



Figure 1 TM 250 variable area flow meter

Application

The TM 250 variable area flow meters with a standard length of 250 mm (9.84 inch) and a completely metal design can be used to measure many different types of liquids and gases passing through closed piping. The robust design means that they can also be used in rough conditions. Different types of flanges, liners and float materials satisfy the requirements of the pharmaceutical and chemical industries.

The measured value is displayed directly on the scale, and output via a switch contact or as a current output.

The main applications for the TM 250 can be found in the following fields:

- Chemical industry
- Water
- Power generation and distribution.

Special Features

Standard design available at short notice

- Robust all-metal fitting with impact-resistant housing cover
- Can also be used for corrosive and flammable media
- Use possible at high pressures and temperatures
- Product and percentage scales
- Can be optionally fitted with heating and cooling sheaths
- Contamination-insensitive guiding of float.

Design and Mode of Operation

The TM 250 operates like the other units in the TM 250 range according to the variable-area flow tube principle: the flowing medium lifts the conical float in the flow tube. The annular gap is then increased until equilibrium exists between the buoyant force of the medium and the force due to the weight of the float. The height of the float is directly proportional to the flow quantity. The movement of the float is transmitted by a magnet to a slave magnet in the display unit outside the flow tube.

The contacts or the electric remote sensor are controlled by a contact lug or a cam which is mounted on the pointer shaft.

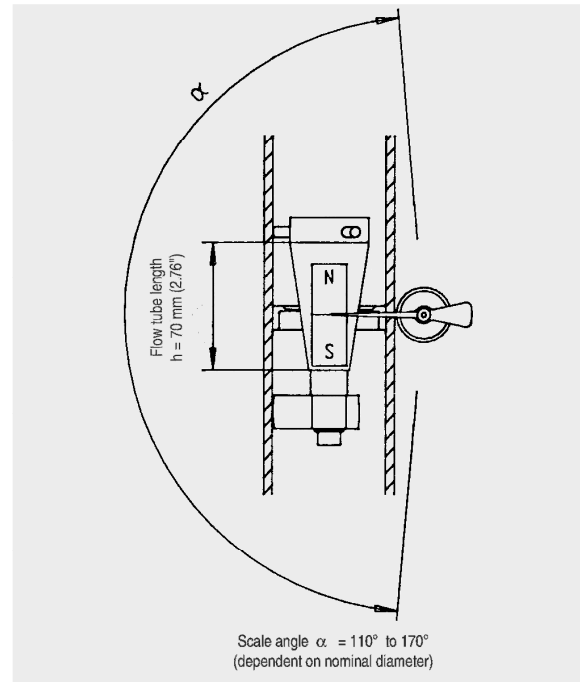


Figure 2 Flow tube/scale angle

Note of Application

The operator of these measuring instruments is responsible for suitability, proper use and corrosion resistance of the used materials with regard to the measuring material. It must be ensured that the materials selected for the flow meter parts in contact with the medium are suitable for the used process media. No external loads may act on the meter. Provide a touch guard for surface temperatures of $>70\text{ }^{\circ}\text{C}$. This touch guard must be designed in a way that the max. allowable ambient temperature on the unit is not exceeded. The flow meter may only be used within the pressure and voltage limits specified on the identification plate. Before replacing the measuring tubes, check that the unit is free of hazardous media and pressures. The measuring instruments are primarily designed for static loads.

1/5

Classification According to PED 97/23/EG

	Order No.	Permissible media	Category
	7ME5820- 7ME5821-		
DN 15	XAxxx-xxxx	Gases and liquids of fluid group 1	Art. 3.3
DN 25	XBxxx-xxxx	Gases and liquids of fluid group 1	Art. 3.3
DN 50	XCxxx-xxxx	Gases and liquids of fluid group 1	III
DN 80	XDxxx-xxxx	Gases and liquids of fluid group 1	III
DN 100	XExxx-xxxx	Gases and liquids of fluid group 1	III

Technical Data of TM 250

Measuring principle	variable area flow meter	
Input		
Measuring range	see tables on page 3	
Pressure rating	PN10 (MWP 145 psi) to PN40 (MWP 580 psi) depending on version (see Tables on page 3 and 4)	
Flow	vertically upwards	
Dimension for measured variables	l/h, from 4.000 l/h (17,6 USgpm) in m ³ /h	
Rated operating conditions		
Mounting	vertical	
Ambient temperature	<80 °C (176 °F) (<70 °C (156 °F)) with contact display	
Medium conditions		
• Accuracy	±2% of full-scale value (±1,6% as option, but not for PTFE liner)	
• Temperature of medium	max. 125 °C (257 °F) (300 °C (572 °F) as option)	
• Viscosity lines		
Q_{max} [m ³ /h]	Q_{max} [USgpm]	Viscosity [mPa s]
≤0.1	≤0.44	1.0
>0.1 to 0.5	>0.44 to 2.2	1.0 to 3.0
>0.5 to 3	>2.2 to 13	1.0 to 5.0
>3 to 10	>13 to 44	1.0 to 8.0
>10 to 25	>44 to 110	1.0 to 10
>25 to 50	>110 to 220	1.0 to 15
>50 to 100	>220 to 440	1.0 to 25
>100	>440	1.0 to 50
Design		
Flanges	DIN, ANSI	
Material		
• Fitting	Stainless steel mat. No. 1.4301 /316Ti	
• Float	Stainless steel mat. No. 1.4571/316Ti Hastelloy, Titan, Aluminum	
• Wetted parts materials	Stainless steel mat. No 1.4571/316Ti, PTFE, C22.8, Hastelloy depending on version	
• Degree of protection (display unit)	IP65	

Technical Data of Contacts

251 Magnet spring contact	
Switching principle	magnet spring contact, twin contact
Connection	appliance plug to DIN 43650
Max. switching frequency	5/min
Max. rating	AC 250 V / 1 A / 50 VA DC 250 V / 1 A / 30 W rating data apply to resistive loads; a suppressor circuit is required for inductive
Hysteresis	±3 % of full-scale value
Ambient temperature	-20 to +70 °C (-4 to 158 °F)
251 Inductive contact	
Switching principle	inductive contact, single contact; twin contact as option
Connection	PG 11
Rated voltage	DC 8V
Self-inductance	500 µH
Self-capacity	80 nF
Ambient temperature	
• without Ex-protection	-20 to + 70 °C (-4 to 158 °F)
• with Ex-protection T6	-20 to + 65 °C (-4 to 149 °F)
Ex-approval	EEx ia IIC T6
252 electric remote sensor, current output	
Principle	rotation angle transmitter
Connection	2-, 3- or 4-wire system
Power supply	DC 12 to 30 V
Self-capacitance	< 10 nF
Short-circuit current	max. 160 mA
Output	
• 2-wire system	4 to 20 mA
• 3-and 4-wire system	0 to 20 mA
Load at 30 V	max. 900 Ω
Ambient temperature	
• without Ex-protection	-20 to + 70 °C (-4 to 158 °F)
• with Ex-protection T6	-20 to + 60 °C (-4 to 140 °F)
Ex-approval	II 2G EEx ia IIC T6

2/5

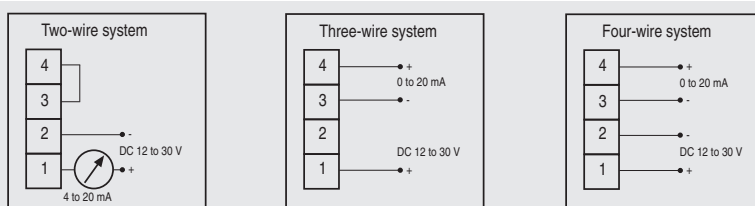


Figure 3 TM 252 rotation angle transmitter, connection diagrams

Measuring Ranges for Liquids

Version		AF-S	CF-S	CF-K	EF-H	FF-P ¹⁾					
Wetted parts mat.		C22.8 Mat.-No. 1.4571/316Ti	Mat.-No. 1.4571/316Ti	Mat.-No. 1.4571/316Ti	PTFE/Hastelloy C	PTFE					
Fitting		Mat.-No. 1.4571/316Ti	Mat.-No. 1.4571/316Ti	Mat.-No. 1.4571/316Ti	Mat.-No. 1.4571/316Ti	Mat.-No. 1.4571/316Ti					
Flange		C22.8	Mat.-No. 1.4571/316Ti	Mat.-No. 1.4571/316Ti	Mat.-No. 1.4571/316Ti with liner PTFE	Mat.-No. 1.4571/316Ti with liner PTFE					
Float/flow tube		Mat.-No. 1.4571/316Ti	Mat.-No. 1.4571/316Ti	Mat.-No. 1.4571/316Ti	Hastelloy	PTFE					
Max. temperature of medium		125 °C (257 °F) optional 300 °C (572 °F)	125 °C (257 °F) optional 300 °C (572 °F)	125 °C (257 °F) optional 160 °C (320 °F)	80 °C (176 °F)	50 °C (122 °F)					
Nominal pressure		DN 15 to DN 80/ (½ to 3 inch): PN 40 (580 psi) DN100 (4 inch): PN 16 (232 psi)	DN15 to DN 80/ (½ to 3 inch): PN 40 (580 psi) DN 100 (4 inch): PN 16 (232 psi)	DN 15 to DN 25 (½ to 1 inch): PN40 (580 psi)	PN 16 (232 psi)	PN 16 (232 psi)					
Connection DIN2501											
DN 15	DN 25	DN 50	DN 80	DN 100	Full-scale value		Flow tube			Nominal diameter	l/h (Usgpm)
					l/h	USgpm					
X	X				16	(0.07)	A		X		
X	X				25	(0.11)	B		X		
X	X				40	(0.18)	C		X		
X	X				63	(0.28)	D		X		
X	X				100	(0.44)	E		X		
X	X				160	(0.7)	F	X	X		
X	X				250	(1.1)	G	X	X	X	DN 15-25 (½-2 inch) 250 (1.1)
X	X				400	(1.76)	H	X	X	X	DN 15-25 (½-2 inch) 400 (1.76)
X	X				630	(2.77)	J	X	X	X	DN 15-25 (½-2 inch) 630 (2.77)
X	X				1,000	(4.4)	K	X	X	X	DN 25 (1 inch) 1,000 (4.4)
X	X				1,600	(7.0)	L	X	X	X	DN 25 (1 inch) 1,600 (7.0)
X					2,500	(11.0)	M	X	X	X	DN 25 (1 inch) 2,500 (11.0)
X	X				4,000	(17.6)	N	X	X	X	DN 50 (2 inch) 4,000 (17.6)
	X				6,300	(27.7)	P	X	X	X	DN 50 (2 inch) 6,300 (27.7)
	X				10,000	(44)	Q	X	X	X	DN 50 (2 inch) 10,000 (44)
X	X	X			16,000	(70)	R	X	X	X	
X	X	X			20,000	(88)	S	X	X	X	
		X	X		25,000	(110)	T	X	X	X	DN 80-100 (3-4 inch) 25,000 (110)
		X	X		40,000	(176)	U	X	X	X	
		X	X		50,000	(220)	V	X	X	X	
		X			63,000	(277)	W	X	X	X	
		X			100,000	(440)	X	X	X	X	

3/5

1) For the FF-P version, only the measuring ranges of the listed nominal diameters are possible.

Nominal diameter	Pressure loss mbar (psi)
DN 15 (½ inch)	60 (0.87)
DN 25 (1 inch)	60 (0.87)
DN 50 (2 inch)	90 (1.3)
DN 80 (3 inch)	160 (2.3)
DN 100 (4 inch)	240 (3.5)

Measuring ranges and pressure losses for liquids (density $\rho = 1\text{kg/l}$ (62.43 lbs/cu.ft) and viscosity 1mPa·s(cp)) with standard scales. The dynamic range is always 1:10.

Measuring Ranges for Air

						Version	CL-A	CL-T	CL-K	EL-T	FL-R
						Wetted parts mat.	Mat.-No. 1.4571/316Ti Aluminium	Mat.-No. 1.4571/316Ti, Titan	Mat.-No. 1.4571/316Ti	PTFE/ Hastelloy C, Titan	PTFE
						Fitting	Mat.-No. 1.4571/316Ti	Mat.-No. 1.4571/316Ti	Mat.-No. 1.4571/316Ti	Mat.-No. 1.4571/316Ti	Mat.-No. 1.4571/316Ti
						Flange	Mat.-No. 1.4571/316Ti	Mat.-No. 1.4571/316Ti	Mat.-No. 1.4571/316Ti	Mat.-No. 1.4571/316Ti with liner PTFE	Mat.-No. 1.4571/316Ti with liner PTFE
						Float/flow tube	Aluminium/ Mat.-No. 1.4571/316Ti	Titan Mat.-No. 1.4571/316Ti	Mat.-No. 1.4571/316Ti	Titan/ Hastelloy	PTFE
						Max. temperature of medium	125 °C (257 °F) optional 300 °C (572 °F)	125 °C (257 °F) optional 300 °C (572 °F)	125 °C (257 °F) optional 160 °C (320 °F)	80 °C (176 °C)	50 °C (122 °F)
						Nominal pressure	DN 15 to DN 80/ (½ to 3 inch): PN 40 (580 psi) DN 100 (4 inch): PN 16 (232 psi)	DN 15 to DN 80/ (½ to 3 inch): PN 40 (580 psi) DN 100 (4 inch): PN 16 (232 psi)	DN15 to DN25 (½ to 1 inch) PN 40 (580 psi)	PN16 (232 psi)	PN 16 (232 psi)
Connection DIN2501											
DN 15	DN 25	DN 50	DN 80	DN 100	Full scale value m³/h (USgpm)	Flow tube					
X	X				0.5 (2,2)	A			X		
X	X				1.0 (4,4)	B			X		
X	X				1.6 (7.04)	C			X		
X	X				2.5 (11)	D			X		
X	X				4.0 (17,6)	E			X		
X	X				12.0 (53)	F	X	X		X	X
X	X				16.0 (70)	G	X	X		X	X
X	X				25.0 (110)	H	X	X		X	
	X				25.0 (110)	H					X
	X				40.0 (176)	J	X	X		X	X
	X	X			63.0 (277)	K	X	X		X	X
	X	X			100.0 (440)	L	X	X		X	
		X			100.0 (440)	L					X
		X			160.0 (704)	M	X	X		X	X
		X	X		250.0 (1100)	N	X	X		X	
		X	X	X	400.0 (1761)	P	X	X		X	
			X	X	400.0 (1761)	P					X
			X	X	630.0 (2774)	Q	X	X		X	

4/5

Nominal diameter	Pressure loss mbar (psi)	Minimum inlet pressure mbar (psi)
DN 15 (½ inch)	40 (0.58)	500 (7.25)
DN 25 (1 inch)	40 (0.58)	100 (1.45)
DN 50 (2 inch)	65 (0.94)	100 (1.45)
DN 80 (3 inch)	80 (1.16)	100 (1.45)
DN 100 (4 inch)	81 (1.16)	100 (1.45)

Measuring ranges and pressure losses for air (pabs= 1.013 bar (14.69 psi) at T=0 °C (32 °F)).
The dynamic range is 1:10 for each flow tube.

Installation and Operating Instructions

The main information for installation and start-up is listed below. Further information can be obtained from VDI/VDE 3513, sheet 3, installation recommendations for variable area meters.

Installation instructions

The variable area meter is delivered protected in a PVC sleeve, and is ready for operation. It has been checked for correct functioning prior to delivery. Before installing, check that the float moves freely: the float must slide smoothly in the flow tube without sticking or tilting. The pointer must smoothly follow the movement of the float. In the rest position (zero flow), the pointer must point to the marked reference point (first scale line). In the end position of the float, the pointer must be positioned above the full-scale value.

The variable area meter must be fitted into the piping vertically and without tension. Magnetic fields from other equipment may influence the result. If several variable area meters are installed next to one another, the following minimum distances must be observed between the main axes of the variable area meters:

- DN 15 to 50 (½ to 2 inch): 250 mm (9.84 inch)
- DN 80 to 100 (3 to 4 inch): 400 mm (15.74 inch).

The flange screws of the PTFE-lined fittings must only be tightened with the following maximum torques:

- DN 15 to 25 (½ to 2 inch): 14 Nm
- DN 50 (2 inch): 25 Nm
- DN 80 (3 inch): 35 Nm
- DN 100 (4 inch): 42 Nm

Interference-free inlet and outlet pipe sections are not usually required. However, additional measures (inlet pipe sections, flow stabilizers) may be meaningful to retain the measuring accuracy in the case of highly asymmetric flow profiles.

To prevent pulsations resulting from compression when measuring gases, a throttle should be positioned directly downstream of the variable area meter. To avoid faulty measurements, the arrangement should be selected such that the pressure in the variable area meter corresponds to the reference pressure for the calibration.

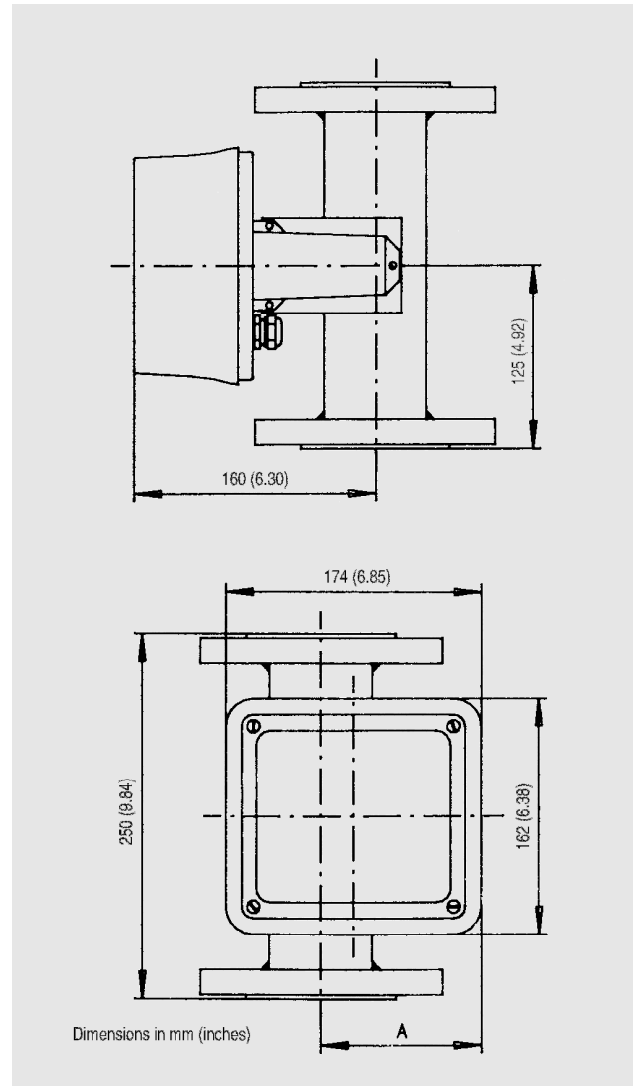
The flow meter may only be used within the pressure and voltage limits specified on the identification plate.

Start-up

- When starting up new plants, material residues (e.g. welding spatter) are carried over in the medium and could be deposited on the variable area meter. In such cases it is recommendable to clean the variable area meter after a short period of operation.
- The float must not be exposed to sudden pressures. It is therefore recommendable to start with a closed valve which is then slowly regulated to the operating pressure. Liquids should be vented carefully to prevent pressure surges resulting from gas bubbles.
- The variable area meter outputs values in all scale ranges according to its accuracy class. Each time a flow is started, permit the variable area meter to settle. When measuring in the lowest range, initially set a higher flow for a short time.

Maintenance and repair

Depending on the medium, contamination, abrasion or chemical reactions may attack the orifice and the float, thus influencing the accuracy of the measurement. In such cases it is recommendable to dismantle the variable area meter and to clean it, including the float, with appropriate agents. The orifice and float must not be damaged mechanically or by aggressive cleaning agents. If erosion is noticed on the orifice or float, recalibration or replacement is necessary. Following all maintenance and cleaning operations, carry out a function test of the variable area meter before using it again.



DN-connection	Dimensions „A“ in mm (inch) Versions		Weight kg (lb)
	AF-S, CF-S, CF-K CL-A, CL-T, CL-K	EF-H, FF-P, EL-T, FL-R	
15 (½ inch)	86 (3.4)	89 (3.5)	4 (8.8)
25 (1 inch)	92 (3.6)	96 (3.5)	5 (11)
50 (2 inch)	92 (3.6)	111 (4.4)	9 (19.8)
80 (3 inch)	125 (4.9)	132 (5.2)	13 (27.7)
100 (4 inch)	138 (5.4)	138 (5.4)	15 (33)

Figure 4 TM 250, dimensions in mm (inches)