



## *Installation and commissioning*

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### ***LC motors***



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*Liquid-cooled 3-phase  
induction motors  
IE3 Premium efficiency*

Part number: 5380 en - 2017.06 / b

**LEROY-SOMER<sup>TM</sup>**

## GENERAL WARNING

These symbols   appear in this document whenever it is important to take special precautions during installation, operation, maintenance or servicing of the motors.

It is essential that electric motors are installed by experienced, qualified and authorised personnel.

In accordance with the main requirements of EU Directives, the safety of people, animals and property should be ensured when fitting the motors into machines.

Particular attention must be given to equipotential ground or earthing connections.

The noise level of the machines, measured under standard conditions, conforms to the requirements of the standard.



**The following preliminary precautions must be taken before working on any stationary device:**

- **Mains voltage disconnected and no residual voltage present**
- **Careful examination of the causes of the stoppage (jammed transmission - loss of phase - cut - out due to thermal protection - lack of lubrication, etc.)**

Dear Customer,

You have just acquired a LEROY-SOMER motor.


This motor benefits from the experience of one of the largest manufacturers in the world, using state-of-the-art technology in automation, specially selected materials and rigorous quality control. As a result, the regulatory authorities awarded our motor factories ISO 9001 - Edition 2008 international certification from the DNV. Similarly, our environmental approach enabled us to achieve ISO 14001:2004 certification.

We thank you for making this choice, and would ask you to read the contents of this manual.

By observing a few essential rules, you will ensure problem-free operation for many years.

## LEROY-SOMER MOTORS

### CE conformity

Our motors conform to standard EN 60034 (IEC 34), and to the 2006/95/EC Low Voltage Directive modified by the 2006/42/EC Machine Directive, which is demonstrated by their marking with the symbol 

<p>Constructions Electriques de Beaucourt (CEB) Rue de Dampierre 90500 BEAUCOURT T +33 (0)3 84 36 40 40 F +33 (0)3 84 36 40 44 N°Ref : C01 T 400 rev B</p> <p>Beaucourt, November 19<sup>th</sup>, 2015</p> <p>We, <b>Constructions Electriques de Beaucourt (CEB)</b>, a company of Emerson / Leroy-Somer group, declare, under our sole responsibility, that the following products :</p>	<p><b>DECLARATION CE OF CONFORMITY AND INCORPORATION</b></p> <p><b>Motor types :</b> <b>FLS, PLS, FLSES, PLSES, SLSHR, LC, FLSHR, FLSAR, FLSHT, FLSB</b> Frame size 280 à 560mm</p>						
<p><b>Asynchronous motors FLS, PLS, FLSES, PLSES, SLSHR, LC, FLSHR, FLSAR, FLSHT, FLSB series</b> Frame size 280 to 560 mm</p>							
<p>Comply with :</p> <table border="0"><tr><td>• European and international standards :</td><td>IEC-EN 60034 / IEC-EN 60072 / IEC-EN 60529</td></tr><tr><td>• The Low Voltage Directive :</td><td>2006/95/CE</td></tr><tr><td>• The ErP Directive :</td><td>2009/125/CE and its application rules (CE) 640/2009 for the concerned motors</td></tr></table>		• European and international standards :	IEC-EN 60034 / IEC-EN 60072 / IEC-EN 60529	• The Low Voltage Directive :	2006/95/CE	• The ErP Directive :	2009/125/CE and its application rules (CE) 640/2009 for the concerned motors
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• The Low Voltage Directive :	2006/95/CE						
• The ErP Directive :	2009/125/CE and its application rules (CE) 640/2009 for the concerned motors						
<p>This conformity permits the use of these ranges of products in machines subject to the application of the Machinery Directive 2006/42/CE, provided that they are integrated or incorporated and/or assembled in accordance with, amongst others, the regulations of standard EN 60204 "Electrical Equipment for Machinery" and the Electromagnetic Compatibility Directive 2004/108/CE.</p> <p>The above defined products shall not be put into service until the machines in which they are incorporated have been declared compliant with related applicable directives.</p> <p>The equipment installation shall comply with all regulations, decrees, ordinances, directives, application notes, standards, state of the art practices as well as any other document relative to their installation. <b>CONSTRUCTIONS ELECTRIQUES DE BEAUCOURT (CEB)</b> shall not be held responsible for failure to comply with these rules.</p> <p>The motors supplied through adapted electronic converters and/or command or monitoring electronic devices, shall be installed by a qualified professional responsible of compliance to all installation rules. This installer shall also be responsible for the conformity with the local EMC rules in force in the considered country where the product is being installed, as well as for the respect of values stamped on motor rating plate(s); the instruction manual, the installation instructions, the maintenance manuals and/or any other document supplied by the manufacturer.</p> <p>Year of CE marking : 2011</p> <table border="0"><tr><td>Quality management : N. STRAUMANN </td><td>Technical management : T. PERA </td></tr></table> <p></p> <p>Constructions Electriques de Beaucourt (CEB) – Siège social : Rue de Dampierre – 90500 BEAUCOURT Société par Actions Simplifiée au capital de 8 004 000 € - RCS Beaufort 321 253 916</p> <p>Page 1 sur 1</p>		Quality management : N. STRAUMANN 	Technical management : T. PERA 				
Quality management : N. STRAUMANN 	Technical management : T. PERA 						

#### NOTE:

LEROY-SOMER reserves the right to modify the characteristics of its products at any time in order to incorporate the latest technological developments. The information contained in this document is therefore liable to be changed without notice.

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All brands and models have been registered and patents applied for.

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# 1 - RECEIPT

On receipt of your motor, check that it has not suffered any damage in transit.

If there are obvious signs of knocks, contact the carrier (you may be able to claim on their insurance) and after a visual check, turn the motor by hand to detect any malfunction.

## 1.1 - Identification

As soon as you receive the motor, check that the nameplate on the machine conforms to your order.

EMERSON Industrial Automation									
MOT. 3~ LC 450 LA 4									
N° 74893200XM01									
2016 4100 kg									
Leroy-Somer									
DE 6326 C3 80 g 3000 h IP 55 1000 m									
NDE 6324 C3 72 g 3700 h IK 08 IM 1001									
IE3									
40°C Ins cl.F S1 100% 6d/h SF 1.0 97.4 %									
V Hz min <sup>-1</sup> kW A cos φ %									
Δ 400 50 1491 1000 1665 0.89 97.4									
Δ 690 50 1491 1000 961 0.89									
Δ 380 50 1490 1000 1739 0.90									
Δ 415 50 1492 1000 1623 0.88									
Δ 460 60 1788 1000 1448 0.89 97.4									
Polyrex EM 103									
Min water flow = 70 l/min									
Max water temp = 38°C Max pressure = 5 bars									

Motor performance when powered by the mains supply

EMERSON Industrial Automation									
MOT. 3~ LC 450 LA 4									
N° 74893200XM01									
2016 4100 kg									
Leroy-Somer									
DE 6326 C3 80 g 3000 h IP 55 1000 m									
NDE 6324 C3 72 g 3700 h IK 08 IM 1001									
IE3									
40°C Ins cl.F S9 % d/h SF									
Inverter settings									
V Hz min <sup>-1</sup> kW A cos φ									
Δ 400 50 1491 1000 1800 0.89									
min. Fsw (kHz) : 3									
Nmax (min <sup>-1</sup> ) : 2610									
Motor performance									
Hz 10 17 25 50 60 87									
T/Tn% 100 100 100 100 83 57									
Polyrex EM 103									
Min water flow = 70 l/min									
Max water temp = 38°C Max pressure = 5 bars									

Motor performance when powered by a drive

### Definition of symbols used on nameplates:



Legal mark of conformity to the requirements of European Directives

**MOT 3 ~** : 3-phase A.C. motor  
**LC** : Series  
**450** : Frame size  
**LA** : Housing symbol  
**4** : Number of poles

#### Motor no.

**74893200** : Motor batch number  
**X** : Year of production  
**M** : Month of production  
**01** : Batch number  
**IE3** : Efficiency class  
**97.4%** : Efficiency at 4/4 load

**IP55 IK08** : Degree of protection

**Ins cl. F** : Insulation class F

**40°C** : Ambient operating temperature

**S1** : Duty - Operating factor

**kg** : Weight

**V** : Supply voltage

**Hz** : Supply frequency

**min<sup>-1</sup>** : Revolutions per minute (rpm)

**kW** : Rated output power

**cos φ** : Power factor

**A** : Rated current

**Δ** : Delta connection

**Y** : Star connection

**Min Water Flow (l/mn)**

**Max Water Temp (°C)**

**Max pressure (bars)**

#### Bearings

**DE** : Drive end

**NDE**

**g** : Amount of grease at each regreasing (in g)

**h** : Regreasing interval (in hours)

**POLYREX EM103** : Type of grease

**A** : Vibration level

**H** : Balancing mode

**Please quote when ordering spare parts**

If the motor is fitted with winding sensors:

- TP111B (1 set of sensors)
- TP121B (2 sets of sensors)

#### Drive power supply plate:

**Inverter settings** : Values required for setting the frequency inverter

**Motor performance** : Torque available at the motor shaft expressed as a % of the rated torque at the frequencies indicated on the plate

**Min. Fsw (kHz)** : Minimum acceptable switching frequency for the motor

**Nmax (min<sup>-1</sup>)** : Maximum acceptable mechanical speed for the motor

## 1.2 - Storage

Prior to commissioning, motors must be stored in a horizontal position:

- Away from humidity (relative humidity < 50%): at higher relative humidity levels the machine insulation can drop very quickly and become virtually non-existent at around 100%. The state of the anti-rust protection on unpainted parts should be monitored.

For very long storage periods the motor can be placed in a sealed covering (heat-shrunk plastic, for example) containing sachets of desiccant corresponding to the volume and degree of humidity in the storage location:

- Away from frequent significant variations in temperature to avoid the risk of condensation. During storage the drain plugs must be removed to allow condensation to escape (located at the lowest point depending on the operation position).

The storage location must be dry and protected from harsh weather conditions and the cold (temperature range should remain between +15°C and +60°C), and be free from vibration, dust and corrosive gases.

- If the area is subject to vibration, try to reduce the effect of this vibration by placing the motor on a damping support (rubber plate or similar) and turn the rotor a fraction of a turn every 2 months to prevent the bearing rings from becoming marked.

- If there are no vibrations, turn the rotor a fraction of a turn every 3 to 4 months.

- Do not remove the rotor locking device (if there are roller bearings).

Even if the motor has been stored in the correct conditions, certain checks must be carried out before it is started up:

### Greasing

	Gade 2 grease	Gade 3 grease	
Storage period	Less than 6 months	Less than 1 year	The motor can be commissioned without regreasing
	Between 6 months and 1 year	Between 1 and 2 years	Regrease before commissioning, as described in section 4.5.2
	Between 1 and 5 years	Between 2 and 5 years	Dismantle the bearing - Clean it - Replace the grease completely
	More than 5 years	More than 5 years	Change the bearing - Regrease it completely

Refer to the nameplate for the grease used by LEROY-SOMER.

## 2 - INSTALLATION RECOMMENDATIONS

In all cases, compatibility of the motor and its environment must be guaranteed before installation and throughout its service life.



**Electric motors are industrial products. They must therefore be installed by qualified, experienced and authorised personnel. The safety of people, animals and property must be ensured when fitting the motors into machines (please refer to current applicable standards).**

## 2.1 - Checking the insulation



**Before starting the motor, it is advisable to check the insulation between phases, and between the phases and earth.**

This check is essential if the motor has been stored for longer than 6 months or if it has been kept in a humid atmosphere.

This measurement must be carried out using a megohmmeter at 500 volts D.C. (do not use a magnetolectric system).

It is better to carry out an initial test at 30 or 50 volts and, if the insulation is greater than 1 megohm, carry out a second test at 500 volts for 60 seconds between the winding and the earth (at any of the motor terminals). The insulation value must be at least 10 megohms in cold state.

If this value cannot be achieved, or if the motor may have been splashed with water or salt spray, or kept for a long period in a very humid place or if it is covered in condensation, it is advisable to dry the motor using the optional space heaters, if fitted (see section 2.6.7.3), or to dry the stator for 24 hours in a drying oven at a temperature of between 110°C and 120°C.

