Submersible Motor Pump

Installation/Operating Manual

DRV / DRS / DRSK

DRV 9-27
DRS 4-6
DRSK

Legal information/Copyright

Original operating manual DRV / DRS / DRSK

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Glossary

Certificate of decontamination

A certificate of decontamination is enclosed by the customer when returning the product to the manufacturer to certify that the product has been properly drained to eliminate any environmental and health hazards arising from components in contact with the fluid handled.

Close-coupled design

Motor directly fitted to the pump via a flange or a drive lantern

Hydraulic system

The part of the pump in which the kinetic energy is converted into pressure energy

Pump set

Complete pump set consisting of pump, drive, additional components and accessories

1 General

1.1 Principles

This operating manual is valid for the type series and variants indicated on the front cover (for details, refer to the table below)

Table 1: Variants covered by this operating manual

Sizes	Impeller types	Material variant
		G
DRV 9	V	✗
DRV 11	V	✗
DRV 12	V	✗
DRV 13	V	✗
DRV 24	V	✗
DRV 27	V	✗
DRS 4	S	✗
DRS 6	S	✗
DRSK	SK	✗

The operating manual describes the proper and safe use of this equipment in all phases of operation.

The name plate indicates the type series and size, the main operating data, the order number and the order item number. The order number and order item number clearly identify the pump set and serve as identification for all further business processes.

In the event of damage, immediately contact your nearest DP service facility to maintain the right to claim under warranty.

1.2 Installation of partly completed machinery

To install partly completed machinery supplied by DP refer to the sub-sections under Servicing/Maintenance.

1.3 Target group

This operating manual is aimed at the target group of trained and qualified specialist technical personnel. [⇨ Section 2.4, Page 9]

1.4 Other applicable documents

Table 2: Overview of other applicable documents

Document	Contents
Data sheet	Description of the technical data of the pump (set)
General arrangement drawing/outline drawing	Description of mating and installation dimensions for the pump (set), weights
Hydraulic characteristic curve	Characteristic curves showing head, flow rate, efficiency and power input
General assembly drawing[1)]	Sectional drawing of the pump
Spare parts lists[1)]	Description of spare parts
Supplementary operating manuals[1)]	e.g. for installation parts for stationary wet installation

1) If agreed to be included in the scope of supply

For accessories and/or integrated machinery components observe the relevant manufacturer's product literature.

1.5 Symbols

Table 3: Symbols used in this manual

Symbol	Description
✓	Conditions which need to be fulfilled before proceeding with the step-by-step instructions
▷	Safety instructions
⇨	Result of an action
⇨	Cross-references
1. 2.	Step-by-step instructions
	Note Recommendations and important information on how to handle the product

2 Safety

DANGER

All the information contained in this section refers to hazardous situations.

In addition to the present general safety information the action-related safety information given in the other sections must be observed.

2.1 Key to safety symbols/markings

Table 4: Definition of safety symbols/markings

Symbol	Description
DANGER	**DANGER** This signal word indicates a high-risk hazard which, if not avoided, will result in death or serious injury.
WARNING	**WARNING** This signal word indicates a medium-risk hazard which, if not avoided, could result in death or serious injury.
CAUTION	**CAUTION** This signal word indicates a hazard which, if not avoided, could result in damage to the machine and its functions.
	**General hazard** In conjunction with one of the signal words this symbol indicates a hazard which will or could result in death or serious injury.
	**Electrical hazard** In conjunction with one of the signal words this symbol indicates a hazard involving electrical voltage and identifies information about protection against electrical voltage.
	**Machine damage** In conjunction with the signal word CAUTION this symbol indicates a hazard for the machine and its functions.

2.2 General

This manual contains general installation, operating and maintenance instructions that must be observed to ensure safe pump operation and prevent personal injury and damage to property.

The safety information in all sections of this manual must be complied with.

This manual must be read and completely understood by the specialist personnel/operators responsible prior to installation and commissioning.

The contents of this manual must be available to the specialist personnel at the site at all times.

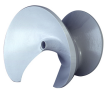
Information attached directly to the pump must always be complied with and be kept in a perfectly legible condition at all times. This applies to, for example:

- Arrow indicating the direction of rotation
- Markings for connections
- Name plate

The operator is responsible for ensuring compliance with all local regulations not taken into account in this manual.

2.3 Intended use

- The pump set must only be operated within the operating limits described in the other applicable documents.
- Only operate pump sets which are in perfect technical condition.
- Do not operate partially assembled pump sets.
- Only use the pump to handle the fluids described in the data sheet or product literature of the pump model.
- The pump set must only be operated within the operating limits described in the other applicable documents.
- Never operate the system without the fluid to be handled.
- Observe the limits for continuous duty specified in the data sheet or product literature (Q_{min} and Q_{max}) (to prevent damage such as shaft fracture, bearing failure, mechanical seal damage, etc).
- When untreated waste water is handled, the duty points in continuous operation lie within 0.7 to 1.2 × Q_{BEP} to minimise the risk of clogging/hardening.
- Avoid duty points for continuous operation at very low speeds and small flow rates (< 0.7 × Q_{BEP}).
- Observe the maximum flow rates indicated in the data sheet or product literature (to prevent overheating, mechanical seal damage, cavitation damage, bearing damage, etc).
- Do not throttle the flow rate on the suction side of the system (prevention of cavitation damage).
- Consult the manufacturer about any use or mode of operation not described in the data sheet or product literature.
- Only use the respective impeller types in combination with the fluids described below.

	Impeller with cutter (impeller type S)	**Suitable for the following fluids:** faeces, domestic sewage and waste water containing long fibres
	Free-flow impeller (impeller type V)	**Suitable for the following fluids:** fluids containing solids and stringy material as well as fluids with entrapped air or entrapped gas
	Open, diagonal single-channel impeller (impeller type SK)	**Suitable for the following fluids:** Fluids containing solid substances and long fibres

Prevention of foreseeable misuse

- Observe the minimum flow velocities required to fully open the swing check valves to prevent the reduction of pressure and risk of clogging.
  (Contact the manufacturer for the required minimum flow velocities/loss coefficients.)
- Never exceed the permissible operating limits specified in the data sheet or product literature regarding pressure, temperature, etc.
- Observe all safety information and instructions in this manual.

2.4 Personnel qualification and training

All personnel involved must be fully qualified to transport, install, operate, maintain and inspect the machinery this manual refers to.

The responsibilities, competence and supervision of all personnel involved in transport, installation, operation, maintenance and inspection must be clearly defined by the operator.

Deficits in knowledge must be rectified by means of training and instruction provided by sufficiently trained specialist personnel. If required, the operator can commission the manufacturer/supplier to train the personnel.

Training on the pump (set) must always be supervised by technical specialist personnel.

2.5 Consequences and risks caused by non-compliance with this manual

- Non-compliance with this operating manual will lead to forfeiture of warranty cover and of any and all rights to claims for damages.
- Non-compliance can, for example, have the following consequences:
  - Hazards to persons due to electrical, thermal, mechanical and chemical effects and explosions
  - Failure of important product functions
  - Failure of prescribed maintenance and servicing practices
  - Hazard to the environment due to leakage of hazardous substances

2.6 Safety awareness

In addition to the safety information contained in this manual and the intended use, the following safety regulations shall be complied with:

- Accident prevention, health and safety regulations
- Explosion protection regulations
- Safety regulations for handling hazardous substances
- Applicable standards, directives and laws

2.7 Safety information for the operator/user

- Fit protective equipment (e.g. contact guards) supplied by the operator for hot, cold or moving parts, and check that the equipment functions properly.
- Do not remove any protective equipment (e.g. contact guards) during operation.
- Provide the personnel with protective equipment and make sure it is used.
- Contain leakages (e.g. at the shaft seal) of hazardous fluids handled (e.g. explosive, toxic, hot) so as to avoid any danger to persons and the environment. Adhere to all relevant laws.
- Eliminate all electrical hazards. (In this respect refer to the applicable national safety regulations and/or regulations issued by the local energy supply companies.)
- If shutting down the pump does not increase potential risk, fit an emergency-stop control device in the immediate vicinity of the pump (set) during pump set installation.

2.8 Safety information for maintenance, inspection and installation

- Modifications or alterations of the pump (set) are only permitted with the manufacturer's prior consent.
- Use only original spare parts or parts/components authorised by the manufacturer. The use of other parts/components can invalidate any liability of the manufacturer for resulting damage.
- The operator ensures that maintenance, inspection and installation are performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.
- Only carry out work on the pump (set) during standstill of the pump.
- Only perform work on the pump set when it has been disconnected from the power supply (de-energised).

- The pump (set) must have cooled down to ambient temperature.
- Pump pressure must have been released and the pump must have been drained.
- When taking the pump set out of service always adhere to the procedure described in the manual. [⇨ Section 6.3, Page 35]
- Decontaminate pumps which handle fluids posing a health hazard.
- As soon as the work has been completed, re-install and re-activate any safety-relevant devices and protective devices. Before returning the product to service, observe all instructions on commissioning. [⇨ Section 6.1, Page 32]

2.9 Unauthorised modes of operation

Never operate the pump (set) outside the limits stated in the data sheet and in this manual.

The warranty relating to the operating reliability and safety of the supplied pump (set) is only valid if the equipment is used in accordance with its intended use.

3 Transport/Temporary Storage/ Disposal

3.1 Checking the condition upon delivery

1. On transfer of goods, check each packaging unit for damage.
2. In the event of in-transit damage, assess the exact damage, document it and notify DP or the supplying dealer and the insurer about the damage in writing immediately.

3.2 Transport

⚠ DANGER

Improper transport

Danger to life from falling parts!

Damage to the pump set!

- Use the attachment point provided (pump handle) for attaching lifting accessories.
- Never suspend the pump set by its power cable.
- Use the lifting chain included in the scope of supply exclusively for lowering/lifting the pump set into/out of the pump sump.
- Securely attach the lifting chain to the pump and crane.
- Use tested, marked and approved lifting accessories only.
- Observe the regional transport regulations.
- Observe the product literature supplied by the lifting accessory manufacturer.
- The load-carrying capacity of the lifting accessory must be higher than the weight indicated on the name plate of the pump set to be lifted. Take into account any additional system components to be lifted.
- Always use the pump handle for transporting the pump (also for manual transport).
- Always place the pump vertically on a solid surface with the motor on top.

To transport the pump set suspend it from the lifting tackle as shown.

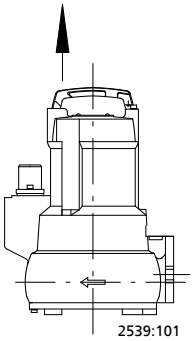


Fig. 1: Transporting the pump set

3.3 Storage/preservation

If commissioning is to take place some time after delivery, we recommend that the following measures be taken for pump set storage:

CAUTION

Improper storage

Damage to the power cables!

- ➢ Support the power cables at the cable entry to prevent permanent deformation.
- ➢ Only remove the protective caps from the power cables at the time of installation.

CAUTION

Damage during storage due to humidity, dirt, or vermin

Corrosion/contamination of the pump (set)!

- ➢ For outdoor storage cover the packed or unpacked pump (set) and accessories with waterproof material.

CAUTION

Wet, contaminated or damaged openings and connections

Leakage or damage to the pump!

- ➢ Clean and cover pump openings and connections as required prior to putting the pump into storage.

Table 5: Ambient conditions for storage

Ambient condition	Value
Relative humidity	5 % to 85 % (non-condensing)
Ambient temperature	-20 °C to +70 °C

– Store the pump set under dry and vibration-free conditions, if possible in its original packaging.

1. Spray-coat the inside wall of the pump casing, and in particular the impeller clearance areas, with a preservative.
2. Spray the preservative through the suction and discharge nozzles.
   It is advisable to then close the pump nozzles (e.g. with plastic caps or similar).

NOTE

Observe the manufacturer's instructions for application/removal of the preservative.

3.4 Return to supplier

1. Drain the pump as per operating instructions. [⇨ Section 7.3, Page 41]
2. Always flush and clean the pump, particularly if it has been used for handling noxious, explosive, hot or other hazardous fluids.
3. If the pump set has handled fluids whose residues could lead to corrosion damage in the presence of atmospheric humidity or could ignite upon contact with oxygen, the pump set must also be neutralised, and anhydrous inert gas must be blown through the pump to ensure drying.
4. Always complete and enclose a certificate of decontamination when returning the pump (set).
   Always indicate any safety and decontamination measures taken.
   [⇨ Section 11, Page 59]

3.5 Disposal

⚠ WARNING

Fluids, consumables and supplies which are hot and/or pose a health hazard

Hazard to persons and the environment!

