CR, CRI, CRN

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.

Warning

If these instructions are not observed, it may lead to electric shock with consequent risk of serious personal injury or death.

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. Handling

When lifting the entire pump with motor, follow these instructions:

- Pump with motor sizes 0.37 - 5.5 kW:
  Lift the pump in the motor flange by means of straps or the like.
- Pump with motor sizes 7.5 - 22 kW:
  Lift the pump by means of the motor eyebolts.
- Pump with motor sizes 30-45 kW:
  Lift the pump by means of the lifting brackets on the motor flange.
- Pump with motor sizes 55-75 kW:
  Lift the pump by means of the eyebolts on the motor side.

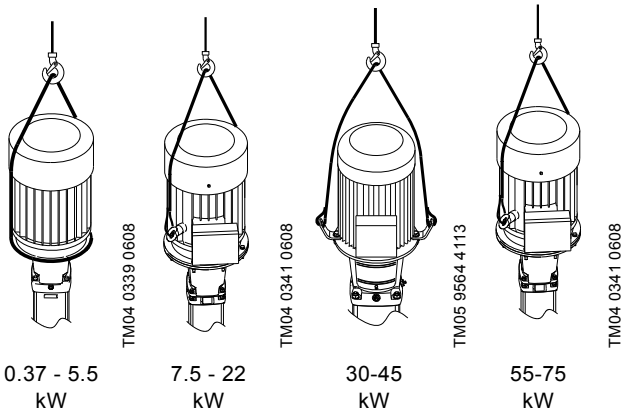

Fig. 1 Correct lifting of a CR pump

In case of CR, CRI and CRN pumps with other motors than MG or Siemens, we recommend you to lift the pump by means of the straps in the motor flange.

Warning

Make sure that the pump remains in a stable position during unpacking and installation by means of the straps used for lifting the pump.

Note that typically the centre of gravity of the pump is close to the motor.

3. Type designation

3.1 Type key for CR, CRI, CRN 1s, 1, 3, 5, 10, 15 and 20

Example	CR	3-	10	X-	X-	X-	X-	XXXX
Type range: CR, CRI, CRN								
Nominal flow rate in m^3/h								
Number of impellers								
Code for pump version								
Code for pipework connection								
Code for materials								
Code for rubber pump parts								
Code for shaft seal								

3.2 Type key for CR, CRN 32, 45, 64, 90, 120 and 150

Example	CR	32-	2	1-	X-	X-	X-	X-	XXXX
Pump range: CR, CRN									
Nominal flow rate in m^3/h									
Number of stages									
Number of impellers with reduced diameter									
Code for pump version									
Code for pipework connection									
Code for materials									
Code for rubber pump parts									
Code for shaft seal									

4. Applications

Grundfos multistage in-line centrifugal pumps, types CR, CRI and CRN, are designed for a wide range of applications.

CR, CRI, CRN

CR, CRI and CRN pumps are suitable for liquid transfer, circulation and pressure boosting of cold or hot clean liquids.

CRN

Use CRN pumps in systems where all parts in contact with the liquid are made of high-grade stainless steel.

Pumped liquids

Thin, clean, non-flammable, non-combustible or non-explosive liquids, not containing solid particles or fibres. The liquid must not attack the pump materials chemically.

When pumping liquids with a density and/or viscosity higher than that of water, use motors with correspondingly higher outputs, if required.

5. Technical data

5.1 Ambient temperature and altitude

Motor power [kW]	Motor make	Motor efficiency class	Maximum ambient temperature [°C]	Maximum altitude above sea level [m]
0.37 - 0.55	Grundfos MG	-	+40	1000
0.75 - 22	Grundfos MG	IE3	+60	3500
30 - 75	Siemens	IE3	+55	2750

If the ambient temperature exceeds the above temperature values or the pump is installed at an altitude exceeding the above altitude values, the motor must not be fully loaded due to the risk of overheating. Overheating may result from excessive ambient temperatures or 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 rated output.

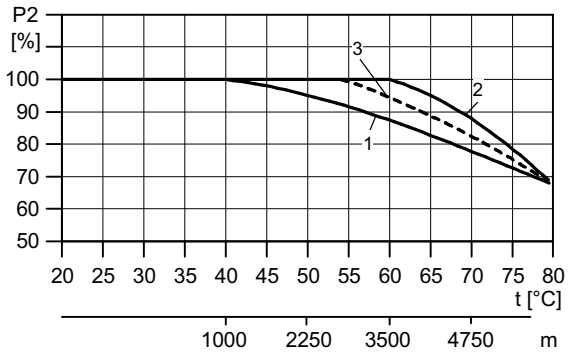

Fig. 2 Motor output depends on temperature/altitude

Pos.	Motor power [kW]	Motor make
1	0.37 - 0.55	MG
	0.37 - 22	MGE
2	0.75 - 22	MG
3	30-75	Siemens

Example

Figure 2 shows that the load of an IE3 motor at an ambient temperature of 70 °C must not be loaded more than 89 % of the rated output. If the pump is installed 4750 metres above sea level, the motor must not be loaded more than 89 % of the rated output.

In cases where both the maximum temperature and the maximum altitude are exceeded, the derating factors must be multiplied (0.89 x 0.89 = 0.79).

Note

For motor bearing maintenance at ambient temperatures above 40 °C, see section 9. Maintenance.

5.2 Liquid temperature

The table on page 16 states the relationship between liquid temperature range and maximum permissible operating pressure.

Note ***The maximum permissible operating pressure and liquid temperature ranges apply to the pump only.***

5.3 Maximum permissible operating pressure and liquid temperature for the shaft seal

Note ***The diagram below applies to clean water and water containing anti-freeze liquids.***

CR, CRI, CRN 1s to 20 and CR, CRN 32 to 150

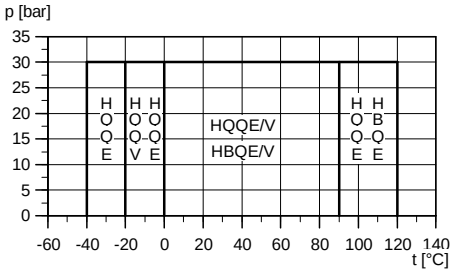

Fig. 3 Maximum permissible operating pressure and liquid temperature

Standard shaft seal	Motor [kW]	Max. temperature range [°C]
HQQE	0.37 - 45	-40 °C to +120 °C
HBQE	55 -75	0 °C to +120 °C
HQQV	0.37 - 45	-20 °C to +90 °C
HBQV	55-75	0 °C to +90 °C

CRI and CRN pumps using a type H shaft seal with EPDM rubber parts, HxxE, can be cleaned in place (CIP) with liquids up to 150 °C for maximum 15 minutes.

Note ***The pumping of liquids above +120 °C may result in periodical noise and reduced pump life.***

CR, CRI, CRN pumps are not suitable for the pumping of liquids above 120 °C for long periods.

5.4 Minimum inlet pressure

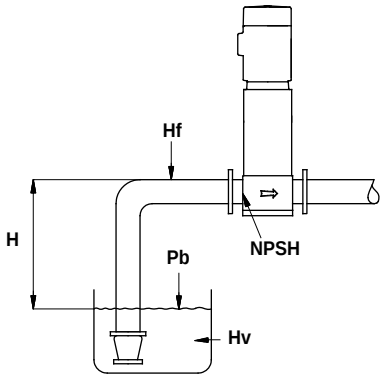

Fig. 4 Schematic view of open system with a CR pump

The maximum suction lift "H" in metres head can be calculated as follows:

$H = p_b \times 10.2 - NPSH - H_f - H_v - H_s$

p_b = Barometric pressure in bar.
(Barometric pressure can be set to 1 bar.)
In closed systems, p_b indicates the system pressure in bar.

