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JUMO flowTRANS DP P

Pitot tube P01 to P04

Applications

- for flow measurement of liquids, gases and steam (saturated steam, overheated steam) in closed pipelines

Brief description

Flow measurements on the basis of the differential pressure method can be carried out with the JUMO flowTRANS DP P pitot tube in liquids, gases and steam in closed pipe systems. The different type series P01 to P04 can be used in a wide range of nominal widths, temperatures, and pressures.

The pitot tube can be mounted into the pipe either using a welding screw connection or a mounting pipe with flange connection, depending on the requirements.

The JUMO dTRANS p02/p20 DELTA differential pressure transmitter is connected to the probe head via a flange plate in the compact design. In the remote mount design type, the differential pressure transmitter is connected to the pitot tube via differential pressure pipes.

Pitot tube P01 and P02

- Flow measurement of liquids and gases
- Temperatures up to 1175 °C
- Nominal width up to DN 2000 (others on request)

Pitot tube P03 and P04

- Flow measurement of saturated steam and overheated steam
- Temperatures up to 450 °C at 100 bar
- Nominal width up to DN 1000

Customer benefits

- Cost advantages compared to flanged devices with large nominal widths
- Bidirectional flow measurement thanks to symmetrical pitot tube profiles
- Short inlet and outlet sections
  due to measurement and averaging of the static and dynamic pressure at four measuring locations along the probe profile
- Low pressure losses
  due to probe profiles with optimized hydraulic design

JUMO flowTRANS DP P01

Special features

- Probe profile with optimized hydraulic design
- Excellent reliability under difficult operating conditions

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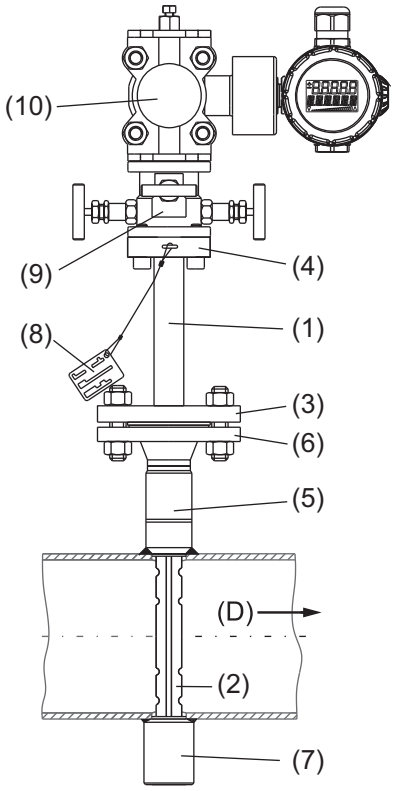
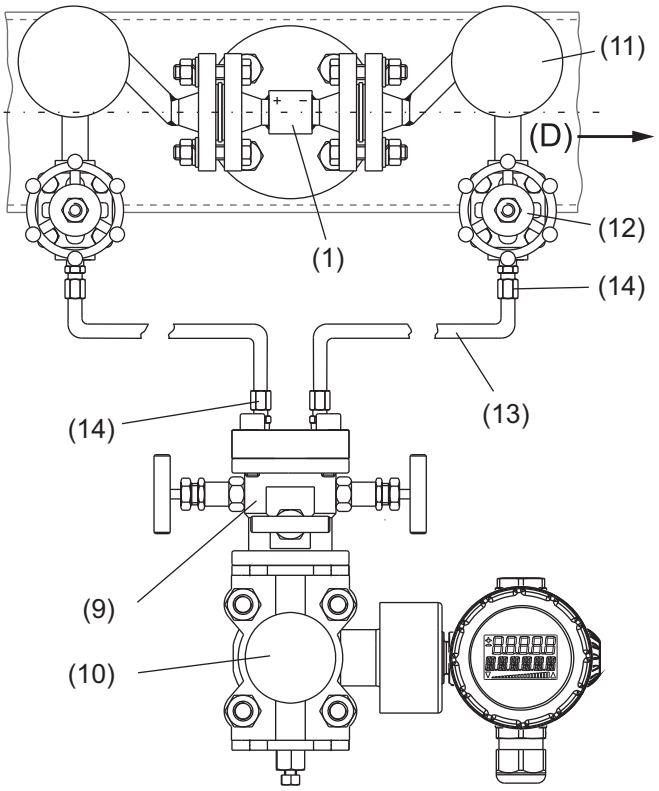
Assembly of a flow measuring system

