Filters are essential components in hydraulic systems since 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.

In-line filters in single and duplex designs are designed and built to meet market demands for applications in high pressure, Off-Line and in-line hydraulic systems.
Studies conducted by our R&D department on filter bodies 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 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 $\beta_{x\,(c)} \geq 1.000$**
5. Fluid type: **HLP - HFC - HFD others**
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. Differential indicator: **pressure differential type Δp bar (MPa)**

Head at top
In-line connection
Series **LMP400**
LMP900
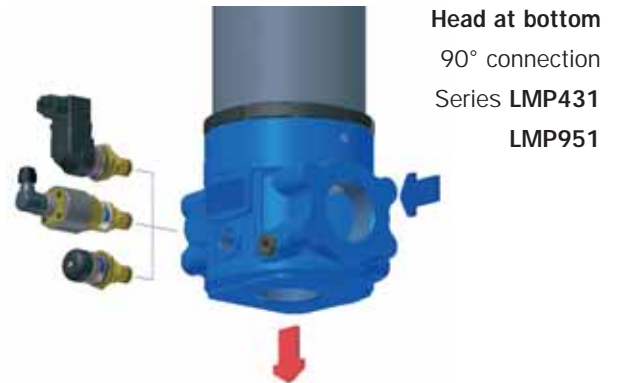
Head at top
90° connection
Series **LMP401**
LMP901

Head at bottom
In-line connection
Series **LMP430**
LMP950

Head at bottom
90° connection
Series **LMP431**
LMP951

Foreword

Installation in open circuits:

Positioning

Return filter mounted externally from the tank

For large size systems.
For flushing systems.

Off-line filter

For fluid power plants.
For test benches.

Over-boost filter

Positioning between the boost pump and piston
pump.
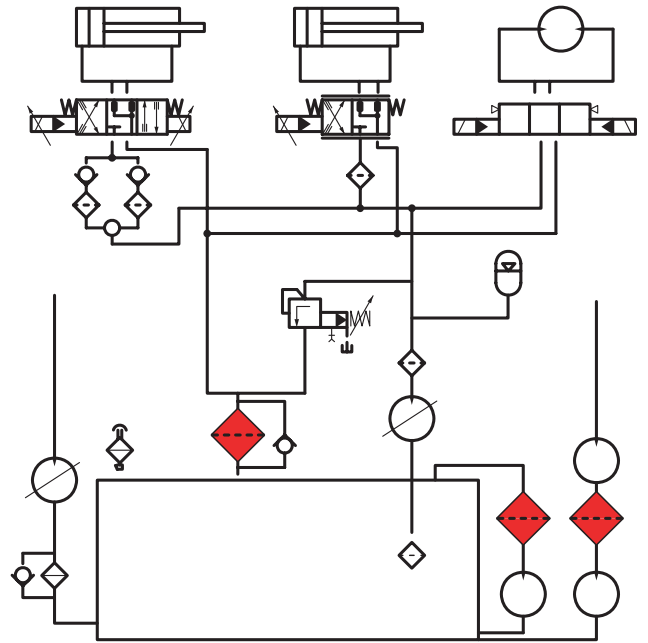
Installations in closed circuits with the following functions:

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

Installations in forced lubrication circuits:

In-line filter for low and medium pressures: protection of
individual components or actuator.

