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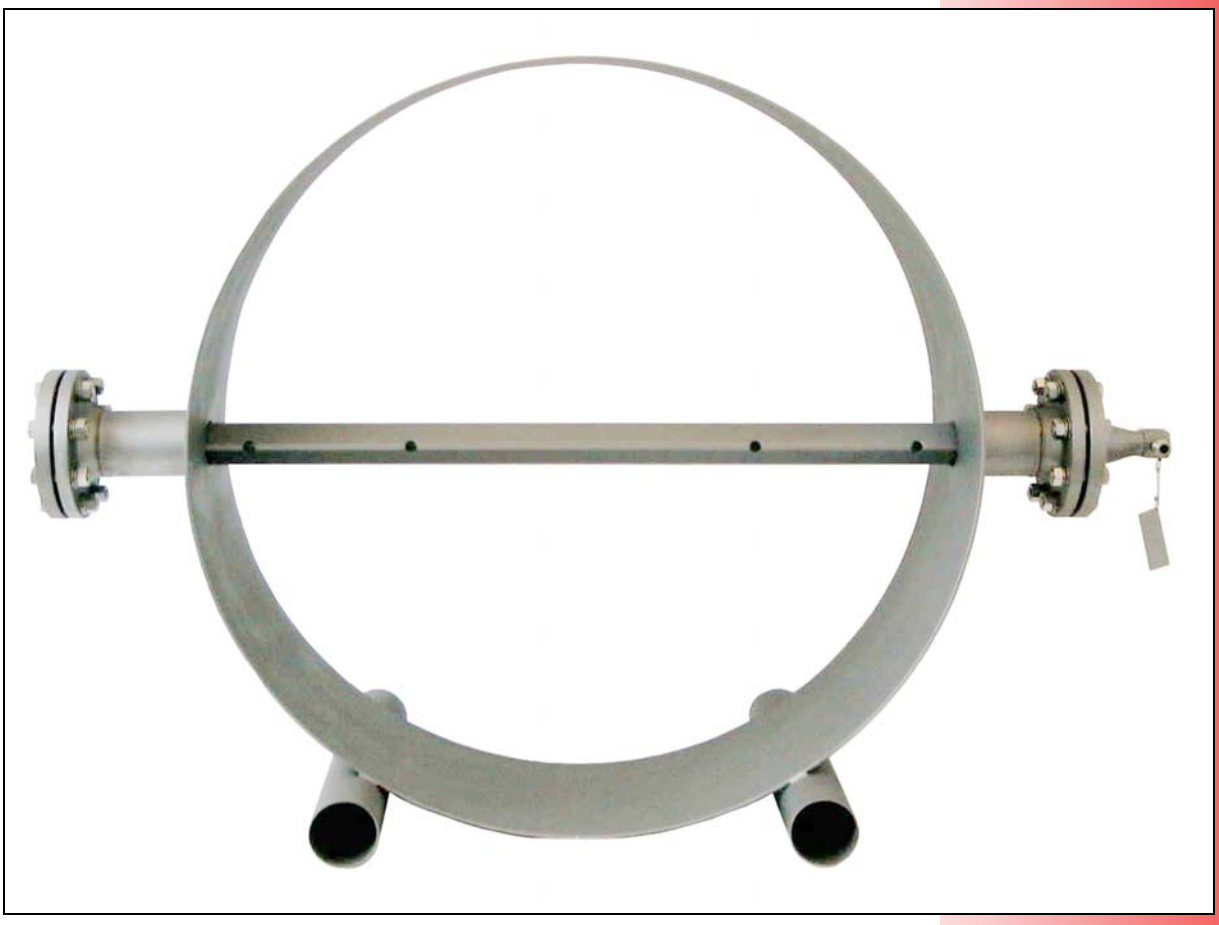
TÜVRheinland® CERT ISO 9001

Itabar-Flow-Sensor for dry gases and air for flue gas measurement

Series: IBF-100



Installation and Operation Manual

12/2013

FLOW

THE EXPERT FOR LEVEL AND FLOW

Thanks for choosing an Instrument from Intra-Automation.

Intra-Automation
Installation- and Operation Manual
12/2013

Technical details subject to be changed without notice.

For comments regarding this brochure, please contact
info@intra-automation.de

Itabar-Flow-Sensor for dry gases and air for flue gas measurement

Series: IBF-100

List of Contents:

1. Safety Instructions

In this manual you will find information for your own safety and to prevent any type of damage. The hints are marked with a danger sign described as follows:

DANGER
means, that death, personal injury or high damage to property **will** occur, if there should be taken no precaution.

WARNING
means, that death, personal injury or high damage to property **can** occur, if there should be taken no precaution.

CAUTION
with danger sign means, that only small personal injuries can occur, if there should be taken no precaution.

CAUTION
without danger sign means, that damage to property can occur, if there should be taken no precaution.

ATTENTION
highlights actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned.

NOTE
Is important information about the product itself, the handling of the product or that part of the manual to which special attention is to be drawn to.

Limited liability

We checked the content of the manual in accordance to the hardware. But we can not guarranty that there will be differences between the manual and the hardware. The manual will be checked regularly to correct the manual in the following versions.

2. General Instructions

NOTE

For reasons of clarity the manual does not contain detailed information about all types of products and cannot take into account every conceivable case of installation, operation or maintenance.

If you require further information or should any problems occur which are not sufficiently explained in the manual, you can consult your local Intra-Automation branch to obtain the necessary information.

May we also draw your attention to the fact that the contents of the manual are not part of a previous or existing agreement, approval or legal relationship or an amendment thereof. All obligations of the Intra-Automation GmbH result from the contract of purchase which also contains the full and solely valid warranty agreement. These contractual warranty conditions are neither extended nor restricted by the contents of the manual.

The contents reflect the technical state at the time of going to print. They are subject to technical modifications in the course of further development.

WARNING

Intrinsically safe devices lose their license as soon as they are operated on circuits which do not meet the requirements of the EC test certificate.

The device may be operated with high pressure and corrosive media. Therefore serious injuries and/ or considerable material damage cannot be ruled out in the event of improper handling of the device.

The perfect and safe operation of this equipment is conditional upon proper transport, proper storage, installation and assembly as well as on careful operation and commissioning.

The equipment may only be used for the purposes specified in this instruction manual.

Exclusion of liability

All modifications to the device require the expressed approval of the manufacturer.

Qualified Personnel

Qualified personnel is persons familiar with installation, commissioning and operation of the product and wo have the appropriate qualifications for their activities, such as:

- training or instruction or authorization to operate and maintain devices/ systems according to the standard of safety technology for high pressures and corrosive media.
- training or instruction according to the standards of safety engineering in the care and use of suitable safety equipment.
- training in first aid.

CAUTION

Modules which are sensitive to electrostatic charge may be destroyed by voltages which are far below the human level of perception. These voltages occur already when you touch a component or electrical connections of a module without first discharging yourself electro-statically. The damage incurred by a module as a result of an overvoltage is not usually immediately perceptible but only becomes noticeable after a long time in operation.

