Schmidt Mess- und Regeltechnik

Operating Manual
Oval Wheel Meter Flowal® Plus OR / OF
Oval wheel meter for liquids

B-EN-OR-OF-20220118

Fon 0 67 32 - 91 91 20 Fax 0 67 32 - 96 24 42 info@schmidt-messtechnik.de

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1. Forward

1.1. Transport, Delivery, Storage
Always protect devices against humidity, soiling, impacts and damages

Delivery Inspection
Check the delivery for completeness upon receipt. Compare the device data with the data on the delivery note and in the order records.
Report any in-transit damage immediately. Damage reported at a later date shall not be recognized.

1.2. Warranty
Please refer the contractual terms and conditions relating to delivery for the scope and period of warranty.
Warranty claims shall be conditional to correct installation and commissioning in accordance with the operating instructions of the device.
The necessary installation, commissioning and maintenance work should only be carried out by qualified and authorized personnel.

1.3. General safety instructions
1. Oval wheel meters are reliable, high accurate volumetric measuring devices. They should only be used for their intended purpose. Always observe the pressure and temperature limits stated on the type plate, as well as all other technical data and safety information during device installation, start-up and operation.
2. Always observe national and international regulations concerning the operation of devices and systems under pressure.
3. Prior to installation, the operator has to ensure that the pressure bearing parts have not been damaged during transportation.
4. The devices have to be installed, operated and serviced by qualified personnel. The operator has the responsibility to ensure that the personnel have received sufficient and appropriate training. In cause of doubt, please contact the manufacturer.
5. The operator must ensure that the materials used (wetted parts) of the device compared with the measured liquid are chemically resistant.
6. The gaskets or sealing elements must be handled with care according to the operating instructions.
7. Symbols used

Warning!
Failure to observe this warning can lead to injury of persons or a security risk.

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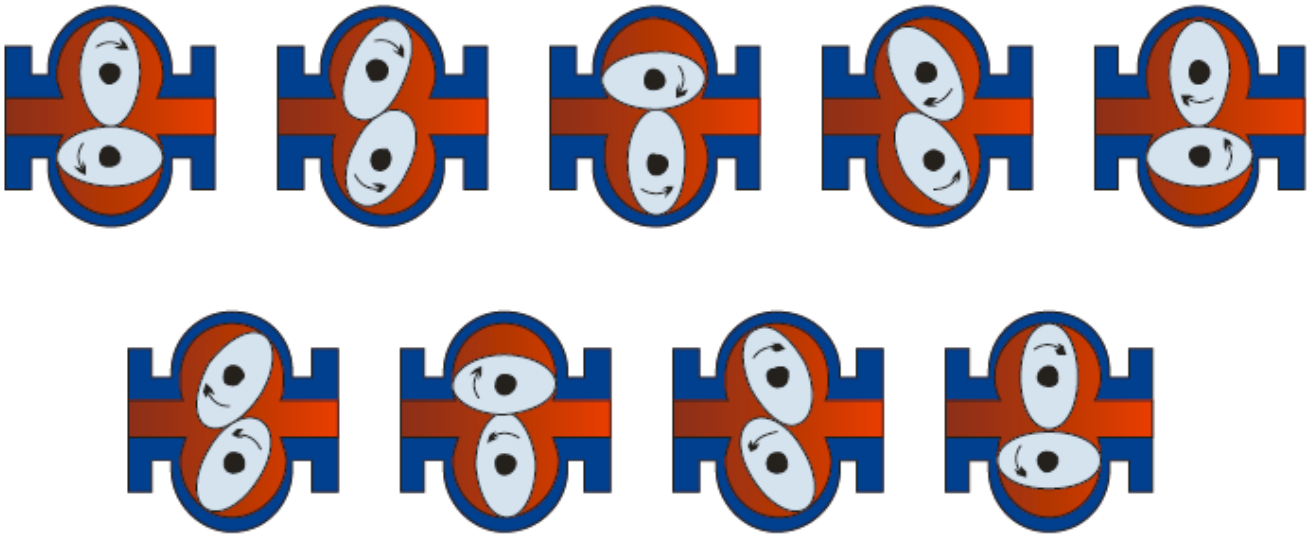
Attention!
Non-compliance can lead to faulty operation or damage to the device.

2. Area of Application
The application area for oval wheel meters 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 Design
3.1 Measuring Principle
belongs to the group of direct volumetric meters for liquids with movable partition walls (displacement flow meters).
The oval wheel meter consists of measurement chamber housing with two pivoted oval wheels which are toothed and roll off each other in counterrotations.
The diagram displays oval wheel movement during the measurement process.



