ENGINEERING
TOMORROW

Operation guide

APP pumps
APP 21-38 with Ceramics
Installation, Operation and Maintenance Manual

hpp.danfoss.com

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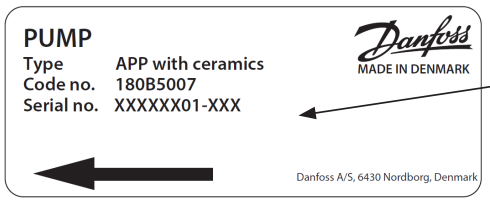
Validity

This manual is valid for APP pumps with ceramics.



The serial number is referring to the Serial no. on the product label. The digits shown (01) indicate the version number of the pump.
This documentation is compatible with previous pump versions.

APP D 21/1200 01 C1B	Code no.	**180B5006**
	Serial no.	XXXXXX**01**-XXX
APP D 21/1500 01 C1B	Code no.	**180B5005**
	Serial no.	XXXXXX**01**-XXX
APP D 26/1500 01 C1B	Code no.	**180B5009**
	Serial no.	XXXXXX**01**-XXX
APP D 30/1200 01 C1B	Code no.	**180B5007**
	Serial no.	XXXXXX**01**-XXX
APP D 38/1500 01 C2B	Code no.	**180B5008**
	Serial no.	XXXXXX**01**-XXX
APP D 30/1200 01 A6B	Code no.	**180B5037**
	Serial no.	XXXXXX**01**-XXX
APP D 21/1500 01 A3B	Code no.	**180B5055**
	Serial no.	XXXXXX**01**-XXX
APP D 21/1200 01 A3B	Code no.	**180B5056**
	Serial no.	XXXXXX**01**-XXX
APP D 26/1500 01 A3B	Code no.	**180B5059**
	Serial no.	XXXXXX**01**-XXX

1. Introduction

1.1 General

The APP with ceramics pumps and pump units are manufactured by Danfoss A/S, and are sold and marketed by a net of authorized distributors world wide.

This manual contains the necessary instructions for the installation, operation and service of the pumps used in a Sea Water Reverse Osmosis (SWRO) system or Brackish Water Reverse Osmosis (BWRO) system.

In case the pump delivered is ATEX certified, the additional ATEX instruction must also be read.

The APP with ceramics pumps must not be used for other purposes than those recommended and specified without first consulting your local pump distributor.

Use of the pump in other applications that are not suitable for the pump unit can cause damages to the pump unit, with risk of personal injury.

All personnel being responsible for operation and maintenance of the pump unit must read and fully understand these instructions, especially the section "Safety", before:

- Transportation of the pump unit
- Lifting the unit
- Installing the pump unit
- Connecting the pump unit to the water system
- Connecting the electric motor and instrumentation
- Commissioning the unit
- Servicing the pump unit, mechanical and electrical parts
- Decommissioning the pump unit

The pump must always be installed and used in accordance with existing national/local sanitary, safety regulations and laws.

It is the responsibility of the safety officer or the chief operator to assure compliance with all local regulations that are not taken into account in this manual.

Changing the pumps' or pump units' operational limits and hardware:

- Changes to the delivered pump or motor pump unit may only be done with a written approval from Danfoss High Pressure Pumps.
- Operation outside the Danfoss specifications requires a written approval from Danfoss High Pressure Pumps.
- If any changes are made without written approval the warranty will automatically become void.

It is important that these instructions are always available to the personnel concerned.

If the recommendations in the manual are not followed, Danfoss reserves the right to void the warranty.

1.2 Symbols

NB!	Indicates something to be noted by the reader
	Indicates a situation which will or could result in damage to the pump and its function
	Indicates a situation which will or could result in personal injury and/or damage to the pump
	Electrical hazard - Indicates a high-voltage warning
	Safety glasses required
	Hearing protection required
	Safety shoes required
	Safety helmet required
Protective garments must be worn	Protective garments must be worn
Danger Hot Do not touch	Danger HOT. Do not touch

1.3 Manufacturer and customer service address

Danfoss A/S
Danfoss High Pressure Pumps
RO Solutions
Nordborgvej 81, DK-6430 Nordborg
Denmark

Telephone: +45 7488 4024
Fax: +45 7445 3831
Email: highpressurepumps@danfoss.com
Homepage: hpp.danfoss.com

Your local Danfoss pump distributor can be found on our homepage.

Data sheets and instructions on all accessories are available on hpp.danfoss.com

1.4 Country specific information

1.4.1 United Kingdom

UK importer:
Danfoss Ltd.
22 Wycombe End
HP9 1NB Beaconsfield
United Kingdom

2. Safety

2.1 General information

Dangers that can arise from not following the instructions:

When the pump or pump unit is managed by untrained personnel, there is a danger of:

- Death or fatal injuries
- Costly damages and claims

All electrical installation work must only be carried out by authorized personnel in accordance with EN60204-1 and/or local regulations.

It is recommended to install a lockable circuit breaker to avoid inadvertent starting and/or electrical hazard. The lockable circuit breaker must be used during installation, operation and maintenance.

It is recommended to place a local safety switch nearby the pump, enabling service personnel to cut power for the electric motor.

Protect the motor and other electrical equipment from overloads with suitable equipment.

In case the pump delivered is ATEX certified, the additional ATEX instruction must also be read.

Always wear suitable safety clothing when handling the pump.

When working near the pump system, safety shoes, safety glasses, hearing protection and safety helmet must always be worn.

Under certain operational conditions the surface of the pump can be above 60°C / 140°F. Under these conditions the pump must be labelled with a “Danger Hot” sign.

When using an electric motor, the motor must always be supplied with adequate cooling ventilation.

When using an electric motor together with a VFD, the motor must be designed for operation with a VFD.

VFD operation may increase the temperature inside the electric motor if the motor is not designed for VFD operation. This can damage the motor and cause unintended breakdown.

Before start-up, the settings for all protective devices, such as sensors/switches and safety valves must be verified and free flow from safety valves must be ensured.

All pipe and hose connections must be stress-free mounted, securely fastened to the pump and well supported. Improper installation will or can result in personal injury and/or damage to the pump.

Use of this manual does not relieve operation and maintenance personnel of the responsibility of applying good judgment when operating and maintaining the pump and its components.

2.2 Preferred system design

Danfoss recommends to build systems with a high degree of safety. Danfoss preferred system design and P&ID are found in appendix 1, Data sheet, and appendix 2, Instruction.

It is always the system builder´s responsibility that the system design does not cause any kind of hazard and is adapted to local regulations and standards.

Proper installation, proper start up and shut-down devices as well as high-pressure protection equipment is essential.

2.3 Commissioning and servicing the unit

It is recommended that commissioning and servicing are carried out by a minimum of two people, where one is acting as a supervisor.

2.4 Adhere to the following important points

- Before using the pump/pump unit it is very important to read and understand this user manual.
- Do not try to lift the pump unit manually; most of the pumps weigh more than 20 kilos, see specific weight for the pump in the appendix 1, Data sheet.
- Always bleed the pump prior to initial start-up.
- Do not mount the pump without the bell housing and a flexible coupling.
- Do not try to start the unit before the system components are mounted, bleeded and adjusted.
- Flush the system throughly before connecting the pump or pump unit.
- Check rotation direction of the motor before mounting the pump.

2.5 In case of doubt

Please contact Danfoss A/S in case of doubt. Contact information is listed in section 1.3, Manufacturer and customer service address.

3. Technical data

3.1 Approved applications and operational limits for the pumps

The pump and the pump units are designed for the use in a Sea Water Reverse Osmosis (SWRO) or Brackish Water Reverse Osmosis (BWRO) systems and Brackish Water Reverse Osmosis (BWRO) system.

The APP pumps must not be used for other purposes than those recommended and specified without first consulting your local pump distributor.

Use of the pump in other applications not suitable for the pump unit can cause damages to the pump unit, with risk of personal injury.

For system integration of the pump, please see appendix 1, Data sheet and appendix 2, Instruction.

3.2 Application range

See appendix 1, Data sheet.

3.3 Electric motor data

See recommended motor in appendix 1, Data sheet or appendix 3, IOM for motors. The motors mentioned are the most common used motors by Danfoss High Pressure Pumps.

3.4 Noise and vibration

Noise level for a pump unit with a "standard" motor measured according to EN ISO 3744: 2010, see appendix 1, Data sheet. Possibilities to reduce noise and vibration are described in the same Data sheet.

3.5 Dimension drawings

Dimensions of the different pumps can be found in appendix 1, Data sheet.

3.6 Space requirement

When doing service or replacing the complete pump unit, it is recommended to have sufficient space available around the pump in order to ensure easy access. Sufficient space means at least 1 meter/40 inches around the pump. When working with high pressures, it is important to have the right space available around the pump as stated in the safety requirements.

3.7 Filtration

(10µm absolute [$ß_{10} \geq 5000$])
Requirements are specified in appendix 1, Data sheet and in appendix 2, Instruction.

Danfoss recommends not to build a filter bypass function or to use filters with an integrated bypass. If the above recommendation is not followed the warranty for the pump will automatically become void.

It should be possible to monitor the condition of the filter via the differential/delta pressure across the filter.

Using insufficient filtration or a filter bypass can cause a failure or decreased service life of the pump.

3.8 Properties of water

It is recommended NOT to use the pumps in feed water concentrations higher than 50,000 ppm TDS without consulting your local Danfoss pump distributor.

3.9 Air bubbles

Large bubbles in a pressurised RO system can result in damage to piping, equipment and the pump.

All air must be bleeded from both the low-pressure and high-pressure side before the RO system is pressurised. Special consideration should be given in order to minimize air bubbles in the feed flow. Air bubbles can cause cavitation.

3.10 Chemicals

The pump should not be exposed to any chemicals as it can result in damage to piping, equipment and internal parts in the pump.

4. Arrival inspection, transportation, handling, lifting and storage

4.1 Arrival inspection

The pump is packed in a cardboard or wood box with plugs in the port connections to protect the pumps from damage during transportation.

When the shipment has arrived it is important to check the pump for any damages. The name plate/type designation must be in accordance with the delivery note and your order.

In case of damage and/or missing parts, a report should be documented and presented to the carrier at once.

4.2 Warning

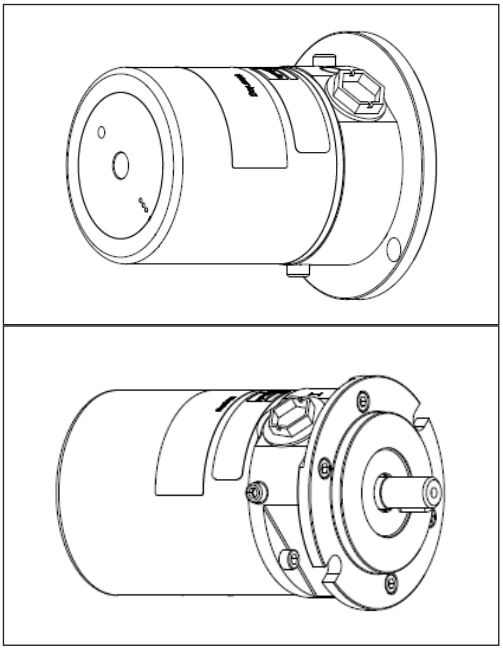
Before any lifting operation is performed, environmental conditions must be taken into consideration (Ex-rated areas, wind speed, wet/dry conditions, lifting height, etc.).

4.3 General safety information

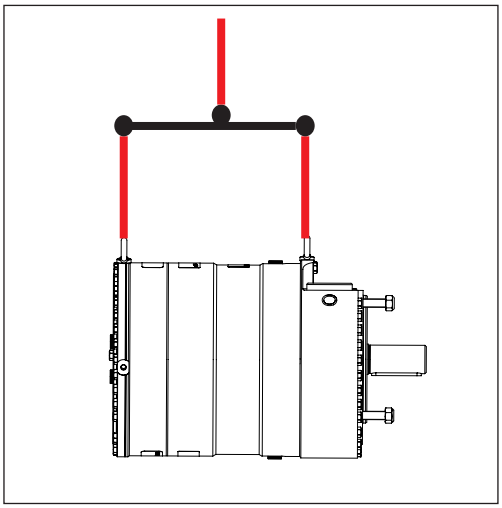
Personnel involved in lifting and transporting the equipment (see Safety, chapter 2) must be trained in handling and in safety procedures for lifting heavy loads. Many of the pumps and pump units weigh more than 20 kilos, which requires lifting slings and suitable lifting devices; e.g. an overhead crane or industrial truck to be used as minimum.

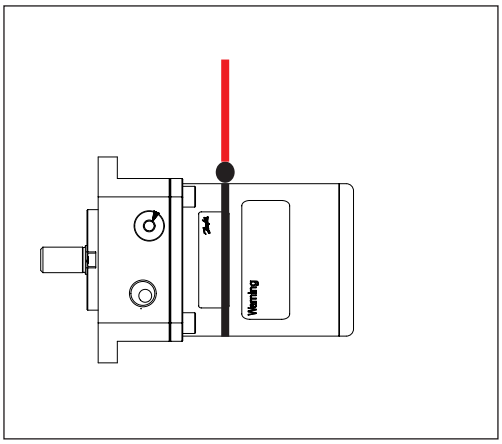
4.4 Transport and handling

Small pumps which have a weight below 20 kilos (weight can be found in appendix 1, Data sheet). can be handled by hand if they are not mounted together with an electric motor. The weight of a small pump with a motor will be above 20 kilos.



Pumps which have a weight above 20 kilos (see appendix 1, Data sheet) must be handled by using lifting eyes and slings.

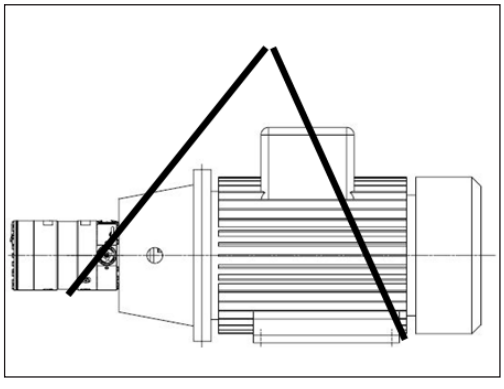




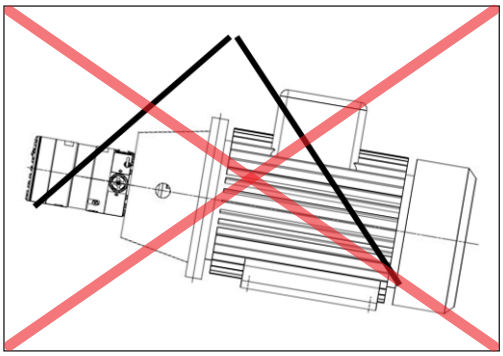
When the pump is mounted together with an electric motor, the pump unit always weigh more than 20 kilos and must be handled by using slings around the pump unit.

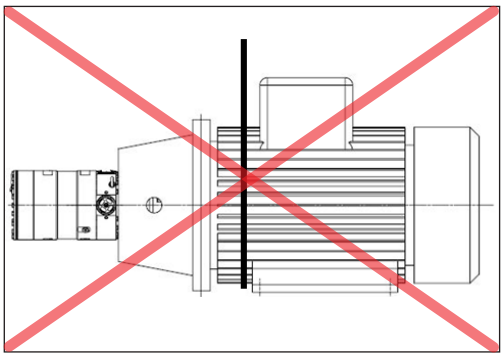
See below examples of where to/not to attach the lifting slings on the pump unit:

Correct lifting with 2 separate slings:



Wrong lifting:





When lifting the pump unit, one sling must be attached to the electric motor and one sling around the pump.

Some motors and pumps have specific lifting eyes.

Do not use connections/nozzles for lifting!
Do not use only one sling!

Make sure that the unit/load is balanced before lifting. The centre of the mass varies from pump/pump unit size to pump/pump unit.

How to mount the pump and the electric motor correctly, see appendix 1, Data sheet or appendix 2, Instruction.

Incorrect lifting can result in personal injury and/or damage to the pump unit, see appendix 2, Instruction.
Once the lifting is done the lifting eye must be removed from the pump.

4.5 Return to supplier

Please see maintenance chapter 7.

4.6 Storage

Each pump is tested before shipment, and will therefore contain water. For storage temperature and frost protection see appendix 2, Instruction.

The pumps are NOT delivered frost protected from the factory.

5. Installation and commissioning

5.1 Important dimensions
Physical dimensions and connections of the pump unit are described in appendix 1, Data sheet.

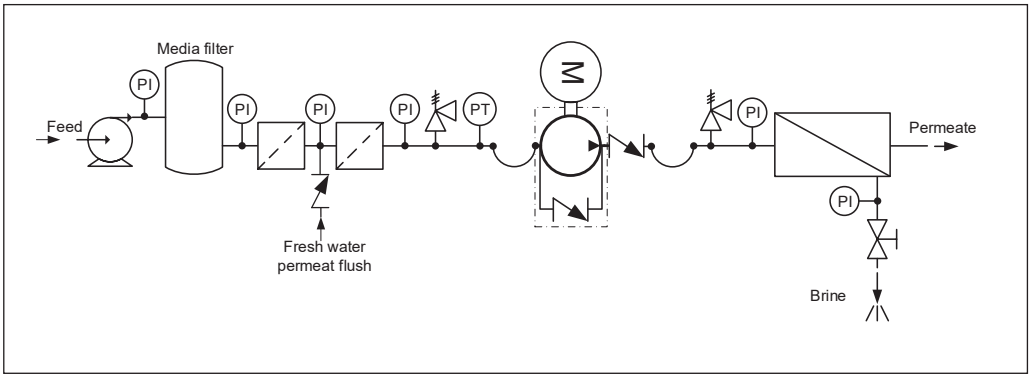
5.2 Cleanliness
It is very important that the tubes and pipes are **completely clean**: no dirt, chips or burrs are allowed. Flush all piping before connecting the high-pressure pump to ensure the system is clean. Internal surfaces of the piping must not be corroded. If dirt or rust is not removed, the pump and the valves can be damaged. In worst case the pump can be damaged beyond repair!

5.3 Fluid temperature
Before start-up, the fluid and pump housing temperature must be within the specified temperature range listed see appendix 1, Data sheet.

5.4 Electrical data
Check voltage, current frequency and rated power on the electric motor and VFD settings on the name plate placed on both the motor and the VFD.

5.5 Local regulations
Commissioning must always be done in accordance with valid regulations and local standards.

Schematic 1: Recommended system design



5.6 Pre mounting checklist, based on Danfoss preferred system design

Table 1: Check points when assembling and commissioning system

	Check points	Comment	OK ?
CP1	Ensure that the environmental conditions are safe.	See Arrival inspection, transportation, handling, lifting and storage, chapter 4.	
CP2	Minimum and maximum start-up temperature for fluid and pump.	See Data sheet or Instruction, appendices 1 and 2.	
CP3	Filtration condition (10 µm absolute ($ß_{10} \geq 5000$)	See Danfoss requirements in Data sheet and Instruction, appendices 1 and 2	
CP4	Power supply for electric motor and VFD.	See Data sheet for the used motor and VFD.	
CP5	Safety circuit / breaker must be sized for the motor and environment (corrosion and humidity)	See Data sheet for the used safety circuit.	
CP6	Bolts and screws must conform to environmental conditions as well as fluid and torque requirements.		
CP7	Instrumentation, pressure switch should be designed to conform to the environment (corrosion and humidity).	See Data sheet for the used equipment.	
CP8	Check the factory settings of the safety/relief valves or pressure relief valves (page 11).	See Data sheets for the used valves.	
CP9	Check the settings of the pressure transmitter/switch (3) set at min. inlet pressure (page 11).	See Data sheet or Instruction, appendices 1 and 2.	
CP10	Check that all pressure indicators (PI) are selected to be able to measure the system pressure range (page 11).	Scaling should at least be 1 bar or more precise.	
CP11	Check coupling distance (air gab – movement of the spider)	3-5 mm	
CP12	Check correct connections on the pump (in & outlet)		
CP13	Check piping for possible air gaps.		

5.7 Lifting and positioning

Lift the pump unit onto base (Remember vibration dampeners, if needed). Fasten the motor to the base.

See also chapter 4, Arrival inspection, transportation, handling, lifting and storage.

5.8 Mount the different equipment

(connections, pipes, tubes, check and safety/relief valves, etc.)

- The hard piping and flexible hoses used, must be of proper design and must be installed in accordance with the manufacturer's recommendations. (see also Data sheet for Hose and hose fittings and Instruction for Assembling Hose kit - both available on www.ro-solutions.danfoss.com).
- Misalignment of the hard pipes may give unintended stress on the pump port connections and may damage the pump.
- Prevent excessive external pipe load.
- Do not connect piping by applying external force (use of wrenches, crane, etc.) Piping must be aligned without residual stress.
- Do not mount expansion joints so that their force applies internal pressure on the pump connections.

• 5.9 Electrics

All electrical installation work must be carried out by authorized personnel in accordance with EN60204-1 and/or local regulations. (see also Safety, chapter 2)

Turn off the safety circuit breaker and lock it.

Mount the power cable on the electric motor.

If a VFD is used, adjust the protective motor switch/VFD to the current limits found on the name plate of the electric motor.

5.10 Instrumentation

The pressure switch/sensor should be mounted as close to the pump as possible. It is recommended to test the pressure/sensor switch via an instrumentation manifold.

Mount the pressure switch/sensors according to the manufacturer's instructions.

5.11 Connections

Mount and tighten connections and check valve(s) as specified.

5.12 Ensure free flow

Ensure free flow from the safety/relief valves 8 and 9 (schematic1, page 11). A blocked safety/relief valve can cause excessive build-up of pressure and thereby cause dangerous situations and damage to the whole system.

5.13 Verify setting of safety/relief valves

Make sure, the safety/relief valves 8 and 9 are placed correctly.

Check the pressure settings on the name plates of the safety/relief valves. If they are within specifications, you can continue.

5.14 Flush the pump

Fully open the pressure valve at the brine outlet.

Close all the bleeding and draining plugs on the high-pressure pump.

Start the feed pump and ensure free flow to the high-pressure pump.

5.15 Bleed and remove air from the pump

Open the bleeding plugs. Keep the plugs open until the high-pressure pump is bleeded.

5.16 Verify direction of rotation

The direction of rotation must always follow the arrow. The arrow is placed on the pump or pump unit.

Check the direction of rotation before mounting the pump.

Unlock the safety circuit breaker. Start the motor for 1 second and observe the direction of rotation either looking at the fan of the motor or the coupling through the inspection hole in the bell housings (not available on all bell housings). If the motor is turning the wrong direction, switch two phases in the connection box of the motor or reprogram the direction in VFD.

When the motor is turning in the right direction, the pump can be mounted.

5.17 Commissioning

- Close all the bleeding and draining plugs.
- Open the pressure valve at the brine site.
- Switch the safety circuit breaker on for both motor(s) and VFD(s).
- Start the feed pump.
- Start the high-pressure pump.
- If a VFD or a soft starter is used, a ramp up time of minimum 10 seconds is required to avoid damage of the pump.
- Monitor the inlet and outlet pressure of the high-pressure pump and look for leakages.
- Check the function of the pressure indicators by slowly closing the valves. The pump unit should stop when the minimum inlet pressure and maximum outlet pressure has been reached.
- Adjust the pressures to the specified inlet and outlet pressure for the system and let the pump unit run until the electric motor and pump temperature is stable.
- If the system is running within the system design limits, the system is released for operation.

5.18 Check the filter condition

Evaluate contamination found in filter, replace filter elements, if necessary.

5.19 Instruct operator and maintenance personnel

Before using the pump/pump unit, the personnel must be instructed in using the pump/pump unit, its function, components, documentation and safety.

Danfoss offers commissioning and service at system manufacturer's location. Rate quotes are offered upon request.

6. Operation of pump unit

6.1 General safety information

Before inspecting the pump unit, read the Safety chapter 2 in this user manual.

6.2 What to listen and look for

If one or more of the following examples are observed, please act as indicated:

A) Loose bolts – check all bolts and, if necessary, contact the maintenance department in order to have all bolts tightened to the specified torque(s).

B) Leakage – if a small leakage from the bell housing is observed. Contact the maintenance department.

C) Leakage – if there is a large leak, the unit should be stopped immediately. Contact the maintenance department.

D) High frequency tones – safety/relief valves are either damaged or running very close to their design pressure, stop the unit immediately. Contact the maintenance department.

E) Increased noise or vibration – requires the unit to be stopped immediately. Contact the maintenance department.

F) Very high temperatures – may indicate that one or more parts are damaged inside the pump. The pump must be stopped immediately and inspected before it is restarted. Contact the maintenance department.

G) Drop in flow and/or pressure – may indicate wear on one or more parts inside the pump. The pump must be stopped immediately and inspected before it is restarted. Contact the maintenance department.

H) Other observations or troubles, please see appendix 7, Right and Wrong or appendix 6, the Trouble shooting guide.
Both appendices give good advises regarding design, installation, wiring and troubleshooting.
See also service and warranty section in appendix 1, Data sheet and appendix 2, Instruction.

If the pump is not stopped for inspection as recommended, it can lead to damage of the pump or break-down. See also service and warranty section in the appendix 1, Data sheet, in appendix 2, Instruction or appendix 4, Instruction for recommended service intervals.

Danfoss offers service of the pump at the system manufacturer's location as well as we offer training in how to service the pump. Quotes are offered upon request.

Danfoss recommends simultaneously to check the filter and membrane condition and to evaluate contamination; filter and membrane elements must be replaced if necessary.

