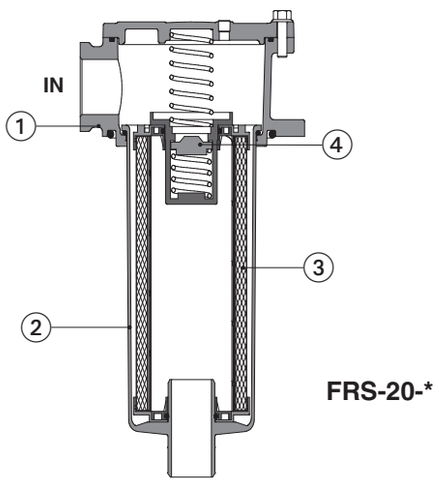
Table **LF050-2/E**

Return line filters, tank-top type FRS

Threaded ports



① Filter head
② Filter bowl
③ Filter element
④ By-pass valve

FRS

Return filters are designed to ensure cleanliness of fluid back to the tank from contamination collected downstream of the hydraulic circuit.

They are specific for installation on the top of the hydraulic tank.

- four head sizes
- threaded ports size from G1/2" to G2" or SAE-12 to SAE-32
- by-pass valve with cracking pressure 3 bar
- high efficency microfibre filter element with filtration rating 7 - 12 - 27 µm(c) (βx (c) >1000, ISO 16889)
- cellulose filter elements with filtration rating 10 or 25 µm (βx (c) >2, ISO 16889)
- without or with electrical or visual clogging indicators

Max flow **600 l/min**

Max working pressure **8 bar**

1 MODEL CODE OF COMPLETE FILTERS

FRS	-	10	-	A	-	F10	-	00	-	R	-	W	**	/	*

Return line filter

Filter size:
10 = ports size 1/2" ÷ 3/4"
20 = ports size 1/2" ÷ 1¼"
30 = ports size 1" ÷ 1½"
40 = ports size 1¼" ÷ 2"

Filter		Max flow [l/min] **(1)**			
lenght:		FRS-10	FRS-20	FRS-30	FRS-40
A	=	45	65	275	355
B	=	55	110	300	480
C	=	-	175	-	550
D	=	-	200	-	430 **(2) (3)**
E	=	-	-	-	600 **(2)**

SN = only body, without filter element

Microfibre filter element, βx(c) >1000 - ISO 16889:
F06 = 7 µm (c)
F10 = 12 µm (c)
F25 = 27 µm (c)

Cellulose filter element, βx (c) >2 - ISO 16889:
C10 = 10 µm (c)
C25 = 25 µm (c)

Series number

Seals material:
- = NBR
PE = FKM

Clogging indicator see sect. 12 :
W = without, indicator port plugged with steel plug
E = electrical indicator **(5)**
V = visual indicator **(5)**

By-pass:
R = by-pass valve with cracking pressure 3 bar

Ports size:
BSPP threaded:

FRS-10	FRS-20	FRS-30	FRS-40
00 = G 1/2"	**00** = G 1/2"	**02** = G 1"	**03** = G 1 1/4"
01 = G 3/4"	**01** = G 3/4"	**03** = G 1 1/4"	**04** = G 1 1/2"
	02 = G 1"	**04** = G 1 1/2"	**05** = G 2"
	03 = G 1 1/4"		

SAE J1926-1 threaded **(4)**:

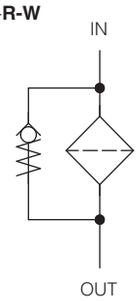
FRS-10	FRS-20	FRS-30	FRS-40
41 = SAE-12 (3/4")	**42** = SAE-16 (1")	**44** = SAE-24 (1 1/2")	**45** = SAE-32 (2")

Note: filters for use in potentially explosive atmosphere are available on request, contact Atos Technical Office

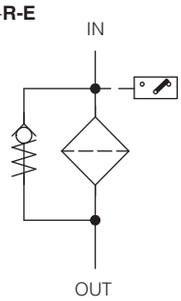
(1) Max flow rates are measured with: Δp 0,5 bar, filter element F25, largest port size, oil viscosity 32 mm²/s - see also section 6
In case of different conditions see section 9 for filter sizing
(2) Available only for FRS-40 series 11, on request
(3) Filters type FRS-40-D is similar to FRS-40-B but it uses filter elements with smaller internal diameter
(4) Filters with SAE threaded ports are available on request
(5) The clogging indicator is supplied disassembled from the filter. The indicator port on filter head is plugged with steel plug

2 HYDRAULIC SYMBOLS (representation according to ISO 1219-1)

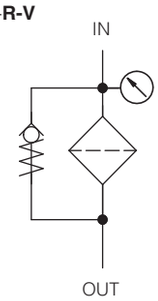
FRS-*-**R-W**



FRS-*-**R-E**



FRS-*-**R-V**



3 MODEL CODE OF FILTER ELEMENTS - only for spare **(1)**

PRS	-	**10**	-	**A**	-	**F10**		**	/	*

Spare filter element for return line filter type FRS

Filter element size:
10 = for FRS-10
20 = for FRS-20
30 = for FRS-30
40 = for FRS-40

Series number

Seals material:
- = NBR
PE = FKM **(2)**

Microfibre filter element, βx(c) >1000 - ISO 16889:
F06 = 7 µm (c)
F10 = 12 µm (c)
F25 = 27 µm (c)

Cellulose filter element, βx (c) >2 - ISO 16889:
C10 = 10 µm
C25 = 25 µm

Filter element lenght:

for FRS-10	for FRS-20	for FRS-30	for FRS-40
A	**A**	**A**	**A**
B	**B**	**B**	**B**
	C		**C**
	D		**D**
			E

(1) Select the filter element according to the model code reported on the filter nameplate, see section 14.1
(2) Filters with FKM seals are available on request
note: the spare filter element includes the by-pass valve

