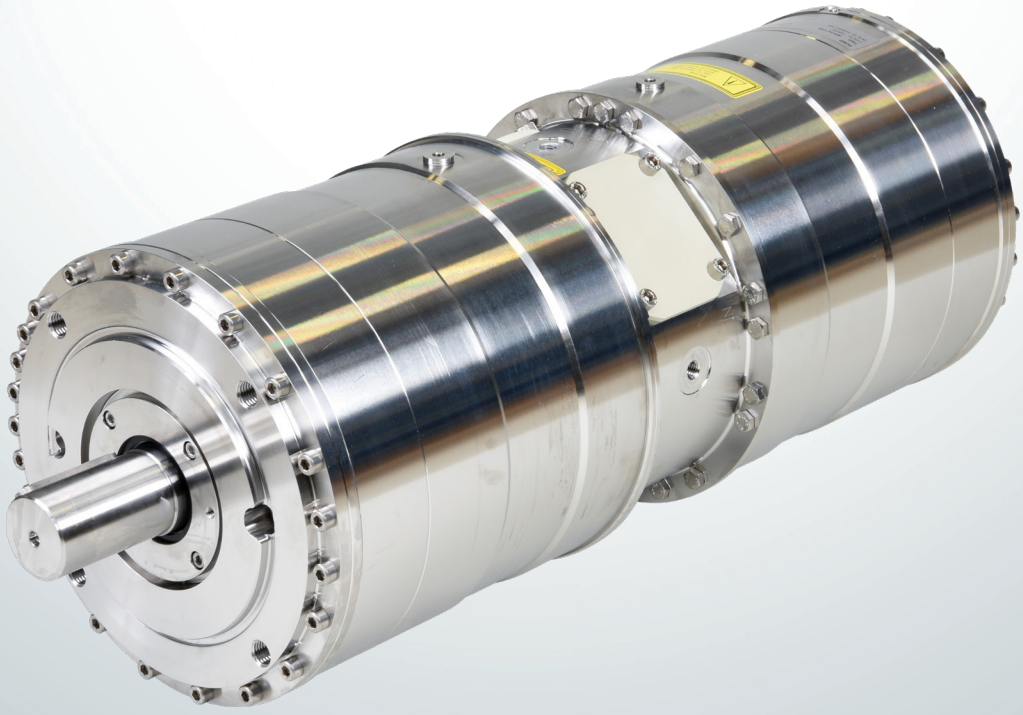
ENGINEERING
TOMORROW

Operation guide

APP pumps with FDA approved seals
APP 53 / APP 65 / APP 78 / APP 86 / APP 92
Installation, Operation and Maintenance Manual



hpp.danfoss.com

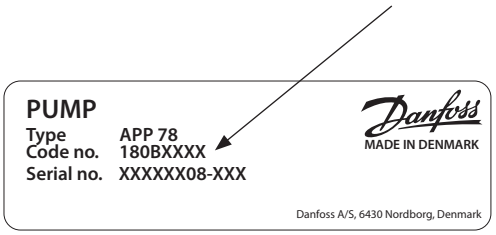
Table of Contents

Contents

Validity

This manual is valid for APP pumps with the following type an serial number or higher:

Type	Serial no.
APP 53	XXXXXX**08**-XXX
APP 65	XXXXXX**08**-XXX
APP 78	XXXXXX**08**-XXX
APP 86	XXXXXX**08**-XXX
APP 92	XXXXXX**08**-XXX



The serial number is referring to the Serial no. on the product label. The digits shown (08) indicate the version number of the pump.

1. Introduction

1.1 General

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

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

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

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

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

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

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

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

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

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

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

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

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

1.2 Symbols

	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
	Danger HOT. Do not touch

1.3 Manufacturer and customer service address

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

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

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

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

1.4 Country specific information

1.4.1 United Kingdom

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

2. Safety

2.1 General information

Dangers that can arise from not following the instructions:

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

- Death or fatal injuries
- Costly damages and claims

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

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

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

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

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

Always wear suitable safety clothing when handling the pump.

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

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

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

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

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

Danger
Installation and maintenance must always take place during complete shutdown in an unpressurised condition.
The drive unit must be secured against inadvertent switching-on (with signs, switching off electricity power supply) in order to avoid serious injuries due to rotating parts. Do not reach inside the working area during the operation of the coupling. For protection against accidental contact appropriate security must be installed.

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

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

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

2.2 Preferred system design

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

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

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

2.3 Commissioning and servicing the unit

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

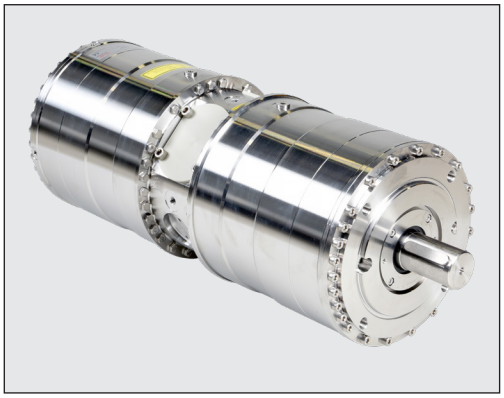
2.4 Adhere to the following important points

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

2.5 In case of doubt

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

3. Technical data



3.1 Approved applications and operational limits for the pumps

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

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

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

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

3.2 Application range

The Danfoss range of APP high-pressure pumps is designed according to EN 809 for use in RO applications with low viscosity and corrosive fluids such as sea water.

3.3 Electric motor data

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

3.4 VFD and Direct on line

Danfoss APP pumps can be used with VFD and direct on line.
Torque limits can be found in the table below:

Nm	APP 53	APP 65	APP 78	APP 86	APP 92
MAWT	878	1,118	1,257	1,112	1,112
MAST	1,700	1,700	1,700	1,700	1,700

MAWT: Maximum allowable working torque
MAST: Maximum allowable starting torque

3.5 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.

3.6 Dimension drawings

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

3.7 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.

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

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

It should be possible to monitor the condition of the filter via the differential/delta pressure across the filter.
Using insufficient filtration or a filter bypass can cause a failure or decreased service life of the pump.

3.9 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.

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

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

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

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

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

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

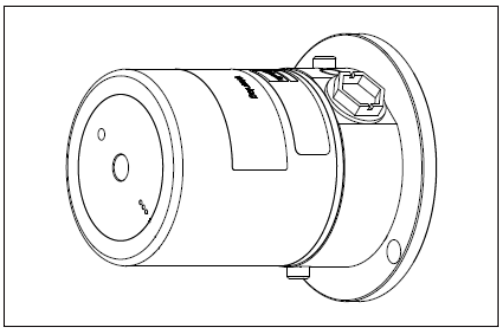
In case of damage and/or missing parts, a report should be documented and presented to the carrier at once.

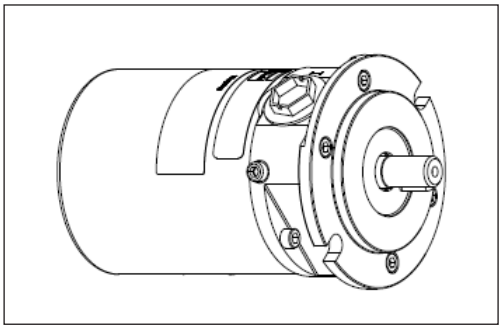
4.2 Warning
Before any lifting operation is performed, environmental conditions must be taken into consideration (Ex-rated areas, wind speed, wet/dry conditions, lifting height, etc.).

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

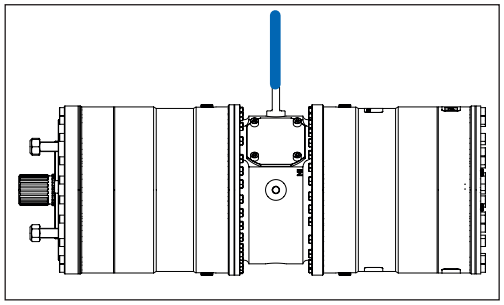
4.4 Transport and handling
Small pumps which have a weight below 20 kilos can be handled by hand if they are not mounted together with an electric motor. The weight of a small pump with a motor will be above 20 kilos.

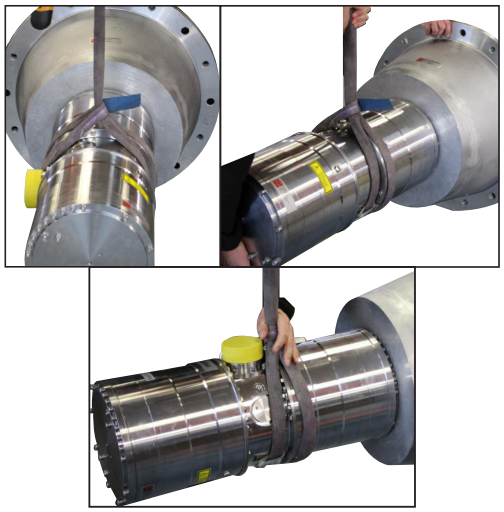
Do not use connections/nozzles for lifting!
Do not use only one sling!





Pumps which have a weight above 20 kilos must be handled by using lifting eyes and slings.



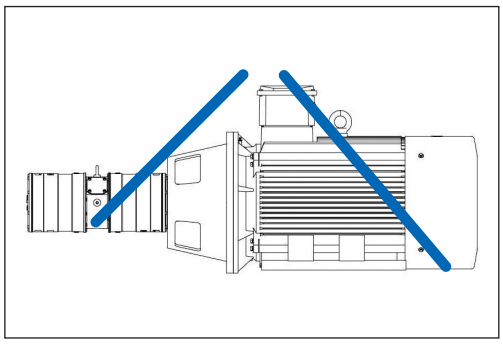


When the pump is mounted together with a bell housing, the pump can be rotated and in that case the lifting eye cannot be used in all positions. When lifting a pump with bell housing, a sling can be used to lift the pump by positioning it on the drive end of the pump outlet.

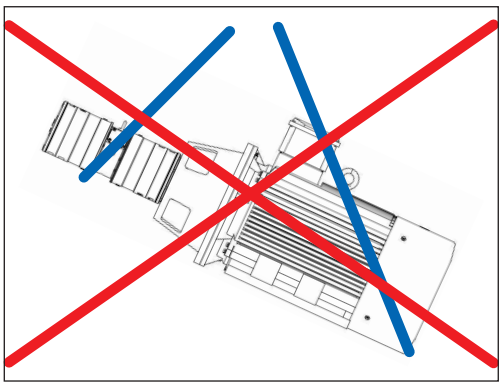
When the pump is mounted together with an electric motor, *it must not be lifted in the lifting eye*. A pump unit with motor must be handled by using two slings around the pump unit. One sling must be attached to the electric motor and one sling around the pump.
Make sure that the unit/load is balanced before lifting. The centre of the mass varies from pump/pump unit size to pump(pump unit).

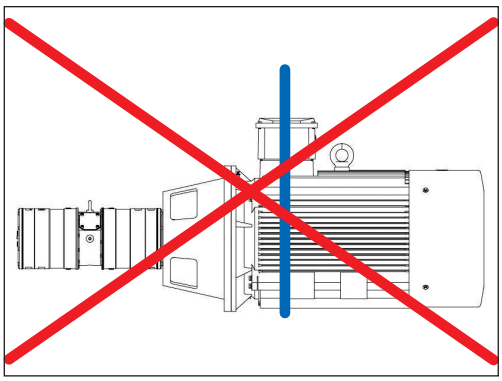
See below examples of where to/not to attach the lifting slings on the pump unit with motor:

Correct lifting with 2 separate slings:



Wrong lifting:





Some motors and pumps have specific lifting eyes.

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

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

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

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

4.5 Return to supplier

Please see maintenance chapter 7.

4.6 Storage

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

The pumps are NOT delivered frost protected from the factory.

5. Installation and commissioning

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

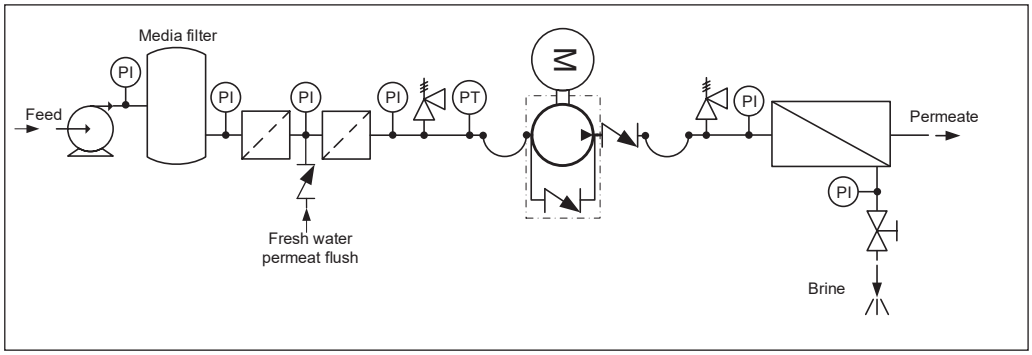
5.2 Cleanliness
It is very important that the tubes and pipes are **completely clean**: no dirt, chips or burrs are allowed. Flush all piping before connecting the high-pressure pump to ensure the system is clean. Internal surfaces of the piping must not be corroded. If dirt or rust is not removed, the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

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

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

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

Schematic 1: Recommended system design



5.6 Pre mounting checklist, based on Danfoss preferred system design

Table 1: Check points when assembling and commissioning system

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

5.7 Lifting and positioning

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

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

5.8 Mount the different equipment

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

- The hard piping and flexible hoses used, must be of proper design and must be installed in accordance with the manufacturer's recommendations. (see also Design guides 180R9084 and 180R9367 - both available on hpp.danfoss.com).
- Misalignment of the hard pipes may give unintended stress on the pump port connections and may damage the pump.
- Prevent excessive external pipe load.
- Do not connect piping by applying external force (use of wrenches, crane, etc.) Piping must be aligned without residual stress.
- Do not mount expansion joints so that their force applies internal pressure on the pump connections.

5.9 Electrics

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

Turn off the safety circuit breaker and lock it.

Mount the power cable on the electric motor.

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

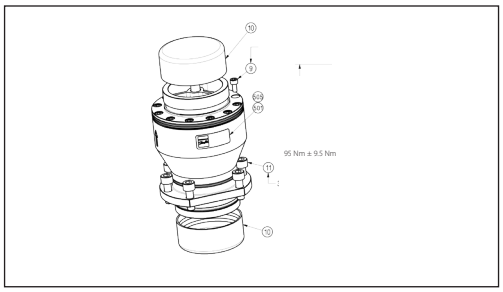
5.10 Instrumentation

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

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

5.11 Connections

Mount and tighten connections and check valve(s) as specified.
Danfoss check valve VCM 92 comes with a flange connection that is easily mounted directly on the outlet port (outlet connection is not required).
Note: Bolts (ref. 11) must be tightened with torque 95Nm ± 9.5 Nm.
Use only Style 77DX coupling or equivalent for the 3" victaulic OSG outlet on the VCM 92.



5.12 Ensure free flow

Ensure free flow from the safety/relief valves 8 and 9 (schematic1, page 10). A blocked safety/relief valve can cause excessive build-up of pressure and thereby cause dangerous situations and damage to the whole system.

5.13 Verify setting of safety/relief valves

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

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

5.14 Flush the pump

Fully open the pressure valve at the brine outlet.

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

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

5.15 Bleed and remove air from the pump

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

5.16 Verify direction of rotation

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

Check the direction of rotation before mounting the pump.

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

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

5.17 Commissioning

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

5.18 Check the filter condition

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

5.19 Instruct operator and maintenance personnel

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

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

6. Operation of pump unit

6.1 General safety information

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

6.2 What to listen and look for

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

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

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

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

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

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

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

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

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

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

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

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

7. Maintenance and service of the pump unit

7.1 General safety information

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

7.2 Service and inspection interval for the pump

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

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

For spare parts and service tools, please see appendix 5, 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) Stop the high-pressure pump.

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

C) Stop the feed pump.

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

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

F) Make sure the system is not pressuized! Slowly unscrew and remove the bolts and gaskets from the inlet/outlet hoses or pipes, be careful about jets of water. Beware that the system can be pressurized!

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

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

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

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

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

7.4 Disassembling and assembling the pump unit

A) Remove all connections from the pump.

B) Disassemble the pump according to the Disassembling and Assembling Instruction (available at hpp.danfoss.com)

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

C) Inspect all parts including shaft seal and if necessary, replace them; see appendix 5, Parts list.

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

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

Product type	Code number	Serial number

Operational conditions

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

Returns without a return number will be rejected !!!

7.5 Assembling the pump unit

Assemble the pump according to the Disassembling and Assembling Instruction (available at hpp.danfoss.com).

7.6 Procedure for mounting the pump onto the electric motor

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

7.7 Getting the pump unit back into operation

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

7.8 Storage of the pump

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

8. Troubleshooting and scrapping criteria

8.1 General safety information

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

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

8.2 Operational conditions which can cause pump failures

The following conditions can cause a pump failure :

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

8.3 Mechanical failure

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

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

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

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

8.4 Electrical failure

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

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

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

8.5 Responsibility

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

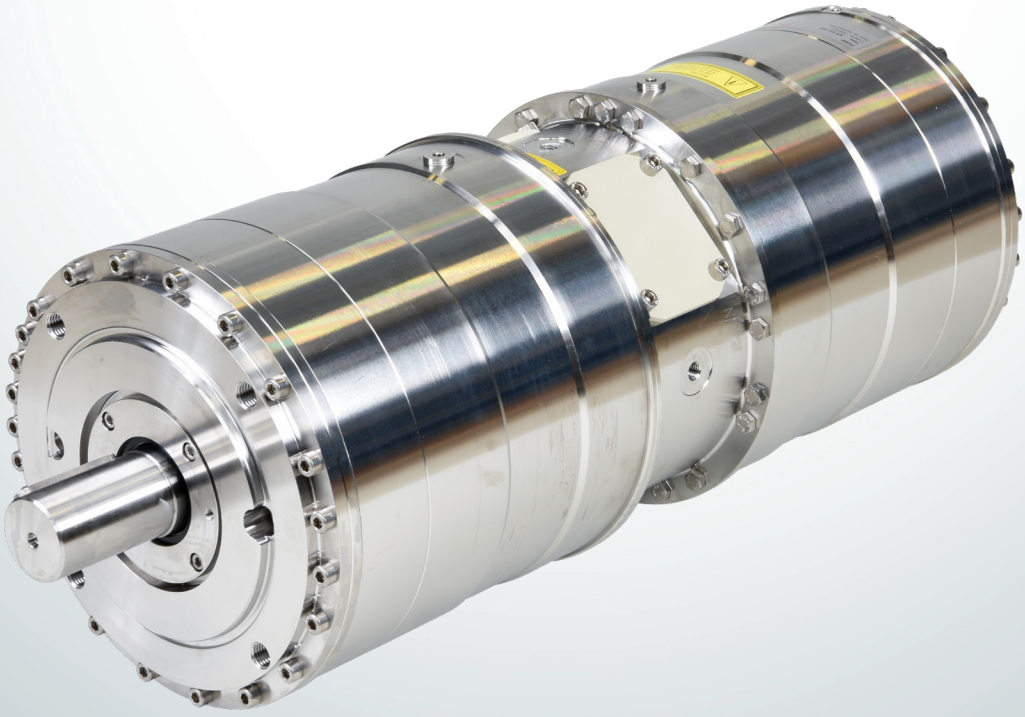
8.6 Scrapping criteria

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

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

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

ENGINEERING
TOMORROW



hpp.danfoss.com

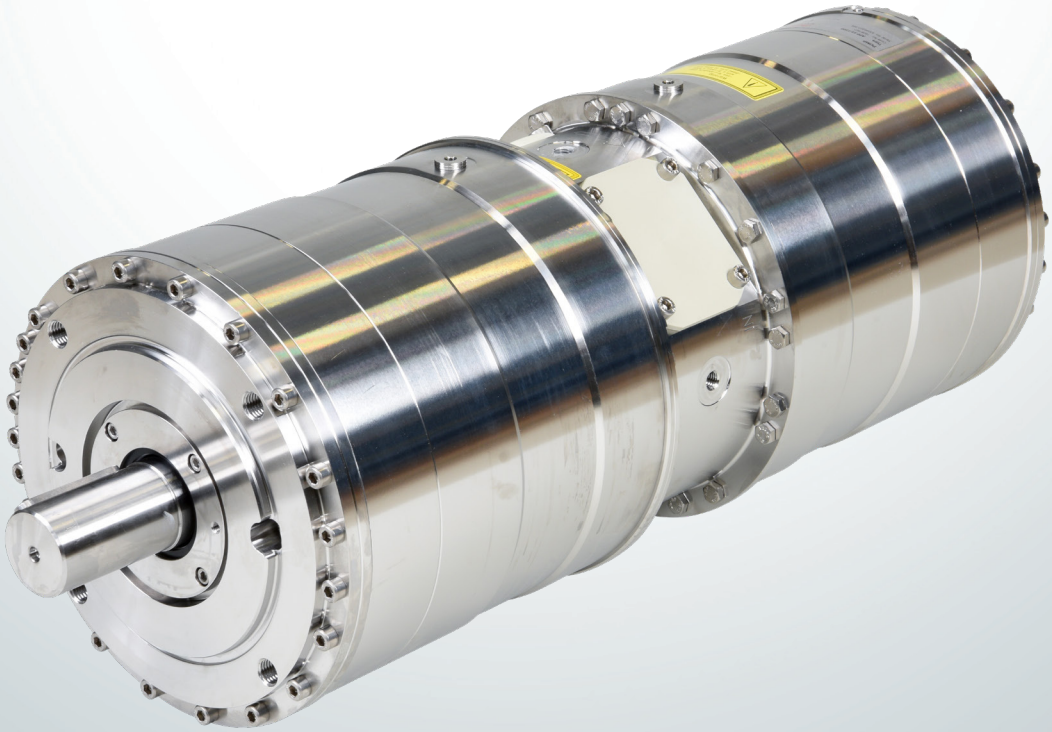
Table of Contents

ENGINEERING
TOMORROW

Data sheet

APP Pumps

APP 53 / APP 65 / APP 78 / APP 86



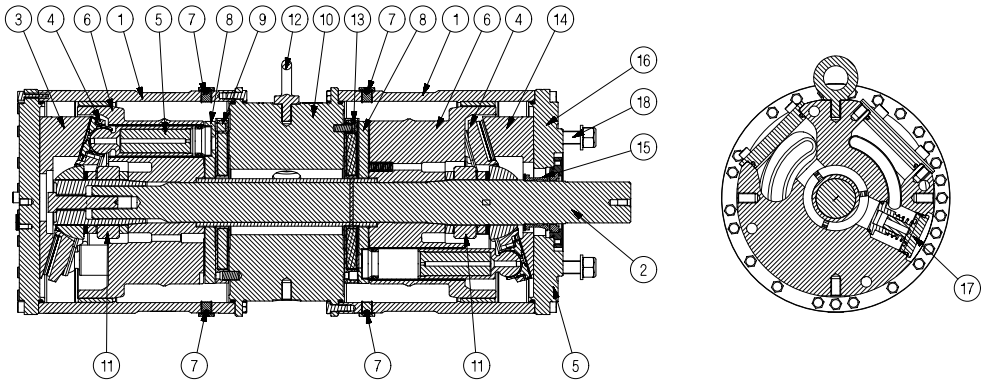
hpp.danfoss.com

Table of Contents

1. Introduction

The Danfoss range of APP high-pressure pumps is designed according to EN 809 for use in RO applications with low viscosity and corrosive fluids such as sea water.
Danfoss APP pumps are positive displacement pumps with axial pistons that move a fixed amount of water in each cycle. Flow is proportional to the number of input shaft revolutions (rpm).
Unlike centrifugal pumps, they produce the same flow at a given speed no matter what the discharge pressure.
The sectional drawing below illustrates the main components of the APP 53-92 pump range.

1	Housing	10	Center flange
2	Shaft	11	Spring cartridge
3	Swash plate (non drive end)	12	Eye bolt
4	Retainer plate	13	Port plate (drive end)
5	Piston	14	Swash plate (drive end)
6	Cylinder barrel	15	Shaft seal
7	Bleeding / drain plug	16	Motor flange
8	Valve plate	17	Flushing valve
9	Port plate (non drive end)	18	Tail stock screws



2. Benefits

- **Zero risk of lubricant contamination:**
  - Oil lubricants are replaced with the pumped medium, water, so there is no contamination risk from the pump.
- **Low maintenance costs:**
  - Efficient design and all-stainless steel construction ensure exceptionally long life. When Danfoss specifications are met, service intervals of 8,000 hours can be expected. Service is easy, and can be carried out on-site due to the simple design and few parts.
- **Low energy costs:**
  - The highly efficient axial piston design provides the lowest energy consumption of any comparable pump on the market.
- **Easy installation:**
  - The most compact and lightest design available.
  - The pump can be installed horizontally in different positions rotating it around the shaft (see section 10 for example).
  - No pulsation dampeners necessary due to extremely low pressure pulsation.
  - Powered directly by electric motors or combustion engines (with special coupling).
  - All pumps are supplied with an integrated flushing valve that allows the fluid to flow from inlet to the outlet, when the pump is not running.
- **High reliability:**
  - All parts are made of high corrosion resistant materials e.g. Duplex (EN1.4462/ UNS S31803) and Super Duplex (EN1.4410/UNS S32750) stainless steel and carbon reinforced PEEK.
- **Certified quality:**
  - Available with positive material idenfication (PMI) certification on request.
  - ISO 9001, ISO 14001, IAFT 16949
  - ATEX certification available for APP S (all Super Duplex) and APP S 674 (API). Please see relevant data sheets.

3. Application examples

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

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

4 Technical data

4.1 APP 53-92

Pump size		APP 53/1500	APP 65/1500	APP78 /1500	APP 86/1700	APP 92/1780
Code number		180B7806	180B7807	180B7808	180B7809	180B7810
Geometric displacement	cm^3/rev.	617	778	888	888	888
	in^3/rev.	37.7	47.3	54.2	54.2	54.2
Pressure						
Max. outlet [1] pressure (MAWP)	barg	83	83	83	70	70
	psig	1,200	1,200	1,200	1,015	1,015
Min. inlet operating pressure	barg	2	2	2	2.5	3.5
	psig	29	29	29	36	50
Max. inlet operating pressure	barg	5	5	5	5	5
	psig	73	73	73	73	73
Max. inlet pressure peak	barg	10	10	10	10	10
	psig	145	145	145	145	145
Min. outlet pressure	barg	30	30	30	30	30
	psig	435	435	435	435	435
Speed						
Min. speed continuous	rpm	700	700	700	700	700
Max. speed continuous	rpm	1,500	1,500	1,500	1,700	1,780
Flow						
Min. flow	m^3/h	24	32	36	36	36
	gpm	106	141	158	158	158
700 rpm at max. pressure	m^3/h	24	32	36	36	36
	gpm	106	141	158	158	158
1000 rpm at max. pressure	m^3/h	35	45	52	52	52
	gpm	154	198	228	228	228
1200 rpm at max. pressure	m^3/h	42	54	62	62	62
	gpm	187	238	275	275	275
1500 rpm at max. pressure	m^3/h	53	68	78	78	78
	gpm	235	299	345	345	345
1700 rpm at max. pressure	m^3/h				88	88
	gpm				387	387
1780 rpm at max. pressure	m^3/h					92
	gpm					405
Efficiency						
1000 rpm [3]	%	88	88	89	89	89
1200 rpm [3]	%	89	89	90	89	89
1500 rpm [3]	%	88	89	89	88	88
1700 rpm[3]	%				88	88
1780 rpm[3]	%					87

Pump size		APP 53/1500	APP 65/1500	APP 78/1500	APP 86/1700	APP 92/1780
Code number		180B7806	180B7807	180B7808	180B7809	180B7810
Technical specifications						
Media [2] temperature	°C	2–50	2-50	2–50	2-50	2-50
	°F	36–122	36-122	36–122	36-122	36-122
Ambient temperature	°C	0–50	0-50	0–50	0-50	0-50
	°F	32–122	32-122	32–122	32-122	32-122
Weight (dry)	kg	196	196	196	196	196
	lb	432	432	432	432	432
Weight (operation)[6]	kg	204	204	204	204	204
	lb	450	450	450	450	450
Sound pressure level	db(A)	84-95	84-95	84-93	84-96	84-96
Footprint with IE3 motor [4]	m^2	1.49	1.49	1.50	1.50	1.50
	$Foot^2$	16.0	17.0	16.1	16.1	16.1
Typical motor size						
Max.speed at max. pressure[5]	kW	132	160	160	200	200
	HP	200	250	250	300	300

[1] Max. allowable working pressure at continuous operation. The pump is designed according to EN809, i.e. to withstand hydrostatic test pressure (HTP) of 1.3 x MAWP. For lower and higher pressure, please contact Danfoss.
[2] Dependent on the NaCl concentration.
[3] Typical efficiency at max. pressure after a system has been commissioned and run in.
[4] Maximum area covered with recommended IE3 motor configurations (excl. of space to service pump)
[5] IE3 and NEMA motors, 4-pole, current insulated ND non drive end bearing
[6] Operating with water

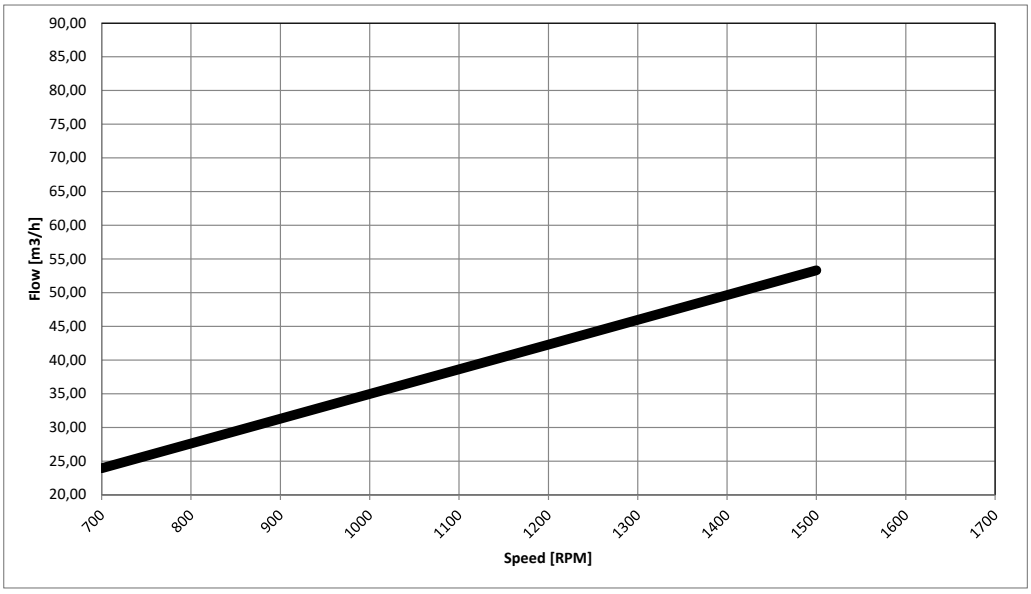
5. Performance curves

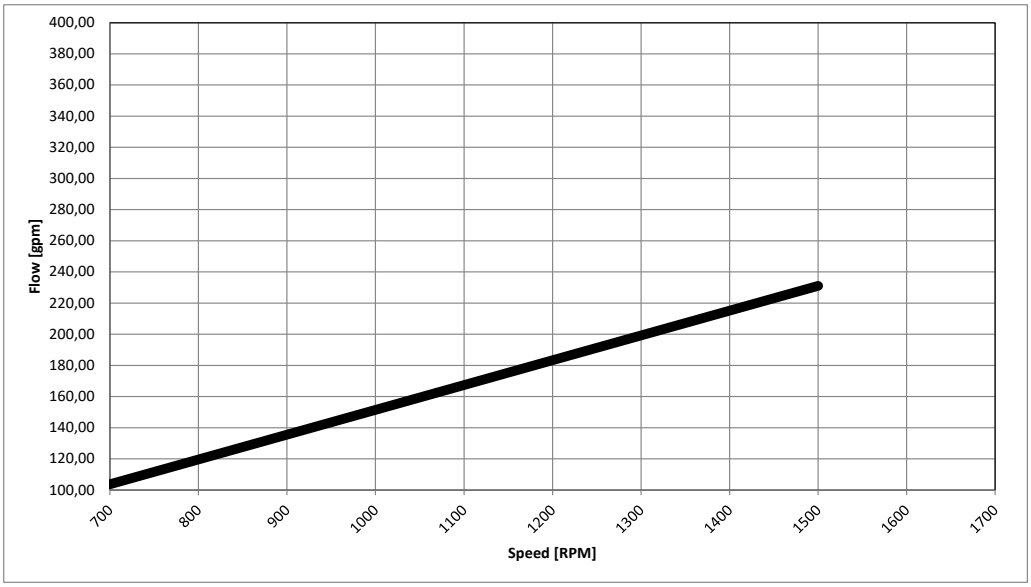
If the flow required and the rotation speed (rpm) of the pump is known, it is easy to select the pump, fitting the application best, by using the diagram below.

