

## Filter solutions for Danfoss PAH, APP and CLP pumps



### Introduction

To ensure optimum pump life, it is important that the incoming fluid is filtered properly. It is recommended to use filters from the Danfoss filter product range as the various filters on the market differ greatly.

Using the filters from the Danfoss product range is the best way to ensure proper filtration. If the filter is not purchased from Danfoss, it is important that a filter with equivalent properties is used.

**Filter element efficiency**

Filter element efficiency for a particular micron ( $\mu$ ) rating is determined by the Beta value for that micron rating. The efficiency is calculated as Beta value minus one divided by the Beta Ratio then multiplied by 100.

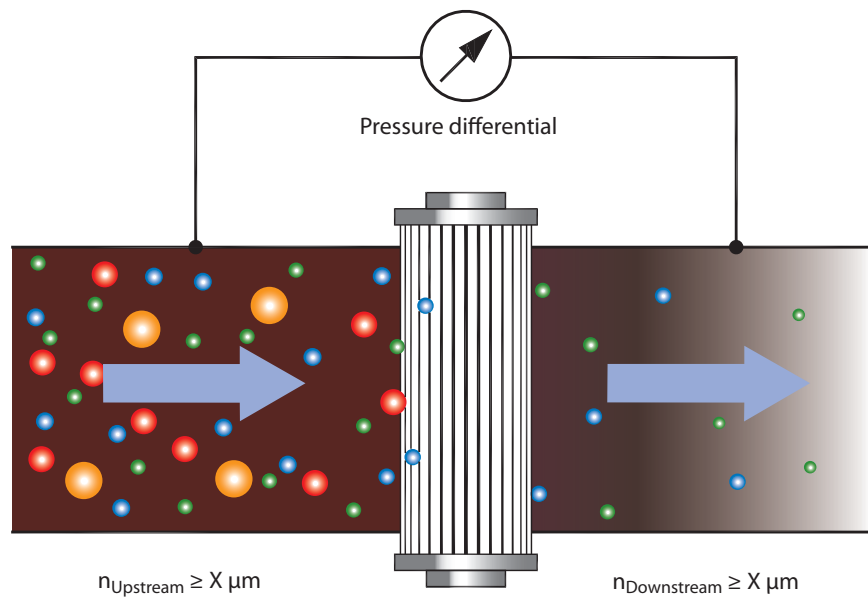
For example, an element with a Beta Ratio of 5000 for a particular micron rating has the following efficiency:

$$\frac{(5000-1)}{5000}$$

equal to 99.98% efficiency.

The following table shows the Beta value, the corresponding efficiency, and the number of particles that will pass through to the downstream side of the element for each 100,000 particles seen in the upstream side of the element.

$\beta$ -value of filter	Filter efficiency	Number of particles downstream for each 100,000 particles upstream
2	50.00%	50,000
4	75.00%	25,000
10	90.00%	10,000
20	95.00%	5,000
40	97.50%	2,500
100	99.00%	1,000
200	99.50%	500
500	99.80%	200
1,000	99.90%	100
2,000	99.95%	50
<b>5,000</b>	<b>99.98%</b>	<b>20</b>
10,000	99.99%	10



$$\beta_x = \frac{n_{Upstream} \geq X \mu m}{n_{Downstream} \geq X \mu m}$$

**Filtration requirement**

The Danfoss PAH, APP and CLP pumps require water with no particles larger than 10 micron (10 µ). Thus a 10 µ absolute filter with a Beta value > 5000 must be used.

- 10 µ means that particles of 10 µ or larger in size will be caught by the filter.
- Absolute filtration means that the fluid is filtered both horizontally and vertically. In comparison, an inferior nominal type of filter will allow particles which are more than 10 µ in length to pass through the filter, as it only filters the fluid according to the diameter of the particles.
- The Beta value > 5000 refers to the efficiency of the filter. A filter with a Beta value of > 5000 catches 99.98% of the particles being 10 µ or larger. This means if there are 100,000 particles in the fluid (10 µ or larger), only 20 of them would pass through that filter. Other types of filters on the market have a Beta value > 10 (90% efficiency), and these filters would allow 10,000 of the 100,000 particles to pass through the filter.

**Filter types**

Pleated polypropylene filter elements use the very latest gradient density micro-fibre media technology to provide a combination of excellent

absolute micron ratings, high flow rates, and high dirt-holding capacity.

