



Data sheet

# APP pumps

## APP 1.5-3.5



|                          |                                                 |    |
|--------------------------|-------------------------------------------------|----|
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## 1. General information

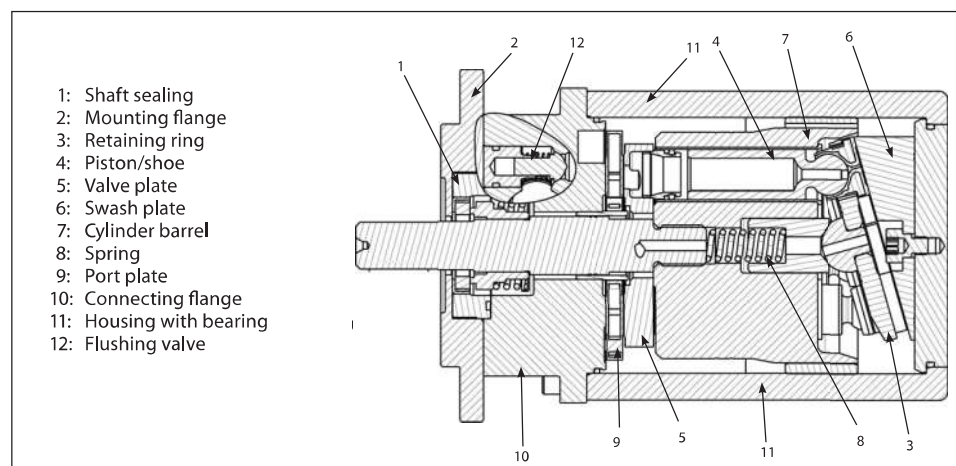
APP 1.5, APP 1.8, APP 2.2, APP 2.5, APP 3.0 and APP 3.5 pumps are designed to supply low viscosity and corrosive fluids under high pressure, e.g. in seawater reverse osmosis filtration applications and for high-pressure saltwater pumping.

The pumps are based on the axial piston principle enabling a very light and compact design. The design ensures 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.

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



## Data sheet

## APP pumps - APP 1.5-3.5

### 2. Benefits

- One of the smallest and lightest pumps on the market.
- Can be powered by a combustion engine.
- Long service life / No preventive maintenance required in the warranty period.
- Generates insignificant pulsations in the high-pressure line.
- No oil lubricant required.
- Integrated flushing valve
- All parts of the pump are made of high corrosion resistant materials; e.g. Duplex (EN1.4462/UNS S31803-S32205) and Super Duplex (EN1.4410/UNS S32750), stainless steel and carbon reinforced PEEK
- High efficiency