Furthermore, this diagram shows 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:

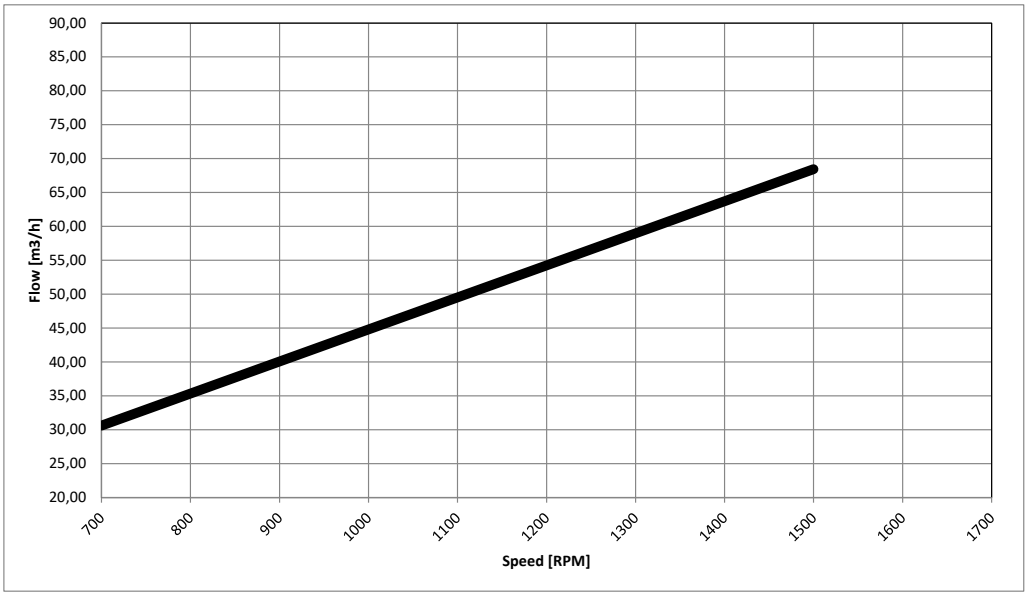
$$\text{Required rpm} = \frac{\text{Required flow x Rated rpm}}{\text{Rated flow}}$$

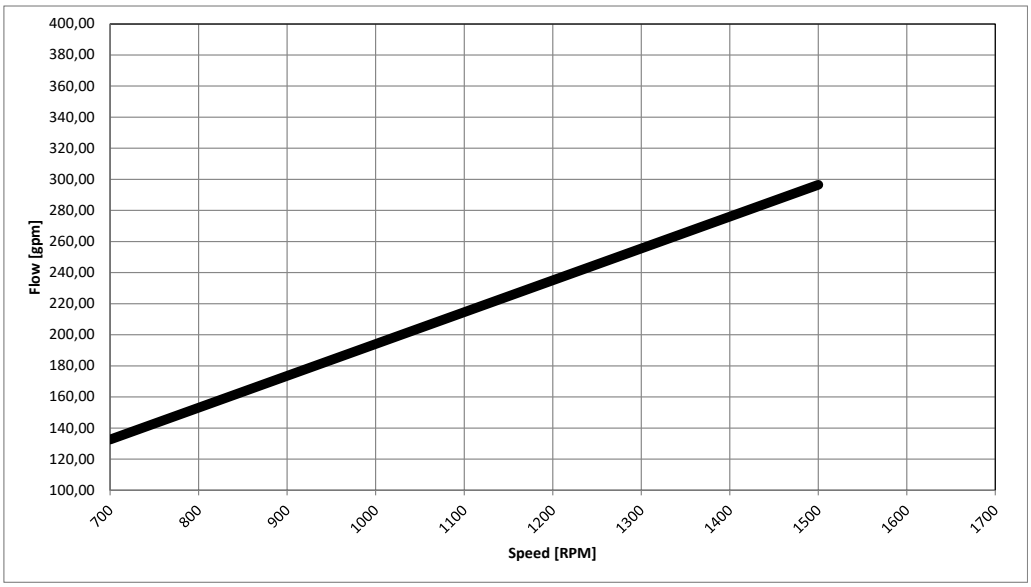
5.1 APP 53 flow at different rpm



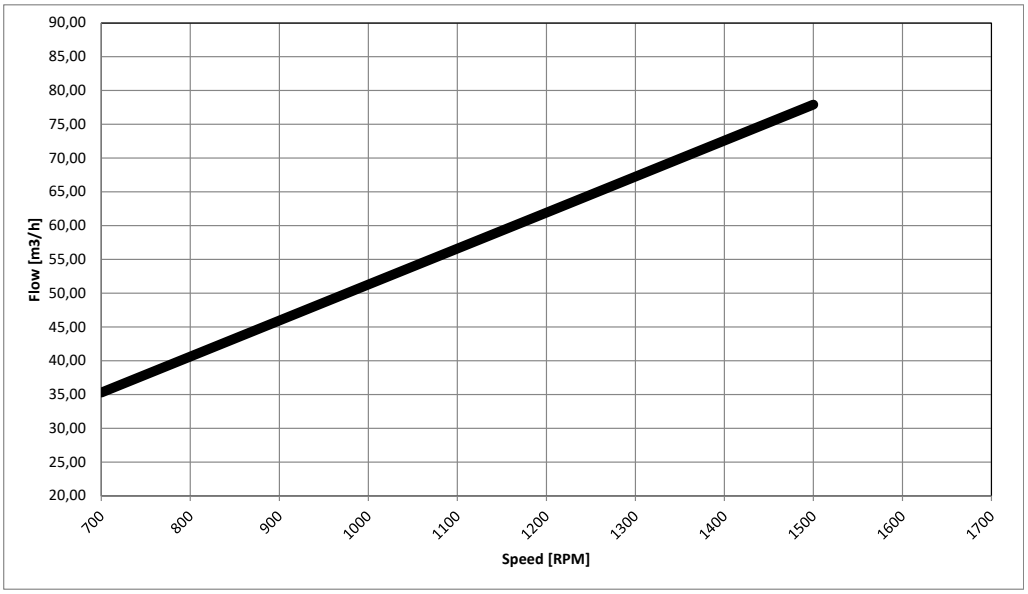


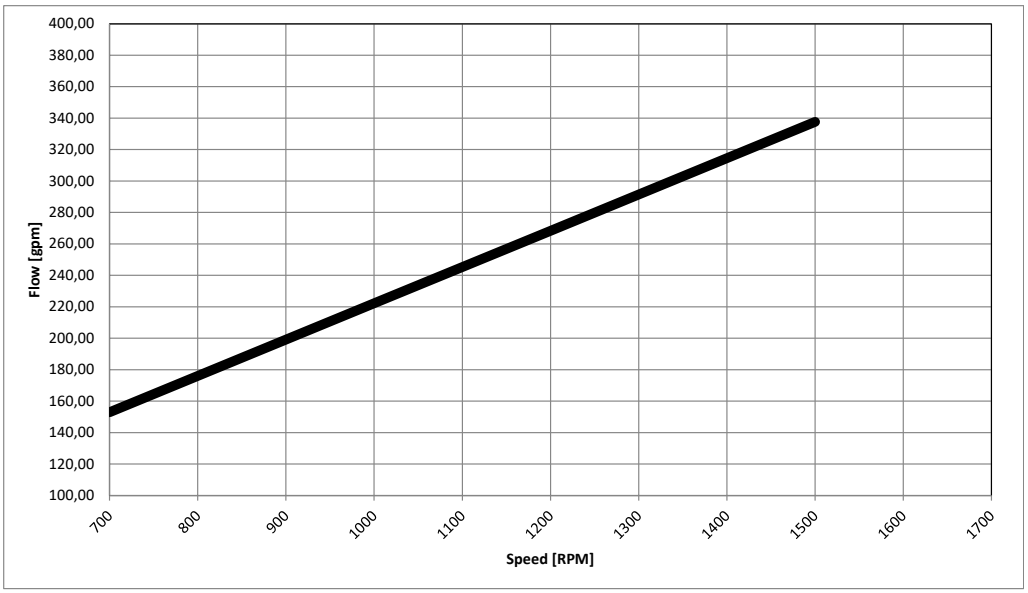
5.2 APP 65 flow at different rpm



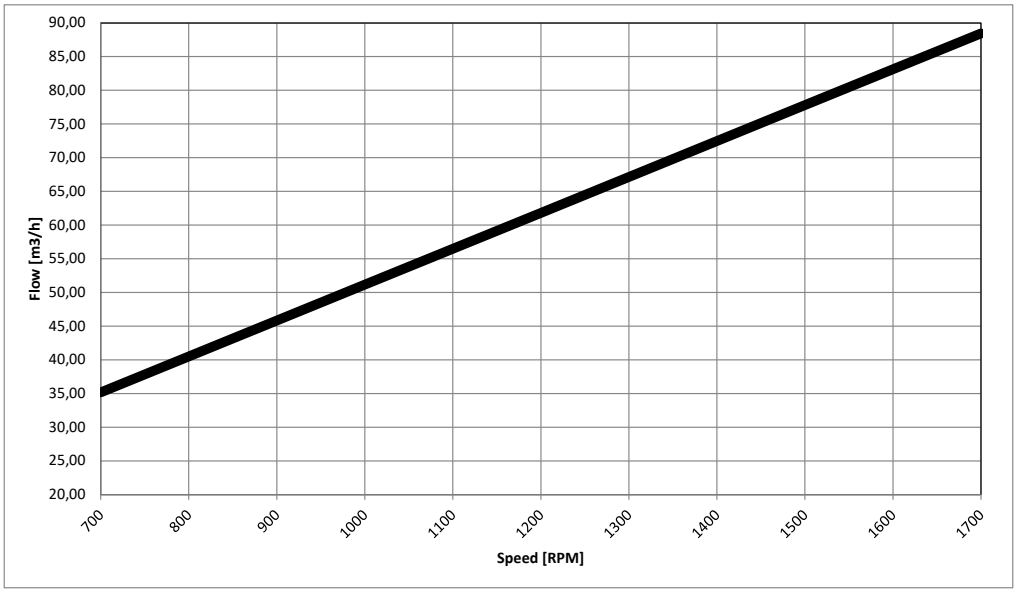


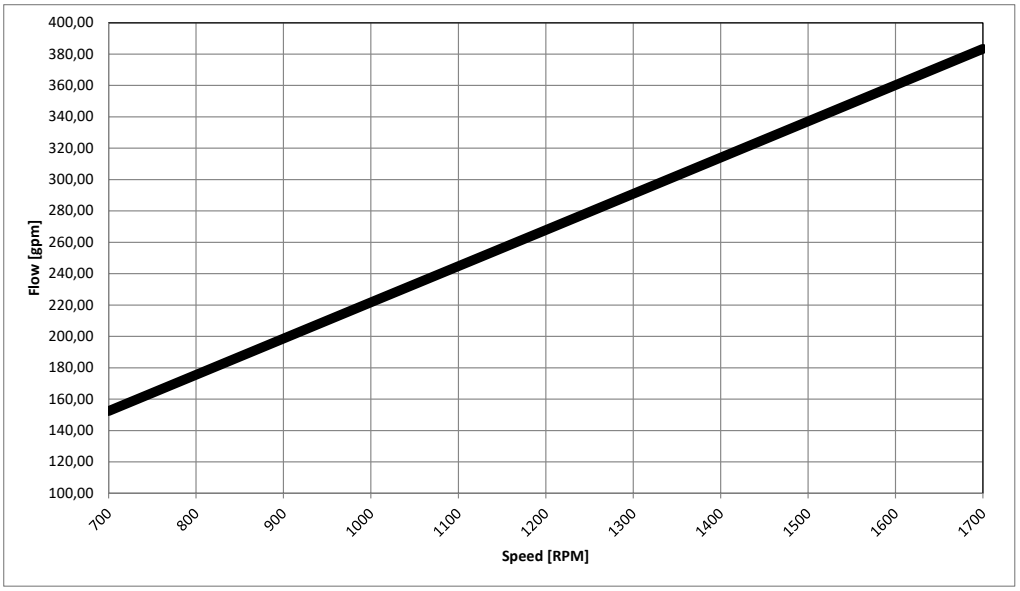
5.3 APP 78 flow at different rpm



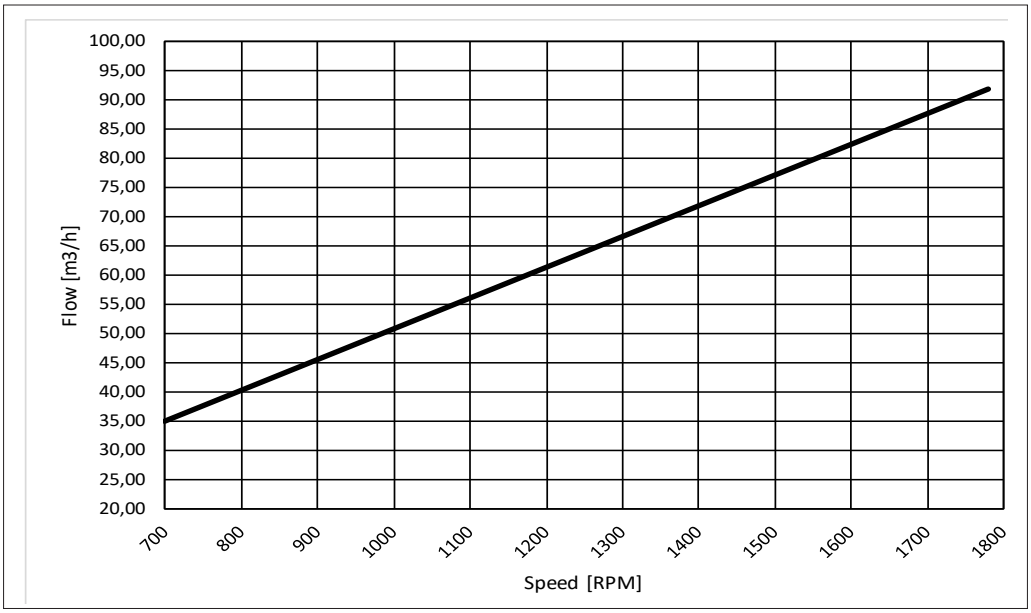


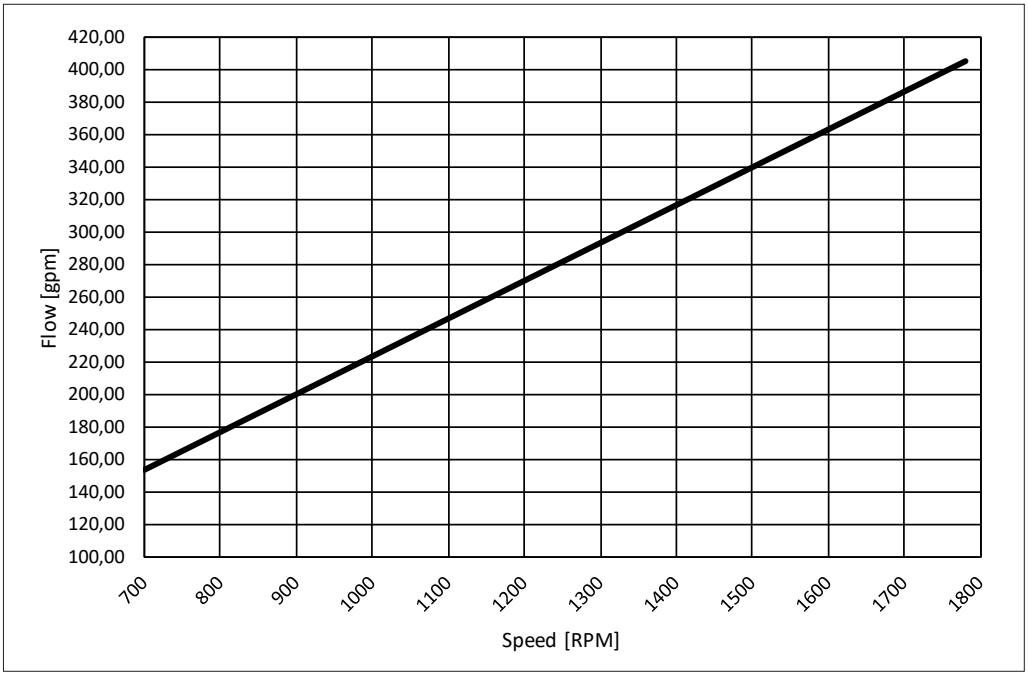
5.3 APP 86 flow at different rpm





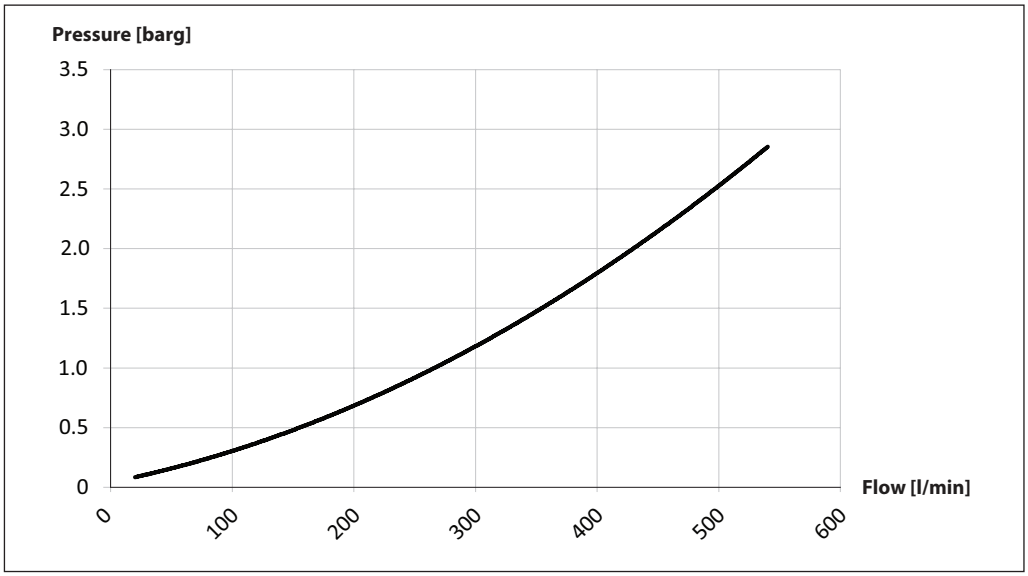
5.4 APP 92 flow at different rpm





6. Flushing valve curves

6.1 APP 53-92 integrated flushing valve



7. Motor requirements

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

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

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

7.1 Calculation factor at 60 barg / 870 psig for APP 53-92

Name	rpm	Calculation factor
APP 53	1500	528
APP 65	1500	534
APP 78	1500	534
APP 86	1700	528
APP 92	1780	522

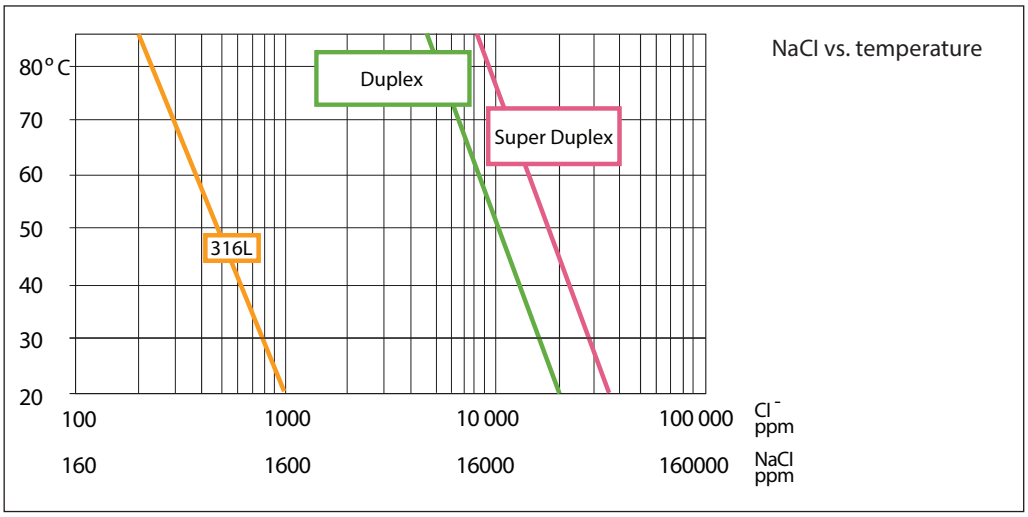
8. Temperature and corrosion

8.1 Operation

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 pump are made of Duplex or 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.

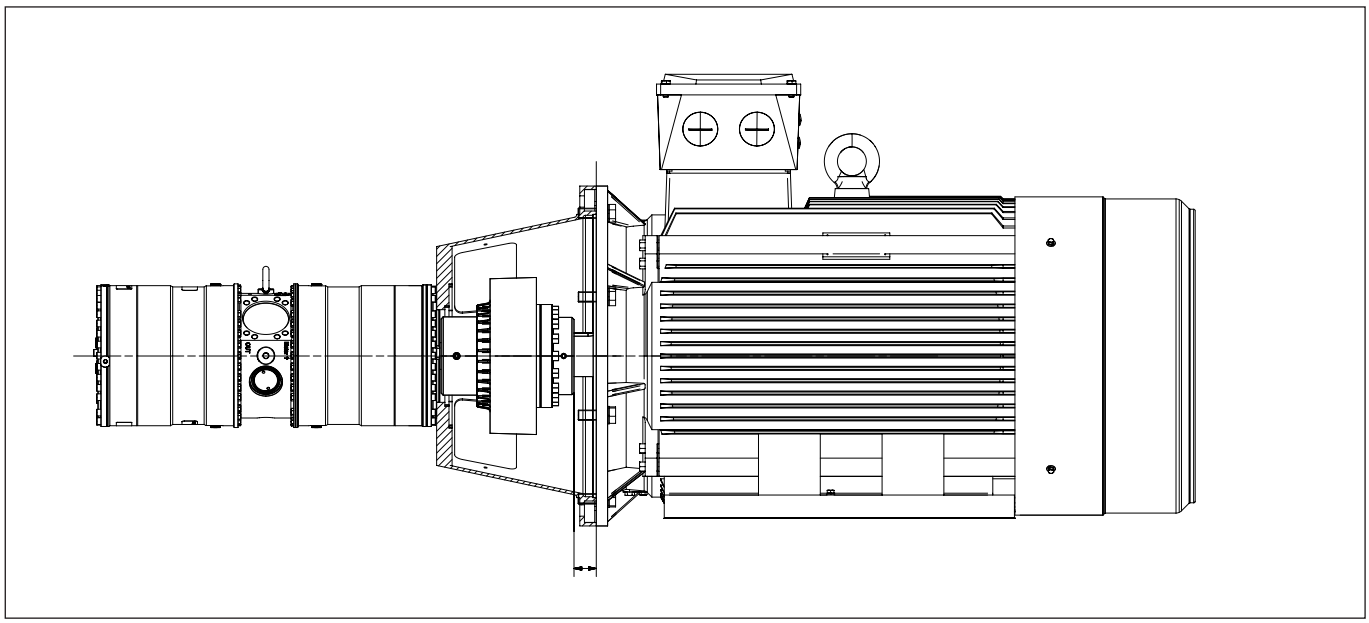


9. Installation

See example below on how to mount the pump and connect it to an electric motor or combustion engine (special coupling).
For further instruction on installation of coupling see APP Pump Instruction 180R9368.

If alternative mounting is required. please contact your Danfoss sales representative for further information.

Note: Do not add any axial or radial loads to the pump shaft.



9.1 Filtration

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

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

Since water has very low vicosity, Danfoss APP pumps have been designed with very narrow clearances in order to control internal leakage rates and improve component 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. $ß_{10} \geq 5000$.

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 the 100,000 particles that enter such filters, 50,000 particles pass right through; 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).

Noise

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

The noise level is influenced by:

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

9.2 RO system with direct supply:

Inlet line:

a) Dimension the inlet line to obtain mini mum pressure loss (large flow, minimum pipe length, minimum number of bends/ connections, and fittings with low or no pressure losses) .

Inlet filter:

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

Inlet pressure:

c In order to eliminate the risk of cavitation and other pump damage, pump inlet pressure must always be maintained according to specifications described in item 4 about technical data.

Low pressure relief valve:

d) Install a low pressure relief valve (9) in order to avoid system or pump damage in case the pump stops momentarily or is spinning backwards.

Monitoring pressure switch:

e Install a monitoring pressure switch (3) between the filter (1) and the pump inlet. Set the minimum inlet pressure according to specifications described in item 4 about technical data. If the inlet pressure is lower than the minimum pressure set, the monitoring pressure switch must prevent the pump from starting or from running.

Hoses:

f) Always use flexible hoses (4) to minimize vibrations and noise. Please consult the Danfoss Hoses and hose fittings data sheet (521B0909) for guidance.

Flushing valve:

g) For easy system filling and flushing, the APP pump has an integrated valve (6).

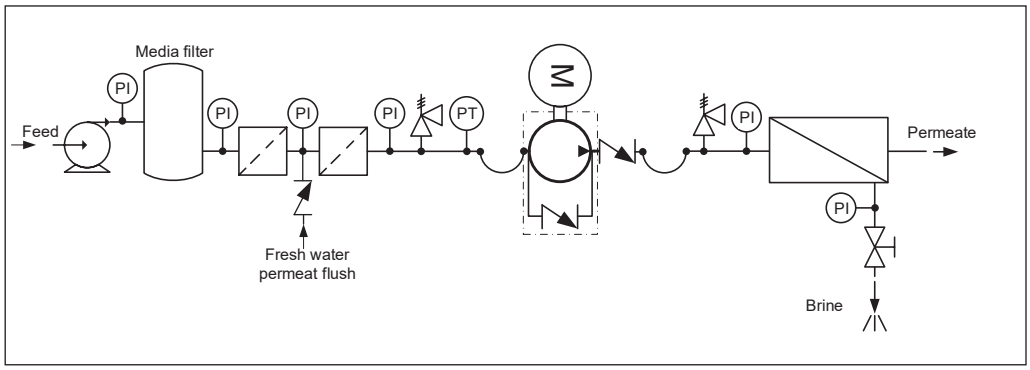
Non-return valve:

h) 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.

