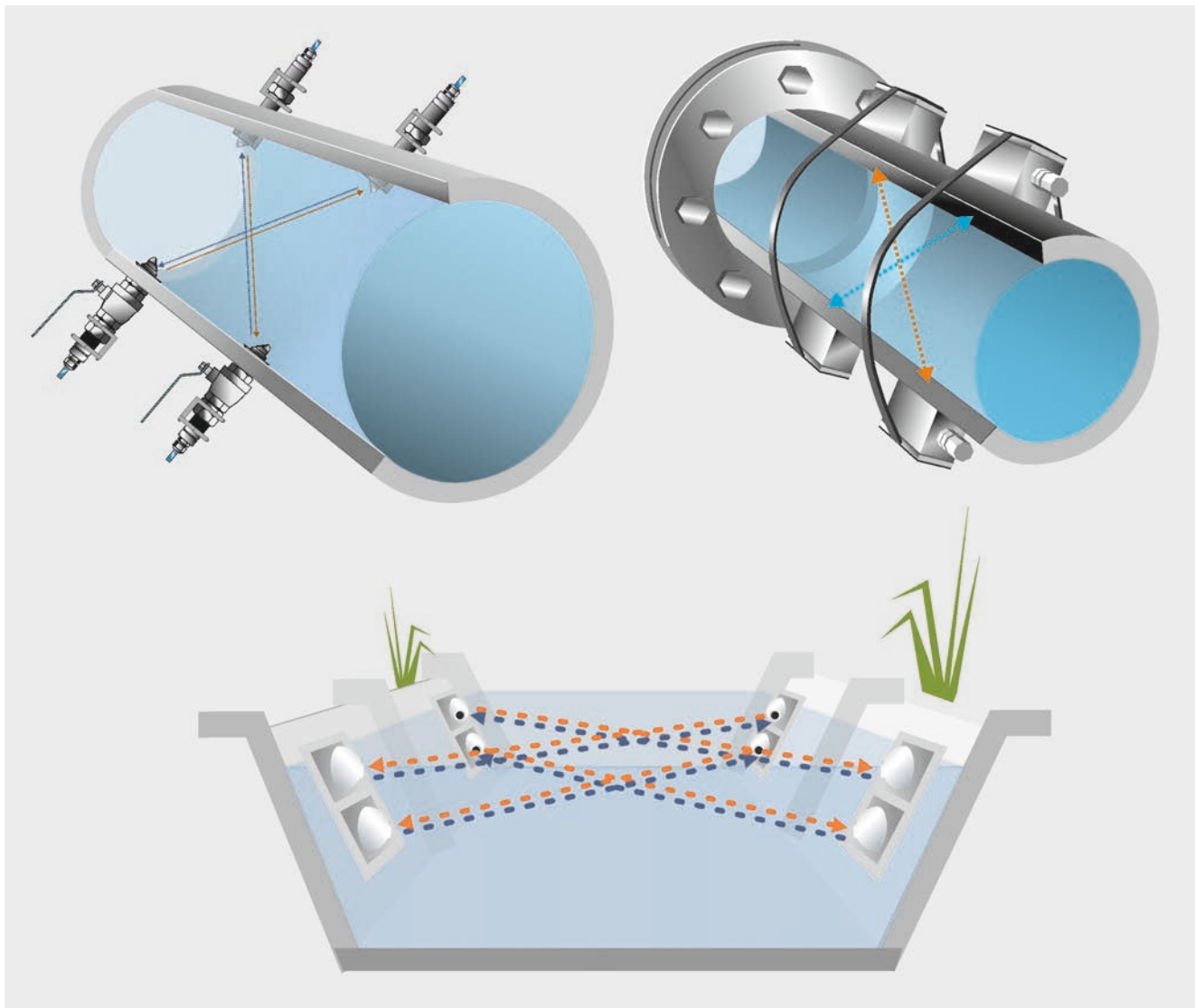


Mounting Instruction Transit Time Sensors



Revised Instruction Manual

Document Revision 04 / 23.03.2023

Original Instruction Manual: German / Rev. 04 / 31.01.2023

**Always use the mounting instructions as a unit with the
Technical Description of the transit time sensors**

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Translation

If the device is sold to a country in the European Economic Area this instruction manual must be translated into the language of the country in which the device is to be used.

Should the translated text be unclear, the original instruction manual (German) must be consulted or a member company of the NIVUS group must be contacted for clarification.

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Names

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Revision History

Rev.	Modifications	Responsible Editor	date
04	Note on the association with the technical description added on the cover sheet and in chapter "1 About this Manual"; Various chapters removed, as these are already included in the associated Technical Description Transit Time Sensors. Pipe sensor NIS0 added everywhere in TSP0; ball sensors NOS0V2H200 and NOS0H2V500 included; addresses of NIVUS locations updated; Chap. "1 About this Manual", "3 Special safety and Precautionary Measures", "4 Duties of the Operator" and "6 Overview Sensors" changed/updated; Chap. "10.9 Clamp-On Sensors Type NIC-CO" revised and supplemented; Chap. "11.5 Ball Sensors" and "14 Holder Bracket for Ball Sensors" added; Chap. "15 Welding Nozzle for Pipe Sensors" and "20 Fastening system for NIC-CO clamp-on sensors" revised and supplemented; minor changes in wording and layout	MoG	23.03.2023
03	Address NIVUS France updated; change history added; information and mounting accessories for sensors NIC0 K1L removed; mounting sensor TSP0 added; individual text corrections	MoG	12.11.2019
02	Mounting device for sensors NIC-CO01 added; layout revised	MoG	14.08.2018
01	---	---	---
00	New Creation	DMR	23.01.2013

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General

1 About this Manual

**Important**

READ CAREFULLY BEFORE USE.

KEEP IN A SAFE PLACE FOR LATER REFERENCE.

These **mounting instructions** are for the installation of the runtime sensors or their connection to NIVUS transmitters/data loggers and are intended exclusively for qualified personnel.

The mounting instructions are a supplement to the **Technical Description Transit Time Sensors**, which contains all basic information on the transit time sensors, such as explosion protection, technical data, dimensions, maintenance and repair as well as topics on warranty and liability, intended use, delivery, storage and transport, declarations of conformity and type examination certificates and much more.

Both instructions for the transit time sensors must be necessarily used as a unit.

Read this instruction manual carefully and completely prior to installation and commissioning since it contains relevant information on the products. Observe the notes and particularly follow the warning notes and safety instructions.

If you should have problems to understand information contained within this instruction manual either contact a member company of the NIVUS group or one of the distributors for further support. The member companies of the NIVUS group cannot be held responsible for damage to persons or material due to incorrectly understood information in this instruction.

- The **wiring diagrams** for sensors, transmitters and data loggers are listed in the respective operating instructions / technical descriptions.
- The description of the **operation** of the transmitters/data loggers is part of the respective operating instructions.




1.1 Applicable Documentation

For the installation and operation of the complete system extra instruction manuals or technical descriptions may be required apart from this manual.

- Technical Description Transit Time Sensors
- Instruction manual for the respective flow measurement transmitter/data logger

These manuals are provided with the respective devices or sensors or are available as download on the NIVUS homepage.

1.2 Signs and Definitions used

Representa- tion	Meaning	Remarks
	(Action) Step	Execute action steps. Should action steps be numbered observe the specified order of the steps.
	Cross-reference	Refers to further or more detailed information
	Refers to a documen- tation	Refers to an accompanying documentation
>Text<	Parameter or menu	Indicates a parameter or a menu that is to be selected or is described

Tab. 1 Structural elements within the manual

Safety Instructions

2 Used Symbols and Signal Words

2.1 Information on the Valuation of Accident Levels



The general warning symbol indicates the risk of personal injuries or death. In the text section the general warning symbol is used in combination with the signal words described below.

DANGER

Warning in high degree of risk



Indicates a high-risk, **imminently** hazardous situation which will result in death or serious injury if not avoided.

WARNING

Warning in medium degree of risk and personal injury



Indicates a **possible** danger with medium risk which may result in a life-threatening situation or (severe) bodily injury if not avoided.

CAUTION

Warning in personal injury or property damage



Indicates a possible danger with moderate risk which may result in minor or moderate personal injury or property damage if not avoided.

WARNING

Danger by electric voltage



Indicates a medium-risk, **imminently** hazardous situation caused by electric shock which will result in death or (serious) injury if not avoided.



Important Notice

Contains information that needs to be highlighted.
Indicates a potentially harmful situation that may damage the product or something in its environment if not avoided.



Note

Contains tips or information.

2.2 Warning Notices on the Device (optional)



General Warning Notice

This symbol refers the operator or user to content in this manual. Consideration of the information contained herein is necessary to maintain the protection provided by the unit for installation and in operation.



Protective earth connection

This symbol refers to the protective conductor terminal of the device. Depending on the type of installation, the unit may only be operated with a suitable protective earth connection in accordance with applicable laws and regulations.

3 Special safety and Precautionary Measures

When working with the NIVUS equipment, the following safety and precautionary measures must be observed and followed generally and at all times. These warnings and notes are not repeated for each description within the document.

WARNING



Check danger due to explosive gases and avoid electrostatic charge

Before starting assembly, installation and maintenance work, be sure to check that all regulations on safety at work have been observed and that there is no possible risk of explosive gases. Use a gas warner for the check.

When working in the sewer system, make sure that no electrostatic charge can occur:

- *Avoid unnecessary movements to reduce the building-up of static charges.*
- *Discharge any static electricity present on your body before you start installing the sensor.*

Disregarding may result in personal injury or damage to the system.

WARNING



Germ Contamination

Particularly due to the use of the sensors in the waste water sector, parts can be contaminated with dangerous germs. Therefore, appropriate precautions must be taken when coming into contact with cables and sensors.

Wear protective clothing.

WARNING



Observe Occupational Safety Regulations!

Before and during mounting works, compliance with all work safety regulations must always be ensured.

Disregarding may lead to personal injury.

WARNING



Do not disable Safety Devices!

It is strictly forbidden to disable the safety devices or to change their mode of operation.

Disregarding may result in personal injury or damage to the system.

WARNING



Disconnect the System from Mains Power

Disconnect the instrument from mains power (if connected) before you begin maintenance, cleaning and/or repair works (qualified personnel only).

Disregarding may lead to electric shock.



Commissioning only by qualified Personnel

The entire measuring system may only be installed and commissioned by qualified personnel.

3.1 Special markings on the device

The labels on the sensor cable are part of the delivery and must not be removed.

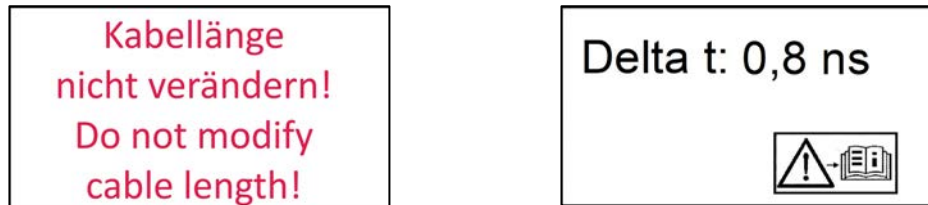


Fig. 3-1 Labels on the sensor cable

⇒ For more information on changing the cable length, see "Technical Description Transit Time Sensors".

4 Duties of the Operator



Strictly observe and comply with guidelines and requirements

In the EEA (European Economic Area), the national transposition of the Framework Directive (89/391/EEC) as well as the associated individual directives and, in particular, the Directive (2009/104/EC) concerning the minimum safety and health requirements for the use of work equipment by workers at work, as amended, must be observed and complied with.

In Germany, the Ordinance on Industrial Safety and Health must be complied with.

Obtain the local operating licence and observe the associated conditions. In addition, you must comply with environmental protection requirements and local legal requirements for the following:

- Safety of personnel (accident prevention regulations)
- Safety of work equipment (protective equipment and maintenance)
- Product Disposal (Waste Management Act)
- Materials Disposal (Waste Management Act)
- Cleaning (Cleaning Agents and Disposal)

Connections

As the operator, before activating the device, make sure that the local regulations (e.g. for the electrical connection) have been observed during installation and commissioning.

Keep the Instruction Manual for future Reference

Keep the instruction manual in a safe place and ensure that it is always available and can be consulted by the user of the product.

Hand over the Instruction Manual

When selling the sensors, this instruction manual must be handed over with them. The manual is part of the standard delivery.

5 Requirements for the Personnel

Installation, commissioning and maintenance may only be carried out by personnel who fulfil the following conditions:

- Qualified personnel with appropriate training
- Authorisation by plant operator



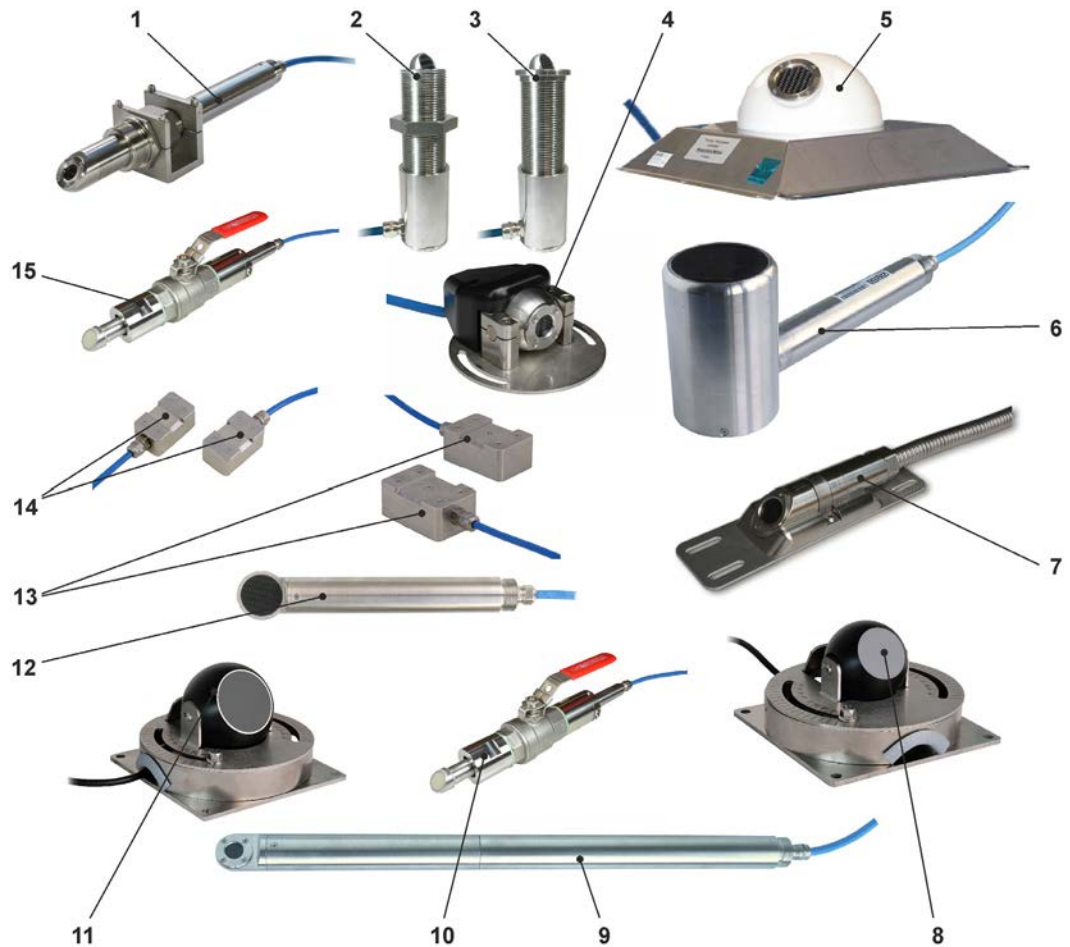
Qualified Personnel

in the sense of these instructions or the warnings on the product itself are persons who are familiar with the installation, assembly, commissioning and operation of the product and who have the qualifications appropriate to their job, such as

- I. Training and instruction or authorisation to switch circuits and devices/systems on and off, to earth and to label them in accordance with the standards of safety technology.*
 - II. Training or instruction in accordance with safety technology standards in maintenance and use of appropriate safety equipment.*
 - III. First Aid Training*
-

Product Specification

6 Overview Sensors



- 1 Flow velocity pipe sensor Type *NIS-V200R* (1 MHz)
- 2 Flow velocity screw-in sensor Type *NOS-V2E* (1 MHz)
- 3 Flow velocity plug-in sensor Type *NOS-V2S* (1 MHz)
- 4 Flow velocity ball head sensor Type *NOS-V20BS* (1 MHz) (with holder, shown without fastening plate and nuts)
- 5 Flow velocity hemisphere sensor Type *NOS-V30BS* (1 MHz)
- 6 Flow velocity rod sensor Type *NOS-V40* (200 kHz)
- 7 Flow velocity wedge sensor Type *NIS-V280KS* (1 MHz)
- 8 Flow velocity ball sensor Type *NOS0H0V500* (500 kHz) (with holder)
- 9 Flow velocity rod sensor Type *NOS-V200* (1 MHz)
- 10 Flow velocity pipe sensor Type *TSP0V200* (1 MHz)
- 11 Flow velocity ball sensor Type *NOS0H0V200* (200 kHz) (with holder)
- 12 Flow velocity rod sensor Type *NOS-V300* (1 MHz)
- 13 Clamp-on sensor pair Type *NIC-CO50* (500 kHz)
- 14 Clamp-on sensor pair Type *NIC-CO01* (1 MHz)
- 15 Flow velocity pipe sensor Type *NIS0V200* (1 MHz)

Fig. 6-1 Overview

Mounting and Fastening of Sensors

7 General Provisions for Sensor Fastening

Before starting the installation work, it is essential to read and observe the following safety instructions.

Disregarding these safety instructions may result in interference with the measurements. NIVUS expressly point out that all permits and work regulations must be obtained or observed.

WARNING



Security Measures

Before starting installation works, be sure to check that all regulations on safety at work have been observed and that there is no possible risk of explosive gases. If necessary, take the necessary measures to avert danger.

Disregarding may lead to personal injury.

CAUTION



Occupational safety regulations for the use of divers

The use of divers requires the observance of special occupational safety regulations. This deployment must be prepared separately and the according approvals must be obtained from the appropriate bodies.

A contracted installation company must have the appropriate expertise and valid approvals for underwater installation.

Disregarding may lead to personal injury.



Expert Knowledge Standards

Prerequisites for a correct and safe measurement place selection and sensor installation in water bodies or rivers are professional competence and a safe handling of the standards DIN EN ISO 748, DIN EN ISO 6416 and the gauging regulations Annex D (gauging regulations only valid in Germany).

Expertise in ultrasonic measurement systems

The executing company must have extensive expertise and sufficient experience in the installation and commissioning of ultrasonic measurement systems. Compared to applications with full filling, applications with partial filling are usually more complex and require much more experience. If this experience is not available to a sufficient degree, contact the NIVUS commissioning service or an authorised specialist company to be on the safe side.

Permission by the responsible authority(ies)

Prior to installing sensors on bridge piers, embankments, groynes, etc., permission must be obtained from the competent authority(ies) for the laying of cables and the operation of the installations in public waters.

8 Mounting Information

The following information applies in large part to all sensors, although there are differences in one or the other sensor type. A distinction must be made between wetted and non-wetted sensors in the same way as for applications with fully filled and part filled pipes, channels and flowing water.

Clamp-on sensors, for example, are used with full filled pipes and are not wetted because they are mounted outside the pipe. In these cases, the flow conditions can be largely ignored for the fastening material.

- Use only non-corrosive fastening material.
- Fasten the inserted sensors permanently and reliably so that the flow velocity sensor faces of each path are exactly aligned against each other.
- The optionally supplied fastening material is designed for normal flow conditions at the measurement place. In waters or canals with very high flow velocities, other conditions apply. Select the mounting material here so that the sensors can withstand all the mechanical loads that occur at the measurement place.
- In case of increased load, an additional flow protection in front of the sensors or a lowered mounting of the sensors is to be provided for mechanical protection.

The design for mounting the sensors must ensure the following points:

- The directional adjustment in the horizontal plane should be independent of the adjustment in the vertical plane.
- When aligned, an accurate indication with a permissible deviation of $\pm 1^\circ$ of the direction above the water surface (e.g. by using a transportable device).
- A $\pm 1^\circ$ accurate alignment in the vertical plane.
- Easy removal of the sensors for maintenance or cleaning purposes, eliminating the need for divers or special equipment.
- If practical, no re-alignment should be necessary after maintenance has been carried out.

9 Selecting Calming Sections

9.1 General Conditions

Proper hydraulic conditions are a prerequisite for a functioning measurement. Therefore, the required hydraulic calming sections must be carefully selected.

- For measurements in open channels and water bodies, the measurement place should have a defined constant flow cross-section and have a well-defined flow profile with a flow velocity that is as constant as possible.
The measurement place should generally be constructed according to DIN EN ISO 748, DIN EN ISO 6416 and the gauging regulation Annex D valid in Germany.
- Avoid falls, bed jumps, fixtures, channel profile changes, slope changes or lateral supply lines directly upstream or downstream the measurement.

The drawings Fig. 9-7 to Fig. 9-11 provide examples on well-suited, less suitable and problematic applications. They serve to illustrate suitable measurement places, but also any critical hydraulic conditions that may prevail.

9.1.1 Support in the selection/assessment of the measurement place

If in doubt when selecting or assessing the planned measurement place, contact your NIVUS representative or the internal sales department (sales@nivus.com) at NIVUS GmbH in Ep-pingen.

The following documents must be provided for the assessment of the measurement place:

- Sketches or drawings
- Photos of the planned measurement place

9.2 Conditions in closed Pipes and Canals

- When measuring in pipes, select the measuring section so that there are no deposits (sand, debris, sludge, etc.) in it under normal operating conditions.
- From a filling level of about 80 % of the nominal diameter, closed pipes tend to temporarily block. In order to avoid pulsations in the measurement section associated with this case, the required diameter must be designed in such a way that a filling level of 80 % is not exceeded in the pipe, regardless of Q_{\min} or Q_{\max} at standard discharges (2 QTW).
- Avoid changes in slope within the measurement section.
- The inlet section must be at least 5x DN, the outlet section must be at least 2x DN. In case of changes or disturbances of the hydraulics and the resulting disturbance of the flow profile, longer calming sections may also be necessary.

9.3 Conditions in Water Bodies and open Canals

In water bodies, additionally pay attention to the following criteria:

- The river bed should have a stable formation and no sediments or scouring (carved swirl holes).
- The bank should have a defined shape and a stable formation and not be prone to change.
- There should be no herbaceous plumes, stones, piles, bed jumps, thresholds, etc. within the measurement path.
- The measurement place must not be set up below cooling water intakes or oxbow tributaries (temperature gradient).
- Any silt, sludge or sediment that may occur must not affect the ultrasonic path.

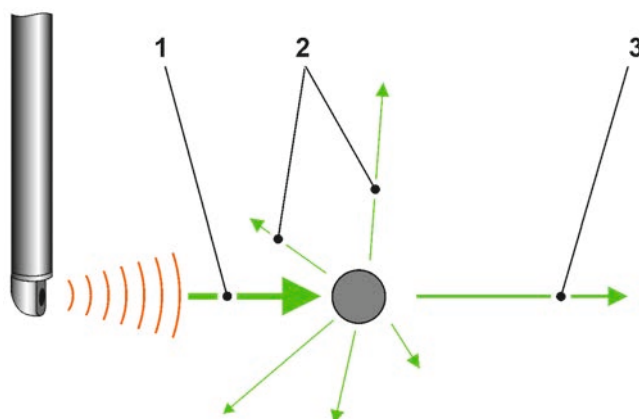
9.4 Influences on the Flow Velocity Measurement

Suspended Solids

If an ultrasonic signal is transmitted through water, part of the energy of the ultrasonic waves is lost. This attenuates the signal. This attenuation means that the intensity of the received signal decreases compared to the output signal. If the attenuation of the signal becomes too high, measurement failure may occur.

The attenuation of the ultrasonic sound waves is due to two mechanisms:

- Friction:
Conversion of acoustic energy into frictional heat due to the viscosity of water.
- Scattering:
When hitting a solid particle (suspended solid) in the water, part of the acoustic energy is scattered.



1 Transmission Signal

- 2 Scattering due to Particles
- 3 Attenuated Signal

Fig. 9-1 Signal attenuation due to suspended solids (scattering of energy) (principle)

Air Bubbles

Air bubbles are introduced into the water below weirs, for example, during free overflow. Oxygen-producing plants or foul gases ascending from the bottom of the watercourse attenuate the acoustic signal.

In strong sunlight, the measurement can therefore be disturbed by biological oxygen. For example, the measurements can stop during the day and start again after sunset.

The propeller water from ships also interrupts the propagation of sound.

Temperature and Salinity

The velocity of sound in water changes due to density differences caused by the temperature or salinity gradient. When there is a high temperature difference between air and water, energy exchange takes place at the water surface. This energy exchange creates a temperature gradient in the water that deflects the acoustic signal from its normally horizontal propagation. In the worst case, this interference is so great that the signal no longer reaches the receiving sensor.

Salinity gradients can produce a similar effect.

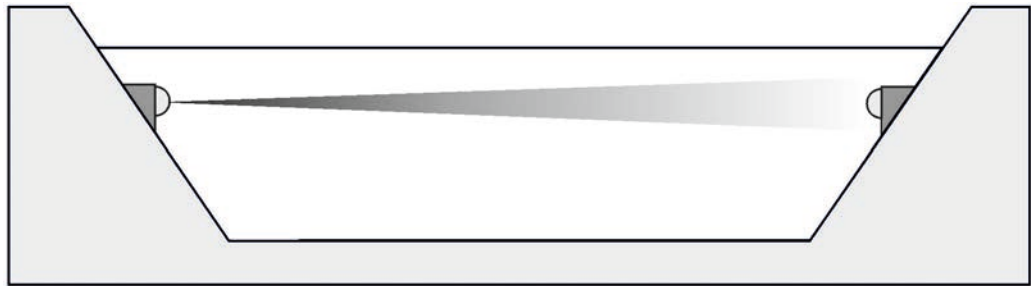


Fig. 9-2 No vertical difference in density (principle)

Temperature changes of 1 °C/m or more occur primarily in slow-flowing waters at the water surface. The temperature changes reach to a depth of approx 0.5 m. In the water layers below, the temperature changes are less strong.

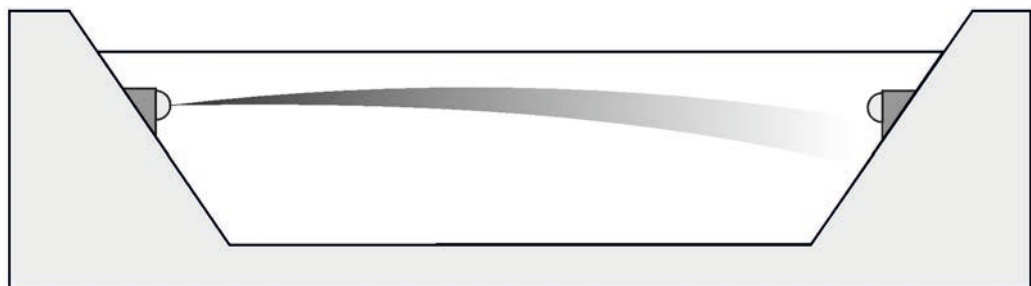
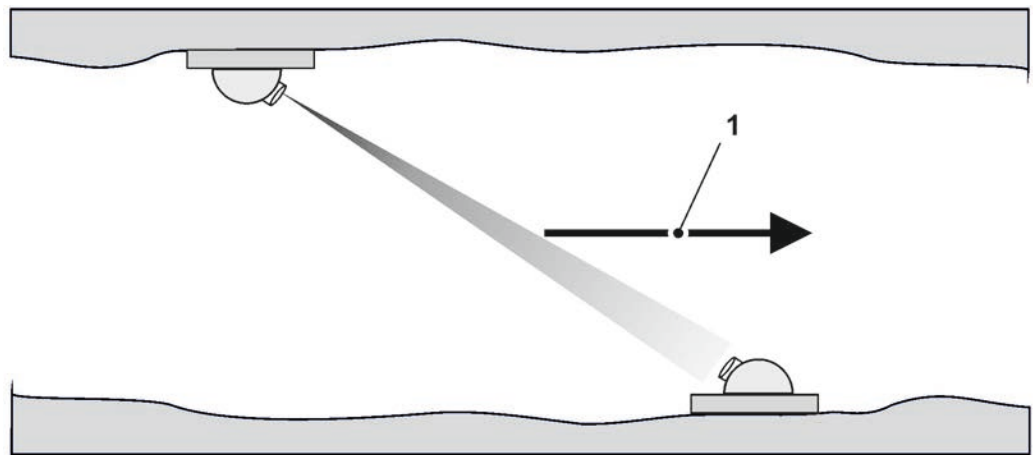


Fig. 9-3 Significant vertical density difference due to solar radiation (principle)



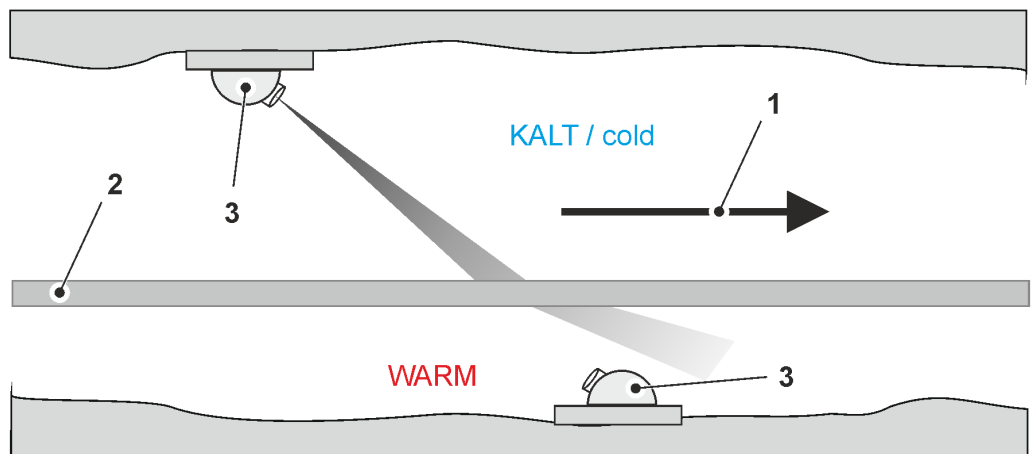
Fig. 9-4 Extreme vertical density difference due to salinity (principle)

Be aware of temperature changes that occur at cooling water intakes and at points where significantly warmer water flows from an oxbow tributary.



