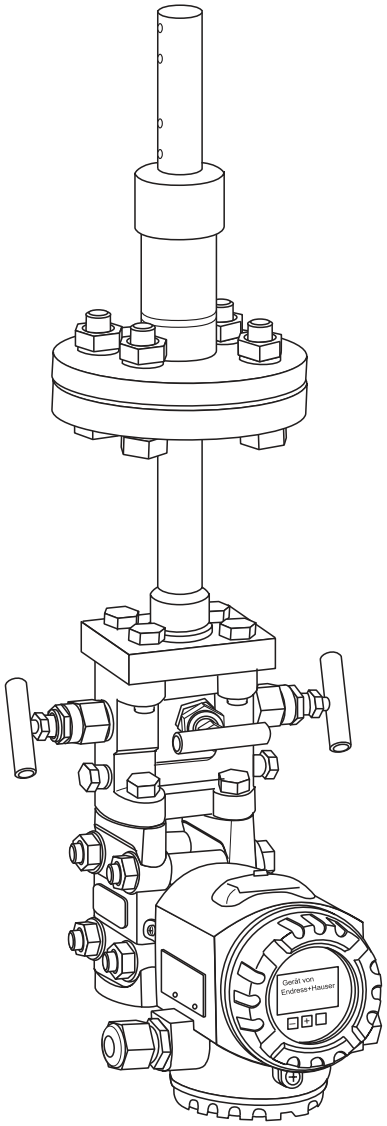
Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Operating Instructions

Deltatop DP61D, DP62D, DP63D

Pitot tubes for differential pressure flow measurement



BA369P/00/en/07.08
71062450

Endress+Hauser

People for Process Automation

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1 Safety instructions

1.1 Designated use

The measuring system is used to measure the volume or mass flow of saturated steam, over-heated steam, gases and liquids.
Resulting from incorrect or from use other than that desiganted the operational safety of the measuring devices can be suspended. The manufacturer accepts no liability for damages being produced from this.

1.2 Installation, commissioning, operation

The Deltatop measuring system is fail-safe and is constructed to the state-of-the-art. It meets the appropriate standards and EC directives. However, if you use it improperly or other than for its designated use, it may pose application-specific hazards, e.g. product overflow due to incorrect installation or configuration. Installation, electrical connection, start-up, operation and maintenance of the measuring device must therefore be carried out exclusively by trained specialists authorised by the system operator. Technical personnel must have read and understood these operating instructions and must adhere to them. You may only undertake modifications or repair work to the device when it is expressly permitted by the operating instructions.

1.3 Hazardous area

Measuring systems for use in hazardous environments are accompanied by separate "Ex documentation", which is an integral part of this Operating Manual. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory.

- Ensure that all personnel are suitably qualified.
- Observe the specifications in the certificate as well as national and local standards and regulations.

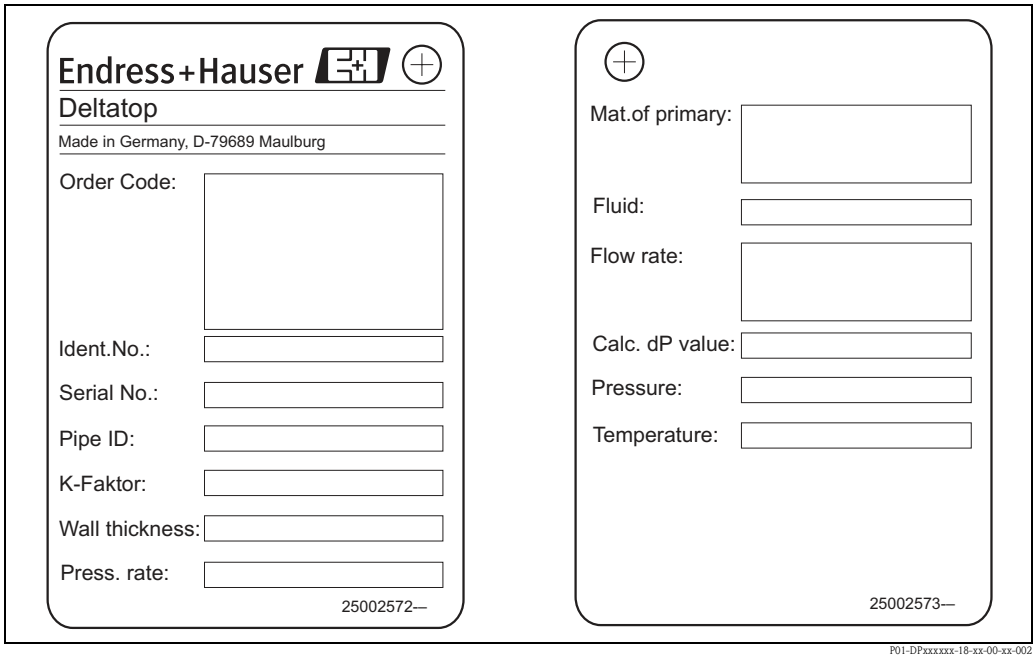
1.4 Notes on safety conventions and symbols

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

Safety conventions	
	**Warning!** A warning highlights actions or procedures which, if not performed correctly, will lead to personal injury, a safety hazard or destruction of the instrument
	**Caution!** Caution highlights actions or procedures which, if not performed correctly, may lead to personal injury or incorrect functioning of the instrument
	**Note!** A note highlights actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned
Explosion protection	
	**Device certified for use in explosion hazardous area** If the device has this symbol embossed on its name plate it can be installed in an explosion hazardous area
	**Explosion hazardous area** Symbol used in drawings to indicate explosion hazardous areas. Devices located in and wiring entering areas with the designation “explosion hazardous areas” must conform with the stated type of protection.
	**Safe area (non-explosion hazardous area)** Symbol used in drawings to indicate, if necessary, non-explosion hazardous areas. Devices located in safe areas still require a certificate if their outputs run into explosion hazardous areas
Electrical symbols	
	**Direct voltage** A terminal to which or from which a direct current or voltage may be applied or supplied
	Alternating voltage A terminal to which or from which an alternating (sine-wave) current or voltage may be applied or supplied
	**Grounded terminal** A grounded terminal, which as far as the operator is concerned, is already grounded by means of an earth grounding system
	**Protective grounding (earth) terminal** A terminal which must be connected to earth ground prior to making any other connection to the equipment
	**Equipotential connection (earth bonding)** A connection made to the plant grounding system which may be of type e.g. neutral star or equipotential line according to national or company practice
	**Temperature resistance of the connection cables** States, that the connection cables must be resistant to a temperature of at least 85 °C.

2 Identification

2.1 Nameplate



Order Code: *Order code of the instrument according to the product structure (see Technical Information TI425P)*
Ident. No.: *Identification number; characterizes the instrument unambiguously*
Serial No.: *Serial number*
Pipe ID: *Inner diameter of the measuring pipe*
K-Faktor: *Flow coefficient of the Pitot tube*
Wall thickness: *wall thickness of the measuring pipe*
Press. rate: *pressure rating*
Mat. of primary: *Material of the Pitot tube*
Fluid: *Fluid for which the instrument has been sized*
Flow rate: *Flow rate for which the instrument has been sized (operating point)*
Calc dP value: *calculated differential pressure at the operating point*
Pressure: *operating pressure*
Temperature: *operating temperature*

2.2 Product structure

See Technical Information TI 425P.

2.3 Documentation

2.3.1 Deltatop

Document	Device	Designation
Technical Information		
TI422P	DO61W, DO62C, DO63C, DO64P, DO65F	Differential pressure flow measurement with orifices and Deltabar differential pressure transmitter
TI425P	DP61D, DP62D, DP63D	Differential pressure flow measurement with Pitot tubes and Deltabar differential pressure transmitter
Operating Instructions		
BA368P	DO61W, DO62C, DO63C, DO64P, DO65F	Differential pressure flow measurement with orifices and Deltabar differential pressure transmitter
BA369P	DP61D, DP62D, DP63D	Differential pressure flow measurement with Pitot tubes and Deltabar differential pressure transmitter

2.3.2 Deltabar S

Document	Device	Designation
Technical Information		
TI382	Deltabar S	Differential pressure transmitter
Operating Instructions		
BA270P	Deltabar S	Differential pressure transmitter - HART
BA294P	Deltabar S	Differential pressure transmitter - PROFIBUS PA
BA301P	Deltabar S	Differential pressure transmitter - FOUNDATION FIELDBUS
Description of Instrument Functions		
BA274P	Cerabar S/Deltabar S/Deltapilot S	Pressure and differential pressure transmitter HART
BA296P	Cerabar S/Deltabar S/Deltapilot S	Pressure and differential pressure transmitter PROFIBUS PA
BA303P	Cerabar S/Deltabar S/Deltapilot S	Pressure and differential pressure transmitter FOUNDATION FIELDBUS
Safety Instructions (ATEX)		
XA235P	Deltabar S	ATEX II 1/2 G EEx ia
XA237P	Deltabar S	ATEX II 1/2 D
XA239P	Deltabar S	ATEX II 1/3 D
XA240P	Deltabar S	ATEX II 2G EEx d
XA241P	Deltabar S	ATEX II 3 G EEx nA
XA242P	Deltabar S	ATEX II 1/2 G EEx id; ATEX II 2 G EEx d
XA243P	Deltabar S	ATEX II 1/2 GD EEx ia
XA275P	Deltabar S	ATEX II 1 GD EEx ia

2.3.3 Omnigrad T (RTD resistance thermometer) iTEMP (temperature head transmitter)

Document	Device	Designation
Technical Information		
TI269T	Omnigrad T TR24	RTD resistance thermometer
TI070R	iTEMP TMT181	temperature head transmitter 4...20 mA
TI078R	iTEMP TMT182	temperature head transmitter HART
TI079R	iTEMP TMT184	temperature head transmitter PROFIBUS PA
Operating Instructions		
KA141R	iTEMP TMT181	temperature head transmitter 4...20 mA
KA142R	iTEMP TMT182	temperature head transmitter HART
BA115R	iTEMP TMT184	temperature head transmitter PROFIBUS PA
Safety Instructions (ATEX)		
XA003T	Omnigrad T TR24	ATEX II 1 GD EEx ia IIC
XA004R	iTMEP TMT181 (4...20 mA)	ATEX II 1 G EEx ia IIC
XA006R	iTEMP TMT182 (HART)	ATEX II 1 G EEx ia IIC
XA008R	iTEMP TMT184 (PROFIBUS PA)	ATEX II 1 G EEx ia IIC

2.3.4 Flow and Energy Manager RMS621/RMC621

Document	Device
Technical Information	
TI092R	Energy Manager RMS621
TI098R	Flow and Energy Manager RMC621
Operating Instructions	
BA127R	Energy Manager RMS621
BA144R	Flow and Energy Manager RMC621

2.4 Certificates and approvals

2.4.1 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 complies with the statutory requirements of the EC directives. Endress+Hauser confirms the successful testing of the device by affixing to it the CE mark.

2.4.2 European Pressure Equipment Directive 97/23/EC (PED)

Deltatop Pitot tubes comply with article 3.3 of the Pressure Equipment Directive 97/23/EC and thus have no CE mark affixed to them.

2.5 Registered trademarks

HART®
Registered trademark of HART Communication Foundation, Austin, USA

PROFIBUS®
Registered trademark of the PROFIBUS Trade Organisation, Karlsruhe, Germany

FOUNDATION Fieldbus®
Registered trademark of the Fieldbus Foundation Austin, Texas, USA

VITON®
Registered trademark of the company, E.I. Du Pont de Nemours & Co., Wilmington, USA

Ermeto®
Registered trademark of the Parker Hannifin GmbH, Bielefeld, Germany

3 Installation

3.1 Incoming acceptance, transport, storage

3.1.1 Incoming acceptance

Check the packing and contents for any sign of damage.
Check the shipment, make sure nothing is missing and that the scope of supply matches your order.

3.1.2 Transport



Caution!
Follow the safety instructions and transport conditions for instruments of more than 18 kg.
Do not lift the measuring instrument by the housing of the transmitter in order to transport it.

3.1.3 Storage

For storing and transport, shock proof packaging of the measuring instrument is required. The original packaging material provides optimum protection.
The permissible storage temperature for the Deltabar transmitter is -40 °C ... +80 °C.

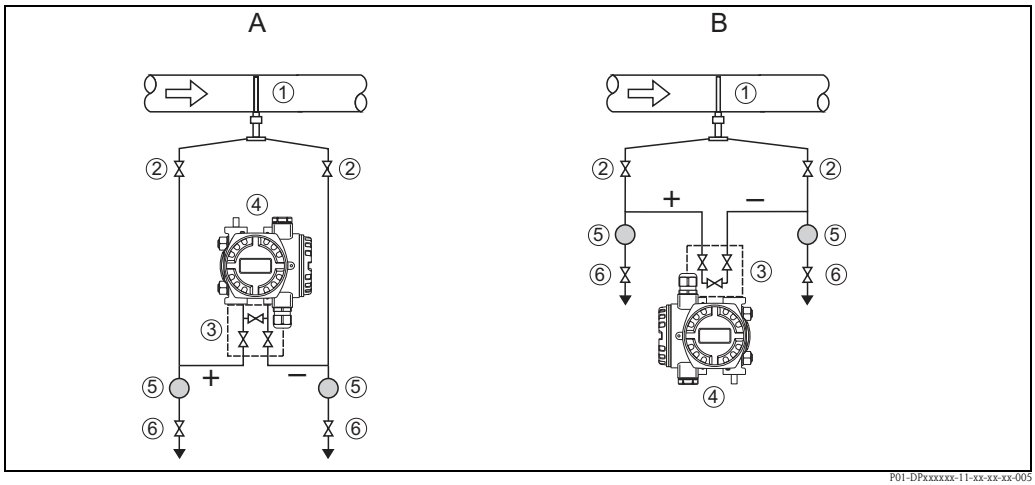
3.2 Dimensions

See Technical Information TI425P.