**Features**

- The absolute particle retention provides excellent protection of the pump and the rest of the system.
- Compatibility with a broad range of process chemicals allows use in most applications.
- High flow rate and long service life ensure minimum downtime of the system.
- High dirt-holding capacity.
- Filter element is easily exchanged.

**Applications**

The Danfoss filters can be used in a wide range of demanding applications such as:

- General water filtration
- RO/DI water filtration
- Various chemicals (see appendix A)

**Technical data /  
Code numbers  
(filter elements)**

The Danfoss filter product range includes different types of main filter elements, all fulfilling the minimum requirement of 10 µ absolute with a Beta value > 5000.

One filter element end has an O-ring seal, and the other end has a closed cap, which has a different design depending on the specific filter type.



Type 1

Gaskets compressed on knife edge seal of housing



Type 2, 3, and 4

Single O-ring located inside element, other end flat closed



Type 5 and 6

Two O-rings located externally on element, other end flat closed

Filter element	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
Max flow (l/min)	15	30	60	60	170	300
Max flow (gpm)	4	7.9	15.6	15.6	44.9	79.3
Max flow (m <sup>3</sup> /h)	0,9	1.8	3.6	3.6	10.2	18.0
Filtration level (Beta > 5000)	10 µ abs	10 µ abs	5 µ abs	10 µ abs	10 µ abs	10 µ abs
Element length	5" (127 mm)	10" (254 mm)	20" (508 mm)	20" (508 mm)	20" (508 mm)	40" (1016 mm)
Element inner diameter	1.06" (27 mm)	1.06" (27 mm)	1.06" (27 mm)	1.06" (27 mm)	1.8" (46 mm)	1.8" (46 mm)
Element outer diameter	2.75" (70 mm)	2.75" (70 mm)	2.75" (70 mm)	2.75" (70 mm)	4" (102 mm)	6.5" (165 mm)
Effective surface	3 sq.ft. (0.28 m <sup>2</sup> )	6 sq.ft. (0.55 m <sup>2</sup> )	12 sq.ft. (1.1 m <sup>2</sup> )	12 sq.ft. (1.1 m <sup>2</sup> )	30 sq.ft. (2.75 m <sup>2</sup> )	194 sq.ft. (18 m <sup>2</sup> )
Max differential pressure at 75°F (24°C)	80 psi (5.5 bar)	80 psi (5.5 bar)	80 psi (5.5 bar)	80 psi (5.5 bar)	43.5 psi (3.0 bar)	43.5 psi (3.0 bar)
Max operating temperature	122°F (50°C)	122°F (50°C)	122°F (50°C)	122°F (50°C)	122°F (50°C)	122°F (50°C)
Materials	Element	Polypropylene	Polypropylene	Polypropylene	Polypropylene	Polypropylene
	End caps	Polypropylene	Polypropylene	Polypropylene	Polypropylene	Polypropylene
	Seals	Buna-N	Buna-N	Buna-N	Buna-N	Buna-N
Code number	180Z0037	180X5225	180Z0019	180Z0006	180Z0083	180Z0011

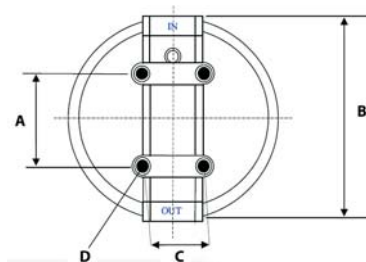
**Replacement of filter element**

At a differential pressure of 2.5 bar (36 psi) the filter element has reached its dirt capacity.

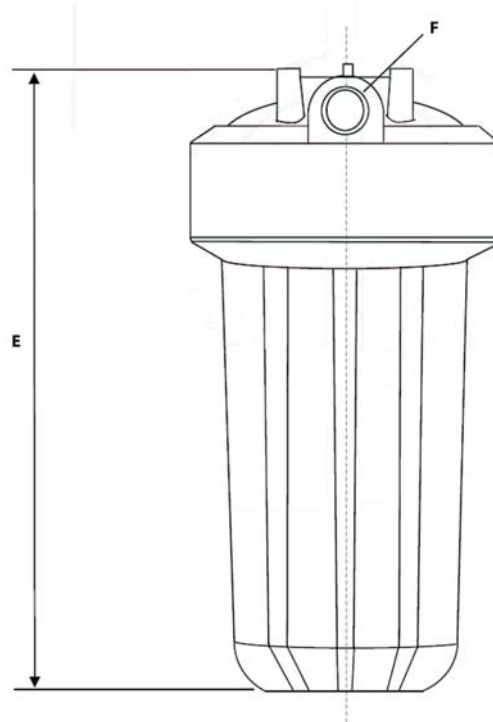
**Technical data /  
Code numbers  
( housings)**