1 Flow direction

Fig. 9-5 No horizontal difference in density (principle)



1 Flow direction
2 Temperature gradient
3 Sensors

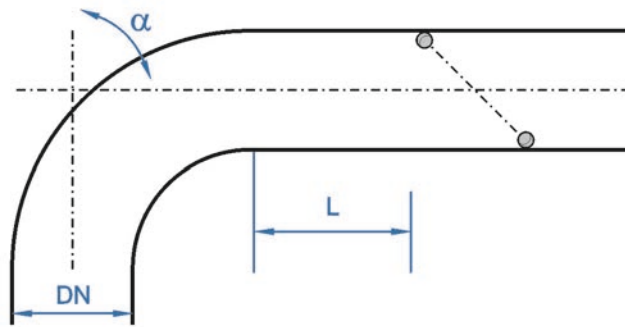
Fig. 9-6 Horizontal density difference due to inlet of warmer water (principle)

9.5 Sensors in partial fillings



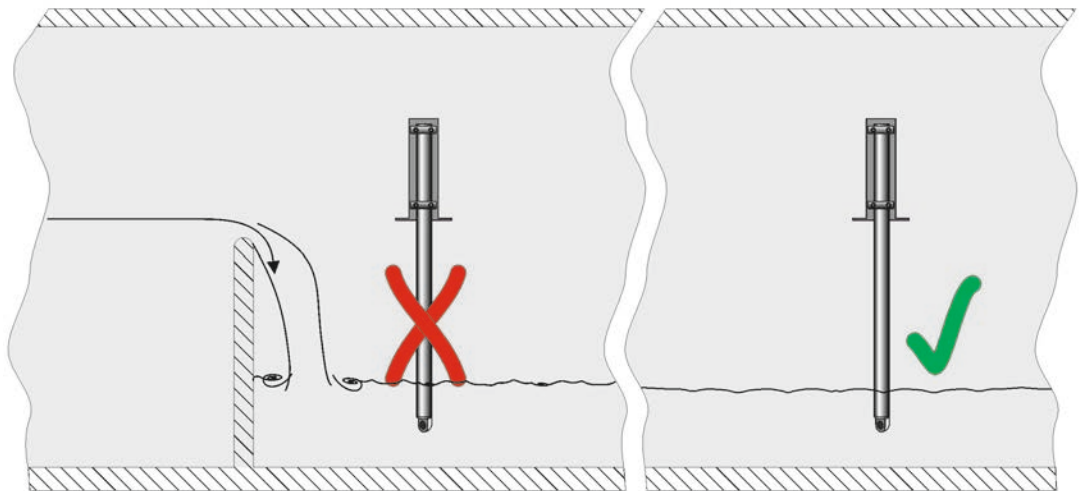
Applicability of Examples

The examples described apply in each case to rod, (hemisphere) ball or wedge sensors.



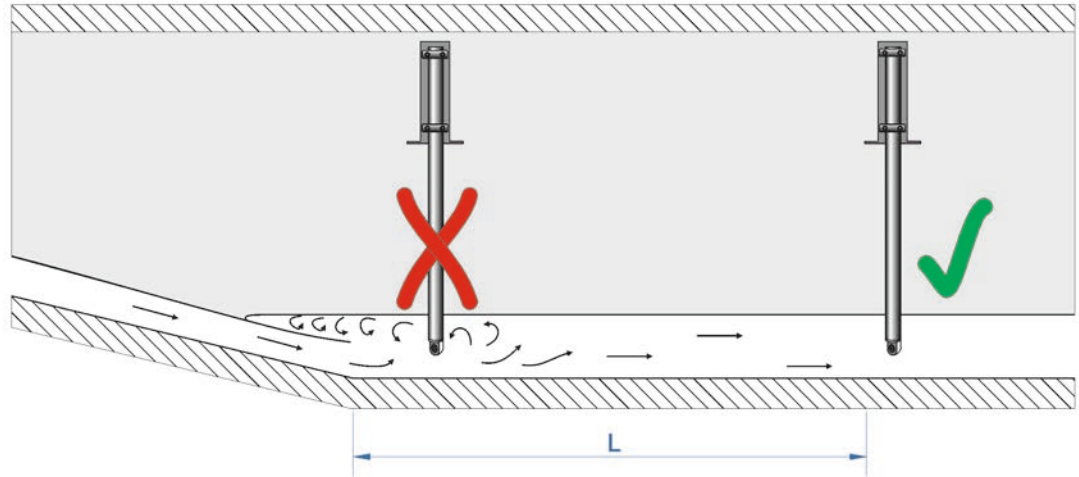
$\alpha < 15^\circ$	$v < 1 \text{ m/s}$ $L > \text{min. } 3x \text{ DN}$	$v > 1 \text{ m/s}$ $L > \text{min. } 5x \text{ DN}$
$\alpha \leq 45^\circ$	$L \geq \text{min. } 5x \text{ DN}$	$L \geq \text{min. } 10x \text{ DN}$
$\alpha \leq 90^\circ$	$L \geq \text{min. } 10x \text{ DN}$	$L \geq \text{min. } 15...20x \text{ DN}$

Fig. 9-7 Position Sensor behind curves or bends (principle)



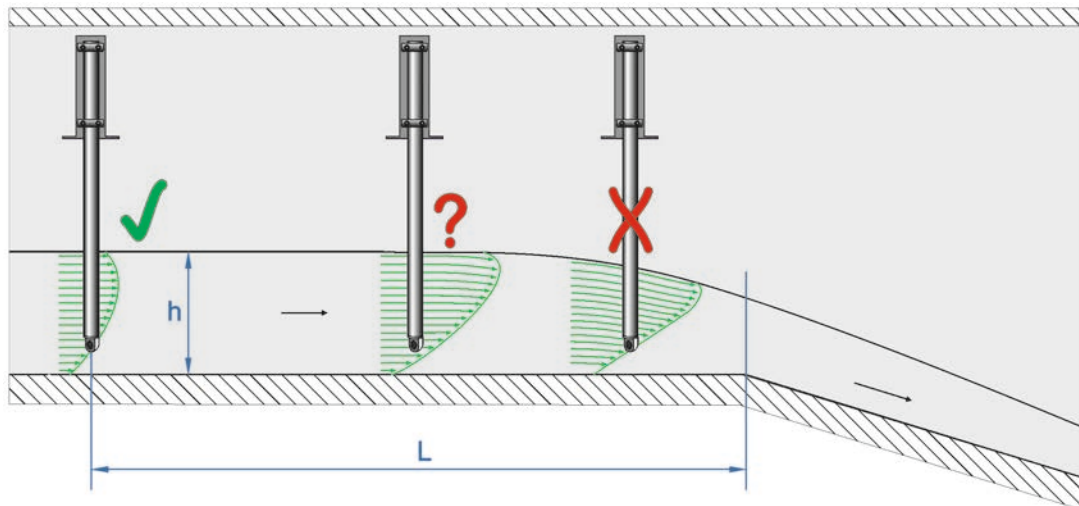
- ✘ = Error! Undefined flow conditions
- ✓ = Distance sufficient for even flow (depending on application 10...50x DN)

Fig. 9-8 Measuring behind fall – eddying (principle)



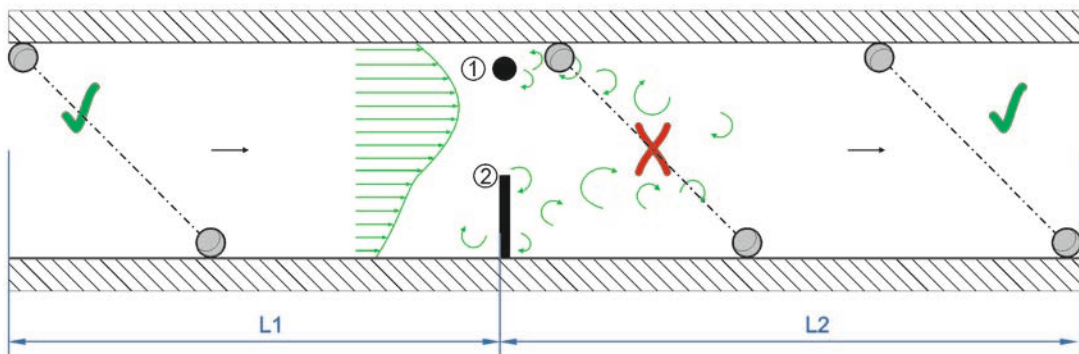
- ✗ = Error! Change in slope = change of flow profile
- ✓ = Distance; depending on slope and flow velocity value
L = min. 20x DN

Fig. 9-9 Error due to change in slope (principle)



- ✗ = Error! Transition from flowing to shooting
Faulty level and velocity measurement
- ? = Critical measurement point, not recommended!
Beginning of the jet lowering
- ✓ = Distance L = min. 5x h_{max} at installation place

Fig. 9-10 Error due to changing flow profile upstream of change in slope or fall (principle)



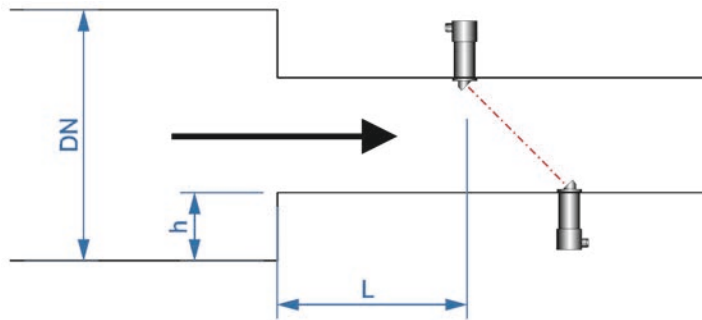
- 1 = Fixtures

- 2 = Obstruction
- h_{max} = Maximum filling level
- x = Error due to eddying!
- ✓ = Distance L1 (upstream of obstruction) = min. $5x h_{max}$
Distance L2 (downstream of obstruction) = min. $10x h_{max}$
in flow velocities >1 m/s

Fig. 9-11 Error due to fixtures or obstructions (top view) (principles)

9.6 Sensors in full pipelines

These installation recommendations apply to pipe sensors and clamp-on sensors.

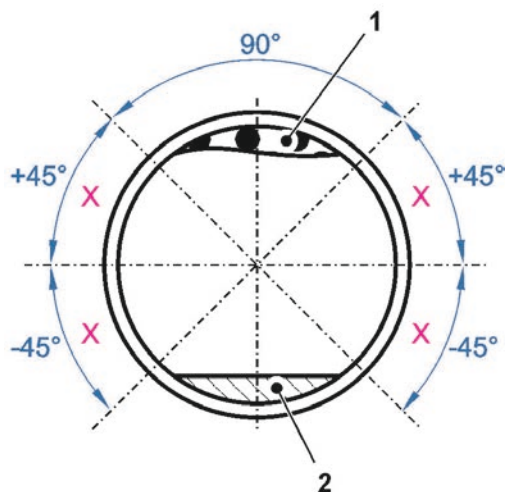


- | | |
|--------------------|------------------------------|
| $h \leq 5\%$ of DN | $L \geq \text{min. } 3x$ DN |
| $h > 5\%$ of DN | $L \geq \text{min. } 5x$ DN |
| $h > 30\%$ of DN | $L \geq \text{min. } 10x$ DN |

Fig. 9-12 Sensor position behind profile changes (principles)

In the case of **horizontal pipes**, the top and bottom of the pipe should be avoided as mounting locations (because of the risk of silting and air bubbles that could cause the measurement to fail).

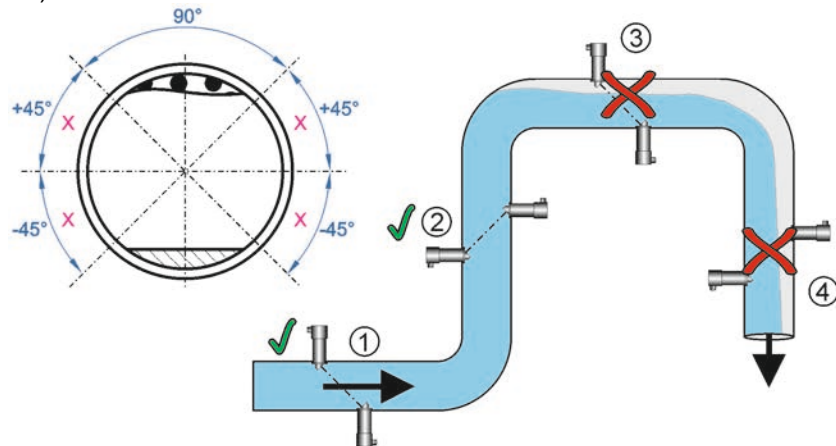
NIVUS recommends a mounting angle of $-45^\circ \dots +45^\circ$ to the horizontal.



- X = Recommended sensor mounting area
- 1 = Risk of air bubbles
- 2 = Risk of silting/sludge

Fig. 9-13 Recommended installation angles for horizontal pipes

With **vertical pipelines**, the dangers of sludge/air bubbles forming on the sensor do not occur. In this case, the installation location can be selected as desired. A correct and reliably functioning measurement is only possible with full filled pipelines. Therefore, installations in downpipes or at the highest point of the pipe are not suitable (Fig. 9-14).



- 1 = Recommended range in the horizontal (sensor installation laterally +/-45°)
- 2 = Recommended range in the vertical
- 3 = Not recommended, as partial filling/empty run
- 4 = No measurement possible due to empty run

Fig. 9-14 Comparison of different installation locations (principle)

NIVUS recommends a slightly rising area or siphoning when planning new measurements in horizontal pipelines (sensor mounting as shown in Fig. 9-15).

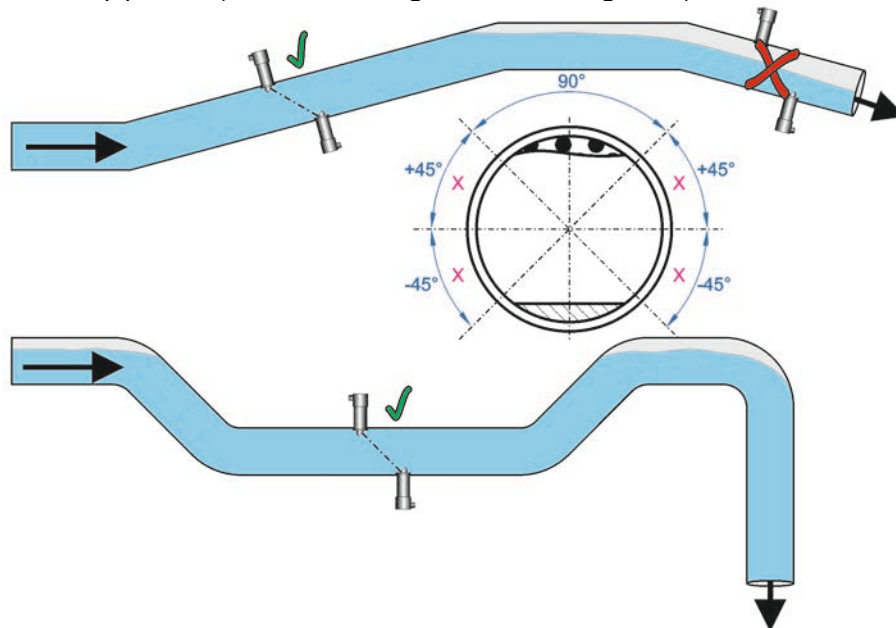


Fig. 9-15 Horizontal line with siphon (principle)

Always install the flow velocity sensors **upstream** of a control or stop valve.

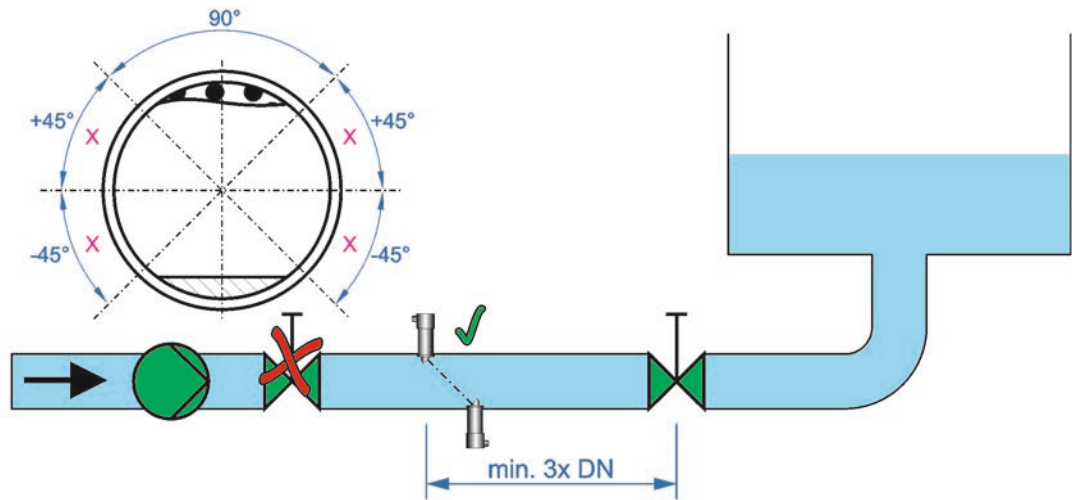


Fig. 9-16 Use of stop and control valves (principle)



Avoid vibrating pipelines

*Do not mount sensors on vibrating pipelines.
This can lead to incorrect measurements.*

10 Sensor Mounting and Positioning

10.1 General Information



Avoid engine supply lines and power lines

To avoid disturbance due to electrical interference, the sensor cable must not be laid close to (or parallel to) motor supply lines and power lines.

The installation of sensors in open channels, canals or water bodies always requires careful pre-planning. An inspection of the measurement place is absolutely necessary. The installation options here are to be prepared very individually.

The two sensors of a path must be mounted according to the geometry and aligned against each other. Use optical aids such as laser distance meters or similar (see Chap. "11 Sensor Alignment").



Carefully mount and align the sensors

*Ensure vibration-free, firm mounting and highly accurate alignment of the sensors.
This is absolutely necessary for a functioning measurement.*

There are labels on the sensor cables so that the sensor pairs can be precisely assigned.

For a measurement with **up to 2 paths**, the sensors are connected **directly to the transmitter**. The designations here are G, F, E and D.

Designation on the Sensor	Sensor Type
G	Sensor 1 (Path 1)
F	Sensor 2 (Path 1)

E	Sensor 1 (Path 2)
D	Sensor 2 (Path 2)

Tab. 2 Sensor designations with 2 paths

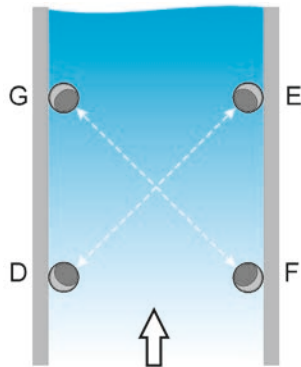


Fig. 10-1 Sensor assignment on the transmitter (principle)

When connected via the intermediate box or the extension module, the sensors are labelled with numbers: 1.1 and 1.2, 2.1 and 2.2, 3.1 and 3.2, 4.1 and 4.2, etc.

Designation on the Sensor	Sensor Type
1.1	Sensor 1 (Path 1)
1.2	Sensor 2 (Path 1)
2.1	Sensor 1 (Path 2)
2.2	Sensor 2 (Path 2)
3.1	Sensor 1 (Path 3)
3.2	Sensor 2 (Path 3)
4.1	Sensor 1 (Path 4)
4.2	Sensor 2 (Path 4)

Tab. 3 Sensor labels with intermediate box/extension module (principle)

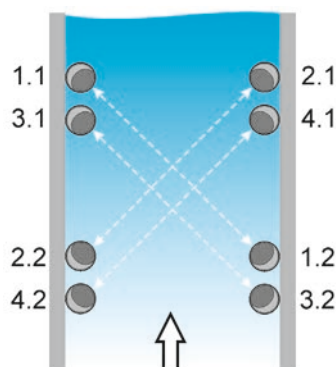


Fig. 10-2 Assignment of the sensors on the intermediate box / on the extension module (principle)

10.2 System Configuration Options

The arrangement of the sensors essentially depends on the hydraulic conditions, the water body geometry, the infrastructure at the respective measurement place as well as the required measurement accuracy.

Single Track System

The simplest arrangement of an ultrasonic system is two hydroacoustic sensors placed transversely opposite each other. The prerequisite is that the main flow runs parallel to the banks.

These conditions are best met in canals and canal-like developed cross-sections of flowing waters.

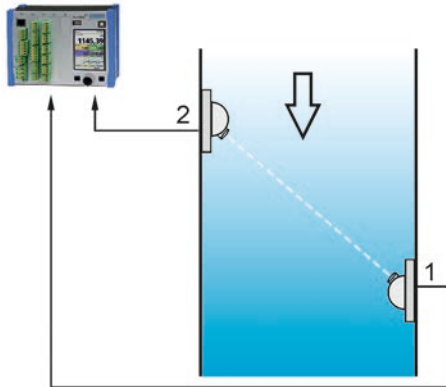


Fig. 10-3 Single track system (principle)

The sensors work alternately as transmitter and receiver. The direction of transmission of the ultrasonic signal is 1-2 against the direction of flow or 2-1 in the direction of flow.

Cross Track System

In natural water bodies, the main flow only occasionally runs parallel to the bank. Bends in the watercourse and the shape of the cross-section have a long-term influence on the main flow direction at different filling levels.

In such cases, the crosswise arrangement is used, in which the angle between the main flow direction and a bank is additionally calculated with the help of the second measurement path.

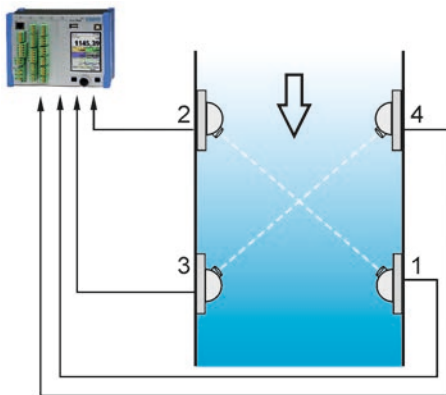


Fig. 10-4 Cross track system (principle)

In this arrangement, the transit time is measured alternately in the measuring paths 1-2 and 3-4.

Multi Level System

In measuring cross-sections with extremely fluctuating water levels or overflowing water-course cross-sections (structured cross-sections), the arrangement of several levels is recommended.

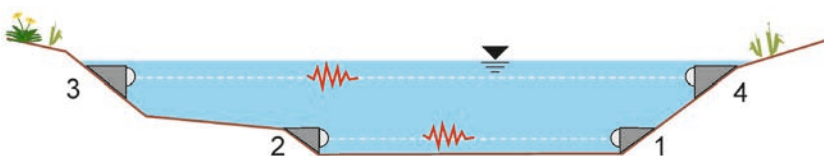
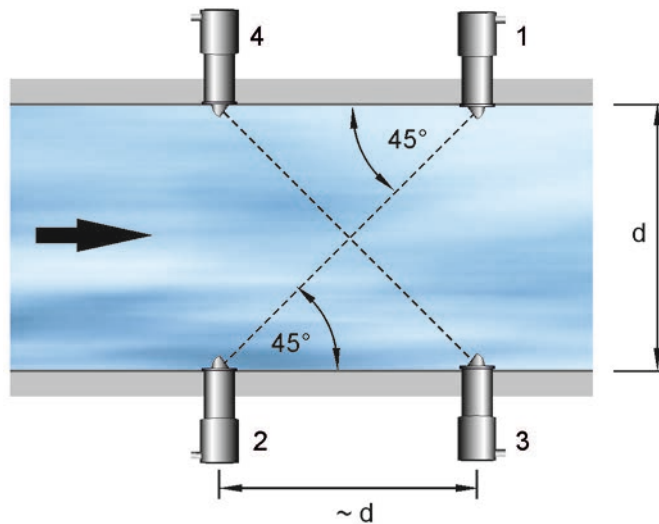


Fig. 10-5 Multi level system (principle)

Each level can be configured in single or cross track arrangement.

If the entire measurement cross-section is recorded with a sufficient number of measurement sections arranged one above the other, the hydrometric calibration as the basis for flow rate determination can be omitted, as the flow profile is sufficiently known due to the measurement in several levels.

The measurement accuracy is highest with a multi level cross track system, since with this arrangement the uncertainties regarding the assumptions about the main flow direction and the flow profile have the least influence on the calculation result.



1...4 Sensor 1, Sensor 2, Sensor 3, Sensor 4
d Inside Diameter/Channel Width

Fig. 10-6 General path arrangements 2-path measurement (principle)

10.3 Calculating the Minimum Water Depth for the Application

To prevent errors caused by reflection of the ultrasonic signal on the water surface or the bottom, the canal or the water body must have a minimum water depth.

This factor can be calculated with the following formula:

$$D_{min} = 27 \times \sqrt{\frac{L}{f}}$$

- D_{min} = Minimum water depth above the path and minimum distance between the bottom and the path; both in metres
- L = Path length in metres
- f = Frequency of the sound transducer in Hertz

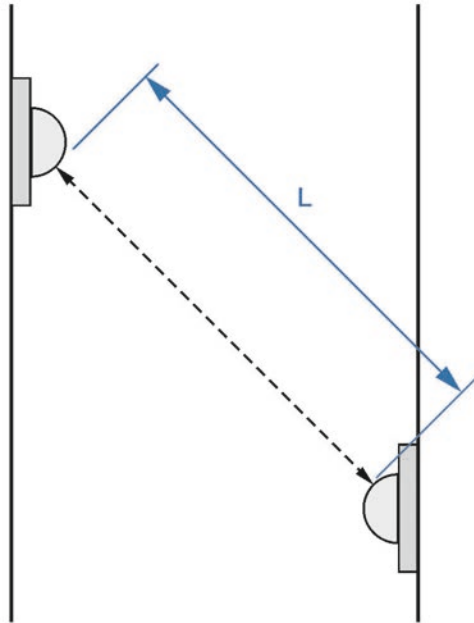


Fig. 10-7 Graphical representation of the path length (principle)

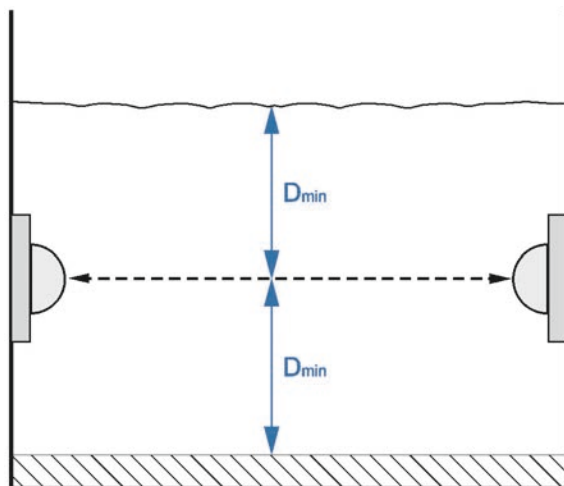


Fig. 10-8 Graphical representation of the minimum water depth (principle)

Examples of the minimum water level for different frequencies of the transducer and path lengths.

Path length L [m]	Frequency of the sound transducer f [kHz]	Minimum depth above and below the path D_{min} [m]
1	1000	0.03
3	1000	0.045
10	200	0.19
30	200	0.33
50	200	0.43
100	200	0.60

Tab. 4 Minimum water level (examples)

A similar limitation may apply to particularly smooth channel bottoms, which reflect rather than absorb the sound signal.

⇒ The frequencies of the NIVUS sensors are listed in the "Technical Description Transit Time Sensors" under the respective specifications of the sensors.

10.4 Rod Sensors Type NOS

The mounting of the pipe holder (stainless steel pipe) for the sensor head can either be screwed from above with the angle bracket (Fig. 10-9) or from the side with the wall bracket (Fig. 10-10). For this purpose, drive-in anchors and hexagon socket head screws with metric thread M12 are recommended. It is essential to ensure that the fastening is attached in such a way that the sensors can be aligned exactly against each other after installation (recommended angle: horizontal 45°). This can be done by optical alignment and by analysing the impulse signal.

The sensor surfaces (carbon surfaces) must be aligned exactly against each other, otherwise a correct measurement cannot be guaranteed.

Check the position of the sensors very carefully.

Since the mounting of the sensors at the measurement place is extremely dependent on the local conditions, a suitable selection of the sensor type and the mounting must be made by trained specialist personnel before mounting.

When mounting rod sensors on vertical watercourse boundaries or channel walls, NIVUS recommends using the sensor bracket (*NOZ00 HAL0* or *NOZ00 HAL90*) for vertical or horizontal alignment of the sensors.

If strong currents are to be expected, a streamlined protective sheet for the sensor holder is recommended (see Chapter "12 Holding Brackets and Flow Protection Sheet for Rod Sensors"). It prevents the sensors from vibrating and from being damaged by flotsam carried in the water.

