Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Technical Information

Deltatop
DO71W, DO74P, DO75F

Differential pressure flow measurement with orifices and Deltabar differential pressure transmitter
The universal measuring system for steam, gases and liquids

Application

- Flow measurement of gases, steam and liquids
- nominal diameters from 1/2" (DN15) to 40" (DN1000)
- Medium temperatures -328 °F (-200 °C) to 1830 °F (1000 °C)
- Pressure up to 6300 psi (420 bar)
- NACE compliant materials

Deltabar differential pressure transmitter

- Approvals for hazardous area: FM, CSA, ATEX
- Relevant safety aspects: SIL
- Connection to all common process control systems: HART, PROFIBUS PA, FOUNDATION Fieldbus

Your benefits

- Selectable according to the application:
  - Operational compact version: minimizes installation costs
  - Modular remote version: for demanding process conditions (high temperature, high pressure) and difficult installation conditions
- Optimized for minimum pressure loss, highest accuracy and maximum measuring dynamics
- Measuring range of the Deltabar differential pressure transmitter adjusted on delivery
- Measurement method globally standardized according to ASME MFC-3M-2004 and ISO 5167
- Optional symmetric orifice for bidirectional measurements
- Robust design; no moving parts

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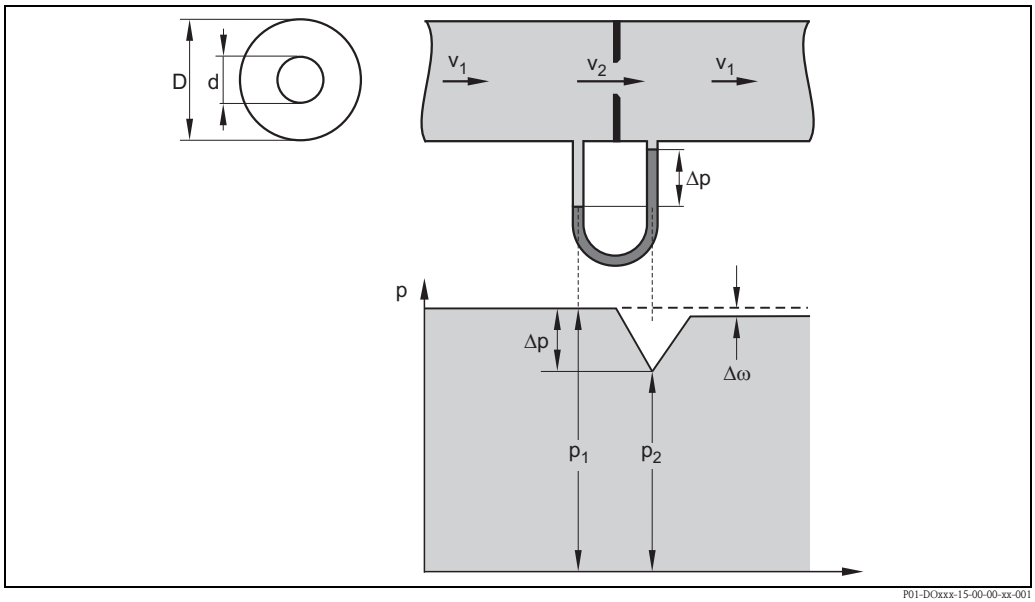
Endress+Hauser
People for Process Automation

Table of Contents

Function and system design

Measuring principle



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Within the orifice the flow velocity is larger than in the rest of the tube. According to the Bernoulli equation this results in a reduction of the static pressure. The pressure difference between the static pressures upstream and downstream of the orifice plate is measured by a differential pressure transmitter.
The value of the differential pressure is very much depending on the diameter ratio (β) of the internal diameter of the orifice bore (d) to the internal diameter of the pipe (D):

$\beta = d/D$

Orifice plates and other similar devices are also designated as primary elements.
The relationship between flow rate (Q) and differential pressure (Δp) is a square root function.

$Q \sim \sqrt{\Delta p}$

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Behind the orifice the pressure recovers partly to its original value. There is a remaining **pressure loss $\Delta\omega$**.

Differential pressure flow measurement with orifice plates (and other types of restrictions) is standardized by ASME MFC-3M-2004 and ISO 5167. This refers to the geometries, system configurations and to the rules of measured value calculation.

Sizing and optimization

The relationship between differential pressure, permanent pressure loss, flow rate and the diameter ratio β as well as the dependencies on further parameters are described in detail by the international standard ASME MFC-3M-2004 and ISO 5167.
Endress+Hauser executes all orifice calculations according to ASME MFC-3M-2004 and ISO 5167-2 based on the application specific process parameters given by the user. Therefore a questionnaire (sizing sheet – data sheet , → 📄 50) should be completed for each measuring point. All primary elements (orifice) will be delivered by Endress+Hauser with an enclosed calculation sheet. This provides the benefit to the user not to be involved in the complicated sizing calculations anymore.
An orifice measurement can be sized with different diameter ratios β. By changing β the measuring point can be optimized to a wide variety of different applications. Endress+Hauser optimizes each measuring point according to one of the following optimization criteria which can be chosen by the user.

- **Optimized by Endress+Hauser**
  Endress+Hauser completely calculates and optimizes the measuring point in consideration of the given process parameters. The optimum solution provides the best achievable compromise between differential pressure, measuring cell selecetion, measurement dynamics, measurement uncertainty and permanent pressure loss.
- **Maximum measurement dynamics (small β)**
  Endress+Hauser calculates and optimizes the measuring point to the smallest reasonably achievable diameter ratio β in order to provide maximum measurement dynamics and minimum measurement uncertainty.
- **Low permanent pressure loss (large β)**
  Endress+Hauser calculates and optimizes the measuring point to the largest reasonably achievable diameter ratio β in order to keep the permanent pressure loss as low as possible.
- **Maximum allowable permanent pressure loss**
  Endress+Hauser calculates the measuring point in consideration of the maximum allowable pressure loss at the layout point (maximum flow rate).
- **Fixed diameter ratio β**
  The sizing has to be executed with a user defined diameter ratio β. Endress+Hauser calculates the measuring point accordingly.
- **Fixed differntial pressure**
  The sizing has to be executed with a user defined differential pressure. Endress+Hauser calculates the primary element in order to meet the requested differential pressure at the layout point.
- **Fixed sizing calculation**
  A complete sizing calculation already exists. Endress+Hauser verifies the calculation and manufactures the primary element according to the given sizing calculation.

Selection and sizing tool "Applicator"

Endress+Hauser's Applicator software is a convenient selection and sizing tool for planning process (for details see the booklet IN013F). The Applicator program is available free of charge either in the form of a CD or can be downloaded from the Internet at:
http://www.products.endress.com/applicator

Applicator Sizing Flow

The "Applicator Sizing Flow" module calculates all necessary data for the selected primary device:

- Differential pressure
- Pressure loss
- Measuring uncertainty
- k-factor
- Upstream and downstream straight lengths
- Pressure ratings
- Medium parameters

Additional options

- Sizing sheet – Data sheet
- Sizing sheet – Calculation sheet
- Determination of the mounting position

Sizing sheet – Data sheet

To ensure that the Deltatop measuring point exactly matches the requirements of the process, the completed Sizing sheet – Data sheet (→ 50) has to be attached to the order.
Endress+Hauser uses the data of this form to determine the optimum configuration of the measuring point.
The Sizing sheet – Data sheet can be generated by the "Applicator" selection and sizing tool.

Selecting the differential pressure transmitter and the measuring cell

If they are ordered together with the primary element, it is possible to order the Deltabar differential pressure transmitter with a suitable measuring cell and calibration even without knowing the complete calculation data. Endress+Hauser will select the most suitable measuring cell based on the calculation results for the primary element. The differential pressure transmitter will be delivered completely configured and preadjusted to the calculated values. This allows easy and convenient ordering and commissioning of the measuring point even for less experienced users.

Deltabar S PMD70/PMD75

Feature of the product structure	Option to be selected
40: "Nominal Range; PN"	Depending on working pressure PN: ■ 78: "Prepared for Deltatop; PN = 2321 psi (160 bar)" ■ 88: "Prepared for Deltatop; PN = 6092 psi (420 bar)" (only available for PMD75)
50: "Calibration; Unit"	8: "Adjusted for Deltatop"

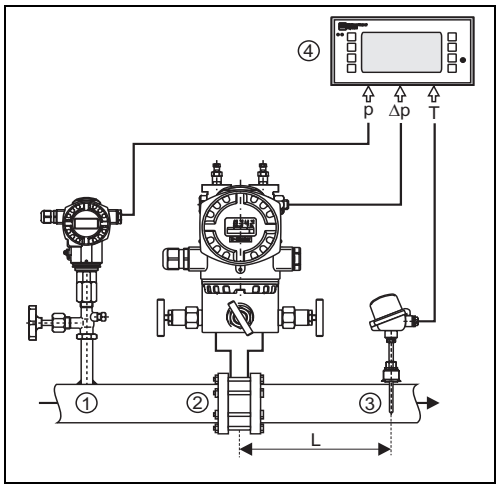
Deltabar M PMD55

Feature of the product structure	Option to be selected
070: "Sensor Nominal Value"	88: "Prepared for Deltatop"
090: "Calibration; Unit"	8: "Adjusted for Deltatop"

Temperature and pressure compensation

Separate process connections
Two additional probes are required for temperature and pressure compensation:

- **An absolute pressure sensor**
  This probe must be mounted on the upstream side of the orifice.
- **A temperature probe**
  In order to avoid disturbances of the flow profile, this probe must be mounted on the downstream side of the orifice. In doing so, the minimum downstream length L has to be observed (→ 🖹 14).



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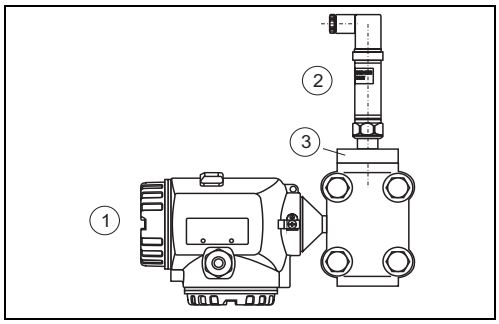
1: *Absolute pressure sensor*
2: *orifice and differential pressure transmitter*
3: *temperature probe*
4: *evaluation unit*

Combined process connection for absolute and differential pressure
An adapter (e.g., → 🖹 49, "oval flange adapter PZO") can be used to screw a pressure transmitter or a pressure transducer into the Deltabar flange. The absolute pressure transmitter must be mounted at the "+" side of the Deltabar.



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1: *Deltabar*
2: *Transmitter for absolute pressure*

Calculation of the compensated volume or mass flow

- **For steam:**
  Flow and Energy Manager RMS621 for water and steam from Endress+Hauser;
  for details see Technical Information TI092R/09/EN.
- **For all media:**
  Universal Flow and Energy Manager RMC621 for gases, liquids and steam from Endress+Hauser;
  for details see Technical Information TI098R/09/EN.
- **For all media:**
  by a PLC;
  In this case the compensation calculation has to be programmed by the user.

Calculation formula for the temperature and pressure compensation

At first the starting point for the compensation has to be defined. The starting point is the calculation sheet, which accompanies every primary element. On the calculation sheet, layout data can be found for a specific operating condition (pressure and temperature).

The relationship between flow and differential pressure is described by a square root function:

$Q_m = \sqrt{2\ \Delta p\ \rho}$ for the mass flow (or volume flow at normal or standard conditions)

and

$Q_v = \sqrt{\frac{2\ \Delta p}{\rho}}$ for the volume flow

where
ρ = the density of the medium.

If the current output of the Deltabar transmitter is set to flow values, the square root function is already implemented. Otherwise the square root function must be computed externally, e.g. in a PLC. Please make sure that the square root function is not applied twice.

Whenever the real operating conditions differ from the conditions used in the calculation sheet, the density of the gas will change and thus also the calculated flow rate will change according to the above-mentioned formula.

$$\rho_2 = \rho_1 \frac{P_2}{P_1} \frac{T_1}{T_2} \frac{Z_1}{Z_2}$$

where
P = absolute pressure
T = absolute temperature (K)
Z = compressibility factor
1 = operating condition according to the calculation sheet
2 = actually measured operating condition

The compensation can now be computed as follows:

$$Q_2 = Q_1 \sqrt{\frac{P_2}{P_1} \frac{T_1}{T_2} \frac{Z_1}{Z_2}}$$ for the mass flow (or volume flow at standard conditions)

$$Q_2 = Q_1 \sqrt{\frac{P_1}{P_2} \frac{T_2}{T_1} \frac{Z_2}{Z_1}}$$ for the volume flow

The compressibility factor Z can be neglected if tis value is close to 1. If the compressibility factor is to be included in the compensation, the value must be determined according to the actually measured pressure and temperature. Compressibility factors are available in the corresponding literature in tables or graphs or can be calculated, e.g. using the Soave-Redlich-Kwong procedure.

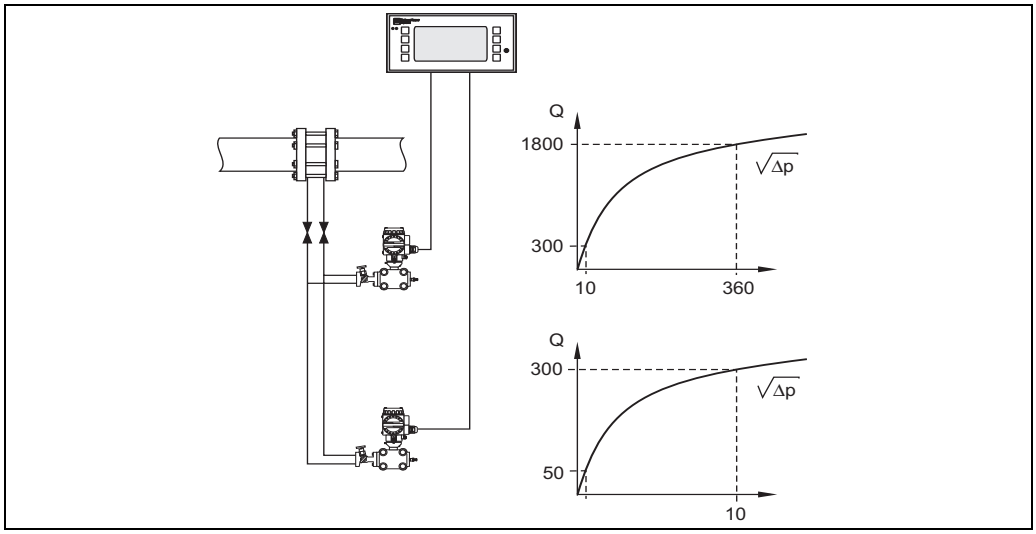
Split range (expansion of the measuring range)

The square root function has a very steep slope in the vicinity of the zero point. Therefore the measuring range is limited from below, which results in an operable flow range of typically 6:1 (max. 12:1).
If the differential pressure is high enough, it is possible to increase the range by connecting multiple differential pressure transmitter with different measuring ranges.
The following Endress+Hauser instrument can be used to evaluate thte measuring signals simultaneously:

- Flow and Energy Manager RMS621 for water and steam (TI092R/09/EN)
- Universal Flow and Energy Manager RMC621 for gases, liquids and steam (TI098R/09/EN)

Note!
- The maximum available operable flow range depends on the differential pressure available.
- The same method can be used to implement redundant measurements.

Example



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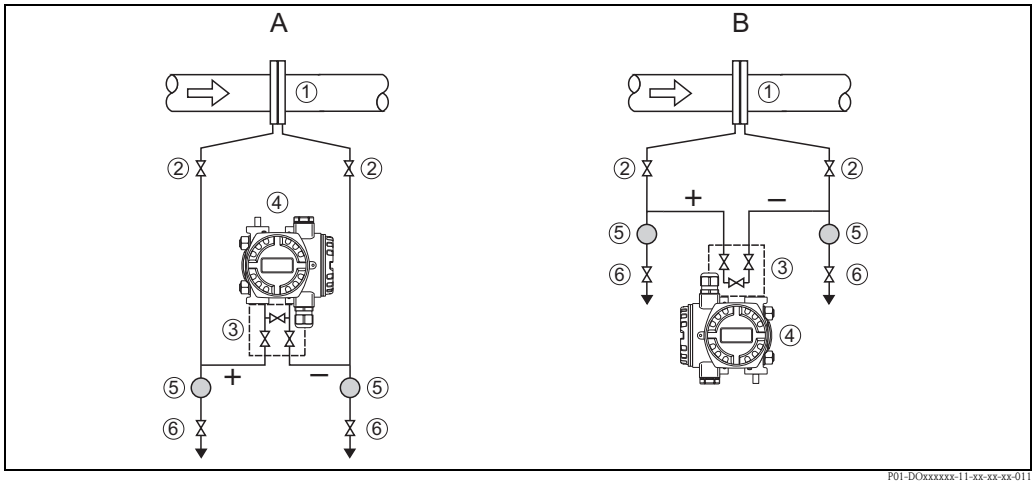
Flow measurements in liquids

With liquid applications, the transmitter must be mounted below the pipe. All impulse pipes must be installed with a slope of at least 1:15 to the process connection – coming from the transmitter. This ensures that trapped air and bubbles rise back to the process pipe and thus do not influence the measurement.

