Foreword

Filters are essential components in hydraulic systems as they perform a role of primary importance, **“Cleaning of the fluid”.** Hydraulic systems require filtration products in order to reduce and maintain particulate contamination in-line with the ISO 4406 cleanliness code.

Filters in the medium and high pressure series are designed and built to meet market demands for applications in high pressure hydraulic systems.
Studies conducted by our R&D department on filter housings and filter elements led to the development of a line of products offering excellent technical features including a reduction in pressure drops combined with high dirt holding capacity of the filter elements.

The choice of filter for a given application must take into account all the technical characteristics of the hydraulic system and its components in relation to the work to be performed.

Filter selection and sizing parameters

1. Application type
2. Type of filter(s)
3. Sensitivity of components: **to ISO 4406 class x/x/x**
4. Filtration efficiency: **µm βx (c) ≥ 1.000**
5. Fluid type: **HLP - HFC - HFD**
6. Kinematic viscosity: **mm^2/sec (cSt)**
7. Operating temperature: **min - max °C (°K)**
8. Working pressure: **bar (MPa)**
9. Effective flow rate: **l/min**
10. Maximum pressure drop: **Δp bar (MPa)**
11. Bypass valve: **with / without**
12. Clogging indicator: **pressure differential type Δp bar (MPa)**

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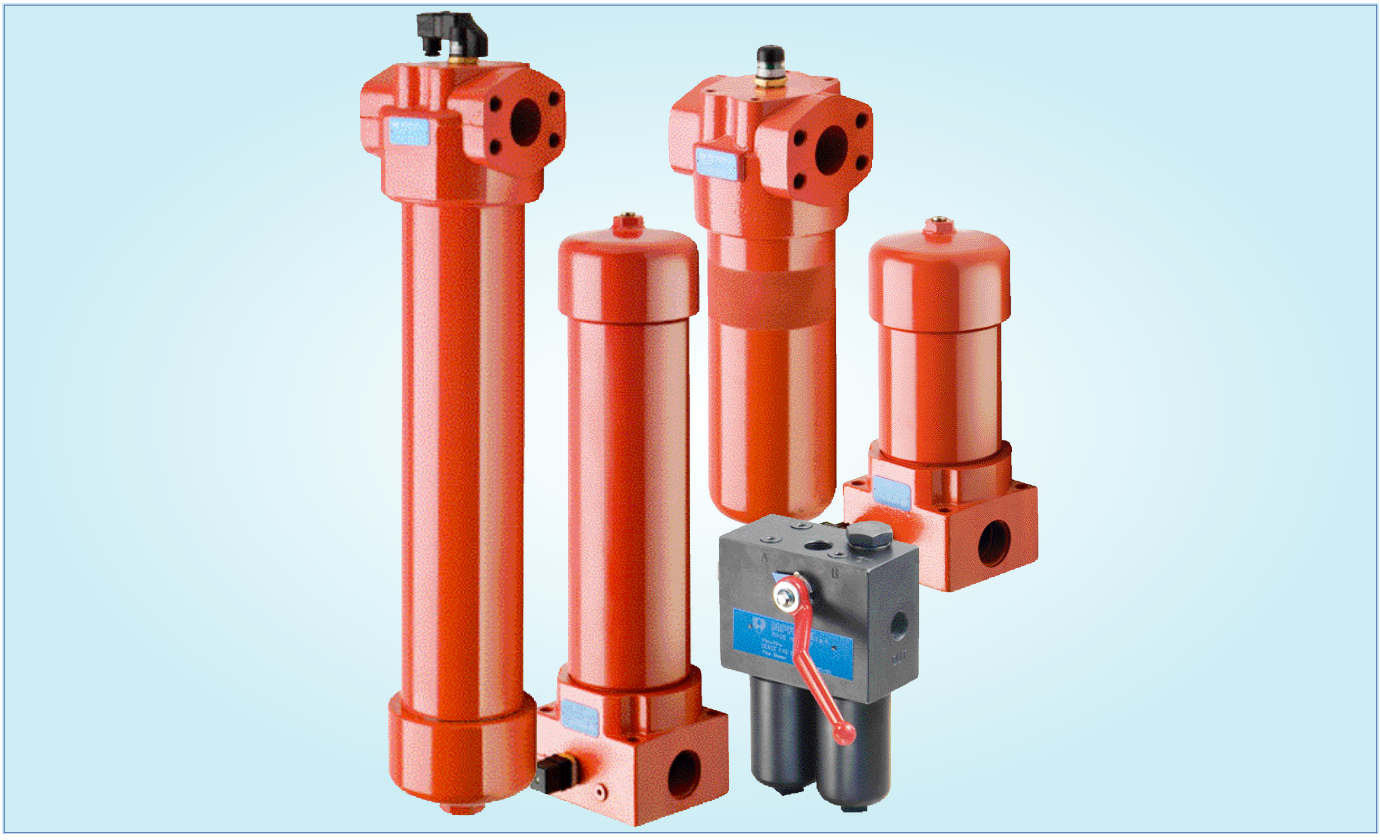