7. Maintenance and service of the pump unit

7.1 General safety information

Before servicing the pump unit, it is necessary to read and understand this user manual, especially the Safety, chapter 2. Remember to wear suitable safety equipment according to Safety, chapter 2.

7.2 Service and inspection interval for the pump

Maintenance and service intervals are depending on the cleanliness level of the water, hydraulic load and temperature of the pump unit. The most important parameter is the filtration of the water.

See the section Service and warranty in the appendix 1, Data sheet, in appendix 2, Instruction and appendix 4, Instruction for recommended service intervals.

For spare parts and service tools, please see appendix 3, Parts list.

Danfoss offers service of the pump at the system manufacturer's location and training in how to service the pump. Quotes are offered upon request.

7.3 Shut down of the system

A) Open the pressure valves at the brine site to release the pressure.

B) Stop the high-pressure pump.

C) Stop the feed pump.

D) Switch off the safety circuit breaker for both the high-pressure pump, feed pump and VFD and lock them. Only personnel servicing the pump unit should be able to unlock/activate the switch again.

E) Open bleeding and drain plugs. Wait until the pump and system are emptied for water.

F) Slowly unscrew and remove the bolts and gaskets from the inlet/outlet hoses or pipes, be careful about jets of water. Beware that the system can be pressurized!

G) Attach the lifting equipment to the pump unit. For instructions on lifting the complete pump unit, see chapter 4, Arrival inspection, transportation, handling, lifting and storage.

H) For the small pumps, unscrew the bolts holding the pump to the bell housing. For the bigger pumps, unscrew the bolts/nuts from the pump and bell housing to the motor. Afterwards unscrew the bolts/nuts holding the pump and bell housing.

I) Carefully pull the pump out of the bell housing by using lifting equipment, if necessary.

J) Hold the pump in different positions above a drip tray; this should allow most of the water trapped in the pump to drain. Clean and dry the pump surface and plug the bleeding and draining plugs.

K) Move the pump to a clean and safe location where the pump can be inspected/ serviced.

7.4 Disassembling and assembling the pump unit

A) Remove all connections from the pump.

B) Disassemble the pump according to the Disassembling and Assembling Instruction (available at www.ro-solutions.danfoss.com)

Clean all parts and surfaces with a fluid compatible with the materials found in the pump. Wipe the parts clean and dry with a lint-free clothing.

C) Inspect all parts including shaft seal and if necessary, replace them; see appendix 3, Parts list.

D) If the pump is going to be returned to Danfoss for repair or a warranty claim, it is important to contact Danfoss in order to receive a return number and a form to fill out with product information. A copy of the form together with contact information and reason for returning should be sent to the email address on the form. The same documents should be attached to the shipment.

Product information (see label on product)
Only 1 product on each report.

Product type	Code number	Serial number

Operational conditions

Application	Inlet pressure	Rpm (pump/motor only)
Hours of operation	Outlet pressure	Number of duty cycles (valves only)
Filtration (µ, absolute/nominal)	Flow	Water temperature
Water type	TDS	Pumps in parallel (yes/no)

Returns without a return number will be rejected !!!

7.5 Assembling the pump unit

Assemble the pump according to the Disassembling and Assembling Instruction (available at www.ro-solutions.danfoss.com).

7.6 Procedure for mounting the pump onto the electric motor

Mount the flexible coupling and bell housing according to appendix 2, Instruction.

7.7 Getting the pump unit back into operation

Find instructions of how to put the pump unit back into operation in chapter 4, Arrival inspection, transportation, handling, lifting and storage and Installation and commissioning, chapter 5.

7.8 Storage of the pump

If the pump has to be shut down for a longer period, instructions can be found in appendix 2, Instruction.

8. Troubleshooting and scrapping criteria

8.1 General safety information

Before inspecting the pump unit, it is necessary to read and understand this user manual, especially the Safety chapter 2.

Remember to wear suitable safety equipment according to Safety chapter 2.

8.2 Operational conditions which can cause pump failures

The following conditions can cause a pump failure :

- The pump is running dry.
- The inlet pressure is too high.
- The inlet pressure is too low.
- The temperature of the fluid is too high.
- The ambient temperature is too high.
- The pump is running against a blocked port/closed manual valve.
- The pump is operating at a pressure out of specification.
- The pump is running with a non-specified/ approved fluid.
- The pump is running in the wrong direction.
- The filtration is insufficient.
- The pump is not being serviced according to Danfoss specifications (end of life).
- There is excessive mechanical load on the shaft coupling and piping.

8.3 Mechanical failure

If the pump is running dry, the temperature will quickly increase which can cause burns.

If there is any leakage at start-up or during operation, a high-pressure jet can cause eye or skin damage.

Leakage can result in flooding, which can cause slipping, tripping or falling.

If water is leaking into the electric motor; it can cause electric shock, fire, short circuit or even death. When mounting the pump vertically always mount the motor above the pump to avoid water leaking into the electric motor.

8.4 Electrical failure

If the wiring of the electric motor is incorrect or the ground connection is missing, it can cause electric shock, burn damages, fire or even death.

If a VFD is used and wrongly programmed, it can damage the pump and lead to high temperatures or other dangers.

All electrical installation must be carried out by authorized personnel in accordance with EN60204-1 and/or local regulations.

8.5 Responsibility

Danfoss takes no responsibility for any abnormal injuries, risks or damages that could arise caused by abnormal conditions, vibrations, corrosion, abrasives, foreign objects or excessive temperatures and shall not be liable for any consequential or incidental damages.

8.6 Scrapping criteria

Whether the pump can be repaired or need to be scrapped, depends on in which conditions the internal parts are, or how damaged the whole unit is. Please use appendix 6, Trouble shooting guide as guideline or send the pump to Danfoss headquarter in Denmark for evaluation.

For other observations or troubles, please see appendix 7, Right and Wrong which gives good advises regarding design, installation, wiring and troubleshooting.

In case the pump needs to be scrapped, please follow your local environmental rules.

Danfoss A/S
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ENGINEERING
TOMORROW

Operation guide

APP pumps
APP 30 - 38 with Ceramics
Installation, Operation and Maintenance Manual

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Data sheet

APP Pumps
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1. Introduction

This data sheet is valid for APP pumps with ceramics.

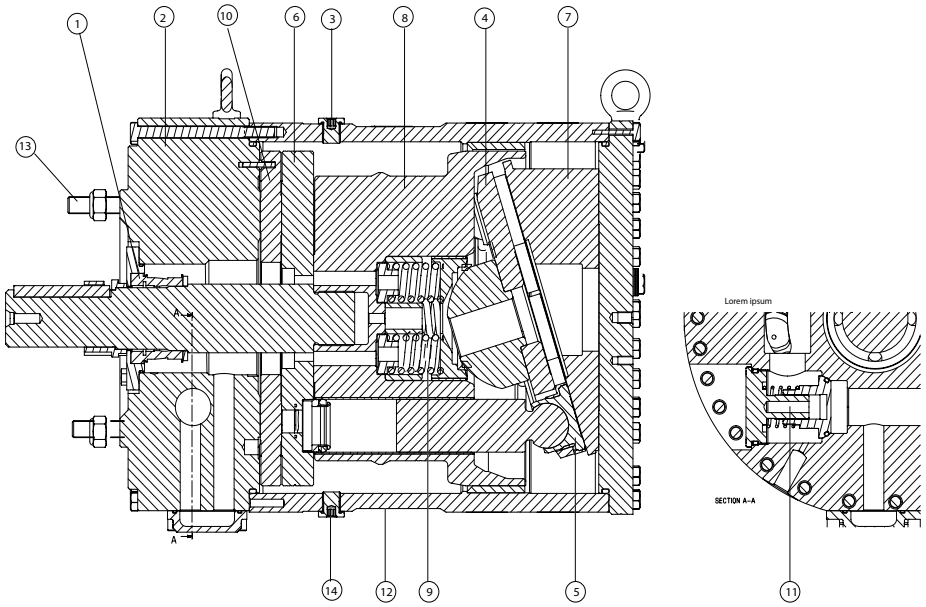
The Danfoss APP high-pressure pumps is designed according to EN 809 for use in applications with low viscosity and corrosive fluids such as:

Sea water
Brackish water
Waste water

Danfoss APP pumps are positive displacement pumps with axial pistons that move a fixed amount of water in each cycle. Flow is proportional to the number of input shaft revolutions (rpm). Unlike centrifugal pumps, they produce the same flow at a given speed no matter what the discharge pressure.

Below sectional drawing is an example of an APP pump.

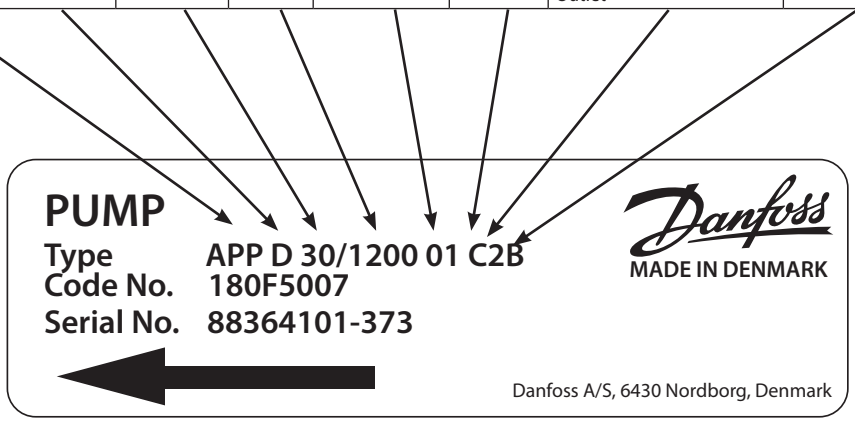
1: Shaft sealing
2: Port flange
3: Bleeding plug
4: Retainer plate
5: Piston/shoe
6: Valve plate
7: Swash plate
8: Cylinder barrel
9: Springs
10: Port plate
11: Flushing valve
12: Housing
13: Tail stock screws
14: Drain plug



2. Naming structure

Note: The naming structure is relevant for chapter 5.

Design	Material type	Capacity (m3/h)	RPM	Special/ Certificates	Sealing materials	Pressure range	Filtration
APP	D: Duplex/Super Duplex steel	21	/1200	01: 3.1 Test Certificate	A: FKM	1: 2-5 Bar Inlet @ 20-83 Bar Outlet	A: Level 1 (10µ ABS)
		26	/1500		C: NBR	2: 3-5 Bar Inlet @ 10-83 Bar Outlet	B: Level 2 (5µ Nom)
		30				3: 2-5 Bar Inlet @ 10–60 Bar Outlet	
		38				6: 3-5 Bar Inlet @ 70-124 Bar Outlet	



3. Benefits

- **Zero risk of lubricant contamination:**
  - Oil lubricants are replaced with the pumped medium, water, so there is no contamination risk from the pump.
- **Low maintenance costs:**
  - Efficient design and all-stainless steel construction ensure exceptionally long design life. Specific service intervals are available in the instruction 180R9446. Service is easy, and can be carried out on-site due to the simple design and few parts.
- **Low energy costs:**
  - The highly efficient axial piston design provides the lowest energy consumption of any comparable pump on the market.
- **Easy installation:**
  - The most compact and lightest design available.
  - The pump can be installed vertically and horizontally.
  - No pulsation dampeners necessary due to extremely low pressure pulsation.
  - Powered directly by electric motors or combustion engines (with special coupling).
  - All pumps are supplied with an integrated flushing valve that allows the fluid to flow from inlet to the outlet, when the pump is not running.
- **High reliability:**
  - All parts are made of highly corrosion resistant materials e.g. Duplex (EN1.4462/ UNS S31803) and Super Duplex (EN1.4410/UNS S32750) stainless steel, carbon reinforced PEEK and ceramic.
- **Certified quality:**
  - IATF 16949, ISO 9001, ISO 14001.
  - Positive Material Identification (PMI) report available on request if ordered with the pump.

4. Application examples

Danfoss APP pumps are built into a broad range of RO desalination plants around the world:

- Containerized solutions for hotels, resorts and residences on islands and in coastal regions
- Mobile systems for humanitarian and military organizations
- Onboard systems for ships and yachts
- Offshore platforms for the oil and gas industry
- Municipal and regional waterworks

5. Technical data

5.1 APP 21 - 38 with ceramics

Pump		APP D 21/1500 01 C1B	APP D 21/1500 01 A6B	APP D 21/1200 01 C1B	APP D 26/1500 01 C1B	APP D 30/1200 01 C2B
Code number APP pumps with ceramics		**180B5005**	**180B5035**	**180B5006**	**180B5009**	**180B5007**
Geometric displacement	cm^3/rev.	256	256	308.5	308.5	444
	in^3/rev.	15.62	15,62	18.83	18.83	27.09
Pressure						
Max. outlet [1] pressure continuous	barg	83	124	83	83	83
	psig	1200	1800	1200	1200	1200
Min. outlet [1] pressure	barg	20	70	20	20	20
	psig	290	1015	290	290	290
Inlet pressure continuous	barg	2-5	3-5	2-5	2-5	2 - 5
	psig	29-72.5	43.5 - 72.5	29-72.5	29-72.5	29 - 72.5
Max. inlet pressure peak	barg	10	10	10	10	10
	psig	145	145	145	145	145
Speed						
Min. speed continuous	rpm	600	600	600	600	600
Max. speed continuous	rpm	1500	1500	1200	1500	1200
Typical flow - Flow curves available in section 6						
1000 rpm at max. pressure	m^3/h	14.80	14.10	17.80	17.80	26.0
1500 rpm at max. pressure	m^3/h	22.20	21.80		26.7	
1200 rpm at max. pressure	GPM	78.18	75.7	94.0	94.3	137.6
Technical specifications						
Media [2] temperature	°C	2-50	2-50	2 - 50	2 - 50	2 - 50
	°F	35.6-122	35.6-122	35.6 - 122	35.6 - 122	35.6 - 122
Ambient temperature	°C	0-50	0-50	0 - 50	0 - 50	0 - 50
	°F	32-122	32-122	32 - 122	32 - 122	32 - 122
Weight (dry)	kg	105	105	105	105	105
	lb	231	231	231	231	231
Sound pressure level[4]	dB(A)	85	87	85	85	85
Footprint with IEC motor[5]	m^2	0.76	0.83	0.76	0.83	0.83
	$foot^2$	8.18	8.93	8.18	8.93	8.93
Typical motor size						
Max. speed at max. pressure	kW	75	90	55	75	90.0
1200 rpm at max. pressure	HP		100	75		125.0
Torque at max. outlet pressure	Nm	355	569	418	426	608
	lbf-ft	262	420	309	314	449

* When operating at rpm above 1200 rpm the min inlet pressure must be more than 3 barg (43.5 psig)

[1] For lower and higher pressure, please contact Danfoss.

[2] Dependent on the NaCl concentration - see chapter 8.

[3] Category 2, Zone 1 or Category 3, Zone 2.

[4] A-weighted sound pressure level at 1 m from the pump unit surfaces (reference box) acc. to EN ISO 20361 section 6.2. The noise measurements are performed acc. to EN ISO 3744:2010 on a motor-pump unit at max. pressure and speed.

[5] Max. area covered with recommended motor configuration (excl. of space to service pump)

5. Technical data APP 21 - 38 with ceramics (continued)

Pump		APP D 38/ 1500 01 C2B	APP D 21/1500 01 A6B	APP D 21/1200 01 A6B	APP D 30/ 1200 01 A6B	APP D 26/1500 01 A6B	APP D 21/ 1500 01 A3B	APP D 21/ 1200 01 A3B	APP D 26/ 1500 01 A3B
Code number APP pumps with ceramics		**180B5008**	**180B5035**	**180B5036**	**180B5037**	**180B5039**	**180B5055**	**180B5056**	**180B5059**
Geometric displacement	cm^3/ rev.	444	256	308.5	444	308.5	256	308.5	308.5
	in^3/ rev.	27.09	15.62	18.83	27.09	18.83	15,62	18.83	18.83
Pressure									
Max. outlet [1] pressure continuous	barg	83	124	124	124	124	60	60	60
	psig	1200	1800	1800	1800	1800	1015	1015	1015
Min. outlet [1] pressure	barg	20	70	70	70	70	10	10	10
	psig	290	1015	1015	1015	1015	145	145	145
Inlet pressure continuous	barg	3-5	3-5	3-5	3-5	3-5	2-5	2-5	2-5
	psig	43.5 - 72.5	43.5-72.5	43.5-72.5	43.5 - 72.5	43.5-72.5	29-72.5	29-72.5	29-72.5
Max. inlet pressure peak	barg	10	10	10	10	10	10	10	10
	psig	145	145	145	145	145	145	145	145
Speed									
Min. speed continuous	rpm	600	600	600	600	600	600	600	600
Max. speed continuous	rpm	1500	1500	1200	1200	1500	1500	1200	1500
Typical flow - Flow curves available in section 6									
1000 rpm at max. pressure	m^3/h	26.2	14.0	17.2	27.00	17	14.8	17.80	17.80
1500 rpm at max. pressure	m^3/h	39.3	21.8			26.3	22.20		26.79
1200 rpm at max. pressure	GPM	138.4	75.5	92.2	137.6	91.4	78.18	94,07	94.37
Technical specifications									
Media [2] temperature	°C	2 - 50	2-50	2-50	2 - 50	2-50	2-50	2-50	2-50
	°F	35.6 - 122	35.6-122	35.6-122	35.6 - 122	35.6-122	35.6-122	35.6-122	35.6-122
Ambient temperature	°C	0 - 50	0-50	0-50	0 - 50	0-50	0-50	0-50	0-50
	°F	32 - 122	30-122	32-122	32 - 122	32-122	32-122	32-122	32-122
Weight (dry)	kg	105	105	105	105	105	105	105	105
	lb	231	231	231	231	231	231	231	231
Sound pressure level[4]	dB(A)	85	87	87	87	87	85	85	85
Footprint with IEC motor[5]	m^2	0.83	0.83	1.10	1.10	1.1	0.76	0.76	0.76
	$foot^2$	8.93	11.84	11.84	11.84	11.84	8.18	8.18	8.18
Typical motor size									
Max. speed at max. pressure	kW	110	90	110	160	110	45	55	75
1200 rpm at max. pressure	HP				200			68	
Torque at max. outlet pressure	Nm	617	537	632	919	644	257.2	302	309
	lbf-ft	455	396	466	678	476	189.2	223	227

* When operating at rpm above 1200 rpm the min inlet pressure must be more than 3 barg (43.5 psig)

[1] For lower and higher pressure, please contact Danfoss.

[2] Dependent on the NaCl concentration - see chapter 8.

[3] Category 2, Zone 1 or Category 3, Zone 2.

[4] A-weighted sound pressure level at 1 m from the pump unit surfaces (reference box) acc. to EN ISO 20361 section 6.2. The noise measurements are performed acc. to EN ISO 3744:2010 on a motor-pump unit at max. pressure and speed.

[5] Max. area covered with recommended motor configuration (excl. of space to service pump)

6. Flow at different rpm

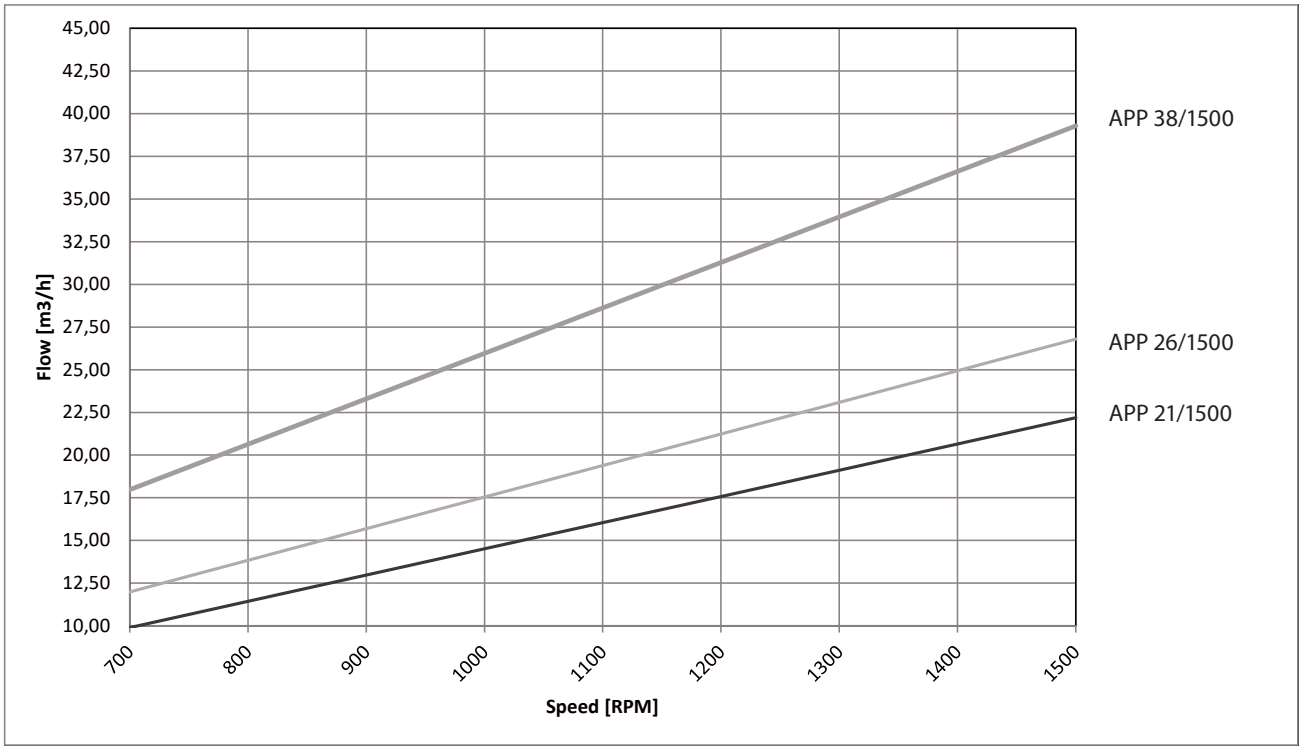
If the flow required and the rotation speed (rpm) of the pump is known, it is easy to select the pump fitting the application best by using the diagrams below.

Furthermore, these diagrams shows that the flow can be changed by changing the rotation speed of the pump.

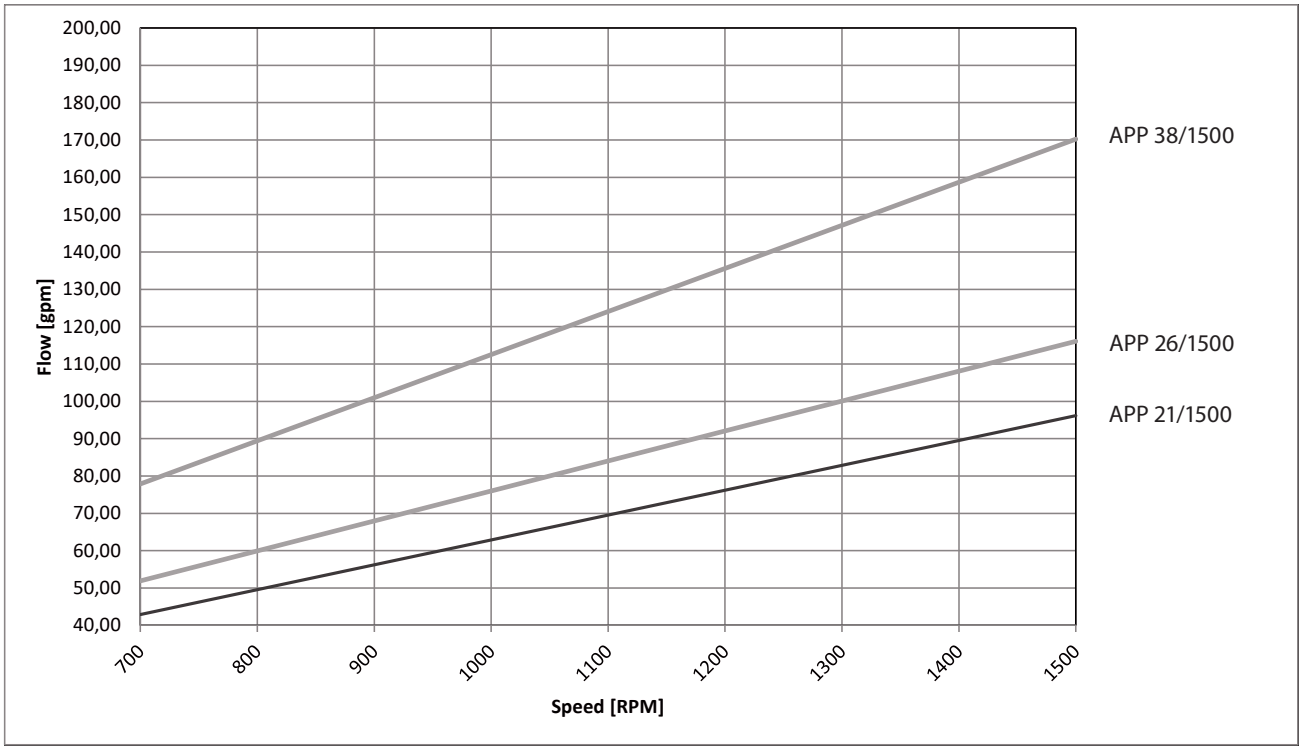
The Flow/Rpm ratio is considered proportional. The Total efficiency is displayed at different ΔP. The total efficiency is relative constant within normal RO pressure variations. The total efficiency can be found in the top of the diagram.

