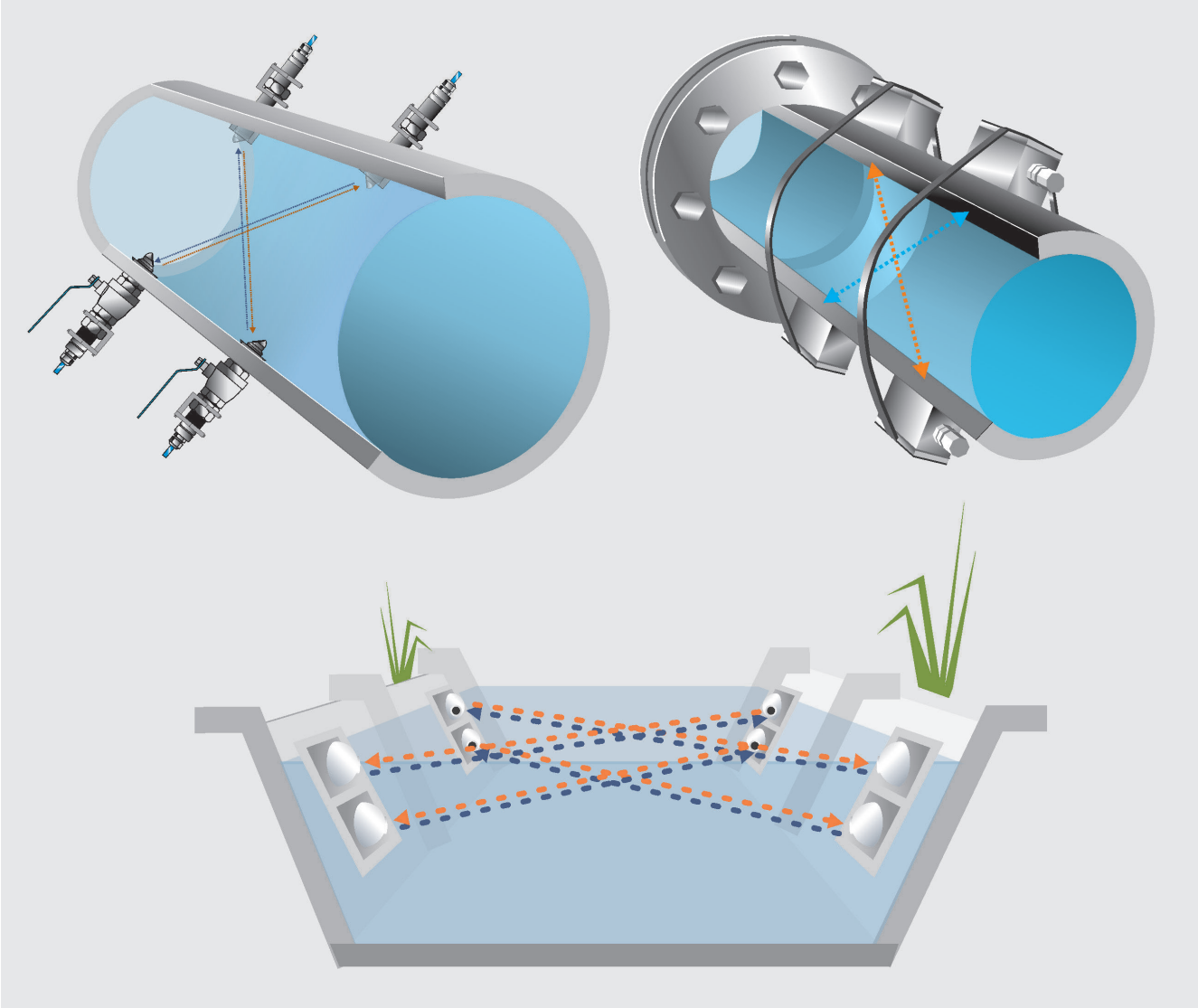
FLOW

Installation Instruction

Transit Time Sensors



Revised Manual

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Important Note

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Translation

If the device is sold to a country in the European Economic Area (EEA) 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 manual (German) must be consulted or one of the legally associated companies and subsidiaries of NIVUS group contacted for clarification.

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Names

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History of changes

Rev.	Changes	Editor in charge	Date
03	Address NIVUS France updated; History of changes added; Information and mounting accessories for NIC0 K1L sensors removed; mounting of TSP0 sensor added; Minor text corrections	MoG	12.11.2019
02	Mounting device for NIC-CO01 sensors added; Layout revised; minor changes: sensor numbers, angle specifications and similar	MoG	14.08.2018
01	---	---	---
00	First version based on the German document	DMR	23.01.2013

Table of Contents

General

1 About this manual

Important Note

READ CAREFULLY BEFORE USE.

KEEP IN A SAFE PLACE FOR LATER REFERENCE.

This instruction manual is intended for installation and connection of transit time sensors to NIVUS transmitters/data loggers. This manual is oriented exclusively to qualified expert personnel.

Read this manual carefully and completely prior to installation and initial start-up since it contains relevant information on these products. Observe the notes and particularly follow the warning notes and safety instructions.
Keep this manual in a safe place and make sure it is available for the users of this product at any time.
If you should have problems to understand information contained within this manual contact one of the legally associated companies and subsidiaries of NIVUS group for further support.
The companies and subsidiaries of NIVUS group cannot be held responsible for damage to persons or material due to incorrectly understood information in this instruction.
In the case of selling the instruments this manual shall be provided to the purchaser since it is a part of the standard delivery.

The description on how to operate the transmitter/data logger as well as the connectable transit time sensors is an integral part of the according instruction manual/technical description.

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.

- Instruction Manual for the respective flow measurement transmitter/data logger
- Technical Instructions for Transit Time Sensors

These manuals are provided with the auxiliary units or sensors and/or are available as download on the NIVUS homepage.

1.2 Signs and definitions used

Image	Meaning	Remark
➲	(Action) Step	Action to be performed by you. Note the numbering of action steps. Observe the order of the working steps!
⇨	Cross-reference	Refers to further or detailed information.
>Text<	Parameter or Menu	Indicates a parameter or a menu that is selected or described.
	Reference to document	Refers to an accompanying documentation.

Table 1 Structural elements within the manual

Safety Instructions

2 General: Used symbols and signal words

2.1 Valuation of the accident level

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

DANGER

Warnings in high degree of risk

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

WARNING

Warnings in medium degree of risk

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

CAUTION

Warnings in low-risk or property damages

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

WARNING

Danger by electric voltage

Indicates a hazard with a high risk of electric shock which may result in a life-threatening situation or (severe) bodily injury if it is not avoided.

Important Note

Contains information that should be highlighted.
Indicates a potentially damaging situation which can result in a damage of the product or an object in its environment.

Note

Contains information and facts.

2.2 Warning notices on the product (option)

General warning label

This symbol is for operators to refer to this manual.
Observing the information contained therein is required in order to maintain protection measures provided by the instrument during installation procedures and operation.

Protective conductor

This symbol refers to the protective conductor of the unit.
Depending on the mode of installation the instrument shall be operated solely connected to an appropriate protective conductor according to applicable laws and regulations.

3 Safeguards and Precautions

Working with NIVUS instruments requires to observe and to follow the safety measures and precautions below generally and at any time. These notes and warnings will not be repeated for each description within the document.

WARNING

Germ contamination

Parts can be contaminated with dangerous germs, especially if the sensors are used in waste water applications. Therefore, appropriate precautions must be taken when contacting cables and sensors.

Wear protective clothing.

WARNING

Observe occupational safety regulations

Before starting and while executing installation work, observing the work safety regulations needs to be checked constantly.

Disregarding may lead in personal injury.

WARNING

Do not disable safety devices!

It is strictly prohibited to disable the safety devices or to change the way they work.

Disregarding may lead to personal injury or damage your facility.

WARNING

Disconnect the systems from mains

Maintenance, cleaning and/or repairs (by qualified personnel only) may only be performed when de-energised.

Disregarding may lead to electric shocks.

CAUTION

Avoid electrostatic discharge

Avoid unnecessary movements to minimise the risk of static energy accumulating.
Discharge any possible static electricity from your body before you begin to install sensors.

Disregarding may impair the measurement or even lead to measurement failure.

Putting into operation by trained experts only

The entire measurement system shall be installed and put into operation by trained expert personnel only.

3.1 Special markings on the device

The safety hints on the sensor cable are part of the delivery. Do **not remove** them.

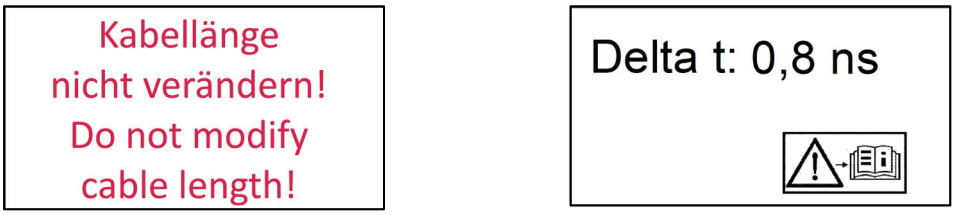


Fig. 3-1 Safety hints on the sensor cable

4 Warranty

The device has been functionally tested before delivery. If it is used as intended (see Sect. “6 Use in accordance with the requirements”) and the operating instructions, the applicable documents (see Sect. “1.1 Applicable documentation”) and the safety notes and instructions contained therein, are observed, no functional restrictions are to be expected and perfect operation should be possible.

