

1. General information

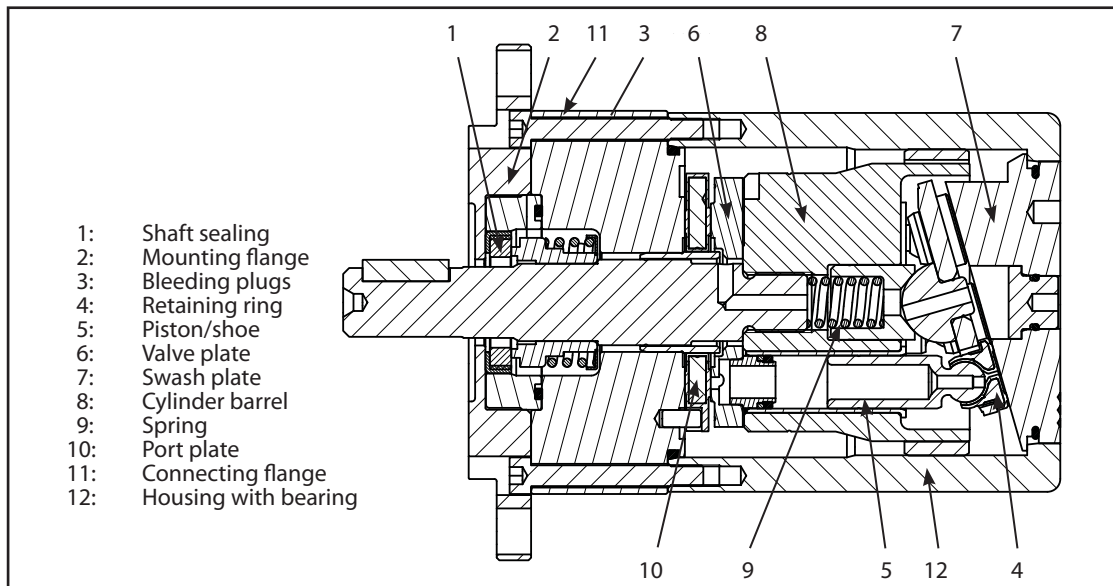


APP0.6, APP1.0, APP1.5, APP1.8, APP2.2 and APP2.5 pumps are designed to supply low viscosity and corrosive fluids under high pressure, eg. in seawater reverse osmosis filtration applications and for high pressure salt water pumping.

The pumps are based on the axial piston principle enabling a very light and compact design, and they are designed so that lubrication of the moving parts in the pumps is provided by the fluid itself. No oil lubrication is thus required.

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

The pumps are fixed displacement pumps in which the flow is proportional to the number of revolutions of the input shaft and the pump displacement, regardless of any counter-pressure.



2. Benefits

- One of the smallest and lightest pumps on the market.
- Can be powered by a combustion engine provided that a special coupling is used.
- Generates insignificant pulsations in the pressure line.
- No preventive maintenance required (no periodic service like e.g. change of lubricant and wearing parts).
- Long service life. Danfoss guarantees 8000 hours maintenance-free operation.
- All parts of the pump are made of non corrosive materials eg. Duplex (SAF 2205/EN1.4462) and Super-duplex (SAF 2507/EN1.4410) stainless steel and carbon reinforced PEEK.
- High efficiency.