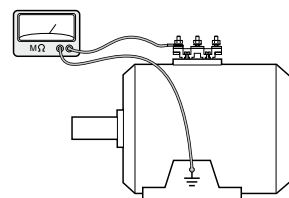
If it is not possible to place the motor in a drying oven:

- Switch on the motor, with the rotor locked, at 3-phase A.C. voltage reduced to approximately 10% of the rated voltage, for 12 hours (use an induction regulator or a reduction transformer with adjustable outlets).

- Or supply the 3 phases in series with a D.C. current, with the voltage at 1 to 2% of the rated voltage.

NB: The A.C. current must be monitored using a clamp ammeter, and the D.C. current using a shunt ammeter. This current must not exceed 60% of the rated current.

It is advisable to place a thermometer on the motor housing: if the temperature exceeds 70°C, reduce the indicated voltage or current by 5% of the original value for every 10°C difference. While it is drying, all the motor orifices must be open (main terminal box cover, auxiliary terminal box covers, drain holes).



**For any insulation or high voltage test, it is advisable to connect the thermal sensors and/or accessories to earth.**



**Caution: If the high voltage test, carried out at the factory before despatch, needs to be repeated, it should be performed at half the standard voltage, i.e. 1/2 (2 U+1000 V). Check that the capacitive effect resulting from the high voltage test is eliminated before connecting the terminals to earth.**

## 2.2 - Checking the motor terminal box

After an extended storage period and after having checked the motor insulation (see section 2.1), the condition of the inside of the main terminal box and the auxiliary terminal boxes should also be checked:

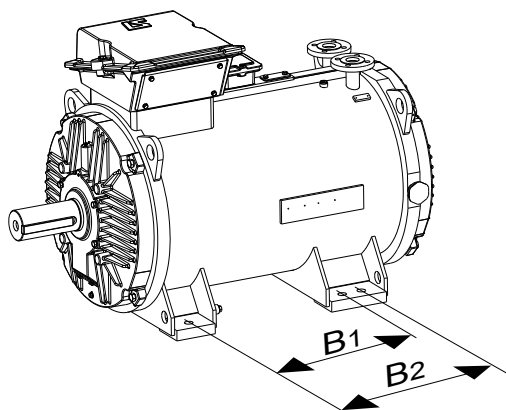
- They must be clean, dry and free from dust.
- There should be no corrosion on the connection elements.
- The seals must be in the correct position.

Otherwise, it will be necessary to recheck the motor's conformance, and some components may even need to be replaced.

## 2.3 - Mounting the motor

**The motor must be mounted in the position specified on the order, on a base which is rigid enough to prevent distortion and vibration.**

Where the motor feet have six fixing holes, it is preferable to use those which correspond to the standard dimensions for the motor power rating (refer to the LC motors technical catalogue) or, should this not be the case, to those shown at B2 in the diagram below.



Provide easy access to the terminal box, condensation drain plugs, air vents and grease nipples.

Use lifting equipment which is compatible with the weight of the motor (indicated on the nameplate).



**The lifting rings are designed to lift the motor only and must not be used to lift the whole machine after the motor has been fitted to it.**

**Note 1: When installing a suspended motor, it is essential to provide protection in case the fixing breaks.**

**Note 2: Never stand on the motor.**

## 2.4 - Cooling circuit

LC motors are designed for the following operating conditions:

- Ambient temperature: -16°C to +40°C
- Altitude: 1000 m maximum

The heat inside the LC motor is dissipated by water circulating in the housing. The water supply system must be installed by the user in accordance with the characteristics indicated on the motor nameplate.



**For use at an ambient temperature below +5°C, a glycol-based antifreeze must be added to the cooling water with an antifreeze to water mix ratio of 40/60.**

**For standard versions, the water inlet temperature is:**

• 32°C for LC 315 to LC 355 L motors. For temperatures between 32°C and 38°C, depending on the number of poles and the power rating, the motor design can be adapted.

• 38°C for LC 355 LK to LC 500 motors.

For temperatures above 38°C, please consult Leroy-Somer.

**The water inlet pressure must not exceed 5 bar.**

The water inlet and outlets must not be obstructed as this could cause the motor to overheat.

The volume of cooling water and the pressure must comply with the values given in the table below:

Frame size	Min. flow rate (litre/min)	Max. pressure drop (bar)	Max. pressure (bar)	Max. water temperature rise (°C)
315	30	1	5	5
315 LK/355	30	1	5	6
355 LK 2-pole	50	1	5	6
355 LK 4-6-pole	40	1	5	6
400	45	1	5	6
400 LK/450	70	1	5	6
500 L 4-pole	100	1	5	6
500 M 6-pole	80	1	5	6

### 2.4.1 - Cooling water properties

LC motor housings have a double steel wall in which the cooling water circulates.

Good practice must be applied in terms of industrial cooling water, in particular to prevent scaling, corrosion and the build-up of organic matter.

The following typical values are given as a guide only:

- pH of 7.5 to 8.5
- CaCO<sub>3</sub> alkalinity: 100 to 400 mg/l
- Chloride Cl<sup>-</sup>: <200 mg/l
- Conductivity: 1000 to 1500 µS/cm

The lower the temperature of the water intake, the better the motor cooling.

## 2.4.2 - Checks before commissioning

If the motor has been out of service for an extended period, check that water can flow freely in the motor cooling system. Remove any potential blockages caused by rust by dissolving it using oxalic acid for example.

- Empty the water from the cooling circuit.
- Fill the cooling circuit with a mix of water and oxalic acid (100g/litre).
- Leave it for 15 minutes.
- Empty the cooling circuit and rinse it out with pressurised water.
- Repeat the process if necessary.

## 2.4.3 - Emptying the housing

- Switch off the motor.
- Shut off the cooling water intake.
- Open the air vents and the water drain holes.
- Let the water drain out.

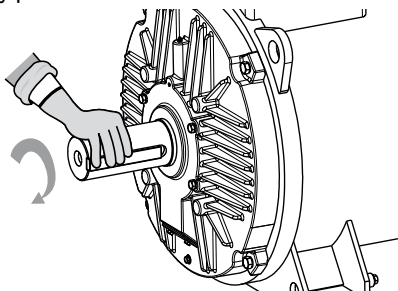
After approximately 10 minutes, replace the drain plugs and fit new seals.

## 2.5 - Coupling

### Preparation

Turn the motor by hand before coupling to detect any possible fault due to handling.

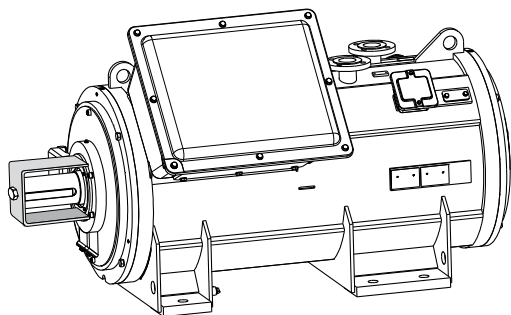
Remove any protection from the shaft extension.



### Rotor locking device

For made-to-order motors with roller bearings, remove the rotor locking device.

In exceptional circumstances when the motor has to be moved after the coupling device has been fitted, the rotor must be immobilised again.



### Balancing

Rotating machines are balanced in accordance with standard ISO 8821:

- Half-key when the shaft extension is marked H
- No key when the shaft extension is marked N
- Full key when the shaft extension is marked F

Any coupling element (pulley, coupling sleeve, slip-ring, etc.) must therefore be balanced accordingly.

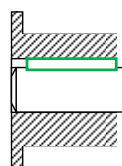
To determine the motor balancing mode, check the nameplate. The motors are balanced with a half-key as standard unless otherwise indicated. The coupling balancing will therefore need to be adapted to the motor balancing, and the coupling will need to be adapted to the length of the shaft key; alternatively any visible parts protruding from the key can be machined off. It is possible to use an adapted shaft key.



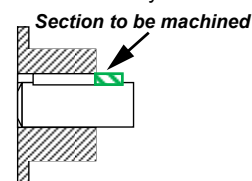
**Failure to follow these recommendations could lead to premature wear of the bearings and may invalidate the warranty.**

### COMPLIANT MOUNTINGS

Coupling adapted to the length of the shaft key

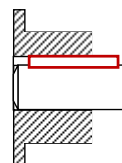


Machining of the visible protruding section of the shaft key



### NON-COMPLIANT MOUNTING

Unmachined open keyway.  
Coupling not adapted to the length of the shaft key



### Motor with 2 shaft extensions



**If the second shaft extension is not used, in order to comply with the balancing class, the key or half-key must be fixed firmly in the keyway so that it is not thrown out during rotation and must be protected against direct contact.**

### Precautions

All measures must be taken to ensure protection against the risks which arise when there are rotating parts (coupling sleeve, pulley, belt, etc.).



**If a motor is started up without a coupling device having been fitted, carefully immobilise the shaft key in its housing.**

Beware of backdriving when the motor is switched off. Appropriate precautions must be taken:

- For pumps, install a non-return valve.
- For mechanical devices, install a backstop or a holding brake.
- etc.

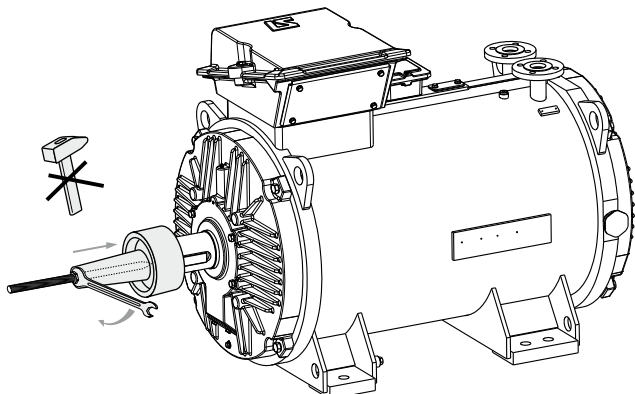
### Tolerances and adjustments

The standard tolerances are applicable to the mechanical characteristics given in our catalogues. They comply fully with the requirements of IEC standard 72-1.

- Users must adhere strictly to the instructions provided by the transmission device supplier.

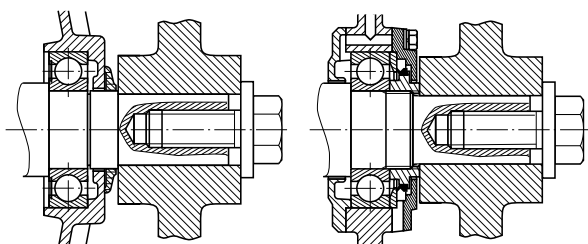


- Avoid impacts which could damage the bearings.  
Use a spanner and grease the tapped hole of the shaft extension with a special lubricant (e.g. molykote grease) to make it easier to fit the coupling.



The hub of the transmission device must be:

- Fully in contact with the shoulder of the shaft or, if this is missing, hard up against the metal stop ring to form a labyrinth seal and thus lock the bearing in place (do not crush the seal).
- Longer than the shaft extension (2 to 3mm) so that it can be tightened using a screw and washer. If it is not, a spacer ring must be inserted without cutting the key (if this ring is large, it must be balanced).



Applied to shoulder of shaft

Applied to stop ring

If there is a second shaft extension, it must only be used for direct coupling and the same recommendations must be followed.



**The 2nd shaft extension may also be smaller than the main shaft extension, and under no circumstances can it deliver torques greater than half the rated torque.**

**Inertia flywheels** must not be mounted directly onto the shaft extension, but installed between end shields and connected by a coupling device.

## Direct connection onto the machine

When the rotating device (pump or fan turbine) is mounted directly on the motor shaft end, check that this device is perfectly balanced and that the radial force and the axial thrust are within the limits indicated in the catalogue for the bearing withstand.

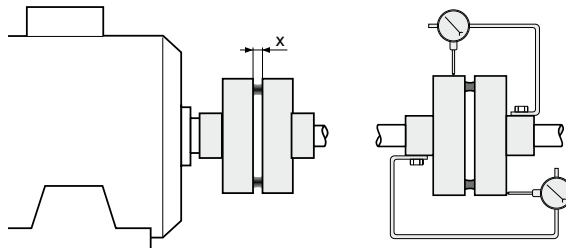
## Direct connection using a coupling sleeve

Selection of the coupling sleeve should take account of the rated torque to be transmitted and the safety factor dependent on the starting conditions for the electric motor.

The machines must be carefully aligned, so that any lack of concentricity and parallelism in the two coupling halves is compatible with the recommendations of the coupling sleeve manufacturer.

The two parts of the coupling sleeve should be provisionally assembled to make it easier to alter their relative position.