- ➢ Collect and properly dispose of flushing fluid and any residues of the fluid handled.
- ➢ Wear safety clothing and a protective mask if required.
- ➢ Observe all legal regulations on the disposal of fluids posing a health hazard.

1. Dismantle the pump (set).
   Collect greases and other lubricants during dismantling.
2. Separate and sort the pump materials, e.g. by:
   - Metals
   - Plastics
   - Electronic waste
   - Greases and other lubricants
3. Dispose of materials in accordance with local regulations or in another controlled manner.

4 Description of the Pump (Set)

4.1 General description

Pump for handling untreated waste water containing long fibres and solid substances, fluids containing air/gas, as well as raw, activated and digested sludge.

4.2 Designation

Example: DRV 919-2 120

Table 6: Designation key

Code	Description
DR	Type series
V	Impeller type, e.g. V = free-flow impeller
9	Nominal flow rate [l/s]
19	Motor rating (kW x 10)
2	Number of poles
120	Nominal impeller diameter [mm]

4.3 Name plate

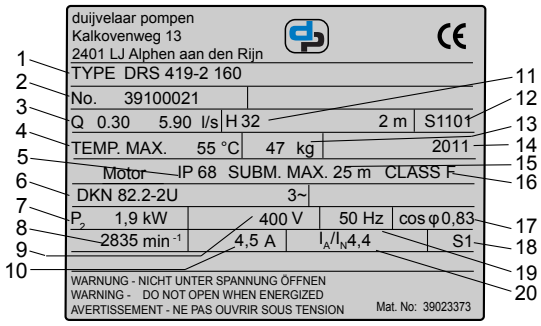


Fig. 2: Name plate (example)

1	Designation [⇨ Section 4.2, Page 15]	2	DP order number
3	Flow rate	4	Maximum fluid and ambient temperature
5	Enclosure	6	Motor type
7	Rated power	8	Rated speed
9	Rated voltage	10	Rated current
11	Head	12	Serial number
13	Total weight	14	Year of construction
15	Maximum submergence	16	Thermal class of winding insulation
17	Power factor at rated operating point	18	Mode of operation
19	Rated frequency	20	Starting current ratio

Key to the series code

S = series, 11 = year of construction 2011, 01 = week 1

4.4 Design details

Design

- Fully floodable submersible motor pump
- Not self-priming
- Close-coupled design

Drive

- Three-phase asynchronous squirrel-cage motor

Shaft seal

- Two bi-directional mechanical seals in tandem arrangement, with liquid reservoir

Impeller type

- Various application-oriented impeller types [⇨ Section 2.3, Page 9]

Standard bearing assembly

- Grease-packed bearings sealed for life
- Maintenance-free

4.5 Installation types

Table 7: Installation type S – stationary wet installation

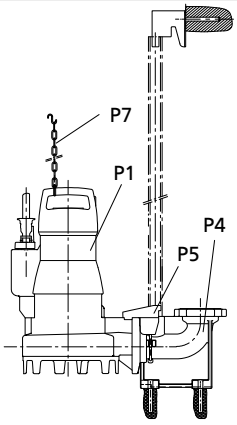
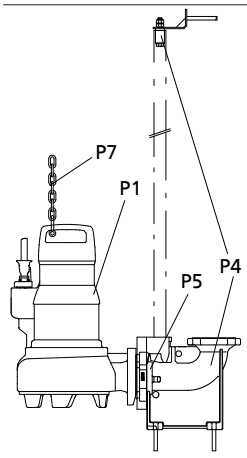
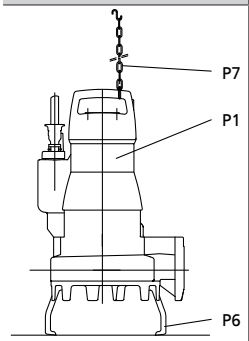
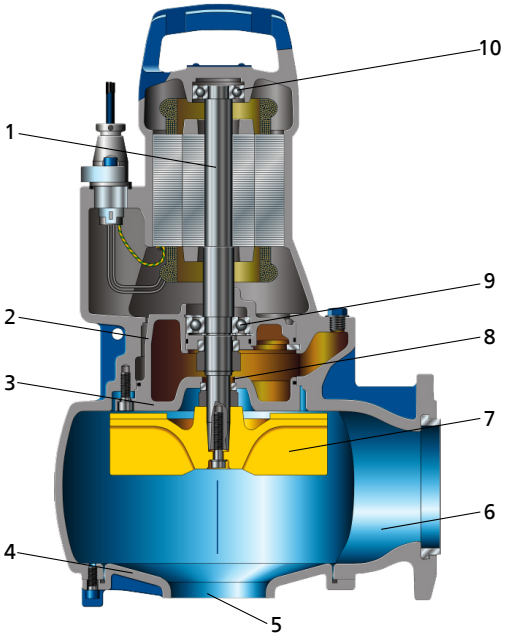
Installation type	Description	Comment
	**Single guide rail arrangement** P1: pump P4: installation parts for single guide rail arrangement P5: claw P7: chain and shackle (length = 5 m)	
	**Twin guide rail arrangement** P1: pump P4: installation parts for twin guide rail arrangement P5: claw and adapter P7: chain and shackle (length = 5 m)	

Table 8: Installation type P – transportable wet installation

Installation type	Description
	P1: pump P6: foot P7: chain and shackle (length = 5 m)

4.6 Configuration and function



1	Shaft	2	Bearing bracket
3	Discharge cover	4	Suction cover
5	Suction nozzle	6	Discharge nozzle
7	Impeller	8	Shaft seal
9	Bearing, pump end	10	Bearing, motor end

Design The pump is designed with an axial fluid inlet and a radial outlet. The hydraulic system sits on the extended motor shaft. The shaft runs in common bearings.

Function The fluid enters the pump axially via a suction nozzle (5) and is accelerated outward in a cylindrical flow by the rotating impeller (7). The flow profile of the pump casing converts the kinetic energy of the fluid into pressure energy. The fluid is pumped to the discharge nozzle (6), where it leaves the pump. At the rear side of the impeller, the shaft (1) enters the casing via the discharge cover (4). The shaft passage through the cover is sealed towards the atmosphere with a shaft seal (8). The shaft runs in rolling element bearings (9 and 10), which are supported by a bearing bracket (2) linked with the pump casing and/or discharge cover.

Sealing The pump is sealed by two bi-directional mechanical seals in tandem arrangement.
A lubricant reservoir in-between the seals ensures cooling and lubrication of the mechanical seals.

4.7 Scope of supply

Depending on the model, the following items are included in the scope of supply:

Stationary wet-installed model (installation type S)

- Pump set complete with power cables
- Claw with sealing elements and fasteners
- Lifting chain
- Mounting bracket with fasteners
- Duckfoot bend with mounting elements
- Guiding accessories
  (guide rails are not included in DP's scope of supply)

Transportable wet-installed model (installation type P)

- Pump set complete with power cables
- 3 feet, or 3 feet and a pump stool, with fastening elements
- Lifting chain

NOTE

A separate name plate is included in KSB's scope of supply.
This name plate must be attached in a clearly visible position outside the place of installation, e.g. at the control panel, pipeline or mounting bracket.

4.8 Dimensions and weights

For dimensions and weights refer to the general arrangement drawing/outline drawing or data sheet of the pump set.

5 Installation at Site

5.1 Safety regulations

⚠ DANGER

Improper installation

Damage to the pump set!

- ➢ Observe the information given in the data sheet and on the name plate of the pump set.

⚠ DANGER

Risk of falling when working at a great height

Danger to life by falling from a great height!

- ➢ Do not step onto the pump (set) during installation work or dismantling work.
- ➢ Pay attention to safety equipment, such as railings, covers, barriers, etc.
- ➢ Observe the applicable local health and occupational safety regulations and accident prevention regulations.

⚠ DANGER

Persons in the tank during pump operation

Electric shock!

Risk of injury!

Danger of death from drowning!

- ➢ Never start up the pump set when there are persons in the tank.

⚠ WARNING

Hands, other body parts or foreign objects in the impeller or intake area

Risk of injury! Damage to the submersible motor pump!

- ➢ Never insert your hands, other body parts or foreign objects into the impeller or impeller intake area.
- ➢ Check that the impeller can rotate freely.

⚠ WARNING

Impermissible solid objects (tools, screws/bolts or similar) in the pump sump/inlet tank during pump start-up

Personal injury and damage to property!

- ➢ Check the pump sump/inlet tank for impermissible solid objects before flooding, and remove, if necessary.

5.2 Checks to be carried out prior to installation

5.2.1 Preparing the place of installation

Place of installation for stationary models

⚠ WARNING

Installation on mounting surfaces which are unsecured and cannot support the load

Personal injury and damage to property!

- ➢ Ensure the concrete's compressive strength is sufficient (in accordance with C35/45 in exposure class XC1 to EN 206-1).
- ➢ The mounting surface must have set and must be completely horizontal and even.
- ➢ Observe the weights indicated.

Resonances

Any resonances at the usual excitation frequencies (1 x and 2 x rotational frequency, blade passing frequency) must be prevented both in the foundation and in the connected piping, as such frequencies may cause extreme vibrations.

1. Check the structural requirements.
   All structural work required must have been prepared in accordance with the dimensions stated in the outline drawing/general arrangement drawing.

Place of installation for transportable models

⚠ WARNING

Incorrect installation/placing down

Personal injury and damage to property!

- ➢ Position the pump set vertically with the motor on top.
- ➢ Use appropriate means to secure the pump set against tilting or tipping over.
- ➢ Refer to the weights given in the data sheet/on the name plate.

Resonances

Any resonances at the usual excitation frequencies (1 x and 2 x rotational frequency, blade passing frequency) must be prevented both in the foundation and in the connected piping, as such frequencies may cause extreme vibrations.

1. Check the structural requirements.
   All structural work required must have been prepared in accordance with the dimensions stated in the outline drawing/general arrangement drawing.

5.2.2 Checking the lubricant level

The lubricant reservoirs have been filled with an environmentally-friendly, non-toxic lubricant at the factory.

1. Position the pump set as shown.
2. Unscrew and remove screw plug 903 with joint ring 411.
   ⇨ The lubricant level must be 40 mm below the filler opening.
3. If the lubricant level is lower, top up the lubricant reservoir through the filler opening until the indicated level is reached..
4. Screw in screw plug 903 with joint ring 411. Observe the tightening torques.
   [⇨ Section 7.6, Page 47]

5.2.3 Checking the direction of rotation

⚠ WARNING

Hands or objects inside the pump casing

Risk of injuries, damage to the pump!

- Never put your hands or any other objects into the pump.
- Prior to energising the pump, check that the inside of the pump is free from any foreign objects.
- Never hold the pump set in your hands when checking the direction of rotation.

CAUTION

Pump set running dry

Increased vibrations!

Damage to mechanical seals and bearings!

- Never operate the pump set for more than 60 seconds outside the fluid to be handled.

✓ The pump set is connected to the power supply.

1. Start the pump set and stop it again immediately to determine the motor's direction of rotation.
2. Check the direction of rotation.
   Impeller rotation must be anti-clockwise, seen from the pump mouth. (The direction of rotation is marked by an arrow on the pump casing.)

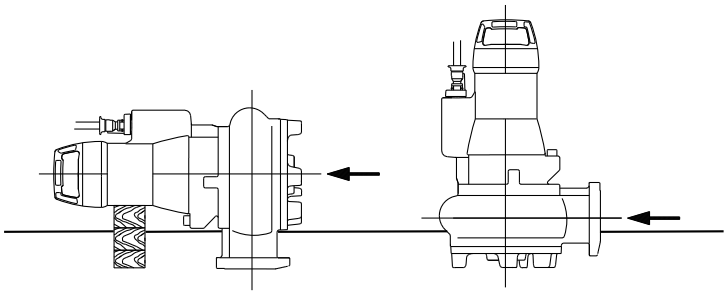


Fig. 3: Checking the direction of rotation

3. If the impeller is running in the wrong direction of rotation, check the electrical connection of the pump and the control system if necessary.
4. Disconnect the pump set from the power supply and make sure it cannot be switched on unintentionally.

5.3 Installing the pump set

Always observe the general arrangement drawing/outline drawing when installing the pump set.

5.3.1 Stationary wet installation

5.3.1.1 Fastening the duckfoot bend

Fastening the duckfoot bend with chemical anchors

Depending on the pump size, the duckfoot bend is fastened with chemical anchors.

