LS

Horizontal split case pump

Installation and operating instructions

Installation and operating instructions

http://net.grundfos.com/qr/i/99536991

Original installation and operating instructions

These installation and operating instructions describe LS.

Sections 1-4 give the information necessary to be able to unpack, install and start up the product in a safe way.

Sections 5-10 give important information about the product, as well as information on service, fault finding and disposal of the product.

CONTENTS

Read this document and the online version of the installation and operating instructions before installing the product. Installation and operation must comply with local regulations and accepted codes of good practice.

1. General information

Grundfos LS horizontal split case pumps are supplied either as a complete pump with motor, base frame and approved coupling guard or as a bare shaft pump.

These instructions apply to both types.

The LS pump can be driven by an electric motor or another type of driver. In the following we assume that the pump is driven by an electric motor.

1.1 Hazard statements

The symbols and hazard statements below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious personal injury.

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious personal injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

The hazard statements are structured in the following way:

SIGNAL WORD

Description of hazard

Consequence of ignoring the warning.

- Action to avoid the hazard.

1.2 Notes

The symbols and notes below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

Observe these instructions for explosion-proof products.

A blue or grey circle with a white graphical symbol indicates that an action must be taken.

A red or grey circle with a diagonal bar, possibly with a black graphical symbol, indicates that an action must not be taken or must be stopped.

If these instructions are not observed, it may result in malfunction or damage to the equipment.

Tips and advice that make the work easier.

2. Receiving the product

2.1 Inspecting the product

The pump is delivered from the factory in a crate or wooden box specially designed for transport by a forklift truck or a similar vehicle.

Upon receipt, check the pump visually to determine whether any damage has happened to it during transport or handling.

Check especially for these points:

1. broken or cracked equipment, including base frame, motor or pump feet and flanges
2. broken motor fan cover, bent eyebolts or damaged terminal box
3. missing parts.

Parts or accessories are sometimes wrapped individually or fastened to the equipment.

If any damage or losses have occurred, promptly notify Grundfos' representative and the carrier's agent at once.

Bolts for LS bare shaft pumps have US threads for which inch tools are required.

Bolts for coupling guard and for mounting of pump and motor on the base frame have metric threads.

2.2 Temporary storage

If you do not store or operate the pump soon after arrival, store it in a clean, dry place with slow, moderate changes in ambient temperature. Protect the pump from moisture, dust, dirt and foreign bodies. Avoid exposing the motor to direct, intense sunlight, rain, snow, ice and also dust for an extended periods of time. Attach a covering structure or an additional cover when using or storing the product outdoors. Before and during storage we recommend these precautions:

1. Make sure that the bearings are filled with the recommended grease to prevent moisture from entering around the shaft. See section *6.3.3 Lubrication*.
2. Make sure that the inlet and outlet ports and all other openings are covered with cardboard, wood or masking tape to prevent foreign objects from entering the pump.
3. Cover the unit with a tarpaulin or other suitable covering if it is to be stored where there is no protective covering.
4. Rotate the shaft two turns every two weeks to prevent corrosion of the bearing surfaces and the stuffing box or sticking of the shaft seal faces.

3. Installing the product

3.1 Location

Install the pump with accessibility for inspection and maintenance. Allow ample space and headroom for the use of an overhead crane or hoist sufficiently strong to lift the unit.

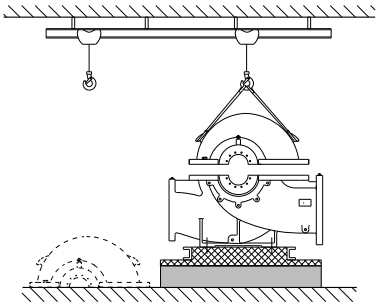

Fig. 1 LS pump with accessibility for inspection and headroom for the use of an overhead crane

Install the pump as close as possible to the supply of pumped liquid, so that the inlet pipe is as short and direct as possible.

3.2 Mechanical installation

WARNING

Crushing hazard

Death or serious personal injury

- Make sure that all installations are performed by persons experienced in the placement, alignment and connection of pumping equipment.

3.2.1 Lifting the product

WARNING

Crushing hazard

Death or serious personal injury

- Handling must be performed by qualified persons.
- When unloading the pump, lift equally at four or more points on the base frame. Do not lift by the motor or by the pump. Do not lift by the flanges or by the eyebolts on the motor.

Lift the pump by means of nylon straps and shackles.

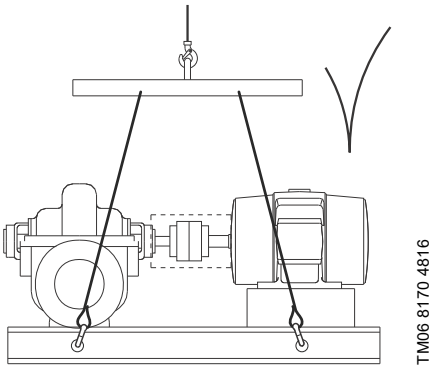

Fig. 2 How to lift and handle the LS pumps

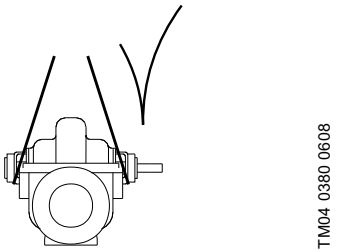

Fig. 3 How to lift and handle the LS bare shaft pumps

3.2.2 Foundation

We recommend that you install the pump on a concrete foundation, which is heavy enough to provide permanent and rigid support for the entire pump. The foundation must be capable of absorbing any vibration, normal strain or shock. We recommend that the weight of the concrete foundation is 3 times the weight of the complete pump unit. For specific requirements, consult the contractor, engineer, or established industry standards.

In installations where silent operation is particularly important, we recommend a foundation that is up to 5 times as heavy as the complete pump unit.

3.2.3 Vibration dampers

Vibration dampers may be required to prevent pump vibrations from being transmitted to the building or the pipes. In order to select the right type of vibration damper, you need this information:

- Forces transmitted through the damper.
- Motor speed. Take the motor speed into account in the case of speed control.
- Desired dampening in %. The recommended value is 70 %.

The choice of vibration dampers differs from installation to installation. In certain cases a wrong damper may increase the vibration level. Vibration dampers must therefore be sized by the supplier of the vibration dampers.

3.2.4 Expansion joints

Expansion joints provide these advantages:

- absorption of thermal expansion and contraction of pipes caused by variations in liquid temperature
- reduction of mechanical influences in connection with pressure surges in the pipes
- isolation of structure-borne noise in the pipes (only rubber bellows expansion joints).

Do not fit expansion joints to make up for inaccuracies in the pipes, such as centre displacement or misalignment of flanges.

Fit the expansion joints at a minimum distance of 2 pipe diameters (DN) away from the pump flange on the inlet side. This prevents turbulence in the joints, thus ensuring optimum inlet conditions and minimum pressure drop on the outlet side.

At flow velocities greater than 2.4 m/s, we recommend that you fit larger expansion joints matching the pipes.

3.2.5 Foundation and preliminary alignment procedure

The foundation and preliminary alignment procedure has four steps:

1. pouring of foundation
2. shimming of base frame
3. preliminary alignment
4. grouting.

Pouring of foundation

We recommend the following procedure to ensure a good foundation:

1. Pour the foundation without interruptions to within 19-32 mm of the final level. Use vibrators to ensure that the concrete is evenly distributed. The top surface must be well scored and grooved before the concrete sets. This provides a bonding surface for the grout.
2. Embed anchor bolts in the concrete as shown in fig. 4. Allow enough bolt length to reach through grout, shims, lower base frame, nuts and washers.

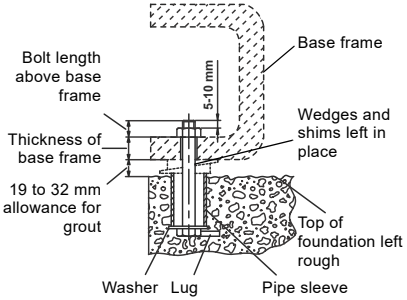

Fig. 4 Typical anchor bolt design

Let the foundation cure for several days before the base frame is shimmed and grouted.

Shimming of base frame

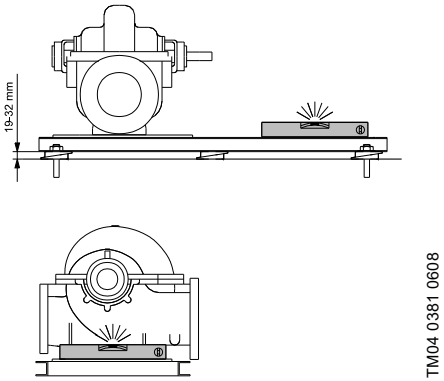

Fig. 5 Shimming of base frame and levelling of pump

1. Lift/jack up the base frame to the final level 19-32 mm above the concrete foundation, and support the base frame by means of blocks and shims, both at the anchor bolts and midway between bolts. See fig. 5.
2. Level the base frame by adding or removing shims under the base frame. See fig. 5.
3. Tighten the anchor bolt nuts against the base frame. Make sure the pipes can be aligned to the pump flanges without putting strain on the pipes or flanges.

Preliminary alignment

DANGER

Electric shock

Death or serious personal injury

- Before starting work on the pump, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

The pump and motor are pre-aligned on the base frame from the factory. Some deformation of the base frame may occur during transport and it is therefore essential to check alignment at the installation site before final grouting.

Inaccurate alignment results in vibration and excessive wear on the bearings, shaft and wear rings.

Carry out alignment of the motor only, as pipe strain will occur if the pump is shifted.

Carry out alignment of the motor by placing shims of different thickness under the motor. If possible, replace several thin shims with one thick shim.

The preliminary alignment procedure has four steps:

1. Checking coupling clearance

Make sure that the gap between the coupling halves is equal to the values in the table and that the keyways are 180 ° displaced.

For a coupling with an outside diameter of Ø [mm]	Coupling clearance [mm]	
	Nominal	Tolerance
∅90-213	3.2	0/-1
∅251-270	4.8	0/-1
∅306-757	6.4	0/-1

2. Checking soft foot on pump and motor

A pump or a motor having a soft foot can be compared to sitting down at a table and finding that the table rocks when someone leans on it. Technically, it is a condition where the feet of a motor or a pump are not at the same level as the base plate.

To check for soft foot, set the pump or motor on its base plate and bolt it down. Set a dial gauge on one foot, loosen the hold-down bolt, and watch the dial gauge. If the dial gauge indicator moves while loosening the bolt, the pump or motor has soft foot. The movement measured by the dial gauge indicates how many shims you need to level the pump or motor. Repeat this procedure at all four corners.