Note!
When measuring in fluids with solid content, such as dirty liquids, installing separators (5) and drain valves (6) is useful for capturing and removing sediment.

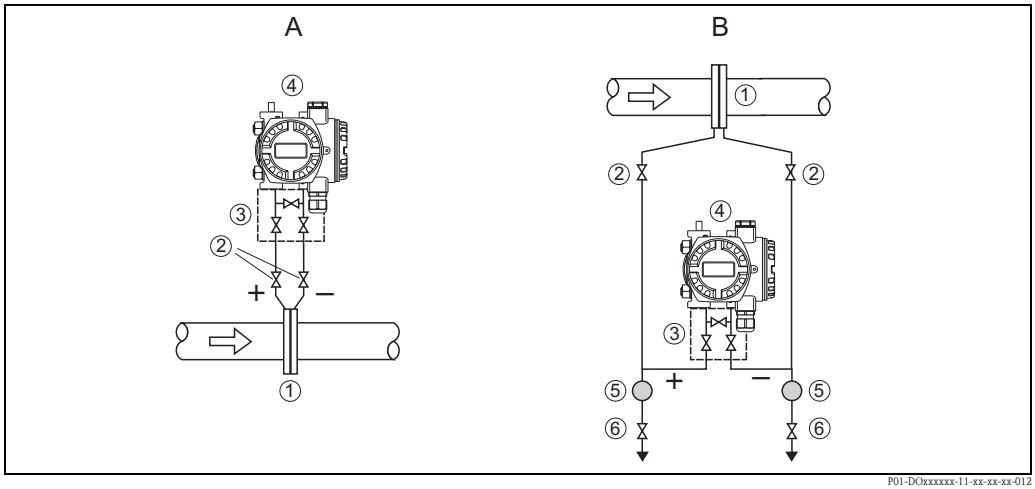


A: *Configuration requires venting of the transmitter* **B:** *Configuration*
1: *Orifice plate* **2:** *Shut-off valves* **3:** *Valve manifold* **4:** *Differential pressure transmitter Deltabar*
5: *Separator (optional)* [1] **6:** *Drain valve (optional)* [1]

Flow measurement in gases

With gas applications, the transmitter must be mounted above the pipe. All impulse pipes must be installed with a slope of at least 1:15 to the process connection – coming from the transmitter. This ensures that any condensate flows back into the process pipe and thus does not influence the measurement.

Note!
When measuring in humid gases, installation of condensate separators (5) and drain valves (6) is useful for capturing and removing condensate.



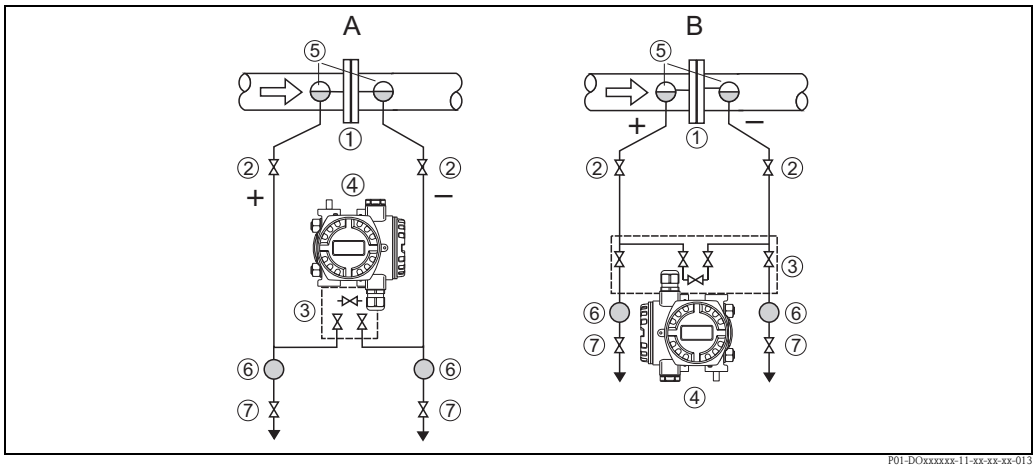
A: *Preferred configuration*
B: *Alternative configuration (if the transmitter can not be mounted above the pipe)*
1: *Orifice plate* **2:** *Shut-off valves* **3:** *Valve manifold* **4:** *Differential pressure transmitter Deltabar*
5: *Separator (optional)* [1] **6:** *Drain valves*

1) e.g. contaminated media.

Flow measurement in steam

With steam applications, there is the possibility to do the mounting with or without condensate pots. If the choice is made to do without condensate pots see flow measurement in liquids.
When the choice is made to do with condensate pots then the two condensate pots must be mounted on the same level. The transmitter must be located below the pipe. The pipes between the transmitter and the condensate pots must be completely filled with water on both sides.
A 5-valve manifold allows simple piping and can be used instead of T-sections and additional blow-out-valves. The impulse pipes must be installed with a slope of at least 1:15 to reliably ensure rising of trapped air in the water of the impulse line to the transmitter. It is recommended to use welded connections for steam applications, behind the condensate pots continue with ½" NPT threat.

Note!
When measuring in steam, installing separators (5) and drain valves (7) is useful for capturing and removing dirt.



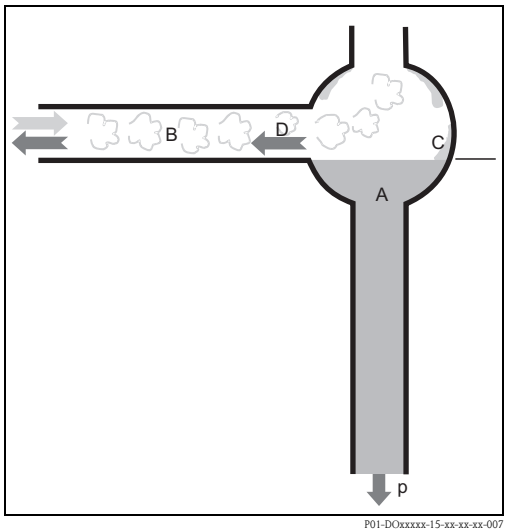
A: *with 3-valve manifold; for easy venting of the transmitter; especially for small differential pressures*
B: *with 5-valve manifold for blowing out the impulse pipes*
1: *Orifice plate* **2:** *Shut-off valves* **3:** *Valve manifold* **4:** *Differential pressure tranmsitter Deltabar* **5:** *Condensate chambers* **6:** *Separator (optional)* **7:** *Drain valves (optional)*

Function of the condensate chambers

The condensate chambers make sure that the impulse lines are alwas completely filled with water and that the membrane of the transmitter is not exposed to hot steam. The water level is maintained by condensing steam. Excess condensate flows back and is re-evaporated.
Using the condensate chambers considerably reduces fluctuations of the water column. The stabilized measuring signal and the increased zero point stability ensure a consistent measuring quality.
The water column transfers the pressure to the transmitter membrane.

Operating conditions

- Both condensate chambers must be mounted at the same level.
- Both condensate chambers must be completely filled before commissioning.



A: *water* **B:** *steam* **C:** *condensing steam*
D: *excess condensate flows back*

Mounting positions

Versions

Compact version

With the compact version of the Deltatop, the orifice, the manifold and the transmitter are delivered readily mounted. Additional piping and additional valves are not required. Thus, leakage problems are eliminated.

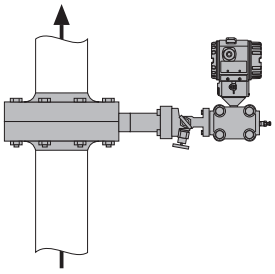
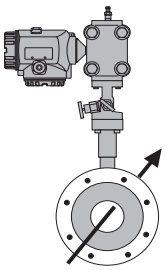
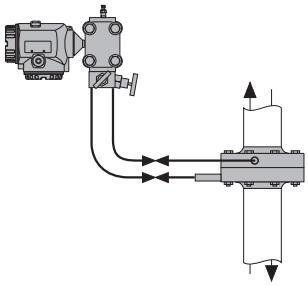
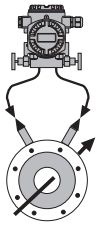
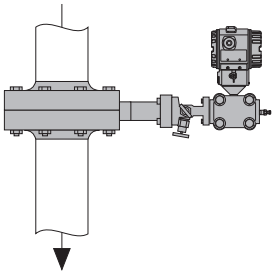
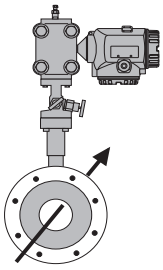
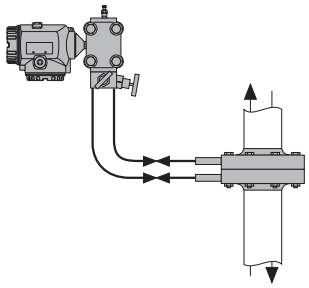
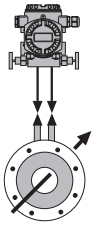
Remote version

With the remote version of the Deltatop, the orifice, the manifolds, the shut-off valves and the transmitter are delivered separately and must be mounted on-site. This version is recommended:
- for high process temperatures which impede a direct mounting of the transmitte.
- if due to shortage of space the transmitter can not be mounted directly at the orifice.

Flow direction

- The flow direction is marked by an arrow on the holding ring (DO75F) or by a labelling of the handle for orifice plates (DO74P) and measuring flanges (DO71W). The labelling is always located on the upstream side of the orifice (+).
- "Mounting left" and "Mounting right" refer to the flow direction.
  For compact instruments, which are mounted from above or from below, the instrument is shipped in a way that the transmitter is mounted at the left or right side, respectively (with respect to the flow direction).
  For steam versions, which are mounted laterally, the condensate chambers and the transmitter are mounted on the left or right side, respectively (with respect to the flow direction).
- For compact versions the transmitter is always mounted in a way such that the display can be read in the specified mounting position and needs not to be rotated.

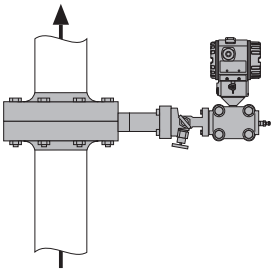
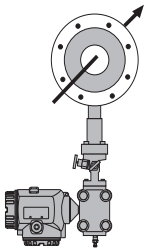
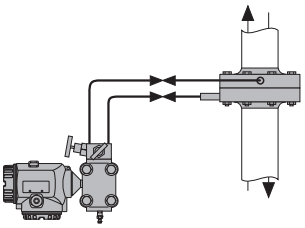
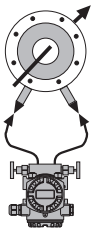
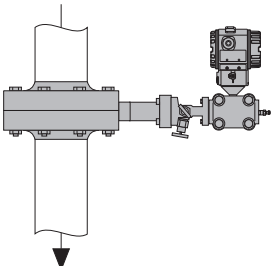
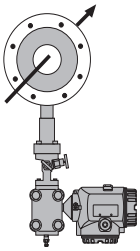
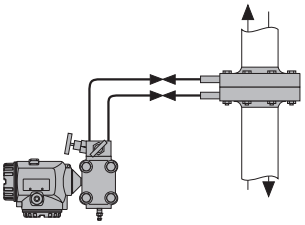
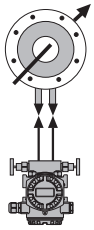
Gas measurements

compact; vertical[1)]	compact; horizontal[2)]	remote; vertical	remote, horizontal
flow upwards DO7xxxx-CM...  P01-DO71Wxxx-11-00-00-xx-001	mounting left DO7xxxx-CB...  P01-DO61Wxxx-11-00-00-xx-007	taps 90° DO7xxxx-BT...  P01-DO71Wxxx-11-00-00-xx-003	tap angle according to DIN DO7xxxx-BF...  P01-DO61Wxxx-11-00-00-xx-019
flow downwards DO7xxxx-CP...  P01-DO71Wxxx-11-00-00-xx-002	mounting right DO7xxxx-CC...  P01-DO61Wxxx-11-00-00-xx-008	taps 0° DO7xxxx-BS...  P01-DO71Wxxx-11-00-00-xx-004	taps 0° DO7xxxx-BE  P01-DO61Wxxx-11-00-00-xx-020

1) recommended housing version for the Deltabar S: T14 (for use of the Deltabar Display)

2) recommended housing version for the Deltabar S: T15 (for use of the Deltabar Display)

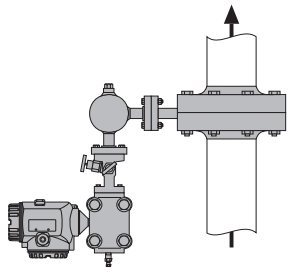
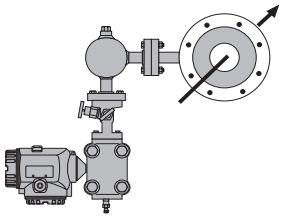
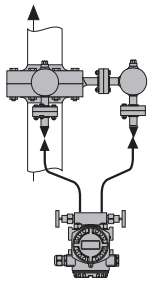
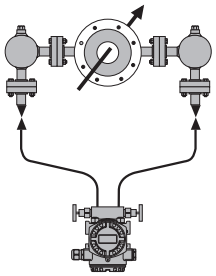
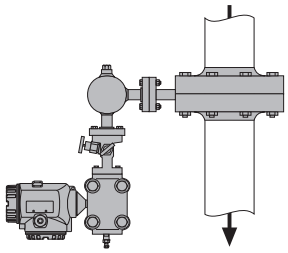
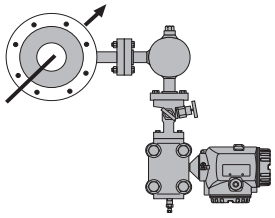
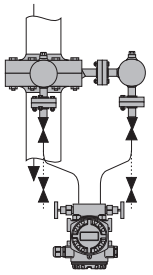
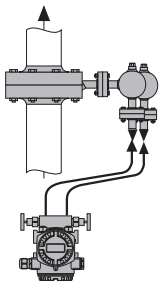
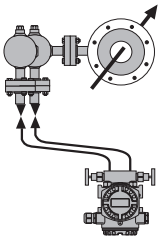
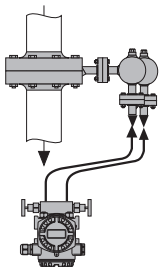
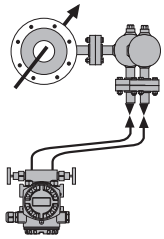
Liquid and steam measurements without condensate pots

compact; vertical[1)]	compact; horizontal[2)]	remote; vertical	remote; horizontal
flow upwards DO7xxxx-EM...  P01-DO71Wxxx-11-00-00-xx-001	mounting left DO7xxxx-EB...  P01-DO61Wxxx-11-00-00-xx-009	taps 90° DO7xxxx-DT...  P01-DO71Wxxx-11-00-00-xx-005	tap angle according to DIN DO7xxxx-DF...  P01-DO61Wxxx-11-00-00-xx-021
flow downwards DO7xxxx-EP...  P01-DO71Wxxx-11-00-00-xx-002	mounting right DO7xxxx-EC...  P01-DO61Wxxx-11-00-00-xx-010	taps 0° DO7xxxx-DS...  P01-DO71Wxxx-11-00-00-xx-006	taps 0° DO7xxxx-DE...  P01-DO61Wxxx-11-00-00-xx-022

1) recommended housing version for the Deltabar S: T14 (for use of the Deltabar Display)

2) recommended housing version for the Deltabar S: T15 (for use of the Deltabar Display)

Steam measurements with condense pots

compact; vertical[1)]	compact; horizontal[1]	remote; vertical	remote; horizontal
flow upwards DO7xxxx-GM...  P01-DO61Wxxx-11-00-00-xx-005	mounting left DO7xxxx-GB...  P01-DO61Wxxx-11-00-00-xx-011	taps 90°; flow upwards DO7xxxx-FN...  P01-DO71Wxxx-11-00-00-xx-007	taps 180° DO7xxxx-FG...  P01-DO61Wxxx-11-00-00-xx-023
flow downwards DO7xxxx-GP...  P01-DO61Wxxx-11-00-00-xx-006	mounting right DO7xxxx-GC...  P01-DO61Wxxx-11-00-00-xx-012	taps 90°; flow downwards DO7xxxx-FR...  P01-DO71Wxxx-11-00-00-xx-008	
		taps 0°, flow upwards DO7xxxx-FM...  P01-DO71Wxxx-11-00-00-xx-009	taps 0°; mounting left DO7xxxx-FB...  P01-DO61Wxxx-11-00-00-xx-024
		taps 0°; flow downwards DO7xxxx-FP...  P01-DO71Wxxx-11-00-00-xx-010	taps 0°; mounting right DO7xxxx-FC...  P01-DO61Wxxx-11-00-00-xx-025

1) recommended housing version for the Deltabar S: T15 (for use of the Deltabar Display)

Installation and process conditions

Up- and downstream lengths

In order to ensure a homogeneous flow profile it is necessary to mount the orifice in a sufficient distance to narrowings or bends of the pipe. The required upstream lengths for different types of obstacles are summarized in the following table. Detailed specifications can be obtained from ASME MFC-3M-2004 and ISO 5167.

