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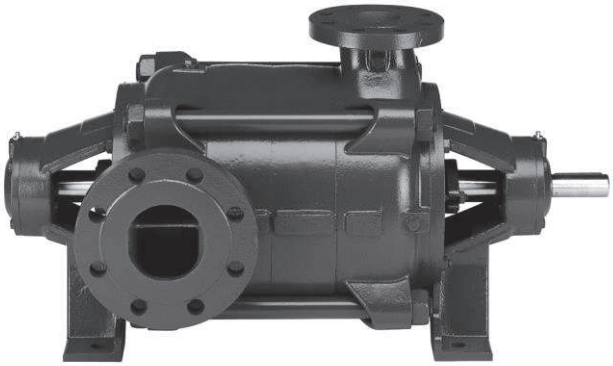

Original Operating Manual

NMH/NMV High-Pressure Centrifugal Pump

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1 General

1.1 About this operating manual

This operating manual contains important instructions that must be observed during installation, operation and maintenance. For this reason, ensure that it is read by specialist personnel and the responsible operator/owner prior to assembly and commissioning. The manual must be available at all times at the location where the system is used.

Please observe the safety instructions described in this operating manual, along with the relevant national accident prevention regulations and any internal work, operational and safety specifications of the operator. We assume no liability for damages and operational interruptions resulting from non-observance of this operating manual.

⚠ WARNING

Pay particular attention to section 2 "Safety instructions" during commissioning and all maintenance work.

Section 2 also provides an explanation of the symbols used in this manual. Knowledge of this operating manual is essential to preventing errors and ensuring safe and uninterrupted operation.

The operating specification does not take local safety regulations into account. The owner bears full responsibility for compliance with these, including on the part of the assembly personnel used.

This operating manual:

- is part of the pump
- is valid for all type series mentioned
- describes safe and proper use in all phases of operation

1.2 Target groups

Target group	Task
System owner	► Ensure that this manual is available at the location where the system is used, including for later reference. ► Ensure that personnel read and observe this operating manual and the other valid documents, in particular the safety and warning information. ► Observe additional system-related regulations and specifications.
Specialist personnel, assembly staff	► Read, observe and follow this operating manual and the other valid documents, in particular the safety and warning information.

Table 1: Target groups and their tasks

1.3 Other valid documents

Document	Purpose
Installation diagram	Installation dimensions, connection dimensions, etc.
Spare parts list	Ordering spare parts
Clearance certificate	Returning the pump
Declaration of conformity	Conformity with standards, content of the declaration of conformity

Table 2: Other valid documents and their purposes

1.4 Warning notices and symbols

Warning notice	Hazard level	Consequences of non-observance
⚠ **DANGER**	Immediate hazard	Death, severe physical injury
⚠ **WARNING**	Potential hazard	Death, severe physical injury
⚠ **CAUTION**	Potentially dangerous situation	Minor physical injury
NOTICE	Potentially dangerous situation	Material damage
	Additional information on explosion protection	Death, minor to severe physical injuries, material damage

Table 3: Warning notices and consequences of non-observance

Symbol	Meaning
	Safety sign ► Follow all instructions identified with safety signs in order to avoid death or injuries.
►	Instruction
1. , 2. , …	Instruction with multiple steps
✓	Condition
→	Reference
	Information, note

Table 4: Symbols and their meanings

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2 Safety

Observe the additional instructions for pumps in areas at risk of explosion.

The manufacturer shall not bear any liability for damages caused as a result of non-observance of this documentation.

2.1 Correct and proper use

- Only use this pump for the purposes of conveying the agreed pumping media.
- Comply with operating limits.
- The water may not contain any abrasive or long-fibered components that may damage the pump materials. Consult the manufacturer if using other media.
- Ensure that the pump is only commissioned with pumping medium and is not operated without it.
- Open the suction-side fitting, and do not use it to control the flow rate.
- To avoid damaging the motor, observe the permitted number of times per hour that the motor can be switched on (→ Manufacturer information).
- Any other use must be agreed with the manufacturer.
- The temperature of the pumping medium must not exceed 140 °C.

Avoiding obvious misuse (examples)

- Observe the operating limits of the pump for temperature, pressure, flow rate and speed.

The use of pumps in ATEX zones is subject to additional specifications related to correct and proper use!

► Do not operate the pump:

- when the fittings are closed
- when the operating range is exceeded (→ data sheet)
- when maintenance intervals are exceeded

→ 9.1.1 Safety, pg 55

The main areas of use are:

- Pressure boosting systems, heating systems, hot and cold water circulation, water supply systems, power stations, filtering systems, filling and emptying of tanks, water circulation in pools and sprinkler systems
- Fresh water, drinking water, boiler feed water, process water, sea and brackish water, hot water, condensate and many media without aggressive components that do not chemically corrode the materials used in the pump

Do not operate the pump without pumping medium. Dry running can lead to damage to the pump.

⚠ WARNING

Any use that goes beyond the purposes described above shall be considered improper use. OSNA shall bear no liability for any resulting damages. The owner bears full risk for improper use.

2.2 General safety instructions

Please observe the following specifications before performing any activities.

2.2.1 Product safety

This pump is constructed according to the latest state of the art and accepted safety rules. Nevertheless, risks to life and limb for the user or third parties are still possible when using the pump, as are impairments to the pump and other material assets.

- Only use the pump in a technically perfect state and for the intended purpose. Ensure compliance with this operating manual and be aware of the hazards and safety issues during operation.
- Keep this operating manual and all other valid documents in a complete and legible state, and store in a location that is accessible at all times to personnel.
- Do not permit any activity that endangers personnel or uninvolved third parties.
- In the event of a safety-relevant fault, stop the pump immediately and have the fault rectified by responsible personnel.
- In addition to this documentation, ensure compliance with the statutory or other regulations for safety and accident prevention, as well as the relevant standards and specifications of the respective country.
- Do not remove any technical stickers.

2.2.2 Duties of the system owner

Safety-conscious work

Observe the safety specifications detailed in this operating manual, along with the occupational safety regulations and all additional internal safety regulations.

- Only use the pump in a technically perfect state and for the intended purpose. Ensure compliance with this operating manual and be aware of the hazards and safety issues during operation.
- Ensure compliance and monitoring:
  - correct and proper use
  - statutory or other safety and accident prevention regulations
  - safety specifications for handling hazardous substances
- Provide personal protective equipment.
- Do not remove contact protection during operation.
- Prevent any dangers from electrical energy (for details, please refer to the

specifications of the VDE and the local energy supplier).

- Switch off the motor during all assembly and maintenance works, and secure against reactivation.

- Only work on the system when the pump is at a standstill.

Personnel qualification

The owner of the system must ensure that the personnel tasked with working on the pump have read and understood this operating manual and all other valid documents before beginning work, in particular information on safety, maintenance and repair.

Work of any kind on the machine may only be performed when it has been completely decommissioned. Reinstall and reactivate all safety mechanisms after work.
Before restarting the machine, ensure that all necessary commissioning steps have been completed.

- Determine responsibilities, tasks and monitoring for personnel.

- Only allow work of any kind to be performed by specialist technical personnel:
  - assembly, maintenance and repair work
  - work on the electrical systems

- Only allow personnel undergoing training to perform work on the pump under the supervision of specialist technical personnel.

Safety mechanisms

- Provide the following safety mechanisms and ensure that they function correctly:
  - for moving components: contact protection for the pump, installed by the customer
  - for potential electrostatic charges: provide appropriate earthing

Guarantee

- Please consult the manufacturer before carrying out any conversions, repairs or changes during the guarantee period.
- Only use original parts or parts approved by the manufacturer.

The use of pumps in ATEX zones is subject to additional specifications related to work safety!

→ 9.1.1 Safety, pg 55

2.2.3 Duties of personnel

- Observe the information on the pump and ensure it is legible (e.g. direction of rotation arrow, fluid connection indicators).

- Do not remove the contact protection for moving parts during operation.

- Use personal protective equipment if necessary.

- Only work on the system when the pump is at a standstill.

- Switch off the motor during all assembly and maintenance works, and secure against reactivation.

- Reinstall the safety mechanisms after working on the pump according to specifications.

2.3 Dangers of non-observance of the safety instructions

- Non-observance of the safety instructions can lead to hazards to personnel, the machine and the environment.

- Non-observance of the safety instructions can also lead to the loss of any damage claims.

- In particular, non-observance can lead to the following dangers:
  - failure of important system functions
  - electrical and mechanical hazards to personnel

2.4 Unauthorized conversion and production of spare parts

Conversions or changes to the machine are only permitted following consultation with the manufacturer. Original spare parts and accessories authorized by the manufacturer help ensure safety. The manufacturer bears no liability for the consequences of the use of other parts.

2.5 Unauthorized modes of operation

The operational safety of the machine is only guaranteed when it is used for the intended purpose according to the operating manual (→ 2.1 Correct and proper use, pg 8).

Never exceed the limit values indicated in the technical data (→ Data sheet).

2.6 Special hazards

2.6.1 Explosion area

- Only use pumps with ATEX certification in areas at risk of explosion. (→ 3.1.2 Type plate, pg 13)

The use of pumps in ATEX zones is subject to additional requirements!

→ 9.1 Additional ATEX instructions, pg 55

2.6.2 Hazardous pumping media

- Observe the safety regulations for handling hazardous substances (e.g. toxic, hazardous to health).

- Use personal protective equipment when performing work on the pump.

2.6.3 Noise emissions

Conditions for measurement:

- Distance to pumping unit: 1 m
- Operation: Free of cavitation
- Motor: IEC standard motor
- Tolerance: ± 3 dB(A)

Drive power in kW	Noise emissions in dB(A)	
	1450 min^{-1}	2900 min^{-1}
0.75	50	58
1.1	53	62
1.5	55	62
2.2	56	63
3.0	58	65
4.0	60	66
5.5	64	70
7.5	65	71
11.0	68	73
15.0	69	74
18.5	69	74
22.0	70	75
30.0	71	75
37.0	72	76
45.0	73	77
55.0	73	79
75.0	74	81
90.0	74	82
110.0	75	83
132.0	76	84

Table 5: Sound pressure level

Low-noise motors can be provided if the expected noise values exceed the permitted limits.

3 Layout and function

3.1 Labeling

3.1.1 Pump type labeling

This operating manual applies to the NMH/NMV type series.

Model code:

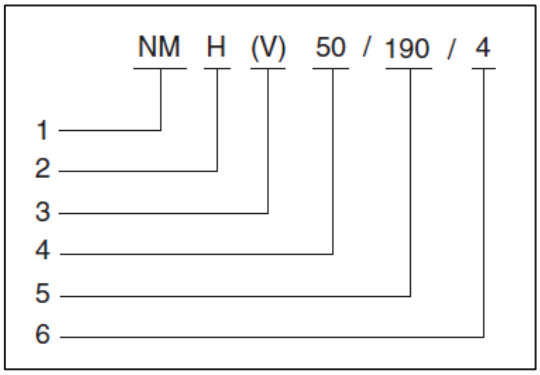

Figure 1: Model code

Key:

1	Type series
2	Horizontal configuration
3	Vertical configuration
4	Nominal diameter of discharge nozzle [mm]
5	Max. impeller diameter [mm]
6	Number of stages

3.1.2 Type plate

Standard configuration:

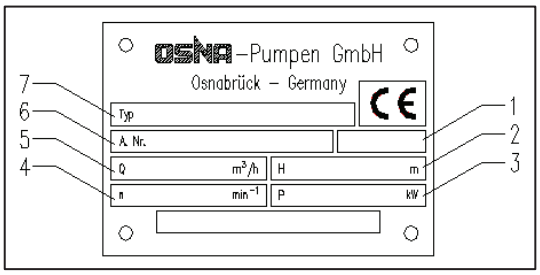

Figure 2: Standard version type plate

ATEX configuration:

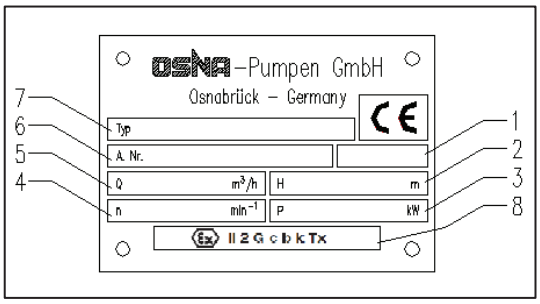

Figure 3: ATEX version type plate

Key:

1	Year of production
2	Delivery head [m]
3	Power requirements [kW]
4	Speed [min^{-1}]
5	Flow rate [m^3/h]
6	Pump number
7	Pump type
8	ATEX protection class

3.2 Scope of delivery of an NMH/NMV high-pressure centrifugal pump

The customer can order the pump:

- with a free shaft (NMH) or without motor (NMV)
- as a complete unit, i.e. fully assembled on base plate with drive motor, coupling and coupling guard

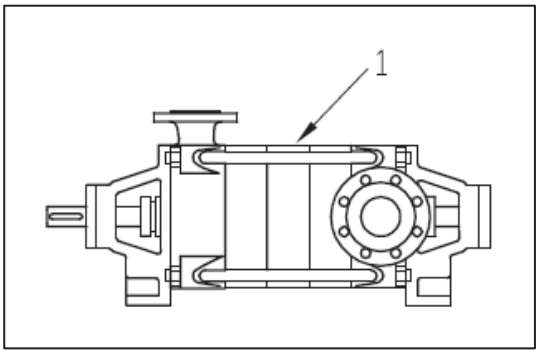

Figure 4: Scope of delivery for NMH with free shaft

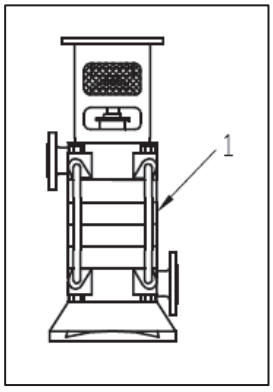

Figure 5: Scope of delivery for NMV without motor

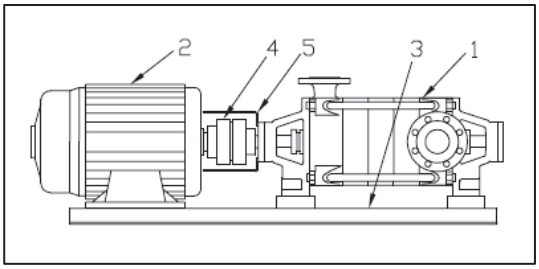

Figure 6: Scope of delivery for NMH as complete unit

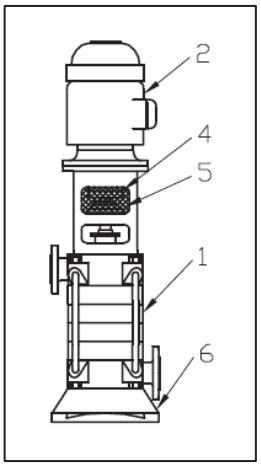

Figure 7: Scope of delivery for NMV as complete unit

Key:

1	Pump
2	Drive motor
3	Baseplate
4	Coupling
5	Coupling guard
6	Pump base

The scope of delivery corresponds to the scope indicated in the order. Please check that the delivery is complete upon receipt. Notify the delivery company of any transport damage immediately. Please also refer to our conditions of sale and delivery. If using other motor brands, please ensure that the motors have the following drive torques as a multiple of the nominal torque.