If the pump was installed a long time ago, the stresses induced in the pump casing by soft foot can cause permanent deformation of the casing.

3. Checking parallel alignment

Place a straight edge across both coupling rims at the top, the bottom and both sides. See fig. 6. After each adjustment, recheck all features of alignment. Parallel alignment is correct when the measurements show that all points of the coupling faces are within 0.2 mm of each other.

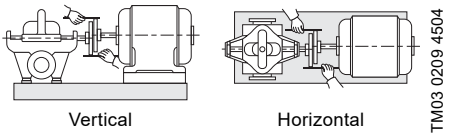

Fig. 6 Checking parallel alignment

4. Checking angular alignment

Insert a pair of inside callipers or a taper gauge at four points at 90 ° intervals around the coupling. See fig. 7. The angular alignment is correct when the measurements show that all points of the coupling faces are within 0.2 mm of each other.

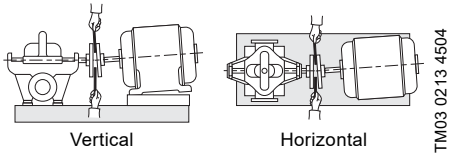

Fig. 7 Checking angular alignment

Recheck the coupling clearance and tighten the set screws on the couplings.

Tightening torques

Description	Dimensions	Tightening torque [Nm]
Hexagon head screw	M6	10 ± 2
	M8	12 ± 2.4
	M10	23 ± 4.6
	M12	40 ± 8
	M16	80 ± 16
	M20	120 ± 24
	M24	120 ± 24

Grouting

Grouting compensates for uneven foundation, distributes the weight of the unit, dampens vibrations and prevents shifting. Use an approved, non-shrinking grout. If you have questions or doubts about the grouting, consult an expert on grouting.

Proceed as follows:

1. Build a strong formwork around the foundation to contain the grout.
2. Soak the top of the concrete foundation thoroughly, then remove surface water.
3. Fill the formwork with grout up to the top edge of the base frame. See fig. 8. Allow the grout to dry thoroughly before attaching the pipe to the pump. 24 hours is sufficient time with approved grouting procedure.
4. When the grout has thoroughly hardened, check the anchor bolt nuts and tighten them if necessary.
5. Approximately two weeks after the grout has been poured, or when the grout has thoroughly dried, apply an oil-based paint to the exposed edges of the grout to prevent air and moisture from getting in contact with the grout.

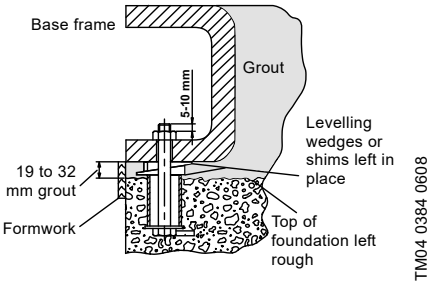

Fig. 8 Sectional view of foundation with anchor bolt, grouting and base frame

3.3 Electrical connection

The electrical connections must be carried out by an authorised electrician in accordance with local regulations.

DANGER

Electric shock

Death or serious personal injury

- Before you remove the terminal box cover and before you remove or dismantle the pump, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

The operating voltage and frequency are marked on the motor nameplate.

Make sure that the motor is suitable for the power supply of the installation site.

Carry out the electrical connections as shown on the motor nameplate or in the wiring diagram on the back of the terminal box cover.

For further information, contact the motor supplier.

DANGER

Electric shock

Death or serious personal injury

- Whenever you use powered equipment in explosive surroundings, observe the rules and regulations generally or specifically imposed by the relevant responsible authorities or trade organisations.

3.3.1 Frequency converter operation

You can connect all three-phase motors to a frequency converter.

However, frequency converter operation often exposes the motor insulation system to a heavier load and causes the motor to be more noisy than usual due to eddy currents caused by voltage peaks.

If in doubt whether the supplied motor can handle frequency converter operation, contact the motor supplier.

In addition, large motors driven via a frequency converter will be loaded by bearing currents.

When the pump is operated via a frequency converter, check the following operating conditions:

Operating conditions	Action
2-, 4- and 6-pole motors, frame size 225 and larger	Ensure that the non-drive-end motor bearing is electrically isolated.
Noise-critical applications	Fit a dU/dt filter between the motor and the frequency converter. It reduces the voltage peaks and thus the noise.
Particularly noise-critical applications	Fit a sinusoidal filter.
Cable length	Fit a cable that meets the specifications laid down by the frequency converter supplier. The length of the cable between the motor and frequency converter affects the motor load.
Supply voltage up to 500 V	Make sure that the motor is suitable for frequency converter operation.
Supply voltage between 500 V and 690 V	• Fit a dU/dt filter. It reduces the voltage peaks and thus the noise. • Or make sure that the motor has reinforced insulation.
Supply voltage of 690 V and upwards	• Fit a dU/dt filter. • Make sure that the motor has reinforced insulation.

3.4 Pipes

Protective covers are fitted to the inlet and outlet ports to prevent foreign bodies from entering the pump during transportation and installation. Remove these covers from the pump before connecting any pipes.

Inlet and outlet pipe

In order to minimise friction losses and hydraulic noise in the pipes, choose a pipe that is one or two sizes larger than the pump inlet and outlet ports. Typically, flow velocities must not exceed 2 m/s (6 ft/sec) for the inlet pipe (port) and 3 m/s (9 ft/sec) for the outlet pipe (port).

Make sure that the NPSH available (NPSHA) is higher than the NPSH required (NPSHR). NPSH = Net Positive Suction Head.

3.4.1 General precautions

When installing the pipes, observe these precautions:

1. Always run the pipes directly to the pump.
2. Do not move the pump to the pipes. This could make the final alignment impossible and cause stress to the pump flanges and pipes.

Make sure that both the inlet and outlet pipes are independently supported near the pump so that no strain is transmitted to the pump when you tighten the flange bolts. Use pipe hangers or other supports with necessary spacing to provide support.

3. When you use expansion joints in the pipe system, fit the joints at a minimum distance of 2 pipe diameters away from the pump on the inlet side. This prevents turbulence in the joints, thus ensuring optimum inlet conditions.
4. Install the pipes as straight as possible and avoid unnecessary bends. Where necessary, use 45 ° or long-sweep 90 ° fittings to reduce friction loss.
5. Make sure that all pipe joints are tight.
6. Where you use flanged joints, ensure that the inside diameters match properly.
7. Remove burrs and sharp edges when making up joints.
8. Make sure that the pipes do not cause stress or strain in the pump.
9. Provide for expansion of pipe material by means of expansion joints on both sides of the pump.
10. Always allow sufficient space and accessibility for maintenance and inspection.

3.4.2 Inlet pipes

Place the pump below system liquid level whenever possible. This will facilitate priming, assure a steady liquid flow and provide a positive suction head.

The sizing and installation of the inlet pipe is extremely important.

You can avoid many NPSH problems if you install the inlet pipe properly. See section *3.4.1 General precautions*.

In section *10. Disposing of the product*, common inlet pipe installations are illustrated for two situations:

- flooded systems
  Closed systems and open systems where the liquid level is above the pump inlet.
- suction lift systems
  Closed systems and open systems where the liquid level is below the pump inlet.

3.4.3 Valves in the inlet pipe

If the pump is operating under permanent suction lift conditions, install a non-return valve in the inlet pipe to avoid having to prime the pump each time it is started. The non-return valve must be of the flap type or a foot-valve with a minimum of pressure loss.

3.4.4 Outlet pipe

The outlet pipe is usually preceded by a non-return valve and an isolating or throttle valve. The non-return valve protects the pump against excessive counterpressure and reverse rotation of the pump and prevents backflow through the pump in case of operational stop or failure of the motor.

In order to minimise friction losses and hydraulic noise in the pipes, flow velocities must not exceed 3 m/s (9 ft/sec) in the outlet pipe (port).

On long horizontal runs, keep the pipe as level as possible.

Avoid high spots, such as loops, as they will collect air and throttle the system or lead to uneven pumping.

3.4.5 Auxiliary pipes

Drains

Install the drain pipes from the pump casing and stuffing boxes to a convenient disposal point.

Flushing pipes

- Pumps fitted with stuffing boxes

When the inlet pressure is below the ambient pressure, supply the stuffing boxes with liquid to provide lubrication and prevent the ingress of air. This is normally achieved via a flushing pipe from the outlet side to the stuffing box. You can fit a control valve or orifice plate in the flushing pipe to control the pressure to the stuffing box.

If the pumped liquid is dirty and cannot be used for flushing the packing rings, we recommend a separate clean, compatible liquid supply to the stuffing box at 1 bar (15 psi) above the inlet pressure.

- Pumps fitted with mechanical seals

Seals requiring recirculation will normally be provided with a flushing pipe from the pump casing.

3.4.6 Measuring instruments

To ensure continuous monitoring of operation, we recommend that you install pressure gauges on the pump inlet and outlet flanges. The pressure gauge on the inlet side must be capable of measuring vacuum. The pressure tappings must only be opened for test purposes. The measuring range of the outlet side pressure gauge must be minimum 20 % above the maximum pump outlet pressure.

When measuring with pressure gauges on the pump flanges, note that a pressure gauge does not register dynamic pressure (velocity pressure). The diameters of the inlet and outlet flanges are different, and this results in different flow velocities in the two flanges. Consequently, the pressure gauge on the outlet flange will not show the pressure stated in the technical documentation, but a value which may be lower.

3.5 Inlet pipe guidelines

3.5.1 Common guidelines

Avoid air pockets or turbulence in the inlet pipe

Never use reducers in a horizontal inlet pipe as shown in fig. 10. Instead, use an eccentric reducer as illustrated in fig. 9.

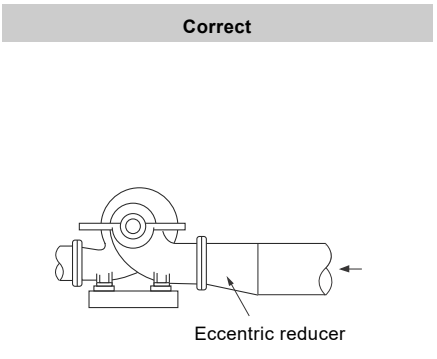

Fig. 9 Correctly mounted reducer

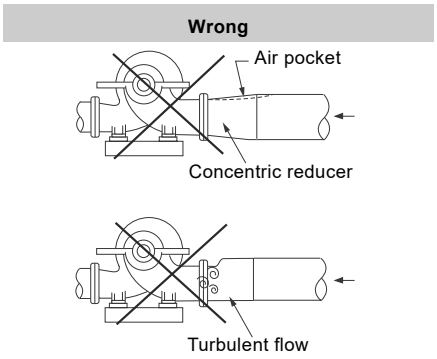

Fig. 10 Reducers resulting in air pockets and turbulence

3.5.2 Flooded systems

Closed systems and open systems where the liquid level is above the pump inlet.

