Technical Information
TI 297P/01/en

Operating Instructions
52012119

Flow Measurement with Primary Devices
deltatop DPO 10, 12, 15 / DPP 10
deltaset DPO 50, 51, 52, 53 / DPP 50

Flowmeter system with orifice plate or Pitot tube and Deltabar S differential pressure transmitter

Deltatop

Deltaset

Application of Deltatop
Deltatop is a compact, ready-to-use flowmeter system. The primary device (orifice plate or Pitot tube) and Deltabar S differential pressure transmitter (with manifold, for steam also with condensate chambers) are readily mounted and optimised using process data supplied by the customer.

Application of Deltaset
Deltaset is the modular flow rate measurement section. The primary device, manifold (and for steam: condensat chambers) are pre-mounted and, with the Deltabar S differential pressure transmitter, optimised to the operating data.

Your benefits
❑ Deltatop and Deltaset
- Complete device, optimised to minimum pressure loss and highest accuracy
- Deltabar S differential pressure transmitter ready adjusted
- Optimum configuration for application
- Display either with flow rate, differential pressure or 0...100% display

❑ Deltatop
- Operational compact version
- No impulse pipes

❑ Deltaset
- Medium temperatures of up to 1000 °C and pressures of up to 400 bar
- Completely modular product range

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The Power of Know How

Overview of Contents

Content of this Technical Information

	Page		Page
Selection of primary device	3	Application examples	20
Deltatop selection guide	4	Temperature and pressure compensation	22
Deltaset selection guide	6	Deltatop versions	25
The measuring system	8	Deltaset versions	42
Deltabar S differential pressure transmitter	9	Components	61
Principle and operation	12	Supplementary documentation	69
Designing the measuring point	17	Flow data sheet	70

Selecting the measuring device

Deltatop or Deltaset?

Device type	Deltatop	Deltaset
Differential pressure transmitter	Deltabar S mounted above manifold on primary device **Compact version**- see page 1	Deltabar S and primary device mounted separately **Separate version** - see page 1
Application	Flow measurement (volume or mass) for liquids, gases or steam	
Nominal diameter of pipe	Orifice plate DN 10 ... DN 1000 (standard) Pitot tube DN 50 ... DN 2000 (optional 12000)	
Process pressure	to PN 160 bar	to PN 400
Process temperature	to 200 °C for gases/liquids to 300 °C for steam (due to the condensat chambers)	to 500 °C for standard materials to 1000 °C for special material
Measuring point	Easily accessible mounting location • Compact version	Difficult to access mounting location • Separate version
Selection guide	Page 4	Page 6

Tab. 1: Selection of optimum device type -– Deltatop or Deltaset?

Type overview

	Deltatop	Deltaset
Undivided orifice plate with corner taps	DPO 10E-□□□□□□□ DPO 10A-□□□□□□□	DPO 50E-□□□□□□□ DPO 50A-□□□□□□□
Annular chamber orifice with corner taps		DPO 51E-□□□□□□□ DPO 51A-□□□□□□□
Orifice flange	DPO 12E-□□□□□□□ DPO 12A-□□□□□□□	DPO 52E-□□□□□□□ DPO 52A-□□□□□□□
Orifice plate		DPO 53E-□□□□ DPO 53A-□□□□
Orifice pipe unit	DPO 15E-□□□□□□□ DPO 15A-□□□□□□□	
Pitot tube	DPP 10-□□□□□□□□	DPP 50-□□□□□□□□

Tab. 2: Type name, depending on primary device.
DIN and ANSI versions are available for each orifice plate type. DIN versions have the ending -E, ANSI versions have the ending -A. Example:DPO 10A-... is a standard orifice plate in the ANSI version.

Selection of primary device

Orifice plates

Orifice plates are used with media (steam, gas, liquids) where the viscosity is not too high (limit value 50 mPas = 50 cSt). The versions differ in the tapping point of the differential pressure. The orifice plates with annular chamber tapping give slightly more accurate differential pressure values than the alternatives (orifice plate with corner or flange tapping). The orifice plate with corner tapping (Deltatop DPO 10) is the cheapest version for new installations. Orifice pipe units (Deltatop DPO15) are used for diameters smaller than DN 50.

Pitot tubes

Pitot tubes are primarily used with large pipe diameters (from approx. DN 200 to DN 12000), but, on account of their countless benefits, are also used at smaller diameters. A considerable advantage is their small installation cost and easy expandability are their constant very low static pressure loss. This makes Pitot tubes the sensible choice for installation at a later date (possible as a “flow tap” version without interrupting operation!). As they can be machined from many different materials, and are also suitable for soiled media, they can be used universally.

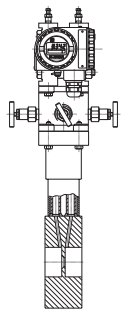
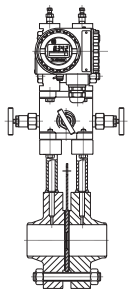
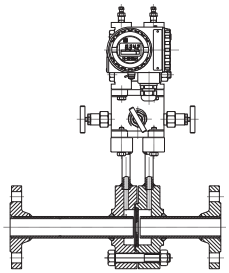
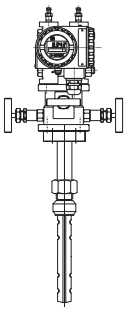
Orifice plate or Pitot tube?

		Orifice plate	Pitot tube
Pipe	Nominal diameter DN	DN 10...DN 2000 DN 10...DN 40: Orifice pipe unit (optionally from DN 4)	DN 25 ... DN 2000 (optionally 12000, single measuring principle for DN > 2,000)
	shape	Round section	Round or square section
Media	State	Steam, gas (also mixtures or moist gases), liquids	
	Max. viscosity	50 mPas (50 cSt)	80 mPas (80 cSt)
	Sensitivity for abrasion	Sharp plate edges can wear away. But: low-cost orifice plate replacement possible	Considerably less than for orifice plate (dynamic pressure in front of probe prevents ingress
	Measures against corrosion	Low-cost through use of corrosion-resistant materials	
	Sensitivity for dirt	Dirt may collect in front of the orifice plate and reduce accuracy	Considerably less than for orifice plate (dynamic pressure in front of probe prevents ingress)
	Inaccuracy at constant density	approx. 1 % of measured value	approx. 1.5 % of measured value
Technical Data	Reproducibility R	0.1 % of max. flow	
	Dynamics	up to 6:1 under constant conditions (p, T)	
	Constant static pressure loss Δw	typically < 1 % of p_{stat} 10 %...80 % of differential pressure Δp relating to β	typically < 1 % of p_{stat} 10 % of calculated differential pressure Δp
	Max. flow velocity v	Liquids up to 12 m/s Gases/steam: up to 60 m/s	Liquids up to 40 m/s Gases/steam: up to 60 m/s
	Min. Reynolds number Re	2.800	4.000
	Typical differential pressure Δp	Liquids 40...600 mbar Gases: 5...200 mbar Steam: 60...2500 mbar	Liquids 5...80 mbar Gases: 1...80 mbar Steam: 3...50 mbar
Installation	Installation type	Open piping, mount with - Adapter flange - Welding neck flange - Measuring flange	Drill piping, mount with - Welding socket and cutting ring screw union - Flange
	Inlet/outlet runs	10/4 x D, dependent on β and obstacles	7/3 x D Less dependent on flow profile than orifice plates due to distribution of bore holes

Tab. 3: Selection of the primary device - orifice plate or Pitot tube

Deltatop selection guide

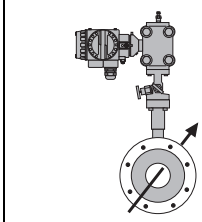
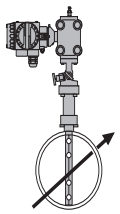
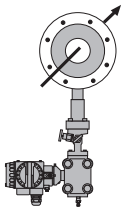
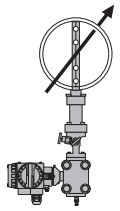
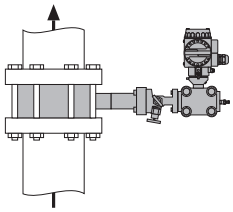
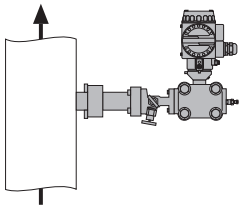
Versions

Primary device	Version Deltatop always incl. manifold; with steam additionally with condensat chambers	
Undivided orifice plate with corner taps	DPO 10E: DN 50...DN 1000 DPO 10A: ANSI 2" ... ANSI 24" to DIN 19205, design type B	 P01-DPO10xxx-14-xx-xx-xx-001
Orifice flange	DPO 12E: DN 50...DN 500 DPO 12A: ANSI 2" ...ANSI 24" to DIN 19214 (Part 1) or ANSI 1636	 P01-DPO12xxx-14-xx-xx-xx-001
Orifice pipe unit	DPO 15E: DN 10...DN 40 DPO 15A: ANSI 1/2" ...ANSI 1 1/2" Orifice plate with piping extension	 P01-DPO15xxx-14-xx-xx-xx- 001
Pitot tube	DPP 10E: DN 25...DN 2000 DPP 10A: ANSI 1" ...ANSI 80"	 P01-DPP10xxx-14-xx-xx-xx-001

Tab. 4: Version of Deltatop
E = DIN version
A = ANSI version

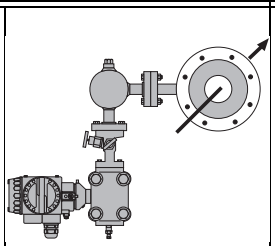
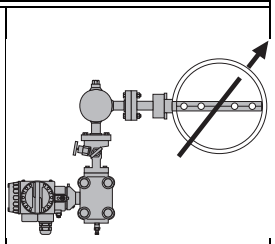
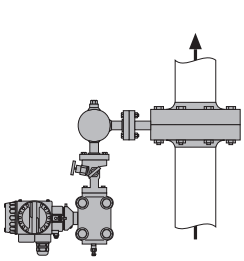
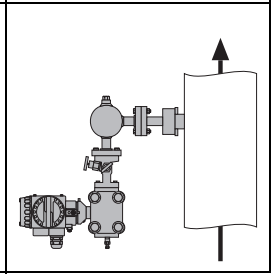
Installation arrangements for Deltatop

Deltatop measuring point for gas/liquids

	Orifice plate		Pitot tube	
Piping horizontal Gas	DPO10E/A-A DPO12E/A-A DPO15E/A-A		DPP 10-A	
Liquids	DPO10E/A-C DPO12E/A-C DPO15E/A-C		DPP 10-C	
Piping vertical Gas Liquids	DPO10E/A-B DPO12E/A-B DPO15E/A-B DPO10E/A-D DPO12E/A-D DPO15E/A-D		DPP10-B DPP10-D	

Tab. 5: Structure of a Deltatop measuring point for liquids and gases
So that there are always constant pressure relationships at the differential pressure transmitter, the pulse lines must always be filled solely with gas or with liquid.
***Piping horizontal:** Arrangement for gas: mounting the differential pressure transmitter above the piping ensures that any condensate always flows towards the piping.*
Arrangement for mediums: installation of the differential pressure transmitter below the piping ensures that any gas bubbles always move towards the piping.
***Vertical piping:** For vapourous liquids, it is recommended that you use Deltaset to avoid gas bubbles in the transmitter flange (which could lead to measuring errors).*

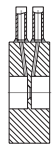
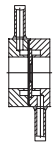
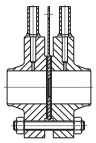
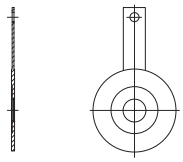
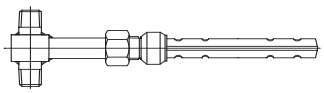
Deltatop measuring point for steam

	Orifice plate		Pitot tube	
Piping horizontal Steam	DPO10E/A-E/F DPO12E/A-E/F DPO15E/A-E/F		DPP 10-K	
Piping Vertical Steam	DPO 10E/A-G/H DPO 12E/A-G/H DPO 15E/F-G/H		DPP 10-L	

Tab. 6: Structure of a Deltatop measuring point for steam
Hot steam must not come into contact with the membrane of the transmitter. To avoid damage through high temperatures, make sure before commissioning that the condensat chambers are completely filled. During installation, make sure that the condensat chambers are aligned symmetrically (same geodetic height). This ensure a constant column of water as the condensing steam forms a constant liquid level in the condensat chambers. With steam, the differential pressure transmitter must always be mounted below the condensat chambers.

Deltaset selection guide

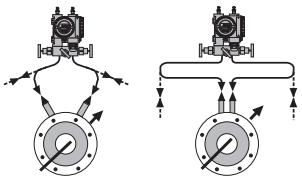
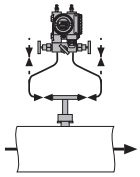
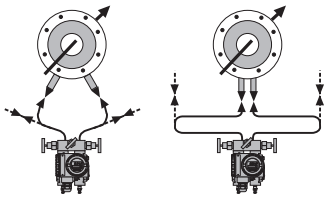
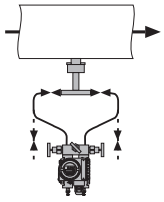
Versions

Primary device	Version	
Undivided orifice plate with corner taps	DPO 50E: DN 50...DN 1000 DPO 50A: ANSI 2" ...ANSI 24" to DIN 19205, design type B	 P01-DPO50xxx-14-xx-x
Annular chamber orifice with corner taps	DPO 51E: DN 50...DN 1000 DPO 51A: ANSI 2" ...ANSI 24" to DIN 19205, design type A	 P01-DPO51xxx-14-xx-
Orifice flange	DPO 52E: DN 25...DN 500 DPO 52A: ANSI 2" ...ANSI 24" to DIN 19214 (Part 1) or ANSI B 16.36	 P01-DPO52xxx-14-80-I
Orifice plate	DPO 53E: DN 50 ... 1000 DPO 53A: ANSI 2" ...ANSI 40"	 P01-DPO53xxx-14-xx-xx-x
Pitot tube	DPP 50E: DN 25...DN 2000 DPP 50A: ANSI 1" ...ANSI 80"	 P01-DPP50xxx-14-xx-x

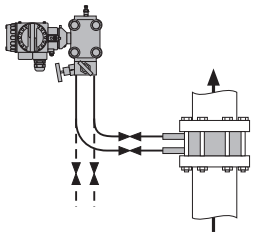
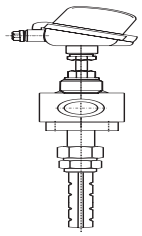
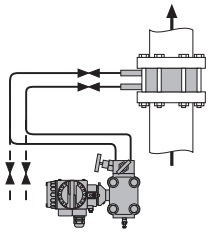
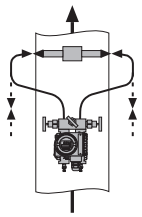
Tab. 7: Versions of Deltaset; E = DIN version / A = ANSI version

Installation arrangements for Deltaset

Deltaset measuring point for gas/liquids

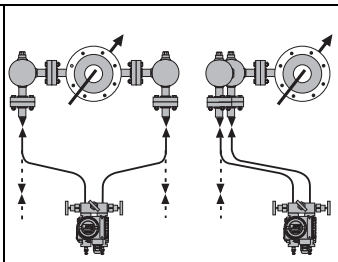
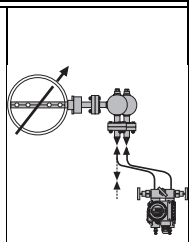
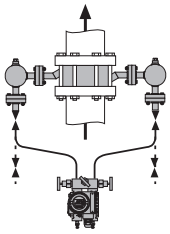
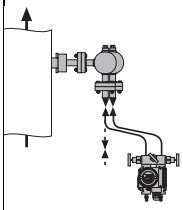
	Orifice plate		Pitot tube	
Piping horizontal Gas	DPO50E/A-A, DPO51E/A-A, DPO52E/A-A		DPP 50-A	
Liquids	DPO50E/A-C, DPO51E/A-C, DPO52E/A-C		DPP 50-C	

Tab. 8: Structure of a Deltaset measuring point for liquids and gases (refer to notes in table 5)

	Orifice plate		Pitot tube	
Piping vertical Gas	DPO50E/A-B DPO51E/A-B DPO52E/A-B		DPP 50-B	
Liquids	DPO50E/A-D DPO51E/A-D DPO52E/A-D		DPP 50-D	

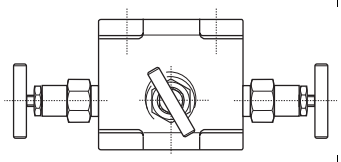
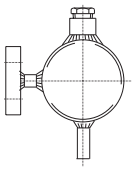
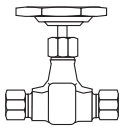
Tab. 8: Structure of a Deltaset measuring point for liquids and gases (refer to notes in table 5)

Deltaset measuring point for steam

	Orifice plate		Pitot tube	
Piping horizontal Steam	DPO50E/A-E DPO51E/A-E DPO52E/A-E		DPP 50-K	
Piping vertical Steam	DPO 50E/A-G/H DPO 51E/A-G/H DPO 52E/A-G/H		DPP 50-L	

Tab. 9: Systematic structure of a Deltaset measuring point for steam (refer to notes in table 6)

Components (Accessories)

manifold	Condensate trap	Shut-off valves
DPM 50 	DPC 50 	DPV 50 
Use always	Use always for steam applications	Use always as shut-off on primary device or as additional rinse or ventilation accesses

Tab. 10: Components for Deltaset

The measuring system

Applications

Differential pressure flow measurement can be used universally. This is true both in the relationship to the pipe diameter (DN 4 to DN 12000) and to the range of media (gases, steam and liquids).

The applications can be basically split into flow measurement for substance currents (= products) and flow measurement for supply currents (= auxiliary material).

Flow measurement with primary devices is particularly used in the following branches:

- Power stations
- Petrochemicals
- Chemicals
- Cement
- Paper/Cellulose
- Biology, pharmaceuticals

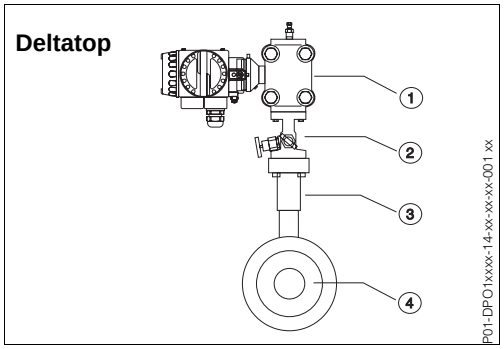
Measuring device

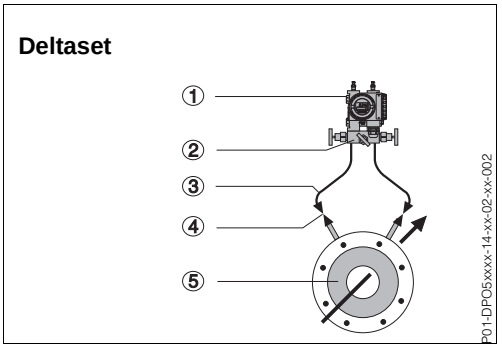
The Deltatop or Deltaset differential pressure flow measuring point consists of several components, the version and assembly depends on the application. The components of the measuring device are:

1. Deltabar S differential pressure transmitter
2. manifold
3. Tapping gland or impulse pipes
4. Shut-off valves (Deltaset)
5. Primary device (orifice plate or Pitot tube)

Two condensat chambers are integrated for steam applications. The applications can be split primarily into the following three criteria:

- Media state: vapourous, gaseous or fluid
- Type of primary device (orifice plate, Pitot tube)
- Process conditions, particularly pressure and temperature



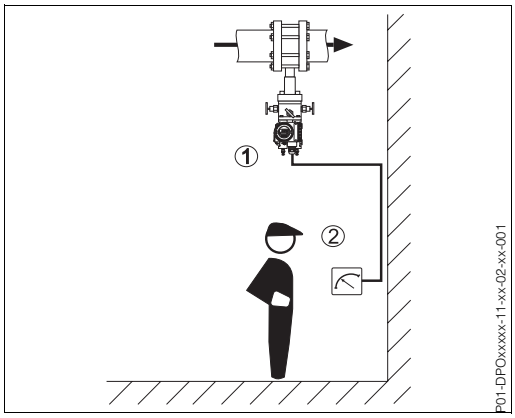


Deltatop with remote display

If you require a separation of the primary device and the measured value display, then there is a low-cost alternative to impulse pipes: Deltatop + remote display. A two-wire signal cable runs from the Deltabar e.g. to the display unit RIA 250 from Endress+Hauser and thus offers:

- Reliable measured value display
- 2 limit relays
- RS-232 interface

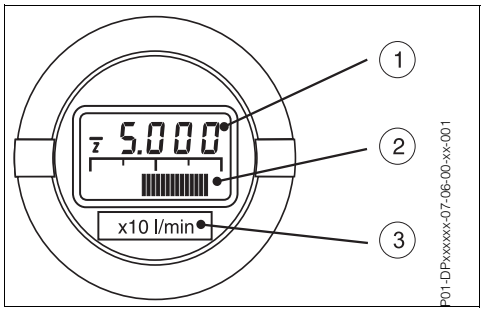
① Deltatop
② Display unit

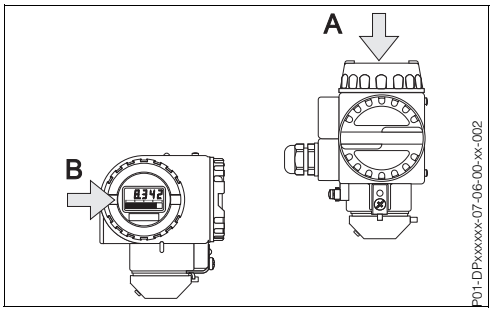


Deltabar S differential pressure transmitter

Deltabar S differential pressure transmitter

The Deltabar S differential pressure transmitter is ordered in addition to Deltatop and/or Deltaset. The scope of supply then comes complete with a mounted Deltabar S.





The display on the Deltabar is selectable - see below, the current differential pressure can be exported to:

① 4 digit digital display
② Bargraph as a trend display (4...20 mA)
③ Inscription specifying the displayed unit

There are two versions for this:
A housing T5 with display at top
B housing T4 with display at side

Deltabar S - benefits at a glance

- High accuracy
- Linearity deviation smaller than 0.1 % of the span
- In the “Platinum” version, the linearity deviation is less than 0.05 % of the set span
- Long-term drift better than 0.1 % per year or 0.25 % per 5 years
- Process temperatures up to 120 °C as standard
- System pressures up to 420 bar
- Uniform modularity for differential pressure and pressure (Deltabar S, Cerabar S) and all components like sensors, electronics, etc.
- Display module rotatable, with 4-digit digital display, bargraph 4...20 mA and specification of the displayed technical unit
- Simple and safe operation over 4...20 mA, HART, PROFIBUS-PA or Foundation Fieldbus
- Zero and span on site with or without reference pressure
- Function monitoring from sensor to electronics
- Numerous software functions such as characteristics, diagnostic codes, totalizers etc.

Display selection

The Deltabar S is supplied fully set, with a choice of flow, differential pressure or percent display option. You choose the type of display when ordering the primary device (last position of the order code of the orifice plates and Pitot tubes.
Example: DPO 10E-❑❑❑❑❑❑F)

Display option	Version	Characteristic	Inscription	4-digit digital display	Bargraph, 4...20mA current output
			③	①	②
F	Flow values, square root	square root	x 10 l/min	0 ... 1000	0...10,000 l/min
P	Differential pressure values, linear	linear	0...200 mbar	0 ... 200.0	0...200 mbar
S	Adjustment 0...100 %, square root	square root	% (sq.rt, rt. ex.)	0 ... 100,0	0...10,000 l/min
T	Adjustment 0...100 %, linear	linear	% (lin.)	0 ... 100,0	0...200 mbar

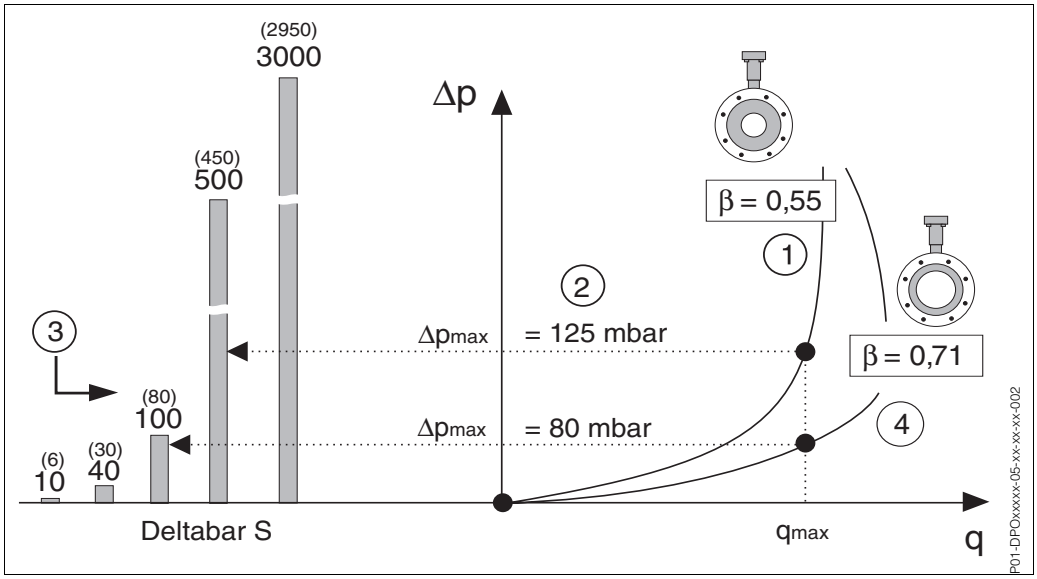
Tab. 11: Display options, numeric example (Columns 5-7) for q = 0...10,000 l/min, Δp_{max} = 200 mbar

Measuring range of the Deltabar sensor

You can obtain good results by choosing the right combination of orifice plate and measuring range. Endress+Hauser optimizes the calculation of the orifice with the selection of the best fitting sensor. The right dynamics should be attained with as little pressure loss as possible (see following chapter).

1. Start with orifice plate characteristic $\beta = 0.55$ (opening ratio)
2. Therefore, at the max. flow q_{max}, there is a max. differential pressure across the orifice plate of e.g. $\Delta p_{max} = 125$ mbar. With the 500 mbar-sensor, this would give an unsuitable combination of measuring cell and orifice plate version.
3. Optimisation: to use the next-smallest sensor, e.g. differential pressure $\Delta p = 80$ mbar for 100 mbar cell
4. Then, the orifice plate characteristic is $\beta = 0.71$

Result: The optimum adjustment of orifice plate calculation and Deltabar sensor minimises the Δp system error and reduces pressure loss.



Ordering the Deltabar S

To optimise Deltatop/Deltaset, order the Deltabar S with the measuring range code (see below). Endress+Hauser does everything else.