CONTENTS

FILTER TYPE

Introduction

Installation in open circuits with the following functions:

Working filter

Contamination control of the major components in-line with the ISO cleanliness level specified.

Safety filter

Individual component protection in order to avoid catastrophic failure of components.

Positioning

Down-stream from the pump

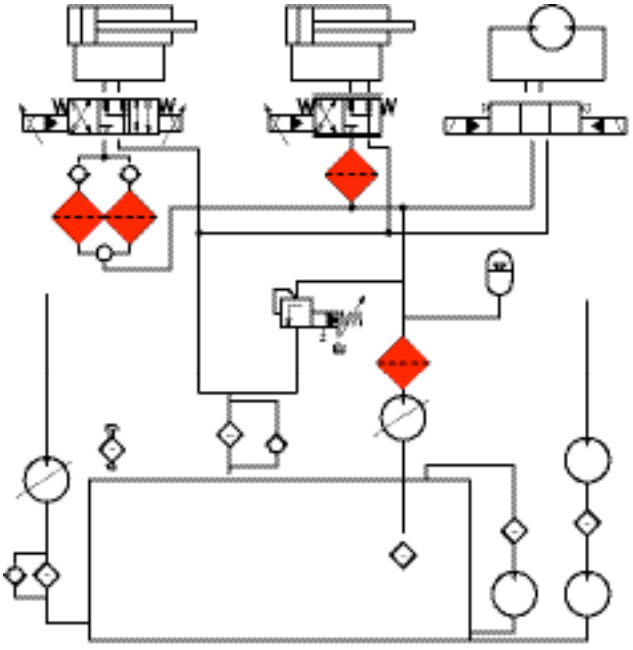
As a working filter for small size systems, with limited extension of the tube core.

Protection of the system as a safety filter.

Up-stream from the components

Protection of individual components as a safety or working filter, for large size systems with extensive use of flexible hoses.

On valve banks, blocks, at inlet and/or pilot line of servo valves with both a safety and working function, for large size systems and/or systems with high in sensitive components and in duplex style for systems with continuous operation.



Installations in closed circuits with the following functions:

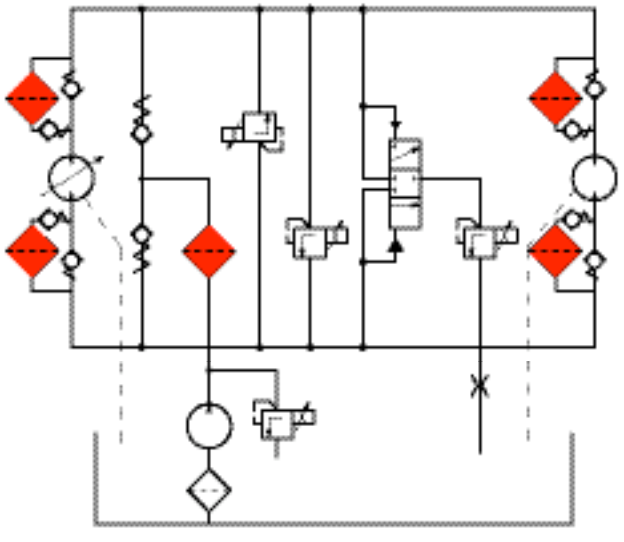
Service filter: on machines with flexible hoses connected with quick couplers.