### 3. Technical data

| APP pumps                                        |                      | APP 1.5  | APP 1.8  | APP 2.2            | APP 2.5  | APP 3.0            | APP 3.5  |
|--------------------------------------------------|----------------------|----------|----------|--------------------|----------|--------------------|----------|
| Code number                                      |                      | 180B3043 | 180B3044 | 180B3045           | 180B3046 | 180B3030           | 180B3032 |
| Geometric displacement                           | cm <sup>3</sup>      | 9.3      | 10       | 12.5               | 15.3     | 17.7               | 20.5     |
|                                                  | in <sup>3</sup> /rpm | 0.56     | 0.61     | 0.76               | 0.93     | 1.08               | 1.25     |
| Rated flow (3000 rpm) <sup>1)</sup>              | m <sup>3</sup> /h    | 1.5      | 1.7      | 2.1                | 2.6      | 3.0                | 3.5      |
|                                                  | gpm                  | 6.6      | 7.5      | 9.2                | 11.4     | 13.2               | 15.4     |
| Outlet min. pressure <sup>2)</sup>               | bar                  | 20       | 20       | 20                 | 20       | 20                 | 20       |
|                                                  | psi                  | 290      | 290      | 290                | 290      | 290                | 290      |
| Outlet max. pressure, continuous <sup>3)</sup>   | bar                  | 80       | 80       | 80                 | 80       | 80                 | 80       |
|                                                  | psi                  | 1160     | 1160     | 1160               | 1160     | 1160               | 1160     |
| Outlet max. pressure, intermittent <sup>4)</sup> | bar                  | 100      | 100      | 100                | 100      | 100                | 100      |
|                                                  | psi                  | 1450     | 1450     | 1450               | 1450     | 1450               | 1450     |
| Inlet min. pressure                              | bar                  | 0.5      | 0.5      | 0.5 <sup>5)</sup>  | 0.5      | 0.5 <sup>5)</sup>  | 0.5      |
|                                                  | psi                  | 7.3      | 7.3      | 7.3                | 7.3      | 7.3                | 7.3      |
| Inlet max. pressure, continuous                  | bar                  | 5        | 5        | 5                  | 5        | 5                  | 5        |
|                                                  | psi                  | 72.5     | 72.5     | 72.5               | 72.5     | 72.5               | 72.5     |
| Inlet max. pressure, peak                        | bar                  | 10       | 10       | 10                 | 10       | 10                 | 10       |
|                                                  | psi                  | 145      | 145      | 145                | 145      | 145                | 145      |
| Max. speed continuous                            | rpm                  | 3450     | 3450     | 3450 <sup>5)</sup> | 3000     | 3450 <sup>5)</sup> | 3000     |
| Min. speed continuous                            | rpm                  | 700      | 700      | 700                | 700      | 700                | 700      |
| Power requirement at 80 bar and 3000 rpm         | kW                   | 4.5      | 4.8      | 6.0                | 7.2      | 8.4                | 9.8      |
|                                                  | hp                   | 6        | 6.3      | 7.9                | 9.6      | 11.3               | 13.1     |
| Torque at 80 bar                                 | Nm                   | 14,2     | 15.3     | 19                 | 23       | 25.6               | 29.7     |
|                                                  | lbf-ft               | 10.5     | 11.3     | 14                 | 17       | 18.8               | 21.9     |
| Weight                                           | Kg                   | 8.6      | 8.6      | 8.6                | 8.6      | 8.6                | 8.6      |
|                                                  | lb                   | 17       | 17       | 17                 | 17       | 17                 | 17       |
| Integrated flushing valve                        |                      | YES      | YES      | YES                | YES      | YES                | YES      |

1) Typical average flow at 80 bar (1160 psi).

2) For lower pressure, please contact Danfoss RO Sales Organization.

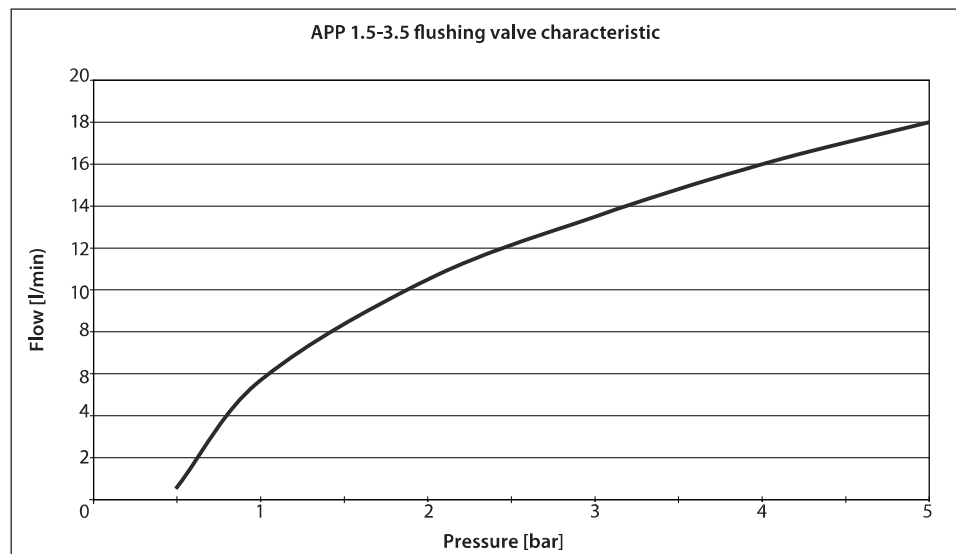
3) For higher pressure, please contact Danfoss RO Sales Organization.

