



Data sheet

# Data sheet APP 16-22



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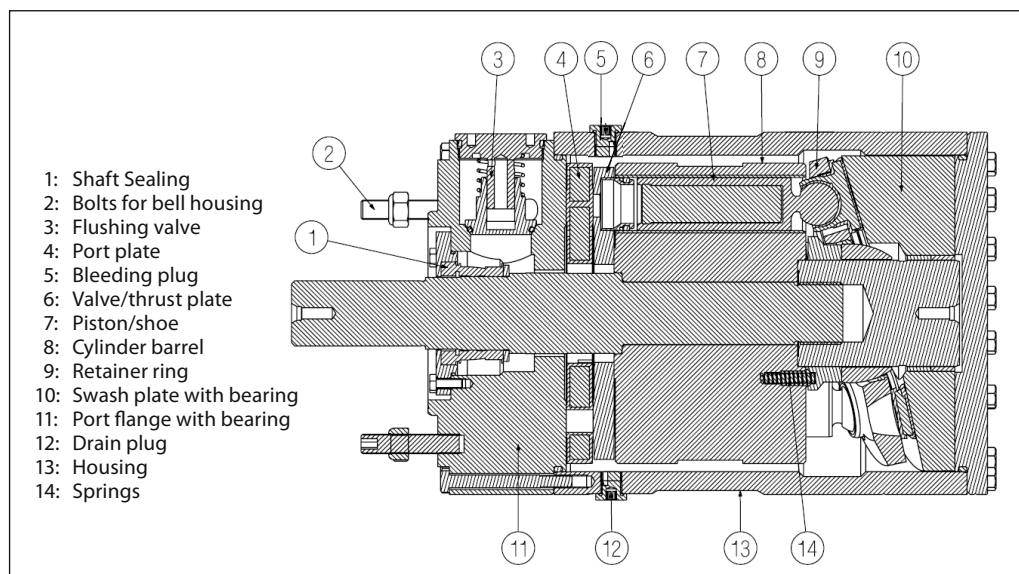
1. General information

APP 16-22 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 salt water pumping.

The pumps are based on the positive displacement principle (axial piston design) which enables a very light and compact design, and

they are designed so that the lubrication of the moving parts in the pumps is provided by the fluid itself. No oil lubrication is thus required.

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.



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

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.

**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.
- Long service life / No preventive maintenance required in the warranty period.
- Generates insignificant pulsations in the pressure line.
- No oil lubricant required
- Integrated flushing valve
- All parts of the pump are made of non-corrosive 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 16 1200	APP 16 1500	APP 17 1200	APP 17 1500	APP 19 1200	APP 19 1500	APP 22 1200	APP 22 1500
Code number		180B3254	180B3250	180B3255	180B3251	180B3256	180B3252	180B3257	180B3253
Geometric displacement	cm <sup>3</sup> /rpm	235	185	252	198	272	220	311	252
	in <sup>3</sup> /rpm	14.3	11.3	15.4	12.1	16.6	13.4	19.0	15.4
Rated flow at max speed <sup>1)</sup>	m <sup>3</sup> /h	16	15.8	17.2	16.9	18.8	18.8	21.5	21.7
	gpm	70.4	69.6	75.7	74.4	82.8	82.8	94.7	95.5
Outlet min. Pressure <sup>2)</sup>	bar	30	30	30	30	30	30	30	30
	psi	435	435	435	435	435	435	435	435
Outlet max. Pressure, continuous <sup>3)</sup>	bar	80	70	80	70	80	70	80	70
	psi	1160	1015	1160	1015	1160	1015	1160	1015
Inlet min. Pressure	bar	2	2	2	2	2	2	2	2
	psi	29	29	29	29	29	29	29	29
Inlet max. Pressure, continuous	bar	5	5	5	5	5	5	5	5
	psi	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5
Inlet max. Pressure, peak	bar	10	10	10	10	10	10	10	10
	psi	145	145	145	145	145	145	145	145
Max. Speed continuous	rpm	1200	1500	1200	1500	1200	1500	1200	1500
Min. Speed continuous	rpm	700	700	700	700	700	700	700	700
Power requirement at max. speed and 60 bar outlet pressure	kW	32	31	35	33	38	37	43	43
	hp	42.9	41.6	46.9	44.3	51.0	49.6	57.7	57.7
Torque at 60 bar outlet pressure	Nm	258	196	276	210	299	236	341	273
	lbf-ft	190.3	144.6	203.6	154.9	220.5	174.1	251.5	201.4
Weight	kg	78	78	78	78	78	78	78	78
	lb	172	172	172	172	172	172	172	172
Integrated flushing valve		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

<sup>1)</sup> Typical average flow at 60 bar (870 psi)

<sup>2)</sup> For lower pressure, please contact Danfoss RO Sales Organization

<sup>3)</sup> For higher pressure, please contact Danfoss RO Sales Organization

The pump is designed according to EN809.

