NK, NKG

Installation and operating instructions

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GRUNDFOS

Original installation and operating instructions.

CONTENTS

Warning

Prior to installation, read these installation and operating instructions. Installation and operation must comply with local regulations and accepted codes of good practice.

1. Symbols used in this document

Warning

If these safety instructions are not observed, it may result in personal injury.

Caution — If these safety instructions are not observed, it may result in malfunction or damage to the equipment.

Note — Notes or instructions that make the job easier and ensure safe operation.

2. General information

NK, NKG are non-self-priming, single stage, centrifugal volute pumps with axial suction port and radial discharge port.

NK pumps comply with EN 733.

NKG pumps comply with ISO 2858.

3. Receiving the product

3.1 Delivery

The pumps are tested 100 % before leaving the factory. The test includes a function test where the pump performance is measured to ensure that the pump meets the requirements of relevant standards. Test certificates are available from Grundfos. After the installation, the alignment of pump and motor must be checked again. See section *7.3 Alignment*.

3.2 Transporting the product

Always transport the pump in the specified position. During transport, the pump must be fastened securely to prevent damage to the shaft and shaft seal caused by excessive vibrations and knocks. The pump must not be lifted by the shaft.

Warning

Pay attention to the pump weight, and take precautions to prevent personal injury if the pump should topple or fall by accident.

3.3 Handling

Warning

Motors from 4 kW and up are supplied with lifting eyes which must not be used for lifting the entire pump unit.

Lift the pumps by means of nylon straps and shackles.

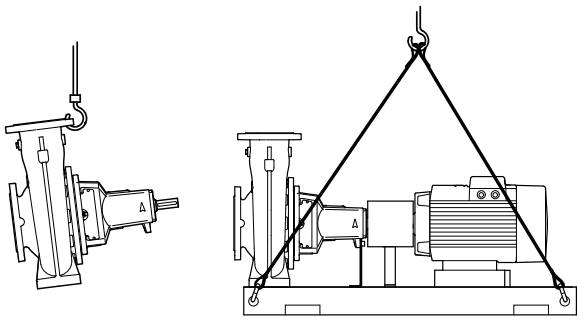

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Fig. 1 Correct lifting of pump

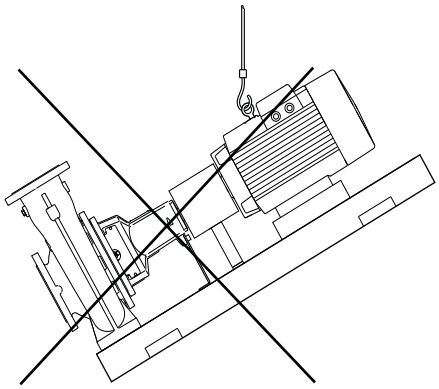

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Fig. 2 Incorrect lifting of pump

3.4 Storing the product

The contractor must inspect the equipment on delivery and make sure that it is stored in such a way that corrosion and damage are avoided.

If more than six months will pass before the equipment is put into operation, please consider applying a suitable corrosion inhibitor to the internal pump parts.

Make sure that the corrosion inhibitor used does not affect the rubber parts with which it comes into contact.

Make sure that the corrosion inhibitor can be easily removed.

To prevent water, dust, etc. from entering the pump, all openings must be kept covered until the pipes are fitted. The cost of having to dismantle the pump during startup to remove foreign objects can be very high.

4. Identification

4.1 Nameplate

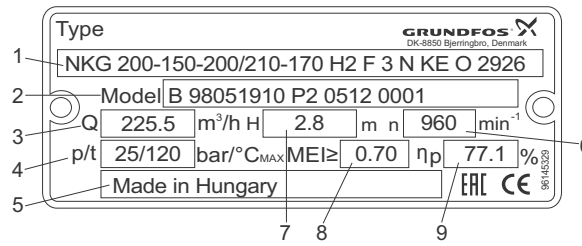

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Fig. 3 Example of NKG nameplate

Legend

Pos.	Description
1	Type designation
2	Model
3	Rated flow
4	Pressure rating or maximum temperature
5	Country of origin
6	Rated speed
7	Pump head
8	Minimum efficiency index
9	Hydraulic pump efficiency at optimum efficiency point

4.2 Type key

Model B

Example 1, pump design according to EN 733	**NK**	**32**	**-125**	**.1**	**/142**	**A1**	**F**	**1**	**A**	**E**	**S**	**BAQE**
Example 2, pump design according to ISO 2858	**NKG**	**200**	**-150**	**-200**	**/210-170**	**H2**	**F**	**3**	**N**	**KE**	**O**	**2926**

Type range

Nominal diameter of suction port (DN)

Nominal diameter of discharge port (DN)

Nominal impeller diameter [mm]

Reduced performance: .1

Actual impeller diameter [mm]

Code for pump version; the codes may be combined

A1	Basic version, grease-lubricated standard bearing design, standard coupling
A2	Basic version, grease-lubricated standard bearing design, spacer coupling
B	Oversize motor
E	With ATEX approval, certificate or test report, the second character of the pump version code is an E
G1	Grease-lubricated heavy-duty bearing design, standard coupling
G2	Grease-lubricated heavy-duty bearing design, spacer coupling
H1	Oil-lubricated heavy-duty bearing design, standard coupling
H2	Oil-lubricated heavy-duty bearing design, spacer coupling
I1	Pump without motor, grease-lubricated standard bearing design, standard coupling
I2	Pump without motor, grease-lubricated standard bearing design, spacer coupling
J1	Pump without motor, grease-lubricated heavy-duty bearing design, standard coupling
J2	Pump without motor, grease-lubricated heavy-duty bearing design, spacer coupling
K1	Pump without motor, oil-lubricated heavy-duty bearing design, standard coupling
K2	Pump without motor, oil-lubricated heavy-duty bearing design, spacer coupling
Y1	Bare shaft pump, grease-lubricated standard bearing design
W1	Bare shaft pump, grease-lubricated heavy-duty bearing design
Z1	Bare shaft pump, oil-lubricated heavy-duty bearing design
X	Special version; used in case of further customisation than already listed

Pipe connection

E	Table E flange
F	DIN flange
G	ANSI flange
J	JIS flange

Flange pressure rating (PN - rated pressure)

1	10 bar
2	16 bar
3	25 bar
4	40 bar
5	Other pressure rating

Materials

	Pump housing	Impeller	Wear ring	Shaft
A	EN-GJL-250	EN-GJL-200	Bronze/brass	1.4021/1.4034
B	EN-GJL-250	Bronze CuSn10	Bronze/brass	1.4021/1.4034
C	EN-GJL-250	EN-GJL-200	Bronze/brass	1.4401
D	EN-GJL-250	Bronze CuSn10	Bronze/brass	1.4401
E	EN-GJL-250	EN-GJL-200	EN-GJL-250	1.4021/1.4034
F	EN-GJL-250	Bronze CuSn10	EN-GJL-250	1.4021/1.4034
G	EN-GJL-250	EN-GJL-200	EN-GJL-250	1.4401
H	EN-GJL-250	Bronze CuSn10	EN-GJL-250	1.4401
I	1.4408	1.4408	1.4517	1.4462
J	1.4408	1.4408	Carbon-graphite-filled PTFE (Graflon®)	1.4462
K	1.4408	1.4408	1.4517	1.4401
L	1.4517	1.4517	1.4517	1.4462
M	1.4408	1.4517	1.4517	1.4401
N	1.4408	1.4408	Carbon-graphite-filled PTFE (Graflon®)	1.4401

Example 1, pump design according to EN 733					**NK**	**32**	**-125**	**.1**	**/142**	**A1**	**F**	**1**	**A**	**E**	**S**	**BAQE**
Example 2, pump design according to ISO 2858					**NKG**	**200**	**-150**	**-200**	**/210-170**	**H2**	**F**	**3**	**N**	**KE**	**O**	**2926**

P	1.4408	1.4517	Carbon-graphite-filled PTFE (Graflon®)	1.4401
R	1.4517	1.4517	Carbon-graphite-filled PTFE (Graflon®)	1.4462
S	EN-GJL-250	1.4408	Bronze/brass	1.4401
T	EN-GJL-250	1.4517	Bronze/brass	1.4462
U	1.4408	1.4517	1.4517	1.4462
W	1.4408	1.4517	Carbon-graphite-filled PTFE (Graflon®)	1.4462
X	Special version			

Rubber parts in pump

The first letter indicates material of O-rings for pump cover and seal cover. O-ring for seal cover is only for double seal arrangements

The second letter indicates material of O-ring for seal housing. O-ring for seal housing is only for double seal arrangements

- E EPDM
- F FXM (Fluoraz®)
- K FFKM (Kalrez®)
- M FEPS (PTFE-sheathed silicone O-ring)
- V FKM (Viton®)
- X HNBR

Shaft seal arrangement

- B Stuffing box
- C Cartridge seal, single
- D Cartridge seal, double
- O Back-to-back, double seal
- P Tandem, double seal
- S Single seal

Shaft seal(s) in pump

Letter or digit code for mechanical shaft seal and shaft seal rubber parts

- 4 letters: Single mechanical shaft seal, such as BQQE, or single cartridge seal, such as HBQV
- 4 digits: Double seal solution; example 2716, where 27 is DQQV, primary seal, and 16 is BQQV, secondary seal; double cartridge seal; example 5150, where 51 is HQQU, primary seal, and 50 is HBQV, secondary seal

The relation between letters and digits of the shaft seals is described on page 6.

Example 1 shows an NK 32-125.1 pump with these characteristics:

- reduced performance
- 142 mm impeller
- grease-lubricated standard bearing design
- standard coupling
- DIN flange to EN 1092-2 pipework connection
- 10 bar flange pressure rating
- cast iron pump housing, EN-GJL-250
- cast iron impeller, EN-GJL-200
- bronze/brass wear ring
- stainless steel shaft, EN 1.4021/1.4034
- EPDM O-ring for pump cover
- single shaft seal arrangement
- BAQE shaft seal

Example 2 shows an NKG 200-150-200 pump with these characteristics:

- 210-170 mm conical impeller
- grease-lubricated heavy-duty bearing design
- spacer coupling
- DIN flange to EN 1092-2 pipework connection
- 25 bar flange pressure rating
- stainless steel pump housing, EN 1.4408
- stainless steel impeller, EN 1.4408
- carbon-graphite-filled PTFE (Graflon®) wear ring
- stainless steel shaft, EN 1.4401
- FFKM O-rings for pump cover and seal cover
- EPDM O-ring for seal housing
- back-to-back double shaft seal arrangement
- primary shaft seal: DQQK
- secondary shaft seal: DQQE

4.2.1 Codes for shaft seals

The digits are only used for double shaft seal solutions.

