FLOWSERVE

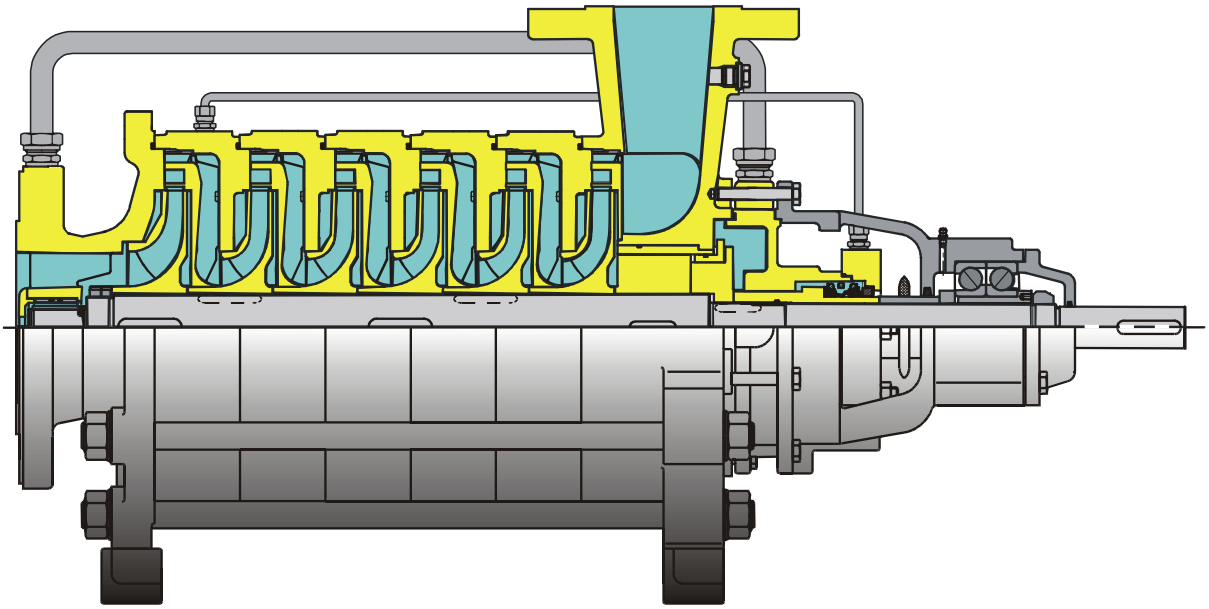
USER INSTRUCTIONS

MSL / MSM 032 - 100

Ring-section type centrifugal pump
in accordance with ISO 5199 / EN 25199

PCN= 71560025 – 07-25 (E) Original Instructions.

Installation
Operation
Maintenance



These instructions must be read prior to installing, operating, using and maintaining this equipment.

Experience In Motion

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Please note: Only trained and skilled operating personnel are allowed to install and operate this pump or pump set. Compliance with these operating instructions and all applicable rules and regulations must be ensured. If you fail to comply with these operating instructions

- people may be put at risk
- the pump or pump set may be damaged
- the manufacturer shall not be held liable for damage that may be caused by such non-compliance.

When working on this pump or pump set be certain not to put people at risk.

If the pump is used in potentially explosive areas, please follow the safety instructions marked with the  symbol.

1 SAFETY

1.1 Safety instructions

This manual gives basic instructions which must be observed during installation, operation and maintenance of the pump.

It is therefore imperative that this manual be read by the fitter and the responsible personnel or operator prior to assembly and commissioning. It must always be kept available at the installation site.

Within this manual, safety instructions are marked with safety symbols.

Safety symbol to ISO 3864-B.3.1

This general hazard symbol highlights information non-compliance with which could cause a risk to personal safety.

Safety symbol to ISO 3864-B.3.6

This symbol refers to electrical safety.

CAUTION

This word gives warning of a hazard to the pump.

This symbol refers to safety instructions to be

followed especially in potentially explosive

atmospheres.

Signs affixed to the pump, e.g.
- arrow indicating the direction of rotation
- symbols indicating fluid connections

must be observed and kept legible.

1.2 Qualification and training of operating personnel

The personnel responsible for operation, maintenance, inspection and assembly must be adequately qualified.

The responsibilities of the operating personnel must be exactly defined by the plant operator.

If the staff do not have the necessary knowledge, they must be trained and instructed, which may be performed by the machine manufacturer or the supplier on behalf of the plant operator, if required.

Moreover, the plant operator is to make sure that the contents of this manual are fully understood by the operating personnel.

1.3 Hazards in the event of non-compliance with the safety instructions

Non-compliance with the safety instructions may cause a risk to the personnel as well as to the environment and the pump and may result in a loss of any right to claim damages.

For example, non-compliance may involve the following hazards:
- Failure of important functions of the equipment
- Failure of specified maintenance and repair procedures
- Electrical, mechanical and chemical hazards affecting personal safety
- Release of environmentally damaging substances.

1.4 Safety at work

When operating the pump, please ensure the safety instructions contained in this manual, the national and international regulations regarding explosion protection and accident prevention and any other operating and safety instructions issued by the plant operator are complied with.

1.5 Safety instructions relevant to operation

- If hot or cold pump components involve hazards, the customer must ensure these components are guarded against accidental contact.
- Contact guards for moving parts (e.g. coupling) must not be removed from the machine while in operation.

- Any leakage of hazardous (e.g. explosive, toxic, hot) fluids (e.g. from the shaft seal) must be drained away so as to prevent any risk to personal safety or the environment. Statutory regulations must be complied with.
- Hazards resulting from electricity must be prevented. Local regulations must be complied with.

1.6 Safety instructions relating to maintenance, inspection and assembly work

It shall be the plant operator's responsibility to ensure that all maintenance, inspection and assembly work is performed by authorized and qualified personnel who have adequately familiarized themselves with the subject matter by studying this manual in detail.

Any work on the machine shall only be performed when it is at a standstill. The procedure for stopping the machine described in this manual must be followed.

Pumps which handle hazardous fluids must be decontaminated.

On completion of work all safety and protective facilities must be re-installed and made operative again.

Prior to restarting the machine, the instructions listed under sub-section 6.4 "Checks before first start-up" must be observed.

1.7 Safety instructions for operation in potentially explosive atmospheres

1.7.1 Sets

If the pump is used in combination with other mechanical or electrical components, the equipment category applicable to the complete set according to Directive 2014/34/EU is the category whose criteria are met by all components used.

The operator is to ensure that all components (pump, coupling, motor) of the pump set are in conformity with Directive 2014/34/EU.

1.7.2 Design of shaft coupling guards

Coupling guards used in potentially explosive areas should meet the following criteria:

- they consist of non-sparking material, such as brass, or of
- steel plate constructions which will prevent the rotating parts from rubbing on the guard, in the case of foreseeable errors.

1.7.3 Liquid level in the pump

Ensure that the pump is filled with liquid at all times, so explosive mixtures inside the pump and dry running of the mechanical seal are avoided.

1.7.4 Shocks and impacts

The pump must be protected against all mechanical shock, during the transport, installation, and operation.

The operator is to ensure external impacts on the pump casing resulting in sparking are avoided, if the pump is operated in potentially explosive atmospheres.

1.8 Earthing / equipotential bonding

In the event of operation in potentially explosive atmospheres, the operator must provide equipotential bonding, i.e. all metal parts of the pump set must have conductive connections to the process systems, for example with earth terminals

1.9 Unauthorized alterations and production of spare parts

Conversion or modification of the pump is not permissible without Flowserve's consent.

Using genuine spare parts and accessories authorized by the manufacturer is in the interest of safety. Use of other parts may exempt the manufacturer from any liability.

1.10 Unauthorized use

The reliability of the pump delivered will only be guaranteed if it is used in the manner intended, in accordance with Section 2.1 of this manual.

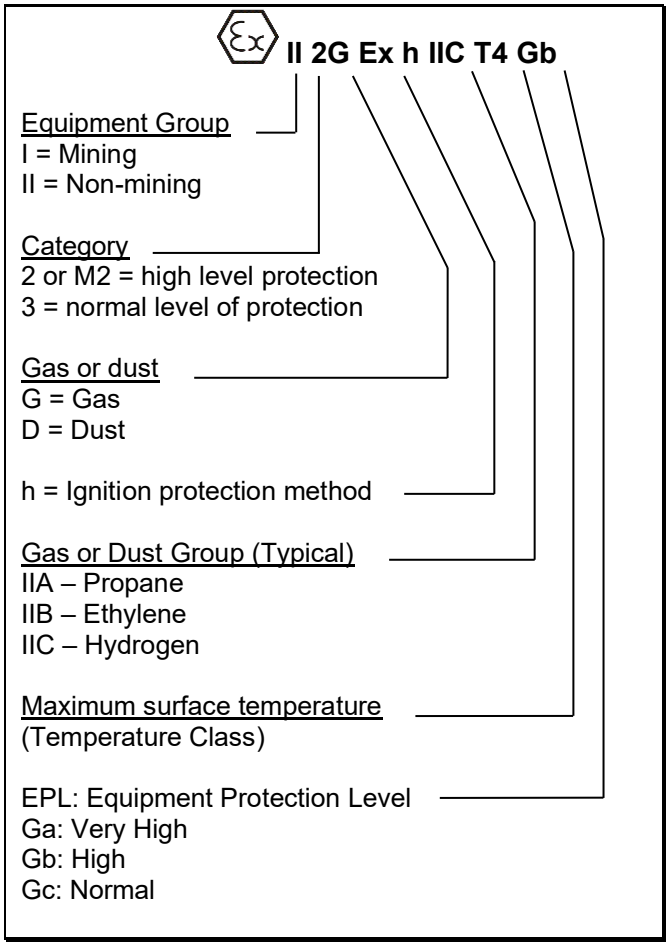
Operation below or above the limit values specified on the data sheet/scope of sale is not permitted.

2 APPLICATION

2.1 Limitation of use

Operation of the pump must be limited to the application and operating conditions stated by the purchaser and confirmed on the manufacturer's data sheet. The pump is covered by warranty under Flowserve's conditions of sale.

In accordance with Directive 2014/34/EU, the pump is allocated to equipment group II, category 2. The nameplate bears the following information:



- The operator must ensure that the permissible maximum temperature of the liquid handled as a function of the temperature class is not exceeded. Refer to Sec 10.2.3 for the limits.
- If the pump is operated in potentially explosive areas of temperature class T4 or T5, the ambient temperature must not exceed 40 °C.
- Temperature classification “T4…T2” is used when the liquid temperature varies and when the pump is required to be used in differently classified potentially explosive atmospheres. The customer is responsible for ensuring that the pump surface temperature does not exceed that permitted in its actual installed location.
- Pumps with stuffing box packings must NOT be operated in potentially explosive areas.

2.2 Wrong use

Operate the pump for the application stated on the data sheet only. Operation outside these limits of product application will increase the risk to personal safety and the environment.

- Do not exceed the density stated on the data sheet as this could cause a motor overload condition and excessive pressures.
- Do not operate the pump outside its characteristic curve so as to avoid cavitation and motor damage. Refer to Sec 10.2.2 for permissible flow range.

Material combinations of pump and mechanical seal and its secondary seal must be suitable for the liquid handled.

2.3 Accessories

The accessories provided with the pump are indicated on the data sheet.

Other accessories may be mounted to the pump or the set only after Flowserve's prior consent.

2.4 Design and working principle

The MSL and MSM high pressure pumps are multi-stage ring-section type centrifugal pumps with closed impellers.

They meet the technical requirements to DIN ISO 5199 / EN 25199.

The pump casings are held together by external tie rods and sealed by O-rings in Perbunan or EPDM.

The axial thrust is balanced by a hydraulic balancing device. The balancing liquid flows back through an external line from the shaft sealing casing to the suction casing.

Suction branch: axial or radial.

The pump feet are bolted to the suction and discharge casings enabling the radial suction and discharge branches to be turned by 90 degrees.

- **Bearings:**
  Discharge side: grease-lubricated anti-friction angular contact ball bearings
  Suction side: sleeve bearing lubricated by the liquid handled when the drive is on the discharge end, or grease-lubricated anti-friction deep groove ball bearing when the drive is on the suction side

- **Shaft seal:**
  Packed stuffing box according to ISO 3069, or Mechanical seal according to EN 12756, or Cartridge seal.

- **Drive:**
  Depending on the actual execution of the pump, the drive is located on the suction side or the discharge side. The driver can be an electric motor or a turbine.
  Direction of rotation when looking from driver to pump: With suction side drive clockwise, with discharge side drive counterclockwise.

2.5 Applications

- Municipal water supply:
  Pumping stations, water treatment plants, booster units.

- Water treatment:
  Filtration, reverse osmosis.
- Pumps for industrial purposes:
  General water supply, cold water, washing plants, boiler feed installations, hot water, pumping of condensate, organic and inorganic solutions, lubricants; power water generation plants.

- Power supply:
  Small and medium-sized thermal stations, waste-burning installations.

- Irrigation:
  Overhead irrigation systems.

2.6 Product identification

The pump identification on the nameplate covers all essential constructional features.

Example:

MSLA 05008 9BA BK3 0R P01

MSL	Series (PN 40 and lower)
A	Construction stage
050	Size
08	Number of stages
9	Impeller trim configuration
B	Hydraulics
A	Bearing
BK3	Shaft seal
0R	Material of construction
P	Casing seal
01	Branch position, flange design

2.7 Nameplate

In the event of queries, please provide the following information as noted on the nameplate:

- Product identification
- Serial number

3 SYSTEM LAYOUT

3.1 Pipework

3.1.1 General

In short discharge lines, the nominal diameter should be such that the piping resistance is only a small proportion of the discharge head. For long pipelines, the most cost-effective solution should be determined on a case-by-case basis.

Flow velocity guidelines:

Suction line: $v_s \approx$ 1.5 to 2.5 m/s

max. 3 m/s

Discharge line: $v_D \approx$ 4 to 6 m/s

Abrupt cross-section transitions or sharp bends should be avoided. Flow disturbances must be kept to a minimum when making necessary branches.

Unfavourable pipework layouts may impair the performance of the pump, especially on the suction side (e.g. bends in several planes in front of the suction branch).

- The pipework must be independently supported and positioned such that the forces and moments exerted on the pump flanges due to the piping never exceed the maximum allowable values (Refer to Sec 10.3).
- Excessive loads could cause distortion of pump components potentially resulting in leakages and be hazardous to personnel, especially if hot liquids are pumped.
- The floor or foundation on which the pump is to be installed must be level and be protected and isolated from external sources of vibration.

CAUTION

- If hot water is handled, excessive pipework loads and moments can cause a misalignment of the coupling between pump and driver, thus reducing operating safety of the unit.

Once the flange bolts have been released, the flanges must not yield more than the amount corresponding to the gasket thickness, nor must they be out of parallel nor bear against each other under stress.

Air-relief valves and drain valves should be installed in the suction and discharge lines.

Shut-off valves should be installed in the suction and discharge lines and in all pipelines connecting the pump with the liquid system.

The valves enable the pump to be depressurized and dismantled without having to drain the system. Flow regulation at constant speed is permissible from the discharge side only.

CAUTION

- The pipes should have at least the nominal diameter of the pump branches. Where this is not possible, it should be ensured that the flow velocity in the suction or feed line does not exceed 3 m/s.
- Flange seals must not extend into the interior of the pipework.
- All pipe components, valves and fittings and the pump branches should be thoroughly cleaned before assembly.
- In the event of unfavourable suction conditions, steady flow should be ensured over a length of 15 x suction branch diameter upstream of the suction branch.
- Shut-off valves in the suction or feed line must be fully open during operation and must **never** be used to control the flow.

3.1.2 Suction or feed line

In order to prevent the formation of air pockets,

- a suction line should gradually rise to the pump, and
- a feed line should slope gradually downward towards the pump.