4 MODEL CODE OF CLOGGING INDICATORS - only for spare - see section 13 and 14

CIA	-	**V**		**

Clogging indicator for return line filter type FRS

Type of indicator:
E = Electrical - pressure switch, switching pressure 2 bar
V = Visual - pressure gauge, range 0 ÷ 10 bar **(1)**

Series number

(1) Visual clogging indicator with rear side connection **CIA-V/P** available on request

5 GENERAL CHARACTERISTICS

Assembly position / location		Vertical position with the bowl downward
Ambient temperature range		**Standard** = -20°C ÷ +70°C **/PE** option = -20°C ÷ +70°C
Storage temperature range		**Standard** = -20°C ÷ +80°C **/PE** option = -20°C ÷ +80°C
Materials	Filter head	Alluminium alloy
	Filter bowl	Nylon PA6 reinforced (FRS-10, FRS-20, FRS-30)
		Steel (FRS-40 series 10), nylon PA6 reinforced (FRS-40 series 11)
Compliance		RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006

6 HYDRAULICS CHARACTERISTICS

FRS-10, FRS-20

Filter size		10			20				
Port size code		**00**	**01**	**41**	**00**	**01**	**02**	**42**	**03**
Ports dimension		G1/2"	G3/4"	SAE 12	G1/2"	G3/4"	G1"	SAE 16	G1 1/4"
Filter lenght		A ÷ B			A ÷ D				
Max flow at Δp 0,5 bar (l/min) -see note-	**F06**	13÷17	13÷17		30÷90	31÷95	31÷122		32÷123
	F10	24÷42	25÷44		40÷110	43÷118	44÷176		45÷180
	F25	40÷50	45÷55		56÷114	61÷127	65÷200		70÷210
	C10	70÷87	76÷97		75÷130	90÷146	92÷263		113÷277
	C25	75÷94	82÷105		85÷140	115÷163	118÷300		168÷300
Max operating pressure		8 bar							
Direction of filtration		See the arrow on the filter head							

FRS-30, FRS-40

Filter size		30				40			
Port size code		**02**	**03**	**04**	**44**	**03**	**04**	**05**	**45**
Ports dimension		G1"	G1 1/4"	G1 1/2"	SAE 24	G1 1/4"	G1 1/2"	G2"	SAE 32
Filter lenght		A ÷ B				A ÷ E			
Max flow at Δp 0,5 bar (l/min) -see note-	**F06**	150÷165	162÷172	166÷176		187÷430	191÷480	194÷500	
	F10	210÷240	230÷256	238÷266		283÷540	295÷600	303÷600	
	F25	240÷270	271÷293	275÷300		336÷585	354÷600 **(1)**	355÷600 **(1)**	
	C10	270÷290	311÷315	326÷330		365÷600 **(1)**	387÷600 **(1)**	400÷600 **(1)**	
	C25	330÷355	380÷390	400÷409		473÷600 **(1)**	514÷600 **(1)**	536÷600 **(1)**	
Max operating pressure		8 bar							
Direction of filtration		See the arrow on the filter head							

Note: Max flow rates are measured with min and max filter lenght. In case of different conditions see section 11
(1) Max flow limited by the max flow speed allowed in connecting pipes.

7 FILTER ELEMENTS

Material		Inorganic microfibre	Cellulose
Filtation rating as per ISO16889	**F06**	$\beta_{06\mu m\,(c)} \geq 1000$	-
	F10	$\beta_{12\mu m\,(c)} \geq 1000$	-
	F25	$\beta_{27\mu m\,(c)} \geq 1000$	-
	C10	-	$\beta_{10\mu m\,(c)} \geq 2$
	C25	-	$\beta_{25\mu m\,(c)} \geq 2$

8 SEALS AND HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -25°C ÷ +100°C, with HFC hydraulic fluids = +10°C ÷ +50°C FKM seals (/PE option) = -25°C ÷ +100°C		
Recommended viscosity	15 ÷ 100 mm²/s - max allowed range 2.8 ÷ 500 mm²/s		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR	HFC	

9 FILTERS SIZING

For the filter sizing it is necessary to consider the Total Δp at the maximum flow at which the filter must work.
The Total Δp is given by the sum of filter head Δp plus plus filter bowl Δp plus the filter element Δp:

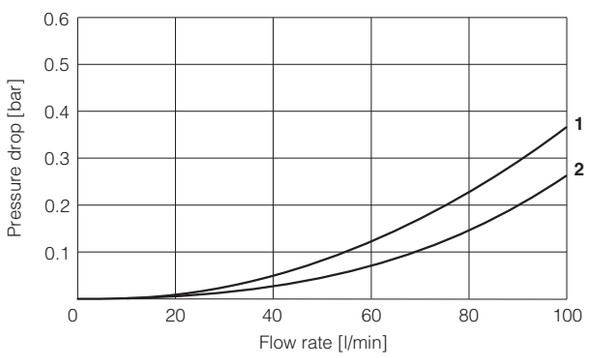
Total Δp = filter head Δp + filter bowl Δp + filter element Δp

In the best conditions the total Δp should not exceed 0,5 bar
See below sections to calculate the Δp of filter head and Δp of the filter element

9.1 Q/Δp DIAGRAMS OF FILTER HEAD + FILTER BOWL

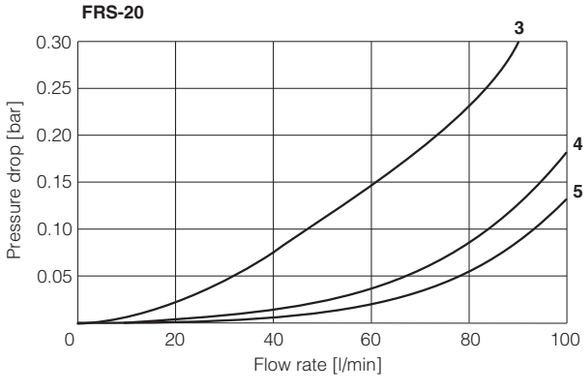
The pressure drop mainly depends on the ports size and fluid density
In the following diagrams are reported the Δp characteristics based on mineral oil with density 0,86 kg/dm³ and viscosity 32 mm²/s

