

CR, CRI, CRN, CRT ATEX-approved pumps

Installation and operating instructions



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GRUNDFOS 

English (GB) Installation and operating instructions

Original installation and operating instructions

These supplementary installation and operating instructions apply to the ATEX-approved Grundfos CR pumps.

The CR pumps comply with ATEX Directive 2014/34/EU.

The pumps are suitable for use in zones classified according to Directive 1999/92/EC. In case of doubt, consult the above-mentioned directives, or contact Grundfos.

CONTENTS

| | Page |
|--|-----------|
| 1. General information | 2 |
| 1.1 Hazard statements | 2 |
| 1.2 Notes | 3 |
| 2. Related installation and operating instructions | 3 |
| 3. Receiving the product | 3 |
| 4. Explosion protection document | 3 |
| 5. Identification | 4 |
| 5.1 Nameplate | 4 |
| 5.2 Type key | 5 |
| 5.3 Drive-end motor bearing | 6 |
| 6. Scope of ATEX categories for CR pumps | 7 |
| 7. Installing the product | 8 |
| 7.1 Pump with single seal | 8 |
| 7.2 Pump with MAGdrive | 8 |
| 7.3 Pump with double seal | 9 |
| 7.4 Bare-shaft pumps | 9 |
| 8. Operating conditions | 10 |
| 8.1 Maximum ambient temperature | 10 |
| 8.2 Maximum liquid temperature | 10 |
| 8.3 Temperature calculation | 11 |
| 9. Before starting up and during operation of an ATEX-approved pump | 12 |
| 9.1 Checklist | 12 |
| 10. Maintenance and inspection | 14 |
| 10.1 Tightening torques | 14 |
| 10.2 Shaft seal | 14 |

1. General information

1.1 Hazard statements

The symbols and hazard statements below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

DANGER



Indicates a hazardous situation which, if not avoided, will result in death or serious personal injury.

WARNING



Indicates a hazardous situation which, if not avoided, could result in death or serious personal injury.

CAUTION



Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

The hazard statements are structured in the following way:

SIGNAL WORD



Description of hazard

Consequence of ignoring the warning.
- Action to avoid the hazard.



Read this document before installing the product. Installation and operation must comply with local regulations and accepted codes of good practice.

1.2 Notes

The symbols and notes below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.



Observe these instructions for explosion-proof products.



A blue or grey circle with a white graphical symbol indicates that an action must be taken.



A red or grey circle with a diagonal bar, possibly with a black graphical symbol, indicates that an action must not be taken or must be stopped.



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



Tips and advice that make the work easier.

2. Related installation and operating instructions

The X on the nameplate indicates that the pump is subject to special conditions for safe use as described in these instructions. The nameplate markings are described in the table in section [5. Identification](#).

In addition to these instructions, observe the following installation and operating instructions:

- CR, CRI, CRN: for standard pumps
- CR, CRI, CRN, CRT: removal of transport bracket and fitting of motor. For pumps without motor
- MG: Grundfos standard motors.

For special versions of the CR pumps, observe the relevant installation and operating instructions:

- CRN MAGdrive
- CR, CRI, CRN: double seal, back-to-back
- CR, CRI, CRN: double seal, tandem
- MG: Grundfos standard motors.

3. Receiving the product

If the pump is delivered without a motor, mount the motor and then adjust the chamber stack and shaft seal according to the procedure described in the installation and operating instructions, "Removal of transport bracket and fitting of motor", supplied with the pump.

4. Explosion protection document

The combination of CR pump and all monitoring equipment must be described in the explosion protection document according to Directive 1999/92/EC.

5. Identification

5.1 Nameplate

The nameplate on the pump head gives the following details:

- data of standard pump
- data of ATEX marking
 - technical file number
 - serial number
 - Ex category.