Type of obstacle	β ≤ 0,2		β = 0,5		β = 0,75	
	A[1)]	B[2)]	A[1]	B[2]	A[1]	B[2]
Upstream length						
90° bend	6 x D	3 x D	22 x D	9 x D	44 x D	20 x D
2x90° bend[3)] in the same plane	10 x D	-	22 x D	10 x D	44 x D	22 x D
2x90° bend in perpendicular planes	19 x D	18 x D	44 x D	18 x D	44 x D	20 x D
concentric reducer	5 x D	-	8 x D	5 x D	13 x D	8 x D
concentric expander	6 x D	-	20 x D	9 x D	36 x D	18 x D
ball/gate valve, fully open	12 x D	6 x D	12 x D	6 x D	24 x D	12 x D
Downstream length						
any obstacle	4 x D	2 x D	6 x D	3 x D	8 x D	4 x D

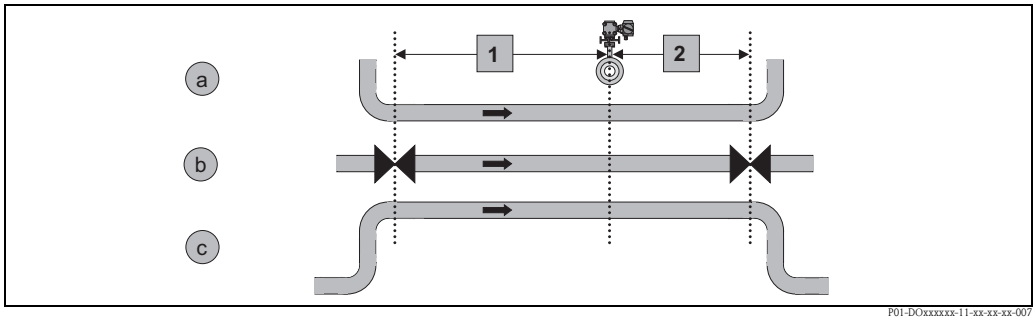
D: inner pipe diameter; β = *d/D: opening ratio (d: inner orifice diameter)*

1) For 0 % of additional uncertainty

2) For 0.5 % of additional uncertainty

3) The required lengths depend on the distance of the two elbows; typical values are given in this table. For detailed specifications refer to ASME MFC-3M part 2 and ISO 5167-2. The upstream length is also calculated by the selection and sizing tool "Applicator".

Examples (schematic)



1: *Upstream length* **2:** *Downstream length* **a:** *90° bend* **b:** *Valve, open* **c:** *2x90° bend*

Note!
- The requirements conerning the pipe as stated in ASME MFC-3M and ISO 5167 must be met (weld seams, roughness etc).
- The required upstream length can be reduced by a rectifier (→ 🖹 46). Details are specified in ASME MFC-3M appendix 1C and ISO 5167-2.

Homogeneity

The fluid must be homogeneous. **Changes of the state of aggregation** (liquid, gas, steam) are not permissible. The pipe must always be **completely filled**.

Temperature, Pressure

	Compact version	Remote version
max. temperature	■ for gases and liquids: 390 °F (200 °C) ■ for steam: 570 °F (300 °C)	■ with standard material: approx. 930 °F (500 °C) ■ with special material: approx. 1830 °F (1000 °C)
max. pressure	6000 psi (420 bar)	

Temperature and pressure may **not be subject to large fluctuations**.
If required, a **temperature and pressure compensation** must be applied for gases and steam (→ 🖹 6).

Reynolds number

A turbulent flow is required for differential pressure flow measurement. The Reynolds number Re determines whether the flow is laminar or turbulent. Re is a non-dimensional parameter which describes the dependency of the flow on the veolicty, the internal diameter of the tube as well as the medium density and viscosity.
For a reliable measurement the Reynolds number should not fall below the values given in the following table:

Type of orifice	approximate minimum Reynolds number[1)]
sharp	Re ≥ 5000
bidirectional	Re ≥ 5000
quarter circle nozzle	Re ≥ 500
conical inlet	Re ≥ 80
segmental orifice	Re ≥ 5000

1) The exact conditions depend on the type of pressure tapping and of the aperture ratio β.

Note!
The Reynolds number and the application limits are calculated by the Applicator selection and sizing tool.

Temperature limits of the materials applied

ASME/AISI/ASTM

Designation	Short designation	Material code	Max. temperature	Reference
Steels				
C-Si	A105	K03504	790 °F (425 °C)	ASME B16.5[1)]
Heat-resistant steels				
C-1/2Mo	A182 Gr. F1	K12822	860 °F (465 °C)	ASME B16.5[1)]
1 1/4Cr-1/2Mo-Si	A 182 Gr. F11 Cl.2	K11572	1090 °F (590 °C)	ASME B16.5[1)]
2 1/4Cr-1Mo	A 182 Gr. F22 Cl.3	K21590	1090 °F (590 °C)	ASME B16.5[1)]
Stainless steels				
18Cr-8Ni	A 182 Gr. F304	S30400	1000 °F (538 °C)	ASME B16.5[1)]
16Cr-12Ni-2Mo	A 182 Gr. F316	S31600	1000 °F (538 °C)	ASME B16.5[1)]
16Cr-12Ni-2Mo	A 182 Gr. F316L	S31603	840 °F (450 °C)	ASME B16.5[1)]
22Cr-5Ni-3Mo-N	A 182 Gr. F51	S31803	600 °F (315 °C)	ASME B16.5[1)]
	A 182 Gr. F904L	N08904	700 °F (375 °C)	ASME B16.5[1)]

1) Values for flanges: Maximum recommended temperature for permanent use or maximum temperature specification of the pressure-temperature ratings.

Plastics

Designation	Short designation	Max. temperature	Reference
PVC	polyvinyl chloride	up to approx.150 °F (70 °C)	manufacturer specification
PP	polypropylene	up to approx. 190 °F (90 °C)	manufacturer specification
PE	polyethylene	up to approx. 170 °F (80 °C)	manufacturer specification
PVDF	polyvinylidene fluoride	up to approx. 260 °F (130 °C)	manufacturer specification
PTFE	polytetrafluorethylene	up to approx. 300 °F (150 °C)	manufacturer specification

Other materials

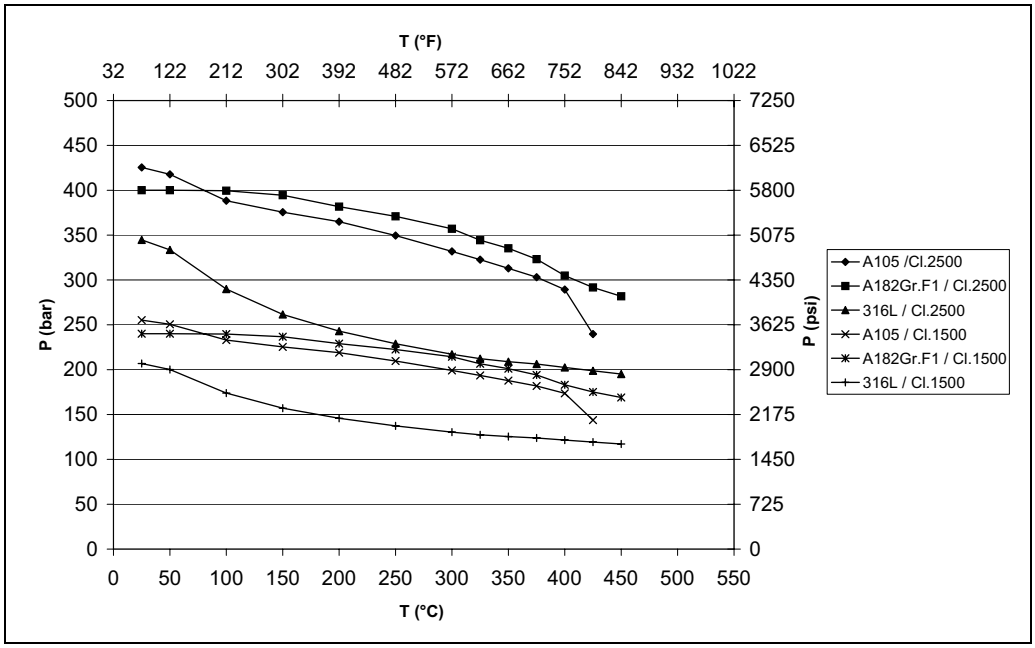
Designation	Short designation	Material code	Max. temperature	Reference
Monel 400	(S-)NiCu 30 Fe	2.4360	790 °F (425 °C)	VdTÜV material data sheet 263
Hastelloy C4	NiMo 16 Cr 16 Ti	2.4610	750 °F (400 °C)	VdTÜV material data sheet 424
Hastelloy C276	NiMo 16 Cr 15 W	2.4819	840 °F (450 °C)	VdTÜV material data sheet 400
Alloy 625	NiCr 22 Mo 9 Nb	2.4856	1650 °F (ca. 900 °C)	Key to steel[1)]
Alloy 825	NiCr 21 Mo	2.4858	840 °F (450 °C)	VdTÜV material data sheet 432

1) Values for forgings: Maximum temperature specification for fatigue strength and 1% creep limit.

Note!
All temperature specifications are only guide values. The temperature limits have to be checked for the individual case. Depending on the pressure and the medium they may strongly deviate from these values.

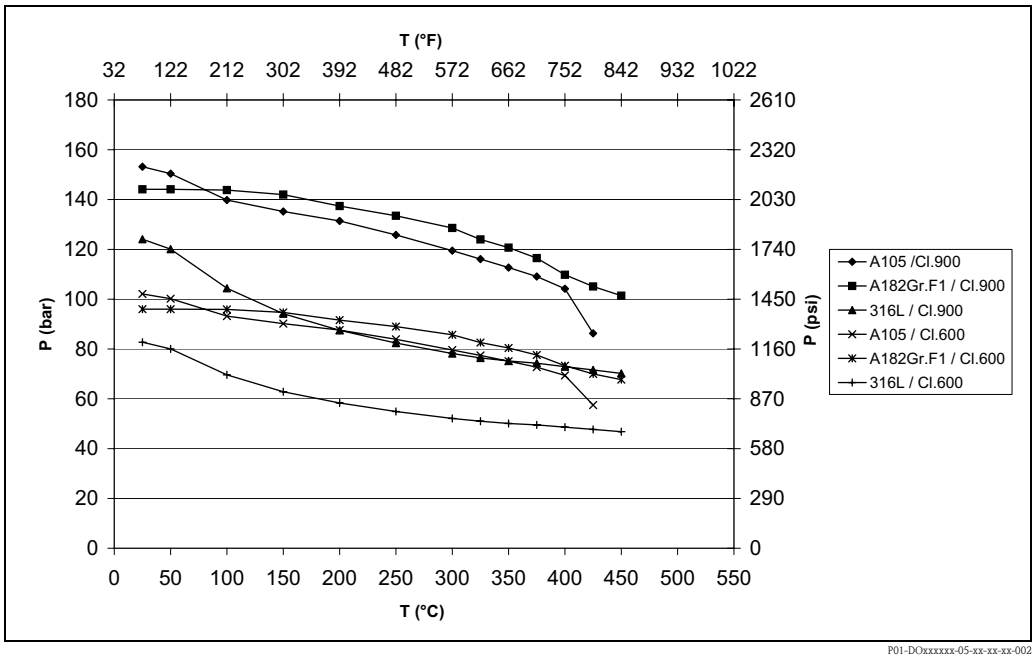
Pressure-temperature curves for flanges according to ANSI B16.5-2009

Cl. 2500 /Cl. 1500



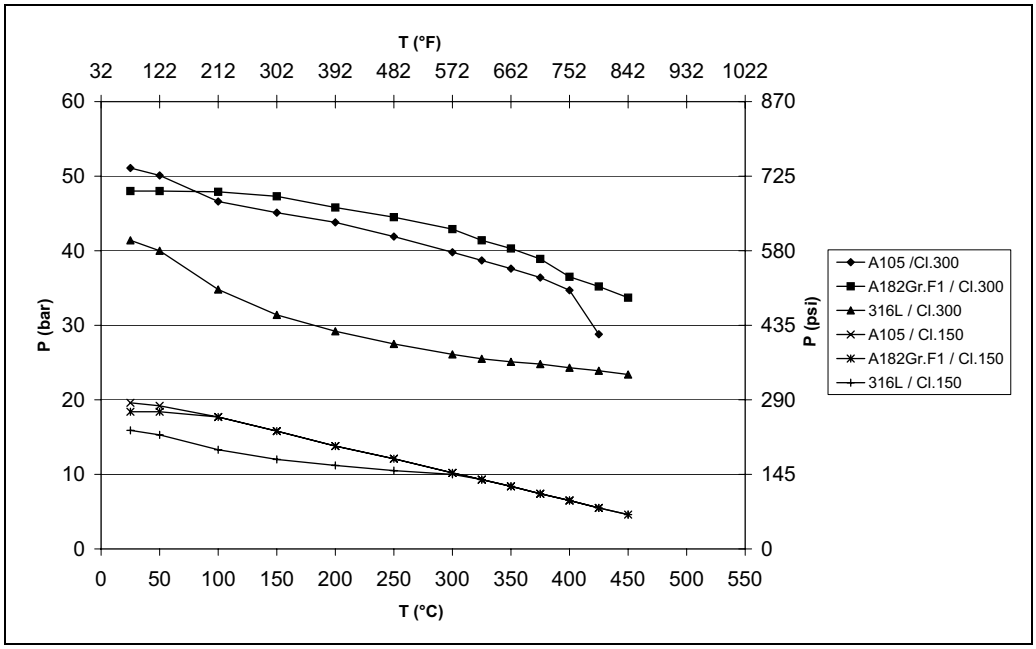
P01-DOxxxxxx-05-xx-xx-xx-003

Cl. 900 / Cl. 600



P01-DOxxxxxx-05-xx-xx-xx-002

Cl. 300 /Cl. 150



P01-DOxxxxxx-05-xx-xx-xx-001

Note!
The values for 316L refer to the 0,2 % yield strength.

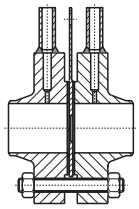
Mechanical construction

Product overview / Types of pressure tapping

The type of pressure tapping has a crucial influence on the mechanical construction of the orifice and on the mounting into the pipe. The product family Deltatop comprises all types of pressure tapping described in ASME MFC-3M and ISO 5167.

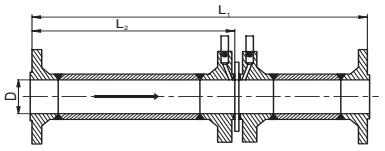
Flange tapping

The pressure is tapped at a distance of 1" (25.4 mm) before (+) and after (-) the orifice. Usually the tapping is realised by a bore through the flange.
Standardized measuring flanges are available for flange tapping (ASME B13.36 or DIN 19214). The orifice plate is exchangeable. Flange tapping is preferred wherever ASME applies.

Product	Remarks	Example
DO71W	■ Flange tapping ■ Welding neck flange for welding in into the pipe included ■ Exchangeable orifice plate	 P01-DOxxxxxx-14-xx-xx-xx-006

Corner tapping

The pressure is tapped directly before (+) and after (-) the orifice.

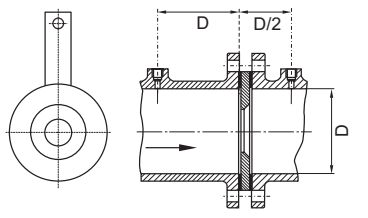
Product	Remarks	Example
DO75F	■ Upstream and downstream lengths included ■ Independent of the precise inner diameter of the pipe ■ End flanges for mounting into the pipe included ■ Wet calibration possible	 P01-DO7xxxxx-14-xx-xx-xx-001

D-D/2 tapping

The pressure is tapped in a distance of 1 D before (+) and 0.5 D after (-) the orifice. D is the inner pipe diameter. Usually the tapping is realised by a single bore in the pipe. The orifice is typically an exchangeable orifice plate. D-D/2 tapping is especially useful for later mounting of a measurement into an existing pipe.

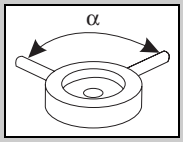
Pipe tapping

The pressure is tapped in a distance of 2.5 D before (+) and 8 D after (-) the orifice. D is the inner pipe diameter. Usually the tapping is realised by a single bore in the pipe. The orifice is an exchangeable orifice plate. With pipe tapping the differential pressure is equal to the remaining pressure loss.