Adjust the parallel plane of both shafts using a gauge. Measure the distance between the two coupling surfaces at one point on the circumference. Rotate them 90°, 180° and 270° in relation to this initial position, and measure each time. The difference between the two extreme values of dimension "x" must not exceed 0.05mm for standard couplings.



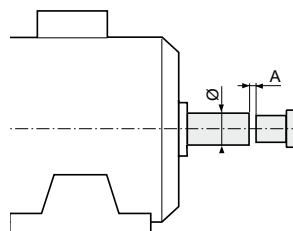
To perfect this adjustment and at the same time check the concentricity of the two shafts, fit 2 gauges as shown in the diagram and slowly turn both shafts.

The deviations registered by either shaft will indicate the need for an axial or radial adjustment if the deviation exceeds 0.05mm.

## Direct connection using a rigid coupling sleeve

The two shafts must be aligned so as to adhere to the tolerances of the coupling sleeve manufacturer.

Maintain the minimum distance between the shaft extensions to allow for expansion of the motor shaft and the load shaft.



Ø (mm)	A (mm) min.
70	1.5
75	2
80	2
90	2
100	2
110	2
120	2
140	2

## Transmission via belt pulleys

The user chooses the diameter of the pulleys.

Cast iron pulleys with a diameter greater than 315 are not recommended for rotation speeds of 3000 min<sup>-1</sup>.

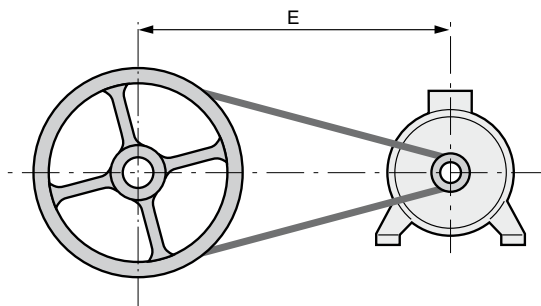
Flat belts cannot be used for rotation speeds of 3000 min<sup>-1</sup> or more.

## Positioning the belts

So that the belts can be correctly positioned, allow for possible adjustment of approximately 3% with respect to the calculated distance E.

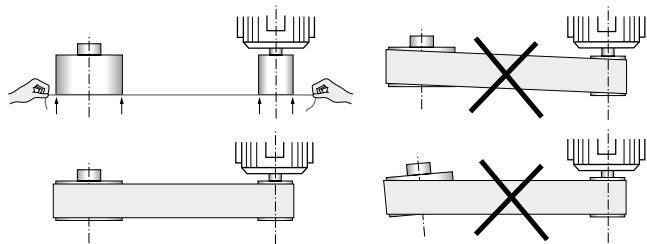
Force must never be used when fitting the belts.

For notched belts, position the notches in the pulley grooves.



### Aligning the pulleys

Check that the motor shaft is completely parallel with that of the receiving pulley.



**Protect all rotating devices before switching the power on.**

### Adjusting the belt tension

The tension of the belts must be adjusted very carefully in accordance with the recommendations of the belt supplier and the calculations made when the product was specified.

Reminder:

- Tension too great = unnecessary force on the end shields which could lead to premature wear of the bearing unit (end shield-bearings) and eventually break the shaft.
- Tension too low = vibration (wearing of the bearing unit).

### Fixed distance between centres:

Place a belt tensioning pulley on the slack side of the belts:

- Smooth pulley on the outside of the belt
- Grooved pulley on the inside of the belts when using V-belts.

## 2.6 - Motor control and protection

### 2.6.1 - Minimising problems caused by motor starting

Operating problems in other equipment connected to the same supply are due to the voltage drop caused by the current demand on starting, which is many times greater than the current absorbed by the motor at full load (approximately 7). See the LC motors technical catalogue.

Even though mains supplies increasingly allow D.O.L. starting, the current inrush must be reduced for certain installations. Jolt-free operation and soft starting ensure greater ease of use and an increased lifespan for the machines being driven.

The two essential parameters for starting cage induction motors are:

- Starting torque
- Starting current

The starting torque and the resistive torque determine the starting time.

Depending on the load being driven, it may be necessary to adapt the torque and the current to the machine starting time and to the possibilities of the mains power supply.

The five essential modes are:

- D.O.L. starting
- Star/delta starting
- Soft starting with autotransformer
- Soft starting with resistors
- Electronic starting

The "electronic" starting modes control the voltage at the motor terminals during the entire starting phase and enable very soft, jolt-free starting.

### 2.6.2 - LEROY-SOMER Digistart electronic starter

This is a multi-function electronics system with a microcontroller, which is used with all 3-phase cage induction motors.

It provides soft starting of the motor with:

- Reduction of the starting current
- Gradual, jolt-free acceleration, achieved by controlling the current absorbed by the motor.

After starting, the DIGISTART performs additional motor control functions in its other operating phases: steady state and deceleration.

- 18 to 1600 A models
- Power supply: 220 to 700 V - 50/60 Hz

DIGISTART is economical to install, as a fused switch is the only additional device needed.

### 2.6.3 - Other control systems

Frequency inverters, flux vector control, etc. Special precautions need to be taken when standard induction motors are being used for variable speed control, powered by a frequency inverter or voltage controller:



**The reference voltage (drive output or motor input) is 400 V at 50 Hz. The drive must deliver a constant voltage/frequency signal to the motor in the operating range up to 50 Hz.**

Water cooling is a highly effective method of transferring heat away from the motor. Cooling efficiency is maintained even at low speeds, which is ideal for constant torque applications of frequency inverters.

#### If the frequency exceeds 50 Hz:

- Carefully check that all the components on a particular transmission are properly aligned.
- The voltage remains constant above 50 Hz.
- The power supplied by the motor up to 60 Hz remains constant (make sure that the power absorbed by the load does not vary differently in this frequency range).

d - Check that the application speed does not exceed the following synchronous speed values:

- 2P motor --> 3600 min<sup>-1</sup>
- 4P motor --> 1800 min<sup>-1</sup>
- 6P motor --> 1200 min<sup>-1</sup>

e - For all other frequency and/or voltage limits, additional precautions must be taken for derating, bearings, ventilation, noise, etc. Please consult Leroy-Somer.

Check that the vibration level of the complete machine complies with the ISO 10816-3 standard.

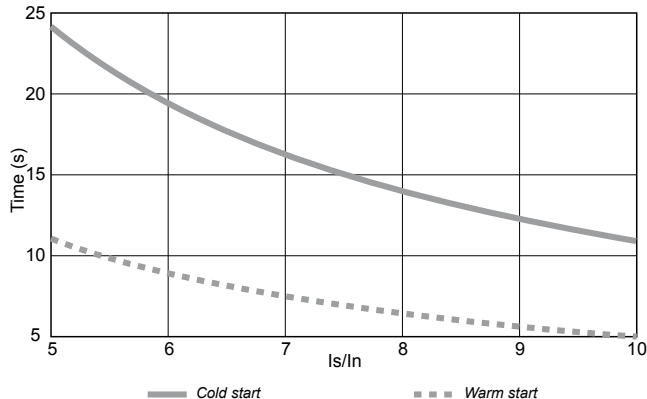
The user is responsible for protecting the motor and drive equipment from hazardous currents in the bearings and voltage peaks in the winding. These instructions cannot guarantee efficiency in all use cases.

## 2.6.4 - Permissible starting and locked rotor times

The calculated starting times must remain within the limits of the graph below, which defines maximum starting times in relation to the starting current.

Two consecutive cold starts and one warm start are allowed (after thermal stabilisation at the rated power).

At least 15 minutes must elapse between each consecutive start.



Permissible motor starting time as a function of the ratio  $I_s/I_N$ .

## 2.6.5 - Earthing (see section 2.7.7)

## 2.6.6 - Power factor compensation capacitors



Before any work is carried out on the motor or in the cabinet, check that the capacitors are isolated and/or discharged (read the voltage at the terminals).

## 2.6.7 - Motor protection devices

### 2.6.7.1 - Line protection

#### Adjusting the thermal protection

This must be set to the value of the current shown on the motor nameplate for the connected mains voltage and frequency.

#### Thermal magnetic protection

The motors must be protected by a thermal magnetic device located between the isolating switch and the motor. These protection devices provide total protection of the motor against non-transient overloads.

This device can be accompanied by fused circuit-breakers.

#### Built-in direct thermal protection

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

### 2.6.7.2 - Built-in indirect thermal protection

The motors can be equipped with optional heat sensors. These sensors can be used to monitor temperature changes at "hot spots":

- Overload detection
- Cooling check
- Monitoring strategic points for maintenance of the installation

It must be emphasized that under no circumstances can these sensors be used to carry out direct regulation of the motor operating cycles.

Type	Operating principle	Operating curve	Breaking capacity (A)	Protection provided	Mounting Number of devices*
Normally closed thermal protection <b>PTO</b>	Bimetallic strip, indirectly heated, with normally closed (NC) contact 		1.6 at 250 V with $\cos \varphi 0.6$	General monitoring for non-transient overloads	Mounted in control circuit 2 or 3 in series
Normally open thermal protection <b>PTF</b>	Bimetallic strip, indirectly heated, with normally open (NO) contact 		1.6 at 250 V with $\cos \varphi 0.6$	General monitoring for non-transient overloads	Mounted in control circuit 2 or 3 in parallel
Positive temperature coefficient thermistor <b>PTC</b>	Variable non-linear resistor with indirect heating 		0	General monitoring for transient overloads	Mounted with associated relay in control circuit 3 in series
Thermocouples <b>T</b> ( $T < 150^{\circ}\text{C}$ ) Copper Constantan <b>K</b> ( $T < 1000^{\circ}\text{C}$ ) Copper cupro-nickel	Peltier effect 		0	Continuous monitoring of hot spots at regular intervals	Mounted on control panels with associated reading device (or recording device) 1 per hot spot
Platinum resistance thermometer <b>PT 100</b>	Linear variable resistor, indirectly heated 		0	High accuracy continuous monitoring of key hot spots	Mounted on control panels with associated reading device (or recording device) 1 per hot spot

- NRT: nominal running temperature.

- The NRTs are chosen according to the position of the sensor in the motor and the temperature rise class.

\* The number of devices relates to the winding protection.

### Alarm and early warning

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



**Caution: The motor may remain powered-up, depending on the type of protection. Ensure that the mains supply is disconnected before any work is carried out in the terminal box or in the cabinet.**

### 2.6.7.3 - Protection against condensation: optional space heaters

Marking: 1 red label

A glass fibre flexible resistor is fixed on 1 or 2 coil end turns. This resistor heats the machines when stopped and thus prevents condensation inside the machines.

Power supply: 200/240 V single-phase 50/60 Hz, unless otherwise specified by the customer.

Motor type	Power (W)
LC 315 LA/LB	150
LC 315 LKA/LKB/LKC	200
LC 355 LA/LB/LC	
LC 355 LKA/LKB/LKC	300
LC 400 LA	
LC 400 LKA	
LC 450 LA/LB	
LC 500 M/L	400

If the drain plugs at the bottom of the motor were not removed at the time of installation, they must be opened approximately every 6 months.



**Caution: Check that the space heaters are powered down before any work is carried out in the terminal box or in the cabinet.**

### 2.6.7.4 - Enhanced protection

Standard motors are compatible with power supplies with the following characteristics:

- $U_{rms} = 400 \text{ V max.}$
- Value of voltage peaks generated at the terminals: 1500 V max. However, they may be supplied with power in harsher conditions if additional protection is provided.

### Reinforced winding insulation

The main effect connected with supplying power via an electronic drive is overheating of the motor due to the non-sinusoidal shape of the signal. In addition, this can result in accelerated ageing of the winding through the voltage peaks generated at each pulse in the power supply signal. For peak values greater than 1500 V, a super-insulation option for the winding is available across the entire range.

### Reinforced insulation of the mechanical parts

Supplying power via a drive may affect the mechanical parts and can lead to premature wear of the bearings. This is because, in any motor, a shaft voltage exists with respect to earth. This voltage, due to electro-mechanical dissymmetries, creates a potential difference between the rotor and the stator. This effect may generate electrical discharges between balls and rings and lead to a reduction in bearing life.

If power is supplied by a PWM drive, a second phenomenon may occur in the form of high frequency currents generated by the IGBT output bridges of the drives. These currents "attempt" to spread towards the drive and therefore flow through the stator and via earth where the link between casing, machine chassis and earth is correctly made.

If the earth connection is not secure, an insulated bearing option is offered across the range for frame sizes above 315.

