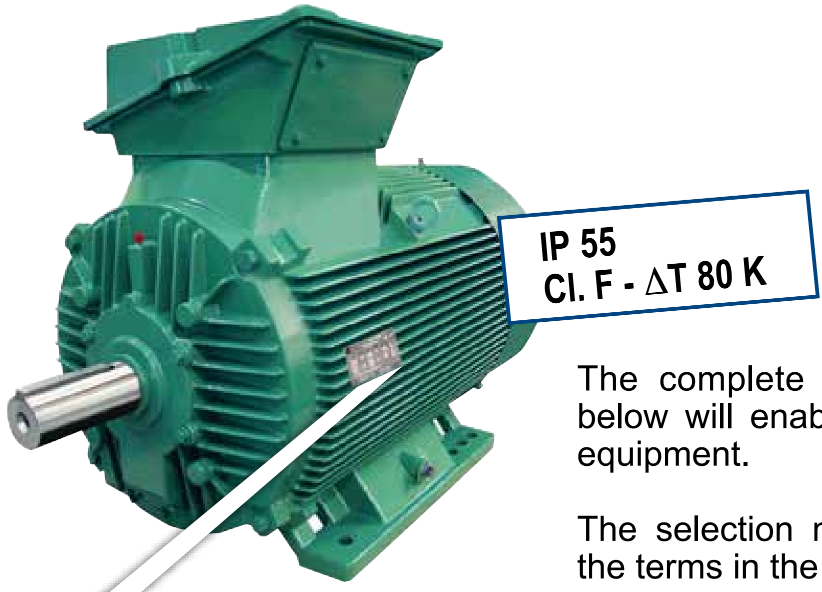
IP55 IK08: Index of protection
I cl. F : Insulation class F
40°C : Ambient operating temperature
S1 : Duty - Duty (operating) factor
kg : Weight
V : Supply voltage
Hz : Supply frequency
min-1 : Revolutions per minute (rpm)
kW : Rated output power
cos φ : Power factor
A : Rated current
Δ : Delta connection
Y : Star connection

Bearings

DE : Drive end bearing
NDE : Non drive end bearing
g : Amount of grease at each regreasing (in g)
h : Regreasing interval (in hours)
POLYREX EM103: Type of grease
A : Vibration level
H : Balancing mode

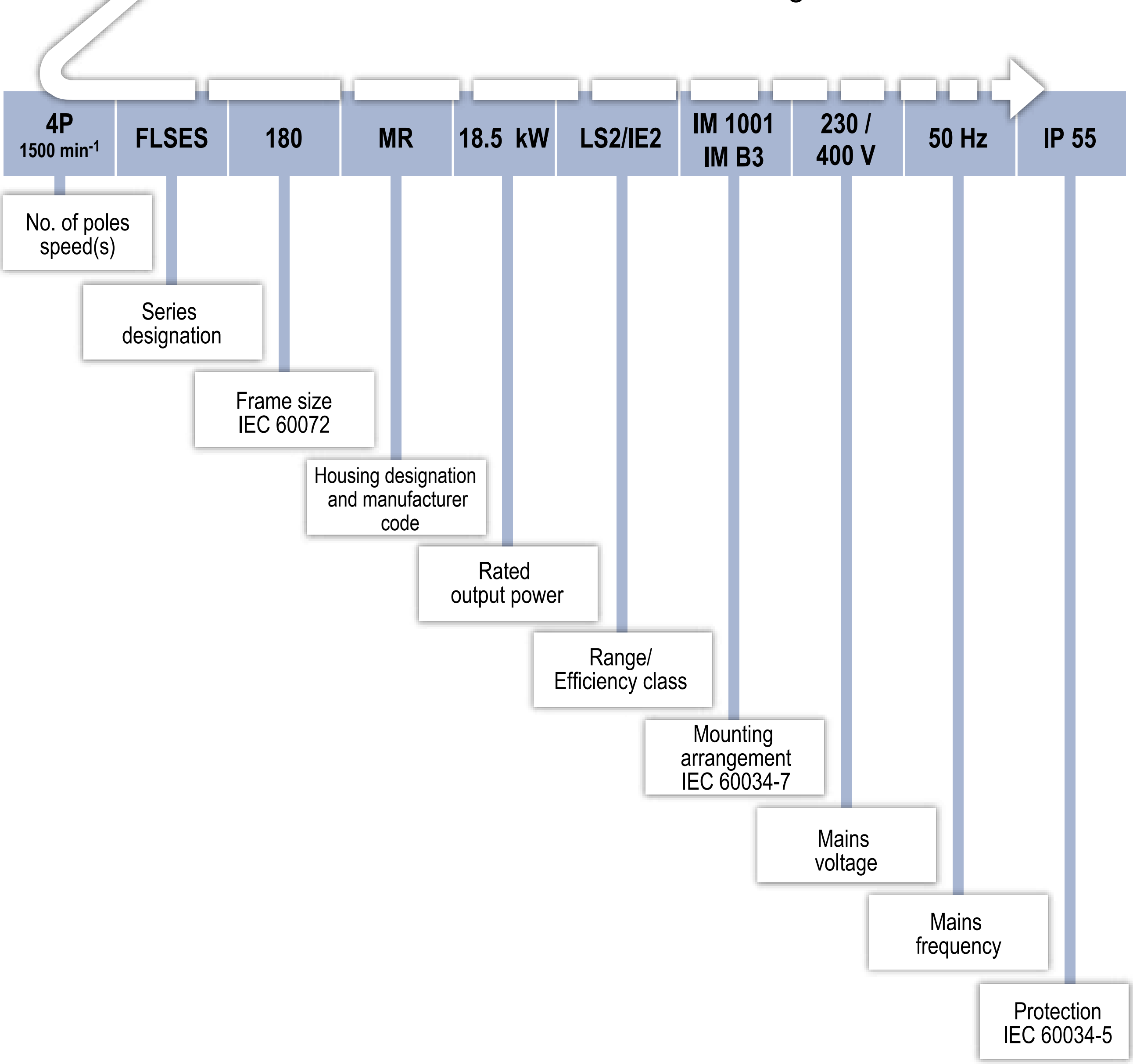
Please quote when ordering spare parts

Designation



The complete motor **reference** described below will enable you to **order** the desired equipment.

The selection method consists of following the terms in the designation.



Description

Component	Materials	Remarks
Housing with cooling fins	Cast iron	- lifting rings for frame size ≥ 90 - earth terminal with an optional jumper screw
Stator	Insulated low-carbon magnetic steel laminations Electroplated copper	- low carbon content guarantees long-term lamination pack stability - welded laminations - semi-enclosed slots - class F insulation
Rotor	Insulated low-carbon magnetic steel laminations Aluminium	- inclined cage bars - rotor cage pressure die-cast in aluminium (or alloy for special applications), or soldered in copper, or keyed for soldered rotors - shrink-fitted to shaft - rotor balanced dynamically, class A, 1/2 key
Shaft	Steel	• for frame size ≤ 132: - closed keyway • for frame size ≤ 160 : - tapped centre hole • for frame size ≥ 160: - open keyway
End shields	Cast iron	
Bearings and lubrication		- permanently greased bearings frame size 80 to 225 - regreasable bearings frame size 250 to 450 - bearings preloaded at NDE up to 315 S, preloaded at DE from size 315 M upwards
Labyrinth seal **Lipseals**	Plastic or steel Synthetic rubber	- labyrinth seal at drive end for foot mounted motors, frame size ≤ 132 - lipseal at drive end for foot and flange mounted or flange mounted motors, frame size ≤ 132 - lipseal at drive end and non drive end for frame sizes 160 to 250 inclusive - decompression grooves for 280 M to 355 LD - labyrinth seal at drive end and non drive end for frame sizes ≥ 355 LK
Fan	Composite up to size 280 inclusive Metal from 315 ST upwards	- 2 directions of rotation: straight blades
Fan cover	Pressed steel	- fitted, on request, with a drip cover for operation in vertical position, shaft end facing down
Terminal box	Cast iron body and cover for all frame sizes.	- IP 55 - fitted with a block with 6 terminals up to 355 LD, 6 or 12 terminals for frame sizes 355LK/400/450 - terminal box fitted with threaded plugs up to 132 - from the 160 to the 355, undrilled cable gland mounting plate (nozzle and cable gland as options) - 1 earth terminal in each terminal box

Other construction types

CORROBLOC FINISH

The CORROBLOC finish is a top coat for the basic cast iron motor described above. In addition to the basic construction, its special finishes resist corrosion in particularly harsh environments, and these qualities are enhanced with age.

Component	Materials	Remarks
Stator - Rotor		- dielectric and anti-corrosion protection for frame sizes 80 to 132
Nameplate	Stainless steel	- nameplate: indelible marking
Screws	Stainless steel	- captive screws for terminal box cover for frame size ≤ 132
Terminal box	Cast iron body and cover	
Cable gland	Brass	
Finish		- system IIIa (see External finish section)

Bearings and lubrication

PERMANENTLY GREASED BEARINGS

Under normal operating conditions, the service life in hours of the lubricant is indicated in the table below for ambient temperatures less than 55°C.

<table>
<tr><th rowspan="3">Series</th><th rowspan="3">Type</th><th rowspan="3">No. of poles</th><th colspan="2" rowspan="2">Types of permanently greased bearing</th><th colspan="9">Grease life according to speed of rotation</th></tr>
<tr><th colspan="3">3000 rpm</th><th colspan="3">1500 rpm</th><th colspan="3">1000 rpm</th></tr>
<tr><th>N.D.E.</th><th>D.E.</th><th>25°C</th><th>40°C</th><th>55°C</th><th>25°C</th><th>40°C</th><th>55°C</th><th>25°C</th><th>40°C</th><th>55°C</th></tr>
<tr><td rowspan="25">FLSES</td><td>80 L</td><td>2</td><td>6203 CN</td><td>6204 C3</td><td>≥40000</td><td>≥40000</td><td>25000</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>80 LG</td><td>4</td><td rowspan="3">6204 C3</td><td rowspan="3">6205 C3</td><td>-</td><td>-</td><td>-</td><td rowspan="3">≥40000</td><td rowspan="3">≥40000</td><td rowspan="3">31000</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>90 S</td><td>2 ; 4 ; 6</td><td>≥40000</td><td>≥40000</td><td>24000</td><td>≥40000</td><td>≥40000</td><td>34000</td></tr>
<tr><td>90 L</td><td>4</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>90 LU</td><td>2 ; 6</td><td>6205 C3</td><td>6205 C3</td><td>≥40000</td><td>≥40000</td><td>24000</td><td>-</td><td>-</td><td>-</td><td>≥40000</td><td>≥40000</td><td>34000</td></tr>
<tr><td>100 L</td><td>2 ; 4</td><td rowspan="3">6205 C3</td><td rowspan="3">6206 C3</td><td>≥40000</td><td>≥40000</td><td>22000</td><td rowspan="2">≥40000</td><td rowspan="2">≥40000</td><td rowspan="2">30000</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>100 LK</td><td>4 ; 6</td><td>-</td><td>-</td><td>-</td><td rowspan="2">≥40000</td><td rowspan="2">≥40000</td><td rowspan="2">33000</td></tr>
<tr><td>112 MG</td><td>2 ; 6</td><td>≥40000</td><td>≥40000</td><td>22000</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>112 MU</td><td>4</td><td>6206 C3</td><td>6206 C3</td><td>-</td><td>-</td><td>-</td><td>≥40000</td><td>≥40000</td><td>30000</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>132 S</td><td>2 ; 4 ; 6</td><td rowspan="2">6207 C3</td><td rowspan="2">6308 C3</td><td>≥40000</td><td>≥40000</td><td>19000</td><td>≥40000</td><td>≥40000</td><td>25000</td><td rowspan="2">≥40000</td><td rowspan="2">≥40000</td><td rowspan="2">30000</td></tr>
<tr><td>132 M</td><td>6</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>132 MU</td><td>2 ; 4</td><td>6307 C3</td><td>6308 C3</td><td>≥40000</td><td>≥40000</td><td>19000</td><td>≥40000</td><td>≥40000</td><td>25000</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>132 MR</td><td>4 ; 6</td><td>6308 C3</td><td>6308 C3</td><td>-</td><td>-</td><td>-</td><td>≥40000</td><td>≥40000</td><td>25000</td><td>≥40000</td><td>≥40000</td><td>30000</td></tr>
<tr><td>160 M</td><td>2 ; 4 ; 6</td><td rowspan="2">6210 C3</td><td rowspan="2">6309 C3</td><td>≥40000</td><td>34800</td><td>17400</td><td>≥40000</td><td>≥40000</td><td>25500</td><td>≥40000</td><td>≥40000</td><td>33000</td></tr>
<tr><td>160 L</td><td>6</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>≥40000</td><td>≥40000</td><td>33000</td></tr>
<tr><td rowspan="2">160 LU</td><td>2 ; 4</td><td>6210 C3</td><td>6309 C3</td><td>≥40000</td><td>34800</td><td>17400</td><td>≥40000</td><td>≥40000</td><td>25500</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>6</td><td>6210 C3</td><td>6309 C3</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>≥40000</td><td>≥40000</td><td>29300</td></tr>
<tr><td>180 M</td><td>2</td><td>6212 C3</td><td>6310 C3</td><td>≥40000</td><td>28200</td><td>14100</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>180 MR</td><td>4</td><td>6210 C3</td><td>6310 C3</td><td>-</td><td>-</td><td>-</td><td>≥40000</td><td>≥40000</td><td>23300</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>180 L</td><td>6</td><td>6212 C3</td><td>6310 C3</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>≥40000</td><td>≥40000</td><td>26300</td></tr>
<tr><td>180 LUR</td><td>4</td><td>6312 C3</td><td>6310 C3</td><td>-</td><td>-</td><td>-</td><td>≥40000</td><td>≥40000</td><td>20300</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>200 LU</td><td>2 ; 4 ; 6</td><td>6312 C3</td><td>6312 C3</td><td>≥40000</td><td>23400</td><td>11700</td><td>≥40000</td><td>≥40000</td><td>20300</td><td>≥40000</td><td>≥40000</td><td>26300</td></tr>
<tr><td>225 SR</td><td>4</td><td>6312 C3</td><td>6313 C3</td><td>-</td><td>-</td><td>-</td><td>≥40000</td><td>37500</td><td>18800</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>225 M</td><td>4 ; 6</td><td>6314 C3</td><td>6314 C3</td><td>-</td><td>-</td><td>-</td><td>≥40000</td><td>36000</td><td>18000</td><td>≥40000</td><td>≥40000</td><td>24000</td></tr>
<tr><td>225 MR</td><td>2</td><td>6312 C3</td><td>6313 C3</td><td>39600</td><td>19800</td><td>9900</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>

Note: on request, all motors can be fitted with grease nipples.

Bearings and lubrication

BEARINGS WITH GREASE NIPPLES

The chart opposite shows the greasing intervals, depending on the type of motor, for standard bearing assemblies of frame size ≥ 160 mm fitted with grease nipples, operating at an ambient temperature of 25°C, 40°C and 55°C on a horizontal shaft machine.

The chart below is valid for FLSES/FLS motors lubricated with Polyrex EM103 grease, which is used as standard.

SPECIAL CONSTRUCTION AND ENVIRONMENT

For vertical shaft machines, the greasing intervals will be approximately 80% of the values stated in the table below.

Note: The quality and quantity of grease and the greasing interval are shown on the machine nameplate.

For special assemblies (motors fitted with DE roller bearings or other types), machines of frame size ≥ 160 mm have bearings with grease nipples.

Instructions for bearing maintenance are given on the nameplates on these machines.

Series	Type	No. of poles	Type of bearing for bearings with grease nipples		Quantity of grease	Greasing intervals in hours								
						3000 rpm			1500 rpm			1000 rpm		
			N.D.E.	D.E.	g	25°C	40°C	55°C	25°C	40°C	55°C	25°C	40°C	55°C
FLSES	160 M*	2 ; 4 ; 6	6210 C3	6309 C3	13	17600	8800	4400	25800	12900	6450	29200	14600	7300
	160 L*	6			13	-	-	-	-	-	-	29200	14600	7300
	160 LU*	2 ; 4			13	17600	8800	4400	17600	8800	4400	-	-	-
		6			15	-	-	-	-	-	-	29200	14600	7300
	180 M*	2	6212 C3	6310 C3	15	14400	7200	3600	-	-	-	-	-	-
	180 MR*	4	6210 C3	6310 C3	15	-	-	-	24200	12100	6050	-	-	-
	180 L*	6	6212 C3	6310 C3	20	-	-	-	-	-	-	27800	13900	6950
	180 LUR*	4	6312 C3	6310 C3	20	-	-	-	21400	10700	5350	-	-	-
	200 LU*	2 ; 4 ; 6	6312 C3	6312 C3	20	12000	6000	3000	21400	10700	5350	25000	12500	6250
	225 SR*	4	6312 C3	6313 C3	25	-	-	-	20000	10000	5000	-	-	-
	225 M*	4 ; 6	6314 C3	6314 C3	25	-	-	-	18800	9400	4700	25400	12700	6350
	225 MR*	2	6312 C3	6313 C3	25	10600	5300	2650	-	-	-	-	-	-
	250 M	2 ; 4 ; 6	6314 C3	6314 C3	25	9400	4700	2350	18800	9400	4700	25400	12700	6350
	280 S/M	2 ; 4 ; 6	6314 C3	6316 C3	35	7200	3600	1800	21000	13230	6615	29000	29000	18270
	315 S/M/L	2	6316 C3	6218 C3	35	7400	5880	2920	-	-	-	-	-	-
	315 S/M/L	4 ; 6	6316 C3	6320 C3	50	-	-	-	15600	12400	6160	25000	25000	12500
	355 L	2	6316 C3	6218 C3	35	7400	3700	1850	-	-	-	-	-	-
	355 L	4 ; 6	6316 C3	6322 C3	60	-	-	-	13200	8316	4160	22000	13860	6930
FLSES/FLS	*355 LK*	*4 ; 6*	*6324 C3*	*6324 C3*	*72*	-	-	-	*7500*	*3700*	*2800*	*20000*	*20000*	*10000*
FLS	*400 L/LV*	*4 ; 6*	*6324 C3*	*6324 C3*	*72*	-	-	-	*7500*	*3700*	*2800*	*20000*	*20000*	*10000*
	400 LK/ 450 L	*4 ; 6*	*6328 C3*	*6328 C3*	*93*	-	-	-	*4600*	*2300*	*1100*	*10000*	*6000*	*3000*

** bearing with grease nipple available to order*

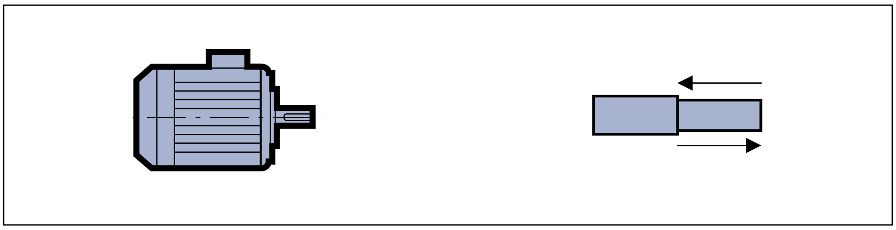
STANDARD BEARING FITTING ARRANGEMENTS

FLSES series		Horizontal shaft	Vertical shaft	
			Shaft facing down	Shaft facing up
Foot mounted motors	Mounting arrangement	B3	V5	V6
	standard mounting	The DE bearing is: - located at DE for frame ≤ 132 - locked for frame ≥ 160	The DE bearing is locked	The DE bearing is: - located at DE for frame ≤ 90 - locked for frame ≥ 100
	on request	DE bearing locked for frame < 132		DE bearing locked for frame < 90
Flange mounted motors (or foot and flange)	Mounting arrangement	B5 / B35 / B14 / B34	V1 / V15 / V18 / V58	V3 / V36 / V19 / V69
	standard mounting	The DE bearing is locked on frames 80 to 315S	The DE bearing is locked on frames 80 to 315S	The DE bearing is locked on frames 80 to 315S
		The NDE bearing is locked on frames 315M to 450	The NDE bearing is locked on frames 315M to 450	The NDE bearing is locked on frames 315M to 450

Axial loads

Horizontal motor

For a bearing life L_{10h} of 25,000 hours and 40,000 hours

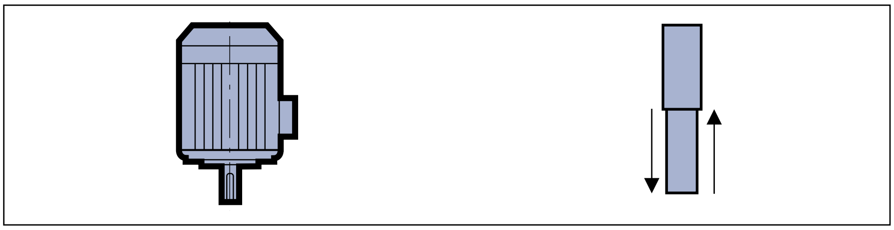


Series	Type	No. of poles	Permissible axial load (in daN) on main shaft extension for standard bearing assembly IM B3/B6 IM B7/B8 IM B5/B35 IM B14/B34											
			3000 rpm				1500 rpm				1000 rpm			
			→		←		→		←		→		←	
			25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours
FLSES	80 L	2	32	23	62	53	-	-	-	-	-	-	-	-
	80 LG	4	-	-	-	-	47	34	87	74	-	-	-	-
	90 S/L	2 ; 4 ; 6	29	20	69	59	45	32	85	72	60	44	100	84
	90 LU	2 ; 6	25	18	75	64	-	-	-	-	54	40	104	87
	100 L	2 ; 4	43	30	93	80	65	47	115	97	-	-	-	-
	100 LK	4 ; 6	-	-	-	-	62	43	112	95	85	59	135	115
	112 MG	2 ; 6	42	29	92	78	-	-	-	-	81	57	131	111
	112 MU	4	-	-	-	-	56	39	116	98	-	-	-	-
	132 S	2 ; 4 ; 6	74	54	134	80	158	111	228	194	131	99	191	159
	132 M	6	-	-	-	-	-	-	-	-	190	146	260	216
	132 MU	2 , 4	105	73	185	157	145	121	235	198	-	-	-	-
	132 MR	4	-	-	-	-	144	101	234	199	-	-	-	-
	160 M	2 ; 4 ; 6	126	91	226	191	174	128	274	228	240	183	340	283
	160 LU	2 ; 4 ; 6	123	88	223	188	177	130	277	230	207	152	307	252
	160 L	6	-	-	-	-	-	-	-	-	222	166	322	266
	180 M	2	185	116	233	146	-	-	-	-	-	-	-	-
	180 MR	4	-	-	-	-	193	140	293	240	-	-	-	-
	180 L	6	-	-	-	-	-	-	-	-	276	212	324	260
	180 LUR	4	-	-	-	-	223	169	286	232	-	-	-	-
	200 LU	2 ; 4 ; 6	247	193	310	256	333	261	396	324	392	280	455	343
	225 SR	4	-	-	-	-	370	290	433	353	-	-	-	-
	225 M	4 ; 6	-	-	-	-	412	322	492	402	485	378	565	458
	225 MR	2	279	219	342	282	-	-	-	-	-	-	-	-
	250 M	2 ; 4 ; 6	307	240	387	320	407	317	487	397	468	361	548	441
	280 S/M	2 ; 4 ; 6	342	258	484	400	483	372	625	514	581	445	723	587
	315 S/M/LA/LB	2 ; 6	411	348	165	102	-	-	-	-	933	761	687	515
	315 S/M/LA/LB	4	-	-	-	-	814	670	568	424	-	-	-	-
	355 LA/LB/LC	2	393	333	147	87	-	-	-	-	-	-	-	-
	355 LA/LB/LC	4 ; 6	-	-	-	-	876	724	630	478	947	764	701	518
	355 LKA	6	-	-	-	-	-	-	-	-	937	760	615	440
	355 LKB	6	-	-	-	-	-	-	-	-	897	725	577	405
FLS	*400 LA*	*4 ; 6*	-	-	-	-	*873*	-	*593*	-	*941*	-	*661*	-
	400 LB/LVB	*4 ; 6*	-	-	-	-	*862*	-	*582*	-	*923*	-	*943*	-
	400 LKB	*6*	-	-	-	-	-	-	-	-	*1162*	-	*941*	-
	450 LA/LVA	*4 ; 6*	-	-	-	-	*1061*	-	*707*	-	*1179*	-	*808*	-
	450 LB/LKB	*4 ; 6*	-	-	-	-	*1041*	-	*687*	-	*1162*	-	*941*	-

Axial loads

Vertical motor
Shaft facing down

For a bearing life L_{10h}
of 25,000 hours
and 40,000 hours

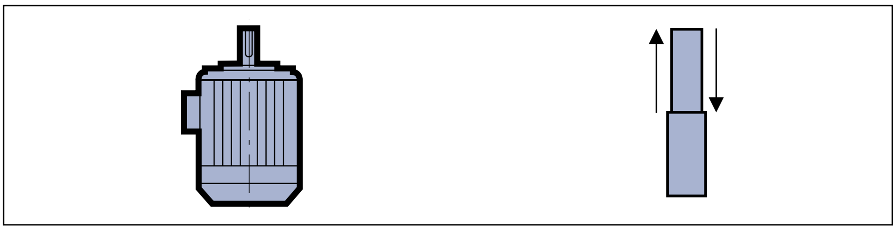


Series	Type	No. of poles	Permissible axial load (in daN) on main shaft extension for standard bearing assembly IM V5 IM V1 / V15 IM V18 / V58											
			3000 rpm ↓		3000 rpm ↑		1500 rpm ↓		1500 rpm ↑		1000 rpm ↓		1000 rpm ↑	
			25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours
FLSES	80 L	2	30	21	64	55	-	-	-	-	-	-	-	-
	80 LG	4	-	-	-	-	45	32	92	78	-	-	-	-
	90 S/L	2 ; 4 ; 6	27	17	74	64	42	29	91	78	56	41	106	90
	90 LU	2 ; 6	21	14	80	68	-	-	-	-	50	37	111	94
	100 L	2 ; 4	40	26	99	86	60	42	123	104	-	-	-	-
	100 LK	4 ; 6	-	-	-	-	55	38	123	104	79	58	147	125
	112 MG	2 ; 6	36	25	101	86	-	-	-	-	74	54	144	122
	112 MU	4	-	-	-	-	49	31	129	111	-	-	-	-
	132 S	2 ; 4 ; 6	67	47	145	125	147	103	247	210	122	90	207	175
	132 M	6	-	-	-	-	-	-	-	-	179	134	279	235
	132 MU	2 , 4	93	65	204	173	136	98	253	215	-	-	-	-
	132 MR	4	-	-	-	-	129	90	260	221	-	-	-	-
	160 M	2 ; 4 ; 6	105	69	261	225	152	105	314	267	215	158	379	323
	160 LU	2 ; 4 ; 6	100	65	261	226	152	105	322	275	178	122	362	306
	160 L	6	-	-	-	-	-	-	-	-	195	139	369	313
	180 M	2	155	97	278	174	-	-	-	-	-	-	-	-
	180 MR	4	-	-	-	-	168	114	345	291	-	-	-	-
	180 L	6	-	-	-	-	-	-	-	-	237	172	394	329
	180 LUR	4	-	-	-	-	188	134	348	293	-	-	-	-
	200 LU	2 ; 4 ; 6	205	150	370	316	286	214	469	396	343	226	534	434
	225 SR	4	-	-	-	-	317	236	520	438	-	-	-	-
	225 M	4 ; 6	-	-	-	-	337	245	614	522	413	305	690	581
	225 MR	2	233	172	412	351	-	-	-	-	-	-	-	-
	250 M	2 ; 4 ; 6	246	178	482	414	326	235	616	524	384	276	688	580
	280 S/M	2 ; 4 ; 6	396	307	484	395	507	394	670	557	602	461	793	651
	315 S/M/LA/LB	2 ; 6	226	156	417	347	-	-	-	-	-	-	-	-
	315 S/M/LA/LB	4					601	449	893	741	683	515	1042	873
	355 LA/LB/LC	2	135	65	524	454	-	-	-	-	-	-	-	-
	355 LA/LB/LC	4 ; 6	-	-	-	-	516	350	1123	957	566	364	1328	1126
	355 LKA	6	-	-	-	-	-	-	-	-	650	442	1349	1140
	355 LKB	6	-	-	-	-	-	-	-	-	393	185	1624	1416
FLS	400 LA	4 ; 6	-	-	-	-	672	-	1058	-	649	-	1315	-
	400 LB/LVB	4 ; 6	-	-	-	-	612	-	1106	-	571	-	1372	-
	400 LKB	6	-	-	-	-	-	-	-	-	671	-	1772	-
	450 LA/LVA	4 ; 6	-	-	-	-	868	-	1247	-	791	-	1668	-
	450 LB/LKB	4 ; 6	-	-	-	-	729	-	1366	-	671	-	1772	-