3. Technical data

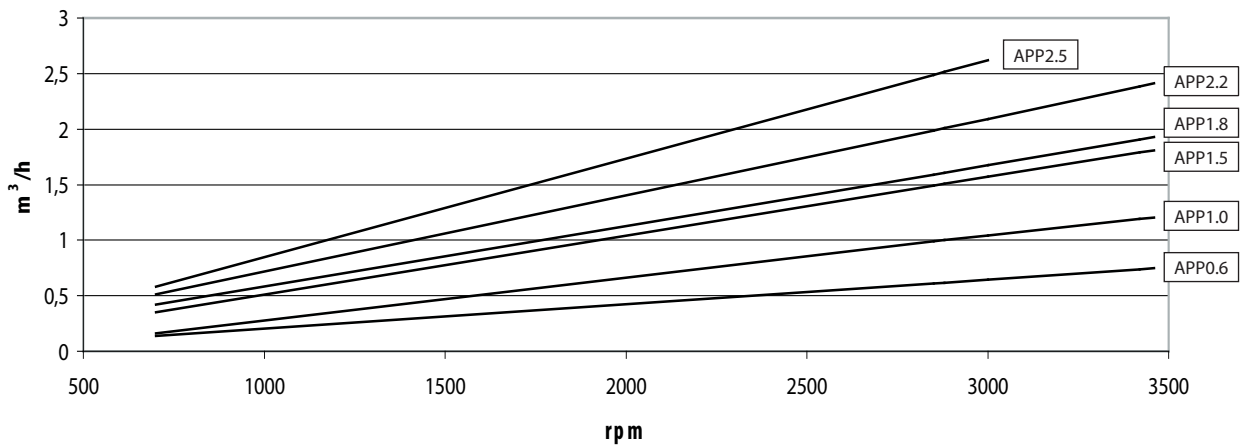
Code number	180B3001		180B3002		180B3026		180B3003		180B3004		180B3000			
APP pumps	APP0.6		APP1.0		APP1.5		APP1.8		APP2.2		APP2.5			
Geometric displacement	cm ³ /rpm (in ³ /rpm)		4	(0.24)	6.3	(0.38)	9.3	(0.56)	10	(0.61)	12.5	(0.76)	15.3	(0.93)
Flow (3000 rpm)	m ³ /h (gpm)		0.6	(2.6)	1.0	(4.4)	1.5	(6.6)	1.7	(7.5)	2.1	(9.2)	2.6	(11.4)
Min. pressure ¹⁾	bar (psi)		20	290	20	290	20	290	20	290	20	290	20	290
Max. pressure, cont. ²⁾	bar (psi)		80	(1160)	80	(1160)	80	(1160)	80	(1160)	80	(1160)	80	(1160)
Max. pressure, intermittent ³⁾	bar (psi)		100	(1450)	100	(1450)	100	(1450)	100	(1450)	100	(1450)	100	(1450)
Max. speed cont. ⁴⁾	rpm		3450		3450		3450		3450		3450 ⁵⁾		3000	
Min. speed cont.	rpm		700		700		700		700		700		700	
Power requirement at 80 bar and 3000 rpm:	kW (hp)		1.9	(2.5)	2.9	(3.9)	4.5	(6)	4.8	(6.3)	6.0	(7.9)	7.2	(9.6)
Weight	kg (lb)		5.2	(9.7)	5.2	(9.7)	8,6	(17)	8.6	(17.0)	8.6	(17.0)	8.6	(17)

- 1) For lower pressure, please contact Danfoss RO Sales Organization.
- 2) For higher pressure, please contact Danfoss RO Sales Organization.
- 3) Intermittent pressure is acceptable for less than 10 seconds per minute.

- 4) For speeds above 3000 rpm the pump must be boosted at a pressure of 2-5 bar (29.0 - 72.5 psi).
- 5) For speeds above 3000 rpm, inspect the pump after every 4000 hours of operation.

4. Flow at different rpm

Using the diagram shown below, it is easy to select the pump which fits the application best if the flow required and the rotation speed (rpm) of the pump are known.