Examples:

JUMO flowTRANS DP P02	**JUMO flowTRANS DP P04**
 Front view	 Front view
Measurement medium: gases	Measurement medium: saturated steam
Design type: compact	Design type: remote mount

(1)	Pitot tube	(2)	Probe profile	(3)	Probe flange
(4)	Probe head	(5)	Mounting pipe	(6)	Mounting flange
(7)	Counter-bearing (if required)	(8)	Nameplate	(9)	Valve block (3- or 5-way valve)
(10)	Differential pressure transmitter	(11)	Condensate trap	(12)	Shut-off device
(13)	12 × 1 mm Ermeto pipe	(14)	Ermeto screw connection	(D)	Flow direction (medium)

The differential pressure transmitter JUMO dTRANS p02 DELTA or JUMO dTRANS p20 DELTA supplements the pitot tube JUMO flowTRANS DP P01, P02, P03 or P04 to create a flow measuring system.

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Measuring principle

Differential pressure method

The measuring principle of the pitot tube uses the pressure difference between the dynamic pressure building up upstream of an obstacle blocking the flow and the static pressure immediately at the rear of the probe.

In accordance with the Continuity Law derived from Bernoulli and the energy equation of a stationary, friction-free pipe flow, the total of the pressure energy, the potential energy, and the kinetic energy must have the same value at every point in the pipe and at any time. **Equation 1**:

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

The measurand p_{stat} is the static pressure applied evenly in all directions. The measurand p_{dyn} stands for the dynamic pressure applied in the direction of flow.

For fluids flowing in horizontal pipelines, where the speeds of flow are low in relation to the Mach number Ma < 1, p_{dyn} can be calculated with the flow speed v, the density ρ and the resistance coefficient ζ in accordance with **Equation 2**:

$$p_{dyn} = \zeta \frac{\rho}{2} v^2$$

If a fixed body is inserted into a steady flow, the flow will back up immediately upstream from this body and will come to a complete standstill at the so-called stagnation point (see S2 in Figure 1). At this point, the total pressure p_{S2} is expressed with **Equation 3**:

$$p_{s2} = p_{stat} + p_{dyn}$$

At the openings on the side of a pitot tube facing away from the flow, only the direction-independent pressure p_{stat} can be applied. The difference between the two pressures, the differential pressure (effective pressure) Δp, is a measure of the speed of the flow against the body (see Figure 2) **Equation 4**:

$$\Delta p = p_{s2} - p_{s1}$$

Applying **Equation 2** and **Equation 3** to **Equation 4** leads to **Equation 5**:

$$\Delta p = \zeta \frac{\rho}{2} v^2$$

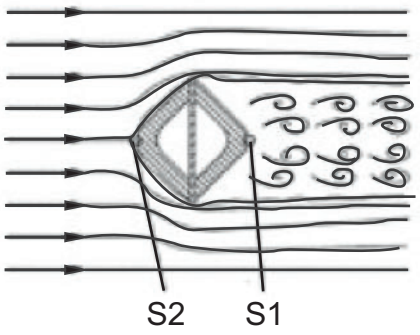

Figure 1: Diagram of the flow field at the profile of the pitot tube

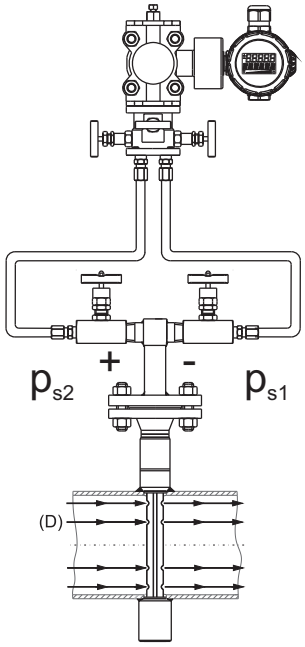

Figure 2: Diagram showing the generation of the differential pressure

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Selection criteria

Preselection of the type series

First, the type series is pre-selected on the basis of the medium to be measured:

Measurement medium	Type series
Liquids and gases	JUMO flowTRANS DP P01
	JUMO flowTRANS DP P02
Steam (saturated steam, overheated steam)	JUMO flowTRANS DP P03
	JUMO flowTRANS DP P04

Specification of the type series

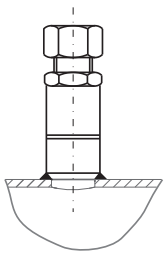
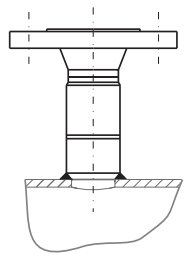
The area of application (operating pressure and temperature of the plant) influences the selection of the probe material and the type of installation into the pipeline. The type series is specified using the following criteria:

Pitot tube for liquids and gases:

Area of application	Probe material	Installation type	Type series
Up to 200 °C (at 25 bar)	1.4571	Welding screw connection	JUMO flowTRANS DP P01
Up to 1175 °C	e.g. 1.4462 (Duplex), etc.	Mounting pipe	JUMO flowTRANS DP P02

Pitot tube for steam:

Area of application	Probe material	Installation type	Type series
Up to 200 °C (at 16 bar)	1.4571	Welding screw connection	JUMO flowTRANS DP P03
Up to 450 °C (at 100 bar)	e.g. 1.4462 (Duplex), etc.	Mounting pipe	JUMO flowTRANS DP P04

Welding screw connection (JUMO flowTRANS DP P01/P03)	**Mounting pipe with flange** (JUMO flowTRANS DP P02/P04)
	

Material of the mounting parts

The material of the mounting parts depends on the material of the pipeline where the pitot tube is to be fitted (weldability).

Selection of the design type

The medium temperature, the installation location, and the local environment will influence the selection of the design type. The JUMO flowTRANS DP P pitot tubes are available in compact and remote mount design types.

Environmental influences	Design type
Medium temperature, ambient temperature, space conditions, read-out options, etc.	compact
	remote mount

The compact design type is the more cost-effective variant due to additional installation and material costs incurred when selecting the remote mount design type.

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Type series

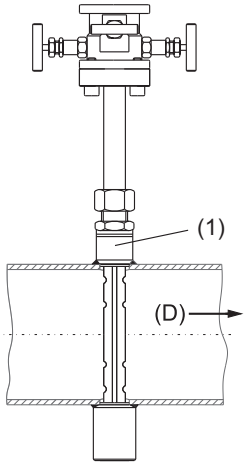
Pitot tubes for liquids and gases

JUMO flowTRANS DP P01

The installation between the pipeline and the pitot tube modules is carried out with a welding screw connection (1) and offers an excellent price/performance ratio for applications without any particularly high requirements for the operating pressure or the operating temperature.

1.4571 is available as a probe material.

The probe's enables a 3- or 5-way valve block to be installed for the direct attachment of the differential pressure transmitter.



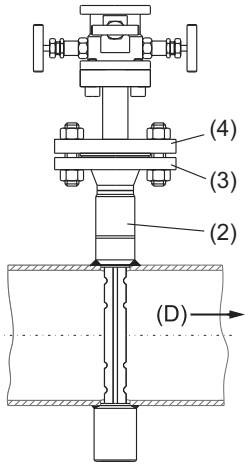
JUMO flowTRANS DP P02

The probe flange (4) is screwed to the mounting flange (3) of the mounting pipe (2). As a result, this version can be used up to PN 400.

The maximum pressure stage is dependent only on the flange pressure stage.

The probe is produced as standard in material 1.4571.

The following materials are also still available: 1.4462 (Duplex), 1.4539, Hastelloy C4, Incoloy 800, Inconel, Monel.



