

Goulds Pumps



GOULDS PUMPS

GOULDS SERIES

Pa PUMPS

INSTALLATION AND OPERATION INSTRUCTIONS

Table of Contents

Data Sheet

1. General	page 3
1.1 Foreword	
1.2 Guarantee	
1.3 Safety regulations	
1.4 Safety instructions	
Dangers of not following safety instructions	
Safety instructions for the operator	
Speed, pressure, temperature	
Permitted forces on flanges	
NPSH	
Sealing, flushing, cooling	
Minimum flows	
Protection against running dry	
Back flow	
2. Description	page 7
2.1 Model	
2.2 Shaft sealing	
2.3 Bearings and lubrication	
Oil lubrication	
Bearing sizes and oil quantities	
Grease lubrication	
3. Transport, Handling and Storage	page 8
3.1 Transport, Handling	
3.2 Storage	
4. Installation, Operation	page 9
4.1 Assembly and connection of pump	
4.2 Installation and alignment of coupling	
Installation	
Alignment	
Permitted displacement for flexible couplings	
4.3 Connecting the pipes to the pump	
Suction and discharge pipe	
Auxiliary pipes	
4.4 Electrical connection	
4.5 Starting up	
Starting up for the first time	
Restarting	
4.6 Operation and monitoring	
Permitted number of starts	
4.7 Shutting down	
4.8 Dismantling	
5. Maintenance, Servicing	page 16
Stuffing boxes	

Operating Instructions

Mechanical seals
Oil changing
Grease lubrication
Couplings
Cleaning the pump

6. Longer periods of non-operation	page 17
6.1 Drained pumps	
6.2 Filled pumps	
7. Faults - Causes and Solutions	page 18
8. Repairs	page 21
9. Spare Parts, Spare Pumps	page 22
9.1 Spare parts	
Ordering spare parts	
9.2 Stand-by pumps	
10. Plant Manager List	page 23
11. Log Book	page 24
Appendix	

I. General

I.1 Foreword

This product complies with the safety requirements of EC Machinery Directive 89/392/EEC, 91/368/EEC, 93/44 EEC and the Austrian Machine Safety Order (MSO) of 27 April 1994.



The staff employed on installation, operation, inspection and maintenance must be able to prove that they know about the relevant accident prevention regulations and that they are suitably qualified for this work. If staff do not have the relevant knowledge, they should be provided with suitable instruction.

The operating safety of the pumps or units (i.e. pump plus motor) supplied is only guaranteed if these are used in accordance with the provisions given in the attached Data Sheet and/or Point 4 in „Installation and Operation“.

The operator is responsible for following the instructions and complying with the safety requirements given in these Operating Instructions.

Smooth operation of the pump or pump unit can only be achieved if installation and maintenance are carried out carefully in accordance with the rules generally applied in the field of engineering and electrical engineering.

If not all the information can be found in these Operating Instructions, please contact us.

The manufacturer takes no responsibility for the pump or pump unit if the Operating Instructions are not followed.

These Operating Instructions should be kept in a safe place for future use.

If this pump or pump unit is handed on to any third party, it is essential that these Operating Instructions and the operating conditions and working limits given in the Confirmation of Order are also passed on in full.

These Operating Instructions do not take into account all design details and variants nor all the possible chance occurrences and events which might happen during installation, operation and maintenance.

Alterations or changes to the machine are only permitted by agreement with the manufacturer. Original spare parts and accessories authorised by the manufacturer should be used for greater safety. We bear no responsibility for the consequences of using other parts.

We retain all copyright in these Operating Instructions: they are intended only for personal use by the owner of the pump or the pump unit. The Operating Instructions contain technical instructions and drawings which may not, as a whole or in part, be reproduced, distributed or used in any unauthorised way for competitive purposes or passed on to others.

I.2 Guarantee

The guarantee is given in accordance with our Conditions of Delivery and/or the confirmation of order.

Repair work during the guarantee period may only be carried out by us, or subject to our written approval. Otherwise the guarantee ceases to apply.

Longer-term guarantees basically only cover correct handling and use of the specified material. The guarantee shall not cover natural wear and tear and all parts subject to wear, such as

Operating instructions

impellers, shaft sealings, shafts, shaft sleeves, bearings, wear rings etc., or damage caused by transport or improper handling.

In order for the guarantee to apply, it is essential that the pump or pump unit is used in accordance with the operating conditions given on the type plate, confirmation of order and in the Data Sheet. This applies particularly for the endurance of the materials and smooth running of the pump and shaft sealing.

If one or more aspects of the actual operating conditions are different, we should be asked to confirm in writing that the pump is suitable.

1.3 Safety regulations

These Operating Instructions contain important instructions which must be followed when the pump is assembled and commissioned and during operating and maintenance. For this reason, these Operating Instructions must be read by the skilled staff responsible and/or by the operator of the plant before it is installed and commissioned, and they must be left permanently ready to hand at the place where the pump or pump unit is in use. The operator must ensure that the contents of the Operating Instructions are fully understood by the staff. The operator must confirm this by signing the „Plant Manager List“ (see Point 10). These Operating Instructions do not refer to the General Regulations on Accident Prevention or local safety and/or operating regulations. The operator is responsible for complying with these (if necessary by calling in additional installation staff).

