Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Technical Information

Deltatop DV61S, DN61S, DN62S, DO69S, DR61S

Universal differential pressure flowmeter systems
With venturi tubes, nozzles, orifice plates and Deltabar S/M differential pressure transmitters. Pressure reduction with restriction orifices.

Application
- Flow measurement of gases, steam and liquids
- Pipe diameters from DN10 (3/8") to DN2000 (80")
- Medium temperatures from -200 °C (-328 °F) to 1000 °C (1832 °F)
- Pressure up to 420 bar (6300 psi)
- Compliant with PED 97/23/EC
- NACE-compliant materials

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

Your benefits
- Customized or application-specific flowmeter systems based on the differential pressure method for special applications, such as:
  - Low pressure loss
  - High abrasion resistance
  - Calibratable meter runs
  - Extended nominal diameter range
  - Controlled pressure reduction
- Optimized for minimum pressure loss, maximum accuracy or maximum turndown
- Measuring range of the Deltabar differential pressure transmitter adjusted on delivery
- Application of international standards (e.g. ISO 5167).
- Robust design; no moving parts

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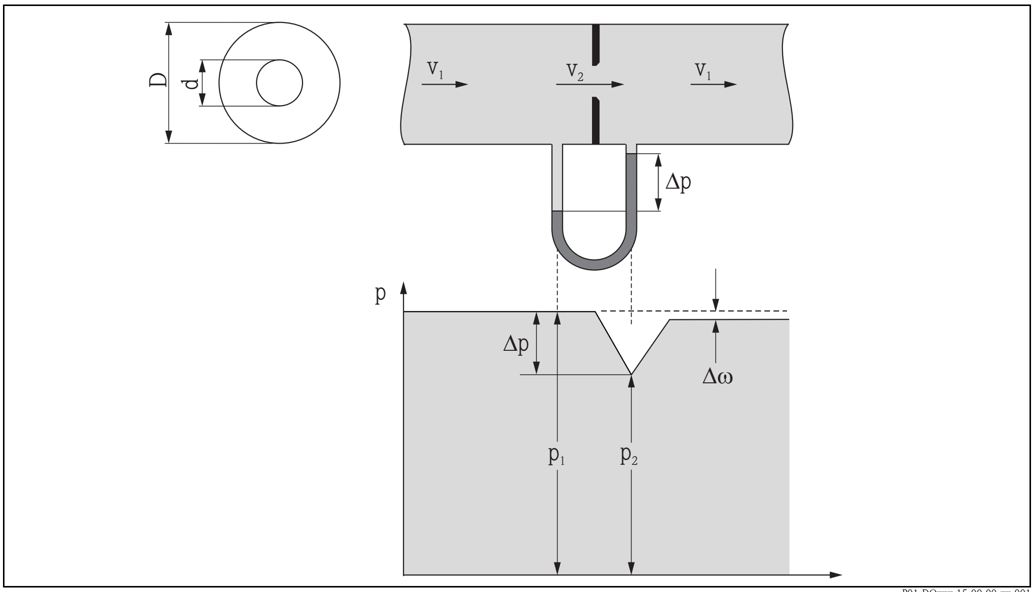
Notes on safety conventions and icons

In order to highlight safety-related or alternative procedures in the manual, the following conventions have been used, each indicated by a corresponding symbol in the margin.

Safety symbols	
	Warning! Indicates an action or procedure which, if not performed correctly, can result in serious personal injury, a safety hazard or the destruction of the device.
	Caution! Indicates an action or procedure which, if not performed correctly, can result in personal injury or the incorrect operation of the device.
	Note! Indicates an action or procedure which, if not performed correctly, can have an indirect effect on operation or trigger an unexpected response on the part of the device.
Type of protection	
	Explosion-protected, type-examined equipment If the device has this symbol embossed on its nameplate, it can be used in a hazardous area or a non-hazardous area, depending on the approval.
	Hazardous area This symbol is used in the drawings to indicate hazardous areas. Devices in hazardous areas, or cables for such devices, must have appropriate explosion protection.
	Safe area (non-hazardous area) This symbol is used in the drawings to indicate non-hazardous areas. Devices in the non-hazardous area also have to be certified if connecting cables lead into the hazardous area.
Electrical symbols	
	Direct current A terminal to which DC voltage is applied or through which direct current flows.
~	**Alternating current** A terminal to which alternating voltage (sine-wave) is applied or through which alternating current flows.
	Ground connection A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
	Protective ground connection A terminal which must be connected to ground prior to establishing any other connections.
	Equipotential connection A connection that has to be connected to the plant grounding system: This may be a potential matching line or a star grounding system depending on national or company codes of practice.
t ≥ 85°C	**Connecting cable immunity to temperature change** Indicates that the connecting cables have to withstand a temperature of at least 85 °C (185 °F).

Function and system design

Measuring principle



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In a primary device with a reduced internal diameter, the flow velocity is larger than in the rest of the pipe. According to the Bernoulli equation this results in a reduction of the static pressure.
The differential pressure between the static pressures upstream and downstream of the primary device is measured by a differential pressure transmitter.
The value of the differential pressure depends greatly on the diameter ratio (β), and the throat inner diameter (d) and the pipe inner diameter (D).

$\beta = d/D$

The relationship between flow rate (Q) and differential pressure (Δp) is a square root function.

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

The pressure increases again downstream of the primary device. There is only a small **pressure loss Δω**.

Flow measurement using primary devices is standardized globally according to standard ISO 5167.
This standard comprises information on the shapes and sizes, system configurations and the rules of calculation.

Sizing and optimization

The relationship between differential pressure, pressure loss, flow rate and the diameter ratio β as a function of other parameters is described in detail by the international standard ISO 5167.
Endress+Hauser executes all the calculations for the primary device on the basis of the process parameters provided by the user. For this purpose, a questionnaire (sizing sheet – data sheet, see page → 71) must be completed. A calculation sheet is enclosed with all the primary devices supplied by Endress+Hauser. As a result, users do not need to perform complicated sizing calculations. Using different diameter ratios and designs, a measurement can be optimized to suit a wide range of applications. Endress+Hauser also optimizes the measuring point when making the calculations.
One of the following optimization criteria can be selected when ordering the device.

- **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 possible compromise between the differential pressure, measuring cell, turndown, measurement uncertainty and permanent pressure loss.
- **Maximum turndown (small β)**
  Endress+Hauser calculates and optimizes the measuring point to the smallest possible diameter ratio β that delivers a maximum turndown and minimum measurement uncertainty.
- **Low permanent pressure loss (large β)**
  Endress+Hauser calculates and optimizes the measuring point to the largest possible 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 is executed with a user-defined diameter ratio β. Endress+Hauser calculates the measuring point accordingly.
- **Fixed differential pressure**
  The sizing is executed with a user-defined differential pressure. Endress+Hauser calculates the primary device in order to achieve the requested differential pressure at the layout point.
- **Fixed sizing calculation**
  A completed sizing calculation is already available. Endress+Hauser verifies the calculation and manufactures the primary device according to the given sizing parameters.

"Applicator" selection and sizing tool for DV61S, DO69S

Endress+Hauser's "Applicator" software is a convenient selection and sizing tool for planning processes (see IN013F). It can be downloaded free from the Internet or used from a CD. The CD can be ordered online at: http://www.products.endress.com/applicator

Applicator Sizing Flow

The "Applicator Sizing Flow" module calculates all the necessary data for the selected primary device:
- Differential pressure
- Pressure loss
- Measuring uncertainty
- Diameter ratio β of the primary device
- Upstream and downstream straight lengths
- Pressure ratings
- Medium parameters

Additional functions

- Sizing sheet - data 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 (→ 🗎 71) must be enclosed with 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 for orifice plates and Venturi tubes within certain limits.

Selecting the differential pressure transmitter and the measuring cell

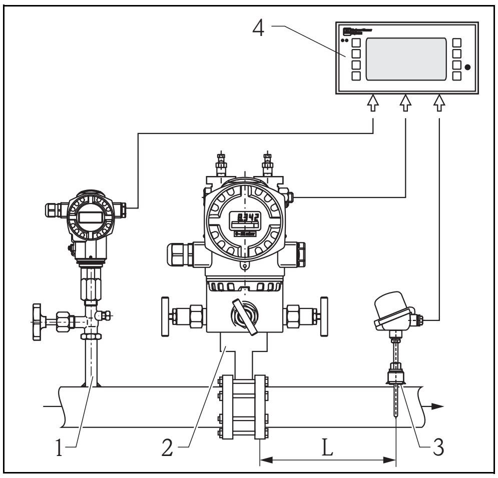
If ordered together, it is possible to order the Deltabar differential pressure transmitter with a suitable measuring cell and calibration even if the complete calculation data are not known.
For this purpose, you must select code "78" or "88" (only for static pressures over 160 bar (2320 psi)) (prepared for Deltatop) for the measuring cell option when ordering the differential pressure transmitter. Also, code "8" (adjusted for Deltatop) has to be selected for the measuring cell calibration.
The best suitable measuring cell will be selected by Endress+Hauser according to the calculation results for the primary device. The differential pressure transmitter will be delivered completely configured and preadjusted to the calculated values. This allows easy and convenient ordering and commissioning even for the less experienced user.

Temperature and pressure compensation

Separate process connections

Two additional sensors are required for temperature and pressure compensation:

- **An absolute pressure sensor**
  According to ISO 5167, this probe must always be installed upstream of the primary device. Ideally, the absolute pressure is measured at the upstream pressure tapping plane.
- **A temperature probe**
  In order to avoid disturbances in the flow profile, this probe must be installed downstream of the primary device. Ensure an adequate downstream straight length is provided (L ≥ 3D).



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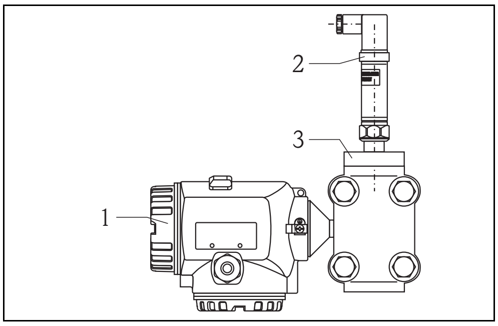
1 Absolute pressure sensor
2 Primary device with differential pressure transmitter
3 Temperature probe
4 Evaluation unit

Combined process connection for absolute and differential pressure
An adapter (e.g. oval flange adapter PZO, → 🗎 67) can be used to screw an absolute pressure transmitter into the side flange of the Deltabar S.
The absolute pressure transmitter must be mounted at the "+" side of the Deltabar S.



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1 Deltabar S
2 Absolute pressure transmitter
3 PZO oval flange adapter

Calculation of the compensated volume flow or mass flow

- **For steam and water:**
  Using the Endress+Hauser RMS621 energy manager; for details see TI092R/09/EN.
- **For steam:**
  Using the Endress+Hauser EngyCal RS33 steam calculator; for details see TI154K/09/EN.
- **For gases/steam and liquids:**
  Using the Endress+Hauser RMC621 flow and energy manager; for details see TI098R/09/EN.
- **For gas or steam:**
  Via the PLC; in this case the compensation calculation has to be programmed by the user.
- **For liquids:**
  Using the Endress+Hauser EngyCal RH33 BTU meter; for details see TI151K/09/EN.

Calculation formula for 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 device. 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 gas.

If the current output of the Deltabar S 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 = operating condition actually measured

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 ignored if the value is close to 1.
If the compressibility factor is to be included in the compensation, the value must be determined according to the acutally measured values of 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 method.

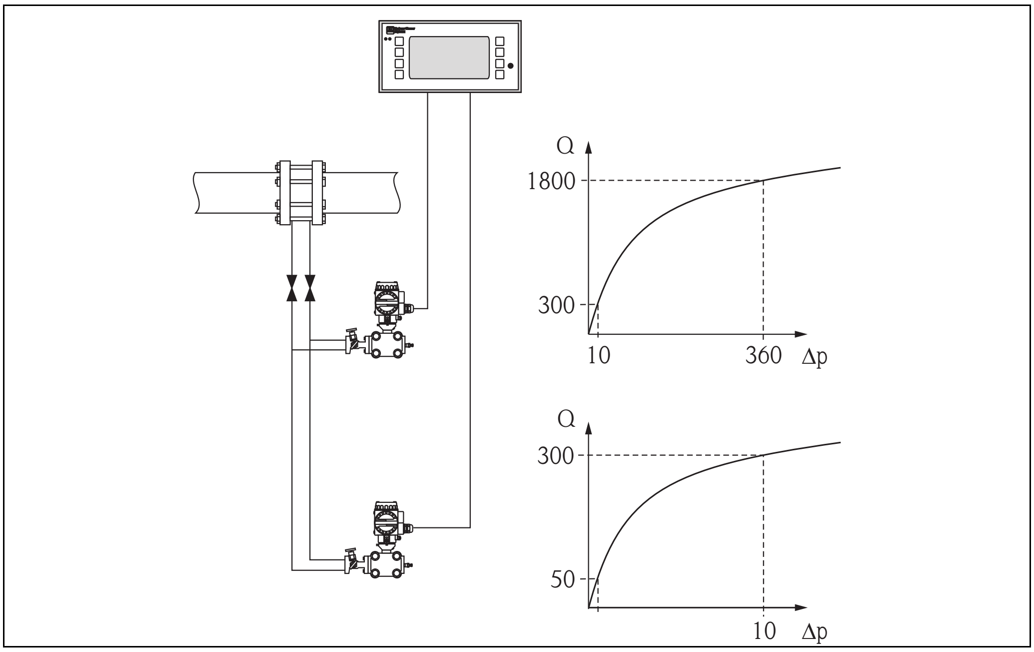
Split range (expansion of the measuring range)

The square root function has a very steep slope in the lower range. Therefore, the measuring range has a lower limit, which results in an operable flow range of typically 6:1 (max. 12:1). If the differential pressure is sufficiently high, it is possible to increase the operable flow range considerably by connecting multiple differential pressure transmitters with different measuring ranges.

The following Endress+Hauser devices can be used to evaluate the measuring signals simultaneously:
- RMS621 energy manager (see Technical Information TI092R/09/EN)
- RMC621 flow and energy manager (see Technical Information TI098R/09/EN)

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

Example



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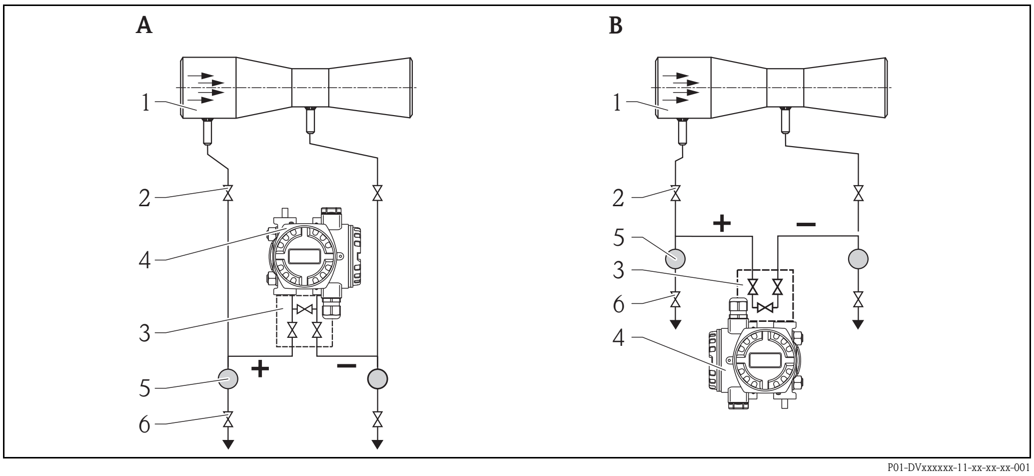
Flow measurement in liquids

With liquid applications, the transmitter must always be mounted below the pipe. All impulse lines must be installed with an upward gradient of at least 1:15 to the process connection – coming from the transmitter. This ensures that air and bubbles trapped in the impulse lines rise up into the process pipe and thus do not influence the measurement.

Note!
If measuring in media containing solids, such as dirty liquids, it is advisable to mount separators (5) and drain valves (6) in order to be able to trap and remove deposits.

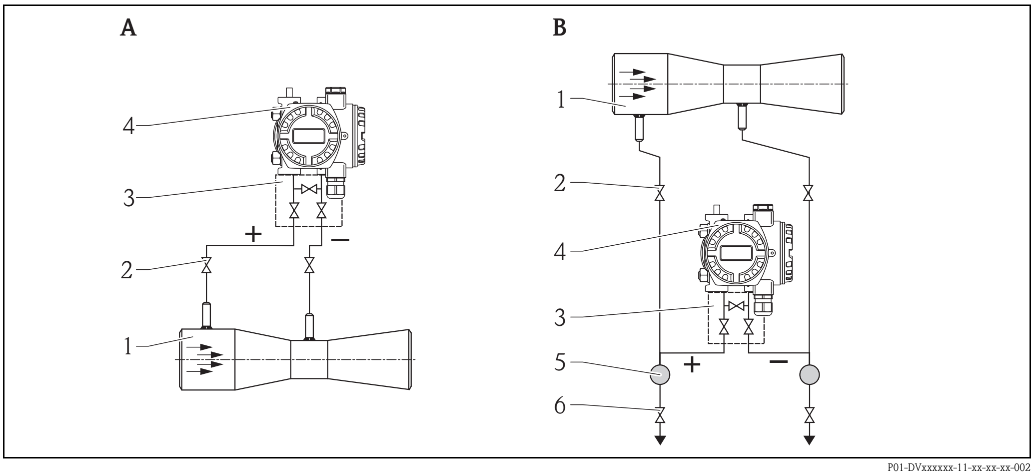


A	*Arrangement requires the transmitter to be vented*	*1*	*Primary device*
B	*Arrangement only for clean media*	*2*	*Shutoff valves*
		3	*3-valve manifold*
		4	*Deltabar differential pressure transmitter*
		5	*Separator (optional)*
		6	*Drain valves (optional)*

Flow measurement in gases

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

Note! Only for version B:
If measuring in wet gases, it is advisable to mount condensate separators (5) and drain valves (6) in order to be able to trap and drain off the condensate.

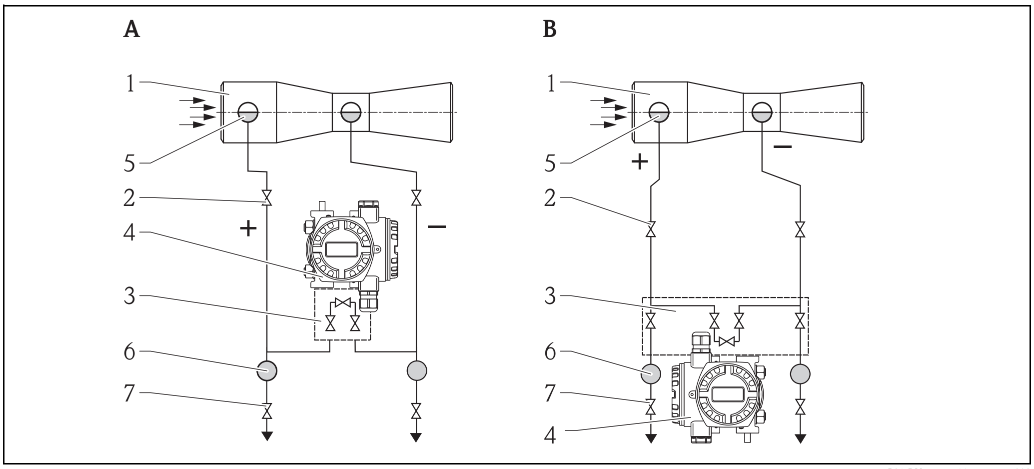


A	*Preferred arrangement*	*1*	*Primary device*
B	*Alternative arrangement (if it is impossible to mount above the pipe; only for clean media)*	*2*	*Shutoff valves*
		3	*3-valve manifold*
		4	*Deltabar differential pressure transmitter*
		5	*Separator (optional)*
		6	*Drain valves (optional)*

Flow measurement in steam

With steam applications, two condensate pots must be used. They must be mounted at the same level. The transmitter must be mounted 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 condensate drain valves.
The impulse lines must be installed with an upward gradient of 1:15 to ensure that any air trapped in the impulse lines rise up into the condensate pots. It is recommended to use flange pairs - or preferably welded connections - for steam applications. Downstream of the shutoff valves, piping can be continued with Ermeto.

Note!
If measuring steam, it is advisable to mount separators (6) and drain valves (7) in order to be able to trap and remove any fouling and dirt.



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A *With 3-valve manifold for easy venting of the transmitter especially for small differential pressures*
B *With 5-valve manifold to purge the pipe*

1 Primary device
2 Shutoff valves
3 Manifold
4 Deltabar differential pressure transmitter
5 Condensate pots
6 Separator
7 Drain valves

Use of condensate pots

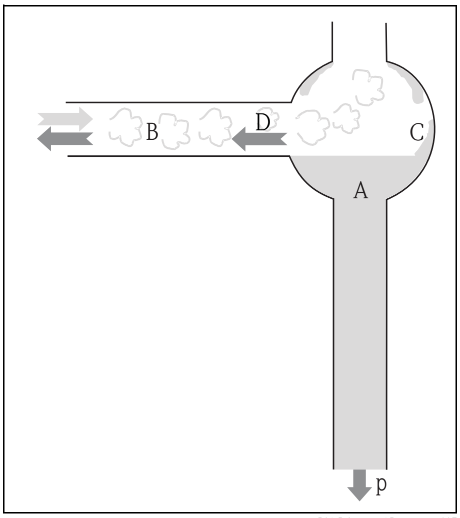
It is advisable to use condensate pots for gaseous media which become liquid when cooled in the impulse lines. This occurs primarily with water vapor but can also occur with other media (such as alcohol) depending on the pressure and temperature conditions.

Function of the condensate pots

The condensate pots ensure that the impulse lines are always filled with water and prevent hot steam from coming into contact with the process isolating diaphragm of the differential pressure transmitter. The water level is maintained by condensing steam. Excess condensate flows back and is re-evaporated. Using the condensate pots considerably reduces fluctuations of the water column. The stabilized measuring signal and the increased zero point stability ensure a consistent measuring accuracy. The water column transfers the pressure p to the transmitter.

Operating conditions

- Both condensate pots must be mounted at the same height.
- Both condensate pots must be filled completely before commissioning.



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A Water
B Steam
C Condensing steam
D Excess condensate flows back

Installation and commissioning

- When installing, make sure that the two condensate pots are at the same height as it will otherwise be difficult to perform a zero point adjustment.
- Before commissioning the measurement operation, it is important to fill the condensate pots with water, along with the impulse lines to the Deltabar differential pressure transmitter. The pots can be filled in the following ways:
  - Via filling caps on the condensate pots (if provided)
  - Via the condensate drain valves or the venting connections of the Deltabar S differential pressure transmitter.
    Therefore, the impulse lines must be connected to the water supply system using a hose fitting, for example.
  - After commissioning the steam piping, wait until the impulse lines and the condensate pots automatically fill up with condensate. All the valves on the manifold must be closed for this purpose.

Caution!
Avoid overheating the Deltabar differential pressure transmitter at all times. Depending on the steam temperature, the temperature at the manifold must be monitored. If there is a risk of overheating, close the shutoff valves in the impulse lines.

Note!
After filling and commissioning the steam supply system, always wait until the system has stabilized before performing the zero point adjustment.

Installation

Installation instructions

- The primary device is calculated to suit specific piping and operating data. For this reason, before installing check whether the data on the nameplate (→ 🗎 23) match the actual operating data.
- Prior to installing, check whether the necessary upstream and downstream straight lengths are observed (see "Upstream and downstream straight lengths" section).
- Observe the necessary orientation for:
  - liquids, → 🗎 11
  - gases, → 🗎 11
  - steam, → 🗎 12
- For the remote version:
  The shutoff valves are mounted on the pressure taps of the primary device or (in the case of steam) on the condensate pots.
- For the remote version:
  Route the impulse lines with a gradient of at least 1:15.
  - A ventilation system must be provided at the highest point for liquids and steam.
  - In the case of gas applications, a drainage system must be provided at the lowest point.