The vertical blue lines indicate where the pump can operate continuously. The required inlet pressure is increasing when the speed changes. The pump power consumption is indicated in the ΔP graph but can also be calculated by using the factors in section 5.2

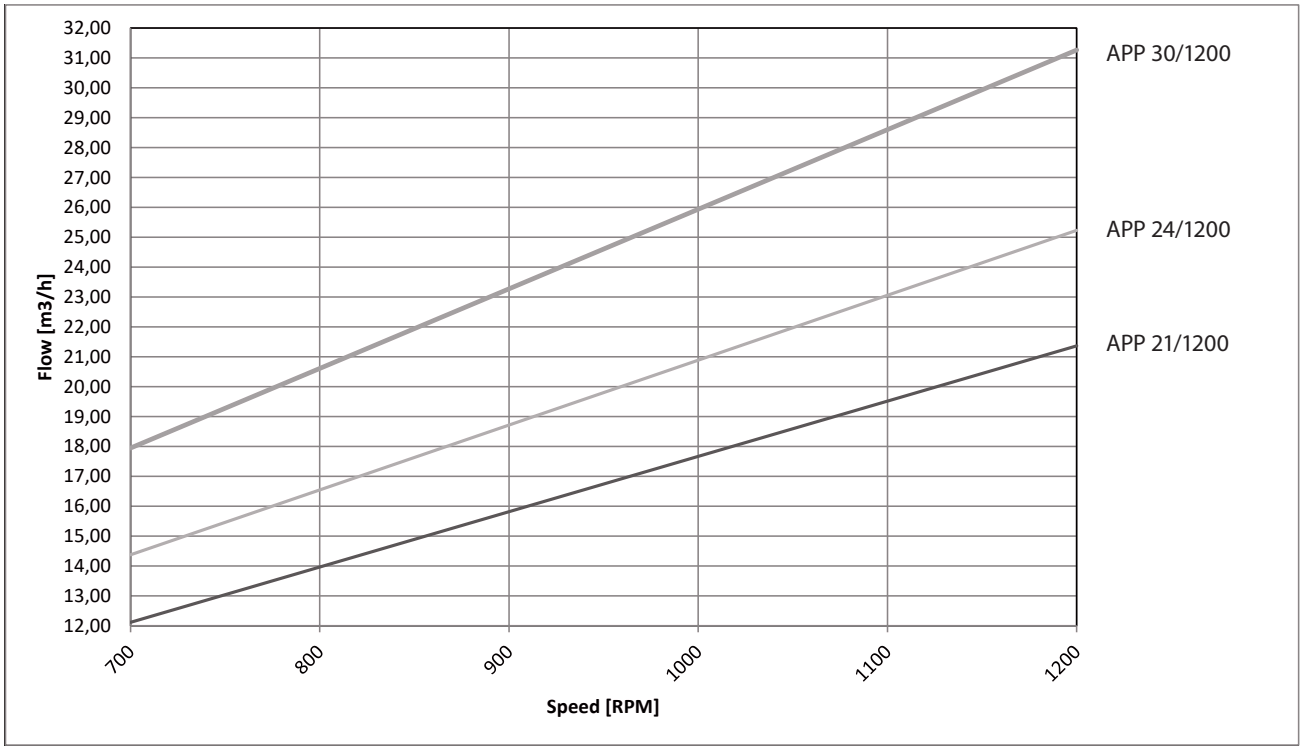
6.1 Data curves for APP 21-38 with ceramics



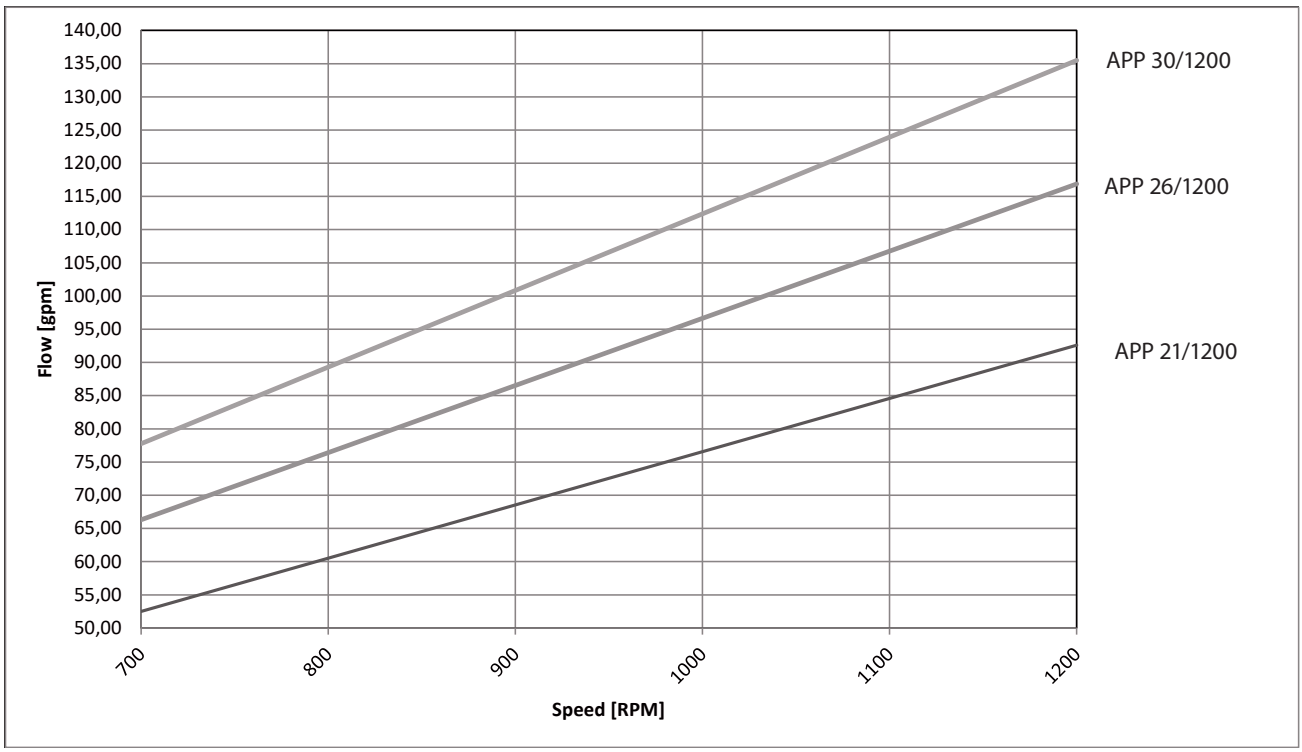
Measured at 80 Bar (870 psi)



Measured at 80 Bar (870 psi)



Measured at 80 Bar (870 psi)



Measured at 80 Bar (870 psi)

7. Motor requirements

The power requirements and torque can be determined using one of the following guiding equations to ensure correct motor selection both:

$$\text{Required power} = \frac{\text{l/min x barg}}{\text{Calc. factor}}\ [\text{kW}] \text{ or } \frac{16.7 \text{ x } m^3/h \text{ x barg}}{\text{Calc. factor}}\ [\text{kW}] \text{ or } \frac{0.35 \text{ x GPM x psig}}{\text{Calc. factor}}\ [\text{hp}]$$

Required torque = barg x torque calcualtion factor [Nm]

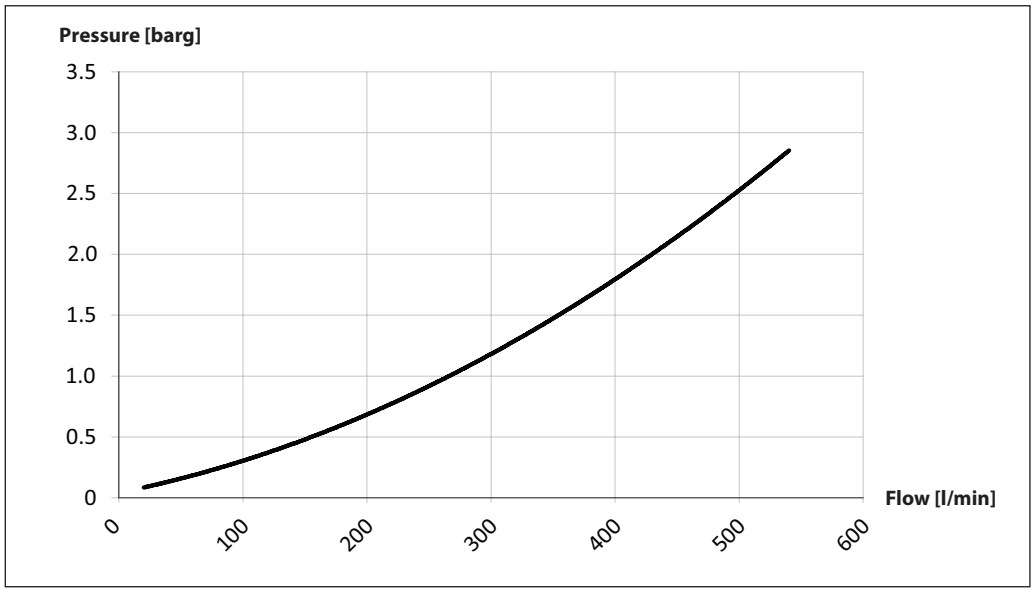
Name	rpm	Power calculation factor	Torques calculation factor
APP x 21	1500	522	4.4357
APP x 21	1200	539	5.2204
APP x 26	1500	525	5.328
APP x 30	1200	543	7.6022
APP x 38	1500	537	7.7100

1 hp	=	0.75 kW
1 GPM	=	3.79 l/min
1 m^3/h	=	4.40 GPM
1 kW	=	1.34 hp
1 l/min	=	0.26 GPM
1 GPM	=	0.23 m^3/h
1 Nm	=	0.7376 lb. ft.

8. Flushing valve curves

All pumps are supplied with an integrated flushing valve that allows the fluid to flow from inlet to the outlet, when the pump is not running.

8.1 APP 21 - 38 integrated flushing valve



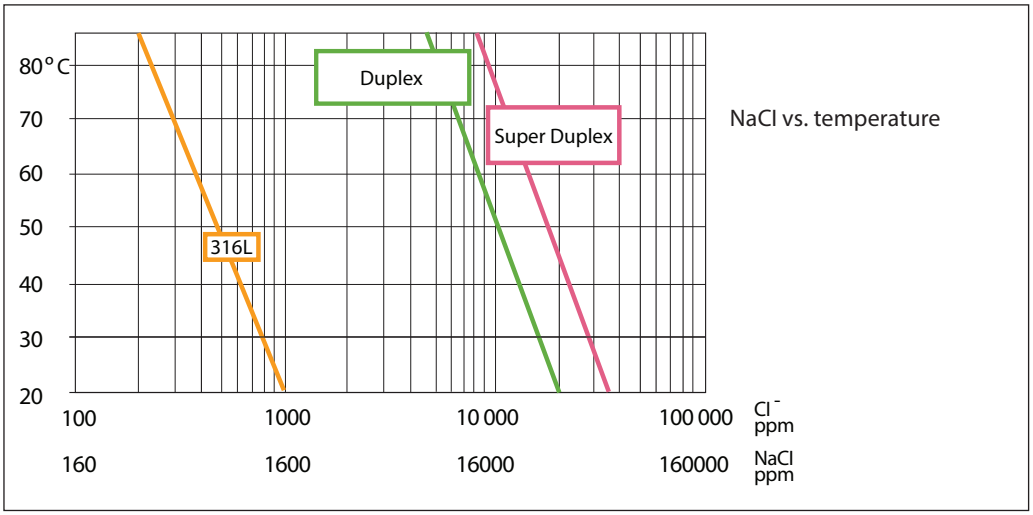
9. Temperature and corrosion

9.1 Temperature

Fluid temperature: Min. +2°C to max. +50°C (Min. +35.6°F to max. +122°F)
Ambient temperature: Min. +2°C to max. +50°C (Min. +35.6°F to max. +122°F)

In case of lower operating temperatures, please contact Danfoss High Pressure Pumps.
The chart below illustrates the corrosive resistance of different types of stainless steel related to NaCl concentration and temperature.

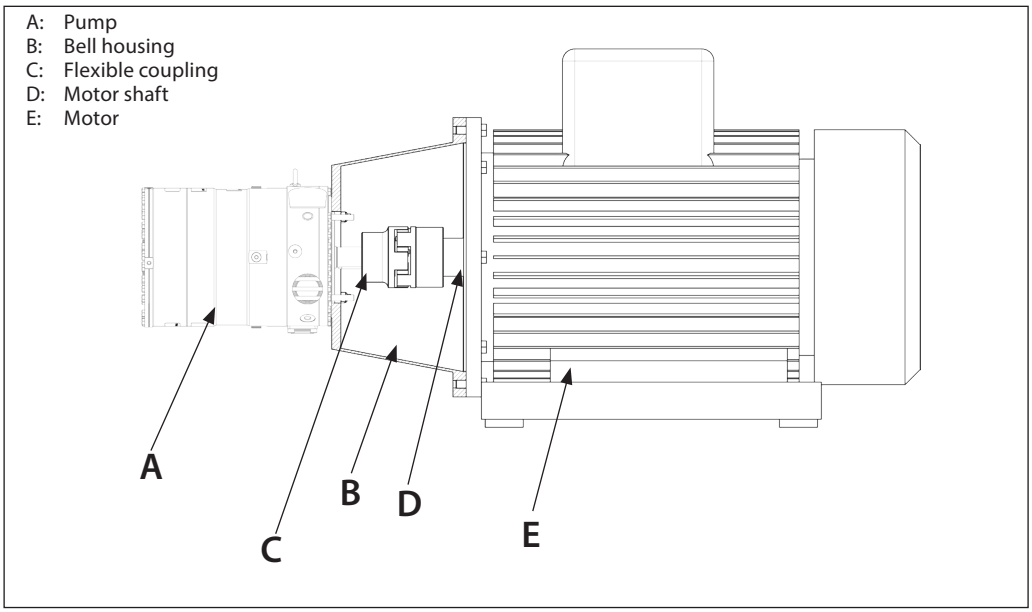
If the water pump is operated above the Duplex line, always flush the water pump with fresh water at all operation stops in order to minimize the risk of crevice corrosion.
In case the pump is stopped for more than one day it should always be flushed with fresh water as described in section 13.



10. Installation

Below drawing shows how the pump is installed to an electric motor. Alignment of the pump and motor shafts is controlled by the mount. This also protects the pump shaft against any axial or radial loads.

During transportation the shaft protection cap must be mounted. Before installing the coupling the cap must be removed.
If alternative mounting is required. please contact your Danfoss sales representative for further information.



10.1 Filtration

Proper filtration is crucial for the performance. maintenance and warranty of your pump.

Protect your pump, and the application in which it is installed in by always ensuring that all filtration specifications are met, and by always changing filter cartridges according to schedule.

High quality water extends the service life of the whole system.

Water to the APP pumps with ceramics must be filtered to 5 µm nominal, using melt-blown depth filter with a proven efficiency of min. 85%. Consult Danfoss for correct choice of filter.

It is important when selecting the filter and filter housing to ensure good cartridge end sealings. As the various filters on the market differ greatly, Danfoss High Pressure Pumps recommends using cartridges with consistent, reliable performance and high efficiency and where fibres are blown continuously onto a central support core. Danfoss High Pressure Pumps does not recommend cartridges requiring any type of binders or resins.

For more information on the importance of proper filtration, including explanation of filtration principles, definitions and guidance on how to select the right filter for your pump, please consult our Filtration information and specifications (Danfoss document number AI317041322125en-000201).

10.2 Noise

Vibrations from the pump can be transferred to the system components that are attached to the pump. To minimize vibrations and noise throughout the system, it is therefore very important to mount the pump unit correctly on a frame with anti-vibration-dampeners, and to use flexible hoses rather than metal pipes where possible.

The noise level is influenced by:

- **Pump speed:**
  High rpm generates more fluid/structure borne pulsations/vibrations than low rpm.
- **Discharge pressure:**
  High pressure generates more noise than low pressure.
- **Pump mounting:**
  Rigid mounting generates more noise than flexible mounting, because of structure-borne vibrations. Be sure to use dampers when mounting.
- **Connections to pump:**
  Pipes connected directly to the pump make more noise than flexible hoses, because of structure-borne vibrations.
- **Variable frequency drives (VFD):**
  Motors regulated by VFDs can produce more noise if the VFD does not have the right settings.

10.3 RO system with direct supply:

Inlet line:

a) Dimension the inlet line to obtain minimum pressure loss (large flow area, minimum pipe length, minimum number of bends/connections, and fittings with low or no pressure losses). If relevant, please consult "Parallel coupled pumps and iSaves" (180R9354)

Inlet filter:

b) Install an inlet filter (1) in front of the APP pump (2). Please consult section 9.1, "Filtration" for guidance on how to select the right filter. Thoroughly clean pipes and flush system prior to start-up.

Low pressure relief valve:

c) Install a low pressure relief valve (9) in order to avoid system or pump damage in case the system stops abruptly, for instance due to a power outage, or if the pump is spinning backwards.

Hoses:

d) Use flexible hoses (4) to minimize vibrations and noise. Please consult the Danfoss Hoses and hose fittings data sheet (AI319454706473en-000201) for guidance.

Inlet pressure:

e) In order to eliminate the risk of cavitation and other pump damage, pump inlet pressure must always be maintained according to specifications described in section 4 about technical data.
Install a monitoring pressure switch (3) between the filter (1) and the pump inlet. Set the minimum inlet pressure according to specifications described in section 4 about technical data. If the inlet pressure is lower than the minimum pressure set, the monitoring pressure switch must prevent the pump from starting or from running.

Flushing valve:

f) For easy system filling and flushing, an integrated flushing valve (6) is in the APP pump.

Non-return valve:

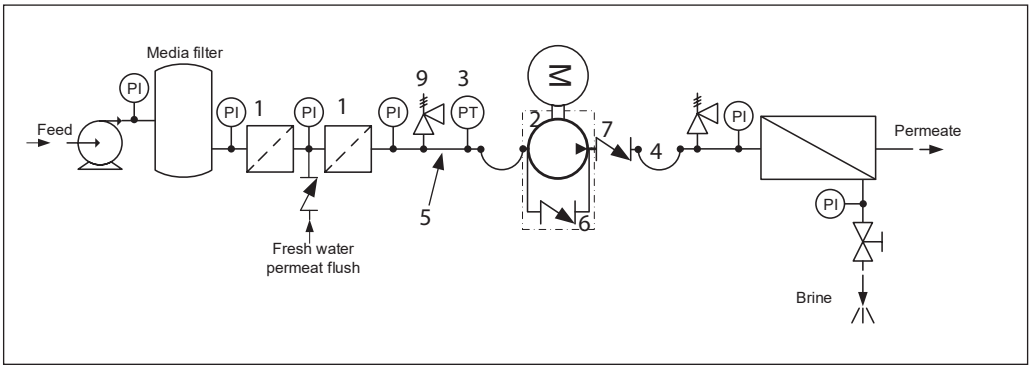
g) A non-return valve (7) in outlet can be installed in order to avoid backspin of the pump. The volume of water in the membrane vessel works as an accumulator and will send flow backwards in case of the pump stops abruptly.

High pressure safety or relief valve:

i) As the Danfoss APP pump begins to create pressure and flow immediately after start-up and regardless of any counter pressure, a safey or pressure relief valve (8) should be installed after the non-return valve to prevent system damage and to avoid high pressure peaks.

Note: If a non-return valve is mounted in the inlet line, a low-pressure relief valve is also required between the non-return valve and the pump as protection against high-pressure peaks.

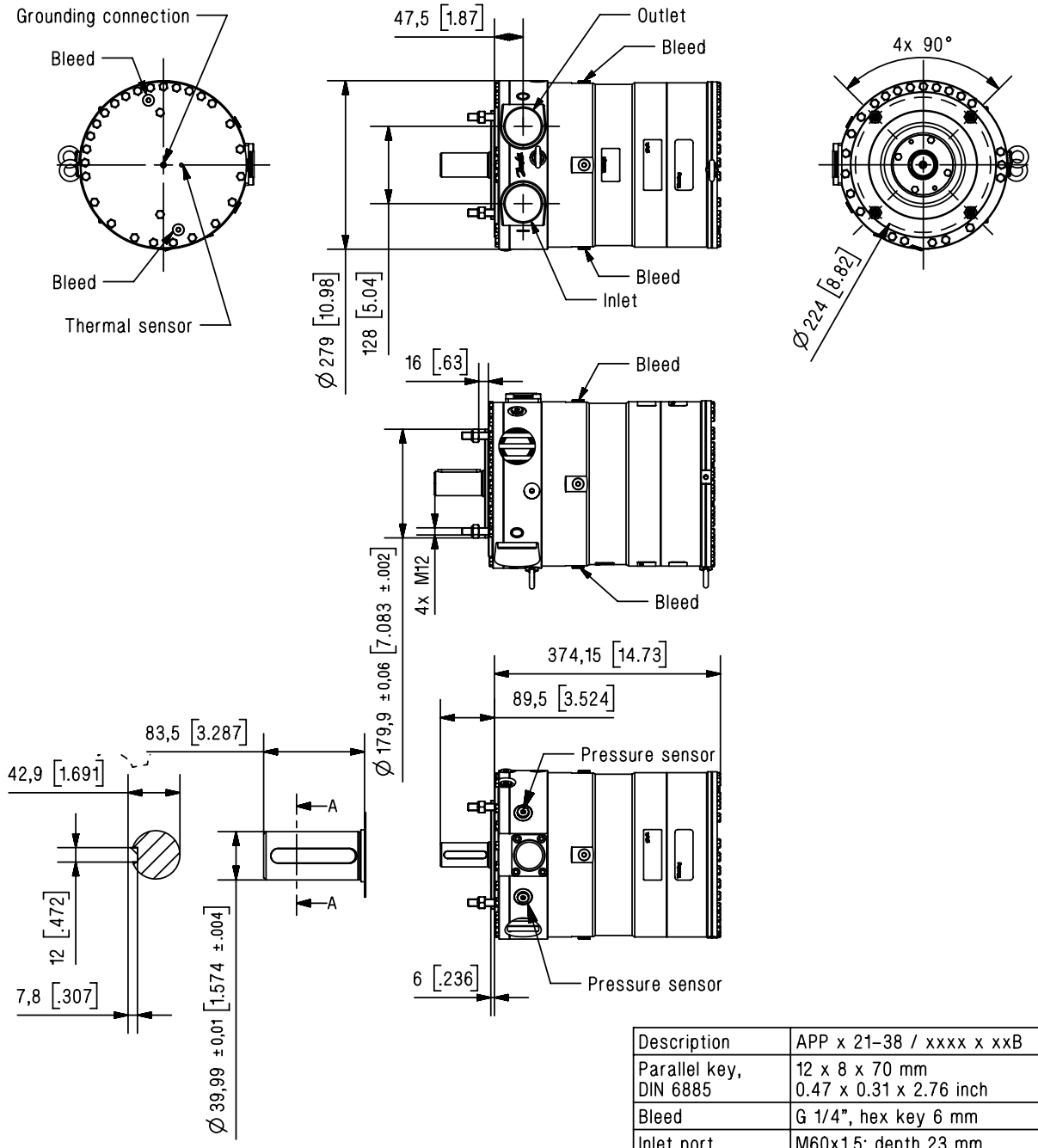
Preferred design - see section 10.3



11. Dimensions and connections

11.1 APP 21- 38 with ceramics

Accessories see section 13.



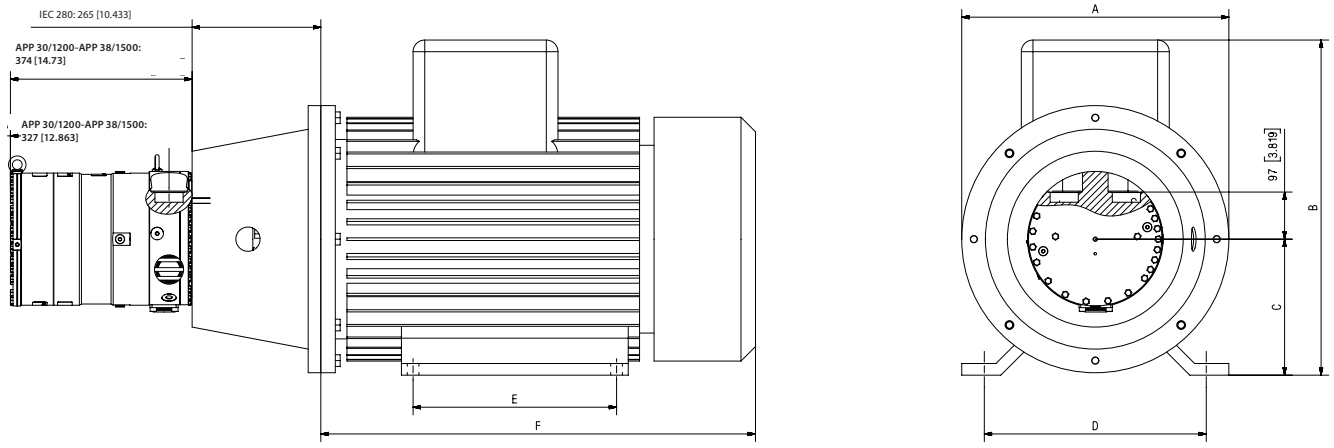
Description	APP x 21–38 / xxxx x xxB
Parallel key, DIN 6885	12 x 8 x 70 mm 0.47 x 0.31 x 2.76 inch
Bleed	G 1/4", hex key 6 mm
Inlet port	M60x1.5; depth 23 mm
Outlet port	M60x1.5; depth 23 mm
Earth connection	M8, depth 11 mm
Thermal sensor	M6, depht 11 mm
Pressure sensor	G 1/4", hex key 6 mm

Dimensions without tolerances acc. To ISO 2768–1 designation C.

