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Danfoss

User manual

Installation, Operation and Maintenance Manual

APP S 674 pumps



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Validity

This manual is valid for APP S 674 pumps with the following code numbers/serial numbers:

APP S 674 3.0	Code no.	180B7057
	Serial no.	02
APP S 674 3.5	Code no.	180B7058
	Serial no.	02
APP S 674 5.1	Code no.	180B7050
	Serial no.	02
APP S 674 6.5	Code no.	180B7051
	Serial no.	02
APP S 674 7.2	Code no.	180B7052
	Serial no.	02
APP S 674 8.2	Code no.	180B7055
	Serial no.	02
APP S 674 9.0	Code no.	180B7056
	Serial no.	02
APP S 674 21	Code no.	180B3094
	Serial no.	02
APP S 674 24	Code no.	180B3088
	Serial no.	02
APP S 674 26	Code no.	180B3096
	Serial no.	02
APP S 674 30	Code no.	180B3097
	Serial no.	02
APP S 674 33	Code no.	180B3089
	Serial no.	02
APP S 674 38	Code no.	180B3091
	Serial no.	02

EC Declaration of Conformity

Danfoss A/S

Danfoss High Pressure Pumps
Nordborgvej 81
6430 Nordborg
Denmark

EG-Konformitätserklärung gemäß EG-Richtlinie 2006/42/EG	EC Declaration of Conformity according to Directive 2006/42/EC	Déclaration de conformité CE conformément à la Directive 2006/42/CE
Hiermit erkläre ich, dass die Maschine gemäß 2006/42/EG conform ist.	We hereby declare that the machine is designed according to the directive 2006/42/EC.	Par la présente, nous déclarons que la machine est conçue conformément à la Directive 2006/42/CE.
Beschreibung der Maschine Technical Pump	Machine description High pressure pump	Description de la machine Pompe haute pression
Maschinen Typ APP S 674 3.0 / APP S 674 3.1 APP S 674 5.1 / APP S 674 6.0 APP S 674 7.2 / APP S 674 8.2 APP S 674 9.0 APP S 674 21 / APP S 674 24 APP S 674 26 / APP S 674 30 APP S 674 33 / APP S 674 36	Machine designation APP S 674 3.0 / APP S 674 3.1 APP S 674 5.1 / APP S 674 6.0 APP S 674 7.2 / APP S 674 8.2 APP S 674 9.0 APP S 674 21 / APP S 674 24 APP S 674 26 / APP S 674 30 APP S 674 33 / APP S 674 36	Type de machine APP S 674 3.0 / APP S 674 3.1 APP S 674 5.1 / APP S 674 6.0 APP S 674 7.2 / APP S 674 8.2 APP S 674 9.0 APP S 674 21 / APP S 674 24 APP S 674 26 / APP S 674 30 APP S 674 33 / APP S 674 36
Seriennummer N/A	Serial number N/A	Numéro de série N/A
Technisches Dossier, Kontaktperson Lene/Quality/Training	Technical dossier, Contact person Manager Quality Department	Personne de contact pour le dossier technique Manager département qualité
Angewandte harmonisierte Normen DIN EN ISO 12100:2011	Used harmonized standards DIN EN ISO 12100:2011	Normes harmonisées appliquées DIN EN ISO 12100:2011

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2013-12-19
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Wolfgang Frischmann
Leiter R&D

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1. Introduction

1.1 General

The APP S 674 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 and Brackish Water Reverse Osmosis (BWRO) system.

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

The APP S 674 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 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.

1.2 Symbols



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



Electrical hazard

1.3 Manufacturer and customer service address

Danfoss A/S
High Pressure Pumps
 Nordborgvej 81, D25
 DK-6430 Nordborg
 Denmark

Telephone: +45 7488 4024
 Fax: +45 7445 3831
 Email: ro-solutions@danfoss.com
 Homepage: www.ro-solutions.com

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

Data sheets and instructions on all accessories are available on www.ro-solutions.danfoss.com

CE Declaration of Conformity can be found on page 5.

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



Electrical hazard

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 from 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.



Protective garments must be worn



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 builders' 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 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, bled and adjusted.
- Flush the system thoroughly 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 High Pressure Pumps in case of doubt. Contact information are listed in section 1.3, Manufacturer and customer service address.

3. Technical data



3.2 Application range

See Data sheet in appendix 1.

3.3 Electric motor data

See recommended motor in appendix 1, Data sheet.

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.



3.1 Approved applications and operational limits for the pumps

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

The APP S 674 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.



3.7 Filtration

(10µm absolute [$\beta_{10} \geq 5000$])

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 bled 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

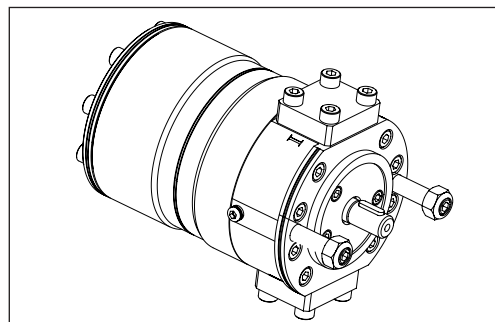
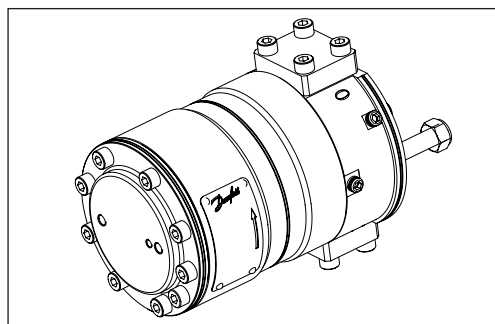
Before any lifting operation is performed, environmental conditions must be taken into consideration (Ex-rated areas, wind speed, wet/dry conditions, lifting height, etc.).

4.3 General safety information

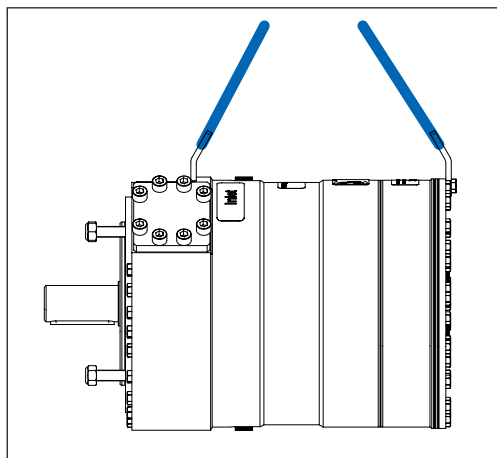
Personnel involved in lifting and transporting the equipment (see Safety, chapter 2) must be trained in handling and safety procedures for lifting heavy loads. Many of the pumps and pump units weigh more than 20 kilos, which requires lifting slings and suitable lifting devices; e.g. an overhead crane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

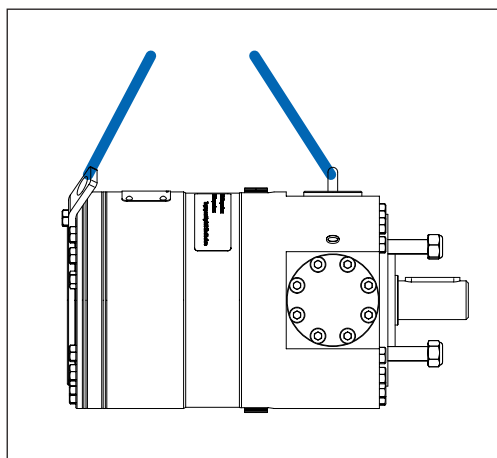


Pumps which have a weight above 20 kilos (see Data sheet, appendix 1) must be handled by using lifting eyes and slings.



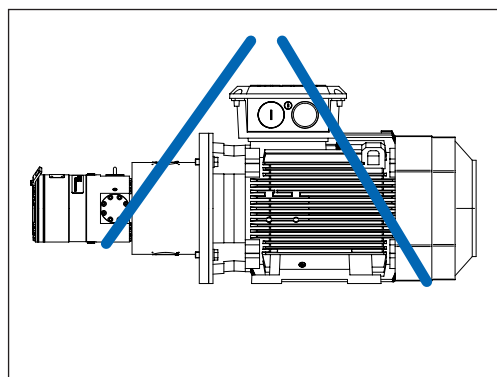
Never use only one sling and make sure the slings do not slip off the pump.

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.

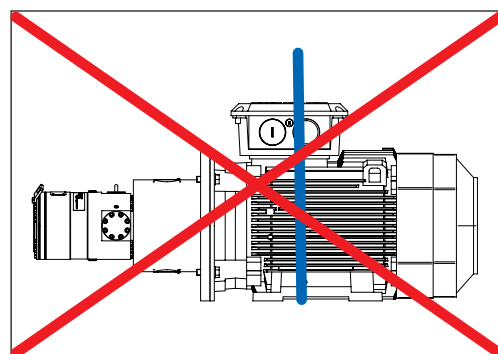
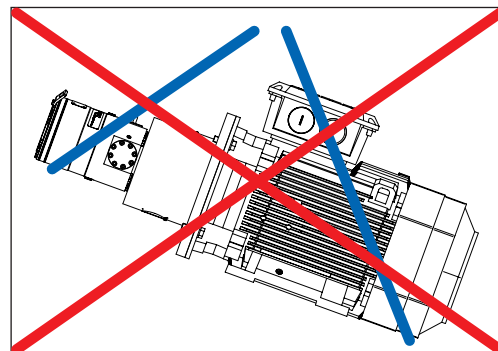


See below examples of where to/not to attach the lifting slings on the pump unit:

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 unit size to pump unit size.

How to mount the pump and the electric motor correctly, see appendix 2, Instruction.



Incorrect lifting can result in personal injury and/or damage to the pump unit, see appendix 2, Instruction.

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.

5.6 Pre mounting checklist, based on Danfoss preferred system design

Figure 1: Recommended system design

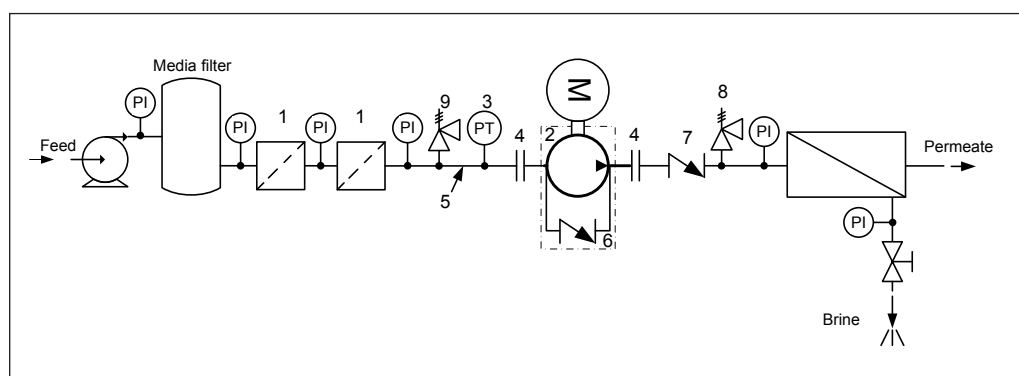


Table 1: Check points when assembling and commissioning system

	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 Instruction, appendix 2.	
CP3	Filtration condition (10 µm absolute [$\beta_{10} \geq 5000$])	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 (8 & 9).	See Data sheets for the used valves.	
CP9	Check the settings of the pressure transmitter/switch (3) set at min. inlet pressure.	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.	Scaling should at least be 1 bar or more precise.	
CP11	Check coupling distance (air gab – movement of the spider)	3 – 5 mm, see Instruction, appendix 2.	
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 dampers, 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.
- 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 (figure 1, item 5.6). 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 (figure 1, item 5.6).

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 bled.

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 housing (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 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. 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 of 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 the Trouble shooting guide, appendix 4. The appendix gives good advises regarding design, installation, wiring and trouble-shooting.

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 breakdown. See also service and warranty section in appendix 1, Data sheet, or appendix 2, Instruction.

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 servicing 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 appendix 1, Data sheet and in appendix 2, Instruction.

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 motor 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) Unscrew the bolts that fasten the pump and bell housing to the motor and afterwards unscrew the bolts/nuts from 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.

Product information (see label on product)		
Product type	Lot number	Serial number
Operational conditions		
Installation	Motor power	Flow rate (m³/h)
Flow rate (m³/h)	Water pressure	Head (m)
Water temperature (°C)	Flow	Water temperature
Water type	Warranty	Range in product (m³/h)

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.

7.4 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 the 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 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 should be attached to the shipment.

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. In order to avoid water leaking into the electric motor, see Installation and commissioning, chapter 5 and Operation, chapter 6.



Electrical hazard

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 4, Trouble shooting guide as guideline or send the pump to Danfoss headquarter in Denmark for evaluation.

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



User manual

Appendices for Installation, Operation and Maintenance Manual

APP S 674 pumps



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Data sheet

APP S 674 pumps

APP S 674 3.0-3.5 / APP S 674 5.1-9.0

APP S 674 21-38



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Our CLP RO pumps have changed name as listed below:

CLP674 050-058 RO will now be called APP S 674 3.0-3.5
CLP674 085-152 RO will now be called APP S 674 5.1-9.0
CLP674 365-640 RO will now be called APP S 674 21-38

This is ONLY a name change.

1. Introduction

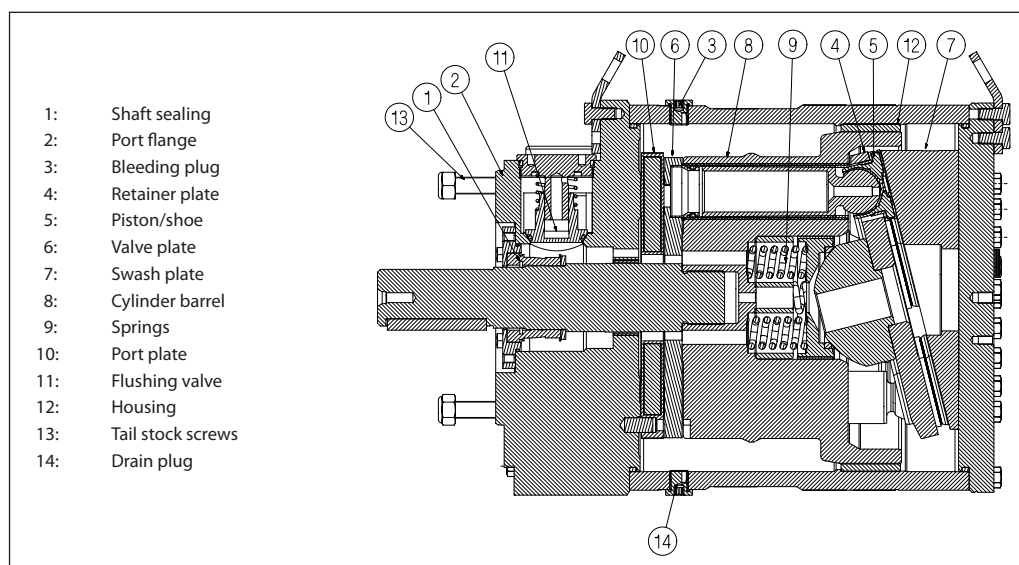
APP S 674 pumps are made according to API 674, 3rd edition. The pump is designed to supply low viscosity and corrosive fluids under high pressure, e.g. in seawater reverse osmosis applications.

Danfoss APP S 674 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 pump shaft revolutions (rpm). Unlike centrifugal pumps, they produce the same flow at a given speed no matter what the discharge pressure.

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

The pumps are made for flange connections.

All parts included in the pumps are designed to provide long service life, i.e. long service life with a constantly high efficiency and minimum service required.



2. Benefits

- **Zero risk of lubricant contamination:**
Oil lubricants are replaced with the pumped medium, seawater or brackish water, so SWRO and BWRO applications are completely free of any contamination risk from the pump.
- **Low maintenance costs:**
Efficient design and all Super Duplex stainless steel construction ensure exceptionally long life. When Danfoss specifications are met, service intervals up to 8,000 hours can be expected.
- **Low energy costs:**
The highly efficient axial piston design provides the lowest power consumption of any comparable pump on the market.
- **Easy configuration:**
 - The lightest and most compact design available. Pump can be installed vertically and horizontally.
 - No pulsation dampeners necessary due to extremely "low pressure" pulsation.
 - Powered direct by electric motor or combustion engine.
 - Pump can be delivered with all types of flange connections.
- **Certified quality:**
 - Pump is designed according to API 674, 3rd edition.
 - Super Duplex stainless steel M-630 from NORSOK M-650 certified foundries.
 - Full traceability and material certificates on pressure containing parts.
 - Pump available as ATEX certified, category 2, zone 1 or category 3, zone 2.

3. Application areas

The pumps are used in RO systems for production of fresh water. This water can be used for drinking or as technical water used for NO_x reduction in gas turbines or as water used for injection into wells.

APP S 674 pumps are not only applicable for offshore applications but can also be used on

refineries or in processes where API 674 is required.

As the APP S 674 pumps are made in Super Duplex stainless steel, it makes them suitable for rough offshore applications. Apart from that the small and compact pumps are a perfect choice for applications where component size really matters.

