ENGINEERING
TOMORROW

Data sheet

APP Pumps
APP 21 - 38 with ceramics

hpp.danfoss.com

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1. Introduction

This data sheet is valid for APP pumps with ceramics.

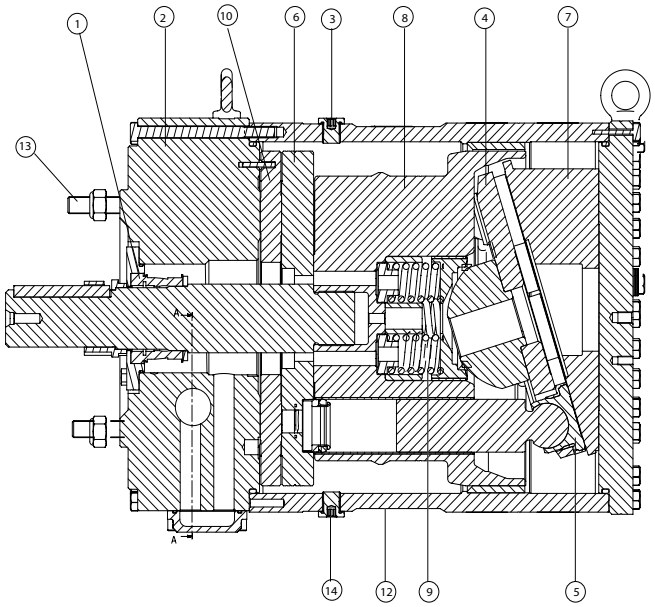
The Danfoss APP high-pressure pumps is designed according to EN 809 for use in applications with low viscosity and corrosive fluids such as:

Sea water
Brackish water
Waste 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.

Below sectional drawing is an example of an APP pump.

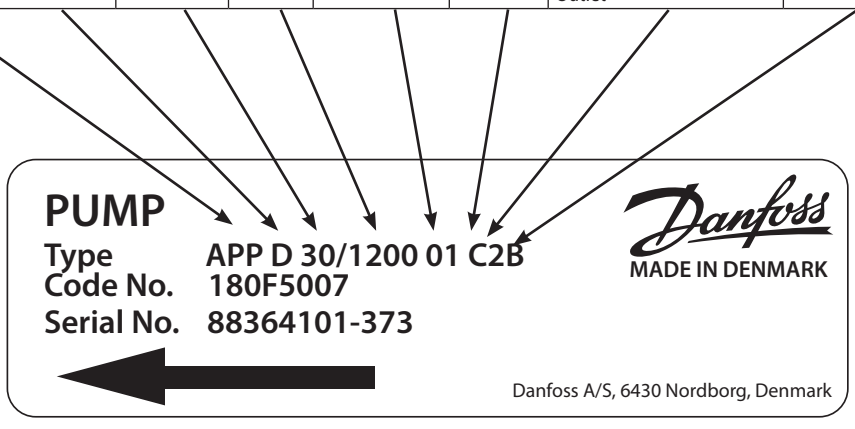
1: Shaft sealing
2: Port flange
3: Bleeding plug
4: Retainer plate
5: Piston/shoe
6: Valve plate
7: Swash plate
8: Cylinder barrel
9: Springs
10: Port plate
11: Flushing valve
12: Housing
13: Tail stock screws
14: Drain plug



2. Naming structure

Note: The naming structure is relevant for chapter 5.

Design	Material type	Capacity (m3/h)	RPM	Special/ Certificates	Sealing materials	Pressure range	Filtration
APP	D: Duplex/Super Duplex steel	21	/1200	01: 3.1 Test Certificate	A: FKM	1: 2-5 Bar Inlet @ 20-83 Bar Outlet	A: Level 1 (10µ ABS)
		26	/1500		C: NBR	2: 3-5 Bar Inlet @ 20-83 Bar Outlet	B: Level 2 (5µ Nom)
		30				3: 2-5 Bar Inlet @ 10–60 Bar Outlet	
		38				6: 3-5 Bar Inlet @ 70-124 Bar Outlet	



3. 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 design life. Specific service intervals are available in the instruction 180R9446. 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 vertically and horizontally.
  - 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 highly corrosion resistant materials e.g. Duplex (EN1.4462/ UNS S31803) and Super Duplex (EN1.4410/UNS S32750) stainless steel, carbon reinforced PEEK and ceramic.
- **Certified quality:**
  - IATF 16949, ISO 9001, ISO 14001.
  - Positive Material Identification (PMI) report available on request if ordered with the pump.