12. Dimensions with motor unit

12.1 APP 21-38 with ceramics

The examples of assemblies with motor are only for IEC motors and couplings. Please make sure to check required motor power and dimensions when selecting size of pump and motor. For advice and calculation tool, please contact Danfoss.



Pump	A mm (inch)	B mm (inch)	C mm (inch)	D mm (inch)	E mm (inch)	F mm (inch)	IEC Electric motor
APP 21 - 38 with ceramics	450 (17.71)	561 (22.08)	225 (8.85)	356 (14.01)	311 (12.24)	707,5 (27.85)	45 kW, IEC 225
APP 21 - 38 with ceramics	550 (21.65)	649 (25.55)	250 (9.84)	406 (15.98)	349 (13.74)	769 (30.27)	55kW IEC 250
APP 21 - 38 with ceramics	550 (21.65)	683 (26.88)	280 (11.02)	457 (17.99)	368 (14.49)	839 (33.03)	75kW, IEC 280S-4
APP 21 - 38 with ceramics	550 (21.65)	693 (27.28)	280 (11.02)	457 (17.99)	419 (16.50)	895 (35.24)	90 kW, IEC 280 M-4
APP 21 - 38 with ceramics	660 (25.98)	862 (33.93)	315 (12.40)	508 (20.00)	406 (15.98)	1053 (41.45)	110kW, IEC 315S-4

13. Accessories

13.1 Accessories for APP 21 - 38 with ceramics

Accessories		Type	Code No.
3" inlet hose kit - 2m (79")		3" Victaulic	**180Z0144**
2" outlet hose APP 30-38	**1.78m (70")**	2 ½" Victaulic	**180Z0263**
	1m (39.4")		**180Z0280**
3" inlet connector APP 30-38		M60 - 3" Victaulic	**180B3208**
Non-return valve (outlet) Super Duplex APP 30-38		M60 - 2 ½" Victaulic	**180H0059**

[1] The installation instruction for Style 77DX is located in the Victaulic document 1-100 Field Installation Handbook (http://static.vieltaulic.com.
When using hoses, please read Design guides: 180R9084 - Right and wrong - Hose assembly routing tips and 180R9367 - Piping connections.

14. Service

Danfoss APP pumps are designed for long operation, low maintenance and reduced lifecycle costs.

Provided that the pump has been running according to the Danfoss specifications, Danfoss recommends 16.000 hours service interval, but as the guarantee is 8000 Hours service-free operation or max. 18 month from date of production it is recommended to perform an inspection before the end of the warranty period to ensure that any potential issues are identified and can be resolved promptly through the warranty claims process

If Danfoss recommendations concerning system-design are not followed, it will strongly influence the life of the APP pumps.
Other factors that affect pump performance and lifetime include:

- Running the pump at speed outside specifications.
- Supplying the pump with water at temperature higher than recommended.
- Running the pump at inlet pressure outside specifications.
- Running the pump at outlet pressure outside the specifications.
- Wrong rotation of the shaft
- Insufficient bleeding of the pump
- Filtration not meetin specifications

If the recommendations in the manual are not followed, Danfoss reserves the right to void the warranty.

Maintenance
Periodic inspections are required to ensure worn parts (if any), are replaced in due time. Operational conditions such as water quality should be taken into consideration when determining the frequency of the inspections.

Pump shutdown:
The APP pumps are made of Duplex/Super Duplex materials with excellent corrosion properties. It is, however, always recommended to flush the pump with freshwater when the system is shut down.
When stopping the pump for more than 1 day flush the pump with permeate by rotating the pump for 10 sec. Flushing through the flushing valve of the pump without rotating the pump is not enough for cleaning the inside of the pump. The pump can be flushed with biocide like the membranes. The biocide must be compatible with the materials used in the pump.

Repair assistance
In case of irregular function of the APP pump, please contact Danfoss High Pressure Pumps.

Danfoss A/S
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ENGINEERING
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Instruction

APP pumps
APP 21 - 38 with Ceramics

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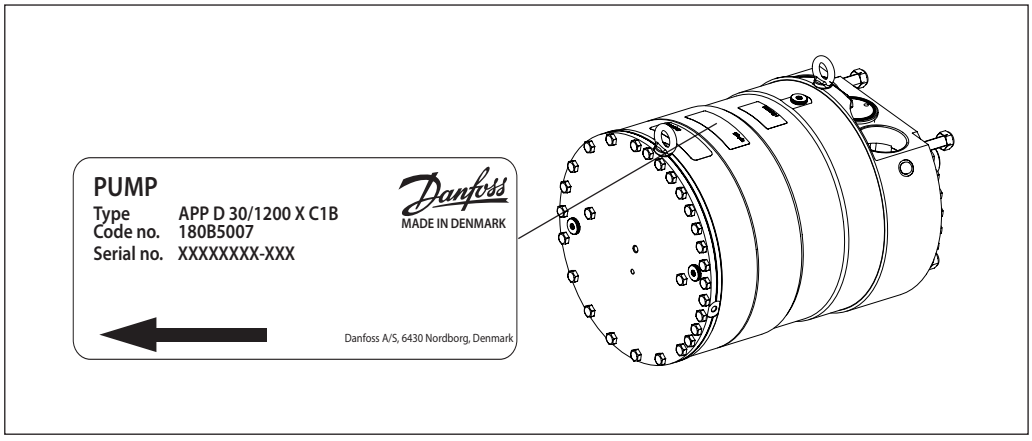
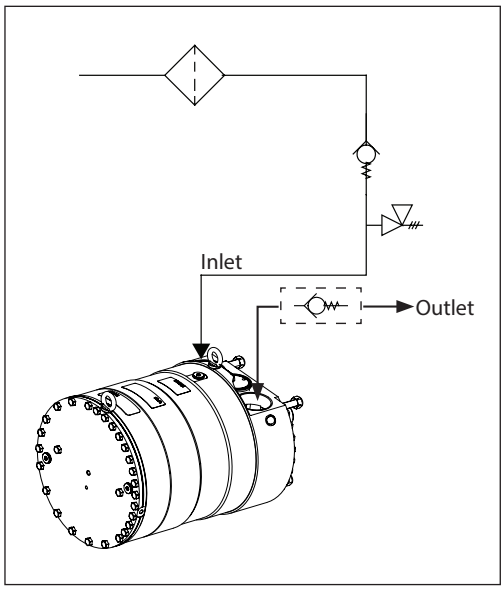
1. Identification



2. System design

The design of the system must ensure that self-emptying of the pump during standstill is avoided.

The inlet pressure of the pump must never exceed the outlet pressure. This may typically occur in boosted or open-ended systems with direct water supply.



2.1 Open-ended systems with direct water supply

The pump is supplied with water directly from a feed pump.

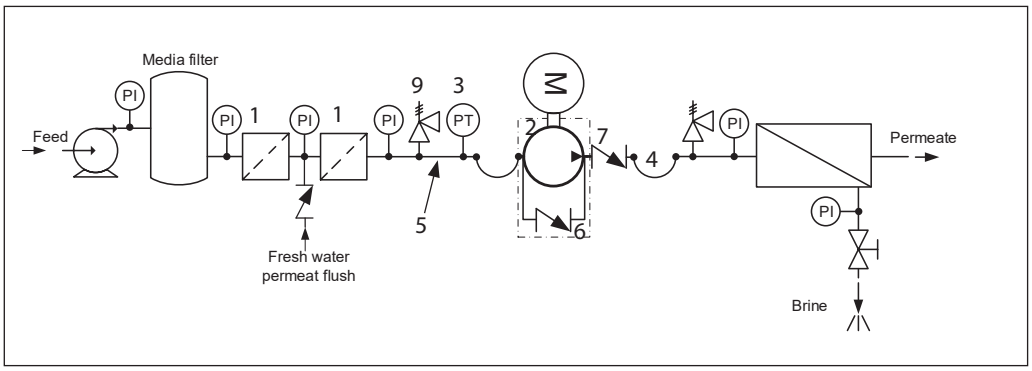
The inlet pressure must be within the limits describes in the datasheet for the specific pump.

To protect the pump from being damaged by peaks of high-pressure in case the pump stops momentarily, it is required to mount a low-pressure relief valve on the inlet line.

2.2 Preferred RO system design and P&ID

1. Dimension the inlet line to obtain minimum pressure loss (large flow, minimum pipe length, minimum number of bends/connections, and fittings with small pressure losses).
2. Place an inlet filter (1) in front of the APP pump (2). Please consult Danfoss filter data sheet for guidance on how to select the right filter. Thoroughly clean pipes and flush system prior to start-up.
3. Place a monitoring pressure switch (3) set at min. inlet pressure between filter and pump inlet. The monitoring switch must stop the pump at pressures lower than minimum pressure.
4. Use flexible hoses (4) to minimize vibrations and noise.
5. In order to eliminate the risk of damage and cavitation, a positive pressure at the inlet (5) is always to be maintained at min. inlet pressure and max. inlet pressure. It is recommend to install safety valve or a pressure relief valve (9) in order to avoid high-pressure peaks in case the pump stops momentarilly or is spinning back-wards.
6. For easy system bleeding and flushing, a bypass non-return valve (6) is integrated in the APP pump.
7. A non-return valve (7) in outlet can be installed in order to avoid backspin of the pump. The volume of water in the membrane vessel works as an accumulator and will send flow backwards in case of the pump stops momentarily.
8. A safety valve or a pressure relief valve (8) can be installed in order to avoid system damage as the Danfoss APP pump creates pressure and flow immediately after start-up, regardless of any counter pressure.

Note: If a non-return valve is mounted in the inlet line, a low-pressure relief valve is also required between non-return valve and pump as protection against high-pressure peaks.



2.3 Reversible pumps

If exposed to high-pressure in the outlet while the electric motor is not energized, the pumps will start spinning backwards. This will not harm the pumps as long as the pressure in the inlet does not exceed the max. pressure peak of 10 barg(145 psig).

If a non-return valve is mounted in the inlet line, a low-pressure relief valve is also required as protection against high-pressure pulses and high-pressure in general.

Alternatively a high-pressure check valve can be mounted in the pump discharge line to prevent the pump from reversing.

The dotted setup ensures that the inlet pressure does not exceed 10 barg (145 psig), when a non-return valve is mounted in the inlet.

In order to avoid the risk of cavitation, the inlet pressure for APP 30 - 38 must be min. 2 barg (29 psig) and 3.5 barg (50.8 psig). The inlet line connection must be properly tightened, as possible entrance of air will cause cavitation.

2.4 General comments

Filtration
A good filtration is vital to ensure a long and trouble-free life of the pump.

As water has very low viscosity, the APP pumps have been designed with very narrow clearance in order to control internal leakage rates and improve component performance. Therefore it is important that the inlet water is filtered properly to minimize the wear of the pump.

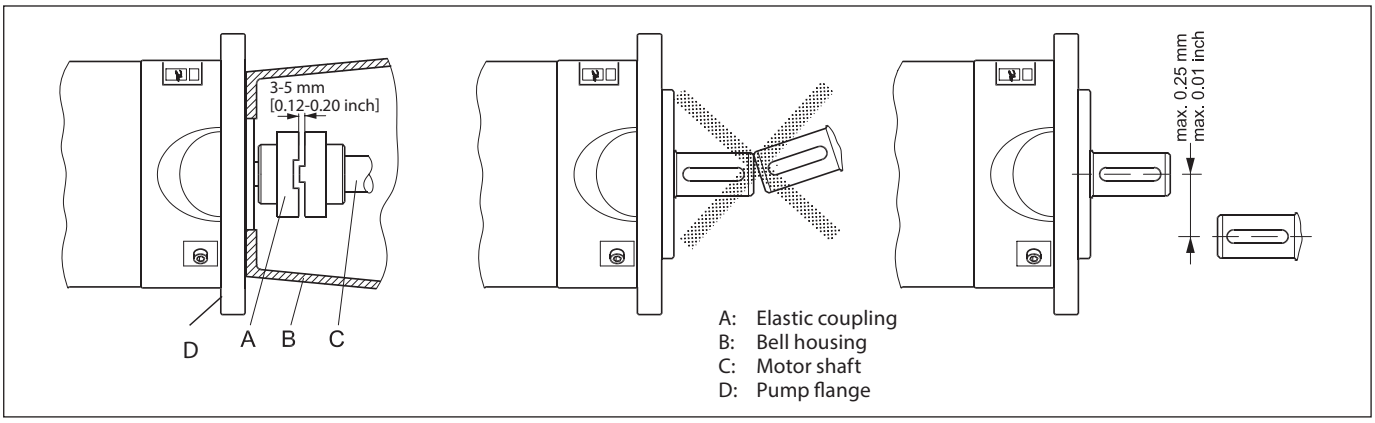
The main filter must have a filtration efficiency of 99.98% at 10 µm. We recommend to use precision depth filter cartridges rated 10 µm abs. $\beta 10 \geq 5000$ (equivalent to a filtration efficiency of 99.98%). Bag filters and string wounded filter cartridges typically have only 50% filtration efficiency. This means that for each 100,000 particles reaching the filter, 50,000 particles pass through it compared to only 20 particles in a filter with an efficiency of 99.98%.

For more information on the importance of proper filtration, please consult our publication "Filtration" (code number 521B1009), which also will provide you with an explanation of filtration definitions and a guidance on how to select the right filter.

Monitoring
It is recommended to continuously monitor the following conditions:

- Filter clogging
- Pressure (inlet- and outlet side of the pump)

3. Building up the pump unit



3.1 Mounting

1. Mount the coupling flush or maximum 1 mm offset from the pump shaft end. Ensure an air gap between coupling parts of 3-5 mm (0.12-0.2 inch).
2. Mount the bell housing on pump. Secure nuts with the right torque.
3. Measure the longest distance "A" from top of bell housing to the button of coupling claw.
4. Mount the coupling on motor shaft. Ensure the coupling and motor flange are not in contact with each other.
5. Measure from motor flange to the top of the coupling. That measurement "B" shall be 3-5 mm (0.12-0.2 inch) shorter than the measurement "A".

("A" and "B" can be found on the next page).

6. Adjust respectively, verify the measurement, and secure both couplings with the right torques on the locking screws (see coupling operation & mounting instruction).

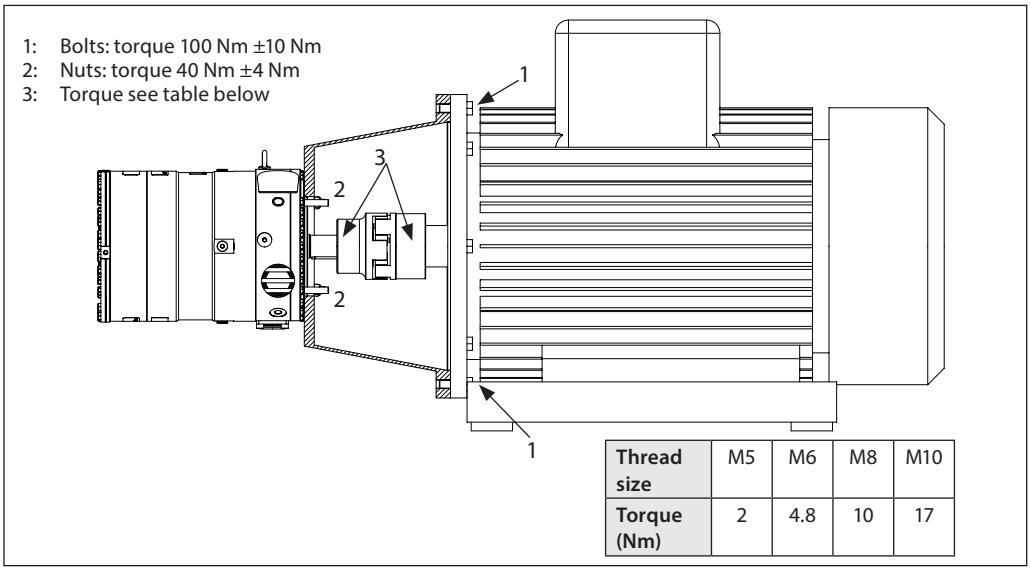
7. Mount the elastic gear ring and mount the bell housing/pump on the motor. After mounting it must be possible to move the elastic gear ring 3-5 mm (0.12 - 0.2 inch) axial "C". The check can be done through the inspection hole of bell housing. Secure flange bolts with the right torque.

If alternative mounting is desired, please contact Danfoss High Pressure Pumps.

Choose proper tolerances to ensure an easy mounting of the elastic coupling without use of tools.

Please take care to observe the recommended length tolerances of the chosen coupling, as an axial force on the pump will damage the pump.

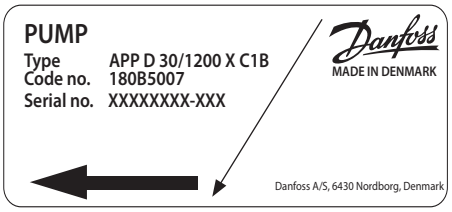
("C" can be found on the drawing below).



Thread size	M5	M6	M8	M10
Torque (Nm)	2	4.8	10	17

3.2 Direction of rotation

Is indicated by an arrow on the pump label.



3.3 Orientation

The pump can be mounted/orientated in any horizontal direction with the inlet and the outlet pointing upwards, downwards or to either side.

3.4 Protection from too high pressures

The pump should be protected against too high pressure by means of a safety valve or a pressure relief valve.

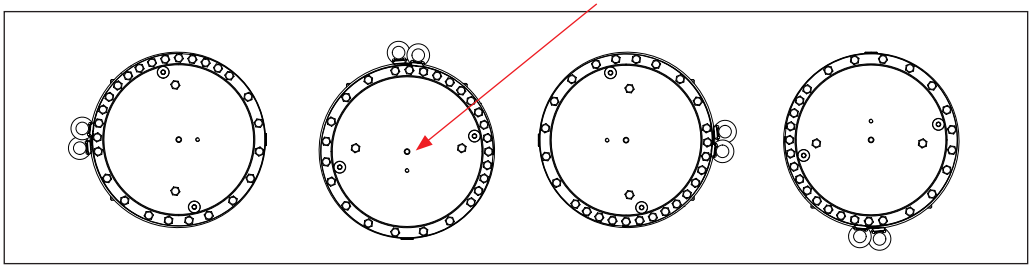
The valve should be placed as close to the pump as possible.

The opening characteristics of the valve must not result in peak pressures higher than 100 barg (1450 psig).

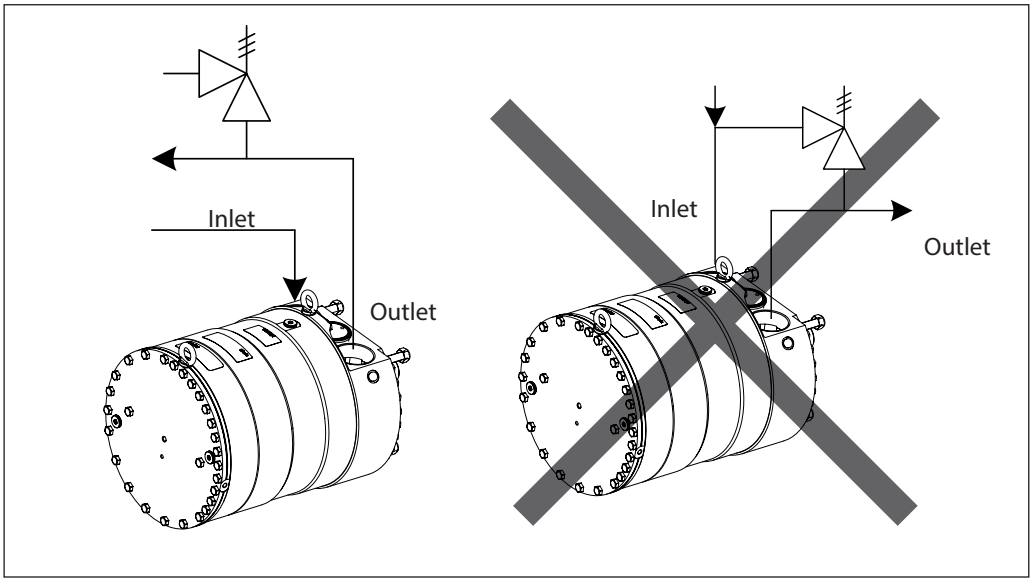
We recommend the use of flexible soft hoses both in the inlet and in the outlet lines.

3.5 Grounding

To prevent stray current corrosion we recommend grounding of the pump and all other parts in the system. All parts in the system must be electrical potential equalized to a single reference point (grounding point). It is recommended that the electrical resistance in the grounding cable is equal to or below 0.25 Ω toards the grounding point.

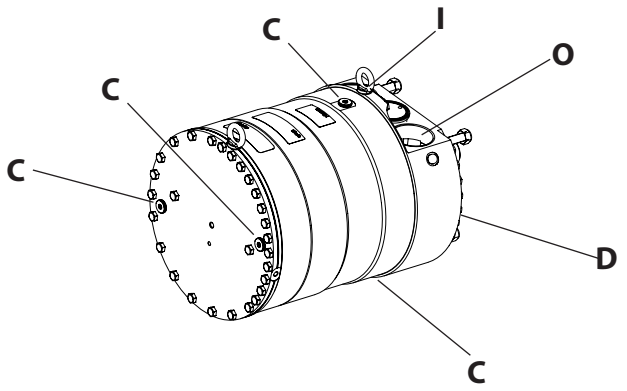


The valve outlet must not be connected directly to the pump suction line. It must be connected directly to the drain.



3.6 Connections

I: Inlet
O: Outlet
C: Bleeding
D: Parallel key



Description			APP 21 - 38 with ceramics
E	Parallel key, DIN 6885	mm	12 × 8 × 70
		in	0.47 × 0.31 × 2.76
F	Bleeding		G ¼", Hexagon AF = 6 mm
I	Inlet port		M60 x 1.5; depth 24 mm
O	Outlet port		M60 x 1.5; depth 24 mm
Mounting flange			ISO 3019-2 180B4TW

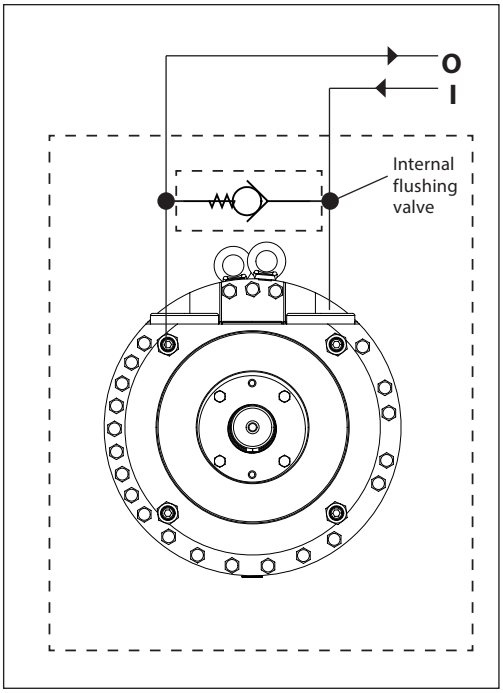
Accessories	Type	Code no.
3" inlet hose kit	**3"** Victaulic	180Z0144 2.00 m [79"]
2" outlet hose kit APP 21-38	**2½"** Victaulic	180Z0263 1.78 m [70"] 180Z0280 1.00 m [39.4"]
3" inlet connector APP 21-38	**3"** Victaulic	180B3208
Non-return valve (outlet) Super Duplex APP 21-38	**2½"** Victaulic (OD 73 mm)	180H0055

For more details on the accessories, please contact Danfoss High Pressure Pumps.
Possible extension see next page.

4. Initial start-up

1. Flush inlet line before connecting the pump, to remove possible impurities from pipes, hoses etc.
2. Connect pump inlet to inlet line and flush the pump for 5 min. by means of the internal flushing valve, to remove possible impurities from pipes, hoses etc.
3. Loosen top bleeding plug "C" (see item 3.5) using an allen key (only plugs with internal hexagan sockets). Retighten the plug, when water appears from the bleeding plug.
4. Make sure that the direction of rotation of the electric motor corresponds to the direction of rotation of the pump (see label on pump).
5. Now the pump is ready for start-up.

WARNING
Make sure that the direction of rotation of the electric motor corresponds to the direction of rotation of the pump (see label on pump). Otherwise the pump will be damaged if a check valve is placed between pump and feed pump.