NPSH = Net Positive Suction Head in metres head (to be read from the NPSH curve on page 14 at the highest flow the pump will be delivering).

H_f = Friction loss in suction pipe in metres head at the highest flow the pump will be delivering.

H_v = Vapour pressure in metres head, see fig. E on page 19. t_m = liquid temperature.

H_s = Safety margin = minimum 0.5 metres head.

If the calculated "H" is positive, the pump can operate at a suction lift of maximum "H" metres head.

If the calculated "H" is negative, an inlet pressure of minimum "H" metres head is required. There must be a pressure equal to the calculated "H" during operation.

Example

p_b = 1 bar.
Pump type: CR 15, 50 Hz.
Flow rate: 15 m^3/h.
NPSH (from page 14): 1.1 metres head.
H_f = 3.0 metres head.
Liquid temperature: +60 °C.
H_v (from fig. E, page 19): 2.1 metres head.

$H = p_b \times 10.2 - NPSH - H_f - H_v - H_s$ [metres head].

$H = 1 \times 10.2 - 1.1 - 3.0 - 2.1 - 0.5 =$ **3.5 metres head**.

This means that the pump can operate at a suction lift of maximum 3.5 metres head.

Pressure calculated in bar: 3.5 x 0.0981 = 0.343 bar.
Pressure calculated in kPa: 3.5 x 9.81 = 34.3 kPa.

5.5 Minimum inlet pressure

The table on page 17 states the maximum permissible inlet pressure. However, the actual inlet pressure + maximum pump pressure (at no flow) must always be lower than the values stated in fig. A, page 16.

The pumps are pressure-tested at a pressure of 1.5 times the values stated in fig. B, page 17.

5.6 Minimum flow rate

Due to the risk of overheating, do **not** use the pump at flows below the minimum flow rate.
The curves below show the minimum flow rate as a percentage of the nominal flow rate in relation to the liquid temperature.

- - - - = air-cooled top.

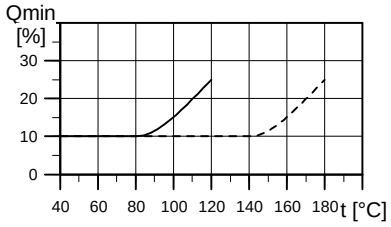

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Fig. 5 Minimum flow rate

Caution ***The pump must not run against a closed discharge valve.***

5.7 Electrical data

See motor nameplate.

5.8 Frequency of starts and stops

Motor size [kW]	Maximum number of starts per hour
≤ 2.2	250
3-4	100
5.5 - 11	50
18.5 - 22	40
30	90
37	50
45	80
55	50
75	50

5.9 Dimensions and weights

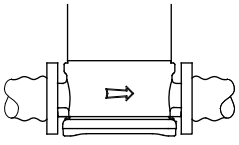
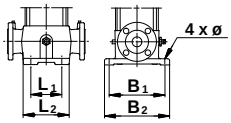
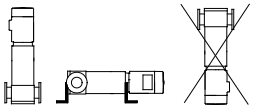
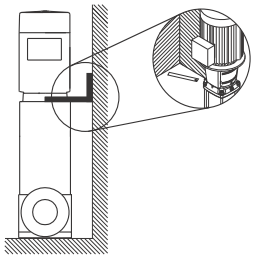
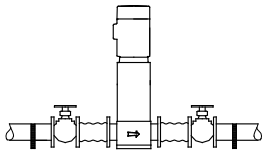
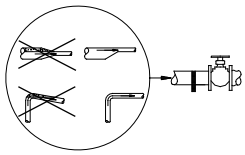
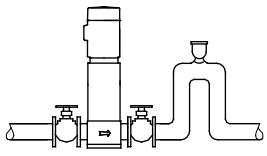
Dimensions: See fig. C, page 18.
Weights: See label on the packing.

5.10 Sound pressure level

See fig. D, page 19.

6. Installation

The pump must be secured to a horizontal, plane and solid foundation by bolts through the holes in the base plate. When installing the pump, follow the procedure below in order to avoid damaging the pump.

Step	Action
1  TM02 0013 3800	Arrows on the pump base show the direction of flow of liquid through the pump.
2  TM00 2256 3393	This information is stated on page 18: • port-to-port lengths • dimensions of the base • pipework connections • diameter and position of foundation bolts.
3  TM01 1241 4097	The pump can be installed vertically or horizontally (CR, CRN 120 and 150, 75 kW, only vertically). However, the motor must neither fall below the horizontal plane nor be installed upside down. Ensure that an adequate supply of cool air reaches the motor cooling fan. Motors above 4 kW must be supported.
3a  TM05 7705 1013	(Additional support for ships' use) To minimise pump vibrations, additional support brackets can be mounted. The brackets can be fitted from the motor or the motor stool to the bulkhead of the ship. Mount the bracket in horizontal position. To minimise further vibration, mount the bracket at an angle of 30-40 ° to the wall.
4  TM02 0116 3800	To minimise possible noise from the pump, we advise you to fit expansion joints on either side of the pump. The foundation/installation must be carried out as described in section *6.1*. Fit isolating valves on either side of the pump to avoid draining the system if the pump needs to be removed for cleaning, repair or replacement. Always protect the pump against backflow by means of a non-return valve (foot valve).
5  TM02 0114 3800	Install the pipes so that air locks do not occur, especially on the suction side of the pump.
6  TM02 0115 3800	Fit a vacuum valve close to the pump if the installation has one of these characteristics: • The discharge pipe slopes downwards away from the pump. • There is a risk of siphon effect. • Protection against backflow of unclean liquids is needed.

6.1 Foundation

Note

The foundation/installation must be carried out in accordance with the following instructions. Non-compliance may result in functional faults which will damage the pump components.

Grundfos recommends to install the pump on a concrete foundation which is heavy enough to provide permanent and rigid support to the entire pump. The foundation must be capable of absorbing any vibration, normal strain or shock. The concrete foundation must have an absolutely level and even surface.

Place the pump on the foundation, and fasten it. The base plate must be supported on the whole area.

The following instruction applies when mounting the pump in vertical or horizontal position.

Place the pump on the foundation, and fasten it. See fig. 6.

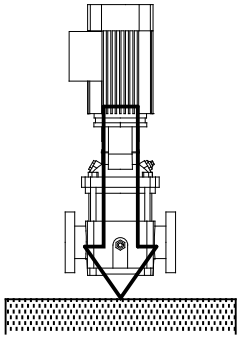


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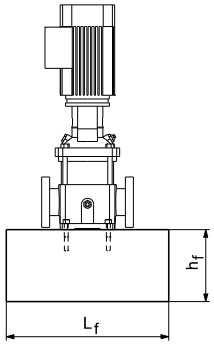
Fig. 6 Correct installation



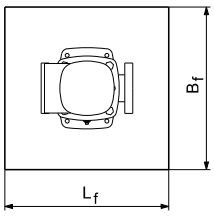


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Fig. 7 Foundation, vertical mounting

The recommended length and width are shown in fig. 7. Note that the length and width of the foundation for pumps with motor size ≤ 30 kW must be 200 mm larger than the base plate.

For pumps with motor size ≥ 37 kW, the length and width must always be 1.5 x 1.5 (L_f x B_f) metres.