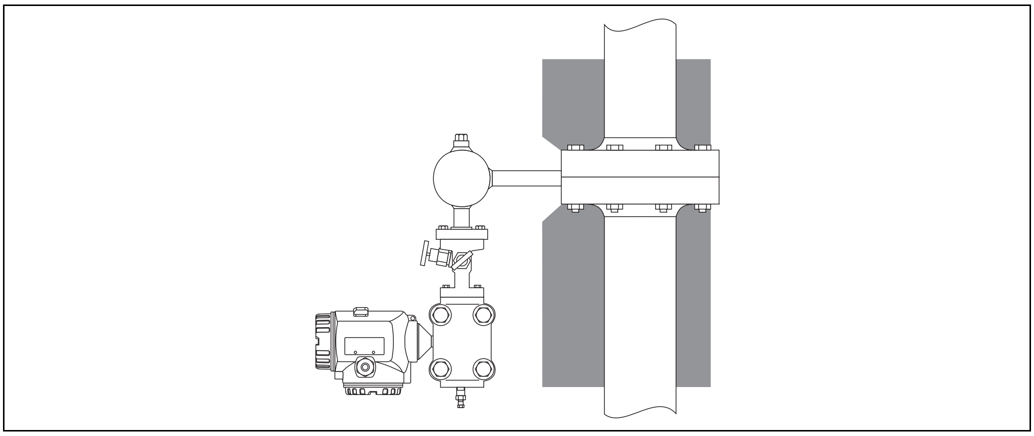
  The impulse lines (+) or (-) must be routed into the appropriate inputs (glands) of the manifold. The transmitter is screwed onto the manifold directly using the mounting material supplied.

Mounting location

- Select a mounting location that always guarantees access to the differential pressure transmitter.
- A remote version of the unit must always be used if the following process temperatures are exceeded. In such instances, the transmitter must be installed at a sufficient distance from the primary device.
  - Gas/liquid: 200 °C (392 °F)
  - Steam: 300 °C (572 °F)

Thermal insulation

In some applications it is important to ensure that no heat is lost or fed. A wide range of materials can be used to provide the required thermal insulation. In the case of insulated pipes, the impulse lines must be kept free to ensure sufficient heat dissipation. This protects the differential pressure transmitter against overheating (or excessive cooling) and applies to both the compact version and the remote version alike. The maximum insulation height permitted for compact versions is 120 mm (4.72 in).



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Caution!
Danger of electronics overheating!
The impulse lines between the primary device and transmitter must always be kept free.

Measuring range limits	The measuring range lower limit is determined by the minimum Reynolds number required for the measurement. The measuring range limit can be calculated by the "Applicator" selection and sizing tool.
Post-installation check	The following checks must be carried out once the device has been installed: ▪ Is the device damaged (visual inspection)? ▪ Do the process temperature/pressure, ambient temperature, measuring range etc. correspond to the specifications of the device? ▪ Does the flow direction indicated on the primary device match the actual flow direction? ▪ Are the measuring point number and labeling correct (visual inspection)? ▪ Is the orientation chosen for the sensor correct, in other words suitable for the sensor type, application and medium properties, particularly the medium temperature? ▪ Is the measuring device protected against moisture and direct sunlight? ▪ Are all screws firmly tightened?

Process

Homogeneity

The fluid must be homogeneous. **No changes of the state of aggregation** (liquid, gas, steam) may occur. The pipe must always be **completely filled**.

Temperature, pressure

	Compact version	Remote version
Max. temperature	▪ For gases and liquids: 200 °C (392 °F) ▪ For steam: 300 °C (572 °F)	▪ With standard material: Approx. 500 °C (932 °F) ▪ With special material: approx. 1000 °C (1832 °F)
Max. pressure	420 bar (6300 psi)	

Temperature and pressure may **not be subject to large fluctuations**.
If required, **temperature and pressure compensation** must be provided for gases and steam (see page → 🗎 8).

Temperature limits of the materials applied

DIN/EN

Designation	Short designation	Material code	Max. temperature	Reference
Steels				
HII (Kesselblech)	P265 GH	1.0425	400 °C (752 °F)	DIN EN10222-2[1)]
C22.8	P250 GH	1.0460	480 °C (896 °F)	DIN EN10222-2[1)]
Heat-resistant steels				
	16 Mo 3	1.5415	530 °C (986 °F)	DIN EN10222-2[1)]
	13 CrMo 4-5	1.7335	570 °C (1058 °F)	DIN EN10222-2[1)]
	10 CrMo 9-10	1.7380	600 °C (1112 °F)	DIN EN10222-2[1)]
	X10 CrMoVNb 9-1	1.4903	670 °C (1238 °F)	DIN EN10222-2[1)]
Stainless steels				
	X 5 CrNi 18-10	1.4301	500 °C (932 °F)	DIN EN10222-5[2)]
	X 5 CrNiMo17-12-2	1.4401	350 °C (662 °F)	DIN EN10222-5[2)]
	X 2 CrNiMo 17-12-2	1.4404	500 °C (932 °F)	DIN EN10222-5[2)]
	X 6 CrNiMoTi 17-12-2	1.4571	500 °C (932 °F)	500 °C (930 °F)[2)]
Duplex	X 2 CrNioMoN 22-5-3	1.4462	280 °C (536 °F)	VdTÜV material data sheet 418
	X 1 NiCrMoCuN 22-20-5	1.4539	400 °C (752 °F)	Manufacturer specification

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

2) Values for forgings: Maximum temperature specification for ultimate tensile strength.

Other materials

Designation	Short designation	Material code	Max. temperature	Reference
Monel 400	(S-)NiCu 30 Fe	2.4360	425 °C (797 °F)	VdTÜV material data sheet 263
Hastelloy C4	NiMo 16 Cr 16 Ti	2.4610	400 °C (752 °F)	VdTÜV material data sheet 424
Hastelloy C276	NiMo 16 Cr 15 W	2.4819	450 °C (842 °F)	VdTÜV material data sheet 400
Alloy 625	NiCr 22 Mo 9 Nb	2.4856	Approx. 900 °C (1652 °F)	Key to steel[1)]
Alloy 825	NiCr 21 Mo	2.4858	450 °C (842 °F)	VdTÜV material data sheet 432

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

ASME/AISI/ASTM

Designation	Short designation	Material code	Max. temperature	Reference
Steels				
C-Si	A105	K03504	425 °C (797 °F)	ASME B16.5[1)]
Heat-resistant steels				
C-1/2Mo	A182 Gr. F1	K12822	465 °C (869 °F)	ASME B16.5[1]
1 1/4Cr-1/2Mo-Si	A 182 Gr. F11 Cl.2	K11572	590 °C (1094 °F)	ASME B16.5[1]
2 1/4Cr-1Mo	A 182 Gr. F22 Cl.3	K21590	590 °C (1094 °F)	ASME B16.5[1]
Stainless steels				
18Cr-8Ni	A 182 Gr. F304	S30400	538 °C (1000 °F)	ASME B16.5[1]
16Cr-12Ni-2Mo	A 182 Gr. F316	S31600	538 °C (1000 °F)	ASME B16.5[1]
16Cr-12Ni-2Mo	A 182 Gr. F316L	S31603	450 °C (842 °F)	ASME B16.5[1]
22Cr-5Ni-3Mo-N	A 182 Gr. F51	S31803	315 °C (599 °F)	ASME B16.5[1]
	A 182 Gr. F904L	N08904	375 °C (707 °F)	ASME B16.5[1]

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

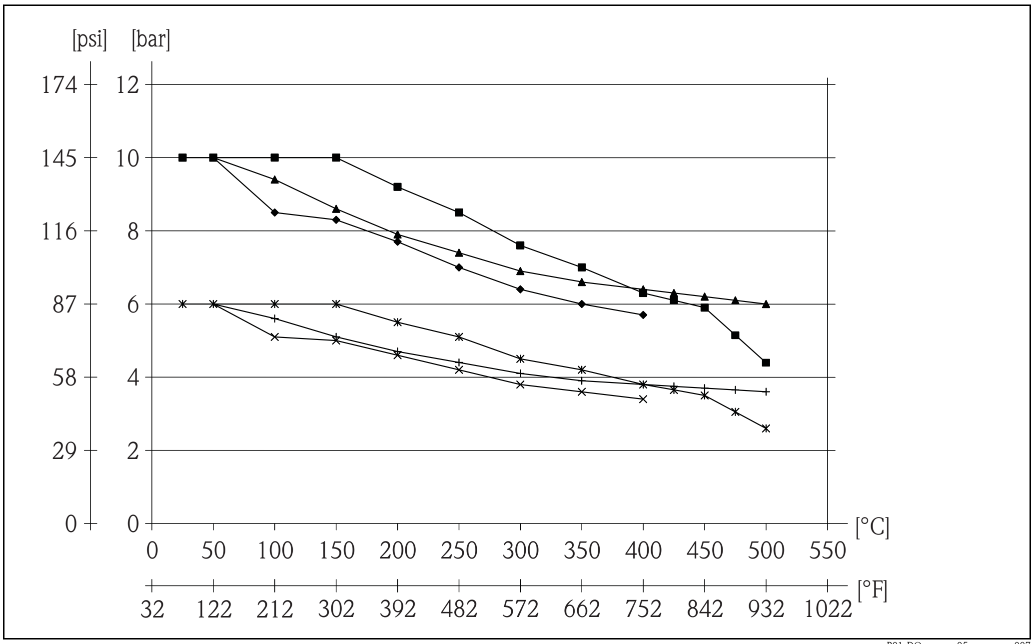
Plastics

Designation	Short designation	Max. temperature	Reference
PVC	Polyvinyl chloride	Up to approx. 70 °C (158 °F)	Manufacturer specification
PP	Polypropylene	Up to approx. 90 °C (194 °F)	Manufacturer specification
PE	Polyethylene	Up to approx. 80 °C (176 °F)	Manufacturer specification
PVDF	Polyvinylidene fluoride	Up to approx. 130 °C (266 °F)	Manufacturer specification
PTFE	Polytetrafluorethylene	Up to approx. 150 °C (302 °F)	Manufacturer specification

Note!
All temperature specifications are only reference 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 ratings for flanges according to EN1092-1:2008

PN6 /PN10



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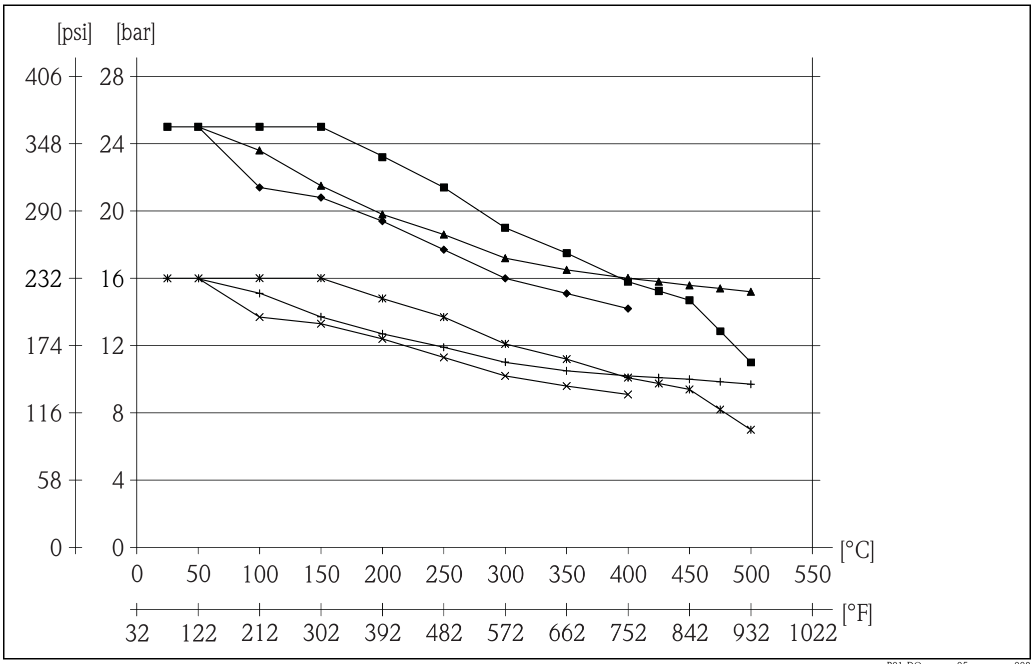
- *C22.8 /PN10*
- *16Mo3 / PN10*
- *316L / PN10*
- *C22.8 / PN6*
- *16Mo3 / PN6*
- *316L / PN6*

PN16 /PN25



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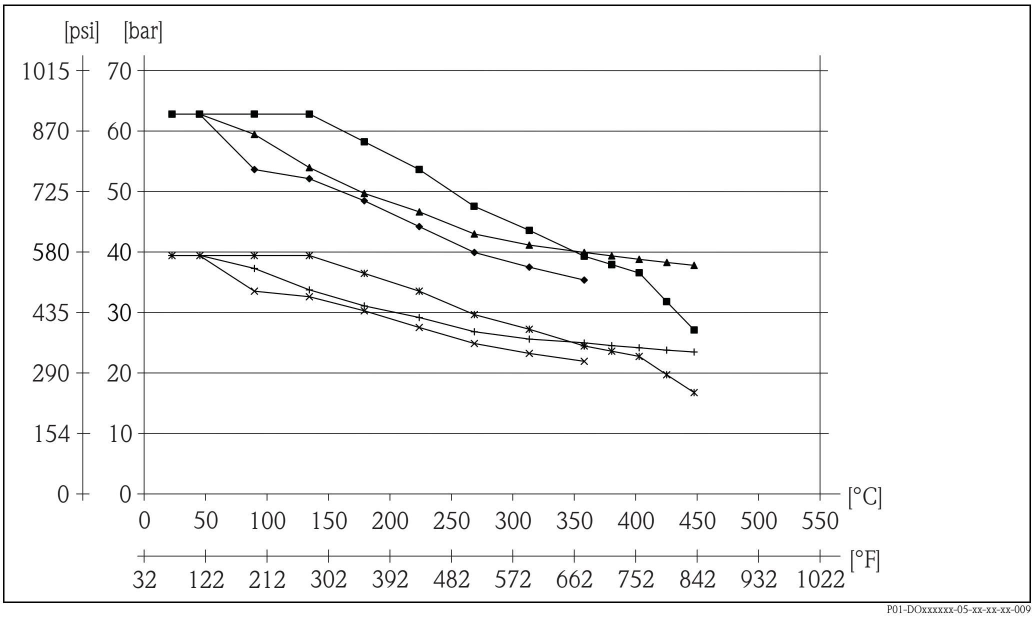
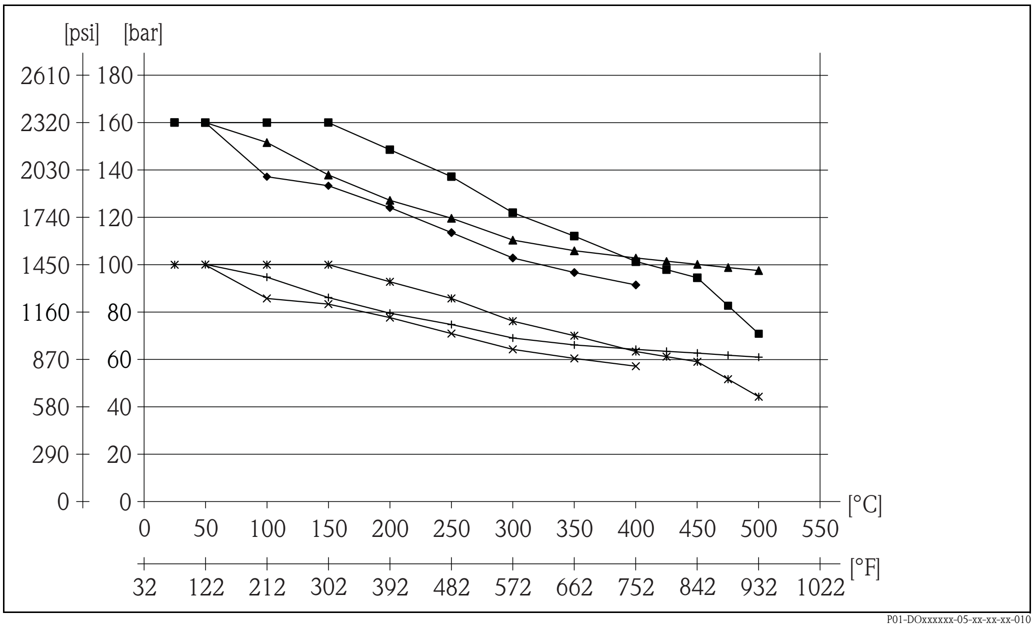
- *C22.8 /PN25*
- *16Mo3 / PN25*
- *316L / PN25*
- *C22.8 / PN16*
- *16Mo3 / PN16*
- *316L / PN16*

PN40 /PN63



C22.8 /PN63
16Mo3 / PN63
316L / PN63
C22.8 / PN40
16Mo3 / PN40
316L / PN40

PN100 /PN160

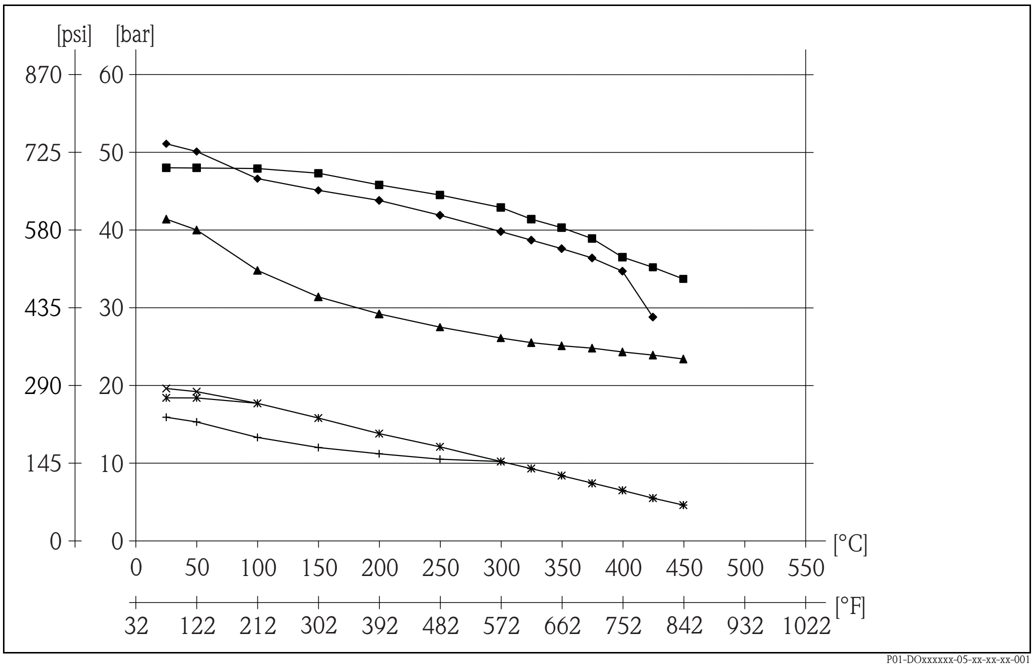


C22.8 /PN160
16Mo3 / PN160
316L / PN160
C22.8 / PN100
16Mo3 / PN100
316L / PN100

Note!
The values for 316L refer to the 1% yield strength.

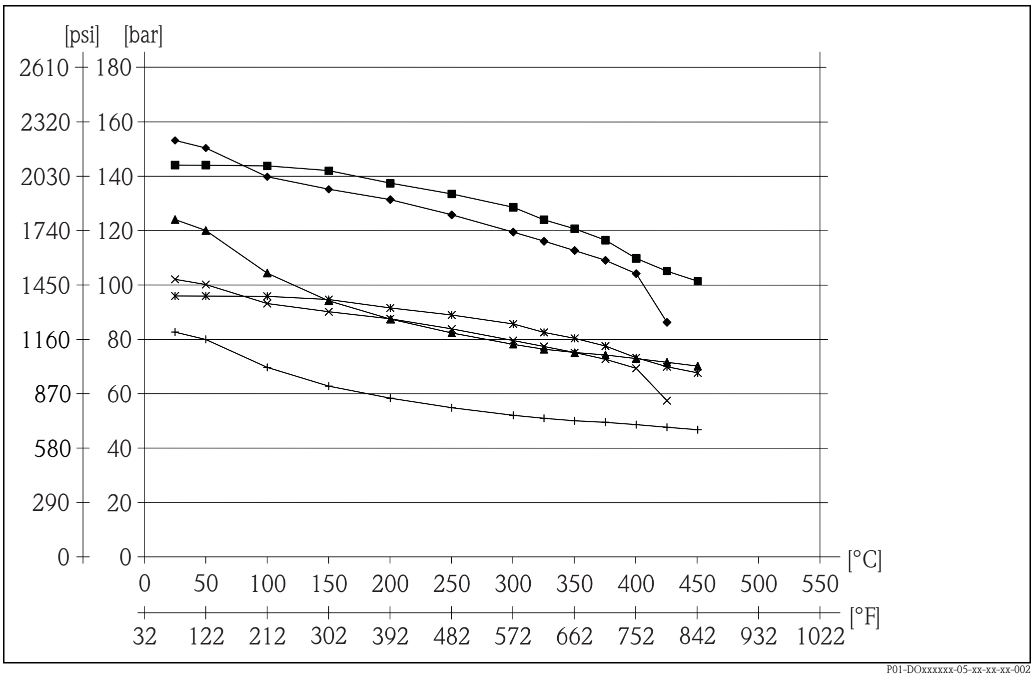
Pressure-temperature ratings for flanges according to ANSI B16.5-2003

Cl. 300 /Cl. 150



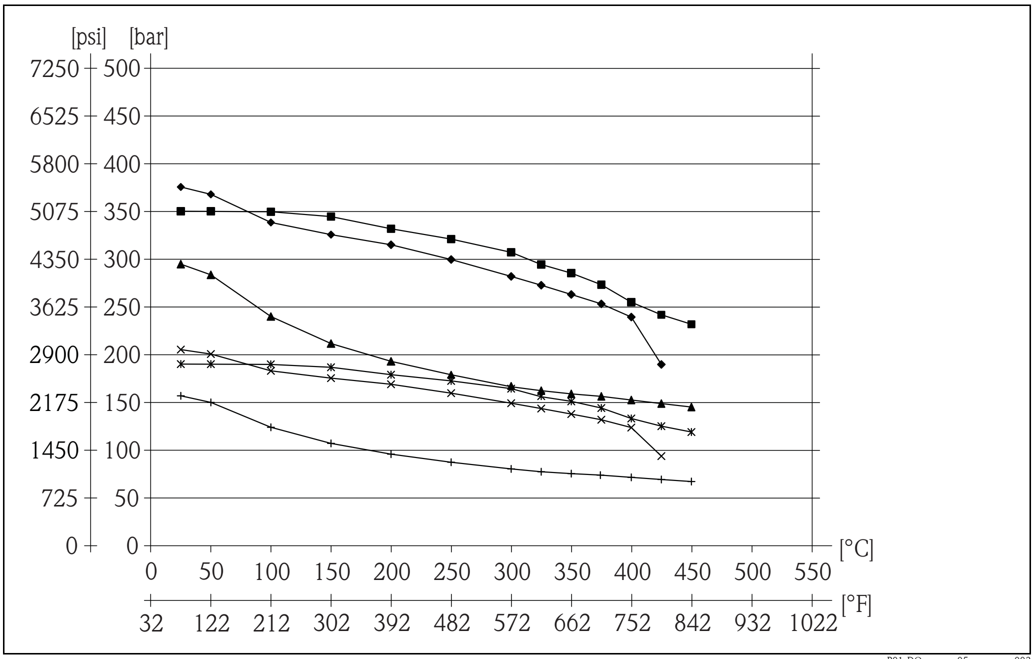
A105 / Cl.300
A182Gr.F1 / Cl.300
316L / Cl.300
A105 / Cl.150
A182Gr.F1 / Cl.150
316L / Cl.150

Cl. 900 / Cl. 600



A105 / Cl.900
A182Gr.F1 / Cl.900
316L / Cl.900
A105 / Cl.600
A182Gr.F1 / Cl.600
316L / Cl.600

Cl. 2500 /Cl. 1500



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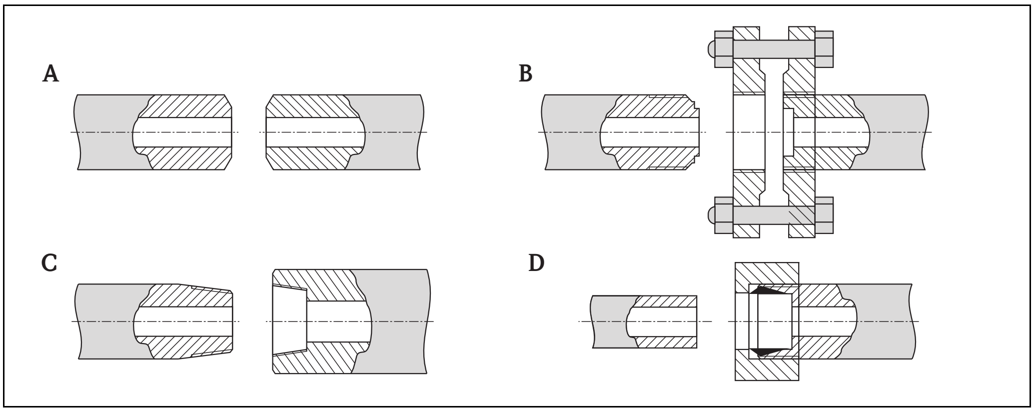
A105 / Cl.2500
A182Gr.F1 / Cl.2500
316L / Cl.2500
A105 / Cl.1500
A182Gr.F1 / Cl.1500
316L / Cl.1500

Differential pressure connection

Differential pressure connection for remote version

For the remote version, the following connections are typically used to connect the impulse lines and the individual components:



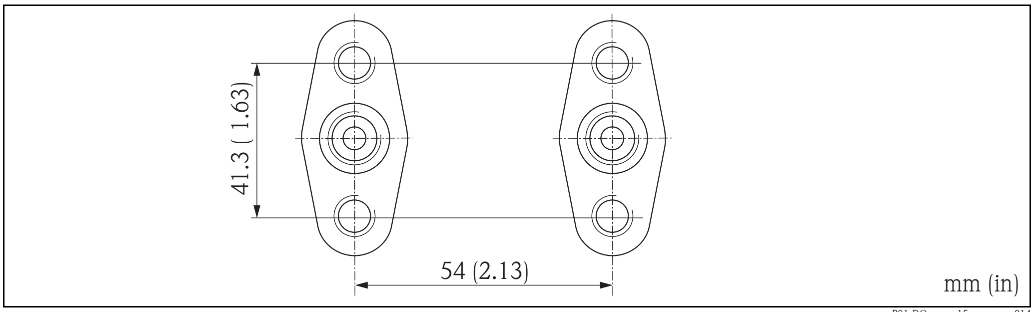
P01-DOxxxxx-15-xx-xx-xx-021

	Outlet (from the primary device)	Inlet (to the accessory)	Application/Remarks
A	Welding connection 14/21.3/24 mm	Welding connection 14/21.3/24 mm	For highly demanding applications; permanent joint
B	G½ DIN 19207	G½ DIN 19207 + 2 flanges[1)]	Disconnectable; especially suited for steam
C	MNPT½	FNPT½	Simple mounting; not suited for steam
D	Pipe 12 mm	Cutting ring (Ermeto 12S)	Simple mounting; easily disconnectable; not suited for steam

1) The flanges are included in the scope of supply of the accessory.