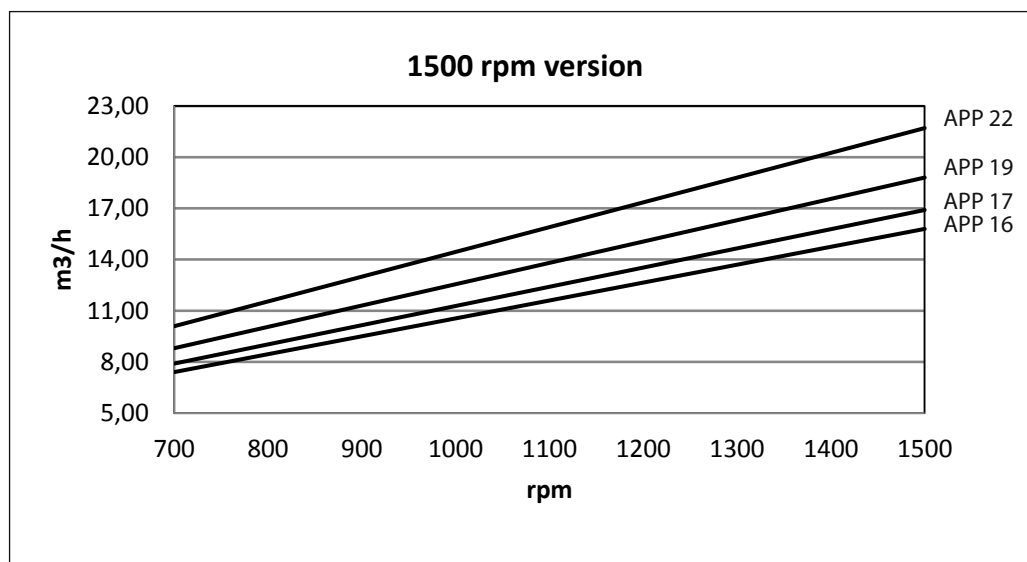
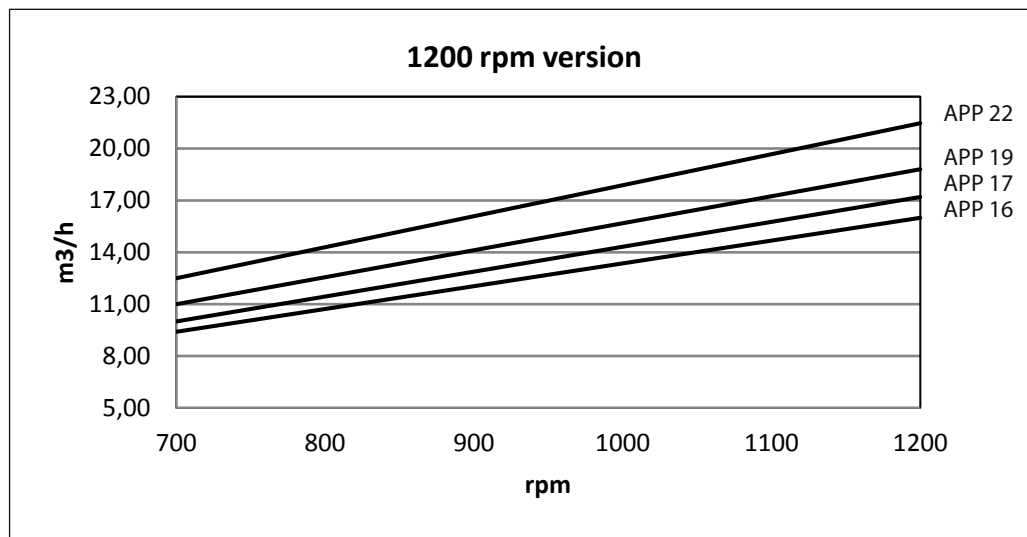
**4. Variants**