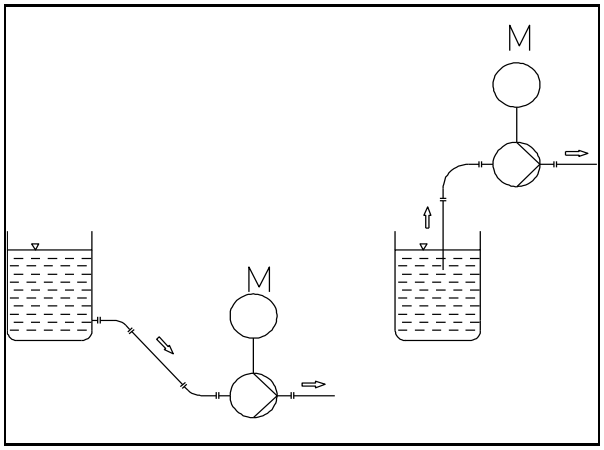


Figure: Feed operation Suction operation

Reducers mounted must be eccentric to eliminate the possibility of air pockets being formed.

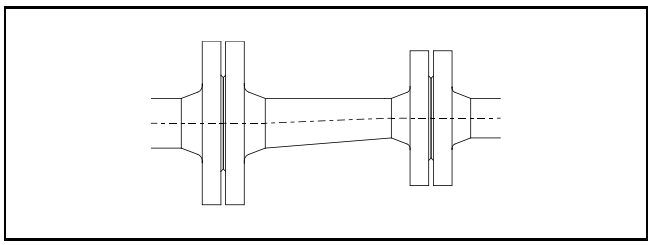


Figure: Eccentric reducer

If the liquid is contaminated, a filter should be fitted upstream of the pump whose free-space sectional area should be three times the pipe cross-sectional area.

CAUTION

- The strainer is for starting purposes only. Solids which are smaller than the mesh size will not be retained by the strainer.
- However, such small particles may collect in the lateral area of the impeller near the clearances, in particular if their concentration is high.
- In order to prevent clogging, it is recommended that the customer provide a sedimentation tank or a larger flushable fine strainer upstream from the pump.

Design:

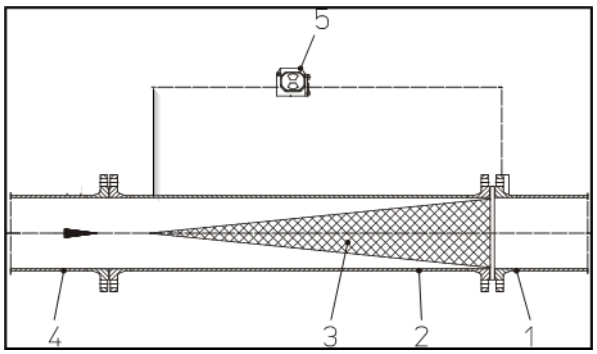
Conical strainer with perforated plate support body with external fine screen, mesh size 0.5 mm, of corrosion-resistant material. The fine screen can be removed after several months of operation, once there are no more deposits.

For new conical strainers supplied by Flowserve the pressure loss can be calculated as follows:

$$H_v = \xi \bullet \frac{v^2}{2g} \quad \text{in m}$$

v = medium flow velocity in reference cross-section, in m/s

ξ = 4, loss coefficient for new conical strainers



1 Pump suction branch / flange
2 Pipe section for strainer
3 Conical strainer
(installed with its tip against flow direction)
4 Feed line
5 Differential pressure measuring instrument

Figure: Feed line with conical strainer

Determining the strainer pressure loss

Example:

Feed line = DN 125

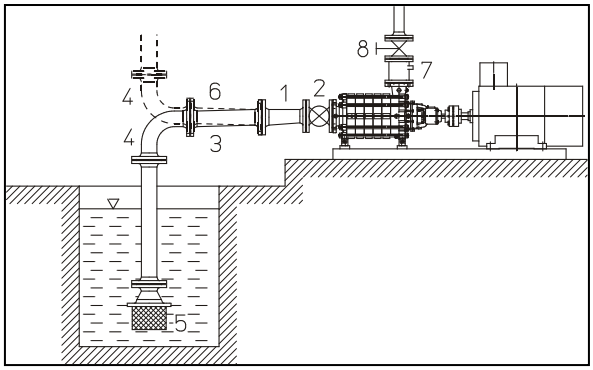
Flow rate 80 m³/h

ζ = 4

v = 1.81 m/s in the feed line

$$H_V = 4 \bullet \frac{1.81^2}{2 \bullet 9.81} = 4 \bullet \frac{3.276}{19.62} = 0.66m$$

The suction line must be leak-proof, and it must be possible to release all air. The suction opening of the suction line should be well below the liquid level, and a foot valve with a strainer should be used. The foot valve must be far enough from the bottom to avoid excessive inlet losses which could impair performance.



1 eccentric reducer (suction operation) or concentric reducer
(feed operation)
2 shut-off valve
3 suction line
4 elbow
5 foot valve with strainer
6 feed line
7 non-return valve
8 shut-off valve

Figure: Pump installation

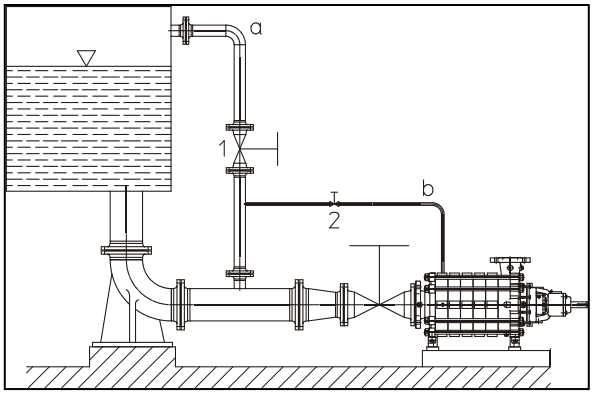
A shut-off valve should be installed in the feed line, it is to be closed for maintenance work.

It should be installed such that air pockets cannot form in the spindle cap, i.e. with the spindle in a horizontal position or pointing vertically downward.

3.1.3 Vacuum equalizing pipe

If the pump draws from a system or tank under vacuum, an equalizing pipe must be installed connecting the vent connection at the suction casing or the highest point of the suction line to a point above the max. liquid level in the suction tank.

- The line should be fitted with a shut-off valve which should only be closed for maintenance work on the pump.
- To assist in starting the pump, we also recommend that a pipeline, which can be shut off, be installed between the first stage and the equalizing line.



a Equalizing line
b Additional line
1 Shut-off valve
2 Shut-off valve (vacuum-tight)

Figure: Vacuum operation

3.1.4 Discharge line

For flow control, install a shut-off valve as close to the pump branch as possible. It is recommended that a non-return valve be installed between pump branch and shut-off valve, thus protecting the pump against reverse rotation and also the pump and the foot valve against water hammer that may occur in the event of sudden shut-down.

3.1.5 Minimum flow line

The minimum flow line (or bypass line) should be used if operation with the discharge side shut-off valve closed is possible. The minimum flow valve ensures that a sufficient rate is automatically returned to the suction side tank.

The minimum flow rate is shown on the curves or the data sheet.

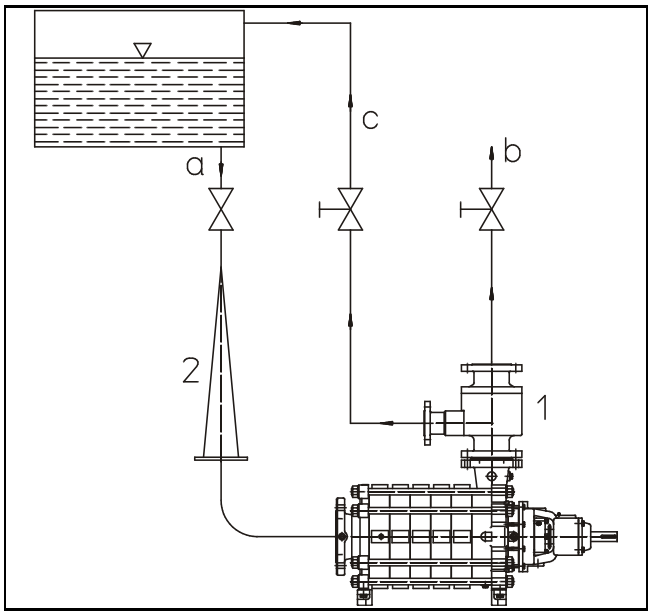
Size	t = 140 °C or lower	t > 140 °C
032	15 % of Q_{opt}	20 % of Q_{opt}
050	20 % of Q_{opt}	25 % of Q_{opt}
065	20 % of Q_{opt}	25 % of Q_{opt}
100	25 % of Q_{opt}	25 % of Q_{opt}

Qopt = Flow at best efficiency point (BEP)

Should an exact calculation be required, please contact Flowserve.

CAUTION

- Continuous operation at minimum flowrate is not permitted, as this operating condition leads to higher pump vibration and premature wear.
- Up to the shut-off or non-return valve, the line should be designed to suit the nominal pressure of the discharge line, afterwards in accordance with the design pressure of the feed water tank.
- Permissible velocity in the minimum flow line: 7 to 10 m/s.
- If an automatic device (bypass non-return valve) is used, ensure that even in the case of trouble, liquid can be returned through the minimum flow line.
- Frequent checks are recommended. Early replacement of the minimum flow valve (which is exposed to heavy wear) will prevent energy losses.
- The minimum flow valve should be installed near the pump discharge branch, upstream of the discharge shut-off valve.
- A non-return valve should be installed in the minimum flow nozzle or the minimum flow line.
- For repair or overhaul work on the pump or the bypass non-return valve, a shut-off valve must be installed in the minimum flow line (c).



a Feed line
b Discharge line
c Bypass line
1 Bypass non-return valve
2 Conical strainer

Figure: Minimum flow control

3.1.6 Balancing line

The balancing line connects the shaft sealing casing with the suction casing. There is no throttling or shut-off device in this line, which serves to hydraulically balance the pump.

The balancing line can also be returned by the customer to the feed tank or the feed line.

3.2 Connections

3.2.1 Venting during pump priming

Before starting the set, the pump and the suction line must be completely vented and filled with the liquid handled. To bleed the air, several holes with plugs have been provided. Similar holes may be used in the pipework. The shut-off valve in the suction or supply line must be fully open.

3.2.2 Seal chamber cooling

Cooling is required if the temperature of the liquid handled exceeds 110 °C in case of a packed stuffing box, or 140 °C if a mechanical seal is installed. For this purpose, the pump is equipped with a sealing casing which can be jacket cooled. The connecting points for the cooling lines are on the bearing housing, see Sec 10.6. The customer should provide either an open circuit, i.e. a cooling water return line to the drain system, or a closed circuit including a return to the cooling circuit to be provided.

3.2.3 Drain line, leakage water line

The pump has connections for leakage water (at the packing/ mechanical seal) and drain.

3.2.4 Pressure monitoring

In order to monitor the pressures upstream and downstream of the pump, the installation of measuring points in the pipeline is recommended.

3.3 Electrical connections

The electrical connection for the driving motor must comply with the relevant local rules and requirements (ELexV, EVU - standards, Directive 2014/34/EU).

 The Use and the connection of the instrumentation and the electrical equipment with the ignition protection type EX « i » intrinsically safe must be done according to the requirement of the standard EN60079-11

The type and the specification of the instrumentation must be taken in consideration for the choice and the connection of the intrinsically safe and the associated electrical equipment.

4 UNPACKING, HANDLING, STORAGE

4.1 Safety measures

- Do not lift heavy equipment overhead of personnel.
- A safe distance must be kept when lifting and moving the equipment.
- Use only approved and suitable lifting equipment.
- The length of the lifting equipment should be such that the pump or the set are lifted in horizontal position.
- Do not attempt to lift the pump or the pump set using eyebolts on pump components.

CAUTION

- Do not remove protection covers from the pump branches, as they prevent contamination of the pump.

4.2 Unpacking

Do not unpack the pump until it has been carefully checked for damage that may have occurred in transit. Report any damage on the counterfoil or delivery note.

Claims must be made immediately on the carrier or the transport insurance.

4.3 Intermediate storage

If the pump or the pump set is not to be installed immediately it should be stored in a dry and vibration-free room.

The packing should be checked for damage on a monthly basis.

4.4 Handling

The pump or the pump set must be lifted as shown:

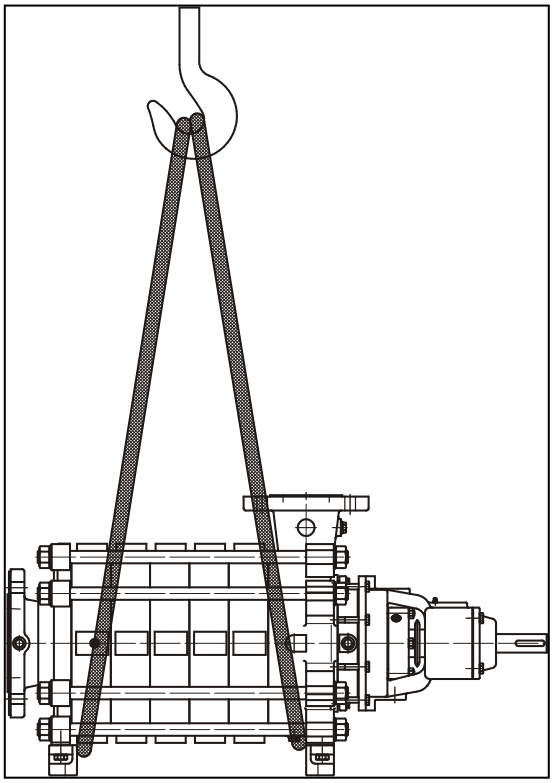


Figure: Lifting the pump

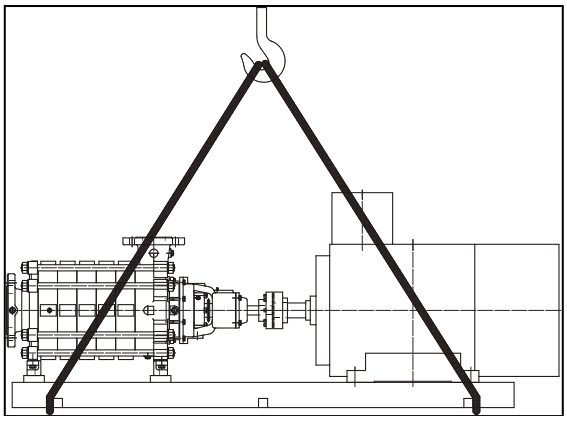


Figure: Lifting the pump set

4.5 Preservation

The clearances of the pumps have been treated by the factory so that the pumps can be stored for 3 months in a dry and vented room without the need for a preservative coating. If preservation has been ordered, please observe the following instructions.

4.5.1 Removal of preservation

To remove the preservative coating, the pump should be filled and drained several times using appropriate agents, e.g. solvent naphtha, diesel oil, or an alkaline detergent. Flush with water, if necessary.

The pump must be installed and put into operation immediately afterwards.

4.5.2 Re-preservation

If the preservation has been ordered and the pump is to be stored for longer time, a new preservative coating should be applied after six months.

For suitable preservatives, contact Flowserve.

5 PUMP INSTALLATION

5.1 Prerequisites

Prior to the installation of the pump, the storage and handling instructions in Section 4 must have been complied with.

5.2 Safety measures

- The pipework must be properly installed. Fluid leakage during operation may cause health hazards or environmental damage.
- The shut-off valves in the suction or feed line and in the discharge line must be closed.
- All internal rules and guidelines must be complied with.
- Hot components must have contact guards.

- Inadequate installation and alignment of the pump results in overload on the pump and could be hazardous to the personnel and the environment, if the pump is operated in potentially explosive areas.
- Leakage caused by inadequate pipework and supply line installation can lead to the formation of explosive mixtures and could be hazardous to the personnel and the environment, if the pump is operated in potentially explosive areas.
- Earth the baseplate to remove any charge accumulation.