4. Technical data

4.1 APP S 674 3.0-3.5

Pumps size		APP S 674 3.0	APP S 674 3.5
Code number		On request	On request
Geometric displacement	cm ³ /rpm	17.7	20.5
	in ³ /rpm	1.08	1.25
Pressure			
Outlet min. pressure, continuous ¹⁾	barg	20	20
	psig	290	290
Outlet max. pressure, MAWP	barg	80	80
	psig	1160	1160
Inlet operating pressure ²⁾	barg	0.5-10	0.5-10
	psig	7.25-145	7.25-145
Inlet design pressure	barg	15	15
	psig	217	217
Speed			
Min. speed, continuous	rpm	700	700
Max. speed, continuous ³⁾	rpm	3000	3000
Typical Flow			
1500 rpm at max pressure	m ³ /h	1.5	1.75
3000 rpm at max pressure	m ³ /h	3.0	3.5
1800 rpm at max pressure	gpm	7.9	9.3
3000 rpm at max pressure	gpm	13.3	15.4
Typical motor size			
1500 rpm at max pressure	kW	4.0	5.5
1800 rpm at max pressure	hp	7.5	7.5
Torque at max outlet pressure	Nm	25.6	29.7
	lbf-ft	18.9	21.9
Media temperatur ⁴⁾	°C	2-50	2-50
	°F	36-122	36-122
Ambient temperatur	°C	0-50	0-50
	°F	32-122	32-122
Weight	kg	15	15
	lb	33	33

¹⁾ For lower pressure, please contact Danfoss High Pressure Pumps

²⁾ If inlet pressure exceeds inlet operating pressure, Danfoss recommends inspection of the pump and shaft seal

³⁾ For higher speed, please contact Danfoss High Pressure Pumps

⁴⁾ Dependent on the NaCl concentration

Data sheet
APP S 674 pumps
4.2 APP S 674 5.1-9.0

Pumps size		APP S 674 5.1	APP S 674 6.5	APP S 674 7.2	APP S 674 8.2	APP S 674 9.0
Code number		On request	On request	On request	On request	On request
Geometric displacement	cm ³ /rpm	50	63	70	80	90
	in ³ /rpm	3.05	3.84	4.27	4.88	5.49
Pressure						
Outlet min. pressure, continuous ¹⁾	barg	30	30	30	30	30
	psig	435	435	435	435	435
Outlet max. pressure, MAWP	barg	80	80	80	80	80
	psig	1160	1160	1160	1160	1160
Inlet operating pressure ²⁾	barg	2.0-10	2.0-10	2.0-10	2.0-10	2.0-10
	psig	29-145	29-145	29-145	29-145	29-145
Inlet design pressure	barg	15	15	15	15	15
	psig	217	217	217	217	217
Speed						
Min. speed, continuous	rpm	700	700	700	700	700
Max. speed, continuous	rpm	1800	1800	1800	1800	1800
Typical Flow						
1000 rpm at max pressure	m ³ /h	2.7	3.4	3.8	4.5	5.1
1800 rpm at max pressure	m ³ /h	5.0	6.4	7.2	8.3	9.3
1200 rpm at max pressure	gpm	14.3	18.0	20.3	23.9	27.0
1800 rpm at max pressure	gpm	22.0	28.2	31.7	36.5	41.0
Typical motor size						
1500 rpm at max pressure	kW	15.0	15.0	18.5	18.5	22.0
1200 rpm at max pressure	hp	15.0	20.0	20.0	20.0	25.0
Torque at max outlet pressure						
	Nm	18.3	22.9	22.9	25.6	29.7
	lbf-ft	13.5	16.9	16.9	18.9	21.9
Media temperatur ³⁾	°C	2-50	2-50	2-50	2-50	2-50
	°F	36-122	36-122	36-122	36-122	36-122
Ambient temperatur	°C	0-50	0-50	0-50	0-50	0-50
	°F	32-122	32-122	32-122	32-122	32-122
Weight	kg	40	40	40	40	40
	lb	88	88	88	88	88

¹⁾ For lower pressure, please contact Danfoss High Pressure Pumps

²⁾ If inlet pressure exceeds inlet operating pressure, Danfoss recommends inspection of the pump and shaft seal

³⁾ Dependent on the NaCl concentration

Data sheet

APP S 674 pumps

4.3 APP S 674 21-38

Pumps size		APP S 674 21	APP S 674 24	APP S 674 26	APP S 674 30	APP S 674 33	APP S 674 38
Code number		On request	On request	On request	On request	On request	On request
Geometric displacement	cm ³ /rpm	256	282	308	362	389	444
	in ³ /rpm	15.6	17.2	18.8	22.1	23.7	27.1
Pressure							
Outlet min. pressure, continuous ¹⁾	barg	30	30	30	30	30	30
	psig	435	435	435	435	435	435
Outlet max. pressure, MAWP	barg	80	80	80	80	80	80
	psig	1160	1160	1160	1160	1160	1160
Inlet operating pressure ²⁾	barg	2.0-10	2.0-10	2.0-10	2.0-10	2.0-10	2.0-10
	psig	29-145	29-145	29-145	29-145	29-145	29-145
Inlet design pressure	barg	15	15	15	15	15	15
	psig	217	217	217	217	217	217
Speed							
Min. speed, continuous	rpm	700	700	700	700	700	700
Max. speed, continuous	rpm	1500	1500	1500	1500	1500	1500
Typical Flow							
700 rpm at max pressure	m ³ /h	10	11	12	14	15.2	17.5
1500 rpm at max pressure	m ³ /h	21.9	24.2	26.7	31.3	33.3	38.4
700 rpm at max pressure	gpm	44	48.4	52.8	61.6	67	77
1500 rpm at max pressure	gpm	96.4	106.5	117.6	138	146.6	169
Typical motor size							
1000 rpm at max pressure	kW	45	45	55	55	75	75
1000 rpm at max pressure	hp	60	60	75	75	100	100
Torque at max outlet pressure	Nm	371	413	451	530	556	639
	lbf-ft	273.6	304.6	332.6	391	410	471.3
Media temperatur ³⁾	°C	2-50	2-50	2-50	2-50	2-50	2-50
	°F	36-122	36-122	36-122	36-122	36-122	36-122
Ambient temperatur	°C	0-50	0-50	0-50	0-50	0-50	0-50
	°F	32-122	32-122	32-122	32-122	32-122	32-122
Weight	kg	110	110	110	110	110	110
	lb	242	242	242	242	242	242

¹⁾ For lower pressure, please contact Danfoss High Pressure Pumps

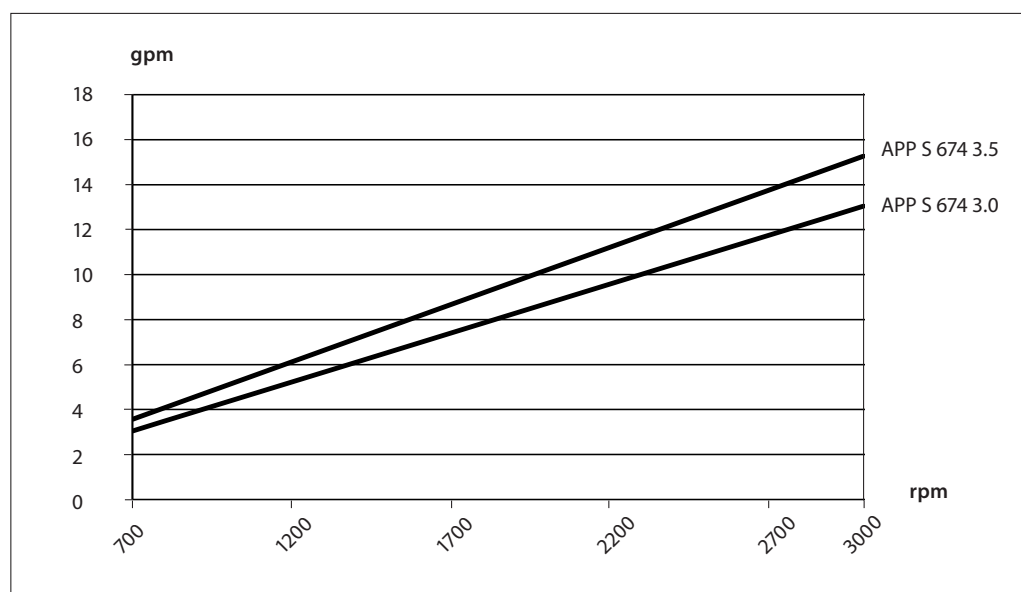
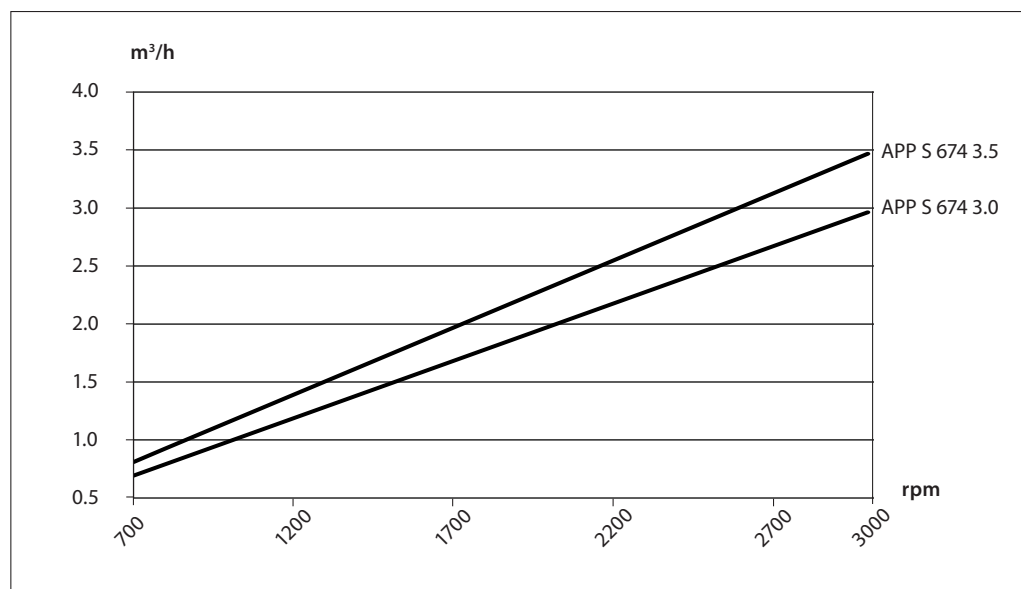
²⁾ If inlet pressure exceeds inlet operating pressure, Danfoss recommends inspection of the pump and shaft seal

³⁾ Dependent on the NaCl concentration

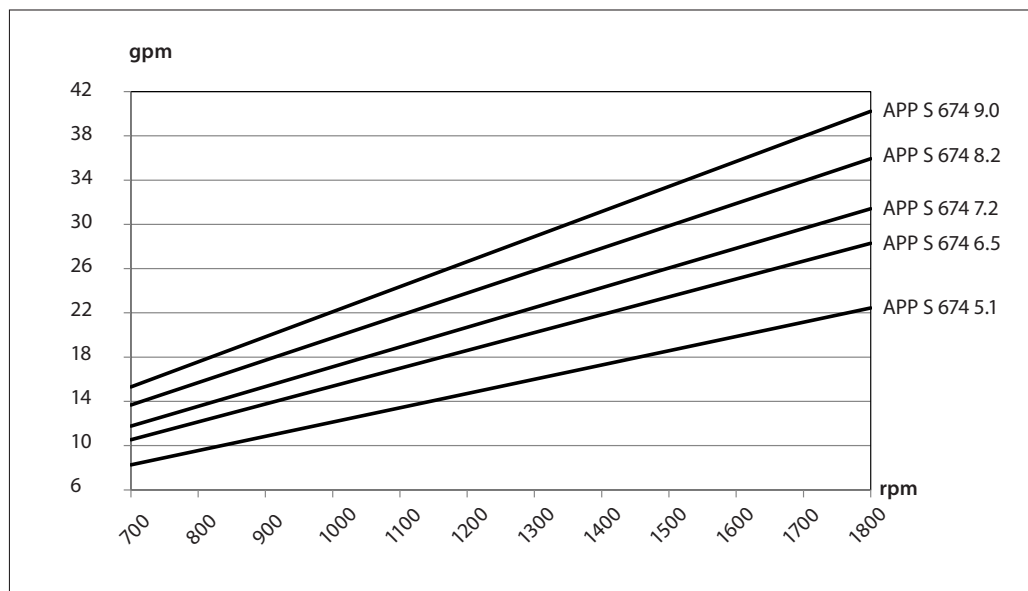
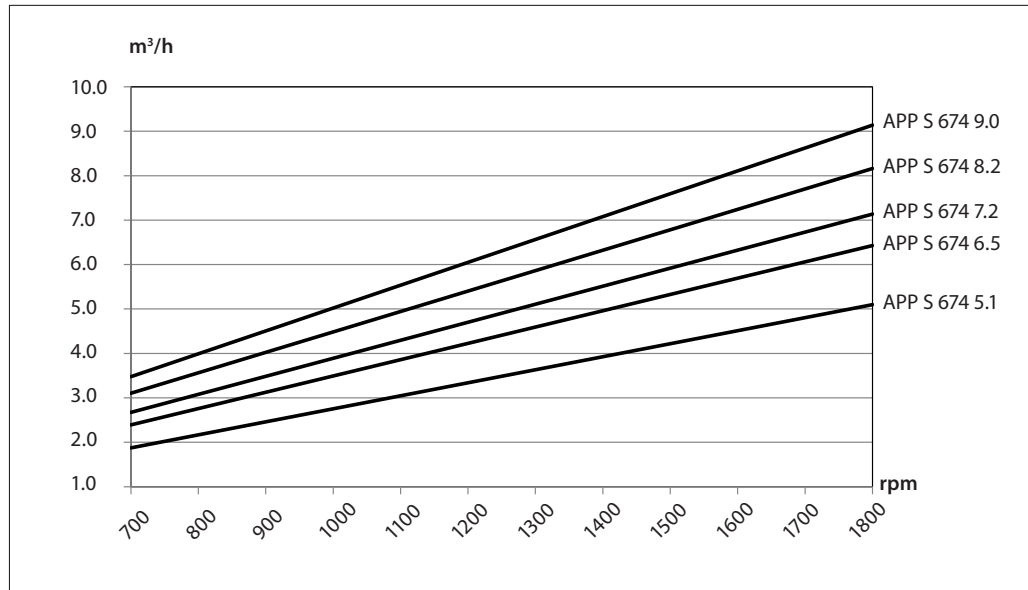
5. Flow

If the required flow and rotation speed (rpm) of the pump are known, the below diagram can be used to select the pump that fits the application best.

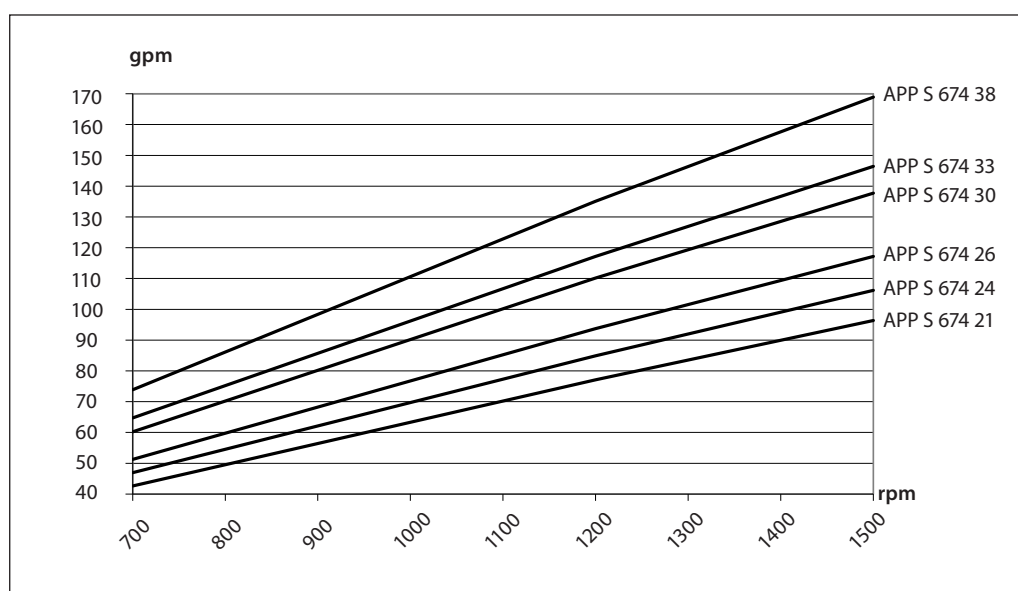
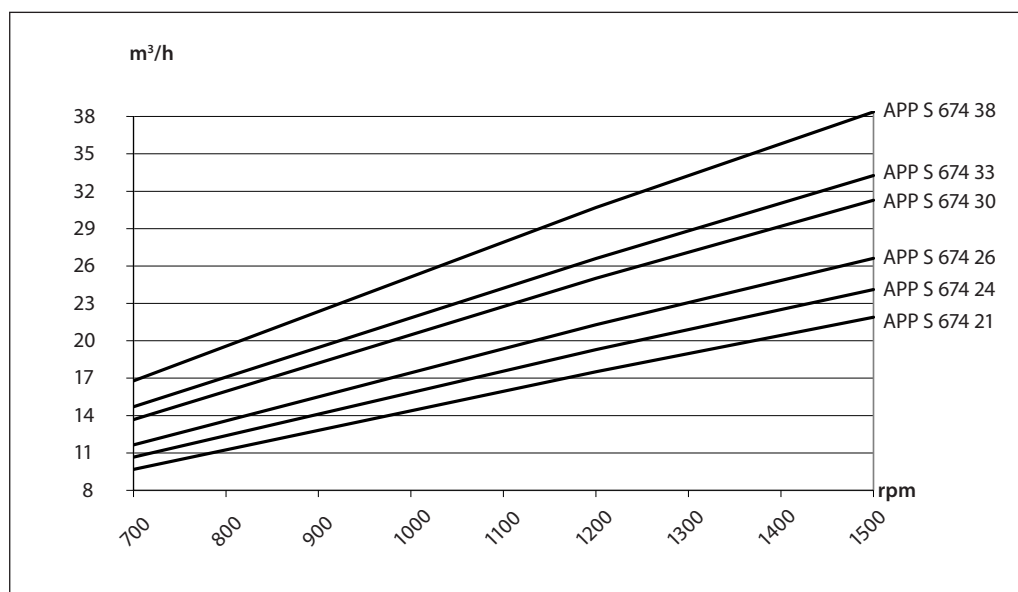
5.1 APP S 674 3.0-3.5 flow curves at max pressure