4) Intermittent pressure is acceptable for less than 10 seconds per minute.

5) For speeds above 3000 rpm the pump must be boosted at a pressure of 2-5 bar (29.0 - 72.5 psi).

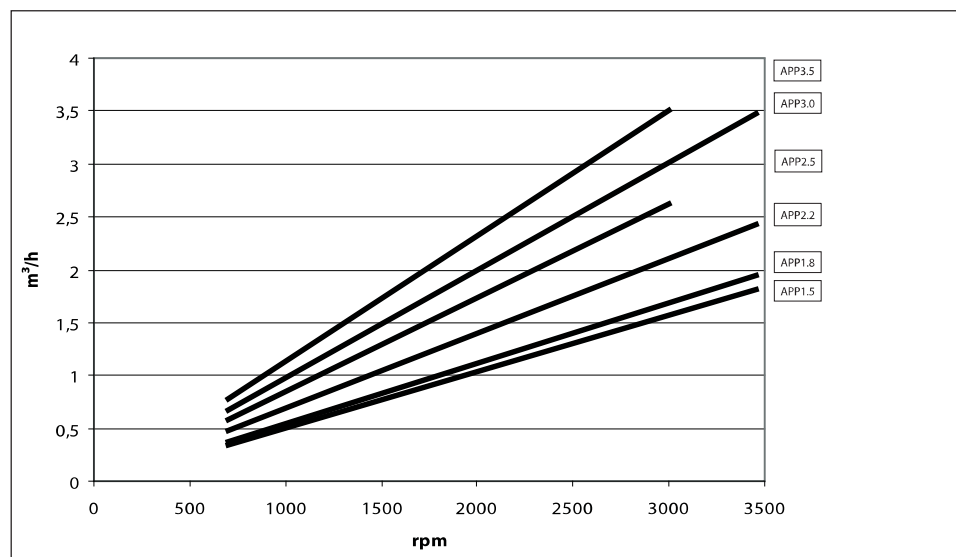
#### 4. Flushing valve

The diagram shows pressure differences across the flushing valve:



#### 5. 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 controlled by changing the rotation speed of the pump. The flow/rpm ratio is constant, and the "required" flow can be obtained by changing the rotation speed to a corresponding value. Thus, the required rpm can be determined as:

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

## 6. Power requirements

| Pump model | Flow  |      |       | Pressure |          |          | rpm  | Calc. factor |
|------------|-------|------|-------|----------|----------|----------|------|--------------|
|            |       |      |       | 60 bar   | 70 bar   | 80 bar   |      |              |
|            | l/min | m³/h | gpm   | 870 psi  | 1015 psi | 1160 psi |      |              |
| APP 1.5    | 25.11 | 1.51 | 6.63  | 3.21 kW  | 3.75 kW  | 4.29 kW  | 2890 | 468.6        |
| APP 1.5    | 30.17 | 1.81 | 7.97  | 3.86 kW  | 4.51 kW  | 5.15 kW  | 3470 | 468.6        |
| APP 1.8    | 26.78 | 1.61 | 7.07  | 3.43 kW  | 4.00 kW  | 4.57 kW  | 2890 | 463.2        |
| APP 1.8    | 32.18 | 1.93 | 8.50  | 4.12 kW  | 4.81 kW  | 5.49 kW  | 3470 | 463.2        |
| APP 2.2    | 33.48 | 2.01 | 8.84  | 4.29 kW  | 5.00 kW  | 5.71 kW  | 2900 | 468.6        |
| APP 2.2    | 40.22 | 2.41 | 10.63 | 5.15 kW  | 6.01 kW  | 6.87 kW  | 3480 | 468.6        |
| APP 2.5    | 41.94 | 2.52 | 11.08 | 5.07 kW  | 5.92 kW  | 6.77 kW  | 2900 | 484.8        |
| APP 3.0    | 48.2  | 2.9  | 12.7  | 6.2 kW   | 7.2 kW   | 8.2 kW   | 2930 | 470.0        |
| APP 3.5    | 56.0  | 3.4  | 14.8  | 7.2 kW   | 8.4 kW   | 9.6 kW   | 2930 | 470.0        |