Digits	Letters	Description
10	BAQE	Single mechanical shaft seal
11	BAQV	Single mechanical shaft seal
12	BBQE	Single mechanical shaft seal
13	BBQV	Single mechanical shaft seal
14	BQBE	Single mechanical shaft seal
15	BQQE	Single mechanical shaft seal
16	BQQV	Single mechanical shaft seal
17	GQQE	Single mechanical shaft seal
18	GQQV	Single mechanical shaft seal
19	AQAE	Single mechanical shaft seal
20	AQAV	Single mechanical shaft seal
21	AQQE	Single mechanical shaft seal
22	AQQV	Single mechanical shaft seal
23	AQQX	Single mechanical shaft seal
24	AQQK	Single mechanical shaft seal
25	DAQF	Single mechanical shaft seal
26	DQQE	Single mechanical shaft seal
27	DQQV	Single mechanical shaft seal
28	DQQX	Single mechanical shaft seal
29	DQQK	Single mechanical shaft seal
50	HBQV	Cartridge seal
51	HQQU	Cartridge seal
52	HAQK	Cartridge seal
	SNEA	Stuffing box
	SNEB	Stuffing box
	SNEC	Stuffing box
	SNED	Stuffing box
	SNOA	Stuffing box
	SNOB	Stuffing box
	SNOC	Stuffing box
	SNOD	Stuffing box
	SNFA	Stuffing box
	SNFB	Stuffing box
	SNFC	Stuffing box
	SNFD	Stuffing box

4.2.2 Letter codes for shaft seals

Example: 10 is BAQE	B	A	Q	E

Shaft seal type

- A O-ring seal with fixed driver
- B Rubber bellows seal
- D O-ring seal, balanced
- G Bellows seal, type B, with reduced seal faces
- H Cartridge seal, balanced

Material, rotating seal face

- A Carbon, metal-impregnated with antimony which is not approved for potable water
- B Carbon, resin-impregnated
- Q Silicon carbide

Example: 10 is BAQE	B	A	Q	E

Material, stationary seat

- A Carbon, metal-impregnated with antimony which is not approved for potable water
- B Carbon, resin-impregnated
- Q Silicon carbide

Material, secondary seal and other rubber and composite parts, except the wear ring

- E EPDM
- V FKM (Viton®)
- F FXM (Fluoraz®)
- K FFKM (Kalrez®)
- X HNBR
- U Dynamic O-rings in FFKM and static O-rings in PTFE

For a thorough description of shaft seal types and materials, see the data booklet "NB, NBG, NK, NKG, NBE, NBGE, NKE, NKGE - Custom-built pumps according to EN 733 and ISO 2858".

4.2.3 Letter codes for stuffing boxes

Example:	S	N	E	A

Stuffing box type

- S Packing type stuffing box

Cooling method

- N Uncooled stuffing box

Barrier liquid

- E With internal barrier liquid
- F With external barrier liquid
- O Without barrier liquid

Material

- A PTFE-impregnated fibre packing rings (Buraflon®) and EPDM O-rings in the pump housing
- B Graphite-PTFE compound packing rings (Thermoflon®) and EPDM O-ring in the pump housing
- C PTFE-impregnated fibre packing rings (Buraflon®) and FKM O-ring in the pump housing
- D Graphite-PTFE compound packing rings (Thermoflon®) and FKM O-ring in the pump housing

For a thorough description of stuffing boxes and materials, see the data booklet "NB, NBG, NK, NKG, NBE, NBGE, NKE, NKGE - Custom-built pumps according to EN 733 and ISO 2858".

5. Applications

5.1 Pumped liquids

Clean, thin, non-explosive liquids without solid particles or fibres. The pumped liquid must not attack the pump materials chemically.

6. Operating conditions

6.1 Ambient temperature and altitude

The ambient temperature and the installation altitude are important factors for the motor life as they affect the life of the bearings and the insulation system.

If the ambient temperature exceeds the recommended maximum ambient temperature or the installation altitude exceeds the recommended maximum altitude above sea level, see fig. 4, the motor must not be fully loaded due to the low density and consequently low cooling effect of the air. In such cases, it may be necessary to use a motor with a higher output.

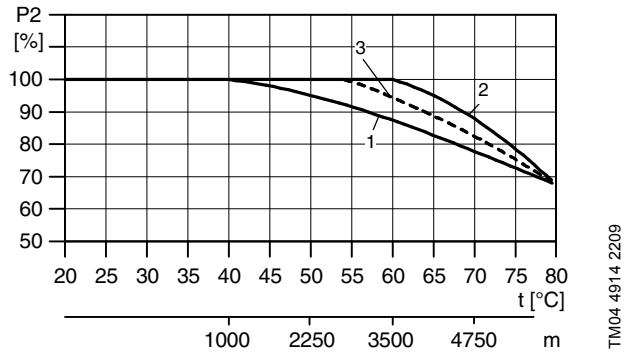


Fig. 4 The maximum motor output depends on the ambient temperature and altitude

Legend

Pos.	Description
1	0.25 - 0.55 kW MG motors
2	0.75 - 22 kW MG motors, IE2/IE3
	0.75 - 450 kW MMG-H motors, IE2
3	0.75 - 462 kW Siemens motors, IE2

Example: A pump with a 1.1 kW IE2 MG motor: If this pump is installed 4750 m above sea level, the motor must not be loaded more than 88 % of the rated output. At an ambient temperature of 75 °C, the motor must not be loaded more than 78 % of the rated output. If the pump is installed 4750 m above sea level at an ambient temperature of 75 °C, the motor must not be loaded more than 88 % x 78 % equal to 68.6 % of the rated output.

6.2 Liquid temperature

-40 - +140 °C.

The maximum liquid temperature is stated on the pump nameplate. It depends on the shaft seal chosen.

For EN-GJL-250 cast iron pump housings, local regulations may not allow liquid temperatures above +120 °C.

6.3 Maximum operating pressure

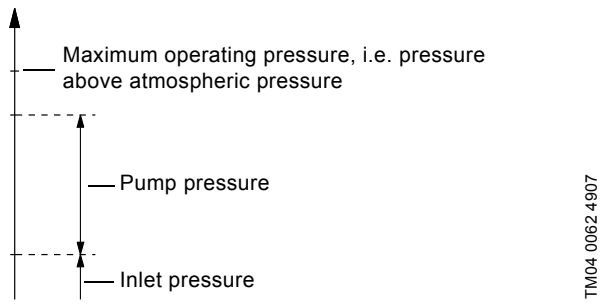


Fig. 5 Pressures in the pump

The inlet pressure + the pump pressure must be lower than the maximum operating pressure stated on the pump nameplate. Operation against a closed discharge valve gives the highest operating pressure.

6.4 Minimum inlet pressure

Pay attention to the minimum inlet pressure to avoid cavitation. The risk of cavitation is higher in the following situations:

- The liquid temperature is high.
- The flow rate is considerably higher than the pump's rated flow rate.
- The pump is operating in an open system with suction lift.
- The liquid is sucked through long pipes.
- The inlet conditions are poor.
- The operating pressure is low.

6.5 Maximum inlet pressure

The inlet pressure + the pump pressure must be lower than the maximum operating pressure stated on the pump nameplate. Operation against a closed discharge valve gives the highest operating pressure.

6.6 Minimum flow rate

The pump must not run against a closed discharge valve as this will cause an increase in temperature/formation of steam in the pump. This may cause shaft damage, impeller erosion, short life of bearings and damage to stuffing boxes or mechanical shaft seals due to stress or vibration. The continuous flow rate must be at least 10 % of the rated flow rate. The rated flow rate is stated on the pump nameplate.

6.7 Maximum flow rate

The maximum flow rate must not be exceeded as otherwise there is a risk of for instance cavitation and overload.

The minimum and maximum flow rates can be read either from the performance curve pages in the relevant data booklets or from a curve for a specific pump when selecting it in Grundfos Product Center.

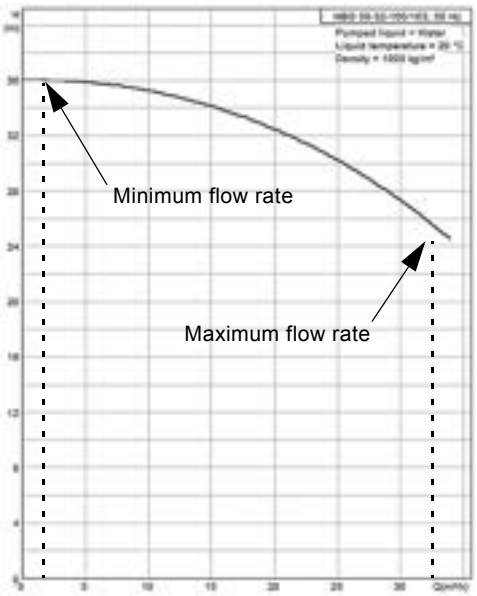
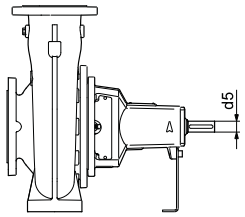


Fig. 6 Example from Grundfos Product Center showing minimum and maximum flow rate

6.8 Shaft seals

Mechanical shaft seals

The operating range of the seals is described for two main applications: pumping of water or pumping of coolants.
Seals with a temperature range of 0 °C and up are mainly used for pumping water, while seals for temperatures below 0 °C are mainly intended for coolants.
Note: We do not recommend operation at maximum temperature and maximum pressure at the same time as the seal life will be reduced and periodical noise will occur.



Shaft seal diameter [mm]					**28, 38**	**48**	**55**	**60**
d5 [mm]					**24, 32**	**42**	**48**	**60**
Shaft seal type		**Seal faces**	**Rubber**	**Code**	**Temperature range**	**Max. pressure [bar]**		
	Bellows seal, type B, unbalanced	AQ_1	EPDM	BAQE	0-120 °C	16	16	16	16
		AQ_1	FKM	BAQV	0-90 °C	16	16	16	16
		BQ_1	EPDM	BBQE	0-120 °C	16	16	16	16
		BQ_1	FKM	BBQV	0-90 °C	16	16	16	16
		Q_1B	EPDM	BQBE	0-100 °C	16	-	-	-
		Q_7Q_7	EPDM	BQQE	-25 - +120 °C	16	16	16	16
		Q_7Q_7	FKM	BQQV	-10 - +90 °C	16	16	16	16
	Bellow seal, type B, unbalanced with reduced seal faces	Q_1Q_1	EPDM	GQQE	-25 - +60 °C	16	16	16	16
		Q_1Q_1	FKM	GQQV	-10 - +60 °C	16	16	16	16
	O-ring seal, type A, unbalanced	Q_1A	EPDM	AQAE	0-120 °C	16	16	16	16
		Q_1A	FKM	AQAV	0-90 °C	16	16	16	16
		Q_1Q_1	EPDM	AQQE	-25 - +90 °C	16	16	16	16
		Q_1Q_1	FKM	AQQV	-10 - +90 °C	16	16	16	16
		Q_1Q_1	HNBR	AQQX	-15 - +90 °C	16	16	16	16
		Q_1Q_1	FFKM	AQQK	0-90 °C	16	16	16	16
	O-ring seal, type D, balanced	AQ_1	FXM	DAQF	0-140 °C	25	25	25	25
		Q_6Q_6	EPDM	DQQE	-20 - +120 °C	25	25	25	25
		Q_6Q_6	FKM	DQQV	-10 - +90 °C	25	25	25	25
		Q_6Q_6	HNBR	DQQX	-15 - +120 °C	25	25	25	25
		Q_6Q_6	FFKM	DQQK	0-120 °C	25	25	25	25

Stuffing box

	Code	**Temperature range**	**Max. pressure [bar]**
Stuffing box without cooling, with internal barrier liquid	SNE	-30 - +120 °C	16
Stuffing box without cooling, without barrier liquid	SNO		
Stuffing box without cooling, with external barrier liquid	SNF		

7. Mechanical installation

7.1 Pump location

The pump must be sited in a well-ventilated, but frost-free location.

Warning

When pumping hot or cold liquids, make sure that persons cannot accidentally come into contact with hot or cold surfaces.

For inspection and repair, allow suitable clearances for pump or motor removal.