FRS-10



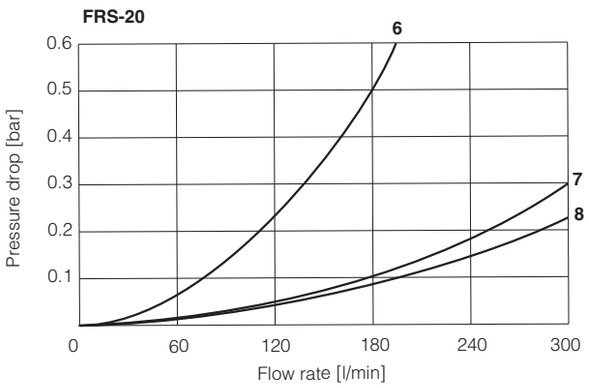
1 = FRS-10-*-00 (G 1/2")
2 = FRS-10-*-01 (G 3/4")
FRS-10-*-41 (SAE-12)

FRS-20



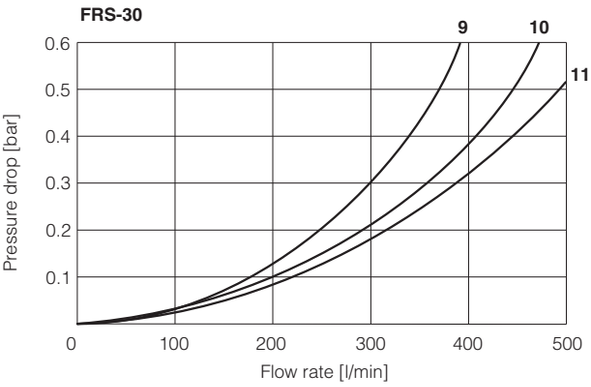
3 = FRS-20-*-00 (G 1/2")
4 = FRS-20-A-01 (G 3/4")
FRS-20-B-01 (G 3/4")
5 = FRS-20-A-02 (G 1")
FRS-20-B-02 (G 1")
FRS-20-A-42 (SAE-16)
FRS-20-B-42 (SAE-16)

FRS-20



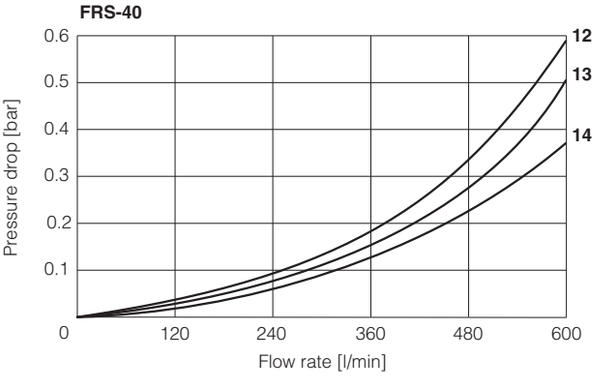
6 = FRS-20-C-01 (G 3/4")
FRS-20-D-01 (G 3/4")
8 = FRS-20-*-03 (G 1 1/4")
7 = FRS-20-C-02 (G 1")
FRS-20-D-02 (G 1")
FRS-20-C-42 (SAE-16)
FRS-20-D-42 (SAE-16)

FRS-30



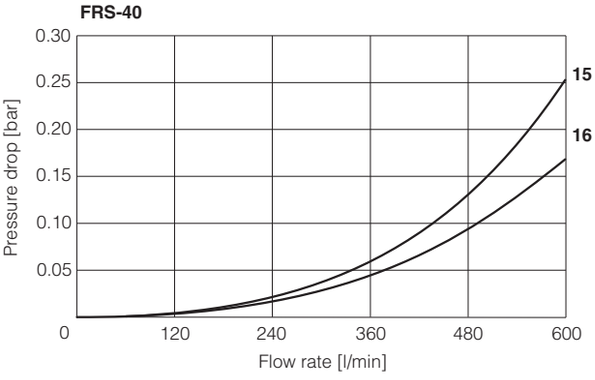
9 = FRS-30-*-02 (G 1")
10 = FRS-30-*-03 (G 1 1/4")
11 = FRS-30-*-04 (G 1 1/2")
FRS-30-*-44 (SAE-24)

FRS-40



12 = FRS-40-A-03 (G 1 1/4")
FRS-40-D-03 (G 1 1/4")
13 = FRS-40-A-04 (G 1 1/2")
FRS-40-D-04 (G 1 1/2")
14 = FRS-40-A-05 (G 2")
FRS-40-D-45 (G 2")
FRS-40-A-45 (SAE-32)
FRS-40-D-45 (SAE-32)

FRS-40



15 = FRS-40-B-04 (G 1 1/2")
FRS-40-C-04 (G 1 1/2")
FRS-40-E-04 (G 1 1/2")
16 = FRS-40-B-05 (G 2")
FRS-40-C-05 (G 2")
FRS-40-E-05 (G 2")
FRS-40-B-45 (SAE-32)
FRS-40-C-45 (SAE-32)
FRS-40-E-45 (SAE-32)

9.2 FILTER ELEMENT Δp

The pressure drop through the filter depends to:
- size of filter element
- filtration rating
- fluid viscosity

The Δp of filter element is given by the formula:

$$\Delta p \text{ of filter element} = Q \times \frac{Gc}{1000} \times \frac{\text{Viscosity}}{30}$$

Q = working flow (l/min)

Gc = Gradient coefficient (mbar/(l/min)). The Gc values are reported in the following table