The safety instructions contained in these Operating Instructions have the following special safety markings as specified in DIN 4844:



Warning against personal accidents which could occur if the safety instructions given in this part of the Operating Instructions are not followed.



Warning against dangerous electrical voltage.

**Please
note**

Warning against possible damage to property or the environment.

It is absolutely essential that safety information affixed directly to the pump or pump unit is followed and maintained so that it is always easily legible.

1.4 Safety instructions

Dangers of not following safety instructions

Failure to follow the safety instructions can result in the following, for example:

- People being at risk because of electrical, mechanical and chemical factors.
- Important functions of the pump or pump unit failing.
- Dangers to the environment as a result of dangerous substances leaking out.

Operating instructions

Safety instructions for the operator

- Depending on the operating conditions, wear and tear, corrosion or age will limit the working life of the pump/pump unit, and its specified characteristics. The operator must ensure that regular inspection and maintenance are carried out so that all parts are replaced in good time which would otherwise endanger the safe operation of the system. If abnormal operation or any damage are observed, the pump must cease operation immediately.
- If the breakdown or failure of any system or unit could lead to people being hurt or property being damaged, such system or unit must be provided with alarm devices and/or spare modules, and they should be tested regularly to ensure that they function properly.
- If there is any risk of injury from hot or cold machine parts, these parts must be protected against contact by the user, or suitable warning signs must be affixed.
- Contact protection on moving parts (e.g. coupling guards) must not be removed from systems that are in operation.
- If dangerous media (e.g. explosive, toxic, hot) leak out (e.g. from shaft seals), these must be directed away so that there is no danger to people or the environment. The provisions of the law must be observed.
- Measures should be taken to exclude any danger from electricity (e.g. by complying with the local regulations on electrical equipment). If work is carried out on live electrical components, they should be unplugged from the mains or the main switch turned off and fuse unscrewed. A motor protection switch is to be provided.
- Basically, all work on the pump or pump unit should only be carried out when the pump is stationary and not under pressure. All parts must be allowed to return to ambient temperature. Make sure that no-one can start the motor during such work. It is essential that the procedure for stopping the system described in the Operating Instructions is observed. Pumps or pump systems that carry media that are dangerous to health must be decontaminated before being taken apart. Safety Data Sheets for the various liquids handled. Immediately the work has been completed, all safety and protective devices must be replaced or restarted.
- Under EC Machinery Directives, every machine must be fitted with one or more emergency command devices by which situations which represent an immediate danger or which could later be dangerous can be avoided. This does not include machines in which the emergency switches cannot reduce the danger, either because they do not reduce the time required to stop the machine or because they do not allow the measures required by the danger to be taken. This emergency switch must:
 - have controls that are clearly marked, easy to see and within easy reach;
 - stop the dangerous movement as quickly as possible without causing any additional danger;
 - trigger any specified safety movements or allow these to be started up.If the emergency command device is no longer operated after an emergency „off“ switch has been triggered, this must be maintained by blocking the emergency command device until it is released again. It should not be possible to block the device without this triggering an emergency „off“ switch. It should only be possible to release the device through an appropriate action; this release should not start the machine up again - it should only make it possible to start it up again.
- If the power supply is interrupted or restored after being interrupted or if it is changed in any other way, this should not cause any danger (e.g. pressure surges).

Speed, Pressure, Temperature

Suitable safety measures must be taken at the plant to ensure that the speed, pressure and temperature of the pump and the shaft sealing do not exceed the limit values given in the Data Sheet. The given admission pressures (system pressures) must also be sufficiently high.

In addition, the pump must be protected against pressure surges such as can be caused by switching off the plant quickly (e.g. by non-return valve on the pressure side, flywheel, air vessel).

Permitted forces on flanges

Basically, the suction and pressure lines should be such that the forces on the pump are kept to a minimum. If this is not feasible, the figures given in the Appendix „Permitted forces and moments“ should not under any circumstances be exceeded.

NPSH

When entering the impeller, the liquid being handled must have a minimum pressure NPSH to prevent cavitation or breaking off of flow. This requirement is met if the unit NPSH value (NPSHA) is well above the pump NPSH value (NPSHR) under all operating conditions.

Attention must be paid to the NPSH value in particular when liquids close to boiling point are being handled. If the value falls below the pump NPSH value, this can lead to damage resulting from cavitation or serious damage from overheating.

The NPSHR for each pump type is given in the sheets of characteristic curves. We can supply leaflets for calculation of NPSH values on request.

Sealing, Flushing, Cooling

Suitable facilities for the regulation and monitoring of sealing, flushing or cooling are to be provided.

When handling dangerous liquids or if temperatures are high, care should be taken to ensure that the pump ceases operating if the sealing, flushing or cooling system fails.

Sealing, flushing and cooling systems must always be operational before the pump is started up. They should not be taken out of operation until the pump has stopped, provided that the nature of the operation allows this at all.

Minimum flows

If the pump is started against a closed pressure line valve, it should be noted that the power taken up by the pump is transmitted to the liquid handled in the form of heat. This can cause the liquid to heat up excessively within a relatively short time, which will then cause damage to the pump's internal fittings. After the pump has reached operating speed, the discharge valve should therefore be opened as quickly as possible. If operating conditions mean that $Q = 0$ is unavoidable, or if hot water is circulating, a free flow non-return valve, or, on smaller systems, a by-pass pipe, should be provided. We should be pleased to advise on determining the minimum flow or designing the by-pass line.

