LEROY SOMER®

3627 en - 2010.03 / e

PLS

Drip-proof 3-phase induction motors 15 to 900 kW

Technical catalogue

EMERSON
Industrial Automation

PLS
Drip-proof 3-phase induction motors
15 to 900 kW

The LEROY-SOMER range of drip-proof 3-phase motors

Other LEROY-SOMER motor ranges

3-phase enclosed induction motor

Cast iron motor

VARMECA variable speed motor

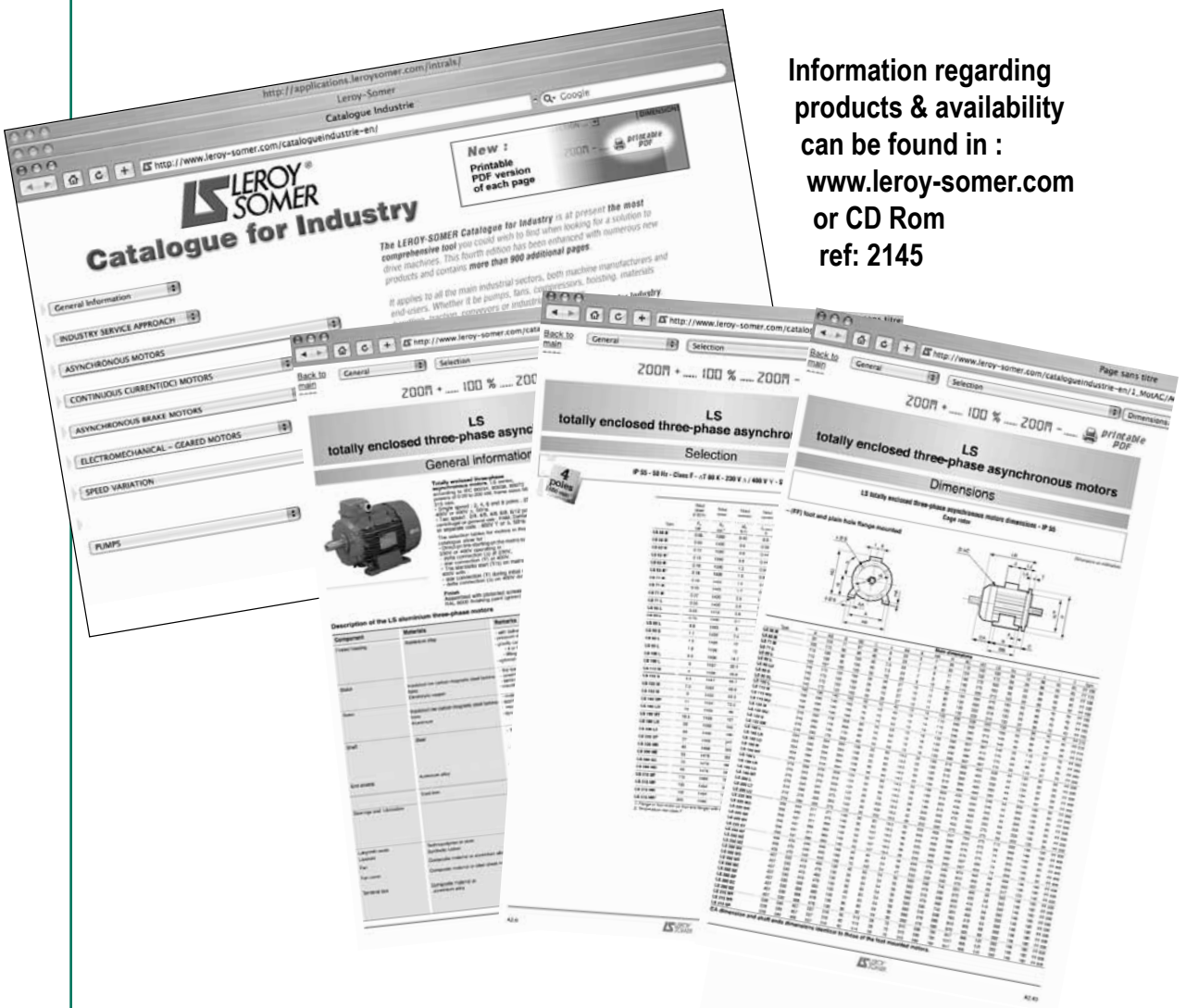
D.C. motor (drip-proof or enclosed)

Motor for variable speed drive systems

3-phase autosynchronous motor

PLS
Drip-proof 3-phase induction motors
15 to 900 kW

LEROY-SOMER offer their clients the opportunity to fix their own delivery dates, **without prior consultation.**



Information regarding products & availability can be found in :
www.leroy-somer.com
or CD Rom
ref: 2145

Guaranteed delivery dates thanks to unique, high performance logistics.

PLS
Drip-proof 3-phase induction motors
15 to 900 kW

IP 23
Cl. F - ΔT 80 K
MULTI-VOLTAGE

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

Simply go through the complete designation step by step.

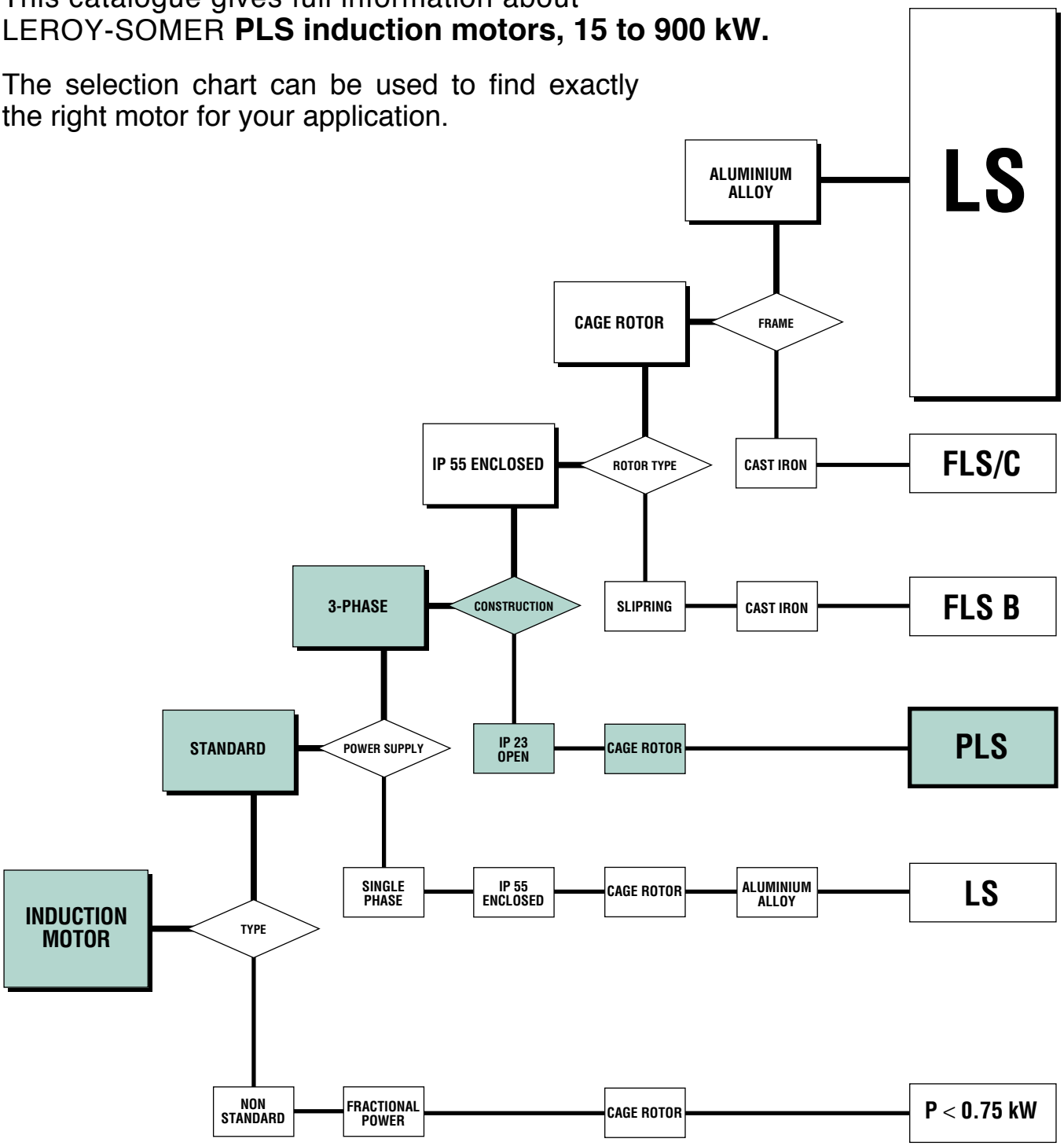
4P 1500 min^{-1}	PLS	180	L	30 kW	IM 1001 IM B3	230 / 400 V	50 Hz	IP 23
No. of poles Speed(s)	Range identification	Frame size IEC 60072-1	Frame type	Rated power	Mounting arrangements IEC 60034-7	Supply voltage	Mains frequency	Degree of Protection IEC 60034-5

For **direct selection** see section : E Page 39

PLS
Drip-proof 3-phase induction motors
15 to 900 kW

This catalogue gives full information about LEROY-SOMER **PLS induction motors, 15 to 900 kW.**

The selection chart can be used to find exactly the right motor for your application.



PLS
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15 to 900 kW

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General information

A1 - Quality commitment

LEROY-SOMER'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 the analyses and the actions for continuously improving the procedures.

LEROY-SOMER 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 **ISO 9001: 2000 certification from the DNV**. Similarly, our environmental approach has enabled us to obtain ISO 14001: 2004 certification.

Products for particular applications or those designed to operate in specific environments are also approved or certified by the following organisations: CETIM, LCIE, DNV, INERIS, EFECTIS, UL, BSRIA, TUV, CCC, GOST, which check their technical performance against the various standards or recommendations.

PLS
Drip-proof 3-phase induction motors
General information

A2 - Standards and approvals

A

ORGANIZATION OF STANDARDS AUTHORITIES

International bodies

<table>
<tr>
<td>Worldwide
  </td>
<td>General
Standardization
ISO
International Standards
Organization
TC Technical committees | SC Sub-committees | WG Working groups</td>
<td>Electronics / Electrotechnical
Standardization
IEC
International Electrotechnical
Commission
TC Technical committees | SC Sub-committees | WG Working groups</td>
</tr>
<tr>
<td>European
  </td>
<td>CEN
European Committee
for Standardization
ECISS
European Committee for
Iron and Steel Standards
TC Technical committees</td>
<td>CENELEC
European Committee for Electrotechnical
Standardization
TC Technical committees | SC Sub-committees | AHG Ad Hoc Groups</td>
</tr>
</table>

Country	Initials	Designation
AUSTRALIA	**SAA**	**S**tandards **A**ssociation of **A**ustralia
BELGIUM	**IBN**	**I**nstitut **B**elge de **N**ormalisation
CIS (ex-USSR)	**GOST**	**Go**sudarstvenne Komitet **St**andartov
DENMARK	**DS**	**D**ansk **S**tandardisieringsraad
FINLAND	**SFS**	**S**uomen **S**tandardisoimisliitto
FRANCE	**AFNOR including UTE**	**A**ssociation **F**rançaise de **N**ormalisation including: **U**nion **T**echnique de l'**É**lectricité
GERMANY	**DIN/VDE**	**V**erband **D**eutscher **E**lektrotechniker
GREAT BRITAIN	**BSI**	**B**ritish **S**tandards **I**nstitution
ITALY	**IEC**	**C**omitato **E**lecttrotechnico **I**taliano
JAPAN	**JIS**	**J**apanese **I**ndustrial **S**tandard
NETHERLANDS	**NNI**	**N**ederlands **N**ormalisatie - **I**nstituut
NORWAY	**NFS**	**N**orges **S**tandardisieringsforbund
SAUDI ARABIA	**SASO**	**S**audi **A**rabian **S**tandards **O**rganization
SPAIN	**UNE**	**U**na **N**orma **E**spañola
SWEDEN	**SIS**	**S**tandardisieringskommissionen **I** **S**verige
SWITZERLAND	**SEV or ASE**	**S**chweizerischer **E**lektrotechnischer **V**erein
UNITED STATES	**ANSI including NEMA**	**A**merican **N**ational **S**tandards **I**nstitute including: **N**ational **E**lectrical **Ma**nufacturers

PLS
Drip-proof 3-phase induction motors
General information

A2 - Standards and approvals

Approvals

Certain countries recommend or insist on approval from national organizations.

Approved products must carry the recognized mark on their identification plates.

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

Approvals for LEROY-SOMER motors (versions derived from standard construction):

Country	Initials	Certification No.	Application
CANADA	**CSA**	LR 57 008	Standard adapted range (see section D2.2.3)
USA	**UL or** ᖵU	E 68554 SA 6704 E 206450	Impregnation systems Stator/rotor assemblies for sealed units Complete motors up to 160 frame size
SAUDI ARABIA	**SASO**		Standard range

For specific approved products (marine, etc), 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
60034-2	Determination of losses and efficiency	NFEN 60034-2	DIN/EN 60034-2	BS 4999-102		
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 powered from the mains ≤ 660 V	NFEN 60034-12	DIN/EN 60034-12	BS EN 60034-12		SEV ASE 3009-12
60034-14	Mechanical vibration in machines of 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 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.

A2 - Standards and approvals

A

PLS motors comply with the standards quoted in this catalogue

List of standards quoted in this document

Reference		Date	International standards
IEC 60034-1	**EN 60034-1**	1999	Electrical rotating machines: ratings and operating characteristics
IEC 60034-5	**EN 60034-5**	2000	Electrical rotating machines: classification of degrees of protection provided by casings of rotating machines.
IEC 60034-6	**EN 60034-6**	1993	Electrical rotating machines (except traction): cooling methods
IEC 60034-7	**EN 60034-7**	2000	Electrical rotating machines (except traction): symbols for mounting positions and assembly layouts
IEC 60034-8		2001	Electrical rotating machines: terminal markings and direction of rotation
IEC 60034-9	**EN 60034-9**	1997	Electrical rotating machines: noise limits
IEC 60034-12	**EN 60034-12**	1999	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**	2004	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 60038		1999	IEC standard voltages
IEC 60072-1		1991	Dimensions and power series for electrical rotating machines: designation of casings between 56 and 400 and flanges between 55 and 1080.
IEC 60085		1984	Evaluation and thermal classification of electrical insulation.
IEC 60721-2-1		1987	Classification of natural environment conditions. Temperature and humidity.
IEC 60892		1987	Effects of an imbalance in the voltage system on the characteristics of three-phase squirrel-cage induction motors.
IEC 61000-2-10/11 & 2-2		1999	Electromagnetic compatibility (EMC): environment
IEC guide 106		1989	Guidelines on the specification of environmental conditions for the determination of operating characteristics of equipment.
ISO 281		2000	Bearings - Basic dynamic loadings and nominal bearing life
ISO 1680	**EN 21680**	1999	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		1999	Mechanical vibration - Balancing. Conventions on shaft keys and related parts
	EN 50102	1998	Degree of protection provided by the electrical housing against extreme mechanical impacts.

A3 - Tolerance on main performance parameters

Tolerances for electromechanical characteristics

IEC 60034-1 specifies standard tolerances for electromechanical characteristics.

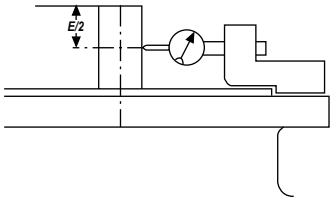
Parameters		Tolerances
Efficiency	machines P ≤ 50 kW	– 15% (1 – η)
	machines P > 50 kW	– 10% (1 – η)
Cos φ		– 1/6 (1 – cos φ) (min 0.02 - max 0.07)
Slip	machines P < 1 kW	± 30%
	machines P ≥ 1 kW	± 20%
Locked rotor torque		– 15%, + 25% of rated torque
Starting current		+ 20%
Run-up torque		– 15% of rated 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

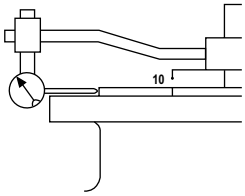
Tolerances and adjustments

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

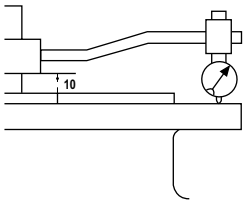
Characteristics	Tolerances
Frame size H ≤ 250	0, — 0.5 mm
≥ 280	0, — 1 mm
Diameter Ø of shaft extension:	
- 11 to 28 mm	j6
- 32 to 48 mm	k6
- 55 mm and over	m6
Diameter N of flange spigot	j6 up to FF 500, js6 for FF 600 and over
Key width	h9
Width of drive shaft keyway (normal keying)	N9
Key depth	
- square section	h9
- rectangular section	h11
① ***Eccentricity of shaft in flanged motors*** (standard class)	
- diameter > 30 up to 50 mm	0.050 mm
- diameter > 50 up to 80 mm	0.060 mm
- diameter > 80 up to 120 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):	
- FF 300 to FF 500	0.125 mm
- FF 600 to FF 740	0.16 mm
- FF 940 to FF 1080	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***

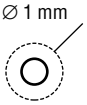
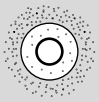
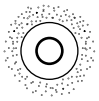
PLS
Drip-proof 3-phase induction motors
Environment

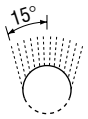
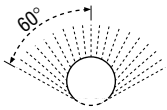
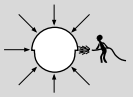
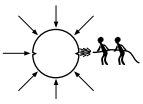
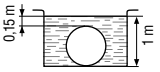
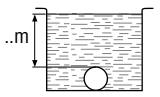
B1 - Definition of “Index of Protection” (IP/IK)

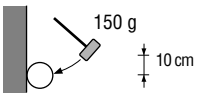
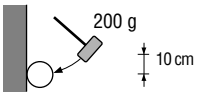
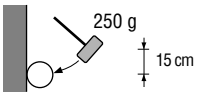
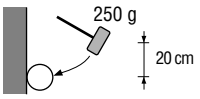
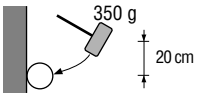
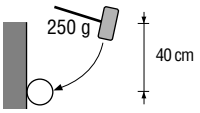
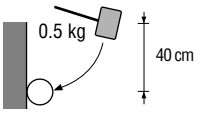
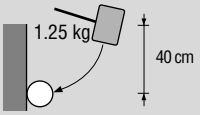
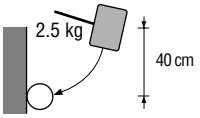
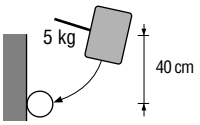
B

Indices of protection of electrical equipment enclosures

PLS motors are IP 23 IK 08 as standard

First number: protection against solid objects		
IP	**Tests**	**Definition**
0		**No protection**
1	∅ 50 mm 	**Protected against solid objects of over 50 mm (eg : accidental hand contact)**
2	∅ 12 mm 	**Protected against solid objects of over 12 mm (eg : finger)**
3	∅ 2.5 mm 	**Protected against solid objects of over 2.5 mm (eg : tools, wire)**
4	∅ 1 mm 	**Protected against solid objects of over 1 mm (eg : small tools, thin wire)**
5		**Protected against dust (no deposits of harmful material)**
6		**Protected against entry of dust**

Second number: protection against liquids		
IP	**Tests**	**Definition**
0		**No protection**
1		**Protected against vertically dripping water (condensation)**
2		**Protected against water dripping up to 15° from the vertical**
3		**Protected against rain falling at up to 60° from the vertical**
4		**Protected against water splashes from all directions**
5		**Protected against jets of water from all directions**
6		**Protected against jets of water comparable to heavy seas**
7		**Protected against the effects of immersion to depths of between 0.15 and 1 m**
8 ..m		**Protected against the effects of prolonged immersion under pressure**

Third number: mechanical protection		
IK	**Tests**	**Definition**
00		**No protection**
01		**Impact energy: 0.15 J**
02		**Impact energy: 0.20 J**
03		**Impact energy: 0.37 J**
04		**Impact energy: 0.50 J**
05		**Impact energy: 0.70 J**
06		**Impact energy: 1 J**
07		**Impact energy: 2 J**
08		**Impact energy: 5 J**
09		**Impact energy: 10 J**
10		**Impact energy: 20 J**

Example:

IP 23 machine

IP: Index of protection

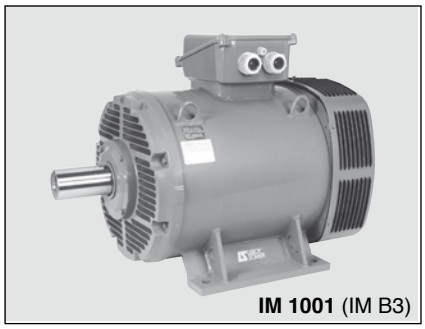
2 : Protected against solid objects of over 12 mm (example: finger)

3 : Protected against rain falling at up to 60° from the vertical

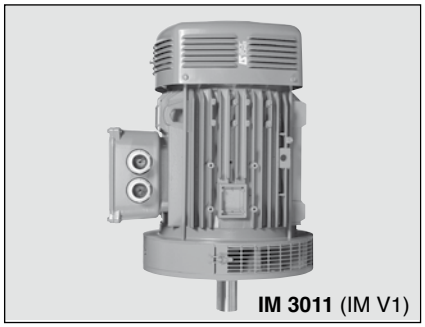
PLS
Drip-proof 3-phase induction motors
Construction

C1 - Mounting arrangements

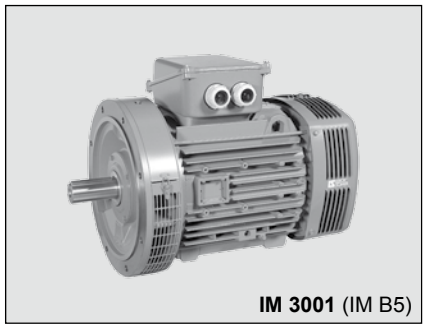
C1.1 - MOUNTING ARRANGEMENTS



IM 1001 (IM B3)



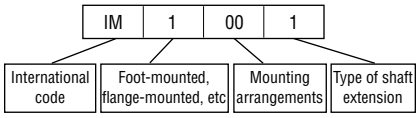
IM 3011 (IM V1)



IM 3001 (IM B5)

The various mounting arrangements for machines are defined in IEC 60034-7. Below is an extract from the standard which shows equivalent terms in current use.

Code formulation



Code I	Code II
IM B 3	IM 1001
IM V 5	IM 1011
IM V 6	IM 1031
IM B 6	IM 1051
IM B 7	IM 1061
IM B 8	IM 1071
IM B 35	IM 2001
IM V 15	IM 2011
IM V 36	IM 2031
IM B 5	IM 3001
IM V 1	IM 3011
IM V 3	IM 3031

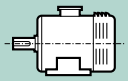
Codes I and II are interchangeable. It should however be noted that the above code list is not exhaustive and you should therefore refer to IEC 60034-7 for other designations. Below you will find the most common mounting arrangements with line drawings and an explanation of the standard symbols used.