- Available as ATEX certified. Category 2, zone 1 and category 3, zone 2.
- Available with material certificates on wetted parts

For more details on the variants, please contact the Danfoss RO Solutions Sales Organisation

**5. Flow at different rpm**

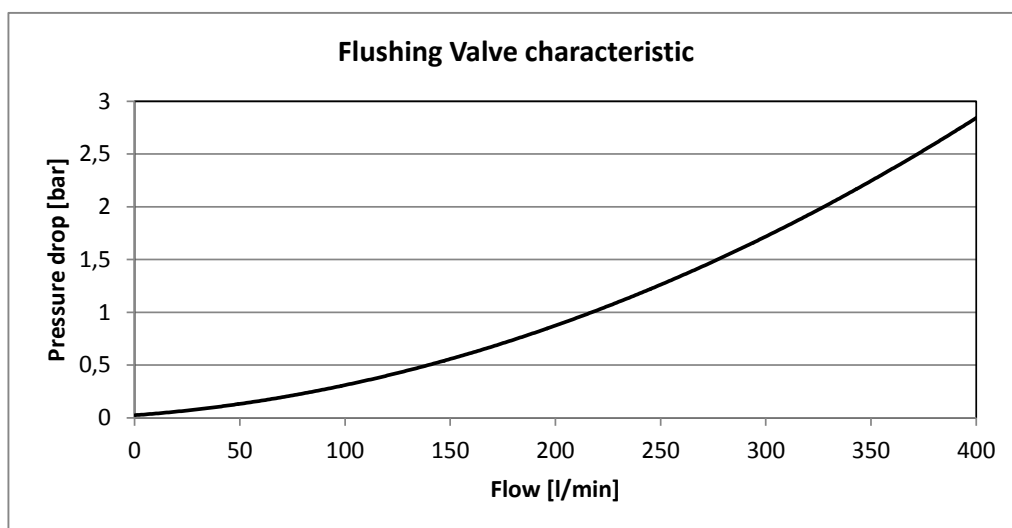
When using the diagrams shown below, it is easy to select the pump which fits the application best if the flow required and the rotation speed (rpm) of the pump are known.



Furthermore, these diagrams 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:

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

6. Flushing valve



7. Power requirements

Pump model	Flow			Pressure			rpm	Calc. factor
				60 bar	70 bar	80 bar		
	l/min	m <sup>3</sup> /h	gpm	870 psi	1015 psi	1160 psi		
APP 16 1200	267	16.0	70.5	32 kW	38 kW	43 kW	1180	496
APP 16 1500	263	15.8	69.5	31 kW	36 kW	41 kW	1480	511
APP 17 1200	287	17.2	75.8	35 kW	40 kW	46 kW	1180	498
APP 17 1500	281	16.9	74.2	33 kW	38 kW	44 kW	1480	513
APP 19 1200	314	18.8	82.9	38 kW	44 kW	50 kW	1180	499
APP 19 1500	313	18.8	82.7	37 kW	43 kW	49 kW	1480	509
APP 22 1200	358	21.5	94.6	43 kW	50 kW	57 kW	1180	501
APP 22 1500	362	21.7	95.6	43 kW	50 kW	57 kW	1480	507

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 <sup>3</sup> /h	=	4.40 gpm
1 gpm	=	0.23 m <sup>3</sup> /h

**8. Temperature and corrosion**

**8.1 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 on the next page illustrates the corrosive resistance of different types of stainless steel related to NaCl concentration and temperature.