Other connection versions are available on request.

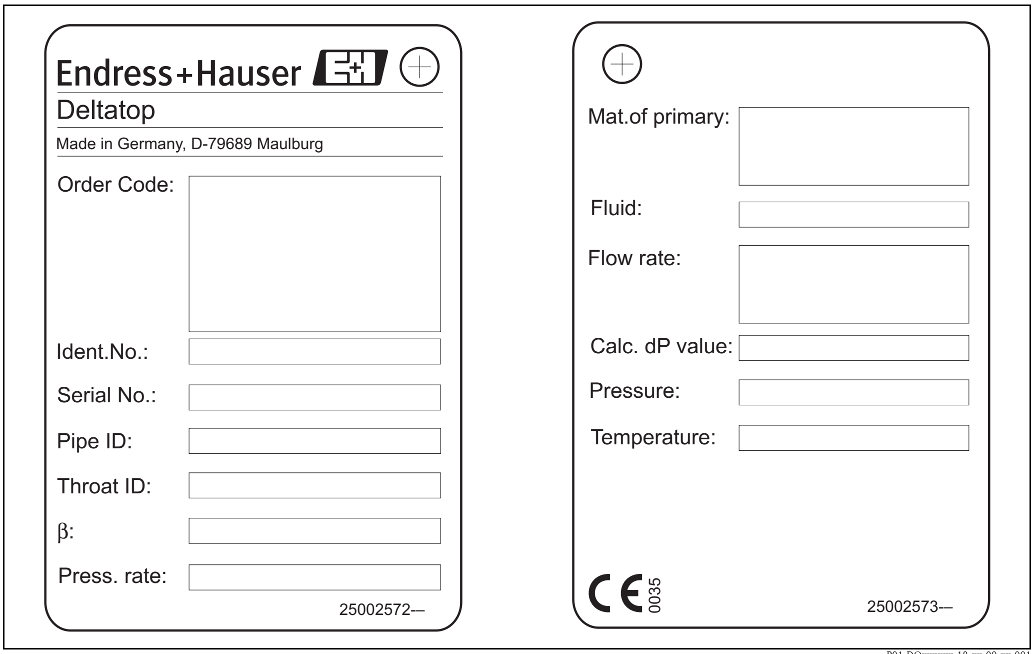
Differential pressure connection for compact version (IEC 61518)



P01-DOxxxxx-15-xx-xx-xx-014

Identification

Nameplate



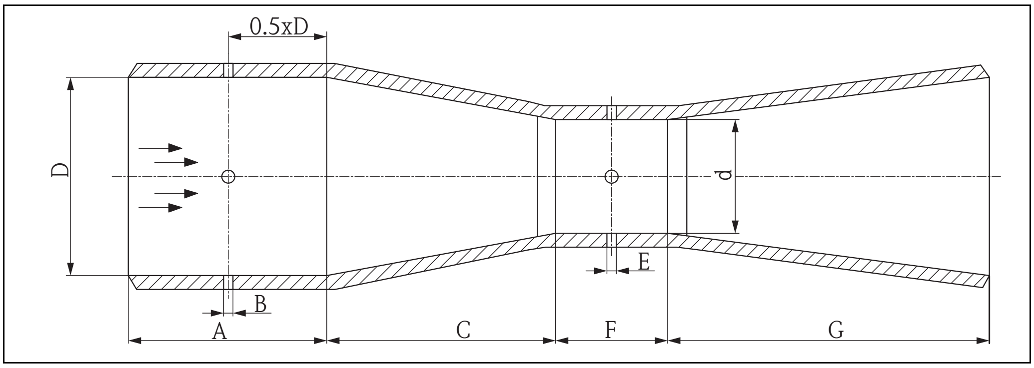
P01-DOxxxxxx-18-xx-00-xx-001

Order code: order code of the device according to the product structure
Ident No: identification number for the unique identification of the device
Serial No.: serial number
Pipe ID: internal diameter of the measuring pipe
Throat ID: throat inner diameter
β: *diameter ratio (= throat diameter / pipe diameter)*
Press. rate: pressure rating
Mat. of primary: material of the primary device
Fluid: fluid for which the device is designed
Flow rate: flow rate for which the device is designed (operating point)
Calc. dP value: calculated differential pressure at the operating point
Pressure: operating pressure
Temperature: operating temperature
CE 0035: CE mark for Pressure Equipment Directive 97/23 EC

DV61S: Venturi tube

Product overview

Many versions of Venturi tubes are available and standardized in accordance with a range of international or national standards, practically all of which can be provided by Endress+Hauser. A Venturi tube generally comprises the following parts:



P01-DV61Sxxx-16-xx-xx-xx-000

A *Entrance cylinder*
B *Upstream pressure tapping in the entrance cylinder*
C *Conical convergent section with fixed angle*
D *Inner diameter of the pipe*
d *Throat inner diameter*
E *Throat pressure tapping*
F *Cylindrical constriction or throat*
G *Conical divergent section (expander) with variable angle*

The main advantages associated with Venturi tubes are:
- Significantly less pressure loss compared to orifice plates and nozzles.
- Less susceptible to abrasion.
- Short upstream and downstream straight lengths
- Bidirectional version possible.
- Can be used for square ducts.

Venturi tubes are standardized internationally in accordance with ISO 5167-4:2003. Divergent designs or calculation methods are also possible following consultation with the manufacturer.

Mechanical construction / technical features

There are three types of Venturi tubes according to ISO 5167:
- Venturi tube with a rough-welded sheet-iron convergent section.
- Venturi tube with a machined convergent section.
- Venturi tube with an "as cast"cast convergent section.

Different application ranges apply for the nominal diameters, beta "β" and Reynolds numbers for all three versions according to ISO 5167. For any other applications, extended standards are available or a wet calibration is recommended.

"As cast" convergent section	Machined convergent section	Rolled/welded convergent section
▪ DN100 to DN800 ▪ β 0.3 to 0.75 ▪ 20000 < Re < 2000000	▪ DN50 to DN250 ▪ β 0.4 to 0.75 ▪ 200000 < Re < 1000000	▪ DN200 to DN1200 ▪ β 0.4 to 0.7 ▪ 200000 < Re < 2000000

The following applies for all the versions:
- Angle of convergent section 21°.
- Angle of divergent section 7-15°.
- The upstream pressure tapping is located 0.5xD upstream of the conical convergent section.
- The length of the throat is the same as the inner diameter of the throat (d).
- The throat pressure tapping is located in the middle of the throat.
- The conical divergent section can be truncated by up to 35%.

Detailed information on the design is provided in the corresponding standards.

Typical special versions are:
- Venturi tubes for square ducts.
  Calculations are performed on the basis of ISO 5167 with the equivalent circular pipe cross-sectional area.
- Bidirectional Venturi tubes.
  In such cases, the angle of the conical divergent section cannot be observed as defined in the standard.

Process connection

Venturi tubes are typically integrated in the customer's piping by flanges or a welding connection. Customers can choose from a wide range of versions and connection options:
- Welding neck flanges (DIN, ANSI ...)
- Slip-on flanges (DIN, ANSI...)
- Welding connections
- Meter runs with attached straight inlet pipe (recommended for wet calibrations)

Pressure tappings

In accordance with ISO 5167, tappings should be made in the plane of the upstream and throat pressure tapping by four individual tappings, interconnected by an averaging ring or annular chamber. This type of tapping is recommended if wet calibration is planned. Depending on the application or requirements, a simple single bore tapping could suffice or even offer certain advantages.

Upstream and downstream straight lengths

The same specifications apply with regard to the necessary upstream and downstream straight lengths for all versions in accordance with ISO 5167:

Diameter ratio β		0.30	0.40	0.50	0.60	0.70	0.75
Single 90° bend 1)	A2)	8	8	9	10	14	16
	B3)	3	3	3	3	3	8
Two or more 90° bends in the same plane or different planes	A2)	8	8	10	10	18	22
	B3)	3	3	3	3	3	8
Reducer from 1.33xD to D over a length of 2.3xD	A2)	4	4	4	4	4	4
	B3)	4)	4)	4)	4)	4)	4)
Expander from 0.67xD to D over a length of 2.5xD	A2)	4	4	5	6	7	7
	B3)	4)	4)	4	4	5	6
Reducer from 3xD to D over a length of 3.5xD	A2)	2.5	2.5	5.5	8.5	10.5	11.5
	B3)	4)	4)	2.5	2.5	2.5	3.5
Expander from 0.75xD to D over a length of 1xD	A2)	2.5	2.5	2.5	3.5	5.5	6.5
	B3)	4)	4)	4)	2.5	3.5	4.5
Full bore ball or gate valve fully open	A2)	2.5	2.5	3.5	4.5	5.5	5.5
	B3)	4)	4)	2.5	2.5	3.5	3.5

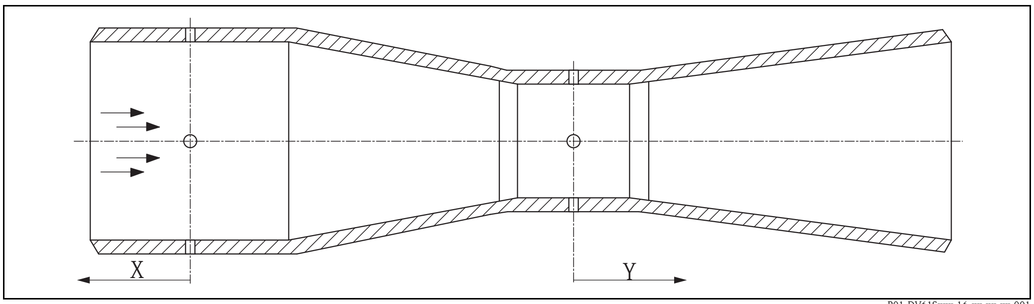
1) The required lengths depend on the distance of the two bends; typical values are given in this table. For detailed specifications refer to ISO 5167-4. The upstream length is also calculated by the "Applicator" selection and sizing tool.

2) A: for zero additional uncertainty

3) B: for 0.5% additional uncertainty

4) The necessary disturbance-free straight length in Row A gives zero additional uncertainty. Data are not available for shorter straight lengths which could be used to give the required straight lengths for Row B.

The straight lengths are measured from the tapping points:



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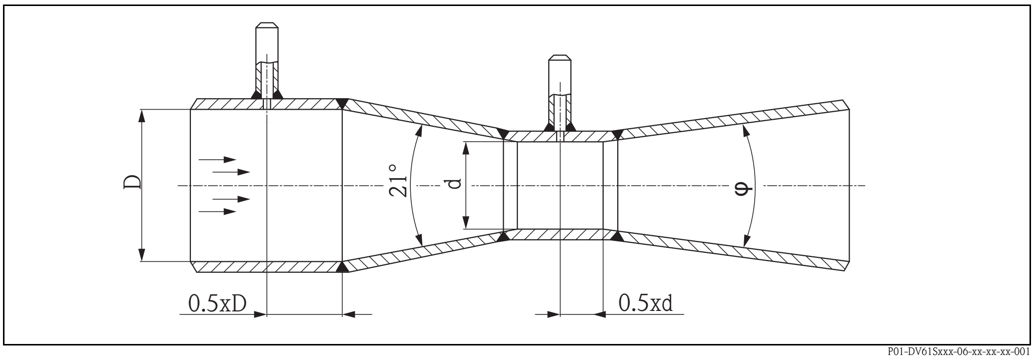
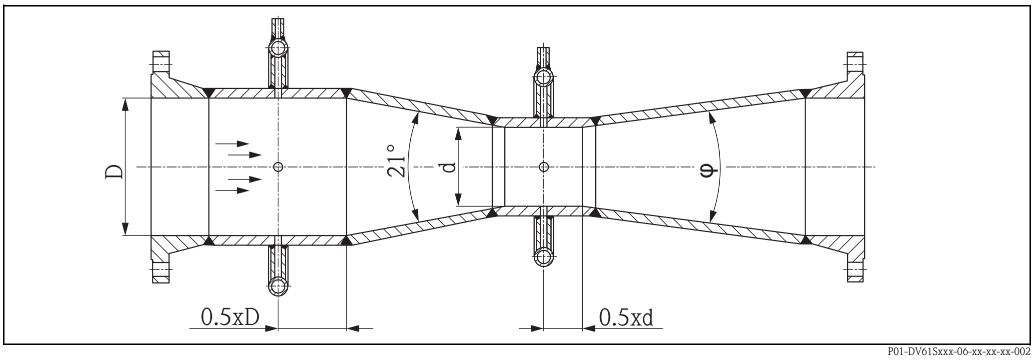
X *Upstream straight length*
Y *Downstream straight length; in most instances, the downstream straight length is already covered by the length of the conical divergent section*

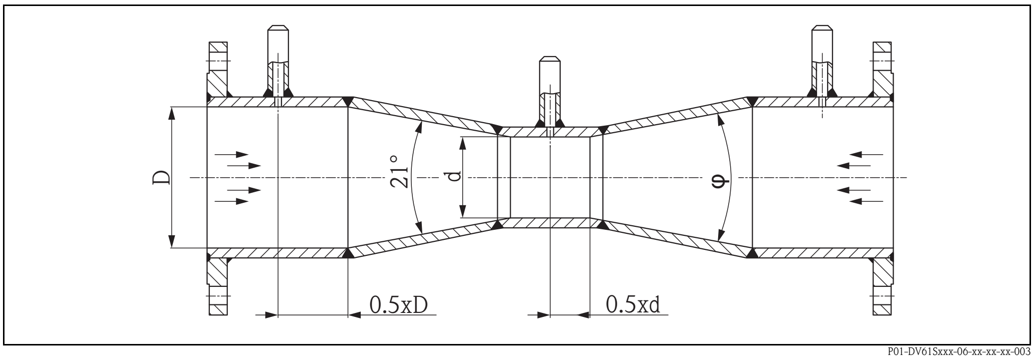
Typical configurations



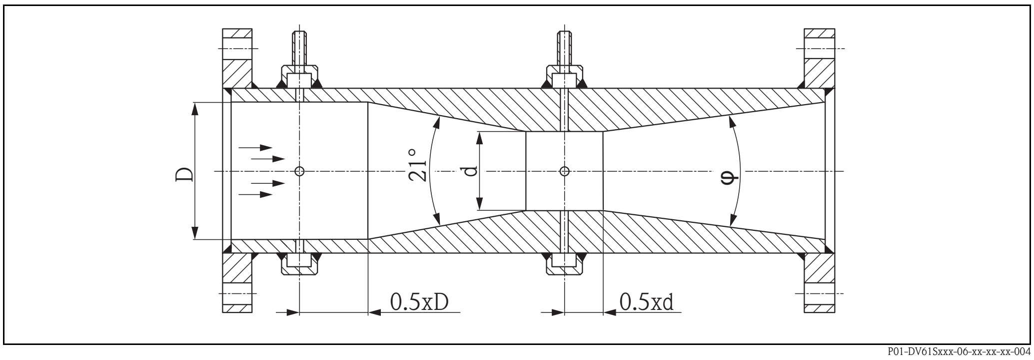
Welded with welding connection and single bore tapping



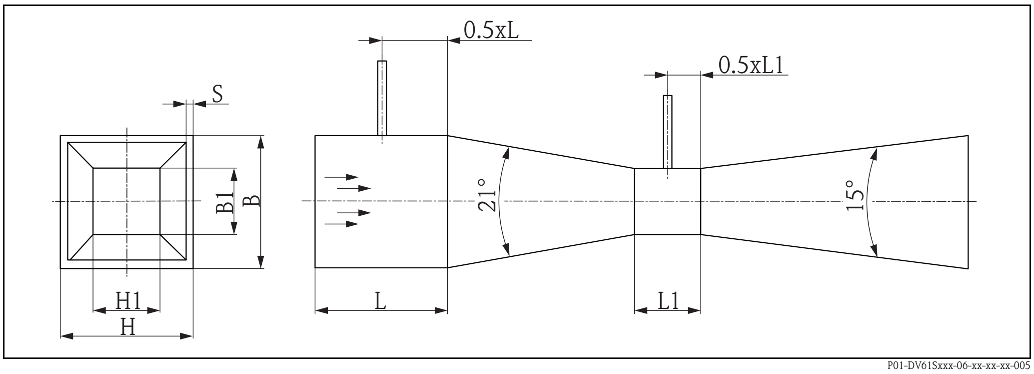
Welded with welding neck flanges and averaging ring



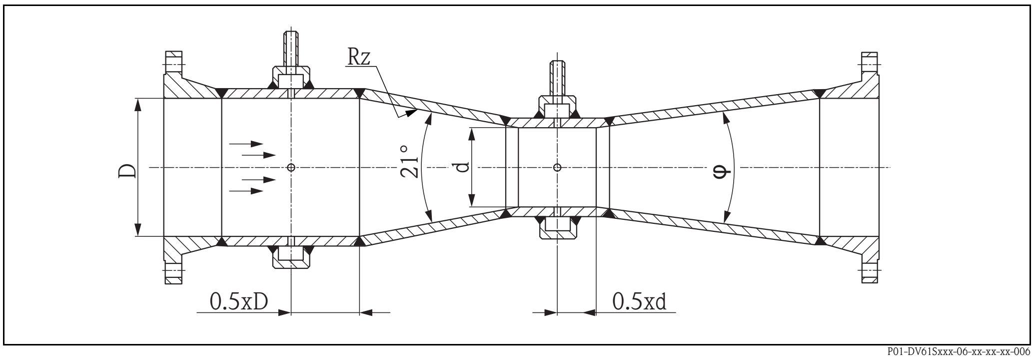
Welded with slip-on flange and single bore tapping, bidirectional



Machined (for small nominal diameters) with slip-on flanges and annular chamber



Square duct



Machined with welding neck flange and annular chamber. As per ISO5167, "as cast" conical convergent section.

Sizing ("Applicator")

The "Sizing Flow" module of the "Applicator" selection and sizing tool can be used to size and configure Venturi tubes as per ISO 5167.

Ordering information

Generally speaking, Venturi tubes are customized solutions. Customers must provide Endress+Hauser with all the relevant application parameters before ordering the device. The sizing sheet - data sheet (→ 🗎 71) or the "Applicator" sizing tool can be used for this purpose.

Based on the data provided, Endress+Hauser creates a modification offer to suit the application.

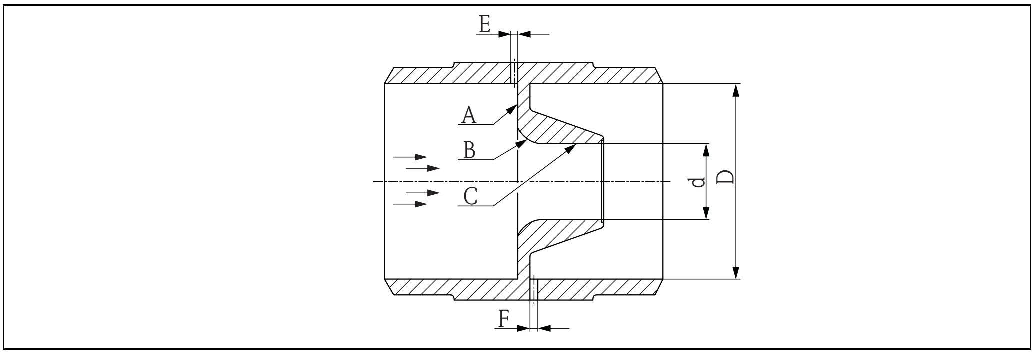
Product structure

010	**Application**			
	B	Gas		
	D	Liquid		
	F	Steam		
	Y	Special version, TSP-no. to be spec.		
020		**Description**		
		9	Special version, TSP-no. to be spec.	
895			**Identification**	
			Z1	Tagging (TAG), see additional spec.
DV61S-				Complete product designation

DN62S: Nozzle

Product overview

As with Venturi tubes, a wide variety of nozzles are available. These nozzles can be standardized or developed in line with manufacturers specifications. Practically all versions can be provided by Endress+Hauser. A nozzle consists of a convergent section with a rounded profile, and a cylindrical throat.



A *Flat front surface*
B *Rounded inlet profile*
C *Cylindrical constriction or throat*
D *Inner diameter of the pipe*
d *Throat inner diameter*
E *Upstream pressure tapping*
E *Throat pressure tapping downstream of the nozzle*

The main advantages of nozzles compared to orifice plates are:
- Less susceptible to abrasion.
- More durable.
- Lower differential pressure with high flow velocities and high pressures.
- Less pressure loss where possible.

Compared to ISA nozzles, long-radius nozzles are even less susceptible to abrasion, have a lower resistance, resulting in less differential pressure and less pressure loss with the same beta "β".
Therefore, long-radius nozzles are the nozzle of choice for high-pressure gas and steam applications or liquid applications with a high flow velocity.

Nozzles are standardized internationally in accordance with ISO 5167-3:2003. Divergent designs and calculation methods are also possible following consultation with the manufacturer.

Mechanical construction / technical features

There are three types of nozzle according to ISO 5167:
- ISA 1932 nozzle
- Long-radius nozzle
- Venturi nozzle (see DN61S)

Different application ranges apply for nominal diameters, beta "β" and Reynolds numbers for all versions according to ISO 5167. For any other applications, extended standards are available or a wet calibration is recommended.

ISA 1932 nozzle	Long-radius nozzle
▪ Corner tapping (single bore tapping or annular chamber) ▪ DN50 to DN500 ▪ β 0.3 to 0.8 ▪ Re > 20000 depending on β	▪ PIpe tapping (D- D/2) ▪ DN50 to DN630 ▪ β 0.2 to 0.8 ▪ Re > 10000

The shape of the inlet profile constitutes the main difference between ISA 1932 nozzles and long-radius nozzles:
- ISA 1932 nozzle comprising two circular segments.
- Long-radius nozzle comprising a quarter ellipse, wherein two different shapes can be used.

The following applies for both versions:
The flat front surface can be inapplicable for large diameter ratios.

Detailed information on the design is provided in the corresponding standards.