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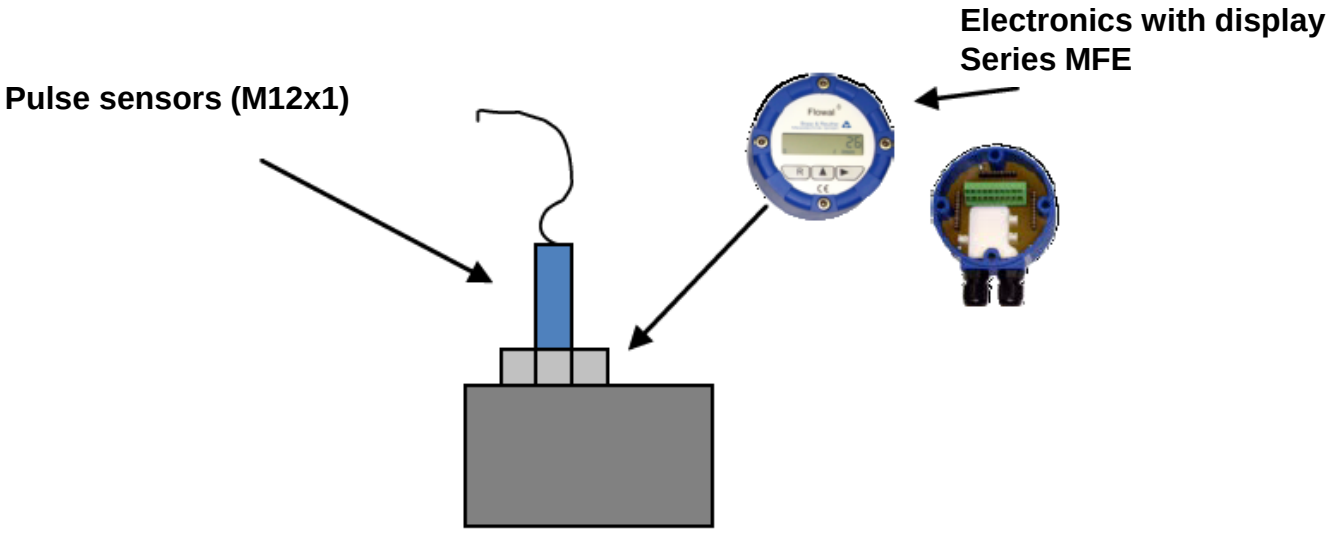
Each revolution the oval wheels displaces a discrete volume of liquid (defined by the space between the oval wheel and measurement chamber) through the chamber.
For measurement purposes, the rotation of the oval wheels is transmitted to a mechanical counter and/or a pulse pick-up via a magnet coupling and gear device.

3.2 System Design
Oval wheel meter Flowal® Plus consists of the following main components:
- measuring transducer (measuring chamber with oval wheels)
- pulse sensors/ electronic with display



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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, iintegrated 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	

Installation note:
Screw the sensor to stop and then turn back as far as can be detected up signals (eg, control of flashing LED on the connector).

See Operation manual Multifunctional electronics MFE1, 2 and 3

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3.2.2 Measuring chamber
Overview: Dates of measuring chamber depending on the pick-up, and counter size

*with Newtonian flow properties

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

Series OR Plus / OF	Measuring range	Pulses		
	l/min	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

Ova wheels: **PEEK**
max. 150 mPa•s

Type OR Plus / OF	Measuring range	Pulses		
	l/min	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

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4. Input
4.1. Measured values
Volume and Volume flow

5. Output
5.1. Pulse pick-up
Original pulses (e.g. see 3.2.1.)

5.2. Output signal
Output signals are dependent of the used evaluation system; see operating manual Multifunctional electronics MFE1, 2 and 3.

M2 / MFE2: scalable pulses
M3 / MFE3: scalable pulses , current output 4-20mA

6. Characteristic Parameters
6.1. Reference conditions
All oval wheel counters are calibrated at test benches approved for fiscal metering with the following reference conditions:
pressure: 2 to 7 bar, temperature: 20°C
liquid: 3 mPa·s

6.2. Tolerated deviation
± 0,5% of measured value
± 0,5% of measured value (optional at restricted measuring range 1:10)

Plastic meters (PV1PK / PP1PK)

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

6.3. Repeatability
< 0,02%

6.4. Influence of ambient temperature
includs in the measuring deviation

6.5. Influence of media temperature
Depending on viscosity of measured media

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7. Operating Conditions
7.1. Installation conditions
7.1.1. Installation instructions

Warning!
Before mounting and operating the device, carefully read and observe the installation instructions.
Before mounting or **disassembling** the device, depressurize and **cool down the system**.