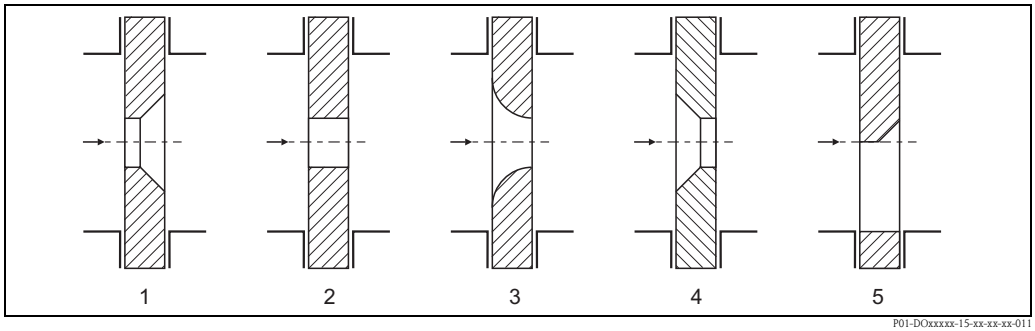
Product	Remarks	Example
DO74P	■ Orifice plate for mounting between two flanges ■ All types of tapping possible; ideal for D-D/2 tapping and pipe tapping and as a replacement for flange tappings	 P01-DOxxxxxx-14-xx-xx-xx-017

Position of the pressure taps

Pressure taps for flanges according to ASME B16.5 and ASME B16.47 similar to DIN19205-1 (Order code F)

DN						
	Cl. 150	Cl. 300	C. 600	Cl. 900	Cl. 1500	Cl. 2500
1 1/2"	135°	135°	135°	135°	135°	135°
2"	135°	90°	90°	90°	90°	90°
2 1/2"	135°	90°	90°	90°	90°	90°
3"	135°	90°	90°	90°	90°	90°
4"	90°	90°	90°	90°	90°	90°
5"	90°	90°	90°	90°	90°	90°
6"	90°	60°	60°	60°	60°	90°
8"	90°	60°	60°	60°	60°	60°
10"	60°	45°	45°	45°	60°	60°
12"	60°	45°	36°	36°	45°	60°
14"	60°	36°	36°	36°	45°	
16"	45°	36°	36°	36°	45°	
18"	45°	30°	36°	36°	45°	
20"	36°	30°	30°	36°	45°	
24"	36°	30°	30°	36°	45°	
28"	26°	26°	26°	36°		
32"	26°	26°	26°	36°		
36"	22,5°	22,5°	26°	36°		
40"	20°	22,5°	22,5°	30°		

Inlet edge orifice



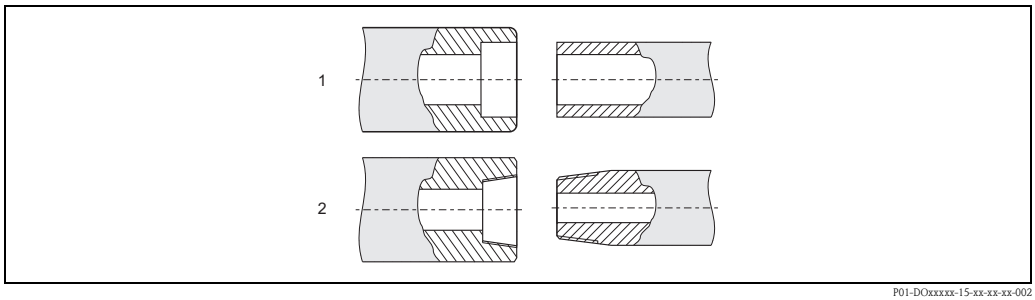
No	Inlet edge	min. Reynolds number	Application
1	sharp	Re ≥ 5000	Standard; should always be used if the Reynolds number is large enough.
2	bidirectional	Re ≥ 5000	apply if flows in both directions are to be measured.
3	quarter circle nozzle	Re ≥ 500	only for Re ≤ 5000
4	conical inlet	Re ≥ 80	only for Re ≤ 500
5	segmental orifice	Re ≥ 5000	■ for liquids with gas content (aperture at the top) ■ for liquids with solid content (aperture at the bottom)

Note!
- The sizing of a flow measuring point can be performed by the Endress+Hauser selection and sizing tool "Applicator". Among other things, "Applicator" determines the suitable edge type for your application.
- The inlet edge of the orifice is selected in feature 80 of the respective product structure.

Differential pressure connection

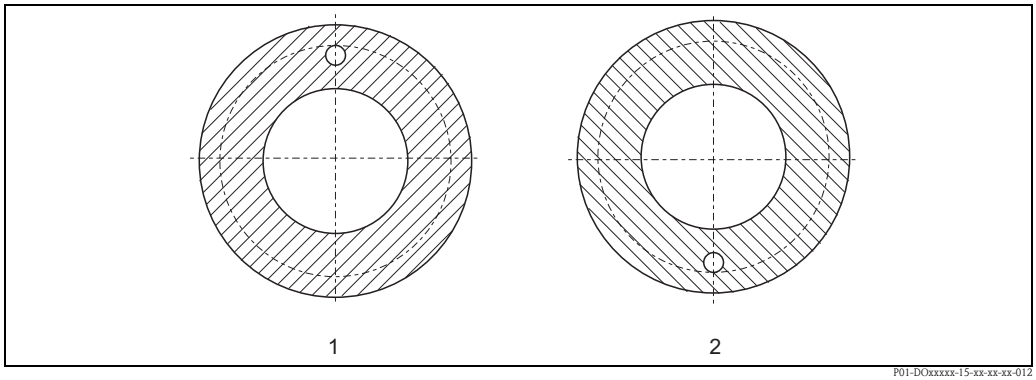
Differential pressure connection for the remote version

For the remote version, the following connections are available for the impulse line between the individual components:



No.	Outlet (from the primary element)	Inlet (to the accessory)	Application/Remarks
1	Socket weld welding connection ½"; ¾"	welding connection: ½"; ¾"	for highly demanding applications; permanent joint
2	FNPT½	MNPT½	simple mounting; not suited for steam

Vent/Drain hole



1: *Orifice plate with vent hole* **2:** *Orifice plate with drain hole*

- Orifice plates with vent hole are applied for liquids with gas formation. Gas can pass the orifice plate through the vent hole.
- Orifice plates with drain hole are applied for gases with condensate formation. Condensate can pass the orifice plate through the drain hole.

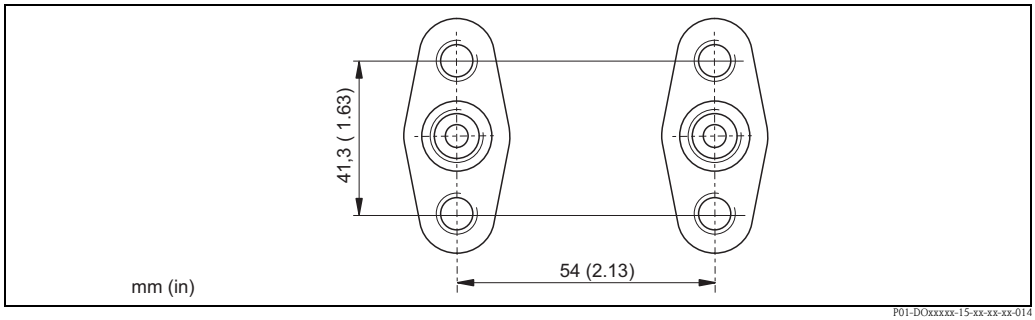
Note!
- Orifice plates with vent or drain hole can only be applied in horizontal pipes.
- Vent and drain hole are not available for the meter run (DO75F).
- Vent or drain hole are selected in feature 90 of the respective product structure.

Dimensions

The diameter of the vent or drain hole depends on the diameter of the orifice:

Diameter of the orifice [in (mm)]	Diameter of the vent or drain hole [in (mm)]
1.000 - 3.500 (25,4 - 88,9)	3/32 (2,4)
3.501 - 4.125 (89,0 - 104,8)	1/8 (3.2)
4.126 - 5.000 (104,9 - 127,0)	5/32 (4,0)
5.001 - 6.000 (127,1 - 152,4)	3/16 (4,8)
6.001 - 6.750 (152,4 - 171,5)	7/32 (5,6)
6.751 - 7.500 (171,5 - 190,5)	1/4 (6,4)
7.501 - 8.375 (190,6 - 212,7)	9/32 (7,1)
8.376 - 9.250 (212,8 - 235,0)	5/16 (8,0)
9.251 - 10.000 (235,1 - 254,0)	11/32 (8,7)
10.001 - 10.875 (254,0 - 276,2)	3/8 (9,5)
10.876 - 11.625 (276,3 - 295,3)	13/32 (10,3)
11.626 - 12.500 (295,3 - 317,5)	7/16 (11,1)
12.501 - 13.250 (317,5 - 336,6)	15/32 (11,9)
> 13.251 (> 336,6)	1/2 (12,7)

Differential pressure connection for the compact version (IEC61518)



Standard connection for differential pressure transmitter (oval flanges or flange plate); dimensions in inch (mm)

Note!
The different pressure connection is selected in feature 100 of the product structure.

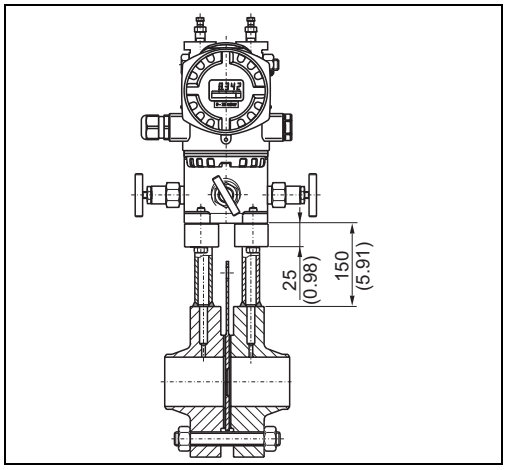
Overview of the product structures

Feature	Name	Description	valid for		
			DO71W	DO74P	DO75F
Primary element					
10	Application; Version	■ Application: "Gas", "Liquid" oder "Steam" ■ Version: "remote" oder "compact" See chapter "Mounting positions", → 11. For DO74P: Definition of the type of pressure tapping (for the calculation)	x	x	x
20	Pipe; Orientation	■ Pipe: "Horizontal", "Vertical" ■ Orientation: – "left", "right", "top/bottom" for horizontal pipes – "upwards", "downwards", "upwards/downwards" for vertical pipes Additionally, the angle of the differential pressure taps must be selected See chapter "Mounting positions", → 11. For tap angles according to DIN, → 20.	x		x
30	Orifice	Defines: ■ the pressure rating of the orifice plate ■ the material of the orifice plate For the temperature limits of the materials, → 16.		x	
40	Process Connection; Orifice	Defines: ■ the pressure rating of the mounting flange or the carrier ring ■ the material of the flange or carrier ring ■ the material of the orifice plate For the temperature limits of the materials, → 16. **Example:** Selection BAN -> PN6 B1, C22.8; 316L means: PN6: pressure rating of the flange/carrier ring B1: form of the gasket surface C22.8: material of the flange/carrier ring 316L: material of the orifice plate	x		x
50	Thickness	Defines the thicklness of the orifice plate.		x	
70	Seal	Defines the type of seal ■ between the orifice plate and the flange (for DO71W and DO75F)	x		x
80	Inlet Edge Orifice	Defines the type of the inlet edge of the orifice, → 21.	x	x	x
90	Vent/Drain	Defines if the orifice plate has a vent hole or drain hole, → 22.	x	x	x
100	Diff. Pressure Connection; Seal	Defines: ■ the type of differential pressure connection, → 21 ■ the material of the seal at the differential pressure connection	x		x
Accessory: Condensate Chambers					
200	2x Condens. Chamber Mat.; Volume; PN	Defines: ■ the material of the condensate chambers ■ the volume of the condensate chambers ■ the pressure rating of the condensate chambers For details, → 39. ✎ Note! If "not selected" is chosen, no condensate chambers are included in the order. In this case "not needed" has to be selected in the features 210 to 230.	x		x
210	Filling Cap Condens. Chamber	Defines the type of filling cap, → 39.	x		x
220	Inlet	Defines the inlet (from the process) of the condensate chamber, → 21.	x		x
230	Outlet	Defines the outlet of the condensate chamber, → 21.	x		x

Feature	Name	Description	valid for		
			DO71W	DO74P	DO75F
Accessory: Shut-off valve					
250	2 x Shut-Off Valve; Gasket	Defines: ■ the type of shut-off valve ■ the material of the gasket For details, → 🖹 38. ✎ Note! If "not selected" is chosen, no shut-off valves are included in the order. In this case "not needed" has to be selected in the features 260 to 280.	x		x
260	Material Shut-Off Valve	Defines the material of the shut-off valve. For the temperature limits of the materials, → 🖹 16.	x		x
270	Inlet Shut-Off Valve	Defines the inlet (from the process) of the shut-off valve, → 🖹 21.	x		x
280	Outlet Shut-Off Valve	Defines the outlet of the shut-off valve, → 🖹 21.	x		x
Accessory: Manifold					
300	Manifold Version	Defines the manifold version, → 🖹 40 ✎ Note! If "not selected" is chosen, no manifold is included in the order. In this case "not needed" has to be selected in the features 310 to 330.	x		x
310	Gasket Manifold	Defines the material of the gasket of the manifold. For the temperature limits of the materials, → 🖹 16.	x		x
320	Process Connection Manifold	Defines the process connection of the manifold, → 🖹 21.	x		x
330	Seal Manifold, Screws	Defines: ■ The material of the seal between the manifold and the transmitter ■ The size of the manifold screws For the temperature limits of the materials, → 🖹 16. ☝ Caution! The manifold screws must be selected in accordance with the Deltabar differential pressure transmitter.	x		x
Differential pressure transmitter					
450	DP-Transmitter Deltabar	Defines if a Deltabar differential pressure transmitter is included in the order.	x		x
Additional options					
500	Add. Option Orifice	These features are used to define additional characteristics of the respective components (e.g. material inspection certificates). The features are optional, which means: ■ It is not necessary to select an option in these features. ■ Multiple options can be selected in these features.	x		x
520	Add. Option Condens. Chamber		x		x
530	Add. Option Shut-Off Valve		x		x
540	Add. Option Manifold		x		x
550	Add. Option General		x	x	x

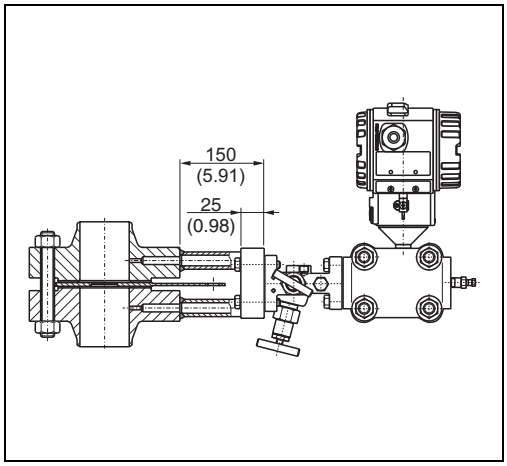
Deltatop DO71W: Flange tap

Typical configurations



P01-DOxxxxxx-06-xx-00-xx-006

For liquids and gases in horizontal pipes, dimensions in mm (in)



P01-DOxxxxxx-06-xx-00-xx-007

For liquids and gases in vertical pipes, dimensions in mm (in)

Design

Measuring flange with exchangeable orifice plate in compact or remote design; accessories included

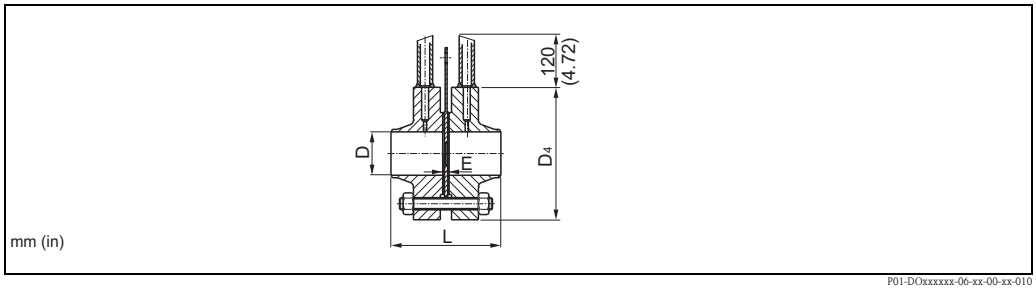
Type of pressure tapping

Flange tapping

Materials

	Version High-carbon steel (C-22.8, A105)	**Stainless steel (316L)**
Flanges DIN	C22.8 (1.0460)	316L (1.4404)
Falnges ASME	A105	316L
Orifice plate	316L (1.4404)	316L (1.4404)
Seal between orifice plate and flange	■ Standard (non Asbestos) ■ Spiral seal: 316L/graphite	

Dimensions; Weight



DO71W Flanges according to ASME B16.36												
Version	**D [in]**	**L [in (mm)]**					**E[1] [in (mm)]**	**Weight[2] [lbs (kg)]**				
		Cl. 300	**Cl. 600**	**Cl. 900**	**Cl. 1500**	**Cl. 2500**		**Cl. 300**	**Cl. 600**	**Cl. 900**	**Cl. 1500**	**Cl. 2500**
DO71W25	1	6.9 (175)	6.9 (175)		6.1 (156)	7.4 (188)	0.118 (3)	33 (15)	33 (15		26 (12)	32 (16)
DO71W40	1½	7.1 (181)	7.1 (181		6.9 (175)	9.1 (232)	0.118 (3)	37 (17)	37 (17)		40 (18)	75 (34)
DO71W50	2	7.0 (179)	7.0 (179)		8.4 (213)	10.4 (264)	0.118 (3)	42 (19)	42 (19)		75 (34)	125 (57)
DO71W65	2½	7.2 (184)	7.2 (184)		8.7 (220)	11.7 (296)	0.118 (3)	51 (23)	51 (23)		108 (49)	156 (71)
DO71W80	3	7.2 (184)	7.6 (197)	8.4 (213)	9.6 (245)	13.7 (347)	0.118 (3)	68 (31)	68 (31)	92 (42)	143 (65)	282 (128)
DO71W1H	4	7.5 (190)	8.7 (222)	9.4 (239)	10.2 (258)	15.4 (391)	0.118 (3)	99 (45)	146 (66)	152 (69)	218 (99)	433 (197)
DO71W1Z	5	8.1 (207)	9.8 (248)	10.4 (264)	12.6 (321)	18.4 (467)	0.118 (3)	126 (57)	225 (102)	257 (117)	389 (177)	733 (333)
DO71W1F	6	8.1 (207)	10.0 (254)	11.4 (289)	13.9 (353)	21.9 (556)	0.118 (3)	148 (67)	260 (118)	330 (150)	495 (225)	1135 (516)
DO71W2H	8	9.0 (228)	11.3 (286)	13.1 (334)	17.1 (435)	25.4 (645)	0.236 (6)	205 (93)	364 (165)	524 (238)	825 (375)	1736 (789)
DO71W2F	10	9.5 (241)	12.8 (324)	14.9 (378)	20.4 (518)	33.4 (848)	0.236 (6)	284 (129)	584 (265)	779 (354)	1360 (618)	3221 (1464)
DO71W3H	12	10.5 (266)	13.0 (330)	16.1 (410)	22.6 (575)	3)	0.236 (6)	423 (192)	708 (321)	970 (441)	2066 (939)	3)
DO71W3F	14	11.5 (292)	13.8 (350)	17.1 (435)	23.9 (607)		0.236 (6)	573 (260)	1036 (470)	1195 (543)	2812 (1278)	
DO71W4H	16	11.8 (301)	15.0 (379)	17.4 (442)	24.9 (632)		0.394 (10)	761 (345)	1407 (638)	1485 (675)	3742 (1701)	
DO71W4F	18	12.9 (328)	15.4 (391)	18.4 (467)	26.1 (664)		0.394 (10)	924 (420)	1496 (680)	2033 (924)	4864 (2211)	
DO71W5H	20	13.1 (333)	15.9 (403)	19.8 (502)	28.4 (721)		0.394 (10)	1124 (510)	2044 (927)	2482 (1128)	6138 (2790)	
DO71W6H	24	13.6 (345)	16.9 (429)	23.4 (594)	32.4 (823)		0.472 (12)	1470 (667)	2771 (1257)	4488 (2040)	9966 (4530)	

1) minimum values; the precise value is determined during the sizing

2) The weight depends on the inner diameter of the pipe. The table gives only approximate values.