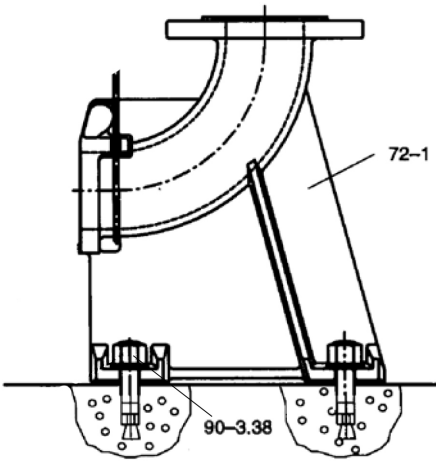


Fig. 4: Fastening the duckfoot bend

1. Position duckfoot bend 72-1 on the floor of the tank/sump.
2. Insert chemical anchors 90-3.38.
3. Bolt duckfoot bend 72-1 to the floor with chemical anchors 90-3.38.

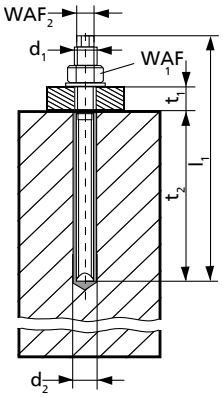


Fig. 5: Dimensions

Table 9: Chemical anchor dimensions

Size (d_1 × l_1)	d_2 [mm]	t_1 [mm]	t_2 [mm]	WAF_1 [mm]	WAF_2 [mm]	M_{d1} [Nm]
M10 × 130	12	20	90	17	7	20
M16 × 190	18	35	125	24	12	60

Table 10: Curing times of mortar cartridge

Floor temperature [°C]	Curing time [min]
-5 to 0	240
0 to +10	45
+10 to +20	20
> +20	10

5.3.1.2 Connecting the piping

⚠ DANGER

Impermissible loads acting on the flange of the duckfoot bend

Danger to life from leakage of hot, toxic, corrosive or flammable fluids!

- ➢ Do not use the pump as an anchorage point for the piping.
- ➢ Anchor the pipelines in close proximity to the pump and connect them without transmitting any stresses or strains.
- ➢ Observe the permissible flange loads.
- ➢ Take appropriate measures to compensate thermal expansion of the piping.

NOTE

When the pump set is used for draining low-level building areas, install a swing check valve in the discharge line to avoid backflow from the sewer system.

CAUTION

Critical speed

Increased vibrations!

Damage to mechanical seals and bearings!

- ➢ Install a swing check valve in longer riser pipes to prevent the pump from excessive running in reverse.
  When fitting a swing check valve, make sure that the unit can still be vented properly.

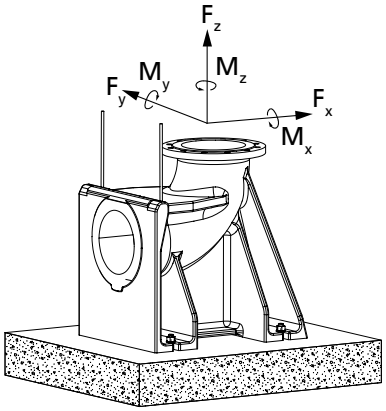


Fig. 6: Permissible flange loads

Table 11: Permissible flange loads

Nominal diameter of the flange	Forces [N]				Moments [Nm]			
	F_y	F_z	F_x	$\sum F$	M_y	M_z	M_x	$\sum M$
50	1350	1650	1500	2600	1000	1150	1400	2050
65								
80	2050	2500	2250	3950	1150	1300	1600	2350
100	2700	3350	3000	5250	1250	1450	1750	2600

5.3.1.3 Fitting the guide rail arrangement (1 or 2 guide rails)

The pump set is guided into the sump or tank along one or two vertical guide rails. It attaches itself automatically to the duckfoot bend which has been fitted to the floor.

NOTE

The guide rails are not included in KSB's scope of supply.
Select guide rail materials which are suitable for the fluid handled or as specified by the operator.

Observe the following dimensions for the guide rails:

Table 12: Guide rail dimensions

Size of hydraulic system	Outside diameter [mm]	Wall thickness [mm][2)]	
		Minimum	Maximum
DN 50 ... DN 65	33.7	2	5
DN 80 ... DN 100	60.3	2	5

Fitting the mounting bracket

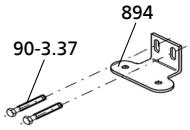


Fig. 7: Fitting the mounting bracket

1. Fasten mounting bracket 894 to the edge of the sump opening with steel anchor bolts 90-3.37 and tighten the anchor bolts to a tightening torque of 10 Nm.
   Observe the hole pattern for the anchor bolts. (See outline drawing.)

Fitting the guide rails (arrangement with 2 guide rails)

CAUTION

Improper installation of the guide rails

Damage to the guide rail arrangement!

- Always adjust the guide rails so that they are in a perfectly vertical position.

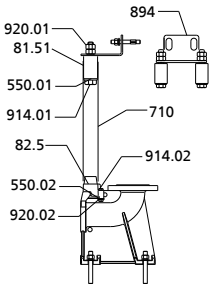


Fig. 8: Fitting 2 guide rails

1. Position adapter 82.5 on duckfoot bend 72.1 and fasten it with screws 914.2, discs 550.02 and nuts 920.02.
2. Place rails 710 onto the conical bosses of adapter 82.5 and position them vertically.
3. Mark the length of rails 710 (up to the lower edge of the mounting bracket), taking into account the adjusting range of the slotted holes in mounting bracket 894.
4. Shorten rails 710 with a 90° cut to the pipe axis. Debur the rails inside and outside.
5. Insert mounting bracket 894 with clamping sleeves 81.51 into guide rails 710 until the mounting bracket rests on the rail ends.
6. Tighten nuts 920.01.
   This expands the clamping sleeves so that they clamp the rails at the inside rail diameter.
7. Secure nut 920.01 with a second nut.

Fitting the guide rails (arrangement with 1 guide rail)

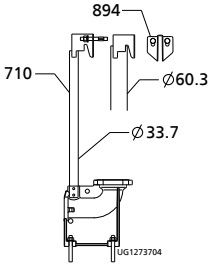


Fig. 9: Fitting 1 guide rail

1. Position rail 710 (for DN 50 - DN 65) into the recess of duckfoot bend 72.1 or (for DN 80 - DN 100) on the conical boss. Place the rail in a vertical position.
2. Mark the length of rail 710 (up to the lower edge of the mounting bracket), taking into account the adjusting range of the slotted holes in mounting bracket 894.
3. Shorten rail 710 with a 90° cut to the pipe axis. Debur the rail inside and outside.
4. Insert mounting bracket 894 into guide rail 710 until the mounting bracket rests on the rail end.

2) To DIN 2440/2442/2462 or equivalent standards

5.3.1.4 Preparing the pump set

Fastening the claw for single guide rail and guide hoop arrangement

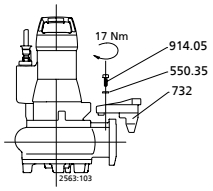


Fig. 10: Fastening the claw for single guide rail and guide hoop arrangement

1. Fasten claw 732 with screw 914.05 and disc 550.35 to the discharge flange (see drawing). Tighten the screw to a torque of 17 Nm.

Fastening the claw for twin guide rail arrangement

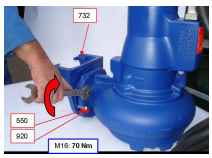
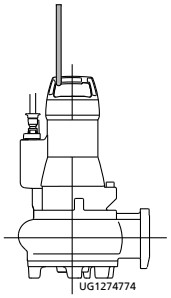


Fig. 11: Fastening the claw for twin guide rail arrangement

1. Fasten claw 732 with screws 914, nuts 920 and discs 550 to the discharge flange (see drawing). Tighten the screws to a torque of 70 Nm.
2. Fit profile seal 410 in the groove of the claw.
   This will seal the duckfoot bend/pump connection.

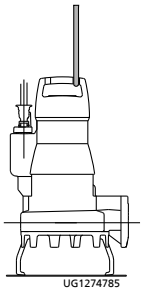
Attaching the lifting chain



Attaching the lifting chain for stationary wet installation

Stationary wet installation

1. Attach the lifting chain with shackle to the recess in the pump handle opposite the discharge nozzle. This attachment point achieves a forward inclination of the pump set towards the discharge nozzle, which allows the pump claw to hook onto the duckfoot bend.

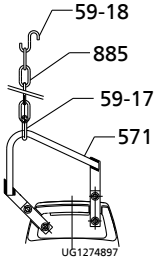


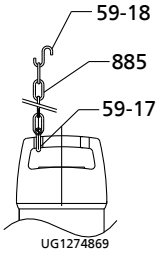
Attaching the lifting chain for transportable wet installation

Transportable wet installation

1. Attach the lifting chain with shackle to the recess in the pump handle on the discharge nozzle side of the pump set. This attachment point achieves an upright position of the pump set.

Table 13: Types of attachment

Drawing	Type of fastening	
	**Shackle with lifting chain at the lifting bail**	
	59-17	Shackle
	59-18	Hook
	571	Lifting bail
	885	Lifting chain

Drawing	Type of fastening	
	**Shackle with lifting chain at the pump casing**	
	59-17	Shackle
	59-18	Hook
	885	Lifting chain

5.3.1.5 Installing the pump set

NOTE

Make sure the pump set with the pre-assembled claw can easily be guided over the mounting bracket, threaded onto the guide wires and lowered down. If required, alter the position of the crane during installation.

1. Guide the pump set over the suspension bracket/mounting bracket and slowly lower it down along the guide rails.
   The pump set attaches itself to duckfoot bend 72-1.
2. Attach the lifting chain to hook 59-18 at the mounting bracket.

5.3.2 Transportable wet-installed model

Before installing the pump set, fit the 3 pump feet, the connection elbow and the connection piece from the installation kit for transportable models.

Fitting the pump feet

1. Undo screws 914.03.
2. Push pump feet 182 into the openings in the suction cover.
3. Tighten screws 914.03 again to the indicated tightening torque.
   [⇨ Section 7.6, Page 47]

Attaching the lifting chain

1. Attach the lifting chain to the shackle on the discharge nozzle side of the pump set (see illustration and table "Types of attachment").

Connecting the piping

The DIN connection can be connected to rigid or flexible pipes.

Fig. 12: Attaching the lifting chain

5.4 Electrical system

5.4.1 Information for planning the control system

For the electrical connection of the pump set observe the "Wiring diagrams" section.
[⇨ Section 9.2, Page 55]
The pump set is supplied with power cables; it is wired for DOL starting.

NOTE

When laying a cable between the control system and the pump set's connection point, verify that the number of cores is sufficient for the sensors. A minimum cross-section of 1.5 mm² is required.

The motors can be connected to electrical low-voltage grids with mains voltages and voltage tolerances to IEC 60038. The permissible tolerances must be observed.

5.4.1.1 Overload protection

1. Protect the pump set against overloading by a thermal time-lag overload protection device in accordance with IEC 60947 and local regulations. [⇨ Section 9.3, Page 56]
2. Set the overload protection device to the rated current specified on the name plate.

5.4.1.2 Level control

CAUTION

Fluid level below the specified minimum

Damage to the pump set by cavitation!

➢ Never allow the fluid level to drop below the specified minimum.

Automatic operation of the pump set in a tank requires the use of level control equipment. Observe the minimum fluid level.

5.4.1.3 Operation on a frequency inverter

The pump set is driven by an induction machine to IEC 60034-12 designed for fixed speed operation. In accordance with IEC 60034-25, section 18, the pump set is suitable for operation on a frequency inverter.

Selection When selecting a frequency inverter, check the following details:

- Data provided by the manufacturer
- Electrical data of the pump set, particularly the rated current
- Only voltage source inverters (VSI) with pulse width modulation (PWM) and carrier frequencies between 1 and 16 kHz are suitable.

Setting Observe the following instructions for setting a frequency inverter:

- Set the current limit to max. 1.2 times the rated current. The rated current is indicated on the name plate.

Start-up Observe the following instructions for starting the frequency inverter:

- Ensure short start ramps (maximum 5 seconds).
- After start-up, operate the pump at maximum speed for a minimum of two minutes. Initiate variable speed control only after that.
  Pump start-up with long start ramps and low frequency may cause clogging.

Operation Observe the following limits during operation on a frequency inverter:

- Only utilise up to 95 % of the rated power P_2 indicated on the name plate.
- Frequency range 30 to 50 Hz

Electromagnetic compatibility

Operation on a frequency inverter produces interference emissions whose level varies depending on the inverter used (type, interference suppression, make). To prevent the drive system, consisting of a submersible motor and a frequency inverter, from exceeding any given limits always observe the EMC information provided by the inverter manufacturer. If the inverter manufacturer recommends a shielded power cable, make sure to use a submersible motor pump with shielded power cables.

