

Operating & Maintenance Instructions

The operating instructions of the centrifugal pump and the accessories should be located close to the pump.

These instructions should be read carefully before installing and commissioning the pump. Every JESCO pump is dimensioned, tested and supplied according to the data of the order. If the operating conditions change at a later date (e.g. different medium, viscosity, temperature, feed conditions, etc.) we must check and confirm, if necessary, in the specific case whether the pump can be operated correspondingly. We cannot accept any liability for damage caused by misuse or failure to observe the operating instructions.

Table of contents

▮ General	BW 5 03 01 / 1
▮ Installation	BW 5 03 01 / 5
▮ Startup	BW 5 03 01 / 9
▮ Maintenance	BW 5 03 01 / 11
▮ Mounting and dismantling	BW 5 03 01 / 12
▮ Troubleshooting	BW 5 03 01 / 14

General

Description of the pump

Centrifugal chemical pumps are used for pumping acids and alkalis and other low-viscosity, aggressive liquids and neutral media.

Before each pump is dispatched, it undergoes a thorough functional test, including measurement of the discharge rate, the pump head and the power consumption of the drive motor.

Each pump has a nameplate showing the type designation and rating, and a corresponding plate for the motor data. In the event of queries, please refer to these plates.

Description of mechanical seal

Mechanical seals basically consist of two perfectly plane surfaces. One surface rotates with the shaft, while the other one is stationary. The sealing effect is achieved by the direct contact between the two plane surfaces. The stationary counter-ring is normally fixed in position.

The sliding ring is able to move axially and radially in order to compensate the shaft deflections during operation. This axial mobility enables mechanical seals to be fitted within practicable manufacturing tolerances, the accuracy required being dependent on the design of the seal.

Type B2I

Single-acting, loaded, internal seal, independent of direction of rotation. Combination of sliding materials in silicon carbide (SiC). Bellows and secondary seals of EPDM or FPM. Metallic parts of stainless steel (1.4571) or Hastelloy C4.

Type B2Q

Single-acting, loaded, internal seal, independent of direction of rotation, with quenching chamber. The chamber is sealed from the atmosphere by a shaft sealing ring to prevent deposits and/or reduction of the temperature in the area of the mechanical seal. Combination of sliding materials in silicon carbide (SiC). Bellows and secondary seals of EPDM or FPM. Metallic parts of stainless steel (1.4571) or Hastelloy C4.

Type B2D

Double-acting, loaded, internal seal, independent of direction of rotation, arranged back-to-back with sealing chamber. This arrangement is the most usual form of double-acting seals used with difficult, chemically particularly aggressive media. Combination of sliding materials in silicon carbide (SiC). Bellows and secondary seals of EPDM or FPM. Metallic parts of stainless steel (1.4571).

Quenching fluid

A clean, usually cold liquid is used for quenching, which must be highly compatible with the medium in order to prevent any chemical reaction. The quenching pressure should not exceed 0.5 bar.

Function of quenching:

- Prevention of crystallizing rings (air seal)
- Absorption of leakage
- Cooling of sliding rings
- Monitoring of leakage rate
- Lubricating film stabilization in vacuum operation

Important:

In order to avoid dry running of the radial seal on the atmosphere side, sealing systems fitted with a quenching chamber must always be supplied with quenching liquid (see installation of quenching fluid, BW 5 03 01/2).

Sealing liquid

For their operation back-to-back double acting seals require a sealing liquid under pressure flowing through the sealing space from bottom to top. The sealing pressure must be 1 to 2 bar higher than the pressure of the medium to be sealed, so that both seals only have to seal against the neutral sealing liquid. The sealing liquid must have good compatibility with the pumped medium.

Function of sealing:

- Prevention of contact between pumped liquid and atmosphere
- Formation of lubricating film between the sliding rings
- Cooling of sliding rings
- Monitoring of leakage rate

Important:

To avoid dry running of the mechanical seal on the atmosphere side, sealing systems provided with a sealing chamber must always be supplied with sealing liquid (see installation of sealing liquid, BW 5 02 01/3).

Sealing liquid installation

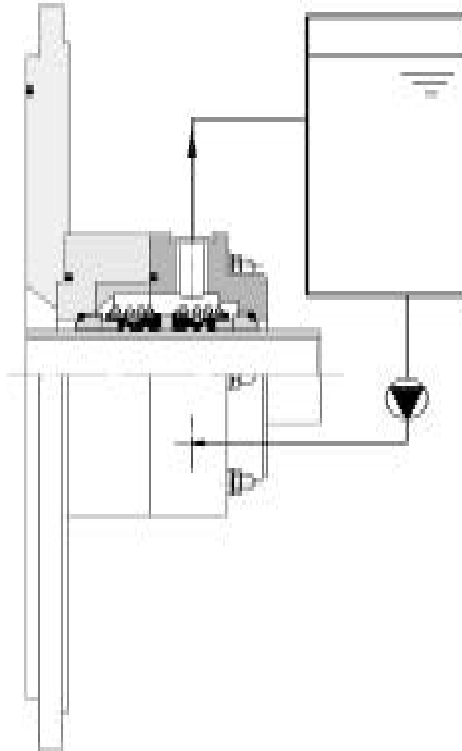
Double-acting mechanical seals basically need a sealing system, which meets the following requirements:

- The space between the mechanical seal on the product and atmosphere side must be filled with clean sealing liquid.
- During operation the pressure of the sealing liquid must always be 1.0 to 2.0 bar higher than the pressure to be sealed.
- A continuous exchange of liquid should take place to prevent overheating in the sealing chamber (by thermo-siphon action or additional circulating device.)