C1.2 - MOUNTINGS AND POSITIONS (IEC STANDARD 60034-7)

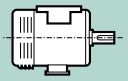
Foot-mounted motors

• all frame sizes

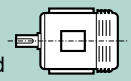
IM 1001 (IM B3)
- Horizontal shaft
- Feet on floor



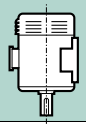
IM 1071 (IM B8)
- Horizontal shaft
- Feet on top



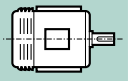
IM 1051 (IM B6)
- Horizontal shaft
- Wall-mounted with feet on left hand side when viewed from drive end



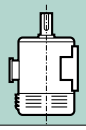
IM 1011 (IM V5)
- Vertical shaft facing down
- Feet on wall



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



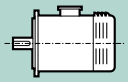
IM 1031 (IM V6)
- Vertical shaft facing up
- Feet on wall



(FF) flange-mounted motors

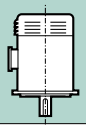
• all frame sizes
(except IM 3001, which is limited to frame size 225)

IM 3001 (IM B5)
- Horizontal shaft

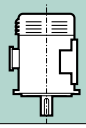


/M 2001 (IM B35)
- Horizontal shaft
- Feet on floor

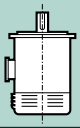
IM 3011 (IM V1)
- Vertical shaft facing down



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

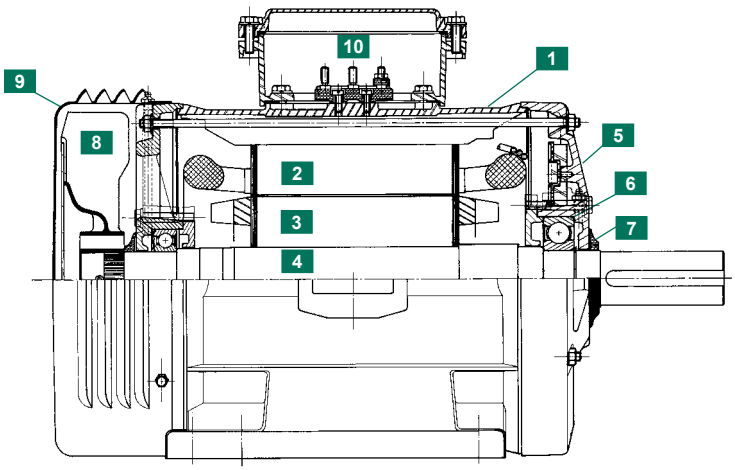
PLS
Drip-proof 3-phase induction motors
Construction

C2 - Components

C

C2.1 - DESCRIPTION OF STANDARD MOTORS

Component	Materials	Remarks
1 Frame	Aluminium alloy or steel	- with integral feet or without feet - gravity die-cast for frame size ≤ 250 • in steel for frame sizes ≥ 280 • 4 or 6 fixing holes for housings with feet • lifting rings
2 Stator	Insulated low-carbon magnetic steel laminations Electroplated copper	- low carbon content guarantees long-term lamination pack stability - welded packs - semi-enclosed slots - class F insulation
3 Rotor	Insulated low-carbon magnetic steel laminations Aluminium or copper	- inclined cage bars - rotor cage pressure die-cast in aluminium for frame size ≤ 315 soldered for frame size ≥ 355 - rotor cage shrink-fitted to shaft for frame sizes ≤ 315 keyed for frame size ≥ 355 - dynamically balanced rotor, class N, 1/2 key
4 Shaft	Steel	
5 End shields	Cast iron or steel	
6 Bearings and lubrication		Standard mounting: - ball bearings C3 play - sealed and “greased for life” for frame sizes 160 L, 180 M and L - semi-protected or open types from frame size 180 LG upwards - regreasable from frame size 225 upwards - bearings preloaded at non drive end
7 Labyrinth seal Lipseals	Plastic or steel Synthetic rubber	- lipseal at drive end for all flange-mounted motors - lipseal or labyrinth seal for foot-mounted motors
8 Fan	Composite material aluminium alloy or steel	- bidirectional fan in motors with 2 poles (P ≤ 250 kW), 4, 6 and 8 poles - unidirectional fan (direction of rotation to be specified at time of ordering) in motors with 2 poles, for power ≥ 280 kW
9 Fan cover	Pressed steel	- fitted, on request, with a drip cover for operation in vertical position, shaft end facing up
10 Terminal box	Composite material aluminium alloy or steel	- can be turned in 4 directions for frame size ≤ 225, on opposite side from the feet - fitted as standard with a terminal block with 6 steel terminals - terminal box comes complete with cable gland for frame size ≤ 315 L, for motors 315 MG and larger sizes, terminal box comes complete with a cable gland support plate, undrilled and removable, without cable gland - 1 earth terminal in each terminal box



C2.2 - MARINE FINISH

The electrical characteristics and dimensions of these motors can be found in technical catalogue ref. 2400.

PLS
Drip-proof 3-phase induction motors
Construction

C3 - Mains connection

C3.1 - TERMINAL BOX

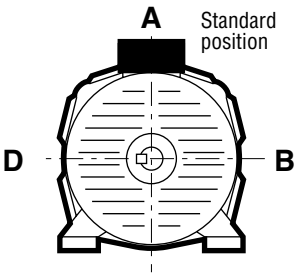
Placed as standard on the top of the motor near the drive end, the terminal box is made up of IP 55 components and is fitted with a cable gland in accordance with the table below.

The standard position of the cable gland is on the right, seen from the drive end but, owing to the symmetrical construction of the box, it can usually be placed in any of the 4 directions, except for:

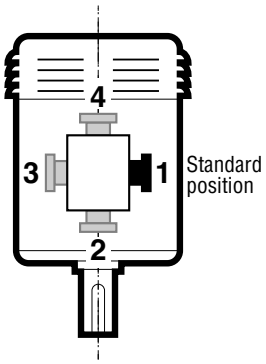
- position **2** for flange-mounted motors.
- positions **2** and **4** for PLS 315 MG/LG/VLG/VLGU, PLS 355 and PLS 400 motors.

If required, the terminal box may be fitted in a different position (on the left or right as seen from the drive end).

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



▼ ***Positions of the cable gland in relation to the drive end***



C3.1.1 - Table of terminal blocks and type of cable gland for PLS 160 to 400 motors

Power kW	2 Poles				4 and 6 Poles			
	230/400 V		400 V Δ		230/400 V		400 V Δ	
15	M6	2 x ISO 25	M6	2 x ISO 25	M6	2 x ISO 25	M6	2 x ISO 25
18,5	M6	2 x ISO 25	M6	2 x ISO 25	M8	2 x ISO 32	M6	2 x ISO 25
22	M8	2 x ISO 32	M6	2 x ISO 25	M8	2 x ISO 32	M6	2 x ISO 25
30	M8	2 x ISO 32	M6	2 x ISO 25	M8	2 x ISO 32	M6	2 x ISO 25
37	M8	2 x ISO 32	M8	2 x ISO 32	M10	2 x ISO 40	M8	2 x ISO 32
45	M10	2 x ISO 40	M8	2 x ISO 32	M10	2 x ISO 40	M8	2 x ISO 32
55	M10	2 x ISO 40	M8	2 x ISO 32	M10	2 x ISO 40	M8	2 x ISO 32
75	M12	2 x ISO 50	M10	2 x ISO 40	M12	2 x ISO 50	M10	2 x ISO 40
90	M12	2 x ISO 50	M10	2 x ISO 40	M12	2 x ISO 50	M10	2 x ISO 40
110	M16	2 x ISO 63	M12	2 x ISO 50	M16	2 x ISO 63	M12	2 x ISO 50
132	M16	2 x ISO 63	M12	2 x ISO 50	M16	2 x ISO 63	M12	2 x ISO 50
160	M16	2 x ISO 63	M12	2 x ISO 50	M16	2 x ISO 63	M12	2 x ISO 50
180	-	-	-	-	M16	-	M16	-
200	M16	2 x ISO 63	M16	2 x ISO 63	M16	2 x ISO 63	M16	2 x ISO 63
250	M16	2 x ISO 63	M16	2 x ISO 63	M16	2 x ISO 63	M16	2 x ISO 63
280	M16	*	M16	*	M16	*	M16	*
315	M16	*	M16	*	M16	*	M16	*

* These motors are supplied with a removable undrilled cable gland support plate.

Frame size	2 Poles				4, 6 and 8 Poles			
	230/400 V		400 V Δ		230/400 V		400 V Δ	
PLS 315 MG/LG	M12	**	M12	**	M12	**	M12	**
PLS 315 VLG/VLGU	M12	**	M12	**	M12	**	M12	**
PLS 355/400	M14	**	M14	**	M14	**	M14	**

** From the PLS 315 MG upwards, the cable gland mounting plates are supplied without cable glands, nozzles or drill holes.

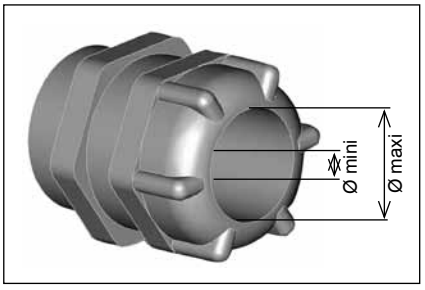
Tightening torque for the nuts on the terminal blocks ▶

Terminal	M4	M5	M6	M8	M10	M12	M14	M16
Torque N.m	2	3.2	5	10	20	35	50	65

Tightening capacity of cable glands

Type of cable gland	Tightening capacity	
	min. cable Ø (mm)	max. cable Ø (mm)
ISO 25	13	19
ISO 32	15	25
ISO 40	21	32
ISO 50	26	38
ISO 63	31	44

Standard cable gland material = plastic (brass on request).
On request, the terminal boxes can be supplied with drill holes, without cable glands.



C3 - Mains connection

C3.1.2 - Terminal blocks and type of cable gland for PLS 315 MG to 400 motors

Whatever the number of poles, cable glands are optional because of the large number of power cable combinations. PLS 315 MG to 400 motors with 2, 4, 6 and 8 poles are supplied with a removable and undrilled cable gland mounting plate.

If you wish to receive a pre-drilled plate fitted with cable glands, your order must specify the number of cables, their diameter and the type of cable gland required.

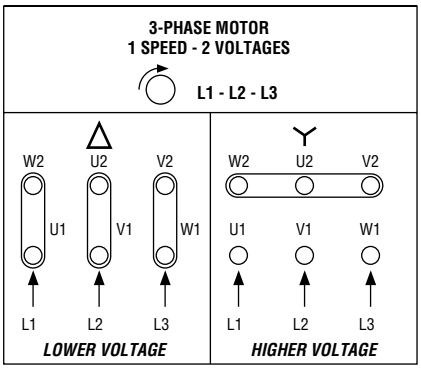
PLS 315 MG/LG/VLG/VLGU motors are supplied with M 12 terminal blocks.

Motors of frame size 355 and 400 are supplied with M14 insulators.

C3.2 - WIRING DIAGRAMS

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

The diagram normally used is shown below.



C3.3 - 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 the motor casing.

C3.4 - FLYING LEADS

Motors can be supplied with flying leads or multicore cables (ask for estimate). Please state cable characteristics (type and supplier, cross-section, length, number of conductors), connection method (on stator coil end turns, or on a separate panel), and the cable gland position required.

C4 - Bearings and lubrication

C4.1 - BEARINGS AND BEARING LIFE

Definitions

Load ratings

- Basic static load C_o:

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).

- Basic dynamic load 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 basic dynamic load 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: an index which depends on the type of contact between the races and balls (or rollers)

p = 3 for ball bearings

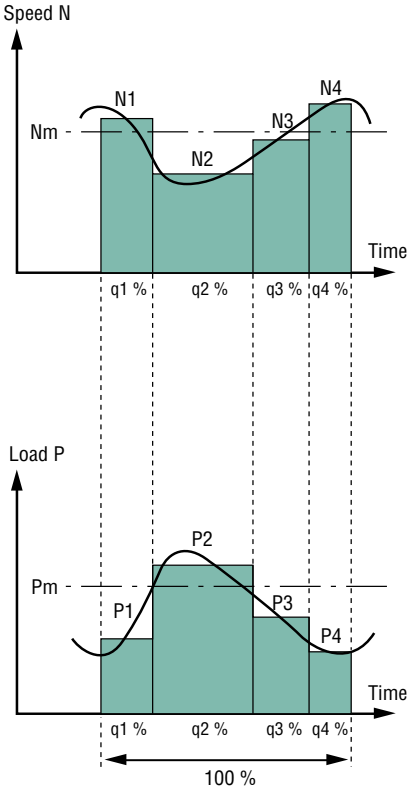
p = 10/3 for roller bearings

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

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

P_m : average equivalent dynamic load

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

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:

$$L_{nah} = a_1 a_2 a_3 L_{10h}$$

with:

a_1: failure probability factor

a_2: factor for the characteristics and tempering of the steel

a_3: factor for the operating conditions (lubricant quality, temperature, speed of rotation, etc)

Under normal operating conditions for PLS motors, the corrected nominal lifetime, calculated with a failure probability factor a1 = 1 (L_{10ah}), is longer than the nominal lifetime L_{10h}.

C4 - Bearings and lubrication

C

C4.2 - 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.

C4.2.1 - Lubrication with grease

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° 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.

C4.2.2 - Regreasing intervals

The chart opposite shows the regreasing intervals, depending on the type of motor, for standard bearing assemblies, operating at an ambient temperature of 25°C on a horizontal shaft machine.

Motors operating at an ambient 40°C need more frequent lubrication. The intervals between greasing will be about half of those shown in the table.

The table opposite is valid for PLS motors lubricated with ESSO UNIREX N3 grease, which is used as standard.

Motor type	Regreasing intervals in hours			
	3000 min^{-1}	1500 min^{-1}	1000 min^{-1}	750 min^{-1}
PLS 160	} *Permanently greased bearings (motors supplied without grease nipples)*			
PLS 180				
PLS 200				
PLS 225	*7400*	*15,000*	*20,000*	-
PLS 250	*5200*	*12600*	*17600*	-
PLS 280	*5200*	*12,600*	*17,600*	-
PLS 315 S/M/L/SU/MU	*5800*	*9800*	*15,800*	-
PLS 315 LD	*5200*	*9000*	*14,400*	-
PLS 315 MG/LG/VLG/VLGU	*3400*	*9000*	*18,000*	*27,000*
PLS 355	*3400*	*7400*	*16,000*	*24,000*
PLS 400	-	*4600*	*12,000*	*20,000*

PLS
Drip-proof 3-phase induction motors
Construction

C4 - Bearings and lubrication

C4.3 - TYPES OF BEARING AND STANDARD FITTING ARRANGEMENTS

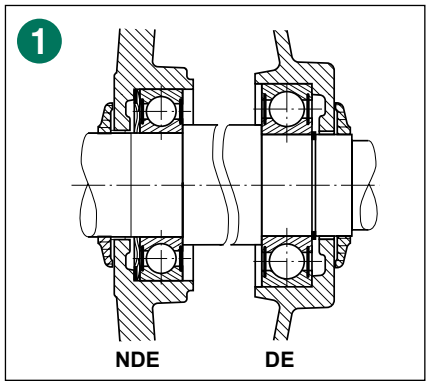
		Horizontal shaft	Vertical shaft	
			Shaft facing down	Shaft facing up
Foot-mounted motors	Mounting arrangement	B3/B6/B7/B8	V5	V6
	standard mounting	The DE bearing is: - located at DE for frame ≤ 180 - locked at DE for frame ≥ 200	The DE bearing is: - located at DE for frame ≤ 180 - locked at DE for frame ≥ 200	The DE bearing is: - locked at DE for frame ≥ 160
	on request	DE bearing locked for frames ≤ 180	DE bearing locked for frames ≤ 180	
Foot-mounted (or foot and flange) motors	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

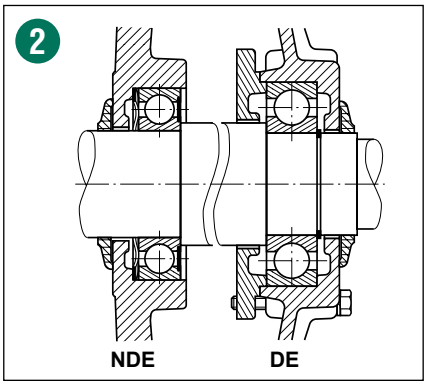
Important: When ordering, state correct mounting type and position (see section C1).

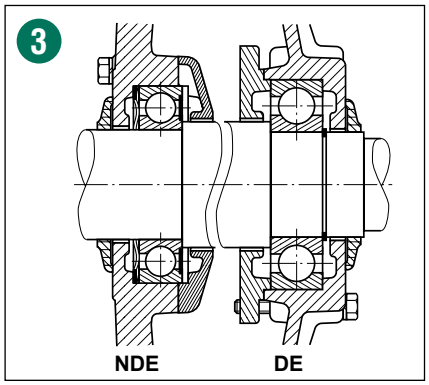
Motor		No. of poles	Standard fitting arrangement			
					Assembly diagram reference	
Frame size	LEROY-SOMER designation		Non drive end bearing (N.D.E.)	Drive end bearing (D.E.)	Foot-mounted motors	Flange-mounted (or foot and flange) motors
160	PLS 160 MG	6	6210 2RS C3	6310 2RS C3	1 (2 for V6)	2
160	PLS 160 L	2 ; 4 ; 6	6210 2RS C3	6310 2RS C3	1 (2 for V6)	2
180	PLS 180 M	2 ; 4 ; 6	6210 2RS C3	6212 2RS C3	1 (2 for V6)	2
180	PLS 180 L	2 ; 4	6210 2RS C3	6212 2RS C3	1 (2 for V6)	2
180	PLS 180 LG	6	6212 Z C3	6312 C3	3	3
200	PLS 200 M	2 ; 4 ; 6	6212 Z C3	6313 C3	3	3
200	PLS 200 LP	2 ; 4	6212 Z C3	6313 C3	3	3
200	PLS 200 L	6	6214 C3	6314 C3	3	3
225	PLS 225 (MR/MU)	2 ; 4 ; 6	6214 C3	6314 C3	4	4
250	PLS 250 SP	2 ; 4 ; 6	6314 C3	6317 C3	5	5
250	PLS 250 MP	2 ; 4 ; 6	6314 C3	6317 C3	5	5
280	PLS 280 SC	4 ; 6	6314 C3	6317 C3	5	5
280	PLS 280 MC	2	6314 C3	6317 C3	5	5
280	PLS 280 MD	4 ; 6	6314 C3	6317 C3	5	5
315	PLS 315 (S/M/L)	2	6316 C3	6316 C3	7	7
315	PLS 315 (S/M/L)	4	6316 C3	6320 C3	8	8
315	PLS 315 (SU/MU/L)	6	6316 C3	6320 C3	8	8
315	PLS 315 LD	2	6316 C3	6219 C3	7	7
315	PLS 315 LD	4 ; 6	6316 C3	6224 C3	8	8
315	PLS 315 MG	2	6317 C3	6317 C3	7	7
315	PLS 315 MG	4 ; 6 ; 8	6317 C3	6322 C3	8	8
315	PLS 315 LG	2	6317 C3	6317 C3	7	7
315	PLS 315 LG	4 ; 6 ; 8	6317 C3	6322 C3	8	8
315	PLS 315 (VLG)	2	6317 C3	6317 C3	7	7
315	PLS 315 (VLG/VLGU)	4 ; 6 ; 8	6317 C3	6322 C3	8	8
355	PLS 355 (LA/LB)	2	6317 C3	6317 C3	9	9
355	PLS 355 (LA/LB)	4 ; 6 ; 8	6324 C3	6324 C3	9	9
400	PLS 400 (LA/LB)	4 ; 6 ; 8	6328 C3	6328 C3	9	9

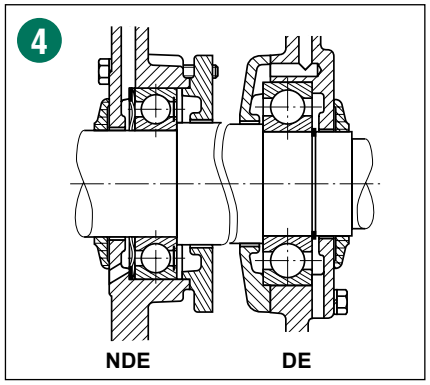
C4 - Bearings and lubrication

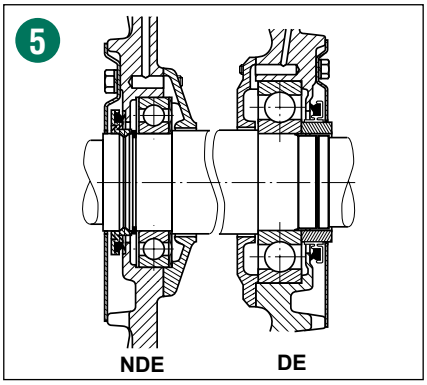
C4.3.1 - Bearing assembly diagrams

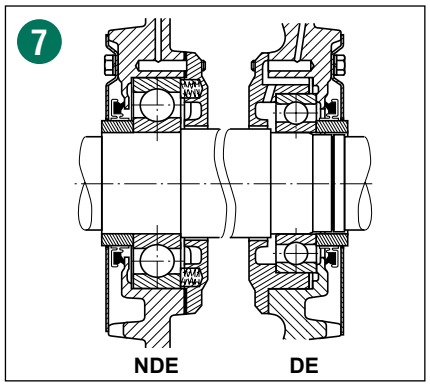


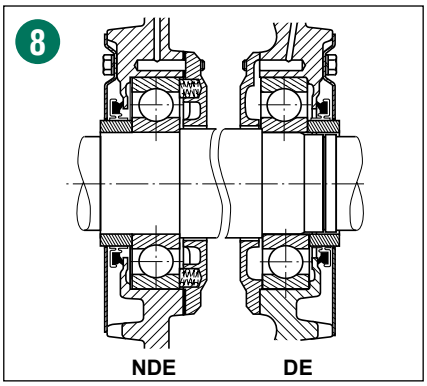


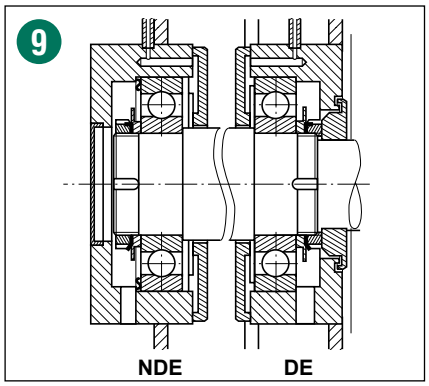








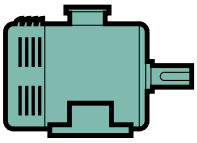


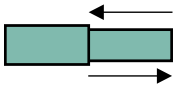


PLS
Drip-proof 3-phase induction motors
Construction

C4 - Bearings and lubrication

C4.3.2 - Permissible axial load (in daN) on main shaft extension for standard bearing assembly





Horizontal motor

Nominal lifetime L_{10h} of bearings: 25,000 hours

Motor		2 poles N = 3000 min^{-1}		4 poles N = 1500 min^{-1}		6 poles N = 1000 min^{-1}		8 poles N = 750 min^{-1}	
Frame size	Type	←	→	←	→	←	→	←	→
		IM B3/B6 IM B7/B8 IM B5/B35 IM B14/B34	IM B3/B6 IM B7/B8 IM B5/B35 IM B14/B34	IM B3/B6 IM B7/B8 IM B5/B35 IM B14/B34	IM B3/B6 IM B7/B8 IM B5/B35 IM B14/B34	IM B3/B6 IM B7/B8 IM B5/B35 IM B14/B34	IM B3/B6 IM B7/B8 IM B5/B35 IM B14/B34	IM B3/B6 IM B7/B8 IM B5/B35 IM B14/B34	IM B3/B6 IM B7/B8 IM B5/B35 IM B14/B34
160	PLS 160 MG	30	(110)*	46	(170)*	322	(422)*	-	-
	PLS 160 L	110	(210)*	210	(310)*	256	(356)*	-	-
180	PLS 180 M	93	(193)*	123	(223)*	159	(259)*	-	-
	PLS 180 L (L/LG)	95	(195)*	115	(215)*	372	420	-	-
200	PLS 200 M	149	197	344	392	425	473	-	-
	PLS 200 L (L/LP)	277	325	350	398	478	544	-	-
225	PLS 225 M (MR/MU)	306	372	411	477	461	527	-	-
250	PLS 250 SP	465	385	599	519	693	613	-	-
	PLS 250 MP	454	374	581	501	675	595	-	-
280	PLS 280 SC	-	-	587	507	618	538	-	-
	PLS 280 MC	449	369	-	-	-	-	-	-
	PLS 280 MD	-	-	557	477	646	566		
315	PLS 315 S (S/SU)	471	291	771	591	855	675	-	-
	PLS 315 M (M/MU)	460	280	739	559	842	662	-	-
	PLS 315 L	443	263	678	498	820	640	-	-
	PLS 315 LD	368	188	573	393	586	406	-	-
	PLS 315 MG	540	240	931	630	1077	777	1193	893
	PLS 315 LG	521	221	900	600	1050	750	1140	840
	PLS 315 VLG	508	208	880	580	1012	712	1086	786
	PLS 315 VLGU	-	-	846	546	980	680	-	-
355	PLS 355 L (LA/LB)	135	415	414	694	530	810	600	881
400	PLS 400 L (LA/LB)	-	-	552	906	635	990	667	1021

( )* The axial loads shown above for IM B3/B6/B7/B8 with frame size ≤ 180 are the permissible axial loads for locked DE bearings (non-standard assembly, special order).