Interference immunity

The submersible motor pump generally meets interference immunity requirements. For monitoring the sensors installed the operator must ensure sufficient interference immunity by appropriately selecting and laying the power cables in the plant. No modifications are required on the power/control cable of the submersible motor pump. Suitable analysing devices must be selected. To monitor the leakage sensor inside the motor using a special relay available from DP is recommended.

5.4.1.4 Sensors

⚠ DANGER

Operating an incompletely connected pump set

Damage to the pump set!

- ➢ Never start up a pump set with incompletely connected cables or non-operational monitoring devices.

CAUTION

Incorrect wiring

Damage to the sensors!

- ➢ Observe the limits stated in the following sections of this manual when connecting the sensors.

The pump set features sensors designed to prevent hazards and damage to the pump set.

Measuring transducers are required for analysing the sensor signals supplied. Suitable devices for 230 V~ can be supplied by DP.

NOTE

Reliable and safe operation of the pump within the scope of our warranty is only possible if the sensor signals are properly analysed as stipulated in this operating manual.

All sensors are located inside the pump set and are connected to the power cable.
For information on wiring and core identification please refer to the "Wiring diagrams" section.
The individual sensors and the limit values to be set are described in the following sections.

5.4.1.5 Motor temperature

Two bimetal switches (terminals 21 and 22, max. 250 V~/2 A) serve as temperature control devices which open when the winding temperature is too high.

Tripping must result in the pump set cutting out. Automatic re-starting is permitted.

⚠ WARNING

Incorrect electrical connection

Electric shock!

- ➢ Adequately insulate conductor 20.

Conductor 20 has no function on standard pump sets.
However, it can be live and must, therefore, be insulated or connected to a dummy terminal.

5.4.1.6 Motor temperature

CAUTION

Insufficient cooling

Damage to the pump (set)!

➢ Never operate a pump (set) without operational temperature monitoring.

The pump set is equipped with double monitoring of the winding temperature. Two bimetal switches (terminals 21 and 22, max. 250 V~/2 A) serve as temperature control devices which open when the winding temperature is too high.

Tripping must result in the pump set cutting out. Automatic re-start is permissible.

5.4.1.7 Monitoring of leakage inside the motor (optional)

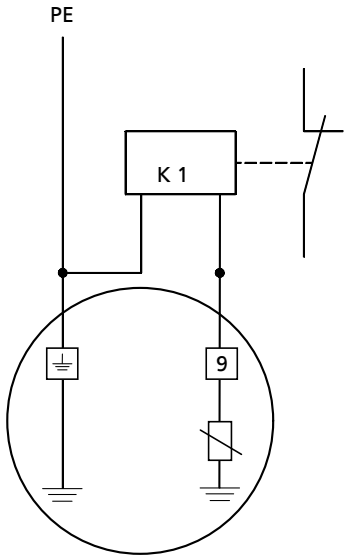
DANGER

Incorrect monitoring of leakage electrode

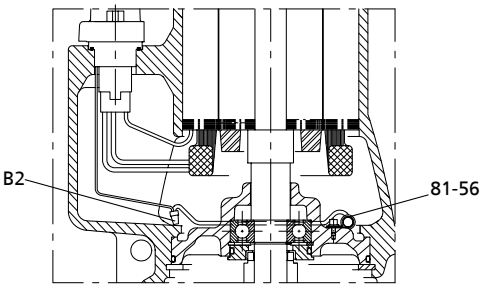
Explosion hazard!

Danger of death from electric shock!

➢ Voltages must be < 30 V AC and tripping currents < 0.5 mA.



Wiring of the electrode relay



Position of the electrode in the motor housing

An electrode fitted inside the motor monitors the winding space (B2) for leakage. The electrode is intended for connection to an electrode relay (core marking 9). Tripping of the electrode relay must result in the pump set cutting out.

Every time the relay trips the pump set, the pump set needs to be inspected and its insulation resistance measured.

The electrode relay (K1) must fulfil the following requirements:

- Sensor circuit 10 to 30 V AC
- Tripping current ≤ 0.5 mA

Example

- Telemécanique RM4-LG01

5.4.2 Electrical connection

⚠ DANGER

Electrical connection work by unqualified personnel

Danger of death from electric shock!

- ➢ Always have any work on the connection to the power supply performed by a trained electrician.
- ➢ Observe regulations EN 60079.

⚠ WARNING

Incorrect connection to the mains

Damage to the mains network, short circuit!

- ➢ Observe the technical specifications of the local energy supply companies.
- ➢ Inspect the power cable for visible damage.
- ➢ Never connect damaged power cables.

CAUTION

Improper routing of power cable

Damage to the power cables!

- ➢ Never move the power cables at temperatures below - 25 °C.
- ➢ Never kink or crush the power cables.
- ➢ Never lift the pump set by the power cables.
- ➢ Adjust the length of the power cable to the site requirements.

CAUTION

Motor overload

Damage to the motor!

- ➢ Protect the motor by a thermal time-lag overload protection device in accordance with IEC 60947 and local regulations.

For electrical connection observe the wiring diagrams in the Annex and the information for planning the control system.

The pump set is supplied complete with power cable. Always connect all marked cores.

⚠ DANGER

Operating a pump set that has not been fully connected

Damage to the pump set!

- ➢ Never start up a pump set with power cables that have not been fully connected or non-operational monitoring devices.

⚠ DANGER

Connection of damaged power cables

Danger of death from electric shock!

- ➢ Check the power cables for damage before connecting them.
- ➢ Never connect damaged power cables.
- ➢ Replace damaged power cables.

CAUTION

Flow-induced motion

Damage to the power cable!

- Run the power cable upwards without slack.

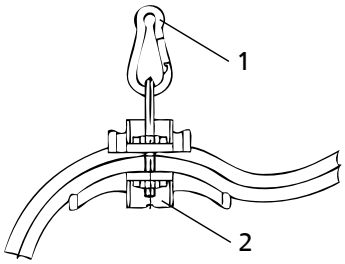


Fig. 13: Fastening the power cables

1. Run the power cables directly upwards without slack, and fasten.
2. Only remove the protective caps from the power cables immediately before connecting the cables.
3. If necessary, adjust the length of the power cables to the site requirements.
4. After shortening the cables, correctly re-affix the markings of the individual cores at the cable ends.

Potential equalisation

Potential equalisation shall be provided for in compliance with EN 60 204. The pump casing is designed with a female thread for an M8x20 hexagon socket head cap screw.

DANGER

Touching the pump set during operation

Electric shock!

- Make sure that the pump set cannot be touched during operation.

DANGER

Chemically corrosive fluids

Electric shock!

- If the pump set is used in chemically corrosive fluids, never use the external terminal for potential equalisation.
- Connect the potential equalisation conductor to a non-wetted flange of the discharge line and establish an electric connection between the newly fitted potential equalisation and the pump set.

6 Commissioning/Start-up/Shutdown

6.1 Commissioning/Start-up

6.1.1 Prerequisites for commissioning/start-up

CAUTION

Fluid level too low

Damage to the pump set!

- ➢ Completely prime the pump set with the fluid to be handled to reliably prevent the formation of a potentially explosive atmosphere.
- ➢ Always operate the pump set in such a way that air cannot enter the pump casing.
- ➢ Never allow the fluid level to drop below the specified minimum (R3).
- ➢ For continuous duty (S1) operate the pump set in fully submerged condition.

Before commissioning/starting up the pump set, make sure that the following conditions are met:

- The pump set has been properly connected to the power supply and is equipped with all protection devices.
- The pump has been primed with the fluid to be handled. The pump has been vented.
- The direction of rotation has been checked.
- After prolonged shutdown of the pump (set), the activities required for returning the equipment to service have been carried out. [⇨ Section 6.4, Page 36]

6.1.2 Start-up

⚠ DANGER

Persons in the tank during pump operation

Electric shock!

Risk of injury!

Danger of death from drowning!

- ➢ Never start up the pump set when there are persons in the tank.

CAUTION

Re-starting while motor is still running down

Damage to the pump set!

- ➢ Do not re-start the pump set before it has come to a standstill.
- ➢ Never start up the pump set while the pump is running in reverse.

✓ The fluid level is sufficiently high.

CAUTION

Start-up against a closed shut-off element

Increased vibrations!

Damage to mechanical seals and bearings!

➢ Never operate the pump set against a closed shut-off element.

1. Fully open the discharge line shut-off element, if any.
2. Start up the pump set.

6.2 Operating limits

⚠ DANGER

Non-compliance with operating limits for pressure, temperature and speed

Explosion hazard!

Leakage of hot or toxic fluid handled!

➢ Comply with the operating data indicated in the data sheet.

➢ Never use the pump to handle fluids it is not designed for.

➢ Avoid prolonged operation against a closed shut-off element.

➢ Never operate the pump at temperatures exceeding those specified in the data sheet or on the name plate unless the written consent of the manufacturer has been obtained.

6.2.1 Frequency of starts

CAUTION

Excessive frequency of starts

Risk of damage to the motor!

➢ Never exceed the specified frequency of starts.

To prevent high temperature increases in the motor, do not exceed the following number of start-ups per hour.

Table 14: Frequency of starts

Interval	Maximum frequency of starts
	[Start-ups]
Per hour	30
Per year	5000

These values apply to mains start-up (DOL, autotransformer, soft starter). This limitation does not apply to operation on a frequency inverter.

6.2.2 Operation on the power supply mains

The maximum permissible deviation in supply voltage is ±10% of the rated voltage. The voltage difference between the individual phases must not exceed 1 %.

6.2.3 Operation on a frequency inverter

CAUTION

Pumping solids-laden fluids at reduced speed

Increased wear and clogging!

➢ Never operate the pump set with flow velocities below 0.7 m/s in horizontal pipes and 1.2 m/s in vertical pipes.

Operation of the pump set on a frequency inverter is permitted in the following frequency ranges:

- **50 Hz:** 30 to 50 Hz
- **60 Hz:** 30 to 60 Hz

6.2.4 Fluid handled

6.2.4.1 Fluid temperature

The pump set is designed for transporting liquids. The pump set is not operational under freezing conditions.

CAUTION

Danger of freezing!

Damage to the pump set!

➢ Drain the pump set or protect it against freezing.

Refer to the maximum permissible fluid temperature and ambient temperature indicated on the name plate and/or in the data sheet.

6.2.4.2 Minimum level of fluid handled

CAUTION

Fluid level below the specified minimum

Damage to the pump set by cavitation!

➢ Never allow the fluid level to drop below the specified minimum.

The pump set is ready for operation when the fluid level has reached dimension "R3" as a minimum (see general arrangement drawing/outline drawing).

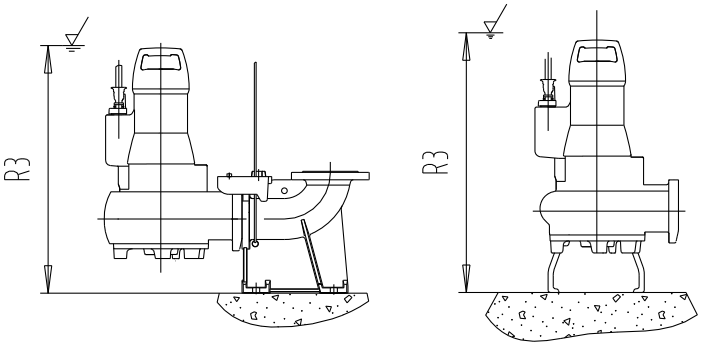


Fig. 14: Minimum level of fluid handled

NOTE

For pump sets with cutters it is recommended to continue pump operation for about 10 seconds after the minimum suction level (marked RS in the general arrangement drawing) has been reached.

Operation is permissible with a fluid level dropping down to dimension R1 (see outline drawing). During that time frequent starting and stopping of the pump set must be avoided.

6.2.4.3 Density of the fluid handled

The pump input power changes in proportion to the density of the fluid handled.

CAUTION

Impermissibly high density of the fluid handled

Motor overload!

- Observe the information about fluid density in the data sheet.
- Make sure the motor has sufficient power reserves.

6.3 Shutdown/storage/preservation

6.3.1 Measures to be taken for shutdown

⚠ DANGER

Electrical connection work by unqualified personnel

Danger of death from electric shock!

- Always have any work on the connection to the power supply performed by a trained electrician.
- Observe regulations EN 60079.

⚠ WARNING

Unintentional starting of pump set

Risk of injury by moving parts!

- Ensure that the pump set cannot be started up unintentionally.
- Always make sure the electrical connections are disconnected before carrying out work on the pump set.

