NB, NBG

Installation and operating instructions

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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

NB, NBG are non-self-priming, single stage, centrifugal volute pumps with axial inlet port and radial outlet port.

NB pumps comply with EN 733.

NBG 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.

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. Do not lift the pump by means of 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.

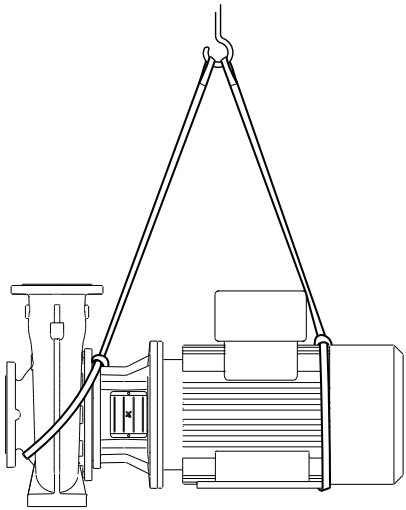
3.3 Handling the product

Weight: See label on the packing.

Warning

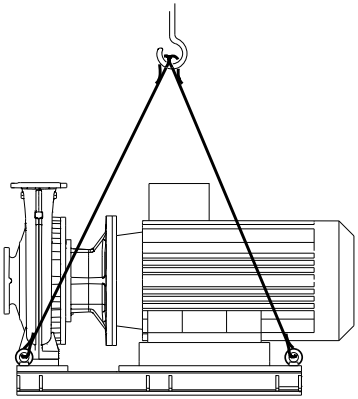
Motors from 4 kW and up are supplied with lifting eyes which must not be used for lifting the entire pump unit. See fig. 4.

Lift the pumps by means of nylon straps and shackles or a hook as shown on figs 1 to 3.



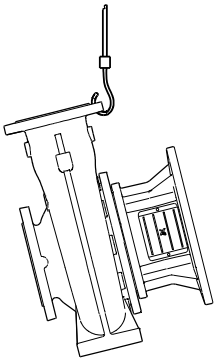
TM03 3973 1306

Fig. 1 Correct lifting of pump without base frame



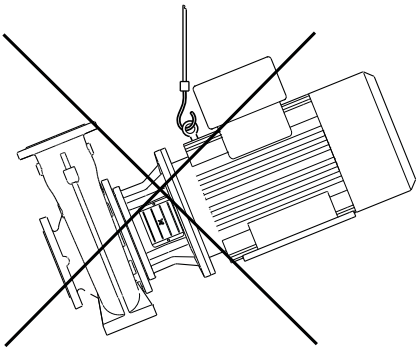
TM04 5179 2809

Fig. 2 Correct lifting of pump with base frame



TM05 3309 1112

Fig. 3 Correct lifting of pump without motor



TM03 3972 1306

Fig. 4 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 easily be removed.

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

4. Identification

4.1 Nameplate

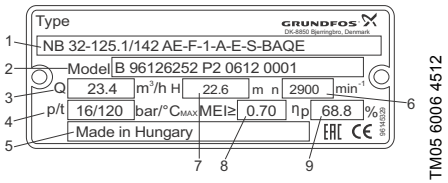


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Fig. 5 Example of nameplate for NB

Legend

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

4.2 Type key

Model B

Example 1, pump design according to EN 733	**NB**		**32**	**-125**	**.1**		**/142**		**AE**	**F**	**1**	**A**	**E**	**S**	**BAQE**		
Example 2, pump design according to ISO 2858	**NBG**	**125**	**-100**	**-160**			**/160-142**		**A**	**F**	**2**	**N**	**K**	**S**	**DQQK**		

Type range

Nominal diameter of inlet port (DN)

Nominal diameter of outlet port (DN)

Nominal impeller diameter [mm]

Reduced performance: .1

Actual impeller diameter [mm]

Code for pump version; the codes may be combined

- A Basic version
- B Oversize motor
- C Without motor
- D Pump housing with feet
- E With ATEX approval, certificate or test report, the second character of the pump version code is an E
- F Version with base frame
- S With support blocks
- 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	1.4301
B	EN-GJL-250	Bronze CuSn10	Bronze/brass	1.4301
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	1.4301
F	EN-GJL-250	Bronze CuSn10	EN-GJL-250	1.4301
G	EN-GJL-250	EN-GJL-200	EN-GJL-250	1.4401

Example 1, pump design according to EN 733	**NB**		**32**	**-125**	**.1**	**/142**	**AE**	**F**	**1**	**A**	**E**	**S**	**BAQE**
Example 2, pump design according to ISO 2858	**NBG**	**125**	**-100**	**-160**		**/160-142**	**A**	**F**	**2**	**N**	**K**	**S**	**DQQK**

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
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

Material of O-ring for pump cover

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

Shaft seal arrangement

S	Single seal

Code for mechanical shaft seal and shaft seal rubber parts

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

- reduced performance
- 142 mm impeller
- basic version
- ATEX approval, certificate or test report
- DIN flange to EN 1092-2 pipe 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 1.4301
- EPDM O-ring for pump cover
- single shaft seal arrangement
- BAQE shaft seal.