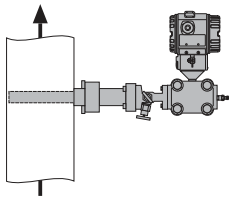
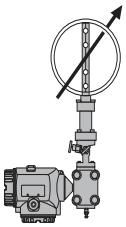
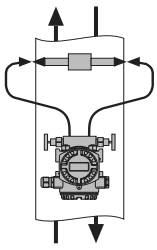
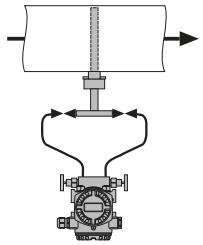
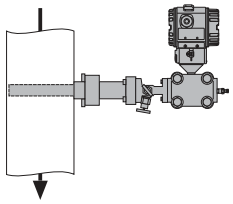
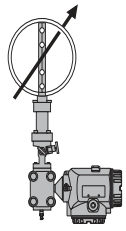
3.3 Mounting position for liquid applications

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

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



A: *Preferred configuration;* ***B:*** *alternative configuration (requires less space; only possible for clean media)*
1: *Pitot tube;* ***2:*** *Shut-off valves;* ***3:*** *Three-valve manifold;* ***4:*** *Differential pressure transmitter Deltabar;* ***5:*** *Separator;* ***6:*** *Drain valves*

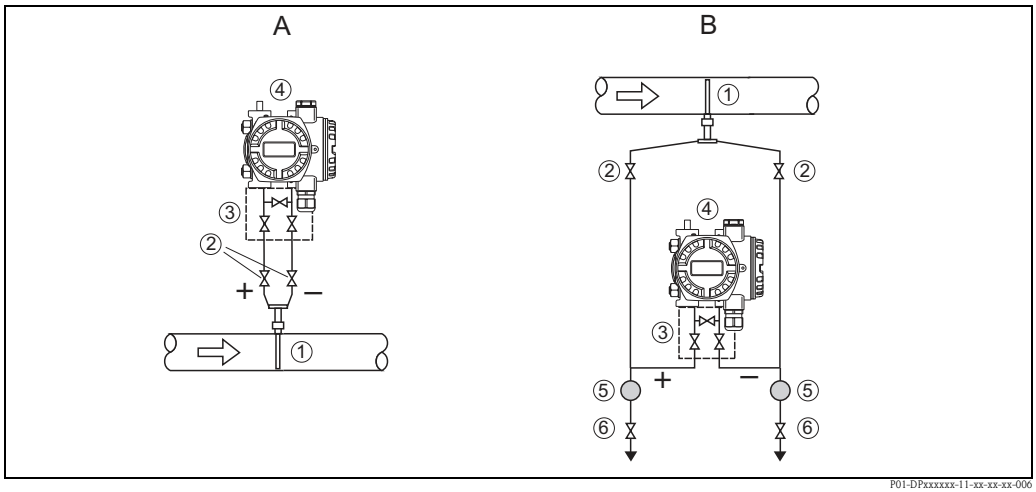
compact; vertical	**compact; horizontal**	**remote; vertical**	**remote; horizontal**
flow upwards DP6xD-EV...  P01-DP61Dxxx-11-00-00-xx-001	mounting left DP6xD-EB...  P01-DP61Dxxx-11-00-00-xx-009	upward/downward DP6xD-DW...  P01-DP61Dxxx-11-00-00-xx-014	top/bottom DP6xD-DD...  P01-DP61Dxxx-11-00-00-xx-017
flow downwards DP6xD-EU...  P01-DP61Dxxx-11-00-00-xx-002	mounting right DP6xD-EC...  P01-DP61Dxxx-11-00-00-xx-010		

Caution!
For flow measurements in vertical pipes, the primary device should be mounted at a position with upward flow. This prevents partial filling of the pipe during the measurement.

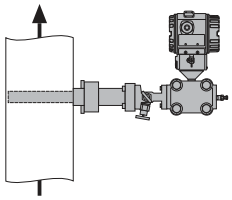
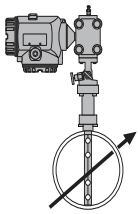
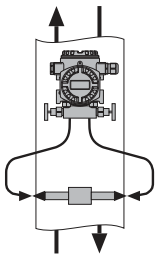
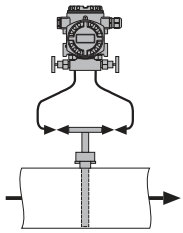
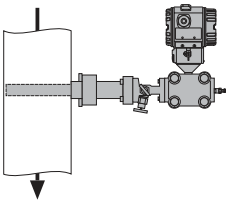
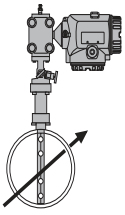
3.4 Mounting position for gas applications

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

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



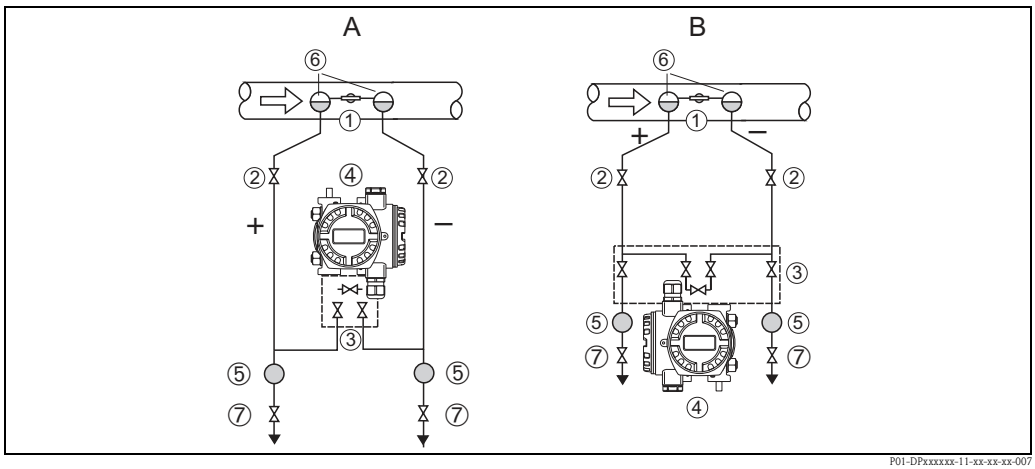
A: *Preferred configuration;* ***B:*** *Alternative configuration (if the transmitter can not be mounted above the pipe)*
1: *Pitot tube;* ***2:*** *Shut-off valves ;* ***3:*** *Three-valve manifold;* ***4:*** *Differential pressure transmitter Deltabar;* ***5:*** *Separator;* ***6:*** *Drain valve*

compact; vertical	**compact; horizontal**	**remote; vertical**	**remote; horizontal**
flow upwards DP6xD-CV...  P01-DP61Dxxx-11-00-00-xx-001	mounting left DP6xD-CB...  P01-DP61Dxxx-11-00-00-xx-007	upward/downward DP6xD-BW...  P01-DP61Dxxx-11-00-00-xx-013	top/bottom DP6xD-BD...  P01-DP61Dxxx-11-00-00-xx-016
flow downwards DP6xD-CU...  P01-DP61Dxxx-11-00-00-xx-002	mounting right DP6xD-CC...  P01-DP61Dxxx-11-00-00-xx-008		

3.5 Mounting position for steam applications

With steam applications, two condensate chambers have to be applied. They must be mounted on the same level. The transmitter must be located below the pipe. The pipes between the transmitter and the condensate chambers must be completely filled with water on both sides.
A 5-valve manifold allows simple piping and can be used instead of T-sections and additional blow-out valves.
The impulse pipes must be installed with a slope of at least 1:15 to reliably ensure rising of trapped air in the water of the impulse line to the transmitter.
It is recommended to use flange pairs – or preferably welded connections – for steam applications.
Behind the condensate chambers Ermeto 12S connections are permissible.

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



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

compact; vertical	compact; horizontal	remote; vertical	remote; horizontal
flow upwards DP6xD-GV... P01-DP61Dxxx-11-00-00-xx-005	mounting left DP6xD-GB... P01-DP61Dxxx-11-00-00-xx-011	flow upwards DP6xD-FV... P01-DP61Dxxx-11-00-00-xx-015	mounting left DP6xD-FB... P01-DP61Dxxx-11-00-00-xx-018
flow downwards DP6xD-GU... P01-DP61Dxxx-11-00-00-xx-006	mounting right DP6xD-GC... P01-DP61Dxxx-11-00-00-xx-012	flow upwards DP6xD-FU... P01-DP61Dxxx-11-00-00-xx-020	mounting right DP6xD-FC... P01-DP61Dxxx-11-00-00-xx-019

3.6 General mounting conditions

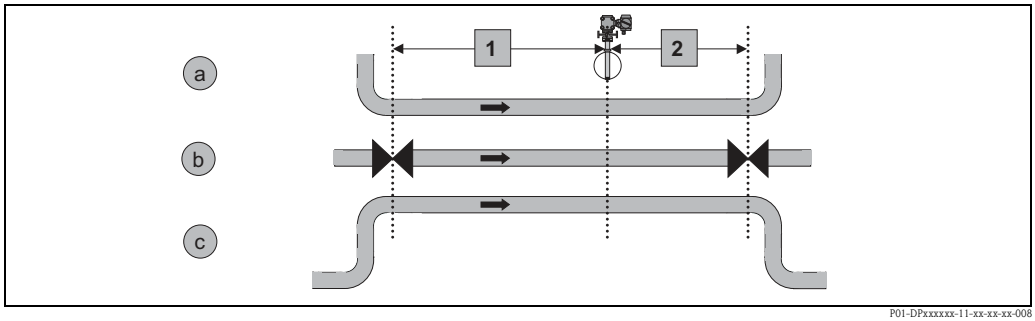
3.6.1 Up- and downstream lengths

In order to ensure a homogeneous flow profile it is necessary to mount the orifice in a sufficient distance to narrowings or bends of the pipe. The required upstream and downstream lengths for different types of obstacles are summarized in the following table:

Type of obstacle	Min. upstream length	Min. downstream length
90° bend	7 x D	3 x D
2x90° bend in the same plane	9 x D	3 x D
2x90° bend in perpendicular planes	17 x D	4 x D
concentric reducer	7 x D	3 x D
concentric expander	7 x D	3 x D
ball/gate valve, fully open	24 x D	4 x D

D: Inner pipe diameter

Examples (schematic)



***1:** upstream length; **2:** downstream length;*
***a:** 90° bend; **b:** valve, open; **c:** 2x90° bend*

Note!
The requirments concerning the pipe according to ISO5167 should be met (weld seams, roughness etc).

3.6.2 Homogeneity

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

3.6.3 Mounting position

- The mounting position must be chosen such that access to the transmitter is always possible.
- If the following process temperatures are exceeded, a remote version has to be used. The transmitter must be mounted in a sufficient distance from the primary device.

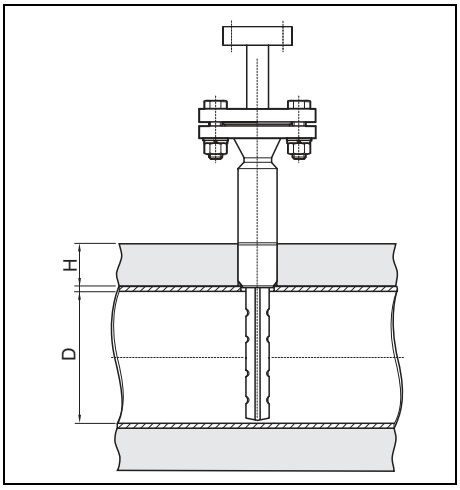
Application	Maximum temperature for the compact version
Gas / Liquids	200 °C (392 °F)
Steam	300 °C (572 °F)

3.6.4 Heat insulation

Some applications require suitable measures to avoid heat loss to the ambiance. A wide range of materials can be used to provide the required insulation.
With the comapct version, the thickness of the insulating layer is taken into account in the sizing. The actual thickness must not be larger than the thickness specified in the Sizing sheet – Data sheet. With insulated pipes make sure that the impulse pipes are not covered in order to ensure sufficient heat dissipation. Otherwise the transmitter may become overheated (or undercooled). This applies equally to both the compact and the remote version.

Caution!
Danger of electronics overheating!
Make sure that the impulse pipes between the primary element and the transmitter are always kept free of insulation.

Caution!
With insulated pipes, the length of the mounting nozzle must be increased by the thickness H of the insulating layer. Therefore, this thickness must be specified on the Sizing sheet – Data sheet (see Technical Information TI425P). The material of the the mounting nozzle extension must be specified in the product structure (feature 080).
The following lengths are available for the extension of the mounting nozzle:
- 50 mm (2")
- 100 mm (4")
- 110 mm (4.3")
- 120 mm (4.7")
- 130 mm (5.1 ")
- ...

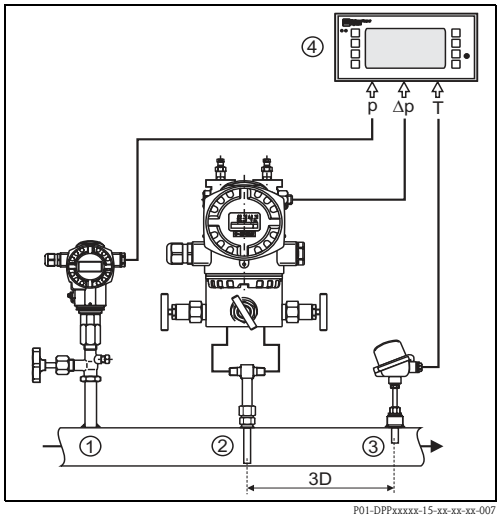


D: *inner pipe diamter;*
H: *thickness of the insulating layer*

3.6.5 Mounting position for temperature and pressure compensation

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

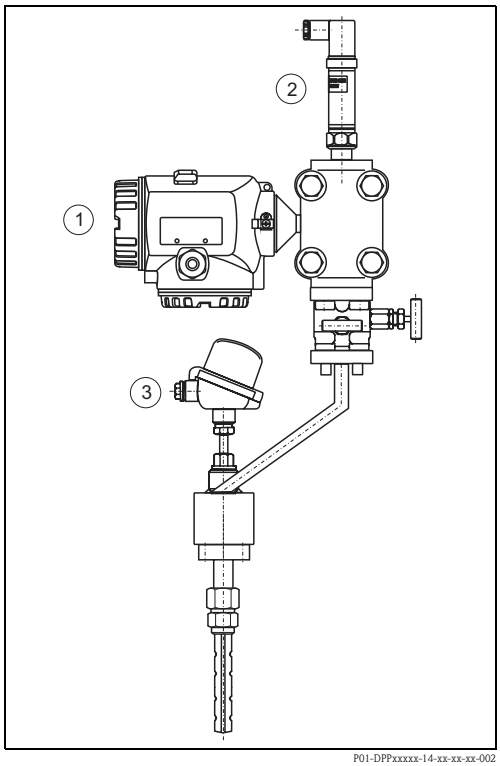
- **An absolute pressure sensor**
  This sensor must be mounted on the upstream side of the Pitot tube.
- **A temperature probe**
  In order to avoid disturbances of the flow profile, this probe is to be mounted on the downstream side of the Pitot tube. The minimum distance between the Pitot tube and the temperature probe is 3D.
  (D: diameter of the pipe)



1: *Absolute pressure probe*
2: *Pitot tube and differential pressure transmitter*
3: *temperature probe*
4: *evaluation unit*

Combined process connection for absolute and cifferential pressure and for the temperature
An adapter (e.g. oval flange adapter PZO, see page 53) can be used to screw an absolute pressure transmitter or an absolute pressure sensor into the Deltabar flange.
The absolute pressure sensor is to be mounted at the "+" side of the Deltabar.