Probe heads

The JUMO flowTRANS DP P01/P02 pitot tubes are available with the following probe heads:

Probe head with 1/4″ and 1/2″ NPT external thread

Probe head with flange plate
for the fitting of 3- and 5-way valve blocks

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Pitot tubes for steam

JUMO flowTRANS DP P03

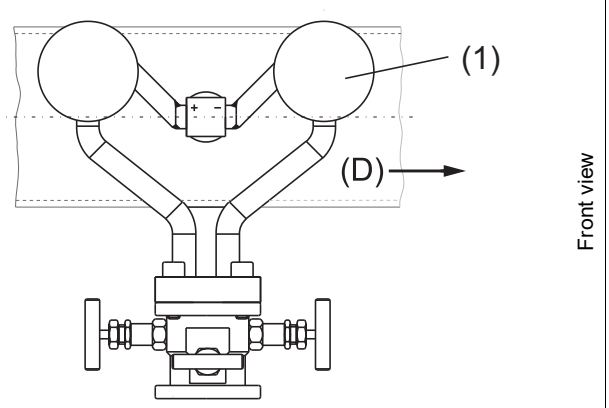
The installation between the pipeline and the pitot tube modules is carried out with a welding screw connection.

For technical safety reasons, it is necessary to ensure the tightness of the screw connection, so the pressure nut must be tightened.

1.4571 is available as a probe material.

The condensate traps are indispensable for measuring the flow of steam:

- The water seal in the condensate traps acts as temperature protection for the connected transmitter
- The water columns in the condensate traps must be positioned at exactly identical, hydrostatic heights above the differential pressure transmitter



JUMO flowTRANS DP P04

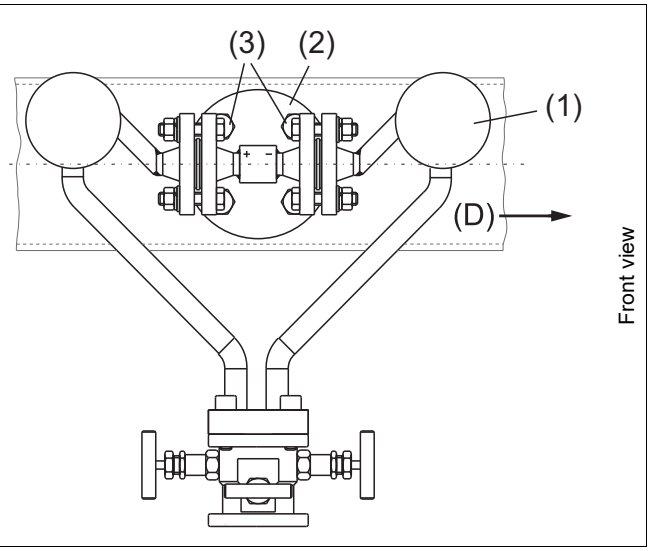
The probe flange (2) is screwed to the mounting flange of the mounting pipe (3).

As a result, this version can be used at operating pressures up to 100 bar at 450 °C.

The probe is produced as standard in material 1.4571.

The condensate traps are indispensable for measuring the flow of steam:

- The water seal in the condensate traps acts as temperature protection for the connected transmitter
- The water columns in the condensate traps must be positioned at exactly identical, hydrostatic heights above the differential pressure transmitter



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Technical data

Mechanical features

	Liquids, gases		Steam	
	JUMO flowTRANS DP P01	**JUMO flowTRANS DP P02**	**JUMO flowTRANS DP P03**	**JUMO flowTRANS DP P04**
Application area				
Up to 200 °C (16 bar)	**x**	**x**	**x**	**x**
Up to 200 °C (25 bar)	**x**	**x**		**x**
Up to 450 °C (100 bar) with 1.4571		**x**		**x**[a]
Up to 1175 °C		**x**[a]		
Nominal width				
DN 25 to DN 2000 (1″ to 80″)	**x**			
DN 40 to DN 800 (1 1/2″ to 32″)			**x**	
DN 40 to DN 1000 (1 1/2″ to 40″)				**x**
DN 40 to DN 2000 (1 1/2″ to 80″)		**x**		
Probe material				
1.4571	**x**	**x**	**x**	**x**
1.4462 (Duplex), Inconel, Monel, 1.4539, Hastelloy C4, Incoloy 800, PVDF		**x**		
Assembly parts material				
C-steel, 1.4571	**x**	**x**	**x**	**x**
1.4462 (Duplex), Inconel, Monel, 1.4539, Hastelloy C4, Incoloy 800, PVDF		**x**		
A335 Grade P1, A335 Grade P11, A335 Grade P22, A335 Grade P91				**x**
Pipeline connection				
Welding screw connection (screw connection with welding socket and pressure nut)	**x**		**x**	
Assembly pipe (flange connection for mounting the probe)		**x**		**x**
Installation and removal				
An interruption to operations is necessary	**x**	**x**		
Emptying of the pipeline is necessary			**x**	**x**

[a] Depending on the use of the materials

Environmental influences

Measurement uncertainty

The measurement uncertainty for the JUMO flowTRANS DP P pitot tubes is ±1 %

Pressure loss

Low pressure losses due to probe profiles with optimized flow properties.