- Disconnect power to the equipment to eliminate electrical shock hazards!

5.3 General

5.3.1 Fitting tools

Standard tools and lifting equipment are to be used. These should be available at the customer's end.

To avoid potential explosion hazards during maintenance, the tools, cleaning and painting materials used must not give rise to sparking, the use of non-sparking tools is highly recommended.

5.3.2 Permissible environment

The ambient temperature range should be from
- 10 °C to + 40 °C.

The atmospheric humidity should be low in order to avoid corrosion.

5.3.3 Space utilization

The space required by the pump or the pump set can be seen from the attached table of dimensions and the arrangement drawing.

Clear and easy access to the shut-off and regulating valves and the measuring instruments must be ensured.

5.3.4 Installation position

MSL and MSM pumps are installed in the horizontal position.

5.3.5 Motor

Prior to assembly the direction of rotation of the motor must be checked (arrow on pump bearing housing).

Driving with high transverse force, such as by belt drive, is not allowed

5.3.6 Preparatory checks

The foundation of the pump must be level and have a minimum of vibration. The consistency of the concrete should at least correspond to BN15, DIN 1045.

We recommend using a baseplate / baseframe.

Prior to installation, checks should be made with regard to:
- possible damage to the pump or the pump set that may have occurred in transit
- freedom of rotation (check that the shaft is free to rotate by hand)
- the foundation dimensions.

5.3.7 Foundation

Prior to placing the pump set on the foundation, which should be well set, the following preparatory work must be carried out:

- roughen and clean foundation surface
- remove shuttering/cores from the anchor holes
- blow out the anchor holes clean
- check the positions and dimensions of the anchor holes against the arrangement drawing.

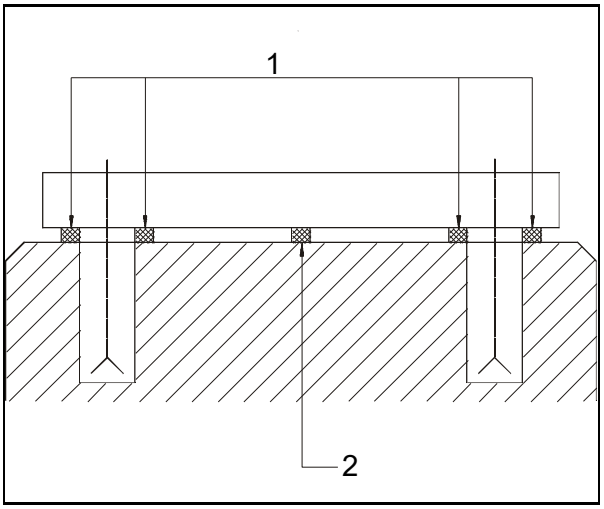
Alternatively, if the baseplate or baseframe is fastened by means of heavy load plugs:
- Scribe and drill plug holes
- Clean plug holes and blow them out
- Insert heavy load plugs

5.3.8 Installation of the set

The complete set mounted on the baseplate/ baseframe must be placed on the foundation with its foundation bolts suspended. If heavy load plugs are used, first screw in the threaded rods in the plugs.

5.4 Alignment of the set

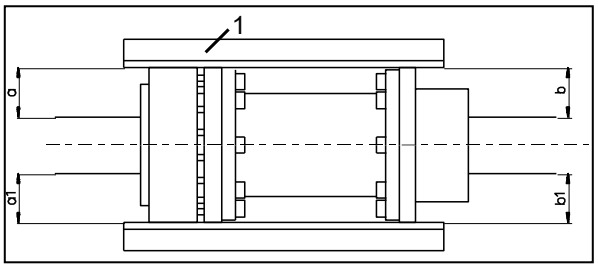
- Place shims under the baseplate/baseframe on both sides of the foundation bolts (see Figure).
- Use a spirit level to align the set.
- If the foundation bolts are more than 800 mm apart, place additional shims between the foundation bolts to prevent the baseframe from sagging (see Figure).
- Care should be taken to minimize distortion of the baseframe during installation.
- The foundation bolts should be embedded in concrete using quick-setting grout (this is not required if heavy load plugs are used).
- Tighten the nuts of the foundation bolts in diagonal sequence (after the grout has set).
- Re-check alignment with a spirit level.



1 shims
2 additional shims if the foundation bolts are more than 800 mm apart

Figure: Position of the shims

After aligning the set the axial clearance between the two coupling halves measured at one point of the coupling must be the same over the complete circumference of the coupling, the permissible tolerance being ± 0.05 mm.
Carry out the radial alignment of the coupling using a beveled straight edge and a feeler gauge.



a=a1 and b=b1, tolerance: ± 0,05 mm
1 beveled straight edge

Figure: Aligning the coupling

5.5 Foot Mounting

As standard the pumps are equipped with a high temperature foot fastening, that means the non-drive end foot is not screwed firmly to the baseplate/baseframe to avoid distortions due to the extension of the pump casing at higher temperatures of the medium pumped.

Hot water foot fastening is part of standard pump equipment. The pump feet must not be bolted firmly to the non-drive side baseplate as this could cause distortion as a result of thermal expansion of the pump casing caused by high liquid temperatures.

For high temperature foot fastening, stud bolts (1) and adjusting nuts (2) are used.

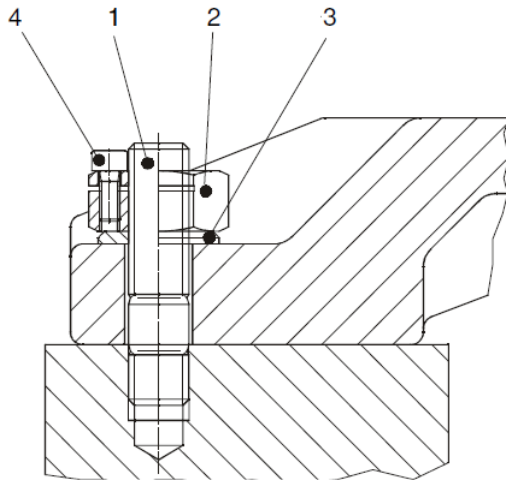


Figure: Hot water foot fastening

Fastening on the non-drive side

Tighten adjusting nut (2) until the washers (3) can be moved by lightly tapping with a hammer. Tighten safety screw (4) to lock adjusting nut (2) in its position.

Guide pins (6) on the casing feet on non-drive side are to ensure that expansion of the pump occurs along its centreline only. These guide pins can move in the guide casings (5), which is bolted to the base-plate (7).

Fastening on the drive side

Firmly lock drive side nuts in their positions at an appropriate torque ⇒ Fixed point of the pump.

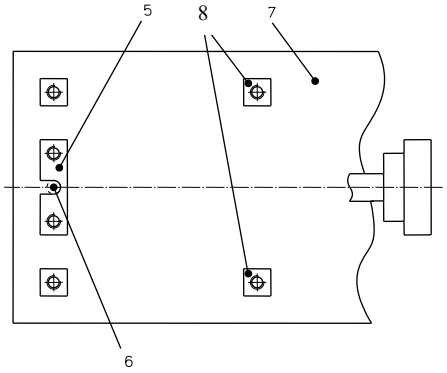


Figure: Hot water foot fastening

1 Stud bolt
2 Adjusting nut
3 Washer
4 Safety screw
5 Guide plate
6 Guide pin
7 Baseplate
8 Fixed point of the pump

5.6 Grouting the baseplate / base-frame

Prior to grouting the baseplate or baseframe, carry out the following preparatory work:

- Check the dimensions with regard to height and alignment of flanges.
- Re-adjust baseframe, if necessary.

Ram earth-humid concrete under the baseplate / baseframe or add shrinkage-free grout until the entire space under the baseplate is filled. Grouting should be a continuous process so as to ensure that no air pockets form under the baseplate or baseframe.

When the grout is set re-tighten the foundation bolts and re-check the alignment of the coupling.

5.7 Pump installation in the piping system

CAUTION

- The pipework forces and moments acting on the pump branches must not exceed the permissible pump branch loads. Refer to Sec 10.3 for permissible nozzle loads.
- The pump must not be used to clean the pipework with chemicals.

- Remove the protection covers from the pump flanges and the auxiliary pipeline connections.
- Insert the flange seals.
- Connect the suction or feed line.
- Connect the discharge line.

5.8 Assembly of coupling

The shaft ends and the coupling parts must be thoroughly cleaned before assembly. Prior to cleaning using solvents, the flexible elements must be removed.

Do not hammer the coupling hubs onto the shaft ends so as to not cause damage to the shaft bearings.

To facilitate installation, heat the coupling parts (to 150 °C max.), if required. If the temperature exceeds 80 °C, the flexible elements must be removed before heating the coupling parts.

The shaft ends must not protrude on the inside of the hubs. Screws are used to secure them axially.

The following instructions for couplings apply to pump sets which conform to Directive 2014/34/EU and are intended for use as a category 2G device in potentially explosive atmospheres.

- Only non-fail-safe couplings (e.g. Siemens Flender N-EUPEX types ADS, BDS and HDS) are released for use in pump sets conforming to Directive 2014/34/EU.
- Fail-safe coupling (e.g. Siemens Flender N-EUPEX types A, B and H) must not be used in pump sets according to directive 2014/34/EU, category 2G.

These couplings have been designed for use under the following conditions:

- no more than 25 starts per hour
- daily operation up to 24 hours
- operation within the specified alignment tolerance
- temperature range in the area next to the coupling: - 30 °C to + 80 °C.

Storage
If coupling components are stored, the storage location needs to be dry and dust free. The flexible elements must not be stored together with chemicals, solvents, fuels, acids or other similar substances. They should not be exposed to light, in particular direct sunlight or artificial light containing a high proportion of ultraviolet light.

- Devices generating ozone, such as fluorescent light sources, mercury-vapor lamps, electrical high voltage systems must be kept away from the storage location. Moist storage locations are not suitable. Ensure no condensation takes place. Air humidity should preferably be below 65 %.

Installation
Various materials of the flexible elements are available. The elements have different colours or colour stripes. Only elements having the same colour must be used in one coupling.

When assembling a pump set, check the tolerances of the coupling holes and the shafts in accordance with table 5.C.1.

Table 5.C.1 - Tolerances for coupling fit

Fit	Shaft tolerance	Coupling hole tolerance
Shaft tolerance acc. to DIN 748/1	k6	H7

- Use protective means to avoid injury on hot parts.
- Observe the tightening torques of the screws as specified

- Non-observance of these instructions may result coupling breakage. Parts flying about put people at risk. The coupling becomes a source of ignition.

Once the coupling parts have been mounted on the shaft ends, the flexible elements need to be installed,

if they have been removed. Heated coupling parts must have cooled to a temperature below + 80 °C. Ensure all flexible elements have the same size, colour and identification.

Pushing together the components to be coupled (pump and motor).

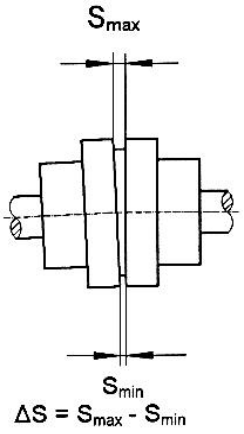
- There is danger of injury caused by squeezing.

5.9 Alignment

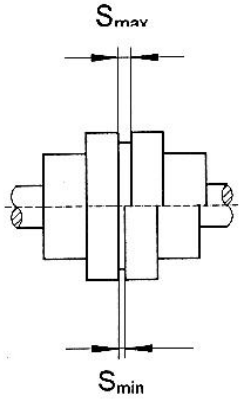
Although the pump has been aligned at the factory, it is most likely that this alignment will have been disturbed during the transportation or handling. Therefore, the alignment must be rechecked and adjusted as necessary at the site. Align the motor to the pump, not the pump to the motor.

The coupling connects the two shaft ends of the driving motor and the pump. Align the shaft ends by observing the tolerances mentioned below.

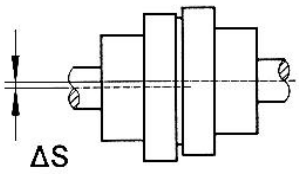
The different types of misalignments are:



- Angular misalignment:
  This can be determined as the difference of clearance dimension $\Delta S = S_{max} - S_{min}$. The permissible values are specified in Sec 10.5.1, as a function of coupling size and speed.



- Axial misalignment:
  The axial misalignment must be within the permissible limits between the minimum and the maximum axial clearance (see Sec 10.5.1).

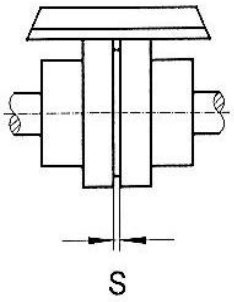


- Radial misalignment:
  This is the radial misalignment between the shaft centre points. The permissible values are the same ΔS values as specified for the angular misalignment.

When aligning, proceed as follows:

- first, correct the angular misalignment
- then, correct the axial misalignment
- finally, correct the radial misalignment

A dial gauge, bevelled straight edge, feeler gauge or laser may be used for shaft alignment.



- There must be no radial misalignment and angular misalignment at the same time.

Securing the coupling on the shaft

To secure the coupling halves on the shaft, set screws are to be used. The tightening torque for set screws depends on the coupling size. Refer to Sec 10.5.2 for the Siemens Flender couplings.

Operation

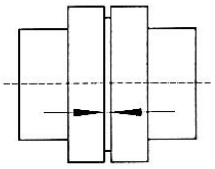
- If anomalies occur during operation (vibration or noise) the pump set must be stopped immediately. The problem should be found using the list of errors in Section 8. This list includes troubles and their causes as well as recommended remedial action.
- If the problem cannot be detected, it is recommended that Flowserve Service be contacted.

Maintenance

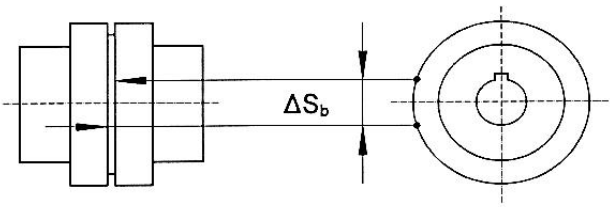
- It is necessary to check the torsional backlash of the coupling halves in relation to each other. This should be done on a regular basis in order to avoid damage to or failure of the system.

The torsional backlash is determined as follows:

Turn one coupling half in relation to the other, without torque, as far as possible. Mark this position, as shown.



Then, turn the coupling halves as far as possible in the other direction, without torque. The distance between the two markings is the torsional backlash ΔS_b.



The corresponding maximum values for the different coupling sizes are included in Sec 10.5.3

If the torsional backlash is greater than the specified value, the flexible elements must be replaced.

- Always replace the complete set of flexible elements (i.e. all elements of one coupling at the same time, regardless of the wear of individual components). The new elements must have the same colour marking. Only spare parts from the manufacturer must be used.

5.10 Hydrostatic test

- If the piping system is to undergo a hydrostatic pressure test, the pump must be excluded from such testing.

5.11 Cleaning, flushing and pickling of the pipework

When the pipework is cleaned, flushed or pickled, the pump should be excluded.

5.12 Shaft seal supply line

If the pump is equipped with a double-acting back-to-back mechanical seal, the shaft sealing chamber must be supplied with a sealing liquid. For this purpose, use the connections on the casing cover / seal cover.

The sealing or flushing liquid must be free from solids, must not crystallize and be compatible with the product.

For example, lime-free water, oils with a maximum viscosity of 12 cST at 50°C or water-glysantine mixtures (glysantine content: 50 % max.) can be used as sealing liquids.

The sealing pressure should exceed the pressure prevailing in front of the mechanical seal (which is similar to the pump suction pressure) by at least 2 bar.

The mechanical seal can be sealed either by means of a thermosiphon sealing liquid pressurizing system, i.e. in a closed circuit, or by the flow-through principle, e.g. using tap water.