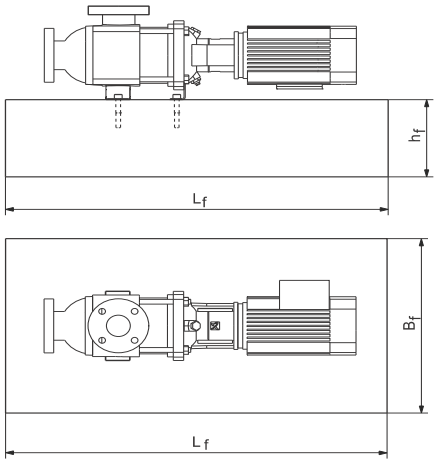

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Fig. 8 Foundation, horizontal mounting

The foundation length and width should always be 200 mm larger than the length and width of the pump. See fig. 8.

The mass of the foundation must be at least 1.5 times the total mass of the pump. 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 you to use a foundation with a mass up to 5 times that of the pump.

The foundation must be provided with bolts for fixing the base plate. See fig. 9.

6.2 Vibration dampening

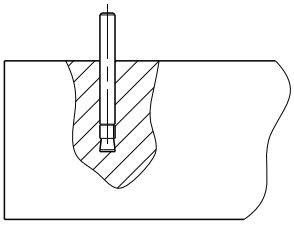

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Fig. 9 Bolt in foundation

When the foundation bolts are in position, the pump can be placed on the foundation. The base plate can now be aligned using shims, if necessary, so that it is completely horizontal. See fig. 10.

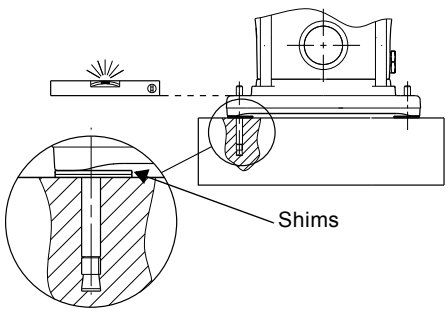

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Fig. 10 Alignment with shims

6.2 Vibration dampening

If vibration dampers are used, they must be installed under the foundation. Pumps with motor size ≤ 30 kW can use vibration dampers as shown in fig. 11.
For pumps with motor sizes ≥ 37 kW, use a Sylomer® plate as shown in fig. 12.

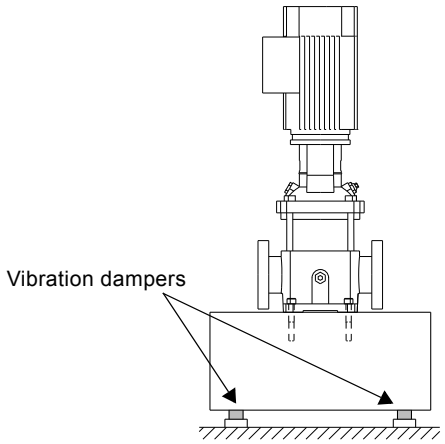

Fig. 11 Pump on vibration dampers

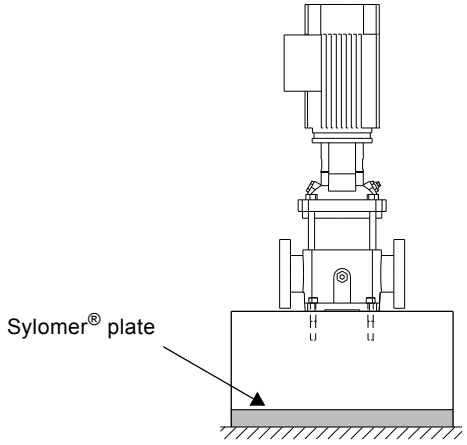

Fig. 12 Pump on Sylomer® plate

6.3 Outdoor installation

When installed outdoors, we recommend you to provide the motor with a rain cover. We also recommend you to open one of the drain holes in the motor flange.

6.4 Hot surfaces

Warning

When pumping hot liquids, care should be taken to ensure that persons cannot accidentally come into contact with hot surfaces.

Figure 13 shows which pump parts get as hot as the pumped liquid.

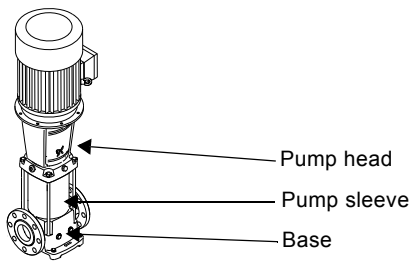

Fig. 13 Hot surfaces on a CR, CRI, CRN pump

6.5 Torques

The table shows the recommended torques for bolts in base and flanges.

CR, CRI, CRN	Base [Nm]	Flange [Nm]
1s-5	40	50-60
10-20	50	60-70
32-150	70	70-80

6.6 Flange forces and torques

If not all loads reach the maximum permissible value stated in the tables below, one of these values may exceed the normal limit. Contact Grundfos for further information.

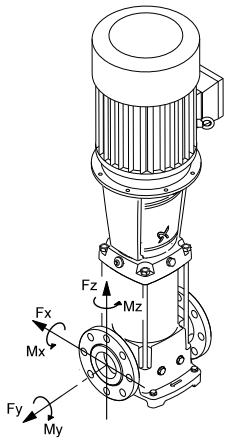

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Fig. 14 Flange forces and torques

Y-direction: Inlet/outlet
Z-direction: Direction of chamber stack
X-direction: 90 ° from inlet/outlet

Forces

Flange, DN [mm]	CR, CRI, CRN	Force, Y-direction [N]	Force, Z-direction [N]	Force, X-direction [N]
25/32	1s to 5	900	1050	850
40	10	1100	1250	1000
50	15 and 20	1500	1550	1350
65	32	1850	2100	1700
80	45	2500	2050	2250
100	64 and 90	3350	2700	3000
125/150	120 and 150	3350	2700	3000

Torques

Flange, DN [mm]	CR, CRI, CRN	Torque, Y-direction [Nm]	Torque, Z-direction [Nm]	Torque, X-direction [Nm]
25/32	1s to 5	1100	850	750
40	10	1300	1050	900
50	15 and 20	1400	1150	1000
65	32	1500	1200	1100
80	45	1150	1300	1600
100	64 and 90	1250	1450	1750
125/150	120 and 150	1250	1450	1750

7. Electrical connection

The electrical connection should be carried out by an authorised electrician in accordance with local regulations.

Warning

The CR pump must be connected to an external mains switch placed close to the pump and to a motor-protective circuit breaker or a CUE frequency converter. It must be possible to lock the mains switch in OFF position (isolated). Type and requirements as specified in EN 60204-1, 5.3.2.

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.

Caution ***The user is to consider whether it is necessary to install an emergency stop switch.***

The operating voltage and frequency are marked on the motor nameplate. Make sure that the motor is suitable for the power supply on which it will be used and the motor terminal connection is correct. You will find a wiring diagram in the terminal box.

7.1 Cable entry/screwed connection

All motors are supplied without screwed cable entries. The table below shows the numbers and sizes of cable entry holes of the terminal box (standard EN 50262).