⇨ Please also note in this regard the next Sect. “5 Liability disclaimer”.

Limitation of warranty

In the event of non-compliance with the safety instructions and instructions in this document, the companies of the NIVUS group reserve the right to limit the warranty.

5 Liability disclaimer

The legally associated companies and subsidiaries of NIVUS group assume no liability

- for damages owing to **a change** of this document. The legally associated companies and subsidiaries of the NIVUS group reserve the right to change the contents of this document and this disclaimer at any time and without any notice.
- for damages to persons or objects resulting from **failure to comply** with applicable **regulations**. When connecting, commissioning and operating the sensors all available information and higher local legal regulations (in Germany e.g. VDE regulations) such as applicable Ex regulations as well as safety requirements and regulations in order to avoid accidents shall be adhered to.
- for damages to persons or objects resulting from **improper use**. For safety and warranty reasons, all internal work on the instruments beyond that involved in normal installation and connection, must be carried out only by qualified NIVUS personnel or persons or companies authorised by NIVUS.
- for damages to persons or objects resulting from the use of instruments in technically **imperfect** condition.
- for damages to persons or objects resulting from the use of instruments **not in accordance with the requirements**.
- for damages to persons or objects resulting from **failure to comply with safety information** contained within this instruction manual.

- for missing or incorrect measurement values or resulting consequential damages due to **improper installation**.

6 Use in accordance with the requirements

This installation instruction supplements the instruction manuals / technical descriptions of the respective flow transmitters or sensors. The document exclusively refers to the installation and the cable laying for the sensor types below:

- NIS Wedge and pipe sensor
- TSP0 Pipe sensor
- NOS Rod sensors, hemispheres and ball head sensors
- NOS Screw-in and plug-in sensors
- NIC- Clamp-On sensors

Please find connection drawings as well as specifications and Declarations of Conformity of sensors, transmitters and data loggers in the respective instruction manuals / technical instructions.

7 User's Responsibilities

Observe and comply with all guidelines and requirements

In the EEA (European Economic Area) national implementation of the framework directive 89/391/EEC and corresponding individual directives, 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, are to be observed and adhered to. In Germany e.g. the Industrial Safety Ordinance must be observed.

Make sure to have a local operating permit available and observe the associated conditions. In addition to this you must observe environmental requirements and local laws on the following points:

- Personnel safety (accident prevention regulations)
- Safety of work materials and tools (safety equipment and maintenance)
- Disposal of products (laws on wastes)
- Disposal of materials (laws on wastes)
- Cleaning (cleansing agents and disposal)

Connections

Operators shall make sure prior to operating the instrument that during installation and initial start-up the local regulations (such as regulations for electrical connection) are observed.

8 Personnel requirements

Installation, commissioning and maintenance shall be executed only by personnel meeting the demands as follows:

- Expert personnel with relevant training and appropriate qualification
- Personnel authorised by the plant operator

Qualified personnel

within the context of this documentation or the safety notes on the product itself are persons who are sufficiently familiar with installation, mounting, starting up and operation of the product and who have the relevant qualifications for their work; for example:

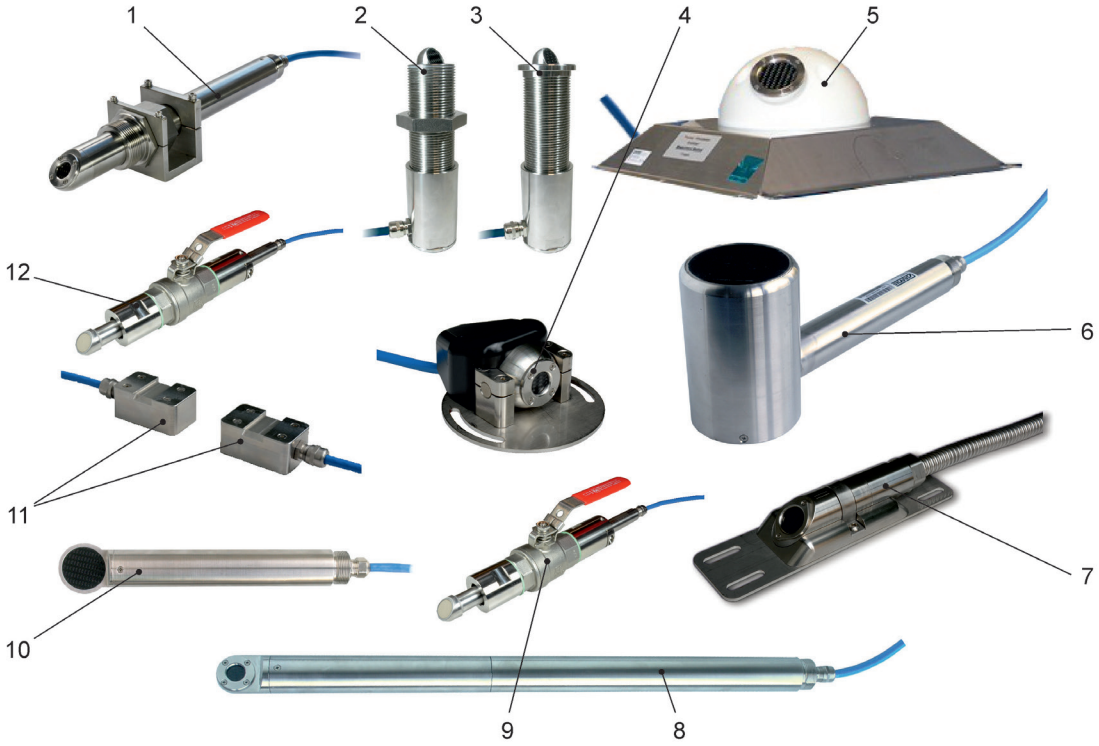
I. Training, instruction or authorisation to activate/deactivate, isolate, ground, and mark electric circuits and devices/systems according to the safety engineering standards.

II. Education and instruction according to the standards of safety engineering regarding the maintenance and use of adequate safety equipment.

III. First aid training

Product specification

9 Overview sensors



1 Flow velocity pipe sensor, type NIS-V200RT
2 Flow velocity screw-in sensor, type NOS-V2E00
3 Flow velocity plug-in sensor, type NOS-V2S00
4 Flow velocity ball head sensor, type NOS-V20BS, GFK sensor face 20 mm
5 Flow velocity hemisphere sensor, type NOS-V30BS, CFK sensor face 40 mm
6 Flow velocity rod sensor, type NOS-V4005, CFK sensor face 65 mm (200 KHz)
7 Flow velocity wedge sensor, type NIS-V280KS0
8 Flow velocity rod sensor, type NOS-V2005, CFK sensor face 20 mm, with extension
9 Flow velocity pipe sensor, type TSP0V200RL
10 Flow velocity rod sensor, type NOS-V3005, CFK sensor face 40 mm
11 Clamp-on sensor pair, type NIC-CO01
12 Flow velocity pipe sensor, type NIS-V200RL0

Fig. 9-1 Overview

Installation and Fastening of the Sensors

10 General Rules for Sensor Fastening

Prior to beginning installation necessarily read the general hints and the general rules for sensor fastening.
Disregarding may result in measurement disturbances. The manufacturer explicitly states that all permissions and process specifications shall be obtained or observed.

WARNING

Measures to avert danger

Please ensure to observe all regulations regarding safety at work as well as danger due to explosive gases prior to beginning of installation works. Respective measures to avert danger shall be taken if required.

Disregarding may lead in personal injury.

CAUTION

Safety Regulations at Work using divers

Using divers can be necessary for the sensor mounting. Diving works require compliance with particular regulations on safety at work. Carefully prepare this measure and consult the respective bodies for according approvals.
A company executing installation shall have expertise as well as all valid approvals required for underwater installation.

Disregarding may lead in personal injury.

Expert knowledge about norms and standards

Expert knowledge and the competent handling of standards are indispensable requirements for a safe and proper measurement site selection and sensor fastening in waters or rivers. See DIN EN ISO 748 and DIN EN ISO 6416.

Expert knowledge about ultrasonic measuring systems

The executing company shall have extensive expertise and a sufficient back-ground on installation and commissioning of ultrasonic measurement systems in part filled applications.

In other cases either contact the NIVUS start-up service or an authorised expert company.

Written authorisations

Prior to the sensors installation at bridge piers, embankments, groynes etc., at the laying of cables as well as the operation of the facilities in public waters, a written authorisation from the competent authority must be obtained.

11 Instructions for installation

The following instructions in large parts apply to all sensors, although there are differences as far as the sensor construction is concerned. It must be distinguished between wet and dry sensors as well as between applications featuring full or part filled pipes. Clamp-on sensors, for example, are used for full pipes and are dry due to being installed on the outside of the pipe. In such a case the flow conditions can be largely neglected when it comes to select fastening material.

- Use only non-corrosive fastening material.
- The sensors shall be durably and reliably fastened in a way that the flow velocity sensor faces of each path are aligned to be exactly facing each other.