PLS
Drip-proof 3-phase induction motors
Construction

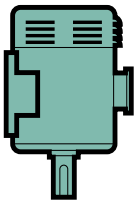
C4 - Bearings and lubrication

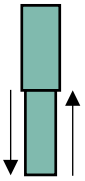
C

C4.3.2 - Permissible axial load (in daN) on main shaft extension for standard bearing assembly

Vertical motor
Shaft facing down

Nominal lifetime L_{10h}
of bearings: 25,000 hours





Motor		2 poles N = 3000 min^{-1}		4 poles N = 1500 min^{-1}		6 poles N = 1000 min^{-1}		8 poles N = 750 min^{-1}	
Frame size	Type	↑ IM V5 IM V1/V15 IM V18/V58..	↓ IM V5 IM V1/V15 IM V18/V69..	↑ IM V5 IM V1/V15 IM V18/V69..	↓ IM V5 IM V1/V15 IM V18/V69..	↑ IM V5 IM V1/V15 IM V18/V69..	↓ IM V5 IM V1/V15 IM V18/V69..	↑ IM V5 IM V1/V15 IM V18/V69..	↓ IM V5 IM V1/V15 IM V18/V69..
160	PLS 160 MG	45	(160)*	60	(226)*	296	(472)*	-	-
	PLS 160 L	85	(210)*	192	(341)*	230	(405)*	-	-
180	PLS 180 M	72	(226)*	101	(263)*	126	(314)*	-	-
	PLS 180 L (L/LG)	71	(234)*	85	(266)*	337	486	-	-
200	PLS 200 M	130	256	309	458	382	553	-	-
	PLS 200 L (L/LP)	238	385	304	475	425	634	-	-
225	PLS 225 M (MR/MU)	232	416	351	577	398	645	-	-
250	PLS 250 SP	393	491	507	661	580	756	-	-
	PLS 250 MP	378	493	482	660	600	762	-	-
280	PLS 280 SC	-	-	477	685	502	748	-	-
	PLS 280 MC	364	503	-	-	-	-	-	-
	PLS 280 MD	-	-	431	695	508	820	-	-
315	PLS 315 S (S/SU)	336	491	620	824	644	1018	-	-
	PLS 315 M (M/MU)	311	505	564	836	621	1048	-	-
	PLS 315 L	273	529	477	839	570	1066	-	-
	PLS 315 LD	171	494	321	818	324	898	-	-
	PLS 315 MG	357	517	682	1010	765	1252	937	1310
	PLS 315 LG	300	560	587	1072	713	1277	816	1364
	PLS 315 VLG	270	580	557	1085	610	1346	706	1412
	PLS 315 VLGU	-	-	483	1125	570	1357	-	-
355	PLS 355 L (LA/LB)	402	396	573	893	580	1220	614	1394
400	PLS 400 L (LA/LB)	-	-	568	1309	612	1627	680	1756

( )* The axial loads shown above for IM V5 with frame size ≤ 180 are the permissible axial loads for locked DE bearings (non-standard assembly, special order).

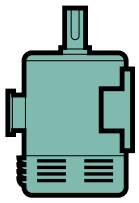
PLS
Drip-proof 3-phase induction motors
Construction

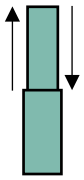
C4 - Bearings and lubrication

C4.3.2 - Permissible axial load (in daN) on main shaft extension for standard bearing assembly

Vertical motor
Shaft facing up

Nominal lifetime L_{10h}
of bearings: 25,000 hours





Motor		2 poles N = 3000 min⁻¹		4 poles N = 1500 min⁻¹		6 poles N = 1000 min⁻¹		8 poles N = 750 min⁻¹	
Frame size	Type	↑ IM V6 IM V3/V36 IM V19/V69..	↓ IM V6 IM V3/V36 IM V19/V69..	↑ IM V6 IM V3/V36 IM V19/V69..	↓ IM V6 IM V3/V36 IM V19/V69..	↑ IM V6 IM V3/V36 IM V19/V69..	↓ IM V6 IM V3/V36 IM V19/V69..	↑ IM V6 IM V3/V36 IM V19/V69..	↓ IM V6 IM V3/V36 IM V19/V69..
160	PLS 160 MG	145	45	184	102	396	372	-	-
	PLS 160 L	185	110	292	241	330	305	-	-
180	PLS 180 M	172	126	201	163	226	214	-	-
	PLS 180 L (L/LG)	171	134	185	166	385	438	-	-
200	PLS 200 M	178	208	357	410	430	505	-	-
	PLS 200 L (L/LP)	286	337	352	427	491	568	-	-
225	PLS 225 M (MR/MU)	298	350	417	511	464	579	-	-
250	PLS 250 SP	313	571	427	741	500	836	-	-
	PLS 250 MP	298	573	402	740	521	842	-	-
280	PLS 280 SC	-	-	397	765	422	828	-	-
	PLS 280 MC	284	583	-	-	-	-	-	-
	PLS 280 MD	-	-	351	775	428	900	-	-
315	PLS 315 S (S/SU)	156	671	440	1004	464	1198	-	-
	PLS 315 M (M/MU)	131	685	384	1016	441	1228	-	-
	PLS 315 L	93	709	297	1019	390	1246	-	-
	PLS 315 LD	0	674	141	998	144	1078	-	-
	PLS 315 MG	57	817	382	1311	465	1552	637	1610
	PLS 315 LG	0	859	287	1372	413	1577	516	1664
	PLS 315 VLG	30	878	257	1385	300	1646	406	1712
	PLS 315 VLGU	-	-	183	1425	270	1657	-	-
355	PLS 355 LA	600	1396	427	1893	422	2220	386	2394
400	PLS 400 L (LA/LB)	-	-	632	2570	790	3027	1020	3456

C4 - Bearings and lubrication

C

C4.3.3 - Permissible radial load on 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 applied to drive shaft extension: Fpr

The radial force Fpr expressed in daN applied to the shaft extension is found by the formula.

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

where:

P_N = rated motor power (kW)

D = external diameter of the drive pulley (mm)

N_N = rated speed of the motor (min^{-1})

k = factor depending on the type of transmission

P_P = 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.

● Permission radial force on the drive shaft extension

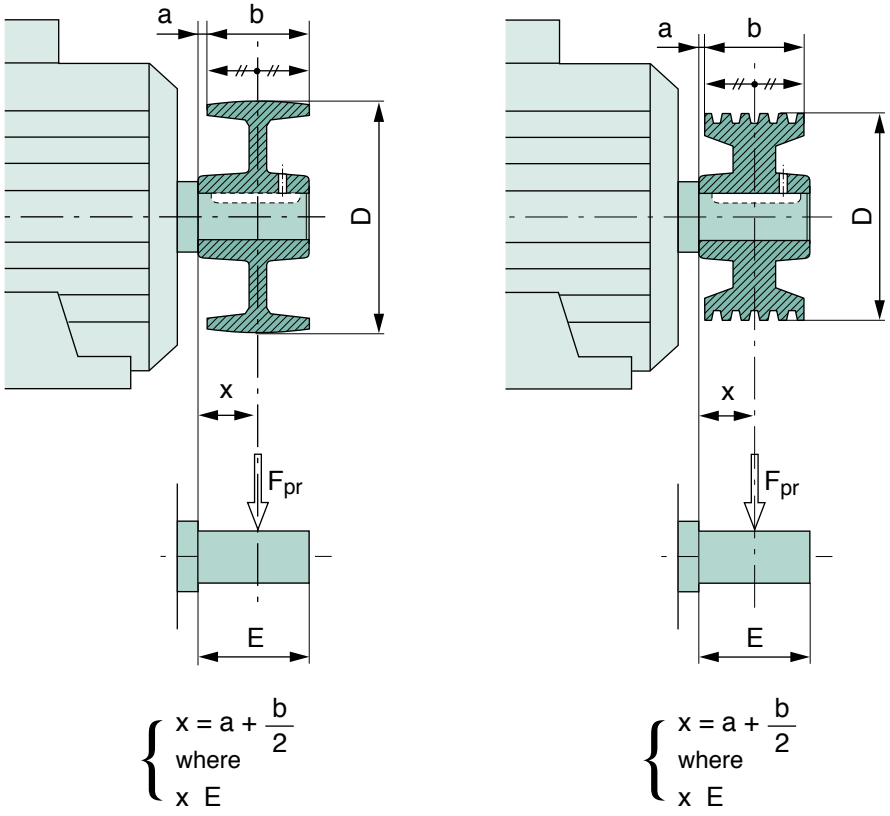
The charts on the following pages indicate, for each type of motor, the radial force F_R at a distance X permissible on the drive end shaft extension, for a bearing life L_{10h} of 25,000 hours.

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 ¼ F_R), applied at distance X, the bearing life L_{10h} changes, at a first approximation, in the ratio k_R, (k_R = Fpr/F_R) as shown in the chart opposite, for standard assemblies.

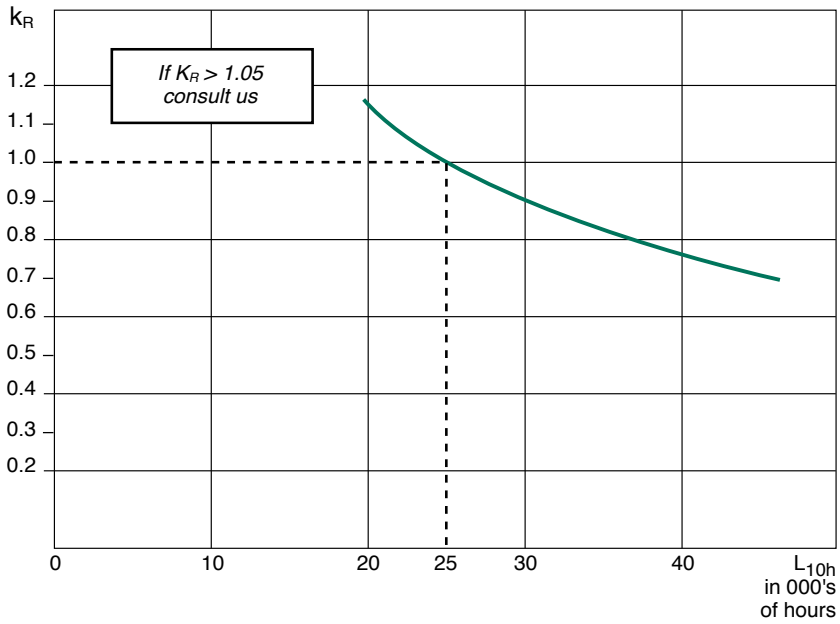
If the load factor k_R is greater than 1.05, you should consult our technical department, stating mounting position and direction of force before opting for a special fitting arrangement.



$$\begin{cases} x = a + \frac{b}{2} \\ \text{where} \\ x \ \ E \end{cases}$$

$$\begin{cases} x = a + \frac{b}{2} \\ \text{where} \\ x \ \ E \end{cases}$$

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



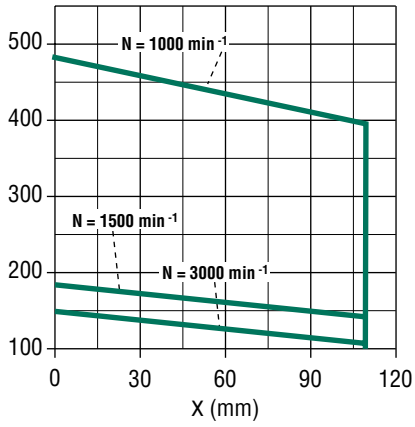
PLS
Drip-proof 3-phase induction motors
Construction

C4 - Bearings and lubrication

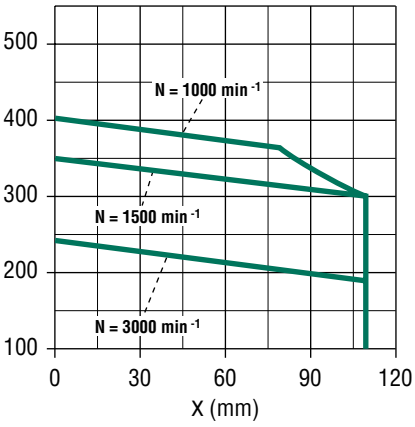
C4.3.3 - Standard fitting arrangement

Permissible radial load on main shaft extension with a bearing life L_{10h} of 25,000 hours.

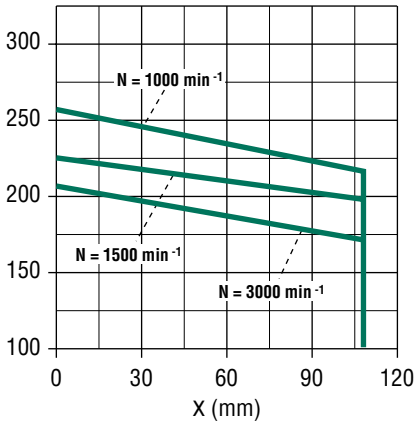
PLS 160 MG



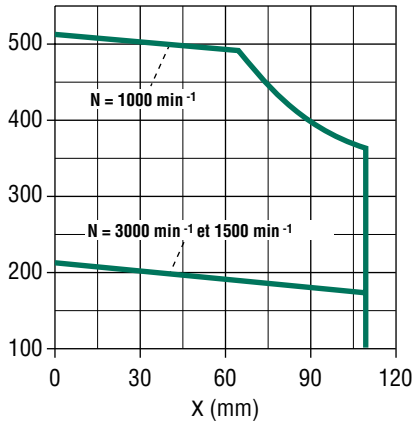
PLS 160 L



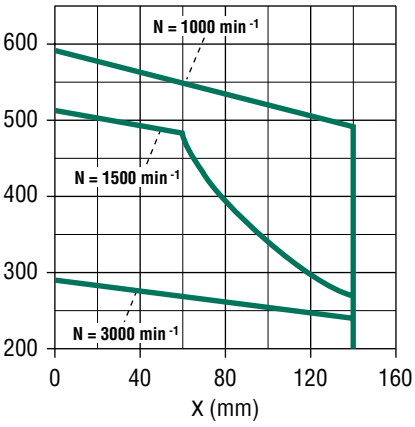
PLS 180 M



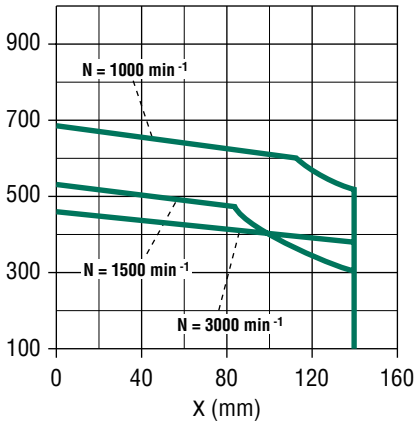
PLS 180 L (L, LG)



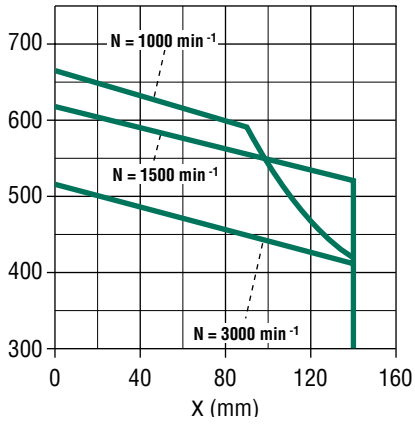
PLS 200 M



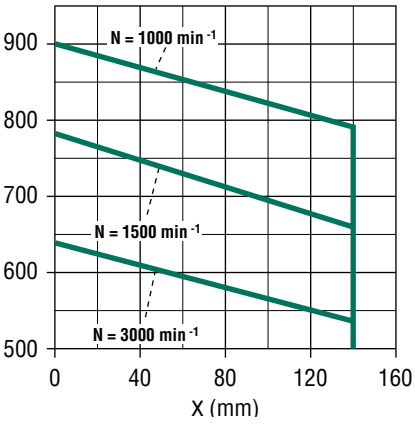
PLS 200 L (LP, L)



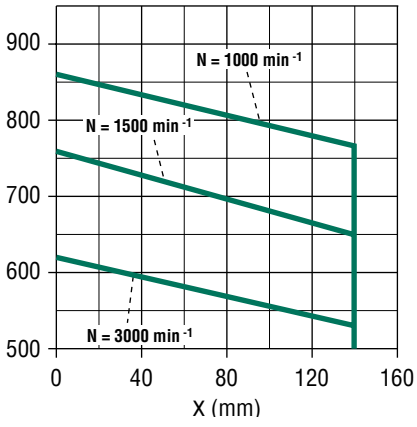
PLS 225 M (MR, MU)



PLS 250 SP



PLS 250 MP



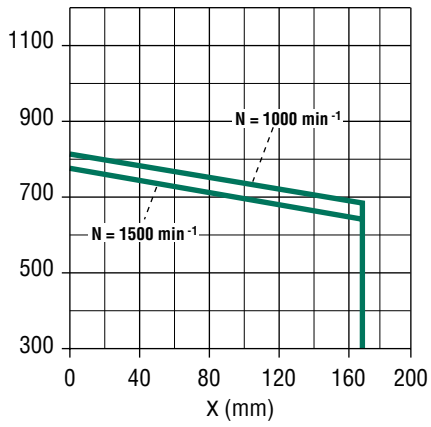
C4 - Bearings and lubrication

C

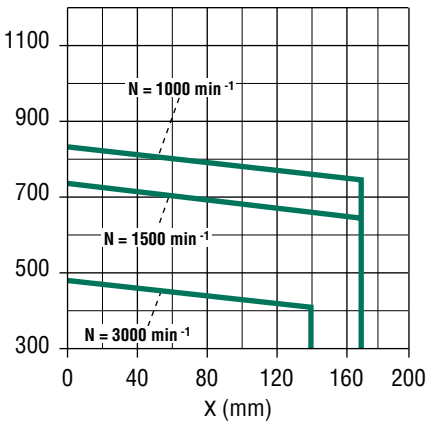
C4.3.3 - Standard fitting arrangement

Permissible radial load on main shaft extension with a bearing life L_{10h} of 25,000 hours.

