VZO 15...50

Technical data [1]

- Volume display on roller counter, in litres
- fuel oil meter with threaded or flanged ends
- for horizontal, vertical or inclined mounting

Option: Reed pulser or RV / IN pulser

Versions available on request:
- different flange drillings, such as ANSI, JIS
- meters in US gallons [2] (option)

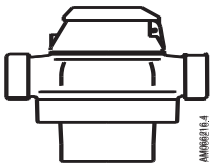
Type			**VZO 15**	**VZO 20**	**VZO 25**	**VZO 40**	**VZO 50**
Nominal diameter	**DN**	**mm**	**15**	**20**	**25**	**40**	**50**
		inch	1/2	3/4	1	1 1/2	2
Installation length		mm	165	165	190	300	350
Nominal pressure with threaded ends	PN	bar	16				
with flanges	PN	bar	25, 40				
Maximum temperature	T_{max}	° C	130, 180				
Maximum flow rate	Q_{max} [3]	l/h	600	1 500	3 000	9 000	30 000
Nominal flow rate	**Q_{cont} [3]**	**l/h**	**400**	**1 000**	**2 000**	**6 000**	**20 000**
Minimal flow rate	Q_{min}	l/h	10 [4]	30	75	225	750
Approx. starting flow rate		l/h	4	12	30	90	300
Max. permissible error			±1 % of actual value				
Repeatability			±0.2 %				
Safety filter mesh size		mm	0.400	0.400	0.400	0.800	0.800
Dirt filter mesh size		**mm**	**0.250**	**0.400**	**0.400**	**0.600**	**0.600**
Volume of the measuring chamber		approx. cm^3	12	36	100	330	1200
Housing finish			enamelled red RAL 3013				
Weight with threaded ends [5]		approx. kg	2.2	2.5	4.2	17.3	–
with flanges PN 25		approx. kg	3.8	4.5	7.5	20.3	41.0
with flanges PN 40		approx. kg	4.4	5.5	7.8	20.5	42.0
Smallest readable amount		l	0.01	0.1	0.1	0.1	1
Registration capacity		m^3	1 000	10 000	10 000	10 000	100 000
Registration time at Q_{cont} until overrunning to zero		h	2500	10 000	5000	1667	5 000
Pulse values of pulsers:							
IN inductive according to IEC 60947-5-6		l/pulse	0.01	0.01	0.1	0.1	1
RV Reed		l/pulse	0.1	1	1	1	10
RV Reed		l/pulse	1	–	–	10	100
Pulse frequency IN	at Q_{max}	Hz	16.667	41.667	8.333	25.000	8.333
	at Q_{min}	Hz	0.278	0.833	0.208	0.625	0.208

1) Manufacturer's specification, valid for the reference conditions as specified under Meter data.
2) 1 US gallon corresponds to 3.785 litres
3) For burners and engines or motors, the meter must be selected on the basis of the permanent flow rate. For higher viscosities, or if the meter is installed on the suction side, the pressure drop and any reduction in the measuring range must also be taken into consideration.
4) Min. flow rate VZO 15 with IN-pulser: 15 l/h
5) Weight without couplings.

Pressure drop curves

See Meter data

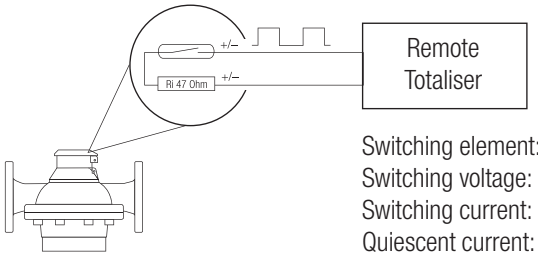
Dimensions

Type	mm	VZO 15	VZO 20	VZO 25	VZO 40	VZO 50
	Length	165	165	190	300	350
	Width	105	105	130	210	280
	Typ ... 130 °C					
	Height	106	115	142	235	291
	Height -RV	130	139	166	259	315
	Height -IN	185	194	221	273	329
	Typ ... 180 °C					
	Height	147	156	183	235	291
	Height -RV	171	180	207	259	315
	Height -IN	225	234	261	313	369

Detailed dimensional diagrams in "APPENDIX: Meter data".

RV Pulsers

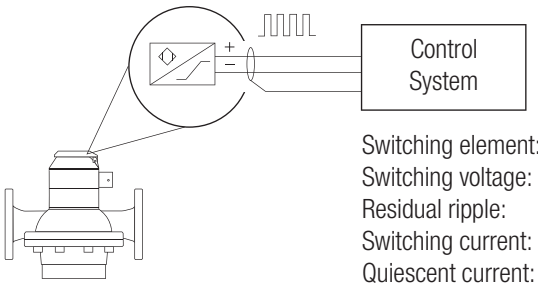
This type of pulser is integrated into the roller counter and thus is especially appropriate for remote totalisation. For other applications the IN inductive pulser is preferable.



Switching element:	• Reed switch with dry contact (inert gas)
Switching voltage:	• max. 48 VAC/DC, Protection class III (SELV)
Switching current:	• max. 50 mA (Ri = 47 Ω/0.5 W)
Quiescent current:	• Open Contact
Switching power:	• max. 2 W
ON-time:	• 50 % ±10 %
Temperature:	• Ambient -10...+70 °C
Protection class:	• IP 65 (IEC 60529) against dust and water-jets
Connections:	• Cast-in cable, length 3 m
Cable cross section:	• 2 x 0.14 mm²

IN Pulsers

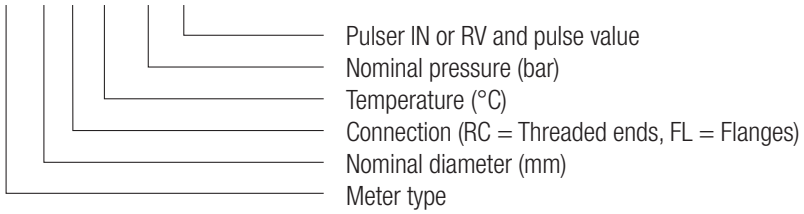
Pulser for industrial applications. Supplied with plug-in pulser sensor.