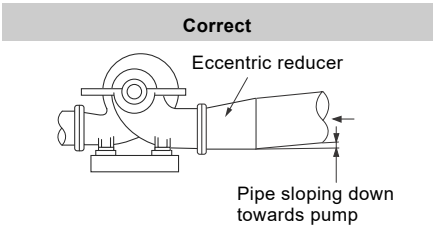

Fig. 11 Correctly mounted inlet pipe

3.5.3 Suction lift systems

Closed systems and open systems where the liquid level is below the pump inlet.

Install the inlet pipe sloping upwards towards the inlet port. Any high point in the pipe will be filled with air and thus prevent proper operation of the pump. When reducing the pipe to the inlet port diameter, use an eccentric reducer with the eccentric side down to avoid air pockets.

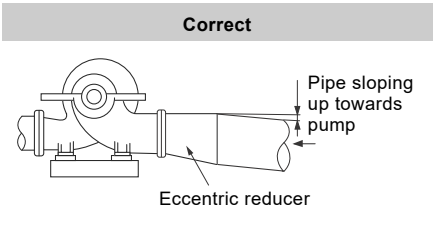

Fig. 12 Correctly mounted inlet pipe

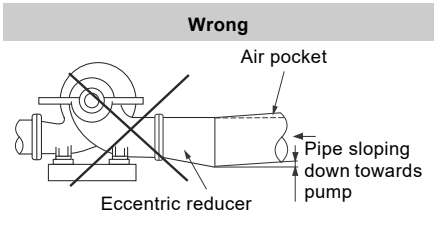

Fig. 13 Inlet pipe resulting in air pockets

3.5.4 Inlet pipe if the feed line comes in different horizontal planes

Avoid high spots, such as loops, as they will collect air and throttle the system or lead to uneven pumping.

Correct

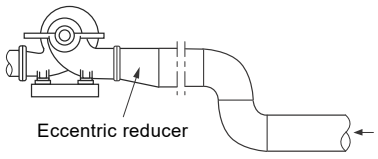

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Fig. 14 Correctly mounted inlet pipe

Wrong

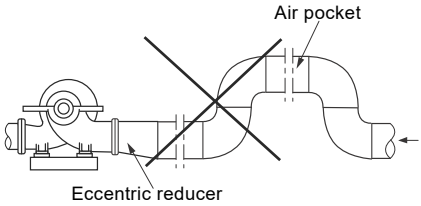

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Fig. 15 Inlet pipe resulting in air pockets

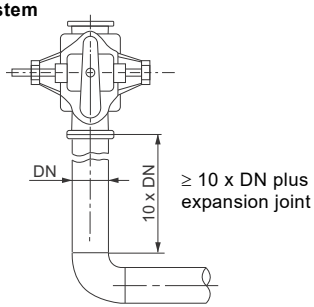
3.5.5 Inlet pipe with a horizontal elbow in the feed line

Make sure that the liquid flow is evenly distributed to both sides of the double-suction impeller.

There is always an uneven, turbulent flow through an elbow. See below. If you install an elbow in the inlet pipe near the pump in a position other than vertical, more liquid will enter one side of the impeller than the other. This will result in heavy, unbalanced thrust loads overheating the bearings, causing rapid wear and reducing the hydraulic performance.

Correct

Open system



Closed system

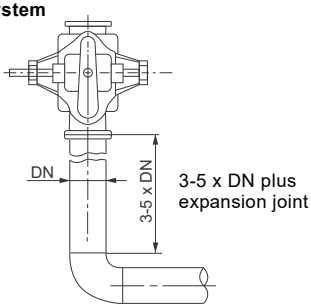


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Fig. 16 Recommended inlet pipe installation with a length of straight pipe between horizontal elbow and pump

Wrong

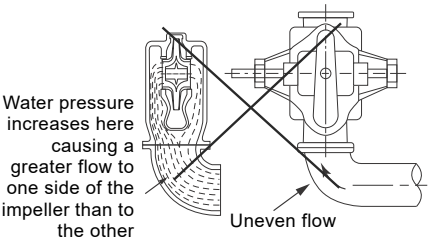

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Fig. 17 Unbalanced loading of a double-suction impeller due to uneven flow through a horizontal elbow close to the pump

3.5.6 Installations with vertical inlet pipe in confined space

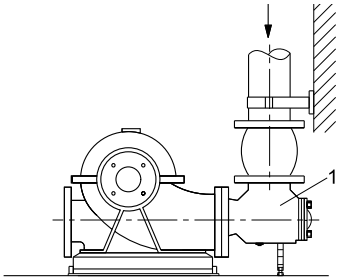

Fig. 18 Inlet diffuser (1) in the inlet pipe

4. Starting up the product

4.1 General information

Do not start the pump until it has been filled with liquid and vented.

CAUTION

Biological hazard

Minor or moderate personal injury

- When pumping drinking water, the pump must be flushed thoroughly with clean water before startup in order to remove any foreign matters, such as preservatives, test liquid or grease.

4.1.1 Pumps with stuffing box

In the case of pumps with stuffing box, check that the stuffing box gland is correctly fitted. It must be possible to turn the pump shaft manually. If the pump has been inactive for a long period, turn it manually to make sure it has not got stuck. Loosen the stuffing box or remove the packing.

4.1.2 Flushing the pipe system

The pump is not designed to pump liquids containing solid particles such as pipe debris and welding slag. Before starting up the pump, the pipe system must be thoroughly cleaned, flushed and filled with clean water.

The warranty does not cover any damage caused by flushing the pipe system by means of the pump.

The startup procedure for the pumps has four steps:

1. Prestart checks. See section *4.2 Prestart checks*.
2. Priming. See section *4.3 Priming*.
3. Starting. See section *4.4 Startup*.
4. Final alignment. See section *4.5 Final alignment*.

Only start the pump when you have gone through all of the prestart checks.

4.2 Prestart checks

Prestart checks have four steps:

1. Bearings
2. Stuffing boxes
3. Pressure gauge
4. Direction of rotation.

4.2.1 Bearings

Make sure that all bearings are properly lubricated. See section *6.3.3 Lubrication*.

4.2.2 Stuffing boxes

Make sure that the stuffing box packing rings have been properly tightened.

This does not apply to pumps with mechanical shaft seals.

4.2.3 Pressure gauges

Make sure that the pressure gauge connections are closed.

4.2.4 Direction of rotation

Check the direction of rotation in the following way:

1. Disconnect the two coupling halves between pump and motor.
2. Make sure that the motor shaft can turn freely.
3. Start the motor briefly to check the direction of rotation. The correct direction of rotation is indicated by the arrows on the pump casing.

The direction of rotation of the pump is not always the same as the flow direction.

4. If the direction of rotation is wrong, correct it by interchanging two phases on the motor.

DANGER

Electric shock

Death or serious personal injury

- Before interchanging two phases, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

5. Check the direction of rotation again.
6. Reassemble the coupling and the guards.

4.3 Priming

If not primed properly, the pump will not deliver liquid.

Closed systems or open systems where the liquid level is above the pump inlet (flooded systems)

Fill the inlet pipe and pump with liquid and vent them before the pump is started. Proceed as follows:

1. Close the outlet isolating or throttle valve.
2. Loosen the vent screw (17) and the plug for shaft seal flushing (20d).

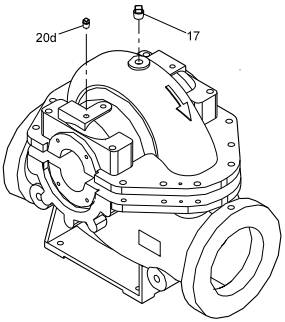

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Fig. 19 Position of the vent valve and plug for shaft seal flushing

WARNING

Hot or cold surface

Death or serious personal injury

- Pay attention to the direction of the vent hole, and ensure that the escaping water does not cause injury to persons or damage to the motor or other components.
- In hot-water installations, pay special attention to the risk of injury caused by scalding hot water and hot surfaces.
- In cold-liquid installations, pay special attention to the risk of injury caused by cold liquids and cold surfaces.

3. Slowly open the isolating valve in the inlet pipe until a steady flow of liquid runs out of the vent hole.
4. Rotate the shaft by hand, if possible, while priming and venting to free entrapped air from the impeller channels.
5. Tighten the vent screw and completely open the isolating or throttle valve(s).

Open systems where the liquid level is below the pump inlet (suction lift systems)

Fill the inlet pipe and pump with liquid and vent them before the pump is started. Proceed as follows:

Suction lift system with foot valve

1. Close the outlet isolating or throttle valve and open the isolating valve in the inlet pipe.
2. Remove the vent screw and connect a priming device to a drain hole.
3. Fill the inlet pipe and casing with liquid at a pressure of 1 to 2 bar from an external source until the inlet pipe and pump are completely filled with liquid.
4. Rotate the shaft by hand while priming and venting to free entrapped air from the impeller channels.
5. Refit the vent screw and tighten it securely.
6. You can fill the inlet pipe with liquid and vent it before you connect the pipe to the pump. You can also install a priming device before the pump.

Suction lift system without foot valve

1. Connect an external vacuum pump to the vent hole on the top of the pump casing.
2. Close the outlet isolating or throttle valve and open the isolating valve in the inlet pipe.
3. Open the valves between the pump and vacuum pump.
4. Start the external vacuum pump.
5. Pump until the inlet pipe and the pump are completely filled with liquid.
6. Rotate the shaft by hand while priming and venting to free entrapped air from the impeller channels.
7. When the liquid runs out of the vacuum pump, stop the external vacuum pump and close the valves between the pump and vacuum pump.

Never let the pump run dry. The pump is not self-priming.
Dry-running will cause serious damage to the stuffing boxes, shaft seals, wear rings and shaft sleeves.

4.3.1 Opening of valves

1. Open the valves for the flushing liquid to the stuffing boxes.
2. Completely open the isolating valve on the inlet side of the pump and leave the outlet isolating or throttle valve partly open.

4.4 Startup

Make sure that the pump is filled with liquid. The pump must not run dry.
Dry-running will cause serious damage to the stuffing boxes, shaft seals, wear rings and shaft sleeves.

1. Start the pump.
2. Vent the pump during startup by loosening the vent screw until a steady flow of liquid runs out of the vent hole.

WARNING

Hot or cold surface

Death or serious personal injury

- Pay attention to the direction of the vent hole, and ensure that the escaping water does not cause injury to persons or damage to the motor or other components.
- In hot-water installations, pay special attention to the risk of injury caused by scalding hot water and hot surfaces.
- In cold-liquid installations, pay special attention to the risk of injury caused by cold liquids and cold surfaces.