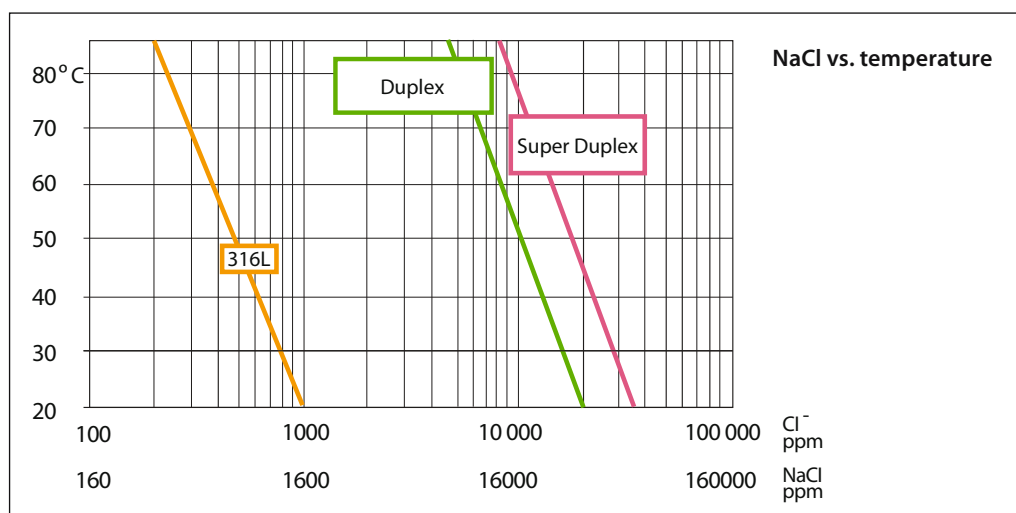
All critical parts of the APP water pump are made of Super Duplex.

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

**8.2 Storage**

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



**9. Noise level**

The sound pressure levels, L<sub>PA</sub>, 1 m<sup>-3</sup> dB(A) for APP 16-22 pumps are typically 82 dB(A) at 60 bar/1500rpm and 84 dB at 80 bar/1500rpm.

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
- If using a VFD the motors can produce higher noise values depending on the operation point.