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 "desired" flow can be obtained by changing the rotation speed to a corresponding value. Thus, the required rpm can be determined as:

$$\text{Required rpm} = \frac{\text{Desired flow} \times \text{Rated rpm}}{\text{Rated flow}}$$

5. Power requirements

Pump model	Flow			Pressure			rpm	Calc. factor
	l/min	m ³ /h	gpm	60 bar	70 bar	80 bar		
				870 psi	1015 psi	1160 psi		
APP0.6	10.2	0.61	2.69	1.38 kW	1.61 kW	1.84 kW	2840	475.8
APP0.6	12.3	0.74	3.25	1.66 kW	1.94 kW	2.21 kW	3400	475.8
APP1.0	16.53	0.99	4.37	2.14 kW	2.49 kW	2.85 kW	2840	474.6
APP1.0	19.83	1.19	5.24	2.57 kW	2.99 kW	3.42 kW	3400	474.6
APP1.5	25.11	1.51	6.63	3.21 kW	3.75 kW	4.29 kW	2890	468.6
APP1.5	30.17	1.81	7.97	3.86 kW	4.51 kW	5.15 kW	3470	468.6
APP1.8	26.78	1.61	7.07	3.43 kW	4.00 kW	4.57 kW	2890	463.2
APP1.8	32.18	1.93	8.50	4.12 kW	4.81 kW	5.49 kW	3470	463.2
APP2.2	33.48	2.01	8.84	4.29 kW	5.00 kW	5.71 kW	2900	468.6
APP2.2	40.22	2.41	10.63	5.15 kW	6.01 kW	6.87 kW	3480	468.6
APP2.5	41.94	2.52	11.08	5.07 kW	5.92 kW	6.77 kW	2900	484.8

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

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

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

6. Inlet pressure

Water supply to the pump is either made from a tank placed above the pump or directly from a feed pump. The pressure at the pump inlet (I) must be in the range: 0.5 - 5 bar (7.3 - 72.5 psi).

7. Temperature and corrosion

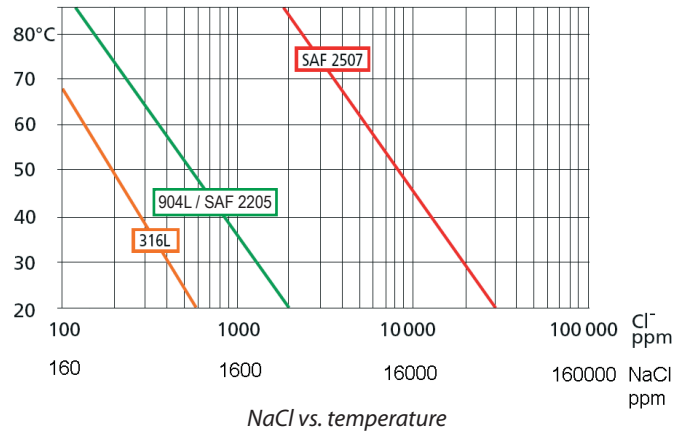
7.1 Operation:

- Fluid temperature: +3°C to +50°C (+37.4°F to 122°F) - dependent on the NaCl concentration
- Ambient temperature: +3°C to +50°C (+37.4°F to 122°F)

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

All critical parts of the APP water pump is made of SAF 2507.

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



7.2 Storage:

- Storage temperature: -40°C to +70°C (+37.4°F to 122°F) – provided that the pump is drained of fluid and stored "plugged".

Antefreeze protection is required at temperatures below 2°C. Danfoss recommends using Dowcal N from Dow Chemical Company or Chillsafe mono propylene glycol from Arco Chemical Company.

8. Noise level

The chart indicates the noise level in dB(A) measured at a distance of 1 m from the pump in a reverberation room.

Type	60 bar (870 psi) 1500 rpm	60 bar (870 psi) 3000 rpm	80 bar (1160 psi) 1500 rpm	80 bar (1160 psi) 3000 rpm
APP0.6	70	73	74	77
APP1.0	73	75	74	77
APP1.5	75	76	73	77
APP1.8	75	76	73	77
APP2.2	75	76	73	77
APP2.5	76	77	74	78

Generally, noise will be reduced if speed is reduced and vice versa. Use flexible hoses in order to minimize vibrations and noise.

Since the pump is typically mounted on a bell housing or frame, the noise level can only be determined for the complete unit (system).

