Operating and Maintenance Instructions

Screw pumps with magnetic drive
Series SN...AR.. and SM...AR..
Design GM..

Order no.: Pump ident. no.: Machine no.: Pump type:

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Persons with a Pacemaker must not install service or operate the pump!

These Operating and Maintenance Instructions contain information from the pump manufacturer. They may need to be supplemented by instructions of the operator company for its personnel. These instructions do not take account of specific information relating to operation and maintenance of the process plant into which the pump is integrated. Such information can only be given by the persons responsible for construction and planning of the plant (plant manufacturer). Such specific instructions relating to operation and maintenance of the process plant into which the pump is integrated have priority over the instructions of the pump manufacturer.

Refer to the operating instructions of the plant manufacturer!
1 General

1.1 Abbreviation
The abbreviation of the screw pump is set up according to the following schema, and is engraved on the type plate.

Example:

Series

Type series
SN = Low pressure
SM = Medium pressure

Design
H = Horizontal foot pump
GH = Horizontal foot pump
E = Cartridge–unit pump for H and GH pumps
F = Flange pump
GF = Flange pump
S = Plinth pump
GS = Plinth pump
EF = Cartridge–unit pump for F, GF, S and GS pumps

Size
= theoretic delivery in [l/min] with normal pitch and 1450 l/min

Type of driving spindle

Direction of screw pitch
R = right (serial design)
L = left

Angle of screw pitch [degrees]

Special design feature
G = Slide bearing
M = Magnetic drive

Magnetic drive size

Magnets fitted
(total length of magnets in cm)

Casing heating
E = Heating bars, electric
P = Heating cartridge for steam or heat carrier
X = Heating shell for steam or heat carrier
Y = Double shell for steam or heat carrier

Material code

1.2 Application and range of utilization
The inside–bearing screw pumps of type series SN...AR..GM... and SM...AR..GM... are three–screw, rotary positive displacement pumps for lubricating liquids which – because of certain characteristic features (e.g. toxic, malodorous, detrimental to health) – call for the service of pumps without shaft seal. The liquids must not contain any abrasive particles nor chemically attack the pump/magnetic drive materials. Due to a modular system, the pumps may be designed as cartridge–unit pumps, horizontal foot–mounted pumps, flange–mounted pumps as well as vertical plinth–mounted pumps.

1.3 Performance data
The exact performance data applicable to the pump can be taken from the order data sheet and/or acceptance test report, and are engraved on the name plate.

The pressure data indicated there apply only to approximated static pressure load. In the case of dynamic alternating static pressure load, consult the manufacturer.

1.4 Warranty
Our warranty for shortcomings in the supply is laid down in our delivery conditions. No liability will be undertaken for damages caused by non–compliance with the operating instructions and service conditions. If at any later date the operating conditions change (e.g. different fluid conveyed, speed, viscosity, temperature or supply conditions), it must be checked by us from case to case and confirmed, if necessary, that the pump is suited for those purposes. Where no special agreements were made, pumps supplied by us may, during the warranty period, only be opened or varied by us or our authorized contract service workshops; otherwise our liability for any defects will cease.

1.5 Testing
Prior to leaving our factory, all pumps are subjected to a thorough test run and performance test on the test stand. Only properly operating pumps, achieving the performance assured by us, leave the factory. Thus, compliance with the following operating instructions ensures fault–free operation and full delivery.

1.6 Availability
As a matter of principle, we recommend stocking replacement pumps and withdrawal units (hydraulic action system) where the supplied pumps are a decisive factor in maintaining a production or delivery process. In this way downtimes can be avoided, or reduced to a minimum.
2 Safety

These operating instructions contain basic safety instructions for installation, operation and maintenance. It is therefore essential that they are read by fitters and all specialist staff and customer personnel prior to installation and start-up. They must always be kept at hand at the place of installation.

The special safety instructions contained in the other chapters must be observed in addition to the general safety instructions in this chapter.

2.1 Identification of safety instructions in the operating manual

The safety instructions contained in these operating instructions which represent a danger to personnel if not complied with are specially marked by the general danger symbol:

![Warning symbol as per DIN 4844–W9](image)

Warning of danger from electric voltage is indicated as follows:

![Warning symbol as per DIN 4844–W8.](image)

Instructions which are essential to avoid endangering the machine and its operation are marked by the word **ATTENTION**

Instructions affixed directly to the machine such as

- Directional markers
- Signs for fluid connections

must always be observed and maintained in fully legible condition at all times.

2.2 Personnel qualification and training

The operating, maintenance, inspection and mounting personnel must be appropriately qualified for the duties assigned to them. The scope of their responsibilities, competency and supervisory duties must be closely controlled by the customer. If the personnel do not have the required knowledge, they must be trained and instructed. If required, this may be provided by the manufacturer/supplier on behalf of the customer. The customer must additionally ensure that personnel fully understand the content of the operating instructions.

2.3 Dangers in the event of non-compliance with safety instructions

Failure to comply with the safety instructions may result in danger to persons, and place the environment and the machine at risk. Non-compliance with the safety instructions will lead to the loss of any claims for damages. Non-compliance may result in the following dangers:

- Failure of important functions of the plant
- Failure of specified methods for maintenance and servicing
- Danger to persons resulting from electrical, mechanical and chemical effects
- Danger to the environment resulting from leakage of hazardous substances

2.4 Responsible working practices

The safety instructions contained in these operating instructions, current national accident prevention regulations, as well as internal working, operating and safety rules of the customer, must be observed.