High pressure safety or relief valve:

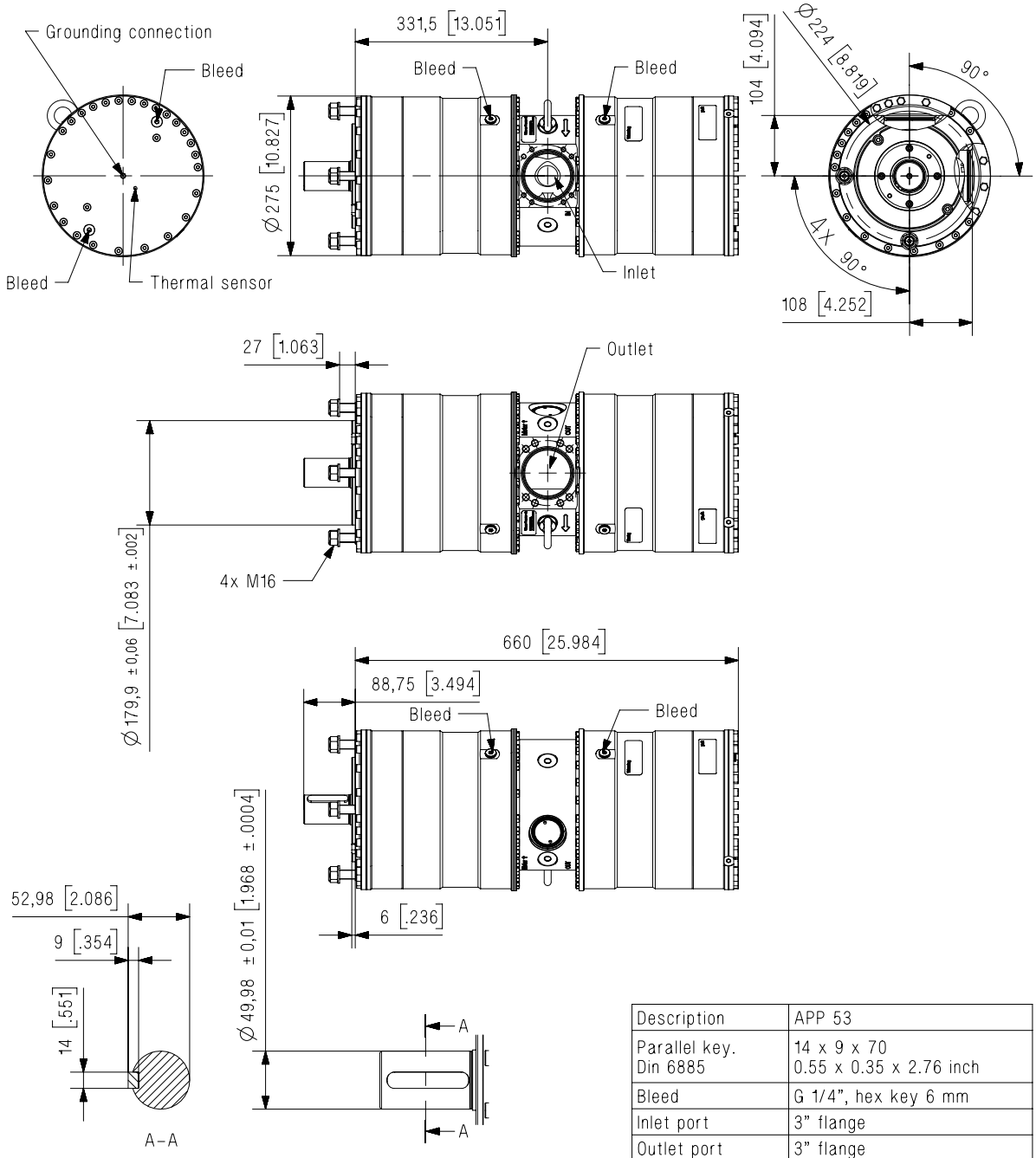
i) As the Danfoss APP pump begins to create pressure and flow immediately after start-up and regardless of any counter pressure, a safety or pressure relief valve (8) should be installed after the non-return valve to prevent system damage and to avoid high pressure peaks.

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



10. Dimensions and connections

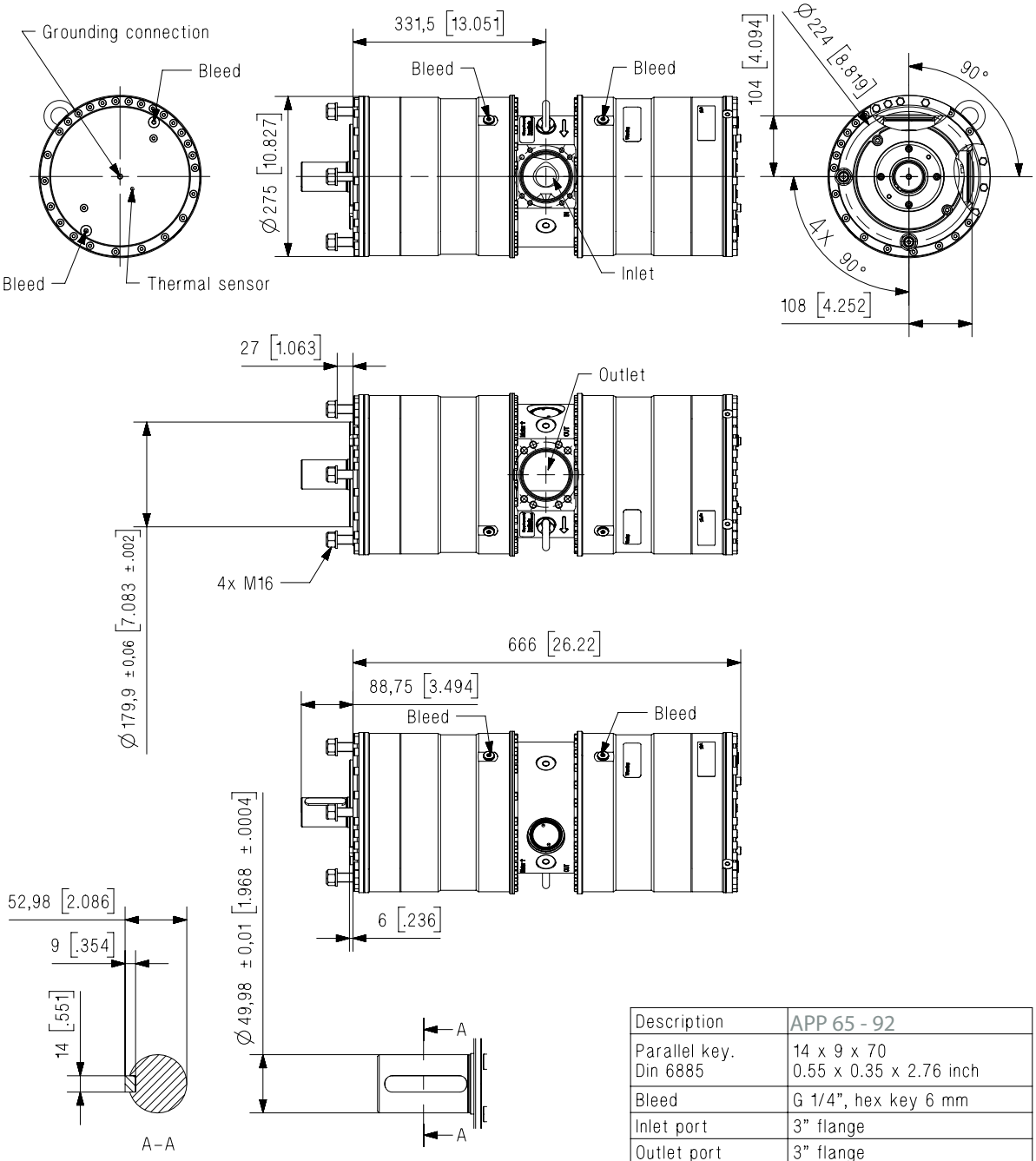
10.1 APP 53



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

Description	APP 53
Parallel key. Din 6885	14 x 9 x 70 0.55 x 0.35 x 2.76 inch
Bleed	G 1/4", hex key 6 mm
Inlet port	3" flange
Outlet port	3" flange
Grounding connection	M8, depth 11 mm
Thermal sensor	M6, depth 11 mm

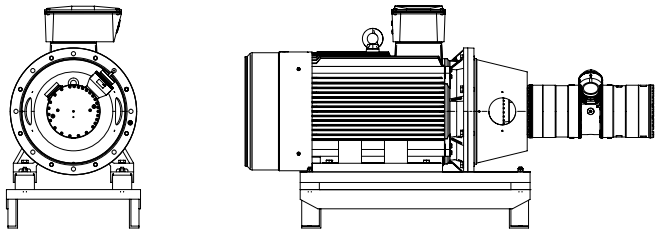
10.2 APP 65 - 92



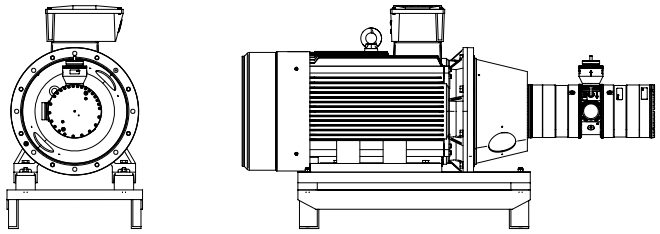
Description	APP 65 - 92
Parallel key. Din 6885	14 x 9 x 70 0.55 x 0.35 x 2.76 inch
Bleed	G 1/4", hex key 6 mm
Inlet port	3" flange
Outlet port	3" flange
Grounding connection	M8, depth 11 mm
Thermal sensor	M6, depth 11 mm

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

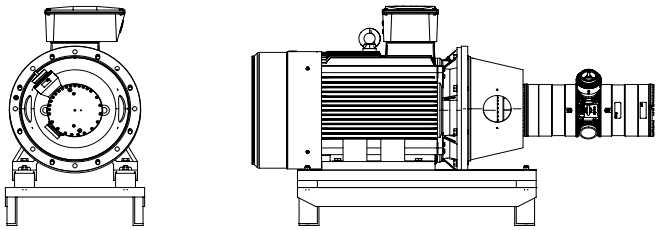
The APP 53-92 connections (inlet and outlet) can be adjusted in intervals of 45 degrees.
Please see typical installations with check valve VCM 92 mounted in the outlet port in the drawing below. Non-standard configurations are available on request. For adjustment on site, please see Installation, Operation and Maintenance Manual or contact Danfoss.



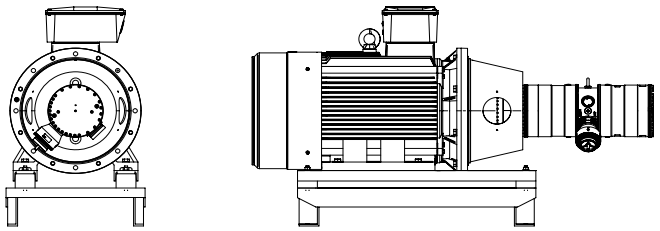
Standard configuration



Non-standard configuration, turned 45 degrees left.

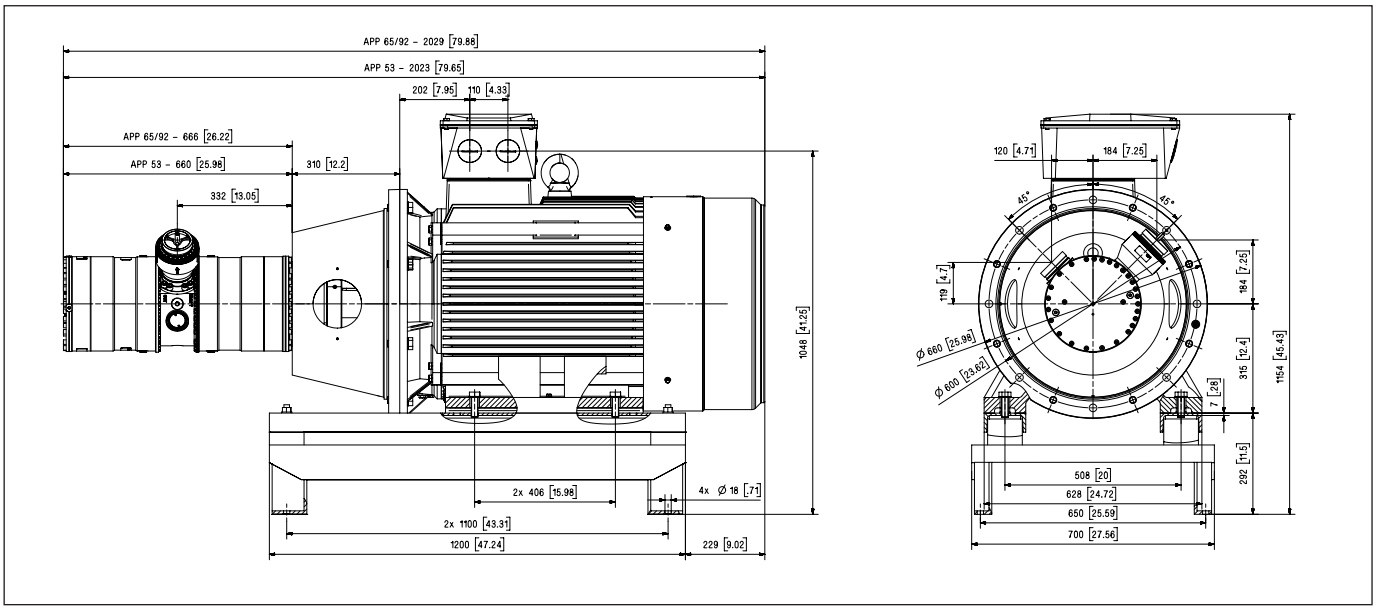


Non-standard configuration, turned 90 degrees left.

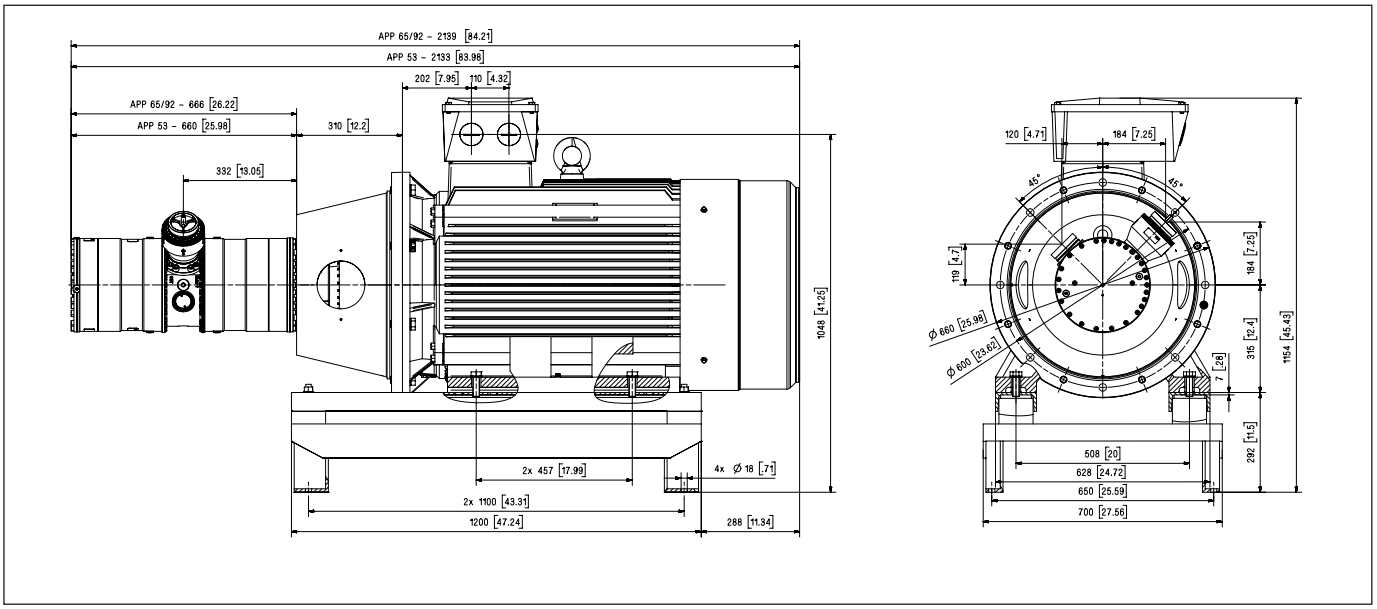


Non-standard configuration, turned 180 degrees .

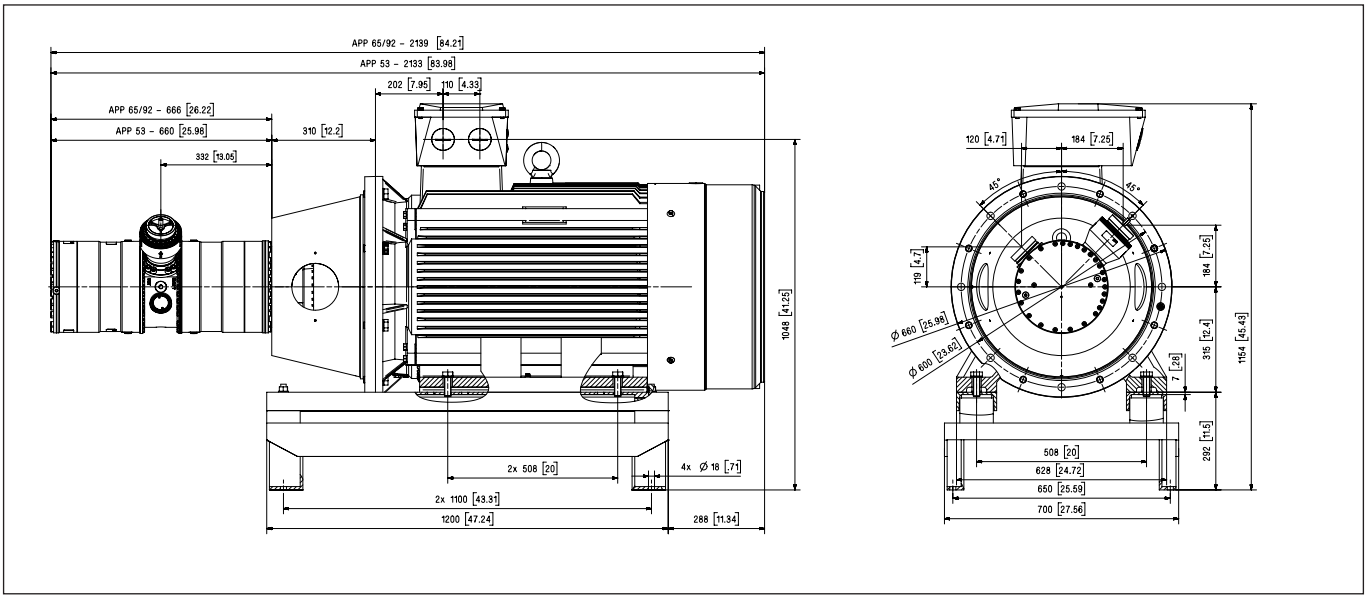
10.3 APP 53-92 with IE3 motor, IEC 315S - 4



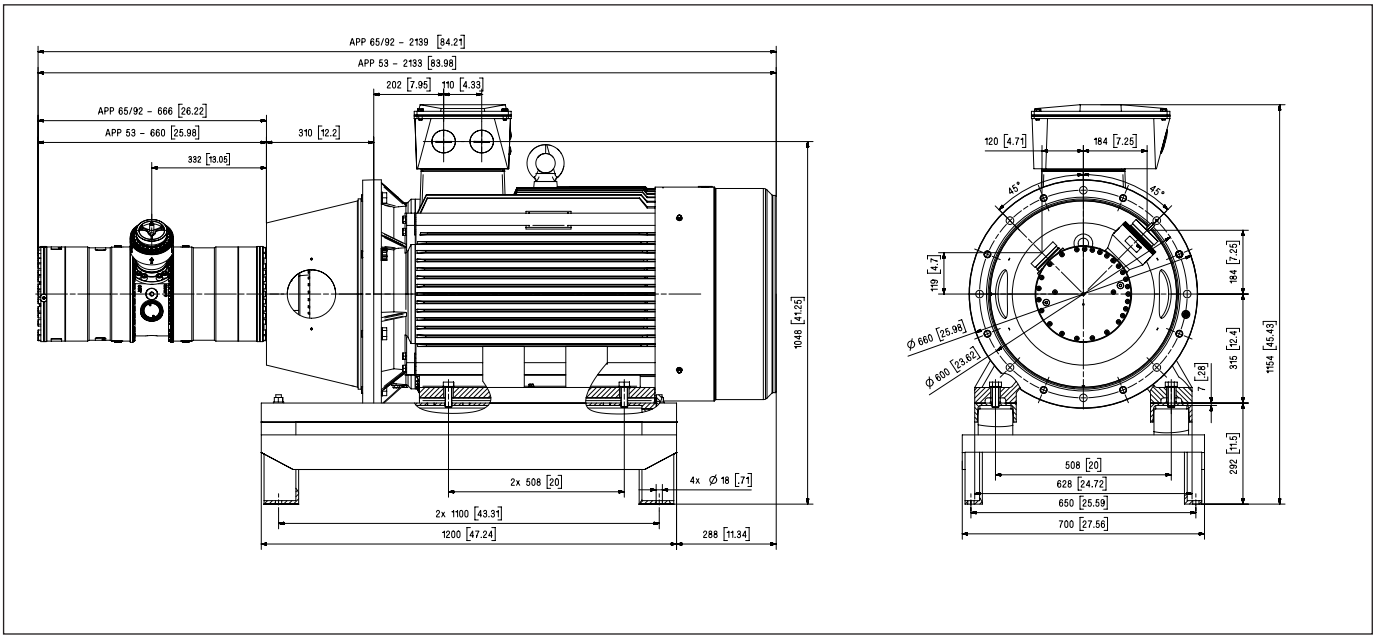
10.4 APP 53-92 with IE3 motor, IEC 315M - 4



10.5 APP 53-92 with IE3 motor, IEC 315L 1-4



10.6 APP 53-92 with IE3 motor, IEC 315L 2 - 4

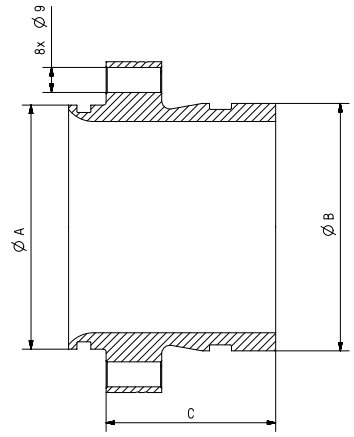


11. Pump connections

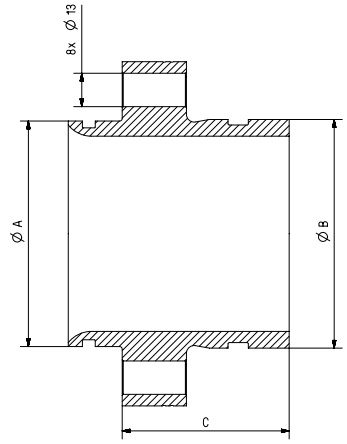
11.1 APP 53 - 92

Use only Style 77DX coupling or equivalent.

3" Victaulic OSG LP Inlet



3" Victaulic OSG HP Outlet



Connection	Diameter (A)	Victaulic [1] (B)	Length (C)	Material	Max. Pressure	Code number
3" Inlet connector	87.8 mm (3.46 inch)	3" Vic. OSG	61.0 mm (2.40")	Super Duplex	10 barg (145 psig)	**180Z1991**
3" outlet connector	87.8 mm (3.46 inch)	3" Vic. OSG	65.0 mm (2.56")	Super Duplex	80 barg (1160 psig)	**180Z1992**

[1]) The installation instuction for Style 77DX is located in the Victaulic document I-100 Field Installation Handbook (htpp://static.victaulic.com)

12. VCM 3" Victaulic

The non-return valve is designed for use in Seawater Reverse Osmosis (SWRO) membrane systems. In case the high-pressure pump stops momentarily, the volume of water in the membrane vessel may work as an accumulator and will send flow backwards.

When using multiple pumps in parallel, the non-return valve prevents the water from one pump to run into the parallel-coupled pumps at start-up.
The VCM 92 is prepared for easy installation on the high pressure outlet of APP 53-92, series 08 or higher..

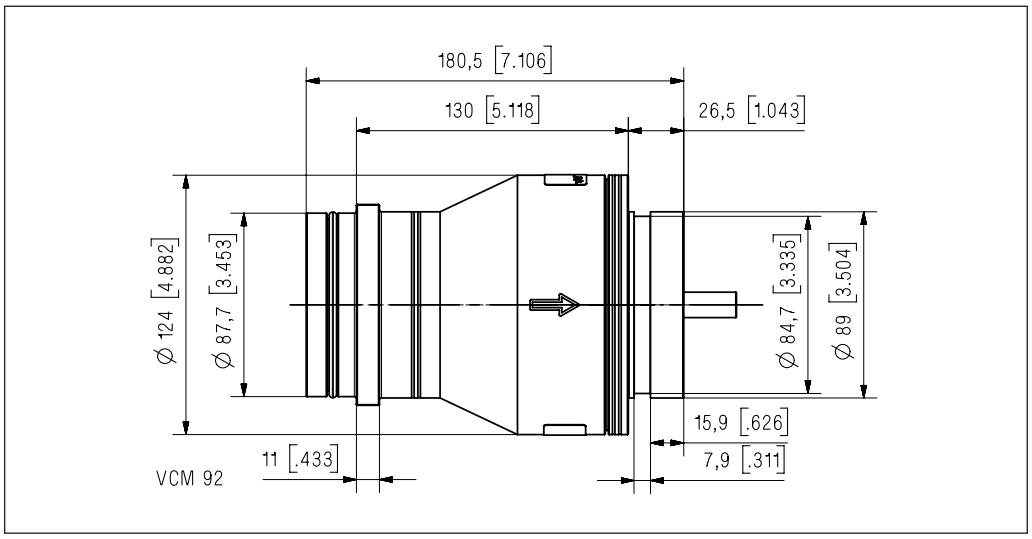
Use only Style 77DX coupling or equivalent.

12.1 Technical data

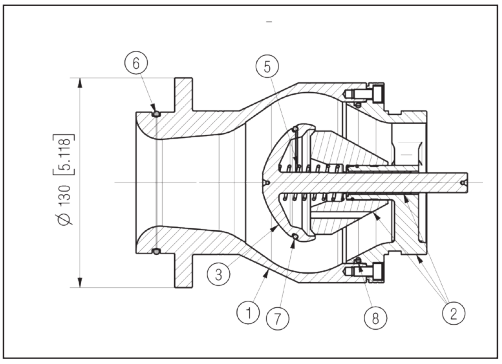
Type	Connection[1)]	Diameter mm (inch)	Victaulic [3)] (outlet connection)	Length mm (inch)	Material2[2)]	Max. pressure barg (psig)	Code number
VCM 92	3" outlet check valve[)]	87.7 (3.45)	3" Vic. OSG	180.5 (7.10)	Super Duplex	83 (1.200)	180H0058

[1)] The check valve is mounted directly in the outlet port with a flange with 8 screws M12 x 25.
[2)] Wetted parts materials: Super Duplex, PEEK, PP, Hasteloy; FKM, NBR
[3)] The installation instuction for Style 77DX is located in the Victaulic document I-100 Field Installation Handbook (htpp://static.victaulic.com)

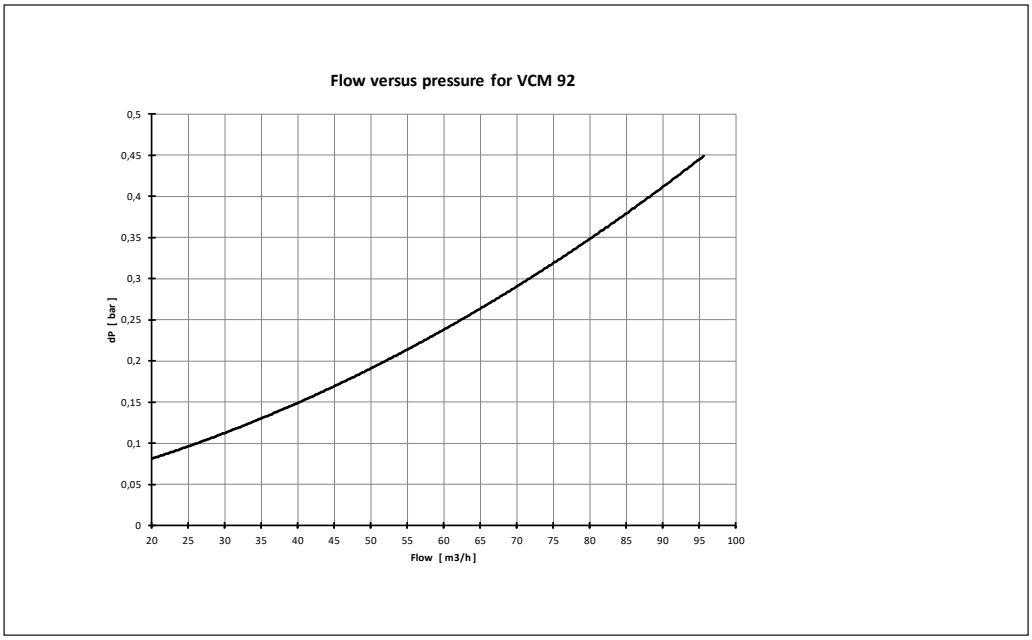
VCM		VCM 92
Min. flow continously	m^3/h	20
	gpm	88
Max. flow continously	m^3/h	92
	gpm	405
Max pressure MAWP	barg	83
	psig	1200
Opening pressure	barg	0.05- 0.08
	psig	0.73-1.16
Pressure loss at max. flow	barg	< 0.45
	psig	< 6.5

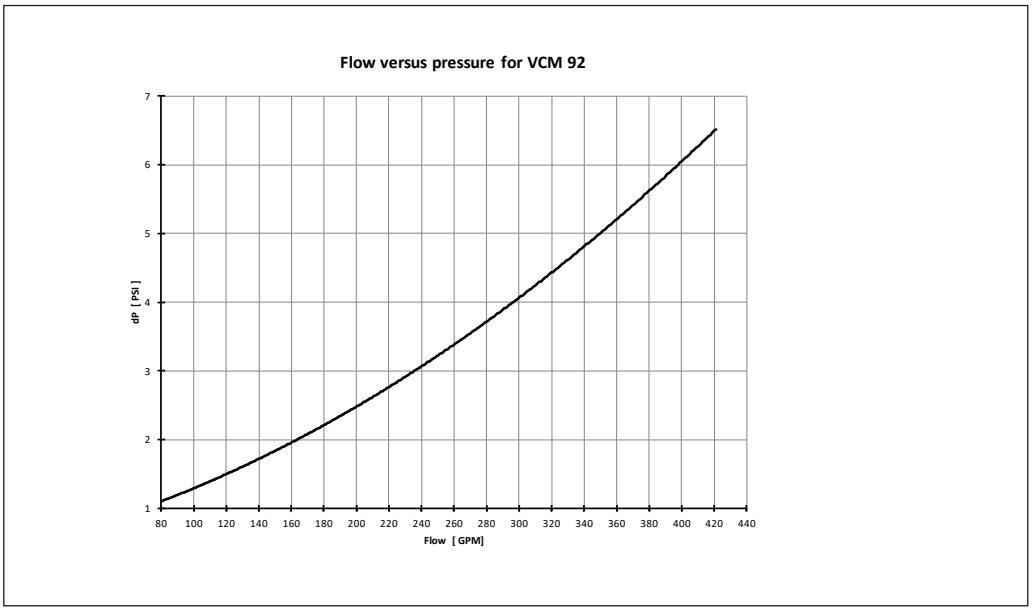


1. Valve housing (Super Duplex)
2. Valve guide and valve stop (Super Duplex, PEEK and PP)
3. Valve Cone (Super Duplex)
5. Spring (Hasteloy)
6. O-ring (NBR)
7. O-ring (FKM 75)
8. O-ring (NBR)



12.2 Flow versus pressure
Pressure drop curves for check valve VCM 92





13. Accessories

Accessories	Type	Code number
Coupling APP 53 - APP 92 IEC 315	Diameter: motor Ø80 mm, pump Ø50	180Z4066
Coupling APP 53 - APP 92 IEC 280	Diameter: motor Ø75 mm, pump Ø50	180Z4081
Coupling kit APP 53 - APP 92 incl. bell housing IEC 315	Ø80/Ø50. IEC 315 Ø660/310	180Z4083
Coupling kit APP 53 - APP 92 incl. bell housing IEC 280	Ø75/Ø50. IEC280 Ø550/265	180Z4082
Base frame incl. vibration dampeners	IEC 315	180Z0661

14. Service and warranty

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

Provided that the pump has been running according to the Danfoss specifications, Danfoss 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 pumps.
Other factors that affect pump performance and lifetime include:

- Insufficient filtration
- Insufficient bleeding and venting
- Running the pump at speed outside specifications.
- Supplying the pump with water at temperature higher than recommended.
- Running the pump at inlet pressure outside specifications.
- Running the pump at outlet pressure outside the specifications.
- Wrong direction of rotation.