Metal cell:

- PMD 235 - ❑❑ 4 8 8 ❑❑❑❑ for stainless steel diaphragm, stat. pressure resistance to 160 bar
- PMD 235 - ❑❑ 5 8 8 ❑❑❑❑ for stainless steel diaphragm, stat. pressure resistance to 420 bar
- PMD 235 - ❑❑ B 8 8 ❑❑❑❑ for Hastelloy-diaphragm, stat. pressure resistance to 160 bar
- PMD 235 - ❑❑ H 8 8 ❑❑❑❑ for Hastelloy-diaphragm, stat. pressure resistance to 420 bar

Ceramic cell:

- PMD 230- ❑❑ 8 8 8 ❑❑❑❑ for ceramic diaphragm, static. pressure resistance to 100 bar

The exact choice of cell nominal operating range (e.g. 100 mbar) is made at the factory on the basis of the Pitot tube calculation or the orifice plate optimisation.

Special case for orifice plate

If you require a particular differential pressure p (e.g. 200 mbar), then order it as follows:

- Metal cell: PMD 235 - ❑❑ x x 9 ❑❑❑❑
- Ceramic cell: PMD 230 - ❑❑ x x 9 ❑❑❑❑

xx stands for the selection of the suitable differential pressure cell, 9 stands for set (lin./rt. ex., from... to..., unit), e.g. set: square root, from 0 to 200 mbar. The orifice plate is then optimised at the factory, so that the required differential pressure is generated at maximum flow.

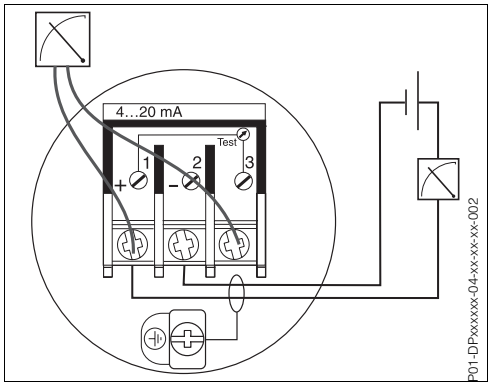
Electrical connection

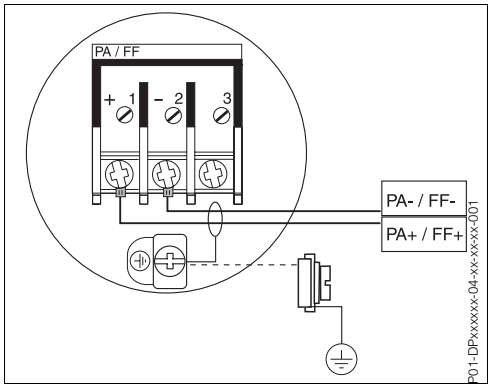
Analogue signal 4...20 mA, HART

For the signal line, use a twisted, screened, two-core cable. The supply voltage in non-hazardous areas is 11.5...45.0 VDC, in hazardous areas 11.5...30VDC.

PROFIBUS-PA or FIELDBUS FOUNDATION

The digital communication signal is transmitted on a bus along a two-core connecting line. The bus line also carries the power supply. For the bus line, use a twisted, screened, two-core cable.





Ambient conditions

- ❑ Ambient temperature: -40...+85 °C
- ❑ Storage temperature: -40...+100 °C
- ❑ Climate class: GPC acc. to DIN 40040
- ❑ Vibration resistance: ±0,1 % (to DIN IEC 68 Part 2-6, relating to sensor span)
- ❑ Ingress protection: IP 65/NEMA 4X
- ❑ Electromagnetic compatibility:
  Interference emission to EN 61326, Equipment Class B;
  Interference immunity to EN 61326, Appendix A (industrial sector), NAMUR-recommendation EMV (NE 21)
  Interference immunity to EN 61000-4-3: 30 V/m

Supplementary Documentation

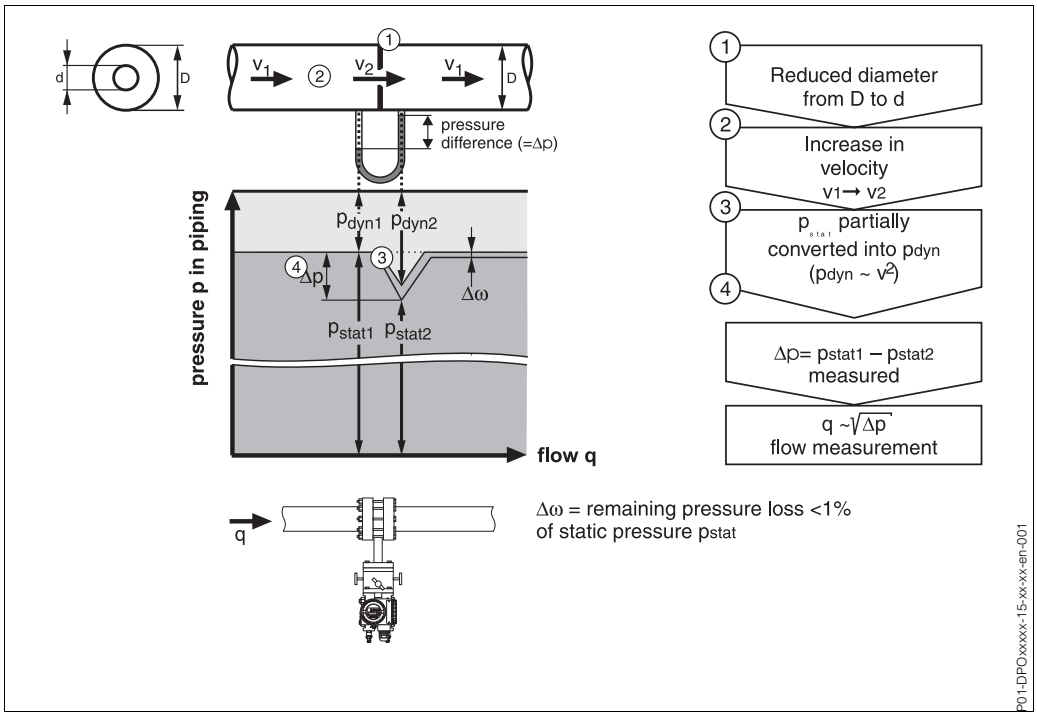
Deltabar S Differential Pressure Transmitter
PMD 230 / 235
Technical Information TI 256P/01/en

Principle and operation

Orifice plate

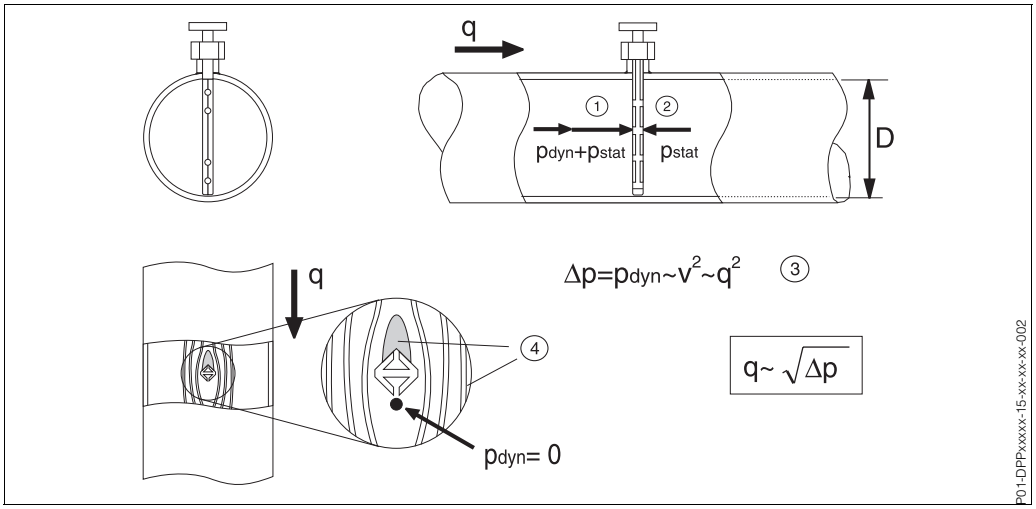
The orifice plate forms a pipe narrowing (diameter d) ①. According to Bernoulli the medium undergoes a velocity increase ② at this point. A small portion of the static pressure p_{stat} is converted into dynamic pressure p_{dyn} ③. This reduction in static pressure is measured using the Deltabar S ④. The differential pressure Δp is proportional to q^2 (q = flow) or. q is proportional to the root of Δp.

Behind the orifice plate, the static pressure reduction (=Δp) is converted back into static pressure. Only a small part (depending on the opening ratio β=d/D) forms a permanent pressure loss Δw. Typically, is Δω is less than 1% of the static pressure p_{stat} in the line.



Pitot tube

The probe is installed in the media line as a pressure sensor. With the flow, the probe records both the static and the dynamic pressure via the probe openings ①. In the minus chamber of the Pitot tube, lying opposite, more or less only the static pressure has any effect, as on this side of the probe the openings are not expose to the dynamic forces of the flow movement ②. The differential pressure corresponds to the dynamic pressure in the pipeline from which the flow can be directly calculated ③. No. ④ shows the path of the flow lines.



Standardisation to ISO 5167-1/A1

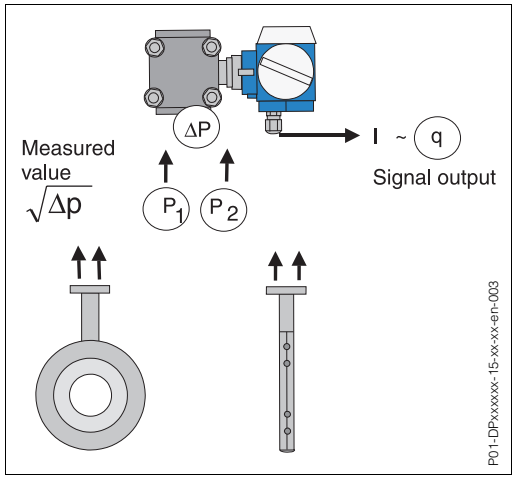
Differential pressure flow measurement is standardised as ISO 5167-1/A1 as the only flow measuring principle in the world. This comprises geometries, arrangements and calculation regulations. The user can therefore rely on a technology used by millions.

The figure on the right shows the main components of a flow rate measuring point. The following are seen as standard:

Orifice plates
DN 50...DN 1000: no orifice plate calibration required (standard values).
DN 4...DN 40: Calibration recommended by standard. With E+H, you can order wet calibration for the orifice plate DPO 15.
Greater than DN 1000: Extrapolation of standard values

Pitot tube
Type calibration. The similarity to valid DIN/ISO standards ensures measurement reliability.

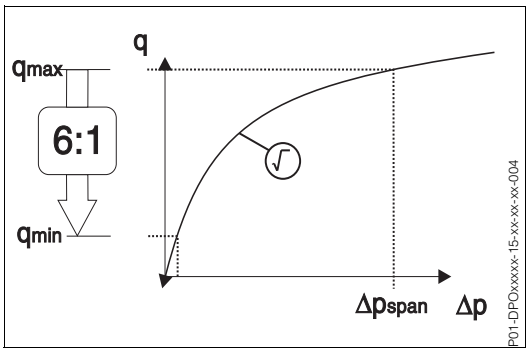
Signal output
The pressure value at the primary device is then turned into a flow-proportional linear current output by a square root characteristic in the transmitter.

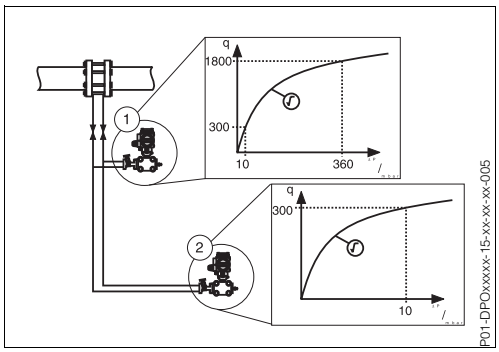


Dynamics

The dynamics provide the ratio of the maximum flow to the minimum flow. By minimum flow, we understand the smallest measurable flow value at the specified accuracy. If a flowmeter has high dynamics, it can accurately record those flows which are considerably smaller than the maximum flow.

Due to the high resolution of the Deltabar S transmitter, Deltatop and Deltaset can achieve dynamics of typically 6:1 to 3:1. The lower limit is considered as the transition of the square root function to the linearised function (see below left). However, even below this mark, there is still very high reproducibility.





If typical dynamics of between 15:1 and 10:1 are required, then a multiple installation is necessary (see above right). For this, e.g. two Deltabar S are used parallel. This low-cost solution is implemented using the Deltaset concept.

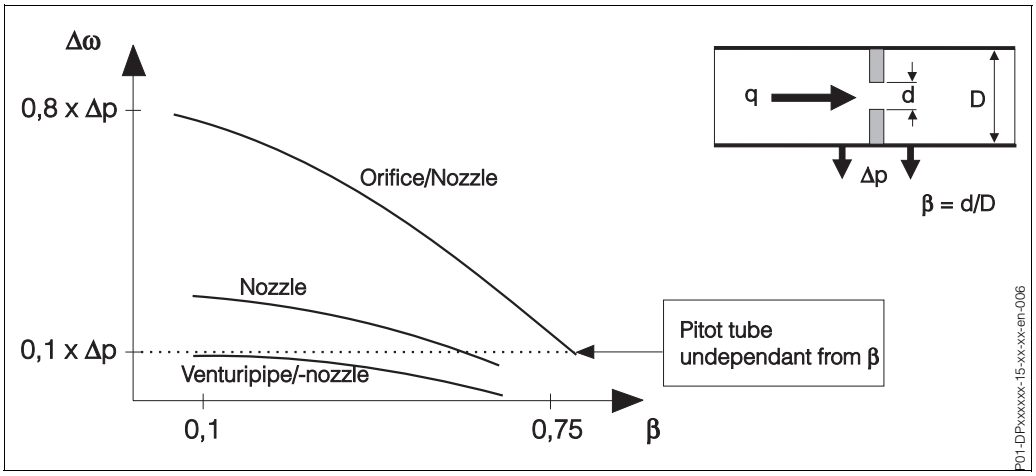
The dynamics are lower under strongly fluctuating process conditions (pressure and temperature). If necessary, we recommend the use of a flow computer (see section on “Compensation”)

Low pressure loss

The remaining pressure loss ($\Delta\omega$) and the dynamics of the orifice plate are dependent on each other. The smaller the orifice plate opening - indicated by the orifice plate ration (β = d/D) - the greater the dynamics of the measuring system and therefore the greater the pressure loss.

With some applications, it is necessary to optimise the maximum dynamics or the minimum pressure loss. This is achieved by selecting the right orifice plate opening during planning. Use the interpret sheet to aid the selection of optimisation criteria. The following optimisation options are possible:

- Standard (optimisation of pressure loss and dynamics)
- Optimisation to minimum pressure loss
- Optimisation to maximum dynamics



Remaining static pressure loss $\Delta\omega$ related to diameter ratio β of the orifice plate

The remaining static pressure loss is less than the differential pressure. Typical static pressures are in the range of 2 bar to 10 bar. Typical differential pressures Δp are between 5 mbar and 200 mbar. Pressure loss is approximately 30 % of the differential pressure Δp. I.e. for small orifice plate opening ratios β the ratio $\Delta\omega/p_{stat}$ is less than 1%. With Pitot tubes, nozzles and Venturi tubes/ nozzles it is much less than 1 %.

The following table shows the remaining pressure losses for typical process pressures for gas, liquids and steam, related to the system pressure.

	typ. static pressure	Orifice plate	Pitot tube
Steam	p_{stat} = 6 bar	Δp = 50 mbar $\Delta\omega$ = 20 mbar = 0.33% von p_{stat}	Δp = 16 mbar $\Delta\omega$ = 6 mbar = 0.10% von p_{stat}
Gas	p_{stat} = 1bar	Δp = 20 mbar $\Delta\omega$ = 5 mbar = 0.50% von p_{stat}	Δp = 7 mbar $\Delta\omega$ = 2 mbar = 0.20% von p_{stat}
Liquid	p_{stat} = 4bar	Δp = 40 mbar $\Delta\omega$ = 18 mbar = 0.45% von p_{stat}	Δp = 25 mbar $\Delta\omega$ = 10 mbar = 0.25% von p_{stat}

Tab. 12: Pressure loss Δp and remaining pressure loss $\Delta\omega$ at typical static pressures (operating pressure)

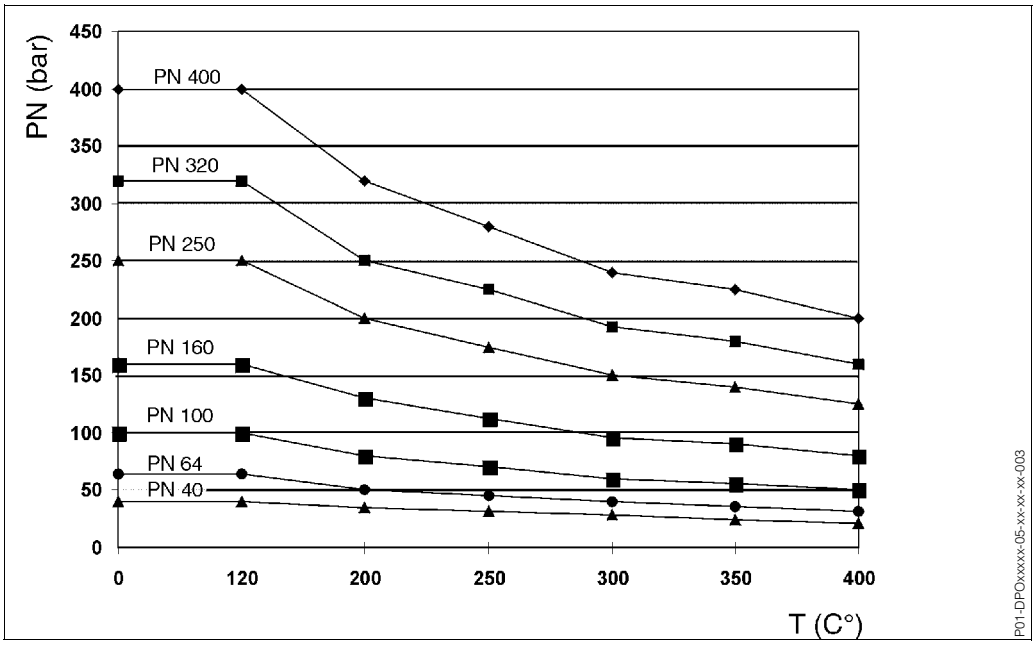
Materials

When selecting the right material for the primary device, alongside corrosion resistance and pressure load capacity, the temperature application limits of the relevant material is of primary importance. The following table shows values for typical materials where the standard materials for Deltatop and Deltaset have a grey background.

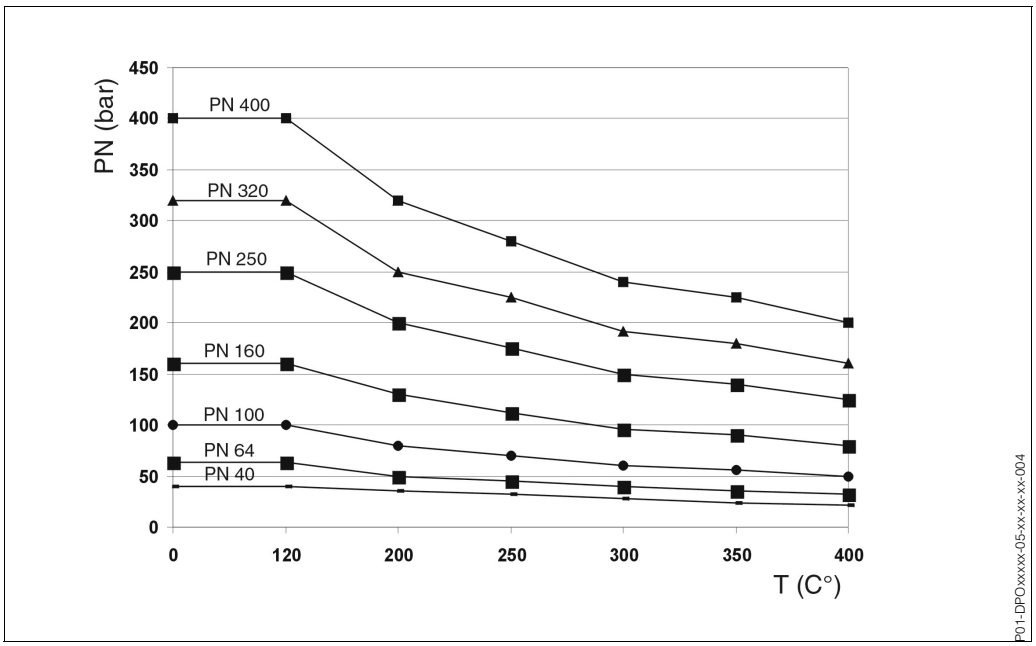
	Name	Material no.	Application temperature
Structural steel	St 37-2	1.0114	to approx. 350 °C
	ST 38.8	1.0305	to approx. 500 °C
	Thick boiler plate H II	1.0425	to approx. 400 °C
	C 22.8	1.0460	to approx. 490 °C
Heat-resistant steel	15 NiCuMoNb5 (WB 36)	1.6368	to approx. 500 °C
	15 Mo 3	1.5415	to approx. 530 °C
	13 CrMo 4 4	1.7335	to approx. 560 °C
	10 CrMo 9 10	1.7380	to approx. 590 °C
	X 20 CrMoV 12 1	1.4922	to approx. 600 °C
Low-temperature steel	TT St 35 N	1.0356	approx. -100...300 °C
	TSt E 355	1.0566	approx. -130...300 °C
Corrosion resistant steel	X 5 CrNi 1810	SS 304	approx. -40...300 °C
	X 6 CrNiTi 1810	SS 321	approx. -190...300 °C
	X 6 CrNiMoTi 17 12 2	SS 316Ti	approx. -60...400 °C
	X 10 Cr 13	SS 410	to approx. 450 °C
Plastic	Polyvenylchlorid	PVC	to approx. 70 °C
	Polypropylene	PP	to approx. 90 °C
	Polyethylene	PE	to approx. 80 °C
	Polyvinylidenefluoride	PVDF	to approx. 130 °C
	Polytetrafluorethylene	PTFE	to approx. 150 °C
Special material	Hastelloy C	2.4610	to approx. 400 °C
	Monel	2.4360	to approx. 400 °C

Tab. 13: Application temperature of some materials

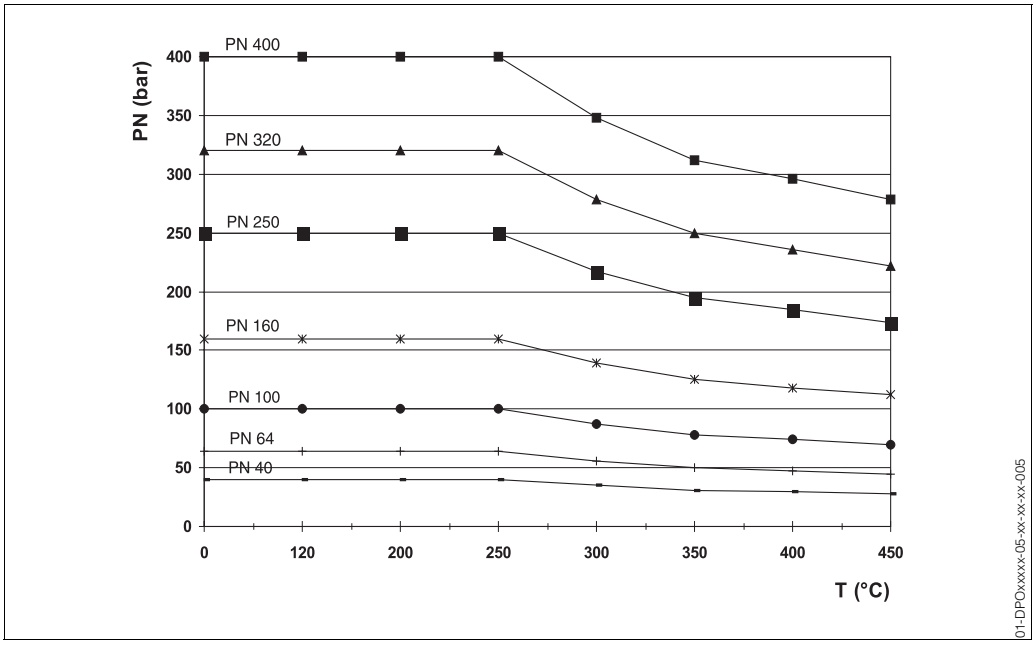
When selecting the right material, alongside the application temperature limit, the pressure load capacity concerning occurring temperatures is of primary importance. You can find an overview of the dependence of a specified pressure rating and the possible application temperature in the pressure/temperature charts below. There, you can see that a high temperature reduces the pressure rating. This is also valid for additional components of the measurement section such as valves, condensat chambers, etc.



Pressure/temperature curve for material C22.8



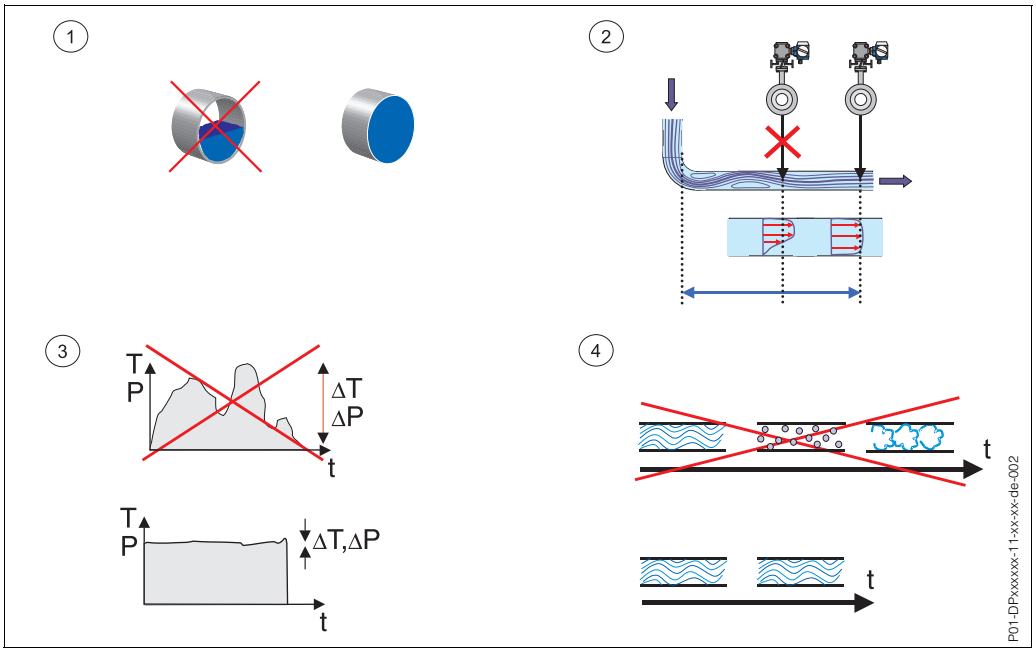
Pressure/temperature curve for material SS 316Ti.



Pressure/temperature curve for material 15Mo3.