5.2 APP S 674 5.1-9.0 flow curves at max pressure



5.3 APP S 674 21-38 flow curves at max pressure



The curves above also show that the flow can be changed by changing the rotation speed of the pump. The flow/rpm ratio is constant, and the "required " flow can be obtained by changing the

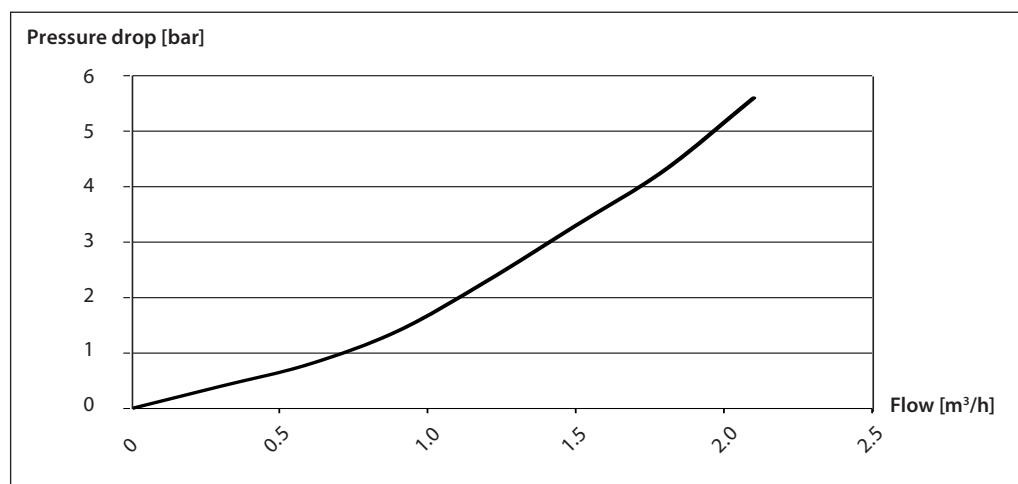
rotation speed to a corresponding value. Thus, the required rpm can be determined as:

$$\text{Required rpm} = \frac{\text{Required flow} \times \text{Typical rpm}}{\text{Typical flow}}$$

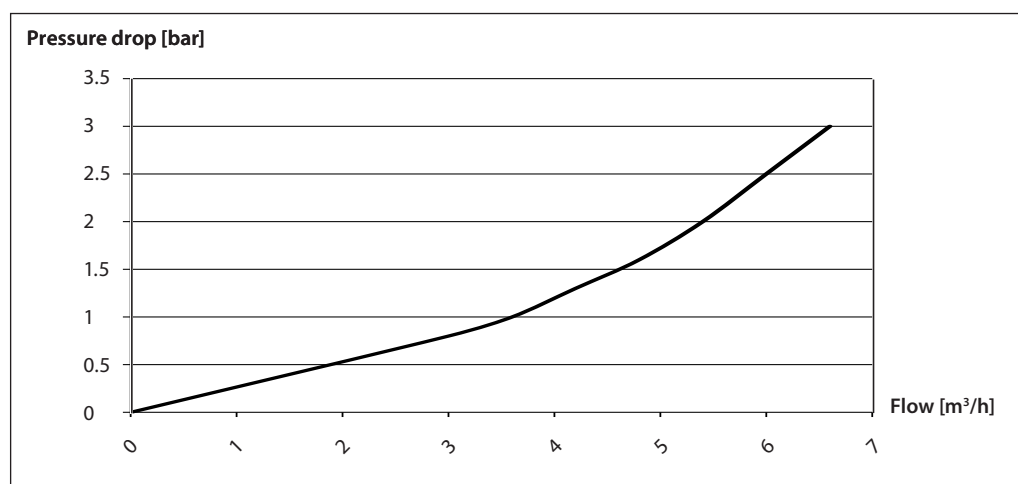
5.4 Flushing valve characteristics

The diagrams show the flow characteristics of the integrated flushing valve that allows the water to flow from inlet to outlet when the pump is not running.

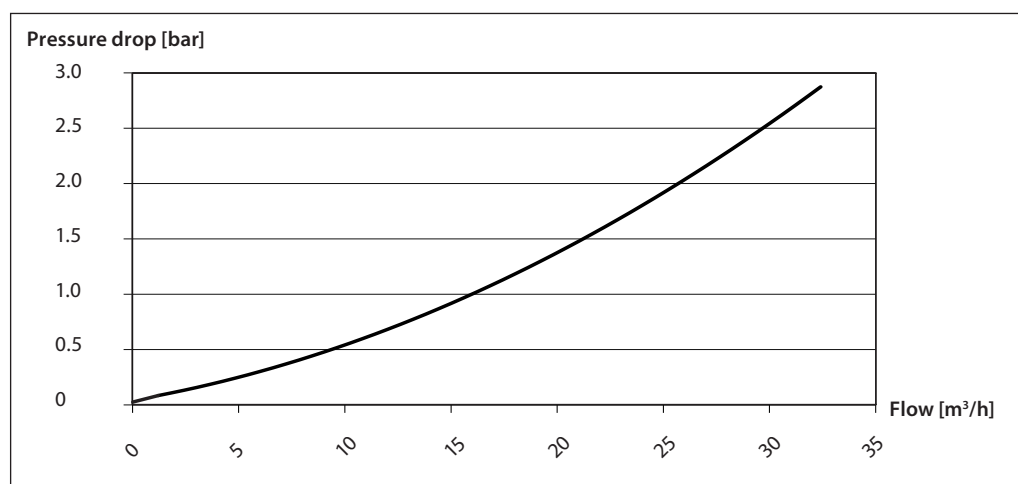
5.4.1 APP S 674 3.0-3.5 integrated flushing valve curve



5.4.2 APP S 674 5.1-9.0 integrated flushing valve curve



5.4.3 APP S 674 21-38 integrated flushing valve curve

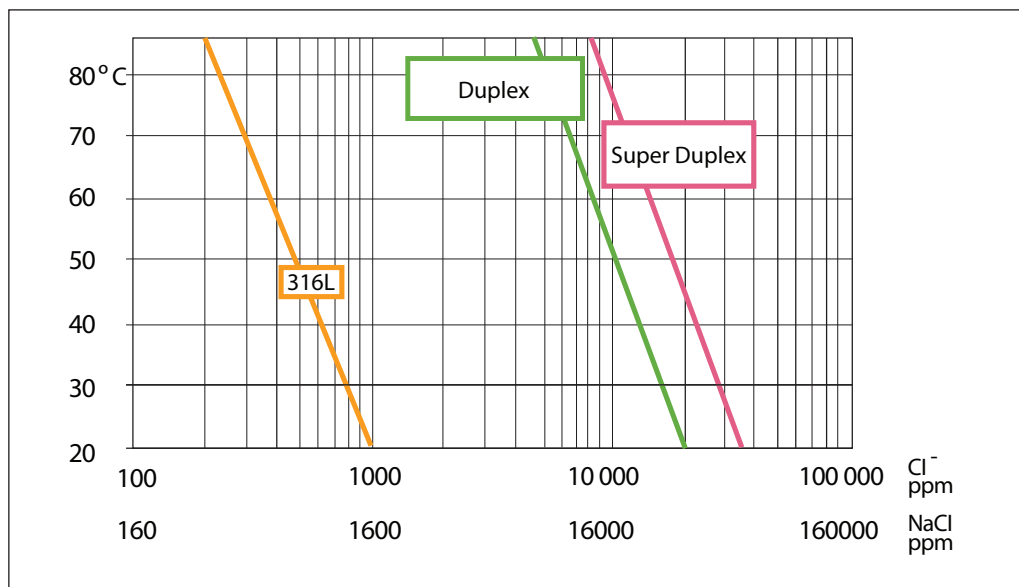


6. Corrosion

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

All wetted parts of the APP S 674 pumps are made of Super Duplex.

If the water pump is operated at high salinity, always flush the water pump with fresh water at operation stop, in order to minimize the risk of crevice corrosion.



7. Motor requirements

The power requirements can be determined using one of the following guiding equations:

$$\text{Required power} = \frac{\text{l/min} \times \text{bar}}{\text{Calc. factor}} [\text{kW}] \text{ or } \frac{16.7 \times \text{m}^3/\text{h} \times \text{bar}}{\text{Calc. factor}} [\text{kW}] \text{ or } \frac{0.26 \times \text{gpm} \times \text{psi}}{\text{Calc. factor}} \times 1.34 [\text{hp}]$$

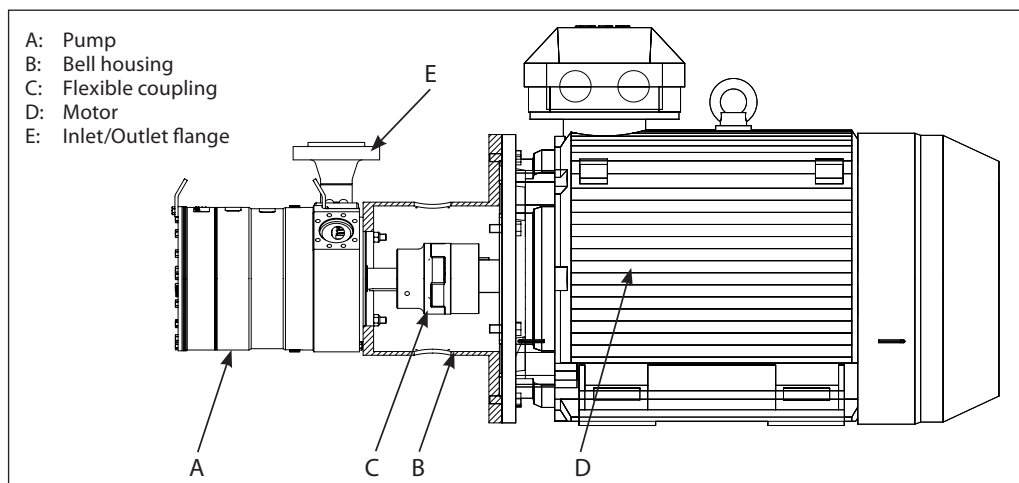
1 hp = 0.75 kW	1 kW = 1.34 hp
1 gpm = 3.79 l/min	1 l/min = 0.26 gpm
1 m ³ /h = 4.40 gpm	1 gpm = 0.23 m ³ /h

APP S 674 3.0-3.5	- Calc. factor: 485
APP S 674 5.1-9.0	- Calc. factor: 485
APP S 674 21-38	- Calc. factor: 504

Both power and torque requirement must be verified in order to determine the correct motor size when the motor does not operate at nominal speed.

8. Installation

The figure below illustrates how to mount and connect all pump sizes to an electric motor or combustion engine. If alternative mounting is required, please contact Danfoss High Pressure Pumps for further information.



8.1 Filtration

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

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

Since water has very low viscosity, Danfoss APP S 674 pumps have been designed with very narrow clearances in order to control internal leakage rates and improve pump performance. **To minimize wear on the pump, it is therefore essential to filter inlet water properly:**

The main filter must have a filtration efficiency of 99.98% at 10 µm. We strongly recommend that you always use precision depth filter cartridges rated 10µm abs. $\beta_{10} \geq 5000$.

Please note that **we do not recommend bag filters or string-wound filter cartridges**, which typically have only 50% filtration efficiency. This means that out of 100,000 particles that enter such filters, 50,000 particles pass right through them; compare this to precision depth filters that are 99.98% efficient, and only allow 20 of the same 100,000 particles to pass through.

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 521B1009).

8.2 Noise

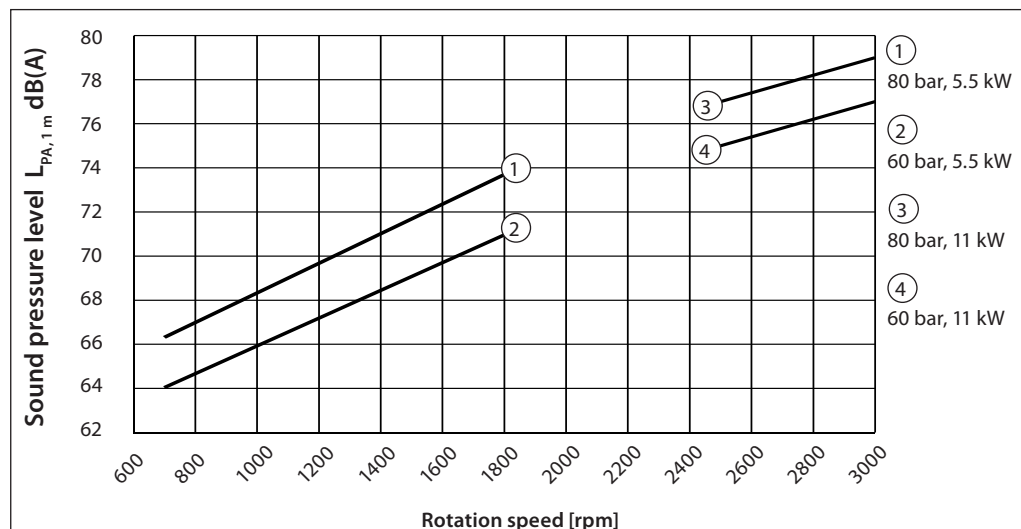
Since the pump unit is mounted on a frame, the overall noise level can only be determined for a complete system. To minimize vibrations and noise throughout the system, it is therefore recommended to mount the pump unit correctly on a frame with dampeners and to use flexible hoses rather than metal pipes where possible.

The noise level is influenced by:

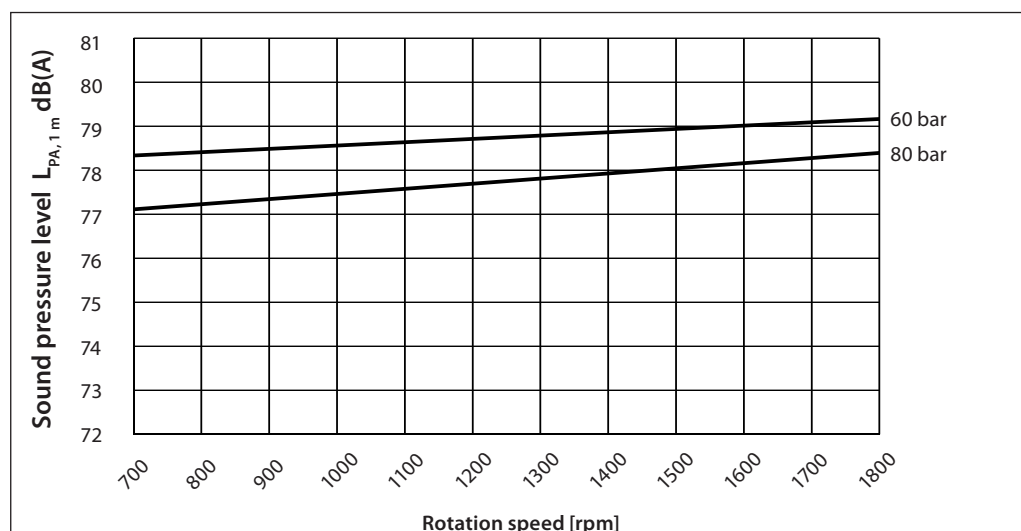
- **Pump speed:**
High rpm makes more fluid/structure-borne pulsations/vibrations than low rpm due to higher frequency.
- **Discharge pressure:**
High pressure makes more noise than low pressure.
- **Pump mounting:**
Rigid mounting makes more noise than flexible mounting due to structure-borne vibrations.
- **Connections to pump:**
Pipes connected directly to the pump make more noise than flexible hoses due to structure-borne vibrations.
- **Variable frequency drives (VFD):**
Motors regulated by VFDs can increase noise level if the VFD does not have the right settings.

The curves on the following page indicate the sound pressure level in dB(A) measured in a reverberation room at a distance of 1 metre from the motor/pump unit surface. The measurements are according to EN ISO 3744: 2010 and the dB(A) $[L_{PA'} 1m]$ values is calculated.