\*) 1 meter from the pump unit surfaces (reference box) acc. to EN ISO 20361 section 6.2. Deviation  $\sigma_{TOT} = \pm 1,6$  dB(A)

10. Filtration

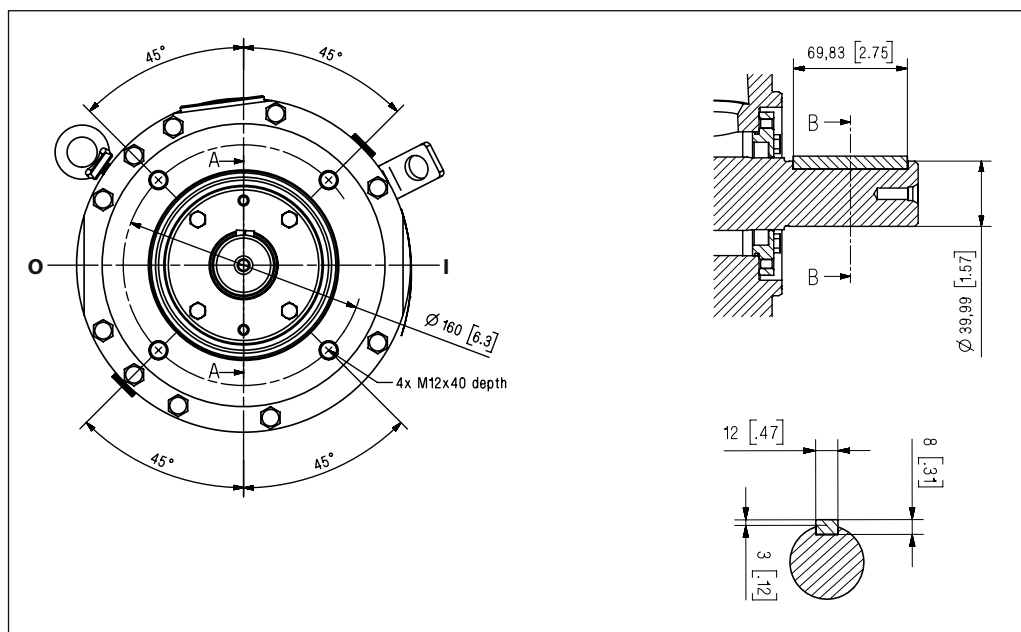
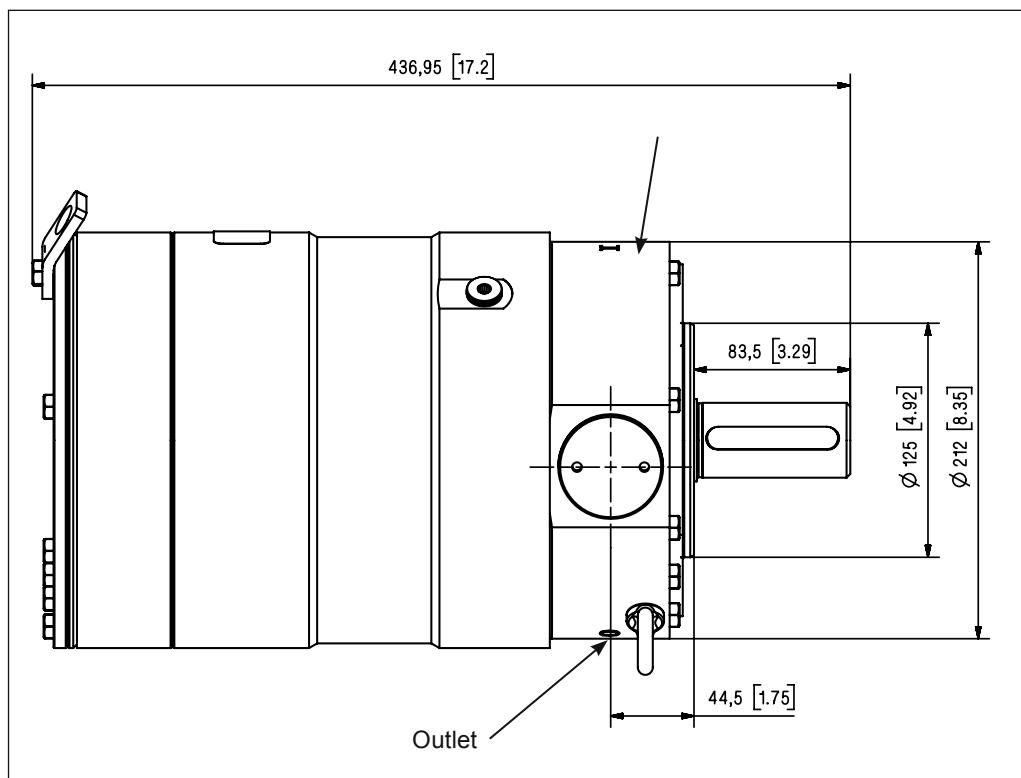
As water has very low viscosity, the APP pumps have been designed with very narrow clearance in order to control internal leakage rates and improve component performance. Therefore it is important that the inlet water is filtered properly to minimize the wear of the pump.