Trade mark

Itabar is a trade mark of Intra-Automation GmbH.

3. Measurement principle of Itabar-Flow-Sensors

Once a corpus like our patented flow sensor profile is being brought into parallel flow with the velocity of w, the fluid will partly pond while passing the barrier. The streamline flowing in the middle of the ponding area, the ponding flow line, hits the barrier vertically. The fluid will totally calm down at this very point, called the ponding point. As ponding flows are always laminar – at least until they reach the corpus (Ponding point) – and therefore are always certainly calculable (even if the flow friction is involved), which makes them very usable for measurement procedures. Using the energy equation acc. to Bernoulli, the outcome is:

$$p_{ges} = p_{stat} + \frac{1}{2}\rho w^2$$

With the patented sensor profile of the Itabar-sensor it is possible to measure the total pressure p_{ges} on the front side as well as the static pressure p_{stat} on the backside of the sensor. From the difference the flow velocity can be calculated:

$$w = \sqrt{\frac{2 * p_{dyn}}{\rho}}$$

At known pipe inside diameter the following applies acc. to the continuity equation:

$$V \sim wA$$

From that completed by a proportional coefficient (or correction coefficient “k”) the following equations result:

$$V = k * w * A \text{ or } m = k * \rho * w * A$$

The correction coefficient “k” is only related to the patented Itabar-sensor-profile. The coefficient has been determined by empiric methods for all sensor profiles by Intra-Automation GmbH. (For additional information please download the detailed product catalogue from www.intra-automation.com.)

4. Product description

Congratulations for your choice of an Itabar®-Flow Sensor series IBF-100

When installed properly, the ITABAR®-sensor offers an array of advantages over other measurement systems with respect to it’s accuracy, pressure loss and installation. The following guide is designed to help you with the sensor’s installation and operation.

5. Operating conditions

The Itabar-Flow-Sensor in your hands can be applied to the following operation conditions

Op. Pressure	max. 100 bar, acc. to flanges specifications
Op. Temperature	-50…+1200°C
Pipe sizes	DN600 up to DN12000

The flow sensor material can be customized to special operating conditions (e.g. corrosive fluids, extreme temperatures).

6. Receipt, Transport and Storing

On receipt of the equipment, the outside packing has to be checked for any damage incurred while shipment. If the packing case is damaged, the local carrier should be notified immediately regarding the liability. Remove the envelope containing the packing list. Carefully remove the equipment from the transport box and inspect for damaged or missing parts. Please check the case to be sure that all parts (e.g. accessories) have been unpacked. For transport or storing please only use the original packing case. Conditions for storing:

- Do not pile up the cases at any time!
- For storage, protect the units against heat frost, humidity, dust of chemical vapour/media.
- Storage temperature: 10°C [50 °F] up to 40 °C [104 °F]

The time of storage is unlimited, but pay attention to the agreed guarantee period.

WARNING
For transport of units with weights higher than 25 kg [55 lbs], only use lifting tools. Please take care of the centre of gravity signed on the packing (without sign if the centre is in the middle of the case). During transport do not enter the area of danger. Wear safety clothes (e.g. shoes) only.

7. Pre-Installation Checks

Before installation, please make sure that all of the following parts are included in the sensor kit:

- Itabar-Sensor, Typ IBF-100
- Two mounting studs with flanges
- Gaskets fort he mounting flanges
- Bolts/Nuts
- Blind flange with end support
- Shut-Off Devices

Compare the specification on the TAG-plate with the given specification of your Purchase order. The TAG-plate contains the following details:

- Serial-no.
- Sensor type
- Pipe inside diameter
- TAG-no. (measurement location number) – if provided
- Material of construction
- Measuring range

fig 1: TAG plate Itabar

NOTE
Make sure that the pipe inside diameter indicated on the TAG-plate matches your pipe diameter!

8. General Instructions for Installation

In order to obtain optimal measurement results, follow the instructions concerning the installation of the Itabar-Flow-Sensor as given below.

8.1 Specification of the Pipe Arrangement at Place of Installation

For design reasons, the pipe arrangement at the installation has to be known before the sensor is manufactured.
For horizontal pipe arrangements the instrument connections are placed in line with the flow direction (see figure 2).
For vertical pipe arrangements the instrument connections for the measurement of the differential pressure are arranged with an angle of 90° to the flow direction (see figure 3).

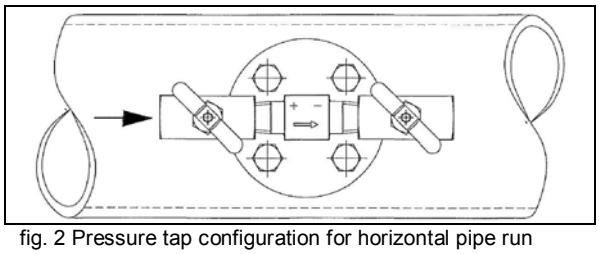


fig. 2 Pressure tap configuration for horizontal pipe run

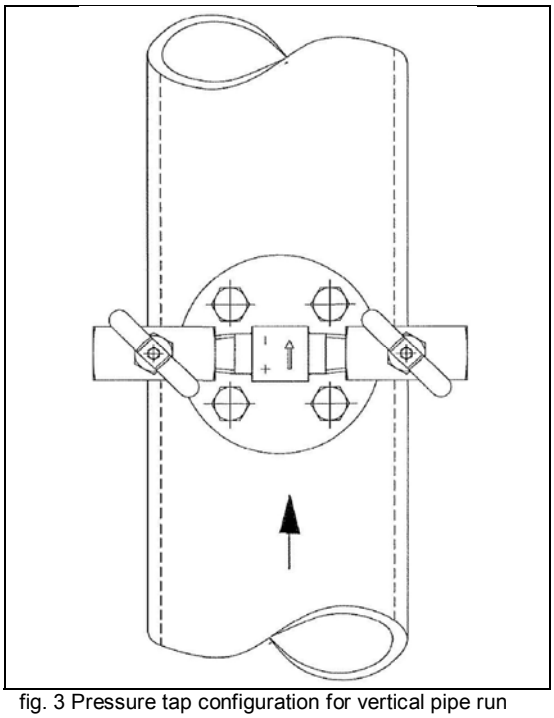


fig. 3 Pressure tap configuration for vertical pipe run

NOTE
In each case, the flow direction is indicated by an arrow on the sensor head.

8.2 Vertical Pipe Arrangement

The Itabar-Sensor for flow measurement of liquids and gases can be installed in vertical pipe runs at any location, however, the instrument connections have to be located in the same horizontal plain (see figs. 3 + 4).