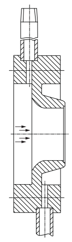
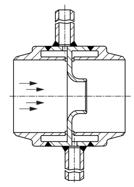
Process connection

Customers can choose from a wide range of versions and connection options for installing the nozzle in the pipe:
- Nozzles with a carrier ring for flange attachment (tapping in the carrier ring)
- Nozzles without a carrier ring for flange attachment (tapping in flange or pipe)
- Weld-in nozzles
- Meter runs with attached straight inlet pipe (recommended for wet calibrations)

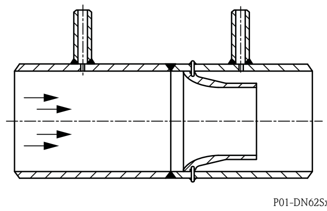
Pressure tappings

Pressure tappings as per ISO 5167:
- ISA 1932 nozzle: corner tapping
- Long-radius nozzle: D–D/2 tapping

DN62S - ISA 1932 nozzle

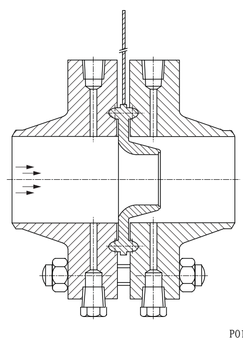
Remarks	Example
Corner tapping with single bore tapping Mounting location: ■ With carrier ring between 2 flanges ■ As weld-in device	 P01-DN62Sxxx-06-xx-xx-xx-009
Corner tapping with annular chamber Mounting location: ■ With carrier ring between 2 flanges ■ As weld-in device	 P01-DN62Sxxx-06-xx-xx-xx-010

DN62S long-radius nozzle

Remarks	Example
D - D/2 tapping Mounting location: ■ With end flanges ■ As weld-in device	 P01-DN62Sxxx-06-xx-xx-xx-011

Other tapping methods (e.g. flange tapping when installing in the measuring flange) are also possible but are not covered by the scope of ISO 5167.

DN62S - ISA 1932 nozzle

Remarks	Example
■ Flange tapping ■ Welding neck flange for welding into the pipe included ■ Replaceable nozzle insert	 P01-DOxxxxxx-14-xx-xx-xx-006

Upstream and downstream straight lengths

The same specifications apply with regard to the necessary upstream and downstream straight lengths for all versions in accordance with ISO 5167:

Diameter ratio β[1]		0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80
		Nozzle upstream length expressed as a multiple of the internal diameter D												
Single 90° bend or T-section (flow from one side only)	A[2]	10	10	10	12	14	14	14	16	18	22	28	36	46
	B[3]	6	6	6	6	7	7	7	8	9	11	14	18	23
Two or more 90° bends in the same plane	A[2]	14	14	16	16	18	18	20	22	26	32	36	42	50
	B[3]	7	7	8	8	9	9	10	11	13	16	18	21	25
Two or more 90° bends in different planes	A[2]	34	34	34	36	36	38	40	44	48	54	62	70	80
	B[3]	17	17	17	18	18	19	20	22	24	27	31	35	40
Reducer from 2xD to D over a length from 1.5xD to 3xD	A[2]	5	5	5	5	5	5	6	8	9	11	14	22	30
	B[3]	[4]	[4]	[4]	[4]	[4]	[4]	5	5	5	6	7	11	15
Expander from 0.5xD to D over a length from 1xD to 2xD	A[2]	16	16	16	16	16	17	18	20	22	25	30	38	54
	B[3]	8	8	8	8	8	9	9	10	11	13	15	19	27
Globe valve, fully open	A[2]	18	18	18	18	20	20	22	24	26	28	32	36	44
	B[3]	9	9	9	9	10	10	11	12	13	14	16	18	22
Full bore ball or gate valve fully open	A[2]	12	12	12	12	12	12	12	14	14	16	20	24	30
	B[3]	6	6	6	6	6	6	6	7	7	5	10	12	15
Abrupt symmetrical diameter reduction	A[2]	30	30	30	30	30	30	30	30	30	30	30	30	30
	B[3]	15	15	15	15	15	15	15	15	15	15	15	15	15
Thermometer well[5] with diameter ≤0.03xD	A[2]	5	5	5	5	5	5	5	5	5	5	5	5	5
	B[3]	3	3	3	3	3	3	3	3	3	3	3	3	3
Thermometer well with diameter between 0.03xD and 0.13xD	A[2]	20	20	20	20	20	20	20	20	20	20	20	20	20
	B[3]	10	10	10	10	10	10	10	10	10	10	10	10	10
		Throat downstream length expressed as a multiple of the internal diameter D												
Fittings (columns 2-8)	A[2]	4	4	5	5	6	6	6	6	7	7	7	8	8
	B[3]	2	2	2.5	2.5	3	3	3	3	3.5	3.5	3.5	4	4

1) Not all the values of β are permitted for some nozzle versions.

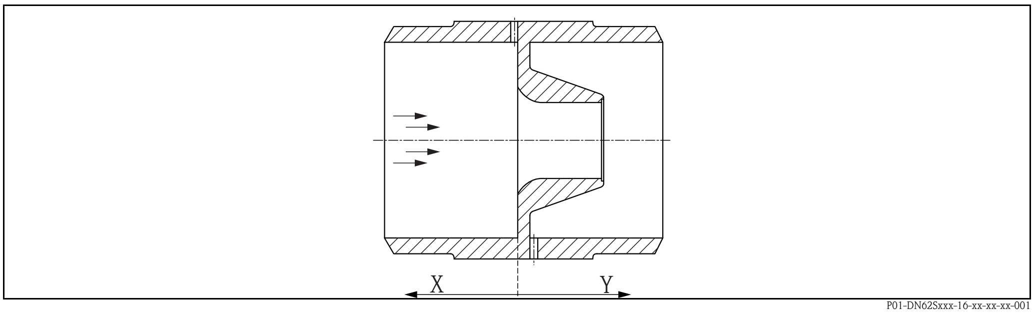
2) A: zero additional uncertainty

3) B: 0.5% additional uncertainty

4) The necessary disturbance-free straight length in Row A gives zero additional uncertainty.
Data are not available for shorter straight lengths which could be used to give the required straight lengths for Row B.

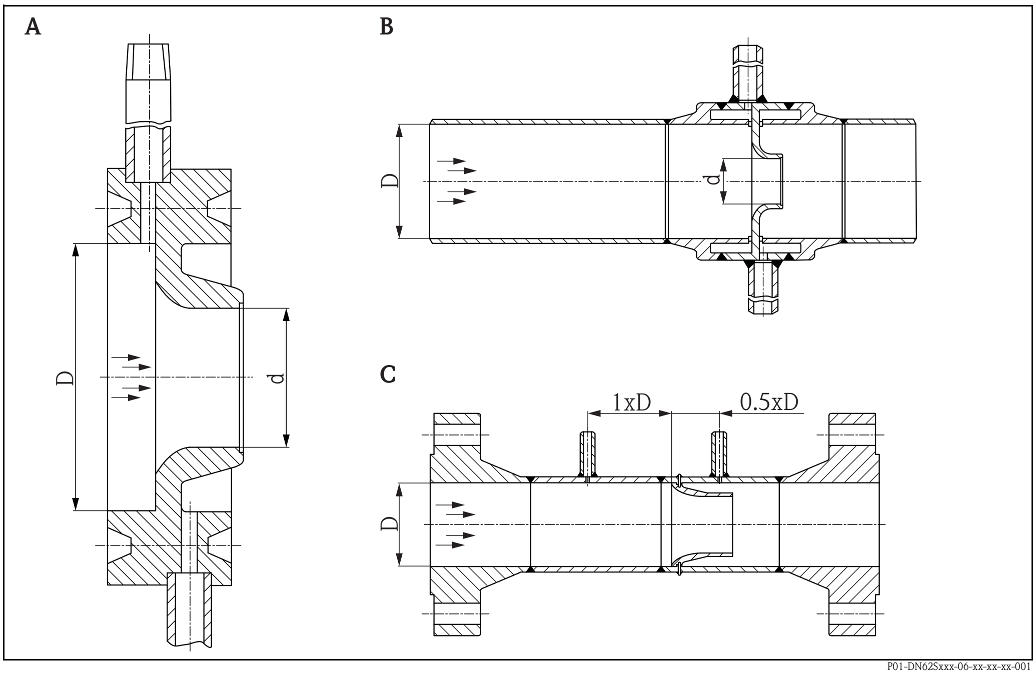
5) The installation of thermometer wells will not alter the required minimum straight lengths for the other fittings.

The straight lengths are measured from the front surface of the nozzle:

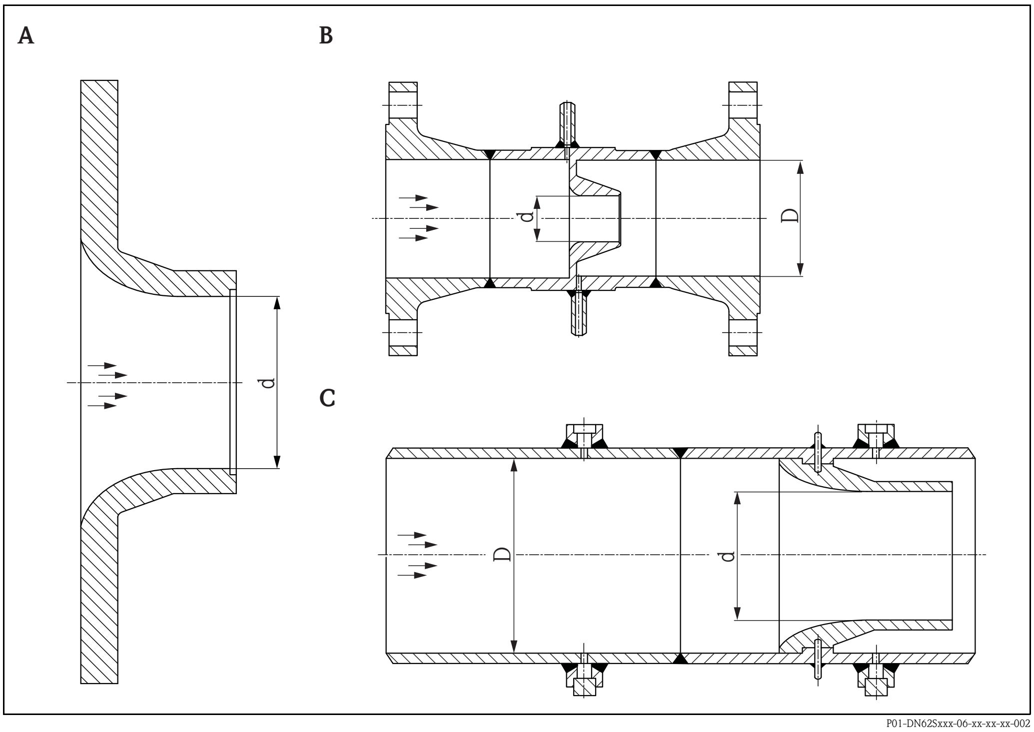


X *Upstream length*
Y *Downstream straight length*

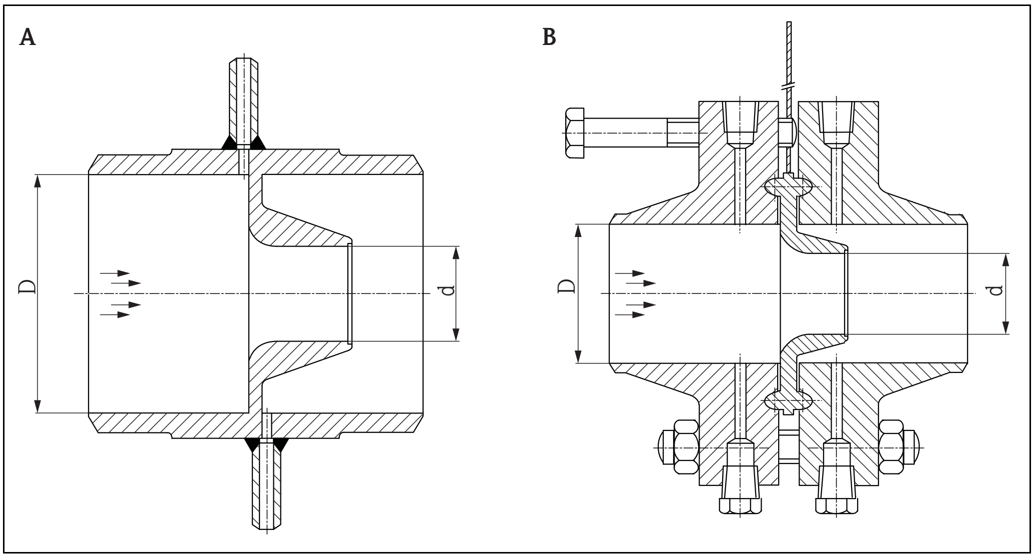
Typical configurations



A *ISA nozzle with carrier ring with RTJ sealing surface and single bore tapping*
B *ISA nozzle with weld connection and welded annular chamber as meter run*
C *Long-radius nozzle with weld connection and weld-on flange, D-D/2 tapping*



A *Long-radius nozzle for flange attachment without a carrier ring*
B *ISA nozzle with weld connection, weld-on flanges and single bore tapping*
C *Long-radius nozzle with weld connection and D-D/2 tapping*



A *ISA nozzle with welding connection and single bore tapping*
B *ISA nozzle with welding neck flange union and flange tapping*

Sizing

Endress+Hauser or one of its sub-contractors size and configure nozzles in accordance with the requirements of the standards to be applied.

Ordering information

Generally speaking, nozzles are customized solutions. Customers must provide Endress+Hauser with all the relevant application parameters before ordering the device. The sizing sheet - data sheet (→ 71) can be used for this purpose.

Based on the data provided, Endress+Hauser creates a modification offer to suit the application.

Product structure

010	**Application**	
	B	Gas
	D	Liquid
	F	Steam
	Y	Special version, TSP-no. to be spec.

020		**Description**	
		9	Special version, TSP-no. to be spec.

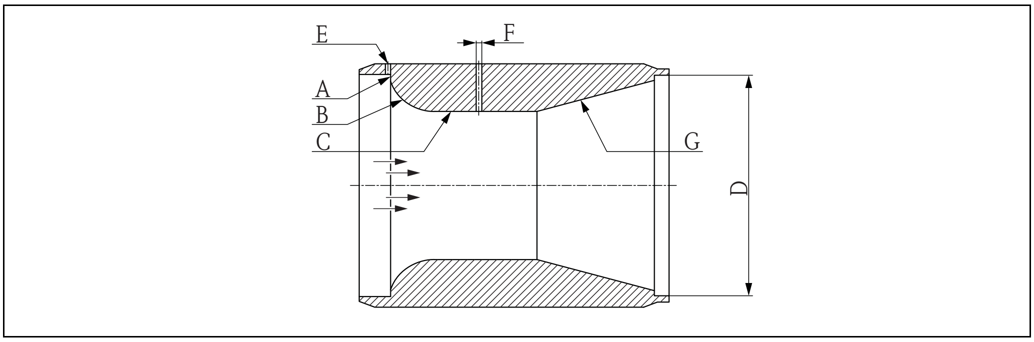
895			**Identification**	
			Z1	Tagging (TAG), see additional spec.

DN62S-				Complete product designation

DN61S: Venturi nozzle

Product overview

Venturi nozzles are standared in accordance with ISO 5167-3:2003. The front face and rounded inlet are identical to ISA 1932 nozzles. However, the Venturi nozzle has an additional conical divergent section to reduce the pressure loss. Throat pressure tapping is located in the throat/constriction of the nozzle.



P01-DN61Sxxx-16-xx-xx-xx-000

A *Flat surface*
B *Rounded inlet profile*
C *Cylindrical constriction or throat*
D *Inner diameter of the pipe*
E *Pressure tapping directly upstream from the nozzle (corner tapping)*
F *Throat pressure tapping in the throat of the nozzle*
G *Conical divergent section*

Compared to ISA1932 nozzles, the Venturi nozzle has the advantage of significantly less pressure loss. The application of a Venturi nozzle is similar to that of a Venturi tube. Venturi nozzles can be advantageous when used with small nominal diameters.

Different application ranges apply for the nominal diameters, beta "β" and Reynolds numbers for Venturi nozzles to ISO 5167 compared to ISA 1932 nozzles. For any other applications, extended standards are available or a wet calibration is recommended.

Venturi nozzle
▪ With conical outlet, shortened to 35% of the length if necessary. ▪ DN65 to DN500 ▪ β 0.316 to 0.775 ▪ 150000 < Re < 2000000

Detailed information on the design is provided in the corresponding standards.

Process connection

Venturi nozzles are normally integrated in the customer's piping by flanges or a welding connection. Customers can choose from different versions and connection options for the nozzle:
- Welding neck flanges (DIN, ANSI...)
- Slip-on flanges (DIN, ANSI...)
- Welding connections
- Meter runs with attached straight inlet pipe (recommended for wet calibrations)

Pressure tappings

In accordance with ISO 5167, corner tappings should be used for upstream pressure tappings (either as single bore tapping or annular chamber). Throat tappings should be made by four individual tappings, interconnected by an averaging ring or annular chamber. This type of tapping is recommended if wet calibration is planned. Depending on the application or requirements, a single bore tapping could suffice or even offer certain advantages (→ 🗎 35).

Upstream and downstream straight lengths

The same specifications apply with regard to the necessary upstream and downstream straight lengths for all versions in accordance with ISO 5167:

Diameter ratio β[1]		0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80
		Nozzle upstream length expressed as a multiple of the internal diameter D												
Single 90° bend or T-section (flow from one side only)	A[2]	10	10	10	12	14	14	14	16	18	22	28	36	46
	B[3]	6	6	6	6	7	7	7	8	9	11	14	18	23
Two or more 90° bends in the same plane	A[2]	14	14	16	16	18	18	20	22	26	32	36	42	50
	B[3]	7	7	8	8	9	9	10	11	13	16	18	21	25
Two or more 90° bends in different planes	A[2]	34	34	34	36	36	38	40	44	48	54	62	70	80
	B[3]	17	17	17	18	18	19	20	22	24	27	31	35	40
Reducer from 2xD to x1xD over a length from 1.5xD to 3D	A[2]	5	5	5	5	5	5	6	8	9	11	14	22	30
	B[3]	[4]	[4]	[4]	[4]	[4]	[4]	5	5	5	6	7	11	15
Expander from 0.5xD to 1xD over a length from 1xD to 2xD	A[2]	16	16	16	16	16	17	18	20	22	25	30	38	54
	B[3]	8	8	8	8	8	9	9	10	11	13	15	19	27
Globe valve, fully open	A[2]	18	18	18	18	20	20	22	24	26	28	32	36	44
	B[3]	9	9	9	9	10	10	11	12	13	14	16	18	22
Full bore ball or gate valve fully open	A[2]	12	12	12	12	12	12	12	14	14	16	20	24	30
	B[3]	6	6	6	6	6	6	6	7	7	5	10	12	15
Abrupt symmetrical diameter reduction	A[2]	30	30	30	30	30	30	30	30	30	30	30	30	30
	B[3]	15	15	15	15	15	15	15	15	15	15	15	15	15
Thermometer well[5] with diameter ≤0.03xD	A[2]	5	5	5	5	5	5	5	5	5	5	5	5	5
	B[3]	3	3	3	3	3	3	3	3	3	3	3	3	3
Thermometer well with diameter between 0.03xD and 0.13xD	A[2]	20	20	20	20	20	20	20	20	20	20	20	20	20
	B[3]	10	10	10	10	10	10	10	10	10	10	10	10	10
		Throat downstream length expressed as a multiple of the internal diameter D												
Fittings (columns 2-8)	A[2]	4	4	5	5	6	6	6	6	7	7	7	8	8
	B[3]	2	2	2.5	2.5	3	3	3	3	3.5	3.5	3.5	4	4

1) Not all the values of β are permitted for some nozzle versions.

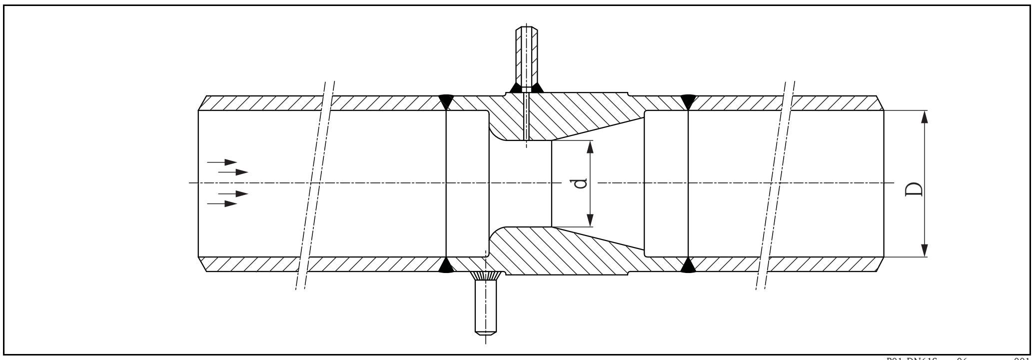
2) A: zero additional uncertainty

3) B: 0.5% additional uncertainty

4) The necessary disturbance-free straight length in Row A gives zero additional uncertainty.
Data are not available for shorter straight lengths which could be used to give the required straight lengths for Row B.

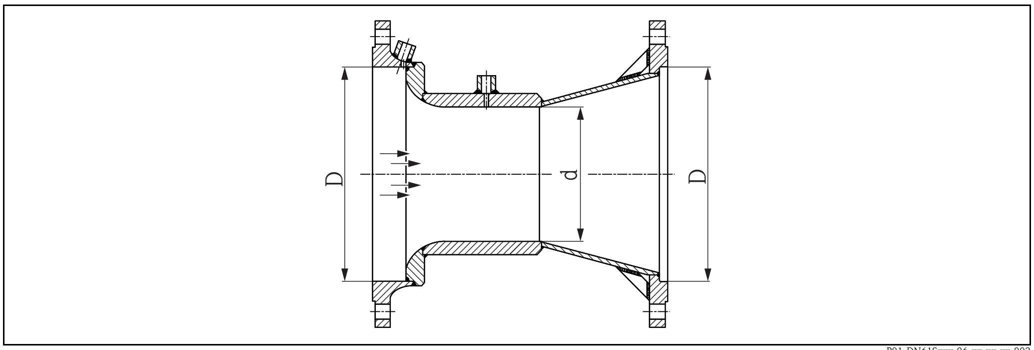
5) The installation of thermometer wells will not alter the required minimum straight lengths for the other fittings.

Typical configurations



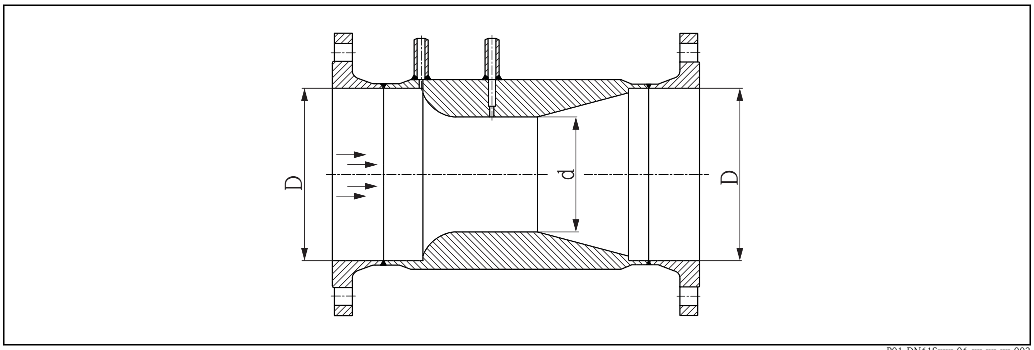
P01-DN61Sxxx-06-xx-xx-xx-001

Meter run, outlet machined, welding connection, single bore tapping



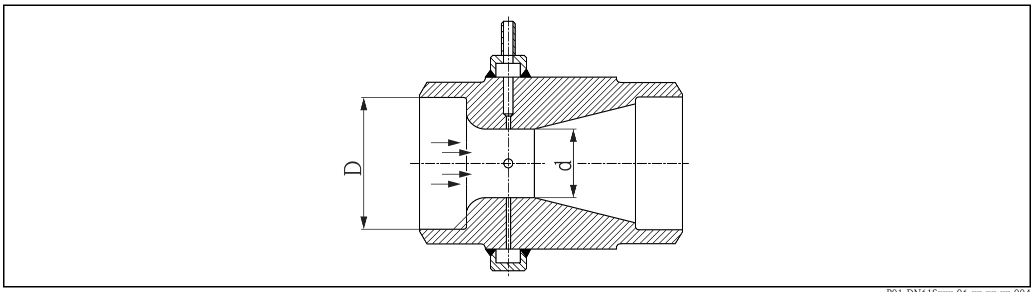
P01-DN61Sxxx-06-xx-xx-xx-002

Outlet welded with flange connection, slip-on flange at outlet, single bore tapping



P01-DN61Sxxx-06-xx-xx-xx-003

Outlet machined, flange connection, welding neck flange, single bore tapping



P01-DN61Sxxx-06-xx-xx-xx-004

Outlet machined, welding connection, annular chamber

Sizing

Endress+Hauser or one of its sub-contractors size and configure nozzles in accordance with the requirements of the standards to be applied.