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 m³/h = 4.40 gpm  
 1 gpm = 0.23 m³/h

## 7. Temperature and corrosion

### 7.1 Operation

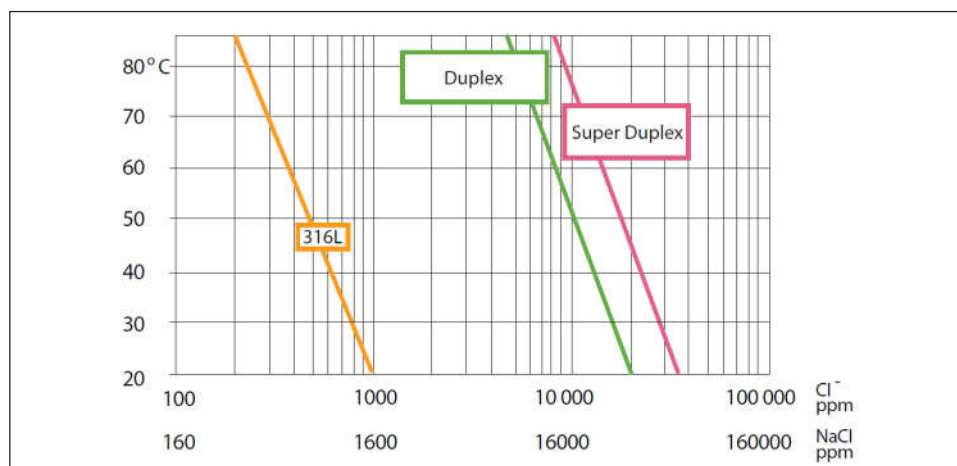
**Fluid temperature:**  
+2°C to +50°C (+35.6°F to 122°F) dependent on the NaCl concentration

**Ambient temperature:**  
+2°C to +50°C (+35.6°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 Super Duplex.

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



## 7.2 Storage

### Storage temperature:

-40°C to +70°C (+40°F to 158°F) provided that the pump is drained of fluid and stored "plugged".

Frost protection is required at temperatures below 2°C. Danfoss recommends to use DOW-FROST from DOW Chemical Company or Chilsafe mono propylene glycol from Arco Chemical Company.

## 8. Noise level

The table indicates the **approximate** 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 |
|---------|---------------------------|---------------------------|
| APP 1.5 | 75                        | 76                        |
| APP 1.8 | 75                        | 76                        |
| APP 2.2 | 75                        | 76                        |
| APP 2.5 | 76                        | 77                        |
| APP 3.0 | 72                        | 77                        |
| APP 3.5 | 72                        | 77                        |

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 must be determined for the complete unit (system).

It is therefore very important that the motor/pump unit is mounted correctly on a frame with antivibration isolation 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