7.1.1.1. General information
- Only trained personnel who have been authorized by the system operator are allowed to perform assembly, electrical installations, commissioning, maintenance and operation. You must have read and understood the instructions and follow their instructions strictly.
- These oval wheel meters are precision flow meters. Inlet and outlet are covered with protective caps against foreign substances. Remove caps shortly before putting the device into operation.
- As indicated on the type plate parameters are maximum values and must not be exceeded. Operating parameters are specified in the contract documents. If you want to use the device under differing operating conditions, consult Schmidt Mess- und Regeltechnik indicating the factory number.
- Install the oval wheel meter in the pressure pipe behind the pump (approximately 3 m liquid column pressure drop for nominal flow rate).
- Install the oval wheel meter in such a way, that it remains filled with liquid also in non-operating condition.
- To avoid measuring inaccuracies due to gas bubbles or contamination, preventive measures must be taken (e.g. gas separator or type N strainer)..
- Oval wheel meters intended for liquid food products must be cleaned thoroughly before putting them into operation (see Maintenance and Cleaning).

7.1.1.2. Installation
- Remove any impurities from the pipework. When doing so, replace the oval wheel meter with a suitable piece of piping.
- Do not remove the caps on the in- and outlet of the oval wheel meter until the device is being installed to prevent the penetration of foreign substances.
- Any flow direction, if applicable note the arrow on the housing of the oval wheel meter
- The housing cover of the oval wheel meter is to be placed vertically so that the axes of the oval wheel are in a horizontal position independent of the position of the pipe.
- The oval wheel meter must be installed free from strain.

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Oval wheel meter correctly installed

horizontal pipeline

vertical pipeline

Wrong !

7.1.2 Start-up conditions

Attention!
Start the oval wheel meter with slowly increasing the flow.

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7.1.3. Exchange of sensors
The sensors (for the pulse pick, if applicable for temperature measurement) can be exchanged under operating conditions.

Warning!
Depending on the temperature risk of burns!

7.2. Ambient conditions
7.2.1. Ambient temperature
Depending on used electronics.

7.2.2. Storage temperature
+10 C to +55° C

7.2.3. Degree of protection
IP 65
According to IEC 529 / EN 60529

7.2.4. Electromagnetic compatibility
According to Guideline EMV 2014/30/EU (EMV-Guideline)
EN 61000-6-2 Immunity for industrial environments
EN 61000-6-3 Immunity residential area

7.3. Process conditions
7.3.1. State of aggregation
Suitable for liquids

7.3.2. Flow limit
Depending on the measuring chamber, see 3.2.2 Measuring Chamber

7.3.3. Viscosity

Oval wheels in stainless steel:	OR 015:	350 mPa·s
	OR 06 bis OR/OF 2:	1000 mPa·s
	OR 5 bis OR/OF 115:	3000 mPa·s

Oval wheels in PEEK: up to 150 mPa·s

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7.3.4. Liquid temperature limits
Depending on the sensor and on the material combination (see 7.3.6)

7.3.5. Liquid pressure limits
Depending on the material combination (see 7.3.6)

7.3.6. Table pressure / temperature range

Series OR Plus	Material Housing / Oval wheel					
	AL1PK	SS1PK	SS1SS	PV1PK	PP1PK	PK1PK
OR015	PN40	PN68	PN 68	PN16	-	-
OR06						
OR1						PN16
OR2						-
OR5				PN10	PN10	
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 wheel					
	AL1PK	SS1PK	SS1SS	PV1PK	PP1PK	PK1PK
OF1	Class300 (50,6 bar)			-	-	
OF2				PN16		
OF10				PN10		
OF50	-		PN40	-		
OF115						
Temp. range	-10…80°C	-20...70°C	-40...130°C	0...70°C	-	