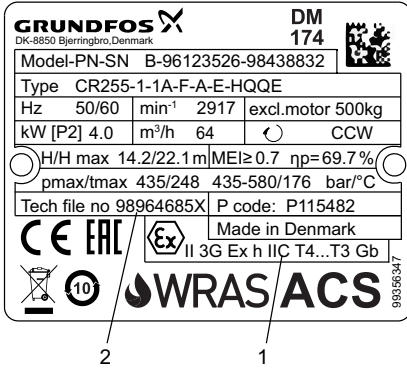


Fig. 1 Example of a CR nameplate with ATEX approval

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| ATEX rating | |
|-------------|--|
| Pos. | Description |
| | Group II I: Underground in mines II: Surface equipment |
| | Category 3G M2: Mining 2G, 3G: Gas/vapours 2D, 3D: Dust |
| | Ex h Protection type |
| 1 | Environment group IIC IIC: Gas/vapours IIIC: Combustible dust IIIB: Non-magnetic dust |
| | Maximum surface temperature according to 80079-36. |
| | T4...T3 Temperature range or specific temperature. T4...T3: Gas T125 °C: Dust |
| | EPL (Equipment Protection Level). Gb, Gc: Gas Db, Dc: Dust |
| | 98964685 File number for technical file stored at DEKRA. |
| 2 | X Indicates that the equipment is subject to special conditions for safe use. The conditions are mentioned in this document. |

Data for the ATEX marking only refers to the part including the coupling. The motor has a separate nameplate.

5.2 Type key

5.2.1 Type key example

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

5.2.2 Key to codes for pump version

| Codes for pump version | |
|------------------------|------------------------------|
| A | Basic version |
| B | Oversize motor |
| E | Pump with certificate |
| H | Horizontal version |
| I | Different pressure rating |
| K | Pump with low NPSH |
| M | Magnetic drive |
| O | Cleaned and dried |
| P | Undersize motor |
| S | High-pressure pump |
| T | Thrust handling device (THD) |
| U | ATEX approved pump |
| Y | Electropolished |
| Z | Pumps with bearing flange |

5.3 Drive-end motor bearing

Make sure to use the correct type of drive-end (DE) motor bearing for the bare-shaft pump. Please check the specific pump range and pump version stated on the nameplate and select the corresponding DE bearing.

| | DE bearing CR 1-64 pump range | | DE bearing CR 95-255 pump range | |
|--|---------------------------------------|-----------------------------------|---------------------------------------|-----------------------------------|
| | Deep-groove ball bearing (62/63xx) | Angular contact bearing (73xx) | Deep-groove ball bearing (62/63xx) | Angular contact bearing (73xx) |
| A Standard pump | 0.37 - 3 kW | 4-45 kW | 75-200 kW | 5.5 - 55 kW |
| T Pump with thrust handling device (THD) ²⁾ | - | - | 5.5 - 55 kW | Not allowed |
| Z Pump with bearing flange ²⁾ | 0.37 - 45 kW | Not allowed | 5.5 - 200 kW | Not allowed |

1) Refer to the codes for pump version in section [5.2 Type key](#).

2) Factory product variants (FPV).

6. Scope of ATEX categories for CR pumps

| Directive | ATEX-approved CR pumps | |
|--------------------------|------------------------|------------------|
| 2014/34/EU | GROUP I | |
| | Category M | |
| Environment: | 1 | 2 |
| EPL ¹⁾ : | Ma | Mb |
| 1999/92/EC ²⁾ | - | - |
| CR pumps | None | CR CRI CRN |
| Motors | None | None |

| 2014/34/EU | GROUP II | | | | | |
|--------------------------|-----------------|---------|--|-------------------------------------|--|-------------------------------------|
| | Category 1 | | Category 2 | | Category 3 | |
| Environment: | G | D | G | D | G | D |
| EPL ¹⁾ : | Ga | Da | Gb | Db | Gc | Dc |
| 1999/92/EC ²⁾ | Zone 0 | Zone 20 | Zone 1 | Zone 21 | Zone 2 | Zone 22 |
| CR pumps | None | None | CR CRI CRN CRT | CR CRI CRN CRT | CR CRI CRN CRT | CR CRI CRN CRT |
| Motors | None | None | • II 2G Ex eb IIC T3 Gb • II 2G Ex db IIC T4 Gb | • II 2D Ex tb IIIC T125 °C Db | • II 2G Ex eb IIC T3 Gb • II 2G Ex db IIC T4 Gb | • II 3D Ex tc IIIC T125 °C Dc |

1) EPL: Equipment Protection Level.

2) **Important:** The link between groups, categories and zones is explained in Directive 1999/92/EC. Note that this is a minimum directive. Some EU countries may therefore have stricter local rules. The user or installer is always responsible for checking that the group and category of the pump correspond to the zone classification of the installation site.

7. Installing the product

DANGER

Explosion risk

- Death or serious personal injury
- Do not let the pump run dry.
 - Make sure that the pump is filled with pumped liquid during operation.



DANGER

Explosion risk

- Death or serious personal injury
- Replace the shaft seal if increased leakage is observed.



DANGER

Explosion risk

- Death or serious personal injury
- Always install the pump with the motor above the pump to avoid overheating of the motor bearings. See fig. 2.