Designing the measuring point

Requirements for flow measurement with primery element and differential pressure transmitter



Requirements for accurate flow measurement with primary device and differential pressure transmitter:

① *Completely filled piping*

② *Constant flow profile*
- *Turbulent flow*
- *Sufficient up- and downstream lengths*
- *No build-ups*

③ *Constant process conditions*
- *Temperature*
- *Pressure*

④ *Homogeneous media*
- *No change in the state of aggregation of liquid/gas/steam*

Filled piping
①

With the flow measurement of liquids, completely filled piping is of the highest importance. When planning the primary device, the flow is determined from the flow velocity and the full pipe cross-sectional area.

With gas and steam, the piping is always completely filled by the medium.

Up- and downstream lengths
②

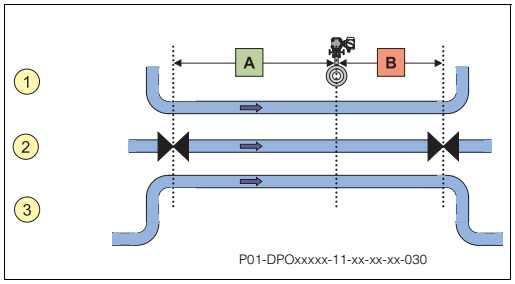
A symmetrical flow profile is the requirement for accurate measurement and is ensured by build-up free piping and sufficiently long up- and downstream lengths.

The flow profile is altered by obstacles in the process line, in the form of narrowings, bends, elbows, etc. The flow settles down again when it passes through a straight section of piping, the inlet run section. The same is true for obstacles after the measuring point: the back-pressure which occurs leads to a change in the flow profile at the pressure tapping point. Therefore, try and keep to straight outlet runs.

The use of flow conditioners allows a reduction in the length of the necessary up- and downstream lengths. The increase in expected errors through reduction without a flow conditioner is shown in the following diagram (see “Reduced upstream length”).

The standard prescribes the up- and downstream lengths to maintain the flow profiles. Use the diagram and the table to determine how large these must be:

A Upstream; B Downstream
① *90° elbow*
② *Valves open*
③ *2x 90° elbows*



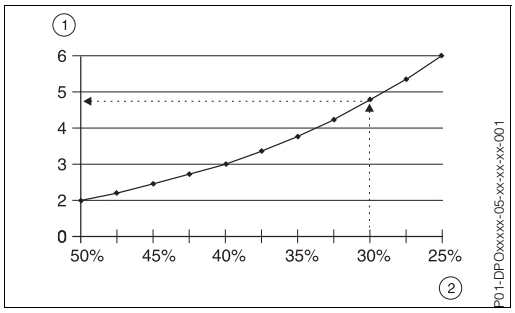
	Orifice plate or nozzle Venturi: use half lengths						Pitot tube	
	Upstream			Downstream			Upstream	Downstream
	β= 0,1	β= 0,5	β= 0,75	β= 0,1	β= 0,5	β= 0,75		
90° elbow	10	14	36	4	6	8	7 x D	3 x D
2x 90° elbow	14	20	42	4	6	8	9 x D	3 x D
3x 90° elbow	34	40	70	4	6	8	18 x D	4 x D
Pipe constriction	5	6	22	4	6	8	7 x D	3 x D
Pipe expander	16	18	38	4	6	8	24 x D	4 x D
Valve, open	18	22	36	4	6	8	30 x D	4 x D

Tab. 14: Up- and downstream lengths
D internal diameter
d Opening diameter
β *d/D Opening ratio*

Reduced upstream lengths

The diagram shows the expected error increase ① related to a reduction in the upstream lengths ②. The factor determined states in which magnitude the accuracy stated on the flow data sheet is reduced.

Example: the typical error of a standard orifice plate in 0.6 %.With an upstream lengths reduced by 30 %, there is therefore an error of 0.6% x factor 4.8 = 2.9 %



Reynolds number

A turbulent flow is required for flow measurement with primary devices. The Reynolds number shows whether it is a laminar or a turbulent flow. It is calculated using the following equation:

$$Re_D = \frac{v \cdot D \cdot \rho}{\nu}$$

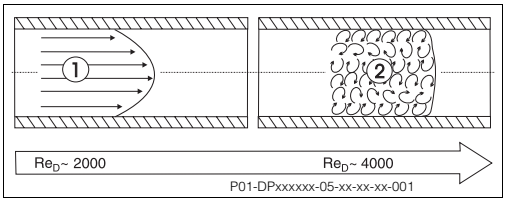
Re_D = Reynolds number, related to pipe diameter D
v = Medium velocity
ρ = Density
ν = Kinematic viscosity

The Reynolds number is a dimensionless parameter which describes the flow related to medium velocity, internal diameter, medium density and its kinematic viscosity.

The diagram on the right shows the relationship between the Reynolds number Re and the type of flow. The Applicator from Endress+Hauser (version 8.01 or higher) calculates the Reynolds number for each application.

The medium viscosity should not fall below the following values:

- ❑ Orifice plate Re = 2.800
- ❑ Pitot tube Re = 4.000
- ❑ Nozzle: Re = 200.000
- ❑ Venturi: Re = 40.000



Type of flow:
① laminar
② turbulent

The kinematic viscosity can be calculated from the dynamic viscosity using the density (kg/m ^{3}):

$$\text{kinematic viskosity } \nu = \frac{\eta}{\rho} = \frac{\text{dyn. viskosity}}{\text{density}} \qquad \left[\frac{m^2}{s}\right]\left[10^6 cSt\right]$$

$$\text{dynamic viskosity } \eta = \nu \cdot \rho \qquad \left[\frac{kg}{m \cdot s}\right]\left[\frac{N \cdot s}{m^2}\right]\left[Pa \cdot s\right]\left[10^{-3} cP\right]$$

The Reynolds number is reversly proportional to the diameter when the flow, density and viscosity are equal.

$$Re \sim \frac{q \cdot \rho}{D \cdot \nu} \Rightarrow Re \sim \frac{1}{D}$$

Reducing the pipe diameter allows the increase of the Reynolds number.
It is generally true: the flows are equal when their Reynolds numbers are equal.

Process conditions
③

Pressure and temperature
The influence of pressure and temperature on flow measurement is only of importance for gases and steam. With high accuracy requirements, pressure and temperature changes must be compensated (see also the chapter “Compensation“).

If you require an adjustment of the display value to changed process data for pressure and temperature, the new operating flow display value is calculated as follows:

$$\text{New operating flow display value } q_{neu} = q \cdot \frac{T \cdot p_{absnew}}{p_{abs} \cdot T_{new}}$$

Example
Previous values: p_{abs} = 2 bar, T = 20 °C = 293.15 K, q = 300 m^3/h
New values: p_{absnew} = 6 bar, T_{new} = 45 °C = 318.15 K

$$\text{New flow display value } q_{neu} = 300\left[\frac{m3}{h}\right] \cdot \frac{293,15[K] \cdot 6[bar]}{2[bar] \cdot 318,15[K]} = 829,28\left[\frac{m3}{h}\right]$$

Medium
④

When interpreting the primary device, you require the process and medium data. The homogenity of the medium, i.e. the composition over time, should not change, as changes lead to measuring errors. The design of the measuring system for different media means that the flow measurement with primary device can be used universally. When the medium is changed, the device need only be set to the changed differential pressure Δp.

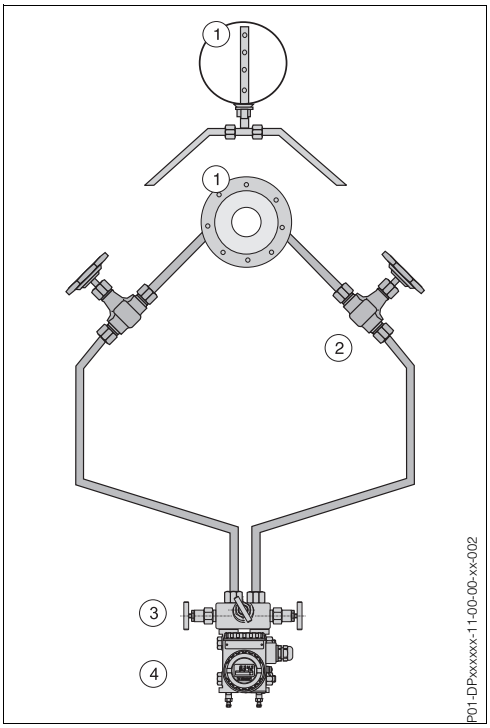
Application examples

Deltaset for liquid

With liquid applications, the transmitter must always be mounted beneath the pipe outlets. This and the 1:15 slope of the piping ensures the increase of air bubbles back to the process pipes.

The following components form a typical liquid application for Deltaset:

1. Orifice plate
   DPO 5❑E(or A)-❑❑❑❑❑❑❑
   or Pitot tube
   DPP 50-❑❑❑❑❑❑❑❑
2. Shut-off valve DPV50-❑❑2
3. manifold DPM50-❑A2❑
4. Deltabar S PMD235-❑❑❑#88❑❑❑❑

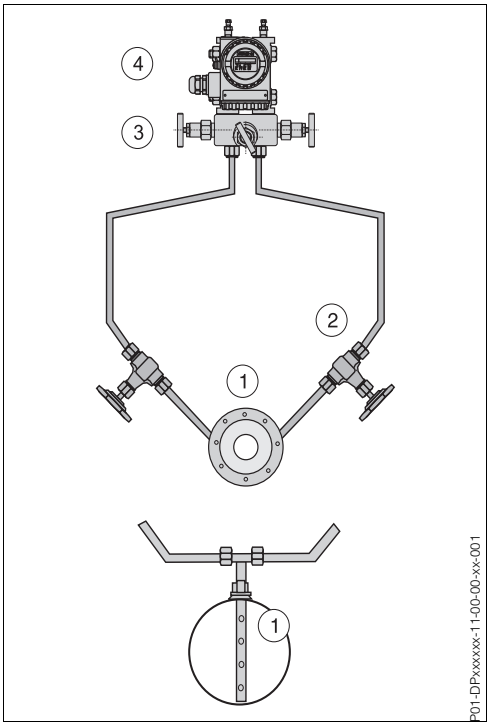


Deltaset for gas

With gas applications, the transmitter must always be mounted above the pipe outlets. Any condensate will flow back into the process pipeline. All horizontal pulse lines must be laid with a gradient of 15:1 to the process connection - coming from the transmitter.

The following components form a typical gas application for Deltaset:

1. Orifice plate
   DPO 5❑E(or A)-❑❑❑❑❑❑❑
   or Pitot tube
   DPP 50-❑❑❑❑❑❑❑❑
2. Shut-off valve DPV50-❑❑2
3. manifold DPM50-❑A2❑
4. Deltabar S PMD235-❑❑❑#88❑❑❑❑



Deltaset for steam

With steam applications, both condensat chambers of the primary device must always be at the same geodesic height and the transmitter must be below the pipe outlets.

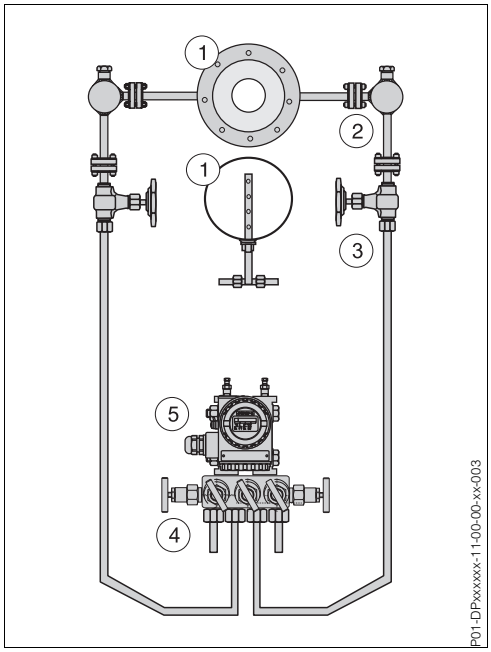
The following components form a typical steam application:

1. Orifice plate
   DPO 5❑E(or A)-❑❑❑❑❑❑❑
   or Pitot tube
   DPP 50-❑❑❑❑❑❑❑❑
2. Condensate trap with flange pairs G1/2"
   DPC50-❑1❑3
3. Shut-off valve DPV50-❑❑3
4. 5-valve manifold DPM50-❑H2❑
5. Deltabar S PMD235-❑❑❑#88❑❑❑❑

The shut-off valves allow the closing of the process taps for the "+" pressure and the "-" pressure of the differential pressure signal of the primary device.

The 5-valve manifold allows simple piping and can be used instead of the T-sections and additional condensate blow-out valves.

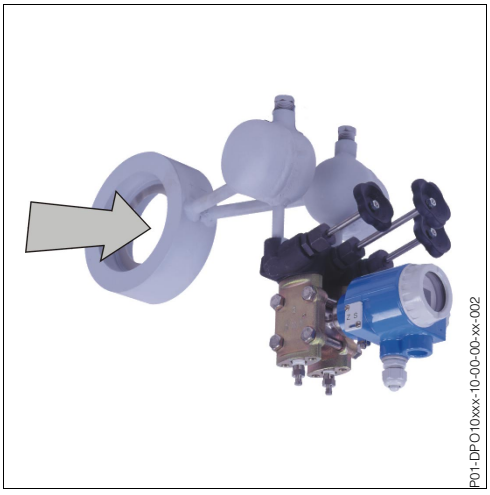
With steam, lay the impulse pipes at a gradient of 15:1 to ensure reliable rising of air injections in the water interface of the transmitter.



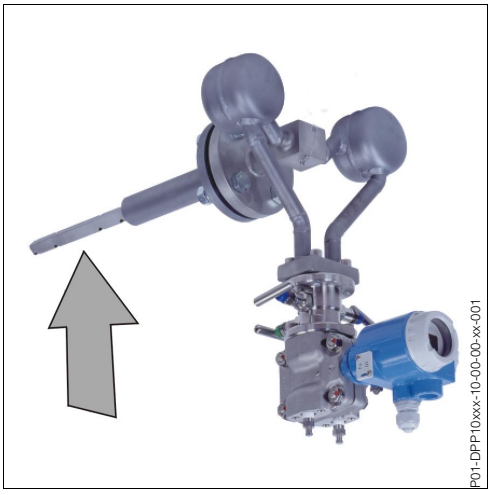
Also, we would recommend the use of flange pairs - or preferably welded connections - for steam applications. Behind the condensat chambers, continue piping Ermeto12S.

Deltatop for steam

Arrangement examples for the compact solution with Deltatop.



Compact standard orifice plate
Deltatop DPO 10
Application: steam, horizontal pipe, mounting right



Pitot tube Deltatop DPP 10
Application: steam, vertical pipe upwards

Temperature and pressure compensation

Parameters

Alongside differential pressure Δp, pressure p and temperature T are test variable of flow q. If there are no strong fluctuations in pressure and temperature, then the accuracy of the differential pressure signal is fully sufficient for the majority of measuring points. There is then no need for any compensation

With some applications, particularly in the gas and steam sectors, a special compensation is required. A change in pressure and/or temperature leads to a change in density. If this is not taken into account, total accuracy may be reduced.

The following parameters are required for compensation:

- Gases: compensation of p and T
- Saturated steam: either p or T are compensated
- Superheated steam: compensation of p and T
- Liquids: compensation of T (very rare)

Both on the process side and on the system side, there are two possibilities for implementing compensation (large differences in price and effort).

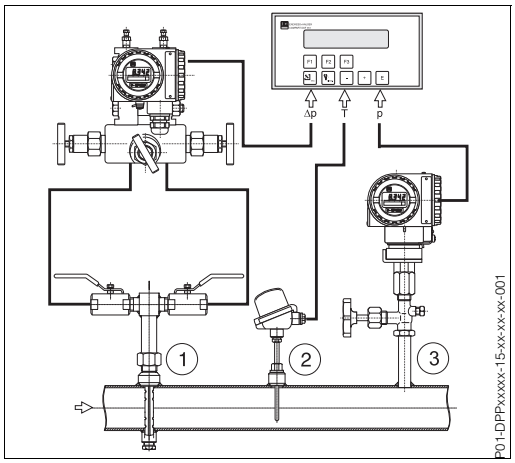
Process side

Version A:

3 special process connections for Δp, T and p, which are evaluated with the flow computer.

- T and p are usually installed separately after the flow measuring point. Recommendation: Temperature transmitter Omnigrad and pressure transmitter Cerabar S.

① Flow q with Pitot tube DPP 50
② Temperature T, e.g. with Omnigrad
③ Process pressure p, e.g. with Cerabar S

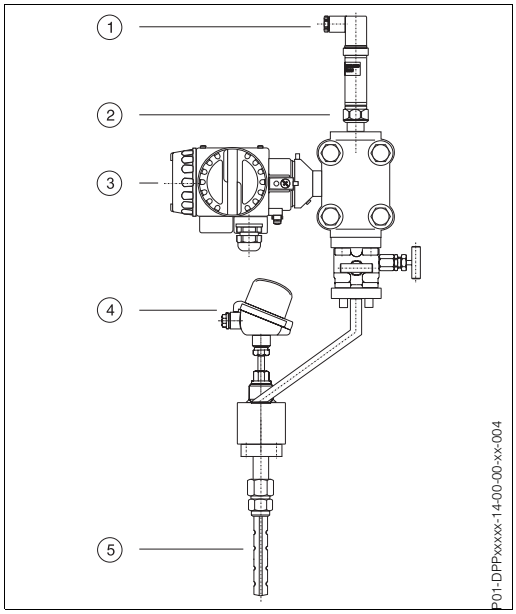


Version B:

Only 1 process connection for Δp, p and T

- Use an adapter to screw a pressure transmitter or a pressure transducer (e.g. Cerabar T, Cerabar M or Cerabar S) into the minus side of the Deltabar S flange. With Pitot tubes, the temperature can be determined using the integrated temperature sensor ④.

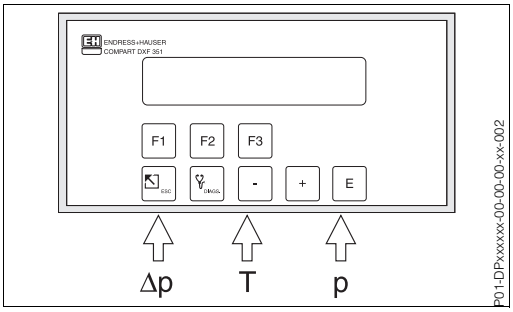
① Process pressure p, e.g. Cerabar T
② NPT adapter 1/4" male, 1/2" female
③ Deltabar S
④ Integrated temperature sensor
⑤ Pitot tube Deltatop DPP 10



System side

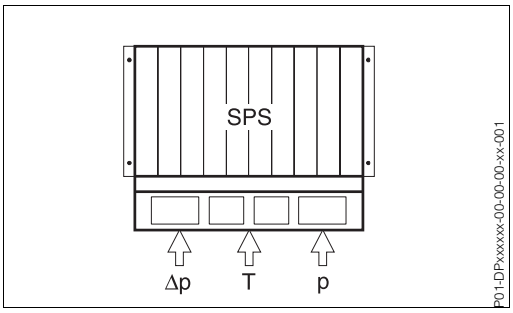
Version 1: flow computer

- The process variables Δp, p and/or T are fed into a flow computer.
  Recommendation: Compart DXF from Endress+Hauser. This provides access to
  - stored flow equations,
  - stored steam and water data
  and other commissioning aids.



Version 2: PLC

- The process variables are fed into the (available) PLC. The flow equations are programmed there. With this solution the investment costs are low, but the commissioning costs are increased.



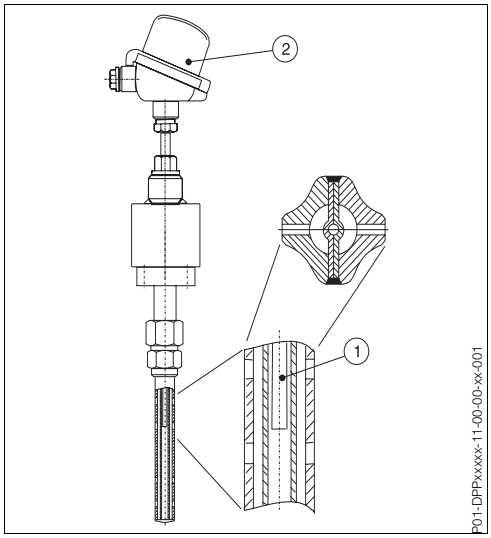
Integrated temperature sensor for Pitot tubes

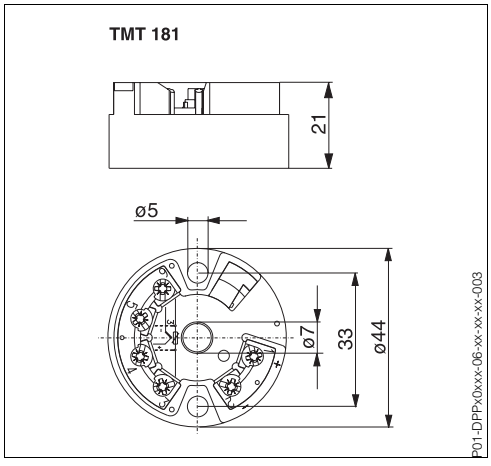
To determine the medium temperature, with Pitot tubes from DN 100 there is optionally an integrated temperature measurement:

❑ With Pt100 temperature sensor
❑ With 4...20 mA temperature transmitter

The benefits of such a temperature measurement:

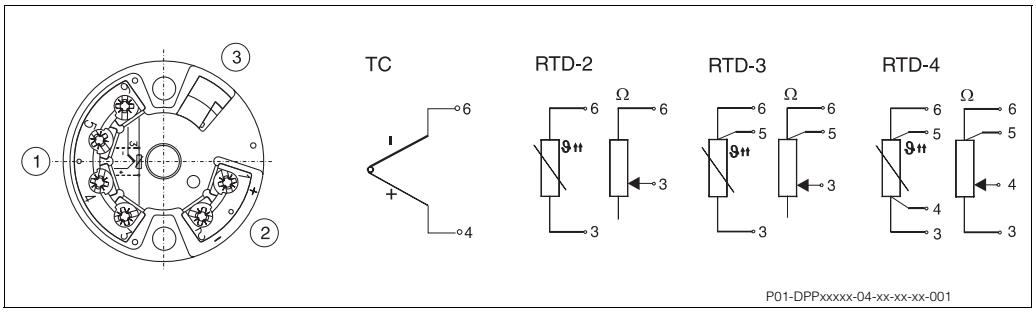
- Resistance thermometer Pt 100 ① is fixed within the probe profile. The protective tube which is formed by the two partition walls between the probe chambers protects it against damage. Also it has no contact with the medium and is not exposed to the operating pressure.
- The rod-shaped resistance thermometer ① made of SS 316TI is particularly robust and resistant to oscillation. The length is dependent on the length of the Pitot tube.
- Rapid installation and removal possible under operating pressure.
- Temperature range between -200 °C and +500°C
- Probe head ② made of aluminium for installing the E+H temperature head transmitter TMT 181 (terminal head to DIN 43729, flat face)





Technical data of the temperature head transmitter iTEMP PCP TMT 181

- ❑ Application
  PC-programmable temperature head transmitter TMT 181 for converting various input signals into scalable4...20 mA analog output signal.
  The TMT 181 is preset to customer specifications according to the specifications in the flow data sheet.
- ❑ Input: Input: resistance thermometer RTD
  PT 100: measuring range limit -200 °C...+850 °C, min. span 10K.
  2, 3 or 4 wire connection
- ❑ Input: Thermocouple TC
  NiCr-Ni: measuring range limit -200 °C...+1372 °C, min. span 50 K
  PtRh10-Pt: measuring range limit 0 °C...+1768 °C, min. span 500 K
- ❑ Output
  Output signal: 4...20 mA
  Max. load: $V_{Power\ Supply}$ - 8 V / 0,022 A
  Digital filter 1rst degree: 0...8 s
  Input current required: ≤ 3,5 mA
  Current limit: ≤ 23 mA
  Switch-on delay: 4 s
  Reply time: 1 s
- ❑ Operating condition
  Ambient temperature: -40...+85 °C (for explosion hazardous areas, see Ex certificatet)
  Storage temperature: -40...+100 °C
  Climate class: to EN 60654-1, Class C
  Electromagnetic compatibility: Interference immunity and interference emission to EN 61326-1 and Namur NE 21
- ❑ Certificates and approvals:
  Ex approval: ATEX II 1 / EEx ia IIC and IIB
  (max. ambient temperature T4 = 85 C, T5 = 70 C, T6 = 55 C)
- ❑ Electric connection
  ① Sensor connection
  ② Supply voltage 8...35 V (with reverse polarity protection) and output signal
  ③ SETUP-Connection
  TC Connection of thermocouples
  RTD Connection of resistance thermometer



- ❑ Supplementary Documentation
  Temperature head transmitter iTEMP PCP
  TMT 181
  Technical Information TI 070R/09/en

Deltatop versions

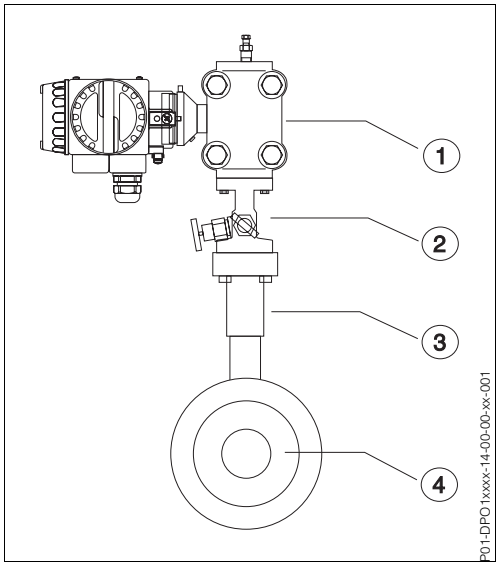
Scope of supply

Deltatop is a compact flowmeter and runs on the basis of differential pressure. All Deltatop versions comprise:

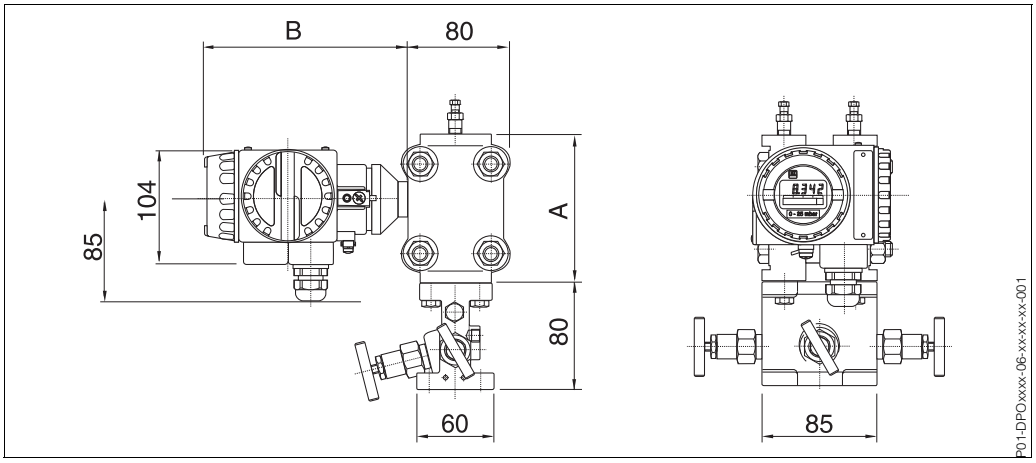
① Deltabar S
② 3- or 5-valve manifold
③ Compact fit
④ Primary device (orifice plate, Pitot tube)

The delivery comes complete with a mounted differential pressure transmitter (which is ordered extra). The Deltabar S is supplied with an optimum differential pressure sensor, so that the customer need not calculate the differential pressure prior to ordering. The differential pressure range and the selected display option (flow, differential pressure or percent value) are preset. A linear signal is made available using the square root characteristic.