HYDRAULIC SCHEMATICS

Style **S**
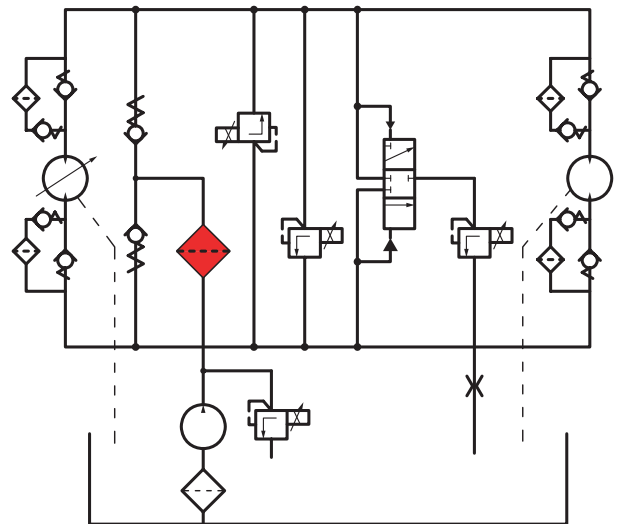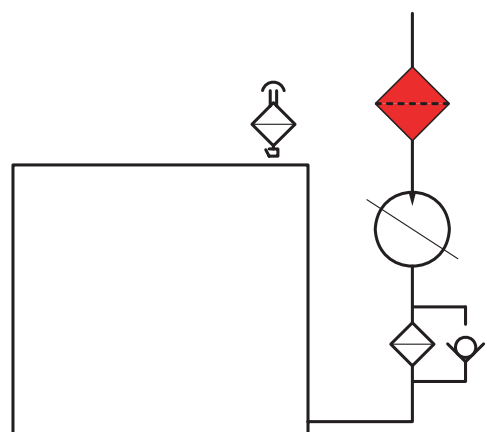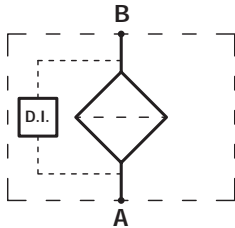

Filter without bypass valve, the entire flow must pass through the cartridge for maximum protection of the system in all operating conditions.

Style **B**
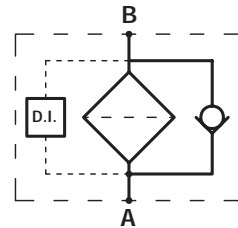
Filter with bypass valve, standard opening Δp 3.5 bar, filtration cannot be assured in all operating conditions. The flow that passes through the bypass valve is proportional to the differential pressure caused by clogging of the cartridge and variations in fluid viscosity related to temperature (see cold starts).

Manifold version
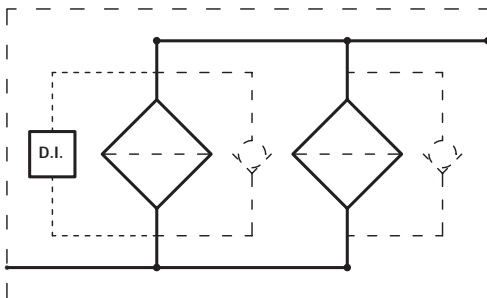
Filters with or without bypass valves, standard opening Δp 3.5 bar, mounted in parallel on 2 to 6 position multiple manifolds.
Single differential indicator required.

Duplex filter
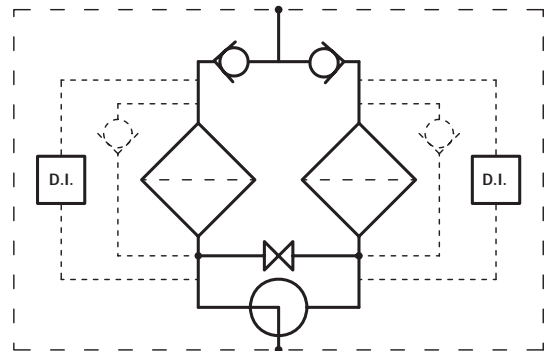
Duplex filter with or without bypass valve, standard opening Δp 3.5 bar.
Two differential clogging indicators required.
The filter is composed of a ball valve on the inlet connection, in 3-way execution layout "L" negative overlap, balancing connection between the two filters and double check valve on the outlet connection.

