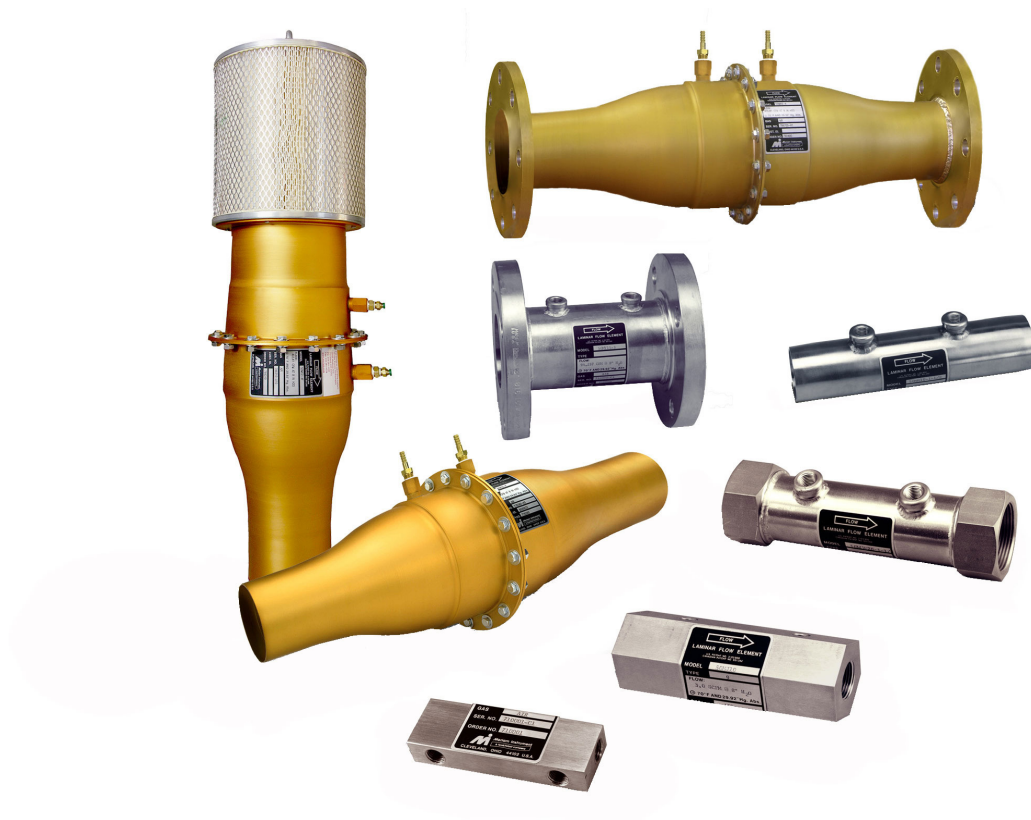


OPERATION MANUAL

Model 50M LFE - Laminar Flow Elements



*** VERSION 2.0 ***

Update: 14.12.2016

GENERAL HINTS

Typographical Conventions

Displayment Means



ATTENTION!

marks a work procedure, which you must implement
references marks which you should not neglect otherwise your health
or the operability of the equipment is endangered



HINTS

marks important additional information, hints and recommendations



ATTENTION!

referring to precautionary measures mark during the handling of
electrostatically unloading-endangered elements or modules.

Displayment Types

Menue Items

Texts of screen displays were shown in cursive letter
(z.B.: *End Program*).

Predefined Parameter

Parameter which are set at the delivery of the unit as factory settings were
underlined. (i.e.: 0 ... 9999)

SAFTEY HINTS



Please consider the references of this manual as well as the operating conditions
and permissible data, which are specified in the data sheets of the device, so that
the equipment functions perfectly and for a long time remains operational:

Adhere with operational planning and the enterprise of the equipment to the general
rules of the technology!

Installation and maintenance work may take place only with technical personnel
and with suitable tools!

Consider the valid accident prevention and safety regulations for electrical devices
during the enterprise and maintenance of the equipment!

Switch off power supply before interferences into the system in any case!

Meet suitable measures, in order to exclude unintentional operation or inadmissible
impairment!

Ensure after an interruption of the electrical supply a defined and controlled restart
of the process!

CONTENT

LFE - Laminar Flow Elements	1
GENERAL HINTS.....	2
Typographical Conventions.....	2
SAFTEY HINTS	2
CONTENT	3
Specific saftey instructions for secure handling of the LFE elements.....	4
Check Delivery Content.....	4
INSTALLATION REQUIREMENTS.....	4
Operation.....	4
Typical Sensors for Evaluation	5
Calibration curves /- tables.....	5
Calculating the Flow	5
Air Flow Measurement	5
Gas Flow Mesurement (other gases than air)	5
Service	6
Cleaning.....	6
Search and solving problems.....	6
DATA SHEETS LFE.....	7
Model 50MK10	7
Model 50MJ10	8
Model 50MW20	9
Model 50MH10	10
Model 50MY15	11
Model 50MC02	Fehler! Textmarke nicht definiert.
Model 50MC02-XX-F	13
Model 50MR02	Fehler! Textmarke nicht definiert.
Model 50MR02-XX-F	16

Introduction

LFE (Laminar Flow Elements) from Meriam can be evaluated with any differential pressure measurement devices to determine the flow of air and gases. LFE measure the actual volume flow! This operation manual describes the models 50MK10, 50MW20, 50MJ10, 50MC2 and 50MY15. Technical drawings of measures and detailed information you can order from us anytime if required.

Specific safety instructions for secure handling of the LFE elements

The fine matrix of the LFE is manufactured of 0,025 mm thin stainless steel sheets and offers because of their precise manufacturing a very high accuracy. Therefore it is strictly forbidden to touch the matrix in order to not hurt it. If the matrix is hurt the characteristics will change and the original performance will be changed and the original calibration may no more be valid. In this case the LFE must be recalibrated in the factory.

Please note also that at models with directly mounted filter on the inlet the filter influences the flow profile what also affects the calibration. The filter therefore should not be removed or added after the calibration. Otherwise the LFE must be recalibrated.

Check Delivery Content

- The supply of the manual of operation for the LFE and a calibration data sheet
- The LFE were supplied with closed caps on the open ends. Dismount these and have a look through the capillaries or matrix elements against a bright light. There should be none of the flow paths closed.
- Check the matrix or capillary for mechanical damages like scratches etc. The area of the in- and outlet of the matrix should not be bended.

Installation Requirements

Ensure before mounting: connect the LFE into a pipe, tube or measurement section only if there is no dirt or other particles inside to see. If dirt is not to exclude in operation and the section will not stay clean for ever it is strictly recommended to use an inlet filter with a filter rate of equivalent to 5µm.