3) in preparation

Versions

Version	Nominal Diameter
DO71W25	1"
DO71W40	1-1/2"
DO71W50	DN50 / 2"
DO71W65	DN65 / 2-1/2"
DO71W80	DN80 / 3"
DO71W1H	DN100 / 4"
DO71W1Z	DN125 / 5"
DO71W1F	DN150 / 6"
DO71W2H	DN200 / 8"
DO71W2F	DN250 / 10"
DO71W3H	DN300 / 12"
DO71W3F	DN350 / 14"
DO71W4H	DN400 / 16"
DO71W4F	DN450 / 18"
DO71W5H	DN500 / 20"
DO71W6H	DN600 / 24"

Product structure

10	Application; Version
B	Gas; remote
C	Gas; compact
D	Liquid; remote
E	Liquid; compact
F	Steam; remote
G	Steam; compact
Y	Special version

20	Pipe; Orientation
B	Horizontal; left
C	Horizontal; right
E	Horizontal; top/bottom 0° tap
G	Horizontal; 180° tap
M	Vertical upwards; 0° tap
N	Vertical upwards; 90° tap
P	Vertical downwards; 0° tap
R	Vertical downwards ; 90° tap
S	Vertical upwards/downwards 0° tap
T	Vertical upwards/downwards 90° tap
Y	Special version

40	Process Connection; Orifice
	ANSI flanges
FBQ	Cl.300 RF, A105; 316L
FBS	Cl.300 RF, 316L; 316L
FCQ	Cl.600 RF, A105; 316L
FCS	Cl.600 RF, 316L; 316L
FDQ	Cl.900 RF, A105; 316L
FDS	Cl.900 RF, 316L; 316L
FEQ	Cl.1500 RF, A105; 316L
FES	Cl.1500 RF, 316L; 316L
FFQ	Cl.2500 RF, A105; 316L
FFS	Cl.2500 RF, 316L; 316L
FKQ	Cl.900 RTJ, A105; 316L
FKS	Cl.900 RTJ, 316L; 316L
FLQ	Cl.1500 RTJ, A105; 316L
FLS	Cl.1500 RTJ, 316L; 316L
FMQ	Cl.2500 RTJ, A105; 316L
FMS	Cl.2500 RTJ, 316L; 316L
Y99	Special version

70	Seal
1	Standard
2	Spiral, 316L/Graphite
9	Special version

80	Inlet Edge Orifice
R	Sharp, Re>5000
S	Quarter circle nozzle, Re 500-5000
U	Segmental orifice
W	Bidirectional
Y	Special version

90	Vent/Drain
A	Not selected
B	Vent hole
C	Drain hole
Y	Special version

100	Diff. Pressure Connection; Seal
B	IEC61518; PTFE
C	IEC61518; FKM
F	FNPT; w/o
V	Socket weld
Y	Special version

200	2x Condens. Chamber Mat.; Volume; PN
1	Not selected
7	Steel; 3" 3000 psi
8	Steel; 4" 6000 psi
9	Special version

210	Filling Cap Condens. Chamber
A	Not needed
Y	Special version

220	Inlet Condens. Chamber
A	Not needed
1	1/2" SW
2	3/4" SW
Y	Special version

230	Outlet Condens. Chamber
A	Not needed
1	1/2" SW
2	3/4" SW
Y	Special version

250	2x Shut-off Valve; Gasket
1	Not selected
6	Valve; PTFE gasket <200°C/392°F
8	Valve; pure graphite gasket <300°C/572°F
9	Special version

260	Material Shut-off Valve
A	Not needed
F	316L
Y	Special version

270	Inlet Shut-off Valve
A	Not needed
D	FNPT 1/2
Y	Special version

280	Outlet Shut-off Valve
A	Not needed
C	FNPT1/2
Y	Special version

300	Manifold Version
111	Not selected
AB2	3 valve, 316L, milled
BB2	5 valve, 316L, milled, vent
KA2	3 valve, 316L, IEC61518, both side
LA2	5 valve, 316L, IEC61518 both side, vent
YY9	Special version

310	Gasket Manifold
A	Not needed
B	PTFE, 200 °C/392 °F
D	Graphite / Graphoil
Y	Special version

320	Process Connection Manifold
A	Not needed
B	FNPT1/2
E	IEC61518
Y	Special version

330	Seal Manifold; Screws
A	Not needed
B	PTFE; UNF7/16, max PN420
D	Viton; UNF7/16, max PN420
K	Graphite; UNF7/16, max. PN420
Y	Special version

450	DP-Transmitter Deltabar
D	Provided, sep. item
W	Not provided

500	Add. Option Orifice (optional; multiple options can be selected)
A1	EN10204-3.1 material (wetted parts) inspection certificate
A2	EN10204-3.1 material, NACE MR0175 (wetted parts) inspection certificate
A5	Cleaned fromn oil+grease
A6	Oxygen service

520	Add. Option Condensation Chamber
C1	EN10204-3.1 material (wetted parts) inspection certificate

530	Add. Option Shut-Off Valve (optional; multiple options can be selected)
D1	EN10204-3.1 material (wetted parts) inspection certificate
D2	EN10204-3.1 material, NACE MR0175 (wetted parts) inspection certificate
D5	Cleaned from oil+grease
D6	Oxygen service

540	Add. Option Manifold (optional; multiple options can be selected)
EB	Mounting bracket, stainless steel
E1	EN10204-3.1 material (wetted parts) inspection certificate
E2	EN10204-3.1 material, NACE MR0175 (wetted parts) inspection certificate
E5	Cleaned from oil+grease
E6	Oxygen service

895	Marking
Z1	Tagging (TAG)

Deltatop DO74P: Plate

Design

Orifice plate for mounting between two flanges

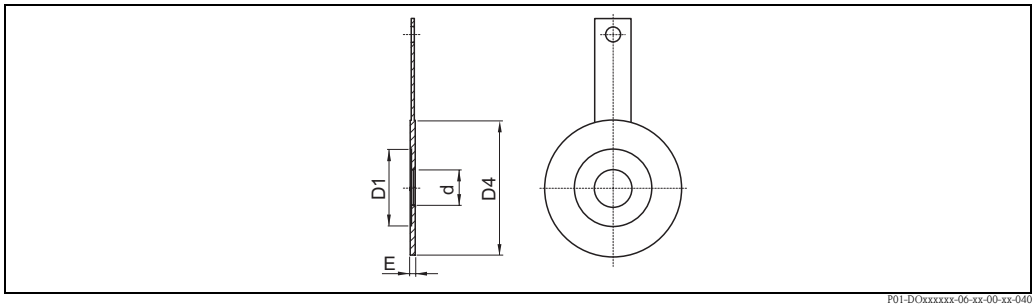
Type of pressure tapping

- Flange tapping
- D-D/2 tapping
- corner tapping
- 2½D / 8D

Material

316L (1.4404)

Dimensions



DO74P Flanges according to ASME B16.5 and ASME B16.47 Series A									
Version		**d_4[in (mm)]**						**E [in (mm)]**	**d_1**
	D [in]	**Cl. 150**	**Cl. 300**	**Cl. 600**	**Cl. 900**	**Cl. 1500**	**Cl. 2500**		
DO74P25	1	2.6 (67)	2.9 (73)	2.9 (73)	3.1 (79)	3.1 (79)	3.4 (86)	0.118 (3)	D + 1 mm (1 mm = 0.0394")
DO74P40	1½	3.4 (86)	3.7 (95)	3.7 (95)	3.9 (98)	3.9 (98)	4.6 (117)	0.118 (3)	
DO74P50	2	4.1 (105)	4.4 (111)	4.4 (111)	5.6 (143)	5.6 (143)	5.7 (146)	0.118 (3)	
DO74P65	2½	4.9 (124)	5.1 (130)	5.1 (130)	6.5 (165)	6.5 (165)	6.6 (168)	0.118 (3)	
DO74P80	3	5.4 (137)	5.9 (149)	5.9 (149)	6.6 (168)	6.9 (175)	7.8 (197)	0.118 (3)	
DO74P1H	4	6.9 (175)	7.1 (181)	7.6 (194)	8.1 (206)	8.3 (210)	9.3 (235)	0.118 (3)	
DO74P1Z	5	7.8 (197)	8.5 (216)	9.5 (241)	9.8 (248)	10.0 (254)	11.0 (279)	0.118 (3)	D + 2 mm (2 mm = 0.0787")
DO74P1F	6	8.8 (222)	9.9 (251)	10.5 (267)	11.4 (289)	11.1 (283)	12.5 (318)	0.118 (3)	
DO74P2H	8	11.0 (279)	12.1 (308)	12.6 (321)	14.1 (359)	13.8 (352)	15.2 (387)	0.157 (4)	
DO74P2F	10	13.3 (340))	14.3 (362)	15.7 (400)	17.1 (435)	17.1 (435)	18.7 (476)	0.157 (4)	
DO74P3H	12	16.1 (410)	16.6 (422)	18.0 (457)	19.6 (499)	20.5 (521)	21.6 (549)	0.157 (4)	
DO74P3F	14	17.8 (451)	19.1 (486)	19.4 (492)	20.5 (521)	22.8 (578)		0.157 (4)	
DO74P4H	16	20.3 (514)	21.3 (540)	22.2 (565)	22.6 (575)	25.2 (641)		0.157 (4)	D + 4 mm (4 mm = 0.157")
DO74P4F	18	21.6 (549)	25.5 (597)	24.1 (613)	25.1 (638)	27.8 (705)		0.157 (4)	
DO74P5H	20	23.9 (606)	25.7 (654)	26.9 (683)	27.5 (699)	29.8 (756)		0.236 (6)	
DO74P6H	24	27.9 (718)	30.5 (775)	31.1 (791)	32.0 (838)	35.5 (902)		0.236 (6)	
DO74P7H	28	32.8 (32)	35.4 (898)	36.0 (915)	37.3 (946)			0.236 (6)	
DO74P8H	32	37.0 (940)	39.6 (1006)	40.2 (1022)	42.3 (1073)			0.315 (8)	
DO74P9H	36	41.3 (1048)	44.0 (1118)	44.5 (1130)	47.2 (1200)			0.315 (8)	
DO74P1T	40	45.7 (1162)	43.9 (1114)	45.5 (1156)	49.3 (1251)			0.394 (10)	

Versions

Version	nominal diamteter
DO74P25	1"
DO74P40	1-1/2"
DO74P50	DN50 / 2"
DO74P65	DN65 / 2-1/2"
DO74P80	DN80 / 3"
DO74P1H	DN100 / 4"
DO74P1Z	DN125 / 5"
DO74P1F	DN150 / 6"
DO74P2H	DN200 / 8"
DO74P2F	DN250 / 10"
DO74P3H	DN300 / 12"
DO74P3F	DN350 / 14"
DO74P4H	DN400 / 16"
DO74P4F	DN450 / 18"
DO74P5H	DN500 / 20"
DO74P6H	DN600 / 24"
DO74P7H	DN700 / 28"
DO74P8H	DN800 / 32"
DO74P9H	DN900 / 36"
DO74P1T	DN1000 / 40"

Product structure

10	Version
M	Flange tapping
N	Tapping D+D/2
P	Corner tapping
R	Pipe tapping 2,5D/8D
Y	Special version

30	Orifice
	ANSI flanges
FAC	Cl.150 RF, 316L
FBC	Cl.300 RF, 316L
FCC	Cl.600 RF, 316L
FDC	Cl.900 RF, 316L
FEC	Cl.1500 RF, 316L
FFC	Cl.2500 RF, 316L
FKC	Cl.900 RTJ, 316L
FLC	Cl.1500 RTJ, 316L
FMC	Cl.2500 RTJ, 316L
Y99	Special version

50	Thickness
1	Standard
9	Special version

80	Inlet Edge Orifice
R	Sharp, Re>5000
S	Quarter circle nozzle, Re 500-5000
T	Conical entrance, Re 50-500
U	Segmental orifice
W	Bidirectional
Y	Special version

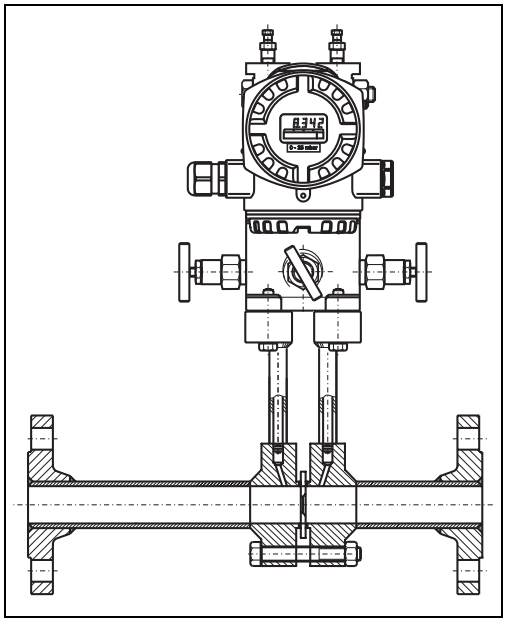
90	Vent/Drain
A	Not selected
B	Vent hole
C	Drain hole
Y	Special version

550	Add. Option General (option; multiple options can be selected)
F1	EN10204-3.1 material (wetted parts) inspection certificate
F2	EN10204-3.1 material, NACE MR0175 (wetted parts) inspection certificate
F5	Cleaned from oil+grease
F6	Oxygen service

895	Marking
Z1	Tagging (TAG)

Deltatop DO75F: Meter Run

Typical configurations



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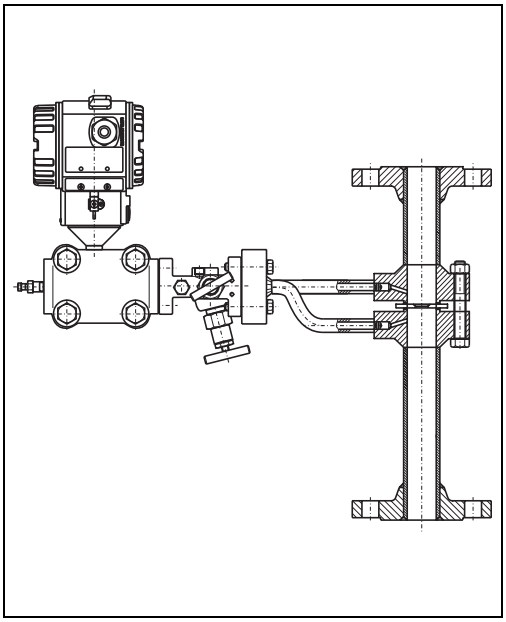
For liquids and gases in horizontal pipes



P01-DOxxxxxx-06-xx-00-xx-053

For liquids and gases in vertical pipes

Design

Meter run with standard orifice in compact or remote version; accessories included

