

Data sheet

## Filter solutions for Danfoss high-pressure pumps and energy recovery devices





## 1. Introduction

### 1.1 Cartridge filters

Cartridge filters are widely used in industrial and domestic applications for removal of suspended solids in 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.

### 1.2 Filtration

Filtration 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.

### 1.3 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 typical based on a weight percent (etc. 60 -95%)
- The 5-40% 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.

### 1.4 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 ( $\mu m$ ), which will pass through the filter under specified test conditions.

- The filter is tested under a specific international well known test method (modified OSU-F2 single-pass filter test system).
- 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.
- 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  $\mu$  in length to pass the filter, as it only filters the fluid according to the diameter of the particles.

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

## 2. Requirements

### 2.1 Filtration requirement

To achieve warranty and assure the service intervals stated from Danfoss, the PAH, PAHT, APP pumps require water with no particles larger than 10 micron (10  $\mu$ ). Thus a 10  $\mu$  absolute filter with a Beta value > 5000 must be used.

- 10  $\mu$  means that particles of 10  $\mu$  or larger in size will be caught by the filter.

- 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  $\mu$  or larger. This means if there are 100,000 particles in the fluid (10  $\mu$  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.

$\beta$ -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

### 2.2 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.

### 2.3 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.

### 2.4 Applications

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

- General water filtration
- RO/DI water filtration
- We recommend CIP cycles in the range of 3-10 PH

### 2.5 Right filter choice

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

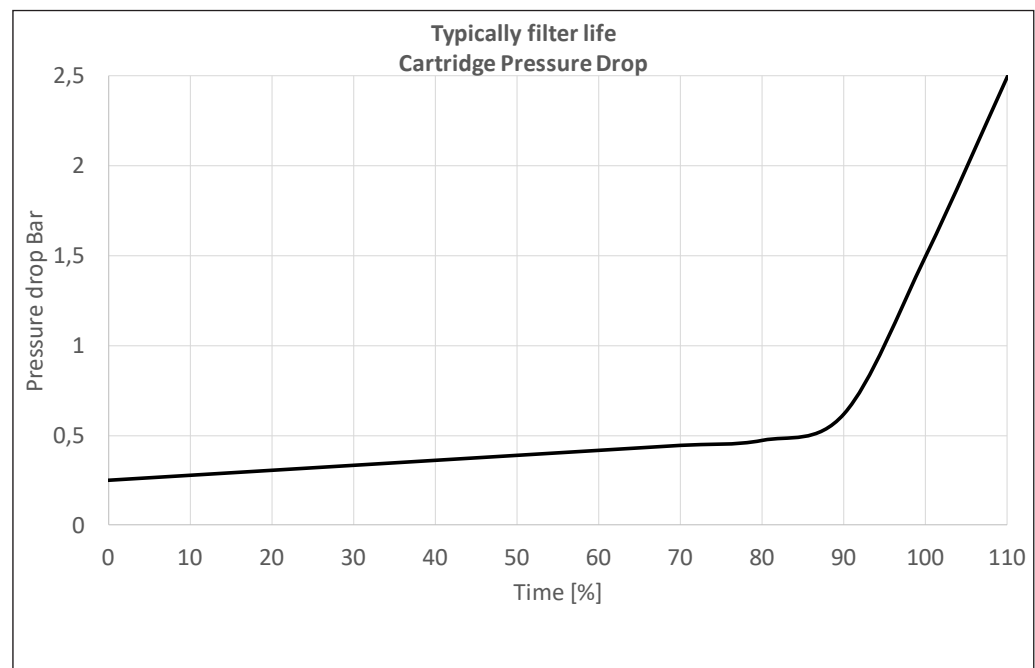
- a) The flow through the filter
- b) Amount of dirt in the fluid (E.g. SDI).

If the fluid is relatively clean (low SDI), 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 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.

The prefilter may be of the type "Nominal filter".



**3. Technical data**
**3.1 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, 5  
Single O-ring located inside element, other end flat closed