Viscosity = effective fluid viscosity in the working conditions (mm^2/s)

Gradient coefficent Gc of FRS filter elements

Filter element size	10		20				30		40				
Filter element lenght	**A**	**B**	**A**	**B**	**C**	**D**	**A**	**B**	**A**	**B**	**C**	**D**	**E**
Filtration rating	**Gc** Gradient coefficient												
F06	37.60	28.90	15.39	8.67	5.66	3.71	2.70	2.50	2.40	1.66	1.47	2.00	0.74
F10	19.80	10.40	10.77	5.86	3.54	2.29	1.62	1.34	1.34	0.84	0.61	0.98	0.37
F25	9.22	7.18	7.14	3.92	2.25	1.88	1.19	1.00	0.98	0.52	0.43	0.71	0.25
C10	4.83	2.74	4.09	2.70	1.64	1.06	0.85	0.83	0.82	0.45	0.36	0.64	0.22
C25	4.13	2.06	2.52	1.41	0.82	0.42	0.39	0.35	0.34	0.23	0.12	0.26	0.16

Examples:

1) calculation of Total Δp for filter type FRS-20-B-F10-02-R at Q = 50 l/min and viscosity 46 mm^2/s (filter element PRS-20-B-F10)
   Δp of filter head + filter bowl = 0,02 bar
   Gc = 5,86 mbar/(l/min)

Filter element Δp = $50 \times \frac{5,86}{1000} \times \frac{46}{30} = 0,45$ bar

Total Δp = 0,02 + 0,45 = **0,47 bar**

2) calculation of Total Δp of filter type FRS-40-C-F25-05-R at Q = 500 l/min and viscosity 46 mm^2/s (filter element PRS-40-C-F25)
   Δp of filter head + filter bowl = 0,13 bar
   Gc = 0,43 mbar/(l/min)

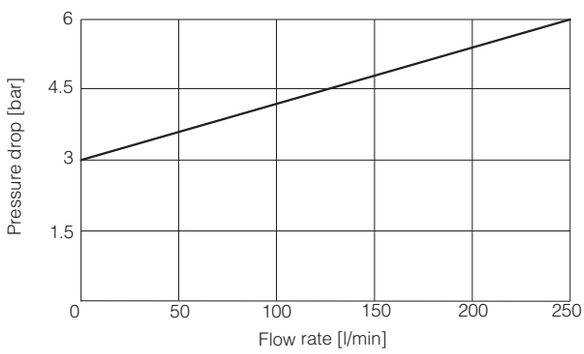
Filter element Δp = $500 \times \frac{0,43}{100} \times \frac{46}{30} = 0,33$ bar

Total Δp = 0,13 + 0,33 = **0,46 bar**

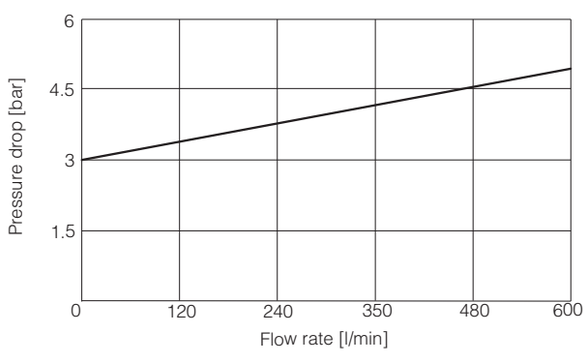
10 **BY -PASS VALVE** - based on mineral oil ISO VG46 at 50°C (viscosity = 32 mm^2/s)

Q/Δp diagrams of flow trough the by pass valve

FRS-10
FRS-20

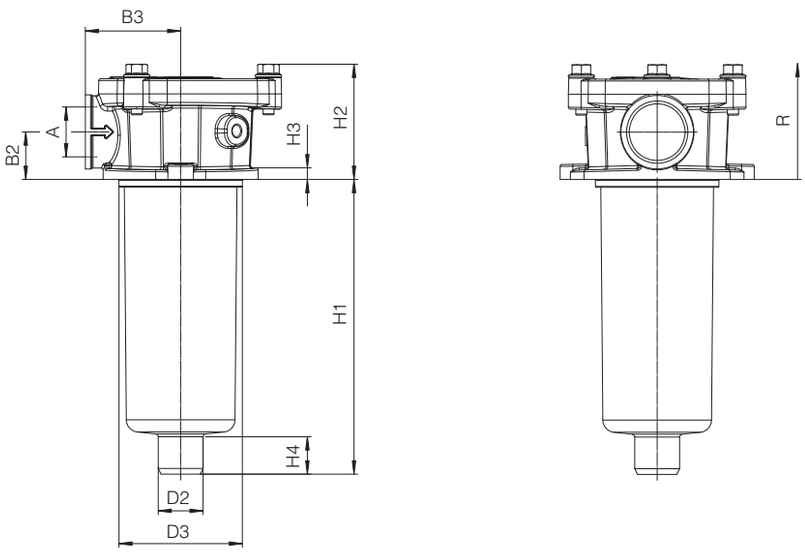


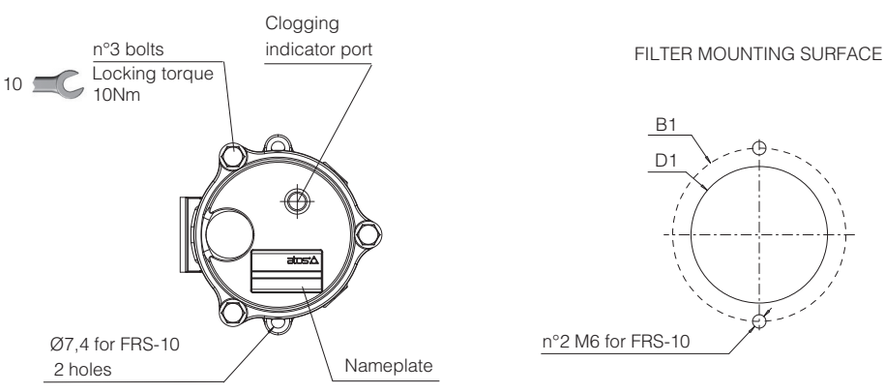
FRS-30
FRS-40



11 **INSTALLATION DIMENSIONS OF FRS FILTERS** [mm]