Housing	5" blue	10" blue	20" blue	20" big blue	20" stainless	40" stainless	
Max flow (l/min)	15	30	60	170	170	300	
Max flow (gpm)	4	7.9	15.6	44.9	44.9	79.3	
Max flow (m <sup>3</sup> /h)	0,9	1.8	3.6	10.2	10.2	18.0	
Housing length	7" (128 mm)	12¼" (311 mm)	22¾" (568 mm)	23⅞" (606 mm)	23½" (597 mm)	42½" (1079 mm)	
Housing diameter	4⅜" (111 mm)	5⅛" (130 mm)	5⅛" (130 mm)	7¼" (183 mm)	7½" (190 mm)	11¾" (300 mm)	
Max differential pressure at 75°F (24°C)	125 psi (8.6 bar)	125 psi (8.6 bar)	125 psi (8.6 bar)	90 psi (6.2 bar)	125 psi (8.6 bar)	125 psi (8.6 bar)	
Max operating temperature	122°F (50°C)	122°F (50°C)	122°F (50°C)	100°F (37.8°C)	122°F (50°C)	122°F (50°C)	
Connections	½" BSP	¾" BSP	¾" BSP	1½" BSP	2" BSP	2" BSP	
Materials	Housing	Poly-propylene	Poly-propylene	Poly-propylene	Poly-propylene	AISI 316	AISI 316
	Caps	Reinforced poly-propylene	Reinforced poly-propylene	Reinforced poly-propylene	Reinforced poly-propylene	AISI 316	AISI 316
	O-ring	Buna-N	Buna-N	Buna-N	Buna-N	Buna-N	Buna-N
Accessories required				Filter adaptor (Code no. 180Z0080)			
Code number	180Z0281	180X5224	180Z0213	180Z0082	180N0242	180Z0010	

**Dimensions**

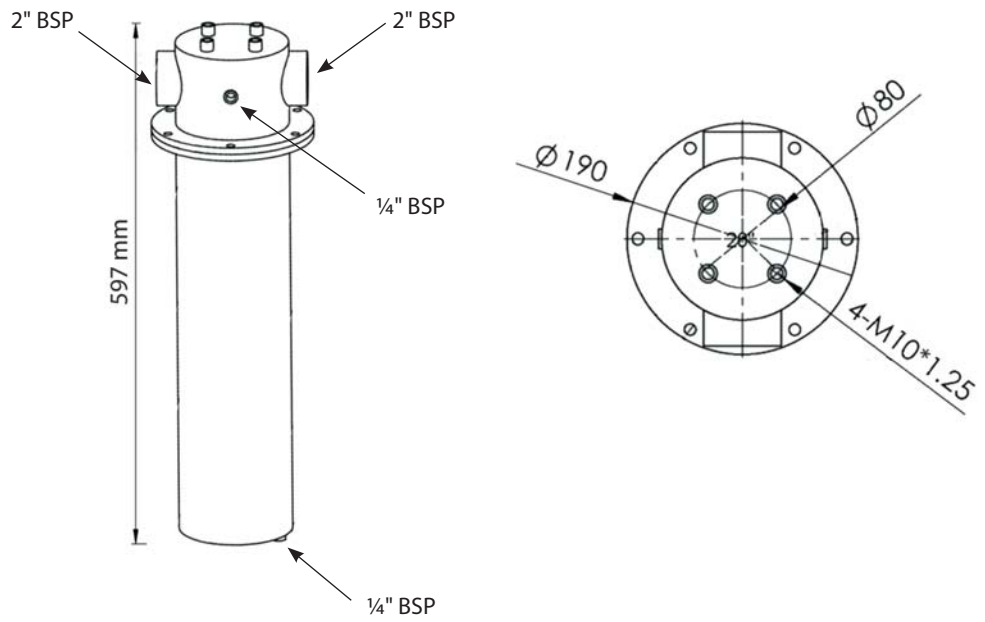


	5" blue	10" blue	20" blue	20" big blue
A	1⅝" (41 mm)	2¼" (57 mm)	2¼" (57 mm)	3" (76 mm)
B	4⅜" (111 mm)	5⅛" (130 mm)	5⅛" (130 mm)	7 ¼" (183 mm)
C	15/16" (33 mm)	2⅜" (60 mm)	2⅜" (60 mm)	3" (76 mm)
D	0,18" (Ø4,5)	0,23" (Ø5,8)	0,23" (Ø5,8)	0,28" (Ø7,2)
E	7" (128 mm)	12¼" (311 mm)	22¾" (568 mm)	23⅞" (606 mm)
F	½" BSP	¾" BSP	¾" BSP	1½" BSP