The steam version differs from the gas or liquid version in terms of design and dimensions.



Dimensions



Dimensioned drawings for Deltabar S with manifold

① Deltabar S–housing
T4 with display on side of Deltabar — Dimension B = 120 mm
T5 with display on top of Deltabar — Dimension B = 150 mm

② Deltabar S–Process connection
PMD 235 with metallic sensor — Dimension A = 106 mm for 10...40 mbar sensor
Dimension A = 100 mm for 100 mbar...40 bar sensor
PMD 230 with ceramic sensor — Dimension A = 96 mm

③ Manifold for gas/liquid applications

The weight of the housing, process connection and manifold together is approx. 8 kg

Deltatop DPO 10
Compact version
Undivided orifice plate with corner taps

Standard orifice plate with corner tapping to DIN 19205 (B) or ISO 5167. For installation between flanges to DIN 263x. With Deltabar S and 3-valve manifold, ready mounted and set.

For the required Ordering Information - see also pp. 27 and 28:

10 Application
Medium and pipe orientation
Figure: Gas measurement, horizontal piping

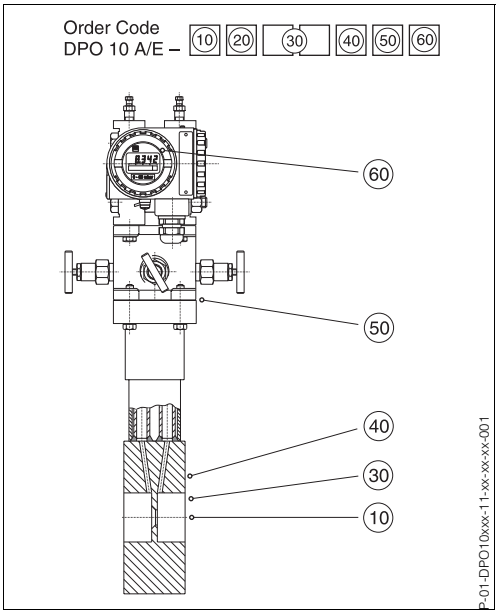
20 Approval
With or without special approvals

30 Nominal diameter pipe, material
Suppliable nominal diameters and material of orifice plate and manifold

40 Pressure rating, facing
Permissible pressure rating and shape of facing

50 Seals
Sealing material on manifold

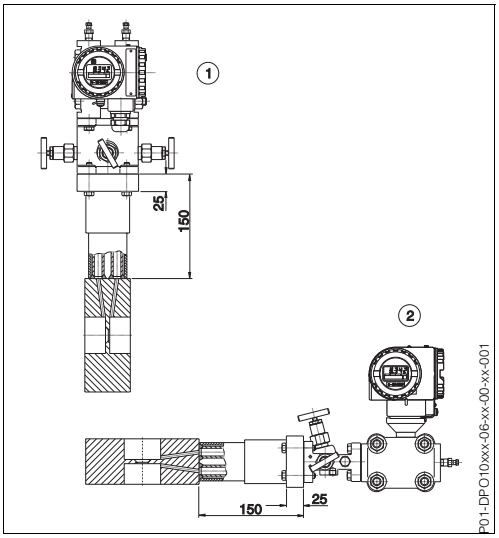
60 Adjustment Deltabar S
Flow, differential pressure or percentage display



Dimensioned drawings (right)

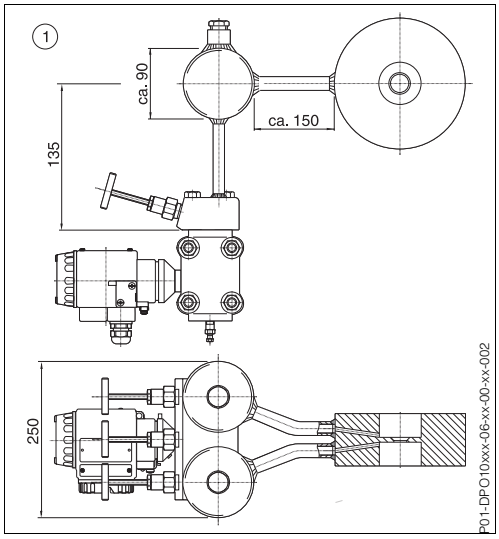
❑ Orifice plates for gases and liquids
① Horizontal piping
② Vertical piping

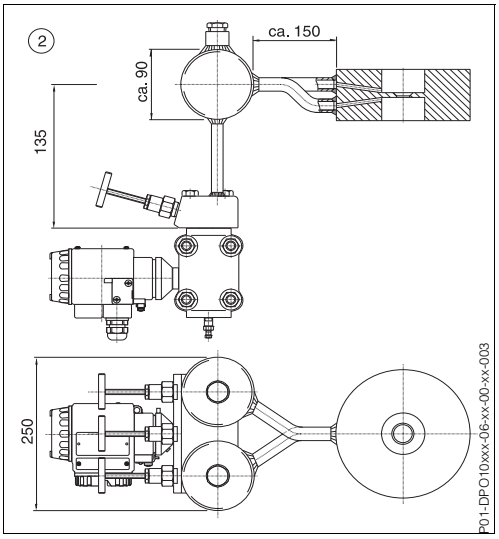
Max. temperature in process tube:
Gases/fluids 200 °C, steam 300 °C



Dimensioned drawings (below)

❑ Orifice plates for steam (mounting left)
(with two condensat chambers):
① for horizontal piping
② for vertical piping





Deltatop DPO 10
Dimension tables

DN (mm)	d_4 (mm)								E (mm)	d_1 (mm)	Weight (approx. kg)
	PN 6	PN 10	PN 16	PN 25	PN 40	PN 64	PN 100	PN 160			
50	96	107		107		112	119		3	D + 1 mm	10
65	116	127		127		137	143		3		10.5
80	132	142		142		147	153		4		12
100	152	162		167		173	180		4		13
125	182	192		193		210	217		4	D + 2 mm	14
150	207	217		223		247	257		5		15
200	262	272	272	283	290	309	324		5		18
250	317	327	328	340	352	364	391	388	5		22
300	372	377	383	400	417	424	458	458	6		27
350	422	437	443	457	474	486	512		6		31
400	472	488	495	514	546	543			6	D + 4 mm	33
500	577	593	617	624	628				8		37
600	678	695	734	731					8		45
700	783	810	804	833					10		57
800	890	917	911	942					10		67
900	990	1017	1011	1042					10		77
1000	1090	1124	1128	1154					10		88

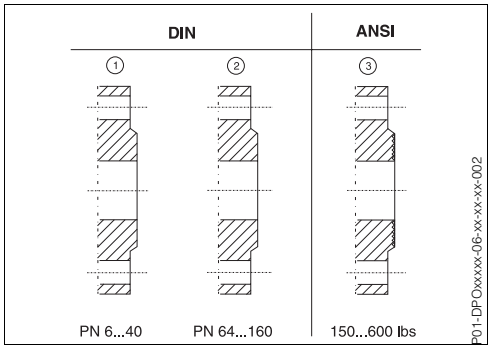
Tab. 15: Dimensions and weight of orifice plate DPO 10E, nominal diameter DN in mm

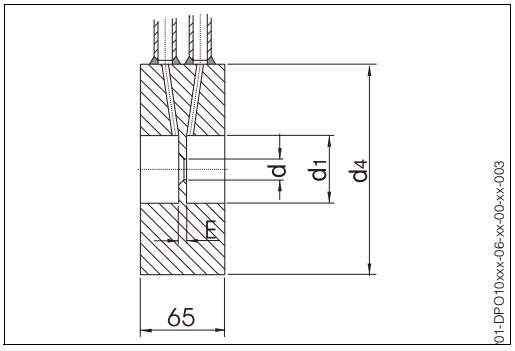
DN (in inches)	d_4						E (mm)	d_1 (mm)	Weight (approx. kg)
	in mm	in inches	in mm	in inches	in mm	in inches			
	150 lbs		300 lbs		600 lbs				
2	104.5	4.1	111	4.4	111	4.4	3	D +1 mm	10
2 1/2	124	4.9	130	5.1	130	5.1	3		10.5
3	136.5	5.4	149.5	5.9	149.5	5.9	4		12
4	174.5	6.9	181	7.1	193.5	7.6	4		13
5	197	7.8	216	8.5	241.5	9.5	4	D +2 mm	14
6	222.5	8.8	251	9.9	266.5	10,5	5		15
8	279.5	11.0	308	12.1	320.5	12.6	5		18
10	339.5	13.3	362	14.2	400	15.7	5		22
12	409.5	16.1	422	16.6	457	18.0	6		27
14	451	17.8	484.4	19.1	492	19.4	6		31
16	514.5	20.3	540	21.3	565	22.2	6	D +4 mm	33
20	606.5	23.9	654	25.7	682.5	26.9	8		37
24	717.5	27.9	774.5	30.5	790.5	31.1	8		45

Tab. 16: Dimensions and weight of orifice plate DPO 10A, nominal diameter DN in inches

Possible facings
① Raised face (Rz=160)
② Shape E (Rz=16)
③ Shape RF (raised face)

Dimensions
d Orifice plate opening
E Orifice plate thickness
d1 Holding ring
d4 Exterior orifice plate
D Pipe internal diameter





Deltatop DPO 10E
Ordering information for standard orifice plate, corner tapping
DIN

10 — Application: pipe orientation

C	Gas flow; horizontal pipe orientation
B	Gas flow; verticals pipe orientation
C	Liquid flow; horizontal pipe orientation
D	Liquid flow; vertical pipe orientation
E	Steam; horizontal pipe, mounting left (version with condensat chambers)
F	Steam; horizontal pipe, mounting right (version with condensat chambers)
G	Steam; vertical pipe, flow upwards (version with condensat chambers)
N	Steam; vertical pipe, flow downwards (version with condensat chambers)
Y	Special version

20 — Approval

1	Without special approvals
2	Material approval to 3.1B, EN 10204
3	Free from oil and grease
4	Confirmed pressure test
5	3.1B application and pressure test
9	Special version

30 — Nominal diameter pipe, material
Letter = nominal diameter / Numeral = material

Example G2: DN 125, Material SS 316Ti

C❑	DN 50	Ring and manifold	[1] Material C22.8
D❑	DN 65	Ring and manifold	[2] Material SS 316TI
E❑	DN 80	Ring and manifold	
F❑	DN 100	Ring and manifold	
G❑	DN 125	Ring and manifold	
H❑	DN 150	Ring and manifold	
K❑	DN 200	Ring and manifold	
L❑	DN 250	Ring and manifold	
M❑	DN 300	Ring and manifold	
N❑	DN 350	Ring and manifold	
P❑	DN 400	Ring and manifold	
Q❑	DN 500	Ring and manifold	
R❑	DN 600	Ring and manifold	
S❑	DN 700	Ring and manifold	
T❑	DN 800	Ring and manifold	
U❑	DN 900	Ring and manifold	
W❑	DN 1000	Ring and manifold	
Y9	Special version		

40 — Pressure rating, facing

C	PN 6	Facing form C
B	PN 10	Facing form C
C	PN 16	Facing form C
D	PN 25	Facing form C
E	PN 40	Facing form C
F	PN 64	Facing form E
G	PN 100	Facing form E
N	PN 160	Facing form E
Y	Special version	

50 — Seals on manifold

1	Viton seals on manifold
2	PTFE seals on manifold, max. PN 100
9	Special version

60 — Adjustment Deltabar S

F	Flow values, square root
P	Differential pressure values, linear
S	Adjustment 0..100%, square root
T	Adjustment 0..100%, linear
Y	Special version

DPO 10E — **Complete product designation**

Deltatop DPO 10A Ordering information for standard orifice plate, corner tapping ANSI

10 — Application: pipe orientation

C	Gas flow; horizontal pipe orientation
B	Gas flow; verticals pipe orientation
C	Liquid flow; horizontal pipe orientation
D	Liquid flow; vertical pipe orientation
E	Steam; horizontal pipe, mounting left (version with condensat chambers)
F	Steam; horizontal pipe, mounting right (version with condensat chambers)
G	Steam; vertical pipe, flow upwards (version with condensat chambers)
N	Steam; vertical pipe, flow downwards (version with condensat chambers)
Y	Special version

20 — Approval

1	Without special approvals
2	Material approval to 3.1B, EN 10204
3	Free from oil and grease
4	Confirmed pressure test
5	3.1B certificate and pressure test
9	Special version

30 — Nominal diameter pipe, material
Letter = nominal diameter / Numeral = material

Example G2: DN 5", Material SS 316Ti

[1] Material C22.8
[2] Material SS 316TI

C❑	DN 2"	Ring and manifold
D❑	DN 2 1/2"	Ring and manifold
E❑	DN 3"	Ring and manifold
F❑	DN 4"	Ring and manifold
G❑	DN 5"	Ring and manifold
H❑	DN 6"	Ring and manifold
K❑	DN 8"	Ring and manifold
L❑	DN 10"	Ring and manifold
M❑	DN 12"	Ring and manifold
N❑	DN 14"	Ring and manifold
P❑	DN 16"	Ring and manifold
Q❑	DN 20"	Ring and manifold
R❑	DN 24"	Ring and manifold
Y9	Special version	

40 — Pressure rating, facing

C	150 lbs	RF
B	300 lbs	RF
C	600 lbs	RF
Y	Special version	

50 — Seals on manifold

1	Viton seals on manifold
2	PTFE seals on manifold, max. PN 100
9	Special version

60 — Adjustment Deltabar S

F	Flow values, square root
P	Differential pressure values, linear
S	Adjustment 0..100%, square root
T	Adjustment 0..100%, linear
Y	Special version

DPO 10A — **Complete product designation**

Deltatop DPO 12
Compact version
Orifice flange

Measuring flange to DIN 19214 (Part 1) or ANSI B 16.36. With Deltabar S and 3x manifold, screws and seals, fully assembled and set.

For the required Ordering Information - see also pp. 31 and 32:

10 Application
Medium and pipe orientation
Figure: Gas measurement, horizontal piping

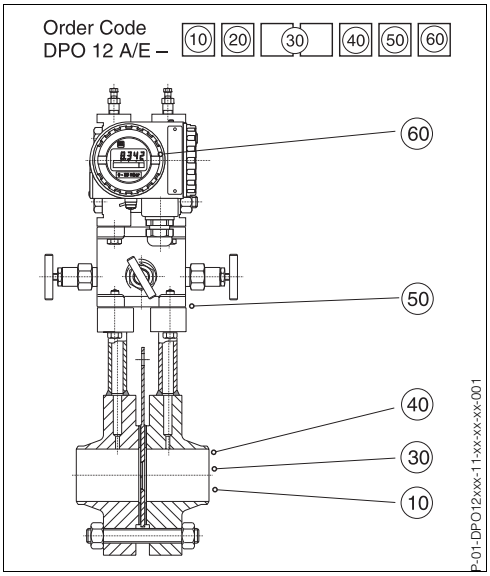
20 Approva
With or without special approvals

30 Nominal diameter pipe, material
Suppliable nominal diameters and material of orifice plate and manifold

40 Pressure rating
Permissible pressure rating and shape of facing

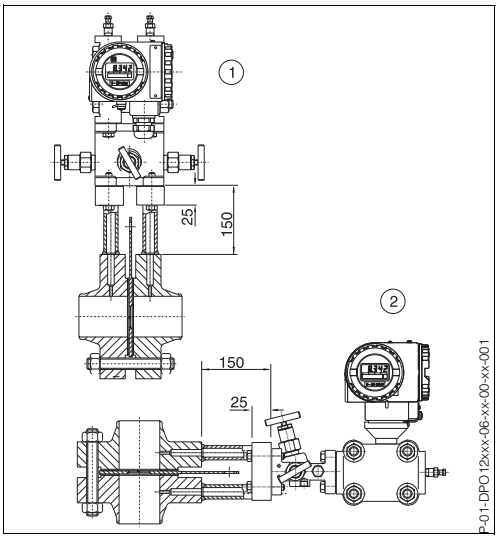
50 Seals on manifold

60 Adjustment Deltabar S
Flow, differential pressure or %-display



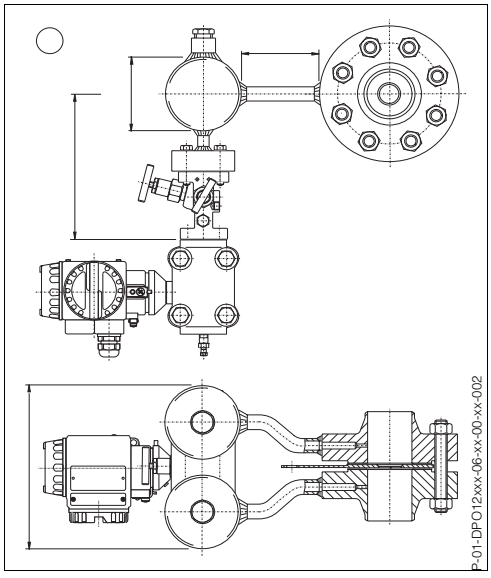
Dimensioned drawings (right):

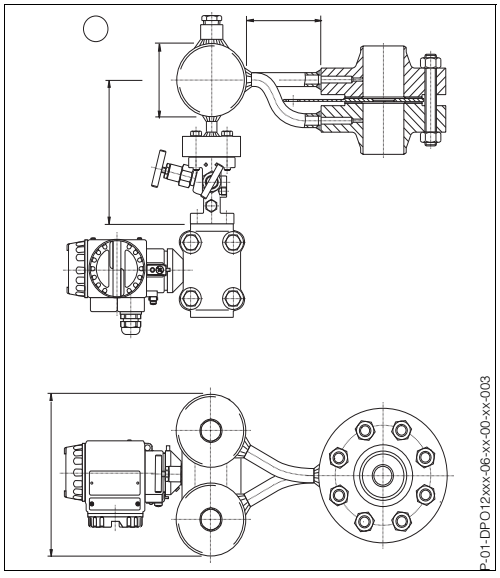
❑ Orifice plates for gases and liquids
① Horizontal piping
② Vertical piping



Dimensioned drawings (below):

❑ Orifice plates for steam
with two condensat chambers:
① Horizontal piping
② Vertical piping





Deltatop DPO 12
Dimension tables

DN (mm)	Length L (mm)						E (mm)	Total weight (approx. kg)
	PN 10	PN 16	PN 25	PN 40	PN 64	PN 100		
50	133	133	135	135	150	159	3	16
65	133	133	139	139	162	170	3	18
80	140	140	148	148	167	170	4	21
100	144	144	162	162	175	191	4	27
125	146	146	164	164	187	222	4	37
150	146	146	174	174	201	242	4	49
200	156	156	180	188	232	272	4	77
250	164	168	192	217	262	326	4	107
300	164	180	196	237	292	352	4	137
350	164	184	257	257	312	390	4	177
400	172	186	277	277	332		4	215
500	176	194	289	289			6	245

Tab. 17: Dimensions and weight of orifice plate DPO 12E in mm

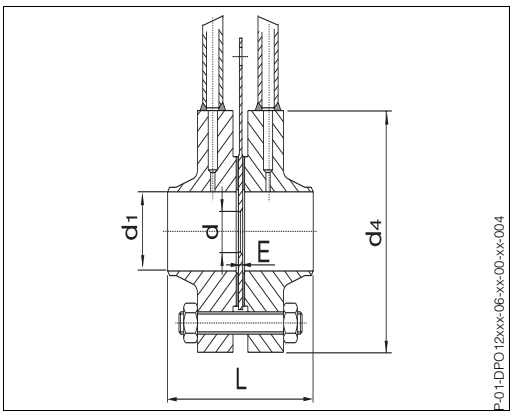
DN (in inches)	Length L (mm)				E (mm)	Total weight (approx. kg)	
	in mm	in inches	in mm	in inches			
	300 lbs		600 lbs			300 lbs	600 lbs
2	179	7.0	179	7.0	3	19	19
2 $^{1}I_{2}$	184	7.2	184	7.2	3	23	23
3	184	7.2	197	7.6	3	31	31
4	190	7.5	222	8.7	3	45	66
5	207	8.1	248	9.8	3	57	102
6	207	8.1	254	10.0	3	67	118
8	228	9.0	286	11.3	3	93	165
10	241	9.5	324	12.8	3	129	265
12	266	10,5	330	13.0	3	192	321
14	292	11.5	350	13.8	6	260	470
16	301	11.8	379	15.0	6	345	638
20	333	13.1	403	15.9	6	510	927
24	345	13.6	429	16.9	6	667	1257

Tab. 18: Dimensions and weight of orifice plate DPO 12A in inches and mm

Dimensions:
d Diameter of orifice plate opening
E Orifice plate thickness
d1 dependent on pipe internal diameter D
L Length

Internal seal between orifice plate disc and measuring flange:
Metallic graphite, smooth facing

- Material of orifice plate: Rust-proof steel SS 316TI
- Angle tapping nozzle 0°



Deltatop DPO 12E Ordering information for orifice flange DIN

10	Application: pipe orientation
C	Gas flow; horizontal pipe orientation
B	Gas flow; verticals pipe orientation
C	Liquid flow; horizontal pipe orientation
D	Liquid flow; vertical pipe orientation
E	Steam; horizontal pipe, mounting left (version with condensat chambers)
F	Steam; horizontal pipe, mounting right (version with condensat chambers)
G	Steam; vertical pipe, flow upwards (version with condensat chambers)
N	Steam; vertical pipe, flow downwards (version with condensat chambers)
Y	Special version

20	Approval
1	Without special approvals
2	Material approval to 3.1B, EN 10204
3	Free from oil and grease
4	Confirmed pressure test
5	3.1B certificate and pressure test
9	Special version

30	Nominal diameter pipe, material		Example G2: DN 125, Material SS 316Ti
C❑	DN 50	Flange and manifold	1 Material C22.8
D❑	DN 65	Flange and manifold	2 Material SS 316TI
E❑	DN 80	Flange and manifold	
F❑	DN 100	Flange and manifold	
G❑	DN 125	Flange and manifold	
H❑	DN 150	Flange and manifold	
K❑	DN 200	Flange and manifold	
L❑	DN 250	Flange and manifold	
M❑	DN 300	Flange and manifold	
N❑	DN 350	Flange and manifold	
P❑	DN 400	Flange and manifold	
Q❑	DN 500	Flange and manifold	
Y9	Special version		

40	Pressure rating	
C	PN1 0	for DN 50 to DN 300
B	PN 10	for DN 350 to DN 500
D	PN 16	for DN 50 to DN 300
E	PN 16	for DN 350 to DN 500
G	PN 25	for DN 50 to DN 300
N	PN 25	for DN 350 to DN 500
L	PN 40	for DN 50 to DN 300
m	PN 40	for DN 350 to DN 500
P	PN 64	for DN 50 to DN 200
R	PN 64	for DN 250 to DN 400
T	PN 100	for DN 50 to DN 150
W	PN 100	for DN 200 to DN 350
Y	Special version	

50	Seals on manifold
1	Viton seals on manifold
2	PTFE seals on manifold, max. PN 100
9	Special version

60	Adjustment Deltabar S
F	Flow values, square root
P	Differential pressure values, linear
S	Adjustment 0..100%, square root
T	Adjustment 0..100%, linear
Y	Special version

DPO 12E	Complete product designation

Deltatop DPO 12A Ordering information for orifice flange ANSI

10	Application: pipe orientation
C	Gas flow; horizontal pipe orientation
B	Gas flow; verticals pipe orientation
C	Liquid flow; horizontal pipe orientation
D	Liquid flow; vertical pipe orientation
E	Steam; horizontal pipe, mounting left (version with condensat chambers)
F	Steam; horizontal pipe, mounting right (version with condensat chambers)
G	Steam; vertical pipe, flow upwards (version with condensat chambers)
N	Steam; vertical pipe, flow downwards (version with condensat chambers)
Y	Special version

20	Approval
1	Without special approvals
2	Material approval to 3.1B, EN 10204
3	Free from oil and grease
4	Confirmed pressure test
5	3.1B certificate and pressure test
9	Special version

30	Nominal diameter pipe, material Letter = nominal diameter / Numeral = material		Example G2: DN 125, Material SS 316Ti
C❑	DN 2"	Flange and manifold	[1] Material C22.8
D❑	DN 2 1/2"	Flange and manifold	[2] Material SS 316TI
E❑	DN 3"	Flange and manifold	
F❑	DN 4"	Flange and manifold	
G❑	DN 5"	Flange and manifold	
H❑	DN 6"	Flange and manifold	
K❑	DN 8"	Flange and manifold	
L❑	DN 10"	Flange and manifold	
M❑	DN 12"	Flange and manifold	
N❑	DN 14"	Flange and manifold	
P❑	DN 16"	Flange and manifold	
Q❑	DN 20"	Flange and manifold	
R❑	DN 24"	Flange and manifold	
Y9	Special version		

40	Pressure rating	
C	300 lbs	for DN 2" to DN 12"
D	300 lbs	for DN 14" to DN 24"
E	600 lbs	for DN 2" to DN 12"
F	600 lbs	for DN 14" to DN 24"
Y	Special version	

50	Seals on manifold
1	Viton seals on manifold
2	PTFE seals on manifold, max. PN 100
9	Special version

60	Adjustment Deltabar S
F	Flow values, square root
P	Differential pressure values, linear
S	Adjustment 0..100%, square root
T	Adjustment 0..100%, linear
Y	Special version

DPO 12A	Complete product designation

Deltatop DPO 15
Compact version
Orifice pipe unit

Orifice pipe unit with up- and downstream lengths. Flange acc. to DIN 263x. With Deltabar S and 3-valve manifold, ready mounted and set.

This version covers the pipe diameter range below DN 50. As the orifice plate standards above this diameter range are valid, the orifice pipe unit can be calibrated by the manufacturer. The integrated up- and downstream lengths and the central orifice plate installation provide high accuracy.