It is therefore very important that the pump is mounted correctly on a frame with dampers to minimize vibrations and noise.

The noise level is influenced by:

- The speed of the pump, high rpm create more noise than low rpm
- Rigid mounting of the pump generates more noise than flexible mounting
- Pipe mounting direct to the pump increases the noise level compared to a flexible hose

9. Filtration

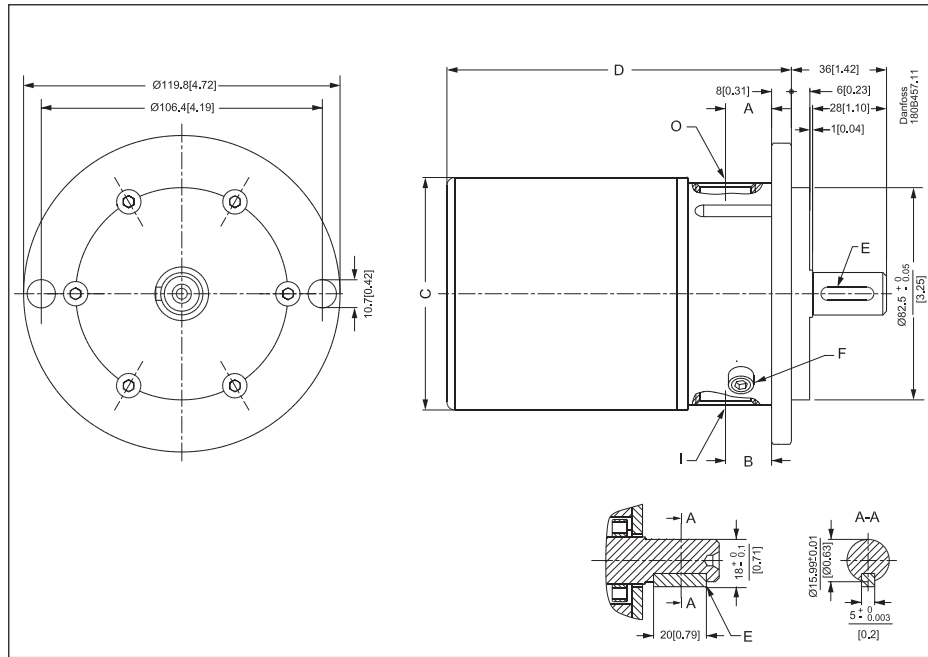
As water has very low viscosity, the APP pumps have been designed with very narrow clearance in order to control internal leakage rates and improve component performance. Therefore it is important that the inlet water is filtered properly to minimize the wear of the pump.

The main filter must have a filtration efficiency of 99.98% at 10 µm. We recommend that you use precision depth filter cartridges rated 10µm abs. β10>5000 (equivalent to a filtration efficiency of 99.98%). Bag filters and string wound filter cartridges typically have only 90% filtration efficiency. This means that for each 100,000 particles reaching the filter, 10,000 particles pass through it compared to only 20 particles in a filter with an efficiency of 99.98%.

For more information on the importance of proper filtration, please consult our publication "Filtration" (code number 521B0861), which also will provide you with an explanation of filtration definitions and a guidance on how to select the right filter.