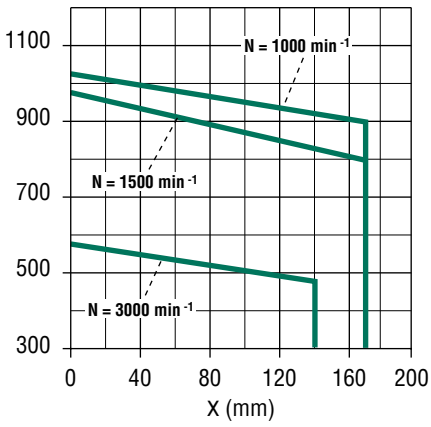
PLS 280 SC



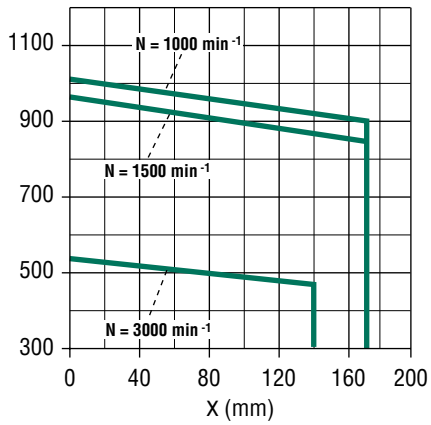
PLS 280 M (MC, MD)



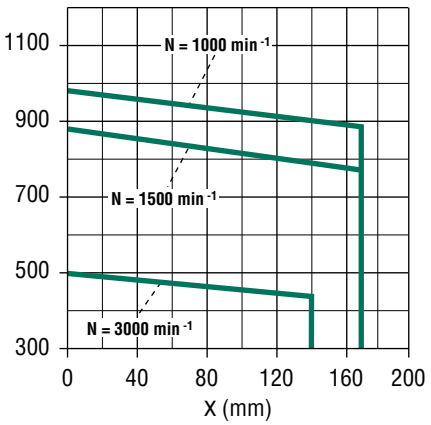
PLS 315 S (S, SU)



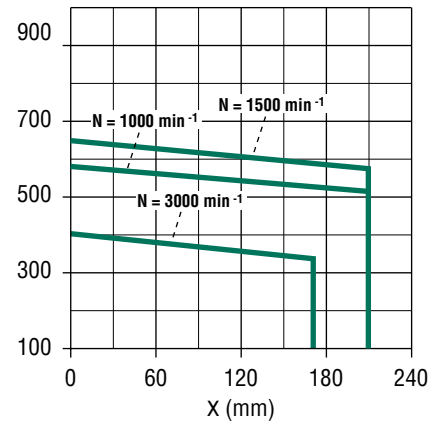
PLS 315 (M, MU)



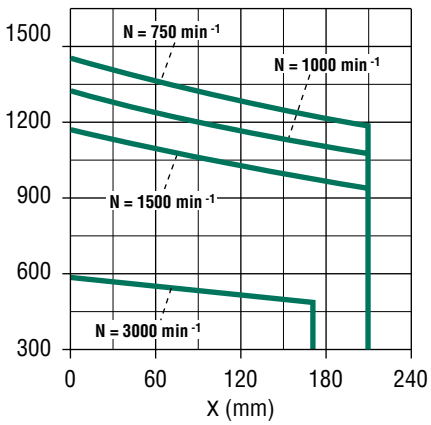
PLS 315 L



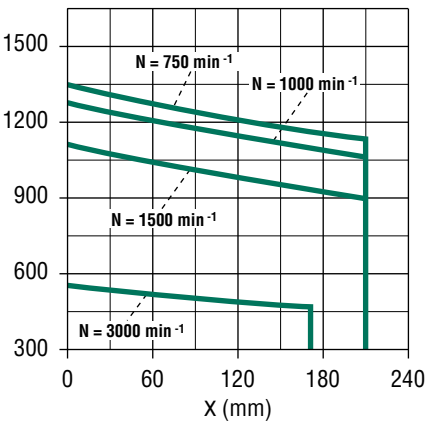
PLS 315 LD



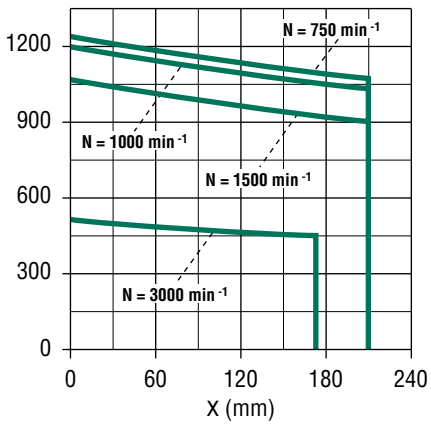
PLS 315 MG



PLS 315 LG



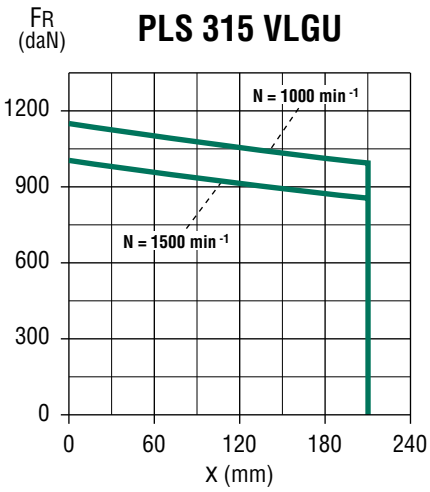
PLS 315 VLG

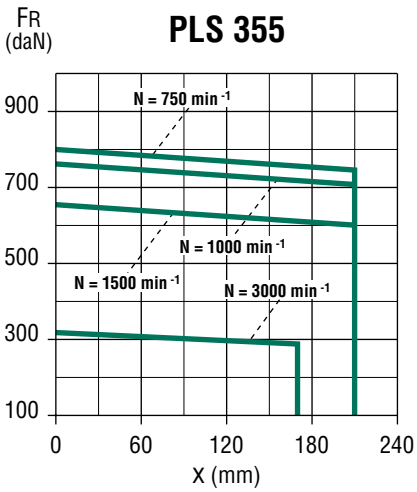


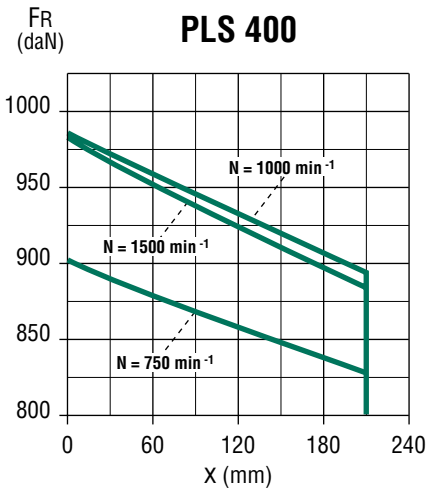
C4 - Bearings and lubrication

C4.3.3 - Standard fitting arrangement

Permissible radial load on main shaft extension with a bearing life L_{10h} of 25,000 hours.







PLS
Drip-proof 3-phase induction motors
Construction

C4 - Bearings and lubrication

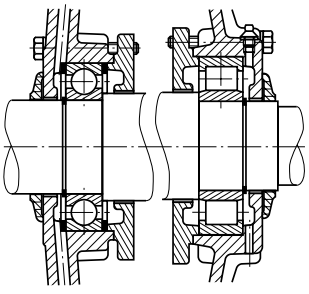
C

C4.4 - TYPES AND SPECIAL FITTING ARRANGEMENTS FOR DE ROLLER BEARINGS

Motor		No. of poles	Standard fitting arrangement			
					Assembly diagram reference	
Frame size	LEROY-SOMER designation		Non drive end bearing (N.D.E.)	Drive end bearing (D.E.)	Foot-mounted motors	Flange-mounted (or foot and flange) motors
160	PLS 160 MG	6	6210 Z C3	NU 310	1	1
160	PLS 160 L	4 ; 6	6210 Z C3	NU 310	1	1
180	PLS 180 M	4 ; 6	6210 Z C3	NU 212	1	1
180	PLS 180 L	4	6210 Z C3	NU 212	1	1
180	PLS 180 LG	6	6212 Z C3	NU 312	1	1
200	PLS 200 M	4 ; 6	6212 Z C3	NU 313	1	1
200	PLS 200 LP	4	6212 Z C3	NU 313	1	1
200	PLS 200 L	6	6214 C3	NU 314	1	1
225	PLS 225 (MR/MU)	4 ; 6	6214 C3	NU 314	1	1
250	PLS 250 SP	4 ; 6	6314 C3	NU 317	2	2
250	PLS 250 MP	4 ; 6	6314 C3	NU 317	2	2
280	PLS 280 SC	4 ; 6	6314 C3	NU 317	2	2
280	PLS 280 (MC/MD)	2 ; 4 ; 6	6314 C3	NU 317	2	2
315	PLS 315 (S/M/L)	4	6316 C3	NU 320	3	3
315	PLS 315 (SU/MU/L)	6	6316 C3	NU 320	3	3
315	PLS 315 LD	4 ; 6	6316 C3	NU 224	3	3
315	PLS 315 MG	4 ; 6 ; 8	6317 C3	NU 322 EC	3	3
315	PLS 315 LG	4 ; 6 ; 8	6317 C3	NU 322 EC	3	3
315	PLS 315 (VLG/VLGU)	4 ; 6 ; 8	6317 C3	NU 322 EC	3	3
355	PLS 355 (LA/LB)	4 ; 6 ; 8	6324 C3	NU 324 EC	4	4
400	PLS 400 (LA/LB)	4 ; 6 ; 8	6328 C3	NU 328 EC	4	4

C4.4.1 - Bearing assembly diagrams

1



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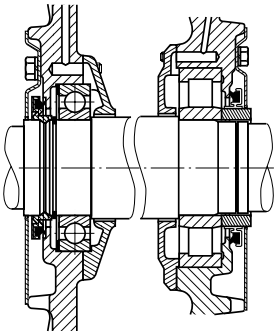

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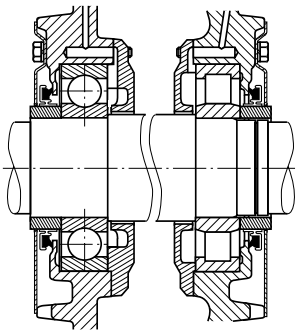

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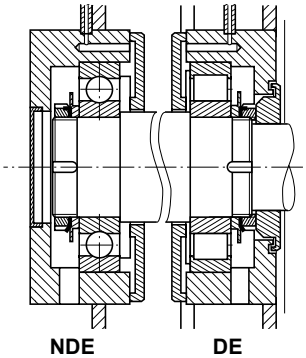
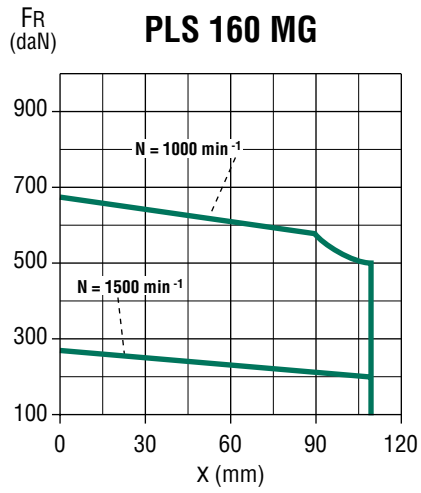
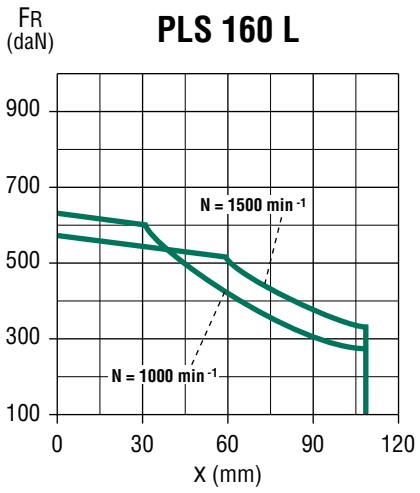


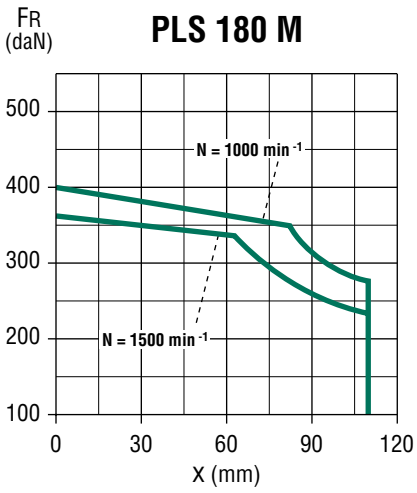
C4 - Bearings and lubrication

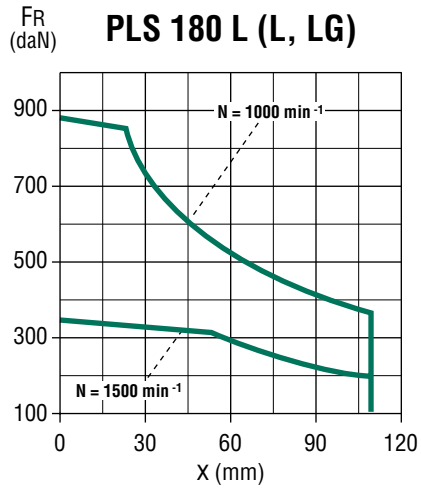
C4.4.2 - Special fitting arrangements

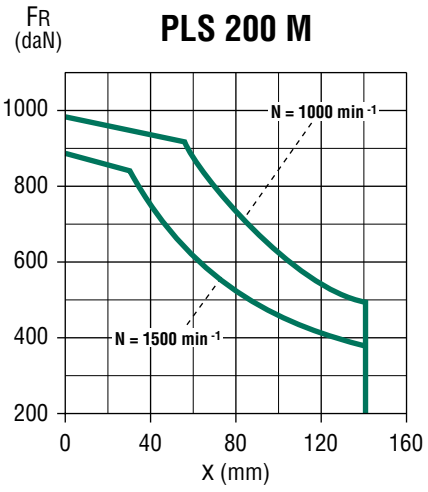
Permissible radial load on main shaft extension with a bearing life L_{10h} of 25,000 hours.

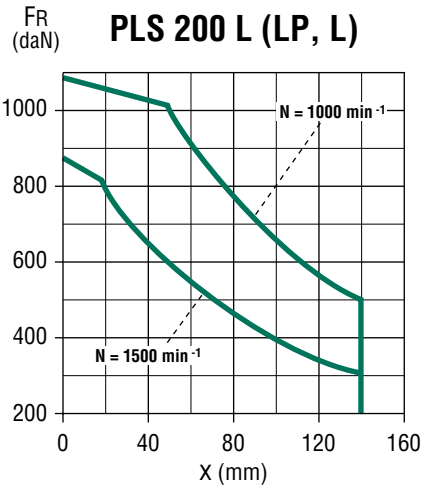


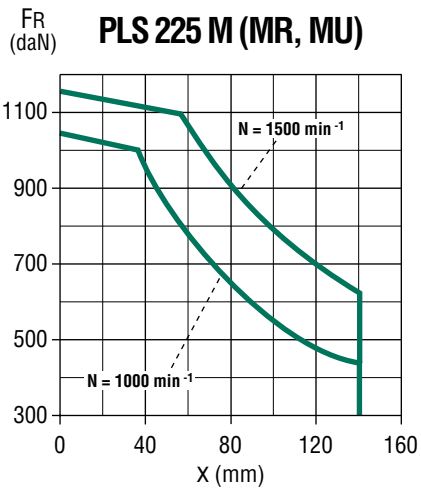


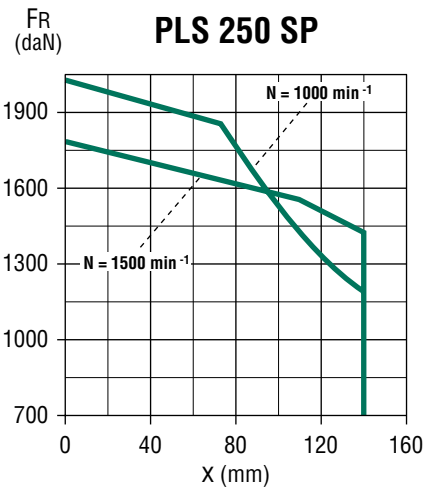


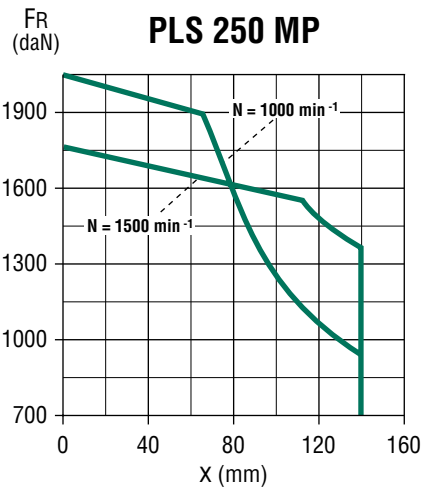












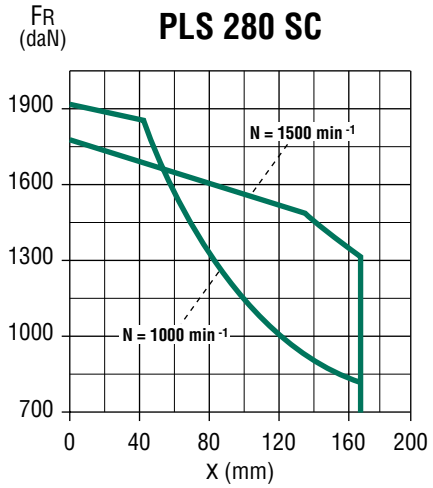
C4 - Bearings and lubrication

C

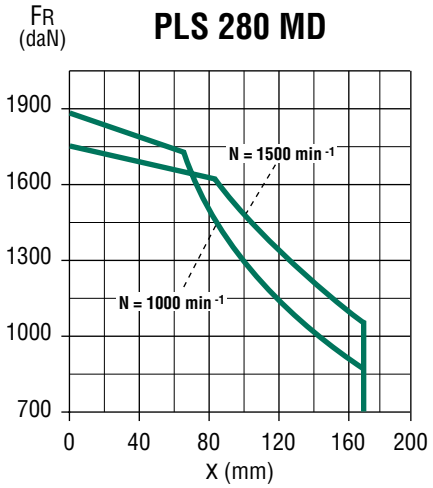
C4.4.2 - Special fitting arrangements

Permissible radial load on main shaft extension with a bearing life L_{10h} of 25,000 hours.

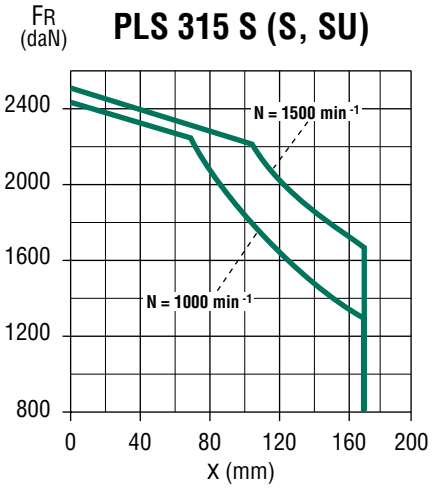
PLS 280 SC



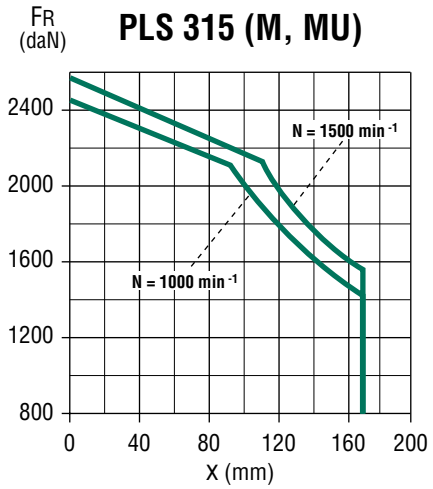
PLS 280 MD



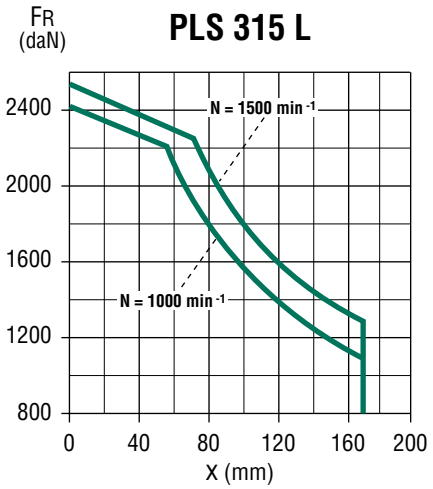
PLS 315 S (S, SU)



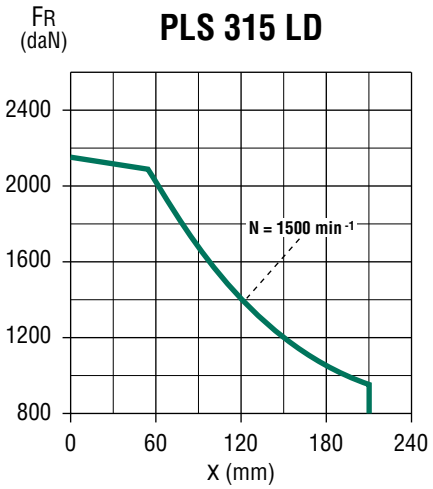
PLS 315 (M, MU)



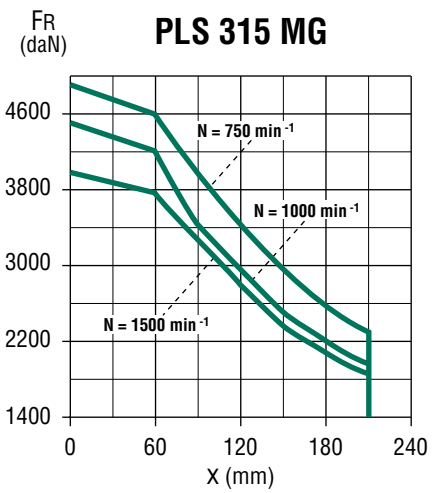
PLS 315 L



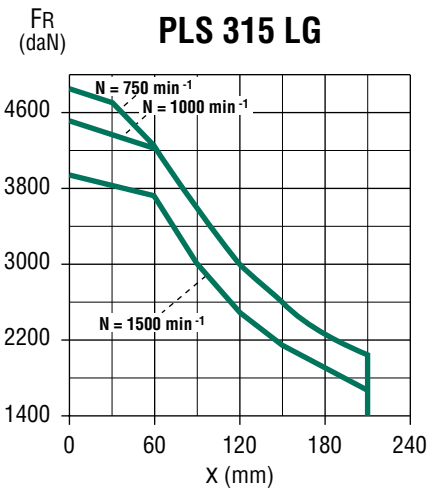
PLS 315 LD



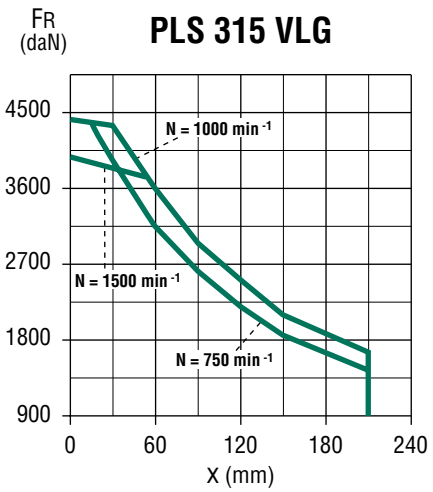
PLS 315 MG



PLS 315 LG



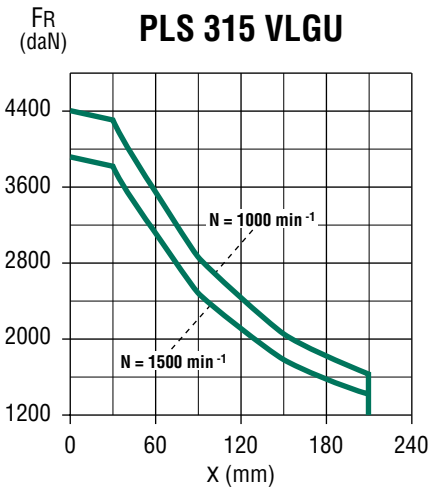
PLS 315 VLG

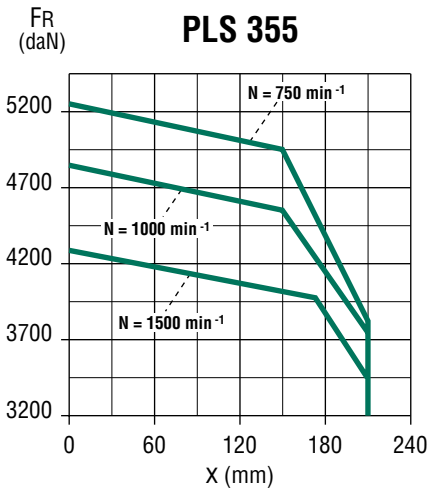


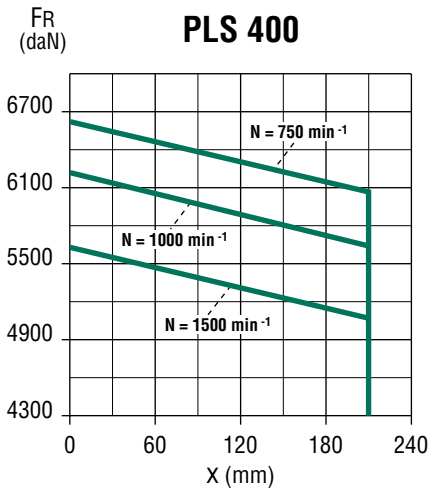
C4 - Bearings and lubrication

C4.4.2 - Special fitting arrangements

Permissible radial load on main shaft extension with a bearing life L_{10h} of 25,000 hours.