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



Type 7  
Two O-rings located externally on element

Filter element	Type 1	Type 2	Type 3	
Element length	127 mm (5")	254 mm (10")	508 mm (20")	
Filtration level (Beta > 5000)	10 µ abs	10 µ abs	5 µ abs	
Max flow (l/min)	15	30	60	
Max flow (m <sup>3</sup> /h)	0.9	1.8	3.6	
Max flow (gpm)	4	7.9	15.6	
Element inner diameter	27 mm (1.06")	27 mm (1.06")	27 mm (1.06")	
Element outer diameter	70 mm (2.75")	70 mm (2.75")	70 mm (2.75")	
Effective surface	0.28 m <sup>2</sup> (3 sq.ft.)	0.55 m <sup>2</sup> (6 sq.ft.)	1.1 m <sup>2</sup> (12 sq.ft.)	
Max differential pressure at 24 °C (75 °F)	4 barg (58 psig)	4 barg (58 psig)	4 barg (58 psig)	
Max operating temperature	50 °C (122 °F)	50 °C (122 °F)	50 °C (122 °F)	
Materials	Element	Polypropylene	Polypropylene	Polypropylene
	End caps	Polypropylene	Polypropylene	Polypropylene
	Seals	Buna-N	Buna-N	Buna-N
Net weight	0.21 kg (0.46 lb)	0.27 kg (0.6 lb)	0.47 kg (1.0 lb)	
Max. differential pressure before replacement of filter	2 barg (29 psig)	2 barg (29 psig)	2 barg (29 psig)	
Code number	180Z0037	180X5225	180Z0019	

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Filter element	Type 4	Type 5	Type 6	Type 7	
Element length	508 mm (20")	508 mm (20")	508 mm (20")	1020 mm (40")	
Filtration level (Beta > 5000)	10 µ abs	10 µ abs	10 µ abs	10 µ abs	
Max flow (l/min)	60	170	170	1000 <sup>1)</sup>	
Max flow (m <sup>3</sup> /h)	3.6	10.2	10.2	60 <sup>1)</sup>	
Max flow (gpm)	15.6	44.9	44.9	264 <sup>1)</sup>	
Element inner diameter	27 mm (1.06")	46 mm (1.8")	46 mm (1.8")	65 mm (2.56")	
Element outer diameter	70 mm (2.75")	115 mm (4.5")	102 mm (4")	153 mm (6")	
Effective surface	1.1 m <sup>2</sup> (12 sq.ft.)	2.45 m <sup>2</sup> (26 sq.ft.)	1.8 m <sup>2</sup> (19 sq. ft.)	10 m <sup>2</sup> (107.6 sq.ft.)	
Max differential pressure at 24 °C (75 °F)	4 barg (58 psig)	3 barg (43.5psig)	3 barg (43.5 psig)	4 barg (58 psig)	
Max operating temperature	50 °C (122 °F)	50 °C (122 °F)	50 °C (122 °F)	50 °C (122 °F)	
Materials	Element	Polypropylene	Polypropylene	Polypropylene	Polypropylene
	End caps	Polypropylene	Polypropylene	Polypropylene	Polypropylene
	Seals	Buna-N	Buna-N	Buna-N	Silicone
Net weight	0.48 kg (1.1 lb)	1.35 kg (3.0 lb)	0.97 kg (2.1 lb)	4.0 kg (8.8 lb)	
Max. differential pressure before replacement of filter	2 barg (29 psig)	2 barg (29 psig)	2 barg (29 psig)	1.5 barg (22 psig)	
Code number	180Z0006	180Z0285	180Z0083	180Z0653	

<sup>1)</sup> Recommended max. flow if the fluid is relatively clean and pre-filtered with a high quality filter, rated less than 5 µ and efficiency of min. 95%. If fluid is not relatively clean a max. flow of 36 m<sup>3</sup>/h is recommended.

### 3.2 Replacement of filter element

At max. differential pressure, the filter element has reached its dirt capacity.

**3.3 Housings**

Housing		5" Blue	10" Blue	20" Blue	20" Big blue	40" Red
Max flow (l/min)		15	30	60	170	1000
Max flow (m <sup>3</sup> /h)		0.9	1.8	3.6	10.2	60
Max. flow (gpm)		4	7.9	15.6	44.9	264
Housing length		184 mm (7.24")	311 mm (12.24")	568 mm (22.36")	600 mm (23.62")	1384 mm (54.48")
Housing diameter		115 mm (4.52")	130 mm (5.11")	130 mm (5.11")	183 mm (7.20")	270 mm (10.62")
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)	16 barg (232 psig)
Max operating temperature		45 °C (113 °F)	45 °C (113 °F)	45 °C (113 °F)	45 °C (113 °F)	60 °C (140 °F)
Connections	Vent					¼" BSP
	Inlet	½" BSP	¾" BSP	¾" BSP	1½" BSP	3" Vic. Cut groove
	Outlet	½" BSP	¾" BSP	¾" BSP	1½" BSP	3" Vic. Cut groove
	Drain					1" Vic. Cut groove
Volume						37 l.
Materials	Housing	Polypropylene	Polypropylene	Polypropylene	Polypropylene	GRP (Glass reinforced polypropylene)
	Caps	Reinforced polypropylene	Reinforced polypropylene	Reinforced polypropylene	Reinforced polypropylene	Polypropylene
	O-ring	Buna-N	Buna-N	Buna-N	Buna-N	Silicone PTFE
	Victaulic fittings					Acetal
Accessories recommended			Filter spanner (Code no. 180N0785)	Filter spanner (Code no. 180N0785)	Filter spanner (Code no. 180N1438)	For vertical mount: Legs for housing (180Z0652)
Net weight		0.7 kg (1.54 lb)	1.4 kg (3.1 lb)	2.1 kg (4.6 lb)	4.1 kg (9 lb)	46 kg (101 lb)
Code number		180Z0281	180X5224	180Z0213	180Z0082	180Z0651