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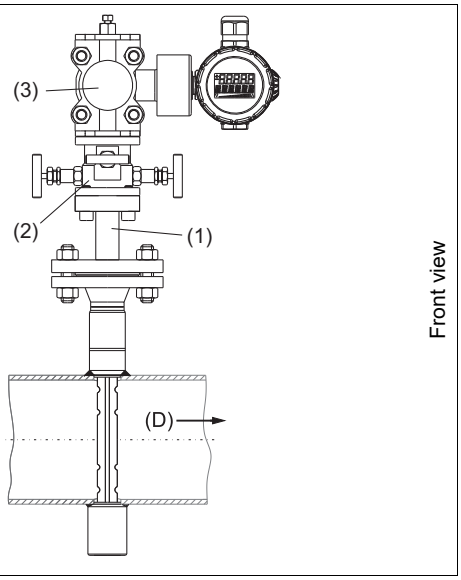
Design

All type series of the pitot tubes for liquids, gases, and steam are available in compact and remote mount design types. The compact and/or remote mount design type refer to the manner in which the components (pitot tube, valve block, and transmitter) are installed.

JUMO flowTRANS DP P – compact design type

In the compact design type, the pitot tube (1), a separate 3- or 5-way valve block (2), and the transmitter (3) are bolted to a compact unit.



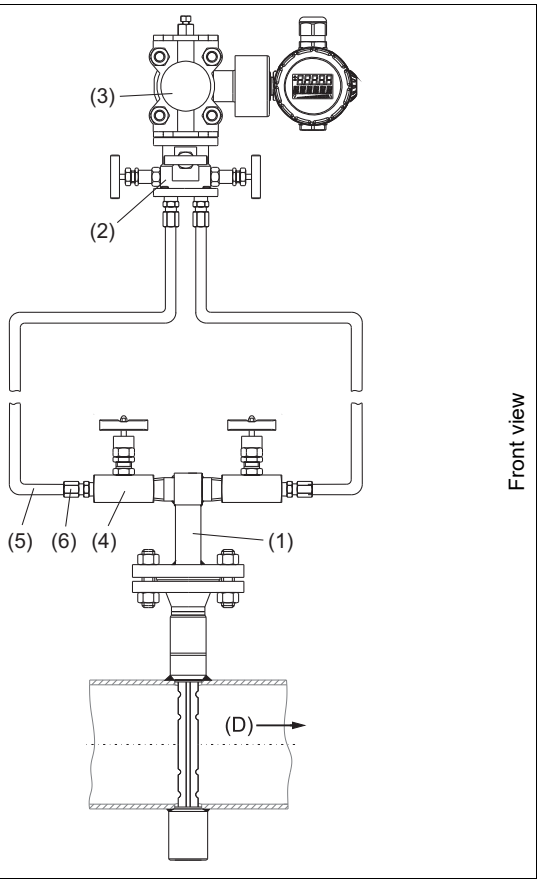
JUMO flowTRANS DP P – remote mount design type

In the remote mount design type, the pitot tube (1) and the transmitter (3) are separated from each other.

In addition to the separate 3- or 5-way valve block (2), two shut-off devices (4), two 12 × 1 mm Ermeto pipes (5), and the corresponding Ermeto screw connections (6) are needed on the shut-off device and the valve block.

If necessary, additional mounting brackets may be needed for the transmitter.

The assembly effort is greater than with the compact design type.