Motor [kW]	Number and size of cable entries	Description
0.25 - 0.55	2 x M20 x 1.5	The holes have precast threads and are closed with knock-out cable entries
0.75 - 3.0	2 x M20	The holes are closed with knock-out cable entries
4.0 - 7.5	4 x M25	The holes are closed with knock-out cable entries
11-22	2 x M20 4 x M40	The holes are closed with knock-out cable entries
30-45	2 x M50 x 1.5	Blanking plug
55-75	2 x M63 x 1.5	Blanking plug

7.2 Three-phase connection

	Mains supply [V]		
	Delta connection		Star connection
50 Hz	220-240	/	380-415
	380-415	/	660-690
60 Hz	220-277	/	380-480 1)
	380-480	/	660-690

1) 60 Hz motors, 0.37 - 1.1 kW: 220-277/380-440 V.

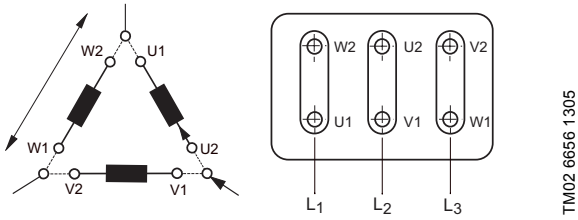

Fig. 15 Delta connection

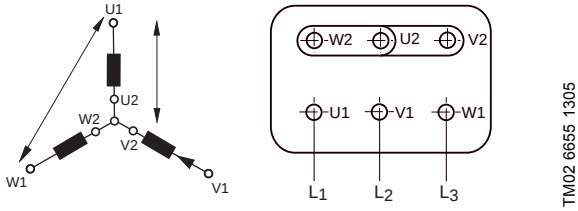

Fig. 16 Star connection

If the motor is provided with PTC sensors or PTO contacts, the connection must be in accordance with the wiring diagram in the terminal box.

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

7.3 Single-phase connection

	Mains supply [V]		
	"Low voltage"		"High voltage"
50 Hz	220-230	/	240

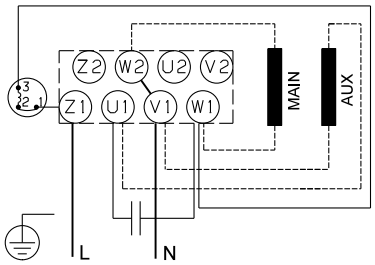

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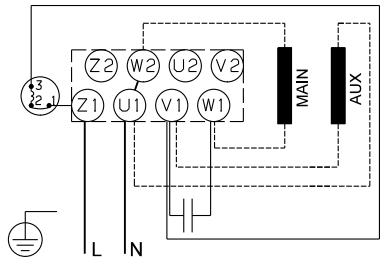
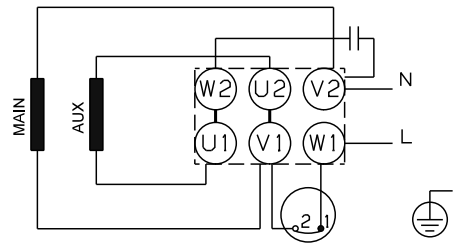
Fig. 17 Connection, "low voltage", 0.37 - 0.75 kW



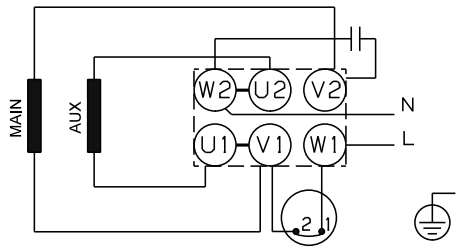
TM04 1694 1008

Fig. 18 Connection, "high voltage", 0.37 - 0.75 kW



TM04 0345 0608

Fig. 19 Connection, "low voltage", 1.1 - 2.2 kW



TM04 0344 0608

Fig. 20 Connection, "high voltage", 1.1 - 2.2 kW

Single-phase Grundfos motors incorporate a thermal switch and require no additional motor protection.

7.4 Terminal box positions

The terminal box can be turned to four positions, in 90 ° steps. Follow this procedure:

1. If necessary, remove the coupling guards. Do not remove the coupling.
2. Remove the bolts securing the motor to the pump.
3. Turn the motor to the required position.
4. Replace and tighten the bolts.
5. Replace the coupling guards.

Carry out the electrical connection as shown in the diagram inside the terminal box cover.

7.5 Frequency converter operation

7.5.1 Motors supplied by Grundfos

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

7.5.2 Phase insulation MG 71 and 80

MG motors, frame sizes 71 and 80, do not have phase insulation as standard. The motors are not suitable for frequency converter operation as they are not protected against the voltage peaks caused by the frequency converter operation. Only motors with a rated voltage equal to or above 460 V have phase insulation.

Caution ***Frequency converter operation of MG motors without phase insulation will cause damage to the motor.***

We recommend you to protect all other motors against voltage peaks higher than 1200 V by 2000 V/µsec.

The above disturbances, i.e. both increased acoustic noise and detrimental voltage peaks, can be eliminated by fitting an LC filter between the frequency converter and the motor.

For further information, please contact the frequency converter or motor supplier.

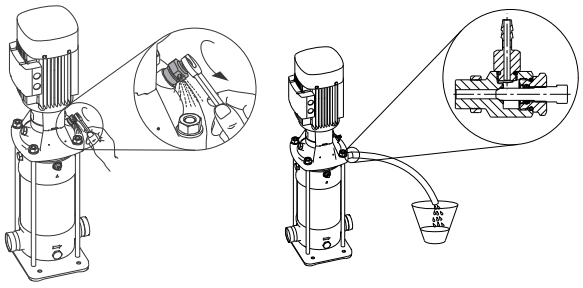
7.5.3 Other motor makes than those supplied by Grundfos

Please contact Grundfos or the motor manufacturer.

8. Startup

Caution

Do not start the pump until it has been filled with liquid and vented. If the pump runs dry, the pump bearings and the shaft seal may be damaged.



TM05 1160 0611 - TM05 8098 1913

Fig. 21 Venting valve, standard and an optional solution with hose connection.

Warning

Pay attention to the direction of the vent hole and take care to ensure that the escaping water does not cause injury to persons or damage to the motor or other components.
In hot-water installations, pay special attention to the risk of injury caused by scalding hot water.

Follow the instructions on page 34.

CR, CRI, CRN 1s to 5

For these pumps, we advise you to open the bypass valve during startup, see fig. 22 for bypass valve location. The bypass valve connects the suction and discharge sides of the pump, thus making the filling procedure easier. Close the bypass valve again when the operation is stable.

When pumping liquids containing air, we advise you to leave the bypass valve open if the operating pressure is lower than 6 bar.

Close the bypass valve if the operating pressure constantly exceeds 6 bar. Otherwise the material at the opening will be worn because of the high liquid velocity.

8.1 Shaft seal run-in

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 up 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.

However, liquids such as kerosene will not evaporate. The leakage may therefore be seen as a shaft seal failure.

9. Maintenance

Warning

Before starting work on the pump, make sure that all power supplies to the pump have been switched off and that they cannot be accidentally switched on.

Pump bearings and shaft seal are maintenance-free.

Motor bearings

Motors not fitted with grease nipples are maintenance-free.

Motors fitted with grease nipples should be lubricated with a high-temperature, lithium-based grease. See the instructions on the fan cover.

In the case of seasonal operation (motor is idle for more than 6 months of the year), we recommend you to grease the motor when the pump is taken out of operation.

Depending on the ambient temperature, the motor bearings must be replaced or lubricated according to the table below. The table applies to 2-pole motors. The number of operating hours stated for bearing replacement are guidelines only.