3.3 General information

The NMH/NMV pump series are non self-priming, multistage, high-pressure centrifugal pumps in horizontal and vertical configuration. The suction and discharge nozzles can be installed at different stages of 90°.

The horizontal-configuration pumps are fitted with anti-friction bearings. The vertical-configuration pumps have one anti-friction bearing (pressure side) and one plain bearing (suction side).

Both vertical and horizontal pumps can be fitted with either an uncooled mechanical seal or an uncooled gland packing.

3.4 Technical data

Main parameters:

NMH/NMV at speed = 1450 min^{-1} (gray cast iron)				
Series	Delivery head	Flow rate		
	H_{max}	Q_{min}	Q_{opt}	Q_{max}
	m	m³/h	m³/h	m³/h
32	104	1.8	8.5	12
40	110	3.75	16.0	25
50	154	5.25	30.0	35
65	198	9.75	42.0	65
80	226	15.0	65.0	100

Table 6: Main parameters at 1450 rpm

NMH/NMV at speed = 2900 min^{-1} (gray cast iron)				
Series	Delivery head	Flow rate		
	H_{max}	Q_{min}	Q_{opt}	Q_{max}
	m	m³/h	m³/h	m³/h
32	336	3.3	16.5	22
40	362	6.6	30.0	44
50	381	10.1	50.0	67
65	400	16.5	80.0	110
80	400	27	135.0	180

Table 7: Main parameters at 2900 rpm

Flange:

NMH/NMV series	Suction side		Pressure side	
	NPS	PN	NPS	PN
32	50	40	32	40
40	65	40	40	40
50	80	40	50	40
65	100	40	65	40
80	125	40	80	40

Table 8: Pump series' flange sizes

Drive unit:

NMH: 50 and 60 Hz electric motor, diesel motor or turbine

NMV: Electric motor with IEC flange, V1 configuration or hydraulic motor with special flange

3.5 Operating point

In order to reach the required operating point, it may be necessary to fit the pump with two different sizes of impeller blade. For this reason, please provide the impeller blade diameter or position on the shaft when ordering spare parts (1st, 2nd impeller, etc., beginning at the suction side of the pump).

Please always indicate the pump type and order number when ordering spare parts, or in the event of any queries.

3.6 Minimum output rates

Pump temperature range	Minimum output rate at design point
–10 to +100 °C	15% of Q_{opt}
+100 to +140°C	20% of Q_{opt}

Table 9: Minimum output rates with closed shut-off valve

3.7 Functional and operating elements

Shaft wearing sleeve:

Shaft wearing sleeve	NMH	NMV
Uncooled gland packing	Up to 110 °C	Up to 100 °C
Uncooled mechanical seal	Up to 140 °C	Up to 140 °C

Table 10: Maximum authorized operating temperature at the shaft seal

The pumps can be fitted with gland packing or mechanical seal as required.

Gland packing consists of a number of compression-molded rings in a stuffing box. Gland packings can be adjusted by hand with tools.

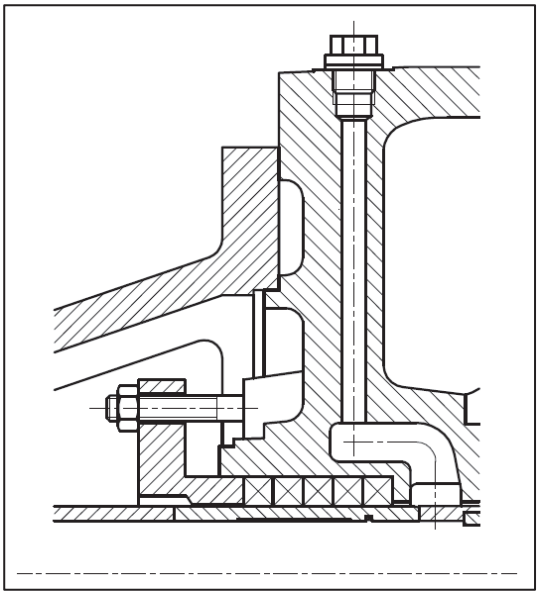

Figure 8: Gland packing

Mechanical seals are mechanical shaft seals with internal flushing of the rotating seal rings (self-adjusting).

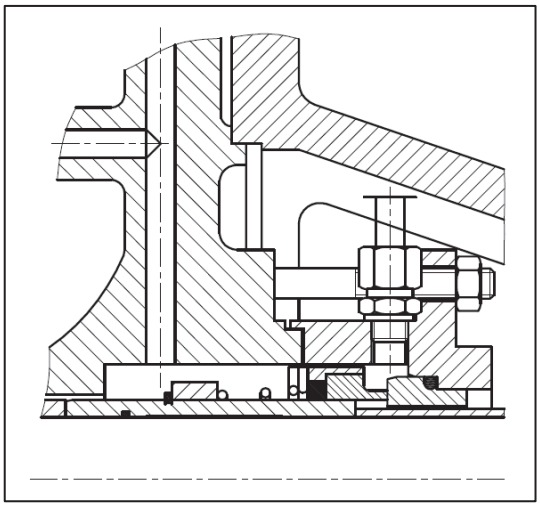

Figure 9: Mechanical seal

The technical dry running properties of gland packing and mechanical seals are extremely limited. For this reason, avoid dry running. Ensure that the pump is vented before commissioning.

3.8 Auxiliary operating systems

When blocking, the pressure of the sealing medium is higher than that of the pumping medium.

Example: Pumping media that crystallize or are laden with solid particles, and can therefore damage the seal over time.

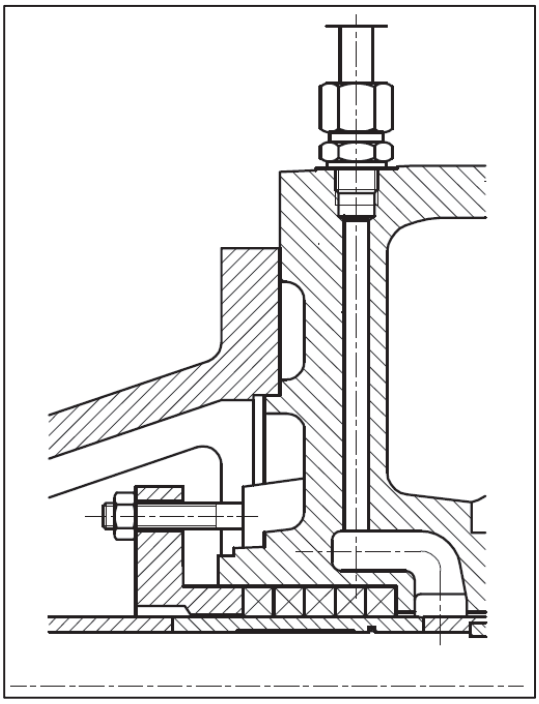

Figure 10: Pressure-side external flushing connection (optional)

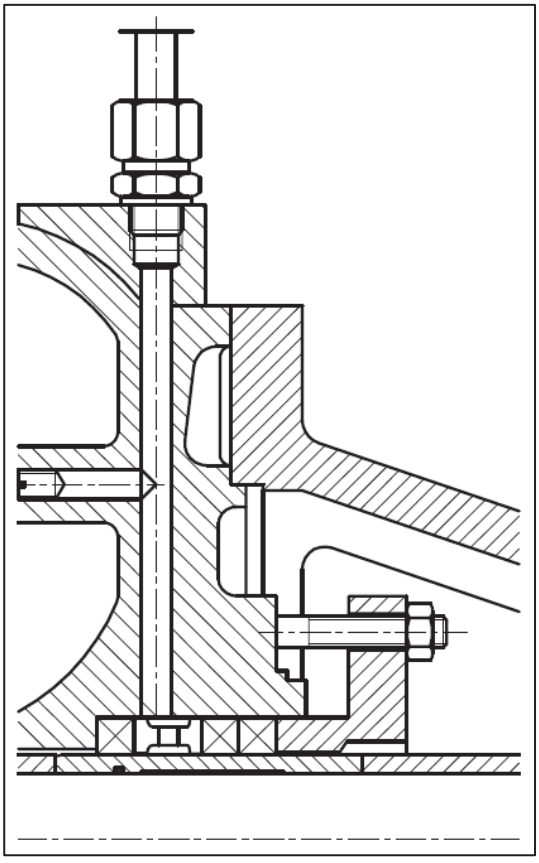

Figure 11: Suction-side external flushing connection (optional)

4 Transport and intermediate storage

4.1 Transport

Weight information (→ Other valid documents)

4.1.1 Unpacking and checking the delivery condition

1. Check that the delivery is complete upon receipt.
2. Unpack the pump/unit upon delivery and check for transport damage.
3. Notify the delivery company of any transport damage immediately.
4. Dispose of the packaging material in line with the applicable local regulations.

4.1.2 Lifting

Transport the pumps carefully and secure them to prevent damage. If using a horizontal pump, transport the entire unit using ropes as shown in Figure 12 (pg 18) (do not secure the ropes on the motor eyelets). Transport vertical pumps as shown in Figure 14 (pg 19).

⚠ DANGER

Risk of death or crushed limbs from falling transported goods!

► Choose lifting equipment that is suitable for the total weight to be transported.

► Secure the lifting equipment according to the following images.

► Do not stand under suspended loads.

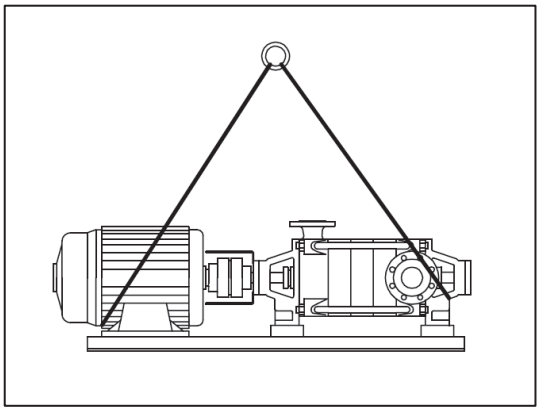

Figure 12: Lifting an NMH centrifugal pump (unit)

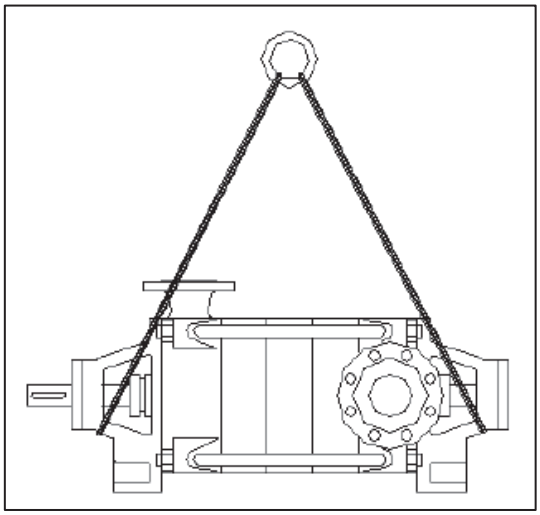

Figure 13: Lifting an NMH centrifugal pump (free shaft end)

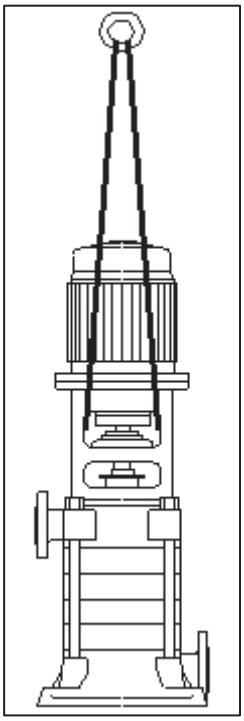

Figure 14: Lifting an NMV centrifugal pump

4.2 Intermediate storage

Ensure during intermediate storage that the pump is not exposed to any weather conditions for a long period of time. If the pump is decommissioned for a longer period of time (approximately 2 to 3 months), ensure that it is fully drained. (→ 6.2 Decommissioning, pg 39)

4.3 Storage

NOTICE

Material damage due to incorrect storage!