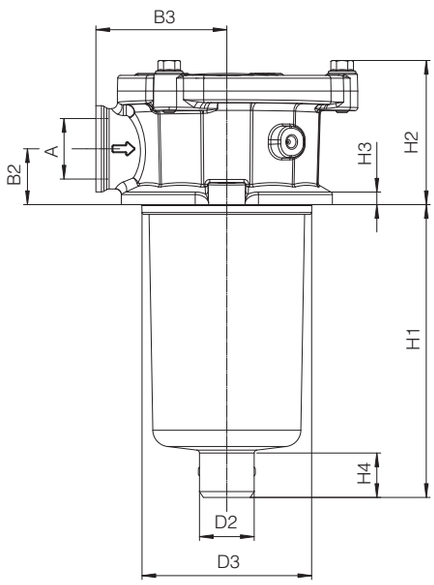
FRS-10

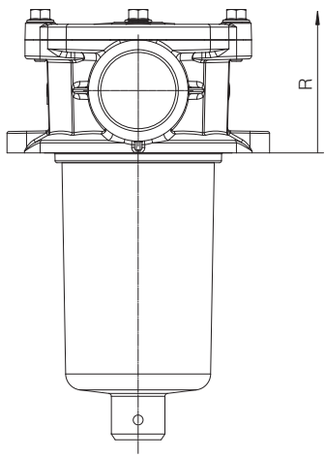


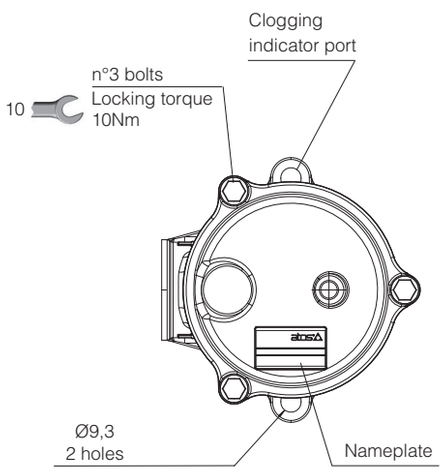


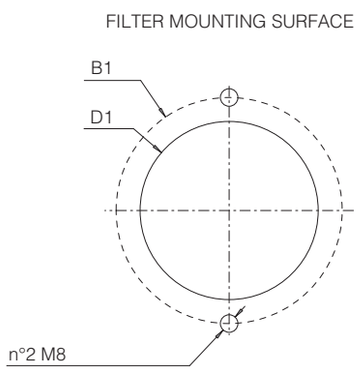
Code	A	B1	B2	B3	D1	D2	D3	H1	H2	H3	H4	R (element removal)	Mass (Kg)
FRS-10-A	1/2" BSPP 3/4" BSPP SAE-12	89	25	51	67,5	24	67	82	60	8	22	150	0,45
FRS-10-B								155				220	0,60

FRS-20







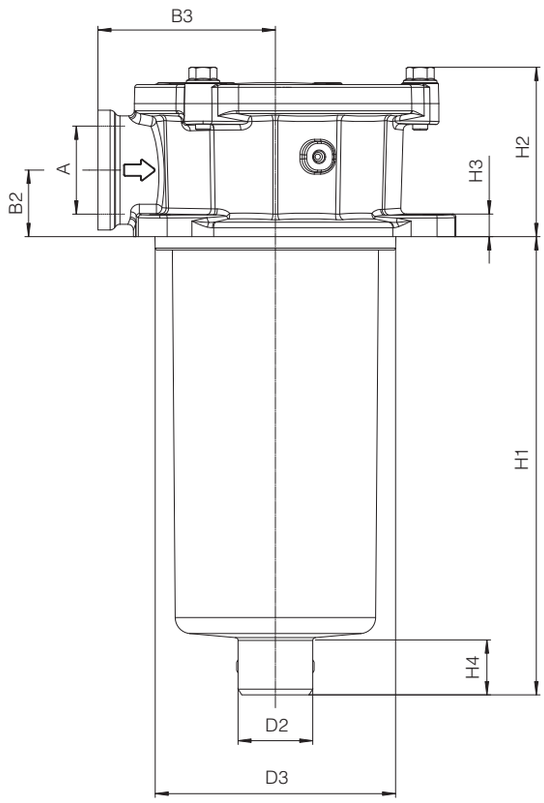


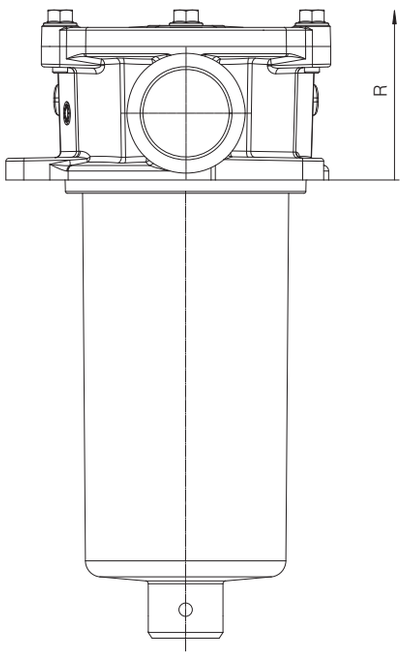
Code	A	B1	B2	B3	D1	D2	D3	H1	H2	H3	H4	R (element removal)	Mass (Kg)
FRS-20-A	1/2" BSPP 3/4" BSPP 1" BSPP 1 1/4" BSPP SAE-16	115	28,5 **(1)**	67	88,5	40	87	92	73	11	24	170	0,80
FRS-20-B								139				220	0,90
FRS-20-C			32 **(2)**					219				295	1,10
FRS-20-D								323				400	1,30