Maintenance
After 8,000 hours of operation it is strongly recommended to inspect the pump and change any worn parts, e.g. pistons and shaft seal. This is done in order to prevent a potential breakdown of the pump. If the parts are not replaced, more frequent inspection is recommended according to our guidelines.

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

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

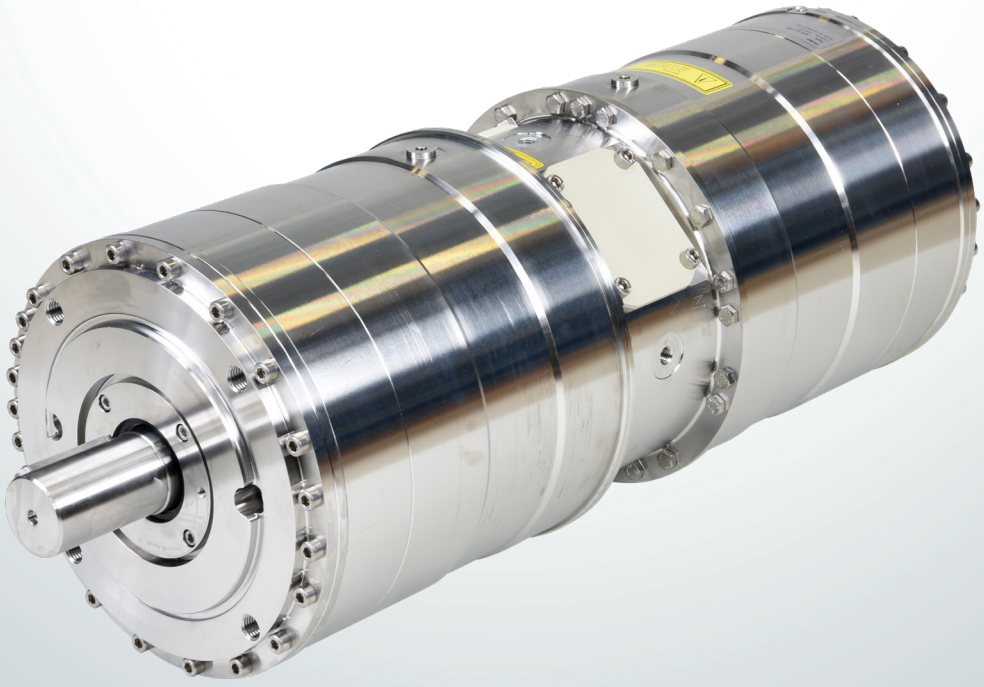
Danfoss A/S
High Pressure Pumps • danfoss.com • +45 7488 2222 • highpressurepumps@danfoss.com

ENGINEERING
TOMORROW

Instruction

APP Pump Instruction

APP 53 / APP 65 / APP 78 / APP 86 / APP 92

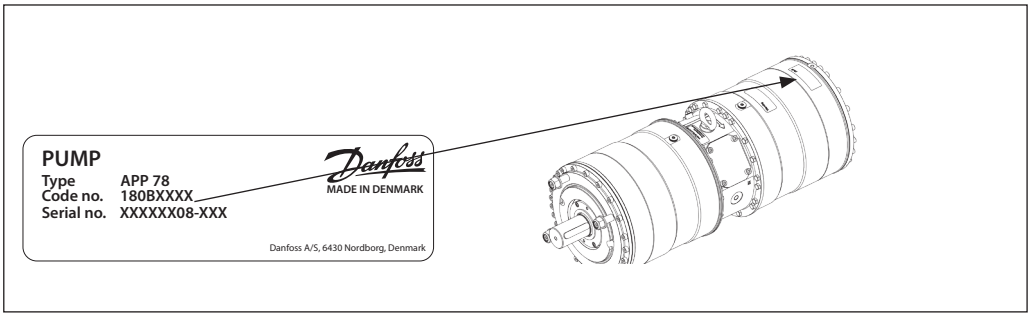


hpp.danfoss.com

Table of Contents

Table of Contents

1. Identification



2. System design

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

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

2.1 Open-ended systems with direct water supply

Axial piston pumps require a certain inlet pressure to perform as intended. Please find min. required feed pressure in the pump data sheet. Please also note that feed pressure must not exceed 5 barg (72.5 psig).

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

Note: The inlet connection must be properly tightened, as possible entrance of air will cause cavitation.

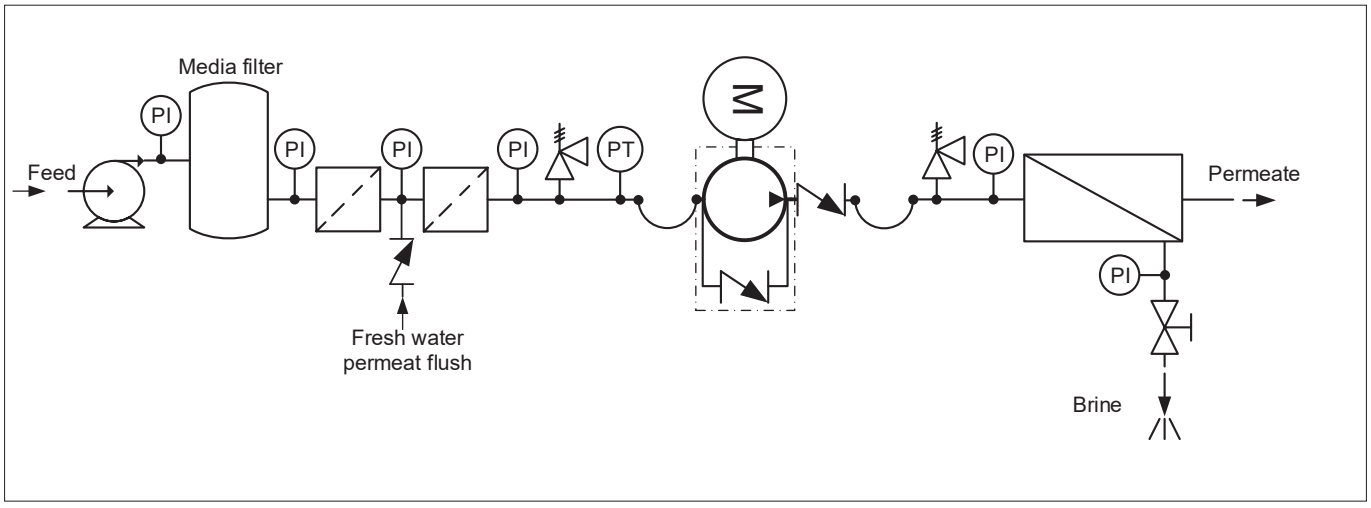
2.2 Preferred RO system design without ERD

1. Dimension the inlet line to obtain minimum pressure loss (large flow, minimum pipe length, minimum number of bends/ connections, and fittings with small pressure losses).
2. Place an inlet filter (1) in front of the APP pump (2). Please consult Danfoss filter data sheet for guidance on how to select the right filter. Thoroughly clean pipes and flush system prior to start-up.
3. Place a monitoring pressure switch (3) set at min. inlet pressure between filter and pump inlet. The monitoring switch must stop the pump at pressures lower than minimum pressure.
4. Use flexible hoses (4) to minimize vibrations and noise.
5. In order to eliminate the risk of damage and cavitation, a positive pressure at the inlet (5) is always to be maintained at min. inlet pressure and max. inlet pressure.

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

6. For easy system bleeding and flushing, a bypass non-return valve (6) is integrated in the APP pump.
7. A non-return valve (7) in outlet can be installed in order to avoid backspin of the pump. The volume of water in the membrane vessel works as an accumulator and will send flow backwards in case of the pump stops momentarily.
8. A safety valve or a pressure relief valve (8) can be installed in order to avoid system damage as the Danfoss APP pump creates pressure and flow immediately after start-up, regardless of any counter pressure.

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



2.3 Preferred RO system design with ERD

For P&ID of a setup with an iSave, please see the iSave® Data sheet 521B1378

2.4 Preferred RO system design with pumps and ERDs in parallel

For systems with Danfoss pumps and ERDs in parallel, please see our publication 180R9354, Guideline for Parallel-coupled pumps and ERD.

2.5 Reversible pumps

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

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

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

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

2.6 General comments

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

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

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

For more information on the importance of proper filtration, please see our data sheet 521B1009 on "Filtration", which also will provide you with an explanation of filtration definitions and a guidance on how to select the right filter.

Monitoring

It is recommended to continuously monitor the following conditions:

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

3. Building up the pump unit with BoWex coupling

3.1 Assembly of the coupling

We recommend to inspect bores, shaft, keyway and feather key for dimensional accuracy before assembly.

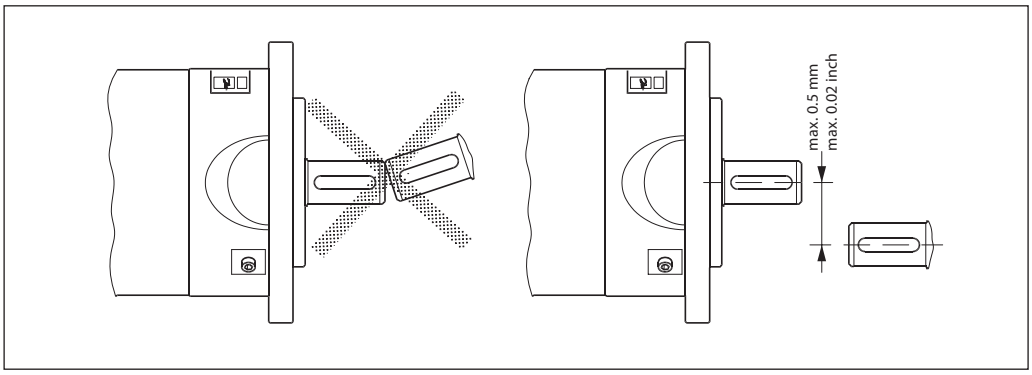
Heating the hubs lightly (approx. 80 °C) allows for an easier mounting on the shaft.

Please pay attention to the ignition risk in potentially explosive atmospheres!

Touching the heated hubs causes burns.
Please wear safety gloves.

With the assembly please make sure that the spline of the hub is fully covered by the internal spline of elastomer (please observe mounting dimensions $L_{coupling}$). Disregarding this advice may cause damage to the coupling.

3.2 Alignment between the motor and pump shaft

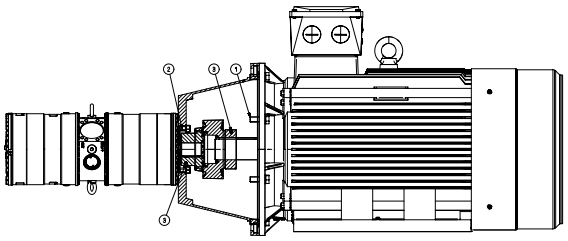


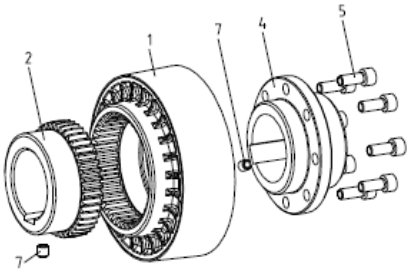
3.3 Overall assembly with coupling BoWex-ELASTIC®, type HEW compact

Danfoss recommends to use a Bowex Elastic HEW Compact Coupling.
See the **Coupling Manual from BoWex.**

1: Bolts 190 Nm ± 10
2: Nuts 100 Nm ± 10
3: Torque see table

Thread size	M5	M6	M8	M10
Torque [Nm]	2	4.8	10	17





Component	Quantity	Description
1	1	Elastomer part
2	1	Hub
4	1	Coupling flange
5	10	Cap screws DIN EN ISO 4762
7	2	Setscrews DIN EN ISO 4029

3.3.1 Mounting

1. Mount the coupling flange (component 4) in front of the elastomer part (component 1) and screw the components together with a tightening torque of 120 Nm. Lubricate inside the coupling hubs (not the shafts).

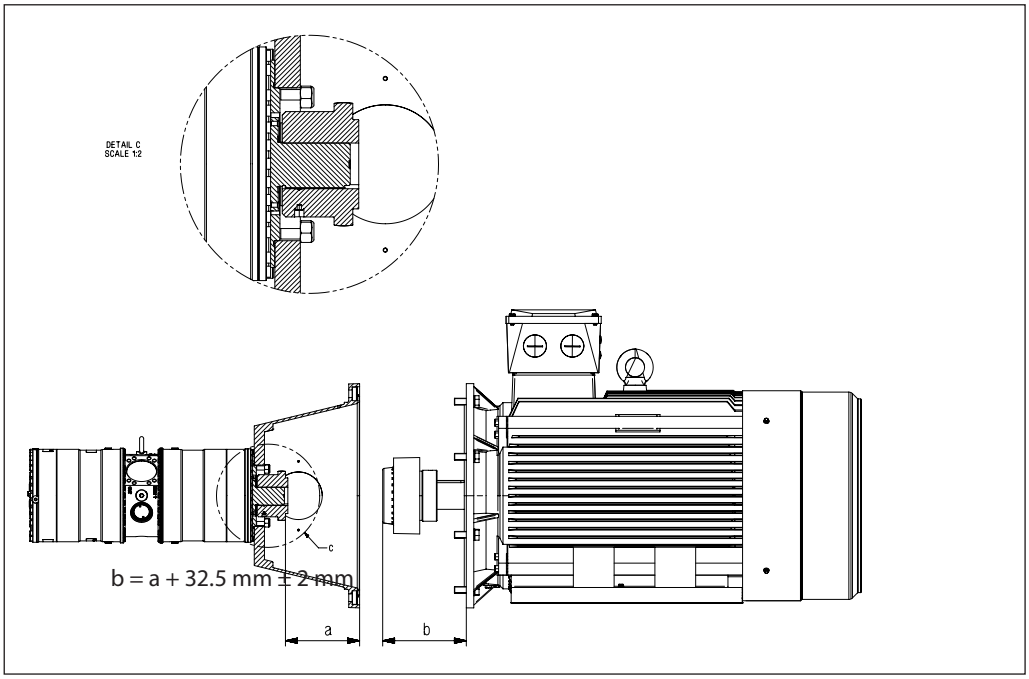
If used in potentially explosive atmospheres the setscrews to fasten the hubs as well as all screw connections must be secured against working loose additionally, e.g. conglutinating with Loctite (average strength).

Please observe the manufacturer's instructions regarding the use of adhesives. Do not apply glue on the rubber surfaces.

2. Mount the bell housing on pump. Secure nuts with the right torque.
3. Push the coupling part all the way down to the shoulder of the pump shaft and secure with right torque on the locking screws. Measure the distance **"a"** from the end of the bell housing to the end of the toothing of the coupling.
4. Mount the coupling on motor shaft without using hammer. If needed then polish motor shaft/key and inside coupling hub.
5. On the motor shaft position the coupling so that the length from the end of the coupling to the end of the motor flange is **"b= a+32.5 mm" ± 2 mm.**
6. Secure coupling on motor shaft with the right torques on the locking scre+ws.
7. Connect carefully pump/bell housing to motor. Turn motor shaft so coupling tooths can interact.
8. Mount motor flange bolts to bell housing and tighten with the right torque.
9. Check coupling space. The pump coupling should be in a position so there is still 3-7 mm space.

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

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



3.4 Direction of rotation
Is indicated by an arrow engraved in the flange of the pump.

3.5 Orientation
APP 53-92 can be mounted/orientated in steps of 45 degrees. Please see Data sheet 521B1340.

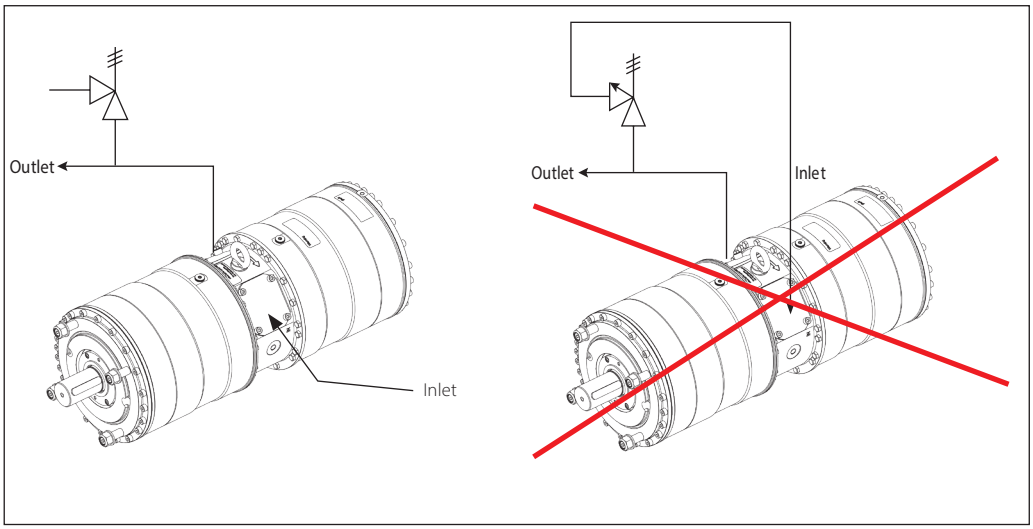
3.6 Protection from too high pressures
The pump should be protected against too high pressure by means of a safety valve or a pressure relief valve.

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

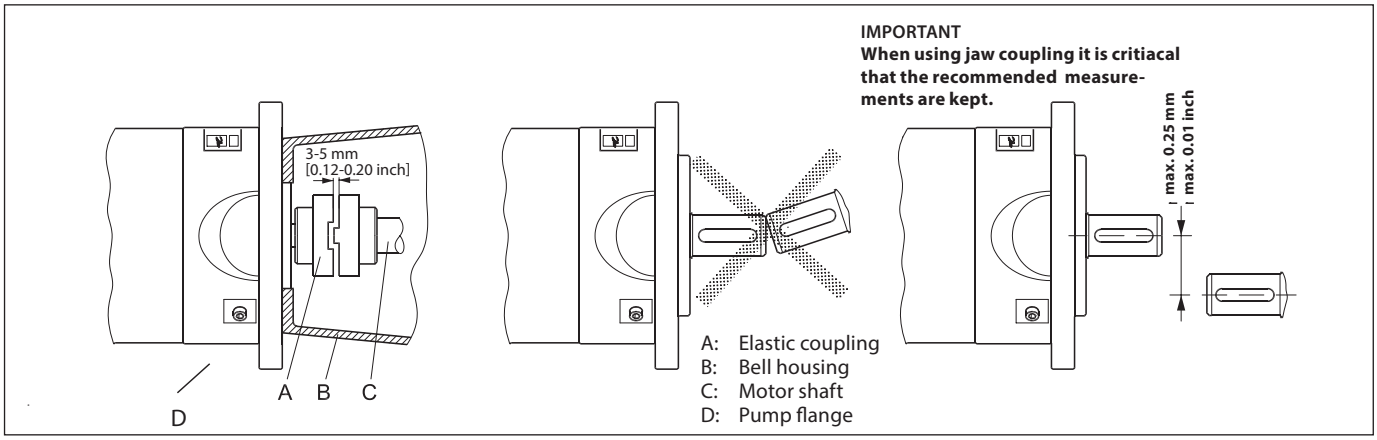
The valve should be placed as close to the pump as possible.

We recommend to install flexible soft hoses both in the inlet and outlet lines.

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



4. Building up the pump unit with jaw coupling



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

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

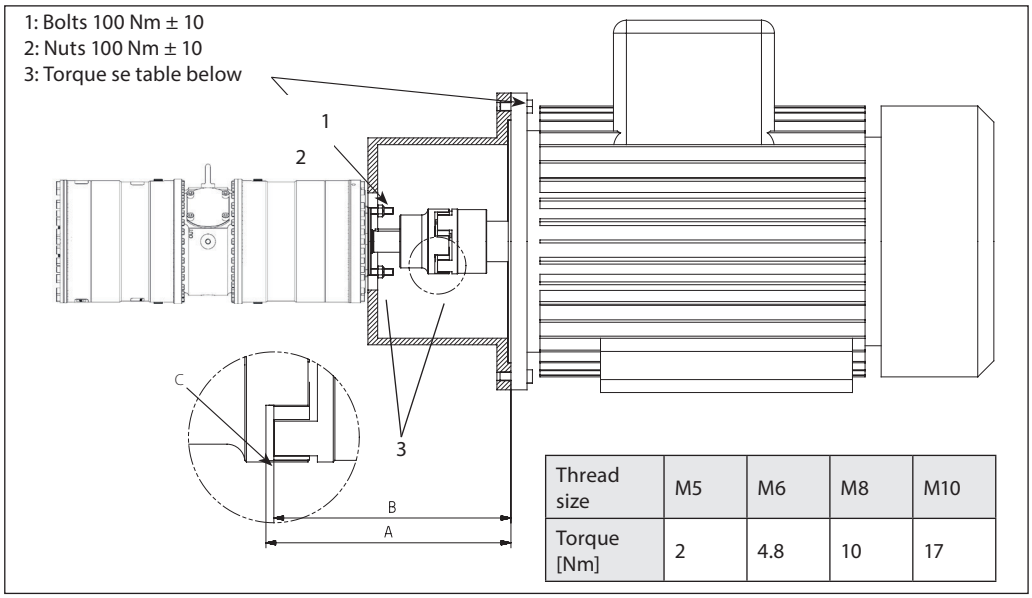
6. Adjust respectively, verify the measurement, and secure both couplings with the right torques on the locking screws (see coupling operation & mounting instruction).

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

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

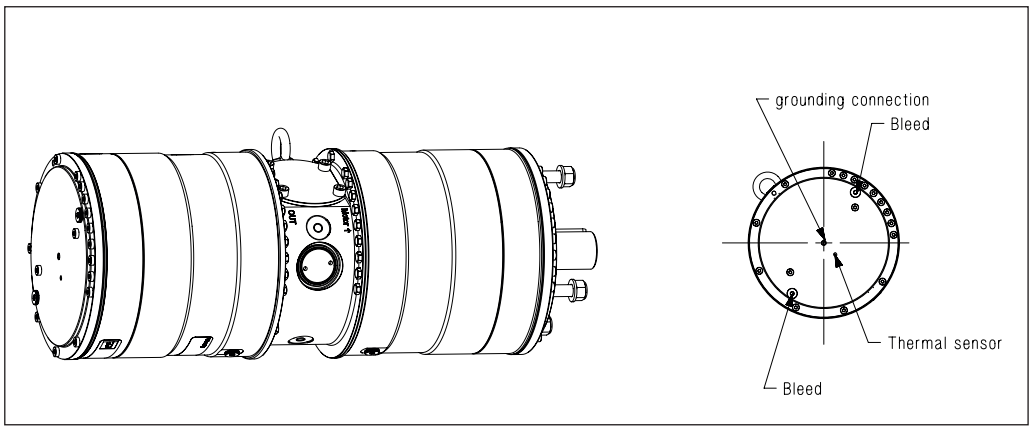
Choose proper tolerances to ensure an easy mounting of the elastic coupling without use of tools.

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



Thread size	M5	M6	M8	M10
Torque [Nm]	2	4.8	10	17

4.2 Connections

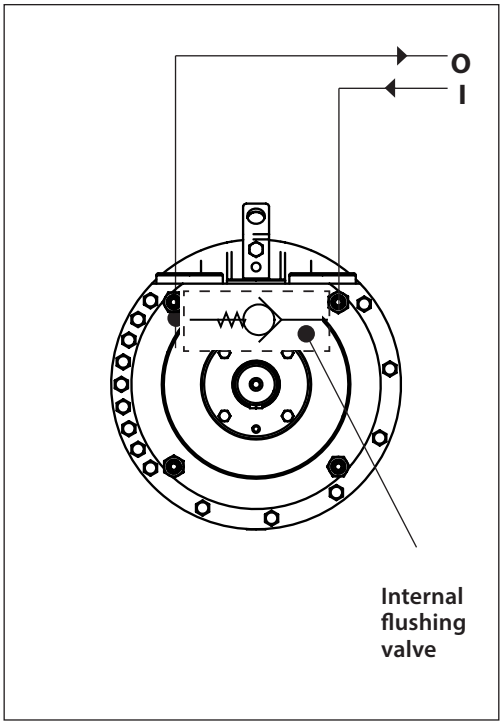


To prevent stray current corrosion we recommend grounding of the pump and all other parts in the system.
All parts in the system must be electrical potential equalized to a single reference point (grounding point).
It is recommended that the electrical resistance in the grounding cable is equal to or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

5. Initial start-up

1. Flush inlet line before connecting the pump, to remove possible impurities from pipes, hoses etc.
2. Connect pump inlet to inlet line and flush the pump for 5 min. by means of the internal flushing valve, to remove possible impurities from pipes, hoses etc.
3. Loosen top bleeding plug (see item 3.5) using an allen key (only plugs with internal hexagon 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, show on the pump flange.
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.
Otherwise the pump will be damaged if a check valve is placed between pump and feed pump.



6. Operation

6.1 Temperature

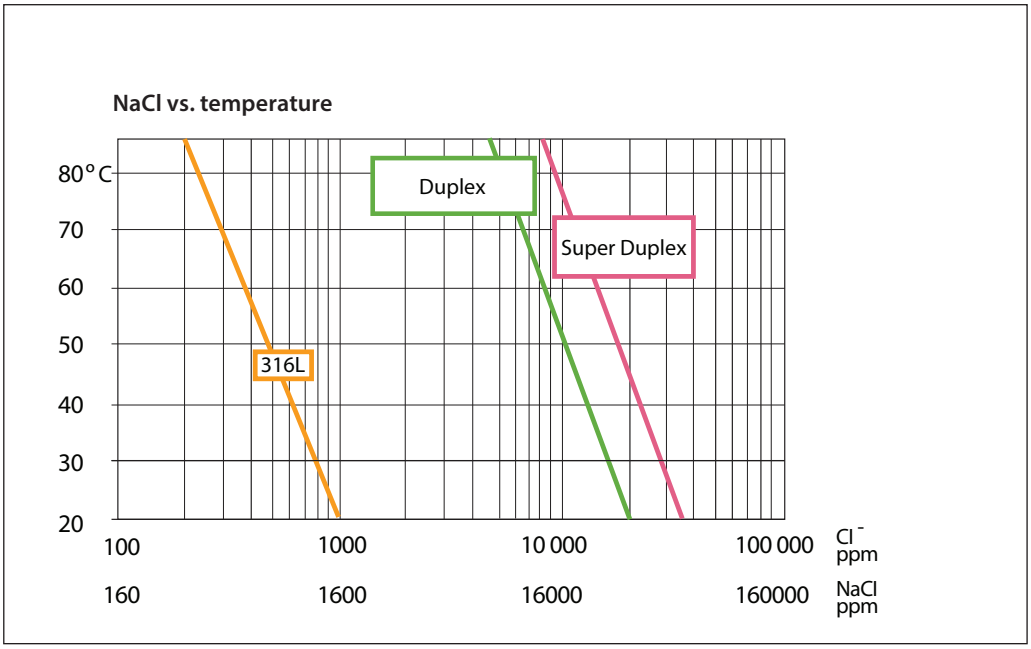
Fluid temperature: Min. +2°C to max. +50°C (Min. +35.6°F to max. +122°F)
Ambient temperature: Min. +2°C to max. +50°C (Min. +35.6°F to max. +122°F)

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

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

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

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



6.2 Pressure

The inlet pressure shall be min. 2 barg (30 psig) and max. 5 barg (72.5 psig). At lower pressures the pump will cavitate, resulting in damage of the pump.

Max. inlet pressure peak (e.g. in case the pump stops momentarily) up to 10 barg (145 psig) are acceptable.

Max. pressure on the pump's outlet line shall be limited at 80 barg (1160 psig) continuously.

For APP 86 min. inlet pressure shall be 2.5 barg (36 psig) and max. outlet pressure shall be 70 barg (1015 psig).

For APP 92 min. inlet pressure shall be 3.5 barg (50 psig) and max. outlet pressure shall be 70 barg (1015 psig).

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

6.3 Dry running

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

6.4 Disconnection

If the inlet line is disconnected from the water supply, the pump will be emptied of water through the disconnected inlet line.

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

6.5 Storage

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

When preparing the pump for long-term storage at temperatures below the freezing point, flush the pump with an anti-freeze medium type monopropylene glycol to prevent internal corrosion or frost in the pump.

For further information on anti-freeze media, please contact Danfoss High Pressure Pumps.

Recommended procedure:

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

Storage:

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

7. Service and warranty

Warranty

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

Provided that the pump has been running according to the Danfoss specifications, Danfoss 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 pumps.
Other factors that affect pump performance and lifetime include:

- Insufficient filtration
- Insufficient bleeding and venting
- Running the pump at speed outside specifications.
- Supplying the pump with water at temperature higher than recommended.
- Running the pump at inlet pressure outside specifications.
- Running the pump at outlet pressure outside the specifications.
- Wrong direction of rotation.

Maintenance

After 8,000 hours of operation it is strongly recommended to inspect the pump and change any worn parts, e.g. pistons and shaft seal. This is done in order to prevent a potential breakdown of the pump. If the parts are not replaced, more frequent inspection is recommended according to our guidelines.

Pump shutdown:

The APP pumps are made of Duplex/Super Duplex materials with excellent corrosion properties. It is, however, always recommended to flush the pump with freshwater when the system is shut down.
When stopping the pump for more than 1 day flush the pump with permeate by rotating the pump for 10 sec. Flushing through the flashing valve of the pump without rotating the pump is not enough for cleaning the inside of the pump. The pump can be flushed with biocide like the membranes. The biocide must be compatible with the materials used in our pump (materials can be found in the parts list in the Service guide and Operating manual).