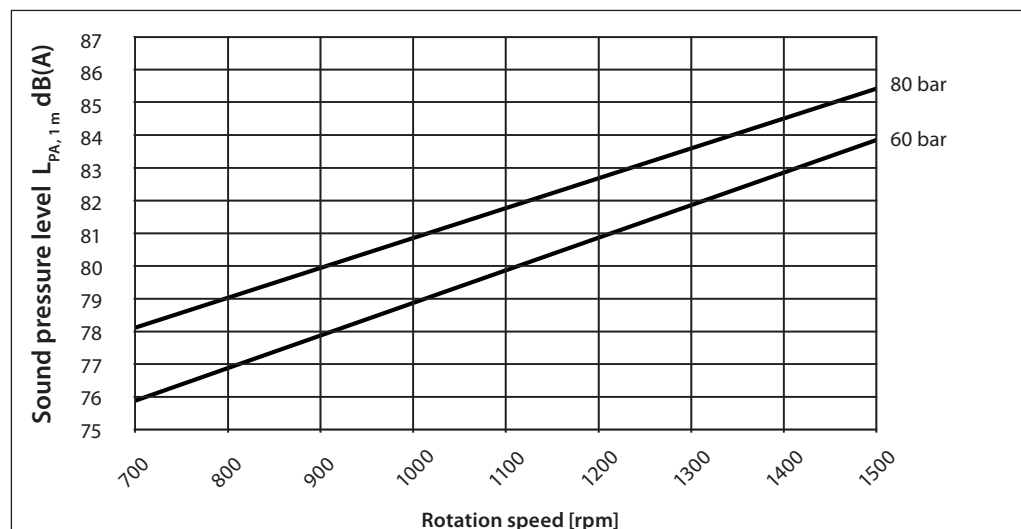
8.2.1 APP S 674 3.0-3.5 pump mounted on motor 5.5 kW 4-pole / 11 kW 2-pole



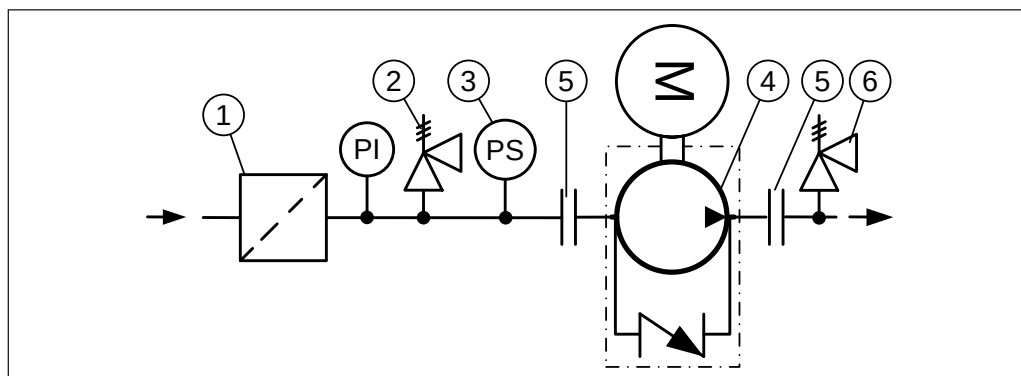
8.2.2 APP S 674 5.1-9.0 pump mounted on motor 22 kW 4-pole



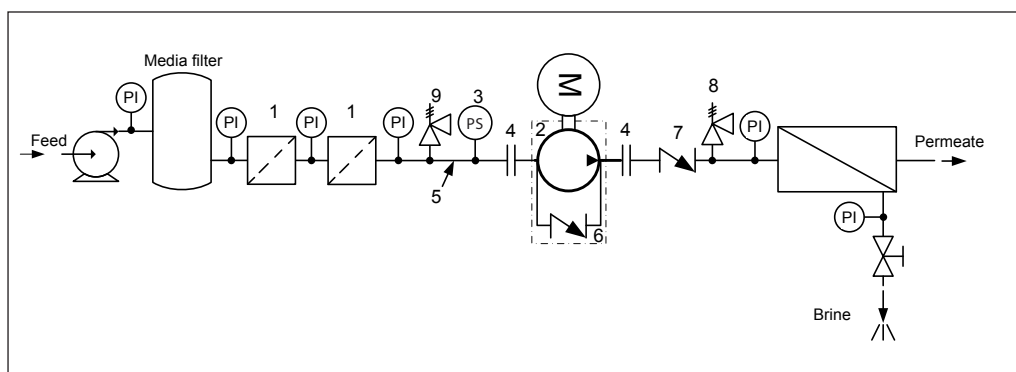
8.2.3 APP S 674 21-38 pump mounted on motor 75 kW 4-pole



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 to protect against high-pressure peaks.

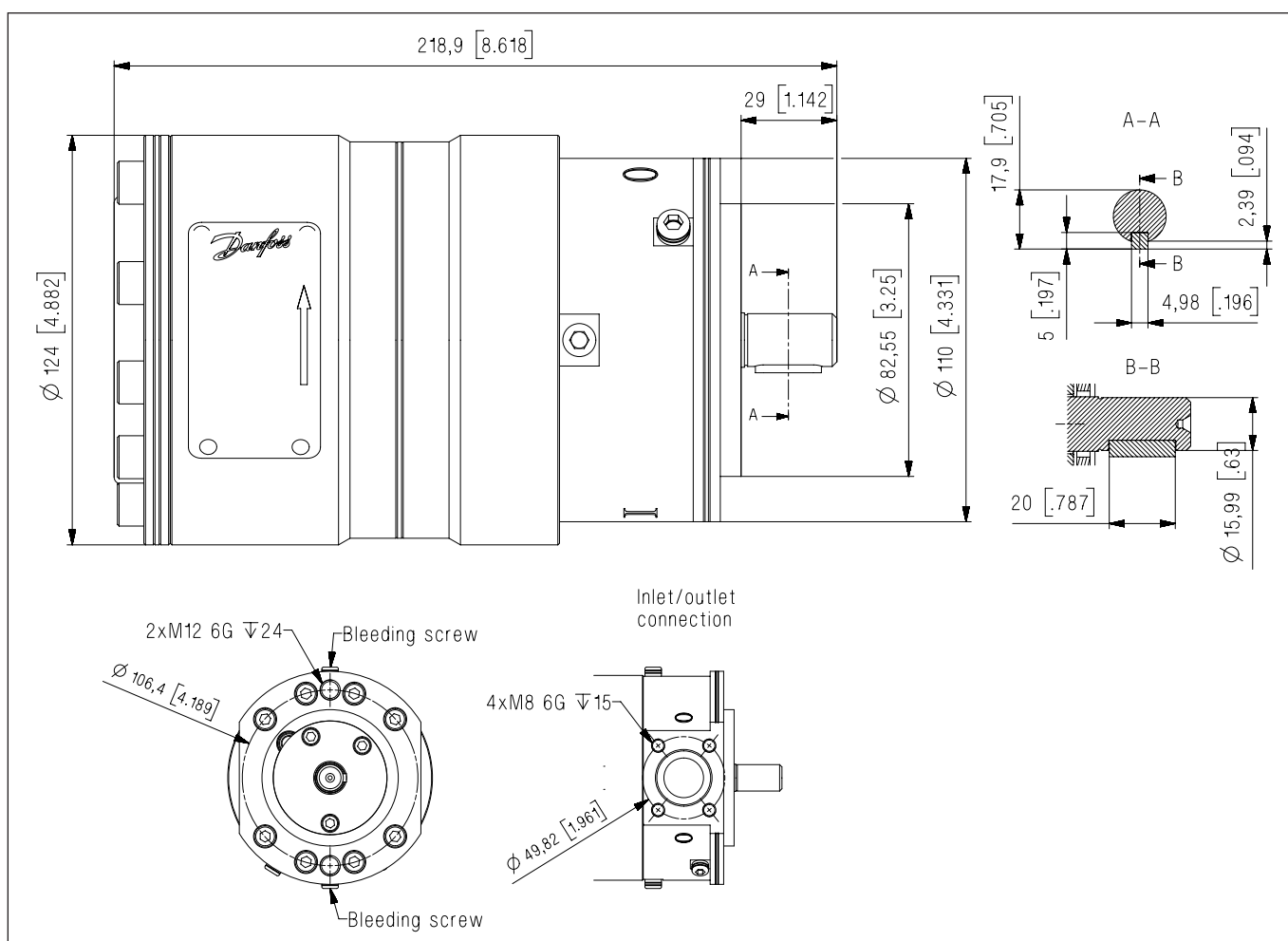


Note: If a non return valve is mounted in the inlet line, a low pressure relief valve is also required between non return valve and pump as protection against high pressure peaks.



9. Dimensions and connections

9.1 APP S 674 3.0-3.5

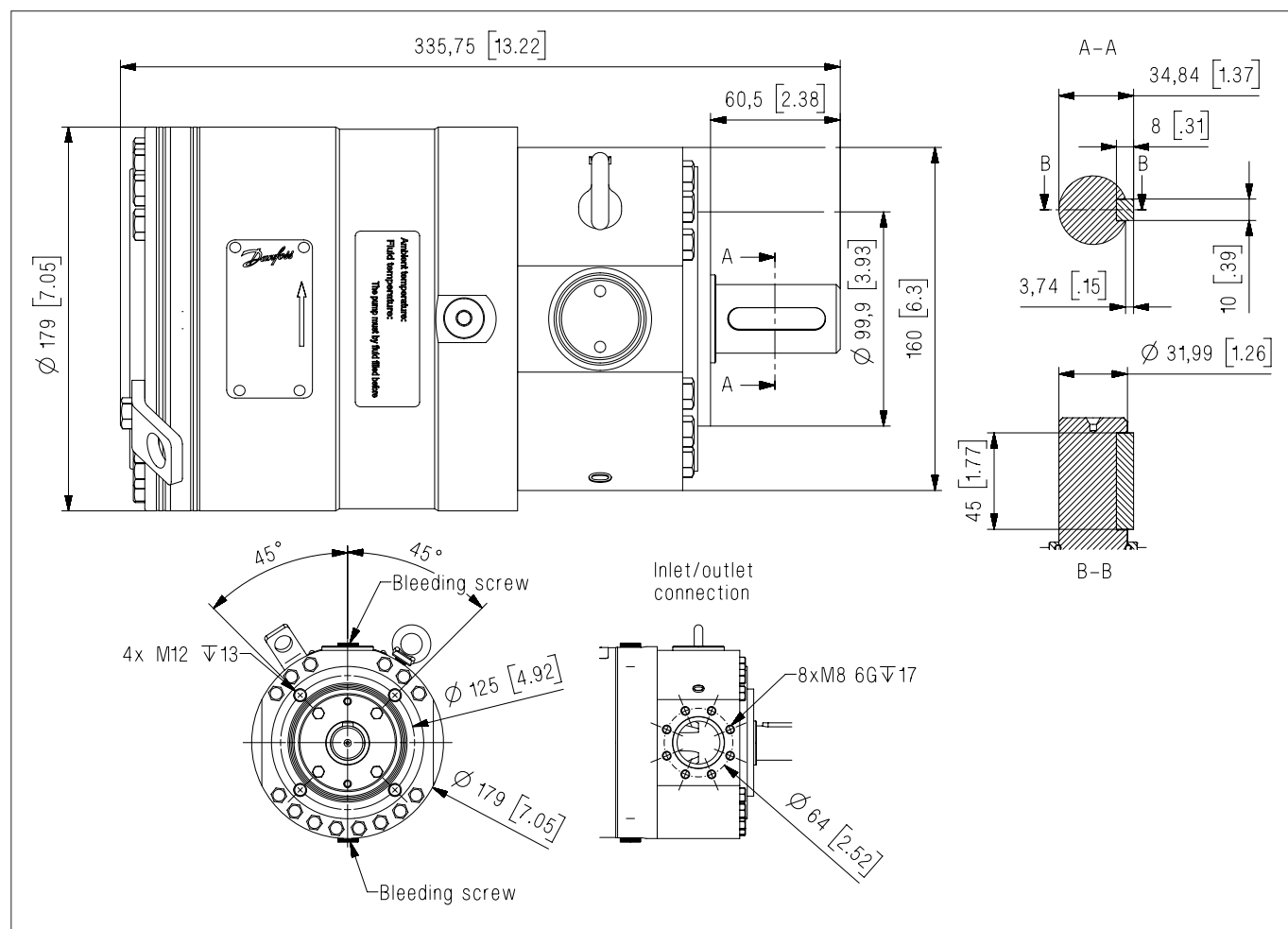


Description	APP S 674 3.0-3.5
Parallel key, DIN 6885, mm (in)	5 × 5 × 5 (0.20 × 0.20 × 0.78)
Bleeding	M6; Hexagon, Allen key 5 mm
Inlet port	4 bolt flange
Outlet port	4 bolt flange
Pump mounting flange	ISO 3019-1 82-2

Accessories	Type
¾" inlet flange	ASME B16.5
¾" outlet flange	ASME B16.5

For other requirements on flange connections, please contact Danfoss High Pressure Pumps.

9.2 APP S 674 5.1-9.0

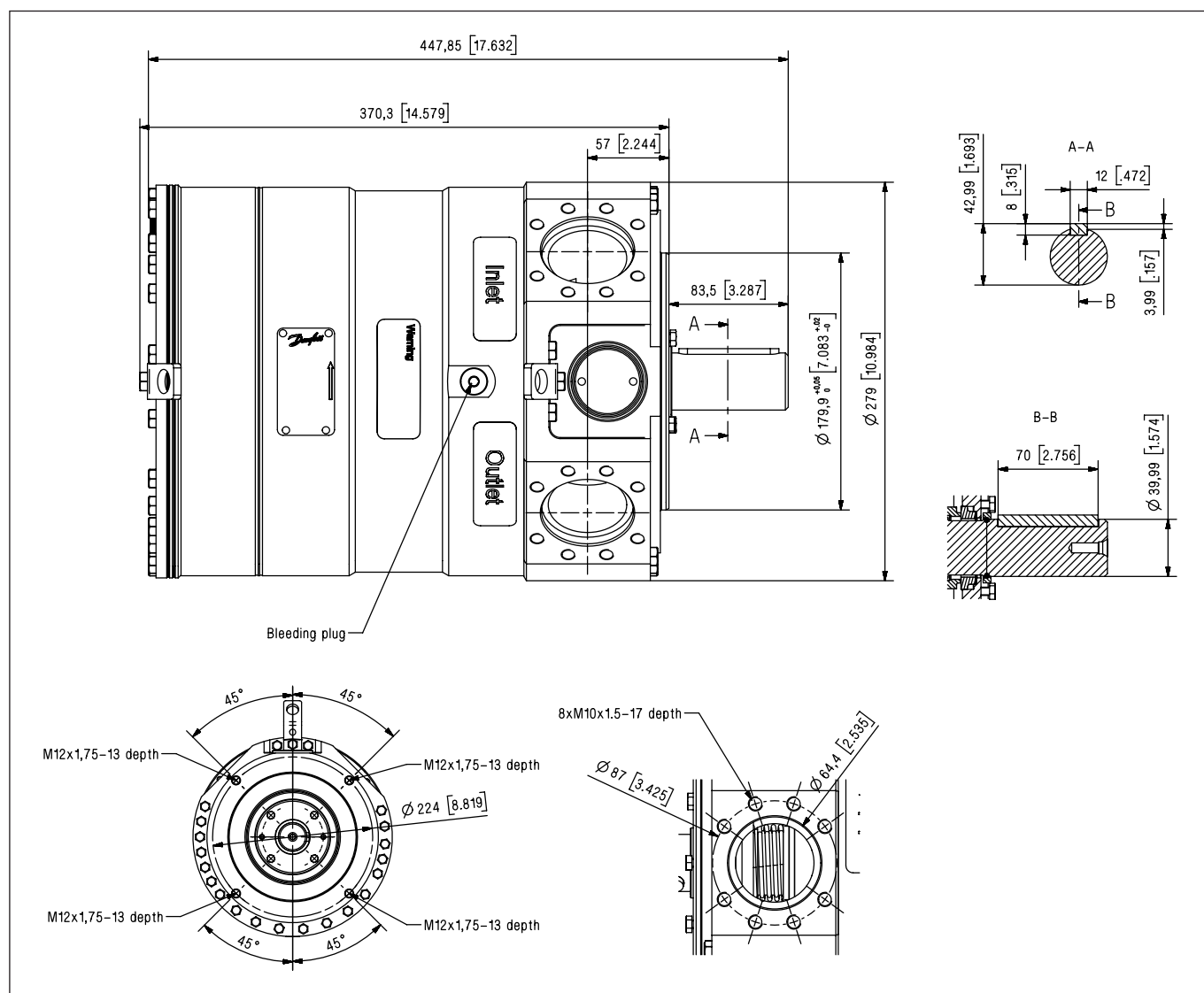


Description	APP S 674 5.1-9.0
Parallel key, DIN 6885, mm (in)	10 × 8 × 45 0.39 × 0.31 × 1.77
Bleeding	G ¼"; Hexagon, Allen key 6 mm
Inlet port	8 bolt flange
Outlet port	8 bolt flange
Pump mounting flange	ISO 3019-2 100 B4

Accessories	Type
1½" inlet flange	ASME B16.5
1½" outlet flange	ASME B16.5

For other requirements on flange connections, please contact Danfoss High Pressure Pumps.

9.3 APP S 674 21-38



Description	APP S 674 21-38
Parallel key, DIN 6885, mm (in)	12 × 8 × 70 (0.47 × 0.31 × 2.76)
Bleeding	G 1/4"; Hexagon, Allen key 8 mm
Inlet port	8 bolt flange
Outlet port	8 bolt flange
Pump mounting flange	ISO 3019-2 180 B4 TW

Accessories	Type
2" inlet flange	ASME B16.5
2" outlet flange	ASME B16.5

For other requirements on flange connections, please contact Danfoss High Pressure Pumps.

10. Service**10.1 Warranty**

Danfoss APP S 674 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 guarantees 8,000 hours service-free operation, however, max. 18 months from date of production.

If Danfoss recommendations concerning system-design are not followed, *it will strongly influence the life of the APP S 674 pumps.*

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

Standstill:

The APP S 674 pumps are made of Super Duplex materials with excellent corrosion properties.

It is, however, always recommended to flush the pump with freshwater when the system is shut down.

10.2 Maintenance

After 8,000 hours of operation **it is strongly recommended to inspect the pump and change any worn parts, e.g. pistons.** This is done in order to prevent a potential breakdown of the pump.

Danfoss A/S

High Pressure Pumps
DK-6430 Nordborg
Denmark

Instruction

APP S 674 pumps

APP S 674 3.0-3.5 / APP S 674 5.1-9.0

APP S 674 21-38



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(180R9276)**

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2.3	Protection from too high pressures
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Our CLP RO pumps have changed name as listed below:

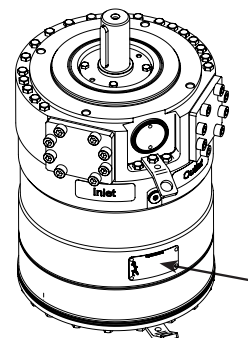
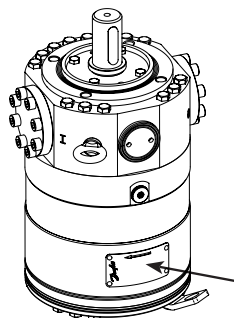
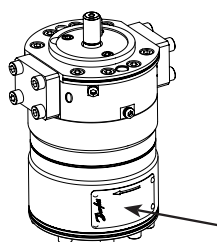
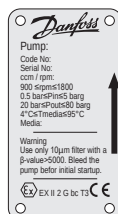
CLP674 050-058 RO will now be called APP S 674 3.0-3.5

CLP674 085-152 RO will now be called APP S 674 5.1-9.0

CLP674 365-640 RO will now be called APP S 674 21-38

This is ONLY a name change.

1. Identification



2. System design

2.1 Open system design

A Inlet line:

Minimize pressure loss by allowing for maximum flow, minimum pipe length, as few bends/connections as possible, and fittings with small pressure losses.

B Inlet filter:

Install the inlet filter (1) in front of the APP S 674 pump (4). Please consult the Danfoss filter data sheet for guidance on how to select the right filter.