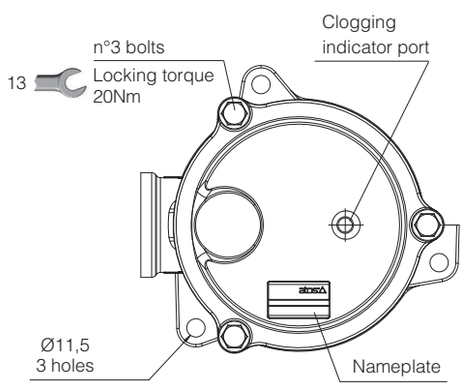
(1) For port size 3/4", 1" and SAE-16

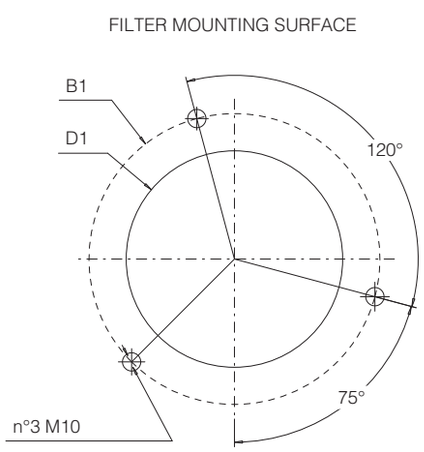
(2) For port size 1 1/4"