#### 2.6.7.5 - Water leakage detector

A water leakage detector is mounted as standard on each motor, on the bottom of the motor depending on the configuration (horizontal or vertical mounting).

The detector uses optical detection technology.

It comprises an infra-red transmitter and an optical receiver. The receiver detects the presence of water through a change in the light transmitted by the transmitter.

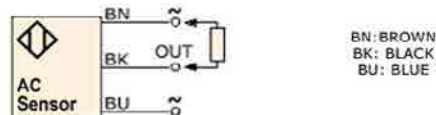
The detector characteristics are as follows:

Voltage	12-28 volts D.C.
Current	100 mA max.
Output type	NPN closed circuit (open in the event of a fault)

The water leakage detector is connected to the auxiliary terminal box and requires an external power supply.



### Electrical connections



The water leakage detector is mounted inside the motor on the drive end shield.

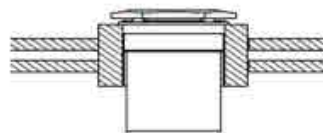
#### 2.6.7.6 - Plug with breathable membrane

Leroy-Somer liquid-cooled LC motors are delivered as standard with a plug with a waterproof breathable membrane. This PTFE membrane is permeable to air and steam, but impermeable to liquids (IP66 min.).

The coolant circulating around these motors means they are subjected to significant changes in temperature. Depending on the ambient conditions, condensation may form inside the motor.

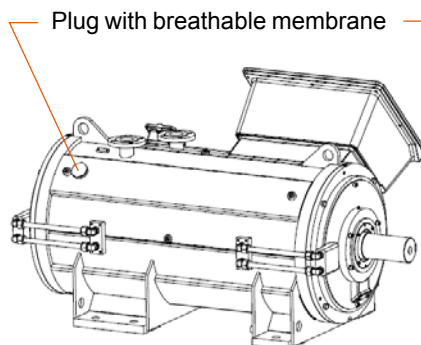
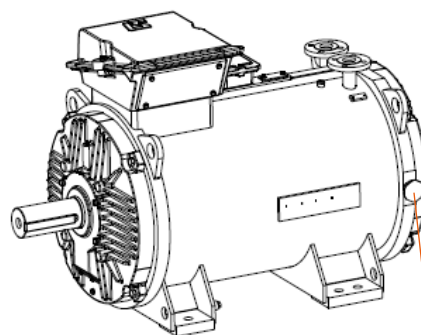
This moisture, which may be present in quite large quantities, could damage the motor. The usual solution is to drain condensation off through the drain holes at the bottom of the motor. These drain holes are present on all motors, but the presence of the breather plug means that maintenance operations are kept to a minimum.

This system is patented by Leroy-Somer.



Inserting the breather plug:

LC 315 to LC 355 L



LC 355 LK, LC 400, LC 450 et LC 500

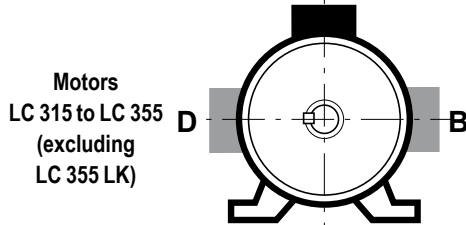
## 2.7 - Electrical connections

### 2.7.1 - Motor terminal boxes

#### 2.7.1.1 - Main terminal box

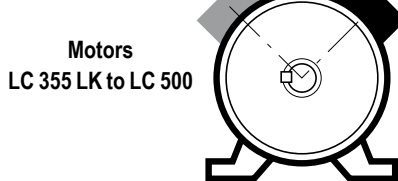
Terminal boxes for LC 315, LC 315 LK and LC 355 (excluding LK versions) motors in a B3 housing are mounted on top of the motor. The standard position of the cable outputs is on the right as seen from the drive end, although they can be positioned on the left or the front as an option.

**A: Standard position**



Terminal boxes for LC 355 LK to LC 500 motors are mounted at a 45° angle on the right as seen from the drive end. The cable outputs can be via the bottom as standard or via the top as an option. The terminal box positioned at a 45° angle on the left is also available as an option

**B: Standard position**



### Dimensions of cable gland mounting plates

Motor type	Diagram	Useful drilling area for cable gland mounting plates (dimensions in mm)	
		Without terminal box spacer (standard)	With terminal box spacer (optional*)
LC 315 LA/LB	1		
LC 315 LKA/LKB/LKC		H = 115 W = 125	H = 135 W = 280
LC 355 LA/LB/LC			
LC 355 LKA/LKB/LKC	2		
LC 400 LA/LB		H = 170 W = 460	H = 170 W = 460
LC 400 LKA			
LC 450 LA/LB	3		
LC 500 M/L		-	H = 290 W = 774

\* Standard for LC 500 motor

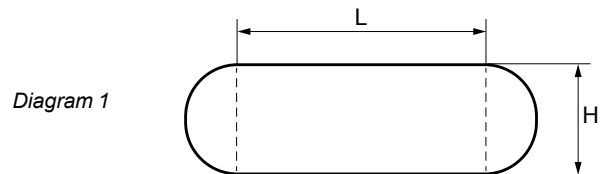


Diagram 1

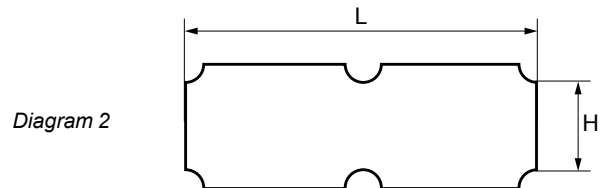


Diagram 2

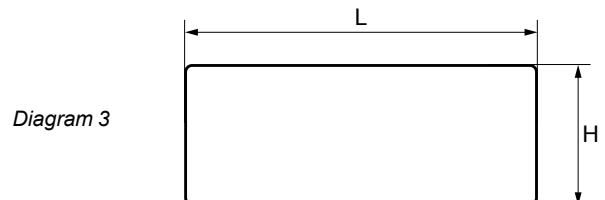
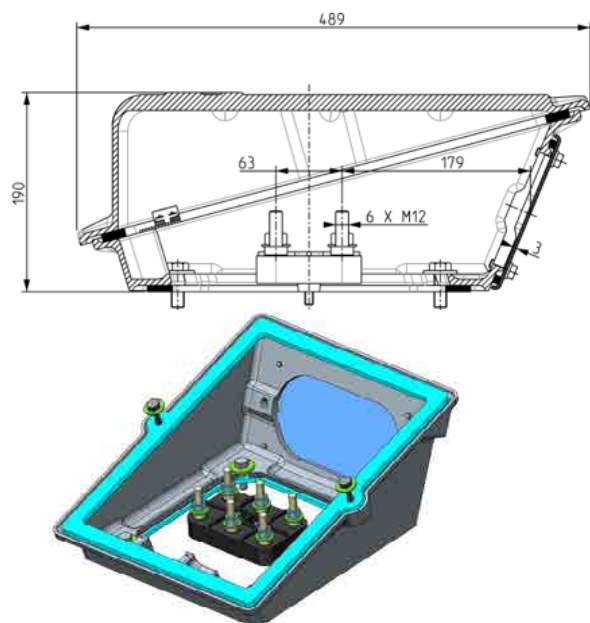
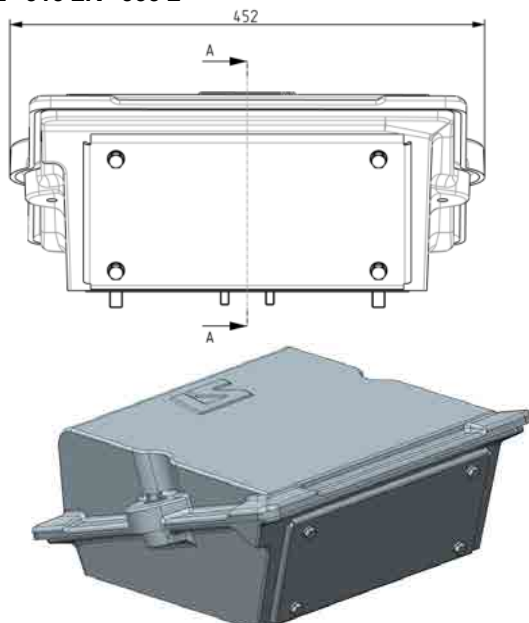


Diagram 3

### SIZE AND DIMENSIONS OF THE MAIN TERMINAL BOXES

Dimensions in millimetres

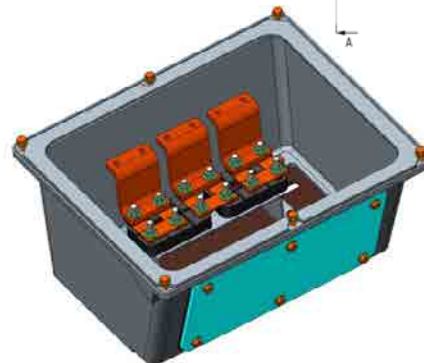
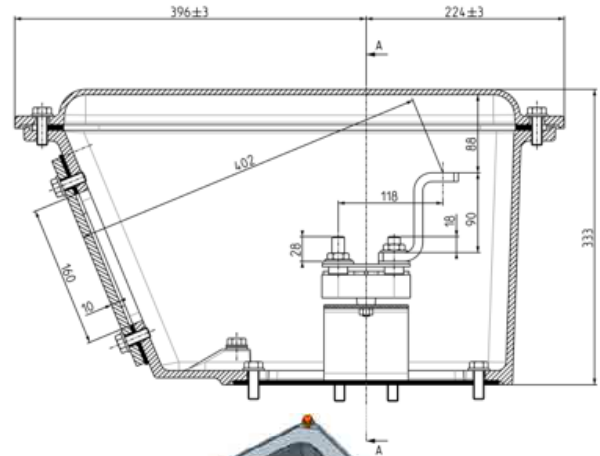
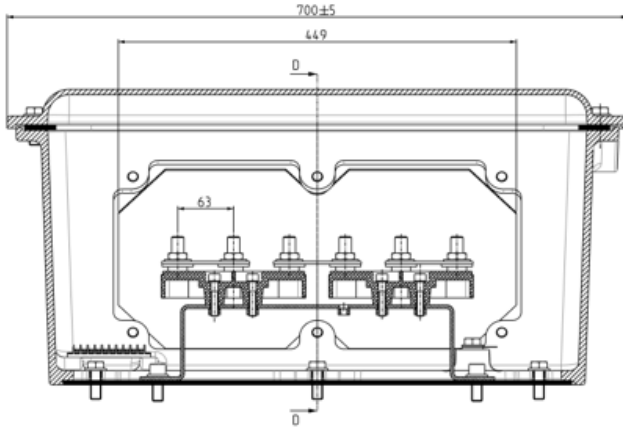
#### LC 315 L - 315 LK - 355 L



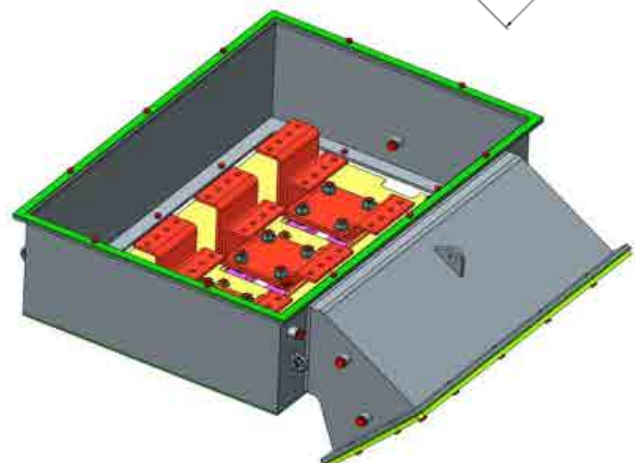
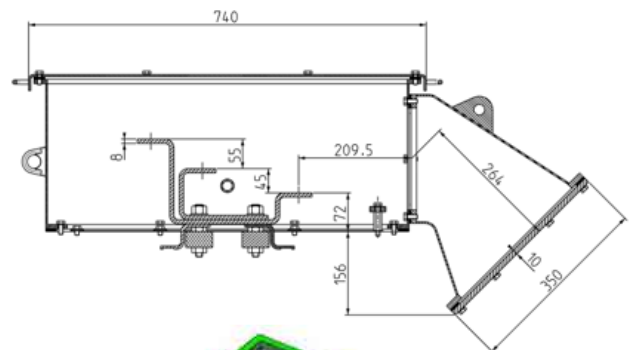
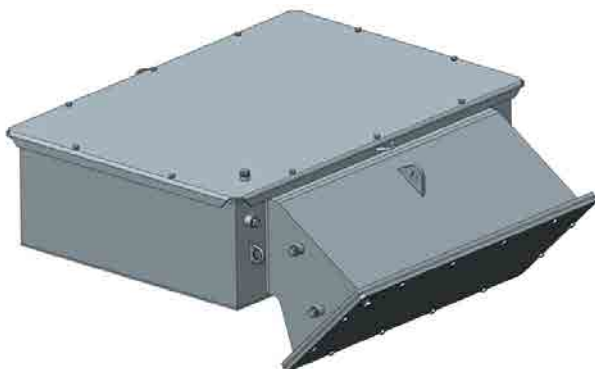
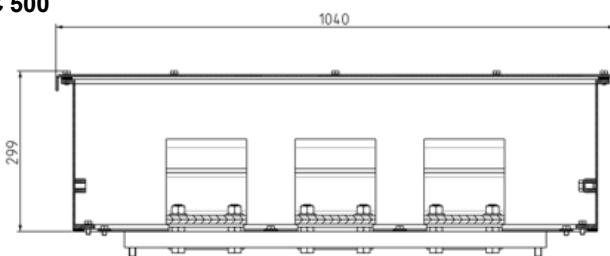


## LC 355 LK - 400 L - 400 LK - 450 L

Dimensions in millimetres



## LC 500



This configuration allows up to 12 conductors to be connected per phase

### 2.7.1.2 - Auxiliary terminal boxes

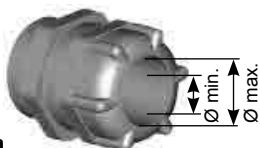
An auxiliary terminal box for additional equipment (water leakage detector for example) is available as standard on these motors. It has 2 plugged drill holes (ISO 16).