Safety filter: protecting pump and motor for systems with large actuators.

Flushing: the filters are installed exclusively during the flushing phase.

Filters with Reverse Flow valves
Reversible filters for bi-directional filtration

Service filter: down-stream from the hydrostatic transmission boost pump.

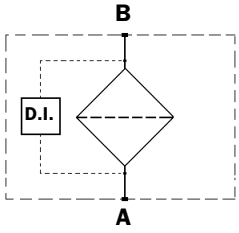


Hydraulic schematics

In-line filters for medium and high pressures can be equipped with internal valves to make them compatible with a large range of application conditions.

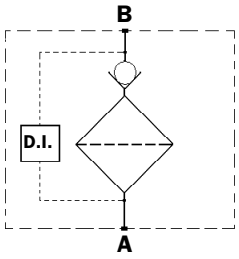
HYDRAULIC SCHEMATICS

Style **S**



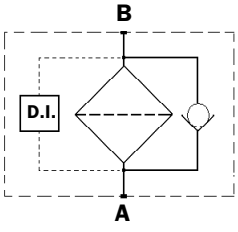
Filter without bypass valve, the entire flow must pass through the cartridge for maximum protection of the system in all operating conditions.

Style **T**



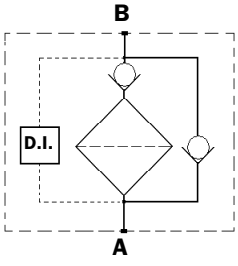
Filter without bypass valve + check valve, this style protects the cartridge from reverse flows and makes it possible to renew the cartridge without having to drain the oil from the pipelines or manifolds.

Style **B**



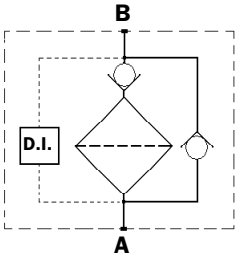
Filter with bypass valve, standard opening Δp 6 bar, filtration cannot be assured in all operating conditions. The flow that passes through the bypass valve is proportional to the differential pressure caused by clogging of the cartridge and variations in fluid viscosity related to temperature (see cold starts).

Style **D**



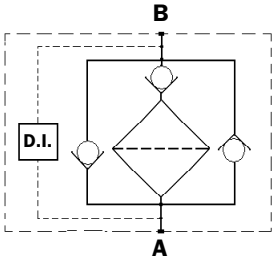
Filter with bypass valve + check valve.

Style **V**



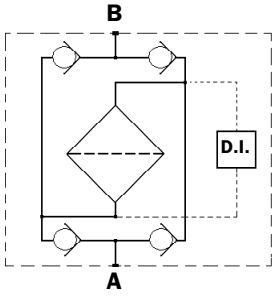
Filter with Reverse Flow valve, this style makes it possible to guarantee the oil flow inside the head in both directions. Filtration is performed in only one direction of flow.

Style **Z**



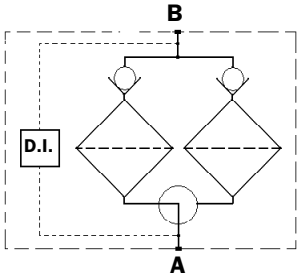
Filter with Reverse Flow valve + bypass valve.