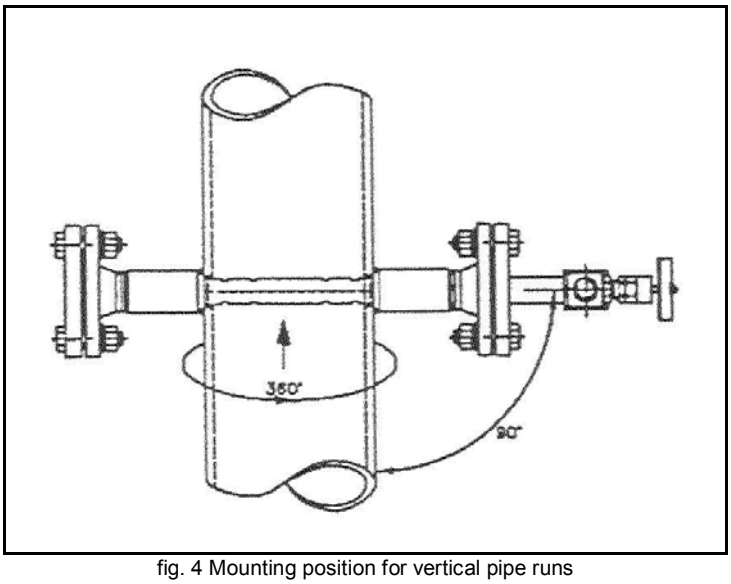


fig. 4 Mounting position for vertical pipe runs

8.3 Horizontal Pipe Arrangement

For flow measurement of gases, the Itabar-Sensor has to be installed in the upper half of the pipe perimeter; the connections to the instruments have to be located below the pipe axis. This will prevent moisture and condensations from entering the instrument connections and from altering the measurement (see figs. 2 + 5).

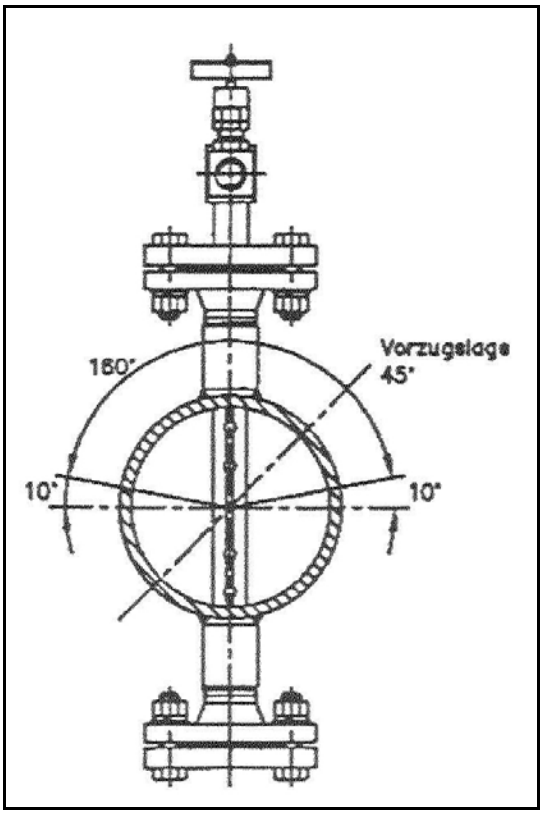


fig. 5 Mounting position for horizontal pipe runs

8.4 Misalignment

The Itabar-Sensor operates based on simple physical principles. Its design incorporates no moving parts which are subject to wear. The sensor is not affected by being slightly out of alignment. The influence on the accuracy of the measurement is neglible as long as the limits in the below fig 6, 7 and 8 are not exceeded (The pictures show IBR-types, but the values are also valid for IBF.)

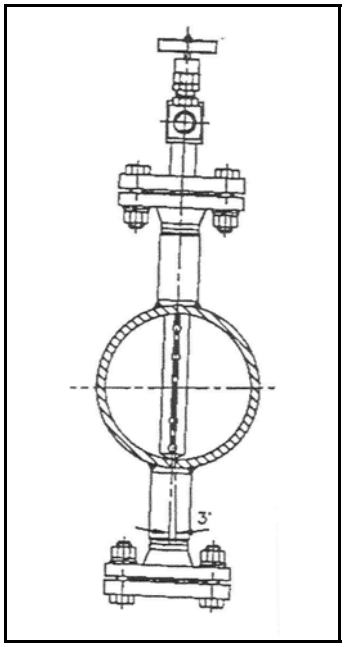


Abb. 6

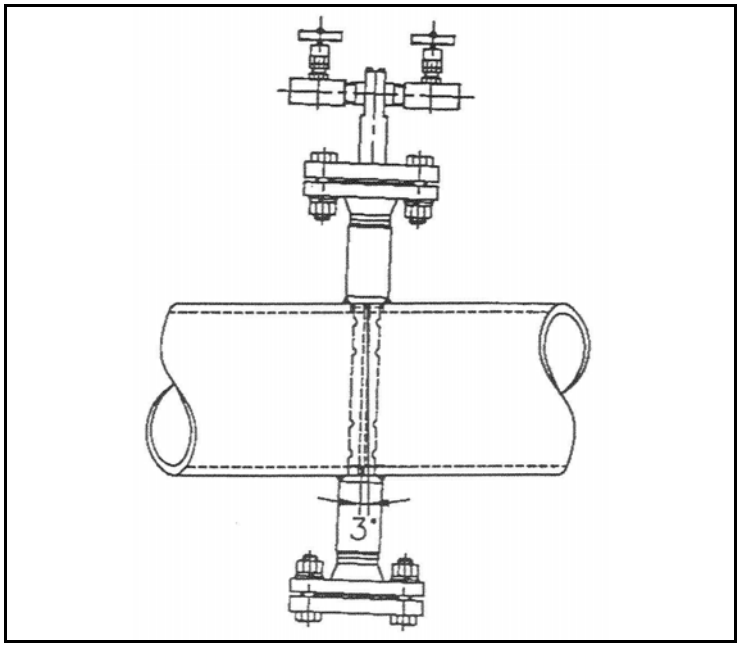


Abb. 7

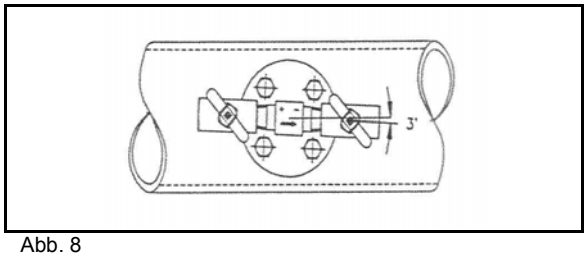


Abb. 8

8.5 Required undisturbed Pipe Run Lengths (in Multiples of D) to achieve an Accuracy of ± 1 %

The accuracy of the measurements with the Itabar-Sensor depends on the development of a stream profile which should be as undisturbed as possible. Therefore, the selection of the installation location within the pipe run is of considerable importance. The following tried and true hints (see table page 11) regarding the required pipe lengths ahead of and behind the sensor are designed to help you in your selection of the most advantageous location.