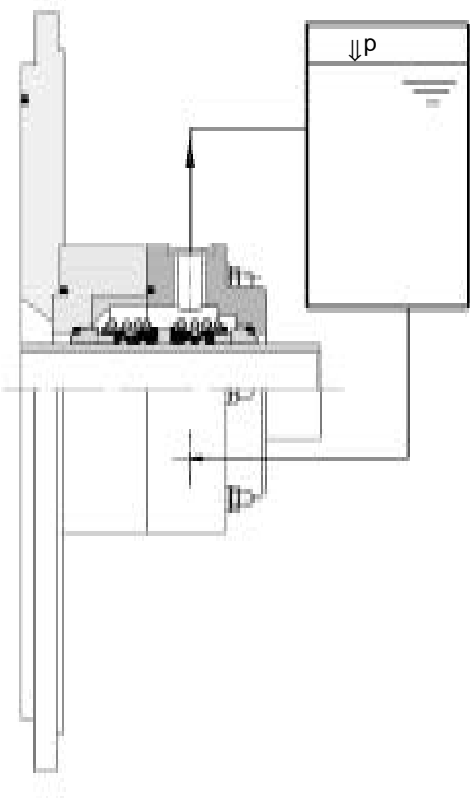
The following functions of the sealing system result from these basic conditions:

- Pressure build-up in the sealing chamber
- Leakage compensation
- Circulation of the sealing liquid

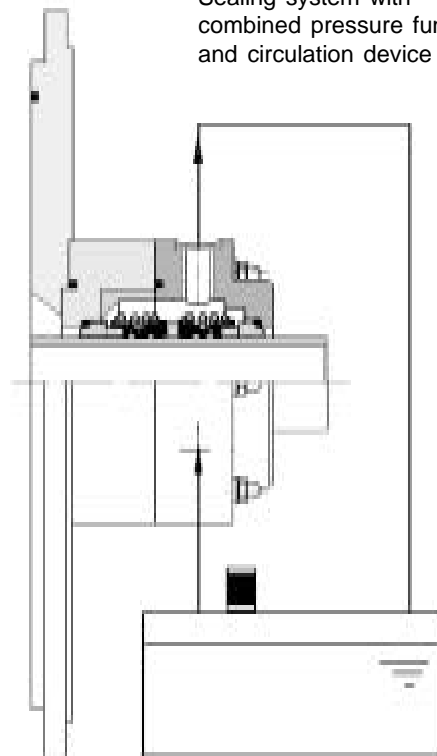
Sealing system with circulation device outside the mechanical seal



Sealing system with thermo-siphon circuit



Sealing system with combined pressure function and circulation device

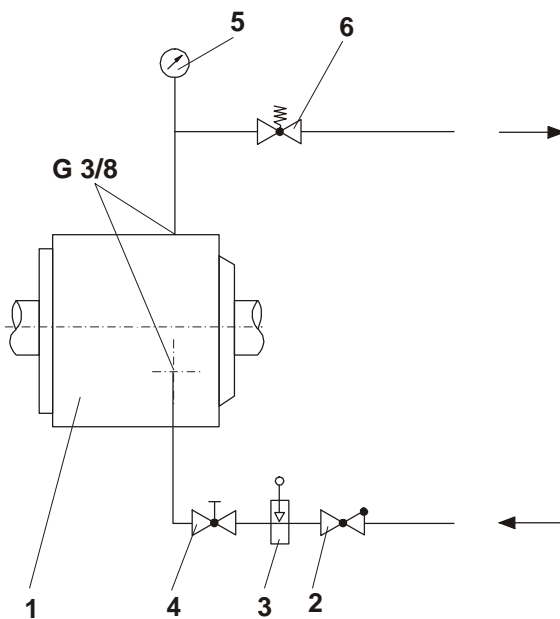


Regulation of the sealing pressure

The sealing pressure can be regulated according to the following diagram:

Legend

- 1 Sealing chamber
- 2 Non-return valve
- 3 Float-type flow meter
- 4 Flow control valve
- 5 Pressure gauge (0-10 bar)
- 6 Backpressure valve



Requirements for sealing liquid:

- Compatible with medium to be sealed
- Suitable regarding corrosion resistance of all parts contacted
- Free from solid matter
- Must not tend to form deposits
- Good lubricating properties
- High specific thermal capacity
- High evaporation temperature
- Not affecting the environment
- Easy procurement and high availability
- During operation the sealing pressure must always be 1.0 to 2.0 bar higher than the pressure to be sealed

Note on temperature:

The outlet temperature must not exceed 60°C and should lie approx. 40°C below the evaporation temperature of the sealing liquid.

Transportation and storage of pump

No special precautions are necessary for transportation and storage of plastic centrifugal pumps under normal ambient conditions. At ambient temperatures below -10°C, however, it must be ensured in particular that especially cast metal parts are protected against impact stress by suitable packing. The pump connectors must be closed.

When putting a pump into service after several years of storage, the following measures must be taken:

- Check elastomer seals for elastic properties
 - replace if necessary.
- Check quality of the bearing grease
 - renew if necessary.
- Check if the mechanical seals can be turned
 - otherwise fill the pump head with water and check after a few minutes if they can be turned. If still not, you should repair the mechanical seal.