Reversible filtration



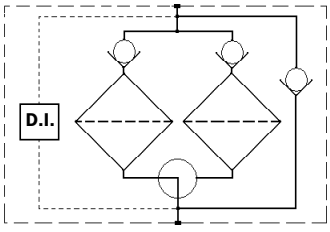
Filter with valve for reversible filtration, this style makes it possible to achieve fluid filtration in both directions of flow.

Style **S**

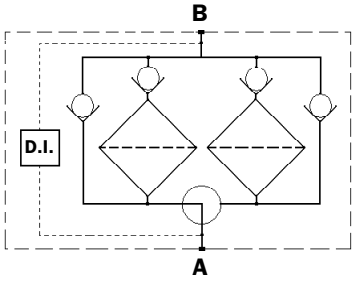


Double filter without bypass valve, the entire flow must pass through the cartridge for maximum protection of the system in all operating conditions.

Style **B**
Series FHD 051



Style **B**
Series FHD 325/332



Double filter with bypass valve, standard opening Δp 6 bar, filtration cannot be assured in all operating conditions, the flow that passes through the bypass valve is proportional to the differential pressure caused by clogging of the cartridge and variations in fluid viscosity related to temperature (see cold starts).

Description

The filter elements are available with surface and depth filtration media.

Surface media are made of stainless steel wire mesh, nominal filtration.

Depth filtration media are made of inorganic fibre impregnated with epoxy resins, absolute filtration.

Differential collapse pressure

Mesh M	Δp	20 bar	Series N
Mesh T	Δp	210 bar	Series H
Fibre A	Δp	20 bar	Series N
Fibre A	Δp	20 bar	Series R
Fibre A	Δp	210 bar	Series H
Fibre A	Δp	210 bar	Series S

Elements with Δp value of 20 bar are utilized in filters with bypass valves.

Elements with Δp value of 210 bar are utilized in filters without bypass valves.

The use of filter elements with Δp value of 20 bar is permitted in filters without bypass valves exclusively during the system start-up phase.

Elements types R and S must be utilized when the filters are equipped with Reverse Flow valves, with or without bypass valve.

Materials

Support tubes - steel with heat-chemical treatment.
Inner support tube - steel with heat-chemical treatment.

Compatibility with fluids, filter elements series N-R-H-S-T

- The filter elements are compatible with:
  Mineral oils to ISO 2943 - 4
  Aqueous emulsions
  Synthetic fluids, water glycol.
- Seals, standard in NBR compatible with:
  Mineral oils to ISO 2943 - 4
  Aqueous emulsions
  Synthetic fluids, water glycol.
- FPM seals compatible with:
  Synthetic fluids type HS-HFDR-HFDS-HFDU
  To ISO 6743-4.
  To ISO 2943

Composition of filtration media

Series: mesh N
Internal support mesh, stainless steel filtration mesh, external support mesh.

Series: fibre N
Internal support mesh, filter media support, filtration media, prefilter media, external support mesh.

Series: fibre R
Internal support mesh, filtration media support, filtration media, prefilter media, external support mesh, external support tube (stainless steel).

Series: fibre H
Stainless steel support tube, stainless steel internal support mesh, filtration media support, filtration media, prefilter media, external support mesh.

Series: fibre S
Stainless steel support tube, stainless steel internal support mesh, filtration media support, filtration media, prefilter media, external support mesh, stainless steel external support tube.

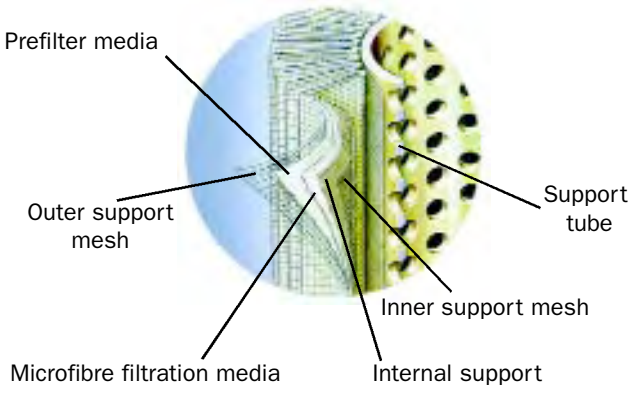
Series: mesh H
Stainless steel support tube, stainless steel internal support mesh, filtration media, stainless steel filtration mesh, external support mesh.