2.5 Safety instructions for the user/operator

- Hot or cold machine parts representing a danger must be protected against accidental contact on site.
- Protection against accidental contact for moving parts (such as the coupling) must not be removed while the machine is in operation.
- When operating pump aggregates in a dust-laden environment (e.g. milling, chipboard manufacture, bakeries), the surfaces of the pumps and motors must be cleaned at regular intervals, depending on local conditions, in order to maintain the cooling effect and eliminate the possibility of spontaneous combustion. Please also see explosion protection regulations (ZH 1/10).
- Leakage (e.g. from the shaft seal) of hazardous substances being handled, such as explosive, toxic or hot materials, must be discharged in such a way that no danger to persons or the environment is created. Legal regulations must be observed.
- Dangers from electrical energy must be eliminated. For details in this regard, please refer to VDE and local power company regulations.
2.6 Safety instructions for maintenance, inspection and installation
The operating company must ensure that all maintenance, inspection and installation tasks are performed by authorized and qualified specialist personnel who have thoroughly studied the operating instructions.
Work on the machine is only to be carried out when the machine is at a standstill. The procedure for shutting down the machine described in the operating instructions must always be followed.
Pumps or aggregates handling fluids which are detrimental to health must be decontaminated. All safety and protective devices must immediately be refitted and made operational on completion of the work. The instructions under Section 6.1, "Preparation for start-up", must be observed before restarting.

2.7 Unauthorized conversion and production of replacement parts
Conversion or modification of the machines is only permissible after consultation with the manufacturer. Original replacement parts and accessories approved by the manufacturer are intrinsic to safe operation. If other parts are used the manufacturer cannot be held liable for the consequences.

2.8 Unacceptable modes of operation
The operational safety of the machine supplied is only ensured when it is used in accordance with Section 1 of the operating instructions. The limit values given on the data sheet must not be exceeded under any circumstances.

3 Transportation and Intermediate Storage

3.1 Packaging
Attention must be paid to the markings on the packaging. The suction and pressure sides and all auxiliary connections must always be closed during transportation and storage. The closing plugs must be removed when the pump aggregate is installed.

3.2 Transportation
The pump or pump aggregate is to be safely transported to the place of installation, if required by means of lifting gear.
The generally applicable safety regulations for lifting loads must be observed. The crane device and cables must be adequately dimensioned. The cables must not be attached to the attachment eyes of the motor.
Complete aggregates, with a base plate–mounted horizontal foot pump and mounted, coupled motor, must be transported to the place of installation as shown in the illustration.

Fig. 1: Transportation of a horizontally mounted pump aggregate

In the case of vertically and horizontally mounted flanged pump aggregates, it is advisable to attach the cables to the wall/foot lantern or intermediate fitting lantern (not shown).

During transportation ensure that the aggregate is secured against toppling over. The attachment eyes of the motor can be used to secure it.

Transport damage

Check the pump for damage on receipt. Any damage detected must be notified immediately.
3.3 Preservation and storage of the screw pumps

3.3.1 Preservation
In the case of storage or prolonged standstill, the pumps must be protected against corrosion. In those cases, an outside and inside preservation is to be provided. The durability of the protection against corrosion, which is limited in time, depends on the composition of the preservative to be applied and the storage conditions.

Under normal circumstances the pumps have no special preservative.
At an additional charge we can, however, supply pumps and replacement parts ex factory with a preservative adequate to the planned storage period.

We will be pleased to specify suitable preservatives for you on request.

3.3.1.1 Outside preservation
The outside preservative should be applied by painting or spraying with a spray gun.

Points of preservation:
All bright and unvarnished parts (e.g. shaft ends, couplings, flange facings, valve and manometer connections).

3.3.1.2 Inside preservation
The preservative is to be applied by filling the pump. For these purposes, the suction side of the pump must first be closed with a dummy flange. During filling, the pressure flange must be on a higher level than the suction flange. During the filling process, the shaft must be slowly cranked against the direction of rotation. Filling must be continued until the preservative reaches the sealing strip of the delivery flange, bubble–free. Then the outlet side is to be closed with a dummy flange.

Note: Not required for pumps made of stainless materials.

Points of preservation:
All bright parts inside the pump (e.g. pump casing inside, screw spindles, ball bearings, pressure–relief valves).

3.3.1.3 Monitoring of preservation
In the event of prolonged storage, the preservation of the pump must be checked by the customer at regular intervals. Every six months the pump level must be checked; if necessary, preservative must be topped up to the sealing strip on the pressure flange. At the same time, the packing must be checked for destruction, and repaired if necessary.

Note: Liability for damages caused by improper preservation cannot be assumed by us.

3.3.1.4 Depreservation
Prior to setting the pump in motion, the preservative applied must be removed.

Environmentally compatible disposal must be ensured.
The preservative applied for inside preservation can normally be removed by flushing the pump with the fluid to be conveyed. Alternative, suitable solvents may be applied for removing the inside and outside preservation. Appropriate solvents are for example: petroleum, benzene, Diesel fuel, spirit, alkalis (industrial cleaners) or any other wax solvents. Steam jet cleaning devices with appropriate admixtures can also be used (allow wax solvent to act beforehand).

Prior to start–up after prolonged storage, all elastomers (O–rings, shaft seals) must be checked for their elasticity of shape. Embrittled elastomers must be exchanged. Elastomers of ethylene–propylene rubber (EPDM) must always be replaced. The pump must be filled with fluid to prevent seizing of the components. A pressure–relief valve attached or fitted in the pipeline must be checked for passage.