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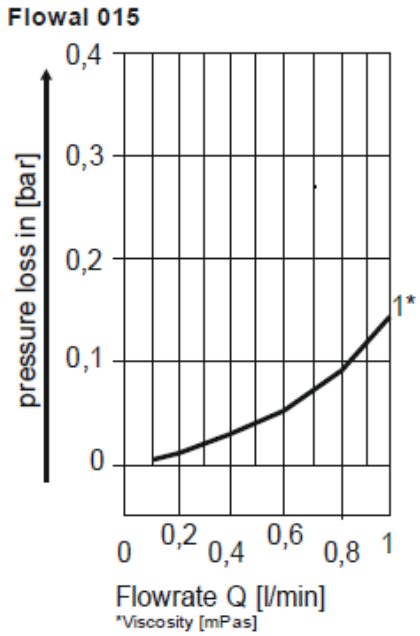
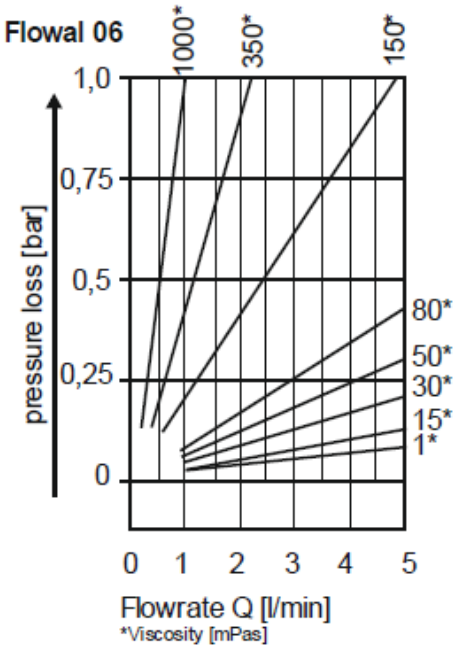
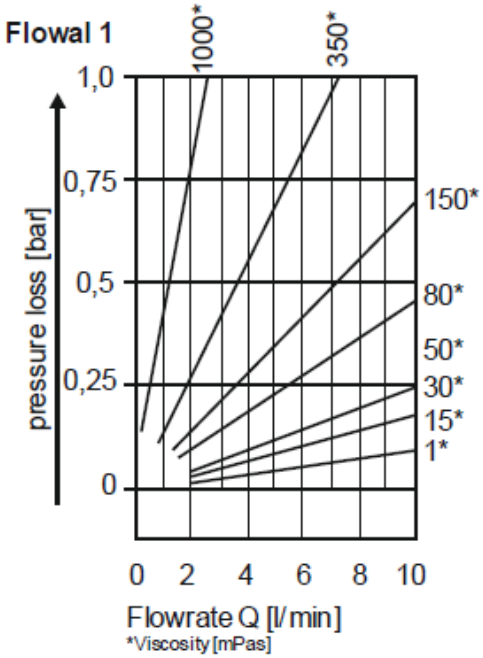
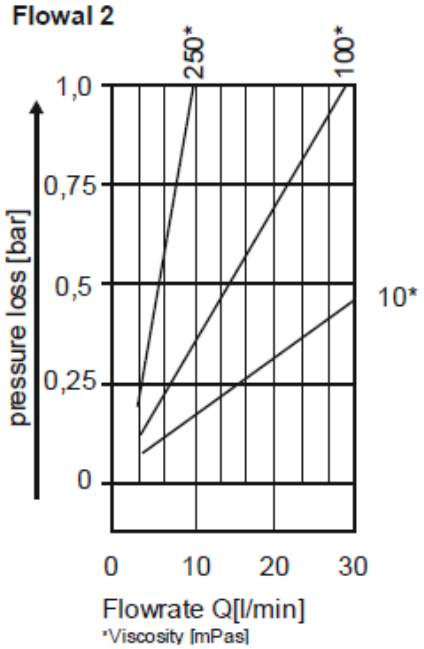
7.3.7. Pressure loss









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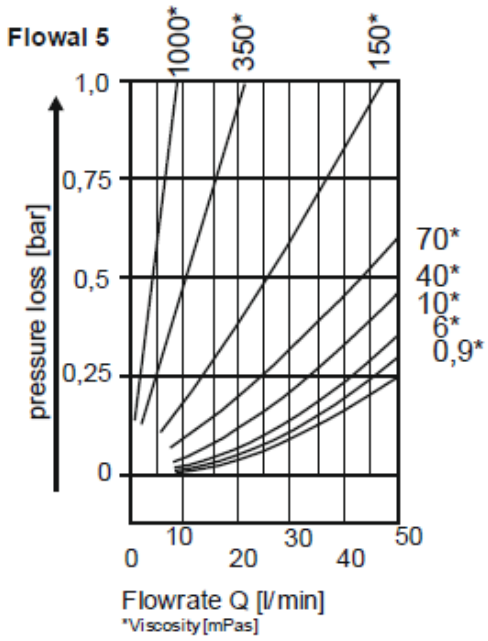