4. 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

5. Technical data

5.1 APP 21 - 38 with ceramics

Pump		APP D 21/1500 01 C1B	APP D 21/1500 01 A6B	APP D 21/1200 01 C1B	APP D 26/1500 01 C1B	APP D 30/1200 01 C2B
Code number APP pumps with ceramics		**180B5005**	**180B5035**	**180B5006**	**180B5009**	**180B5007**
Geometric displacement	cm^3/rev.	256	256	308.5	308.5	444
	in^3/rev.	15.62	15,62	18.83	18.83	27.09
Pressure						
Max. outlet [1] pressure continuous	barg	83	124	83	83	83
	psig	1200	1800	1200	1200	1200
Min. outlet [1] pressure	barg	20	70	20	20	20
	psig	290	1015	290	290	290
Inlet pressure continuous	barg	2-5	3-5	2-5	2-5	3 - 5
	psig	29-72.5	43.5 - 72.5	29-72.5	29-72.5	29 - 72.5
Max. inlet pressure peak	barg	10	10	10	10	10
	psig	145	145	145	145	145
Speed						
Min. speed continuous	rpm	600	600	600	600	600
Max. speed continuous	rpm	1500	1500	1200	1500	1200
Typical flow - Flow curves available in section 6						
1000 rpm at max. pressure	m^3/h	14.80	14.10	17.80	17.80	26.0
1500 rpm at max. pressure	m^3/h	22.20	21.80		26.7	
1200 rpm at max. pressure	GPM	78.18	75.7	94.0	94.3	137.6
Technical specifications						
Media [2] temperature	°C	2-50	2-50	2 - 50	2 - 50	2 - 50
	°F	35.6-122	35.6-122	35.6 - 122	35.6 - 122	35.6 - 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	105	105	105	105	105
	lb	231	231	231	231	231
Sound pressure level[4]	dB(A)	85	87	85	85	85
Footprint with IEC motor[5]	m^2	0.76	0.83	0.76	0.83	0.83
	$foot^2$	8.18	8.93	8.18	8.93	8.93
Typical motor size						
Max. speed at max. pressure	kW	75	90	55	75	90.0
1200 rpm at max. pressure	HP		100	75		125.0
Torque at max. outlet pressure	Nm	355	569	418	426	608
	lbf-ft	262	420	309	314	449

* When operating at rpm above 1200 rpm the min inlet pressure must be more than 3 barg (43.5 psig)

[1] For lower and higher pressure, please contact Danfoss.

[2] Dependent on the NaCl concentration - see chapter 8.

[3] Category 2, Zone 1 or Category 3, Zone 2.

[4] A-weighted sound pressure level at 1 m from the pump unit surfaces (reference box) acc. to EN ISO 20361 section 6.2. The noise measurements are performed acc. to EN ISO 3744:2010 on a motor-pump unit at max. pressure and speed.

[5] Max. area covered with recommended motor configuration (excl. of space to service pump)

5. Technical data APP 21 - 38 with ceramics (continued)

Pump		APP D 38/ 1500 01 C2B	APP D 21/1500 01 A6B	APP D 21/1200 01 A6B	APP D 30/ 1200 01 A6B	APP D 26/1500 01 A6B	APP D 21/ 1500 01 A3B	APP D 21/ 1200 01 A3B	APP D 26/ 1500 01 A3B
Code number APP pumps with ceramics		**180B5008**	**180B5035**	**180B5036**	**180B5037**	**180B5039**	**180B5055**	**180B5056**	**180B5059**
Geometric displacement	cm^3/ rev.	444	256	308.5	444	308.5	256	308.5	308.5
	in^3/ rev.	27.09	15.62	18.83	27.09	18.83	15,62	18.83	18.83
Pressure									
Max. outlet [1] pressure continuous	barg	83	124	124	124	124	60	60	60
	psig	1200	1800	1800	1800	1800	1015	1015	1015
Min. outlet [1] pressure	barg	20	70	70	70	70	10	10	10
	psig	290	1015	1015	1015	1015	145	145	145
Inlet pressure continuous	barg	3-5	3-5	3-5	3-5	3-5	2-5	2-5	2-5
	psig	43.5 - 72.5	43.5-72.5	43.5-72.5	43.5 - 72.5	43.5-72.5	29-72.5	29-72.5	29-72.5
Max. inlet pressure peak	barg	10	10	10	10	10	10	10	10
	psig	145	145	145	145	145	145	145	145
Speed									
Min. speed continuous	rpm	600	600	600	600	600	600	600	600
Max. speed continuous	rpm	1500	1500	1200	1200	1500	1500	1200	1500
Typical flow - Flow curves available in section 6									
1000 rpm at max. pressure	m^3/h	26.2	14.0	17.2	27.00	17	14.8	17.80	17.80
1500 rpm at max. pressure	m^3/h	39.3	21.8			26.3	22.20		26.79
1200 rpm at max. pressure	GPM	138.4	75.5	92.2	137.6	91.4	78.18	94,07	94.37
Technical specifications									
Media [2] temperature	°C	2 - 50	2-50	2-50	2 - 50	2-50	2-50	2-50	2-50
	°F	35.6 - 122	35.6-122	35.6-122	35.6 - 122	35.6-122	35.6-122	35.6-122	35.6-122
Ambient temperature	°C	0 - 50	0-50	0-50	0 - 50	0-50	0-50	0-50	0-50
	°F	32 - 122	30-122	32-122	32 - 122	32-122	32-122	32-122	32-122
Weight (dry)	kg	105	105	105	105	105	105	105	105
	lb	231	231	231	231	231	231	231	231
Sound pressure level[4]	dB(A)	85	87	87	87	87	85	85	85
Footprint with IEC motor[5]	m^2	0.83	0.83	1.10	1.10	1.1	0.76	0.76	0.76
	$foot^2$	8.93	11.84	11.84	11.84	11.84	8.18	8.18	8.18
Typical motor size									
Max. speed at max. pressure	kW	110	90	110	160	110	45	55	75
1200 rpm at max. pressure	HP				200			68	
Torque at max. outlet pressure	Nm	617	537	632	919	644	257.2	302	309
	lbf-ft	455	396	466	678	476	189.2	223	227

* When operating at rpm above 1200 rpm the min inlet pressure must be more than 3 barg (43.5 psig)

[1] For lower and higher pressure, please contact Danfoss.

[2] Dependent on the NaCl concentration - see chapter 8.

[3] Category 2, Zone 1 or Category 3, Zone 2.

[4] A-weighted sound pressure level at 1 m from the pump unit surfaces (reference box) acc. to EN ISO 20361 section 6.2. The noise measurements are performed acc. to EN ISO 3744:2010 on a motor-pump unit at max. pressure and speed.