Note: If on the plant side, the pipelines, (oil) tanks or other parts are wetted with paraffin–containing preservative, the entire plant must be depreserved as paraffin is detrimental to the air separating capability of oil. This may result in unsteady operation of the pump and loud noise.

3.3.2 Storage
During storage of the pump, the suction and outlet branches and all other supply and discharge branches must always be closed with dummy flanges or dummy plugs.

Storage should be in a dry, dust–free room. During storage, the pump should be cranked at least once a month. During this process, parts such as the shaft and bearings should change their position.
4 Description

4.1 Structural design

4.1.1 Screw pump

Three-screw pumps in horizontal and vertical design form, with a double-threaded driving spindle and two double-threaded idler spindles, enclosed in a housing insert with narrow running clearance. The delivery elements are installed in a pump housing which is closed off on the drive side and the end side by pump caps.

4.1.1.1 Bearing and lubrication

By a medium-lubricated axial/radial silicon carbide compact slide bearing.

4.1.1.2 Pipeline and auxiliary connections

For execution, branch positions and dimensions of all connections, see order-specific installation drawing.

4.1.1.3 Heating

Where heavy heating oils or other fluids which tend to solidification when cooling are to be pumped, the following equipment is available for pump heating.

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<th>Heating electrical</th>
<th>Heating with steam or heat carrier</th>
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① Only pumps of steel-welded construction are fitted with a heating jacket.

For further details on pump heating and the necessary heating capacity, refer to our specific brochure VM 4.70/Z.–Nr. 6000002024.

4.1.1.4 Pressure relief valve

For safety reasons, screw pumps must generally be equipped with a pressure relief valve.

Most pumps are already equipped with a pressure relief valve when they leave the factory. The standard trigger pressure of this valve is approximately 10% above the operating pressure. Pumps that are supplied without a pressure relief valve must be provided with a suitable safety valve by the customer. The safety valve must be fitted in the discharge pipeline between the pump and the first shut-off device.

4.1.2 Magnetic drive

The magnetic drive is flanged onto the screw pump by way of an intermediate cover on the drive side. The driving spindle of the pump is rigidly connected to the rotor of the magnetic drive by way of a driver-type fastening.

4.1.2.1 Bearing bracket

The driving shaft with the bolted-on outer magnet rotor is borne by a one-piece bearing bracket in amply dimensioned lifetime lubricated roller bearings. The lifetime lubrication is not harmful to the environment.

4.1.2.2 Can/Sealing

Rows of permanent magnets of alternating polarity are arranged on the outer magnet rotor which is supported in roller bearings. Separated by the stationary can, the inner magnet rotor with matching magnet assembly fits concentrically into the outer magnet rotor. The can hermetically seals the rotor space exposed to the delivery medium from the non-exposed driving part.

4.2 Mode of operation

4.2.1 Screw pump

Through the suction connection, the fluid is conveyed into the suction chamber of the pump. From there the fluid flows into the spindle chambers, which are constantly formed by the rotary motion at the spindle end on the suction side. By the translatory rotary motion, the chambers filled with the fluid move from the suction side to the outlet side. During this process the closed chamber volume does not change. At the spindle end on the outlet side the chamber opens towards the delivery chamber. The fluid is steadily pushed out into the delivery chamber from where it is transported, through the pressure connection, into the pressure pipeline.

The axial thrust acting on the faces of the profile flanks on the outlet side is hydraulically balanced by an appropriate dimensioning of the compensating piston of the driving spindles and the compensating journals of the idler spindles. Thus the bearing is relieved of the hydraulic axial thrust.

The idler spindles are hydraulically driven by means of appropriate dimensioning of the spindles. Only the torque resulting from the fluid friction is transmitted via the profile flanks. They are therefore practically stress-free, and not subject to any wear. As a result of the constant chamber volume the medium inside the pump is transported, almost entirely free of turbulence and squeezing, from the suction side to the outlet side.

The structural design and mode of operation of the screw pump ensure a very low noise level and an almost pulsation-free delivery.

4.2.2 Magnetic drive

The torque is transmitted, without contact, from the prime mover onto the pump via the magnetic field lines between the outer and inner magnet rotors. By variation of the magnet assembly, the transmitted power can be adapted to operational requirements. The magnet material is cobalt-samarium. In addition to a very high energy density, this material is also highly temperature-resistant. In operation, the prime mover and the pump rotate at the same speed. This also applies to the run-up and run-down phases.

Overloading of the magnetic drive causes the outer magnet rotor to race. Briefly switching it off re-synchronizes it, and the pump can be restarted. Racing for a short time does not lead to demagnetization or damage the magnets.
The magnets in the medium are encapsulated and thus protected against any effects of the delivery medium. The heat dissipation within the magnetic drive is discharged by a fluid circulation device between the delivery and suction chambers.

### 4.3 Construction of the pump aggregate

#### 4.3.1 Drive

The pumps can be directly coupled with electric motors or any other prime movers. In most cases, surface-cooled three-phase squirrel cage induction motors are used as driving motors, type IM B3 or IM V1, class of protection IP 54 to IEC standard, class B insulation, outputs and main dimensions to DIN 42 673 or 42 677.

**ATTENTION** It must be ensured that the motor is balanced to the rated power of the magnetic drive. The magnetic drive may break away if the motor power is too high.

The exact motor data are to be found on the order data sheet.