C Monitoring pressure switch:

Install the monitoring pressure switch (3) between the filter and the pump inlet. Set the minimum inlet pressure according to pump specifications. The monitoring pressure switch stops the pump if inlet pressure is lower than the set minimum pressure.

D Monitoring temperature switch when the pump operates in a hazardous area:

Install the monitoring temperature switch between the filter and the pump, on either side of the monitoring pressure switch. Set the temperature according to pump specifications. The monitoring temperature

switch stops the pump if inlet temperature is higher than the set value.

E Connections:

Ensure flange loads (5) do not exceed max. allowable loads on process connections according to API 674 3rd edition (pipe size).

F Inlet pressure:

In order to eliminate the risk of cavitation and other pump damage, inlet pressure must be maintained in-between pump specifications.

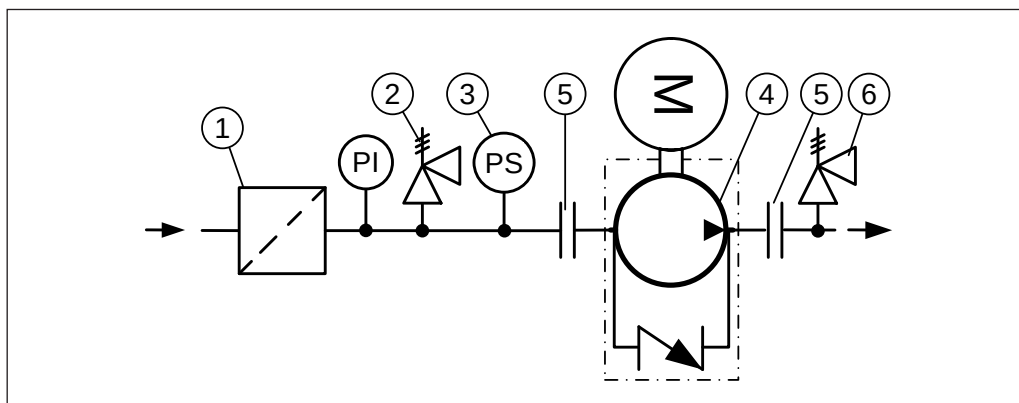
G LP relief valve (2):

Can be installed in order to avoid system or pump damage in case the pump stops momentarily or spinning backwards.

H HP relief valve:

As the Danfoss APP S 674 pump begins to create pressure and flow immediately after start-up and regardless of any counter pressure, a pressure relief valve (6) should be installed to prevent system damage.

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 to protect against high-pressure peaks.



2.2 RO system with APP S 674 pump

The numbers in brackets refer to the drawing on next page.

A 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).

B Place an inlet filter (1) in front of the APP S 674 pump (2). Please consult section 10, "Filtration" for guidance on how to select the right filter. Thoroughly clean pipes and flush system prior to start-up.

C 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.

D Ensure flange loads (4) do not exceed max. allowable loads on process connections according to API 674 3rd edition (pipe size).

E 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. Recom-

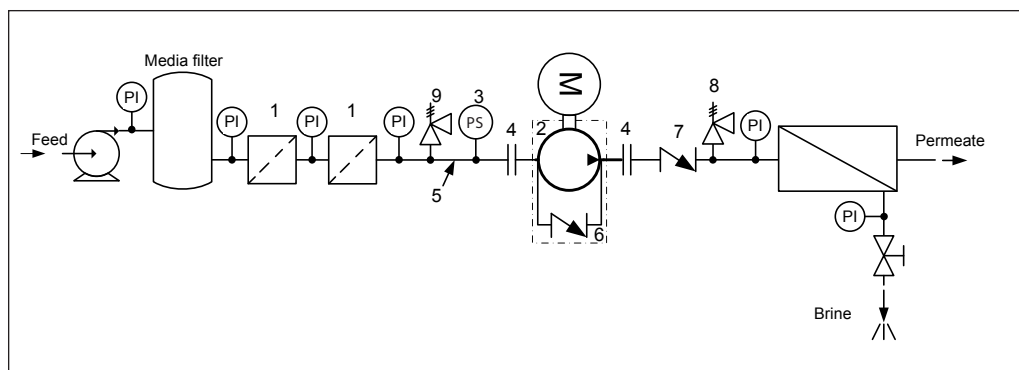
mend to install safety valve or a pressure relief valve (9) in order to avoid high pressure peaks in case the pump stops momentarily or is spinning backwards.

F For easy system bleeding and flushing, a bypass non-return valve (6) is integrated in the APP S 674 pump.

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 the pump stops momentarily.

H A safety valve or a pressure relief valve (8) can be installed in order to avoid system damage as the Danfoss APP S 674 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.



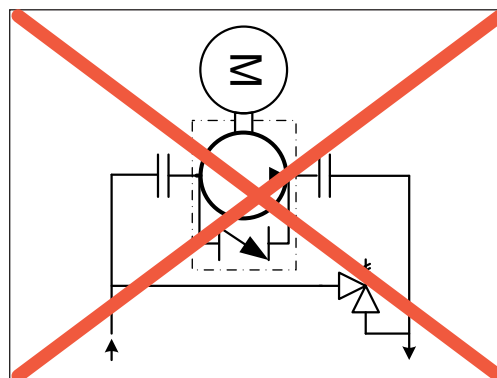
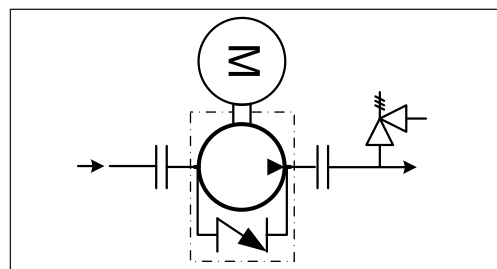
2.3 Protection of too high pressures

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

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

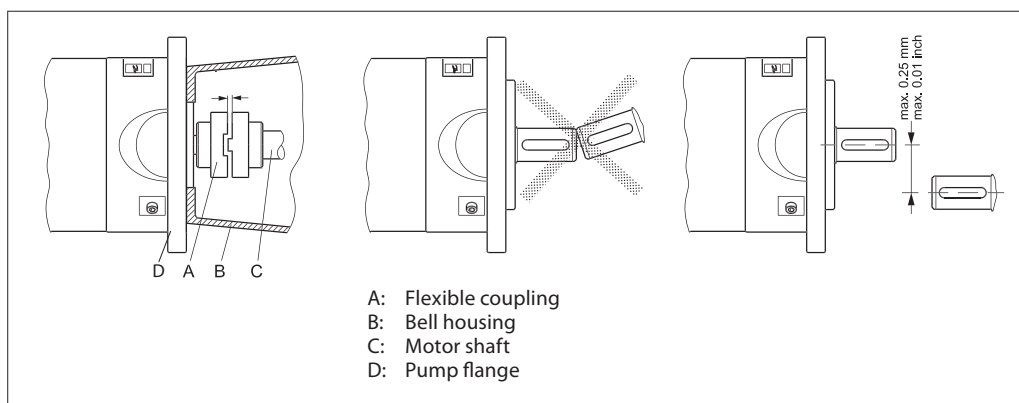
The opening characteristics of the valve must not result in peak pressures higher than 80 bar (1,160 psi).

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



3. Building up the pump unit

3.1 Mounting



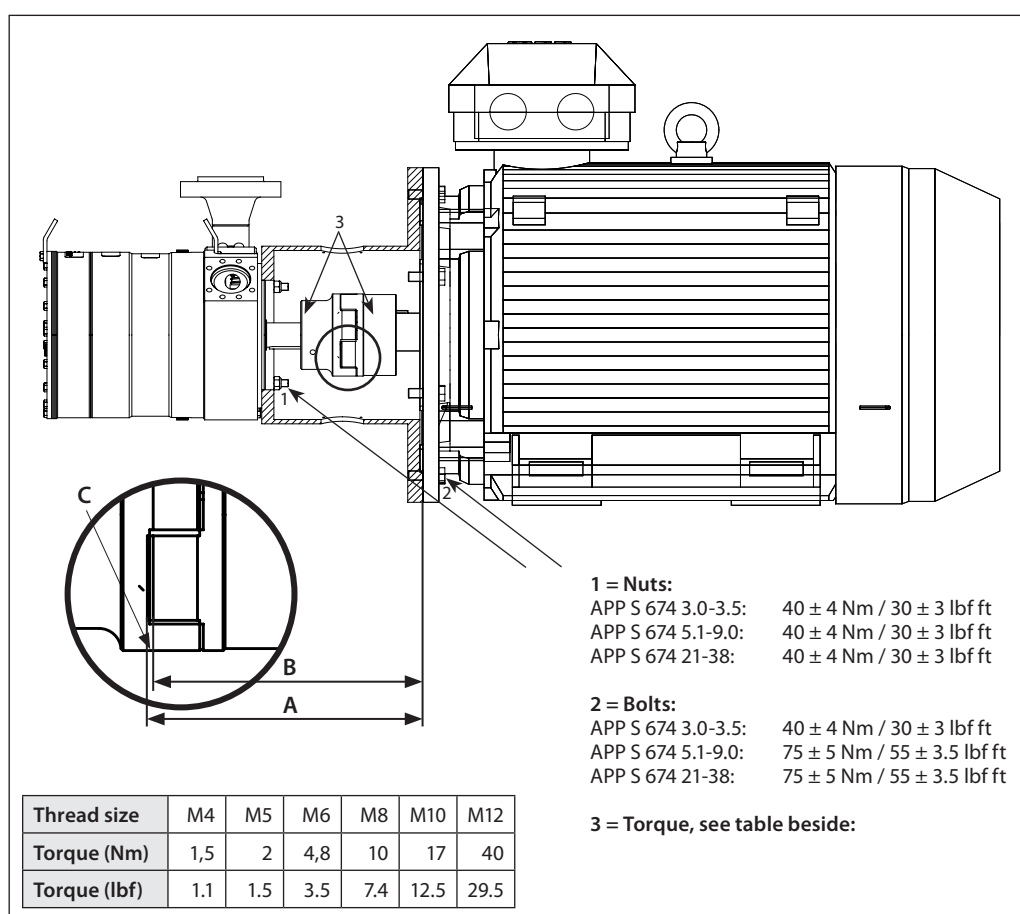
1. Mount the coupling on the pump shaft. Ensure an air gap between coupling and pump flange of min. 4 mm (0.16 in).
2. Mount the bell housing on the pump. Secure nuts with the right torque.
3. Measure the longest distance "A" from top of bell housing to the button of coupling claw.
4. Mount the coupling on the 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. The measurement "B" shall be 3-5 mm (0.12 - 0.2 in) shorter than the measurement "A".
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 flexible gear ring and mount the bell housing/pump on the motor. After mounting it must be possible to move the flexible gear ring 3-5 mm (0.12 - 0.2 in) axial "C". The check can be done through the inspection hole of the bell housing. Secure flange bolts with the right torque.

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

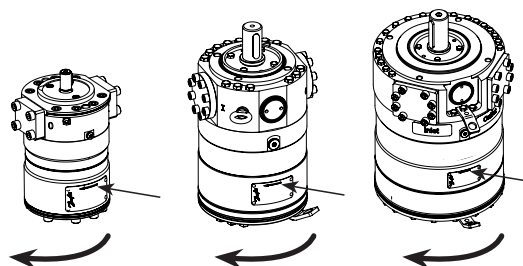
Choose proper tolerances to ensure an easy mounting of the flexible coupling without use of tools.

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



3.2 Direction of rotation

The direction of rotation is indicated by an arrow at the pump label.

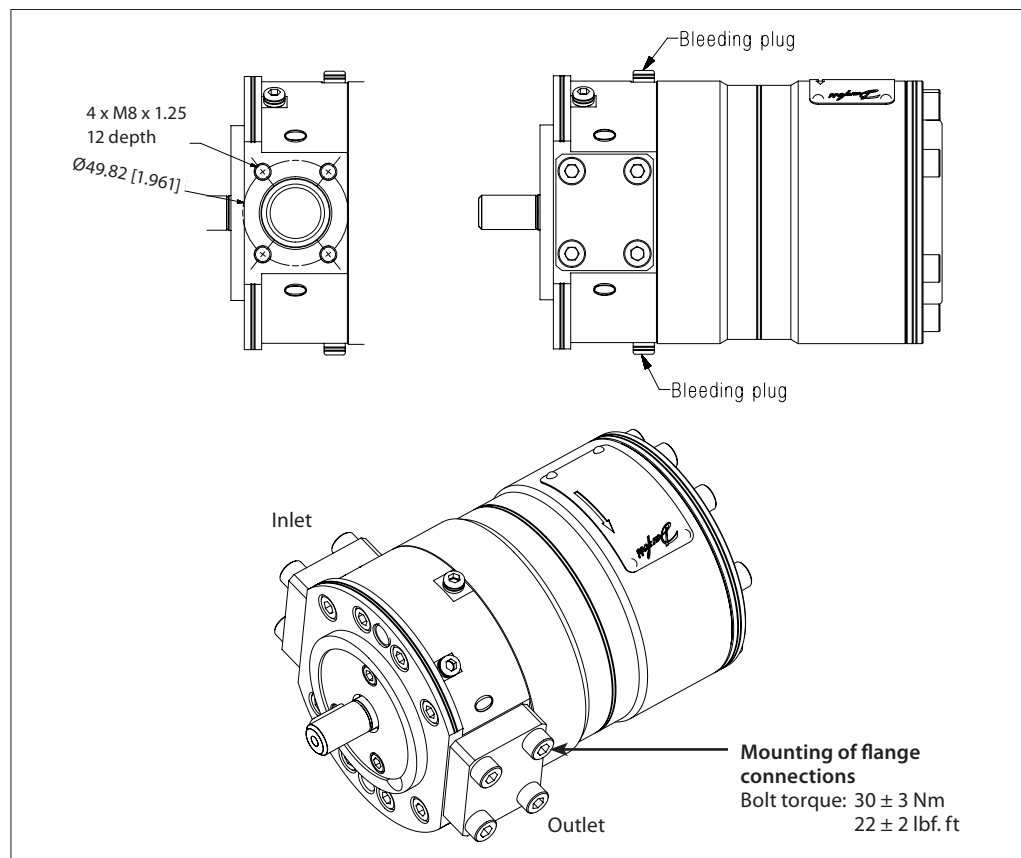


3.3 Orientation

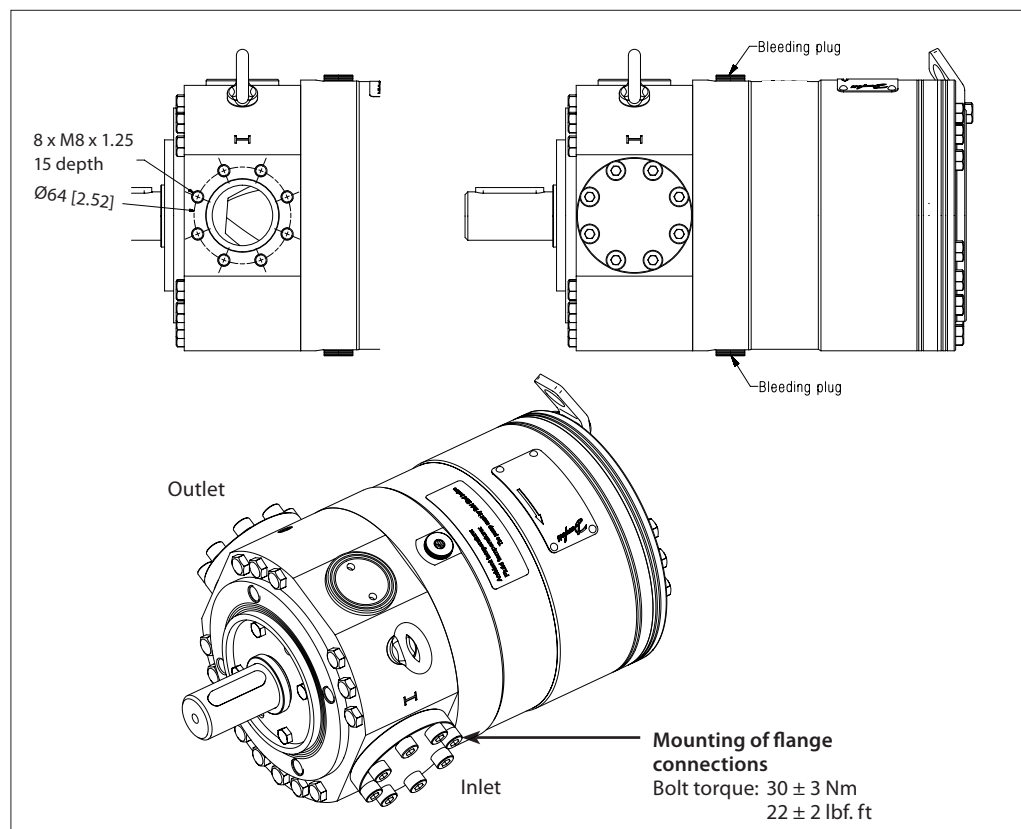
The pump can be mounted/orientated in any horizontal direction; vertically only with the shaft pointing upwards.