Example 2 shows an NBG 125-100-160 pump with these characteristics:

- 160-142 mm conical impeller
- basic version
- DIN flange to EN 1092-2 pipe connection
- 16 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-ring for pump cover
- single shaft seal arrangement
- DQQK shaft seal.

4.2.1 Letter codes for shaft seals

Example: 10 = 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

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 English-language data booklet entitled "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. 6, 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.

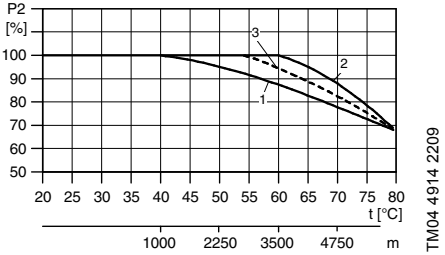


Fig. 6 The maximum motor output depends on the ambient temperature and altitude

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 % = 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 Max. operating pressure

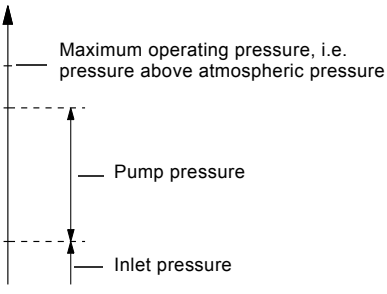


Fig. 7 Pressures in the pump

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

6.6 Minimum flow rate

The pump must not run against a closed 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

Do not exceed the maximum flow rate 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. See www.grundfos.com.

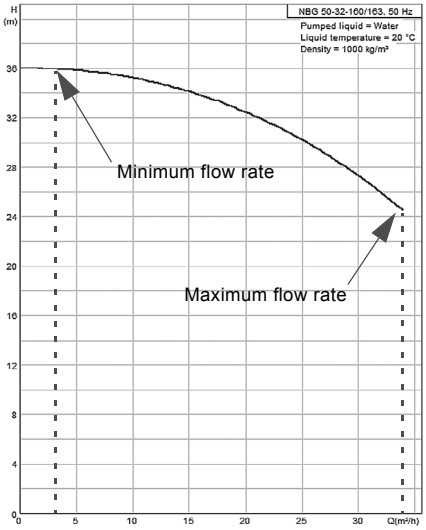


Fig. 8 Example from Grundfos Product Center in www.grundfos.com showing minimum and maximum flow rate

6.8 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.

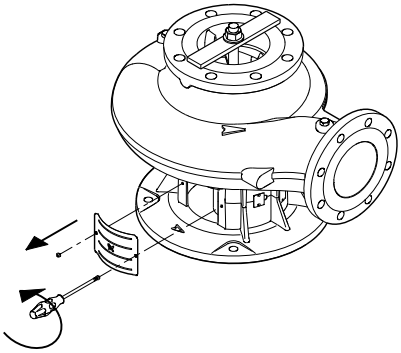
Note We do not recommend that you operate the pump at maximum temperature and maximum pressure at the same time as the seal life will be reduced and periodic noise will occur.

Shaft seal diameter [mm]						**28, 38**	**48**	**55**	**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

7. Mounting of motor on bare shaft pumps

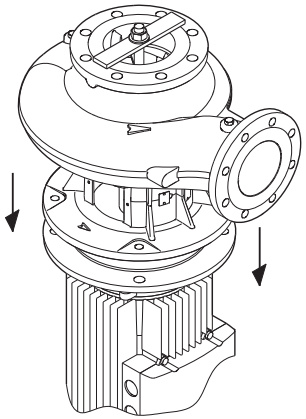
7.1 Mounting of motor on pump housing without feet

The pumps are supplied with a transport bracket protecting the shaft seal during transport. When you mount the motor, follow the instructions shown in these drawings.