NOTE

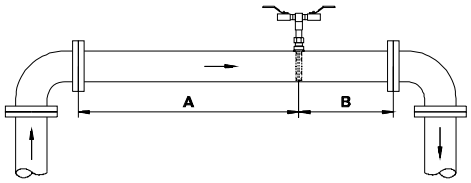
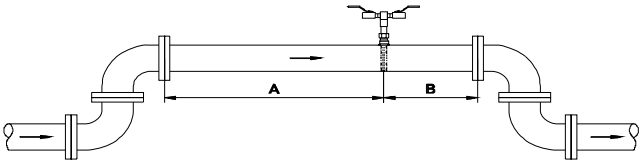
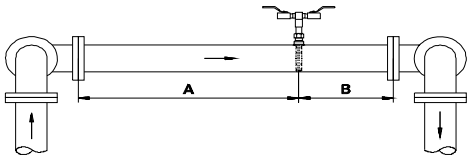
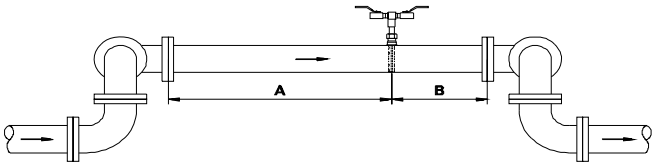
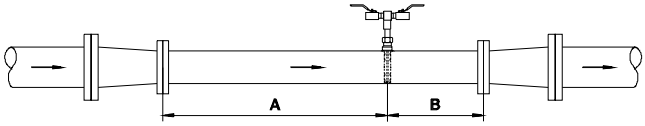
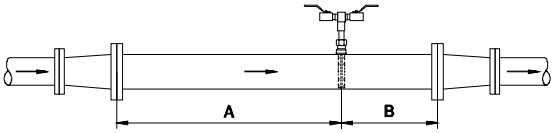
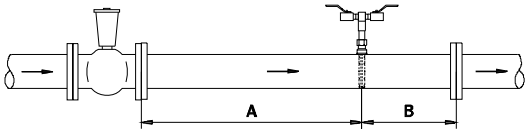
As a general rule, control valves, throttle valves and gate-type valves should be installed behind the sensor.

NOTE

If the recommended straight pipe lengths are not available, the measuring accuracy can be adjusted to the specific conditions of the measuring section by conducting a comparison measurement.

The measurement guarantees that the differential pressure corresponds to the true flow velocity, thereby assuring the specified accuracy.

For details, please contact us.

D = Pipe diameter	A = Upstream	B= Downstream
	7D	3D
	9D	3D
	17D	4D
	18D	7D
Restriction in the pipe run 	7D	3D
Widening in the pipe run 	7D	3D
Control device 	24D	4D

(The pictures show IBR-types, but the values are also valid for IBF.)

9. Installation of the Itabar-Sensor

WARNING

Please observe the general security notes of this manual! Take good care to always wear adequate safety clothes while installing the sensor!

NOTE

It is particularly important to make sure that the distance from the gasket surface to the pipe agrees with the H-dimension you gave in your order (Fig. 9).

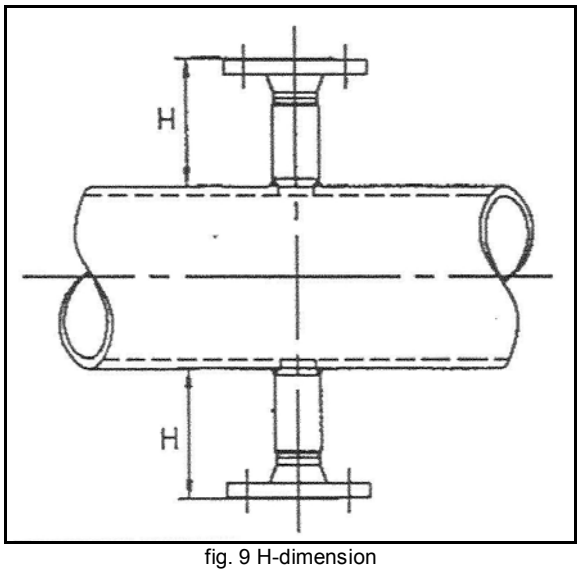


fig. 9 H-dimension

Standard H-Dimension for an Itabar-Flow-Sensor type IBF-100 is 150 mm.

Installation type IBF-100

1.) Drill a hole into the pipe. Size of the hole: inside diameter of the mounting stud.
2.) Tack the mounting stud with 1-2 mm clearance onto the pipe. The bolting holes in the flange have to form an angle of 45° with the pipe axis (fig. 10).

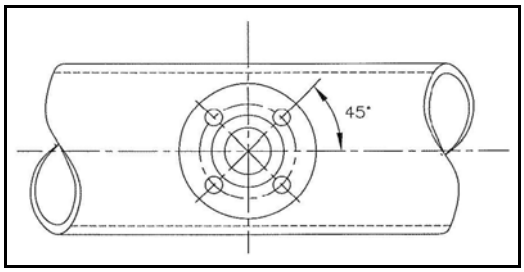


fig. 10

NOTE

If the mounting flange has 8 bolting holes, the stud has to be welded to the pipe in a way that the holes form an angle of 22,5° with the pipe axis (Abb. 11).

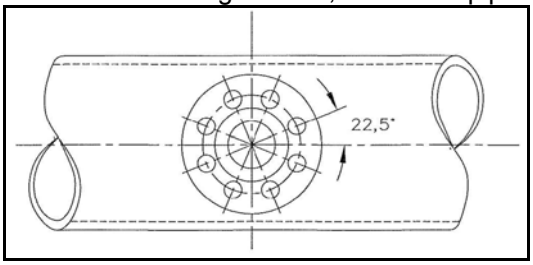


fig. 11

3.) Take care of the H-dimension (fig. 9)!
4.) Check the alignment of the mounting stud.

Installation of the opposite end support:

5.) Take a cord and tie one end around the existing welding stud. Wrap the other end around toe pipe so that it forms a loop around the pipe. Mark the half-way point of the pipe circumference on the pipe.
6.) Take the blind flange with the end support off the second mounting stud.
7.) Drill a second hole at the marked point. Dimension of the hole: inside diameter of the mounting stud.
8.) Tack the second mounting stud with 1-2 mm clearance onto the pipe, analogously item 2.
9.) Take care of the H-dimension (fig. 9)!
10.) Now insert the sensor into the pipe and install the blind flange with end support. Correct the alignment of the mounting studs with observation of the tolerances indicated in chapter 8.4.
11.) Now the final welding of both studs can take place.
12.) After that, the definite installation of the Itabar-Sensor can be done. Place the supplied gasket onto the flange face. Insert the sensor into the mounting stud. Take car that the arrow on the sensor flange points in flow direction. Tighten the bolts and nuts firmly. After that, install the blind flange with end support (Do not forget the gasket!).

10. Installation of the Accessories and the Differential Pressure Transmitter

10.1 Accessories

The instrument valves for the differential pressure lines are pre- installed by the manufacturer, if it is part of the order.
When installing multi- directional valve block, make sure that all bolts are tightened uniformly and opposite bolts are tightened in sequence.

