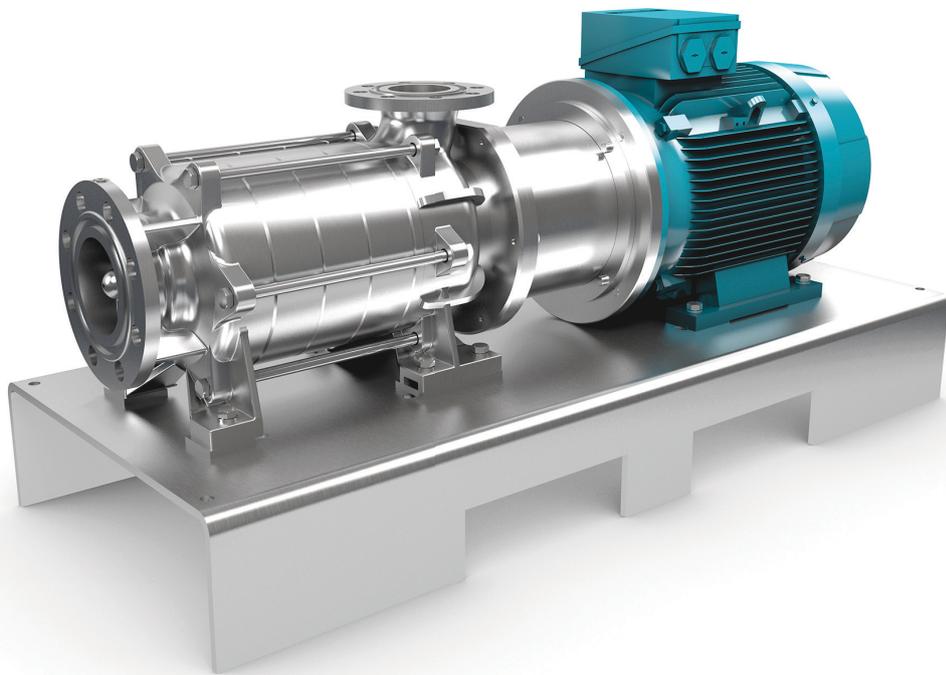


Multistage pumps NHM/NHKM 100



Operating instructions



**Translation of the original operating instructions
Please read and retain**



Service?
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1 Introduction

1.1 Addresses

Manufacturer

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Delivery address for returns

EDUR-Pumpenfabrik
Eduard Redlien GmbH & Co. KG
Marie-Curie-Straße 15
24145 Kiel
Germany

1.2 Applicable documents

The overall documentation encompasses the following other applicable documents:

- Data sheet
- Hydraulic water characteristic curve
- Dimension sheet/installation plan
- Supplier documentation for assemblies from external suppliers
- Test certificates, if included in the scope of delivery of external suppliers and contractually agreed
- Acceptance test certificates, if contractually agreed
- Further documents, if contractually agreed.

1.3 About these operating instructions

In these operating instructions, safety information is contained in the 'Safety' chapters and in the warnings that can occur in all chapters.

The warnings are subdivided into hazard levels and are identified as follows:

WARNING

This warning indicates a possibly hazardous situation. Failure to observe this warning can result in death or severe physical injuries.

CAUTION

This warning indicates a possibly hazardous situation. Failure to observe this warning can result in moderate or slight physical injuries.

NOTICE

This warning constitutes a warning concerning property damage.

A pump assembly always consists of the pump and a motor. For simplification, the term **pump** is used in the operating instructions.

The pump is intended for installation in machines or systems. For simplification, the word **system** is used in the operating instructions.

1.4 Signs on the pump

The signs are part of the pump. They must not be removed, painted over or rendered illegible. Damaged, illegible or missing signs must be replaced.

Signs on the pump

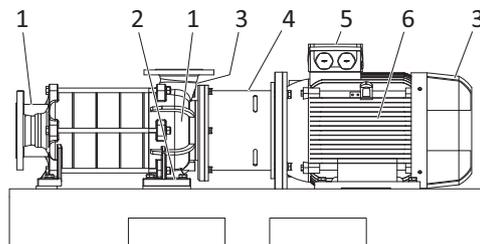


Fig. 1-1 Signs on the pump

Item	Sign	Comment
1		Direction of flow The arrow indicates the specified direction of flow.
2		Pump type plate , see Type plate on the pump casing, page 7.
3		Direction of rotation The arrow indicates the specified direction of rotation of the pump.
4		Warning of magnetic field Warns the personnel of a magnetic field.
5		Read instructions Requests the personnel to read the instructions before working on the pump.
6		Motor type plate , see Type plate on the motor, page 8.

Tab. 1-1 Explanations concerning the signs

Type plate on the pump casing

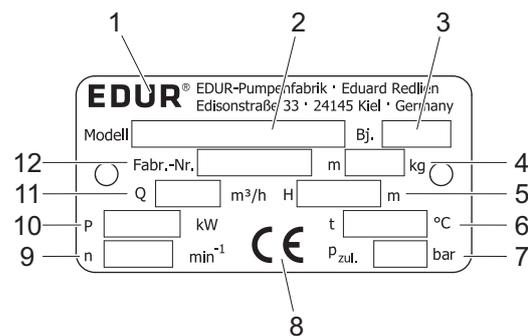


Fig. 1-2 Type plate on the pump casing

- 1 Manufacturer
- 2 Model designation
- 3 Year of construction
- 4 Overall weight
- 5 Head
- 6 Maximum temperature of the pumped fluid
- 7 Maximum permissible pressure
- 8 CE symbol
- 9 Rated speed
- 10 Power consumption
- 11 Volumetric flow/delivery rate
- 12 Factory number/serial number

Type plate on the motor

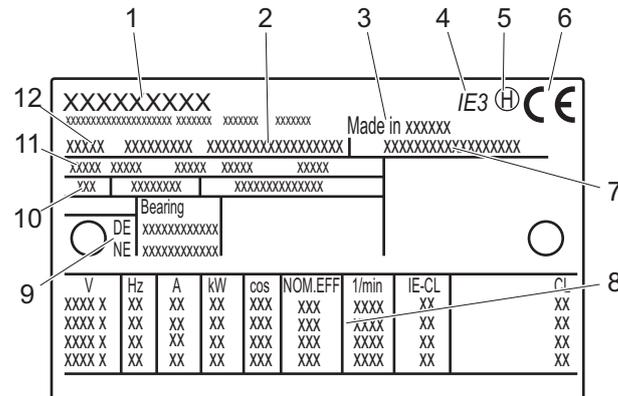


Fig. 1-3 Type plate on the motor

- 1 Manufacturer
- 2 Motor designation
- 3 Country of origin
- 4 Efficiency class
- 5 Balancing
- 6 CE symbol
- 7 Serial number with year of manufacture
- 8 Rated motor data
- 9 Storage
- 10 Weight | Insulation class | Temperature range
- 11 Standards | Size | Type | Protection class
- 12 Number of phases

The item numbers in the figure may deviate depending on the motor make.

2 Safety

2.1 Reading the operating instructions

The personnel that carries out work on the pump must have read and understood the operating instructions. The operating instructions must be available at the operating location and be retained throughout the entire service life of the pump.

The local, generally valid, statutory and other binding accident prevention and environmental protection regulations must be observed in addition to the operating instructions.

2.2 Proper use

The pump is intended for installation in machines and systems for pumping pure fluids or slightly contaminated fluids.

Possible application areas include booster stations, irrigation systems, boiler feed and condensate systems, washing systems, filter technology, water treatment and hardening systems, refrigeration technology, marine engineering or general mechanical engineering.

Each pump is built for a specific customer. The materials and seals are selected for the respective pumped fluid and the operating area. The pump may only be operated with the approved pumped fluid and within the specified limits of the operating area, see Chapter 1.2 Applicable documents, page 5.

2.3 Improper use

The pump may only be operated in installed condition within a pipe network. Switching it on even temporarily outside of the pipe network is considered improper.

The pump must not be operated in an explosive environment.

2.4 Basic safety instructions

Installation and removal work, operation and maintenance may only be carried out by qualified specialist personnel. Qualified specialist personnel includes persons who are able to independently recognise and avoid possible hazards based on their training and experience. The owner must ensure these qualifications.