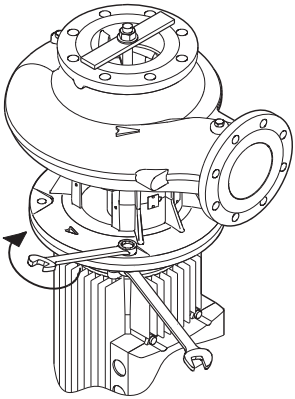
TM05 3327 1212

1. Remove the coupling guard and loosen the set screws in the shaft.



TM03 3906 1212

2. Place the pump on the motor.



TM03 3907 1212

3. Fit and tighten the motor screws to the correct torque. See below.

M8: 12 ± 2.4 Nm

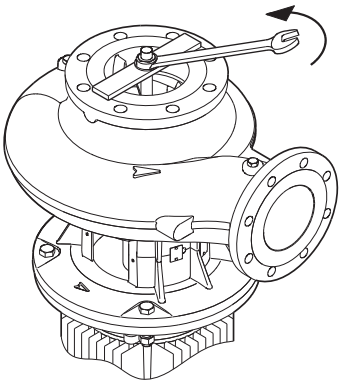
M10: 25 ± 5 Nm

M12: 40 ± 8 Nm

M16: 100 ± 20 Nm

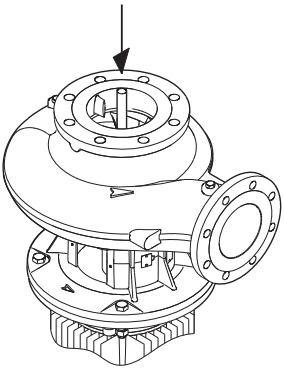
M20: 150 ± 30 Nm

M24: 200 ± 40 Nm



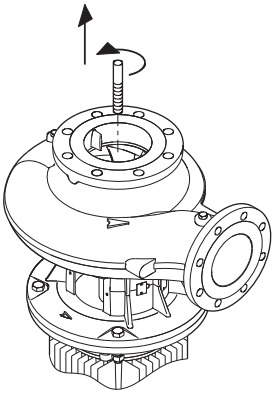
TM03 3908 1212

4. Remove the nut, washer and transport bracket.



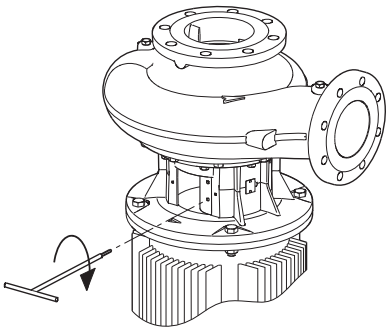
TM03 3909 1212

5. Press down the threaded pipe to ensure that the shaft is in bottom position.



TM03 3910 1212

6. Remove the threaded pipe.



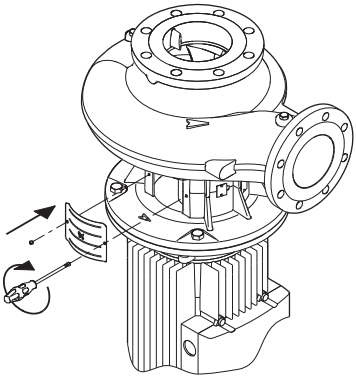
TM03 3911 1212

7. Apply Loctite 243 to the threads of the set screws. Tighten the set screws to the correct torque. See below.

M5: 6 ± 2 Nm

M6: 8 ± 2 Nm

M8: 15 ± 3 Nm



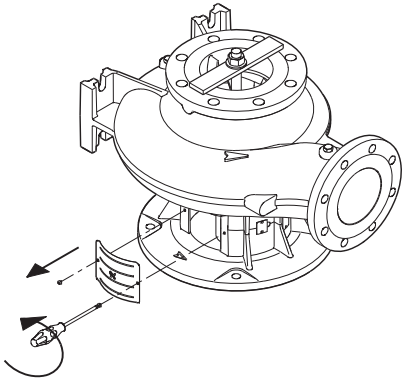
TM03 3912 1212

8. Fit the coupling guard. Tighten the screws to the correct torque. See below.

M5 x 10 mm: 6 ± 2 Nm

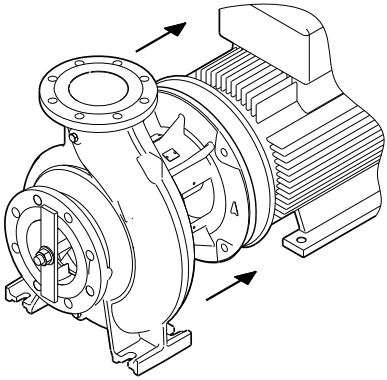
7.2 Mounting of motor on pump housing with feet

The pumps are supplied with a transport bracket protecting the shaft seal during transport. When you mount the motor, follow the instructions shown in these drawings.