Switching element:	• Inductiv slot initiator according to IEC 60947-5-6
Switching voltage:	• 5...15 VDC
Residual ripple:	• max. 5 %
Switching current:	• >3 mA at 8 VDC / 1 kΩ
Quiescent current:	• <1 mA at 8 VDC / 1 kΩ
ON-time:	• 50 % ±10 %
Ambient temperature:	• -10...+70° C
Protection class:	• IP 65 (IEC 60529) against dust and water-jets
Connections:	• Pulser supplied with special plug. Required cable min. 2 x 0.35 mm² and 4...6 mm external diameter or the cable is already mounted if the option "Order No. 80019" is chosen.
Option:	• Cable mounted, 2 x 0.5 mm², PVC black, length 3 m (Order No. 80019)

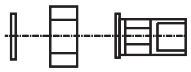
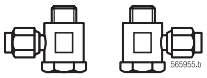
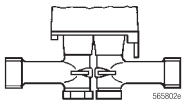
Type designation key

VZO 25 FL 130/25-IN 0.1

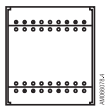


Accessories

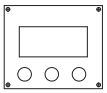
Ordering details for accessories

	Type	Description	Order No.
Threaded connections 	VSR 1/2"	for DN 15	81160
	VSR 3/4" 3 1/2"	for DN 20	81163
	VSR 3/4"	for DN 20	81166
	VSR 1"	for DN 25	81169
	VSR 1 1/2"	for DN 40	81181
Threaded connections kit 	PS-Kit VZO 4	1/8" – 8	81583
Mounting kit 	PS-Kit VZO 8	Mounting Kit	81130
	VSR 3/8"	Threaded connections to suit PS-Kit VZO 8	81156

Order details for supplementary equipment

	Type	Description	Order No.
Isolated switch amplifier 	Ex version	with relay output, max. 10 Hz	81705
	Ex version	with electronic output, max. 5 kHz	80013

Order details for supplementary equipment with mounting kits

	Type	Description	Order No.
Transducers 	Flow calculator	freely programmable, with analogue output 4...20 mA, indication of flow rate, limiting values	92439
	Differential flow calculator	freely programmable, with analogue output 4...20 mA, indication of flow rate, limiting values. Both inputs can be read out individually.	92440
	Frequency current converter	freely programmable.	92439
Mounting kit	Kit	for wall mounting or on DIN-35 mm rail	on request

Meter data

Function

CONTOIL® flow meters work on the volumetric principle of rotary piston meters (positive displacement meters).
The main features of this measuring principle are large measuring ranges, high accuracy, suitability for high viscosities and independence from power supply; flow disturbances do not influence proper operation.

Construction

Rotary piston, guide roller and drive are the only moving parts in contact with the liquid. Their movement is transmitted by a magnetic coupling through a sealing plate. The hydraulic part is completely separated from the totalising module.

VZF/VZFA 15 ... 50
Connections are made radially with two cable entries underneath the display unit which can be mounted and rotated through 90° steps.

VZO/VZOA 15 … 50
With the exception of the counter with the RV Reed pulser, the roller counter can be rotated through 360° for optimum readability.

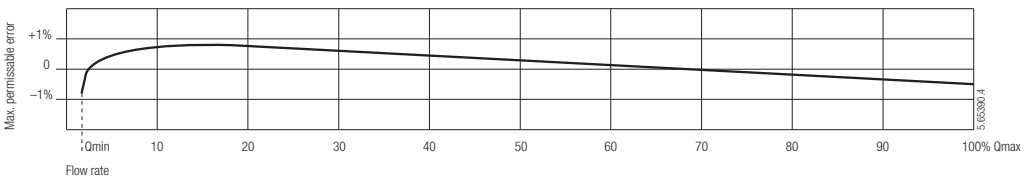
VZO/VZOA 4 and 8
The connections for the inlet and outlet are situated vertically from below in the base plate. With the OEM meter version the connections are situated on the side.

Measuring error limits: Reference conditions

Measuring error limits according to technical data of meter in % of actual value for the whole measuring range.

Reference conditions

Liquid: Calibration oil similar to extra light heating oil, density at 20 °C = 814 kg/m^3
Viscosity = 5.0 mm^2/s according to DIN 51757 / ISO 3104 (corresponds to 4.1 mPa.s)
Temperature: 18...25 °C
Horizontal mounting, readings from counter.
CONTOIL® Oil meters are never to be tested with water, otherwise they will get damaged.



Pressure drop curves

Viscosity information

Kinematic viscosity	Stokes, Centi-Stokes, mm^2/s	St, cSt, mm^2/s
Dynamic viscosity	Pascal seconds, millipascal seconds	Pas, mPa.s
	Poise, Centipoise (outmoded)	P, cP

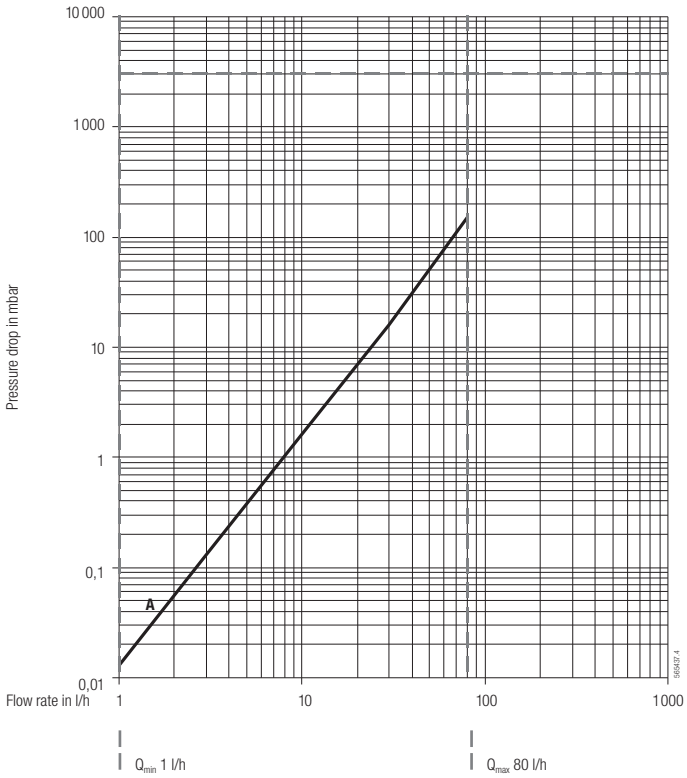
Conversion

cSt 3 density = mPa.s
Engler degrees °E to mPa.s: only use conversion table
Saybolt units to mPa.s: only use conversion table
Redwood units to mPa.s: only use conversion table