A second auxiliary terminal box with 2 plugged drill holes (ISO 20) can be mounted on request (for connecting thermal protection devices for example).

## 2.7.2 - Tightening capacity of cable glands (optional)



Adapt the cable gland and its reducer, if present, to the diameter of the cable being used. In order to maintain the motor's original IP55 protection it is essential to tighten the cable gland seal correctly (so that it cannot be unscrewed by hand). When there are several cable glands and some are not being used, ensure that they are always covered and tighten them so that they also cannot be unscrewed by hand.

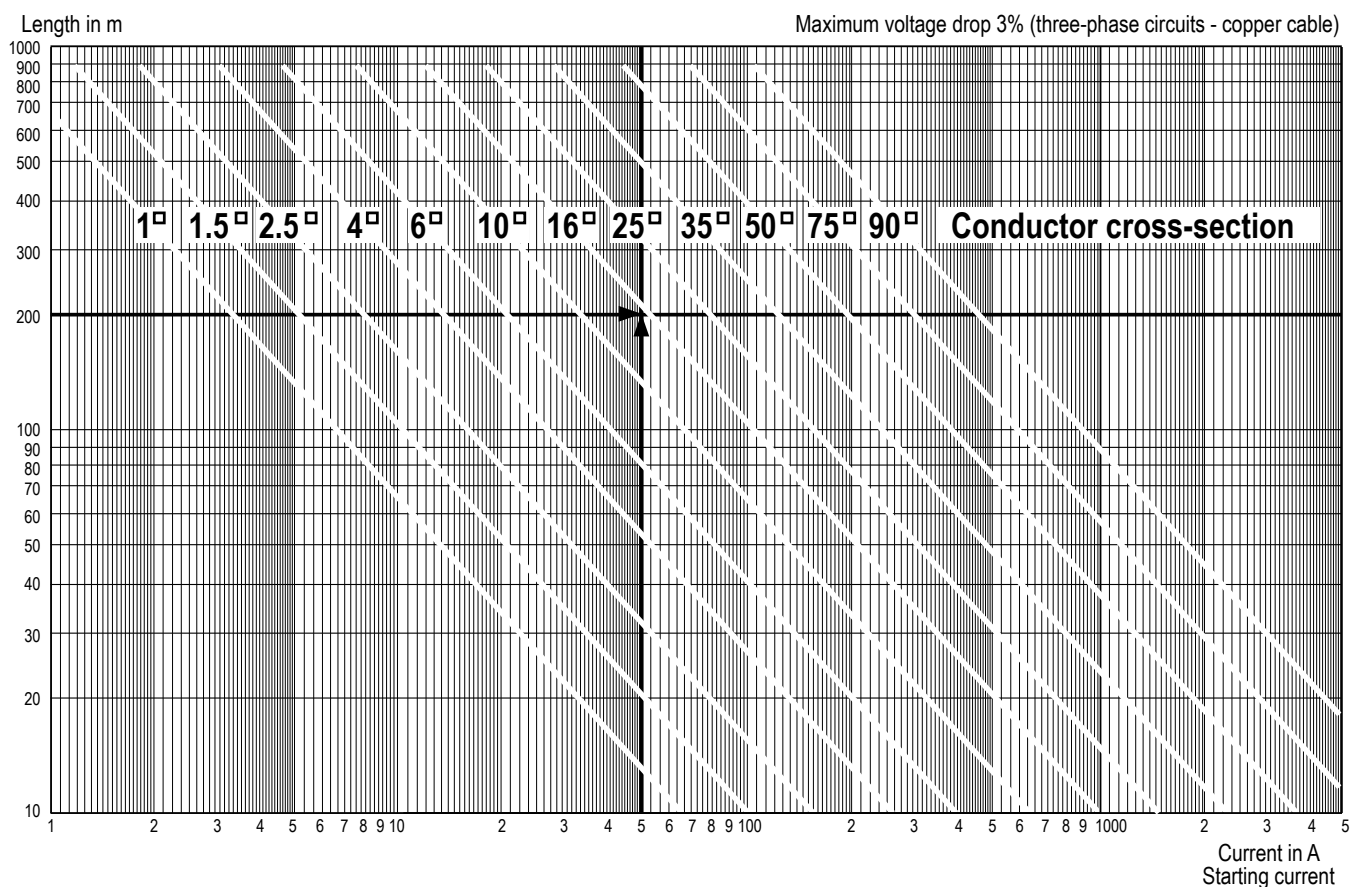


Cable gland type	Min. cable Ø - Max. cable Ø (mm)	
	Polyamide cable gland	Brass cable gland
ISO M16	5 - 10	5.5 - 9.5
ISO M20	9.5 - 15	8.5 - 13
ISO M25	13 - 19	12 - 17
ISO M32	15 - 25	15 - 22
ISO M40	21 - 32	19.5 - 28
ISO M50	26 - 38	25.5 - 36
ISO M63	31 - 34	33 - 46
ISO M75	-	37 - 53
ISO M90	-	40 - 62
ISO M110	-	60 - 82

## 2.7.3 - Power supply cable cross-sections

The higher the current, the greater the voltage drop in the cables (standard NFC 15.100 or end user's national standard). The voltage drop should therefore be calculated for the starting current to see if this is suitable for the application.

If the most important criterion is the starting torque (or starting time), the voltage drop should be limited to 3% maximum (the equivalent of a loss of torque of around 6 to 8%). The chart below can be used to select the conductors according to the length of the supply cables and the starting current, in order to limit the voltage drop to 3% maximum.



This table does not allow the installer to dispense with checking the protective systems.



For motors with flying leads, the power supply cable must not be used for handling.



## 2.7.4 - Motor-drive connection

### 2.7.4.1 - Environment

#### Influence of the mains supply

Each industrial power supply has its own intrinsic characteristics (short-circuit capability, voltage value and fluctuation, phase imbalance, etc.) and supplies equipment some of which can distort its voltage either permanently or temporarily (notches, voltage dips, overvoltage, etc.). The quality of the mains supply has an impact on the performance and reliability of electronic equipment, especially variable speed drives. Nidec drives are designed to operate with the mains supplies typically found on industrial sites throughout the world. However, for each installation, it is important to know the characteristics of the mains supply so that you can take corrective steps in the event of abnormal conditions.

#### Transient overvoltages

There are numerous sources of overvoltages on an electrical installation:

- Connection/disconnection of banks of power factor correction capacitors
- High-power thyristor-controlled equipment (oven, DC drive, etc.)
- Overhead power supply

#### Connection/disconnection of a bank of power factor correction capacitors

Connecting power factor correction capacitors in parallel on the drive power supply line when the drive is running can generate transient overvoltages that are likely to trip the drive safety devices, or even damage it in extreme cases. If banks of power factor correction capacitors are used on the power supply line, make sure that:

- The threshold between steps is low enough to avoid causing overvoltage on the line
- The capacitors are not permanently connected

#### Presence of commutation notches on the line

When high-power thyristor-controlled equipment is connected on the same line as the drive, it is essential to ensure that the harmonics generated by the commutation notches do not excessively distort the mains voltage and do not create voltage peaks with amplitude higher than  $1.6 \times \text{mains } V_{rms}$ . If this is the case, it is essential to take corrective measures to guarantee the mains quality.

#### Unbalanced power supply

In the same way as can be seen on an electric motor, the line phase voltage imbalance of a drive may have consequences on its operation. Please refer to the drive installation manual.

#### Equipotential bonding

The equipotential earth bonding of some industrial sites is not always observed. This lack of equipotentiality leads to leakage currents which flow via the earth cables (green/yellow), the machine chassis, the pipework, etc. and also via the electrical equipment. In some extreme cases, these currents can trip the drive. It is essential that the earth network is designed and implemented by the installation supervisor so that its impedance is as low as possible, so as to distribute the fault currents and high-frequency currents without them passing through electrical equipment. Metal grounds must be mechanically connected to each other with the largest possible

electrical contact area. Under no circumstances can earth connections designed to protect people, by linking metal grounds to earth via a cable, serve as a substitute for ground connections (see IEC 61000-5-2).

The immunity and radio-frequency emission level are directly linked to the quality of the ground connections.

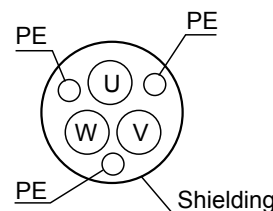
### 2.7.4.2 - Good wiring practice

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

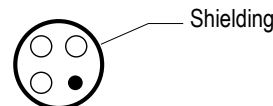
### 2.7.4.3 - Connecting the power cable shielding

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

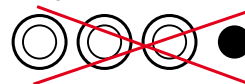
For compliance with standard EN 61800-3, the power conductors between drive and motor must be shielded. Use a special variable speed cable: shielded with low stray capacity and with 3 PE conductors  $120^\circ$  apart (see diagram below). There is no need to shield the drive power supply cables.



**CAUTION: The configuration below is only acceptable if the motor cables incorporate phase conductors with a cross-section of less than  $10 \text{ mm}^2$  (motors  $< 30 \text{ kW}/40 \text{ HP}$ ).**

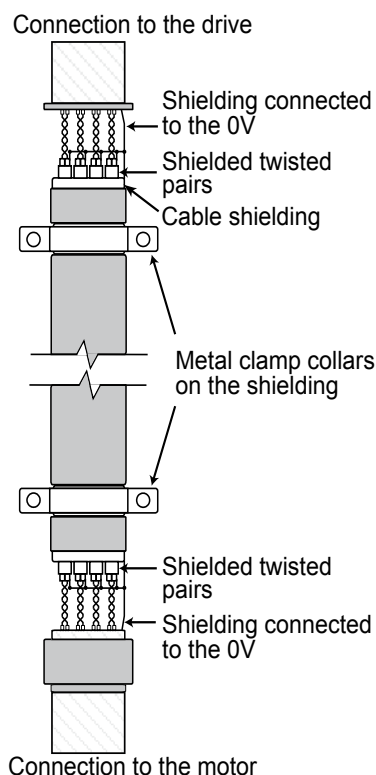


The use of shielded single core cables is prohibited.



#### 2.7.4.4 - Connecting the drive control cable and encoder cable shielding

**CAUTION:** Strip back the shielding on the metal clamp collars in order to ensure 360° contact.



#### 2.7.4.5 - Typical motor-drive installation

The following information is given for guidance only, and should never be used as a substitute for the current standards, nor does it relieve the installer of their responsibility. Depending on the installation, extra optional elements can be added:

**Switch-fuse:** A padlockable breaking device must be installed to isolate the installation should operator intervention be necessary.