For the required Ordering Information - see also pp. 36 and 37:

10 Application
Medium and pipe orientation
Figure: Gas measurement, horizontal piping

20 Approval
With or without special approvals

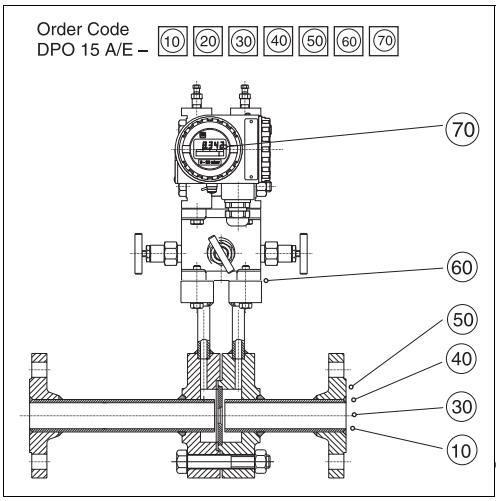
30 DN flange connection, material, length

40 Pressure rating

50 Shape of facing of pipe flange

60 Seals on manifold

70 Adjustment Deltabar S
Flow, differential pressure or %- display

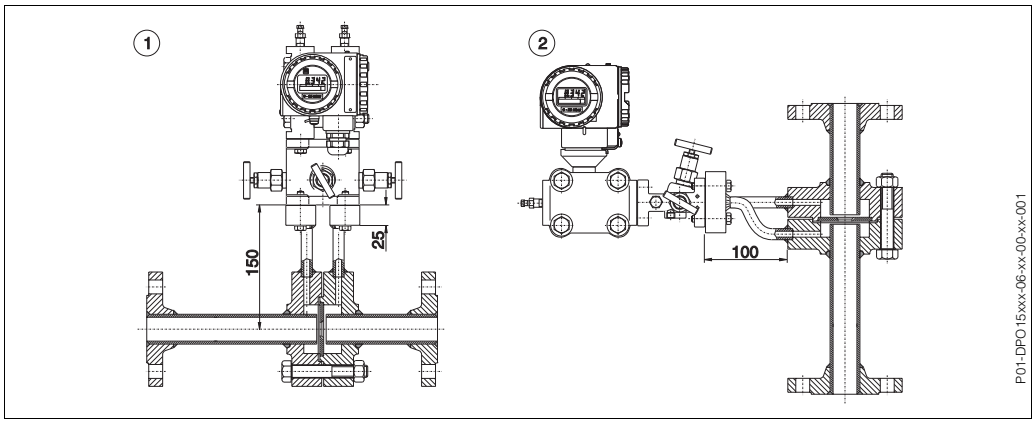


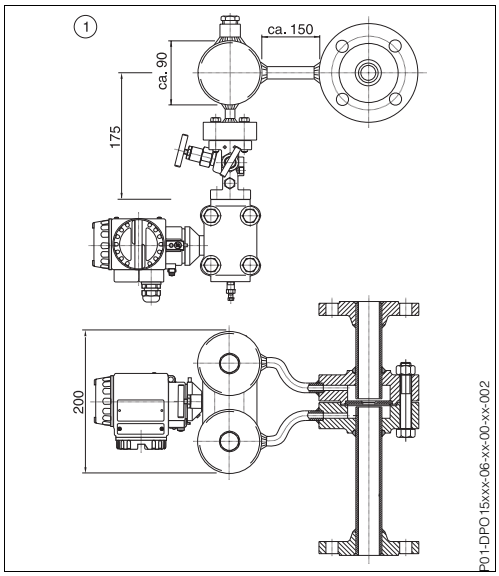
Dimensioned drawings (right):

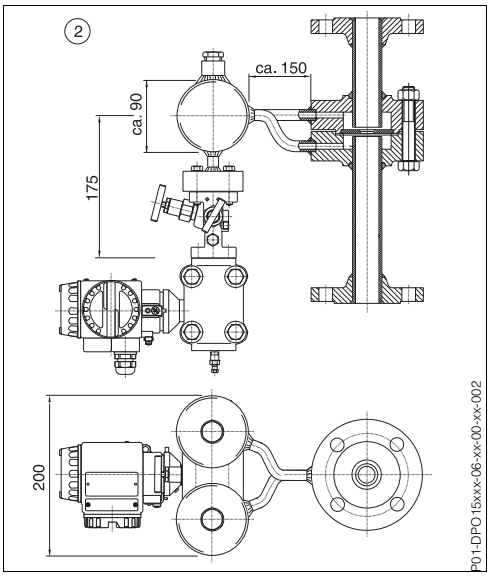
❑ Orifice plates for gases and liquids
① for horizontal piping
② for vertical piping with Deltabar housing T4

Dimensioned drawings (below):

❑ Orifice plates for steam (with two condensat chambers):
① Horizontal piping
② Vertical piping







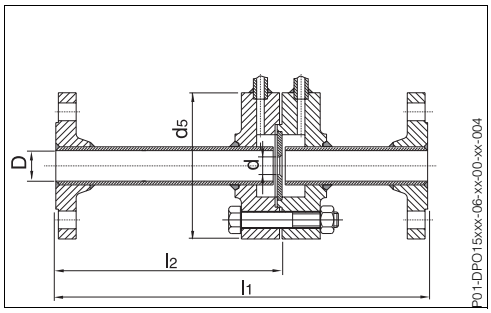
DN	l1 (mm)	l2 (mm)	Total weight (kg, approx.)
DIN			
10	400	230	11
15	550	380	12
20	700	500	16
25	900	650	19
32	1100	800	22
40	1300	1000	25
ANSI			
1/2	550	380	12
3/4	700	500	16
1	900	650	19
1 1/2	1300	1000	25

Tab. 19: Dimensions of DPO 15E and DPO 15A

Material of orifice plate: rust-proof steel SS 316TI
Limit thickness insulation from which the orifice plate must be lengthened: 120 mm
Max. temperature in process tube: gases/fluids 200 °C, steam 300 °C
Angle of tapping nozzle: 0 °

Dimensions:

d Diameter of orifice plate opening
D Pipe internal diameter
d5 See table
l1 Length
l2 Distance from orifice plate to flange



	PN 6	PN 10/16 PN 40	PN 64 PN 100			150 lbs	300 lbs 600 lbs
DN 10	75	90	100		**DN 1/2"**	88,9	95,2
DN 15	80	95	105		**DN 3/4"**	98,6	117,3
DN 20	90	105			**DN 1"**	108,0	124,0
DN 25	100	115	140		**DN 1 1/2"**	127,0	155,4
DN 32	120	140	155				
DN 40	130	150	170				

Tab. 20: Dimensions of d5 for DPO 15E and DPO 15A

Deltatop DPO 15E Ordering information for orifice pipe unit, DIN

10	Application: pipe orientation
C	Gas flow; horizontal pipe orientation
B	Gas flow; verticals pipe orientation
C	Liquid flow; horizontal pipe orientation
D	Liquid flow; vertical pipe orientation
E	Steam; horizontal pipe, mounting left (version with condensat chambers)
F	Steam; horizontal pipe, mounting right (version with condensat chambers)
G	Steam; vertical pipe, flow upwards (version with condensat chambers)
N	Steam; vertical pipe, flow downwards (version with condensat chambers)
Y	Special version

20	Approval
1	Without special approvals
2	Material approval to 3.1B, EN 10204
3	Free from oil and grease
4	Confirmed pressure test
5	3.1B certificate and pressure test
6	Wet calibration with certificate
9	Special version

30	Flange connection, material, length	
C	DN 10	C22.8; length 400
B	DN 10	SS 316TI; length 400
C	DN 15	C22.8; length 550
D	DN 15	SS 316TI; length 550
I	DN 20	C22.8; length 700
J	DN 20	SS 316TI; length 700
E	DN 25	C22.8; length 900
F	DN 25	SS 316TI; length 900
K	DN 32	C22.8; length 1100
L	DN 32	SS 316TI; length 1100
G	DN 40	C22.8; length 1300
N	DN 40	SS 316TI; length 1300
Y	Special version, e.g. DN4	

40	Pressure rating
1	PN 6
2	PN 10
3	PN 16
4	PN 25
5	PN 40
6	PN 64
7	PN 100
9	Special version

50	Facing of pipe flange
C	Facing form C
B	Facing form E
C	Facing: groove
D	Facing: recess
Y	Special version

60	Seals on manifold
1	Viton seals on manifold
2	PTFE seals on manifold, max. PN 100
9	Special version

70	Adjustment Deltabar S
F	Flow values, square root
P	Differential pressure values, linear
S	Adjustment 0..100%, square root
T	Adjustment 0..100%, linear
Y	Special version

DPO 15E	Complete product designation

Deltatop DPO 15A Ordering information for orifice pipe unit, ANSI

10	**Application: pipe orientation**								
	C	Gas flow; horizontal pipe orientation							
	B	Gas flow; verticals pipe orientation							
	C	Liquid flow; horizontal pipe orientation							
	D	Liquid flow; vertical pipe orientation							
	E	Steam; horizontal pipe, mounting left (version with condensat chambers)							
	F	Steam; horizontal pipe, mounting right (version with condensat chambers)							
	G	Steam; vertical pipe, flow upwards (version with condensat chambers)							
	N	Steam; vertical pipe, flow downwards (version with condensat chambers)							
	Y	Special version							
20		**Approval**							
		1	Without special approvals						
		2	Material approval to 3.1B, EN 10204						
		3	Free from oil and grease						
		4	Confirmed pressure test						
		5	3.1B certificate and pressure test						
		6	Wet calibration with certificate						
		9	Special version						
30			**Flange connection, material, length**						
			C	DN 1/2"	C22.8; length 550				
			B	DN 1/2"	SS 316TI; length 550				
			C	DN 3/4"	C22.8; length 700				
			D	DN 3/4"	SS 316TI; length 700				
			E	DN 1"	C22.8; length 900				
			F	DN 1"	SS 316TI; length 900				
			G	DN 1 1/2"	C22.8; length 1300				
			N	DN 1 1/2	SS 316TI; length 1300				
			Y	Special version, e.g. DN4					
40				**Pressure rating**					
				1	150 lbs				
				2	300 lbs				
				3	600 lbs				
				9	Special version				
50					**Facing of pipe flange**				
					C	Flange facing: groove			
					B	Flange facing: recess			
					C	Flange facing: raised face (RF)			
					Y	Special version			
60						**Seals on manifold**			
						1	Viton seals on manifold		
						2	PTFE seals on manifold, max. PN 100		
						9	Special version		
60							**Adjustment Deltabar S**		
							F	Flow values, square root	
							P	Differential pressure values, linear	
							S	Adjustment 0..100%, square root	
							T	Adjustment 0..100%, linear	
							Y	Special version	
DPO 15E									**Complete product designation**

Deltatop DPP 10
Compact version with Pitot tube

Pitot tube with probe profile made of SS 316TI, metallic graphite seal. With Deltabar S and 3-valve manifold, ready mounted and set.

For the required Ordering Information - see also pp. 41:

10 Application
Medium and pipe orientation
Figure: Gas measurement, horizontal piping

20 Approval
With or without special approvals

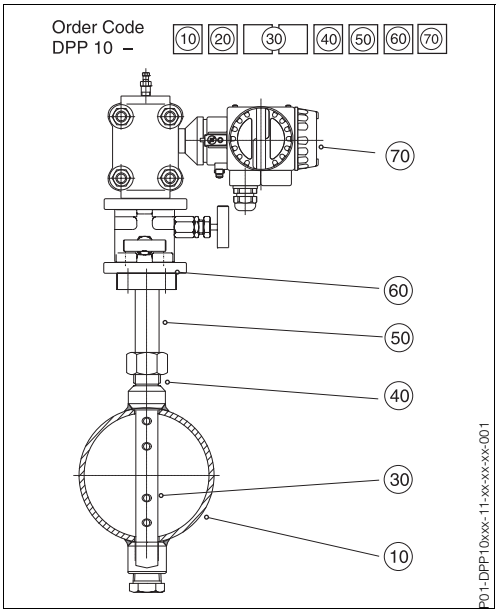
30 Nominal diameter pipe, material
Suppliable nominal diameters and material of welding parts

40 Probe installation
Cutting ring, flange or flow tap

50 Temperature sensor (as option)

60 Seals on manifold

70 Adjustment Deltabar S
Flow, differential pressure or %-display



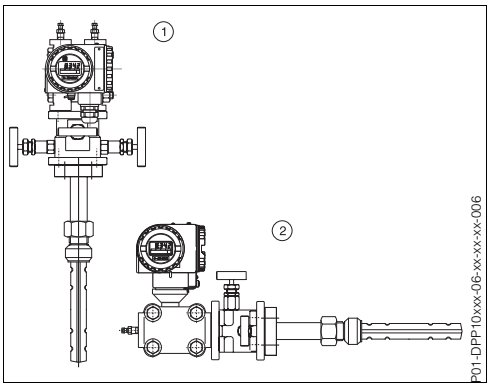
- With the Pitot tube, flow direction from DN 65 or 2 1/2" is insignificant, as the probe has a symmetrical construction.
- Material of probe profile:: Rust-proof steel SS 316TI

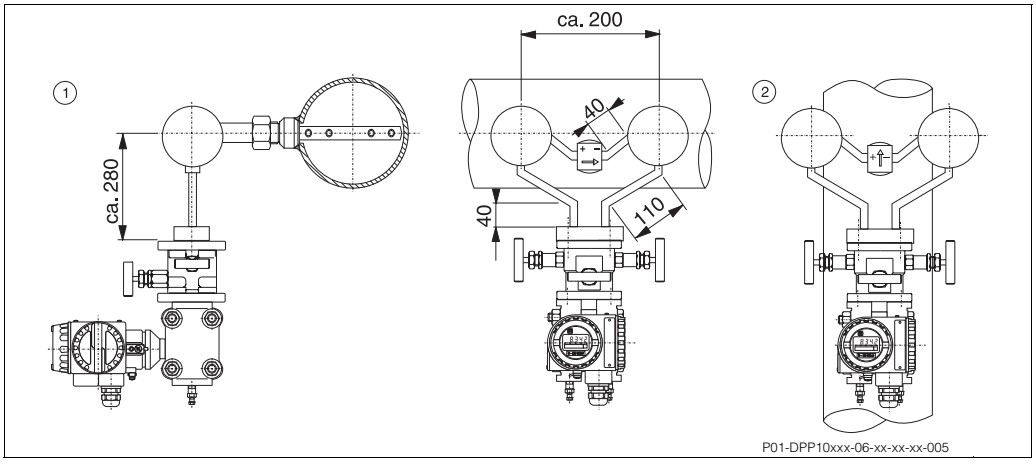
Dimensioned drawings (right):

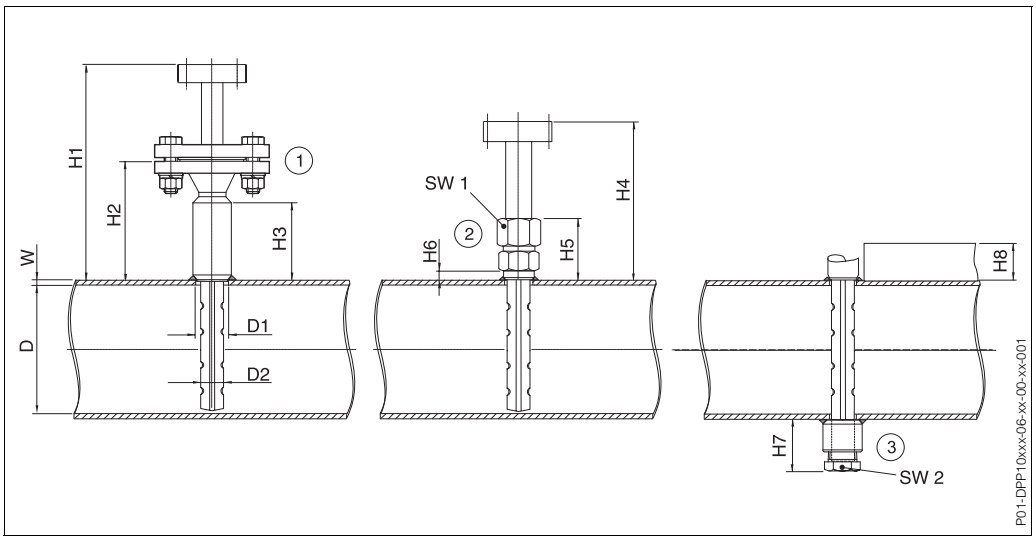
❑ Pitot tubes for gases and fluids:
① for horizontal piping
② for vertical piping with Deltabar housing T4

Dimensioned drawings (below):

❑ Pitot tubes for steam (with two condensat chambers):
① for horizontal piping
② for vertical piping







① *Flange: Max. temperature 200 °C, for steam 300 °C/116 bar*
② *Cutting ring: max. temperature 200 °C, for steam 200 °C/16 bar*
③ *Pitot tubes from DN 700 generally with steady, optionally for smaller nominal diameters (e.g. for large flow velocities)*

D *Pipe inner diameter (acc. to design sheet)*
D1 *Mounting drillhole*
D2 *Probe profile*
H1 *Distance to flange plate*
H2 *Distance to mounting flange*
H3/H6 *With insulated pipes, this minimum dimension must be increase by the insulation thickness H8 (this is also valid for H1/H2 and H4/H5)*
H7 *Height of the steady*
H8 *Hgh insulation (acc. to design sheet, standard 120 mm)*
W *Pipe wall thickness*
AF *Across flats*

	Mounting drill hole	**Probe profile**	**Flange ①**			**Cutting ring ②**				**Steady**	
	D1	**D2**	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**SW1**	**H7**	**SW2**
DN 65/DN 80	16	12	180	80	50 *	130	48	10 *	27	40	22
DN ≥ DN 100	35	25	227	127	90 *	148	68	15 *	45	55	36

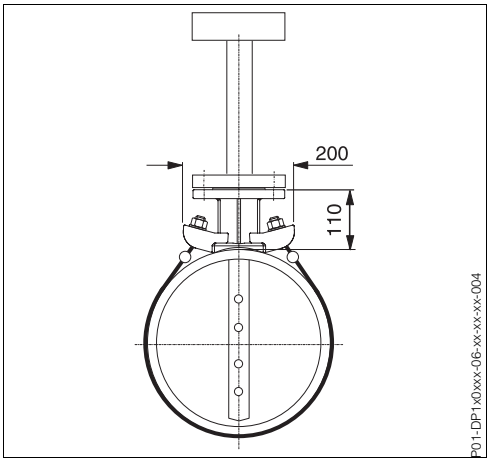
Tab. 21: Dimensions of Pitot tube DPP 10, all dimensions in mm

	Pipe DN 65/DN 80	**Pipe ≥DN 100**
Probe PN 40 bar	Flange DN 25	Flange DN 32
Probe PN 100 bar	Flange DN 25	Flange DN 40
Probe PN 160 bar	Flange DN 25	Flange DN 40
Probe PN 300 lbs	Flange DN 1"	Flange DN 1 1/4"
Probe PN 600 lbs	Flange DN 1"	Flange DN 1 1/4"
Probe PN 1500 lbs	Flange DN 1"	Flange DN 1 1/4"

Tab. 22: Nominal diameter of flanges for Pitot tube DPP 10

Saddle flange
The saddle flange allows the Pitot tube to be mounted on pipes (nominal diameter DN 65...DN 500), upon which it is not possible to weld a cutting ring screw union or a flange (e.g. with cast or concrete pipes).

- Saddle flange
  Material: GGG-40/EWS-coated
  Dimensions: see Fig., 90 mm wide
  Flange loss: DN 40/50, PN 4 for gas, PN 16 for water
  Saddle seal: NBR
  Weight: 5.5 kg
- Holding bracket
  From rust-proof steel, fully-vulcanised, 70 mm wide

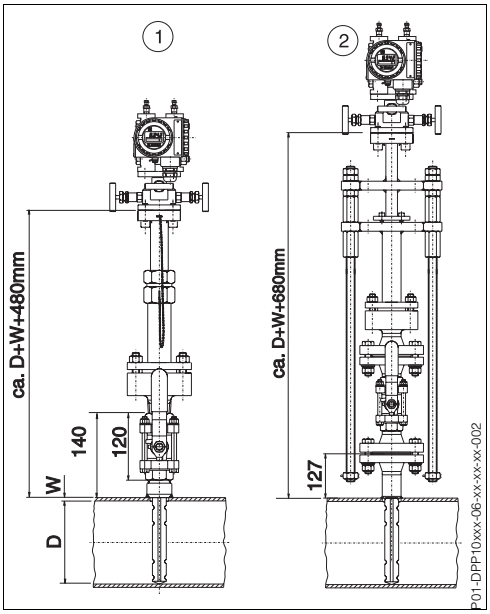


Flow tap
You can use the flow tap solution to repair or replace the Pitot tube during operation.

D Internal diameter of piping
W Wall thickness of pipe;
From DN 700 with steady 1NPT, Depth 51 mm
Max. temperature 300 °C, C, for steam 350 °C

① Flow tap with fixing chain
Distance from pipe - manifold (if probe in pipe): D + W + 480 mm
Distance from pipe - manifold (if probe removed from pipe): 2D + 2W + 480 mm

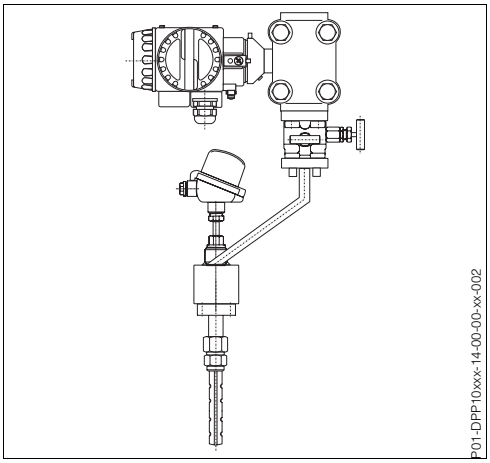
② Flow tap with spindle
Distance from pipe - manifold (if probe in pipe): D + W + 680 mm
Distance from pipe - manifold (if probe removed from pipe): 2D + 2W + 680 mm



Temperature sensor
To determine the medium temperature, with Pitot tubes from DN 100 there is optionally an integrated temperature measurement:

❏ With Pt100 temperature sensor
❏ With 4...20 mA temperature sensor

You can find additional information on the temperature sensor on page 23.



Deltatop DPP 10 Ordering Information for Pitot tube

10 Application: pipe orientation

C	Gas flow; horizontal pipe orientation
B	Gas flow; verticals pipe orientation
C	Liquid flow; horizontal pipe orientation
D	Liquid flow; vertical pipe orientation
K	Steam; horizontal pipe, mounting left (version with condensat chambers)
P	Steam; horizontal pipe, mounting right (version with condensat chambers)
L	Steam; vertical pipe, flow upwards (version with condensat chambers)
Q	Steam; vertical pipe, flow downwards (version with condensat chambers)

20 Approval

1	Without special approvals
2	Material approval to 3.1B, EN 10204
3	Free from oil and grease
4	Confirmed pressure test
5	3.1B certificate and pressure test
9	Special version)

30 Nominal diameter pipe, material
Letter = nominal diameter / Numeral = material

Example G2: DN 125, Material SS 316Ti
1 Material C22.8
2 Material SS 316TI

D❑	DN 65	2 1/2"		
E❑	DN 80	3"		
F❑	DN 100	4"		
G❑	DN 125	5"		
H❑	DN 150	6"		
K❑	DN 200	8"		
L❑	DN 250	10"		
M❑	DN 300	12"		
N❑	DN 350	14"		
P❑	DN 400	16"		
Q❑	DN 500	20"		
R❑	DN 600	24"		
S❑	DN 700	28"		with end support
T❑	DN 800	32"		with end support
U❑	DN 900	36"		with end support
V❑	DN 1000	40"		with end support
W❑	DN 1200	48"		with end support
W3	DN 1500	60"	C 22.8	with end support
W4	DN 1500	60"	SS 316Ti	with end support
X❑	DN 1800	72"		with end support
X3	DN 2000	80"	C 22.8	with end support
X4	DN 2000	80"	SS 316Ti	with end support
Y	Special version			

40 Pitot tube installation

C	Cutting ring	PN 40
B	Flange DIN 2527	PN 40
C	Flange DIN 2527	PN 100
D	Flange DIN 2527	PN 160
E	Flange ANSI B16.5	300 lbs
F	Flange ANSI B16.5	600 lbs
G	Flange ANSI B16.5	1500 lbs
N	Flow tap with spindle	
I	Flow tap with fixing chain	
L	Saddle flange for non-weldable pipes	
Y	Special version	

50 Integrated temperature sensor

1	Without temperature sensor
2	With integrated Pt100 temperature sensor
3	With integrated 4...20 mA temperature sensor
9	Special version

60 Seals on manifold

1	Viton seals on manifold
2	PTFE seals on manifold, max. PN 100
Y	Special version)

70 Adjustment Deltabar S

F	Flow values, square root
P	Differential pressure values, linear
S	Adjustment 0..100%, square root
T	Adjustment 0..100%, linear
Y	Special version

DPP 10 — **Complete product designation**

Deltaset versions

Scope of supply

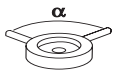
Deltaset is a modular flowmeter system based on Differential pressure values. It complements Deltatop during installations with impulse pipes, e.g.

- at process temperatures above 300°C (impulse pipes as cooling section),
- to be able to install the transmitter despite impeded access to the piping,
- if available impulse pipes are to be used.

In the individual ordering positions, select the primary device (orifice plate or Pitot tube), 2 shut-off valves, 2 condensat chambers and the manifold. The delivery comes complete with enclosed Deltabar S differential pressure transmitter (which is ordered extra). The primary device, 2 shut-off valves (and 2 condensat chambers for steam applications) are premounted. The impulse pipes can be mounted by the customer between the shut-off valves and the manifold.

The Deltabar S is supplied with an optimum differential pressure sensor, so that the customer need not calculate the primary device prior to ordering. The differential pressure is preset, as is the square root or linear characteristic and the selected display option (flow, differential pressure or percentage value).

Angle α of tapping nozzle

	**One-part orifice plate with corner tapping DPO 50**		**Two-part orifice plate with corner tapping (annular chamber) DPO 51**		**Measuring flange orifice plate DPO 52**	
	Liquid, Gas	Steam	Liquid, Gas	Steam	Liquid, Gas	Steam
Piping horizontal	0 °	0 °	0° No. 2 *	0° No. 2 *	α to DIN 19205 No. 10 *	180° No. 2 *
Piping vertical bottom –> top	0 °	90 °	0° No. 12 *	90° No. 4 *	90° No. 13 *	90° No. 6 *
Piping vertical top –> bottom	0 °	90 °	0° No. 12 *	90° No. 5 *	90° No. 13 *	90° No. 7 *

Tab. 23: Angle α for tapping nozzle
*The numbers with * are related to the appropriate arrangement acc. to DIN 19205 (Part 1) listed in Table 7. This standard specifies the standard tapping angles.*

Connection selection

The following figure gives an example of the components forming a Deltaset measuring point:

- Pitot tube for steam (left)
- Orifice plate for gas (right)

□ This position in the order code sets the connections of the individual components

The table shows with which pressure taps the components can be ordered - you can find additional information with the appropriate ordering information.