⚠ WARNING

Fluids handled and supplies posing a health hazard and/or hot fluids handled and supplies

Risk of injury!

- Observe all relevant laws.
- When draining the fluid take appropriate measures to protect persons and the environment.
- Decontaminate pumps which handle fluids posing a health hazard.

CAUTION

Danger of frost/freezing

Damage to the pump set!

- If there is any danger of frost/freezing, remove the pump set from the fluid handled and clean, preserve and store it.

The pump set remains installed

✓ Make sure sufficient fluid is available for the operation check run of the pump set.

1. For prolonged shutdown periods, start up the pump set regularly between once a month and once every three months for approximately one minute.
   This will prevent the formation of deposits within the pump and the pump intake area.

The pump (set) is removed from the pipe and stored

✓ All safety regulations are observed.

1. Clean the pump set.
2. Preserve the pump set.
3. Observe the information for storage and preservation. [⇨ Section 3.3, Page 12]

6.4 Returning to service

For returning the pump set to service observe the sections on commissioning/start-up and operating limits.

For returning the pump set to service after storage also follow the instructions for maintenance/inspection.

⚠ WARNING

Failure to re-install or re-activate protective devices

Risk of personal injury from moving parts or escaping fluid!

➢ As soon as the work is complete, re-install and/or re-activate any safety-relevant and protective devices.

NOTE

On pumps/pump sets older than 5 years we recommend replacing all elastomer seals.

7 Servicing/Maintenance

7.1 Safety regulations

The operator ensures that maintenance, inspection and installation are performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.

⚠ WARNING

Unintentional starting of the pump set

Risk of injury by moving components and shock currents!

- ➢ Ensure that the pump set cannot be started unintentionally.
- ➢ Always make sure the electrical connections are disconnected before carrying out work on the pump set.

⚠ WARNING

Fluids handled, consumables and supplies which are hot and/or pose a health hazard

Risk of injury!

- ➢ Observe all relevant laws.
- ➢ When draining the fluid take appropriate measures to protect persons and the environment.
- ➢ Decontaminate pumps which handle fluids posing a health hazard.

⚠ WARNING

Hot surface

Risk of injury!

- ➢ Allow the pump set to cool down to ambient temperature.

⚠ WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

- ➢ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

⚠ WARNING

Insufficient stability

Risk of crushing hands and feet!

- ➢ During assembly/dismantling, secure the pump (set)/pump parts to prevent tilting or tipping over.

A regular maintenance schedule will help avoid expensive repairs and contribute to trouble-free, reliable operation of the pump, pump set and pump parts with a minimum of servicing/ maintenance expenditure and work.

NOTE

All maintenance work, service work and installation work can be carried out by DP Service or authorised workshops.

Never use force when dismantling and reassembling the pump set.

7.2 Servicing/inspection

DP recommends the following regular servicing schedule:

Table 15: Overview of maintenance work

Maintenance interval	Maintenance work	For details see ...
Every 4000 operating hours; at least once a year	Measure the insulation resistance.	[⇨ Section 7.2.1.3, Page 38]
	Check the power cables.	[⇨ Section 7.2.1.2, Page 38]
	Visually inspect the lifting chain.	[⇨ Section 7.2.1.1, Page 38]
	Check the sensors.	[⇨ Section 7.2.1.4, Page 39]
	Change the lubricant.	[⇨ Section 7.2.2.1.3, Page 40]
	Check the bearings.	
Every five years	General overhaul	

7.2.1 Inspection work

7.2.1.1 Checking the lifting chain

✓ The pump set has been lifted out of the pump sump and cleaned.

1. Inspect the lifting chain and its fasteners for any visible damage.
2. Replace any damaged components by original spare parts.

7.2.1.2 Checking the power cables

Visual inspection

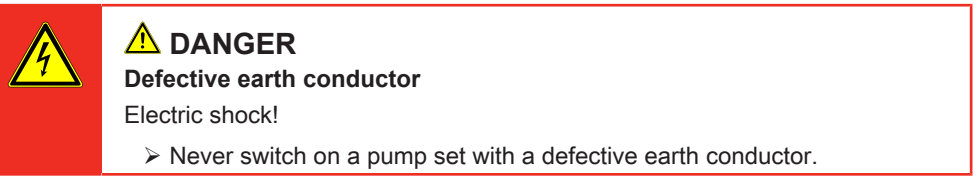
✓ The pump set has been pulled out of the pump sump and cleaned.

1. Inspect the power cable for any visual damage.
2. Replace any damaged components by original spare parts.

Checking the earth conductor

✓ The pump set has been pulled out of the pump sump and cleaned.

1. Measure the resistance between earth conductor and earth.
   The resistance measured must be less than 1 Ω.
2. Replace any damaged components by original spare parts.



⚠ DANGER

Defective earth conductor

Electric shock!

➢ Never switch on a pump set with a defective earth conductor.

7.2.1.3 Measuring the insulation resistance

Measure the insulation resistance of the motor winding during annual maintenance work.

✓ The pump set has been disconnected in the control cabinet.

✓ Use an insulation resistance measuring device.

✓ The recommended measuring voltage equals 500 V (maximum permissible 1000 V).

1. Measure the winding to chassis ground.
   To do so, connect all winding ends together.
2. Measure the winding temperature sensors to chassis ground.
   To do so, connect all core ends of the winding temperature sensors together and connect all winding ends to chassis ground.

⇨ The insulation resistance of the core ends to chassis ground must not be lower than 1 MΩ.
If the resistance measured is lower, power cable and motor resistance must be measured separately. Disconnect the power cable from the motor for this purpose.

NOTE

If the insulation resistance of the power cable is lower than 1 MΩ, the power cable is defective and must be replaced.

NOTE

If the insulation resistance values measured on the motor are too low, the winding insulation is defective. The pump set must not be returned to service in this case.

7.2.1.4 Checking the sensors

CAUTION

Excessive test voltage

Damage to the sensors!

➢ Use a commercially available ohmmeter to measure the resistance.

The tests described below measure the resistance at the core ends of the control cable. The actual sensor function is not tested.

Bimetal switches in the motor

Table 16: Resistance measurement of bimetal switches in the motor

Measurement between terminals ...	Resistance
	[Ω]
20 and 21, and terminals 21 and 22	< 1

If the specified tolerances are exceeded, disconnect the power cable at the pump set and repeat the check inside the motor.
If the tolerances are exceeded here, too, the motor section has to be opened and overhauled. The temperature sensors are fitted in the stator winding and cannot be replaced.

Leakage sensor in the motor

Table 17: Resistance measurement of the leakage sensor in the motor

Measurement between terminals ...	Resistance
	[kΩ]
9 and earth conductor (PE)	> 60

Lower resistance values suggest water ingress into the motor. In this case the motor section must be opened and serviced.

7.2.2 Lubrication and lubricant change

7.2.2.1 Lubricating the mechanical seal

The mechanical seal is supplied with lubricating liquid from the lubricant reservoir.

7.2.2.1.1 Intervals

Change the lubricant every 4000 operating hours but at least once a year.

7.2.2.1.2 Lubricant quality

The lubricant reservoir is filled at the factory with environmentally friendly, non-toxic lubricant of medicinal quality (unless otherwise specified by the customer).
The following lubricants can be used to lubricate the mechanical seals:

Table 18: Oil quality

Description	Properties	
Paraffin oil or white oil	Kinematic viscosity at 40 °C	<20 mm²/s
Alternative: motor oil grades SAE 10W to SAE 20W	Ignition temperature	>185 °C
	Flash point (to Cleveland)	+160 °C
	Solidification point (pour point)	-15 °C

Recommended oil types:

- Merkur WOP 40 PB, made by SASOL
- Merkur white oil Pharma 40, made by DEA
- Thin-bodied paraffin oil No. 7174, made by Merck
- Thin-bodied paraffin oil, type Clarex OM, made by HAFA
- Equivalent brands of medical quality, non-toxic
- Water-glycol mixture

⚠ WARNING

Lubricant contaminating fluid handled

Hazard to persons and the environment!

➢ Using machine oil is only permitted if the oil is disposed of properly.

7.2.2.1.3 Lubricant quantity

Table 19: Lubricant quantity depending on the motor

Motor version	Lubricant quantity
	[l]
Standard	0,25

7.2.2.1.4 Changing the lubricant

Draining the lubricant

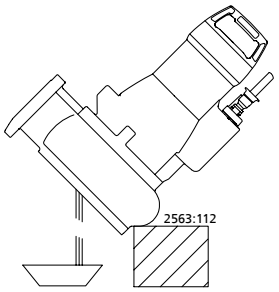


Fig. 15: Draining the lubricant

✓ The suction cover and the impeller have been removed. [⇨ Section 7.4.3, Page 42]

1. Place a suitable container under the pump set.
2. Slide mechanical seal 433.02 along the shaft.
3. Drain the oil.

Filling in the lubricant

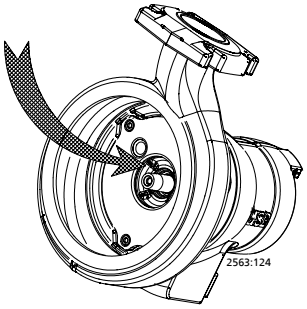


Fig. 16: Filling in the lubricant

1. Fill 0.25 litres of oil through the opening between the stationary assembly of mechanical seal 433.02 and rotor 818.
2. Thoroughly clean rotor 818 and the contact face of the stationary assembly of mechanical seal 433.02. Remove any oil residues.
3. Fit the rotating assembly of mechanical seal 433.02.
4. Fit impeller 230 and suction cover 162. Observe the tightening torques.
[⇨ Section 7.6, Page 47]

7.2.2.2 Lubricating the rolling element bearings

The rolling element bearings of the pump sets are grease-packed and maintenance-free.

7.3 Drainage/cleaning

⚠ WARNING

Fluids, consumables and supplies which are hot and/or pose a health hazard

Hazard to persons and the environment!

- ➢ Collect and properly dispose of flushing fluid and any residues of the fluid handled.
- ➢ Wear safety clothing and a protective mask if required.
- ➢ Observe all legal regulations on the disposal of fluids posing a health hazard.

1. Always flush the pump if it has been used for handling noxious, explosive, hot or other hazardous fluids.
2. Always flush and clean the pump before transporting it to the workshop.
Provide a certificate of decontamination for the pump set. [⇨ Section 11, Page 59]

7.4 Dismantling the pump set

7.4.1 General information/Safety regulations

⚠ WARNING

Unqualified personnel performing work on the pump (set)

Risk of injury!

- ➢ Always have repair and maintenance work performed by specially trained, qualified personnel.

⚠ WARNING

Hot surface

Risk of injury!

- ➢ Allow the pump set to cool down to ambient temperature.

⚠ WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

- ➢ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

Observe the general safety instructions and information.

For dismantling and reassembly observe the general assembly drawing.

In the event of damage you can always contact our service staff.

⚠ DANGER

Insufficient preparation of work on the pump (set)

Risk of injury!

- ➢ Properly shut down the pump set.
- ➢ Close the shut-off elements in suction and discharge line.
- ➢ Drain the pump and release the pump pressure.
- ➢ Close any auxiliary connections.
- ➢ Allow the pump set to cool down to ambient temperature.

⚠ WARNING

Components with sharp edges

Risk of cutting or shearing injuries!

- ➢ Always use appropriate caution for installation and dismantling work.
- ➢ Wear work gloves.

7.4.2 Preparing the pump set

✓ The notes and steps stated in [⇨ Section 7.4.1, Page 41] have been observed/carried out.

1. De-energise the pump set and secure it against unintentional start-up.
2. Drain the lubricant.
3. Drain the leakage chamber and leave it open for the duration of the disassembly.

7.4.3 Dismantling the pump section

Dismantle the pump section in accordance with the relevant general assembly drawing.

1. Remove suction cover 162.
2. Undo and remove the M8 impeller fastening screw.
   The impeller/shaft connection is a tapered fit.
3. For removing the impeller, an M10 jacking thread is provided at the impeller hub.
   Screw in the jack as shown in the drawing below and remove the impeller.

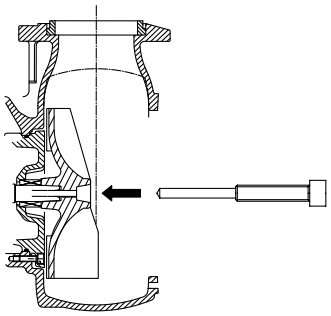


Fig. 17: Forcing screw

NOTE

The forcing screw is not included in the scope of supply. It can be ordered separately from DP.

7.4.4 Removing the mechanical seal and motor part (standard design)

✓ The oil has been drained.