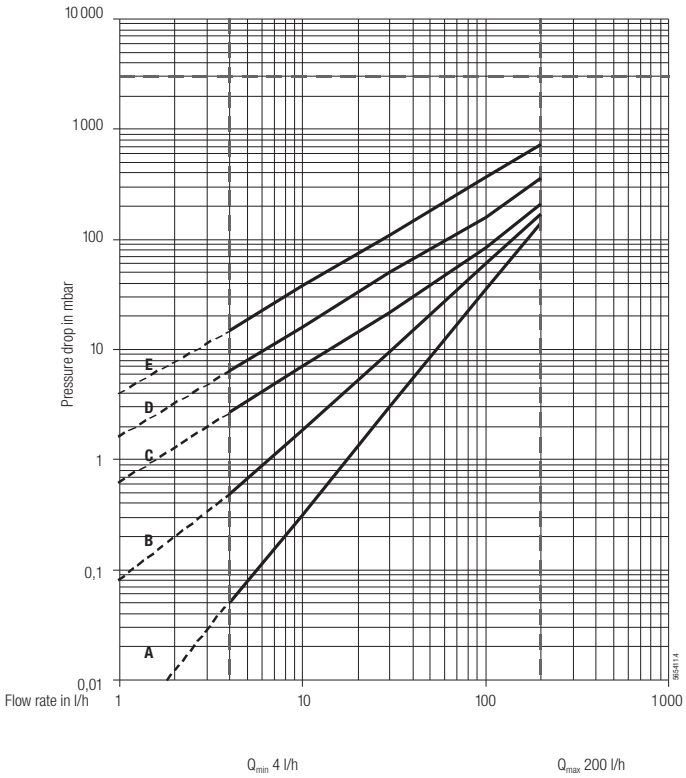
Rule of thumb

1 cSt 1 mm^2/s 1 mPa.s

DN 4



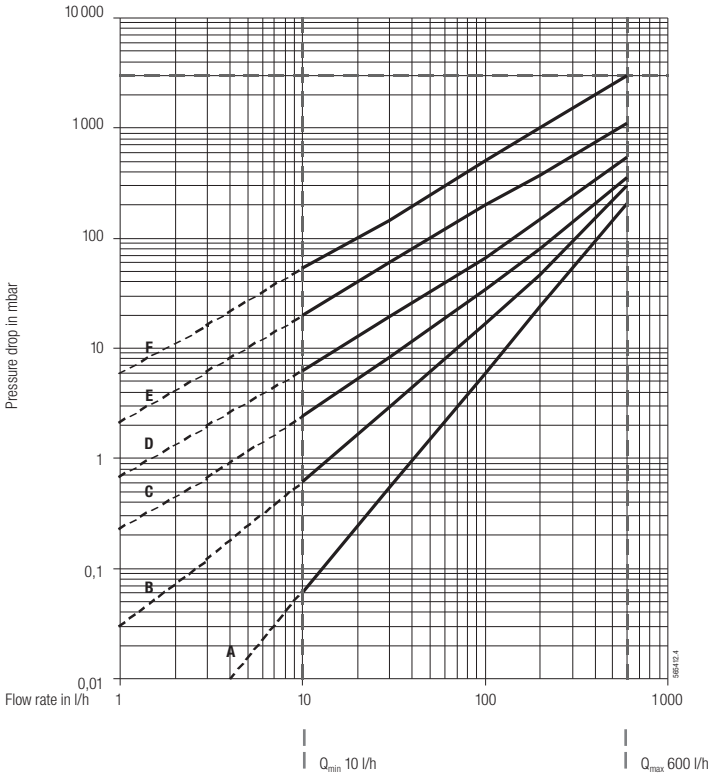
DN 8



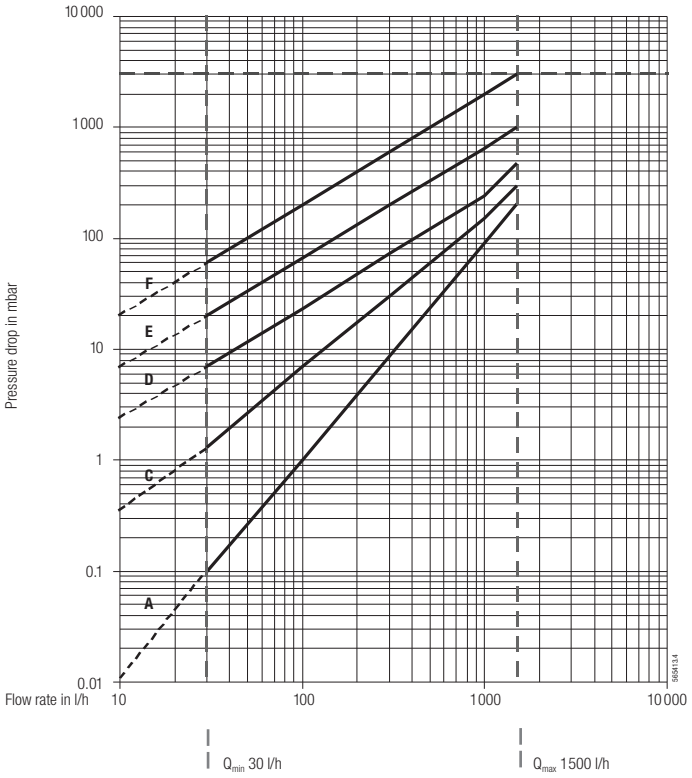
Viscosity diagrams: A = 5 mPa.s B = 50 mPa.s C = 100 mPa.s D = 200 mPa.s E = 500 mPa.s

For a pressure drop of more than 1 bar, it is recommended to use the next larger meter size.
Maximum permissible pressure drop = 3 bar