Observe all local, statutory and system-specific regulations and requirements.

Do not carry out any independent modifications or conversions. Modifications and conversions must be approved by the manufacturer.

Always operate the pump in the specified direction of rotation and with pumped fluid.

When pumping pumped fluids that pose a risk to health and the environment, observe the statutory and operational safety regulations. Avoid any risk of inhalation, swallowing or contact with eyes, skin and mucous membranes.

2.5 Specific safety instructions

Danger from magnetic field

The magnetic field of the magnetic coupling can lead to serious personal injury and property damage. Observe the following safety instructions.

- Persons with cardiac pacemakers or implanted defibrillators must not be in the vicinity of the pump or work on the pump. These persons must maintain a safety distance of at least 1 metre. There is a danger to life.
- Ensure that no magnet-sensitive devices, such as ID cards with magnetic strips, electrical, electronic and precision mechanical devices, are located in the vicinity of the pump.
- Ensure that no magnetisable metal parts can be attracted to the magnetic coupling.
- Ensure that parts of the magnetic coupling cannot be attracted by magnetisable metals.

2.6 Personal protective equipment

The personal protective equipment is dependent on the operating location and the pumped fluid. The scope of the personal protective equipment must be defined by the owner.

The manufacturer recommends the following as the minimum requirement:

- Safety shoes
- Protective gloves
- Safety glasses (optional)
- Ear protectors (optional)

2.7 Protective devices

The owner must install the following protective devices on all pumps:

- Coupling guard (if not supplied)
- Facility for disconnecting the power supply in an emergency
- Motor protection/overload protection

The owner must install further protective devices depending on the type, the technical data and the installation location:

- Contact protection in the case of very hot or cold pumped fluids

- Soundproofing if the statutory specifications concerning noise emissions are exceeded
- Protection against weather and environmental influences,

When pumping pumped fluids that pose a risk to health and the environment, the owner must implement corresponding safety measures, e.g. installing a collection facility.

The pump must only be operated with installed and functioning protective devices.

3 Technical data

The type plate and the applicable documents contain the technical data. The technical data specified here are generally valid and can deviate in individual cases.

3.1 Pump

Multistage pump	
Delivery volume	Max. 170 m ³ h ⁻¹
Head	Max. 290 m
Permissible pressure	Max. 40 bar
Fluid temperature range	-50°C to 140°C
Shaft seal	Magnetic coupling

Tab. 3-1 Pump technical data

3.2 Motor

IEC three-phase motor (self-cooled)	
Protection class	IP55
Insulation class	F (155°C)
Operating mode	S1 continuous operation
Ambient temperature (permissible coolant temperature)	-20°C to 40°C
Installation height above MSL	Max. 1000 m
Rotational speed	1,450 (1,750) rpm 2,900 (3,500) rpm
Frequency	50 (60) Hz

Tab. 3-2 Motor technical data

3.3 Noise emissions

Rated power requirement [kW]	Emission sound pressure level LpA [dB] at rotational speed	
	1,450 rpm	2,900 rpm
7.5	66	72
11.0	68	74
15.0	69	75
18.5	70	76
22.0	71	77
30.0	72	78
37.0	73	79
45.0	74	80
55.0	74	80
75.0	76	81
90.0	77	82
110.0	78	83

Tab. 3-3 Emission sound pressure level LpA

The emission sound pressure level actually determined on site may deviate significantly from the specified values due to the operating and installation conditions. The values have a measurement tolerance of ± 3 dB and cannot be guaranteed.

Increased noise emissions can occur due to cavitation, defective or worn bearings and due to vibrations. Observe installation and maintenance instructions, see Chapter 7 Installation, page 20 and Chapter 10 Maintenance, page 31.

4 Design and function

4.1 Pump

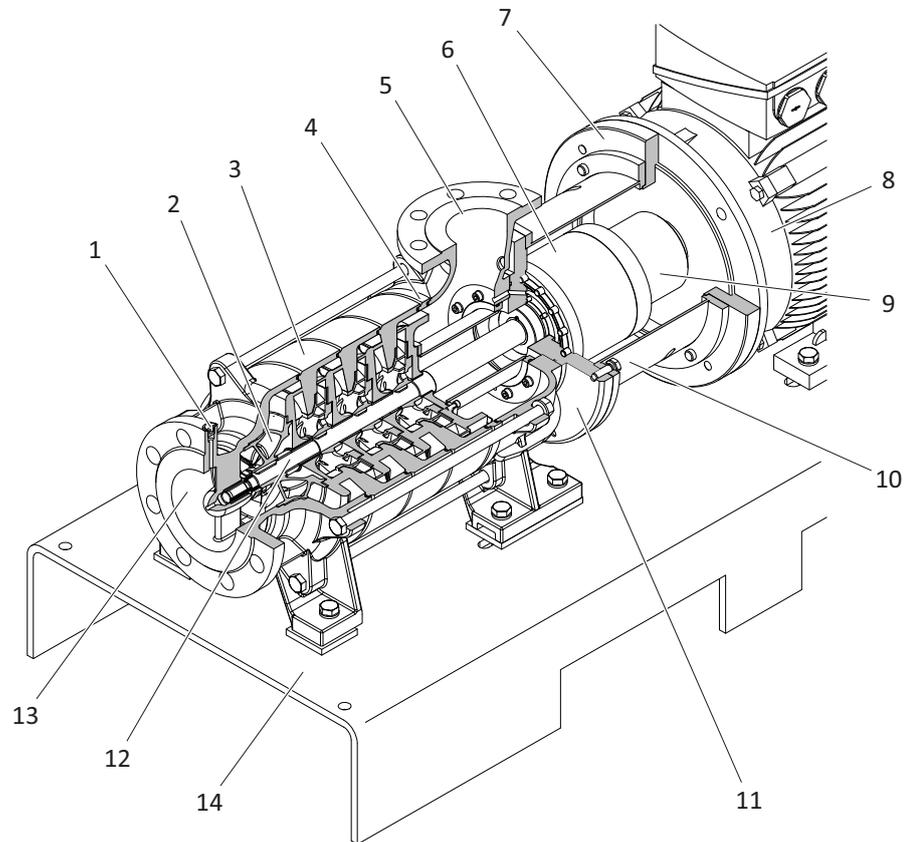


Fig. 4-1 Pump design

- 1 Venting screw
- 2 Impeller
- 3 Stage casing
- 4 End stage casing
- 5 Pressure fitting
- 6 Magnetic coupling
- 7 Intermediate flange
- 8 Motor
- 9 Half of the coupling
- 10 Lantern
- 11 Bearing support
- 12 Shaft
- 13 Suction nozzle
- 14 Base plate

The pumps transfer energy from the pump to the pumped fluid through fluidic processes.

The characteristic feature is the successively arranged impellers, through which the pumped fluid flows in sequence.

By means of an energy gradient, the pumped fluid flows via the suction nozzle into the pump, where it encounters the rotating impellers of the first stage. The impeller is driven by the motor. The motor drives the impeller via a shaft with a magnetic coupling. The vanes of the impeller apply force onto the pumped fluid and increase its angular momentum. Energy is transferred to the pumped fluid and the pressure and absolute velocity increase. The energy content that is present in kinetic form in the increased absolute velocity is transformed into additional static pressure energy by means of a diffuser element. Guide vanes are used as the diffuser element. Together, the impeller and diffuser element are referred to as the pump's hydraulic system.

In the flow channels of the casing, the pumped fluid is delivered from the diffuser element, through which it previously flowed, to the impeller inlet of the downstream stage. The above described energy transfer process is then repeated.

To maintain the flow, an energy gradient must also be present at the pressure nozzle. Losses in the system caused by friction or leakages increase the pump's power consumption.

The magnetic coupling prevents the pumped fluid from escaping at the rotating shaft. The venting screws are used to release trapped air.

A so-called lantern is inserted between the motor and cover.

The design of the casing is dependent on the specific type and the number of stages. In the multistage pump, a stage is the name given to the unit consisting of the impeller, diffuser element and casing. The inlet casing with suction nozzle is located upstream of the first stage. The final stage always contains the delivery casing with pressure nozzle.