- Pumps fitted with motors up to and including 4 kW require a 0.3 m clearance behind the motor.
- Pumps fitted with motors of 5.5 kW and up require a 0.3 m clearance behind the motor and at least a 1 m clearance above the motor to allow the use of lifting equipment.

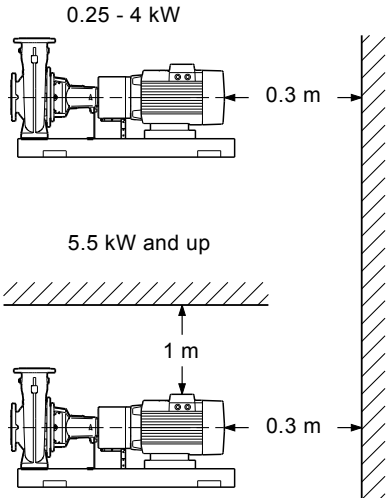


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Fig. 7 Clearance behind the motor

7.2 Foundation and grouting of horizontally mounted NK, NKG pumps with base frame

We recommend that you install the pump on a plane and rigid concrete foundation which is heavy enough to provide permanent support for the entire pump. The foundation must be capable of absorbing any vibration, normal strain or shock. As a rule of thumb, the weight of the concrete foundation must be 1.5 times the weight of the pump.

The foundation must be 100 mm larger than the base frame on all four sides. See fig. 8.

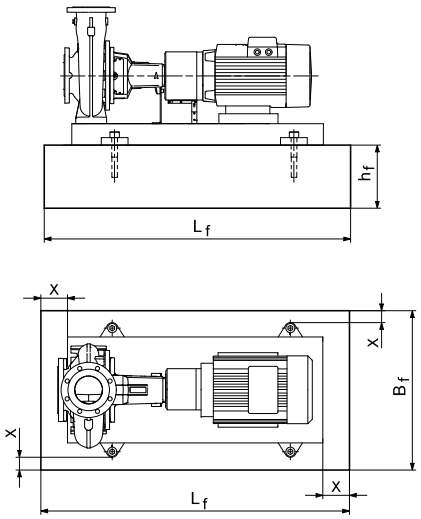

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Fig. 8 Foundation, X equal to minimum 100 mm

The minimum height of the foundation, h_f, can then be calculated:

$$h_f = \frac{m_{pump} \times 1.5}{L_f \times B_f \times \delta_{concrete}}$$

The density, δ, of concrete is usually taken as 2,200 kg/m^3.

Place the pump on the foundation, and fasten it. The base frame must be supported under its entire area. See fig. 9.

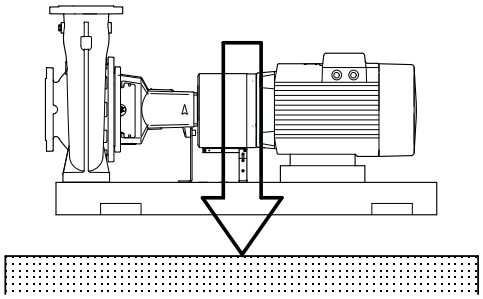

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Fig. 9 Correct foundation

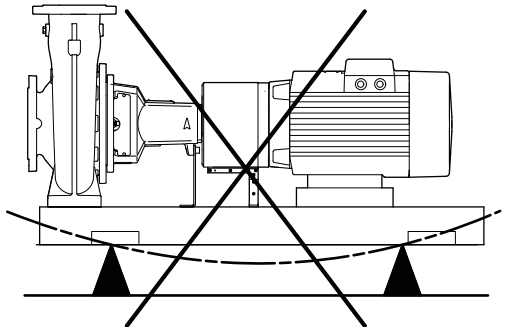

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Fig. 10 Incorrect foundation

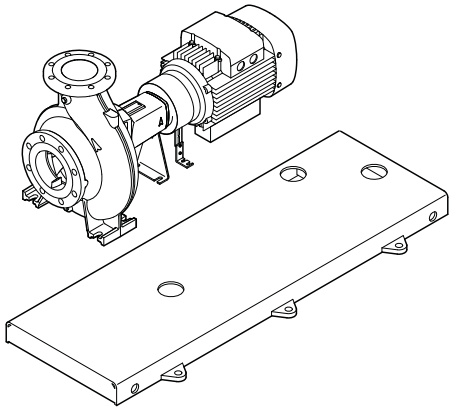

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Fig. 11 Base frame with pouring holes

It is important to prepare a good foundation prior to the installation of the pump.

NK, NKG pumps with base frame are always prepared for grouting.

For NK, NKG pumps with 2-pole motors equal to or bigger than 55 kW, grouting of the base frame is mandatory in order to prevent vibration energy from the rotating motor and liquid flow to evolve.

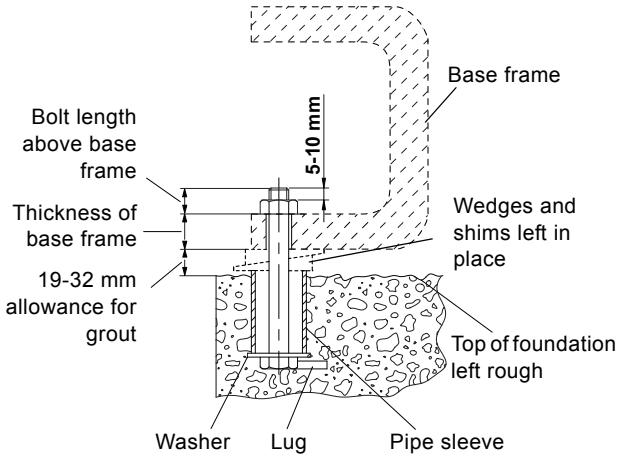
	P2 lower than or equal to 45 kW	P2 equal to or higher than 55 kW
2-pole	Grouting optional	Grouting mandatory
4-pole	Grouting optional	
6-pole	Grouting optional	

7.2.1 Procedure

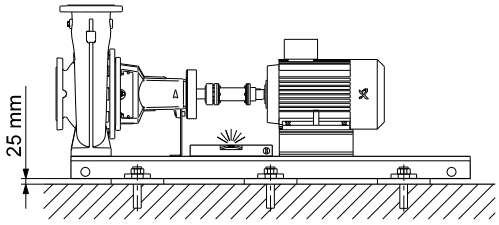
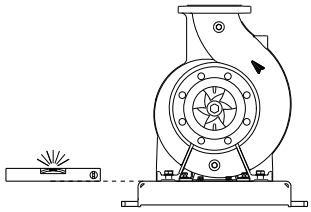
1. Preparing the foundation
2. Levelling of the base frame
3. Preliminary alignment
4. Grouting
5. Final alignment according to section *7.3 Alignment*.

1: Preparing the foundation

We recommend the following procedure to ensure a good foundation.

Step	Action	Illustration
1	Use an approved, non-shrinking concrete. Contact your concrete supplier for advice if any doubts. Pour the foundation without interruptions to within 19 to 32 mm of the final level. Use vibrators to ensure that the concrete is evenly distributed. The top surface must be well scored and grooved before the concrete sets. This provides a bonding surface for the grout.	
2	Embed foundation bolts in the concrete. Allow enough bolt length to reach through grout, shims, lower base frame, nuts and washers.	 TM03 0190 4707
3	Let the foundation cure for several days before the base frame is levelled and grouted.	

2: Levelling of the base frame

Step	Action	Illustration
1	Lift/jack up the base frame to the final level 19-32 mm above the concrete foundation, and support the base frame by means of blocks and shims both at the foundation bolts and midway between bolts.	 TM04 0488 0708
2	Level the base frame by adding or removing shims under the base frame.	 TM04 0489 0708
3	Tighten the foundation bolt nuts against the base frame. Make sure the piping can be aligned to the pump flanges without putting strain on pipes or flanges.	

3: Preliminary alignment

Warning

Before starting work on the pump, make sure that the power supply has been switched off and cannot be accidentally switched on again.

The pump and motor are pre-aligned on the base frame from the factory. Some deformation of the base frame may occur during transport and it is therefore essential to check the alignment at the installation site prior to final grouting.

A flexible coupling will only compensate for minor misalignments and must not be used to compensate for excessive misalignment of the pump and motor shafts. Inaccurate alignment results in vibration and excessive wear on the bearings, shaft or wear rings.

Warning

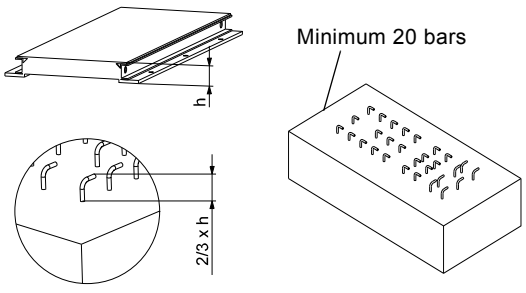
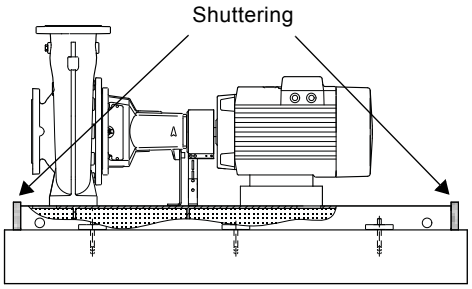
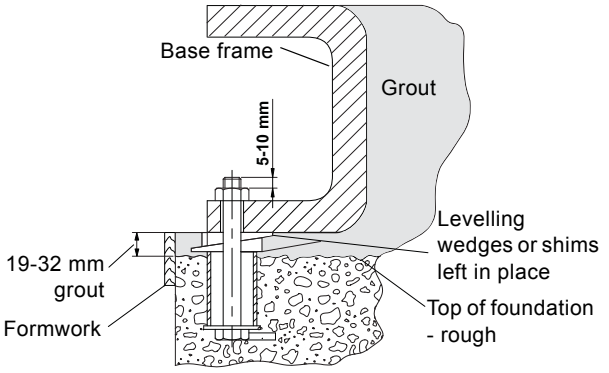
Carry out alignment of the motor only, as pipe strain will occur if the pump is shifted.

Carry out alignment of the motor by placing shims of different thickness under the motor. If possible, replace several thin shims with one thick shim.

See section *7.3 Alignment*.

4: Grouting

Grouting compensates for an uneven foundation, distributes the weight of the unit, dampens vibrations and prevents shifting. Use an approved, non-shrinking grout. If you have questions or doubts about the grouting, please contact an expert on grouting.

Step	Action	Illustration
1	Embed reinforcing steel bars into the foundation by means of 2K anchor adhesive glue. The number of steel bars depends on the size of the base frame, but it is advisable to distribute a minimum of 20 bars evenly over the whole area of the base frame. The free end of the steel bar must be 2/3 the height of the base frame to ensure a proper grouting.	 TM04 0490 0708 - TM04 0491 0708
2	Soak top of concrete foundation thoroughly, then remove surface water.	
3	Ensure proper shuttering at both ends of the base frame.	 TM03 4590 2206
4	If necessary, check the levelling of the base frame again before grouting. Pour non-shrinking grout through the openings of the base frame until the space underneath the base frame has been filled completely. Fill the formwork with grout up to the base frame top level. Allow the grout to dry thoroughly before attaching piping to the pump. 24 hours is sufficient time with approved grouting procedure. When the grout has thoroughly hardened, check the foundation bolt nuts, and tighten, if necessary. Approximately two weeks after the grout has been poured, or when the grout has thoroughly dried, apply an oil-based paint to the exposed edges of the grout to prevent the grout from getting into contact with air and moisture.	 TM03 2946 4707

7.3 Alignment

7.3.1 General information

When a complete unit is supplied assembled from the factory, the coupling halves have been accurately aligned by means of foil inserted under the pump and motor mounting surfaces as required.

