

OVAL WHEEL METER FLOWAL® PLUS

SERIES OR Plus / OF

1. IDENTIFICATION

Manufacturer Bopp & Reuther Messtechnik
Am Neuen Rheinhafen 4
67346 Speyer
Phone: +49 6232 657-0
Fax: +49 6232 657-505

Product type Direct volumetric meter (positive displacement meter)

Product name Oval Wheel Meter of the family Flowal® Plus, series OR Plus / OF

2. RANGE OF APPLICATION

The application area for Oval Wheel Meters of the family Flowal® Plus encompasses the simple, reliable and cost-effective measurement of liquid volumes or volumetric flow rates. They have an extremely robust design and combine years of experience with state-of-the-art technologies. They can be used in various industries, e.g. mechanical engineering,

plant construction, food industry, semiconductor industry, environment industry, automotive industry, etc. Due to the available material combinations, this series is also suitable for measuring aggressive or corrosive media.

3. MEASURING PRINCIPLE AND SYSTEM CONFIGURATION

3.1 Measuring principle

Oval Wheel Meter belong to the group of direct volumetric meters for liquids with movable partition walls (displacement flow meters).

The Oval Wheel Meter consists of a measurement chamber housing with two pivoted oval wheels which are toothed and roll off each other in counter-rotations. Each revolution the oval

wheels displaces a discrete volume of liquid (defined by the space between the oval wheel and measurement chamber) through the chamber.

For measurement purposes, the rotation of the oval wheels is transmitted to a mechanical counter and / or a pulse pick-up via a magnet coupling and gear device.

3.2 System configuration

Oval Wheel Meter of the family Flowal® Plus consists of the following main components:

- measuring transducer: measuring chamber with oval wheels
- pulse pick up or multifunctional electronic



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3.2.1 Pulse pick-up or multifunctional electronic

Type	Function	Power supply	Loading capacity Output	Connection (all M12x1)	Temperature	Ex	Pro-tection
Pulse pick-up							
Reed RM	passive reed sensor for connection to PLC / PLS	via PLC / PLS	max 170V, max 0,5A, max 10W	cable 2m	-25 to 80°	Ex	IP67
NAMUR A1	for connection to NAMUR power supply (approx. 8.2VDC)	via NAMUR supply unit	acc. NAMUR	cable 2m, integrated on the sensor	-25 to 70°C	Ex	
Magnetic field sensor							
N1	open collector sensor NPN	NPN 10 - 30VDC	max 200mA	plug-in connector opt. cable 3m	-25 to 85°	-	IP67
P1	open collector sensor PNP	PNP 10 - 30VDC	max 200mA	plug-in connector opt. cable 3m	-25 to 85°	-	
NT	open collector sensor NPN	NPN 5 - 24VDC	max 25mA	cable 1m, integrated on the sensor	-40 to 125°C	-	
PT	open collector sensor PNP	PNP 18 - 30VDC	max 100mA	cable 2m, integrated on the sensor	-25 to 130°C	-	
Multifunctional electronic							
M1	on-site indicator flow / volume	internal battery	without output	no connection	-20 to 80° -20 to 125° high temperature	-	IP65
MFE1						Ex	
M2	on-site indicator flow / volume with Pulse output	internal battery	pulse output open collector max 30mA	terminal block in the terminal compartment	-20 to 80° -20 to 125° high temperature	-	
MFE2						Ex	
M3	on-site indicator flow / volume with Pulse output and flow-proportional current output; optional return flow detection; memory for density+correction factor for mass conversion; optional PT1000	24VDC (4-20mA) two wire-device	pulse output open collector max 30mA and current output in two-wire technology	terminal block in the terminal compartment	-20 to 80° -20 to 125° high temperature	-	
MFE3						Ex	

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3.2.2 Measuring chamber

Overview: dates of measuring chamber depending on the counter size

Oval wheels: stainless steel - max. 3000 mPa*s*

*with Newtonian properties

Series OR Plus / OF	Measuring Range	Pulses		
		Imp/n	Imp/l	Hz _{max}
015	0,03 - 1	2	~3100	52
06	0,2 - 5	2	~333	28
1	0,4 - 10	2	~166	28
2	1 - 30	2	~100	50
5	2 - 50	2	~40	33
10	4 - 100	2	~20	33
50	15 - 300	2	~4	20
115	35 - 660	2	~1,7	19