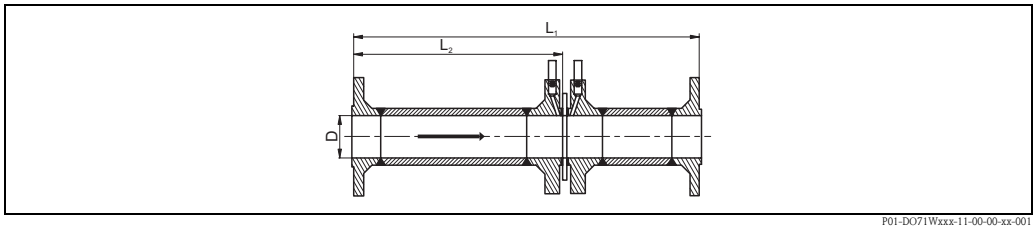
Type of pressure tapping

Corner tapping with annular chamber

Materials

	High-carbon	Stainless steel	High temperature version
Meter run ASME (pipe)	A106	316L	
Orifice flanges ASME	A105	316L	
Flanges ASME	A105	316L	
Orifice plate	316L (1.4404)	316L (1.4404)	316L (1.4404)
Seal between orifice plate	■ standard (non Asbestos)		■ standard

Dimensions; weight



P01-DO71Wxxx-11-00-00-xx-001

Version	D	L_1 [in (mm)]	L_2 [in (mm)]	Weight [lbs (kg)]
DO75F15	1/2"	21.8 (550)	14.3 (380)	ca. 26 (approx. 12)
DO75F20	3/4"	28.84 (700)	18.03 (500)	ca. 35 (approx. 16)
DO75F25	1"	35.77 (900)	22.63 (650)	ca. 42 (approx. 19)
DO75F40	1½"	45.59 (1300)	31.06 (1000)	ca. 55 (approx. 25)
DO75F50	2"	70°	44°	1)

1) in preparation

Versions

Version	Nominal Diameter; Overall Length
DO75F15	DN15 / 1/2", 21.8"
DO75F20	DN20 / 3/4", 28.84"
DO75F25	DN25 / 1", 33.77"
DO75F40	DN40 / 1-1/2", 45.59"
DO75F50	DN50 / 2", 70"

Product structure

10	Application; Version
B	Gas; remote
C	Gas; compact
D	Liquid; remote
E	Liquid; compact
F	Steam; remote
G	Steam; compact
Y	Special version

20	Pipe; Orientation
B	Horizontal; left
C	Horizontal; right
E	Horizontal; top/bottom 0° tap
G	Horizontal; 180° tap
M	Vertical upwards; 0° tap
N	Vertical upwards; 90° tap
P	Vertical downwards; 0° tap
R	Vertical downwards ; 90° tap
S	Vertical upwards/downwards 0° tap
T	Vertical upwards/downwards 90° tap
Y	Special version

40	Process Connection; Orifice
	ANSI flanges
FAQ	Cl.150 RF, A105; 316L
FAS	Cl.150 RF, 316L; 316L
FBQ	Cl.300 RF, A105; 316L
FBS	Cl.300 RF, 316L; 316L
FCQ	Cl.600 RF, A105; 316L
FCS	Cl.600 RF, 316L; 316L
FEQ	Cl.1500 RF, A105; 316L
FES	Cl.1500 RF, 316L; 316L
Y99	Special version

70	Seal Annular Chamber
1	Sandard
9	Special version

80	Inlet Edge Orifice
R	Sharp, Re>5000
S	Quarter circle nozzle, Re 500-5000
W	Bidirectional
Y	Special version

90	Vent/Drain
A	Not selected
Y	Special version

100	Diff. Pressure Connection; Seal
B	IEC61518; PTFE
C	IEC61518; FKM
F	FNPT; w/o
V	Socket weld
Y	Special version

200	2x Condens. Chamber Mat.; Volume; PN
1	Not selected
7	Steel; 3" 3000 psi
8	Steel; 4" 6000 psi
9	Special version

210	Filling Cap Condens. Chamber
A	Not needed
Y	Special version

220	Inlet Condens. Chamber
A	Not needed
1	1/2" SW
2	3/4" SW
Y	Special version

230	Outlet Condens. Chamber
A	Not needed
1	1/2" SW
2	3/4" SW
Y	Special version

250	2x Shut-Off Valve; Gasket
1	Not selected
6	Valve; PTFE gasket <200°C/392°F
8	Valve; pure graphite gasket <300°C/572°F
9	Special version

260	Material Shut-Off Valve
A	Not needed
F	316L
Y	Special version

270	Inlet Shut-Off Valve
A	Not needed
D	FNPT 1/2
Y	Special version

280	Outlet Shut-Off Valve
A	Not needed
C	FNPT1/2
Y	Special version

300	Manifold Version
111	Not selected
AB2	3 valve, 316L, milled
BB2	5 valve, 316L, milled, vent
KA2	3 valve, 316L, IEC61518, both side
LA2	5 valve, 316L, IEC61518 both side, vent
YY9	Special version

310	Gasket Manifold
A	Not needed
B	PTFE, 200°C/392°F
D	Graphite/Graphoil
Y	Special version

320	Process Connection Manifold
A	Not needed
B	FNPT1/2
E	IEC61518
Y	Special version

330	Seal Manifold; Screws
A	Not needed
B	PTFE; UNF7/16, max PN420
D	Viton; UNF7/16, max PN420
K	Graphite; UNF7/16, max. PN420
Y	Special version

450	DP-Transmitter Deltabar
D	Provided, sep. item
W	Not provided

500	Add. Option Orifice (optional; multiple options can be selected)
A1	EN10204-3.1 material (wetted parts) inspection certificate
A2	EN10204-3.1 material, NACE MR0175 (wetted parts) inspection certificate
A5	Cleaned from oil+grease
A6	Oxygen service

520	Add. Option Condensation Chamber
C1	EN10204-3.1 material (wetted parts) inspection certificate

530	Add. Option Shut-Off Valve (optional; multiple options can be selected)
D1	EN10204-3.1 material (wetted parts) inspection certificate
D2	EN10204-3.1 material, NACE MR0175 (wetted parts) inspection certificate
D5	Cleaned from oil+grease
D6	Oxygen service

540	Add. Option Manifold (optional; multiple options can be selected)
EB	Mounting bracket, stainless steel
E1	EN10204-3.1 material (wetted parts) inspection certificate
E2	EN10204-3.1 material, NACE MR0175 (wetted parts) inspection certificate
E5	Cleaned from oil+grease
E6	Oxygen service

550	Add. Option General (optional; multiple options can be selected)
FE	Wet calibration
F8	Pressure test + certificate

895	Marking
Z1	Tagging (TAG)

Accessories

Overview

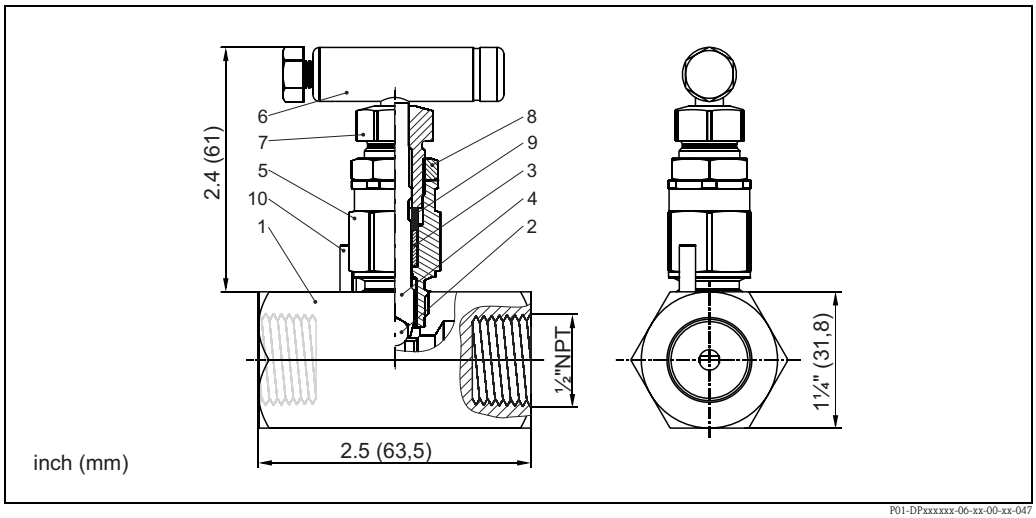
The following accessories are available for the differential-pressure flow measurement with orifices:

- DA71V: Shut-Off Valve (→ 🖹 38)
- DA71C: Condensate pot (→ 🖹 39)
- DA73M: Manifold (→ 🖹 40)
- DA73R: Rectifier (→ 🖹 46)

The condensate pots, shut-off valves and manifold can be ordered together with the orifice. They are included in the product structures DO61W, DO75F.
Alternatively, they can be ordered by their own product structures which are displayed in the following chapters. The rectifier can only be ordered by its own product structure.

Deltatop DA73V: shut-Off Valve (accessory)

Dimensions



Input FNPT½; output FNPT½

Weight

Order code	Weight
DA73V-6*CC*	Approx. 1.8 lbs (0,8 kg)

Usage

Universal valve; not suited for humid gases;
DA73V-6*V... and DA73V-6*W...: for pressure ratings up to PN160

Design

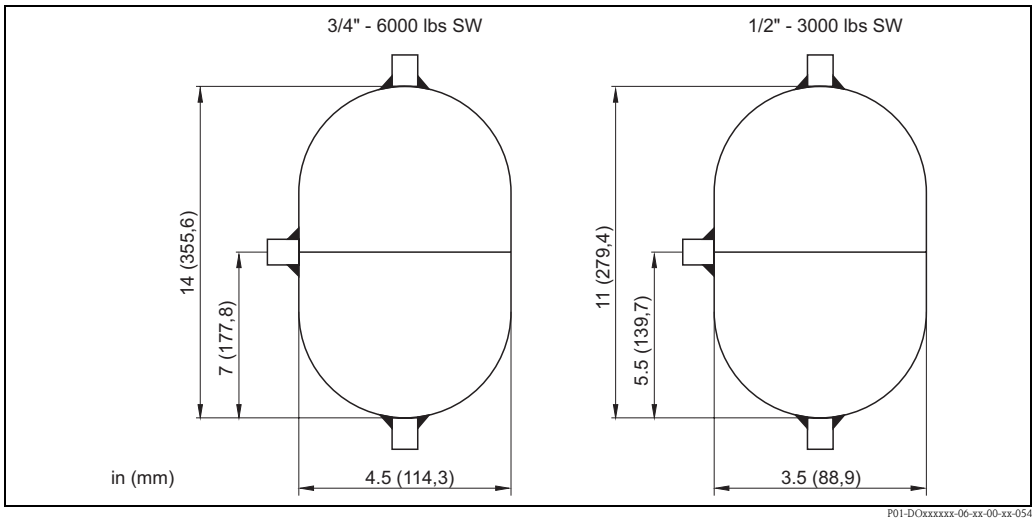
- Body: die-pressed part
- Surface: stainless steel
- Stem thread: internal for all versions
- Replaceable valve seat
- Stem with cold rolled surface, back seat and non-rotating cone tip

Materials

Pos.	Description	Material
1	Valve body	ASTM A479-316
2	Ball	316S.S
3	Stem seal	Teflon
4	Stem	ASTM A479-316
5	Bonnet	ASTM A479-316
6	Handle assembly	300SERIES SS
7	Packing adjuster	ASTM A479-316
8	Jamnut	300SERIES SS
9	Packing follower	ASTM A479-316
10	Rollpin	300SERIES SS

Deltatop DA71C: Condensate pot (accessory)

Dimensions



Material

Description	Material
Condensate pots	SA234 WPB CS
Connections	SA105CS

Product structure

200	Material; Volume; PN
7	Steel; 3" 3000 psi
8	Steel; 4" 6000 psi
Y	Special version

210	Filling Cap
1	Not selected
9	Special version

220	Inlet
F	Welding conn. 21,3mm; w/o
1	1/2" SW
2	3/4" SW
Y	Special version

230	Outlet
1	1/2" SW
2	3/4" SW
Y	Special version

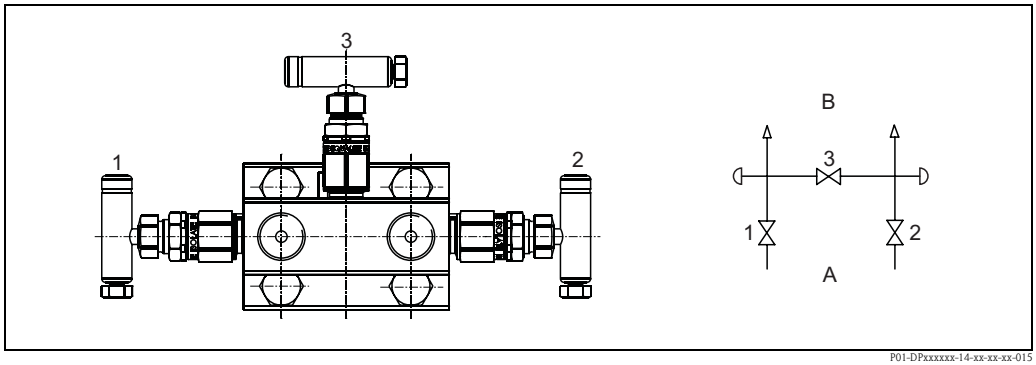
520	Additional Option Condensation chamber
C1	EN10204-3.1 material (wetted parts)

Deltatop DA73M: Manifold (accessory)

Usage

3-valve manifold

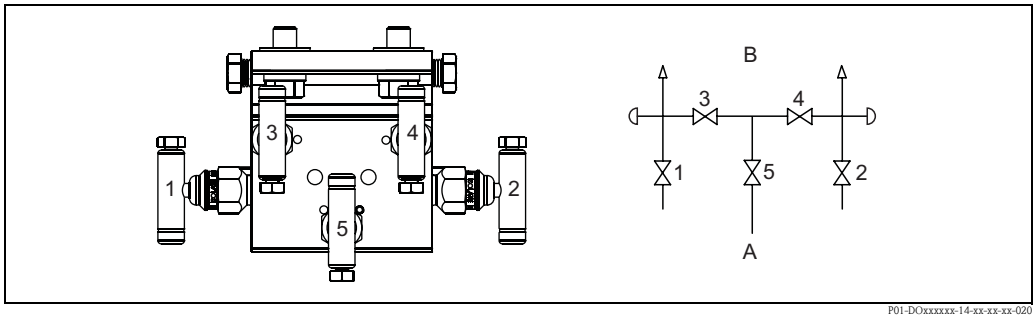
The manifold is used to connect the impulse pipes to the differential pressure transmitter. Valves 1 and 2 can be used to separate the transmitter from the impulse pipes.
Valve 3 is used for zero point adjustment between the impulse pipes.



Left: *Milled version (for gases and liquids)*
A: *Process side* **B:** *Transmitter side*

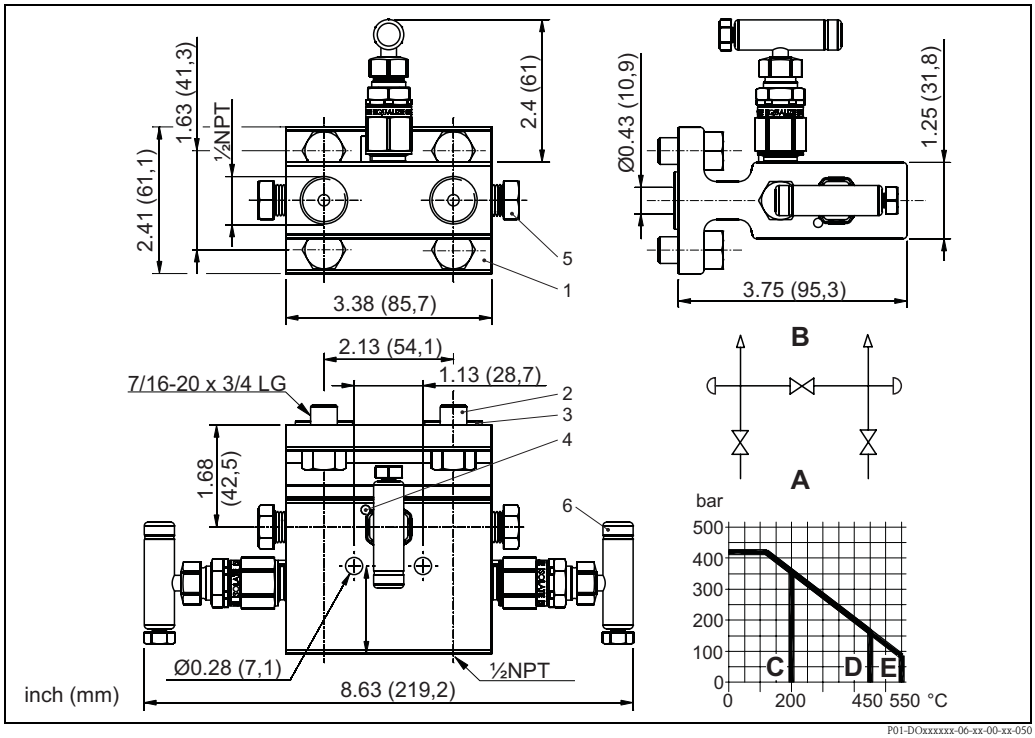
5-valve manifold

The manifold is used to connect the impulse pipes to the differential pressure transmitter. Valves 1 and 2 can be used to separate the transmitter from the impulse pipes.
Valves 3 and 4 are used for zero point adjustment between the impulse pipes.
Valve 5 offers the possibility of venting or purging the impulse pipes.