Reference standards

All filter elements comply with the following **ISO** standards

I S O	**2941**	- Collapse and burst resistance.
I S O	**2942**	- Bubble point test resistance.
I S O	**2943**	- Compatibility with fluids.
I S O	**3723**	- Resistance to axial deformation.
I S O	**3724**	- Fatigue test with flow.
I S O	**3968**	- Pressure drop.
I S O	**16889**	- Filtration efficiency by means of Multipass.

Inorganic microfibre



Multipass test in compliance with new ISO 16889 standard. Contaminant ISO MTD

Value β	2	10	75	100	200	1000
Filtration efficiency in %	50%	90%	98.70%	99%	99.50%	99.90%

Filter element	(µm ©)					
A03	<3	<3	<3	<3	3.30	4.2
A06	<3	<3	4.31	4.53	5.07	6.3
A10	<6	<6	6.12	6.41	7.12	9.0
A16	<7	<7	10.45	10.97	12.13	13.9
A25	<9	12.34	15.82	16.30	17.46	19.3

Multipass test
in compliance with original ISO 4572 standard.
Contaminant ACFTD

Value β	200
Filtration efficiency in %	99.50%

	µm
A03 3 µm	3
A06 6 µm	6
A10 10 µm	10
A16 16 µm	16
A25 25 µm	25

The above data are referred to a final Δp value of 16 bar

Characteristics of filter elements with nominal filtration, M / T series

For the square stainless steel wire mesh filtration degree is defined as the maximum diameter of a sphere corresponding to the mesh size, in microns.

International standards for fluid contamination control

Components	Recommended filtration								
Servo valves			●	●	●				
Proportional Valves				●	●	●			
Variable displacement Pumps					●	●	●		
Cartridge valves						●	●	●	
Piston pumps						●	●	●	
Vane pumps							●	●	●
Pressure / flow rate control valves							●	●	●
Solenoid valves							●	●	●
ISO code	12/10/7	13/11/8	14/12/9	15/13/10	16/14/11	17/15/12	18/16/13	19/17/14	20/18/15
NAS code	1	2	3	4	5	6	7	8	9
Absolute filtration recommended	3 micron				6 micron		10 micron		>10

Microfibre filter elements tested in collaboration with the following independent institutes.

Institute of Filtration (France)

I.F.T.S.

Kungl Tekniska Högskolan
Royal Institute of Technology

Filter sizing

Correct sizing of the filter, having in-line or manifold connections must be based on a total pressure drop of between 0.8 and 1.5 bar.
For styles with reverse flow valves, reversible flow, and duplex filters, the total pressure drop can be between 1.5 and 3 bar.

The pressure drop calculation is performed by adding together the value for the housing and the value for the filter element.

The pressure drop in the housing is proportional to the fluid density kg/dm^3. All the graphs in the catalogue are based on a mineral oil with density of 0.86 kg/dm^3.
The filter element pressure drop value is proportional to viscosity mm^2/s (cSt), the Y values in the catalogue are referred to viscosity of 30 mm^2/s (cSt).