- **Thermosiphon sealing liquid system**

  The difference between the sealing liquid outlet level at the mechanical seal and the thermosiphon inlet level should be about 0.7 m. To avoid air pockets, the supply line must be sloping gradually downwards, and the return line must have a gradual rise.
  Once the sealing pressure tank is filled with sealing liquid, a gas volume (compressed air or nitrogen) is to be added on top of the sealing liquid.

- **Flow-through sealing of the mechanical seal**

  If the mechanical seal is sealed by application of the flow-through principle, control valves must be installed at the inlets and outlets of the supply lines and a pressure gauge in front of the entry of the supply lines into the shaft sealing chamber.
  The control valves are to be used to control the admission pressure for the sealing liquid and the pressure in the shaft sealing chamber.

6 STARTING AND STOPPING PROCEDURES

6.1 Prerequisites

The pump or the pump set must have been installed in accordance with the instructions of Section 5.

6.2 Safety measures

- Do not operate the pump beyond the operating limits specified by Flowserve.
- If there is no shaft seal, interrupt all further work and install a shaft seal. Priming the pump with the liquid handled in the absence of a shaft seal may present a human-health or environmental hazard.
- Ensure that people and the environment are not put at risk through explosive, toxic, hot, crystalline, or acid liquids handled.
- The pump must be completely primed and vented.
- In the case of cooled mechanical seals, the mechanical seal chamber needs to be vented. Unscrewing the vent screw on the mechanical seal cover (see Section 10.6) poses hazards to personnel, if the liquid handled is hot or dangerous. For this reason, the customer needs to connect a pipeline with a valve to the vent hole.
- Before checking the direction of rotation, make sure that the pump is primed. If that is not possible, decouple the pump from the motor before checking the direction of rotation.
- If the liquid pumped is hot, to avoid distortions or heat shocks to the pump, the temperature increase shall be lower than 40°C per hour and should be uniform across the pump.
- Safety measures should be taken at the customer's end to ensure (for example by means of a relief valve) that the permissible pump casing pressure is not exceeded during operation.

- The operator must ensure the permissible maximum temperature of the liquid handled as a function of the temperature class is not exceeded (Refer Sec 10.2.3).
- Specific restrictions resulting from the design and mode of operation of the pump must be considered.
- Otherwise, temperatures in excess of the liquid temperature can occur on the pump casing, posing a hazard to personnel and environment in potentially explosive areas.
- The operator must ensure that the possibility of the mechanical seal running dry is ruled out. Operation of pumps equipped with single-acting mechanical seal and double-acting mechanical seal in tandem arrangement is only permissible with the pumps primed. The shaft sealing chamber in pumps with double-acting back-to-back arrangement must be sealed at all times.

- Be sure that all electrical connections comply with the local rules and regulations and that this work is done by authorized personnel only.

CAUTION

- The flow rate should be changed at constant speed only on the discharge side. During operation the regulating valve in the suction or feed line should always be fully open.
- Do not run the pump with the regulating valve closed for more than 30 seconds if there is no minimum flow bypass line.
- In pump installations involving high liquid temperatures, the alignment needs to be verified at elevated temperature. Once the unit has run at the actual operating temperature, shut it down and check the alignment immediately. Re-align the motor to the pump, if necessary.

6.3 Electrical connection

Connect the electrical supply to the motor in accordance with the connection diagram in the terminal box.

6.4 Checks before first start-up

- Are the pipelines connected and are the flange connections tight?
- Is the pump including the pipework correctly primed and completely vented?
- Inspect all the auxiliary and flushing pipes and check against possible clogging.
- Is the shut-off valve in the discharge line throttled?
- Is the suction side valve fully open?
- Rotating parts guarded against accidental contact?
- Protective devices (such as motor circuit breaker) correctly installed and adjusted?
- Is the motor ready for operation?
- Is the direction of rotation of the motor correct? (check by momentarily switching on the motor)
- Is the coupling correctly aligned? (see section 5.9)
- Can the washers of the foot fastening be moved? (see section 5.5)
- Has the shaft seal been installed?
- In the case of jacket cooling, check that the cooling liquid flows.
- In case of double mechanical seal, check the flow and the pressure of the barrier or buffer fluid, check the level if applicable.

CAUTION

- If the discharge pressure does not rise steadily as the speed increases, stop the motor and re-vent and re-fill the pump.
- Do not switch the pump on and off more often than ten (10) times per hour (this applies to a max. density of 1000 kg/m³ of the liquid handled). The motor manufacturer's instructions should be followed.

6.5 Starting procedure

- Check everything using the checklist of sub-section 6.4.
- Switch on the motor.
- Check the pressure gauges at the pressure measuring points.
- Open the discharge side-regulating valve to adjust the duty point of the pump.

CAUTION

- A fluid quantity of a few cm³ per hour will typically leave the mechanical seal in the form of vapour, mist or droplets. If there should be a considerable increase in the leakage rate after the start-up phase, stop the pump and check the mechanical seal.
- If a stuffing box is installed, the leakage rate after start-up should be higher than during operation. After about 1 hour, tighten the gland nuts gradually until there is a slight drop leakage.
- Observe the operating range specified under Section 10.2.2.
- Avoid operation with a totally closed shut-off valve.
- Avoid sudden variations of the handled liquid temperature as that could lead to a thermal shock and may damage the pump.
- System must be operated in such a way that a pressure surge due to water hammer does not occur.
- Make sure that there is sufficient margin of NPSH.

Leakage from a pump with single-acting mechanical seal can lead to the formation of explosive mixtures and be hazardous to the personnel and the environment if the pump is operated in potentially explosive areas. To avoid potential hazards from fugitive emissions of vapor or gas the surrounding area must be well ventilated.

6.6 Particular information

The following parameters should be monitored during operation:

- power consumption of the motor
- smoothness of pump operation (no vibration)
- bearing temperature
- leakage

6.7 Stopping procedure

- Close the discharge side-regulating valve.
- Switch off the motor.
- When the pump is at rest, close the shut-off valves of the feed and cooling lines.
- Switch off the mechanical seal supply systems.

CAUTION

- If there is danger of freezing, the pump should be drained down.

- Please note that there will always be some residual liquid even if the pump is emptied in vertical position.
- Ensure that the pump does not contain any hazardous substances when it is returned to the manufacturer's factory.
- Ensure that during prolonged inactivity the pump is operated for about five minutes every 1 to 3 months. Follow the instructions under 6.5.
- If pumps equipped with mechanical seals are shut down for a long period, the pump rotor may get stuck. To prevent this, turn it by hand every three weeks.

7 MAINTENANCE, DISASSEMBLY, ASSEMBLY

7.1 Prerequisites

The pump or the pump set must have been taken out of operation in accordance with the instructions of Section 6.

7.2 Safety measures

- Flush the pump thoroughly before disassembly to purge away the residual liquid left after draining the pump.
- Ensure that people and the environment are not put at risk through explosive, toxic, hot, crystalline, or acid liquids handled.
- Ensure good functionality of the bearings, for example by regular checking of the bearing temperature or vibration behavior. The bearing housing 'skin' temperature must not exceed 95 °C in continuous operation. Bearing operation must be vibration-free. Heat exchange between the bearing bracket and the environment must not be impaired (no insulation!).
- Visual inspection of the mechanical seal is required at regular intervals to check it for leakage. A few cm³ per hour in the form of vapour or mist or drops are acceptable.

- The pump may be disassembled and assembled in line with these installation and operating instructions by skilled personnel only. Inadequate assembly of the pump can be hazardous to the personnel and the environment if the pump is operated in potentially explosive areas.
- Old or improperly lubricated anti-friction bearings can lead to higher temperatures on the pump and be hazardous to the personnel and the environment if the pump is operated in potentially explosive areas.
- Leakage from a pump with single-acting mechanical seal can lead to the formation of explosive mixtures and be hazardous to the personnel and the environment if the pump is operated in potentially explosive areas.
- The pump must be completely vented and drained and rendered inert before any disassembly operation.

CAUTION

- The workplace for disassembly or assembly must be clean.

7.3 Maintenance and inspection

7.3.1.1 Basic information on bearing service life and grease working life

In accordance with EN ISO 5199, Flowserve guarantees the anti-friction bearings for a service life of at least 17,500 hours of operation or two years' continuous duty.

The anti-friction bearings in these pumps are designed for a longer service life. Therefore, in practice, their service life is not usually dictated by the material fatigue in the bearings themselves, but by the deterioration of the grease with age and its resulting loss of lubricating ability.

The information given regarding lubrication intervals, grease and bearing replacement is based on years of experience and design calculations in order to extend the period of reliable and trouble-free operation, even in adverse conditions. This information does not refer to modes of operation that are particularly favorable, thus extending lubricating intervals.

The result is that, in many cases, grease and bearings are often replaced more frequently than warranted by the age of the grease to avoid sudden failure.

We recommend using the Flowserve early fault detection system, RedRaven Detect, as part of maintenance based on the actual condition of the equipment. This can ensure reliable operation of the pumps, even beyond the recommended service life of the bearings.

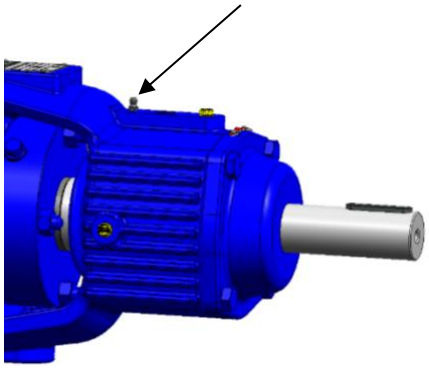
The main function of the RedRaven Detect system is to detect operating conditions which lead to excessive wear or premature failure. It is also able to detect the onset of bearing damage due to insufficient lubrication.

7.3.1.2 Relubricating the bearings

The anti-friction bearings of the pump need to be relubricated via the grease nipples on the bearing housing, as specified in the table below:

	Bearing code	Lubrication interval	Quantity of grease
032/050	7309 BEXXX	7800 h	26 g
065/100	7312 BEXXX	6000 h	40 g

Table: Lubrication intervals



The number of possible relubrication cycles is limited to two due to the constraints on the size of the bearing housing. The bearings then have to be removed, washed out and filled with a fresh quantity of grease.

It may be necessary to shorten the lubrication intervals in particularly adverse operating conditions (e.g. dusty surroundings, high ambient temperatures or fluctuating temperatures).

If the pump is run without any specific monitoring of the roller bearings, then these will need to be replaced after about 17,500 hours of operation or two years.

7.3.1.3 Roller bearing grease

The bearings leave the factory filled with polyurea-based high-temperature grease. The following types of grease can be used for relubrication:

Manufacturer	Product
SKF	LGHP2
Fuchs	Renolit PU-8-061-2
Klüber	Klüberquiet BQH 72-102

Flowserve should be consulted on the Suitability of other makes of grease.

Table 1: Types of grease

7.3.2 Mechanical seal

Generally, virtually no maintenance is required on mechanical seals. The mechanical seal should exhibit only light visible leakage. In the case of heavy leakage, the mechanical seal should be checked (see also Section 6.6).

7.3.3 Packed stuffing box

With a packed stuffing box, there is always a leakage in the form of drops. In the case of heavy leakage, the packing and the shaft wearing sleeve should be checked (for scores).

7.3.4 Driving motor

Maintenance of the driving motor should be in compliance with the motor manufacturer's instructions.

7.3.5 Further maintenance instructions

Make sure that there is no leak on the gaskets and check periodically for possible damage all the sealing elements.

Use the appropriate thread locker to lock all the tapered threads such as NPT, BSP. The selection of the thread locker product must be based on the sealing type, temperature and the nature of the liquid.

For more detailed maintenance information, please obtain a corresponding copy of service instructions from Flowserve.

In dirty or dusty environments, regular checks must be made and dirt removed from areas around close clearances, bearing housing and motors.
Do not use aggressive cleaning agents that could damage the gaskets or sealing elements.

7.4 Disassembly

Operating troubles needing pump disassembly are unlikely in the event of careful monitoring and maintenance of the pump.

However, if trouble occurs, the reason should be found before disassembly, if possible. Repair and overhaul work should be carried out by Flowserve personnel, or the pump should be inspected at the manufacturer's factory.

Please note that any disassembly work to be performed during the warranty period requires the approval of Flowserve.

If you disassemble the pump, all components should be treated with utmost care.

All parts must be cleaned carefully, checked for wear and reconditioned or replaced by spare parts, if necessary. It is vital that the shaft is checked for concentricity. Use only genuine spare parts.

7.4.1 Preparation for disassembly

- Disconnect power to the motor.
- Drain the system between suction side and discharge side shut-off valves.
- Disconnect and dismantle existing sensors and monitoring devices, if necessary.
- Dismantle coupling.
- Drain the liquid from the pump.
- Dismantle shaft seal supply lines, if any.
- Disconnect the pump from the pipework.
- Dismantle balancing line.

7.4.2 Spare parts

For re-assembly, replace all O-rings and gaskets.

The item numbers of spare parts, please refer to the components list, Section 9.

All parts must be ordered from Flowserve to ensure compliance and safe operation of the machine.

7.4.3 Disassembly of the pump

Mark positions and sequence of the parts with a coloured pen or a scriber, for later re-assembly.

Measure and record shaft projection to bearing cover (dimension X, Sections 7.4.3.1 and 7.6.2.2).

7.4.3.1 Disassembly of the bearings

<u>Discharge side drive</u>

Sleeve bearings, lubricated by the liquid handled (non-drive side)

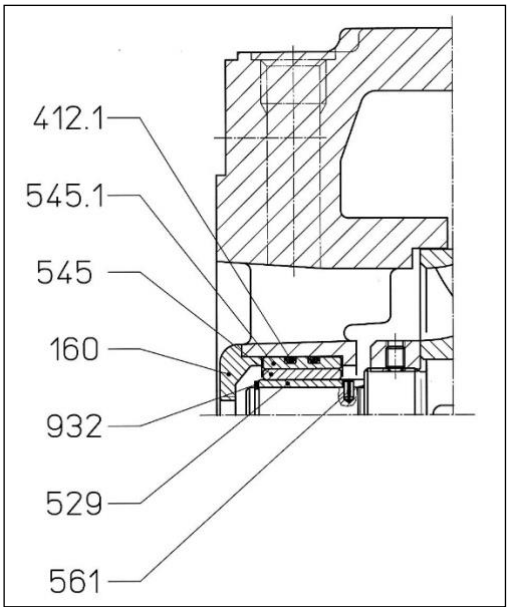


Figure: Axial suction branch

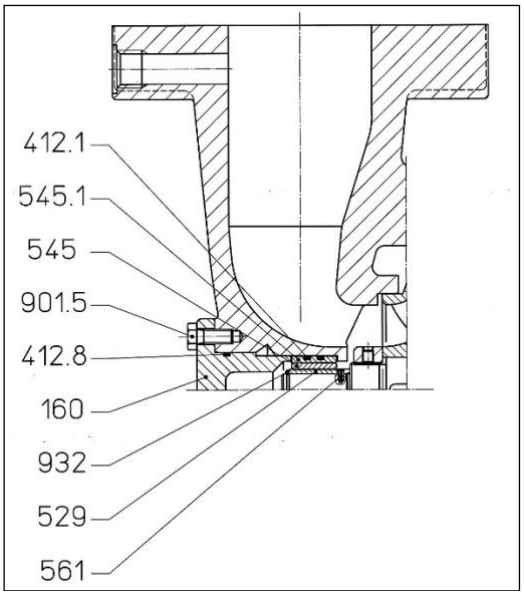


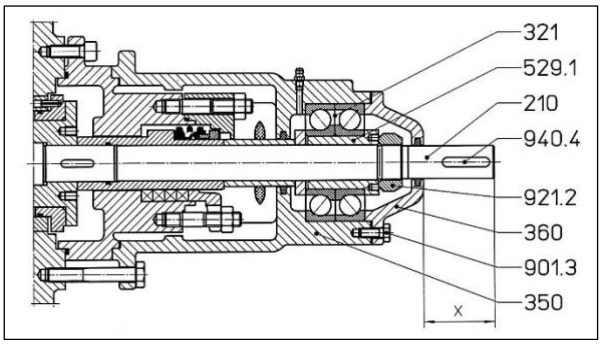
Figure: Radial suction branch

- Release bolts 901.5 (only for Radial suction)
- Remove bearing cover 160 and O-ring 412.8 (only for Radial suction) using forcing screws.
- Remove circlip 932.
- Withdraw bearing bush 545 / 545.1, with O-rings 412.1.
- Withdraw bearing sleeve 529.