Deltatop DP62D and DP63D are available in a version with integrated Pt100 temperature probe.



1: *Deltabar*
2: *Absolute pressure probe*
3: *Pt100 temperature probe*

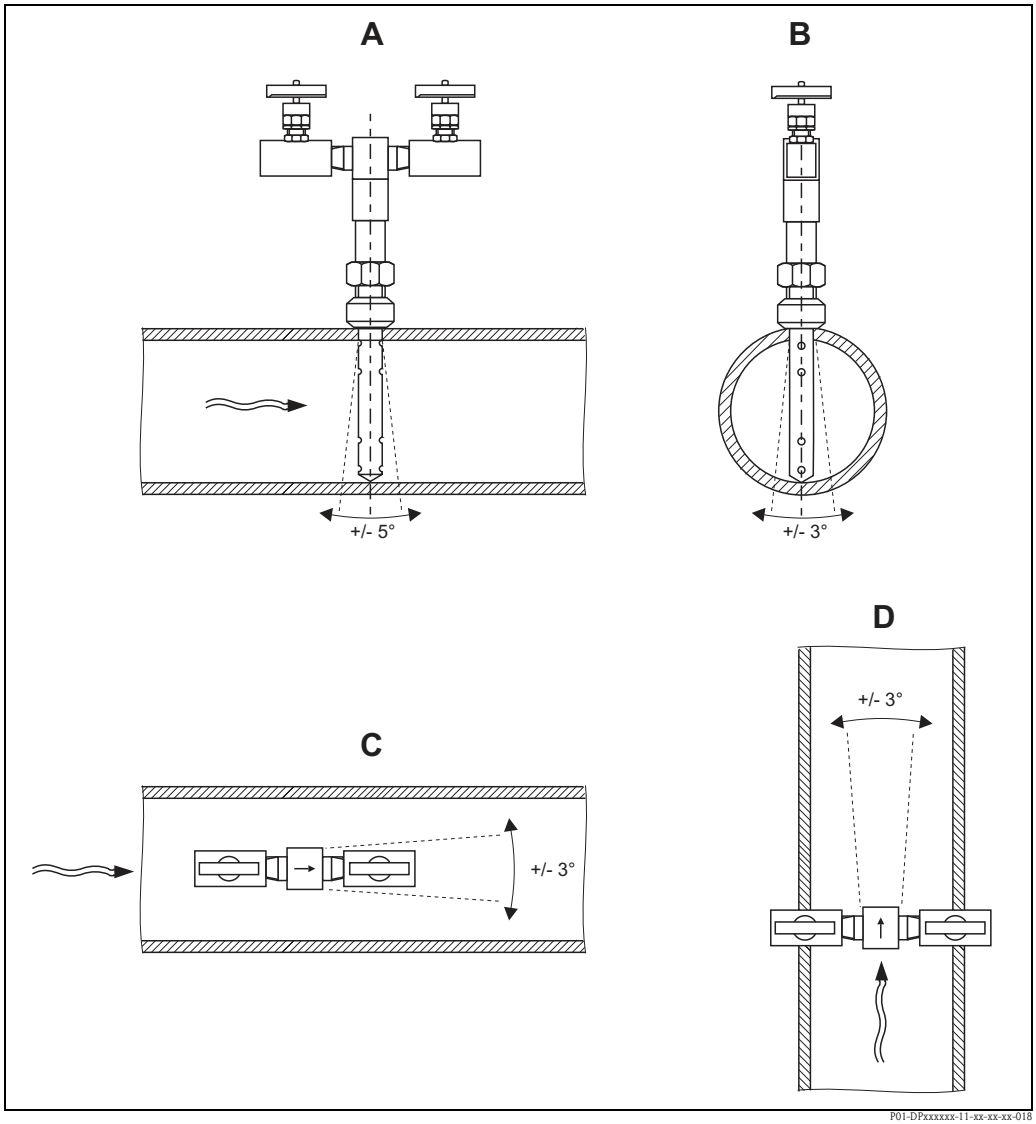
For the calculation of the compensated flow refer to page 38 f.

3.6.6 Measuring range

The lower limit of the measuring range is determined by the minimum Reynolds number required for the measurement. For details see Technical Information TI25P.
The upper limit of the measuring range is determined by the mechanical load.
Both limits can be calculated by the "Applicator" selection and sizing tool.

3.6.7 Alignment of the Pitot tube

The alignment of the Pitot tube must be within the following limits:

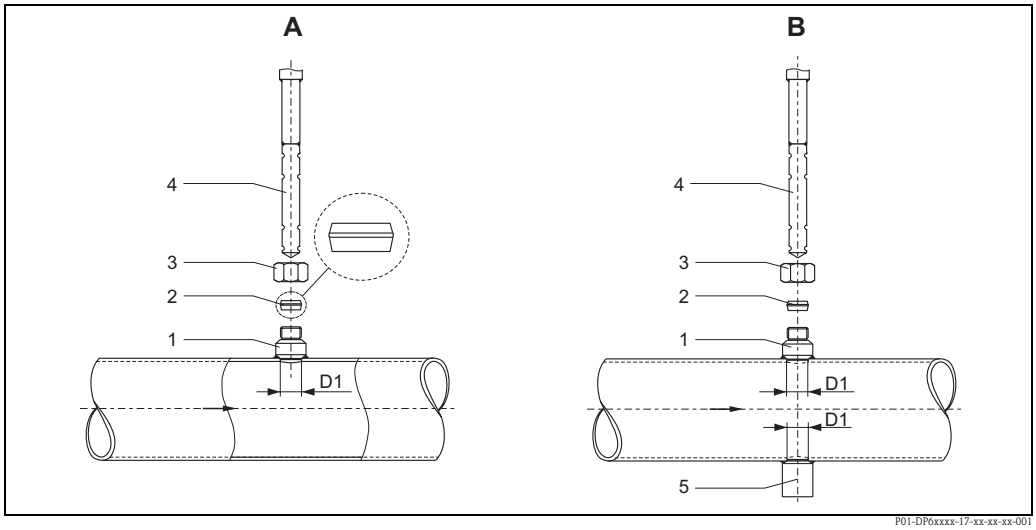


A: *axial alignment;*
B: *radial alignment;*
C: *alignment in the flow direction (for horizontal pipes)*
D: *alignment in the flow direction (for vertical pipes)*

3.7 General mounting hints

- The primary element is calculated for specific pipe and operating data. Therefore it is essential to check if the data on the nameplate (see page 6) match the actual operating data.
- Before installing the device, check if the required upstream and downstream lengths are provided (see page 15).
- Observe the required mounting position:
  – for liquids: page 11
  – for gases: page 12
  – for steam: page 13
- For remote versions:
  The shut-off valves are mounted to the pressure taps of the primary element or (in the case of steam applications) to the condensate chambers.
- For remote versions:
  The impulse pipes have to be installed with a slope of at least 1:15.
  – For steam and liquids, a venting possibility has to be provided at the highest point.
  – For gases, a drainage has to be provided at the lowest point.
  The impulse lines (+) and (-) have to be mounted to the respective inlets (process connection) of the manifold. The transmitter is directly screwed to the manifold with the supplied screws and gaskets.

3.8 Installation steps for the cutting ring version



A: *without end support;* ***B:*** *with end support*
1: *welding socket;* ***2:*** *cutting ring;* ***3:*** *union nut;* ***4:*** *probe;* ***5:*** *end support*
D1: *diameter of the hole (depending on the probe, see below)*

Probe	Diamter of the hole (D1)
DP61D	18 mm (0.71")
DP62D	35 mm (1.4")
DP63D	47 mm (1.9")

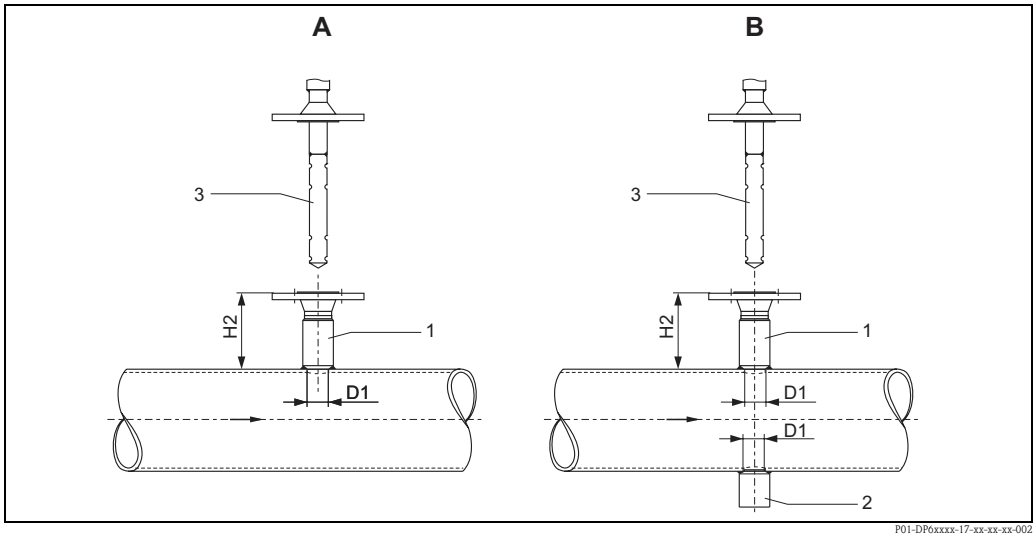
Note!
Before installing the Pitot tube, perform the following checks:
- Do the pipe dimensions (inner diameter, wall thickness, thickness of insulation) match the data of the order and the specifications of the instrument?
- Do the medium properties and process data match the specifications on the supplied calculation sheet?

1. Drill a hole with the diameter D1 into the pipe.
2. Remove the cutting ring (2) from the welding socket (1) in order to protect it from thermal stress which is generated by the welding process. The union nut (3) must remain on the welding socket in order to to protect the thread from being damaged.
3. Tack the welding socket (1) onto the pipe leaving a gap of approx. 2mm. Align the welding socket exactly at right-angle to the pipe axis (e.g. using a stud).
4. If an end support is to be mounted:
   a. Take a cord and tie one of its ends around the welding socket (1). Wrap the other end of the cord around the pipe so that it forms a loop around the pipe. Mark the half-way point of the circumference on the pipe.
   b. Drill a second hole with the diameter D1 into the pipe.
   c. Tack the end support (5) onto the pipe leaving a gap of approx. 2 mm.
   d. Insert the probe (4) into the pipe and check the alignment of the end support (5). If necessary, adjust the alignment.
5. Perform the final welding.
6. Remove the union nut (3) from the welding socket (1) and slip it over the probe (4).
7. Slip the cutting ring (2) over the probe (4). The shorter cone of the cutting ring mus point in the direction of the probe head.

8. Insert the probe (4) together with the union nut (3) and the cutting ring (2) into the welding socket until the probe tip touches the opposite pipe wall or the end support, respectively.
9. Check if the cutting ring (2) is properly seated and slightly tighten the union nut (3).
10. Align the probe so that the arrow on the probe points exactly in the direction of the flow. (The upstream side is marked"+", the downstream side is marked "-".) Tighten the union nut (3).
11. Check the sensor alignment again. If the sensor is not aligned correctly, loosen the union nut (3) and repeat the last installation step.
12. **Installation of the shut-off valves (for the remote version):**
    The shut-off valves have to be mounted to the nozzles of the primary element or (in the case of steam applications) to the condensate chambers.

    ✎ Note!
    With welding connections the shut-off valves are already mounted on delivery.
13. **Installation of the manifold and the transmitter (for the remote version):**
    The impulse pipes have to be installed with the required slope
    (for liquids: → 📄 11, for gases: → 📄 12, for steam: → 📄 13).
    – For steam and liquids, a venting possibility has to be provided at the highest point.
    – For gases, a drainage has to be provided at the lowest point.
    The impulse lines (+) and (-) have to be mounted to the respective inlets (process connections) of the manifold. The transmitter is directly screwed to the manifold with the supplied screws and gaskets.

3.9 Installation steps for the flange version

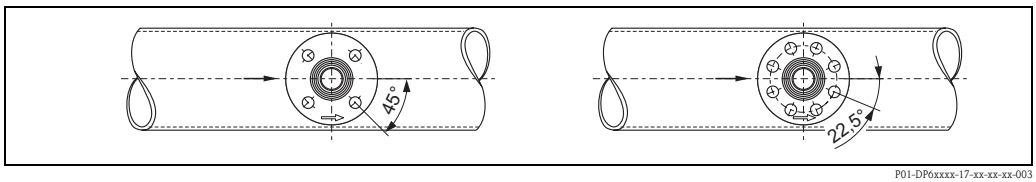


A: *without end support;* ***B:*** *with end support*
1: *welding socket;* ***2:*** *end support;* ***3:*** *probe*
D1: *diameter of the hole (depending on the probe, see below)*
H2: *distance from the outer pipe wall to the gasket surface of the flange (depending on the probe, see below)*

Probe	Diameter of the hole (D1)	distance of the flange gasket surface (H2)
DP61D	18 mm (0.71")	80 mm (3.1")
DP62D	35 mm (1.4")	127 mm (5.0")
DP63D	47 mm (1.9")	150 mm (5.9")

Note!
Before installing the Pitot tube, perform the following checks:
- Do the pipe dimensions (inner diameter, wall thickness, thickness of insulation) match the data of the order and the specifications of the instrument?
- Do the medium properties and process data match the specifications on the supplied calculation sheet?