Protection against running dry

The pumps must not run dry under any circumstances, since overheating can damage pump components (e.g. mechanical seals).

Back flow

In systems where pumps are operating in closed circuits under pressure (gas cushions, steam pressure), the pressure of the gas cushion must not be reduced via the pump, since the back flow speed may be much higher than the operating speed, which would destroy the unit.

2. Description

2.1 Model

Model Pa: horizontal shaft with external bearing on both sides, pressure side drive normal design, rotating clockwise (seen from the drive side) with suction branch on left and discharge branch radially above. Grease lubrication (oil lubrication on 123 Pa).

Special versions: suction branch on right or radially above, oil lubrication, drive on suction side (anti-clockwise)

Please see the Data sheet and Appendices for the sectional drawings and index of parts for each pump, and the detail drawings of the shaft sealing.

2.2 Shaft Sealing

There are basically two methods of shaft sealing: the stuffing box and the mechanical seal. You will find the type of shaft sealing on your pump under the „Notes on construction“.

Instructions on packing a stuffing box and on installing and operating mechanical seals are given in the relevant detail drawings in the Appendix.

See Appendix, „Operations“, for when the stuffing boxes and mechanical seals should be used.

Please note

You will find more information on stuffing boxes and mechanical seals, and the risks of accidents that these may involve, under Point 4.6 „Operation and Monitoring“ and in Point 5 „Maintenance and Repairs“.

2.3 Bearings and Lubrication

The pump shaft is guided in oversized roller bearings. Your Data Sheet will tell you whether your pump is designed for grease lubrication or oil lubrication.

- Grease lubrication: standard design, except for 123 Pa
- Oil lubrication: standard design with 123 Pa, special design with 43 Pa up to 103 Pa

Oil lubrication

See Table of Lubricants T 011-007 in the Appendix for choice of oil and oil quality.

If the type of oil is changed, check that the new oil is compatible with the left-over oil.

Method of measurement	Level
Dip stick	between the minimum and maximum mark (make sure that dip stick is inserted correctly)
Oil sight glass	to middle
Oil level pipe	to marking

Bearing sizes and oil quantities

Pump size	Grease lubrication		Oil lubrication		Qty. of oil in litres
	Bearing type intake	Bearing type discharge	Bearing type intake	Bearing type discharge	
33 Pa	6305-2Z-C3	6305-2Z-C3	-	-	-
43 Pa *)	6306-2Z-C3	6306-2Z-C3	6306-C3	6306-C3	ca. 0.12
51 Pa *)	6307-2Z-C3	2x 7307 BG	6307-C3	2x 7307 BG	ca. 0.14
53 Pa *)	6307-2Z-C3	2x 7307 BG	6307-C3	2x 7307 BG	ca. 0.14
63 Pa *)	6307-2Z-C3	2x 7307 BG	6307-C3	2x 7307 BG	ca. 0.14
83 Pa *)	6308-2Z-C3	2x 7308 BG	6308-C3	2x 7308 BG	ca. 0.18
103 Pa *)	6308-2Z-C3	2x 7308 BG	6308-C3	2x 7308 BG	ca. 0.18
123 Pa	-	-	NU 310	2x 7310 BG	ca. 1.8

*) Standard design: grease lubrication
Special design: oil lubrication

The quantity of oil give applies for both bearing casings together.

Grease lubrication

Grease lubricants to be chosen from Table T 011-007 in Appendix.

The bearings are already filled with grease and are thus ready for use.

If the type of grease is changed, check that it is compatible with the left-over oil.

3. Transport, Handling, Storage

3.1 Transport, Handling

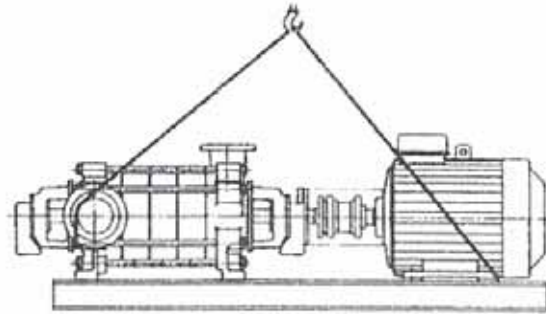
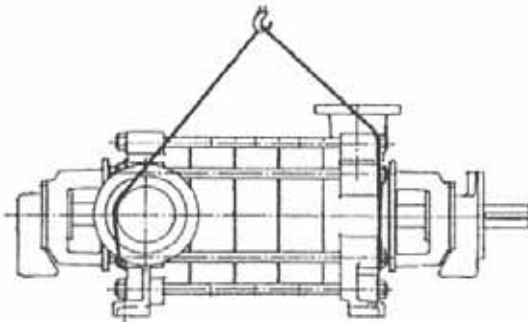
- Check the pump/pump unit immediately upon delivery/receipt of despatch for damage or missing parts.
- The pump/pump unit must be transported carefully and by competent personnel. Avoid serious impacts.
- Keep the pump/pump unit in the same position in which it was supplied from the factory. Take note of the instructions on the packaging.
- The intake and discharge side of the pump must be closed with plugs during transport and storage.