5. Operation

5.1 Temperature

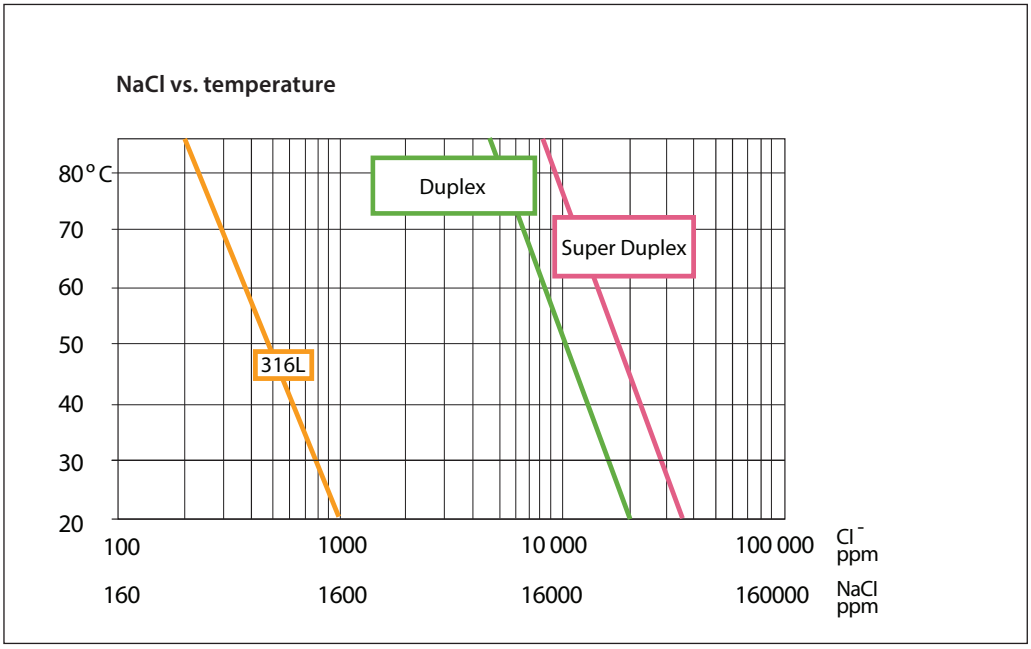
Fluid temperature: Min. +2°C to max. +50°C (Min. +35.6°F to max. +122°F)
Ambient temperature: Min. +2°C to max. +50°C (Min. +35.6°F to max. +122°F)

In case of lower operating temperatures, please contact Danfoss High Pressure Pumps.

The chart below illustrates the corrosive resistance of different types of stainless steel related to NaCl concentration and temperature.

The APP water pump is made of Duplex and Super Duplex.

If the water pump is operated above the Super Duplex line, always flush water pump with fresh water at operation stop in order to minimize the risk of crevice corrosion.



5.2 Pressure

The inlet pressure for APP 30 - 38 must be min. 2 barg (29 psig) and max. 5 barg (72.5 psig). At lower pressures the pump will cavitate, resulting in damage of the pump.
Max. inlet pressure peak (e.g. in case the pump stops momentarily) up to 10 barg (145 psig) are acceptable.
Max. pressure on the pump's outlet line should be limited at 83 barg (1200 psig) continuously.

Note: The pump unit should include a pressure gauge on the high-pressure side.

5.3 Dry running

When running, the pump must always be connected to the water supply in order to avoid damage if it should run dry.

5.4 Disconnection

If the inlet line is disconnected from the water supply, the pump will be emptied of water through the disconnected inlet line.
When starting up again, follow the bleeding procedure described under section 4: Initial start up.

5.5 Storage

Storage temperature: Min. -40°C to max. +70°C (Min. -40°F to max. +158°F)

When preparing the pump for long-term storage or for temperatures below the freezing point, flush the pump with an anti-freeze medium type monopropylene glycol to prevent internal corrosion or frost in the pump.
For further information on anti-freeze media, please contact Danfoss High Pressure Pumps.

Recommended procedure:

1. Disconnect the water supply to the pump.
2. Through the lower bleeding plug, empty the pump housing of water and close it again.
3. Connect the pump to a tank containing anti-freeze additive. Connect a hose to the inlet port of the pump and via another hose return the flow from the outlet port to the tank with antifreeze additives.
4. Quickly start and stop the pump. **Make sure that the pump does not run dry.** The pump is now protected against internal corrosion and frost.

Storage:
Storage of pump that have been in operation:
For shorter periods of storage flush the pump with permeate rotating the pump for 10 sec., empty permeate and store.
For long term storage (more than 2 months) Danfoss recommends servicing the product and clean any biological growth of the surface. Store the pump dry without water inside.

6. Service

6.1 Warranty

Danfoss APP pumps are designed for long operation, low maintenance and reduced lifecycle costs.

Provided that the pump has been running according to the Danfoss specifications, Danfoss recommends 16.000 hours service interval, but as the guarantee is 8000 Hours service free operation or max. 18 month from date of production it is recommended to perform an inspection before the end of the warranty period to ensure that any potential issues are identified and can be resolved promptly through the warranty claims process

If Danfoss recommendations concerning system-design are not followed, it will strongly influence the life of the APP pumps.

6.2 Maintenance

After 16,000 hours of operation, **it is strongly recommended** to inspect the pump and change any worn parts, e.g. pistons and shaft seal. This is done in order to prevent a potential breakdown of the pump.

If the parts are not replaced, more frequent inspection is recommended according to our guidelines.

Standstill:
The APP pumps are made of Duplex/Super Duplex materials with excellent corrosion properties. **It is however, always recommended to flush the pump with fresh water when the system is shut down.**

When stopping the pump for more than 1 day flush the pump with permeate by rotating the pump for 10 sec. Flushing through the flushing valve of the pump without rotating the pump is not enough for cleaning the inside of the pump. The pump can be flushed with biocide like the membranes. The biocide must be compatible with the materials used in our pump (materials can be found in the parts list in the Operating guide.

6.3 Repair

In case of irregular function of the APP, please contact Danfoss High Pressure Pumps sales organisation.

Danfoss A/S
High Pressure Pumps • danfoss.com • +45 7488 2222 • highpressurepumps@danfoss.com

Electric Motors

Motor Manual

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Manual

HOYER
MOTORS

HOYER MOTORS

Motor Manual

General

This manual concerns the following types of standard induction motors from Hoyer:
HMA3, HMC3, HMA2, HMC2, HMD, HMT, MS, Y2E1, Y2E2, YDT
These motors are manufactured in accordance with IEC/EN 60034-4 and IEC/EN 60072.
Motors are rated for the ambient temperature range -20°C to +40°C and site altitudes ≤1000 m above sea level.
Low-voltage motors are components for installation in machinery. They are CE marked according to the Low Voltage Directive 2014/35/EU.
Motors not fulfilling the IE3 efficiency level must be equipped with a variable speed drive when used in EU.

Transport and storage

Check the motor for external damage immediately upon receipt and, if found, inform the forwarding agent right away.
Check all rating plate data, and compare it with the requirement of the motor.
Turn the shaft by hand to check free rotation, remove transport locking if used.
Transport locking must be used again for internal transport also. It is also important that transport locking is used when motors are transported mounted on equipment.
All motors should be stored indoors, in dry, vibration- and dust-free conditions.

Lifting eyebolts must be tightened before use. Damaged eyebolts must not be used, check before use. Lifting eyes at motor must not be used to lift the motor when it is attached to other equipment.

Before commissioning, measure the insulation impedance. If values are ≤ 10MΩ at 25°C, the winding must be oven dried.
The insulation resistance reference is halved for each 20°C rise in motor temperature.
It is recommended that shafts are rotated periodically by hand to prevent grease migration.

Installation

The motor must be fixed on a stable, clear and flat foundation. It must be sufficiently rigid to withstand possible short circuit forces.
It is important to ensure that the mounting conditions do not cause resonance with the rotational frequency and the doubled supply frequency.
Only mount or remove drive components (pulley, coupling, etc.) using suitable tools, never hit the drive components with a hammer as this will cause damage to the bearing.
The motor are balancing with half key, ensure that the drive components are also the same.
Correct alignment is essential to avoid bearing, vibration and shaft failure.
Use appropriate methods for alignment.
Re-check the alignment after the final tightening of the bolts or studs.
Check that drain holes and plugs face downwards. We recommend opening the drain hole for motors placed outdoors and not running 24 hours / day, so that the motor can breathe, thus ensuring a dry motor.

Electrical connection

Work is only permitted to be carried out by qualified specialists and must to be carried out in accordance with local regulations.
Before work commences, ensure that all power is switched off and cannot be switched on again. This also applies to the auxiliary power circuits, e.g. anti-condense heaters.
Check that supply voltage and frequency are the same as rated data.
Motors can be used with a supply deviation of ± 5% voltage and ± 2% frequency, according to IEC60034-1.

Connection diagrams for main supply and accessory as PTC or heater are located inside the terminal box.

Connections must be made in such a way as to ensure that a permanently safe electrical connection is maintained, both for the main supply and the earth connection.
We recommend that crimped connections are made in accordance with IEC 60352-2.

Tightening torques for terminal board screws:

Thread	M5	M6	M8	M10	M12	M16	M20	M24
T.(Nm)	2.5	3.5	7	12	18	35	55	80

Ensure that the terminal box is clean and dry.
Unused glands must be closed with blind caps.
Check the terminal box gasket before it is remounted.

Maintenance

Inspect the motor at regular intervals, keep it clean and ensure free ventilation air flow, check the condition of shaft seals and replace if necessary. Both electrical and mechanical

connections must be checked and tightened if necessary.
Bearing size and type are specified on the rating plate. Motor types HMA3 and HMC3 is as standard with lifetime greased bearings in motors size ≤180 for cast iron and size ≤132 for aluminium. Motor types HMA2 and HMC2 is as standard with lifetime greased bearing in motors size ≤225.
Motor types MS and Y2E is as standard with lifetime greased bearing in motors size ≤160.

Typical duty hours for lifetime lubricated bearings.

Frame size	Poles	Typical lifetime
56 - 160	2 - 8	40,000h
180	2	35,000h
200	2	27,000h
225	2	23,000h
180 - 225	4 - 8	40,000h

Motors with a re-greasing system must be lubricated with high quality lithium complex grease, NLGI grade 2 or 3, with a temperature range of between -40°C to +150°C.
Motors are normal fitted with a data plate with greasing information; if it is missing use the following re-greasing intervals.

Frame size	Grease (g)	2 pole (h)	4 pole (h)	6 pole (h)	8 pole (h)
160	20	4200	7000	8500	8500
180	20	4200	7000	8500	8500
200	25	3100	6500	8500	8500
225	25	3100	6500	8500	8500
250	35	2000	6000	7000	7000
280	35	2000	6000	7000	7000
315	50	1500	5500	6500	6500
355	60	1000	4000	5000	6000
400	80	800	3000	4000	6000

Grease the motor while running, open the grease outlet plug and let the motor run 1-2 hours before the outlet grease plug is closed again.
Grease the motor for the first time during commissioning.

The following applies in general for both lifetime lubricated and re-lubricated bearings:
At 60Hz the time will be reduced by app. 20%.
Data for vertically mounted motors are half of the above values.

The table values are based on an ambient temperature of 25°C. The values must be halved for every 15K increase in bearing temperature.
Higher speed operations, e.g. frequency converter drive will require shorter greasing intervals. Typically, doubling the speed will reduce the values by 50%.

Special note for Atex Zone 22 and nA motors

Designation of motor according to IEC standard:
II 3D Ex tc IIIB T120°C
II 3G Ex nA IIC T3

The hazardous 3-phase asynchronous motors are in accordance with International standard IEC 60079-31 and IEC 60079-15.
Only one electrical installation may be installed in one specified area (zone).

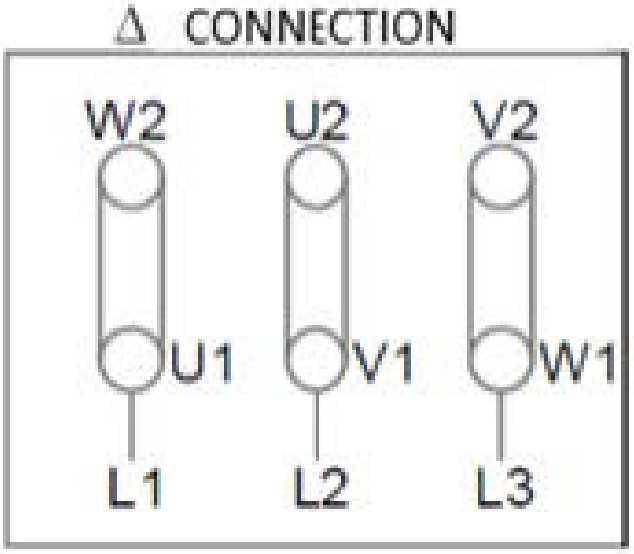
Only certificated cable glands may be used. Unused glands must be closed.
Connections must be made in such a way as to ensure that a permanently safe electrical connection is maintained, both for the main supply and earth connection.
Installations must be in accordance with actual standards for installation in hazardours area.

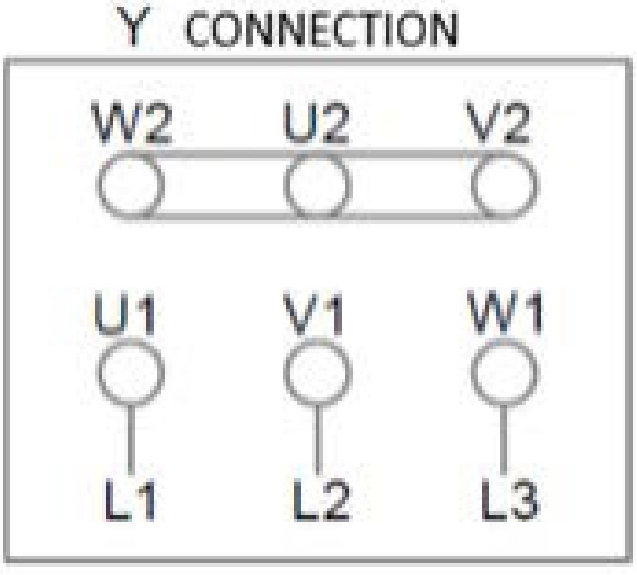
It is recommended that the IEC standard is followed according to temperature and dust on the motor surface.
The use of motors with so much surface dust that the motor temperature increases is not permitted.
Regularly cleaning is recommended.
The radial shaft sealing ring is part of the ATEX certification. It is important that the ring is always intact.
The shaft sealing must be regularly checked, and if dry it must be lubricated. It is recommended that the seal is re-lubricated regularly.
Always use the original seal ring when replaced.
Replacing bearings also means replacing the seals.

All machines must be inspected regularly for mechanical damage.
The user is responsible for changing parts in accordance with the lifetime of parts, in particular:
bearings, grease and lubrication of shaft sealing.

Maintenance, repairs and replacement on this type must only be carried out by qualified specialists.

Connection diagram
Anschlußdiagram
Anslutningdiagramm
Forbindelsesdiagram
Aansluitdiagram
Connection
Conexión
Collegamento
Schemat polacsen





EU Declaration of Conformity

The Manufacturer:	SVEND HØYER A/S Over Hadstenvej 42 DK 8370 Hadsten Denmark

Hereby declares that

The products:	HOYER MOTORS, 3-phase induction motors	
	Aluminum motors	MS 56 - 180
		HMAx 56 – 180
	Cast iron motors	Y2E2 80 - 400
		HMCx 80 – 400
	HOYER MOTORS, 1-phase induction motors	
	Aluminum motors	ML 56 – 112
		MY 63 – 112

Are in conformity with the following:

Standards:	IEC/EN 60034 (All relevant standards on the IEC/EN 60034 series)
Directive:	Low Voltage Directive 2014/35/
EU	

Motor type HMAx and HMCx is also conformity with:

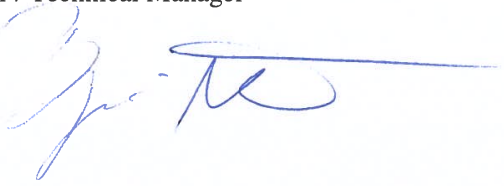
Standards:	IEC/EN 60079-0:2018, IEC/EN 60079-0/A11:2013, IEC/EN 60079-15:2010, IEC/EN 60079-31:2014
Directive:	Eco design for electrical motors 2009/640/EC and 2014/4EU ATEX directive 2014/34/EU Ex II 3D Ex tc IIIB T120°C Ex II 3G Ex nA IIC T3
CE marking:	CE

This declaration of conformity is issued under the sole responsibility of the manufacturer.

I hereby declare that the equipment's named above have been designed to comply with the relevant sections of the above referenced specifications.

Signed by: Bjarne Nør / Technical Manager

December 2018:



1/3

x = 2, 3

HOYER

EXCEEDING EXPECTATIONS

Hoyer Motors, Motor Manual, April 2019

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ENGINEERING
TOMORROW

Instruction

APP pumps

APP 21 and APP 38 with Ceramics
Recommended service intervals

hpp.danfoss.com

Operating guide **APP 21 and APP 38 with ceramics**

Table of Contents

1. General information

This guideline provides information on the recommended service intervals. The recommendation is based upon good engineering practice and on experience gained from operation even under extreme conditions. The recommendation is for guidance only.

2. Design/features

Danfoss APP pumps are designed for long operation and low maintenance and life cycle costs.

Provided that the pump has been running according to the Danfoss specifications, Danfoss guarantees one year service-free operation, however, max. 18 months from date of production.

After one year of operation it is recommended to inspect the pump and replace worn parts, if any. If the Danfoss recommendations concerning system-design (see our data sheet) are not followed, the service life of the APP pumps might be affected.

The recommended service intervals on the different parts in the APP pumps appear from the table below:

Pos.	Qty.	Description	Material	Service interval APP 30/1200 rpm	Service interval APP 38/1500 rpm
1	1	Housing, main bearing	Duplex, PEEK	No need for service	No need for service
11, 125, 211*	1	Mounting flange/ end flange	Wetted part: Duplex Dry part: AISI 316L	No wear part	No wear part
121, 181*	1	Port flange	Duplex	No wear part	No wear part
31	1	Swash plate	Super Duplex	80,000 hours	80,000 hours
66	5/7/9	Piston	Super Duplex and PEEK	32,000 hrs.	24,000 hrs.
92	1	Valve plate	Super Duplex	48,000 hours	48,000 hours
91	1	Port plate	Super Duplex, PEEK	48,000 hours	48,000 hours
61	1	Cylinder barrel	Super Duplex	48,000 hours	48,000 hours
65	1	Retainer plate	Super Duplex	48,000 hours	48,000 hours
64	1	Retainer ball	Super Duplex	48,000 hours	48,000 hours
71	1	Retainer guide	Super Duplex	48,000 hours	48,000 hours
62	1/4	Spring	Duplex	48,000 hours	48,000 hours
63	1	Spring guide	Duplex or PP	48,000 hours	48,000 hours
142	1	Stop for shaft seal	PP	No wear part	No wear part
124, 215*	1	Shaft seal	Hastelloy and NBR	32,000 hours	32,000 hours
125	1	Cover/flange for shaft seal	Super Duplex	No wear part	No wear part
93	5/7/9	Back-up ring	PTFE	32,000 hours	32,000 hours
*		O-ring (overall)	NBR	32,000 hours	32,000 hours
*		Screw (overall)	AISI 316	32,000 hours	32,000 hours
*		Pin (overall)	AISI 316, Duplex or PEEK	No wear part	No wear part
152	1	Valve cone (flushing valve)	Duplex or PEEK	64,000 hours	64,000 hours
3, 129*	2	Bleeding screw	Duplex	No wear part	No wear part
67	1	Key	AISI 316	48,000 hours	48,000 hours

* depends on pump size

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ENGINEERING
TOMORROW

Service guide

APP pumps
APP 21 - 38 with Ceramics
Disassembling and assembling

hpp.danfoss.com

Table of Contents

Contents

1. Introduction

This document covers the instructions for disassembling and assembling the axial piston pumps APP 21 - 38 with ceramics.

Tools provided with toolset 180B4654:

- Torque wrench 4-20Nm
- Torque wrench 20-100 Nm
- Lifting eye
- Hex Socket 6 mm, 3/8" - short
- Hex Socket 10 mm, 3/8"
- Hex Socket 24 mm, 3/8"
- Hex Socket 13 mm, 3/8"
- Ringgaffelnøgle 13 mm
- Shaft seal extracter, ø45
- Mandrel for thrust plate
- Press bush, ø45
- Stop for retaining plate
- Screw M8 x 140 RS A4-80 ISO4014
- Screw M8 x 20 CS RS A4-80
- Møtrik 8, 0x6, 5x13,0
- Screw M8 x 70 RS A4-80
- NV24 flush valve tool
- Calibrates for back-up ring

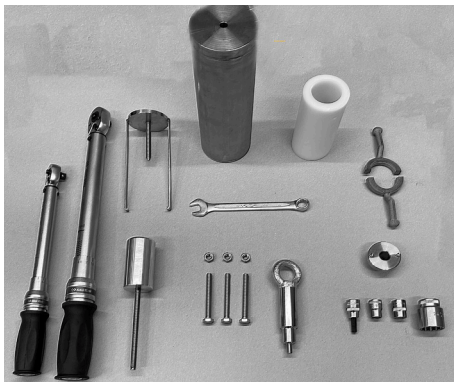
The disassembly instruction shows how to take the product apart. Some parts have their own disassembly section in this document as they are typically not necessary to take apart during inspections. instructions on what to inspect is also indicated in this document.

Important: It is essential that the pump is serviced in conditions of absolute cleanliness.

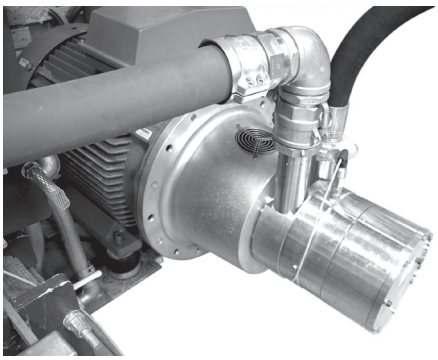
Place the pump on a pallet or other stable surface above the ground. Ensure that the pump cannot roll. It must be possible to place the pump vertically with the shaft pointing downwards. This can be done between two pallets or between two boards on a pallet provided that the distance is minimum 50 mm.

For a better understanding of the pump, please see the exploded view on page 18 and 19.

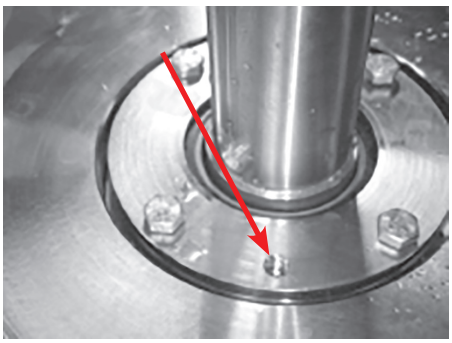
WARNING:
Do not reuse disassembled O-rings or shaft seal as they might be damaged. Always use new O-rings.



2. Disassembling the pump



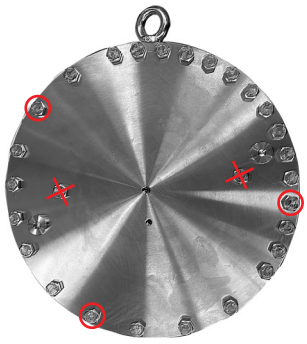
1. Disconnect the pump and motor from the system. Remove non-return valve and connector from the pump.



2. Using a 10 mm socket, unscrew the four bolts from shaft seal flange. If the shaft seal flange is stuck, screw in the two bolts in holes in the flange to remove it.

3. The ceramic ring can normally be inspected without removing it from the cover for shaft-seal. If for some reason it needs to be changed the ceramic ring can be removed by gently pushing it from the back of the sealing ring.

4. Turn pump into vertical position with shaft pointing downwards.



5. Replace the three bolts that is circled in red with the longer bolt and nut from the tool kit. Screw the nut towards the flange.
WARNING:
Do not loosen the two screws that are crossed out as they keep the swash plate in place.

6. Remove all the remaining bolts on the mounting flange.
WARNING:
Do not loosen the two screws that are crossed out as they keep the swash plate in place.

7. Turn each nut one round at the time to make sure that the flange is removed as straight upwards as possible.
   When the flange is fully released the three remaining bolt can be removed.

8. Screw the eye bolt in the M8 hole in the middle of the flange. Pull it straight upwards.

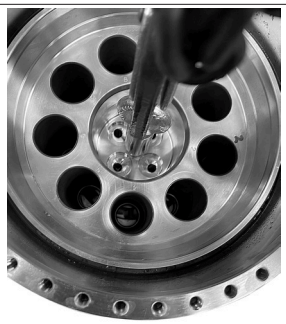
9. Swash plate must be placed so that its surface is not scratched. For further disassembling of swash plate, see page 7.

10. Tilt the retainer plate to horizontal position for easy removal of pistons, if required.
    Remove by hand the pistons one by one. Be careful not to scratch the pistons
    WARNING: Do not use any tools.

11. Remove the retainer plate and the retainer ball.
    Do not loosen the three screws in the retainer plate.

12. Remove the retainer guide, the 4 springs and the spring guide.

13. Mount a 8 mm eye bolt in the cylinder barrel. Before lifting the rotor out. Lift the rotor slightly abover the housing (5-10mm) Use a screwdriver to push the portplate portplate (pos. 91 in the exploded view page 18) down to avoid it from sticking and dropping from the rotor once lifted. Visual inspect that the port plate have dropped through the cylinders.

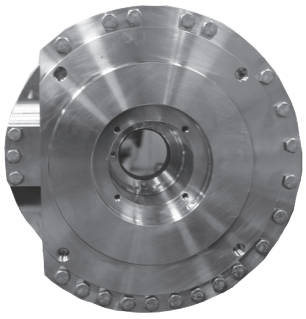


14. Great care must be taken when lifting, as it is a tight fit between the housing bearing and the rotor assembly.
WARNING: If the cylinder barrel is dropped or lowered too fast into housing, the main bearing/shaft bearing might be damaged. It is not replaceable.

15. Place cylinder barrel upside down. For further disassembling of cylinder barrel and valve plate see page 8.

16. Remove the port plate by hand.

17. Remove, by hand, the two pins.
Note: The following operation is only necessary if O-ring on port flange is to be changed.