This device must provide protection against overheating and short-circuits. The fusing rating is stated in the drive documentation. The switch-fuse can be replaced with a circuit-breaker (with appropriate breaking capacity).

**RFI filter:** This filter's role is to reduce the drive electromagnetic emissions, and thus comply with EMC standards. Leroy-Somer drives are equipped with an internal RFI filter as standard. Some environments require the addition of an external filter. Please consult the drive documentation to find out the drive conformance levels, with and without an external RFI filter.

**Drive power cables:** These cables do not necessarily need shielding. Their cross-section is recommended in the drive documentation, however, it can be adapted according to the type of cable, installation method, cable length (voltage drop), etc.

**Line reactor:** The role of the line reactor is to reduce the risk of damage to the drives following phase imbalance or significant disturbance on the electrical mains supply. It can also reduce low-frequency harmonics.

**Motor reactor:** Different types of reactor or filter are available. The motor reactor can, depending on the circumstances, reduce high-frequency earth leakage currents, residual currents between phases,  $dV/dt$  voltage peaks, etc. The choice of reactor depends on the distance between motor and drive.

**Motor power cables:** These cables must be shielded to ensure EMC conformance of the installation. The cable shielding must be connected over 360° at both ends. The cable cross-section is recommended in the drive documentation, however, it can be adapted according to the type of cable, installation method, cable length (voltage drop), etc.

**Encoder cables:** The sensor cable shielding is important due to interference with the power cables. This cable must be laid at least 30cm away from any power cables.

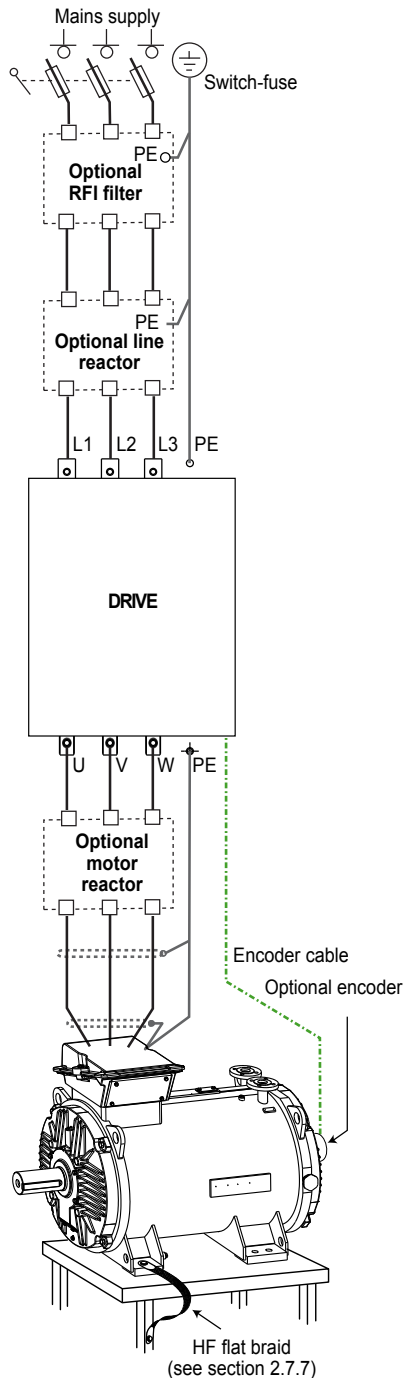
**Sizing of power cables:** The drive and motor power supply cables must be sized according to the applicable standard, and according to the design current, stated in the drive documentation.

The different factors to be taken into account are:

- The installation method: in a conduit, a cable tray, suspended, etc.
- The type of conductor: copper or aluminium.

Once the cable cross-section has been determined, check the voltage drop at the motor terminals. A significant voltage drop results in an increase in the current and additional losses in the motor (overheating).

**Equipotential bonding between the chassis, motor, drive, transformer and earth in accordance with good practice will contribute significantly to reducing the voltage on the shaft and the motor casing, resulting in fewer high-frequency leakage currents. Premature breakage of bearings and auxiliary equipment, such as encoders, should also be avoided wherever possible.**



## 2.7.5 - Terminal block wiring diagram

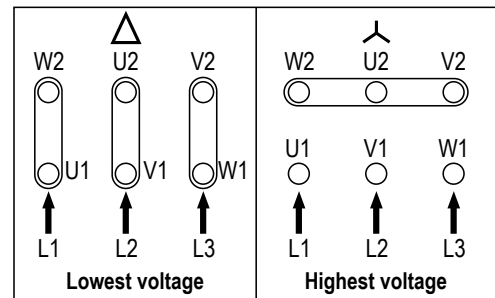


Particular attention must be paid to the information on the nameplate in order to choose the correct type of connection for the supply voltage.

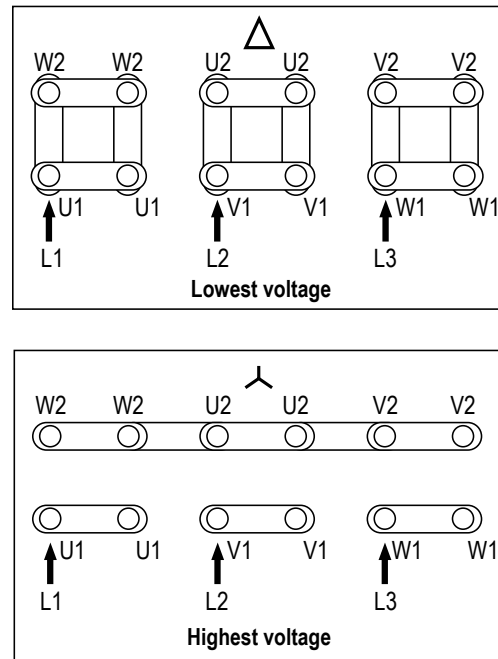
All motors are supplied with a wiring diagram in the terminal box (if required, ask the supplier for this diagram, specifying the motor type and number shown on the motor nameplate). The connector links required for coupling can be found inside the terminal box.

The standard wiring diagrams are as follows:

For LC 315 L, 315 LK and 355 L motors, connection is on 6 terminals:



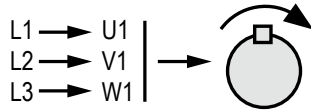
For LC 355 LK, 400 L, 400 LK, 450 and 500 motors, connection is on 12 terminals:



When the motor is powered by a drive, L1, L2 and L3 are replaced by the U, V and W connections on the drive.

### 2.7.6 - Direction of rotation

In all cases, the direction of rotation from the shaft end is given by:



If 2 phases of the power supply are changed over, the motor will run in an anti-clockwise direction (check first that the motor has been designed to run in both directions of rotation).

### 2.7.7 - Earth terminal

The earth terminal is located 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 identified by the symbol  $\perp$  in the terminal box moulding.

There is also an earth terminal on one of the feet of the housing; another terminal can be requested as an option.

For Drive application, a grounding bar is systematically fitted inside the terminal box, with earths straps and terminal box spacer, as provided by the option described on page 57 § "Motor Protection" of technical catalog n° 5370en.



**It is compulsory to earth the motor. Earthing must be performed in accordance with current regulations (regarding protection of workers).**

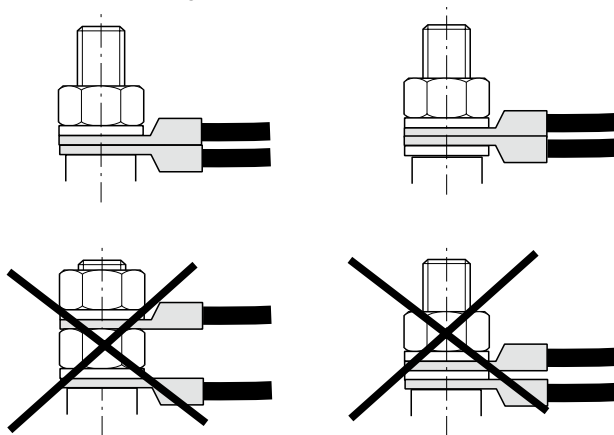
When the motor is controlled by a drive, refer to section 2.7.4 for the earth connections.

### 2.7.8 - Connecting the power supply cables to the terminal block

The cables must be fitted with connectors suitable for the cable cross-section and the terminal diameter.

They must be crimped in accordance with the connector supplier's instructions.

Connection must be carried out with connector resting on connector (see diagrams below):



### Tightening torque for the nuts on the terminal blocks

Terminal	M4	M5	M6	M8	M10	M12	M14	M16
Torque N.m	1	2.5	4	10	20	35	50	65

Series	Motor type	Terminals
LC	315 LA/LB/LKA/LKB/LKC	M12
	355 LA/LB/LC	
	355 LKA/LKB	M14
	400 LA/LB/LKA	
	450 LA/LB	
	500 M/L	M16

If using cables without connectors, attach callipers.

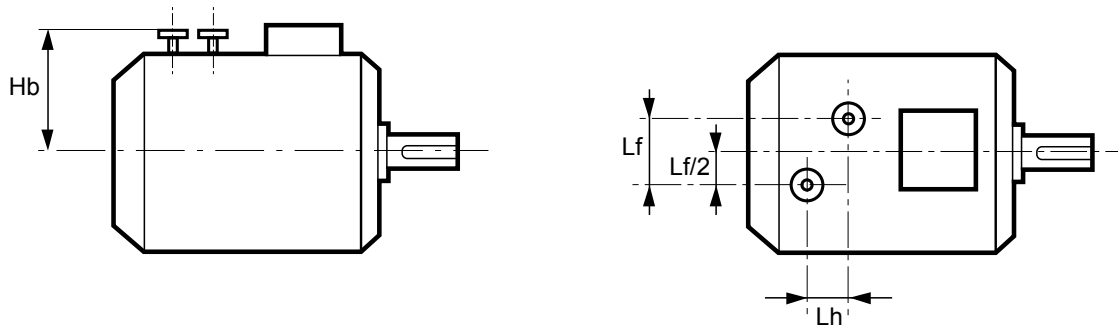
If any nuts on the brass terminal block are lost, they must be replaced by brass nuts, not steel ones.

When closing the box, ensure that the seal is correctly positioned.



**As a general rule, check that no nut, washer or other foreign body has fallen into or come into contact with the winding. If there is a foreign body, it is vital that it is removed.**

## 2.8 - Connecting the cooling system



Type	Dimensions of the water connection flanges			
	Size	Lf	Lh	Hb
LC 315 LA	DN25-PN16 EN1092-1	140	0	340
LC 315 LB	DN25-PN16 EN1092-1	140	0	340
LC 315 LKA	DN32-PN16 EN1092-1	160	0	380
LC 315 LB	DN32-PN16 EN1092-1	160	0	380
LC 315 LKC (2 & 4-pole)	DN32-PN16 EN1092-1	160	0	380
LC 355 LA	DN32-PN16 EN1092-1	160	0	380
LC 355 LB	DN32-PN16 EN1092-1	160	0	380
LC 355 LC (4-pole)	DN32-PN16 EN1092-1	160	0	380
LC 355 LKA	DN50-PN16 EN1092-1	180	150	385
LC 355 LKB	DN50-PN16 EN1092-1	180	150	385
LC 355 LKC (6-pole)	DN50-PN16 EN1092-1	180	150	385
LC 400 LA	DN50-PN16 EN1092-1	180	150	385
LC 400 LB (6-pole)	DN50-PN16 EN1092-1	180	150	385
LC 400 LKA	DN50-PN16 EN1092-1	180	150	435
LC 450 LA	DN50-PN16 EN1092-1	180	150	435
LC 450 LB	DN50-PN16 EN1092-1	180	150	435
LC 500 M/L	DN50-PN16 EN1092-1	180	150	500

### Water circuit capacity of LC motors by frame size:

Type	Qty (in litres)
LC 315	12.5
LC 315 LK / LC 355 L	16
LC 355 LK / LC 400 L	21
LC 400 LK / LC 450	27
LC 500 M	43
LC 500 L	51

## 2.9 - Filling

### Precautions to be taken during filling:

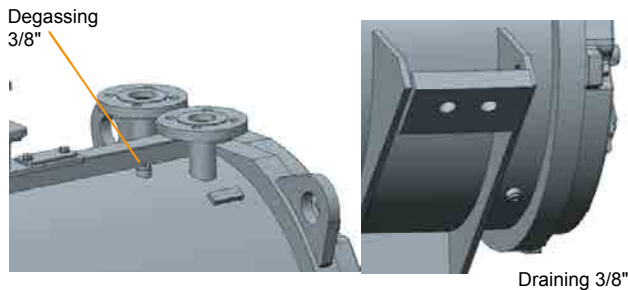
- Check that the plugs are securely in the drain holes.
- Open the motor's air vents.
- Make sure that the water inlet and outlet valves are clean.
- Attach the cooling water circuit pipes to the motor's inlet and outlet valves.
- Turn the water supply on.
- Fill the motor.
- When the water level reaches the air vent, turn the water off.
- Close the motor's air vents.
- Pressurise the circuit until it reaches the working pressure.