5-valve manifold with venting valve, milled version (for gases and liquids)
A: *Process side;* **B:** *Transmitter side*

Version: 3-valve, manifold



A: *Process side* **B:** *Transmitter side*
C: *PTFE gasket* **D:** *Pure graphite gasket 1.0460* **E:** *Pure graphite gasket 1.4404*

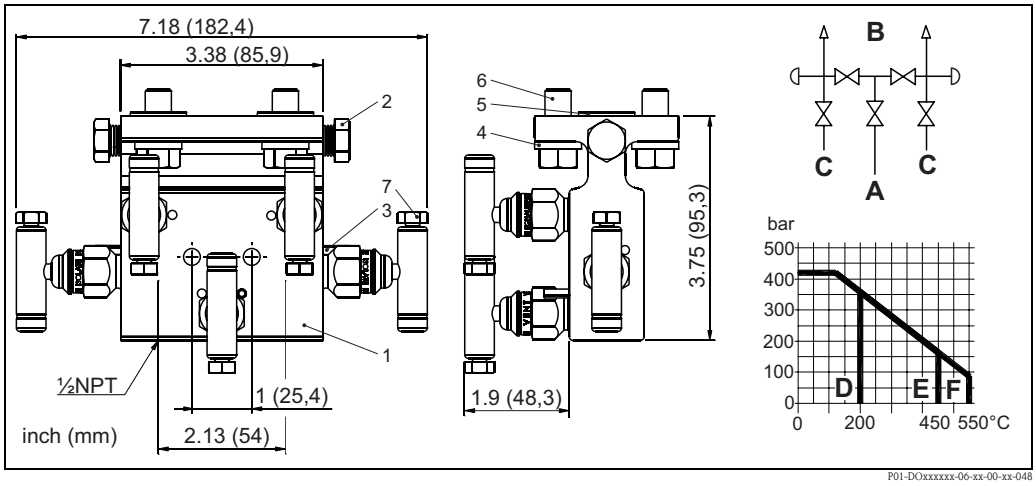
Design

- External stem thread
- Stem with cold rolled surface, back seat and non-rotating needle tip
- Inlet: 1/2 NPT female
- Outlet: IEC 61518, type B
- Weight: approx. 4.4 lbs (2.0 kg), including 4 screws with washers and 2 seals

Materials

Pos.	Description	Material
1	Manifold body	ASTM A479-316
2	Mounting bolts	ASTM A479-316
3	Flange seal	Teflon
4	Rollpin	300SERIES SS
5	1/4" NPT hexhd. plug	316 stainless steel
6	Handle assembly	300SERIES SS

Version: 5-valve, manifold



A: *Process side* **B:** *Transmitter side* **C:** *Vent* **D:** *PTFE gasket* **E:** *Pure graphite gasket 1.0460* **F:** *Pure graphite gasket 1.4404*

Usage

Gas and liquid applications

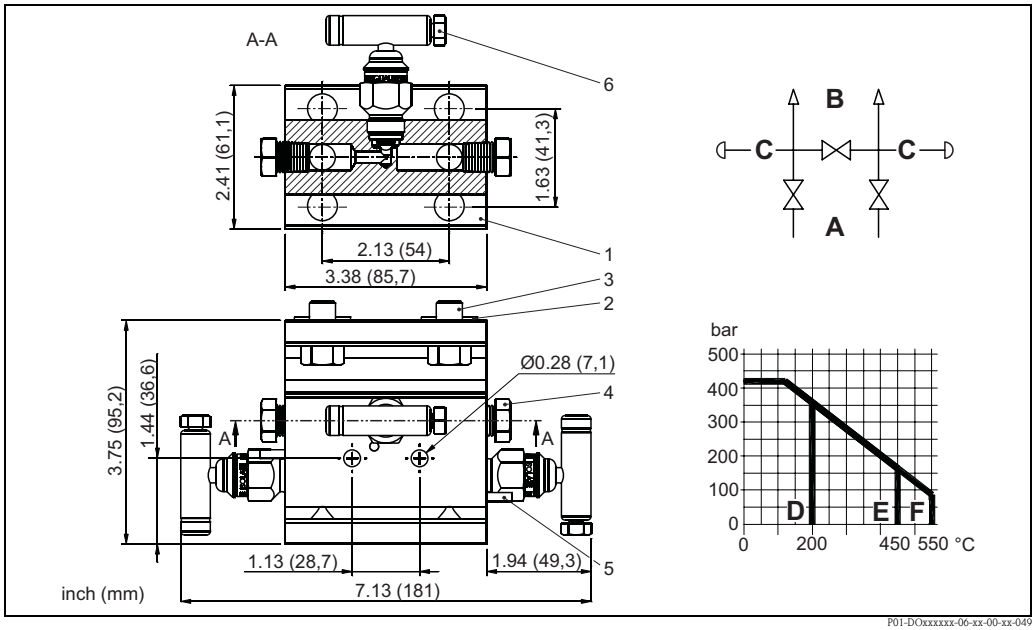
Design

- External stem thread
- Stem with cold rolled surface, back seat and non-rotating needle tip
- Inlet: 1/2 NPT female
- Outlet: IEC 61518, Type B
- Weight: approx. 7.3 lbs (3.3 kg), including 4 screws with washers and 2 seals

Materials

Pos.	Description	Material
1	Manifold body	ASTM A479-316
2	1/4" NPT hexhd. plug	INCONEL625
3	Rollpin	300SERIES SS
4	Washer	ASTM A108
5	Flange seal	Teflon
6	Mounting bolt	ASTM A449-Type 1
7	Handle assembly	300SERIES SS

Version: 3-valve, manifold, IEC61518, both sides



A: *Process side* **B:** *Transmitter side* **C:** *Purge valve* **D:** *PTFE gasket* **E:** *Pure graphite gasket 1.0450*
F: *Pure graphite gasket 1.4404*

Usage

For the compact version of Deltatop

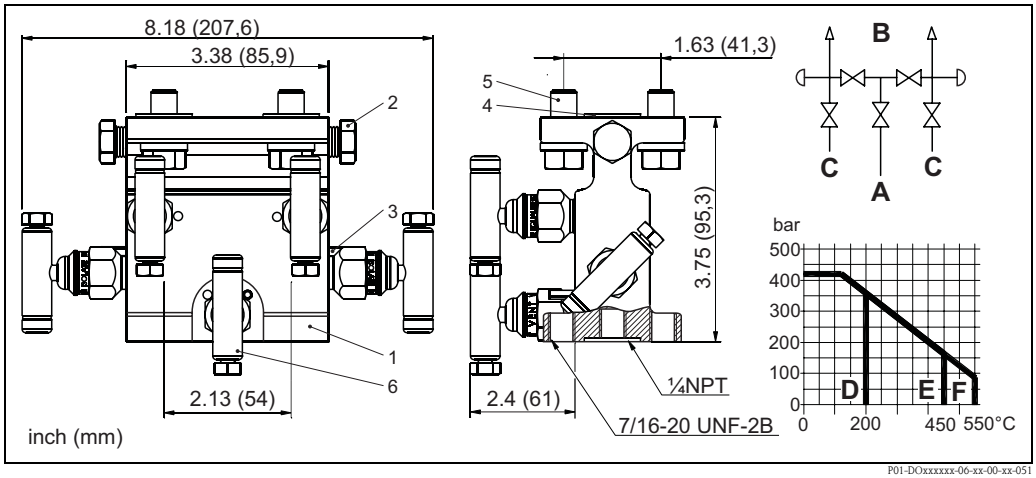
Design:

- Body: die-pressed part
- External stem thread
- Stem with cold rolled surface, back seat and non-rotating needle tip
- Inlet: turned groove ∅18.5 acc. to IEC 61518
- IEC 61518, type B
- Weight: approx. 4.9 lbs (2.2 kg), including 4 screws with washers and 2 seals

Materials

Pos.	Description	Material
1	Manifold body	ASTM A479-316
2	Flange seal	Teflon
3	Mounting bolts	ASTM A449-Type 1
4	1/4" NPT hexhd. plug	INCONEL625
5	Rollpin	300SERIES SS
6	Handle assembly	300SERIES SS

Version: 5-valve, manifold, IEC61518, both sides



A: *Process side* **B:** *Transmitter side* **C:** *Vent* **D:** *PTFE gasket* **E:** *Pure graphite gasket 1.0460* **F:** *Pure graphite gasket 1.4404*

Usage

For the compact version of Deltatop

Design

- Body: die-pressed part
- External stem thread
- Stem with cold rolled surface, back seat and non-rotating needle tip
- Inlet: turned groove ∅18.5 acc. to IEC 61518
- Outlet (to transmitter): IEC 61518, type B
- Outlet (test/vent): 1/4 NPT female with screw plug
- Weight: approx. 7.3 lbs (3.3 kg), including 4 screws with washers and 2 seals

Materials

Pos.	Description	Material
1	Manifold body	ASTM A479-316
2	1/4" NPT hexhd. plug	ASTM A479-316
3	Rollpin	300 SERIES SS
4	IEC flange seal	GRAFOIL
5	Mounting bolt 7/16-20 X 1" LG.	ASTM A479-316
6	Handle assembly	300SERIES SS

Product structure DA73M

300	Version
AB2	3 valve, 316L, milled
BB2	5 valve, 316L, milled, vent
KA2	3 valve, 316L, IEC61518, both side
LA2	5 valve, 316L, IEC61518, both sides, vent
YY9	Special version

310	Gasket
B	PTFE, 200°C
D	Graphite / Graphoil
Y	Special version

320	Process connection
B	FNPT1/2
E	IEC61518
Y	Special version

330	Seals; Screws
B	PTFE; UNF7/16, max 420bar
D	Viton; UNF7/16, max 420bar
K	Graphite; UNF7/16, max 420bar
Y	Special version

540	Additional option
EB	Mounting bracket, stainless steel
E1	EN10204-3.1 material (wetted parts) inspection certificate
E2	EN10204-3.1 material, NACE MR0175 (wetted parts) inspection certificate
E5	Cleaned from oil+grease
E6	Oxygen service

895	Marking
Z1	Tagging (TAG)

Product structure DA73V

250	Version; Gasket
6	Valve; PTFE gasket < 200°C
8	Valve; pure graphite gasket < 300°C
9	Special version,

260	Material
F	316L
Y	Special version

270	Inlet
D	FNPT1/2
Y	Special version

280	Output
C	FNPT1/2
Y	Special version

530	Additional option
D1	EN10204-3.1 material (wetted parts) inspection certificate
D2	EN10204-3.1 material, NACE MR0175 (wetted parts) inspection certificate
D5	Cleaned from oil+grease
D6	Oxygen service

Deltatop DA63R: Rectifier (accessory)

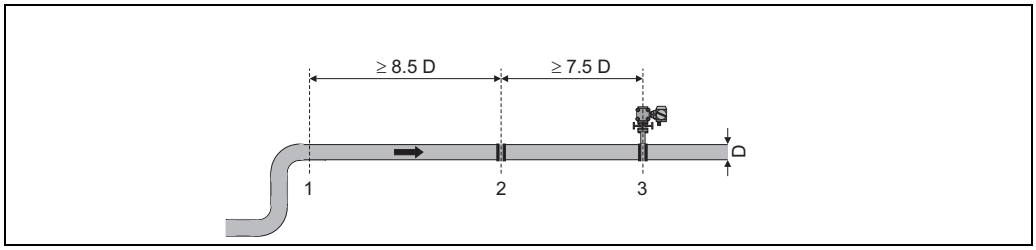
Usage

The rectifier can be used to reduce the required upstream length between an obstacle in the pipe and the orifice.

Installation conditions

- Distance between rectifier and obstacle: min. 8,5 D
- Distance between rectifier and orifice: min. 7,5 D

D: inner pipe diameter



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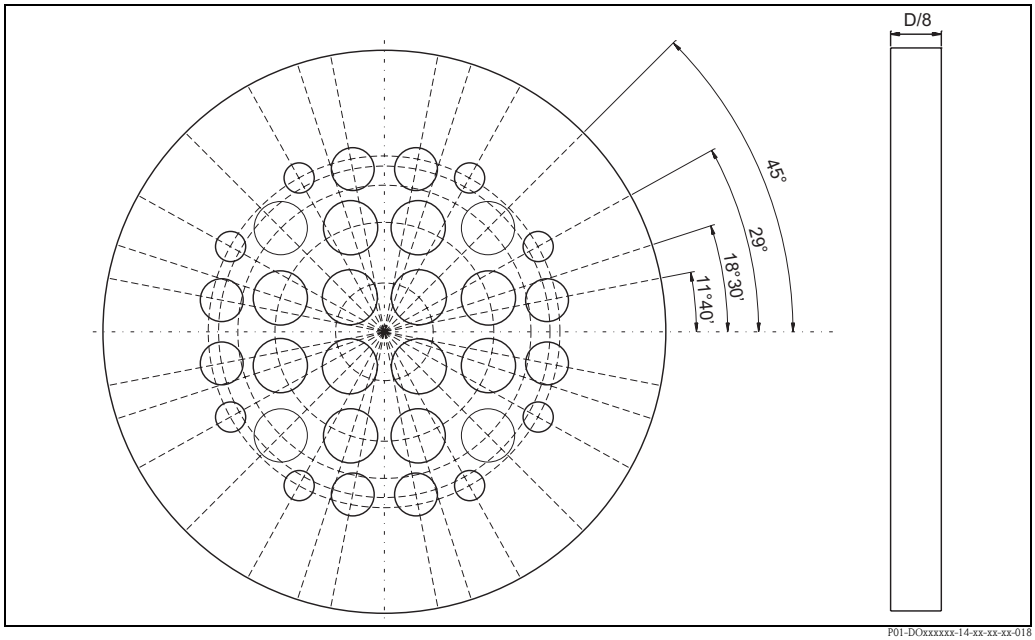
Pressure loss

Pressure loss across the rectifier:

$\Delta p = 1{,}5\ \rho\ v^2$

– Δp: Pressure loss across the rectifier [Pa]
– ρ: Density of the fluid [kg/m^3]
– v: Flow velocity [m/s]

Dimensions



The Zanker perforated plate conditioner according to ISO 5167-2 consists of 32 bores in a circular symmetrical arrangement. The dimensions of the bores depend on the inner diameter *D* of the pipe:

- 4 bores, bore diameter 0,141 *D*, reference diameter 0,25 *D*
- 8 bores, bore diameter 0,139 *D*, reference diameter 0,56 *D*
- 4 bores, bore diameter 0,1365 *D*, reference diameter 0,75 *D*
- 8 bores, bore diameter 0,11 *D*, reference diameter 0,85 *D*
- 8 bores, bore diameter 0,077 *D*, reference diameter 0,90 *D*

The plate thickness is 1/8 *D*.
The plate diameter is adjusted to the outer diameter of the flange (according to feature 30 "orifice").