Warranty

Every pump is given a functional test before dispatch with measurement of rate of delivery, pump head and power consumption of the drive motor. A warranty for durability of materials can only be provided if the exact operating conditions were known when the system was designed.

Excluded from the warranty are all sealing elements and damage resulting from non-observance of these operating and maintenance instructions.

Our "General Sales Conditions" have over-riding priority.

General technical safety information

The operating safety of the pump is only guaranteed if used for the intended purpose (according to the test certificate).

Removal of environmentally hazardous leaking media conveyed must comply with the statutory regulations. Avoid danger of accidents during installation and disassembly.

Ensure the stability of the pump during installation. Secure installation parts against falling. Support or underlay loose components. Connecting flanges, tapped holes and other openings on pumps must be closed during transportation and storage.

Caution:

Eye-bolts on pump components and motors must not be used for lifting the completely fitted pump or even the entire assembly. The eye-bolts are only provided for raising individual components during installation and dismantling. Use eyes on base plate, if present, for crane suspension of the assembly or place ropes around casing (connectors, bearing bodies).

EC machine guidelines

- Any work done on the whole pump arrangement may only be carried out by authorized and trained personnel.
- According to the Machine Guidelines 89/392/EEC, these products are not regarded as machines; they can, however, be built into installations which are regarded as machines. In this case, please observe the following note!



Note

We distinctly emphasize that operation is prohibited until it has been confirmed that the machine (plant) into which these products have been built corresponds to the conditions of the EC Machine Guidelines 89/392/EEC. A respective declaration of conformity is supplied with the product on request.

Alignment of coupling

Standard pumps are normally fitted with an elastic detachable coupling and are aligned carefully at the factory.

This adjustment can change during transportation to the plant or during erection onto the foundation and must therefore be checked and corrected if necessary.

Check

Use a straight-edge, dial gauge or feeler gauge in two places displaced by 90° at the periphery of the coupling to check the alignment

Straight-edge

Installation

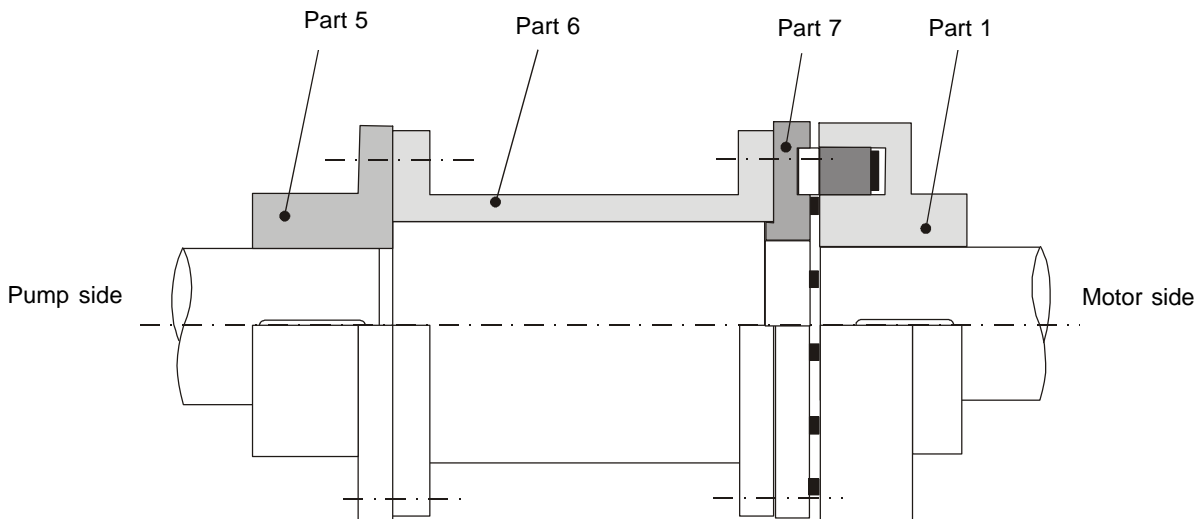
Installation of complete pump assembly

Erection/foundation

Every complete pump assembly is carefully set up and tested at the factory before delivery.

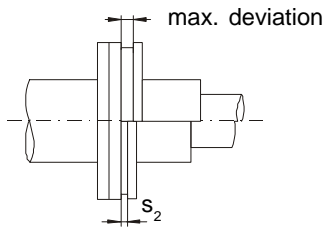
The complete assembly must be secured in the plant onto a level, stable foundation using the corresponding fixing straps. Any unevenness must be averaged out by suitable base plates. In general base plates should be cast, the foundation bolts only being tightened after the concrete has set. With free (non-cast) installation the foundation must meet special requirements. After tightening the foundation bolts successfully, the alignment of the complete assembly, especially of the elastic coupling, must be checked.

Feeler gauge



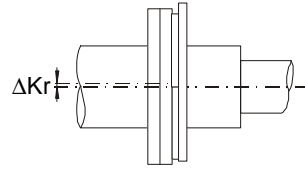
Axial offset

Axial offset of coupling parts 1 and 7 is possible within the max. permissible deviation for dimension s_2 (see table).



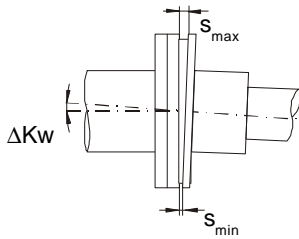
Radial offset DKr

Radial offset of coupling parts 1 and 7 is permissible within the values for ΔKr .



Angular offset D Kw

The max. permissible angular offset ΔKw is determined as the difference between dimensions s_{max} and s_{min} (for max. permissible values see table).



