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Technical data sheet

Filter solutions for Danfoss PAH, APP and CLP pumps

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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 (µ) 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.

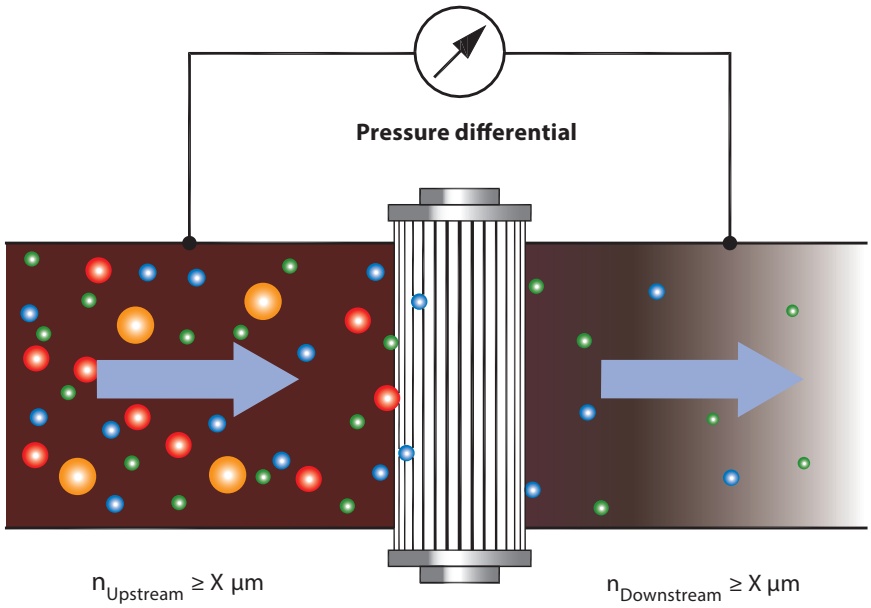
The following table shows the Beta value, the corresponding efficiency, and the number of particles that will pass through to the downstream side of the element for each 100,000 particles seen in the upstream side of the element.

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.

β-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
5,000	**99.98%**	**20**
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 (see appendix B)

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)

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 60 l/min fluid containing many small dirt particles a filter for a flow up to 170 l/min should be chosen.

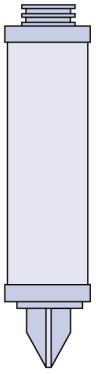
If the fluid is relatively dirty with larger particles, a cheaper and less efficient pre-filter should be placed in front of the main filter. This will ensure a long life of the more expensive main filter, as most of the larger dirt particles will be caught in the cheaper pre-filter.

Technical data / codenumbers (absolute filters)

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, 2, 3, 4 and 5
Single O-ring located inside element, other end flat closed



Type 6
Two O-rings located externally on element, other end with spear

Filter element		Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
Element length		127 mm (5″)	254 mm (10″)	508 mm (20″)	508 mm (20″)	508 mm (20″)	508 mm (20″)
Filtration level (Beta > 5000)		10 µ abs	10 µ abs	5 µ abs	10 µ abs	10 µ abs	10 µ abs
Max flow (l/min)		15	30	60	60	170	170
Max flow (m^3/h)		0.9	1.8	3.6	3.6	10.2	10.2
Max flow (gpm)		4	7.9	15.6	15.6	44.9	44.9
Element inner diameter		27 mm (1.06″)	27 mm (1.06″)	27 mm (1.06″)	27 mm (1.06″)	46 mm (1.8″)	46 mm (1.8″)
Element outer diameter		70 mm (2.75″)	70 mm (2.75″)	70 mm (2.75″)	70 mm (2.75″)	115 mm (4.5″)	102 mm (4″)
Effective surface		0.28 m^2 (3 sq.ft.)	0.55 m^2 (6 sq.ft.)	1.1 m^2 (12 sq.ft.)	1.1 m^2 (12 sq.ft.)	2.45 m^2 (26 sq.ft.)	1.8 m^2 (19 sq.ft.)
Max differential pressure at 24 °C (75 °F)		4 barg (58 psig)	4 barg (58 psig)	4 barg (58 psig)	4 barg (58 psig)	3.0 barg (43.5 psig)	3.0 barg (43.5 psig)
Max operating temperature		50 °C (122 °F)	50 °C (122 °F)	50 °C (122 °F)	50 °C (122 °F)	50 °C (122 °F)	50 °C (122 °F)
Materials	Element	Polypropylene	Polypropylene	Polypropylene	Polypropylene	Polypropylene	Polypropylene
	End caps	Polypropylene	Polypropylene	Polypropylene	Polypropylene	Polypropylene	Polypropylene
	Seals	Buna-N	Buna-N	Buna-N	Buna-N	Buna-N	Buna-N
Code number		180Z0037	180X5225	180Z0019	180Z0006	180Z0285	180Z0083

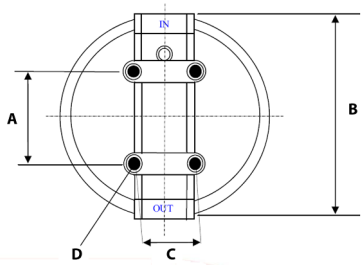
Replacement of filter elements

At a differential pressure of 2.0 barg (29 psig) the filter element has reached its dirt capacity.