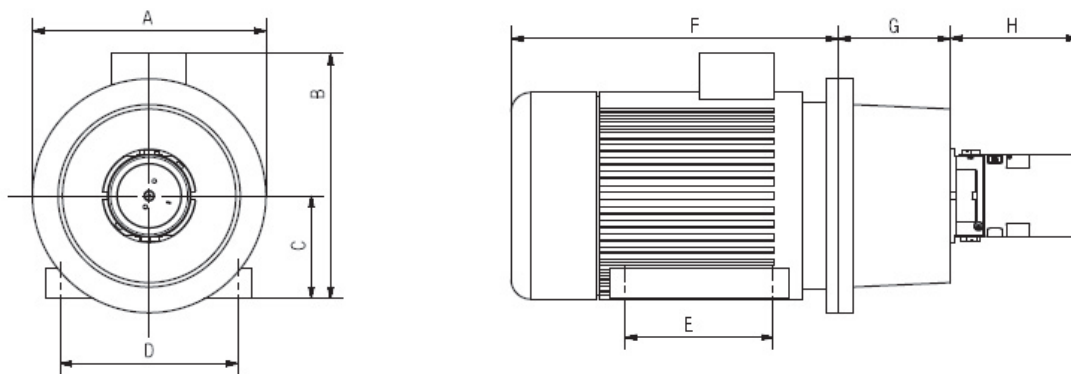
10. Dimensions

10.1 Pump



Description	APP0.6 and APP1.0	APP1.5, APP1.8, APP2.2 and APP2.5
A Port position, mm (in)	15.9 (0.63)	18.8 (0.74)
B Port position, mm (in)	15.9 (0.63)	21.0 (0.83)
C mm (in)	$\varnothing 88 (3.5)$	$\varnothing 105 (4.1)$
D mm (in)	131 (5.2)	166 (6.5)
E Parallel key, DIN 6885, mm (in)	$5 \times 5 \times 20$ ($0.20 \times 0.20 \times 0.78$)	$5 \times 5 \times 20$ ($0.20 \times 0.20 \times 0.78$)
F Bleeding	M6, Hexagon AF = 5 mm	M6, Hexagon AF = 5 mm
I Inlet connection	BSP G $\frac{1}{2}$ " ; 15 (0.59) deep	BSP G $\frac{3}{4}$ " ; 15 (0.59) deep
O Outlet connection	BSP G $\frac{1}{2}$ " ; 15 (0.59) deep	BSP G $\frac{1}{2}$ " ; 17 (0.67) deep
Pump mounting flange	SAE A 2	SAE A 2

10.2 Complete unit



Pump	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	G (mm)	H (mm)	IEC Electric motor
APP0.6	200	245	90	140	100	265	100	131	1.5 kW, FPA 90S-2
APP1.0	200	245	90	140	125	290	100	131	2.2 kW, FPA 90L-2
APP1.5	250	280	100	160	140	325	120	166	3.0 kW, FPA 100L-2
APP1.8	250	302	112	190	140	340	120	166	4.0 kW, FPA 112M-2
APP2.2	300	342	132	216	140	390	144	166	5.5 kW, FPA 132S1-2
APP2.5	300	342	132	216	178	430	144	166	7.5 kW, FPA 132S2-2

11. Installation

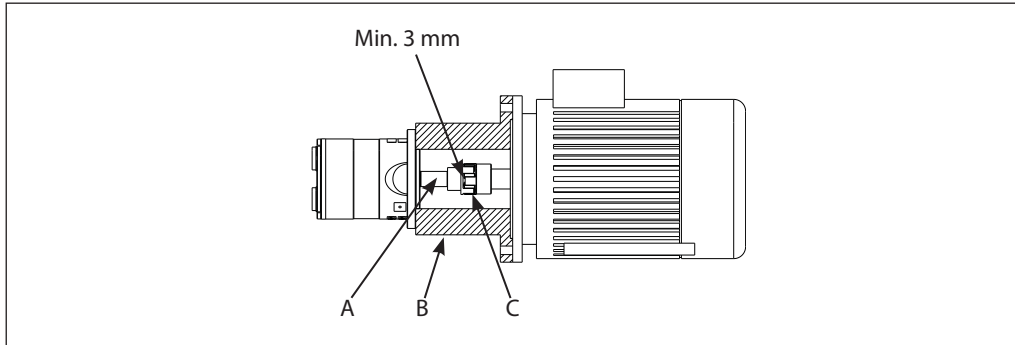
11.1 Mounting

The figure below illustrates how to mount the pump and connect it to electric motor/combustion engine.