Oval wheels: PEEK - max. 150 mPa*s

Series OR Plus / OF	Measuring Range	Pulses		
		Imp/n	Imp/l	Hz _{max}
015	0,03 - 1	2	~3100	52
06	0,2 - 7	2	~333	39
1	0,4 - 14	2	~166	39
2	1 - 30	2	~100	50
5	2 - 60	2	~40	40
10	3 - 120	2	~20	40

4. INPUT

4.1 Measured value

Volume and volumetric flow

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5. Characteristic parameter

5.1 Reference conditions

Due to the high precision manufacturing process the accuracy meets the standard specifications without individual calibration. Optionally the meter can be calibrated on test benches, which can be traced to reference conditions:

5.2 Accuracy

± 0,5 % of measured value
± 0,25 % of measured value (optional at restricted measuring range)

Plastic meters:

OR1 / OR2 / OF2 ± 0,6% of measured value
OR5 / OR10 / OF10 ± 0,8% of measured value

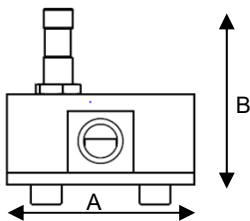
5.3 Repeatability

± 0,02%

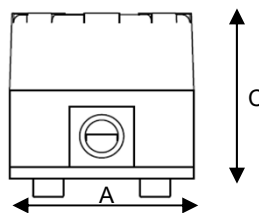
6. CONSTRUCTION DETAILS

6.1 Design / dimensions / weights: OR Plus

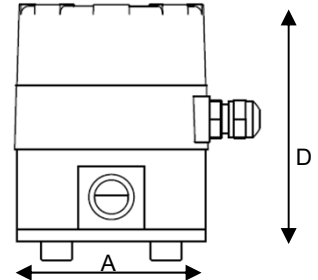
Pulse pick-up



Multifunctional electronic
M1/MFE1



Multifunctional electronic
M2/M3 / MFE2/MFE3



Type OR Plus	A (mm)	C (mm)	B _{max} *, D (mm)	Installation dimension (mm)	PP1PK (kg)	AL1PK (kg)	SS1PK (kg)	SS1SS (kg)	PV1PK (kg)
OR015	78	70	96	73	-	0,6	1,3	1,3	0,6
OR06	78	75	101	73	-	0,6	1,3	1,4	0,6
OR1	78	85	111	73	-	0,7	1,6	1,8	0,6
OR2	99	93	120	90	-	1,5	3,1	3,4	1,1
OR5	112	98	125	102	0,9	1,9	3,8	4,2	1,2
OR10	112	125	152	102	1,4	2,4	4,9	5,6	2,1
OR50	220	187	213	184	-	-	-	31	-
OR115	260	245	271	196	-	-	-	55	-

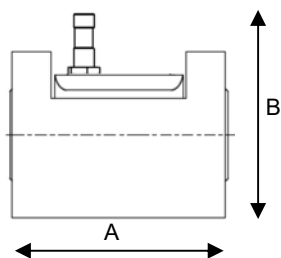
*B_{max} depending on sensor

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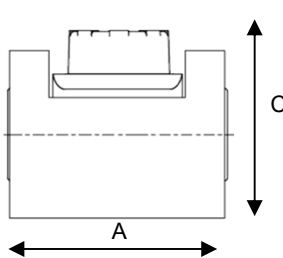
SERIES OR Plus / OF

6.2 Design / dimensions / weights: OF

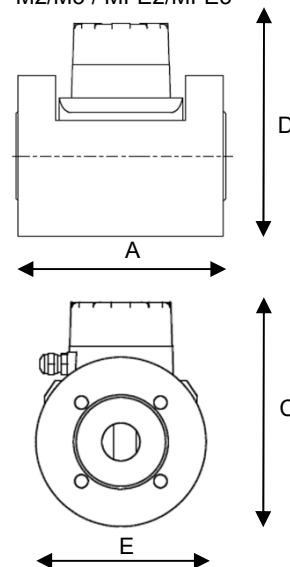
Pulse pick-up



Multifunctional electronic
M1/MFE1



Multifunctional electronic
M2/M3 / MFE2/MFE3



Type OF	A (mm) Installation dimension	C (mm)	B _{max} *, D (mm)	E (mm)	PP1PK (kg)	AL1PK (kg)	SS1PK (kg)	SS1SS (kg)	PV1PK (kg)
OF1	140	108	135	95	-	2,3	6,4	6,6	-
OF2	140	108	135	95	-	2,2	6,2	6,5	1,7
OF10	170	153	180	130	-	5,1	14,2	15	3,8
OF50	184	165	192	220	-	-	-	31	-
OF115	196	243	270	260	-	-	-	55	-