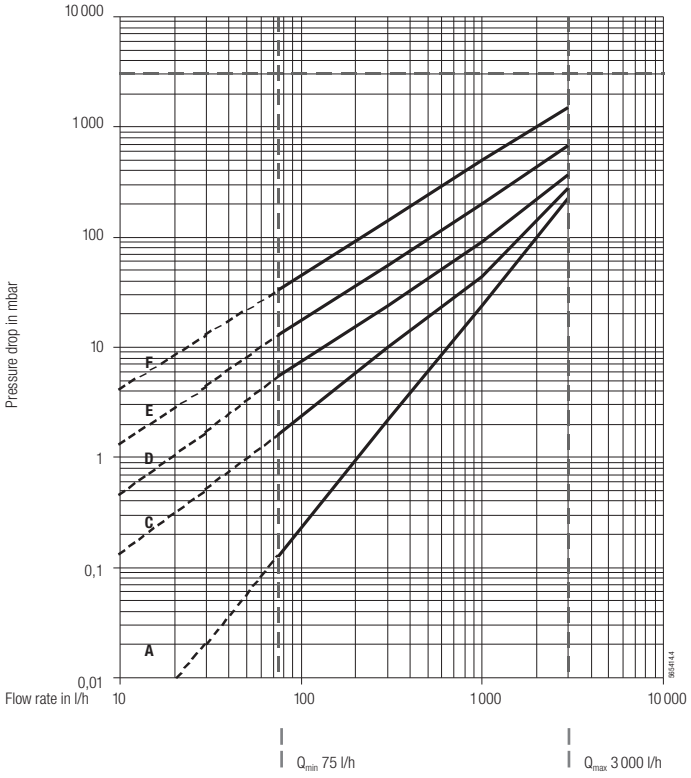
DN 15



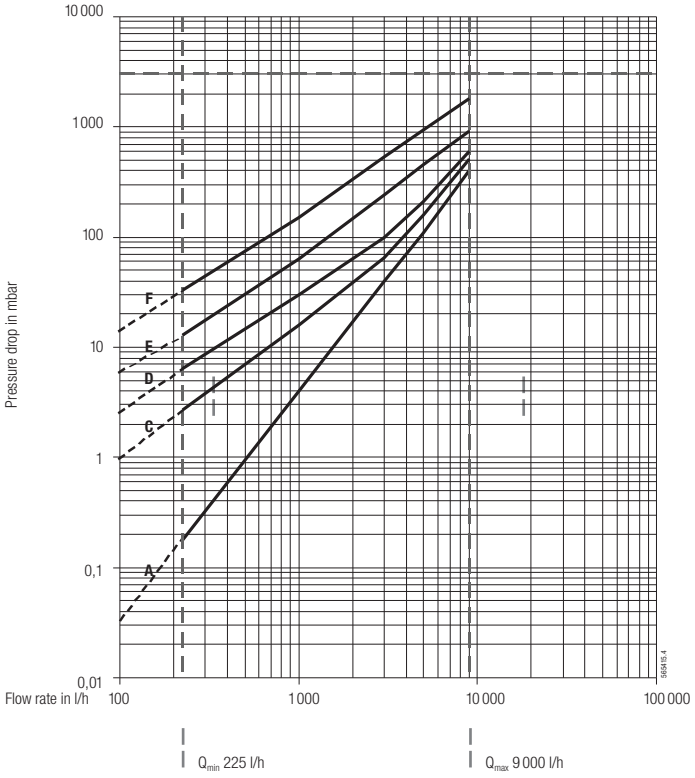
DN 20



DN 25



DN 40

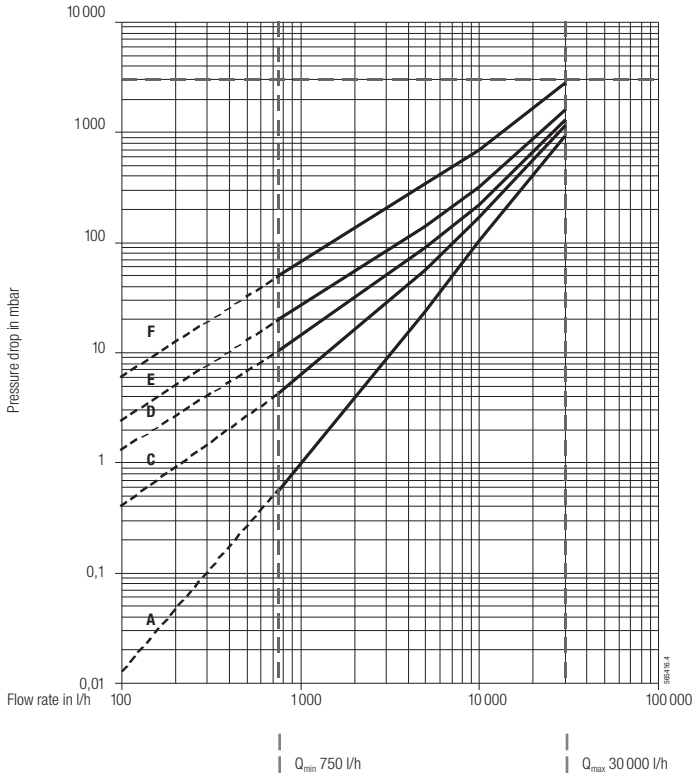


Viscosity diagrams:

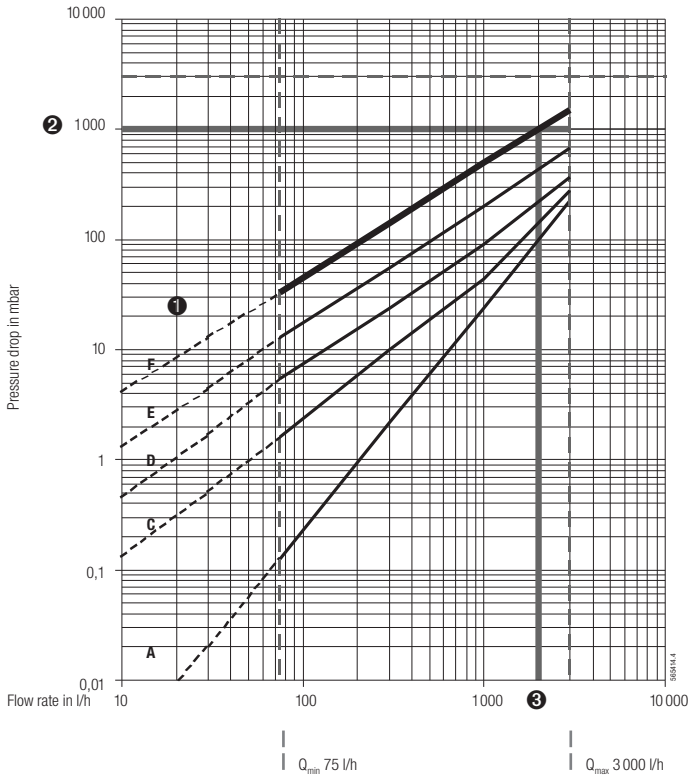
A = 5 mPa.s	C = 50 mPa.s	E = 200 mPa.s
B = 25 mPa.s	D = 100 mPa.s	F = 500 mPa.s

For a pressure drop of more than 1 bar, it is recommended to use the next larger meter size.
Maximum permissible pressure drop = 3 bar

DN 50



Example



Mineral oil, viscosity 450 mPa.s
VZO 25 mounted on pressure side of pumps

❶ Viscosity curves DN 25
select closest curve
F = 500 mPa.s

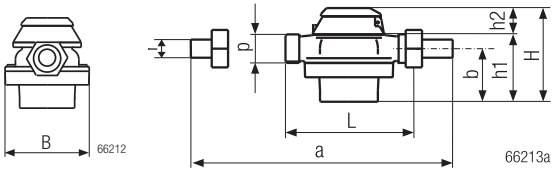
❷ Assume max. permissible pressure drop = 1 bar

❸ The intersection of curve F with the line corresponding to 1bar gives a flow rate of 2000 l/h.