**3.4 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).

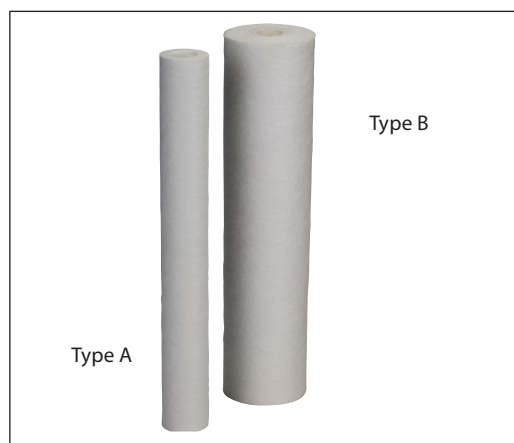
Polypropylene fibre melt blown design with poly core (90% efficiency) provides optimum sediment filtering capacity.

		Type A	Type B
Max flow (l/min)		30	85
Max flow (m <sup>3</sup> /h)		1.8	5.1
Max flow (gpm)		7.9	22.5
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

**3.5 Right pre-filter choice**

The 4.5" pre-filter (180Z0081) with a large graded density structure is a better pre-filter but more expensive.

If the flow demand is very low, a less expensive pre-filter (180Z0396) is a good alternative.


**3.6 Replacement of filter element**

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

**3.7 Cross reference tabel**

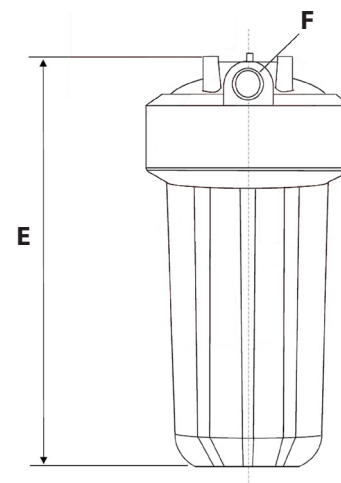
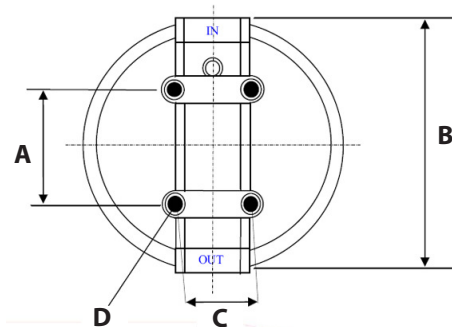
Housing \ Element	180Z0396	180Z0081
180Z0213 (20" blue housing)	X	
180Z0082 (20" big blue housing)		X

**NOTE**

Pre-filter elements and filter housings are ordered separately.