1. Undo and remove screws 914.02 at bearing bracket 330.
2. Remove rotor unit 818 from bearing bracket 330.
3. Press mating ring 433.02 out of bearing bracket 330.
4. Remove circlip 932.02.
5. Take bearing bracket 330 off rotor 818.
6. Remove circlip 932.03.
7. Remove primary ring 433.01.
8. Pull off mating ring carrier 476.
9. Take mating ring 433.01 out of mating ring carrier 476.
10. Remove circlip 932.01.
11. Pull off rolling element bearing 321.02.
12. Pull off rolling element bearing 321.01.

7.5 Reassembling the pump set

7.5.1 General information/Safety regulations

⚠ WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

➢ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

CAUTION

Improper reassembly

Damage to the pump!

➢ Reassemble the pump (set) in accordance with the general rules of sound engineering practice.

➢ Use original spare parts only.

NOTE

Before reassembling the motor section, check that all joints relevant to explosion protection (flamepaths) are undamaged. Any components with damaged flamepaths must be replaced. Refer to the "Flamepaths" annex for the position of the flamepaths.

Sequence Always reassemble the pump set in accordance with the corresponding general assembly drawing.

Sealing elements

- O-rings
  - Check O-rings for any damage and replace by new O-rings, if required.
- Assembly adhesives
  - Avoid the use of assembly adhesives, if possible.

Tightening torques For reassembly, tighten all screws and bolts as specified in this manual.
[⇨ Section 7.6, Page 47]

7.5.2 General information/Safety regulations

⚠ WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

➢ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

CAUTION

Improper reassembly

Damage to the pump!

➢ Reassemble the pump (set) in accordance with the general rules of sound engineering practice.

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Sequence Always reassemble the pump set in accordance with the corresponding general assembly drawing.

Sealing elements

- O-rings
  - Check O-rings for any damage and replace by new O-rings, if required.
- Assembly adhesives
  - Avoid the use of assembly adhesives, if possible.

Tightening torques For reassembly, tighten all screws and bolts as specified in this manual.
[⇨ Section 7.6, Page 47]

7.5.3 Reassembling the pump section

7.5.3.1 Installing the mechanical seal

Observe the following to ensure trouble-free operation of the mechanical seal:

- The shaft surface must be absolutely clean and undamaged.
- Immediately before installing the mechanical seal, wet the seal faces with a drop of oil.
- For easier installation of the bellows-type mechanical seal, wet the inside diameter of the bellows with soapy water (not oil).
- To prevent any damage to the rubber bellows, place a thin foil (of approximately 0.1 to 0.3 mm thickness) around the free shaft stub.
  Slide the rotating assembly over the foil into its installation position.
  Then remove the foil.

✓ The shaft and rolling element bearings have been properly fitted in the motor.

1. Slide drive-end mechanical seal 433.01 onto shaft 210 and secure it with circlip 932.01.
2. Insert O-rings 412.03 into intermediate casing 113 and push the intermediate casing into bearing bracket 330 up to the stop.
3. Slide pump-end mechanical seal 433.02 onto shaft 210.

For special mechanical seals with covered spring, tighten the socket head cap screw at the rotating assembly before fitting the impeller. Observe installation dimension "A".

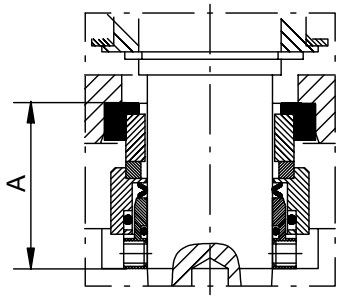


Fig. 18: Installation dimension "A"

Table 20: Installation dimension A

Pump size	Installation dimension "A" [mm]
All sizes	29

7.5.3.2 Fitting the impeller

7.5.3.2.1 Fitting impeller type S and cutter

NOTE

For bearing brackets with tapered fit make sure that the tapered fit of impeller and shaft is undamaged and installed free from grease.

1. Slide impeller 230 onto the shaft end.
2. Insert grooved pin 561 into impeller 230.
3. Place impeller body 23-7 on the centring hub.
4. Insert impeller screw 914.04 and tighten it to a torque of 30 Nm.
5. Fasten ring 500 in the suction cover with screws 914.06.

CAUTION

Incorrect assembly

Clearance gap inaccurate!

- Pull the rotor assembly right up to the suction cover until it will not go any further. Maintain this position until dimensions x and y have been measured.

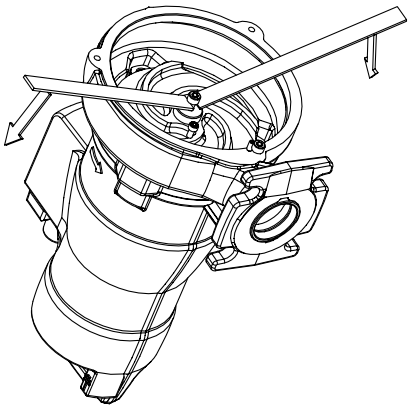


Fig. 19: Pulling the rotor assembly right up to the suction cover

6. Pull the rotor assembly right up to the suction cover until it will not go any further.

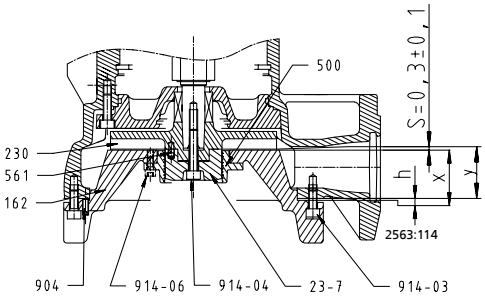


Fig. 20: Adjusting impeller type S

h	Distance between suction cover and pump casing
s	Clearance gap between suction cover and impeller vanes
x	Distance between the upper side of the suction cover and the mounting holes of the suction cover
y	Distance between the bottom of the pump casing and the impeller vanes

7. Measure dimension x on the suction cover
   Dimension x is the distance between the upper side of the suction cover and the mounting holes of the suction cover.
8. Measure dimension y between the pump casing and the impeller vanes.
   Dimension y is the distance between the bottom of the pump casing and the impeller vanes.
9. Use screws 904 to set dimension h (h = x + s - y),
   where s (0.3 + -0.1) is the clearance between the suction cover and the impeller vanes.
10. Tighten the suction cover with screws 914.03.
11. Rotate the impeller body to check that the impeller turns smoothly.
    Make sure that the suction cover and impeller do not touch each other.

7.5.4 Mounting the motor part

CAUTION

Wrong screws/bolts

Damage to the pump set!

- ➢ Always use the original bolts/screws for assembling a pump set.
- ➢ Never use screws/bolts of different dimensions or of a lower property class.

7.5.5 Checking the connection of motor/power supply

Once reassembly has been completed, carry out the steps described in [⇨ Section 7.2.1, Page 38] .

7.6 Tightening torques

Table 21: Tightening torques

Thread	Tightening torques
	[Nm]
M8	17
Impeller screw M8	40
Screw plug 903	23

7.7 Spare parts

7.7.1 Ordering spare parts

Always quote the following data when ordering replacement or spare parts:

- – Order number
- – Order item number
- – Type series
- – Size
- – Year of construction
- – Motor number

Refer to the name plate for all data.

Also specify the following data:

- – Part number and description [⇨ Section 9.1, Page 50]
- – Quantity of spare parts
- – Shipping address
- – Mode of dispatch (freight, mail, express freight, air freight)

7.7.2 Recommended spare parts stock for 2 years' operation to DIN 24296

Table 22: Quantity of spare parts for recommended spare parts stock[3)]

Part No.	Description	Number of pumps (including stand-by pumps)						
		2	3	4	5	6 and 7	8 and 9	10 and more
230	Impeller	1	1	2	2	3	4	50 %
320 / 321.02	Rolling element bearing, pump end	1	1	2	2	3	4	50 %
321.01 / 322	Rolling element bearing, motor end	1	1	2	2	3	4	50 %
433.01	Mechanical seal, motor end	2	3	4	5	6	7	90 %
433.02	Mechanical seal, pump end	2	3	4	5	6	7	90 %
99-9	Set of sealing elements	4	6	8	8	9	10	100 %

7.7.3 Sets of spare parts

Table 23: Overview of spare parts sets

Description	Part No.
Rolling element bearing, motor end	321.01
Rolling element bearing, pump end	3210.02
Mechanical seal, motor end	433.01
Mechanical seal, pump end	433.02
Set of seal elements	99-9
Repair kit	99-20
1 set of circlips	-

3) For two years of continuous operation or 4000 operating hours

8 Trouble-shooting

⚠ WARNING

Improper work to remedy faults

Risk of injury!

- For any work performed to remedy faults, observe the relevant information given in this instruction manual and/or in the product literature provided by the accessories manufacturer.

If problems occur that are not described in the following table, consultation with the DP service is required.

A Pump is running, but does not deliver

B Pump delivers insufficient flow rate

C Excessive current/power input

D Insufficient discharge head

E Vibrations and noise during pump operation

Table 24: Trouble-shooting

A	B	C	D	E	Possible cause	Remedy
-	✗	-	-	-	Pump delivers against an excessively high pressure.	Re-adjust to duty point.
-	✗	-	-	-	Gate valve in the discharge line is not fully open.	Fully open the gate valve.
-	-	✗	-	✗	Pump is running in the off-design range (part load/ overload).	Check the pump's operating data.
✗	-	-	-	-	Pump or piping are not completely vented.	Vent by lifting the pump off the duckfoot bend and lowering it again.
✗	-	-	-	-	Pump intake clogged by deposits	Clean the intake, pump components and lift check valve.
-	✗	-	✗	✗	Supply line or impeller clogged	Remove deposits in the pump and/or piping.
-	-	✗	-	✗	Dirt/fibres in the clearance between the casing wall and impeller; sluggish rotor.	Check whether the impeller can be easily rotated. Clean the impeller if required.
-	✗	✗	✗	✗	Wear of internal components	Replace worn components by new ones.
✗	✗	-	✗	-	Defective riser (pipe and sealing element)	Replace defective riser pipes, replace sealing elements.
-	✗	-	✗	✗	Impermissible air or gas content in the fluid handled	Contact the manufacturer.
-	-	-	-	✗	System-induced vibrations	Contact the manufacturer.
-	✗	✗	✗	✗	Wrong direction of rotation	Check the electrical connection of motor and control system, if any.
-	-	✗	-	-	Wrong supply voltage	Check the mains power supply. Check the cable connections.
✗	-	-	-	-	Motor is not running because of lack of voltage.	Check the electrical installation. Contact the energy supplier.
✗	-	✗	-	-	Motor winding or connection cable are defective.	Replace by new original DP parts or contact the manufacturer.
-	-	-	-	✗	Defective rolling element bearing	Contact the manufacturer.
-	✗	-	-	-	Water level lowered too much during operation	Check level control equipment.
✗	-	-	-	-	Temperature control device monitoring the winding has tripped the pump as a result of excessive winding temperatures.	The motor will restart automatically once it has cooled down.
✗	-	-	-	-	The temperature limiter (explosion protection) has tripped the pump as a result of excessive winding temperatures.	Have cause determined and eliminated by qualified and trained personnel.
✗	-	-	-	-	Motor has been tripped by leakage monitor.	Have cause determined and eliminated by qualified and trained personnel.