Important:

If angular and radial offset occur simultaneously, the sum of the two displacement values must not exceed those for DKr or DKw, respectively..

		Coupling size						
		H 80	H 95	H 110	H 125	H 140	H 160	H 180
Axial offset [mm]								
Dimension s_2		5	5	5	5	5	6	6
Admissible deviation s_2		+1	+1	+1	+1	+1	+1	+1
Angular offset ($s_{max}-s_{min}$) ΔKw [mm]								
at 50 Hz	1450 rpm	0,20	0,23	0,27	0,26	0,30	0,27	0,30
	2900 rpm	0,13	0,11	0,14	0,10	0,12	0,14	0,12
at 60 Hz	1750 rpm	0,20	0,23	0,23	0,21	0,24	0,20	0,23
	3500 rpm	0,10	0,11	0,09	0,11	0,12	0,11	0,12
Radial offset ΔKr [mm]								
at 50 Hz	1450 rpm	0,20	0,23	0,27	0,26	0,30	0,27	0,30
	2900 rpm	0,13	0,11	0,14	0,10	0,12	0,14	0,12
at 60 Hz	1750 rpm	0,20	0,23	0,23	0,21	0,24	0,20	0,23
	3500 rpm	0,10	0,11	0,09	0,11	0,12	0,11	0,12
Tightening torque for part 5/6, 6/7	[NM]	13	13	14	17,5	29	35	44
Width across flats (screw according to DIN 912)	[mm]	5	5	6	6	8	8	8

Installation and assembly of pump and drive motor

If the assembly is only completed at site, installation of the coupling should be performed as follows:

For the first installation, generally it is not necessary to dismantle the coupling, since its two complete halves are placed onto the shaft pivots of pump and motor.

1. Clean pump and motor shaft ends, cover it with a thin grease film and insert adjusting springs.
2. Fit coupling halves onto pump and motor shaft end using a tension device. If no such device is available, position coupling halves evenly by lightly tapping.
Caution: Hold pump shaft on impeller side and motor shaft on fan side against each other when fitting without tension device (remove fan cover if necessary). Axial impact load onto the roller bearings of the pump or motor must be avoided. Heating of the coupling parts makes fitting possibly easier. In order to ensure simple dismantling of the intermediate piece (part 6), dimension b of the below drawing must be observed by all means when fitting the coupling halves.
3. The intermediate piece (part 6) is marked with a groove all around the "zero side" to ensure correct functioning. This side must be screwed to the coupling half on the pump side (part 5).
4. Tighten and check screw connections according to the tightening torques specified in the table on page BW 5 03 01/5.
5. Align coupling as described on BW 5 03 01/4.

Laying of pipes

Nominal widths

The nominal widths of the pipes should not be smaller than those of the pump connections. The width of short pipes should be large enough to ensure that the resistance to flow is as small as possible, especially in the suction pipe. For long pipes the economical width should be determined from case to case.

Changes in cross-section and direction

Abrupt changes in cross-section and direction, as well as unduly sharp bends should be avoided. Flange seals must not project internally.

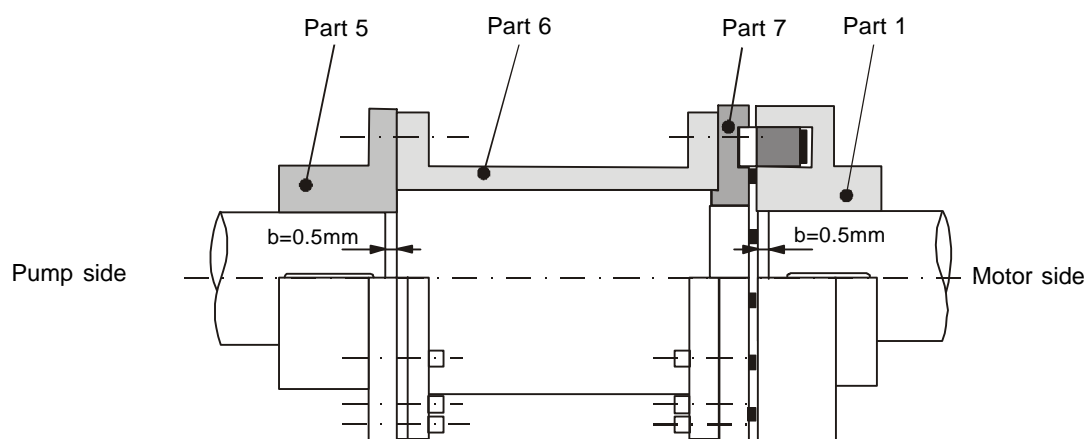
Supporting and flange mounting

Pipes should be connected to the pump without stress. They should be supported close to the pump and screwed on easily so as to avoid distortion. After releasing the screws the flanges must neither be inclined nor spring or press against each other.

Stress possibly applied to the piping (e.g. due to temperature influences, etc.) must be kept away from the pump body by appropriate measures, e.g. installation of compensators.

Cleaning of piping

Before mounting, all piping parts and fittings must be cleaned thoroughly.

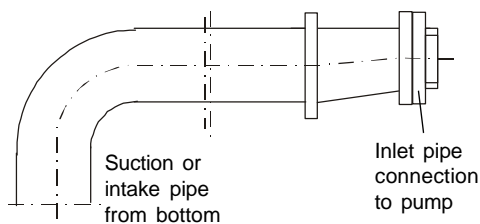


Suction or intake pipe

Direction and cross-section of pipes

Suction or intake pipes should generally be layed as short as possible and without sharp changes in direction (e.g. arches instead of angles). The pipe cross-section must be selected so that flow speeds of max. 2.0 m/s are not exceeded.