- A: Flexible coupling
- B: Bell housing
- C: Motor shaft

If alternative mounting is required, please contact Danfoss Sales Organization for further information. To ensure easy mounting of the flexible coupling without using tools, the tolerances must be dimensioned accordingly.

Note: Any axial and/or radial loads on the shaft must be avoided, see "User guide" (521B0888).

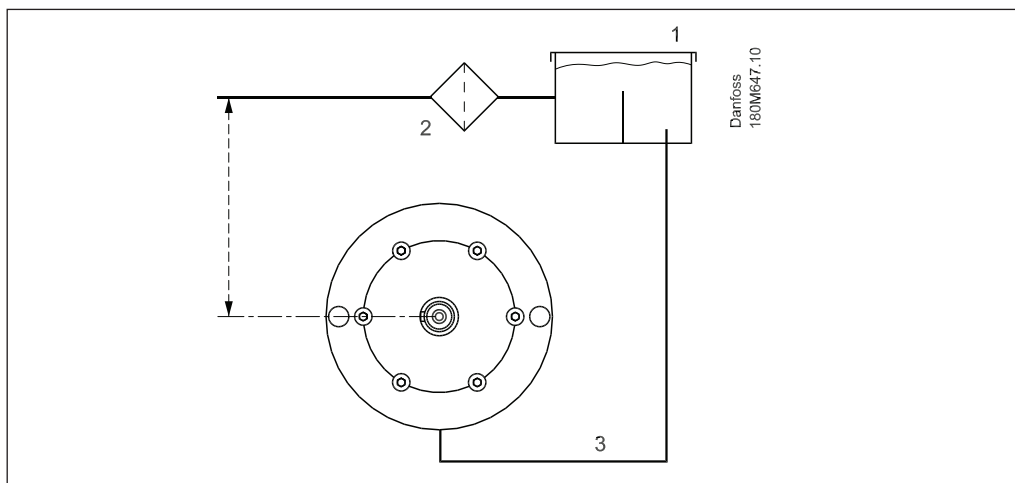


The pump should be connected to the rest of the plant with flexible hoses.

11.2 Open-ended systems with water supply from tank

In order to eliminate the risk of cavitation, a positive inlet pressure should always be maintained by observing the following guidelines:

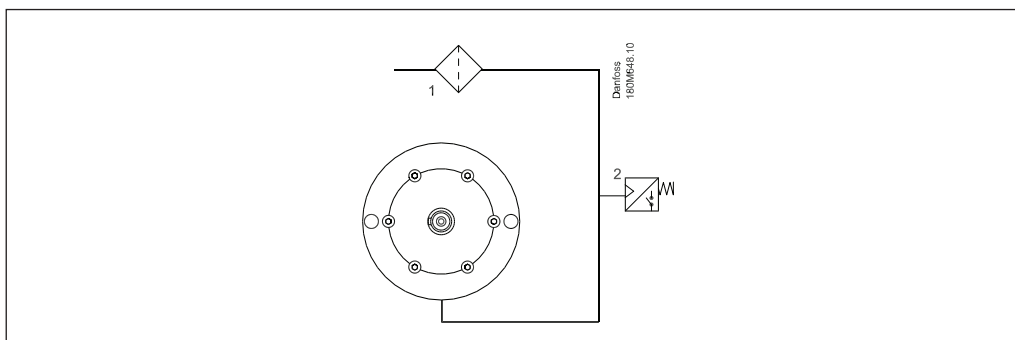
1. Place the tank (1) above pump inlet (water level in tank should always be above the pump).
2. Place a filter (2) in the water supply line in front of the tank.
3. Dimension the inlet line (3) with minimum pressure drop (large internal diameter, minimum length of pipe, avoid bends and fittings with small internal diameter).