[5] Max. area covered with recommended motor configuration (excl. of space to service pump)

6. Flow at different rpm

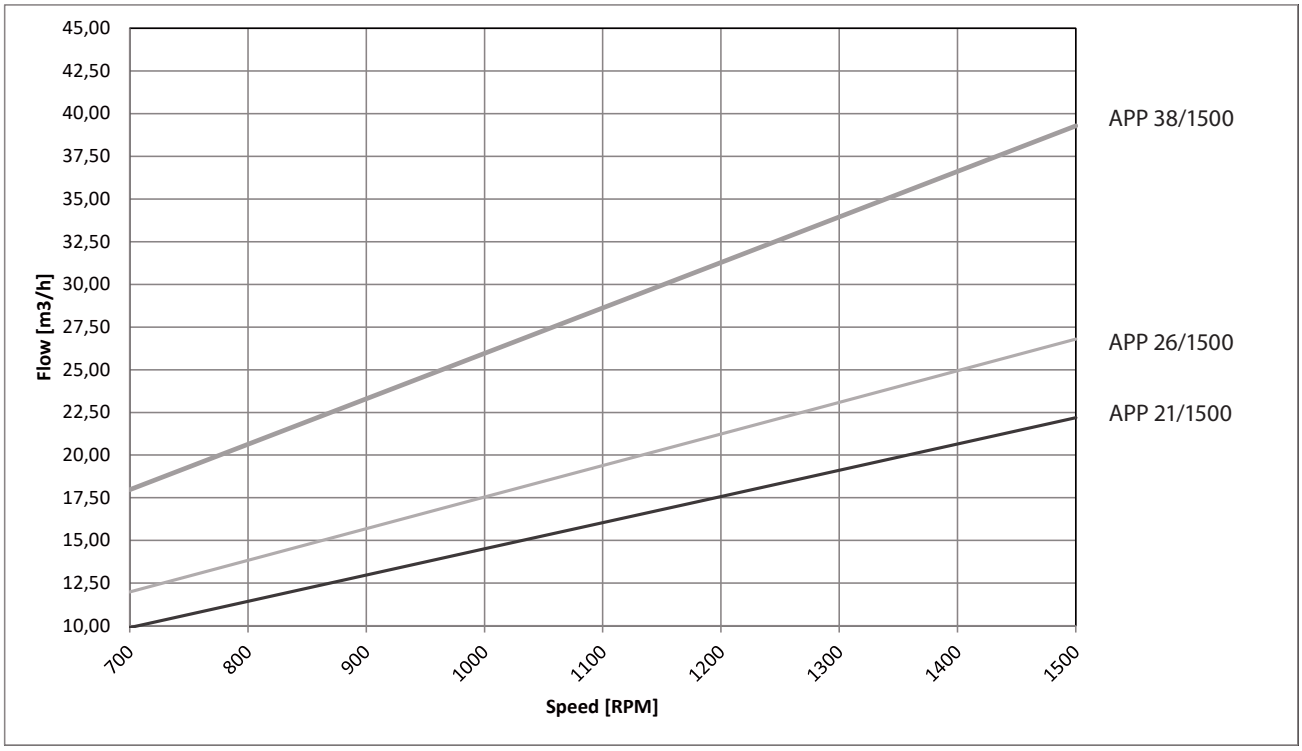
If the flow required and the rotation speed (rpm) of the pump is known, it is easy to select the pump fitting the application best by using the diagrams below.

Furthermore, these diagrams shows that the flow can be changed by changing the rotation speed of the pump.

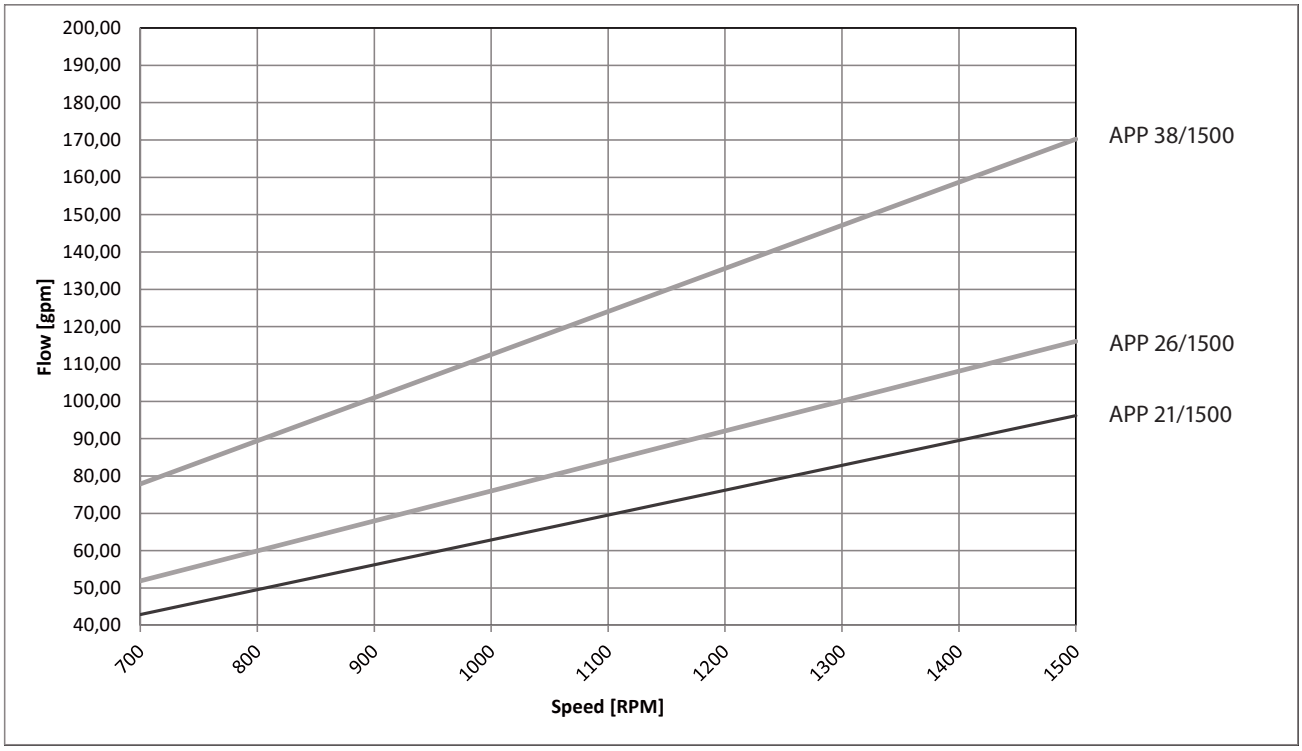
The Flow/Rpm ratio is considered proportional. The Total efficiency is displayed at different ΔP. The total efficiency is relative constant within normal RO pressure variations. The total efficiency can be found in the top of the diagram.