*B_{max} depending on sensor

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6.3 Material

Code	Housing	Oval wheels	Sleeve bearing	Axle	seals
PP1PK	PP	PEEK	PEEK	ceramics stainless steal	Viton
AL1PK	Alu	PEEK	PEEK	stainless steal	Viton
SS1PK	stainless steel	PEEK	PEEK	stainless steel	Viton
SS1SS	stainless steel	stainless steel	coal	stainless steel	Viton
PV1PK	PVDF	PEEK	PEEK	ceramics stainless steal	Viton
PK1PK	PEEK	PEEK	PEEK	ceramics stainless steal	Viton

PK: Polyetheretherketone (PEEK)
 PP: Polypropylene
 PV: Polyvinylidenfluoride (PVDF)
 SS: stainless steel
 AL: Aluminium

Seals: depending on the medium on request: EPDM, FEP (max.PN 25)

7. OPERATING CONDITIONS

7.1 Liquid temperature limit

Depending on the sensor and on the material combination (see 7.4)

7.2 Liquid pressure limit

Depending on the material combination (see 7.4)

7.3 Viscosity

Stainless steel – Oval wheels : OR015: 350 mPa·s
 OR06 up to OR2 / OF2: 1000 mPa·s
 OR5 up to OR115 / OF115: 3000 mPa·s

PEEK – Oval wheels: up to 150 mPa·s

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Material design: SS1SS					
	Viscosity range (mPa·s)				
	0,3 - 1,5	1,5 - 150	150 - 350	350 - 1000	1000 - 3000
Type	Qmin - Qmax (l/min)	Qmin - Qmax (l/min)	Qmin - Qmax (l/min)	Qmin - Qmax (l/min)	Qmin - Qmax (l/min)
OR015	0,03 - 1	0,03 - 1	0,01 - 0,3	-	-
OR06	0,2 - 5	0,2 - 5	0,1 - 1,8	0,05 - 0,6	-
OR1 / OF1	0,4 - 10	0,4 - 10	0,2 - 7,5	0,1 - 2,5	-
OR2 / OF2	1 - 30	1 - 30	0,4 - 11	0,3 - 4	-
OR5	2 - 50	2 - 50	1 - 25	0,6 - 12,5	0,3 - 4,5
OR10 / OF10	4 - 100	4 - 100	2 - 70	1 - 35	1 - 12
OR50 / OF50	15 - 300	15 - 300	4 - 180	3 - 90	2 - 30
OR115 / OF115	35 - 660	35 - 660	10 - 480	6 - 240	3 - 100

Material design: SS1PK / AL1PK / PV1PK / PP1PK					
	Viscosity range (mPa·s)				
	0,3 - 1,5	1,5 - 150	150 - 350	350 - 1000	1000 - 3000
Type	Qmin - Qmax (l/min)	Qmin - Qmax (l/min)	Qmin - Qmax (l/min)	Qmin - Qmax (l/min)	Qmin - Qmax (l/min)
OR015	0,03 - 1	0,03 - 1	-	-	-
OR06	0,2 - 7	0,2 - 7	-	-	-
OR1 / OF1	0,4 - 14	0,4 - 14	-	-	-
OR2 / OF2	1 - 30	1 - 30	-	-	-
OR5	2 - 60	2 - 60	-	-	-
OR10 / OF10	3 - 120	3 - 120	-	-	-

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7.4 Pressure- / temperature range

Series OR Plus	Material Housing / Oval wheels					
	AL1PK	SS1PK	SS1SS	PV1PK	PP1PK	PK1PK
OR015	PN40	PN68	PN 68	PN16	-	-
OR06						PN16
OR1						PN16
OR2				PN10	PN10	-
OR5						
OR10						
OR50				-		-
OR115	-		-			
Temp. range	-10...80°C	-20...70°C	-40...130°C	0...70°C	0...40°C	-20...80°C