The spare part drawing shows the detailed design of the pump. The spare part drawing can be downloaded in the service area of the EDUR homepage, www.edur.com.

4.2 Magnetic coupling

The magnetic coupling transfers the force of the motor to the shaft. The transmission of force is carried out without contact. The magnetic coupling is hermetically sealed. No maintenance is required for trouble-free operation.

4.3 Expansion stages

The pumps can be supplied in the following expansion stages.

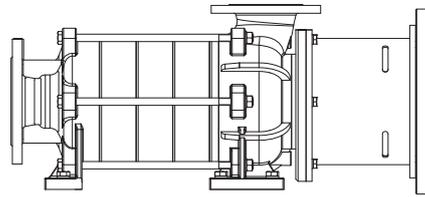


Fig. 4-2 Expansion stage L, pump with magnetic coupling and lantern

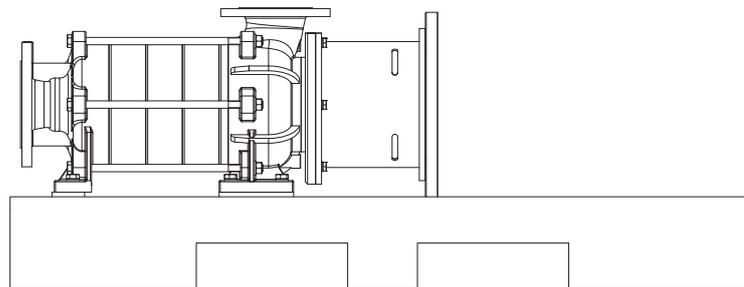


Fig. 4-3 Expansion stage G, pump with magnetic coupling and lantern, mounted on base plate

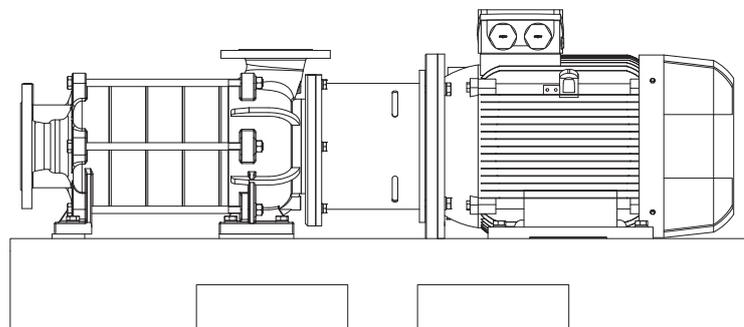


Fig. 4-4 Expansion stage A, pump coupled to motor, with lantern, mounted on base plate

5 Transport

5.1 Safety during transport

Improper transport can lead to personal injury and property damage. Observe the following safety instructions.

- Transport must only be carried out by qualified and trained personnel.
- Transport the pump in the horizontal position only.
- Use suitable lifting and lashing equipment. Observe the weight data on the type plate and the packaging.

- Do not use the ring bolts on the motor. The ring bolts on the motor are only designed for the weight of the motor.
- Do not remain beneath suspended loads.
- Make sure that nobody remains in the danger zone.
- Wear safety shoes.
- Only use the approved lifting equipment, see the following chapter.

5.2 Transporting the pump with a crane

Any variant not shown here is not permissible.

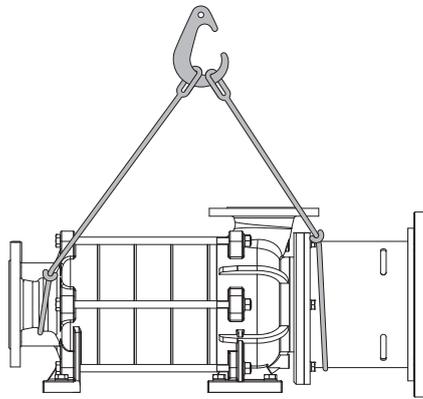


Fig. 5-1 Pump without motor and not mounted on a base plate

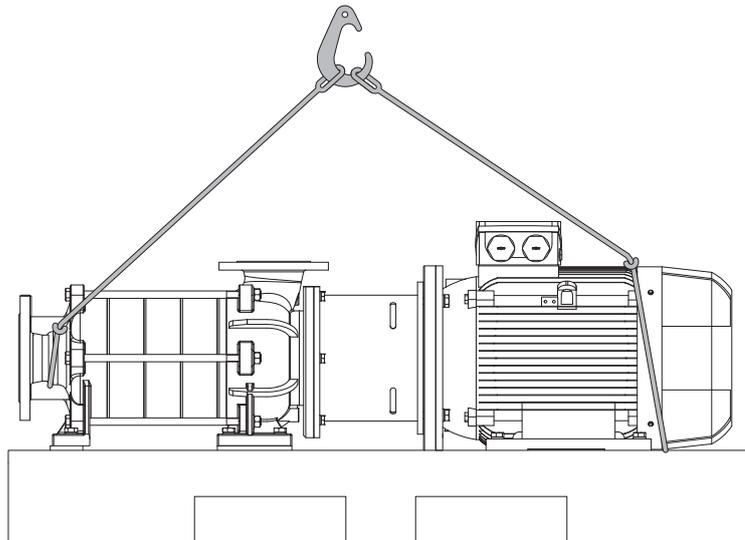


Fig. 5-2 Pump with motor mounted on a base plate

1. Fasten lashing equipment to the pump, see figure.
2. Raise the pump carefully and transport it to the destination location.

3. Put the pump down carefully.
4. Remove the lashing equipment.

5.3 Transporting the pump with an industrial truck

Pump secured on transport pallet

The pump is secured on a transport pallet for shipping. After delivery, the pump can be transported on the pallet and with the packaging using a suitable industrial truck.

If the pump is transported again at a later date, it can again be placed on a transport pallet and secured to the pallet.

Pump without transport pallet

Any variant not shown here is not permissible.

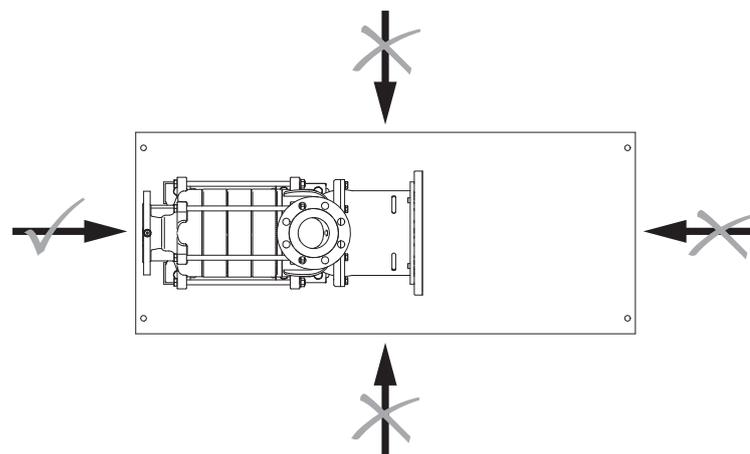


Fig. 5-3 Pump without motor on a base plate measuring 650 mm in width

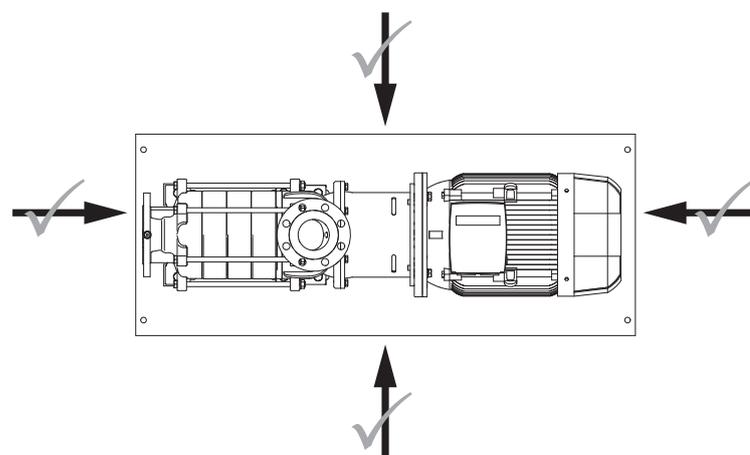


Fig. 5-4 Pump with motor on a base plate measuring 650 mm in width

6 Storage

6.1 Safety during storage

Improper storage can lead to damage to the pump and to environmental pollution. Observe the following safety instructions.