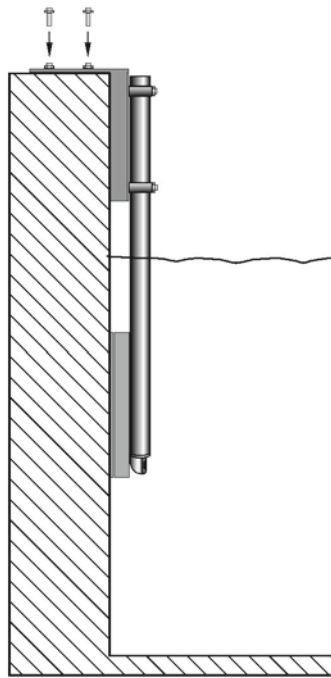


Fig. 10-9 Fastening the angle bracket to a wall

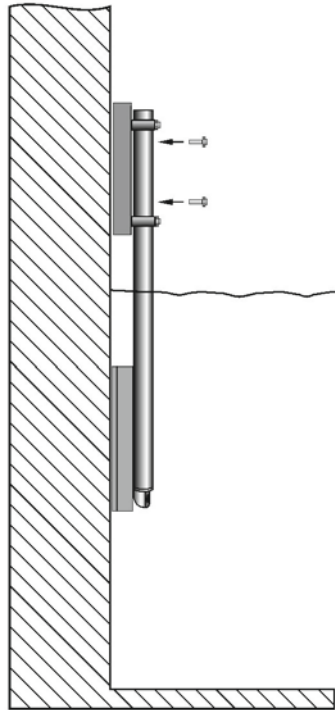
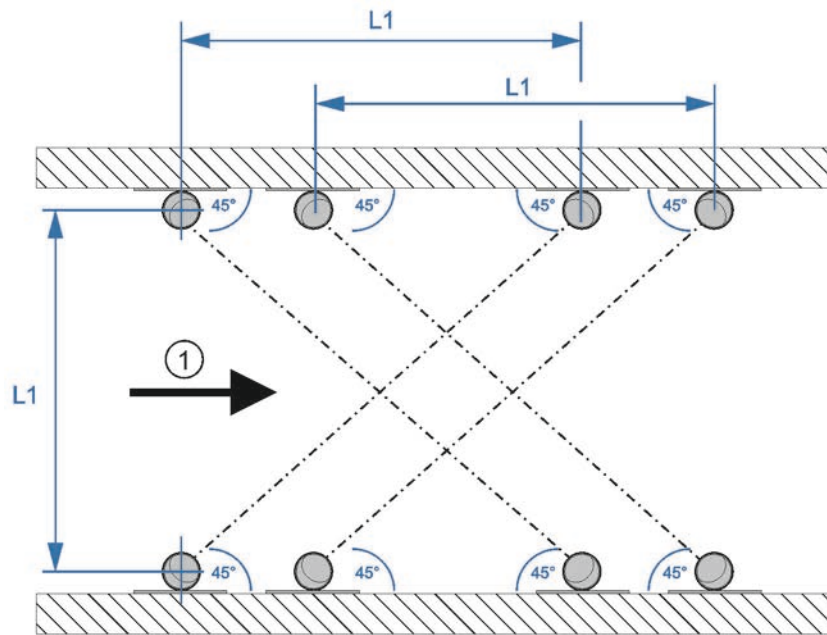
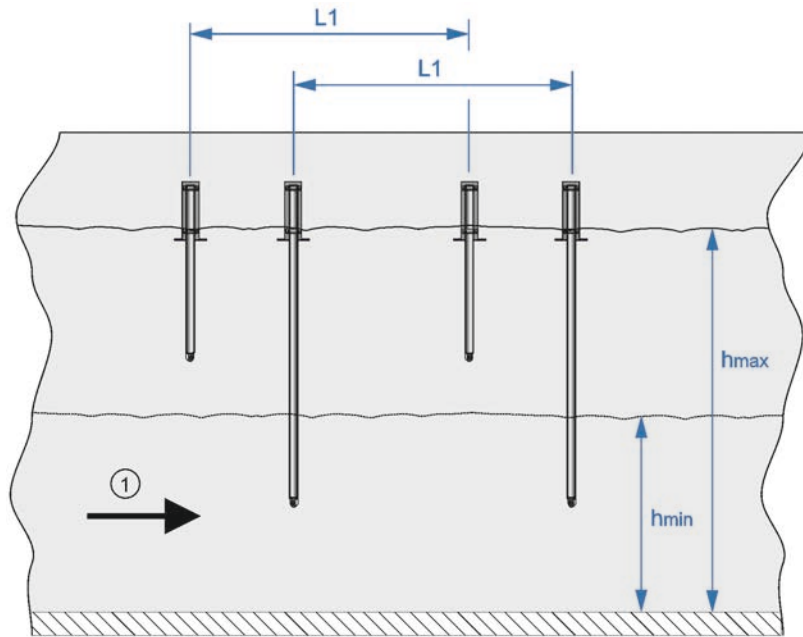


Fig. 10-10 Fastening the wall bracket to a straight wall



- 1 Flow direction
- L1 Channel width / sensor distance (observe mounting distance wall - sensor)

Fig. 10-11 Installation example rod sensors 2 levels/4 paths (top view)



- 1 Flow direction
- L1 Channel width / sensor distance

Fig. 10-12 Installation example rod sensors 2 levels/4 paths (lateral view)

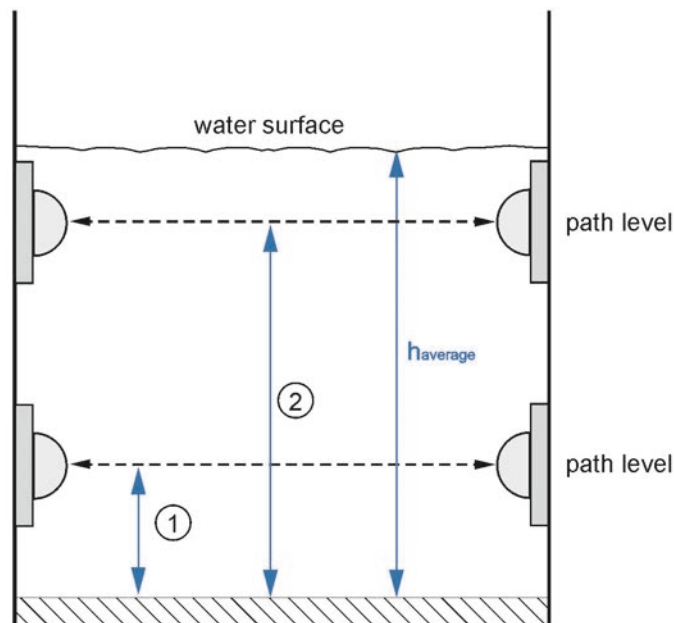


To determine the levels, follow guidelines

The positioning of the measurement paths in different levels depends on the main measurement task.

For example: minimum, medium and maximum discharge.

Information on defining the levels can be found in the DIN 6416 guidelines or contact NIVUS.



- 1 Lower Path(s) / 40 % of $h_{average}$
- 2 Upper Path(s) / 80 % of $h_{average}$

Fig. 10-13 Division of the levels when measuring the average discharge

10.5 Hemisphere and Ball Head Sensors Type NOS and Ball Sensors Type NOS0

The holding devices (*NOZ00 HALHK*, *NOZ00 HAL1VK*) for fixing the hemisphere and the ball head for the flow velocity sensors type NOS and the mounting device (*NOS00 HALHxVK*) for fixing the ball sensors type NOS0 were designed for use on vertical and inclined water body boundaries (embankments and similar). It can be used to compensate for angles in two different levels. This enables the adjustment of the sensors and their alignment to each other. Their shape reduces any influence on the flow behaviour. Less tressing can occur on the sensors, caused for example by objects carried along by the water (algae, leaves, foliage, grass or similar).

NIVUS recommends connecting the sensors type NOS-V30B via the optionally available underwater plug connector (NOS sensor connection A or B). These plug connectors can be used up to 12 m water column.

After mounting the sensors, they must be optically aligned with each other (see Chapters "11.4 Hemisphere Sensors" and "11.5 Ball Sensors").

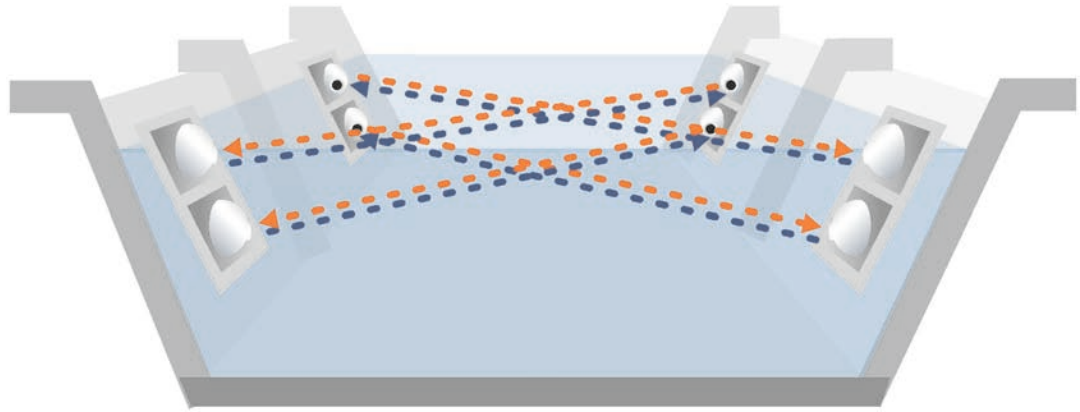


Fig. 10-14 Installation example hemisphere sensors 2 levels/2 paths

10.6 Wedge Sensors Type NIS

Four stainless steel screws with countersunk heads (size M5, length 30...70 mm) and the appropriate dowels are required to fasten a wedge sensor to the channel wall.

The length of the screws must be selected in such a way that secure and permanent sensor fastening is ensured under all operating conditions.

The countersunk screws must be screwed completely into the mounting plate to reduce turbulence or tressing. Protruding fastening material such as stud bolts are not recommended by NIVUS.



Fastening elements for wedge sensors must be flush with the mounting plate

If screws or other fastening parts protrude into the medium to be measured, there is a risk of tressing due to grass, algae, etc.

This can lead to malfunctions or failure of the measurement.

The sensors of a path that are associated with each other must be mounted according to the geometry and aligned against each other. For alignment use optical aids (laser distance meters or similar) (see Chap. "11.3 Wedge Sensors").

The wedge sensor has been flow-optimised to reduce the risk of clogging due to weed growth. Nevertheless, there is a risk of weeds on the sensor plate under certain circumstances. For this reason, no gap must remain between the sensor plate and the channel wall/embankment. If there is a mounting gap in the area of the sensor tip, cover it with silicone or another suitable material.



Channel wall for installation must be exactly flat

Otherwise there is a risk of sensor body breakage and resulting sensor leakage when fastening.

The ingress of water into the electronics can lead to irreparable destruction.

CAUTION



Use appropriate tools

The base plate must not be bent during installation/dismantling and the mounting holes must not be drilled out.

Only use a **suitable screwdriver** to dismantle the wedge sensor. Never use chisels, hammers, crowbars, levers, hammer drills and similar tools.

Do not use force when dismantling.

Disregarding this may result in irreparable damage to the sensor.

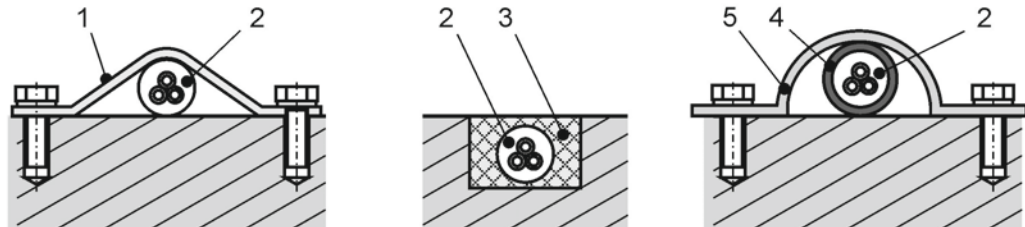


Do not loosen/dismantle any parts

Do not remove or loosen any parts (e.g. base plate, cable gland etc.) from/on the wedge sensor.

This can result in leakage and measurement failure.

Lead the sensor cable out behind the sensor on the channel wall and cover the cable with a thin stainless steel sheet to avoid build-up. Alternatively, the cable can be laid in a (self-made) slot, which is then closed again with permanently elastic material. Installation in armoured conduits and similar robust cable protection systems is also permissible. According cable covers can be acquired from NIVUS.



- 1 Stainless Steel Sheet/Cable Cover, e.g. Type ZMS0 140
- 2 Cable
- 3 Permanently Elastic Material
- 4 Cable Conduit
- 5 Pipe Clamp

Fig. 10-15 Mounting proposal for cable laying

CAUTION



Lay cables in a protected manner

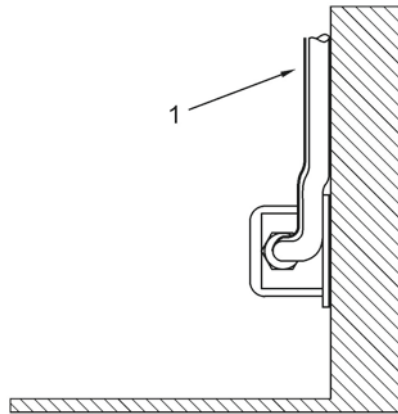
Do not lay the cable loosely, unprotected or across the medium.

Disregarding can lead to build-up or sensor/cable breakage.

Observe the installation radius

The minimum bending radius of the standard signal cable is 10 cm.

With smaller radii there is a risk of cable breakage!



1 Protective Cover

Fig. 10-16 Protective cover for laying cables



Lay sensor cables without interference

To avoid disturbance due to electrical interference, the sensor cable must not be laid close to or parallel to motor supply lines and power lines.

This can lead to measurement inaccuracies or even measurement failure.

Example for 2-Path Measurements with Wedge Sensors

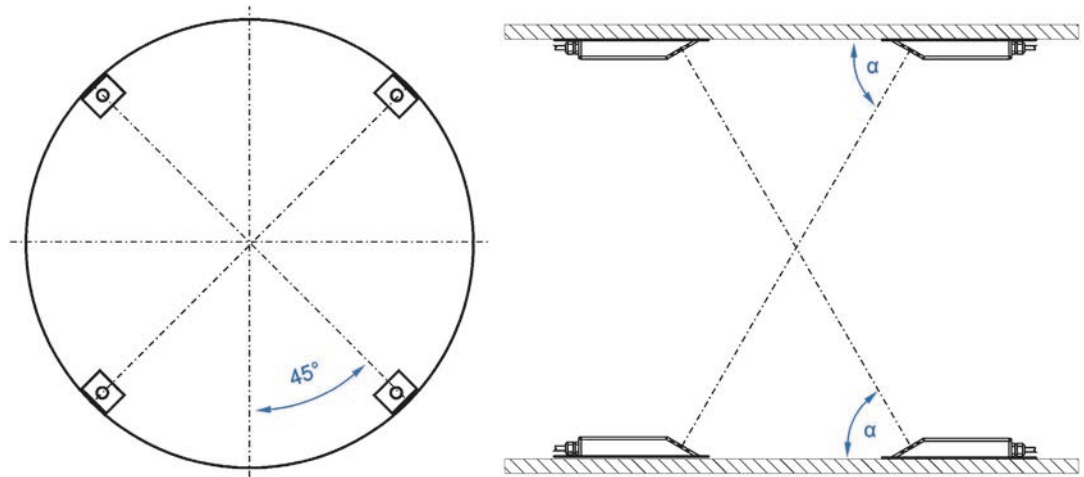
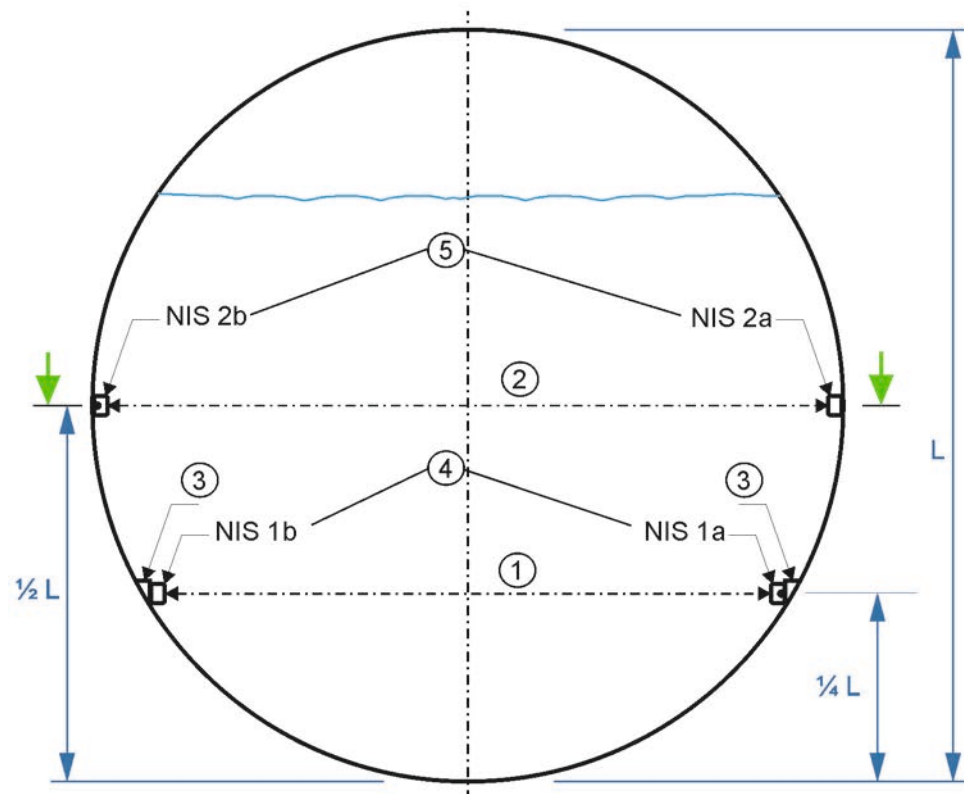


Fig. 10-17 2-path measurement in full pipe



- 1 Path 1
- 2 Path 2
- 3 Mounting Wedge
- 4 Sensor Pair Path 1
- 5 Sensor Pair Path 2

Fig. 10-18 2-path measurement in part filled pipe

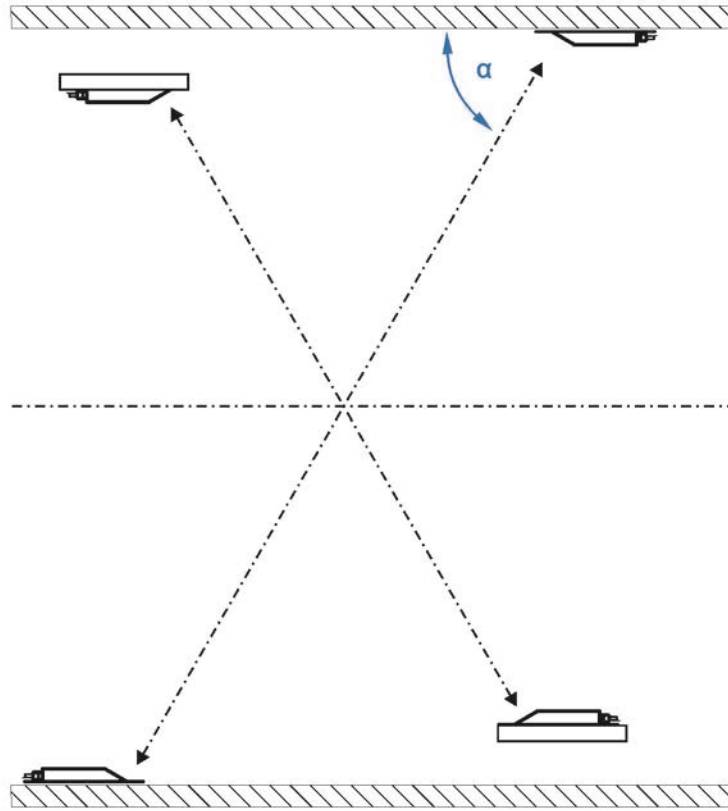


Fig. 10-19 Sectional view of 2-path measurement in part filled pipe

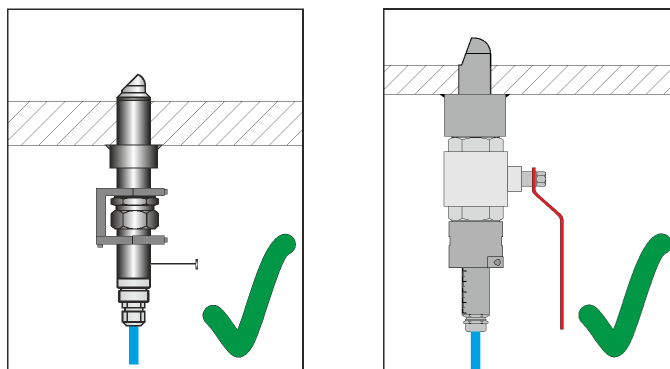
10.7 Pipe Sensors Type NIS, Type NIS0 and Type TSP0

The sensors used must be permanently and reliably fastened in such a way that the bevelled side of sensor 1 with the built-in flow velocity sensor points exactly against the direction of flow of the medium. The adjustment aid (see Fig. 17-2) points in the direction of flow. The flow velocity sensor integrated in sensor 2 must point exactly in the direction of flow against sensor 1.

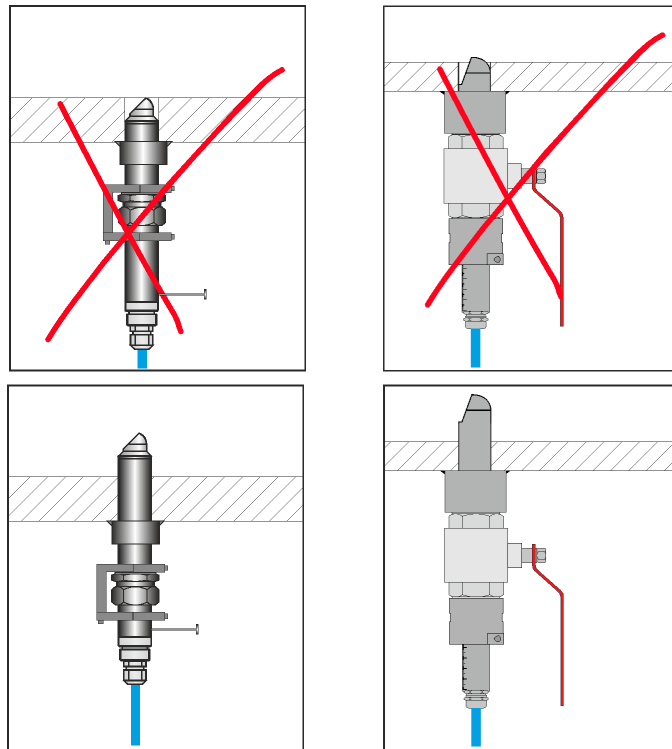
Use only non-corrosive fastening material.

The types NIS, NIS0 or TSP0 pipe sensors are screwed into the socket by means of a sealing ring and fastening element (or optionally with an additional stop ball valve for pressure-less removal).

When mounting, it is important that the horizontal part of the pipe sensor is exactly flush with the pipe wall.



Correct Installation



Error: Measurement Failure

If the nozzles are not positioned exactly (slightly too tight), this can be compensated for by pushing the sensors in deeper.

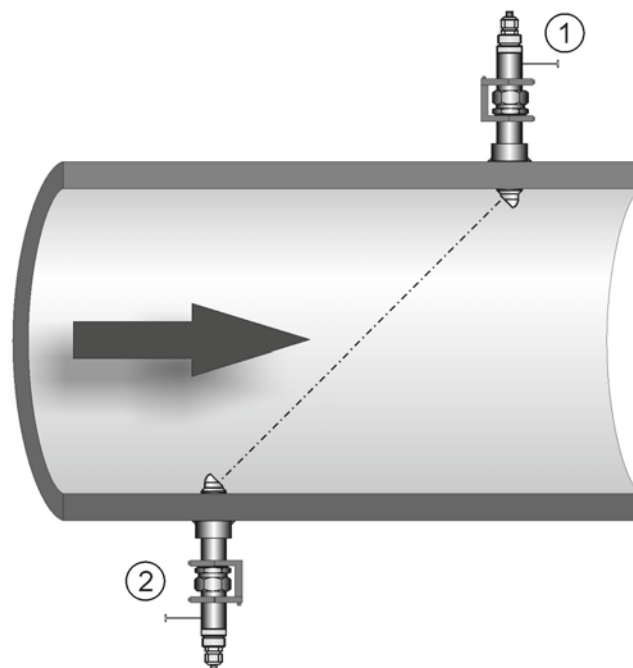
Fig. 10-20 Information on sensor positioning



NIS-/NIS0/TSP0 Sensors in full filling

Sensors with the article number "NIS-", "NIS0" and "TSP0" are generally only suitable for 1- and 2-path systems.

Always route the measurement path(s) through the centre of the pipe when it is full.



- 1 Sensor 1: Sensor face against flow direction
- 2 Sensor 2: Sensor face in flow direction

Fig. 10-21 Information on pipe sensor mounting



Note the following when mounting the sensors

- *Attach the welding nozzle at a 90° angle.*
 - *Place and align the pipe sensors so that the bevelled side of sensor 1 points exactly against the direction of flow and the bevelled side of sensor 2 points with the direction of flow and against sensor 1.*
-

Depending on the pipe material, weld (steel, stainless steel 1.4571), glue (PVC), plastic-weld (HDPE) or laminate (PVC) the sensor nozzles.

For retrofitting, NIVUS recommends the use of a tapping saddle (see Chap. "16 Tapping saddle for pipe sensors"). For cast iron or concrete pipes, a steel or stainless steel clamp with welded-on nozzles and gasket can be screwed onto the pipe wall.

If in doubt, contact the pipework contractor and ask them to install the sensor nozzles. NIVUS recommends the use of a drill bit (38 mm diameter for 1½" or 24 mm diameter for 1") and a slow-running drill with slip clutch for drilling steel and stainless steel pipes. Use cutting paste to cool the drill bit.



Use an extended core bit for thicker pipe walls

Check the wall thickness of the pipe before drilling. Use an extended core bit if necessary. Standard drill bits may not go far enough into the wall material.

If possible, drilling in concrete pipes should be carried out by a specialised company. Always observe the following instructions:

- Drill a core hole with a diameter of at least 45 mm.
- Cool the diamond tool used.
- Flush dust discharge with coolant.
- For drilling through a ball valve, use a drill bit with 36 mm outer diameter and the corresponding extension (Fig. 18-1).

Drill bits, extensions and cutting paste can be purchased from NIVUS if required. Ideally, weld, glue or laminate the welding nozzle **after** drilling.

WARNING

Risk of accidents when drilling

Use only a low contact pressure depending on the pipe material and wall thickness. Otherwise, the drill may block.

Do not exceed the specified drilling speed.

Disregarding may lead to personal injury.

WARNING

Use mobile power accident protection

Always use a mobile power accident protection when drilling in damp rooms and/or in filled pipes.

Disregarding may lead to electric shock.



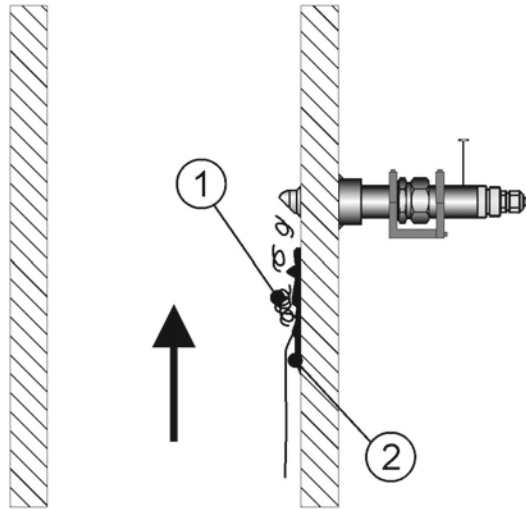
When drilling, ensure unobstructed chip evacuation and remove drill burrs

Ensure unobstructed chip evacuation by removing any chips that have formed. Deburr holes after drilling.



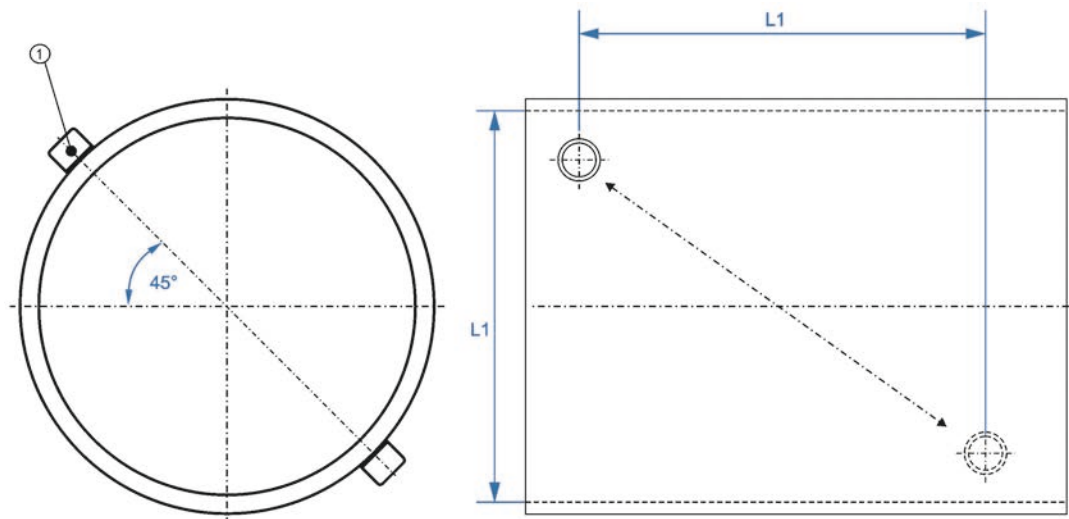
Avoid burning the pipeline during welding

Deposited welding pearls can cause turbulence and thus falsify the measured values (Fig. 10-22).