Sizing

Δp Total
Δpc Filter body
Δpe Filter element
Y Multiplication factor (see pages 13 to 14)
Q l/min = flow rate
V1 = reference viscosity 30 mm^2/s (cSt)
V2 = operating viscosity in mm^2/s
Δp Tot. = Δpc + Δpe
Δpe = Y : 1000 x Q x (V2/V1)

Calculation example with HLP fluid
Variation in viscosity

Data:
Filter with in-line connections
Pressure = 380 bar
Flow rate = 150 l/min
Viscosity = 46 mm^2/s (cSt)
Density = 0.86 kg/dm^3
Filtration = 10 µ absolute
With bypass valve

Filter type - FHP 135 3 **(see bodies pressure drop graphs on page 54)**

Practical example

Q = 150 l/min
V_2 = 46 mm^2/s
Pmax = 380 bar
Filtration = 10 µ absolute
Δp Tot. max = **1.5 bar** (max. recommended value)
Filter element series N, Δp max 20 bar
Δpc = 0.657 bar (* see diagram)
Δpe = (3.38 : 1000) x 150 x (46/30) = 0.777 bar
Δp Tot. = 0.657 + 0.777 = 1.434 bar

Sized filter type:
FHP 135 3 S A G2 A10 N P01

Calculation examples with HFD fluid
Variations in viscosity and density

Data:
Filter with in-line connections
Pressure = 380 bar
Flow rate = 150 l/min
Viscosity = 46 mm^2/s (cSt)
Density = 1.1 kg/dm^3
Filtration = 10 µ absolute
With bypass valve

Filter type - FHP 135 3 **(see bodies pressure drop graphs on page 54)**

Practical example

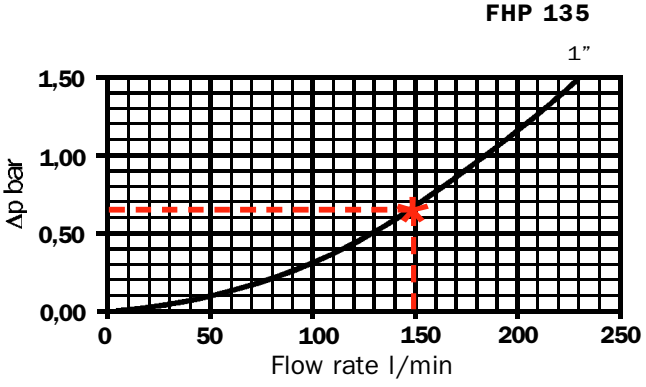
Q = 150 l/min
V_2 = 46 mm^2/s
Pmax = 380 bar
Filtration = 10 µ absolute
Δp Tot. max = **1.5 bar** (max. recommended value)
Filter element N series, Δp max 20 bar
Δpc = 0.657 x (1.1/0.86)= 0,84
Δpe = (3.38 : 1000) x 150 x (46/30) = 0.777 bar
Δp Tot. = 0,84 + 0.777 = 1,62 bar
Filter type:
FHP 135 3 S A G2 A10 N P01 (Δp max exceeded)

Switch to next size up **FHP 320...**

Pressure drops Δp Body

The curves are plotted using mineral oil with density of 0.86 kg/dm^3 to ISO 3968.

Δp varies proportional with density.



For Y values see next page:

Filter Element		Series N - R					Series N
		Filtration					
Type		A 0 3	A 0 6	A 1 0	A 1 6	A 2 5	M 2 5
HP 037	1	70,66	53,20	25,77	20,57	14,67	04,90
	2	26,57	23,27	12,46	09,88	05,58	02,20
	5	36,57	32,28	18,00	13,38	08,00	02,90
HP 050	1	31,75	33,00	13,16	12,33	07,29	01,60
	2	24,25	21,26	11,70	09,09	04,90	01,40
	3	17,37	16,25	08,90	07,18	03,63	01,25
	4	12,12	10,75	06,10	05,75	03,08	01,07
	5	07,00	06,56	03,60	03,10	02,25	00,80
HP 065	1	58,50	43,46	26,66	19,66	10,71	01,28
	2	42,60	25,64	17,66	13,88	07,32	01,11
	3	20,50	15,88	08,18	06,81	03,91	00,58
HP 135	1	20,33	18,80	09,71	08,66	04,78	02,78
	2	11,14	10,16	06,60	06,38	02,22	01,11
	3	06,48	06,33	03,38	03,16	02,14	01,01
HP 320	1	10,88	09,73	05,02	03,73	02,54	01,04
	2	04,40	03,83	01,75	01,48	00,88	00,71
	3	02,75	02,11	01,05	00,87	00,77	00,61
	4	02,12	01,77	00,98	00,78	00,55	00,47
HP 500	1	4,44	3,67	2,3	2,1	1,65	0,15
	2	3,37	2,77	1,775	1,68	1,24	0,10
	3	2,22	1,98	1,114	1,09	0,75	0,075
	4	1,81	1,33	0,93	0,86	0,68	0,050
	5	1,33	1,15	0,766	0,676	0,48	0,040