3.4 Connections

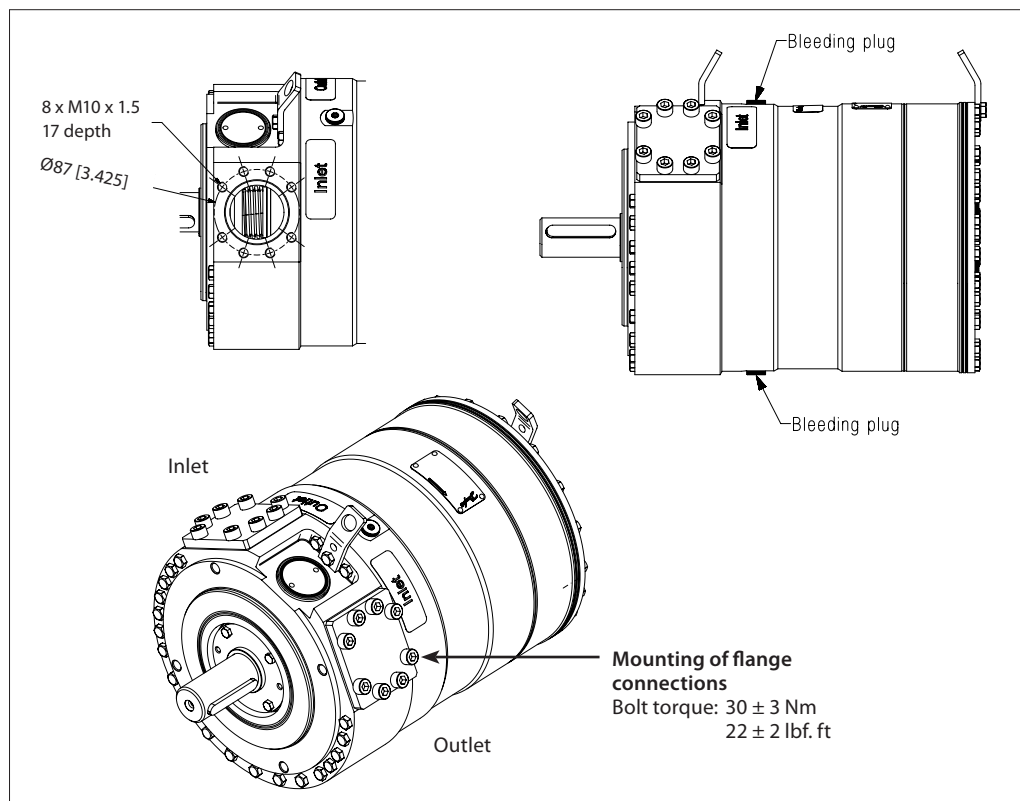
3.4.1 APP S 674 3.0-3.5



3.4.2 APP S 674 5.1-9.0



3.4.3 APP S 674 21-38



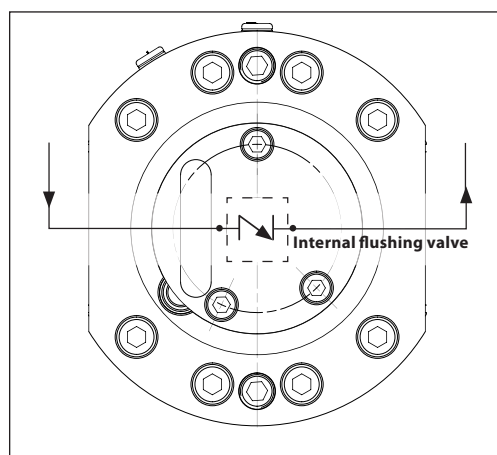
4. Initial start-up

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 using an internal flushing valve, to remove possible impurities from pipes, hoses etc.
3. Loosen top bleeding plug (see item 3.4) 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.

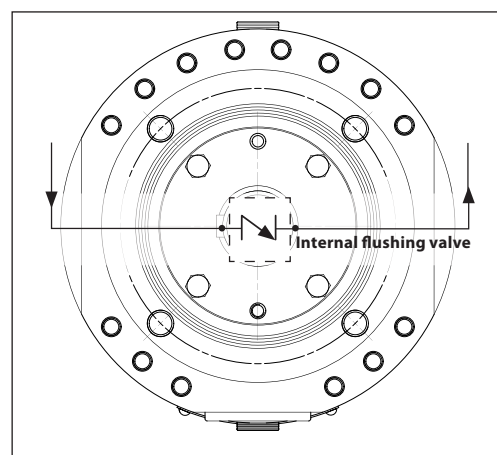
WARNING!

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.

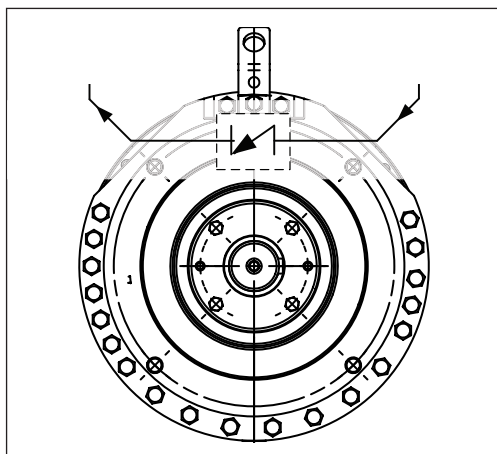
4.1 APP S 674 3.0-3.5



4.2 APP S 674 5.1-9.0



4.3 APP S 674 21-38



5. Technical data

Pumps size		APP S 674 3.0-3.5	APP S 674 5.1-9.0	APP S 674 21-38
Outlet min. pressure, continuous ¹⁾	barg	20	30	30
	psig	290	435	435
Outlet max. pressure, MAWP	barg	80	80	80
	psig	1,160	1,160	1,160
Inlet operating pressure ²⁾	barg	0.5-10	2.0-10	2.0-10
	psig	7.25-145	29-145	29-145
Inlet design pressure	barg	15	15	15
	psig	217	217	217
Min. speed, continuous	rpm	700	700	700
Max. speed, continuous	rpm	3,000	1,800	1,500
Media temperatur ³⁾	°C	2-50	2-50	2-50
	°F	36-122	36-122	36-122
Ambient temperatur	°C	0-50	0-50	0-50
	°F	32-122	32-122	32-122
Storage temperature	°C	-40 to +70	-40 to +70	-40 to +70
	°F	-40 to +158	-40 to +158	-40 to +158
Weight	Kg	15	40	110
	lb	33	88	242

¹⁾ For lower pressure, please contact Danfoss High Pressure Pumps

²⁾ If inlet pressure exceeds inlet operating pressure, Danfoss recommends inspection of the pump and shaft seal

³⁾ Dependent on the NaCl concentration

Inlet pressure:

If using lower inlet pressure than stated in above table, the pump will cavitate, which will damage the pump.

The inlet line connection must be properly tightened as entrance of air will cause cavitation.

Outlet pressure:

MAWP (Maximum Allowable Working Pressure) must be within specifications.

If pump operates below minimum outlet pressure, it may cause cavitation/erosion in the pump.

Note: We recommend that the pump unit includes a pressure gauge at inlet and outlet.

Dry running:

When running, the pump must always be connected with water supply in order to avoid pump damage.

Disconnection:

If inlet line is disconnected from the water supply, the pump will be emptied which will cause dry running.

When starting up again, follow the bleeding procedure described in section 4: Initial start-up.

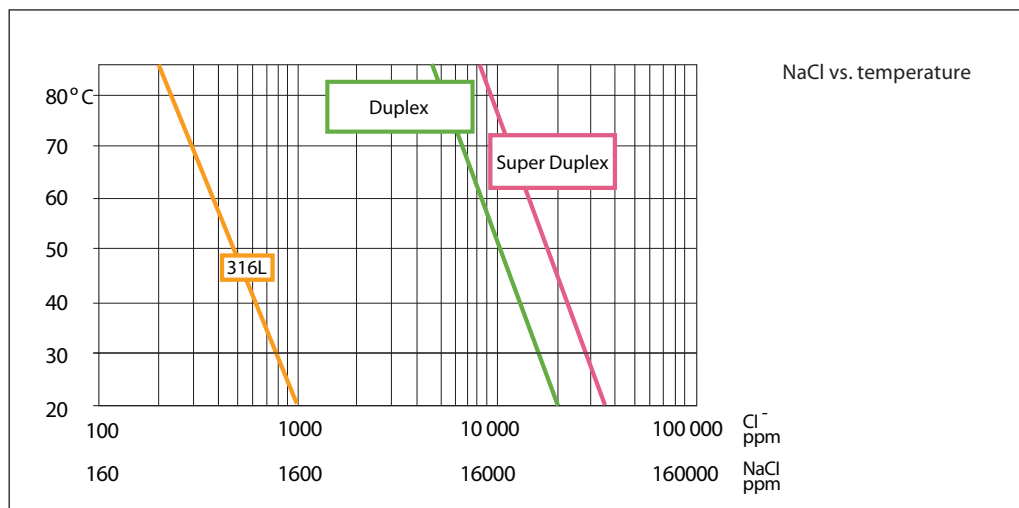
6. Operation

6.1 Temperature

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 S 674 pump is made of 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 minimise the risk of crevice corrosion.



7. Long-term shutdown

For a long-term shutdown period, the SWRO system including the pump must be flushed with fresh water (permeate) to remove any salt.

It is recommended to make few turns on the pump to flush it properly.

8. Storage

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 water supply to the pump.
2. Through the lower bleeding plug, empty the pump housing for 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 through another hose return the flow from the outlet port to the tank with anti-freeze 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.

9. Service and warranty

Danfoss APP S 674 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 guarantees 8,000 hours service-free operation, however, max 18 months from date of production.

If Danfoss recommendations concerning system-design are not followed, *it will strongly influence the life of the APP S 674 pumps.*

Maintenance:

After 8,000 hours of operation, it is strongly recommended to inspect the pump and change any worn parts, e.g. pistons. 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 service intervals.

Standstill:

The APP S 674 pumps are made of Super Duplex materials with excellent corrosion properties.

It is always recommended to flush the pump with freshwater when the system is shut down.

9.1 Repair

In case of irregular function of the APP S 674 pump, please contact Danfoss High Pressure Pumps.

9.2 Recommended service intervals

The recommended service intervals on the different parts in the APP S 674 pumps appear from the table below:

Position	Qty. for all pump sizes			Description	Material	Service interval
	3.0-3.5	5.1-9.0	21-38			
1	1	1	1	Housing, main bearing	Super Duplex, PEEK	No need for service
121	1	1	1	Port flange	Super Duplex	No wear part
31	1	1	1	Swash plate	Super Duplex	40,000 hours
66	7	9	9	Pistons	Super Duplex, PEEK	Recommended inspection on a yearly basis; evaluate, if replacement is needed
92	1	1	1	Valve plate	Super Duplex	24,000 hours
91	1	1	1	Port plate	Super Duplex, PEEK	24,000 hours
61	1	1	1	Cylinder barrel	Super Duplex	40,000 hours
65	1	1	1	Retainer plate	Super Duplex	24,000 hours
64	1	1	1	Retainer ball	Super Duplex	40,000 hours
71		1	1	Retainer guide	Super Duplex, PEEK	40,000 hours
62	1	1	4	Spring	Hastelloy, C4	40,000 hours
63	1			Spring guide	PEEK	40,000 hours
142		1	1	Stop for shaft seal	Super Duplex	No wear part
124	1	1	1	Shaft seal	Hastelloy and NBR/FFKM	It is good practice to change the seal after each disassembly of the pump
125	1	1	1	Flange for shaft seal	Super Duplex	No wear part
93	7	9	9	Back-up ring	Teflon	24,000 hours
				O-ring (overall)	NBR	24,000 hours
5, 123, 126, 127, 128, 133, 147, 153				Screw (overall)	AISI 316	No wear part
				Pin (overall)	AISI 316, PEEK	
				Pin (overall)	AISI 316, Super Duplex	No wear part
152	1	1	1	Valve cone (flushing valve)	Super Duplex, PEEK	40,000 hours
134	2			Bleeding screw	Super Duplex	No wear part
3		2	4	Bleeding screw	Super Duplex	No wear part
67	1	1	1	Parallel key	AISI 316	40,000 hours

EC Declaration of Conformity

Danfoss A/S

Danfoss High Pressure Pumps
Nordborgvej 81
6430 Nordborg
Denmark

EO-Konformitätserklärung gemäß EG-Richtlinie 2006/42/EG	EC Declaration of Conformity according to Directive 2006/42/EC	Déclaration de conformité CE conformément à la Directive 2006/42/CE
Hiermit erkläre ich, dass die Maschine gemäß 2006/42/EG conforms.	We hereby declare that this machine is designed according to the directive 2006/42/EC.	Par la présente, nous déclarons que la machine est conçue conformément à la Directive 2006/42/CE.
Beschreibung der Maschine High pressure pump	Machine description High pressure pump	Description de la machine Pompe haute pression
Maschinenart APP S 674 3.0 / APP S 674 3.5 APP S 674 5.1 / APP S 674 6.5 APP S 674 7.2 / APP S 674 8.2 APP S 674 9.0 APP S 674 21 / APP S 674 24 APP S 674 26 / APP S 674 30 APP S 674 33 / APP S 674 36	Machine designation APP S 674 3.0 / APP S 674 3.5 APP S 674 5.1 / APP S 674 6.5 APP S 674 7.2 / APP S 674 8.2 APP S 674 9.0 APP S 674 21 / APP S 674 24 APP S 674 26 / APP S 674 30 APP S 674 33 / APP S 674 36	Type de machine APP S 674 3.0 / APP S 674 3.5 APP S 674 5.1 / APP S 674 6.5 APP S 674 7.2 / APP S 674 8.2 APP S 674 9.0 APP S 674 21 / APP S 674 24 APP S 674 26 / APP S 674 30 APP S 674 33 / APP S 674 36
Seriennummer N/A	Serial number N/A	Numéro de série N/A
Technisches Dossier, Kontaktperson Lars Christensen	Technical dossier, Contact person Manager Quality Department	Personne de contact pour le dossier technique Manager Département qualité
Angewandte harmonisierte Normen EN 10182:2011	Used harmonised standards EN 10182:2011	Normes harmonisées appliquées EN 10182:2011

Hersteller / Manufacturer / Titulaire

Abnehmer / Buyer / Destinataire

Signature des fabricant / Titulaire



2013 - 12 - 19
Date

2013 - 12 - 19
Date

2013 - 12 - 19
Date

Wolfgang Frischmann
Leiter R&D

Wolfgang Frischmann
Leiter R&D

Wolfgang Frischmann
Chef de R&D

Danfoss A/S
High Pressure Pumps
DK-6430 Nordborg
Denmark

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Parts list

APP S 674 pumps

APP S 674 3.0-3.5 / APP S 674 5.1-9.0

APP S 674 21-38



Parts list	APP S 674 pumps
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APP S 674 5.1-9.0	4. Spare parts list APP S 674 5.1-9.0
APP S 674 21-38	5. Exploded view APP S 674 5.1-9.0
(521B1248)	6. Spare parts list APP S 674 21-38
	7. Exploded view APP S 674 21-38

1. General

This parts list provides an overview of the content of the various service sets for the

- APP S 674 3.0-3.5
- APP S 674 5.1-9.0
- APP S 674 21-38

as well as exploded views of the pumps.

Our CLP RO pumps have changed name as listed below:

CLP674 050-058 RO will now be called APP S 674 3.0-3.5
 CLP674 085-152 RO will now be called APP S 674 5.1-9.0
 CLP674 365-640 RO will now be called APP S 674 21-38

This is ONLY a name change.