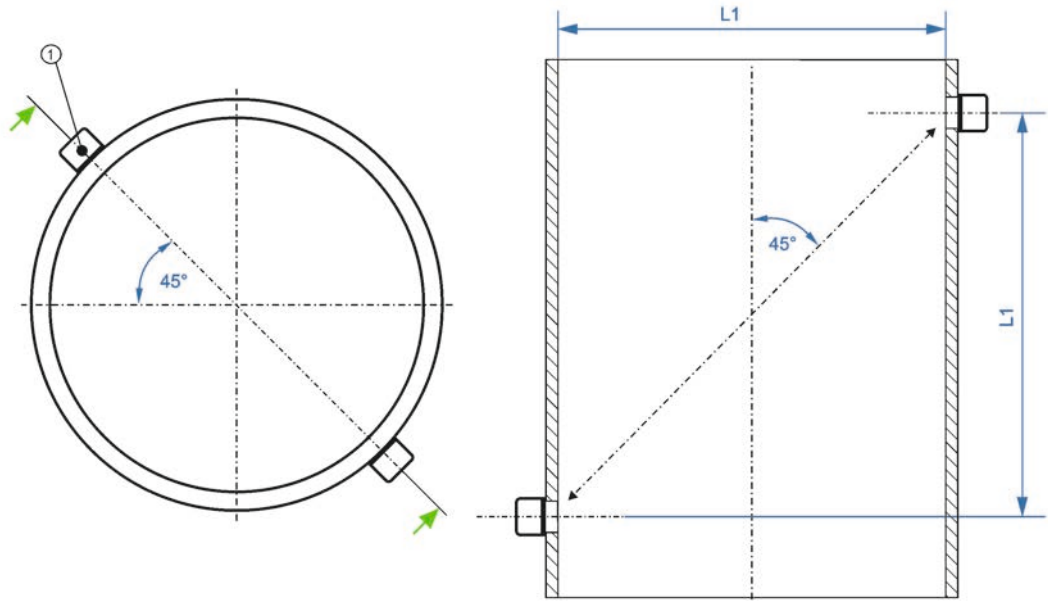
- 1 Eddying
- 2 Welding pearls burn-off

Fig. 10-22 Incorrect measurement values due to burning of the pipeline



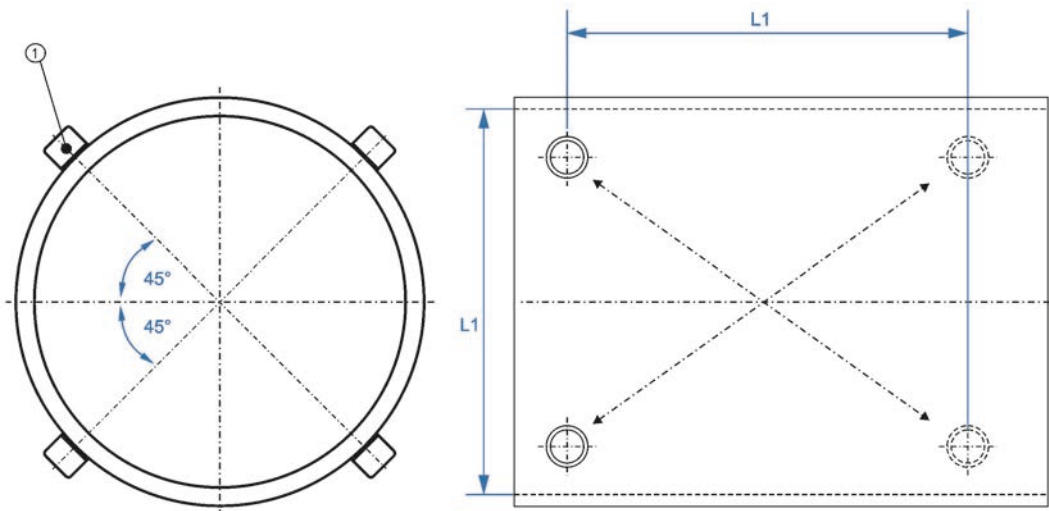
- 1 Inside thread 1" (Type TSP0/Typ NIS0), 1¼" (Type NOS) or 1½" (Type NIS)
- L1 Inside Diameter / Sensor Distance

Fig. 10-23 Example of a 1-path measurement in a pipe (>DN300) (side view)



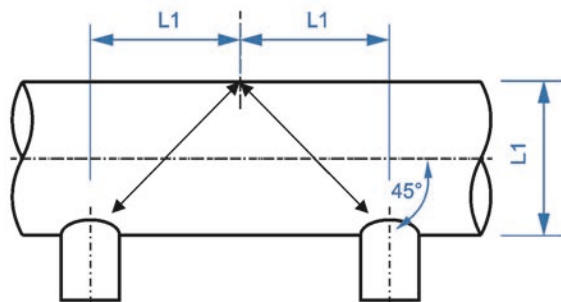
- 1 Inside thread 1" (Type TSP0/Typ NIS0), 1¼" (Type NOS) or 1½" (Type NIS)
- L1 Inside Diameter / Sensor Distance

Fig. 10-24 Example of a 1-path measurement in a pipe (sectional view)



- 1 Inside thread 1" (Type TSP0/Typ NIS0), 1¼" (Type NOS) or 1½" (Type NIS)
- L1 Inside Diameter / Sensor Distance

Fig. 10-25 Example of a 2-path measurement in a pipe (side view)



- L1 Inside Diameter,
Sensor Distance = 2x Inside Diameter

Fig. 10-26 Example of a 1-path reflection measurement in a small metal pipe

10.7.1 Pipe sensor Type NIS

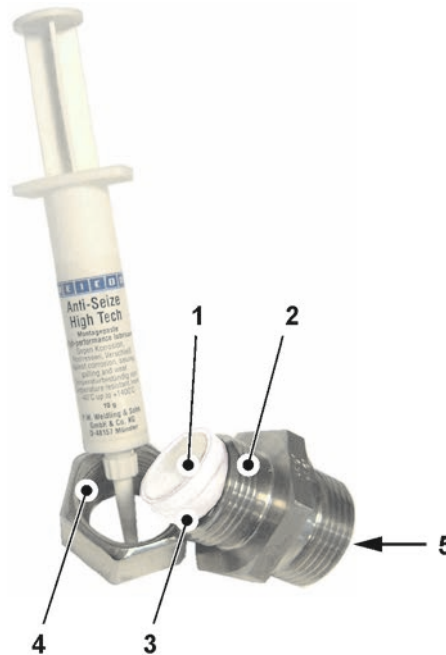


Grease thread with grease paste

When mounting pipe sensors, use a special grease paste for stainless steel screw connections according to DIN 2353 (e.g. Volz GmbH Grease Paste 325-250).

For type NIS pipe sensors, the thread of the sleeve nut, the thread and the cone must be slightly greased during pre-assembly.

The screw connections are greased on delivery. Any grease paste required can be obtained from NIVUS.



- 1 Gasket ring
- 2 Thread
- 3 Inside cone
- 4 Inside thread of sleeve nut
- 5 O-ring inside the screw connection

Fig. 10-27 Use of grease paste with sensors type NIS

- ➡ Before assembly, grease the screw connection at all points marked in Fig. 10-27.
- ➡ Carry out the mounting of the pipe sensor according to DIN 3859-2:
 1. Screw the screw connection into the welding nozzle, ball valve or nozzle of the tapping saddle using a 55 mm pipe spanner or open-end spanner.
 2. Slide the sleeve nut and the gasket ring over the flow velocity sensor.
 3. Insert the sensor into the screw connection as far as necessary for the application (Fig. 10-21).
 4. Push the gasket ring into the screw connection.
 5. Hand-tighten the sleeve nut.
 6. Draw a mark on the sleeve nut for later checking of the revolutions.
 7. Tighten the sleeve nut by approx. ½ turn using a 50 mm open-ended spanner.

The fastening element is an indispensable part of the pipe sensors. It holds the pipe sensor securely in position and, when mounted correctly, prevents the sensor from being thrown out.

WARNING



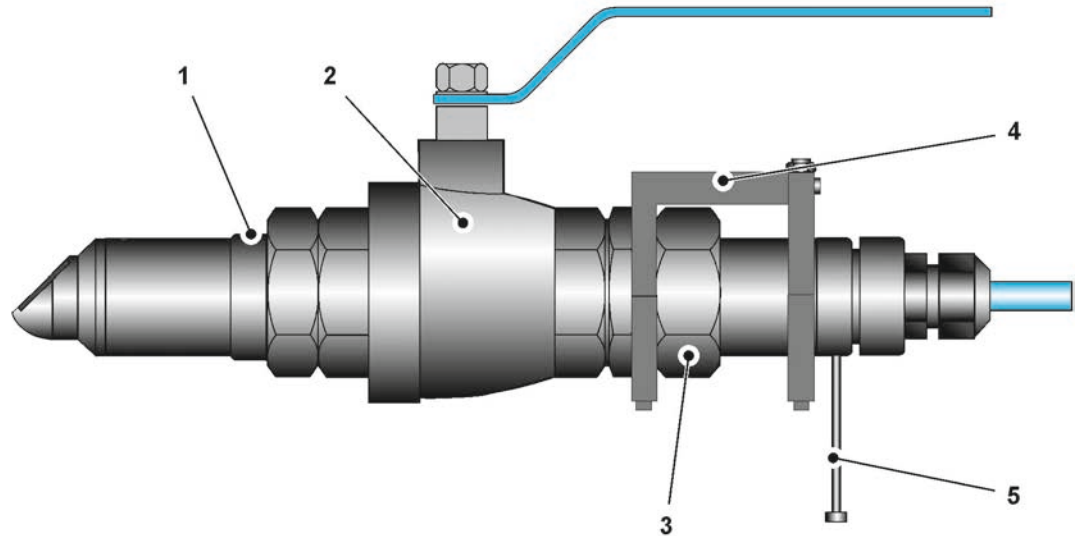
Always install pipe sensors with fastening element

The pipe sensor must never be installed without a fastening element. The gasket ring inserted in the screw connection serves only as a seal. It has no fastening function whatsoever.

Flow velocity sensors without a fastening element can come loose from the screw connection and endanger persons as well as plant parts.

If this is not observed, persons can be injured by the sensor being thrown out.

In addition, an uncontrollable discharge of the medium to be measured may occur and the plant may be flooded.



- 1 Double Nipple
- 2 Ball Valve
- 3 Sensor Screw Connection
- 4 Fastening Element for Pipe Sensors
- 5 Alignment Aid (screw M4)

Fig. 10-28 Components for pipe sensor mounting



Clean and degrease components

Before starting the assembly, the rear area of the pipe sensor as well as the clamping area (semi-circular milling) of the rear upper and lower clamp element must be degreased with suitable means to ensure a secure clamping.

The sensor body and clamping area of the clamp elements must be dry.

Without degreasing and drying both components and the sensor body, the static friction between the sensor and the fastening element is reduced by an unknown amount. This means that reliable fastening of the sensor is no longer guaranteed.

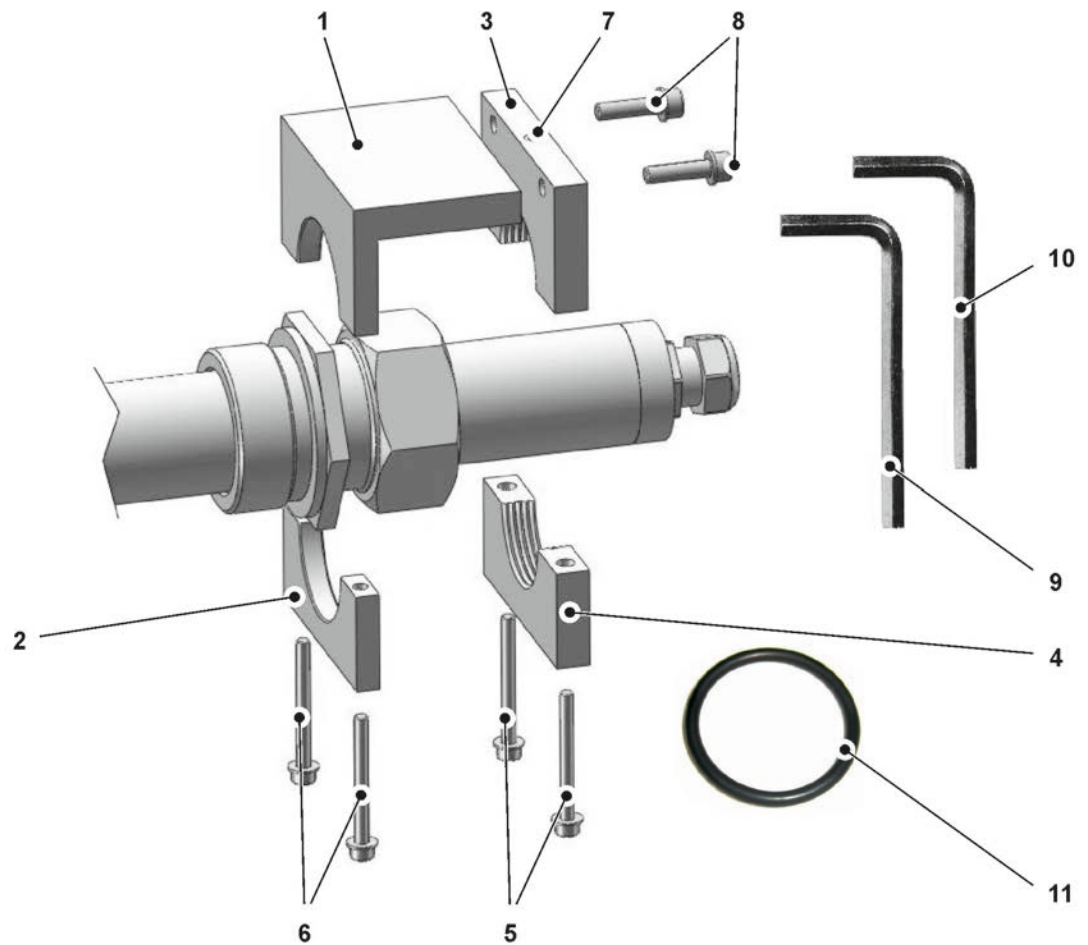


Observe maximum continuous and impact loads

The fastening element for pipe sensors supplied by NIVUS was tested by an independent test centre with a continuous load of 4 bar as well as an impact load (30 seconds) of 8 bar.

Higher pressure ranges cannot be safely absorbed.

The fastening element for pipe sensors consists of the following components:



- 1 Front upper clamping element
- 2 Front lower clamping element
- 3 Rear upper clamping element
- 4 Rear lower clamping element
- 5 2x Hexagon socket screw M5
- 6 2x Hexagon socket screw M4
- 7 Welded threaded pin as additional clamping protection
- 8 2x Hexagon socket screw M5
- 9 Hexagon socket spanner 3 mm
- 10 Hexagon socket spanner 2.5 mm
- 11 Spare O-ring for sensor screw connection

Fig. 10-29 Exploded drawing fastening element

➔ **Mounting Procedure:**

1. Lightly grease the O-ring inside the sensor screw connection.



Fig. 10-30 Greasing the sensor screw connection

2. Screw the sensor screw connection into the welded nozzle or the ball valve.



Fig. 10-31 Fastening the sensor screw connection to the ball valve

3. Position the pipe sensor as described earlier in this chapter.



Fig. 10-32 Positioning the sensor

4. Fasten the sensor by tightening the sleeve nut lightly by hand and turn it an additional $\frac{1}{2}$ turn.



Fig. 10-33 Fastening the sensor

5. Screw the front upper and lower clamping elements together with two hexagon socket screws M4 (Fig. 10-29 Pos. 7) behind the sleeve nut of the sensor screw connection.

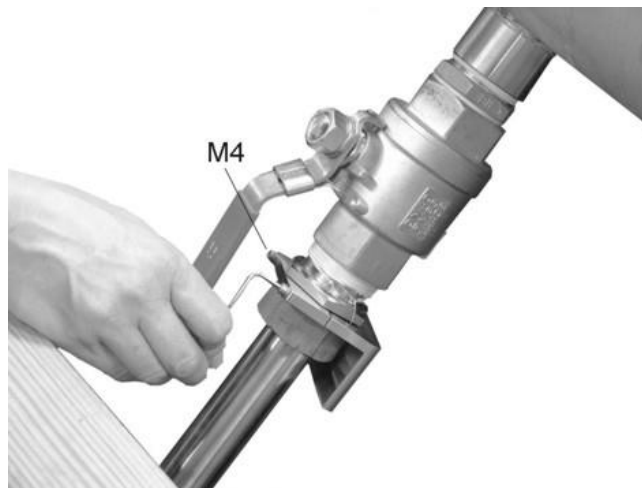


Fig. 10-34 Fastening the front lower clamping element

6. Screw the upper rear clamping element (Fig. 10-29 Pos. 3) to the upper front clamping element with two M5 hexagon socket screws.



Fig. 10-35 Connect rear upper and front upper clamping element

7. Screw the lower rear clamping element to the upper rear clamping element with two more M5 hexagon socket screws.
Tighten both hexagon socket screws with at least 6 Nm to ensure the tested safety.
8. Check the tightness of the entire screw connection. If liquid escapes under operating conditions, retighten the corresponding screw connections or put the entire plant out of operation again and replace defective gaskets, Teflon tapes, etc.



Fig. 10-36 Fastening the final clamping element

- ➡ Procedure for **dismantling** the sensor for cleaning and checking:

WARNING



Pipe must be depressurised

Before dismantling the sensor, make sure that the pipe is emptied or depressurised in order to prevent the medium from shooting out and the associated possible hazards from flying parts.

1. Loosen the two hexagon socket screws M5 (Fig. 10-35) and the sleeve nut.



Fig. 10-37 Loosening the sleeve nut for sensor dismantling

- Remove the sensor, leaving the two screwed rear clamping elements unchanged on the pipe sensor body.



Fig. 10-38 Remove sensor for cleaning and checking

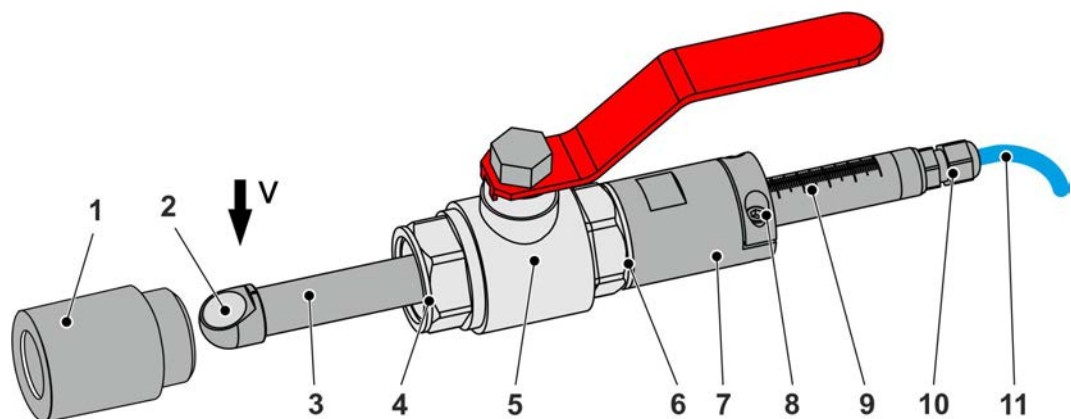
- Check the sensor and clean it if necessary.
- Replace the cutting ring and push the sensor back into the screw connection. The screwed rear clamping elements remaining on the sensor body serve as a stop and positioning aid (Fig. 10-38).
- Tighten the sleeve nut and the two M5 hexagon socket screws again.



Fig. 10-39 Secure sensor again during installation

10.7.2 Pipe sensor Type TSP0/NIS0

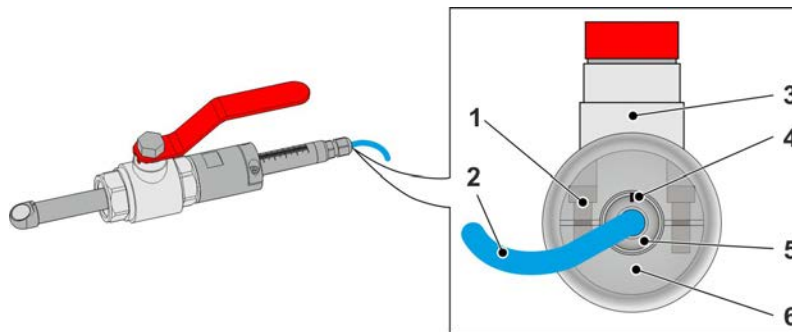
10.7.2.1 Overview of Components



- Welding Nozzle
- Sensor face
- Pipe sensor

- 4 Flat gasket
- 5 Stop ball valve G1", SW39
- 6 Flat gasket
- 7 Sensor clamping, SW36
- 8 2x M5 clamping screws for sensor clamping
- 9 Scaling for the pipe wall thickness (only valid if the supplied welding nozzle G1", Pos. 1, is used)
Centre axis of the scaling = alignment aid: align centre axis against the direction of flow
- 10 Cable gland
- 11 Sensor cable

Fig. 10-40 Pipe sensor TSP0/NIS0 with welding nozzle



- 1 2x M5 clamping screws for sensor clamping
- 2 Sensor cable
- 3 Stop Ball Valve
- 4 Scaling
- 5 Pipe sensor Type TSP0/NIS0
- 6 Sensor clamping

Fig. 10-41 Pipe sensor TSP0/NIS0: view of the sensor end on the cable side

10.7.2.2 Install pipe sensor Type TSP0/NIS0 in emptied pipeline



Be sure to use a stop ball valve

The stop ball valve for unpressurised removal is part of the delivery and must be used in any case.

The following procedure describes how the pipe sensor is installed in an empty pipe using the G1" welding nozzle (included in the delivery).

- ⇒ When using a NIVUS G1½" welding nozzle, the installation of a reducing double nipple is required. Then it is essential to include the procedure for determining the insertion depth in Chapter "10.7.2.4 Installing TSP0/NIS0 pipe sensor with customer welding nozzle or NIVUS welding nozzle G1½"" in the assembly (see page 51 ff.).

Required Tools

- 1x Open-end spanner SW39
- 1x Torque spanner SW36
- 1x Torque spanner with hexagon bit SW4 (for cylinder head screws M5 with hexagon socket); required torque 3.4 Nm

Prerequisites

- The welding nozzle (Fig. 10-40 Pos. 7) is welded to the pipeline.
- A hole is drilled in the pipeline.
- The clamping screws (Fig. 10-40 Pos. 8) of the sensor clamp are loosened, the pipe sensor (Fig. 10-40 Pos. 3) is (freely movable) inserted into the sensor clamping.

Installation

🔄 Procedure:

1. Determine the pipe wall thickness.
2. Sealing the joint:
Make sure that the flat gasket (Fig. 10-40 Pos. 6) is inserted correctly.
Use the open-end spanner SW39 and the torque spanner SW36 to tighten the sensor clamp on the stop ball valve with min. 10 Nm.

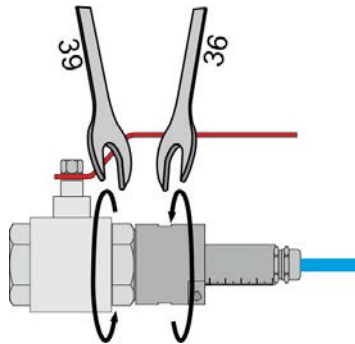


Fig. 10-42 Tightening the sensor clamping

3. Insert the flat seal (Fig. 10-40 Pos. 4) at the front of the stop ball valve (Fig. 10-40 Pos. 5) and screw the stop ball valve loosely into the welding nozzle by hand.
4. Tighten the stop ball valve with an open-end spanner SW39.

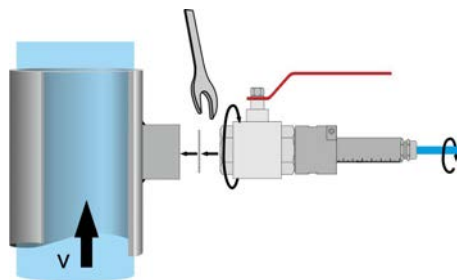


Fig. 10-43 Tightening the stop ball valve

5. Using the scale, push the pipe sensor in until the previously determined pipe wall thickness is reached/readable on the scale.
In the illustration below, the wall thickness corresponds to 3.1 cm (example).

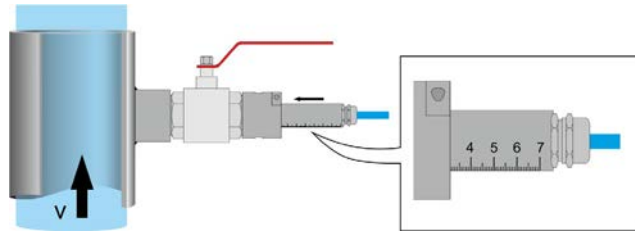


Fig. 10-44 Insert sensor (pipe wall thickness)

6. Align the pipe sensor with the centre axis (Fig. 10-45 Pos. 1) of the scale (Fig. 10-40 Pos. 9) against the direction of flow as shown in the figure below: Centre axis of the scale vertically against the direction of flow. Put on the clamping screws (Fig. 10-40 Pos. 8).

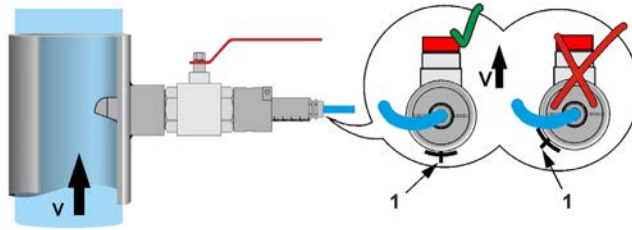


Fig. 10-45 Aligning the pipe sensor against the direction of flow

7. Finally, tighten the two clamping screws for sensor clamping with the torque spanner with hexagon bit SW4 to 3.4 Nm.

10.7.2.3 Install pipe sensor Type TSP0/NIS0 in full or part filled pipeline



Be sure to use a stop ball valve

The stop ball valve for unpressurised removal is part of the delivery and must be used in any case.

The following procedure describes how the pipe sensor is installed in a full or part filled pipe using the G1" welding nozzle (included in the delivery).

- ⇒ When using a NIVUS G1½" welding nozzle, the installation of a reducing double nipple is required. Then it is essential to include the procedure for determining the insertion depth in Chapter "10.7.2.4 Installing TSP0/NIS0 pipe sensor with customer welding nozzle or NIVUS welding nozzle G1½"" in the assembly (see page 51 ff.).

Required Tools

- 1x Open-end spanner SW39
- 1x Torque spanner SW36
- 1x Torque spanner with hexagon bit SW4 (for cylinder head screws M5 with hexagon socket); required torque 3.4 Nm

Prerequisites

- The pipe wall thickness is known.
- The welding nozzle (Fig. 10-40 Pos. 1) is welded to the pipeline.
- A hole is drilled in the pipeline.
- The stop ball valve (Fig. 10-40 Pos. 5) is unscrewed from the sensor clamping (Fig. 10-40 Pos. 7) and screwed to the welding nozzle together with the flat gasket (Fig. 10-40 Pos. 4).

- The clamping screws (Fig. 10-40 Pos. 8) of the sensor clamp are loosened, the pipe sensor (Fig. 10-40 Pos. 3) is (freely movable) inserted into the sensor clamping.

Installation

➡ Procedure:

1. Open the stop ball valve (Fig. 10-40 Pos. 5).



Grease thread with grease paste

When mounting pipe sensors, use a special grease paste for stainless steel screw connections according to DIN 2353 (e.g. Volz GmbH Grease Paste 325-250).

On type TSP0/NIS0 pipe sensors, the thread of the sensor clamping (for screwing into the stop ball valve) must be slightly greased.

The screw connections are greased on delivery. Any grease paste required can be obtained from NIVUS.

2. Grease the thread of the sensor clamping (Fig. 10-40 Pos. 7) (for screwing into the stop ball valve) with special grease paste for stainless steel screw connections.
3. Push the flat gasket onto the pipe sensor (Fig. 10-40 Pos. 3) and put it on the sensor clamping (Fig. 10-40 Pos. 7).
4. Push the pipe sensor with sensor clamping through the stop ball valve (Fig. 10-40 Pos. 5) and the welding nozzle (Fig. 10-40 Pos. 1).
5. Use the open-end spanner SW39 and the torque spanner SW36 to tighten the sensor clamp on the stop ball valve with min. 10 Nm.

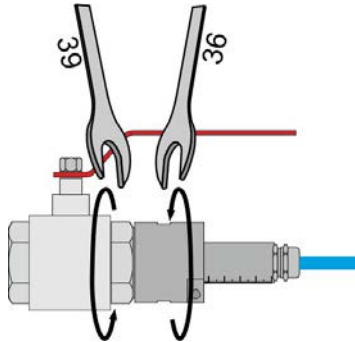


Fig. 10-46 Tightening the sensor clamping

6. Using the scale, push the pipe sensor in until the pipe wall thickness is reached/readable on the scale.
In the illustration below, the wall thickness corresponds to 3.1 cm (example).

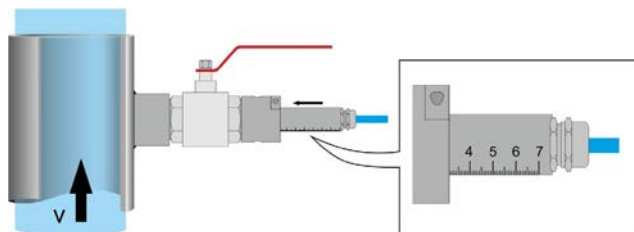


Fig. 10-47 Insert sensor (pipe wall thickness)

7. Align the pipe sensor with the centre axis (Fig. 10-48 Pos. 1) of the scale (Fig. 10-40 Pos. 9) against the direction of flow as shown in the figure below: Centre axis of the scale vertically against the direction of flow.
Put on the clamping screws (Fig. 10-40 Pos. 8).

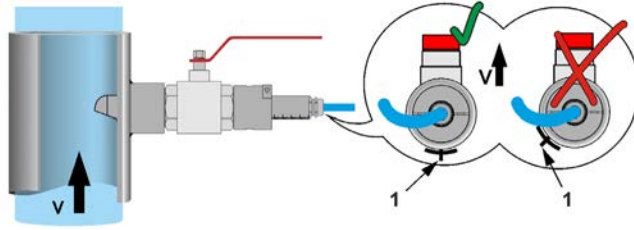


Fig. 10-48 Aligning the pipe sensor against the direction of flow

8. Finally, tighten the two clamping screws for sensor clamping with the torque spanner with hexagon bit SW4 to 3.4 Nm.

10.7.2.4 Installing TSP0/NIS0 pipe sensor with customer welding nozzle or NIVUS welding nozzle G1½"

If the pipe sensor TSP0/NIS0 is not mounted with the NIVUS welding nozzle G1" included in the delivery, the scaling on the pipe sensor does not correspond to the pipe wall thickness. The insertion depth of the pipe sensor must be determined accordingly and observed during installation.

Using a customer welding nozzle

➡ Procedure

1. In general, the installation of the pipe sensor is carried out according to one of the two previously described installation variants from Chapter "10.7.2.2 Install pipe sensor Type TSP0/NIS0 in emptied pipeline" or "10.7.2.3 Install pipe sensor Type TSP0/NIS0 in full or part filled pipeline" (depending on the installation situation on site), even if a customer's own welding nozzle is used.
A **distinction** must be made
 - when determining the pipe wall thickness (Chap. 10.7.2.2 - Working Step 1) and
 - when inserting the pipe sensor (Chap. 10.7.2.2 - Working Step 5; Chap. 10.7.2.3 - Working Step 6), as the scaling cannot be used directly as described. Here, the insertion depth must first be determined according to the instructions "Determining the Insertion Depth L" and then used in the respective working step.

Using the NIVUS welding nozzle G1½" and the reducing double nipple

Required Components and Aids

- 1x Reducing double nipple *ZUB0RED15X1Z*
- Teflon tape for sealing

➡ Procedure

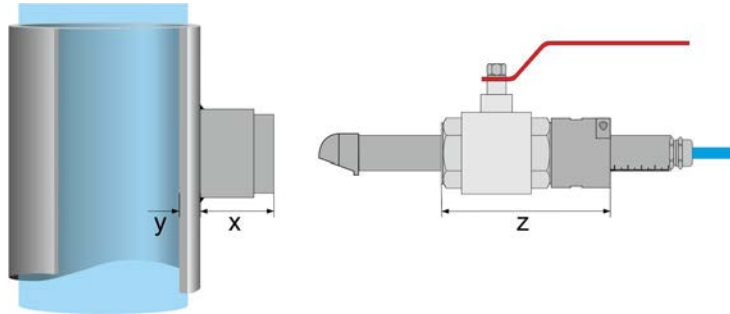
1. In general, the installation of the pipe sensor is carried out according to one of the two previously described installation variants from Chapters "10.7.2.2 Install pipe sensor Type TSP0/NIS0 in emptied pipeline" or "10.7.2.3 Install pipe sensor Type TSP0/NIS0 in full or part filled pipeline" (depending on the installation situation on site), even if a NIVUS G1½" welding nozzle is used.
A **distinction** must be made
 - when determining the pipe wall thickness (Chap. 10.7.2.2 - Working Step 1) (the collar thickness of the reducing double nipple must be included) *1 and
 - when inserting the pipe sensor (Chap. 10.7.2.2 - Working Step 5; Chap. 10.7.2.3 - Working Step 6), as the scaling cannot be used directly as described. Here, the insertion depth must first be determined according to the instructions "Determining the Insertion Depth L" and then used in the respective working step.