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Mounting

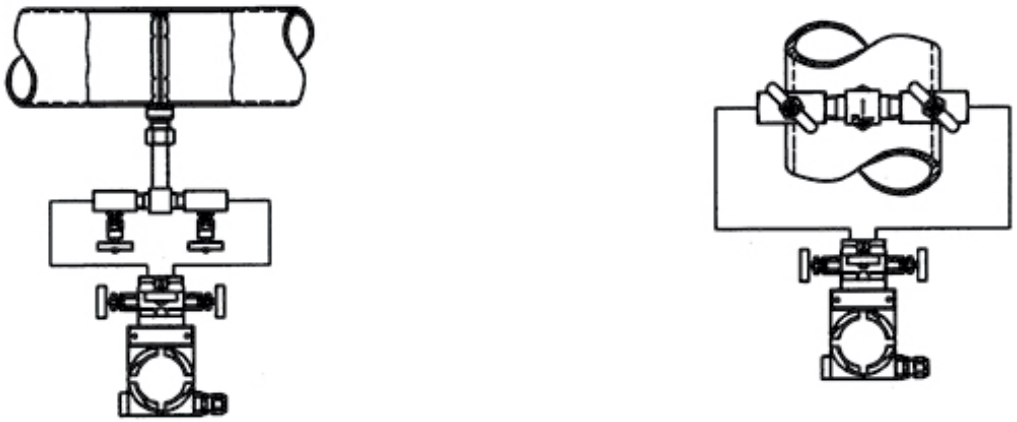
Installation position (liquids)

NOTE!

Never fit the pitot tube from above into the pipeline! Rising air bubbles may distort the measuring result!

Recommended installation position:

- Fit the pitot tube from the side or from below into the pipeline
- Install the differential pressure transmitter under the effective pressure outlet



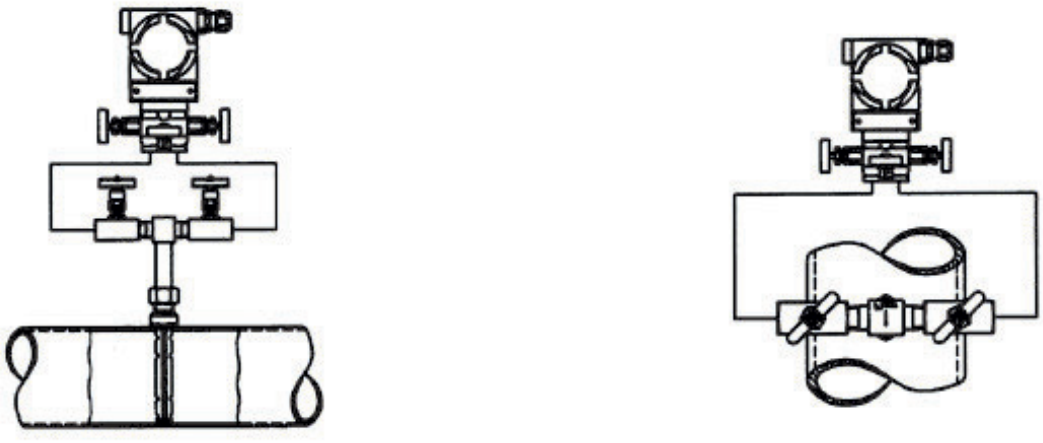
Installation position (gases)

NOTE!

Never fit the pitot tube from below into the pipeline! Liquid transported in gases can cause the liquid level to rise and may distort the measuring result!

Recommended installation position:

- Fit the pitot tube from the side or from above into the pipeline
- Install the differential pressure transmitter above the effective pressure outlet



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Installation position (steam)

NOTE!

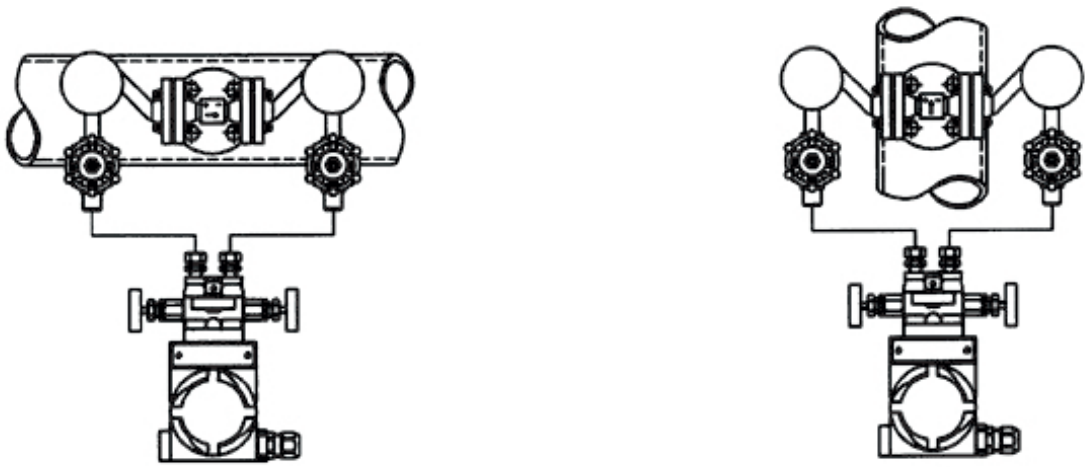
Never fit the pitot tube from above into the pipeline! The exchange between the steam-water aggregate states must be able to run smoothly!