The vertical blue lines indicate where the pump can operate continuously. The required inlet pressure is increasing when the speed changes. The pump power consumption is indicated in the ΔP graph but can also be calculated by using the factors in section 5.2

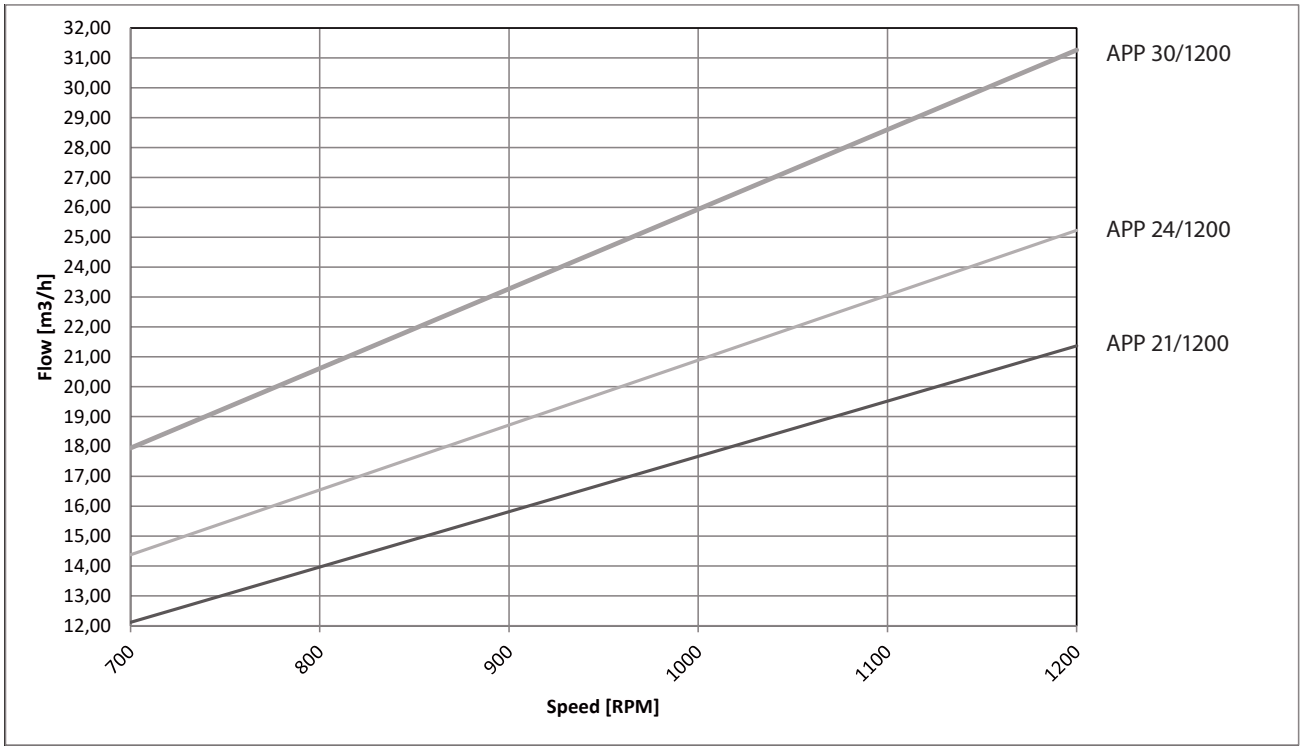
6.1 Data curves for APP 21-38 with ceramics