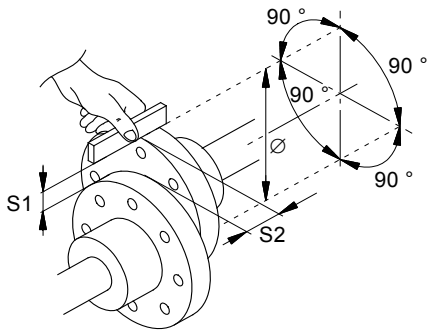
As the pump/motor alignment may be affected during transport and installation, it must always be checked again before starting the pump.

It is important to check the final alignment when the pump has obtained its operating temperature under normal operating conditions.

7.3.2 How to align the unit

It is very important that the pump/motor alignment is carried out correctly. Follow the procedure below.

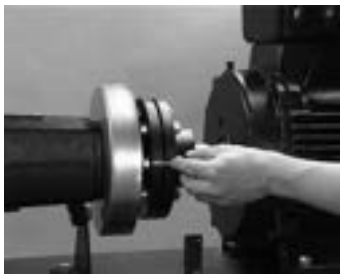
The values for ∅ and S2 can be found in the following table. The value for S1 is 0.2 mm.

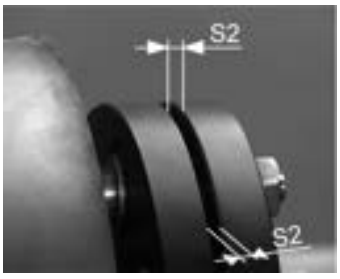


TM01 8753 0800

Fig. 12 Alignment

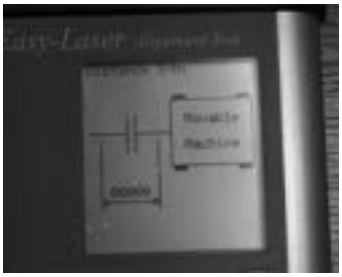
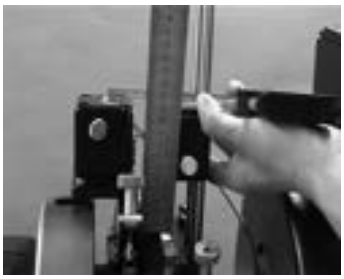
Aligning the pump and motor with a straight-edge ruler

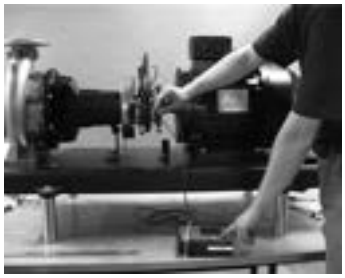
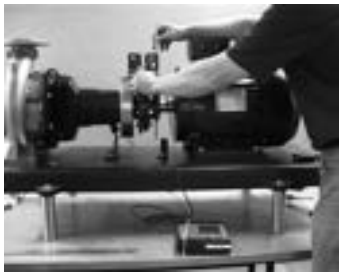
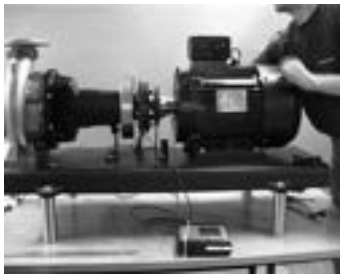
Step	Action
1  TM03 8340 1007	Make a rough alignment of pump and motor, and tighten the screws in the base frame to the correct torque. See the table *Tightening torques* on page 15.
2  TM03 8301 1007	Make a mark on the coupling, for instance with a marker pen.
3  TM03 8300 1007	Hold a straight-edge ruler against the coupling, and determine the inaccuracy, if any, with a feeler gauge.
4  TM03 8302 1007	Turn the coupling 90 °, and repeat the measurement with straight-edge and feeler gauge. If the measured values are less than 0.2 mm, the alignment is complete. Go to step *8*.

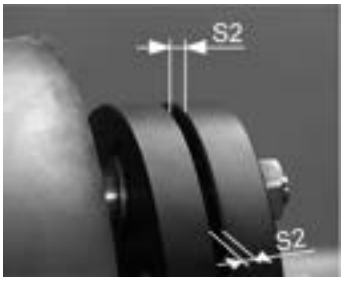
Step	Action
5  TM03 8321 1007	Adjust the position of the motor. Loosen the screws that hold the motor in place.
6  TM03 8322 1007	Insert shims with the required thickness.
7  TM03 8324 1007	Tighten the screws to the correct torque. Go to step *3*, and check the alignment once more.
8  TM03 8325 1007	Check the gap S2 both vertically and horizontally. See the table *Air-gap width S2* on page 15. If the air-gap width is within the tolerances, the alignment is complete. If not, go to step *6*.

Aligning the pump and motor with laser equipment

Step	Action
9	 TM03 8340 1007 Make a rough alignment of pump and motor, and tighten the screws in the base frame to the correct torque. See the table *Tightening torques* on page 15.
10	 TM03 8303 1007 Fasten one laser bracket to the pump coupling.
11	 TM03 8304 1007 Fasten the other laser bracket to the motor coupling.
12	 TM03 8305 1007 Place laser unit S, stationary, on the stationary part and laser unit M, movable, on the movable part.
13	 TM03 8306 1007 Interconnect the laser units, and connect one laser unit to the control box.
14	 TM03 8307 1007 Make sure that the laser units are at the same height.

Step	Action
15	 TM03 8309 1007 Measure the distance between the white lines on the laser units.
16	 TM03 8308 1007 Enter the distance.
17	 TM03 8310 1007 Measure the distance between the S unit and the centre of the gap between the couplings.
18	 TM03 8311 1007 Enter the distance.
19	 TM03 8312 1007 Measure the distance from the S unit to the first screw on the motor.
20	 TM03 8313 1007 Enter the distance.

Step	Action
21	 TM03 8314 1007 Measure the distance from the S unit to the rear screw on the motor.
22	 TM03 8315 1007 The control box shows that the laser units must be turned to position 9 o'clock.
23	 TM03 8316 1007 Turn the laser units to position 9 o'clock.
24	 TM03 8319 1007 Confirm on the control box.
25	 TM03 8317 1007 Turn the laser units to position 12 o'clock. Confirm on the control box.
26	 TM03 8318 1007 Turn the laser units to position 3 o'clock. Confirm on the control box.

Step	Action
27	 TM03 8320 1007 If the measured values are less than 0.1 mm, the alignment is complete. Go to step *32*.
28	 TM03 8321 1007 Adjust the position of the motor. Loosen the screws that hold the motor in place.
29	 TM03 8322 1007 Insert shims with the required thickness.
30	 TM03 8324 1007 Tighten the screws to the correct torque again.
31	 TM03 8320 1007 Repeat the alignment until the values are within the tolerances. Go to step *22*.
32	 TM03 8325 1007 Check the gap S2. See the table *Air-gap width S2* on page 15.

Tightening torques

Description	Dimensions	Tightening torque [Nm]
Hexagon head screw	M6	10 ± 2
	M8	12 ± 2.4
	M10	23 ± 4.6
	M12	40 ± 8
	M16	80 ± 16
	M20	120 ± 24
	M24	120 ± 24

Air-gap width S2

Outside coupling diameter [mm]	Air-gap width S2 [mm]			
	Standard coupling		Spacer coupling	
	Nominal	Tolerance	Nominal	Tolerance
80	-	-	4	0/-1
95	-	-	4	0/-1
110	-	-	4	0/-1
125	4	0/-1	4	0/-1
140	4	0/-1	4	0/-1
160	4	0/-1	4	0/-1
200	4	0/-1	6	0/-1
225	4	0/-1	6	0/-1
250	4	0/-1	8	0/-1

Note

Measure S2 all the way around the coupling. The maximum permissible deviation between the largest and the smallest measurement is 0.2 mm.

If the coupling and motor are not supplied by Grundfos, make sure to follow the coupling manufacturer's instructions.

Warning

The coupling guard must always be fitted during operation.

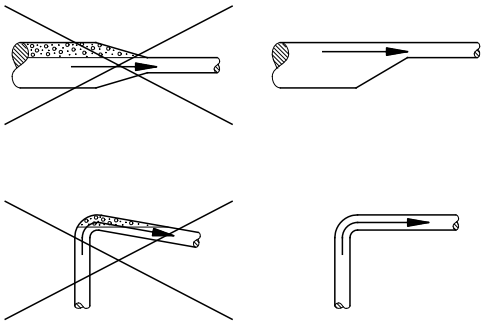
7.4 Pipework

7.4.1 Piping

When installing the pipes, make sure that the pump housing is not stressed by the pipework.

The suction and discharge pipes must be of an adequate size, taking the pump inlet pressure into account.

Install the pipes so that air locks are avoided, especially on the suction side of the pump.

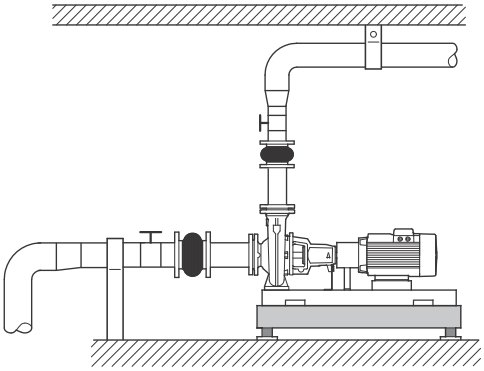


TM00 2263 3393

Fig. 13 Pipelines

Fit isolating valves on either side of the pump to avoid having to drain the system if the pump needs to be cleaned or repaired.

Make sure the pipes are adequately supported as close to the pump as possible, both on the suction and the discharge side. The counter-flanges must lie true against the pump flanges without being stressed as stress would cause damage to the pump.



TM05 3488 1412.

Fig. 14 Pipeline mounting

7.4.2 Bypass

Warning

The pump is not allowed to run against a closed valve as this will cause an increase in temperature/ formation of steam in the pump which may cause damage to the pump.

If there is any danger of the pump running against a closed discharge valve, ensure a minimum liquid flow through the pump by connecting a bypass or drain to the discharge pipe. The minimum flow rate must be at least 10 % of the maximum flow rate. The flow rate and head are stated on the pump nameplate.

7.5 Vibration damping

7.5.1 Elimination of noise and vibrations

In order to achieve optimum operation and minimum noise and vibration, consider vibration damping of the pump. Generally, always consider this for pumps with motors of 11 kW and up. Vibration damping is mandatory for motors of 90 kW and up. Smaller motor sizes, however, may also cause undesirable noise and vibration.

Noise and vibration are generated by the revolutions of the motor and pump and by the flow in pipes and fittings. The effect on the environment is subjective and depends on correct installation and the state of the rest of the system.

Elimination of noise and vibrations is best achieved by means of a concrete foundation, vibration dampers and expansion joints. See fig. 14.

7.5.2 Vibration dampers

To prevent the transmission of vibrations to buildings, we recommend isolating the pump foundation from building parts by means of vibration dampers.

The selection of the right vibration damper requires the following data:

- forces transmitted through the damper
- motor speed, taking speed control, if any, into consideration
- required damping in % - suggested value is 70 %.