DANGER!
From faulty installation, leakages may occur. Only use undamaged gaskets, which are suitable for your application (regarding pressure, temperature, fluid).

10.2 Differential Pressure (Δp) Transmitter

When measuring dry gases and air, the differential pressure transmitter should always be installed above the Itabar-sensor in order to avoid measurement degradation due to condensation and presence of solid particles (see Fig. 12).
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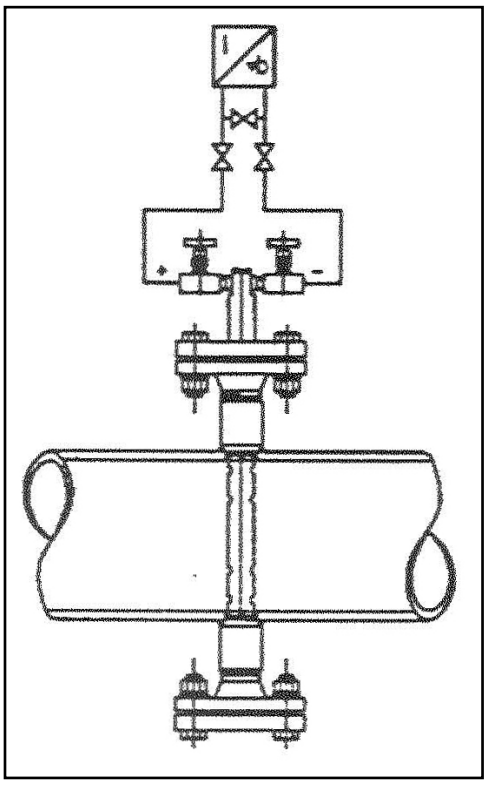


fig. 12

10.3 Itabar-Sensor with Flange Plate

The version with flange plate makes a direct installation of the differential pressure transmitter onto the sensor possible (fig. 13). So the pressure lines and fittings are not needed. The flange plate with a manifold is the ideal combination. It eliminates error sources (like interchanging the differential pressure connections) because it is completely assembled by the manufacturer. Prior to the installation of the Itabar-Sensor, please check if all screws are fastened thightly.

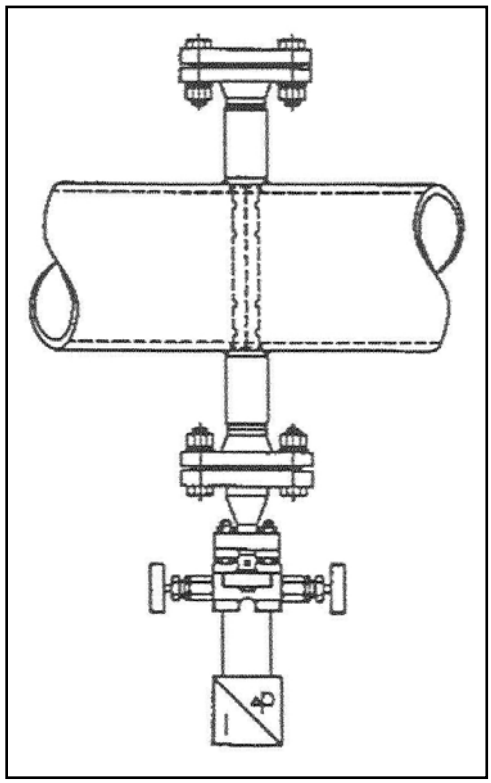


Abb. 13

11. Set-Up

Make sure that

- all installation openings are closed,
- all installed parts are securely bolted together and
- all instrument valves are closed.

Now the pipe can be cleared for the appropriate medium.
IBF: Check all connections for tightness, especially the flanges.
Then open the instrument valves to the Δp-transmitter.

12. Preventive maintenance of the Itabar-Sensors

Itabar-Sensors are insensitive to dirt and soil build-up and therefore nearly maintenance-free. On flue gas applications, a possible obstruction can be solved without de-installation of the sensor either with pressurized air or mechanically.

To clean the sensor with pressurized air, please charge the purge inlets with 6 to 8 bar. While purging, close the valves to the transmitter.

To clean the sensor mechanically, de-install the blind flange, detach the plugs on the chambers and foraminate the chambers with a 6 mm diameter wire.

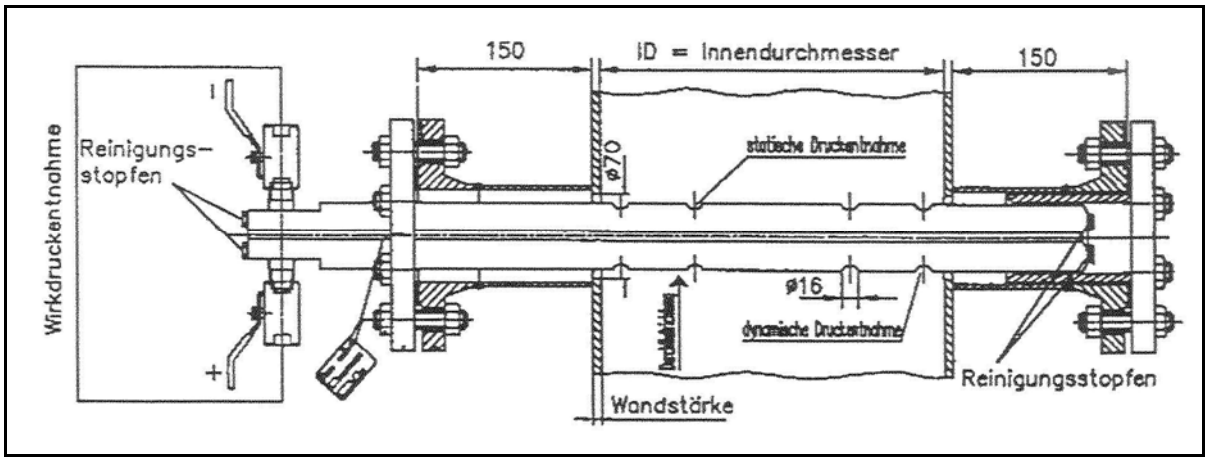
13. Trouble Shooting

If, after the start-up of the Itabar-Sensor, any measuring errors will occur, they may possibly be corrected quite easily:

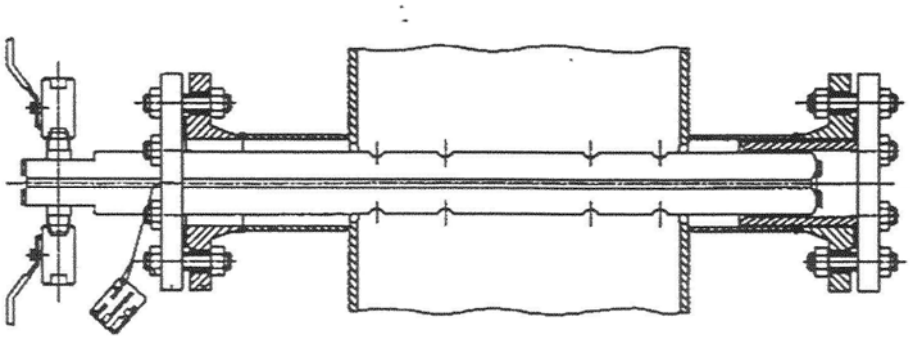
Error:	***Correction:***
No differential pressure indication	Check whether all instrument valves to the Δp-transmitter are opened. Check the alignment of the sensor with the pipe. The arrow on the sensor must point exactly in the flow direction (downstream).