Motor size [kW]	Bearing replacement interval [operating hours]				
	40 °C	45 °C	50 °C	55 °C	60 °C
0.37 - 0.75	18000	-	-	-	-
1.1 - 7.5	20000	15500	12500	10000	7500
Motor size [kW]	**Lubrication interval [operating hours]**				
	40 °C	**45 °C**	**50 °C**	**55 °C**	**60 °C**
11 - 18.5	4500	3400	2500	1700	1100
22	4000	3100	2300	1500	1000
30-55	4000	3000	2000	1500	-
75	2000	1500	1000	500	-

Intervals for 4-pole motors are twice as long as those for 2-pole motors.

If the ambient temperature is lower than 40 °C, bearings must be replaced/lubricated at the intervals mentioned under 40 °C.

10. Frost protection

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

Drain the pump by loosening the vent screw in the pump head and by removing the drain plug from the base.

Warning

Pay attention to the direction of the vent hole and take care to ensure that the escaping water does not cause injury to persons or damage to the motor or other components.
In hot-water installations, pay special attention to the risk of injury caused by scalding hot water.

Do not tighten the vent screw and replace the drain plug until the pump is to be used again.

CR, CRI, CRN 1s to 5

Before replacing the drain plug in the base, screw the bypass valve out against the stop. See fig. 22.

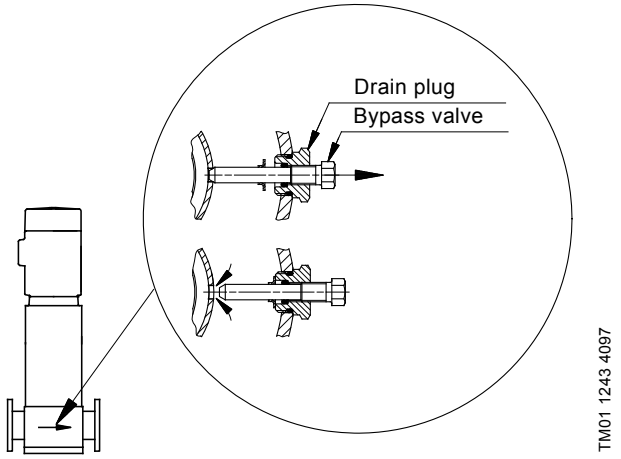


Fig. 22 Location of drain plug and bypass valve

Fit the drain plug by tightening the large union nut followed by the bypass valve.

11. Service

We recommend you to repair pumps with motors of 7.5 kW and up at pump site. Necessary lifting equipment must be available.

Note

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

If Grundfos is requested to service the 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 to be paid by the customer.

However, any application for service (no matter to whom it may be made) must include details about the pumped liquid if the pump has been used for liquids which are toxic or injurious to health.

11.1 Service kits and manuals

Service kits and manuals for CR, CRI and CRN, see www.grundfos.com (WebCAPS), WinCAPS or Service Kit Catalogue.

12. 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.

Fault	Cause	Remedy
1. Motor does not run when started.	a) Supply failure.	Connect the power supply.
	b) Fuses are blown.	Replace fuses.
	c) Motor-protective circuit breaker has tripped.	Reactivate the motor-protective circuit breaker.
	d) Thermal protection has tripped.	Reactivate the thermal protection.
	e) Main contacts in motor-protective circuit breaker are not making contact or the coil is faulty.	Replace contacts or magnetic coil.
	f) Control circuit is defective.	Repair the control circuit.
	g) Motor is defective.	Replace the motor.
2. Motor-protective circuit breaker trips immediately when power supply is switched on.	a) One fuse/automatic circuit breaker is blown.	Replace the fuse/cut in the circuit breaker.
	b) Contacts in motor-protective circuit breaker are faulty.	Replace motor-protective circuit breaker contacts.
	c) Cable connection is loose or faulty.	Fasten or replace the cable connection.
	d) Motor winding is defective.	Replace the motor.
	e) Pump mechanically blocked.	Remove the mechanical blocking of the pump.
	f) Motor-protective circuit breaker setting is too low.	Set the motor-protective circuit breaker correctly.
3. Motor-protective circuit breaker trips occasionally.	a) Motor-protective circuit breaker setting is too low.	Set the motor-protective circuit breaker correctly.
	b) Low voltage at peak times.	Check the power supply.
4. Motor-protective circuit breaker has not tripped but the pump does not run.	a) Check 1 a), b), d), e) and f).	
5. Pump performance not constant.	a) Pump inlet pressure is too low (cavitation).	Check the suction conditions.
	b) Suction pipe/pump partly blocked by impurities.	Clean the suction pipe/pump.
	c) Pump draws in air.	Check the suction conditions.
6. Pump runs but gives no water.	a) Suction pipe/pump blocked by impurities.	Clean the suction pipe/pump.
	b) Foot or non-return valve blocked in closed position.	Repair the foot or non-return valve.
	c) Leakage in suction pipe.	Repair the suction pipe.
	d) Air in suction pipe or pump.	Check the suction conditions.
	e) Motor runs in the wrong direction of rotation.	Change the direction of rotation of the motor.
7. Pump runs backwards when switched off.	a) Leakage in suction pipe.	Repair the suction pipe.
	b) Foot or non-return valve defective.	Repair the foot or non-return valve.
8. Leakage in shaft seal.	a) Shaft seal is defective.	Replace the shaft seal.
9. Noise.	a) Cavitation.	Check the suction conditions.
	b) Pump does not rotate freely (frictional resistance) because of incorrect pump shaft position.	Adjust the pump shaft. Follow the procedure in fig. F, G or H at the end of these instructions.
	c) Frequency converter operation.	See section *7.5 Frequency converter operation*.

13. Disposal

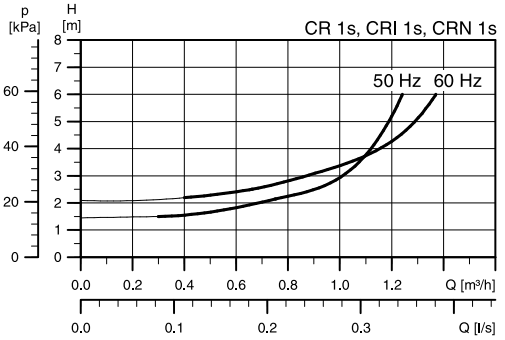
This product or parts of it must be disposed of in an environmentally sound way:

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.

Appendix

NPSH



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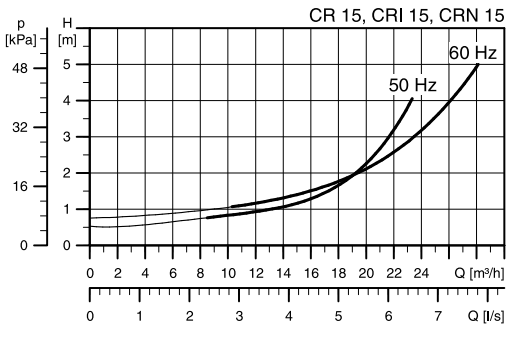

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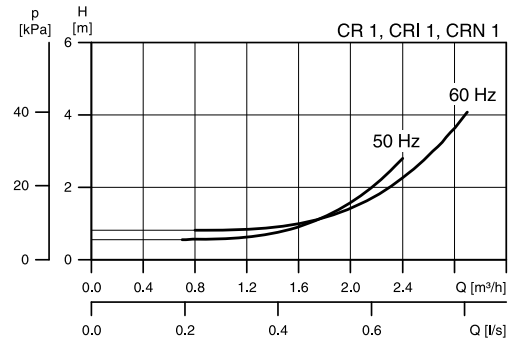