Note: The water circuit inlet and outlet are marked on the motor.

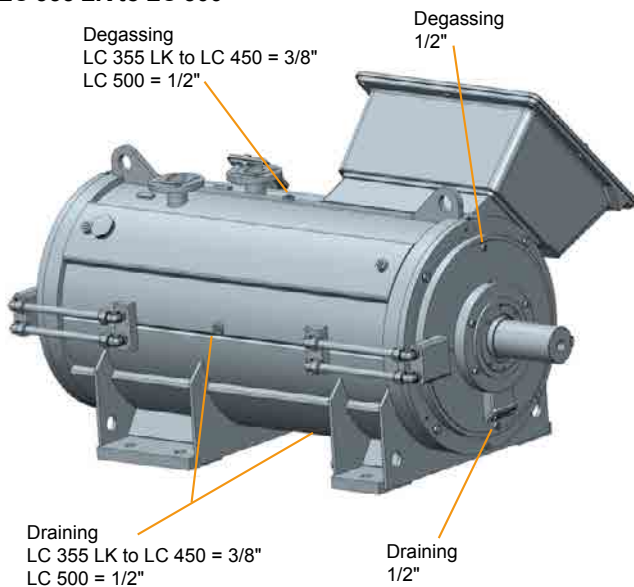
### Water circuit bleed valve and degassing valves:

LC motors are fitted as standard with water circuit bleed valves and degassing valves.

#### LC 315 L to LC 355 L



#### LC 355 LK to LC 500



## 3 - START-UP

### 3.1 - Initial start-up

Activate the water cooling system, making sure you check the flow rate, pressure and temperature of the water.

Before commissioning the motor, rotate it at no load (no mechanical load) for 2 to 5 minutes, to ensure there is no abnormal noise. If there is an abnormal noise, see section 6.

### 3.2 - Operation



**The motor must never operate without water in the cooling system.**

Check the water flow rate and pressure according to the characteristics indicated on the motor nameplate.

## 4 - CHECKS AFTER START-UP

### 4.1 - Checking the cooling system

For checking and operational purposes, it is recommended that the water temperature and the differential pressure are checked regularly and recorded at the water inlet and outlet. These measurements should be consistently compared to the initial values: the differential pressure and water temperature indicate the potential need to clean the water circuit.

### 4.2 - Mechanical check

After approximately 50 hours' operation, check that the screws fixing the motor and the coupling device are still tight; check the tightness of any cable glands and the fixing screws on the terminal box. In the case of chain or belt transmission, check that the tension is correctly adjusted.

### 4.3 - Cleaning

To ensure the motor operates correctly, remove any dust or foreign bodies.

Necessary precaution: Check that the motor is totally sealed (terminal box, drain holes, etc.) before carrying out any cleaning operation.

Dry cleaning (vacuuming or compressed air) is always preferable to wet cleaning.



**Always clean at reduced pressure from the centre of the motor outwards to avoid introducing dust and particles under the seals.**

### 4.4 - Draining condensation

Temperature variations cause condensation to form inside the motor, which must be removed before it adversely affects motor operation.

Condensation drain holes, located at the bottom of the motors (taking account of their operating position) are sealed with plugs which must be removed and then replaced every six months (if they were not replaced, the motor degree of protection would no longer be maintained). Clean the holes and plugs before reassembly.

#### Plug with breathable membrane

Make sure that this device is not damaged or blocked.

Note: In conditions of high humidity and significant temperature variations, a shorter period is recommended.

As long as it poses no risk to the motor protection, the condensation drain plugs can be removed.

## 4.5 - Greasing

### 4.5.1 - Type of grease

The type of grease is shown on the motor nameplate. Polyrex EM103 grease is used as standard and we recommend that this is used for subsequent lubrication. **Avoid mixing greases (even if the base soaps are the same).**

### 4.5.2 - Bearings with grease nipples

**The bearings are lubricated in the factory.**

The end shields are fitted with bearings lubricated by Técalémit Hydraulic M8 x 125 grease nipples.



**The frequency of lubrication and quantity and quality of grease are indicated on the nameplates. Refer to these to ensure correct lubrication of the bearings.**



**Even in the event of prolonged storage or downtime, the interval between 2 greasing operations should never exceed 2 years.**



**For vertical shaft machines, the greasing intervals will be approximately 50% of the values stated in the table overleaf.**

Series	Type	Number of poles	Type of bearing for bearings with grease nipples		Quantity of grease	Greasing intervals in hours									
			N.D.E.	D.E.		3000 min <sup>-1</sup>			1500 min <sup>-1</sup>			1000 min <sup>-1</sup>			
						25°C	40°C	55°C	25°C	40°C	55°C	25°C	40°C	55°C	
LC	315 LA	2	6316 C3	6218 C3	33	7500	3700	2400	-	-	-	-	-	-	
	315 LA	4; 6	6316 C3	6320 C3	51	-	-	-	16600	10400	6500	26100	26100	20700	
	315 LB	2	6316 C3	6218 C3	33	7500	3700	3000	-	-	-	-	-	-	
	315 LB	4; 6	6316 C3	6320 C3	51	-	-	-	16600	10400	6500	26100	26100	16400	
	315 LKA	2	6316 C3	6218 C3	33	7500	7500	3700	-	-	-	-	-	-	
	315 LKA	4; 6	6316 C3	6322 C3	60	-	-	-	14300	9000	4500	23600	23600	11800	
	315 LKB	2	6316 C3	6218 C3	33	7500	4700	3000	-	-	-	-	-	-	
	315 LKB	4; 6	6316 C3	6322 C3	60	-	-	-	14300	7100	3600	23600	23600	11800	
	315 LKC	2	6316 C3	6218 C3	33	7500	4700	3000	-	-	-	-	-	-	
	315 LKC	4	6316 C3	6322 C3	60	-	-	-	14300	7100	4500	-	-	-	
	355 LA	2	6316 C3	6218 C3	33	7500	3700	1900	-	-	-	-	-	-	
	355 LA	4; 6	6316 C3	6322 C3	60	-	-	-	11300	7100	3600	23600	18700	11800	
	355 LB	2	6316 C3	6218 C3	33	7500	3700	1900	-	-	-	-	-	-	
	355 LB	4; 6	6316 C3	6322 C3	60	-	-	-	14300	7100	3600	23600	18700	11800	
	355 LC	4	6316 C3	6322 C3	60	-	-	-	14300	14300	11300	-	-	-	
	355 LKA	2	6317 C3	6317 C3	37	6600	6600	5200	-	-	-	-	-	-	
	355 LKA	4; 6	6324 C3	6324 C3	72	-	-	-	10000	6300	3100	21600	21600	13600	
	355 LKB	2	6317 C3	6317 C3	37	6600	6600	6600	-	-	-	-	-	-	
	355 LKB	4; 6	6324 C3	6324 C3	72	-	-	-	12500	12500	12500	21600	21600	21600	
	400 LA	4; 6	6324 C3	6324 C3	72	-	-	-	12500	12500	12500	21600	21600	21600	
	400 LB	6	6324 C3	6324 C3	72	-	-	-	-	-	-	21600	21600	21600	
	400 LKA	4; 6	6324 C3	6326 C3	81	-	-	-	11000	8800	5500	19800	9900	6200	
	450 LA	4; 6	6324 C3	6326 C3	81	-	-	-	16500	11000	11000	19800	9900	6200	
	450 LB	4; 6	6324 C3	6326 C3	81	-	-	-	16500	11000	11000	19800	19800	19800	
	500 M/L	4; 6	6330 C3	6330 C3	104	-	-	-	8500	8500	8500	16700	16700	16700	
	In position V1 (IM3011)														
	400 LKA	4; 6	6324 C3	7326	81	-	-	-	5500	4400	2750	9900	4950	3100	
	450 LA	4; 6	6324 C3	7326	81	-	-	-	8250	5500	5500	9900	4950	3100	
	450 LB	4; 6	6324 C3	7326	81	-	-	-	8250	5500	5500	9900	9900	9900	
	500 M/L	4; 6	6330 C3	7330	104	-	-	-	4250	4250	4250	8350	8350	8350	

## 4.6 - Checking the end shields

### 4.6.1 - Checking the bearings

As soon as you detect any of the following on the motor:

- abnormal noise or vibration
  - abnormal temperature rise in the bearing even though it has been lubricated correctly
- the condition of the bearings must be checked.

**Damaged bearings must be replaced as soon as possible** to prevent worse damage to the motor and the equipment being driven.

When one bearing needs to be replaced, **the other bearing must also be replaced.**

**The seals should be changed routinely** when the bearings are changed.

The free bearing must allow the rotor shaft to expand (check its identification during dismantling).

### 4.6.2 - Reconditioning the end shields

**Always begin by cleaning the waste grease channel.**

If using the type of grease stated on the nameplate, remove the covers and clean the grease nipple heads.

If a different grease from that on the nameplate is being used, the motor must be dismantled and the bearings and accessories cleaned with degreasing agent (carefully clean the grease inlet and outlet passages) to remove the old grease before relubrication.

To ensure correct lubrication, fill the inner free spaces of the bearing retainers, flanges and grease pipes and 30% of the bearing free space.

Then rotate the motor shaft to distribute the grease.



**Too much grease causes the bearing to overheat (statistics show that more bearings are damaged through too much grease than too little).**

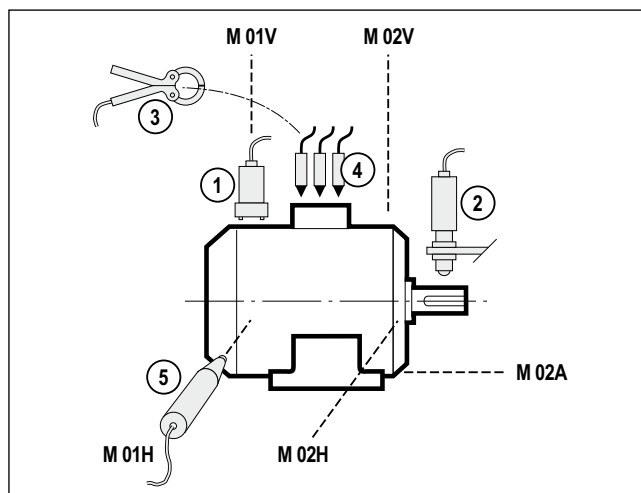
**The new grease must be recently manufactured, of an equivalent performance level and must not contain any impurities (dust, water, etc.).**



## 5 - PREVENTIVE MAINTENANCE

Please consult LEROY-SOMER who, in its continuous search for ways to help customers, has evaluated numerous methods of preventive maintenance.

The diagram and the table below give the recommended equipment to use and the ideal positions to take measurements of all parameters which can affect the operation of the machine, such as eccentricity, vibration, state of the bearings, structural problems, electrical problems, etc.



Detector	Measurement	Measurement points								
		M 01V	M 01H	M 02V	M 02H	M 02A	Shaft	E01	E02	E03
① Accelerometer	For measuring vibrations	●	●	●	●	●				
② Photo-electric cell	For measuring speed and phase (balancing)						●			
③ Clamp ammeter	For measuring current (D.C. and 3-phase A.C.)							●	●	●
④ Voltage probe	For measuring voltage							●	●	●
⑤ Infra-red probe	For measuring temperature	●		●						



The following actions are necessary for LC motors:

- Clean and check the cooling circuit regularly according to the instructions in this manual.
- The coating on the housing and the inlet and outlet valves must always be kept in good condition.
- If there is a risk of freezing, anti-freeze must be added to the cooling water.
- Always check that the correct proportions of additives are added to the water to protect the machine from corrosion and algae. The type and quantity of additive to use should be indicated by the additive manufacturer according to the machine installation conditions.