NOTE:

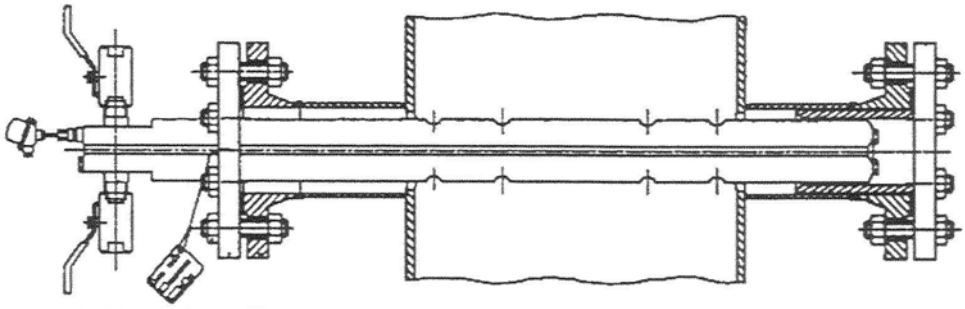
With highly corrosive media it is possible (if the sensor material has been specifically selected for such operating conditions) that a connection between the plus and minus sides has been formed. This can only be checked after removal of the sensor from the pipe. Close the holes in the sensor rod and blow through both minus and plus connections of the sensor (e.G. with pressurized air). If air emerges from the opposite connection, the sensor is defective. In this case, please notify the manufacturer.



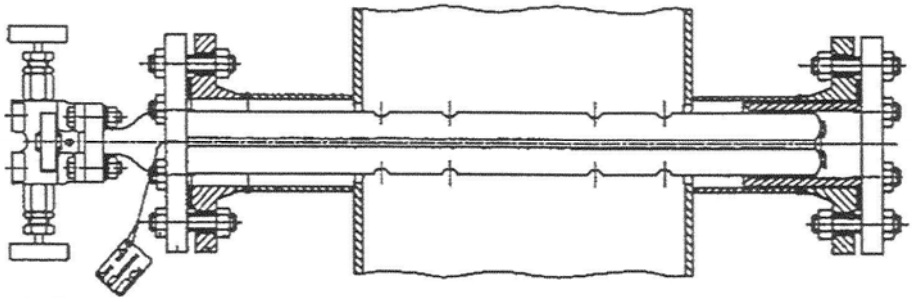
14. Designs of IBF-100



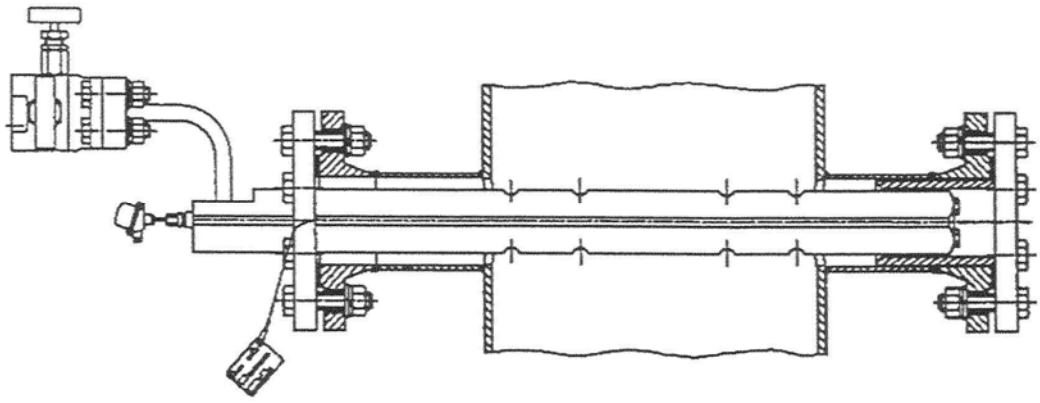
IBF-100



IBF-100 with integrated RTD



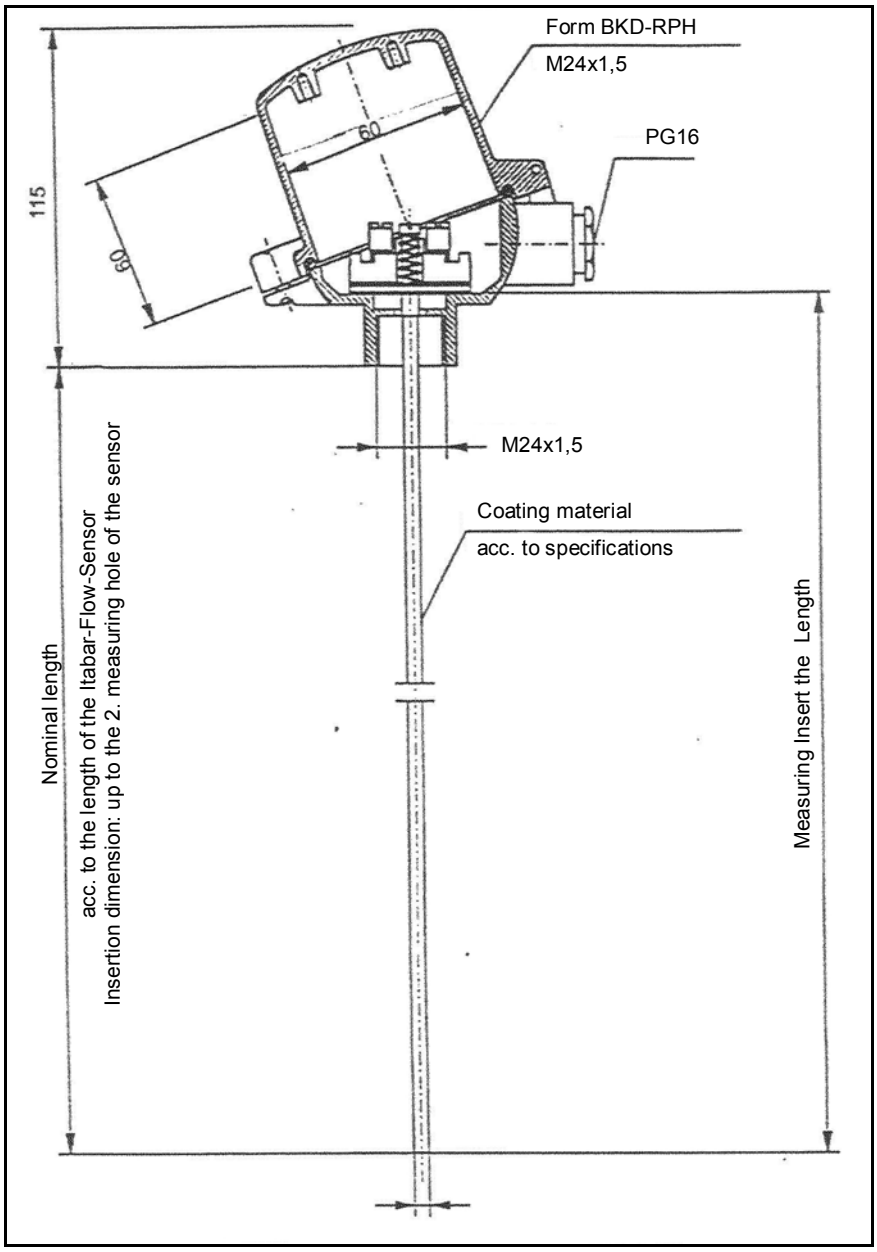
IBF-100 with flange plate for direct mounting of a transmitter