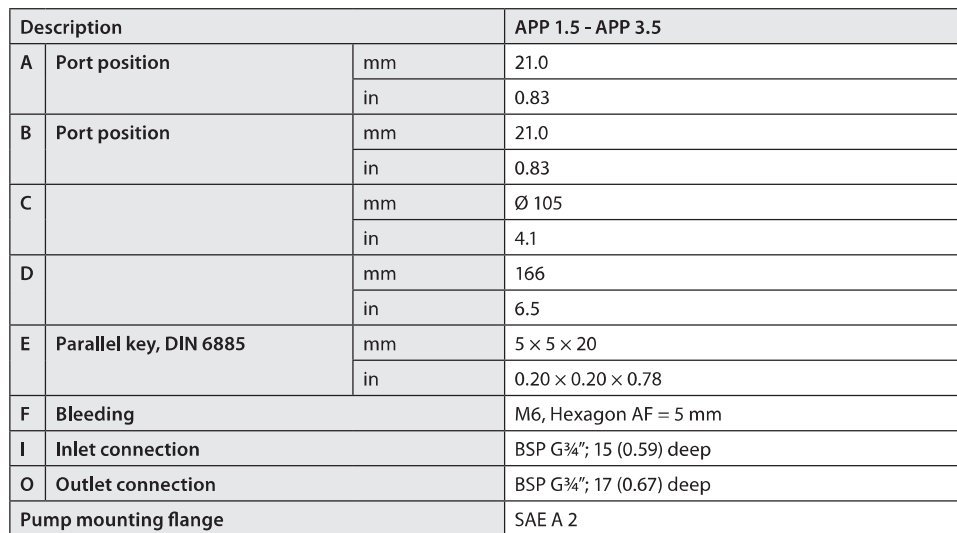
As water has very low viscosity, the APP pumps have been designed with very narrow clearance in order to control internal leakage rates and improve component performance. Therefore it is important that the inlet water is filtered properly to minimize the wear of the pump.

The main filter must have a filtration efficiency of 99.98% at 10 µm. We recommend to use precision depth filter cartridges rated 10µm abs. B10>5000 (equivalent to a filtration efficiency of 99.98%). Bag filters and string wound filter cartridges typically have only 50% filtration efficiency. This means that for each 100,000 particles reaching

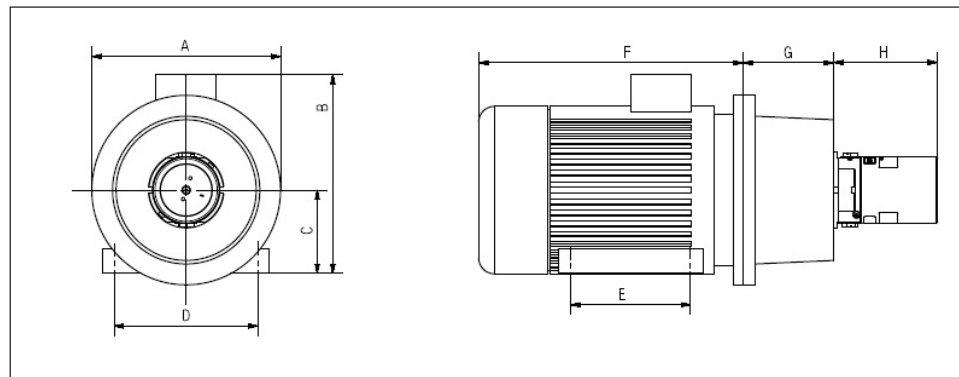
the filter, 50,000 particles pass through it compared to only 20 particles in a filter with an efficiency of 99.98%.

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

## 10.1 Pump



## 10.2 Complete unit



| Pump    | A<br>(mm) | B<br>(mm) | C<br>(mm) | D<br>(mm) | E<br>(mm) | F<br>(mm) | G<br>(mm) | H<br>(mm) | IEC Electric motor  |
|---------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------------------|
| APP 1.5 | 250       | 260       | 100       | 160       | 140       | 325       | 120       | 166       | 3.0 kW, IEC 100L-2  |
| APP 1.8 | 250       | 290       | 112       | 190       | 140       | 340       | 120       | 166       | 4.0 kW, IEC 112M-2  |
| APP 2.2 | 300       | 338       | 132       | 216       | 140       | 403       | 144       | 166       | 5.5 kW, IEC 132S1-2 |
| APP 2.5 | 300       | 338       | 132       | 216       | 178       | 403       | 144       | 166       | 7.5 kW, IEC 132S2-2 |
| APP 3.0 | 350       | 422       | 160       | 254       | 210       | 505       | 188       | 166       | 11 kW, IEC 160M1-2  |
| APP 3.5 | 350       | 422       | 160       | 254       | 210       | 505       | 188       | 166       | 11 kW, IEC 160M1-2  |