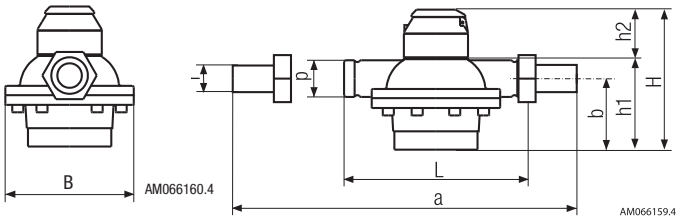
Dimensions in mm

Flow sensors (all types)

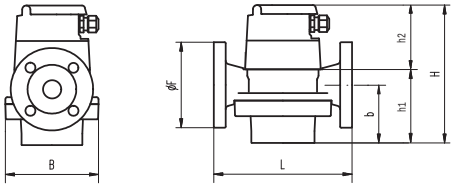
DN 15, 20, 25: with threaded ends (ISO 228-1)



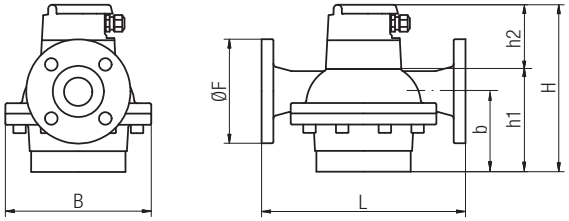
DN 40: with threaded ends (ISO 228-1)



DN 15, 20, 25: with flanges (DIN 2501/SN 21843)



DN 40, 50: with flanges (DIN 2501/SN 21843)



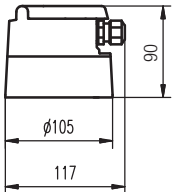
Nominal size	L	B	a	Ø F	b	h1	p	r
DN 15	165	105	260	95	45	65	G $^{3}/_{4}$”	G $^{1}/_{2}$”
DN 20	165	105	260	105	54	74	G 1”	G $^{3}/_{4}$”
DN 25	190	130	305	115	77	101	G 1$^{1}/_{4}$”	G 1”
DN 40	300	210	440	150	116	153	G 2”	G 1$^{1}/_{2}$”
DN 50	350	280	–	165	166	209	–	–

Dimensions of transducer groups / measurement transducer

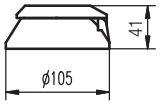
Oil flow meter	VZF / VZFA	VZO 15 - 25						VZO 40 - 50 / VZOA 15 - 50					
Max. temperature	130/180°C	130°C			180°C			130°C			180°C		
Pulsers	all	-	RV	IN	-	RV	IN	-	RV	IN	-	RV	IN
Dimensional drawing	1	2	3	6	5	4	7	5	4	6	5	4	7

VZF(A), VZO(A) Dimensional drawings 1 - 7 from table above

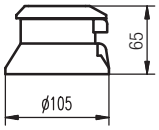
1



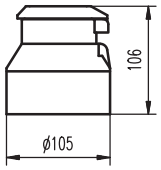
2



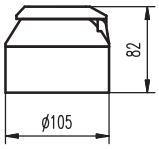
3



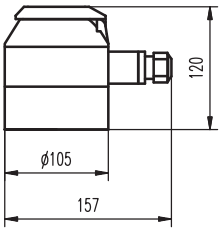
4



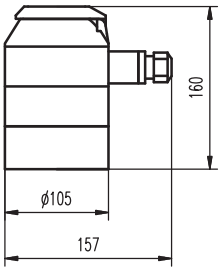
5



6

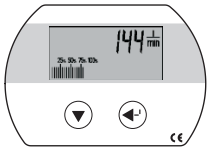


7

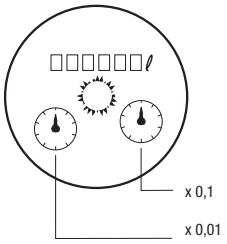


Display / Roller counter

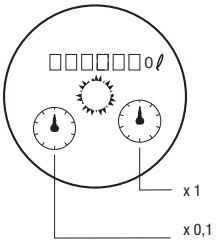
VZF / VZFA



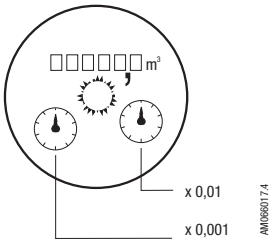
VZO / VZOA 15



VZO / VZOA 20, 25, 40



VZO / VZOA 50



Selection of the optimal meter

Type		VZF 15-50	VZO 4-8	VZO 15-50	VZFA 15-50	VZOA 4-8	VZOA 15-50
Application							
Direct consumption measurement		●	●	●	●	●	●
Differential measurement		–	–	–	●	–	●
Measuring points with metrolog. approval / calibration (optional)		–	–	–	–	●	●
Measuring points with marine type approval (optional)		●	–	●	●	–	●
Most frequent areas of use							
Domestic / industrial burner	light/medium oil	●	●	●	●	●	●
	heavy oil [1]	●	–	●	●	–	●
Common applications							
Heating systems		●	●	●			
High performance furnaces							
Fuel types							
Light heating fuel		●	●	●	●	●	●
Medium heating fuel		●	●	●	●		●
Heavy heating fuel		●	–	●	●	–	●
Display of flow data							
Total volume		●	●	●	●	●	●
Resettable volume		●	–	–	●	–	–
Instantaneous flow rate		●	–	–	●	–	–
Method of display							
LCD Electronic display		●	–	–	●	–	–
Total volume display on roller counter		–	●	●	–	●	●
Measuring error limits							
±1 % if actual value		●	●	●	–	●	–
±0,5 % of actual value or smaller		–	–	–	●	–	●
PTB approval	Class 1	–	–	–	●	●	●
EC approval/verification	Class 1	–	–	–	–	DN 4	–
	Class 0.5	–	–	–	–	DN 8	●
Outputs [2]							
Current output	4..20mA	●	–	–	●	–	–
Digital outputs	volume pulses	●	–	–	●	–	–
	frequency signal	●	–	–	●	–	–
	min/max limiting values	●	–	–	●	–	–
Pulser (Option)							
Inductive, with decadic pulse value		–	–	●	–	–	●
Reed pulser for remote totalisation		–	●	●	–	●	●

1) Only in accordance with the maximum mesh size of the dirt filter as per technical data.
2) Two freely selectable independent outputs are always available.

Fuels and suitable Meter sizes	DN 4	DN 8	DN 15	DN 20	DN 25	DN 40	DN 50
Light heating fuel	●	●	●	●	●	●	●
Medium heating fuel	●	●	●	●	●	●	●
Heavy heating fuel	–	–	●	●	●	●	●

● applicable
– not applicable

Application note
For viscosities higher than 5mPa.s or for installations on the suction side of a pump, pressure drop and possible limitation of flow range must be taken into consideration.