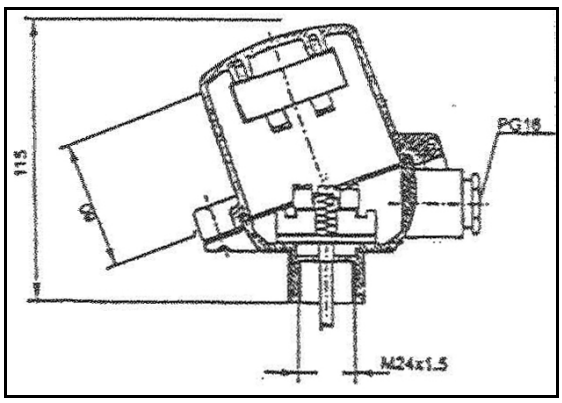
PT100 with flange plate and integrated RTD

15. IBF-100 with integrated PT100 RTD (Resistance Thermometer)

Technische Daten PT100:



PT100 with head transmitter:



Technial Data PT100:

1. **(°C) for measuring inserts**
   Temperature limits
   - ♦ Sensors 1,5 to 3,2 mm: -200...+550°C
   - ♦ EExi, EExd, 1,5 to 3,2 mm: -200…+500°C

2. **Accuracy classes:**
   Resitance thermometers acc. to IEC 751
   - ♦ Class A ± (0,15 + 0,002 [t])
   - ♦ Class B ± (0,3 + 0,002 [t])
   - ♦ Class 1/2 DIN ± (0,15 + 0,002 [t])
   - ♦ Class 1/3 DIN ± (0,1 + 0,002 [t])

3. **Coating of the measuring insert:**
   The sensors (Resistance thermometers (RTDs) and thermo elements (TEs)) are located in compressed MgO-powder, which is coated by a protective metal pipe. The coating is free of pores and can be bended to a limited radius.
   Important: Do not bend the coating in a range of 50 mm from the sensor tip.

4. **Connection block**
   Made from ceramics and fixed to the connection head by two M-4 spring screws (up to 10 mm clearance. Diameters and distance of the screw are according to the head types A and B.

5. **Typical resistance values of the wires inside the measuring inserts +15 to +35°C (for the cable length)**
   For d 3 mm diameter: approx. 0,28 Ω/m

6. **Isolation resistance @ +15 to +35°C**
   ≥ 100 MΩ with U ≤ 100 V DC

7. **Sensing length of the measuring insert:**
   For RTD: max. 40 mm for all diameters of measuring insert.

8. **Response time**
   The values are related to measuring inserts without protective pipes. The response time is the time shift of the sensor reacting on temperature changes:
   - ♦ t 0,5: needed time to reach 50 % of the total temperature change.
   - ♦ t 0,9: needed time to reach 90 % of the total temperature change.

	in water		**in air**	
	approx. 0,2 m/s		approx. 1 m/s	
Meas. insert	t0,5	t0,9	t0,5	t0,9
RTD 3 mm ∅	1,6 s	5,5 s	25 s	86 s

9. **Ansprechzeit 2**
   The values are related to measuring inserts applied in Itabar-Flow-Sensors. The response time is the time shift of the sensor reacting on temperature changes:♦ t 0,5: needed time to reach 50 % of the total temperature change.
   - ♦ t 0,9: needed time to reach 90 % of the total temperature change.

	in water		**in air**	
Meas. insert	approx. 0,2 m/s		approx. 1 m/s	
	t0,5	t0,9	t0,5	t0,9
RTD 3 mm ∅	2,4 s	8,3 s	37,5 s	129 s

10. **Immersion length**
    To avoid mistakes from temperature transfer and temperature radiation, the following minimal immersion lengths are recommended:

Measuring insert	**in liquids:**	**in gases/steam**
RTD 3 mm ∅	45 mm	55 mm

11. **Measuring inserts for explosion proof applications**
    The measuring inserts have to be located in zone1 (Class 1, Div. 1) or zone 2 (Class 1, Div. 2), but not in zone 0. All measuring inserts made for explosion proof applications are supplied with a lable. Once ordering spares for existing installations, always indicate the technical data of the version supplied in the past.

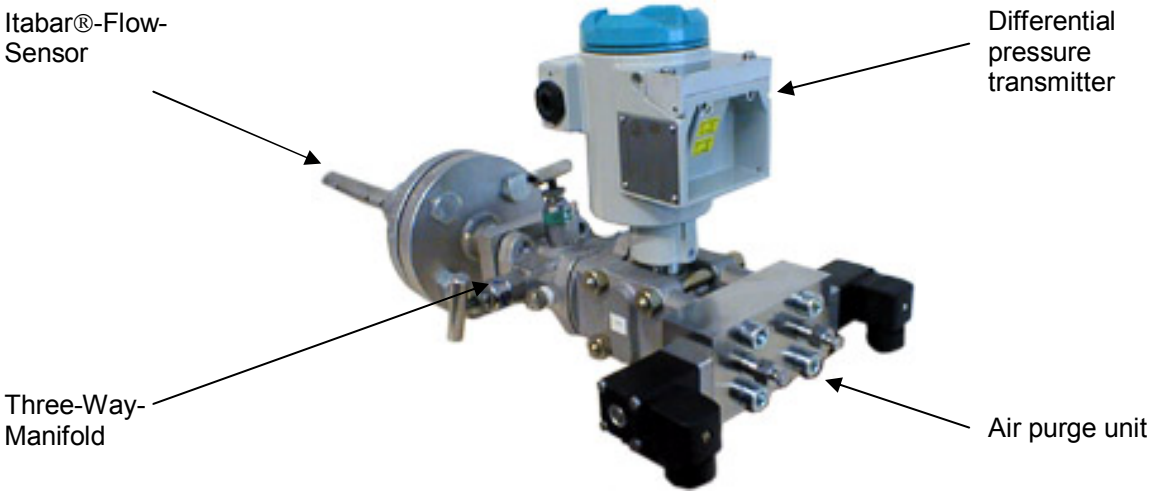
    Protection type „explosion proof“ for EExd version
    The measuring insert alone cannot fulfil the requirements for EExd. The system must contain an EExd connection head with type approved cable gland and a neck pipe with flame barrier acc. to EN 50018.