Unequal nominal widths of suction connection and horizontal suction pipes must be compensated for by eccentric spacers (see drawing).



The installation of suction pipes must be absolutely tight. To prevent the formation of air pockets, the suction pipe must rise towards the pump, the intake line being layed with a slight downward gradient. "Priming over the mountain" should be avoided. If local conditions do not allow the suction pipe to rise continuously, a venting device should be provided at its highest point.

Fittings in the suction or intake pipe

If the pump is operated without priming chamber in the case of suction operation, a foot valve (non-return valve) must be installed at the end of the suction pipe to prevent the pump and pipe from emptying during standstill. For dirty media a suction filter must be mounted so that dirt from swamp or air from the liquid cannot enter the pipe (see installation examples). In the case of intake operation, a low-loss shutoff valve should be integrated in the intake pipe so that the pump can be removed (e.g. for revision) without having to empty the supply tank.

Pressure pipe

Pressure pipe cross-sections

Pressure pipe cross-sections should be dimensioned so that the flow speed is in the range of 1-3 m/s. The optimum pipe width within this tolerance must be defined from case to case.

Fittings in the pressure pipe

Shutoff valve

A shutoff valve must be installed in the pressure line close to the pump to regulate the flow of the pumped medium.

Prevention of reverse flow

When long pressure pipes or high pressures are involved a backstop must be installed. In the case of standstill the pump is mechanically relieved, and siphoning, i.e. flowing back of the pumped medium is prevented. Thus harmful pressure surges on the pump and foot valve can be avoided.

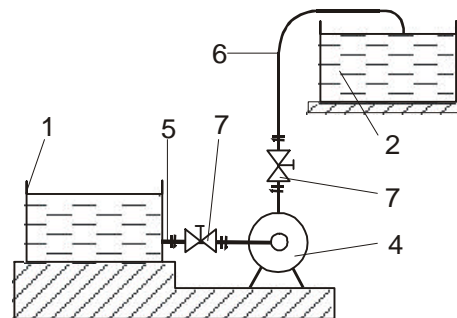
Suction action

In general standard pumps of the N series are not self-priming. If the media are free from solid matter the pump can operate in the suction mode by using a foot valve (non-return valve at the end of the suction pipe). It is essential that the basic physical conditions are fulfilled and that suction pipe is completely filled with liquid before startup (see examples of installation). If a priming chamber is provided a normal-priming centrifugal pump is able to evacuate the suction pipe itself, i.e.: under these conditions the medium can be primed from a lower level (see examples of installation). Also in this case correct operation depends on adherence to the basic physical conditions.

Examples of installation

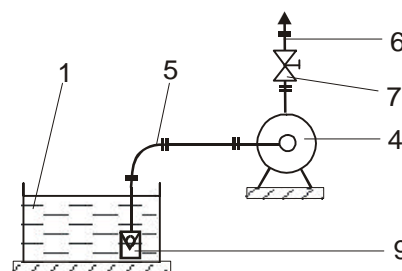
Flooded suction

As long as the level of the tank liquid is maintained above the height of the pump head, the pump will not run dry. The level can be controlled by a suitable level switch.



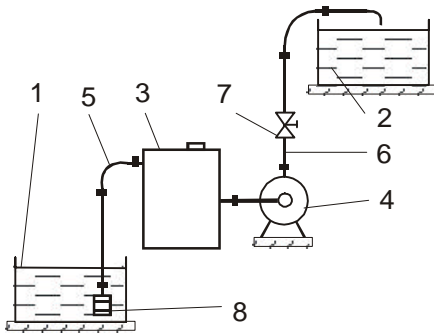
Suction with non-return valve

The use of this suction mode is only recommended with clean media ensuring safe functioning of the non-return valve.



Suction with priming chamber

The priming chamber must be filled before starting. The level in the priming chamber is maintained when the pump is running, because the medium is primed into the priming chamber due to the vacuum formed in the suction pipe. The volume of the priming chamber must match the capacity of the centrifugal pump and the volume of the suction pipe.



Legend

- | | | |
|--------------------|------------------|-----------------------------------|
| 1 Supply tank | 2 Receiving tank | 3 Priming chamber |
| 4 Centrifugal pump | 5 Suction pipe | 6 Pressure pipe |
| 7 Shutoff valve | 8 Suction filter | 9 Foot valve,
non-return valve |

Commissioning

Measures to be taken before startup

- ⚠ Remove impurities (solid matter) from the piping, resulting from installation.
- ⚠ Check piping for tightness (compression test).
- ⚠ Check if piping connections to pump are under stress (see supporting and flange mounting).
- ⚠ Check coupling between pump and drive unit for proper alignment and adjust, if necessary (see alignment of coupling).
- ⚠ Fill and vent pump and system correctly (see filling and venting of the pump).
- ⚠ Check direction of rotation of whole unit (see direction of rotation).

Filling and venting of the pump

The pump is filled and vented at the same time as the system. While filling, it is advisable to turn the pump shaft slowly by hand.

Direction of rotation

The motor must rotate in the direction indicated by the arrow on the motor casing. To check the direction of rotation the motor may be briefly switched on. Rotation in the wrong direction affects the discharge capacity and can result in damage to the pump.