Please note

Dispose of all packing materials in accordance with local regulations.

- Lifting devices (e.g. fork-lift truck, crane, crane device, pulleys, sling ropes, etc.) must be sufficiently strong. The weight of the pump/pump unit is given in the Data Sheet.
- The pump/pump unit may only be lifted by solid points such as the casing, flanges or frame. The following illustration shows the correct method of carrying by crane.

Operating instructions



**Please
note**

Sling ropes must not be fixed to ends of shafts or the ring loops of the motor.



Do not stand underneath suspended loads; take note of the general regulations on prevention of accidents.



The pump/pump unit must be secured against tipping over and slipping until it has been fixed in its final location.

3.2 Storage

Pumps or pump units that are stored for a long time before use must be protected against moisture, vibrations and dirt (e.g. by wrapping in oil paper or plastic sheeting). Pumps must basically be stored in a place where they are protected from the weather, e.g. under cover. During this time, all suction and discharge branches and all other intakes and outlets must be closed with dummy flanges or plugs.

4. Installation, Operation

4.1 Assembly and connection of pump

The pump and motor (= pump unit) must be provided with a shared foundation base made in steel or cast iron or a welded steel profile frame where this does not exist already or if it is not included in the delivery. This foundation base must be placed on a foundation which can withstand all loads that arise during operation.

The size of the foundation and the location and size of the recesses for the foundation anchors are given in the dimension drawing, which is binding.

**Please
note**

Sufficient space must be provided for maintenance and repair work, especially for replacing the drive motor or the complete pump unit.

The motor fan must be able to take in enough cool air, and the intake grille must therefore be at least 10 cm away from any wall, etc.

Operating Instructions

To prevent vibrations being transmitted to adjoining components, the foundation should be laid on a suitable insulating base (panels providing insulation against structure-borne sound or vibration panels).

**Please
note**

The size of these insulating panels will vary, depending on circumstances, and should therefore be determined by an experienced specialist..

Concrete foundations must be completely set before the pump unit is installed. Place the pump unit on the foundation and level with a spirit level (on shaft or flange). Cast the joint between the foundation base and anchors and the foundation.

Note:

- Use jointing compounds that will not shrink and with sufficient resistance.
- Avoid air bubbles.
- Check that the compound has properly set and hardened.

After setting, tighten the foundation anchor evenly and firmly. Check alignment of pump unit and adjust if necessary; check that all screws between the pump/motor and the foundation base fit snugly.

4.2 Installation and Alignment of Coupling



*Make sure that nobody can start the motor during work on the coupling.
According to Accident Prevention Regulations, the pump unit may only be operated when the coupling guard is mounted.*

Installation

If the pump unit is not completely assembled until it reaches its place of use and no separate operating instructions have been supplied by the manufacturer, you should proceed according to the following points:

- Before starting installation, carefully clean shaft ends and coupling components.
- Pull coupling onto shaft end, do not hit. The coupling may be heated beforehand in an oil bath to approx. 100 °C (pulling on is then easier). Remove rubber packs from coupling section first.
- The coupling sections must be flush with the shaft end surfaces.
- Secure coupling hubs against axial sliding using a pin screw.

Alignment

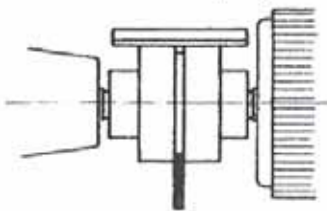
The following procedure should also be followed for pump units mounted complete on frames: check coupling again after installation on the foundation plate.

Operating instructions

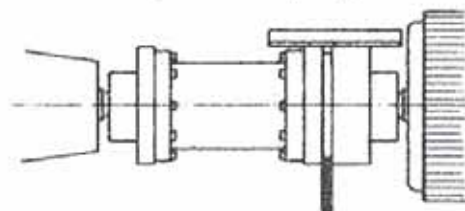
Adjustment using dial gauge:



Adjustment using precision ruler:
Normal coupling



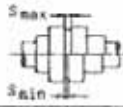
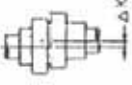

Expansion coupling



- Check/measure the alignment at several points using a precision ruler and sensor. If a dial gauge is used, one coupling side is to be turned.
- When aligning, keep the parallel and angular displacement of the shaft ends to a minimum. The alignment can be more precise if a dial gauge is used. The permitted displacement for your coupling is given in the following table (this only applies for couplings supplied originally by us). You will find the exact designation for your coupling on the Data Sheet.