- Corrosion protection agents can be dangerous to health and the environment. Collect corrosion protection and cleaning agents and dispose of them properly. Observe the safety instructions on the corrosion protection agent packaging.
- Wear protective gloves.

Store the pump under the conditions specified here.

- The storage location must be covered, dry, well ventilated, frost-free and as vibration-free as possible.
- The humidity should be constant.
- Store the pump horizontally.
- Preserve the pump if it is stored for a long time. Tightly seal the suction and pressure nozzles. Check the corrosion protection every 3 months.
- Rotate the shaft by hand once a month, e.g. rotate the fan on the motor.
- If stored for more than two years, check the motor shaft bearings before installation and exchange them if necessary. If stored for more than four years, check the motor shaft bearings before installation and generally exchange them.

6.2 Removing preserving agents

The pump is preserved on delivery. Depending on storage, the preservation lasts for six to 12 months.

Oils and waxes which are applied onto the surfaces are used as corrosion protection agents. It is not necessary to remove the corrosion protection agent.

6.3 Preserving the pump

The pump must be preserved after removal and prior to renewed storage. The corrosion protection agent to be used is dependent on the materials that are used and the operating conditions. Oils or waxes are suitable as corrosion protection agents. If you are uncertain which to choose, contact the manufacturer.

The preservation must be checked approx. every 3 months and refreshed if necessary.

Stainless steel pumps can be stored without preservation.

⚠ WARNING**Risk of contamination when pumping pumped fluids that can be dangerous to health and the environment**

Pumped fluids that can be dangerous to health and the environment can chemically burn, poison or otherwise injure persons and damage the environment.

- Completely decontaminate the pump prior to preservation.
-

⚠ WARNING**Risk of contamination due to corrosion protection agents that can be dangerous to health and the environment**

Corrosion protection agents that can be dangerous to health and the environment can chemically burn, poison or otherwise injure persons and damage the environment.

- Observe the safety data sheet.
 - Avoid direct contact with the corrosion protection agent.
 - Wear safety gloves and safety glasses.
-

⚠ CAUTION**Risk of crushing due to moving components**

When the impeller is rotating, there is a risk of crushing between moving and stationary components.

- Wear safety gloves.
-

NOTICE**Damage to the sealing elements**

Oils and greases can damage sealing elements with elastomers made of EP rubber.

- Avoid contact with oils and greases.
-

Prerequisites

- The pump has been removed, cleaned and decontaminated if necessary.
- The pump is in a horizontal position.

Procedure

1. Firmly screw in the venting screw(s) and drain screw(s).
 2. Remove the casing according to the instructions in chapter 10.3.3 Remove and install the casing, page 34.
 3. Install the casing according to the instructions in chapter 10.3.3 Remove and install the casing, page 34. In this process, evenly and sparingly apply corrosion protection agent onto all metal surfaces in the interior in stages using a brush or an atomiser.
 4. Seal the suction and pressure nozzles.
-

7 Installation

7.1 Safety during installation

Improper installation can lead to personal injury and property damage. Observe the following safety instructions.

- Installation must only be carried out by qualified and trained personnel.
- Observe the requirements for the installation location, see Chapter 7.2 Requirements for the installation location, page 20.
- Carry out installation in voltage-free condition.
- Observe the direction of flow.
- Secure the pipes and pump to prevent stumbling, and provide a safety area if necessary.
- Pay attention to noise emissions and fit soundproofing if necessary.

Observe the approved installation position, see figure. Any other installation position requires the approval of the manufacturer. Improper installation results in the risk of leaks at the feed lines and the risk of tearing off the pipe.

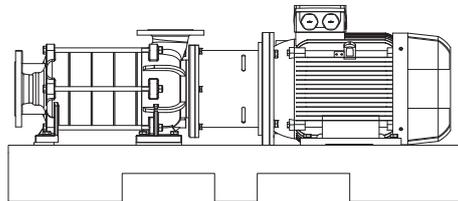


Fig. 7-1 Approved installation position

7.2 Requirements for the installation location

The installation location must meet the following requirements:

- The atmosphere must not be explosive.
- The installation location should be dust-free and not corrosive.
- The pump must be freely accessible for monitoring, servicing, maintenance, installation and removal.
- A sufficient air supply must be ensured for cooling the motor. The motor fan must not be blocked. Impermissible heating can cause damage to the motor.
- The pump must be protected against environment influences such as wind, rain, frost or sand.

The foundations must meet the following requirements:

- The foundations must be horizontal, flat, clean and free of oil.
- The foundations must be able to absorb the deadweight of the pump assembly and all operating forces.
- They must be sufficiently strong to ensure a functional set-up.
- Structural stability must be guaranteed during operation.

7.3 Requirements for the pipe system

The criteria listed in the following must be observed when designing the pipe system to ensure trouble-free and efficient pump operation:

- Route pressure and suction lines as per the respectively valid regulations and the relevant accident prevention regulations.
- Do not place strain on the pump due to the weight of the pipes.
- Never use the pump as a point for fixing the pipes.
- The pipe system must not cause any forces or torques (torsion, thermal expansion) to act on the pump that are higher than the permissible forces and torques, see Chapter 7.4 Permissible forces and torques, page 22.
- Provide suitable compensators to reduce the stresses that occur due to temperature fluctuations and vibrations.
- Provide slide gate valves close to the pump in the pressure and suction lines for maintenance work.
- Provide a non-return valve to avoid reverse flows.
- Providing a foot valve in the suction line for self-priming pumps during suction mode is recommended to prevent the pump and suction line from running empty during standstill.
- Use a suction strainer or filter to keep impurities in the pumped fluid away from the pump. No air from the fluid level or swirled-up dirt from the 'sump' may enter the suction line via the suction strainer in this case. Regularly clean the suction strainer and filter.
- Dimension the rated pipe widths comparatively large. Using rated widths that correspond at least to those of the pump connections is recommended.
- Design fittings so that they constrict the full pipe cross-section as little as possible.
- Always design the suction line as short and straight as possible in order to minimise pressure losses and achieve a high $NPSH_A$.
- Route the suction line without raised points in order to avoid gas accumulations.

- Position unavoidable pipe bends on one level only in order to avoid extensive pipe flow turbulence.
- Wherever possible, design cross-section extensions with an extension angle of $< 8^\circ$ to minimise pressure losses and prevent flow separation.
- Provide a straight pipe section with a length that is five times the inner diameter of the suction flange as a settling section between the suction flange and upstream fittings, cross-section changes or pipe deflections in order to avoid additional pressure losses and cavitation in the event of flow onto the pump impeller. Shorter settling sections are possible but can affect the hydraulic performance of the pump and/or lead to cavitation.
- Route the suction line to the pump with a descent of at least 10° for admission mode, and an ascent of at least 10° for suction mode, to avoid air pocket formation.
- Guarantee that the fluid level in the suction vessel is located a vertical distance of at least four times the inner diameter of the suction line above the inlet into the suction line in order to avoid air-sucking surface vortices.
- Round the transition from the suction vessel to the suction line or provide it with a chamfer to avoid cavitation in the pump inlet. This particularly applies in the case of pumped fluids that are close to or in boiling state.
- In the case of a pumped fluid that is close to or in boiling state, first route the suction line downstream of the suction vessel downwards over the longest possible section in order to prevent pumped fluid degassing.

7.4 Permissible forces and torques

The force and torque data apply to static pipe loads.

i	Information
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Forces and torques for materials that are not listed will be provided on request.