3. When the pipe system has been filled with liquid, slowly open the outlet isolating or throttle valve until it is completely open. Ensure that the differential pressure developed by the pump is within the performance range of the pump and/or close to the designed duty point. Throttle the outlet isolating valve or reduce the speed of the pump if the flow exceeds the rated performance range or the differential pressure is lower than the rated performance range.
4. Adjust the stuffing box gland (stuffing boxes only). With the pump running, tighten the stuffing box gland to allow a leakage of 40-60 drops per minute. This is required for shaft sleeve lubrication. Tighten the stuffing box gland evenly to provide uniform compression on the packing rings. After initial startup, additional packing rings and adjustment may be required until the packing rings are properly seated.
5. Ensure the pump unit is operating smoothly without abnormal noise, vibration or overheating.

Do not allow a stuffing box to run dry, and do not overtighten the stuffing box gland to eliminate leaking as the shaft sleeve will become damaged.

4.5 Final alignment

Make the final alignment by shimming the motor only.

1. Let the pump run until it has reached its operating temperature under normal operating conditions (approximately 1 hour).
2. Stop the pump.
3. Remove the coupling guard.
4. Check the alignment on the coupling by means of dial gauges. See below.

Checking coupling alignment by means of dial gauges

Alternatively, use laser equipment for the final alignment.

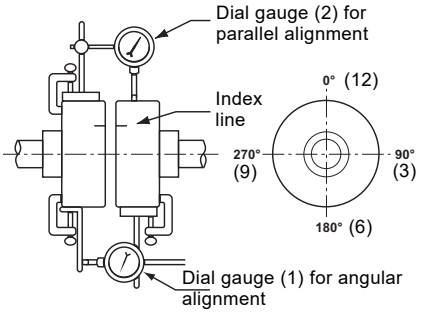
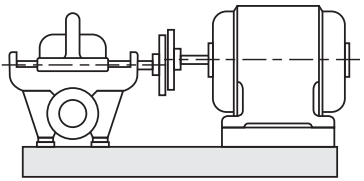


Fig. 20 The end view of the coupling is seen from the motor

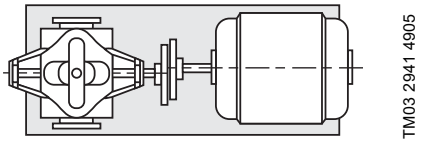
The coupling alignment procedure has four steps:

Parallel alignment - vertically



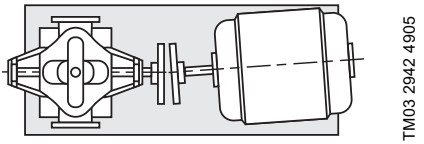
1. Mount the dial gauge (2) in position 0 ° (12 o'clock). See fig. 20.
2. Make the index lines on the two coupling halves. See fig. 20.
3. Set the dial gauge pointer to zero, turn the motor and pump shaft simultaneously until the dial gauge is in position 180 ° (6 o'clock) and check that the index lines are still in line.
4. Read the dial gauge (2). If the dial gauge shows a deflection exceeding 0.2 mm, add or remove the shims under the motor until the reading of the dial gauge is within the allowable tolerance of 0.2 mm.

Parallel alignment - horizontally



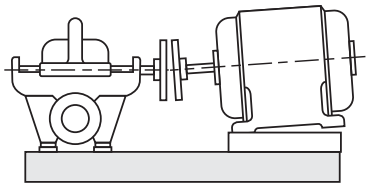
1. Turn the motor and pump shaft to 270 ° (9 o'clock).
2. Set the dial gauge pointer to zero, turn the motor and pump shaft to 90 ° (3 o'clock) and check that the index lines are still in line.
3. Read the dial gauge. If the dial gauge shows a deflection exceeding 0.2 mm, move the motor sideways until the reading of the dial gauge is within the allowable tolerance of 0.2 mm.
4. Remove the dial gauge (2).

Angular alignment - horizontally



1. Mount the dial gauge (1) in position 90 ° (3 o'clock). See fig. 20.
2. Make the index lines on the two coupling halves. See fig. 20.
3. Set the dial gauge pointer to zero, turn the motor and pump shaft simultaneously until the dial gauge is in position 270 ° (9 o'clock) and check that the index lines are still in line.
4. Read the dial gauge (1). If the dial gauge shows a deflection exceeding 0.2 mm, move the motor sideways until the deflection is halved.
5. Set the dial gauge pointer to zero, turn the motor and pump shaft simultaneously until the dial gauge is in position 90 ° (3 o'clock) and read the dial gauge (1) again.
6. Now the reading must be within the allowable tolerance of 0.2 mm. If not, repeat the procedure.

Angular alignment - vertically



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1. Turn the motor and pump shaft until the dial gauge (1) is in position 0 ° (12 o'clock).
2. Set the dial gauge pointer to zero, turn the motor and pump shaft simultaneously until the dial gauge is in position 180 ° (6 o'clock) and check that the index lines are still in line.
3. Read the dial gauge (1). If the dial gauge shows a deflection exceeding 0.2 mm, add or remove the shims under the motor until the deflection is halved.
4. Set the dial gauge pointer to zero, turn the motor and pump shaft simultaneously until the dial gauge is in position 0 ° (12 o'clock) and read the dial gauge (1) again.
5. Now the reading must be within the allowable tolerance of 0.2 mm. If not, repeat the procedure.
6. Remove the dial gauge (1).

The coupling tolerances may differ from coupling make to coupling make. For the standard coupling, the allowable tolerance is 0.2 mm. For other coupling types, see the coupling data supplied with the pump.

Finish the alignment procedure by refitting and tightening the coupling.

4.6 Greasing the grid coupling

Pack the spaces between and around the grid with as much lubricant as possible and wipe off the excess lubricant so that it is flush with the top of the grid. See section *6.3.3 Lubrication*.

Position the seals on the hubs so they line up with the grooves in the coupling cover. Position the gaskets on the flanges of the lower coupling cover half and assemble the covers so that the matching marks are on the same side.

Push the gaskets in until they stop against the seals and secure the coupling cover halves with the fasteners provided and tighten them properly. Make sure that the gaskets stay in position during this tightening procedure.

Once the coupling is completely assembled, remove both of the lubricating plugs in the covers, insert a lubricating nipple in one of the lubricating holes, pump in lubricant until it is forced out of the opposite lubricating hole and refit the two lubrication plugs. The installation is now complete.

WARNING

Crushing hazard

Death or serious personal injury

- To protect persons from rotating machine parts, always install all guards after the installation is complete and before starting the pump.

5. Product introduction

5.1 Applications

Grundfos LS horizontal split case pumps are typically used in these applications:

- circulation in heating and air conditioning systems, water condensing and boiler feed systems
- liquid transfer and pressure boosting in various industrial systems
- water distribution and water treatment in public water systems.

5.2 Pumped liquids

Clean, thin, non-aggressive liquids, not containing solid particles or fibres. Do not pump liquids that will attack the pump materials chemically.

CAUTION

Hot liquid

Minor or moderate personal injury

- Do not exceed the maximum operating temperature stated on the nameplate.

When pumping liquids with a density and/or viscosity higher than that of water, the head and flow will be reduced. Alternatively, use motors with correspondingly higher outputs.

The stuffing box packing rings or mechanical shaft seal O-rings chosen must be suitable for the liquid to be pumped.

Special stuffing box packing rings or shaft seal O-rings may be required if you use the pump for pumping treated water:

- at temperatures above 80 °C (176 °F).
- containing additives to prevent system corrosion, calcareous deposits, etc. (this may be the case in heating and ventilating systems).

When pumping liquids other than water, select an appropriate stuffing box or shaft seal. For further information, contact Grundfos.

5.3 Identification

The type designation and rating information of Grundfos horizontal split case pumps are stated on the nameplate. See fig. 21. The type designation includes model number, size and type.

Permanent records for this pump are kept under its year-week code and serial number (fig. 21, 4 and 5) and this number must therefore be stated in all correspondences and spare parts orders.

For more information about weight, see the label on the packaging.

5.3.1 Nameplate

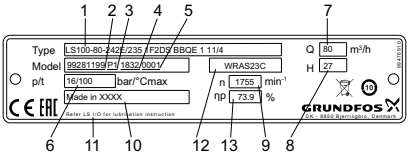

Fig. 21 Nameplate of CE-marked LS pump

Pos.	Description
1	Type designation
2	Product number
3	Place of production
4	Production year and week
5	Serial number
6	Maximum pressure and temperature
7	Rated flow rate (duty-point flow rate)
8	Head at rated flow rate (duty-point head)
9	Speed
10	Country of production
11	Reference to lubrication instruction. See section *6.3.3 Lubrication*.
12	Liquid temperature rating, only for WRAS-approved pumps
13	Hydraulic pump efficiency at optimum efficiency point

5.3.2 Type key

The type key is an explanation of the product type designation. See fig. 21, pos. 1.

Example	LS	125	-100	-305X	/273.1	, (W)	1	F2	D	S	BBQE	1

Type range
LS horizontal version

Nominal diameter of the inlet port (DN)

Nominal diameter of the outlet port (DN)

Maximum impeller diameter [mm]
If suffix is used:
"X" = different impeller or construction design for single-stage pump, such as A, B, C....Z.
"x2" = double-stage impeller design.