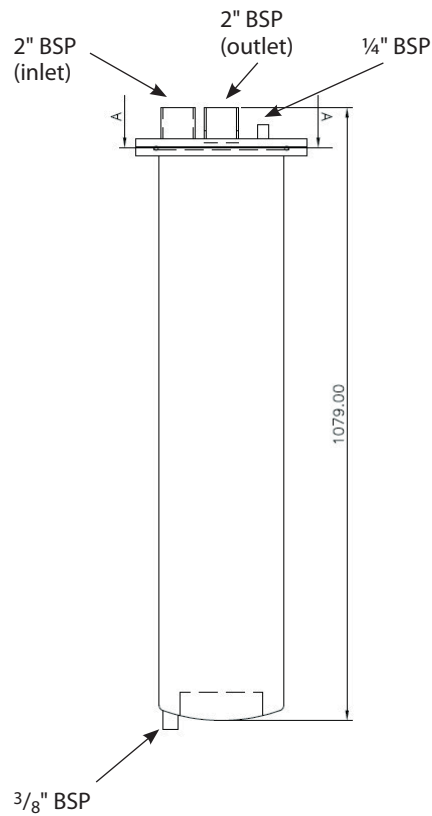


Dimensions (continued)

20" stainless housing



40" stainless housing



Adaptor (for 20" big blue housing)



**Cross reference table**

Element / Housing	180Z0037 (Type 1)	180X5225 (Type 2)	180Z0019 (Type 3)	180Z0006 (Type 4)	180Z0083 (Type 5)	180Z0011 (Type 6)
180Z0281 (5" blue housing)	X					
180X5224 (10" blue housing)		X				
180Z0213 (20" blue housing)			X	X		
180Z0082 (20" big blue housing) + 180Z0080 (filter adaptor required)					X	
180N0242 (20" stainless housing)					X	
180Z0010 (40" stainless housing)						X

**Pressure drop**

Element / Housing	Flow	15 l/min	30 l/min	60 l/min	150 l/min	300 l/min
180Z0037 (Type 1) / 180Z0281 (5" blue housing)		3.62 psi (0.250 bar)				
180X5225 (Type 2) / 180X5224 (10" blue housing)		1.52 psi (0.105 bar)	2.76 psi (0.190 bar)			
180Z0019 (Type 3) / 180Z0213 (20" blue housing)			1.81 psi (0.125 bar)	4.93 psi (0.340 bar)		
180Z0006 (Type 4) / 180Z0213 (20" blue housing)			1.81 psi (0.125 bar)	4.93 psi (0.340 bar)		
180Z0083 (Type 5) / 180Z0082 (20" big blue housing) + 180Z0080 (filter adaptor)				1.89 psi (0.130 bar)	5.66 psi (0.390 bar)	
180Z0083 (Type 5) / 180N0242 (20" stainless housing)				0.87 psi (0.060 bar)	2.32 psi (0.160 bar)	
180Z0011 (Type 6) / 180Z0010 (40" stainless housing)					1.74 psi (0.120 bar)	5.29 psi (0.365 bar)

**Note:**

- Filter elements and filter housings are ordered separately.
- Some filter elements can be used in combination with more than one filter housing.
- If the big blue 20" filter element (180Z0083) is used with the 20" big blue filter housing (180Z0082), it is vital that the filter adaptor (180Z0080) is ordered too.

**Right filter choice**

There are 2 factors to consider in order to choose the right filter:

- a) The flow through the filter
- b) Amount of dirt in the fluid

If the fluid is relatively clean, the filter choice can be based on the pump size as this will indicate the flow through the filter.

If the fluid is relatively dirty with small particles, a larger filter size should be chosen to increase

the dirt-holding capacity. For instance, for a flow of 150 l/min fluid containing many small dirt particles a filter for a flow up to 300 l/min should be chosen.

If the fluid is relatively dirty with larger particles, a cheaper and less efficient pre-filter should be placed in front of the main filter. This will ensure a long life of the more expensive main filter, as most of the larger dirt particles will be caught in the cheaper pre-filter.