The responsibility for checking the functions of the dry-running protection, such as flow rate, sealing pressure and temperature of the barrier or flushing liquid, rests with the installer or owner.

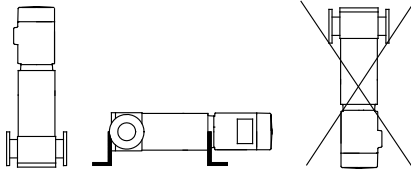


Fig. 2 Positioning the pump

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7.1 Pump with single seal

7.1.1 Non-flammable liquids

Category 2G/D/M2

Make sure that the pump is filled with pumped liquid during operation. If this is not possible, ensure appropriate monitoring, for example dry-running protection to stop the pump in case of malfunction.

Category 3G/D

No additional monitoring, for example dry-running protection, is required for the pump system.

7.1.2 Flammable liquids, pump unit

Category 2G/D/M2 and 3G/D/M2

Make sure that the pump is filled with pumped liquid during operation. If this is not possible, ensure appropriate monitoring, for example dry-running protection to stop the pump in case of malfunction. Ensure sufficient ventilation around the pump.

The leakage rate of a shaft seal is 1-10 ml for each 24 hours of operation. For some types of liquids, the leakage will not be visible due to evaporation. During the run-in period, larger leakage of 1-20 ml per 24 hours of operation can occur. Liquids like oil or glycol-water mixtures evaporate slower than water and will leave residuals. Ensure proper ventilation to maintain the zone classification.

Category M2

Protect the pump with a guard to prevent damage from falling or ejected objects.

7.2 Pump with MAGdrive

DANGER

Explosion risk

- Death or serious personal injury
- Always fill the pump with liquid and ensure that the required minimum flow rate is obtained.



See the CRN MAGdrive installation and operating instructions at <http://net.grundfos.com/qr/i/96464310>.

7.3 Pump with double seal

Back-to-back or tandem

7.3.1 Non-flammable liquids, pump unit

Category 2G/D

Make sure that the pump is filled with pumped liquid during operation. If this is not possible, ensure appropriate monitoring, for example dry-running protection to stop the pump in case of malfunction.

Category 3G/D

No additional monitoring, such as dry-running protection, is required for the pump system.

7.3.2 Flammable liquids, pump unit

Category 2G/D/M2 and 3G/D/M2

Make sure that the pump is filled with pumped liquid during operation. If this is not possible, ensure appropriate monitoring, for example dry-running protection to stop the pump in case of malfunction. Ensure sufficient ventilation around the pump.

The leakage rate of a shaft seal is 1-10 ml for each 24 hours of operation. For some types of liquids, the leakage will not be visible due to evaporation. During the run-in period, larger leakage of 1-20 ml per 24 hours of operation can occur. Liquids like oil or glycol-water mixtures evaporate slower than water and will leave residuals. Ensure proper ventilation to maintain the zone classification.

Category M2

Protect the pump by a guard to prevent damage from falling or ejected objects.

7.4 Bare-shaft pumps

Bare-shaft pumps with motors of 4 kW and up must use angular contact bearings.

However, if the pumps are fitted with a thrust handling device (THD) or a bearing flange, they must never be used with angular contact bearings. If in doubt, contact Grundfos.



Check if the pump is fitted with a thrust handling device (THD). If the pump is a THD marked pump, follow the instructions below.

The thrust handling device (THD) is factory-fitted on CR, CRN 95-255 for motor sizes of 75 kW and above.

7.4.1 Bare-shaft pumps with a thrust handling device

DANGER

Explosion risk



Death or serious personal injury
- Temperature monitoring of the motor bearings is required to ensure that the pump stops in case of overheating.

DANGER

Explosion risk



Death or serious personal injury
- Do not use ATEX motors with angular contact bearings on pumps fitted with a thrust handling device (THD).

DANGER

Explosion risk



Death or serious personal injury
- Temperature sensors must be installed by qualified persons in accordance with local regulations.

Minimum flow rate

Due to the risk of overheating, do not use the pump at flows below the minimum flow rate.

The curve below shows the minimum flow rate as a percentage of the rated flow rate in relation to the liquid temperature.

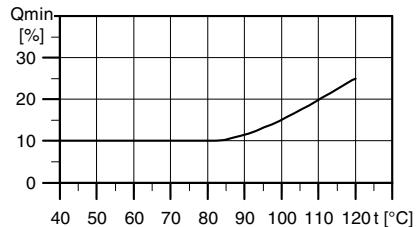


Fig. 3 Minimum flow rate in percentage of nominal flow

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8. Operating conditions

DANGER



Explosion risk

- Death or serious personal injury
- Ensure that the required minimum inlet pressure is always available.