## 11. Installation

### 11.1 Mounting

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

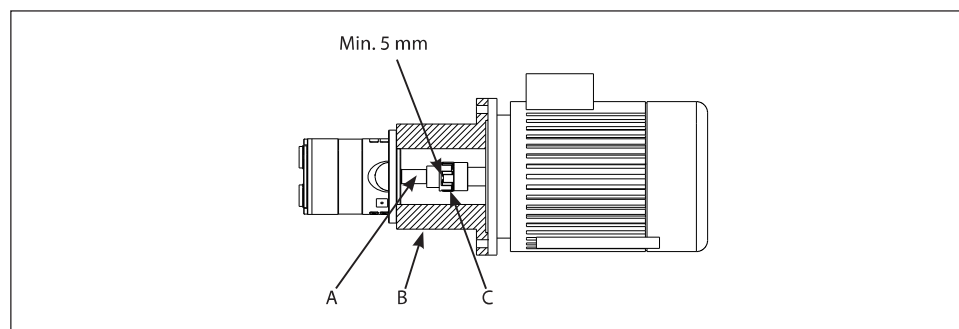
- A: Flexible coupling
- B: Bell housing
- C: Motor shaft

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.**

If alternative mounting is required, please contact Danfoss Sales Organization for further information.

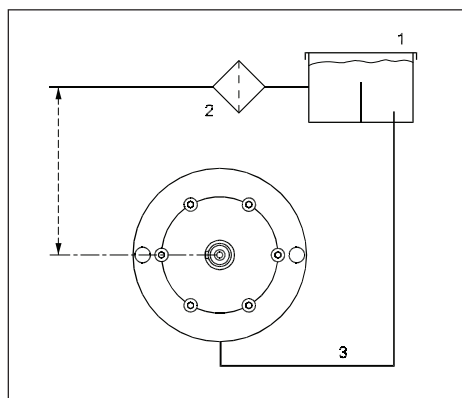
The pump should be connected to the rest of the plant with flexible hoses.



### 11.2 Open-ended system with direct water supply

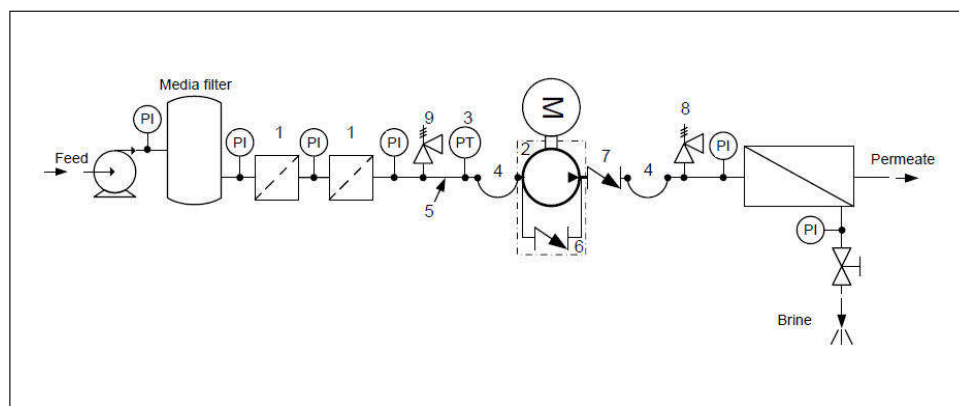
In order to eliminate the risk of cavitation, a positive inlet pressure is always to be maintained. Please see technical data (part 3.) for specific pressure values.

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. inlet pressure - between filter and pump inlet. The monitoring switch must stop the pump at pressures lower than min. inlet pressure. Please see technical data (part 3.) for specific pressure values.



### 11.3 RO system with APP pump

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 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 (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.
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 (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.



**12. Service****12.1 Warranty**

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

Provided that the pump has been running according to the Danfoss specifications, Danfoss 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.

**12.2 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.

**Standstill**

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

**12.3 Repair**

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

**Danfoss A/S**

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