CAUTION

- The anti-rotation locking grooved pin 561 should remain in the shaft.

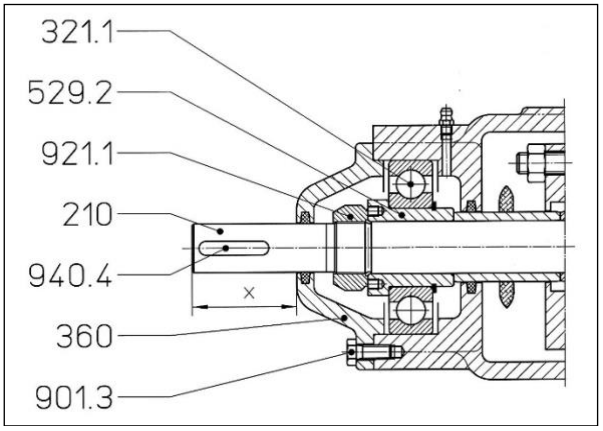
Angular contact bearing, grease lubrication (drive side)



- Remove key 940.4
- Release bolts 901.3.
- Dismantle bearing cover 360.
- Support shaft 210 and the key 940.4 and release shaft nut 921.2.
- Withdraw shaft sleeve 529.1 with bearing 321.

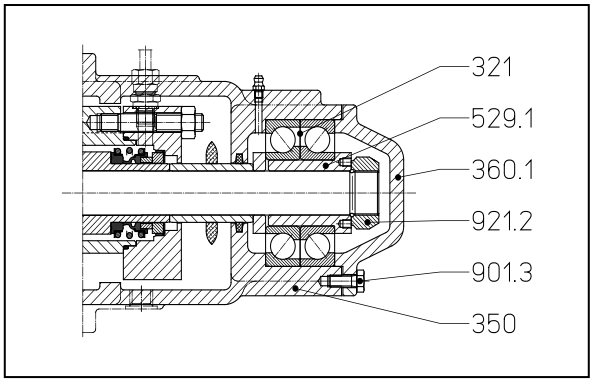
Suction side drive

Rolling contact bearing, grease lubrication (drive side)



- Remove key 940.4
- Release bolts 901.3.
- Dismantle bearing cover 360.
- Support shaft 210 and the key 940.4 and release shaft nut 921.1.
- Withdraw shaft sleeve 529.2 with bearing 321.1.

Angular contact bearing, grease lubrication (non-drive side)



- Release bolts 901.3.
- Dismantle bearing cover 360.1.
- Support shaft 210 and the key 940.4 and release shaft nut 921.2.
- Withdraw shaft sleeve 529.1 with bearing 321.

7.4.3.2 Disassembly of the shaft seal

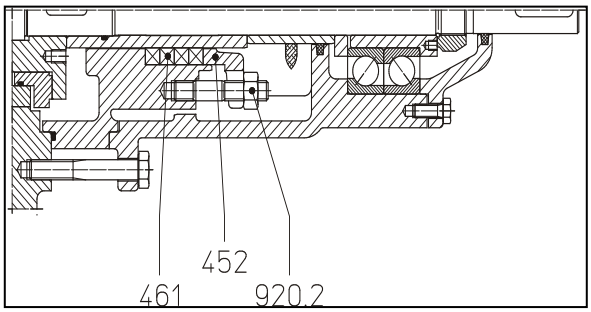


Figure: Stuffing box packing

- Release nuts 902.2.
- Push back the stuffing box gland 452.
- Remove packing rings 461, using a packing extractor.

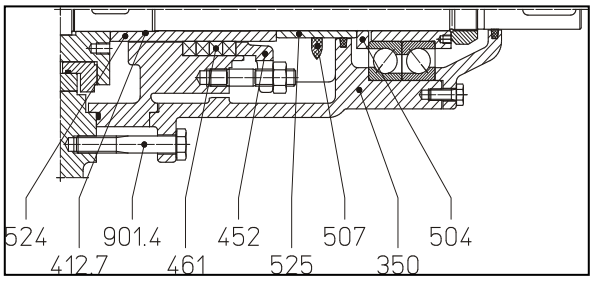


Figure: Stuffing box packing

- Dismantle rolling contact bearing in accordance with Section 7.4.3.1.
- Remove spacer ring 504 (not applicable for the drive side in the case of suction side drive).
- Release bolts 901.4.
- Remove bearing housing 350.
- Remove spacer sleeve 525 with thrower 507.
- Remove stuffing box gland 452.

- Remove shaft wearing sleeve 524 with O-ring 412.7.

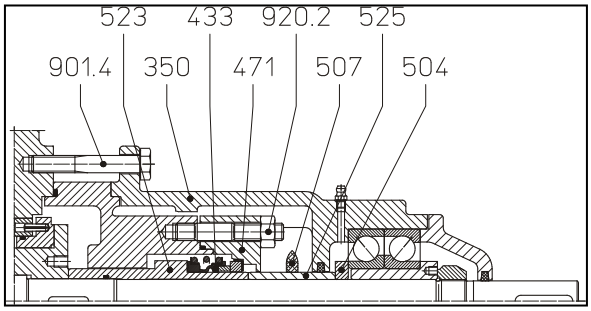


Figure: Mechanical seal

Dismantle rolling contact bearing in accordance with section 7.4.3.1.

- Remove spacer ring 504 (not applicable for the drive side in the case of suction side drive).
- Release bolts 901.4.
- Remove bearing housing 350.
- Remove spacer sleeve 525 with thrower 507.
- Remove nuts 920.2.
- Remove seal cover 471 with stationary seal ring.
- Remove shaft sleeve 523 with mechanical seal 433.

Dismantling a double back-to-back mechanical seal:

- Determine working mode on the basis of the installation drawing.
- Observe documentation.

7.4.3.3 Dismantling the balancing drum

- Dismantle rolling contact bearing, shaft seal, as per Sections 7.4.3.1 and 7.4.3.2.
- Release bolts 914.5.
- Remove housing for shaft seal 441.0.
- Withdraw part 603.2.
- Withdraw part 542.2 with O-ring 412.5.
- Remove balance drum 603.1.

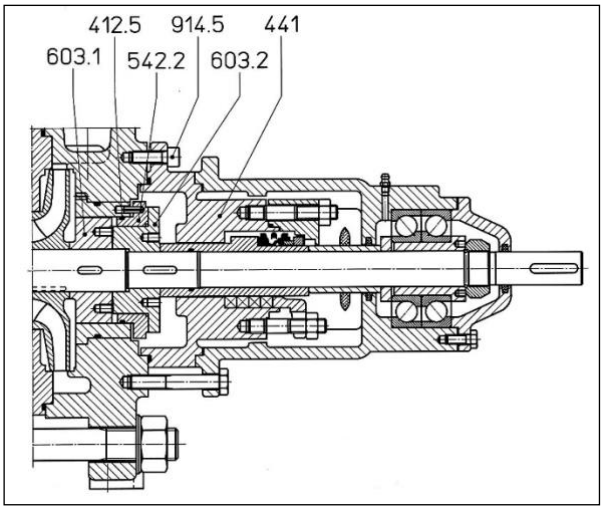
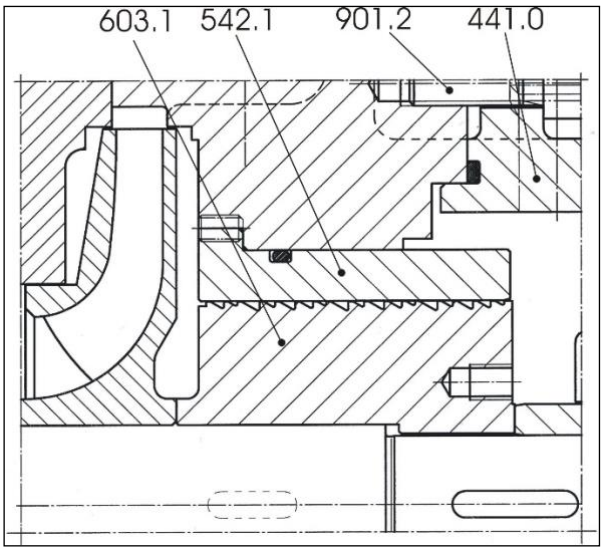


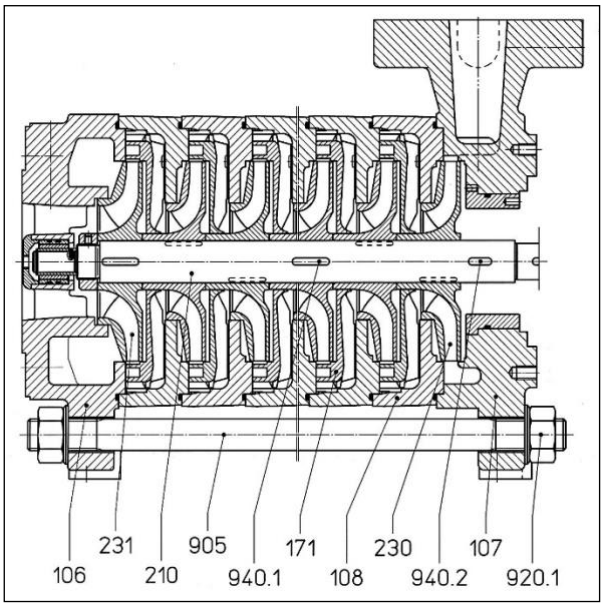
Figure: Balancing drum

Design with straight drum (special applications only)



- Dismantle rolling contact bearing, shaft seal, as per Sections 7.4.3.1 and 7.4.3.2.
- Release bolts 901.2.
- Remove housing for shaft seal 441.0.
- Remove balance drum 603.1.

7.4.3.4 Dismantling hydraulics unit



- Dismantle bearing, shaft seal and balance drum, in accordance with 7.4.3.1, 7.4.3.2, and 7.4.3.3.
- Remove key 940.2.
- Release nuts 920.1.
- Remove tie rods 905.
- Support stage casings, dismantle discharge casing 107.
- Remove, stage by stage, impeller 230, key 940.1, stage casing 108 with diffuser 171.

7.5 Work after disassembly

- Clean all parts.
- Clean the clearances and sealing surfaces.

The following pump components, if existing, must be checked:

- **Mechanical seal:**
  If the running faces are damaged or worn, replace the mechanical seal.

- **Running clearances:**
  With a new pump, the diameter difference between the impeller clearance area and the casing or cover clearance area is 0.3 mm to 0.5 mm. In the case of excessive wear in the clearance area, the components must be replaced to restore the proper running clearances. Contact Flowserve.

- **Felt rings, O-rings, Bearings**
  Replace any damaged felt rings. Replace all the O-rings and the bearings.

7.6 Assembly

CAUTION

- The assembly work must be based on good engineering practice.
- Unnecessary extra force should not be used during the assembly as that will cause damage to the parts.

- Heavy parts should be supported during assembly.
- Before assembly, apply a layer of an appropriate erection substance on the fitting points. Observe instructions with regard to cleanliness and safety.
- The properties of new pump components must not be changed without our head office's consent.
- All parts must be clean and free from chips or dust.
- The unit may be re-assembled in the reverse manner to disassembling.
- Follow the tightening torques specified.
- Quick-sticking glues are not permitted.

7.6.1 Tightening torques

Thread	M24x1,5	M27x1,5	M30x1,5
Torque [Nm]	230	380	550

7.6.2 Pump assembly

- It is recommended that the pump be assembled vertically.
- Assembly starts on the suction side.
- Install the parts in their original position.
- Follow the cross-sectional drawing with list of components.
- Lightly tighten the nuts of the tie rods.
- Place the pump on its feet, in horizontal position, on a flat work surface.
- Tighten nuts of the tie rods in several stages in a diagonal sequence with the final tightening torque specified in Sec 7.6.1.

7.6.2.1 Shaft seal

Stuffing box packing

CAUTION

- The packing rings must not be inserted until after the pump, including the bearings, has been completely installed.

- Only pre-compressed packing rings are permissible.
- Thoroughly clean the packing area and the stuffing box gland.
- The first packing ring should now be laterally bent open and pushed on the shaft protecting sleeve.
- Slide the packing ring into the packing chamber using the stuffing box gland.
- Install the other packing rings in the same manner, however with the gaps 180° apart.
- Turn the gland nuts finger tight.
- Check that the gland is not tightened at a slant.

CAUTION

- The pump rotating assembly must be free to rotate by hand.
- The stuffing box leakage must not be adjusted until after start-up (see Section 6).

Dimensions in mm	Pump size			
	032	050	065	100
Packing cross-section	10		10	
Number of rings, normal	4		4	
Number of rings, with external cooling	5		5	
Shaft sleeve diameter	45		70	

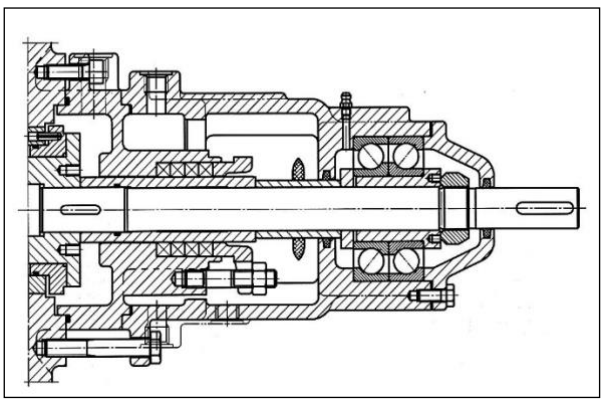


Figure: Uncooled stuffing box packing

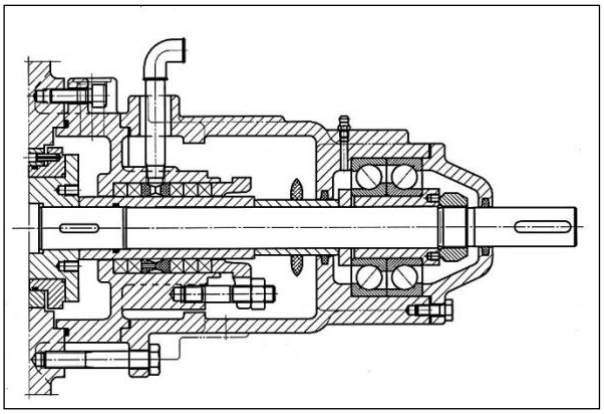


Figure: Stuffing box packing with external cooling

Mechanical seals

CAUTION

- Utmost care should be taken when mounting the rotary and stationary seal rings so as to avoid contamination and/or distortion on the sealing surfaces.
- EPDM seals must not be exposed to oil or grease.
- In order to achieve the compression pressure required for the operational reliability of the mechanical seal, check the installation dimension against the installation drawing.

- Install the mechanical seal in the reverse manner to disassembling.