► Ensure that the pump is correctly stored.

1. Close all openings with blank flanges, blind plugs or plastic covers.
2. Ensure that the storage area meets the following conditions:
   – dry
   – free of frost
   – free of vibrations
3. Rotate the shaft once per month by several rotations.

NOTICE

Damage to bearings due to high water pressure or splashing water!

► Do not use water jets or steam jet cleaners to clean the bearing areas and motor.

NOTICE

Damage to seals due to incorrect cleaning agent!

► Ensure that the cleaning agent does not corrode the seals.

1. Choose the cleaning agent according to the area of use.
2. Dispose of preservatives in line with the applicable local regulations.
3. When storing for longer than 6 months:
   – Check all elastomers (round seals, shaft seal rings, gaskets and gland packing) for elasticity, and replace if necessary.

4.4 Disposal

Plastic parts may be contaminated by toxic or radioactive pumping media. If this is the case, cleaning is not sufficient.

⚠ WARNING

Risk of poisoning and environmental damage from pumping medium!

► Use personal protective equipment when performing work on the pump.

► Before disposing of the pump:
   – Collect any remaining pumping medium in the pump, and dispose of it in line with the locally valid regulations.
   – Neutralize any pumping medium residues in the pump.

► Dispose of the pump in line with the applicable local regulations.

5 Assembly and installation

5.1 Preparing for installation

NOTICE

Material damage due to contamination!

► Only remove covers, transport caps and sealing caps immediately before connecting the pump to the pipelines.

⚠ CAUTION

Ensure compliance with all safety specifications during installation and operation.

1. Ensure that the required ambient conditions are met (→ 5.1.1 Preparing the installation location, pg 21)

2. Please consult the manufacturer when installing at altitudes over 1000 m above mean sea level.

5.1.1 Preparing the installation location

► Ensure that the installation location meets the following conditions:

- pump is freely accessible from all sides
- sufficient space for installing/removing piping, as well as for maintenance and repair work, in particular for installing/removing the pump and motor
- no effects from external vibrations on the pump (bearing damage)
- protection against frost

Temperature [°C]	Relative humidity [%]		Installation altitude above mean sea level [m]
	long term	short term	
-10 to 40	≤ 85	≤ 100	≤ 1000

Table 11: Ambient conditions

5.1.2 Preparing the base surface and foundations

► Ensure that the base surface and foundations meet the following conditions:

- level
- clean (no oils, dust or other contaminations)
- foundations can support the weight of the pump unit and all operating forces
- stability of the pump unit ensured

5.1.3 Removing the preservative

Only necessary for preserved pump.

WARNING

Risk of poisoning from preservatives and cleaning agents in the food and drinking water area!

► Only use cleaning agents that are compatible with the pumping medium.

► Remove the preservative completely.

NOTICE

Damage to bearings due to high water pressure or splashing water!

► Do not use water jets or steam jet cleaners to clean the bearing areas.

NOTICE

Damage to seals due to incorrect cleaning agent!

► Ensure that the cleaning agent does not corrode the seals.

1. Choose the cleaning agent according to the area of use.
2. Dispose of preservatives in line with the local regulations.
3. If storing for longer than 6 months:
   - Replace elastomers made from EPDM.
   - Check all elastomers (round seals, shaft seals) for proper elasticity and replace if necessary.

5.2 Installation

5.2.1 Installing the pump

Prior to installation, remove the packaging (if present) and check the pump for any transport damage. Ensure that the installation area is dry and free of frost.

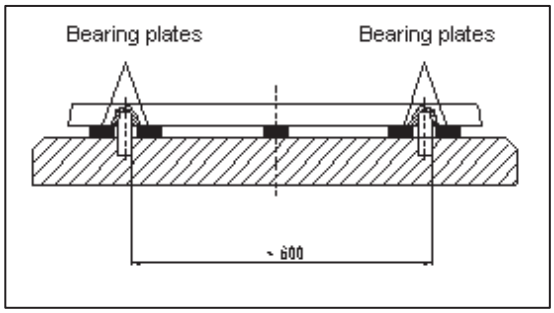

Figure 15: Mounting material for complete units

⚠ CAUTION

Do not operate the pump in areas where there is a risk of explosion. Ensure that the pump is installed and connected in line with the local regulations.

We recommend installing the pump on a noise-insulating base, in order to prevent transmission noises to parts of the building.

Provide an outlet for leakage fluid during maintenance work.

During installation, align the entire unit on the foundation using a spirit level (on shaft/discharge nozzle). Maintain the distance between the coupling halves according to the installation plan. Always insert bearing plates on the left and right side next to the mounting material between the base plate/base frame and the foundation. Provide additional bearing plates if the distance between the mounting materials is greater than 800 mm. Ensure that all bearing plates sit solidly. Base plates with a width greater than 400 mm must be filled out after mounting with a vibration-dampening mortar up to the upper edge of the frame.

If the pump and motor are delivered separately, place the pump onto the foundation without the motor, align using a precision spirit level and secure. For alignment purposes, always insert bearing plates on the left and right side next to the mounting material between the pump base and the foundation. Ensure that all bearing plates sit solidly.

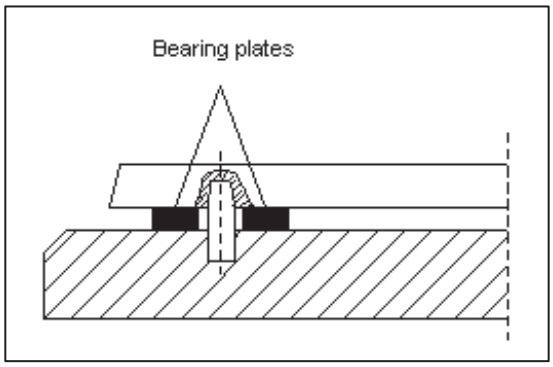

Figure 16: Mounting material for pump with open shaft end

If the pump has two or more anchoring points (see overall diagram or installation plan), ensure that they are not strained axially or radially.

NOTICE

Material damage due to strain on the base plate!

► Place and secure the base plate to the foundation as follows.

✓ Aids, tools, material:
(not included in delivery)
- Foundation bolts
- Steel shims
- Mortar casting compound, vibration free
- Spirit level

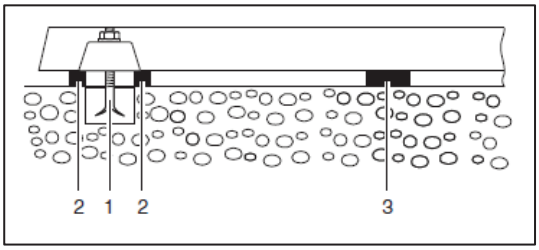

Figure 17: Aligning the base plate

1. Lift the pump unit (→ 4.1.2 Lifting, pg 18).

2. Insert the foundation screws from below into the fastening holes on the base plate.

If using adhesive anchors, observe the manufacturer's information.

3. Place the pump unit on the foundation, inserting the foundation screws into the prepared anchoring holes as you do so.

4. Align the pump unit to the required height and system dimensions as follows using steel shims:
   - Use one steel shim (2) to the left and right of each foundation screw (1).
   - If the distance between the anchoring holes is greater than 700 mm, add additional steel shims (3) on each side of the base plate in the middle.

5. Ensure that the base plate and the steel shims lie flat.

6. Check the maximum permitted height deviation (1 mm/m) laterally and longitudinally using a machine spirit level.

7. Repeat the process until the baseplate is correctly aligned.

The use of pumps in ATEX zones is subject to additional requirements!

→ 9.1.3 Installation and connection, pg 57

Take the following additional measures when operating pumps in ATEX zones

- Only use touch guard elements (e.g. coupling guard) made from electrically conductive materials.

- Secure the grub screw for connecting the coupling halves (e.g. using Loctite medium strength)

- Remove any metal shavings and dirt residues from all touch guard elements.
- The motor must meet the requirements of the area at risk of explosion (group, category).
- Install a soft-closing non-return valve between the discharge nozzle and the shut-off valve to prevent the backflow of pumping medium after the pump is switched off.
- If using a frequency inverter, please consult the manufacturers of the pump and the frequency inverter beforehand.

5.2.2 Securing the pump unit

Filling out the base plate with a mortar casting compound improves the insulation properties.

1. Fill out the anchoring holes with mortar casting compound.
2. Once the mortar casting compound has set, screw the base plate tightly at three points using the specified tightening torque.
3. Before tightening the remaining screws, compensate for any unevenness in the mounting surface using spacers on each screw.
4. Check the pump unit for tensions using a straitedge.
5. Fill out the inside of the base plate if provided. Knock on the base plate to prevent cavities.

5.2.3 Assembling the motor

Only necessary if the pump unit is completed at the installation location.

Ensure that the shaft is cleaned of anti-rusting agent, and that both coupling halves are pushed onto the shaft. We recommend checking the direction of rotation as per section 6.1.3 (pg 37) before assembling the motor.

⚠ CAUTION

Incorrect direction of rotation on the pump can lead to damage to the mechanical seal and a reduction in performance. Please observe the direction of rotation arrow on the pump.

NOTICE

Incorrectly aligned shafts can cause increased wear on the bearings, seal rings, shaft seals and elastic coupling elements. They can also cause increased noise when the unit is running.

Place the motor on the base plate. Compensate for the height difference between the shafts precisely using shims. The distance between the shaft ends should not exceed 3 mm.

5.3 Fine alignment of the coupling

The unit is correctly aligned when a ruler placed across both halves of the coupling is the same distance from the respective shaft at all points around the circumference. Do not forget to turn the measurement point by hand. Furthermore, both halves of the coupling must be the same distance from each other at all points around the circumference. Check this using a tracer or gauge.

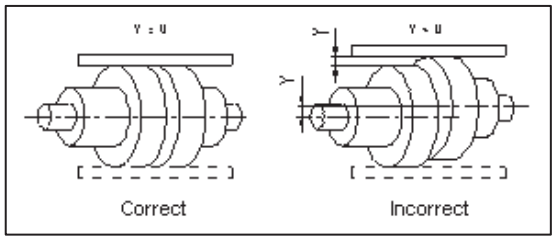

Figure 18: Positional alignment of the shafts

NOTICE

Material damage due to shocks and impacts!

► Do not tilt the two halves of the coupling when pushing them onto the shaft.

► Avoid knocking the pump components.

The central axes of the pump and motor are aligned according to their:

a) position
b) direction

Achieve both of these conditions by inserting or removing shims of different thicknesses under the pump or motor feet as appropriate. Afterwards, tighten the fastening screws of the pump and motor.

a) Position

A ruler placed on the coupling must lie flat on both halves, offset by 90°, around the circumference (→ Figure 18, pg 26).

b) Direction

The axial distance (x) between the halves of the coupling must be equal around the entire circumference. Set coupling distance x to 4 - 5 mm, and secure against axial displacement (→ Figure 19, pg 26).

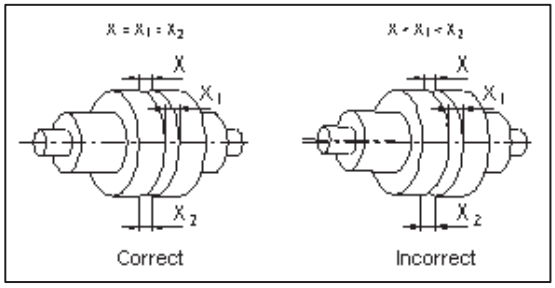

Figure 19: Directional alignment of the shafts

5.3.1 Horizontal configuration

1. Apply a very thin layer of molybdenum disulfide (e.g. Molykote) to the shaft ends on the pump and motor.

2. Insert the keys.

3. If using fitting device, remove the rubber buffer and heat the two halves of the coupling to around 100 °C.

4. Push the pump-side and motor-side coupling halves onto the shaft until the shaft end is flush with the coupling hub. When assembled, maintain a distance of 4 - 5 mm between the coupling halves.

5. Tighten the grub screws on both coupling halves.

6. Place suitable bearing plates beneath the motor/pump until the ends of the respective shafts are flush.

7. Insert the motor screws, but do not tighten (→ 5.4 Aligning the motor, pg 28).

8. Mount the coupling guard.

The coupling guard must always be mounted after aligning the coupling.

⚠ DANGER

Risk of death due to rotating parts!

- ► Use personal protective equipment when performing work on the pump.
- ► Prevent the keys from being slung away when checking the direction of rotation.
- ► Ensure sufficient clearance to rotating parts.

⚠ DANGER

Never operate the pump without the coupling guard.

5.3.2 Vertical configuration

Vertical pumps are always delivered with a complete coupling (assembled on the pump).

1. Apply a very thin layer of molybdenum disulphide (e.g. Molykote) to the shaft ends on the pump.

2. Insert the keys.

3. If using fitting device, remove the rubber buffer and heat the two halves of the coupling to around 100 °C.

4. Push the pump-side and motor-side coupling halves onto the shaft until the shaft end is flush with the coupling hub. When assembled, maintain a distance of 4 - 5 mm between the coupling halves.

5. Tighten the grub screw on the motor-side coupling half.

6. Place the motor on the pump. Ensure here that both halves of the coupling fit securely.

7. Secure the motor to the pump with screws.

The coupling guard must always be mounted after aligning the coupling.

⚠ DANGER

Risk of death due to rotating parts!

- ► Use personal protective equipment when performing work on the pump.
- ► Prevent the keys from being slung away when checking the direction of rotation.
- ► Ensure sufficient clearance to rotating parts.

⚠ DANGER

Never operate the pump without the coupling guard.