The two pressure connection lines for the DP pressure transmitter should have about the same pipe length and diameter if possible and should be absolutely tight.

The temperature sensor should have at least a distance of two times of the inner flow element diameter to the LFE inlet. If an absolute pressure sensor is used it should be connected close to the inlet side of the LFE or at the positive DP-pressure tap of the DP-connectors.

The LFE can be connected into the line with the thread, flange- or pipe connectors supplied with the element with straight pipes depending on the model. In any case please verify and respect the flow direction of the LFE (see arrow mark). Concerning the mounting direction there is no limitation. In general the horizontal mounting direction is preferred compared to the vertical direction, because the temperature may increase with 1°C/m height.

To achieve good measurement results one has to regard the manufacturers recommendation of straight lengths of inlet and outlet lines. This is to avoid turbulencies of the flow at the inlet of the LFE. It is recommended to respect as a straight **inlet length of 10xD and also a outlet length of 5xD (D=LFE matrix diameter)**. Is it not possible to hold this recommendation the LFE should be calibrated from the manufacturer with the actually used flow sections. This allows the maximum possible accuracy for your application.

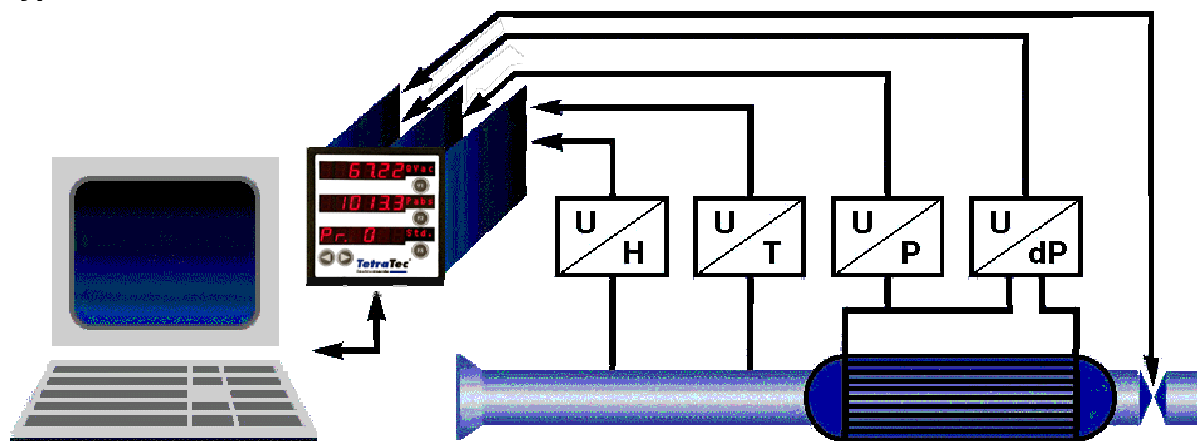
Operation

Procedure:

- Put at first the line into operation.
- Measure the differential pressure at the DP-pressure taps.
- Measure the gas temperature and if required the humidity of the flowing air.

- For the accurate evaluation of the volume or mass flow one has to measure also the static absolute pressure in the line to calculate the density and also the viscosity of the flowing gas correctly.
- With all of these measured sensor data later the evaluation can be done. The flow can be calculated manually or by using a flow computer what does do this calculation online.

Typical Sensors for Evaluation



H = rel. humidity / T = temperature / P = absolute pressure / dP = differential pressure

Calibration curves /- tables

Each LFE is calibrated against a "calibration master device" which is traceable to the PTB (the highest german calibration institute). As a standard the LFE is calibrated with dry clean air and the calibration results will be converted and corrected on standard calibration conditions of 21,1°C, 1013,25 mbar abs. and 0% rel. humidity.

Every LFE comes with an own calibration certificate. For this purpose at the order should be defined the measurement units of the customer at least if they should be different than our standard. Based on the calibration data the actual flow rate Q can be calculated:

$$Q = (B \times dP + C \times dP^2) \times F = Q_{cal} \times F$$

B, C = calibration coefficients; shown for every LFE in the calibration certificate

F = viscosity correctur factor = calibration viscosity / actual viscosity

Q_{cal} = volume flow at calibration condition

Please confirm that you are using the right calibration certificate for the LFE. (Compare the serial number).

Calculating the Flow

With the formulas, tables and diagrams shown in the calibration certificate the volume flow can be calculated.

Air Flow Measurement

Procedure:

- Read the differential pressure.
- Use the formula to calculate the flow:

$$Q_{cal} = B \times dP + C \times dP^2$$

The resulting calibration volume flow must be corrected with the viscosity factor to achieve the actual volume flow and this again has to be multiplied with the density to receive the mass flow

Gas Flow Measurement (other gases than air)

The same procedure as described above can be applied in principal for any other Gas than air. But the actual volume flow must be calculated with the viscosity factor, the actual viscosity of the actual gas as well as the density of the used media must be used for the calculation of the mass flow. This procedure is only valid if the LFE is operated within the same Reynolds number range as found in the calibration!

Service

Because the LFE has no moving parts it is almost free of service. But it is recommended to clean the LFE in regular periods of 3 to 5 years and shelter it also by a suitable filtration (better 5 µm) of the flowing media against bringing in dust and dirt into the matrix.

Cleaning

Procedure:

- Take the LFE out of the line
- Inspect the matrix and capillaries for mechanical damages and on closing dirt of the flow paths in the inner spaces of the matrix
- Try to blow out the LFE with clean and oil free compressed air against the recommended flow direction.

Attention: Please never touch the surface of the matrix or the capillaries because this may lead to mechanical damages of these.

- If you find oily or gluing dirt on the LFE it may only be cleaned with proper and completely in water resolving cleaning means which don't build sedimentation. Please contact our company for accepted cleaning fluids, because not acceptable cleaning fluids can lead to damages of the LFE.



HINTS For maintenance and repair we offer a special cleaning and recalibration service.