FRS-30



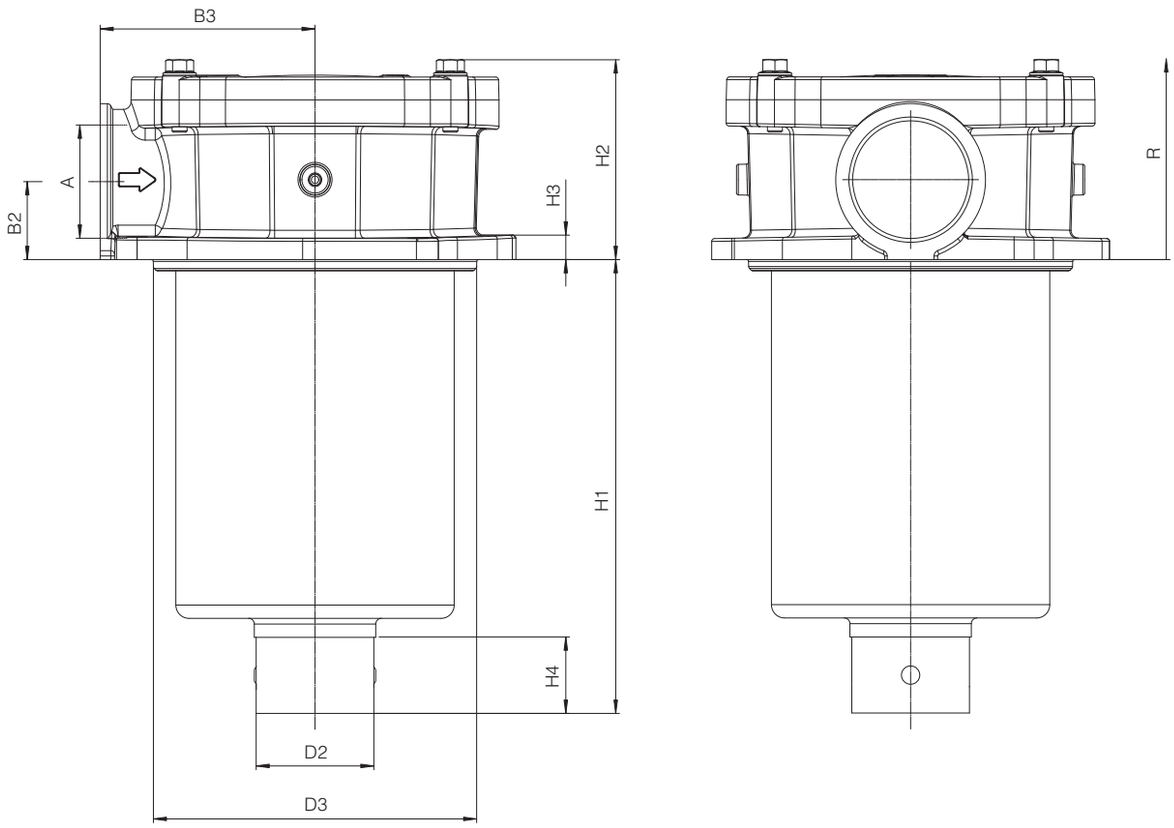


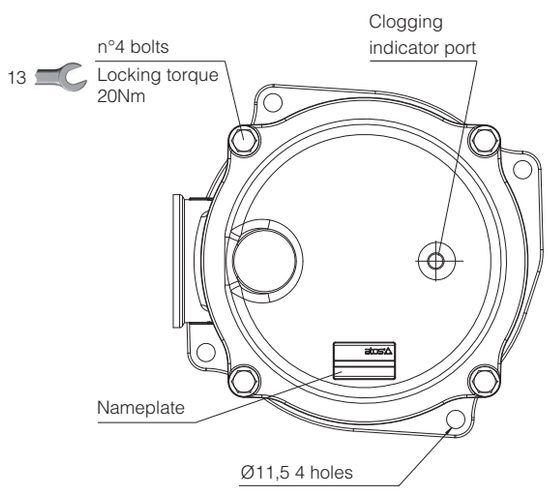


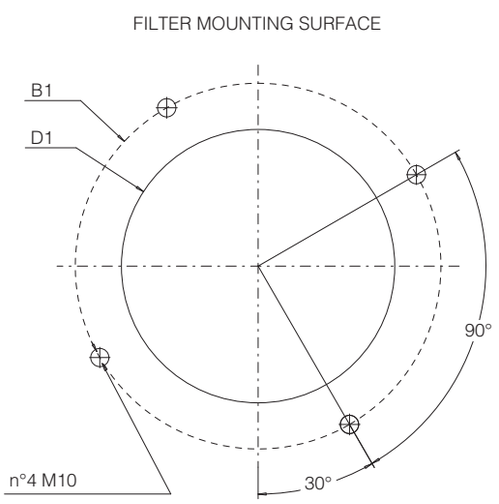


Code	A	B1	B2	B3	D1	D2	D3	H1	H2	H3	H4	R (element removal)	Mass (Kg)
FRS-30-A	1" BSPP 1 1/4" BSPP 1 1/2" BSPP SAE-24	175	35	95	130	40	129	234	90	11	30	320	2,10
FRS-30-B								263				360	2,40

FRS-40







Code	A	B1	B2	B3	D1	D2		D3	H1		H2	H3	H4		R (element removal)	Mass (Kg)
						series 10	series 11		series 10	series 11			series 10	series 11		
FRS-40-A	1 1/4" BSPP 1 1/2" BSPP 2" BSPP SAE-32	220	42	115	175	50	65	174	181	165	105	11	50	37	270	3,20
FRS-40-B						63			240	224					330	3,60
FRS-40-C									289	274					380	4,20
FRS-40-D **(1) (2)**									-	224					330	3,60
FRS-40-E **(1)**									-	424					530	4,00

(1) Available only for series 11, on request
(2) Filter type FRS-40-D is similar to FRS-40-B but it uses filter elements with smaller internal diameter

12 ACCESSORIES - to be ordered separately

Following accessories can be assembled on return filters type FRS-20, FRS-30 and FRS-40 (not available for FRS-10) to avoid the foam or air/oil emulsion inside the tank caused by the return flow.

The discharge ending pipes **DSC-END-*** are used to extend the outlet port of the FRS filters below the oil level in the tank.
They are available with length 250 (200 mm for FRS-40) and 500 mm

The diffusers **DIFF-FRS** are used in case of high flow rates to evenly distribute the return flow inside the tank.
They can be mounted directly on the filter bowl or using the connecting pipes **CONN-END-***, available with lengths of 250 (200 for FRS-40) and 500 mm.

MODEL CODE OF DISCHARGE ENDING PIPES (1)

DSC-END	-	250	FRS-20/30
Discharge ending pipe		**Pipe lenght** for **FRS-20** and **FRS-30**: 250 = 250 mm 500 = 500 mm **Pipe lenght** for **FRS-40**: 200 = 200 mm 500 = 500 mm	**Filter type**: FRS-20/30 = for FRS-20 and FRS-30 FRS-40 = for FRS-40

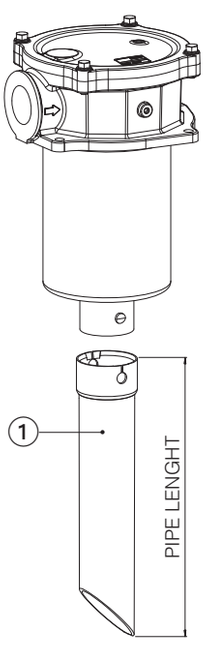
MODEL CODE OF CONNECTING ENDING PIPES (2)

CONN-END	-	250	FRS-20/30
Connecting ending pipe		**Pipe lenght** for **FRS-20** and **FRS-30**: 250 = 250 mm **Pipe lenght** for **FRS-40**: 200 = 200 mm (for FRS-40) 500 = 500 mm (for FRS-40)	**Filter type**: FRS-20/30 = for FRS-20 and FRS-30 FRS-40 = for FRS-40

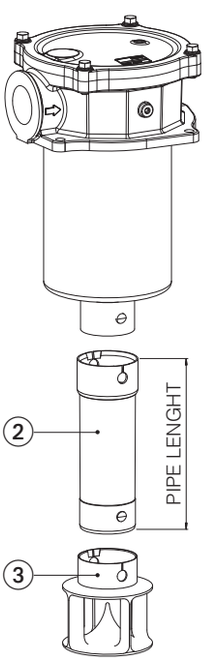
MODEL CODE OF DIFFUSERS (3)

DIFF	-	FRS-20/30
Diffuser		**Filter type**: FRS-20/30 = for FRS-20 and FRS-30 FRS-40 = for FRS-40

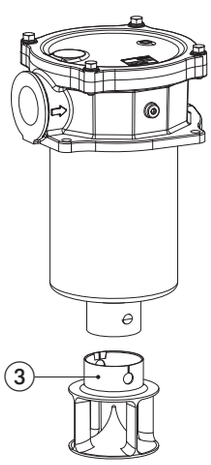
DISCHARGE ENDING PIPE



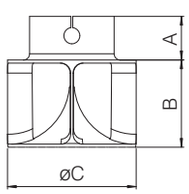
CONNECTING ENDING PIPE



DIFFUSER

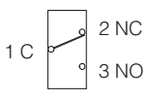


DIFFUSER DIMENSIONS



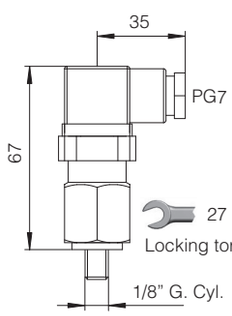
DIFFUSER CODE	DIMENSIONS		
	A	B	C
DIFF-FRS-20, DIFF-FRS-30	30	45	75
DIFF-FRS-40	35	70	105