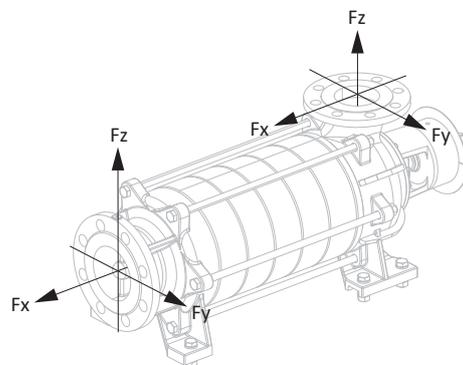


Fig. 7-2 Permissible forces and torques

Forces and torques for cast iron (0.6025) at 20°C

Pressure fitting						Suction nozzle					
Forces [N]						Forces [N]					
∅ DN	F _y	F _z	F _x	∑F*	∑M*	∅ DN	F _y	F _z	F _x	∑F*	∑M*
100	945	1175	1050	1840	910	125	1245	1120	1380	2170	1067

*∑F and ∑M are vector sums of the forces and torques

Tab. 7-1 Forces and torques for cast iron

7.5 Requirements for the electrical connection

The following requirements must be observed when connecting the motor:

- To protect the pump and the motor, always install overload protection, e.g. a motor circuit breaker. Operation without overload protection is impermissible.
- Observe the connection values and circuit type on the motor type plate. The specified voltage must not be exceeded.
- Earth the pipes and pump.

Information

The power must be reduced as specified by the motor supplier if the pump is operated at ambient temperatures over 40°C or at installation heights over 1000 m (above MSL).

Tightening torques for terminal board connections on the motor

Thread	Tightening torque [Nm]
M4	0.8 to 1.2
M5	1.8 to 2.5
M6	2.7 to 4.0
M8	5.5 to 8.0
M10	9.0 to 13.0
M12	14.0 to 20.0
M16	27.0 to 40.0

Tab. 7-2 Tightening torques depending on the thread

7.6 Complete pump

Upon delivery of the expansion stages L and G, the pumps need to be completed before installation.

In all cases, the pump and motor must be mounted on a common base plate.

7.6.1 Requirements for the base plate

Base plates provided by the customer must meet the following requirements.

The base plate and the pump support should be configured so that the forces and torques occurring can be absorbed, see Chapter 7.4 Permissible forces and torques, page 22. The configuration needs to ensure that the maximum offset values between the motor and pump shaft are observed. Misalignment due to mechanical forces – for example, heat expansion or hydraulic pipeline thrust – has to be minimised as far as possible.

The base plate must cover the area under the support structure of the pump and motor. The underside of welded base plates must be reinforced under the pump and motor mount with cross members that are welded on.

7.6.2 Mount motor

If the pump is delivered without a motor, a motor must be installed first. The motor must fulfil the requirements from the data sheet of the offer. If you are uncertain which to choose, contact the manufacturer.

Vertical installation is described in the following section.

WARNING

Weight of the pump and the motor

There is a risk of crushing and abrasions during installation.

- Note the weight of the pump and the motor.
 - Transport the pump and motor using suitable lifting equipment.
 - Wear protective gloves and safety shoes.
 - Secure the pump and the motor to prevent them from tipping during installation.
-

NOTICE

Improper installation

The pump can be damaged due to improper installation.

- Ensure for cleanliness during installation. No particles may enter the magnetic coupling. Keep all contact surfaces clean and free from foreign objects.
- Do not scratch contact surfaces.

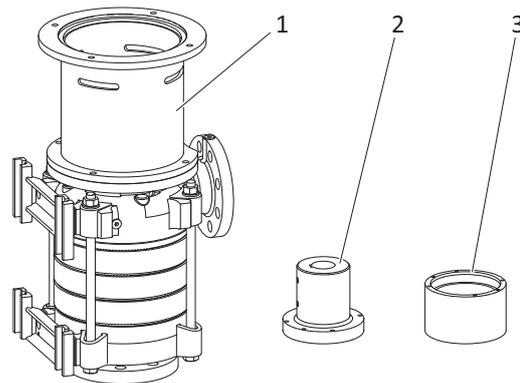


Fig. 7-3 Delivery state

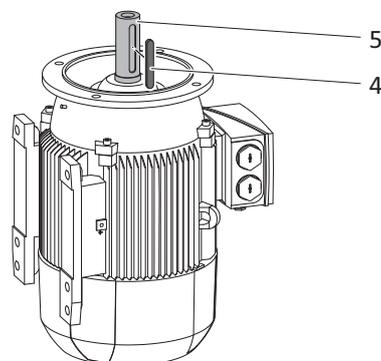
- 1 Pump with mounted pump-side half of the coupling (inner rotor of the magnetic coupling) and lantern
- 2 motor-side half of the coupling including screws
- 3 Outer rotor of the magnetic coupling including screws

i Information

Screws, washers and possibly nuts for fastening to the motor flange must be provided by the customer. The key for the motor shaft is included in the scope of delivery of the motor.

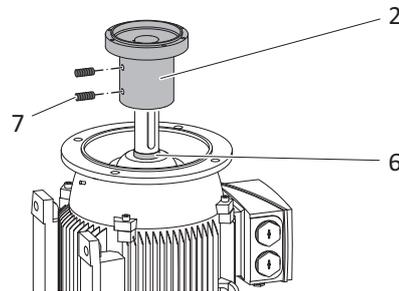
Procedure

1. Place the motor onto a firm, level surface as shown in the figure.



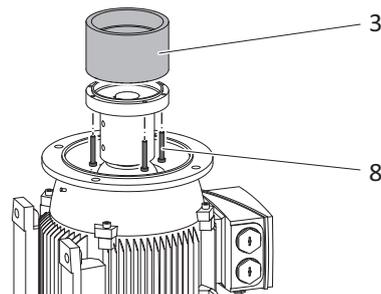
2. If a coupling is already on the motor shaft, remove it.
3. Press key **(4)** into the key groove of the motor shaft **(5)**.

- Position the motor-side half of the coupling **(2)**. Make sure that the coupling half lies on the motor shaft collar **(6)**.

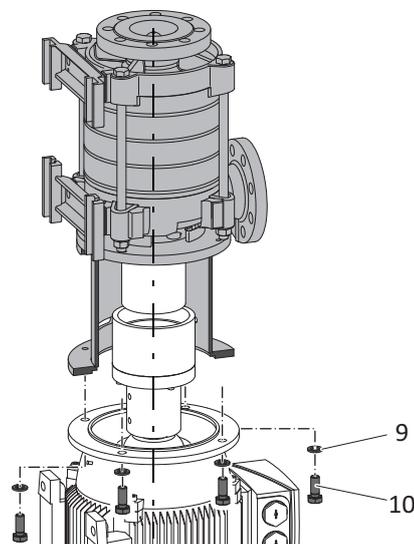


- Coat the threaded pin **(7)** with medium-strength screw locking fluid (e.g. Weicon AN302-43), screw in and tighten it.
- ATTENTION!** Do not use force, or any hammer blows. There is a risk of breaking or damaging the magnets.

Put on outer rotor **(3)**. Coat the screws **(8)** with medium-strength screw locking fluid (e.g. Weicon AN302-43) and screw in. Only tighten the screws slightly at first.



- Tighten the opposite screws **(8)** in each case. Observe tightening torques, see Chapter 10.3.1 Tightening torques, page 33.
- Lift the pump using suitable lifting gear and place it centred on the motor as shown in the figure. Ensure that the pump and motor feet are aligned.



9. Screw the pump and motor with the screws **(10)** and the washers **(9)**. Only tighten the screws slightly at first.
10. Tighten the opposite screws **(10)** in each case. Observe tightening torques, see Chapter 10.3.1 Tightening torques, page 33.

7.7 Installing the pump

WARNING

Weight of the pump

There is a risk of crushing and abrasions during installation.

- Note the weight of the pump.
- Transport the pump using suitable lifting equipment.
- Wear protective gloves and safety shoes.

NOTICE

Checking the direction of rotation without pumped fluid

Operation without a pumped fluid is impermissible. Dry running for even a short time to check the direction of rotation can damage the magnet coupling.

- Fill and ventilate the pump before checking the direction of rotation.

Prerequisite

- Corrosion protection agent has been removed if necessary.
- Flange covers have been removed.
- The pump and motor are mounted on a common base plate.
- The system is voltage-free and secured to prevent reactivation.
- There are no foreign objects in the pump.

Procedure

1. Position the pump at the installation location.
2. Align the pump.
3. Bolt the base plate to the foundation.
4. If the pump housing has two pump feet, loosen the pump foot from the suction casing. This prevents thermally related tensions.
5. Connect pipes.
6. Connect the motor according to the wiring diagram.
7. Protect cable glands to prevent dust and moisture from entering.
8. For this purpose, mount the potential equalization to the intended earth connection.