1. Drill a hole with the diameter D1 into the pipe.
2. Tack the welding socket (1) onto the pipe leaving a gap of approx. 2 mm. The bolt holes of the flange mus be at 45° angles (for four holes) or 22,5° angles (for eight holes) to the pipe axis.



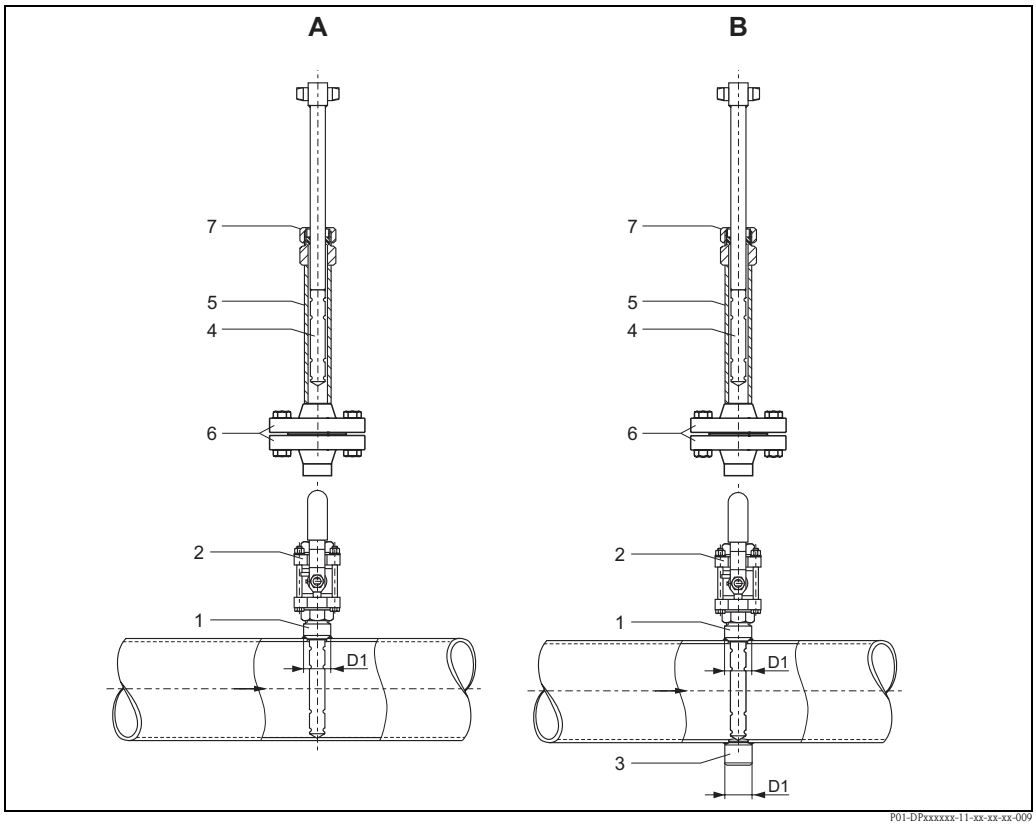
3. If an end support is to be mounted:
   a. Take a cord and tie one of its ends around the welding socket (1). Wrap the other end of the cord around the pipe so that it forms a loop around the pipe. Mark the half-way point of the circumference on the pipe.
   b. Drill a second hole with the diameter D1 into the pipe.
   c. Tack the end support (2) onto the pipe leaving a gap of approx. 2 mm.
   d. Insert the probe (3) into the pipe and check the alignment of the end support (2). If necessary, correct the alignment.

4. Check the distance H2 between the outer pipe wall and the gasket surface of the flange as well as the alignment of the welding socket (1) and the end support (2).
5. Perform the final welding.
6. Place the supplied gasket on the gasket surface of the flange. Insert the probe (3) into the welding socket (1) and make sure that the arrow on the probe head points in the flow direction. Tighten the bolts and nuts.
7. **Installation of the shut-off valves (for the remote version):**
   The shut-off valves are mounted to the nozzles of the primary element or (in the case of steam applications) to the condensate chambers.

   ✎ Note!
   With welding connections the shut-off valves are already mounted on delivery.
8. **Installation of the manifold and the transmitter (for the remote version):**
   The impulse pipes have to be installed with the required slope
   (for liquids: → 📄 11, for gases: → 📄 12, for steam: → 📄 13).
   – For steam and liquids, a venting possibility has to be provided at the highest point.
   – For gases, a drainage has to be provided at the lowest point.
   The impulse lines (+) and (-) have to be mounted to the respective inlets (process connections) of the manifold. The transmitter is directly screwed to the manifold with the supplied screws and gaskets.

3.10 Installation steps for the Flowtap version with safety chain

3.10.1 Mounting



A: *without end support;* ***B:*** *with end support;*
1: *welding socket;* ***2:*** *ball valve (open);* ***3:*** *end support;* ***4:*** *probe;* ***5:*** *protecting tube;* ***6:*** *packing;* ***7:*** *nuts at the top packing*
D1: *diameter of the hole (depending on the probe, see below)*

Probe	Diamter of the hole (D1)
DP61D	18 mm (0.71")
DP62D	35 mm (1.4")
DP63D	47 mm (1.9")

Note!
Before installing the Pitot tube, perform the following checks:
- Do the pipe dimensions (inner diameter, wall thickness, thickness of insulation) match the data of the order and the specifications of the instrument?
- Do the medium properties and process data match the specifications on the supplied calculation sheet?

1. Drill a hole with the diamter D1 into the pipe.
2. Tack the welding socket (1) onto the pipe leaving a gap of approx. 2 mm.
3. If an end support is to be mounted:
   a. Take a cord and tie one of its ends around the welding socket (1). Wrap the other end of the cord around the pipe so that it forms a loop around the pipe. Mark the half-way point of the circumference on the pipe.
   b. Drill a second hole with the diameter D1 into the pipe.

c. Tack the end support (3) onto the pipe leaving a gap of approx. 2 mm.

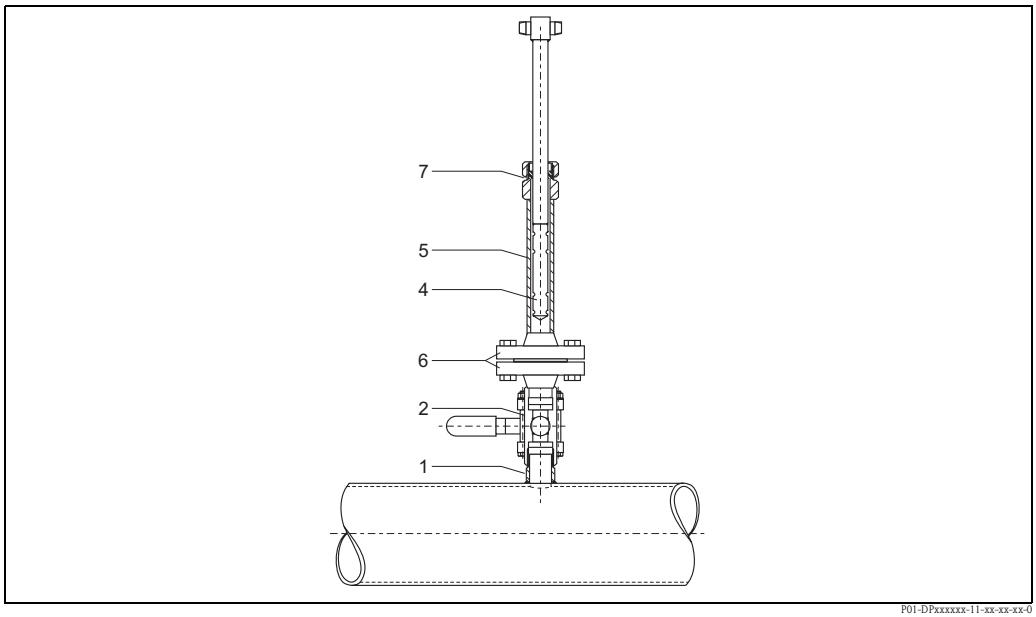
d. Insert the probe (4) into the pipe and check the alignment of the end support (3). If necessary, correct the alignment.

4. Perform the final welding.
5. Apply a suitable sealing compound to the threaded nozzle of the ball valve (2)and screw it into the welding scoket (1).
6. Verify that the probe (4) is fully retracted into the protecting tube (5).
7. Apply a suitable sealing compound to the threaded nozzle of the packing (6) and screw it into the ball valve (2).
8. Open the valve (2).
9. Slightly loosen the packing (7) until the probe (4) can be moved. Insert the probe into the pipe until the probe tip touches the opposite pipe wall or the wall of the end support, respectively.
10. Tighten the nuts at the top and bottom packing (6/7).
11. **Installation of the shut-off valves (for the remote version):**
The shut-off valves are mounted to the nozzles of the primary element or (in the case of steam applications) to the condensate chambers.

✎ Note!
With welding connections the shut-off valves are already mounted on delivery.

12. **Installation of the manifold and the transmitter (for the remote version):**
The impulse pipes have to be installed with the required slope
(for liquids: → 🖹 11, for gases: → 🖹 12, for steam: → 🖹 13).
– For steam and liquids, a venting possibility has to be provided at the highest point.
– For gases, a drainage has to be provided at the lowest point.
The impulse lines (+) and (-) have to be mounted to the respective inlets (process connections) of the manifold. The transmitter is directly screwed to the manifold with the supplied screws and gaskets.

3.10.2 Insertion and removal of the probe without process interruption



1: *welding socket;* ***2:*** *ball valve (closed);* ***4:*** *probe ;* ***5:*** *protecting tube;* ***6:*** *packing with flange;* ***7:*** *nuts at the top packing*

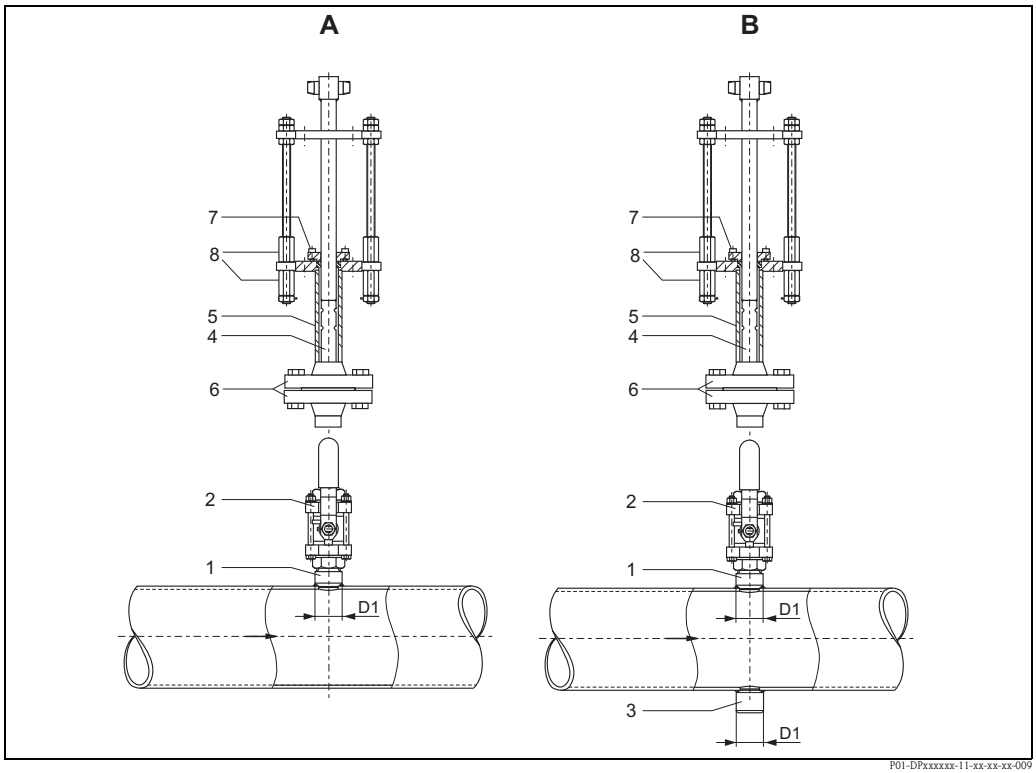
With the Flowtap version, the Pitot tube can be removed (e.g. for cleaning) without the need of an interruption of the process. To do so, perform the following steps:

1. Close the valves at the probe head. If required, depressurize and disconnect the impulse lines.
2. Slightly loosen the nuts at the packings (6/7) until the probe can be moved without medium escaping.
3. Retract the probe from the pipe until the safety chain defines the limit stop.
4. Close the ball valve (2).
5. The probe can now be completely disconnected from the pipe:
   a. Detach safety chain; withdraw probe
   b. if there is not enough space: disconnect at the packing (6).

For insertion of the probe perform these steps in reverse order.

3.11 Installation steps for the Flowtap version with spindle

3.11.1 Mounting



A: *without end support;* ***B:*** *with end support;*
1: *welding socket;* ***2:*** *ball valve (open);* ***3:*** *end support;* ***4:*** *probe;* ***5:*** *protecting tube;* ***6:*** *packing;* ***7:*** *nuts at the top packing;* ***8:*** *drive nuts*
D1: *diameter of the hole (depending on the probe, see below)*

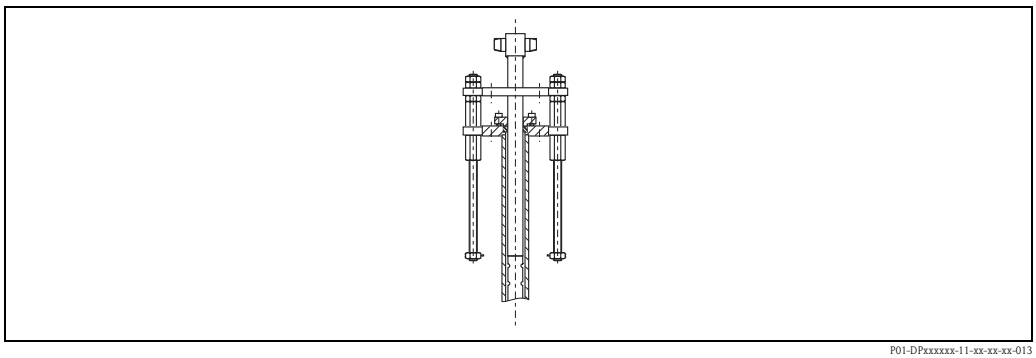
Probe	Diamter of the hole (D1)
DP61D	18 mm (0.71")
DP62D	35 mm (1.4")
DP63D	47 mm (1.9")

Note!
Before installing the Pitot tube, perform the following checks:
- Do the pipe dimensions (inner diameter, wall thickness, thickness of insulation) match the data of the order and the specifications of the instrument?
- Do the medium properties and process data match the specifications on the supplied calculation sheet?