#### 4.3.2 (Driving-) Shaft coupling and contact protection

Power transmission is effected via a flexible coupling to DIN 740. Additional radial forces must not act on the driving spindle.

Protection against accidental protection to **EN 809** is provided where the product package comprises a pump, base plate and shaft coupling, or where a wall/foot lantern or intermediate fitting lantern is supplied as part of the product package.

**According to accident prevention regulations, the pump must only be operated with a protection against accidental contact as per EN 809.**

If no contact protection is provided, it must be attached by the operator.

#### 4.3.3 Base plate

Horizontal foot pumps are mounted with the drive motor on a common base plate. Base plates can be provided in cast or steel design.

#### 4.3.4 Wall/foot lantern

Horizontally or vertically mounted flange pumps are connected to the drive motor by way of a wall/foot lantern.

#### 4.3.5 Fitting lantern

Fitting in fluid tanks is enabled by using fitting lanterns.

#### 4.3.6 Motor lantern/intermediate lantern

Vertically mounted plinth pumps are connected to the drive motor by way of a motor lantern or intermediate lantern. In the plinth pumps the end-side cover is executed as a round foot for vertical plinth mounting.
5  Installation/Mounting

5.1  Installation

The pumps can be horizontally or vertically mounted.

For safety reasons the "downward–facing motor" arrangement is not permitted.

5.2  Mode of fastening

The mode of fastening is dependent on the design type and size of the pump and the coupled motor, as well as local installation conditions.

Horizontal foot pumps are normally mounted with the drive motor on a common base plate. Flange pumps can be fastened by means of a wall/foot lantern, either horizontally or vertically, at the place of installation.

Vertical plinth pumps have a small installation area due to their design, and can also be fastened on a concrete foundation or foundation frame.

In the case of flange and insertion pumps which are installed in immersion bodies, tanks, cylinder housings etc., the fixing flange of the pump, together with the flange contact surface, provides a fastening option in the various executions.

Precise details on form and dimensions are given in the installation drawing.

5.3  Foundation

5.3.1  General

The foundation may be a floor/concrete base or a load–bearing steel foundation frame. 

Note: The foundation must be designed so it can take the weight of the pump aggregate across its entire area.

5.3.2  Characteristiques of a steel foundation frame

A steel foundation frame must be designed so that the base plate makes contact across its entire area, and can be bolted or welded down. 

ATTENTION: If the base plate is only supported at four points the pump aggregate will hang down in the middle. This will affect the alignment of the coupling and may also lead to severe noise being generated.

5.3.3  Characteristiques of a floor/concrete foundation

The foundation must be horizontal, flat and clean, and be capable of bearing the full load upon it.

Note: Concrete foundations must be executed with standard concrete of strength class B 25 as a minimum.

5.3.4  Alignment of the pump aggregate

The pump aggregate must be aligned to its pre–set height and system dimensions. This is done using suitable steel shims, arranged directly adjacent to each fixing bolt.

The total height of the steel shims is determined by the pre–set system dimensions of the plant. The steel shims and the base plate must sit flush.

If the fixing holes are more than 750 mm apart, we recommend fitting additional steel shims in the middle of the base plate.

5.4  Checking the coupling alignment

5.4.1  Checking the coupling alignment in case of horizontal setup on base plate (if used)

A complete delivered pump aggregate has been carefully assembled at the factory. After proper installation, and prior to start–up of the pump aggregate, the alignment of the coupling must be checked.

The measurements are taken in two planes, each offset by 90°, on the circumference of the coupling.

If a height, lateral or angle offset is detected between the two coupling halves, the drive motor should be re–aligned such that the coupling halves are flush with each other (level out with flat packing shims as necessary).

The gap between the two coupling halves must be the same all round the circumference of the coupling. The specified gap is shown in the installation diagram.

The spacing between the straight–edge laid over both coupling halves and the respective shaft must be the same all round the circumference.
5.5 Assembly of pump and motor
If the aggregate is only assembled at the place of use, the coupling is assembled as follows:

1. Coat the pump and motor shaft ends with a fine film of molybdenum disulfide (e.g. Molykote) and insert keys.

2. Push on the coupling halves on the pump and motor side with the aid of a pusher device until the shaft end is flush to the coupling hub. If no puller is available, heating the coupling halves to approx. 100 °C (without rubber buffer) facilitates pushing.

3. Tighten the grub screw on both coupling hubs.

4. When assembling the pump and motor, make sure the specified gap between the coupling halves is maintained (see our installation drawings).

5. In the case of horizontally mounted pump aggregates fixed on a base plate or directly on the foundation, the coupling must be aligned as described in Section 5.4. In the case of pump aggregates with flanged motor, the coupling does not need to be re-aligned.

6. Mount the contact protection. According to accident prevention regulations, the pump must only be operated with a protection against accidental contact.

5.6 Space required for maintenance and repair

The pump must be accessible from all sides in order to be able to carry out necessary visual inspections. Adequate space must be provided for maintenance and repair work, in particular for removal of the drive motor, the magnetic drive or of the cartridge–unit. It must also be ensured that all pipelines can be attached and removed without hindrance.

5.7 Laying the pipelines

5.7.1 Nominal widths
If possible, the nominal widths of the suction and pressure pipelines should be rated so that the rate of flow does not exceed a maximum of 1 m/s in the suction pipeline and 3 m/s in the pressure pipeline. If possible, suction pipelines laid “uphill” are to be avoided.