11.3 Open-ended system with direct water supply

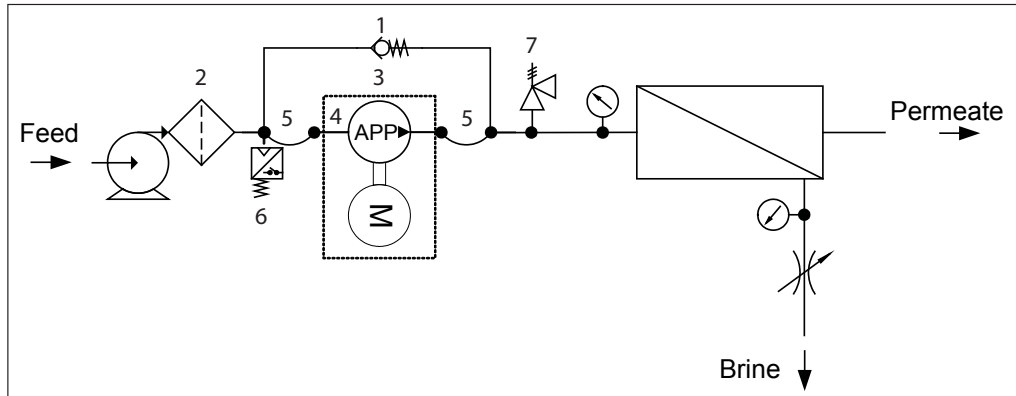
In order to eliminate the risk of cavitation, a positive inlet pressure is always to be maintained at min. 0.5 bar (7.3 psi) and max. 5 bar (72.5 psi).

1. Place the filter (1) in the water supply line in front of the pump.
2. Place a monitoring pressure switch (2) set at min. 1 bar (14.5 psi) between filter and pump inlet. The monitoring switch must stop the pump at pressures lower than 1 bar. (14.5 psi) At speeds above 3000 rpm - use 2 bar (29 psi) as set point.



11.4 RO system with APP pump

1. For easy system bleeding and flushing, apply a bypass non-return valve (1) in parallel with the APP pump.
2. Place an inlet filter (2) in front of the APP pump (3). Please consult section 9, "Filtration" 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 (6) set at min. 1 bar between filter and pump inlet. The monitoring switch must stop the pump at pressures lower than 1 bar (14.5 psi). At 3000 rpm - use 2 bar (29 psi) as set point.
4. 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).
5. In order to eliminate the risk of damage and cavitation, a positive pressure at the inlet (4) is always to be maintained at min. 0.5 bar (7.3 psi) and max. 5 bar (72.5 psi). At speeds above 3000 rpm the pressure at the inlet of the water pump must be min. 2 bar (29 psi).
6. Use flexible hoses (5) to minimize vibrations and noise.
7. Install a safety valve (7) in order to avoid system damage as the Danfoss APP pump creates pressure and flow immediately after start-up, regardless of any counter-pressure.



12. Service

Provided that the pump has been running according to the Danfoss specifications on pre-filtration, pressure, and rotation speed, Danfoss guarantees minimum 8000 hours operation, however max. 18 months from date of sale.

To prevent a total and disastrous breakdown, Danfoss recommends a pump inspection after max. 8000 hours – at which any worn parts must be replaced.

Note: It is always recommended to replace pistons and shaft sealing if another service-free period is to be obtained.

If the pistons are not replaced, more frequent inspection is recommended.

The APP pump is made of duplex/super duplex materials with fine corrosion properties. However, **it is always recommended to flush the pump when the system is shut down.**

The shaft sealing in the APP pump is made of AISI 316. At high TDS and high water temperature, the service life of the shaft sealing will be reduced. For these applications it is recommended to replace the shaft sealing after approx. 4000 hours operation.

12.1 Periodic maintenance

Water acts as lubricant in the APP. Thus there is no oil in the pump.

By operation below the curve for SAF 2507 in the figure in section 7.1, no parts are expected to be replaced within the first 8000 hours of operation.

12.2 Repair

In case of irregular function of the APP, please contact the Danfoss RO Solutions Sales Organisation.

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