Fuel oils

Characteristics of different fuels

Fuel			extra light	light	medium	heavy	Bunker C
Density at 15° C	min.	kg/dm³	0.82	0.82	0.82	0.82	0.90
	max.	kg/dm³	0.86	0.95	0.96	0.99	1.01
Specific volume at average density		l/kg	1.19	1.12	1.12	1.11	1.08
Viscosity at 20° C		mPa.s	8	14	50	420	4200
40° C		mPa.s	3	5	16	60	380
100° C		mPa.s	–	–	3	10	35
Energy value		kWh/kg	11.8	10.6	11.4	11.2	11.0

Indicative values on power for burners

Burners

Burner			Fuel oil meter	
Power	Flow rate heating fuel EL		Flow rate	Size
up to kW	kg/h	l/h	Q_{min}....Q_{cont} l/h	DN
500	42	50	1... 50	4
1 300	113	135	4 ...135	8
4 000	336	400	10 ... 400	15
10 000	840	1 000	30 ... 1 000	20
20 000	1 680	2 000	75 ... 2 000	25
60 000	5 040	6 000	225 ... 6 000	40
200 000	16 800	20 000	750 ... 20 000	50

Formula for consumption in litres/hour:

$$\frac{\text{Burner power in kW}}{\text{Energy value of fuel in kWh/kg x density in kg/dm}^3}$$

Example:

$$\frac{\text{4000 kW}}{\text{11.8 kWh/kg x 0.84 kg/dm}^3} = 4000 : 9.912 = 403 \text{ l/h}$$

How to obtain an optimal measurement?

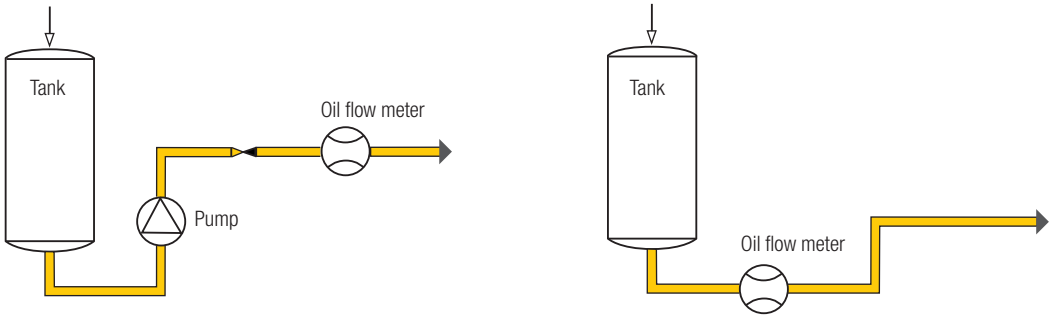
Planning

Flow meters are precision measuring instruments. They achieve optimal results if

- a few important rules are observed during plant design,
- mounting and commissioning are carried out with care,
- the meters are used for their defined purpose only.

Layout of Pipework

- The quantities consumed by all consumers must be registered by the meter.
- Rotary piston meters do not require flow conditioners or inlet runs (after bends, T-pieces or fittings). They may be mounted in horizontal, vertical or inclined position, except with the head pointing downwards.
- The layout of piping must ensure that the meter is at all times filled with liquid and that no inclusions of air or gas may occur. Do not install the instrument at the highest point of the installation.
- Meter and accessory equipment must be easily accessible.



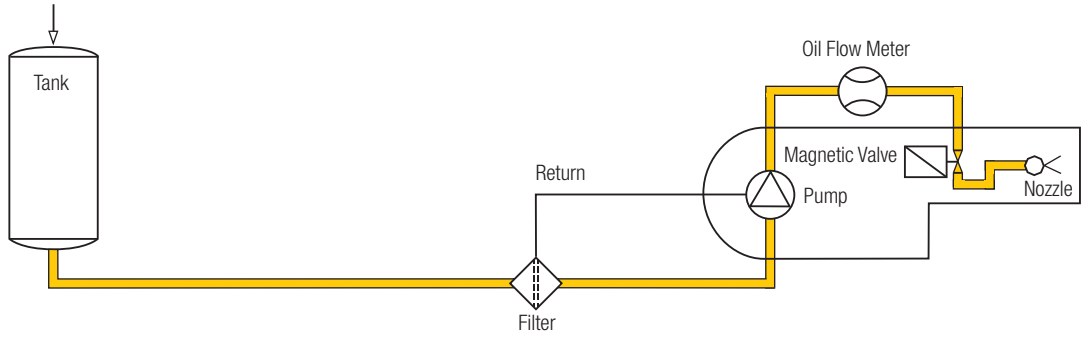
Selection of the Meter and Ancillaries

To be considered when selecting the meter:

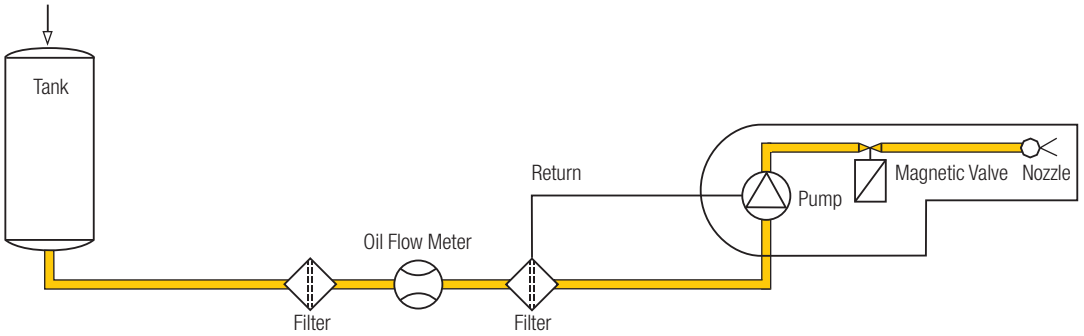
- Operating temperature
- Viscosity of the medium
- Operating pressure
- Flow rate
- Resistance of the material against fuel to be metered and working conditions

The technical data are valid for the following reference conditions: EL heating fuel / diesel at 20° C. For higher viscosities or if the meter is mounted on the suction side of a pump, it is necessary to determine the pressure drop and the flow rate that can still be attained by using the pressure loss curves (page 25ff). If the pressure drop is more than 1 bar, it is advised to use the next larger meter size. Maximum permissible pressure drop = 3 bar.