5.4 Aligning the motor

ⓘ Horizontal configuration only. Alignment options:
- with shims
- with adjustment screws

5.4.1 Aligning the motor with shims

1. Align the motor so that the two halves of the coupling are precisely flush, using shims if necessary.
2. Check the alignment of the motor to the pump.
3. If the height displacement persists, repeat the alignment process.
4. Afterwards, tighten the motor screws.

5.4.2 Aligning the motor with adjustment screws

ⓘ Observe the spindle's angle of rotation when adjusting the adjustment screws.

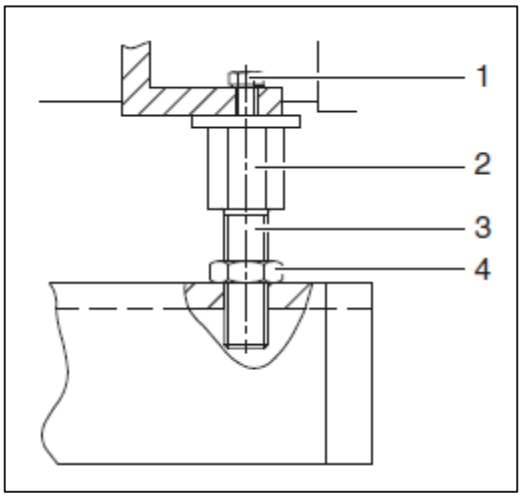

Figure 20: Aligning the motor with adjustment screws

1. Determine the angle required for the wrench rotations for the measured height displacement.
2. Loosen the hexagon head bolt (1)

3. Perform the following steps on all adjustment screws (3):
   - Hold the adjustment screw (3) at the hexagon head (2) and loosen the lock nut (4).
   - Adjust the adjustment screw (3) by the required angle.
   - Hold the adjustment screw (3) at the hexagon head (2) and tighten the lock nut (4).

4. Tighten the hexagon head bolt (1).

5. Check the alignment.

6. If the height displacement persists, repeat the alignment process.

7. Afterwards, tighten the motor screws.

5.5 Planning pipelines

5.5.1 General

Determine the nominal widths of the pipelines, taking the local conditions into account. To keep flow losses to a minimum, avoid sudden constrictions and sharp bends. Route pipelines free of tension and pressure tight. Install them in a way that prevents forces and torques being transferred to the pump. Never use the pump as an anchor point for the pipeline.

Fit the suction pipe rising to the pump and the inlet pipe declining to the pump, in order to prevent the formation of air bubbles. Support the pipes immediately before the pump, and connect without tension. Ensure that the weight of the pipes does not strain the pump. If using short pipes, the nominal widths must be at least equal to those of the pump connections. If using long pipelines, determine the cost-effective nominal width on a case-by-case basis.

⚠ CAUTION

Before commissioning new systems, the tanks, pipelines and connections must be thoroughly cleaned, flushed and blown through. Welding beads, scales and other contaminations often only fall off after a longer period of time. Ensure that they are kept away from the pump by fitting a strainer in the suction pipe.

Taper pieces to larger nominal widths should have an extending angle of approx. 8° to prevent increased pressure losses. Install check valves and shut-off devices depending on the type of system and pump (→ Figure 21, pg 29).

Take appropriate measures to compensate any expansions of the pipelines caused by temperature influences, in order to avoid straining the pump with forces and torques.

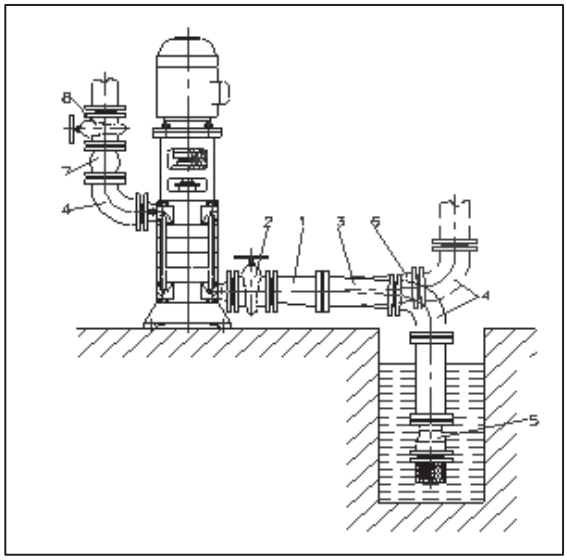

Figure 21: Functional and operating elements

Key:

1	Eccentric taper piece
2	Shut-off valve
3	Suction pipe
4	Elbow
5	Foot valve with inlet strainer
6	Inlet pipe
7	Check valve
8	Control fitting

* not included in delivery

Control fitting

(→ Figure 21, pg 29, 8)

A control fitting is always required to regulate the pump power and block the pipeline during assembly work.

Check valve

(→ Figure 21, pg 29, 7)

A check valve is always required to protect the pump.

Monitoring fitting

Monitoring fittings are required to monitor the suction and inlet pressure. Monitoring valves help monitor the operating data.

Flushing the shaft seal

If the pumping medium is contaminated, we recommend flushing the shaft seal. This prevents contamination from penetrating the shaft seal, and therefore also prevents excessive wear.

Sealing and flushing fluid pressure

The pressure of sealing and flushing fluid should always be 1 bar above the pump operating pressure.

Sealing the shaft seal

Sealing the shaft seal prevents air entry at high suction heads.

Leak fluid (leakage)

Drain leak fluid using pipes or hoses.

Auxiliary pipes

Route auxiliary pipes according to their nominal connection values, provided that they are not pressurized internally by the pump. The connections on the pump are indicated. All auxiliary pipes must have a control fitting and non-return valve.

The use of pumps in ATEX zones is subject to additional requirements!

→ 9.1.3 Installation and connection, pg 57

5.5.2 Avoiding contaminations in the pipelines

1. Clean all pipeline components and fittings prior to assembly.
2. Ensure that gaskets do not protrude inwards.
3. Remove any blank flanges, plugs, protective films and/or protective coatings on flanges.

NOTICE

Material damage due to contamination in the pump!

► Ensure that the pump is free of contaminations.

5.5.3 Configuring supports and flange connections

NOTICE

Material damage due to excessively high forces and torques in the pipes acting on the pump!

► Do not exceed the permitted values.

1. Calculate the forces in the pipeline and observe all operating conditions:
   - cold/warm
   - empty/filled
   - pressurized/unpressurized
   - change in the flange position
2. Ensure that the pipeline supports have permanent low-friction properties and do not seize up due to corrosion.

5.5.4 Determining nominal widths

Keep the flow resistance as low as possible.

1. Set the nominal width of the suction pipe to be greater than that of the suction nozzle.
2. Set the nominal width of the suction pipe to be greater than that of the suction nozzle.
3. The flow rate may not exceed 1.5 m/s.

5.5.5 Determining pipeline lengths

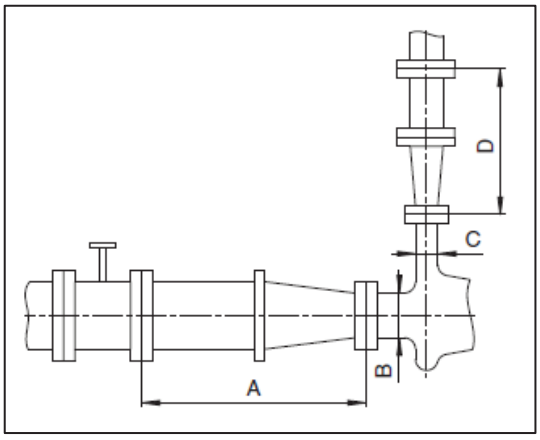

Figure 22: Recommended straight pipeline lengths upstream and downstream of the pump

A > 5x DNs

B DNs

C DNd

D > 5x DNd

Ensure compliance with the recommended pipeline lengths when installing the pump.

Suction side: Shorter lengths are possible, but this may limit the hydraulic performance data.
Pressure side: Shorter lengths are possible, but this may lead to increased noise levels.

5.5.6 Optimizing changes in cross-section and direction

1. Avoid bend radii that are smaller than 1.5 times the nominal pipe width.

2. Avoid sudden changes to the cross-section along the pipeline.

5.5.7 Providing safety and monitoring systems (recommended)

Preventing contamination

1. Install a filter in the suction pipe.

2. Install a differential pressure display with contact manometer to monitor contamination.

Preventing backflow

Install a non-return valve between the discharge nozzle and the shut-off valve to prevent medium backflow after the pump is switched off.

Enabling separation and blocking of the pipelines

For maintenance and repair work.

1. Provide shut-off devices in the suction and pressure pipe.

2. Recommended: Provide a drainage mechanism.

Enabling measurement of operating conditions

1. Provide manometers in the suction and pressure pipe to measure pressure.

2. Provide a torque measurement instrument on the motor side.

3. Provide a temperature measurement instrument on the pump side.

5.6 Attaching the pipelines

5.6.1 Installing auxiliary pipelines

Observe the manufacturer information for any auxiliary operating systems, if used.

1. Install auxiliary pipelines to the auxiliary connections, sealed and without tension (→ Installation plan).

2. Prevent air pockets by routing the pipelines rising to the pump.

5.6.2 Installing the suction pipe

1. Remove transport and sealing caps on the pump.

2. Fit the filter in the suction pipe to prevent contamination.

3. Prevent air pockets by routing the pipeline rising to the pump.

4. Ensure that the gaskets do not protrude inwards.

5. During suction operation, install a foot valve in the suction pipe to prevent the pump and suction pipe from emptying when not in operation.

NOTICE

Always open the suction-side fitting when operating the pump, and do not use it to control the flow rate.

5.6.3 Installing the pressure pipe

1. Remove transport and sealing caps on the pump.

2. Prevent air pockets by routing the pipeline constantly declining to the pump.

3. Ensure that the gaskets do not protrude inwards.

5.6.4 Checking for lack of tension in the pipeline connection

✓ Pipeline routed and cooled

1. Disconnect the connection flange of the pipelines from the pump.

2. Check whether the pipeline can move freely in all directions in the expected area of expansion:
   - Nominal width < 150 mm: by hand
   - Nominal width > 150 mm: with small lever

3. Ensure that the flanges are plane parallel.

4. Reconnect the connection flange of the pipelines to the pump.

NOTICE

Material damage due to excessively high forces and torques in the pipes acting on the pump!

► Do not exceed the permitted values.

5.7 Electrical connection

⚠ CAUTION

Electrical connection must be carried out by a specialist electrician, in line with the specifications of the local energy supplier or the VDE.

⚠ DANGER

Risk of death from electric shock!

- ► Only allow work on the electrical systems to be carried out by a qualified electrician.
- ► Ensure that the supply of electricity is switched off and secured against reactivation when performing all maintenance work.

⚠ DANGER

Risk of death due to rotating parts!

- ► Use personal protective equipment when performing work on the pump.
- ► Prevent the keys from being slung away when checking the direction of rotation.
- ► Ensure sufficient clearance to rotating parts.

5.7.1 Connecting the motor

Observe the manufacturer information for the motor.

Only use approved motors when operating pumps in ATEX zones!

Install a motor protection switch to protect the motor. If using three-phase motors with star-delta switch, ensure that the switching points between star and delta are timed very closely together. Longer switching times can lead to damage to the pump.

1. Connect the motor according to the circuit diagram.

2. Ensure that no danger arises due to electrical energy.

3. Install an EMERGENCY STOP switch.

4. Adjust the time relay to the motor power accordingly.

Adjusting the time relay with star-delta activation:

Motor power	Time relay setting
≤ 30 kW	3 s 30%
> 30 kW	5 s 30%

Table 12: Settings for the time relay when using three-phase motors with star-delta switch

NOTICE

Material damage due to improper use of three-phase motor with star-delta switch!

► Adjust the time relay according to the motor power (→ Table 12, pg 35).

5.7.2 Earthing the pump

Always earth pumps in ATEX zones!

- Ensure that motors, couplings and monitoring devices provided by the customer meet the specified category and temperature class in the respective ATEX zone (→ 9.1.2 Explosion protection marking, pg 56).

- Only use touch guard elements (e.g. coupling guard) made from electrically conductive materials.

- The motor must meet the requirements of the area at risk of explosion (group, category).

- If using a frequency inverter, please consult the manufacturer of the pump and the frequency inverter beforehand.

Earth the motor and the pump separately from each other.

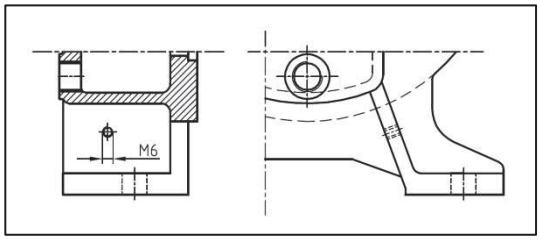

Figure 23: NMH earthing screws

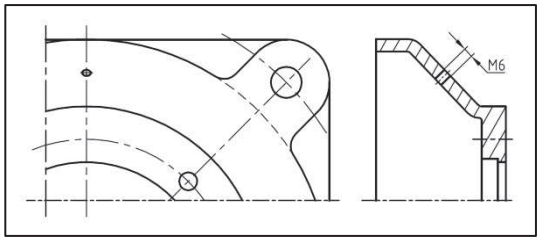

Figure 24: NMV earthing screws

For information on measures for earthing the motor, please refer to the manufacturer's documentation.

6 Commissioning/ decommissioning

6.1 Commissioning

6.1.1 Determining the pump configuration

⚠ DANGER

Risk of explosion!

► Ensure that no pumps with gland packing are used in areas at risk of explosion.

► Determine the pump configuration (→ Order data sheet)

Pump configurations relate to the type of shaft seal or auxiliary operating system, for example.