Axial loads

Vertical motor
Shaft facing up

For a bearing life L_{10h}
of 25,000 hours
and 40,000 hours



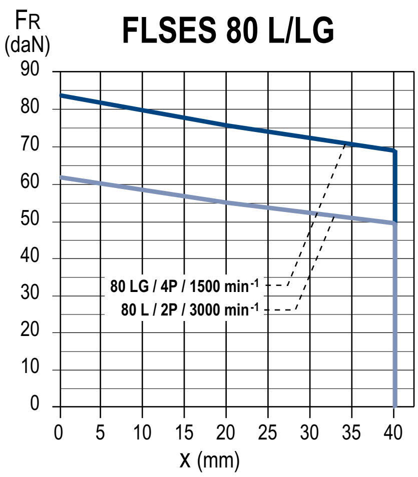
Series	Type	No. of poles	Permissible axial load (in daN) on main shaft extension for standard bearing assembly IM V6 IM V3 / V36 IM V19 / V69											
			3000 rpm ↓		↑		1500 rpm ↓		↑		1000 rpm ↓		↑	
			25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours
FLSES	80 L	2	60	51	34	25	-	-	-	-	-	-	-	-
	80 LG	4	-	-	-	-	85	72	52	38	-	-	-	-
	90 S/L	2 ; 4 ; 6	67	57	34	24	82	69	51	38	96	81	66	50
	90 LU	2 ; 6	71	60	30	81	-	-	-	-	100	84	61	46
	100 L	2 ; 4	90	76	49	36	110	92	73	54	-	-	-	-
	100 LK	4 ; 6	-	-	-	-	105	88	73	54	129	108	97	72
	112 MG	2 ; 6	86	72	51	37	-	-	-	-	123	103	94	70
	112 MU	4	-	-	-	-	109	91	69	51	-	-	-	-
	132 S	2 ; 4 ; 6	127	107	86	66	217	182	177	129	182	150	147	115
	132 M	6	-	-	-	-	-	-	-	-	249	205	209	165
	132 MU	2 , 4	173	145	124	89	216	179	173	135	-	-	-	-
	132 MR	4	-	-	-	-	219	184	170	124	-	-	-	-
	160 M	2 ; 4 ; 6	205	169	161	125	252	205	214	167	315	258	279	223
	160 LU	2 ; 4 ; 6	200	165	161	126	252	205	222	175	278	222	262	206
	160 L	6	-	-	-	-	-	-	-	-	295	239	269	213
	180 M	2	203	127	230	144	-	-	-	-	-	-	-	-
	180 MR	4	-	-	-	-	268	214	245	191	-	-	-	-
	180 L	6	-	-	-	-	-	-	-	-	285	220	346	281
	180 LUR	4	-	-	-	-	251	197	285	230	-	-	-	-
	200 LU	2 ; 4 ; 6	268	213	304	250	349	277	406	333	406	289	471	371
	225 SR	4	-	-	-	-	380	299	457	375	-	-	-	-
	225 M	4 ; 6	-	-	-	-	417	325	534	442	493	385	610	501
	225 MR	2	296	235	349	288	-	-	-	-	-	-	-	-
	250 M	2 ; 4 ; 6	326	258	402	334	406	315	536	444	464	356	608	500
	280 S/M	2 ; 4 ; 6	396	307	484	395	507	394	670	557	602	461	793	651
	315 S/M/L	2	226	156	417	347	-	-	-	-	-	-	-	-
	315 S/M/L	4 ; 6	-	-	-	-	601	449	893	741	683	515	1042	873
	355 L	2	135	65	524	454	-	-	-	-	-	-	-	-
	355 L	4 ; 6	-	-	-	-	516	350	1123	957	566	364	1328	1126

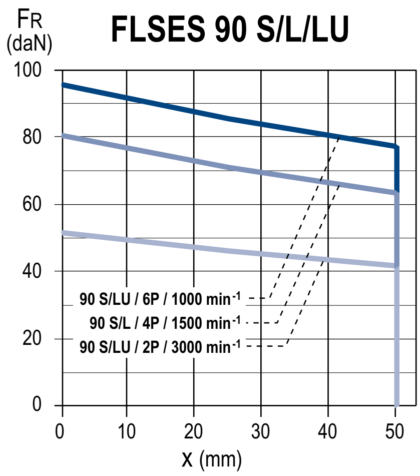
400 and 450: please consult us

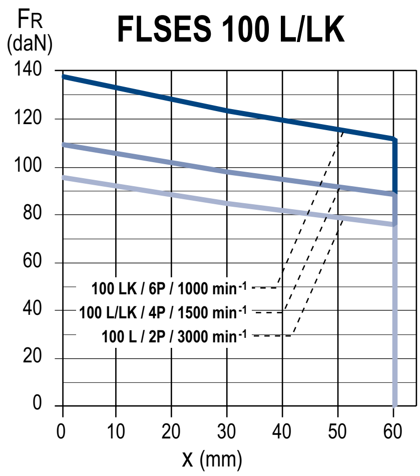
Radial loads

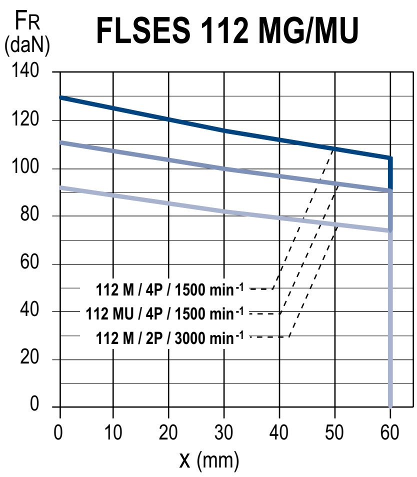
STANDARD FITTING ARRANGEMENT

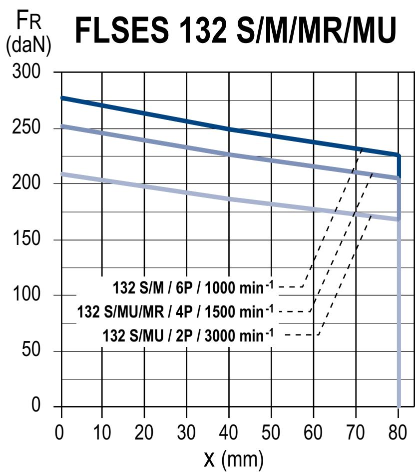
Permissible radial load on main shaft extension with a bearing life L10h of 25,000 hours.
FR: Radial Force
X : distance with respect to the shaft shoulder

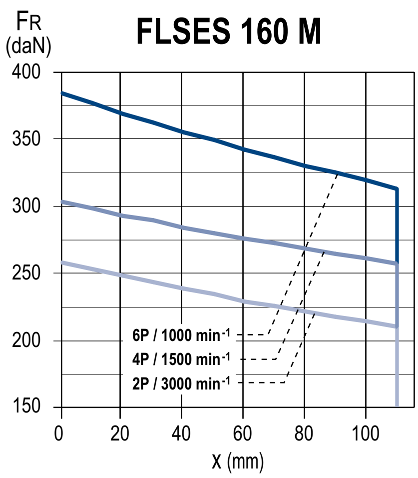


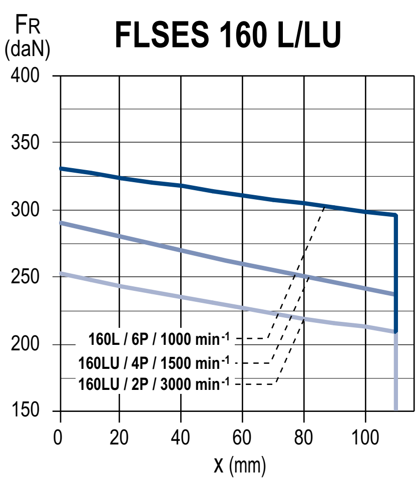


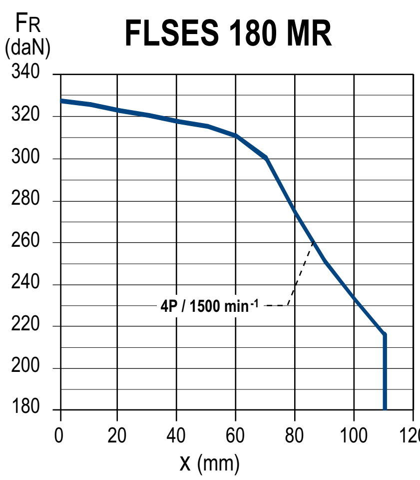


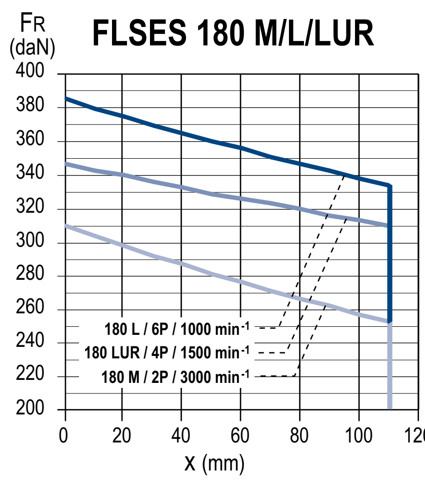








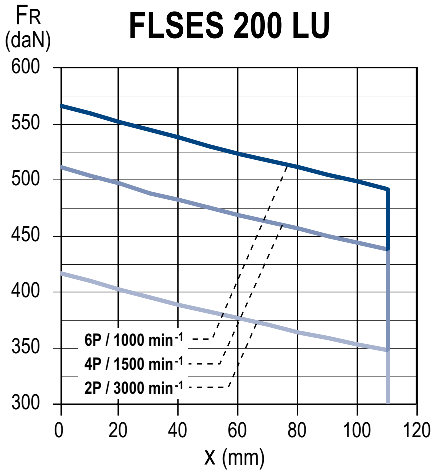


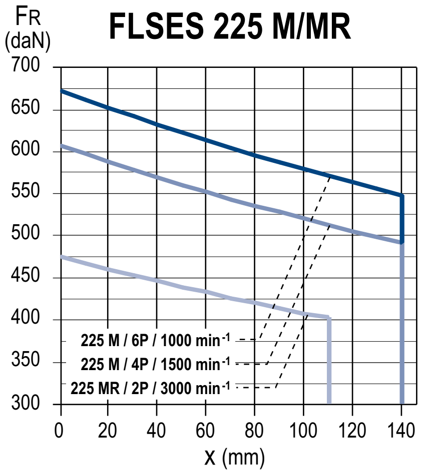


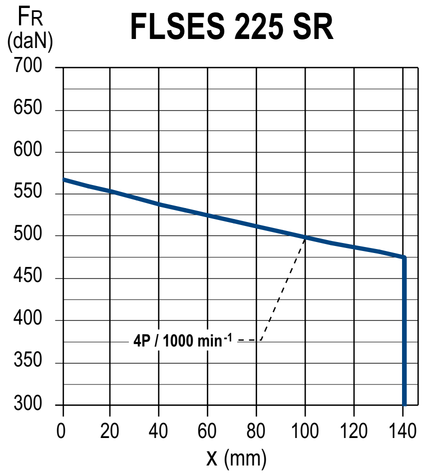
Radial loads

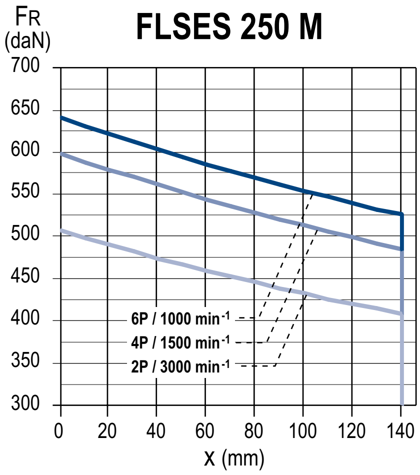
STANDARD FITTING ARRANGEMENT

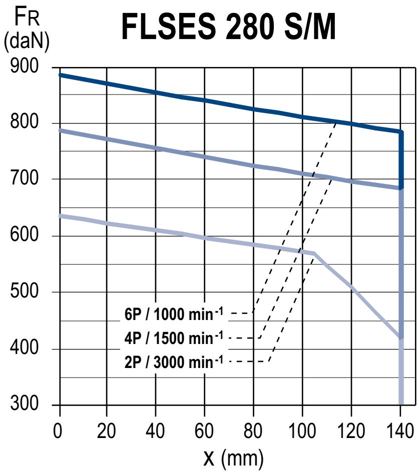
Permissible radial load on main shaft extension with a bearing life L10h of 25,000 hours.
FR: Radial Force
X : distance with respect to the shaft shoulder

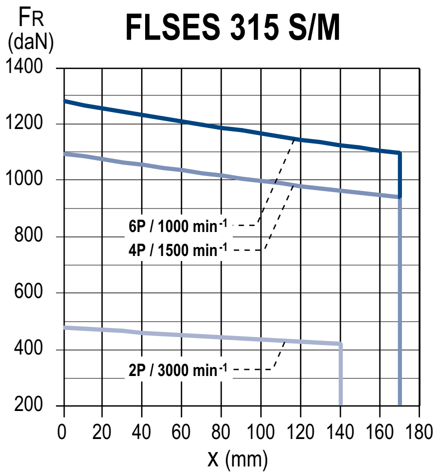


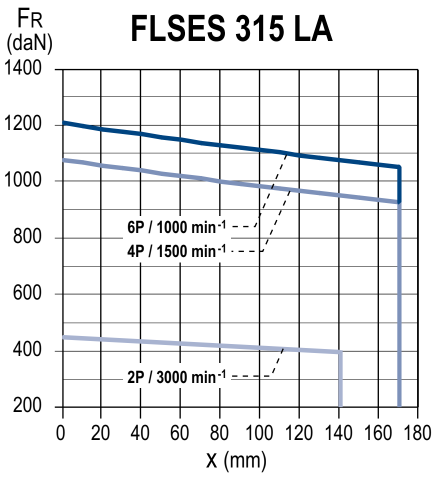


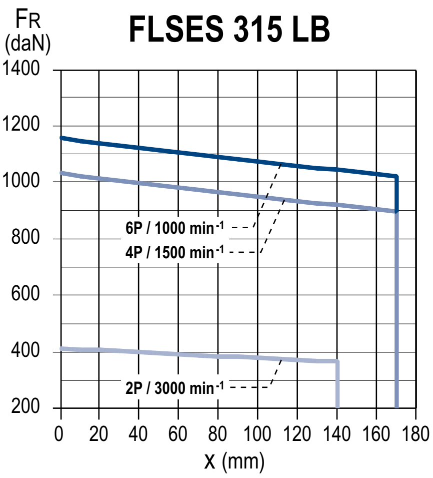








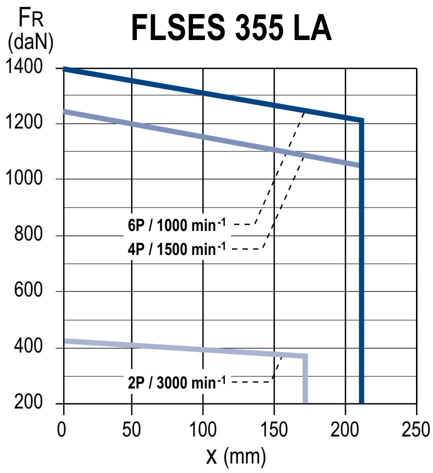


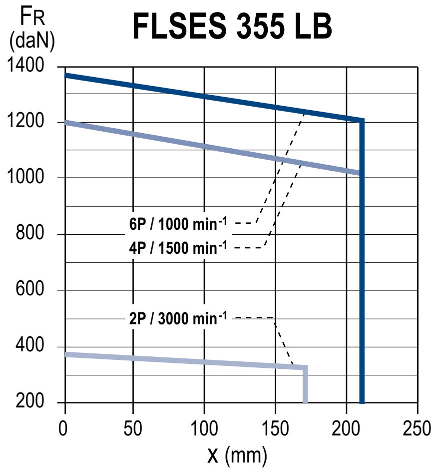


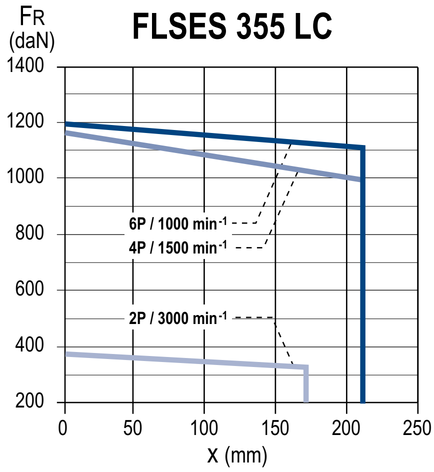
Radial loads

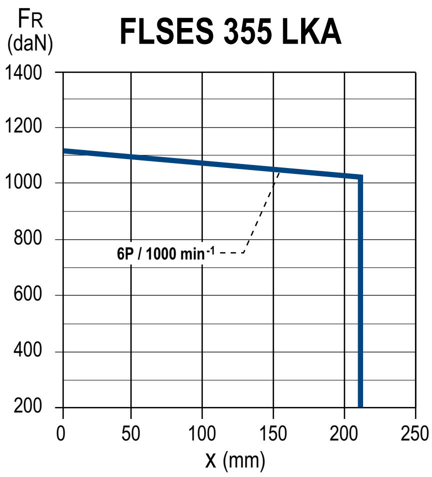
STANDARD FITTING ARRANGEMENT

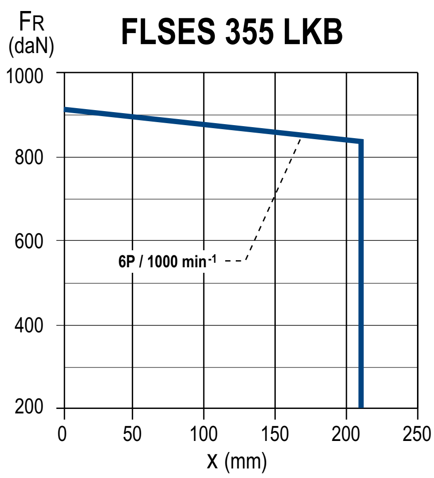
Permissible radial load on main shaft extension with a bearing life L10h of 25,000 hours.
FR: Radial Force
X : distance with respect to the shaft shoulder

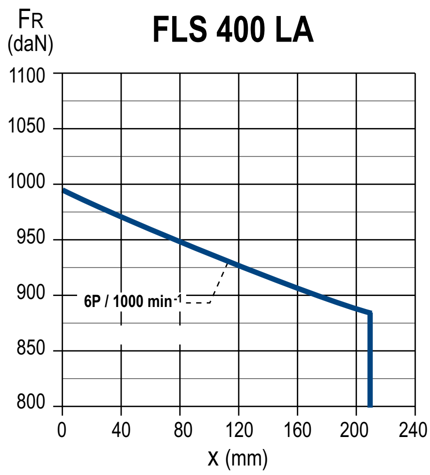


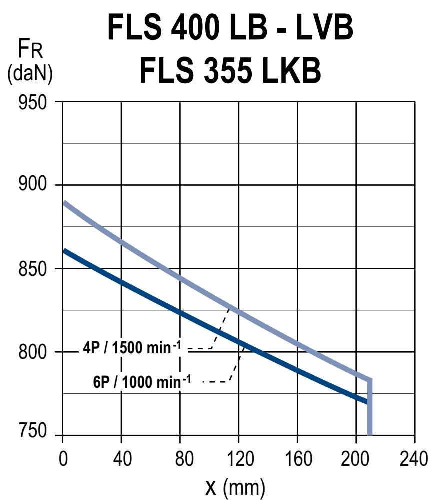


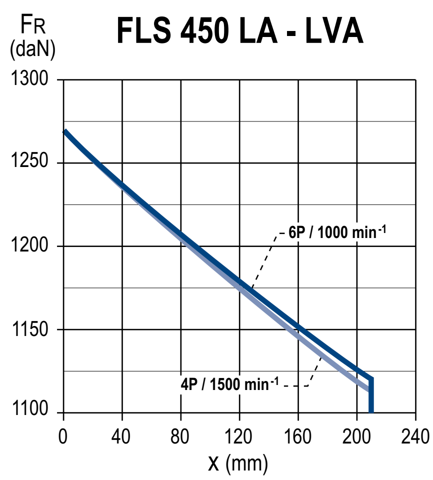


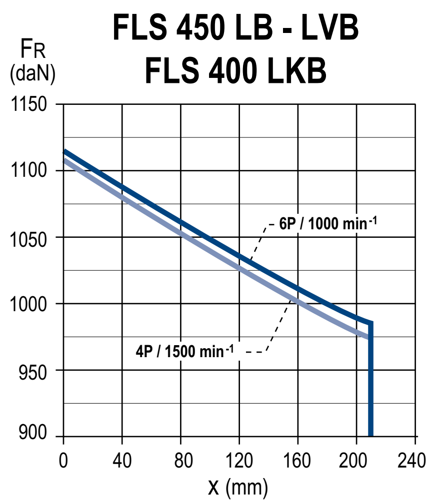












Radial loads

SPECIAL FITTING ARRANGEMENTS

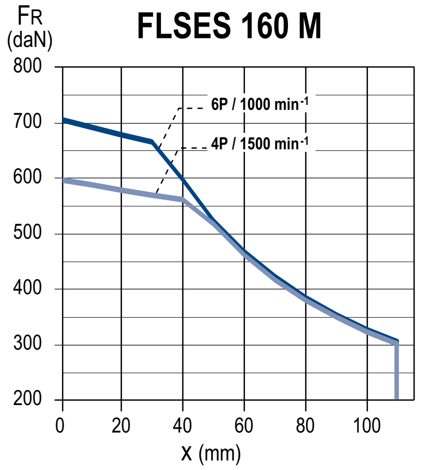
Type of drive end roller bearings

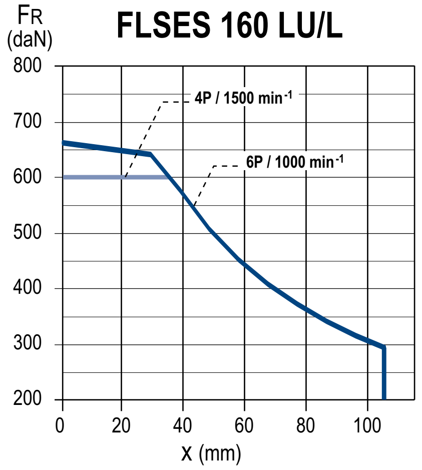
Series	Type	No. of poles	Non-drive end bearing (N.D.E.)	Drive end bearing (D.E.)
FLSES	**160M**	4 ; 6	6210 C3	NU 309
	160L	6		
	160LU	4		
	160LU	6	6210 C3	NU 310
	180MR	4		
	180L	6	6312 C3	NU 310
	180LUR	4		
	200LU	4 ; 6	6312 C3	NU 312
	225SR	4	6312 C3	NU 313
	225M	4 ; 6	6314 C3	NU 314
	250M	4 ; 6	6314 C3	NU 314
	280S/M	4 ; 6	6314 C3	NU 316
	315S/M/L	4 ; 6	6316 C3	NU 320
	355L	4 ; 6	6316 C3	NU 322
FLSES/FLS	***355 LK***	*6*	*6324 C3*	*NU 324*
FLS	***400 LA/LB***	*4 ; 6*	*6324 C3*	*NU 324*
	400 LKA/LKB	*4 ; 6*	*6328 C3*	*NU 328*
	450 LA/LB/LVA/LVB	*4 ; 6*	*6328 C3*	*NU 328*

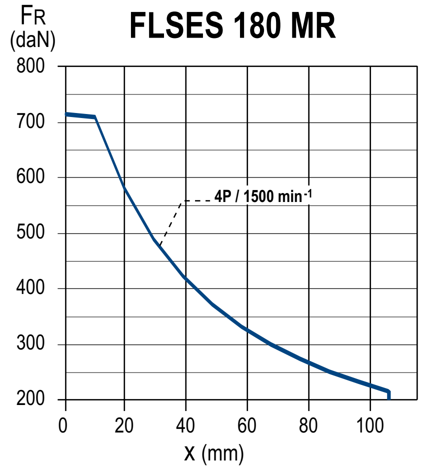
Radial loads

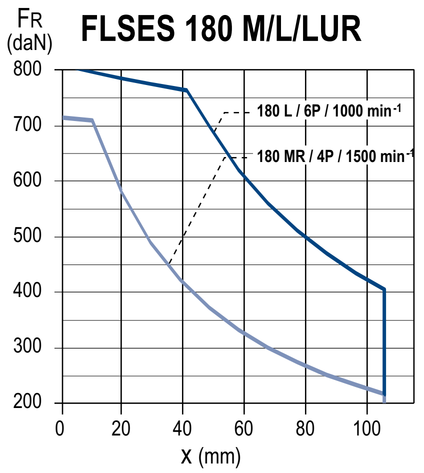
SPECIAL FITTING ARRANGEMENTS

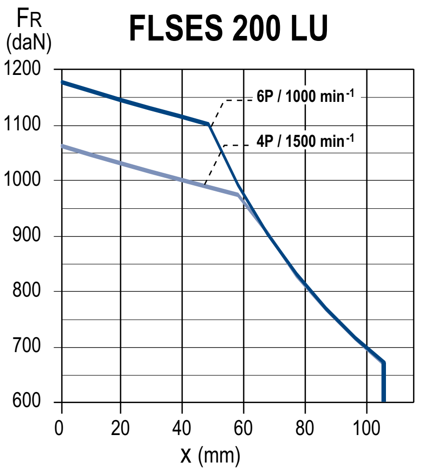
Permissible radial load on main shaft extension with a bearing life L10h of 25,000 hours.
FR: Radial Force
X : distance with respect to the shaft shoulder

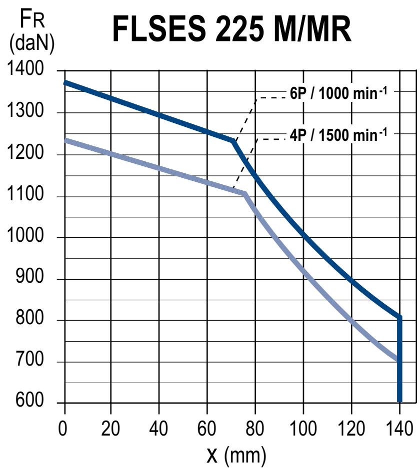


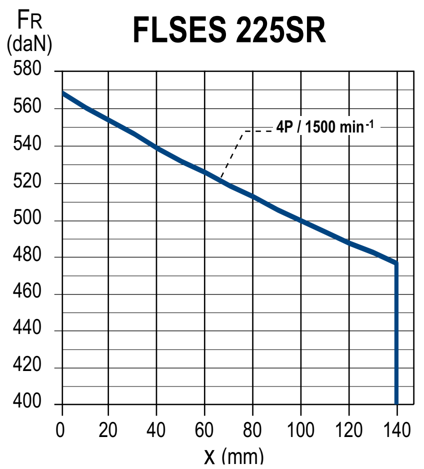


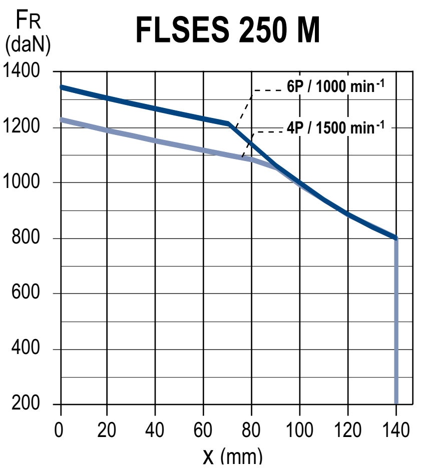


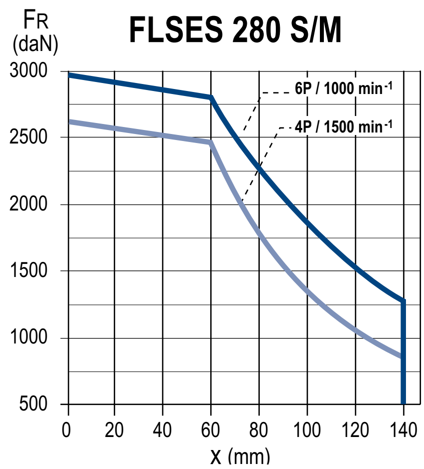








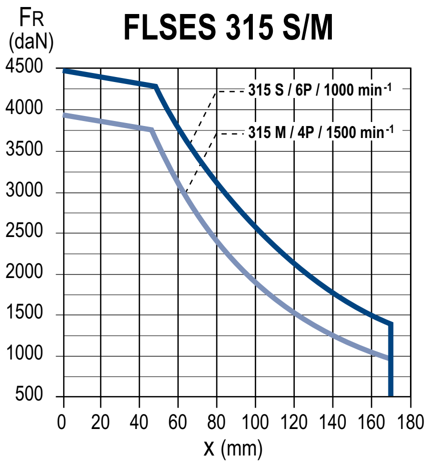


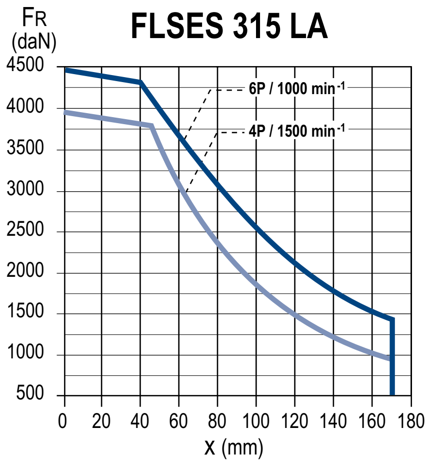


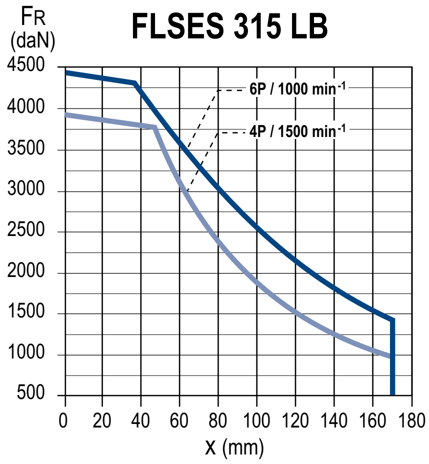
Radial loads

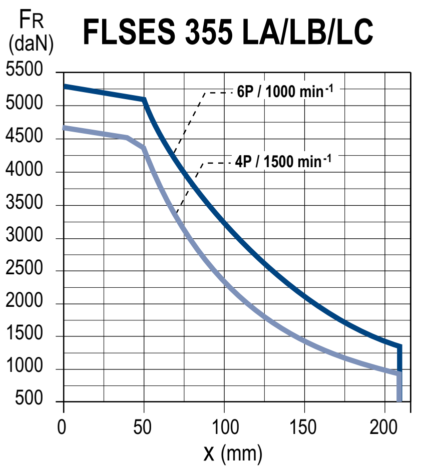
SPECIAL FITTING ARRANGEMENTS

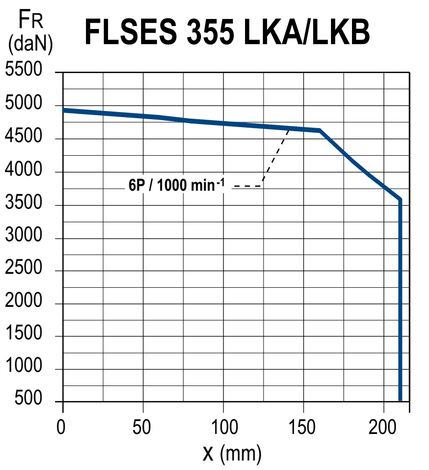
Permissible radial load on main shaft extension with a bearing life L10h of 25,000 hours.
FR: Radial Force
X : distance with respect to the shaft shoulder