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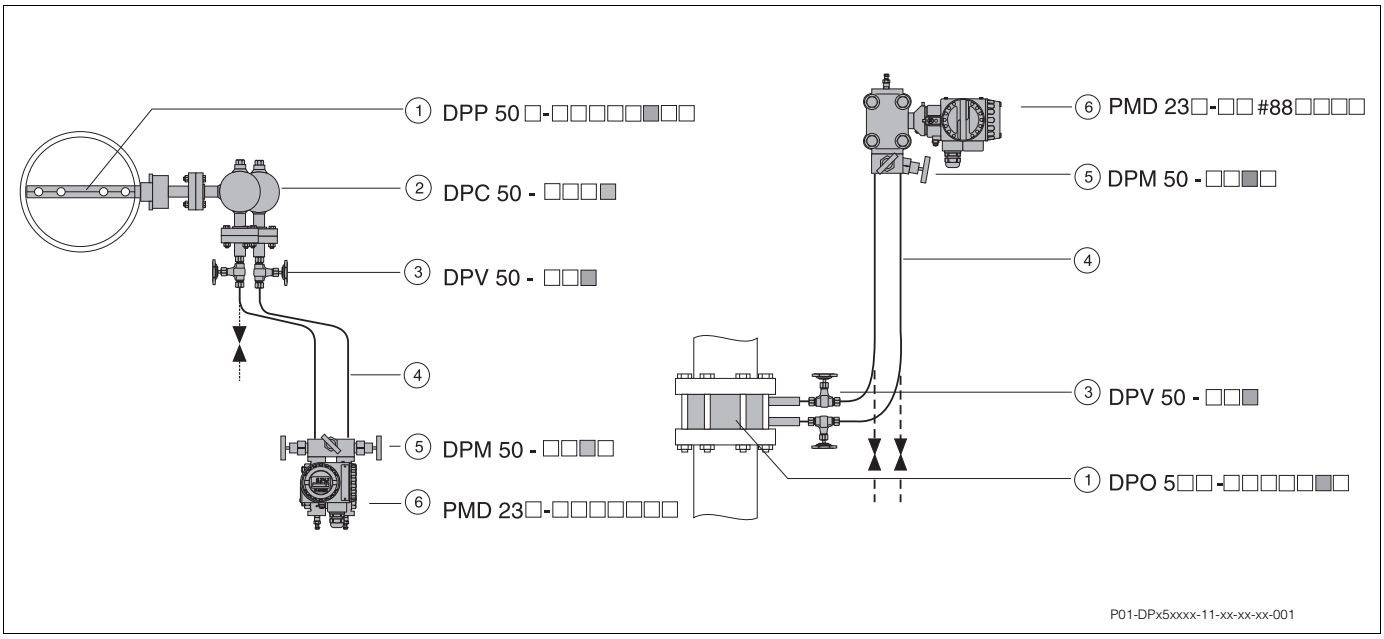
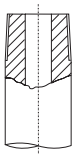
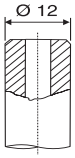
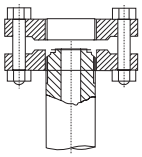
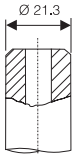


	Pressure taps	Thread 1/2 NPT	Pipe for cutting ring	G 1/2 with flange pair	Pipe for welded connection	
						
				Use with steam		
		Use with gases and liquids				
①	**Primary device** DPO 50/51/52/53, DPP50	DPO 5❑❑-❑❑❑❑❑1❑ DPP 50-❑❑❑❑❑1❑ 1/2 NPT male	DPO 5❑❑-❑❑❑❑❑2❑ DPP 50-❑❑❑❑❑2❑ Pipe 12 mm for cutting ring	DPO 5❑❑-❑❑❑❑❑3❑ DPP 50-❑❑❑❑❑3❑ G 1/2	DPO 5❑❑-❑❑❑❑❑4❑ DPP 50-❑❑❑❑❑4❑ Welded connection 21.3	
②	**2 condensat chambers** DPC 50 (for steam)			DPC 50-❑❑❑3 G1/2 with flange pair DIN 19207 / G 1/2 /	DPC 50-❑❑❑4 Welded connection 21.3 / Welded connection 21.3	
③	**2 shut-off valves** DPV 50 Input/output	DPV 50-❑❑1 1/2 NPT female / 1/2 NPT female	DPV 50-❑❑2 Cutting ring / Cutting ring	DPV 50-❑❑3 G1/2 with flange pair DIN 19207 / Cutting ring	DPV 50-❑❑4 Welded connection 21.3 / Cutting ring	DPV 50-❑❑5 Welded connection 21.3 / Welded connection 14 x 2.5
④	**2 x pressure piping**	Not in scope of supply	Not in scope of supply	Not in scope of supply	Not in scope of supply	Not in scope of supply
⑤	**manifold** DPM 50	DPM 50-❑❑1❑ 1/2 NPT female	DPM 50-❑❑2❑ Cutting ring	DPM 50-❑❑❑❑	DPM 50-❑❑❑❑	DPM 50-❑❑5❑ Welded connection 14 x 2.5

Tab. 24: This table shows which pressure taps are possible with the components of Deltaset.

Deltaset DPO 50
Undivided orifice plate with corner tapping

Primary device acc. to DIN 19205 (B) bzw. ISO 5167. For installation between flanges to DIN 263x.
The (specially ordered) shut-off valves DPV 50 or condensat chambers DPC 50 are supplied premounted, the 3-valve manifold DPM 50 is also supplied. The Deltabar S differential pressure transmitter is optimised and set.

For the required Ordering Information - see also pp. 46 and 47:

10 Application
Medium and pipe orientation
Figure: Gas measurement, horizontal piping

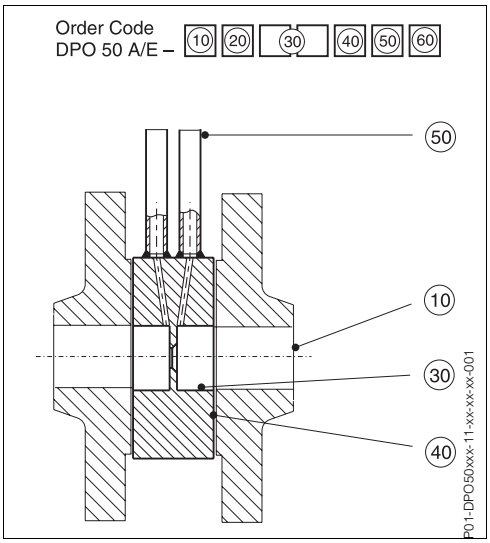
20 Approval
With or without special approvals

30 Nominal diameter pipe, material

40 Pressure rating, facing

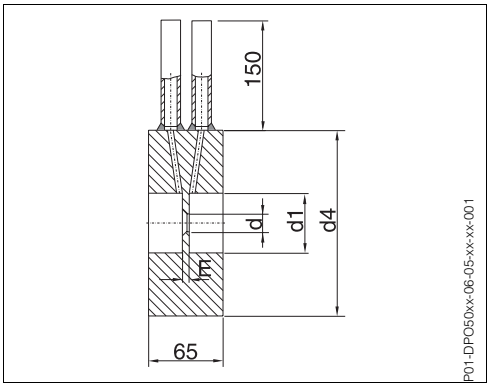
50 Connection of tapping nozzle
See table on page 42

60 Adjustment Deltabar S
Flow, differential pressure or percentage display



Dimensioned drawings (right)

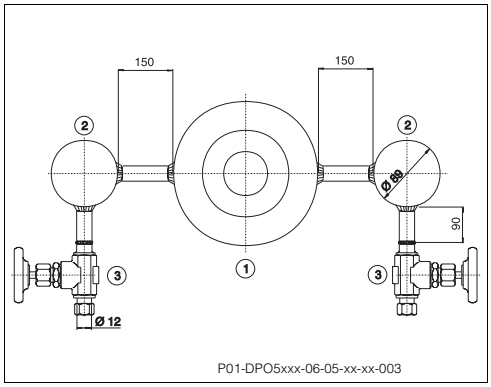
❑ Orifice plates for gases and liquids
For dimensions table, see page 44

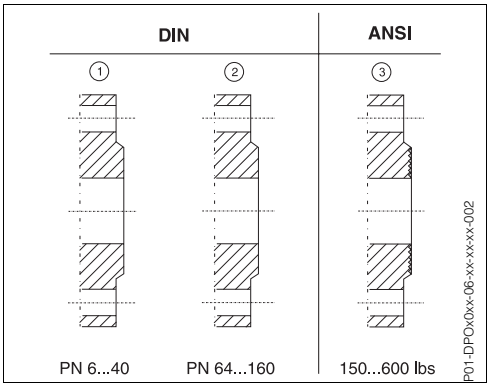


Dimensioned drawings (below)

❑ Orifice plates for steam
(arrangement example)
① Orifice plate
② Condensate trap
③ Shut-off valve

❑ Possible facings
① Raised face (Rz=160)
② Shape E (Rz=16)
③ Shape RF (raised face)





Dimensions for orifice plates
DIN flange
DPO 50E
DPO 51E
DPO 53E

DN (mm)	d_4 (mm)								E (mm)	d_1 (mm)	Weight (approx. kg)
	PN 6	PN 10	PN 16	PN 25	PN 40	PN 64	PN 100	PN 160			
50	96	107		107		112	119		3	D + 1 mm	10
65	116	127		127		137	143		3		10.5
80	132	142		142		147	153		4		12
100	152	162		167		173	180		4		13
125	182	192		193		210	217		4	D + 2 mm	14
150	207	217		223		247	257		5		15
200	262	272	272	283	290	309	324		5		18
250	317	327	328	340	352	364	391	388	5		22
300	372	377	383	400	417	424	458	458	6		27
350	422	437	443	457	474	486	512		6		31
400	472	488	495	514	546	543			6		33
500	577	593	617	624	628				8		37
600	678	695	734	731					8		45
700	783	810	804	833					10		57
800	890	917	911	942					10		67
900	990	1017	1011	1042					10		77
1000	1090	1124	1128	1154					10		88

Tab. 25: Dimensions and weight of orifice plate DPO 50E, nominal diameter DN in mm

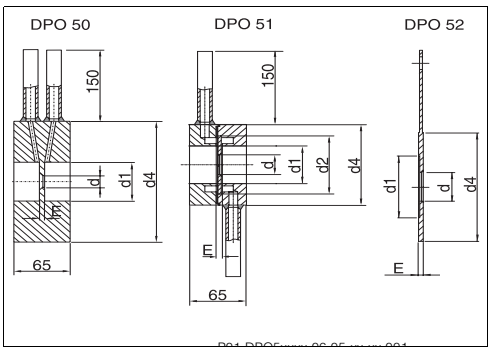
Dimensions for orifice plates
ANSI flange
DPO 50E
DPO 51A
DPO 53A

DN (in inches)	d_4						E (mm)	d_1 (mm)	Weight (approx. kg)
	in mm	in inches	in mm	in inches	in mm	in inches			
	150 lbs		300 lbs		600 lbs				
2	104.5	4.1	111	4.4	111	4.4	3	D +1 mm	10
2 1/2	124	4.9	130	5.1	130	5.1	3		10.5
3	136.5	5.4	149.5	5.9	149.5	5.9	4		12
4	174.5	6.9	181	7.1	193.5	7.6	4		13
5	197	7.8	216	8.5	241.5	9.5	4	D +2 mm	14
6	222.5	8.8	251	9.9	266.5	10,5	5		15
8	279.5	11.0	308	12.1	320.5	12.6	5		18
10	339.5	13.3	362	14.2	400	15.7	5		22
12	409.5	16.1	422	16.6	457	18.0	6		27
14	451	17.8	484.4	19.1	492	19.4	6		31
16	514.5	20.3	540	21.3	565	22.2	6		33
20	606.5	23.9	654	25.7	682.5	26.9	8	D +4 mm	37
24	717.5	27.9	774.5	30.5	790.5	31.1	8		45

Tab. 26: Dimensions and weight of orifice plate DPO 50A, nominal diameter DN in inches

Dimensions:
d Diameter of orifice plate opening (determined in design)
E Orifice plate thickness
d1 Internal diameter of holding ring
d4 Exterior orifice plate diameter
D Pipe internal diameter

Limit thickness of insulation from which the orifice plate neck must be lengthened: 120 mm



Deltaset DPO 50E
Ordering information for corner tapping
DIN

10	**Application: pipe orientation**								
	C	Gas flow; horizontal pipe orientation							
	B	Gas flow; verticals pipe orientation							
	C	Liquid flow; horizontal pipe orientation							
	D	Liquid flow; vertical pipe orientation							
	E	Steam; horizontal pipe,							
	G	Steam; vertical pipe, flow upwards							
	N	Steam; vertical pipe, flow downwards							
	Y	Special version							
20		**Approval**							
		1	Without special approvals						
		2	Material approval to 3.1B, EN 10204						
		3	Free from oil and grease						
		4	Material approval to 3.1A, EN 10204						
		9	Special version						
30			**Nominal diameter pipe, material** Letter = nominal diameter / Numeral = material						Example G2: DN 125, Material SS 316Ti
			C❑	DN 50	Ring and nozzle				1 Material C22.8
			D❑	DN 65	Ring and nozzle				2 Material SS 316TI
			E❑	DN 80	Ring and nozzle				3 Material 15Mo3
			F❑	DN 100	Ring and nozzle				
			G❑	DN 125	Ring and nozzle				
			H❑	DN 150	Ring and nozzle				
			K❑	DN 200	Ring and nozzle				
			L❑	DN 250	Ring and nozzle				
			M❑	DN 300	Ring and nozzle				
			N❑	DN 350	Ring and nozzle				
			P❑	DN 400	Ring and nozzle				
			Q❑	DN 500	Ring and nozzle				
			R❑	DN 600	Ring and nozzle				
			S❑	DN 700	Ring and nozzle				
			T❑	DN 800	Ring and nozzle				
			U❑	DN 900	Ring and nozzle				
			W❑	DN 1000	Ring and nozzle				
			Y9	Special version					
40				**Pressure rating, facing**					
				C	PN 6	Facing form C			
				B	PN 10	Facing form C			
				C	PN 16	Facing form C			
				D	PN 25	Facing form C			
				E	PN 40	Facing form C			
				F	PN 64	Facing form E			
				G	PN 100	Facing form E			
				N	PN 160	Facing form E			
				Y	Special version				
50						**Connection of pressure taps**			
						1	1/2 NPT male, not with steam		
						2	Pipe without thread, diameter 12 mm, not with steam		
						3	G 1/2, shape V to DIN ISO 19207		
						4	Welded connection 21.3 x 6.3		
						9	Special version		
60							**Adjustment Deltabar S**		
							F	Flow values, square root	
							P	Differential pressure values, linear	
							S	Adjustment 0..100%, square root	
							T	Adjustment 0..100%, linear	
							Y	Special version	
DPO 50E								**Complete product designation**	

Deltaset DPO 50A Ordering information for Corner tapping, ANSI

10								**Application: pipe orientation**		
								C	Gas flow; horizontal pipe orientation	
								B	Gas flow; verticals pipe orientation	
								C	Liquid flow; horizontal pipe orientation	
								D	Liquid flow; vertical pipe orientation	
								E	Steam; horizontal pipe, mounting left	
								G	Steam; vertical pipe, flow upwards	
								N	Steam; vertical pipe, flow downwards	
								Y	Special version	
20							**Approval**			
							1	Without special approvals		
							2	Material approval to 3.1B, EN 10204		
							3	Free from oil and grease		
							4	Material approval to 3.1A, EN 10204		
							9	Special version		
30				**Nominal diameter pipe, material** Letter = nominal diameter / Numeral = material						Beispiel G2: DN 5", Material 1.4571
				C❑	DN 2"	Ring and nozzle				1 Material C22.8
				D❑	DN 2 1/2"	Ring and nozzle				2 Material SS 316TI
				E❑	DN 3"	Ring and nozzle				3 Material 15Mo3
				F❑	DN 4"	Ring and nozzle				
				G❑	DN 5"	Ring and nozzle				
				H❑	DN 6"	Ring and nozzle				
				K❑	DN 8"	Ring and nozzle				
				L❑	DN 10"	Ring and nozzle				
				M❑	DN 12"	Ring and nozzle				
				N❑	DN 14"	Ring and nozzle				
				P❑	DN 16"	Ring and nozzle				
				Q❑	DN 20"	Ring and nozzle				
				R❑	DN 24"	Ring and nozzle				
				Y9	Special version					
40								**Pressure rating, facing**		
								C	150 lbs RF (roughened facing)	
								B	300 lbs RF (roughened facing)	
								C	600 lbs RF (roughened facing)	
								Y	Special version	
50									**Connection of pressure taps**	
								1	1/2 NPT male (not with steam)	
								2	Pipe without thread, diameter 12 mm (not with steam)	
								3	G 1/2", shape V to DIN ISO 19207	
								4	Welded connection 21.3 x 6.3	
								9	Special version	
60										**Adjustment Deltabar S**
									F	Flow values, square root
									P	Difference, linear
									S	Adjustment 0..100%, square root
									T	Adjustment 0..100%, linear
									Y	Special version
DPO 50A										**Complete product designation**

Deltaset DPO 51
Annular chamber orifice

Primary device acc. to DIN 19205 (A) or ISO 5167, orifice plate made of SS 316Ti, for mounting between flanges to DIN 263x with flat seal.
The (specially ordered) shut-off valves DPV 50 or condensat chambers DPC 50 are supplied premounted, the 3-valve manifold DPM 50 is also supplied. The Deltabar S differential pressure transmitter is optimised and set.

For the required Ordering Information - see also pp. 49 and 50:

10 Application
Medium and pipe orientation
Figure: Gas measurement, horizontal piping

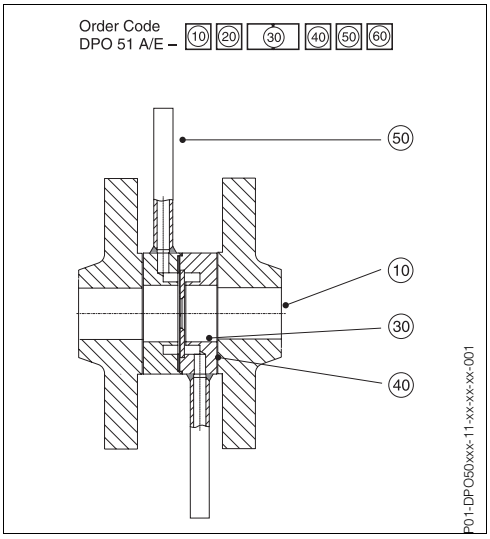
20 Approval
With or without special approvals

30 Nominal diameter pipe, material

40 Pressure rating, facing

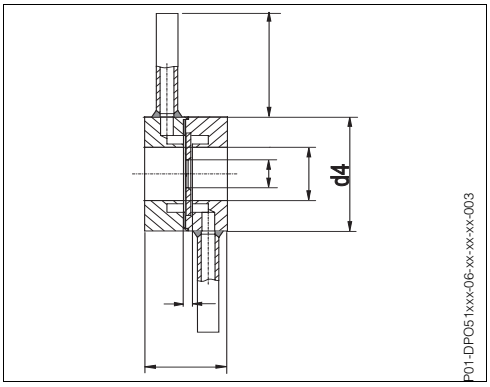
50 Connection of tapping nozzle
See table on page 43

60 Adjustment Deltabar S
Flow, differential pressure or percentage display



Dimensioned drawing (right)

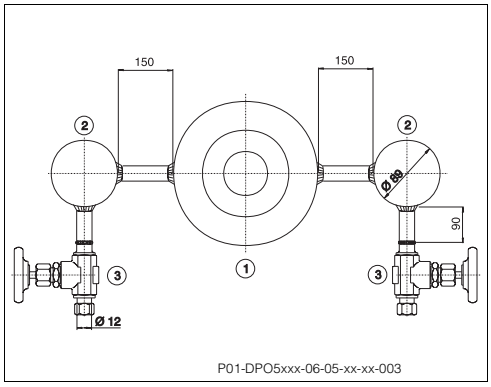
❑ Orifice plates for gases and Liquids
For dimensions table, see page 45

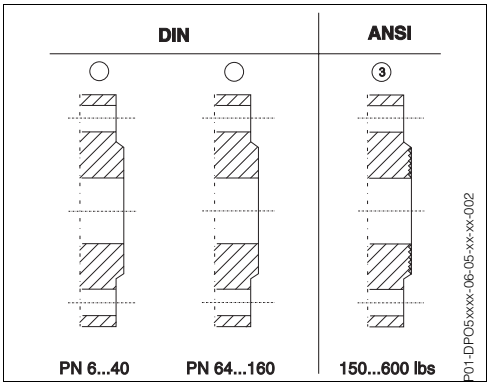


Dimensioned drawings (below)

❑ Orifice plates for steam
(arrangement example)
① Orifice plate
② Condensate trap
③ Shut-off valve

❑ Possible facings
① Raised face (Rz=160) ② Shape E (Rz=16)
③ Shape RF (raised face)





Deltaset DPO 51 E Ordering Information for annular chamber orifice DIN

10 Application: pipe orientation

C	Gas flow; horizontal pipe orientation
B	Gas flow; verticals pipe orientation
C	Liquid flow; horizontal pipe orientation
D	Liquid flow; vertical pipe orientation
E	Steam; horizontal pipe, mounting left
F	Steam; horizontal pipe, mounting right
G	Steam; vertical pipe, flow upwards
N	Steam; vertical pipe, flow downwards
Y	Special version

20 Approval

1	Without special approvals
2	Material approval to 3.1B, EN 10204
3	Free from oil and grease
9	Special version

30 Nominal diameter pipe, material
Letter = nominal diameter / Numeral = material

Example G2: DN 125, Material SS 316Ti
[1] Material C22.8
[2] Material SS 316TI

C❑	DN 50	Ring and nozzle
D❑	DN 65	Ring and nozzle
E❑	DN 80	Ring and nozzle
F❑	DN 100	Ring and nozzle
G❑	DN 125	Ring and nozzle
H❑	DN 150	Ring and nozzle
K❑	DN 200	Ring and nozzle
L❑	DN 250	Ring and nozzle
M❑	DN 300	Ring and nozzle
N❑	DN 350	Ring and nozzle
P❑	DN 400	Ring and nozzle
Q❑	DN 500	Ring and nozzle
R❑	DN 600	Ring and nozzle
S❑	DN 700	Ring and nozzle
T❑	DN 800	Ring and nozzle
U❑	DN 900	Ring and nozzle
W❑	DN 1000	Ring and nozzle
Y9	Special version	

40 Pressure rating, facing

C	PN 6	Facing form C
B	PN 10	Facing form C
C	PN 16	Facing form C
D	PN 25	Facing form C
E	PN 40	Facing form C
F	PN 64	Facing form E
G	PN 100	Facing form E
Y	Special version	

50 Connection of pressure taps

1	1/2 NPT male (not with steam)
2	Pipe without thread, diameter 12 mm (not with steam)
3	G 1/2, shape V to DIN ISO 19207 (without flange pair)
4	Welded connection 21.3 x 6.3
9	Special version

60 Adjustment Deltabar S

F	Flow values, square root
P	Differential pressure values, linear
S	Adjustment 0..100%, square root
T	Adjustment 0..100%, linear
Y	Special version

DPO 51E — **Complete product designation**

Deltaset DPO 51 A Ordering Information for annular chamber orifice ANSI

10	**Application: pipe orientation**									
	C	Gas flow; horizontal pipe orientation								
	B	Gas flow; verticals pipe orientation								
	C	Liquid flow; horizontal pipe orientation								
	D	Liquid flow; vertical pipe orientation								
	E	Steam; horizontal pipe, mounting left								
	F	Steam; horizontal pipe, mounting right								
	G	Steam; vertical pipe, flow upwards								
	N	Steam; vertical pipe, flow downwards								
	Y	Special version								
20		**Approval**								
		1	Without special approvals							
		2	Material approval to 3.1B, EN 10204							
		3	Free from oil and grease							
		9	Special version							
30			**Nominal diameter pipe, material** Letter = nominal diameter / Numeral = material							Example G2: DN 125, Material SS 316Ti 1 Material C22.8 2 Material SS 316TI
			C❑	DN 2"	Ring and nozzle					
			D❑	DN 2 1/2"	Ring and nozzle					
			E❑	DN 3"	Ring and nozzle					
			F❑	DN 4"	Ring and nozzle					
			G❑	DN 5"	Ring and nozzle					
			H❑	DN 6"	Ring and nozzle					
			K❑	DN 8"	Ring and nozzle					
			L❑	DN 10"	Ring and nozzle					
			M❑	DN 12"	Ring and nozzle					
			N❑	DN 14"	Ring and nozzle					
			P❑	DN 16"	Ring and nozzle					
			Q❑	DN 20"	Ring and nozzle					
			R❑	DN 24"	Ring and nozzle					
			Y9	Special version						
40					**Pressure rating, facing**					
				C	150 lbs	RF (roughened facing)				
				B	300 lbs	RF (roughened facing)				
				C	600 lbs	RF (roughened facing)				
				Y	Special version					
50						**Connection of pressure taps**				
					1	1/2 NPT male (not with steam)				
					2	Pipe without thread, diameter 12 mm (not with steam)				
					3	G 1/2", shape V to DIN ISO 19207 (without flange pair)				
					4	Welded connection 21.3 x 6.3				
					9	Special version				
60							**Adjustment Deltabar S**			
						F	Flow values, square root			
						P	Differential pressure values, linear			
						S	Adjustment 0..100%, square root			
						T	Adjustment 0..100%, linear			
						Y	Special version			
DPO 51A							**Complete product designation**			

Deltaset DPO 52
Orifice flange

Primary device acc. to DIN 19214 or ANSI B16.36. orfice plate with screws and seals.
The (specially ordered) shut-off valves DPV 50 or condensat chambers DPC 50 are supplied premounted, the 3-valve manifold DPM 50 is also supplied. The Deltabar S differential pressure transmitter is optimised and set.