Series OF	Material Housing / Oval wheels					
	AL1PK	SS1PK	SS1SS	PV1PK	PP1PK	PK1PK
OF1	Class300 (50,6 bar)			-	-	-
OF2				PN16		
OF10				PN10		
OF50	-		PN40	-		
OF115	-		PN40	-		
Temp. range	-10...80°C	-20...70°C	-40...130°C	0...70°C	-	

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7.5 Process connection

OR Plus: Female threads G $\frac{1}{4}$, G $\frac{1}{2}$, G $\frac{3}{4}$, G1, G2

OR015 G $\frac{1}{4}$
OR06 / OR1 G $\frac{1}{2}$
OR2 G $\frac{3}{4}$
OR5 / OR10 G1
OR50 / OR115 G2

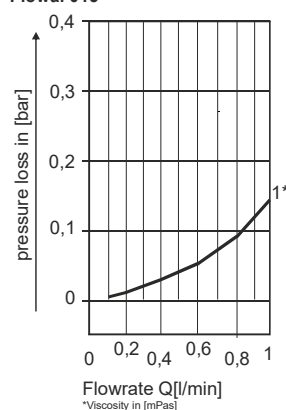
OF: Flanges DIN DN15/25/50; ANSI $\frac{1}{2}$ "/1"/2"

OF1 / OF2 DN15, PN40 (DIN EN 1092-1 form B1)
OF10 DN25, PN40 (DIN EN 1092-1 form B1)
OF50 / OF115 DN50, PN40 (DIN EN 1092-1 form B1)

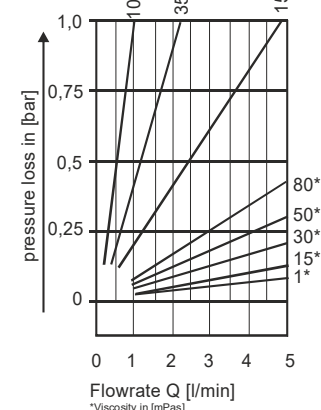
OF1 / OF2 Flange $\frac{1}{2}$ " ANSI 150/300 lbs
OF10 Flange 1" ANSI 150/300 lbs
OF50 / OF115 Flange 2" ANSI 150 lbs