See the CR, CRI, CRN installation and operating instructions:

- <http://net.grundfos.com/qr/i/96462123>
- <http://net.grundfos.com/qr/i/99078486>

DANGER

Explosion risk



- Death or serious personal injury
- Do not operate the pump with higher liquid temperature than the maximum liquid temperature (t_{max}) stated on the pump nameplate.
 - The calculated maximum permissible liquid temperature must not be exceeded.

8.1 Maximum ambient temperature

The maximum ambient temperature for the pump: - 20 to +60 °C.

8.2 Maximum liquid temperature

In normal pump operation, the highest temperatures are to be expected at the surface of the pump casing and at the shaft seal. The surface temperature will normally follow the temperature of the liquid.

You can calculate the permissible liquid temperature by finding the maximum permissible temperature at the surface of the pump during operation in the table shown in section [8.3.1 Temperature class](#), and reduce it with the temperature contribution from shaft seals, see table in section [8.3.2 Shaft seal temperature](#).

Section [8.3 Temperature calculation](#) contains a diagram which shows how the maximum surface temperature depends on the liquid temperature and the temperature contribution from the shaft seal.

Calculation example

Based on temperature contribution from a HQXX shaft seal, media class 1, shaft diameter $\varnothing 22$ and pressure 2.5 Mpa.

Temperature class (T_4) = 135 °C, see section [8.3.1 Temperature class](#).

Temperature contribution from HQXX shaft seal = 24 °C, see section [8.3.2 Shaft seal temperature](#).

Safety margin for Group II = 5 °C according to the ATEX standard.

Result

Maximum permissible liquid temperature:

T_4 -contribution from shaft seal-safety margin = 135 - 24 - 5 = 106 °C.

Pumps that are allowed to pump liquids up to a maximum of 150 °C are equipped with a tandem shaft seal. In this case, the temperature and flow rate of the flushing liquid must be according to the description in the installation and operating instructions "CR, CRI, CRN-Double seal (tandem)" at <http://net.grundfos.com/qr/i/96477555>.

Make sure that the combination of CR pump and dry-running protection is described in the explosion protection document according to Directive 1999/92/EC.



The responsibility for checking the correct flow rate and the temperature of the flushing liquid rests with the installer or owner.



Increased leakage rate can indicate damaged elastomers and rubber parts in the pump. For some liquid types, the leakage is not visible due to evaporation.

8.3 Temperature calculation

The illustration below shows the maximum surface temperature of the pump as a result of the maximum liquid temperature and temperature rise in the shaft seal.

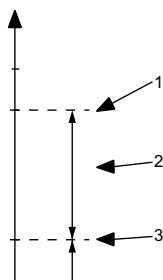


Fig. 4 Maximum surface temperature

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| Pos. | Figure legend |
|------|--|
| 1 | Maximum surface temperature of the pump |
| 2 | Temperature rise in the shaft seal. Calculated by Grundfos. See section 8.3.2 Shaft seal temperature . |
| 3 | Maximum liquid temperature |

8.3.1 Temperature class

| Temperature class | Maximum surface temperature [°C] |
|-------------------|----------------------------------|
| T1 | 450 |
| T2 | 300 |
| T3 | 200 |
| T4 | 135 |
| T5 | 100 |
| T6 | 85 |

The maximum surface temperature for dust is stated on the nameplate.

8.3.2 Shaft seal temperature

In order to calculate the pump surface temperature and temperature class, the below tables show the temperature rise in the shaft seal for different shaft diameters, different pressure values and various media classes.

| Shaft seal: HQQx/HUUx/HQUx and AUUx/AQQx/DQQx Rpm: 2900/3500 | | | |
|---|----------------|-----|----|
| Shaft diameter [mm] | Pressure [MPa] | | |
| | 1 | 2.5 | 4 |
| Shaft seal temperature rise [°C] | | | |
| 12 | 22 | 24 | 26 |
| 16 | | | |
| 22 | | | |
| 28 | | | |
| 36 | | | |

| Shaft seal: HQBx/HUBx Rpm: 2900/3500 | | | |
|---|----------------|-----|----|
| Shaft diameter [mm] | Pressure [MPa] | | |
| | 1 | 2.5 | 4 |
| Shaft seal temperature rise [°C] | | | |
| 12 | 18 | 20 | 22 |
| 16 | | | |
| 22 | | | |
| 28 | | | |
| 36 | | | |

9. Before starting up and during operation of an ATEX-approved pump

DANGER

Explosion risk

- Death or serious personal injury
- Do not run the pump at speeds exceeding the rated speed. See pump nameplate.