Mounting on pressure side of pump (burners)

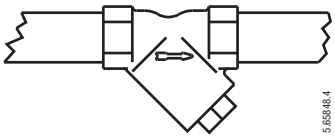


Mounting on suction side of pump (burners)



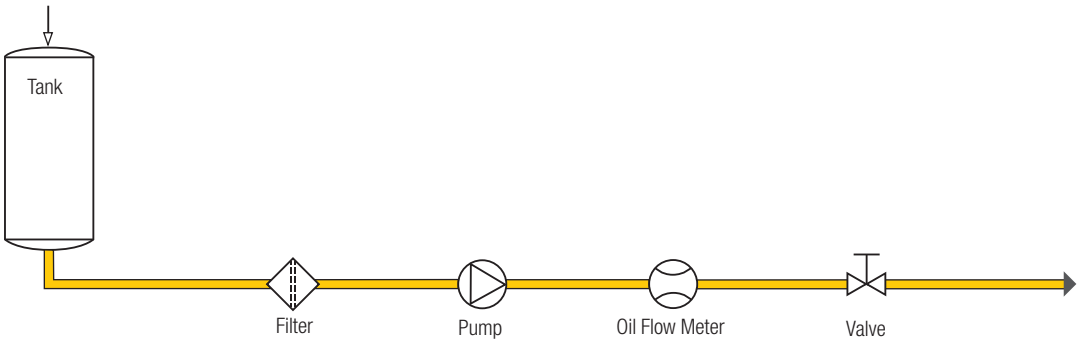
Impurities in plant or fuel

Should impurities occur in the plant or in the fuel, a dirt filter has to be installed before the meter. The filter mounted in the meter inlet is only a safety filter and is too small to act as a dirt filter.

Maximum mesh size of dirt filter	Meter	VZF	VZO	VZFA/VZOA
	DN 4	–	0,080 mm	0.080 mm
	DN 8	–	0.100 mm	0.100 mm
	DN 15	0.250 mm	0.250 mm	0.100 mm
	DN 20	0.400 mm	0.400 mm	0.100 mm
	DN 25	0.400 mm	0.400 mm	0.250 mm
	DN 40	0.600 mm	0.600 mm	0.250 mm
	DN 50	0.600 mm	0.600 mm	0.250 mm

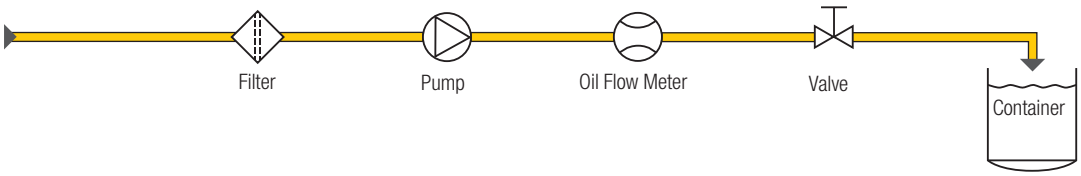
Stop valves or cocks

In order to avoid backflow and draining, stop valves have to be mounted after the meter. Backflow and draining cause measuring errors and can damage the meter.



Filling/Dosing

For filling and dosing the valve has to be mounted between meter and outlet. The shorter the pipe section between meter and outlet, the higher the accuracy. Fast opening and shutting of the valve should be avoided (pressure hammer!).



Remote Processing/Ancillaries

Any backflow must be avoided on meters equipped with pulsers for remote processing. If this cannot be achieved by appropriate plant design, a non-return valve should be fitted.

Electrical wiring and installations

Electrical wiring and installations are subject to statutory regulations which must be taken into account when planning the system. For installations in zones subject to explosion hazards, consult an appropriate expert.

The following factors should be taken into account during plant design:

- ancillaries connected to the meter
- environmental interference
- maximum permissible cable lengths (with or without amplifier)
- junction boxes, cable guides

Cable lengths on the VZF meter outputs

A cable with wire diameter of 0.5mm is generally suitable up to 25 m and such of 0.8 mm will go up to 100 m. In all other cases the limiting factors should be considered.

- for the analogue current output: (4..20mA)

Limiting factors are supply voltage (U) and resistance of the load (RL). To ensure the maximum current signal of 21.5 mA with sufficient operating voltage for the meter the following formula is used to calculate the maximum permissible resistance (RL) which consists of the resistance of the cable plus the resistance of other components within the circuit. Knowing the resistance of the other components, the maximum permissible length for the cable can then be calculated.

$$R_L = \frac{(U - 5)\ V}{0.0215\ A}\ [\Omega]$$

Example:
Supply voltage
U = 24 V

$$R_L = \frac{(24 - 5)\ V}{0.0215\ A} = \frac{19\ V}{0.0215\ A} = 883\ \Omega$$

- for the semi conductor relay output: (volume pulses, frequency signal, limit switch)

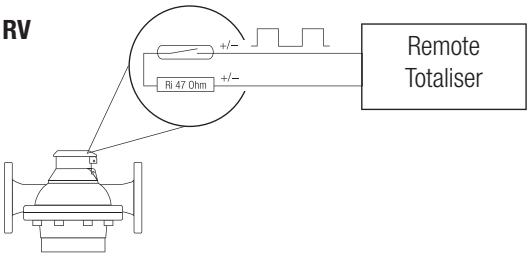
Limiting factors depend on the input specification of the higher system or the totalizer. The ability of the input to detect the actual state of the switch is specified by the system manufacturer.
For the relay switch a maximum of 100 Ω at ON-state has to be considered together with the cable's resistance. A minimum of 10M Ω at OFF-state has to be considered together with the cable's capacity. The maximum permissible length of the cable depends on the individual properties for resistance and capacity.

Pulsers IN and RV

Power supply

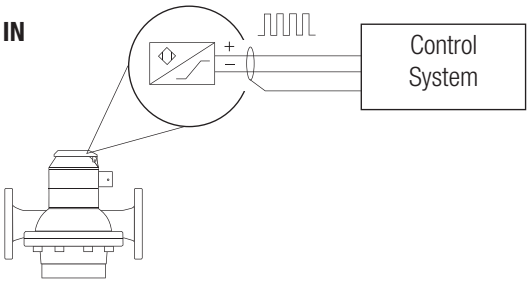
Our range of products includes passive pulsers for the remote processing of flow data. The pulser generates one pulse per unit of volume and is to be supplied with power from the pulse processing device.

RV



Power supply 5...48 VAC/DC

IN



Power supply 5...15 VDC

Selection of the appropriate pulser

The selection of the most appropriate pulser and pulse value depends on the application. As a rule, remote totalisation demands rather large pulse values, whereas analogue signals, dosing control or indication of actual flow rate tend to need small values. Battery supplied devices can only be used together with Reed pulsers.

Selection of the processing device

The pulse length depends on the flow rate. Continuous contact may occur at zero flow. The device connected must therefore be able to accept continuous load; otherwise, protective measures have to be taken. For remote totalisation, it is recommended to use an electronic pulse counter with a low power consumption and bounce filter.