7.6 Pressure loss

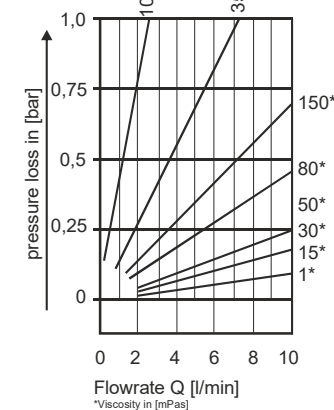
Flowal 015



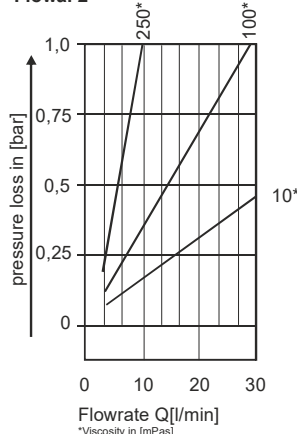
Flowal 06



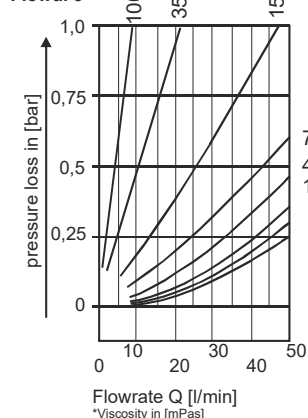
Flowal 1



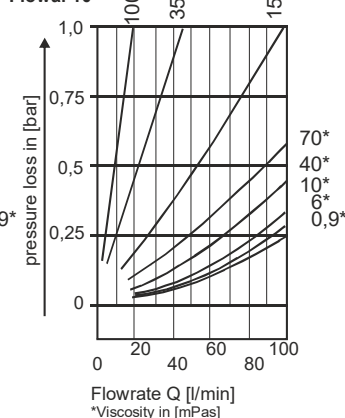
Flowal 2



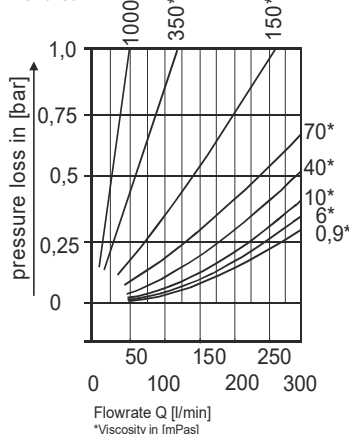
Flowal 5



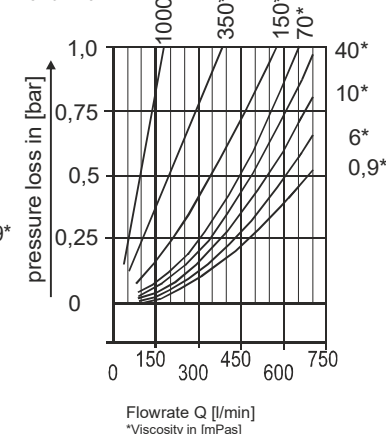
Flowal 10



Flowal 50



Flowal 115



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8. CERTIFICATES AND APPROVALS

**EG-Conformity declaration,
Bopp & Reuther Messtechnik GmbH**

EC type-examination certificate

Directive 2014/34/EU (Ex-protection), IEC-Ex

Directive 2014/30/EU (EMC-Electromagnetic Compatibility)

Directive 2014/68/EU (PED - Pressure Equipment Directive)
fluids in group 1 Classification acc. Article 4, section 3
(according to good engineering practice, designed and
manufactured)

Namur

**Directive 2011/65/EU (RoHS-Restriction of Hazardous
Substances)**

CE Mark:

The measuring system fulfills the legal requirements of the EC Directives 2014/30/EU and 2014/34/EU including all published revisions or amendments to date. Bopp & Reuther Messtechnik GmbH confirms successful device testing and affixing of the CE Mark.

9. DOCUMENTATION

MANUALS

A-EN-01280-00 Operating manual Flowal® Plus Series OR Plus / OF

ACCESSORIES

A-EN-17208-00 Operating manual Multifunctional Electronics MFE1, MFE2, MFE3

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10. MODEL CODE

Flowal®Plus		Oval Wheel Meter, Flowal® Plus Type OR						
Oval wheel meter for measuring of small volumes and volume flow rate								
		Code					Description	
		SS1SS						
Flow rate *	Type							
0,03 – 1 l/min	OR015							
0,2 – 5 l/min	OR06							
0,4 – 10 l/min	OR1							
1 – 30 l/min	OR2							
2 – 50 l/min	OR5							
4 – 100 l/min	OR10							
15 – 300 l/min	OR50							
35 – 660 l/min	OR115							
		AL1PK	SS1PK	PV1PK	PP1PK	PK1PK		
Flow rate *	Type							
0,03 - 1 l/min	OR015				-	-		
0,2 - 7 l/min	OR06				-	-		
0,4 - 14 l/min	OR1				-	On request		
1 - 30 l/min	OR2				-	-		
2 - 60 l/min	OR5				-	-		
3 - 120 l/min	OR10				-	-		
Material								
					-AL1PK			Housing: Aluminium / Wheels : PEEK
					-SS1PK			Housing: stainless steel / Wheels: PEEK
					-SS1SS			Housing: stainless steel / Wheels: stainless steel
					-PV1PK			Housing: PVDF / Wheels: PEEK
					-PP1PK			Housing: Polypropylene / Wheels: PEEK
					-PK1PK			Housing: PEEK / Wheels: PEEK
Threads								
					-G08			Inside thread G 1/4" acc. ISO 228 - only OR015
					-G15			Inside thread G 1/2" acc. ISO 228 - only OR06/1
					-G20			Inside thread G 3/4" acc. ISO 228 - only OR2
					-G25			Inside thread G 1" acc. ISO 228 - only OR5/10
					-G50			Inside thread G 2" acc. ISO 228 - only OR50/115
Flow direction								
					-L			from left to right
					-R			from right to left
					-B			from bottom to top
					-T			from top to bottom
Seal								
					-OO			Viton (FKM)
					-O1			EPDM
					-O2			FEP
Options								
					-O3			Display shouldered (wall mounted)
					-O4			on spacer bolt shouldered display, Tmax. 125°C - only -SS1SS
Output	Sensors - Screw-in sensors M12x1	Ex				/RM		REED, not OR015
		non-Ex				/N1		NPN - non Ex, 10-30 VDC
						/P1		PNP - non Ex, 10-30VDC
						/PT		PNP - non Ex, T max 130°C, 18-30 VDC
						/NT		NPN – non Ex, Tmax 125°C, 5-24 VDC
		Ex				/A1		Namur Sensor acc. to DIN EN 60947-5-6 - Ex
	Multi-function display - Ex	Ex				/MFE1		Volume metering and metered flow display, battery powered
						/MFE2		with impulse output, battery powered
						/MFE3		with impulse- and power output, 10-30 VDC
						/MFE3-VT		with impulse- and power output, 10-30 VDC / Massconverter
	Multi-function display - non Ex	non-Ex				/M1		Volume metering and metered flow display, battery powered
						/M2		with impulse output, battery powered
						/M3		with impulse- and power output, 10-30 VDC
						/M3-VT		with impulse- and power output, 10-30 VDC / Massconverter