**Pre-filtration (nominal filters)**

Danfoss offers two different pre-filtration solutions that can be used in addition to the main filters (and **not** instead of the main filters).

Polypropylene fibre string-wound design with poly core (90% efficiency) provides optimum sediment filtering capacity.

	Type A	Type B
Max flow (l/min)	30	85
Max flow (gpm)	7.9	22.5
Max flow (m <sup>3</sup> /h)	1.8	5.1
Filtration level	1 µ Nominal	3-layered filter - first layer is 25 µ nominal - second layer is 10 µ nominal - third layer is 3 µ nominal
Element length	20" (508 mm)	20" (508 mm)
Element outer diameter	2.5" (65 mm)	4.5" (115 mm)
Element inner diameter	1.02" (26 mm)	1.10" (28 mm)
Max differential pressure at 75°F (24°C)	50 psi (3.4 bar)	50 psi (3.4 bar)
Max operating temperature	122°F (50°C)	122°F (50°C)
Materials	Element	Polypropylene
	Core	Polypropylene
	Seal	Foam polyethylene
Code number	180N0174	180Z0081*
Housing	Element	180N0174
	180Z0213 (20" blue housing)	X
	180Z0082 (20" big blue housing)	X

Note:

- Pre-filter elements and filter housings are ordered separately.

\* 5 pcs in a box

**Right pre-filter choice**

The 3-layered pre-filter (180Z0081) is a better pre-filter but also more expensive.

If the flow demand is very low, a less expensive pre-filter (180N0174) is a good alternative.

**Appendix A:****Various chemicals**

The filters are compatible with the following process liquids and gases:

- Water
- Drinking water
- Mineral water
- Condensate
- Demineralised water
- Aqueous solutions (pH 3.9)
- Galvanic baths (pH 3.9)
- Galvanic baths (pH 3)
- Fluorobate baths
- Cyanide baths, alkaline
- Pyrophosphate baths
- Acids and alkalis (pH 0-14)
- Hydrochloric acid
- Sulphuric acid
- Nitric acid
- Pickling and phosphate baths
- Radioactive solutions
- Photochemical liquids
- Alkalis (inc conc)
- Hydraulic liquids
- Heating oil diesel, petrol
- Lubricating oils
- Sugar and glucose liquors
- Liquids (beverages)
- Air, non-corrosive gases

**Appendix B****Cartridge Filters & Ratings  
Nominal or Absolute**

Cartridge filters are widely used in industrial and domestic applications for removal of suspended solids in drinking water. The variety of cartridges available and the confusing methods of ratings, however, make selection of cartridges difficult for consumers. It becomes important for users, therefore, to understand cartridge filters, how they work, and how manufacturers rate them.

**Filtration**

Let us begin with filtration itself. Filtration - defined in its most basic sense - is a process of removing unwanted solids from fluids by passing the fluid through a form of sieving material that retains the solids, but allows the fluid to pass through. Filtration efficiency is, therefore, the percentage of solid retention by the sieve. It is this "sieve" that we refer to as the filter medium, or simply the filter. A contaminant is generally referred to as the material that is to be removed from the fluid, and the clean fluid is called the filtrate. In today's market, manufacturers use three types of ratings to evaluate filters: nominal rating, absolute rating and beta ratio.

**Nominal filter rating**

A nominal filter rating is an arbitrary value determined by the filter manufacturer, based upon removal of some percentage of all particles of a given size or larger.

- The rating is based on a weight percent (etc. 90%)
- The 10% that pass through are NOT defined by the manufacturer (normally much larger particles pass through).
- The rating is based on a weight analysis test.
- It is NOT possible to reproduce the filter.
- Particle unloading is rising when the  $\Delta P$  across the filter increases
- There is a high risk of channelling when a filter medium has some oversized pores or a wide pore-sized distribution.
- There is a high risk of bypass when cartridge-to-housing seal is ineffective.

**Absolute filter rating**

The absolute rating or cut-off point of a filter refers to the diameter of the largest hard spherical particle, normally expressed in micrometres ( $\mu\text{m}$ ), which will pass through the filter under specified test conditions.

- The filter is tested under a specific international well known test method (ISO MTD) according to the ISO 16889 standard.
- The rating is based on a particle measuring test.
- The filter is reproducible.
- Higher  $\Delta P$  does not result in particle unloading.
- The filter can withstand flow pulsations as well as viscosity and temperature changes.
- There is no risk of channelling due to the high quality of the filter media.

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