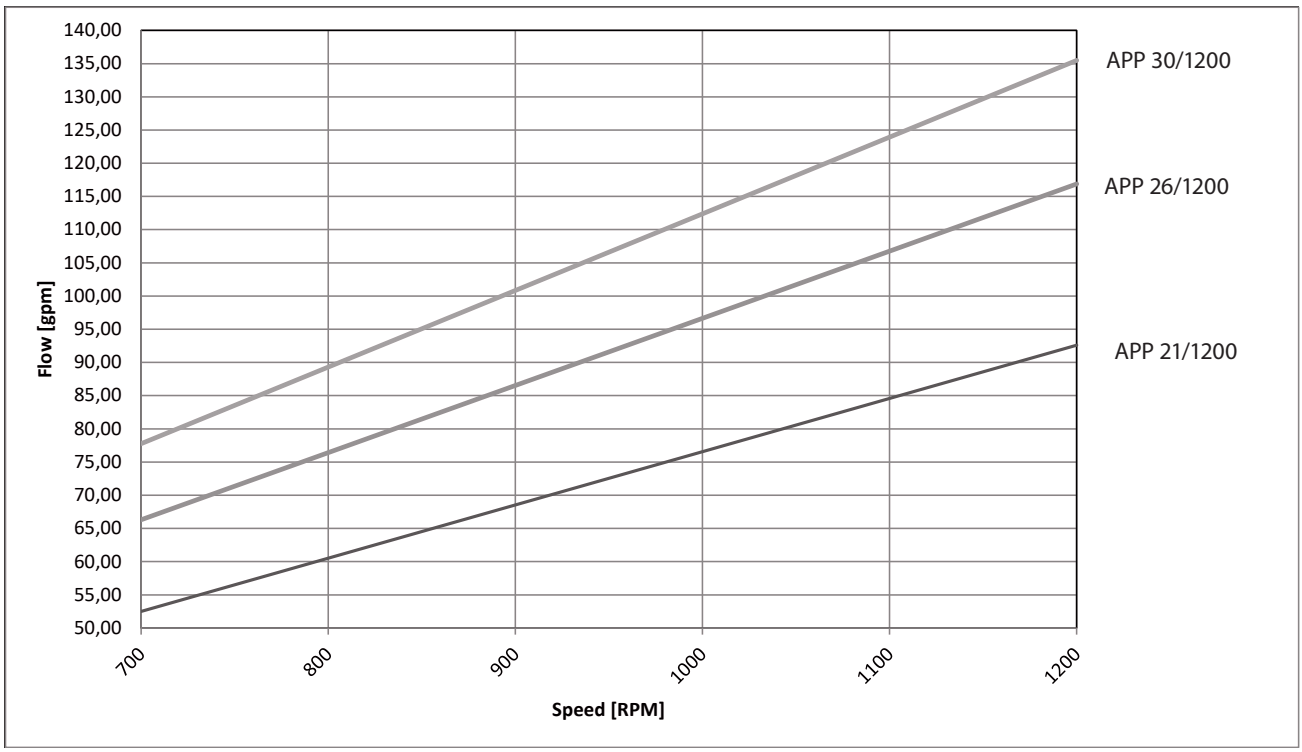
Measured at 80 Bar (870 psi)



Measured at 80 Bar (870 psi)



Measured at 80 Bar (870 psi)



Measured at 80 Bar (870 psi)

7. Motor requirements

The power requirements and torque can be determined using one of the following guiding equations to ensure correct motor selection both:

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

Required torque = barg x torque calcualtion factor [Nm]

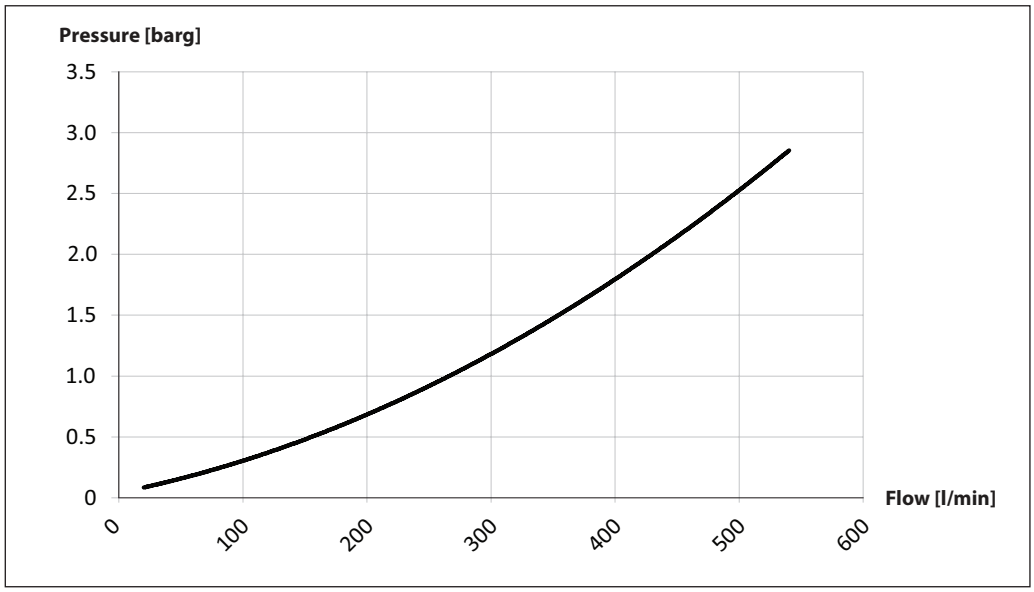
Name	rpm	Power calculation factor	Torques calculation factor
APP x 21	1500	522	4.4357
APP x 21	1200	539	5.2204
APP x 26	1500	525	5.328
APP x 30	1200	543	7.6022
APP x 38	1500	537	7.7100

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
1 Nm	=	0.7376 lb. ft.

8. Flushing valve curves

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.