Search and solving problems

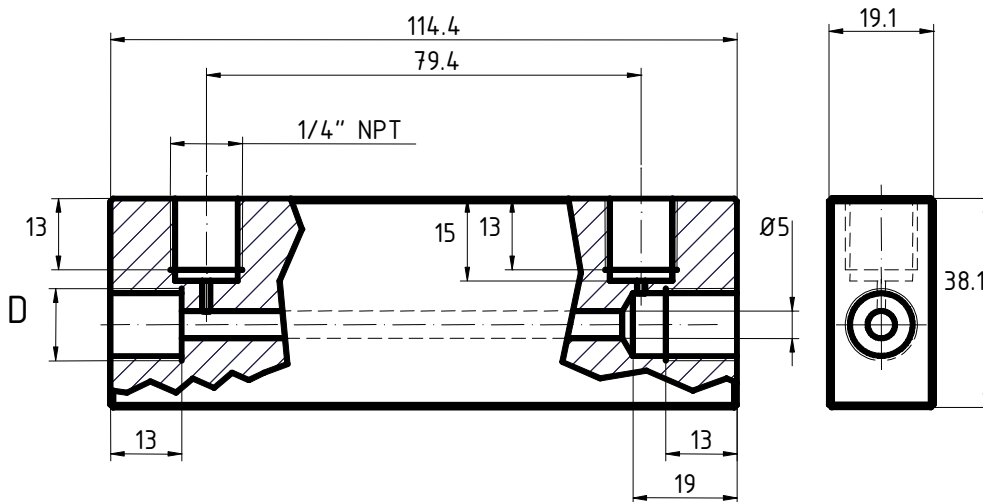
Problem	Possible cause	Solving problem
Display shows unrealistic differential pressure or wrong flow value	Recommended straight in- and outlet sections not present	Straight inlet section 10 x D Straight outlet section 5 x D i.e.: D = 100 mm inlet 1 m, outlet section 0,5 m
	LFE Matrix polluted	Reinigen oder LFE ersetzen
	Line and DP connecting tubes could be bended to narrow so that flow and pressure measurement cannot work properly	Control line and DP connection tubes for straight and reasonable bending and correct that if that solves the error.
	DP connecting tubes have a different length and / or diameter or are layed out in different positions	Correct that if that solves the error
	Reducers or Extenders are directly at the intrance into the LFE and are disturbing the flow profile and lead to turbulencies.	Recommended straight in- and outlet sections see above.
differential pressure is pulsating	Turbulent flow profile in the LFE or leakage Leak in DP connecting tubes.	Lower static pressure or lower flow, thightening of the leakage.

Data Sheets LFE

Model 50MK10

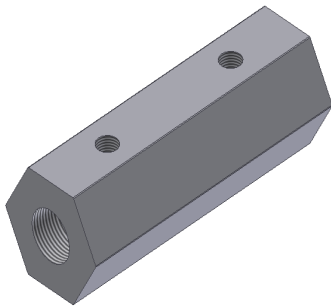


Stainless steel body with integrated stainless steel capillary tubes fixed inside the body with an Epoxy filling. Process and differential pressure connections are threads with 1/4" NPTF
Differential pressure at nominal flow: 0 - 20 mbar,
Operation limits: 0 - 70°C / 0,4 - 10 bar abs



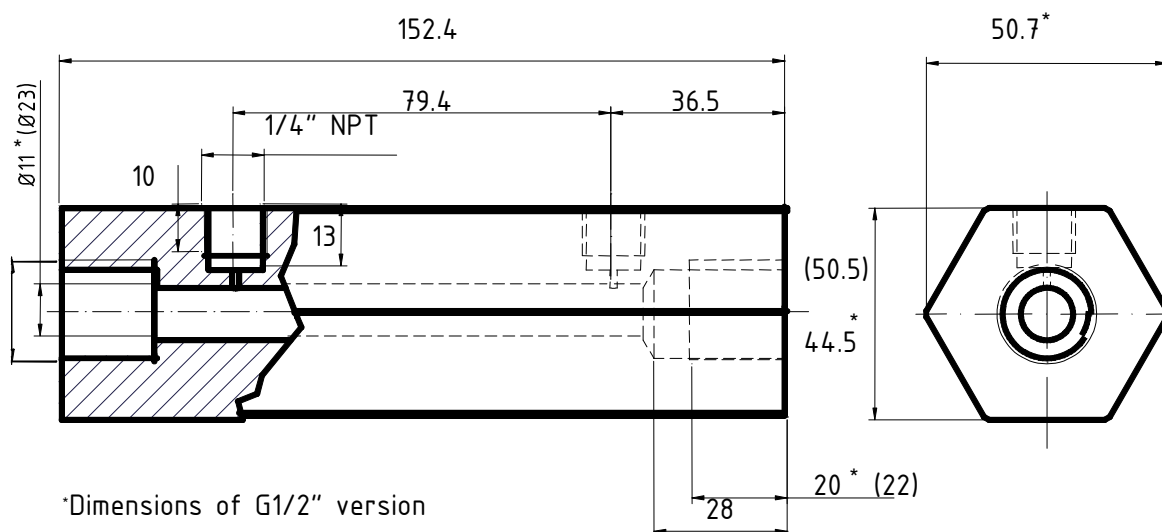
Part No.	Process Connection	Nominal flow and differential pressure (+/-10 % Tolerance) At calibration conditions: 1013,25 mbar abs., 21,1 °C, 0,0 %r.H.		
	Nominal Width	Qv L/min	Qm g/min	DP mbar
50MK10-08	1/4	0 - 0,0054	0 - 6,44 x 10-3	0 – 10
50MK10-07	1/4	0 - 0,018	0 - 2,10 x 10-2	0 – 10
50MK10-06	1/4	0 - 0,035	0 - 4,21 x 10-2	0 – 10
50MK10-05	1/4	0 - 0,071	0 - 8,48 x 10-2	0 – 10
50MK10-04	1/4	0 - 0,13	0 - 0,156	0 – 10
50MK10-03	1/4	0 - 0,23	0 - 0,275	0 – 10
50MK10-02	1/4	0 - 0,42	0 - 0,506	0 – 10
50MK10-01	1/4	0 - 1,3	0 - 1,56	0 – 10

Model 50MJ10



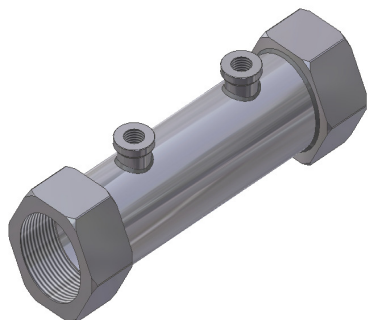
Stainless steel body with integrated stainless steel matrix. Differential pressure connections are 1/4" NPTF, Process connections are threads with NPTF.