D1 - Supply voltage

D

D1.1 - REGULATIONS AND STANDARDS

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

Since 1998, voltages at the point of delivery have to be maintained between the following extreme values:

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

The IEC 60038 standard gives the European reference voltage as 230/400 V three-phase and 230 V single-phase, with a tolerance of +6% to -10% until 2003 and ±10% from then on.

The tolerances usually permitted for power supply sources are indicated below:

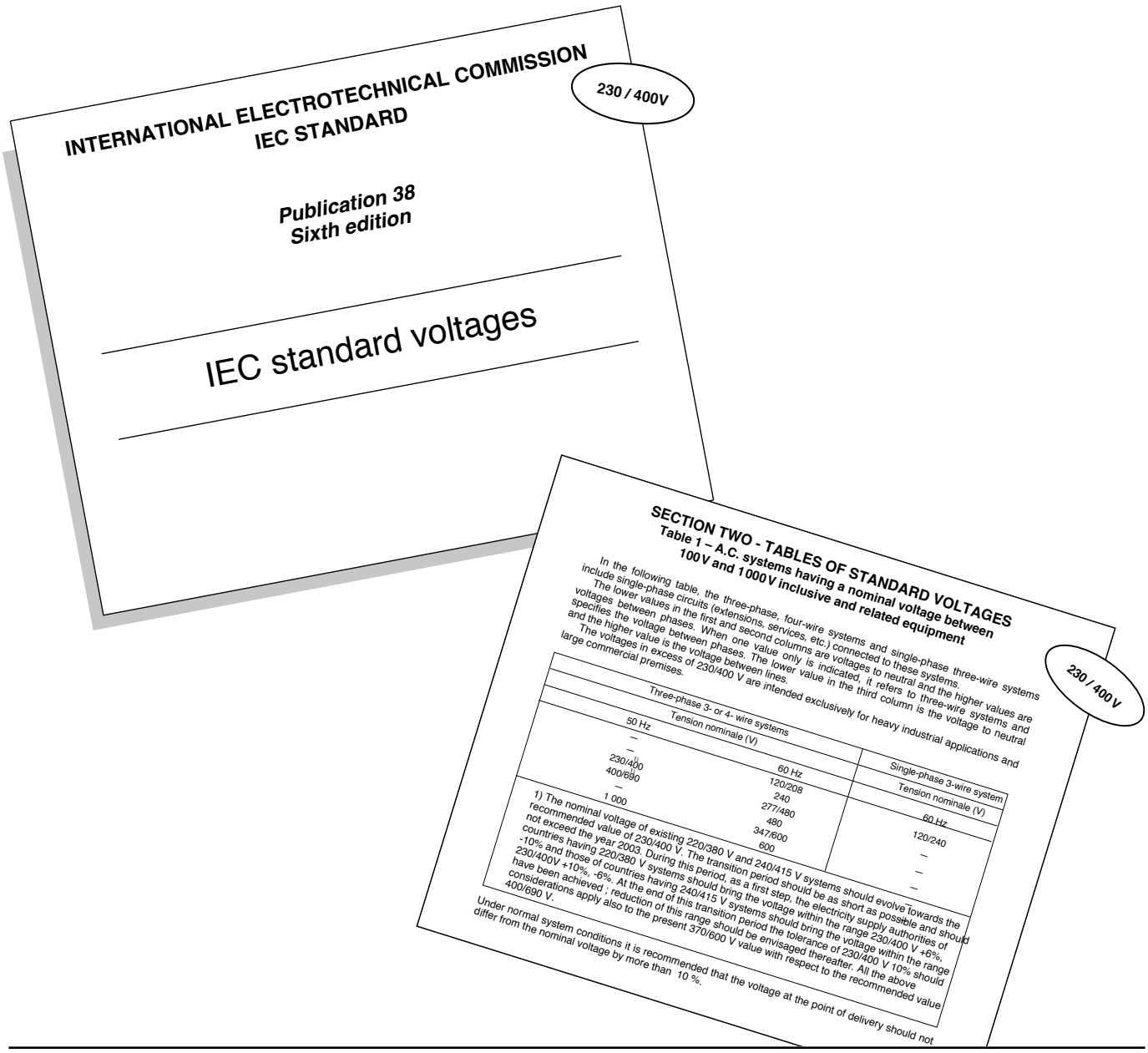
- maximum line drop between customer delivery point and customer usage point: 4%.
- Variation in frequency around nominal frequency:
  - continuous state : ±1%
  - transient state : ±2%
- Three-phase mains phase-balance error:
  - zero-sequence component and/or negative phase sequence component compared to positive phase sequence component: < 2%
- Harmonics:
  - relative harmonic content: <10%
  - individual harmonic voltages: to be established
- Surges and transient power cuts: to be established

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

This means that the same motor can operate on the following existing supplies:
- 220/380 V ±5%
- 230/400 V ±5% and ±10%
- 240/415 V ± 5%

and is therefore suitable for a large number of countries worldwide where for example it is possible to extend them to some 60 Hz supplies:
- 265/460 V ± 10%

From 2008, 380 and 415 V - 50 Hz voltage supplies must be eliminated.



D1 - Supply voltage

D1.2 - EFFECTS ON MOTOR PERFORMANCE

D1.2.1 - 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 (precise values for each motor can be supplied on request).

	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 UN.

D1.2.2 - 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	$N \frac{f'}{f}$	cos φ unchanged	Efficiency unchanged
Variable	$Pu\left(\frac{u'/u}{f/f'}\right)^2$	$M\left(\frac{u'/u}{f/f'}\right)^2$	$N \frac{f'}{f}$	Depends on level of saturation of machine	

M = minimum and maximum values of starting torque.

D1.2.3 - Phase voltage imbalance

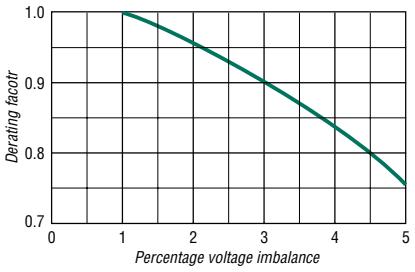
The phase imbalance for voltage is calculated as follows:

$$\% \text{ Voltage imbalance} = 100 \times \frac{\text{maximum difference in voltage compared to average voltage value}}{\text{average voltage value}}$$

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



D1.2.4 - Phase current imbalance

Voltage imbalances induce current imbalances. Natural lack of symmetry due to manufacture also induces current imbalances.

D2 - Power - Torque - Efficiency - Power Factor (Cos φ)

D

D2.1 - 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:

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

D2.2 - RATED POWER IN RELATION TO FRAME SIZE AND NUMBER OF POLES

The table below (NFC 51-160) shows rated power for continuous operation according to frame size.

Frame size	RATED POWER FOR CONTINUOUS OPERATION		
	2 poles 3000 min^{-1}	4 poles 1500 min^{-1}	6 poles 1000 min^{-1}
	kW	kW	kW
160 MG	-	-	7.5
160 L	18.5 - 22	15 - 18.5	11
180 M	30	22	15
180 L	37	30	18.5
200 M	45	37	22
200 L	55	45	30
225 M	75	55	37
250 S	90	75	45
250 M	110	90	55
280 S	-	110	75
280 M	132	132	90
315 S	160	160	110
315 M	200	200	132

D2.3 - INFLUENCEOFMOTORLOAD ON POWER FACTOR COS φ AND EFFICIENCY

Efficiency and power factor cos φ vary according to the motor load.

The table opposite gives the intermediate load values that correspond to the full load (4/4) values shown in the motor selection tables.

These values are average values and are to be used for information only.

Efficiency η						Power factor Cos φ					
1/2	3/4	4/4	1/2	3/4	4/4	1/2	3/4	4/4	1/2	3/4	4/4
94.5	96	**96**	72	75	**75**	0.86	0.9	**0.92**	0.5	0.62	**0.71**
93.5	95	**95**	71	74	**74**	0.85	0.89	**0.91**	0.49	0.62	**0.7**
92.5	94	**94**	70	73	**73**	0.83	0.88	**0.9**	0.48	0.61	**0.69**
91.5	93	**93**	68	72	**72**	0.8	0.86	**0.89**	0.47	0.6	**0.68**
91	92	**92**	67	71	**71**	0.78	0.85	**0.88**	0.46	0.59	**0.67**
90	91	**91**	66	70	**70**	0.76	0.84	**0.87**	0.46	0.59	**0.66**
89	90	**90**	65	69	**69**	0.75	0.83	**0.86**	0.46	0.58	**0.65**
88	89	**89**	64	67	**68**	0.73	0.81	**0.85**	0.46	0.58	**0.64**
87	88	**88**	62	66	**67**	0.71	0.8	**0.84**	0.45	0.57	**0.63**
86	87	**87**	61	65	**66**	0.69	0.79	**0.83**	0.44	0.56	**0.62**
85	86	**86**	60	64	**65**	0.67	0.77	**0.82**	0.44	0.56	**0.61**
84	85	**85**	59	63	**64**	0.66	0.76	**0.81**	0.44	0.55	**0.6**
83	84	**84**	57	62	**63**	0.65	0.75	**0.8**			
82	83	**83**	56	60	**62**	0.63	0.74	**0.79**			
81	82	**82**	55	59	**61**	0.61	0.72	**0.78**			
80	81	**81**	54	58	**60**	0.59	0.71	**0.77**			
79	80	**80**	53	58	**59**	0.58	0.7	**0.76**			
77	79	**79**	52	57	**58**	0.56	0.69	**0.75**			
76	78	**78**	51	55	**57**	0.55	0.68	**0.74**			
75	77	**77**	49	54	**56**	0.54	0.67	**0.73**			
73	76	**76**				0.52	0.63	**0.72**			

D3 - Noise and vibration

D3.1 - MOTOR NOISE LEVELS

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, at synchronous speed at 50Hz.

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).

The PLS machines in this catalogue are standard Level A, half-key balancing

Expressed as sound power level (Lw) according to the standard, the level of sound is also shown as sound pressure level (Lp) in the table below for 50 Hz motors:

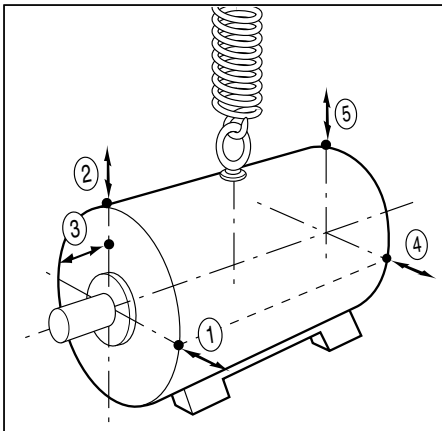
Motor type	2 poles			4 poles			6 poles			8 poles		
	IEC 60034-9	PLS	PLS	IEC 60034-9	PLS	PLS	IEC 60034-9	PLS	PLS	IEC 60034-9	PLS	PLS
	Power LwA		Pressure LpA	Power LwA		Pressure LpA	Power LwA		Pressure LpA	Power LwA		Pressure LpA
PLS 160 MG	96	87	76	91	78	67	85	77	66	-	-	-
PLS 180 M	99	89	78	91	80	69	88	77	66	-	-	-
PLS 180 L (L/LG)	99	89	78	94	80	69	88	77	66	-	-	-
PLS 200 M	101	90	79	94	84	72	88	78	67	-	-	-
PLS 200 L (L/LP)	101	90	79	97	84	72	91	78	67	-	-	-
PLS 225 M (MR/MU)	103	90	79	97	86	74	91	78	67	-	-	-
PLS 250 S and M	103	90	79	100	87	75	94	79	68	-	-	-
PLS 280 S (SC)	105	90	79	100	87	75	97	79	68	-	-	-
PLS 280 M (MC/MD)	105	90	79	103	87	75	97	79	68	-	-	-
PLS 315 S (S/SU)	107	97	85	103	96	84	97	88	76	-	-	-
PLS 315 M (M/MU)	107	97	85	103	96	84	100	88	76	-	-	-
PLS 315 L	107	97	85	106	96	84	100	88	76	-	-	-
PLS 315 LD	107	99	87	106	96	84	100	88	76	-	-	-
PLS 315 MG	107	101	89	106	98	86	100	89	77	97	89	77
PLS 315 LG	107	101	89	106	98	86	103	89	77	97	89	77
PLS 315 VLG/VLGU	107	101	89	106	98	86	103	89	77	97	89	77
PLS 355 LA	107	102	90	106	102	90	103	94	82	99	92	80
PLS 355 LB	109	102	90	108	102	90	103	94	82	99	92	80
PLS 400 LA	-	-	-	108	103	91	103	94	82	99	92	80
PLS 400 LB	-	-	-	108	103	91	106	94	82	99	92	80

The maximum standard tolerance for all these values is + 3 dB(A).

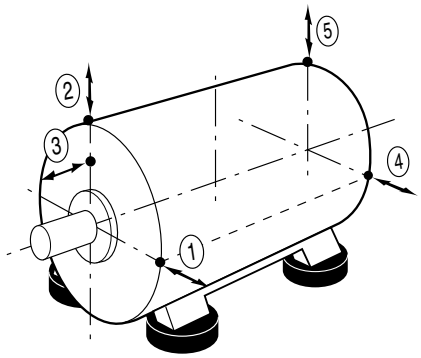
D3.2 - VIBRATION LEVELS - BALANCING

In accordance with standard NFC 51-111, the machines in this catalogue have level A balancing. Class B is available on request.
Vibration levels of machines with frame size ≥ 315 (not included in the standard) will have to be agreed in advance between customer and supplier. By default, the targeted vibration levels are level A for the 315 M.

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



▲ *Measuring system for suspended machines*



▲ *Measuring system for machines on flexible mountings*

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

PLS
Drip-proof 3-phase induction motors
15 to 900 kW

PLS
Drip-proof 3-phase induction motors
Electrical characteristics

PAGES

E

E1 - Selection data

PLS
Drip-proof 3-phase induction motors
Electrical characteristics

E1 - Selection data

E

2 poles 3000 min^{-1}

IP 23
Cl. F - ΔT 80 K
MULTI-VOLTAGE

MAINS SUPPLY Δ 230 / Y 400 V or Δ 400 V **50 Hz**

Type	Rated power* at 50 Hz	Rated speed	Rated torque	Rated current	Power factor**	Efficiency IEC 60034-2 1996***	Starting current/ Rated current	Starting torque/ Rated torque	Maximum torque/ Rated torque	Moment of inertia	Weight	Noise
	P_N kW	N_N min^{-1}	C_N N.m	I_N (400 V) A	Cos φ	h	I_D/I_N	M_D/M_N	M_M/M_N	J kg.m^2	IM B3 kg	LP db(A)
PLS 160 L	18,5	2934	60,2	35,1	0,85	89,5	6,7	2,6	2,9	0,037	80	76
PLS 160 L	22	2936	71,6	42	0,84	90	7,2	2,7	3,0	0,041	86	76
PLS 180 M	30	2936	97,6	57,2	0,84	90,1	7,5	2,6	3,3	0,054	102	78
PLS 180 L	37	2940	120	67,2	0,87	91,4	7,3	2,8	3,1	0,081	123	78
PLS 200 M	45	2950	146	83,1	0,85	92	7,3	2,2	3,0	0,102	170	79
PLS 200 LP	55	2950	178	96,9	0,88	93,1	7,7	2,8	3,2	0,14	185	79
PLS 225 MR	75	2945	243	134	0,87	92,9	7,6	2,8	3,1	0,17	240	79
PLS 250 SP	90	2960	290	163	0,85	93,8	7,4	2,4	3,1	0,4	325	79
PLS 250 MP	110	2960	355	196	0,86	94,2	7,7	2,5	3,3	0,44	350	79
PLS 280 MC	132	2958	426	232	0,87	94,6	7,8	2,5	3,5	0,48	455	79
PLS 315 S	160	2974	514	276	0,88	95	8,2	2,7	3,4	1,25	645	85
PLS 315 M	200	2974	642	341	0,89	95,2	8,3	2,8	3,4	1,42	705	85
PLS 315 L	250	2974	803	421	0,9	95,3	8,2	2,9	3,4	1,68	790	85
PLS 315 LD	280	2972	900	466	0,91	95,4	8,0	2,8	3,1	1,97	900	87
PLS 315 LD	315	2972	1012	529	0,9	95,5	8,3	3,1	3,4	1,97	910	87
PLS 315 LG	355	2965	1143	617	0,87	95,5	6,5	1,7	2,0	2,8	1030	89
PLS 315 LG	400	2965	1288	695	0,87	95,5	7,0	1,9	2,0	3,1	1120	89
PLS 315 VLG	450	2975	1444	778	0,87	96	7,0	1,9	2,1	3,5	1200	89
PLS 355 LA	500	2978	1602	761	0,87	96	5,7	1,3	2,2	6,3	1700	90
PLS 355 LB	710	2978	2277	1207	0,88	96,5	8,4	1,6	2,2	8	2050	90

* Power ratings higher than 710 kW can be ordered. Please consult Leroy-Somer.

***Power factor - Cos φ*	****Efficiency - η*	*Calculation of rated torque*	*Noise level*
Use on 3/4 and 1/2 load: section D	*Use on 3/4 and 1/2 load: section D*	$M_N = \frac{60 \times P_N}{2\pi\ N_N}$	*section D*

PLS
Drip-proof 3-phase induction motors
Electrical characteristics

E1 - Selection data

4 poles 1500 min^{-1}

IP 23
Cl. F - ΔT 80 K
MULTI-VOLTAGE

MAINS SUPPLY Δ 230 / Y 400 V or Δ 400 V **50 Hz**

Type	Rated power* at 50 Hz P_N kW	Rated speed N_N min^{-1}	Rated torque C_N N.m	Rated current I_N (400 V) A	Power factor** Cos φ	Efficiency IEC 60034-2 1996*** h	Starting current/ Rated current I_D/I_N	Starting torque/ Rated torque M_D/M_N	Maximum torque/ Rated torque M_M/M_N	Moment of inertia J kg.m^2	Weight IM B3 kg	Noise LP db(A)
PLS 160 L	15	1450	98,8	30,2	0,83	86,4	5,9	2,0	2,6	0,049	80	67
PLS 160 L	18,5	1445	122	36,9	0,83	87,2	6,0	2,1	2,7	0,063	88	67
PLS 180 M	22	1450	145	43,5	0,83	88	6,4	2,3	2,8	0,074	98	69
PLS 180 L	30	1450	198	57,1	0,85	89,2	5,7	2,4	2,5	0,123	128	69
PLS 200 M	37	1445	245	71,4	0,84	89	5,4	2,3	2,4	0,15	165	72
PLS 200 LP	45	1465	293	84,7	0,84	91,3	6,1	2,5	2,5	0,22	190	72
PLS 225 MR	55	1465	359	101	0,86	91,5	5,9	2,2	2,3	0,36	240	74
PLS 250 SP	75	1475	486	143	0,82	92,6	6,2	2,4	2,5	0,65	335	75
PLS 250 MP	90	1475	583	167	0,84	92,8	6,5	2,5	2,6	0,75	360	75
PLS 280 SC	110	1472	714	207	0,82	93,4	5,7	2,2	2,5	0,87	460	75
PLS 280 MD	132	1470	858	245	0,83	93,7	6,2	2,4	2,6	1,07	520	75
PLS 315 S	160	1468	1041	291	0,85	93,5	6,1	2,1	2,7	2,07	635	84
PLS 315 M	200	1468	1301	363	0,85	93,6	6,3	2,2	2,8	2,48	720	84
PLS 315 L	250	1470	1624	452	0,85	94	7,3	2,6	2,9	2,96	820	84
PLS 315 LD	280	1472	1816	504	0,85	94,3	7,2	2,6	2,8	3,45	935	84
PLS 315 MG	315	1475	2039	573	0,84	94,5	5,5	1,6	2,0	4,6	940	86
PLS 315 LG	355	1477	2295	645	0,84	94,5	5,5	1,8	2,0	5,3	1030	86
PLS 315 LG	400	1477	2586	724	0,84	95	6,0	1,7	2,1	5,9	1130	86
PLS 315 VLG	450	1480	2904	804	0,85	95	6,0	1,7	2,1	6,3	1280	86
PLS 315 VLGU*	500	1479	3228	889	0,85	95,5	6,0	1,6	2,1	6,8	1350	86
PLS 355 LA	550	1487	3532	973	0,85	96	6,8	1,6	2,2	10,5	1900	90
PLS 355 LB	685	1488	4396	1211	0,85	96	7,0	1,6	2,2	12	2150	90
PLS 400 LA	720	1491	4611	1267	0,85	96,5	7,5	1,7	2,2	21,6	2600	91
PLS 400 LB	900	1491	5764	1584	0,85	96,5	7,0	1,7	2,2	27	3050	91

• échauffement classe F
* Possibilité de puissances supérieures à 900 kW. Nous consulter SVP.