Ordering information

Generally speaking, nozzles are customized solutions. Customers must provide Endress+Hauser with all the relevant application parameters before ordering the device. The sizing sheet - data sheet (→ 71) can be used for this purpose.

Based on the data provided, Endress+Hauser creates a modification offer to suit the application.

Product structure

010	Application			
	B	Gas		
	D	Liquid		
	F	Steam		
	Y	Special version, TSP-no. to be spec.		

020		Description		
		9	Special version, TSP-no. to be spec.	

895			Identification	
			Z1	Tagging (TAG), see additional spec.

DN61S-				Complete product designation

DO69S: Orifice - special designs

Product overview

In addition to the standard products DO61W, DO62C, DO63C, DO64P, DO65F (see TI00422F/00/EN), Endress+Hauser also supplies primary devices in the form of orifice plates in a wide range of special designs which cannot be specified within the framework of the standard products mentioned above.
In particular these include:
- Weld-in orifices
- Meter runs with weld-in inlet and outlet pipes
- Non-standardized orifice plates (e.g. nominal diameters outside the standard range)
- Special designs or additional fittings
- Multiple tappings as redundant or split-range measurements
- Special materials

General properties of orifice plates, see TI00422F/00/EN.

Mechanical construction / technical features

Weld-in orifices

Weld-in primary devices are the preferred solution in applications involving high pressures, high safety requirements, or are used to drive down costs (flange connections not required):
- Applications with superheated steam (PN100 or higher)
- Extremely toxic gases (leak-tightness)
- Large nominal diameters

Meter runs with weld-in upstream and downstream straight lengths

Meter runs are generally used in applications with increased measuring uncertainty requirements:
- Standards-compliant version of upstream and downstream straight lengths
- Calibratable

Non-standardized orifice plates

Primary devices that are not within the scope of international standard ISO 5167 are not covered by the range of standard products. However, the general properties and advantages of primary devices extend well beyond this scope of application. For example, the range of application of orifice plates can be significantly increased by using special orifice shapes or large nominal diameters:
- Dual cone orifice plates (very low Reynolds number)
- Eccentric orifice plates (fluids containing solids, sludges)
- Nominal diameters larger than DN1000

Special designs

Customized solutions can often provide the answer to special requirements, with additional fittings, devices or special designs delivered to the customer. Examples include:
- Integrated temperature or pressure measurement
- Integrated pipe tapping (D-D/2 or "vena contracta")
- Weld-on flanges
- Compact transmitter with additional shutoff valve

Multiple tappings

Multiple tappings can be required if the customer wants to implement a redundant measurement architecture or increase the measuring range. Due to the quadratic dependence between flow and differential pressure, turndown values of approx. 6:1 to max. 12:1 are possible with one transmitter. With sufficient differential pressure, additional transmitters can be used to increase the measuring range. Redundant or split-range measurements can be implemented in different ways:
- By using adapters to mount additional transmitters on the existing single tapping.
  A transmitter can only be replaced if all the transmitters are disconnected from the process.
- Each transmitter is connected to the existing single tapping with an individual fitting.
  Every transmitter can be replaced without impacting the other transmitters.
- Completely separate tapping with tapping borehole, fitting and transmitter. In this scenario the measurement can still be performed even if an individual tapping bore is blocked.
- Compact transmitter with additional shutoff valve.

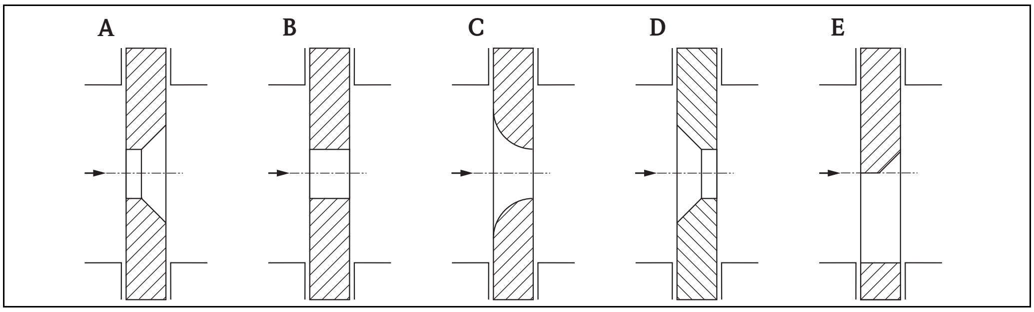
Special materials

Orifice plates and other primary devices can generally be made from practically any material.
Special materials or coatings can be necessary due to the following requirements:

- Aggressive, corrosive or toxic media
- Extremely high or low temperatures
- Aggressive environment
- Special certificates

Orifice edge

Typical versions of the orifice edge or the insert:

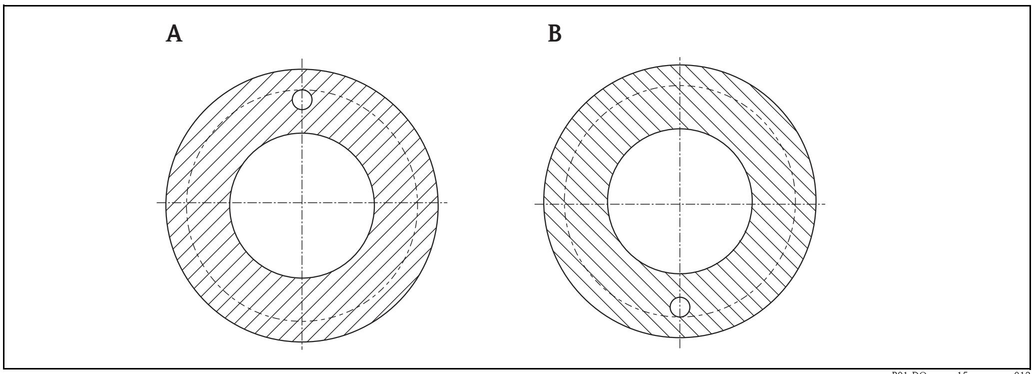


P01-DOxxxxx-15-xx-xx-xx-011

	Orifice edge	Min. Reynolds number	Usage
A	Sharp	Re ≥ 5000	Standard; should always be used if the Reynolds number is large enough.
B	Bidirectional	Re ≥ 5000	Use if flow is to be measured in both directions.
C	Quarter circle	Re ≥ 500	Only for Re ≤ 5000
D	Conical inlet	Re ≥ 80	Only for Re ≤ 500
E	Segmental orifice	Re ≥ 5000	▪ For liquids with gas content (aperture at the top) ▪ For liquids with solid content (aperture at the bottom)

Note!
Endress+Hauser's "Applicator" selection and sizing tool can be used to size a flow measuring point.
Among other things, "Applicator" determines the suitable orifice type for your measuring point.

Vent hole/drain hole



P01-DOxxxxx-15-xx-xx-xx-012

A *Orifice plate with vent hole*
B *Orifice plate with drain hole*

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

Note!
- Orifice plates with a vent or drain hole can only be used in horizontal pipes.
- Vent holes and drain holes are not available for annular chamber orifice plates.

Dimensions

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

Diameter of the orifice [mm (in)]	Diameter of the vent hole or drain hole [mm (in)]
25.4 - 88.9 (1.000 - 3.500)	2.4 (3/32)
89.0 - 104.8 (3.501 - 4.125)	3.2 (1/8)
104.9 - 127.0 (4.126 - 5.000)	4.0 (5/32)
127.1 - 152.4 (5.001 - 6.000)	4.8 (3/16)
152.4 - 171.5 (6.001 - 6.750)	5.6 (7/32)
171.5 - 190.5 (6.751 - 7.500)	6.4 (1/4)
190.6 - 212.7 (7.501 - 8.375)	7.1 (9/32)
212.8 - 235.0 (8.376 - 9.250)	8.0 (5/16)
235.1 - 254.0 (9.251 - 10.000)	8.7 (11/32)
254.0 - 276.2 (10.001 - 10.875)	9.5 (3/8)
276.3 - 295.3 (10.876 - 11.625)	10.3 (13/32)
295.3 - 317.5 (11.626 - 12.500)	11.1 (7/16)
317.5 - 336.6 (12.501 - 13.250)	11.9 (15/32)
> 336.6 (> 13.251)	12.7 (1/2)

Process connection

Customers can choose from a wide range of versions and connection options for installing the orifice plates in the pipe:
- Orifice plates with a carrier ring for flange attachment (tapping in the carrier ring)
- Orifice plates without a carrier ring for flange attachment (tapping in flange or pipe)
- Weld-in orifices
- Meter runs with attached straight inlet pipe (recommended for wet calibrations)

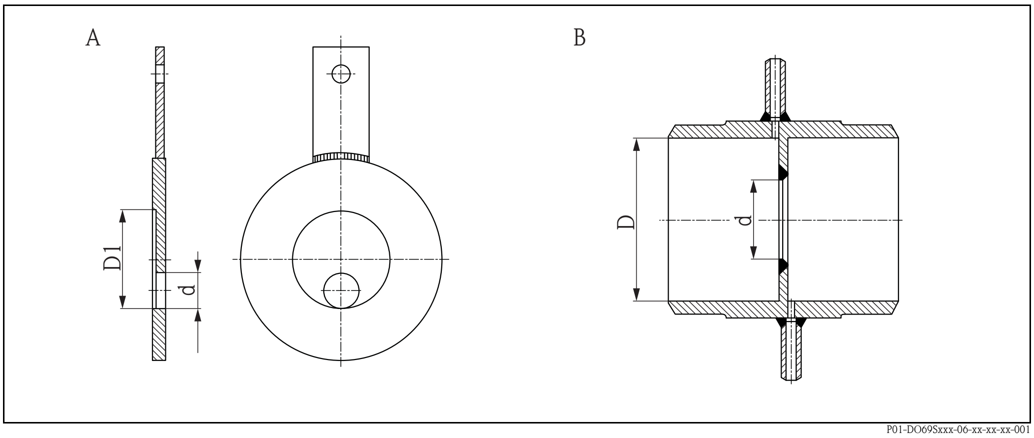
Pressure tappings

Pressure tappings as per ISO 5167. Compact version or remote version, see TI00422F/00/EN

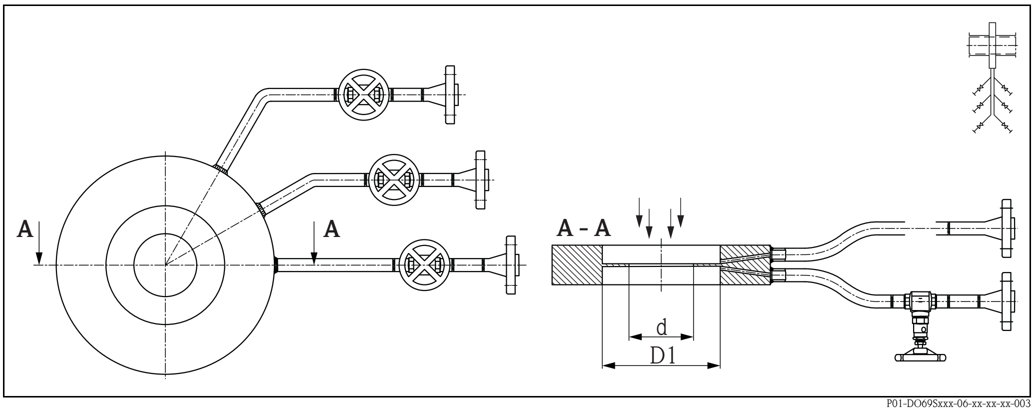
Upstream and downstream straight lengths

Upstream and downstream straight lengths, see TI00422F/00/EN

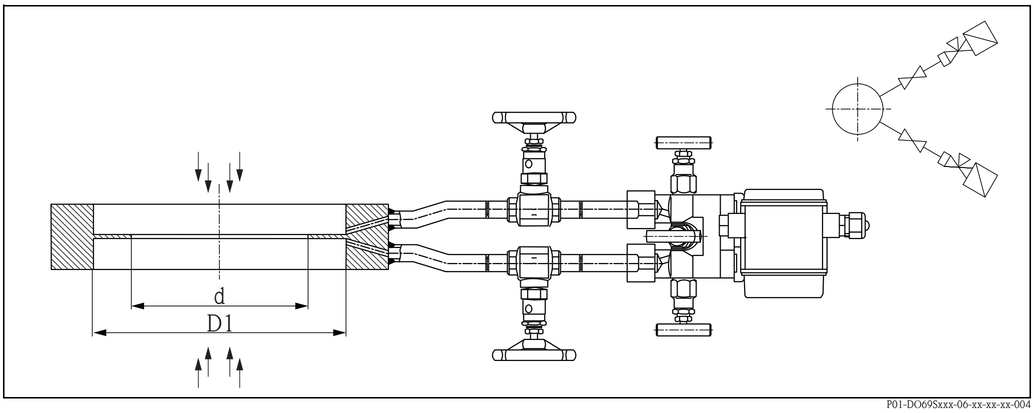
Typical configurations



A *Eccentric orifice plate*
B *Weld-in orifice*

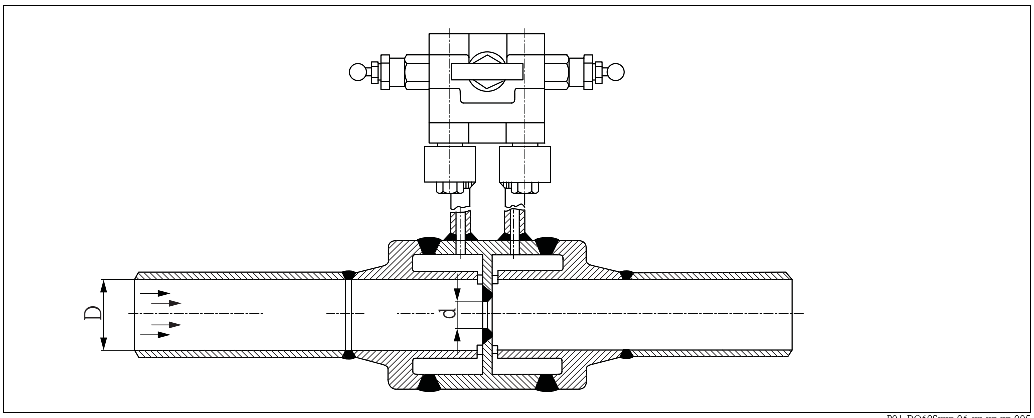


Triple tapping with additional shutoff valve



Steam, bidirectional, double tapping, compact version

Flanges according to DIN EN		Flanges according to ASME B16.5 and ASME B16.47 Series A	
D (mm)	**D1**	**D (in)**	**D1**
25 - 125	d + 1 mm (0.04 in)	1 - 4	d + 1 mm (0.04 in)
150 - 350	d + 2 mm (0.08 in)	5 - 14	d + 2 mm (0.08 in)
400 - 1000	d + 4 mm (0.16 in)	16 - 40	d + 4 mm (0.16 in)



High-pressure weld-in orifice, fully welded as compact version

Sizing

Endress+Hauser or one of its sub-contractors size and configure orifice plates in accordance with the requirements of the standards to be applied.

Ordering information

Generally speaking, special orifice plate designs are customized solutions. Customers must provide Endress+Hauser with all the relevant application parameters before ordering the device. The sizing sheet - data sheet (→ 71) can be used for this purpose.

Based on the data provided, Endress+Hauser creates a modification offer to suit the application.

Product structure

010	Application			
	B	Gas		
	D	Liquid		
	F	Steam		
	Y	Special version, TSP-no. to be spec.		
020		**Description**		
		9	Special version, TSP-no. to be spec.	
895			**Identification**	
			Z1	Tagging (TAG), see additional spec.
DO69S-				Complete product designation

DR61S: Restriction orifice

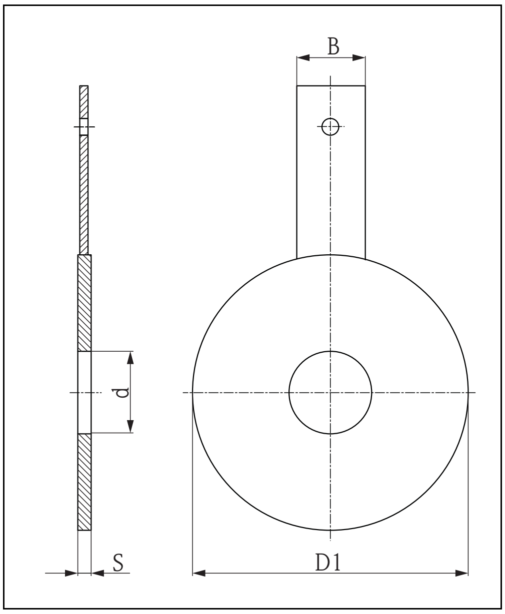
Product overview

Restriction orifices are installed in pipes with the specific aim of reducing pressure or restricting flow. Generally speaking, restriction orifices are very similar to orifice plates but the former do not need an additional transmitter as in the case of flow measurement. Restriction orifices are therefore a purely mechanical way of reducing the pipe cross-sectional area.

Restriction orifices, like orifice plates, are available in a wide range of designs.
Restriction orifices are usually designed as orifice plates with a cylindrical bore.

Other versions are also possible, such as:
- Restriction orifices with a carrier ring
- Weld-in devices
- The associated flanges are included in the delivery

Other customer-specific structural details can also be taken into consideration, such as:
- Front surface turned or machined upstream
- Bevelled outlet downstream



P01-DR61Sxxx-16-xx-xx-xx-000

Due to the pressure reduction requirements, restriction orifices are generally subject to a much higher mechanical load than orifice plates. For this reason, the plate thickness must be calculated individually for each specific application. The thickness is calculated based on AD2000 tables and data sheets.

The bore which is required to create the desired pressure loss is calculated following the formula for calculating pressure loss for orifice plates defined in ISO 5167.

Other calculation methods are also possible on request.

If restriction orifices are used specifically to reduce pressure, this can result in cavitation or a far higher noise level. The noise level calculation is included in the calculation of the restriction orifice. Additional structural measures can also help in such situations:

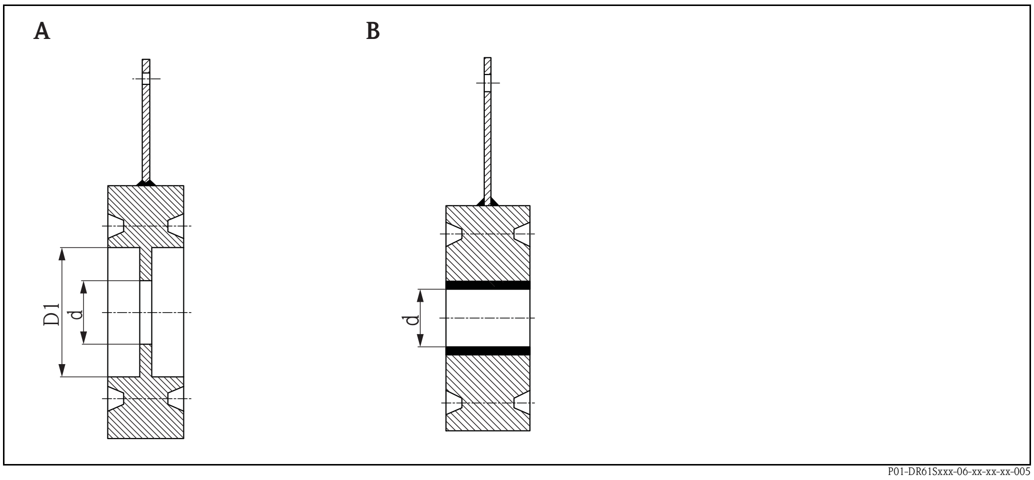
To protect the edge of the orifice (e.g. in the event of cavitation):
- Reinforced/armored orifice edge.

To reduce the noise level:
- Multihole orifices
- Multistep restriction orifices, can also be used to reduce the risk of cavitation

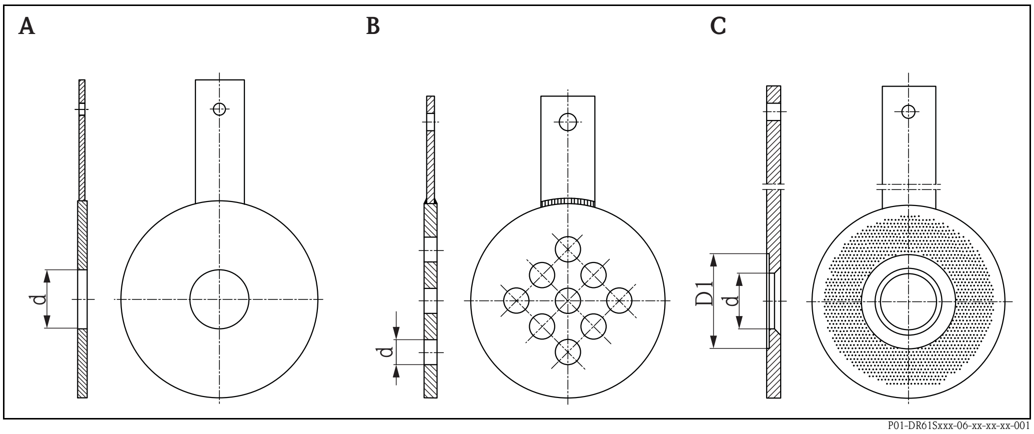
Upstream and downstream straight lengths

There are no specific requirements for the upstream and downstream straight lengths of a restriction orifice.

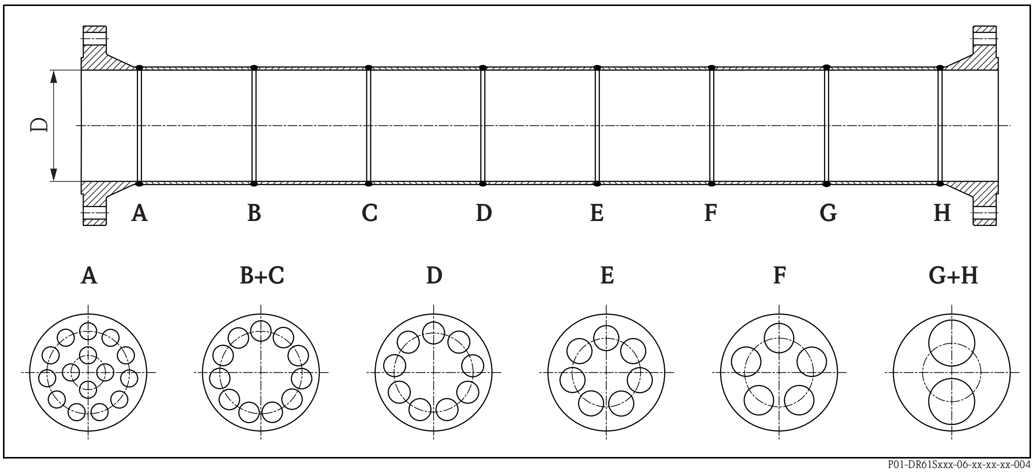
Typical configurations



A *Restriction orifice with carrier ring*
B *Restriction orifice, armored, RTJ sealing surface*



A *Restriction orifice*
B *Multihole orifice with 9 bores*
C *Restriction orifice with machined inlet and conical outlet*



Multihole multistep

Dimensions "D1", → 🗎 40.

Sizing

The sizing and calculations for restriction orifices is performed by Endress+Hauser or one of its sub-contractors in accordance with the customer|s requirements or the specific standards to the applied.

Ordering information

Generally speaking, restriction orifices are customized solutions. Customers must provide Endress+Hauser with all the relevant application parameters, and particularly the desired pressure loss, before ordering the device. The sizing sheet - data sheet (→ 🗎 71) can be used for this purpose.

Based on the data provided, Endress+Hauser creates a modification offer to suit the application.