    Protection type „intrinisc safe“ for EExi-version
    The measuring insert is equipped with one ort wo measuring circuits. They are tested for dielectric stength by loading 500 V AC to the measuring circuits and to the ground inbetween the circuits. The lable of the measuring inserts contain notes for the application in intrinsically safe measuring circuits. The output-sides installed devices are type proof accordingly. Performance loss and warmth loss fulfil the requirements acc. to EN 50020. The connection head is supplied equipped with a terminal for grounding.

12. **Advantages RTD PT100**
    - excellent long-term stability
    - output signal temperature-linear
    - good corrosion resistance
    - high Accuracy

13. **Tolerances as a funciton of the temperture for RTDs (100 Ω) Standard IEC 751**

16. IBF-100 with air-purge unit LSP-compact



Advantages

- simple handling, simple installation
- simple construction (few system components)
- simple control

Description

In the past, regarding a pitot tube in applications contaminated with solids, the sensor had to be de-installed in revolving intervals to clean it to guarantee an optimal measuring result. The option was a complex air purge unit.

The air purge unit LSP compact provides an alternative solution on considerably lower cost.

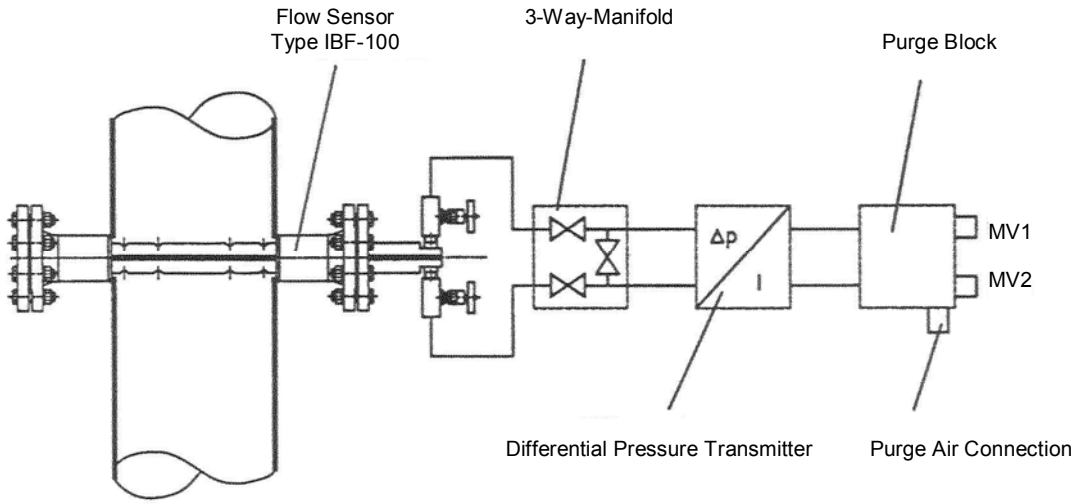
Due to it's compact design (only few system components) the LSP-compact is not error-sensible and very easy to install (see picture above).

The complex control-box-installation is not necessary and the possible storage of spare parts is reduced.

Basically, the LSP-compact is a 2/2-Way-Vavle with direct control. Therefore, the LSP-compact can be controlled by client's relays or SPS.

Also the LSP-control can be done by the Digiflow. purging time, interval and holding time can be programmed according to the process. At the same time the Digiflow keeps the last measured value before the purging action.

Configuration



Installation

The purge block is screwed directly to the differential pressure transmitter, using the supplied screws and gaskets. At the other side the pressure connections are to be mounted. The vent screws of the transmitter are to be screwed into the purge block. So not only the sensor but also the measuring chambers of the transmitter get purged and cleaned from contaminations. Sideways on the purge block there is the purge air connection (standard connection: ½“ NPT). The magnetic valves MV1 and MV2 are operated with 220 V/50 Hz (other supplies optionally possible).

Technical Data:

Standard, non-Ex

Article-no.	:	EJG-21..
Valve type	:	2/2 Way, direct control
Medium	:	Air
Mode of operation	:	NC
Pipe connection	:	¼" NPT
Mounting position	:	each
Nomimal width	:	3 mm
Kv – flow value	:	approx. 0,23 m³/h
Op. pressure difference	:	max. 6 bar
Nominal lift	:	1 mm
Leakage rate	:	bubble tight
Fluid temperature	:	-10 ... + 90 °C
Environmental temperature	:	max. 55 °C
Material valve body	:	Anodized Aluminium or Stainless Steel
Material inside parts	:	Stainless Steel
Material gaskets	:	FPM
Nominal voltage	:	AC: 24 V, 110 V or 220 V / 50 Hz DC: 24 V
Protection class	:	without
On-time	:	100%
Ingress Protection	:	IP 65
Electrical connection	:	nach DIN 43650
Consumption	:	21 VA AC (Start) 12 VA/ 8 W (Operation)
Weight	:	approx. 2,7 kg

EEx ed-Ausführung

Article-no.	:	EJG-22..
Valve type	:	2/2 Way, direct control
Medium	:	Air
Mode of operation	:	NC
Pipe connection	:	¼" NPT
Mounting position	:	each
Nomimal width	:	2 mm
Kv – flow value	:	approx. 0,23 m³/h
Op. pressure difference	:	max. 5 bar
Nominal lift	:	1 mm
Leakage rate	:	bubble tight
Fluid temperature	:	-10 ... + 100 °C for temperature class T6
Environmental temperature	:	-30 ... + 60 °C (for single mounting)
Surface temperature	:	max. 135 °C
Material valve body	:	Anodized Aluminium or Stainless Steel
Material inside parts	:	Stainless Steel
Material gaskets	:	FPM
Nominal voltage	:	UC: 230 V / 50 Hz
Protection class	:	EEx M II 2G/D T4; EEx EM II 2G/D T4 (PTB 00 ATEX 2129X)
On-time	:	100%
Ingress Protection	:	IP 65
Electrical connection	:	press fitted cable (3000 mm)
Consumption	:	7 Watt
Weight	:	approx. 2,7 kg

Besides the products covered by this brochure, Intra-Automation GmbH also manufactures other high-quality and high precision instruments for industrial measurement tasks. For more information, please contact us (contact details on the backside of this brochure).

Flow measurement

Itabar®-Flow Sensor

IntraSonic IS210 Ultrasonic Flow Meter

Level measurement

ITA-mag. Level Gauge

MAGLINK Level Indicator

Other Measurement Tasks:

DigiFlow Flow and Level Computers

IntraCon Digital Controllers

IntraDigit Digital Indicators / Meters

INTRA-AUTOMATION

MESS- UND REGELINSTRUMENTE / MEASUREMENT AND CONTROL

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