The use of pumps in ATEX zones is subject to additional requirements!

→ 9.1.4 Operation, pg 59

6.1.2 Filling the pump

✓ Auxiliary operating system ready

✓ Preservative removed

(→ 5.1.3 Removing the preservative, pg 22)

1. Fill the pump and suction pipe with pumping medium.
2. Open the suction-side fitting.
3. Open the pressure-side fitting.
4. Open the auxiliary operating systems (if present) and check for flow.
5. Ensure that all connections and joints are sealed.

⚠ CAUTION

Check that there is enough water in the well or feed tank.

Do not operate the pump without water. Dry running can lead to damage to the pump.

⚠ WARNING

Risk of poisoning or injury due to hazardous pumping media!

► Collect any escaping pumping medium safely and dispose of in an environmentally friendly way.

NOTICE

Material damage due to dry running!

► Ensure that the pump is properly filled.

6.1.3 Checking direction of rotation

⚠ CAUTION

Incorrect direction of rotation on the pump can lead to damage to the mechanical seal and a reduction in performance. Please observe the direction of rotation arrow on the pump.

The cast direction of rotation arrow on the pump indicates the specified direction of rotation.

Before checking the direction of rotation, secure the pump against activation.

1. Decouple the motor from the pump.
2. Switch the motor on and immediately off again.
3. Check whether the motor's direction of rotation corresponds to the arrow on the pump.
4. If the direction of rotation is different, reverse this by swapping two phases.
5. Recouple the motor with the pump.
6. Mount the coupling guard.

⚠ DANGER

Risk of death due to rotating parts!

► Use personal protective equipment when performing work on the pump.

► Prevent the keys from being slung away when checking the direction of rotation.

► Ensure sufficient clearance to rotating parts.

After checking the direction of rotation, ensure that all safety and protective mechanisms are reinstalled and reactivated.

⚠ DANGER

Never operate the pump without the coupling guard.

6.1.4 Starting the pump

- ✓ Pump correctly installed and connected
- ✓ Motor correctly installed and connected
- ✓ Motor correctly installed and aligned
- ✓ All connections established, sealed and free of tension
- ✓ Any auxiliary operating systems ready
- ✓ All safety mechanisms installed and function tested
- ✓ Pump correctly prepared, filled and vented

⚠ DANGER

Risk of injury due to running pump!

- ► Do not touch the running pump.
- ► Do not perform any work on the running pump.

⚠ DANGER

Risk of poisoning or injury due to spurting pumping medium!

- ► Use personal protective equipment when performing work on the pump.

NOTICE

Material damage due to dry running!

- ► Ensure that the pump is properly filled.

NOTICE

Open the suction-side fitting, and do not use it to control the flow rate. Do not close the pressure-side fitting!

Do not open the pressure-side fitting above the operating point (→ 3.6 Minimum output rates, pg 15).

0.1 MPa = 1 bar ≈ 10 m

1. Open the suction-side fitting.
2. Close the pressure-side fitting.
3. Switch on the motor and ensure that it runs quietly.
4. Once the motor has reached its nominal speed, slowly open the pressure-side fitting until the operating point is reached.
5. Ensure a temperature increase of < 50 °C/h if using the pump with hot pumping medium.
6. After the first pressure and temperature loads, check whether the pump is tight.
7. If using hot pumping media, switch the pump off briefly when at operating temperature, check the coupling alignment and realign the motor if necessary (→ 5.4 Aligning the motor, pg 28).
8. Set a slight leakage on the gland packing, if present (→ 6.5.2 Gland packing, pg 42).

6.2 Decommissioning

⚠ **DANGER**

Risk of injury due to hot pump components!

► Use personal protective equipment when performing work on the pump.

⚠ **DANGER**

Risk of injury due to running pump!

► Do not touch the running pump.

► Do not perform any work on the running pump.

⚠ WARNING

Risk of poisoning or injury due to hazardous pumping media!

► Use personal protective equipment when performing work on the pump.

► Take the following measures in the event of operating interruptions:

Flow medium behavior	Duration of operating interruption (depending on process)	
	short	long
Solid components settle	► Flush pump.	► Flush pump.
Solidified/frozen, non-corrosive	► Heat or drain pump and containers.	► Drain pump and containers.
Solidified/frozen, corrosive	► Heat or drain pump and containers.	► Drain pump and containers. ► Apply preservative to pump and containers.
Remains fluid, non-corrosive	–	–
Remains fluid, corrosive	–	► Drain pump and containers. ► Apply preservative to pump and containers.

Table 13: Measures depending on the behavior of the pumping medium

Pump to be	Measure
Shut down for longer period	► Take measures according to the pumping medium
Drained	► Close suction and pressure-side fittings.
Disassembled	► Deactivate the motor and secure against unauthorized reactivation.
Put into storage	► Observe the storage measures (→ 4.3 Storage, pg 19).

Table 14: Measures in the event of operational interruption

Drain the pump completely if shutting down for a longer period (approx. 2 - 3 months), or if there is a danger of frost.

NOTICE

This work must be carried out by a specialist service provider.

⚠ CAUTION

Disconnect the pump from the electricity supply if shutting down for a longer period.

6.2.1 Switching off the pump

1. Pressure-side fitting closed (recommended)
2. Switch off the motor.
3. Check all tie bolts and tighten if necessary.

6.2.2 Draining the pump and protecting against frost

The pump must be drained if there is a danger of frost. A pump that remains empty over a longer period must be preserved.

6.3 Recommissioning

⚠ CAUTION

The pump must move easily for recommissioning.

Check that the pump moves easily before recommissioning.

If the pump was preserved after decommissioning, flush it thoroughly before recommissioning.

Perform all further work steps in line with 6.1 Commissioning, pg 36.

Take the following measures before recommissioning following operating interruptions of > 1 year:

Shut down time	Measure
> 1 year	► Check visually for leaks
> 2 years	Replace elastomer seals (gaskets, round seals, shaft seal rings and gland packings). ► Replace anti-friction bearings.

Table 15: Measures following longer shut down times

6.4 Operating the stand-by pump

✓ Stand-by pump filled and vented

Operate the stand-by pump at least once per week.

1. Open the suction-side fitting fully.
2. Open the pressure-side fitting as far as required for the stand-by pump to reach operating temperature and be evenly warmed through (→ 6.1.4 Starting the pump, pg 38).

6.5 Shaft seal

6.5.1 Mechanical seal

NOTICE

Material damage due to dry running!

► Ensure that the pump is properly filled.

Mechanical seals are self-adjusting mechanical shaft seals that require no maintenance. The mechanical seal must never run dry. Ensure therefore that the pump is filled.

Do not reinstall mechanical seals after removing them for inspection or maintenance. Replace them with new seals, or relap the contact surface.

6.5.2 Gland packing

Gland packing consists of a number of compression-moulded rings in a stuffing box. Gland packings can be adjusted by hand with tools.

⚠ WARNING

Excessive tightening places too much tension on the packing rings. This leads to wear and ultimately loss of tightness in the stuffing box.

Replace the gland packing if the leaks in the stuffing box persist. Check at the same that the shaft wearing sleeves are in a good condition. Any worn or scored shaft wearing sleeves can lead to premature destruction of the packing.

NOTICE

Material damage due to dry running!

► Ensure that the pump is properly filled.

7 Maintenance and repair

7.1 General information

We can provide trained customer service technicians for assembly and repair work. Please present proof of the conveyed goods upon request.

(DIN safety data sheet or clearance certificate)

DANGER

Risk of injury due to hot pump components!

► Use personal protective equipment when performing work on the pump.

DANGER

Risk of injury due to running pump!

► Do not touch the running pump.

► Do not perform any work on the running pump.

WARNING

Risk of poisoning or injury due to hazardous pumping media!

► Use personal protective equipment when performing work on the pump.

Ensure that the pump runs smoothly and quietly at all times. Maximum permitted room temperature 40 °C.

The mechanical seal displays only limited or invisible leakage losses (in vapor form). It requires no maintenance.

The reserve pumps must be activated once per week in order to ensure operational readiness. To do so, switch the reserve pumps on and immediately off again. Monitor the function of the additional connections.

The pump shaft of the NMV series is supported in the suction casing in a zero-maintenance bearing shell made from PTFE graphite. The pump shaft and motor shaft are connected rigidly by means of a muff coupling.

7.2 Operational monitoring

Ensure that the pump runs smoothly and quietly at all times. Maximum permitted room temperature 40°C. The bearing temperature may be up to 50°C above the room temperature, but may not exceed 90°C (measured externally on the bearing housing).

NOTICE

Material damage due to dry running!

► Ensure that the pump is properly filled.

► Longer operation against a closed shut-off device is not permitted.

If using a gland packing, this should drip slightly during operation. The gland may only be tightened slightly. Leakage is always required if using pure graphite packing rings. If leakage is too high after a longer period of operation, evenly tighten the nuts on the gland by 1/6 of a rotation, and observe the leakage. If it is no longer possible to adjust the gland, insert an additional packing ring. It is generally not required to replace the entire packing.

If using mechanical seals, these display only limited or invisible leakage losses (in vapor form). They require no maintenance.

The reserve pumps must be activated once per week in order to ensure operational readiness. To do so, switch the reserve pumps on and immediately off again. Monitor the function of the additional connections.

Replace the elastic elements of the coupling promptly should you notice signs of wear over time.

The bearings have a high-quality lithium-soap grease. Under normal operating conditions, this is sufficient for 15,000 operating hours or 2 years. If operating under unfavorable conditions, such as high room temperature, high humidity, dusty air, aggressive industrial atmospheres, etc., check the bearings at an earlier time, and clean and relubricate if necessary. When relubricating, use a lithium-soap grease that is free of resins or acids, does not become brittle and protects against rust.

Only half fill the cavities of the bearings with grease. If necessary, you can also lubricate the bearings with other soap-based greases. As greases with different soap bases may not be mixed, ensure that the bearings are thoroughly washed beforehand. Adjust the necessary relubrication intervals according to the greases used.

1. Test at appropriate intervals:
   - Maintenance of the minimum flow rate
   - Room temperature < 40 °C
   - Temperature of the anti-friction bearings < 90 °C (measured on the bearing housing)
   - No change in the normal operating conditions
   - Alignment of the coupling and condition of the elastic elements

2. Please ensure the following for smooth operation:
   - No dry running
   - No leaks
   - No cavitation
   - Gate valve open on suction side
   - Filter free and clean
   - Sufficient inlet pressure
   - No unusual running noises or vibrations
   - No unpermitted leakage on the shaft seal
   - Auxiliary operating systems function correctly

The use of pumps in ATEX zones is subject to additional requirements!

→ 9.1.4 Operation, pg 59

7.3 Maintenance

Service life of the anti-friction bearings in the permitted operating range: > 2 years

Intermittent operation, high temperatures, low viscosity and unfavorable ambient and process conditions can reduce the service life of the anti-friction bearings.

Mechanical seals wear naturally, although this depends heavily on the respective operating conditions. It is therefore not possible to make any general statements about the service life.

DANGER

Risk of death from electric shock!

- ► Only allow work on the electrical systems to be carried out by a qualified electrician.
- ► Ensure that the supply of electricity is switched off and secured against reactivation when performing all maintenance work.

DANGER

Risk of injury due to hot pump components!

- ► Use personal protective equipment when performing work on the pump.

DANGER

Risk of injury due to running pump!

- ► Do not touch the running pump.
- ► Do not perform any work on the running pump.

WARNING

Risk of poisoning or injury due to hazardous pumping media!

- ► Use personal protective equipment when performing work on the pump.

The use of pumps in ATEX zones is subject to additional requirements!

→ 9.1.5 Maintenance and repair, pg 59

Ensure compliance with the following additional requirements when operating the pump in an ATEX zone:

- Replace the anti-friction bearing in the motor in line with the manufacturer specifications.
- Replace the anti-friction bearing and the plain bearing in the pump after 9000 operating hours.
- Check the following at appropriate intervals (at least monthly):
  - Motor and coupling in line with the manufacturer's operating manual
  - Surface temperature of the motor and pump
  - Any changes in running noise or vibrations
  - Deformation of the touch guard elements and distance to the hazardous parts
  - Function of the monitoring devices

Always earth pumps in ATEX zones!

7.3.1 Anti-friction bearings and grease lubrication

Relubricate after no more than 7500 operating hours or 1 year under normal operating conditions.

1. Clean the anti-friction bearings thoroughly.
2. Use grease with the following properties:
   - lithium soap base
   - free of resins
   - free of acids
   - anti-rust effect
   - non-drying
3. Only half fill the cavities in the anti-friction bearings with grease.

7.3.2 Servicing the electric motors

⚠ CAUTION

Electrical connection must be carried out by a specialist electrician, in line with the specifications of the local energy supplier or the VDE.

⚠ DANGER

Only perform the inspection when the system is switched off and secured.

⚠ DANGER

Risk of death from electric shock!

- ► Only allow work on the electrical systems to be carried out by a qualified electrician.
- ► Ensure that the supply of electricity is switched off and secured against reactivation when performing all maintenance work.

7.3.3 Servicing the mechanical seals

Mechanical seals feature a functional drop leak (→ manufacturer information)

Mechanical seals are self-adjusting mechanical shaft seals that require no maintenance. The mechanical seal must never run dry. Ensure therefore that the pump is filled.

Do not reinstall mechanical seals after removing them for inspection or maintenance. Replace them with new seals, or relap the contact surface.

- ➢ In the event of heavy leakage, replace the mechanical seal with auxiliary seals and check that the auxiliary operating systems function properly.

7.3.4 Servicing the gland packing

Gland packing consists of a number of compression-moulded rings in a stuffing box. Gland packings can be adjusted by hand with tools.