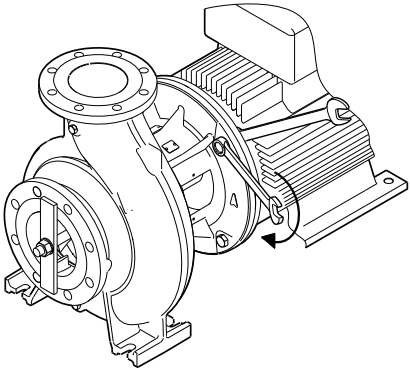
TM03 3913 1206

1. Remove the coupling guard and loosen the set screws in the shaft.



TM03 3905 1206

2. Place the pump at the end of the motor and push the parts together.



TM03 3914 1206

3. Fit and tighten the motor screws to the correct torque. See below.

M8: 12 ± 2.4 Nm

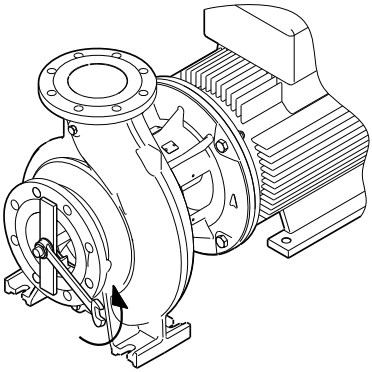
M10: 25 ± 5 Nm

M12: 40 ± 8 Nm

M16: 100 ± 20 Nm

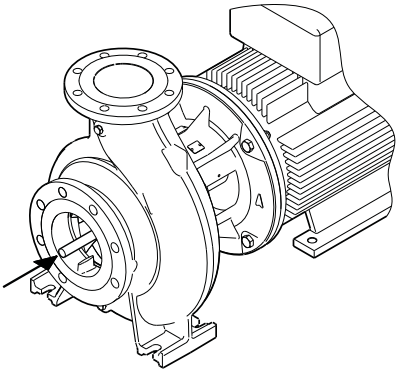
M20: 150 ± 30 Nm

M24: 200 ± 40 Nm



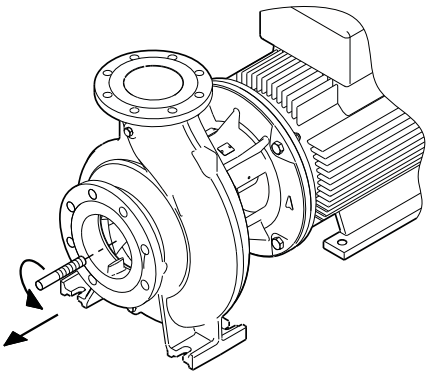
TM03 3915 1206

4. Remove the nut, washer and transport bracket.



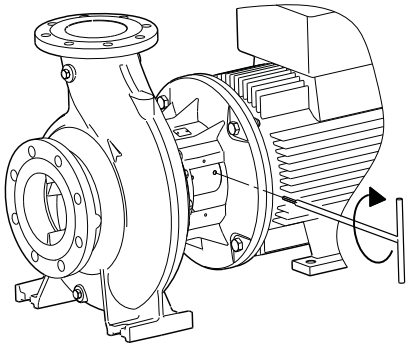
TM03 3916 1206

5. Press down the threaded pipe to ensure that the shaft is in bottom position.



TM03 3917 1206

6. Remove the threaded pipe.



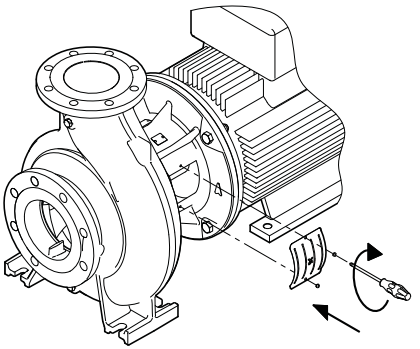
TM03 3918 1206

7. Apply Loctite 243 to the threads of the set screws. Tighten the set screws to the correct torque. See below.

M5: 6 ± 2 Nm

M6: 8 ± 2 Nm

M8: 15 ± 3 Nm



TM03 3919 1206

8. Fit the coupling guard. Tighten the screws to the correct torque. See below.

M5 x 10 mm: 6 ± 2 Nm

8. Mechanical installation

8.1 Pump location

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

Warning

When pumping hot or cold liquids, take care to ensure that persons cannot accidentally come into contact with hot or cold surfaces.

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

Vertical installation

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

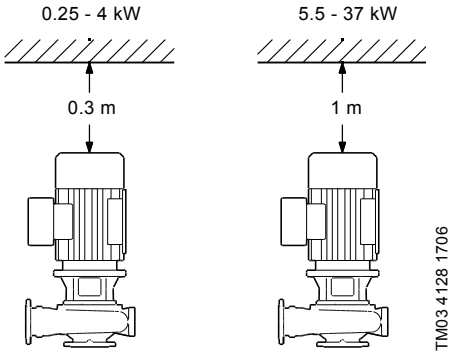


Fig. 9 Clearance above the motor

Horizontal installation

- 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.
- NB pumps with base frame must have the same clearance as pumps with motors from 5.5 to 200 kW.