## 6 - TROUBLESHOOTING GUIDE

Incident	Possible cause	Remedy
Abnormal noise	Originating in motor or machine being driven?	Uncouple the motor from the equipment being driven and test the motor on its own
Noisy motor	<b>Mechanical cause</b> if the noise persists after switching off the power supply (if the motor is operating with a drive, set the drive to "freewheel" mode)	
	- Vibration	- Check that the key conforms to the type of balancing (see section 2.5)
	- Damaged bearings	- Change the bearings
	- Mechanical friction: coupling	- Check and replace the faulty part
	<b>Electrical cause</b> if the noise stops after switching off the power supply	- Check the power supply at the motor terminals - Check the drive settings (if used)
	- Normal voltage and 3 phases balanced	- Check the connection of the terminal block and the tightening of the connectors
	- Abnormal voltage	- Check the power supply line
	- Phase imbalance	- Check the winding resistance
	<b>Other possible causes:</b> - Incorrect drive parameter settings - Drive malfunction	- Refer to the drive manual
Motor heats abnormally	- Faulty supply voltage	- Check
	- Terminal connection fault	- Check
	- Overload	- Check the current consumption in relation to that indicated on the motor nameplate
	- Partial short-circuit	- Check the electrical continuity of the windings and/or the installation
	- Phase imbalance	- Check the winding resistance
	- Water leak	- Check the condition of the water inlet and outlet valves - Check the pipe connections - Check the water pressure level
	<b>Other possible causes:</b> - Incorrect drive parameter settings - Drive malfunction	- Refer to the drive manual
Motor does not start	<b>No load</b> - Mechanical obstruction	When switched off: - Check by hand that the shaft rotates freely
	- Broken power supply line	- Check the fuses, electrical protection, starting device
	- Position feedback (drive message)	- Check the wiring, drive settings and operation of the position sensor
	- Thermal protection	- Check
	<b>On load</b> - Phase imbalance	When switched off: - Check the direction of rotation (phase order) - Check the resistance and continuity of the windings - Check the electrical protection
	- Drive	- Check the parameter settings and sizing (max. current that can be delivered by the drive)
	- Position feedback (drive message)	- Check the wiring, drive settings and operation of the position sensor
	- Thermal protection	- Check

## 7 - POSITION OF LIFTING RINGS



**Position of lifting rings for lifting the motor only  
(not connected to the machine)**

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

All our motors are fitted with grab handles, making them easier to handle without risk.

A diagram of the sling hoisting method appears below with the required dimensions.

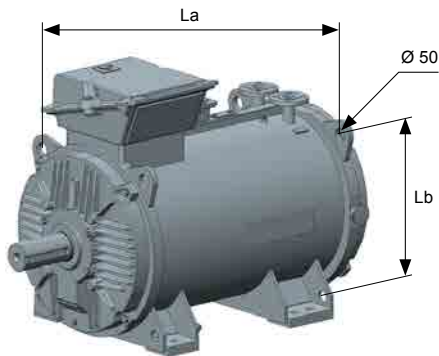
To prevent any damage to the motor during handling (for example, when changing the motor from a horizontal to a vertical position), it is vital to follow these instructions.



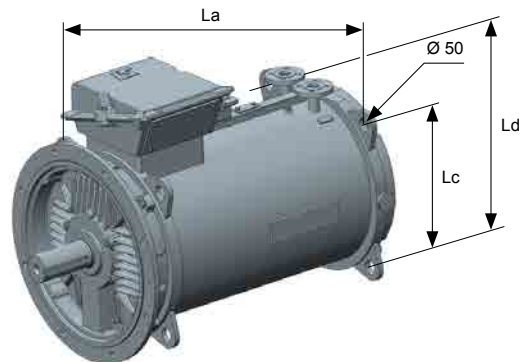
**Motors intended for use in the vertical position may be delivered in the horizontal position on a pallet. When the motor is pivoted, the shaft must under no circumstances be allowed to touch the ground, as the bearings may be irreparably damaged. Moreover, additional special precautions must be taken, as the integral motor lifting rings are not designed for pivoting the motor.**

### • Horizontal position

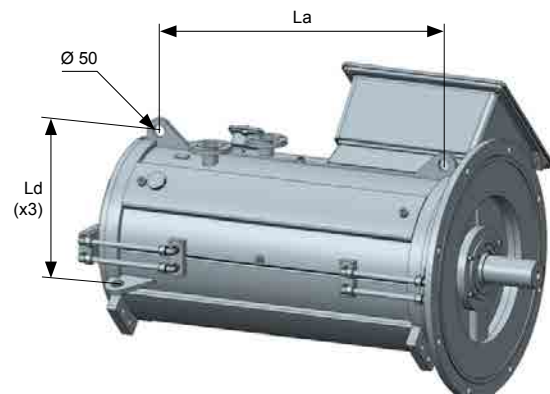
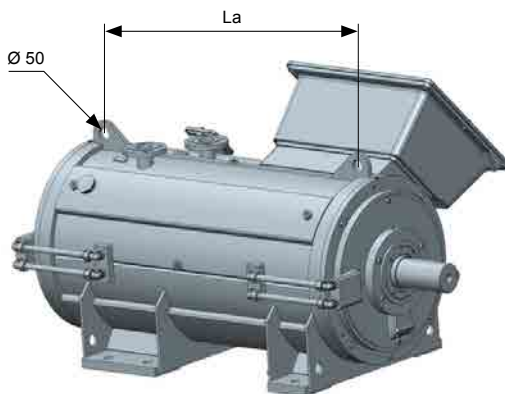
#### LC 315 and LC 355



### • Vertical position



#### LC 355 LK to LC 500

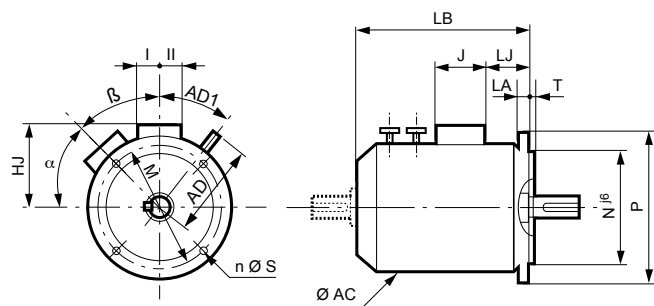


## 8 - SPARE PARTS

When ordering spare parts, you must indicate the complete motor type, its serial number and the information given on the nameplate (see section 1).

Part numbers can be found on the cross-sectional diagrams and their descriptions are given in the parts list. (See section 10 - Cross-sectional views)

For flange mounted motors, indicate the type of flange and its dimensions (see below).



Our extensive service network can dispatch the necessary parts without delay.

To ensure that our motors operate correctly and safely, we recommend the use of original manufacturer spare parts.

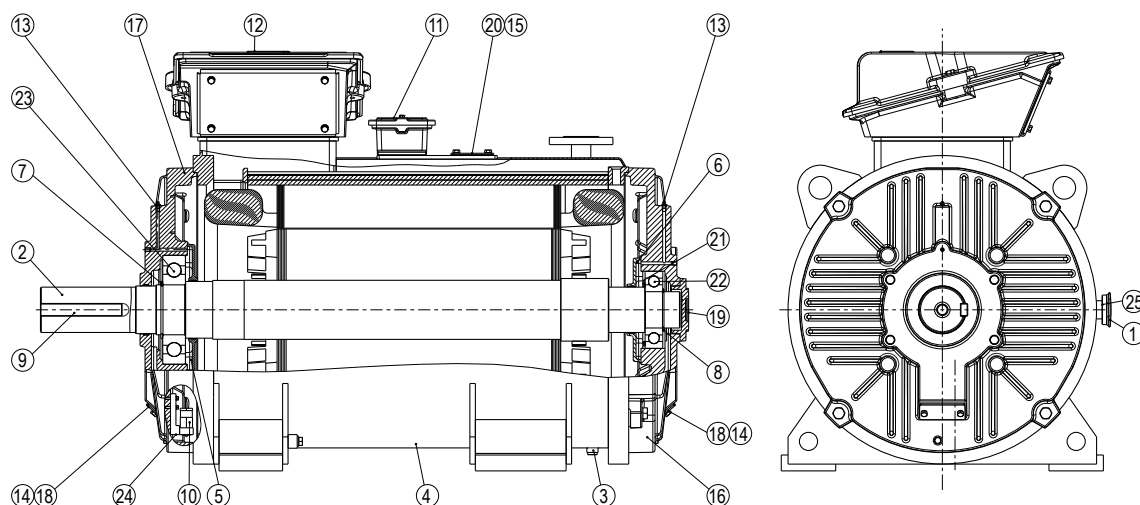
In the event of failure to comply with this advice, the manufacturer cannot be held responsible for any damage.

## 9 - RECYCLING

At the end of life, we advise that you contact a salvage company to recycle the various motor components.

## 10 - CROSS-SECTIONAL VIEWS

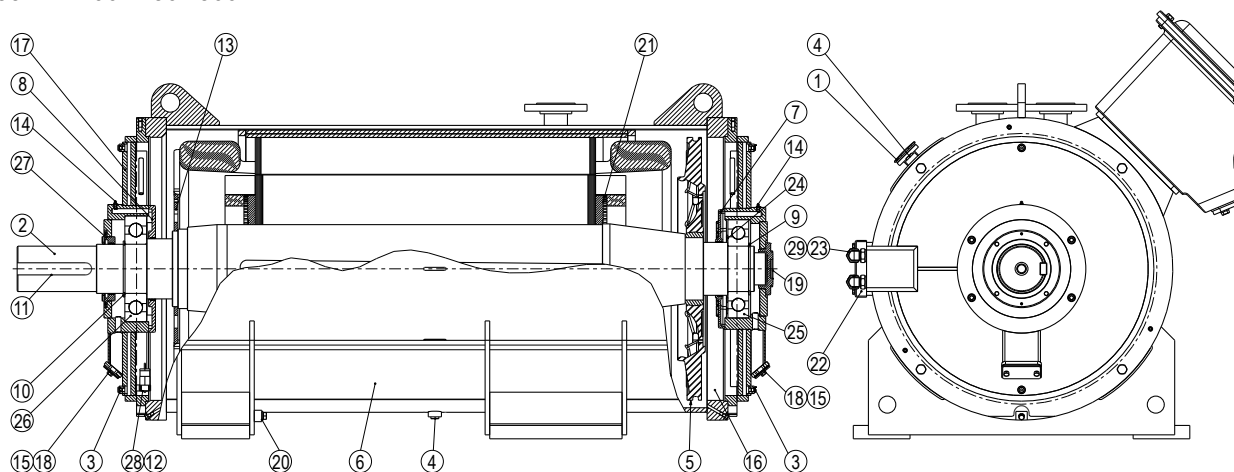
### LC 315 - 355 L



Ref.	Description	Qty
1	Plug with breathable membrane	1
2	Shaft	1
3	Plug	3
4	Foot mounted housing	1
5	Bearing retainer	1
6	Bearing retainer	1
7	Circlip	1
8	Circlip	1
9	Key	1
10	Level controller	1
11	Auxiliary terminal box assembly	1
12	Terminal box assembly	1
13	Grease nipple	2

Ref.	Description	Qty
14	Plate seal	2
15	Closure plate seal	1
16	NDE shield	1
17	DE shield	1
18	Closure plate	2
19	Closure plate	1
20	Closure plate	1
21	Spring	6
22	Bearing	1
23	Bearing	1
24	Water leakage detector mount	1
25	Breather mount	1

### LC 355 LK - 400 - 450 - 500



Ref.	Description	Qty
1	Plug with breathable membrane	1
2	Shaft	1
3	Plug	4
4	Plug	5
5	Internal stirrer	1
6	Foot mounted housing	1
7	Bearing retainer	1
8	Bearing retainer	1
9	Circlip	1
10	Circlip	1
11	Key	1
12	Level controller	1
13	Balancing disc	1
14	Grease nipple	2
15	Plate seal	2

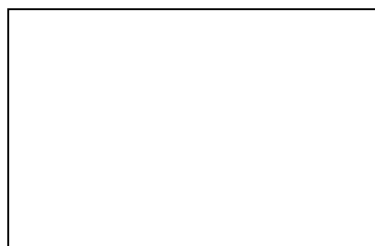
Ref.	Description	Qty
16	NDE shield	1
17	DE shield	1
18	Closure plate	2
19	Closure plate	1
20	Earth terminal	1
21	Clamping plate	2
22	Link bridge	2
23	Swivel male connector	8
24	Spring	8
25	Bearing	1
26	Bearing	1
27	AEGIS 130 ring support	1
28	Detector mount	1
29	Tube	4







**LEROY-SOMER<sup>TM</sup>**



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