Repair

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

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

Electric Motors

Motor Manual

hoyermotors.com

Manual

HOYER
MOTORS

HOYER
MOTORS

Motor Manual

General

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

Transport and storage

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

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

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

Installation

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

Electrical connection

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

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

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

Tightening torques for terminal board screws:

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

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

Maintenance

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

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

Typical duty hours for lifetime lubricated bearings.

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

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

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

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

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

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

Special note for Atex Zone 22 and nA motors

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

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

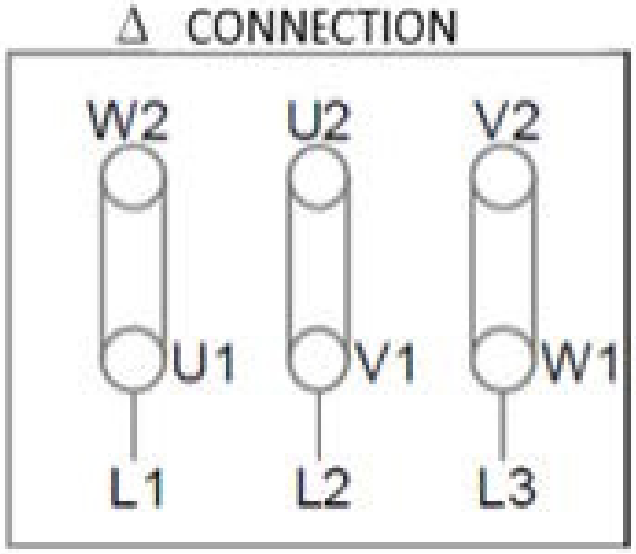
Only certificated cable glands may be used. Unused glands must be closed.
Connections must be made in such a way as to ensure that a permanently safe electrical connection is maintained, both for the main supply and earth connection.
Installations must be in accordance with actual standards for installation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

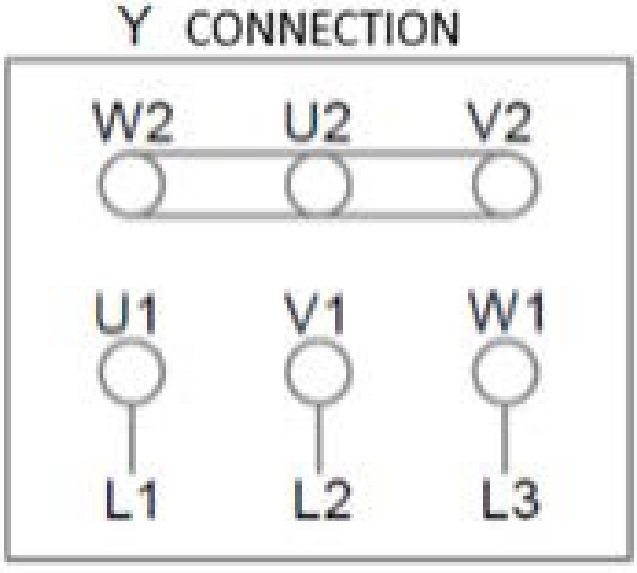
It is recommended that the IEC standard is followed according to temperature and dust on the motor surface.
The use of motors with so much surface dust that the motor temperature increases is not permitted.
Regularly cleaning is recommended.
The radial shaft sealing ring is part of the ATEX certification.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

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

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

Connection diagram
Anschlußdiagram
Anslutningdiagramm
Forbindelsesdiagram
Aansluitdiagram
Connection
Conexión
Collegamento
Schemat polacsen





EU Declaration of Conformity

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

Hereby declares that

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

Are in conformity with the following:

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

Motor type HMAx and HMCx is also conformity with:

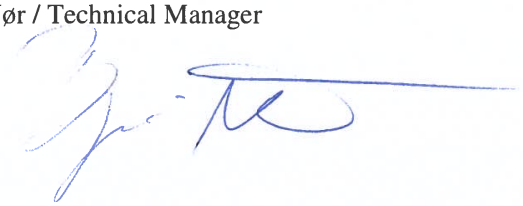
Standards:	IEC/EN 60079-0:2018, IEC/EN 60079-0/A11:2013, IEC/EN 60079-15:2010, IEC/EN 60079-31:2014
Directive:	Eco design for electrical motors 2009/640/EC and 2014/4EU ATEX directive 2014/34/EU Ex II 3D Ex tc IIIB T120°C Ex II 3G Ex nA IIC T3
CE marking:	CE

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

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

Signed by: Bjarne Nør / Technical Manager

December 2018:



1/3

x = 2, 3

HOYER

EXCEEDING EXPECTATIONS

Hoyer Motors, Motor Manual, April 2019

Head Offices

Denmark
Over Hadstenvej 42 · DK-8370 Hadsten
T +45 86 98 21 11 · F +45 86 98 17 79
CVR no. 17 63 06 95
hoyermotors@hoyermotors.com
hoyermotors.com

China
19 Jingwu Middle Road · Beilun District
Ningbo 315821 · Zhejiang
T +86 574 26 28 15 77 · F + 86 574 2628 1573
hoyermotors@hoyermotors.cn
hoyermotors.cn

Branch Offices

Germany
Landsberger Straße 155 · 80687 München
T +49 89 700 88 235 · F +49 89 543 56 333
germany@hoyermotors.com
hoyermotors.com

Sweden
Liljeholmsstranden 5 · PO box 44017
SE-100 73 Stockholm
T +46 8 446 877 13
sweden@hoyermotors.com
hoyermotors.com

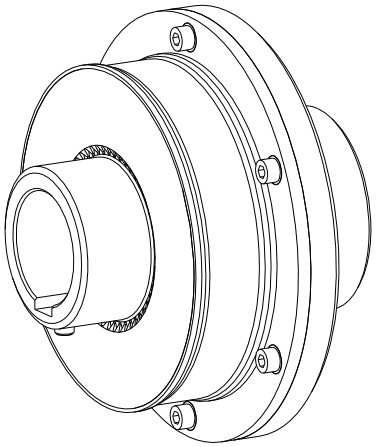
Benelux
Vasteland 78 · 3011 BN, Rotterdam
Tel. +31 10 420 35 20 · Fax.+31 10 420 44 51
benelux@hoyermotors.com
hoyermotors.com

Korea
302ho · Code square · 3150-1 · Daejeo 2-dong
Gangseo-gu · Busan · Korea
T +82 51 996 0251 · F +82 51 996 0252
korea@hoyermotors.com
hoyermotors.com

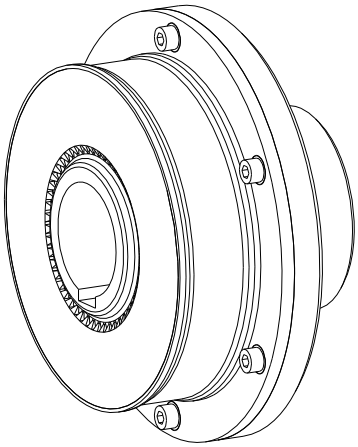
BoWex-ELASTIC®

highly flexible flange coupling type
HEW1, HEW2 and their combinations

according to directive 2014/34/EU
for finish bored, pilot bored and unbored couplings



Type HEW1

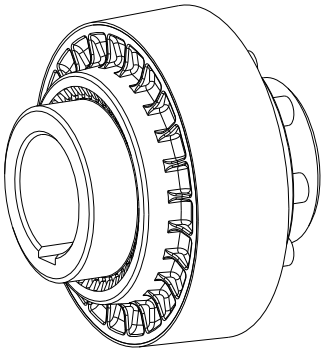


Type HEW2

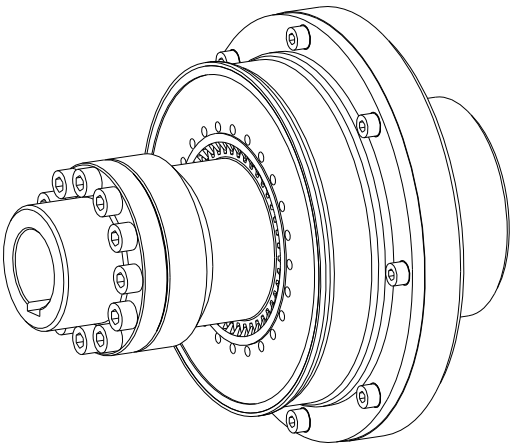
BoWex-ELASTIC®

highly flexible flange coupling types
HEW Compact and HEW-ZS and their combinations

for finish bored, pilot bored and unbored couplings



Type HEW Compact



Type HEW-ZS

Please observe protection note ISO 16016.	Drawn: 2017-04-24 Shg/Hk	Replacing: KTR-N dated 2013-06-10
	Verified: 2017-04-24 Shg	Replaced by:

KTR-Group	BoWex-ELASTIC® Operating/Assembly instructions Type HEW, HEW Compact and HEW-ZS	KTR-N 40114 EN Sheet: 2 of 22 Edition: 7

BoWex-ELASTIC® HEW is a highly flexible plug-in shaft coupling. It dampens torsional vibrations, reduces shocks and insulates structure-borne noise.
The **BoWex-ELASTIC® HEW** coupling compensates for relatively large shaft displacements, for example caused by inaccuracies in production, thermal expansion etc.

Table of contents

Please observe protection note ISO 16016.	Drawn: 2017-04-24 Shg/Hk	Replacing: KTR-N dated 2013-06-10
	Verified: 2017-04-24 Shg	Replaced by:

KTR-Group	BoWex-ELASTIC® Operating/Assembly instructions Type HEW, HEW Compact and HEW-ZS	KTR-N 40114 EN Sheet: 3 of 22 Edition: 7

1 Technical data

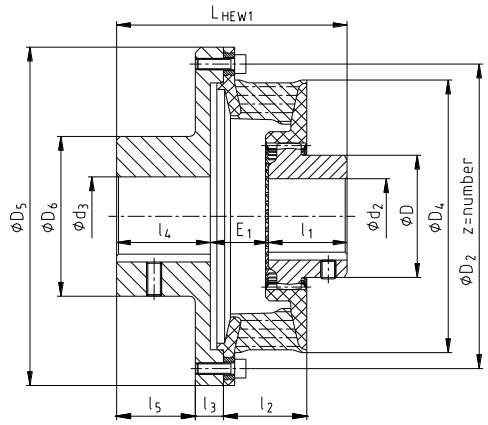


Illustration 1: BoWex-ELASTIC® type HEW1

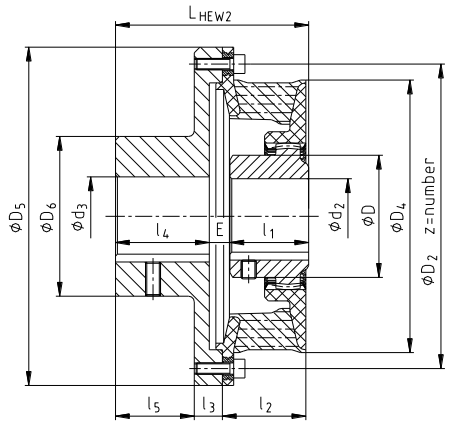


Illustration 2: BoWex-ELASTIC® type HEW2

Table 1: Dimensions – type HEW1 and HEW2

Size	Max. finish bore [mm]		Dimensions [mm]								
	d_2	d_3	D	D_2	z x M		D_4	D_5	D_6	l_1	l_2
42	48	50	68	162	6	M6	146	180	85	50	45
48	48	55	68	180	8	M6	164	200	92	50	45
65	65	75	96	224	8	M8	205	245	125	70	55
80	80	80	124	295.27	8	M10	266	318	130	90	70
G 80	85	95	124	333.4	8	M10	302	358	145	90	80
100	100	110	152	438.15	8	M12	350	478	158	110	80
125	125	125	192	438.15	16	M12	416	478	175	140	99
G 125	125	125	192	489	8	M12	440	530	175	140	95
150	160	160	225	542.9	6	M16	470	585	225	150	100
G 150	160	160	225	542.9	6	M16	504	585	225	150	108
200	180	200	250	641.35	12	M16	568	683	280	175	149
G 200	180	200	200	250	12	M16	600	683	280	175	149

Table 1: Continuation of Dimensions – type HEW1 and HEW2

Size	Dimensions [mm]							Weight with max. bore [kg]	Mass moment of inertia [kgm²]	
	l_3	l_4	l_5	E	E_1	L_{HEW} [1]	L_{HEW} [2]		J_A	J_L
42	15	50	42	4	32	132	104	4.3	0.0121	0.0015
48	17	55	45	4	32	137	109	5.5	0.0204	0.0019
65	28	75	63	5	42	187	150	13.2	0.0752	0.0071
80	17	80	70	5	45	215	160	19.7	0.1449	0.0285
G 80	22	90	78	5	55	235	185	25.9	0.2748	0.0422
100	14	111.5	113	26	57	278	207	48.5	0.8356	0.1050
125	14	170	158	-	45	327	-	67.2	0.9498	0.2617
G 125	14	170	158	-	45	327	-	76.6	1.4492	0.3034
150	18	150	145	-	70	380	-	110	2.7206	0.5303
G 150	18	150	145	-	70	380		113.4	2.7809	0.5861
200	26	220	214	-	85	480		195	6.6418	1.1406
G 200	26	220	214	-	85	480		200	6.6099	1.3419

Please observe protection note ISO 16016.	Drawn: 2017-04-24 Shg/Hk	Replacing: KTR-N dated 2013-06-10
	Verified: 2017-04-24 Shg	Replaced by:

KTR-Group	BoWex-ELASTIC® Operating/Assembly instructions Type HEW, HEW Compact and HEW-ZS	KTR-N 40114 EN Sheet: 4 of 22 Edition: 7

1 Technical data

Table 2: Torques – type HEW1 and HEW2

Size	Elastomer hardness [Shore A]	Torque [Nm]		Size	Elastomer hardness [Shore A]	Torque [Nm]	
		T_{KN}	$T_{K\,max.}$			T_{KN}	$T_{K\,max.}$
42	40 / T40	130	390	125	40 / T40	3000	9000
	50 / T50	150	450		50 / T50	4000	12000
	65 / T65	180	540		65 / T65	5000	15000
48	40 / T40	200	600	G 125	40 / T40	4000	12000
	50 / T50	230	690		50 / T50	5200	16000
	65 / T65	280	840		65 / T65	6500	20000
65	40 / T40	350	1050	150	T40	5500	16500
	50 / T50	400	1200		T50	7000	21000
	65 / T65	500	1500		T65	9000	27000
80	40 / T40	750	2250	G 150	T40	7000	21000
	50 / T50	950	2850		T50	9200	27600
	65 / T65	1200	3600		T65	11500	34500
G 80	40 / T40	1250	3750	200	T40	9500	28500
	50 / T50	1600	4800		T50	12500	37500
	65 / T65	2000	6000		T65	16000	48000
100	40 / T40	2000	6000	G 200	T40	11500	34500
	50 / T50	2500	7500		T50	15000	45000
	65 / T65	3200	9600		T65	19500	58500

BoWex® HEW Compact

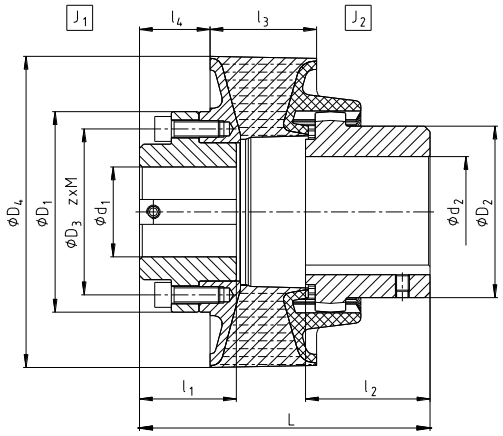


Illustration 3: BoWex-ELASTIC® type HEW1

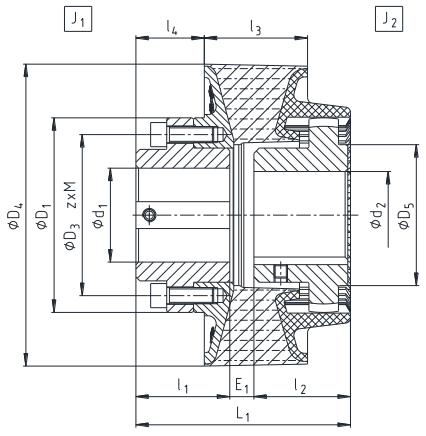


Illustration 4: BoWex-ELASTIC® type HEW2

Table 3: Dimensions – type HEW Compact

Size	Max. finish bore [mm]		Dimensions [mm]													Weight with pilot bored coupling [kg]	Mass moment of inertia with pilot bored coupling [kgm²]	
	d_1	d_2	D_1	D_2	D_3	D_4	l_1	l_2	l_3	l_4	E	L	L_1	z	M		J_1	J_2
42-130	42	42	90	65	78	131	42	42	45	37	34	118	98	6	M6	3.4	0.003	0.001
65-180	65	65	130	96	110	180	60	55	55	47	30	145	122	8	M10	9.0	0.014	0.006
80-225	75	80	145	124	120	225	70	90	77	51	50	210	158	10	M12	18.9	0.035	0.029
100-305	100	100	200	152	175	305	90	110	90	73	58	258	187	16	M12	40.2	0.152	0.087
125-365	125	125	235	192	205	365	120	140	150	90	68	328	240	12	M16	75.0	0.36	0.26

Please observe protection note ISO 16016.	Drawn: 2017-04-24 Shg/Hk	Replacing: KTR-N dated 2013-06-10
	Verified: 2017-04-24 Shg	Replaced by:

KTR-Group	BoWex-ELASTIC® Operating/Assembly instructions Type HEW, HEW Compact and HEW-ZS	KTR-N 40114 EN Sheet: 5 of 22 Edition: 7

1 Technical data

Table 4: Technical data - HEW Compact

Size	Elastomer hardness [Shore A]	Torque T_{KN} [Nm]	Torque T_{Kmax} [Nm]	Torque T_{KW} [Nm]	Operating speed $n_{max.}$ [rpm]	Perm. damping power P_{KW} [W] 60 °C	80 °C	90 °C	$C_{dyn.}$ with 60 °C [Nm/rad]	Relative damping ψ	Resonance factor $V_R \approx 2 \cdot \pi/\psi$	Radial spring stiffness C_r [N/mm]
42	T50	150	450	45	7300	24	12	6	780	0.6	10.5	178
	T65	180	540	54					2400	0.8	7.9	600
	T70	210	630	63					2900	1.2	5.2	710
65	T50	400	1200	120	5500	48	24	12	2850	0.6	10.5	379
	T65	500	1500	150					7800	0.8	7.9	955
	T70	575	1725	173					9500	1.2	5.2	1240
80	T50	900	2700	270	4400	96	48	24	5000	0.6	10.5	420
	T65	1100	3300	330					13000	0.8	7.9	1090
	T70	1300	3900	390					16500	1.2	5.2	1450
100	T50	2000	6000	600	3200	156	78	39	17000	0.6	10.5	760
	T65	2600	7800	780					44000	0.8	7.9	1850
	T70	3000	9000	900					50000	1.2	5.2	2250
125	T40	3000	9000	900	2900	192	96	48	15000	0.6	10.5	476
	T50	4000	12000	1200					25000	0.8	7.9	750
	T65	5000	15000	1500					62000	1.2	5.2	1930

BoWex® HEW-ZS

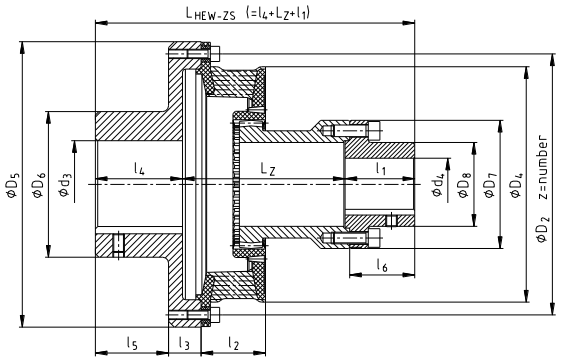


Illustration 5: BoWex-ELASTIC® type HEW-ZS (size 48 to G 80)

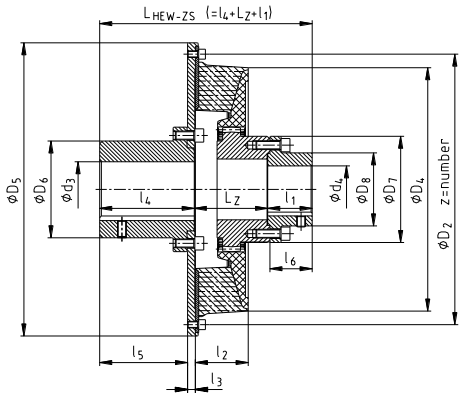


Illustration 6: BoWex-ELASTIC® type HEW-ZS (size 100 to G 125)

Table 5: Dimensions – type HEW-ZS[1)]

Size	Max. finish bore [mm] d_3	d_4	Dimensions [mm] D_2	z	x M	D_4	D_5	D_6	D_7	D_8	l_1	l_2	l_3
48	55	28	180	8	M6	164	200	92	78	45	50	45	17
65	75	45	224	8	M8	205	245	125	110	72	55	55	28
80	80	65	295.27	8	M10	266	318	130	145	100	90	70	17
G 80	95	65	333.4	8	M10	302	358	145	145	100	90	80	22
100	110	90	438.15	8	M12	350	478	158	180	135	80	80	16
125	125	120	438.15	16	M12	416	478	175	225	180	80	99	18
G 125	125	120	489	8	M12	440	530	175	225	180	80	95	15

Please observe protection note ISO 16016.	Drawn: 2017-04-24 Shg/Hk	Replacing: KTR-N dated 2013-06-10
	Verified: 2017-04-24 Shg	Replaced by:

KTR-Group	BoWex-ELASTIC® Operating/Assembly instructions Type HEW, HEW Compact and HEW-ZS	KTR-N 40114 EN Sheet: 6 of 22 Edition: 7

1 Technical data

Table 5: Continuation of Dimensions – type HEW-ZS[1)]

Size	Dimensions [mm]			Spacer HEW-ZS L_Z [mm]					Weight with max. bore [kg]	Mass moment of inertia [kgm²]	
	l_4	l_5	l_6	100	120	140	180	250		J_A	J_L
48	55	45	45	●	●				6.9	0.0203	0.0050
65	75	63	56		●	●			16.0	0.0747	0.0160
80	80	70	75			●	●		25.5	0.1447	0.0699
G 80	90	78	75				●	●	34.2	0.2752	0.1412
100	111.5	110	76				●	●	54.0	0.8459	0.0992
125	170	171	76				●	●	84.2	1.1814	0.3017
G 125	170	157	76				●	●	93.5	1.6853	0.3690

[1)] Torques of BoWex-ELASTIC® type HEW-ZS see table 2.

BoWex-ELASTIC® couplings with attachments that may generate heat, sparks and static charging (e. g. combinations with brake drums, brake disks, overload systems such as torque limiters, fans etc.) are not permissible for the use in potentially explosive atmospheres. A separate analysis must be performed.

2 Advice

2.1 Coupling selection

For a long-lasting and failure-free operation of the coupling it must be selected according to the selection instructions (according to DIN 740 part 2) for the particular application (see catalogue drive technology "BoWex-ELASTIC®").
If the operating conditions (performance, speed, modifications on engine and machine) change, the coupling selection must be reviewed.
Please make sure that the technical data regarding torque refer to the elastomer part only.
The transmittable torque of the shaft-hub-connection must be reviewed by the customer and is subject to his responsibility.

For drives subject to torsional vibrations (drives with cyclic stress due to torsional vibrations) it is necessary to perform a torsional vibration calculation to ensure a reliable selection. Typical drives subject to torsional vibrations are e. g. drives with diesel engines, piston pumps, piston compressors etc. If requested, KTR will perform the coupling selection and the torsional vibration calculation.

2.2 General advice

Please read through these operating/assembly instructions carefully before you start up the coupling.

Please pay special attention to the safety instructions!

The **BoWex-ELASTIC®** coupling is suitable and approved for the use in potentially explosive atmospheres. When using the coupling in potentially explosive atmospheres, please observe the special advice and instructions regarding safety in enclosure A.

The operating/assembly instructions are part of your product. Please store them carefully and close to the coupling.

Please observe protection note ISO 16016.	Drawn: 2017-04-24 Shg/Hk	Replacing: KTR-N dated 2013-06-10
	Verified: 2017-04-24 Shg	Replaced by:

2 Advice

2.3 Safety and advice symbols

	**Warning of potentially explosive atmospheres**	This symbol indicates notes which may contribute to preventing bodily injuries or serious bodily injuries that may result in death caused by explosion.
	**Warning of personal injury**	This symbol indicates notes which may contribute to preventing bodily injuries or serious bodily injuries that may result in death.
	**Warning of product damages**	This symbol indicates notes which may contribute to preventing material or machine damage.
	**General advice**	This symbol indicates notes which may contribute to preventing adverse results or conditions.
	**Warning of hot surfaces**	This symbol indicates notes which may contribute to preventing burns with hot surfaces resulting in light to serious bodily injuries.

2.4 General hazard warnings

With assembly, operation and maintenance of the coupling it has to be made sure that the entire drive train is secured against accidental switch-on. You may be seriously hurt by rotating parts. Please make absolutely sure to read through and observe the following safety indications.

- All operations on and with the coupling have to be performed taking into account "safety first".
- Please make sure to switch off the power pack before you perform your work on the coupling.
- Secure the power pack against accidental switch-on, e. g. by providing warning signs at the place of switch-on or removing the fuse for current supply.
- Do not reach into the operating area of the coupling as long as it is in operation.
- Please secure the coupling against accidental contact. Please provide for the necessary protection devices and covers.

2.5 Intended use

You may only assemble, operate and maintain the coupling if you

- have carefully read through the operating/assembly instructions and understood them
- had technical training
- are authorized by your company

The coupling may only be used in accordance with the technical data (see table 1 to 4 in chapter 1). Unauthorized modifications on the coupling design are not admissible. We will not assume liability for any damage that may arise. In the interest of further development we reserve the right for technical modifications.
The **BoWex-ELASTIC® type HEW, HEW Compact and HEW-ZS** described in here corresponds to the technical status at the time of printing of these operating/assembly instructions.

2 Advice

2.6 Reference to EC Machinery Directive 2006/42/EC

The couplings supplied by KTR should be considered as components, not machines or partly completed machines according to EC Machinery Directive 2006/42/EC. Consequently KTR does not have to issue a declaration of incorporation. For details about safe assembly, start-up and safe operation please refer to the present operating/assembly instructions considering the warnings.

3 Storage, transport and packaging

3.1 Storage

The coupling hubs are supplied in preserved condition and can be stored at a dry and roofed place for 6 - 9 months.
With favourable storage conditions the properties of the elastomer part remain unchanged up to 5 years.

The storage rooms must not include any ozone-generating devices like e. g. fluorescent light sources, mercury-vapour lamps or electrical high-voltage appliances.
Humid storage rooms are not suitable.
Please make sure that condensation is not generated. The best relative air humidity is less than 65 %.

3.2 Transport and packaging

In order to avoid any injuries and any kind of damage please always make use of proper transport and lifting equipment.

The couplings are packed differently each depending on size, number and kind of transport. Unless otherwise contractually agreed, packaging will follow the in-house packaging specifications of KTR.

4 Assembly

The coupling is generally supplied in individual parts. Before assembly the coupling has to be inspected for completeness.

4.1 Components of the couplings

Components of BoWex-ELASTIC®, type HEW1 and HEW2

Component	Quantity	Description
1	1	Elastomer part
2	1	Hub
4	1	Coupling flange
5	see table 1 [1)]	Cap screws DIN EN ISO 4762 [1)]
7	2	Setscrews DIN EN ISO 4029

[1)] With size 150 nuts as per DIN EN ISO 4014 are required additionally.

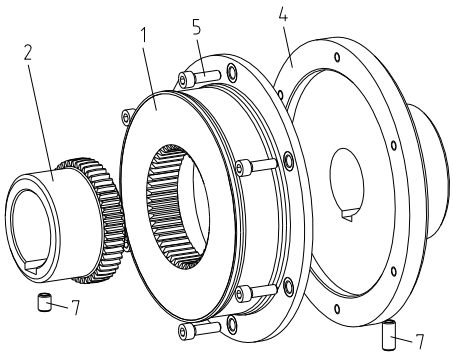


Illustration 7: BoWex-ELASTIC® type HEW1

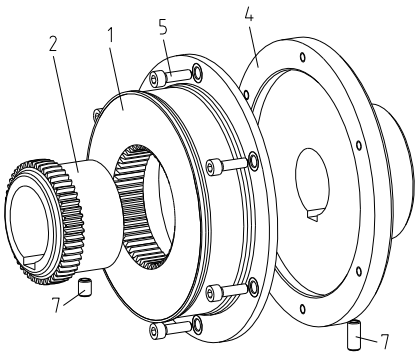


Illustration 8: BoWex-ELASTIC® type HEW2

KTR-Group	BoWex-ELASTIC® Operating/Assembly instructions Type HEW, HEW Compact and HEW-ZS	KTR-N 40114 EN Sheet: 9 of 22 Edition: 7

4 Assembly

4.1 Components of the couplings

Components of BoWex-ELASTIC®, type HEW compact

Component	Quantity	Description
1	1	Elastomer part
2	1	Hub
4	1	Coupling flange
5	see table 3	Cap screws DIN EN ISO 4762
7	2	Setscrews DIN EN ISO 4029

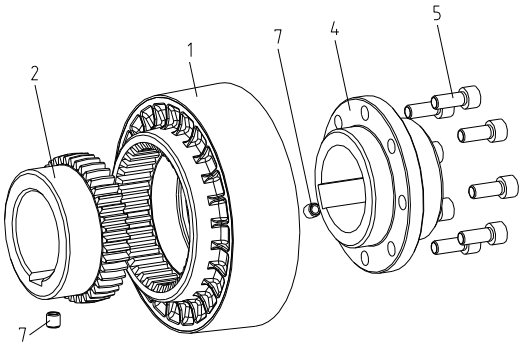


Illustration 9: BoWex-ELASTIC® type HEW Compact

Components of BoWex-ELASTIC®, type HEW-ZS

Component	Quantity	Description
1	1	Elastomer part
2	1	Hub spec.
3	1	Intermediate flange hub
4	1	Coupling flange
4.1	1	Additional flange
4.2	1	Flange hub
4.3	see table 5	Cap screws DIN EN ISO 4762
5	see table 1	Cap screws DIN EN ISO 4762
6	see table 5	Cap screws DIN EN ISO 4762
7	2	Setscrews DIN EN ISO 4029

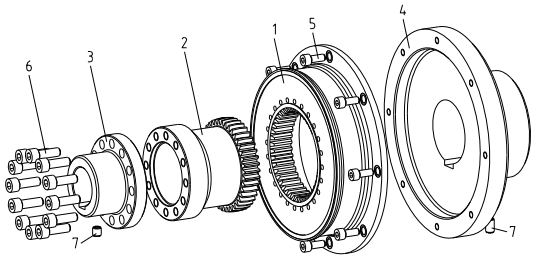


Illustration 10: BoWex-ELASTIC® type HEW-ZS (size 48 to G 80)

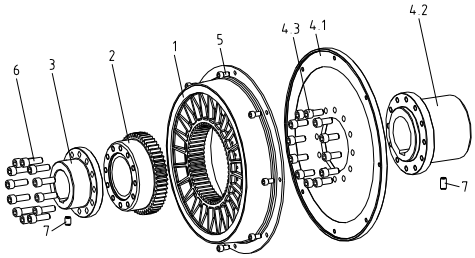


Illustration 11: BoWex-ELASTIC® type HEW-ZS (size 100 to G 125)

Table 6: Cap screws DIN EN ISO 4762

Size	48	65	80	G 80	100	125	G 125
Quantity z (component 4.3)	-	-	-	-	15	12	12
Quantity z (component 6)	8	12	12	12	12	12	12

Please observe protection note ISO 16016.	Drawn: 2017-04-24 Shg/Hk	Replacing: KTR-N dated 2013-06-10
	Verified: 2017-04-24 Shg	Replaced by:

4 Assembly

4.2 Advice for finish bore

The maximum permissible bore diameters d (see table 1 to 5 in chapter 1 - technical data) must not be exceeded. If these figures are disregarded, the coupling may tear. Rotating particles may cause danger to life.