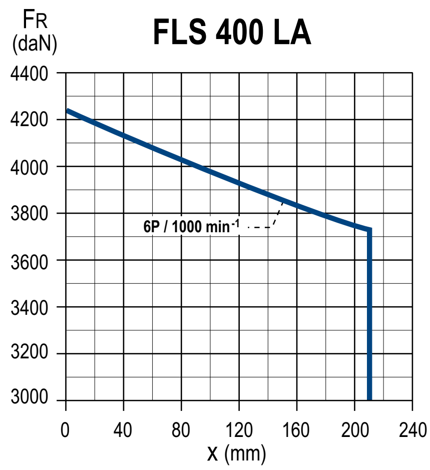


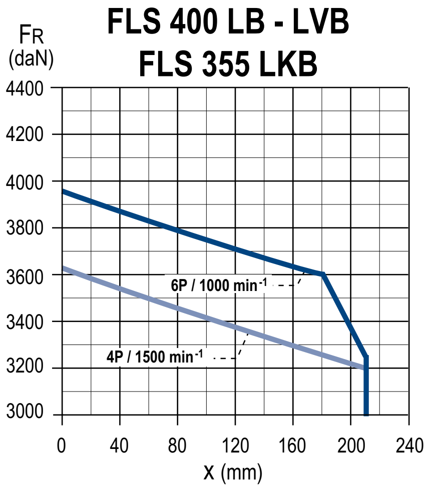


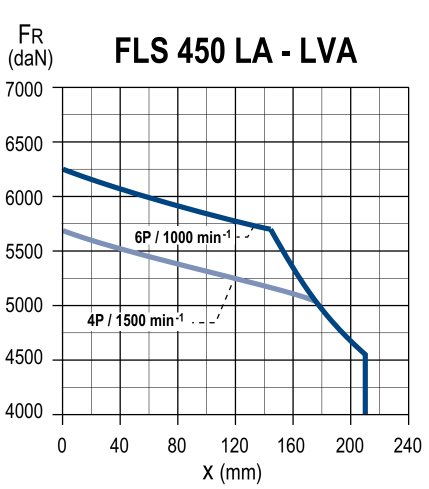


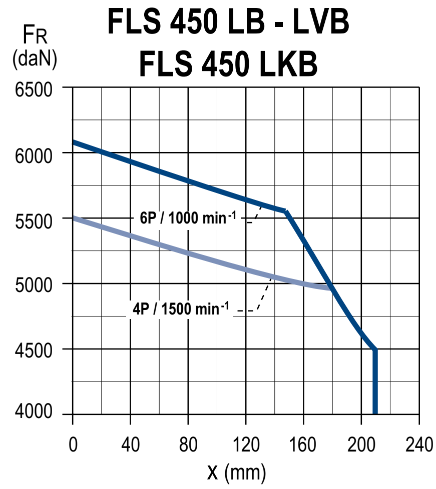












Mains connection

Descriptive table of terminal boxes for rated supply voltage of 400 V (According to EN 50262)

Series	Type	No. of poles	Terminal box material	Power + auxiliaries	
				Number of drill holes	Drill hole diameter*
FLSES	80	2 ; 4	Cast iron	1 2 if auxiliaries (number of drill holes)	ISO M20 x 1.5
	90	2 ; 4 ; 6			
	100	2 ; 4 ; 6			
	112	2 ; 4 ; 6			
	132	2 ; 4 ; 6		2	ISO M25 x 1.5
	160	2 ; 4 ; 6		0	Removable undrilled mounting plate
	180	2 ; 4 ; 6			
	200	2 ; 4 ; 6			
	225	2 ; 4 ; 6			
	250	2 ; 4 ; 6			
	280	2 ; 4 ; 6			
	315	2 ; 4 ; 6			
FLSES/FLS	*355/400/450*	*2 ; 4 ; 6*			

** As an option, both ISO M25 cable glands may be replaced by 1 ISO x M25 and 1 ISO x M32 (to comply with standard DIN 42925).*

TERMINAL BLOCKS
DIRECTION OF ROTATION

Standard motors are fitted with a block of six 6 terminals complying with standard NFC 51 120, with the terminal markings complying with IEC 60034-8 (or NFEN 60034-8).
When the motor is running in U1, V1, W1 or 1U, 1V, 1W from a direct mains supply L1, L2, L3, it turns clockwise when seen from the drive end.
If any two of the phases are changed over, the motor will run in an anti-clockwise direction (make sure that the motor has been designed to run in both directions).
If the motor is fitted with accessories (thermal protection or space heater), these must be connected on screw dominos with labelled wires.

Series	Type	400 V Mains Power Supply		
		230/400 V connections		400 VD connections
		No. of poles	Terminals	Terminals
FLSES	80 to 112	2 ; 4 ; 6	M5	M5
	132 S to 160	2 ; 4 ; 6	M6	M6
	180 M	2	M6	M6
	180 L	6	M6	M6
	180 LUR	4	M8	M6
	200 LU	2 (30kW) ; 4 ; 6 (18.5kW)	M8	M6
	200 LU	2 (37kW) ; 6 (22kW)	M8	M8
	225 M	6	M8	M8
	225 to 250	4	M10	M10
	250 M	6	M10	M10
	208 to 315	2 ; 4 ; 6	M12	M12
	355 L	2 ; 4 ; 6	M12	M12
FLSES/FLS	*355 LK*	*4 ; 6*	*M14*	*M14*
FLS	*400/450*	*4 ; 6*	*M14*	*M14*

Tightening torque for the nuts on the terminal blocks

Terminal	M5	M6	M8	M10	M12	M14	M16
Torque N.m	3.2	5	10	20	35	50	65

2 poles - 3000 min^{-1}

IP55 - CLASS F - ΔT80K - S1 - CLASS IE2

Type	MAINS SUPPLY 400 V 50 Hz															
	Rated power	Rated speed	Rated torque	Rated current	Power factor			Efficiency IEC 60034-2-1 2007			Starting current/ Rated current	Starting torque/ Rated torque	Maximum torque/ Rated torque	Moment of inertia	Weight	Noise
	P_N	N_N	M_N	$I_{N\ (400V)}$	Cos φ			η			Id/In	Md/Mn	M_M/Mn	J	IM B3	LP
	kW	min^{-1}	N.m	A	4/4	3/4	2/4	4/4	3/4	2/4				kg.m^2	kg	db(A)
FLSES 80 L	0.75	2855	2.5	1.6	0.85	0.78	0.66	78.8	79.1	77.3	6.5	2.4	3.0	0.00084	17.5	61
FLSES 80 L	1.1	2854	3.7	2.3	0.87	0.81	0.69	80.1	80.9	79.6	6.1	1.8	2.3	0.00106	17.9	61
FLSES 90 S	1.5	2855	5.0	3.0	0.88	0.82	0.72	81.4	81.6	79.7	8.0	3.7	3.1	0.00169	23.2	64
FLSES 90 LU	2.2	2844	7.4	4.2	0.91	0.87	0.79	83.8	84.9	84.3	8.0	3.4	2.9	0.00251	29	64
FLSES 100 L	3	2848	10.0	5.6	0.91	0.87	0.78	84.8	85.9	85.4	8.1	3.8	4.3	0.00291	34.8	66
FLSES 112 MG	4	2915	13.4	7.5	0.91	0.88	0.8	86.7	87.8	87.6	7.8	3.3	3.7	0.00748	42	69
FLSES 132 S	5.5	2915	18.7	10.3	0.9	0.88	0.82	88.1	89.0	88.6	7.6	2.6	3.3	0.0154	68	72
FLSES 132 S	7.5	2920	24.5	13.4	0.92	0.9	0.85	88.1	88.6	87.8	7.7	2.9	3.2	0.0203	77	72
FLSES 132 MU	9	2920	29.4	16.0	0.91	0.89	0.84	88.9	90.0	90.0	7.9	1.8	2.2	0.0219	79	72
FLSES 160 M	11	2950	35.2	20.3	0.86	0.82	0.73	89.5	89.6	88.1	6.9	3.1	3.0	0.0373	115	74
FLSES 160 M	15	2946	48.7	26.8	0.89	0.86	0.79	90.7	90.6	89.4	8.0	3.4	3.5	0.0530	134	74
FLSES 160 LU	18.5	2945	60.6	33.0	0.89	0.86	0.8	91.3	91.8	91.2	8.0	3.7	3.6	0.0592	141	74
FLSES 180 M	22	2938	71.5	37.6	0.92	0.91	0.88	91.4	92.0	91.7	7.7	2.4	2.9	0.0812	168	75
FLSES 200 LU	30	2950	97.1	52.7	0.89	0.87	0.81	92.3	92.5	91.8	7.3	2.9	3.1	0.113	236	75
FLSES 200 LU	37	2954	120	64.1	0.9	0.87	0.81	92.9	93.1	92.5	7.9	2.9	3.3	0.137	258	75
FLSES 225 MR	45	2954	145	77.7	0.9	0.87	0.81	93.2	93.4	92.7	8.1	3.1	3.5	0.159	276	76
FLSES 250 M	55	2960	178	94.4	0.9	0.89	0.84	93.7	93.9	93.2	7.5	2.3	2.9	0.332	390	77
FLSES 280 S	75	2954	242	127	0.9	0.89	0.84	94.6	94.9	94.6	6.8	2.4	2.7	0.430	505	78
FLSES 280 M	90	2954	291	150	0.91	0.89	0.85	94.9	95.3	95.2	7.3	2.4	2.3	0.510	548	79
FLSES 315 S	110	2970	354	186	0.9	0.89	0.84	95.1	95.1	94.4	6.3	1.8	2.5	1.30	980	82
FLSES 315 M	132	2967	425	224	0.9	0.89	0.85	94.7	95.0	94.5	6.3	1.9	2.2	1.36	1020	82
FLSES 315 LA	160	2964	516	270	0.9	0.9	0.87	95.2	95.5	95.2	6.0	1.8	2.6	1.48	1060	82
FLSES 315 LB	200	2972	643	336	0.9	0.88	0.83	95.7	95.9	95.5	7.3	2.4	3.0	1.92	1190	82
FLSES 355 LA	250	2978	802	439	0.86	0.83	0.76	95.7	95.7	95.0	7.1	2.1	3.1	3.26	1540	84
FLSES 355 LB	315	2981	1009	540	0.88	0.86	0.81	95.7	95.7	95.1	7.6	2.6	3.3	3.68	1713	84
FLSES 355 LC	355	2981	1137	623	0.87	0.84	0.78	95.7	95.4	94.5	7.1	2.2	2.8	3.71	1731	83
FLS 355 LD *1	*400*	*2977*	*1284*	*623*	*0.89*	*0.87*	*0.82*	*95.3*	*95.5*	*95.4*	*7.8*	*2.0*	*2.7*	*4.03*	*1915*	*84*

** Motors are not concerned by IE2*
1. Class F temperature rise

4 poles - 1500 min^{-1}

IP55 - CLASS F - ΔT80K - S1 - CLASS IE2

Type	MAINS SUPPLY 400 V 50 Hz															
	Rated power	Rated speed	Rated torque	Rated current	Power factor			Efficiency IEC 60034-2-1 2007			Starting current/ Rated current	Starting torque/ Rated torque	Maximum torque/ Rated torque	Moment of inertia	Weight	Noise
	P_N	N_N	M_N	$I_{N\,(400V)}$	Cos φ			η			Id/In	Md/Mn	M_M/Mn	J	IM B3	LP
	kW	min^{-1}	N.m	A	4/4	3/4	2/4	4/4	3/4	2/4				kg.m^2	kg	db(A)
FLSES 80 LG	0.75	1442	5	1.6	0.81	0.73	0.61	81.8	82.9	81.9	6.0	2.0	2.9	0.00279	19.9	44
FLSES 90 S	1.1	1445	7.3	2.4	0.82	0.74	0.59	81.8	82.2	79.6	6.7	2.4	2.7	0.00312	21.9	50
FLSES 90 L	1.5	1445	9.9	3.2	0.82	0.74	0.6	82.9	84.2	83.3	6.8	2.4	3.1	0.00404	24.4	50
FLSES 90 LU	1.8	1450	14.2	3.8	0.82	0.74	0.6	83.5	84.0	82.5	7.3	2.8	3.2	0.00404	25.3	50
FLSES 100 L	2.2	1450	14.2	4.7	0.81	0.72	0.58	84.4	85.3	84.5	7.8	3.2	3.6	0.00531	34	52
FLSES 100 LK	3	1450	19.5	6.1	0.83	0.76	0.65	85.6	87.2	87.3	6.5	2.0	2.8	0.0108	42	52
FLSES 112 MU	4	1455	26.1	8.2	0.81	0.74	0.61	87	87.9	87.4	7.8	2.4	3.2	0.0129	47	52
FLSES 132 S	5.5	1460	36.2	10.8	0.84	0.78	0.67	88.1	88.8	88.3	7.8	2.6	3.4	0.0226	70	59
FLSES 132 MU	7.5	1455	49.2	14.3	0.86	0.81	0.71	88.8	89.9	89.8	7.9	2.7	3.4	0.0294	84	59
FLSES 132 MR	9	1465	58	18.1	0.8	0.73	0.61	89.3	89.4	88.1	8.1	3.4	3.3	0.0328	88	59
FLSES 160 M	11	1464	71.6	20.6	0.84	0.8	0.69	91	91.7	91.6	8.1	2.9	3.3	0.0731	125	65
FLSES 160 LU	15	1464	98	27.5	0.86	0.81	0.71	91.5	92.3	92.3	7.9	2.8	3.2	0.0861	136	65
FLSES 180 MR	18.5	1459	120	34.3	0.85	0.81	0.71	91.2	92.0	92.1	7.5	3.0	3.5	0.0957	144	64
FLSES 180 LUR	22	1471	142	42	0.81	0.76	0.64	92.2	92.6	92.0	7.4	3.3	3.3	0.139	180	64
FLSES 200 LU	30	1470	195	56.1	0.84	0.79	0.7	92.7	93.4	93.5	6.4	2.6	2.2	0.204	246	66
FLSES 225 SR	37	1470	241	69.5	0.83	0.79	0.69	92.9	93.7	93.8	6.6	2.7	2.7	0.247	275	66
FLSES 225 M	45	1479	291	81.4	0.85	0.82	0.73	93.7	94.1	93.9	6.8	2.6	2.4	0.576	366	68
FLSES 250 M	55	1480	357	102	0.83	0.79	0.69	94.1	94.5	94.2	6.6	2.3	2.5	0.625	400	68
FLSES 280 S	75	1481	484	140	0.82	0.77	0.66	94.1	94.1	93.5	7.2	2.9	2.8	0.800	503	74
FLSES 280 M	90	1480	581	166	0.83	0.79	0.69	94.4	94.7	94.3	7.5	2.9	2.7	0.940	553	74
FLSES 315 S	110	1484	708	199	0.84	0.81	0.73	94.8	95.1	94.6	6.5	2.5	2.4	2.24	1022	75
FLSES 315 M	132	1481	851	236	0.85	0.82	0.75	95.1	95.4	95.2	6.7	2.6	2.3	2.64	1092	74
FLSES 315 LA	160	1482	1031	278	0.87	0.84	0.76	95.5	95.9	95.8	7.0	3.1	2.8	2.26	1051	74
FLSES 315 LB	200	1473	1297	350	0.86	0.83	0.73	95.9	96.1	95.8	7.2	3.2	3.0	2.75	1163	74
FLSES 355 LA	250	1490	1603	437	0.86	0.83	0.74	95.9	95.9	95.4	7.5	2.5	3.2	5.16	1486	80
FLSES 355 LB	315	1488	2020	546	0.87	0.84	0.75	95.9	96.1	95.7	8.0	1.8	2.7	5.90	1605	77
FLSES 355 LC	*355*	*1487*	*2280*	*621*	*0.86*	*0.82*	*0.73*	*95.9*	*96*	*95.7*	*7.4*	*1.8*	*2.9*	*6.60*	*1695*	*80*
***FLS 355 LD**[*1]*	*400*	*1489*	*2564*	*696*	*0.87*	*0.84*	*0.77*	*95.9*	*95.9*	*94.9*	*7.4*	*2.1*	*2.1*	*7.40*	*1930*	*80*
FLS 400 LB*	*400*	*1491*	*2559*	*694*	*0.87*	*0.85*	*0.78*	*95.6*	*96.2*	*95.1*	*8.0*	*2.0*	*2.6*	*11.70*	*2350*	*82*
FLS 355 LKB*	*450*	*1490*	*2880*	*774*	*0.88*	*0.86*	*0.79*	*95.4*	*95.5*	*94.8*	*7.6*	*1.8*	*2.3*	*11.70*	*2320*	*82*
FLS 400 LB*	*450*	*1490*	*2880*	*774*	*0.88*	*0.86*	*0.79*	*95.4*	*95.5*	*94.8*	*7.6*	*1.8*	*2.3*	*11.70*	*2350*	*87*
FLS 355 LKB*	*500*	*1490*	*3200*	*862*	*0.88*	*0.86*	*0.79*	*95.1*	*95.1*	*94.2*	*6.5*	*1.7*	*2.2*	*11.70*	*2320*	*82*
FLS 400 LVB*	*500*	*1490*	*3200*	*862*	*0.88*	*0.86*	*0.79*	*95.1*	*95.1*	*94.2*	*6.5*	*1.7*	*2.2*	*11.70*	*2350*	*87*
FLS 450 LA*	*500*	*1492*	*3200*	*866*	*0.87*	*0.84*	*0.77*	*95.8*	*95.2*	*95.3*	*8.0*	*1.6*	*2.2*	*21.00*	*3100*	*82*
FLS 450 LVA*	*550*	*1491*	*3525*	*942*	*0.88*	*0.85*	*0.78*	*95.8*	*95.8*	*95.2*	*7.9*	*1.5*	*2.1*	*21.00*	*3100*	*85*
FLS 450 LB*	*630*	*1493*	*4030*	*1090*	*0.87*	*0.84*	*0.77*	*95.9*	*95.9*	*95.2*	*8.2*	*1.5*	*2.1*	*24.00*	*3450*	*82*
FLS 450 LVB*	*675*	*1491*	*4326*	*1168*	*0.87*	*0.84*	*0.68*	*95.9*	*95.9*	*95.6*	*8.0*	*1.4*	*1.9*	*24.00*	*3450*	*85*

** Motors are not concerned by IE2*
1. Class F temperature rise

6 poles - 1000 min^{-1}

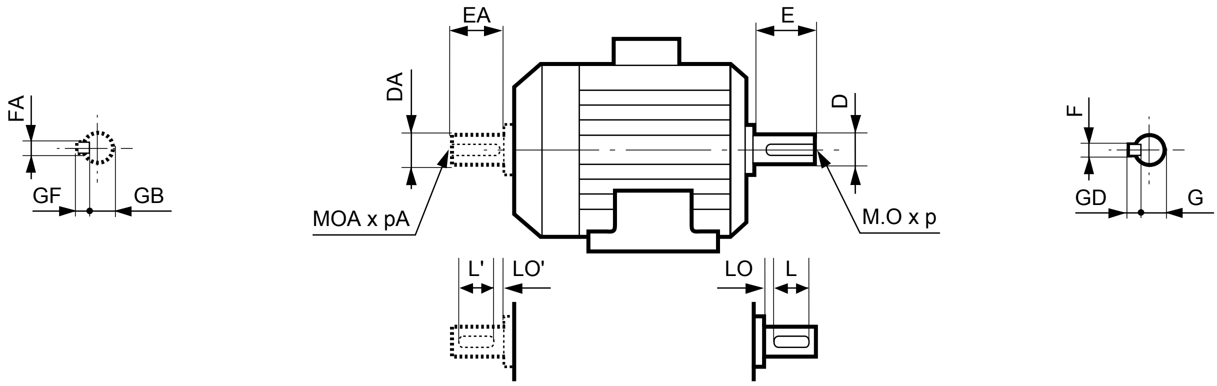
IP55 - CLASS F - ΔT80K - S1 - CLASS IE2

Type	Rated power	Rated speed	Rated torque	Rated current	Power factor			Efficiency IEC 60034-2-1 2007			Starting current/ Rated current	Starting torque/ Rated torque	Maximum torque/ Rated torque	Moment of inertia	Weight	Noise
MAINS SUPPLY 400 V 50 Hz	P_N	N_N	M_N	$I_{N (400V)}$	Cos φ			η			Id/In	Md/Mn	M_M/Mn	J	IM B3	LP
	kW	min^{-1}	N.m	A	4/4	3/4	2/4	4/4	3/4	2/4				kg.m^2	kg	db(A)
FLSES 90 S	0.75	940	7.6	1.94	0.73	0.64	0.5	76.3	76.9	74.1	4.2	2.0	2.2	0.00320	21.4	45
FLSES 90 LU	1.1	945	11.1	2.7	0.75	0.66	0.53	78.5	79.5	77.8	4.6	2.1	2.4	0.00482	26.5	45
FLSES 100 LK	1.5	955	15	3.43	0.79	0.73	0.6	79.9	81.9	81.6	5.3	1.8	2.0	0.0111	35.1	48
FLSES 112 MG	2.2	960	22.1	5.2	0.74	0.65	0.52	82.1	82.7	82.1	5.5	2.1	2.4	0.0111	43	48
FLSES 132 S	3	965	29.9	6.6	0.78	0.72	0.6	85.1	86.3	86.1	6.0	2.4	2.5	0.0219	63	55
FLSES 132M	4	964	39.4	8.8	0.77	0.71	0.59	85.3	86.5	85.9	6.1	2.4	2.7	0.0285	71	55
FLSES 132 MR	5.5	969	54.1	13.3	0.69	0.64	0.52	86.3	87.4	86.5	6.0	2.4	2.9	0.0403	89	55
FLSES 160 M	7.5	974	74	16.4	0.75	0.68	0.56	88.3	88.5	87.3	5.7	1.8	2.7	0.0912	110	56
FLSES 160 L	9	973	87.4	19.2	0.77	0.7	0.59	88	88.3	87.3	5.9	1.9	2.7	0.108	119	72
FLSES 160 LU	11	970	107.9	23.7	0.76	0.68	0.55	88.7	89.0	87.7	5.8	1.9	2.7	0.127	130	56
FLSES 180 L	15	973	147	30.1	0.8	0.74	0.63	90.1	91.0	90.9	6.9	2.5	3.1	0.205	172	63
FLSES 200 LU	18.5	978	181	37.1	0.79	0.74	0.64	90.9	91.6	91.2	6.8	2.4	3.0	0.259	230	65
FLSES 200 LU	22	975	214	44.2	0.79	0.75	0.65	90.9	91.6	91.2	6.7	2.3	2.9	0.307	250	65
FLSES 225 M	30	985	291	56	0.84	0.8	0.71	93	93.6	93.3	6.6	2.5	2.8	0.646	339	66
FLSES 250 M	37	984	357	68.5	0.84	0.8	0.7	93.1	93.6	93.4	6.3	2.2	2.6	0.780	369	66
FLSES 280 S	45	985	436	81	0.86	0.83	0.74	93.6	94.1	94.0	6.6	2.3	2.4	1.03	505	65
FLSES 280 M	55	982	535	99	0.86	0.83	0.76	93.5	94.2	94.4	6.3	2.4	2.3	1.20	546	65
FLSES 315 S	75	987	726	140	0.82	0.78	0.69	94.2	94.5	93.9	5.8	2.6	1.9	2.60	974	72
FLSES 315 M	90	985	873	168	0.82	0.79	0.71	94.3	94.6	94.2	5.7	2.1	1.9	3.00	1033	72
FLSES 315 LA	110	988	1063	205	0.82	0.78	0.68	94.6	94.9	94.4	6.7	2.6	2.1	3.45	1105	72
FLSES 315 LB	132	985	1280	240	0.84	0.81	0.73	94.7	95.1	94.9	6.1	2.4	2.4	3.95	1182	72
FLSES 355 LA	160	991	1542	293	0.83	0.79	0.69	95.0	95.0	94.3	7.2	1.9	3.0	6.80	1420	76
FLSES 355 LB	200	991	1927	370	0.82	0.77	0.67	95.2	95.3	94.6	6.9	1.9	3.0	7.70	1517	76
FLSES 355 LC	250	989	2414	448	0.84	0.81	0.72	95.5	95.7	95.4	6.6	1.8	2.7	9.30	1688	76
FLSES 355 LKA	315	993	3029	579	0.82	0.78	0.68	95.7	95.8	95.2	7.8	2.1	3.2	13.45	2330	79
FLSES 355 LKB	355	991	3420	668	0.80	0.75	0.65	95.7	95.9	95.5	6.9	1.9	2.8	20.70	2725	79
FLS 400 LA*	*400*	*996*	*3851*	*778*	*0.78*	*0.72*	*0.61*	*95.1*	*94.8*	*93.6*	*8.0*	*2.0*	*2.2*	*33.00*	*3230*	*80*
FLS 400 LKB*	*500*	*996*	*4809*	*958*	*0.79*	*0.73*	*0.62*	*95.4*	*95.2*	*94.2*	*8.0*	*2.0*	*2.2*	*35.00*	*3350*	*80*
FLS 450 LB*	*500*	*996*	*4809*	*958*	*0.79*	*0.73*	*0.62*	*95.4*	*95.2*	*94.2*	*8.0*	*2.0*	*2.2*	*35.00*	*3400*	*80*
FLS 450 LB*	*550*	*996*	*5273*	*1038*	*0.80*	*0.74*	*0.63*	*95.6*	*95.7*	*95.0*	*7.5*	*1.8*	*1.9*	*35.00*	*3400*	*80*