Option C: 3-point Calibration with certificate

Suitable strainer: Type L for OR015 and type Y for the remaining sizes

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Flowal®Plus		Oval Wheel Meter, Flowal® Plus type OF					
Oval wheel meter for measuring of small volumes and volume flow rate							
		Code				Description	
Flow rate *	Typ	SS1SS					
1 - 30 l/min	OF2						
4 - 100 l/min	OF10						
15 - 300 l/min	OF50						
35 - 660 l/min	OF115						
Flow rate *	Typ	AL1PK	SS1PK	PP1PK	PV1PK		
1 - 30 l/min	OF2						
3 - 120 l/min	OF10						
Material					-AL1PK -SS1PK -SS1SS -PP1PK -PV1PK	Housing: Aluminium / Wheels : PEEK Housing: stainless steel / Wheels: PEEK Housing: stainless steel / Wheels: stainless steel Housing: Polypropylene / Wheels: PEEK; in preparation Housing: PVDF / Wheels: PEEK; in preparation	
Flanges					-F15HB -F25HB -F50HB -A15RR -A25RR -A50RR -A15SR -A25SR	DN15 PN40 DIN EN 1092-1 Form B1 - only OF2 DN25 PN40 DIN EN 1092-1 Form B1 - only OF10 DN50 PN40 DIN EN 1092-1 Form B1 - only OF50/115 1/2" ANSI 150 RF - only OF2 1" ANSI 150 RF - only OF10 2" ANSI 150 RF - only OF50/115 1/2" ANSI 300 RF - only OF2 1" ANSI 300 RF - only OF10	
Flow direction					-L -R -B -T	from left to right from right to left from bottom to top from top to bottom	
Seal					-OO -O1 -O2	Viton (FKM) EPDM FEP	
Options					-O3 -O4	Display shouldered (wall mounted) on spacer bolt shouldered display, Tmax. 125°C - only -SS1SS	
Output	Sensors - Screw-in sensors M12x1	Ex non-Ex			/RM /N1 /P1 /PT /NT /A1	REED NPN - non Ex, 10-30 VDC PNP - non Ex, 10-30 VDC PNP - non Ex, T max 130°C, 18-30 VDC NPN - non Ex, T max 125°C, 5-24 VDC Namur Sensor acc. to DIN EN 60947-5-6 - Ex	
	Multi-function display - Ex	Ex			/MFE1 /MFE2 /MFE3 /MFE3-VT	Volume metering and metered flow display, battery powered with impulse output, battery powered with impulse- and power output, 10-30 VDC with impulse- and power output, 10-30 VDC / Massconverter	
	Multi-function display - non Ex	non-Ex			/M1 /M2 /M3 /M3-VT	Volume metering and metered flow display, battery powered with impulse output, battery powered with impulse- and power output, 10-30 VDC with impulse- and power output, 10-30 VDC / Massconverter	

Option C: 3-point Calibration with certificate

Suitable strainer: Type Y