- Bores on the hubs/coupling flange machined by the customer have to observe concentricity or axial runout (see illustration 12).

- Please make absolutely sure to observe the figures for Ø d_{max}.
- Carefully align the hub or coupling flange when the finish bores are drilled.
- Provide for a setscrew according to DIN EN ISO 4029 with a cup point or an end plate to fasten the hub or coupling flange axially.

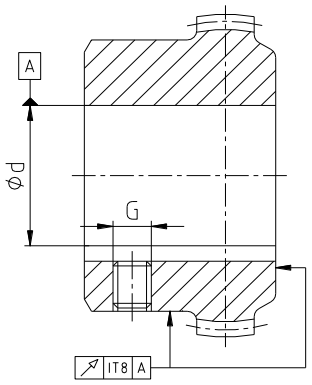


Illustration 12: Concentricity and axial runout

The customer bears the sole responsibility for all machining processes performed subsequently on unbored or pilot bored as well as finish machined coupling components and spare parts. KTR does not assume any warranty claims resulting from insufficient remachining.

Table 7: Setscrews DIN EN ISO 4029

Size	42	48	65	80	G 80	100	125	G 125	150	G150	200	G 200
Thread size	M8	M8	M10	M10	M10	M12	M16	M16	M16	M16	M20	M20
Tightening torque T_A [Nm]	10	10	17	17	17	40	80	80	80	80	140	140

Table 8: Recommended fit pairs acc. to DIN 748/1

Bore [mm]		Shaft tolerance	Bore tolerance
above	up to		
	50	k6	H7 (KTR standard)
50		m6	

If a feather keyway is intended to be used in the hub, it should correspond to the tolerance ISO JS9 (KTR standard) with normal operating conditions or ISO P9 with difficult operating conditions (frequently alternating torsional direction, shock loads, etc.).

The transmittable torque of the shaft-hub-connection must be reviewed by the customer and is subject to his responsibility.

4 Assembly

4.3 Assembly of the coupling

We recommend to inspect bores, shaft, keyway and feather key for dimensional accuracy before assembly.

Heating the hubs lightly (approx. 80 °C) allows for an easier mounting on the shaft.

Please pay attention to the ignition risk in potentially explosive atmospheres!

Touching the heated hubs causes burns.
Please wear safety gloves.

With the assembly please make sure that the distance dimension E (see table 1 and 4) is observed to allow for axial clearance of the sleeve while being in operation.
Disregarding this advice may cause damage to the coupling.

With the assembly please make sure that the spline of the hub is fully covered by the internal spline of the elastomer. (Please observe mounting dimensions L, L_{HEW1}, L_{HEW2} or L_{HEW-ZS}.)
Disregarding this advice may cause damage to the coupling.

- **Applies with type HEW-ZS only (size 100 to G 125)!**
  Screw the flange hub (component 4.2) with the additional flange (component 4.1) at the tightening torques T_A specified in table 9.

Table 9: Cap screws DIN EN ISO 4762

Size	100	125	G 125
Tightening torque T_A [Nm]	355	355	355

- Mount the hub, flange hub with additional flange or the coupling flange onto the shaft of the driving and driven side.
- Shift the power packs in axial direction until the mounting dimension L, L_{HEW1}, L_{HEW2} or. L_{HEW-ZS} has been achieved.
- If the power packs have already been firmly assembled, shifting the hub, flange hub or the coupling flange or coupling flange axially on the shafts allows for adjusting the mounting dimension.
- Fasten the hub, flange hub or coupling flange by tightening the setscrews DIN EN ISO 4029 with a cup point (tightening torques see table 7).
- **Valid for type HEW-ZS only!**
  Mount the hub spec. (component 2) in front of the intermediate shaft hub (component 3) and screw the components at the tightening torques T_A specified in table 10.

Table 10: Cap screws DIN EN ISO 4762

Size	48	65	80	G 80	100	125	G 125
Tightening torque T_A [Nm]	41	69	120	120	190	295	295

4 Assembly

4.3 Assembly of the coupling

Valid for type HEW only!
Mount the elastomer part (component 1) in front of the coupling flange (component 4) and screw the components at the tightening torques T_A specified in table 11.

Table 11: Cap screws DIN EN ISO 4762

Size	42	48	65	80	G 80	100	125	G 125	150	G 150	200	G 200
Tightening torque T_A [Nm]	14	14	35	69	69	120	120	120	295	295	410	410

- Position the elastomer part (component 1) in front of the flange hub with additional flange or coupling flange.
- Hand-tighten the components first. Afterwards tighten the screws at the tightening torque T_A specified in table 11.

Valid for type HEW Compact only!
Mount the coupling flange (component 4) in front of the elastomer part (component 1) and screw the components at the tightening torques T_A specified in table 12.

Table 12: Cap screws DIN EN ISO 4762

Size	42	65	80	100	125
Tightening torque T_A [Nm]	14	69	120	120	250

If used in potentially explosive atmospheres the setscrews to fasten the hubs as well as all screw connections must be secured against working loose additionally, e. g. conglutinating with Loctite (average strength).

Please observe the manufacturer's instructions regarding the use of adhesives.
Do not apply glue on the rubber surfaces.

4.4 Displacements - alignment of the couplings

The **BoWex-ELASTIC® HEW** couplings accept a position deviation of the machine parts to be connected up to the data specified in table 13.
With alignment, the radial and angular displacement should be kept as small as possible, because the service life is increased in this way if the operating conditions are otherwise maintained.

The **BoWex-ELASTIC® HEW** coupling has to be aligned from the coupling hub on the shaft side towards one of the machined surfaces of the flange hub.

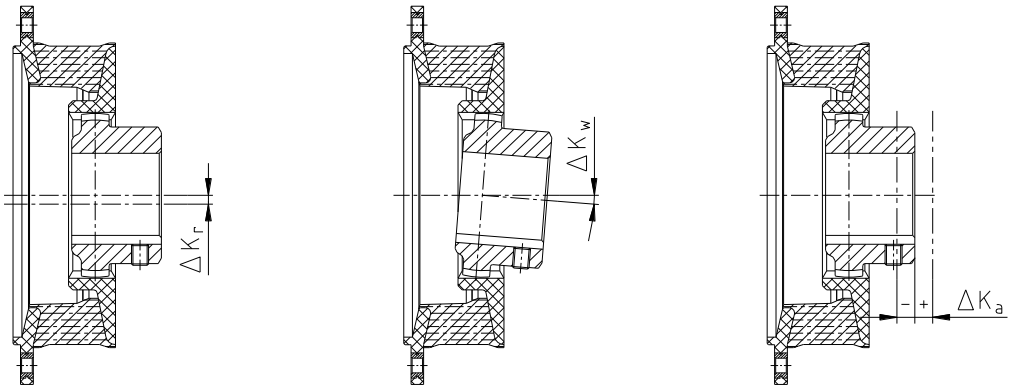
In order to ensure a long service life of the coupling and avoid danger with the use in potentially explosive atmospheres, the shaft ends must be accurately aligned.
Please absolutely observe the displacement figures specified (see table 11).
If the figures are exceeded, the coupling will be damaged.
The more accurate the alignment of the coupling, the longer is its service life.
If used in hazardous areas for the explosion group IIC (marking II 2GD c IIB T X), only half of the displacement figures (see tables 13 and 14) are permissible.

4 Assembly

4.4 Displacements - alignment of the couplings

Please note:

- The displacement figures specified in tables 13 and 14 are maximum figures which must not arise in parallel. If radial and angular displacements arise at the same time, the permissible displacement values may only be used proportionally (see illustration 14).
- The displacement figures specified are general standard figures that apply up to an ambient temperature of 80 °C, ensuring a sufficient service life of the **BoWex-ELASTIC®** coupling.
  Displacement figures between the speeds specified have to be interpolated accordingly. If necessary, please ask about the displacement for the corresponding coupling type.
- Please inspect with a dial gauge, ruler or feeler whether the permissible displacement figures of tables 13 and 14 can be observed.



Radial displacement | Angular displacement | Axial displacement

Illustration 13: Displacements

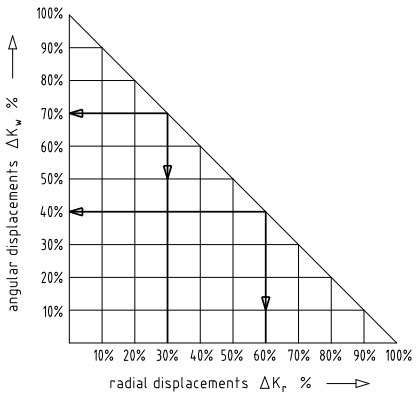
Examples of the displacement combinations specified in illustration 14:

Example 1:
ΔK_r = 30 %
ΔK_w = 70 %

Example 2:
ΔK_r = 60 %
ΔK_w = 40 %

$\Delta K_{total} = \Delta K_r + \Delta K_w \leq 100\ \%$

Illustration 14: Combinations of displacement



KTR-Group	BoWex-ELASTIC® Operating/Assembly instructions Type HEW, HEW Compact and HEW-ZS	KTR-N 40114 EN Sheet: 14 of 22 Edition: 7

4 Assembly

4.4 Displacements - alignment of the couplings

Table 13: Displacement figures

Displacement figures	Elastomer hardness [Shore A]	Size							
		42 HE	48 HE	65 HE G 65 HE	80 HE G 80 HE	100 HE	125 HE G 125 HE	150 HE G 150 HE	200 HE G 200 HE
Perm. radial displacement with n = 1500 rpm ΔK_r [mm]	40 [3]	1.1	1.2	1.6	1.8	2.2	2.5	2.8	3.0
	50 [3]	1.0	1.1	1.5	1.7	2.0	2.3	2.5	2.7
	65 [2] [3]	0.5	0.5	0.7	0.8	1.0	1.1	1.3	1.5
Perm. radial displacement with n = 3000 rpm ΔK_r [mm]	40 [3]	0.8	1.1	1.4	1.6	2.0	2.2	2.5	2.8
	50 [3]	0.7	1.0	1.3	1.5	1.8	2.0	2.2	2.5
	65 [2] [3]	0.4	0.4	0.5	0.6	0.8	0.8	1.0	1.2
Max. radial displacement $\Delta K_{r\,max.}$ [mm] [1]	40 [3]	3.6	3.8	5.1	5.7	6.5	7.5	8.0	8.5
	50 [3]	3.3	3.5	4.7	5.3	6.0	6.9	7.5	8.0
	65 [2] [3]	1.5	1.7	2.2	2.4	3.0	3.3	4.0	4.5
Perm. angular displacement with n = 1500 rpm ΔK_w [°]	40 [3]	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	50 [3]	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
	65 [2] [3]	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Perm. angular displacement with n = 3000 rpm ΔK_w [°]	40 [3]	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	50 [3]	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
	65 [2] [3]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Max. angular displacement $\Delta_{Kw\,max.}$ [°] [1]	40 / 50 / 65 [2] [3]	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Perm. axial displacement ΔK_a [mm]	40 / 50 / 65 [2] [3]	±2	±2	±2	±2	±3	±3	±5	±5

[1] For short-term start-up operation
[2] With size 125 = 70 ShA
[3] applies for compound T as well

Table 14: Displacement figures of HEW Compact

Displacement figures	Size														
	42-130			65-180			80-225			100-305			125-365		
Elastomer hardness [Shore A]	T50	T65	T70	T50	T65	T70	T50	T65	T70	T50	T65	T70	T40	T52	T65
Max. axial displacement ΔK_a [mm]	± 2			± 2			± 2			± 2			± 2		
Max. radial displacement with n=1500 rpm ΔK_r [mm] ±	±1.1	±1	±0.5	±1.6	±1.5	±0.7	±1.8	±1.7	±2.2	±2.2	±2	±1	±2.5	±2.3	±1.1
Max. radial displacement with n=3000 rpm ΔK_r [mm]	±0.55	±0.5	±0.25	±0.8	±0.75	±0.35	±0.9	±0.85	±1.1	±1.1	±1	±0.5	±1.25	±1.15	±0.55
Max. angular displacement with n=1500 rpm ΔK_w [°]	±1	±0.75	±0.5	±1	±0.75	±0.5	±1	±0.75	±1	±1	±0.75	±0.5	±1	±0.75	±0.5
Max. angular displacement with n=3000 rpm ΔK_w [°]	±0.5	±0.4	±0.25	±0.5	±0.4	±0.25	±0.5	±0.4	±0.5	±0.5	±0.25	±0.25	±0.5	±0.4	±0.25

5 Start-up

Before start-up of the coupling, please inspect the tightening of the setscrews in the hubs, the alignment and the distance dimension L, L_{HEW1}, L_{HEW2} or L_{HEW-ZS} and adjust, if necessary, and also inspect all screw connections for the tightening torques specified, dependent on the type of coupling.

If used in potentially explosive atmospheres the setscrews to fasten the hubs as well as all screw connections must be secured against working loose additionally, e. g. conglutinating with Loctite (average strength).

Finally the coupling protection against accidental contact must be fitted. It is required in accordance with DIN EN ISO 12100 (Safety of Machinery) and the directive 2014/14/EU and must protect against

- access with the little finger
- falling down of solid foreign objects.

The cover may provide for openings intended for necessary heat dissipation. These openings have to comply with DIN EN ISO 13857.
The cover must be electrically conductive and included in the equipotential bonding. Bellhousings (magnesium share below 7.5 %) made of aluminium and damping rings (NBR) can be used as connecting element between pump and electric motor. The cover may only be taken off with standstill of the unit.

If the couplings are used in locations subject to dust explosion and in mining the user must make sure that there is no accumulation of dust in a dangerous volume between the cover and the coupling. The coupling must not operate in an accumulation of dust.

For covers with unlocked openings on the top face no light metals must be used if the couplings are used as equipment of equipment group II (*if possible, from stainless steel*).
If the couplings are used in mining (equipment group I M2), the cover must not be made of light metal. In addition, it must be resistant to higher mechanical loads than if it is used as equipment of equipment group II.

During operation of the coupling, please pay attention to

- different operating noise
- vibrations occurring.

If you note any irregularities with the coupling during operation, the drive unit must be switched off immediately. The cause of the breakdown must be specified by means of the table „Breakdowns“ and, if possible, be eliminated according to the proposals. The potential breakdowns mentioned can be hints only. To find out the cause all operating factors and machine components must be considered.

Coating of coupling:

If coated (priming, paintings, etc.) couplings are used in potentially explosive atmospheres, the requirements on conductibility and coating thickness must be considered. In case of paintings up to 200 µm electrostatic load does not have to be expected. Multiple coatings exceeding 200 µm are prohibited for explosion group IIC.

6 Breakdowns, causes and elimination

The below-mentioned failures can result in a use of the **BoWex-ELASTIC®** coupling other than intended. In addition to the specifications given in these operating and assembly instructions please make sure to avoid such failures.
The errors listed can only be clues to search for the failures. When searching for the failure the adjacent components must generally be considered.

If used other than intended the coupling can become a source of ignition.
EU directive 2014/34/EU requires special care by the manufacturer and the user.

General failures with use other than intended:

- Important data for the coupling selection were not forwarded.
- The calculation of the shaft-hub-connection was not considered.
- Coupling components with damage occurred during transport are assembled.
- If the heated hubs are assembled, the permissible temperature is exceeded.
- The clearance of the components to be assembled is not coordinated with one another.
- Tightening torques have been fallen below/exceeded.
- Components are mixed up by mistake/assembled incorrectly.
- No original KTR components (purchased parts) are used.
- Old/already worn out elastomer parts or those stored for too long are used.
- The coupling used/the coupling protection used is not suitable for the operation in potentially explosive atmospheres or does not correspond to EU directive 2014/34/EU.
- Maintenance intervals are not observed.

Breakdowns	Causes	Hazard notes for potentially explosive atmospheres	Elimination
Different operating noise and/or vibrations occuring	Micro friction by faulty alignment on the spline of the elastomer part	Danger of ignition due to hot surfaces	1) Set the unit out of operation 2) Eliminate the reason for misalignment (e. g. loose foundation bolts, breaking of the engine mount, heat expansion of unit components, modification of the installation dimension E of the coupling) 3) For inspection of wear see item 5.4
	Screws for axial fastening of hubs working loose		1) Set the unit out of operation 2) Inspect alignment of coupling 3) Tighten the screws to fasten the hubs and secure against working loose 4) For inspection of wear see item 5.4
Fracture of elastomer part / spline	Fracture of elastomer part / spline caused by high dynamic energy / overload	none	1) Set the unit out of operation 2) Disassemble the coupling and remove remainders of the elastomer part 3) Inspect coupling components and replace coupling components that are damaged 4) Insert elastomer part, assemble coupling components 5) Find out the reason for overload

6 Breakdowns, causes and elimination

Breakdowns	Causes	Hazard notes for potentially explosive atmospheres	Elimination
Fracture of elastomer part / spline	Operating parameters do not meet with the performance of the coupling	none	1) Set the unit out of operation 2) Review the operating parameters and select a bigger coupling (consider mounting space) 3) Assemble new coupling size 4) Inspect alignment
	Operating error of the unit		1) Set the unit out of operation 2) Disassemble the coupling and remove remainders of the elastomer part 3) Inspect coupling components and replace coupling components that are damaged 4) Insert elastomer part, assemble coupling components 5) Instruct and train the service staff
Excessive wear on the spline of the elastomer part, fracture of elastomer	Vibrations of drive	Danger of ignition due to hot surfaces	1) Set the unit out of operation 2) Disassemble the coupling and remove remainders of the elastomer part 3) Inspect coupling components and replace coupling components that are damaged 4) Insert elastomer part, assemble coupling components 5) Inspect alignment, adjust if necessary 6) Find out the reason for vibrations
	Ambient/contact temperatures which are too high for the elastomer part, max. permissible e. g. T4 = - 30 °C/+ 80 °C		1) Set the unit out of operation 2) Disassemble the coupling and remove remainders of the elastomer part 3) Inspect coupling components and replace coupling components that are damaged 4) Insert elastomer part, assemble coupling components 5) Inspect alignment, adjust if necessary 6) Inspect and adjust ambient/contact temperature
	e. g. contact with aggressive liquids/oils, influence by ozone, too high ambient temperature etc. causing a physical change of the elastomer part	none	1) Set the unit out of operation 2) Disassemble the coupling and remove remainders of the elastomer part 3) Inspect coupling components and replace coupling components that are damaged 4) Insert elastomer part, assemble coupling components 5) Inspect alignment, adjust if necessary 6) Make sure that other physical modifications of the elastomer part are excluded

If you operate with a worn elastomer part (see chapter 9.3 and 9.4) a proper operation meeting the explosion protection requirements and the directive 2014/34/EU is not ensured.

7 Disposal

In respect of environmental protection we would ask you to dispose of the packaging or products on termination of their service life in accordance with the legal regulations and standards that apply, respectively.

- **Metal**
  Any metal components have to be cleaned and disposed of by scrap metal.
- **Nylon materials**
  Nylon materials have to be collected and disposed of by a waste disposal company.

8 Spares inventory, customer service addresses

A basic requirement to ensure the readiness for use of the coupling is a stock of the most important spare parts on site.

Contact addresses of the KTR partners for spare parts and orders can be obtained from the KTR homepage at www.ktr.com.

KTR does not assume any liability or warranty for the use of spare parts and accessories which are not provided by KTR and for the damages which may incur as a result.

9 Enclosure A

Advice and instructions regarding the use in potentially explosive atmospheres

Type HEW1 and HEW2: hub / elastomer / coupling flange

Annex A applies for BoWex-ELASTIC® HEW1 and HEW2 only.

9.1 Intended use in hazardous locations

Conditions of operation in potentially explosive atmospheres

BoWex-ELASTIC® couplings are suitable for the use according to EU directive 2014/34/EU.

Industry (with the exception of mining)

- Equipment group II of category 2 and 3 (*coupling is not approved for equipment group 1*)
- Media class G (*gases, fogs, steams*), zone 1 and 2 (*coupling is not approved for zone 0*)
- Media class D (*dusts*), zone 21 and 22 (*coupling is not approved for zone 20*)
- Explosion group IIB (*explosion class IIA are included in IIB*)

Temperature class:

Temperature class	Ambient or operating temperature T_a	Max. surface temperature [1]
T4, T3, T2, T1	- 30 °C to + 80 °C	115 °C [2]
T5	- 30 °C to + 65 °C	100 °C
T6	- 30 °C to + 50 °C	85 °C

Explanation:
The maximum surface temperatures each result from the maximum permissible ambient or operating temperature T_a plus the maximum temperature increase ΔT of 35 K which has to be taken into account.

1) The ambient or operating temperature T_a is limited to + 80 °C due to the permissible permanent operating temperature of the BoWexELASTIC® elastomer parts used.
2) The maximum surface temperature of + 115 °C applies for the use in locations which are potentially subject to dust explosion, too.

9 Enclosure A

Advice and instructions regarding the use in potentially explosive atmospheres

9.2 Inspection intervals for couplings in potentially explosive atmospheres

Explosion group	Inspection intervals
3G 3D	For couplings which are classified in category 3G or 3D the operating and assembly instructions that are usual for standard operation apply. During the standard operation which has to be subject to the ignition risk analysis the couplings are free from any ignition source. Merely the temperature increase produced by self-heating and depending on the coupling type has to be considered: for BoWex-ELASTIC®: ΔT = 35 K
II 2GD c IIB T4, T5, T6	An inspection of the torsional backlash and a visual inspection of the elastomer set must be performed after 3000 operating hours for the first time, at the latest after 6 months after start-up of the coupling. If you note insignificant or no wear on the elastomer part upon this initial inspection, further inspections can each be performed after 6000 operating hours or at the latest after 18 months, provided that the operating parameters remain the same. If you note significant wear with the initial inspection so that it would be recommendable to replace the elastomer part, please find out the cause according to the table „Breakdowns“, if possible. The maintenance intervals must be adapted to the modified operating parameters without fail.

BoWex-ELASTIC®

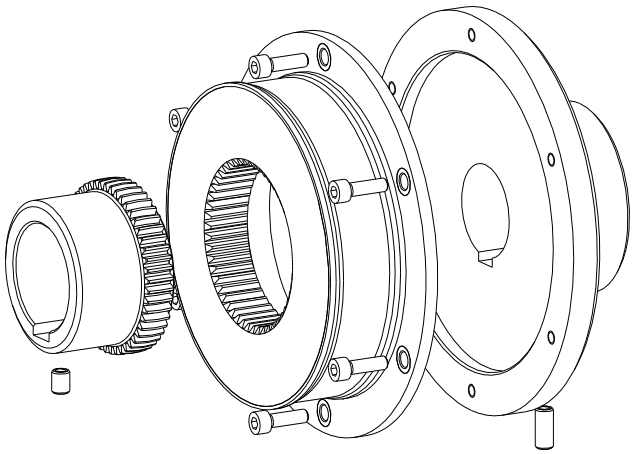


Illustration 15: BoWex-ELASTIC® type HEW1

- Here the backlash between the hub and the nylon spline must be inspected via torsional backlash, each separately from the driving and the driven side.
  The friction/wear may only be $\mathbf{X}_{max.}$ of the original spline thickness before the elastomer part must be replaced.
  When reaching the torsional backlash $\Delta\mathbf{S}_{max.}$, the elastomer part must be replaced immediately, irrespective of the inspection intervals.
- Visual inspection of the elastomer part (cracks, holes or anything similar).

9 Enclosure A

Advice and instructions regarding the use in potentially explosive atmospheres

9.3 Inspection of torsional backlash

To inspect the torsional backlash the power pack which is switched off needs to be secured against accidental switch-on.

- Turn the hub opposite the direction of drive.

Here the elastomer part must not be axially displaced from its position of wear.

- Mark elastomer part and hub (see Illustration 16).
- Turn the hub in the direction of drive and measure the torsional backlash $\Delta S_{max.}$
- When reaching the torsional backlash ΔS_{max} the elastomer part must be replaced.

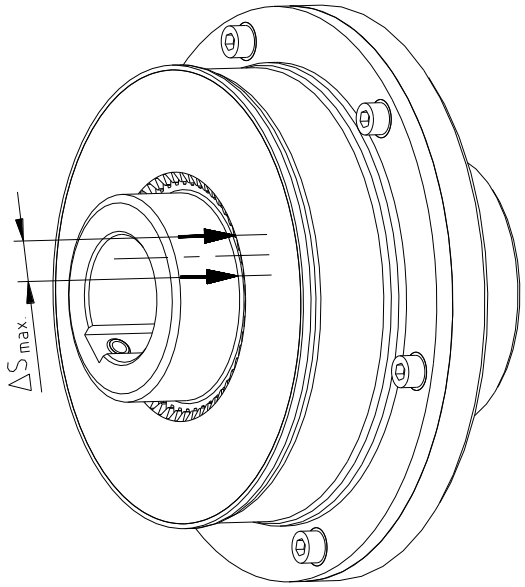


Illustration 16: Marking of the elastomer part and hub

9.4 Standard values of wear

If the torsional backlash is ≥ $\Delta S_{max.}$ [mm] / friction ≥ $X_{max.}$ [mm], the elastomer part must be replaced.

Reaching the limits for replacing depends on the operating conditions and the existing operating parameters.

In order to ensure a long service life of the coupling and avoid danger with the use in potentially explosive atmospheres, the shaft ends must be accurately aligned.
Please absolutely observe the displacement figures specified (see tables 13 and 14).
If the figures are exceeded, the coupling will be damaged.

9 Enclosure A

Advice and instructions regarding the use in potentially explosive atmospheres

9.4 Standard values of wear

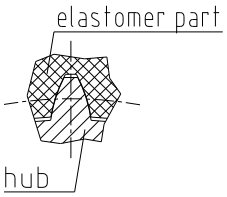


Illustration 17: Elastomer part in new condition

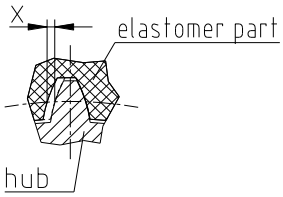


Illustration 18: Wear of elastomer part

Table 15:

Size	Limits of wear each hub		Size	Limits of wear each hub	
	Wear $X_{max.}$ [mm]	Torsional backlash $\Delta S_{max.}$ [mm]		Wear $X_{max.}$ [mm]	Torsional backlash $\Delta S_{max.}$ [mm]
42	1.0	1.7	100	1.8	3.1
48	1.0	1.8	125	2.0	3.5
65	1.4	2.5	G 125	2.0	3.5
80	1.6	2.7	150	2.0	3.5
G 80	1.6	2.7			

9.5 marking of coupling for potentially explosive atmospheres

The ATEX marking of the BoWex-ELASTIC® coupling is done on the polyamide flange of the elastomer specifying the following details:

Short labelling:
(standard)

II 2GD c IIB T X

Complete labelling:

II 2G c IIB T6, T5 resp. T4
- 30 °C ≤ T_a ≤ + 50 °C, + 65 °C resp. + 80 °C
II 2D c T 115 °C - 30 °C ≤ T_a ≤ + 80 °C

The labelling with explosion group IIB includes the explosion group IIA.

The customer bears the sole responsibility for all machining processes performed subsequently on unbored or pilot bored as well as finish machined coupling components and spare parts. KTR does not assume any warranty claims resulting from insufficient remachining.

9 Enclosure A

Advice and instructions regarding the use in potentially explosive atmospheres

9.6 EU Certificate of conformity

EU Certificate of conformity

according to EU directive 2014/34/EU dated February 26, 2014
and to the legal regulations

The manufacturer - KTR Systems GmbH, D-48432 Rheine - states that the

BoWex-ELASTIC® highly flexible flange couplings

in an explosion-proof design described in these operating/assembly instructions are devices corresponding to article 1 (3) b) of directive 2014/34/EU and comply with the general safety and health requirements according to enclosure II of directive 2014/34/EU.

The BoWex-ELASTIC® complies with the specifications of directive 2014/34/EU. One or several directives specified in the respective type examination certificate IBExU01ATEXB004_05 X were in part replaced by updated versions.
KTR Systems GmbH being the manufacturer confirms that the product mentioned above is in accordance with the specifications of the new directives, too.