** Motors are not concerned by IE2*

Shaft extensions

Dimensions in millimetres

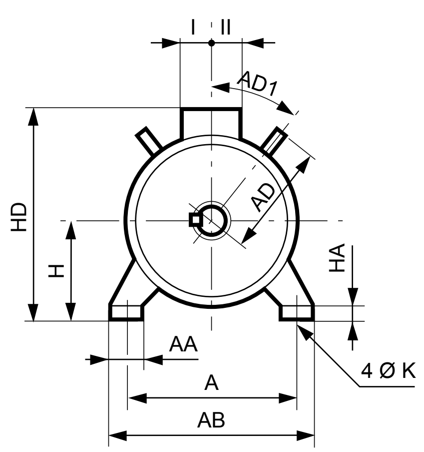


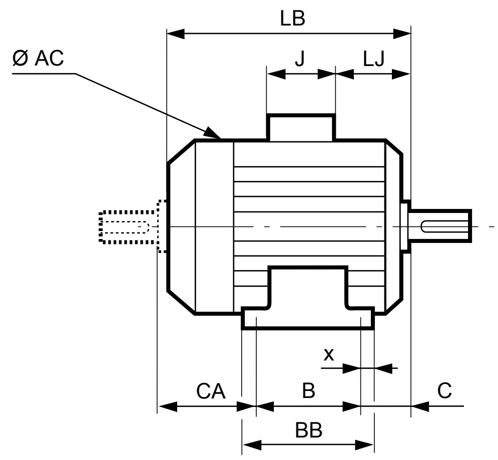
Type	Main shaft extensions																	
	4 and 6 poles									2 poles								
	F	GD	D	G	E	O	p	L	LO	F	GD	D	G	E	O	p	L	LO
FLSES 80 L/LG	6	6	19j6	15.5	40	6	16	30	6	6	6	19j6	15.5	40	6	16	30	6
FLSES 90 S/L/LU	8	7	24j6	20	50	8	19	40	6	8	7	24j6	20	50	8	19	40	6
FLSES 100 L/LK	8	7	28j6	24	60	10	22	50	6	8	7	28j6	24	60	10	22	50	6
FLSES 112 MG/MU	8	7	28j6	24	60	10	22	50	6	8	7	28j6	24	60	10	22	50	6
FLSES 132 S/M/MR/MU	10	8	38k6	33	80	12	28	63	10	10	8	38k6	33	80	12	28	63	10
FLSES 160 M/L/LU	12	8	42k6	37	110	16	36	100	6	12	8	42k6	37	110	16	36	100	6
FLSES 180 M/MR/L/LUR	14	9	48k6	42.5	110	16	36	98	12	14	9	48k6	42.5	110	16	36	98	12
FLSES 200 LU	16	10	55m6	49	110	20	42	90	20	16	10	55m6	49	110	20	42	90	20
FLSES 225 SR/M/MR	18	11	60m6	53	140	20	42	125	15	16	10	55m6	49	110	20	42	90	20
FLSES 250 M	18	11	65m6	58	140	20	42	125	15	18	11	60m6	53	140	20	42	125	15
FLSES 280 S/M	20	12	75m6	67.5	140	20	42	125	15	18	11	65m6	58	140	20	42	125	15
FLSES 315 S/M	22	14	80m6	71	170	20	42	140	30	18	11	65m6	58	140	20	42	125	15
FLSES 315 L	25	14	90m6	81	170	24	50	140	30	20	12	70m6	62.5	140	20	42	125	15
FLSES/FLS 355 L/LK	*28*	*16*	*100m6*	*90*	*210*	*24*	*50*	*180*	*30*	*22*	*14*	*80m6*	*71*	*170*	*20*	*42*	*140*	*30*
FLS 400 L/LK/LV	*28*	*16*	*110m6*	*100*	*210*	*24*	*50*	*180*	*30*	-	-	-	-	-	-	-	-	-
FLS 450 L/LV	*32*	*18*	*120m6*	*109*	*210*	*24*	*50*	*180*	*30*	-	-	-	-	-	-	-	-	-

Type	Secondary shaft extensions																	
	4 and 6 poles									2 poles								
	FA	GF	DA	GB	EA	OA	pA	L'	LO'	FA	GF	DA	GB	EA	OA	pA	L'	LO'
FLSES 80 L/LG	5	5	14j6	11	30	5	15	25	3.5	5	5	14j6	11	30	5	15	25	3.5
FLSES 90 S/L/LU	6	6	19j6	15.5	40	6	16	30	6	6	6	19j6	15.5	40	6	16	30	6
FLSES 100 L/LK	8	7	24j6	20	50	8	19	40	6	8	7	24j6	20	50	8	19	40	6
FLSES 112 MG/MU	8	7	24j6	20	50	8	19	40	6	8	7	24j6	20	50	8	19	40	6
FLSES 132 S/M/MR/MU	8	7	28k6	24	60	10	22	50	6	8	7	28k6	24	60	10	22	50	6
FLSES 160 M/L/LU	12	8	42k6	37	110	16	36	100	6	12	8	42k6	37	110	16	36	100	6
FLSES 180 M/MR/L/LUR	14	9	48k6	42.5	110	16	36	98	12	14	9	48k6	42.5	110	16	36	98	12
FLSES 200 LU	16	10	55m6	49	110	20	42	90	20	16	10	55m6	49	110	20	42	90	20
FLSES 225 SR/M/MR	18	11	60m6	53	140	20	42	125	15	16	10	55m6	49	110	20	42	90	20
FLSES 250 M	18	11	60m6	53	140	20	42	125	15	18	11	60m6	53	140	20	42	125	15
FLSES 280 S/M	20	12	60m6	53	140	20	42	125	15	18	11	60m6	53	140	20	42	125	15
FLSES 315 S/M	20	12	70m6	62.5	140	20	42	125	15	18	11	65m6	58	140	20	42	125	15
FLSES 315 L	20	12	70m6	62.5	140	20	42	125	15	20	12	70m6	62.5	140	20	42	125	15
FLSES 355 L	20	12	70m6	62.5	140	20	42	125	15	20	12	70m6	62.5	140	20	42	125	15
FLSES/FLS 355 LK	*28*	*16*	*100m6*	*90*	*210*	*24*	*50*	*180*	*30*	*22*	*14*	*80m6*	*71*	*170*	*20*	*42*	*140*	*30*
FLS 400 L/LK/LV	*28*	*16*	*110m6*	*100*	*210*	*24*	*50*	*180*	*30*	-	-	-	-	-	-	-	-	-
FLS 450 L/LV	*32*	*18*	*120m6*	*109*	*210*	*24*	*50*	*180*	*30*	-	-	-	-	-	-	-	-	-

Foot mounted IM 1001 (IM B3)

Dimensions in millimetres



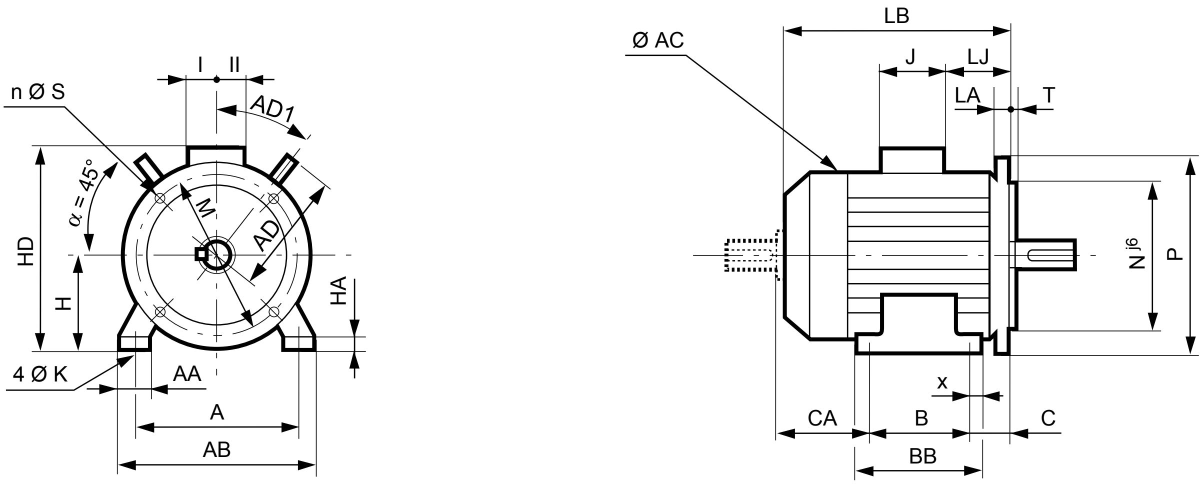


Type	Main dimensions																		
	A	AB	B	BB	C	X	AA	K	HA	H	AC*	HD	LB	LJ	J	I	II	AD	AD1
FLSES 80 L	125	170	100	130	50	18	32	10	10	80	170	228	212	7	136	68	68	-	-
FLSES 80 LG	125	170	100	130	52	23	32	10	10	80	185	238	245	9	136	68	68	-	-
FLSES 90 S	140	170	100	162	56	29	26	10	10	90	185	248	239	8.5	136	68	68	135	40
FLSES 90 L	140	170	125	162	56	29	26	10	10	90	185	248	239	8.5	136	68	68	135	40
FLSES 90 LU	140	170	125	162	56	29	26	10	10	90	185	248	266	8.5	136	68	68	135	40
FLSES 100 L	160	196	140	185	63	29	40	12	13	100	204	258	300	8	136	68	68	270	40
FLSES 100 LK	160	200	140	174	63	22	42	12	12	100	226	276.5	319	52	120	60	60	-	-
FLSES 112 MG	190	230	140	174	70	32	48	12	12	112	233	294	309	18.5	136	68	68	148	40
FLSES 112 MU	190	230	140	174	70	32	48	12	12	112	233	294	305	18.5	136	68	68	148	40
FLSES 132 S	216	255	140	240	89	48	63	12	16	132	262	347	385	23	136	68	68	165	37.5
FLSES 132 M	216	255	178	240	89	48	63	12	16	132	262	347	385	23	136	68	68	165	37.5
FLSES 132 MR	216	255	178	240	89	48	63	12	16	132	262	347	447	23	136	68	68	165	37.5
FLSES 132 MU	216	255	178	240	89	48	63	12	16	132	262	347	447	23	136	68	68	165	37.5
FLSES 160 M	254	294	210	294	108	20	65	14.5	20	160	312	440	495	30	246	126	147	-	-
FLSES 160 L	254	294	254	294	108	20	65	14.5	20	160	312	440	495	30	246	126	147	-	-
FLSES 160 LU	254	294	254	294	108	20	65	14.5	20	160	312	440	510	30	246	126	147	-	-
FLSES 180 M	279	330	279	335	121	28	70	14.5	28	180	350	481	552	42	246	126	147	-	-
FLSES 180 MR	279	324	241	295	121	25	80	14.5	25	180	312	460	510	30	246	126	147	-	-
FLSES 180 L	279	330	279	335	121	28	70	14.5	28	180	350	481	552	42	246	126	147	-	-
FLSES 180 LUR	279	330	279	335	121	28	70	14.5	28	180	350	481	552	42	246	126	147	-	-
FLSES 200 LU	318	374	305	361	133	28	80	18.5	44	200	410	530	672	49	246	126	147	230	45
FLSES 225 SR	356	426	286	375	149	32	80	18.5	26	225	410	555	678.5	55.5	246	126	147	230	45
FLSES 225 M	356	426	311	375	149	32	80	18.5	26	225	540	664	779	69.5	352	173	210	-	-
FLSES 225 MR	356	426	311	375	149	32	80	18.5	26	225	410	555	678.5	55.5	246	126	147	230	45
FLSES 250 M	406	476	349	413	168	32	80	24	26	250	540	689	779	69.5	352	173	210	-	-
FLSES 280 S	457	527	368	432	190	32	80	24	26	280	540	719	959	69.5	352	173	210	-	-
FLSES 280 M	457	527	419	483	190	32	80	24	26	280	540	719	959	69.5	352	173	210	-	-
FLSES 315 S	508	600	406	610	216	58	100	28	35	315	600	840	1177	101	452	219	269	343	45
FLSES 315 M	508	600	457	610	216	58	100	28	35	315	600	840	1177	101	452	219	269	343	45
FLSES 315 LA	508	600	508	610	216	58	100	28	35	315	600	840	1177	101	452	219	269	343	45
FLSES 315 LB	508	600	508	610	216	58	100	28	35	315	600	840	1177	101	452	219	269	343	45
FLSES 355 LA	610	710	630	756	254	76	100	28	35	355	822	922	1303	121	452	219	269	-	-
FLSES 355 LB	610	710	630	756	254	76	100	28	35	355	822	922	1303	121	452	219	269	-	-
FLSES 355 LC	610	710	630	756	254	76	100	28	35	355	822	922	1303	121	452	219	269	-	-
FLSES/FLS 355 LK	*610*	*750*	*630*	*815*	*254*	*40*	*128*	*28*	*45*	*355*	*787*	*1117*	*1702*	*52*	*700*	*224*	*396*	-	-
FLS 400 L/LV	*686*	*800*	*710*	*815*	*280*	*65*	*128*	*35*	*45*	*400*	*787*	*1162*	*1702*	*52*	*700*	*224*	*396*	-	-
FLS 400 LK	*686*	*824*	*800*	*950*	*280*	*59*	*140*	*35*	*45*	*400*	*877*	*1210*	*1740*	*68*	*700*	*224*	*396*	-	-
FLS 450 L/LV	*750*	*890*	*800*	*950*	*315*	*94*	*140*	*35*	*45*	*450*	*877*	*1260*	*1740*	*68*	*700*	*224*	*396*	-	-

* AC: housing diameter without lifting rings

Foot and flange mounted IM 2001 (IM B35)

Dimensions in millimetres

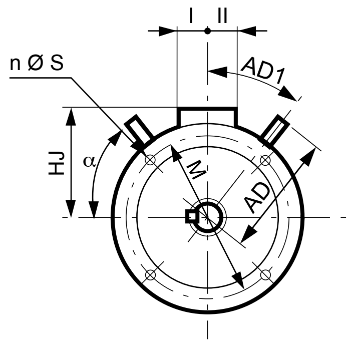


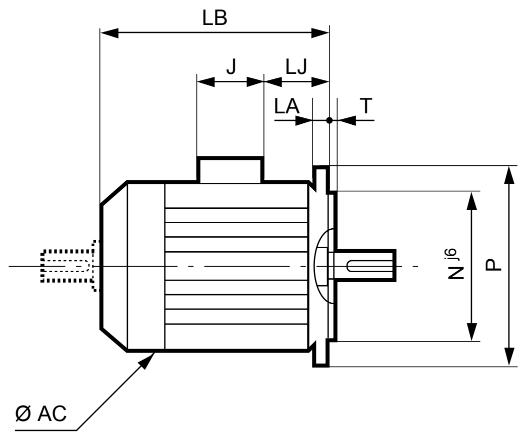
Type	Main dimensions																			
	A	AB	B	BB	C	X	AA	K	HA	H	AC*	HD	LB	LJ	J	I	II	AD	AD1	Symbol
FLSES 80 L	125	170	100	130	50	18	32	10	10	80	170	228	212	7	136	68	68	-	-	FF 165
FLSES 80 LG	125	170	100	130	70	23	32	10	10	80	185	238	265	9	136	68	68	-	-	FF 165
FLSES 90 S	140	170	100	162	76	29	26	10	10	90	185	248	261	46	136	68	68	135	40	FF 165
FLSES 90 L	140	170	125	162	76	29	26	10	10	90	185	248	261	8.5	136	68	68	135	40	FF 165
FLSES 90 LU	140	170	125	162	76	29	26	10	10	90	185	248	288	46	136	68	68	135	40	FF 165
FLSES 100 L	160	196	140	185	76	29	40	12	13	100	204	258	300	46	136	68	68	270	40	FF 215
FLSES 100 LK	160	200	140	174	63	22	42	12	12	100	226	276.5	319	52	120	60	60	-	-	FF 215
FLSES 112 MG	190	230	140	174	70	32	48	12	12	112	233	294	309	18.5	136	68	68	148	40	FF 215
FLSES 112 MU	190	230	140	174	70	32	48	12	12	112	233	294	305	18.5	136	68	68	148	40	FF 215
FLSES 132 S	216	255	140	240	89	48	63	12	16	132	262	347	385	23	136	68	68	165	37.5	FF 265
FLSES 132 M	216	255	178	240	89	48	63	12	16	132	262	347	385	23	136	68	68	165	37.5	FF 265
FLSES 132 MR	216	255	178	240	89	48	63	12	16	132	262	347	447	23	136	68	68	165	37.5	FF 265
FLSES 132 MU	216	255	178	240	89	48	63	12	16	132	262	347	447	23	136	68	68	165	37.5	FF 265
FLSES 160 M	254	294	210	294	108	20	65	14.5	20	160	312	440	495	30	246	126	147	-	-	FF 300
FLSES 160 L	254	294	254	294	108	20	65	14.5	20	160	312	440	495	30	246	126	147	-	-	FF 300
FLSES 160 LU	254	294	254	294	108	20	65	14.5	20	160	312	440	510	30	246	126	147	-	-	FF 300
FLSES 180 M	279	330	279	335	121	28	70	14.5	28	180	350	481	552	42	246	126	147	-	-	FF 300
FLSES 180 MR	279	324	241	295	121	25	80	14.5	25	180	312	460	510	30	246	126	147	-	-	FF 300
FLSES 180 L	279	330	279	335	121	28	70	14.5	28	180	350	481	552	42	246	126	147	-	-	FF 300
FLSES 180 LUR	279	330	279	335	121	28	70	14.5	28	180	350	481	552	42	246	126	147	-	-	FF 300
FLSES 200 LU	318	374	305	361	133	28	80	18.5	44	200	410	530	672	49	246	126	147	230	45	FF 350
FLSES 225 SR	356	426	286	375	149	32	80	18.5	26	225	410	555	678.5	55.5	246	126	147	230	45	FF 400
FLSES 225 M	356	426	311	375	149	32	80	18.5	26	225	540	664	779	69.5	352	173	210	-	-	FF 400
FLSES 225 MR	356	426	311	375	149	32	80	18.5	26	225	410	555	678.5	55.5	246	126	147	230	45	FF 400
FLSES 250 M	406	476	349	413	168	32	80	24	26	250	540	689	779	69.5	352	173	210	-	-	FF 500
FLSES 280 S	457	527	368	432	190	32	80	24	26	280	540	719	959	69.5	352	173	210	-	-	FF 500
FLSES 280 M	457	527	419	483	190	32	80	24	26	280	540	719	959	69.5	352	173	210	-	-	FF 500
FLSES 315 S	508	600	406	610	216	58	100	28	35	315	600	840	1177	101	452	219	269	343	45	FF 600
FLSES 315 M	508	600	457	610	216	58	100	28	35	315	600	840	1177	101	452	219	269	343	45	FF 600
FLSES 315 LA	508	600	508	610	216	58	100	28	35	315	600	840	1177	101	452	219	269	343	45	FF 600
FLSES 315 LB	508	600	508	610	216	58	100	28	35	315	600	840	1177	101	452	219	269	343	45	FF 600
FLSES 355 LA	610	710	630	756	254	76	100	28	35	355	822	922	1303	121	452	219	269	-	-	FF 740
FLSES 355 LB	610	710	630	756	254	76	100	28	35	355	822	922	1303	121	452	219	269	-	-	FF 740
FLSES 355 LC	610	710	630	756	254	76	100	28	35	355	822	922	1303	121	452	219	269	-	-	FF 740
FLSES/FLS 355 LK	*610*	*750*	*630*	*815*	*254*	*40*	*128*	*28*	*45*	*355*	*787*	*1117*	*1702*	*52*	*700*	*224*	*396*	-	-	*FF 740*
FLS 400 L/LV	*686*	*800*	*710*	*815*	*280*	*65*	*128*	*35*	*45*	*400*	*787*	*1162*	*1702*	*52*	*700*	*224*	*396*	-	-	*FF 940*
FLS 400 LK	*686*	*824*	*800*	*950*	*280*	*59*	*140*	*35*	*45*	*400*	*877*	*1210*	*1740*	*68*	*700*	*224*	*396*	-	-	*FF 940*
FLS 450 L/LV	*750*	*890*	*800*	*950*	*315*	*94*	*140*	*35*	*45*	*450*	*877*	*1260*	*1740*	*68*	*700*	*224*	*396*	-	-	*FF 1080*

* AC: housing diameter without lifting rings

Flange mounted IM 3001 (IM B5) IM 3011 (IM V1)

Dimensions in millimetres





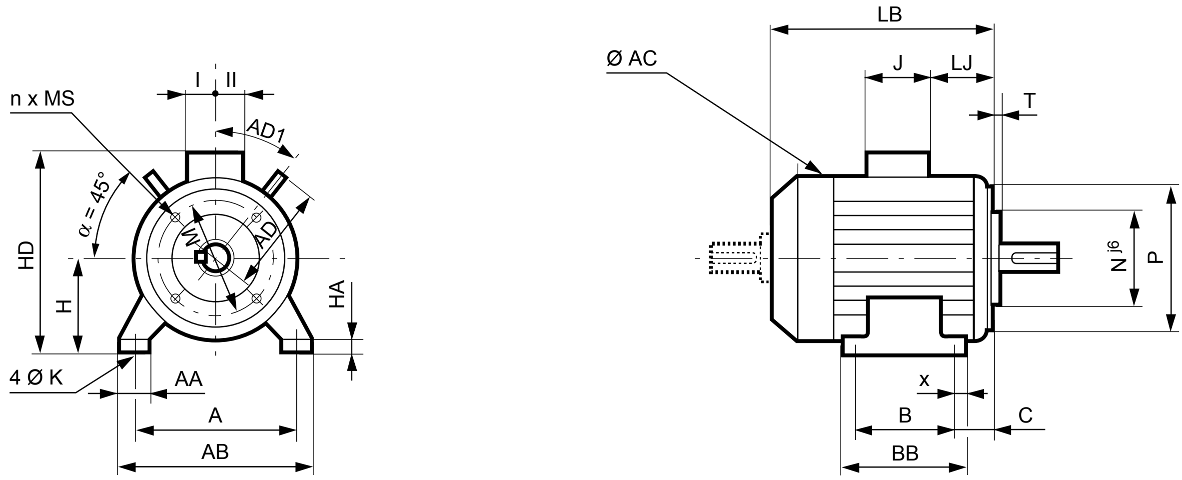
IEC symbol	Flange dimensions							
	M	N	P	T	n	α°	S	LA
FF 165	165	130	200	3.5	4	45	12	10
FF 165	165	130	200	3.5	4	45	12	10
FF 165	165	130	200	3.5	4	45	12	10
FF 165	165	130	200	3.5	4	45	12	10
FF 165	165	130	200	3.5	4	45	12	10
FF 215	215	180	250	4	4	45	14.5	12
FF 215	215	180	250	4	4	45	14.5	12
FF 215	215	180	250	4	4	45	14.5	12
FF 215	215	180	250	4	4	45	14.5	11
FF 265	265	230	300	4	4	45	14.5	12
FF 265	265	230	300	4	4	45	14.5	12
FF 265	265	230	300	4	4	45	14.5	12
FF 265	265	230	300	4	4	45	14.5	12
FF 300	300	250	350	5	4	45	18.5	14
FF 300	300	250	350	5	4	45	18.5	14
FF 300	300	250	350	5	4	45	18.5	14
FF 300	300	250	350	5	4	45	18.5	14
FF 300	300	250	350	5	4	45	18.5	14
FF 300	300	250	350	5	4	45	18.5	14
FF 300	300	250	350	5	4	45	18.5	14
FF 350	350	300	400	5	4	45	18.5	15
FF 400	400	350	450	5	8	22.5	18.5	16
FF 400	400	350	450	5	8	22.5	18.5	16
FF 400	400	350	450	5	8	22.5	18.5	16
FF 500	500	450	550	5	8	22.5	18.5	18
FF 500	500	450	550	5	8	22.5	18.5	18
FF 500	500	450	550	5	8	22.5	18.5	18
FF 600	600	550	660	6	8	22.5	24	22
FF 600	600	550	660	6	8	22.5	24	22
FF 600	600	550	660	6	8	22.5	24	22
FF 600	600	550	660	6	8	22.5	24	22
FF 740	740	680	800	6	8	22.5	24	25
FF 740	740	680	800	6	8	22.5	24	25
FF 740	740	680	800	6	8	22.5	24	25
FF 740	*740*	*680*	*800*	*6*	*8*	*22.5*	*24*	*25*
FF 940	*940*	*880*	*1000*	*6*	*8*	*22.5*	*28*	*28*
FF 940	*940*	*880*	*1000*	*6*	*8*	*22.5*	*28*	*28*
FF 1080	*1080*	*1000*	*1150*	*6*	*8*	*22.5*	*28*	*30*

Type	Main dimensions								
	AC*	LB	HJ	LJ	J	I	II	AD	AD1
FLSES 80 L	170	212	148	7	136	68	68	-	-
FLSES 80 LG	185	265	158	9	136	68	68	-	-
FLSES 90 S	185	261	158	46	136	68	68	135	40
FLSES 90 L	185	261	158	8.5	136	68	68	135	40
FLSES 90 LU	185	288	158	46	136	68	68	135	40
FLSES 100 L	204	300	158	46	136	68	68	270	40
FLSES 100 LK	226	319	176.5	52	120	60	60	-	-
FLSES 112 MG	233	309	182	18.5	136	68	68	148	40
FLSES 112 MU	233	305	182	18.5	136	68	68	148	40
FLSES 132 S	262	385	215	23	136	68	68	165	37.5
FLSES 132 M	262	385	215	23	136	68	68	165	37.5
FLSES 132 MR	262	447	215	23	136	68	68	165	37.5
FLSES 132 MU	262	447	215	23	136	68	68	165	37.5
FLSES 160 M	312	495	280	30	246	126	147	-	-
FLSES 160 L	312	495	280	30	246	126	147	-	-
FLSES 160 LU	312	510	280	30	246	126	147	-	-
FLSES 180 M	350	552	301	42	246	126	147	-	-
FLSES 180 MR	312	510	280	30	246	126	147	-	-
FLSES 180 L	350	552	301	42	246	126	147	-	-
FLSES 180 LUR	350	552	301	42	246	126	147	-	-
FLSES 200 LU	410	672	330	49	246	126	147	230	45
FLSES 225 SR	410	678.5	330	55.5	246	126	147	230	45
FLSES 225 M	540	779	439	69.5	352	173	210	-	-
FLSES 225 MR	410	678.5	330	55.5	246	126	147	230	45
FLSES 250 M	540	779	439	69.5	352	173	210	-	-
FLSES 280 S	540	959	439	69.5	352	173	210	-	-
FLSES 280 M	540	959	439	69.5	352	173	210	-	-
FLSES 315 S	600	1177	525	101	452	219	269	343	45
FLSES 315 M	600	1177	525	101	452	219	269	343	45
FLSES 315 LA	600	1177	525	101	452	219	269	343	45
FLSES 315 LB	600	1177	525	101	452	219	269	343	45
FLSES 355 LA	688	1303	567	121	452	219	269	-	-
FLSES 355 LB	688	1303	567	121	452	219	269	-	-
FLSES 355 LC	688	1303	567	121	452	219	269	-	-
FLSES/FLS 355 LK	*787*	*1702*	*762*	*52*	*700*	*224*	*396*	-	-
FLS 400 L/LV	*787*	*1702*	*762*	*52*	*700*	*224*	*396*	-	-
FLS 400 LK	*877*	*1740*	*810*	*68*	*700*	*224*	*396*	-	-
FLS 450 L/LV	*877*	*1740*	*810*	*68*	*700*	*224*	*396*	-	-

* AC: housing diameter without lifting rings

Foot and face mounted IM 2101 (IM B34)

Dimensions in millimetres

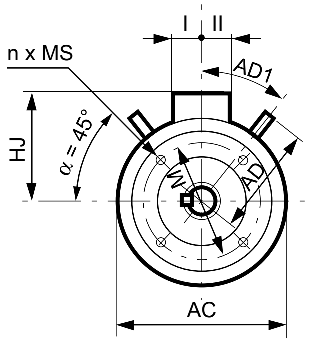


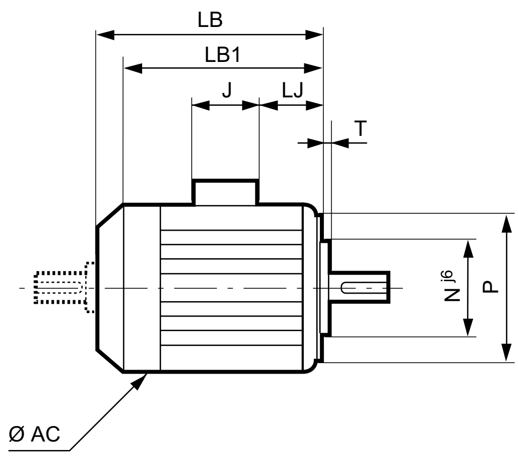
Type	Main dimensions																			
	A	AB	B	BB	C	X	AA	K	HA	H	AC*	HD	LB	LJ	J	I	II	AD	AD1	Symbol
FLSES 80 L	125	170	100	130	50	18	32	10	10	80	170	228	212	7	136	68	68	-	-	FT 100
FLSES 80 LG	125	170	100	130	70	23	32	10	10	80	185	238	245	9	136	68	68	-	-	FT 100
FLSES 90 S	140	170	100	162	76	29	26	10	10	90	185	248	239	8.5	136	68	68	135	40	FT 115
FLSES 90 L	140	170	125	162	76	29	26	10	10	90	185	248	239	8.5	136	68	68	135	40	FT 115
FLSES 90 LU	140	170	125	162	76	29	26	10	10	90	185	248	266	8.5	136	68	68	135	40	FT 115
FLSES 100 L	160	196	140	185	63	29	40	12	13	100	204	258	300	8	136	68	68	270	40	FT 130
FLSES 100 LK	160	200	140	174	63	22	42	12	12	100	226	276.5	319	52	120	60	60	-	-	FT 130
FLSES 112 MG	190	230	140	174	70	32	48	12	12	112	233	294	309	18.5	136	68	68	148	40	FT 130
FLSES 112 MU	190	230	140	174	70	32	48	12	12	112	233	294	305	18.5	136	68	68	148	40	FT 130
FLSES 132 S	216	255	140	240	89	48	63	12	16	132	262	347	385	23	136	68	68	165	37.5	FT 215
FLSES 132 M	216	255	178	240	89	48	63	12	16	132	262	347	385	23	136	68	68	165	37.5	FT 215
FLSES 132 MR	216	255	178	240	89	48	63	12	16	132	262	347	447	23	136	68	68	165	37.5	FT 215
FLSES 132 MU	216	255	178	240	89	48	63	12	16	132	262	347	447	23	136	68	68	165	37.5	FT 215

* AC: housing diameter without lifting rings

Face mounted IM 3601 (IM B14)

Dimensions in millimetres





IEC symbol	Faceplate dimensions					
	M	N	P	T	n	MS
FT 100	100	80	120	3	4	M6
FT 100	100	80	120	3	4	M6
FT 115	115	95	140	3	4	M8
FT 115	115	95	140	3	4	M8
FT 115	115	95	140	3	4	M8
FT 130	130	110	160	3.5	4	M8
FT 130	130	110	160	3.5	4	M8
FT 130	130	110	160	3.5	4	M8
FT 130	130	110	160	3.5	4	M8
FT 215	215	180	250	4	4	M12
FT 215	215	180	250	4	4	M12
FT 215	215	180	250	4	4	M12
FT 215	215	180	250	4	4	M12

Type	Main dimensions								
	AC*	LB	LB1**	LJ	J	I	II	AD	AD1
FLSES 80 L	170	212	7	136	68	68	-	-	-
FLSES 80 LG	185	245	9	136	68	68	-	-	-
FLSES 90 S	185	239	8.5	136	68	68	135	40	40
FLSES 90 L	185	239	8.5	136	68	68	135	40	40
FLSES 90 LU	185	266	8.5	136	68	68	135	40	40
FLSES 100 L	204	300	8	136	68	68	270	40	40
FLSES 100 LK	226	319	52	120	60	60	-	-	-
FLSES 112 MG	233	309	18.5	136	68	68	148	40	40
FLSES 112 MU	233	305	18.5	136	68	68	148	40	40
FLSES 132 S	262	385	23	136	68	68	165	37.5	37.5
FLSES 132 M	262	385	23	136	68	68	165	37.5	37.5
FLSES 132 MR	262	447	23	136	68	68	165	37.5	37.5
FLSES 132 MU	262	447	23	136	68	68	165	37.5	37.5

* AC: housing diameter without lifting rings
** LB1: non-ventilated motor

Non-standard flanges

Optionally, Emerson Industrial Automation motors can be fitted with flanges and faceplates that are larger or smaller than standard. This means that motors can be adapted to all types of situation without the need for costly and time-consuming modifications.