⚠ WARNING

Excessive tightening places too much tension on the packing rings. This leads to wear and ultimately loss of tightness in the stuffing box.

NOTICE

Material damage due to dry running!

- ► Ensure that the pump is properly filled.

If using a gland packing, this should drip slightly during operation. The gland may only be tightened slightly. Leakage is always required if using pure graphite packing rings. If leakage is too high after a longer period of operation, evenly tighten the nuts on the gland by 1/6 of a rotation, and observe the leakage. If it is no

longer possible to adjust the gland, insert an additional packing ring or replace the packing rings.

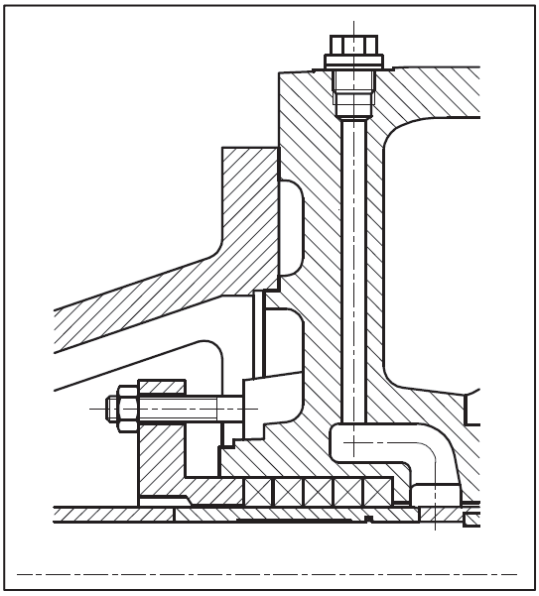

Figure 25: Pressure-side stuffing box (standard)

Replacing the packing rings:

1. Remove the old gland packing entirely and clean the stuffing box.

2. Check the surface quality of the shaft running surface.

3. Place new rings around the shaft. When doing this:
   - push in each new ring with the gland
   - rotate each new ring until the joints are offset by 90°

4. Slightly tighten the nuts on the gland by hand, alternating sides. Ensure that the pump shaft rotates easily.

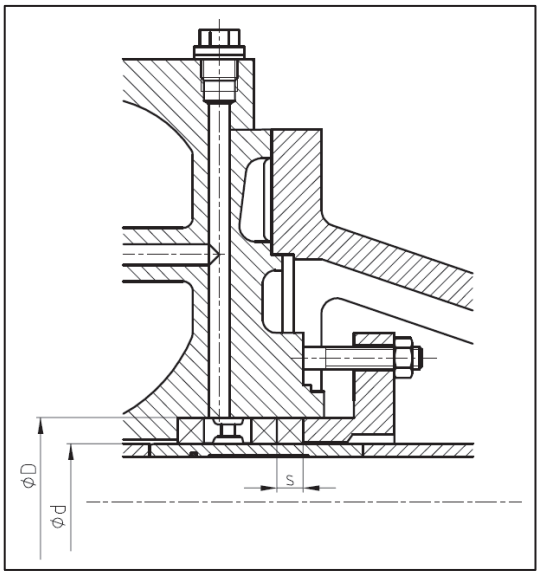

Figure 26: Suction-side stuffing box (standard)

Pump type	Dimensions [mm]		
	D	d	S
NMH/NMV 32	51	35	8
NMH/NMV 40	51	35	8
NMH/NMV 50	63	43	10
NMH/NMV 65	65	45	10
NMH/NMV 80	85	60	12

Table 16: Stuffing box dimensions

7.4 Sending the pump to the manufacturer

- ✓ Pump depressurized
- ✓ Pump completely drained
- ✓ Electrical connections disconnected and motor secured against reactivation
- ✓ Pump cooled down
- ✓ When using couplings with spacer: spacer removed

✓ Auxiliary operating system shut down, depressurized and drained

✓ Manometer removed together with supply lines and holders

1. Only send pumps or individual components to the manufacturer together with a verifiable and completely filled out clearance certificate. Request a clearance certificate from the manufacturer if required.

2. Using the following table, take the action required for returning the pump according to the necessary repair.

Repair	Action for return
At customer	►Return defective component to manufacturer.
At manufacturer	►Flush pump. ►Send complete pump (not disassembled) to manufacturer.
At manufacturer, with guarantee claim	►Only when using hazardous pumping medium: flush pump. ►Send complete pump (not disassembled) to manufacturer.

Table 17: Measures for return

7.5 Disassembling the pump

⚠ **DANGER**

Risk of death from electric shock!

► Only allow work on the electrical systems to be carried out by a qualified electrician.

► Ensure that the supply of electricity is switched off and secured against reactivation when performing all maintenance work.

⚠ **DANGER**

Risk of injury due to hot pump components!

► Use personal protective equipment when performing work on the pump.

⚠ DANGER

Risk of injury due to running pump!

► Do not touch the running pump.

► Do not perform any work on the running pump.

⚠ WARNING

Risk of poisoning or injury due to hazardous pumping media!

► Use personal protective equipment when performing work on the pump.

✓ Pump depressurized

✓ Pump fully drained, flushed and decontaminated

✓ Electrical connections disconnected and motor secured against reactivation

✓ Pump cooled down

✓ Coupling guard removed

✓ When using couplings with spacer: spacer removed

✓ Auxiliary operating system shut down, depressurized and drained

✓ Manometer removed together with supply lines and holders

During disassembly:

- Precisely mark the installation location and position of all components prior to disassembly.
- This assembled components concentrically, and do not cant.
- Disassemble the pump (→ Cross-section diagram).

7.6 Ordering spare parts

Please have the following information to hand when ordering spare parts (→ type plate, cross-section diagram):

- Customer number (if available)
- Short designation of the pump series
- Order number/pump number
- Year of production
- Parts number
- Designation
- Quantity
- Delivery method
- Delivery address

8 Faults and troubleshooting

Please consult the manufacturer should you experience any faults that are not described in the following table, or cannot be traced back to the described causes.

In the following table, each potential fault is given a number. Use this number to find the corresponding cause and remedy in the troubleshooting table.

Fault	Number
Pump does not deliver	1
Flow rate too low	2
Flow rate too high	3
Pumping pressure too low	4
Pumping pressure too high	5
Pump runs noisily	6
Temperature of the anti-friction bearings too high	7
Pump leaks	8
Motor power consumption too high	9

Table 18: Fault/number allocation

Fault number									Cause	Remedy
1	2	3	4	5	6	7	8	9		
X	-	-	-	-	-	-	-	-	Inlet/suction pipe and/or pressure pipe closed by fitting	► Open fitting.
-	X	-	X	-	-	-	-	-	Inlet/suction pipe not completely opened	► Open fitting.
X	X	-	X	-	X	-	-	-	Inlet/suction pipe, pump or suction strainer blocked or encrusted	► Clean inlet/suction pipe, pump or suction strainer.
-	X	-	X	-	X	-	-	-	Cross-section of the inlet/suction pipe too tight	► Enlarge cross-section. ► Clean suction pipe of encrustations. ► Fully open fitting.
X	-	-	-	-	-	-	-	-	Transport sealing cap not removed	► Remove transport sealing cap. ► Disassemble pump and check for dry running damage.
-	X	-	X	-	X	-	-	-	Suction head too high: $NPSH_{pump}$ is greater than $NPSH_{system}$	► Increase inlet pressure. ► Consult manufacturer.
X	-	-	-	-	X	-	-	-	Inlet/suction pipe and pump not correctly drained or not completely filled.	► Completely fill and drain pump and/or pipeline.
X	-	-	-	-	X	-	-	-	Inlet/suction pipe contains air pockets	► Install fitting for venting. ► Correct pipeline routing.
X	X	-	X	-	X	-	-	-	Air sucked in	► Seal source of fault.
X	X	-	X	-	X	-	-	-	Gas component too high: pump cavitated	► Consult manufacturer.
-	X	-	X	-	X	-	-	-	Temperature of pumping medium too high: pump cavitated	► Increase inlet pressure. ► Reduce temperature. ► Consult manufacturer.

Fault number									Cause	Remedy
1	2	3	4	5	6	7	8	9		
-	X	-	X	-	-	-	-	-	Geodetic delivery head and/or pipeline resistance too high	► Remove deposits in pump and/or pressure pipe. ► Install larger impeller and consult manufacturer.
-	X	-	-	X	X	-	-	-	Pressure-side fitting not opened far enough	► Open pressure-side fitting.
X	X	-	-	X	X	-	-	-	Pressure line blocked	► Clean pressure line.
X	X	-	X	-	X	-	-	-	Incorrect direction of rotation on pump	► Swap any two phases on motor.
X	X	-	X	-	-	-	-	-	Speed too low	► Compare required motor speed with pump type plate. Replace motor if necessary. ► Increase speed if possible.
-	X	-	X	-	X	X	-	-	Pump components worn	► Replace worn pump components.
-	-	X	X	-	X	-	-	X	Pressure-side fitting opened too far	► Throttle with pressure-side fitting. ► Machine down impeller. Consult manufacturer and adjust impeller diameter.
-	-	X	-	-	X	-	-	X	Geodetic delivery head, pipeline resistance and/or other resistances lower than designed	► Throttle flow rate with pressure-side fitting. Observe minimum flow rate here. ► Machine down impeller. Consult manufacturer and adjust impeller diameter.
-	-	X	-	X	-	-	-	-	Viscosity lower than indicated	► Machine down impeller. Consult manufacturer and adjust impeller diameter.
-	-	X	-	X	X	X	-	X	Speed too high	► Compare required motor speed with pump type plate. Replace motor if necessary. ► Reduce speed if possible.
-	-	X	-	X	X	-	-	X	Number of stages too high	► Throttle flow rate with pressure-side fitting. Observe minimum flow rate here. ► Install pump with lower number of stages.
X	X	-	X	-	X	-	-	-	Impeller imbalanced or blocked	► Disassemble pump and check for dry running damage. ► Clean impeller.
-	X	-	X	-	X	-	-	-	Hydraulic pump components dirty, sticky or encrusted	► Disassemble pump. ► Clean components.
-	-	-	-	-	-	X	-	X	Defective anti-friction bearing in motor	► Replace anti-friction bearing.

Fault number									Cause	Remedy
1	2	3	4	5	6	7	8	9		
-	-	-	-	-	-	X	-	-	Lubricant: too much, too little or not suitable	► Reduce, increase or replace lubricant.
-	-	-	-	-	-	-	X	-	Tie bolts not tightened correctly	► Tighten tie bolts.
-	-	-	-	-	-	-	X	-	Mechanical seal worn	► Replace mechanical seal.
-	-	-	-	-	-	-	X	-	Defective casing seal	► Replace casing seal.
-	-	-	-	-	-	-	X	-	Shaft sleeve penetrated	► Replace shaft sleeve and round seal.
-	-	-	-	-	X	X	X	X	Pump under tension	► Check pipeline connections and pump fastening. ► Check coupling alignment. ► Check support foot fastening.
-	-	-	-	-	X	X	-	-	Coupling incorrectly aligned	► Align coupling.
-	X	-	X	-	X	-	-	X	Motor runs on 2 phases	► Check fuse and replace if necessary. ► Check wire connections and insulation.

Table 19: Troubleshooting table

9 Appendix

9.1 Additional ATEX instructions

Additional requirements for safe operation in areas at risk of explosion

9.1.1 Safety

Correct and proper use:

The pump is classified as non-electric equipment, and therefore fulfills the requirements for devices of equipment group II, categories 2 and 3.

Do not operate the pump:

- when the fittings are closed
- when the operating range is exceeded (→ data sheet)
- when maintenance intervals are exceeded

Duties of the system owner:

- Assess and document the risk of explosion in the various operating areas of the system according to Annex I of the Directive 2014/34/EU.
- Ensure compliance with Directive 99/92/EC on measures for ensuring the health and safety of workers in atmospheres at risk of explosion.
- Only operate the pump in line with the explosion protection marking.
- Observe the enclosed data sheet.
- Ensure the following at all times:
  - Pump earthed (earthing screw located on the bearing housing of the pump) → 5.7.2 Earthing the pump, pg 35
  - No contact between the coupling and the coupling guard
  - Suction and pressure pipe, inside of the pump, seal area and auxiliary systems completely filled with pumping medium at all times
  - Authorized surface temperature on the pump not exceeded
  - Fittings installed correctly on the suction and pressure side
  - Pump serviced regularly and monitored
  - No risk of dry pump running, e.g. via level monitoring or flow rate measurement
- Ensure that motors, couplings and monitoring devices provided by the customer meet the specified category and temperature class in the respective zone.
- Inform personnel of the particular risk of explosion when removing dust deposits.

Materials and media:

Ensure the following:

- All attachment parts are electrically conductive
- Electrostatic charging is avoided: Only use pumping media with a conductivity > 10^{-8} S/m.

9.1.2 Explosion protection marking

ATEX marking

The pumps in the NMH/NMV series meet the following ATEX Ex protection class:

Key:

1 ATEX symbol
2 Equipment group 2
3 Gases
4 Category 2
5 Constructional safety
6 Temperature class 3

Temperature classes:

Flammable gases and vapors are divided into temperature classes according to their inflammability in contact with hot surfaces.

Temperature class	Mixture ignition temperature [°C]	Max. surface temperature [°C]
T1	t > 450	450
T2	450 ≥ t > 300	300
T3	300 ≥ t > 200	200
T4	200 ≥ t > 135	135
T5	135 ≥ t > 100	100
T6	100 ≥ t > 85	85

Table 20: Temperature classes

DANGER

Only use the pump up to the temperature class indicated on the type plate.

The surface temperature of the pump must always be lower than the lowest ignition temperature of the temperature class.