Actual impeller diameter [mm]

Potable-water code (optional)
ACS or WRAS-certified pump

Pump variant

1: Basic version, grease-lubrication, pump with motor, common base frame, standard coupling
2: Grease-lubrication, bare shaft pump with common base frame, standard coupling
3: Grease-lubrication, bare shaft pump
4: Grease-lubrication, pump with motor, separate base frames, spacer coupling
5: Grease-lubrication, bare shaft pump with separate base frame, spacer coupling
6: Oil-lubrication, pump with motor, common base frame, standard coupling
7: Oil-lubrication, bare shaft pump with common base frame, standard coupling
8: Oil-lubrication, bare shaft pump
9: Oil-lubrication, pump with motor, separate base frames, spacer coupling
0: Oil-lubrication, bare shaft pump with separate base frame, spacer coupling
X: Special variant

Code for pipe connection

F1: 10 bar, DIN PN 10
F2: 16 bar, DIN PN 16
F3: 25 bar, DIN PN 25
XX: Special flanges
G1: 175 PSI (12 bar), ANSI 125LB/150LB
G2: 250 PSI (17.2 bar), ANSI 250LB/300LB
G3: 400 PSI (27.6 bar), ANSI 250LB/300LB

Code for shaft and sleeve materials (sleeve is only used for 25 bar pump)

D: SS420 and no sleeve
E: SS304 and no sleeve
J: SS316 and no sleeve
L: Duplex stainless steel and no sleeve
X: Special
A: SS420 and SS304
C: SS420 and SS316
B: SS420 and bronze
K: Duplex stainless steel and duplex stainless steel

Example	LS	125	-100	-305X	/273.1	, (W)	1	F2	D	S	BBQE	1

Code for pump casing and impeller materials

S:	Cast iron and SS304	Q:	Ductile iron and SS304
C:	Cast iron and SS316	G:	Ductile iron and SS316
B:	Cast iron and bronze	A:	Ductile iron and bronze
D:	Cast iron and duplex stainless steel	H:	Ductile iron and duplex stainless steel
U:	SS304 and SS304	J:	SS316 and SS316
K:	Duplex stainless steel and duplex stainless steel		
X:	Special		

Code for shaft seal or stuffing box

BAQE:	Rubber bellows seal, unbalanced, carbon*/SiC, EPDM
BAQV:	Rubber bellows seal, unbalanced, carbon*/SiC, FKM
AAQE:	O-ring seal, unbalanced, carbon*/SiC, EPDM
AAQV:	O-ring seal, unbalanced, carbon*/SiC, FKM
DAQE:	O-ring seal, balanced, carbon*/SiC, EPDM
DAQV:	O-ring seal, balanced, carbon*/SiC, FKM
SAQE:	Rubber bellows seal, balanced, carbon*/SiC, EPDM
SAQV:	Rubber bellows seal, balanced, carbon*/SiC, FKM
BBQE:	Rubber bellows seal, unbalanced, carbon/SiC, EPDM
BBQV:	Rubber bellows seal, unbalanced, carbon/SiC, FKM
ABQE:	O-ring seal, unbalanced, carbon/SiC, EPDM
ABQV:	O-ring seal, unbalanced, carbon/SiC, FKM
DBQE:	O-ring seal, balanced, carbon/SiC, EPDM
DBQV:	O-ring seal, balanced, carbon/SiC, FKM
SBQE:	Rubber bellows seal, balanced, carbon/SiC, EPDM
SBQV:	Rubber bellows seal, balanced, carbon/SiC, FKM
BQQE:	Rubber bellows seal, unbalanced, SiC/SiC, EPDM
BQQV:	Rubber bellows seal, unbalanced, SiC/SiC, FKM
AQQE:	O-ring seal, unbalanced, SiC/SiC, EPDM
AQQV:	O-ring seal, unbalanced, SiC/SiC, FKM
DQQE:	O-ring seal, balanced, SiC/SiC, EPDM
DQQV:	O-ring seal, balanced, SiC/SiC, FKM
SQQE:	Rubber bellows seal, balanced, SiC/SiC, EPDM
SQQV:	Rubber bellows seal, balanced, SiC/SiC, FKM
BBVP:	Rubber bellows seal, carbon/aluminium oxide, nitrile rubber
SNEK:	Stuffing box with synthetic polymer packing rings, uncooled, with internal barrier fluid

Direction of rotation
(Pump direction of rotation as seen from the motor end)

1:	Clockwise
2:	Counterclockwise

* Antimony, not approved for potable water.

The example shown is an LS 125-100-305F/273.1, standard type with standard coupling, DIN PN 16 flange, cast iron pump casing with SS304 impeller, BBQE mechanical shaft seal and clockwise direction of rotation.

6. Servicing the product

6.1 Contaminated pumps

CAUTION

Biological hazard

Minor or moderate personal injury

- Flush the pump thoroughly with water and rinse the pump parts in water after dismantling.

The product will be classified as contaminated if it has been used for a liquid which is injurious to health or toxic.

If you request Grundfos to service the product, contact Grundfos with details about the liquid before returning the product for service. Otherwise, Grundfos can refuse to accept the product for service.

Any application for service must include details about the liquid.

Clean the product in the best possible way before you return it.

Costs of returning the product are to be paid by the customer.

6.2 Operating checks

Warning

The sound pressure level is so high that hearing protection must be used.

1. Check the pump and pipes for leaks.
2. Check and record the pressure gauge readings for future reference.
3. Check the differential pressure. If the differential pressure is lower than anticipated, the motor may be overloaded. See description of measuring instruments in section *3.4.6 Measuring instruments*.
4. Measure the motor current consumption and compare the result with the rated current stated on the motor nameplate. In case of overload, throttle the outlet isolating or throttle valve until the motor is no longer overloaded.
5. Check the bearings for lubrication and temperature. Normal temperature is 70 °C (158 °F). The maximum temperature depends on the type of lubrication. See the lubricating plate on the pump.

Stop the pump immediately if you notice any defects.

Do not start the pump unless the defects have been remedied. See section *8. Fault finding the product*. Report immediately to the supplier that you cannot remedy the defects.

The operating checks apply both during the startup procedure and when checking the pump during normal operation.

6.3 Maintaining the product

DANGER

Electric shock

Death or serious personal injury

- Before starting work on the pump, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

WARNING

Hot or cold surface

Death or serious personal injury

- Pay attention to the direction of the vent hole, and ensure that the escaping water does not cause injury to persons or damage to the motor or other components.
- In hot-water installations, pay special attention to the risk of injury caused by scalding hot water and hot surfaces.
- In cold-liquid installations, pay special attention to the risk of injury caused by cold liquids and cold surfaces.

6.3.1 General information

Routine maintenance is essential to maintain the pump in a good condition.

A high degree of cleanliness must be maintained during all maintenance procedures.

Consumable items including spare parts dismantling and re-assembly:

- tools
- re-assembly procedure.

Detailed information is mentioned in service manual.

6.3.2 Frequency of inspections

Carry out inspections in accordance with the maintenance table below.

Depending on operating and environmental conditions together with a comparison of previous inspections, the frequency of inspections may be altered to maintain satisfactory operation of the pump.

Every week	• Visually check for leaks. • Check for vibrations. • Hand test the bearing housing for any sign of temperature rise. • Check correct leaking from the stuffing boxes (approximately 40-60 drops per minute).
Every month	• Check the pump bearing temperature.
Every 6 months	• Check the shaft for scores. • Check the alignment of the pump and motor. • Check the fixing bolts and tighten, if necessary. • Check the coupling for wear.
Every year	• Check whether the grease in the pump bearings has hardened. • Check the rotating assembly for wear. • Check the wear ring clearances. **CAUTION** **Sharp element**  Minor or moderate personal injury - Wear protective gloves to protect yourself against sharp edges on the impeller and wear rings.

Between the regular maintenance inspections, be aware of signs of motor or pump trouble.

Common symptoms are listed in section *8. Fault finding the product*.

Remedy any fault immediately and avoid costly repairs and shutdowns.

6.3.3 Lubrication

Pump bearings

Pump bearings are lubricated before delivery.

We recommend relubricating intervals of 2000 operating hours. However, depending on duty conditions, this may vary.

To refill the bearings with fresh grease, follow this procedure:

1. Remove the bearing cap.
2. Add enough grease to fill up 1/3 of the ball bearing.
3. Note the quantity required.
4. Refit the bearing cap.

Grease quantity

Inlet size	Grease quantity [g]
DN 65 to DN 100	11
DN 125 to DN 150	17
DN 200 to DN 300	25
DN 350 to DN 450	50

Repeat this procedure the first three times. Based on the first three relubrications, determine the correct quantity of grease required.

For future relubrications, apply the established quantity of grease through the lubricating nipples. You do not have to remove the bearing caps.

For every 10,000 operating hours or every two years:

1. Remove the bearing caps from pump.
2. Remove old grease.
3. Thoroughly clean the bearing caps.
4. Refill the bearings with fresh grease.
5. Refill the bearing caps completely with fresh grease.
6. Refit the bearing caps in accordance with the assembly instructions.
7. Start the pump briefly several times to distribute the grease in the bearings and to prevent overheating of the grease.

Grease specifications: See *Ball bearing grease* below.

Do not overgrease.

Too much grease can cause overheating and premature bearing failure.

Motor bearings

Lubricate the motor bearings in accordance with the indications on the motor nameplate.

Grease specifications: See *Ball bearing grease* below.

Ball bearing grease

Manufacturer	Lubricant
Shell	Gadus S2 V2202[1)]
SKF	LGHP 2[1)]
Exxon	Polyrex
Chevron	SRI grease NLGI 2
	Black pearl NLGI 2
Philips	Polytac
Texaco	Polystar RB

[1)] Grundfos recommends Shell Gadus S2 V2202 or SKF LGHP 2 grease for relubrication.

Grid coupling

A grid coupling must be regreased at intervals. Normally, the interval is one year, but it can be shorter if the environment is aggressive or the operating conditions are harsh. Use the same grease for the coupling as for the ball bearings. See *Ball bearing grease*.

Proceed like this:

1. Remove the coupling guards.
2. Remove the two lubricating plugs.
3. Pump grease into one of the lubricating holes to push the old grease out of the opposite hole.
4. Keep pumping until the fresh grease comes out.
5. Refit and fasten the two plugs.
6. Mount the coupling guards again.

7. Taking the product out of operation

The following shutdown procedures apply to most normal shutdowns. If the pump is to be inoperative for a long time, follow the storage procedures in section *7.2 Long-term shutdown*.

1. Always close the outlet or throttle valve before stopping the pump. Close the valve slowly to prevent hydraulic shock, but make sure that the pump does not run against a closed valve for more than a few seconds.
2. Switch off the power supply to the motor.

7.1 Short-term shutdown

1. For overnight or temporary shutdown periods under non-freezing conditions, the pump may remain filled with liquid. Make sure the pump is fully primed before restarting.
2. For short or frequent shutdown periods at temperatures below 0 °C, keep the liquid moving within the pump casing and insulate or heat the pump exterior to prevent freezing.

7.2 Long-term shutdown

For long shutdown periods or to isolate the pump for maintenance, close the inlet and outlet valves. If no inlet valve is fitted and the pump has positive inlet height, drain all liquid from the inlet pipe to terminate the liquid flow into the pump inlet port. If applicable, turn off any external source of cooling or lubricating liquid to the stuffing boxes or shaft seals. Remove the plugs in the pump drain and vent tappings, as required, and drain all liquid from the pump casing. Remove the stuffing box glands and packing rings, if applicable.

CAUTION

Hot or cold surface

Minor or moderate personal injury

- Make sure that the escaping water does not cause injury to persons or damage to the motor or other components.
- In hot-water installations, pay special attention to the risk of injury caused by scalding hot water.
- In cold-liquid installations, pay special attention to the risk of injury caused by cold liquids and cold surfaces.