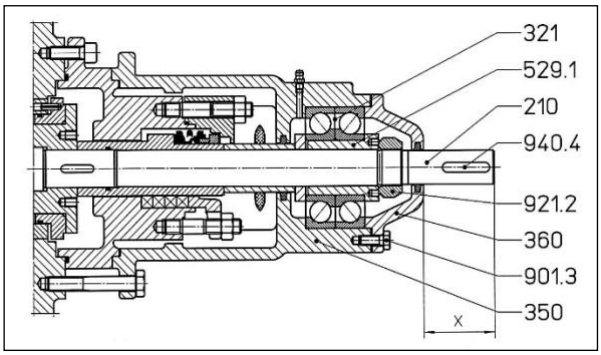
7.6.2.2 Bearings

Discharge side drive

Sleeve bearing (non-drive side)

- Install sleeve bearing in the reverse manner to disassembling.

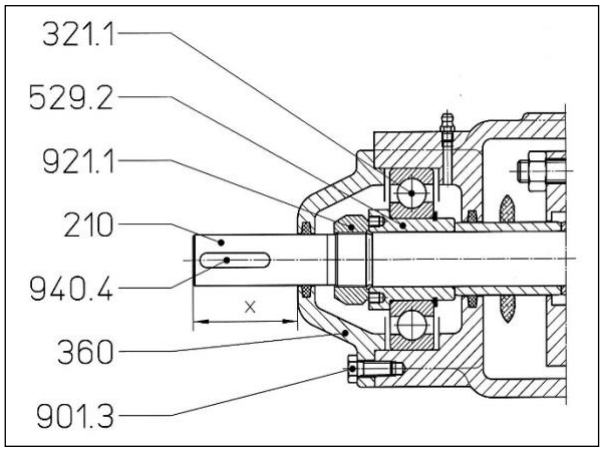
Angular contact bearing (drive side)



- Slide angular contact ball bearings in X-arrangement (face-to-face) on bearing sleeve 529.1 and install them together.
- Tighten shaft nut 921.2.
- Install bearing cover 360.
- Tighten bolts 901.3. Tightening torque: 14 Nm for MSL/MSM 032/050 and 50 Nm for MSL/MSM 065/100
- Check axial clearance between the bearing housing, 350, end face and the bearing cover, 360 (0.2 to 1.0 mm).

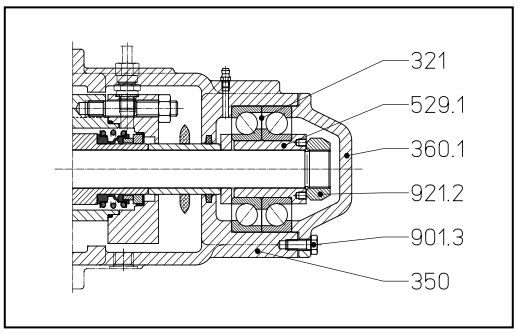
Suction side drive

Rolling contact bearing (drive side)



- Insert bearing sleeve 529.2 with bearing 321.1.
- Tighten shaft nut 921.1.
- Tighten bolts 901.3 to fasten bearing cover 360.

Angular contact bearing (non-drive side)



- Slide angular contact ball bearings in X-arrangement (face-to-face) on bearing sleeve 529.1 and install them together.
- Tighten shaft nut 921.2.
- Install bearing cover 360.1.
- Tighten bolts 901.3. Tightening torque: 14 Nm for MSL/MSM 032/050 and 50 Nm for MSL/MSM 065/100
- Check axial clearance between the bearing housing, 350, and bearing cover, 360.1 (0.2 to 1.0 mm).

CAUTION

- Check axial position of the rotor. Dimension X (refer to figure) must be the same as before disassembly. In case of deviation, contact Flowserve.

- Upon completion of the pump assembly, the bearing housing(s) must be filled with polyuria based high temperature grease. Refer to Sec 7.3.1.3 for suitable greases. Below table shows the amount of grease for each of the bearing housing(s).

	Bearing code	Quantity of grease
032/050	7309 BEXXX	70 g
065/100	7312 BEXXX	160 g

Table: Initial grease quantity for new bearings

8 LOCATING TROUBLES

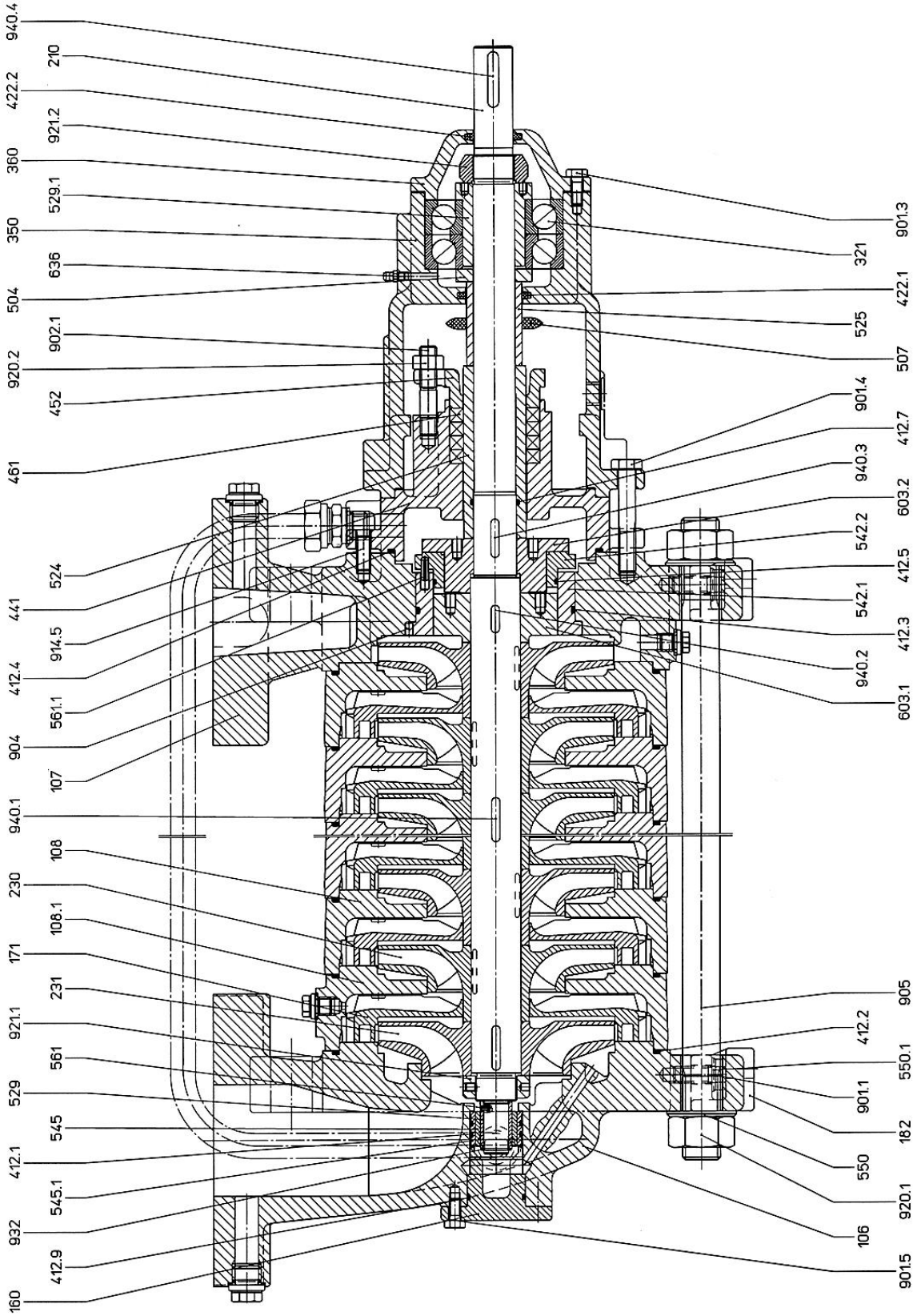
8.1 Troubles and possible causes

Trouble	Cause	Remedial action
Insufficient liquid delivered	Wrong direction of rotation.	Re-connect the motor.
	Counter-pressure too high.	Check the system for contaminants, re-adjust the duty point.
	Suction lift too high or insufficient NPSHA.	Check liquid levels, open suction side shut-off valves, clean suction side filter / dirt trap.
	Pump / pipeline insufficiently filled with liquid.	Vent and re-fill the pump / pipeline.
	Sealing clearances too great due to wear.	Replace worn pump components, wear rings.
	Leakage in casing or suction pipework.	Replace casing seal, check flange connections.
	Impellers or diffusers clogged.	Disassemble the pump, clean the impellers or diffusers.
Insufficient suction performance of pump	Suction lift too high or insufficient NPSHA.	Check liquid levels, open suction side shut-off valves, clean suction side filter / dirt trap.
	Leakage in casing, shaft seal, foot valve or suction pipework.	Replace casing seal, check shaft seal, check flange connections.
	Loose or clogged parts in the pump.	Open the pump and clean it.
Pump leakage	Casing bolts not tight enough.	Check tightening torque of the tie rods.
	Defective mechanical seal.	Check the sealing surfaces and secondary seals of the mechanical seal, replace damaged components.
	Damaged seals.	Replace seals.
Temperature increase in the pump	Discharge side valve closed.	Open discharge side valve.
	Suction lift too high or insufficient NPSHA	Check liquid levels, open suction side shut-off valves, clean suction side filter / dirt trap.
	Pump / pipeline insufficiently filled with liquid.	Vent and re-fill the pump / pipeline.
Increase in bearing temperature	Internal components worn	Renew worn parts.
	Excessive clearances.	Install wear rings, diaphragm bushes.
	Increase in axial thrust.	Check clearances, throttling gap and balancing line.
	Insufficient, too much, contaminated or unsuitable lubricant.	Add, reduce or replace lubricant.
	Bearings worn.	Replace bearings.
	Shaft sealing area insufficiently cooled.	Check cooling lines, remove any deposits in the cooling liquid container.
	Coupling misaligned or coupling components worn.	Align or replace.
	Pump distorted, or sympathetic vibrations in the pipework.	Check pump and pipework fastening. Install vibration-absorbing pipework support.
	Flow rate too low / too high.	Ensure minimum flow / throttle discharge side shut-off valve.
	Internal/external rings of the thrust bearings loose.	Axially clamp internal / external rings.
Unsteady running of pump, excessive noise	Suction lift too high or insufficient NPSHA.	Check liquid levels, open suction side shut-off valves, clean suction side filter / dirt trap.
	Pump / pipeline insufficiently filled with liquid.	Vent and re-fill the pump / pipeline.
	Base of the pump not level. Pump distorted.	Check pump installation and adjustment.
	Foreign substances in the pump.	Open the pump and clean it.
Motor circuit breaker switches off	Requirements as to pumping conditions not met.	Check the pumping conditions on the basis of the data sheet.
	Base of the pump not level. Pump distorted.	Check the installation of the pump.
	Foreign substances in the pump.	Open the pump and clean it.