Parts list

APP S 674 pumps

2. Spare parts list APP S 674 3.0-3.5

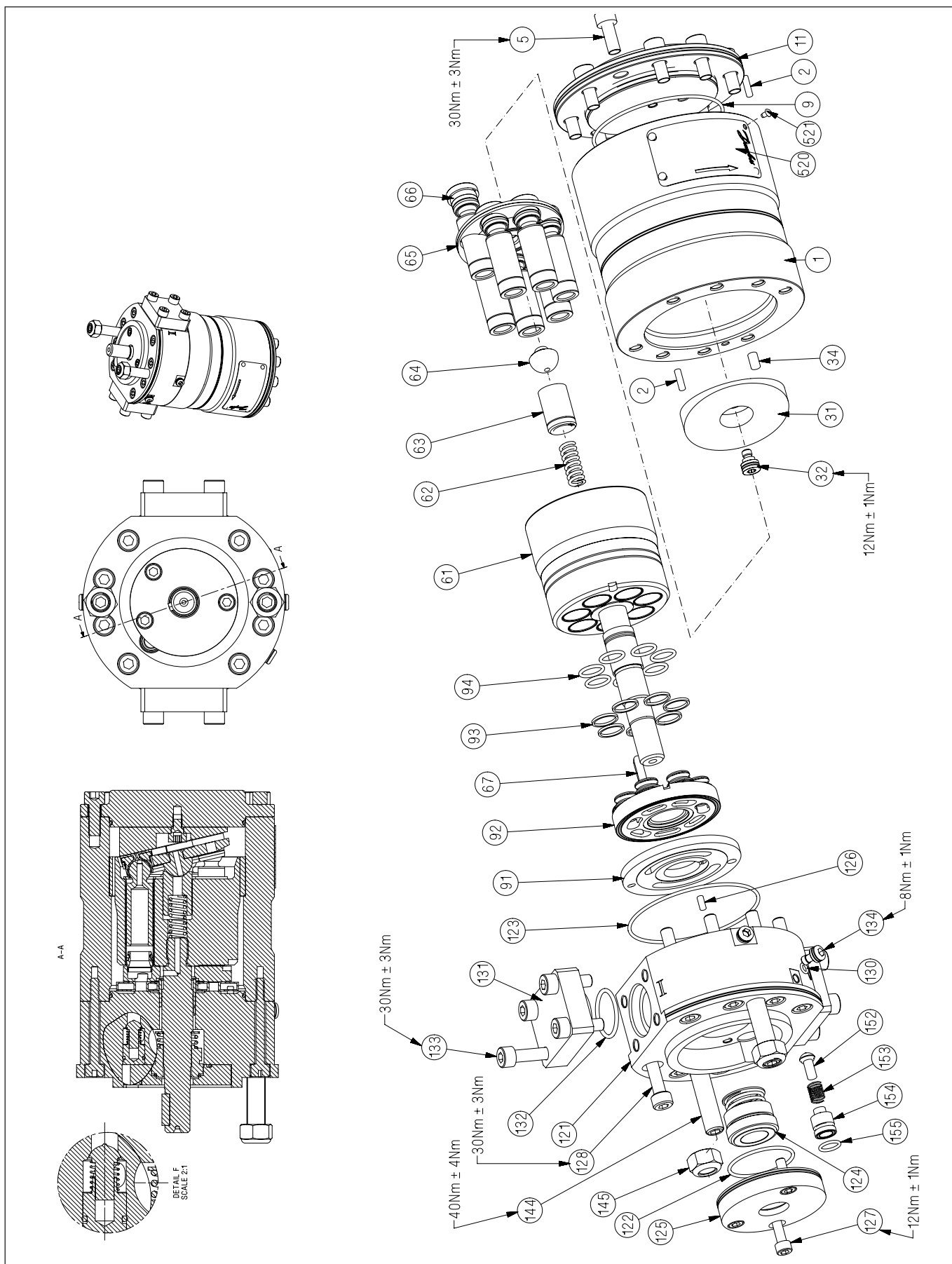
¹ Including PMI report

² Including material certificate - no traceability

³ Including material certificate - traceability

Pos.	Qty.	Designation	Material	180B4265 - Seal set APP S 674 3.0-3.5	180B4197 - Shaft seal	180B4231 - Cylinder barrel	180B4232 - Valve plate set	180B4233 - Retainer set	180B4234 - Piston set	180B4235 - Swash plate APP S 674 3.0	180B4236 - Swash plate APP S 674 3.5	180B4237 - Flushing valve set
1	1	Housing	Super Duplex / PEEK									
2	2	Pin	AISI 316	X								
5	9	Screw M8x20	AISI 316	X								
9	1	O-ring	NBR	X								
11	1	End flange	Super Duplex									
31	1	Swash plate	Super Duplex							X ¹	X ¹	
32	1	Tight fitting bolt	Super Duplex							X ¹	X ¹	
34	1	Pin	PEEK	X								
61	1	Cylinder barrel	Super Duplex/PEEK			X ¹						
62	1	Spring	Hastelloy C4					X				
63	1	Spring guide	PEEK					X				
64	1	Retainer ball	Super Duplex					X ¹				
65	1	Retainer plate	Super Duplex					X ¹				
66	7	Piston	Super Duplex/PEEK						X ¹			
67	1	Key	AISI 316	X								
91	1	Port plate	Super Duplex/PEEK				X					
92	1	Valve plate	Super Duplex				X ¹					
93	7	Back-up ring	PTFE	X								
94	7	O-ring	NBR	X								
121	1	Port flange	Super Duplex/PEEK									
122	1	O-ring	NBR	X								
123	1	O-ring	NBR	X								
124	1	Shaft seal	NBR		X							
125	1	Cover for shaft seal	Super Duplex									
126	1	Pin	PEEK	X								
127	3	Screw M6x16	AISI 316	X								
128	8	Screw M8x55	AISI 316	X								
130	3	O-ring	NBR	X								
131	2	Connection cover	AISI 316									
132	2	O-ring	NBR	X								
133	8	Screw M8x25	AISI 316	X								
134	3	Bleed screw M6	Super Duplex	X ²								
144	2	Tailstock screw M12	AISI 316	X								
145	2	Check nut M12	AISI 316	X								
152	1	Valve cone	PEEK									X
153	1	Spring	Hastelloy C276									X
154	1	Valve guide	Super Duplex									X ²
155	1	O-ring	NBR									X
	1	Press bush tools		X								
	1	Instruction		X					X			

3. Exploded view APP S 674 3.0-3.5



Parts list

APP S 674 pumps

4. Spare parts list APP S 674 5.1 - 9.0

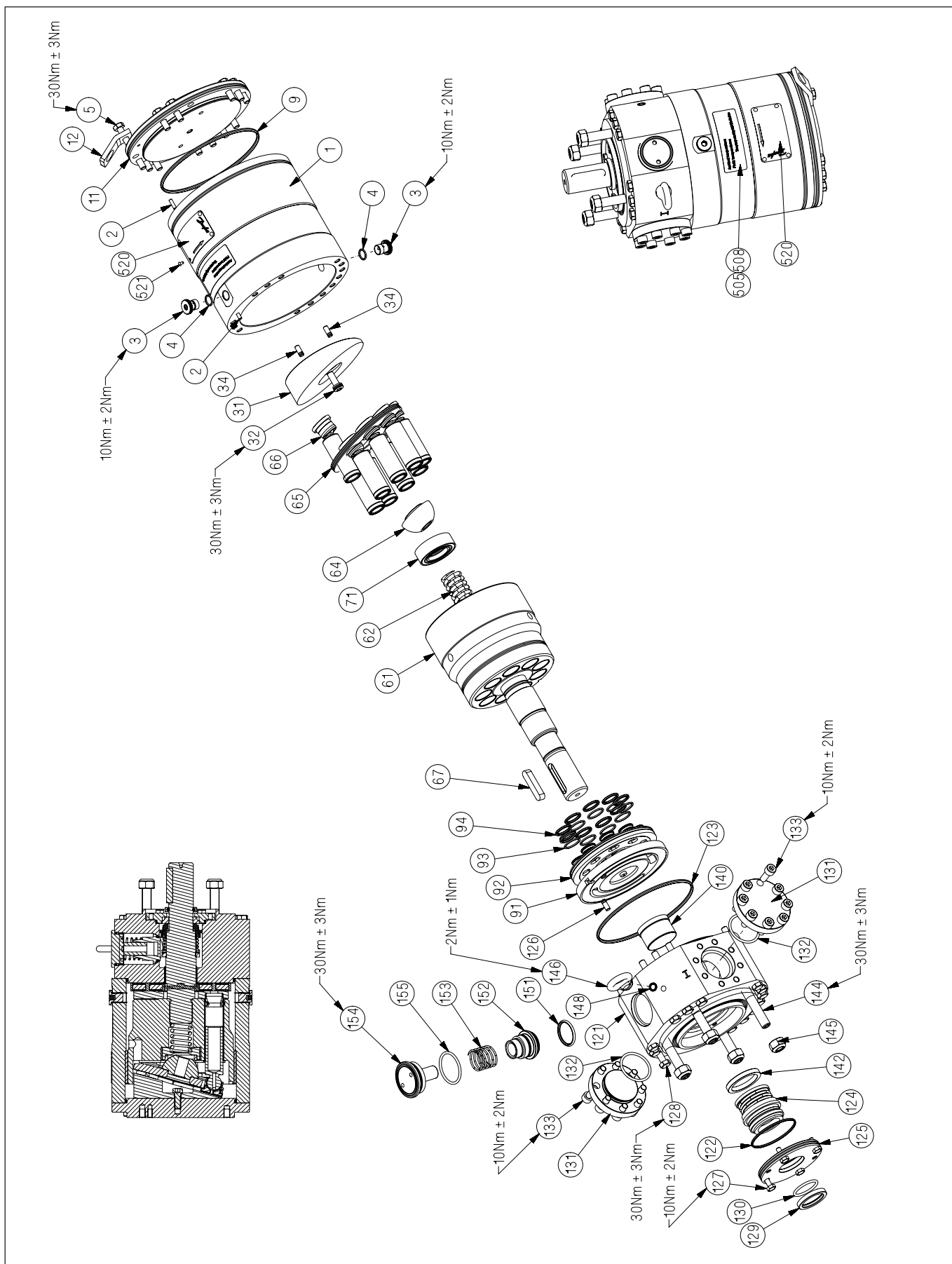
¹ Including PMI report

² Including material certificate - no traceability

³ Including material certificate - traceability

Pos.	Qty.	Designation	Material	180B4261 - Seal set APP S 674 5.1-9.0	180B4243 - Shaft Seal	180B4244 - Cylinder barrel	180B4245 - Valve plate set	180B4246 - Retainer set	180B4247 - Piston set	180B4262 - Swash plate APP S 674 5.1	180B4263 - Swash plate APP S 674 6.5	180B4264 - Swash plate APP S 674 7.2	180B4248 - Swash plate APP S 674 8.2	180B4249 - Swash plate APP S 674 9.0	180B4250 - Flushing valve set
1	1	Housing	Super Duplex/PEEK												
2	2	Pin	AISI 316	X											
3	2	Bleeding plug	Super Duplex	X ²											
4	2	O-ring	NBR	X											
5	14	Screw M8x25	AISI 316	X											
9	1	O-ring	NBR	X											
11	1	End flange	Super Duplex												
31	1	Swash plate	Super Duplex							X ¹	X ¹	X ¹	X ¹	X ¹	
32	1	Screw M8x20	Super Duplex							X	X	X	X	X	
34	2	Pin	Super Duplex	X ¹											
61	1	Cylinder barrel	Super Duplex/PEEK			X ¹									
62	1	Spring	Hastelloy C276					X ¹							
64	1	Retainer ball	Super Duplex					X ¹							
65	1	Retainer plate	Super Duplex					X ¹							
66	9	Piston	Super Duplex/PEEK						X ¹						
67	1	Key	AISI 316	X											
71	1	Retainer guide	Super Duplex/PEEK					X ¹							
91	1	Port plate	Super Duplex/PEEK				X								
92	1	Valve plate	Super Duplex				X ¹								
93	9	Back-up ring	PTFE	X											
94	9	O-ring	NBR	X											
121	1	Port flange	Super Duplex/PEEK												
122	1	O-ring	NBR	X											
123	1	O-ring	NBR	X											
124	1	Shaft seal	Hastelloy C4/NBR		X										
125	1	Cover for shaft seal	Super Duplex												
126	1	Pin	Super Duplex	X ¹											
127	4	Screw M6x16	AISI 316	X											
128	14	Screw M8x90	AISI 316	X											
129	1	Stop bush	PP	X											
130	1	O-ring	NBR	X											
131	2	Connection cover	AISI 316												
132	2	O-ring	NBR	X											
133	16	Screw M8x25	AISI 316	X											
142	1	Stop for shaft seal	Super Duplex		X ¹										
144	4	Tailstock screw M12x60	AISI 316	X											
145	4	Check nut M12	AISI 316	X											
151	1	O-ring	FPM	X											X
152	1	Valve cone	Super Duplex												X ¹
153	1	Spring	Hastelloy C276												X
154	1	Plug/guide	Super Duplex												X ³
155	1	O-ring	NBR	X											X
	1	Press bush tool Ø35		X											
		Instruction		X					X						X

5. Exploded view APP S 674 5.1 - 9.0



Parts list

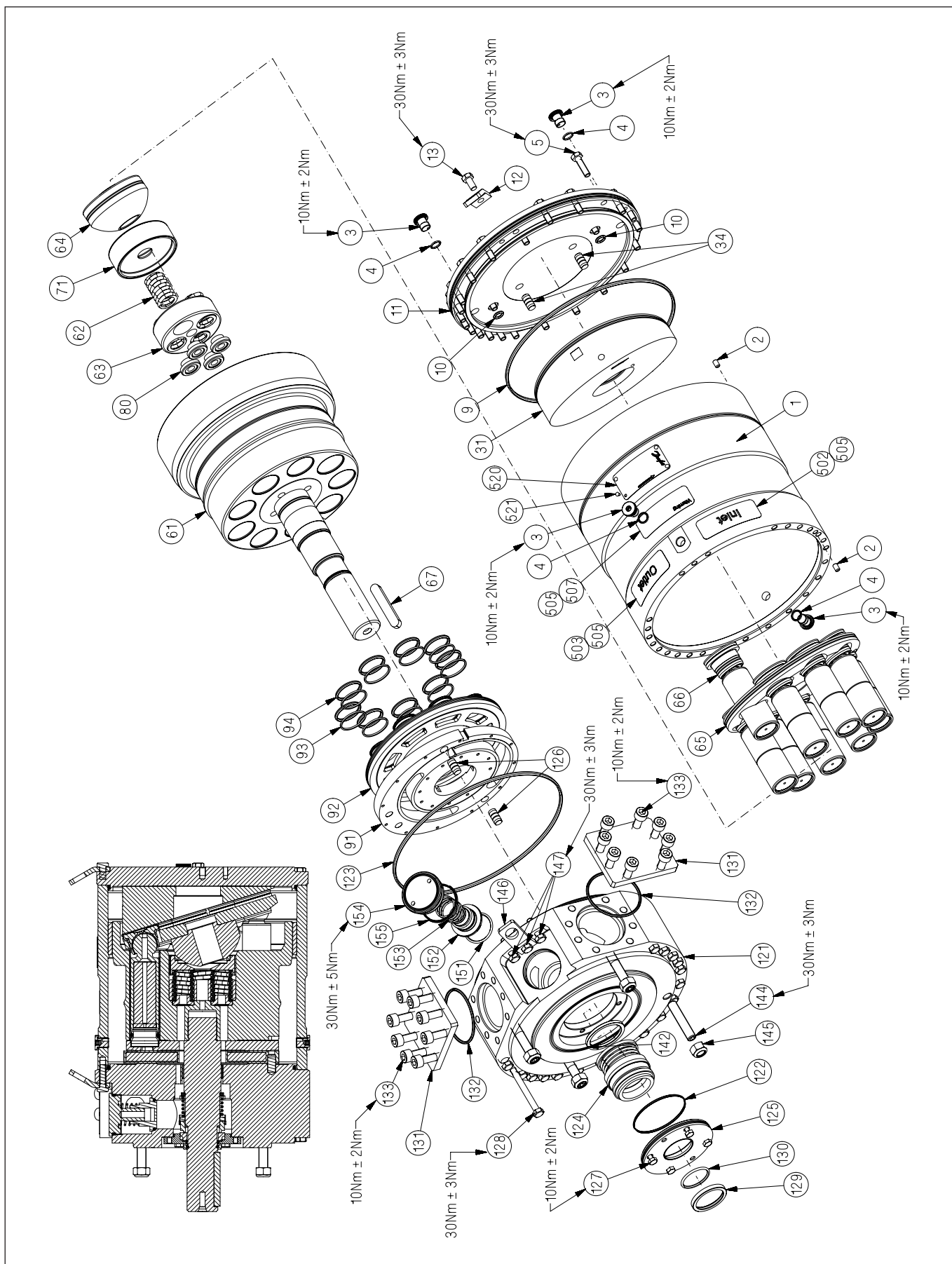
APP S 674 pumps

6. Spare parts list APP S 674 21-38

- ¹ Including PMI report
² Including material certificate - no traceability
³ Including material certificate - traceability

Pos.	Qty.	Designation	Material	180B4088 - Seal set	180B4211 - Shaft Seal	180B4210 - Cylinder barrel	180B4364 - Valve plate set APP S 674 21-33	180B4365 - Valve plate set APP S 674 38	180B4207 - Retainer set APP S 674 21-33	180B4213 - Retainer set APP S 674 38	180B4089 - Piston set	180B4094 - Swash plate APP S 674 21	180B4095 - Swash plate APP S 674 24	180B4093 - Swash plate APP S 674 26	180B4092 - Swash plate APP S 674 30	180B4090 - Swash plate APP S 674 33	180B4091 - Swash plate APP S 674 38	180B4208 - Flushing valve set
1	1	Housing	Super Duplex/PEEK															
2	2	Pin	AISI 316	X														
3	4	Bleeding plug	Super Duplex	X ²														
4	4	O-ring	NBR	X														
5	25	Screw M8x30	AISI 316	X														
9	1	O-ring	NBR	X														
10	2	O-ring	NBR	X														
11	1	End flange	Super Duplex															
12	1	Lifting eye	AISI 316															
13	1	Screw M8x16	AISI 316	X														
31	1	Swash plate	Super Duplex									X ¹	X ¹	X ¹	X ¹	X ¹	X ¹	
34	2	Pin	Super Duplex	X ¹														
61	1	Cylinder barrel	Super Duplex/PEEK			X ¹												
62	4	Spring	Hastelloy C276						X ¹	X ¹								
63	1	Spring guide	PP						X	X								
64	1	Retainer ball	Super Duplex						X ¹	X ¹								
65	1	Retainer plate	Super Duplex						X ¹	X ¹								
66	9	Piston	Super Duplex/PEEK								X ¹							
67	1	Key	AISI 316	X														
71	1	Retainer guide	Super Duplex/PEEK						X ¹	X ¹								
80	4	Spacer	Super Duplex							X ¹								
91	1	Port plate	Super Duplex/PEEK				X	X										
92	1	Valve plate	Super Duplex				X ¹	X ¹										
93	9	Back-up ring	PTFE	X														
94	9	O-ring	NBR	X														
121	1	Port flange	Super Duplex/PEEK															
122	1	O-ring	NBR	X														
123	1	O-ring	NBR	X														
124	1	Shaft seal	Hastelloy C4/FFKM		X ¹													
125	1	Cover for shaft seal	Super Duplex															
126	2	Pin	Super Duplex	X ¹														
127	4	Screw M6x16	AISI 316	X														
128	19	Screw M8x100	AISI 316	X														
129	1	Stop bush	PP	X														
130	1	O-ring	FPM	X														
131	2	Connection cover	AISI 316															
132	2	O-ring	NBR	X														
133	16	Screw M10x30	AISI 316	X														
142	1	Stop for shaft seal	Super Duplex		X ¹													
144	4	Tailstock screw M12x60	AISI 316															
145	4	Check nut M12	AISI 316	X														
146	1	Lifting eye	AISI 316															
147	3	Screw M8x30	AISI 316	X														
151	1	O-ring	FPM	X														X
152	1	Valve cone	Super Duplex															X ¹
153	1	Spring	Hastelloy C276															X
154	1	Plug/guide	Super Duplex															X ³
155	1	O-ring	NBR	X														X
	1	Instruction		X							X							X

7. Exploded view APP S 674 21-38



8. Tool sets

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

Designation	180B4347 – Tool set (APP S 674 21-38)
Adjustable pin wrench	x
Nut M8x6.5x13	x
Guide bolt M8x140mm	x
Press Bush Ø45	x
Eye bolt M8	x
Press bush for valve plate	x
Stop for retainer plate	x
Screw M8x20	x
Screw M8x70	x
Screw M8x140	x