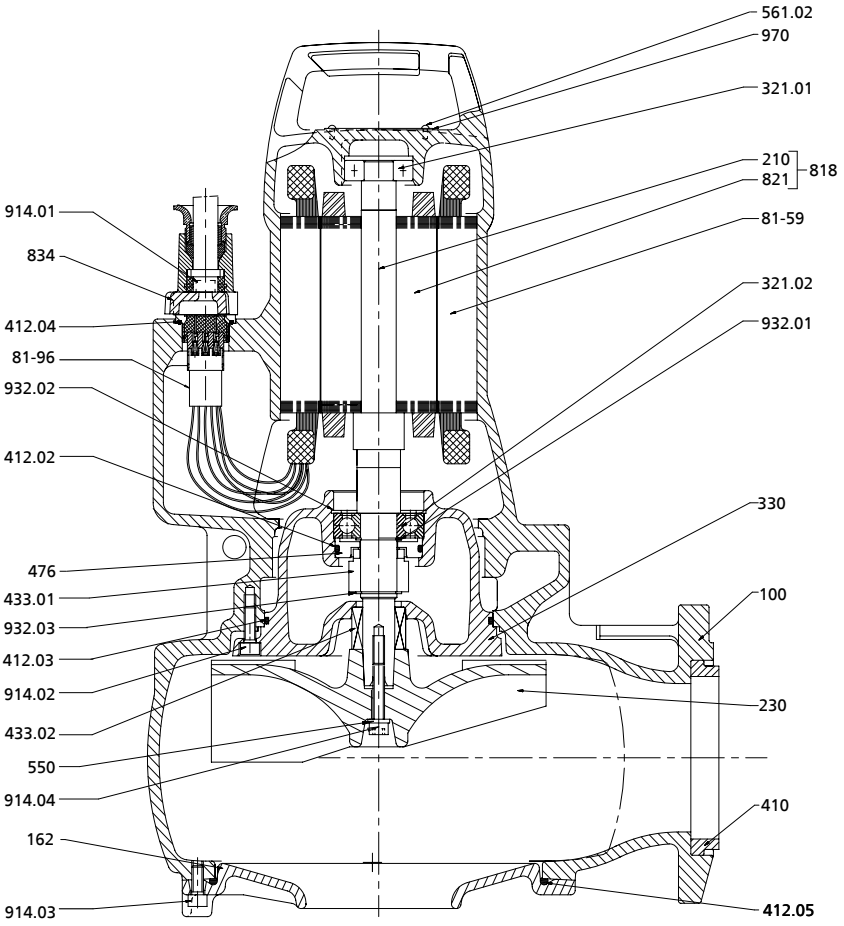
9 Related Documents

9.1 General assembly drawings with list of components

9.1.1 General assembly drawing DRV series, standard design

Sizes of hydraulic system
DN 50 ... 100

Motor sizes
002...042
004...044



General assembly drawing of the pump set, version Standard

Table 25: List of components

Part No.	Description	Part No.	Description
100	Casing	550	Disc
162	Suction cover	561.02	Grooved pin
210	Shaft	81-2	Plug
230	Impeller	81-59	Stator
321.01/.02	Radial ball bearing	818	Rotor
330	Bearing bracket	821	Rotor core pack
410	Profile seal	834	Cable gland
412.01/.02/.03/.04/.05	O-ring	914.01/.02/.03/.04	Hexagon socket head cap screw
433.01/.02	Mechanical seal	932.01/.02/.03	Circlip
476	Mating ring carrier	970	Label/plate