NOTE!

Do not insulate the condensate traps!

Recommended installation position:

- Fit the pitot tube from the side into the pipeline
- Install the differential pressure transmitter below the effective pressure outlet
  The water columns in the condensate traps must be positioned at exactly identical, hydrostatic heights above the differential pressure transmitter.



Inlet and outlet section

As the precision of the measuring result of the pitot tube depends on the formation of a flow profile that is as undisturbed as possible, the importance of selecting a suitable installation position must not be underestimated.

In general, control valves, throttle valves, and shut-off valves should be installed downstream of the pitot tube. If it is not possible to comply with the specified values, the pitot tube may also be installed downstream of an elbow or in short inlet and outlet sections. Naturally, this will impair the precision. In unfavorable flow conditions, the loss of precision may be approx. 3 %.

NOTE!

If the recommended straight sections for the inlet and outlet are not available, the measuring precision can be adjusted to the conditions of the meter run with a comparative measurement (e.g. Pitot tube, individual point measurement).

An individual point measurement guarantees that the differential pressure corresponds to the genuine speed, so achieving the specified degree of precision.

Details are available on request from the manufacturer.

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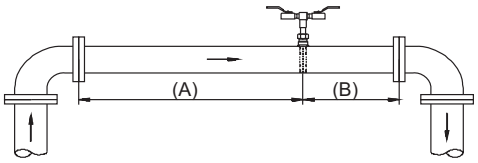
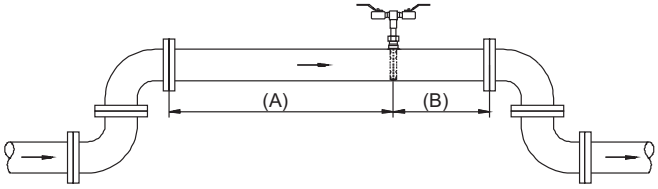
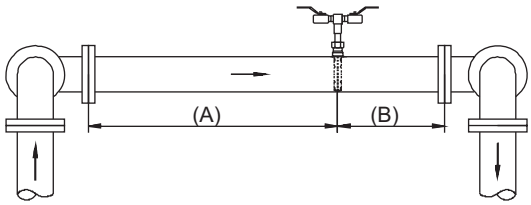
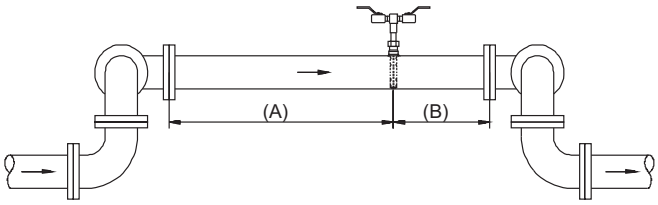
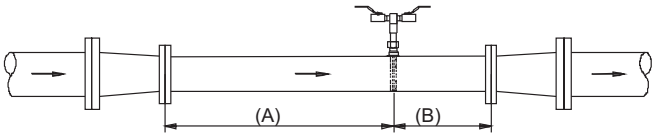
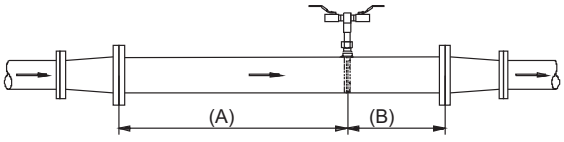
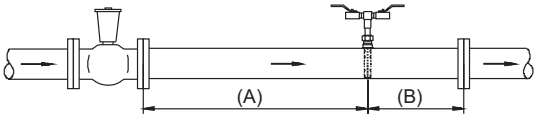
The following inlet and outlet sections have confirmed and proven their value in practice, and are helpful in selecting a suitable installation location:

(A)	(B)	
7 × DN	3 × DN	
9 × DN	3 × DN	
17 × DN	4 × DN	
18 × DN	4 × DN	
7 × DN	3 × DN	Constriction of the pipeline 
7 × DN	3 × DN	Expansion of the pipeline 
24 × DN	4 × DN	Regulation unit 

(A) Inlet section (B) Outlet section DN Nominal width (pipe diameter)

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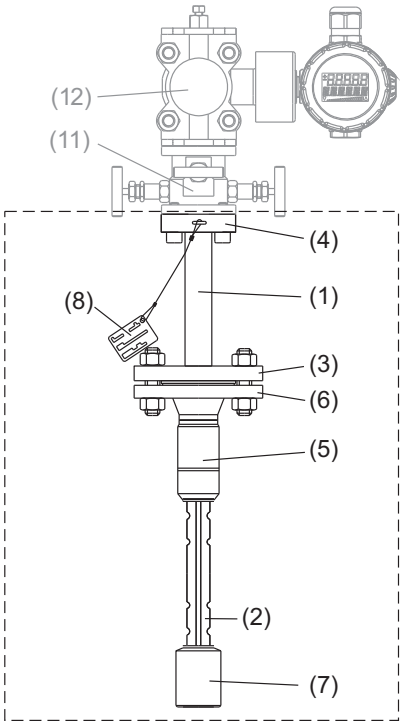
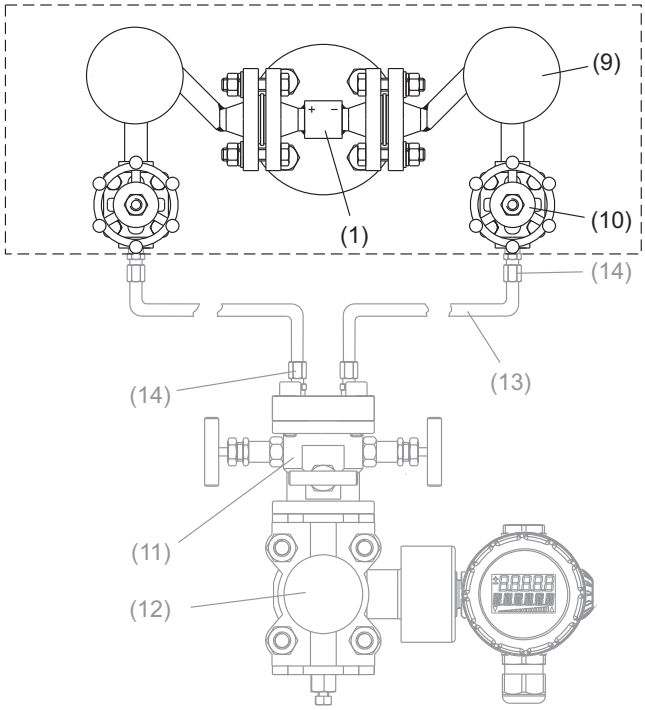
Scope of delivery

Examples

JUMO flowTRANS DP P02	**JUMO flowTRANS DP P04**
 Front view	 Front view
Measurement medium: gases	Measurement medium: saturated steam
Design type: compact	Design type: remote mount

(1) Pitot tube
(2) Probe profile
(3) Probe flange
(4) Probe head
(5) Mounting pipe
(6) Mounting flange
(7) Counter-bearing (if required)
(8) Nameplate
(9) Condensate trap
(10) Shut-off device

Accessories

(11) Valve block (3- or 5-way valve)
(12) Differential pressure transmitter
(13) 12 × 1 mm Ermeto pipe
(14) Ermeto screw connection

The differential pressure transmitter JUMO dTRANS p02 DELTA or JUMO dTRANS p20 DELTA supplements the pitot tube JUMO flowTRANS DP P01, P02, P03 or P04 to create a flow measuring system.

Other accessories available on request.