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.  $\beta_{10} > 5000$  (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.

11. Dimensions

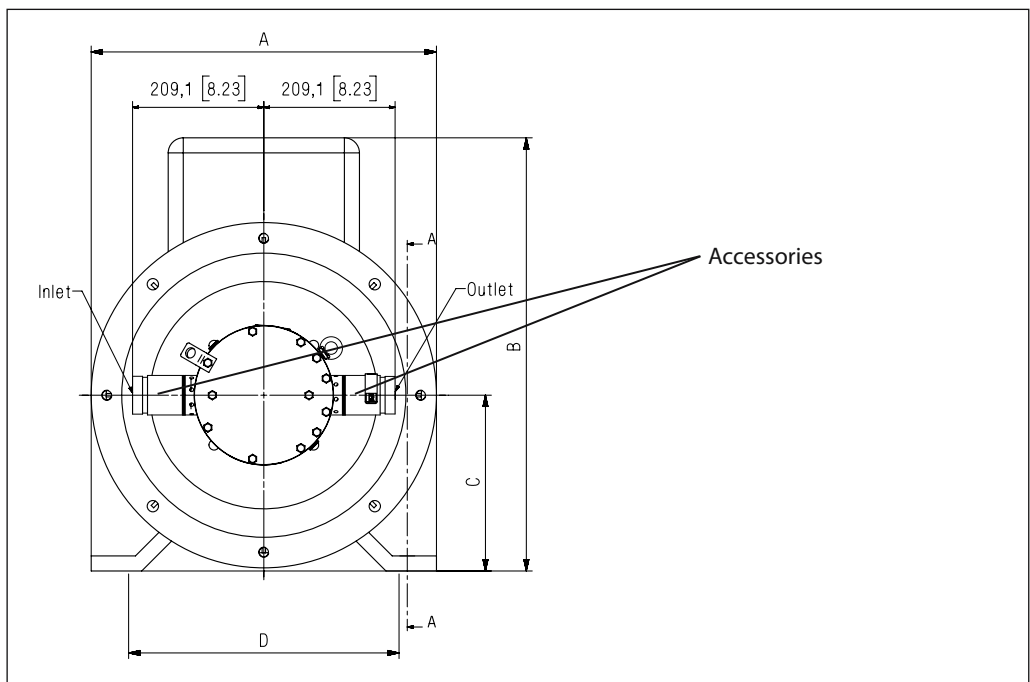
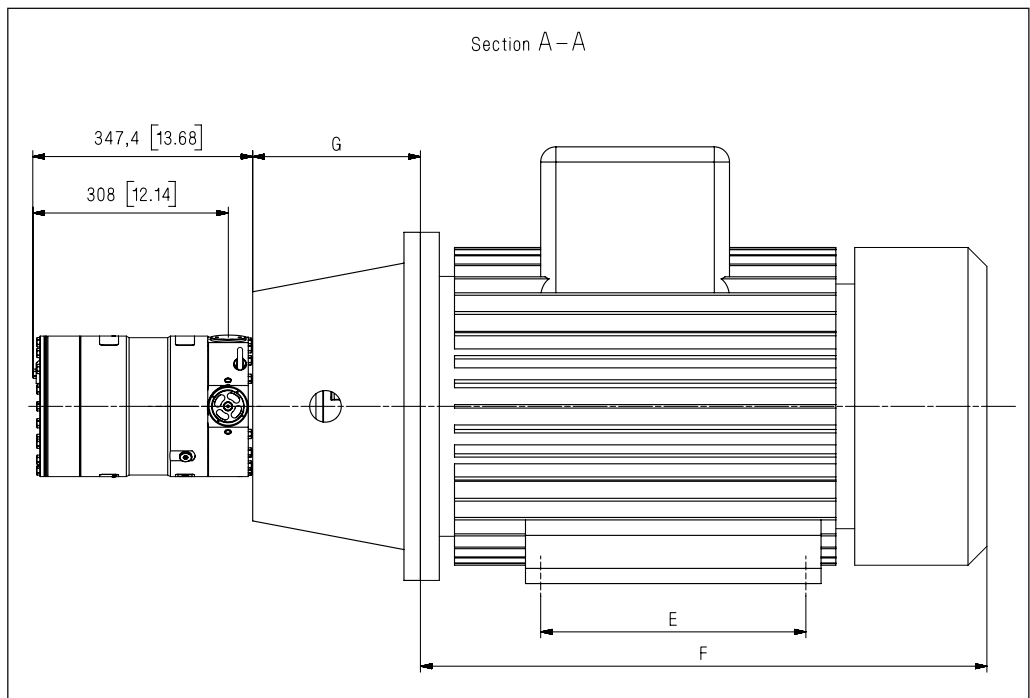


Description	APP 16 – APP 22	
Parallel key, DIN 6885	mm	12 × 8 × 70
	In	0.47 × 0.31 × 2.76
Bleeding	G ¼", Hexagon AF = 6 mm	
Inlet port	M52 x 1.5; depth 21 mm	
Outlet port	M52 x 1.5; depth 21 mm	
Pump mounting flange	125 B 4	

Accessories	Type	Code no.
2" inlet hose kit 2 m/79"	2" Victaulic	180Z0298
2" inlet Vic. Super Duplex	2" Victaulic	180Z0165
Non-return valve (outlet) Super Duplex	2" Victaulic (OD 63 mm)	180H0256

For more details on the accessories, please contact the Danfoss RO Solutions Sales Organisation.

12. Dimensions, complete unit





Pump	A (mm) (P)	B (mm) (HD)	C (mm) (H)	D (mm) (A)	E (mm) (B)	F (mm) (LB)	G (mm)	IEC Electric motor
APP 16	450	560	225	356	286	675	262	37 kW, IEC 225 S4
APP 17	450	560	225	356	311	705	262	45 kW, IEC 225 M4
APP 19	550	615	250	406	349	775	265	55 kW, IEC 250 M4
APP 22	550	680	280	457	368	835	265	75 kW, IEC 280 S4

**Note: Examples of different pump/motor sizes and drawing dimensions are only for IEC motors and couplings. Please always check required motor power and dimensions.**