HP series filter elements

Multiplication factor "Y" for definition of the pressure drop of filter elements.

Reference viscosity 30 mm^2/s

Filter Element		Series N					Series N
		Filtration					
Type		A 0 3	A 0 6	A 1 0	A 1 6	A 2 5	M 2 5
HF 320	1	03,65	02,95	02,80	01,80	00,90	-
	2	02,03	01,73	01,61	01,35	00,85	-
	3	01,84	01,42	01,42	01,22	00,80	-

HF series filter elements

Multiplication factor "Y" for definition of the pressure drop of filter elements.

Reference viscosity 30 mm^2/s

Filter Element	Serie H - S					Serie H
	Filtration					
Type	A 0 3	A 0 6	A 1 0	A 1 6	A 2 5	T 10
HP 020 0	216,2	162,5	72,72	58,04	36,36	*
1	108,1	81,25	36,36	29,02	18,18	
HP 050 1	47,33	34,25	21,50	20,50	14,71	
2	29,10	25,95	14,04	10,90	05,88	
3	20,85	19,50	10,68	08,61	04,36	*
4	14,55	12,90	07,32	06,90	03,69	
5	09,86	09,34	06,40	04,80	02,50	
HP 065 1	62,28	58,56	26,66	21,66	12,42	
2	43,30	36,63	17,66	14,44	08,88	*
3	20,55	16,90	08,55	07,09	04,16	
HP 135 1	29,16	25,33	13,00	12,47	05,92	
2	14,28	11,04	07,86	07,60	04,44	*
3	08,96	07,46	04,89	04,16	03,07	
HP 320 1	13,00	12,19	06,80	06,40	03,32	
2	06,45	05,31	03,01	02,89	01,73	
3	04,13	03,14	01,90	01,78	01,17	*
4	03,17	02,71	01,80	01,70	01,10	
HP 500 1	9,7	8,81	4,55	4,47	2,8	
2	5,46	4,63	2,88	2,88	2,2	
3	3,9	3,74	2,22	2,07	1,53	*
4	03,10	02,48	01,56	01,53	01,02	
5	01,93	01,83	01,14	01,08	00,69	

HP series filter elements

Multiplication factor "Y" for determination of the pressure drop of filter elements.

Reference viscosity 30 mm^2/s

* "Y" values supplied on request

Filter Element	Serie H					Series N
	Filtration					
Type	A 0 3	A 0 6	A 1 0	A 1 6	A 2 5	T 10
HF 320 1	06,50	06,20	03,95	03,32	02,70	
2	03,17	02,87	02,23	02,02	01,65	*
3	02,60	02,40	01,64	01,62	01,42	

HF series filter elements

Multiplication factor "Y" for determination of the pressure drop of filter elements.