According to article 13 (1) b) ii) of directive 2014/34/EU the technical documentation is deposited with the institution:

IBExU
Institut für Sicherheitstechnik GmbH
Fuchsmühlenweg 7

09599 Freiberg

Rheine, 2017-04-24
Date

i. V.
Reinhard Wibbeling
Engineering/R&D

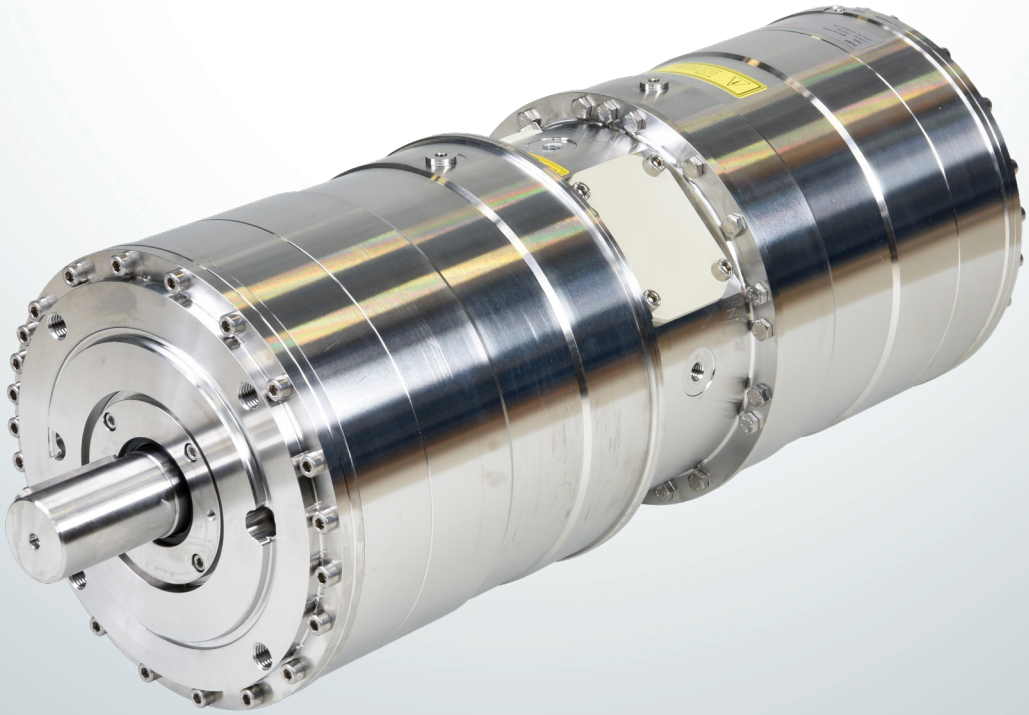
i. A.
Andreas Huecker
Product Manager

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

ENGINEERING
TOMORROW

Instruction

APP pumps
APP 53 - 92
Recommended service intervals



hpp.danfoss.com

Table of Contents

1. General information

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

The recommendation is for guidance only.

2. Design/features

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

Provided that the pump has been running according to the Danfoss specifications, Danfoss guarantees one year service-free operation, however, max. 18 months from date of production. After one year of operation it is recommended to inspect the pump and replace worn parts, if any.

If the Danfoss recommendations concerning system-design (see our data sheet) are not followed, the service life of the APP pumps might be affected.

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

Pos.	Qty.	Description	Material	Service interval APP 53 - 78	Service interval APP 86 - 92
1	2	Housing, main bearing	Duplex, PEEK	No need for service	No need for service
11, 14	1	End flange/ motor flange	Duplex	No wear part	No wear part
121	1	Center flange	Duplex	No wear part	No wear part
31	2	Swash plate	Super Duplex	48,000 hours	40,000 hours
66	18	Piston	Super Duplex, PEEK and PP	Recommended inspection on a yearly basis and evaluated acc. to app. 1 Replace after 24,000 hours.	Recommended inspection on a yearly basis and evaluated acc. to app. 1 Replace after 8,000 hours
92	2	Valve plate	Super Duplex	32,000 hours	24,000 hours
91, 95	2	Port plate	Super Duplex, PEEK	32,000 hours	24,000 hours
61	2	Cylinder barrel	Super Duplex	48,000 hours	40,000 hours
65	2	Retainer plate	Super Duplex	48,000 hours	40,000 hours
64	2	Retainer ball	Super Duplex	48,000 hours	40,000 hours
82	2	Retainer guide assembly	Super Duplex, Duplex and PP	48,000 hours	40,000 hours
81	9	Spring	Duplex	48,000 hours	40,000 hours
142	1	Stop for shaft seal	Duplex	No wear part	No wear part
124	1	Shaft seal	Hastelloy and NBR	24,000 hours	24,000 hours
125	1	Cover/flange for shaft seal	Super Duplex	No wear part	No wear part
93	8	Back-up ring	PTFE	24,000 hours	24,000 hours
*		O-ring (overall)	NBR	24,000 hours	24,000 hours
*		Screw (overall)	AISI 316	24,000 hours	24,000 hours
*		Pin (overall)	AISI 316, Duplex or PEEK	No wear part	No wear part
152	1	Valve cone (flushing valve)	Duplex or PEEK	48,000 hours	48,000 hours
3	6	Bleeding screw	Duplex	No wear part	No wear part
67	1	Key	AISI 316	40,000 hours	40,000 hours

3. Appendix 1

Pistons:
The pistons are the heart of the pump regarding service.

If the pistons break down, the pump will suffer a breakdown.

In case of doubt - the pistons must be replaced.

The pictures below is ment as a guideline for evaluating the wear of the sliding surface.

Cavitation of the piston shoes.
New inspection is required in 3,000-4,000 hours.

Cavitation of the piston shoes.
All pistons must be replaced within the next 500-1,000 hours.

Cavitation of the piston shoes.
All pistons must be replaced within the next 100-200 hours.

Cavitation of the piston shoes.
All pistons must be replaced immediately.

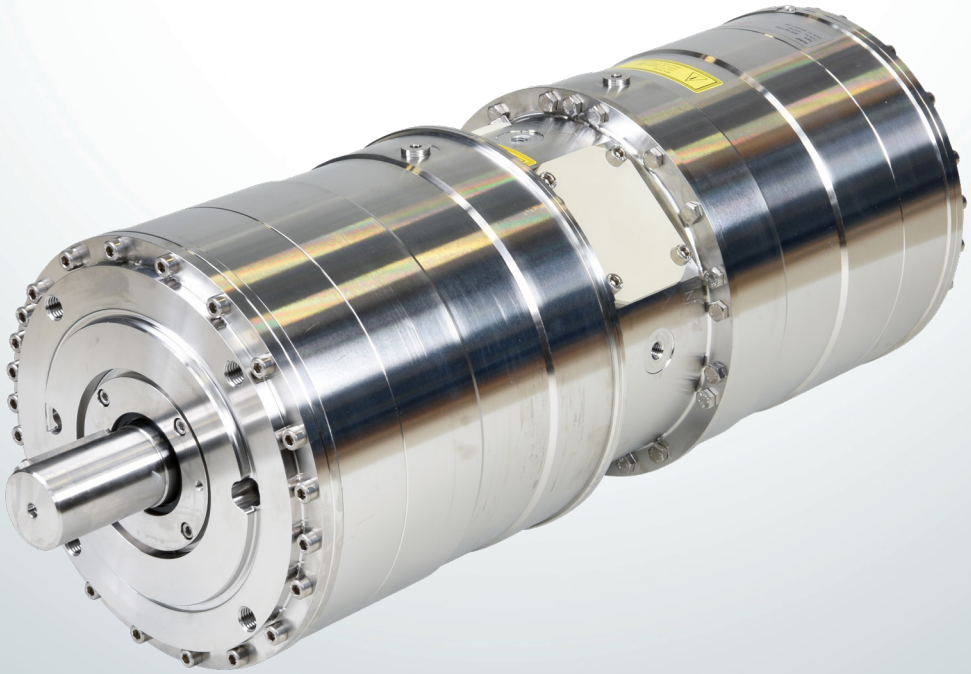
Abrasive wear of the piston shoes.
All pistons must be replaced immediately.

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

ENGINEERING
TOMORROW

Parts list

APP Pumps
APP 53 / APP 65 / APP 78 / APP 86 / APP 92



hpp.danfoss.com

Table of Contents

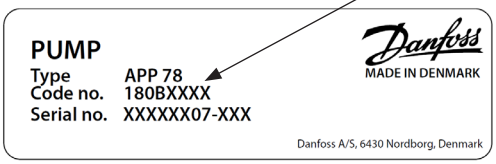
Table of Contents

1. Validity

This Parts list contains two part list tables, for serial numbers:

- 07 and higher and
- up to 06

You find the serial number in the label of the pump.



The serial no. is referring to the Serial no. on the product label. The digits shown (08) indicate the version number of the pump.

2. Parts list APP 53-92 - serial no. 07 or higher

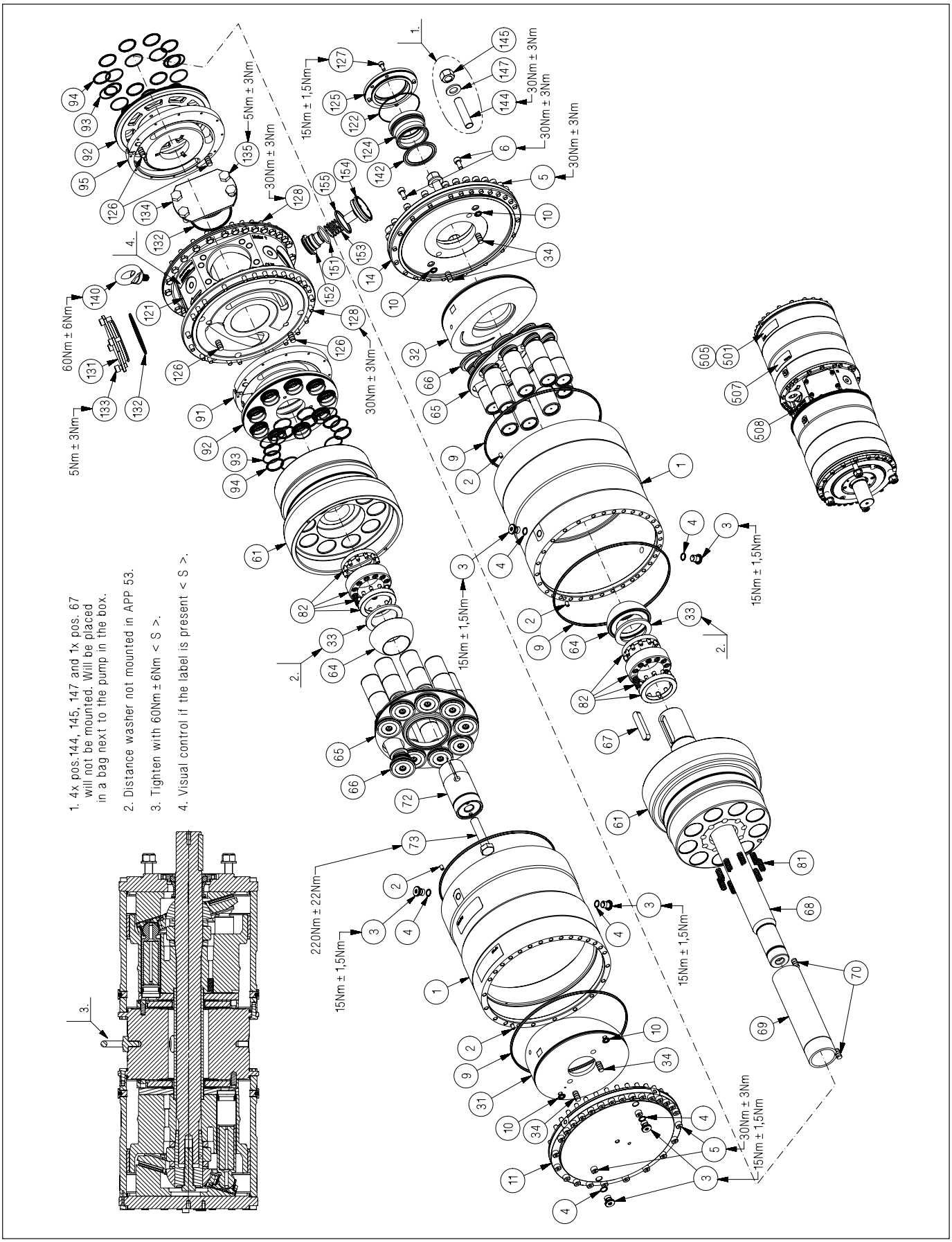
Pos.	Qty.	Description	Material	180B4634 - APP 53-92 Screw kit	180B4635 - APP 53-92 Shaft seal kit	180B4636 - APP 53-92 Seal kit exc. shaft seal	180B4553 - APP 53 Piston kit	180B4554 - APP 65-92 Piston kit	180B4555 - APP 53-65 Retainer kit	180B4566 - APP 78 Retainer kit	180B4562 - APP 86-92 Retainer kit	180B4557 - APP 53-65 Valve plate kit	180B4558 - APP 78-92 Valve plate kit	180B4560 - APP 53 Swash plate kit	180B4601 - APP 65 Swash plate kit	180B4561 - APP 78-92 Swash plate kit	180B4556 - APP 53-92 Flushing valve kit	180B4559 - APP 53 -92 Cylinder barrel kit	180B4649 - APP 53-92 Port flange kit [2]
0001	2	Complete Housing	1.4462/PEEK																
0002	4	Pin ø6 x 10	A4			x													
0003	6	Bleeding plug G1/4"	1.4410			x													
0004	6	O-ring (ø11 x 2 mm)	NBR			x													
0005	51	Cyl.screw M8 x 30 A4-80	A4-80	x															
0006	2	Screw M8 x 16 A4-80	A4-80	x															
0009	4	O-ring (ø228x 4 mm)	NBR			x	x	x											x
0010	4	O-ring (ø9.2 x 2.6 mm)	NBR											x	x	x			
0011	1	End flange	1.4462																
0014	1	Motor flange APP 53 - 92	1.4462																
0144	4	Threaded pin M16 x 80	A4																
0145	4	Hex lock nut M16	A4																
0147	4	Washer ø17xø30x3	A4																
0031	1	Swash plate APP 53 (non-drive end)	1.4410											x					
0031	1	Swash plate APP 65 (non-drive end)	1.4410												x				
0031	1	Swash plate APP 78-92 (non-drive end)	1.4410													x			
0032	1	Swash plate APP 53 (drive end)	1.4410											x					
0032	1	Swash plate APP 65 (drive end)	1.4410												x				
0032	1	Swash plate APP 78-92 (drive end)	1.4410													x			
0033	2	Distance washer [1]	PP													x			
0034	4	Pin (ø10.5 x 20)	1.4410			x								x	x	x			
0064	2	Retainer ball DLC	1.4410/DLC						x	x	x								
0065	2	Ass. Retainer plate	1.4410/PEEK						x	x	x								
0061	2	Cyl.barrel with insert	1.4410/PEEK															x	
0066	18	Piston	1.4410/PEEK				x												
0066	18	Piston w. insert	1.4410/PEEK					x											
0067	1	Key (14 x 9 x 70	A4			x													
0068	1	Shaft APP H	1.4410																
0069	1	Distance pipe APP 53-92	1.4462																
0070	2	Pin (ø10.5 x 20)	1.4410															x	
0072	1	Cone bushing DLC	1.4410/DLC															x	
0073	1	Screw M16x75 DLC	1.4410/DLC															x	
0081	9	Compression spring (ø1.9 x ø11 x 45.3)	1.4462									x	x						
0082	2	Assembly spring guide APP 53-65	1.4410/PP						x										
0082	2	Assembly spring guide APP 78	1.4410/PP							x									
0082	2	Assembly spring guide APP 86-92	1.4410/PP								x								
0091	1	Port plate	1.4410/PEEK									x							
0091	1	Port plate 17	1.4410/PEEK										x						
0092	2	Int. Valve plate	1.4410									x							
0092	2	Int. Valve plate 17	1.4410										x						
0095	1	Port plate (shaft side)	1.4410/PEEK									x							
0095	1	Port plate (shaft side) 17	1.4410/PEEK										x						
0093	18	Back-up ring	PTFE/Carbon			x						x	x						
0094	18	O-ring (ø30.2 x 3 mm)	NBR			x						x	x						

Parts list[7] (continued) APP 53-92 - serial no. 07 or higher

Pos.	Qty.	Description	Material	180B4634 - APP 53-92 Screw kit	180B4635 - APP 53-92 Shaft seal kitseal kit	180B4636 - APP 53-92 Seal kit exc. shaft seal	180B4553 - APP 53 Piston kit	180B4554 - APP 65-92 Piston kit	180B4555 - APP 53-65 Retainer kit	180B4566 - APP 78 Retainer kit	180B4562 - APP 86-92 Retainer kit	180B4557 - APP 53-65 Valve plate kit	180B4558 - APP 78-92 Valve plate kit	180B4560 - APP 53 Swash plate kit	180B4601 - APP 65 Swash plate kit	180B4561 - APP 78-92 Swash plate kit	180B4556 - APP 53-92 Flushing valve kit	180B4559 - APP 53-92 Cylinder barrel kit	180B4649 - APP 53-92 Port flange kit [2]
0121	1	Center flange APP H	1.4462																x
0122	1	O-ring (ø80.0 x 2 mm)	NBR			x													
0124	1	Shaft seal	NBR		x														
0125	1	Cover for shaft seal	1.4462																
0126	4	Pin (ø10.5 x 20)	1.4410									x	x						x
0127	4	Screw M6 x 12 A4-80	A4-80		x														
0128	50	Screw M8 x 20 A4-80	A4-80	x															
0131	1	3" Cover for Inlet port	PP																
0132	2	O-ring (ø79 x 3.5)	NBR			x													
0133	4	Screw M8 x 16 A4-80	A4-80																
0134	1	3" Cover for Outlet port	PP																
0135	4	Screw M10 x 16 A4-80	A4-80																
0140	1	Lifting eye M12 (DIN 580E)	AISI 316																
0142	1	Washer for shaft seal	1.4462		x														
0151	1	O-ring (ø35 x 3)	NBR			x											x		
0152	1	Valve cone	1.4410														x		
0153	1	Compression spring	1.4462														x		
0154	1	Plug/guide	1.4410														x		
0155	1	O-ring (ø47.2 x 3.5)	NBR			x											x		
	1	Instruction		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

[1] Not mounted in APP 53
[2] Only compatible with pump series 08 or higher

3. Exploded view
APP 53-92 serial no. 07 or higher



4. Parts list APP 53-86 - serial no. up to 06

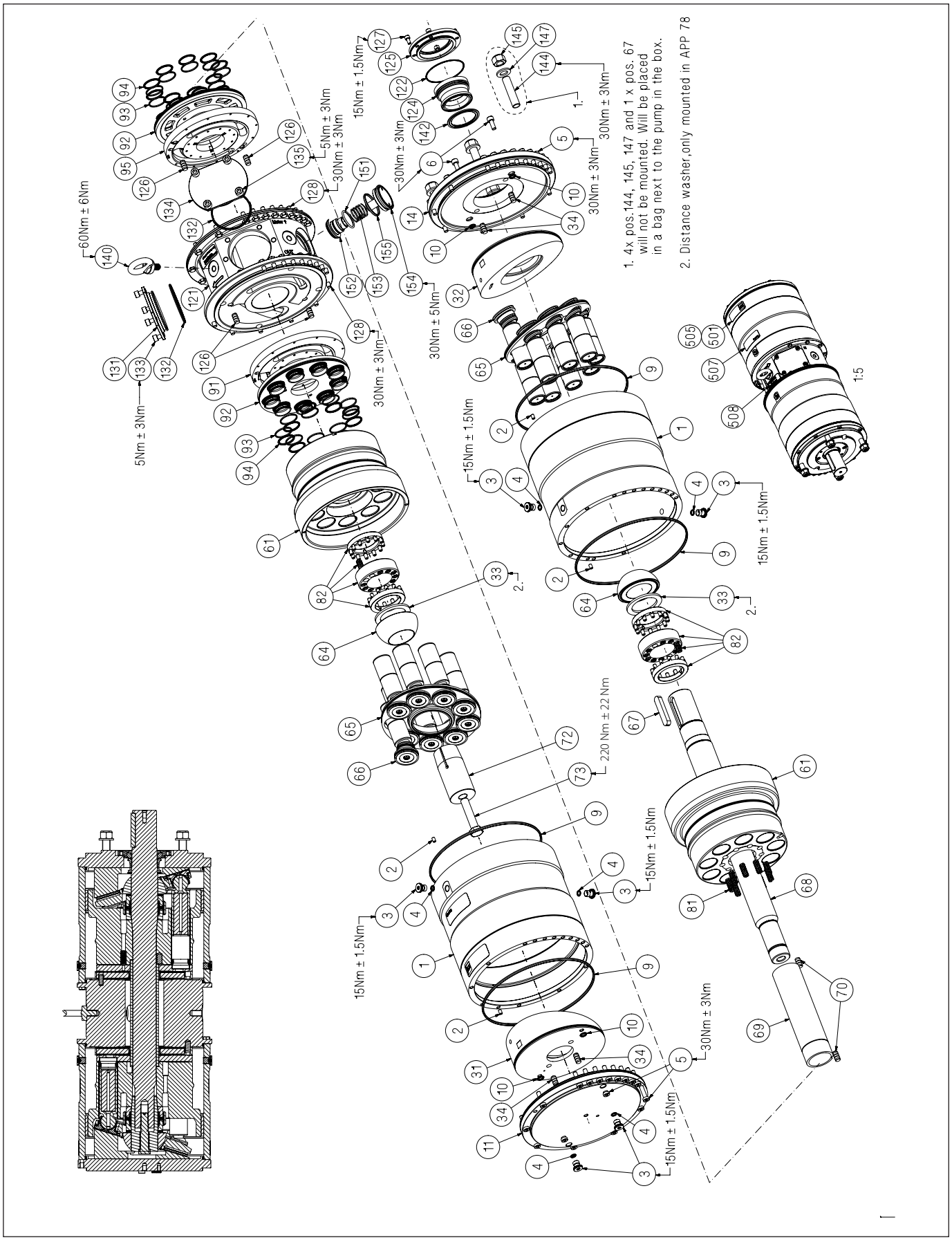
Pos.	Qty.	Description	Material	180B4552 - APP 53-86 Screw & seal kit	180B4553 - APP 53 Piston kit	180B4554 - APP 65-86 Piston kit	180B4555 - APP 53-65 Retainer kit	180B4566 - APP 78 Retainer kit	180B4562 - APP 86 Retainer kit	180B4557 - APP 53-65 Valve plate kit	180B4558 - APP 78-86 Valve plate kit	180B4560 - APP 53 Swash plate kit	180B4601 - APP 65 Swash plate kit	180B4561 - APP 78-86 Swash plate kit	180B4556 - APP 53-86 Flushing valve kit	180B4559 - APP 53-86 Cylinder barrel kit
0001	2	Complete Housing	1.4462/PEEK													
0002	4	Pin ø6 x 10	A4	x												
0003	6	Bleeding plug G1/4"	1.4410													
0004	6	O-ring (ø11 x 2 mm)	NBR	x												
0005	32	Cyl.screw M8 x 30 A4-80	A4-80	x												
0006	2	Screw M8 x 16 A4-80	A4-80	x												
0009	4	O-ring (ø228x 4 mm)	NBR	x	x	x										
0010	4	O-ring (ø9.2 x 2.6 mm)	NBR	x								x	x	x		
0011	1	End flange	1.4462													
0014	1	Motor flange APP H	1.4462													
0144	4	Threaded pin M16 x 70	A4													
0145	4	Hex lock nut M16	A4													
0147	4	Washer ø17xø30x3	A4													
0031	1	Swash plate APP 53 (non-drive end)	1.4410									x				
0031	1	Swash plate APP 65 (non-drive end)	1.4410										x			
0031	1	Swash plate APP 78-86 (non-drive end)	1.4410											x		
0032	1	Swash plate APP 53 (drive end)	1.4410									x				
0032	1	Swash plate APP 65 (drive end)	1.4410										x			
0032	1	Swash plate APP 78-86 (drive end)	1.4410											x		
0033	2	Distance washer[1)]	PP										x	x		
0034	4	Pin (ø10.5 x 20)	1.4410	x								x	x	x		
0064	2	Retainer ball DLC	1.4410/DLC				x	x	x							
0065	2	Ass. Retainer plate	1.4410/PEEK				x									
0065	2	Ass. Retainer plate 17	1.4410/PEEK					x	x							
0061	2	Cyl.barrel with insert	1.4410/PEEK													x
0066	18	Piston	1.4410/PEEK		x											
0066	18	Piston w. insert	1.4410/PEEK			x										
0067	1	Key (14 x 9 x 70	A4	x												
0068	1	Shaft APP H	1.4410													
0069	1	Distance pipe APP H	1.4462													
0070	2	Pin (ø10.5 x 20)	1.4410													x
0072	1	Cone bushing DLC	1.4410/DLC													x
0073	1	Screw M16x75 DLC	1.4410/DLC													x
0081	9	Compression spring (ø1.9 x ø11 x 45.3)	1.4462							x	x					
0082	2	Assembly spring guide APP 53-65	1.4410/PP				x									
0082	2	Assembly spring guide APP 78	1.4410/PP					x								
0082	2	Assembly spring guide APP 86	1.4410/PP						x							
0091	1	Port plate	1.4410/PEEK							x						
0091	1	Port plate 17	1.4410/PEEK								x					
0092	2	Int. Valve plate	1.4410/PP							x						
0092	2	Int. Valve plate 17	1.4410/PP								x					
0093	18	Back-up ring	PTFE/Carbon	x						x	x					
0094	18	O-ring (ø30.2 x 3 mm)	NBR	x						x	x					
0095	1	Port plate (shaft side)	1.4410/PEEK							x						
0095	1	Port plate (shaft side) 17	1.4410/PEEK								x					

Parts list (continued)
APP 53-86 - serial no. up to 06

Pos.	Qty.	Description	Material	180B4552 - A PP 53-86 Screw & seal kit	180B4553 - APP 53 Piston kit	180B4554 - APP 65-86 Piston kit	180B4555 - APP 53-65 Retainer kit	180B4566 - APP 78 Retainer kit	180B4562 - APP 86 Retainer kit	180B4557 - APP 53-65 Valve plate kit	180B4558 - APP 78-86 Valve plate kit	180B4560 - APP 53 Swash plate kit	180B4601 - APP 65 Swash plate kit	180B4561 - APP 78-86 Swash plate kit	180B4556 - APP 53-86 Flushing valve kit	180B4559 - APP 53-86 Cylinder barrel kit
0121	1	Center flange APP H	1.4462													
0122	1	O-ring (ø80.0 x 2 mm)	NBR	x												
0124	1	Shaft seal	NBR	x												
0125	1	Cover for shaft seal	1.4462													
0126	4	Pin (ø10.5 x 20)	1.4410	x						x	x					
0127	4	Screw M6 x 12 A4-80	A4-80	x												
0128	30	Screw M8 x 20 BUMAX	A4-100	x												
0131	1	3" Cover for Inlet port	PP													
0132	2	O-ring (ø79 x 3.5)	NBR	x												
0133	4	Screw M8 x 16 A4-80	A4-80													
0134	1	3" Cover for Outlet port	PP													
0135	4	Screw M10 x 16 A4-80	A4-80													
0140	1	Lifting eye M12 (DIN 580E)	AISI 316													
0142	1	Washer for shaft seal	1.4462	x												
0151	1	O-ring (ø35 x 3)	NBR	x											x	
0152	1	Valve cone	1.4410												x	
0153	1	Compression spring	1.4462												x	
0154	1	Plug/guide	1.4410												x	
0155	1	O-ring (ø47.2 x 3.5)	NBR	x											x	
	1	Instruction		x	x	x	x	x	x	x	x	x	x	x	x	x

[1] Not mounted in APP 53

5. Exploded view
APP 53-86 - serial no. up to 06



6. Tool sets

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

Designation	180Z0665 Tool set APP 53-92
Press bush	1
Cone bushing extractor	1
M6 Allen key	1
M8 Allen key	1
M8 x 140 (30 mm thread) Unbraco	1
M8 x 70 (full thread) Unbraco)	3
Valve plate fixation device	3
Tool bracket	1
Tool, washer	2
M16 pin	1
Nut M16 A4	4
ø17/30 x 3 washer	1
Screw M8 x 40 A4-80	1
Valve plate mount	1
24 mm, 1/2" socket	1
Flush valve tool	1
Torque wrench 60-340 Nm	1
Fork wrench 13 mm	2
Fork wrench 24 mm	1
Fork wrench 30 mm	1
Distance adapter	1
Screwdriver 5.5 x 1 mm	2
Screw (M8 x 16 mm)	2
Screw (M6 65 mm)	2
Shaft tool	1

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

ENGINEERING
TOMORROW

Service guide

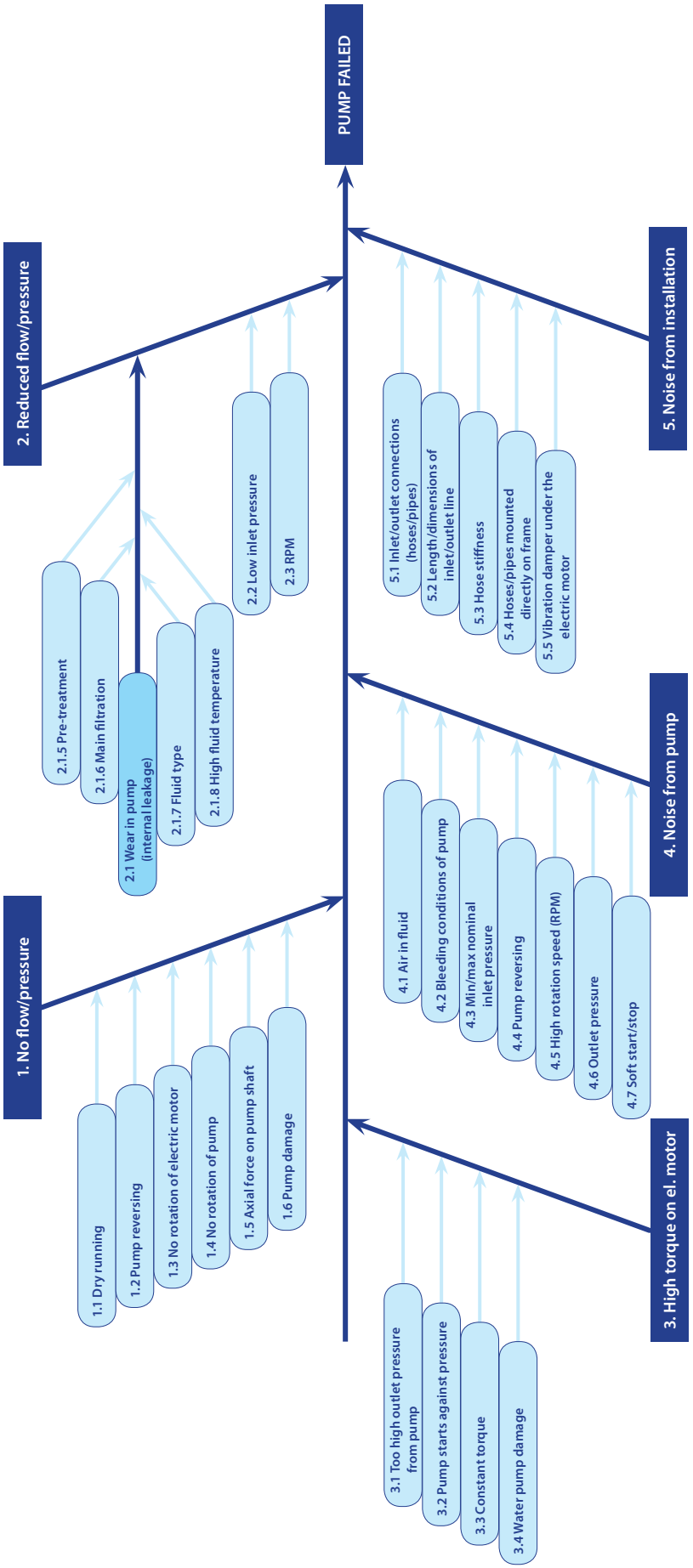
Trouble shooting guide
APP, APP S and APP S 674 pumps

hpp.danfoss.com

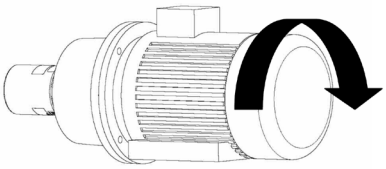
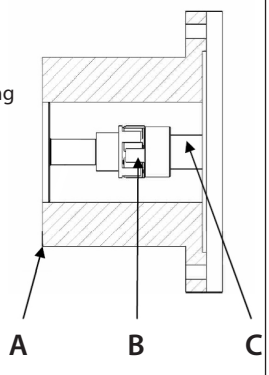
Table of contents

Table of Contents

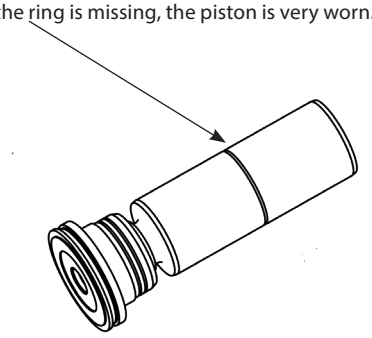
Trouble shooting fish bone chart



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 User manual).
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, APP S or APP S 674 pump is shown by an arrow on the label on 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 and 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 are available on hpp.danfoss.com.