Differential pressure at nominal flow: 0 - 20 mbar,
Operation limits: 0 - 70°C / 0,4 - 10 bar abs

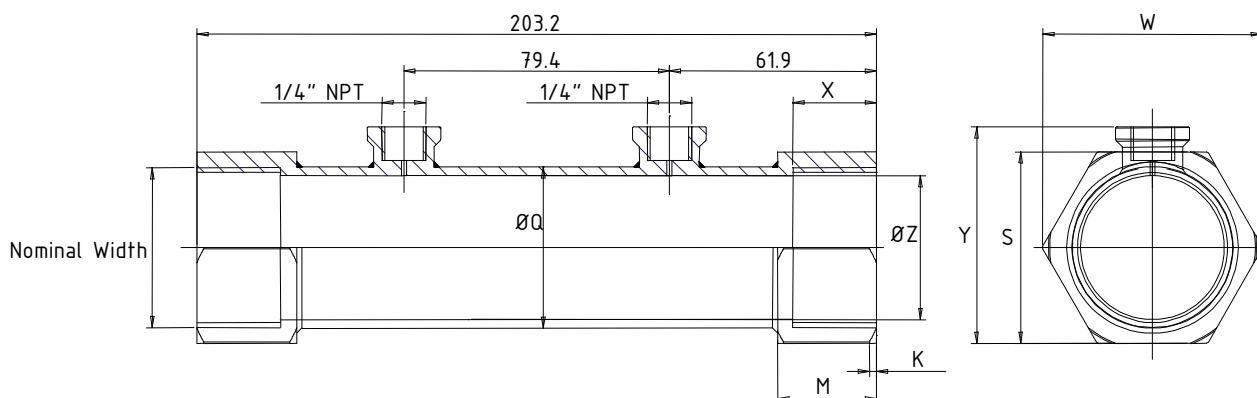


Part-No.	Process Connection	Nominal flow and differential pressure (+/-10 % Tolerance) At calibration conditions: 1013,25 mbar abs., 21,1 °C, 0,0 %r.H.		
	Nominal Width	Qv L/min	Qm g/min	DP mbar
50MJ10-14	1/2	0 – 2,8	0 – 3,39	0 – 20
50MJ10-13	1/2	0 – 5,0	0 – 6,1	0 – 20
50MJ10-12	1/2	0 – 11	0 – 12,6	0 – 20
50MJ10-11	1/2	0 – 20	0 – 23,7	0 – 20
50MJ10-10	1/2	0 – 45	0 – 54,3	0 – 20
50MJ10-09	3/4	0 – 85	0 – 102	0 – 20

Model 50MW20

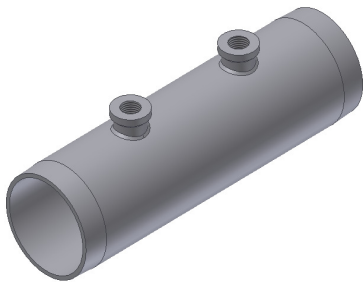


Stainless steel body with integrated stainless steel matrix. Differential pressure connections are 1/4" NPTF, Process connections are threads with NPTF. Differential pressure at nominal flow: 0 - 20 mbar, Operation limits: 0 - 70°C / 0,4 - 10 bar abs

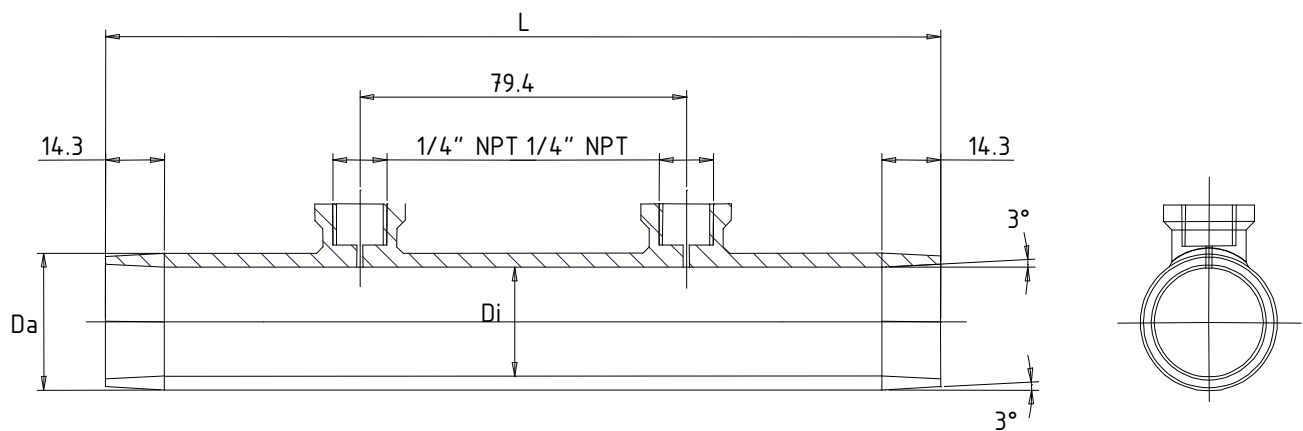


Part No.	Process Connection	Abmessungen								Nominal flow and differential pressure (+/-10 % Tolerance) At calibration conditions: 1013,25 mbar abs., 21,1 °C, 0,0 %r.H.		
	Nominal Width	SW [mm]	X [mm]	Z [mm]	Q [mm]	W [mm]	Y [mm]	M [mm]	K [mm]	Qv L/min	Qm g/min	DP mbar
50MW20-01	1	41,3	23,0	28,5	33,3	47,3	49,6	29,5	1,5	0 – 210	0 – 254	0 – 20
50MW20-01.5	1 1/2	57,2	25,0	43,0	48,2	65,65	65,0	29,5	2,5	0 – 620	0 – 746	0 – 20
50MW20-02	2	69,9	24,0	55,0	60,0	80,4	77,1	29,5	3,0	0 – 1130	0 – 1357	0 – 20

Model 50MH10

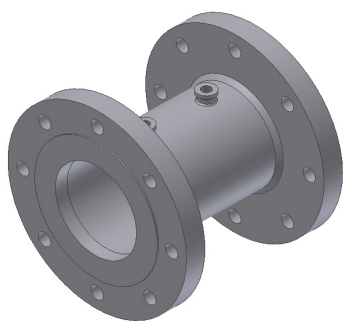


Stainless steel body with integrated stainless steel matrix. Differential pressure connections are 1/4" NPTF, Process connections are plunt tube ends. Differential pressure at nominal flow: 0 - 20 mbar, Operation limits: 0 - 70°C / 0,4 - 6 bar abs