Reference viscosity 30 mm^2/s

* "Y" values supplied on request

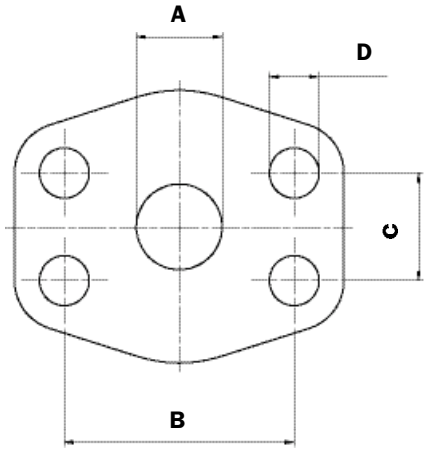
INDICATORS/CARTRIDGES Combination

Efficient operation and application safety are guaranteed when the filter components are selected correctly.
The correct style of cartridge and relative indicator pressure value for each filter layout can be selected using the following table.
H - S - T series cartridges (Δp 210 bar) can be replaced with N and R series cartridges (Δp 20 bar) during system flushing phases.

Filter layout (single)	Cartridge Series	Indicator Trip
S without bypass	**H** mesh cartridges **H** fibre cartridges **S** FHP 500 filters only	**7** bar
B with bypass	**N** mesh and fibre cartridges	**5** bar
T with check valve, without bypass valve	**H** mesh cartridges **H** fibre cartridges **S** FHP 500 filters only	**7** bar
D with check valve, with bypass valve	**N** mesh and fibre cartridges	**5** bar
V with Reverse Flow valves, without bypass valve	**S** fibre cartridge	**7** bar
Z with Reverse Flow valve, with bypass valve	**R** mesh and fibre cartridges	**5** bar
V with valve for reversible filtration	**S** mesh and fibre cartridges	**7** bar

Double filter layout	Cartridge Series	Indicator Trip in bar
B with bypass	**R** mesh and fibre cartridges	**5** bar
S without bypass	**H (only for FHD 020 series)**	**7 - 10** bar
	S mesh and fibre cartridges	**7 - 10** bar

Sizes / Connections to SAE flange



Connection to 3000 psi SAE flange

Size	3/4" SAE 3000 PSI **M**	3/4" SAE 3000 PSI **UNC**	1" SAE 3000 PSI **M**	1" SAE 3000 PSI **UNC**	1 1/4" SAE 3000 PSI **M**	1 1/4" SAE 3000 PSI **UNC**	1 1/2" SAE 3000 PSI **M**	1 1/2" SAE 3000 PSI **UNC**	2" SAE 3000 PSI **M**	2" SAE 3000 PSI **UNC**
A	19	19	25,5	25,5	32	32	38	38	51	51
B	47,63	47,63	52,37	52,37	58,72	58,72	69,85	69,85	77,77	77,77
C	22,23	22,23	26,19	26,19	30,18	30,18	35,71	35,71	42,88	42,88
D	M10	3/8" UNC	M10	3/8" UNC	M10	7/16" UNC	M12	1/2" UNC	M12	1/2" UNC

Connection to 6000 psi SAE flange

Size	3/4" SAE 6000 PSI **M**	3/4" SAE 6000 PSI **UNC**	1 1/4" SAE 6000 PSI **M**	1 1/4" SAE 6000 PSI **UNC**	1 1/2" SAE 6000 PSI **M**	1 1/2" SAE 6000 PSI **UNC**	2" SAE 6000 PSI **M**	2" SAE 6000 PSI **UNC**
A	19	19	32	32	38	38	51	51
B	50,80	50,80	66,68	66,68	79,38	79,38	96,82	96,82
C	23,80	23,80	31,75	31,75	36,50	36,50	44,45	44,45
D	M10	3/8" UNC	M14	1/2" UNC	M16	5/8" UNC	M20	3/4" UNC

SAE flange connections available on in-Line filters

Filter	SAE 3000 PSI					SAE 6000 PSI			
Type	**3/4"**	**1"**	**1 1/4"**	**1 1/2"**	**2"**	**3/4"**	**1 1/4"**	**1 1/2"**	**2"**
FMP 135	x								
FMP 320		x	x	x					
FHP 135	x					x			
FHP 320		x	x	x			x		
FHP 500				x	x			x	x
FHF 320								x	
FHD 332								x	