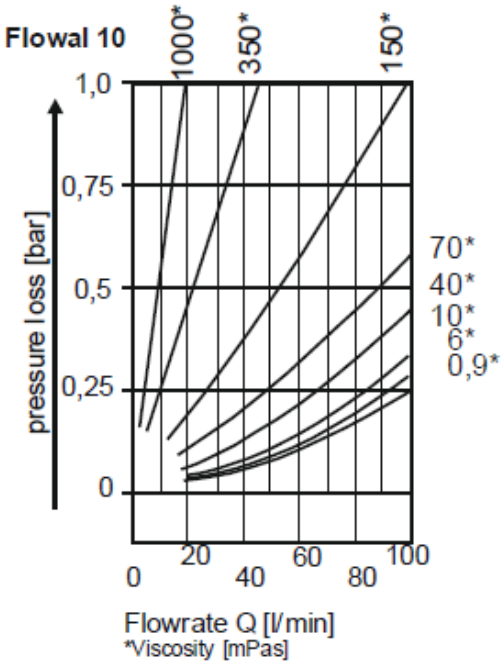

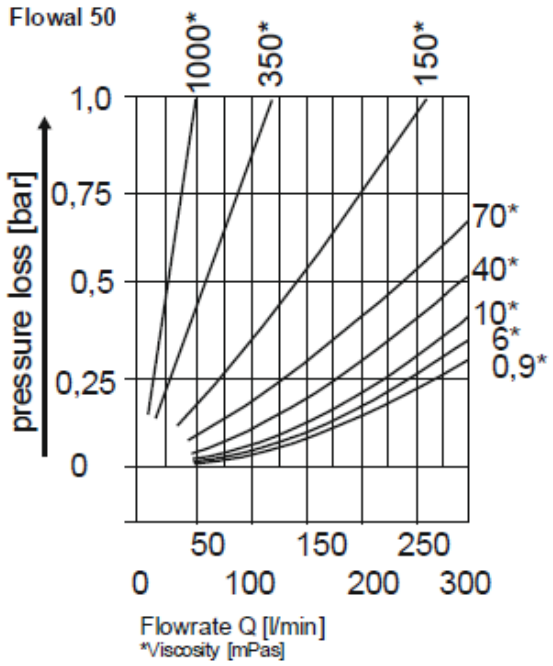

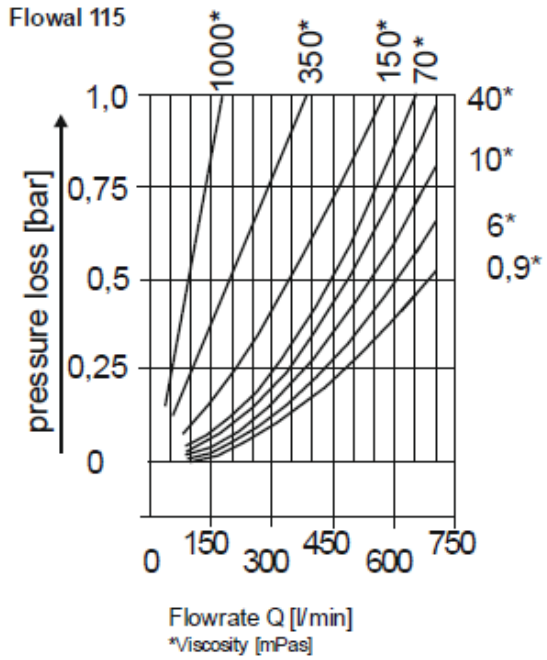

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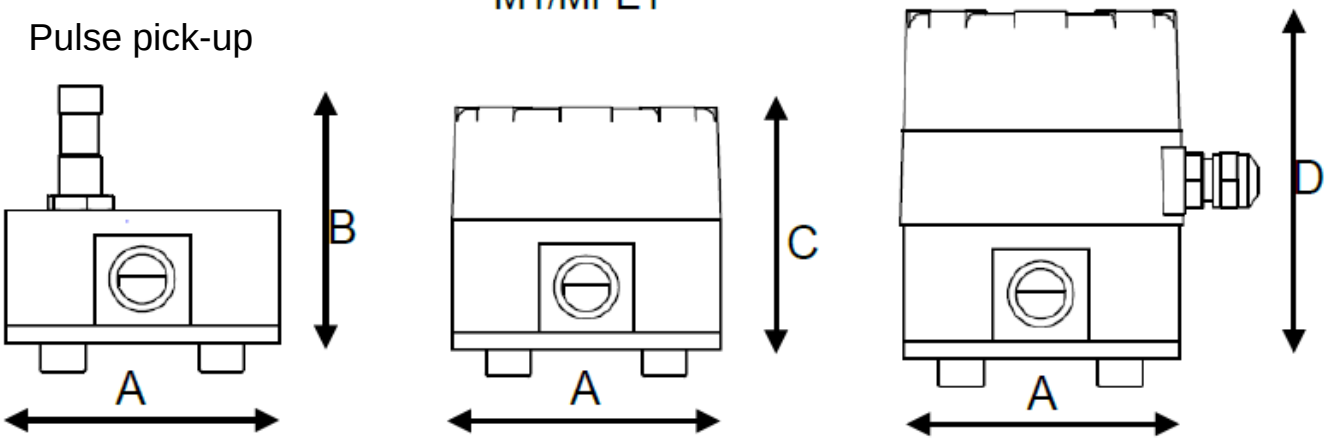
8. Constructive Design
8.1. Model/Dimensions/Weights
8.1.1. Flowal® Plus, OR