Guideline

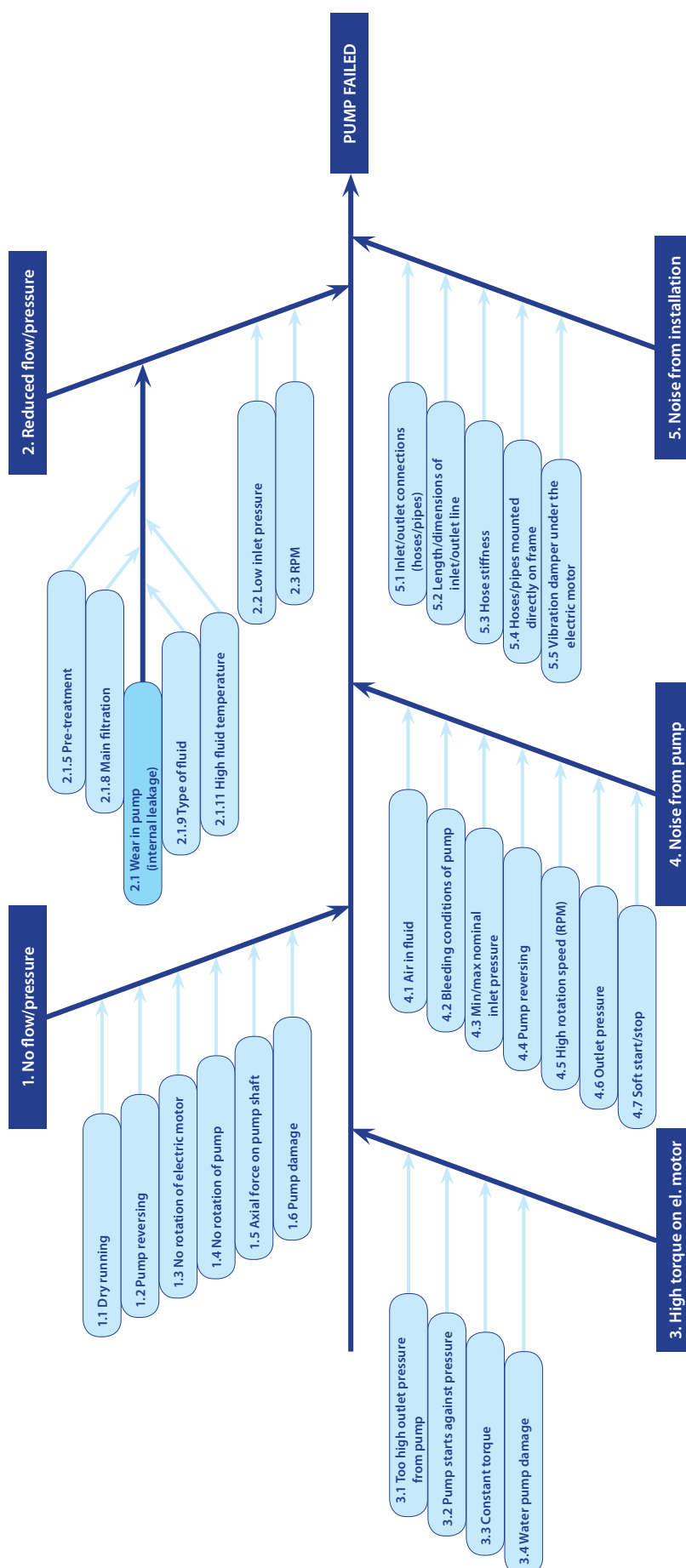
Trouble shooting guide for APP and APP S 674 pumps



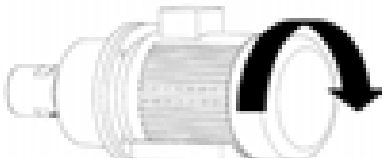
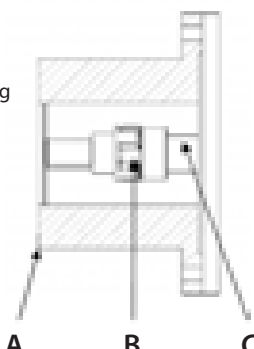
Instruction	Trouble shooting guide for APP and APP S 674 pumps
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Table of Contents	Trouble shooting fish bone chart
Trouble shooting guide for APP and APP S 674 pumps	1. No flow/no pressure
	2. Reduced flow/reduced pressure
	3. High torque on electric motor
	4. Noise from pump
	5. Noise from installation
	6. Typical signs of wear
	6.1 Valve plate
	6.2 Port plate
	6.3 Swash plate

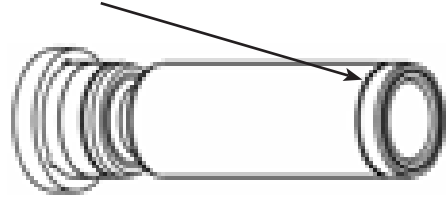
Trouble shooting
fish bone chart



1. No flow/no pressure

Cause	Remedy	Comments
1.1 Dry running (no water supply to the pump)	If no water comes out of the pump: 1.1.1 Check that inlet valve is open. 1.1.2 Check that booster pump is running.	Mount a low pressure switch in front of the pump and check its set point/ function. The low pressure switch ensures that the pump does not start until the inlet pressure has reached minimum inlet pressure (see Data sheet).
1.2 Pump reversing (electric motor is running the wrong direction, i.e. counter-clockwise)	1.2.1 Change the phase on the electric motor to make it run clockwise. WARNING: - The pump must not run without water for more than a few seconds. - If the pump takes in water from the high-pressure outlet line, it builds up pressure in pump housing and will eventually break down.	Rotation direction for the APP or APP S 674 pump is shown by an arrow on the sticker on the side of the pump. 
1.3 No rotation of electric motor	1.3.1 Check that main switch is switched on. 1.3.2 Check the electricity at the facility. 1.3.3 Ensure that motor relay is switched on. 1.3.4 Ensure that fuse is not blown. 1.3.5 Ensure that booster pump is started. 1.3.6 Check that the monitor switches are working correctly. 1.3.7 Disconnect pump from electric motor and check that the motor is capable of running with no load.	If motor-type relay or the electrical fuse is blown, check that electric motor is sized correctly.
1.4 No rotation of pump	1.4.1 Ensure that coupling between electric motor and pump is connected. 1.4.2 Check if coupling is damaged. 1.4.3 Check that electric motor is sized correctly. 1.4.4 Check that the electrical installation is correctly sized. 1.4.5 Contact Danfoss Sales office for guidelines in how to troubleshoot internal pump parts.	
1.5 Axial load on pump shaft (may cause high internal leakage) Only applying to APP 0.6 to APP 3.5 and APP 21 to APP 26 only. Also applying to APP S 674 pumps.	1.5.1 Ensure that the air gap between the two coupling parts is min 5 mm. It should always be possible to move the plastic part on the coupling at least 3 mm.	To ensure easy mounting of the flexible coupling without using tools, the tolerances must be dimensioned accordingly. WARNING: Any axial and/or radial loads on the shaft must be avoided. Any axial or radial load will cause breakdown. A - Bell housing B - Flexible coupling C - Motor shaft 
1.6 Pump damage (the internal parts may be damaged)	1.6.1 Contact Danfoss sales office for guidelines in how to troubleshoot internal pump parts.	Instructions on internal elements 180R9092/180R9085 for APP 0.6-1.0 180R9091/180R9147/180R9089 for APP 1.5-3.5 180R9093/180R9090 for APP 5.1-10.2 180R9228/180R9227 for APP 11-13 and APP 16-22 180R9121/180R9139 for APP 21-38 180R9281 for APP S 674 3.0-3.5 180R9280 for APP S 674 5.1-9.0 180R9278 for APP S 674 21-38 – are available on www.ro-solutions.com .

2. Reduced flow/reduced pressure

Cause	Remedy	Comments
2.1 Wear on pump Large internal leakage due to: - Pre-treatment - Main filtration - Fluid type - High fluid temperature	2.1.1 Dismantle the pump. 2.1.2 Check valve plate. Valve plate has marks/scratches on the surface facing the port plate. Minor wear on valve plate can cause large internal leakage. See Index 6.1. 2.1.3 Check port plate. Port plate has marks/scratches on the surface facing the valve plate. Minor wear on port plate can cause large internal leakage. See Index 6.2. 2.1.4 Check cylinder barrel. Liners in cylinder barrel may be scratched or worn. Insert a piston in the liner and check the fit. If there is any space (clearance) between liner and piston, liner or piston is worn. 2.1.5 Analyse fluid for content of particles. 2.1.6 Check that filters are OK and working correctly. 2.1.7 Install correct pre-filter (1µm nom. string-wound filter). 2.1.8 Check that the correct filter type is used (particles in fluid must not exceed 10 µm). Danfoss High Pressure Pumps supplies filters, please contact the sales office. 2.1.9 The APP and APP S 674 pumps are designed for seawater operation; for any other fluid, please contact Danfoss High Pressure Pumps sales office for further help. 2.1.10 If fluid temperature is above 50°C, stop the pump immediately. 2.1.11 Check internal parts (see above).	Typical signs of wear: Polished surface all over the swash plate. Normally, only half of the swash plate = the pressure side is polished. See index 6.3. If the ring is missing, the piston is very worn.  The filters can be bypassed, even if they are correctly mounted. Some filters can create channelling where particles can pass through the filter in tunnels. String wound filters are typically channelling filters. A string wound filter may have a filtration efficiency of only 50%, which will cause internal wear and must always be followed by a main filter. Insufficient filtration means that too many or too large hard particles can pass the main filter because it is damaged, bypassed or simply too poor. Filtration efficiency must be 99.98% (Beta = 5000) at 10 µm to prevent abnormal wear of the pump. Temperature > 50° C will cause wear on internal pump parts. Mount a temperature switch and check its set point / function. The temperature switch will ensure that the pump stops at fluid temperatures > 50° C.
2.2 Low inlet pressure	2.2.1 Check that booster pump supplies the right pressure/flow. 2.2.2 Check if filters require replacement.	If the pressure drop across the filters is too high, the booster pump does not deliver sufficient flow/pressure. No pressure or low pressure results in cavitation and insufficient internal lubrication causing wear on internal pump parts. Mount a low-pressure switch in front of the pump and check its set point/ function. The low-pressure switch ensures that the pump does not start until the inlet pressure has reached 1 bar.
2.3 Rotation speed (rpm)	2.3.1 If VFD-operated, check frequency. 2.3.2 Check that rotation speed of the electric motor is as stated on name plate on electric motor. Check that the motor rotor winding is not damaged.	Speeds below 700 rpm result in insufficient internal lubrication causing wear on the internal pump parts.

3. High torque on electric motor

Cause	Remedy	Comments
3.1 Too high outlet pressure from pump	3.1.1 Check fluid salinity. 3.1.2 Check temperature. 3.1.3 Check pressure drop across RO membrane.	Pump conditions may change (more salt, lower water temperature or scaling of RO membrane) causing higher pressure, resulting in higher motor torque.
3.2 Pump starts against pressure	3.2.1 Check that electric motor is correctly sized. 3.2.2 Check internal parts (see item 2.1). 3.2.3 Systems with more than one electric motor installed: Start motors simultaneously.	Pumps run in parallel with cascade start, may switch off the motor relay due to too high torque caused by high outlet pressure.
3.3 Constant torque	3.3.1 Please contact Danfoss sales office.	If the electric motor is too small for the APP or APP S 674 pump, it cannot provide sufficient torque.

4. Noise from pump

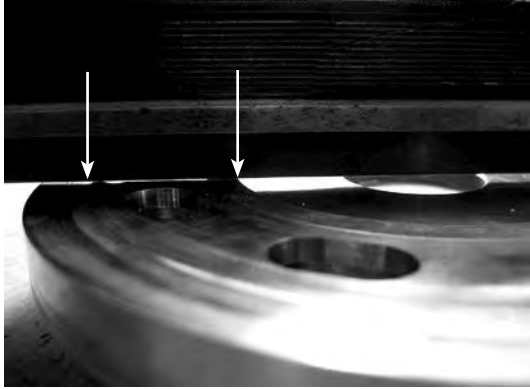
Cause	Remedy	Comments
3.4 Water pump damage	3.4.1 Dismantle pump and check for wear.	Too heavy damage in the pump will increase friction causing a high torque (see item 6, Typical signs of wear).
4.1 Air in fluid	4.1.1 Ensure that the entire inlet line is bled before starting up the system. 4.1.2 Ensure that air cannot enter into the inlet line.	Small air bubbles will accumulate and create large bubbles causing internal cavitation and thus making the pump very noisy. WARNING: The pump can only run few minutes with air in the fluid without being damaged.
4.2 Bleeding conditions of pump	4.2.1 Follow the instructions "Initial start-up" supplied with the new pump. 4.2.2 Ensure that the pump is completely bled before start-up.	The pump and the inlet line must be completely bled before start-up, otherwise the pump will cavitate and make high noise. WARNING: The pump can only run few minutes with air in the fluid without being damaged.
4.3 Min/max nominal inlet pressure	4.3.1 Ensure that inlet pressure is between 1 and 5 bar. 4.3.2 Check the pump for internal damage.	Too high inlet pressure causes too high pressure inside the pump damaging the pistons and eventually the pump. Inlet pressure below 1 bar causes cavitation and insufficient internal lubrication resulting in wear on internal pump parts. Mount a low-pressure switch in front of the pump and check its set point/ function. The low-pressure switch will ensure that the pump does not start until the inlet pressure has reached 1 bar.
4.4 Pump reversing	4.4.1 Dismantle pump and check if anything is broken or worn (See "1. No flow", item 1.2 Pump reversing"). WARNING: The pump must not run without water for more than a few seconds. If the pump takes in water from the high-pressure outlet line, it builds up pressure and will eventually be damaged.	If pump rotates in wrong direction, it will take in water from the high-pressure outlet line. Pressure will be built up inside the pump and it will eventually be damaged.
4.5 High rotation speed (rpm)	4.5.1 If electric motor rpm is too high, dismantle pump and check for damage. 4.5.2 If the rpm is within the specified range of the pump data sheet and abnormal noise remains, dismantle pump and check for damage.	Higher rpm than specified in the pump data sheet results in wear of the pistons, i.e. pistons may be damaged. High rpm will also increase pressure pulsations from the pump, and the noise level will increase. If rpm is changed, noise frequency will also change.
4.6 Outlet pressure	4.6.1 If outlet pressure is too low, check set point of outlet pressure valve. 4.6.2 If outlet pressure is lower than mentioned in the pump data sheet, please contact Danfoss High Pressure Pumps technical support. 4.6.3 If outlet pressure has exceeded its maximum, check set point of outlet pressure valve. 4.6.4 Check internal parts for wear/damage.	At too low outlet pressure, the pump will create higher pressure pulsations and thus make noise. Too low pressure also causes insufficient internal lubrication and wear on internal parts. Pump may eventually be damaged. Too high outlet pressure may damage the pump.
4.7 Soft start/stop	4.7.1 Check if noise is normal when the pump is running at operation speed. 4.7.2 If noise is abnormal at operation speed, check internal parts (see above).	Noise frequency changes during soft start-up/ stop.

5. Noise from installation

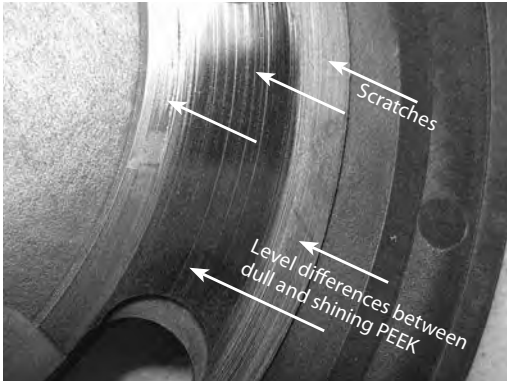
Cause	Remedy	Comments
5.1 Inlet/outlet connections (hoses/pipes)	5.1.1 Use flexible hoses at inlet/outlet connections. Danfoss can provide flexible hoses. Please contact Danfoss sales office for further information. 5.1.2 Mount the connections to the frame by a vibration damper mounting plate.	Non-flexible connections mounted directly on the frame will cause even small pressure pulsations from pump and create vibrations in the system/plant.
5.2 Length/dimension of inlet/outlet line	5.2.1 Increase pipe diameter and/or reduce the number of bends.	Too small pipes or too many bends may create too fast flow/turbulence through the pipes and thus increase the noise level.
5.3 Hose stiffness	5.3.1 Use a more flexible hose. Danfoss can provide flexible hoses. Please contact Danfoss sales office for further information.	Too stiff hoses cannot damp the small pressure pulsations from the pump, and subsequently vibrations occur in the system/plant.
5.4 Hoses/pipes mounted directly on frame	5.4.1 Mount the connections to the frame by a vibration damper mounting plate.	If the hoses are mounted directly on the frame, the small pressure pulsations from the pump can be transferred to the frame and the rest of the system/plant.
5.5 Vibration damper under the electric motor	5.5.1 Mount a vibration damper below the motor/pump.	When no damper is installed below the electric motor, vibrations from the motor and pump may be transferred to the frame and the rest of the system/plant.

6. Typical signs of wear

6.1 Valve plate

Picture 1 	A normally worn valve plate has no marks/scratches but only a slightly polished surface. No scratches or marks should be felt. The surface must be flat and level.
Picture 2 Scratches 	A worn valve plate has scratches, and/or a polished surface. Even small scratches will give a loss of flow.
Picture 3 	A good way to identify a worn valve plate is to hold a straight knife edge over the valve plate. When holding it up to the light, it will be possible to see any space between the knife edge and the valve plate. See picture 3. If any light can be seen between the two arrows on the picture, the valve plate is worn. If any scratches or marks can be felt by running a fingernail over the surface, the valve plate is worn. The valve plate on picture 3 is highly damaged.

6.2 Port plate

Picture 1  Scratches Level differences between dull and shining PEEK	If the port plate has scratches, level differences or both between the arrows, the port plate must be replaced. Even small scratches or wear will cause loss of flow. To check: See item 6.1, picture 3
--	--

6.3 Swash plate

Picture 1 	If the swash plate is polished 360°, it is an indication of insufficient filtration. The surface of the swash plate must be plane and even at same level all over. To check this, please see item 6.1, picture 3. If the surface has any marks/scratches it is worn/damaged and a new one is required. Please contact Danfoss High Pressure Pumps sales office for further information.
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