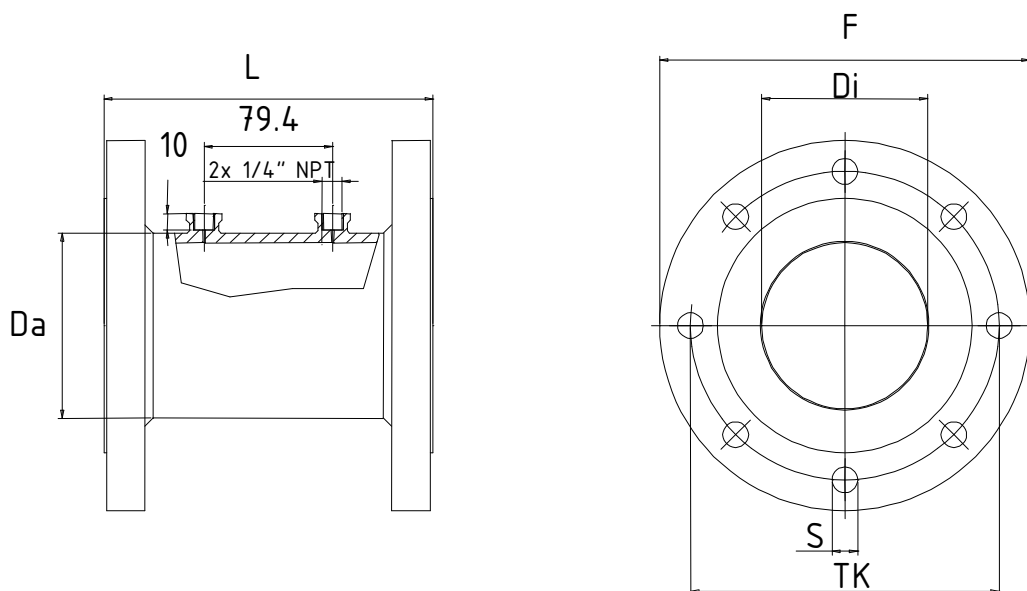
Part No.	Process Connection	Dimensions			Nominal flow and differential pressure (+/-10 % Tolerance)at calibration conditions: 1013,25 mbar abs., 21,1 °C, 0,0 %r.H.		
	Nominal Width	L [mm]	Da [mm]	Di [mm]	Qv L/min	Qm g/min	DP mbar
50MH10-01	1"	203.2	33.3	26.5	0 - 210	0 – 254	0 – 20
50MH10-01.25	1 1/4"	203.2	42.0	36.5	0 - 450	0 – 543	0 – 20
50MH10-01.5	1 1/2"	203.2	48.8	42.0	0 - 650	0 – 780	0 – 20
50MH10-02	2"	203.2	60.3	54.0	0 - 1100	0 – 1350	0 – 20
50MH10-02.5	2 1/2"	203.2	68.0	60.0	0 - 1700	0 – 2030	0 – 20
50MH10-03	3"	203.2	88.9	82.0	0 - 2550	0 – 3050	0 – 20
50MH10-04	4"	203.2	114.3	102.5	0 - 4500	0 – 5430	0 – 20
50MH10-05	5"	203.2	141.3	129.0	0 - 7100	0 – 8480	0 – 20
50MH10-06	6"	203.2	168.3	156.0	0 - 10200	0 – 12200	0 – 20
50MH10-08	8"	304.8	219.0	195.0	0 - 18100	0 – 21700	0 – 20
50MH10-10	10"	304.8	273.0	249.0	0 - 28300	0 – 33900	0 – 20
50MH10-12	12"	304.8	323.9	303.0	0 - 40800	0 – 48800	0 – 20
50MH10-16	16"	304.8	406.4	386.0	0 - 63700	0 – 76300	0 – 20

Model 50MY15



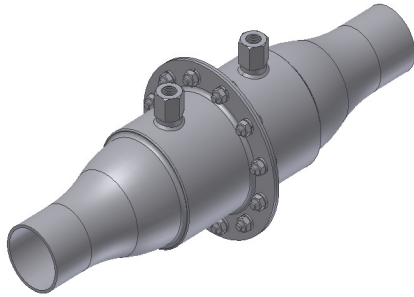
Stainless steel body with integrated stainless steel matrix. Differential pressure connections are 1/4" NPTF, Process connections are flanges acc. ANSI 150 lbs.

Differential pressure at nominal flow: 0 - 20 mbar,
Operation limits: 0 - 70°C / 0,4 - 10 bar abs



Part No.	Process Connection	Dimensions						Nominal flow and differential pressure(+/-10 % Tolerance) at calibration conditions: 1013,25 mbar abs., 21,1 °C, 0,0 %r.H.		
	Nominal Width	L [mm]	Da [mm]	Di [mm]	F [mm]	TK [mm]	S [mm]	Qv L/min	Qm g/min	DP mbar
50MY15-02.5	2 1/2"	203.2	68.0	60.0	177.8	139,7	15,8	0 - 1700	0 – 2030	0 – 20
50MY15-03	3"	203.2	88.9	82.0	190.5	152,4	15,8	0 - 2550	0 – 3050	0 – 20
50MY15-04	4"	203.2	114.3	102.5	228.6	190,5	15,8	0 - 4500	0 – 5430	0 – 20
50MY15-05	5"	203.2	141.3	129.0	254.0	215,9	19,0	0 - 7100	0 – 8480	0 – 20
50MY15-06	6"	203.2	168.3	156.0	279.4	241,3	19,0	0 - 10200	0 – 12200	0 – 20
50MY15-08	8"	304.8	219.0	195.0	342.9	298,4	19,0	0 - 18100	0 – 21700	0 – 20
50MY15-10	10"	304.8	273.0	249.0	406.4	361,5	22,2	0 - 28300	0 – 33900	0 – 20
50MY15-12	12"	304.8	323.9	303.0	482.6	431,8	22,2	0 - 40800	0 – 48800	0 – 20
50MY15-16	16"	304.8	406.4	386.0	596.9	539,7	25,4	0 - 63700	0 – 76300	0 – 20