- The optional fastening material is designed for normal flow conditions at the measurement place. In water bodies or channels featuring very high flow velocities the applicable conditions vary. In such cases the fastening material shall be chosen to remain intact even under the mechanical stress prevailing at the measurement point.
- To mechanically protect the sensors in case of increased stress additional protection against flow upstream of the sensors or recessed sensor installation shall be considered.

The construction for sensor fastening should ensure the following points:

- The horizontal level adjustment must be independent from the vertical level adjustment.
- During alignment ensure proper indication of direction with a max. permissible deviation of ±1° above the water surface (e.g. by using a portable instrument)
- Not more than ±1° deviation from the vertical level.
- Easy removal of sensors for maintenance or cleaning, no divers or special equipment should be required if possible.
- Realignment after maintenance shall be avoided if possible.

12 Choosing Calming Sections

12.1 General Notes

Clear and defined hydraulic conditions are indispensable prerequisites for accurate measurements. This is why one has to be especially attentive to the required hydraulic calming sections.

- If measuring in open channels and rivers observe that measurement places should have a defined wetted cross-sectional area and a well formed flow profile with a constant flow velocity.
  The measurement place generally should be such to comply with DIN EN ISO 748, DIN EN ISO 6416 and, in Germany, the German Level Rule Appendix D.
- Strictly avoid falls, steps or obstructions, fittings, changes of the channel profiles or supplies from the side upstream as well as downstream of the measurement point.

The drawings Fig. 12-7 to Fig. 12-11 give an example of appropriate, ill-suited and problematic applications. Moreover, they are used to indicate appropriate measurement places or also critical hydraulic conditions possibly prevailing.

12.1.1 Support for selecting/assessing the measurement place

If in doubt regarding selection or assessment of the planned measurement place contact your NIVUS representative or the NIVUS Technical Sales and Support (sales@nivus.com) in Eppingen.

The following information/documents shall be at our disposal in order to assess the measurement place:

- sketches or drawings
- photos of the planned measurement place

12.2 Conditions in closed Pipes and Channels

- When measuring in pipes the measurement sections have to be selected in a way that there is no sedimentation (sand, grit, sludge etc.) arising under standard operating conditions.
- As from a filling level of approx. 80 % of the nominal diameter closed pipes are tending to sudden short-term impoundage. To avoid pulsation within the measurement section due to that circumstance construct the required diameter in a way that the filling level

never exceeds 80 % independent from Q_{min} or Q_{max} in case of standard discharge (2 QTW).

- Avoid changes of slopes within the measurement section.
- The length of the approach channel must be min. 5x nominal diameter, the length of the discharge channel must be min. 2x nominal diameter. Longer sections may be required however in case of disturbed hydraulic conditions and distorted flow profiles resulting from these conditions.

12.3 Conditions in waters and open channels

In waters the following criteria must be respected:

- The water bed shall be stable and shall be free of sedimentation or scour holes.
- The bank should have a definite shape and a stable formation and do not have a disposition to changes.
- There should be no weeds, stones, piles, steps, sills or similar within the measurement path.
- Do not position the measurement place below cooling water inlets or inlets from oxbow lakes (temperature gradient).
- Silt, sludge or sedimentation being disposed must not disturb the ultrasonic path.

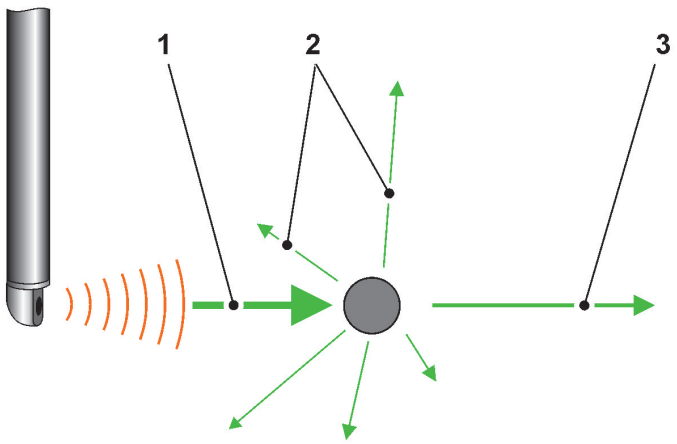
12.4 Influence to the flow velocity measurement

Suspended particles

If an ultrasonic signal transmitted through the water a part of the ultrasonic wave's energy is lost and the signal is attenuated. A result of this attenuation is a drop of intensity compared to the original signal. The measurement may fail if this signal attenuation becomes too high.

There are two reasons for the attenuation of the ultrasonic waves:

- Friction:
  Transformation of acoustic energy to frictional heat as a result of water viscosity.
- Stray:
  When impinging on a solid particle (suspended solid) in water a part of the acoustic energy is scattered.



1 Sent signal

2 Scattering by particles

3 Subdued/attenuated signal

Fig. 12-1 Signal attenuation by suspended particles (energy scattering) (principle)

Air bubbles

Air bubbles e.g. intrude into water below weirs with free overfall. Plants producing oxygen or biogas rising from the water bed will attenuate the acoustic signal.
In case of high solar irradiation the measurement due to biologic oxygen may be disturbed in a way that the measurement fails during daytime and resumes after sunset.
A ship's propeller wash will interrupt the propagation of sound as well by bringing air bubbles into the water.

Temperature and salt content

The sound velocity in water will vary depending on density variations caused by the gradients of temperature or salt content. High temperature differences between water and air will cause an exchange of energy at the water surface. This generates a temperature gradient in the water, deflecting the acoustic signal from its normal horizontal path. In the worst case the deflection prevents the signal from reaching the receiving sensor.
There may be similar effects caused by the salt content gradient.

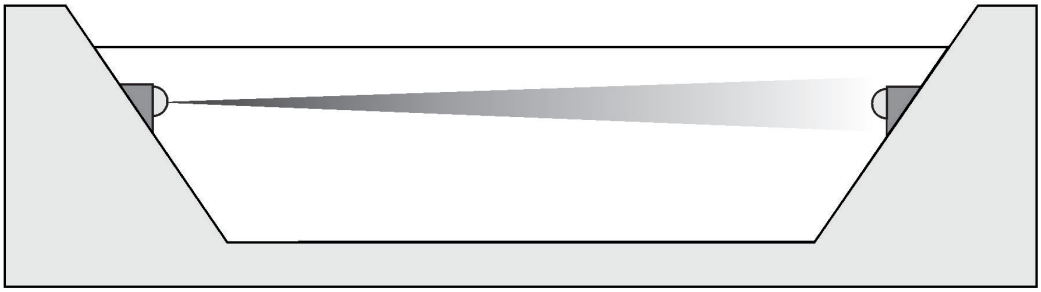


Fig. 12-2 No vertical density difference of the signal (principle)

Changes in temperature of 1 °C/m or more can be found mostly at the water surface of slowly moving waters reaching to a depth of approx. 0.5 m. Temperature changes in the water layers situated below are lower.

Fig. 12-3 Significant vertical density difference caused by solar irradiation (principle)

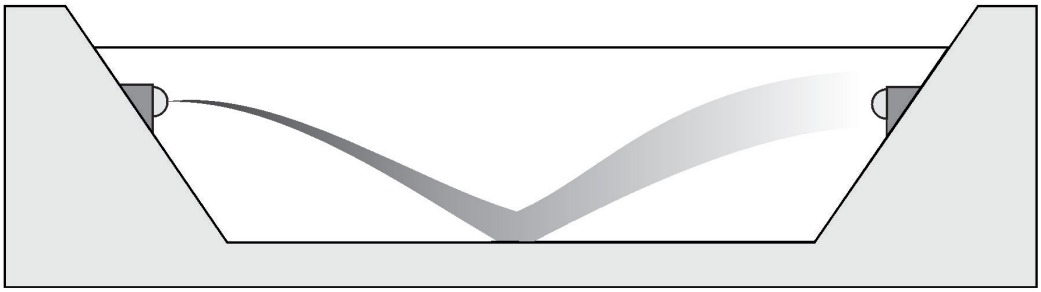
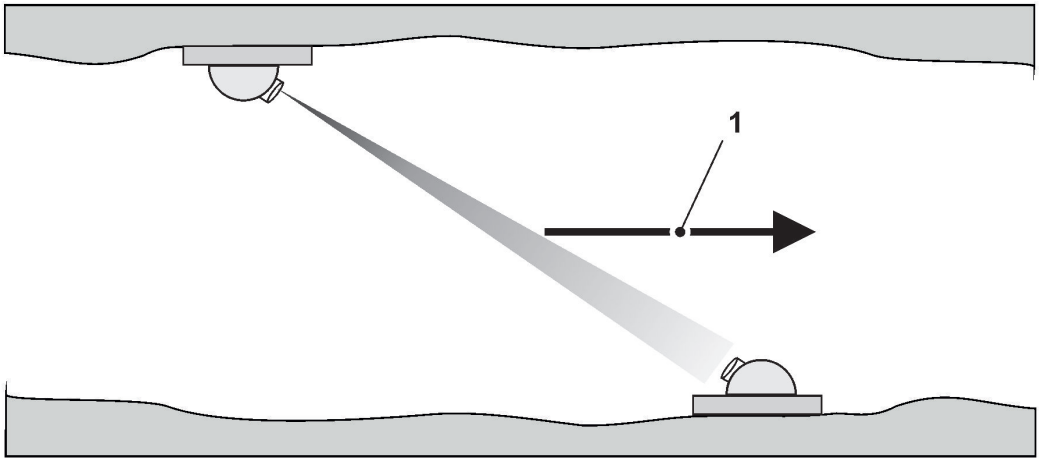