9.1 Checklist

DANGER

Explosion risk

- Death or serious personal injury
- Follow the checklist below.



Observe this checklist:

1. Check that the ATEX rating of the motor, pump and accessories corresponds to the specified category. See section 6. [Scope of ATEX categories for CR pumps](#). If the motor, pump or accessory categories differ, the lower rating is valid.
 2. If the pump falls under category M2, check that the pump is protected by a guard to prevent damage from falling or ejected objects.
 3. Clean the cavities behind the pump's coupling guard on a regular basis to avoid hazardous dust deposits.
 4. Check that the motor output power corresponds to the required P_2 of the pump, see nameplates.
 5. Check that the pump is as ordered, see nameplates.
 6. Check the axial alignment of the chamber stack. See the label on the inside of the coupling guard. Check that the shaft seal components, rubber parts and seal surfaces are suitable for the pumped liquid.
 7. Check that the shaft can rotate freely. There must be no mechanical contact between impeller and chamber.
 8. Check that the pump has been filled with liquid and vented. The pump must never run dry.
 9. Check the direction of rotation of the motor, see the arrow on the top of the fan cover.
 10. If you have chosen a pump with double seal, back-to-back, check that the seal chamber is pressurised. Always pressurise the chamber during operation. Always use ATEX-approved equipment.
 11. If you have chosen a pump with double seal, tandem, check that the seal chamber is completely filled with liquid. The seal chamber must always be filled with flushing liquid during operation. The dry-running protection must be ATEX-approved.
 12. Follow the special startup procedures for these pump types:
 - MAGdrive pumps
 - pumps with double seal, back-to-back
 - pumps with double seal, tandem.
- For further information, see the installation and operating instructions for the pump in question.
13. Check that the liquid temperature never exceeds the maximum liquid temperature, t_{max} , stated on the nameplate.
 14. Avoid overheating of the pump. Operation against a closed outlet valve may cause overheating. Install a bypass with a pressure relief non-return valve.
 15. Check for abnormal noise during operation to avoid overheating of the pump.
 16. Re-vent the pump in either of these situations:
 - the pump has been stopped for a period of time.
 - air has accumulated in the pump.
 17. If the pump is with bearing bracket, check for bearing noise every week. Replace the bearing if it shows signs of wear.
 18. The auto-ignition temperature of the pumped liquid must be 50 K above the maximum surface temperature of the pump.
 19. Make sure to apply the correct inlet pressure. Use the correct table for the vapour pressure for the pumped liquid. See section [9.1.1 Specification and calculation of inlet pressure](#).

9.1.1 Specification and calculation of inlet pressure

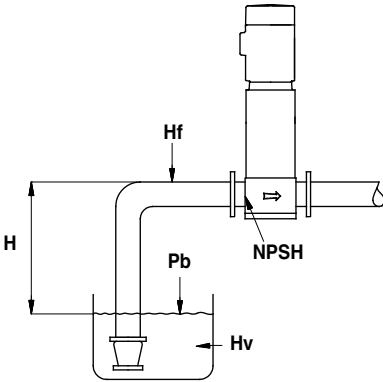


Fig. 5 Schematic view of open system with a CR pump

Calculation of inlet pressure

Calculate the maximum suction lift "H" in m head 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.
 (10 bar = 1 MPa)

NPSH = Net Positive Suction Head in m head, to be read from the NPSH curve in the appendix* (at the highest flow rate the pump will be delivering).

* Link to appendix, see section [Appendix with NPSH curves](#).

H_f = Friction loss in the inlet pipe in m head at the highest flow rate the pump will be delivering.

H_v = Vapour pressure for water in m head. See fig. 6. If the pumped liquid is not water, then use the vapour pressure for the liquid which is being pumped.

t_m = Liquid temperature.

H_s = Safety margin = minimum 0.5 m head.