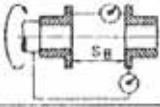
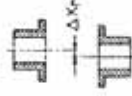
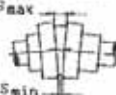
Permitted displacement for flexible couplings

Design ..GK, A..FK, B..FK, H..FK

Coupling size	H 80 FK	10 GK	H 95 FK	H 110 FK	12 GK	B 125 FK	H 125 FK	B 140 FK	H 140 FK	15 GK	B 160 FK	H 160 FK	B 180 FK	H 180 FK	B 200 FK	H 200 FK	B 225 FK	H 225 FK	B 250 FK	B 280 FK	A 315 FK	A 350 FK	A 400 FK
outer diameter of coupling [mm]	80	90	95	110	125	140	160	180	200	225	250	280	315	350	400								
axial distance S 	S _{max}	3			5			8															
	S _{min}	2			3																		
max. radial displacement ΔK_r 	0.1			0.2			0.3			0.4													
max. radial displacement S _{max} - S _{min} $\Delta K_W = S_{max} - S_{min}$ 	0.1			0.2			0.3			0.4													

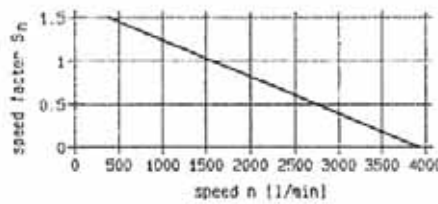
Operating instructions

Design NAN.. and NHN..

Coupling size	NHN 150 FK	NHN 180 FK	NHN 200 FK	NAN 215 FK	NHN 215 FK	NAN 235 FK	NHN 235 FK	NAN 250 FK	NHN 250 FK	NHN 270 FK	NHN 300 FK	NHN 320 FK	NHN 350 FK	NHN 370 FK
outer diameter of coupling [mm]	168	180	200	215	215	235	235	250	250	270	300	320	350	370
axial distance S 	S_n = nominal length of extension coupling ± 0.3 ± 0.4 ± 0.5 ± 0.6 ± 0.7													
max. radial displacement ΔK_r 	0.2					0.3								
max. radial displacement $S_{max} - S_{min}$ $\Delta K_w = S_{max} - S_{min}$ 	0.2		0.3					0.4						

The given values ΔK_r and ΔK_w apply for 1500 min⁻¹.

For all other speeds, the following applies:
 $\Delta K_w \cdot S_n$ bzw. $\Delta K_r \cdot S_n$



- Align the coupling again after pump has reached normal operating temperature and system pressure (if applicable), check once again and if necessary adjust. Read Point 4.5 „Starting up“ first.
- It must be possible to turn the unit by hand smoothly and easily.
- Mount coupling guard as shown in drawing no. 6396-312 (appendix).

Please note

The installation and alignment of the coupling must be carried out with the utmost care and attention, and the motor will then run more reliably and last longer. Badly aligned couplings cause noise, vibration and increased wear on bearings, couplings and shaft seals.

4.3 Connecting the pipes to the pump

Suction and discharge pipe

- The pipes must be of a size and design that liquid can flow freely into the pump and that the pump functions without problems. Particular attention is to be paid to ensuring that suction pipes are airtight and that the NPSH values are observed. Lay the suction pipe in the horizontal section towards the pump so that it is slightly inclined upwards so that no air pockets occur. In most cases, it is recommended that a non-return valve is installed in the discharge pipe shortly after the pump.
- When laying the pipes, make sure that the pump is accessible for maintenance and installation.
- Please note 1.4: „Permitted Forces on Flanges“.

Operating instructions

- Before connecting up to pump: remove protective coverings from suction and discharge branches.
- To protect the shaft sealing (especially mechanical seals) against foreign bodies, it is recommended that a sieve, 800 micron, is installed in the suction/intake pipe when the motor is being started up.
- Before starting up, the pipe system, fittings and equipment must be cleaned to remove weld spatter, scale etc.. Any pollutants are to be completely removed from pump units that are directly or indirectly connected to drinking water systems before being installed and taken into use.
- If the pipe system is tested with the pump installed, do not exceed the maximum permitted casing pressure of the pump and/or shaft sealing (see Data Sheet).
- When emptying the pipe after the pressure test, make sure that the pump is treated properly (danger of rust and problems when starting up).
- In the case of pumps with stuffing boxes, replace packing after pressure test (packing may be over-compressed and thus no longer suitable for use).

Auxiliary pipes

Any sealing, flushing or cooling pipe connections must be installed. Please consult the Data Sheet to see which pipes, pressures and quantities are necessary. The position and size of connections to the pump are given in the Appendix, „Summary of Screwed Connections“.

The relevant detail drawing of the shaft sealing contains a diagrammatic proposal for the pipework and fittings. This proposal does not take into account the safety requirements for each specific pump unit.

**Please
note**

Point 1.4, „Sealing, flushing, cooling“ must be observed as regards regulation and monitoring.

It is recommended that a pipeline is installed to take off any leakage from the shaft seal. For connection, see Appendix, „Summary of Screwed Connections“.

4.4 Electrical connection



Electrical connection work may only be carried out by an authorised professional. The rules and regulations valid for electrical technology, especially those concerned with safety measures, must be observed. The regulations of the national power supply companies operating in that area must also be observed.

Before starting work, check that the information on the motor rating plate is the same as the local mains network. The power supply cable of the coupled drive motor must be connected up in accordance with the wiring diagram produced by the motor manufacturer.

A protective motor switch is to be provided.

**Please
note**

The direction of rotation should only be checked when the pump is full. Dry running will cause damage to the pump.

Operating Instructions

4.5 Starting up



The plant may only be started up by people who are familiar with the local safety regulations and with these Operating Instructions (especially with the safety regulations and safety instructions given here).

In order to be able to observe and monitor the shaft sealing, no protective covering is provided in this area. If the pump is running, particular care should therefore be taken (watch out for long hair, loose pieces of clothing etc.).