Ignition protection class:

The ignition protection class describes the type of measures taken to prevent a surrounding explosive atmosphere from igniting.

Ignition protection class	Meaning	For area	
		Non-electrical equipment	Electrical equipment
b	Control of ignition sources	X	-
c	Constructional safety	X	-
d	Flameproof enclosure	X	X
e	Increased safety	-	X
fr	Flow restriction	X	-
g	Inherent safety	X	-
k	Liquid immersion	X	-
o	Oil immersion	-	X
p	Pressurization	X	X
q	Powder filling	-	X
m	Encapsulation	-	X
i	Intrinsic safety	-	X

Table 21: Ignition protection classes

Ex atmosphere

The Ex atmosphere describes the type of explosive atmosphere in a zone.

Ex atmosphere	Meaning
G	Flammable gases and vapors
D	Flammable dusts

Table 22: Ex atmosphere

Equipment groups/areas of use/zone/category

Pumps are divided into equipment groups and categories according to the area in which they are used. The zone is based on the likelihood of an explosive atmosphere, and differentiates between gases and dusts. The category describes the constructional safety of the pump, and depends on the zone.

Equipment group/area of use	Zone	Category	Likelihood of dangerous explosive atmospheres	Constructional safety
I / mining	Comparable to 0 (G) and 1 (G)	M1	-	Very high
I / mining	Comparable to 2 (G)	M2	-	High
II / others	0 (G) 20 (D)	1	Persistent, for long periods or frequently	Very high
II / others	1 (G) 21 (D)	2	Occasional (arising fault must not become source of ignition)	High
II / others	2 (G) 22 (D)	3	Unlikely, if so then rarely and briefly (surface temperature must not become an ignition source in normal operation)	Normal

Table 23: Equipment groups/areas of use/zone/category

9.1.3 Installation and connection

The required measures for installation and connection depend on the category (→ 9.1.2 Explosion protection marking, pg 56).

Performing basic measures

- Only use touch guard elements (e.g. coupling guard) made from electrically conductive materials.
- Secure the grub screw for connecting the coupling halves (e.g. using Loctite medium strength)
- Remove any metal shavings and dirt residues from all touch guard elements.
- Install a soft-closing non-return valve between the discharge nozzle and the shut-off valve to prevent the backflow of pumping medium after the pump is switched off.

- The motor must meet the requirements of the area at risk of explosion (group, category).

- If using a frequency inverter, please consult the manufacturers of the pump and the frequency inverter beforehand.

Performing measures for category 2

Ensure that there are monitoring devices to prevent self-warming caused by dry running.

Type and configuration of shaft seal (→ data sheet)	Measure
Single mechanical seal	If the pumping medium contains gas-laden substances: ► Ensure that the following components for temperature measurement on the stationary seal ring of the mechanical seal meet the specifications of Directive 2014/34/EU: – Temperature sensor on stationary seal ring of the mechanical seal – Temperature monitoring instrument ► Retrofit an appropriate temperature measuring instrument if required
Double mechanical seal in back-to-back configuration	► Retrofit a pressure gauge for the sealing medium
Double mechanical seal in tandem configuration	► Retrofit a fill level gauge for the supply tank if necessary. ► Retrofit a pressure gauge for the sealing medium if the temperature difference between the sealing medium and the temperature class < 50 Kelvin.
Single mechanical seal with quench and secondary seal with lip	

Table 24: Possible devices for monitoring self-warming due to dry running

Monitoring the system for parameter behavior

Parameter [1)]	Measure
Constant	► Monitor motor power: – Reaction time < 5 s – Precision < 15 % – Record of the effective power of all three phases – Monitoring of overload and underload ► Alternatively: Monitor flow rate and/or tank level (→ data sheet)
At least one not constant	► Monitor flow rate and/or tank level – Reaction time < 5 s – Monitor minimum and maximum value (→ data sheet)

Table 25: Measures against unauthorized self-warming

1) Flow rate, delivery head, density, viscosity, speed, output

Ensuring ignition source monitoring

Ensure that ignition sources are monitored as per the minimum requirements of the ignition protection level (IPL) according to EN 13463-6 (or DIN EN ISO 13849-1 for monitoring devices that are not IPL certified):

IPL 1 for category 2

IPL 2 for category M2 / mining

9.1.4 Operation

Observing the maximum authorized operating temperature

Observe the maximum authorized operating temperature (→ data sheet).

Observing the maximum authorized temperature of the pumping medium

Temperature class	Authorized pumping medium temperature [°C] 1)
T4	80
T3	140
T2	140
T1	140

Table 26: Max. pumping medium temperature

1) Applies to the specific heat capacity of water (c_{Water} = 4.2 KJ/kgK) and at speeds < 3000 min^{-1}

Safe operation

Ensure the following operating conditions:

- No dry running
- No operation while overloaded
- No operation when the suction-side fittings are closed
- No operation (even briefly when starting) when the pressure-side fittings are closed

9.1.5 Maintenance and repair

Maintenance intervals shorten under difficult operating conditions.

Performing measures

- Replace the anti-friction bearing in the motor in line with the manufacturer specifications.
- Replace the anti-friction bearing and the plain bearing in the pump after 9000 operating hours.
- Check the following at appropriate intervals (at least monthly):
  - Motor and coupling in line with the manufacturer's operating manual
  - Surface temperature of the motor and pump
  - Any changes in running noise or vibrations
  - Deformation of the touch guard elements and distance to the hazardous parts
  - Function of the monitoring devices

9.2 Spare parts list for constant operation over two years as per DIN 24296

Part no.	Part designation	Number of identical pumps (including reserve pumps)						
		2	3	4	5	6 and 7	8 and 9	> 9
		Set/quantity of spare parts						
211	Pump shaft with small parts	1	1	2	2	2	3	30%
230	Impeller (set)	1	1	1	2	2	3	30%
321	Radial grooved ball bearing (set)	1	1	2	2	3	4	50%
370	Foil bearing	1	1	2	2	3	4	50%
412	Round seal (set)	4	8	8	8	9	12	150%
433	Mechanical seal (set)	2	3	4	5	6	7	90%
461	Gland packing (set)	4	6	8	8	9	12	150%
504	Correction ring	1	1	2	2	3	4	50%
524	Shaft wearing sleeve	2	2	2	3	3	4	50%
525	Interstage sleeve	2	2	2	3	3	4	50%

Table 27: Spare parts for constant operation over two years

9.3 Cross-sections

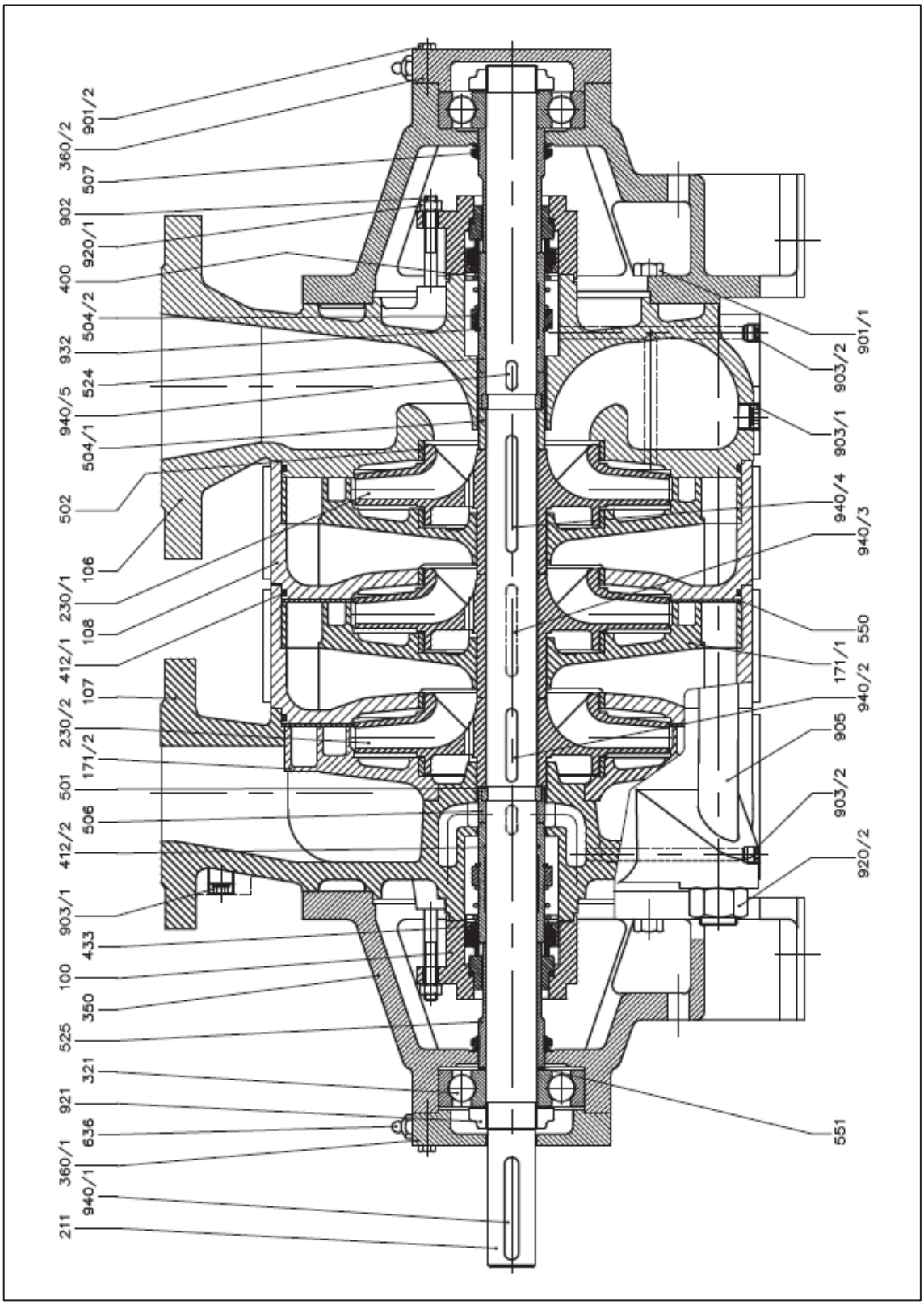

Figure 27: Cross-section of NMH with mechanical seal

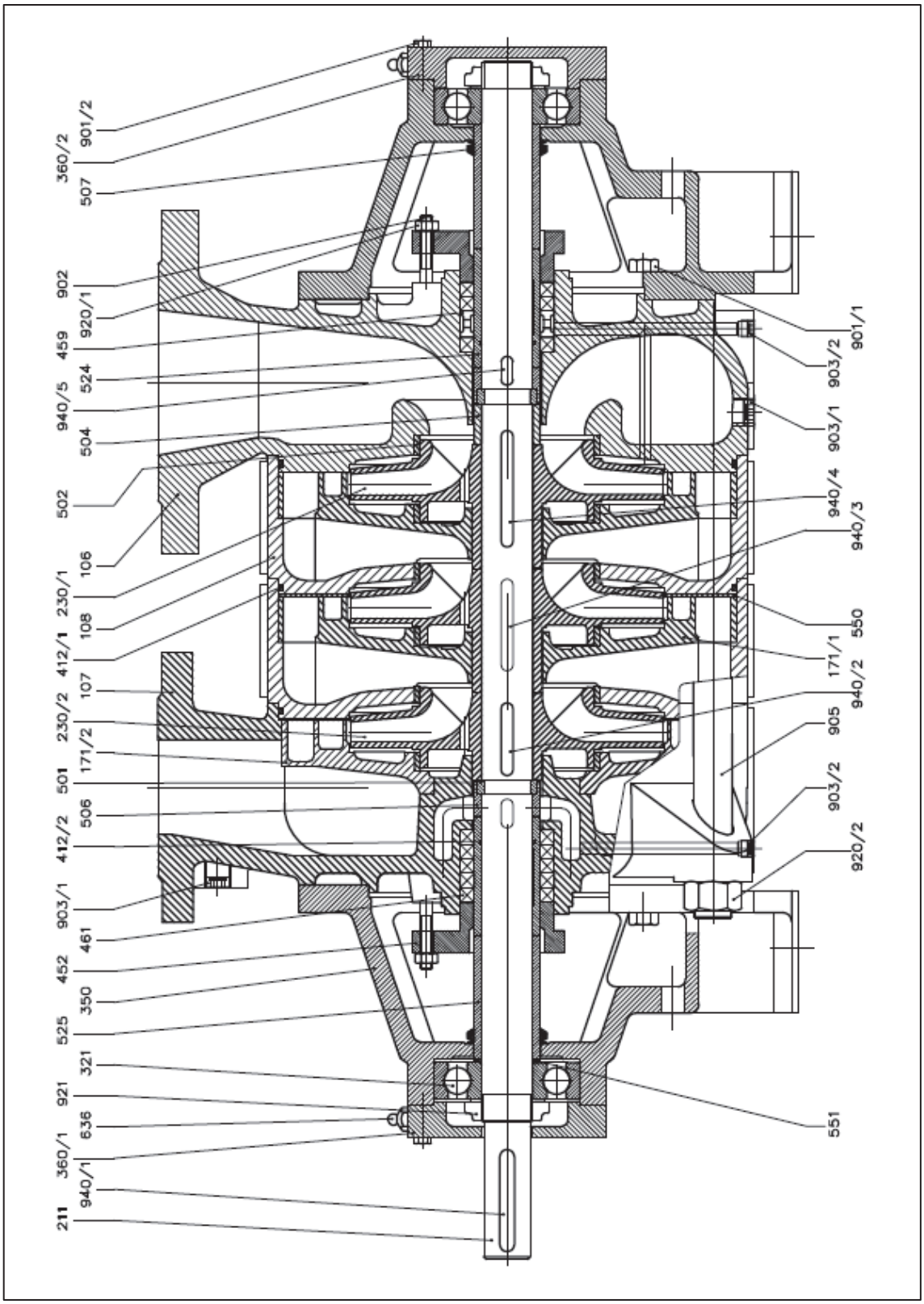

Figure 28: Cross-section of NMH with gland packing

Part no.	Designation	Part no.	Designation
100	Casing	501	Multiple ring
106	Suction casing	502	Casing wear ring
107	Delivery casing	504	Correction ring
108	Stage casing	504/1	Spacer ring
171/1	Diffuser	504/2	Spacer ring
171/2	Diffuser	506	Retaining ring
		507	Thrower
		524	Shaft wearing sleeve
211	Pump shaft	525	Spacer sleeve
230/1	Impeller	550	Disc
230/2	Impeller	551	Support disc
321	Radial grooved ball bearing	636	Grease nipple
350	Bearing housing		
360/1	Bearing cover		
360/2	Bearing cover	901/1	Hexagon head bolt
		901/2	Hexagon head bolt
		902	Stud
400	Gasket	903/1	Screwed plug
412/1	O-ring	903/2	Screwed plug
412/2	O-ring	905	Tie bolt
433	Mechanical seal	920/1	Hexagon nut
		920/2	Hexagon nut
		921	Shaft nut
452	Gland	932	Circlip
459	Lantern neck bush	940/1	Key
461	Gland packing	940/2	Key
		940/3	Key
		940/4	Key
		940/5	Key