5.7.2 Change of cross–sections and directions
Sudden changes of cross–sections and directions, as well as hairpin bends, are to be avoided.
5.7.3 Supports and flange connections
The pipelines must be connected to the pump, stress-free. They must be supported close to the pump and must allow easy screwing-on to avoid twisting. When the connections are loosened the pipeline must neither be slanted nor springing, nor must it be under pressure. Any thermal stresses occurring on the pipelines must be kept away from the pump by suitable means, e.g. installing compensators.

5.7.4 Cleaning pipelines prior to attachment
Prior to assembly, all pipeline parts and valves must be thoroughly cleaned; especially in the case of welded pipelines, burrs and welding beads must be removed. Flange gaskets must not protrude inwards. Blanking flanges, plugs, protective film and/or protective paint on flanges and seals must be removed completely. Water residues, still in the pipeline network from pressing-out or steeping for example, must be removed.
Delivery of water destroys the pump. The pump relies on the fluid being conveyed for its lubrication.

5.7.4.1 Inlet/suction conditions (NPSH)
To ensure fault-free continuous operation, the inlet and suction conditions of the plant must be appropriately adjusted to the pump demand (NPSH req.)
The service condition is fulfilled when the plant NPSH value (NPSH avail.) is above the pump NPSH (NPSH req.). The NPSH req. is given in the characteristic sheets of the respective pumps.

ATTENTION When pumping air-laden or volatile liquids, particular attention must be paid to the NPSH requirements of the plant.

5.7.5 Stop valves
Stop valves are to be installed in the suction and pressure pipelines close to the pump.

5.7.6 Pressure–relief valve
See Section 4.1 ...

5.7.7 Check valve
It is recommended to install a check valve between the pressure connection of the pump and the stop valve in order to prevent the pump from running dry when it is at a standstill and the pressure stop valve is open.

5.7.8 Vent valve
A vent valve must be provided at the highest point in the pressure pipeline.

5.7.9 Filtering
To protect the pump against coarse dirt contamination, we recommend as a matter of principle installing a filter in the suction pipeline, mesh width 0.6 mm.

Note: The service life of the pump is decisively influenced by the degree of dirt contamination of the fluid being conveyed, that is, by the number, size and hardness of the abrasive components.

5.7.10 Auxiliary pipelines (if present)
All auxiliary pipelines must be connected in accordance with the installation drawing, stress–free and sealed.

5.8 Safety and control devices

5.8.1 Manometers
Suitable pressure gauges are to be installed in the inlet and pressure pipelines, and in the pressurized auxiliary pipelines.

5.8.2 Safety device in the pressure pipeline
ATTENTION For pumps delivered without a pressure–relief valve, an overload protection must be provided in the control, or a pressure–relief valve (return valve) in the pressure pipeline (see separate Operating Instructions).

5.9 Electrical connections
The power supply cables of the coupled drive motor must be connected by a trained electrician, according to the motor manufacturer’s circuit diagram. The applicable VDE regulations and local power company rules must be observed.
Danger from electrical energy must be eliminated.
6 Start–up/Shutdown

6.1 Preparation for start–up

6.1.1 Filling the pump with fluid

Prior to initial operation, the screw pump must be filled with fluid and bled. This at the same time provides the spindles with the sealing required for suction.

The pump must not run dry.

Before filling, the operator must ensure careful and thorough rinsing of the pump if the fluid to be conveyed is not chemically compatible with the test medium (see performance test report). The fluid is filled through a bore hole in the pump casing or via the pressure pipeline. The pump must be filled with fluid until the fluid emerges free from air. In the case of immersion pump aggregates the filling level must ensure adequate covering of the inlet rim before and during operation.

During bleeding of the pump and the plant, hazardous or environmentally harmful fluid and gas emerging must be safely collected and discharged.

6.1.2 Control of drive motor direction of rotation

The direction of rotation of the motor must match the direction of rotation arrow on the pump. The motor can be briefly switched on with the suction and pressure valves open to check the direction of rotation. If the direction of rotation is wrong there is no pump suction. This damages the pump. The direction of rotation of the three–phase motor can be reversed by swapping any two phases.

If the direction of rotation is to be checked before the pump is filled with fluid, the drive motor must be disconnected from the pump. The pump must not run dry.

6.1.3 Switching on any auxiliary devices

Before switching on the pump, any additional devices (e.g. heating, cooling, quench system, pressure relief system) must be set in operation and must have reached the necessary flow/temperature and pressure values.

Note: Ensure that flow/temperature and pressure values are in accordance with the order data sheet or manufacturer’s operating instructions!

6.2 Start–up

6.2.1 Starting

1. Prior to starting, the stop valves in the suction and pressure pipelines must be completely opened.

2. Where the pump is fitted with a pressure–relief valve, it is set on our test panel to respond 10% above the operating pressure. The opening pressure can be altered within narrow limits by means of an adjusting screw. The installation of a pressure–relief valve is always required when an impermissibly high pressure rise is possible, due to a stop device or throttle point in the pressure pipeline for example.

If the pressure–relief valve has a hand–wheel regulation, the pump can be started at zero pressure. For this, the pressure–relief valve must be completely opened using the hand–wheel. The starting torque of the motor is thereby reduced.

When starting and stopping the pump under pressure, make sure that the speed– and viscosity–dependent pressure load is not exceeded.

If this is not ensured, the pump must be started and stopped at zero pressure. This also applies to pumps with speed–controlled drive motors.

3. During starting, a vent valve installed on the outlet side of the plant must be opened until the air has escaped from the suction side of the pump. As soon as fluid emerges the vent valve can be closed. The pump is self–priming and is automatically vented without counter–pressure.