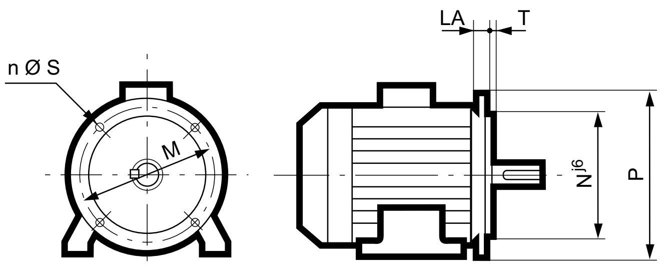
The tables below give the flange and faceplate dimensions and indicate flange/motor compatibility.
The bearing and shaft extension for each frame size remain standard.

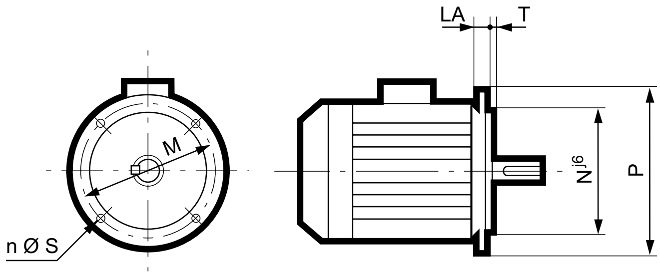
Dimensions in millimetres

(FF) Flange mounted

IEC symbol	Flange dimensions						
	M	N	P	T	n	S	LA
FF 115	115	95	140	3	4	10	10
FF 130	130	110	160	3.5	4	10	10
FF 165	165	130	200	3.5	4	12	10
FF 215	215	180	250	4	4	15	12
FF 265	265	230	300	4	4	15	14
FF 300	300	250	350	5	4	18.5	14
FF 350	350	300	400	5	4	18.5	15
FF 400	400	350	450	5	8	18.5	16
FF 500	500	450	550	5	8	18.5	18**
FF 600	600	550*	660	6	8	24	22
FF 740	*740*	*680**	*800*	*6*	*8*	*24*	*22*
FF 940	*940*	*880**	*1000*	*6*	*8*	*28*	*28*
FF 1080	*1080*	*1000**	*1150*	*6*	*8*	*28*	*30*

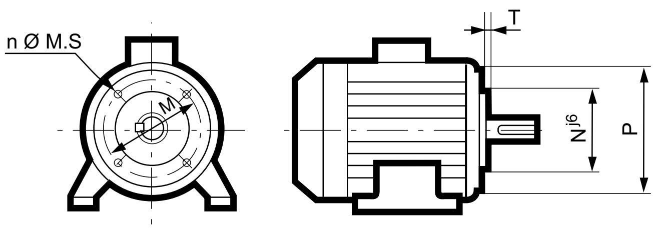
* Tolerance Njs^6
** LA = 22 for HA ≥ 280

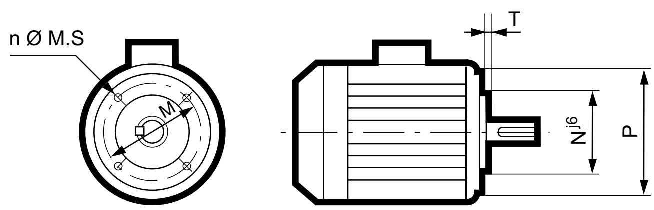




(FT) Face mounted

IEC symbol	Faceplate dimensions					
	M	N	P	T	n	M.S
FT 85	85	70	105	2.5	4	M6
FT 100	100	80	120	3	4	M6
FT 115	115	95	140	3	4	M8
FT 130	130	110	160	3.5	4	M8
FT 165	165	130	200	3.5	4	M10
FT 215	215	180	250	4	4	M12
FT 265	265	230	300	4	4	M12





Mechanical options

Modified flanges

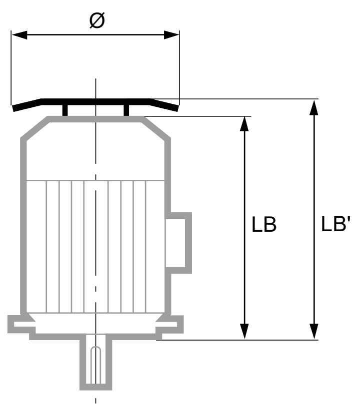
Motor type	Mounting forms \ Flange type	(FF) Flange mounted														(FT) Face mounted								
		FF 85	FF 100	FF 115	FF 130	FF 165	FF 215	FF 265	FF 300	FF 350	FF 400	FF 500	FF 600	FF 740	FF 940	FT 65	FT 75	FT 85	FT 100	FT 115	FT 130	FT 165	FT 215	FT 265
80 L	all	■	■	■	■	●	◆									◆	◆	◆	●	◆	◆	◆		
80 LG / 90	B5/B35 (1)	◆	◆	◆	◆	●	■	■										◆	◆	■	■	◆		
80 LG / 90	B3/B14/B34	■	■	■	■	■	■	■										◆	◆	●	◆	◆		
100 L	all	■	■	■	■	■	●	■										◆	◆	◆	●	◆		
100 LK	all				■	■	●	◆												◆	●	◆	◆	
112 MU/MG	all				■	■	●	◆												◆	●	◆	◆	
132 S/M/MR/MU	all					■	■	●	◆												■	■	●	
160 M/L/LU	all						◆	◆	●	◆														
180 M/MR/L/LUR	all							●	●	◆	◆ (1)													
200 LU	all									●	◆													
225 SR/M/MR	all										●	◆												
250 M	all										◆	●												
280 S/M	all										◆ (1)	●												
315 S	all											◆ (1)	●											
315 M/ML	all												●											
355 L	all												◆ (1)	●										
355 LK	all													●	◆									
400 L	all													●	◆									
400 LK	all													●	◆									
450	all													●	◆									

● Standard ■ Modified bearing location ◆ Adaptable without modification (1) dimension C need not comply with IEC 60072

Drip cover for operation in vertical position, shaft end facing down

Dimensions in millimetres

Motor type	LB'	Ø
FLSES 80	LB + 20	145
FLSES 90	LB + 20	185
FLSES 100	LB + 20	185
FLSES 112 MG	LB + 20	185
FLSES 112 MU	LB + 25	210
FLSES 132 S	LB + 25	210
FLSES 132 MR/MU/M	LB + 30	240
FLSES 160	LB + 60	320
FLSES 180 M/MR	LB + 60	320
FLSES 180 L/LUR	LB + 60	360
FLSES 200 LU	LB + 75	400
FLSES 225 M/MR	LB + 130	420
FLSES 225 SR	LB + 75	400
FLSES 250 M	LB + 130	420
FLSES 280	LB + 130	420
FLSES 315	LB + 118	620
FLSES 355 L	LB + 112	710
FLSES/FLS 355 LK	*LB + 160*	*650*
FLS 400/450	*LB + 160*	*650*

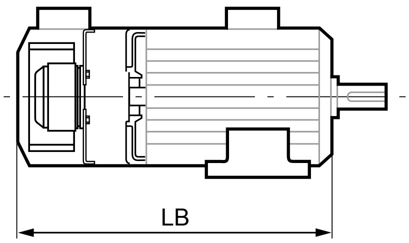


Motors with brake motors, forced ventilation, space heaters

The integration of high-efficiency motors within a process often requires accessories to make operation easier:
- Forced ventilation for motors used at high or low speeds.
- Holding brakes for maintaining the rotor in the stop position without needing to leave the motor switched on.
- Emergency stop brakes to immobilise loads in case of failure of the motor torque control or loss of power supply.

Notes:
- Without forced ventilation, there is a possibility of overspeed with optional class B balancing.
- The motor temperature is monitored by sensors built into the windings.

Series FLSES	LB dimensions with Forced Ventilation	
	Foot or face mounted motors	Flange mounted motor
80 L	317	
80 LG	331	353
90 S		
90 L		
90 LU		
100 L	373	
100 LK	422	
112 MG	412	
112 MU		
132 S	458	
132 MR		
132 M		
132 MU		
160M	641	
160 L		
160 LU	702	
180 MR	641	
180 M	689	
180 L		
180 LUR		
200 LU	819	
225 SR	825.5	
225 MR		
225 M	917	
250 M		
280 S	1167	
280 M	1167	
315 S	1477	
315 M		
315 LA/LB		
355 LA/LB/LC	1668	
355 LKA/LKB	1995	



HEATERS

Type	Power (W)
FLSES 80 L	16
FLSES 80 LG to 132	25
FLSES 160 to 200	52
FLSES 225 SR/MR	
FLSES 225 M	84
FLSES 250 M	
FLSES 280 to 315	100*
FLSES 355 - *FLS 355 to 450*	*150**

The space heaters use 220/240 V, single-phase, 50 or 60 Hz.

*** It is possible to increase the power when asking for estimate (quotation).**

Position of the lifting rings

LIFTING THE MOTOR ONLY

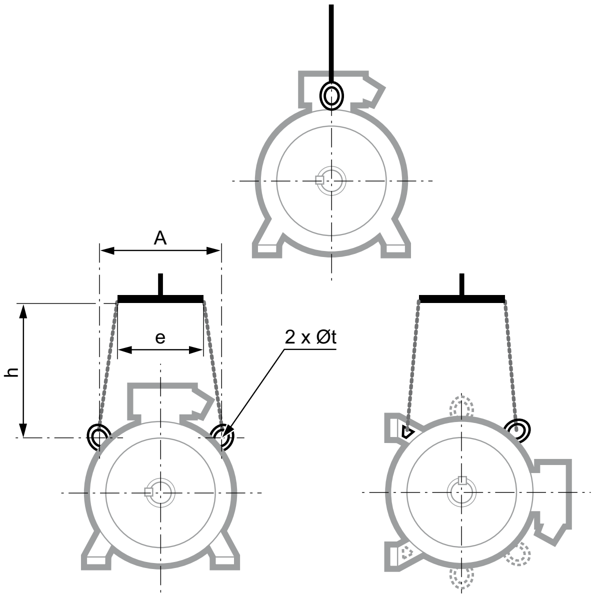
(not coupled to the machine)

The regulations stipulate that over 25 kg, suitable handling equipment must be used.

All our motors are fitted with grab handles, making them easier to handle without risk. A diagram of the sling hoisting method appears below with the required dimensions.

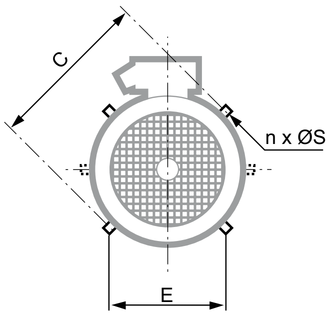
To prevent any damage to the motor during handling (for example: switching the motor from horizontal to vertical), it is essential to follow these instructions.

HORIZONTAL POSITION

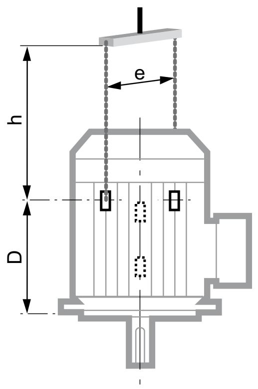


Type	Horizontal position			
	A	e min.	h min.	Øt
FLSES 100	152	200	150	22
FLSES 112	145	200	150	22
FLSES 132	180	200	150	25
FLSES 160	200	260	150	14
FLSES 180 M/MR	200	260	150	14
FLSES 180 L/LUR	200	260	150	14
FLSES 225 SR/MR	270	260	150	14
FLSES 225 M	360	265	200	30
FLSES 250	360	380	200	30
FLSES 280	360	380	500	30
FLSES 315 S/M/LA/LB	440	400	500	60
FLSES 355	545	500	500	60
FLSES/FLS 355LK	*685*	*710*	*500*	*30*
FLS 400	*735*	*710*	*500*	*30*
FLS 450	*730*	*710*	*500*	*30*

VERTICAL POSITION



View from above**



Side view

Separate ring ≤ 25 kg
Built-in ring > 25 kg

Type	Vertical position						
	C	E	D	n**	ØS	e min.*	h min.
FLSES 160	320	200	230	2	14	320	350
FLSES 180 M/MR	320	200	230	2	14	320	270
FLSES 180 L/LUR	390	265	290	2	14	390	320
FLSES 225 SR/MR	410	300	295	2	14	410	450
FLSES 225 M	480	360	405	4	30	540	350
FLSES 250	480	360	405	4	30	590	550
FLSES 280 S	480	360	585	4	30	590	550
FLSES 280 M	480	360	585	4	30	590	550
FLSES 315S/ M/LA/LB	620	-	715	2	35	650	550
FLSES 355	760	-	750	2	35	800	550
FLSES/FLS 355 LK	*810*	*350*	*1135*	*4*	*30*	*810*	*600*
FLS 400	*810*	*350*	*1135*	*4*	*30*	*810*	*600*
FLS 450	*960*	*400*	*1170*	*4*	*30*	*960*	*750*

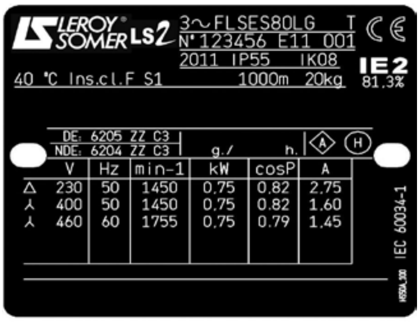
** if the motor is fitted with a drip cover, allow an additional 50 to 100 mm to avoid damaging it when the load is swung.*

*** if n = 2, the lifting rings form an angle of 90° with respect to the terminal box axis.*
if n = 4, this angle becomes 45°.

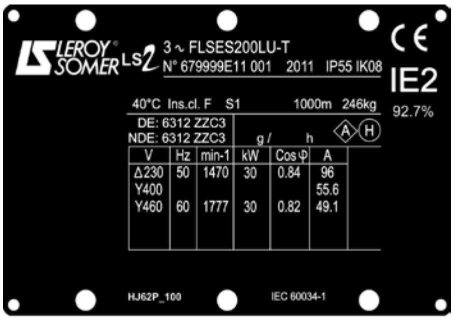
Identification

NAMEPLATES

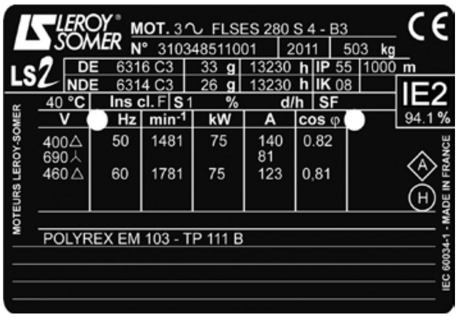
FLSES 80 to FLSES 132



FLSES 160 to FLSES 250



FLSES 280 to FLSES 355



* Other logos can optionally be provided: agreement prior to ordering is essential.

DEFINITION OF SYMBOLS USED ON NAMEPLATES

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

- **MOT 3 ~** : Three-phase A.C. motor
- **FLSES** : Series
- **200** : Frame size
- **LU** : Housing symbol
- **T** : Impregnation index

Motor no.

- **679999** : Serial number
- **E** : Month of production
- **11** : Year of production
- **001** : Motor batch number
- **IE2** : Efficiency class
- **92.7%** : Efficiency at 4/4 load

Please quote when ordering spare parts

- **IP55 IK08**: Index of protection
- **I cl. F** : Insulation class F
- **40°C** : Ambient operating temperature
- **S1** : Duty - Duty (operating) factor
- **kg** : Weight
- **V** : Supply voltage
- **Hz** : Supply frequency
- **min-1** : Revolutions per minute (rpm)
- **kW** : Rated power
- **cosφ** : Power factor
- **A** : Rated current
- **Δ** : Delta connection
- **Y** : Star connection

Bearings

- **DE** : Drive end bearing
- **NDE** : Non drive end bearing
- **g** : Amount of grease at each regreasing (in g)
- **h** : Regreasing interval (in hours)
- **POLYREX EM103**: Type of grease
- **(A)** : Vibration level
- **(H)** : Balancing mode

Designation

The complete motor **reference** described below will enable you to **order** the desired equipment.

The selection method consists of following the terms in the designation.

4P 1500 min^{-1}	PLSES	225	MG	55 kW	LS2/IE2	IM 1001 IM B3	230 / 400 V	50 Hz	IP 23
No. of poles speed(s)	Series designation	Frame size IEC 60072	Housing designation and manufacturer code	Rated output power	Range/ Efficiency class	Mounting arrangement IEC 60034-7	Mains voltage	Mains frequency	Protection IEC 60034-5

Description

Component	Materials	Remarks
Housing	Aluminium or steel	- aluminium: frame size 180 to 200, 250 SP/MP - steel: frame size 225 to 400 except 250 SP/MP - gravity or low pressure die casting, frame size ≤ 250 - lifting rings
Stator	Insulated low-carbon magnetic steel laminations Electroplated copper	- low carbon content guarantees long-term lamination pack stability - welded laminations - semi-enclosed slots - class F insulation
Rotor	Insulated low-carbon magnetic steel laminations Aluminium or copper	- inclined cage bars - rotor cage pressure die-cast in aluminium - rotor cage shrink-fitted to shaft - rotor balanced dynamically, class A, 1/2 key
Shaft	Steel	
End shields	Cast iron or steel	
Bearings and lubrication		**Standard mounting:** - ball bearings C3 play - permanently greased bearings for frame size ≤ 200 - regreasable bearings from frame size 225 upwards - bearings preloaded at non drive end
Labyrinth seal **Lipseals**	Plastic or steel Synthetic rubber	- lipseal at drive end for all motors
Fan	Composite Aluminium alloy or steel	- bidirectional fan in motors with 2 poles (P ≤ 250 kW), 4 poles for frame size 180 to 315 except 315 MGU and LG - unidirectional fan (direction of rotation to be specified at time of ordering) in motors with 2 poles, for frame size 315 MGU and LG
Fan cover	Pressed steel	- fitted, on request, with a drip cover for operation in vertical position, shaft end facing up
Terminal box	Composite Aluminium alloy or steel	- can be turned in 4 directions, opposite the feet - fitted as standard with a terminal block with 6 steel terminals - terminal box comes fitted with threaded plugs for frame size ≤ 280 SD/MD, for motors 280 MG to 315 and larger sizes, terminal box comes complete with a removable undrilled cable gland support plate, without cable gland - 1 earth terminal in each terminal box

Bearings and lubrication

PERMANENTLY GREASED BEARINGS

Under normal operating conditions, the service life in hours of the lubricant is indicated in the table below for ambient temperatures less than 55°C.

Series	Type	No. of poles	Types of permanently greased bearing		Grease life according to speed of rotation					
					3000 rpm			1500 rpm		
			N.D.E.	D.E.	25°C	40°C	55°C	25°C	40°C	55°C
PLSES	180 LG	2	6212 C3	6312 C3	≥40000	30000	15000	-	-	-
	180 LGU	4	6212 C3	6312 C3	-	-	-	≥40000	≥40000	25500
	200 M	2 ; 4	6212 C3	6313 C3	≥40000	25200	12600	≥40000	≥40000	23700
	200 LU	2	6214 C3	6314 C3	≥40000	22200	11100	-	-	-
	200 LR	4			-	-	-	≥40000	≥40000	22500

Note: on request, all motors can be fitted with grease nipples.

Bearings and lubrication

BEARINGS WITH GREASE NIPPLES

The chart opposite shows the greasing intervals, depending on the type of motor, for standard bearing assemblies of frame size ≥ 250 mm fitted with grease nipples, operating at an ambient temperature of 25°C, 40°C and 55°C on a horizontal shaft machine.

The chart below is valid for PLSES/PLS motors lubricated with Polyrex EM103 grease, which is used as standard.

SPECIAL CONSTRUCTION AND ENVIRONMENT

For vertical shaft machines, the greasing intervals will be approximately 80% of the values stated in the table below.

Note: The quality and quantity of grease and the greasing interval are shown on the machine nameplate.

For special assemblies (motors fitted with DE roller bearings or other types), machines of frame size ≥ 160 mm have bearings with grease nipples.

Instructions for bearing maintenance are given on the nameplates on these machines.

Series	Type	No. of poles	Type of bearing for bearings with grease nipples N.D.E.	D.E.	Quantity of grease g	Greasing intervals in hours 3000 rpm 25°C	3000 rpm 40°C	3000 rpm 55°C	1500 rpm 25°C	1500 rpm 40°C	1500 rpm 55°C
PLSES	180 LG*	2	6212 C3	6312 C3	20	15200	7600	3800	-	-	-
	180 LGU*	4			20	-	-	-	27000	13500	6750
	200 M*	2 ; 4	6212 C3	6313 C3	25	13400	6700	3350	25200	12600	6300
	200 LU*	2	6214 C3	6314 C3	25	11800	5900	2950	-	-	-
	200 LR*	4			25	-	-	-	23800	11900	5950
	225 MG	2 ; 4	6314 C3	6317 C3	40	8200	4100	2100	15000	10000	5000
	250 SP	2 ; 4			40	8200	4100	2100	15000	10000	5000
	250 MP	2			40	8200	4100	2100	-	-	-
	250 MF	4			40	-	-	-	15000	10000	5000
	280 SD	4			40				15000	10000	5000
	280 MD	2			40	8200	4100	2100	-	-	-
	280 MG	4	6316 C3	6320 C3	50	-	-	-	15000	7800	3900
	315 S	2		6316 C3	35	9200	4600	2300	-	-	-
	315 SUR	4		6320 C3	50	-	-	-	15000	7800	3900
	315 M	2		6316 C3	35	9200	4600	2300	-	-	-
	315 MUR	4		6320 C3	50	-	-	-	15000	7800	3900
	315 MGU	4	6317 C3	6322 C3	55	-	-	-	13200	13200	8316
	315 L	2	6316 C3	6316 C3	35	9200	4600	2300	-	-	-
	315 LD	2		6219 C3	35	8200	4100	2100	-	-	-
	315 LDS	4		6320 C3	50	-	-	-	15000	7800	3900
	315 LU	4		6224 C3	50	-	-	-	13400	6700	3400
PLSES/PLS	*315LG*	*2*	*6317 C3*	*6317 C3*	*35*	*6500*	*6500*	*4095*	-	-	-
		4	*6317 C3*	*6322 C3*	*55*	-	-	-	*13200*	*13200*	*8316*
PLS	*315 VLG/VLGU*	*2*	*6317 C3*	*6317 C3*	*35*	*6500*	*6500*	*4095*	-	-	-
		4	*6317 C3*	*6322 C3*	*55*	-	-	-	*13200*	*13200*	*8316*
	355 L	*2*	*6317 C3*	*6317 C3*	*35*	*6500*	*6500*	*4095*	-	-	-
		4	*6324 C3*	*6324 C3*	*72*	-	-	-	*7500*	*3700*	*2800*
	400 L	*4*	*6328 C3*	*6328 C3*	*93*	-	-	-	*4600*	*2300*	*1100*

** bearing with grease nipple available to order*

STANDARD BEARING FITTING ARRANGEMENTS

PLSES series		Horizontal shaft	Vertical shaft Shaft facing down	Vertical shaft Shaft facing up
Foot mounted motors	Mounting arrangement	B3	V5	V6
	standard mounting	The DE bearing is: - located at DE for frame 180 - locked for frame ≥ 200	The DE bearing is: - located at DE for frame 180 - locked for frame ≥ 200	The DE bearing is locked
	on request	DE bearing locked for frame 180	The DE bearing is locked for frame 180	
Flange mounted motors (or foot and flange)	Mounting arrangement	B5/B35	V1/V15	V3/V36
	standard mounting	The DE bearing is locked	The DE bearing is locked	The DE bearing is locked

Axial loads

Horizontal motor

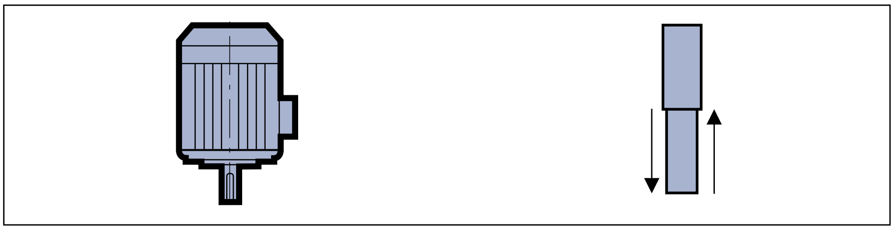
For a bearing life L_{10h} of 25,000 hours and 40,000 hours

Series	Type	No. of poles	Permissible axial load (en daN) on main shaft extension for standard bearing assembly IM B3 / B6, IM B7 / B8, IM B5 / B35							
			3000 rpm				1500 rpm			
			→		←		→		←	
			25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours
PLSES	180 LG	2	252	198	300	246	-	-	-	-
	180 LGU	4	-	-	-	-	336	264	384	312
	200 M	2 ; 4	287	226	335	274	387	307	435	355
	200 LU	2	321	253	387	319	-	-	-	-
	200 LR	4	-	-	-	-	403	313	469	379
	225 MG	2 ; 4	389	305	469	385	618	506	538	426
	250 SP	2 ; 4	385	301	465	381	585	474	505	394
	250 MP	2	377	294	457	374	-	-	-	-
	250 MF	4	-	-	-	-	569	459	489	379
	280 SD	4	-	-	-	-	531	423	451	343
	280 MD	2	368	286	448	366	-	-	-	-
	280 MG	4	-	-	-	-	783	642	603	462
	315 S	2	476	398	296	218	-	-	-	-
	315 SUR	4	-	-	-	-	748	609	568	429
	315 M	2	466	389	286	209	-	-	-	-
	315 MUR	4	-	-	-	-	720	582	540	402
	315 MGU	4	-	-	-	-	866	709	726	569
	315 LD	2 ; 4	382	317	202	137	751	612	571	432
	315 L	2	451	374	271	194	-	-	-	-
	315 LU	4	-	-	-	-	577	464	397	284
PLSES/PLS	*315 LG*	*2, 4*	*504*	*417*	*364*	*277*	*860*	*703*	*720*	*563*
PLS	*315 VLG*	*2 ; 4*	*508*	-	*208*	-	*880*	-	*580*	-
	315 VLGU	*4*	-	-	-	-	*846*	-	*546*	-
	355 L/LA/LB	*2 ; 4*	*135*	-	*415*	-	*414*	-	*694*	-
	400 L/LA/LB	*4*	-	-	-	-	*552*	-	*906*	-