Filter elements

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	Serie N
Fibre A	Δp 20 bar	Serie N
Cellulose P	Δp 20 bar	Serie N
Mesh M	Δp 20 bar	Serie W
Fibre A	Δp 20 bar	Serie W

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

Compatibility with fluids and filter elements Series N

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

Compatibility with fluids and W series filter elements

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

N.B. P series cellulose cartridges are compatible only with mineral oils to ISO 2943 - 4.

Composition of filtration media

Series N-W: mesh M (style M25)
Internal support mesh, filtration mesh, external support mesh.

Series N-W: Fibre A
Internal support mesh, filter media support, filtration media, prefilter media, external support mesh.

Series N: Cellulose P
Internal support mesh, cellulose filtration media, 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

Prefilter media

Outer support mesh

Microfibre filtration media

Internal support

Inner support mesh

Support tube
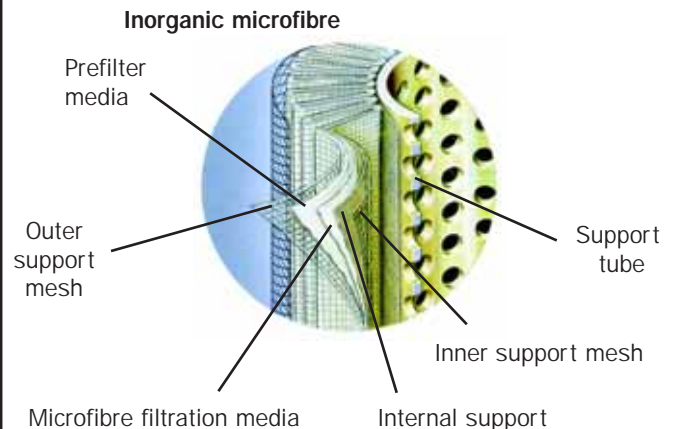
Multipass test in compliance with new ISO 16889 standard. Contaminant ISO MTD							Multipass test in compliance with original ISO 4572 standard. Contaminant ACFTD	
Value β	2	10	75	100	200	1000	Value β	200
Filtration efficiency in %	50%	90%	98.70%	99%	99.50%	99.90%	Filtration efficiency in %	99.50%
Filter element				(µm ©)				µm
A03	<3	<3	<3	<3	3.30	4.2	A03 3 µm	3
A06	<3	<3	4.31	4.53	5.07	6.3	A06 6 µm	6
A10	<6	<6	6.12	6.41	7.12	9.0	A10 10 µm	10
A16	<7	<7	10.45	10.97	12.13	13.9	A16 16 µm	16
A25	<9	12.34	15.82	16.30	17.46	19.3	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 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.

Characteristics of filter elements with nominal filtration, P series

For cellulose cartridges, filtration efficiency expressed in micron is to be construed as nominal $\beta_{X©}> 2$

International standards for fluid contamination control

Components	Recommended filtrations								
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.

VETENSKAP OCH KONST
KUNGL TEKNISKA HÖGSKOLAN
Royal Institute of Technology

Filter sizing

Correct sizing of the filter must be based on a variable pressure drop depending on the application:

- return filter Δp from 0.4 to 0.6 bar
- filter on lubrication lines Δp from 0.3 to 0.5 bar
- off-line fluid power plants Δp from 0.3 to 0.4 bar
- off-line filter test benches Δp from 0.1 to 0.3 bar
- over-boost filter Δp from 0.4 to 0.6 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 referred to mineral oil with density of $0.86\ kg/dm^3$.
The filter element pressure drop value is proportional to viscosity mm^2/s, the Y values in the catalogue are referred to viscosity of $30\ mm^2/s$.