For the required Ordering Information - see also pp. 53 and 54:

10 Application
Medium and pipe orientation
Figure: Gas measurement, horizontal piping

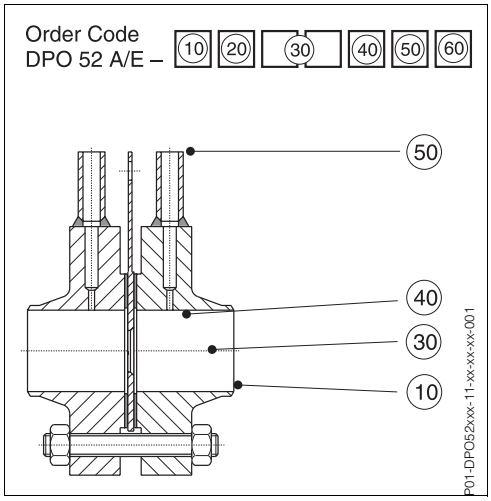
20 Approval
With or without special approvals

30 Nominal diameter pipe, material

40 Pressure rating

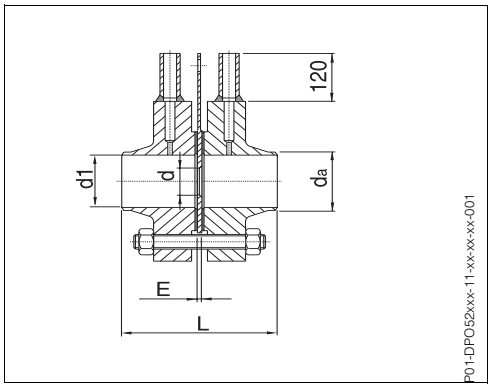
50 Connection of tapping nozzle
See table on page 43

60Adjustment Deltabar S
Flow, differential pressure or percentage display



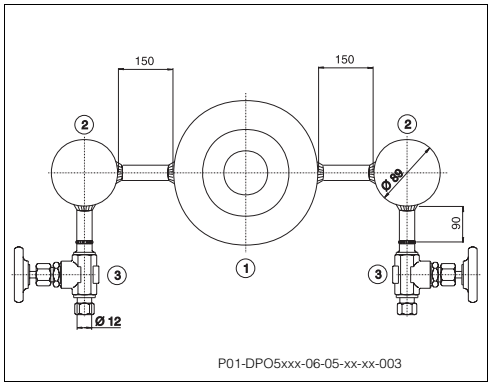
Dimensioned drawing

❑ Orifice plates for gases and liquids
See dimensions table on next page



Dimensioned drawings

❑ Orifice plates for steam
(arrangement example)
① Orifice plate
② Condensate trap
③ Shut-off valve



DN (mm)	**da** (mm)	**Length L** (mm)						**E** (mm)	**Weight** (approx. kg)
		PN 10	**PN 16**	**PN 25**	**PN 40**	**PN 64**	**PN 100**		
50	60.3	133	133	135	135	150	159	3	9
65	76.1	133	133	139	139	162	170	3	11
80	88,9	140	140	148	148	167	170	4	14
100	114.3	144	144	162	162	175	191	4	20
125	139.7	146	146	164	164	187	222	4	30
150	168.3	146	146	174	174	201	242	4	42
200	219.1	156	156	180	188	232	272	4	70
250	272	164	168	192	217	262	326	4	100
300	323.9	164	180	196	237	292	352	4	130
350	355.6	164	184	257	257	312	390	4	170
400	406.4	172	186	277	277	332		4	208
500	508	176	194	289	289			6	238

Tab. 27: Dimensions and weight of orifice plate DPO 52E, nominal diameter DN in mm

DN	**da**	**Length L**				**E** in mm	**Weight** 300 lbs(600 lbs) approx. kg
(inches)	in mm	in mm	in inches	in mm	in inches		
		300 lbs		**600 lbs**			
2	60.3	179	70.5	179	70.5	3	12 (12)
2 1/2	73.0	184	72.4	184	72.4	3	16 (16)
3	88,9	184	72.4	197	77.6	3	24 (24)
4	114.3	190	74.8	222	87.4	3	38 (59)
5	141.3	207	81.5	248	97.6	3	50 (95)
6	168.3	207	81.5	254	100.0	3	60 (111)
8	219.1	228	89.8	286	112.6	3	86 (158)
10	273.0	241	94.9	324	127.6	3	122 (258)
12	323.8	266	104.7	330	129.9	3	185 (314)
14	355.6	292	115.0	350	137.8	6	253 (463)
16	406.4	301	118.5	379	149.2	6	338 (631)
20	508.0	333	131.1	403	158.7	6	503 (920)
24	609.6	345	135.8	429	168.9	6	660 (1250)

Tab. 28: Dimensions and weight of orifice plate DPO 52A, nominal diameter DN in inches

Deltaset DPO 52E Ordering information for orifice flange DIN

10 — Application: pipe orientation

C	Gas flow; horizontal pipe orientation
B	Gas flow; verticals pipe orientation
C	Liquid flow; horizontal pipe orientation
D	Liquid flow; vertical pipe orientation
E	Steam; horizontal pipe, mounting left
F	Steam; horizontal pipe, mounting right
G	Steam; vertical pipe, flow upwards
N	Steam; vertical pipe, flow downwards
Y	Special version

20 — Approval

1	Without special approvals
2	Material approval to 3.1B, EN 10204
3	Free from oil and grease
9	Special version

30 — Nominal diameter pipe, material
Letter = nominal diameter / Numeral = material

Example G2: DN 125, Material SS 316Ti
1 Material C22.8
2 Material SS 316TI

C❑	DN 50	Flange and nozzle
D❑	DN 65	Flange and nozzle
E❑	DN 80	Flange and nozzle
F❑	DN 100	Flange and nozzle
G❑	DN 125	Flange and nozzle
H❑	DN 150	Flange and nozzle
K❑	DN 200	Flange and nozzle
L❑	DN 250	Flange and nozzle
M❑	DN 300	Flange and nozzle
N❑	DN 350	Flange and nozzle
P❑	DN 400	Flange and nozzle
Q❑	DN 500	Flange and nozzle
Y9	Special version	

40 — Pressure rating

C	PN 10	(for DN 50...DN 300)
B	PN 10	(for DN 350...DN 500)
D	PN 16	(for DN 50...DN 300)
E	PN 16	(for DN 350...DN 500)
G	PN 25	(for DN 50...DN 300)
N	PN 25	(for DN 350...DN 500)
L	PN 40	(for DN 50...DN 300)
m	PN 40	(for DN 350...DN 500)
P	PN 64	(for DN 50...DN 300)
R	PN 64	(for DN 350...DN 500)
Y	Special version	

50 — Connection of pressure taps

1	1/2 NPT male (not with steam)
2	Pipe without thread, diameter 12 mm (not with steam)
3	G 1/2, shape V to DIN ISO 19207 (without flange pair)
4	Welded connection 21.3 x 6.3
9	Special version

60 — Adjustment Deltabar S

F	Flow values, square root
P	Differential pressure values, linear
S	Adjustment 0..100%, square root
T	Adjustment 0..100%, linear
Y	Special version

DPO 52E — **Complete product designation**

Deltaset DPO 52A
Odering information for orifice flange
ANSI

10	**Application: pipe orientation**									
	C	Gas flow; horizontal pipe orientation								
	B	Gas flow; verticals pipe orientation								
	C	Liquid flow; horizontal pipe orientation								
	D	Liquid flow; vertical pipe orientation								
	E	Steam; horizontal pipe, mounting left								
	F	Steam; horizontal pipe, mounting right								
	G	Steam; vertical pipe, flow upwards								
	N	Steam; vertical pipe, flow downwards								
	Y	Special version								
20		**Approval**								
		1	Without special approvals							
		2	Material approval to 3.1B, EN 10204							
		3	Free from oil and grease							
		9	Special version							
30			**Nominal diameter pipe, material** Letter = nominal diameter / Numeral = material							Example G2: DN 125, Material SS 316Ti 1 Material C22.8 2 Material SS 316TI
			C❑	DN 2"	Flange and nozzle					
			D❑	DN 2 1/2"	Flange and nozzle					
			E❑	DN 3"	Flange and nozzle					
			F❑	DN 4"	Flange and nozzle					
			G❑	DN 5"	Flange and nozzle					
			H❑	DN 6"	Flange and nozzle					
			K❑	DN 8"	Flange and nozzle					
			L❑	DN 10"	Flange and nozzle					
			M❑	DN 12"	Flange and nozzle					
			N❑	DN 14"	Flange and nozzle					
			P❑	DN 16"	Flange and nozzle					
			Q❑	DN 20"	Flange and nozzle					
			R❑	DN 24"	Flange and nozzle					
			Y9	Special version						
40					**Pressure rating**					
					C	300 lbs	(for DN 2"...DN 12")			
					D	300 lbs	(for DN 14"...DN 24")			
					E	600 lbs	(for DN 2"...DN 12")			
					F	600 lbs	(for DN 14"...DN 24")			
					Y	Special version				
50						**Connection of pressure taps**				
						1	1/2 NPT male (not with steam)			
						2	Pipe without thread, diameter 12 mm (not with steam)			
						3	G 1/2", shape V to DIN ISO 19207 (without flange pair)			
						4	Welded connection 21.3 x 6.3			
						9	Special version			
60							**Adjustment Deltabar S**			
							F	Flow values, square root		
							P	Differential pressure values, linear		
							S	Adjustment 0..100%, square root		
							T	Adjustment 0..100%, linear		
							Y	Special version		
DPO 52A								**Complete product designation**		

Deltaset DPO 53
Orifice plate

Primary device to DIN 19206. Orifice plate made of SS 316TI. For D-D/2 pressure tapping or flange tapping. The Deltabar S differential pressure transmitter is ordered separately and comes optimised and set.

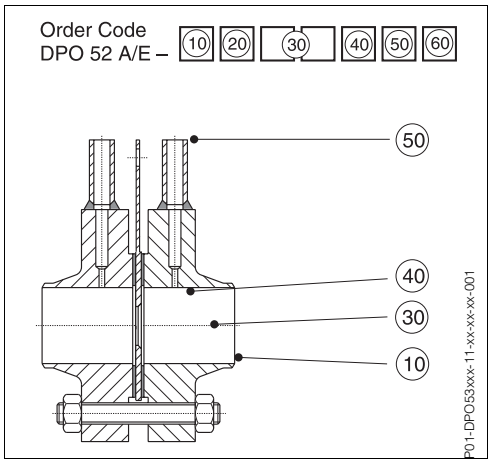
For the required Ordering Information - see also pp. 56:

10 Approval
With or without special approvals

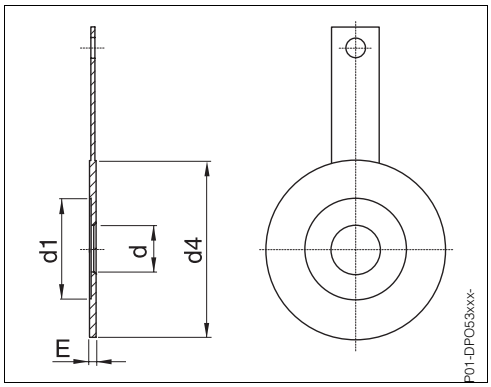
20 DN nominal diameter

30 Pressure rating

40 Adjustment Deltabar S
Flow, differential pressure or percentage display



Dimensioned drawing
For dimensions table, see page 45



Deltaset DPO 53E Ordering information for orifice plate DIN

10		**Approval**
	1	Without special approvals
	2	Material approval to 3.1B, EN 10204
	3	Free from oil and grease
	9	Special version

20			**Nominal diameter DN**
	C	DN 50	L DN 350
	B	DN 65	m DN 400
	C	DN 80	N DN 500
	D	DN 100	P DN 600
	E	DN 125	Q DN 700
	F	DN 150	R DN 800
	G	DN 200	S DN 900
	N	DN 250	T DN 1000
	K	DN 300	
	Y	Special version	

30		**Pressure rating**
	C	PN 10
	B	PN 16
	C	PN 25
	D	PN 40
	E	PN 64
	F	PN 100
	G	PN 160
	Y	Special version

40		**Adjustment Deltabar S**
	F	Flow values, square root
	P	Differential pressure values, linear
	S	Adjustment 0..100%, square root
	T	Adjustment 0..100%, linear
	Y	Special version

DPO 53E	**Complete product designation**

Deltaset DPO 53A, Ordering information for orifice plate ANSI

10		**Approval**
	1	Without special approvals
	2	Material approval to 3.1B, EN 10204
	3	Free from oil and grease
	9	Special version

20			**Nominal diameter DN**
	C	DN 2"	L DN 14"
	B	DN 2 1/2"	m DN 16"
	C	DN 3"	N DN 20"
	D	DN 4"	P DN 24"
	E	DN 5"	Q DN28"
	F	DN 6"	R DN 32"
	G	DN 8"	S DN 36"
	N	DN 10"	T DN 40"
	K	DN 12"	
	Y	Special version	

30		**Pressure rating**
	C	150 lbs
	B	300 lbs
	C	600 lbs
	Y	Special version

40		**Adjustment Deltabar S**
	F	Flow values, square root
	P	Differential pressure values, linear
	S	Adjustment 0..100%, square root
	T	Adjustment 0..100%, linear
	Y	Special version

DPO 53A	**Complete product designation**

Deltaset DPP 50
Pitot tube

The specially ordered shut-off valves DPV 50 or or condensat chambers DPC 50 are supplied premounted. The Deltabar S differential pressure transmitter is optimised and set.

For the required Ordering Information - see also page 60:

10 Applikation, medium and pipe orientation
Horizontal or vertical

20 Approval
With or without special approvals

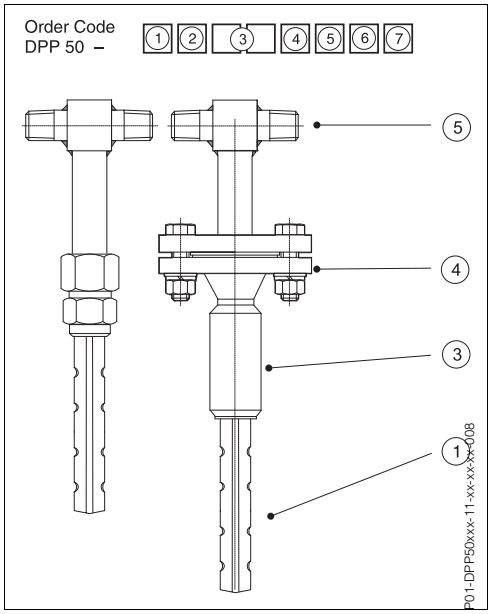
30 Nominal diameter DN and material of the welding socket

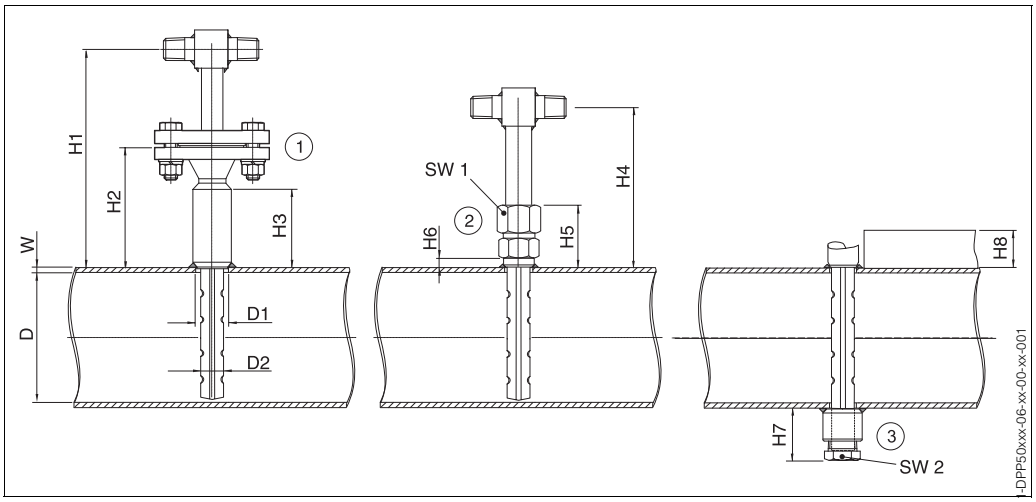
40 Probe installation

50 Connection of pressure taps

60 Integrated temperature sensor (as option)

70 Adjustment Deltabar S
Flow, differential pressure or percentage display





① *Flange*
② *Cutting ring: max. temperature 200 °C, for steam 200 °C/16 bar*
③ *Pitot tubes from DN 700 generally with steady, optionally for smaller nominal diameters (e.g. for large flow velocities)*
D *Pipe inner diameter*
D1 *Mounting drillhole* *D2* *Probe profile*
H1 *Distance to tapping nozzle* *H2* *Distance to mounting flange*
H3/H6 *With insulated pipes, this minimum dimension must be increase by the insulation thickness H8 (this is also valid for H1/H2 and H4/H5)*
H7 *Height of the steady* *H8* *High insulation*
W *Pipe wall thickness* *SW* *Across flats*

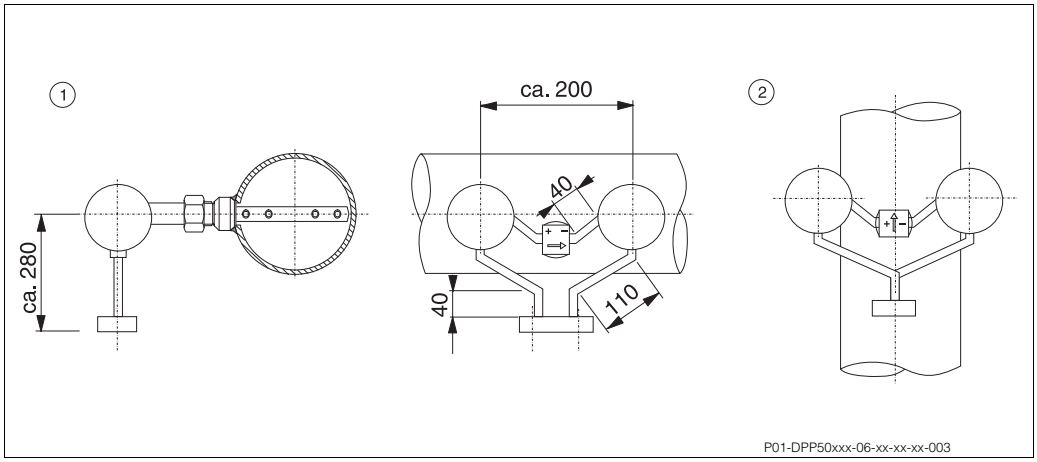
	Mounting drill hoe	Probe profile	Flange ①			Cutting ring ②				Steady	
	D1	D2	H1	H2	H3	H4	H5	H6	SW1	H7	SW2
DN 65/DN 80	16	12	180	80	50 *	130	48	10 *	27	40	22
DN ≥ DN 100	35	25	227	127	90 *	148	68	15 *	45	55	36

Tab. 29: Dimensions of Pitot tube DPP 50, all dimensions in mm

- With the Pitot tube, the flow direction from DN 50 is insignificant, as the probe has a symmetrical construction.
- Material of probe profile: rust-proof steel SS 316TI

	Pipe DN 65/DN 80	**Pipe ≥ DN 100**
Flange PN 40	Flange DN 25	Flange DN 32
Flange PN 100	Flange DN 25	Flange DN 40
Flange PN 160	Flange DN 25	Flange DN 40
Flange PN 300 lbs	Flansch DN 1"	Flansch DN 1 1/4"
Flange PN 600 lbs	Flansch DN 1"	Flansch DN 1 1/4"
Flange PN 1500 lbs	Flansch DN 1"	Flansch DN 1 1/4"

Tab. 30: Nominal diameter of flanges for Pitot tube DPP 50 (see ① at figure above)

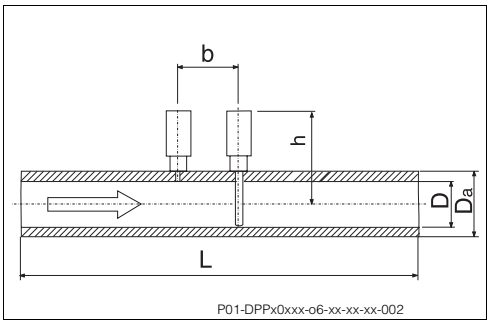


Dimensioned drawings:
Pitot tubes for steam (with two condensat chambers)
① Horizontal piping
② Vertical piping

Pipe installation

Special version for small pipe diameters

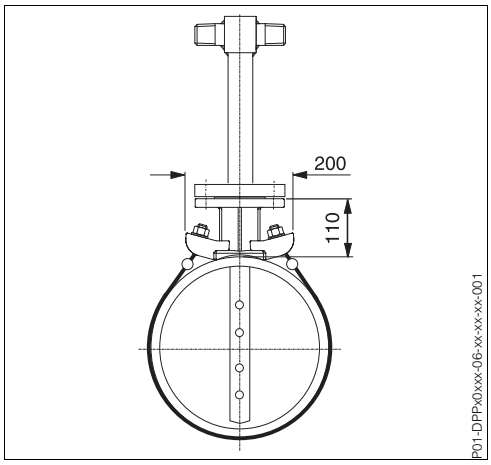
DN 25...DN 50
Welded connection
Max. temperature 200 °C, for steam 300 °C



	Pipe length L	**Height or tapping nozzle h**	**Spacing of tapping nozzle b**	**Internal diameter D**	**External diameter Da**
DN 25	250	33	54	29.7	33.7
DN 40	400	26	54	43.1	48.2
DN 50	500	30	54	54.5	60.3

Saddle flange
The saddle flange allows the Pitot tube to be mounted on pipes (nominal diameter DN 65...DN 500), upon which it is not possible to weld a cutting ring screw union or a flange (e.g. with cast or concrete pipes).

- Saddle flange
  Material: GGG-40/EWS coated
  Dimensions: see Fig., 90 mm wide
  Flange loss: DN 40/50, PN 4 for gas, PN 16 for water
  Saddle seal: NBR
  Weight: 5.5 kg
- Holding bracketFrom rust-proof steel, fully-vulcanised,
  70 mm wide



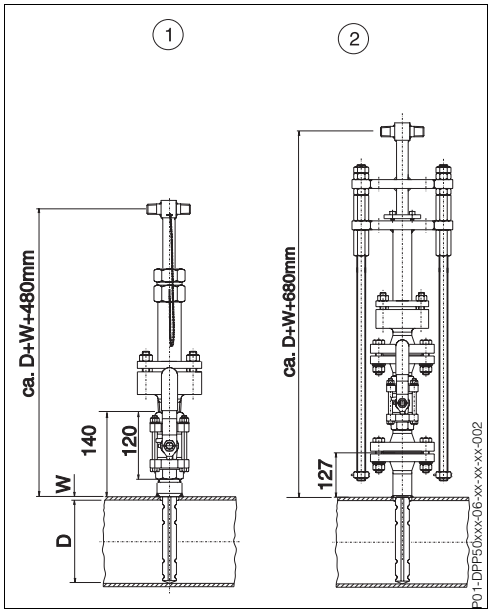
Flow tap
The Pitot tube can be replaced during operation.

D Internal diameter of piping
W Wall thickness of pipe;
From DN 700 with steady 1NPT,
Depth 51 mm

Max. temperature 300 °C, for steam 350 °C

① Flow tap with fixing chain
Distance from pipe - manifold (if probe removed from pipe): D + W + 480 mm
Distance from pipe - manifold (if probe removed from pipe): 2D + 2W + 480 mm

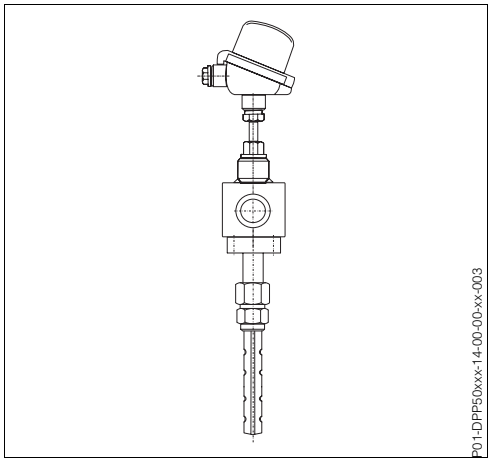
② Flow tap with spindle
Distance from pipe - manifold (if probe in pipe): D + W + 680 mm
Distance from pipe - manifold (if probe removed from pipe): 2D + 2W + 680 mm



Temperature sensor
To determine the medium temperature, with Pitot tubes from DN 100 there is optionally an integrated temperature measurement:

❑ With Pt100 temperature sensor
❑ With 4...20 mA temperature sensor

You can find additional information on the temperature sensor on page 23.



Deltaset DPP 50 Ordering Information for Pitot tube

10 — Application: Pipe orientation

C	Gas flow; horizontal pipe orientation
B	Gas flow; verticals pipe orientation
C	Liquid flow; horizontal pipe orientation
D	Liquid flow; vertical pipe orientation
K	Steam flow; horizontal pipe (version with condensat chambers)
L	Steam flow; vertical pipe, flow upwards (version with condensat chambers)
Q	Steam flow; vertical pipe, flow downwards (version with condensat chambers)
m	Flue gas flow, horizontal pipe with rinse connection
N	Flue gas flow, vertical pipe with rinse connection (Y = special version)

20 — Approval

1	Without special approvals
2	Material approval to 3.1B, EN 10204
3	Free from oil and grease (9 = special version)

30 — Nominal diameter pipe, material of welding socket (flange) Example G2: DN 125, Material SS 316Ti

Letter = nominal diameter / Numeral = material

A❑	DN 25	1"		with pipe (250 mm)	1 Material C22.8
B❑	DN 40	1 1/2"		with pipe (400 mm)	2 Material SS 316TI
C❑	DN 50	2"		with pipe (500 mm)	
D❑	DN 65	2 1/2"			
E❑	DN 80	3"			
F❑	DN 100	4"			
G❑	DN 125	5"			
H❑	DN 150	6"			
K❑	DN 200	8"			
L❑	DN 250	10"			
M❑	DN 300	12"			
N❑	DN 350	14"			
P❑	DN 400	16"			
Q❑	DN 500	20"			
R❑	DN 600	24"			
S❑	DN 700	28"		with end support	
T❑	DN 800	32"		with end support	
U❑	DN 900	36"		with end support	
V❑	DN 1000	40"		with end support	
W❑	DN 1200	48"		with end support	
W3	DN 1500	60"	C 22.8	with end support	
W4	DN 1500	60"	SS 316Ti	with end support	
X❑	DN 1800	72"		with end support	
X3	DN 2000	80"	C 22.8	with end support	
X4	DN 2000	80"	SS 316Ti	with end support	(Y = Special version)9

40 — Pizot tube installation

C	Cutting ring	PN 40
B	Flange DIN 2527	PN 40
C	Flange DIN 2527	PN 100
D	Flange DIN 2527	PN 160
E	Flange ANSI B16.5	300 lbs
F	Flange ANSI B16.5	600 lbs
G	Flange ANSI B16.5	1500 lbs
N	Flow tap with spindle	
I	Flow tap with fixing chain	
K	Pipe installation with welded connection, PN 100	
L	Saddle flange for non-weldable pipes	
Y	Special version	

50 — Connection of pressure taps

1	1/2 NPT male (not with steam)
2	Pipe without thread, diameter 12 mm (not with steam)
3	G 1/2", shape V to DIN ISO 19207 (without flange pair)
4	Welded connection 21.3 x 6.3 (9 = special version)

60 — Integrated temperature sensor

1	Without temperature sensor
2	With integrated Pt100 temperature sensor
3	With integrated 4...20 mA temperature sensor (Y = Special version)

70 — Adjustment Deltabar S

F	Flow values, square root
P	Differential pressure values, linear
S	Adjustment 0..100%, square root
T	Adjustment 0..100%, linear (Y = Special version)

DPP 50- — **Complete product designation**

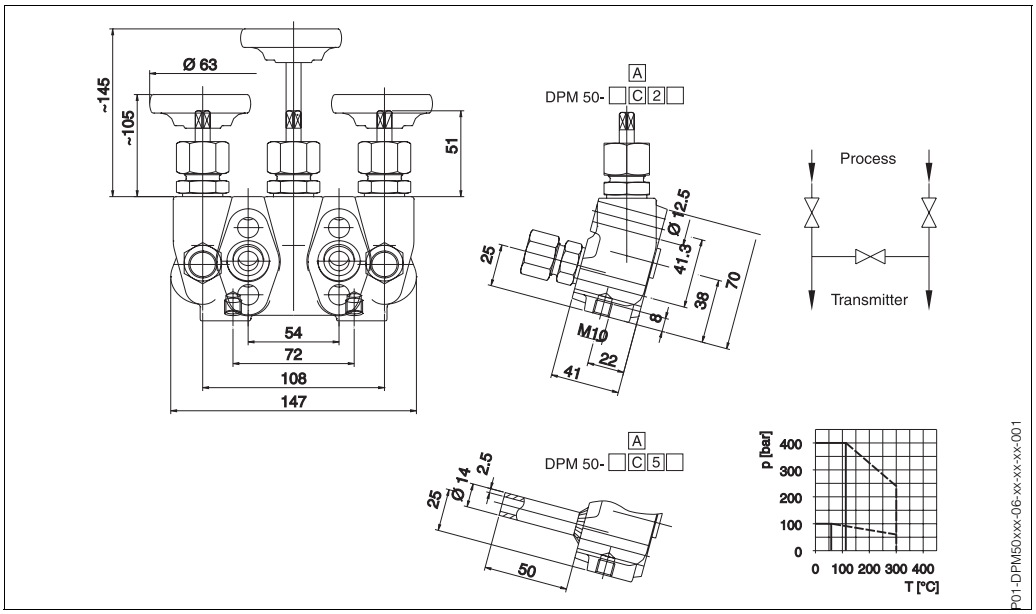
Components

Manifold
Deltaset DPM 50

The manifold is primarily used to connect the impulse pipes to the differential pressure transmitter Deltabar S. If both of the main taps are closed, the differential pressure transmitter can be removed from the measuring device.
With a three route manifold, there is a third manifold available for zero point adjustment between the impulse pipes.
The five route manifold offers the additional possibility of ventilating or emptying the impulse pipes without the need to remove the measuring device. Two additional shut-off or vent manifolds at the differential pressure transmitter can serve the same purpose. If being used with steam, it is preferably that you use a 5-valve manifold.