*1 measure the collar thickness of the reducing double *ZUB0RED15X1Z* and

write it down. Wrap the two threads with Teflon tape and screw them into the G1½" welding nozzle before further assembly. The **collar thickness** is **included** in the calculation of the insertion depth in the further procedure.

Determining the Insertion Depth L

Factors influencing the insertion depth L



- x Length of the customer's own assembly (e.g. welding nozzle, sleeve etc.);
Alternatively: NIVUS welding nozzle G1½" + NIVUS reducing double nipple
ZUBORED15X1Z
- y Pipe wall thickness
- z Length (= stop ball valve + sensor clamping + 2 pcs. flat gasket = 137 mm;
Alternatively: stop ball valve + sensor clamping + 1 pc. flat gasket)

Fig. 10-49 Factors influencing the insertion depth L

Calculating the Insertion Depth L

$$L = x + y + z$$

➡ Determine and mark the insertion depth

1. Measure the length of the assembly x (if using the reducing double nipple *ZUBORED15X1Z*, include its collar thickness).
2. Determine the pipe wall thickness y.
3. Calculate insertion depth L (see previous calculation).
4. Mark insertion depth L on the pipe sensor (Fig. 10-50) for adjustment after installation.

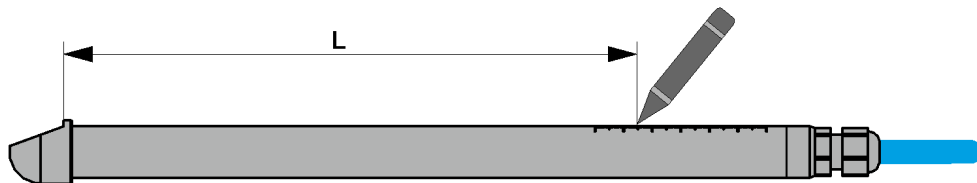


Fig. 10-50 Marking the insertion depth L on the pipe sensor

10.8 Screw-in and plug-in sensors Type NOS

Positioning the sensors on the pipe

To determine the centre of the pipe, a spirit level with spacer is required. Place it on top - at right angles to the pipe run (Fig. 10-51).

Push the two spacers on the right and left of the spirit level outwards as far as possible so that the spirit level itself no longer rests on the pipe, only its spacers.

Now align the spirit level so that it is horizontal. Transfer the spirit level mark to the pipe using a pencil, wax crayon or similar.

Repeat alignment and marking at a distance of 2...3x d (pipe diameter) and connect the two markings. The pipe axis is located along this marking.

Additionally, implementing this procedure on the other side of the pipe leads to a higher accuracy.

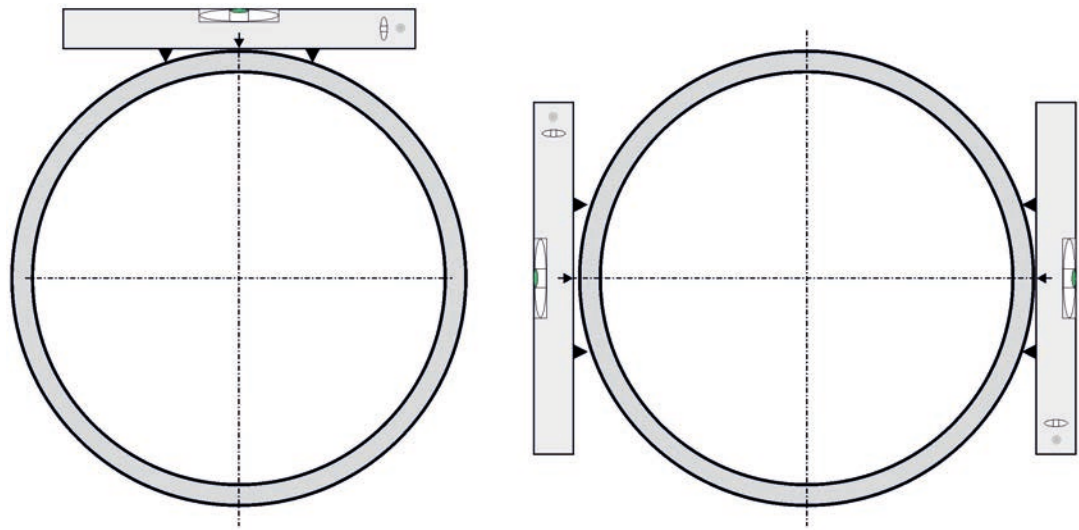


Fig. 10-51 Determining the pipe centre

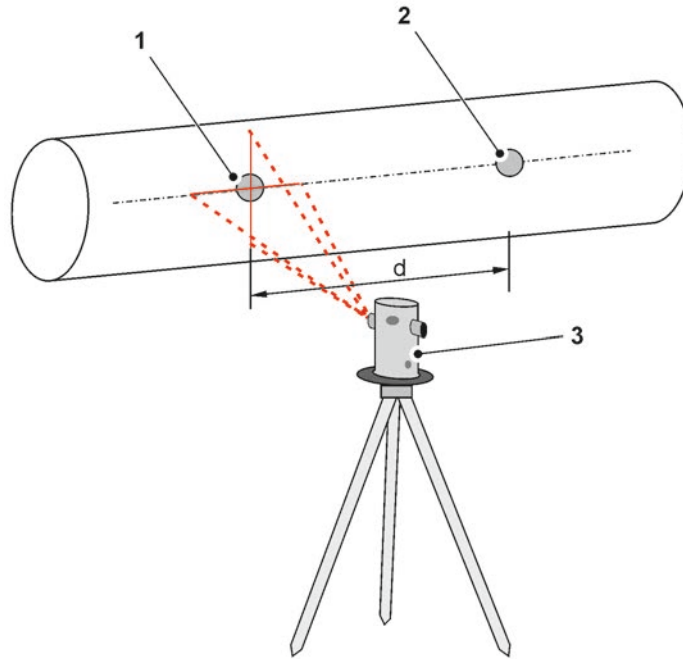
The sensor positions are determined using a laser levelling device (e.g. "Lasermark Gizmo-Lite").

Position 1 (front)

Align the pointer on the horizontal line (pipe centre) (Fig. 10-52) and draw the vertical line on the pipe. The upper point is important for transferring the vertical line to the rear half of the pipe.

Position 2 (front)

Position 2 is drawn on the horizontal line at a distance of 1x d (pipe diameter) from position 1. Again, it is important that the top point of the vertical line is applied to the back half of the pipe.



- 1 Sensor Position 1
- 2 Sensor Position 2
- 3 Laser Levelling Device

Fig. 10-52 Determining the sensor positions 1/2 (front/rear)

Position 1 (rear)

Align the pointer with the vertical and horizontal lines transferred above and draw the vertical line.

Position 2 (rear)

Procedure analogous to position 1 (rear). Between position 1 and position 2 must be the distance d (pipe diameter).

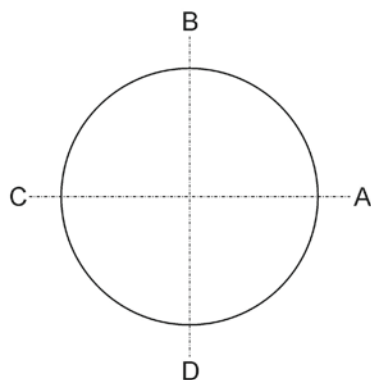


Fig. 10-53 Checking the sensor position distances

The circumference distances between AB and CB must be equal.
If this is not the case, carry out the above procedure again.

If the pipe is accessible all around, also check the distances between AD and CD to see if they are identical to AB and CB.

If not, repeat the measurement as described above.

Positioning a multi-path measurement in the pipe

When measuring more than 2 paths in the pipe in several levels, the screw-in or plug-in sensors must be used at corresponding angles of 18°, 30°, 45° and 54°.

The example below shows the different sensor distances of each path in a 508 mm diameter pipe.

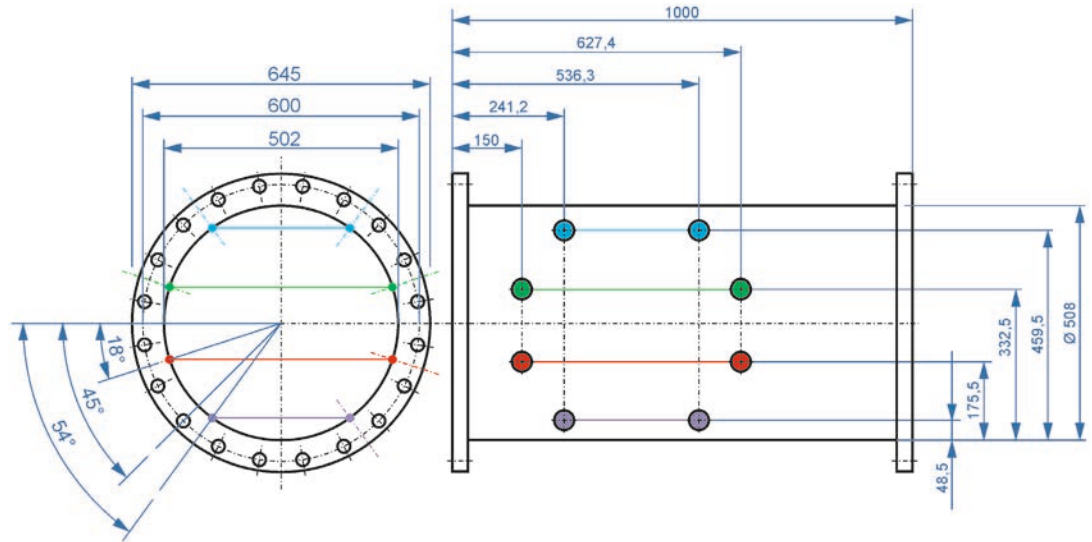


Fig. 10-54 Example positioning a multi-path measurement

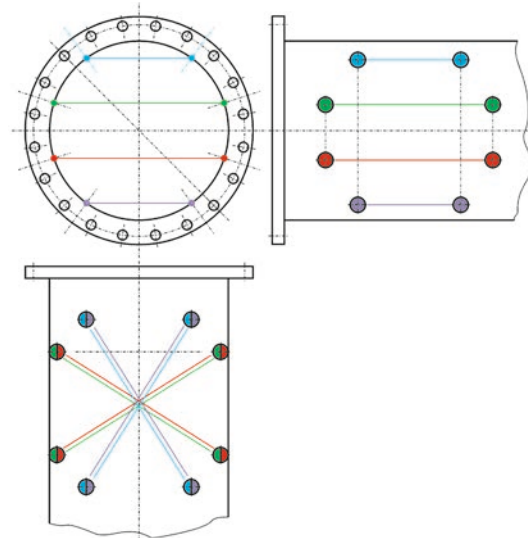


Fig. 10-55 Path courses in the example above

For the screw-in and plug-in sensors type NOS, the same criteria apply for the selection of the measurement place as for the types NIS, NIS0 or TSP0 pipe sensors (see Chap. "10.7 Pipe Sensors Type NIS, Type NIS0 and Type TSP0").

The screw-in and plug-in sensors Type NOS are screwed into 1¼" nozzles and aligned. The drill hole must have a diameter of at least 43 mm.

NIVUS recommends wrapping the thread of the sensors with Teflon cord/tape and applying mounting paste before screwing them in.

This measure prevents "seizing" in the nozzle and, at the same time, it serves to seal the sensors.



Fig. 10-56 Mounting preparation screw-in sensor



Grease thread with grease paste

When mounting pipe sensors, use a special grease paste for stainless steel screw connections according to DIN 2353 (e.g. Volz GmbH Grease Paste 325-250). Slightly grease the thread with it.

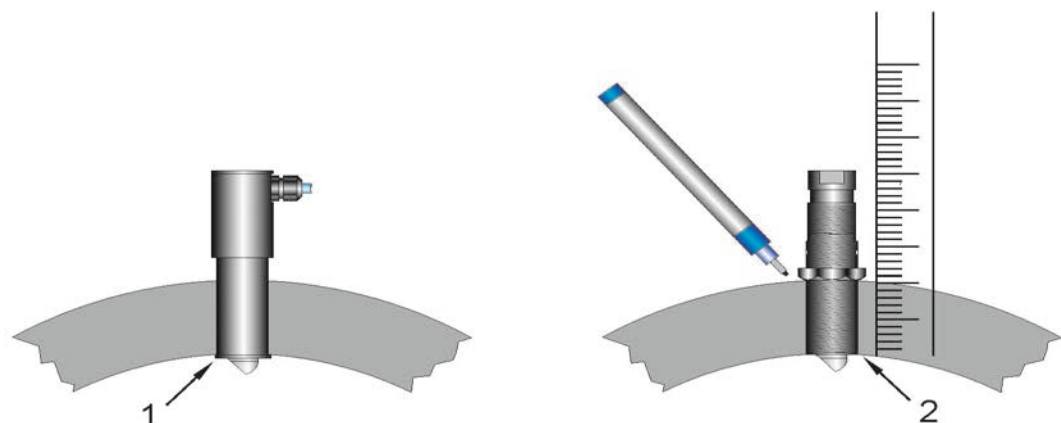
Any grease paste required can be obtained from NIVUS.

When mounting screw-in and plug-in sensors, make sure that the sensor is flush with the inner wall of the pipe. This can be measured beforehand, e.g. with a metre rule, and drawn on the sensor thread in colour with a felt-tip pen (Fig. 10-57). Secure the sensor with a lock nut after screwing it in.



First align the sensor completely, then connect it

The sensor may only be connected after complete alignment (as shown in Fig. 10-60).

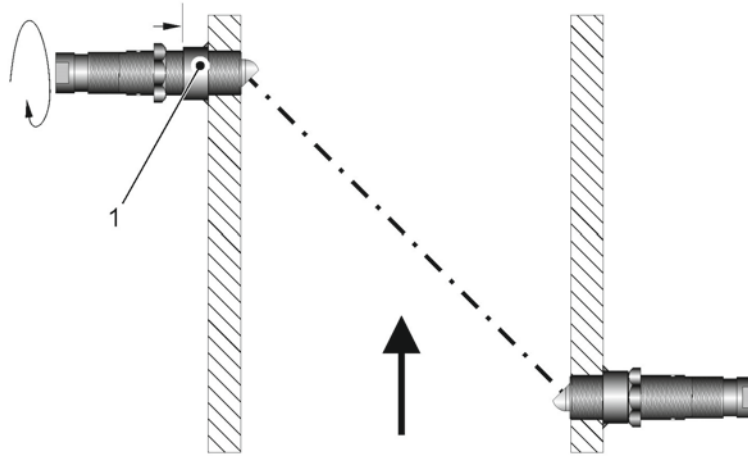


- 1 Insertion sensor with positioning ring (to be mounted from inside)
- 2 Screw-in sensor flush with the inner pipe wall

Fig. 10-57 Determining the sensor position for plug-in/screw-in sensors

➡ Procedure:

1. Screw in the screw-in sensor up to the marking or stop and align it in its beam position. First align the sensor head approximately in or against the direction of flow (Fig. 10-58).



1 1 1/4" Nozzle

Fig. 10-58 Positioning screw-in sensor

2. On the underside of the sensor is a lengthwise groove that runs exactly parallel to the sensor head. Here, mark the alignment of the sensor head with a pencil.

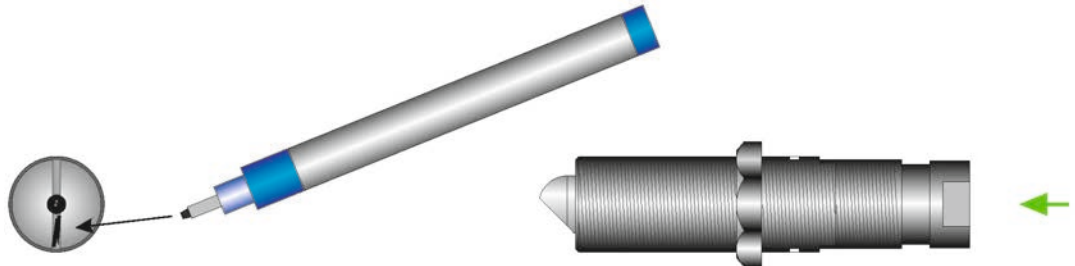
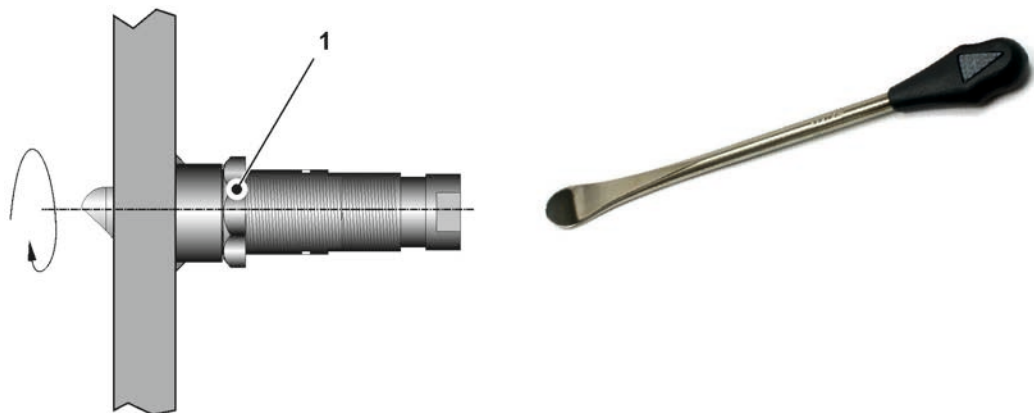


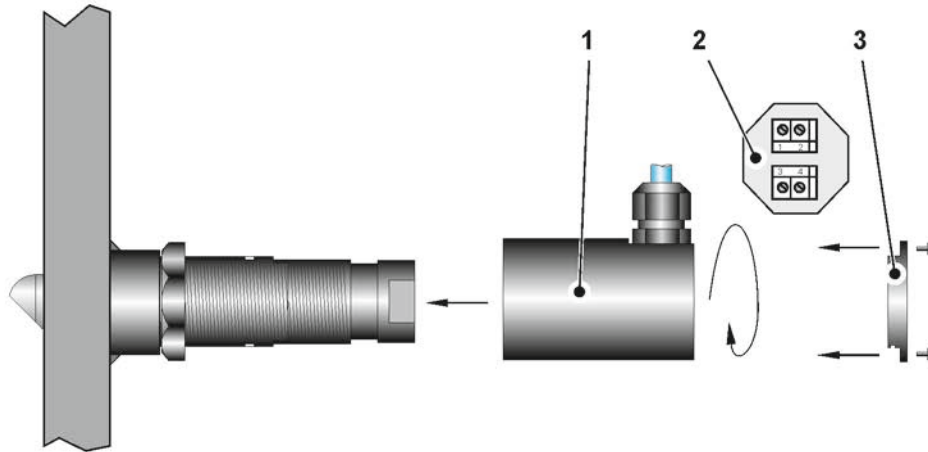
Fig. 10-59 Mark adjustment aid for screw-in sensors

3. Then align the sensor head with the aid of a mounting iron. Make sure that the two sensors are aligned exactly against each other. To do this, the lock nut (Fig. 10-60 Pos. 1) may have to be loosened again slightly.



1 Lock Nut

Fig. 10-60 Sensor alignment screw-in sensor



- 1 Sensor Connection Sleeve
- 2 Connection Board
- 3 Closing Cap

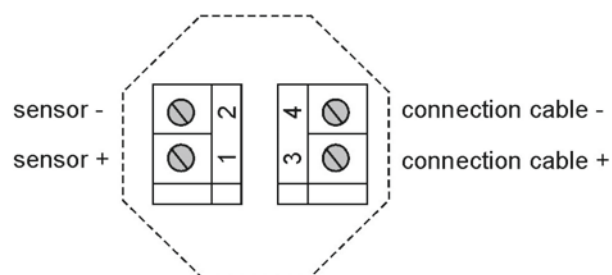
Fig. 10-61 Screwing the sensor connection sleeve on

4. Screw the sensor connection sleeve (without closing cap) onto the sensor as far as it will go. Connect the sensor cables to the connection board as shown in Fig. 10-63.



Fig. 10-62 Cables in sensor connection sleeve

5. Run the sensor line through the screw connection.



- | | | |
|---------|---|--|
| Clamp 1 | = | Sensor + (RD/BK) |
| Clamp 2 | = | Sensor - (BK) |
| Clamp 3 | = | Connection cable + (silver) - to transmitter |
| Clamp 4 | = | Connection cable - (copper) - to transmitter |

Fig. 10-63 Connection board

6. Finally, insert the connection board into the sensor connection sleeve and fasten the cover with two screws on the sensor connection sleeve (Fig. 10-61).

10.9 Clamp-On Sensors Type NIC-CO

10.9.1 Basic Information on Mounting the Clamp-On Sensors

The following points must be observed when **mounting** the clamp-on sensors:

- Clamp-on sensors used must be fixed permanently and reliably. Use only non-corrosive fastening material.
- The sensor mounting must not affect the stability of the pipe under any circumstances.

Prerequisites for good acoustic transmission of the ultrasonic signal are:

- A cleaned, smooth pipe surface:
 - Remove dirt particles, deposits and rust before installation using an orbital sander and sandpaper, sanding brushes, sanding discs or other suitable tools
 - Smooth out paint coats (complete removal of paint is not necessary)
- For reliable sound signal coupling into the medium to be measured, it is necessary to use a suitable acoustic coupling paste. This is to be applied between the sensor surface and the outer wall of the pipe (thin layer). The first delivery includes a tube of coupling paste.
The coupling paste *ZUBOKOP100* can also be reordered from NIVUS at a charge. Alternatively, you can also use the coupling pads *ZUBOKOP1001* (for Type *NIC-CO01*) and *ZUBOKOP1002* (for Type *NIC-CO50*) which either are supplied with the sensors and the fastening system or can be purchased from NIVUS at extra costs.
- The material and wall thickness of the pipe must be known or determined, as these are included in the parameterisation of the respective transmitter and indirectly also determine the mounting distance of the two sensors. The wall thickness can be determined, for example, with the wall thickness gauge *NBMOTG* by NIVUS.
Various common materials are already stored in the menu of the respective transmitter and can also be selected directly there.
The suitability of other pipe materials must be agreed with NIVUS before commissioning.



Parameterise the transmitter beforehand

Before mounting the clamp-on sensors, the transmitter must be parameterised.

The transmitter calculates the required sensor distance. This sensor distance must be pre-set during sensor installation.



Also observe the operating instructions for the corresponding transmitter.

10.9.2 Mounting Options

The clamp-on sensors can be attached to the pipes in various ways. These are described in the following chapters.

- Direct sensor mounting with tensioning belts (see Chap. "10.9.2.1 Direct Mounting of Clamp-On Sensors with Tensioning Belts")
- Mounting the sensors with movable sensor shoes (with and without scale bar) (see Chap. "10.9.2.2 Mounting the clamp-on sensors with movable sensor shoes (only NIC-CO01)")
- Sensor mounting with fastening rail(s) (see Chap. "10.9.2.3 Clamp-on sensor mounting with fastening rail(s)")

10.9.2.1 Direct Mounting of Clamp-On Sensors with Tensioning Belts

Use the optionally supplied tensioning belts, the metal band or the stainless steel cables (see Chapter "20 Fastening system for NIC-CO clamp-on sensors") (each with suitable fasteners) to attach the sensor.

These belts/cables can be purchased from NIVUS at extra costs. For details of the respective version and dimensions, see Chap. "20 Fastening system for NIC-CO clamp-on sensors": Tab. 6 Fastening elements.

Please contact NIVUS Eppingen or your local representative directly for article numbers and prices.

Alternatively, own fastening variants can be chosen, whereby these must also meet the requirements described in Chapter "10.9.1 Basic Information on Mounting the Clamp-On Sensors".

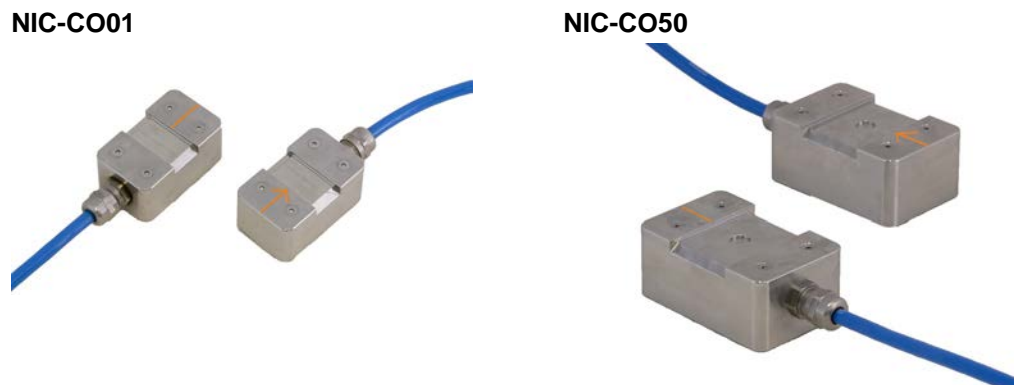


Fig. 10-64 Clamp-on sensor pairs

Installation

➤ Preconditions:

- The sensors are connected.
- The transmitter/measurement place is parameterised.
- The sensor position is specified.

➤ Procedure:

1. Determine the outer pipe diameter/circumference and provide tensioning belts or the metal band in the appropriate length.
For the metal band, the appropriate length is approx. 60 mm longer than the determined pipe circumference.
2. Grease the first sensor head (contact surface) with coupling grease (thin layer) or place a coupling pad underneath.
3. Place the sensor at the determined sensor position and lead the tensioning belt/metal band around the sensor (use the guide surface on the sensor for alignment).
Make sure that
 - the **arrow** engraved on the sensor pair (see Fig. 10-64) points in the direction of flow.
 - the **sensor cable** must always point "outwards" and that the ultrasound direction points to the second sensor of the measurement.
4. Close and tighten the tensioning belts or metal band according to the following steps 5 or 6.
5. Insert the **tensioning belt** into the fastener and tighten it using the ratchet function.
Make sure that the sensor is aligned lengthwise on the pipe.
Proceed with working step 7.

6. Bend the **metal band** approx. 30 mm at one end and hook it into the endless clamp. Insert the other end into the screw and turn it with a slotted screwdriver or an SW10 spanner until the metal band is tight. Bend the free end inwards to prevent injury (shorten a little beforehand if necessary). Make sure that the sensor is aligned lengthwise on the pipe. Proceed with working step 7.
7. Proceed in the same way as before and mount the second sensor parallel to the pipe. The required distance between the sensors is specified by the parameterised transmitter and must be confirmed by a trial measurement. Correct the sensor position if necessary.

Cleaning

1. Mark the sensor position on the pipe for later reinstallation.
2. Remove the sensors from the pipe and clean.
3. After cleaning grease with coupling grease (thin layer) or place new coupling pads underneath.
4. Reattach and align the sensors according to the previous procedure.

10.9.2.2 Mounting the clamp-on sensors with movable sensor shoes (only NIC-CO01)



Fig. 10-65 Clamp-on sensor pair NIC-CO01

Use the optionally supplied tensioning belts, the metal band or the NIVUS measuring bar (see Chapter "20 Fastening system for NIC-CO clamp-on sensors"). The measuring bar can only be used if both clamp-on sensors are mounted on the same side of the pipe (with V-arrangement).

The fastening system can be ordered from NIVUS at extra costs. The components can be variably combined, depending on the measurement place (pipe diameter, accessibility, etc.) and the sensors used (*NIC-CO01* or *NIC-CO50*) (see Chap. "20 Fastening system for NIC-CO clamp-on sensors": Tab. 6 Fastening elements).

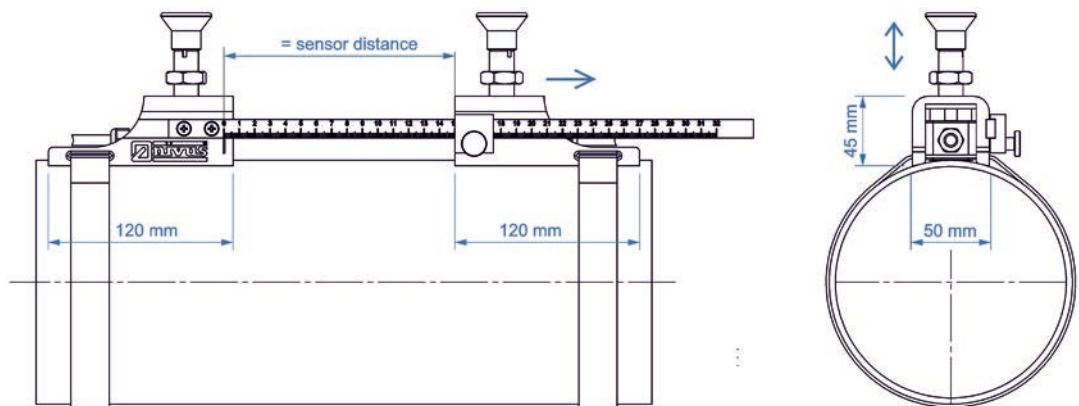


Fig. 10-66 Dimensions of the ZUB-CORA00101 / RA00102 fastening system

Installation

- ➡ Preconditions:
- The sensors are connected.

- The transmitter/measurement place is parameterised.
- The sensor position is specified.

➡ Procedure:

1. Determine the outer pipe diameter/circumference and provide tensioning belts or the metal band in the appropriate length.
For the metal band, the appropriate length is approx. 60 mm longer than the determined pipe circumference.
2. Screw in the threaded sleeve (Fig. 10-67 Pos. 1) on the locking bolt until it is clearly visible 1...2 mm below the inner edge (Fig. 10-67, green line) of the sensor shoe (Fig. 10-67 Pos. 3).
3. Place the lock nut (Fig. 10-67 Pos. 2) on the sensor shoe by hand.