2. Reduced flow/reduced pressure

Cause	Remedy	Comments
2.1 Wear on pump Large internal leakage due to:	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 Pre-treatment Analyse fluid for content of particles. - Check that filters are OK and working correctly. 2.1.6 Main filtration 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. 2.1.7 Fluid type The APP, APP S 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. 2.1.8 High fluid temperature If fluid temperature is above 50 °C (122 ° F), stop the pump immediately. - 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 wounded filters are typically channelling filters. A string wounded 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 (122 ° F) 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 (122 ° F).
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 min. limit (see User manual) 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 High Pressure Pumps sales office.	If the electric motor is too small for the APP, APP S or APP S 674 pump, it cannot provide sufficient torque.

4. Noise from pump

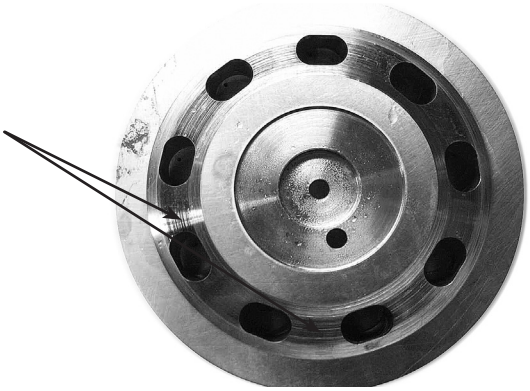
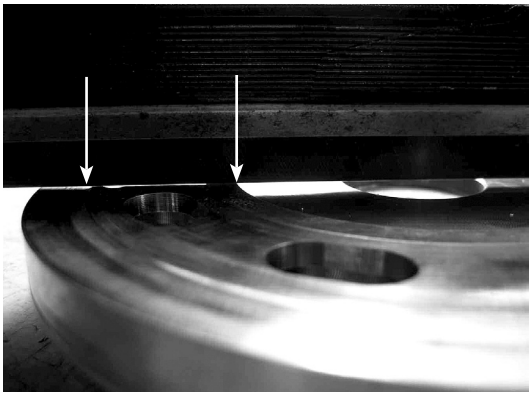
Cause	Remedy	Comments
3.4 Water pump damage	3.4.1 Dismantle pump and check for wear.	Too heavy damage in the pump will increase friction causing a high torque (see item 6, Typical signs of wear).
4.1 Air in fluid	4.1.1 Ensure that the entire inlet line is bled before starting up the system. 4.1.2 Ensure 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 within the limits specified in the User manual. 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 min. limit 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 min. inlet pressure has been reached.
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

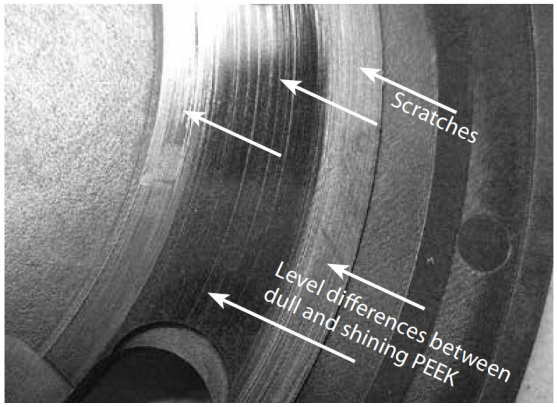
Cause	Remedy	Comments
5.1 Inlet/outlet connections (hoses/pipes)	5.1.1 Use flexible hoses at inlet/outlet connections. Danfoss can provide flexible hoses. Please contact Danfoss High Pressure Pumps sales office for further information. 5.1.2 Mount the connections to the frame by a vibration dampener 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 High Pressure Pumps sales office for further information.	Too stiff hoses cannot dampen 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 dampener 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 dampener under the electric motor	5.5.1 Mount a vibration dampener below the motor/pump.	When no dampener 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  	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 	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.

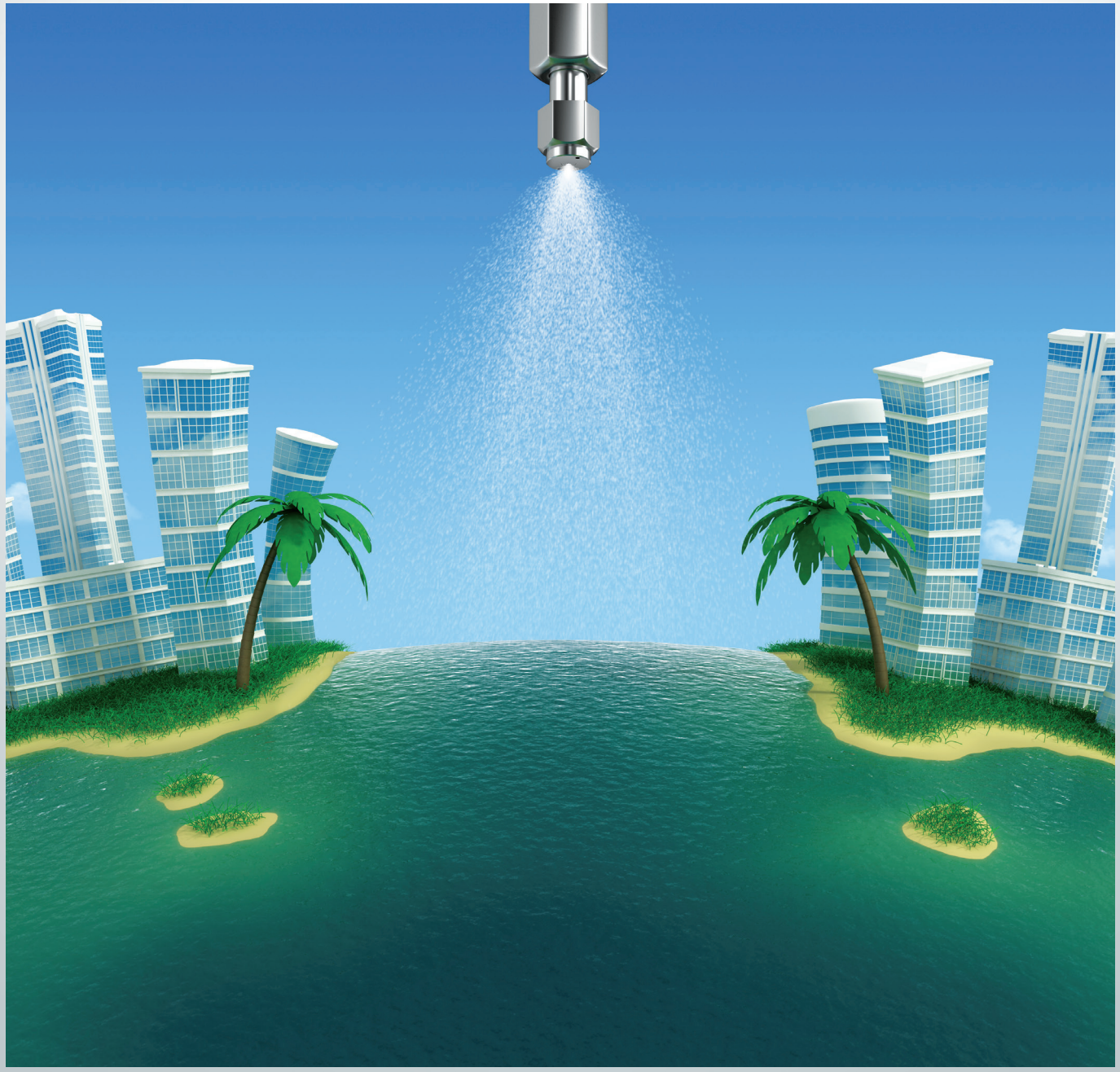
Danfoss A/S
High Pressure Pumps • danfoss.com • +45 7488 2222 • highpressurepumps@danfoss.com

ENGINEERING
TOMORROW

Service guide

Right and wrong

Trouble shooting guide for water hydraulic systems

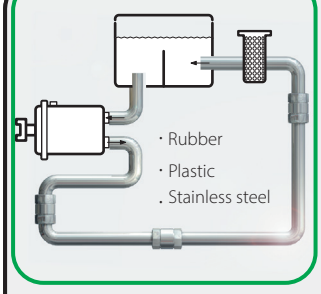


hpp.danfoss.com

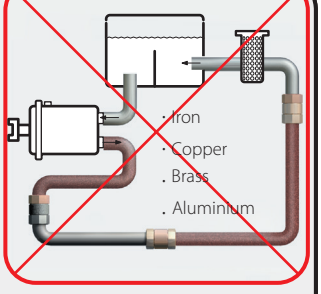
Design

1.

Choice of material



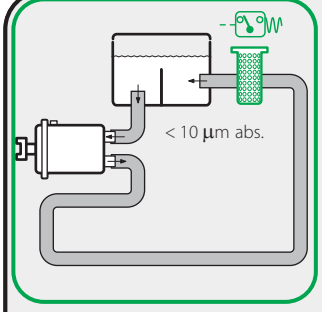
Always use system components made of corrosion proof materials



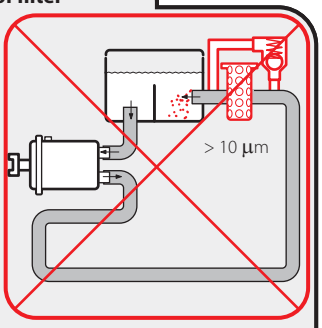
Non-corrosion proof materials may cause damage

2.

Choice of filter



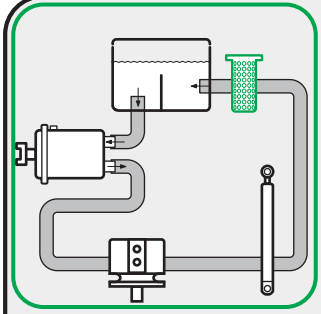
Install a 10 micron absolute filter with pressure switch



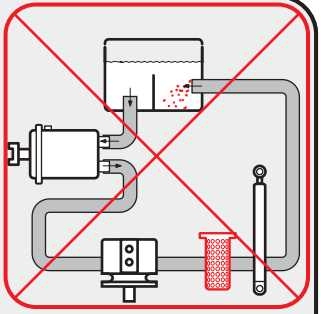
Return filter with bypass valve and poorer filterability than 10 µ will damage the system

3.

Filter location



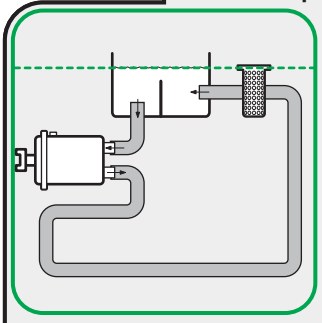
Locate the return filter in the return line immediately before the tank



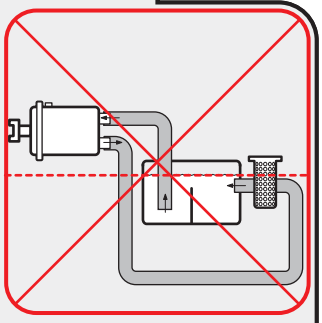
Placing the return filter upstream of the final load may damage the pump

4.

Pump location



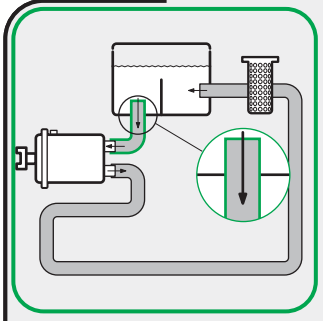
Pump always to be placed below water surface level



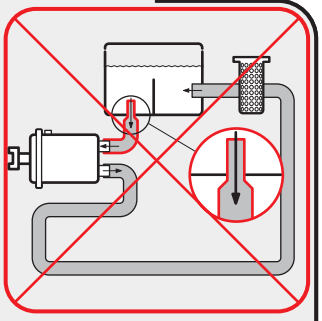
Pump location above water surface level will cause damage

5.

Suction conditions



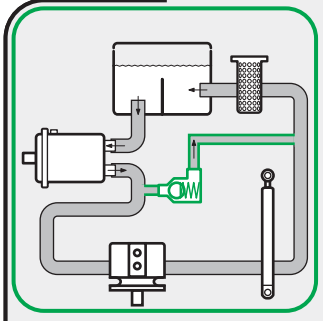
System to be dimensioned to provide a suction pressure of the pump inlet of max. 0.1 bar vacuum



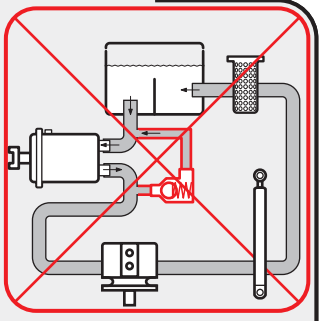
Poor suction conditions will cause malfunction and damage the pump

6.

Pressure Relief valve



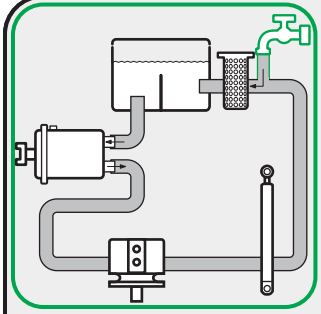
Pressure relief valve to be mounted vertically or with vertical outlet and connected to return hose or tank



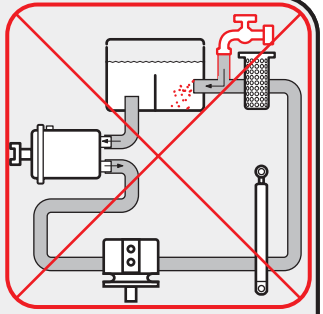
Coupling the pressure relief valve outlet directly to the pump inlet may damage the pump

7.

Water supply



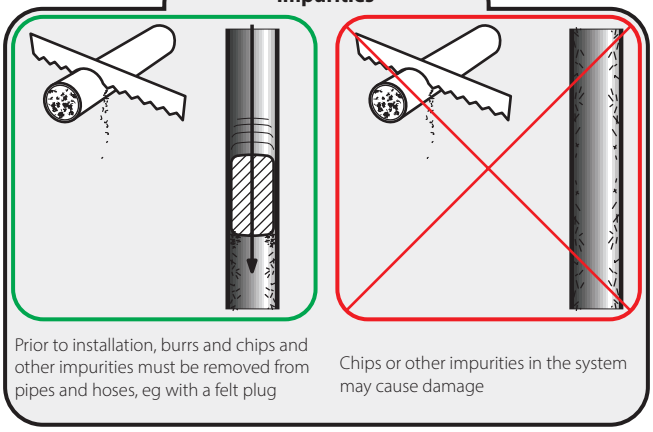
System to be filled via filter



Filling system with unfiltered water causes damage

Installation

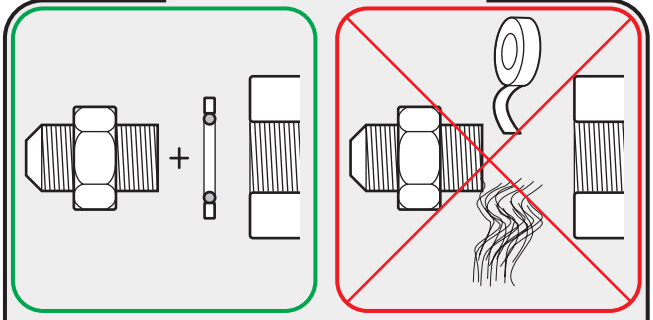
8. **Impurities**



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

Chips or other impurities in the system may cause damage

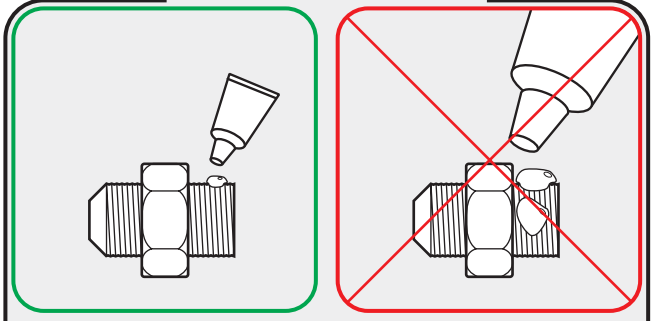
9. **Sealing**



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

Using teflon tape or packing yarn in joints may cause damage

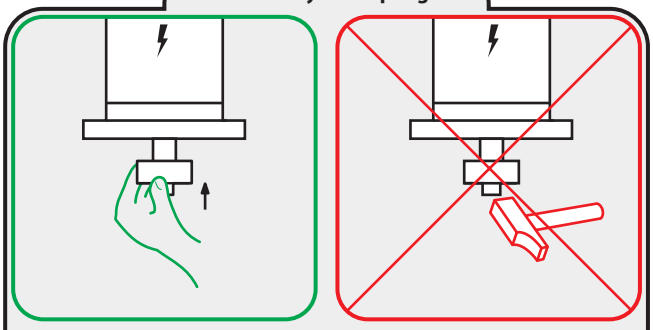
10. **Grease**



Correctly limited quantities of grease prevent seizing

Too much grease may develop biofilm causing operational failures

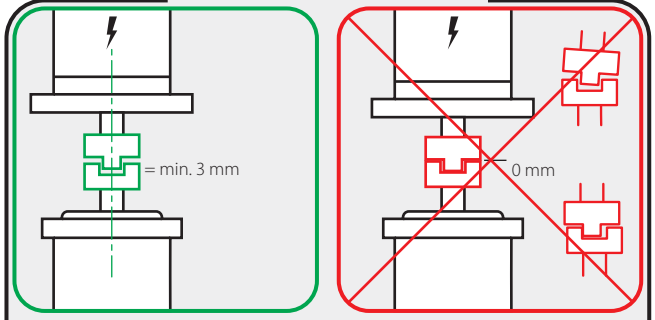
11. **Assembly of coupling**



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

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

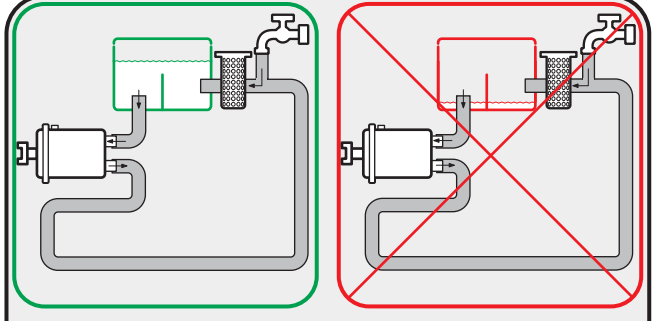
12. **Coupling**



Ensure always to have 3 mm distance between coupling flanges

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

13. **Water supply**

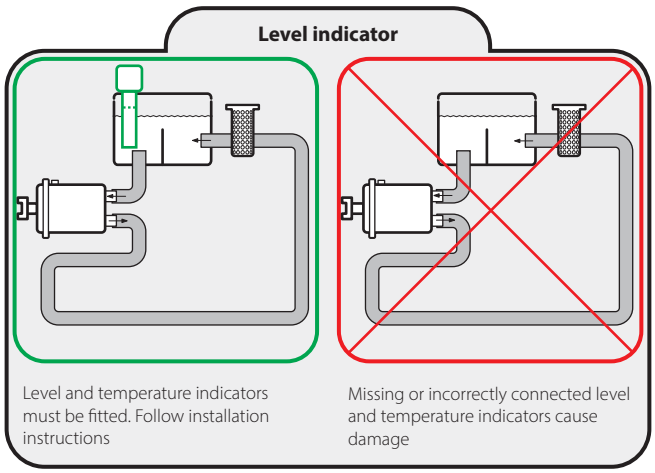


Fill system with water before starting to ensure lubrication and cooling

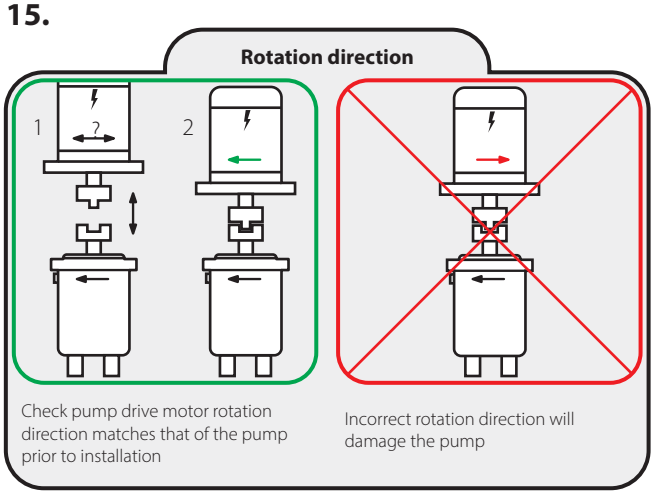
Starting without water will cause damage

Wiring

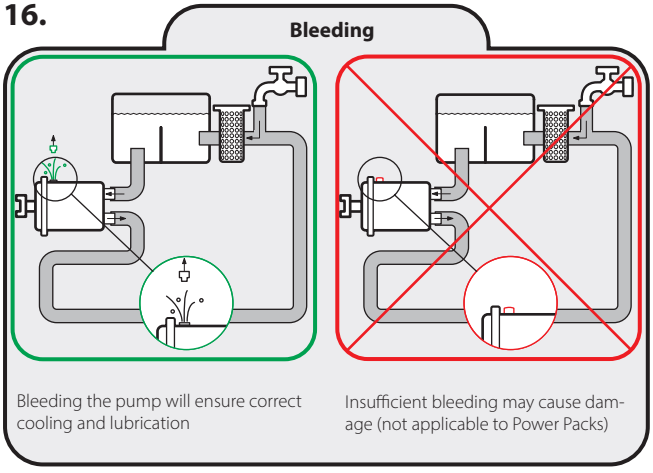
14.



15.



16.



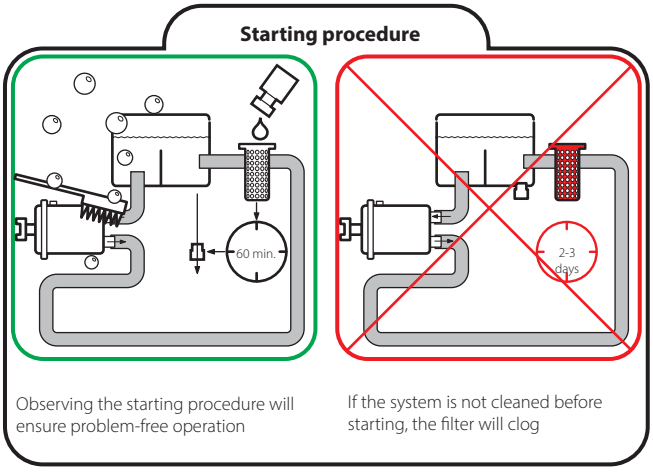
Starting procedure

Cleaning procedure

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

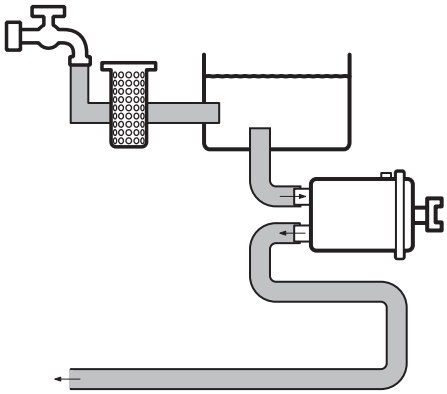
Flushing procedure

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



Trouble shooting

Open ended water systems



No water supply

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

No

Yes

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

No

Yes

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

Yes

No

- Is water coming through the filter?

Yes

No

- Replace filter element

- Turn on the tap for water supply

- Is the electric motor of the pump unit rotating?

No

Yes

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

Yes

- Lower inlet temperature or provide better cooling

No

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

No

Yes

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

No

Yes

- Replace filter element

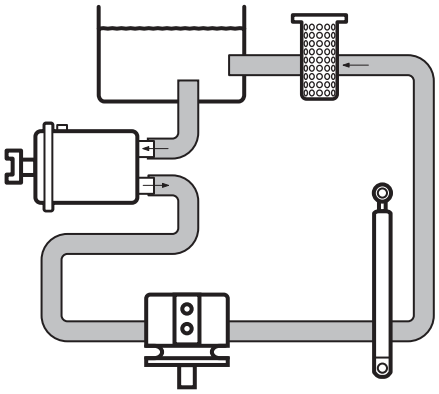
- A blown fuse / or short circuit?
- Check power supply and fuses and contact electrician

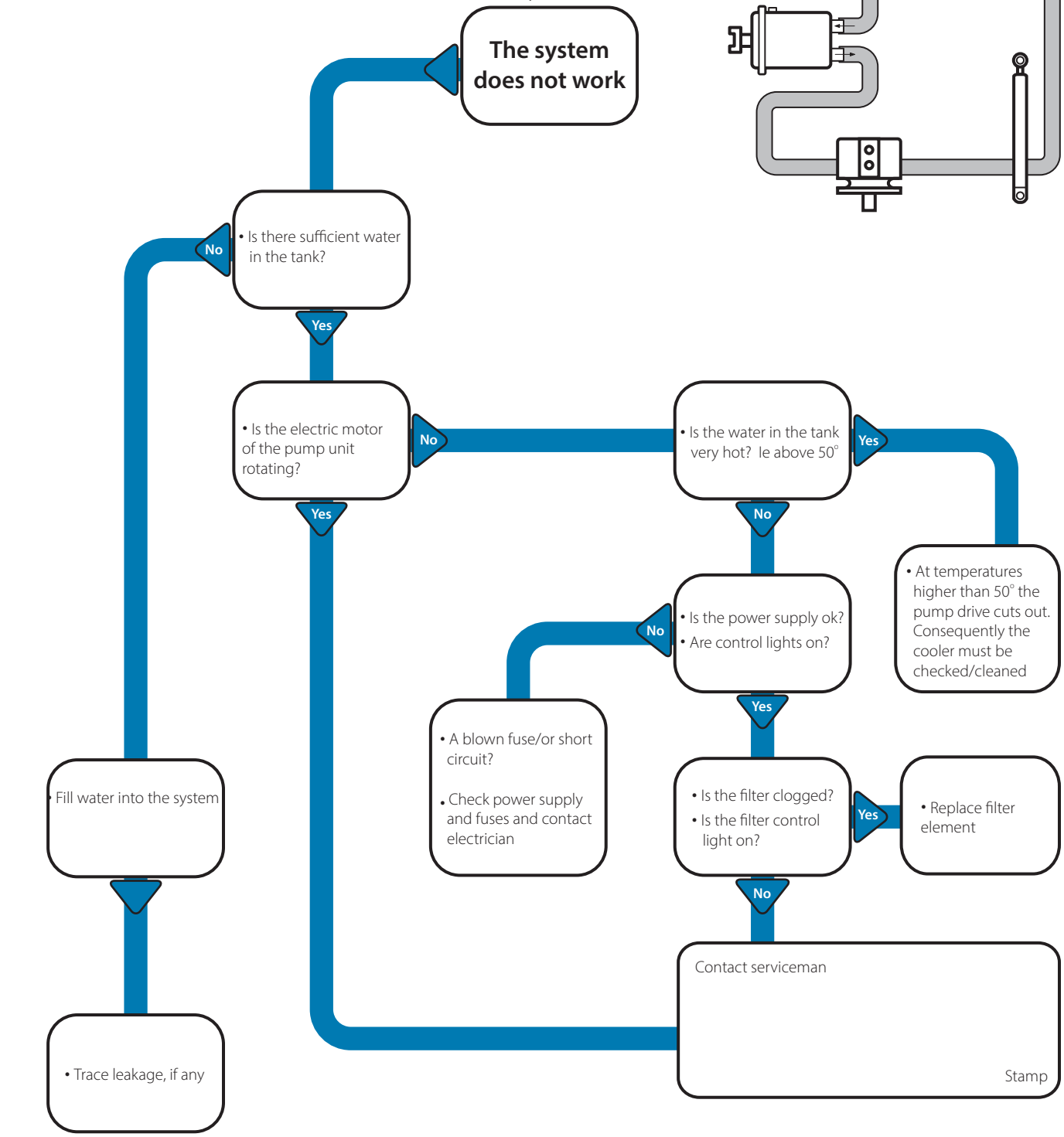
Contact serviceman

Stamp

Trouble shooting

Closed water systems





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