### 13. Installation

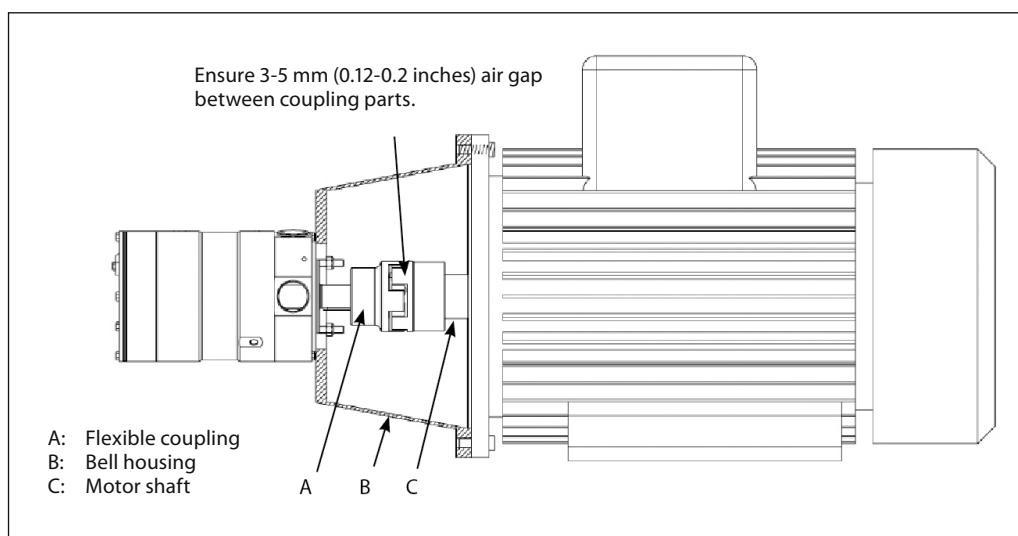
#### 13.1 Mounting

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

To ensure easy mounting of the flexible coupling without using tools, the tolerances must be dimensioned accordingly.

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

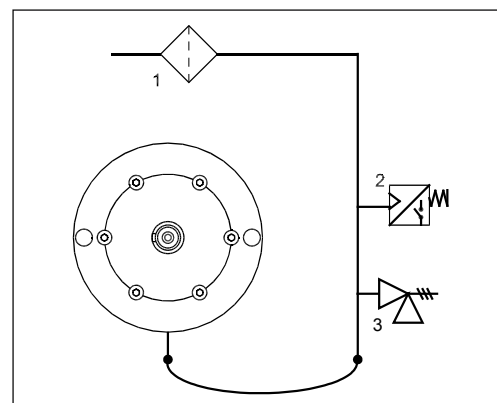
**Note: Any axial and radial loads on the pump shaft must be avoided.**



#### 13.2 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 (section 3.) for specific pressure values.

- Place the filter (1) in the water supply line in front of the pump.
- 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 (section 3.) for specific pressure values
- Install a low pressure safety valve or a pressure relief valve (3) in order to avoid system or pump damage in case the pump stops momentarily or spinning backwards.



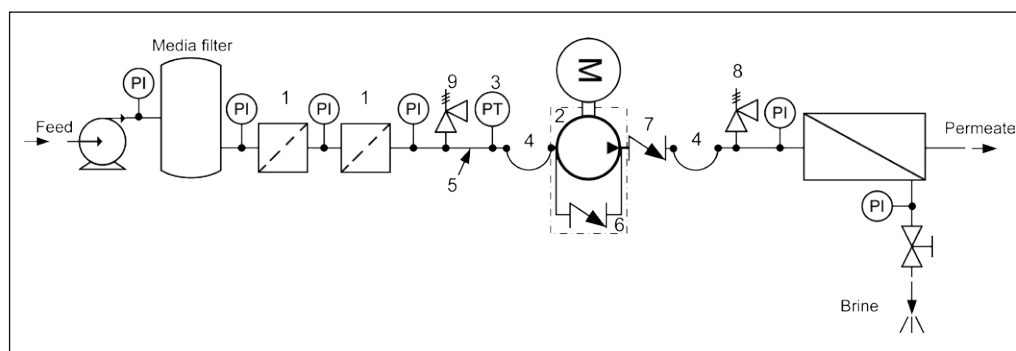
**Note: If a non return valve is mounted in the inlet line, a low pressure relief valve is also required between non return valve and pump as protection against high pressure peaks.**

**13.3 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 10, "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. Recommend to install safety valve or a pressure relief valve (9) in order to avoid

6. high pressure peaks in case the pump stops momentarily or 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 counterpressure.

**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.**



**14. Service**

**14.1 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.**

**14.2 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.

**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.**

**14.3 Repair**

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



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