4. The fluid level in the tank must be checked. It must be ensured that, when the plant is running, the fluid level in the tank does not fall below the minimum limit. Top up fluid as necessary.

6.2.2 Drive

Switch on the motor. The pump and motor must run up synchronously.

Pay attention to product–specific characteristics. Refer to the operating instructions of the drive motor manufacturer.

Note: The magnetic drive was designed for the pump and the coupled drive motor. Under unfavorable conditions (e.g. system overvoltage) the maximum torque on the magnetic drive may be exceeded, especially when the pump is starting up, and in rare cases it could break away.

Overloading of the magnetic drive causes the outer magnet rotor to race; this does not cause damage or demagnetization.

Prolonged operation with the magnetic drive broken away may result in damage to the pump due to excessive heat build–up in the can. By shutting down the pump for a short time the magnetic drive can be re–synchronized and the pump then restarted.

6.2.3 Checking the delivery values

When the motor has reached its operating speed, the inlet pressure and outlet pressure of the pump must be checked using manometers.

For pumps fitted with a hand–regulated pressure–relief valve, the hand–wheel must be closed slowly beforehand, until the pump outlet pressure is reached. The motor must not be overloaded. The current consumption can be checked with an ammeter. In this connection, the temperature and viscosity of the fluid must also be checked. The readings must be checked against the layout or acceptance test report.

If there should be an inadmissible increase in pressure, mounted pressure–relief valves may shift the media from the discharge to the intake side (recirculation). Recirculation leads to heating up of the medium. An inadmissible pressure and temperature increase can be
indicated by a pressure gauge and a thermometer. Determine the cause immediately and eliminate it in order to avoid damage to the pump as the result of excessive heating up and the related drop in viscosity.

6.3 Shutdown

6.3.1 Stopping and interrupting operation

1. Switch off the motor. Make sure the pump runs down smoothly and evenly.

2. If a check valve is installed in the pressure pipeline, the stop valve can remain open. If no check valve is fitted, the stop valve must be closed.

3. Flush the pump, pressure relief valve and magnetic drive if need be (refer to Section “Flushing procedure”).

Note: If fluids which tend to polymerization, crystallization, solidification or the like are handled by the pump, the pump must be flushed out before each interruption of operation. The pump must also be flushed out when the fluid is changed. All interior areas of the pump, the pressure relief valve and the magnetic drive through which the delivery medium flows must be cleaned such that blocking deposits of solid matter are prevented. It is advisable to connect the pump to a separate flushing system. The pump should be flushed with a suitable solvent, to which some lubricant has been added, in order to ensure emergency functioning during flushing.

For delivery of polyhydric and isocyanates, the flushing agent must be free of water. Softeners, such as Mesamoll (supplier: BAYER), Genomoll (supplier: HOECHST) or Plantinol AH and Plastomol DIDA (supplier: BASF), are suitable as lubricating and flushing agents. Other equivalent softeners may also be used.

The flushing fluid is to be replaced when saturated. For prolonged downtimes, the interior of the pump should be filled with undiluted softener, and air humidity should be prevented from entering.

Flushing procedure

After stopping the motor and closing off the stop valves in the intake and delivery pipe, start the flushing system as follows.

1. Open the stop valve in the flushing system and start the motor.

2. Flush the pump, pressure relief valve and magnetic drive sufficiently (for approx. 15 minutes). The flushing pressure should be approx. 3 bar.

3. After flushing, stop the motor and close the stop valve in the flushing system.

4. Drain all flushing agent from the pump.

5. For prolonged downtimes, fill the pump with undiluted softener.

6.3.2 Measures in case of prolonged interruption

If a prolonged interruption is intended, the pump must be drained thoroughly via the connections on the pump casing.

Safe draining and environmentally compatible disposal of the fluid must be ensured.

Preservative should then be applied to the pump (see Section 3.3).
7 Maintenance/Repair

7.1 Maintenance

- The instructions in Section 2, Safety, must be observed in maintenance and repair work.
- Regular monitoring and maintenance of the pump and drive motor increases their service life.

The following instructions are generally applicable.

7.1.1 General monitoring

1. The pump and the magnetic drive must not run dry.
2. The drive motor must not be overloaded.
3. The pump and the drive motor must run in synchronism (refer to Section 6).
4. The bearing temperature on the driving shaft may be max. 50°C above room temperature, but must not exceed 80°C.
5. The suction and pressure pipelines must be checked for leaks. Air must be prevented from entering the delivery system.
6. Pressure and temperature monitors must be observed.

7.1.2 Maintenance of components

7.1.2.1 Bearing of the driving spindle of the pump

The built-in axial–radial compact slide bearing is maintenance-free. It is designed to match the service life of the pump under normal operating conditions.

7.1.2.2 Bearing of the driving shaft of the magnetic drive

The built-in groove ball bearings are maintenance-free. Both bearings are designed for a service life of approx. 24,000 hours under normal operating conditions. Against external influences such as dust, splash water, aggressive ambient air, to mention a few, the grooved ball bearings are additionally protected by cover disks and by a felt strip placed inside the bearing cover.

7.1.2.3 Pressure–relief valve

Pressure–relief valves must be checked from time to time, in particular after prolonged downtimes, for passage and functioning. Leaking pressure–relief valves may cause damage to the pump. Damaged parts should be replaced or repaired as necessary.

Note: Operating instructions for pressure–relief valves should be ordered separately.