Starting

Before startup check once more if the system and the pump are filled and vented correctly. If the mechanical seal is operated with quenching or sealing chamber it must be checked if the supply of the quenching fluid or sealing liquid is ensured.

Shutoff valves

The shutoff valve in the pressure pipe must be closed, the shutoff valve on the suction side must be opened.

Switching on the motor

Shutoff valve on the pressure side

Directly after startup the shutoff valve on the pressure side must be slightly opened.

Insufficient venting

If the discharge head does not rise with increasing speed, switch off the pump and re-vent the unit.

Adjusting the discharge values

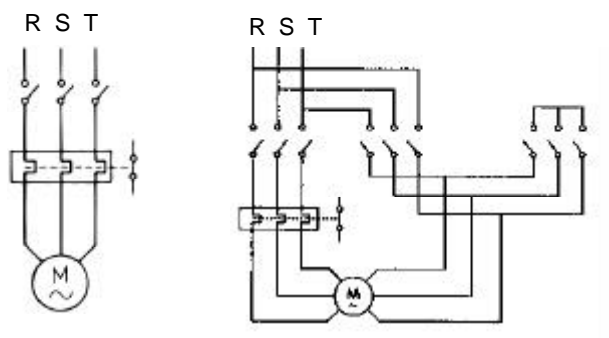
After reaching the operating speed, the shutoff valve on the pressure side should be opened to such an extent that the necessary discharge values are attained. The shutoff valve on the suction side must not be used for adjusting the discharge flow. The discharge flow can be increased provided that the maximum load of the motor is taken into account.

Operating against a closed shutoff valve

It is essential to avoid operation for any length of time against the closed shutoff valve on the pressure side, because apart from the pumped fluid becoming warm, the pump might be damaged.

Electrical connection

The electric motor mounted on the pump should be connected according to the instructions printed inside the terminal box cover. In addition to the usual fuses, each pump motor must be protected by a thermal motor protection switch (see fig. 1). The external electrical connection should be made by a qualified electrician in accordance with local regulations.



direct starting

star-delta starting

Fig.1

Motor data

Surface-cooled 3-phase motor according to IEC standards, speed 1450 rpm or 2900 rpm, voltage 3x230/400V or 3x400/690V, frequency 50Hz, enclosure IP55, insulation class F, mounting IM B3.

Motor power [kW]	Rated current [A] at	
	1450 rpm	2900 rpm
0,55	1,5	---
0,75	2,0	---
1,1	2,7	2,4
1,5	3,5	3,3
2,2	4,8	4,6
3,0	6,6	6,2
4,0	8,8	7,9
5,5	11,5	10,5
7,5	15,5	14,0
11,0	21,0	21,5
15,0	29,0	28,0
18,5	36,0	33,0
22,0	42,0	41,0
30,0	55,0	53,0
37,0	67,0	66,0
45,0	84,0	79,0
55,0	97,0	99,0

Changing the operating data

Higher density of the pumped medium

If the density of the pumped medium is higher than assumed when ordering, or when the pump was originally dimensioned, it is essential to make sure that the motor is not overloaded.

Higher flow rate

If the flow rate is higher than mentioned in the order or originally dimensioned, it is important to ensure that the head is still adequate. If it is not, this could result in cavitation and thus damage to the pump.

Measures to be taken in the case of longer standstills

If the concentration of the pumped liquid is likely to change, or if it may crystallize when the pump is out of operation for a longer time, the pump must be emptied and flushed with a conserving liquid.

Dry running

It is also essential to ensure that the mechanical seal does not run dry - even for a short time - as this can damage the sliding faces and prevent the shaft seal from functioning correctly.

Switching off the pump

Pressure pipe

If a non-return valve is fitted in the pressure pipe, the shutoff valve may remain open. If there is no non-return valve in the pressure pipe, the shutoff valve must be kept closed.

Motor

Switch off the motor.

Switching the pump on again

Before switching on again, make sure that the pump shaft is not rotating.

If the shutoff valve in the pressure pipe is leaking or not fully closed, it is possible that the pump shaft rotates backwards due to the reverse flow of the pumped medium.

Maintenance

Standard pumps of the N series require hardly any maintenance. As a standard, they are fitted with a high-quality, maintenance-free mechanical seal which is automatically adjusted by spring action. The bearings of the electric motor are permanently lubricated. The pump bearing should be checked regularly and greased or lubricated according to the below diagram, if necessary.

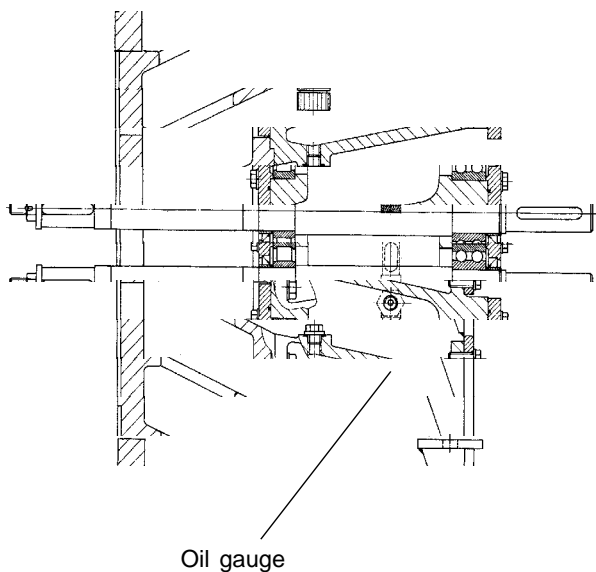
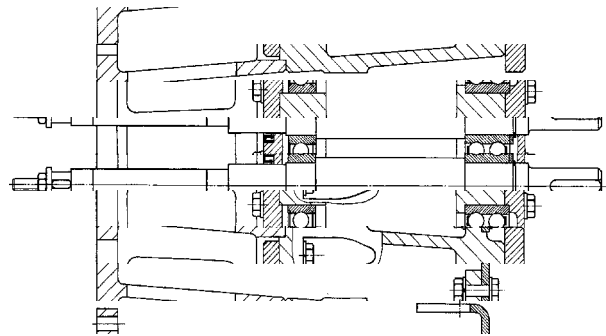
Apart from this, maintenance of the complete pump unit is reduced to a mere inspection of the following points at regular intervals:

- Does the pump attain the desired capacity (discharge flow/head)?
- Is any unusual noise or vibration of the pump or motor observed?
- Is the mechanical seal perfectly tight?
- Is the temperature rise of the motor normal?

Lubrication diagram

Bearing support A1

Maintenance-free, bearing lubricated for life.



- ⚠ Oil level must always be between the marks in the oil gauge.
- ⚠ The oil should be exchanged every 3000 hours of operation.

⚠ Amount of oil

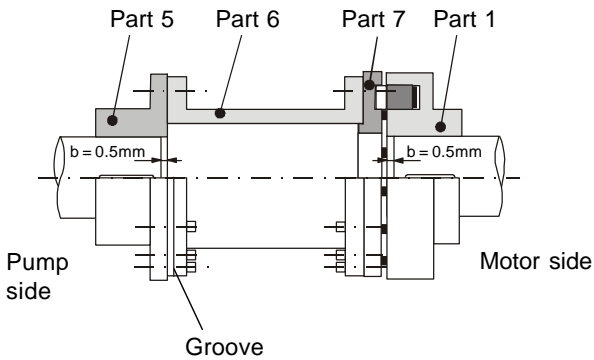
Size	Amount of oil
50/32-125 to 125/80-315	0.8 - 0.85 l
200/150-250	1.1-1.2 l

Recommendation of grease

	Bearing temperature		
	20° C - 40° C	40° C - 70° C	70° C - 100° C
ARAL	ALUR E 22	KOSMOL T 46	KOSMOLT T 100
BP	ENERGOL SHF LT 15	TURBINOL 32	ENERGOL RC-R 100
ESSO	SPINESSO 10	TERESSO 32	NUTO 100
MOBIL OIL	GARGOYLE ARCTIC OIL 155	GARGOYLE ARCTIC OIL 155	VACTRA OIL HEAVY ISO VG 100
SHELL	CLAVUS OIL 22	TELLUS OIL 22	TELLUS OIL 100

Detachable coupling

After loosening the screw connections, parts 5 and 7 are pushed out of the centerings using the release thread located in part 6. Part 7 is then pushed as far as possible into part 7 so that part 6 can be removed radially. Withdraw part 7 from part 1. Re-assembly is done in reverse order. Refer to BW 5 03 01 / 7 before recommissioning.



**Mounting and dismantling
Complete pump body**

The standard application of extension couplings ensures simple dismantling of bearing supports and internal pump components without dismantling the pipe connections and motor. This avoids laborious alignment of the pump and motor when assembling the system.

Spiral casing

- Loosen fixing screws.
- Remove spiral housing forwards.

Impeller

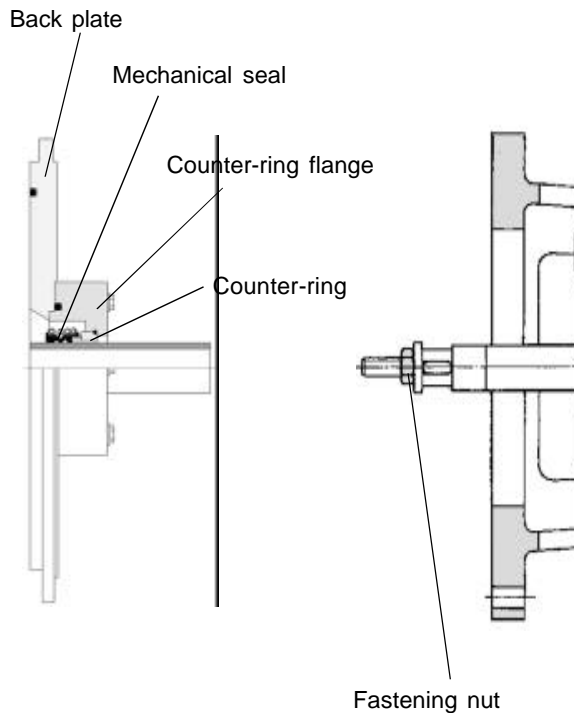
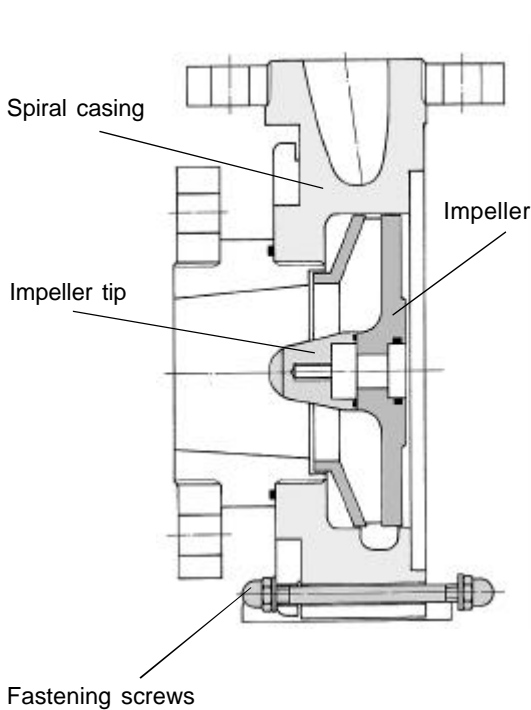
- Unscrew impeller cap.
(Caution: left-hand thread).
- Release fastening nut.
- Remove impeller forwards from the motor shaft.