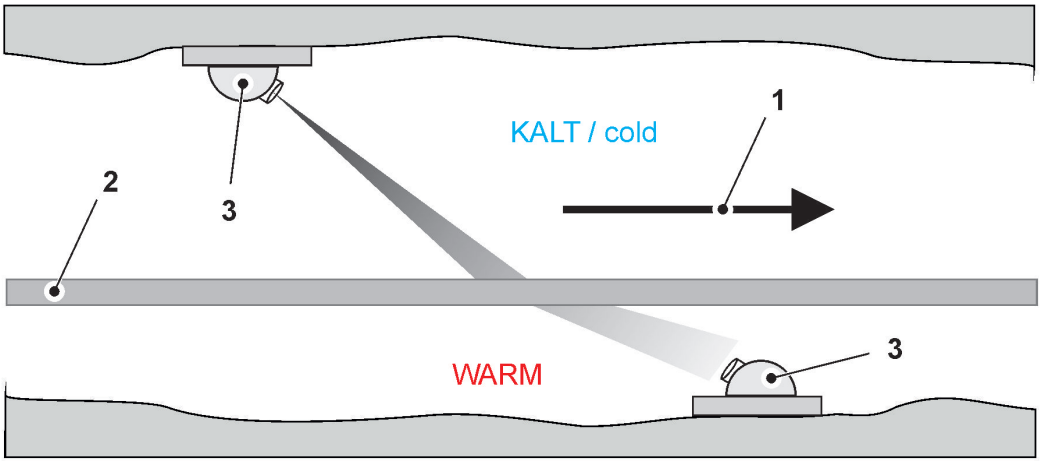
Fig. 12-4 Extreme vertical density difference caused by the salt content (principle)

Changes in temperature are of importance, among other things, at cooling water inlet as well as places where much warmer water flows from cutting off meanders of rivers.



1 Flow direction

Fig. 12-5 No horizontal density difference of the signal (principle)



1 Flow direction

2 Temperature gradient

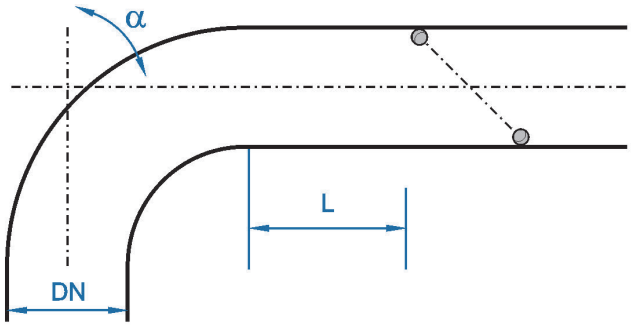
3 Sensors

Fig. 12-6 Horizontal density difference caused by discharge of hot water (principle)

12.5 Sensors in partial filling

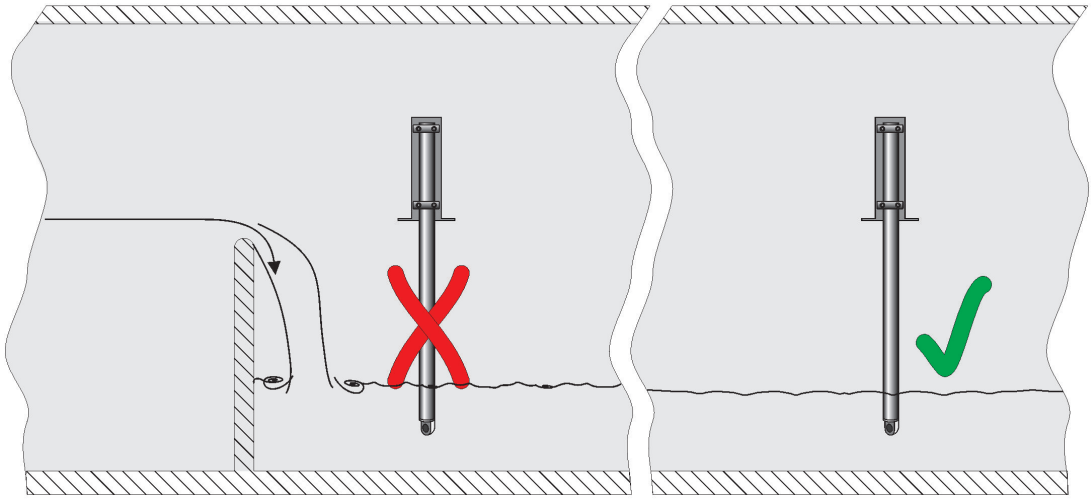
Validity of examples

These examples apply for rod sensors, hemispheres or wedge sensors.



	v < 1 m/s	v > 1 m/s
α < 15°	L > min. 3x DN	L > min. 5x DN
α ≤ 45°	L ≥ min. 5x DN	L ≥ min. 10x DN
α ≤ 90°	L ≥ min. 10x DN	L ≥ min. 15…20x DN

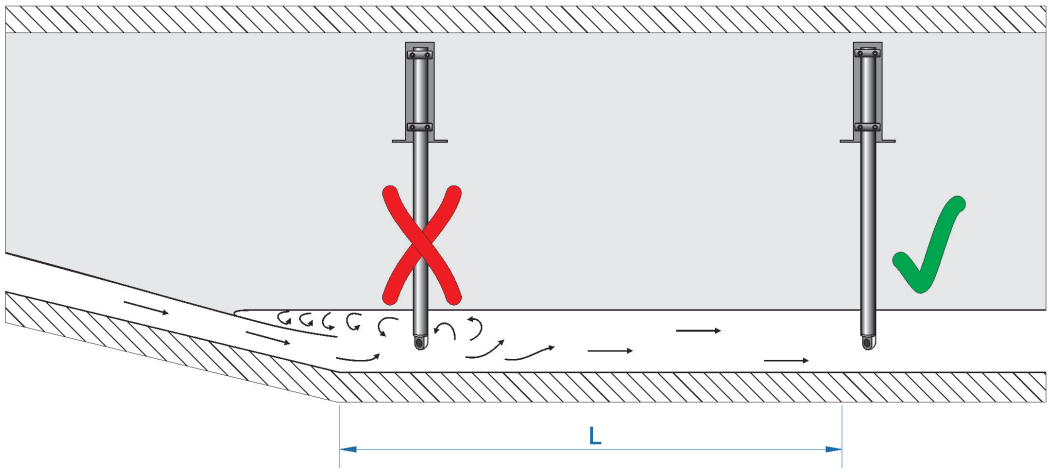
Fig. 12-7 Sensor position behind curves or elbows (principle)



× = Error! Indefinable flow conditions

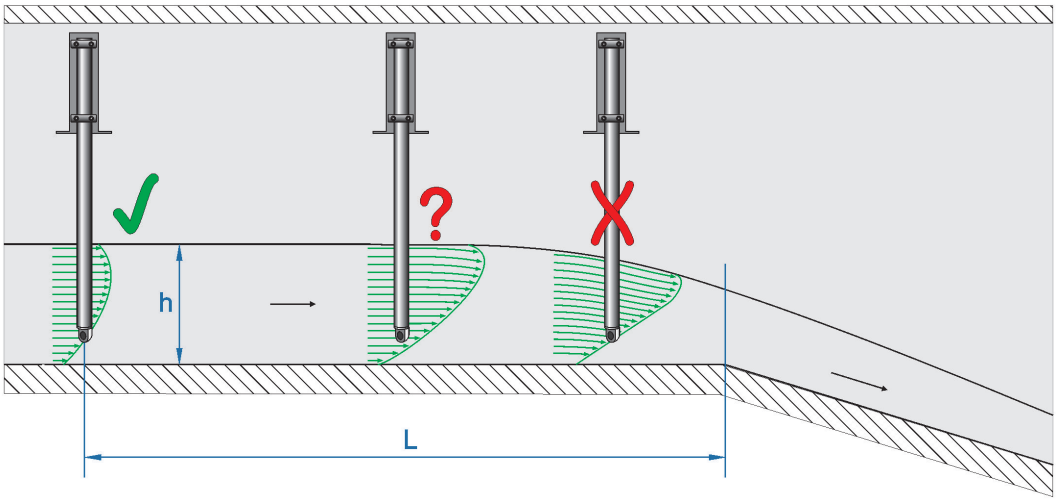
✓ = Sufficient distance to obtain straight flow (10...50x DN depending on application)

Fig. 12-8 Measuring behind fall – turbulence (principle)