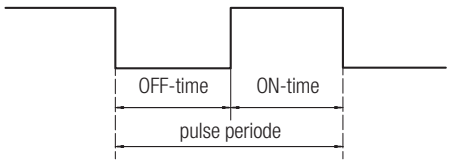
Correct pulse processing

Interrupted flow may cause hydraulic oscillation of the liquid in certain plants (hydraulic vibration with minimal backward/forward flow). The pulses which can occur in such cases may be interpreted as forward flow by the connected device. Such faulty pulses do not affect the indication of the actual value since they can only occur at almost zero flow. However, if the pulser controls a counting device, hydraulic vibration must be avoided by an appropriate modification or layout of the plant.

Pulse values

Pulse values depend on type and nominal size of the meter. They are listed in the technical information of the meter concerned.

Pulse period



Pulse period as well as on- and off-times can be calculated with the following formula:

$$\text{Pulse period in s} = \frac{\text{pulse value in litres} \times 3600}{\text{flow Q in l/h}}$$

$$\text{On-time} = \frac{\text{pulse period in s} \times \text{on-time in \% of pulse period}}{100}$$

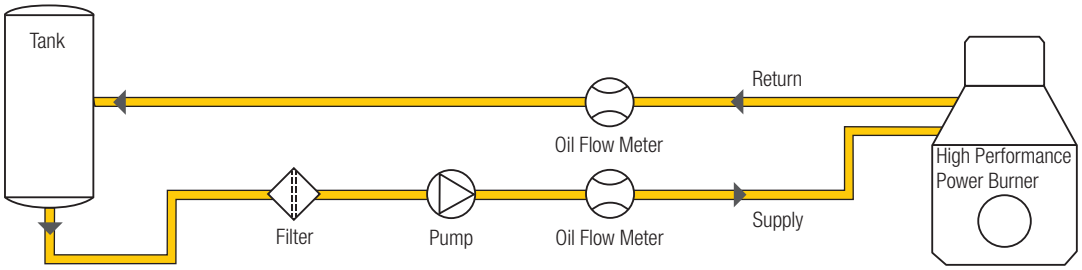
$$\text{Off-time} = \text{pulse period in s minus on-time}$$

We recommend that this calculation be carried out for the highest and lowest expected flow rates.

Application examples

Differential measurements

For differential measurements, the piping remains unchanged, with circulation back into the tank. A flowmeter is installed in both supply and return pipes. The consumption is determined as the difference between the amount in the supply section and the amount in the return section. The meter loads therefore correspond to the supply and return flow rates.



Reasons for using special meters for differential measurements

Standard meters feature a large measuring range and a max. permissible error of ±1%. This makes them unsuitable for differential measurements, as the following example shows:

Full load

Supply	400 l/h	Error ±1 %	= nominal ±4.0 l
Return	150 l/h	Error ±1 %	= nominal ±1.5 l
Consumed	250 l/h	Divergence	nominal ±5.5 l

Maximum divergence
Consumed = 5.5 x 100 : 250 = ±2.2 %

Min. load

Supply	400 l/h	Error ±1 %	= nominal ±4.0 l
Return	360 l/h	Error ±1 %	= nominal ±3.6 l
Consumed	40 l/h	Divergence	nominal ±7.6 l

Maximum divergence
Consumed = 7.6 x 100 : 40 = ±19 %

For an optimal result, special meters are therefore used for differential measurements. These are precisely matched to the operating conditions and are calibrated in pairs. This means that the measurement error can be significantly reduced (for example: ±0.1 % at constant flow rates on the supply side and ±0.3 % with slightly variable flow rates on the return side).

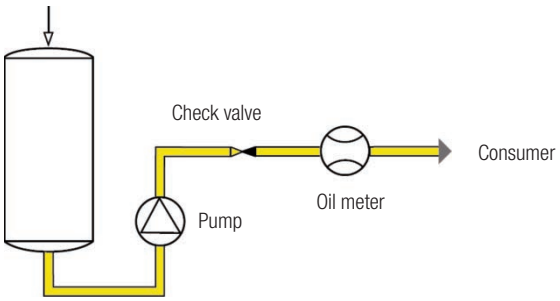
CONTOIL® meter with CE approval

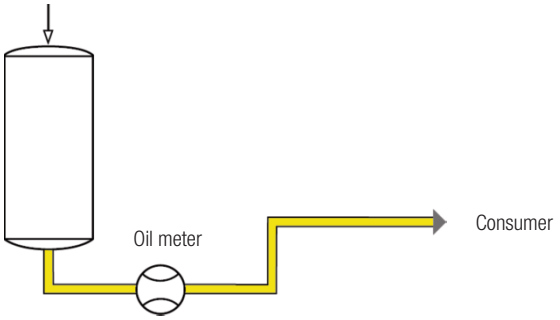
Installation examples

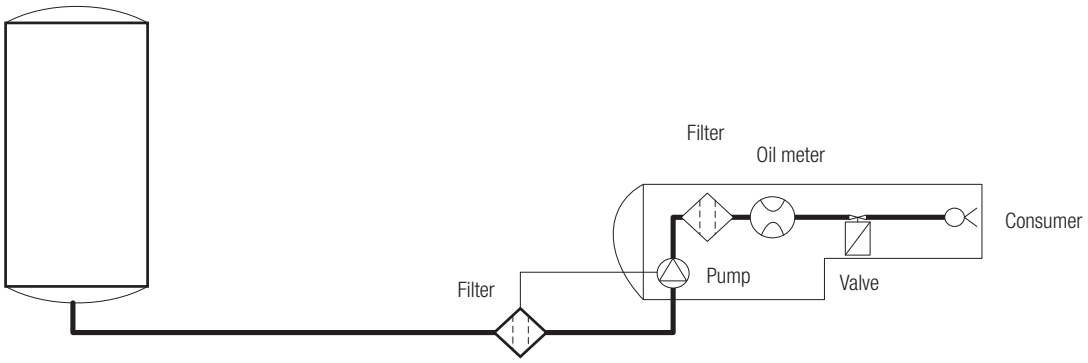
The installation drawings listed here are just examples and has to be interpreted as such.

Installation position
All installation positions are valid, except upside down!

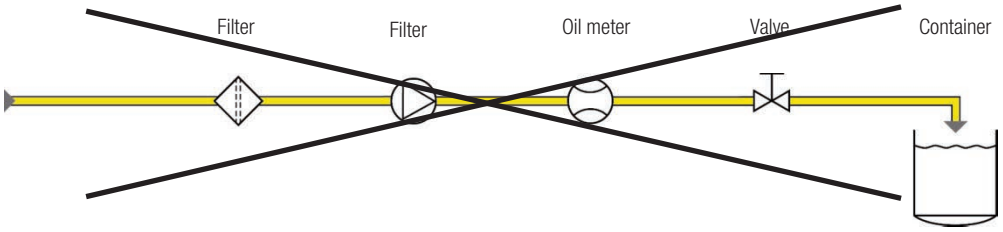
Person responsible:
The user/engineer is responsible for correct, legal installation







Incorrect installation!



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