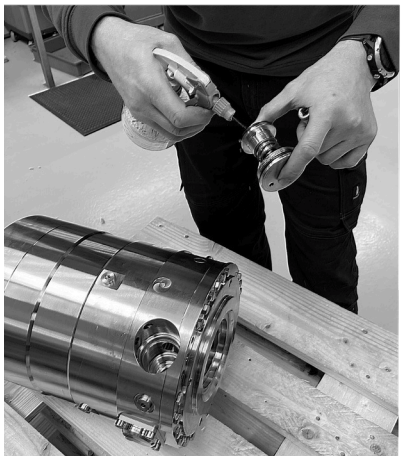


18. Place the pump horizontally.
19. Remove the remaining screws in port flange by using a 13 mm combination wrench. Carefully separate housingand port flange.

20. Ensure that pin is not lost.

3. Flushing valve removal and inspection

1. Start by removing the 3 bolts blocking the acces to the flush valve



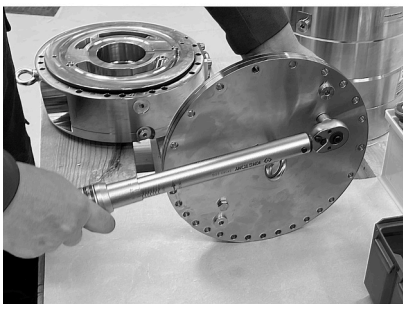
2. Use the flush valve tool to remove the flush valve.

3. There is two seals that can be changed on the flushing valve. One at the cone and one at the cone housing.
Before installing the flush valve lubricate the valve and housing body with water

4. Tighten the flushing valve according to the torque rating shown in the exploded view.

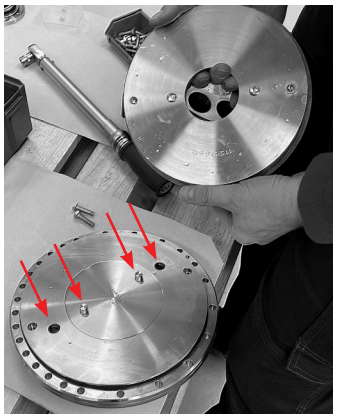
4. Swash plate disassembling and assembling

Note:Do not separate the swash plate from the end flange unless absolutely necesary Inspection of wear surfaces is possible even when assembled.

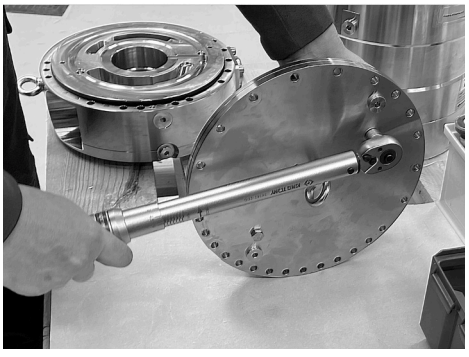


1. Place the end flange and in vertical position and unscrew the two screws that keeps the swash plate in place

2. When the screws are removed the swachplate can be separated from the endflange. make sure to place the swashplate with the ceramic upwards to keep the ceramic surfaces clean.



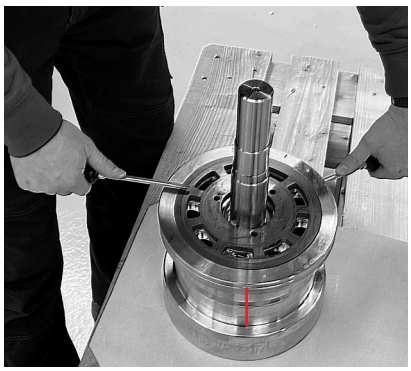
3. When assembling the swashplate and end flange be sure that the two pins and two O-rings are installed.



4. Install the two bolts that keeps the swash plate and end flange together. Tighten according to the torque value in the exploded view.

5. Disassembling and assembling

1. Lubricate the shaft and shaftseal with water and use the shaftseal exstractor to pull of the shaft seal

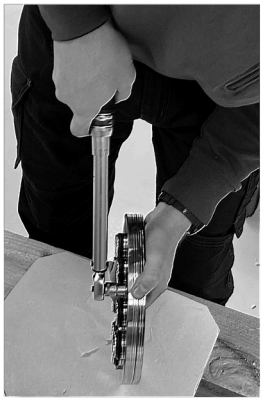


2. Mark the position of the valve plate and carefully use two flat faced screw drivers to remove the valve plate.

3. The portplate consist of a ceramic part and a steel part. The parts can be taken apart by unscrewing the 3 screws holding them together.

4. When the plates are seperated the static seal between the plates can be inspected and replaced if needed

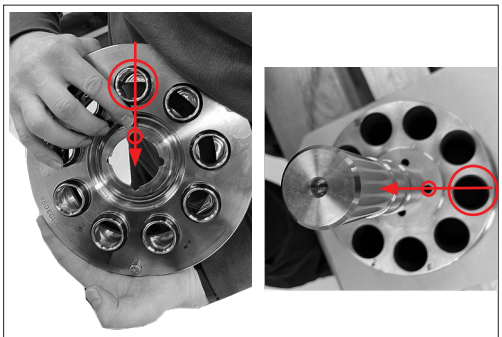
5. When reassembling the plates, make sure the pins in the cover plate are aligned with the pin holes in the valve plate.



6. Install the three screws and wedge lock washers. Tighten according to the torque specified in the exploded view.

7. The seals on the pressure shoes can be removed by hand.

8. If the seals have been replaced they should be set by the set tool for cover seals to ensure correct alignment of the seal.



9. The valve plate must be oriented correct when reinstalled on the cylinder barrel. If you forgot to mark the orientation, you can find the correct orientation by aligning the following holes on the valveplate and cylinder barrel. When installed correct the four flow channels are aligned.

10. Lubricate all orings and cylinders. Use the press bush for valve plate to slowly push the valve plate in place. ensure all O-rings are sliding into the cylinders avoiding to pinch them.

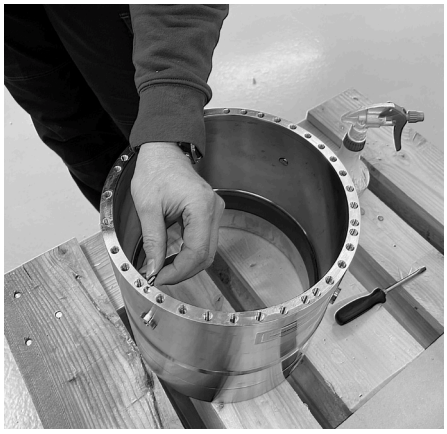
6. Assembling the pump

WARNING:
Do not use silicone when assembling the pump. Do not reuse disassembled O-rings; they might be damaged. Always use new O-rings.

Important:
It is essential that the pump is serviced in conditions of absolute cleanliness. All parts must be absolute clean before mounting.

Note:
Place the pump on a pallet or other stable surface above the ground. Ensure that the pump cannot roll. It must be possible to place the pump vertically with the shaft pointing downwards. This can be done between two pallets or between two boards on a pallet provided that the distance is minimum 50 mm.

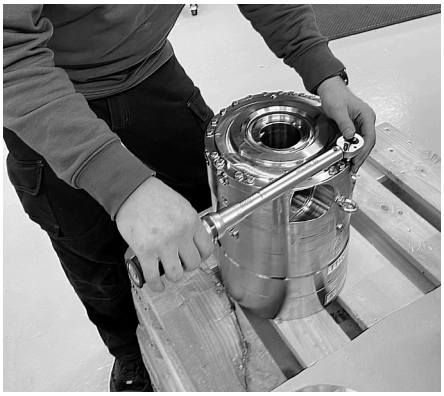
1. Lubrication:
   - To prevent seizing-up, lubricate all threads with PTFE lubrication type.
   - O-rings inside pump may be lubricated only with clean filtered water.
   - O-rings for port flange, mounting flange and flushing valve must be lubricated.
   - It is important to lubricate ALL parts to be assembled with clean filtered water (Especially all PEEK parts).



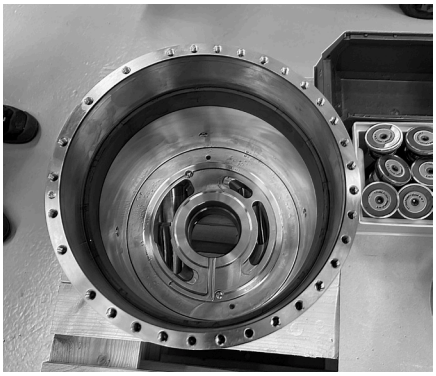
2. Place the housing on a table. The center bearing should be closest to the bottom. install the pin for orientation.

3. Install the the oring for the housing and lubricate it with water.

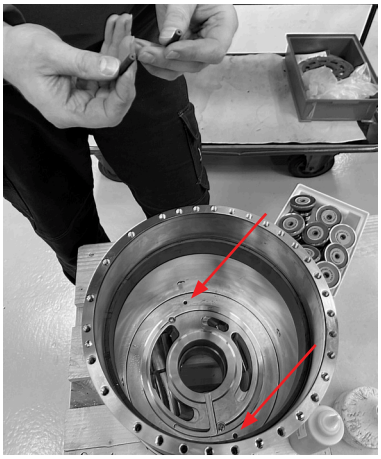
4. Position motor flange by aligning the pin hole over housing guide pin.
5. Gently press downwards. Be careful not to squeeze O-ring. If O-ring is damaged, the pump will leak.



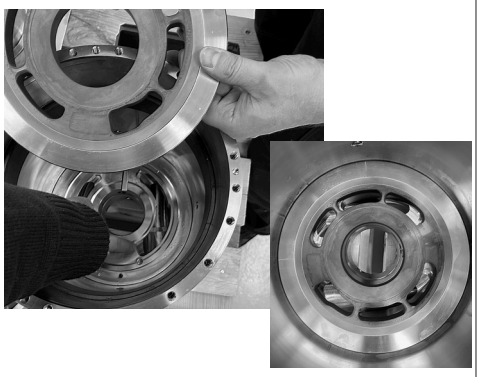
6. Screw in the rest of the screws on port flange. Tighten screws to a torque according to exploded view.



7. Rotate the pump 180 degrees as shown on the picture.



8. Install the two pins in the motor flange. for alignment of the portflange.



9. Ensure port plate is fitted tightly against the bottom.

IMPORTANT: Lubricate port plate with clean filtered fresh water. If valve plate is disassembled from cylinder barrel please see page 11 before continuing.

10. Screw eye bolt in the assembled cylinder barrel.
11. Make sure there is enough free space for the shaft beneath the housing. Gently lower cylinder barrel into housing.

WARNING!
If cylinder barrel is dropped or lowered too fast into housing, main bearing and ceramic valve plate might be damaged. Replacement of mainbearing can only be done at Danfoss, Nordborg.

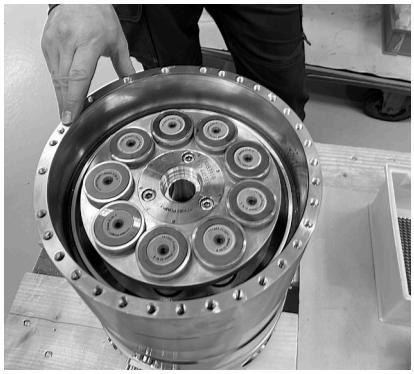
12. Unscrew M8 eye bolt.
13. Place the four springs and spring guide in cylinder barrel. Springs must be positioned in the holes.

14. Retainer guide, retainer ball and retainer plate must be mounted as on this picture.

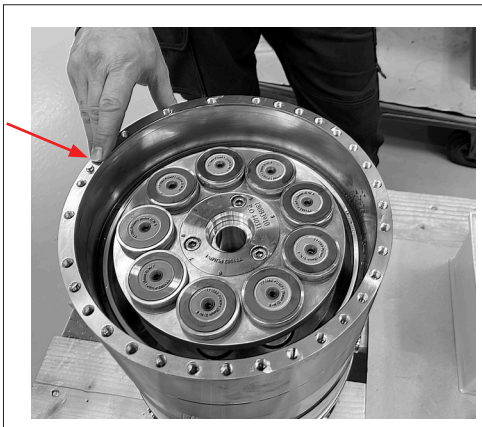
15. Lubricate the cylinder barrel with clean filtered water. Install the Retainer guide in the cylinder barrel and place the complete retainer plate with the ball towards the bearing.
Retainer ball and retainer plate in the cylinder barrel.

16.

Note: If pistons are replaced, place new pistons in clean filtered water for a couple of minutes. Exercise piston shoes to make them "run" smoother.



17. Place pistons in retainer plate and cylinder barrel. When pistons are placed, tilt retainer plate for easier placement of swash plate. If swash plate has been disassembled from mounting flange, see page 7 for assembly of swash plate.



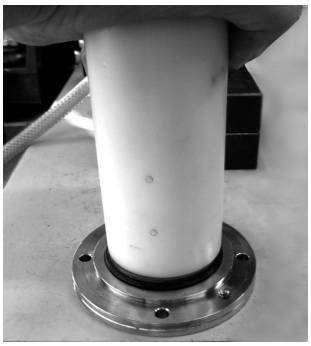
18. Place the pin in the housing and lubricate the piston shoes and swashplate with clean filtered water.

19. Lubricate the O-ring on the end flange. Align the pinhole in the flange with the pin in the housing. Install the three bolts and nuts from the tool kit . Turn each nut one round at a time to ensure mounting flange is mounted as straight downwards as possible. Be careful not to squeeze the O-ring.

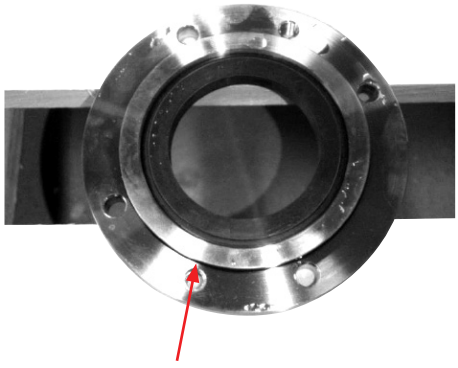
20. Screw in the rest of the bolts and replace the 3 bolts from the toolkit. Cross tighten the screws according to the torque indicated in the exploded view.

21. Rotate the pump - Shaft end upwards. Lubricate the shaft with clean filtered water and install the distance washer and then the shaft seal. Note the ceramic surface have to point upwards.

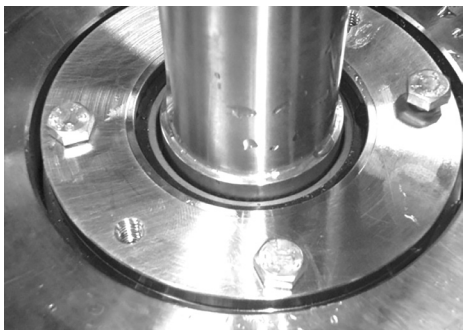
22. Use the shaft seal extractor to push the shaftseal down towards the shoulder of the shaftseal stop



23. If the ceramic ring is exchanged, use the shaft seal tool to press the seal into the cover for shaft seal.
WARNING:
Ensure that the face with rubber seal is positioned against shoulder in shaft seal flange.



24. Remove old O-ring and fit new one on shaft seal flange.



25. Lubricate the shaft seal with clean filtered water. Place the shaft seal cover on the port flange.

7. Changing pistons

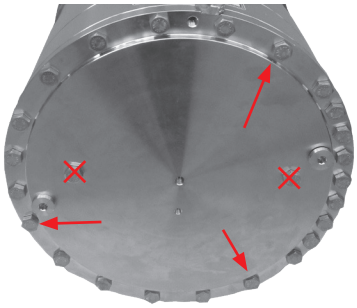
Tools needed are:

13 mm combination wrench
6 mm allen key:

The tools are available from the tool kit 180B4654 the content of the toolkit can be found in page 2.

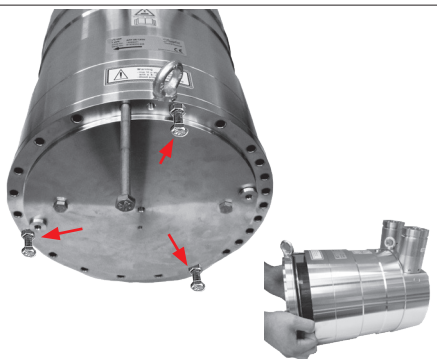
7.1. Disassembling

1. Disconnect the pump from the rest of the system.

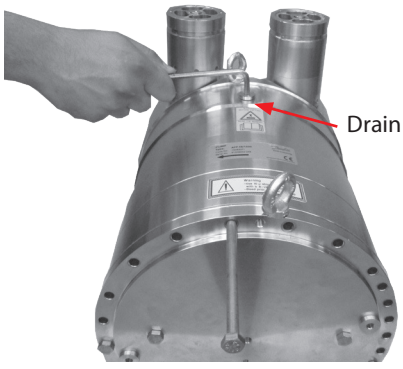


2. Replace the three bolt with the bolt and nuts from the tool kit. Screw the nuts towards the flange to keep it in place while removing the remaining bolts.
Note: There is still water inside the pump.

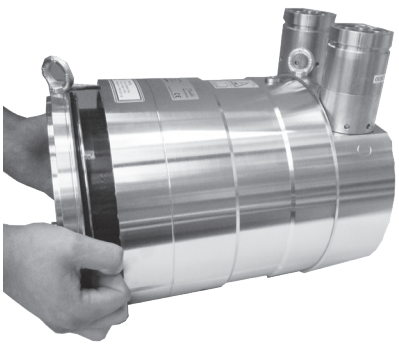
3. Mount the guide bolt in the top hole.



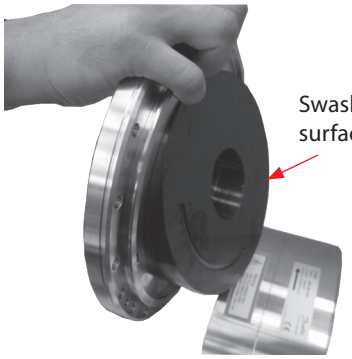
4. Turn each nut a couple of rounds at a time so the flange is removed as straight forward as possible..



5. If the flange does not move forward - loosen the drain plug to empty the pump from water by releasing vacuum.

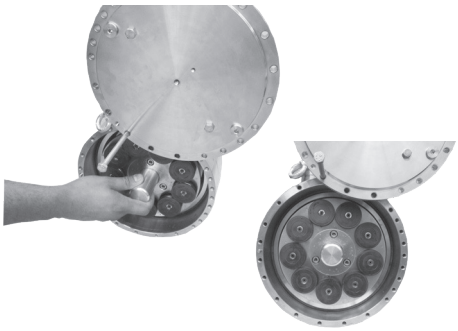


6. Remove the flange when the remaining three screws have been loosened. The guide bolt must remain mounted.

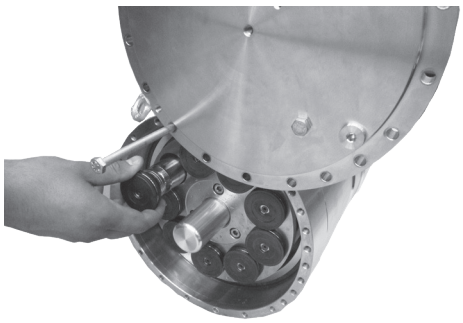


7. Carefully turn the flange and push it backwards to make it rest on the housing surface. Ensure not to scratch the swash plate surface.

8. Adjust the retainer plate to be parrallel to the end flange.

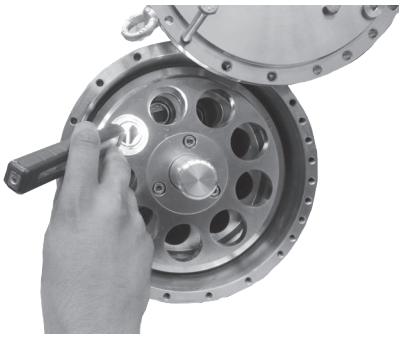


9. Screw the stop for the retainer plate into the centre to keep retainer plate/retainer ball assembly in place.



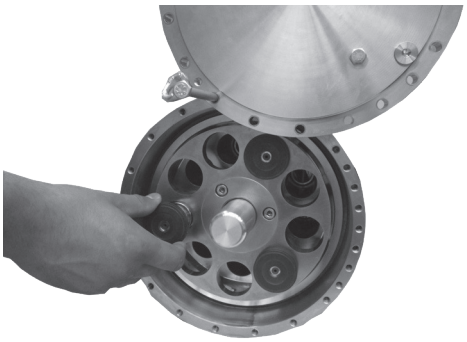
10. Carefully remove the pistons one by one.

11. **Warning:**
Ensure that the piston shoes and the piston surfaces are not damaged during removal. It is recommended to place the pistons upside down on an even and clean base/surface.

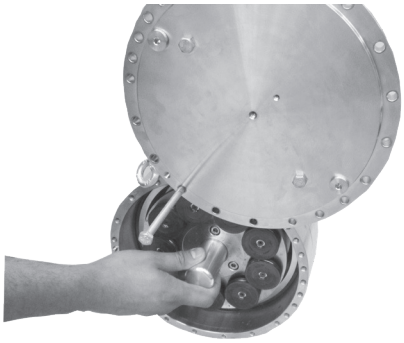


12. Inspect the piston liners.
Replace any worn parts.

7.2 Assembling

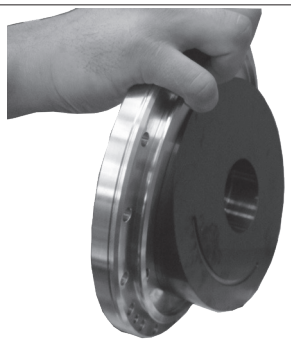


1. Lubricate pistons with clean filtered water. Insert the pistons arbitrarily.

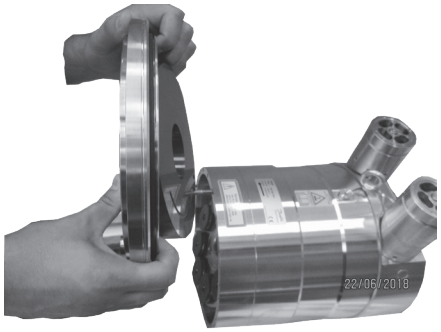


2. Remove the stop for retainer plate.

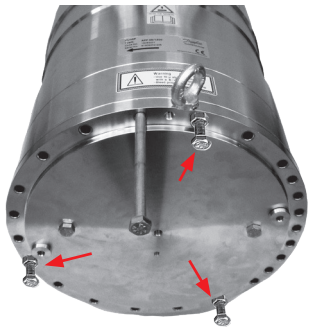
3. Place the retainer plate in an angle corresponding to the orientation of the swash plate.



4. Tilt the flange and replace the flange O-ring.



5. Lubricate the O-ring and pistons with clean filtered water. Turn the flange and gently push it into the housing.



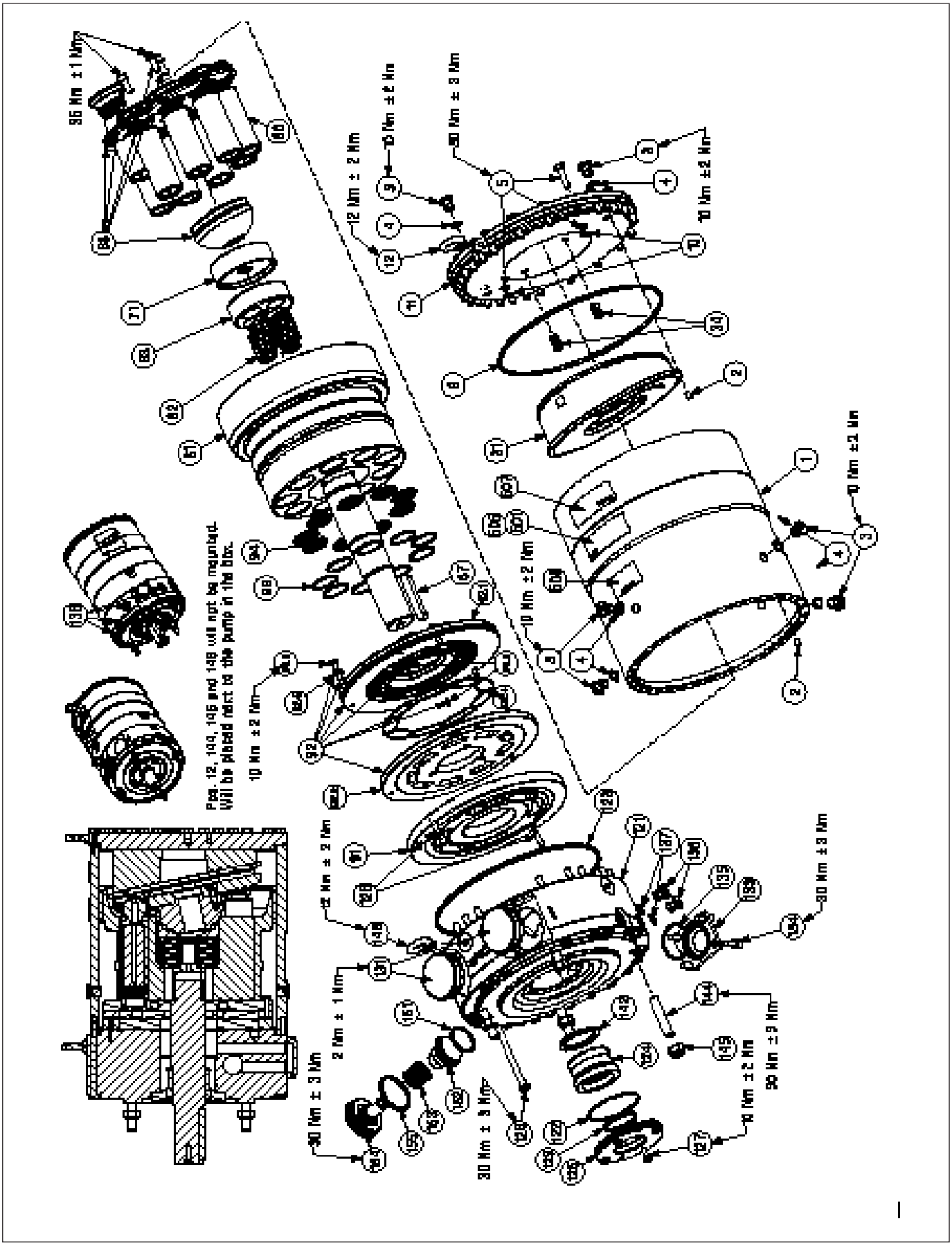
6. Install the three bolts and nuts from the tool kit . Turn each nut one round at a time to ensure mounting flange is mounted as straight downwards as possible. Be careful not to squeeze the O-ring.