Product structure

010	**Application**			
	B	Gas		
	D	Liquid		
	F	Steam		
	Y	Special version, TSP-no. to be spec.		
020		**Description**		
		9	Special version, TSP-no. to be spec.	
895			**Identification**	
			Z1	Tagging (TAG), see additional spec.
DR61S-				Complete product designation

Certificates and approvals

CE mark, Declaration of Conformity	The device is designed to meet state-of-the-art safety requirements, has been tested and left the factory in a condition in which it is safe to operate. The device complies with the applicable standards and regulations as listed in the EC Declaration of Conformity and thus meets the statutory requirements of the EC Directive. Endress+Hauser confirms the successful testing of the device by affixing to it the CE mark.
European Pressure Equipment Directive 97/23/EC (PED)	The European Pressure Equipment Directive 97/23/EC (PED) categorizes primary devices (orifice plates) as follows depending on the nominal diameter, medium, pressure and temperature: ■ Article 3.3 (≤ DN25/1"): no CE mark ■ Category I: CE mark excluding the ID number of the notified body for QA monitoring ■ Category II/III: CE mark including the ID number of the notified body for QA monitoring For reasons of safety, all devices with > DN25/1" are automatically assigned to Category III. In the case of weld-in devices, the following procedure is usually recommended for cost reduction reasons: ■ The production drawing is examined by the notified body (e.g. TÜV). ■ Production takes place in accordance with the Technical Regulations for Pressure. ■ The parts are inspected in accordance with AD2000 HP5/3. ■ The unit is delivered without a pressure test. ■ The customer is responsible for performing the pressure test in an installed condition once the unit has been welded into place. ■ Once the pressure test has been performed, Endress+Hauser creates the certificate of conformity and the identification nameplate witch CE-mark.

Accessories

Overview

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

- DA61V: Shutoff valve (→ 🗎 47)
- DA61C: Condensate pot (→ 🗎 52)
- DA63M: Manifold (→ 🗎 54)
- DA63R: Rectifier (→ 🗎 64)
- PZO: Oval flange adapter (→ 🗎 67)

The condensate pots, shutoff valves and manifold can be requested and ordered together with the primary device. Any accessories ordered are preinstalled upon delivery. Manifolds are generally ordered separately and can be delivered ready mounted on the transmitter.
Accessories can also be ordered through their own product structures which are provided in the following sections. The flow conditioner can only be ordered through its own product structure.

DA61V: Shutoff valve

Usage

Shutoff valves are used in remote versions to shut off the measuring point.
Depending on local and national regulations, a second shutoff valve might be recommended, or mandatory, for high-pressure and high-temperature applications.

Mode of operation

The shutoff valve is designed to disconnect the measuring system from the measuring pipe if leaks are found or if maintenance work is being performed on the impulse lines.

Installation and commissioning

The shutoff valves must be closed on completion of the installation work. As part of the commissioning routine, the shutoff valves must first be opened carefully and the entire measuring system must be inspected for leaks.

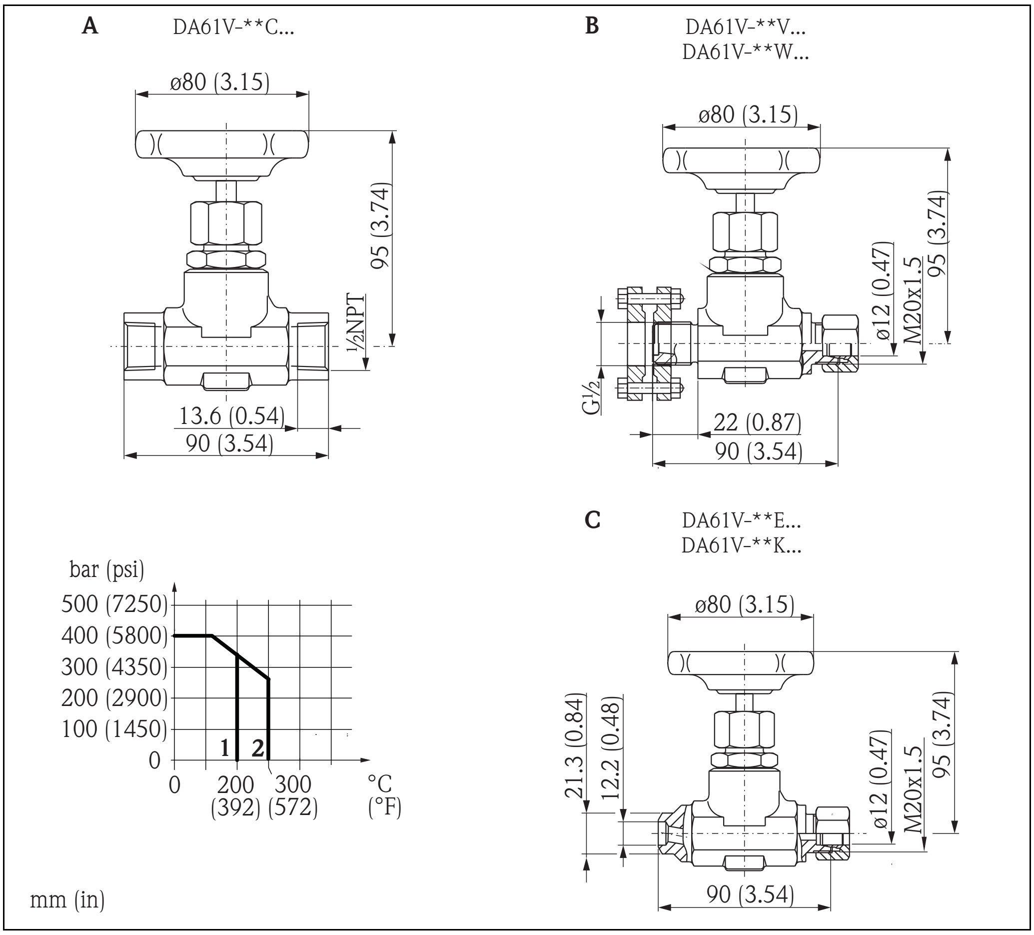
Design

- Body: die-pressed part
- Surface: steel, phosphatized
- Stem thread:
  - internal for DA61V-2..., DA61V-3...
  - external for DA61V-4...
- Replaceable valve seat
- Stem with cold rolled surface, back seal and non-rotating needle tip

Packing

- PTFE
- Pure graphite

Dimensions



A *Inlet FNPT1/2; outlet FNPT1/2*
B *Inlet, nipple DIN 19207 and threaded flanges; outlet, cutting ring*
C *Inlet, welding connection; outlet, cutting ring*

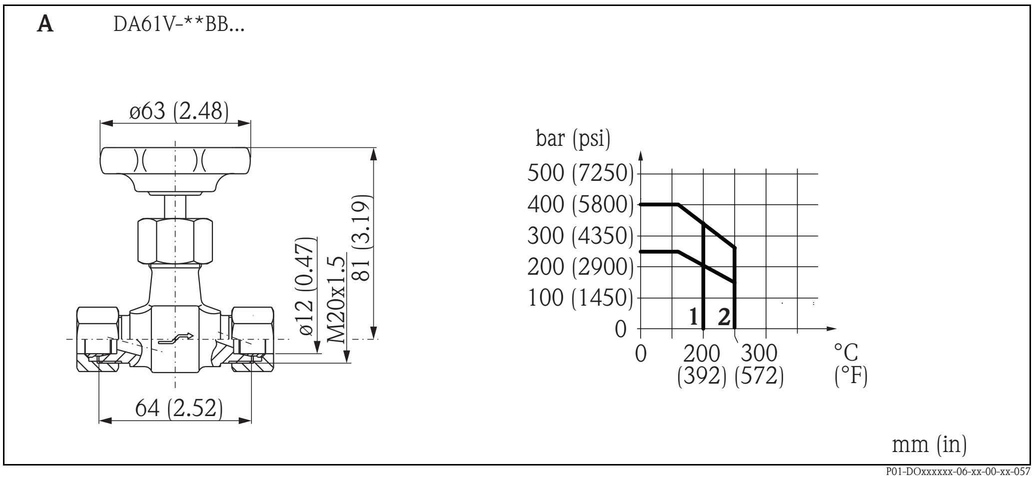
1 *PTFE packing*
2 *Pure graphite packing internal stem thread*

Weight

	Order code	Weight
A	DA61V-**CC*	Approx. 0.8 kg (1.76 lbs)
B	DA61V-**V** DA61V-**W**	Approx. 1.45 kg (3.20 lbs)
C	DA61V-**E** DA61V-**K*	Approx. 0.73 kg (1.61 lbs)

Materials

Component	"steel" version	"316L" version
Body	1.0460	1.4571
Bonnet	1.0501	1.4571
Valve seat	1.4571/1.4021	1.4571
Valve stem	1.4104	1.4571
Needle tip	1.4122 v.	1.4571
Packing	Pure graphite (up to +300 °C (+572 °F)	PTFE (up to +200 °C (+392 °F)
Union nut Gland nut	Steel –	1.4571 –



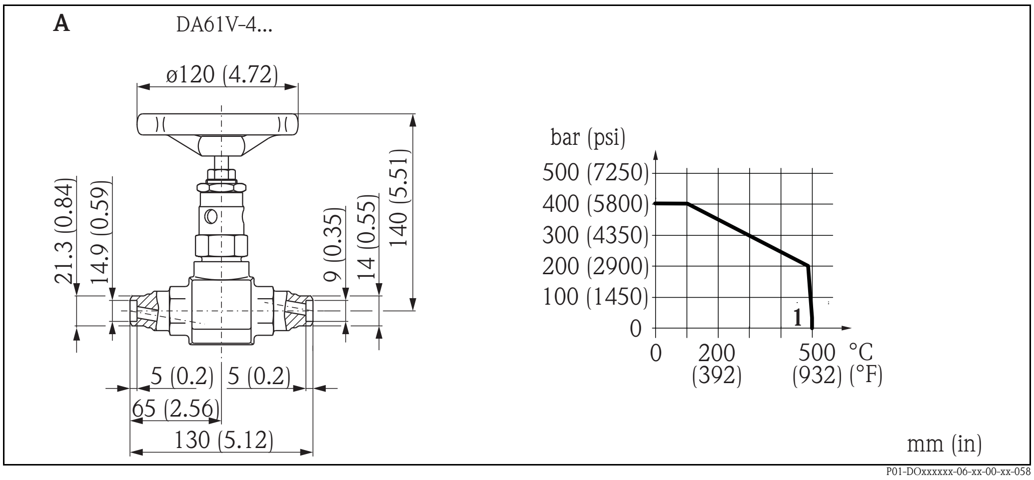
A *Inlet cutting ring: outlet cutting ring*
1 *PTFE packing*
2 *Pure graphite packing*

Weight

Order code	Weight
DA61V-**BB*	Approx. 0.47 kg (1.04 lbs)

Materials

Component	"steel" version	"316L" version
Body	1.0460	1.4571
Valve stem	1.4104	1.4571
Needle tip	1.4122 v.	1.4571
Packing	PTFE (up to +300 °C (+572 °F)	
Union nut	Steel	1.4571



A *Inlet, welding connection 21.3 mm; outlet, welding connection 14 mm*
1 *Body material 1.5415*

Weight

Order code	Weight
DA61V-4****	Approx. 1.6 kg (3.53 lbs)

Materials

Component	Material
Body	1.5415
Bonnet	1.7709
Valve stem	1.4021
Needle tip	1.4122 v.
Valve seat	1.4021
Packing	Pure graphite
Gland nut	2.0550

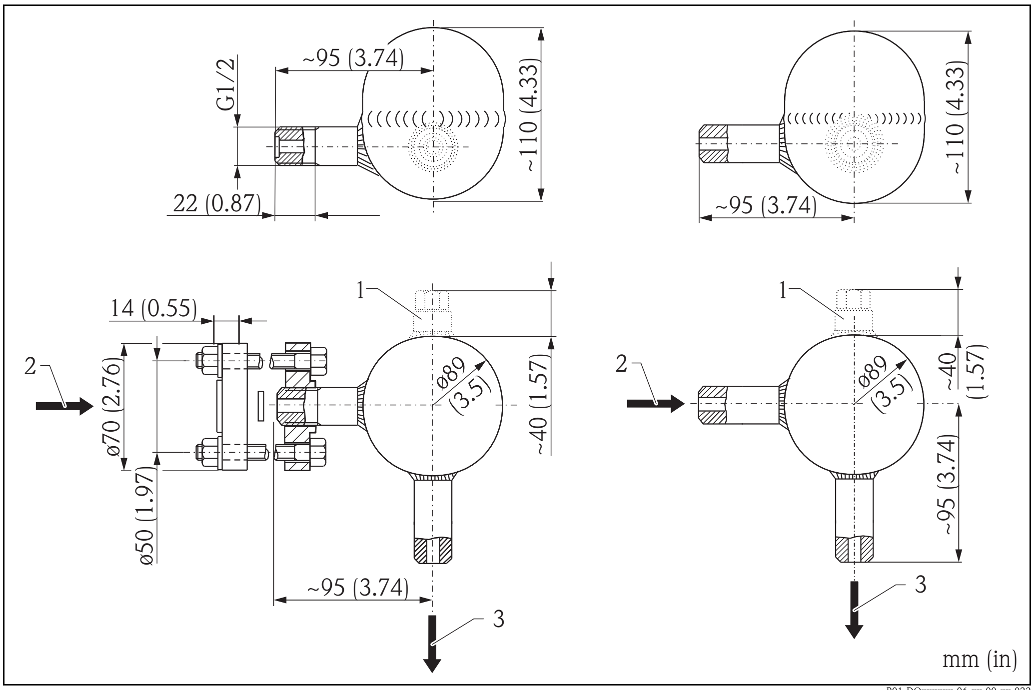
Product structure

250	**Version; Gasket**					
	2	Valve; PTFE gasket <200°C/392°F				
	3	Valve; pure graphite gasket <300°C/572°F				
	4	Valve HT; pure graphite gasket >300°C/572°F				
	9	Special version, TSP-no. to be spec.				
260		**Material**				
		C	C22.8			
		D	316Ti			
		G	16Mo3			
		Y	Special version, TSP-no. to be spec.			
270			**Inlet**			
			B	Ermeto 12S		
			C	FNPT1/2		
			E	Welding conn. 21.3 mm		
			K	Tap, welding conn. 17.2 mm		
			V	G1/2 DIN19207 steel + 2x flange		
			W	G1/2 DIN19207 stainl. steel + 2x flange		
			Y	Special version, TSP-no. to be spec.		
280				**Outlet**		
				B	Cutting ring (Ermeto 12S)	
				C	FNPT1/2	
				L	Welding conn. 14 mm	
				Y	Special version, TSP-no. to be spec.	
550					**Additional option**	
					F1	EN10204-3.1 material (valve body) inspection certificate
					F2	EN10204-3.1 material, NACE MR0175 (valve body) inspection certificate
					F3	EN10204-3.2 material (valve body) inspection certificate
					F4	PMI test
					F5	Cleaned from oil+grease
					F6	Oxygen service
					F7	PWIS free, PWIS = paint-wetting impairment substances
DA61V-						Complete product designation

Note!
If ordering via this structure, the scope of delivery contains one valve. The weights specified in the above table also refer to one valve.

DA61C: Condensate pot

Dimensions



P01-DOxxxxxx-06-xx-00-xx-022

1 Filling cap NPT1/2 (optional)
2 From primary device
3 To differential pressure transmitter

Weight

Material	Weight
HII (265 GH)	Approx. 1.7 kg (3.75 lbs)
316L	Approx. 1.7 kg (3.75 lbs)
16Mo3	Approx. 2.2 kg (4.85 lbs)

Additional weight for flanges at the inlet (DA61C-**V... and DA61C-**W...):
Approx. 0.7 kg (1.54 lbs).

Product structure

200	**Material; Volume; PN**					
	B	HII (265 GH); 300cm^3; PN100				
	C	316L; 300cm^3; PN100				
	K	16Mo3; 250cm^3; PN250				
	Y	Special version, TSP-no. to be spec.				
210		**Filling cap**				
		1	Not selected			
		2	NPT1/2			
		9	Special version, TSP-no. to be spec.			
220			**Inlet**			
			F	Welding conn. 21.3mm; w/o		
			K	Tap, welding conn. 17.2mm		
			V	G1/2 DIN19207 steel + 2x flange		
			W	G1/2 DIN19207 stainl. steel + 2x flange		
			Y	Special version, TSP-no. to be spec.		
230				**Outlet**		
				E	Welding conn. 21.3mm	
				M	Tap, 12mm	
				N	Tap, G1/2 DIN19207	
				Y	Special version, TSP-no. to be spec.	
550					**Additional option**	
					F1	EN10204-3.1 material (wetted parts) inspection certificate
					F2	EN10204-3.1 material, NACE MR0175 (wetted parts) inspection certificate
					F3	EN10204-3.2 material (wetted parts) inspection certificate
					F4	PMI test
DA61C-						Complete product designation

✎ Note!
If ordering via this structure, the scope of delivery contains one condensate pot. The weights specified in the above table also refer to one condensate pot.

DA63M: Manifold

Usage

The manifold is used to separate the Deltabar differential pressure transmitter from the process and for the regular zero point adjustment of the Deltabar differential pressure transmitter.

Mode of operation

If the Deltabar differential pressure transmitter has to be removed from the measuring point (e.g. to be replaced or repaired), the transmitter can be completely disconnected and removed from the process by closing all three valves.

Commissioning

As part of the commissioning routine, zero point adjustment must be performed for the Deltabar S differential pressure transmitter. During initial commissioning all the valves should be closed when starting up the process. Then the valves on the plus and minus side should be opened carefully. The equalization valve remains closed. It must then be ensured that the impulse lines, manifold and transmitter are completely vented (in the case of liquids and steam) or drained (in the case of gas).

Zero point adjustment

To perform zero point adjustment, the valve on the minus side is first closed and then the equalization valve is opened in such a way that both the plus and minus side of the transmitter are exposed to the same static process pressure. In this state, zero point adjustment can be performed for the Deltabar S differential pressure transmitter (see Operating Instructions of Deltabar S). Following zero point adjustment, the measuring system is put back into operation in the reverse order. Zero point adjustment should be checked and corrected at regular intervals. Similarly, the measuring system should be checked for complete venting and drainage at regular intervals.

Venting/draining

The additional valves in 5-valve manifolds are used to vent and drain the pipes, or to empty the impulse lines completely for maintenance, for example. In steam applications the valves are used to purge the impulse lines.

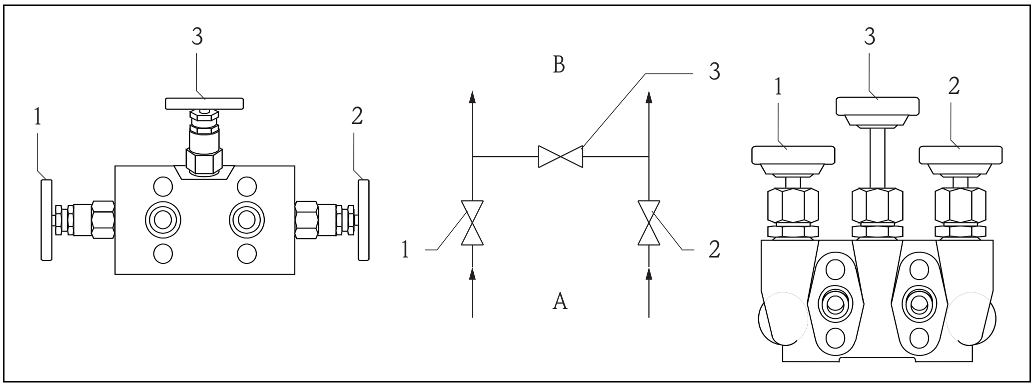
Note!
The complete venting/drainage of the Deltabar S differential pressure transmitter is always performed via appropriate units on the side of the transmitter flanges opposite the manifold.

Caution!
If all three valves on the manifold are opened simultaneously, the differential pressure causes the medium to flow through the manifold. In the case of hot media, this can cause the manifold and the Deltabar S differential pressure transmitter to overheat. For this reason, never open all three valves simultaneously during operation.

Versions

3-valve manifold

The manifold is used to connect the impulse lines to the differential pressure transmitter.
Valves 1 and 2 can be used to separate the differential pressure transmitter from the process.
Valve 3 is used to perform the zero point adjustment of the transmitter.



P01-DOxxxxxx-14-xx-xx-xx-014

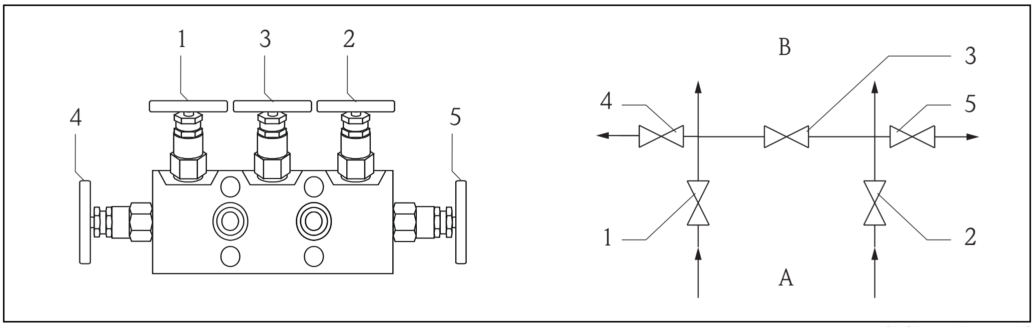
Left Milled version (for gases and liquids)
Right Forged version (for steam)

A Process side
B Transmitter side

5-valve manifold

The manifold is used to connect the impulse lines to the differential pressure transmitter.
Valves 1 and 2 can be used to separate the differential pressure transmitter from the process. Valve 3 is used to perform the zero point adjustment of the transmitter. With valves 4 and 5, you can:

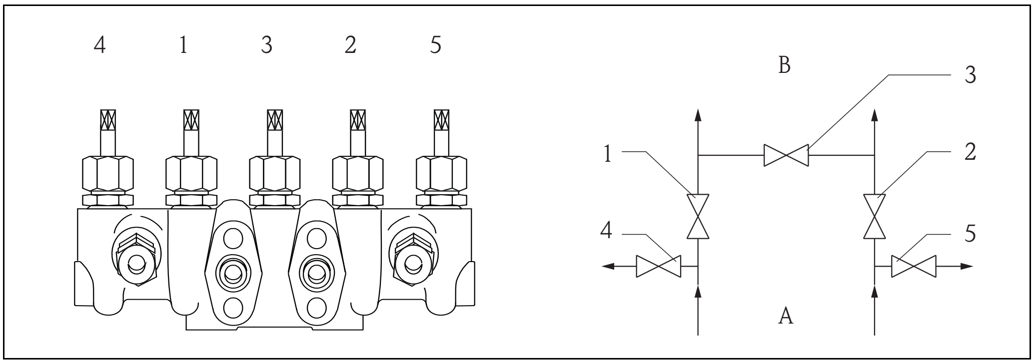
- Vent the impulse lines (for liquids and steam)
- Drain the impulse lines (for gases)
- Completely empty the impulse lines (e.g. if performing maintenance)



P01-DOxxxxxx-14-xx-xx-xx-015

Venting,
Milled version (for gases and liquids);

A Process side
B Transmitter side

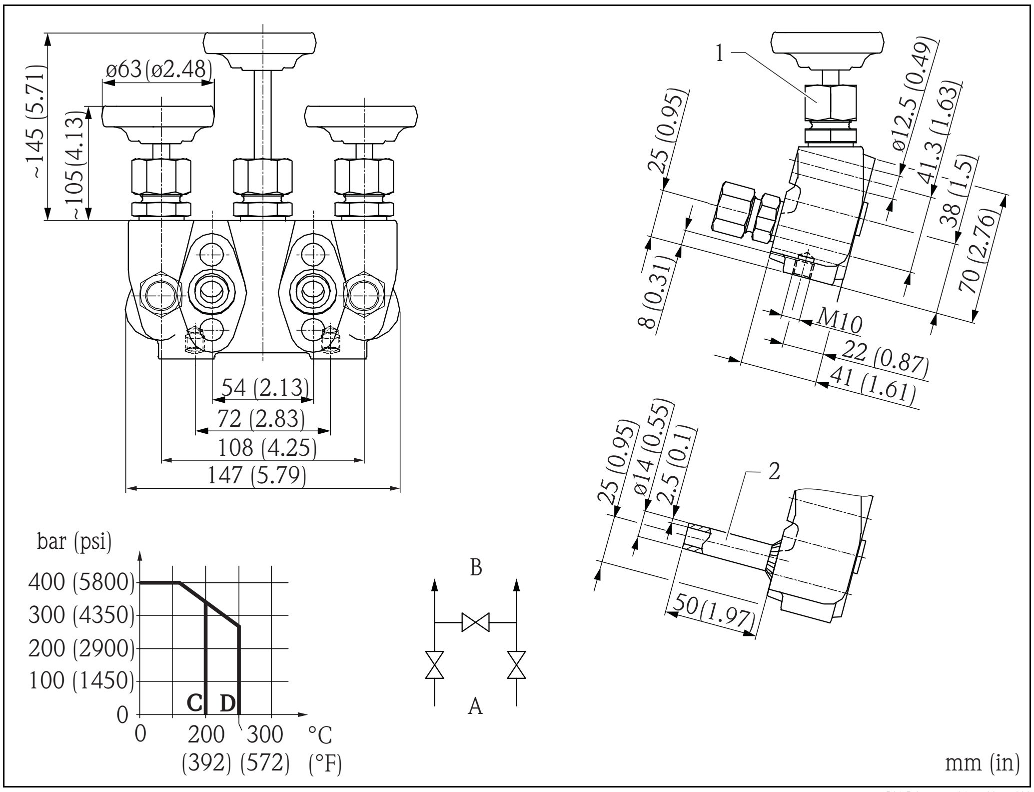


P01-DOxxxxxx-14-xx-xx-xx-016

Purging,
Forged version (for steam)