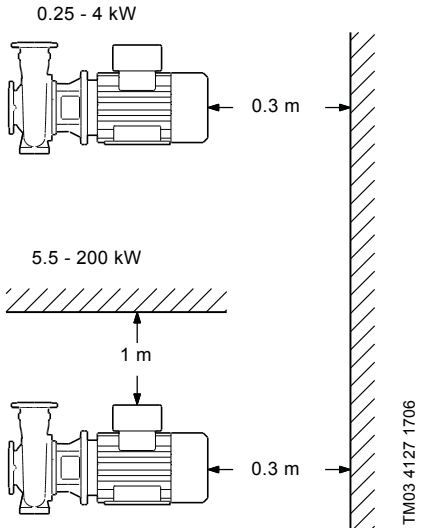


Fig. 10 Clearance behind the motor

8.2 Installation positions

Arrows on the pump housing show the direction of flow of liquid through the pump.

The pumps can be installed with the motor/pump shaft in all positions between vertical and horizontal, but the motor must never fall below the horizontal plane.

Horizontal motors with feet must always be supported.

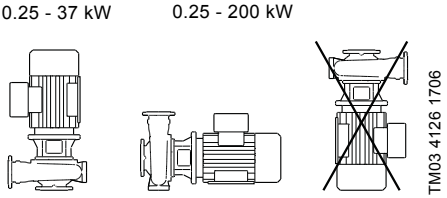


Fig. 11 Installation positions

Fit isolating valves on either side of the pump as this makes it unnecessary to drain the system if the pump needs to be cleaned or repaired.

8.3 Foundation of NB, NBG pump without base frame

Caution Carry out the foundation/installation in accordance with the following instructions. Non-compliance may result in functional faults which will damage the pump components.

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 at least 1.5 times the weight of the pump. The concrete foundation must have an absolutely level and even surface.

Place the pump on the foundation, and fasten it. See fig. 12.

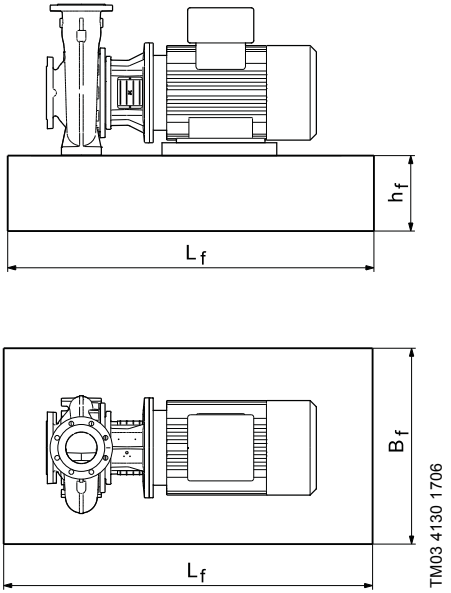


Fig. 12 Foundation

The foundation length and width must always be 200 mm larger than the length and width of the pump. See fig. 12.

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.

In installations where noise-less operation is particularly important, we recommend a foundation with a mass up to 5 times that of the pump. See also *8.6 Vibration damping* on page 21.

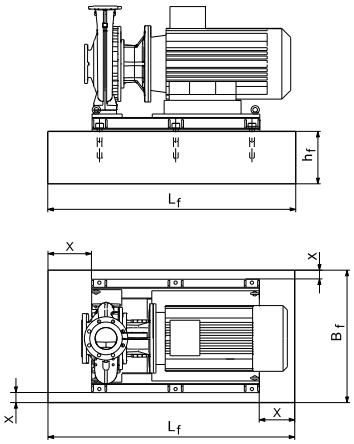
8.4 Foundation of NB, NBG pump with base frame

Note

This section applies only to 50 Hz pumps as base frames are not supplied for 60 Hz pumps.

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. 13.



TM05 1558 2709

Fig. 13 Foundation, X = min. 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. 14.

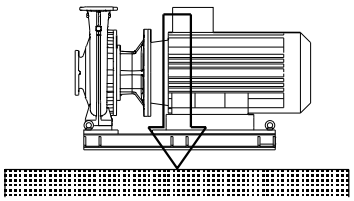


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Fig. 14 Correct foundation

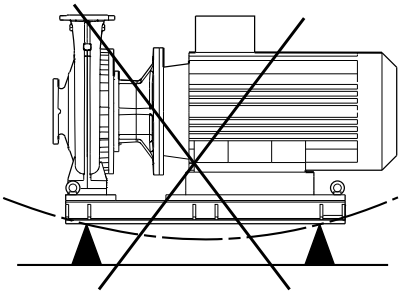

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Fig. 15 Incorrect foundation

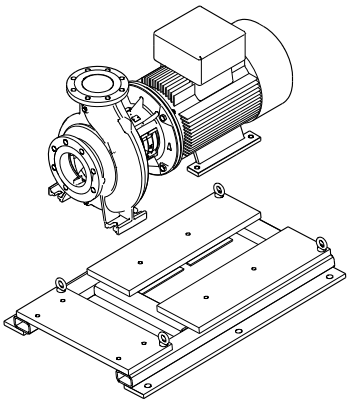

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Fig. 16 Base frame with pouring holes

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

NB, NBG pumps with base frame are always prepared for grouting. Grouting anchors are welded to the base frame.