Multifunctional electronics

M2/M3/MFE2/MFE3

M1/MFE1

Pulse pick-up



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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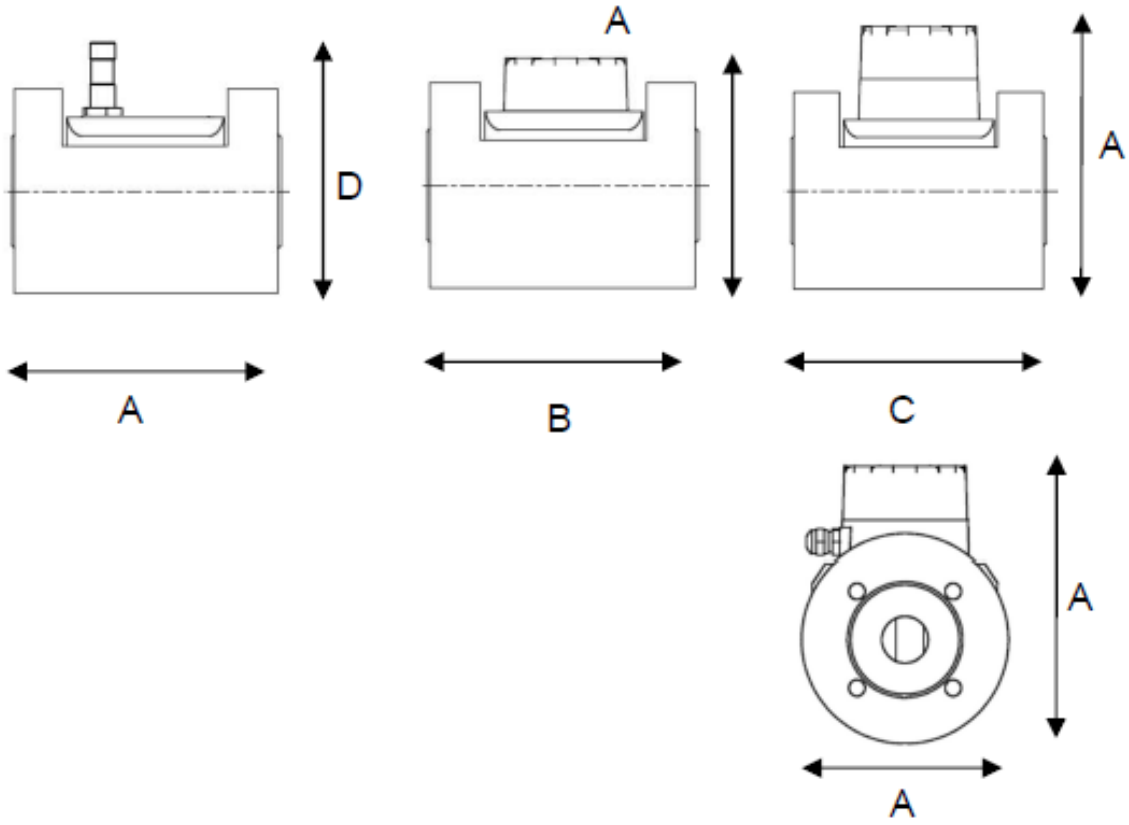
8.1.2. Flowal® Plus, OF

Multifunctional electronics

M2/M3/MFE2/MFE3

M1/MFE1

Pulse pick-up



Type OF	A (mm) **Installation dimenson**	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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8.2. Materials

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

PK: Polyetheretherketone (PEEK)
PP: Polypropylene
PV: Polyvinylidenefluoride (PVDF)
SS: stainless steel
AL: Aluminum
Seals: depending on the medium on request: EPDM, FEP (max.PN 25)

8.3. Process connection

Flowal® Plus	
OR Plus	Female threads G¼, G½, G¾, G1, G2
OF	Flanges DIN DN15/25/50; ANSI ½“/1“/2“