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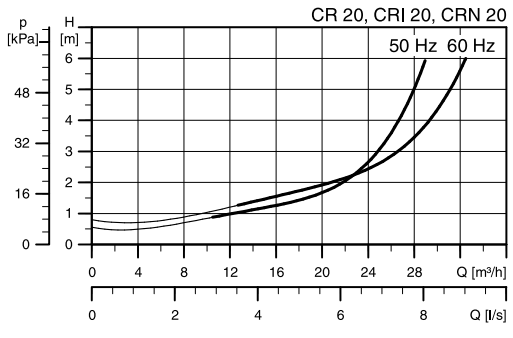

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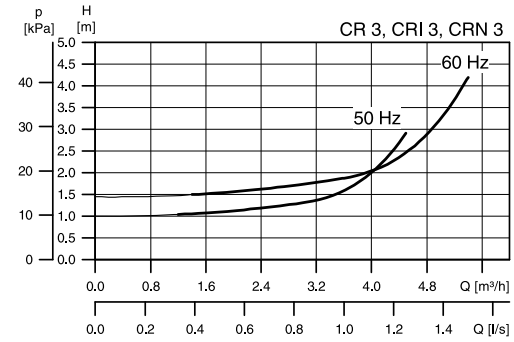

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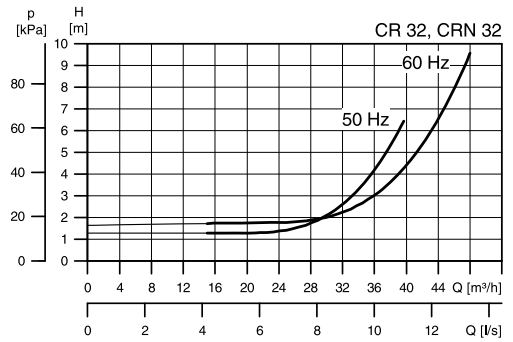

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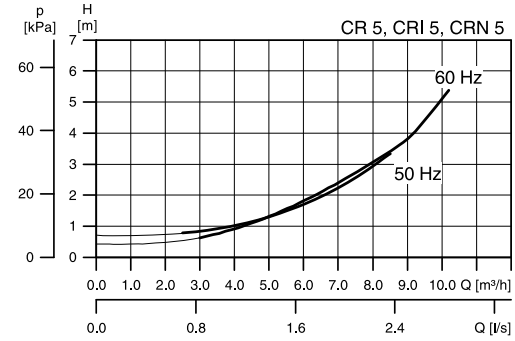

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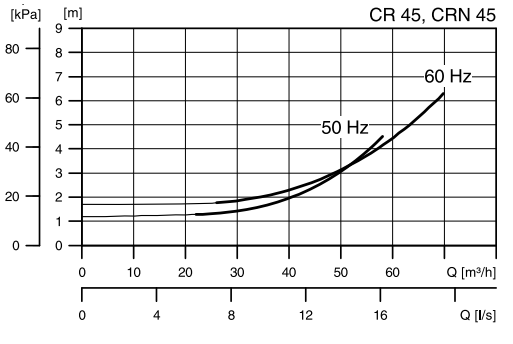

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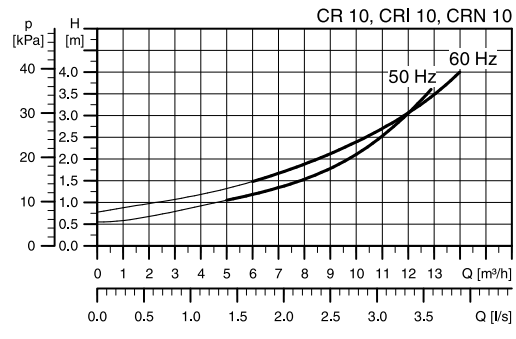

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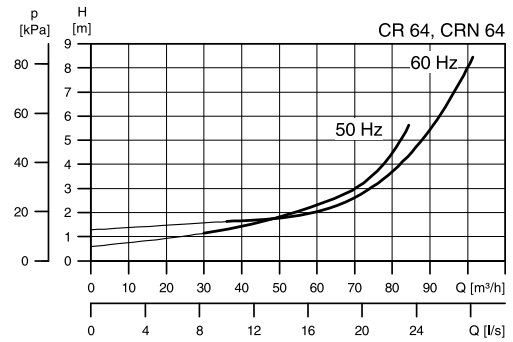

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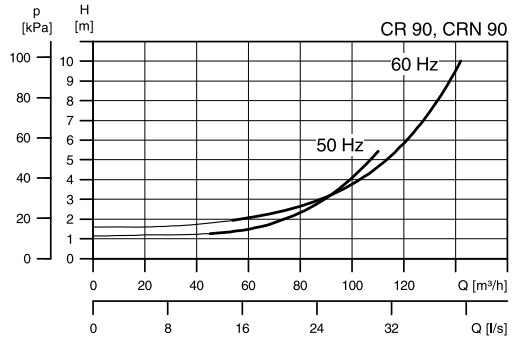

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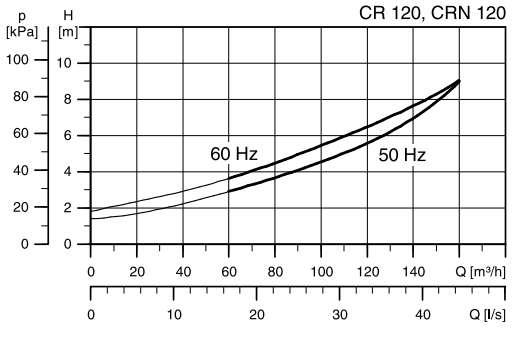

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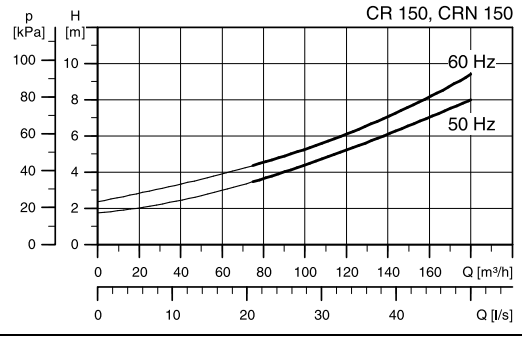


TM03 8765 2507

Fig. A

Maximum permissible operating pressure / liquid temperature range

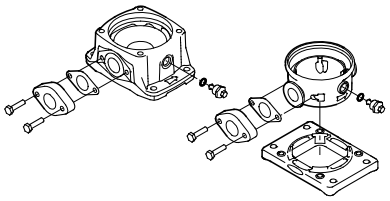
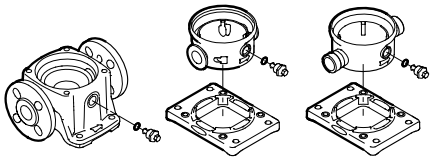
			Oval		PJE - CLAMP - CA - UNION DIN - FGJ	
						