For NB, NBG 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.

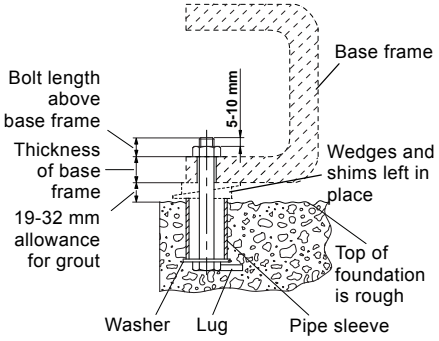
Poles	P2 lower than or equal to 45 kW	P2 equal to or higher than 55 kW
2-pole	Grouting optional	Grouting mandatory
4-pole	Grouting optional	
6-pole	Grouting optional	

Procedure

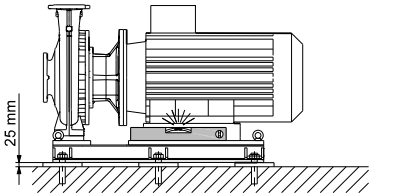
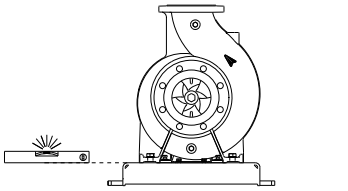
1. Preparing the foundation
2. Levelling of the base frame
3. Grouting.

1: Preparing the foundation

We recommend the following procedure to ensure a good foundation.

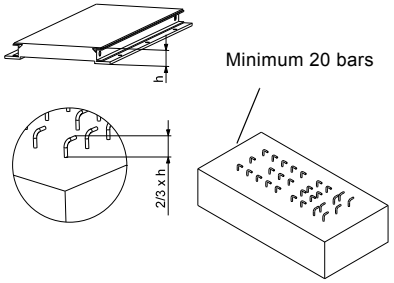
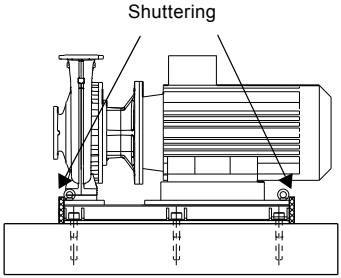
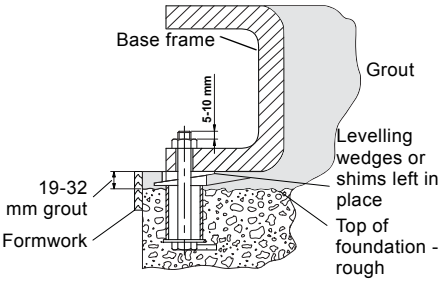
Step	Action	Illustration
1	Use an approved, non-shrinking concrete. Contact your concrete supplier for advice if any doubts. Pour the foundation without interruptions to within 19-32 mm of the final level. Use vibrators to ensure that the concrete is evenly distributed. The top surface must be well scored 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 part of base frame, nuts and washers.	
3	Let the foundation cure for several days before levelling and grouting the base frame.	

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.	
2	Level the base frame by adding or removing shims under the base frame.	
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: 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 we recommend that you 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.	 TM05 1562 3011
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 pouring the grout, 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

8.5 Pipework

8.5.1 Piping

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

The inlet and outlet 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 inlet side of the pump.

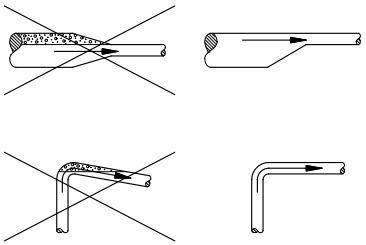


Fig. 17 Pipelines

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 inlet and the outlet side. The counter-flanges must lie true against the pump flanges without being stressed as stress would cause damage to the pump.

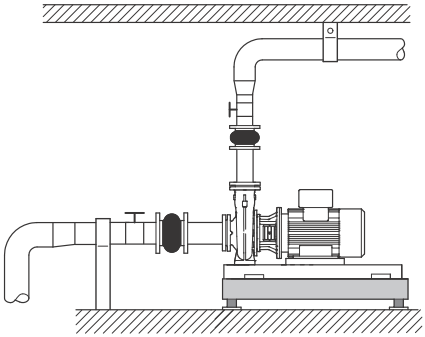


Fig. 18 NB, NBG pump installation

8.5.2 Direct mounting in pipes

Pumps fitted with motors up to and including frame size 132 are suitable for direct mounting in supported pipes.