Axial loads

**Vertical motor
Shaft facing down**

**For a bearing life L_{10h}
of 25,000 hours
and 40,000 hours**

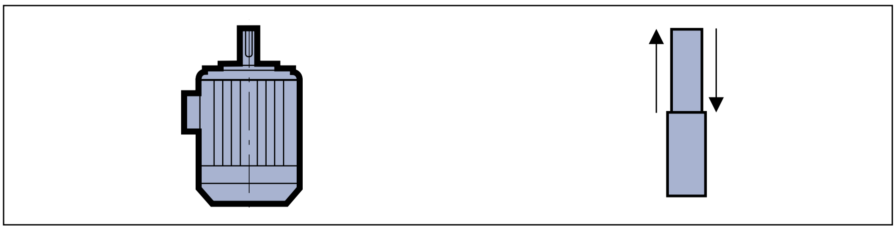


Series	Type	No. of poles	Permissible axial load (in daN) on main shaft extension for standard bearing assembly IM V5 IM V1 / V15							
			3000 rpm ↓		3000 rpm ↑		1500 rpm ↓		1500 rpm ↑	
			25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours
PLSES	180 LG	2	217	163	356	302	-	-	-	-
	180 LGU	4	-	-	-	-	293	221	455	383
	200 M	2 ; 4	247	187	396	335	347	265	501	420
	200 LU	2	288	220	438	369	-	-	-	-
	200 LR	4	-	-	-	-	346	255	566	476
	225 MG	2 ; 4	320	236	573	488	533	419	663	549
	250 SP	2 ; 4	312	228	574	490	490	377	661	548
	250 MP	2	300	216	576	492	-	-	-	-
	250 MF	4	-	-	-	-	457	345	677	564
	280 SD	4	-	-	-	-	416	302	665	554
	280 MD	2	279	195	591	507	-	-	-	-
	280 MG	4	-	-	-	-	593	449	897	753
	315 S	2	345	265	491	411	-	-	-	-
	315 SUR	4	-	-	-	-	531	388	921	778
	315 M	2	321	242	506	427	-	-	-	-
	315 MUR	4	-	-	-	-	472	329	960	818
	315 MGU	4	-	-	-	-	704	539	1000	835
	315 LD	2 ; 4	188	121	500	433	514	371	962	819
	315 L	2	286	207	529	450	-	-	-	-
	315 LU	4	-	-	-	-	322	204	832	714
PLSES/PLS	315 LG	2 ; 4	390	300	550	457	610	445	1124	957
PLS	315 VLG	2 ; 4	270	-	580	-	557	-	1085	-
	315 VLGU	4	-	-	-	-	483	-	1125	-
	355 L/LA/LB	2 ; 4	402	-	396	-	573	-	893	-
	400 L/LA/LB	4	-	-	-	-	568	-	1309	-

Axial loads

Vertical motor
Shaft facing up

For a bearing life L_{10h}
of 25,000 hours
and 40,000 hours

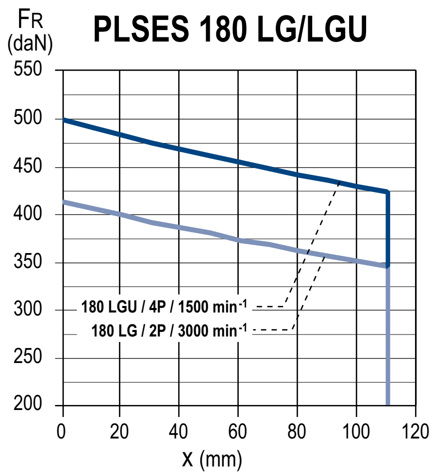


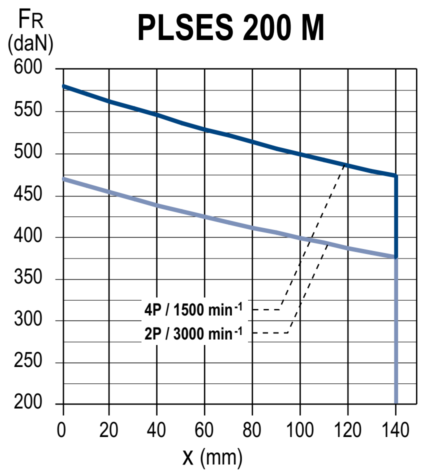
Series	Type	No. of poles	Permissible axial load (in daN) on main shaft extension for standard bearing assembly IM V6 IM V3 / V36							
			3000 rpm ↓		3000 rpm ↑		1500 t/rpm ↓		1500 t/rpm ↑	
			25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours	25,000 hours	40,000 hours
PLSES	180 LG	2	265	211	308	254	-	-	-	-
	180 LGU	4	-	-	-	-	341	269	407	335
	200 M	2 ; 4	295	235	348	287	395	313	453	372
	200 LU	2	354	286	372	303	-	-	-	-
	200 LR	4	-	-	-	-	412	321	500	410
	225 MG	2 ; 4	400	316	493	408	409	339	741	629
	250 SP	2 ; 4	392	308	494	410	410	297	741	628
	250 MP	2	380	296	496	412	-	-	-	-
	250 MF	4	-	-	-	-	377	265	757	644
	280 SD	4	-	-	-	-	745	222	333	634
	280 MD	2	359	275	511	427	-	-	-	-
	280 MG	4	-	-	-	-	413	269	1077	933
	315 S	2	165	85	671	591	-	-	-	-
	315 SUR	4	-	-	-	-	351	208	1101	958
	315 M	2	141	62	686	607	-	-	-	-
	315 MUR	4	-	-	-	-	292	149	1140	998
	315 MGU	4	-	-	-	-	704	539	1000	835
	315 LD	2 ; 4	8	-	680	613	334	191	1142	999
	315 L	2	106	27	709	630	-	-	-	-
	315 LU	4	-	-	-	-	142	24	1012	894
PLSES/PLS	*315 LG*	*2 ; 4*	*60*	*0*	*498*	*444*	*682*	*518*	*1011*	*848*
PLS	*315 VLG*	*2 ; 4*	*30*	*-*	*878*	*-*	*257*	*-*	*1385*	*-*
	315 VLGU	*4*	*-*	*-*	*-*	*-*	*183*	*-*	*1425*	*-*
	355 L/LA/LB	*2 ; 4*	*600*	*-*	*1396*	*-*	*427*	*-*	*1893*	*-*
	400 L/LA/LB	*4*	*-*	*-*	*-*	*-*	*632*	*-*	*2570*	*-*

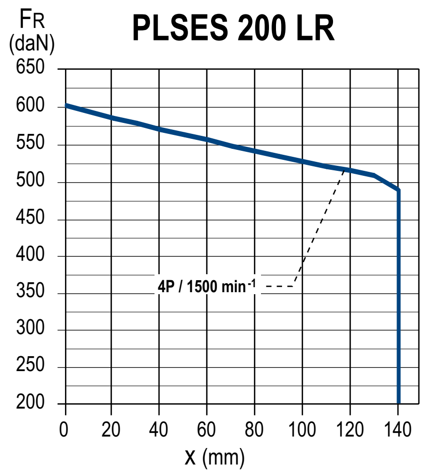
Radial loads

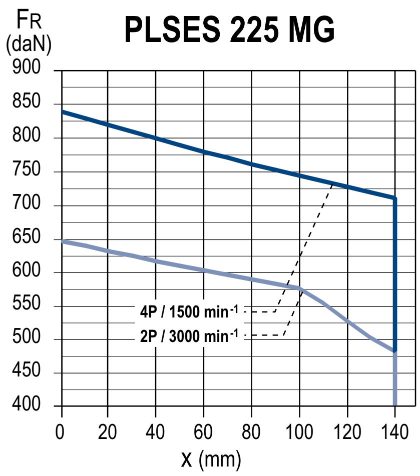
STANDARD FITTING ARRANGEMENT

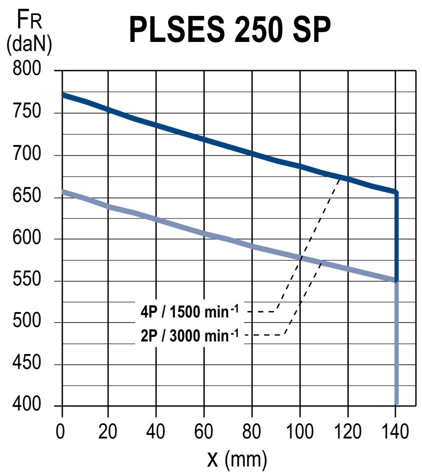
Permissible radial load on main shaft extension with a bearing life L10h of 25,000 hours.
FR: Radial Force
X : distance with respect to the shaft shoulder

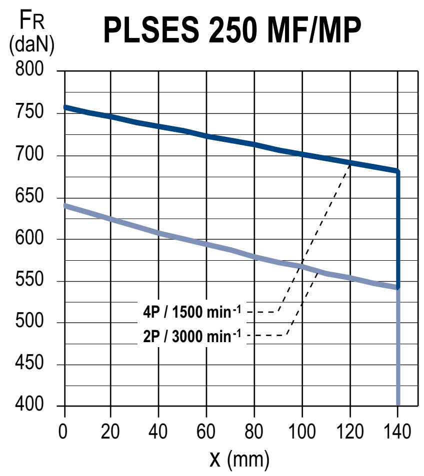


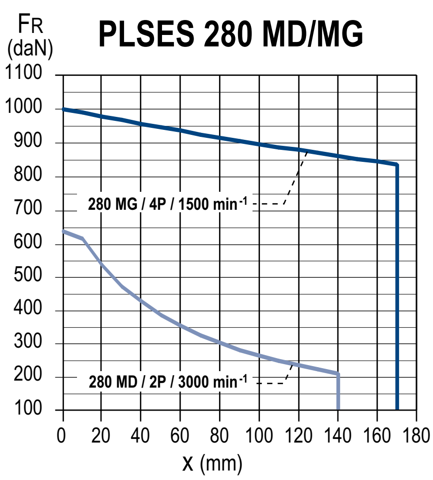


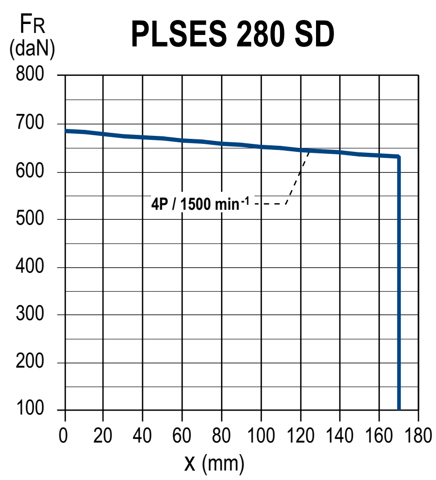


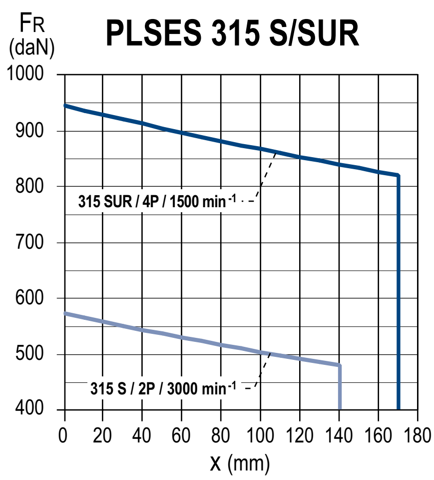








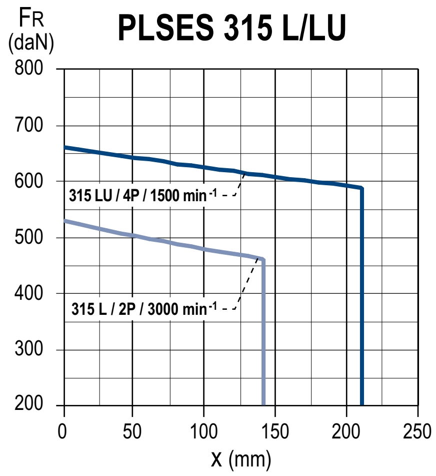


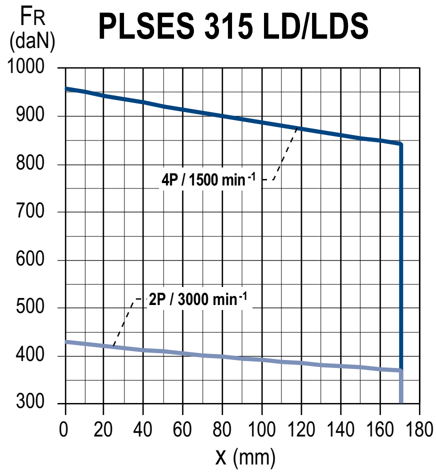


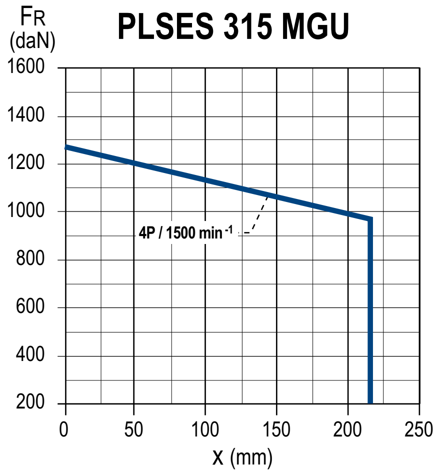
Radial loads

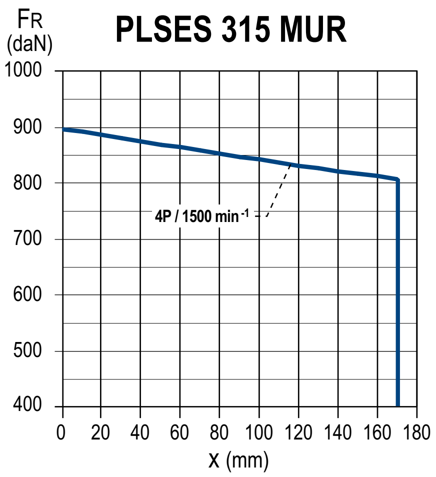
STANDARD FITTING ARRANGEMENT

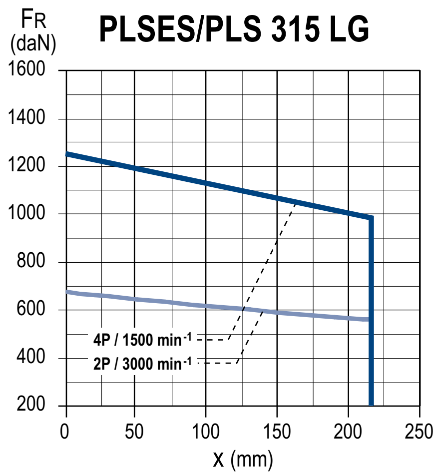
Permissible radial load on main shaft extension with a bearing life L10h of 25,000 hours.
FR: Radial Force
X : distance with respect to the shaft shoulder

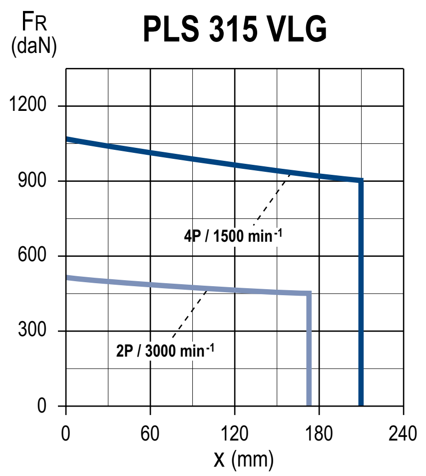


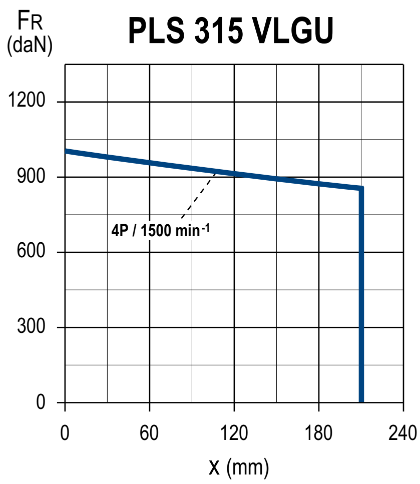


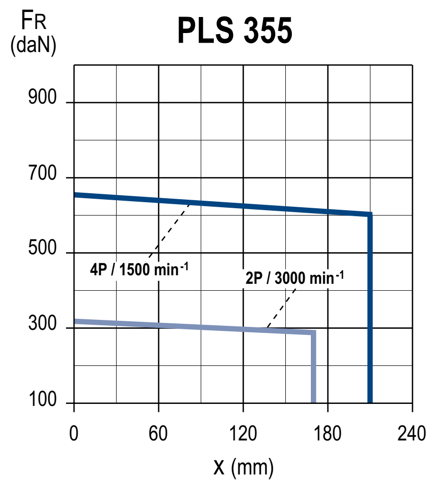


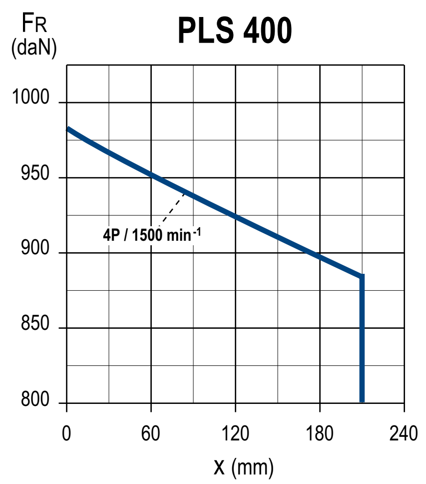












Radial loads

SPECIAL FITTING ARRANGEMENTS

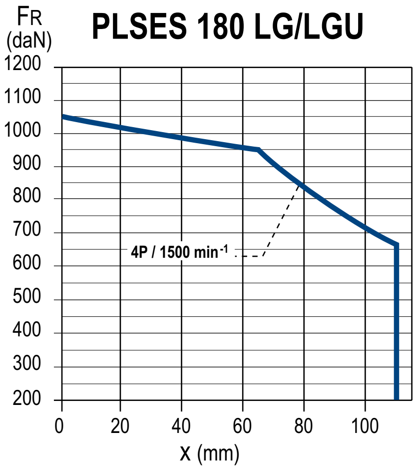
Type of drive end roller bearings

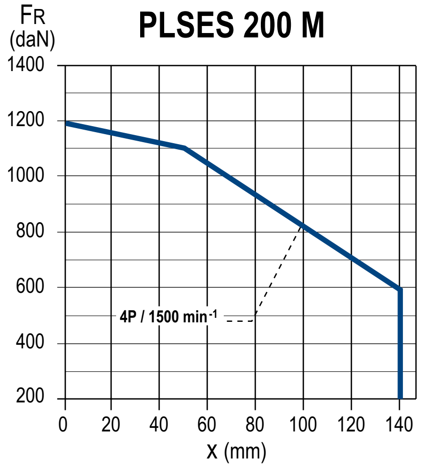
<table>
<tr><th>Series</th><th>Type</th><th>No. of poles</th><th>Non-drive end bearing
(N.D.E.)</th><th>Drive end bearing
(D.E.)</th></tr>
<tr><td rowspan="13">PLSES</td><td>180 LGU</td><td>4</td><td>6212 C3</td><td>NU 312</td></tr>
<tr><td>200 M</td><td>4</td><td>6212 C3</td><td>NU 313</td></tr>
<tr><td>200 LR</td><td>4</td><td>6214 C3</td><td>NU 314</td></tr>
<tr><td>225 MG</td><td>4</td><td rowspan="4">6314 C3</td><td rowspan="4">NU 317</td></tr>
<tr><td>250 SP</td><td>4</td></tr>
<tr><td>250 MF</td><td>4</td></tr>
<tr><td>280 SD</td><td>4</td></tr>
<tr><td>280 MG</td><td>4</td><td>6316 C3</td><td>NU 320</td></tr>
<tr><td>315 SUR</td><td>4</td><td>6316 C3</td><td>NU 320</td></tr>
<tr><td>315 MUR</td><td>4</td><td>6316 C3</td><td>NU 320</td></tr>
<tr><td>315 MGU</td><td>4</td><td>6317 C3</td><td>NU 322</td></tr>
<tr><td>315 LDS</td><td>4</td><td rowspan="2">6316 C3</td><td rowspan="2">NU 224</td></tr>
<tr><td>315 LU</td><td>4</td></tr>
<tr><td>PLSES/PLS</td><td>315 LG</td><td>4</td><td>6317 C3</td><td>NU 322</td></tr>
<tr><td rowspan="3">PLS</td><td>315 VLG/VLGU</td><td>4</td><td>6317 C3</td><td>NU 322</td></tr>
<tr><td>355 LA/LB</td><td>4</td><td>6324 C3</td><td>NU 324</td></tr>
<tr><td>400 LA/LB</td><td>4</td><td>6328 C3</td><td>NU 328</td></tr>
</table>

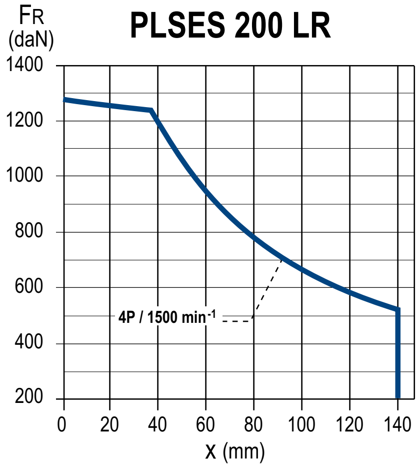
Radial loads

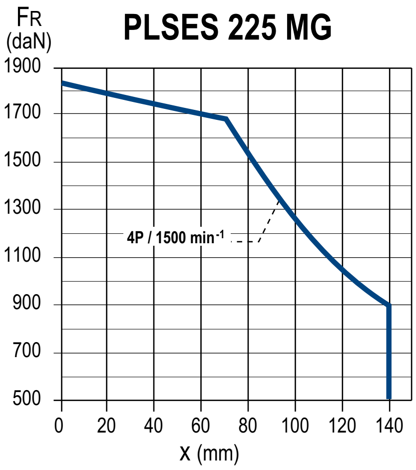
SPECIAL FITTING ARRANGEMENTS

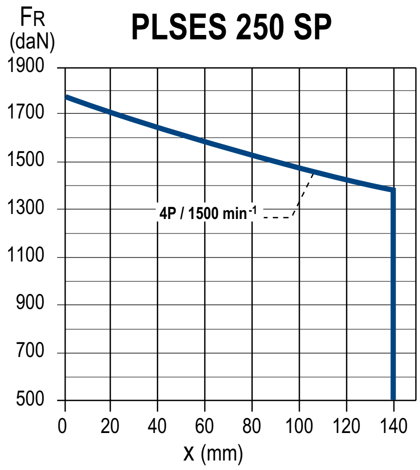
Permissible radial load on main shaft extension with a bearing life L10h of 25,000 hours.
FR: Radial Force
X : distance with respect to the shaft shoulder

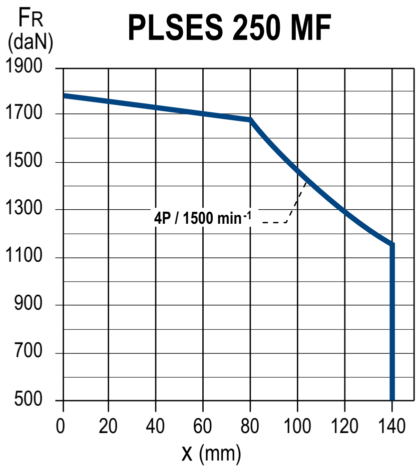


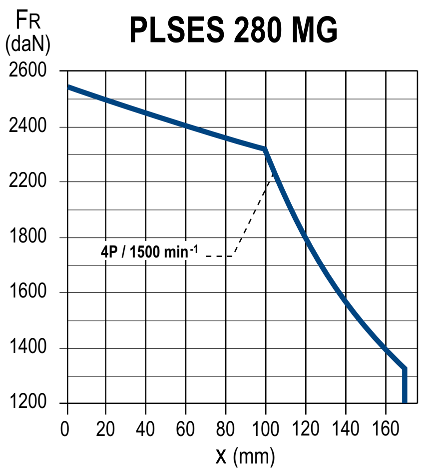


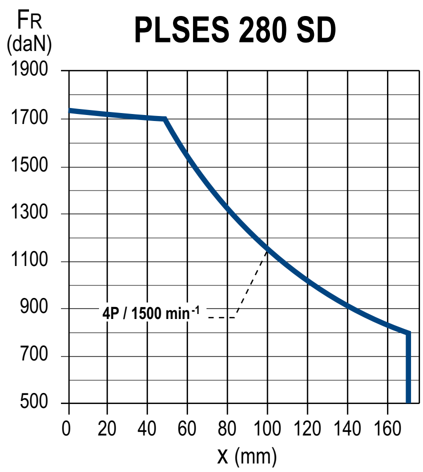








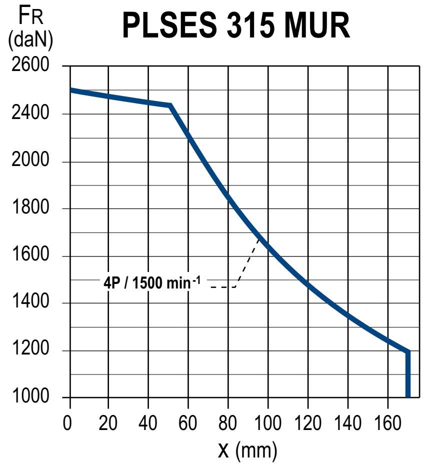


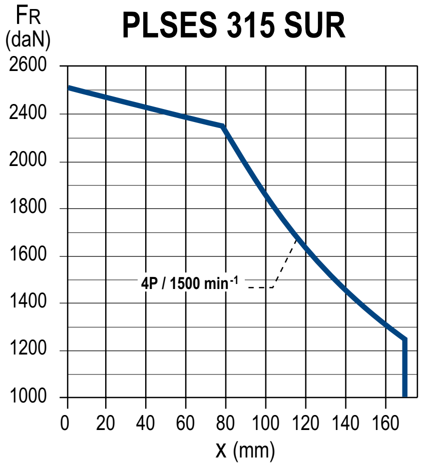


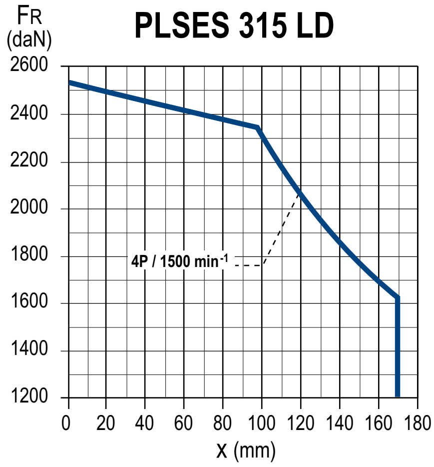
Radial loads

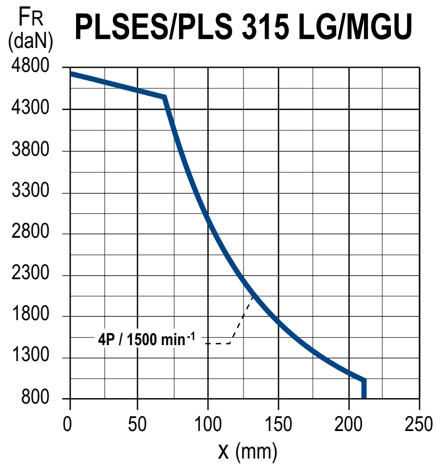
SPECIAL FITTING ARRANGEMENTS

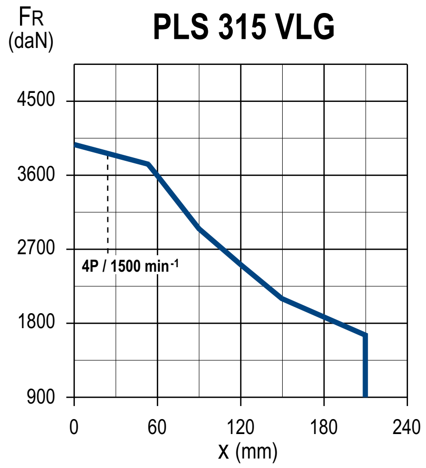
Permissible radial load on main shaft extension with a bearing life L10h of 25,000 hours.
FR: Radial Force
X : distance with respect to the shaft shoulder

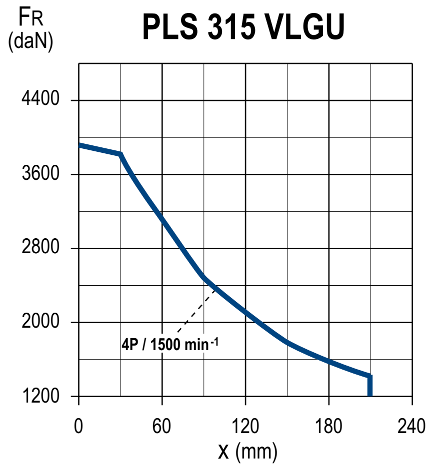


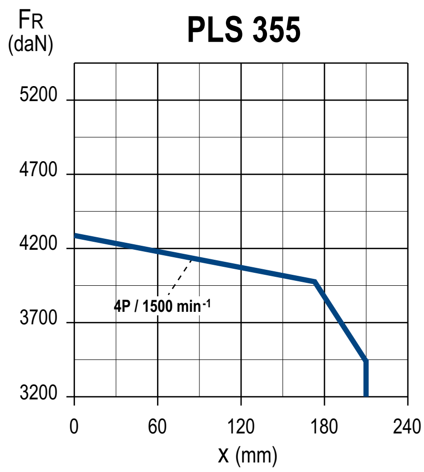


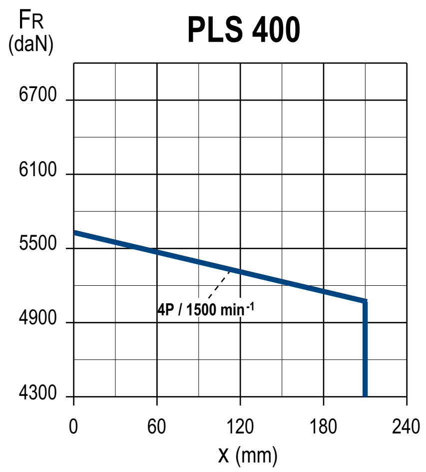












Mains connection

Descriptive table of terminal boxes for rated supply voltage of 400 V (According to EN 50262)

Series	Type	No. of poles	Terminal box material	Power + auxiliaries Number of drill holes	Power + auxiliaries Drill hole diameter
PLSES	**180**	2 ; 4	Aluminium alloy	3	2xM40 + 1xM16
	200	2 ; 4			
	225	2 ; 4			2xM63 + 1xM16
	250	2 ; 4			
	280 MD/SD	2 ; 4			
PLSES/PLS	***280 MG - 315 to 400***	*2 ; 4*		0	Removable undrilled mounting plate

TERMINAL BLOCKS
DIRECTION OF ROTATION

Standard motors are fitted with a block of six 6 terminals complying with standard NFC 51 120, with the terminal markings complying with IEC 60034-8 (or NFEN 60034-8).
When the motor is running in U1, V1, W1 or 1U, 1V, 1W from a direct mains supply L1, L2, L3, it turns clockwise when seen from the drive end.
If any two of the phases are changed over, the motor will run in an anti-clockwise direction (make sure that the motor has been designed to run in both directions).
If the motor is fitted with accessories (thermal protection or space heater), these must be connected on screw dominos with labelled wires.