7.1.2.4 Coupling

The alignment of the coupling and the condition of the flexible elements in the coupling should be checked after initial start–up and at regular intervals.

Note: Worn flexible elements must be replaced.

7.1.2.5 Drive

Refer to the operating instructions of the motor manufacturer.

7.2 Repair

General

Trained Service fitters are available on request to carry out mounting and repair work.

Where repairs are carried out by the operator’s own personnel or by specialist fitters, it must be ensured that the pump is fully drained and cleaned. This particularly applies to pumps which are sent for repair to our factory or one of our service workshops. We must refuse acceptance of repair work on pumps filled with fluid, for the protection of our staff and for environmental reasons. Otherwise we must invoice the customer/operator for the costs of environmentally compatible disposal.

Where repairs are to be carried out on pumps which have been operated with hazardous substances and/or environmentally harmful media, the customer/operator must inform its own personnel on site, or our personnel where repairs are returned to our factory or a service workshop, without being specifically requested to do so.

In such cases a verification of delivery material, for example in the form of a DIN safety data sheet, must be submitted to us together with the request for a Service fitter.

Alternatively, you can request a certificate of safety (form no. 448/191) from our Service department, filling it out truthfully, correctly and in full. Send the completed form to the center commissioned with carrying out the repair, or hand it to our Service fitter.

Hazardous substances are:

- Toxic substances
- Health–endangering substances
- Corrosive substances
- Irritants
- Explosive substances
- Fire–inducing substances
- Highly flammable, easily flammable and normally flammable substances
- Carcinogenic substances
- Substances impairing fertility
- Genetically distorting substances
- Substances in other ways hazardous to humans

For all work on site, the operator’s own personnel and/or our fitters must be advised of the possible dangers involved in the repair work.
7.2.1 Dismounting the screw pump with magnetic drive
Before dismounting, the following work must be carried out:

- The power supply cable must be disconnected from the motor by an authorized electrician. Electrical danger must be eliminated! The motor must be secured against being switched on.
- Close all stop devices in the suction and pressure pipelines.
- Drain the fluid in flowable condition from the pump. Note: Use a collecting tank.
- Hazardous substances and/or environmentally harmful media must be drained off and collected such that no danger to life and limb is created. Environmentally compatible disposal must be ensured.
- The pump and the can of the magnetic drive must be depressurized and drained.
- Close off heating system pipes (if fitted).
- Allow the pump, the magnetic drive and the motor to cool to ambient temperature.
- Remove the manometer cables, manometers and retaining brackets.
- Remove the contact protection.
- Remove the motor from the base plate or pump bracket. Note: Use suitable lifting gear.
- Remove supply/suction and pressure pipelines as appropriate.
- Loosen the fastening and remove the pump from the base plate or pump bracket. Note: Use suitable lifting gear.

7.2.2 Mounting the screw pump

Before remounting check all parts for wear and fouling marks. As necessary, replace with original replacement parts. Clean all parts before mounting. Always fit new gaskets.

The pump must be mounted by a qualified technician using the pertaining sectional drawing. To prevent damage, it is especially important to ensure that the components are mounted concentrically and that they are not tilted.

When the screw pump and the magnetic drive have been mounted the following work must be carried out:

- Align coupling if necessary (see Section 5.4).
- Attach supply/suction and pressure pipelines.
- Attach manometer lines, manometers and brackets to pump.
- Mount heating system pipes (if fitted).
- Attach contact protection.
- The power supply cable must be connected to the motor by an authorized electrician. Electrical danger must be eliminated! Pay attention to direction of rotation.
- Fill pump with fluid.

Start up pump as per instructions in Section 6.

7.3 Replacement parts/spare parts
The parts marked in the parts list can be provided as replacement/spare parts. The drive spindle (12) and idler spindles (13) are available only as a complete spindle set. However, for operational safety reasons, we recommend you always stock a complete cartridge–unit or standby pump. The advantage is that in the event of a fault or damage the standby unit can replace the non–functioning unit quickly and without great effort.

When ordering spare and replacement parts, besides the part number, denomination and quantity, the following should also be quoted:

Pump abbreviation,
Pump number,
Year of construction.

This information is engraved on the name plate of the pump.
8 Operating Faults, Causes and Remedial Action

8.1 Faults with reference number for cause and remedial action

The table below is intended as a guide to identifying faults and their possible causes. Faults relating to the pressure–relief valve are listed separately.

If faults occur which are not listed here, or which cannot be traced back to the listed causes, we recommend consulting the factory, or one of our branch offices or sales offices.

The pump must be depressurized and drained when faults are being rectified.

### Screw pump and magnetic drive faults

<table>
<thead>
<tr>
<th>Fault</th>
<th>Reference numbers for cause and remedial action</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pump suction and no delivery</td>
<td>1, 2, 3, 4, 5, 11, 22</td>
</tr>
<tr>
<td>Delivery too low</td>
<td>2, 6, 7, 8, 9, 10, 11, 22</td>
</tr>
<tr>
<td>Pump operates noisily</td>
<td>4, 5, 6, 7, 8, 10, 11, 12, 13</td>
</tr>
<tr>
<td>Irregular delivery</td>
<td>6, 7, 10</td>
</tr>
<tr>
<td>Pump gets too warm</td>
<td>6, 7, 11, 14, 16</td>
</tr>
<tr>
<td>Pump is seized</td>
<td>14, 15, 16, 21</td>
</tr>
<tr>
<td>Motor overload</td>
<td>6, 13, 14, 15, 16, 21</td>
</tr>
</tbody>
</table>