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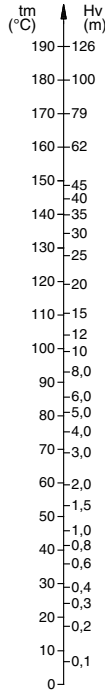


Fig. 6 Vapour pressure for water in m head

If the calculated "H" is positive, the pump can operate at a suction lift of maximum "H" m head. If the calculated "H" is negative, an inlet pressure of minimum "H" m 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 m³/h.
 NPSH (see the appendix*): 1.1 m head.
 $H_f = 3.0$ m head.
 Liquid temperature: 60 °C.
 H_v (see fig. 6): 2.1 m head.
 $H = P_b \times 10.2 - NPSH - H_f - H_v - H_s$ [m head].
 $H = 1 \times 10.2 - 1.1 - 3.0 - 2.1 - 0.5 = 3.5$ m head.
 This means that the pump can operate at a suction lift of maximum 3.5 m 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.

* Link to appendix, see section [Appendix with NPSH curves](#).

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9.1.2 Appendix with NPSH curves



Appendix:

The appendix referred to in section 9.1.1 is found in the standard CR, CRI, CRN installation and operating instructions: <http://net.grundfos.com/qr/i/96462123>

10. Maintenance and inspection

Service documentation is available in Grundfos Product Center (<http://product-selection.grundfos.com/>).

If you have any questions, please contact the nearest Grundfos company or service workshop.

10.1 Tightening torques

DANGER

Explosion risk

Death or serious personal injury

- The coupling screws, shaft seal, shaft seal flange screws and shaft seal set screws must be tightened according to the specified torque values.



10.1.1 Coupling

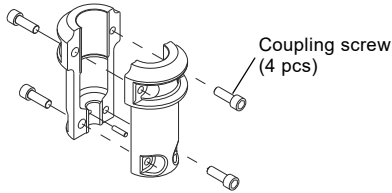


Fig. 7 Coupling screws

| Pump size | Coupling screws (4 pcs) | |
|-------------------------------------|-----------------------------------|--|
| | Tightening torque | |
| CR, CRI, CRN 1s, 1, 3 | M6-13 Nm M8-31 Nm M10-61 Nm | |
| CR, CRI, CRN 10, 15, 20 | M6-13 Nm M8-31 Nm M10-62 Nm | |
| CR, CRI, CRN 32, 45, 64, 90 | M10-85 Nm | |
| CR, CRI, CRN 120, 150 | M10-85 Nm M16-100 Nm | |
| CR, CRN 95, 125, 155, 185, 215, 255 | M10-85 Nm M16-100 Nm | |

10.2 Shaft seal

CR, CRI, CRN 1s, 1, 3, 5, 10, 15, 20, 95, 125, 155, 185, 215, 255

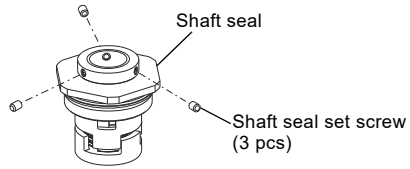


Fig. 8 Shaft seal and shaft seal set screws for CR, CRI, CRN 1s, 1, 3, 5, 95, 125, 155, 185, 215, 255

| Pump size | Tightening torque | |
|-------------------------------------|--------------------------------|-------------------------------|
| | Shaft seal | Shaft seal set screws (3 pcs) |
| CR, CRI, CRN 1s, 1, 3, 5 | M28-35 Nm | M5 - 2.5 Nm |
| CR, CRI, CRN 10, 15, 20 | M33-35 Nm | |
| CR, CRN 95, 125, 155, 185, 215, 255 | Hex 60-100 Nm Hex 75-150 Nm | M6-6 Nm |

CR, CRN 32, 45, 64, 90, 120, 150

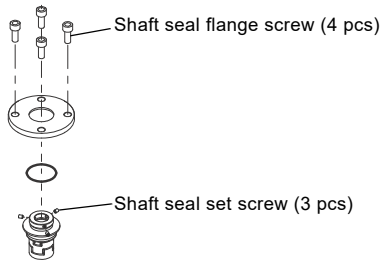


Fig. 9 Shaft seal flange screws and shaft seal set screws for CR, CRN 32, 45, 64, 90, 120, 150

| Pump size | Tightening torque | |
|-----------------------------|----------------------------------|-------------------------------|
| | Shaft seal flange screws (4 pcs) | Shaft seal set screws (3 pcs) |
| CR, CRI, CRN 32, 45, 64, 90 | M10-62 Nm | M6-6 Nm |
| CR, CRI, CRN 120, 150 | | |

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YETKİLİ GRUNDFOS SERVİSLERİ

| Firma | Adres | Telefon Cep telefonu Faks | İlgili Kişi Eposta |
|---|--|--|--|
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