Starting up for the first time

- If a pump is oil-lubricated, first open both oil drains „AS“ and drain off any liquid that may have collected (e.g. condensation). Close oil drains „AS“ and fill oil as described in Point 2.3 (for position of all secondary connections, see Summary of Screwed Connections in Appendix). Fill to level described in Point 2.3.
- For pumps with grease lubrication, no further lubrication is needed before initial start-up.
- Pump and suction pipe must be filled with liquid when starting up. When filling, open vent screw „LV“ on the first step casing (seen from the suction side).
- Turn pump unit once again by hand and check that it moves smoothly and evenly.
- Check that coupling guard is installed and that all safety devices are operational.
- Switch on any sealing, flushing or cooling devices that are provided. See Data Sheet for quantity and pressure.
- Open slide valve in suction /intake pipe.
- Set discharge side slide valve to approx. 25% of rated flow quantity. With pumps with a discharge branch rated width less than 200, the slide valve can remain closed when starting up (see also Point 1.4 „Minimum quantities“).
- Check direction of rotation by switching on and off briefly. It must be the same as the directional arrow on the bearing frame.
- Start drive device.
- As soon as it reaches normal operating speed, open discharge valve immediately and adjust the required operating point.
- Packing:
Packings need leakage to operate perfectly (liquid being handled to drip out).
To start with, set the leakage rate fairly high. During the first few hours of operation, slowly reduce the leakage rate as the pump is running by gradually tightening the packing gland (see item „69“ and „M2“ in the sectional drawing). The guideline value is around 10 drops/minute.

**Please
note**

Packings that run dry will harden and then destroy the shaft sleeve and/or the shaft.

Restarting

Basically, the same procedure should be followed as for starting up for the first time. However, there is no need to check the direction of rotation and the accessibility of the pump unit.

The pump should only be automatically restarted if it has been made sure that the pump has remained filled whilst lying idle.

4.6 Operation and Monitoring



Be particularly careful not to touch hot machine parts and when working in the unprotected shaft seal area. Remember that automatically controlled systems may switch themselves on suddenly at any time. Suitable warning signs should be affixed.

**Please
note**

Regular monitoring and maintenance will extend the life of your pump or pump system.

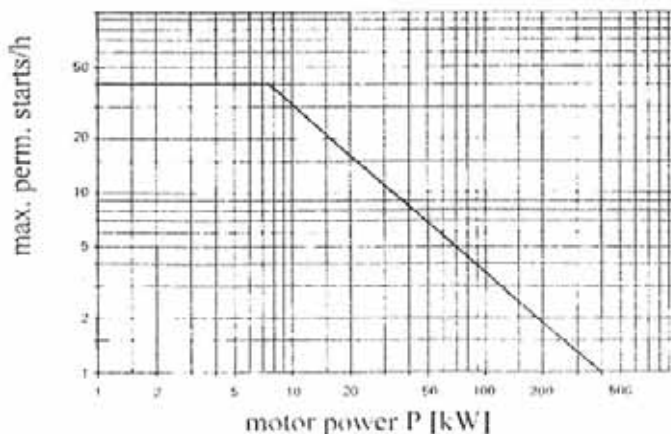
- You must observe the area of application given on the Data Sheet.
- Do not exceed the output given on the motor rating plate.
- Avoid dry running, running against closed discharge valves or operation whilst the liquid handled is in the vapour phase.
- Avoid sudden changes in temperature (temperature shocks).
- The pump and motor should run evenly and without vibrations; check at least once a week.
- The bearing temperature (measured on the bearing frame) should be max. 50 °C above ambient temperature and should not exceed 90 °C; check at least once a week.
- Check oil level at least once a week and top up if necessary.
- Check leakage rate from packings at least once a week (see Point 4.5 „Packings“).
- Check the regulating and monitoring facilities of any sealing, flushing or cooling systems once a week to ensure that they function properly. Outgoing cool water should be body temperature.
- Pumps which are exposed to corrosive chemicals or to wear through abrasion must be inspected periodically for corrosion or wear and tear. The first inspection should be carried out after six months. All further inspection intervals should be determined on the basis of the state of the pump.

Permitted number of starts

Do not exceed the pump's permitted number of starts - see diagram.

With electric motors, the permitted number of starts is given in the attached motor operating instructions.

If two different figures are given, the lower figure is valid.



4.7 Shutting down

- Close slide valve in discharge pipe. This is not necessary if there is a spring-loaded non-return valve.
- Switch of motor (make sure it runs down quietly).
- Close slide valve on suction side.
- Close auxiliary systems. Do not shut down cooling system until pump has cooled down.
- If there is any risk of freezing, empty pump, cooling areas and pipes completely.

If the pump also remains under operating conditions (pressure and temperature) when stationary: leave all sealing, flushing and cooling systems switched on.

The shaft sealing must remain sealed if there is a risk of air being sucked in (in the event of supply from vacuum systems or parallel operation with shared suction pipe).

4.8 Dismantling



The operator's or manufacturer's fitters should be informed as to the nature of the liquid handled. In the case of pumps handling dangerous liquids, the liquid handled should be disposed of by environmentally acceptable means before the pump is dismantled.