9.1.2 Exploded views with list of components

9.1.2.1 Exploded view DRS series, standard design

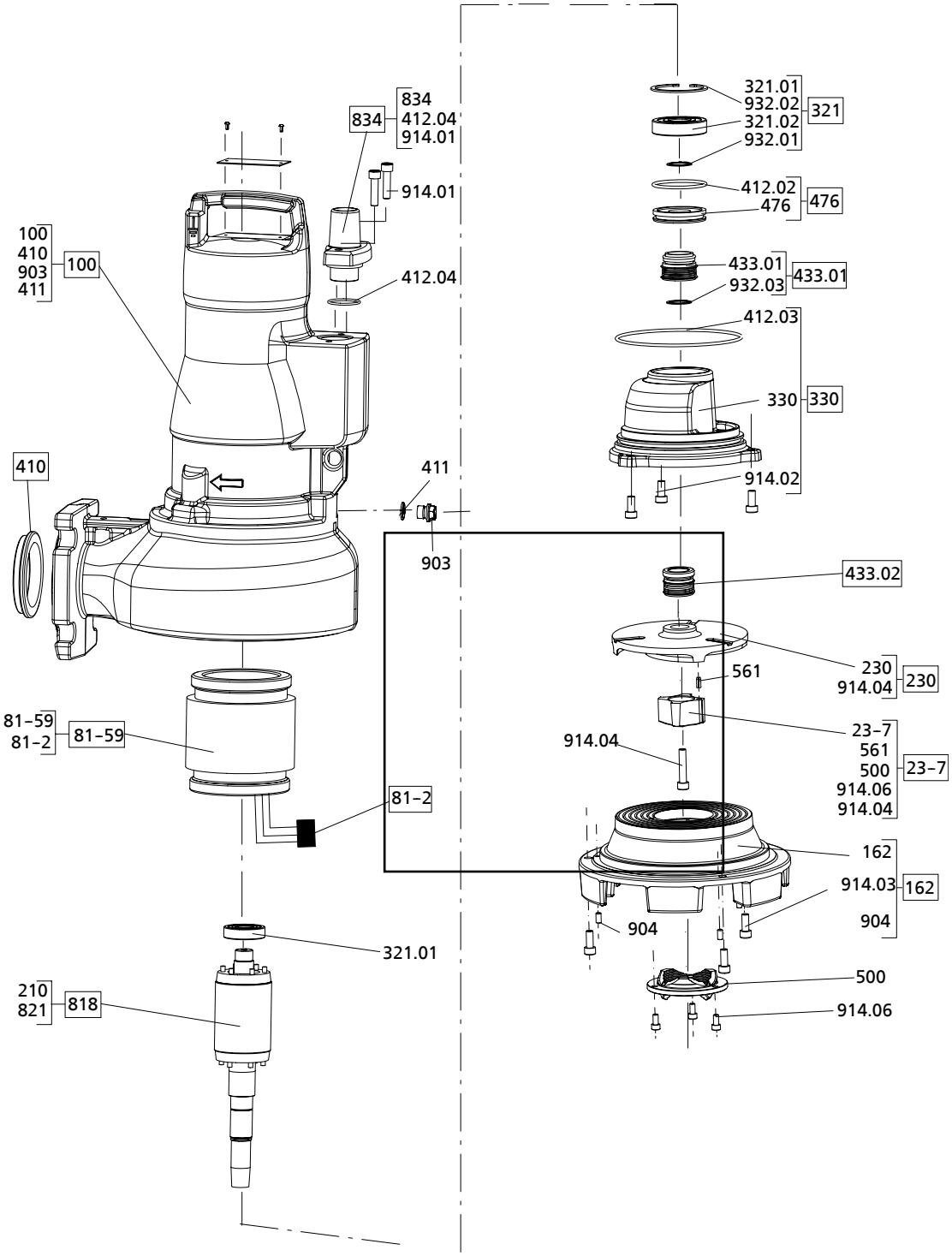


Fig. 21: DRS series, standard design

9.1.2.2 Exploded view DRV series, standard design

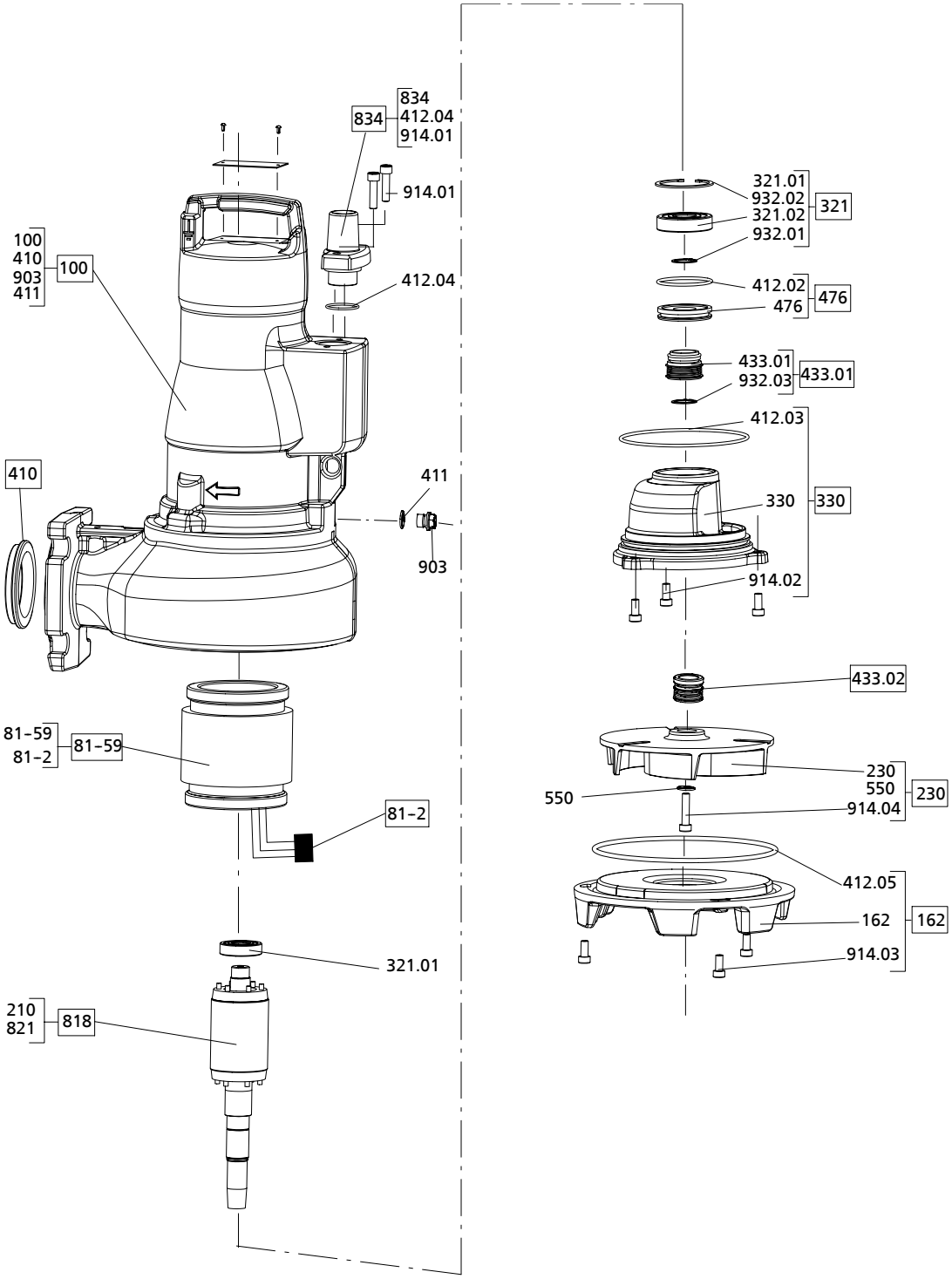


Fig. 22: DRV series, standard design

9.1.2.3 Exploded view DRSK series, standard design

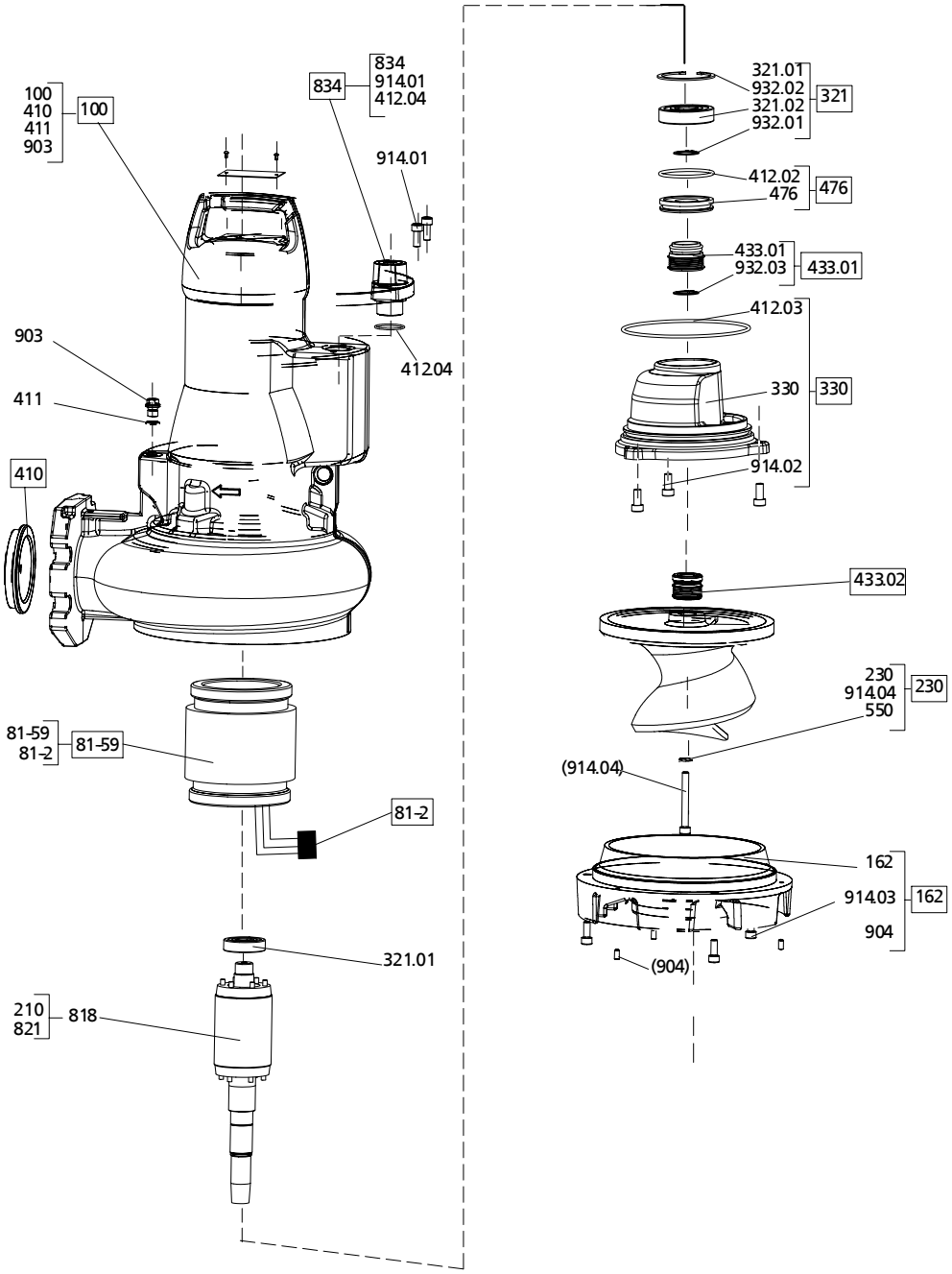


Fig. 23: DRSK series, standard design

9.1.2.4 List of components in the exploded views

Table 26: List of components

Part No.	Description	Part No.	Description
100	Casing	500	Ring
113	Intermediate casing	550	Disc
162	Suction cover	561	Grooved pin
182	Feet	69-6	Temperature sensor
210	Shaft	69-16	Moisture sensor
23-7	Impeller body	81-2	Plug
230	Impeller	81-59	Stator
321.01/.02	Radial ball bearing	818	Rotor
330	Bearing bracket	821	Rotor core pack
355	Bearing bracket housing	834	Cable gland
410	Profile seal	99-9	Set of sealing elements
411	Joint ring	903	Screw plug
412.01/.02/.03/.04/.05	O-ring	904	Grub screw
433.01/.02	Mechanical seal	914.01/.02/.03/.04/.06	Hexagon socket head cap screw
476	Mating ring carrier	932.01/.02/.03/.04	Circlip
59-17	Shackle		

9.2 Wiring diagrams

9.2.1 Standard design

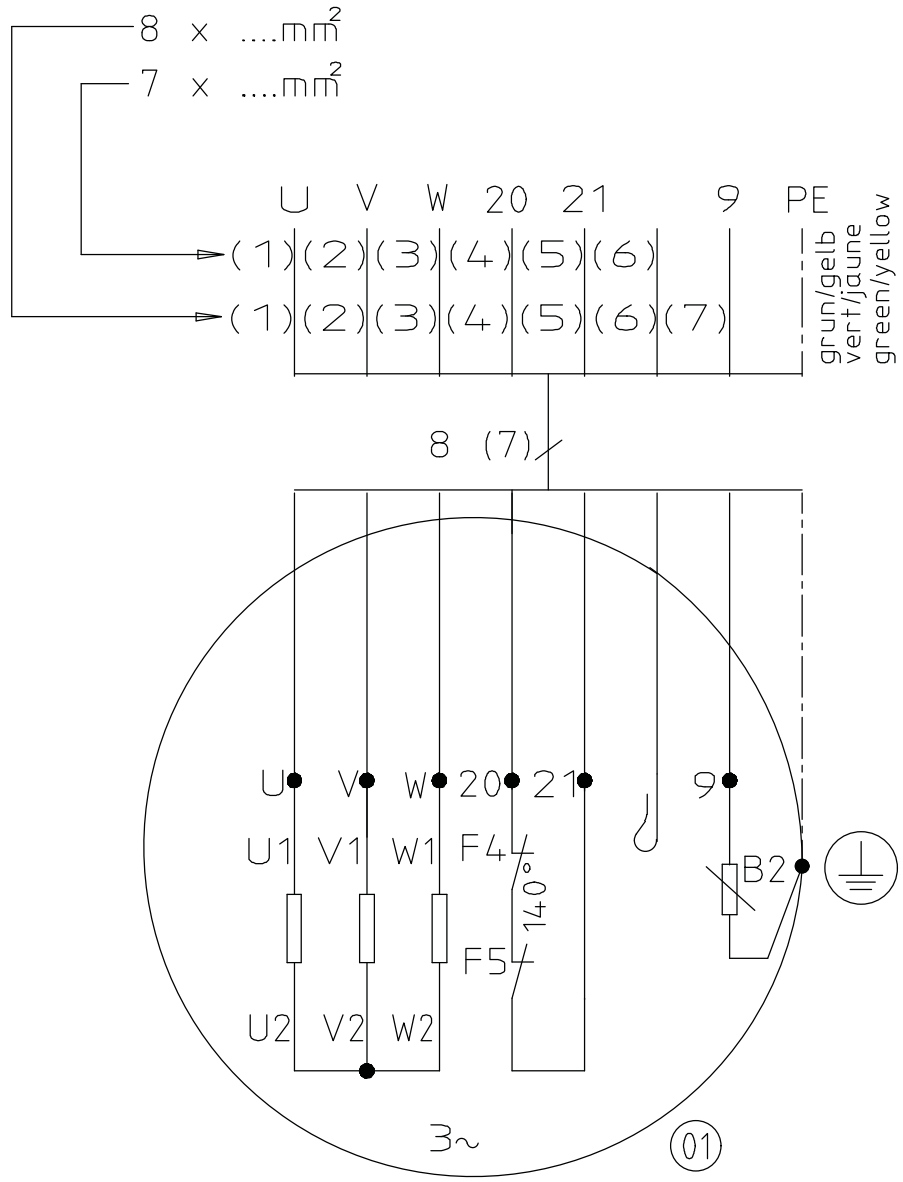
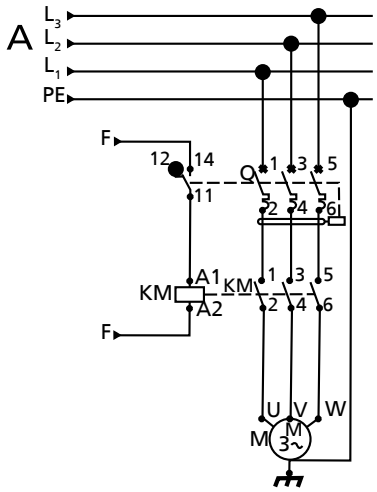
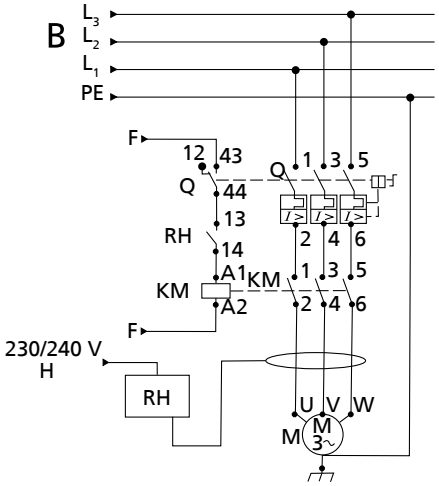
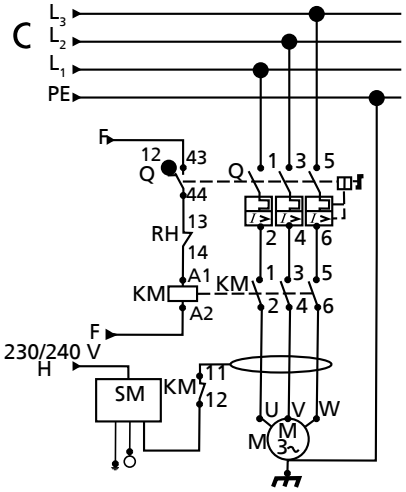


Fig. 24: Wiring diagram for version Standard

B2	Motor moisture protection

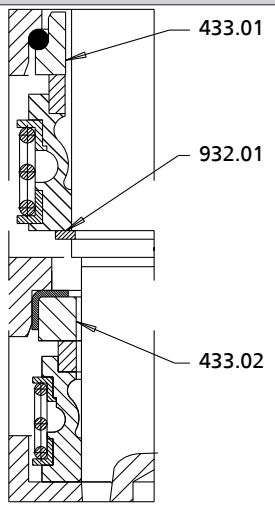
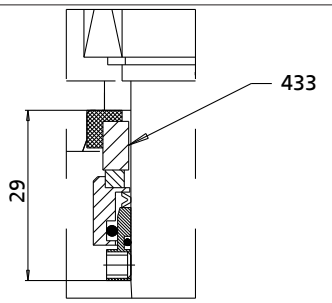
9.3 Wiring diagrams overload protection

Table 27: Examples of wiring diagrams for overload protection

Key	Circuit diagram
Q: residual current device 3~30 mA e.g. residual current device Merlin Guérin C60 L, trip characteristic K – Earth leakage module VIGI, instantaneous, 3~ 30 mA – Auxiliary contact (change-over contact) **KM**: Motor contactor 3~ e.g. Télémécanique LC1 D0910 **F**: Remote control	
Q: Motor contactor e.g. Télémécanique GV2M + GV2 AN 11 **KM**: Motor contactor 3~ e.g. Télémécanique LC1 D0910 **RH**: Earth leakage protection relay with separate toroid e.g. Vigirex RH 328 A Merlin Guérin + Tore **F**: Remote control **H**: Auxiliary supply	
Q: Motor contactor e.g. Télémécanique GV2M + GV2 AN 11 **KM**: Motor contactor 3~ e.g. Télémécanique LC1 D0910 **SM**: Insulation monitor, de-energised e.g. V12G1LOHM SM21 Merlin Guérin **F**: Remote control **H**: Auxiliary supply	

9.4 Installation drawings of the mechanical seal

Table 28: Sectional drawings of the mechanical seal

Part No.	Description	Sectional drawing
433.01	Mechanical seal (bellows-type mechanical seal)	
932.01	Circlip	
433.02	Mechanical seal (bellows-type mechanical seal)	
433	Mechanical seal (mechanical seal with covered springs - HJ)	

10 EU Declaration of Conformity

Manufacturer:

Duijvelaar Pompen
D.P. Pumps
Kalkovenweg 13
2401 LJ Alphen aan den Rijn (Holland)

The manufacturer herewith declares that **the product**:

DRV 9-27, DRS 4-6, DRSK

Serial number: S 1901 - S 2052

- is in conformity with the provisions of the following Directives as amended from time to time:
  - Pump set: Machinery Directive 2006/42/EC

The manufacturer also declares that

- the following harmonised international standards have been applied:
  - ISO 12100
  - EN 809
  - EN 60034-1, EN 60034-5/A1

Person authorised to compile the technical file:

Menno Schaap
Manager Competence Centre Products
D.P. Industries B.V.
Kalkovenweg 13
2401 LJ Alphen aan den Rijn (The Netherlands)

The EU Declaration of Conformity was issued in/on:

Alphen aan den Rijn, 20.02.2019

Menno Schaap
Manager Competence Centre Products
D.P. Industries B.V.
2401 LJ Alphen aan den Rijn

11 Certificate of Decontamination

Type: .....

Order number/

Order item number[4]: .....

Delivery date: .....

Applications: .....

Fluid handled[4]: .....

Please tick where applicable[4]:

				
☐	☐	☐	☐	☐
Corrosive	Oxidising	Flammable	Explosive	Hazardous to health
				
☐	☐	☐	☐	☐
Seriously hazardous to health	Toxic	Radioactive	Bio-hazardous	Safe

Reason for return[4]: .....

Comments: .....

.....

The product/accessories have been carefully drained, cleaned and decontaminated inside and outside prior to dispatch/ placing at your disposal.

We herewith declare that this product is free from hazardous chemicals, biological and radioactive substances.

For mag-drive pumps, the inner rotor unit (impeller, casing cover, bearing ring carrier, plain bearing, inner rotor) has been removed from the pump and cleaned. In cases of containment shroud leakage, the outer rotor, bearing bracket lantern, leakage barrier and bearing bracket or intermediate piece have also been cleaned.

For canned motor pumps, the rotor and plain bearing have been removed from the pump for cleaning. In cases of leakage at the stator can, the stator space has been examined for fluid leakage; if fluid handled has penetrated the stator space, it has been removed.

☐ No special safety precautions are required for further handling.

☐ The following safety precautions are required for flushing fluids, fluid residues and disposal:

.....

.....

We confirm that the above data and information are correct and complete and that dispatch is effected in accordance with the relevant legal provisions.

.....	.....	.....
Place, date and signature	Address	Company stamp

4) Required fields

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