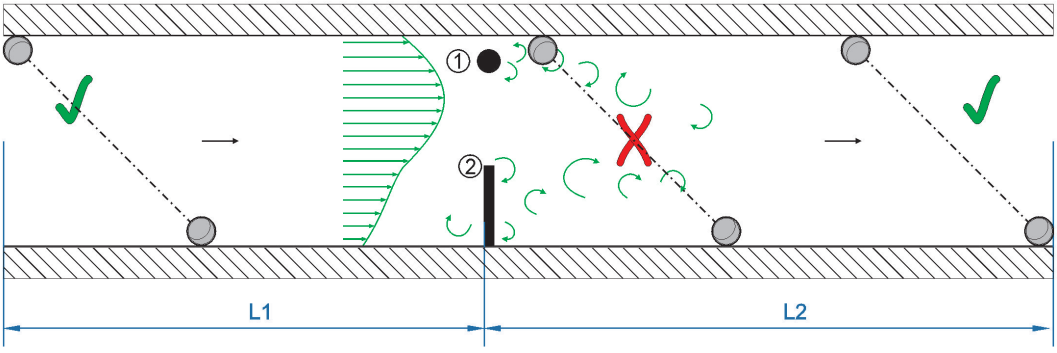
× = Error! Alternation of slope = alternation of flow profile
✓ = Distance depending on slope and flow velocity value
L = min. 20x DN

Fig. 12-9 Error caused by alternation of slope (principle)



× = Error! Transition from flowing to shooting
Faulty level and velocity measurement
? = Critical measurement point, not recommended!
Begin of sinking flow
✓ = Distance L = min. 5x h_{max} at place of installation

Fig. 12-10 Error caused by alternation of flow profile front of slope alternation or fall (principle)



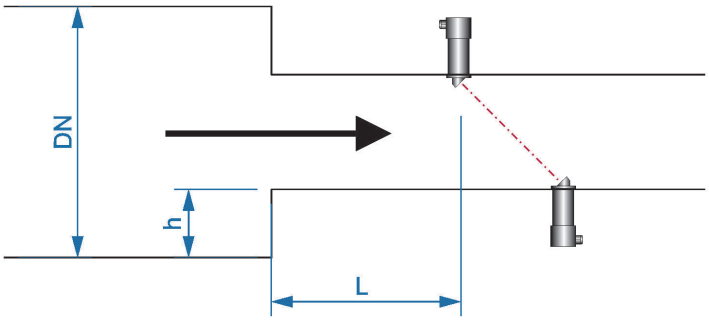
1 = Fixtures
2 = Obstruction

h_{max}	=	Max. level/height
×	=	Error caused by vortex formation!
✓	=	Distance L1 (upstream of obstruction) = min. 5x h_{max} Distance L2 (downstream of obstruction) = min. 10x h_{max} in case of flow velocities >1 m/s

Fig. 12-11 Errors caused by fixtures or obstructions (top view) (principle)

12.6 Sensors in full Pipes

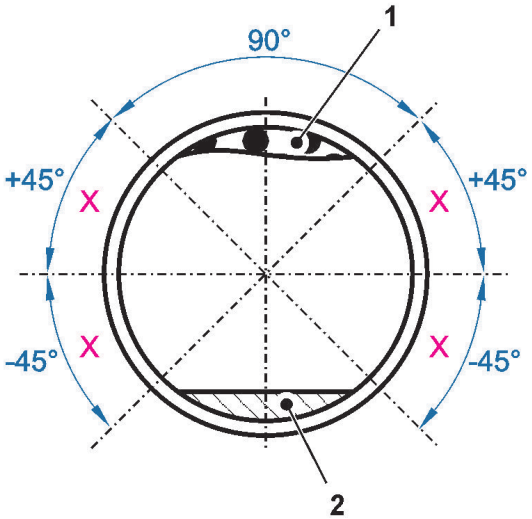
These installation suggestions are valid for the sensor types NOS-V2E, NOS-V2S, NIS-V200, TSP0V200 and NIC-CO01.



h ≤ 5 % of DN	L ≥ min. 3x DN
h > 5 % of DN	L ≥ min. 5x DN
h > 30 % of DN	L ≥ min. 10x DN

Fig. 12-12 Sensor position after change of profile (principle)

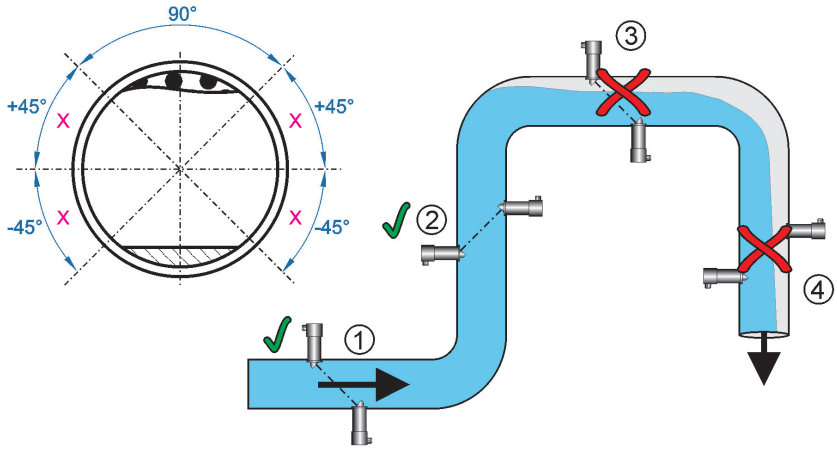
In case of **horizontally laid pipes** avoid pipe top and pipe bottom as mounting place (risk of soiling or air bubbles resulting in measurement failure).
NIVUS recommends a mounting position of -45°...+45° to the horizontal.



X	=	Recommended sensor installation positions
1	=	Risk of air-bubbles
2	=	Risk of sludge deposits

Fig. 12-13 Recommended installation angles for horizontal pipes

At **pipes laid vertically** the danger of swamping / air does not appear in which case any arbitrary mounting place for the sensor can be selected.
A correct and reliable measurement can be performed only in full filled pipes. For this reason do not install measurements in downpipes or at the highest point of the pipeline (Fig. 12-14).



1 = Recommended range in horizontal position (sensor can be installed on the side)
2 = Recommended range in vertical pipe
3 = Not recommended due to part filling/idling
4 = Measuring impossible due to idling

Fig. 12-14 Comparison of installation places (principle)

In case of planning measurements in horizontal pipelines NIVUS recommends to consider a slightly inclined section or an inverted siphon (sensor installation as depicted in Fig. 12-15).

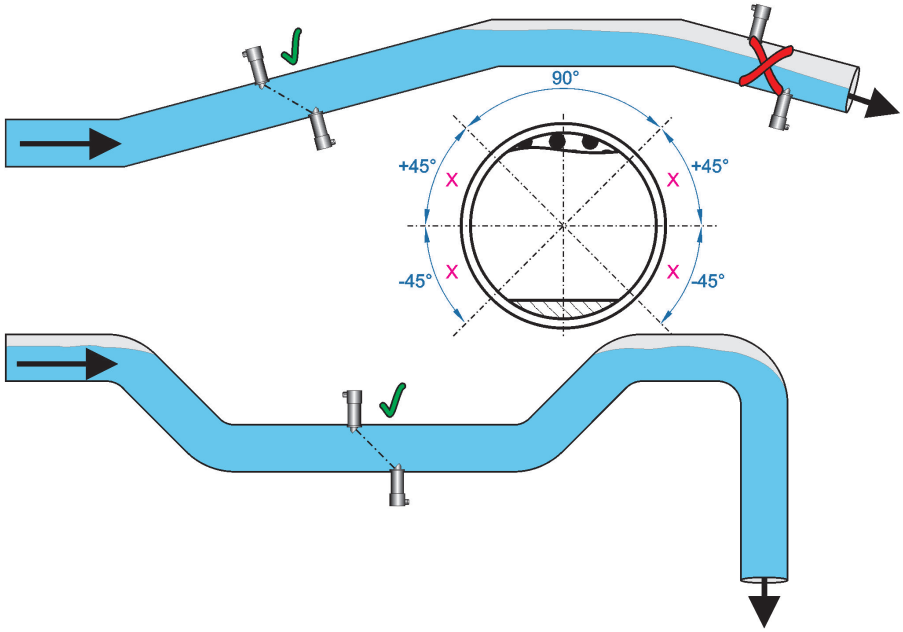


Fig. 12-15 Horizontal pipe with inverted siphon (principle)

Shut-off valves and control fittings shall be installed **always downstream** of flow velocity sensors.

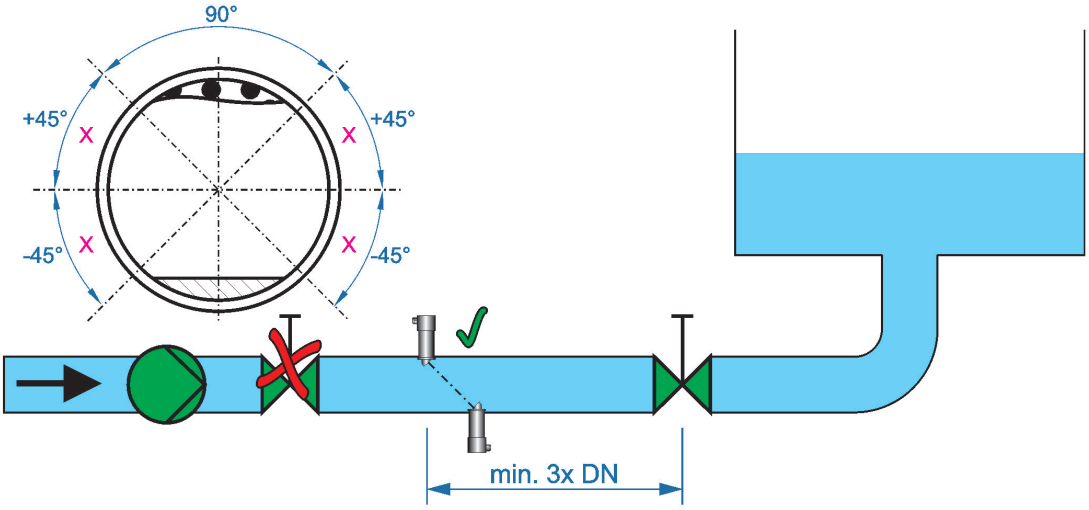


Fig. 12-16 Using shut-off valves and control fittings (principles)

Avoid vibrating pipelines

Never install sensors on vibrating pipelines since this may result in measurement errors.