1. Drill a hole with the diameter D1 into the pipe.
2. Tack the welding socket (1) onto the pipe leaving a gap of approx. 2 mm.
3. If an end support is to be mounted:
   a. Take a cord and tie one of its ends around the welding socket (1). Wrap the other end of the cord around the pipe so that it forms a loop around the pipe. Mark the half-way point of the pipe circumference on the pipe.
   b. Drill a second hole with the diameter D1 into the pipe.
   c. Tack the end support (3) onto the pipe leaving a gap of approx. 2 mm.

d. Insert the probe (4) into the pipe and check the alignment of the end support (3). If necessary, correct the alignment.

4. Perform the final welding.
5. Apply a suitable sealing compound to the threaded nozzle of the ball valve (2)and screw it into the welding scoket (1).
6. Verify that the probe (4) is fully retracted into the protecting tube (5).
7. Apply a suitable sealing compound to the threaded nozzle of the packing (6) and screw it into the ball valve (2).
8. Open the ball valve (2).
9. Slightly loosen the packing (7) until the probe (4) can be moved.
10. Insert the probe into the pipe by turning the drive nuts (8) clockwise as viewed from the top. The nuts must be tightened alternately, about two turns at a time, to prevent an undesired tilt of the probe. Continue this procedure until the probe touches the opposite pipe wall or the wall of the end support.
11. If the probe is completely within the pipe, the threaded rods with the nuts should be in the following position:

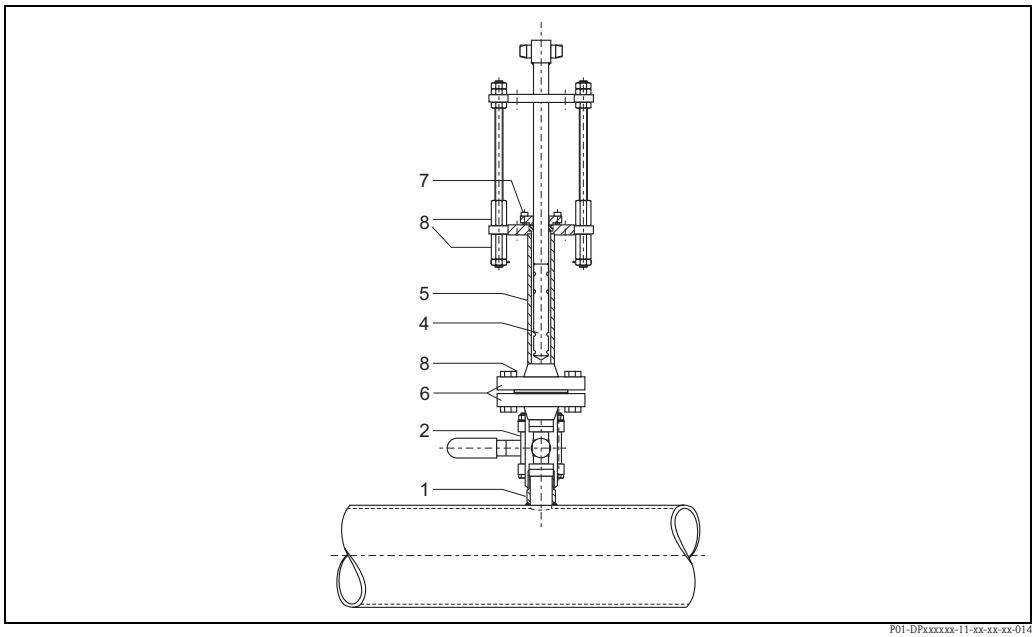


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12. Tighten the nuts at the packings (6/7).
13. **Installation of the shut-off valves (for the remote version):**
    The shut-off valves are mounted to the nozzles of the primary element or (in the case of steam applications) to the condensate chambers.

    ✎ Note!
    With welding connections the shut-off valves are already mounted on delivery.
14. **Installation of the manifold and the transmitter (for the remote version):**
    The impulse pipes have to be installed with the required slope
    (for liquids: → 📄 11; for gases: → 📄 12; for steam: → 📄 13).
    – For steam and liquids, a venting possibility has to be provided at the highest point.
    – For gases, a drainage has to be provided at the lowest point.
    The impulse lines (+) and (-) have to be mounted to the respective inlets (process connections) of the manifold. The transmitter is directly screwed to the manifold with the supplied screws and gaskets.

3.11.2 Insertion and removal of the probe without process interruption



1: *welding socket;* ***2:*** *ball valve (closed);* ***4:*** *probe ;* ***5:*** *protective tube;* ***6:*** *packing;* ***7:*** *nuts at the top packing;* ***8:*** *drive nuts*

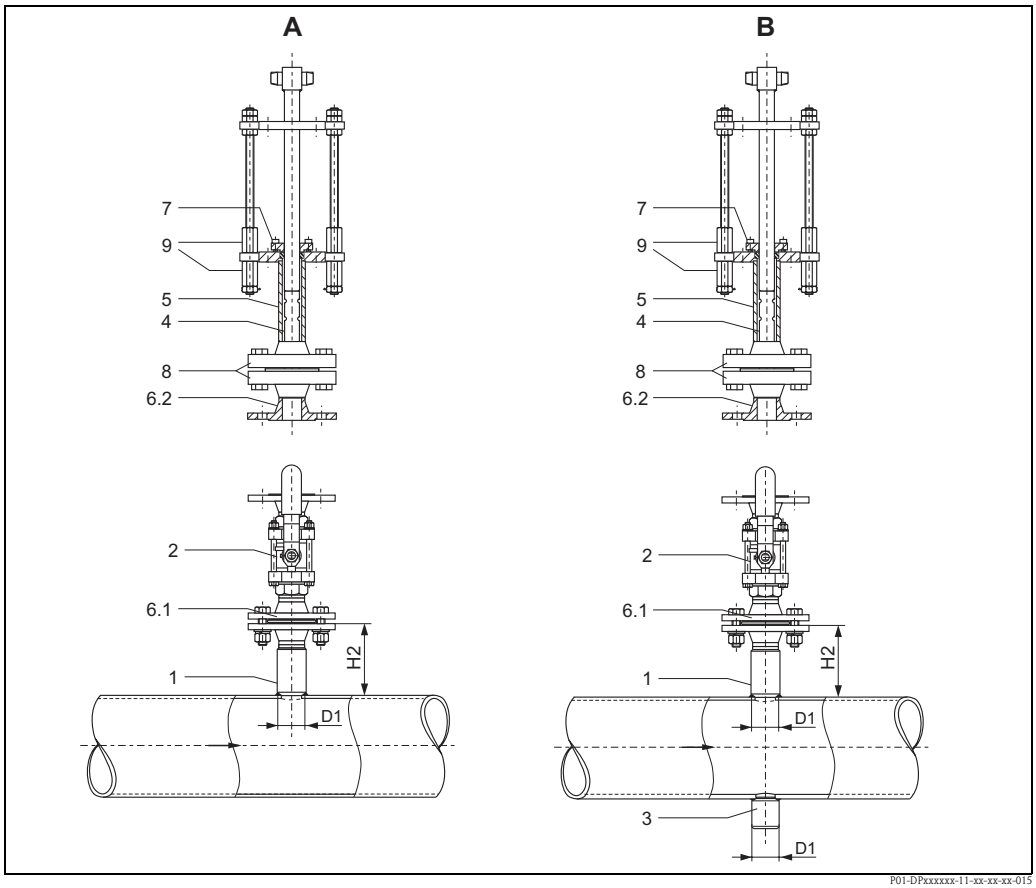
With the Flowtap version, the Pitot tube can be removed (e.g. for cleaning) without the need of an interruption of the process. To do so, perform the following steps:

1. Close the valves at the probe head. If required, depressurize and disconnect the impulse lines.
2. Slightly loosen the nuts at the packings (6/7) until the probe can be moved without medium escaping.
3. Retract the Flowtap by rotating the drive nuts (8) counter-clockwise as viewed from top. The nuts must be turned alternately, about two turns a time, to prevent an undesired tilt of the probe.
4. If the probe is fully retracted (observe the position of the threaded bolts), the ball valve (2) can be closed and the probe can be completely disconnected (disconnect at the packing (6)).

For insertion of the probe perform these steps in reverse order.

3.12 Installation steps for a Flowtap version with flange

3.12.1 Mounting

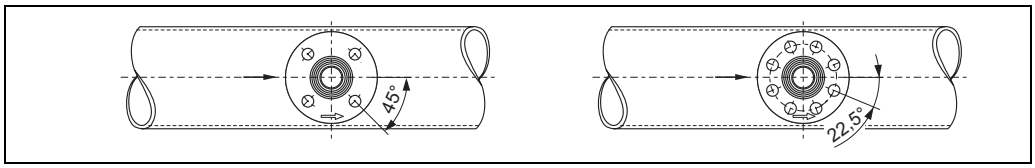


1: welding socket; 2: ball valve(open); 3: end support; 4: probe 5: protecting tube; 6.1: lower mounting flange; 6.2: upper mounting flange; 7: nuts at the top packing; 8: packing; 9: drive nuts
D1: Diameter of the hole (depending on the probe, see below);
H2: Distance from the outer pipe wall to the gasket surface of the lower flange (depending on the probe, see below)

Probe	Diameter of the hole (D1)	distance of the flange gasket surface (H2)
DP61D	18 mm (0.71")	80 mm (3.1")
DP62D	35 mm (1.4")	127 mm (5.0")
DP63D	47 mm (1.9")	150 mm (5.9")

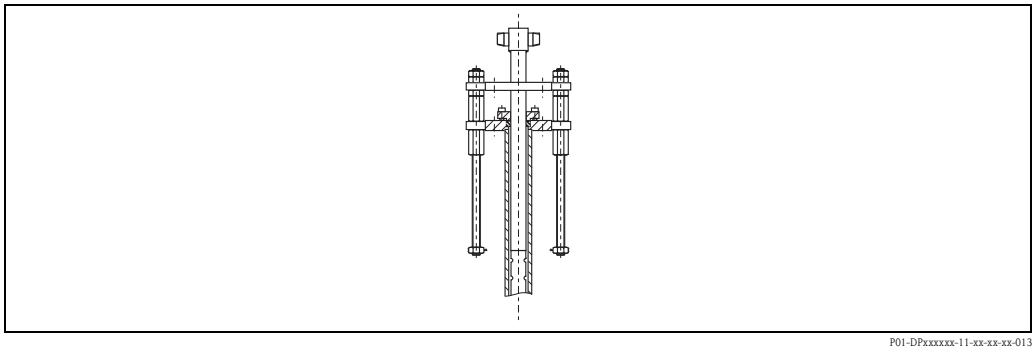
Note!
Before installing the Pitot tube, perform the following checks:
- Do the pipe dimensions (inner diameter, wall thickness, thickness of insulation) match the data of the order and the specifications of the instrument?
- Do the medium properties and process data match the specifications on the supplied calculation sheet?

1. Drill a hole with the diameter D1 into the pipe.
2. Tack the welding socket (1) onto the pipe leaving a gap of approx. 2 mm. The bolt holes of the flange mus be at 45° angles (for four holes) or 22,5° angles (for eight holes) to the pipe axis.



P01-DP6xxxx-17-xx-xx-xx-003

3. If an end support is to be mounted:
   a. Take a cord and tie one of its ends around the welding socket. Wrap the other end of the cord around the pipe so that it forms a loop around the pipe. Mark the half-way point of the pipe circumference on the pipe.
   b. Drill a second hole with the diameter D1 into the pipe.
   c. Tack the end support (3) onto the pipe leaving a gap of approx. 2 mm.
   d. Insert the probe (4) into the pipe and check the alignment of the end support (2). If necessary, correct the alignment.
4. Check the distance H2 between the outer pipe wall and the gasket surface of the lower flange as well as the alignment of the welding socket (1) and the end support (3).
5. Perform the final welding.
6. If the ball valve is not mounted to the welding socket yet:
   Place the supplied gasket onto the gasket surface of the lower mounting flange (6.1) and mount the ball valve (2).
7. Verify that the probe (4) is fully retracted into the protecting tube (5). Observe the position of the threaded bolts.
8. Place the supplied gasket onto the gasket surface of the upper mounting flange (6.2). Connect the upper mounting flange (6.2) to the ball valve. Make sure that the arrow on the upper mounting flange (6.2) points in the direction of the flow.
9. Insert the probe into the pipe by turning the drive nuts (9) clockwise as viewed from the top. The nuts must be tightened alternately, about two turns at a time, to prevent an undesired tilt of the probe. Continue this procedure until the probe contacts the opposite pipe wall or the wall of the end support.
10. If the probe is completely within the pipe, the threaded rods with the nuts should be in the following position:

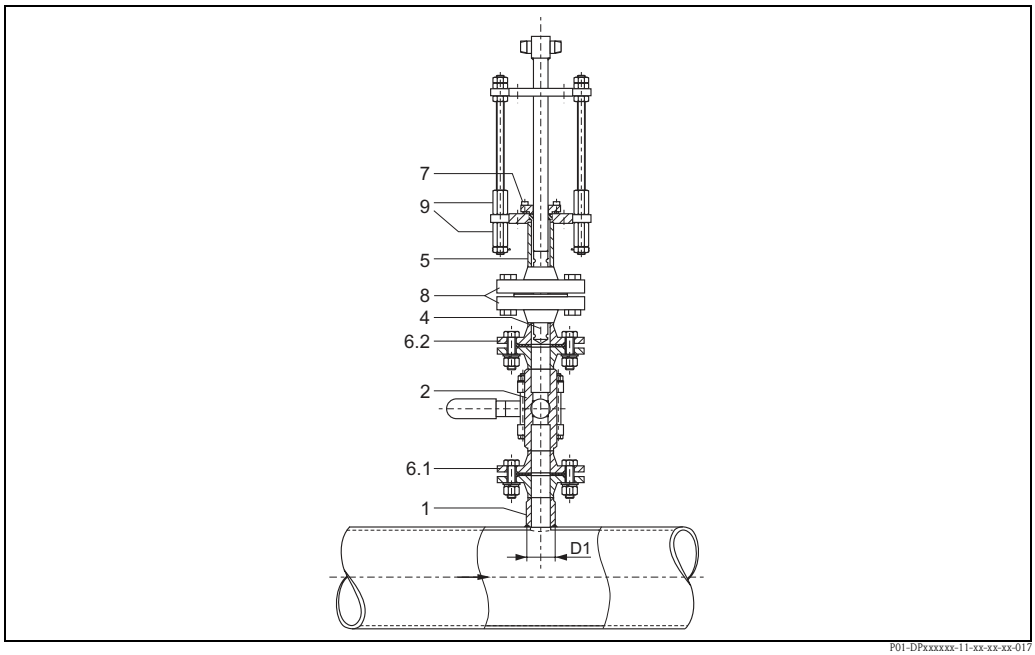

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11. Tighten the nuts at the packings (7/8).
12. **Installation of the shut-off valves (for the remote version):**
    The shut-off valves are mounted to the nozzles of the primary element or (in the case of steam applications) to the condensate chambers.