DN15, PN40 (DIN EN 1092-1 form B1)
DN25, PN40 (DIN EN 1092-1 form B1)
DN50, PN40 (DIN EN 1092-1 form B1)

Flanges ½“ ANSI 150 lbs
Flanges 1“ ANSI 150 lbs
Flanges 2“ ANSI 150 lbs

Flangse ½“ ANSI 300 lbs
Flanges 1“ ANSI 300 lbs

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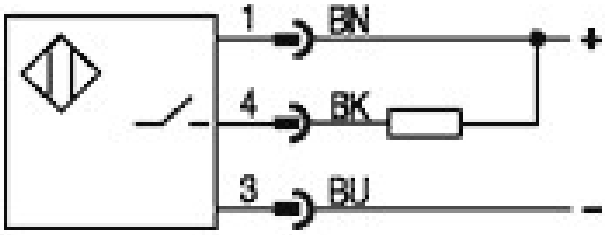
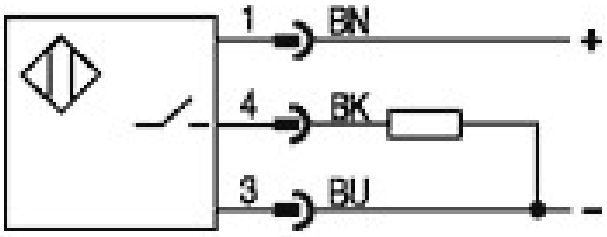
8.4. Electrical connection
8.4.1. Electrical connection for pulse pick-up without MFE

Magnet field sensor
NPN

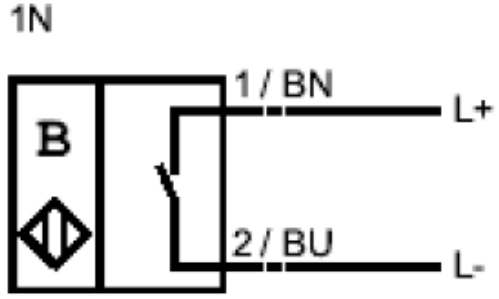


Magnet field sensor
PNP

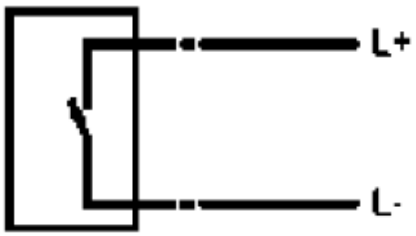


Attention!
When installing in hazardous areas, each national installation regulations must be observed (for Germany: EN 60079-14 and VDE 0165).

Namur-Sensor A1
RM



Reedsensor R1



8.4.2 Electrical for pulse pick-up with MFE
See operating manual Multifunctional electronics MFE 1, 2 and 3

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9. Indicator
9.1. General
The oval wheel meter series Flowal® Plus are set at the factory on request to the operating conditions specified in the order. The values which are set in the electronic display are shown in the attached data sheet configuration.

9.2. Electronic indicator
The electronic indicator Type MFE1, MFE2 or MFE3 (Code: M1, M2, M3) evaluates the original impulses of an oval wheel meter in a quantity or flow indicator. The indicator is an LC Display.

Multifunctional electronic	**Standard**	Ex
Battery-powered display	M1	MFE1
Battery-powered display, pulse output	M2	MFE2
pulse output, current output 4-20mA, PT 1000 input, 2nd signal input for forward and return flow detection (with 2nd sensor), memory for density and correction factor, powered directly by the current loop	M3	MFE3

(See operating manual Multifunctional electronics MFE1, 2 and 3

9.3. Pulse value, K-Factor
The volume or the flow rate is calculated using a multiplication of the pulses generated with the device-specific K-factor.
For devices that are supplied with calibration, you receive a test certificate with your device, the device-specific pulse factor (K factor) in pulses per liter will be listed. This K factor is also specified on the device. If the device is supplied without calibration, the standard K factor should be used (see 3.2.2).

10. Certificates and Approvals
Electromagnetic compatibility according to EN 61000-6-3, EN 61000-6-2

Pressure Equipment Directive: According to the Pressure Equipment Directive 97/23/EG, the oval wheel meters of the Flowal series are suitable for group 1 liquids
Classification according to Article 3, §3 (designed and manufactured according to Good Engineering Practice)

CE mark: The measuring system meets the legal requirements of the EC directives 2004/108/EC and 94/9/EC including the changes or supplements published to date.

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Appendix
A. Troubleshooting/Error Detection
The oval wheel meter series Flowal® Plus operates maintenance-free. If a fault occurs or there is suspicion of an incorrect message, check the installation conditions as stated in section 7.