9. Fill and ventilate the pump.
10. Check the direction of rotation.

Briefly switch on the motor and immediately switch it off again. Monitor the direction of rotation of the fan impeller. The direction of rotation must correspond to the direction of rotation arrow. If the direction of rotation is incorrect, check the electrical connection on the motor, and also check the switchgear if necessary.

8 Removal

8.1 Safety during removal

Improper removal can lead to personal injury and property damage. Observe the following safety instructions.

- Removal must only be carried out by qualified and trained personnel.
- Carry out removal in voltage-free and unpressurised condition.
- Observe the statutory regulations when pumping pumped fluids that can be dangerous to health and the environment.
- Carry out removal carefully. Do not use force.

8.2 Removing the pump

⚠ WARNING**Weight of the pump**

There is a risk of crushing and abrasions during removal.

- Note the weight of the pump.
 - Transport the pump using suitable lifting equipment.
 - Wear protective gloves and safety shoes.
 - Secure the pump to prevent it from tipping during removal.
-

⚠ WARNING**Risk of contamination when pumping pumped fluids that can be dangerous to health and the environment**

Pumped fluids that can be dangerous to health and the environment can chemically burn, poison or otherwise injure persons and damage the environment.

- Avoid direct contact with the pumped fluid.
 - Wear personal protective equipment. If necessary, wear a protective mask.
 - Collect escaping pumped fluid and dispose of it properly.
 - Decontaminate and flush the pipe system and pump.
-

Prerequisites

- The system/pump is switched off and depressurised.
- The pipe system and pump have been flushed and decontaminated if necessary.
- The pump is at ambient temperature.

Procedure

1. Close the slide gate valves in the pressure and suction lines.
2. Switch off the pump's voltage and secure it to prevent reactivation.
3. Disconnect the electrical connections and secure the cable ends.
4. Remove the earthing from the pump.
5. Place a collection container for collecting the pumped fluid or the flushing fluid beneath the pump.
6. Unscrew the drain screw.
7. Unscrew the venting screw.
8. Drain the pumped fluid or flushing fluid into a collection container.
9. Screw in the drain and venting screws.
10. Release the pressure-side flange connection.
11. Release the suction-side flange connection.
12. If present, release the fasteners on the foundation.
13. Lift the pump with the motor out from the pipe system.
14. Place the pump down on a horizontal, firm surface and secure it to prevent tipping.
15. Preserve the pump if it is stored for a long time, see Chapter 6.3 Preserving the pump, page 18.

9 Operation

9.1 Safety during operation

- Only operate the pump in flawless condition. Immediately shut off the system and secure it to prevent reactivation in the event of damage, leaks, overheating, unusual vibrations and noises.
- Only operate the pump within the pipe system.
- Only operate the pump when all safety devices are installed and functional.
- The pump can become extensively heated due to pumping hot pumped fluids. Do not touch the pump during operation. Wear protective gloves when working in the vicinity of the pump.
- The pump's noise emissions can exceed the statutory limit values. Wear ear protectors when remaining in the vicinity of the running pump.
- Exceeding the permissible pressure and temperature range can lead to leaks and cause the pump to burst. Adhere to the pump's pressure and temperature range, see type plate and chapter 1.2 Applicable documents, page 5.
- In the event of a fire, a hot pump can burst due to the use of cold extinguishing agent. Do not unnecessarily cool the pump excessively when extinguishing.
- Damage to the magnetic coupling if the pump is operated without pumped fluid. Fill and ventilate the pump before commissioning it.

9.2 Initial commissioning

Prerequisite

- The pipe system and pump have been flushed.

Procedure

1. Fill the suction line and pump with pumped fluid. Ventilate the suction line and pump.
2. Completely open the slide gate valve in the suction line.
3. Completely close the slide gate valve in the pressure line.
4. Switch on the motor.

The pump now pumps against the closed slide gate valve in the pressure line.

5. Immediately after reaching the operating speed, slowly open the slide gate valve in the pressure line and regulate the operating point.

9.3 Operation

The pump is usually controlled by the overall system's central control system. The following points must be taken into consideration during operation:

- Regulating the pump output via the suction-side slide gate valve can cause damage to the pump and the shaft seals. Regulate the pump output exclusively using the pressure-side slide gate valve.
- If the slide gate valve in the pressure line is closed abruptly or for a long time during operation, this can lead to pressure surges in the pump and therefore to damage to the pump and/or the system. Do not close the slide gate valve in the pressure line abruptly during operation.
- Do not operate the pump against the closed slide gate valve.
- Pumps that are not required (redundancy) must be switched on 1x a week, as the impeller can otherwise seize and shaft seal leaks can develop.
- Check shut-down pumps for damage before recommissioning.

9.4 Ending operation

Procedure

1. Close the slide gate valve in the pressure line.

If a non-return valve is installed and there is sufficient back-pressure in the pressure line, the slide gate valve can remain open.

2. Switch off the pump motor.
3. Close the slide gate valve in the suction line to prevent running empty.

Drain the pump completely at temperatures below freezing or in the event of long down times.

10 Maintenance

10.1 Safety during maintenance

Improper maintenance can lead to personal injury and property damage. Observe the following safety instructions.

- Perform all maintenance work at the specified intervals.
- Maintenance work must only be carried out by qualified and trained personnel.
- When replacing components, use only original spare parts or spare parts approved by the manufacturer.

- Carry out maintenance work only when the pump has been depressurised and drained.
- Perform maintenance work in voltage-free condition. Secure the system to prevent reactivation.
- When pumping hot or very cold pumped fluids, wait until the pump has reached the ambient temperature.
- Close the slide gate valves at the suction nozzle and the pressure nozzle.
- Completely drain the pump casing before opening the pump. Collect the pumped fluid in suitable containers. Exercise particular care with pumped fluids that pose a risk to health and the environment. Wear personal protective equipment. If necessary, wear a protective mask.
- Decontaminate the pump prior to maintenance work in the case of pumped fluids that pose a risk to health and the environment. Document decontamination.
- Note the weight of the pump. There is a risk of crushing and abrasions. Use suitable lifting equipment. Wear protective gloves and safety shoes.
- Observe tightening torques, see Chapter 10.3.1 Tightening torques, page 33.

10.2 Maintenance schedule

Assembly	Maintenance activity	Interval
Pump	Check delivery data (pressure, delivery volume).	Daily
	Check pump operation (smooth, vibration-free).	Daily
	Check pump for leaks.	Daily
	Check that screws are firmly seated, tighten if necessary, see Chapter 10.3.1 Tightening torques, page 33. WARNING! Check only when the pump has been switched off.	Every 6 months
Motor	Check power consumption.	Daily
	Check shaft bearings (temperature, vibrations).	Daily
	Exchange shaft bearings.	After 20,000 hours of operation, but after 3 years at the latest
Pump and motor	Remove dust, dirt and deposits. WARNING! Clean only when the pump has been switched off.	Depending on the degree of soiling

Tab. 10-1 Maintenance activities and intervals

10.3 Maintenance work

10.3.1 Tightening torques

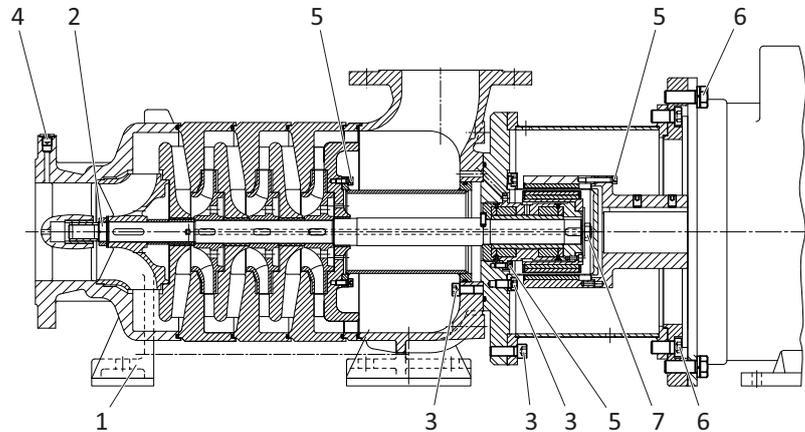


Fig. 10-1 Tightening torques

Item	Thread	Tightening torque [Nm]
1	M16	200
2	M26 × 1.25	55
3	M10	30
	M12	60
4	G $\frac{1}{4}$	20
5	M6	10
6	M8	20
	M10	30
	M12	60
	M16	75
7	M16 × 1.5	20

Tab. 10-2 Tightening torques depending on the thread

10.3.2 Exchanging shaft bearings

Defective and worn shaft bearings lead to consequential damage. Vibrations, increased noise emissions and increased power consumption with otherwise constant operating conditions indicate wear.