    ✎ Note!
    With welding connections the shut-off valves are already mounted on delivery.

13. **Installation of the manifold and the transmitter (for the remote version):**
The impulse pipes have to be installed with the required slope
(for liquids: → 11; for gases: → 12; for steam: → 13).
– For steam and liquids, a venting possibility has to be provided at the highest point.
– For gases, a drainage has to be provided at the lowest point.
The impulse lines (+) and (-) have to be mounted to the respective inlets (process connections) of the manifold. The transmitter is directly screwed to the manifold with the supplied screws and gaskets.

3.12.2 Insertion and removal of the probe without process interruption



1: *welding socket;* ***2:*** *ball valve (closed);* ***4:*** *probe;* ***5:*** *protecting tube;* ***6.1:*** *lower mounting flange;* ***6.2:*** *upper mounting flange;* ***7:*** *nuts at the top packing;* ***8:*** *packing;* ***9:*** *drive nuts*

With the Flowtap version the Pitot tube can be removed (e.g. for cleaning) without the need of an interruption of the process. To do so, perform the following steps:

1. Close the valves at the probe head. If required, depressurize and disconnect the instrument lines.
2. Slightly loosen the nuts at the packings (7/8).
3. Retract the Flowtap by rotating the drive nuts (9) counter-clockwise as viewed from top. The nuts must be turned alternately, about two turns a time, to prevent undesired tilting of the sensor.
4. If the probe is fully retracted (observe position of the threaded bolts), the ball valve (2) can be closed and the probe can be completely disconnected (disconnect at the upper mounting flange (6.2)).

For insertion of the probe perform these steps in reverse order.

3.13 Installation check

3.13.1 Checks after first installation

Perform the following checks after installing the measuring device:

- Do the process temperature/pressure, ambient temperature, measuring range etc. correspond to the specifications of the device?
- Does the arrow on the head of the pipe or the flange plate 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 sensor type, application and fluid properties, in particular fluid temperature?
- Is the measuring device protected against moisture and direct sunlight?
- Are the screws of the packing or the flange firmly tightened?
- Are the threaded connections and/or flange connections tight?

3.13.2 Additional checks when demounting/mounting the probe during the operation of the plant

When demounting/mounting the probe during the operationof the plant, perform the following additional checks:

- Is the device damaged (visual inspection)?
- Is the probe free of deposit and damages?

4 Wiring

4.1 Wiring of the Deltabar S differential pressure transmitter

The wiring of the Deltabar S differential pressure transmitter is described in the following Operating Instructions:

Communication	Operating Instructions
4...20 mA HART	BA270P
PROFIBUS PA	BA294P
Foundation Fieldbus	BA301P

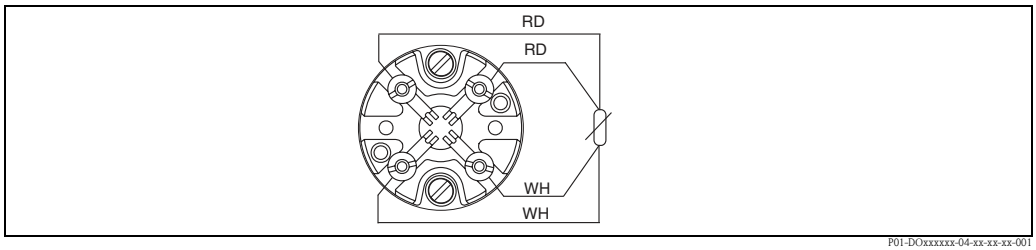
The appropriate Operating Instructions are supplied together with the Deltabar S.

4.2 Wiring of the integrated Pt100 temperature sensor

Caution!
Before connection please note the following:
- The power supply must be identical to the data on the nameplate.
- Switch off power supply before connecting up the instrument.
- Connect equipotential bonding to transmitter ground terminal before connecting up the instrument .

Warning!
When you use the measuring system in hazardous areas, make sure to comply with national standards and the specifications in the safety instructions (XA's). Make sure you use the specified cable gland.

4.2.1 4-wire terminal block (Omnigrad T TR24)

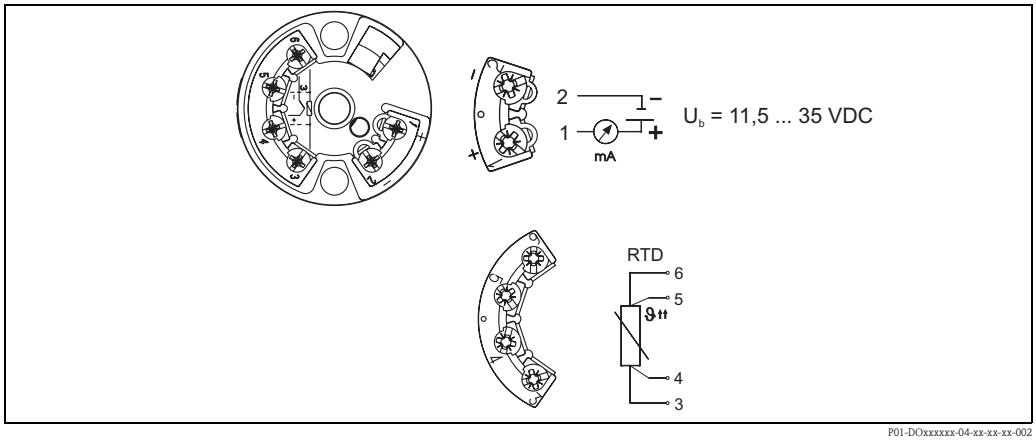


RD: red; WH: white

Note!
Although the terminal block of the Pt100 is always supplied for 4-wire connection, 3-wire connection is possible as well. In this case one of the terminals remains disconnected.

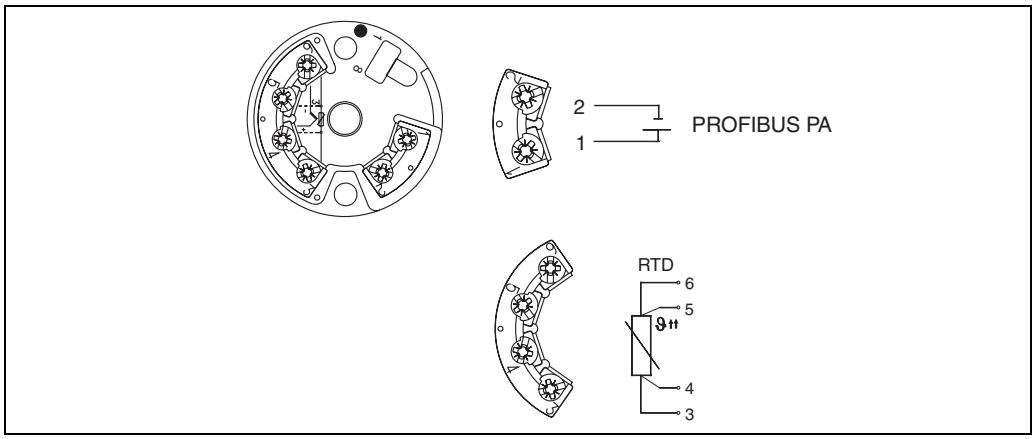
Note!
For details see Technical Information TI 269T.

4.2.2 4...20mA, with or without HART (iTEMP TMT181/TMT182)



Note!
For details see Operating Instructions KA141R (4...20mA) or KA142R (HART).

4.2.3 PROFIBUS PA (iTEMP TMT184)



P01-DOxxxxxx-04-xx-xx-xx-003

Note!
For details see Operating Instructions BA115R.

5 Operation and commissioning

5.1 Configuration of the Deltabar S differential pressure transmitter

The operation of the Deltabar S differential pressure transmitter and the commissioning of the measurement are described in the following Operating Instructions:

Communication	Operating Instructions
4...20 mA HART	BA270P
PROFIBUS PA	BA294P
Foundation Fieldbus	BA301P

The appropriate Operating Instructions are supplied together with the Deltabar S.



Note!
If the differential pressure transmitter is ordered with the primary device, then it is completely pre-configured on delivery. A parametrization is not required in this case.
If an unconfigured differential pressure transmitter is used, the configuration data can be obtained from the supplied calculation sheet or can be calculated by the "Applicator" selection and sizing tool.



Note!
The formulae according to which the flow is calculated are summarized in the Appendix (→ 55).

5.2 Configuration of a temperature and pressure compensation

5.2.1 Calculation of the compensated volume or mass flow

- **for steam**
  by Energy Manager RMS621 from Endress+Hauser;
  for details see Technical Information TI092R
- **for all media**
  by Flow and Energy Manager RMC621 from Endress+Hauser;
  for details see Technical Information TI098R
- **for all media**
  by a PLC;
  in this case the compensation calculation has to be programmed by the user.

5.2.2 Calculation formula for the temperature and pressure compensation

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

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

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

and

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

where
ρ = the density of the medium.

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

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

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

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

The compensation can now be computed as follows:

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

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

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

5.3 Usage of the accessories

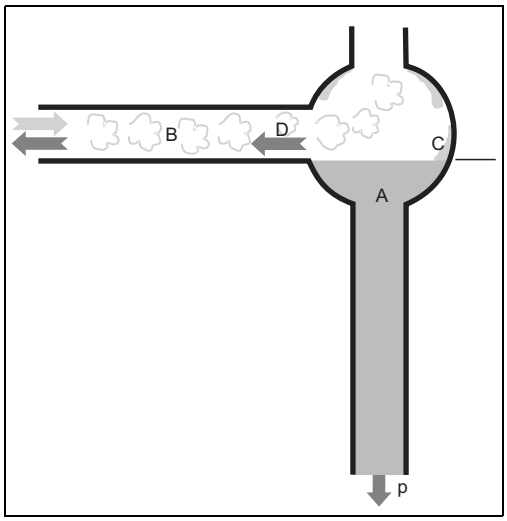
5.3.1 Condensate pots (for steam applications)

Usage

Usage of condensate pots is recommended for gaseous media, which condense when cooling down in the impulse pipes. This is mainly the case in steam; depending on temperature and pressure it may also occur in other media (e.g. in alcohols).

Operating principle

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



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

Installation and commissioning

- When installing the condensate pots, make sure that they are located at the same height. Otherwise the zero point adjustment is hardly achievable.
- Before commissioning, the condensate chambers as well as the impulse pipes to the Deltabar differential pressure transmitter must be completely filled with water. There are different possible methods for the filling of the condensate chambers:
  – through the filling nozzle at the condensate chambers (if present)
  – through the condensate drain valve or the venting valve of the Deltabar differential pressure transmitter. To do so, the impulse lines must be connected to the water supply, e.g. by a hose connector.
  – after the commissioning of the steam pipe wait until the impulse pipes and the condensate chambers have been filled by themselves with condensate. To do so, the valves at the manifold have to be closed.

Caution!
It is essential to avoid any overheating of the Deltabar differential pressure transmitter. Depending on the steam temperature the temperature at the manifold has to be monitored. If there is any risk of overheating, the shut-off valves in the impulse pipes must be closed.

Note!
In any case after filling and after commissioning of the steam supply, wait for stable conditions before performing the zero point adjustment.

5.3.2 Shut-off valves

Usage

Shut-off-valves are used with remote versions for high pressure and high temperature applications. They are used as a primary shut-off for the measuring point.
Depending on national regulations primary shut-off with two shut-off valves per impulse pipe may be recommended or required.

Operating principle

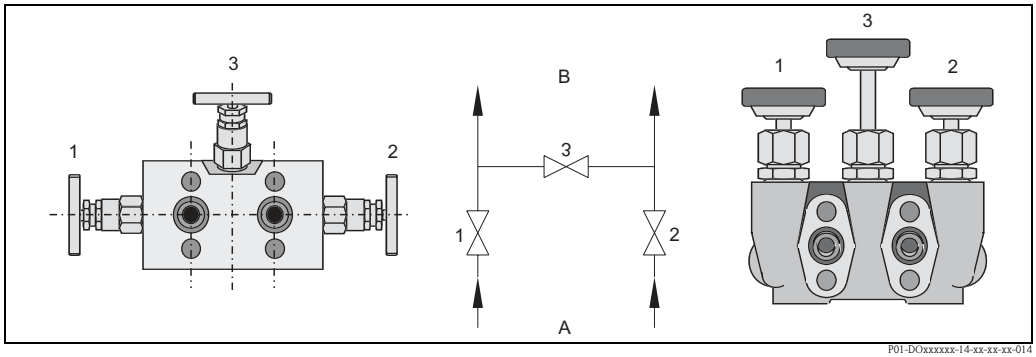
The primary shut-off provides separation close to the process between the measuring system and the measuring pipe in the case of leakages or if maintenance measures are carried out at the impulse pipes.