Technical data / code numbers (housings)

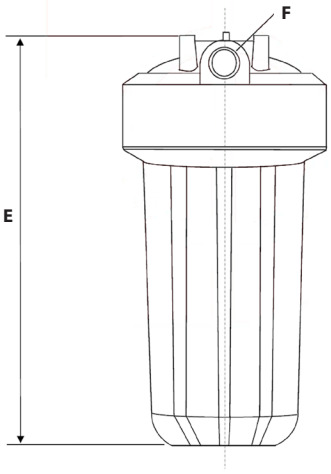
Housing		5" blue	10" blue	20" blue	20" big blue
Max flow (l/min)		15	30	60	170
Max flow (gpm)		4	7.9	15.6	44.9
Max flow (m^3/h)		0.9	1.8	3.6	10.2
Housing length		184 mm (7 ¼")	311 mm (12 ¼")	568 mm (22 ⅜")	600 mm (23 ⅝")
Housing diameter		115 mm (4 ½")	130 mm (5⅛")	130 mm (5⅛")	183 mm (7¼")
Max pressure at 45 °C (113 °F)		8.6 barg 125 (psig)	8.6 barg 125 (psig)	8.6 barg 125 (psig)	6.2 barg (90 psig)
Max operating temperature		45 °C (113 °F)	45 °C (113 °F)	45 °C (113 °F)	45 °C (113 °F)
Connections		½" BSP	¾" BSP	¾" BSP	1½" BSP
Materials	Housing	Polypropylene	Polypropylene	Polypropylene	Polypropylene
	Caps	Reinforced polypropylene	Reinforced polypropylene	Reinforced polypropylene	Reinforced polypropylene
	O-ring	Buna-N	Buna-N	Buna-N	Buna-N
Accessories recommended			Filter spanner (Code no. 180N0785)	Filter spanner (Code no. 180N0785)	Filter spanner (Code no. 180N1438)
Code number		180Z0281	180X5224	180Z0213	180Z0082

Dimensions




Filter spanner

	5" blue	10" blue	20" blue	20" big blue
A	39 mm (1 ½")	56 mm (2 ⅕")	56 mm (2 ⅕")	77 mm (3")
B	120 mm (4 ¾")	133 mm (5 ¼")	133 mm (5 ¼")	185 mm (7 ¼")
C	32 mm (1 ¼")	58 mm (2 ¼")	58 mm (2 ¼")	77 mm (3")
D	ø4,2 (11/64")	ø5,7 (15/64")	ø5,7 (15/64")	ø7,7 (5/16")
E	184 mm (7 ¼")	311 mm (12 ¼")	568 mm (22 ⅜")	600 mm (23 ⅝")
F	½" BSP	¾" BSP	¾" BSP	1½" BSP



Cross reference table

Element / Housing	180Z0037 (Type 1)	180X5225 (Type 2)	180Z0019 (Type 3)	180Z0006 (Type 4)	180Z0285 (Type 5)	180Z0083 (Type 6)
180Z0281 (5" blue housing)	X					
180X5224 (10" blue housing)		X				
180Z0213 (20" blue housing)			X	X		
180Z0082 (20" big blue housing)					X	

Pressure drop total Element + housing

Element / Housing \ Flow	15 l/min	30 l/min	60 l/min	150 l/min
180N1442+180N1443+180Z0037 (Type 1) 180Z0281 (5" blue housing)	0.250 barg (3.62 psig)			
180X5225 (Type 2) 180X5224 (10" blue housing)	0.105 barg (1.52 psig)	0.190 barg (2.76 psig)		
180Z0019 (Type 3) 180Z0213 (20" blue housing)		0.125 barg (1.81 psig)	0.340 barg (4.93 psig)	
180Z0006 (Type 4) 180Z0213 (20" blue housing)		0.125 barg (1.81 psig)	0.340 barg (4.93 psig)	
180Z0285 (Type 5) 180Z0082 (20" big blue housing)			0.130 barg (1.89 psig)	0.390 barg (5.66 psig)

Pre-filtration Technical data / code no. (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 melt blown 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^3/h)	1.8	5.1
Filtration level	3 µ Nominal Graded density structure	3 µ Nominal Graded density structure
Element length	508 mm (20″)	508 mm (20″)
Element outer diameter	64 mm (2.5″)	116 mm (4.5″)
Element inner diameter	26 mm (1.02″)	28 mm (1.10″)
Max differential pressure at 24 °C (75 °F)	3.4 barg (50 psig)	3.4 barg (50 psig)
Max operating temperature	50 °C (122 °F)	50 °C (122 °F)
Materials Element	Polypropylene	Polypropylene
Core	Polypropylene	Polypropylene
Seal	None	None
Code number	180Z0396	180Z0081

Housing \ Element	180Z0396	180Z0081
180Z0213 (20″ blue housing)	X	
180Z0082 (20″ big blue housing)		X

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

Right pre-filter choice

The 4.5″ pre-filter (180Z0081) with a large graded density structure is a better pre-filter but also more expensive.
If the flow demand is very low, a less expensive pre-filter (180Z0396) is a good alternative.

Type A

Type B

Replacement of filter element

At a different pressure of 1.5 barg (22 psig) the filter element has reached its dirt capacity

Appendix A:

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

Various chemicals

- Water
- Drinking water
- Mineral water
- Condensate
- Demineralised water
- Aqueous solutions (pH 3.9)
- Galvanic baths (pH 3.9)
- Galvanic baths (pH 3)
- Flourobate 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 ΔP 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 (µm), 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 ΔP 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.