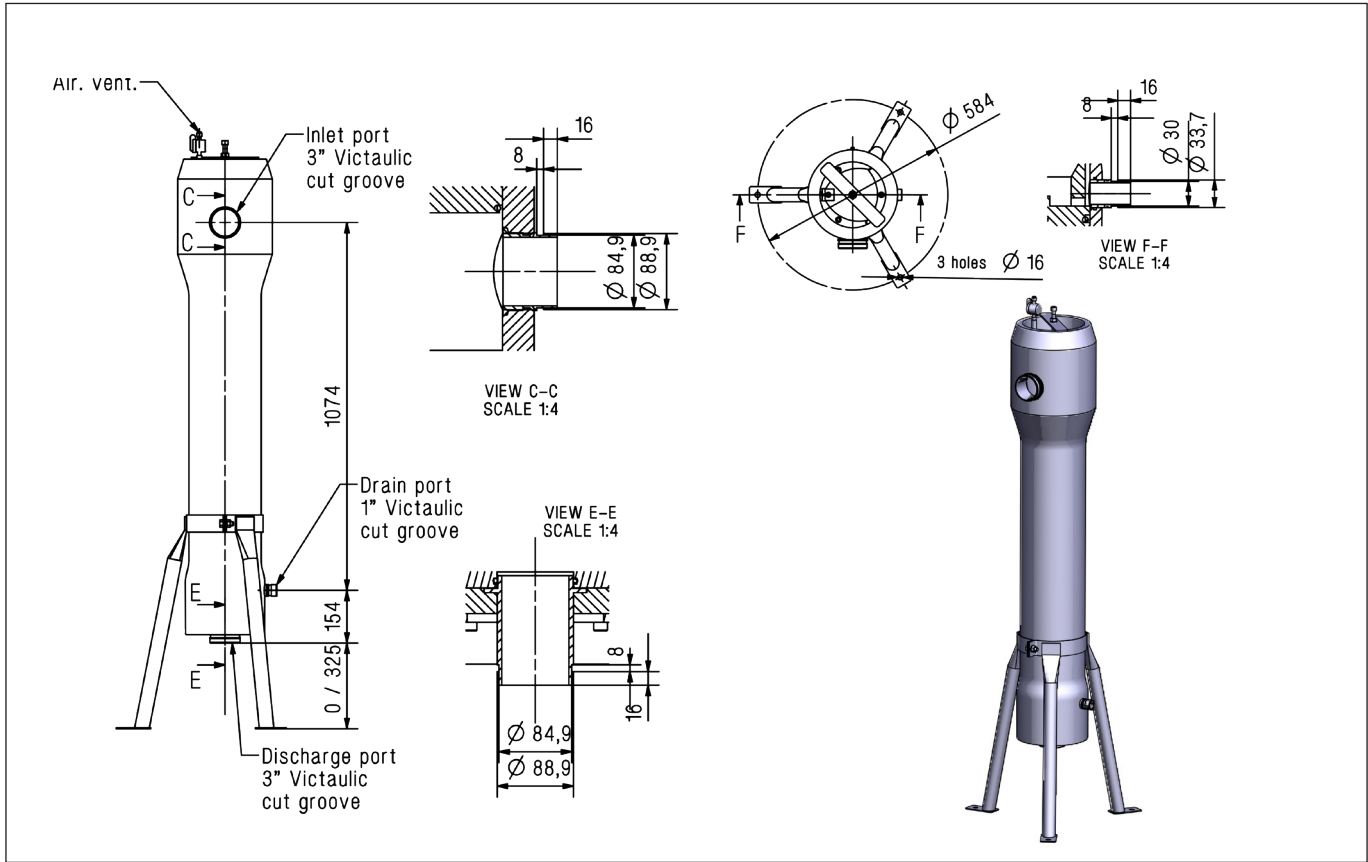


4. Dimensions

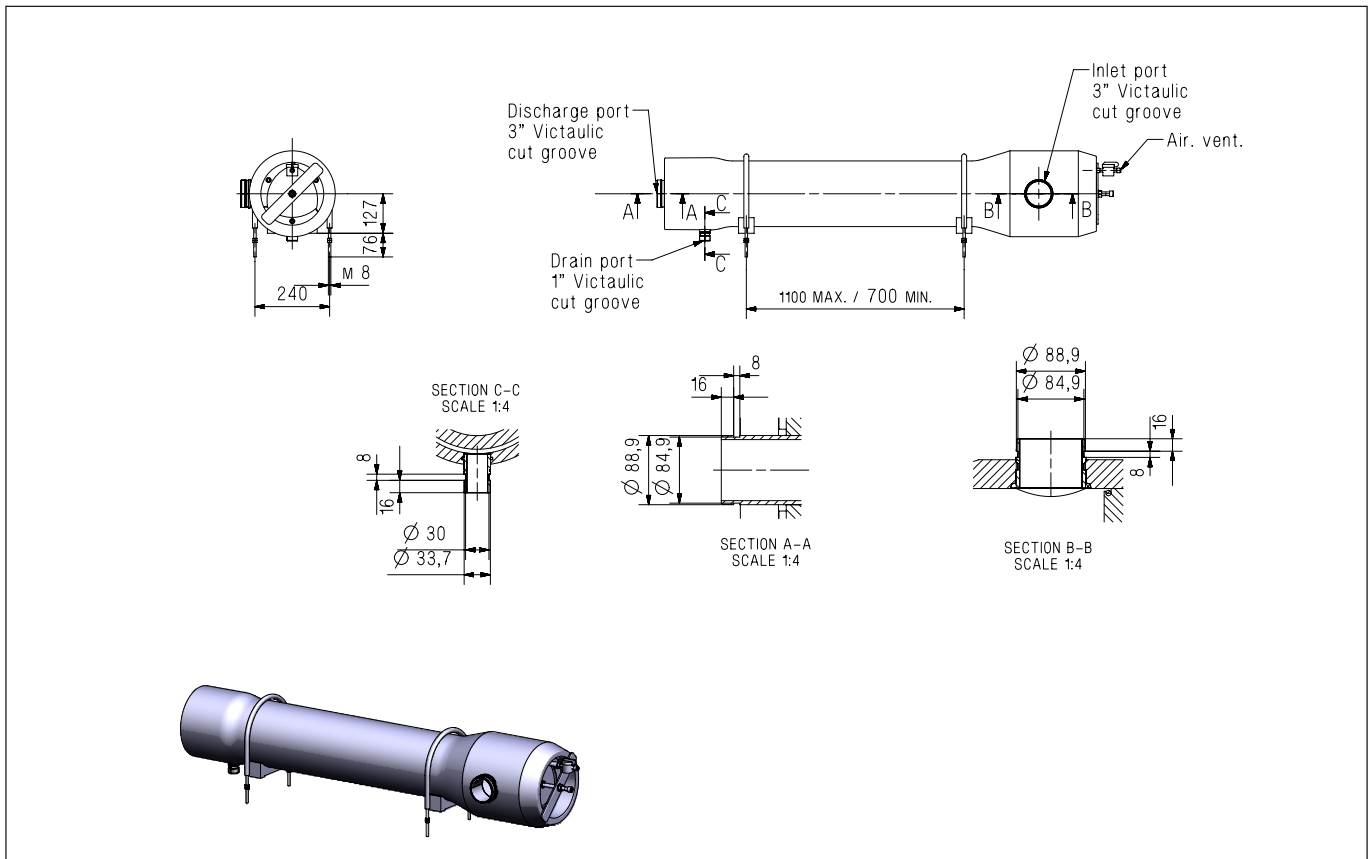


	5" Blue	10" Blue	20" Blue	20" Big blue
A	39 mm (1 1/2")	56 mm (2 1/5")	56 mm (2 1/5")	77 mm (3")
B	120 mm (4 3/4")	133 mm (5 1/4")	133 mm (5 1/4")	185 mm (7 1/4")
C	32 mm (1 1/4")	58 mm (2 1/4")	58 mm (2 1/4")	77 mm (3")
D	ø4,2 (11/64")	ø5,7 (15/64")	ø5,7 (15/64")	ø7,7 (5/16")
E	184 mm (7 1/4")	311 mm (12 1/4")	568 mm (22 3/8")	600 mm (23 5/8")
F	1/2" BSP	3/4" BSP	3/4" BSP	1 1/2" BSP
Code number	180Z0281	180X5224	180Z0213	180Z0082

4.1 Vertical mount



4.2 Horizontal mount



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### 5. Accessories



Filter spanner	5" Blue	10" Blue	20" Blue	20" Big blue
Code no.	180N1488	180N0785	180N0785	180N1438

### 6. Cross reference table

Element	180Z0037 (Type 1)	180X5225 (Type 2)	180Z0019 (Type 3)	180Z0006 (Type 4)	180Z0285 (Type 5)	180Z0083 (Type 6)	180Z0653 (Type 7)
Housing							
180Z0281 (5" blue housing)	X						
180X5224 (10" blue housing)		X					
180Z0213 (20" blue housing)			X	X			
180Z0082 (20" big blue housing)					X		
180Z0651 (40" red housing)							X

### 7. Pressure drop total Element + housing

Element / Housing	Flow	15 l/min	30 l/min	60 l/min	150 l/min	666 l/min	1000 l/min
180Z0037 (Type 1) 180Z0281 (5" blue housing)		0.250 barg (3.6 psig)					
180X5225 (Type 2) 180X5224 (10" blue housing)		0.105 barg (1.5 psig)	0.190 barg (2.8 psig)				
180Z0019 (Type 3) 180Z0213 (20" blue housing)			0.125 barg (1.8 psig)	0.340 barg (4.9 psig)			
180Z0006 (Type 4) 180Z0213 (20" blue housing)			0.125 barg (1.8 psig)	0.340 barg (4.9 psig)			
180Z0285 (Type 5) 180Z0082 (20" big blue housing)				0.130 barg (1.9 psig)	0.390 barg (5.7 psig)		
180Z0653 (Type 7) 180Z0651 (40" red housing)						0.128 barg (1.8 psig)	0.230 barg (3.6 psig)

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