### Pressure–relief valve faults

<table>
<thead>
<tr>
<th>Fault</th>
<th>Reference numbers for cause and remedial action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivery pressure drops</td>
<td>17</td>
</tr>
<tr>
<td>Pressure–relief valve does not open</td>
<td>18</td>
</tr>
<tr>
<td>Pressure–relief valve does not close</td>
<td>19</td>
</tr>
<tr>
<td>Pressure–relief valve knocks</td>
<td>20</td>
</tr>
</tbody>
</table>

8.2 Causes and remedial action

<table>
<thead>
<tr>
<th>Ref. no.:</th>
<th>Cause</th>
<th>Remedial action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pump not filled with fluid before initial operation.</td>
<td>Fill pump with fluid.</td>
</tr>
<tr>
<td>2</td>
<td>Stop valves/sliders not open or only partially open.</td>
<td>Fully open stop valves/sliders during operation.</td>
</tr>
<tr>
<td>3</td>
<td>Motor direction of rotation wrong.</td>
<td>The direction of rotation of the motor must match the direction of rotation arrow on the pump. The direction of rotation can be reversed by swapping any two phases.</td>
</tr>
<tr>
<td>4</td>
<td>Suction pipeline or shaft seal leaky.</td>
<td>Retighten flange screw connections. Check shaft seal.</td>
</tr>
<tr>
<td>5</td>
<td>Air in suction and pressure system.</td>
<td>Open vent valve on pump pressure side until air has escaped. Close valve again.</td>
</tr>
<tr>
<td>6</td>
<td>Wrong fluid viscosity.</td>
<td>Check that viscosity matches entries in acceptance test report. In case of zero–pressure delivery of low–viscosity fluids, apply 1 to 2 bar to pump.</td>
</tr>
<tr>
<td>7</td>
<td>Pressure–relief valve leaking.</td>
<td>Check pressure–relief valve for passage. If necessary, regrind valve seat and/or exchange valve cone.</td>
</tr>
<tr>
<td>8</td>
<td>Geodetic suction head too high.</td>
<td>Check underpressure on suction side using connected pressure/vacuum gauge. Increase fluid level in tank, lower pump.</td>
</tr>
<tr>
<td>9</td>
<td>Motor speed too low.</td>
<td>Check speed and current consumption of motor. Check voltage and frequency against motor rating plate.</td>
</tr>
<tr>
<td>10</td>
<td>Air separating time in operating tank too short.</td>
<td>Provide better air separation in operating tank. Return lines must emerge below oil level of tank.</td>
</tr>
<tr>
<td>11</td>
<td>Fluid level in tank too low.</td>
<td>Fill tank to necessary fluid level.</td>
</tr>
<tr>
<td></td>
<td>Issue Description</td>
<td>Solution</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>12</td>
<td>Flow rate in suction and pressure pipelines too high.</td>
<td>Flow rate in suction pipeline must not exceed max. 1 m/s, and in pressure pipeline max. 3 m/s.</td>
</tr>
<tr>
<td>13</td>
<td>Motor speed too high.</td>
<td>Check speed and current consumption. Check voltage and frequency against motor rating plate.</td>
</tr>
<tr>
<td>14</td>
<td>Delivery pressure too high.</td>
<td>Set specified delivery pressure via pressure–relief valve. Pump outlet pressure must not be exceeded.</td>
</tr>
<tr>
<td>15</td>
<td>Foreign bodies in pump.</td>
<td>Dismantle pump, remove foreign bodies and smooth damaged points with oilstone. Check suction filter and strainer.</td>
</tr>
<tr>
<td>16</td>
<td>Bearing of the driving spindle is damaged.</td>
<td>Replace bearing.</td>
</tr>
<tr>
<td>17</td>
<td>Pressure spring fatigued.</td>
<td>Install new pressure spring.</td>
</tr>
<tr>
<td></td>
<td>Valve seat leaking.</td>
<td>Install new valve cone.</td>
</tr>
<tr>
<td>18</td>
<td>Pressure spring heavily pre–tensioned.</td>
<td>Release pressure spring using adjusting screw, and reset to required pressure.</td>
</tr>
<tr>
<td></td>
<td>a) Due to foreign body or</td>
<td>Consult factory.</td>
</tr>
<tr>
<td></td>
<td>b) Operating temperature of plant substantially higher than quoted on order.</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Pressure spring not pre–tensioned, or insufficiently pre–tensioned.</td>
<td>Turn adjusting screw to right until required operating pressure is reached.</td>
</tr>
<tr>
<td></td>
<td>Valve seat leaking.</td>
<td>Rework or replace valve cone and valve housing.</td>
</tr>
<tr>
<td>20</td>
<td>Pressure–relief valve knocking.</td>
<td>Check overpressure with pressure valve closed. Reset valve. Opening pressure 10 % above operating pressure.</td>
</tr>
<tr>
<td>21</td>
<td>Bearing of the magnetic drive shaft is damaged.</td>
<td>Replace bearing.</td>
</tr>
<tr>
<td>22</td>
<td>Magnetic drive break–away.</td>
<td>Stop motor and restart.</td>
</tr>
</tbody>
</table>
9 Associated Documentation (examples of execution)

The pictorial presentation may not correspond with the pump supplied.
The actual design will be stated in the specific order documents.

9.1 Sectional drawing 696 0007 029
9.2 Sectional drawing 696 4107 008
9.3 Sectional drawing 010–108