Versions

Version	Nominal Diameter
DA63R25	DN25 / 1"
DA63R40	DN40 / 1-1/2"
DA63R50	DN50 / 2"
DA63R65	DN65 / 2-1/2"
DA63R80	DN80 / 3"
DA63R1H	DN100 / 4"
DA63R1Z	DN125 / 5"
DA63R1F	DN150 / 6"
DA63R2H	DN200 / 8"
DA63R2F	DN250 / 10"
DA63R3H	DN300 / 12"
DA63R3F	DN350 / 14"
DA63R4H	DN400 / 16"
DA63R4F	DN450 / 18"
DA63R5H	DN500 / 20"
DA63R6H	DN600 / 24"
DA63R7H	DN700 / 28"
DA63R8H	DN800 / 32"
DA63R9H	DN900 / 36"
DA63R1T	DN1000 / 40"

Product structure

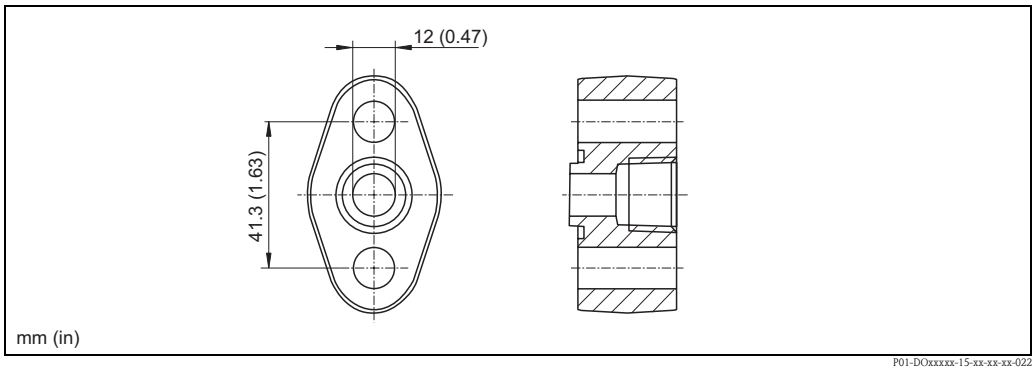
10	Version
S	Standard
Y	Special version

30	Pressure Rating, Material
	EN flanges
BAC	PN6 B1, 316L
BBC	PN10 B1, 316L
BCC	PN16 B1, 316L
BDC	PN25 B1, 316L
BEC	PN40 B1, 316L
BFC	PN63 B2, 316L
BGC	PN100 B2, 316L
BHC	PN160 E, 316L
	ANSI flanges
FAC	Cl.150 RF, 316L
FBC	Cl.300 RF, 316L
FCC	Cl.600 RF, 316L
FDC	Cl.900 RF, 316L
FEC	Cl.1500 RF, 316L
FFC	Cl.2500 RF, 316L
FKC	Cl.900 RTJ, 316L
FLC	Cl.1500 RTJ, 316L
FMC	Cl.2500 RTJ, 316L
Y99	Special version

550	Additional Option (optional, multiple options can be selected)
F1	EN10204-3.1 material (wetted parts) inspection certificate
F2	EN10204-3.1 material, NACE MR0175 (wetted parts) inspection certificate

Oval flange PZO for Deltabar S

Dimensions



P01-DOxxxxx-15-xx-xx-xx-022

Product structure PZO

010	Approval
B	EN10204-3.1 material, oval flange inspection certificate
R	Basic version
S	Cleaned from oil+grease, oxygen service
Y	Special version, to be specified

020	Process Connection
A	FNPT1/2-14
E	JIS RC1/4"
Y	Special version, to be specified

030	Material
1	316L
2	Steel C22.8
9	Special version, to be specified

040	Seal
1	PTFE
2	FKM Viton
9	Special version, to be specified

050	Mounting Screw
1	2x Mounting screw M10
2	2x Mounting screw UNF7/16-20
3	Not selected
4	2x Mounting screw M12
9	Special version, to be specified

Sizing sheet - Data sheet

Sizing Sheet - data sheet / Orifice

Sheet 1/2

Fields marked with * are mandatory to be filled-in

Project:					
Customer:		**Project-no.:**		**Contact partner:**	

Order Code

	Order code	Order no.*	Position(s) *
Primary element			
Transmitter			

Tag:

Main Parameter

Medium: * **Status *** ☐ **Gas** ☐ **Liquid** ☐ **Steam**

Operating Conditions

Pressure * For gauge pressure the ambient pressure is additionally required if different from sea level.

☐ **absolute** ☐ **gauge** **ambient pressure:** unit

Only for gases: The values for requested flow resp. density of the medium are based on the following conditions:

	operating	normal	standard (acc. to reference conditions)		unit
Flow rate *	☐	☐	☐	**Reference temp.:**	
Density *	☐	☐	☐	**Reference pressure:**	

	minimum	nominal	maximum	unit *
Requested flow:			*	
Pressure:		*		
Temperature:		*		
Density: 1)				
Viscosity: 1)				
Z-factor: 1,2)				
Isentropic index: 1,2)				

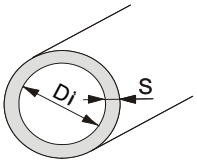
The sizing will be based on the maximum requested flow and nominal pressure and temperature.
The maximum requested flow will be set as upper range value.
1) For clearly specified fluids (e.g. water or air) those entries are not mandatory.
2) For gases only. If there are no values available the sizing will be based on standard values or the ideal gas law.

Flowmeter

Nominal width: * **Pressure rating:***

Pipe dimensions * **Mounting position s. sheet 2**

☐ **Pipe (round) ***



		unit
Inner diameter (DI):		
Wall thickness (S):		
Isolation thickness:		
Pipe material:		

The exact specification of the internal dimensions is absolutely necessary.
Nominal widths of DIN pipes DNxxx are not sufficient. Nominal widths of ANSI pipes including schedules according to ASME are sufficient.

Additional Data

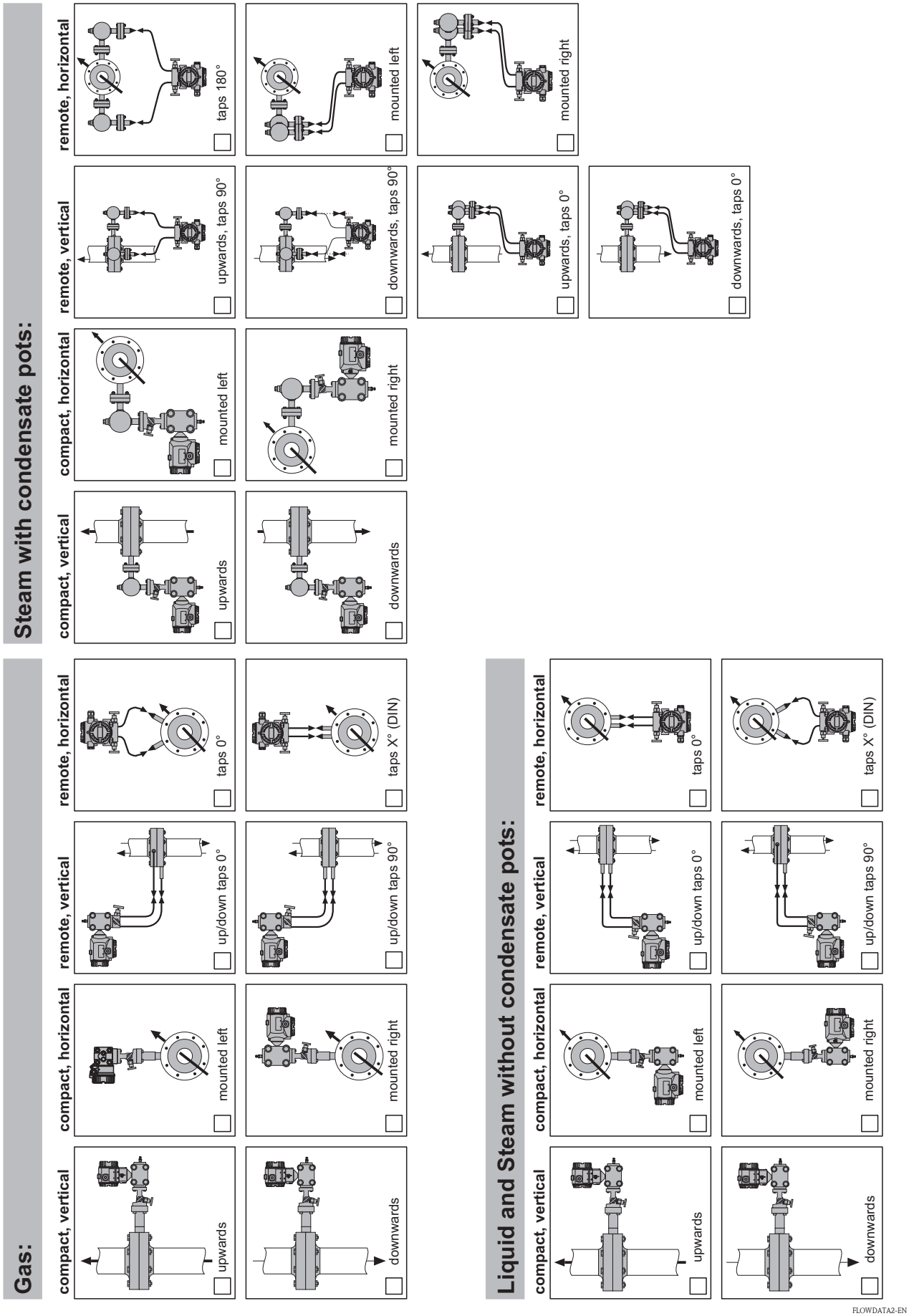
Optimization criteria

☐ Optimized by E+H
☐ Maximum Turn Down (small ß)
☐ Low pressure loss (large ß)
☐ Maximum allowable pressure loss — unit
☐ Fixed diameter ratio ß
☐ Fixed differential pressure — unit
☐ Fixed calculation (attachment)

FLOWDATA1-EN

Sizing Sheet - Mounting Position / Orifice

Not applicable for orifice plates DO64P



Instructions for the completion of the sizing sheet - data sheet

- The order code of a primary element does not completely describe the final instrument. Further information is required. The optimized sizing and calculation of the primary element is based on the requested information about process parameters and pipe dimensions etc. Additionally Endress+Hauser checks if the given infomation matches the order code of the instrument. Furthermore the feasibilty of the measuring point has to be checked as well. A completely filled-in questionaire incl. information on project, order codes and tag-no. assures the correct assignment of primary elements to differential transmitters and accessories during order processing.
- The sizing sheet – data sheet can be filled-in and printed via the Endress+Hauser sizing software Applicator. All required data can be entered or are available in the database.
- All fields marked with an asterisk * have to be completed. The order cannot be processed and production of the device cannot be started as long as those points are not clarified.
- All parameters have to be filled-in with their value and complete and correct unit (e.g. flow rate in Sm^3/h and not m^3/h for flow at standard conditions).

Section	Field / Parameter	Explanation of the entry	mandatory		
			A[1)]	B[1)]	C[1)]
Project					
	Project Customer Project no.	Order specific customer data			
Order code					
Primary element	Order code	Order code of the selected primary element			
	Order no.* Positions*	Order position, to be assigned to this data sheet.			yes
Transmitter	Order code	Order code of the associated differential pressure transmitter.			
	Order no. * Positions*	Order position of the dp transmitter, to be assigned to the primary element.			yes
Tag					
	Tag	Tag no. for clear assignment of primary element and dp-transmitter.			
Main parameter					
	Medium* Status*	Exact designation of the fluid with name (e.g. water) or chemical formula (e.g. CH_4). And type of fluid or state of aggregate of the medium at the given operating conditions – gas, liquid or steam. Depending on this entry further information will be required.	yes		
Operating conditions					
Process		The differential pressure calculation is based on the correct information about the process conditions. Generally, the layout point for the primary element is maximum requested flow rate at nominal pressure and nominal temperature.			
	Pressure* (absolute or gauge)	Clearly state whether the static pressure is given as absolute or gauge pressure.	yes	yes	
	Ambient pressure	The primary element calculation is always based on absolute static pressure in the pipe. If the static pressure is given as gauge pressure additionally the average ambient pressure (if different from sea level) or alternatively the height of the location above sea level has to be specified.	yes		
	Flow rate* Density* (at operating / normal / standard conditions)	For gases only: Values of flow rate and/or density can be related to the actual operating conditions (nominal pressure and temperature) or to normal or standard conditions. The resulting difference may be huge depending on pressure and temperature. Please check carefully. Please additionally clearly specify the units of flow rate and density (e.g. flow rate in Sm^3/h and not m^3/h for flow at standard conditions).	yes		
	Operating conditions	For gases only: The values of flow rate or density are related to the nominal process conditions (pressure and temperature).	yes		
	Normal conditions	For gases only: The values of flow rate or density are related to normal conditions (pressure and temperature).: Pressure: 101,325 kPa abs (1 atm / 760 Torr). Temperature: 32 °F (0 °C / 273,15 K)	yes		

Section	Field / Parameter	Explanation of the entry	mandatory		
			A[1)]	B[1)]	C[1)]
	Standard conditions (acc. to reference conditions)	For gases only: The values of flow rate or density are related to standard conditions (pressure and temperature).: Pressure: 101,325 kPa abs. (14,696 psi abs.) Temperature: 59 °F (15 °C) If there are other reference conditions to be considered, the values for those conditions have to be clearly specified additionally.	yes		
	Reference temp.	Reference temperature at standard conditions	yes		
	Reference pressure	Reference pressure at at standard conditions	yes		
	Req. flow	Specification of the desired measuring range (minimum ... maximum) and of the operating point (nominal). The measuring dynamics is typically between 1:3 and 1:6 (minimum : maximum). A measuring dynamics of more than 1:10 usually requires cascading (split range) of several differential pressure transmitters (→ 🖹 8). Too large measuring dynamics between the nominal and the maximum flow can result in an increased measuring uncertainty at the operating point and should be avoided.	yes	yes	
	Pressure	Static pressure in the pipe upstream (plus side) of the primary element.	yes	yes	
	Temperature	Temperature of the fluid at the primary element.	yes	yes	
Fluid properties		Clearly defined liquids and gases like steam, oxygen, nitrogen, pure water or ethanol do not require further entries of fluid properties. All necessary information about these data is easily accessible in the relevant literature.Mixtures (e.g. natural gas) or brand names (e.g. Shell motor oil) do not provide sufficient information for the calculation. More information is required. If the fluid properties of a mixture are not clear, a list of ingredients and their composition can be attached to this datasheet for clarification.The Endress+Hauser sizing tool Applicator provides a large medium database with all necessary fluid properties for a big variety of fluids.			
	Density	The density is an essential input value of the flow calculation. This field must be completed in case of mixtures and brand names.	yes		
	Viscosity	The influence of the viscosity value on the calculation is normally very small but the Reynolds No. is a function of the viscosity. This may be a limiting factor for the measurement especially with highly viscous liquids.	yes		
	Z-Factor	For gases only: The compressibility factor Z does have an influence on the density especially at higher pressure and/or higher temperature. If the density is given at normal or standard conditions this may have a quite big impact on the calculation result. If this value is not available, the calculation will be done with the factor set to 1 or in case of clear defined mixtures with a factor calculated or estimated from the ingredients.	yes		
	Isentropic index	For gases only: The isentropic index (or specific heat ratio) is required for the calculation of the expansion factor. If the value is not available, the calculation will be done with standard values: 1,65 for monoatomic gases (e.g. Helium He) 1,4 for diatomic gases (e.g. nitrogen N_2) 1,28 for triatomic gases (e.g. carbon dioxide CO_2)	yes		
Flowmeter					
	Nominal width*	Nominal width of the pipe according to the relevant standards, e.g. 8" (ASME) or DN200 (DIN).		yes	
	Pressure rating*	Pressure rating of the selected connection (e.g. flange) according to the relevant standard, e.g. Cl. 600 lbs (ASME) or PN40 (DIN).		yes	
Pipe dimensions					
	Pipe (round)	Orifices can only be applied in round pipes. Therefore, no other selection is possible.		yes	
	Inner diameter (DI)	Mean inner diameter of the pipe. All current standards for differential pressure calculation require the specification of the exact mean diameter. Incorrect specifications result in measuring errors. Usually the inner diameter is not equal to the nominal diameter. A pipe with a nominal diameter of DN200 according to ISO may have an inner diamter between 194 mm and 215 mm depending on the pressure rating. For pipes according to ASME, specification of the nominal diameter and the schedule number are sufficient.	yes	yes	
	Wall thickness (S)	Exact specification of the wall thickness simplifies the checking of the pipe data on the basis of the relevant standards.		yes	
	Isolation thickness	Thickness of a possible thermal isolation of the pipe or of other covering shells. If the isolation is very thick, an extension of the taps or the neck of a compact version may be required.			

Section	Field / Parameter	Explanation of the entry	mandatory		
			A[1)]	B[1)]	C[1)]
	Pipe material	Specification of the correct pipe material. The selected material of flanges or carrier rings should match the pipe material. If there are welding connections, weldability has to be ensured.		yes	
Additional Data					
Optimization criteria		For all optimization criteria: Endress+Hauser calculates the measuring point in consideration of the requested optimization criterium as far as reasonably achievable and in accordance with the valid standards.			
	Optimized by E+H	Endress+Hauser completely calculates and optimizes the measuring point in consideration of the given process parameters. The optimum solution provides the best achievable compromise between differential pressure, measuring cell selecetion, measurement dynamics, measurement uncertainty and permanent pressure loss.	yes		
	Maximum measurement dynamics (small β)	Endress+Hauser calculates and optimizes the measuring point to the smallest reasonably achievable diameter ratio β in order to provide maximum measurement dynamics and minimum measurement uncertainty.	yes		
	Low permanent pressure loss (large β)	Endress+Hauser calculates and optimizes the measuring point to the largest reasonably achievable diameter ratio β in order to keep the permanent pressure loss as low as possible.	yes		
	Maximum allowable permanent pressure loss	Endress+Hauser calculates the measuring point in consideration of the maximum allowable pressure loss at the layout point (maximum flow rate). The entry of the requested maximum permanent pressure loss is mandatory.	yes		
	Fixed diameter ratio β	The sizing has to be executed with a user defined diameter ratio β. Endress+Hauser calculates the measuring point accordingly. The entry of the requested fixed diameter ratio is mandatory.	yes		
	Fixed differential pressure	The sizing has to be executed with a user defined differential pressure. Endress+Hauser calculates the primary element in order to meet the requested differential pressure at the layout point. The entry of the requested fixed differential pressure is mandatory.	yes		
	Fixed sizing calculation (attachment)	A completed sizing calculation already exists. Endress+Hauser verifies the calculation and manufactures the primary element according to the given sizing calculation. The corresponding calculation sheet has to be attached.	yes		
Mounting position					
	Mounting position	A suitable mouting position in accordance with the situation on site can be chosen by marking the check box below the pictogram. The chosen mouting position has to match with the order code. Possibly existing order code exclusion will be checked by Endress+Hauser.		yes	

1) A: mandatory for differential pressure calculation;
B: mandatory for instrument selection (material, pressure rating etc.);
C: mandatory for order processing (assignment of devices)

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