The temperature of the shaft bearing must not exceed 90°C (measured at the motor, outer side, and on the pump bearing housing).

The shaft bearings have lifetime lubrication, are maintenance-free and cannot be re-lubricated. Under normal operating conditions, the shaft bearings should be exchanged after 20,000 hours of operation, but after 3 years at the latest. In the case of high ambient temperatures, corrosive or very dusty environments, the

shaft bearings must be checked more frequently and exchanged earlier if necessary.

To exchange the shaft bearings, contact the motor manufacturer or commission a specialist workshop.

10.3.3 Remove and install the casing

The removal and installation of the casing is similar on all pumps. The example shown here can be applied to all pumps. Refer to the spare part drawing for the specific design.

The numbers in **bold** print in the legend correspond to the part numbers on the spare part drawing.

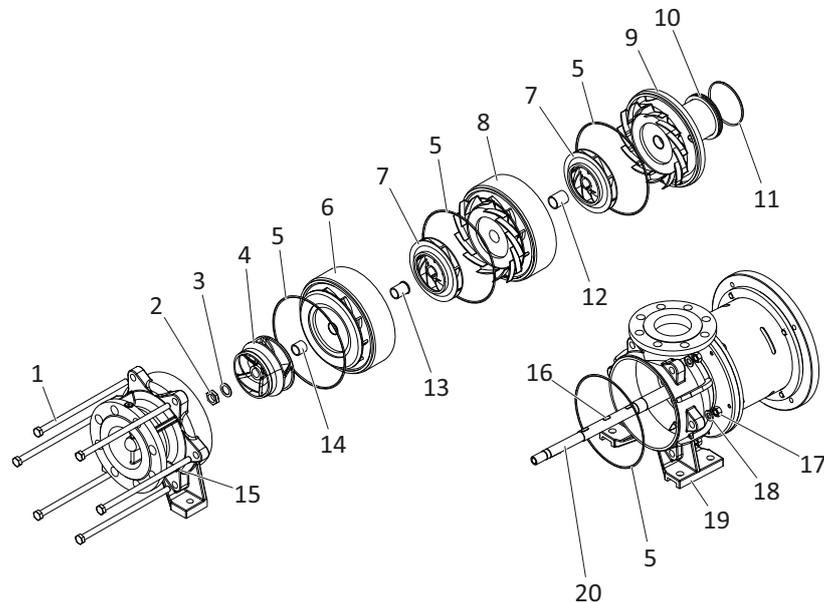


Fig. 10-2 Remove and install the casing, example

- 1 **905** Connecting screw
- 2 **922** Impeller nut
- 3 **930** Tooth lock washer
- 4 **230.1** Impeller
- 5 **412** O-ring
- 6 **108** Stage casing
- 7 **730** Impeller
- 8 **108** Stage casing
- 9 **117** End stage casing
- 10 **712** Intermediate pipe
- 11 **412** O-ring
- 12 **525.1** Spacer sleeve
- 13 **525** Spacer sleeve
- 14 **545** Spacer sleeve
- 15 **106** Suction casing
- 16 **940** Key
- 17 **920** Nut
- 18 **554** Washer
- 19 **107** Delivery casing
- 20 **210** Shaft

Remove the casing

NOTICE

Improper removal

Improper removal can cause damage to the sealing surfaces.

- Work with particular caution.
- Avoid damaging the sealing surfaces.

To remove the casing, the pump should be positioned vertically on the motor and secured to prevent tipping.

Prerequisite

- The pump has been cleaned and decontaminated if necessary.
- The pump has been separated from the base plate.
- NOTE! Only applies to vertical removal. The pump is standing vertically and is secured to prevent tipping.

Procedure

1. Release the connecting screws **(1)** and remove the suction casing **(15)**.
2. Remove the O-ring **(5)**.
3. Unscrew the impeller nut **(2)** and remove together with the tooth lock washer **(3)**.
4. Remove the impeller **(4)**.

Screw forcing bolts into the threaded holes to release the impeller if it is seized.

NOTE! The first impeller in NHKM pumps does not have any threaded holes for forcing screws.

5. Remove the spacer sleeve **(14)**.
6. Remove the key(s) **(16)** from the shaft **(20)**.
7. Remove the stage casing **(6)**.
8. Press the spacer sleeve **(13)** out of the stage casing **(6)**.
9. Remove the O-ring **(5)**.
10. Remove the impeller **(7)**.

Screw forcing bolts into the threaded holes to release the impeller if it is seized.

11. Remove the key(s) **(16)** from the shaft **(20)**.
12. Remove the stage casing **(8)**.
13. Press the spacer sleeve **(12)** out of the stage casing **(8)**.
14. Repeat steps 9 to 13 for all other stage casings.

15. Remove the O-ring **(5)**.
16. Remove the impeller **(7)**.
Screw forcing bolts into the threaded holes to release the impeller if it is seized.
17. Remove the key(s) **(16)** from the shaft **(20)**.
18. Remove the end stage casing **(9)** together with the intermediate pipe **(10)**.
19. Remove the O-ring **(5)**.

Installing the casing

To install the casing, the pump should be positioned vertically on the motor and secured to prevent tipping.

Prerequisite

- The sealing elements and sealing surfaces do not reveal any damage and have been cleaned.

Procedure

1. Set up the pump vertically and secure to prevent tipping.
2. First stretch the new O-rings **(5 + 11)** and insert them into the O-ring grooves in the end stage casing **(9)** and in the intermediate pipe **(10)**.
3. Place the end stage casing **(9)** together with the intermediate pipe **(10)** on the delivery casing **(19)**.
4. Press the key **(16)** into the key groove located directly on the delivery casing.
5. Push the impeller **(7)** onto the shaft **(20)**.

NOTE! Depending on the number of stages, the design can also consist of just the end stage casing. In this case, installation is continued with step 18.
6. First stretch the new O-ring **(5)** and insert it into the O-ring groove of the stage casing **(8)**.
7. Place the stage casing **(8)** onto the end stage casing **(9)**.
8. Insert the spacer sleeve **(12)** into the stage casing **(8)**.
9. Press a further key **(16)** into the next key groove.
10. Push a further impeller **(7)** onto the shaft **(20)**.
11. Repeat steps 6 to 10 for each additional stage casing.
12. First stretch the new O-ring **(5)** and insert it into the O-ring groove of the stage casing **(8)**.
13. Insert the spacer sleeve **(13)** on the rear side of the stage casing **(6)**.
14. Place the stage casing **(6)** on the stage casing **(8)**.

15. Push the spacer sleeve **(14)** over the shaft **(20)** until it rests on the spacer sleeve **(13)**.
16. Press a further key **(16)** into the next key groove.
17. Push the impeller **(4)** onto the shaft **(20)**.
18. First stretch the new O-ring **(5)** and insert it into the O-ring groove of the suction casing **(15)**.
19. Place the suction casing **(15)** onto the stage casing **(6)** or the end stage casing **(9)**.
20. Screw in the connecting screws **(1)** with washers **(18)** and nuts **(17)** and only tighten slightly at first.
21. Tighten the opposite connecting screws in each case. Observe tightening torques, see Chapter 10.3.1 Tightening torques, page 33.

11 Faults

11.1 Safety during fault rectification

Improper fault rectification can lead to personal injury and property damage. Observe the following safety instructions.