## Number of working cartridges installed in LMP - LMD filters

LMP 210 1	1 cartridge	CU 210 1
LMP 210 2	1 cartridge	CU 210 2
LMP 210 3	1 cartridge	CU 210 3
LMP 400 2	1 cartridge	CU 400 2
LMP 400 3	1 cartridge	CU 400 3
LMP 400 4	1 cartridge	CU 400 4
LMP 400 5	1 cartridge	CU 400 5
LMP 400 6	1 cartridge	CU 400 6
LMD 400/401 4	1 cartridge	CU 400 4
LMD 431 5	1 cartridge	CU 400 5
LMD 431 6	1 cartridge	CU 400 6
LMP 900 1	1 cartridge	CU 900
LMP 900 2	2 cartridges	CU 900
LMP 902 2	4 cartridges	CU 900
LMP 903 2	6 cartridges	CU 900
LMP 950 2	1 cartridge	CU 950 2
LMP 950 3	1 cartridge	CU 950 3
LMP 952 3	2 cartridges	CU 950 3
LMP 953 3	3 cartridges	CU 950 3
LMP 954 3	4 cartridges	CU 950 3
LMP 955 3	5 cartridges	CU 950 3
LMP 956 3	6 cartridges	CU 950 3
LMD 951 3	1 cartridge	CU 950 3
LMD 952 3	2 cartridges	CU 950 3
LMD 953 3	3 cartridges	CU 950 3

Filter housing Δp pressure drop

The curves are plotted utilising mineral oil with density of $0.86\ kg/dm^3$ to ISO 3968.
Δp varies proportionally with density.

LMP 900 - 901
F1 - 3" - Δp housing
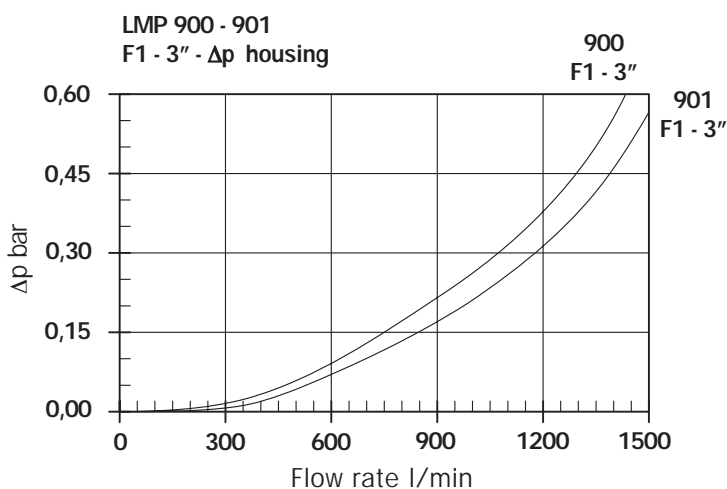
For Y values see next page:

Sizing data for single cartridge, head at top

Δp Tot.
Δpc Filter housing
Δpe Filter element
Y Multiplication factor (see page 11)
Q l/min = flow rate
V1 = reference viscosity 30 mm^2/s (cSt)
V2 = operating viscosity in mm^2/s (cSt)
Δp Tot. = Δpc + Δpe
Δpe = Y : 1000 x Q x (V2/V1)

Calculation example with HLP Mineral Oil Variation in viscosity

Data:
Filter with in-line connections
Pressure   = 15 bar
Flow rate   = 700 l/min
Viscosity   = 46 mm^2/s (cSt)
Density   = 0.86 kg/dm^3
Filtration   = 10 μ absolute
With bypass valve

Filter type - LMP 900 1 (see housings pressure drop graphs on page 52)

Practical example

Q	=	700 l/min
V_2	=	46 mm^2/s (cSt)
Pmax	=	15 bar
Filtration	=	10 μ absolute

Δp Tot. max   = **0.6 bar** (max. recommended value)
Filter element series N, Δp max 20 bar
Δpc = 0.13 bar (* see diagram)
Δpe = (0.3166 : 1000) x 700 x (46/30) = 0.34 bar
Δp Tot. = 0.13 + 0.34 = 0.47 bar