Model 50MC02

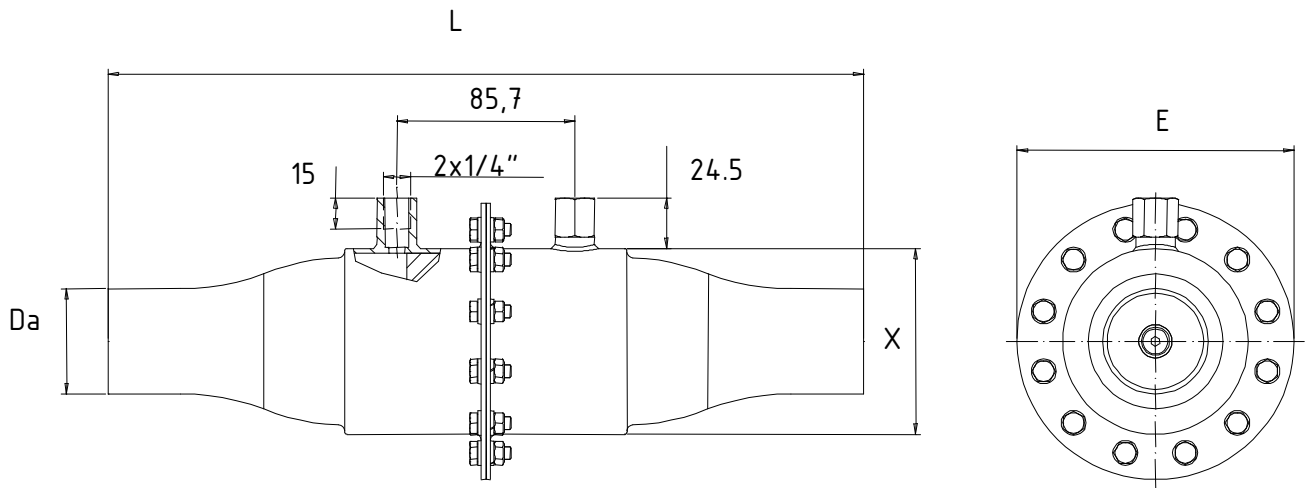


Aluminium body with integrated stainless steel matrix.

Differential pressure connections are 1/4" NPTF, Process connections are plunt tube ends.

Difference pressure at nominal flow: 0 - 20 mbar,

Operation limits: 0 - 50°C, 0,6 - 1,4 bar abs

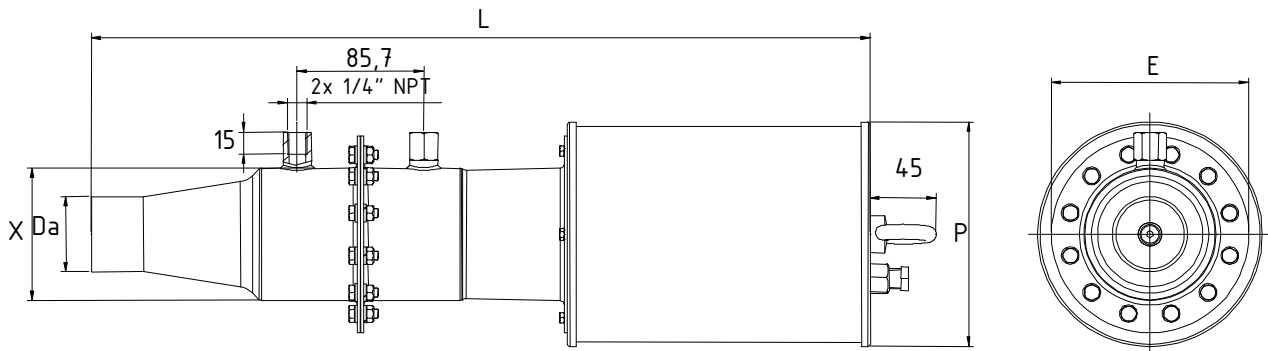
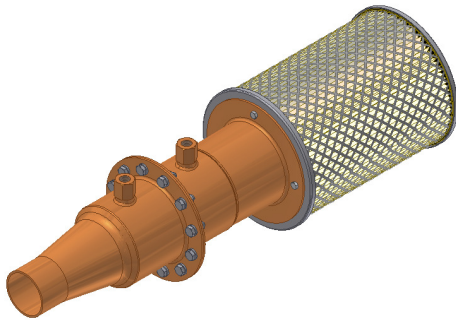


Part No.	Process Connection	Dimensions			Nominal flow and pressure decline (+/-10 % Tolerance) at calibration conditions: 1013,25 mbar abs., 21,1 °C, 0,0 %r.H.			
	Nominal Width	L [mm]	Da [mm]	X [mm]	E [mm]	Qv L/min	Qm g/min	DP mbar
50MC02-02	2"	370.0	50.8	89.5	133.4	0 - 2800	0 - 3400	0 - 20
50MC02-04	4"	610.0	101.6	172.0	215.0	0 - 11300	0 - 13600	0 - 20
50MC02-06	6"	765.0	152.1	260.8	304.8	0 - 28300	0 - 33900	0 - 20
50MC02-08	8"	915.0	203.8	381.5	425.5	0 - 63700	0 - 76300	0 - 20

Model 50MC02-XX-FS

with integrated inlet filter

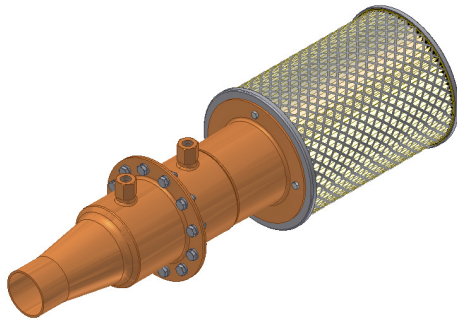
Aluminium body with integrated stainless steel matrix.
Differential pressure connections are 1/4" NPTF,
Process connections are plunt tube ends.
Differential pressure at nominal flow: 0 - 20 mbar,
Operation limits: 0 - 50°C, 0,6 - 1,4 bar abs



Part No.	Process Connection	Dimensions					Nominal flow and differential pressure (+/-10 % Tolerance) at calibration conditions: 1013,25 mbar abs., 21,1 °C, 0,0 %r.H.		
	Nominal Width	L [mm]	Da [mm]	X [mm]	E [mm]	P [mm]	Qv L/min	Qm g/min	DP mbar
50MC02-02-F	2"	430	50.8	89.5	133.4	152	0 - 2800	0 - 3400	0 - 20
50MC02-04-F	4"	720	101.6	172.0	215.0	232	0 - 11300	0 - 13600	0 - 20
50MC02-06-F	6"	870	152.1	260.8	304.8	350	0 - 28300	0 - 33900	0 - 20
50MC02-08-F	8"	1300	203.8	381.5	425.5	400	0 - 63700	0 - 76300	0 - 20