13 Sensor Installation and positioning

13.1 General Notes

Avoid engine (motor) lines and main power lines

To avoid disturbances from electrical interferences, the sensor cable must not be laid close (or parallel) to engine (motor) lines or main power lines.

The installation of sensors in open channels or water bodies always requires previous planning. A measuring point inspection is required. Mounting options might be very individual.

Both sensors of each path must be mounted according to the geometry and must be aligned to face each other. Use optical aids like a laser distance meter (or others) to achieve this (see chapter “14 Sensor alignment”).

Install and align the sensors carefully

A vibration-free, firm installation and a high accurate sensor alignment are necessarily required to ensure the measurement to operate properly.

There are additional markings on the sensor cables to assign the sensors correctly.

The sensors can be connected **directly to the transmitter** if the measurement does not require more than **two paths**. The designations 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)

Table 2 Sensor markings up to two paths

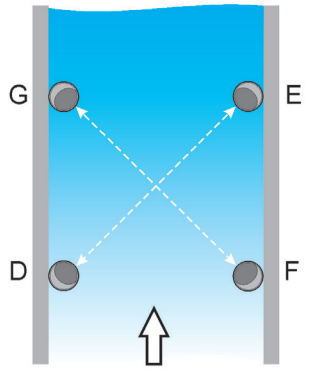


Fig. 13-1 Sensor assignment to the transmitter (principle)

The sensors are designated with numbers in case of connecting via adapter box or via extension module: 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)

Table 3 Sensor markings for adapter box/extension module (principle)

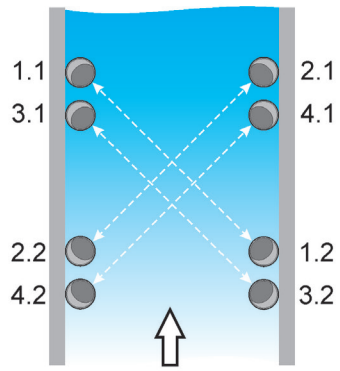


Fig. 13-2 Sensor allocation to the adapter box/extension module (principle)

13.2 Possibilities of the System Configuration

The arrangement of the sensors is dependent on the hydraulic conditions, water body geometry and the infrastructure of the respective measurement place as well as the accuracy of measurement.

Single-path system

The most simple ultrasonic sensor arrangement consists of two hydro-acoustic sensors facing each other diagonally. A prerequisite is that the flow is running parallel to the banks. Such prerequisites can be mostly found in channels and canal-like straightened courses of flowing waters.

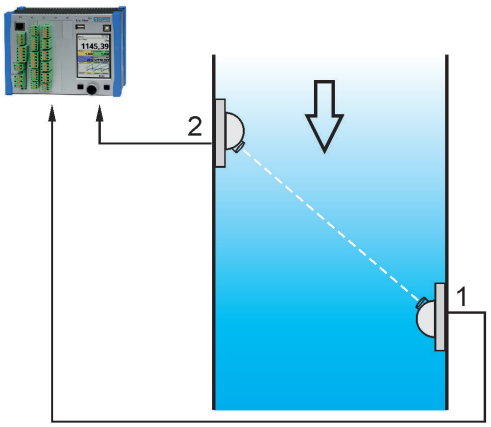


Fig. 13-3 Single-path system (principle)

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

Multi-path system (crossed-paths)

In natural waters the main flow direction only occasionally is parallel to the banks. Bends and curves within the watercourse sustainably influence the main flow direction at varying flow levels.
In such cases two measurement paths are arranged crosswise, where the second path is used to additionally calculate the angle between the main flow direction and one of the banks.

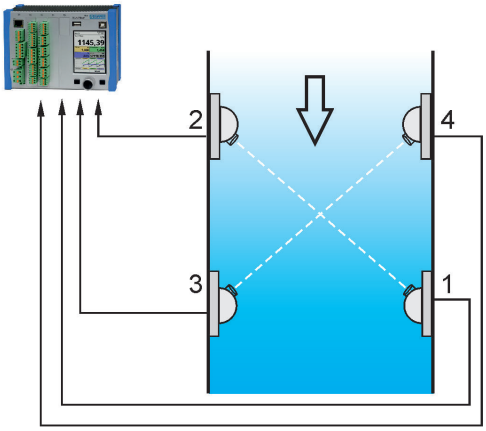


Fig. 13-4 Multi-path system (crossed-paths) (principle)

This arrangement alternately measures the transit time within the measurement paths 1-2 and 3-4.

Multi-layer system

In measurement sections featuring extremely fluctuating water levels or extensive geometries (divided cross sections) it is recommended to use multiple layers.

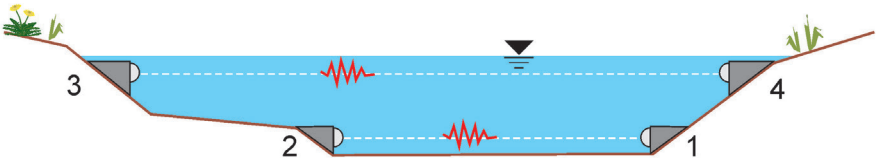
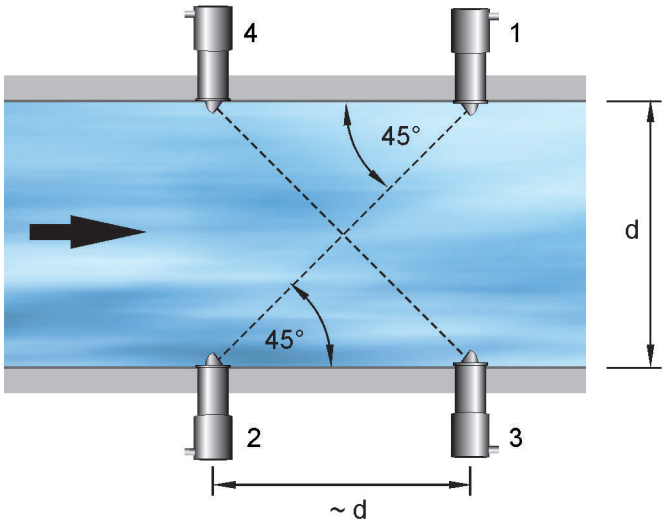


Fig. 13-5 Multi-layer system (principle)

Each layer can be configured as single-path or multi-path measurement.
As soon as the entire cross-sectional area is detected by using an appropriate number of measurement paths arranged above each other, the hydrometric calibration as base for flow

measurement can be neglected since the flow profile is known properly thanks to using multiple layers for measuring.
The highest accuracy can be achieved by using a crosswise multi-layer arrangement since this configuration reduces the influence of uncertainties regarding the main flow direction and the flow profile on the result of the calculation.



1…4	Sensor 1, Sensor 2, Sensor 3, Sensor 4
d	Inner diameter/channel width

Fig. 13-6 General path positioning, 2-path measuring (principle)

13.3 Calculation of Minimum Water depth of the Application

The channel or the water body must have a minimum water depth in order to eliminate errors caused by reflections of the ultrasonic signal at the water surface.
This factor can be calculated by using the formula below:

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

- D_{min} = Minimum water depth above the path and minimum distance between channel bottom and path - each in meters
- L = path length in meters
- f = converter frequency in Hertz

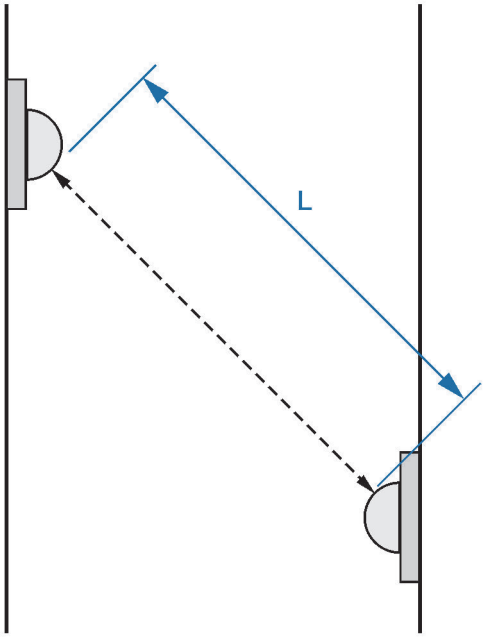


Fig. 13-7 Graphical representation path length (principle)

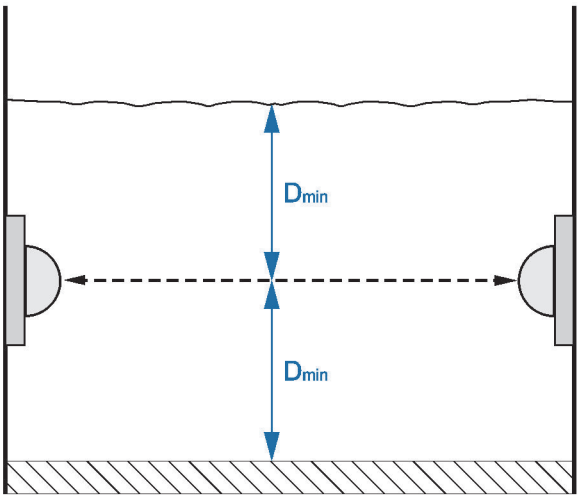


Fig. 13-8 Graphical representation Minimum water depth (principle)

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

Path length L [m]	Converter frequency 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

Table 4 Minimum water level (examples)

Similar restrictions are valid for very smooth water beds which rather reflect than absorb the acoustic signal.