Tightening torque for the nuts on the terminal blocks

Terminal	M8	M10	M12	M14	M16
Torque N.m	10	20	35	50	65

Series	Type	400 V Mains Power Supply – 230/400 V connections No. of poles	400 V Mains Power Supply – 230/400 V connections Terminals	400 V Mains Power Supply – 400 VD connections Terminals
PLSES	**180 LG**	2	M8	M8
	180 LGU	4	M8	M6
	200	2 ; 4	M10	M8
	225 MG	4		
	225 MG	2	M12	M10
	250 SP/MF	2 ; 4		
	250 MP	2	M16	M12
	280	2 ; 4		
	315 S/SUR	2 ; 4		
	315 M/MUR/L/LD/LU/LDS	2 ; 4	M16	M16
PLSES/PLS	***315 LG/MGU***	*2 ; 4*	*M12*	*M12*
PLS	***315 VLG/VLGU***	*2 ; 4*	*M12*	*M12*
	355 / 400	*2 ; 4*	*M14*	*M14*

2 poles - 3000 min^{-1}

IP23 - CLASS F - ΔT80K - S1 - CLASS IE2

Type	MAINS SUPPLY 400 V 50 Hz																
	Rated power	Rated speed	Rated torque	Rated current	Power factor			Efficiency IEC 60034-2-1 2007			Starting current/ Rated current	Starting torque/ Rated torque	Maximum torque/ Rated torque	Moment of inertia	Weight	Noise
	P_N	N_N	M_N	$I_{N\,(400V)}$	Cos ϕ			η			Id/In	Md/Mn	M_M/Mn	J	IM B3	LP
	kW	min^{-1}	N.m	A	4/4	3/4	2/4	4/4	3/4	2/4				kg.m^2	kg	db(A)
PLSES 180 LG	37	2958	120	68	0.85	0.80	0.70	92.8	92.8	91.8	7.4	2.8	3.1	0.081	167	76
PLSES 200 M	45	2952	145	79	0.88	0.85	0.78	93.0	93.4	93.0	7.5	2.8	3.1	0.102	182	76
PLSES 200 LU	55	2950	179	95	0.90	0.88	0.83	93.2	93.4	92.6	7.5	2.8	3.2	0.14	222	78
PLSES 225 MG	75	2973	241	131	0.88	0.85	0.77	93.9	93.8	92.8	8.5	2.5	3.1	0.17	364	78
PLSES 250 SP	90	2972	290	157	0.88	0.84	0.76	94.4	94.2	93.1	8.8	2.6	3.3	0.40	450	79
PLSES 250 MP	110	2970	352	194	0.86	0.83	0.74	94.4	94.4	93.6	8.6	2.6	3.6	0.44	381	79
PLSES 280 MD	132	2963	426	222	0.89	0.88	0.84	94.6	94.5	93.7	9.0	2.9	3.5	0.48	488	79
PLSES 315 S	160	2975	512	275	0.88	0.86	0.80	95.1	95.2	94.9	8.1	2.6	3.4	1.25	640	79
PLSES 315 M	200	2974	642	341	0.89	0.87	0.82	95.1	95.0	94.3	7.8	2.5	3.3	1.42	702	79
PLSES 315 L	250	2971	802	419	0.91	0.89	0.84	95.1	95.1	94.5	8.3	2.9	3.0	1.68	792	79
PLSES 315 LD	280	2973	900	466	0.91	0.90	0.87	95.2	95.4	95.0	8.0	2.8	3.0	1.97	885	85
PLSES 315 LD	315	2970	1011	531	0.90	0.88	0.82	95.1	95.2	94.8	7.5	2.8	3.1	1.97	891	85
PLSES 315 LG	355	2973	1140	610	0.88	0.87	0.85	95.4	95.6	95.0	5.8	1.8	2.3	2.80	1030	85
PLS 315 LG	*400*	*2965*	*1288*	*695*	*0.87*	-	-	*94.6*	-	-	*7.0*	*1.9*	*2.0*	*3.10*	*1120*	*89*
PLS 315 VLG	*450*	*2975*	*1444*	*778*	*0.87*	-	-	*95.1*	-	-	*7.0*	*1.9*	*2.1*	*3.50*	*1200*	*89*
PLS 355 LA	*500*	*2978*	*1602*	*872*	*0.87*	*0.85*	*0.78*	*95.1*	*95.1*	*94.9*	*6.1*	*1.2*	*2.7*	*6.30*	*1700*	*90*
PLS 355 LB	*710*	*2978*	*2277*	*1207*	*0.88*	-	-	*95.6*	-	-	*8.4*	*1.6*	*2.2*	*8.00*	*2050*	*90*

** Motors are not concerned by IE2*

4 poles - 1500 min⁻¹

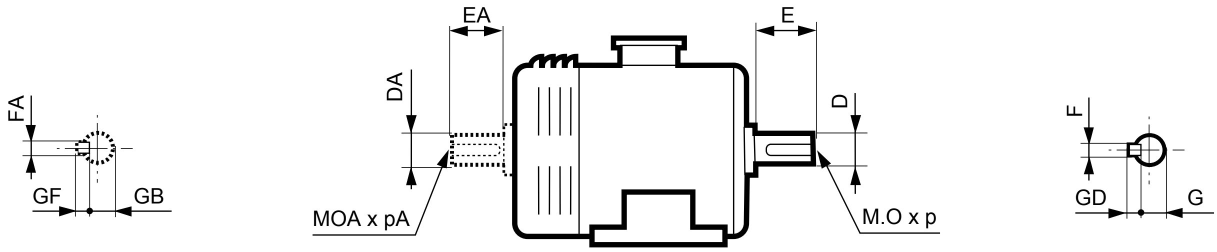
IP23 - CLASS F - ΔT80K - S1 - CLASS IE2

Type	MAINS SUPPLY 400 V 50 Hz															
	Rated power	Rated speed	Rated torque	Rated current	Power factor			Efficiency IEC 60034-2-1 2007			Starting current/ Rated current	Starting torque/ Rated torque	Maximum torque/ Rated torque	Moment of inertia	Weight	Noise
	P_N	N_N	M_N	$I_{N (400V)}$	Cos φ			η			Id/In	Md/Mn	M_M/Mn	J	IM B3	LP
	kW	min^{-1}	N.m	A	4/4	3/4	2/4	4/4	3/4	2/4				$kg.m^2$	kg	db(A)
PLSES 180 LGU	30	1467	195	58.0	0.81	0.76	0.65	92.4	93.2	93.1	6.5	2.8	2.6	0.123	168	76
PLSES 200 M	37	1469	239	71.0	0.81	0.76	0.66	92.9	93.6	93.6	6.5	2.7	2.7	0.15	186	76
PLSES 200 LR	45	1469	292	85.0	0.83	0.79	0.69	93.1	93.9	94.0	6.7	2.7	2.5	0.22	224	78
PLSES 225 MG	55	1482	355	104.0	0.81	0.76	0.65	93.5	93.7	93.0	7.0	2.6	2.6	0.36	353	78
PLSES 250 SP	75	1483	482	142.0	0.81	0.75	0.65	94.0	94.1	93.2	7.7	3.0	3.0	0.65	376	79
PLSES 250 MF	90	1480	581	164.0	0.84	0.80	0.71	94.3	94.6	94.0	7.2	2.7	2.9	0.75	461	79
PLSES 280 SD	110	1479	710	204.0	0.83	0.78	0.68	94.5	94.8	94.4	7.3	2.8	3.0	0.87	504	79
PLSES 280 MG	132	1485	849	245.0	0.82	0.78	0.68	94.8	94.7	93.8	7.6	2.8	3.1	1.07	698	79
PLSES 315 SUR	160	1486	1030	295.0	0.83	0.78	0.67	94.9	94.7	93.6	8.3	3.0	2.8	2.07	836	79
PLSES 315 MUR	200	1488	1282	370.0	0.82	0.78	0.68	95.1	95.2	94.6	8.5	3.1	3.4	2.48	942	79
PLSES 315 LDS	250	1482	1609	447.0	0.85	0.81	0.72	95.2	95.3	94.6	6.7	2.4	2.5	2.96	906	85
PLSES 315 LU	280	1481	1817	511.0	0.83	0.79	0.70	95.3	95.6	95.4	6.8	2.5	2.8	3.45	952	85
PLSES 315 MGU	315	1487	2023	562.0	0.85	0.82	0.72	95.2	95.3	94.7	6.6	2.2	2.8	4.60	1122	84
PLSES 315 LG	355	1488	2278	633.0	0.85	0.80	0.70	95.3	95.3	94.8	6.9	2.3	3.0	5.10	1153	84
PLS 315 LG*	*400*	*1477*	*2586*	*724*	*0.84*	-	-	*94.1*	-	-	*6.0*	*1.7*	*2.1*	*5.90*	*1130*	*86*
PLS 315 VLG*	*450*	*1480*	*2904*	*804*	*0.85*	-	-	*94.1*	-	-	*6.0*	*1.7*	*2.1*	*6.30*	*1280*	*86*
PLS 315 VLGU*1	*500*	*1479*	*3228*	*889*	*0.85*	-	-	*94.6*	-	-	*6.0*	*1.6*	*2.1*	*6.80*	*1350*	*86*
PLS 355 LA*	*550*	*1487*	*3532*	*973*	*0.85*	-	-	*95.1*	-	-	*6.8*	*1.6*	*2.2*	*10.5*	*1900*	*90*
PLS 355 LB*	*685*	*1488*	*4396*	*1211*	*0.85*	-	-	*95.1*	-	-	*7.0*	*1.6*	*2.2*	*12.0*	*2150*	*90*
PLS 400 LA*	*720*	*1491*	*4611*	*1267*	*0.85*	-	-	*95.6*	-	-	*7.5*	*1.7*	*2.2*	*21.6*	*2600*	*91*
PLS 400 LB*	*900*	*1491*	*5764*	*1584*	*0.85*	-	-	*95.6*	-	-	*7.0*	*1.7*	*2.2*	*27.0*	*3050*	*91*

** Motors are not concerned by IE2*
1. Class F temperature rise

Shaft extensions

Dimensions in millimetres

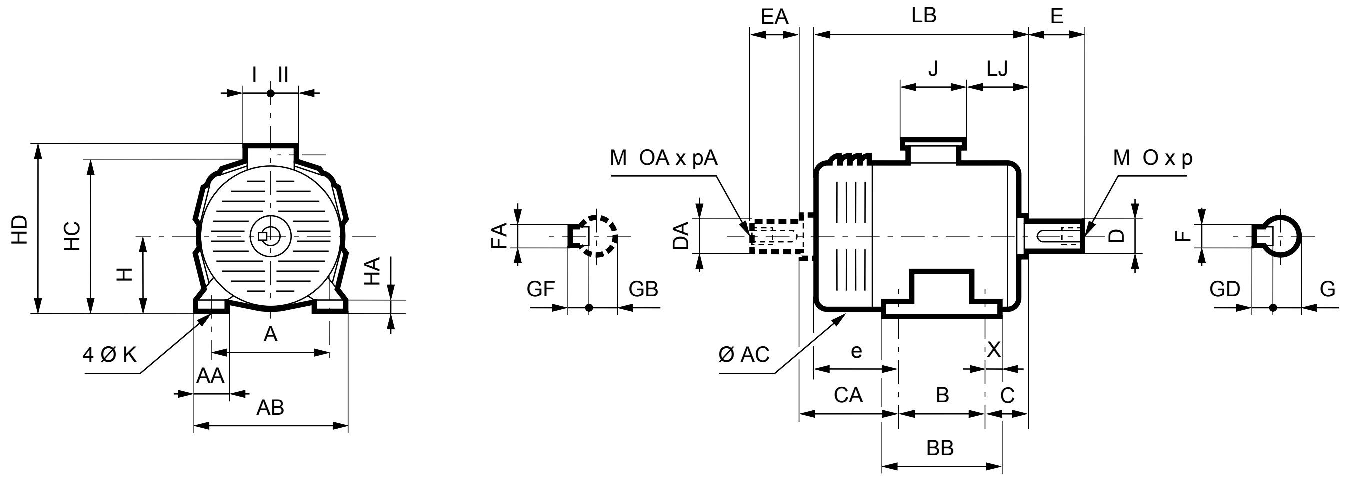


Type	Main shaft extensions													
	4 poles							2 poles						
	F	GD	D	G	E	O	p	F	GD	D	G	E	O	p
PLSES 180 LG/LGU	16	10	55m6	49	110	20	42	16	10	55m6	49	110	20	42
PLSES 200 M/LR/LU	18	11	60m6	53	140	20	42	18	10	60m6	53	140	20	42
PLSES 225 MG	18	11	65m6	58	140	20	42	18	11	60m6	53	140	20	42
PLSES 250 SP/MP/MF	20	12	75m6	67.5	140	20	42	18	11	65m6	58	140	20	42
PLSES 280 MD/MG	22	14	80m6	71	170	20	42	18	11	65m6	58	140	20	42
PLSES 315 S/SUR/L/LDS/M/MUR	25	14	90m6	81	170	24	50	20	12	70m6	62.5	140	20	42
PLSES 315 LU/LD	28	16	100m6	90	210	24	50	22	14	80m6	71	170	20	42
PLSES/PLS 315 LG/MGU/VLG/VLGU	*28*	*16*	*100m6*	*90*	*210*	*24*	*50*	*22*	*14*	*80m6*	*71*	*170*	*20*	*42*
PLS 355 L	*28*	*16*	*110m6*	*100*	*210*	*24*	*50*	*22*	*14*	*80m6*	*71*	*170*	*20*	*42*
PLS 400 L	*32*	*18*	*120m6*	*109*	*210*	*24*	*50*	-	-	-	-	-	-	-

Type	Secondary shaft extensions													
	4 and 6 poles							2 poles						
	FA	GF	DA	GB	EA	OA	pA	FA	GF	DA	GB	EA	OA	pA
PLSES 180 LG/LGU	16	10	55m6	49	110	20	42	16	10	55m6	49	110	20	42
PLSES 200 M/LR/LU	18	11	55m6	49	110	20	42	16	10	55m6	49	110	20	42
PLSES 225 MG	18	11	65m6	58	140	20	42	18	11	60m6	53	140	20	42
PLSES 250 SP/MP/MF	20	12	65m6	58	140	20	42	18	11	65m6	58	140	20	42
PLSES 280 MD/MG	20	12	65m6	58	140	20	42	18	11	65m6	58	140	20	42
PLSES 315 S/SUR/L/LDS/M/MUR	20	12	75m6	67.5	140	20	42	18	11	70m6	62.5	140	20	42
PLSES 315 LU/LD	20	12	75m6	67.5	140	20	42	18	11	70m6	62.5	140	20	42
PLSES/PLS 315 LG/MGU/VLG/VLGU	*22*	*14*	*80m6*	*71*	*170*	*20*	*42*	*22*	*14*	*80m6*	*71*	*170*	*20*	*42*
PLS 355 L	*28*	*16*	*110m6*	*100*	*210*	*24*	*50*	*22*	*14*	*80m6*	*71*	*170*	*20*	*42*
PLS 400 L	*32*	*18*	*120m6*	*109*	*210*	*24*	*50*	-	-	-	-	-	-	-

Foot mounted IM 1001 (IM B3)

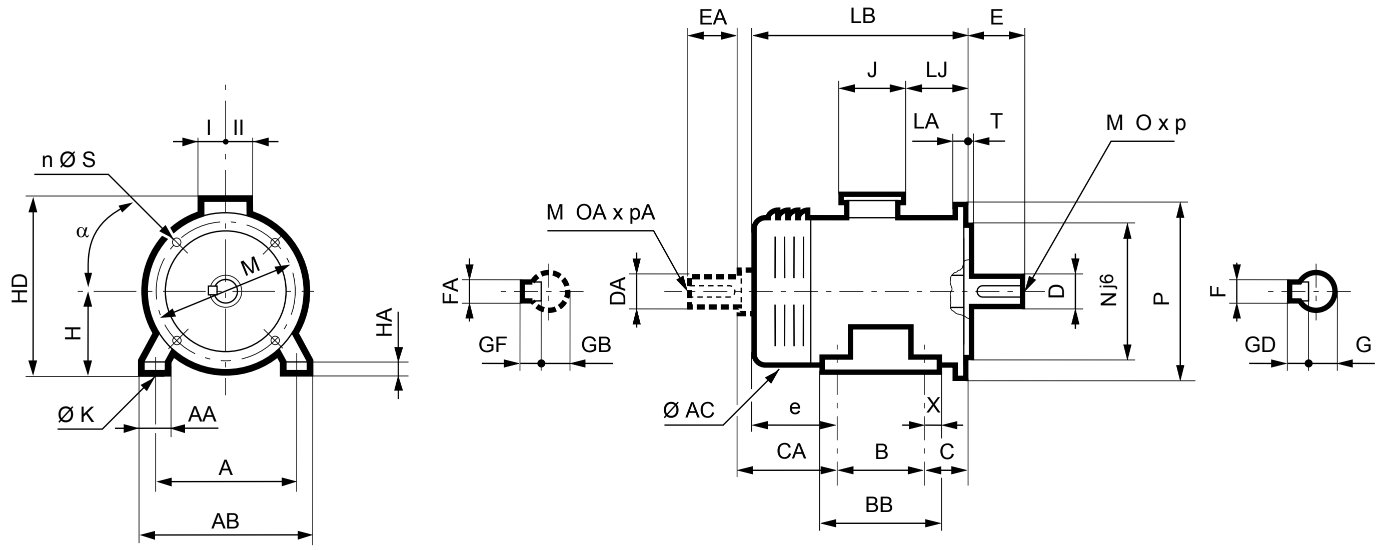
Dimensions in millimetres



Type	Main dimensions																
	A	AB	B	BB	C	X	AA	K	HA	H	AC	HD	LB	LJ	J	I	II
PLSES 180 LG	279	344	279	323	121	22	60	14.5	30	180	387	451	580	177	186	112	98
PLSES 180 LGU	279	344	279	323	121	22	60	14.5	30	180	387	451	630	177	186	112	98
PLSES 200 LR	318	378	305	345	133	20	60	18.5	32	200	437	496	707.5	213.5	186	112	98
PLSES 200 LU	318	378	305	345	133	20	60	18.5	32	200	437	496	692.5	213.5	186	112	98
PLSES 200 M	318	378	267	347	133	20	60	18.5	30	200	387	471	630	177	186	112	98
PLSES 225 MG	356	416	311	351	149	20	60	18.5	26	225	443	629	824	175.5	292	151	181
PLSES 250 MF	406	466	349	397	168	24	60	24	26	250	443	654	904	209	292	151	181
PLSES 250 MP	406	470	349	400	168	26	94	24	40	250	490	643	779	157.5	292	151	181
PLSES 250 SP	406	470	311	400	168	26	94	24	40	250	490	643	779	157.5	292	151	181
PLSES 280 MD	457	517	419	467	190	24	60	24	26	280	443	684	904	209	292	151	181
PLSES 280 MG	457	537	419	499	190	40	80	24	27	280	548	830	940	242	418	180	236
PLSES 280 SD	457	517	368	467	190	24	60	24	26	280	443	684	904	209	292	151	181
PLSES 315 L	508	608	508	588	216	40	100	28	26	315	548	865	1026	242	418	180	236
PLSES 315 LD/LDS	508	608	508	588	216	40	100	28	26	315	548	865	1086	242	418	180	236
PLSES 315 LG	508	608	508	588	216	40	100	27	26	315	660	880	1141	248	418	206	206
PLSES 315 LU	508	608	508	588	216	40	100	28	26	315	548	865	1106	242	418	180	236
PLSES 315 M	508	608	457	537	216	40	100	28	26	315	600	865	940	242	418	180	236
PLSES 315 MGU	508	608	457	588	216	40	100	28	26	315	660	880	1141	248	418	206	206
PLSES 315 MUR	508	608	457	537	216	40	100	28	26	315	600	865	1106	242	418	180	236
PLSES 315 S	508	608	406	486	216	40	100	28	26	315	600	865	881	242	418	180	236
PLSES 315 SUR	508	608	406	486	216	40	100	28	26	315	600	865	1026	242	418	180	236
PLS 315 VLG	*508*	*608*	*560*	*640*	*216*	*40*	*100*	*27*	*26*	*315*	*660*	*890*	*1191*	*248*	*428*	*205*	*195*
PLS 315 VLGU	*508*	*608*	*560*	*640*	*216*	*40*	*100*	*27*	*26*	*315*	*660*	*890*	*1261*	*248*	*428*	*205*	*195*
PLS 355 L	*610*	*710*	*630*	*710*	*254*	*30*	*100*	*28*	*26*	*355*	*705*	*1078*	*1470*	*130*	*700*	*224*	*396*
PLS 400 L	*686*	*806*	*710*	*800*	*280*	*45*	*80*	*35*	*26*	*400*	*795*	*1173*	*1755*	*177*	*700*	*224*	*396*

Foot and flange mounted IM 2001 (IM B35)

Dimensions in millimetres



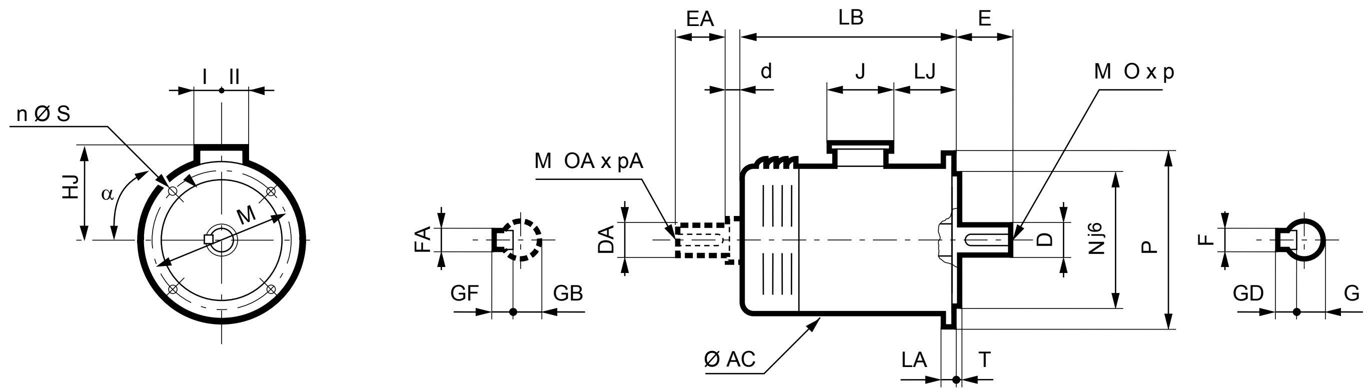
Type	Main dimensions																	
	A	AB	B	BB	C	X	AA	K	HA	H	AC	HD	HJ	LB	LJ	J	I	II	Symbol
PLSES 180 LG	279	344	279	323	121	22	60	14.5	30	180	387	451	271	580	177	186	112	98	FF 350
PLSES 180 LGU	279	344	279	323	121	22	60	14.5	30	180	387	451	271	630	177	186	112	98	FF 350
PLSES 200 LR	318	378	305	345	133	20	60	18.5	32	200	437	496	296	707.5	213.5	186	112	98	FF 400
PLSES 200 LU	318	378	305	345	133	20	60	18.5	32	200	437	496	296	692.5	213.5	186	112	98	FF 400
PLSES 200 M	318	378	267	347	133	20	60	18.5	30	200	387	471	271	630	177	186	112	98	FF 400
PLSES 225 MG	356	416	311	351	76	20	60	18.5	26	225	443	629	404	824	175.5	292	151	181	FF 500
PLSES 250 MF*	406	466	349	397	168	24	60	24	26	250	443	654	404	904	209	292	151	181	FF 600
PLSES 250 MP*	406	470	349	400	168	26	94	24	40	250	490	643	393	779	157.5	292	151	181	FF 600
PLSES 250 SP*	406	470	311	400	168	26	94	24	40	250	490	643	393	779	157.5	292	151	181	FF 600
PLSES 280 MD*	457	517	419	467	190	24	60	24	26	280	443	684	404	904	209	292	151	181	FF 600
PLSES 280 MG*	457	537	419	499	190	40	80	24	27	280	548	830	550	940	242	418	180	236	FF 600
PLSES 280 SD*	457	517	419	467	190	24	60	24	26	280	443	684	404	904	209	292	151	181	FF 600
PLSES 315 L*	508	608	508	588	216	40	100	28	26	315	548	865	550	1026	242	418	180	236	FF 740
PLSES 315 LD/LDS*	508	608	508	588	216	40	100	28	26	315	548	865	550	1086	242	418	180	236	FF 740
PLSES 315 LG*	508	608	508	588	216	40	100	28	26	315	660	880	565	1141	248	418	206	206	FF 740
PLSES 315 LU*	508	608	508	588	216	40	100	28	26	315	548	865	550	1106	242	418	180	236	FF 740
PLSES 315 M*	508	608	457	537	216	40	100	28	26	315	600	865	550	940	242	418	180	236	FF 740
PLSES 315 MGU*	508	608	457	588	216	40	100	28	26	315	660	880	565	1141	248	418	206	206	FF 740
PLSES 315 MUR*	508	608	457	537	216	40	100	28	26	315	600	865	550	1106	242	418	180	236	FF 740
PLSES 315 S*	508	608	406	486	216	40	100	28	26	315	600	865	550	881	242	418	180	236	FF 740
PLSES 315 SUR*	508	608	406	486	216	40	100	28	26	315	600	865	550	1026	242	418	180	236	FF 740
PLS 315 VLG	*508*	*608*	*560*	*640*	*216*	*40*	*100*	*27*	*26*	*315*	*660*	*890*	*575*	*1191*	*248*	*428*	*205*	*195*	*FF740*
PLS 315 VLGU	*508*	*608*	*560*	*640*	*216*	*40*	*100*	*27*	*26*	*315*	*660*	*890*	*575*	*1261*	*248*	*428*	*205*	*195*	*FF740*
PLS 355 L	*610*	*710*	*630*	*710*	*254*	*30*	*100*	*27*	*26*	*355*	*705*	*1078*	*723*	*1470*	*130*	*700*	*224*	*396*	*FF 940*
PLS 400 L	*686*	*806*	*710*	*800*	*280*	*45*	*100*	*35*	*26*	*400*	*795*	*1173*	*773*	*1755*	*177*	*700*	*224*	*396*	*FF 940*

* For frame size ≥ 250 mm used as IM B5 (IM 3001), please consult Emerson Industrial Automation.