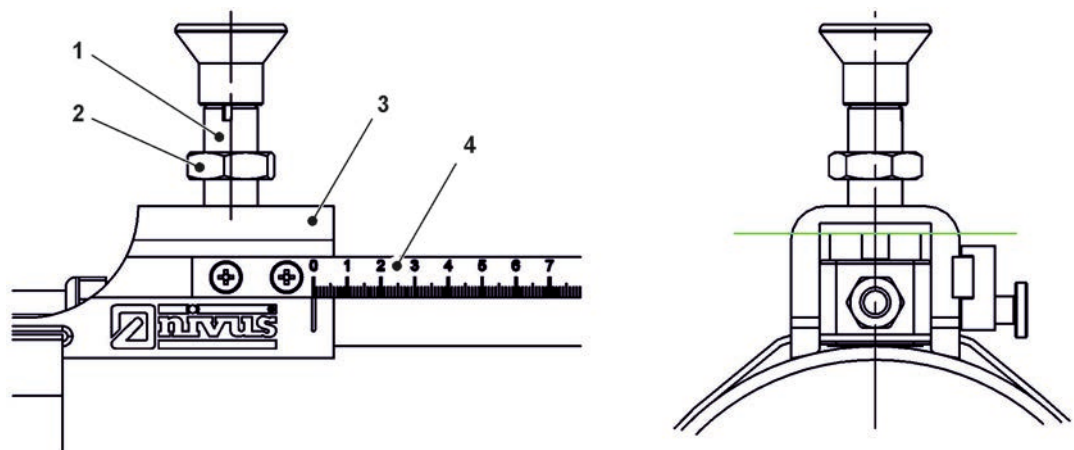


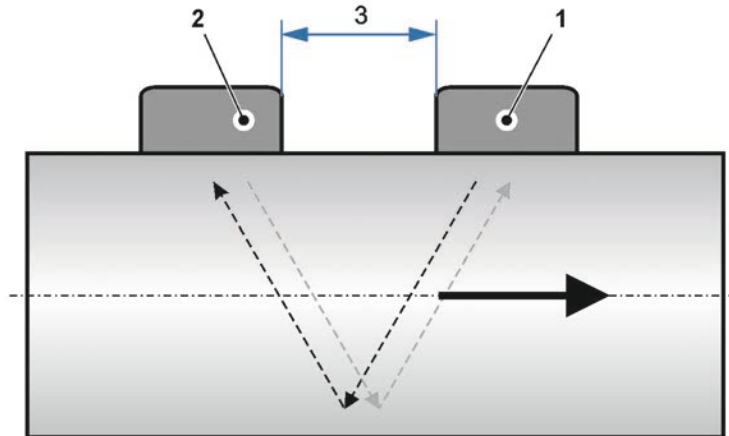
Fig. 10-67 Install the fastening system

4. Place the first sensor shoe at the determined sensor position and guide the tensioning belt/metal band through the guide in the sensor shoe.
5. Close and tighten the tensioning belts or metal band according to the following steps 6 or 7.
6. Insert the **tensioning belt** into the fastener and tighten it using the ratchet function.
The sensor shoe aligns itself lengthwise on the pipe due to its shape.
Proceed with working step 8.
7. Bend the **metal band** approx. 30 mm at one end and hook it into the endless clamp. Insert the other end into the screw and turn it with a slotted screwdriver or an SW10 spanner until the metal band is tight. Bend the free end inwards to prevent injury (shorten a little beforehand if necessary).
The sensor shoe aligns itself lengthwise on the pipe due to its shape.
Proceed with working step 8.
8. Grease the sensor head (contact surface) with coupling grease (thin layer) or place a coupling pad underneath.
9. Pull up the locking bolt and push the sensor into the sensor shoe as far as it will go.
Make sure that
 - the **arrow** engraved on the sensor pair (see Fig. 10-65) points in the direction of flow.
 - the **sensor cable** must always point "outwards" and that the ultrasound direction points to the second sensor of the measurement.
10. Release the locking bolt again. The sensor is clamped in the groove (top side of sensor) by the spring pressure.
11. Proceed in the same way as before and mount the second sensor shoe parallel to the pipe. The required distance (Fig. 10-68/Fig. 10-69 Pos. 3) between the sensors is specified by the parameterised transmitter and must be confirmed by a trial measurement before fastening.
With a **V-arrangement**, the distance can be read off the measuring bar

(Fig. 10-67 Pos. 4). The measuring bar is attached in such a way that the front edge of the sensor shoe of sensor 2 corresponds exactly to the distance to be set on the measuring bar (Fig. 10-66).

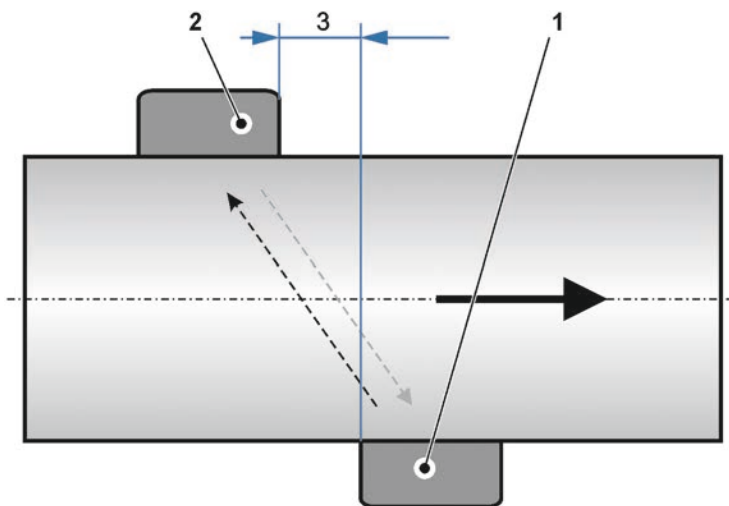
With a **V-arrangement**, the distance must be determined and set without the support of the measuring bar (Fig. 10-67 Pos. 4), as the two sensors are mounted on opposite sides of the pipe (Fig. 10-69).

12. Insert the second sensor and carry out a new test measurement. If necessary, loosen the second sensor shoe again and correct the position.



- 1 Sensor 1
- 2 Sensor 2
- 3 Required distance between the sensors

Fig. 10-68 1-Path measurement, path arrangement: side by side (V-arrangement) (principle)



- 1 Sensor 1
- 2 Sensor 2
- 3 Required distance between the sensors

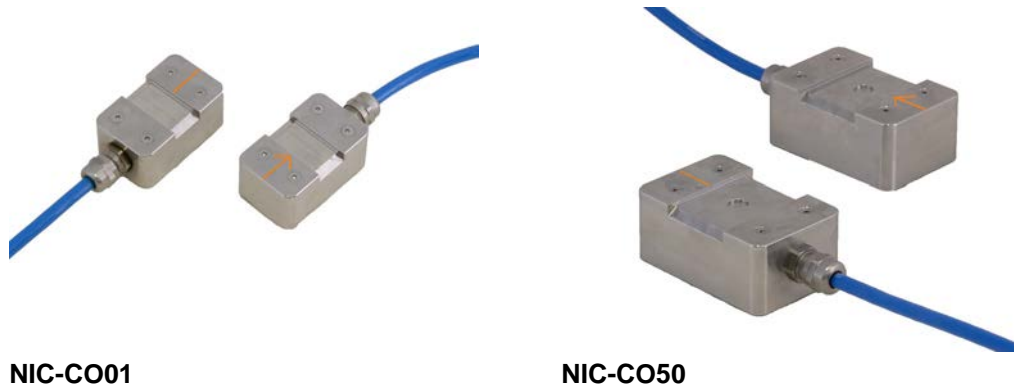
Fig. 10-69 1-Path measurement, path arrangement: diagonal (V-arrangement) (principle)

Cleaning

1. Mark the sensor position on the pipe for later reinstallation.
2. Pull up the respective locking bolt and pull the sensor backwards out of the sensor shoe.

3. After cleaning, grease with coupling grease (thin layer) or reinsert with new coupling pads underneath up to the stop.
The position and adjustment of the sensors remain unchanged.

10.9.2.3 Clamp-on sensor mounting with fastening rail(s)



NIC-CO01

NIC-CO50

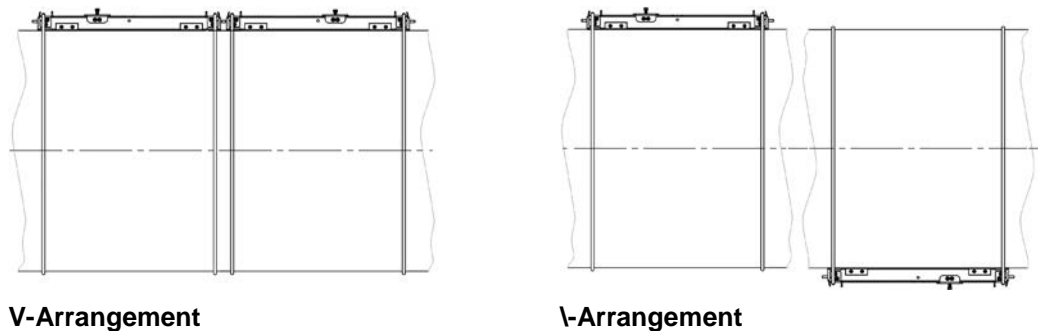
Fig. 10-70 Clamp-on sensor pairs

For sensor mounting, use the mounting rails and the optionally supplied tensioning belts / the metal strap with the clamp belt pairs or the stainless steel cables with clamping element NIVUS (see Chap. "20 Fastening system for NIC-CO clamp-on sensors").
The mounting rail (one or two) can be used with V-arrangement and with \-arrangement.

- **V-Arrangement:** Both clamp-on sensors are mounted on the same side of the pipe and are fixed with one or two mounting rails, depending on the pipe diameter (following table) (Fig. 10-71 Figure 1).

	NIC-CO01	NIC-CO50
1 Mounting Rail	< DN400	< DN650
2 Mounting Rails	> DN400	> DN650

- **\-Arrangement:** The clamp-on sensors are each mounted in a mounting rail on opposite sides of the pipe (Fig. 10-71 Figure 2).



V-Arrangement

\-Arrangement

Fig. 10-71 Mounting rails with different arrangements

The fastening system can be ordered from NIVUS at extra costs. The components can be variably combined, depending on the measurement place (pipe diameter, accessibility, etc.) and the sensors used (*NIC-CO01* or *NIC-CO50*) (see Chap. "20 Fastening system for NIC-CO clamp-on sensors": Tab. 6 Fastening elements).

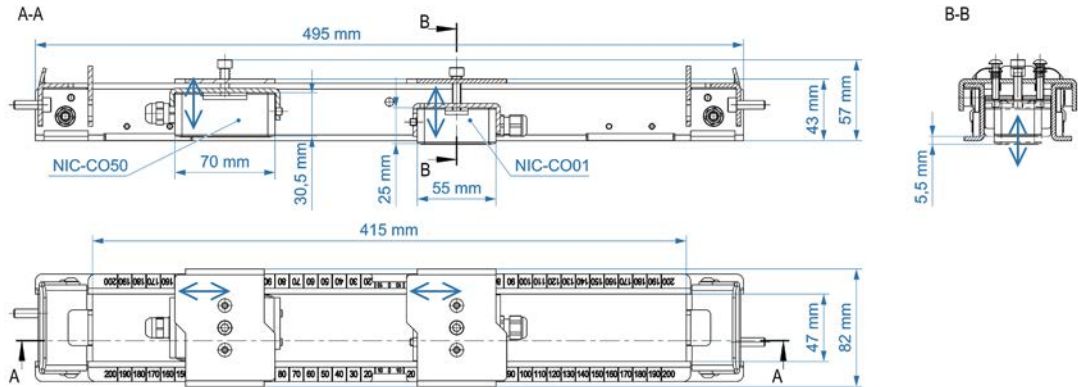


Fig. 10-72 Dimensions mounting rail from ZUB-CORA00103 / RA00104

Installation

➤ Preconditions:

- The sensors are connected.
- The transmitter/measurement place is parameterised.
- The sensor position is specified.

➤ Procedure:

1. Pull cover(s) (Fig. 10-73) off the mounting rail(s) (not screwed, only clamped).

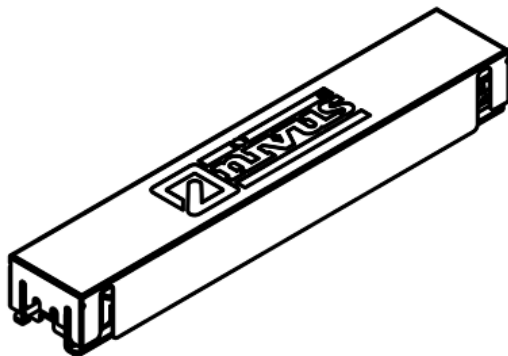


Fig. 10-73 Cover

2. Determine the outer pipe diameter/circumference and provide tensioning belts or the metal band or stainless steel cables in the appropriate length. For the metal band, the appropriate length is approx. 60 mm longer than the determined pipe circumference.
3. If two mounting rails are used in a V-arrangement (see info table on page 64 earlier in the chapter), connect them together for pre-alignment with the connecting screws M6x20 (Fig. 10-74 Pos. 5) (insert; screwing with nuts is possible, but not required).

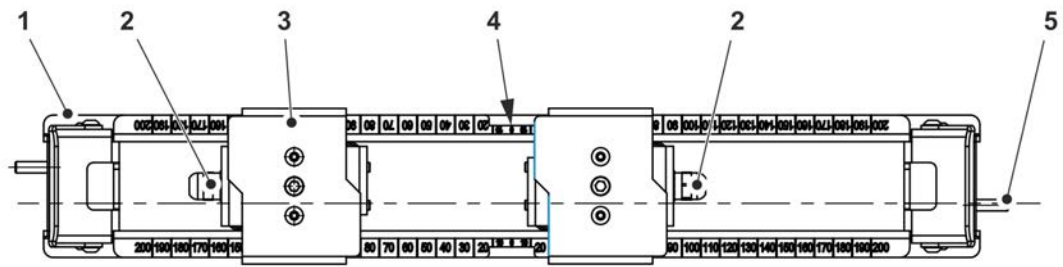


Fig. 10-74 Inserting the sensors

4. Insert tensioning belts, metal straps or stainless steel cables (2 each per mounting rail) in the guides on the mounting rail.
5. Place the mounting rail at the appropriate position on the pipe, ensuring that any coupling pads used rest on the pipe.
6. Close and tighten the tensioning belts or metal band or stainless steel cables according to the working steps 7 or 11 or 12.
7. Insert the **tensioning belt** into the fastener and tighten it using the ratchet function.
Proceed with working step 13.
8. Insert the sensors into the appropriate sensor holder (Fig. 10-72, Fig. 10-74 Pos. 3).
9. Grease the sensor heads (contact surfaces) with coupling grease (thin layer) or place a coupling pad underneath.
10. Insert the sensors in the sensor holder (Fig. 10-74 Pos. 3) at the centre recess (at the scale zero point) (Fig. 10-74 Pos. 4) in the mounting rail (Fig. 10-74 Pos. 1).
Make sure that
 - the **arrow** engraved on the sensor pair (see Fig. 10-70) points in the direction of flow.
 - the **sensor cable** (Fig. 10-74 Pos. 2) must always point "outwards" and that the ultrasound direction points to the second sensor of the measurement.
11. Bend the **metal band** approx. 30 mm at one end and hook it into the endless clamp. Insert the other end into the screw and turn it with a slotted screwdriver or an SW10 spanner until the metal band is tight. Bend the free end inwards to prevent injury (shorten a little beforehand if necessary).
Proceed with working step 13.
12. Close the **stainless steel cable** (Fig. 10-75 Pos. 4) with the associated tensioning system:
One side of the stainless steel cable is connected to the tension lock ex works, the other side is open. Turn the lock nut (Fig. 10-75 Pos. 7) on the tension lock to the end of the threaded rod (Fig. 10-75 Pos. 6). Place the open end of the stainless steel cable around the free bolt (Fig. 10-75 Pos. 5) on the tension lock and place the stainless steel cable on the pipe. Make sure that the second lock nut (Fig. 10-75 Pos. 9) does not touch the pipe (if necessary, turn it in the direction of the bolt on the tension lock). To secure the stainless steel cable, the four cable clamps supplied must be fastened at a distance of approx. 30 mm from each other. To do this, place the U-shaped threaded rod (Fig. 10-75 Pos. 3) around the stainless steel cable (double in this case), place the holder (Fig. 10-75 Pos. 2) on top and firmly connect the two parts by tightening the nuts (Fig. 10-75 Pos. 1).
Screw in the lock nut (Fig. 10-75 Pos. 7) on the threaded rod (Fig. 10-75 Pos. 6) until it contacts the bolt (Fig. 10-75 Pos. 8) on the tension lock. Be careful that the tension of the stainless steel cable does not become too tight and accidentally deforms the mounting rail.
Place the second lock nut (Fig. 10-75 Pos. 9) on the bolt from the other side. Position the protruding stainless steel cable in such a way that there is no risk of injury.
Proceed with working step 13.

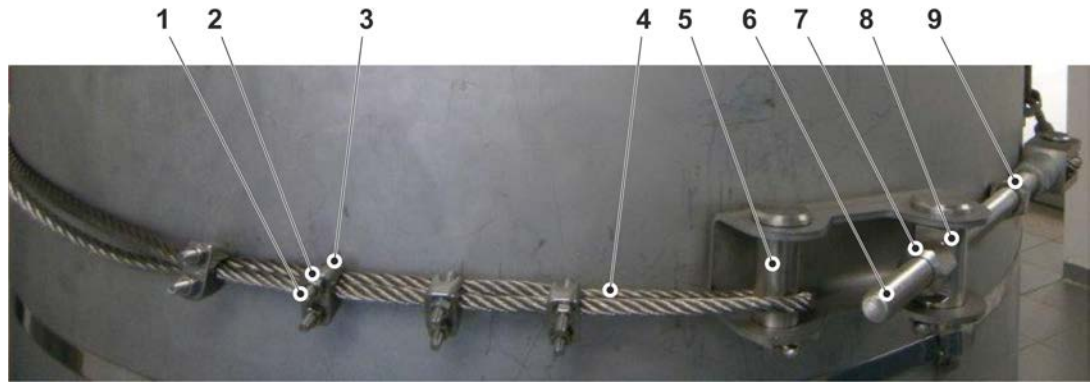


Fig. 10-75 Tensioning the stainless steel cable

13. If necessary, proceed in the same way for the second mounting rail.
14. Move the sensor holders (Fig. 10-76 Pos. 1) using the scale (Fig. 10-76 Pos. 4) to adjust the sensor position.
The correct distance (Fig. 10-76) between the sensors is specified by the connected transmitter.
See the corresponding operating instructions of the measuring transmitter.

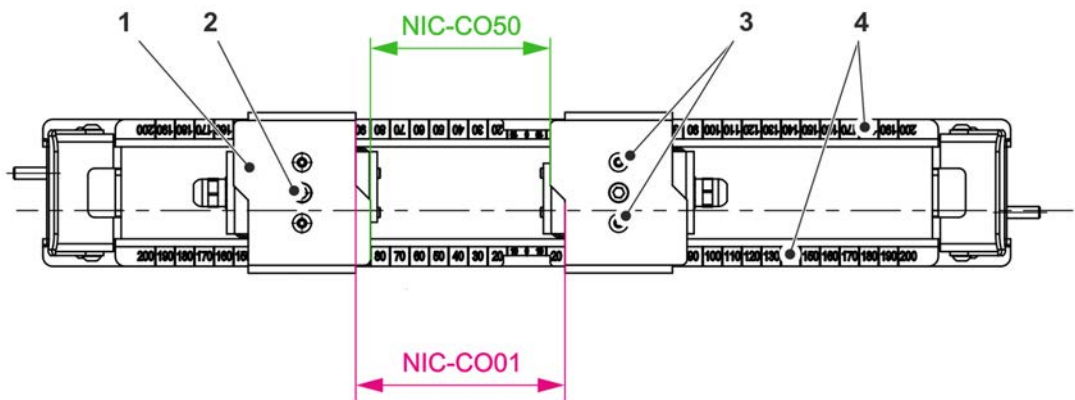
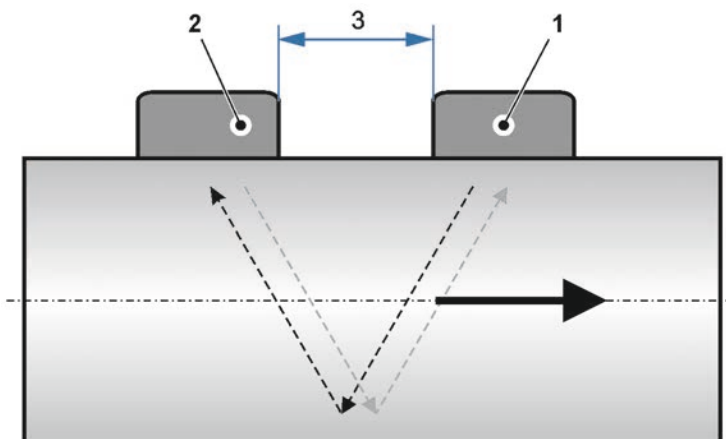


Fig. 10-76 Distance of the sensors

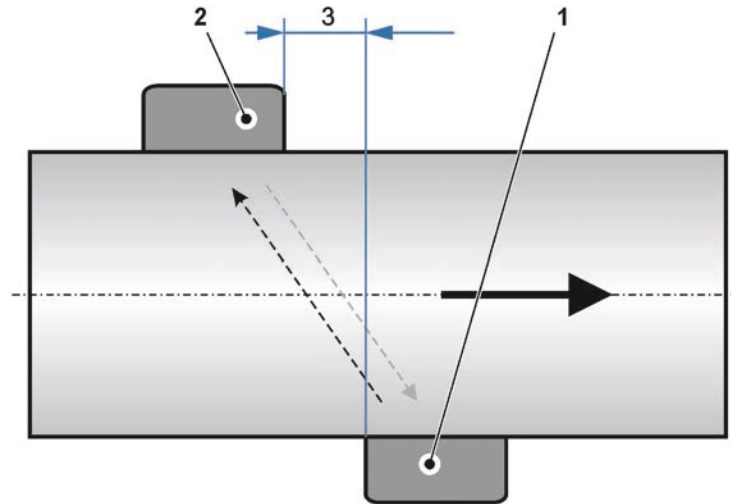
15. Press the sensors onto the pipe by screwing in the cylinder head screws M6 (Fig. 10-76 Pos. 2) so that the ultrasonic signals can be reliably applied and received.
Attention: Do NOT adjust the two factory mounting screws (Fig. 10-76 Pos. 3).
16. Perform test measurement and correct adjustment if necessary.



- 1 Sensor 1 (shown without sensor holder)
- 2 Sensor 2 (shown without sensor holder)

- 3 Required distance between the sensors/sensor holders (see Fig. 10-76)

Fig. 10-77 1-Path measurement, path arrangement: side by side (V-arrangement) (principle)



- 1 Sensor 1 (shown without sensor holder)
- 2 Sensor 2 (shown without sensor holder)
- 3 Required distance between the sensors/sensor holders (see Fig. 10-76)

Fig. 10-78 1-Path measurement, path arrangement: diagonal (\-arrangement) (principle)

17. Attach the covers of the sensor holders, taking care not to pinch the sensor cables.

Cleaning

1. Remove cover(s) from the mounting rail(s).
2. Mark the sensor position on the pipe for later reinstallation.
3. Loosen cylinder head screw(s) M6 (Fig. 10-76 Pos. 2) on the sensor holders.
Attention: Do NOT adjust the two factory mounting screws (Fig. 10-76 Pos. 3).
4. Move the sensor holder(s) and remove them from the mounting rail(s) (Fig. 10-74 Pos. 1) at the centre recess (at the scale zero point) (Fig. 10-74 Pos. 4).
5. Remove sensor(s) from the sensor holders and clean them.
6. After cleaning grease with coupling grease (thin layer) or place new coupling pads underneath.
7. Reattach and align the sensors according to the previous procedure.
8. Attach the cover(s) of the sensor holder(s), taking care not to pinch the sensor cables.

11 Sensor Alignment

11.1 General

Precise sensor alignment is very important for error-free functioning of the transit time measurement.

The transmitting surfaces of the respective sensors must "see" each other in both directions (with and against the flow direction).



Align the sensors accurately

The flow velocity sensors of each path must be exactly aligned against each other.

For measurement places where the sensor beam point is accessible, NIVUS recommends using a laser distance meter (e.g. Bosch DLE) or a theodolite system for sensor alignment.

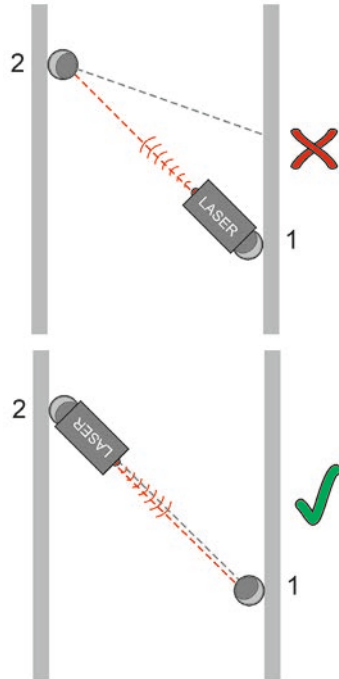


Fig. 11-1 Laser distance meter for sensor alignment

The laser distance meter must be placed exactly on the transmitting surface of the sensor so that the laser beam can be aligned with the opposite sensor.

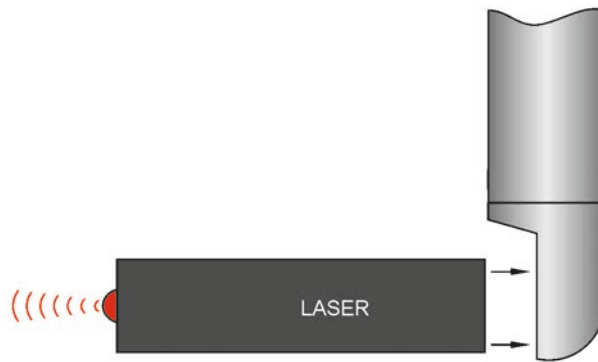
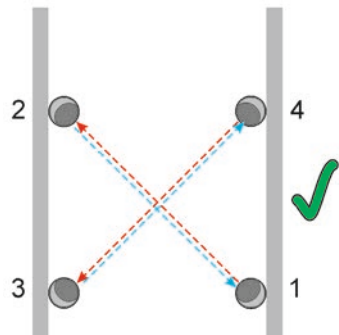


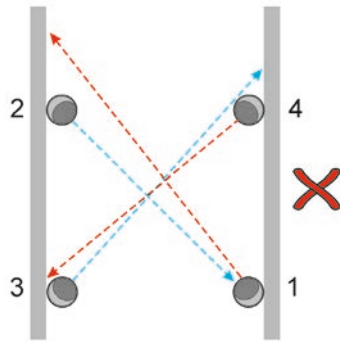
Fig. 11-2 Putting the laser distance meter exactly onto the transmitting surface

Proceed in the same way with the second sensor. This is the only way to ensure that the transmitting surfaces of the two sensors are exactly opposite each other.



Correct:

All 4 sensors are aligned against each other



Error:
Sensors are not aligned against each other

Fig. 11-3 Schematic representation of sensor alignment

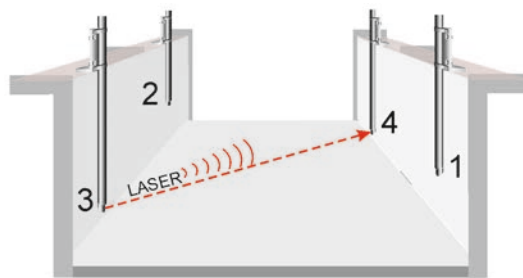


Fig. 11-4 Sensor alignment example

At measurement places where the sensor beam point is not accessible, the measurement of the measurement place and the mounting of the sensor holders must be carried out very precisely.

11.2 Rod Sensors

When using rod sensors, these can then be aligned against each other from above by slightly turning or moving them up/down and simultaneously observing the signal strength on the transmitter.

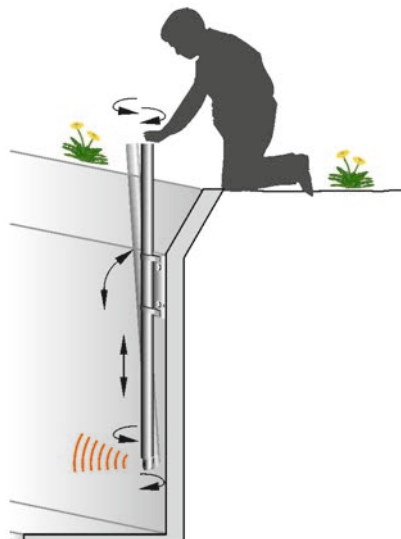


Fig. 11-5 Sensor alignment rod sensors horizontal and vertical

11.3 Wedge Sensors

Wedge sensors **cannot** be aligned **after** mounting. These must be mounted so that the sensor surfaces are precisely aligned against each other. Therefore, use a laser distance meter for the assembly.

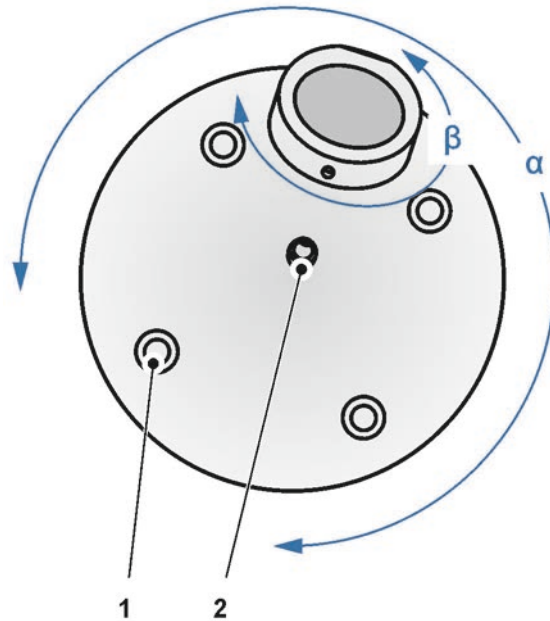
11.4 Hemisphere Sensors

Sensor on mounting plate

To adjust the angle α , loosen the four screws (Fig. 11-6 Pos. 1) with a hexagon socket spanner 5 mm and tighten them again after the adjustment.

Sensor head

To adjust the angle β , loosen the four screw (Fig. 11-6 Pos. 2) with a hexagon socket spanner 4 mm and tighten them again after the adjustment.



- α = Sensor rotatable on the mounting plate
- β = Sensor head rotatable in itself
- 1 = 4x screw to tighten the sensor - loosen to adjust the angle α
- 2 = 1x screw to tighten the sensor head on the sensor - loosen to adjust the angle β

Fig. 11-6 Sensor alignment hemisphere sensor

11.5 Ball Sensors

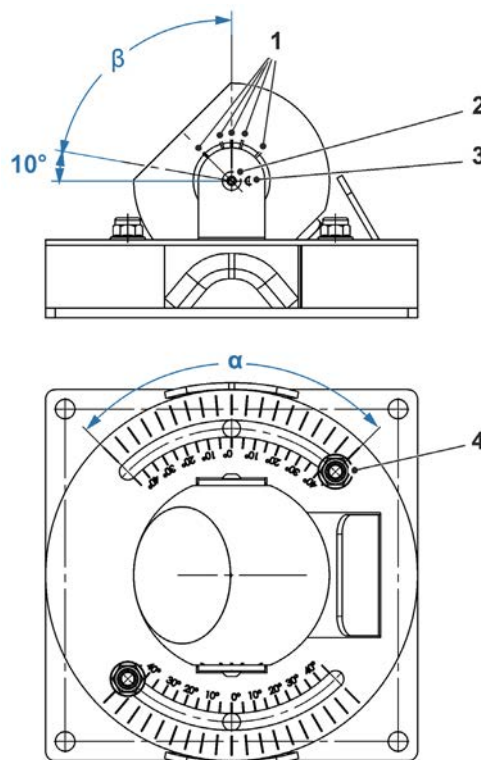
Sensor holder on mounting plate

To adjust the angle α , loosen the two nuts (Fig. 11-7 Pos. 4), rotate the sensor holder and tighten the two nuts again after the adjustment.