			Operating pressure	**Liquid temperature range**	**Operating pressure**	**Liquid temperature range**
50 Hz	CR, CRI, CRN 1s		16 bar	-20 °C to +120 °C	25 bar	-20 °C to +120 °C
	CR, CRI, CRN 1		16 bar	-20 °C to +120 °C	25 bar	-20 °C to +120 °C
	CR, CRI, CRN 3		16 bar	-20 °C to +120 °C	25 bar	-20 °C to +120 °C
	CR, CRI, CRN 5		16 bar	-20 °C to +120 °C	25 bar	-20 °C to +120 °C
	CR, CRI 10-1	→ 10-16	16 bar	-20 °C to +120 °C	16 bar	-20 °C to +120 °C
	CR, CRI 10-17	→ 10-22	-	-	25 bar	-20 °C to +120 °C
	CRN 10		-	-	25 bar	-20 °C to +120 °C
	CR, CRI 15-1	→ 15-7	10 bar	-20 °C to +120 °C	-	-
	CR, CRI 15-1	→ 15-10	-	-	16 bar	-20 °C to +120 °C
	CR, CRI 15-12	→ 15-17	-	-	25 bar	-20 °C to +120 °C
	CRN 15		-	-	25 bar	-20 °C to +120 °C
	CR, CRI 20-1	→ 20-7	10 bar	-20 °C to +120 °C	-	-
	CR, CRI 20-1	→ 20-10	-	-	16 bar	-20 °C to +120 °C
	CR, CRI 20-12	→ 20-17	-	-	25 bar	-20 °C to +120 °C
	CRN 20		-	-	25 bar	-20 °C to +120 °C
	CR, CRN 32-1-1	→ 32-7	-	-	16 bar	-30 °C to +120 °C
	CR, CRN 32-8-2	→ 32-14	-	-	30 bar	-30 °C to +120 °C
	CR, CRN 45-1-1	→ 45-5	-	-	16 bar	-30 °C to +120 °C
	CR, CRN 45-6-2	→ 45-11	-	-	30 bar	-30 °C to +120 °C
	CR, CRN 45-12-2	→ 45-13-2	-	-	33 bar	-30 °C to +120 °C
	CR, CRN 64-1-1	→ 64-5	-	-	16 bar	-30 °C to +120 °C
	CR, CRN 64-6-2	→ 64-8-1	-	-	30 bar	-30 °C to +120 °C
	CR, CRN 90-1-1	→ 90-4	-	-	16 bar	-30 °C to +120 °C
	CR, CRN 90-5-2	→ 90-6	-	-	30 bar	-30 °C to +120 °C
	CR, CRN 120		-	-	30 bar	-30 °C to +120 °C
	CR, CRN 150		-	-	30 bar	-30 °C to +120 °C
60 Hz	CR, CRI, CRN 1s		16 bar	-20 °C to +120 °C	25 bar	-20 °C to +120 °C
	CR, CRI, CRN 1		16 bar	-20 °C to +120 °C	25 bar	-20 °C to +120 °C
	CR, CRI, CRN 3		16 bar	-20 °C to +120 °C	25 bar	-20 °C to +120 °C
	CR, CRI, CRN 5		16 bar	-20 °C to +120 °C	25 bar	-20 °C to +120 °C
	CR, CRI 10-1	→ 10-10	16 bar	-20 °C to +120 °C	16 bar	-20 °C to +120 °C
	CR, CRI 10-12	→ 10-17	-	-	25 bar	-20 °C to +120 °C
	CRN 10		16 bar	-20 °C to +120 °C	25 bar	-20 °C to +120 °C
	CR, CRI 15-1	→ 15-5	10 bar	-20 °C to +120 °C	-	-
	CR, CRI 15-1	→ 15-8	-	-	16 bar	-20 °C to +120 °C
	CR, CRI 15-9	→ 15-12	-	-	25 bar	-20 °C to +120 °C
	CRN 15		10 bar	-20 °C to +120 °C	25 bar	-20 °C to +120 °C
	CR, CRI 20-1	→ 20-5	10 bar	-20 °C to +120 °C	-	-
	CR, CRI 20-1	→ 20-7	-	-	16 bar	-20 °C to +120 °C
	CR, CRI 20-8	→ 20-10	-	-	25 bar	-20 °C to +120 °C
	CRN 20		10 bar	-20 °C to +120 °C	25 bar	-20 °C to +120 °C
	CR, CRN 32-1-1	→ 32-5	-	-	16 bar	-30 °C to +120 °C
	CR, CRN 32-6-2	→ 32-10-2	-	-	30 bar	-30 °C to +120 °C
	CR, CRN 45-1-1	→ 45-4	-	-	16 bar	-30 °C to +120 °C
	CR, CRN 45-5-2	→ 45-7	-	-	30 bar	-30 °C to +120 °C
	CR, CRN 64-1-1	→ 64-3	-	-	16 bar	-30 °C to +120 °C
	CR, CRN 64-4-2	→ 64-5-2	-	-	30 bar	-30 °C to +120 °C
	CR, CRN 90-1-1	→ 90-3	-	-	16 bar	-30 °C to +120 °C
	CR, CRN 90-4-2		-	-	30 bar	-30 °C to +120 °C
	CR, CRN 120		-	-	30 bar	-30 °C to +120 °C
	CR, CRN 150		-	-	30 bar	-30 °C to +120 °C

Fig. B

Maximum inlet pressure for CR, CRI and CRN

50 Hz		60 Hz	
CR, CRI, CRN 1s			
CR, CRI, CRN 1s-2 → CR, CRI, CRN 1s-36	10 bar	CR, CRI, CRN 1s-2 → CR, CRI, CRN 1s-27	10 bar
CR, CRI, CRN 1			
CR, CRI, CRN 1-2 → CR, CRI, CRN 1-36	10 bar	CR, CRI, CRN 1-2 → CR, CRI, CRN 1-25 CR, CRI, CRN 1-27	10 bar 15 bar
CR, CRI, CRN 3			
CR, CRI, CRN 3-2 → CR, CRI, CRN 3-29 CR, CRI, CRN 3-31 → CR, CRI, CRN 3-36	10 bar 15 bar	CR, CRI, CRN 3-2 → CR, CRI, CRN 3-15 CR, CRI, CRN 3-17 → CR, CRI, CRN 3-25	10 bar 15 bar
CR, CRI, CRN 5			
CR, CRI, CRN 5-2 → CR, CRI, CRN 5-16 CR, CRI, CRN 5-18 → CR, CRI, CRN 5-36	10 bar 15 bar	CR, CRI, CRN 5-2 → CR, CRI, CRN 5-9 CR, CRI, CRN 5-10 → CR, CRI, CRN 5-24	10 bar 15 bar
CR, CRI, CRN 10			
CR, CRI, CRN 10-1 → CR, CRI, CRN 10-6 CR, CRI, CRN 10-7 → CR, CRI, CRN 10-22	8 bar 10 bar	CR, CRI, CRN 10-1 → CR, CRI, CRN 10-5 CR, CRI, CRN 10-6 → CR, CRI, CRN 10-17	8 bar 10 bar
CR, CRI, CRN 15			
CR, CRI, CRN 15-1 → CR, CRI, CRN 15-3 CR, CRI, CRN 15-4 → CR, CRI, CRN 15-17	8 bar 10 bar	CR, CRI, CRN 15-1 → CR, CRI, CRN 15-2 CR, CRI, CRN 15-3 → CR, CRI, CRN 15-12	8 bar 10 bar
CR, CRI, CRN 20			
CR, CRI, CRN 20-1 → CR, CRI, CRN 20-3 CR, CRI, CRN 20-4 → CR, CRI, CRN 20-17	8 bar 10 bar	CR, CRI, CRN 20-1 CR, CRI, CRN 20-2 → CR, CRI, CRN 20-10	8 bar 10 bar
CR, CRN 32			
CR, CRN 32-1-1 → CR, CRN 32-4 CR, CRN 32-5-2 → CR, CRN 32-10 CR, CRN 32-11-2 → CR, CRN 32-14	4 bar 10 bar 15 bar	CR, CRN 32-1-1 → CR, CRN 32-2 CR, CRN 32-3-2 → CR, CRN 32-6 CR, CRN 32-7-2 → CR, CRN 32-10-2	4 bar 10 bar 15 bar
CR, CRN 45			
CR, CRN 45-1-1 → CR, CRN 45-2 CR, CRN 45-3-2 → CR, CRN 45-5 CR, CRN 45-6-2 → CR, CRN 45-13-2	4 bar 10 bar 15 bar	CR, CRN 45-1-1 → CR, CRN 45-1 CR, CRN 45-2-2 → CR, CRN 45-3 CR, CRN 45-4-2 → CR, CRN 45-7	4 bar 10 bar 15 bar
CR, CRN 64			
CR, CRN 64-1-1 → CR, CRN 64-2-2 CR, CRN 64-2-1 → CR, CRN 64-4-2 CR, CRN 64-4-1 → CR, CRN 64-8-1	4 bar 10 bar 15 bar	CR, CRN 64-1-1 CR, CRN 64-1 → CR, CRN 64-2-1 CR, CRN 64-2 → CR, CRN 64-5-2	4 bar 10 bar 15 bar
CR, CRN 90			
CR, CRN 90-1-1 → CR, CRN 90-1 CR, CRN 90-2-2 → CR, CRN 90-3-2 CR, CRN 90-3 → CR, CRN 90-6	4 bar 10 bar 15 bar	CR, CRN 90-1-1 → CR, CRN 90-2-2 CR, CRN 90-2-1 → CR, CRN 90-4-2	10 bar 15 bar
CR, CRN 120			
CR, CRN 120-1 → CR, CRN 120-2-1 CR, CRN 120-2 → CR, CRN 120-5-1 CR, CRN 120-6-1 → CR, CRN 120-7	10 bar 15 bar 20 bar	CR, CRN 120-1 CR, CRN 120-2-2 → CR, CRN 120-3 CR, CRN 120-4-1 → CR, CRN 120-5-2	10 bar 15 bar 20 bar
CR, CRN 150			
CR, CRN 150-1-1 → CR, CRN 150-1 CR, CRN 150-2-1 → CR, CRN 150-4-1 CR, CRN 150-5-2 → CR, CRN 150-6	10 bar 15 bar 20 bar	CR, CRN 150-1-1 CR, CRN 150-1 → CR, CRN 150-2 CR, CRN 150-3-2 → CR, CRN 150-4-2	10 bar 15 bar 20 bar