The selection of vibration damper differs from installation to installation. In certain cases, a wrong damper may increase the vibration level. Vibration dampers must therefore be sized by the supplier of the vibration dampers.

If you install the pump on a foundation with vibration dampers, always fit expansion joints on the pump flanges. This is important to prevent the pump from "hanging" in the flanges.

7.6 Expansion joints

Expansion joints provide these advantages:

- absorption of thermal expansion and contraction of pipework caused by variations in liquid temperature
- reduction of mechanical influences in connection with pressure surges in the pipework
- isolation of structure-borne noise in the pipework; this applies only to rubber bellows expansion joints.

Note Do not install expansion joints to make up for inaccuracies in the pipework, such as centre displacement or misalignment of flanges.

The expansion joints must be fitted at a minimum distance of 1 to 1 1/2 pipe diameters away from the pump on the suction and the discharge side. This prevents turbulence in the joints, thus ensuring optimum suction conditions and minimum pressure loss on the discharge side. At flow velocities greater than 5 m/s, we recommend fitting larger expansion joints matching the pipework.

Figures 15 and 16 show examples of rubber bellows expansion joints with or without limiting rods.

TM02 4979 1902

Fig. 15 Rubber bellows expansion joint with limiting rods

TM02 4981 1902

Fig. 16 Rubber bellows expansion joint without limiting rods

Expansion joints with limiting rods can be used to reduce the effects of the expansion/contraction forces on the pipework. We always recommend expansion joints with limiting rods for flanges larger than DN 100.

Anchor the pipes in such a way that they do not stress the expansion joints and the pump. Follow the supplier's instructions and pass them on to advisers or pipe installers.

Figure 17 shows an example of a metal bellows expansion joint with limiting rods.

TM02 4980 1902

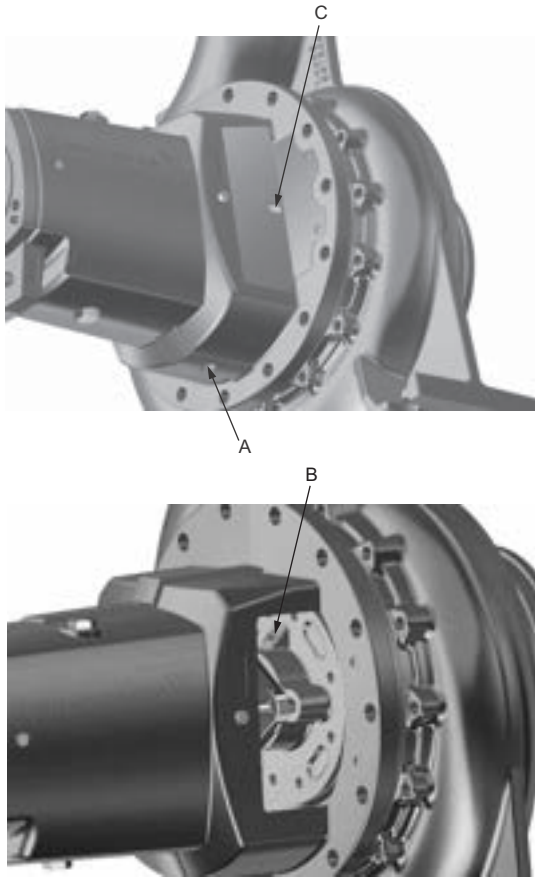
Fig. 17 Metal bellows expansion joint with limiting rods

Due to the risk of rupture of the rubber bellows, metal bellows expansion joints may be preferred at temperatures above +100 °C combined with high pressure.

7.7 Stuffing box piping

Pumps with stuffing box will always have a continuous leakage during normal operation. We recommend to connect a drainage pipe to the drain hole of the bearing bracket, pos. A, G1/2, to collect the leaking liquid.

For pumps with stuffing box, type SNF, and external barrier liquid, connect the drain pipe to the hole, pos. B, G1/8, before starting the pump. The outlet hole for the external flushing pipe, pos. C, is ∅10.

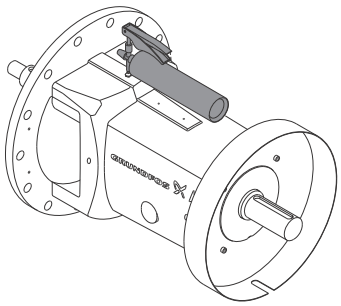


TM06 3413 0315 - TM06 3414 0315

Fig. 18 Pipe connections for stuffing box operation

7.8 Bearing bracket

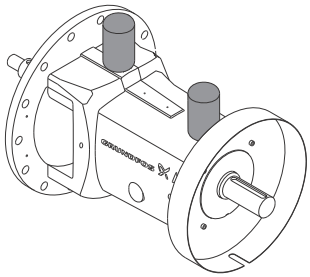
7.8.1 Bearing bracket with grease lubrication



TM06 1826 3014

Fig. 19 Bearing bracket with grease nipples

Relubricate the bearings by means of a grease gun. See section *11.2.1 Grease-lubricated bearings* to get recommended re-lubricating intervals.

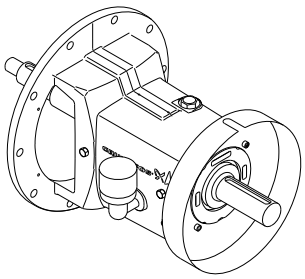


TM04 5173 3014

Fig. 20 Bearing bracket with automatic grease lubricators

The lubricators are supplied separately. Remove the grease nipples, fit the grease lubricators on top of the bearing bracket and set them to empty within 12 months according to the instructions supplied with the lubricators.

7.8.2 Bearing bracket with constant-level oiler



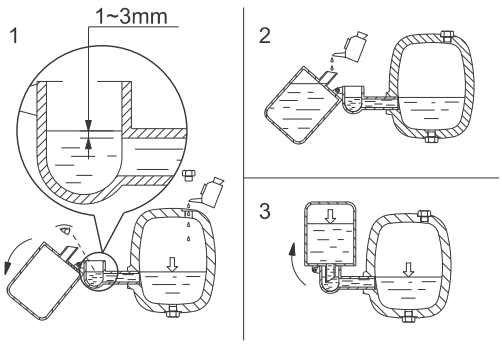
TM04 5174 2709

Fig. 21 Bearing bracket with constant-level oiler

Caution There is no oil in bearing bracket when it is delivered.

Note Fit the constant-level oiler on the bearing bracket before filling oil into the bearing bracket. See instructions on the label on the reservoir.

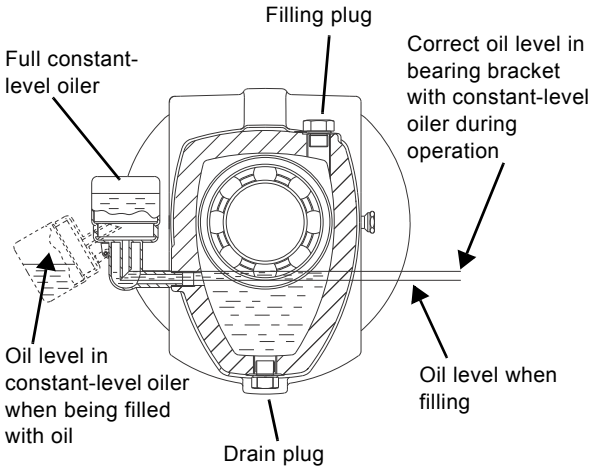
Filling of oil



TM05 3612 1612

Fig. 22 Filling of oil

Step	Action
1	Remove the filling plug.
2	Hinge down the constant-level oiler, and pour the oil through the filling hole until the oil reaches level in the connection elbow. See 1 in fig. 22.
3	Fill the reservoir of the constant-level oiler with oil, and snap it back into operating position. Now oil will be filled into the bearing bracket. Air bubbles can be seen in the reservoir during this process. Continue until the correct oil level is reached. See 2 in fig. 22.
4	When no bubbles appear in the reservoir, refill the reservoir, and snap it back into operating position. See 3 in fig. 22.
5	Fit the filling plug.



TM04 4773 2009

Fig. 23 Filling of oil

The oil level in the bearing bracket must always be as shown in fig. 23.

Caution Check the oil level regularly during operation, and add oil, if necessary. The oil level must always be visible in the sight glass.

Checking the oil level

The oil level in the bearing bracket will be correct as long as the function of the constant-level oiler is correct. To check the function of the constant-level oiler, slowly drain oil through the drain plug until the constant-level oiler starts to operate, i.e. until air bubbles can be seen in the reservoir.

7.9 Bearing monitoring

7.9.1 Vibration level

The vibration level gives an indication of the condition of the bearings.

Bearing brackets with constant-level oiler are prepared for vibration measurement by means of the shock pulse method (SPM). See fig. 24.

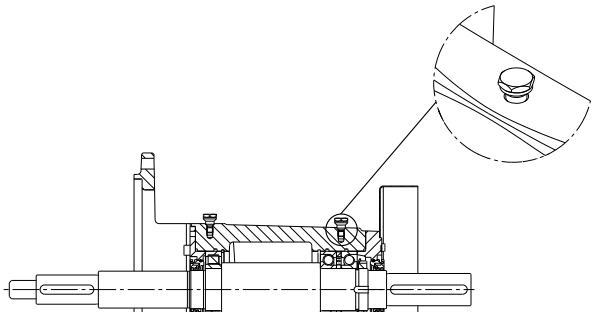


Fig. 24 Bearing bracket with SPM measuring points

Bearing brackets with automatic grease lubricators or grease nipples are prepared for retrofitting of SPM fittings. Holes are plugged from factory. See fig. 25.

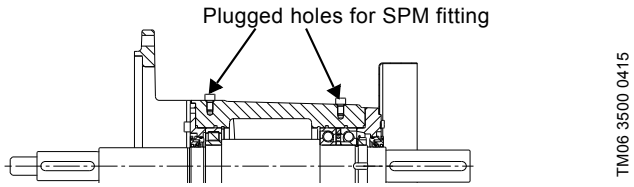


Fig. 25 Bearing bracket for retrofitting of SPM measuring equipment

7.9.2 Temperature

Bearing brackets with automatic grease lubricators, grease nipples or constant-level oiler have tappings for Pt100 sensors for monitoring the temperature of the bearings.

These sensors can be factory-fitted, but can also be retrofitted. A Grundfos sensor is available.

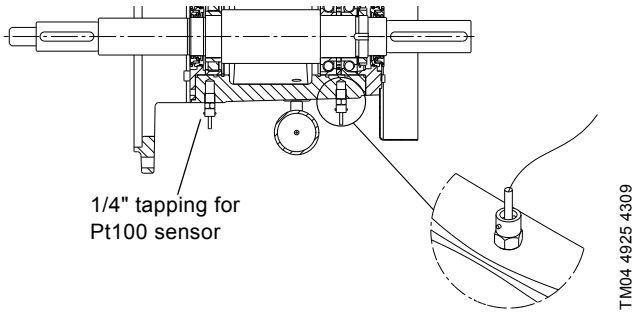


Fig. 26 Pt100 sensors fitted in bearing bracket

7.10 Pressure gauge and mano-vacuum gauge

To ensure continuous monitoring of the operation, we recommend installing a pressure gauge on the discharge side and a mano-vacuum gauge on the suction side. Open the pressure gauge tappings only for test purposes. The measuring range of the gauges must be 20 % above the maximum pump discharge pressure.