- Fault rectification must only be carried out by qualified and trained personnel.
- When replacing components, use only original spare parts or spare parts approved by the manufacturer.
- Carry out fault rectification only when the pump has been depressurised and drained.
- Carry out fault rectification in voltage-free condition. Secure the system to prevent reactivation.
- When pumping hot or very cold pumped fluids, wait until the pump has reached the ambient temperature.
- Before opening the pump, close the slide gate valve at the suction nozzle and the pressure nozzle.
- Completely drain the pump casing before opening the pump. Collect the pumped fluid in suitable containers. Exercise particular care with pumped fluids that pose a risk to health and the environment. Wear personal protective equipment. If necessary, wear a protective mask.
- Decontaminate the pump prior to fault rectification in the case of pumped fluids that pose a risk to health and the environment. Document decontamination.

11.2 Fault table

Contact the manufacturer in the event of faults that are not listed here.

Fault	Cause	Fault rectification
Pump blocked	Bearing damage on the motor shaft	– Exchange shaft bearings.
	Impeller blocked	– Remove deposits and foreign objects from the interior of the pump.
Head/delivery rate too low	Pump and/or suction line not completely ventilated or filled	– Ventilate and fill pump and/or suction line.
	Suction head too high/system NPSH value too low	– Completely open the slide gate valve in the suction line. – Check the foot valve/suction strainer. – Increase the fluid level if necessary.
	Gas content in the pumped fluid too high	– Re-seal the suction line. – Check the suction strainer. – Increase the fluid level if necessary.
	Air pocket formation in the suction line	– Change the suction line. – Install a vent valve.
	Incorrect direction of rotation	– Check the electrical connection, change if necessary.
	Pump component wear	– Exchange components.
	Rotational speed too low	– Contact the manufacturer.
	Density/viscosity of the pumped fluid higher than specified in the order confirmation	– Contact the manufacturer.
Pump not running smoothly	Suction head too high/system NPSH value too low	– Completely open the slide gate valve in the suction line. – Check the foot valve/suction strainer. – Increase the fluid level if necessary.
	Air pocket formation in the suction line	– Change the suction line. – Install a vent valve.
	Pump running outside of the characteristic curve	– Re-regulate the operating point.
	Forces from the pipe system are acting on the pump	– Check pipe connections, the pump fastening and the pipe clamp mounting spacing, and correct if necessary.
Leaks on casing parts	Connecting screws loosened	– Tighten the connecting screws.
	Casing seal(s) worn or defective	– Renew casing seal(s).

Fault	Cause	Fault rectification
Drive overloaded	Pump running outside of the characteristic curve	– Re-regulate the operating point.
	Rotational speed too high	– Contact the manufacturer.
	Density/viscosity of the pumped fluid higher than specified in the order confirmation	– Contact the manufacturer.
No pumping despite the motor running	Maximum torque of the magnetic coupling exceeded, the magnetic coupling is "torn off"	– Switch off the pump and wait until standstill. Then switch the pump on again.
Motor protection tripping	Pump running outside of the characteristic curve	– Re-regulate the operating point.
	Rotational speed too high	– Contact the manufacturer.
	Density/viscosity of the pumped fluid higher than specified in the order confirmation	– Contact the manufacturer.
	Motor protection device not set correctly or defective	– Check the motor protection device, exchange if necessary.
Pump becomes hot	Suction head too high/system NPSH value too low	– Completely open the slide gate valve in the suction line. – Check the foot valve/suction strainer. – Increase the fluid level if necessary.
	Gas content in the pumped fluid too high	– Re-seal the suction line. – Check the suction strainer. – Increase the fluid level if necessary.
	Air pocket formation in the suction line	– Change the suction line. – Install a vent valve.
	Delivery rate too low	– Re-regulate the operating point.

Tab. 11-1 Causes and rectification of faults

12 Disposal

12.1 Safety during disposal

Improper disposal can lead to personal injury and property damage. Observe the following safety instructions.

- Disposal must only be carried out by qualified and trained personnel.
- Decontaminate the pump prior to disposal in the case of pumped fluids that pose a risk to health and the environment. Document decontamination.

- Note the weight of the pump and the individual components. There is a risk of crushing and abrasions. Use suitable lifting equipment. Wear protective gloves and safety shoes.
- Observe the statutory regulations concerning the disposal of industrial waste.

12.2 Disposing of the pump

Prerequisite

- The pump has been cleaned thoroughly and decontaminated if necessary.

Procedure

1. Properly disassemble the pump.
2. Separate components according to materials, e.g.:
 - Metal
 - Plastic
 - Electrical scrap
 - Greases and lubricants
3. Dispose of components according to local specifications or send for controlled disposal. Send reusable materials for recycling.

12.3 Returning

If necessary, the pump can be sent to the manufacturer for maintenance. The address can be found on the cover of these operating instructions.

Prerequisite

- The pump has been cleaned thoroughly and decontaminated if necessary.

Procedure

1. Fill in the certificate of unobjectionability completely.
2. Properly seal the pump openings.
3. Package the pump on a pallet for safe transport.
4. Send the pump and the certificate of unobjectionability to the manufacturer.

 Information

Pumps without a certificate of unobjectionability will not be opened by the manufacturer.

13 Annex

13.1 Content of the declaration of conformity

EC declaration of conformity
according to EC Machinery Directive 2006/42/EC, Annex II, 1 A

We,

EDUR-Pumpenfabrik
Eduard Redlien GmbH & Co. KG
Edisonstraße 33
24145 Kiel
Germany

hereby declare that the machine designated in the following complies with the fundamental health and safety requirements of the EC Directive.

Designation of the machine:

NHM 100
NHKM 100

The precise type designation is located on the pump type plate.

Model designation and factory number, see cover sheet.

Applied harmonised standards:

DIN EN ISO 12100:2011
DIN EN 809:2012

Representative for compiling the relevant technical documents:

Tjark Kaeding (Head of Technical Department)
EDUR-Pumpenfabrik, Edisonstraße 33, 24145 Kiel, Germany

13.2 Content of the declaration of incorporation

Declaration of incorporation according to EC Machinery Directive 2006/42/EC, Annex II, 1 B

We,

EDUR-Pumpenfabrik
Eduard Redlien GmbH & Co. KG
Edisonstraße 33
24145 Kiel
Germany

that the incomplete machine designated in the following:

Designation of the machine:

NHM 100
NHKM 100

The precise type designation is located on the pump type plate.

Model designation and factory number, see cover sheet.

the following fundamental requirements of EC Machinery Directive 2006/42/EC, Annex I, are contained:

1.1.1.; 1.1.2.; 1.1.3.; 1.1.5.

Applied harmonised standards:

DIN EN ISO 12100: 2011
DIN EN 809: 2012

This incomplete machine may only be commissioned when it has been determined that the machine into which this incomplete machine is to be incorporated complies with the provisions of the Machinery Directive.

Representative for compiling the relevant technical documents:

Tjark Kaeding (Head of Technical Department)
EDUR-Pumpenfabrik, Edisonstraße 33, 24145 Kiel, Germany

13.3 Certificate of unobjectionability

The certificate of unobjectionability can also be downloaded in the service area of the EDUR homepage, www.edur.com.

CERTIFICATE OF UNOBJECTIONABILITY

Please complete this form in detail and attach it to the pump to be repaired.

This certificate of unobjectionability being sent by us, the signer, with the pump and its component parts for inspection-/repair order,

Model: Serial number: Date of delivery:

Reason for inspection-/repair order: Range of application: Pumped medium:

was **not** used for / in liquids hazardous to health or environment. Before dispatch / delivery the pump was drained carefully and cleaned inside and outside. During further handling particular safety measures will not be necessary.

was used for / in liquids hazardous to health or environment.

Before dispatch / delivery the pump was drained carefully and cleaned inside and outside. During further handling particular safety measures will **not** be necessary.

Before dispatch / delivery the pump was drained carefully and cleaned inside and outside. Following safety measures will be necessary with regard to the pumped liquid and rinsing liquids:

Please attach the safety data sheet.

We confirm that the before mentioned information is correct and complete and that the dispatch / delivery is made according to the legal requirements.

Company name and address:

Phone: Telefax: E-Mail:

Name: Position:

Date: Company stamp/Signature:

Please use this delivery address for shipping units to us:

EDUR-Pumpenfabrik Eduard Redlien GmbH & Co. KG • Marie-Curie-Straße 15 • 24145 Kiel, Germany

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