Sensor head

To adjust the angle β , loosen the hexagon socket pins (Fig. 11-7 Pos. 3) and the pan-head screws (Fig. 11-7 Pos. 2) on both sides with a hexagon socket spanner. Tilt the sensor head and after adjustment first retighten the pan-head screws and then secure the sensor head by tightening the hexagon socket pins.

For a rough orientation there are markings (Fig. 11-7 Pos. 1) on the side of the sensor head. These are at 0°, 30°, 45°, 60° and 90° to the horizontal.

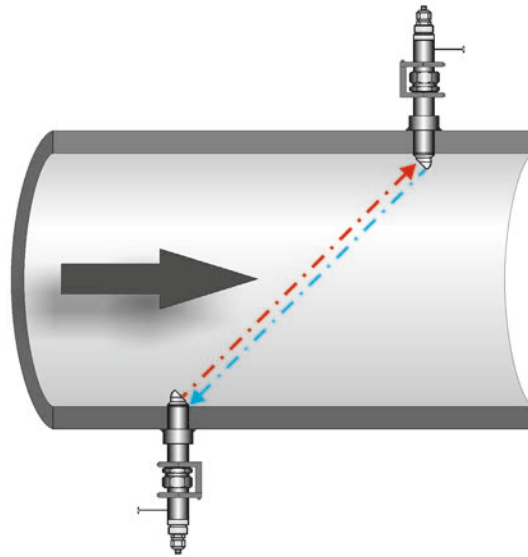


- α = Sensor holder rotatable on mounting plate (+/- 45°)
- β = Sensor head tilting (range max. 80°; tilt at least 10° to the horizontal to ensure correct function)
- 1 = Markings at 0°, 30°, 45°, 60° and 90° to the horizontal
- 2 = 2x hexagon socket pin to secure the sensor head - loosen to adjust the angle β
- 3 = 2x Pan-head screw to tighten the sensor head on the sensor - loosen to adjust the angle β
- 4 = 2x nut to tighten the sensor holder - loosen to adjust the angle α

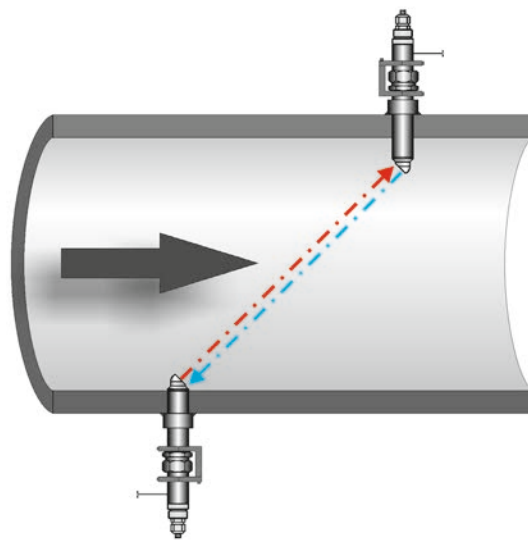
Fig. 11-7 Sensor alignment ball sensors Type NOS0H2V200 / NOS0H2V500

11.6 Pipe, screw-in and plug-in sensors Type NOS

In closed pipelines, both sensors of each path must be aligned against each other by slightly rotating the sensors. If the sensor nozzles are mounted slightly too short (too short a distance) on the pipe, it may be possible to increase the signal strength by pushing the sensor slightly into the pipe. This compensates for any incorrect sensor distance.



Sensor alignment with exact sensor nozzle installation



Sensor alignment with inaccurate sensor nozzle installation

Fig. 11-8 Sensor alignment in pipelines by inserting

Accessories and Installation Aids

12 Holding Brackets and Flow Protection Sheet for Rod Sensors

Two holder variants are available for fastening the NOS rod sensors:

- Fastening on a vertical wall (*NOZ00HAL0*)
- Fastening to a horizontal wall crown with a minimum width of 400 mm (*NOZ00HAL90*)

The following mounting material is included with the respective holder:

- 4x hexagon socket screw M12x30
- 4x dowel SX 12x60
- 4x washer

For secure fastening of the sensor:

- 4x adjustment screw M12
- 4x lock nut M12



Mount holder brackets vertically

When mounting, install the holder brackets exactly vertically with the aid of a spirit level.

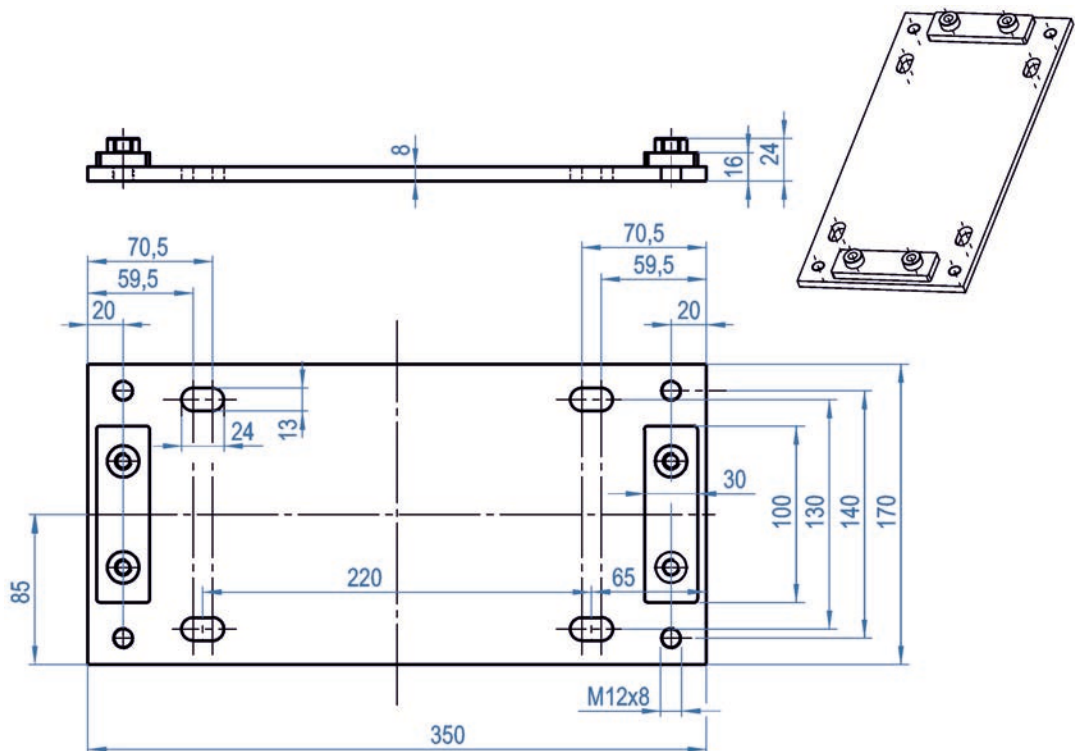


Fig. 12-1 Holder bracket (*NOZ00HAL0*) for rod sensors

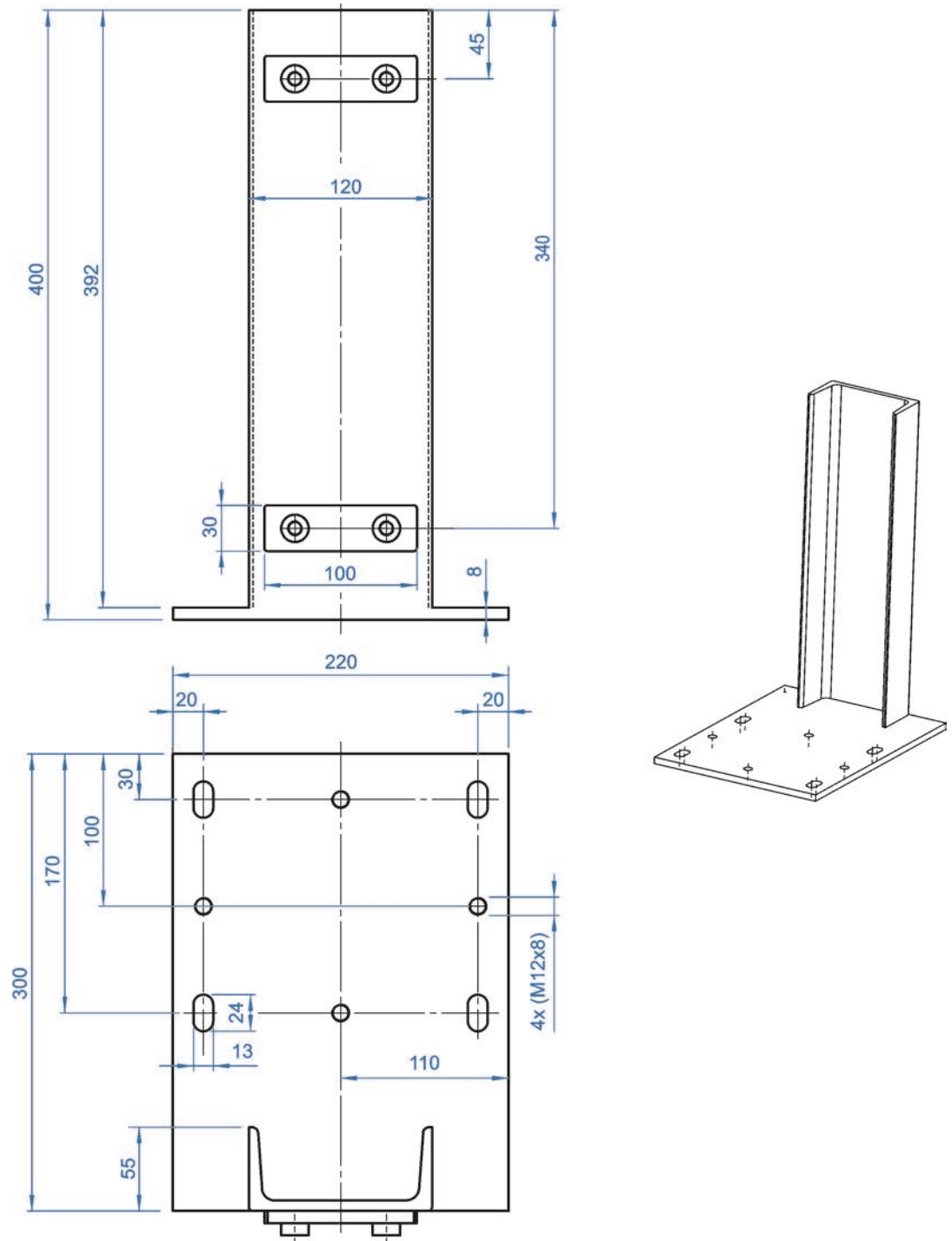


Fig. 12-2 Holder bracket (NOZ00HAL90) for rod sensors

Flow Protection Sheet for Rod Sensors

Streamlined protection sheets in lengths 1300/3000 mm are available for the rod sensors. These protection sheets are needed in case of high flow speeds (risk of vibration) and/or flotsam (risk of build-up).

The fastening is carried out by means of an M8 drop-in anchor with the aid of a hammer tool.

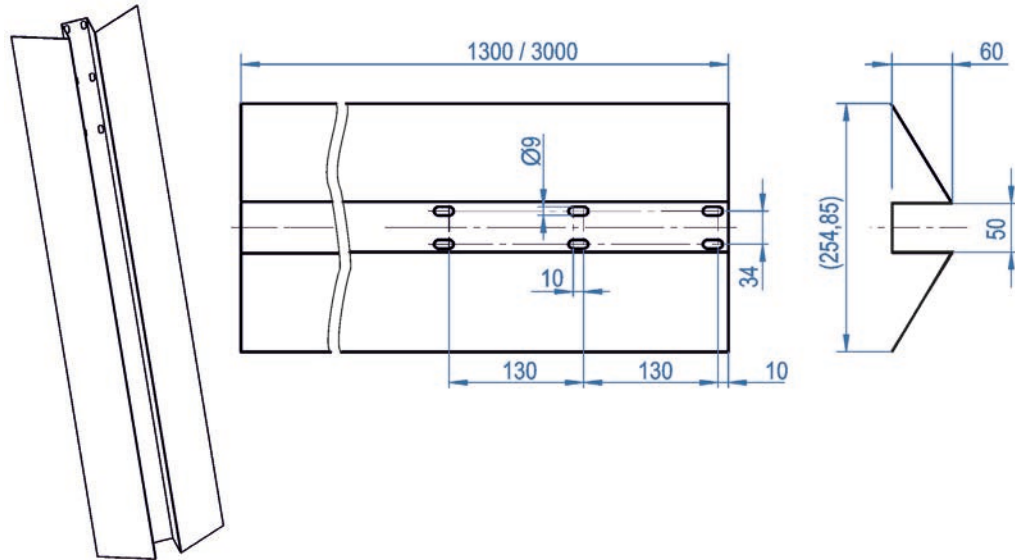


Fig. 12-3 Flow protection sheet for rod sensors

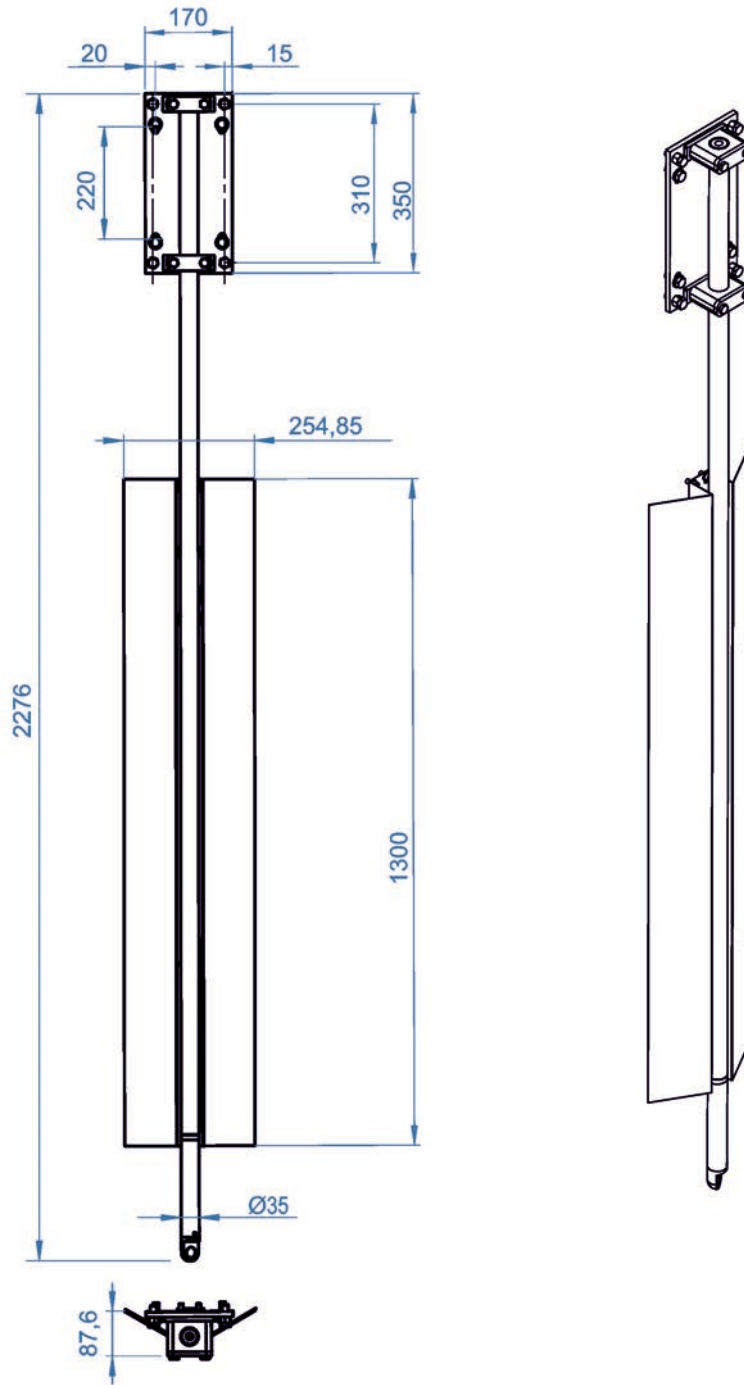


Fig. 12-4 Holder bracket (NOZ00HAL0) with flow protection sheet

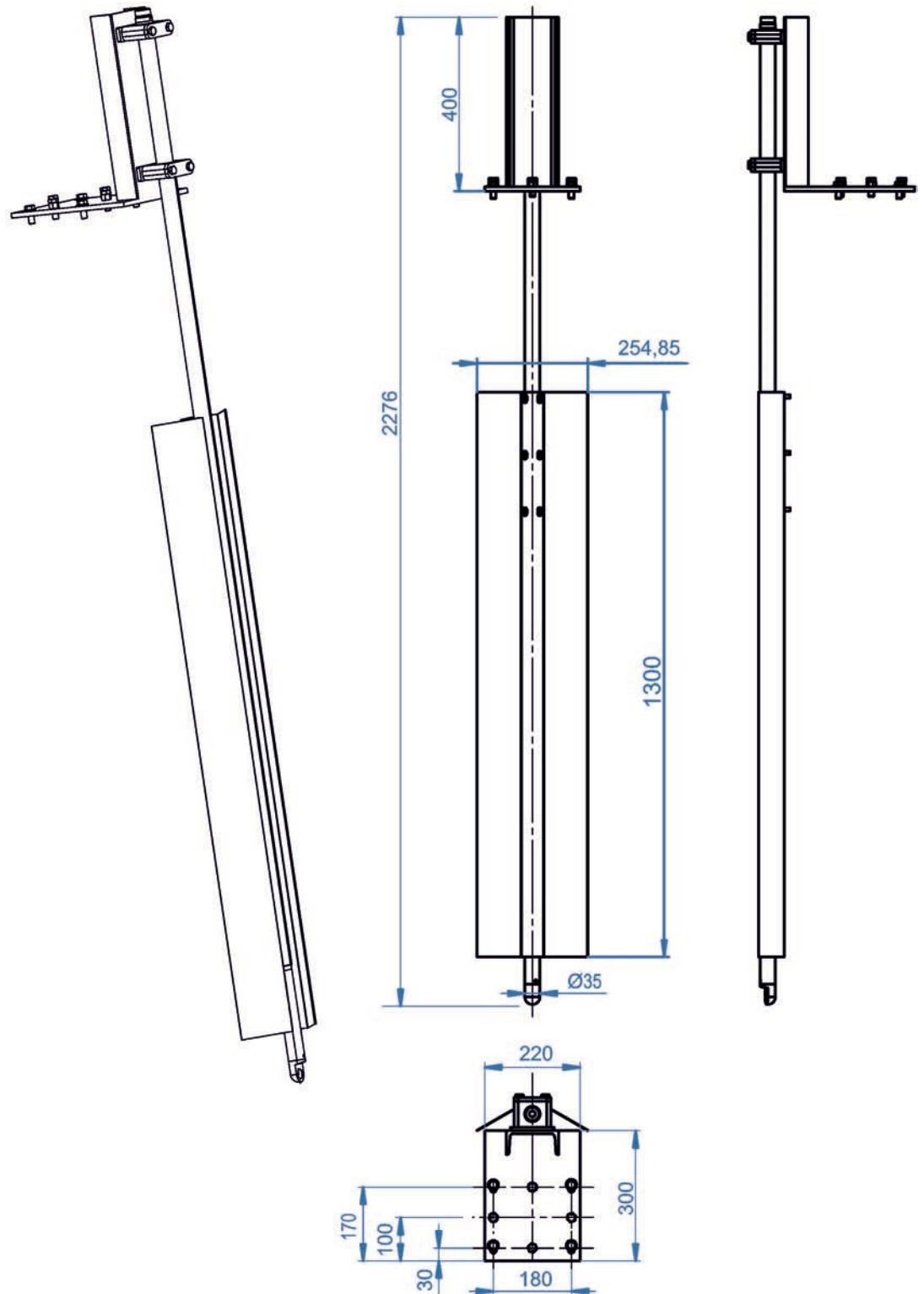


Fig. 12-5 Holder bracket (NOZ00HAL90) with flow protection sheet

13 Holder Bracket for Hemisphere Sensors

Flow-optimised holder brackets are optionally available for the hemisphere sensors. For fastening, cylinder head screws M8x40 made of stainless steel with hexagon socket and flat heads are enclosed.

For the cable version, there are pre-stamped embossments on two sides of the bracket that can be broken out (e.g. with pliers).

Then the enclosed edge protector must be attached to this broken-out part of the bracket.

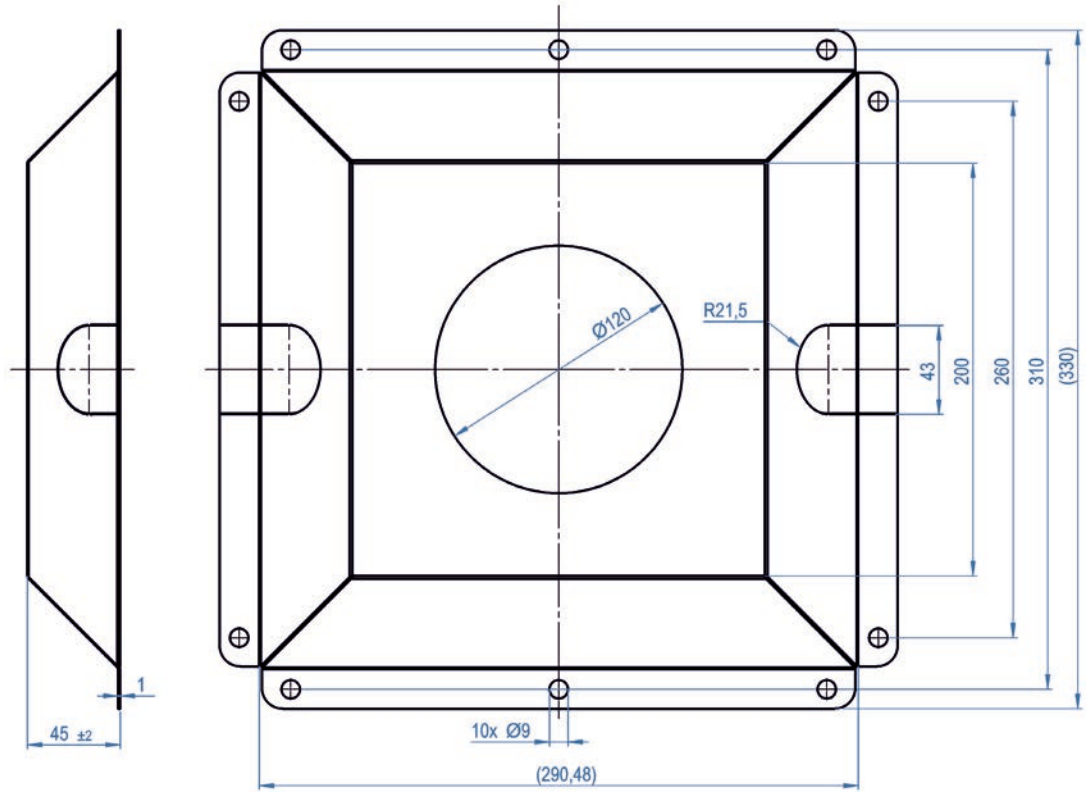


Fig. 13-1 Holder bracket (NOZ00HALHK) for hemisphere sensors

14 Holder Bracket for Ball Sensors

The ball sensors *NOS0H2V200* / *NOS0H2V500* are always mounted with appropriate holder brackets due to their design. These are fixed to a flat surface with four screws (through holes 10 mm).

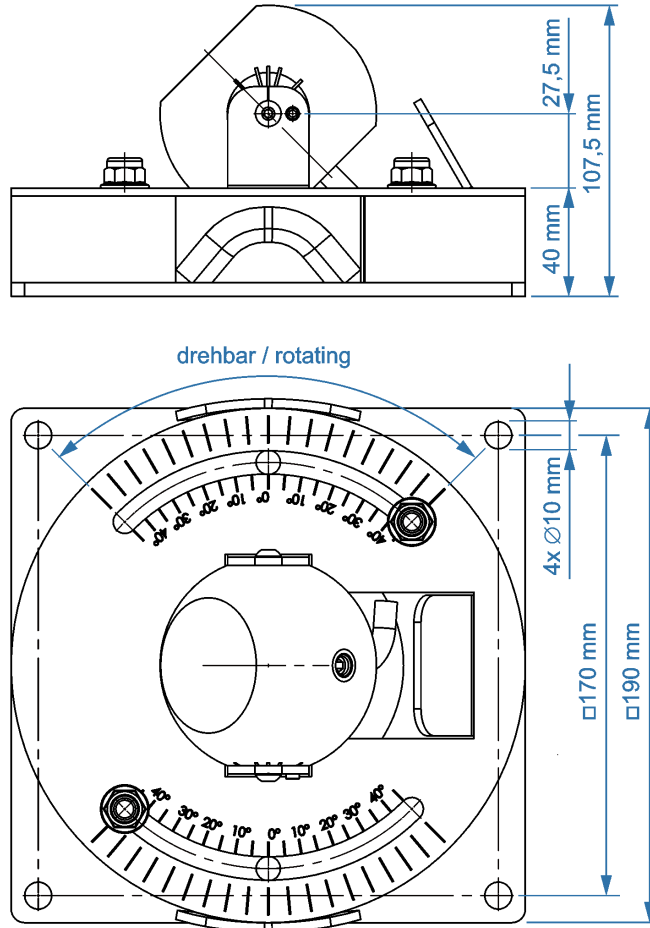


Fig. 14-1 Holder bracket (*NOS00HAL5VK*) for ball sensors *NOS0H0V500*

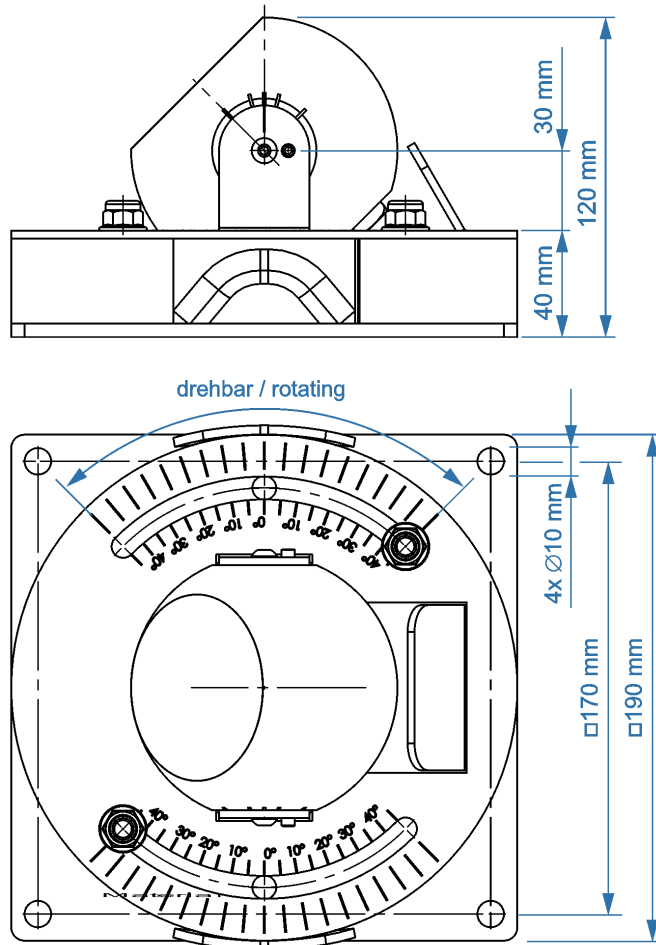


Fig. 14-2 Holder bracket (NOS00HAL2VK) for ball sensors NOS0H0V200

15 Welding Nozzle for Pipe Sensors

For mounting NIS, NIS0 or TSP0 pipe sensors, welding sockets in steel or stainless steel (1.4571) are available.

For special applications (where there is very little space at the installation place) a welding nozzle with external thread is available. A ball valve can be screwed directly onto this.



Fig. 15-1 View welding nozzle

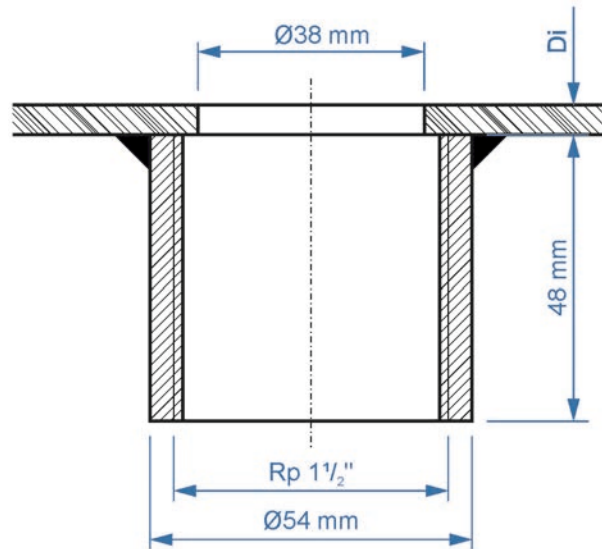


Fig. 15-2 Mounting the welding nozzle

16 Tapping saddle for pipe sensors

General Description

For retrofitting the NIS, NIS0 and TSP0 pipe sensors suitable tapping saddles can be obtained from NIVUS. These are available in two different designs:

- for pipe diameters DN100...DN400 (Fig. 16-1);
in different sizes depending on the pipe outside diameter/ circumference
- for pipe diameters DN450...DN1000 (Fig. 16-3);
individually manufactured depending on the pipe outside diameter/circumference



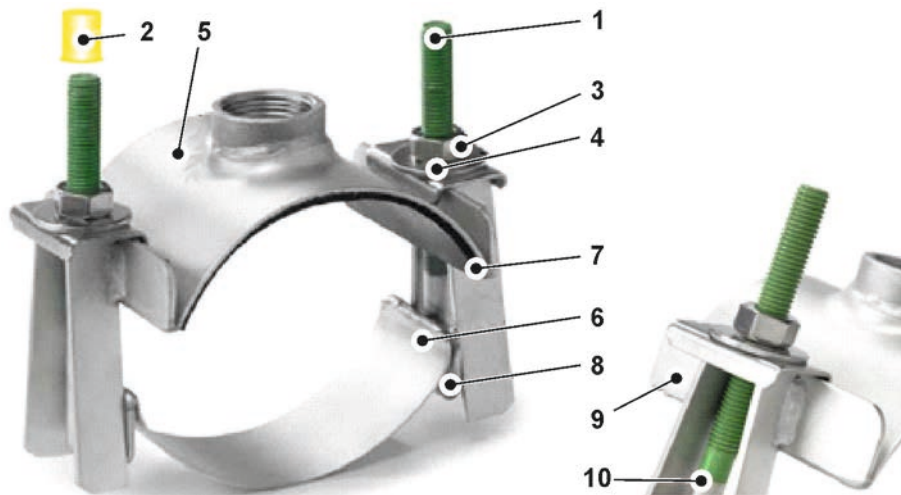
Details and order numbers can be obtained from the NIVUS GmbH in Eppingen via sales@nivus.com or the respective contact person on site.