When measuring with pressure gauges on the pump flanges, it must be noted that a pressure gauge does not register dynamic pressure. On all NK and NKG pumps, the diameters of the suction and discharge flanges are different which results in different flow velocities at the two flanges. Consequently, the pressure gauge on the discharge flange will not show the pressure stated in the technical documentation, but a value which may be up to 1.5 bar or approx. 15 m lower.

7.11 Ammeter

To check the motor load, we recommend connecting an ammeter.

8. Flange forces and torques

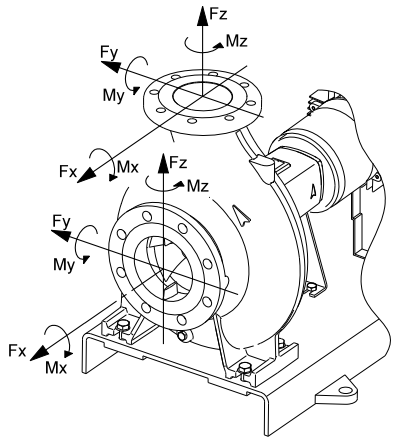


Fig. 27 Flange forces and torques

Grey cast iron	Diameter DN	Force [N]				Torque [Nm]			
		Fy	Fz	Fx	ΣF*	My	Mz	Mx	ΣM*
Horizontal pump, z-axis, discharge port	32	298	368	315	578	263	298	385	560
	40	350	438	385	683	315	368	455	665
	50	473	578	525	910	350	403	490	718
	65	595	735	648	1155	385	420	525	770
	80	718	875	788	1383	403	455	560	823
	100	945	1173	1050	1838	438	508	613	910
	125	1120	1383	1243	2170	525	665	735	1068
	150	1418	1750	1575	2748	613	718	875	1278
	200	2600	2100	2095	4055	805	928	1138	1680
	250	3340	2980	2700	5220	1260	1460	1780	2620
	300	4000	3580	3220	6260	1720	1980	2420	3560
Horizontal pump, x-axis, suction port	50	525	473	578	910	350	403	490	718
	65	648	595	735	1155	385	420	525	770
	80	788	718	875	1383	403	455	560	823
	100	1050	945	1173	1838	438	508	613	910
	125	1243	1120	1383	2170	525	665	735	1068
	150	1575	1418	1750	2748	613	718	875	1278
	200	2100	1890	2345	3658	805	928	1138	1680
	250	2700	3340	2980	5220	1260	1460	1780	2620
	300	3220	4000	3580	6260	1720	1980	2420	3560
	350	3760	4660	4180	7300	2200	2540	3100	4560

Stainless steel	Diameter DN	Force [N]				Torque [Nm]			
		Fy	Fz	Fx	ΣF*	My	Mz	Mx	ΣM*
Horizontal pump, z-axis, discharge port	32	595	735	630	1155	525	595	770	1120
	40	700	875	770	1365	630	735	910	1330
	50	945	1155	1050	1820	700	805	980	1435
	65	1190	1470	1295	2310	770	840	1050	1540
	80	1435	1750	1575	2765	805	910	1120	1645
	100	1890	2345	2100	3675	875	1015	1225	1820
	125	2240	2765	2485	4340	1050	1330	1470	2135
	150	2835	3500	3150	5495	1225	1435	1750	2555
Horizontal pump, x-axis, suction port	50	1050	945	1155	1820	700	805	980	1435
	65	1295	1190	1470	2310	770	840	1050	1540
	80	1575	1435	1750	2765	805	910	1120	1645
	100	2100	1890	2345	3675	875	1015	1225	1820
	125	2485	2240	2765	4340	1050	1330	1470	2135
	150	3150	2835	3500	5495	1225	1435	1750	2555
	200	4200	3780	4690	7315	1610	1855	2275	3360

* ΣF and ΣM are the vector sums of the forces and torques.

If not all loads reach the maximum permissible value, one of the values is allowed to exceed the normal limit. Contact Grundfos for further information.

9. Electrical connection

The electrical connection must be carried out by a qualified electrician in accordance with local regulations.

Warning

Before removing the terminal box cover and before removing/dismantling the pump, make sure that the power supply has been switched off and that it cannot be accidentally switched on again.

The pump must be connected to an external mains switch.

The operating voltage and frequency are stated on the nameplate. Make sure that the motor is suitable for the power supply of the installation site.

The electrical connection must be carried out as shown in the wiring diagram inside the terminal box cover.

Warning

Whenever powered equipment is used in explosive surroundings, the rules and regulations generally or specifically imposed by the relevant responsible authorities or trade organisations must be observed.

9.1 Motor protection

Three-phase motors must be connected to a motor-protective circuit breaker.

All three-phase Grundfos MG and MMG motors of 3 kW and up incorporate a thermistor. See the instructions in the motor terminal box.

Carry out the electrical connection as shown in the wiring diagram on the back side of the terminal box cover.

Warning

Before starting any repair work on motors incorporating a thermal switch or thermistors, make sure that the motor cannot restart automatically after cooling.

9.2 Frequency converter operation

All three-phase motors can be connected to a frequency converter.

Frequency converter operation will often expose the motor insulation system to a heavier load and cause the motor to be more noisy than usual due to eddy currents caused by voltage peaks.

A large motor driven via a frequency converter will be loaded by bearing currents.

Check these operating conditions if the pump is driven via a frequency converter:

Operating conditions	Action
2-, 4- and 6-pole motors, frame size 225 and larger	Check that one of the motor bearings is electrically isolated. Contact Grundfos.
Noise critical applications	Fit an output filter between the motor and the frequency converter; this reduces the voltage peaks and thus the noise.
Particularly noise critical applications	Fit a sinusoidal filter.
Cable length	Fit a cable that meets the specifications laid down by the frequency converter supplier. The length of the cable between motor and frequency converter affects the motor load.
Supply voltage up to 500 V	Check that the motor is suitable for frequency converter operation.
Supply voltage between 500 V and 690 V	Fit a sinusoidal filter between the motor and the frequency converter which reduces the voltage peaks and thus the noise, or check that the motor has reinforced insulation.
Supply voltage of 690 V and higher	Fit a sinusoidal filter and check that the motor has reinforced insulation.

10. Commissioning and startup

Note

Do not start the pump until it has been filled with liquid and vented.

10.1 General information

Warning

When pumping drinking water, the pump must be flushed through with clean water before startup in order to remove any foreign matters such as preservatives, test liquid or grease.

10.1.1 Pumps with stuffing box

In the case of pumps with stuffing box, check that the stuffing box gland is correctly fitted. It must be possible to turn the pump shaft manually. If the pump has been inactive for a long period, turn it manually to make sure it has not got stuck. Loosen the stuffing box or remove the packing.

10.2 Commissioning

10.2.1 Flushing the pipe system

Caution

The pump is not designed to pump liquids containing solid particles such as pipe debris and welding slag. Before starting up the pump, the pipe system must be thoroughly cleaned, flushed and filled with clean water.

The warranty does not cover any damage caused by flushing the pipe system by means of the pump.

10.3 Priming

Closed systems or open systems where the liquid level is above the pump inlet

1. Close the discharge isolating valve and slowly open the isolating valve in the suction pipe. Both the pump and the suction pipe must be completely filled with liquid.
2. Loosen the priming plug in order to vent the pump. Once liquid runs out, tighten the priming plug.

Warning

Pay attention to the orientation of the priming hole to ensure that the escaping water does not cause personal injury or damage to the motor or other components.

In hot-liquid installations, pay special attention to the risk of personal injury caused by scalding hot liquid.

In cold-liquid installations, pay special attention to the risk of personal injury caused by cold liquid.

Suction operation with non-return valve

The suction pipe and the pump must be filled with liquid and vented before the pump is started.

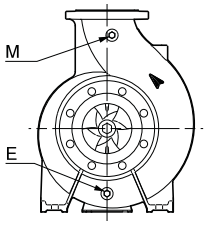
1. Close the discharge isolating valve and slowly open the isolating valve in the suction pipe.
2. Remove the priming plug, M.
3. Pour liquid through the hole until the suction pipe and the pump are completely filled with liquid.
4. Fit the priming plug, M.

The suction pipe may be filled and vented via the priming plug. See fig. 28. Alternatively a priming device with funnel can be installed before the pump.

Open systems where the liquid level is below the pump inlet

1. If an isolating valve is fitted on the suction side of the pump, the valve must be fully open.
2. Close the discharge isolating valve and tighten the priming and drain plugs.
3. Connect a manual venting pump instead of a priming device with funnel.
4. Install a slide valve between the venting pump and the centrifugal pump in order to protect the venting pump against excessive pressure.
5. Once the slide valve at the manual venting pump has been opened, vent the suction pipe using short, rapid pump strokes until the liquid runs out on the discharge side.
6. Close the valve at the venting pump.

E Drain plug
M Priming plug



TM03 3935 1206

Fig. 28 Drain and priming plug

10.4 Checking the direction of rotation

Warning

The pump must be filled with liquid when checking the direction of rotation.

The correct direction of rotation is shown by arrows on the pump housing. Seen from the pump end, the direction of rotation must be counter-clockwise. See fig. 28.

10.5 Startup

Before starting the pump, completely open the isolating valve on the suction side of the pump and leave the isolating valve on the discharge side almost closed.

Start the pump.

Vent the pump during startup by loosening the air vent screw in the pump head/cover until a steady stream of liquid runs out of the vent hole.

Warning

Pay attention to the orientation of the vent hole to ensure that the escaping water does not cause personal injury or damage to the motor or other components.

In hot-liquid installations, pay special attention to the risk of personal injury caused by scalding hot liquid.

In cold-liquid installations, pay special attention to the risk of personal injury caused by cold liquid.

When the pipework has been filled with liquid, slowly open the isolating valve on the discharge side until it is completely open.

Caution

If the pump is fitted with a motor with an output selected on the basis of a specific maximum flow rate, the motor may be overloaded if the differential pressure is lower than anticipated.

Check for overload by measuring the motor current consumption and comparing the value with the rated current stated on the motor nameplate. In case of overload, throttle the valve on the discharge side until the motor is no longer overloaded.

Always measure the motor current consumption during startup.

Note

At the moment of start, the input current of the pump motor is up to six times higher than the full-load current stated on the motor nameplate.

10.6 Shaft seal run-in period

The seal faces are lubricated by the pumped liquid, meaning that there may be a certain amount of leakage from the shaft seal. When the pump is started for the first time, or when a new shaft seal is installed, a certain run-in period is required before the leakage is reduced to an acceptable level. The time required for this depends on the operating conditions, i.e. every time the operating conditions change, a new run-in period will be started.

Under normal conditions, the leaking liquid will evaporate. As a result, no leakage will be detected.

Liquids such as kerosene will not evaporate, and drops will be visible, but this is not a shaft seal failure.

Mechanical shaft seals

Mechanical shaft seals are precision components. If the mechanical shaft seal of a recently installed pump fails, this will normally happen within the first few hours of operation. The main cause of such failures is improper installation of the shaft seal or the pipe for barrier liquid and/or mishandling of the pump during installation.

Stuffing box

The stuffing box gland must not be too tight during startup in order to let sufficient liquid lubricate the shaft and the packing rings. Once the stuffing box housing and the stuffing box gland have reached approximately the same temperature as the pump parts, the running-in of the stuffing box gland is complete. If the stuffing box leaks too much, retighten the gland slightly and evenly while the pump is running. To ensure continuous lubrication, a few drops should always drop from the stuffing box to protect the packing rings or shaft sleeve. We recommend 40 to 60 drops/minute.