Table 28: NMH parts list

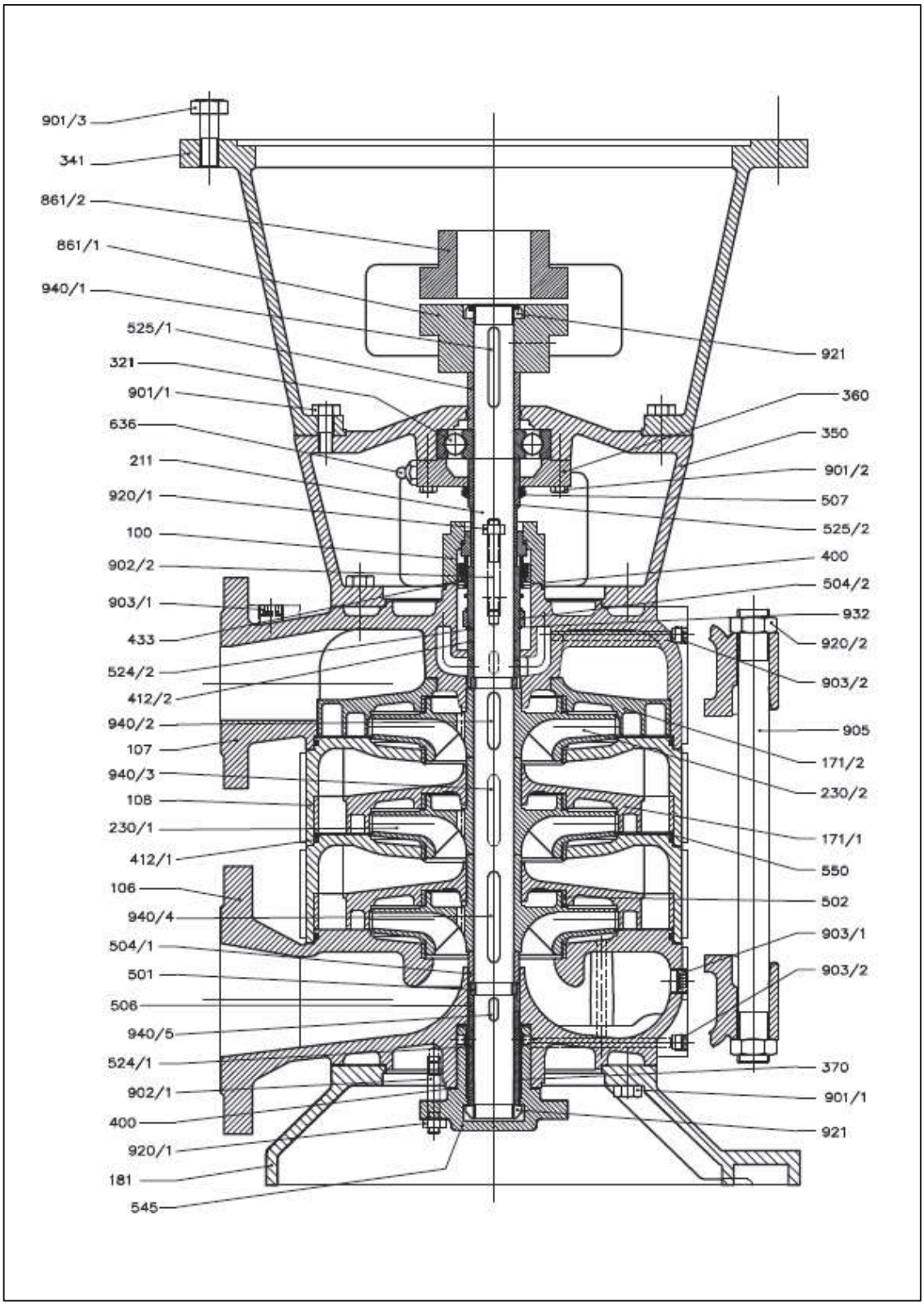

Figure 29: Cross-section of NMV with mechanical seal

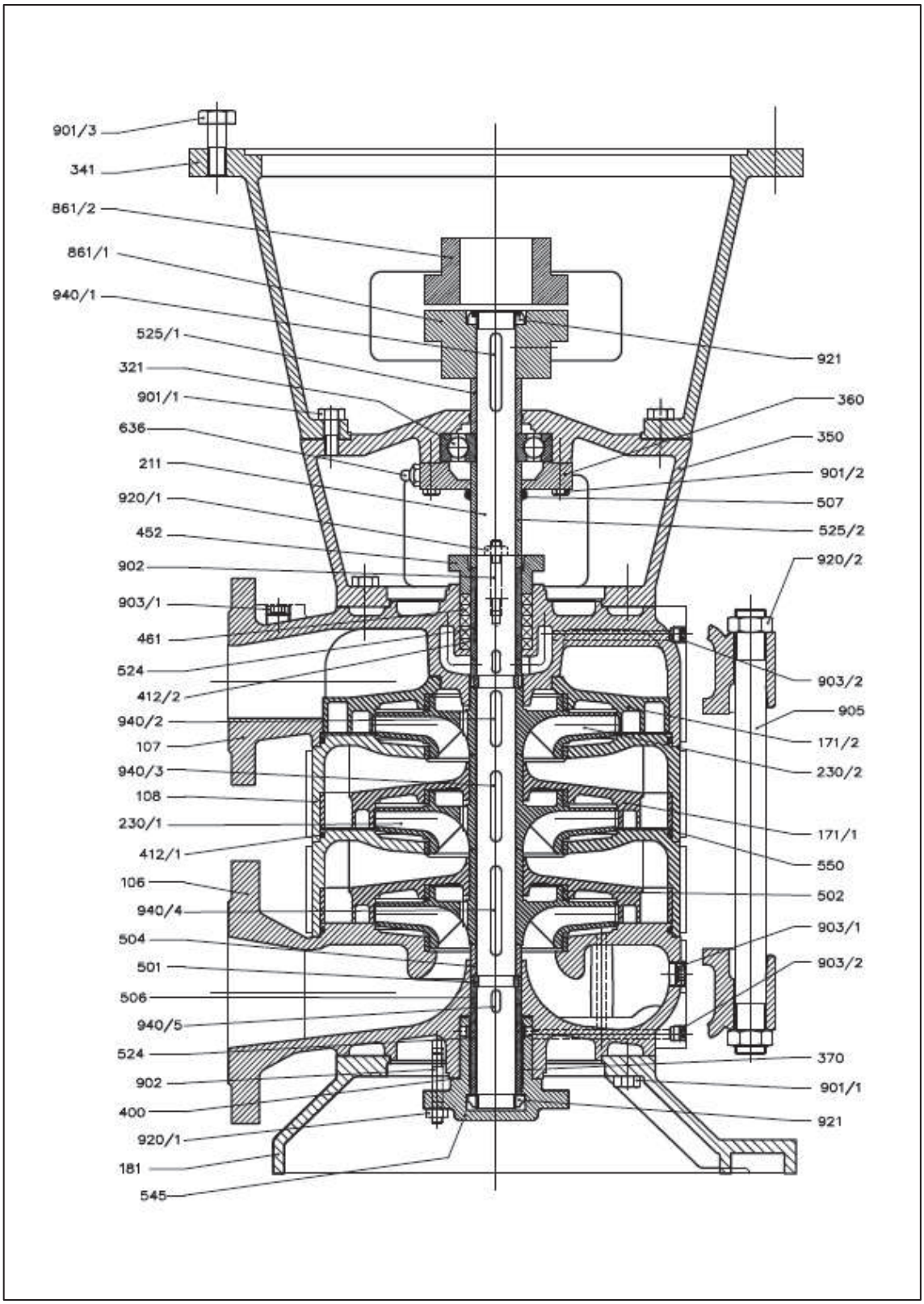

Figure 30: Cross-section of NMV with gland packing

Part no.	Designation	Part no.	Designation
100	Casing	501	Multiple ring
106	Suction casing	502	Casing wear ring
107	Delivery casing	504	Correction ring
108	Stage casing	504/1	Spacer ring
171/1	Diffuser	504/2	Spacer ring
171/2	Diffuser	506	Retaining ring
181	Pump stool	507	Thrower
		524	Shaft wearing sleeve
		524/1	Shaft wearing sleeve
211	Pump shaft	524/2	Shaft wearing sleeve
230/1	Impeller	525/1	Spacer sleeve
230/2	Impeller	525/2	Spacer sleeve
		545	Bearing bush
		550	Disc
321	Radial grooved ball bearing		
341	Motor stool		
350	Bearing housing	636	Grease nipple
360	Bearing cover		
370	Bearing shell		
		861/1	Pump-side coupling half
		861/2	Motor-side coupling half
400	Gasket		
412/1	O-ring		
412/2	O-ring	901/1	Hexagon head bolt
433	Mechanical seal	901/2	Hexagon head bolt
		901/3	Hexagon head bolt
		902	Stud
452	Gland	903/1	Screwed plug
461	Gland packing	903/2	Screwed plug
		905	Tie bolt
		920/1	Hexagon nut
		920/2	Hexagon nut
		921	Shaft nut
		932	Circlip
		940/1	Key
		940/2	Key
		940/3	Key
		940/4	Key
		940/5	Key

Table 29: NMV parts list

9.4 Declaration of Conformity as per EC Directive 2006/42/EC, Annex IIA

We hereby declare under our sole responsibility as manufacturer that the following machine series conform to the relevant specifications of the **EC Machinery Directive 2014/34/EC** both in their type and in the configurations distributed by us.

Designation: **NMH/NMV 32/40/50/65/80**

Pump number: 170000 - 200000

The machine also corresponds with the following directives published in the Official Journal of the European Union:

- Niederspannungsrichtlinie (2014/35/EC)

This declaration shall cease to be valid in the event of any modifications to the machine and/or its protective mechanisms not agreed with us and approved in writing.

Applied harmonized standards and their references in the Official Journal of the European Union:

- DIN EN 809 : 2012
- DIN EN ISO 12100 : 2011
- DIN EN ISO 13732 : 2008
- DIN EN ISO 13857 : 2008
- DIN EN 60034 : 2007
- DIN EN 60204-1 : 2009

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Osnabrück, 31.10.2016 i.V. Arensmann

Rik Arensmann
Technical Director/QM Officer

9.5 Declaration of Conformity as per EC Directive 2014/34/EC, Annex VI

We hereby declare under our sole responsibility as manufacturer that the following machine series of the type, as well as the configurations distributed by us, conform to the relevant specifications of the **EC Directive 2014/34/EC**.

Designation:	**NMH/NMV 32/40/50/65/80**
Pump number:	170000 - 200000

The machine corresponds to the following protection class:

Ex II 2 G c T3

This declaration shall cease to be valid in the event of any modifications to the machine and/or its protective mechanisms not agreed with us and approved in writing.

Applied harmonized standards and their references in the Official Journal of the European Union:

- DIN EN ISO 13463-1 : 2009
- DIN EN ISO 13463-5 : 2011
- DIN EN ISO 15198 : 2007

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Osnabrück, 24.02.2017 i.V. Arensmann

Rik Arensmann
Technical Director/QM Officer

9.6 Clearance Certificate

Please copy and send with the pump.

Clearance Certificate

Legal provisions oblige all businesses to protect their employees, other persons and the environment from damaging effects when handling hazardous substances. Products and their components may therefore only be repaired or inspected when the following declaration has been fully and correctly filled out and singed by an authorized and qualified specialist. Please provide the necessary information should safety measures on the part of the system owner still be required despite complete draining and cleaning. This clearance certificate is part of the repair or inspection order.

We hereby assure that the enclosed device

Type: _____

Serial no.: _____

is free of substances that are hazardous to health. No special safety measures are required for further handling. The device was fully drained and thoroughly cleaned inside and outside before dispatch.

Company/institute: _____

Address: _____

Town/city, ZIP code: _____

Phone: _____

Name: _____

Position: _____

Date: _____

Signature, company stamp: _____

Notes

OSNA PUMPENTECHNOLOGIE

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SYSTEMS
WATER TREATMENT
ENGINEERING
SERVICES

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