Frequencies of NIVUS-Sensors:

- 1000 kHz: NOS-V2005, NOS-V3005, NOS-V20BS, NOS-V30BS, NOS-V30BX, NIS, NIS0, TSP0, NIC-CO01
- 500 kHz : NOS-V20BX
- 200 kHz: NOS-V4005, NOS-V20BX

13.4 Rod sensors type NOS

The fastening of the pipe holder (stainless steel pipe) for the sensor head can either be screwed to the angular holder (Fig. 13-9) from the top or to the wall holder (Fig. 13-10) from the side (NIVUS recommends using wedge anchors and key screws with M12 metric thread). It is necessarily required to install the holder bracket in a way which enables to accurately adjust the sensors to one another after installation (recommended angle 45° horizontally). This can be achieved by visible adjustment and by analysing the impulse signal.
Adjust the sensor faces (carbon surfaces) exactly to one another since otherwise measurement is not guaranteed to operate without any problems.

Check the sensor positions keenly.

Since sensor installation on measurement places extremely depends on local conditions it is necessary to let trained expert personnel choose sensor type as well as installation method prior to installation.
For installation of rod sensors on vertical water embankments or channel walls we recommend to use the NIVUS sensor holder (NOZ00 HAL0 or NOZ00 HAL90) for vertical or horizontal sensor adjustment.

In case of expecting heavy flow conditions we recommend to install a flow-optimised baffle plate (see chapter “15 Holder brackets and protective sheet for rod sensors”) at the sensor holder. This may avoid sensor vibration as well as damage caused by debris/flotsam or similar.

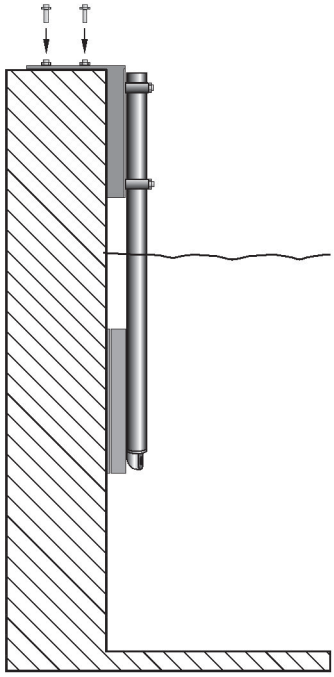


Fig. 13-9 Fixing the angle bracket on a wall

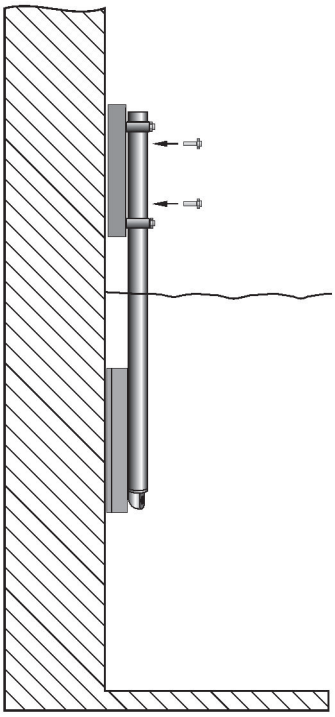
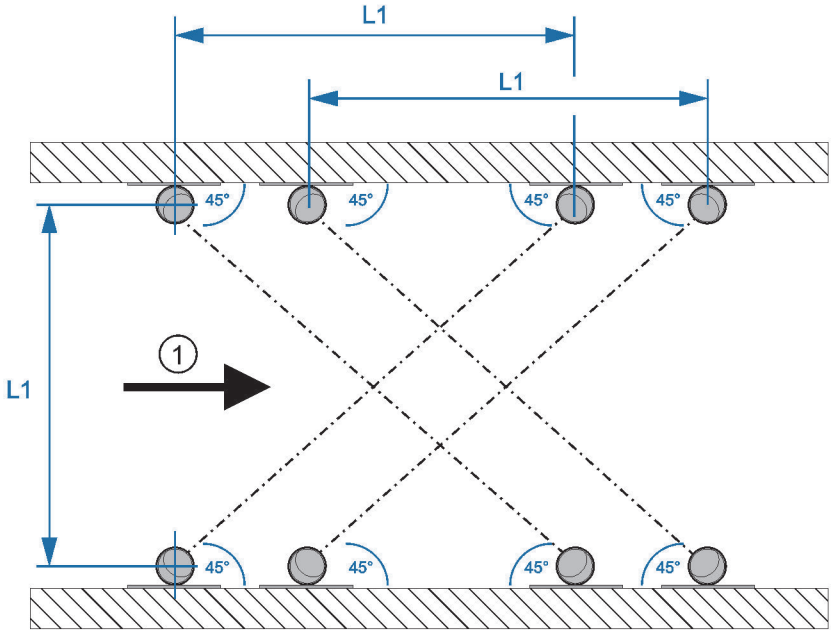


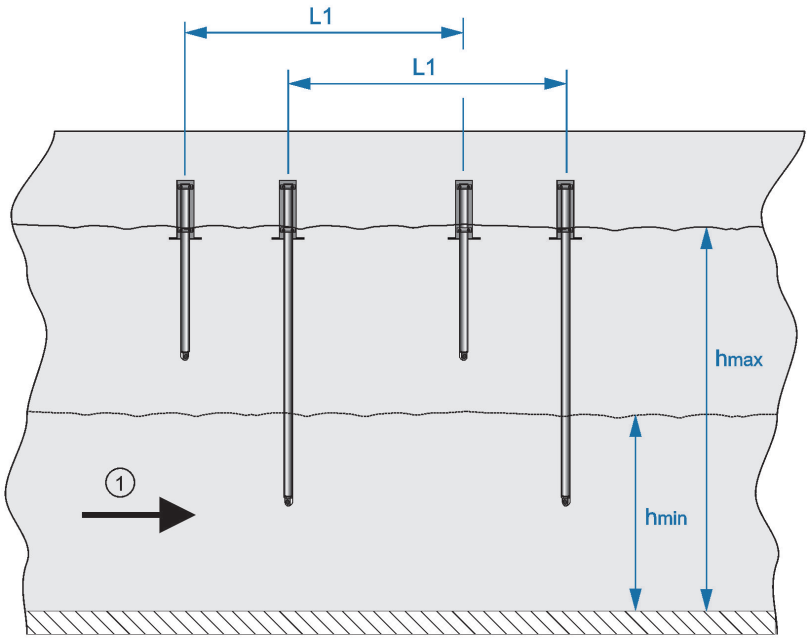
Fig. 13-10 Fixing the wall mount on a straight wall



1 Flow direction

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

Fig. 13-11 Installation example rod sensors 2 levels/4 paths (top view)



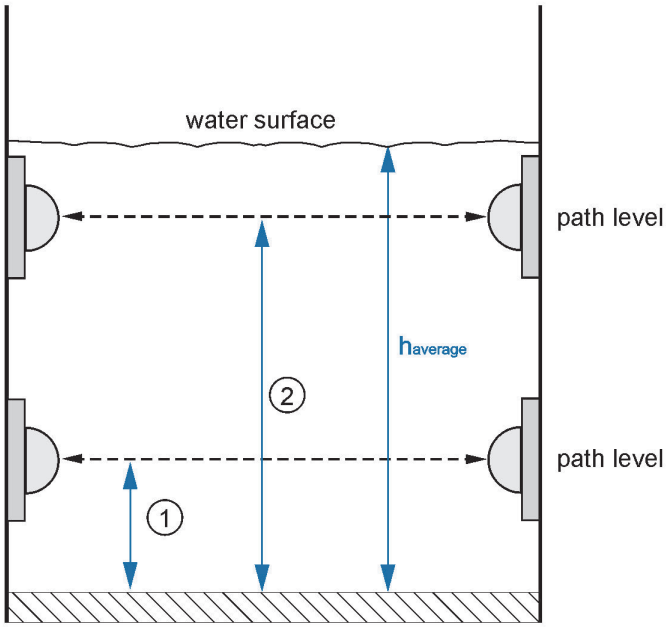
1 Flow direction
L1 Channel width / sensor distance

Fig. 13-12 Installation example rod sensors 2 levels/4 paths (side view)

Observe the guidelines to determine the levels

Positioning the measurement paths in different levels depends on the main measurement task.
Example: minimum, average and maximum discharge.