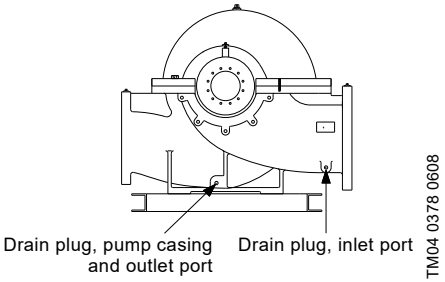

Fig. 22 Example of drain plugs

1. After draining the pump during long shutdown periods under freezing conditions, blow out all liquid in passages and air pockets using compressed air. You can prevent freezing of pumped liquid by filling the pump with antifreeze solution.

WARNING

Harm to health

Death or serious personal injury

- Do not use antifreeze solution if you use the pump for public or potable-water supply.

2. Rotate the shaft by hand monthly to coat the bearings with lubricant and delay oxidation and corrosion.
3. Where applicable, follow the motor manufacturer's storage recommendations.

Do not tighten the vent screw or refit the drain plug until the pump is to be used again.

8. Fault finding the product

DANGER

Electric shock

Death or serious personal injury

- Before you remove the terminal box cover and before you remove or dismantle the pump, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

Faults

A: The pump delivers no liquid.

B: The pump does not deliver enough liquid.

C: The pump does not create enough pressure.

D: The pump loses liquid after running for a short time.

E: The pump consumes too much power.

F: The motor is overloaded.

G: Vibrations.

H: Cavitation noise.

I: The pump bearings are overheated.

J: The pump operates for a short time and then stops.

K: Reference numbers to remedies.

A	B	C	D	E	F	G	H	I	J	Causes	K
•									•	The pump is not primed, lack of priming liquid, incomplete priming.	1
•										Loss of priming liquid.	2
•	•		•						•	The suction lift or static lift is too high.	3
•	•									The outlet pressure is too high (measured at the outlet port).	4
•	•	•								The speed is too low.	5
•	•									Wrong direction of rotation.	6
•	•									The impeller is completely clogged.	7
	•									The inlet pipe is partially blocked.	8
	•	•	•				•		•	Air leak in the inlet pipe or flange.	9
	•		•						•	Air leak in the stuffing box. The flushing pipe may be blocked.	10
	•		•	•			•			Cavitation; insufficient NPSH (depending on installation).	11
	•	•		•						The impeller or wear rings are worn.	12
	•	•								Defective packing rings.	13
	•									The non-return valve is too small or partially obstructed. The cross section of the non-return valve port must be at least as large as the cross section of the inlet pipe.	14
	•		•				•			The inlet pipe is not immersed deeply enough.	15
		•								The impeller diameter is too small. This is the most probable cause, if none of the above causes apply.	16

Faults

A: The pump delivers no liquid.
B: The pump does not deliver enough liquid.
C: The pump does not create enough pressure.
D: The pump loses liquid after running for a short time.
E: The pump consumes too much power.
F: The motor is overloaded.
G: Vibrations.
H: Cavitation noise.
I: The pump bearings are overheated.
J: The pump operates for a short time and then stops.

Causes

K: Reference numbers to remedies.

A	B	C	D	E	F	G	H	I	J		K
		●								Obstruction in the casing.	17
		●	●	●			●			Air or gases in the liquid.	18
		●		●						The actual duty point of the pump lies to the right of the specified duty point on the pump curve. The result is lower head, higher flow and higher power consumption.	19
				●	●					The viscosity or specific gravity of the pumped liquid is higher than that of water.	20
				●	●	●		●		The shaft is bent due to damage.	21
				●	●	●		●		Mechanical failure of the bearing and/or impeller.	22
				●		●		●		Misalignment.	23
				●	●					Electrical defects.	24
				●	●		●			The speed is too high.	25
						●				The foundation is not rigid enough.	26
								●		The lubricating oil or grease is dirty or contaminated.	27

No.	Cause	Remedy
1	The pump is not primed, lack of priming liquid, incomplete priming.	Fill the pump and inlet pipe completely with pumped liquid.
2	Loss of priming liquid.	Mend possible leaks in the inlet pipe, joints and fittings. Vent the pump casing to remove accumulated air.
3	The suction lift or static lift is too high.	Reduce the difference in height between the water reservoir or water supply and the pump.
4	The outlet pressure is too high.	Make sure that valves in the outlet pipe are fully open. For parallel operation, this indicates that the outlet pressure is higher than designed friction losses in the pipes. Review system design and actual pressure developed in the system with parallel operation.
5	The speed is too low.	1. Make sure that the motor receives full voltage. 2. Make sure that the frequency is correct. 3. Make sure that all phases are connected.
6	Wrong direction of rotation.	Compare the direction of rotation with the directional arrow on the pump casing. If required, change the direction of rotation by interchanging two phases in the motor.

No.	Cause	Remedy
7	The impeller is completely clogged.	Dismantle the pump and clean the impeller.
8	The inlet pipe is partially blocked.	Remove any obstructions in the inlet pipe.
9	Air leak in the inlet pipe or flange.	Replace or repair the defective pipe section or flange.
10	Air leak in the stuffing box.	Clean the flushing pipe. Replace the stuffing box packing rings, if necessary.
11	Cavitation; insufficient NPSH (depending on installation).	1. Increase the net positive suction head by placing the pump in a lower position. 2. Pressurise the inlet vessel.
12	The impeller or wear rings are worn.	Replace the impeller and/or wear rings. If necessary, also replace the bearings and the shaft.
13	Defective packing rings.	Replace the packing rings.
14	The non-return valve is too small or partially obstructed.	Replace or clean the non-return valve.
15	The inlet pipe is not immersed deeply enough.	Extend the inlet pipe so that the risk of sucking air is eliminated.
16	The impeller diameter is too small.	Check with Grundfos if you can use a larger impeller. If not, reduce the outlet pipe friction losses. But be careful not to seriously overload the motor.
17	Obstruction in pump casing.	Dismantle the pump and remove the obstruction.
18	Air or gases in the liquid.	Remove the gas or air from the pumped liquid. See 11 above.
19	The actual duty point of the pump lies to the right of the specified duty point on the pump curve. The result is lower head, higher flow and higher power consumption.	Install an orifice plate immediately after the outlet flange. The orifice plate will raise the system characteristic or increase the counterpressure thus increasing the head and lowering the flow. The size of the orifice plate must be adapted so that the pressure corresponds to the required duty point.
20	The viscosity or specific gravity of the pumped liquid is higher than that of water.	Use a larger motor. Consult Grundfos for recommended size. Test the liquid for viscosity and specific gravity.
21	The shaft is bent due to damage.	Check the deflection of the shaft. The total indicator runout must not exceed 0.05 mm. Possibly replace the shaft.
22	Mechanical failure of bearing and/or impeller.	Check the bearings and the impeller for damage. Replace the bearings or the impeller, if necessary.
23	Misalignment.	Realign the pump and motor.
24	Electrical defects.	Check that the voltage and frequency of the power supply are correct. Remedy the possible defects in the motor. Check that the motor is properly cooled.
25	The speed is too high.	Check that the frequency of the power supply corresponds to the frequency stated on the motor nameplate.
26	The foundation is not rigid enough.	Retighten the anchor bolt nuts. Make sure that the foundation is made according to the installation and operating instructions.
27	The lubricating oil or grease is dirty or contaminated.	Clean the bearings and bearing housings according to the instructions and relubricate the bearings.

9. Technical data

9.1 Operating conditions

9.1.1 Ambient temperature and altitude

The ambient temperature and the installation altitude are important factors for the motor lifetime, as they affect the life of the bearings and the insulation system.

If the ambient temperature or the altitude exceeds the recommended maximum ambient temperature or maximum altitude above sea level, the motor must not be fully loaded due to the low density and consequently low cooling effect of the air. See fig. 23. In such cases, it may be necessary to use a motor with a higher output.

Ambient temperature

Motor make	Motor P2	Permissible ambient temperature
MG	0.25 - 0.55 kW	-20 - +40 °C
	0.75 - 22 kW	-20 - +60 °C
Siemens	0.75 - 462 kW	-20 - +55 °C
MMG-H2	0.75 - 450 kW	-20 - +60 °C
MMG-H3	0.75 - 200 kW	-30 - +60 °C
MMG-G2	0.75 - 630 kW	-20 - +60 °C
MMG-G3	0.75 - 315 kW	-20 - +60 °C

Maximum motor output in relation to ambient temperature and altitude

Motor make	Motor P2	Derating curve
MG	0.25 - 0.55 kW	Fig. 23, curve 1
	0.75 - 22 kW	Fig. 23, curve 2
Siemens	0.75 - 462 kW	Fig. 23, curve 3
MMG-H2	0.75 - 450 kW	Fig. 23, curve 2
MMG-H3	0.75 - 200 kW	Fig. 23, curve 2
MMG-G2	0.75 - 630 kW	Fig. 23, curve 2
MMG-G3	0.75 - 315 kW	Fig. 23, curve 2

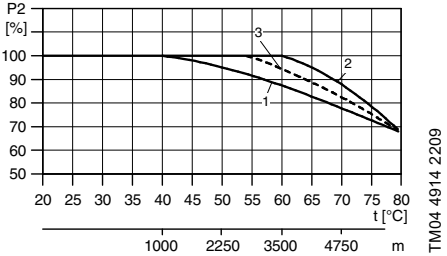

Fig. 23 Relationship between motor output (P2) and ambient temperature

Example

Figure 23 shows that an MG IE3 motor must not be loaded by more than 89 % of the rated output at an ambient temperature of 70 °C. If the pump is installed 4750 metres above sea level, the motor must not be loaded by more than 89 % of the rated output. In cases where both the maximum temperature and the maximum altitude are exceeded, the derating factors must be multiplied (0.89 x 0.89 = 0.79).

9.1.2 Liquid temperature

The maximum liquid temperature marked on the pump nameplate depends on the mechanical shaft seal used:

Temperature range for NBR: 0-100 °C.

Temperature range for FKM: 15-100 °C.

9.1.3 Pressure in the pump

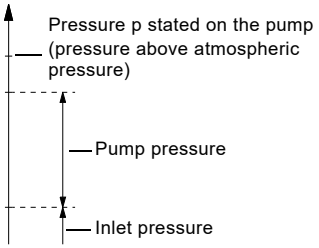

Fig. 24 Pressure in the LS pump

Maximum outlet pressure

The maximum outlet pressure is the pressure (p) stated on the pump nameplate.

Minimum inlet pressure

The minimum inlet pressure must correspond to the NPSH curve for the pump + a safety margin of minimum 0.5 metres head.

NPSH appears from the data booklet and Grundfos Product Center.

Maximum inlet pressure

The inlet pressure + pump pressure must be lower than the maximum pressure (p) of the pump. This is stated on the nameplate. See fig. 21, 7.