DN100...DN400

All metal parts of the tapping saddle are made of stainless steel (1.4301/V2A). The clamp is fully etched and passivated to prevent corrosion of the base material and to restore the original corrosion resistance.

The bolts are coated with Teflon to prevent cold welded joints.

The rubber gasket ensures a perfect seal. The rubber gasket is treated with antioxidant/anti-ozonant to increase its life.



- 1 Threaded bolt M12/M14/M16, Teflon-coated
- 2 Thread protection cap
- 3 Screw nut
- 4 Washer
- 5 Saddle piece with 1½" internal thread for cutting ring screw connection
- 6 Saddle piece with threaded bolt
- 7 Rubber gasket
- 8 Side bar
- 9 Retaining bracket
- 10 Screw yoke

Fig. 16-1 Overview tapping saddle DN100...DN400

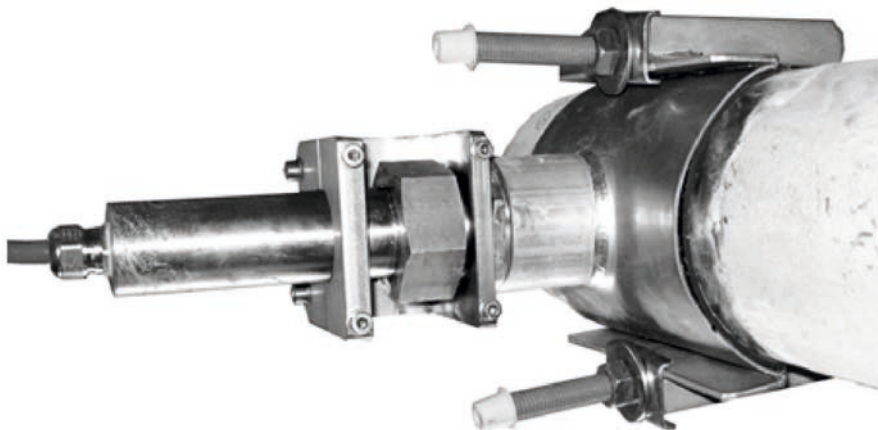


Fig. 16-2 Installation example with tapping saddle DN100...DN400

DN450...DN1000



- 1 2x tensioning belt (from DN600: 4x semi-circular tensioning belt)
- 2 1x mounting plate with sensor mounting nozzle with 1½" internal thread and internal round sealing ring
- 3 2x clamping bolts (from DN600: 4x clamping bolts)
- 4 2x nut / 4x lock nut (from DN600: 4x nut / 8x lock nut)

All metal parts of this system are made of stainless steel (1.4301/V2A)

Fig. 16-3 Overview tapping saddle DN450...DN1000



Fig. 16-4 Installation example with tapping saddle DN450...DN1000

➤ Preparation for installation:

1. Check the pipe/mounting point for possible damage.
2. Clean the pipe (dirt, grease, etc.).
3. Check pipe diameter and dimension of the tapping saddle.
4. Grease the thread of the socket with suitable grease paste for stainless steel screw connections.
Soft soap can be used as a lubricant for the rubber gasket (never oil or grease).

➤ Mounting the tapping saddle DN100...DN400:

1. Drill a Ø38 mm hole in the pipe. Cool the drill bit (see Chapter "18 Drill Bit and Extension for Pipe Sensors") with cutting paste.
2. Deburr the hole with a file and remove chips.
3. Remove the thread protection cap from the threaded bolts of the tapping saddle.
4. Back off the nuts to the end of the threaded bolts, but do not remove them completely.

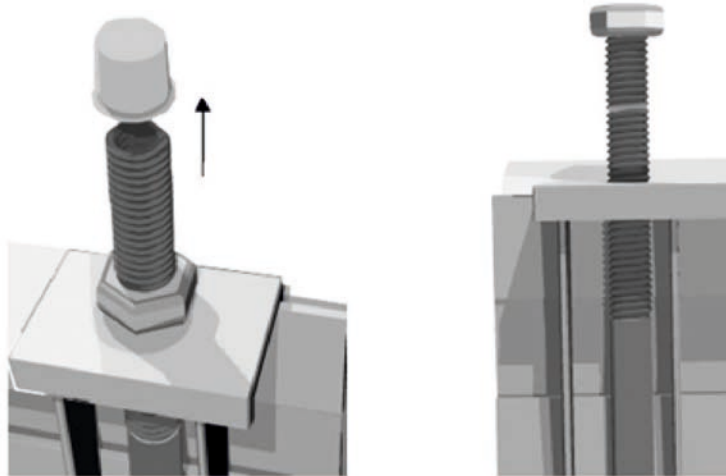


Fig. 16-5 Remove protection caps and loosen nuts

5. Unfold the saddle pieces.

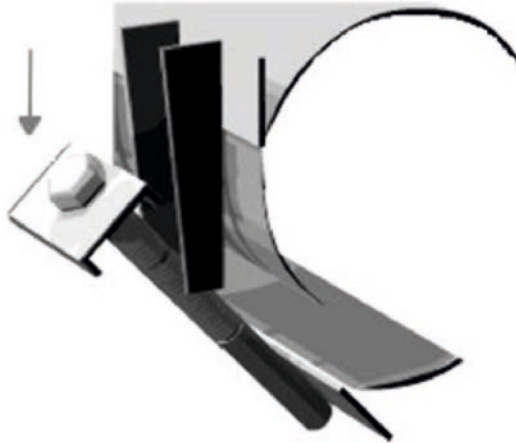


Fig. 16-6 Unfold the saddle pieces

6. Screw the sensor screw connection into the greased nozzle of the tapping saddle hand-tight.
7. Insert the sensor and hand-tighten the sensor screw connection.
8. Place the saddle piece with the sensor on the pipe and insert the sensor through the hole in the pipe. Place the lower saddle piece around the pipe.

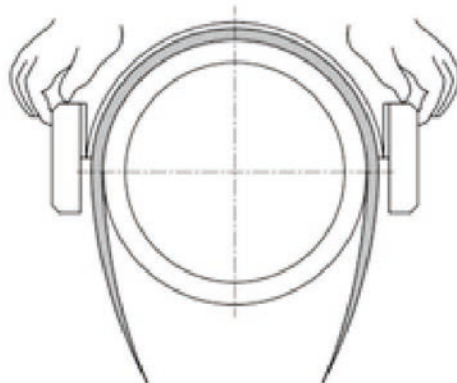


Fig. 16-7 Putting on the saddle piece

9. Place the retaining bracket over the bolt yokes on one side and tighten the nuts by hand. The retaining bracket is hooked into the side bracket by tightening the nuts (Fig. 16-8).

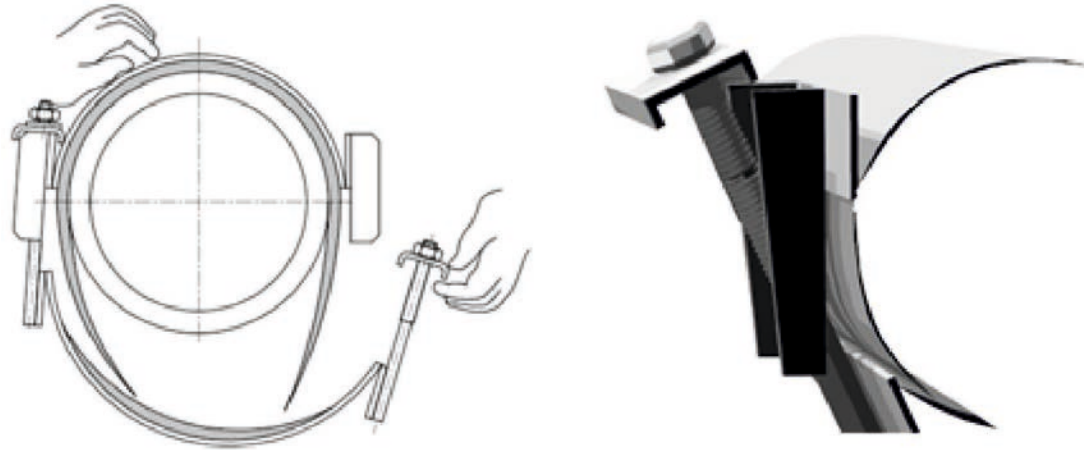


Fig. 16-8 Hooking the retaining brackets

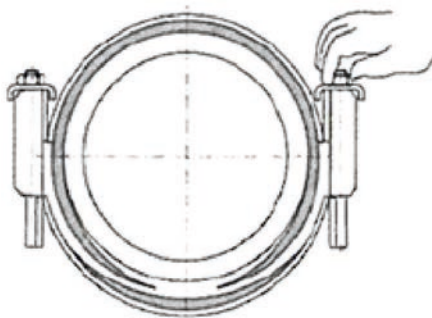


Fig. 16-9 Tightening the bolts

10. Before tightening the tapping saddle, make sure that the pipe sensor is not tilted and can be pushed further into the pipe. Tighten all nuts evenly with the aid of a spanner (300 mm long) or torque spanner (Fig. 16-10).
When the nuts are tightened, the retaining bracket is automatically pressed into the side bar.
The following **max. torques** are permissible (when using a torque spanner):
 - Bolt M12, spanner size 19 mm: torque 65 Nm
 - Bolt M14, spanner size 22 mm: torque 85 Nm
 - Bolt M16, spanner size 24 mm: torque 110 Nm
 For plastic pipes, use a lower torque (ask the pipe manufacturer for the permissible load).

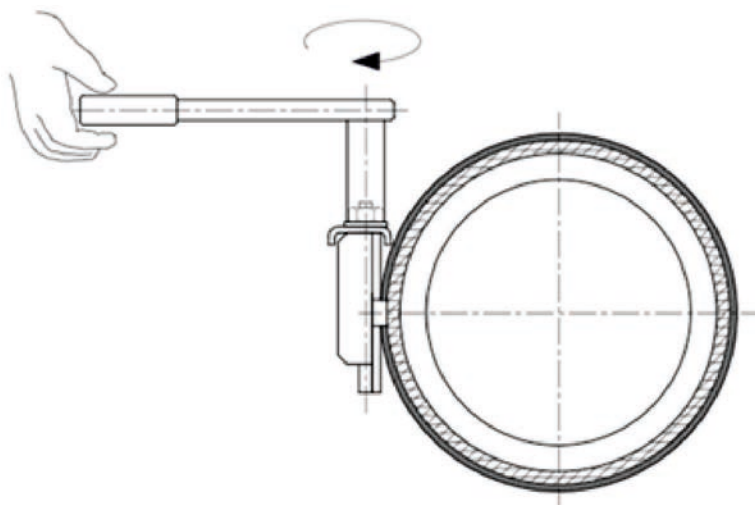


Fig. 16-10 Tightening the nuts

11. After fastening the tapping saddle, align the pipe sensor according to Chapter "10.7 Pipe Sensors Type NIS, Type NIS0 and Type TSP0" and tighten the screw connection.

CAUTION***Parts getting loose through vibration***

When mounting on vibrating system parts such as pipelines of neighbouring pumps or the like, be sure to secure the nuts on the fastening or clamping bolt with a lock nut.

The vibrations can otherwise cause the nuts to loosen and people to be injured by parts vibrating out.

17 (Stop) Ball Valve for Pipe Sensors

The additional use of a corrosion-resistant (stop) ball valve with a straight passage enables quick and uncomplicated shut-off of the sensor installation location after removal of the NIS, NIS0 or TSP0 pipe sensor from depressurised pipes.

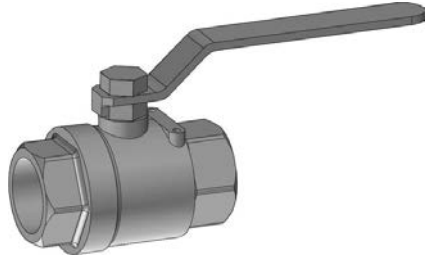
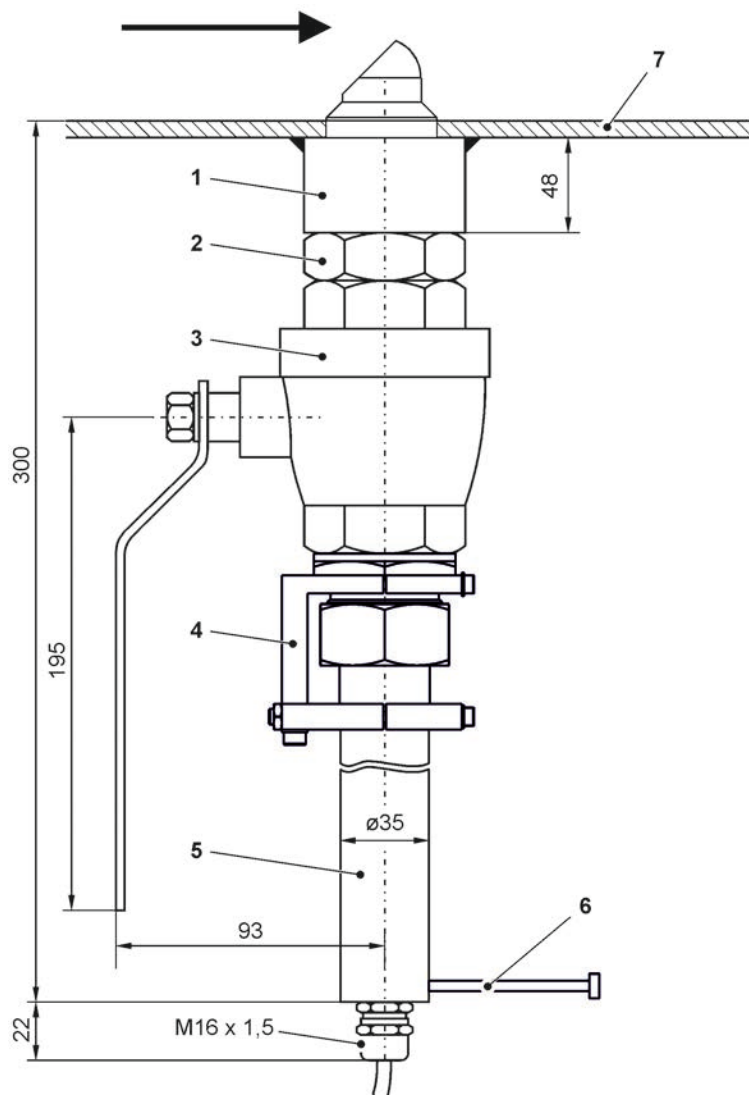


Fig. 17-1 (Stop) ball valve



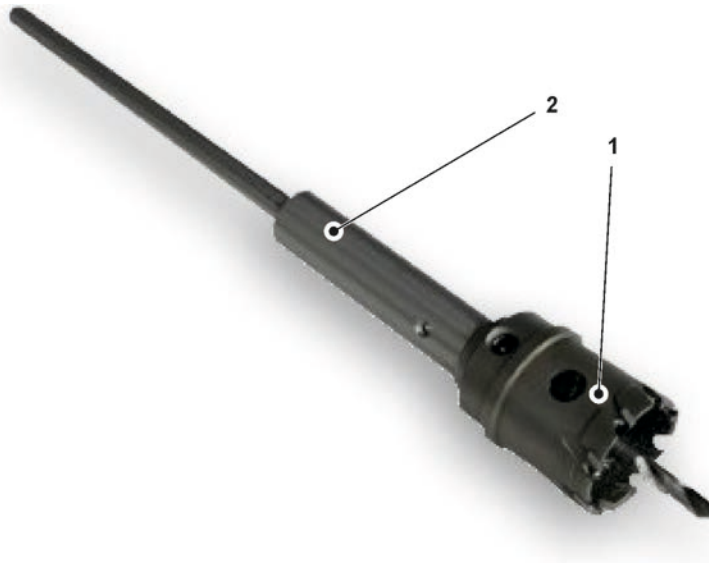
- 1 Welding Nozzle
- 2 Hexagon double nipple SW50
- 3 (Stop) ball valve
- 4 Fastening element
- 5 Pipe sensor

- 6 Alignment aid
- 7 Pipe wall

Fig. 17-2 Sensor mounting by means of fastening element using ball valve and welding nozzle

18 Drill Bit and Extension for Pipe Sensors

Drill bits in Ø36 mm and Ø38 mm are available for preparing NIS, NIS0 and TSP0 pipe sensors for installation in steel and stainless steel pipes. The Ø36 mm diameter drill bit is designed for drilling through a ball valve. This requires an additional extension.

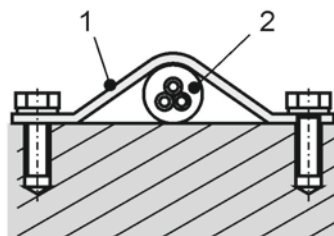


- 1 Drill bit Ø36 mm
- 2 Extension for drill bit

Fig. 18-1 Drill bit with extension

19 Cable Protection Sheet

To avoid build-up on sensor cables in the medium, cable cover sheets made of stainless steel (1.4571) of one metre length are available. These can be used to securely fasten the sensor cables to horizontal surfaces.



- 1 Cable cover sheet, e.g. Type ZMS0 140
- 2 Cable

Fig. 19-1 Cable laying with cover sheet

20 Fastening system for NIC-CO clamp-on sensors

For mounting the clamp-on sensors NIC-CO, NIVUS provides a mounting system with various components. The mounting system is suitable for full pipes up to max. DN2500 and different measuring arrangements. The mounting system can be varied according to these application characteristics. The table below provides an overview on the different versions.

ZUB-	Fastening System	
Version		
CO	Sensor seat for NIC-CO clamp-on sensors	
	Type	
	RA00100	2x sensor shoes for sensor mounting - Type NIC-CO01 ; <i>Note: 1x fastening element* required per sensor shoe (2x in total)</i>
	RA00101	2x movable sensor shoes for sensor mounting - Type NIC-CO01 ; ruler 32 cm for DN50 - DN500, <i>Note: 1x fastening element* required per sensor shoe (2x in total)</i>
	RA00102	2x movable sensor shoes for sensor mounting - Type NIC-CO01 ; ruler 78 cm for DN50 - DN1000, <i>Note: 1x fastening element* required per sensor shoe (2x in total)</i>
	RA00103	2x rail fastening (incl. metal cover) for sensor mounting - Type NIC-CO01 , for DN100...1000; <i>Note: 2x fastening element* required per rail fastening (4x in total)</i>
	RA00104	2x rail fastening (incl. metal cover) for sensor mounting - Type NIC-CO50 , for DN800...6000; <i>Note: 2x fastening element* required per rail fastening (4x in total)</i>
ZUB-	CO	

* For a selection of possible fastening elements, see the following table (Tab. 6)

Tab. 5 Type key / overview of variants

Tensioning belts for temporary fastening of NIC-CO sensors	
<i>ZUB0SPANN0350</i>	1x Tensioning belt, blue; width: 25 mm; length: 3.5 m; up to DN1000
<i>ZUB0SPANN0650</i>	1x Tensioning belt, blue; width: 25 mm; length: 6.5 m; up to DN2000
<i>ZUB0SPANN1000</i>	1x Tensioning belt, blue; width: 25 mm; length: 10 m; up to DN3000
<i>ZUB0SB50300</i>	2x Clamp band (stainless steel V2A) with quick lock; width 14.3 mm; length 1 m; for DN50...300
<i>ZUB0ME3001000</i>	2x Metal band (stainless steel V2A); width 14 mm; Länge 5 m; incl. 4x clamping elements; for DN300...1000
<i>ZUB0ES1000</i>	2x Stainless steel cable with clamping element, Ø 8 mm, length 4 m, up to DN1000, recommended in connection with Type NIC-CO50
<i>ZUB0ES2000</i>	2x Stainless steel cable with clamping element, Ø 8 mm, length 7 m, up to DN2000, recommended in connection with Type NIC-CO50

ZUB0ES3000	2x Stainless steel cable with clamping element, \varnothing 8 mm, length 10 m, up to DN3000, recommended in connection with Type NIC-CO50
ZUB0ES4000	2x Stainless steel cable with clamping element, \varnothing 8 mm, length 15 m, up to DN4000, recommended in connection with Type NIC-CO50
ZUB0ES6000	2x Stainless steel cable with clamping element, \varnothing 8 mm, length 20 m, up to DN6000, recommended in connection with Type NIC-CO50

Tab. 6 Fastening elements

The current device version is indicated by the article number, which can be found on the nameplate on the original packaging.

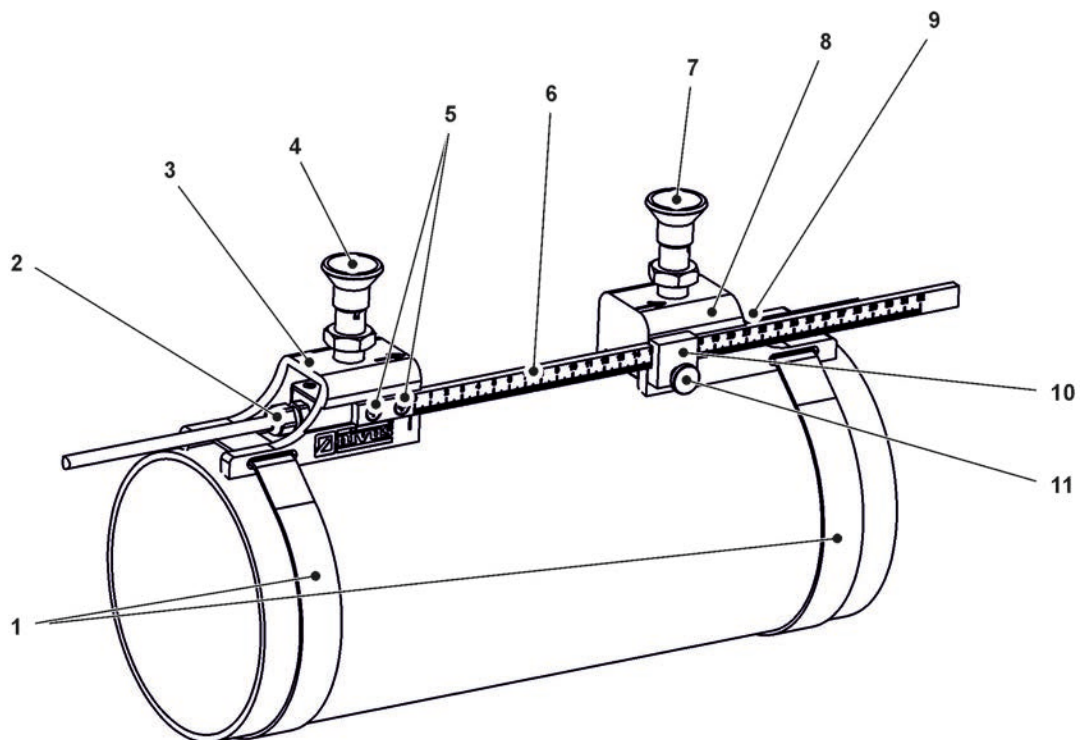
The NIVUS clamp-on sensors are placed and aligned individually on the pipe with sensor shoes (both V-arrangement and \-arrangement possible) or with mounting systems with scale. Tensioning belts, metal bands or stainless steel cables are provided for fastening in all options.

Fastening systems as mounting aids are available in two basic designs:

- 2x sensor shoe connected with ruler in V-arrangement (both sensors side by side on the same side of the pipe) (see Fig. 20-1) (for details on design see Tab. 5).
- 2x rail fastening for guiding the sensor brackets (see Fig. 20-2); both V-arrangement (both sensors on the same side of the pipe) and \-arrangement (sensors on opposite sides of the pipe) are possible; the rail fastenings are protected from ingress of dirt with covers (for details on design see Tab. 5).

The different tensioning belts and stainless steel cables are used depending on the pipe diameter (details see Tab. 6).

Alternatively, the metal band with 5 m length (up to DN1000) can be adapted accordingly (details see Tab. 6).

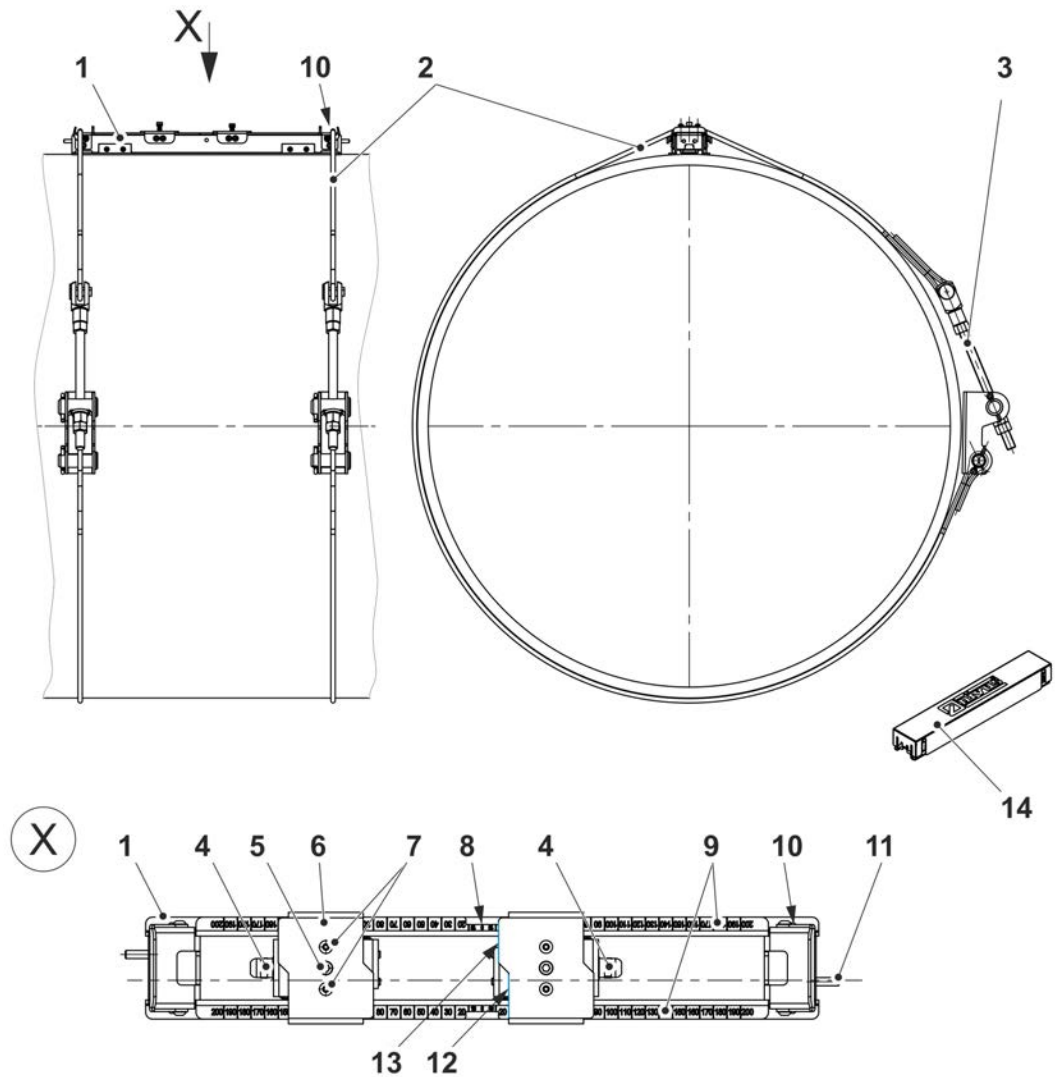


- 1 Tensioning belts with locks or metal bands with endless clamps

- 2 Clamp-On Sensor *NIC-CO01* (not included in the mounting system *ZUB-CO*)
- 3 Sensor shoe, left
- 4 Locking bolt, adjustable (for clamping the clamp-on sensor)
- 5 Screws (to fasten the ruler)
- 6 Ruler
- 7 Locking bolt, adjustable (for clamping the clamp-on sensor)
- 8 Sensor shoe, right
- 9 Clamp-On Sensor *NIC-CO01* (not included in the mounting system *ZUB-CO*)
- 10 Holding block (to fasten the ruler)
- 11 Pressure screw (to fasten the ruler)

Note: Positions 3, 4, 5, 6, 7, 8, 10 and 11 are delivered pre-assembled.

Fig. 20-1 Fastening system with ruler for *NIC-CO01* clamp-on sensors



- 1 Fastening rail (for 1...2 sensor holders)
- 2 Tensioning cable (2x per fastening rail)
- 3 Tensioning system (2x per fastening rail)

- 4 Clamp-On Sensor *NIC-CO50* (alternatively *NIC-CO01*) (not included in the mounting system *ZUB-CO*) (shown without cable)
- 5 M6 set screw for fixing the sensor (in the sensor holder/on the pipe)
- 6 Sensor holder (same design but different sizes for *NIC-CO50* and *NIC-CO01*)
- 7 Factory assembly screw; **DO NOT adjust**
- 8 Zero point of the scale and suspension point for the sensor holders
- 9 Scale to adjust the sensor position
- 10 Guide for tensioning belts, metal band or stainless steel cables
- 11 Connecting screw M6x20 when using two fastening rails
- 12 Reading edge of the distance of the sensor *NIC-CO01* from the zero point
- 13 Reading edge of the distance of the sensor *NIC-CO50* from the zero point
- 14 (Metal) cover (shown in reduced size)

Note: The mounting system (without clamp-on sensors) is delivered pre-assembled.

Fig. 20-2 Fastening system with cover for clamp-on sensors *NIC-CO01/50*

The **installation** is carried out according to Chapter "10.9 Clamp-On Sensors Type *NIC-CO*".

References

The following standards and regulations were used as sources for the preparation of these installation instructions:

- DIN EN ISO 748
- DIN EN ISO 6416
- Construction and operation of ultrasonic flow measurement systems (LfU)

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