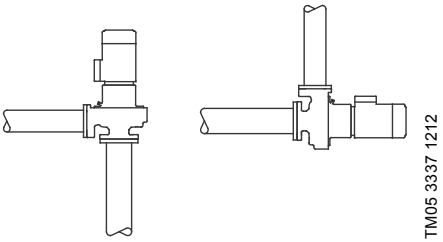


Fig. 19 Direct mounting in pipes

This type of installation does not allow the use of expansion joints.

Note To ensure quiet operation, suspend the pipes from suitable pipe hangers.

8.5.3 Bypass

Warning

The pump must not 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 valve, ensure a minimum liquid flow through the pump by connecting a bypass or drain to the outlet 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.

8.6 Vibration damping

8.6.1 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. 18.

8.6.2 Vibration dampers

To prevent the transmission of vibrations to buildings, we recommend that you isolate 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 will differ 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.

8.7 Expansion joints

Expansion joints provide these advantages:

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

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

Fit the expansion joints at a minimum distance of 1 to 1 1/2 pipe diameters away from the pump on the inlet and the outlet side. This prevents turbulence in the expansion joints, thus ensuring optimum inlet conditions and minimum pressure loss on the outlet side. At flow velocities greater than 5 m/s, we recommend that you fit larger expansion joints matching the pipes.

Figures 20 and 21 show examples of rubber bellows expansion joints with or without limiting rods.

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Fig. 20 Rubber bellows expansion joint with limiting rods

Fig. 21 Rubber bellows expansion joint without limiting rods

Use expansion joints with limiting rods to reduce the effects of the expansion or contraction forces on the pipes. We always recommend that you use 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 22 shows an example of a metal bellows expansion joint with limiting rods.

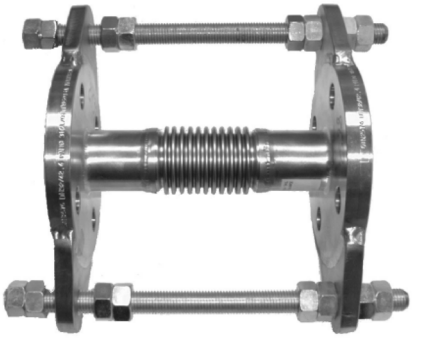

Fig. 22 Metal bellows expansion joint with limiting rods

Due to the risk of rupture of the rubber bellows, we recommend that you use metal bellows expansion joints at temperatures above +100 °C combined with high pressure.

8.8 Measuring instruments

8.8.1 Pressure gauge and mano-vacuum gauge

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

When measuring with pressure gauge on the pump flanges, note that a pressure gauge does not register dynamic pressure. On all NB, NBG pumps, the diameters of the inlet and outlet flanges are different which results in different flow velocities at the two flanges. Consequently, the pressure gauge on the outlet 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.

8.8.2 Ammeter

To check the motor load, we recommend that you connect an ammeter.

9. Flange forces and torques

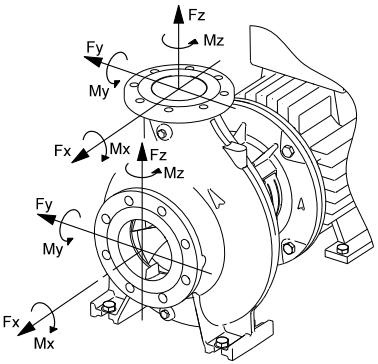

Fig. 23 Flange forces and torques

Grey cast iron	Diameter DN	Force [N]				Torque [Nm]			
		Fy	Fz	Fx	ΣF*	My	Mz	Mx	ΣM*
Horizontal pump, z-axis, outlet 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, inlet 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, outlet 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, inlet 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.

10. 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.

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 using powered equipment in potentially explosive environments, observe the rules and regulations generally or specifically imposed by the relevant responsible authorities or trade organisations.

10.1 Motor protection

Connect three-phase motors 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.

10.2 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 280 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 will affect 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 will reduce the voltage peaks and thus the noise, or check that the motor has reinforced insulation.
Supply voltage of 690 V and higher	Fit a dU/dt filter and check that the motor has reinforced insulation.

11. Startup

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

11.1 General information

Warning

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

11.1.1 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.

11.2 Priming

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

1. Close the isolating valve in the outlet pipe and slowly open the isolating valve in the inlet pipe. Both the pump and the inlet 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 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 the cold liquid.