9.1.4 Flow rate

Minimum flow rate

The pump must not run against a closed outlet valve as this will cause an increase in the temperature or formation of steam in the pump. This may cause shaft damage, impeller erosion, short life of bearings, damage to stuffing boxes or mechanical shaft seals due to stress or vibration.

The continuous flow rate must be at least 25 % of the flow rate in the best efficiency point.

Maximum flow rate

The maximum flow rate must not exceed the value stated on the nameplate. If the maximum flow rate is exceeded, cavitation and overload may occur.

Operating at reduced flow and/or head

Do not operate the pump at a flow rate below 10 % of the maximum flow rate stated on the nameplate or with the outlet isolating or throttle valve closed. Operating the pump under such conditions may involve the risk of the pump being overheated. To prevent possible damage, use protective devices such as liquid temperature relay, bearing temperature relay, inlet pressure monitoring, etc.

If a pump is operated at reduced head, the flow rate will increase and the motor will consume more current than normal. This will result in overheating of the motor. In such situations, throttle the valve on the outlet side instead. If an automatic throttle valve is installed, this can be done automatically.

9.1.5 Frequency of starts and stops

The recommended maximum number of starts per hour below apply to complete pumps with a motor supplied by Grundfos. The values are recommendations only.

0 to 50 kW

15 starts per hour. The motor must be stopped for at least 3 minutes before restart.

51 to 100 kW

10 starts per hour. The motor must be stopped for at least 5 minutes before restart.

101 to 315 kW

5 starts per hour. The motor must be stopped for at least 10 minutes before restart.

Greater than 315 kW

2 starts per hour.

9.2 Flange forces and torques

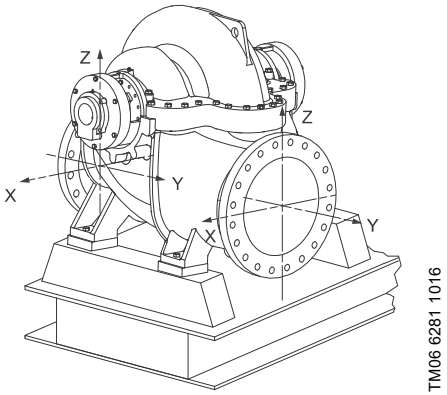

Fig. 25 Flange forces and torques

Horizontal pump, side branch, y-axis

If not all loads reach the maximum permissible value, one of the values is allowed to exceed the normal limit. Contact Grundfos for further information.

Casting material	Diameter DN	Force [N]				Torque [Nm]			
		Fy	Fz	Fx	ΣF	My	Mz	Mx	ΣM
Gray cast iron, ductile iron	50	647	530	589	1020	294	338	412	603
Gray cast iron, ductile iron	65	840	676	747	1312	406	469	573	843
Gray cast iron, ductile iron	80	981	804	883	1550	338	383	471	692
Gray cast iron, ductile iron	100	1315	1059	1177	2060	368	427	515	765
Gray cast iron, ductile iron	125	1623	1311	1453	2542	430	497	609	892
Gray cast iron, ductile iron	150	1962	1589	1766	3080	515	603	736	1074
Gray cast iron, ductile iron	200	2629	2119	2354	4101	677	780	956	1413
Gray cast iron, ductile iron	250	3277	2649	2923	5121	927	1074	1310	1928
Gray cast iron, ductile iron	300	3924	3159	3512	6141	1265	1457	1781	2619
Gray cast iron, ductile iron	350	4571	3689	4101	7161	1619	1869	2281	3355
Gray cast iron, ductile iron	400	5219	4218	4689	8182	2031	2340	2855	4208
Gray cast iron, ductile iron	450	5866	4748	5278	9202	2502	2884	3517	5180
Gray cast iron, ductile iron	500	6514	5278	5866	10222	3017	3473	4253	6269
Gray cast iron, ductile iron	550	7161	5808	6455	11242	3590	4135	5033	7446
Gray cast iron, ductile iron	600	7809	6337	7044	12263	4238	4885	5945	8800
Gray cast iron, ductile iron	700	9131	7396	8222	14327	5673	6533	7952	11775
Gray cast iron, ductile iron	800	10437	8455	9400	16376	7331	8441	10270	15220
Gray cast iron, ductile iron	900	11743	9513	10577	18426	9211	10603	12896	19124
Gray cast iron, ductile iron	1000	13048	10571	11754	20475	11312	13019	15830	23489
Gray cast iron, ductile iron	1200	15660	12688	14109	24574	16177	18616	22623	33597
Stainless steel	50	1619	1324	1472	2551	981	1128	1373	2011
Stainless steel	65	2100	1690	1867	3280	1015	1173	1432	2108
Stainless steel	80	2453	2011	2207	3875	1128	1275	1570	2305
Stainless steel	100	3286	2649	2943	5150	1226	1422	1717	2551
Stainless steel	125	4058	3278	3633	6355	1433	1657	2029	2973
Stainless steel	150	4905	3973	4415	7701	1717	2011	2453	3581
Stainless steel	200	6573	5297	5886	10251	2256	2600	3188	4709
Stainless steel	250	8191	6622	7308	12802	3090	3581	4365	6426

Casting material	Diameter DN	Force [N]				Torque [Nm]			
		Fy	Fz	Fx	ΣF	My	Mz	Mx	ΣM
Stainless steel	300	9810	7897	8780	15353	4218	4856	5935	8731
Stainless steel	350	11429	9221	10251	17903	5396	6229	7603	11183
Stainless steel	400	13047	10546	11723	20454	6769	7799	9516	14028
Stainless steel	450	14666	11870	13194	23004	8339	9614	11723	17266
Stainless steel	500	16285	13194	14666	25555	10055	11576	14175	20895
Stainless steel	550	17903	14519	16137	28106	11968	13783	16775	24819
Stainless steel	600	19522	15843	17609	30656	14126	16285	19816	29332
Stainless steel	700	22828	18491	20556	35816	18909	21776	26508	39250
Stainless steel	800	26092	21137	23499	40940	24437	28135	34233	50733
Stainless steel	900	29356	23782	26442	46064	30702	35343	42986	63748
Stainless steel	1000	32621	26428	29385	51188	37705	43398	52766	78296
Stainless steel	1200	39149	31720	35272	61435	53923	62052	75409	111991

9.3 Sound pressure level

The data in this table applies for pumps including motor, such as MG, MMG, Siemens and TECO motors.

The values stated are maximum sound pressure levels. Tolerances are according to ISO 4871.

50 Hz

2-pole: n = 2900 min^{-1}

4-pole: n = 1450 min^{-1}

6-pole: n = 970 min^{-1}

Motor [kW]	Maximum sound pressure level [dB(A)] - ISO 3743		
	Three-phase motors		
	2-pole	4-pole	6-pole
0.25	56	41	-
0.37	56	45	-
0.55	57	42	40
0.75	56	42	43
1.1	59	50	43
1.5	58	50	47
2.2	60	52	52
3	59	52	63
4	63	54	63
5.5	63	57	63
7.5	60	58	66
11	60	60	66
15	60	60	66
18.5	60	63	66
22	66	63	66
30	71	65	59
37	71	66	60
45	71	66	58
55	71	67	58
75	73	70	61
90	73	70	61
110	76	70	61
132	76	70	61
160	76	70	65
200	76	70	-
250	82	73	-
315	82	73	-
355	77	75	-
400	-	75	-

60 Hz

2-pole: n = 3500 min^{-1}

4-pole: n = 1750 min^{-1}

6-pole: n = 1170 min^{-1}

Motor [kW]	Maximum sound pressure level [dB(A)] - ISO 3743		
	Three-phase motors		
	2-pole	4-pole	6-pole
0.25	-	-	-
0.37	-	-	-
0.55	-	-	-
0.75	-	-	-
1.1	64	51	43
1.5	64	52	47
2.2	65	55	52
3	54	57	63
4	68	56	63
5.5	68	62	63
7.5	73	62	66
11	70	66	66
15	70	66	66
18.5	70	63	66
22	70	63	66
30	71	65	62
37	71	65	63
45	75	65	62
55	75	68	62
75	77	71	66
90	77	71	66
110	81	75	66
132	81	75	66
160	81	75	69
200	81	75	-
280	86	-	-
288	-	77	-
353	86	-	-
362	-	77	-
398	81	-	-
408	-	79	-
460	-	79	-

10. Disposing of the product

Dispose of this product or parts of it in an environmentally sound way:

1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

The crossed-out wheelie bin symbol on a product means that it must be disposed of separately from household waste. When a product marked with this symbol reaches its end of life, take it to a collection point designated by the local waste disposal authorities. The separate collection and recycling of such products will help protect the environment and human health.

Argentina
Bombas GRUNDFOS de Argentina S.A.
Ruta Panamericana km. 37.500 Centro Industrial Garin
1619 Garín Pcia. de B.A.
Phone: +54-3327 414 444
Telefax: +54-3327 45 3190

Australia
GRUNDFOS Pumps Pty. Ltd.
P.O. Box 2040
Regency Park
South Australia 5942
Phone: +61-8-8461-4611
Telefax: +61-8-8340 0155

Austria
GRUNDFOS Pumpen Vertrieb Ges.m.b.H.
Grundfosstraße 2
A-5082 Grödig/Salzburg
Tel.: +43-6246-883-0
Telefax: +43-6246-883-30

Belgium
N.V. GRUNDFOS Bellux S.A.
Boomsesteenweg 81-83
B-2630 Aartselaar
Tél.: +32-3-870 7300
Télécopie: +32-3-870 7301

Belarus
Представительство ГРУНДФОС в Минске
220125, Минск
ул. Шафарнянская, 11, оф. 56, БЦ «Порт»
Тел.: +7 (375 17) 286 39 72/73
Факс: +7 (375 17) 286 39 71
E-mail: minsk@grundfos.com

Bosnia and Herzegovina
GRUNDFOS Sarajevo
Zmaja od Bosne 7-7A,
BH-71000 Sarajevo
Phone: +387 33 592 480
Telefax: +387 33 590 465
www.ba.grundfos.com
e-mail: grundfos@bih.net.ba

Brazil
BOMBAS GRUNDFOS DO BRASIL
Av. Humberto de Alencar Castelo Branco, 630
CEP 09850 - 300
São Bernardo do Campo - SP
Phone: +55-11 4393 5533
Telefax: +55-11 4343 5015

Bulgaria
Grundfos Bulgaria EOOD
Slatina District
Iztochna Tangenta street no. 100
BG - 1592 Sofia
Tel. +359 2 49 22 200
Fax. +359 2 49 22 201
email: bulgaria@grundfos.bg