IEC symbol	Flange dimensions							
	M	N	P	T	n	α°	S	LA
FF 350	350	300	400	5	4	45	18.5	15
FF 400	400	350	450	5	8	22.5	18.5	16
FF 500	500	450	550	5	8	22.5	18.5	18
FF 600	600	550	660	6	8	22.5	24	25
FF 740	*740*	*680*	*800*	*6*	*8*	*22.5*	*24*	*25*
FF 940	*940*	*880*	*1000*	*6*	*8*	*22.5*	*28*	*28*
FF 1080	*1080*	*1000*	*1150*	*6*	*8*	*22.5*	*28*	*30*

Flange mounted IM 3001 (IM B5) IM 3011 (IM V1)

Dimensions in millimetres



Type	Main dimensions							
	AC	HJ	LB	LJ	J	I	II	Symbol
PLSES 180 LG	387	271	580	177	186	112	98	FF 350
PLSES 180 LGU	387	271	630	177	186	112	98	FF 350
PLSES 200 LR	437	296	707.5	213.5	186	112	98	FF 400
PLSES 200 LU	437	296	692.5	213.5	186	112	98	FF 400
PLSES 200 M	387	271	630	177	186	112	98	FF 400
PLSES 225 MG	443	404	824	175.5	292	151	181	FF 500
PLSES 250 MF*	443	404	904	209	292	151	181	FF 600
PLSES 250 MP*	490	393	779	157.5	292	151	181	FF 600
PLSES 250 SP*	490	393	779	157.5	292	151	181	FF 600
PLSES 280 MD*	443	404	904	209	292	151	181	FF 600
PLSES 280 MG*	548	550	940	242	418	180	236	FF 600
PLSES 280 SD*	443	404	904	209	292	151	181	FF 600
PLSES 315 L*	548	550	1026	242	418	180	236	FF 740
PLSES 315 LD/LDS*	548	550	1086	242	418	180	236	FF 740
PLSES 315 LG*	660	565	1141	247	428	206	206	FF 740
PLSES 315 LU*	548	550	1106	242	418	180	236	FF 740
PLSES 315 M*	600	550	940	242	418	180	236	FF 740
PLSES 315 MGU*	660	565	1141	252	428	206	206	FF 740
PLSES 315 MUR*	600	550	1106	242	418	180	236	FF 740
PLSES 315 S*	600	550	881	242	418	180	236	FF 740
PLSES 315 SUR*	600	550	1026	242	418	180	236	FF 740
PLS 315 VLG	*660*	*575*	*1191*	*248*	*428*	*205*	*195*	*FF740*
PLS 315 VLGU	*660*	*575*	*1261*	*248*	*428*	*205*	*195*	*FF740*
PLS 355 L	*705*	*723*	*1470*	*130*	*700*	*224*	*396*	*FF 940*
PLS 400 L	*795*	*773*	*1755*	*177*	*700*	*224*	*396*	*FF 940*

* For frame size ≥ 250 mm used as IM B5 (IM 3001), please consult Emerson Industrial Automation.

IEC symbol	Flange dimensions							
	M	N	P	T	n	α°	S	LA
FF 350	350	300	400	5	4	45	18.5	15
FF 400	400	350	450	5	8	22.5	18.5	16
FF 500	500	450	550	5	8	22.5	18.5	18
FF 600	600	550	660	6	8	22.5	24	25
FF 740	*740*	*680*	*800*	*6*	*8*	*22.5*	*24*	*25*
FF 940	*940*	*880*	*1000*	*6*	*8*	*22.5*	*28*	*28*
FF 1080	*1080*	*1000*	*1150*	*6*	*8*	*22.5*	*28*	*30*

Mechanical options

Non-standard flanges

Motor type \ Flange type	(FF) Flange mounted							
	FF 300	FF 350	FF 400	FF 500	FF 600	FF 740	FF 940	FF 1080
PLSES 180 LG/LGU	◆	●	◆					
PLSES 200 M/LR		◆	●	◆				
PLSES 225 MG			◆	●				
PLSES 250 SP/MP/MF				◆	●			
PLSES 280 MD/MG				◆	●			
PLSES 315 S/SUR/L/LD/LDS/M/MUR					◆	●		
PLSES 315 LU					◆	●		
PLSES/PLS 315 LG/MGU					◆	●		
PLS 355						◆	●	
PLS 400							●	◆

● Standard ◆ Adaptable without shaft modification

Motors with forced ventilation, space heaters

The integration of high-efficiency motors within a process often requires accessories to make operation easier:
- Forced ventilation for motors used at high or low speeds.

Notes:
- Without forced ventilation, there is a possibility of overspeed with optional class B balancing.
- The motor temperature is monitored by sensors built into the windings.

HEATERS

Type	Power (W)
PLSES 180 to 200	52
PLSES 225 to 280	84
PLSES/PLS 315	*100*
PLS 355 / 400	*200*

The space heaters use 200/240V, single phase, 50 or 60 Hz.

Position of the lifting rings

LIFTING THE MOTOR ONLY

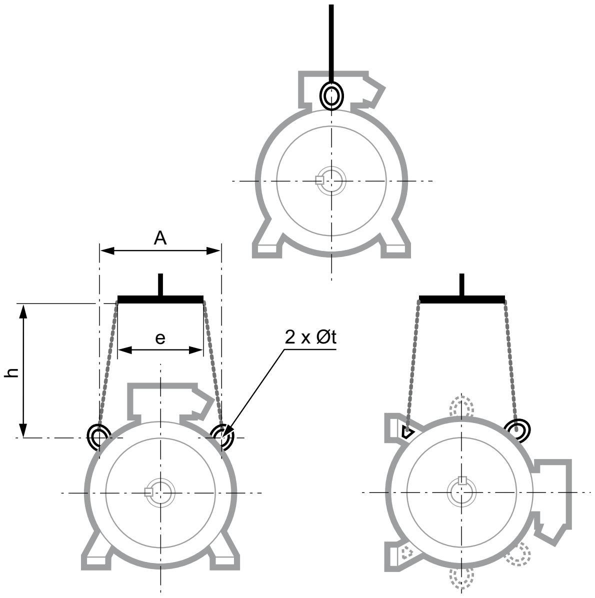
(not coupled to the machine)

The regulations stipulate that over 25 kg, suitable handling equipment must be used.

All our motors are fitted with grab handles, making them easier to handle without risk. A diagram of the sling hoisting method appears below with the required dimensions.

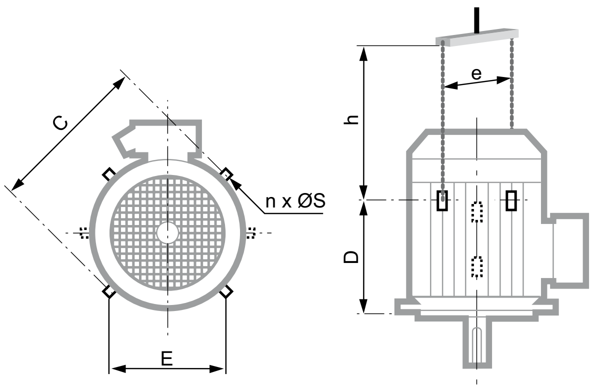
To prevent any damage to the motor during handling (for example: switching the motor from horizontal to vertical), it is essential to follow these instructions.

HORIZONTAL POSITION



Type	Horizontal position			
	A	e min.	h min.	Øt
PLSES 180 LG/LGU	270	260	200	14
PLSES 200 M/LU/LR	280	260	200	14
PLSES 225 MG	310	300	300	30
PLSES 250 SP/MP/MF	310	300	300	30
PLSES 280 SD	310	300	300	30
PLSES 280 MD/MG	310	300	300	30
PLSES 315 S/SUR	385	380	500	30
PLSES 315 M/MUR/L/LD/LDS/LU	385	380	500	30
PLSES 315 MG/MGU/LG	450	750	550	48

VERTICAL POSITION



View from above**　　Side view

Type	Vertical position					
	C	E	n**	ØS	e min.*	h min.
PLSES 180 LG/LGU	430	270	2	14	430	450
PLSES 200 M/LU/LR	400	280	2	14	400	450
PLSES 225 MG	450	310	2	14	450	490
PLSES 250 SP/MP/MF	450	310	4	30	450	490
PLSES 280 SD	450	310	4	30	450	490
PLSES 280 MD/MG	450	310	4	30	450	490
PLSES 315 S/SUR	500	385	4	30	500	500
PLSES 315 M/MUR/L/LD/LDS/LU	500	385	4	30	500	500
PLSES 315 MG/MGU/LG	750	450	4	48	750	450

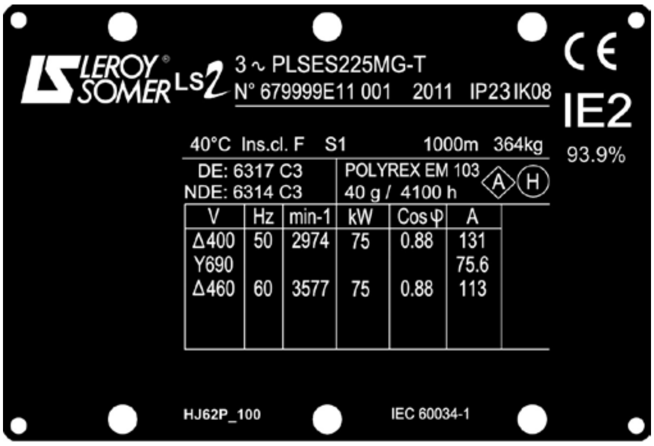
** if the motor is fitted with a drip cover, allow an additional 50 to 100 mm to avoid damaging it when the load is swung.*

*** if n = 2, the lifting rings form an angle of 90° with respect to the terminal box axis.*
if n = 4, this angle becomes 45°.

Identification

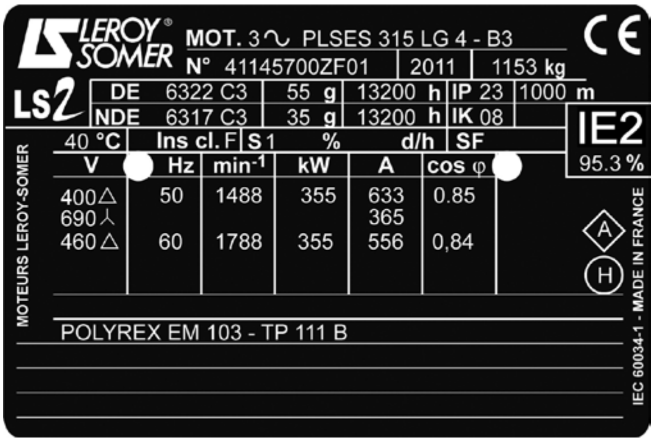
NAMEPLATES

PLSES 180 to PLSES 315



* Other logos can optionally be provided: agreement prior to ordering is essential.

PLSES 315 LG/MGU



DEFINITION OF SYMBOLS USED ON NAMEPLATES

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

MOT 3 ~ : Three-phase A.C. motor
PLSES : Series
225 : Frame size
MG : Housing symbol
T : Impregnation index

Motor no.

679999 : Serial number
E : Month of production
11 : Year of production
001 : Batch number
IE2 : Efficiency class
93.9% : Efficiency at 4/4 load

IP23 IK08 : Index of protection
I cl. F : Insulation class F
40°C : Ambient operating temperature
S1 : Duty - Duty (operating) factor
kg : Weight
V : Supply voltage
Hz : Supply frequency
min-1 : Revolutions per minute (rpm)
kW : Rated output power
cos φ : Power factor
A : Rated current
Δ : Delta connection
Y : Star connection

Bearings

DE : Drive end bearing
NDE : Non drive end bearing
40g : Amount of grease at each regreasing (in g)
4100h : Regreasing interval (in hours)
POLYREX EM103: Type of grease
A : Vibration level
H : Balancing mode

Please quote when ordering spare parts

Calculating the efficiency of an induction motor

MACHINE EFFICIENCY

Efficiency is the ratio between the output power (needed to drive a machine) and the power absorbed (power consumed). This value is therefore necessarily less than 1. The difference between the output power and the power absorbed consists of the electrical machine losses. 85% efficiency therefore means there are 15% losses.

Direct measurement method
With the direct method, efficiency is calculated using mechanical (torque C and speed Ω) and electrical (power absorbed Pabs) measurements. If the measuring tools are specified (use of a torquemeter), this method has the advantage of being relatively easy. However, it does not provide any information about machine performance and the origins of the potential losses.

$$\eta = \frac{P_u}{P_{abs}} \text{ where } P_u = C\Omega$$

Indirect measurement methods
These methods determine efficiency by determining the machine losses. Conventionally, a distinction is made between three types of losses: joule losses (stator Pjs and rotor Pjr), iron losses (Pf) and mechanical losses (Pm) which are relatively easy to measure. Miscellaneous losses which are more difficult to determine, called additional losses, are added to these losses.

In standard IEC 60034-2 dated 1972 and applicable until November 2010, the method for calculating additional losses uses a fixed percentage of 0.5% of the power absorbed.

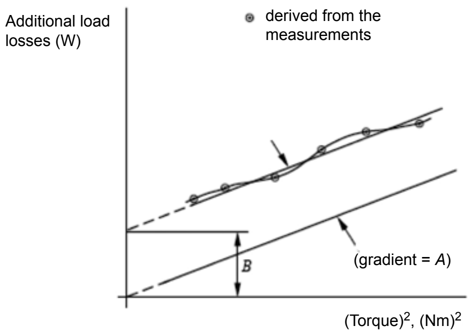
$$\eta = \frac{P_{abs} - P_{js} - P_{jr} - P_f - P_m - P_{sup}}{P_{abs}} \text{ where } P_{sup} = 0.5\%\ P_{abs}$$

Additional losses come from a variety of sources: surface losses, busbar currents, high-frequency losses, losses linked to leakage flux, etc. They are specific to each machine and contribute to reducing efficiency but they are very complex to calculate from a quantitative point of view.
In the new standard IEC 60034-2-1 dated September 2007, these additional losses must be measured precisely. This is a similar approach to that taken by the North American (IEEE112-B) and Canadian (CSA390) standards, which deduct the additional losses from a thermally-stable on-load curve.

The residual losses are calculated at each load point: 25%, 50%, 75%, 100%, 115% and 125%:

$$P_{res} = P_{abs} - P_{js} - P_{jr} - P_f - P_m - P_u \text{ where } P_u = C\Omega$$

The straight line is drawn by approximating the curve points as closely as possible. The measure is acceptable if a correlation coefficient of 0.95 or higher can be ensured.



The line to 0 gives the additional losses at the nominal point, ie. at 100% load.

From then on, the usual equation gives the efficiency:

$$\eta = \frac{P_{abs} - P_{js} - P_{jr} - P_f - P_m - P_{sup}}{P_{abs}}$$

Note that with this method, the Joule losses must be corrected according to the temperature and the iron losses corrected according to the resistive voltage dip in the stator.

Units of measurement and standard formulae

Electricity and electromagnetism

Parameters				Unit		Units and expressions not recommended
French name	**English name**	**Symbol**	**Definition**	**SI**	**Non SI, but accepted**	**Conversion**
Fréquence	Frequency Period	*f*		Hz (hertz)		
Courant électrique	Electric current (intensity)	*I*		A (ampere)		
Potentiel électrique Tension Force électromotrice	Electric potential Voltage Electromotive force	*V* *U* *E*		V (volt)		
Déphasage	Phase angle	φ		rad	° degree	
Facteur de puissance	Power factor	cos φ				
Réactance Résistance Impédance	Reactance Resistor Impedance	*X* *R* *Z*		Ω (ohm)		*j* is defined as $j^2 = -1$ ω rotational frequency = 2 π . *f*
Inductance propre (self)	Self inductance	*L*		H (henry)		
Capacité	Capacitance	*C*		F (farad)		
Quantité d'électricité	Current load, Quantity of electricity	*Q*		C (coulomb)	A.h 1 A.h = 3600 C	
Résistivité	Resistivity	ρ		Ω.m		Ω/m
Conductance	Conductance	*G*		S (siemens)		1/ Ω = 1 S
Nombre de tours (spires) de l'enroulement Nombre de phases Nombre de paires de pôles	Number of turns (coil) Number of phases Number of pairs of poles	*N* *m* *p*				
Champ magnétique	Magnetic field	*H*		A/m		
Différence de potentiel magnétique Force magnétomotrice	Magnetic potential difference Magnetomotive force Current linkage, cumulative current	*Um* *F, Fm* *H*		A		The unit AT (ampere-turns) is incorrect because it treats "turn" as a physical unit
Induction magnétique, Densité de flux magnétique	Magnetic induction, Magnetic flux density	*B*		T (tesla) = Wb/m^2		(gauss) 1 G = 10^{-4} T
Flux magnétique	Magnetic flux, Magnetic induction flux	Φ		Wb (weber)		(maxwell) 1 max = 10^{-8} Wb
Potentiel vecteur magnétique	Magnetic vector potential	*A*		Wb/m		
Perméabilité du milieu Perméabilité du vide	Permeability Permeability of vacuum	$\mu = \mu_o \mu_r$ μ_o		H/m		
Permittivité	Permittivity	$\varepsilon = \varepsilon_o \varepsilon_r$		F/m		

Units of measurement and standard formulae

Thermodynamics

Parameters				Unit		Units and expressions not recommended
French name	**English name**	**Symbol**	**Definition**	**SI**	**Non SI, but accepted**	**Conversion**
Température Thermodynamique	Temperature Thermodynamic	T		K (kelvin)	temperature Celsius, t, °C $T = t + 273.15$	°C: Degree Celsius t_C: Temp. in °C t_F: Temp. in °F f temperature Fahrenheit °F
Ecart de température	Temperature rise	ΔT		K	°C	1°C = 1 K
Densité de flux thermique	Thermal flux density	q, φ		W/m²		
Conductivité thermique	Thermal conductivity	λ		W/m.K		
Coefficient de transmission thermique globale	Total heat transmission coefficient	K		W/m².K		
Capacité thermique	Thermal capacity	C		J/K		
Capacité thermique massique	Specific thermal capacity	c		J/kg.K		
Energie interne	Internal energy	U		J		

Noise and vibration

Parameters				Unit		Units and expressions not recommended
French name	**English name**	**Symbol**	**Definition**	**SI**	**Non SI, but accepted**	**Conversion**
Niveau de puissance acoustique	Sound power level	L_W	$L_W = 10 \lg(P/P_0)$ ($P_0 = 10^{-12}$ W)	dB (decibel)		lg logarithm to base 10 lg10 = 1
Niveau de pression acoustique	Sound pressure level	L_P	$L_P = 20 \lg(P/P_0)$ ($P_0 = 2x10^{-5}$ Pa)	dB		

Dimensions

Parameters				Unit		Units and expressions not recommended
French name	**English name**	**Symbol**	**Definition**	**SI**	**Non SI, but accepted**	**Conversion**
Angle (angle plan)	Angle (plane angle)	α, β, T, φ		rad	degree: ° minute: ' second: "	180° = π rad = 3.14 rad
Longueur Largeur Hauteur Rayon	Length Breadth Height Radius Curved length	l b h r s		m (metres)	micrometre	cm, dm, dam, hm 1 inch = 1" = 25.4 mm 1 foot = 1' = 304.8 mm µm micron µ angström: A = 0.10 nm
Aire, superficie	Area	A, S		m²		1 square inch = 6.45 10^{-4} m²
Volume	Volume	V		m³	litre: l liter: L	UK gallon = 4.546 10^{-3} m³ US gallon = 3.785 10^{-3} m³

Units of measurement and standard formulae

Mechanics

Parameters				Unit		Units and expressions not recommended
French name	English name	Symbol	Definition	SI	Non SI, but accepted	Conversion
Temps Période (durée d'un cycle)	Time Time interval / duration Period (periodic time)	t T		s (second)	minute: min hour: h day: d	Symbols ' and " are reserved for angles minute not written as mn
Vitesse angulaire Pulsation	Angular velocity Rotational frequency	ω	$\omega = \frac{d\varphi}{dt}$	rad/s		
Accélération angulaire	Angular acceleration	α	$\alpha = \frac{d\omega}{dt}$	rad/s^2		
Vitesse Célérité	Speed Velocity	$u, v, w,$ c	$v = \frac{ds}{dt}$	m/s	1 km/h = 0.277,778 m/s 1 m/min = 0.0166 m/s	
Accélération Accélération de la pesanteur	Acceleration Acceleration of free fall	a $g = 9.81 m/s^2$	$a = \frac{dv}{dt}$ *in Paris*	m/s^2		
Vitesse de rotation	Speed of rotation	N		s^{-1}	min^{-1}	tr/mn, RPM, TM, etc
Masse	Mass	m		kg (kilogram)	tonne: t 1 t = 1,000 kg	kilo, kgs, KG, etc 1 pound: 1 lb = 0.4536 kg
Masse volumique	Mass density	ρ	$\frac{dm}{dV}$	kg/m^3		
Masse linéique	Linear density	ρ_e	$\frac{dm}{dL}$	kg/m		
Masse surfacique	Surface density	ρ_A	$\frac{dm}{dS}$	kg/m^2		
Quantité de mouvement	Momentum	P	$p = m.v$	kg. m/s		
Moment d'inertie	Moment of inertia	J, I	$I = \sum m.r^2$	kg.m^2		$J = \frac{MD^2}{4}$ kg.m^2 pound per square foot = 1 lb.ft^2 = 42.1 x 10^{-3} kg.m^2
Force Poids	Force Weight	F G	 $G = m.g$	N (newton)		kgf = kgp = 9..81 N pound force = lbF = 4.448 N
Moment d'une force Couple	Moment of force, Torque	M T	$M = F.r$	N.m		mdaN, mkg, m.N 1 mkg = 9.81 N.m 1 ft.lbF = 1.356 N.m 1 in.lbF = 0.113 N.m
Pression	Pressure	p	$p = \frac{F}{S} = \frac{F}{A}$	Pa (pascal)	bar 1 bar = 10^5 Pa	1 kgf/cm^2 = 0..981 bar 1 psi = 6894 N/m^2 = 6894 Pa 1 psi = 0.06894 bar 1 atm = 1.013 x 10^5 Pa
Contrainte normale Contrainte tangentielle	Normal stress Shear stress, Shear	σ τ		Pa Emerson use the MPa = 10^6 Pa		kg/mm^2, 1 daN/mm^2 = 10 MPa psi = pound per square inch 1 psi = 6894 Pa
Facteur de frottement	Friction coefficient	μ				incorrectly = friction coefficient f
Travail Énergie Énergie potentielle Énergie cinétique Quantité de chaleur	Work Energy Potential energy Kinetic energy Quantity of heat	W E Ep Ek Q	$W = F.l$	J (joule)	Wh = 3600 J (watt-hour)	1 N.m = 1 W.s = 1 J 1 kgm = 9.81 J (calorie) 1 cal = 4.18 J 1 Btu = 1055 J (British thermal unit)
Puissance	Power	P	$P = \frac{W}{t}$	W (watt)		1 ch = 736 W 1 HP = 746 W
Débit volumique	Volumetric flow	q_V	$q_V = \frac{dV}{dt}$	m^3/s		
Rendement	Efficiency	η		< 1		%
Viscosité dynamique	Dynamic viscosity	η, μ		Pa.s		poise, 1 P = 0.1 Pa.s
Viscosité cinématique	Kinematic viscosity	ν	$\nu = \frac{\eta}{\rho}$	m^2/s		stokes, 1 St = 10^{-4} m^2/s

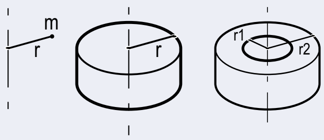
Unit conversions

Unit	MKSA (IS international system)	AGMA (US system)
Length	1 m = 3.2808 ft 1 mm = 0.03937 in	1 ft = 0.3048 m 1 in = 25.4 mm
Weight	1 kg = 2.2046 lb	1 lb = 0.4536 kg
Torque	1 Nm = 0.7376 lb.ft 1 N.m = 141.6 oz.in	1 lb.ft = 1.356 N.m 1 oz.in = 0.00706 N.m
Force	1 N = 0.2248 lb	1 lb = 4.448 N
Moment of inertia	1 kg.m^2 = 23.73 lb.ft^2	1 lb.ft^2 = 0.04214 kg.m^2
Power	1 kW = 1.341 HP	1 HP = 0.746 kW
Pressure	1 kPa = 0.14505 psi	1 psi = 6.894 kPa
Magnetic flux	1 T = 1 Wb / m^2 = 6.452 10^4 line / in^2	1 line / in^2 = 1.550 10^{-5} Wb / m^2
Magnetic losses	1 W / kg = 0.4536 W / lb	1 W / lb = 2.204 W / kg

Multiples and sub-multiples		
Factor by which the unit is multiplied	**Prefix to be placed before the unit name**	**Symbol to be placed before that of the unit**
10^{18} or 1,000,000,000,000,000,000	exa	E
10^{15} or 1,000,000,000,000,000	peta	P
10^{12} or 1,000,000,000,000	tera	T
10^{9} or 1,000,000,000	giga	G
10^{6} or 1,000,000	mega	M
10^{3} or 1,000	kilo	k
10^{2} or 100	hecto	h
10^{1} or 10	deca	da
10^{-1} or 0.1	deci	d
10^{-2} or 0.01	centi	c
10^{-3} or 0.001	milli	m
10^{-6} or 0.000,001	micro	µ
10^{-9} or 0.000,000,001	nano	n
10^{-12} or 0.000,000,000,001	pico	p
10^{-15} or 0.000,000,000,000,001	femto	f
10^{-18} or 0.000,000,000,000,000,001	atto	a

Standard formulae used in electrical engineering

Mechanical formulae

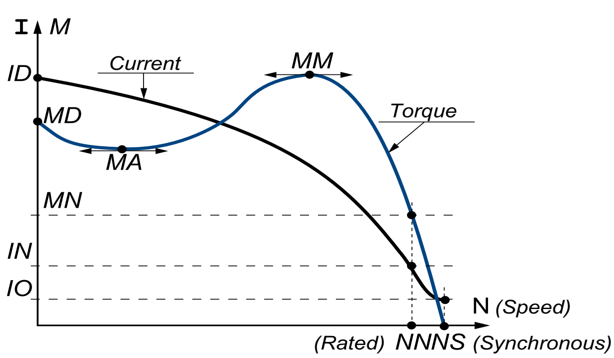
Title	Formula	Unit	Definitions / notes
Force	$F = m \cdot \gamma$	F in N m in kg γ in m/s^2	A force F is the product of a mass m by an acceleration γ
Weight	$G = m \cdot g$	G in N m in kg g = 9.81 m/s^2	
Moment	$M = F \cdot r$	M in N.m F in N r in m	The moment M of a force in relation to an axis is the 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	$P = F\ .\ V$	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.m^2 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	$J = m \cdot r^2$	J in kg.m^2 m in kg r in m	
Solid cylinder around its axis	$J = m \cdot \frac{r^2}{2}$		
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.m^2 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

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.

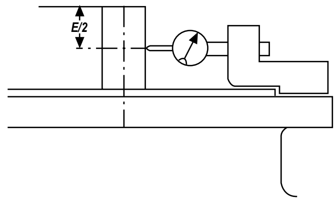
Parameters		Tolerances
Efficiency	machines P ≤ 150 kW machines P > 150 kW	**– 15% of (1 – η)** **– 10% of (1 – η)**
Cos φ		**– 1/6 (1 – cos φ)** **(min 0.02 - max 0.07)**
Slip	machines P < 1 kW machines P ≥ 1 kW	**± 30%** **± 20%**
Locked rotor torque		**– 15%, + 25% of rated torque**
Starting current		**+ 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

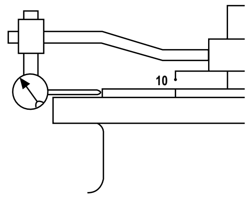
TOLERANCES AND ADJUSTMENTS

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.

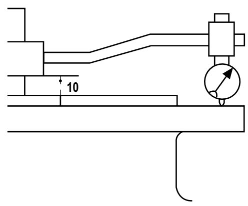
Characteristics	Tolerances
Frame size H ≤ 250 ≥ 280 Diameter ∅ of the shaft extension: - 11 to 28 mm - 32 to 48 mm - 55 mm and over	**0, — 0.5 mm** **0, — 1 mm** **j6** **k6** **m6**
Diameter N of flange spigots	**j6 up to FF 500,** **js6 for FF 600 and over**
Key width	**h9**
Width of drive shaft keyway (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***

Configurator

The configurator can be used to choose the most suitable motor and provides the technical specifications and corresponding drawings.

To register online:
www.leroy-somer.com/en/solutions_and_services/drive_systems/configurator

- Help with product selection
- Print-outs of technical specifications
- Print-outs of 2D and 3D CAD files
- The equivalent of 300 catalogues in 10 languages

Availability of products

Being able both to respond to urgent requests and adhere to promised customer lead times calls for a powerful logistics system.

The availability of motors is ensured by the network of approved partners and Leroy-Somer central services all working together.

The selection data in the "Guaranteed Availability Drive Systems" catalogue specify the product delivery time for each family in the form of a colour code and according to the quantities per order.

Please consult Leroy-Somer.

Notes

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