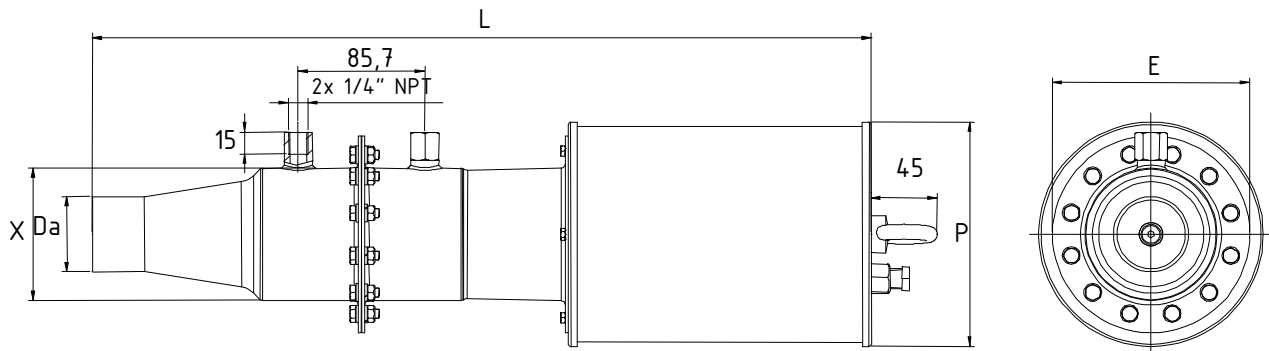
Model 50MC02-XX-FE

with integrated inlet filter



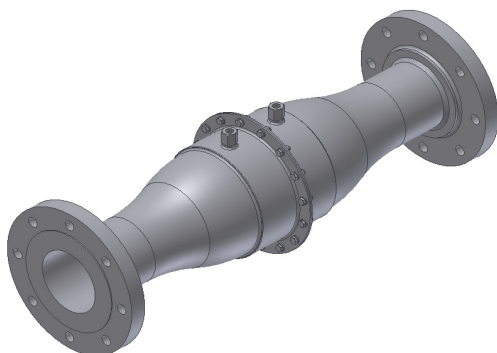
Aluminium body with integrated stainless steel matrix.
Differential pressure connections are 1/4" NPTF,
Process connections are plunt tube ends.
Difference pressure at nominal flow: 0 - 20 mbar,
Operation limits: 0 - 50°C, 0,6 - 1,4 bar abs

Special version with exchangeable filter pressure
drop smaller 3 – 6 mbar
and influence of the filter exchange less 0,3% on
calibration.



Part No.	Process Connection	Dimensions					Nominal flow and pressure decline (+/-10 % Tolerance) at calibration conditions: 1013,25 mbar abs., 21,1 °C, 0,0 %r.H.		
	Nominal Width	L [mm]	Da [mm]	X [mm]	E [mm]	P [mm]	Qv L/min	Qm g/min	DP mbar
50MC02-02-F	2"	430	50.8	89.5	133.4	152	0 - 2800	0 - 3400	0 – 20
50MC02-04-F	4"	780	101.6	172.0	215.0	285	0 - 11300	0 - 13600	0 – 20
50MC02-06-F	6"	880	152.1	260.8	304.8	420	0 - 28300	0 - 33900	0 – 20
50MC02-08-F	8"	1300	203.8	381.5	425.5	450	0 - 63700	0 - 76300	0 – 20

Model 50MR02

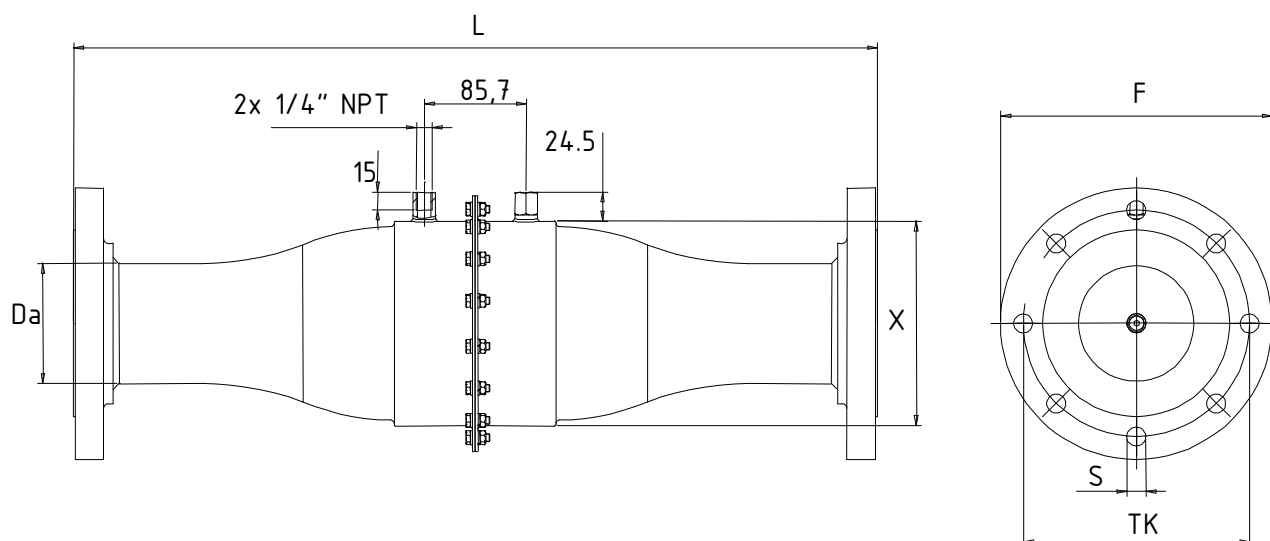


Aluminium body with integrated stainless steel matrix.

Differential pressure connections are 1/4" NPTF, Process connections are flanges acc. ANSI 150 lbs.

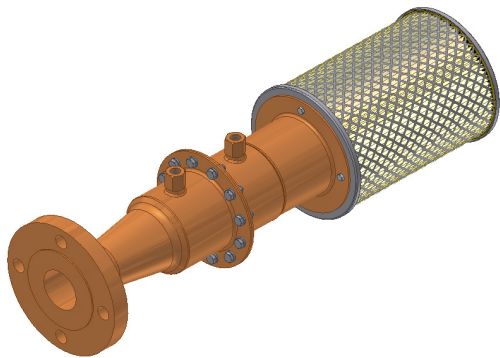
Difference pressure at nominal flow: 0 - 20 mbar,

Operation limits: 0 - 50°C, 0,6 - 1,4 bar abs



Part No.	Process Connection	Dimensions						Nominal flow and pressure decline (+/-10 % Tolerance) at calibration conditions: 1013,25 mbar abs., 21,1 °C, 0,0 %r.H.		
	Nominal Width	L [mm]	Da [mm]	X [mm]	F [mm]	TK [mm]	S [mm]	Qv L/min	Qm g/min	DP mbar
50MR02-02	2"	390,0	50,8	89,5	152,4	120,6	15,8	0 - 2800	0 - 3400	0 - 20
50MR02-04	4"	630,0	101,6	172,0	228,6	190,5	15,8	0 - 11300	0 - 13600	0 - 20
50MR02-06	6"	785,0	152,4	260,8	279,4	241,3	19,0	0 - 28300	0 - 33900	0 - 20
50MR02-08	8"	935,0	203,8	381,5	342,0	298,4	19,0	0 - 63700	0 - 76300	0 - 20