A Process side
B Transmitter side

Version: 3-valve, forged



P01-DOxxxxxx-06-xx-00-xx-032

A	*Process side*	*1*	*Cutting ring*
B	*Transmitter side*	*2*	*Weld connection*
C	*PTFE packing*		
D	*Pure graphite packing*		

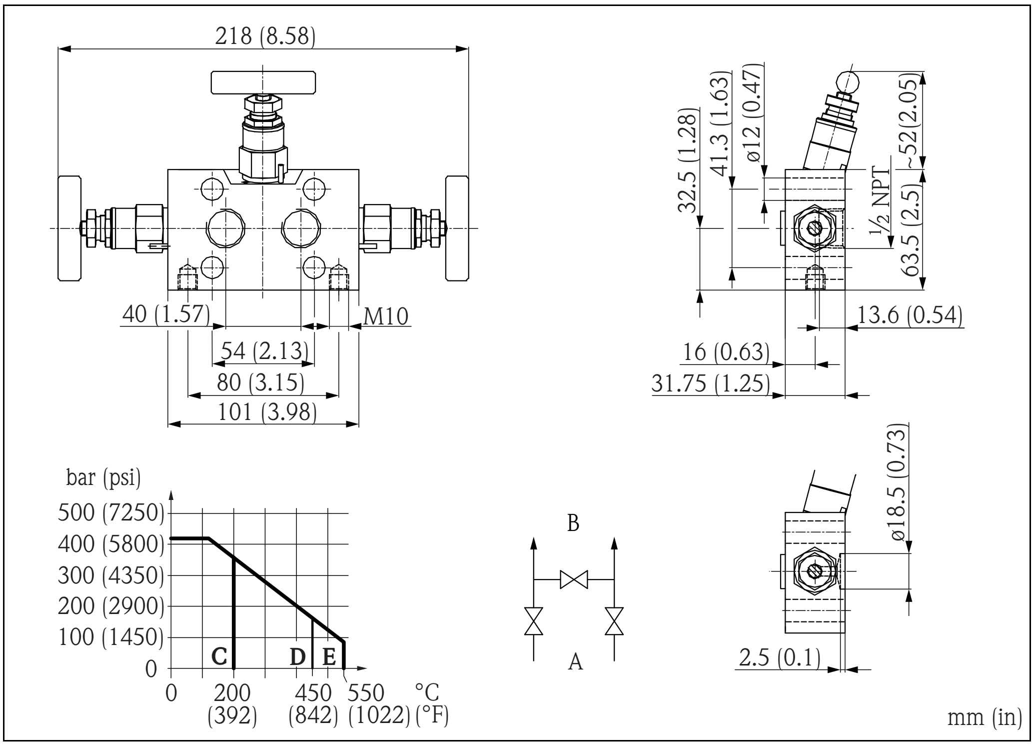
Design

- Body: die-pressed part
- Surface: steel phosphatized
- Internal stem thread
- Replaceable valve seat
- Stem with cold rolled surface, back seal and non-rotating needle tip
- Handwheels made of plastic
- Inlet:
  - Cutting ring fitting for pipe ∅12 mm, series S, G 3/8
  - Welding socket for pipe ∅14 x 2.5 mm
- Outlet: IEC 61518, Form A
- Weight: approx. 3.2 kg (7.06 lbs), including 4 screws with washers and 2 seals

Materials

Component	"steel" version	"316Ti" version
Body	1.0460	1.4571
Bonnet	1.0501	1.4571
Valve seat	1.4571	1.4571
Valve stem	1.4104	1.4571
Needle tip	1.4122 v.	1.4571
Packing	▪ PTFE (up to +200 °C (+392 °F)) ▪ Pure graphite (up to +300 °C (+572 °F))	▪ PTFE (up to +200 °C (+392 °F)) ▪ Pure graphite (up to +300 °C (+572 °F))
Union nut	Steel	1.4571
Welding socket	1.4515	1.4571

Version: 3-valve, milled



P01-DOxxxxxx-06-xx-00-xx-033

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

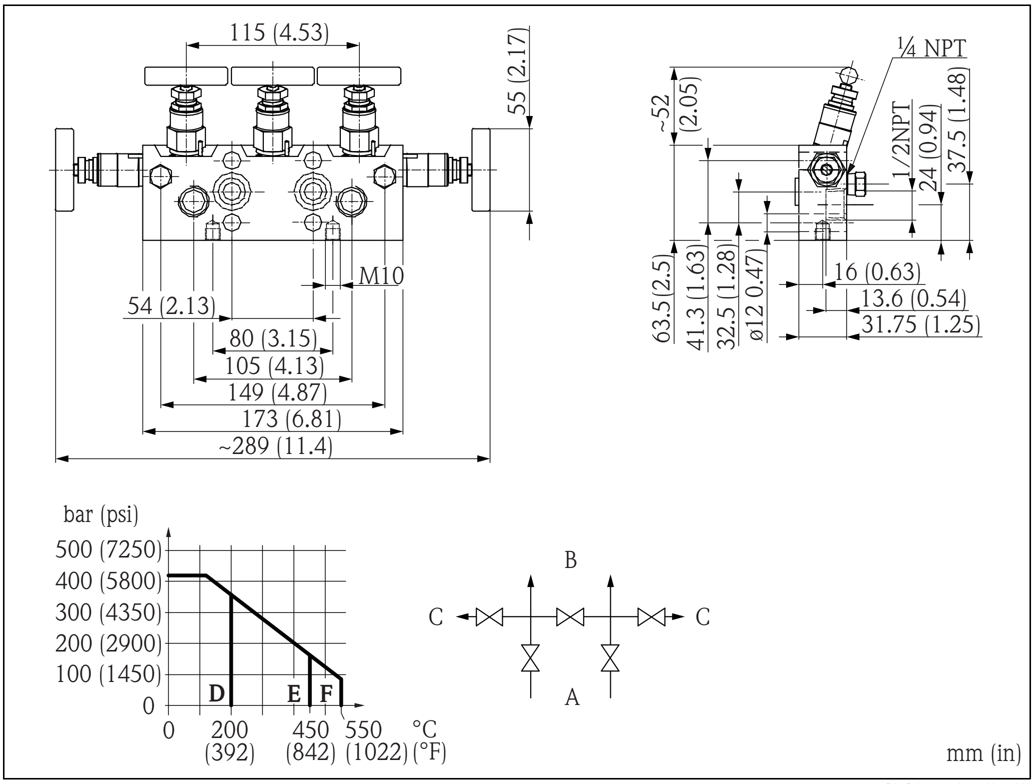
Design

- Surface: steel phosphatized
- External stem thread
- Stem with cold rolled surface, back seal and non-rotating needle tip
- Inlet: sleeve ½ NPT
- Outlet: IEC 61518, Form A
- Weight: approx. 2.0 kg (4.41 lbs), including 4 screws with washers and 2 seals

Materials

Component	"steel" version	"316L" version
Body	1.0460	1.4404 (316L)
Bonnet	1.4401 (316)	1.4401 (316)
Valve stem	1.4404	1.4404
Needle tip	1.4122 v.	1.4571
Packing	▪ PTFE (up to +200 °C (+392 °F)) ▪ Pure graphite (up to +550 °C (+1022 °F))	▪ PTFE (up to +200 °C (+392 °F)) ▪ Pure graphite (up to +550 °C (+1022 °F))
Gland nut	1.4301	1.4301
T-handle	Stainless steel	Stainless steel

Version: 5-valve, milled, vent



P01-DOxxxxxx-06-xx-00-xx-034

A *Process side*
B *Transmitter side*
C *Venting*
D *PTFE packing*
E *Pure graphite packing 1.0460*
F *Pure graphite packing 1.4404*

Usage

Gas and liquid applications

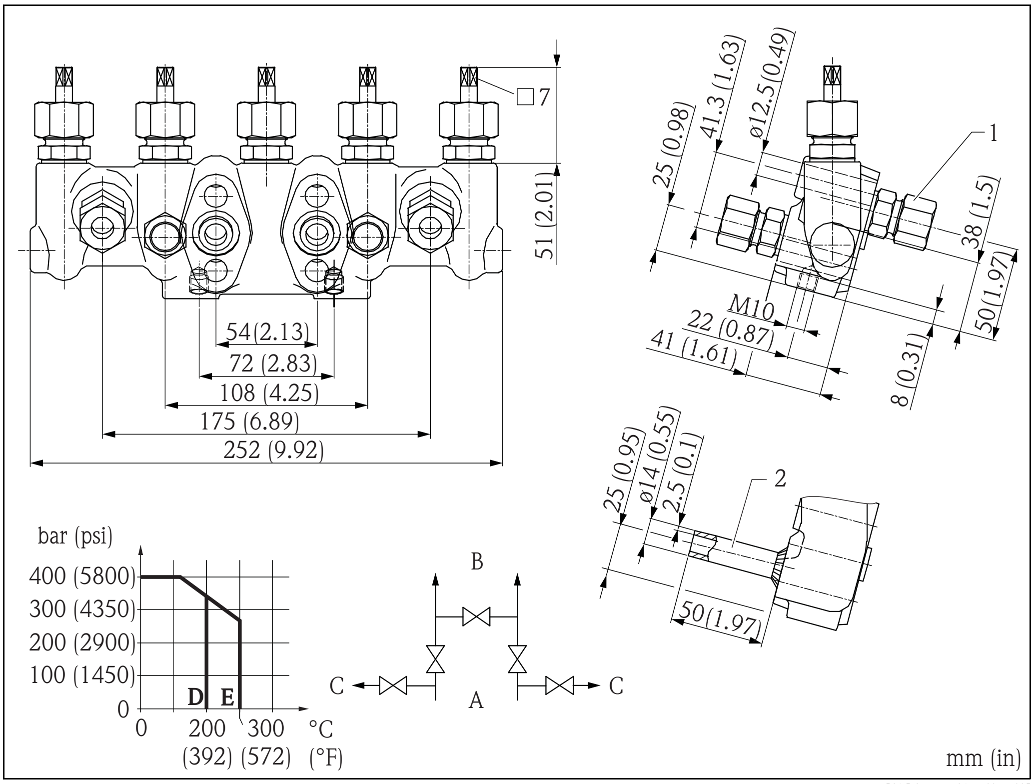
Design

- Surface: steel phosphatized
- External stem thread
- Stem with cold rolled surface, back seal and non-rotating needle tip
- Inlet: sleeve ½ NPT
- Outlet: IEC 61518, Form A
- Weight: approx. 3.3 kg (7.28 lbs), including 4 screws with washers and 2 seals

Materials

Component	"steel" version	"316L" version
Body	1.0460	1.4404 (316L)
Bonnet	1.4401 (316)	1.4401 (316)
Valve stem	1.4404	1.4404
Needle tip	1.4122 v.	1.4571
Packing	▪ PTFE (up to +200 °C (+392 °F)) ▪ Pure graphite (up to +550 °C (+1022 °F))	▪ PTFE (up to +200 °C (+392 °F)) ▪ Pure graphite (up to +550 °C (+1022 °F))
Gland nut	1.4301	1.4301
T-handle	Stainless steel	Stainless steel
Screw plug	1.0501	1.4404

Version: 5-valve, forged, purge valve



P01-DOxxxxxx-06-xx-00-xx-035

A	*Process side*	*1*	*Cutting ring fitting*
B	*Transmitter side*	*2*	*Weld connection*
C	*Purge valve*		
D	*PTFE packing*		
E	*Pure graphite packing*		

Usage

Steam applications

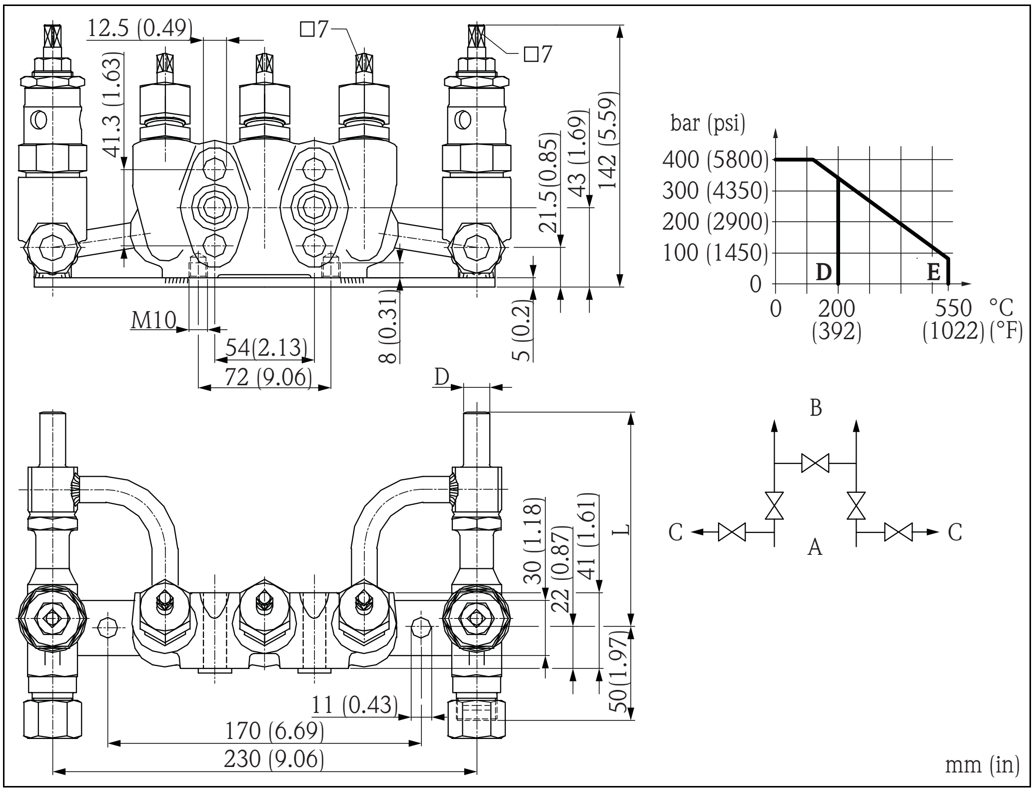
Design

- Body: die-pressed part
- Surface: steel phosphatized
- Internal stem thread
- Replaceable valve seat
- Stem with cold rolled surface, back seal and non-rotating needle tip
- Inlet/purge valve
  - Cutting ring fitting for pipe ø12 mm; series S, G$^3/_8$
  - Welding socket for pipe ø14 x 2.5 mm
- Outlet: IEC 61518, Form A
- Weight: approx. 4.6 kg (10.14 lbs), including 4 screws with washers and 2 seals

Materials

Component	"steel" version	"316Ti" version
Body	1.0460	1.4571
Bonnet	1.0501	1.4571
Valve seat	1.4571	1.4571
Valve stem	1.4104	1.4571
Needle tip	1.4122 v.	1.4571
Packing	■ PTFE (up to +200 °C (+392 °F)) ■ Pure graphite (up to +300 °C (+572 °F))	■ PTFE (up to +200 °C (+392 °F)) ■ Pure graphite (up to +300 °C (+572 °F))
Union nut	Steel	1.4571

Version: 5-valve, high-temperature, forged, purge valve



P01-DOxxxxxx-06-xx-00-xx-036

A *Process side*
B *Transmitter side*
C *Purge valve*
D *PTFE packing*
E *Pure graphite packing*

Usage

High temperature steam applications

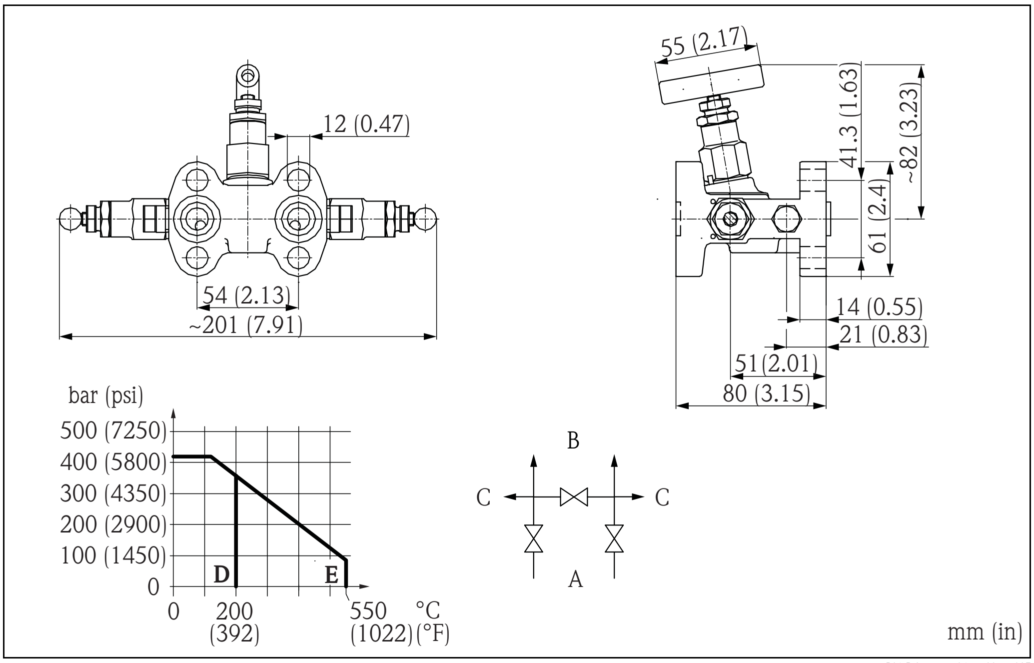
Design

- Body: die-pressed part
- Surface: steel phosphatized
- Manifold: internal stem thread
- Purge valves: external stem thread
- Replaceable valve seat
- Stem with cold rolled surface, back seal and non-rotating needle tip
- Inlet: butt weld end for pipe 14 x 2.5 mm
- Outlet manifold: IEC61518, Type A
- Outlet purge valve: cutting ring fitting for pipe ø12 mm
- Weight: approx. 5.6 kg (12.35 lbs), including 4 screws with washers and 2 seals

Materials

Component	**"steel" version**		**"316Ti" version**	
	manifold	**purge valve**	**manifold**	**purge valve**
Body	1.0460	1.5415	1.4571	1.4571
Bonnet	1.0501	1.7709	1.4571	1.4571
Valve seat	1.4571	1.4021	1.4571	1.4571
Valve stem	1.4104	1.4021	1.4571	1.4571
Needle tip	1.422 v.	1.422 v.	1.4571	1.4571
Packing	PTFE	Pure graphite	PTFE	Pure graphite
Union nut	Steel	-	1.4571	-
Gland nut	-	2.0550	-	1.4301

Version: 3-valve, forged, IEC 61518, both sides



P01-DOxxxxxx-06-xx-00-xx-037

A	*Process side*	*D*	*PTFE packing*
B	*Transmitter side*	*E*	*Pure graphite packing 1.4404*
C	*Vent valve*		

Usage

For the compact version of Deltatop

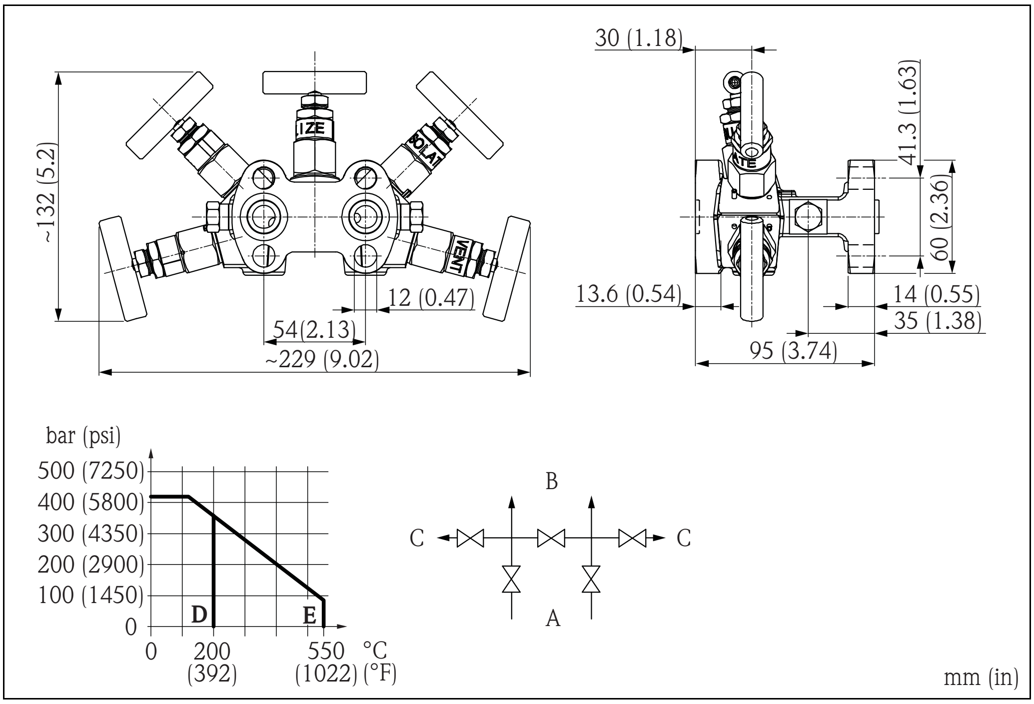
Design

- Body: die-pressed part
- External stem thread
- Stem with cold rolled surface, back seal and non-rotating needle tip
- Inlet: turned groove, ø18.5 acc. to IEC 61518
- Outlet: IEC 61518, Form A
- Weight: approx. 2.2 kg (4.85 lbs), including 4 screws with washers and 2 seals

Dimensions

Component	**"316Ti" version**
Body	1.4404 (316L)
Bonnet	1.4401 (316)
Valve stem	1.4404
Needle tip	1.4571
Packing	■ PTFE (up to +200 °C (+392 °F)) ■ Pure graphite (up to +550 °C (+1022 °F))
Gland nut	1.4301
T-handle	Stainless steel

Version: 5-valve, forged, IEC 61518, both sides, venting



P01-DOxxxxxx-06-xx-00-xx-038

A Process side
B Transmitter side
C Vent valve
D PTFE packing
E Pure graphite packing 1.4404

Usage

For the compact version of Deltatop

Design

- Body: die-pressed part
- External stem thread
- Stem with cold rolled surface, back seal and non-rotating needle tip
- Inlet: turned groove, ø18.5 acc. to IEC 61518
- Outlet (to transmitter): IEC 61518 Form A
- Outlet (test/vent): sleeve ¼ NPT with screw plug
- Weight: approx. 3.3 kg (7.28 lbs), including 4 screws with washers and 2 seals

Dimensions

Component	Material
Body	1.4404 (316L)
Bonnet	1.4401 (316)
Valve stem	1.4404 (316L)
Needle tip	1.4571
Packing	▪ PTFE (up to +200 °C (+392 °F)) ▪ Pure graphite (up to +550 °C (+1022 °F))
Gland nut	1.4301
T-handle	Stainless steel
Screw plug	1.4404 (316L)

Product structure

300	**Version**						
	AA1						3 valve, steel, forged
	AA2						3 valve, 316Ti, forged
	AB1						3 valve, steel, milled
	AB2						3 valve, 316L, milled
	BB1						5 valve, steel, milled, vent
	BB2						5 valve, 316L, milled, vent
	CA1						5 valve, steel, forged, purge valve
	CA2						5 valve, 316Ti, forged, purge valve
	DA1						5 valve HT, steel, 16Mo3, forged, purge valve
	DA2						5 valve HT, 316Ti, forged, purge valve
	KA2						3-valve, 316L, IEC61518, both side
	LA2						5-valve, 316L, IEC61518, both side, vent
	YY9						Special version, TSP-no. to be spec.
310		**Gasket**					
		B					PTFE, 200°C/392°F
		C					PTFE/pure graphite, HT
		Y					Special version, TSP-no. to be spec.
320			**Process Connection**				
			B				FNPT1/2
			C				Cutting ring (Ermeto 12S)
			D				Welding conn. 14mm
			E				IEC61518
			Y				Special version, TSP-no. to be spec.
330				**Seals; Screws**			
				B			PTFE; UNF7/16, max PN420
				C			PTFE; M10, max PN160
				D			Viton; UNF7/16, max PN420
				E			Viton; M10, max PN160
				F			Viton; M12, max PN420
				Y			Special version, TSP-no. to be spec.
540					**Additional option**		
					E1		EN10204-3.1 material (valve body) inspection certificate
					E2		EN10204-3.1 material, NACE MR0175 (valve body) inspection certificate
					E3		EN10204-3.2 material (valve body) inspection certificate
					E5		Cleaned from oil+grease
					E6		Oxygen service
					E7		PWIS free, PWIS = paint-wetting impairment substances
					EA		Mounting bracket, steel
					EB		Mounting bracket, stainless steel
895						**Marking**	
						Z1	Tagging (TAG), see additional spec.
DA63M-							Complete product designation

DA63R: Rectifier

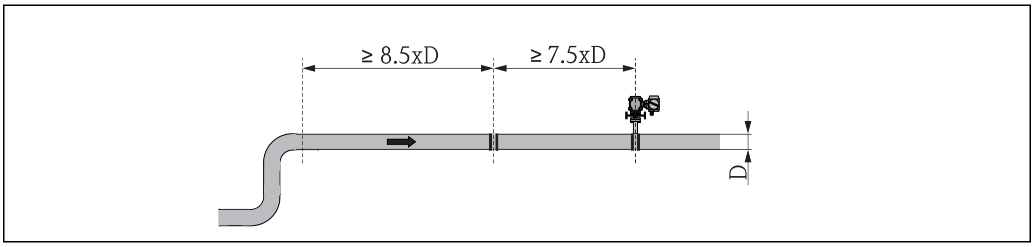
Usage

DA63R rectifier, also calles Zanker flow conditioner plate can be used to reduce the required upstream length between a flow disturbance in the pipe and the orifice plate.