7. Remove the guide bolt.
   Install the rest of the bolts and replace the 3 bolts from the toolkit. Cross tighten the screws according to the toque indicated in the exploded view.

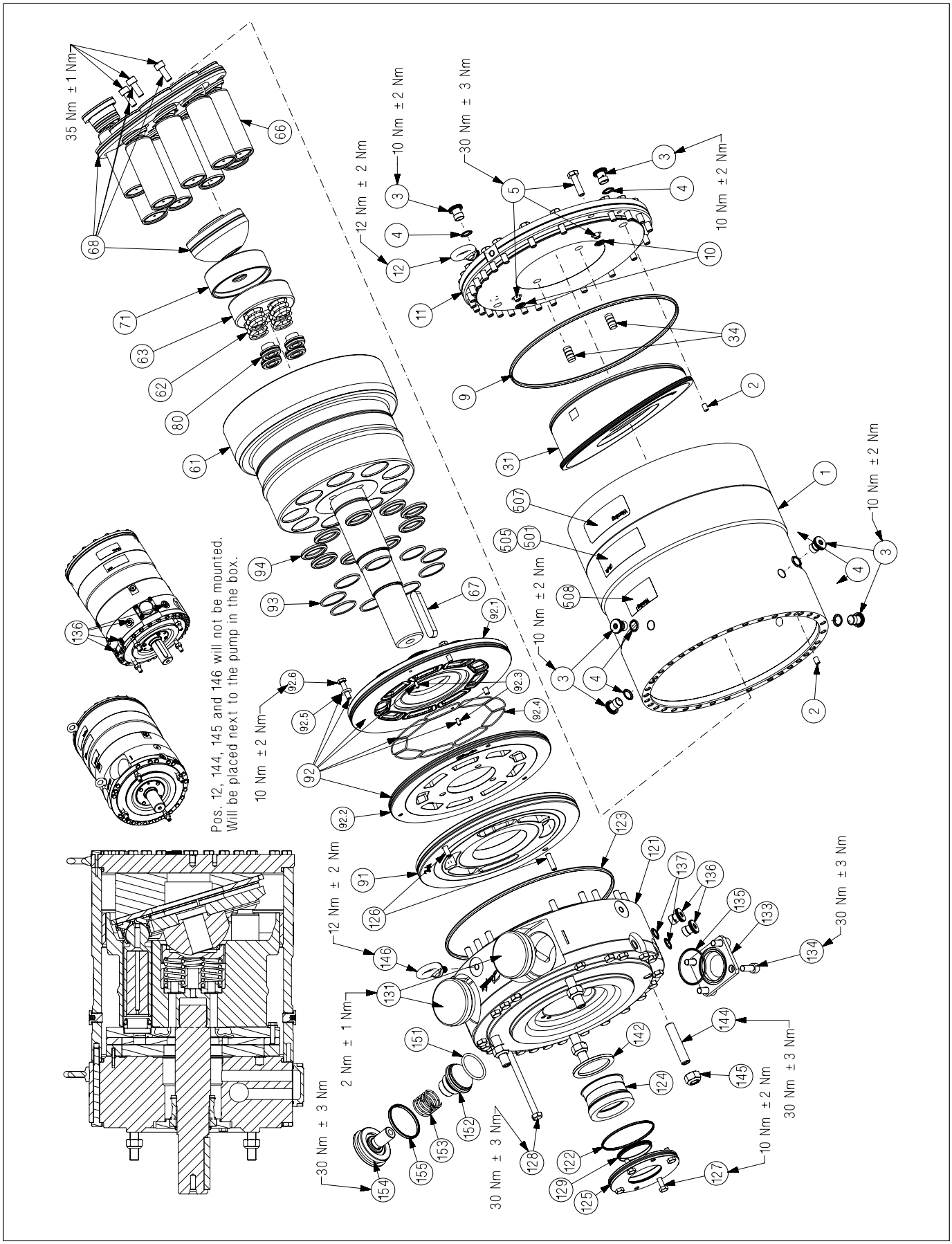
8. Connect the pump to the rest of the system and bleed the pump.

8. Exploded view

Exploded view APP 21-26 with ceramics



8.1. Exploded view APP 30-38 with ceramics



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Parts list

APP Pumps
APP 21 and APP 38 with Ceramics

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Table of contents

1. General

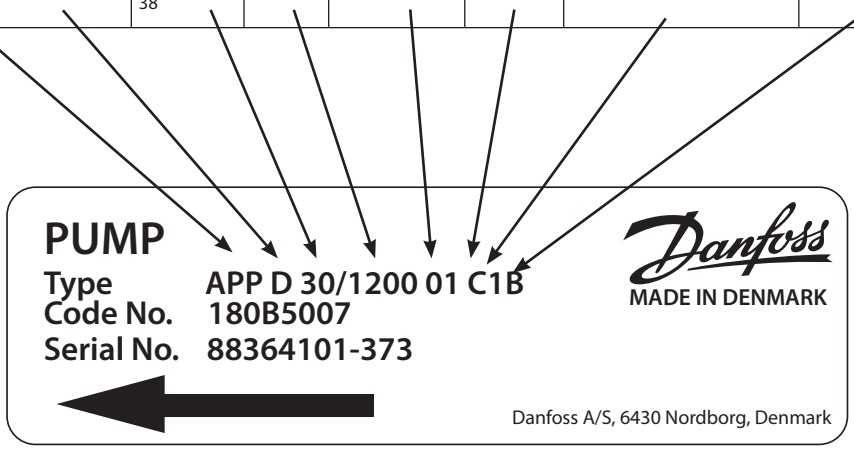
This parts list provides a content overview of the various service sets as well as an exploded view for:

Type
APP D 21/1200 01 C1B
APP D 21/1500 01 C1B
APP D 21/1500 01 A6B
APP D 21/1200 01 A3B
APP D 21/1500 01 A3B
APP D 26/1500 01 C1B
APP D 26/1500 01 A3B
APP D 30/1200 01 C2B
APP D 30/1200 01 A6B
APP D 38/1500 01 C2B

1.1. Naming structure

Note: The naming structure is relevant for chapter 2.

Design	Material type	Capacity (m3/H)	RPM	Special/ certificates	Sealing material	Pressure range	Filtration
APP	D: Duplex/Super Duplex steel	21	/1200	01: 3.1 Test certificate	C: NBR	1: 2-5 Bar inlet @ 20-83 Bar outlet	A: Level 1 (10µ ABS)
		26	/1500		A: FKM	2: 3-5 Bar inlet @ 20-83 Bar outlet	B: Level 2 (5µ Nom)
		30				6: 3-5 Bar inlet @ 70-124 Bar outlet	
		38					



2. Parts list APP 21-38 with ceramics

Pos.	Qnt.	Designation	Material	180B4656 - Screw kit APP x 21-38/ xxxx x xxB	180B4710 - Shaft seal kit APP x 21-38/xxxx x AxB	180B4657 - Shaft seal kit APP x 21-38/xxxx x CxB	180B4709 - Seal kit excl. shaft seal APP x 21-38/xxxx x AxB	180B4655 - Seal kit excl. shaft seal APP x 21-38/xxxx x CxB	180B4664 - Cylinder barrel kit APP x 21-38/xxxx x xxB	180B4661 - Valve plate kit APP x 30/1200 x C2B/ APP x 38/1500 x C2B	180B4716 - Valve plate kit APP x 21/1500 x C1B	180B4714 - Valve plate kit APP x 30/1200 x A6B	180B4715 - Valve plate kit APP x 21/1200 x C1B, APP x 26/1500 x C1B	180B4712 - Valve plate kit APP x 21/1200 x A3B, APP x 26/1500 x A3B	180B4679 - Valve plate ceramic part APP x 21-38/xxxx x xxB	180B4680 - Valve plate steel part APP x 21-38/xxxx x xxB	180B4660 - Retainer kit APP x 21-38/xxxx x xxB **excluding APP x 30/1200 x x6B**	180B4759 - Retainer kit APP x 30/1200 x x6B
1	1	Asm. housing	Duplex / PEEK															
2	2	Pin Ø6 m6 x 10	AISI 316															
3	1	Bleeding plug, G1/4"	Super Duplex															
4	1	O-RING 11,0X2,0	See naming structure				x	x										
5	28	Screw M8 x 30 RS A4-80	AISI 316	x														
9	1	O-ring 228,00 x 4,00	See naming structure				x	x										
10	2	O-ring 9,19 x 2,62	See naming structure				x	x										
11	1	End flange	Duplex															
12	1	Lifting eye	AISI 316															
31	1	Complete swash plate 21,03 degr.	Super Duplex															
34	1	Pin ø10,41 x 20	Super Duplex															
61	1	Complete cylinder barrel	Super Duplex / Peek						x									
62	4	Spring	Duplex													x	x	
63	1	Spring guide	PP													x	x	
66	9	Piston	Super Duplex / PEEK															
67	1	Key	AISI 316													x	x	
68	1	Complete retainer	Super Duplex													x	x	
71	1	Complete retainer guide	Super Duplex / PEEK															
80	4	Distance washer	Super Duplex															
91	1	Port plate	Super Duplex / ceramics							x	x	x	x	x				
92	1	Complete valve plate	Super Duplex / ceramics							x	x	x	x	x				
92.1	1	Asm thrust pad holder	Super Duplex							x	x	x	x	x		x		
92.2	1	Ass. valve plate	Super Duplex / ceramics							x	x	x	x	x	x			
92.3	2	Pin ø4 x 9	PEEK							x	x	x	x	x				
92.4	9	O-ring 37,1 x 1,6	See naming structure				x	x		x	x	x	x	x				
92.5	3	Wedge lock washer M6	SMO254							x	x	x	x	x	x	x		
92.6	3	Screw M6 x 25 BUMAX SDX	Super Duplex	x						x	x	x	x	x				

2.1. Parts list APP 21-38 with ceramics (continued)

Pos.	Qnt.	Designation	Material	180B4656 - Screw kit APP x 21-38/ xxxx x xxB	180B4710 - Shaft seal kit APP x 21-38/xxxxx x AxB	180B4657 - Shaft seal kit APP x 21-38/xxxx x CxB	180B4709 - Seal kit excl. shaft seal APP x 21-38/xxxx x AxB	180B4655 - Seal kit excl. shaft seal APP x 21-38/xxxx x CxB	180B4664 - Cylinder barrel kit APP x 21-38/xxxx x xxB	180B4661 - Valve plate kit APP x 30/1200 x C2B/ APP x 38/1500 x C2B	180B4716 - Valve plate kit APP x 21/1500 x C1B	180B4718 Valve plate kit APP x 21/1500 x A6B	180B4715 - Valve plate kit APP x 21/1200 x C1B, APP x 26/1500 x C1B	180B4712 - Valve plate kit APP x 21/1200 x A3B, APP x 26/1500 x A3B	180B4679 - Valve plate ceramic part APP x 21-38/xxxx x xxB	180B4680 - Valve plate steel part APP x 21-38/xxxx x xxB	180B4660 - Retainer kit APP x 21-38/xxxx x xxB **excluding APP x 30/1200 x x6B**	180B4759 - Retainer kit APP x 30/1200 x x6B
93	9	Back-up ring	PTFE				x	x		x	x	x	x	x				
94	9	Cover seal	See naming structure				x	x		x	x	x	x	x				
121	1	Port flange	Super Duplex															
122	1	O-ring 68,00 x 2,00	See naming structre				x	x										
123	1	O-ring 228,00 x 4,00	See naming structure				x	x										
124	1	Shaft seal	Hastelloy C276		x	x												
125	1	Cover for shaft seal	Super Duplex															
126	2	PIN Ø6,45x24	PEEK							x	x	x	x	x				
127	4	Screw M6 x 16.0	AISI 316	x														
128	23	Screw M8 x 100	AISI 316	x														
129	1	Protector ring	PP				x	x										
131	2	Plug	PP															
133	1	Monitor cover	Duplex															
134	4	Screw M8 x 20	AISI 316	x														
135	1	O-ring 45,00 x 2,00	See naming structure				x	x										
136	4	Bleeding plug G1/4"	Super Duplex															
137	2	O-RING 11,0X2,0	See naming structure				x	x										
140	1	Bearing	PEEK															
142	1	Stop for shaft seal	Polypropylene															
144	4	Threaded pin M12x60	AISI 316															
145	4	Locking nut M12	AISI 316															
146	1	Lifting eye M8	AISI 316															
151	1	O-ring 35,00 x 3,00	See naming structure				x	x										
152	1	Valve cone	Super Duplex															
153	1	Spring	Duplex															
154	1	Plug/guide	Super Duplex															
155	1	O-ring 47,22 x 3,53	See naming structure				x	x										
		Instruction		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

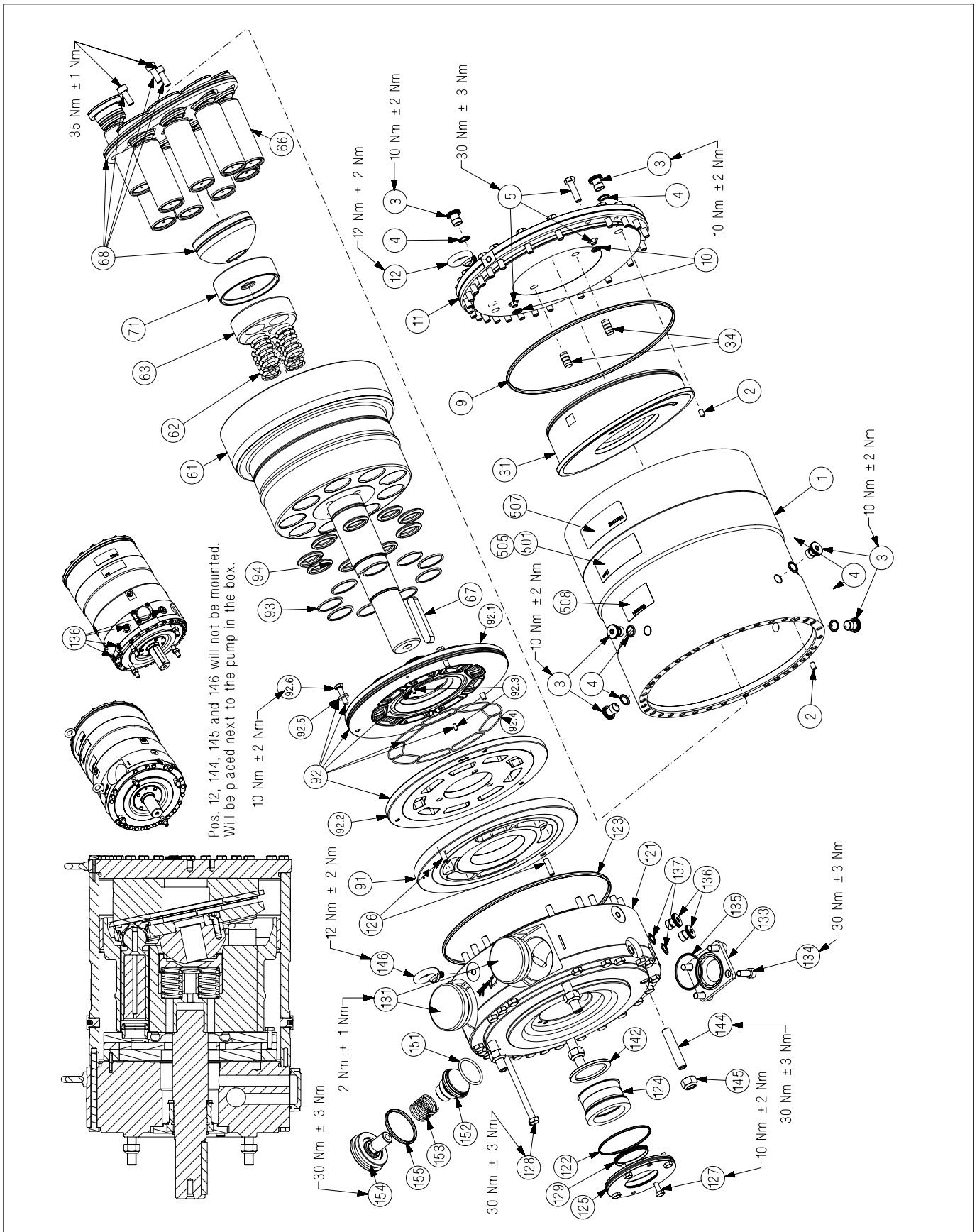
2.2. Parts list APP 21-38 with ceramics (continued)

Pos.	Qnt.	Designation	Material	180B4658 - Piston kit APP x 21-38/xxxx x x1B/x2B	180B4659 - Piston kit APP x 21-38/xxxx x x3B/x6B	180B4662 - Swash plate kit APP x 30/1200 x x2B, APP x 38/1500 x x2B	180B4701 - Swash plate kit APP x 30/1200 x x3B	180B4702 - Swash plate kit APP x 30/1200 x x6B	180B4703 - Swash plate kit APP x 21/1200 x x3B, APP x 26/1500 x x3B	180B4704 - Swash plate kit APP x 21/1200 x x1B, APP x 26/1500 x x1B	180B4705 - Swash plate kit APP x 21/1200 x x6B, APP x 26/1500 x x6B	180B4706 - Swash plate kit APP x 21/1500 x x3B	180B4707 - Swash plate kit APP x 21/1500 x x1B	180B4708 - Swash plate kit APP x 21/1500 x x6B	180B4666 - Port flange kit APP D 21-38/xxxx x x xB	180B4667-Port plate kit APP x 30/1200 x x2B, APP x 38/1500 x x2B, APP 21/1500 x x3B	180B4772 – Port plate kit APP x 21//1200 x x3B, 26/1500x x3B	180B4781 Port plate kit APP x 21/1500 x x6B	180B4776 - Port plate kit APP x 21/1500 x x1B	180B4170 - Flush valve kit APP x 21-38/xxxx x xxx
1	1	Asm. housing	Duplex / PEEK																	
2	2	Pin Ø6 m6 x 10	AISI 316																	
3	1	Bleeding plug, G1/4"	Super Duplex																	
4	1	O-RING 11,0X2,0	See naming structure																	
5	28	Screw M8 x 30 RS A4-80	AISI 316																	
9	1	O-ring 228,00 x 4,00	See naming structure																	
10	2	O-ring 9,19 x 2,62	See naming structure																	
11	1	End flange	Duplex																	
12	1	Lifting eye	AISI 316																	
31	1	Complete swash plate 21,03 degr.	Super Duplex			x	x	x	x	x	x	x	x	x						
34	1	Pin ø10,41 x 20	Super Duplex																	
61	1	Complete cylinder barrel	Super Duplex / Peek																	
62	4	Spring	Duplex																	
63	1	Spring guide	PP																	
66	9	Piston	Super Duplex / PEEK	x	x															
67	1	Key	AISI 316																	
68	1	Complete retainer	Super Duplex																	
71	1	Complete retainer guide	Super Duplex / PEEK																	
80	4	Distance washer	Super Duplex																	
91	1	Port plate	Super Duplex / ceramics													x	x	x	x	
92	1	Complete valve plate	Super Duplex / ceramics																	
92.1	1	Asm thrust pad holder	Super Duplex																	
92.2	1	Ass. valve plate	Super Duplex / ceramics																	
92.3	2	Pin ø4 x 9	PEEK																	
92.4	9	O-ring 37,1 x 1,6	See naming structure																	
92.5	3	Wedge lock washer M6	SMO254																	
92.6	3	Screw M6 x 25 BUMAX SDX	Super Duplex																	

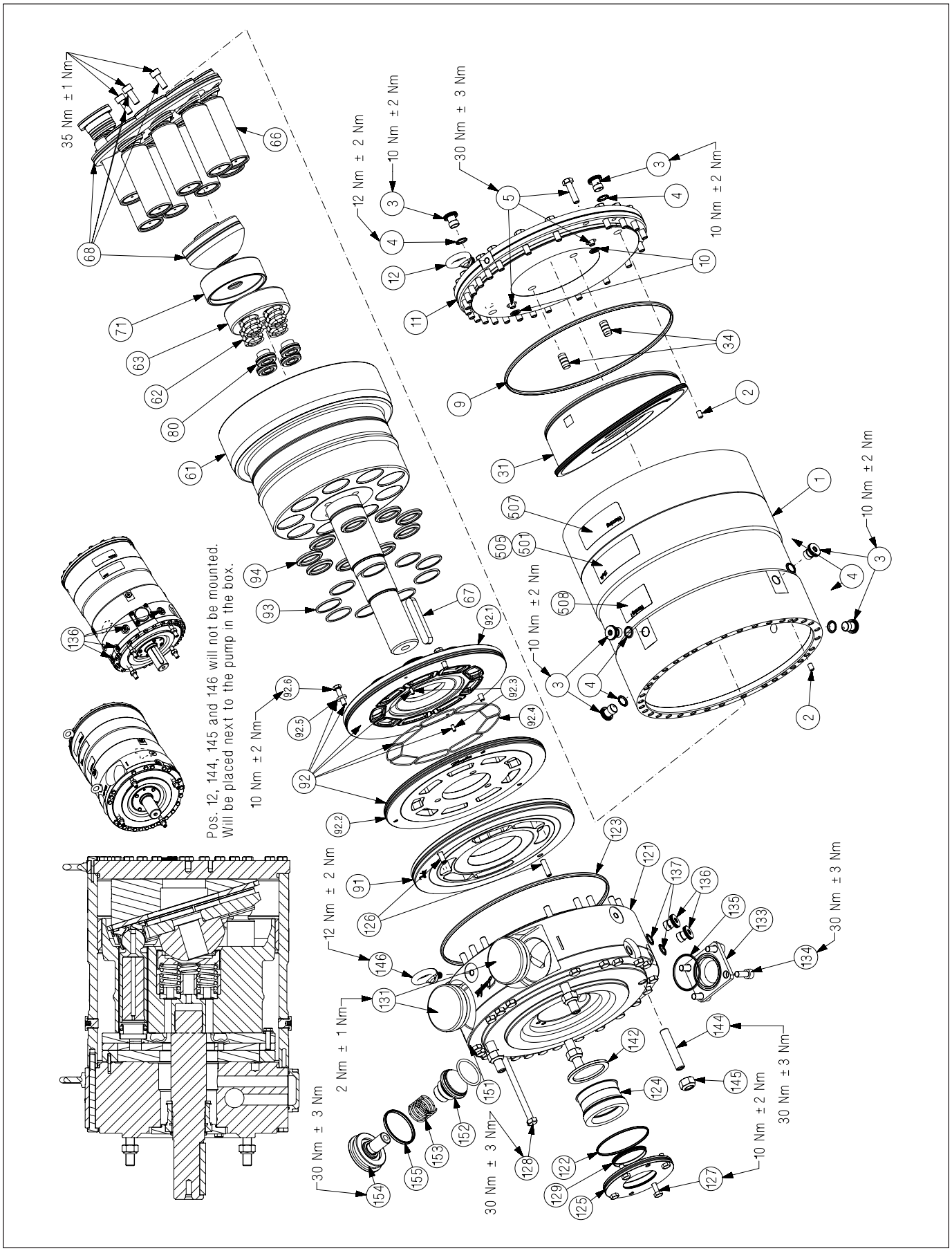
2.3. Parts list APP 21-38 with ceramics (continued)

Pos.	Qnt.	Designation	Material	180B4658 - Piston kit APP x 21-38/xxxx x x1B/x2B	180B4659 - Piston kit APP x 21-38/xxxx x x3B/x6B	180B4662 - Swash plate kit APP x 30/1200 x x2B, APP x 38/1500 x x2B	180B4701 - Swash plate kit APP x 30/1200 x x3B	180B4702 - Swash plate kit APP x 30/1200 x x6B	180B4703 - Swash plate kit APP x 21/1200 x x3B, APP x 26/1500 x x3B	180B4704 - Swash plate kit APP x 21/1200 x x1B, APP x 26/1500 x x1B	180B4705 - Swash plate kit APP x 21/1200 x x6B, APP x 26/1500 x x6B	180B4706 - Swash plate kit APP x 21/1500 x x3B	180B4707 - Swash plate kit APP x 21/1500 x x1B	180B4708 - Swash plate kit APP x 21/1500 x x6B	180B4666 - Port flange kit APP D 21-38/xxxx x xxB	180B4667-Port plate kit APP x 30/1200 x x2B, APP x 38/1500 x x2B, APP 21/1500 x x3B	180B4772 – Port plate kit APP x 21//1200 x x3B, 26/1500x x3B	180B4756 - Port plate kit APP x 21/1200, 26/1500 x C1B, 30/1200 x x6B	180B4776 - Port plate kit APP x 21/1500 x x1B	180B4170 - Flush valve kit APP x 21-38/xxxx x xxx
93	9	Back-up ring	PTFE																	
94	9	Cover seal	See naming structure																	
121	1	Port flange	Super Duplex												x					
122	1	O-ring 68,00 x 2,00	See naming structure																	
123	1	O-ring 228,00 x 4,00	See naming structure																	
124	1	Shaft seal	Hastelloy C276																	
125	1	Cover for shaft seal	Super Duplex																	
126	2	PIN Ø6,45x24	PEEK																	
127	4	Screw M6 x 16.0	AISI 316																	
128	23	Screw M8 x 100	AISI 316																	
129	1	Protector ring	PP																	
131	2	Plug	PP																	
133	1	Monitor cover	Duplex																	
134	4	Screw M8 x 20	AISI 316																	
135	1	O-ring 45,00 x 2,00	See naming structure																	
136	4	Bleeding plug G1/4"	Super Duplex																	
137	2	O-RING 11,0X2,0	See naming structure																	
140	1	Bearing	PEEK																	
142	1	Stop for shaft seal	Polypropylene																	
144	4	Threaded pin M12x60	AISI 316																	
145	4	Locking nut M12	AISI 316																	
146	1	Lifting eye M8	AISI 316																	
151	1	O-ring 35,00 x 3,00	See naming structure																	
152	1	Valve cone	Super Duplex																	x
153	1	Spring	Duplex																	x
154	1	Plug/guide	Super Duplex																	x
155	1	O-ring 47,22 x 3,53	See naming structure																	
		Instruction		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

3. Exploded view
APP 21 - 26 with ceramics



3.1. Exploded view (continued)
APP 30 - 38 with ceramics



4. Tool sets

Note:
The parts listed are not sold separately, only in various kits.