Sized filter type:
LMP 900 1 B A F1 A10 N P01

Calculation examples with HFD fluid Variations in viscosity and density

Data:
Filter with in-line connections
Pressure   = 15 bar
Flow rate   = 700 l/min
Viscosity   = 46 mm^2/s (cSt)
Density   = 1.1 kg/dm^3
Filtration   = 10 μ absolute
With bypass valve

Filter type - LMP 900 1 (see housings pressure drop graphs on page 52)

Practical example

Q	=	700 l/min
V_2	=	46 mm^2/s (cSt)
Pmax	=	15 bar
Filtration	=	10 μ absolute

Δp Tot. max   = **0.6 bar** (max. recommended value)
Filter element series N, Δp max 20 bar
Δpc = 0.13 x (1.1/0.86)= 0.17
Δpe = (0.3166 : 1000) x 700 x (46/30) = 0.34 bar
Δp Tot. = 0.17 + 0.34 = 0.51 bar
Filter type:
LMP 900 1 B V F1 A10 N P01

Data for sizing multicartridge filters with head at top

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

For multicartridge filter sizing, the value of flow rate "Q l/min" must be divided by the number of cartridges.

Calculation example with HLP Mineral Oil Variation in viscosity

Data:
Filter with in-line connections
Pressure   = 10 bar
Flow rate   = 1400 l/min
Viscosity   = 46 mm^2/s (cSt)
Density   = 0.86 kg/dm^3
Filtration   = 6 µ absolute
With bypass valve

Filter type - LMP 952 number of installed cartridges 2
(see housings pressure drop graphs on pages 78 to 79)

Practical example

Q   = 1400 l/min
V$_2$ = mm^2/s (cSt)
Pmax   = 10 bar
Filtration   = 6 µ absolute
Δp Tot. max = **0.6 bar** (max. recommended value)
Filter element series N, Δp max 20 bar
Δpc = 0.1 bar (* see diagram)
Δpe = (0.4 : 1000) x (1400/2) x (46/30) = 0.43 bar
Δp Tot. = 0.1 + 0.43 = 0.53 bar

Sized filter type:
LMP 952 B A F3 A06 N P01

Calculation examples with HFD fluid Variations in viscosity and density

Data:
Filter with in-line connections
Pressure = 10 bar
Flow rate = 1400 l/min
Viscosity = 46 mm^2/s (cSt)
Density   = 1.1 kg/dm^3
Filtration = 6 µ absolute
With bypass valve

Filter type - LMP 952
(see housings pressure drop graphs on pages 78 to 79)

Practical example

Q   = 1400 l/min
V$_2$ = mm^2/s (cSt)
Pmax   = 10 bar
Filtration   = 6 µ absolute
Δp Tot. max = **0.6 bar** (max. recommended value)
Filter element series N, Δp max 20 bar
Δpc = 0.1 x (1.1/0.86)= 0.127 bar
Δpe = (0.4 : 1000) x (1400/2) x (46/30) = 0.43 bar
Δp Tot. = 0.127 + 0.43 = 0.557 bar
Filter type:
LMP 952 B V F3 A06 N P01

Filter housing Δp pressure drop

The curves are plotted utilising mineral oil with density of 0.86 kg/dm^3 to ISO 3968. Δp varies proportionally with density.
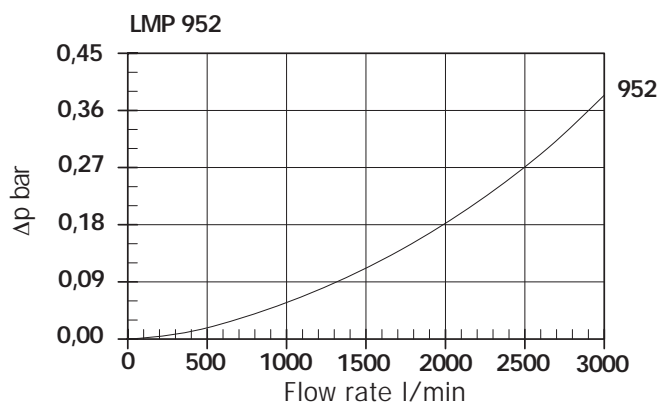
Multiplication factor "Y" for definition of the pressure drop of filter elements.