10.7 Motor start/stop

Frame size	Max. number of motor starts per hour		
	Number of poles		
	2	4	6
56-71	100	250	350
80-100	60	140	160
112-132	30	60	80
160-180	15	30	50
200-225	8	15	30
250-315	4	8	12

10.8 Reference readings of monitoring equipment

We recommend taking initial readings of these parameters:

- vibration level - use SPM measuring points
- bearing temperature - if sensors have been fitted
- inlet and outlet pressure - use pressure gauges.

The readings can be used as reference in case of abnormal operation.

11. Maintenance

Warning

Before starting work on the product, switch off the power supply. Make sure that the power supply cannot be accidentally switched on.

11.1 Pump

The pump is maintenance-free.

11.1.1 Mechanical shaft seals

Mechanical shaft seals are maintenance-free, working almost without any leakages. If any considerable and increasing seepage occurs, the mechanical shaft seal must be checked immediately. If the sliding surfaces are damaged, the entire shaft seal must be replaced. Mechanical shaft seals must be treated with the greatest care.

11.1.2 Stuffing box

If the stuffing box leaks too much and cannot be further tightened, the stuffing box must be repacked. After removal, clean and check the shaft sleeve, chamber and stuffing box gland. For further information, see the service instructions for NK.

11.1.3 Replacement of packing rings

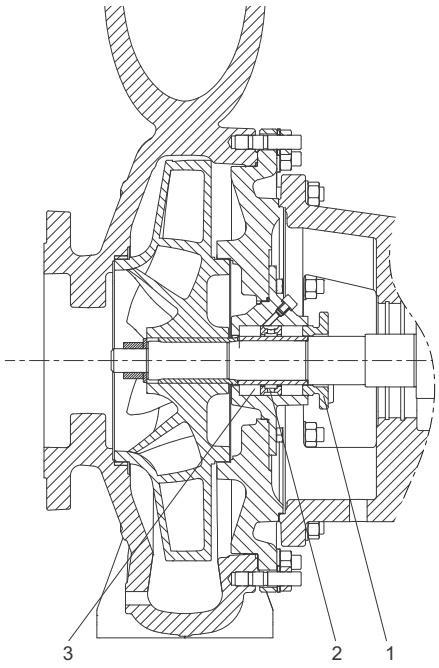


Fig. 29 Sectional view of a stuffing box

Pos.	Description
1	Stuffing box gland
2	Packing ring
3	Distribution ring

Follow these steps when replacing the packing rings:

1. Loosen stuffing box gland and remove it.
2. Remove old packing ring, distribution ring, if any, and packing rings behind the distribution ring, using a packing ring hook.
3. Insert two new packing rings one at a time. Push them firmly into position, staggering the joints 120 degrees.
4. Insert distribution ring, if any.
5. For D24/D32, insert one, and for D42/D48/D60, insert two more packing rings, staggering the joints 120 degrees. If no distribution ring is used, two extra packing rings will be required.
6. Reinstall stuffing box gland.

Starting the pump with new packing rings

Packing rings require lubrication. Therefore, the stuffing box must always be allowed to leak 40 to 60 drops per minute. Never overtighten the stuffing box gland.

For suction lift applications, it can be necessary to slightly overtighten the gland while starting the pump to avoid air from entering the pump. Air in the pump in this situation will result in the pump being unable to draw the liquid to the pump.

Loosen the gland immediately when the pump delivers liquid allowing a leakage of 40 to 60 drops per minute. Readjust after a few hours of operation if leakage increases.

11.1.4 Shaft sleeve replacement

The shaft sleeve can be worn out as the sleeve life depends on the application. When the leakage is too high even with new packing rings in combination with a slight overtightening, the shaft sleeve needs to be replaced.

11.2 Lubrication of bearings in bearing bracket

11.2.1 Grease-lubricated bearings

Pump with greased-for-life bearings

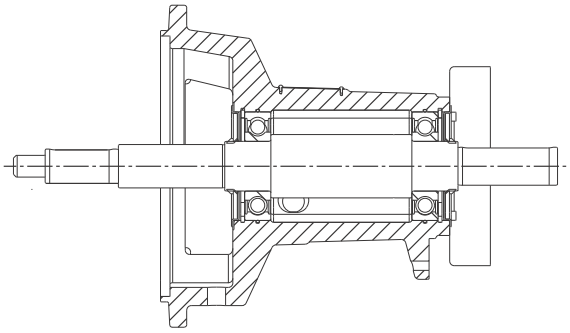


Fig. 30 Bearing bracket with closed, greased-for-life bearings

The bearing bracket with closed, greased-for-life bearings is maintenance-free. Under optimum operating conditions, the bearing life will be approx. 17,500 operating hours. After that period, it is advisable to replace the bearings. See section *13.1 Service kits*.

Note To check the bearings, regularly listen to them by means of a solid rod. There are no SPM measuring points for this type of bearing bracket.

Pump with lubrication nipples or automatic grease lubricators

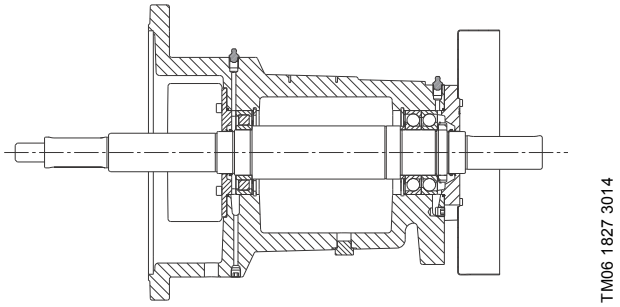


Fig. 31 Bearing bracket with open roller bearing and double angular contact bearing lubricated via grease nipples

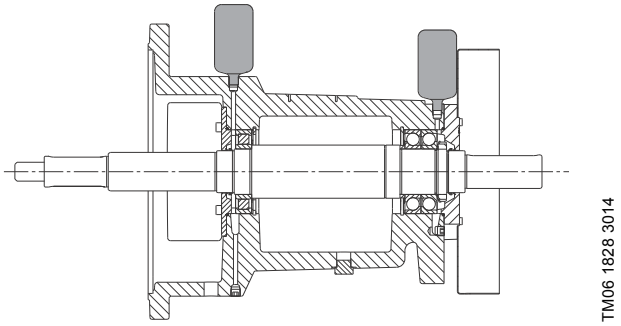


Fig. 32 Bearing bracket with open roller bearing and double angular contact bearing lubricated via automatic grease lubricators

If the pump has grease nipples or automatic grease lubricators, the grease in the bearings must be renewed during the whole life time.

Under optimum operating conditions, the bearing life will be approx. 100,000 operating hours. After that period, it is advisable to replace the bearings. See section *13.1 Service kits*. New bearings must be filled with grease according to Grundfos specifications. Clean up all the used grease in the bearing bracket before replacing the new bearing.

Automatic grease lubricators

Replace lubricators every 12 months. When replacing the lubricators, follow this procedure:

1. Remove the main drain plug, see fig. 33, in the bottom of the bearing bracket for one hour during operation to remove old and excess grease.
2. Fit the new lubricators on top of the bearing bracket and set them to empty within 12 months according to the instruction supplied with the lubricators.
3. Refit the main drain plug in the bottom of the bearing bracket.

Grundfos recommends SKF SYSTEM 24 lubricators, type LAGD 125/HP2 or LAGD 60/HP2.

Quantity	Product number
2 x LAGD 125/HP2	96887371
2 x LAGD 60/HP2	97776374

Relubrication via grease nipples

Grundfos recommends the following relubricating intervals and grease quantities:

Diameter of shaft [mm]	Relubricating interval [operating hours]	Grease quantity [g]	
		Roller bearing	Angular contact bearing
24	7500	11	15
32	4500	13	20
42	4500	22	30
48	3500	27	38
60	3500	30	41

Caution The relubricating interval is an estimated value, valid for an operating temperature up to 70 °C. We recommend to halve the intervals for every 15 °C increase in operating temperature above 70 °C.

How to renew grease

Follow this procedure to renew grease:

1. Place a suitable container under the bearing bracket to collect used grease.
2. Remove the grease drain plugs. See fig. 33.
3. Fill the bearing bracket with the recommended quantity of grease by means of a grease gun.
4. Refit the drain plugs.

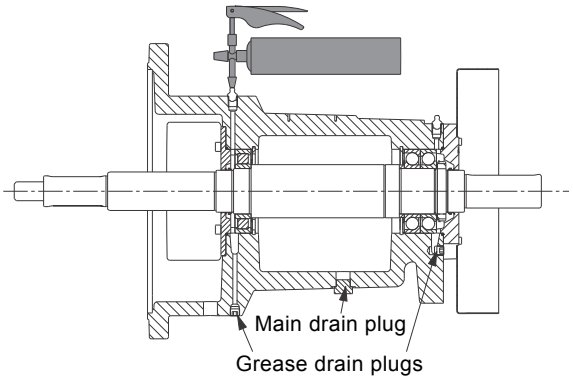


Fig. 33 Renewing the grease

Grundfos recommends SKF LGHP2 grease for relubrication. See the table below.

Basic characteristics	
Code, DIN 51825	K2N-40
Consistency class, NLGI	2-3
Thickener	Polyurea (di-urea)
Base oil	Mineral
Operating temperature	-40 - +150 °C, -40 - +302 °F
Dropping point, ISO 2176	240 °C, 464 °F
Density, DIN 5175	At 20 °C, 68 °F: 0.85 - 0.95 g/cm^3
Base oil viscosity	
40 °C, 104 °F	96 mm^2/s
100 °C, 212 °F	10.5 mm^2/s

Note If there is visible grease leakage, we advise you to open the bearing bracket cover and replace the V ring. See section *13.1 Service kits*.

Caution If the pump has been stored or out of operation for more than six months, we recommend you to replace the grease before it is put into operation.

Caution In case of ingress of contamination, more frequent relubrication than indicated by the relubricating interval will reduce the negative effects of foreign particles. This will reduce the damaging effects caused by overrolling the particles. Liquid contaminants, such as water or process liquids, also call for shorter relubricating intervals. In case of severe contamination, consider continuous relubrication.

Never mix greases with different thickeners, such as a lithium-based grease with a sodium-based grease, before checking with the suppliers.

Caution Never mix a mineral oil with a synthetic oil.

Some lubricants are compatible, but assessing the compatibility of two lubricants can be difficult. As a general rule, always relubricate a bearing with the same lubricant as was used originally.

11.2.2 Oil-lubricated bearings

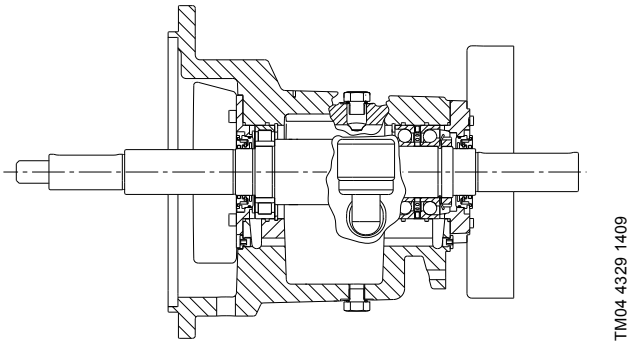


Fig. 34 Bearing bracket with oil-lubricated roller and double angular contact bearings

Under optimum operating conditions, the life of the roller and double angular contact bearings will be approx. 100,000 operating hours. After that period, it is advisable to replace the bearings. See section *13.1 Service kits*.

Note To monitor the bearing condition, regularly measure vibration levels using the SPM measuring points on the bearing bracket. See section *7.9.1 Vibration level*.