Designation	180B4654- Tool set APP x 21-38/xxxx x xxB
Torque wrench 4-20 Nm	x
Torque wrench 20-100 Nm	x
Lifting eye	x
Hex Socket 6 mm, 3/8" - short	x
Hex socket 10 mm, 3/8"	x
Hex socket 24 mm, 3/8"	x
Hex socket 13mm, 3/8"	x
Spanner 13 mm	x
Shaft seal extracter, ø45	x
Mandrel for thrust plate	x
Press bush, ø45	x
Stop for retaining plate	x
Screw M8 x 140 RS A4-80 ISO4014	x
Screw M8 x 20 CS RS A4-80	x
Nut 8,0x6,5x13,0	x
Screw M8 x 70 RS A4-80	x
NV24 flush valve tool	x
Calibrates for back-up ring	x

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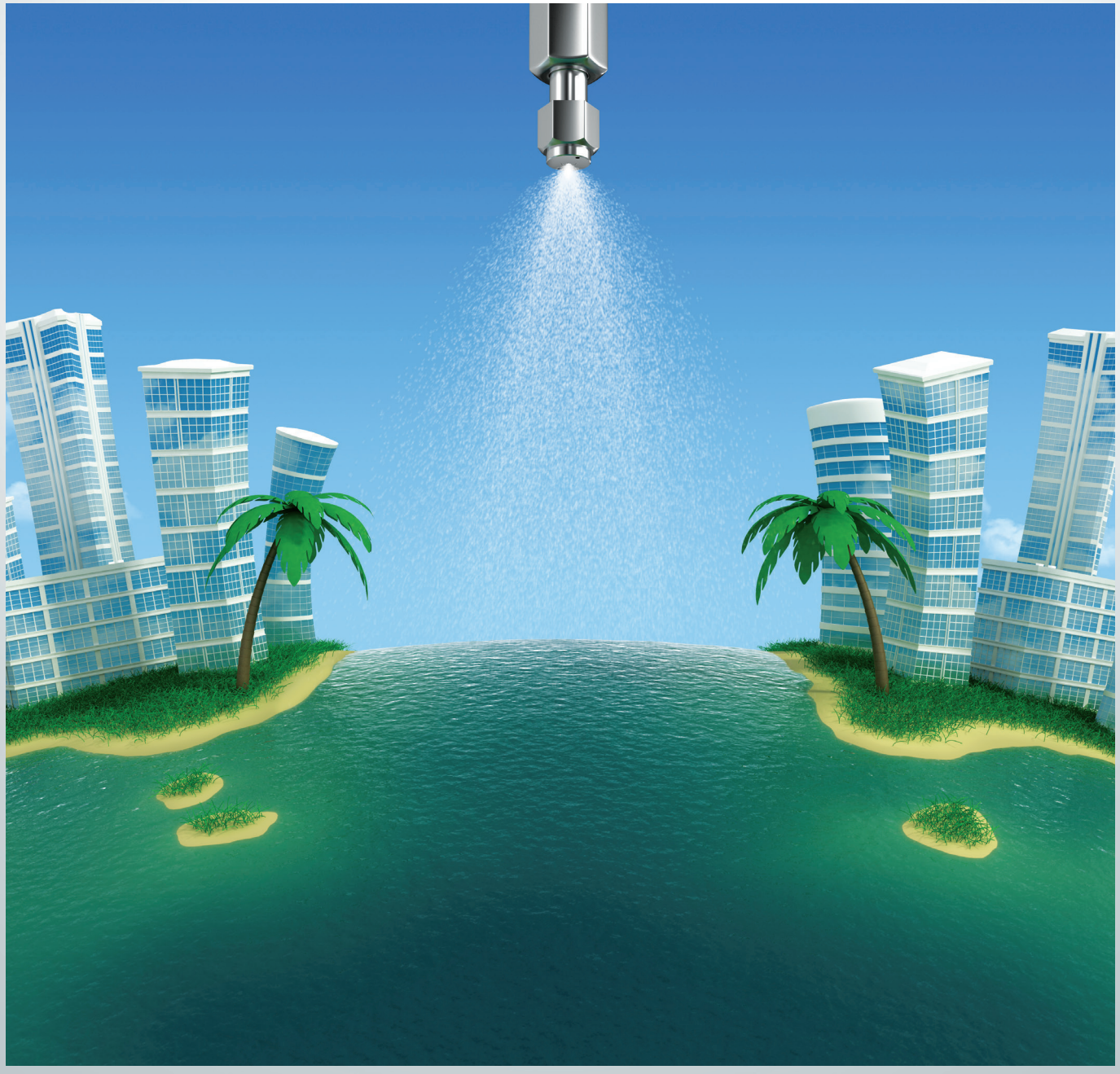
Service guide

Right and wrong
Trouble shooting guide for water hydraulic systems



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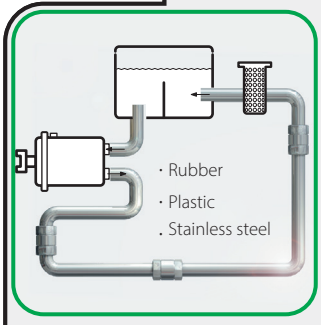
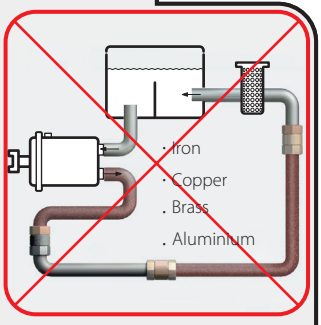
Design

1.

Choice of material



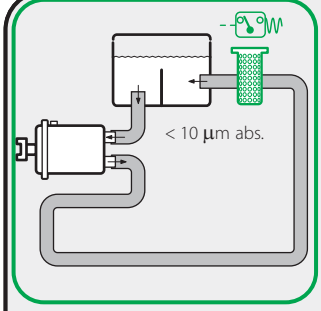
Always use system components made of corrosion proof materials



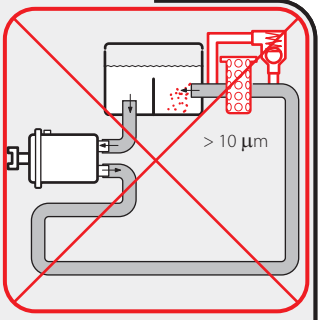
Non-corrosion proof materials may cause damage

2.

Choice of filter



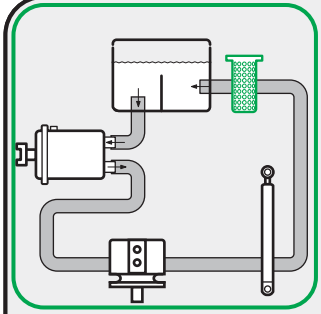
Install a 10 micron absolute filter with pressure switch



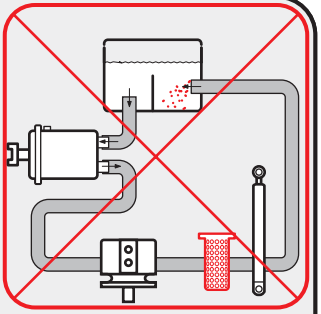
Return filter with bypass valve and poorer filterability than 10 µ will damage the system

3.

Filter location



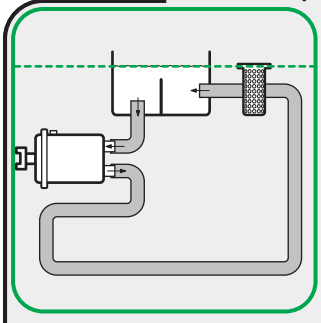
Locate the return filter in the return line immediately before the tank



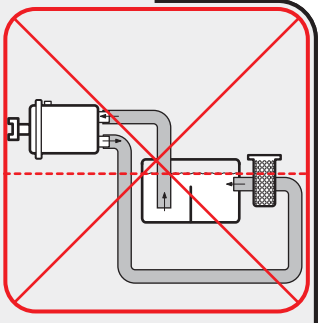
Placing the return filter upstream of the final load may damage the pump

4.

Pump location



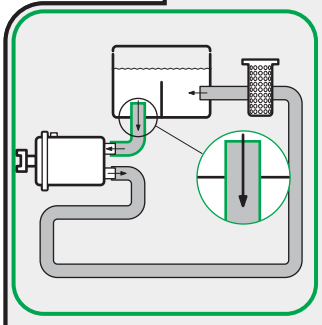
Pump always to be placed below water surface level



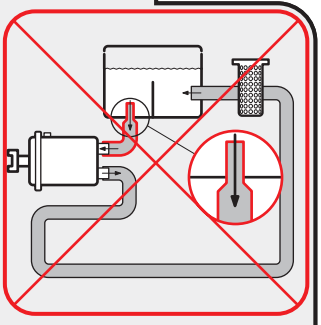
Pump location above water surface level will cause damage

5.

Suction conditions



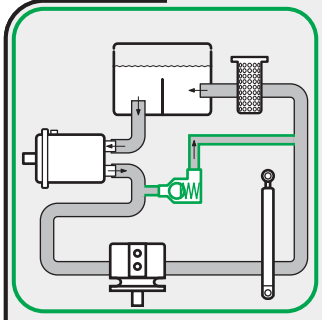
System to be dimensioned to provide a suction pressure of the pump inlet of max. 0.1 bar vacuum



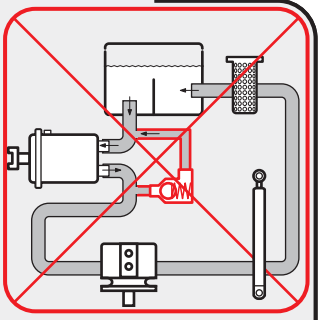
Poor suction conditions will cause malfunction and damage the pump

6.

Pressure Relief valve



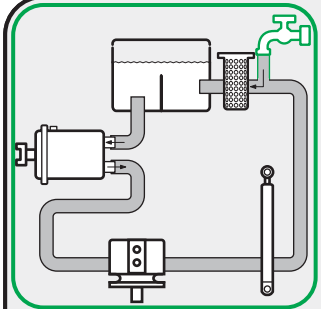
Pressure relief valve to be mounted vertically or with vertical outlet and connected to return hose or tank



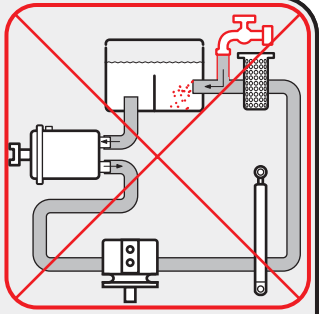
Coupling the pressure relief valve outlet directly to the pump inlet may damage the pump

7.

Water supply



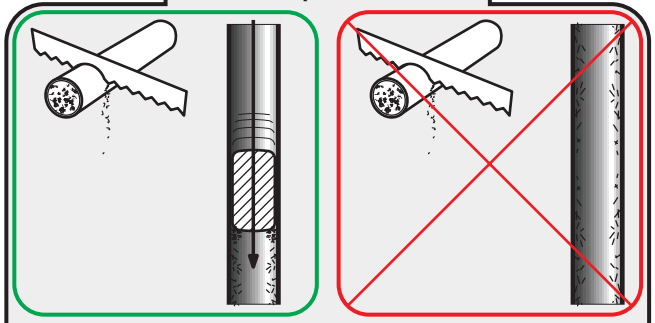
System to be filled via filter



Filling system with unfiltered water causes damage

Installation

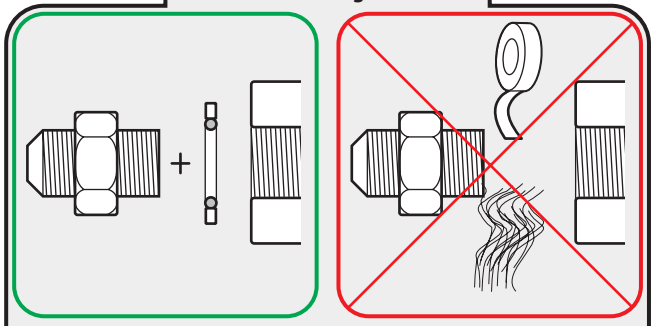
8. **Impurities**



Prior to installation, burrs and chips and other impurities must be removed from pipes and hoses, eg with a felt plug

Chips or other impurities in the system may cause damage

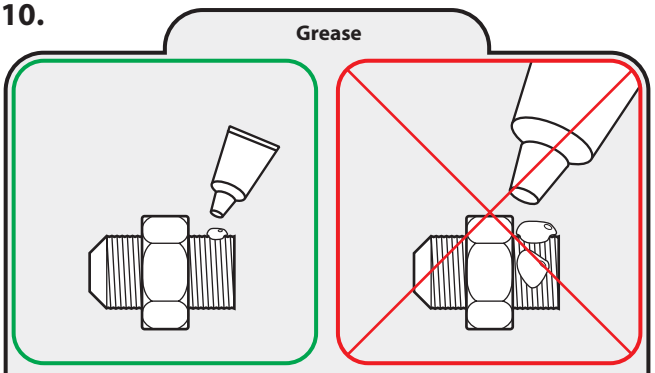
9. **Sealing**



Fittings in screwed components to be sealed with O-rings or bonded seals

Using teflon tape or packing yarn in joints may cause damage

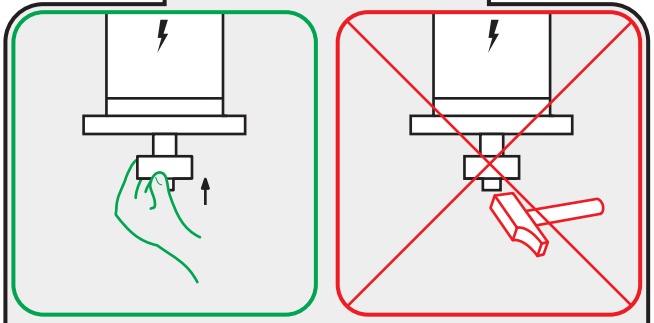
10. **Grease**



Correctly limited quantities of grease prevent seizing

Too much grease may develop biofilm causing operational failures

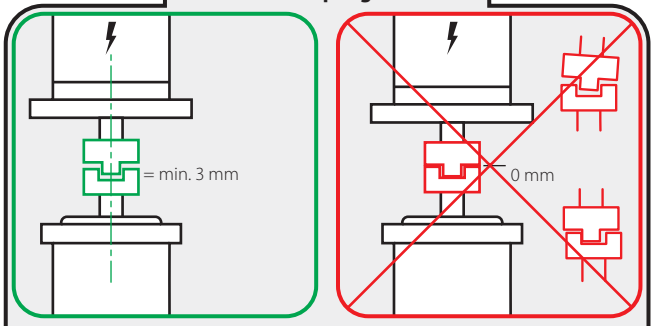
11. **Assembly of coupling**



The coupling must be easy and simple to assemble (see product instruction)

Never use force when assembling the coupling parts, as this will damage the motor/pump

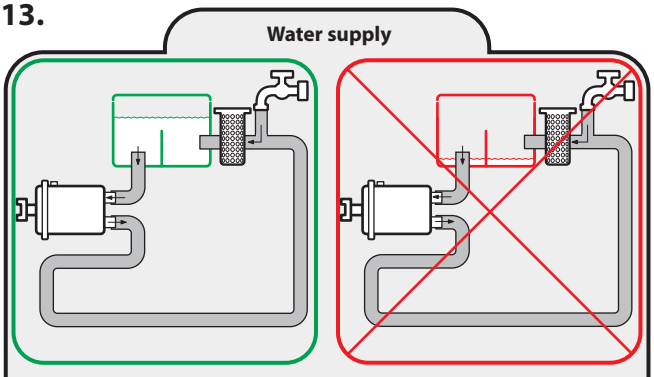
12. **Coupling**



Ensure always to have 3 mm distance between coupling flanges

Insufficient distance and/or misalignment between the coupling flanges will damage the pump

13. **Water supply**

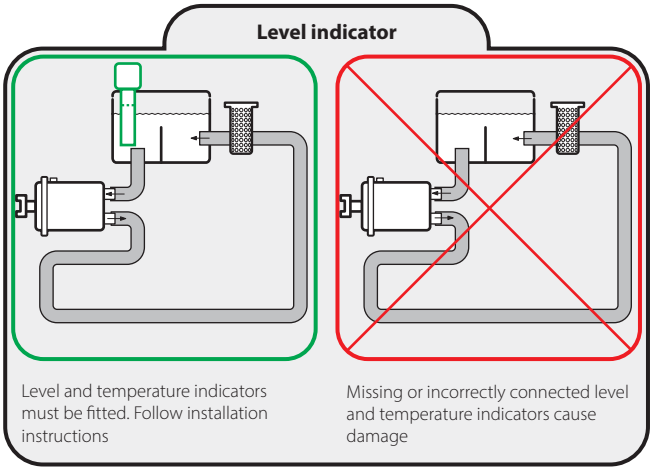


Fill system with water before starting to ensure lubrication and cooling

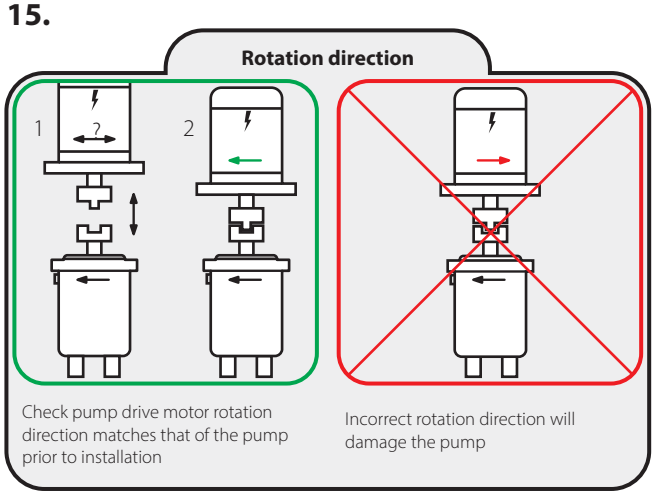
Starting without water will cause damage

Wiring

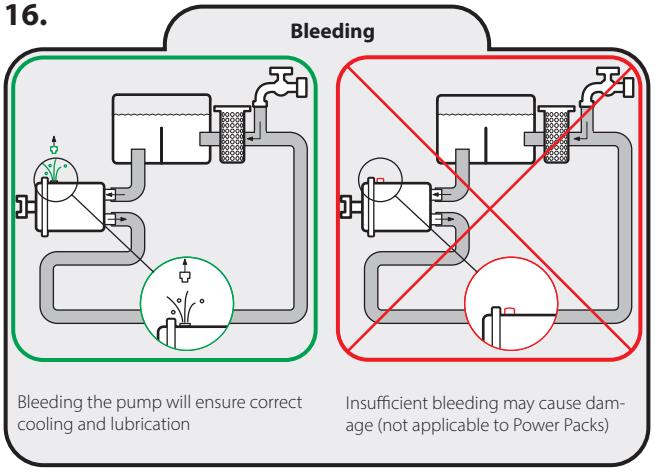
14.



15.



16.



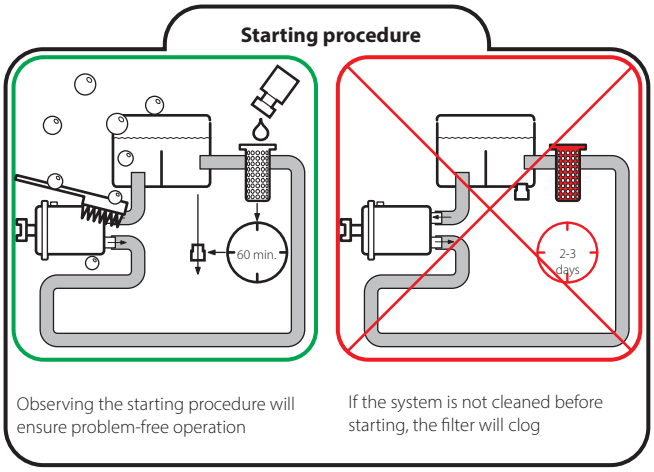
Starting procedure

Cleaning procedure

1. Fill cold water into the system via the return filter and bleed the pump (Power Packs PPH 4 - 6.3 - 10 and 12.5 are self-bleeding)
2. Start and bleed the system -without pressure by opening the bypass valve
3. Add the cleaning agent to give 3% agent/water solution
4. Run the system for 60 min. and activate all components as often as possible to ensure effective flushing with the cleaning agent
5. Empty the system of the cleaning agent solution

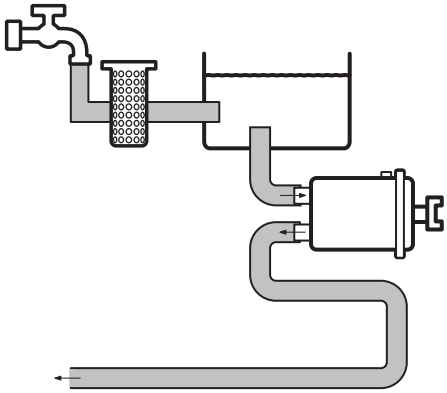
Flushing procedure

6. Fill cold water through the return filter and bleed the pump (Power Packs PPH 4 - 6.3 - 10 and 12.5 are self-bleeding)
7. Run the system for 30 min. and activate all components as often as possible
8. Empty the system of the water
9. Alternatively the system may be flushed by running the unit without the return hose while continuously filling up water. The flushing should continue until there is no trace of cleaning agent in the return water
10. Change the return filter element, fill cold water through the return filter and bleed the pump during start up
11. The system is now ready for operation



Trouble shooting

Open ended water systems



No water supply

- Is the water supply ok?
- Is water supplied to the pump?

No

Yes

- Is the electric motor of the pump unit rotating?

No

- Is the water in the tank very hot? Ie above 50°

Yes

- Lower inlet temperature or provide better cooling

Yes

- Is water coming out of the tap?
- Are all taps open?

No

Yes

- Is the control light for "low pump suction pressure" on?
- The filter is clogging

Yes

No

- Is water coming through the filter?

Yes

No

- Replace filter element

- Turn on the tap for water supply

No

- Is the power supply ok?
- Are control lights on?

No

Yes

- Is the filter clogged?
- Is the filter control light on?

No

Yes

- Replace filter element

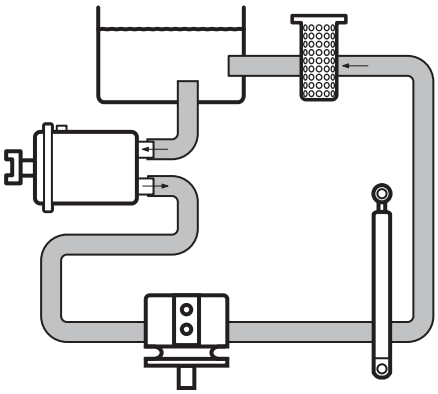
- A blown fuse / or short circuit?
- Check power supply and fuses and contact electrician

Contact serviceman

Stamp

Trouble shooting

Closed water systems



The system does not work

• Is there sufficient water in the tank?

No

Yes

• Is the electric motor of the pump unit rotating?

No

Yes

• Is the water in the tank very hot? Ie above 50°

Yes

No

• At temperatures higher than 50° the pump drive cuts out. Consequently the cooler must be checked/cleaned

• Is the power supply ok?
• Are control lights on?

No

Yes

• A blown fuse/or short circuit?

• Check power supply and fuses and contact electrician

• Is the filter clogged?
• Is the filter control light on?

Yes

• Replace filter element

No

Contact serviceman

Stamp

• Fill water into the system

• Trace leakage, if any

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