Installation and commissioning

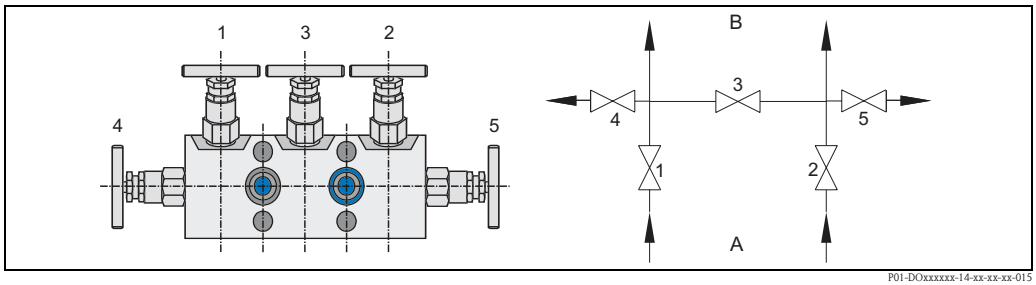
After completion of the installation, the shut-off valves must be closed. When starting the commissioning, the shut-off valves should be opened cautiously and the complete measuring system should be checked for leakages.

5.3.3 Manifold

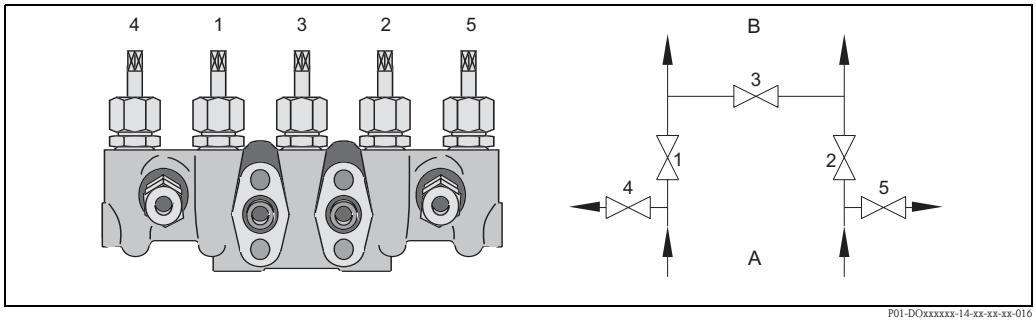
Versions



3-valve manifold



5-valve manifold; milled



5-valve manifold; forged

Valve	Application
1, 2	Separates the Deltabar differential pressure transmitter from the process
3	Equalization valve (zero point adjustment of the Deltabar differential pressure transmitter)
4, 5	■ Venting (for liquids and steam) ■ Draining (for gases) ■ Complete emptying of the impulse pipes (e.g. for maintenance purposes)

Usage

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

Operating principle

If the Deltabar differential pressure transmitter has to be removed from the measuring point (e.g. for exchange or repair), it is possible to completely separate the transmitter from the process by closing all three valves.

Commissioning

During commissioning a zero point adjustment of the Deltabar differential pressure transmitter should be performed in any case. During the first commissioning, when starting the process, all valves should be closed. Then, the valves of the "-" and "+" side should be opened cautiously. The equalization valve remains closed.
After this, make sure that the impulse pipes, the manifold and the transmitter are completely vented (for liquids and steam) or drained (for gases).

Zero point adjustment

To perform the zero point adjustment, first close the valve at the "-" side and then open the equalization valve (3), such that the "+" and the "-" side of the transmitter are exposed to the same static process pressure (+). In this state the zero point adjustment of the Deltabar differential pressure can be performed (refer to the Operating Instructions of the Deltabar). After completion of the zero point adjustment the measuring system is put back into operation by performing the same steps in reverse order.
The zero point adjustment should be checked and – if necessary – adjusted regularly. Also the measuring system should regularly be checked for complete venting or draining, respectively.

Venting/draining

The additional valves of 5-valve manifolds are used for venting or draining or to empty the impulse pipes completely (e.g. for maintenance purposes). In steam applications these valves are used to blow out the impulse pipes.



Note!
The complete venting or draining of the Deltabar differential pressure transmitter is always performed by appropriate devices at the side opposite to the transmitter flanges.



Caution!
If all three valves at the manifold are opened at the same time, the pressure difference may cause a flow of the medium through the manifold. With hot media this may result in an overheating of the manifold and of the Deltabar differential pressure transmitter. Therefore, it is essential to avoid simultaneous opening of all three valves under operating conditions.

6 Troubleshooting

6.1 Error messages of the Deltabar S

Error messages of the Deltabar S differential pressure transmitter are described in the following Operating Instructions:

Communication	Operating Instructions
4...20 mA HART	BA270P
PROFIBUS PA	BA294P
Foundation Fieldbus	BA301P

The appropriate Operating Instructions are supplied together with the Deltabar S.

6.2 Application errors

Error	Possible cause; measure
No flow indicated	**Installation errors** ■ No contact between process and transmitter -> Check, if the valves to the differential pressure transmitter are open. **Configuration errors** ■ Configuration of the transmitter or flow calculator false or missing -> Check and adjust configuration
Zero point drift; measured value fluctuations	**Planning error**s ■ high turndown -> if necessary use different measuring cell or mutliple transmitters ("split range", see Technical Information TI425P) **Installation errors** ■ Gas or liquid in the impulse pipe/in the transmitter -> vent or drain impulse pipes and transmitter (see page 43) **Calibration errors** ■ low-flow-cut-off not activated -> activate low-flow-cut-off (see Operating Instructions of Deltabar) ■ no zero point adjustment -> perform zero point adjustment (see page 43) ■ no compensation for gas measurements -> complete temperature and pressure compensation (see page 38)
Wrong measuring value	**Planning errors** ■ wrong pipe data; wrong flow data; wrong medium data -> compare values of the sizing sheet - data sheet to the actual values ■ inappropriate pipe (disturbed flow caused by fixtures, weld seams, protruding sealings, in- and outlets, fittings etc.) -> remove obstacles disturbing the flow profile ■ relative humidity does not match the planning data -> make sure that the relative humidity matches the specifications on the calculation sheet ■ wrong measuring range of the differential pressure transmitter -> if necessary, use different measuring cell ■ Pitot tube too long or too short -> check whethter the length of the Pitot tube is equal to "inner pipe diameter + wall thickness" **Installation errors** ■ wrong mounting position -> check mounting position (see page 11, 12, 13) ■ wrong or imprecise alignment of the Pitot tube -> check alignment of the Pitot tube (see page 18) ■ Upstream or downstream length too short -> check up and downstream lengths (see page 15) ■ leakages -> check complete measuring system for leakages ■ welding socket projects into the interior of the pipe -> mount the welding socket on the outside ot the pipe **Calibration error** ■ compensation for gas measurements wrong or missing -> complement temperature and pressure compensation (see page 38) ■ wrong transmitter settings -> check configuration of the Deltabar differential pressure transmitter (see Operating Instructions of Deltabar) -> check configuration of the Flow Manager (see Operating Instructions of RMC621/RMS621) **Maintenance errors** ■ Pressure tap holes of the Pitot tube blocked by dirt —> Clean Pitot tube

7 Maintenance and repairs

7.1 Maintenance

The following maintenance tasks should be performed in regular intervals:

- Checking of the zero-point adjustment
- for wet gases: drain the condensate
- for soiled media: remove the sediment
- for abrasive media: check the primary device for abrasions
- for build-up formation: check and clean the primary device; exchange gaskets
- after the cutting ring connection has been opened several times (approx. 10 times): replace the cutting ring



Note!
Primary elements do not require further maintenance if used appropriately. During standard revisions of the measuring point it is recommended to examine the primary element carefully to ensure its funcitonality (material/edge sharpness, traces of wear)



Caution!
Required maintenace work must be carried out with considerationof the responsible department and/or trained staff. Security advices of these departments and the staff have to be taken into account (checking pressure/temperature; valves have to be closed)



Caution!
If maintenance measures (e.g. exchange of the transmitter or the manifold) have to be carried out under process conditions, it must be ensured that all valves are closed and that there is no danger of leaking medium. If necessary, temperature and pressure have to be checked before unmounting the instrument.

7.2 Exterior cleaning

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

7.3 Replacing seals

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

7.4 Spare parts

Material number	Description
71071871	Cutting ring DP61D, 316Ti
71071873	Cutting ring DP62D, 316Ti
71071875	Cutting ring DP63D, 316Ti
71071876	End support DP61D, 316Ti
71071879	End support DP62D, 316Ti
71071882	End support DP63D, 316Ti
71071884	End support DP61D, Steel
71071886	End support DP62D, Steel
71071888	End support DP63D, Steel
71071889	Cutting ring connection DP61D, 316Ti Cutting ring, 316Ti W/o extension
71071890	Cutting ring connection DP62D, 316Ti Cutting ring, 316Ti W/o extension
71071893	Cutting ring connection DP63D, 316Ti Cutting ring, 316Ti W/o extension
71071894	Cutting ring connection DP61D, Steel Cutting ring, Steel W/o extension
71071895	Cutting ring connection DP62D, Steel Cutting ring, Steel W/o extension
71071896	Cutting ring connection DP63D, Steel Cutting ring, Steel W/o extension
71071897	Screw set UNF7/16x1-3/4", Steel, Viton Consists of: ■ 4x Screw, length 1-3/4", Steel ■ 4x Washer ■ 2x Seal Viton Usage: Manifold DA63M, milled Not for manifold + connection IEC61518, both side
71071899	Screw set UNF7/16x1-3/4", Steel, PTFE Consists of: ■ 4x Screw, length 1-3/4", Steel ■ 4x Washer ■ 2x Seal PTFE Usage: Manifold DA63M, milled Not for manifold + connection IEC61518, both side
71071900	Screw set UNF7/16x2-1/4", Steel, Viton Consists of: ■ 4x Screw, length 2-1/4", Steel ■ 4x Washer ■ 2x Seal Viton Usage: Manifold DA63M, forging Not for manifold + connection IEC61518, both side

Material number	Description
71071901	Screw set UNF7/16x2-1/4", Steel, PTFE Consists of: ■ 4x Screw, length 2-1/4", Steel ■ 4x Washer ■ 2x Seal PTFE Usage: Manifold DA63M, forging Not for manifold + connection IEC61518, both side

7.5 Return

The following procedures must be carried out before a transmitter is sent to Endress+Hauser e.g. for repair or calibration:

- Remove all residue which may be present. Pay special attention to the gasket grooves and crevices where fluid may be present. This is especially important if the fluid is dangerous to health, e.g. corrosive, poisonous, carcinogenic, radioactive, etc.
- Always enclose a duly completed "Declaration of contamination" form (a copy of the “Declaration of contamination” is included at the end of this operating manual). Only then can Endress +Hauser transport, examine and repair a returned device.
- Enclose special handling instructions if necessary, for example a safety data sheet as per EN 91/155/EEC.

Additionally specify:

- An exact description of the application.
- The chemical and physical characteristics of the product.
- A short description of the error that occurred (specify error code if possible)
- Operating time of the device.

7.6 Disposal

In case of disposal please seperate the different components according to their material consistence.

7.7 Contact addresses of Endress+Hauser

Contact addresses can be found on our homepage: www.endress.com/worldwide. If you have any questions, please do not hesitate to contact your Endress+Hauser representative.

8 Accessories

8.1 Overview

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

- DA62V: Shut-off valves (see Technical Information TI425P)
- DA62C: Condensate pots (see Technical Information TI425P)
- DA63M: Manifold (see Technical Information TI425P)
- DA62P: Purge unit (see page 50)
- PZO: Oval flange adapter (see page 53)

The condensate pots, shut-off valves and manifold can be ordered together with the orifice. They are included in the product structures DO61W, DO62C , DO63C and DO65F.
Alternatively, they can be ordered by their own product structures. For details refer to Technical Information TI4252P.
The purge unit can only be ordered by its own product structure.

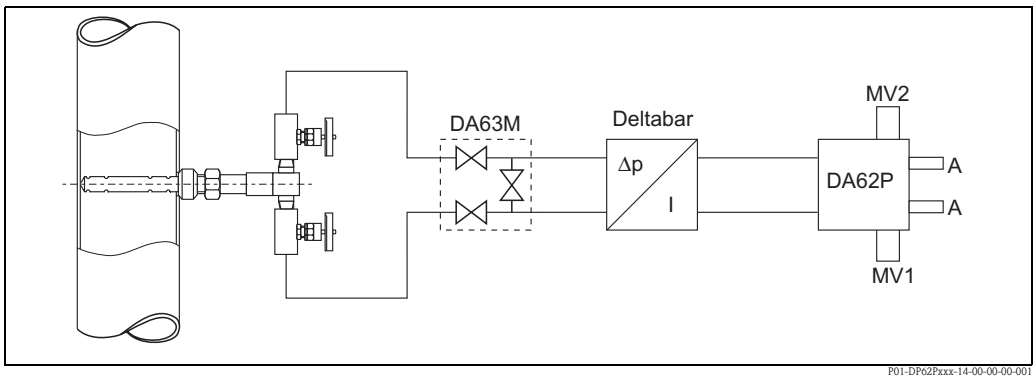
8.2 Purge unit DA62P

8.2.1 Usage

With flow measurements of waste gases or soiled air, solid particles often settle at the profile of the Pitot tube and, depending on the degree of soiling, reduce the measuring accuracy or even inhibit the functionality of the Pitot tube.
In many applications, regular manual cleaning of the Pitot tube is no feasible solution. Demounting of the probe, thourough cleaning and remounting often are too cost-intensive and time-consuming. Furthermore no measuring data are available during the cleaning procedure.
The purge unit DA62P helps to perform a fully automatic and effortless cleaning.
Usage of the purge unit is recommended if the solid contents exceeds 100 mg/m^3. The usability of the purge unit is limited for moist or adhering solids.

8.2.2 System design

The purge unit consists mainly of a purging block with solenoid valves which can be triggered directly. A customer-provided relay or a PLC can be used to trigger the two valves.



MV1, MV2: solenoid valves; A: air purge connection

8.2.3 Mounting

1. The purge unit is directly mounted to the differential pressure transmitter with the supplied screws (M10 x 50 mm, DIN 912) an seals (material: PTFE).
2. The vent valves (¼" NPT) supplied together with the differential pressure transmitter are screwed into the purge unit. The impulse pipes are mounted on the opposite side of the tranmsitter. This ensures that not only the Pitot tube but also the measuring chambers of the differential pressure transmitter are purged and cleared from deposit.
3. The connections for the purging air are located at the bottom of the purge unit. By default the size of the connections is ¼" FNPT (other connections on demand).