Fig. C

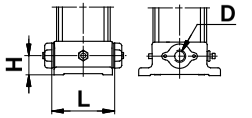
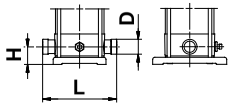
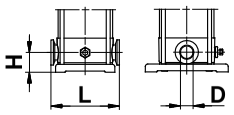
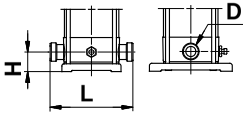
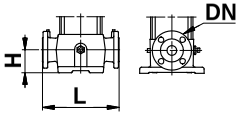
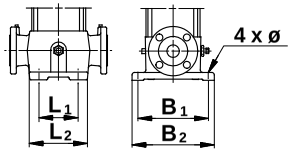
Pump Type	Oval			PJE			CLAMP - FlexiClamp			UNION			DIN - FGJ							
	 TM00 2251 3393			 TM00 2252 3393			 TM00 2253 3393			 TM00 2254 3393			 TM00 2255 3393			 TM00 2256 3393				
	L [mm]	H [mm]	D [Rp]	L [mm]	H [mm]	D [mm]	L [mm]	H [mm]	D [mm]	L [mm]	H [mm]	D [G]	L [mm]	H [mm]	DN	L_1 [mm]	L_2 [mm]	B_1 [mm]	B_2 [mm]	Ø [mm]
CR 1s	160	50	1	-	-	-	-	-	-	-	-	-	250	75	25/32	100	145	180	220	13
CRI, CRN 1s	-	-	-	210	50	42.2	162	50	30	228	50	2	250	75	25/32	100	150	180	220	13
CR 1	160	50	1	-	-	-	-	-	-	-	-	-	250	75	25/32	100	145	180	220	13
CRI, CRN 1	-	-	-	210	50	42.2	162	50	30	228	50	2	250	75	25/32	100	150	180	220	13
CR 3	160	50	1	-	-	-	-	-	-	-	-	-	250	75	25/32	100	145	180	220	13
CRI, CRN 3	-	-	-	210	50	42.2	162	50	30	228	50	2	250	75	25/32	100	150	180	220	13
CR 5	160	50	1¼	-	-	-	-	-	-	-	-	-	250	75	25/32	100	145	180	220	13
CRI, CRN 5	-	-	-	210	50	42.2	162	50	30	228	50	2	250	75	25/32	100	150	180	220	13
CR 10	200	80	1½	-	-	-	-	-	-	-	-	-	280	80	40	130	178	215	256	13.5
CRI, CRN 10	-	-	-	261	80	60.1	202	80	50	-	-	-	280	80	40	130	200	215	248	13
CR 15	200	80	2	-	-	-	-	-	-	-	-	-	300	90	50	130	176	215	256	13.5
CRI, CRN 15	-	-	-	261	90	60.1	202	90	50	-	-	-	300	90	50	130	200	215	248	13
CR 20	200	80	2	-	-	-	-	-	-	-	-	-	300	90	50	130	176	215	256	13.5
CRI, CRN 20	-	-	-	261	90	60.1	202	90	50	-	-	-	300	90	50	130	200	215	248	13
CR 32	-	-	-	-	-	-	-	-	-	-	-	-	320	105	65	170	223	240	298	14
CRN 32	-	-	-	-	-	-	-	-	-	-	-	-	320	105	65	170	226	240	298	14
CR 45	-	-	-	-	-	-	-	-	-	-	-	-	365	140	80	190	248	266	331	14
CRN 45	-	-	-	-	-	-	-	-	-	-	-	-	365	140	80	190	251	266	331	14
CR 64	-	-	-	-	-	-	-	-	-	-	-	-	365	140	100	190	248	266	331	14
CRN 64	-	-	-	-	-	-	-	-	-	-	-	-	365	140	100	190	251	266	331	14
CR 90	-	-	-	-	-	-	-	-	-	-	-	-	380	140	100	199	261	280	348	14
CRN 90	-	-	-	-	-	-	-	-	-	-	-	-	380	140	100	199	261	280	348	14
CR 120	-	-	-	-	-	-	-	-	-	-	-	-	380	180	125	275	344	380	472	18
CRN 120	-	-	-	-	-	-	-	-	-	-	-	-	380	180	125	275	344	380	472	18
CR 150	-	-	-	-	-	-	-	-	-	-	-	-	380	180	125	275	344	380	472	18
CRN 150	-	-	-	-	-	-	-	-	-	-	-	-	380	180	125	275	344	380	472	18

Fig. D

Airborne noise emitted by pumps with motors fitted by Grundfos

Motor [kW]	50 Hz	60 Hz
	$\bar{L}_{pA}$ [dB(A)]	$\bar{L}_{pA}$ [dB(A)]
0.37	50	55
0.55	50	53
0.75	50	54
1.1	52	57
1.5	54	59
2.2	54	59
3.0	55	60
4.0	62	66
5.5	60	65
7.5	60	65
11	60	65
15	60	65
18.5	60	65
22	66	70
30	71	75
37	71	75
45	71	75
55	71	75
75	73	77

Fig. E