Model 50MR02-XX-FS

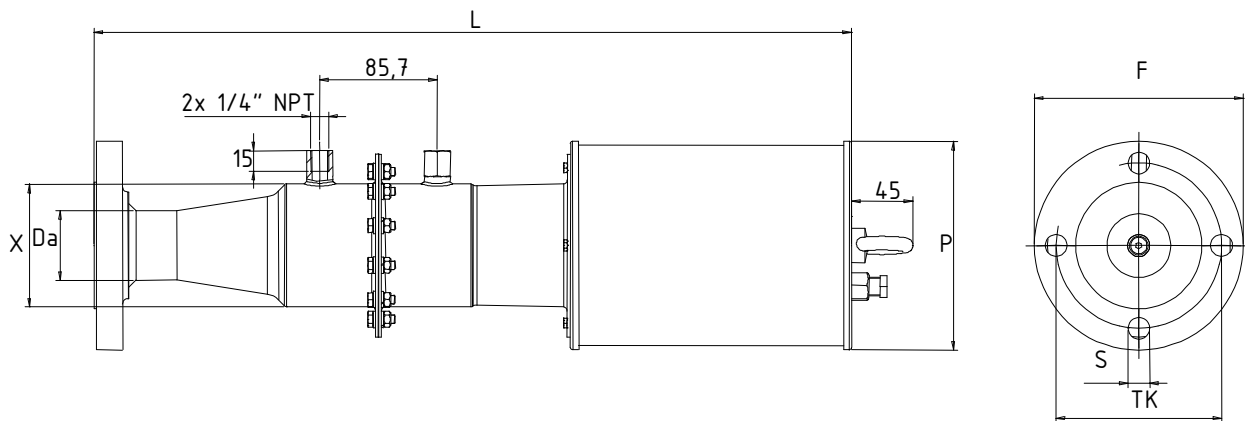


Aluminium body with integrated stainless steel matrix.

Differential pressure connections are 1/4" NPTF,
Process connections are flanges acc. ANSI 150 lbs.

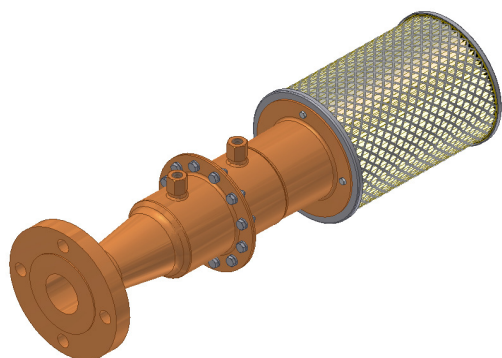
Differential pressure at nominal flow: 0 - 20 mbar,

Operation limits: 0 - 50°C, 0,6 - 1,4 bar abs



Part No.	Process Connection	Dimensions			Nominal flow and differential pressure (+/-10 % Tolerance) at calibration conditions: 1013,25 mbar abs., 21,1 °C, 0,0 %r.H.						
	Nominal Width	L [mm]	Da [mm]	X [mm]	F [mm]	P [mm]	TK [mm]	S [mm]	Qv L/min	Qm g/min	DP mbar
50MR02-02-F	2"	452	50.8	89.5	152,4	152	120,6	15,8	0 - 2800	0 - 3400	0 - 20
50MR02-04-F	4"	753	101.6	172.0	228,6	232	190,5	15,8	0 - 11300	0 - 13600	0 - 20
50MR02-06-F	6"	910	152.1	260.8	279,4	350	241,3	19,0	0 - 28300	0 - 33900	0 - 20
50MR02-08-F	8"	1329	203.8	381.5	342,0	400	298,4	19,0	0 - 63700	0 - 76300	0 - 20

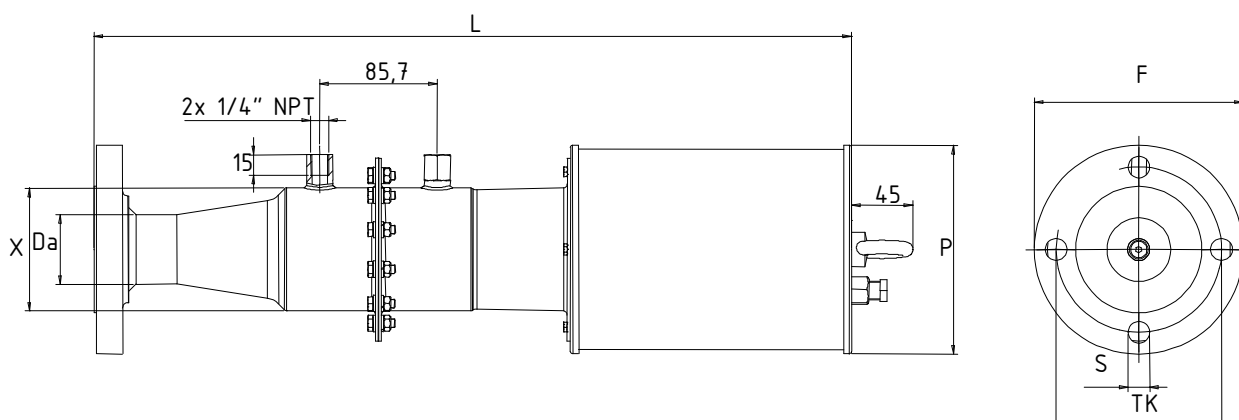
Model 50MR02-XX-FE



Aluminium body with integrated stainless steel matrix.

Differential pressure connections are 1/4" NPTF,
Process connections are flanges acc. ANSI 150 lbs.
Difference pressure at nominal flow: 0 - 20 mbar,
Operation limits: 0 - 50°C, 0,6 - 1,4 bar abs

Special version with exchangeable filter pressure
drop smaller 3 – 6 mbar
and influence of the filter exchange less 0,3% on
calibration.



Part No.	Process Connection	Dimensions			Nominal flow and pressure decline (+/-10 % Tolerance) at calibration conditions: 1013,25 mbar abs., 21,1 °C, 0,0 %r.H.						
	Nominal Width	L [mm]	Da [mm]	X [mm]	F [mm]	P [mm]	TK [mm]	S [mm]	Qv L/min	Qm g/min	DP mbar
50MR02-02-F	2"	460	50.8	89.5	152,4	152	120,6	15,8	0 - 2800	0 - 3400	0 – 20
50MR02-04-F	4"	800	101.6	172.0	228,6	285	190,5	15,8	0 - 11300	0 - 13600	0 – 20
50MR02-06-F	6"	900	152.1	260.8	279,4	420	241,3	19,0	0 - 28300	0 - 33900	0 – 20
50MR02-08-F	8"	1300	203.8	381.5	342,0	450	298,4	19,0	0 - 63700	0 - 76300	0 – 20