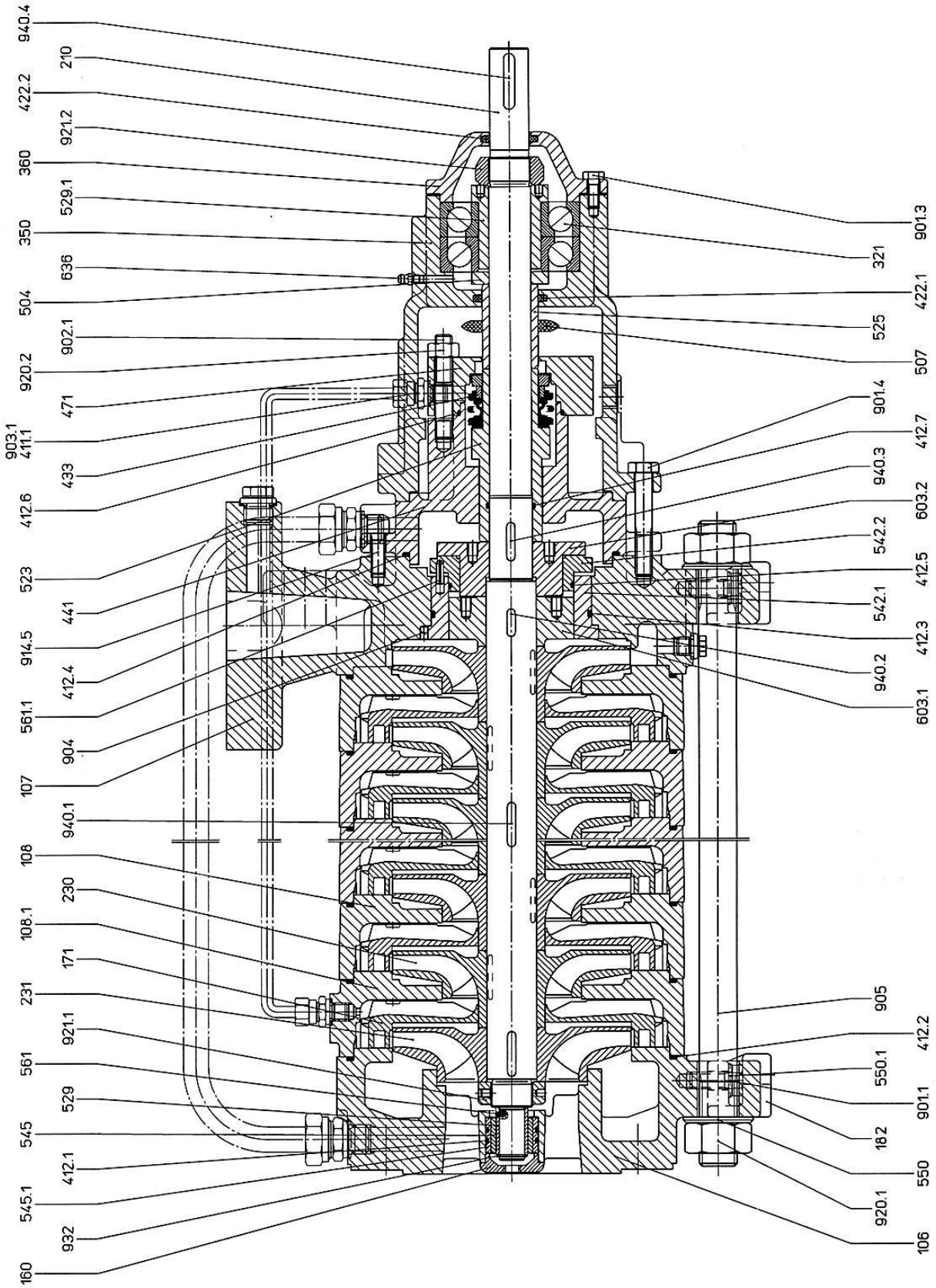
9 SECTIONAL DRAWINGS / PARTS LIST

9.1 Sectional Drawings

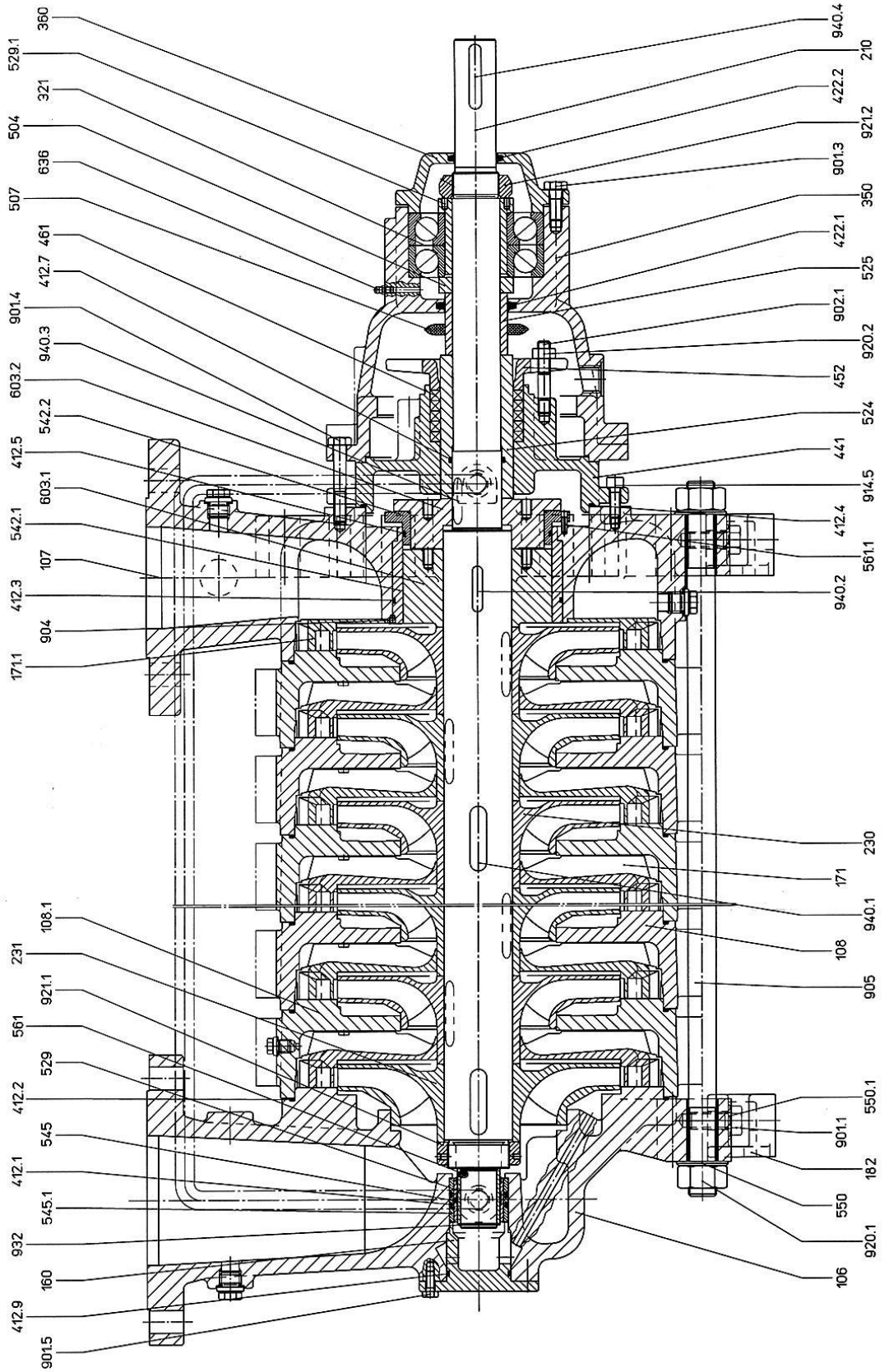
9.1.1 MSL/MSM 032 and 050 – Drive on the Discharge side, Radial suction



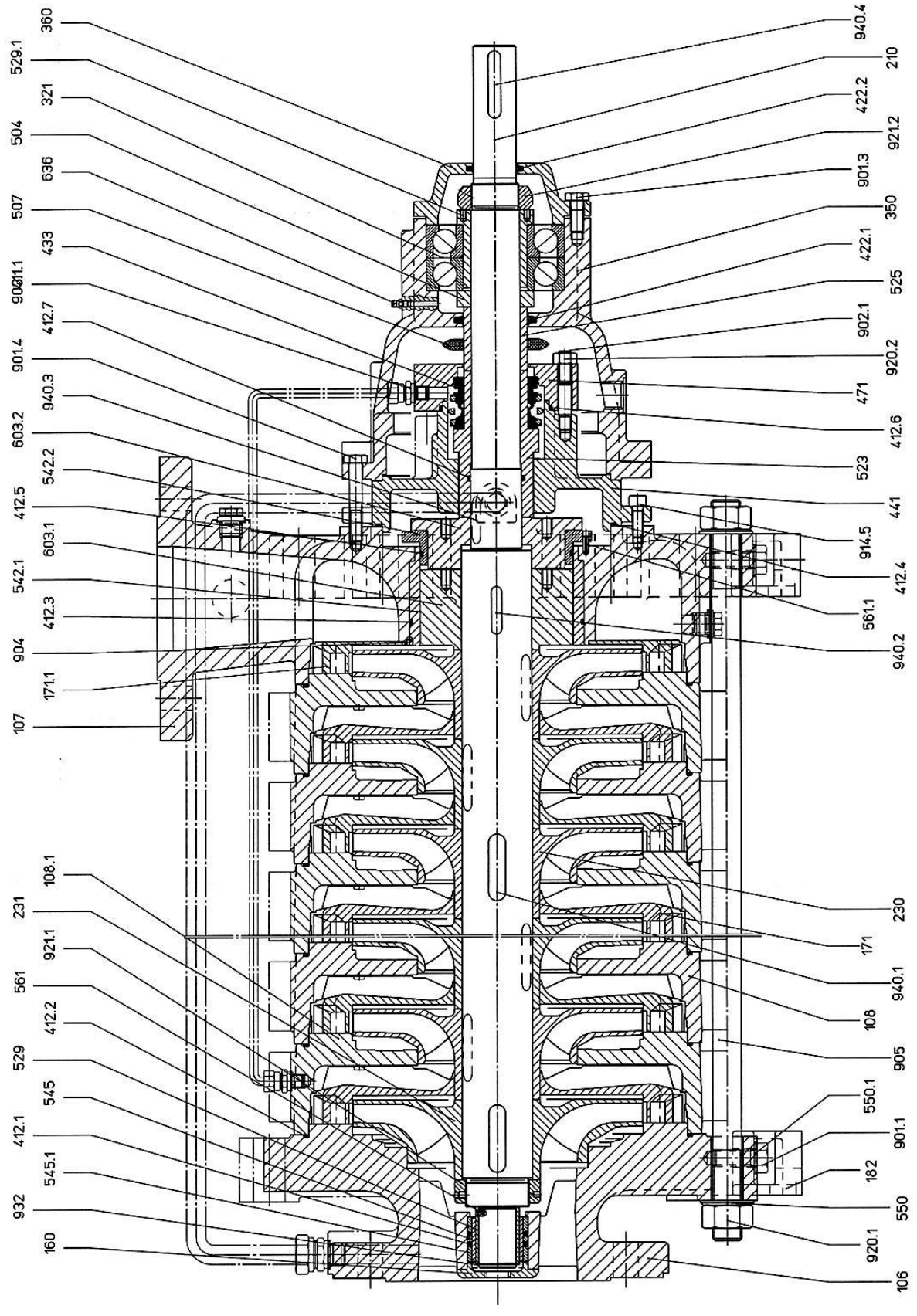
9.1.2 MSL/MSM 032 and 050 – Drive on the Discharge side, Axial suction



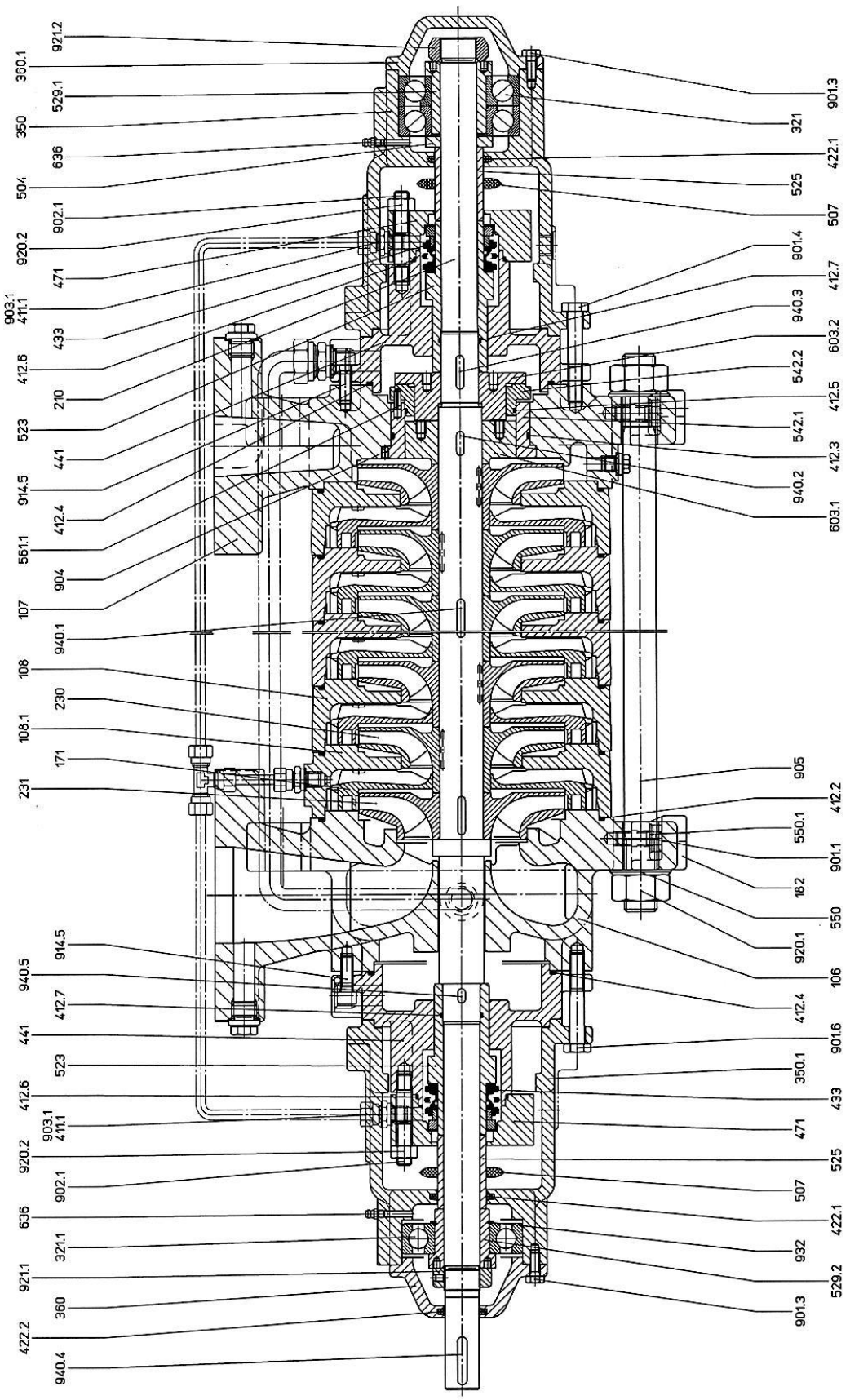
9.1.3 MSL/MSM 065 and 100 – Drive on the Discharge side, Radial suction



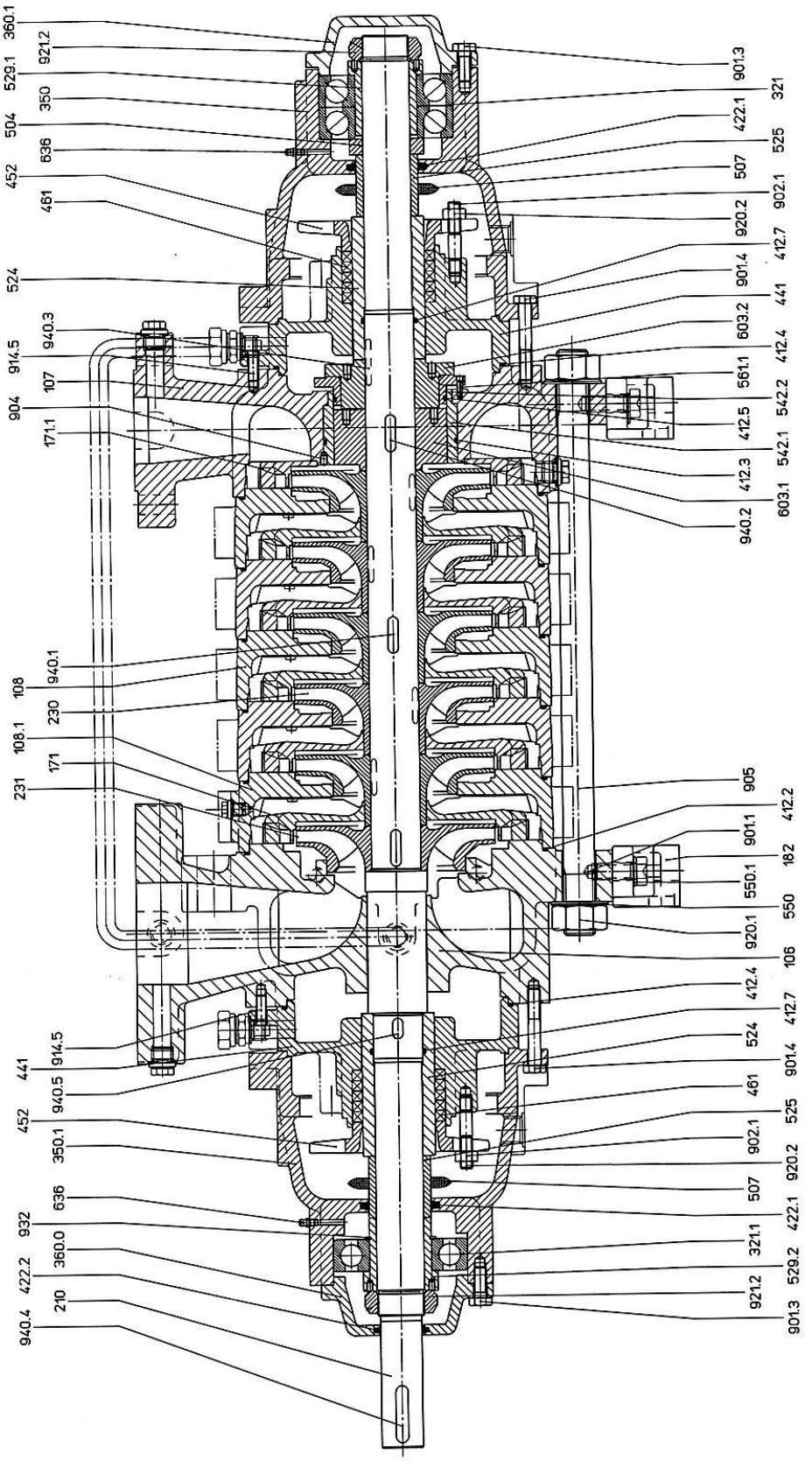
9.1.4 MSL/MSM 065 and 100 – Drive on the Discharge side, Axial suction



9.1.5 MSL/MSM 032 und 050 - Drive on the Suction side



9.1.6 MSL/MSM 065 and 100 - Drive on the Suction side



9.2 Parts list

Part number DIN	Denomination
106	Suction casing
107	Discharge casing
108/.1	Stage casing
160	Cover
171	Diffuser
171.1	Diffuser last stage
182	Foot
210	Shaft
230	Impeller
231	Suction impeller
321	Radial ball bearing
321.1	Radial ball bearing
350/.1	Bearing housing
360/.1	Bearing cover
411.1	Joint ring
412.1/.2/.../.9	O-Ring
422.1/.2	Felt ring
433	Mechanical seal
441	Housing for shaft seal
452	Gland
458	Lantern ring
461	Gland packing
471	Seal cover
504	Spacer ring
507	Thrower
523	Shaft sleeve
524	Shaft wearing sleeve
525	Spacer sleeve
529/.1/.2	Bearing sleeve
542.1/.2	Throttling bush
545/.1	Bearing bush
550/.1	Disc
561/.1	Grooved pin
603.1/.2	Balance drum
636	Grease nipple
901.1/.2/.../.5	Hexagon head bolt
902.1	Stud
903.1	Screwed plug
904	Grub screw
905	Tie rod
914.5	Hexagon socket head cap screw
920.1/.2	Nut
921.1/.2	Shaft nut
932	Circlip
940.1/.2/.3/.4	Key

10 TECHNICAL DATA / LIMITS

10.1 Material of construction - Casing

The 16th and 17th characters in the product identification code (Refer Sec 2.6) on the nameplate indicate the material of construction.