Canada
GRUNDFOS Canada Inc.
2941 Brighton Road
Oakville, Ontario
L6H 6C9
Phone: +1-905 829 9533
Telefax: +1-905 829 9512

China
GRUNDFOS Pumps (Shanghai) Co. Ltd.
10F The Hub, No. 33 Suhong Road
Minhang District
Shanghai 201106
PRC
Phone: +86 21 612 252 22
Telefax: +86 21 612 253 33

COLOMBIA
GRUNDFOS Colombia S.A.S.
Km 1.5 vía Siberia-Cota Conj. Potrero Chico,
Parque Empresarial Arcos de Cota Bod. 1A.
Cota, Cundinamarca
Phone: +57(1)-2913444
Telefax: +57(1)-8764586

Croatia
GRUNDFOS CROATIA d.o.o.
Buzinski prilaz 38, Buzin
HR-10010 Zagreb
Phone: +385 1 6595 400
Telefax: +385 1 6595 499
www.hr.grundfos.com

GRUNDFOS Sales Czechia and Slovakia s.r.o.
Čajkovského 21
779 00 Olomouc
Phone: +420-585-716 111

Denmark
GRUNDFOS DK A/S
Martin Bachs Vej 3
DK-8850 Bjerringbro
Tlf.: +45-87 50 50 50
Telefax: +45-87 50 51 51
E-mail: info_GDK@grundfos.com
www.grundfos.com/DK

Estonia
GRUNDFOS Pumps Eesti OÜ
Peterburi tee 92G
11415 Tallinn
Tel: + 372 606 1690
Fax: + 372 606 1691

Finland
OY GRUNDFOS Pumput AB
Trukkikuja 1
FI-01360 Vantaa
Phone: +358-(0) 207 889 500

France
Pompes GRUNDFOS Distribution S.A.
Parc d'Activités de Chesnes
57, rue de Malacombe
F-38290 St. Quentin Fallavier (Lyon)
Tél.: +33-4 74 82 15 15
Télécopie: +33-4 74 94 10 51

Germany
GRUNDFOS GMBH
Schlüterstr. 33
40699 Erkrath
Tel.: +49-(0) 211 929 69-0
Telefax: +49-(0) 211 929 69-3799
e-mail: infoservice@grundfos.de
Service in Deutschland:
e-mail: kundendienst@grundfos.de

Greece
GRUNDFOS Hellas A.E.B.E.
20th km. Athinon-Markopoulou Av.
P.O. Box 71
GR-19002 Peania
Phone: +0030-210-66 83 400
Telefax: +0030-210-66 46 273

Hong Kong
GRUNDFOS Pumps (Hong Kong) Ltd.
Unit 1, Ground floor
Siu Wai Industrial Centre
29-33 Wing Hong Street &
68 King Lam Street, Cheung Sha Wan
Kowloon
Phone: +852-27861706 / 27861741
Telefax: +852-27858664

Hungary
GRUNDFOS Hungária Kft.
Tópark u. 8
H-2045 Törökbálint,
Phone: +36-23 511 110
Telefax: +36-23 511 111

India
GRUNDFOS Pumps India Private Limited
118 Old Mahabalipuram Road
Thoraipakkam
Chennai 600 096
Phone: +91-44 2496 6800

Indonesia
PT. GRUNDFOS POMPA
Graha Intirub Lt. 2 & 3
Jln. Cililitan Besar No.454. Makasar, Jakarta Timur
ID-Jakarta 13650
Phone: +62 21-469-51900
Telefax: +62 21-460 6910 / 460 6901

Ireland
GRUNDFOS (Ireland) Ltd.
Unit A, Merrywell Business Park
Ballymount Road Lower
Dublin 12
Phone: +353-1-4089 800
Telefax: +353-1-4089 830

Italy
GRUNDFOS Pompe Italia S.r.l.
Via Gran Sasso 4
I-20060 Truccazzano (Milano)
Tel.: +39-02-95838112
Telefax: +39-02-95309290 / 95838461

Japan
GRUNDFOS Pumps K.K.
1-2-3, Shin-Miyakoda, Kita-ku, Hamamatsu
431-2103 Japan
Phone: +81 53 428 4760
Telefax: +81 53 428 5005

Korea
GRUNDFOS Pumps Korea Ltd.
6th Floor, Aju Building 679-5
Yeoksam-dong, Kangnam-ku, 135-916
Seoul, Korea
Phone: +82-2-5317 600
Telefax: +82-2-5633 725

Latvia
SIA GRUNDFOS Pumps Latvia
Deglava biznesa centrs
Augusta Deglava ielā 60, LV-1035, Rīga,
Tālr.: + 371 714 9640, 7 149 641
Fakss: + 371 914 9646

Lithuania
GRUNDFOS Pumps UAB
Smolensko g. 6
LT-03201 Vilnius
Tel: + 370 52 395 430
Fax: + 370 52 395 431

Malaysia
GRUNDFOS Pumps Sdn. Bhd.
7 Jalan Peguam U1/25
Glenmarie Industrial Park
40150 Shah Alam
Selangor
Phone: +60-3-5569 2922
Telefax: +60-3-5569 2866

Mexico
Bombas GRUNDFOS de México S.A. de C.V.
Boulevard TLC No. 15
Parque Industrial Stiva Aeropuerto
Apodaca, N.L. 66600
Phone: +52-81-8144 4000
Telefax: +52-81-8144 4010

Netherlands
GRUNDFOS Netherlands
Veluwezoom 35
1326 AE Almere
Postbus 22015
1302 CA ALMERE
Tel.: +31-88-478 6336
Telefax: +31-88-478 6332
E-mail: info_gnl@grundfos.com

New Zealand
GRUNDFOS Pumps NZ Ltd.
17 Beatrice Tinsley Crescent
North Harbour Industrial Estate
Albany, Auckland
Phone: +64-9-415 3240
Telefax: +64-9-415 3250

Norway
GRUNDFOS Pumper A/S
Strømsveien 344
Postboks 235, Leirdal
N-1011 Oslo
Tlf.: +47-22 90 47 00
Telefax: +47-22 32 21 50

Poland
GRUNDFOS Pompy Sp. z o.o.
ul. Klonowa 23
Baranowo k. Poznania
PL-62-081 Przeźmierowo
Tel: (+48-61) 650 13 00
Fax: (+48-61) 650 13 50

Portugal
Bombas GRUNDFOS Portugal, S.A.
Rua Calvet de Magalhães, 241
Apartado 1079
P-2770-153 Paço de Arcos
Tel.: +351-21-440 76 00
Telefax: +351-21-440 76 90

Romania
GRUNDFOS Pompe România SRL
Bd. Biruintei, nr 103
Pantelimon county Ilfov
Phone: +40 21 200 4100
Telefax: +40 21 200 4101
E-mail: romania@grundfos.ro

Russia
ООО Грундфос Россия
ул. Школьная, 39-41
Москва, RU-109544, Russia
Тел. (+7) 495 564-88-00 (495) 737-30-00
Факс (+7) 495 564 8811
E-mail grundfos.moscow@grundfos.com

Serbia
Grundfos Srbija d.o.o.
Omladinskih brigada 90b
11070 Novi Beograd
Phone: +381 11 2258 740
Telefax: +381 11 2281 769
www.rs.grundfos.com

Singapore
GRUNDFOS (Singapore) Pte. Ltd.
25 Jalan Tukang
Singapore 619264
Phone: +65-6681 9688
Telefax: +65-6681 9689

Slovakia
GRUNDFOS s.r.o.
Prievozská 4D
821 09 BRATISLAVA
Phona: +421 2 5020 1426
sk.grundfos.com

Slovenia
GRUNDFOS LJUBLJANA, d.o.o.
Leskoškova 9e, 1122 Ljubljana
Phone: +386 (0) 1 568 06 10
Telefax: +386 (0)1 568 06 19
E-mail: tehnika-si@grundfos.com

South Africa
Grundfos (PTY) Ltd.
16 Lascelles Drive, Meadowbrook Estate
1609 Germiston, Johannesburg
Tel.: (+27) 10 248 6000
Fax: (+27) 10 248 6002
E-mail: lgradidge@grundfos.com

Spain
Bombas GRUNDFOS España S.A.
Camino de la Fuentecilla, s/n
E-28110 Algete (Madrid)
Tel.: +34-91-848 8800
Telefax: +34-91-628 0465

Sweden
GRUNDFOS AB
Box 333 (Lunnagårdsgatan 6)
431 24 Mölndal
Tel.: +46 31 332 23 000
Telefax: +46 31 331 94 60

Switzerland
GRUNDFOS Pumpen AG
Bruggacherstrasse 10
CH-8117 Fällanden/ZH
Tel.: +41-44-806 8111
Telefax: +41-44-806 8115

Taiwan
GRUNDFOS Pumps (Taiwan) Ltd.
7 Floor, 219 Min-Chuan Road
Taichung, Taiwan, R.O.C.
Phone: +886-4-2305 0868
Telefax: +886-4-2305 0878

Thailand
GRUNDFOS (Thailand) Ltd.
92 Chaloem Phrakiat Rama 9 Road,
Dokmai, Pravej, Bangkok 10250
Phone: +66-2-725 8999
Telefax: +66-2-725 8998

Turkey
GRUNDFOS POMPA San. ve Tic. Ltd. Sti.
Gebze Organize Sanayi Bölgesi
Ihsan dede Caddesi,
2. yol 200. Sokak No. 204
41490 Gebze/ Kocaeli
Phone: +90 - 262-679 7979
Telefax: +90 - 262-679 7905
E-mail: satis@grundfos.com

Ukraine
Бізнес Центр Європа
Столичне шосе, 103
м. Київ, 03131, Україна
Телефон: (+38 044) 237 04 00
Факс.: (+38 044) 237 04 01
E-mail: ukraine@grundfos.com

United Arab Emirates
GRUNDFOS Gulf Distribution
P.O. Box 16768
Jebel Ali Free Zone
Dubai
Phone: +971 4 8815 166
Telefax: +971 4 8815 136

United Kingdom
GRUNDFOS Pumps Ltd.
Grovebury Road
Leighton Buzzard/Beds. LU7 4TL
Phone: +44-1525-850000
Telefax: +44-1525-850011

U.S.A.
GRUNDFOS Pumps Corporation
9300 Loiret Blvd.
Lenexa, Kansas 66219
Phone: +1-913-227-3400
Telefax: +1-913-227-3500

Uzbekistan
Grundfos Tashkent, Uzbekistan The Representative Office of Grundfos Kazakhstan in Uzbekistan
38a, Oybek street, Tashkent
Телефон: (+998) 71 150 3290 / 71 150 3291
Факс: (+998) 71 150 3292

Addresses Revised 15.01.2019

99536991 0320

ECM: 1252303