Mechanical seal

- Carefully remove back plate forwards, together with the mechanical seal.
- In order to dismantle the counter-ring of the mechanical seal, detach the counter-ring flange or quenching/sealing chamber from the back plate. The counter-ring can now be pressed out carefully of the counter-ring flange.

Measures to be taken when mounting new mechanical seals

- During mounting make sure that everything is absolutely clean and that sealing faces and O-rings are not damaged. A possibly existing sliding face protection must be removed immediately without leaving residues on the faces.
- Never use lubricants for sliding faces but mount them absolutely dry, free of dust and clean.
- When pressing counter-rings ensure that the stress is distributed evenly.



Mounting aids

Mechanical seals with elastomer bellows are fitted on the shaft using normal or relieved water (with detergent additive). Sealing seat and shaft must be wetted thoroughly. Never use oil or grease! After mounting check whether the angle rings, the spring and the slide ring are seated correctly and firmly.

Replacement of carbon shaft sleeves before installation of the shaft sleeve

Remove old shaft sleeve by heating. Clean shaft thoroughly using an abrasive cloth (grain size 400) and a solvent. Remove grease residues.

Mounting of the new shaft sleeve

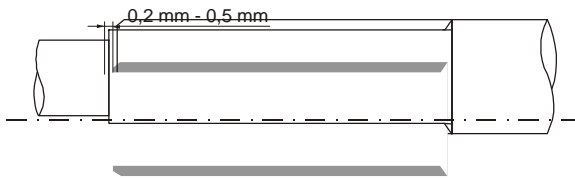
Caution: Shaft must be visible by 0.2 to 0.5 mm with the corresponding sleeve (see drawing). Clean the shaft once more (remove dust).

Caution: Use protective glasses during gluing!

Coat the relevant shaft section uniformly with the adhesive. Slide shaft sleeve in one operation onto the shaft.

Remove adhesive residues.

Drying time according to the user instructions (attached to the adhesive).



Mounting the pump

- The pump is assembled in reverse order.
- Ensure that the O-rings are firmly seated. (Use new O-rings, if possible.)
- It is essential that assembly is stress-free.

Troubleshooting

In the event of faults that occur the following table may be treated as instructions on how to determine their possible causes. If faults occur that are not mentioned here, or if they cannot be traced back to the causes listed and remedied, consult the supplier.

Fault	Cause	Remedy
Pump not pumping	Motor rotating in wrong direction	Exchange 2 mains leads
	Pump primes in air	Check suction pipe, foot valve and mechanical seal for leakage
	Pump not adequately filled	Fill pump to pressure connection
	Suction pipe contains air pockets	Lay the piping to that air can escape
	Existing back-pressure higher than maximum pump pressure	Use a larger pump
Pump discharge insufficient	Stop valve in suction and pressure pipe not fully open	Fully open the stop valve
	Piping or impeller blocked	Clean piping and the impeller
	Geodetic head too large	Use a larger pump
	Piping resistance greater than assumed	Lay pipes with larger cross-section or use a larger pump.
	Suction head too high (formation of steam in the pump, cavitation)	Clean suction strainer, foot valve and suction pipe, enlarge cross-section, or mount pump at a lower position.
	Viscosity of the pumped medium higher than assumed	Dilute or preheat (to observe max. operating temp.)
	Priming of air	Check suction pipe and mechanical seal for leakage Seal suction pipe, replace seal
Pump discharge too high	The head in the installation is lower than that of the pump	Throttle the stop valve on the pressure side Possibly install a smaller pump
Motor overloaded	Pump pumping too much	See above "Pump discharge too high"
	Solids in the pump	Open the pump and clean it
	Impeller fouling casing; Causes: - Impeller not fixed tight enough - Impeller deformed by excessive-temperature	- Examine impeller fixing and tighten up if necessary - Replace impeller and eliminate reason for excess temperature
	Pump distorted	Connect piping free from stress
	Density or viscosity of medium too high	Check discharge data, fit a larger motor
Unsteady or noisy running	Pump discharge too high	See under "Pump discharge too high"
	Suction head too high	See under "Pump discharge insufficient"
	Cross section of suction pipe too small	Enlarge cross-section of suction pipe
	Stop valve on suction side throttled too severely	Open stop valve
	Motor bearing damaged	Examine bearing, renew if necessary
Shaft seal (mechanical seal) dripping	Mechanical seal worn	Install a new mechanical seal
	Mechanical seal unsuitable for the medium handled	Consult the supplier - install the appropriate mechanical seal
Pump dripping from casing	Piping does not fit into the pipe connections	Adjust the piping to match
	Sealing material unsuitable	Use correct sealing material
	Spiral casing leaking	Tighten up connections and fixing screws Examine O-ring and replace if necessary