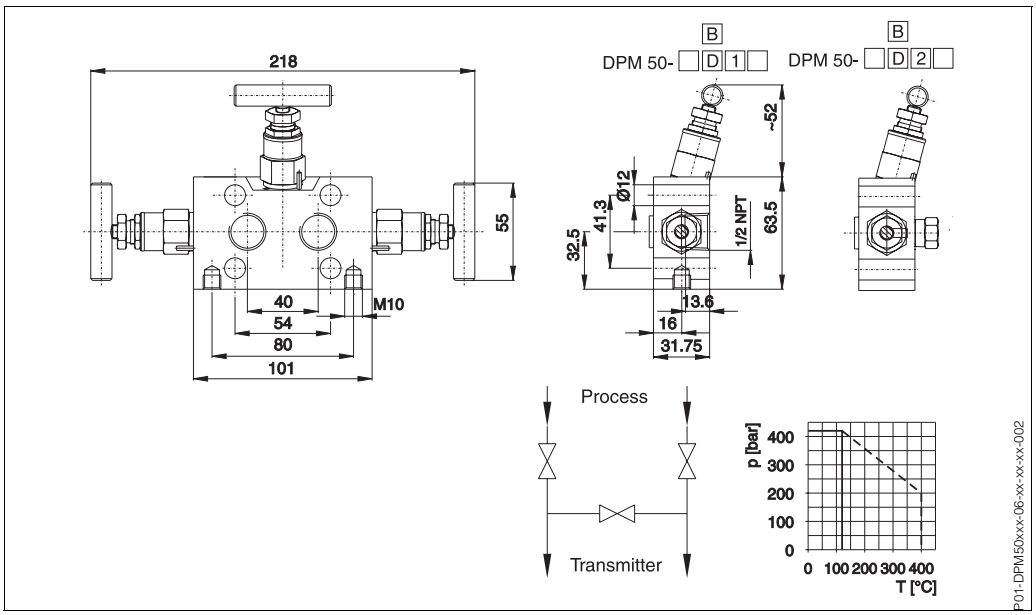
3-valve manifold, forged part with handwheel

PN 100/PN 400, manifold directly flangeable to DIN IEC65B/333/CDV
Variants: see ordering information on page 63

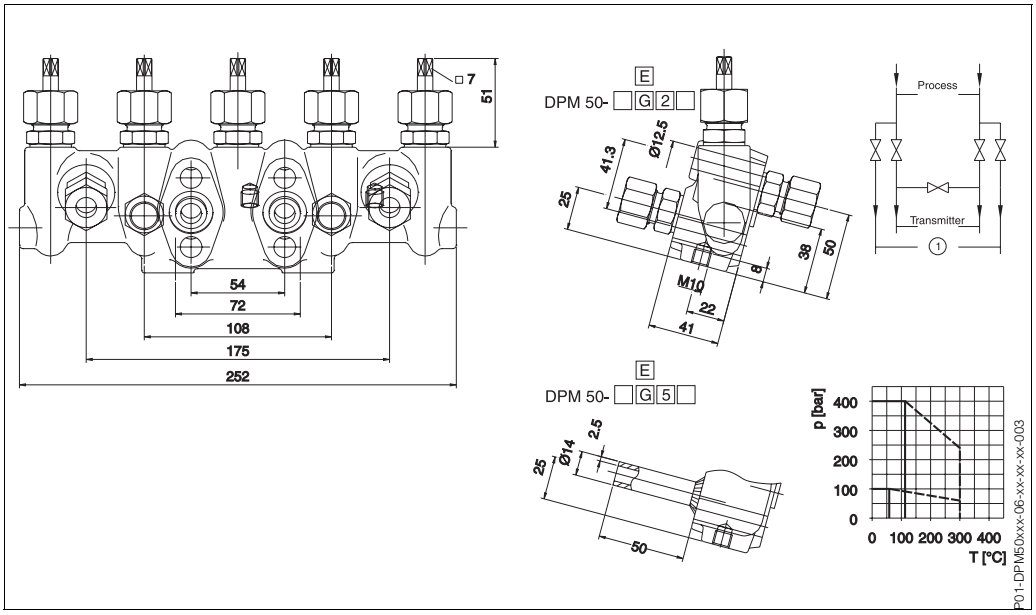


3-valve manifold, milled with hand knob

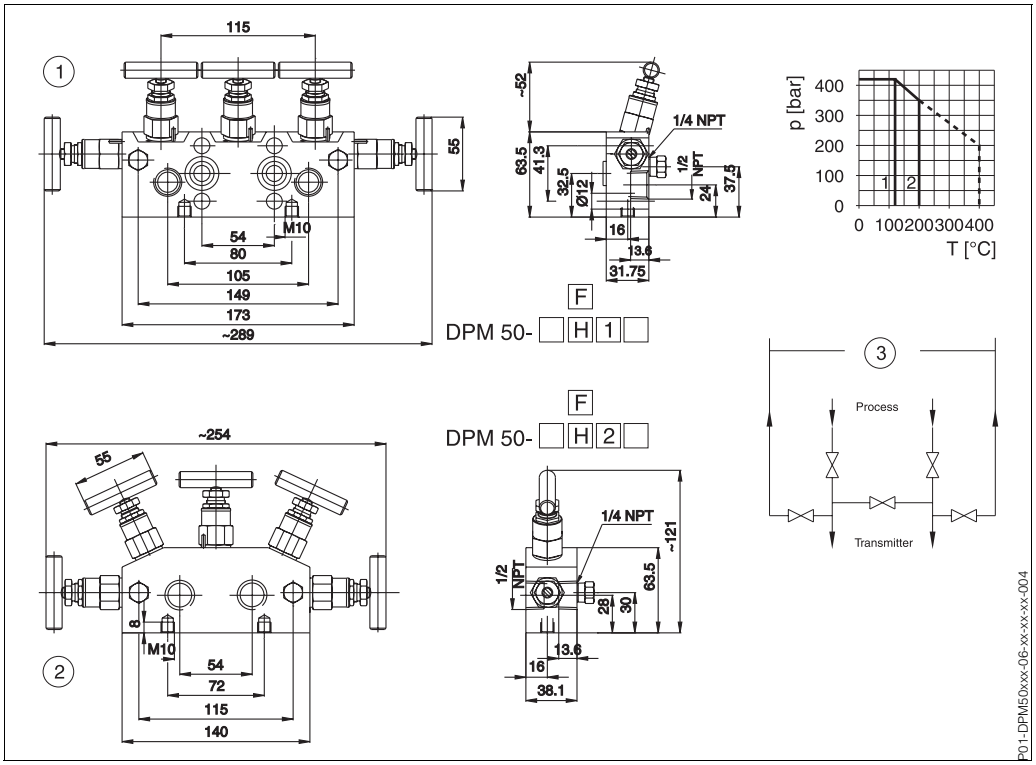
PN 420, manifold directly flangeable to DIN IEC65B/333/CDV
Variants: see ordering information on page 63



5-valve manifold
Forged part with square
PN 100/PN 400
Manifold directly flangeable to DIN IEC65B/333/CDV
Versions: see ordering information on page 63
① Blow-out (wiring scheme)



5-valve manifold
milled with hand knob
PN 100/PN 400
Versions: see ordering information on page 63
① Installation in the impulse pipes
② Directly flangeable to DIN IEC65B/333/CDV
③ Venting/Testing (wiring scheme)



Deltaset DPM 50 Ordering Information for manifold

10		**Approval**						
		1	Without special approvals					
		2	Material approval to 3.1B, EN 10204					
		3	Free from oil and grease (only for stainless steel version)					
		9	Special version					
20		**Manifold type, material**						
		C	3-valve	C 22.8	Forging, with hand wheel key			
		B	3-valve	C 22.8	Milled with hand lever			
		C	3-valve	SS 316Ti	Forging, with with hand wheel key			
		D	3-valve	SS 316Ti	Milled with hand lever			
		E	5-valve	C 22.8	Forging, with square			
		F	5-valve	C 22.8	Milled with hand lever			
		G	5-valve	SS 316Ti	Forging, with square			
		N	5-valve	SS 316Ti	Milled with hand lever			
		Y	Special version					
30			**Connection to process (impuls pipe connection)**					
			1	Connection 1/2" NPT female (only manifolds of type B, D, F, H)				
			2	Connection cutting ring Ermeto 12S				
			5	Welded connection 14 x 2.5 (only manifolds of type A, E, C, G)				
			9	Special version				
40				**Manifold seals/screws**				
				3	Viton seal/screws M10, max. PN 160			
				4	Viton seal/screws M12, max. PN 400			
				5	Viton seal/screws 7/6 UNF, max. PN 400			
				6	PTFE seal/screws M10, max. PN 100			
				7	PTFE seal/screws 7/6 UNF, max. PN 100			
				9	Special version			
DPM 50-					**Complete product designation**			

Shut-off valves Deltaset DPV 50

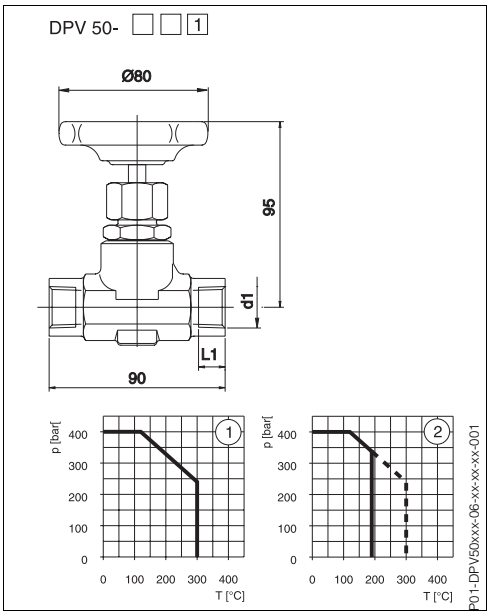
As two (or four) shut-off valves are required for a Deltaset measuring point, DPV 50 always comprises a pair comprising two shut-off valves.

Closing the shut-off valves isolates the impulse pipes including the manifold and transmitter from the process for cleaning and repair purposes.

Basically with primary devices, two shut-off valves are required for process isolation. With certain applications it is recommended that you install two additional shut-off valves in the impulse pipes. They allow venting of ingressed gas or the blowing-out of collected condensate without the need to interrupt measurement or even production. The alternative to this is a 5 route manifold.

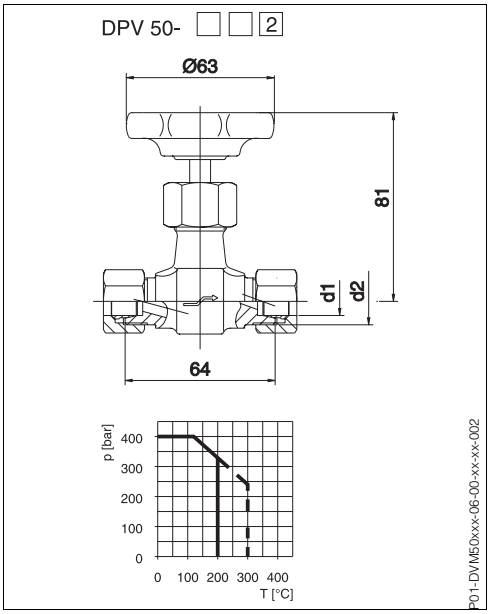
Shut-off valve sleeve/sleeve PN 400, DN 10
Input: 1/2 NPT innen
Output: 1/2 NPT female

d1: 1/2 NPT
L1: 13,6 mm
①: Steel, pure graphite packingt
②: Stainless steel, PTFE packing



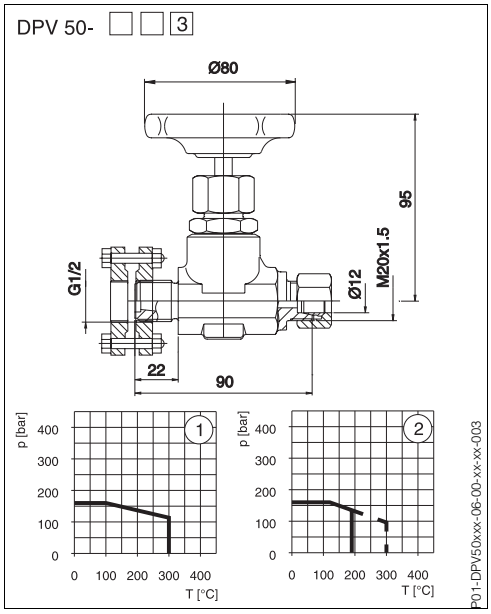
Shut-off valve cutting ring PN 400
Input: Cutting ring screw union
Output: cutting ring screw union

d1: 12 mm Ermeto 12S)
d2: Connection thread M 20x 1.5



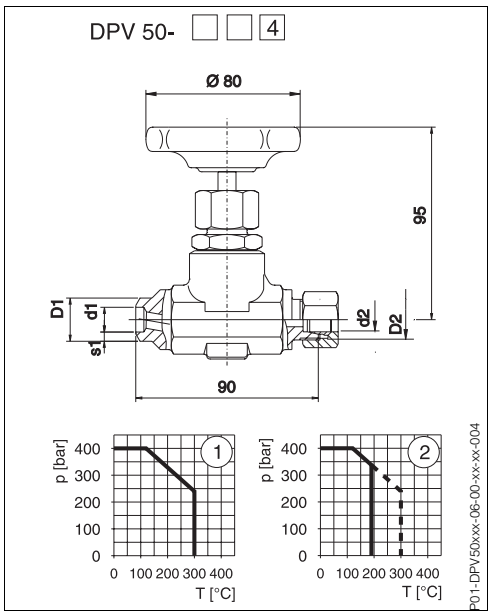
Shut-off valve flange/cutting ring
PN 160, DN 8, DIN 19208
Input: flange
Output: cutting ring screw union

①: Steel, pure graphite packing
②: Stainless steel, PTFE packing



Shut-off valve welded connection/cutting ring
PN 400, DN 8
Input: welded connection
Output: cutting ring screw union

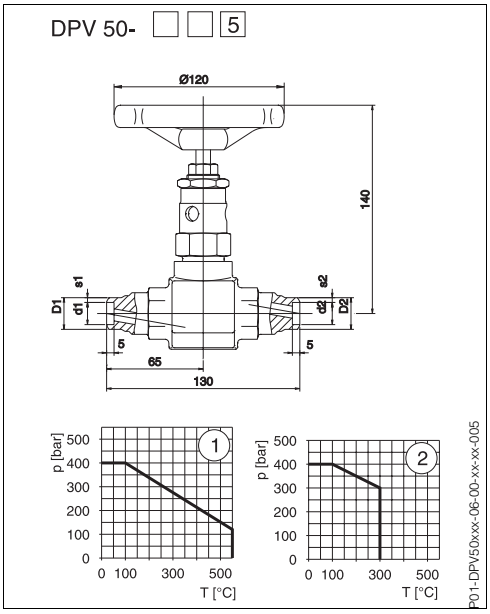
D1: 21.3 mm
d1: 12.2 mm
D2: M 20 x 1.5
d2: 12 mm
s1: 7.1 mm
①: Steel, pure graphite packing
②: Stainless steel, PTFE packing



Shut-off valve welded connection/welded connection
PN 320...PN 500, DN 8
Input: welded connection
Output: welded connection

D1: 21.3 mmS
1: 3.2 mmD
2: 14.0 mmS
2: 2.5 mm

①: 15Mo3 (1.5415), pure graphite packing
②: Stainless steel, PTFE packing

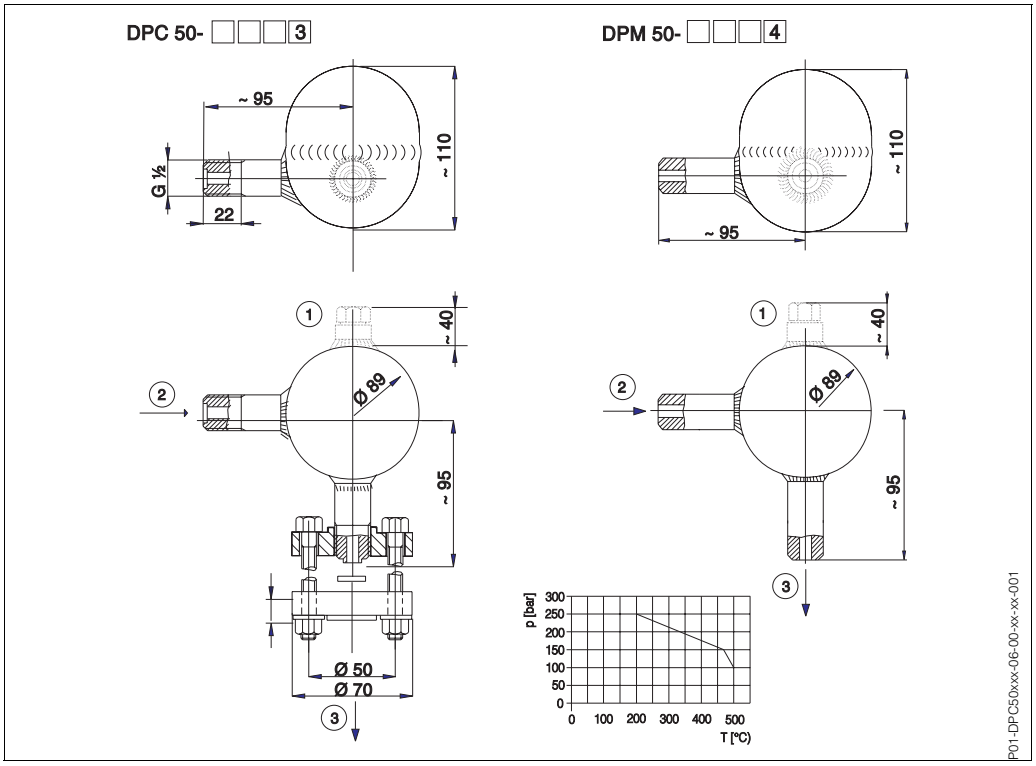


Deltaset DPV 50 Ordering Information for 2 valves

10						**Approval**
					1	Without special approvals
					2	Material approval to 3.1B, EN 10204
					3	Free from oil and grease (only for stainless steel version)
					4	Material approval to 3.1A, EN 10204
					9	Special version
20						**Valve material**
					1	C22.8 (for connection types 1,2,3)
					2	SS 316TI (for connection types 1...4)
					3	15Mo3/1.5415 (for connection type 5)
					Y	Special version
30						**Connection process side/Connection Deltabar side**
					1	Connection 1/2" NPT female, PN 400, input + output
					2	Connection of cutting ring Ermeto 12S, PN 400, input + output
					3	G 1/2" with flange pair, output of cutting ring Ermeto 12S, PN 160
					4	Welded connection 21.3 x 6.3; output of cutting ring Ermeto 12S, PN 400; SS 316TI
					5	Welded connection 21.3 x 6.3; output of welded connection 14 x 2.5; 1.5415
					9	Special version
DPV 50-						**Complete product designation**

Condensat chambers Deltaset DPC 50

As two condensat chambers are required for a Deltaset measuring point with steam applications, DPC 50 always comprises a pair comprising two condensat chambers.



① *Filling nozzle, 1/2" NPT (optional)*
② *From differential pressure transducer*
③ *To differential pressure transmitter*

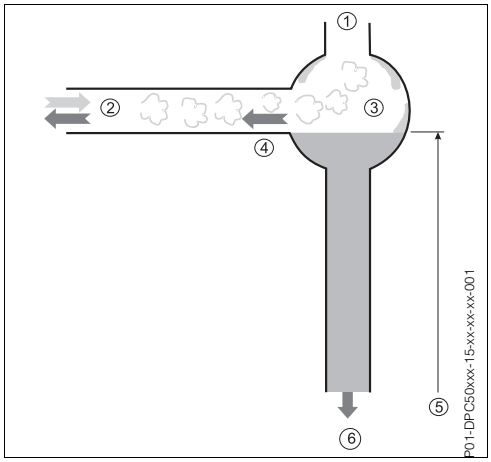
DPC 50-❑❑❑3
Condensate trap with connection G 1/2 (DIN 19207, shape V for ③ or shape R for ②) and one flange pair (DIN 19207 with sealing ring and four screws M10x45)

DPC 50-❑❑❑4
Condensate vessel with welded connection 21.3 x 6.3

Functioning principle of the condensat chambers:

Mount both condensat chambers at the same height to obtain the same distance to the differential pressure.

① Fill the water column using the filling nozzle and then close the nozzle
② Steam enters
③ Condensate runs into water column
④ Condensate flows back
⑤ Constant water column to Δp transmitter
⑥ To manifold and Deltabar S



Deltaset DPC 50 Ordering Information for 2 condensate chambers

10		**Approval**				
		C	Without special approvals			
		B	Material approval to 3.1B, EN 10204			
		C	Free from oil and grease (only for stainless steel version)			
		D	Material approval to 3.1A, EN 10204			
		Y	Special version			
20			**Filling cap**			
			1	With filling nozzle		
			2	Without filling nozzle		
			Y	Special version		
30				**Material, filling volume, PN**		
				C	Material HII/C22.8; 300 cm^3; PN 100	
				B	Material SS 316TI; 300 cm^3; PN 100	
				C	Material 15M03; 300 cm^3; PN 250	
				Y	Special version	
40					**Connection** (inlet = outlet)	
					3	Connection G 1/2", one flange pair
					4	Welded connection 21.3 x 6.3
					9	Special version
DPC 50-						**Complete product designation**

Supplementary documentation

System information	Deltatop / DeltasetSI 039P/00/en
Technical Information	Deltabar S differential pressure transmitter PMD 230 / 235 TI 256P/01/en Temperature head transmitter iTEMP PCP TMT 181 TI 070R/09/en Flow computer Compart DXF TI 032D/06/en
Operating instructions	Deltabar S differential pressure transmitter BA 174P/01/en

Flow data specification

Instructions of completion For ordering purposes, it is necessary to specify your operating data, as they are the basis for the customer-specific and optimised design of the measuring device.

Process data	Description of specification	Example
Primary device	Type of primary device, orifice plate or Pitot tube.	Orifice with corner taps DPO 10
Medium	Type of medium, with chemical formula if known. For mixtures with mixture ratio.	Air
Flow + unit	Maximum flow value with flow unit	3000 m^3/h
Pressure + unit + pressure type	Specification of operating pressure for calculation of primary device. Maximum value important for checking of application limits of the selected device, but not absolutely essential. Unit of operating pressure, absolute or relative pressure values.	2 bar abs.
Temperature + unit	Specification of operating temperature for calculation of primary device. The selected material and design type of Deltatop and Deltaset limit the maximum possible temperature. Temperature unit.	20 °C
Standard/ operating density + unit	Density specification on required for special media (for the calculation of primary device), as data available for media listed in Applicator of version 8.02 or higher. Always state density with unit.	1.293 kg/m^3
Viscosity	State viscosity under operating conditions. This is particularly important when calculating the primary device for oils. Each primary device has application limits relating to viscosity. Specify in µPas or in m^2/s.	100x10^3 µPas
Pipe: dimensions	*Pipe internal diameter:* Specifying the nominal pipe diameter (DN) is insufficient as the pipe internal diameter can vary strongly depending on the wall thickness, for DN 50 e.g. between 48 ... 52 mm. The internal diameter is decisive for the correct calculation of the differential pressure transmitter. *Wall thickness:* Specification only required for Pitot tubes. *Insulation thickness:* This defines the length of the differential pressure transducer neck piece (standard 120 mm).	51 mm 3 mm 150 mm
Pipe: material	Specification of pipe material for estimation of flow behaviour (friction, thermal expansion coefficient) and weldability.	SS 316Ti
Additional gas data	*Isentropic exponent:* Specify for special gases; it is typically between 1.2 ...1.4. *Compressibility factor:* Used to calculate the change in density of gases (relating to their change between operating and standard conditions). The dimensionless compressibility lies typically between 0.95 ... 1.01. *Relative humidity:* Also required for the adjustment of density to the operating values. Need only be taken into account at higher relative humidities (greater than 70%).	None
Optimisation criteria	With orifice plate systems, Endress + Hauser offers the optimisation of the flow rate measuring system. It can be optimised to minimum pressure loss, max. dynamics or standard calculation (optimisation to both criteria). The measuring sensor ideally suitable to the differential pressure calculation is selected (and in so doing also the ideal transmitter measuring range).	Standard

Tab. 31: Ordering specifications for the design of Deltatop and Deltaset

Flow data sheet

The data in bold type are particularly necessary for the design of the measurement section.

Please complete the fields carefully to make sure that Deltatop or Deltaset exactly fulfils the requirements of your process.

Flow Data

When ordering DELTATOP or DELTASET

All information asked for in bold type is required for designing the measurement section!

Customer . . . . . .

Reference No. . . . . . *Measuring point No.* . . . . . .

Primary device . . . . . .

Medium	. . . . . **Gas**	. . . . . **Steam**	. . . . . **Liquid**	
Flow + Unit	. . . . . *Minimum*	. . . . . **Maximum = Full scale value**	. . . . . **Unit**	
Pressure + Unit	. . . . . **Operating**	. . . . . *Maximum*	. . . . . **Unit**	☐ **rel.** ☐ **abs.**
Temperature + Unit	. . . . . **Operating**	. . . . . *Maximum*	. . . . . **Unit**	
Standard/Operating density + unit		. . . . .	. . . . . *Unit*	
Viscosity	. . . . . *µPas*	*or*	. . . . . *m²/s*	

Pipe Dimensions	. . . . . *Internal diameter*	. . . . . *Wall thickness*	. . . . . *Insulation thickness*	. . . . . *Unit*
Pipe Material	. . . . .			

For gas mixtures only

Other gas specifications	. . . . . *Isentropic index*	. . . . . *Compressibility factor*
Relative humidity	. . . . . *% r.h.*	

Optimisation criterium (optional, for orifice plates only) (cross one box only)

☐ *Minimum pressure loss and high dP accuracy (standard)*

☐ *Maximum dynamics (low β)*

☐ *Lowest remaining pressure loss (high β)*

Specify measuring range for the optional temperature transmitter

.....°C 4 mA *..... °C 20 mA*

P01-DPxxxxxx-16-xx-xx-en-001

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