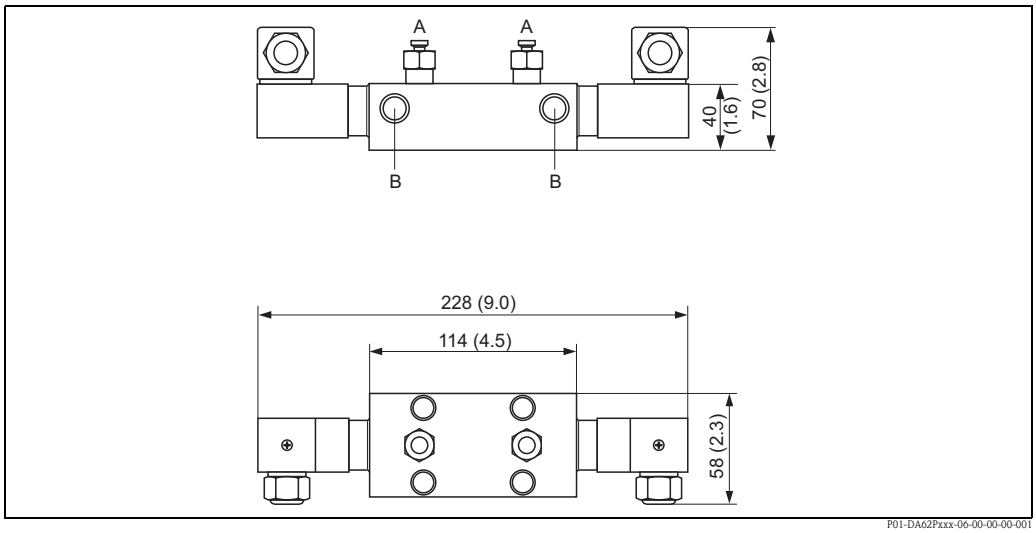
8.2.4 Triggering

The voltage required for triggering the magnetic valves MV1 and MV2 is indicated on the nameplate of the DA62P.
The purge unit can be triggered by manual switches, switching elements, relays or by a PLC.

8.2.5 Technical data

Type of valve	2-way valve, directly triggered
Medium	air
Operating mode	normally closed
Pipe connection	¼" NPT
Mounting position	arbitrary
Nominal diameter	■ Non-Ex area: 3 mm (0.12") ■ ATEX: 2 mm (0.08 ")
flow coefficient Kv	approx. 0,23 m^3/h
Difference of operating pressure	■ Non-Ex area: max. 6 bar (87 psi) ■ ATEX: max. 5 bar (72 psi)
Overall height of lift	1 mm (0.04")
Leak rate	bubble tight
Temperature of medium	■ Non-Ex area: -10 ... +90 °C (14 ... +194 °F) ■ ATEX: -10 ... +100 °C (14 ... 212 °F) for temperature class T6
Ambient temperature	■ Non-Ex area: max 55 °C (131 °F) ■ ATEX: -30 ... +60 °C (-22 ... +140 °F) für Einezlmontage
Material of valve chamber	■ anodically oxidized aluminium ■ stainless steel
Material of inner parts	stainless steel
Material of seals	FPM
Nominal voltage	■ 230 VAC, 50 Hz ■ 115 V AC, 50 Hz ■ 24 VDC
Protection class	for the ATEX version : EEx M II 2G/Dn T4; EEx EM II 2G/D T4 (PTB 00 ATEX 2129X)
On-time	100 %
Type of protection	IP65
Electrical connection	■ Non-Ex area: according to DIN 43650 ■ ATEX: expansion-fit cable (3000 mm)
Power consumption	■ Non-Ex area: 21 VA AC (pick up); 12 VA / 8W (operation) ■ ATEX: 7 W
Weight	approx. 2,7 kg (6 lbs)

8.2.6 Dimensions



Dimensions in mm (inch)
***A:** Vent valves ¼"NPT; **B:** Purge air connections "FNPT (max. 3,5 bar [50 psi])*

8.2.7 Product structure Deltatop DA62P

400	**approval**
A	non-hazardous area
B	ATEX II 2G EEx m II T4
Y	special version, to be specified

410	**power supply**
1	230V 50Hz
2	115V 50Hz
3	24VDC
9	special version, to be specified

420	**material body material**
1	Aluminium
2	316Ti
9	special version, to be specified

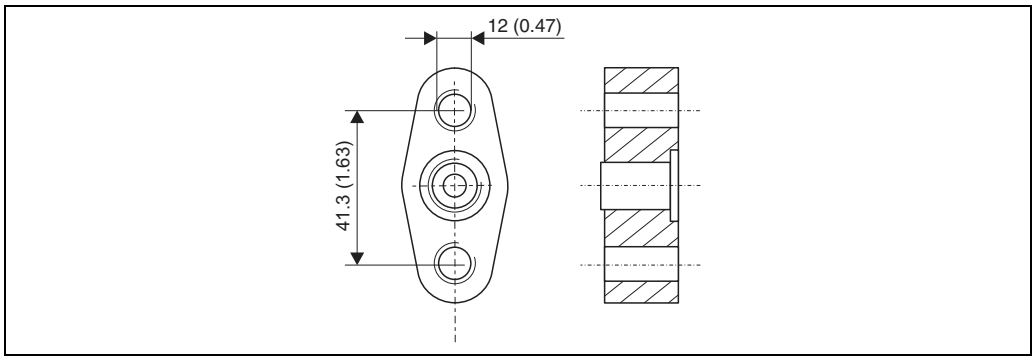
430	**Seals; Screws**
B	PTFE; UNF7/16
C	PTFE; M10
D	Viton; UNF7/16
E	Viton; M10
F	Viton; M12
Y	special version, to be specified

550	**additional option (optional; several options can be selected)**
FG	varistor, spark quenching
FH	varistor + LED, spark quenching
F1	EN10204-3.1 material (wetted parts) inspection certificate
F5	oil+grease free
F7	cleaned for silicone-free service
F6	oxygen service
F8	pressure test + certificate

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

8.3 Oval flange adapter PZO

8.3.1 Dimensions



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

8.3.2 Product structure PZO

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

020	Process Connection
A	FNPT1/2-14

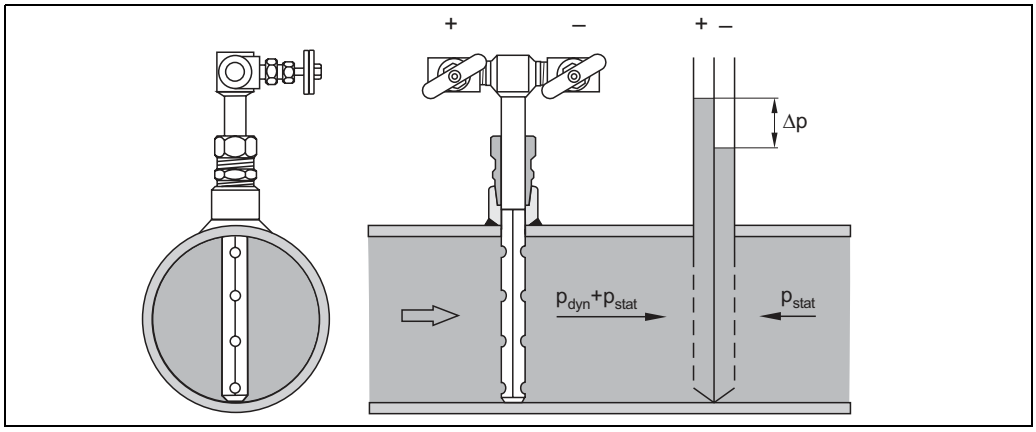
030	Material
2	Steel C22.8
1	316L

040	Seal
1	PTFE
2	FKM Viton

050	Mounting Screw
1	2x Mounting screw M10
4	2x Mounting screw M12
2	2x Mounting screw UNF7/16-20
3	Not selected

9 Appendix

9.1 Measuring principle



P01-DOxxx-15-00-00-xx-002

The front of the pitot tube is exposed to the static pressure p_{stat} plus the dynamic pressure p_{dyn}. The back of the tube is exposed only to the static pressure p_{stat}. The resulting **differential pressure Δp** can be used to calculate the **flow rate Q**.

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

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

P01-DOxxxxx-15-xx-xx-xx-008

Downstream of the Pitot tube the static pressure p_{stat} is reduced by the permanent pressure loss **Δω**. With Pitot tubes this pressure loss Δω is much less significant than with other primary elements.

9.2 Flow calculation

According to the continuity law derived by Bernoulli and the energy equation, the sum of the pressure energy and the potential and kinetic energy of a flowing fluid inside a pipe and in conditions of stationary and frictionless flow is the same at any time and in any part of the pipe:

$p_{stat} + p_{dyn} = \text{const.}$

From this law, the following flow equations can be derived:

9.2.1 Volumetric flow for gases under standard conditions

$$Q_{vn} = k\, A\, \varepsilon \sqrt{\frac{2\, \Delta p\, P_b\, Z_n\, T_n}{\rho_n\, P_n\, Z_b\, T_b}}$$

9.2.2 Volumetric flow for gases under operating conditions

$$Q_v = k\, A\, \varepsilon \sqrt{\frac{2\, \Delta p}{\rho_b}}$$

9.2.3 Mass flow for gases and steam

$$Q_m = k\, A\, \varepsilon \sqrt{2\, \Delta p\, \rho_b}$$

9.2.4 Mass flow for liquids

$$Q_m = k\, A \sqrt{2\, \Delta p\, \rho_b}$$

9.2.5 Volumetric flow for liquids

$$Q_v = k\, A \sqrt{\frac{2\, \Delta p}{\rho_b}}$$

9.2.6 Expansion factor

$$\varepsilon = \frac{\Delta p}{\kappa\, P_b} \left\{ \left(1 - \frac{2\, b}{\sqrt{\pi\, A}} \right)^2 0.31424 - 0.09484 \right\}$$

9.2.7 Definition of the symbols

Symbol	Quantity	Unit
Δp	Differential pressure at the probe	Pa
ρ_n	Medium density at standard conditions	kg/m^3
ρ_b	Medium density at operating conditions	kg/m^3
ε	Expansion factor	1
A	Cross sectional area of the pipe	m^2
b	Width of the probe perpendicular to the flow direction	m
k	k-factor of the Pitot tube	1
κ	Isentropic exponent of the gas[1)]	1
P_b	Operating pressure	Pa
P_n	Absolute pressure of the gas at standard conditions	Pa
Q_m	Mass flow	kg/s

Symbol	Quantity	Unit
Q_v	Volumetric flow	m^3/s
Q_{vn}	Volumetric flow at standard conditions	m^3/s
T_b	Temperature of the gas at operating conditions	K
T_n	Temperature of the gas at standard conditions	K
Z_b	Real gas factor at operating conditions	1
Z_n	Real gas factor at standard conditions	1

1) The isentropic exponent is: 1,66 for monoatomic gases; 1,4 for diatomic gases; 1,3 for triatomic gases

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Endress+Hauser

People for Process Automation

Declaration of Hazardous Material and De-Contamination

Erklärung zur Kontamination und Reinigung

RA No. ☐☐☐☐☐☐☐☐

Please reference the Return Authorization Number (RA#), obtained from Endress+Hauser, on all paperwork and mark the RA# clearly on the outside of the box. If this procedure is not followed, it may result in the refusal of the package at our facility.

Bitte geben Sie die von E+H mitgeteilte Rücklieferungsnummer (RA#) auf allen Lieferpapieren an und vermerken Sie diese auch außen auf der Verpackung. Nichtbeachtung dieser Anweisung führt zur Ablehnung ihrer Lieferung.

Because of legal regulations and for the safety of our employees and operating equipment, we need the "Declaration of Hazardous Material and De-Contamination", with your signature, before your order can be handled. Please make absolutely sure to attach it to the outside of the packaging.

Aufgrund der gesetzlichen Vorschriften und zum Schutz unserer Mitarbeiter und Betriebseinrichtungen, benötigen wir die unterschriebene "Erklärung zur Kontamination und Reinigung", bevor Ihr Auftrag bearbeitet werden kann. Bringen Sie diese unbedingt außen an der Verpackung an.

Type of instrument / sensor
Geräte-/Sensortyp _____

Serial number
Seriennummer _____

☐ **Used as SIL device in a Safety Instrumented System /** *Einsatz als SIL Gerät in Schutzeinrichtungen*

Process data/ *Prozessdaten*
Temperature / *Temperatur* _____ [°F] _____ [°C]
Pressure / *Druck* _____ [psi] _____ [Pa]
Conductivity / *Leitfähigkeit* _____ [µS/cm]
Viscosity / *Viskosität* _____ [cp] _____ [mm^2/s]

Medium and warnings
Warnhinweise zum Medium

	Medium /concentration *Medium /Konzentration*	Identification CAS No.	flammable *entzündlich*	toxic *giftig*	corrosive *ätzend*	harmful/ irritant *gesundheits-schädlich/ reizend*	other * *sonstiges**	harmless *unbedenklich*
Process medium / *Medium im Prozess*								
Medium for process cleaning / *Medium zur Prozessreinigung*								
Returned part cleaned with / *Medium zur Endreinigung*								

* explosive; oxidising; dangerous for the environment; biological risk; radioactive
* *explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv*

Please tick should one of the above be applicable, include safety data sheet and, if necessary, special handling instructions.
Zutreffendes ankreuzen; trifft einer der Warnhinweise zu, Sicherheitsdatenblatt und ggf. spezielle Handhabungsvorschriften beilegen.

Description of failure / *Fehlerbeschreibung* _____

_____

_____

Company data / *Angaben zum Absender*

Company / *Firma* _____

_____

Address / *Adresse*

_____

_____

Phone number of contact person / *Telefon-Nr. Ansprechpartner:*

_____

Fax / E-Mail _____

Your order No. / *Ihre Auftragsnr.* _____

"We hereby certify that this declaration is filled out truthfully and completely to the best of our knowledge.We further certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free of any residues in dangerous quantities."

"Wir bestätigen, die vorliegende Erklärung nach unserem besten Wissen wahrheitsgetreu und vollständig ausgefüllt zu haben. Wir bestätigen weiter, dass die zurückgesandten Teile sorgfältig gereinigt wurden und nach unserem besten Wissen frei von Rückständen in gefahrbringender Menge sind."

(place, date / *Ort, Datum)*

Name, dept./ *Abt.* (please print / *bitte Druckschrift*)

Signature / *Unterschrift*

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People for Process Automation

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