Suction operation with non-return valve

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

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

The inlet pipe may be filled and vented via the priming plug. See fig. 24. 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 inlet side of the pump, the valve must be fully open.
2. Close the isolating valve in the outlet pipe 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 inlet pipe using short, rapid pump strokes until the liquid runs out on the outlet side.
6. Close the valve at the venting pump.

E: Drain plug
M: Priming plug

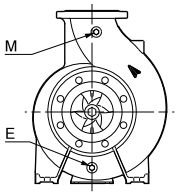

Fig. 24 Drain and priming plug

11.3 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. 24.

11.4 Starting up the pump

1. Open the isolating valve on the inlet side of the pump completely and leave the isolating valve on the outlet side almost closed.
2. Start the pump.
3. Vent the pump during startup by loosening the air vent screw in the pump head or 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 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 the cold liquid.

4. When the pipes have been filled with liquid, slowly open the isolating valve on the outlet 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.

5. Check the 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 outlet side until the motor is no longer overloaded.
6. Always measure the motor current consumption during startup.

Note

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

11.5 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 has been 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 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 seals and/or mishandling of the pump during installation.

11.6 Start/stop

Frame size	Maximum number of 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

11.7 Reference readings of monitoring equipment

We recommend that you take initial readings of these parameters:

- vibration level - use SPM (shock pulse method) measuring points
- inlet and outlet pressure - use pressure gauges.

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

12. Maintenance

Warning

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

12.1 Pump

The pump is maintenance-free.

12.2 Mechanical shaft seals

Mechanical shaft seals are maintenance-free, working almost without any leakages. If any considerable and increasing seepage occurs, check the mechanical shaft seal immediately. If the sliding surfaces are damaged, replace the entire shaft seal. Treat mechanical shaft seals with the greatest care.

12.3 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, clean and check it regularly.

12.4 Lubrication

Motor bearings

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

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

Grease specifications: See section *12.4.1 Bearing grease*.

12.4.1 Bearing grease

Use lithium-based grease according to the following specifications:

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

13. 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. 24.

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

Warning

Take care 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 the 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 prevents the shaft seal faces from seizing up.

14. 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 you request Grundfos to service such a pump, contact Grundfos with details about the pumped liquid, etc. before you return the pump for service. Otherwise Grundfos can refuse to accept the pump for service.

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

14.1 Service kits

Service kits for NB, NBG, see Grundfos Product Center in www grundfos.com or Service Kit Catalogue.

15. Technical data

15.1 Electrical data

See the motor nameplate.

15.2 Sound pressure level

The data in this table applies for pumps 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 motors		
	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	-

16. 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 inlet pipe.	Vent the inlet pipe or the pump.
	d) Counter-pressure is too high.	Set the duty point in accordance with the data sheet. Check the system for impurities.
	e) Inlet pressure is too low.	Increase the liquid level on the inlet side. Open the isolating valve in the inlet pipe. Make sure that all the conditions in section *8.5 Pipework* are complied with.
	f) Inlet pipe or impeller blocked by impurities.	Clean the inlet pipe or pump.
	g) Pump draws in air due to defective seal.	Check the pipeline seals, pump housing gaskets and shaft seals. Replace gaskets and seals, if necessary.
	h) Pump draws in air due to low liquid level.	Increase the liquid level on the inlet 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 outlet side. Otherwise, fit a more powerful motor.
	d) Motor-protective circuit breaker overload setting incorrect.	Check the setting of the motor-protective circuit breaker and adjust it, if necessary.
	e) Motor runs on two phases.	Check the electrical connection. Replace the fuse, if defective.

Fault	Cause	Remedy
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 inlet side. Open the isolating valve in the inlet pipe. Make sure that all the conditions in section *8.5 Pipework* are complied with.
	b) Air in inlet pipe or pump.	Vent the inlet pipe or the 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 inlet 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 pipes 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) Foreign bodies in pump.	Clean the pump.
	k) Frequency converter operation.	See section *10.2 Frequency converter operation*.
4. Leaking pump, connections or mechanical shaft seal.	a) Pump stressed by pipes thus causing leaks in pump housing or at 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) Shaft surface defective.	Replace the shaft.
5. Too high temperature in pump or motor.	a) Air in inlet pipe or pump.	Vent the inlet pipe or the pump and replenish.
	b) Inlet pressure too low.	Increase the liquid level on the inlet side. Open the isolating valve in the inlet pipe. Make sure that all the conditions in section *8.5 Pipework* are complied with.
	c) Bearings lubricated with too little, too much or unsuitable lubricant.	Replenish, reduce or replace the lubricant.
	d) Axial pressure too high.	Check the relief holes of the impeller and the lock rings on the inlet side.
	e) Motor-protective circuit breaker defective or setting incorrect.	Check the setting of the motor-protective circuit breaker and replace, if necessary.
	f) Motor overloaded.	Reduce the flow rate.

17. 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.

Subject to alterations.

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