Installation conditions

- Distance between flow conditioner and flow disturbance: min. 8.5 D
- Distance between flow conditioner and orifice: min. 7.5xD

D: inner pipe diameter



P01-DOxxxxxx-11-xx-xx-xx-015

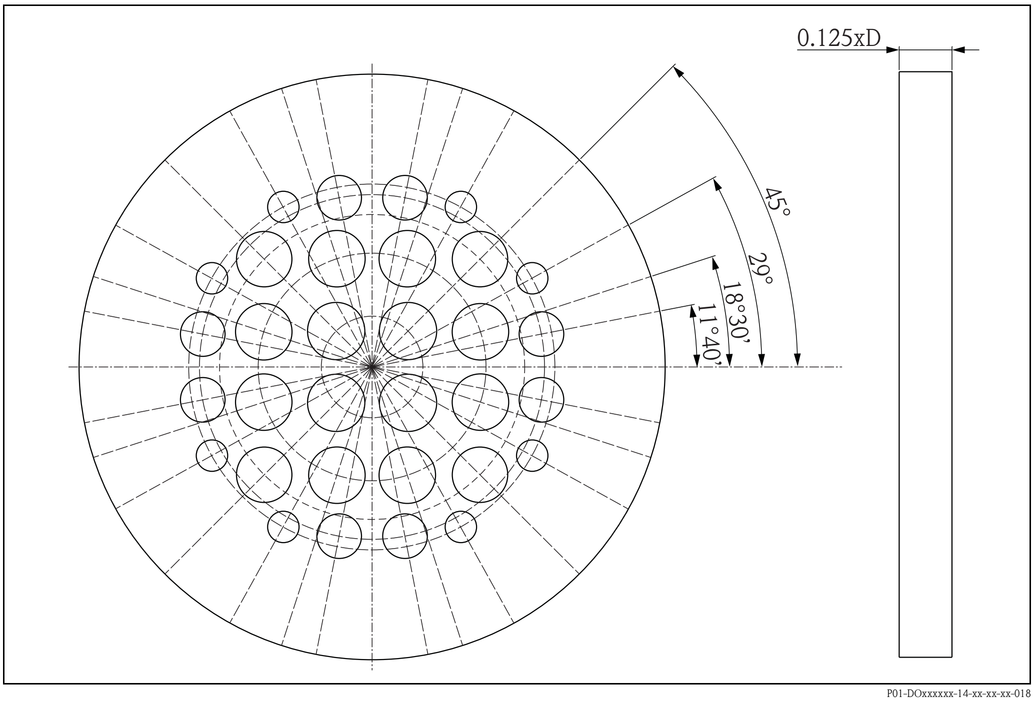
Pressure loss

The following pressure loss occurs at the flow conditioner:

$\Delta p = 1.5\ \rho\ v^2$

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

Dimensions



The Zanker flow conditioner plate 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

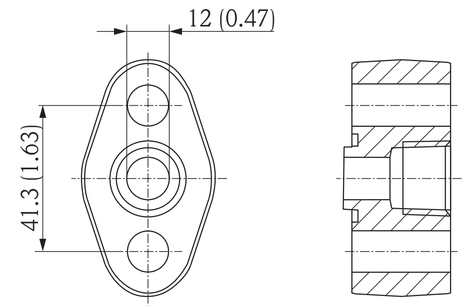
The plate thickness is 0.125xD.
The plate diameter is adjusted to the outer diameter of the flange (according to feature 30 "orifice").

Product structure

	Nominal diameter				
	25	DN25 / 1"			
	40	DN40 / 1-1/2"			
	50	DN50 / 2"			
	65	DN65 / 2-1/2"			
	80	DN80 / 3"			
	1H	DN100 / 4"			
	1Z	DN125 / 5"			
	1F	DN150 / 6"			
	2H	DN200 / 8"			
	2F	DN250 / 10"			
	3H	DN300 / 12"			
	3F	DN350 / 14"			
	4H	DN400 / 16"			
	4F	DN450 / 18"			
	5H	DN500 / 20"			
	6H	DN600 / 24"			
	7H	DN700 / 28"			
	8H	DN800 / 32"			
	9H	DN900 / 36"			
	1T	DN1000 / 40"			
010		**Version**			
		S	Standard		
		Y	Special version, TSP-no. to be spec.		
030			**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 B2, 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, TSP-no. to be specified	
550				**Additional option**	
				F1	EN10204-3.1 material (wetted parts) inspection certificate
				F2	EN10204-3.1 material, NACE MR0175 (wetted parts) inspection certificate
DA63R-					Complete product designation

Oval flange PZO for Deltabar S

Dimensions



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

Product structure PZO

010	**Approval**					
	R	Basic version				
	B	EN10204-3.1 material, oval flange inspection certificate				
	S	Cleaned from oil+grease, oxygen service				
	Y	Special version, TSP-no. to be spec.				
020		**Process connection**				
		A	FNPT1/2-14			
		E	JIS RC1/4"			
		Y	Special version, TSP-no. to be spec.			
030			**Material**			
			2	Steel C22.8		
			1	316L		
			9	Special version, TSP-no. to be spec.		
040				**Seal**		
				1	PTFE	
				2	FKM Viton	
				9	Special version, TSP-no. to be spec.	
050					**Mounting Screw**	
					1	2x Mounting screw M10
					4	2x Mounting screw M12
					2	2x Mounting screw UNF7/16-20
					3	Not selected
					9	Special version, TSP-no. to be spec.
PZO-						Complete product designation

Documentation

Deltatop

Document	Product	Designation
Technical Information		
TI00422P	DO61W, DO62C, DO63C, DO64P, DO65F	Differential pressure flow measurement with orifice plates and Deltabar S differential pressure transmitter
TI00425P	DO61D, DP62D, DP63D	Differential pressure flow measurement with Pitot tubes and Deltabar S differential pressure transmitter
Operating Instructions		
BA00368P	DO61W, DO62C, DO63C, DO64P, DO65F	Differential pressure flow measurement with orifice plates and Deltabar S differential pressure transmitter
BA00369P	DP61D, DP62D, DP63D	Differential pressure flow measurement with Pitot tubes and Deltabar differential pressure transmitter

Deltabar S / M

Document	Product	Designation
Technical Information		
TI00382P	Deltabar S	Differential pressure transmitter
TI00434P	Deltabar M	Differential pressure transmitter
Operating Instructions		
BA00270P	Deltabar S	Differential pressure transmitter - HART
BA00294P	Deltabar S	Differential pressure transmitter - PROFIBUS PA
BA00301P	Deltabar S	Differential pressure transmitter - FOUNDATION Fieldbus
BA00382P	Cerabar M / Deltabar M / Deltapilot M	Pressure and differential pressure transmitter, flow and hydrostatics - HART
BA00383P	Cerabar M / Deltabar M / Deltapilot M	Pressure and differential pressure transmitter, flow and hydrostatics - PROFIBUS PA
BA00384P	Cerabar M / Deltabar M / Deltapilot M	Pressure and differential pressure transmitter, flow and hydrostatics - FOUNDATION Fieldbus
Description of Device Functions		
BA00274P	Cerabar S / Deltabar S / Deltapilot S	Pressure and differential pressure transmitter - HART
BA00296P	Cerabar S / Deltabar S / Deltapilot S	Pressure and differential pressure transmitter - PROFIBUS PA
BA00303P	Cerabar S / Deltabar S / Deltapilot S	Pressure and differential pressure transmitter - FOUNDATION Fieldbus
Safety Instructions		
XA00235P	Deltabar S	ATEX II 1/2 G Ex ia
XA00237P	Deltabar S	ATEX II 1/2 D
XA00239P	Deltabar S	ATEX II 1/3 D
XA00240P	Deltabar S	ATEX II 2 G Ex d
XA00241P	Deltabar S	ATEX II 3 G Ex nA
XA00242P	Deltabar S	ATEX II 1/2 G Ex id; ATEX II 2 G Ex d
XA00243P	Deltabar S	ATEX II 1/2 GD Ex ia
XA00275P	Deltabar S	ATEX II 1 GD Ex ia
XA00457P	Deltabar M	ATEX II 1/2 G Ex ia; ATEX 2 G Ex ia
XA00458P	Deltabar M	ATEX II 1/2 D
XA00459P	Deltabar M	ATEX II 2 G Ex d
XA00460P	Deltabar M	ATEX II 2 G Ex ia; ATEX II 1/2 D Ex ia
XA00461P	Deltabar M	ATEX II 3 G Ex nA

Omnigrad T, iTEMP

Omnigrad T – resistance temperature detector
iTEMP – temperature head transmitter

Document	Product	Designation
Technical Information		
TI00269T	Omnigrad T TR24	Resistance temperature detector
TI00070R	iTEMP TMT181	Temperature head transmitter 4 to 20 mA
TI00078R	iTEMP TMT182	Temperature head transmitter HART
TI00079R	iTEMP TMT184	Temperature head transmitter PROFIBUS PA
Operating Instructions		
KA00141R	iTEMP TMT181	Temperature head transmitter 4 to 20 mA
KA00142R	iTEMP TMT182	Temperature head transmitter HART
BA00115R	iTEMP TMT184	Temperature head transmitter PROFIBUS PA
Safety Instructions		
XA00003T	Omnigrad T TR24	ATEX II 1 GD Ex ia IIC
XA00004R	iTEMP TMT181 (4 to 20 mA)	ATEX II 1 G Ex ia IIC
XA00006R	iTEMP TMT182 (HART)	ATEX II 1 G Ex ia IIC
XA00008R	iTEMP TMT184 (PROFIBUS PA)	ATEX II 1 G Ex ia IIC

RMS621/RMC621 flow and energy manager

Document	Product
Technical Information	
TI00092R	RMS621 energy manager
TI00098R	RMC621 flow and energy manager
Operating Instructions	
BA00127R	RMS621 energy manager
BA00144R	RMC621 flow and energy manager

RH33 BTU meter / RS33 steam computer

Document	Product
Technical Information	
TI00151K	EngyCal® RH33 BTU meter
TI00154K	EngyCal® RS33 steam calculator
Operating Instructions	
BA00290K	RH33 universal BTU meter
BA00294K	RS33 steam calculator

Sizing sheet - data sheet

Sizing Sheet - data sheet / Orifices - Nozzles - Venturi tubes - Restriction orifices Sheet 1/2

Fields marked with * are mandatory to be filled in

Project:

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

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:			* 3)	
Pressure:		*		
Temperature:		*		
Density: 1)				
Viscosity: 1)				
Z-factor: 1,2)				
Isentropic index: 1,2)				

The sizing will be based on maximum requested flow and nominal pressure and temperature.
1) For clearly specifid 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.
3) The maximum requested flow will be set as upper range value.

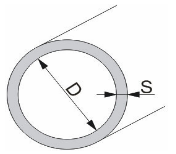
Flowmeter

Description: *

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

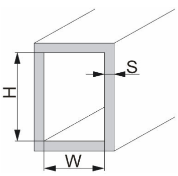
Pipe dimensions *

☐ **Pipe (round)**



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

☐ **Square ducts (Venturi tubes only)**



		unit
Height of channel (H):		
Width of channel (W):		
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 (mark only one option)

☐ Optimized by E+H
☐ Maximum Turn Down (small ß)
☐ Low pressure loss (large ß)

		unit
☐ Maximum allowable pressure loss		
☐ Fixed diameter ratio ß		
☐ Fixed differential pressure		
☐ Fixed calculation (attachment)		

Only for restriction orifices: required downstream pressure

FLOWDATA1-EN

Sizing Sheet - data sheet / Orifices - Nozzles - Venturi tubes - Restriction orifices Sheet 2/2

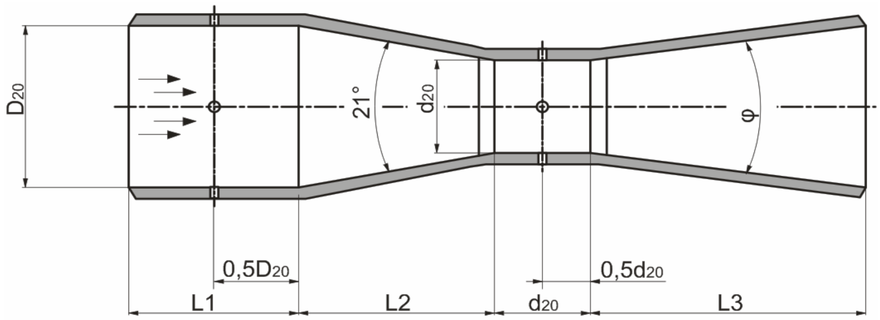
Design (only for Venturi tubes)

Process connection

- ☐ Welding neck flanges
- ☐ Slip-on flanges
- ☐ Welding connections
- ☐ ________

Pressure tapping

- ☐ Single tapping
- ☐ Annular chamber
- ☐ Averaging ring
- ☐ ________



Conical divergent section

Core angle of outlet φ (°) ________

- ☐ truncated outlet

FLOWDATA2-EN

Instructions for the completion of the sizing sheet - data sheet

- The order code of a primary device does not completely describe the final device. Further information is required. The optimized sizing and calculation of the measuring system is based on the requested information about process parameters and pipe dimensions etc. Additionally Endress+Hauser checks if the given information matches the order code of the device. Furthermore the feasibility of the measuring point is checked as well. A fully completely data sheet including information on the project, order codes and the tag number ensures the correct assignment of primary devices to differential transmitters during order processing.
- The sizing sheet - data sheet can also be created and printed via Endress+Hauser's "Applicator" sizing software. 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 indicated with their value and complete and correct unit (e.g. flow rate in Nm^3/h under reference conditions and not m^3/h)

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 device	Order code	Order code of the selected primary device.			
	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 device.			yes
Tag					
	Tag	Tag no. for clear assignment of primary device and dp-transmitter.			
Main parameter					
	Medium* Status*	Exact designation of the medium with name (e.g. water) or chemical formula (e.g. CH_4), type of fluid or state of aggregate of the medium at the given operating conditions - gas, liquid. Select steam for water vapor. Other information will be required depending on the data entered (see medium properties).	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 device is the maximum requested flow rate at nominal pressure and temperature.			
	Pressure* (absolute or gauge)	Clearly state whether the static pressure is given as absolute or gauge pressure.	yes	yes	
	Ambient pressure	The differential pressure calculation is always based on absolute static pressure in the pipe. If the static pressure is given as gauge pressure, the average ambient pressure (if different from sea level), or alternatively the height of the location above sea level, also has to be specified.	yes		
	Flow rate* Density* (at operating / normal or 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 significant depending on pressure and temperature. Please ensure the option selected is correct. Please also clearly specify the units of flow rate and density (e.g. flow rate in Sm^3/h under standard conditions or kg/Nm^3 for reference density).	yes		
	Operating conditions	For gases only: The flow or density values refer to the nominal operating conditions (pressure and temperature).	yes		

Section	Field / parameter	Explanation of the entry	Mandatory		
			A[1)]	B[1)]	C[1)]
	Normal conditions	For gases only: The flow or density values refer to normal conditions (pressure and temperature). Pressure: 101.325 kPa abs. Temperature: 0°C (273.15 K)	yes		
	Standard conditions (acc. to reference conditions)	For gases only: The flow or density values refer to standards conditions (pressure and temperature): Pressure: 101.325 kPa abs. (14.696 psi abs.) Temperature: 15 °C (59 °F) 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 standard conditions.	yes		
	Req. flow	Specification of the desired measuring range (minimum to maximum) and of the operating point (nominal). The operable flow range is typically between 1:3 and 1:6 (minimum : maximum). An operable flow range of more than 1:10 usually requires cascading (split range) of several differential pressure transmitters (see page → 10). If the operable flow range is too large between the nominal and the maximum flow, this can result in an increased measuring uncertainty at the operating point and should therefore be avoided.	yes	yes	
	Pressure	Static pressure in the pipe upstream (plus side) of the primary device.	yes	yes	
	Temperature	Temperature of the fluid at the primary device.	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 the necessary data can be obtained from 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 properties of a mixture are not known, a list with the ingredients and the composition of the ingredients can be supplied to clarify the mixture's properties. Endress+Hauser's "Applicator" sizing program has an extensive medium database containing all the necessary medium properties for a wide range of gases and liquids.			
	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 viscosity is incorporated into the calculation of the Reynolds number. High viscosity values (low Reynolds number) are a limiting factor for the application of orifice plates, particularly with liquids.	yes		
	Z-Factor	For gases only: The compressibility factor Z does have an influence on the gas density especially at higher pressure and/or higher temperature levels. If the gas density is indicated as the reference density or the density under standard conditions, the compressibility can significantly influence the calculation result. If this value is not available, the calculation will be performed with the factor set to 1, or in case of clearly defined mixtures, with a factor calculated or estimated from the ingredients.	yes		
	Isentropic exponent	For gases only: The isentropic exponent (also known as the adiabatic exponent 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					
	Description	Brief description of the desired primary device			
	Modification	Modification or offer number if available			
	Nominal width*	Nominal width of the pipe according to the relevant standard, e.g. DN200 (DIN) or 8" (ASME)		yes	
	Pressure rating*	Pressure rating of the selected connection (e.g. flange) according to the relevant standard, e.g. PN40 (DIN) oder Cl.600lbs (ASME).		yes	

Section	Field / parameter	Explanation of the entry	Mandatory		
			A[1]	B[1]	C[1]
Pipe dimensions					
	Pipe (round) / square duct	Choose whether the installation is in a round or square duct. Only one option can be selected. Square ducts are only possible when using Venturi tubes.		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 diameter between 194 mm and 215 mm depending on the pressure rating. For pipes according to ASME, it suffices to specify the nominal diameter and the schedule number.	yes	yes	
	Wall thickness (S)	Exact specification of the wall thickness makes it easier to check the pipe data on the basis of the relevant standards.		yes	
	Isolation thickness	Thickness of a possible thermal insulation of the pipe or of other covering shells. If the insulation is very thick, an extension of the taps or the neck of a compact version may be required.			
	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 criterion as far as reasonably achievable and in accordance with the valid standards.			
	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 possible compromise between the differential pressure, measuring cell, turndown, measurement uncertainty and permanent pressure loss.	yes		
	Maximum turndown (small β)	Endress+Hauser calculates and optimizes the measuring point to the smallest possible diameter ratio β that delivers a maximum turndown and minimum measurement uncertainty.	yes		
	Low permanent pressure loss (large β)	Endress+Hauser calculates and optimizes the measuring point to the largest possible diameter ratio ß in order to keep the permanent pressure loss as low as possible.	yes		
	Maximum allowable permanent pressure loss	The measurement may not exceed a 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). It is absolutely essential to enter the maximum permitted permanent pressure loss with the correct unit.	yes		
	Fixed diameter ratio β	The sizing is executed with a user-defined diameter ratio β. Endress+Hauser calculates the measuring point accordingly. It is absolutely essential to enter the desired diameter ratio.	yes		
	Fixed differential pressure	The sizing is executed with a user-defined differential pressure. Endress+Hauser calculates the measuring point accordingly. Endress+Hauser calculates the primary device in order to achieve the requested differential pressure at the layout point. It is absolutely essential to enter the desired differential pressure with the correct unit.	yes		
	Fixed sizing calculation (attachment)	A completed sizing calculation is already available. Endress+Hauser verifies the calculation and manufactures the primary device according to the given sizing parameters. The corresponding calculation must be enclosed.	yes		

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

Maintenance and repair

Maintenance

Perform the following maintenance tasks at regular intervals:
- Check the zero point adjustment
- In the case of wet gases, drain the condensate
- In the case of dirty media, drain the sediment
- In the case of abrasive media, check the primary device for wear
- In the case of buildup, check and clean the primary device; replace the seals

Note!
If operated correctly, primary devices do not require any further maintenance work. However, when performing standard inspections of the equipment, it is advisable to inspect the primary device to guarantee future operation (material/sharp edges/signs of wear).

Caution!
- Any maintenance work required may only be performed by specially trained technicians or taking the specialist departments into account. It is particularly important to comply with the safety instructions of these departments and staff (check pressure/temperature; valves must be shut).
- When performing necessary maintenance tasks (e.g. replacing the transmitter or manifold) under process conditions, make sure that all the valves are shut so that there is no danger of medium escaping. Where warranted, before disassembly check the temperature and ensure pressure is not supplied.

Exterior cleaning

When cleaning the exterior, always use cleaning agents that do not corrode the surface of the housing and the seals.

Replacing seals

Under normal circumstances, wetted seals must not be replaced. Replacement is necessary only in special circumstances, for example if aggressive or corrosive fluids are incompatible with the seal material.

Spare parts

Material number	Description
71071897	Screw set UNF7/16x1¾", steel, Viton Comprising: ▪ 4x screws, length 1¾", steel ▪ 4x washers ▪ 2x Viton seals Usage: manifolds DA63M, milled Not for manifolds + connection IEC61518, both sides
71071899	Screw set UNF7/16x1¾", steel, PTFE Comprising: ▪ 4x screws, length 1¾", steel ▪ 4x washers ▪ 2x seals, PTFE Usage: manifolds DA63M, milled Not for manifolds + connection IEC61518, both sides
71071900	Screw set UNF7/16x2¼", steel, Viton Comprising: ▪ 4x screws, length 2¼", steel ▪ 4x washers ▪ 2x Viton seals Usage: manifolds DA63M, forged Not for manifolds + connection IEC61518, both sides
71071901	Screw set UNF7/16x2¼", steel, PTFE Comprising: ▪ 4x screws, length 2¼", steel ▪ 4x washers ▪ 2x seals, PTFE Usage: manifolds DA63M, forged Not for manifolds + connection IEC61518, both sides

Return	**Returning devices** The measuring device must be returned if repairs or a factory calibration are required, or if the wrong measuring device has been ordered or delivered. According to legal regulations, Endress+Hauser, as an ISO-certified company, is required to follow certain procedures when handling returned products that are in contact with medium. To ensure swift, safe and professional device returns, please read the return procedures and conditions on the Endress+Hauser website at www.services.endress.com/return-material
Disposal	When disposing, separate and recycle the device components based on the materials.
Contact addresses at Endress+Hauser	Contact addresses can be found on our homepage: www.endress.com/worldwide. If you have any questions, please contact your Endress+Hauser office.

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People for Process Automation

TI00455P/00/EN/01.11
71145178
FM+SGML 9.0 ProMoDo

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