Warning!
Always observe local regulations and all the safety instructions in these operating instructions when working at the electrical connections.

General
If the fault cannot be detected, please contact the service department of Schmidt Mess- und Regeltechnik or return the device for repair work to Schmidt Mess- und Regeltechnik (see Appendix B2).

B. Maintenance, Cleaning, Repairs, Hazardous Substances
B.1 Maintenance, Cleaning
If the oval wheel meter will not be in operation for a longer period of time, it has to be dismounted, thoroughly cleaned and conserved with acid-free oil. Oval wheel meters used for liquid food may not be preserved in this way. In- and outlet are to be covered with caps. Make sure to store the oval wheel meter in a dry room.

Cleaning of the oval wheel meters
The oval wheels have to be dismounted if the pipes are flushed with hot water..
- Loosen the screws on housing cover, lift housing cover with pressure screws, pull off oval wheels from axle, handle with great care, do not place on stone floors, use support made of wood or rubber material.
- When mounting, put on the oval wheels toothed in, i.e. in a way that the M marks on the wheel face each other. Turn the oval wheel manually to make sure they are properly inserted (once). When inserting the gaskets, make sure it fits precisely.

Fon 0 67 32 - 91 91 20 Fax 0 67 32 - 96 24 42 info@schmidt-messtechnik.de

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B.2 Repair / Hazardous Media

Before sending the oval wheel meter to Schmidt Mess- und Regeltechnik, make sure to observe the following:

- Attach a declaration of contamination describing the malfunction, state the application field and the chemical/physical properties of the media (please find the respective form in appendix)
- Remove all residues of the media and pay special attention to sealing grooves and slits. This is of extreme importance if the medium is hazardous to health, i.e. caustic, toxic, carcinogenic or radioactive etc.
- Please do not return the device if you are not perfectly sure that all media hazardous to health have been cleaned off. Costs incurred due to inadequate cleaning of the device and possible costs for disposal and/or personal injuries (causticization etc.) will be billed to the operating company.

Please ask our customer service for help and advice if your oval wheel meter does not work properly.

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C. Form
C.1. Declaration on contamination of products and components

DECLARATION ON CONTAMINATION OF PRODUCTS AND COMPONENTS

Please complete this form and return in advance by Fax to +49 (0) 6232 / 657 561 in order to receive an equipment return authorisation (ERA) number. No action to repair or examine the product will be done, until a valid declaration of contamination has been received.

ERA number: _____

Contact information

Company name + address	Contact person
	Name:
	Phone:
	E-Mail:

Product information

Type: Id. no.: Serial no.:

Reason for return (e.g. calibration, repair). Please describe in detail.

Contamination information

The product was contaminated with:

☐	poisonous	☐	corrosive, irritant	☐	flammable
☐	hazardous	☐	oxidizing	☐	cancer-causing, health hazard
☐	explosive	☐	environmental hazardous	☐	other: _____

The product was cleaned with: _____

Packaging and shipping Instructions

- remove any cables, connectors, separate filters and mounting materials
- double bag each item in suitable protective foil (sealed)
- transport in suitable shipping container (e.g. original B & R shipping container) and include a copy of this declaration form at
- the shipping documents to the outside

By signing this form you are accepting full responsibility for its contents and confirming that any decontamination has taken place in accordance with legal regulations.

Print name: Date:

Legally valid signature:

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Important notes!
Technical changes and errors excepted.

These operating instructions are an integral part of the device and must be kept accessible to the personnel in the immediate vicinity of the device at all times. Persons who install, operate or service this device must read and understand these operating instructions carefully before starting any work. All safety instructions and instructions in this manual must be adhered to. In addition, the local accident prevention regulations and general safety regulations for the area of application of the device as well as all national and international legal regulations and technical standards apply.

All illustrations in this operating manual serve the basic understanding. Photos can be examples of a variant. The illustrations may differ from the actual design of the units. No claims can be deduced from any deviations.

The device has been designed and constructed exclusively for the intended use described here.

Persons installing, operating or maintaining this device must be technically qualified personnel and must comply with the applicable accident prevention regulations.

limitations of liability
All information and instructions in this operating manual have been compiled taking into account the applicable standards and regulations, the state of the art as well as our many years of knowledge and experience. Schmidt Mess- und Regeltechnik accepts no liability for damage due to

- Failure to observe this manual
- Improper use of the device
- Working by untrained personnel with this device
- Unauthorized modifications or technical modifications not approved by the manufacturer
- Use of unauthorized spare parts

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