- Before starting to disassemble the pump unit make sure that it cannot be switched on again.
- The pump casing must be depressurised and empty.
- All valves in the suction, intake and discharge pipes must be closed.
- All components must have cooled down to ambient temperature.

5. Maintenance, Servicing



Work should only be carried out on the pump or pump unit when it is not in operation. You must observe Point 1.4 „Safety instructions“.

**Please
note**

Maintenance and servicing work must only be carried out by trained, experienced staff who are familiar with the contents of these Operating Instructions, or by the Manufacturer's own service staff. The work carried out must be duly entered in the „Log Book“ (see Point 11) and confirmed by being signed.

Stuffing boxes

Stuffing boxes require constant maintenance (see also Point 4.5, „Starting up for the first time“). If the leakage rate can no longer be set correctly, the packing is worn out and must be replaced in good time (increased wear on shaft sleeve and/or shaft).



Because of the risk of accidents, addition of packing to pumps during operation or at operating pressure or temperature is strictly forbidden.

Operating instructions

Mechanical seals

If the liquid being handled drips out at the mechanical seal, it is damaged and must be replaced.



Before opening the pump, it is essential that you note Point 1.4 „Safety Instructions“, Point 4.8 „Dismantling“ and Point 8 „Repairs“.

Oil changing

(only with oil-lubricated pumps)

- After the first 200 operating hours, drain off the oil (oil drains „AS“) and rinse with fresh oil. Close oil drains „AS“ again and fill in oil at connections „FS“ (for all connections, see „Summary of Screwed Connections“ in Appendix) in accordance with Point 2.3. Fill to level described in Point 2.3.
- After this, change oil every six months or every year (depends on air humidity).
- If the pump is left idle for any length of time, the oil should be changed after two years.
- For choice and quantity of oil, see Point 2.3 „Bearings and Lubrication“.

**Please
note**

Old oil should be disposed of in accordance with the valid national environmental regulations.

Grease lubrication

- Bearings on pumps that are lubricated for life require no maintenance.
- If the pump is left non-operational for any length of time, the grease in the bearings should be changed after four years.

Couplings

Check the play in the coupling components regularly approx. every 1000 operating hours.

**Please
note**

If wear is heavy, it must be assumed that the motor is not properly aligned with the pump or that the distance between the coupling sections has changed. Replace worn elements and re-install or adjust coupling, as described in Point 4.2.

Cleaning the pump

Dirt on the outside of the pump has an adverse effect on transmission of heat. The pump should therefore be cleaned with water at regular intervals (depending on the degree of dirt).

**Please
note**

The pump should not be cleaned with pressurised water - water will get into the bearings

6. Longer periods of non-operation

**Please
note**

After long stationary periods, packings may have hardened; these must be replaced before start-up. When starting up, follow the instructions for starting up for the first time (see Point 4.5)!

Operating Instructions

6.1 Drained pumps

- Turn by hand at least 1x week (do not switch on because of dry running).
- If necessary, unblock by tapping gently on the shaft in axial direction.
- Replace bearing oil after 2 years or grease after 4 years.

6.2 Filled pumps

- Switch stand-by pumps on and immediately off again once a week.
- If the stand-by pump is at operating pressure and temperature:
leave all sealing, flushing and cooling systems switched on.
- Replace bearing oil after 2 years or grease after 4 years.
- Do not tighten the stuffing box until there are no leaks.

7. Faults - Causes and Solutions

The following notes on causes of faults and how to repair them are intended as an aid to recognising the problem. The manufacturer's Customer Service Department is available to help repair faults that the operator cannot or does not want to repair. If the operator repairs or changes the pump, the design data on the Data Sheet and Points 1.2-1.4 of these Operating Instructions should be particularly taken into account. If necessary, the written agreement of the manufacturer must be obtained.

Faults	Code no. for cause and method of repair
Discharge too low	1, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17
Discharge stops after a time	8, 10, 11, 12, 30
Head too low	2, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 30, 34
Head too high	3, 5, 34
Drive mechanism overloaded	2, 3, 5, 15, 16, 25, 27
Pump not running quietly	7, 10, 14, 22, 23, 24, 25, 29, 30, 33
Temperature in the pump too high	7, 10, 30
Temperature in the shaft sealing too high	17, 18, 19, 20, 21
Temperature at the bearing too high	2, 14, 23, 24, 25, 26, 29, 31, 32
Pump leaking	25, 28
Leakage rate at shaft sealing too high	16, 19, 20, 21, 22, 23, 25

Meaning of code number for cause and method of repair

1. Back-pressure too high
 - open discharge valve further
 - reduce resistance in discharge pipe (e.g. clean filter if necessary)
 - use larger impeller (note available motor power)
2. Back-pressure too low, discharge too low
 - throttle discharge valve