***Power factor - Cos φ*	****Efficiency - η*	*Calculation of rated torque*	*Noise level*
Use on 3/4 and 1/2 load: section D	*Use on 3/4 and 1/2 load: section D*	$M_N = \frac{60 \times P_N}{2\pi\ N_N}$	*section D*

PLS
Drip-proof 3-phase induction motors
Electrical characteristics

E1 - Selection data

E

6 poles 1000 min^{-1}

IP 23
Cl. F - ΔT 80 K
MULTI-VOLTAGE

MAINS SUPPLY Δ 230 / Y 400 V or Δ 400 V **50 Hz**

Type	Rated power* at 50 Hz P_N kW	Rated speed N_N min^{-1}	Rated torque M_N N.m	Rated current I_N (400 V) A	Power factor** Cos φ 4/4	Efficiency CEI 60034-2 1996*** η	Starting current/ Rated current I_D / I_N	Starting torque/ Rated torque M_D / M_N	Maximum torque/ Rated torque M_M / M_N	Moment of inertia J kg.m^2	Weight IM B3 kg	Noise LP db(A)
PLS 160 MG	7,5	970	73,8	17,1	0,75	84,5	5,0	1,7	2,3	0,085	81	66
PLS 160 L	11	960	109	22,6	0,8	87,9	5,2	1,8	2,1	0,116	102	66
PLS 180 M	15	960	149	30,4	0,81	88	5,2	2,1	2,2	0,17	114	66
PLS 180 LG	18,5	960	184	37,3	0,82	87,2	5,2	2,0	2,3	0,193	144	66
PLS 200 M	22	980	214	45,3	0,79	88,8	6,5	2,2	2,9	0,27	169	67
PLS 200 L	30	968	296	60,4	0,8	89,6	5,5	2,0	2,5	0,32	230	67
PLS 225 MR	37	966	366	74,3	0,8	89,9	5,8	2,2	2,6	0,39	240	67
PLS 250 SP	45	976	440	91,7	0,77	92	6,0	2,2	2,6	0,82	310	68
PLS 250 MP	55	976	538	112	0,77	92	5,9	2,2	2,6	0,88	325	68
PLS 280 SC	75	974	735	152	0,77	92,2	5,9	2,2	2,6	1,16	465	68
PLS 280 MD	90	978	879	173	0,81	92,8	5,2	2,1	2,4	1,44	525	68
PLS 315 SU	110	978	1074	208	0,82	93,1	6,0	2,1	2,5	3,36	645	76
PLS 315 MU	132	982	1284	251	0,81	93,9	5,1	2,1	2,3	3,54	750	76
PLS 315 L	160	982	1556	303	0,81	94,1	5,2	2,2	2,4	4,16	840	76
PLS 315 LD	180	982	1750	341	0,81	94,2	5,1	2,2	2,4	4,43	910	76
PLS 315 LD	200	982	1945	390	0,79	93,8	4,9	2,2	2,4	4,43	910	76
PLS 315 MG	220	980	2144	422	0,8	94	6,6	2,0	2,2	7,3	1030	77
PLS 315 LG	250	980	2436	477	0,8	94,5	6,6	2,0	2,2	8	1100	77
PLS 315 VLG	280	980	2728	525	0,81	95	6,7	2,1	2,1	9,6	1330	77
PLS 315 VLGU	315	985	3054	591	0,81	95	6,9	2,1	2,1	10,8	1430	77
PLS 355 LA	370	990	3569	687	0,81	96	7,2	1,3	2,1	15	1940	82
PLS 355 LB	450	990	4341	835	0,81	96	7,2	1,3	2,1	18	2210	82
PLS 400 LA	500	990	4823	917	0,82	96	7,4	1,4	2,1	29	2720	82
PLS 400 LB	600	990	5788	1100	0,82	96	7,8	1,4	2,2	35	3100	82

* Power ratings higher than 600 kW can be ordered. Please consult Leroy-Somer.

***Power factor - Cos φ*	****Efficiency - η*	*Calculation of rated torque*	*Noise level*
Use on 3/4 and 1/2 load: section D	*Use on 3/4 and 1/2 load: section D*	$M_N = \frac{60 \times P_N}{2\pi\ N_N}$	*section D*

PLS
Drip-proof 3-phase induction motors
Electrical characteristics

E1 - Selection data

8 poles 750 min^{-1}

IP 23
Cl. F - ΔT 80 K
MULTI-VOLTAGE

MAINS SUPPLY Δ 230 / Y 400 V or Δ 400 V **50 Hz**

Type	Rated power* at 50 Hz P_N kW	Rated speed N_N min^{-1}	Rated torque M_N N.m	Rated current I_N (400 V) A	Power factor** Cos φ	Efficiency CEI 60034-2 1996*** h	Starting current/ Rated current I_D / I_N	Starting torque/ Rated torque M_D / M_N	Maximum torque/ Rated torque M_M / M_N	Moment of inertia J kg.m^2	Weight IM B3 kg
PLS 315 MG	132	735	1715	275	0,75	92,5	4,7	1,6	1,7	6,7	940
PLS 315 LG	160	735	2079	333	0,75	92,5	5	1,6	1,7	8	1090
PLS 315 LG	180	735	2338	373	0,75	93	5,2	1,6	1,8	8,9	1230
PLS 315 VLG	200	735	2598	414	0,75	93	5,2	1,6	1,8	10	1330
PLS 355 LA	285	740	3678	532	0,81	95,5	7,7	1,3	2,1	18,3	1940
PLS 355 LB	330	740	4258	617	0,81	95,5	7,6	1,3	2,2	19	2210
PLS 400 LA	375	740	4839	691	0,82	95,5	7,1	1,25	2,1	39	2720
PLS 400 LB	450	740	5807	830	0,82	95,5	7,1	1,25	2	47	3100

* Power ratings higher than 450 kW can be ordered. Please consult Leroy-Somer.

***Power factor - Cos φ*	****Efficiency - η*	*Calculation of rated torque*	*Noise level*
Use on 3/4 and 1/2 load: section D	*Use on 3/4 and 1/2 load: section D*	$M_N = \frac{60 \times P_N}{2\pi \, N_N}$	*section D*

PLS
Drip-proof 3-phase induction motors
15 to 900 kW

PLS
Drip-proof 3-phase induction motors
Dimensions

F

PAGES

PLS
Drip-proof 3-phase induction motors
Dimensions

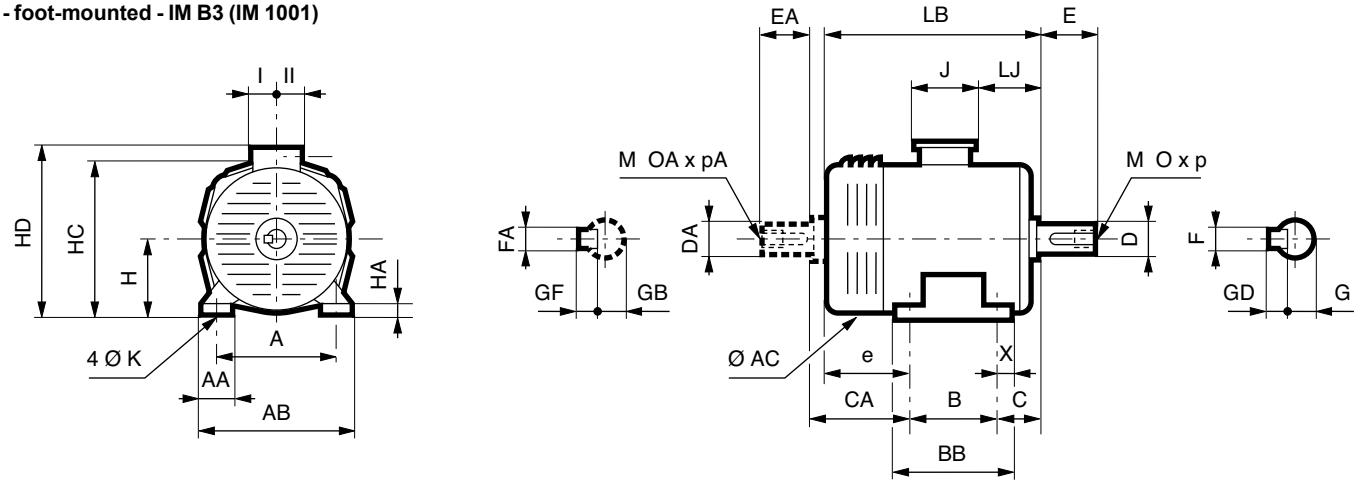
F1 - Foot-mounted

Dimensions in millimetres

F

Dimensions of PLS drip-proof 3-phase induction motors - IP 23
Cage rotor

- foot-mounted - IM B3 (IM 1001)



Type	Main shaft extensions													
	4, 6 and 8 poles							2 and 2/4 poles						
	F	GD	D	G	E	O	p	F	GD	D	G	E	O	p
PLS 160 MG/L	14	9	48k6	42.5	110	16	36	14	9	48k6	42.5	110	16	36
PLS 180 M/L	16	10	55m6	49	110	20	42	16	10	55m6	49	110	20	42
PLS 180 LG	16	10	55m6	49	110	20	42	16	10	55m6	49	110	20	42
PLS 200 M/LP	18	11	60m6	53	140	20	42	18	11	60m6	53	140	20	42
PLS 200 L	18	11	60m6	53	140	20	42	18	11	60m6	53	140	20	42
PLS 225 MR/MU	18	11	65m6	58	140	20	42	18	11	60m6	53	140	20	42
PLS 250 SP/MP	20	12	75m6	67.5	140	20	42	18	11	65m6	58	140	20	42
PLS 280 SC/MC/MD	22	14	80m6	71	170	20	42	18	11	65m6	58	140	20	42
PLS 315 S/SU/M/MU/L	25	14	90m6	81	170	24	50	20	12	70m6	62.5	140	20	42
PLS 315 LD	28	16	100m6	90	210	24	50	22	14	80m6	71	170	20	42
PLS 315 MG/LG/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, 6 and 8 poles							2 and 2/4 poles						
	FA	GF	DA	GB	EA	OA	pA	FA	GF	DA	GB	EA	OA	pA
PLS 160 MG/L	14	9	48k6	42.5	110	16	36	14	9	48k6	42.5	110	16	36
PLS 180 M/L	14	9	48k6	42.5	110	16	36	14	9	48k6	42.5	110	16	36
PLS 180 LG	16	10	55m6	49	110	20	42	16	10	55m6	49	110	20	42
PLS 200 M/LP	16	10	55m6	49	110	20	42	16	10	55m6	49	110	20	42
PLS 200 L	18	11	60m6	53	140	20	42	18	11	60m6	53	140	20	42
PLS 225 MR/MU	18	11	65m6	58	140	20	42	18	11	60m6	53	140	20	42
PLS 250 SP/MP	18	11	65m6	58	140	20	42	18	11	65m6	58	140	20	42
PLS 280 SC/MC/MD	18	11	65m6	58	140	20	42	18	11	65m6	58	140	20	42
PLS 315 S/SU/M/MU/L	20	12	75m6	67.5	140	20	42	20	12	70m6	62.5	140	20	42
PLS 315 LD	20	12	75m6	67.5	140	20	42	20	12	70m6	62.5	140	20	42
PLS 315 MG/LG/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	-	-	-	-	-	-	-

PLS
Drip-proof 3-phase induction motors
Dimensions

F1 - Foot-mounted

Dimensions in millimetres

F

Dimensions of PLS drip-proof 3-phase induction motors - IP 23
Cage rotor

- foot-mounted - IM B3 (IM 1001)

Type	Main dimensions																			
	A	AB	B	BB	C	X	AA	K	HA	e	H	AC	HD	HC	LB	LJ	J	I	II	CA
PLS 160 MG	254	294	210	298	108	22	44	14	24	180	160	343	407	332	498	118	205	100	95	187
PLS 160 L	254	294	254	298	108	22	44	14	24	136	160	343	407	332	498	118	205	100	95	143
PLS 180 M	279	324	241	319	121	20	68	14	30	136	180	343	427	352	498	118	205	100	95	143
PLS 180 L	279	324	279	319	121	20	68	14	30	123	180	343	427	352	523	118	205	100	95	130
PLS 180 LG	279	344	279	323	121	22	60	14	30	180	180	387	450	374	580	168	205	100	95	190
PLS 200 M	318	378	267	347	133	20	60	19	30	230	200	387	470	394	630	168	205	100	95	240
PLS 200 LP	318	378	305	347	133	20	60	19	30	192	200	387	470	394	630	168	205	100	95	202
PLS 200 L	318	378	305	345	133	20	60	19	32	215	200	437	520	419	653	198	217	103	145	227
PLS 225 MU	356	416	311	351	149	20	60	19	32	233	225	437	545	444	693	198	217	103	145	245
PLS 225 MR	356	416	311	351	149	20	60	19	32	248	225	437	545	444	708	198	217	103	145	260
PLS 250 SP	406	470	311	400	168	26	94	24	40	300	250	490	643	495	779	158	292	148	180	310
PLS 250 MP	406	470	349	400	168	26	94	24	40	262	250	490	643	505	779	158	292	148	180	272
PLS 280 SC	457	517	368	467	190	24	60	24	26	266	280	490	684	524	824	209	292	148	180	276
PLS 280 MC	457	517	419	467	190	24	60	24	26	215	280	490	684	524	824	209	292	148	180	225
PLS 280 MD	457	517	419	467	190	24	60	24	26	295	280	490	684	524	904	209	292	148	180	305
PLS 315 S	508	608	406	486	216	40	100	28	26	258	315	600	776	615	880	305	292	148	180	271
PLS 315 SU	508	608	406	486	216	40	100	28	26	318	315	600	776	615	940	305	292	148	180	331
PLS 315 M	508	608	457	537	216	40	100	28	26	267	315	600	776	615	940	305	292	148	180	280
PLS 315 MU	508	608	457	537	216	40	100	28	26	352	315	600	776	615	1025	305	292	148	180	365
PLS 315 L	508	608	508	588	216	40	100	28	26	301	315	600	776	615	1025	305	292	148	180	314
PLS 315 LD	508	608	508	588	216	40	100	28	26	361	315	600	865	615	1085	241	420	180	235	374
PLS 315 MG	508	608	457	537	216	40	100	27	26	378	315	660	890	650	1051	248	428	205	195	393
PLS 315 LG	508	608	508	588	216	40	100	27	26	407	315	660	890	650	1131	248	428	205	195	422
PLS 315 VLG	508	608	560	640	216	40	100	27	26	415	315	660	890	650	1191	248	428	205	195	430
PLS 315 VLGU	508	608	560	640	216	40	100	27	26	485	315	660	890	650	1261	248	428	205	195	500
PLS 355 L	610	710	630	710	254	30	100	27	26	586	355	705	1078	710	1470	130	700	224	396	596
PLS 400 L	686	806	710	800	280	45	80	35	26	765	400	795	1173	800	1755	177	700	224	396	775

PLS
Drip-proof 3-phase induction motors
Dimensions

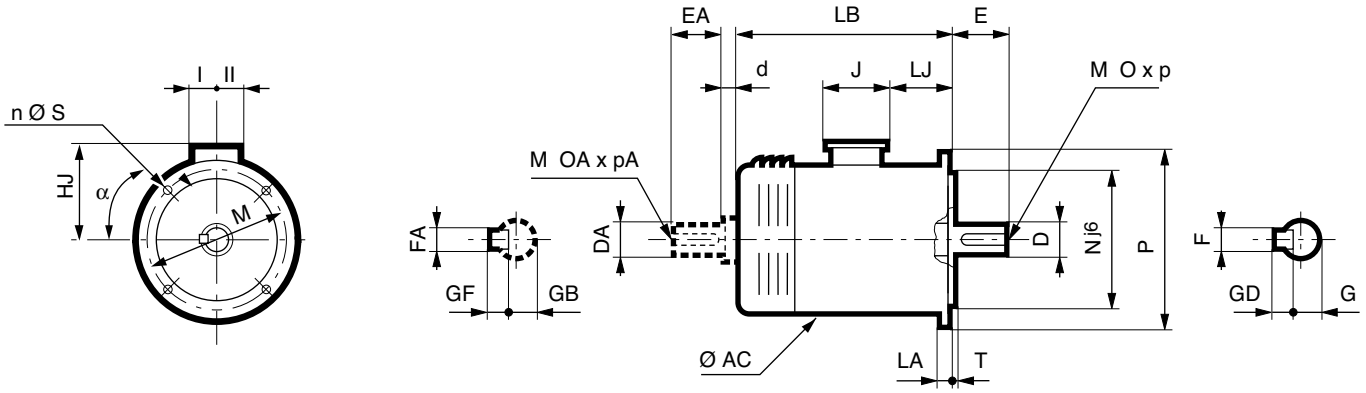
F2 - Foot and flange-mounted

Dimensions in millimetres

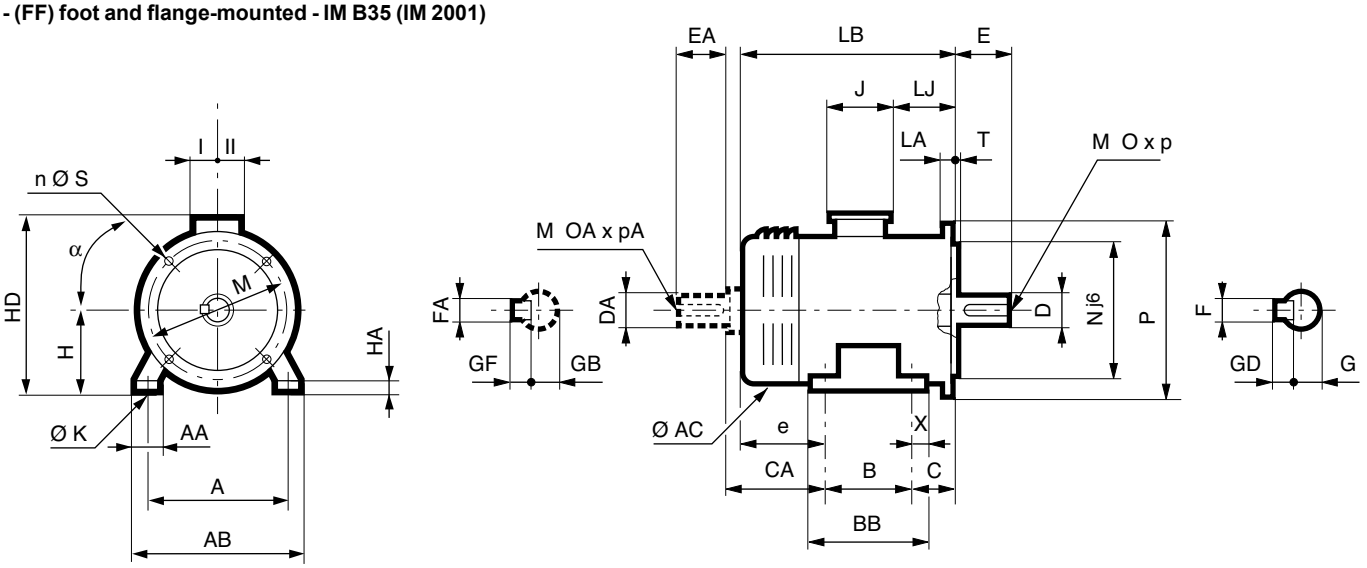
F

Dimensions of PLS drip-proof 3-phase induction motors - IP 23
Cage rotor

- (FF) foot and flange-mounted - IM B5 (IM 3001)* - IM V1 (IM 3011)



- (FF) foot and flange-mounted - IM B35 (IM 2001)



Dimension CA and shaft extensions are identical to those for foot-mounted motors

* For frame size ≥ 250 mm used as IM B5 (IM 3001), please consult Leroy Somer.

PLS
Drip-proof 3-phase induction motors
Dimensions

F2 - Foot and flange-mounted

Dimensions in millimetres

F

Dimensions of PLS drip-proof 3-phase induction motors - IP 23
Cage rotor

- (FF) flange-mounted **- foot and flange-mounted (FF)**

Type	Main dimensions																				IEC Sym.
	A	AB	B	BB	C	X	AA	K	HA	e	H	AC	HD	HJ	LB	LJ	J	I	II	CA	
PLS 160 MG	254	294	210	298	108	22	44	14	24	180	160	343	407	247	498	118	205	100	95	187	FF350
PLS 160 L	254	294	254	298	108	22	44	14	24	136	160	343	407	247	498	118	205	100	95	143	FF350
PLS 180 M	279	324	241	319	121	20	68	14	30	136	180	343	427	247	498	118	205	100	95	143	FF350
PLS 180 L	279	324	279	319	121	20	68	14	30	123	180	343	427	247	523	118	205	100	95	130	FF350
PLS 180 LG	279	344	279	323	121	22	60	14	30	180	180	387	450	270	580	168	205	100	95	190	FF350
PLS 200 M	318	378	267	347	133	20	60	19	30	230	200	387	470	270	630	168	205	100	95	240	FF400
PLS 200 LP	318	378	305	347	133	20	60	19	30	192	200	387	470	270	630	168	205	100	95	202	FF400
PLS 200 L	318	378	305	345	133	20	60	19	32	215	200	437	520	320	653	198	217	103	145	227	FF400
PLS 225 MU	356	416	311	351	149	20	60	19	32	233	225	437	545	320	693	198	217	103	145	245	FF500
PLS 225 MR	356	416	311	351	149	20	60	19	32	248	225	437	545	320	708	198	217	103	145	260	FF500
PLS 250 SP	406	470	311	400	168	26	94	24	40	300	250	490	643	393	779	158	292	148	180	310	FF600
PLS 250 MP	406	470	349	400	168	26	94	24	40	262	250	490	643	393	779	158	292	148	180	272	FF600
PLS 280 SC	457	517	368	467	190	24	60	24	26	266	280	490	684	404	824	209	292	148	180	276	FF600
PLS 280 MC	457	517	419	467	190	24	60	24	26	215	280	490	684	404	824	209	292	148	180	225	FF600
PLS 280 MD	457	517	419	467	190	24	60	24	26	295	280	490	684	404	904	209	292	148	180	305	FF600
PLS 315 S	508	608	406	486	216	40	100	28	26	258	315	600	776	455	880	305	292	148	180	271	FF740
PLS 315 SU	508	608	406	486	216	40	100	28	26	318	315	600	776	455	940	305	292	148	180	331	FF740
PLS 315 M	508	608	457	537	216	40	100	28	26	267	315	600	776	455	940	305	292	148	180	280	FF740
PLS 315 MU	508	608	457	537	216	40	100	28	26	352	315	600	776	455	1025	305	292	148	180	365	FF740
PLS 315 L	508	608	508	588	216	40	100	28	26	301	315	600	776	455	1025	305	292	148	180	314	FF740
PLS 315 LD	508	608	508	588	216	40	100	28	26	361	315	600	865	455	1085	241	420	180	235	374	FF740
PLS 315 MG	508	608	457	537	216	40	100	27	26	378	315	660	890	575	1051	248	428	205	195	393	FF740
PLS 315 LG	508	608	508	588	216	40	100	27	26	407	315	660	890	575	1131	248	428	205	195	422	FF740
PLS 315 VLG	508	608	560	640	216	40	100	27	26	415	315	660	890	575	1191	248	428	205	195	430	FF740
PLS 315 VLGU	508	608	560	640	216	40	100	27	26	485	315	660	890	575	1261	248	428	205	195	500	FF740
PLS 355 L	610	710	630	710	254	30	100	27	26	586	355	705	1078	723	1470	130	700	224	396	596	FF940
PLS 400 L	686	806	710	800	280	45	80	35	26	765	400	795	1173	773	1755	177	700	224	396	775	FF940

For frame size ≥ 250 mm used as IM B5 (IM 3001), please consult Leroy-Somer.

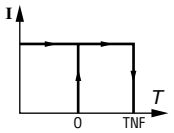
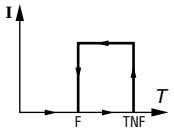
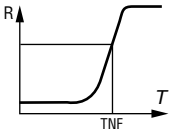
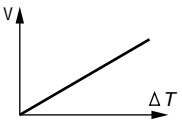
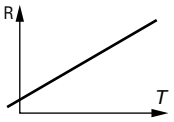
IEC Symbol	Standard flange dimensions							
	M	N	P	T	n	S	LA	a
FF 350	350	300	400	5	4	19	15	45°
FF 400	400	350	450	5	8	19	16	22°30
FF 500	500	450	550	5	8	19	18	22°30
FF 600	600	550	660	6	8	24	22	22°30
FF 740	740	680	800	6	8	24	25	22°30
FF 940	940	880	1000	6	8	28	28	22°30
FF 1080	1080	1000	1150	6	8	28	30	22°30

G1 - Electrical options

G1.1 - THERMAL PROTECTION

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. The various types are shown in the table below, with a description of each. It must be emphasized that sensors cannot be used to carry out direct adjustments to the motor operating cycles.

Built-in indirect thermal protection

Type	Symbol	Operating principle	Operating curve	Cut-off	Protection provided	Number of devices
Normally closed thermostat (closed when de-energized)	PTO	Bimetallic strip, indirectly heated, with normally closed (NC) contact		2.5 A at 250V with Cos φ 0.4	General surveillance for non-transient overloads	2 or 3 in series
Normally open thermostat (open when de-energized)	PTF	Bimetallic strip, indirectly heated, with normally open (NO) contact		2.5 A at 250V with Cos φ 0.4	General surveillance for non-transient overloads	2 or 3 in parallel
Positive temperature cœfficient thermistor	PTC	Variable non-linear resistor with indirect heating		0	General surveillance for transient overloads	3 in series
Thermocouples	*T* (*T*<150°C) Copper Constantan K (*T*<1000°C) Copper Copper-Nickel	Peltier effect		0	Continuous surveillance at hot spots	1 per hot spot
Platinum resistance thermometer	PT 100	Variable linear resistor with indirect heating		0	High accuracy continuous surveillance at key hot spots	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 class.

Fitting thermal protection

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

Alarm and Safety

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

PLS
Drip-proof 3-phase induction motors
Optional features

G1 - Electrical options

G1.2 - SPACE HEATERS

Severe climatic conditions 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 domino or terminal block in the motor terminal box. The heaters must be switched off while the motor is running. They must only be switched on when the motor is cold and stationary.

Motor type	No. of poles	Heater type	Number and power P(W)
PLS 160	2 - 4 - 6	ACM 1	2 x 25
PLS 180 to PLS 200	2 4 - 6	ACM 1 ACM 4	1 x 25 2 x 25
PLS 225 and PLS 250	2 4 - 6	ACM 4 ACM 5	2 x 25 2 x 40
PLS 280 and PLS 315 S/SU/M/MU/L/LD	2 4 - 6	ACM 5 ACM 6	2 x 40 2 x 50
PLS 315 MG/LG/VLG/VLGU	2 - 4 - 6 - 8	-	2 x 50
PLS 355 and PLS 400	2 - 4 - 6 - 8	-	4 x 50

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

G2 - Mechanical options - Non-standard flanges

Optionally, LEROY-SOMER 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 table below gives flange-motor compatibility.

The bearing and shaft extension for each frame size remain standard.

(FF) Flange-mounted

Motor type \ Flange type	FF 300	FF 350	FF 400	FF 500	FF 600	FF 740	FF 940	FF 1080
PLS 160	✱	●						
PLS 180	✱	●	✱					
PLS 200		✱	●	✱				
PLS 225			✱	●				
PLS 250				✱	●			
PLS 280				✱	●			
PLS 315					✱	●		
PLS 355						✱	●	
PLS 400							●	✱

● Standard

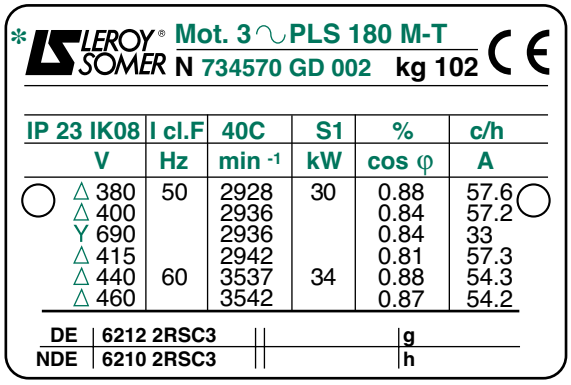
✱ Adaptable without shaft modification

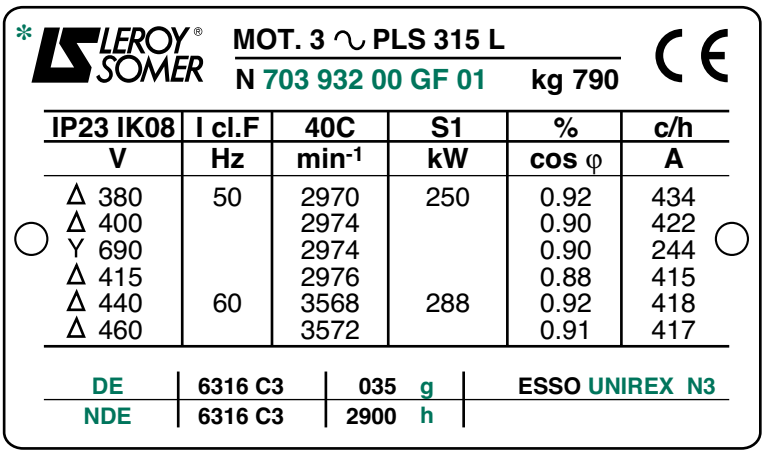
PLS
Drip-proof 3-phase induction motors
Maintenance

H1 - Identification - Nameplates

H

NAMEPLATES





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

▼ ***Definition of symbols used on nameplates***

LEGAL MARK OF CONFORMITY OF PRODUCT TO THE REQUIREMENTS OF EUROPEAN DIRECTIVES.

MOT 3 ~ : Three-phase A.C. motor
PLS : Series
180 : Frame size
M : Housing symbol
T : Impregnation index

Motor no.
734570 : Serial number
G : Year of production
D : Month of production
002 : Batch number

70393200 : Serial number
G : Year of production
F : Month of production
01 : Batch number

kg : Weight
IP23 IK08 : Index of protection
I cl. F : Insulation class F
40 °C : Contractual ambient operating temperature (IEC 60034-1)
S : Duty
% : Operating factor
c/h : Number of cycles per hour

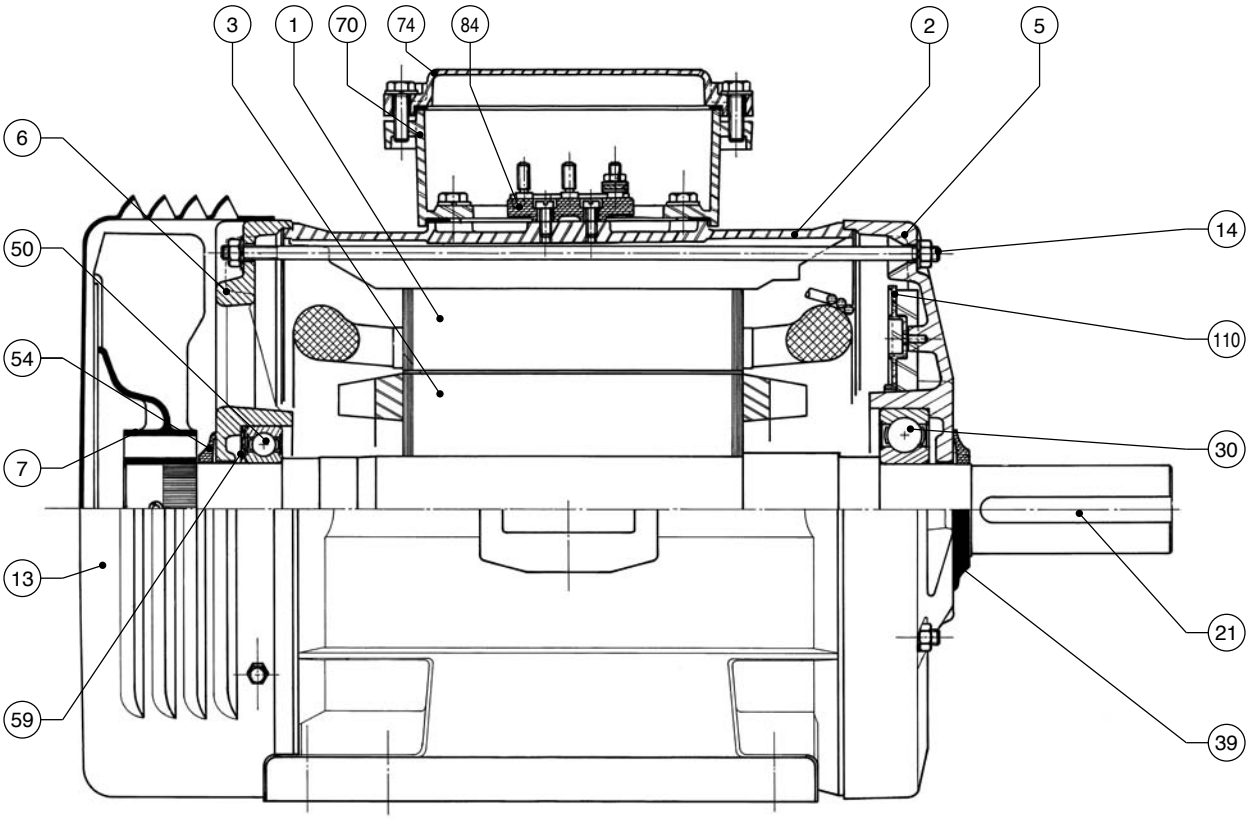
V : Supply voltage
Hz : Supply frequency
min-1 : Revolutions per minute (rpm)
kW : Rated output power
cos φ : Power factor
A : Rated current
Δ : Delta connection
Y : Star connection

Bearings
DE : «Drive end» Drive end bearing
NDE : «Non drive end» Non drive end bearing
g : Quantity of grease at each regreasing (in g)
h : Regreasing interval (in hours)

UNIREX N3 : Type of grease

H2 - Cross-sectional views and parts list

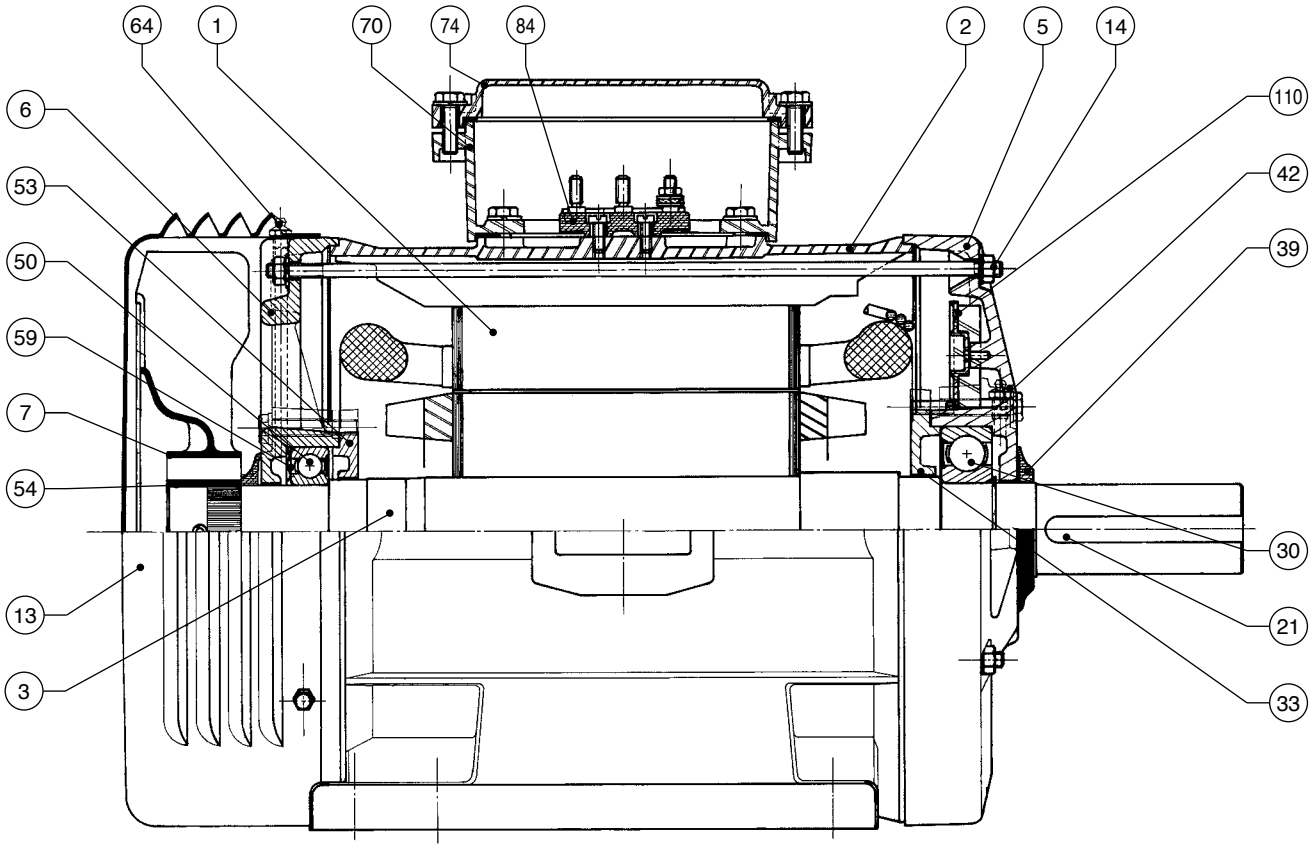
H2.1 - FRAME SIZES: 160 MG / L
180 M / L



No.	Description	No.	Description	No.	Description
1	Wound stator	13	Fan cover	54	Non drive end seal
2	Frame	14	Tie rods	59	Preloading (wavy) washer
3	Rotor	21	Key	70	Terminal box
5	DE shield	30	Drive end bearing	74	Terminal box lid
6	NDE shield	39	Drive end seal	84	Terminal blocks
7	Fan	50	Non drive end bearing	110	Protective grille

H2 - Cross-sectional views and parts list

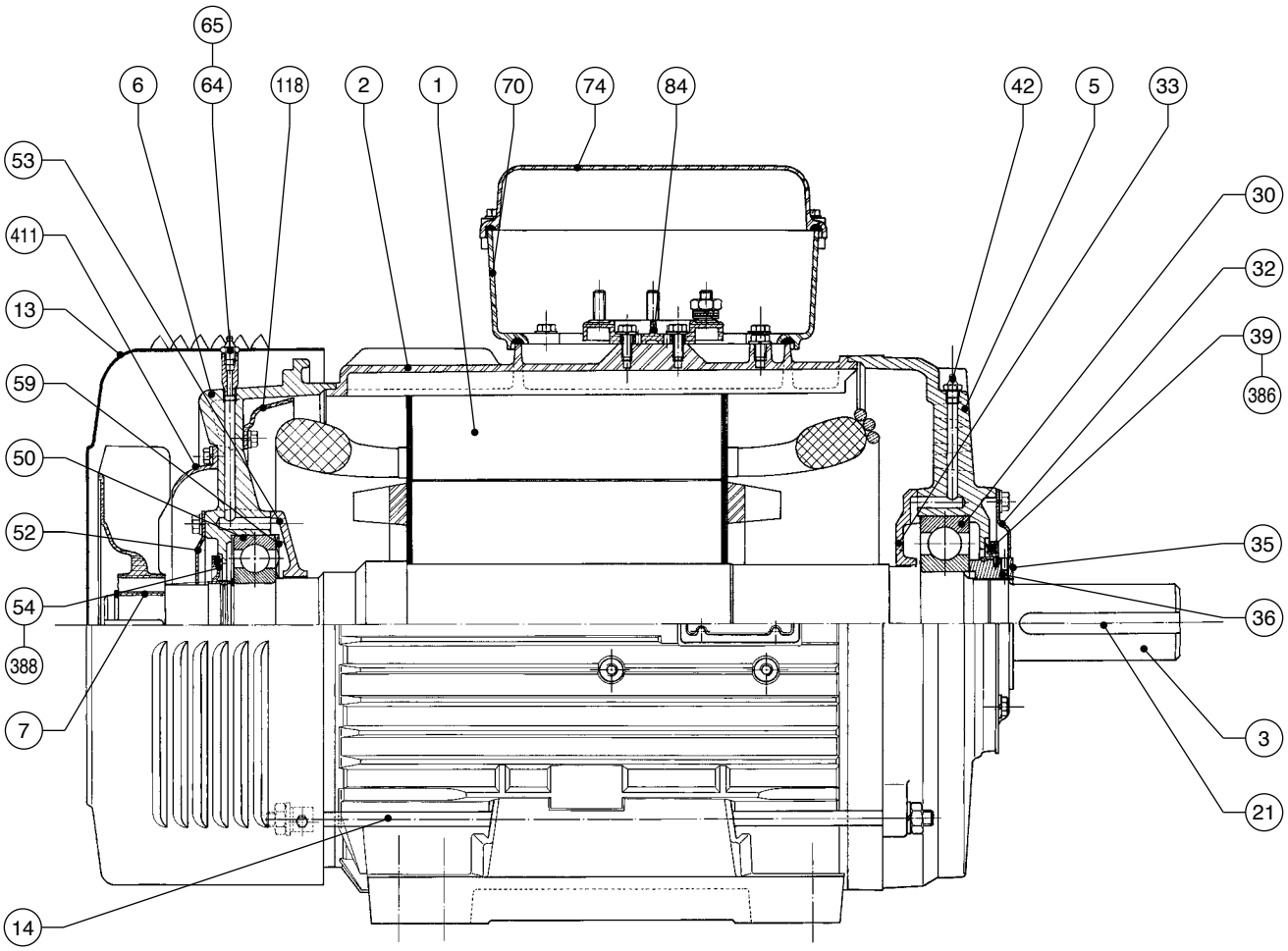
H2.2 - FRAME SIZES: 180 LG
200 M / L / LP
225 MR / MU



No.	Description	No.	Description	No.	Description
1	Wound stator	21	Key	59	Preloading (wavy) washer
2	Frame	30	Drive end bearing	64	Grease nipple
3	Rotor	33	Inner DE bearing retainer	70	Terminal box
5	DE shield	39	Drive end seal	74	Terminal box lid
6	NDE shield	42	Grease nipple	84	Terminal blocks
7	Fan	50	Non drive end bearing	110	Protective grille
13	Fan cover	53	Inner NDE bearing retainer		
14	Tie rods	54	Non drive end seal		

H2 - Cross-sectional views and parts list

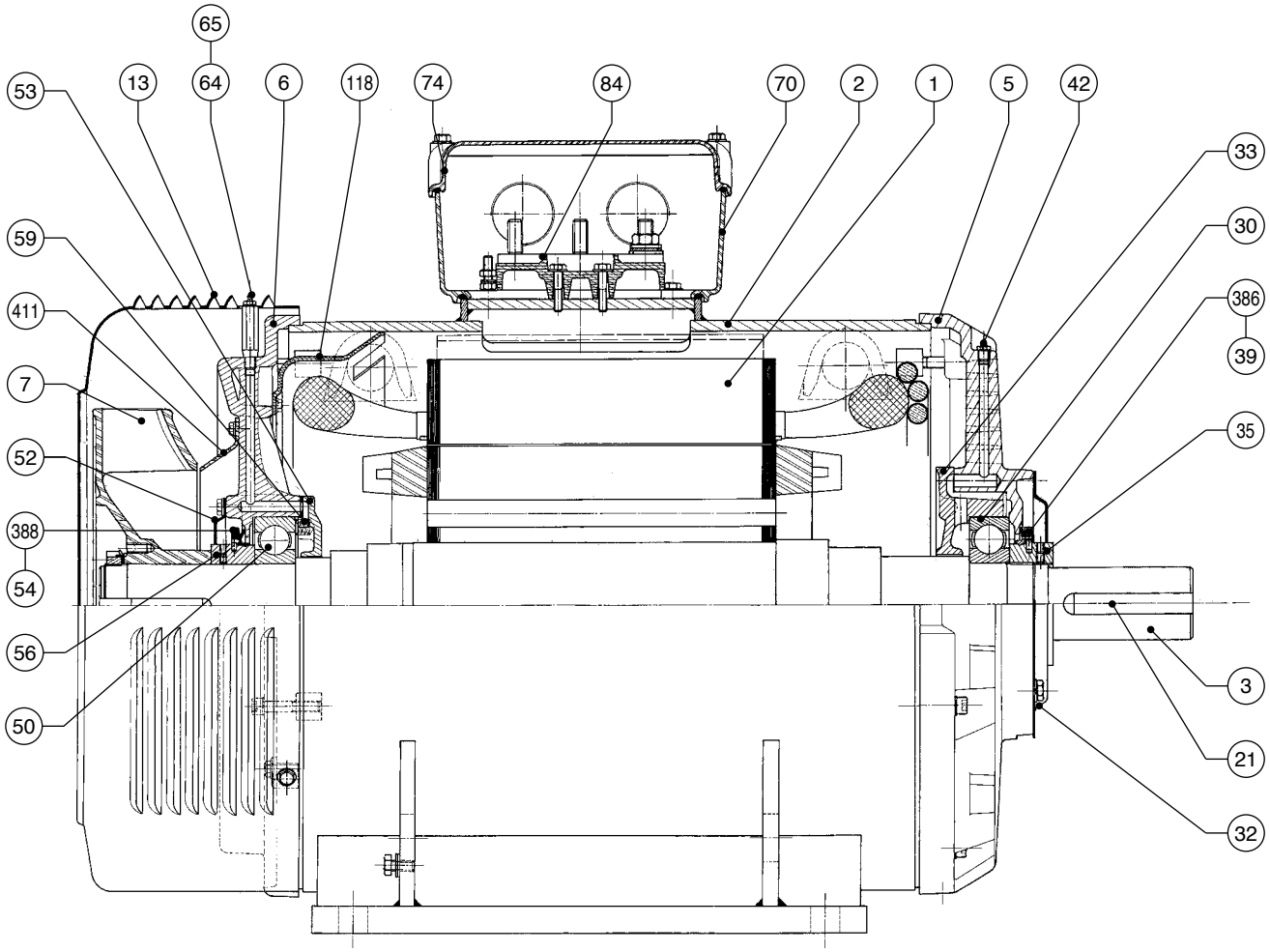
H2.3 - FRAME SIZES: 250
280



No.	Description	No.	Description	No.	Description
1	Wound stator	32	DE external cover	64	Grease nipple
2	Frame	33	Inner DE bearing retainer	65	Extension for grease nipple
3	Rotor	35	DE mobile grease valve	70	Terminal box
5	DE shield	39	Drive end seal	74	Terminal box lid
6	NDE shield	42	Grease nipple	84	Terminal blocks
7	Fan	50	Non drive end bearing	118	Internal deflector
13	Fan cover	52	Outer NDE bearing retainer	386	DE seal support
14	Tie rods	53	Inner NDE bearing retainer	388	NDE seal support
21	Key	54	Non drive end seal	411	External deflector
30	Drive end bearing	59	Preloading (wavy) washer		

H2 - Cross-sectional views and parts list

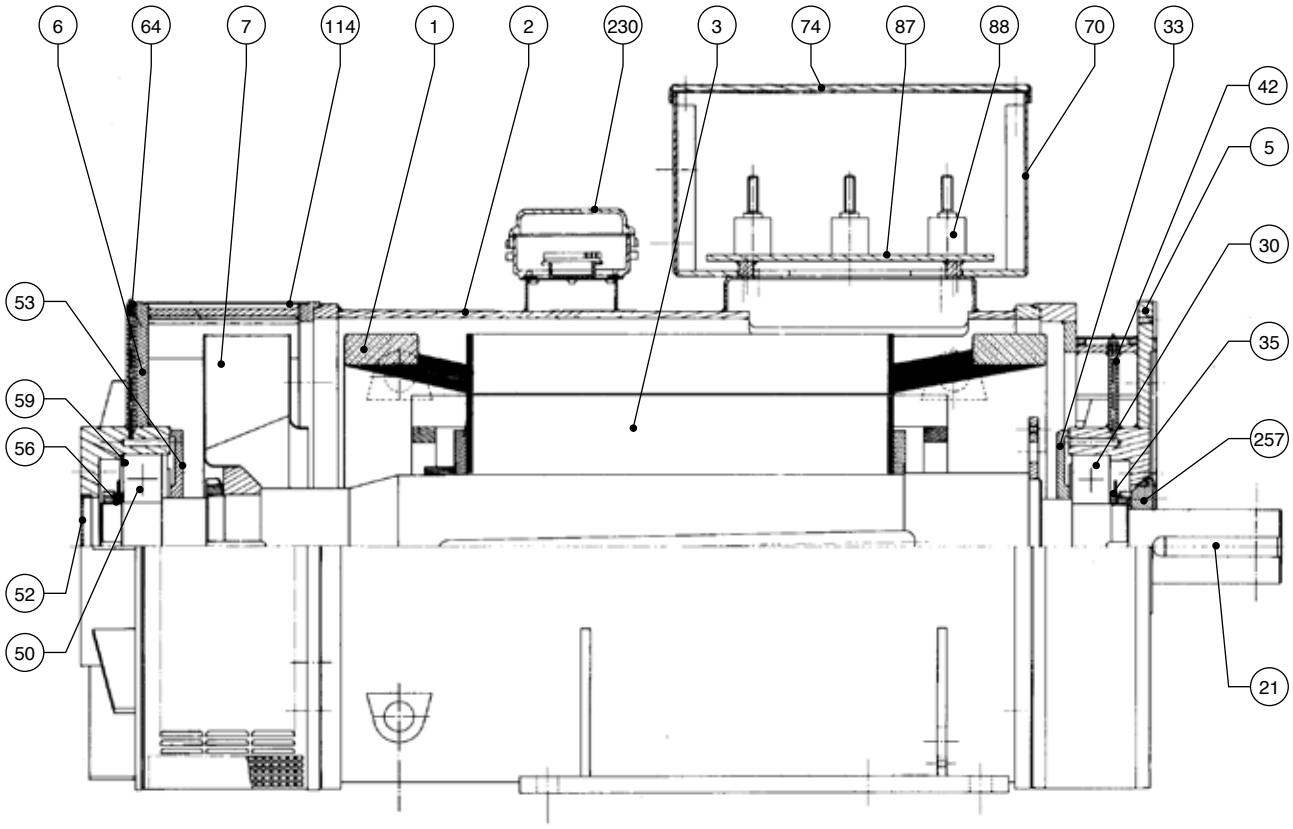
H2.4 - FRAME SIZES: 315



No.	Description	No.	Description	No.	Description
1	Wound stator	33	Inner DE bearing retainer	64	Grease nipple
2	Frame	35	DE mobile grease valve	65	Extension for grease nipple
3	Rotor	39	Drive end seal	70	Terminal box
5	DE shield	42	Grease nipple	74	Terminal box lid
6	NDE shield	50	Non drive end bearing	84	Terminal blocks
7	Fan	52	Outer NDE bearing retainer	118	Internal deflector
13	Fan cover	53	Inner NDE bearing retainer	386	DE seal support
21	Key	54	Non drive end seal	388	NDE seal support
30	Drive end bearing	56	NDE mobile grease valve	411	External deflector
32	DE external cover	59	Preloading (wavy) washer		

H2 - Cross-sectional views and parts list

H2.5 - FRAME SIZES: 355
400



No.	Description	No.	Description	No.	Description
1	Wound stator	33	DE internal cover (front)	64	NDE grease nipple (rear)
2	Housing	35	Moving part of DE grease valve (front)	70	Stator terminal box
3	Rotor	42	DE grease nipple (front)	74	Stator terminal box lid
5	Drive end shield (DE)	50	NDE bearing (rear)	87	Isolator support
6	Non-drive end shield (NDE)	52	Outer NDE bearing retainer (rear)	88	Isolators
7	Fan	53	Inner NDE bearing retainer (rear)	114	NDE end shield cover band (rear)
21	Shaft extension key	56	Moving part of NDE grease valve (rear)	230	Cast iron terminal box for isotherms
30	Drive end bearing	59	NDE preloading (wavy) washer	257	Labyrinth seal

I - SCOPE OF APPLICATION
These General Conditions of Sale («GCS») shall apply to the sale of all products, components, software and services (referred to as «Products») proposed or sold by the Seller to the Client. Said GCS shall also apply to all quotation or offers made by the Seller, and are an integral part of all orders. «Seller» is understood to mean all companies directly or indirectly controlled by LEROY-SOMER. As a complementary measure, orders are also subject to the latest version in force of the Inter-Union General Conditions of Sale for France of the F.I.E.E.C. (*Fédération des Industries Electriques, Electroniques et de Communication* [Federation of Electrical, Electronic and Communication Industries]), inasmuch as they are not contrary to the GCS.
The acceptance of the Seller's offers or quotations, or any order, entails the acceptance without reservation of these GCS and rules out all contrary provisions shown on all other documents and, in particular, on the Client's order forms and the Client's General Conditions of Purchase.
If the sale concerns castings, by way of derogation to Paragraph 1 above, said castings shall be subject to the latest version in force of the *Conditions Générales Contractuelles des Fonderies Européennes* [General Contractual Conditions of European Foundries].
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All orders, even those taken by the Seller's agents and representatives, and regardless of the transmission method, shall only bind the Seller after written acceptance thereby of the order.
The Seller reserves the option of modifying the characteristics of its Products without notice. However, the Client shall retain the possibility of specifying the characteristics on which its commitment is contingent. In the absence of any such express stipulation, the Client may not refuse delivery of new, modified Products.
The Seller may not be held liable for an unsatisfactory selection of Products if said selection results from conditions of use that are incomplete and/or mistaken, or not disclosed to the Seller by the Client.
Except in the event of a stipulation to the contrary, the offers and quotations remitted by the Seller shall only be valid for thirty days as from the date on which they are drawn up.
Where the Products must comply with standards, specific regulations and/or be received by control and inspection agencies, the price request must be accompanied by the technical specification, all terms and conditions the Seller must comply with. Reference shall be made thereto on the quotation or offer. Approval and attendance costs shall always be borne by the Client.

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Tariffs are expressed exclusive of tax and may be revised without notice.
Prices are either deemed to be firm for the period of validity specified on the quotation, or subject to a revision formula attached to the offer and which specifies, according to the regulations, parameters pertaining to the materials, products, various services and salaries for which the indices are published in the B.O.C.C.R.F. (*Bulletin Officiel de la Concurrence, de la Consommation et de la Répression des Fraudes* [French Official Journal of Competition and Consumer Matters, and Anti-Fraud Measures]).
All additional costs, in particular approval costs, specific checks, etc., shall be invoiced in addition.

IV - DELIVERY
Sales are governed by the latest edition in force of the INCOTERMS published by the Internal Chamber of Commerce («I.C.C. INCOTERMS»).
The Products shall be dispatched according to the conditions stated on the order acknowledgement issued by the Seller for all orders of Products.
Except in the event of specific provisions, the prices correspond to Products that are made available in the Seller's factories, including basic packaging.
Except in the event of a provision to the contrary, the Products shall always be transported at the risk of the addressee. In all cases, it shall be the responsibility of the addressee to make any claims to the carrier, within the delivery time and in the forms specified by law, concerning the state or number of parcels received, and to concomitantly provide the Seller with a copy of such declaration. Failure to comply with said procedure shall exempt the Seller from any liability. In any event, the Seller's liability may not exceed the amount of the indemnities received from its insurers.
If the provisions concerning transportation are amended by the Client subsequent to the acceptance of the order, the Seller reserves the right to invoice any supplemental costs that may result therefrom.
Except in the event of a contractual or statutory obligation to the contrary, packaging shall not be returnable.
In the event that a delivery of Products is delayed for a reason not attributable to the Seller, the Products stored on the Seller's premises shall be insured at the exclusive risk of the Client. Consideration for storage, costs will be invoiced at a rate of 1% (*one per cent*) of the total amount of the order, per week or partial week of storage, with no deductible or *de minimis* amount, as from the date of Products availability provided for in the contract. Upon expiration of a period of thirty days as from said date, the Seller may, at its discretion, either freely dispose of the Products and/or agree with the Client on a new delivery date for said Products, or invoice the Client in full for payment, according to the timeframes and amount provided for contractually. In any event, down payments shall inure to the Seller as indemnities, without prejudice to any other action the Seller may take.

V - DELIVERY TIME
The Seller shall only be bound by the delivery time mentioned on its order acknowledgement. Said delivery time shall only start to run as from the date of issuance of the order acknowledgement by the Seller, and subject to the fulfilment of the conditions provided for on the confirmation receipt, in particular receipt of the down payment for the order, notification of the opening of an operative irrevocable and confirmed documentary credit that complies in all respects to the Seller's request (*in particular regarding the amount , currency, validity and licence*), acceptance of the payment conditions accompanied by the implementation of any guarantees requested, etc.
Exceeding delivery time shall not grant the Client entitlement to damages and/or penalties.
Except in the event of a specific condition to the contrary, the Seller reserves the right to make partial deliveries.
Delivery times shall be interrupted by right and without the need for any judicial formalities, by any failure to pay or late payment by the Client.

VI - TESTS - QUALIFICATION
The Products manufactured by the Seller are checked and tested before leaving its factories. Clients may be present at said tests if specified on the order.
Specific tests and/or trials, as well as approval of Products, requested by the Client, whether carried out on the Client's premises or in the Seller's factories, on site, or by control and inspection agencies, must be specified on the order and are always at Client's expense.
Prototypes for Products specially developed or adapted for a Client must be qualified by the Client before serial production in order to ensure that it is compatible with the other components that make up its equipment, and that it is adapted to the intended use. Said qualification will also enable the Client to ensure that the Products comply with the technical specification. In this respect, the Client and Seller shall sign a Product Approval Form in two original, one of which shall be retained by the Client and one by the Seller.
In the event that the Client requires delivery without having firstly qualified the Products, said Products shall be delivered as they stand and shall always be deemed to be prototypes ; the Client shall then be solely liable for using the Products or delivering them to its own clients. However, the Seller may also decide not to deliver the Products that have not received the Client's prior approval.

VII - PAYMENT CONDITIONS
All sales shall be deemed to be completed and payable at the Seller's registered office, without any possible derogation, regardless of the payment method, where the contract was concluded and where delivery was made.
Where the Client is located out of French territory, invoices shall be payable in cash upon receipt, or by a bank draft or a bill of exchange, within 30 (thirty) days net.
All early payment compared to the deadline fixed shall give right to a discount of 0.2% (*nought point two* per cent) per month, of the amount concerned of the invoice.
Except in the event of provisions to the contrary, where the Client is located outside of French Territory, invoices shall be payable in cash against remittance of shipping documents, or by irrevocable documentary credit confirmed by a first rate French bank, at Client's expense.
Payment shall be understood to mean the funds being made available on the Seller's bank account and must imperatively be made in the invoicing currency.
Pursuant to French Law no. 2008-776 of 4 August 2008, failure to pay an invoice when due shall trigger, after service of formal notice that has remained without effect, payment to the Seller of a flat-rate penalty on the due date of the receivable, which shall be applied to amount inclusive of tax of monies owed if the invoice is liable to VAT (*Value Added Tax*), and the suspension of pending orders. Said penalty is equal to the European Central Bank interest rate on the main refinancing operations + 10 basis points.
The collection of said monies via litigation shall trigger an increase of 15% (*fifteen per cent*) of the amount claimed, with a minimum of Euros 500 exclusive of tax (*five hundred euros exclusive of tax*), with tax in addition if due.
Moreover, subject to compliance with the statutory provisions in force, in the event of total or partial failure to pay any invoice or instalment whatsoever, regardless of the payment method used, all amounts that remain owed to the Seller (*including its subsidiaries, affiliated or allied companies, whether French or foreign*) for all deliveries and services, regardless of the due date originally provided for, shall immediately become due.
Notwithstanding any specific payment conditions provided for between the parties, the Seller reserves the right to require, in the event of a decline in the Client's credit rating, a payment incident or bankruptcy of the Client :
- the payment in cash, before the Products leave the factory, for all orders currently being fulfilled,
- down payments to be made on all orders,
- alternative or different payment guarantees.

VIII - PAYABLE AND RECEIVABLE BALANCE
Except where prohibited by law, the Seller and the Client expressly agree to balance their payables and receivables arising from their trade relations, even if all conditions defined by law for legal balancing are not met.
For the application of said clause, the Seller shall mean any company of the LEROY-SOMER Group.

IX - TRANSFER OF RISK / RESERVE OF TITLE
Risk shall be transferred as soon as the Products are made available, according to the delivery conditions stipulated on the order acknowledgement.
The transfer to the Client of title shall take place after payment in full. In the event that the restitution of the Products delivered is claimed by the Seller, the Seller is entitled to retain any down payment as compensation.
Remittance of a bill that creates an obligation to pay (*bill of exchange or other*) shall not constitute payment and discharge.
For as long as the price has not been paid in full, the Client is required to inform the Seller, within twenty-four hours, of the sequestration, requisition or confiscation of the Products for the benefit of a third party, and to take all protective measures to make known the Seller's property right in the event of action by creditors, and to cause such right to be respected.

X - CONFIDENTIALITY
Each of the parties undertakes to maintain the confidentiality of all technical, trade, financial or other information received from the other party, whether orally, in writing or by any other means of communication, when any order is negotiated and/or fulfilled.
This confidentiality obligation shall apply throughout the period during which the order is fulfilled and for 5 (five) years subsequent to completion or cancellation thereof, regardless of the reasons therefor.

XI - INDUSTRIAL AND INTELLECTUAL PROPERTY
Data, studies, results, information or software, whether patentable or not obtained by the Seller when any order is fulfilled shall remain the exclusive property of the Seller.
With the exception of instruction and maintenance manuals, documents of any nature remitted to the Client shall remain the exclusive property of the Seller and must be returned to it upon request, even if the Client was invoiced for part of the cost of the study, and said documents may not be disclosed to third parties or used without the Seller's prior written agreement.

XII - CANCELLATION / TERMINATION
The Seller reserves the right to cancel or terminate immediately, at the Seller's discretion, by right and without the need for any judicial formalities, the contract in the event of failure to pay any portion whatsoever of the price, when due, or in the event of any breach of any of the Client's contractual obligations. Down payments and any amount already paid shall remain in Seller's hands in the form of indemnities, without prejudice to the Seller's right to claim damages. In the event that the contract is cancelled, the Products must be returned to the Seller immediately, regardless of where the Products are located, at Client's expense and risk, under penalty of 10% (*ten per cent*) of the value thereof, per week's delay.

XIII - WARRANTY
The Seller warrants the Products against all operating defects caused by a material or manufacturing fault, for a period of twelve months as from the date on which the Products are made available, unless a different statutory provision subsequently applies, under the conditions defined below.
The warranty may only be triggered insofar as the Products have been stored, used and maintained in accordance with the Seller's instructions and manuals. The warranty does not apply where the defect results, in particular, from :
- inadequate monitoring, maintenance or storage,
- normal wear and tear on the Products,
- servicing or modification of the Products without the Seller's prior written authorisation,
- abnormal use of the Products or use of the Products for a purpose other than that intended,
- faulty installation of the Products on the premises of the Client and/or the end user,
- failure by the Client to disclose the purpose or conditions of use of the Products,
- failure to use genuine spare parts,
- force majeure or any event that is beyond the control of the Seller.

In any case, the warranty is limited to the replacement or repair of the parts or Products deemed faulty by the Seller's technical departments. If the repair is entrusted to a third party, the repair shall only be carried out once the Seller has agreed to the quotation for the repair.
All Products returns must have been given the Seller's prior, written authorisation.
The Products to be repaired must be dispatched carriage paid, to the address given by the Seller. If the Products are not accepted under warranty, their return to the Client shall be invoiced to the Client or the end user.
This warranty shall apply to the Seller's Products that are made readily available and therefore does not cover the de-installation and re-installation of said Products in the equipment into which it is mounted.
Repair, modification or replacement of any part or Product during the warranty period may not result in the warranty period being extended.
The provisions of this article constitute the Seller's sole obligation concerning the warranty of the Products delivered.

XIV - LIABILITY
The Seller's liability is strictly limited to the obligations stipulated in these GCS and those expressly accepted by the Seller. All penalties and indemnities provided for therein constitute lump sum damages that include discharge for the Seller and are exclusive of any other penalty or indemnification.
With the exception of the Seller's gross negligence and the compensation of bodily injury, the Seller's liability shall be limited, in total, to the contractual amount, exclusive of tax, of the Product(s) that give(s) right to compensation.
The Seller may under no circumstances be required to indemnify consequential, indirect and / or punitive damages that the Client may use as the basis for a claim; as a result, the Seller may not be required to indemnify, in particular, production losses, operating losses or lost profit or, in general, any damage eligible for indemnification other than bodily injury or damage to property.
The Client undertakes to hold harmless the Seller and / or its insurers from any and all claims made by its insurers and/or any third party in a contractual relation with the Client, in excess of the limit and for the exclusions listed above.

XV - SPARE PARTS AND ACCESSORIES
Spare parts and accessories shall be supplied upon request, to the extent of their availability. Associated costs shall be invoiced in addition.
The Seller reserves the right to require a minimum quantity or invoicing amount per order.

XVI - WASTE MANAGEMENT
The Products that form the purpose of the sale does not fall within the scope of the European Directive 2002/96/EC (WEEE) dated January 27th, 2003, and all related legislation of Member States of the European Union that result therefrom, on the composition of electrical and electronic equipment and the disposal of waste from such equipment.
In accordance with Article L 541-2 of the French Environment Code, it is the responsibility of the waste holder to ensure the disposal thereof or to cause the disposal thereof at its own expense.

XVII - FORCE MAJEURE
With the exception of the Client's obligation to pay the monies owed to the Seller in respect of an order, the Client and Seller may not be held liable for the total or partial failure to perform their contractual obligations if such failure results from the occurrence of a force majeure. Delays or disturbances in production that totally or partially result from war (whether declared or not), terrorist act, strikes, riots, accidents, fires, floods, natural disasters, transportation delays, shortage of components or materials, governmental decision or action (including prohibition on import/export or the withdrawal of an import/export licence) shall, in particular, be deemed a force majeure.
If one of the parties is delayed or prevented from performing its obligations by reason of this Article for a period in excess of 180 consecutive days, each party may then terminate, by right and without any need for judicial formalities, the unperformed part of the order, by written notice to the other party, without liability. However, the Client shall be required to pay the price agreed pertaining to the Products already delivered on the date of termination.

XVIII - PROHIBITION ON UNLAWFUL PAYMENTS
The Client shall refrain from being engaged in any activity that would expose the Seller or any of its affiliates to a risk of penalties under laws and regulations of any relevant jurisdiction prohibiting improper payments, including but not limited to bribes or gifts of an obviously unreasonable amount, to any government or agency officials, to political parties or their officials or candidates for public office, or to any employee of any customer or supplier.

XIX - TRADE COMPLIANCE LAWS
The Client agrees that all applicable import, export control and sanctions laws, regulations, orders and requirements, as they may be amended from time to time, including without limitation those of the European Union, the United States of America, and the jurisdictions in which the Seller and the Client are established or from which Products may be supplied, and the requirements of any licences, authorisations, general licences or licence exceptions relating thereto ("Trade Compliance Laws") will apply to its receipt and use of Products, as well as related services and technology. In no event shall the Client use, transfer, release, export or re-export the Products, related services or technology in violation of Trade Compliance Laws.
Seller shall have no obligation to supply any Products, or services unless and until it has received any necessary licences or authorisations or has qualified for general licences or licence exceptions under Trade Compliance Laws.
If for any reason any such licences, authorisations or approvals are denied or revoked, or if there is a change in any Trade Compliance Laws that would prohibit Seller from fulfilling the contract, or would in the reasonable judgement of Seller otherwise expose Seller and/or Seller's Affiliate(s) to a risk of liability under Trade Compliance Laws, Seller shall be relieved without liability of all obligations under the contract.

XX - SEVERABILITY
All clauses and/or provisions of these General Conditions that are deemed or become null or void shall not cause the nullity or voidance of the contract, but solely the clause and/or provision concerned.

XXI - DISPUTES
THIS CONTRACT SHALL BE GOVERNED BY AND INTERPRETED IN ACCORDANCE WITH THE LAWS OF FRANCE.
ANY DISPUTE IN RELATION TO THE INTERPRETATION OR THE EXECUTION OF THIS CONTRACT NOT AMICABLY SETTLED BETWEEN THE PARTIES WITHIN A 30 DAY PERIOD, SHALL BE SETTLED BY THE COMPETENT COURT OF ANGOULÊME (FRANCE), EVEN IN THE CASE OF INTRODUCTION OF THIRD PARTIES OR THE ENVOLVEMENT OF SEVERAL DEFENDANTS. HOWEVER, THE SUPPLIER RESERVES THE EXCLUSIVE RIGHT TO BRING THE DISPUTE TO THE COMPETENT COURTS OF THE SELLER OR THE CLIENT.

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