The bearings are lubricated with mineral oil. Intervals for oil change as well as the required quantities are specified below.

Bearing temperature	Initial oil change	Subsequent oil changes
Up to 70 °C	After 400 hours	Every 4400 hours
70-90 °C		Every 2200 hours

Bearing type	Diameter of coupling shaft [mm]	Approximate oil quantity [ml]
Roller and angular contact bearings	42	850
	48	1700
	60	1350

Changing of oil

Step	Action
1	Place a suitable container under the bearing bracket to collect used oil.
2	Remove the vent/filling plug and the drain plug.
3	After drainage of the bearing bracket, fit the drain plug, and fill the bearing bracket with new oil. See section *7.8.2 Bearing bracket with constant-level oiler*.

Note Check the oil level regularly during operation, and add oil, if necessary. The level must always be visible in the sight glass.

Basic characteristics Shell Omala 68	Test method	
Viscosity grade	ISO	68
AGMA EP Gear Oil Grade		68
Old AGMA Grade		2 EP
Viscosity:		
At 40 °C, 104 °F	D 445	68 mm^2/s
At 100 °C, 212 °F	D 445	8.8 mm^2/s
Flash point, COC, °F	D 92	405
Pour point, °F	D 97	-15

11.3 Monitoring equipment

It is advisable to take weekly readings of these parameters:

- vibration level - use SPM measuring points
- bearing temperature - if sensors have been fitted
- inlet and outlet pressure - use pressure gauges.

Alternatively, follow the maintenance plan laid out for your application.

11.4 Motor

Check the motor at regular intervals. It is important to keep the motor clean in order to ensure adequate ventilation. If the pump is installed in a dusty environment, it must be cleaned and checked regularly.

11.4.1 Lubrication

Motors up to and including frame size 132 have maintenance-free, greased-for-life bearings.

Motors of frame sizes larger than 132 must be greased according to the indications on the motor nameplate. Grease spills from the motor may occur.

Grease specifications: See section *11.4.2 Bearing grease*.

11.4.2 Bearing grease

Lithium-based grease according to the following specifications must be used:

- NLGI class 2 or 3
- viscosity of basic oil: 70-150 cSt at +40 °C
- temperature range: -30 - +140 °C during continuous operation.

12. Periods of inactivity and frost protection

Pumps which are not being used during periods of frost must be drained to avoid damage.

Drain the pump by removing the drain plug. See fig. 28.

Do not tighten the priming plug or replace the drain plug until the pump is to be used again.

Warning

Care must be taken to ensure that the escaping liquid does not cause personal injury or damage to the motor or other components.

In hot-liquid installations, pay special attention to the risk of personal injury caused by scalding hot liquid.

In cold-liquid installations, pay special attention to the risk of personal injury caused by cold liquid.

If the pump is to be drained prior to a long period of inactivity, inject a few drops of silicone oil on the shaft at the bearing bracket. This will prevent the shaft seal faces from seizing up.

13. Service

Warning

If a pump has been used for a liquid which is injurious to health or toxic, the pump will be classified as contaminated.

If Grundfos is requested to service such a pump, Grundfos must be contacted with details about the pumped liquid, etc. before the pump is returned for service. Otherwise Grundfos can refuse to accept the pump for service.

Possible costs of returning the pump are paid by the customer.

13.1 Service kits

Service kits for NK, NKG, see Grundfos Product Center or Service Kit Catalogue.

14. Technical data

14.1 Electrical data

See the motor nameplate.

14.2 Sound pressure level

See table on page 29.

14.3 Belt drive

If the unit is belt-driven, the following data must not be exceeded:

	Max. motor power [kW] for shaft end				
Speed n [min^{-1}]	**Ø24**	**Ø32**	**Ø42**	**Ø48**	**Ø60**
1000	4	7	11	18	22
1500	5	10	25	32	38
2000	6	14	25	-	-
2500	7	17.5	-	-	-
3000	10	20	-	-	-

For higher power outputs, mount an intermediate shaft with pedestal bearings.

14.4 Operation with combustion engine

Warning

When operating with petrol or diesel engines, the engine manufacturer's installation and operating instructions must be strictly observed. Particularly the direction of rotation is very important. Viewed from the drive shaft end, the pump rotates to the right, clockwise. Viewed from the drive shaft end, the motor must therefore rotate to the left, counter-clockwise. The correct direction of rotation is indicated by the arrow on the pump housing.

If the engine is installed in a closed area, the combustion air data as well as data for exhaust gases must be particularly noted.

When draining the tank, make sure to have containers of adequate size ready for this purpose.

15. Fault finding

Warning

Before removing the terminal box cover and before removing/dismantling the pump, make sure that the power supply has been switched off and that it cannot be accidentally switched on again.

Fault	Cause	Remedy
1. Pump delivers no or too little liquid.	a) Wrong electrical connection, for instance two phases.	Check the electrical connection and remedy, if necessary.
	b) Wrong direction of rotation.	Interchange two phases of the power supply.
	c) Air in suction pipe.	Vent and fill the suction pipe and pump.
	d) Counter-pressure too high.	Set the duty point in accordance with the data sheet. Check the system for impurities.
	e) Inlet pressure too low.	Increase the liquid level on the suction side. Open the isolating valve in the suction pipe. Make sure that all the conditions in section *7.4 Pipework* are complied with.
	f) Suction pipe or impeller blocked by impurities.	Clean the suction pipe or pump.
	g) Pump draws in air due to defective seal.	Check the pipeline seals, pump housing gaskets and shaft seals, and replace, if necessary.
	h) Pump draws in air due to low liquid level.	Increase the liquid level on the suction side and keep it as constant as possible.
2. Motor-protective circuit breaker has tripped because the motor is overloaded.	a) Pump blocked by impurities.	Clean the pump.
	b) Pump running above rated duty point.	Set the duty point in accordance with the data sheet.
	c) Density or viscosity of liquid higher than specified when ordering.	If less flow is sufficient, reduce the flow on the discharge side. Or fit a more powerful motor.
	d) Motor-protective circuit breaker overload setting incorrect.	Check the setting of the motor-protective circuit breaker and replace, if necessary.
	e) Motor runs on two phases.	Check the electrical connection. Replace the fuse, if defective.
3. Pump makes too much noise. Pump runs unevenly and vibrates.	a) Inlet pressure too low, i.e. pump cavitates.	Increase the liquid level on the suction side. Open the isolating valve in the suction pipe. Make sure that all the conditions in section *7.4 Pipework* are complied with.
	b) Air in suction pipe or pump.	Vent and fill the suction pipe or pump.
	c) Counter-pressure lower than specified.	Set the duty point in accordance with the data sheet.
	d) Pump draws in air due to low liquid level.	Increase the liquid level on the suction side and keep it as constant as possible.
	e) Impeller out of balance or clogged impeller blades.	Clean and check the impeller.
	f) Inner parts worn.	Replace the defective parts.
	g) Pump stressed by pipework thus causing starting noise.	Mount the pump so that it is not stressed. Support the pipes.
	h) Defective bearings.	Replace the bearings.
	i) Defective motor fan.	Replace the fan.
	j) Defective coupling.	Replace the coupling. Align the coupling. See section *7.3.2 How to align the unit*.
	k) Foreign bodies in pump.	Clean the pump.
	l) Frequency converter operation	See section *9.2 Frequency converter operation*.
4. Leaking pump, connections, shaft seal or stuffing box.	a) Pump stressed by pipework thus causing leaks in pump housing or connections.	Mount the pump so that it is not stressed. Support the pipes.
	b) Pump housing gaskets and gaskets at connections defective.	Replace pump housing gaskets or gaskets at connections.
	c) Mechanical shaft seal dirty or stuck together.	Check and clean the mechanical shaft seal.
	d) Mechanical shaft seal defective.	Replace the mechanical shaft seal.
	e) Stuffing box defective.	Retighten the stuffing box. Repair or replace the stuffing box.
	f) Shaft surface or shaft sleeve defective.	Replace the shaft or the shaft sleeve. Replace the packing rings in the stuffing box.

Fault	Cause	Remedy
5. Too high temperature in pump or motor.	a) Air in suction pipe or pump.	Vent the suction pipe or the pump and replenish.
	b) Inlet pressure too low.	Increase the liquid level on the suction side. Open the isolating valve in the suction pipe. Make sure that all the conditions in section *7.4 Pipework* are complied with.
	c) Bearings lubricated with too little, too much or unsuitable lubricant.	Replenish, reduce or replace the lubricant.
	d) Pump with bearing seat stressed by pipework.	Mount the pump so that it is not stressed. Support the pipes. Check the alignment of the coupling. See section *7.3.2 How to align the unit*.
	e) Axial pressure too high.	Check the relief holes of the impeller and the lock rings on the suction side.
	f) Motor-protective circuit breaker defective or setting incorrect.	Check the setting of the motor-protective circuit breaker and replace, if necessary.
	g) Motor overloaded.	Reduce the flow rate.
6. Oil leaking from bearing bracket.	a) Bearing bracket has been filled with too much oil through the filling hole, resulting in an oil level above the bottom of the shaft.	Drain off oil until the constant-level oiler starts to operate, i.e. when air bubbles can be seen in the reservoir.
	b) Oil seals defective.	Replace the oil seals.
7. Oil leaking from reservoir.	a) Threads on reservoir damaged.	Replace the reservoir.

16. Disposal

This product or parts of it must be disposed of in an environmentally sound way:

1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

Sound pressure levels

The data in this table applies for pump including motor, (MG, MMG, Siemens and TECO motors).

The values stated are maximum sound pressure levels. Tolerances are according to ISO 4871.

50 Hz

2-pole: n = 2900 min^{-1}

4-pole: n = 1450 min^{-1}

6-pole: n = 970 min^{-1}

Motor [kW]	Maximum sound pressure level [dB(A)] - ISO 3743		
	Three-phase motors		
	2-pole	4-pole	6-pole
0.25	56	41	-
0.37	56	45	-
0.55	57	42	40
0.75	56	42	43
1.1	59	50	43
1.5	58	50	47
2.2	60	52	52
3	59	52	63
4	63	54	63
5.5	63	57	63
7.5	60	58	66
11	60	60	66
15	60	60	66
18.5	60	63	66
22	66	63	66
30	71	65	59
37	71	66	60
45	71	66	58
55	71	67	58
75	73	70	61
90	73	70	61
110	76	70	61
132	76	70	61
160	76	70	65
200	76	70	-
250	82	73	-
315	82	73	-
355	77	75	-
400	-	75	

60 Hz

2-pole: n = 3500 min^{-1}

4-pole: n = 1750 min^{-1}

6-pole: n = 1170 min^{-1}

Motor [kW]	Maximum sound pressure level [dB(A)] - ISO 3743		
	Three-phase motor		
	2-pole	4-pole	6-pole
0.25	-	-	-
0.37	-	-	-
0.55	-	-	-
0.75	-	-	-
1.1	64	51	43
1.5	64	52	47
2.2	65	55	52
3	54	57	63
4	68	56	63
5.5	68	62	63
7.5	73	62	66
11	70	66	66
15	70	66	66
18.5	70	63	66
22	70	63	66
30	71	65	62
37	71	65	63
45	75	65	62
55	75	68	62
75	77	71	66
90	77	71	66
110	81	75	66
132	81	75	66
160	81	75	69
200	81	75	-
280	86	-	-
288	-	77	-
353	86	-	-
362	-	77	-
398	81		
408	-	79	-
460	-	79	-

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