WHEN SPEED IS TOO LOW

3. Speed too high
 - reduce speed
 - compare speed of motor with specified pump speed (rating plate)
 - when adjusting speed (frequency transformer) check reference value setting
4. Speed too low
 - increase speed (check available motor power)
 - compare speed of motor with specified pump speed (rating plate)
 - when adjusting speed (frequency transformer) check reference value settings
5. Impeller diameter too large
 - use smaller impeller
6. Impeller diameter too small
 - use larger impeller (check available motor power)
7. Pump and/or pipes not completely filled with liquid
 - fill
 - vent
8. Pump or suction/intake pipe blocked
 - clean
9. Air pocket in pipeline
 - vent
 - improve course of pipe
10. NPSH of system too small
 - increase liquid level
 - increase admission pressure
 - reduce resistance in the intake/suction pipe (change course and rated width, open shutoff valves, clean filters)
11. Air being sucked in
 - increase liquid level
 - check suction pipe is vacuum-tight
 - provide spindles in suction pipe fittings with water seal
12. Air being sucked in through shaft sealing
 - clean sealing pipe
 - increase sealing pressure
 - replace shaft sealing
13. Direction of rotation is wrong
 - swap over two phases of power supply (to be done by a specialist electrician)

Operating instructions

14. Inner components suffering from wear
 - replace worn parts
15. Density and/or viscosity of liquid handled is too high
 - seek assistance
16. Stuffing box not straight
 - tighten evenly
17. Stuffing box too tight
 - loosen
18. Shaft sealing worn
 - tighten packing
 - replace packing and/or mechanical seal
 - check sealing, flushing and cooling pipes (pressure)
 - avoid dry running
19. Lines and roughness on shaft or shaft sleeve
 - replace parts
20. Unsuitable packing material
 - use suitable material (check shaft or shaft sleeve for damage beforehand)
21. Deposits on mechanical seal
 - clean
 - replace mechanical seal if necessary
 - if necessary provide additional rinsing or quench
22. Impeller out of balance
 - remove blocks/deposits
 - replace if broken or unevenly worn
 - check shafts to ensure that they are running true
23. Coupling not aligned
 - align pump unit better
24. Coupling distance too small
 - change
25. Forces in pipeline too high (pump unit under strain)
 - change (support pipes, use compensators, etc.)
 - is foundation plate/frame properly cast in place?
26. Too much, too little or the wrong type of lubricant
 - change

Operating Instructions

27. Electricity supply not right
 - check voltage of all phases (2-phase running)
 - check cable connections
 - check fuses
28. Sealing insufficient
 - tighten screws
 - replace sealing
29. Bearing damaged
 - replace
 - check lubricant and bearing space for pollutants (rinse oil area)
30. Discharge too small
 - increase minimum amount carried (open slide valves, bypass)
31. Discharge too high
 - reduce amount carried (throttle slide valve)
32. Relief fittings insufficient
 - clean relief openings in impeller
 - replace worn parts (impeller, split rings)
 - adjust in line with the system pressure/intake pressure given on ordering
33. System-related vibrations (resonance)
 - seek assistance
34. Manometer indicator wrong
 - check manometer
 - get rid of blockages
 - put manometer in suitable place (no flow distortion or burbling)

8. Repairs



Repairs to the pump or pump system may only be carried out by authorised skilled personnel or by the manufacturer's specialist staff.

We would be pleased to send you detailed repair instructions on request. Trained Customer Service engineers are available to assist with installation and repair work on request.

When removing the pump, you must comply with Point 1.4 „Safety instructions“, Point 3.1 „Transport, Handling“ and Point 4.8 „Dismantling“.

9. Spare Parts, Spare Pumps

9.1 Spare parts

Spare parts should be selected to last for two-years continuous operation.

If no other guidelines are applicable, we recommend that you stock the number of parts listed below (in accordance with VDMA 24296).

spare part	Number of pumps (incl. stand-by pumps)							
	2	3	4	5	6/7	8/9	10/more	
	number of spare parts							
impeller	i	i	i	2i	2i	3i	30%	
diffuser	i/2	i/2	i/2	i	i	3i/2	15%	
wear ring-casing	2i	2i	2i	4i	4i	6i	30%	
shaft with key and shaft screws/nuts	1	1	2	2	2	3	30%	
bearing (roller bearing)	1	1	2	2	2	3	30%	
shaft sleeve	2	2	2	3	3	4	50%	
packing rings	16	16	24	24	24	32	40%	
joints for pump casing	sets	4	6	8	8	9	12	150%
other joints	sets	4	6	8	8	9	10	100%
mechanical seal		2	3	4	5	6	7	90%

i=no. of steps

Please note

To ensure optimum availability, we recommend that suitable quantities of spare parts are held in stock, especially if these are made from special materials and in the case of mechanical seals, because of the longer delivery times.

Ordering spare parts

When ordering spare parts, please supply the following information:

- Type: _____ Order no.: _____
- Part designation _____ in sectional drawing _____

All the information is given in the Data Sheet and the relevant sectional drawing.

9.2 Stand-by pumps



It is essential that a sufficient number of stand-by pumps are kept ready for use in plants where failure of a pump could endanger human life or cause damage to property or high costs. Regular checks should be carried out to ensure that such pumps are always ready for use (see Point 6.2).

Operating instructions

10. Plant Manager List

Each plant manager should sign below to confirm that he has received, read and understood these Operating Instructions. He undertakes to follow the instructions conscientiously. If these instructions are not followed, the manufacturer's guarantee and liability shall cease to apply.

Name:	Date:	Signature:

Operating Instructions

11. Log Book

Each plant operator shall duly enter all maintenance and service work that has been carried out, and shall see that the person responsible confirms such work by signing below.

maintenance work:	Date:	Signature Plant operator	Confirmed by person responsible: