Flow Meter with Flow Rate Counter

Media 4Z

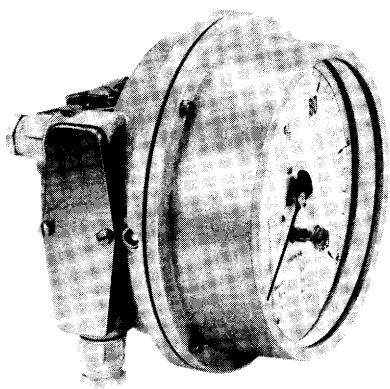


Fig. 1 · Media 4Z

1. Construction and mode of operation

The instrument connected to an orifice plate assembly is used for measuring the flow rate operating to the differential pressure method. The flow meter indicates the flow of liquids, gases and vapours and counts the flow rate by means of an optoelectronic pick-up.

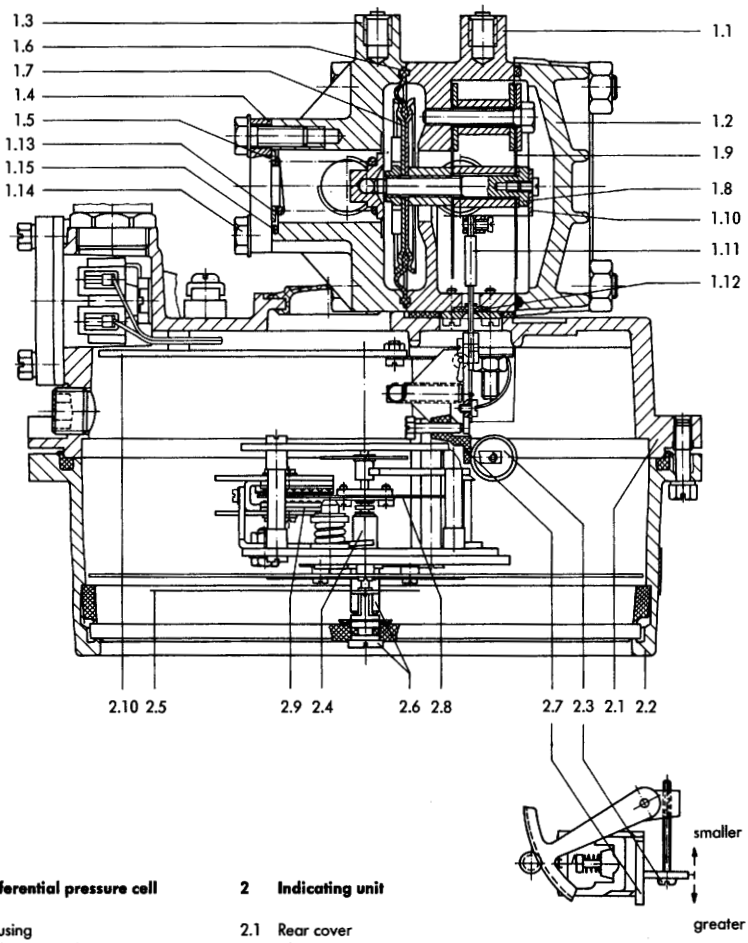
The Media 4Z Indicator consists essentially of the differential pressure cell with measuring diaphragm and measuring spring, and the indicating unit with gear mechanism, counting equipment and scale.

Besides the required orifice plate assembly (orifice flange or orifice tube) in addition accessories such as condensation chambers, shut-off valves or valve blocks (multi-way single-spindle valves) can be used.

Edition January 1988

Mounting and operating instruction

EB 9521 E



Measuring range adjustment

1 Differential pressure cell

1.1 Housing
1.2 High pressure head
1.3 Low pressure head
1.4 Spring plate
1.5 Measuring spring
1.6 Measuring diaphragm
1.7 Diaphragm plates
1.8 Diaphragm shaft
1.9 Guide springs
1.10 Connection link
1.11 Lever
1.12 Gasket
1.13 Disc
1.14 Screw
1.15 O-ring

2 Indicating unit

2.1 Rear cover
2.2 Closing cover
2.3 Feeler roll
2.4 Gear mechanism
2.5 Pointer
2.6 Zero adjustment
2.7 Range plate
2.8 Coding disc
2.9 Optoelectronic pick-up
2.10 Printed board with electronic unit

Fig. 2 · Media 4Z, top view section

The differential pressure $\Delta p = p_1 - p_2$ produced by the orifice plate creates a force on the measuring diaphragm (1.6) which is balanced by the measuring spring (1.5). The deflection of the diaphragm (1.6) and the lever (1.11), which is proportional to the differential pressure, is transferred from the pressure cell to the flexible gasket (1.12) and transmitted to the gear mechanism via the range plate (2.7) and the adjustable feeler roll (2.3). The indication for the flow rate 0...100 % is quadratic because of the relationship of the flow rate Q and the differential pressure Δp according to the equation:

$$Q = K \cdot \sqrt{\Delta p}$$

At counting equipment the coding disc (2.8), fixed on the pointer shaft, is frictionslessly sensed by the optoelectronic pick-up. The picked up number is converted to a corresponding pulse signal at succeeding electronic unit to control the pulse counter. For 100 % flow rate the pulse signal optionally can be designed for 70...3000 pulses/h by a counting range plug.

The flow rate measured by the instrument results as follows:

$$Q = \frac{\text{Diff. of counted pulses during the period of reading}}{\text{pulses/h}} \cdot Q_{max}$$

1.1 Technical data

Flow meter									
Measuring span max. mbar	60	100	160	250	400	600	1000	1600	2500
min. mbar	40	60	100	160	250	400	600	1000	1600
Nominal pressure	PN 40, unitalateral overrangeable up to 40 bar								
With measuring diaphragm for measuring spans of 40 through 600 mbar, 250 through 1600 mbar or 1600 through 2500 mbar									
Volumes within the dp-cell	High pressure chamber: approx. 80 cm³, Low pressure chamber: approx. 25 cm³								
Displacement volume	max. 9 cm³ (with minimum span: 5 cm³)								
Scale Scale version upon request:	Scale 270°, Scale length approx. 300 mm 0 ... 100 % squared for any linear measured value, for measured values according to equation, curve or table								
Characteristic	Indication linear to differential pressure								
Non-conformity	< ± 2.5 %	< ± 1.6 % (inclusive of hysteresis)							
Sensivity	< 0.5 %	< 0.25 %							
Effects in % of span	Ambient temperature: < 0.03 %/°C Static pressure: < 0.03 %/1 bar								
Protection type	IP 54								
Flow Rate Counter									
Counting range	Δp = 3.1 ... 100 % (≙ 17.7 ... 100 % flow rate)								
Output and Display	At flow Q = 100 %: 70.33 ... 3000 pulses/h or units/h on built-in pulse counter (depending on the arrangement of the diodes of the counting range plug) Floating transistor limit contact for connecting an external counter (U_{max} = 30 V d.c.; I_{max} = 0.3 A)								
Characteristic	$Q = K \cdot \sqrt{\Delta p}$								
Deviation from the characteristic at Q ≧ 40 %:	< ± 3.2 %	< ± 2 % of the upper-range value							
Pick-up frequency	≧ 13 Hz (pick-up intervals 75 ms)								
Pick-up accuracy	± 0.25 % of the upper-range value								
Supply	220 V, 110 V or 24 V a.c. (reconnectable) optionally with a d.c. module 24 V								
Environmental conditions	admissible ambient temperature: − 20 ... + 50 °C admissible storage temperature: − 20 ... + 85 °C								
Total weight	approx. 3.6 kg								

Note: All deviations in % of span. All pressures in bar (gauge).

2. Installation

2.1 Arrangement of the equipment

The basic arrangement of the equipment used is shown in the schematics below. The decision whether the flowmeter is to be fastened above or below the point of measurement or whether condensation chambers are to be installed depends on the type of process fluid and on the site conditions. The installation schematics show the normal and the reversed installation position. Normal installation should be preferred; only when there is no other choice, especially in steam measurements, reversed installation should be employed. It is recommended to consult the VDE/VDI Regulation 3512, Sheet 1, for further details.

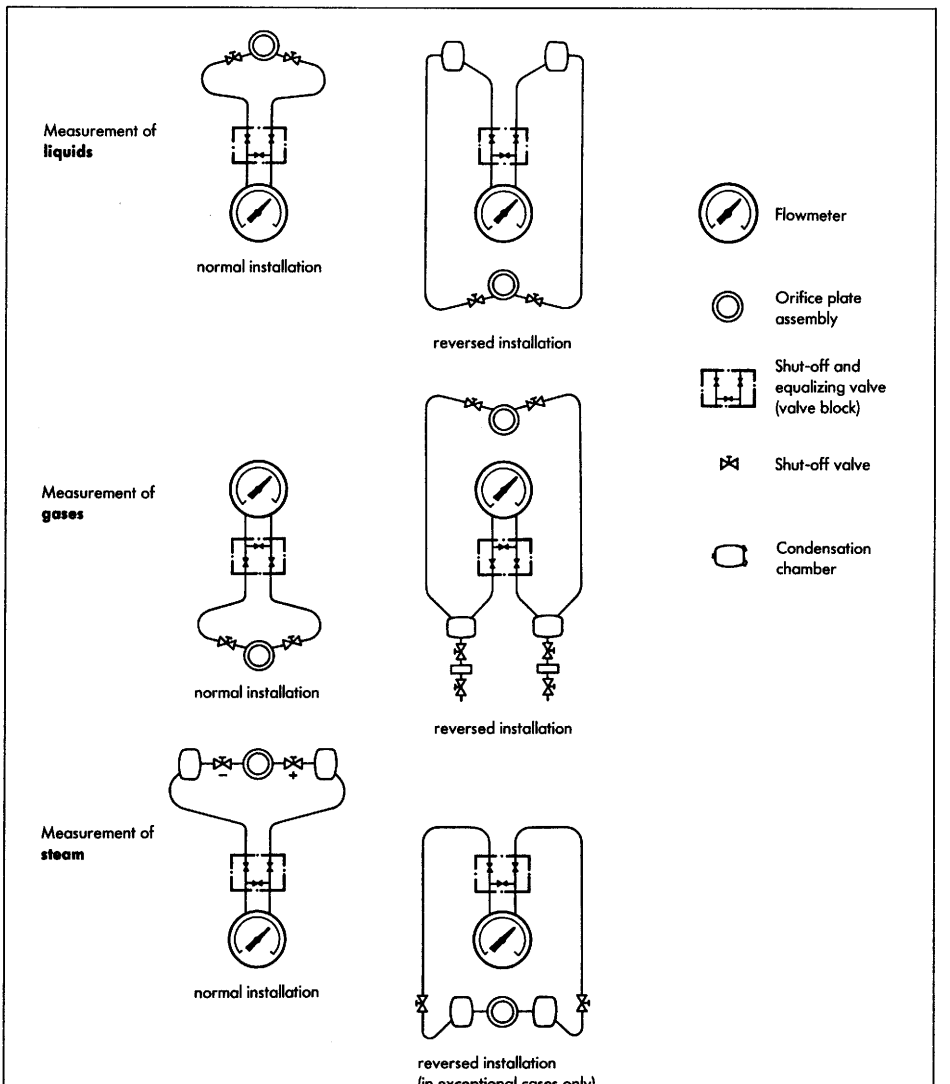


Fig. 3 · Installation schematics

2.2 Orifice plate assembly

(Orifice flange or orifice tube)

The direction of flow shall correspond to the attached arrow. An undisturbed length of straight pipe is required upstream and downstream from the orifice plate assembly (see fig. 4 and 5). The orifice tubes supplied by us have these pipe runs welded on. In the case of orifice flanges, the smooth length of pipe upstream from the orifice plate is indicated in the confirmation of order. The orifice plate assemblies and the gaskets must not be displaced eccentrically relative to the piping.

Control valves that vary continuously the condition of the process fluid, e.g. manually operated control valves or temperature controllers, must not be installed upstream of the orifice plate assembly. The actual condition should correspond to the calculated condition as closely as possible. On the other hand, controllers that keep the condition constant, e.g. pressure controllers upstream from the measuring facility, exercise a favourable influence.

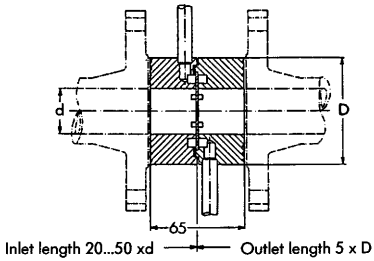


Fig. 4 · Orifice Flange Type 90

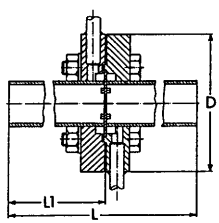


Fig. 5 · Orifice Tube Type 91

Dimensions Orifice Tube

Nominal size	DN	15	20	25	32	40	50
Overall length	L	550	700	900	1100	1300	1500
Inlet length	L1	381	501	651	801	1001	1201
Mounting ring	Diameter D	89	92	99	119	129	139
Weight	approx. kg	4.0	4.5	5.5	8.5	12	16

2.3 Differential pressure lines

The differential pressure line shall consist of tubes having an OD of 12 mm, the arrangement should be carried out according to fig. 3 and fig. 6. For good sealing of the pressure lines compression type connections should be used (section 5). Pipe runs that would normally be installed horizontally shall be mounted with a steady slope of not less than 1:20, i.e. sloping downward from the orifice plate or from the point that allows venting.

The minimum bending radius shall not be less than 50 mm.

Before the differential pressure lines are connected to the instrument they shall be flushed thoroughly.

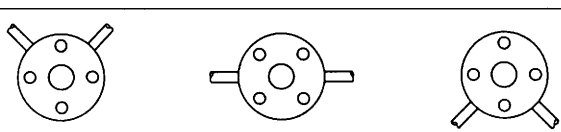


Fig. 6 · Arrangement of differential pressure lines

2.4 Media 4Z Indicator

Prior to installation, compare the operating data with those of the differential pressure pick-up. Make sure that the high pressure line is connected to the high pressure connection and that the low pressure line is connected to the low pressure connection.

Attention:

For connecting the differential pressure lines compression type connections are necessary, beyond that the free process fluid connections of the differential pressure cell must be closed by screw or vent plugs (see accessories section 5).

Prior to connecting the differential pressure pipes, clean the connections carefully. Under no circumstances must the instrument be flushed with compressed air or pressurized water.

At the point of installation, fasten the instrument to the pipe, wall or mounting plate. For mounting on vertical or horizontal pipe, use the mounting device with clamp; for wall mounting, use mounting device without clamp (see dimension drawing section 6).

2.4.1 Electrical connection

Connect wires for supply and eventually external counter via the PG 13.5 gland screw at terminals (fig. 7).

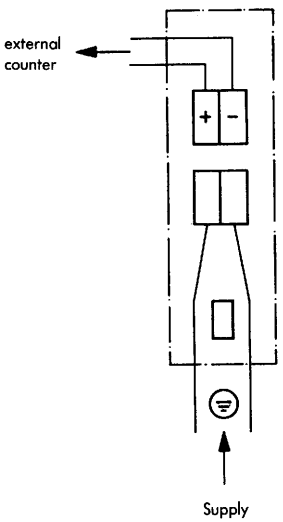


Fig. 7 · Electrical connection

2.5 Accessories

2.5.1 Condensation chambers (Fig. 8)

Condensation chambers for maintaining a constant liquid column are required in steam measurements; when liquid flow is measured, they are required only if the flowmeter is installed above the point of measurement. In steam measurement service, the chambers must be installed at exactly the same level as the differential pressure pick-up and fastened with pipe clamps or lugs.

Separation chambers for collecting condensate are required when gas flow is to be measured, if the flowmeter is installed below the point of measurement.

2.5.2 Shut-off valves

When shut-off valves are installed at the orifice plate, they must be fastened by means of clamps, preferably on the pipe. In this case, fastening the chambers may not be required.

2.5.3 Shut-off and equalizing valve

The combination of 3 resp. 5 valves to a valve block or a Samson mult-way single-spindle valve is used to shut-off both pressure lines and for short circuiting for zero adjustment. With a 5-block valve additionally lines for blowing out or flushing through can be connected. Install as shown in fig. 3 and 9.

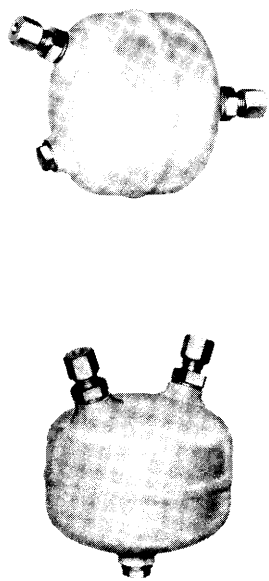


Fig. 8 · Codensation – resp. separation chamber

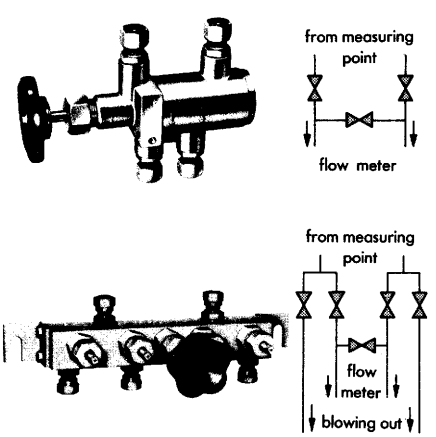


Fig. 9 · Multi-way single-spindle valve and 5-block valve

3. Start-up

3.1 Steam flow measurement

The steam should not contact directly the measuring diaphragm of the instrument. Therefore, unscrew the differential pressure lines below the multi-way single-spindle valve or valve block and fill the instrument with water.

Or, upon start-up of the plant (steam is on) and with the multi-way single-spindle valve or valve block in the closed position, wait for approx. 20 minutes until condensate fills the lead lines above the valve up to the orifice. Then place the instrument into service by slowly opening the single-spindle valve. If a valve block is installed instead of a single-spindle valve, first open the high pressure pipe, then close the valve block by-pass and open the low pressure pipe. Wait a little while, then open the two vent plugs of the measuring cell one after the other until condensate escapes free of bubbles, and then tighten plugs again. Also, vent the condensating chamber. Slightly tapping against the casing of the flowmeter or the condensating chamber facilitates the escape of air.

Subsequently check zero adjustment as described in paragraph 4.1 and place the instrument into service again.

Note:

In the case of reversed installation, i.e. measuring instrument installed above the point of measurement, the pressure lines may drain partly when the system is made pressureless. Upon new plant start-up, the measuring system will have to be vented so that it fills up again with condensate.

3.2 Liquid flow measurement

Place the instrument into service by slowly opening the multi-way single-spindle valve. If a valve block is installed instead of a single-spindle valve, first open the high pressure pipe, then close the valve block by-pass and open the low pressure pipe. Open the vent plugs of the measuring cell until the air has escaped; then tighten the plugs again.

Subsequently check zero adjustment as described in paragraph 4.1 and place the instrument into service again.

4. Operation

4.1 Zero adjustment

Close the single-spindle valve slowly. The high and low pressure pipes from the primary element or the vessel respectively are now shut-off. The outlets to the indicating instrument are short-circuited within the valve so that pressure balance occurs in the instrument. Therefore, the pointer must be on zero. If this is not the case, adjust the adjusting screw (2.6) until zero position is obtained. Now open the single-spindle multi-way valve slowly and continuously to the fully open position. The instrument is in operation again. If a valve block is installed instead of a single-spindle valve, first close the low pressure pipe, then open the valve block by-pass and close the high pressure pipe (opening in reversed sequence).

4.2 Correction in the case of different operating conditions, using the correction tables for flow measurement

If the prevailing operating condition of the process fluid deviated from the condition on which the calculation is based, an appropriate correction must be made. For steam, correction table 1 shall be used, while for compressed gas, correction table 2 applies.

4.3 Draining

In gas flow measurements, condensate must be drained from the condensating chamber from time to time. Prior to opening the drain plugs, close the valves in the differential pressure lines (valve block).

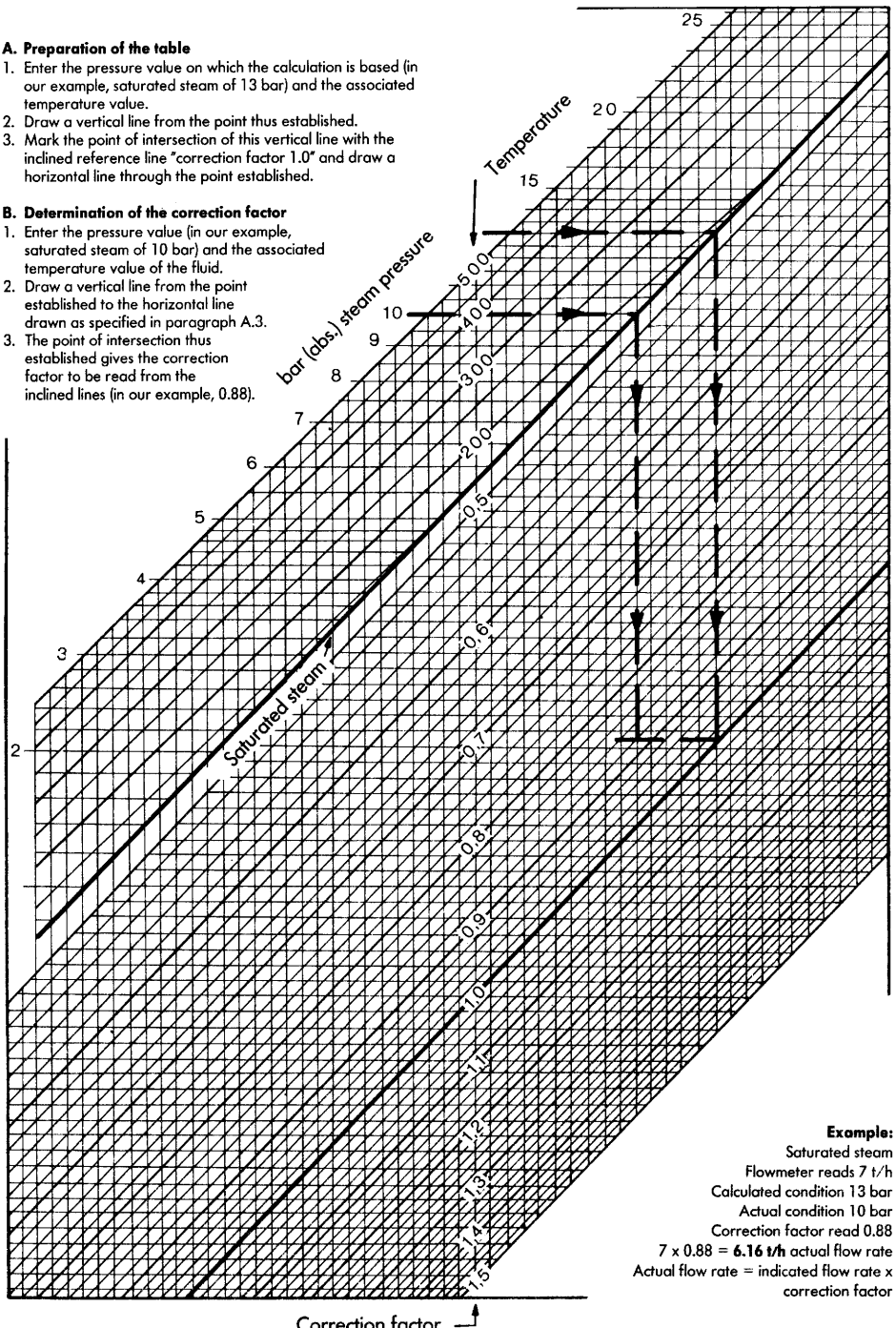
Correction Table 1
Steam flow measurement

A. Preparation of the table

1. Enter the pressure value on which the calculation is based (in our example, saturated steam of 13 bar) and the associated temperature value.
2. Draw a vertical line from the point thus established.
3. Mark the point of intersection of this vertical line with the inclined reference line "correction factor 1.0" and draw a horizontal line through the point established.

B. Determination of the correction factor

1. Enter the pressure value (in our example, saturated steam of 10 bar) and the associated temperature value of the fluid.
2. Draw a vertical line from the point established to the horizontal line drawn as specified in paragraph A.3.
3. The point of intersection thus established gives the correction factor to be read from the inclined lines (in our example, 0.88).



Example:
Saturated steam
Flowmeter reads 7 t/h
Calculated condition 13 bar
Actual condition 10 bar
Correction factor read 0.88
7 x 0.88 = **6.16 t/h** actual flow rate
Actual flow rate = indicated flow rate x correction factor

Correction Table 2

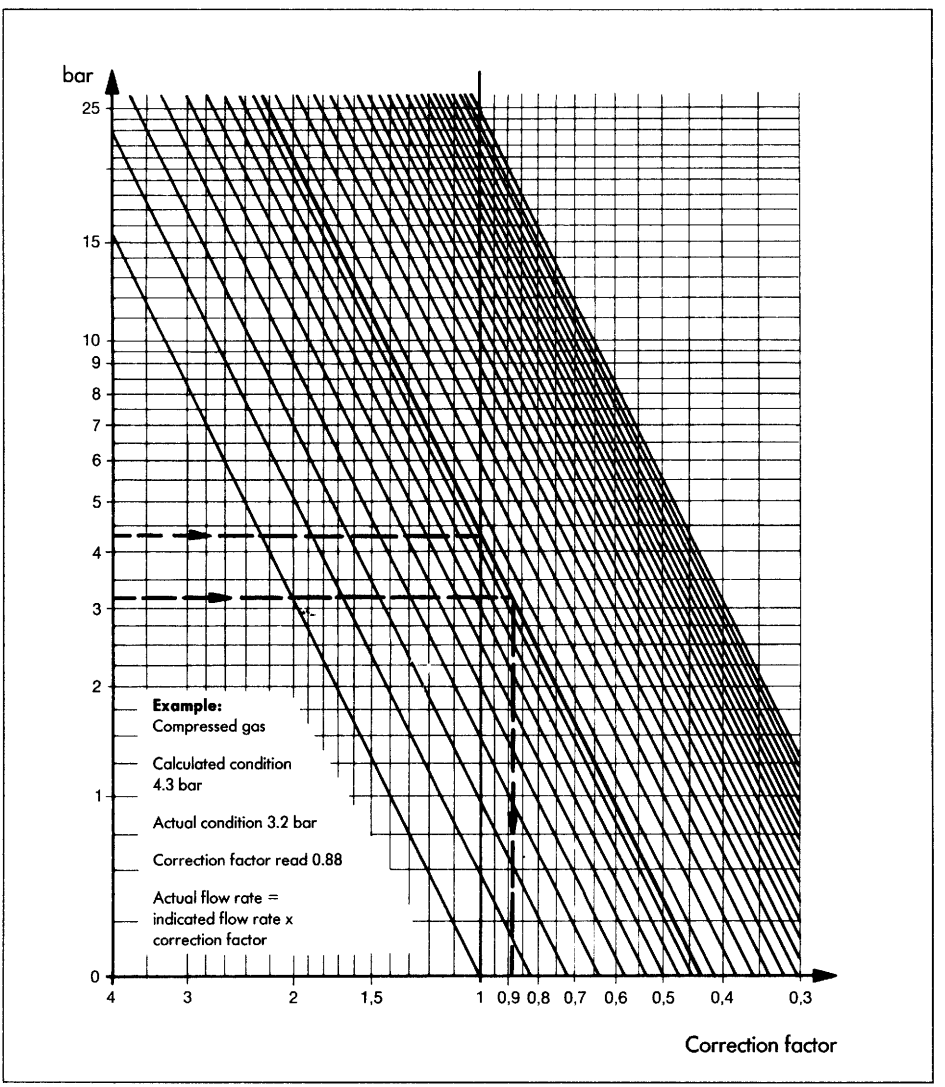
Compressed gas flow measurement

A. Preparation of the table

1. Enter the pressure value on which the calculation is based (in our example, 4.3 bar) on the line "correction factor 1".
2. Draw an inclined line through this point parallel to the inclined lines.

B. Determination of the correction factor

1. Enter the operating pressure value (in our example, 3.2 bar) on the line "correction factor 1".
2. Draw a horizontal line through this point.
3. Draw a vertical line from the point of intersection of the horizontal line with the inclined line drawn as specified in paragraph A.2
4. Read correction factor (in our example, 0.88).



4.4 Adjustment of measuring span/measuring range

The measuring span of the flowmeter is determined by the measuring cell (three versions, different measuring diaphragms (1.6) and guide spring (1.9)) on the one hand, and by the measuring spring (1.5) installed on the other hand.

The instrument is set by the manufacturer to the measuring range specified in the order, and the measuring range can be changed subsequently only within the range permitted by the measuring spring installed.

The measuring span can be adjusted continuously up to 60 % of the maximum measuring span. When a different span is to be adjusted, the measuring spring (1.5) must be exchanged. See instrument serial plate and table 3.

4.4.1 Adjusting and changing the measuring range (Fig. 2)

Adjustment should preferably be made on the test bench only.

Unscrew the casing front section and apply a pressure to the measuring cell that corresponds to the required upper range value. Then adjust the feeler roll (2.3) at the measuring range plate (2.7) upwards and downwards until the pointer (2.5) is on the full scale value.

Remove the pressure; the pointer must return into the zero position; correct zero point with the adjuster (2.6).

Apply again full load (upper range value) to the measuring cell and readjust feeler roll again until the pointer is on the scale end point.

If necessary, repeat the adjustment procedure until zero point and end point correspond to the desired measuring range.

Attention

In no case loosen pointer (2.5) **from gear mechanism.**

Exakt coordination to coding disc and with that for counting gets lost.

4.4.2 Changing the measuring range by exchanging the measuring spring (Fig. 2 and 10)

Adjustment must be made on the test bench only.

If the measuring range is to exceeded that of the measuring spring, the measuring spring required shall be selected from the Table 3. Only the springs suiting the existing measuring cell (see serial plate) can be exchanged. Proceed as follows:

Unscrew closing cover (2.2) and set zero point with adjusting screw (2.6). Unscrew screws (1.14) and remove the spring plate (1.4), measuring spring (1.5) and washer(s) (1.13) from the low pressure side of the measuring cell. Install a new spring (1.5) and fasten spring plate with two screws (1.14). Check zero position, correct deviation by installing washers of different thickness (for order number see Table 3).

For this purpose, the spring plate must be removed each time. When zero position is obtained, screw on the spring plate firmly; check O-ring (1.15) for proper position and replace, if necessary.

Adjust the measuring range as described in paragraph 4.4.1.

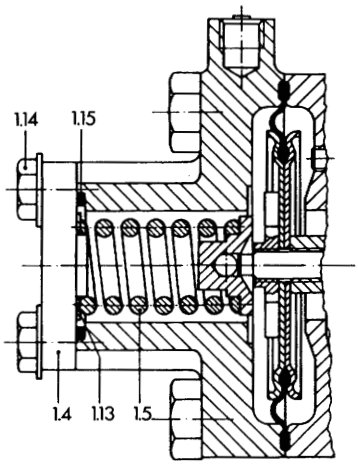


Fig. 10 · Measuring spring

Note:

When the measuring range, which in flow measurements corresponds to the differential pressure, is changed, it should be noted that the flow rate reading changes, too. In this case, a new calculation is required. Also, the aperture ratio

$$m = \frac{d^2}{D^2}$$

of the orifice must be taken into consideration.

Table 3

Measuring cell	Measuring range (mbar) min.	max.	Measuring spring Wire ⌀ mm	Length ± 0,1 mm	Order-No.
1 Diaphragm 0.4/52 Guide spring 0.5	0...40	0...60	1.2	34.4	1400-5871
	0...60	0...100	1.6	32.7	1400-5872
	0...100	0...160	1.8	32.2	1400-5873
	0...160	0...250	2.25	32	1400-5874
	0...250	0...400	2.5	31.9	1400-5875
	0...400	0...600	2.8	31.7	1400-5876
2 Diaphragm 0.4/70 Guide spring 0.8	0...250	0...400	2.25	32.4	0270-1725
	0...400	0...600	2.5	32.2	1400-5880
	0...600	0...1000	3	31.8	1400-5881
	0...1000	0...1600	3.4	31.6	1400-5882
3 Diaphragm 0.6/70 Guide spring 0.8	0...1600	0...2500	3.6	31.6	1400-5885

Part	Designation	Order-No.
1.14	Washers	1400-5653
1.16	O-ring 22 x 2	8421-0080

4.5 Change of the adjusted pulse number

The pulse number (pulses per how 100 % of flow rate) specified in the order is impressed on serial plate.

This adjusted pulse number can be changed subsequently by changing the diodes set on counting range plug. For this purpose remove plug carefully from p.c. board electronic.

By soldering in of 1 up to max. 12 diodes (Order-No. 8826-0415), pulse numbers of 70 to 3000 p/h are attainable.

To coordinate the desired pulse number to the diodes set the given pulse number must be transformed to the datum pulse-time:

$$\text{pulse-time [ms]} = \frac{3\,600\,000}{\text{pulse number [p/h]}}$$

In following table the pulse-times are allocated to the corresponding places of diodes.

The determined value for the pulse-time must be looked up from table 4. If it is not to be found, so a diode is to be set to the diode place of the next following lower pulse-time. With the differential value of determined value and table value than the corresponding places are to be looked up subsequently in the table until the differential value is 0 or $< 12{,}5$.

1. Example: Desired pulse number 1500 p/h

Transformed to the pulse-time it follows

$$\frac{3\,600\,000}{1500} = 2\,400 \text{ ms}$$

Look up this value from table → not available, next following lower value is **1600** – on corresponding place **7** solder in a diode.

As differential value results 2400 – **1600** = 800. Look up value from table → available, on corresponding place **6** solder in next diode.

2. Example: Desired pulse number 100 p/h

$$\frac{3\,600\,000}{100} = 36\,000 \text{ ms}$$

Look up this value from table → not available, next following lower value is **25600** – on place **11** solder in a diode.

As differential value results 36000 – **25600** = 10400

Look up this value from table → not available, next following lower value is **6400** – on corresponding place **9** solder in next diode.

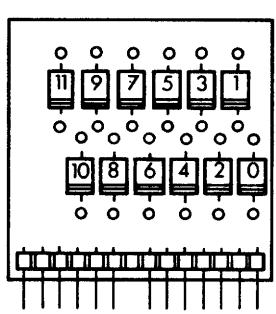
As differential value results 10400 – **6400** = 4000

Look up this value from table → not available, next following lower value is **3200** – on corresponding place **8** solder in next diode.

As differential value results 4000 – **3200** = 800

Look up this value from table → available, on corresponding place **8** solder in next diode.

Table 4

Pulse-time [ms]	Place of diode	Diodes set on counting range plug
12.5	**0**	
25	**1**	
50	**2**	
100	**3**	
200	**4**	
400	**5**	
800	**6**	
1600	**7**	
3200	**8**	
6400	**9**	
12800	**10**	
25600	**11**	

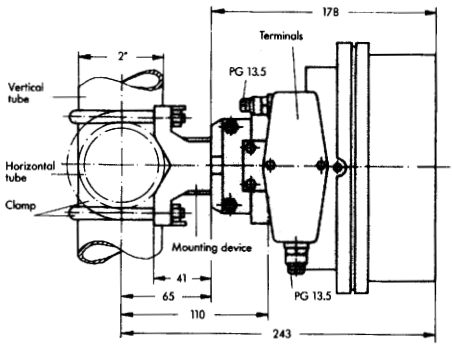
5. Connection accessories

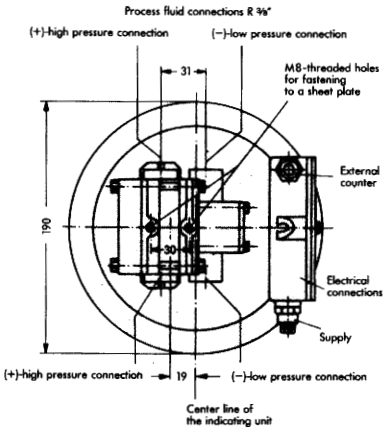
The instruments are delivered without process fluid connections. Required pressure type connections, screw- and vent plugs or throttles for damping of any oscillations by the measured medium (specially for gas measurement) must be ordered separately.

Q'ty	Designation	Order-No. standard	washed for O_2
2	Connections for tube ⌀ 12 mm, Steel	1400-5842	1400-5843
2	Connections for tube ⌀ 12 mm, Stainless Steel	1400-5844	1400-5845
2	Connections for tube ⌀ 10 mm, Steel	1400-5846	1400-5847
2	Connections for tube ⌀ 8 mm, Steel	1400-5860	1400-5861
2	Connections for tube ⌀ 12 mm, with throttle, Steel	1400-5848	1400-5849
2	Connections for tube ⌀ 8 mm, with throttle, Steel	1400-5850	1400-5851
2	Connections for tube ⌀ 6 mm, with throttle, Steel	1400-5852	1400-5853
2	Special connections with throttle (Messer)		1400-5858
2	Vent plugs, brass, with gaskets	1400-5654	1400-5658
2	Screw plugs, brass, with gaskets	1400-5655	1400-5659
1	Screw plug (half set), brass, with gasket	1400-5662	1400-5663
1	Mounting device for tube mounting	1400-5656	

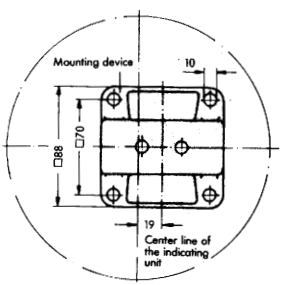
6. Dimensions in mm

Tube mounting





Wall mounting



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