Reference viscosity 30 mm$^{2/s}$

| Filter Element	Filtration							
	Serie N - W						Serie N	
Type	A 0 3	A 0 6	A 1 0	A 1 6	A 2 5	M 2 5	P 1 0	P 2 5
CU 210 1	5,3	3,92	1,9	1,66	1,2	0,098	0,48	0,41
2	3	2,3	1,21	0,88	0,68	0,065	0,42	0,35
3	1,55	1,33	0,69	0,49	0,42	0,049	0,23	0,17
CU 400 2	3,133	2,550	1,457	1,225	0,780	0,192	0,750	0,640
3	2,150	1,700	0,940	0,781	0,500	0,102	0,400	0,340
4	1,600	1,285	0,709	0,615	0,400	0,084	0,340	0,270
5	1,000	0,833	0,475	0,340	0,200	0,057	0,240	0,190
6	0,822	0,580	0,300	0,267	0,175	0,053	0,220	0,177
CU 900 1	0,860	0,6333	0,3166	0,300	0,2142	0,050	-	-
CU 950 2	1,030	0,8	0,5875	0,4	0,2571	0,050	-	-
3	0,443	0,4	0,2625	0,1833	0,152	0,020		
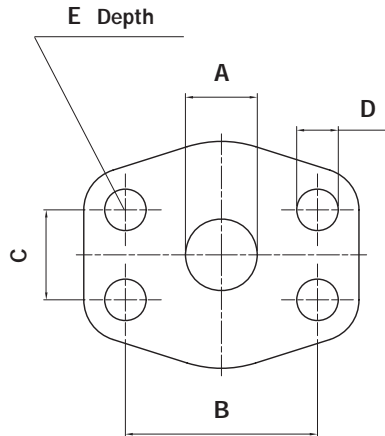
FLANGE SAE 3000 PSI

Connection to 3000 psi SAE flange

Dimension	2″ SAE 3000 PSI M	2″ SAE 3000 PSI UNC	2 1/2″ SAE 3000 PSI M	2 1/2″ SAE 3000 PSI UNC	3″ SAE 3000 PSI M	3″ SAE 3000 PSI UNC	4″ SAE 3000 PSI M	4″ SAE 3000 PSI UNC
A	51	51	63	63	73	73	99	99
B	77,77	77,77	88,90	88,90	106,38	106,38	130,18	130,18
C	42,88	42,88	50,80	50,80	61,93	61,93	77,77	77,77
D	M12	1/2″ UNC	M12	1/2″ UNC	M16	5/8″ UNC	M16	5/8″ UNC
E	20	20	20	20	25	25	25	25

FLANGE DIN PN 16
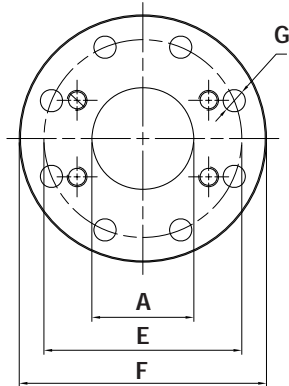
Connection Flange IN-OUT	DIN PN16 DN80	DIN PN16 DN100
A	73	99
E	160	180
F	200	220
G	18	18

SAE flange connections available on in-Line filters

Filter	SAE 3000 PSI				DIN PN16	
Type	2″	2 1/2″	3″	4″	DN80	DN100
LMP400/1	X	X				
LMP430/1	X	X				
LMD400/1/31		X				
LMP900/1			X	X		
LMP902/3				X		
LMP950/1			X	X		
LMP952/3/4/5/6				X		
LMD951/2/3			X	X	X	X