13 CHARACTERISTICS OF CLOGGING INDICATORS

Model code	CIA-E electrical		CIA-V visual
Switching pressure	2 bar		green sector = 0 ÷ 3 bar red sector = 3 ÷ 10 bar
Switching tolerance at 20°C	± 10% of switching pressure		-
Electric connection	Electric plug connection as per DIN 43650 with cable gland type PG7		-
Power supply	14 VDC ÷ 30 VDC	125 VAC ÷ 250 VAC	
Max current - resistive (inductive)	4 A (3 A) ÷ 3 A (2 A)	5 A (3 A) ÷ 3 A (2 A)	
Fluid temperature	-25°C ÷ +100°C		-25°C ÷ +100°C
Protection degree according to DIN 40050	IP65 with mathing connector		-
Hydraulic connection	G1/8" BSP		G1/8" BSP
Duty factor	100%		100%
Mass (Kg)	0,16		0,04
Electric scheme / Hydraulic symbol	 The electric scheme shows the switch position in case of clean filter element		

14 DIMENSIONS OF CLOGGING INDICATORS

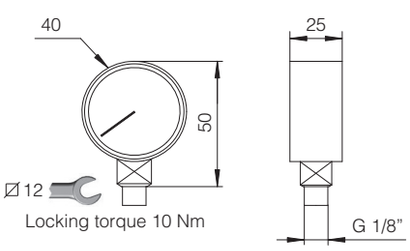
CIA-E



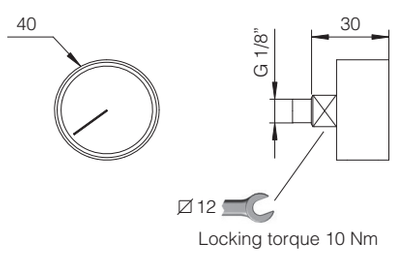
Electric connector
DIN 43650
Black color

Note: add sealant on indicator threads

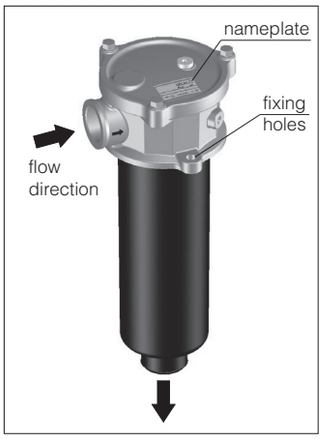
CIA-V



CIA-V/P
(available on request)



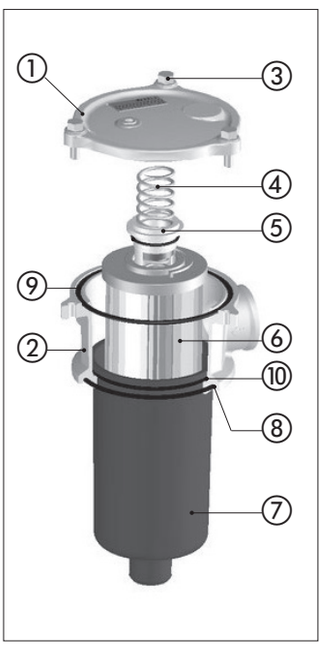
15 INSTALLATION AND COMMISSIONING



The tank flange with the filter mounting surface must be free of scratches.
During the filter installation, pay attention to respect the flow direction, shown by the arrow on the filter head.
Install the filter on the tank cover using the fixing holes on the filter head.
Connect the IN port of the filter to the system return pipe.
The OUT port of the filter can be connected to a pipe which length has to be properly sized so that its end remains under the oil level. See section 12 for additional discharge ending pipes.
Make sure that there is enough space for the replacement of the filter element.
Never run the system without the filter element.
For filters ordered with clogging indicator, code E or V:
- remove the steel plug from the indicator port on the filter head
- install the clogging indicator and lock it at the specified torque

During the cold start up (fluid temperature lower than 30°C), a false clogging indicator signal can be given due to the high fluid viscosity.

16 MAINTENANCE



The filter element must be replaced as soon as the clogging indicator switches to highlight the filter clogged condition
For filters without clogging indicator, the filter element must be replaced according to the system manufacturer's recommendations.
Select the new filter element according to the model code reported on the filter nameplate, see section 17.2

For the replacement of the filter element, proceed as follow:
- switch-off the system and make sure that there is no residual pressure in the filter line (i.e. pressurized tank); the filter has no pressure bleeading device
- pay attention to the fluid and filter surface temperature. Always use suitable gloves an protection glasses
- remove the cover ① from the filter head ② by releasing the bolts ③
- remove the spring ④ and the bowl ⑦
- remove the dirty filter element ⑥ pulling it upward carefully
- clean the bowl ⑦
- install the bowl ⑦ after having checked the good condition of the seal ⑧
- insert the new filter element over the spigot in the filter bowl; the filter element includes the by-pass valve ⑤
- install the spring ④
- mount the cover and lock the relevant bolts ③ after having checked the good condition of the seal ⑨

⚠ **WARNING**: The dirty filter elements cannot be cleaned and re-used. They are classified as "dangerous waste material", then they must be disposed of by authorized Companies, according to the local laws.

16.1 SEALS KIT

Filter type	Seal kit code
FRS-10	GUARN FRS-10 ⑧+⑨+⑩
FRS-20	GUARN FRS-20 ⑧+⑨+⑩
FRS-30	GUARN FRS-30 ⑧+⑨+⑩
FRS-40	GUARN FRS-40 ⑧+⑨+⑩

17.2 SPARE SPRING ④

Filter type	Seal kit code
FRS-10	MO-1246
FRS-20	MO-1247
FRS-30	MO-1248
FRS-40	MO-1249

16.2 FILTER IDENTIFICATION NAMEPLATE

① Model code of complete filter
② Model code of filter element
③ Filter matrix code

17 RELATED DOCUMENTATION

LF010	Fluid contamination
LF020	Filtration guidelines

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