Type MSL

Code	Suction casing	Discharge casing / Stage casing
0R, 0U	Grey cast iron	Grey cast iron
1R, SC	Spheroidal graphite iron	Spheroidal graphite iron
4R	Stainless steel	Stainless steel

Type MSM

Code	Suction casing	Discharge casing / Stage casing
0X, SA	Grey cast iron	Spheroidal graphite iron
1R	Spheroidal graphite iron	Spheroidal graphite iron
TA, TB	Grey cast iron	Chromium steel
TD, TE, TF	Chromium steel	Chromium steel

10.2 Operating limits

10.2.1 Permissible pressure

Permissible maximum operating gauge pressure (bar) as a function of the casing material and temperature of the liquid handled [1)]

Type MSL

Pump Size	Materials of construction															
	Grey cast iron						Spheroidal graphite iron				Stainless steel					
	-10 to 120 °C		< 140 °C		< 180 °C		- 10 to 120 °C		< 180 °C		20 to 100 °C		< 140 °C		< 180 °C	
	S	D	S	D	S	D	S	D	S	D	S	D	S	D	S	D
032, 050, 065, 100	16	40	15	38	14	34	16	40	15	37	13	32	12	30	11	28

Type MSM

Pump Size	Materials of construction																	
	Grey cast iron/ Spheroidal graphite iron						Grey cast iron/ Chromium steel						Chromium steel					
	-10 to 120 °C		< 140 °C		< 180 °C		-10 to 120 °C		< 140 °C		< 180 °C		-10 to 120 °C		< 140 °C		< 180 °C	
	S	D	S	D	S	D	S	D	S	D	S	D	S	D	S	D	S	D
032, 050, 065, 100	16	63	15	58	14	56	16	63	15.5	62.5	15	60	16	63	15.7	62.5	15.5	60

S = Suction flange, D = Discharge flange

[1)] Please ensure the operating limits for the mechanical seal are not exceeded

10.2.2 Permissible flow rate

This operating range is applicable if waterlike liquids are pumped. If liquids having distinctly different physical properties are pumped, it may be necessary to narrow the permissible operating limits.

Size:
032: 0.15 to 1.1 Q/Q_{opt}
050: 0.2 to 1.1 Q/Q_{opt}
065: 0.2 to 1.1 Q/Q_{opt}
100: 0.25 to 1.1 Q/Q_{opt}

10.2.3 Permissible maximum surface temperatures of the pump

The highest temperatures usually occur on the pump casing surface, on the bearing housing in the area of the anti-friction bearings (see Sec 10.2.4), and on the seal cover near the mechanical seal.

The temperature occurring on the pump casing is almost the same as that of the liquid handled.
If the pump is adequately filled with liquid, the temperature of the liquid handled in the shaft seal area should not increase by more than 40 K with a mechanical seal. Exact values according to the operating instructions of the mechanical seal manufacturer.

Thus, the following theoretical maximum temperature of the liquid handled as a function of the temperature class according to ISO 80079-36 is obtained. The maximum operating temperature of the pump and the operating limits of the mechanical seal must be observed (if there is any doubt, please contact Flowserve or the mechanical seal manufacturer).

Temperature class acc. to ISO 80079-36	Max. temperature of the liquid handled
T5	60 °C
T4	95 °C
T3	160 °C
T2	180 °C *)

*) Design limits

10.2.4 Bearing temperature

When a pump is put into operation, the temperature of the bearings can be higher than during normal operation. The temperature of the bearings drops after a running-in phase as the bearings reach steady-state temperature after about five days.

Under normal operating conditions, the bearing housing 'skin' temperature (measured on the outside of bearing housing) should not exceed 95 °C, provided the requirements for appropriate pump operation are met and regular maintenance on the bearings is provided. Insulation of the bearing housing is NOT permissible.

The temperature may increase under unfavorable operating conditions, e.g. high fluid temperatures or prolonged periods of operation near the permissible characteristic limits. The maximum permissible bearing housing temperature is 110 °C.

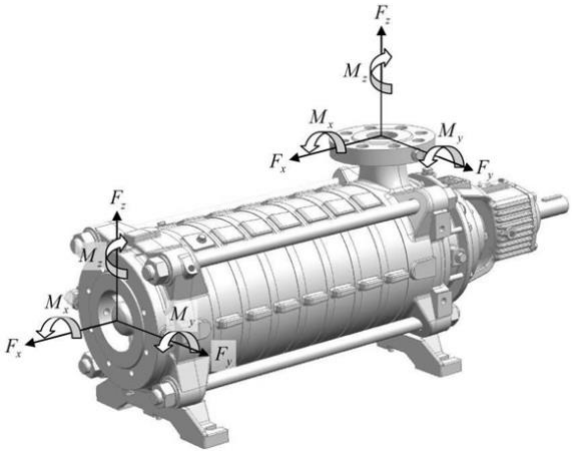
If the temperature is measured directly on the outer race of the bearing, the above-mentioned temperature limits can be increased by approximately 10 K.

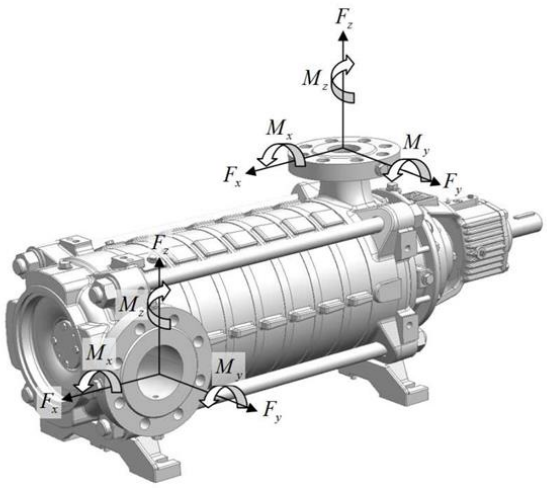
10.3 Permissible nozzle loads

The maximum allowable nozzle forces and moments are in accordance with DIN ISO 5199 / EN 25199.

Casing material: Grey cast iron or Spheroidal graphite iron (see Sec 10.1 for materials of construction based on the pump code)

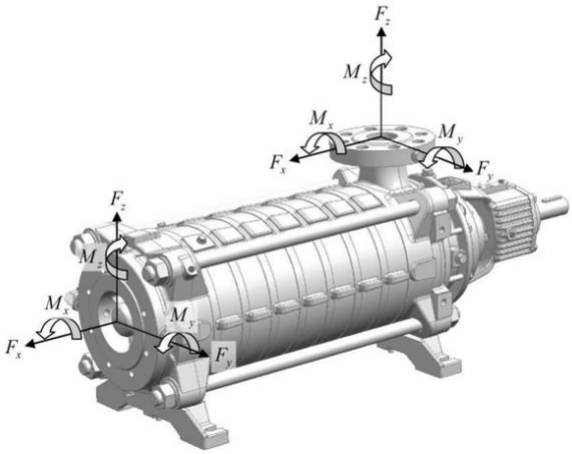
	Nominal nozzle diameter DN						
	32	**50**	**65**	**80**	**100**	**125**	**150**
Forces [N]	Axial nozzle orientation						
Fx				700	940	1105	1400
Fy				630	840	995	1260
Fz				575	755	895	1135
	Vertical nozzle orientation						
Fx	250	420	520	630	840	995	
Fy	240	375	435	575	755	895	
Fz	295	460	590	700	940	1095	
	Horizontal nozzle orientation						
Fx	250	420	520	630	840	995	
Fy	295	460	590	700	940	1095	
Fz	240	375	475	575	755	895	
Moments [Nm]	All nozzle orientations						
Mx	196	295	327	360	409	523	654
My	82	164	196	213	245	327	409
Mz	115	213	229	262	311	458	507

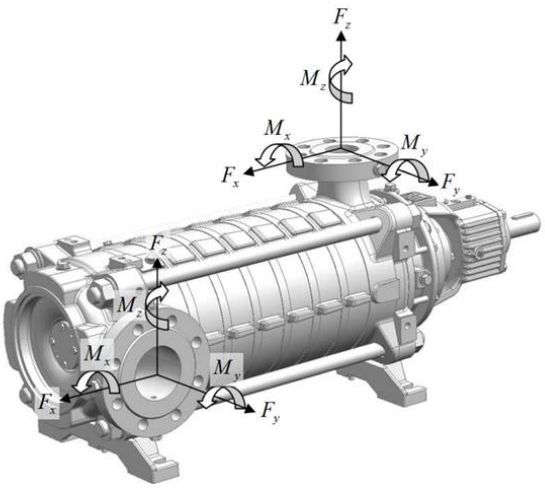




Casing material: Chromium steel or Stainless steel (see Sec 10.1 for materials of construction based on the pump code)

	Nominal nozzle diameter DN						
	32	**50**	**65**	**80**	**100**	**125**	**150**
Forces [N]	Axial nozzle orientation						
Fx				1455	1950	2299	2910
Fy				1310	1746	2066	2619
Fz				1193	1571	1892	2357
	Vertical nozzle orientation						
Fx	524	873	1077	1310	1746	2066	
Fy	495	786	989	1193	1571	1862	
Fz	611	960	1222	1455	1950	2299	
	Horizontal nozzle orientation						
Fx	524	873	1077	1310	1746	2066	
Fy	611	960	1222	1455	1950	2299	
Fz	495	786	989	1193	1571	1862	
Moments [Nm]	All nozzle orientations						
Mx	407	611	679	747	849	1086	1358
My	170	340	407	441	509	679	849
Mz	238	441	475	543	645	1086	1052





10.4 Flange design

Nominal diameters and flange ratings / nominal pressures

According to ISO/EN/DIN

Pump size	Nominal diameter DN (mm)			Flange rating / Nominal pressure PN			
				Casing material			
	Suction side		Discharge side	Grey cast iron, Spheroidal graphite iron		Chromium steel, Stainless steel	
	Axial	Radial		Suction side	Discharge side	Suction side	Discharge side
032	80	50	32	EN 1092-2 PN 16, PN 25	EN 1092-2 PN 40 (MSL) PN 63 (MSM)	EN 1092-1 PN 16, PN 25	EN 1092-1 PN 40 (MSL) PN 63 (MSM)
050	100	80	50				
065	125	100	65				
100	150	125	100				

According to ASME

Pump size	Nominal diameter NPS (in)			Flange pressure rating (Class)			
				Casing material			
	Suction side		Discharge side	Grey cast iron, Spheroidal graphite iron		Chromium steel, Stainless steel	
	Axial	Radial		Suction side	Discharge side	Suction side	Discharge side
032	3	2	1 ¼	ASME B16.1 250 FF ASME B16.42 300 FF	ASME B16.1 250 RF (MSL) ASME B16.42 300 RF (MSL) 600 RF drilling (MSM)	ASME B16.5 300 RF	ASME B16.5 300 RF (MSL) 600 RF drilling (MSM)
050	4	3	2				
065	5	4	2 ½				
100	6	5	4				

10.5 Siemens Flender couplings

10.5.1 Permissible misalignment for N-EUPEX couplings

Coupling Size		Axial play s (mm)	Permissible angular and radial misalignment ΔS max in mm at speed (rpm)				
N-EUPEX	N-EUPEX DS		750	1000	1500	2000	3000
68	76	2 – 4	0.25	0.2	0.2	0.15	0.15
80	88	2 – 4	0.25	0.2	0.2	0.15	0.15
95	103	2 – 4	0.25	0.25	0.2	0.2	0.15
110	118	2 – 4	0.3	0.25	0.2	0.2	0.15
125	135	2 – 4	0.3	0.25	0.25	0.2	0.15
140	152	2 – 4	0.35	0.3	0.25	0.2	0.2
160	172	2 – 6	0.4	0.35	0.3	0.25	0.2
180	194	2 – 6	0.4	0.35	0.3	0.25	0.2
200	218	2 – 6	0.45	0.4	0.3	0.3	0.2
225	245	2 – 6	0.5	0.4	0.35	0.3	0.25

10.5.2 Tightening torque for set screws

Coupling Size		Torque (Nm)
N-EUPEX	N-EUPEX DS	
68	76	4
80	88	4
95	103	4
110	118	4
125	135	8
140	152	8
160	172	15
180	194	25
200	218	25
225	245	25

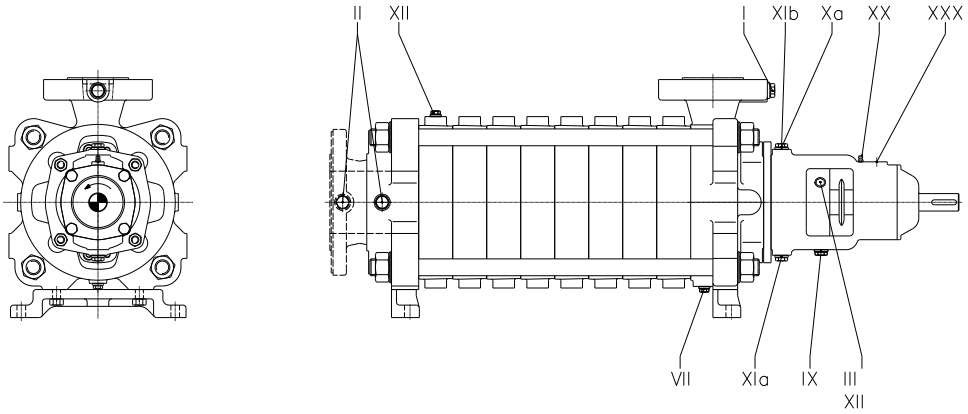
10.5.3 Permissible torsional backlash for N-EUPEX couplings

N-EUPEX Coupling Size	ΔSb (mm)
68	5.5
80	5
95	6
110	7
125	8
140	8
160	8
180	8
200	8.5
225	9

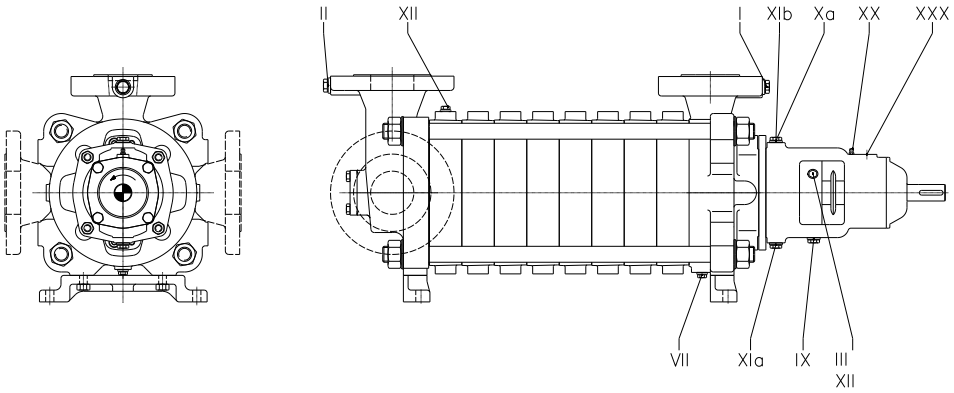
N-EUPEX DS Coupling Size	ΔSb (mm)
76	7
88	5
103	7
118	9
135	10.5
152	11.5
172	9
194	8
218	7
245	6.5

10.6 Connections

axial Inlet



radial Inlet



Pos.	Connection	Pump size	
		032/050	065/100
I [1)]	Discharge pressure, temperature	G1/2	G1/2
II [1)]	Suction pressure, temperature	G1/2	G1/2
III [1)]	Vent	G1/4	G1/4
VII [1)]	Pump drain	G1/4	G1/2
IX	Seal area drain	G3/8	G3/4
Xa	Flushing connection	G1/4	G1/4
XIa	External jacket cooling - inlet	G3/8	G1/2
XIb	External jacket cooling - outlet	G3/8	G1/2
XII	Connection for circulation/ vacuum equalizing line (from 1st Stage Casing)	G1/4	G1/4
XX	Grease lubrication for anti-friction bearing	Grease nipple	Grease nipple
XXX	Vibration measurement		

[1)] Plugged

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