8.1 APP 21 - 38 integrated flushing valve



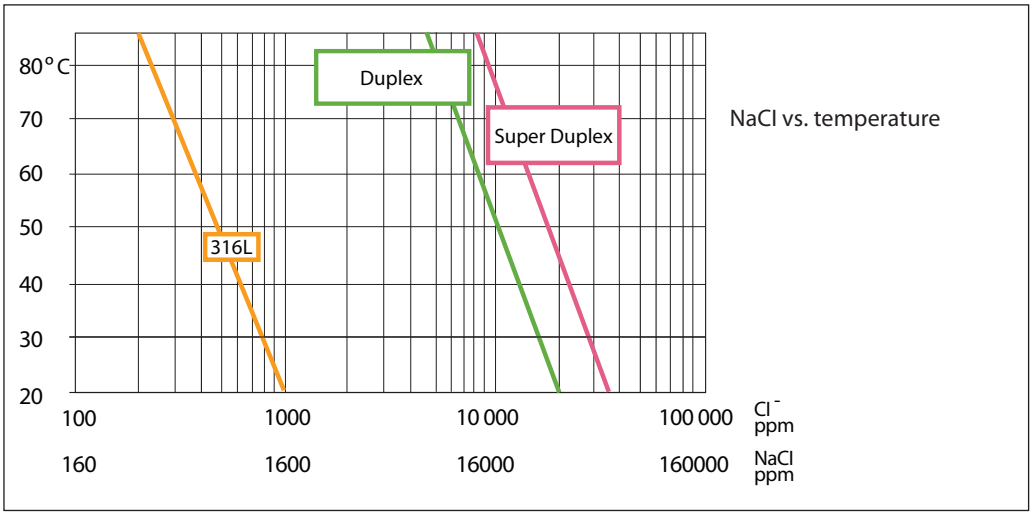
9. Temperature and corrosion

9.1 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.

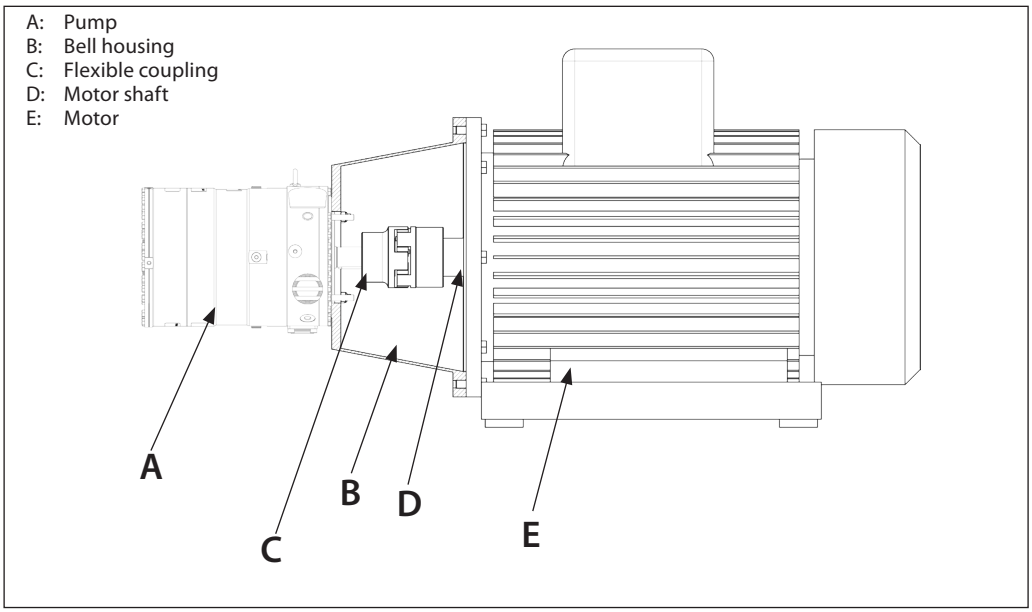
If the water pump is operated above the Duplex line, always flush the water pump with fresh water at all operation stops in order to minimize the risk of crevice corrosion.
In case the pump is stopped for more than one day it should always be flushed with fresh water as described in section 13.



10. Installation

Below drawing shows how the pump is installed to an electric motor. Alignment of the pump and motor shafts is controlled by the mount. This also protects the pump shaft against any axial or radial loads.

During transportation the shaft protection cap must be mounted. Before installing the coupling the cap must be removed.
If alternative mounting is required. please contact your Danfoss sales representative for further information.



10.1 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 in by always ensuring that all filtration specifications are met, and by always changing filter cartridges according to schedule.

High quality water extends the service life of the whole system.

Water to the APP pumps with ceramics must be filtered to 5 µm nominal, using melt-blown depth filter with a proven efficiency of min. 85%. Consult Danfoss for correct choice of filter.

It is important when selecting the filter and filter housing to ensure good cartridge end sealings. As the various filters on the market differ greatly, Danfoss High Pressure Pumps recommends using cartridges with consistent, reliable performance and high efficiency and where fibres are blown continuously onto a central support core. Danfoss High Pressure Pumps does not recommend cartridges requiring any type of binders or resins.

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 AI317041322125en-000201).

10.2 Noise

Vibrations from the pump can be transferred to the system components that are attached to the pump. 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.
- **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 dampers 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.

10.3 RO system with direct supply:

Inlet line:

a) Dimension the inlet line to obtain minimum pressure loss (large flow area, minimum pipe length, minimum number of bends/connections, and fittings with low or no pressure losses). If relevant, please consult "Parallel coupled pumps and iSaves" (180R9354)

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.

Low pressure relief valve:

c) Install a low pressure relief valve (9) in order to avoid system or pump damage in case the system stops abruptly, for instance due to a power outage, or if the pump is spinning backwards.

Hoses:

d) Use flexible hoses (4) to minimize vibrations and noise. Please consult the Danfoss Hoses and hose fittings data sheet (AI319454706473en-000201) for guidance.

Inlet pressure:

e) In order to eliminate the risk of cavitation and other pump damage, pump inlet pressure must always be maintained according to specifications described in section 4 about technical data.
Install a monitoring pressure switch (3) between the filter (1) and the pump inlet. Set the minimum inlet pressure according to specifications described in section 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.

Flushing valve:

f) For easy system filling and flushing, an integrated flushing valve (6) is in the APP pump.

Non-return valve:

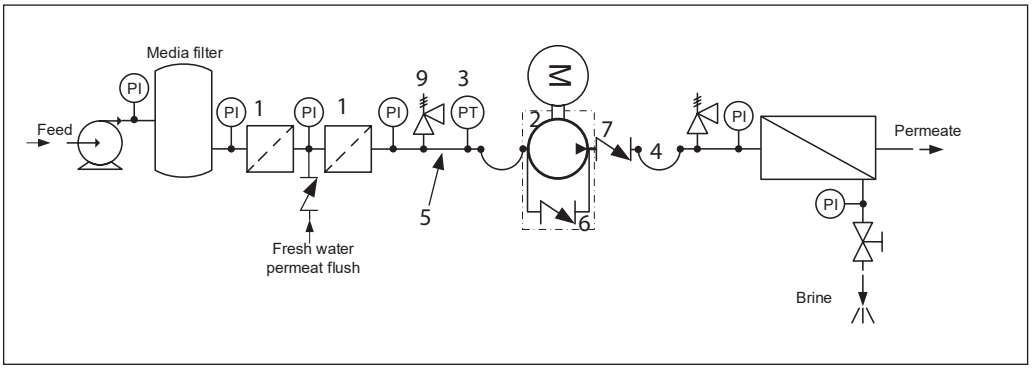
g) A non-return valve (7) in outlet can be installed in order to avoid backspin of the pump. The volume of water in the membrane vessel works as an accumulator and will send flow backwards in case of the pump stops abruptly.

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 safey 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 the pump as protection against high-pressure peaks.

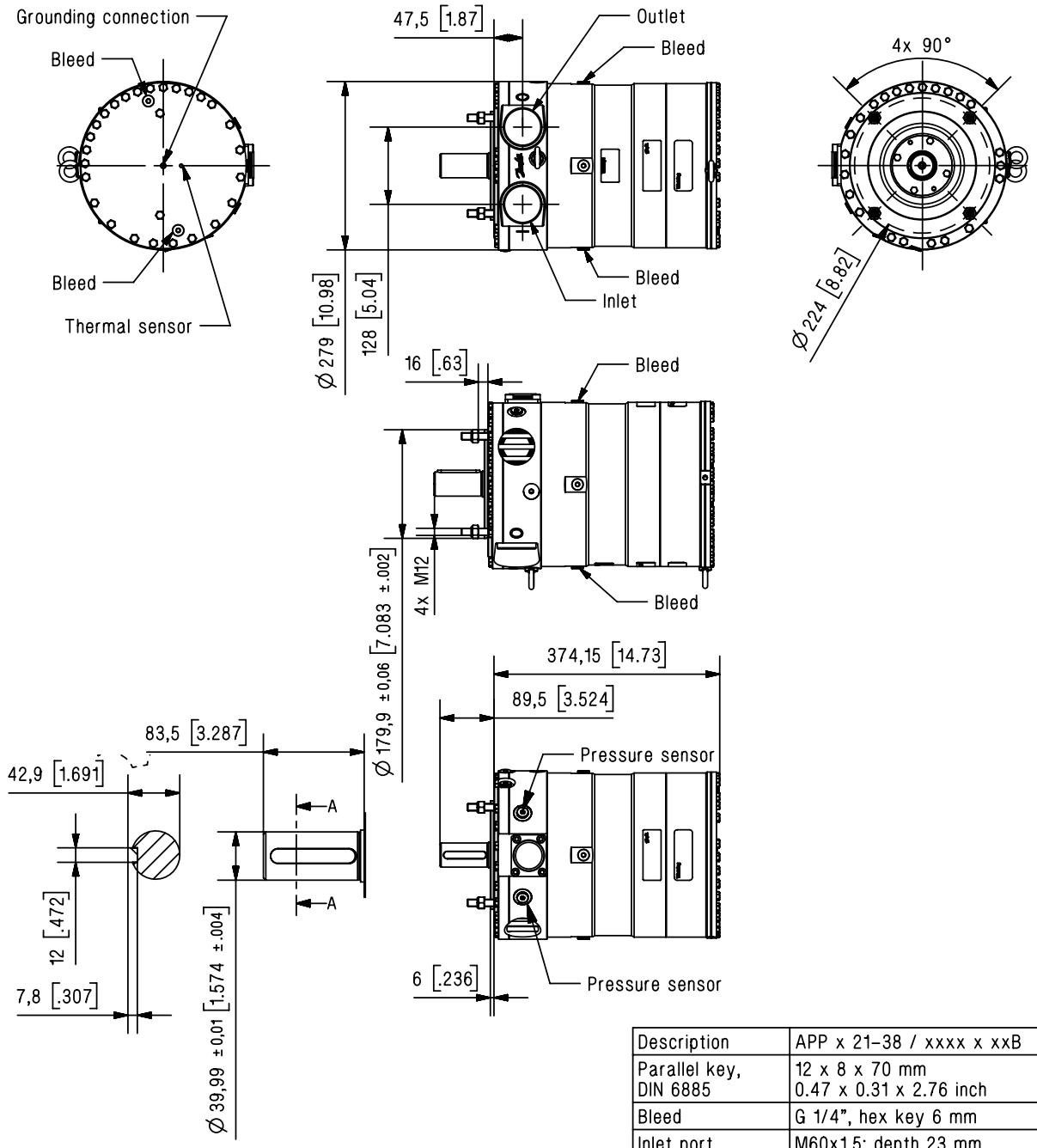
Preferred design - see section 10.3



11. Dimensions and connections

11.1 APP 21- 38 with ceramics

Accessories see section 13.



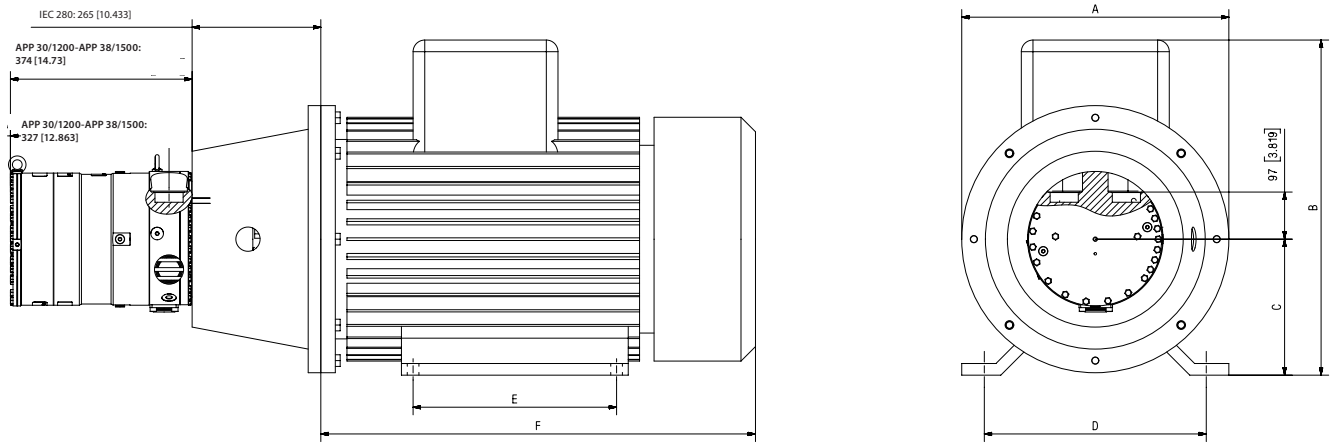
Description	APP x 21–38 / xxxx x xxB
Parallel key, DIN 6885	12 x 8 x 70 mm 0.47 x 0.31 x 2.76 inch
Bleed	G 1/4", hex key 6 mm
Inlet port	M60x1.5; depth 23 mm
Outlet port	M60x1.5; depth 23 mm
Earth connection	M8, depth 11 mm
Thermal sensor	M6, depht 11 mm
Pressure sensor	G 1/4", hex key 6 mm

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

12. Dimensions with motor unit

12.1 APP 21-38 with ceramics

The examples of assemblies with motor are only for IEC motors and couplings. Please make sure to check required motor power and dimensions when selecting size of pump and motor. For advice and calculation tool, please contact Danfoss.



Pump	A mm (inch)	B mm (inch)	C mm (inch)	D mm (inch)	E mm (inch)	F mm (inch)	IEC Electric motor
APP 21 - 38 with ceramics	450 (17.71)	561 (22.08)	225 (8.85)	356 (14.01)	311 (12.24)	707,5 (27.85)	45 kW, IEC 225
APP 21 - 38 with ceramics	550 (21.65)	649 (25.55)	250 (9.84)	406 (15.98)	349 (13.74)	769 (30.27)	55kW IEC 250
APP 21 - 38 with ceramics	550 (21.65)	683 (26.88)	280 (11.02)	457 (17.99)	368 (14.49)	839 (33.03)	75kW, IEC 280S-4
APP 21 - 38 with ceramics	550 (21.65)	693 (27.28)	280 (11.02)	457 (17.99)	419 (16.50)	895 (35.24)	90 kW, IEC 280 M-4
APP 21 - 38 with ceramics	660 (25.98)	862 (33.93)	315 (12.40)	508 (20.00)	406 (15.98)	1053 (41.45)	110kW, IEC 315S-4

13. Accessories

13.1 Accessories for APP 21 - 38 with ceramics

Accessories		Type	Code No.
3" inlet hose kit - 2m (79")		3" Victaulic	**180Z0144**
2" outlet hose APP 30-38	**1.78m (70")**	2 ½" Victaulic	**180Z0263**
	1m (39.4")		**180Z0280**
3" inlet connector APP 30-38		M60 - 3" Victaulic	**180B3208**
Non-return valve (outlet) Super Duplex APP 30-38		M60 - 2 ½" Victaulic	**180H0059**

[1] The installation instruction for Style 77DX is located in the Victaulic document 1-100 Field Installation Handbook (http://static.vieltaulic.com.
When using hoses, please read Design guides: 180R9084 - Right and wrong - Hose assembly routing tips and 180R9367 - Piping connections.

14. Service

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 recommends 16.000 hours service interval, but as the guarantee is 8000 Hours service-free operation or max. 18 month from date of production it is recommended to perform an inspection before the end of the warranty period to ensure that any potential issues are identified and can be resolved promptly through the warranty claims process

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:

- 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 rotation of the shaft
- Insufficient bleeding of the pump
- Filtration not meetin specifications

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

Maintenance
Periodic inspections are required to ensure worn parts (if any), are replaced in due time. Operational conditions such as water quality should be taken into consideration when determining the frequency of the inspections.

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 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 the pump.

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

Danfoss A/S
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