You can find information on how to define levels in the DIN 6416 directives or contact NIVUS.



1 Bottom path(s) / 40 % of $h_{average}$
2 Upper path(s) / 80 % of $h_{average}$

Fig. 13-13 Allocation of level when measuring average discharge

13.5 Hemisphere sensor type NOS

Holder bracket for hemisphere (NOZ00 HALHK) for the flow velocity sensor type NOS has been designed for use on vertical and non-vertical water body boundaries (slopes or similar). It allows adjusting angles in two different levels which enables to adjust sensors to one another. Its shape has almost no effect on the flow behaviour and helps to avoid the risk of build-up caused by debris or solids (such as algae, leafs, foliage, grass or similar).
NIVUS recommend connecting the sensors using the optional underwater plug connectors (NOS sensor connection A or B). These connectors can be used up to 12 m water column.
After installation visibly align the hemisphere sensors as depicted below (see chapter “14.4 Hemispheres”).

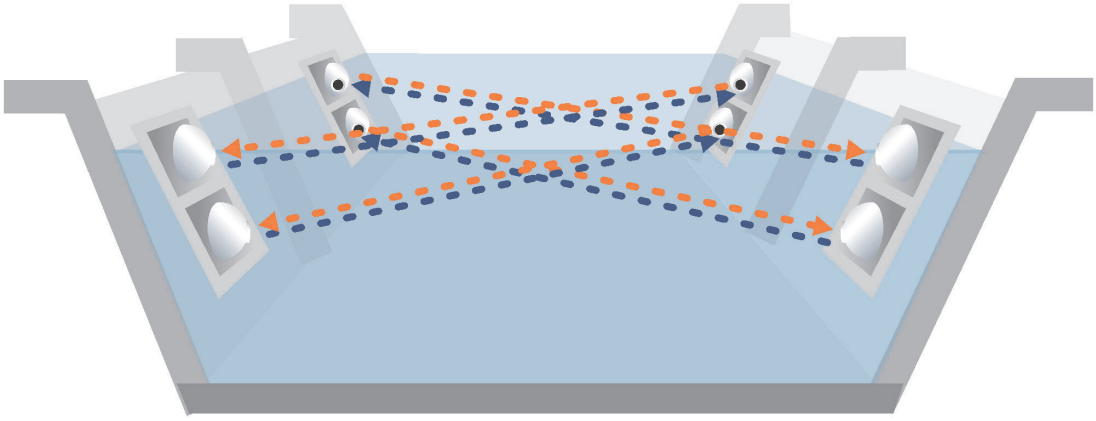


Fig. 13-14 Installation example hemisphere sensors 2 layers / 2 paths

13.6 Wedge sensor type NIS

To install the wedge sensor on the channel wall four stainless steel screws with a counter-sunk head (size M5, length 30…70 mm; 1.18…2.76 in) as well as the accompanying dowels are required.
Choose the screw length in a way that safe and durable sensor fastening is ensured under any operational conditions.
In order to reduce vorticity formation or the risk of build-up use well-fitting counter-sunk screws and screw them into the mounting plate completely.
NIVUS does not recommend the use of stud bolts or similar.

Fastening elements for wedge sensors should be as flush as possible with the mounting plate

There is a risk of build-up due to grass, algae or similar and hence the risk of measurement failure if any screws or other fastening parts should extend into the measurement medium.

This can cause disturbances or may lead to measurement failures.

The sensor pairs of each path must be fastened according to the geometry and shall be aligned facing each other. For direction finding of signals optical aids such as a Laser distance meter can be used (see chapter “14.3 Wedge Sensors”).

To reduce the risk of build-up the wedge sensor has been optimised for flow conditions. Nevertheless there may be a certain kind of risk of build-up on the sensor mounting plate. This is the reason why there is no gap allowed to be left between sensor mounting plate and channel bottom. Any gap or seam which might have been emerged in the area around the sensor tip due to installation has to be sealed with silicone or similar material.

For sensor installation on the channel bottom the ground has to be absolutely flat (plane surface)

Otherwise the sensor may break and leak.

Water is leaking into electronic components causing irreversible damage.

CAUTION

Use appropriate tools

Do not deform the ground plate neither during installation nor dismantling. Never enlarge installation boreholes.
Always use an ***appropriate screwdriver*** *for sensor dismantling. Never use prybars, chisels, hammers, levers, crowbars, hammer drills or similar tools.*
It is not allowed to use any kind of force during dismantling procedures.

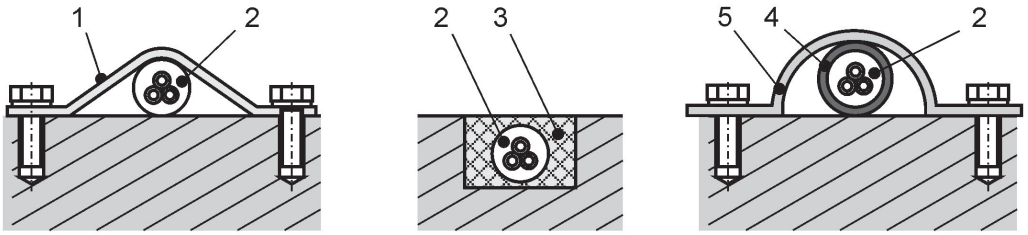
Disregarding may irreversibly damage the sensor.

Do not loosen or remove parts

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

This could lead to leakage and cause a failure in the measurement.

The sensor cable must be laid on the channel ground from behind the wedge sensor to the channel wall. In order to avoid the risk of build-up cover the cable with a thin stainless steel sheet or lays it into a slot which has to be sealed with permanently elastic material subsequently. It is also allowed to lay the cables in armoured conduits and similar robust cable protection systems.
Appropriate covers are available from NIVUS.



1 Stainless steel sheet/cable cover, e.g. type ZMS0 140

2 Cable

3 Permanently elastic material (silicone or similar)

4 Empty conduit

5 Pipe clamp

Fig. 13-15 Installation suggestion for cable extension

CAUTION

Ensure protected cable layout

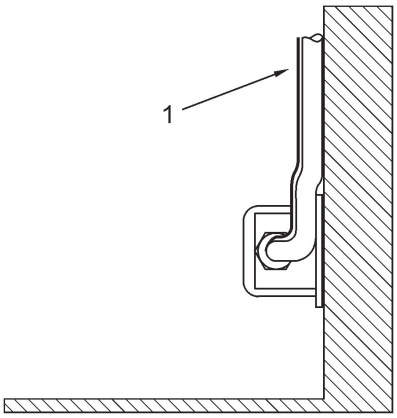
Never run the cable slackly, uncovered or across the medium.

Risk of build-up, sensor or cable tear-off.

Observe the bending radius

The minimum bending radius of the standard signal cable is 10 cm (3.94 in).

Smaller radii may result in cable break!



1 Protective cover

Fig. 13-16 Protective cover for cable routing

Protect the sensor cables from disturbing influences

Do not lay the sensor cable close (or parallel) to motor power supply lines and power lines in order to avoid disturbances caused by electric interference.

This may impair the measurement or even lead to measurement failure.

Examples of a 2-path measurement using wedge sensors

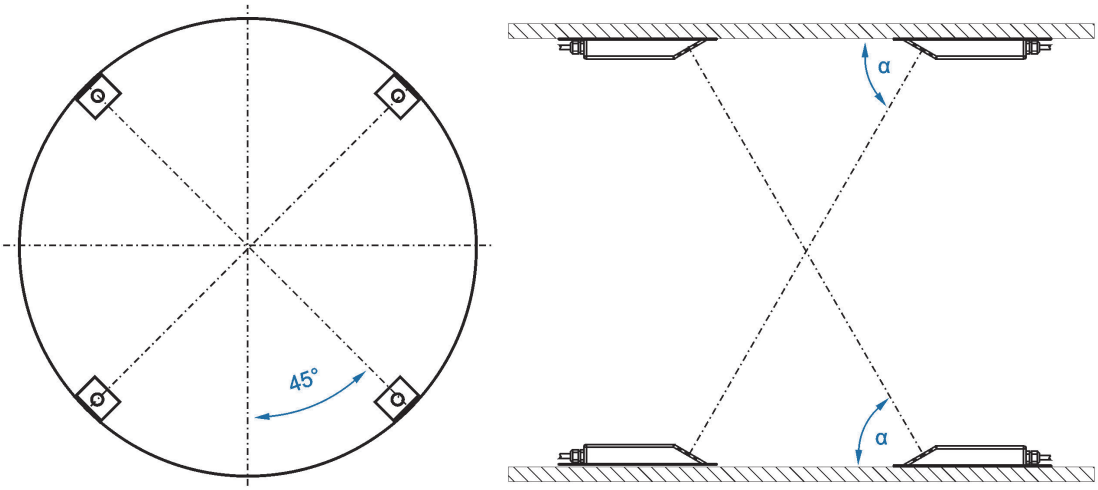
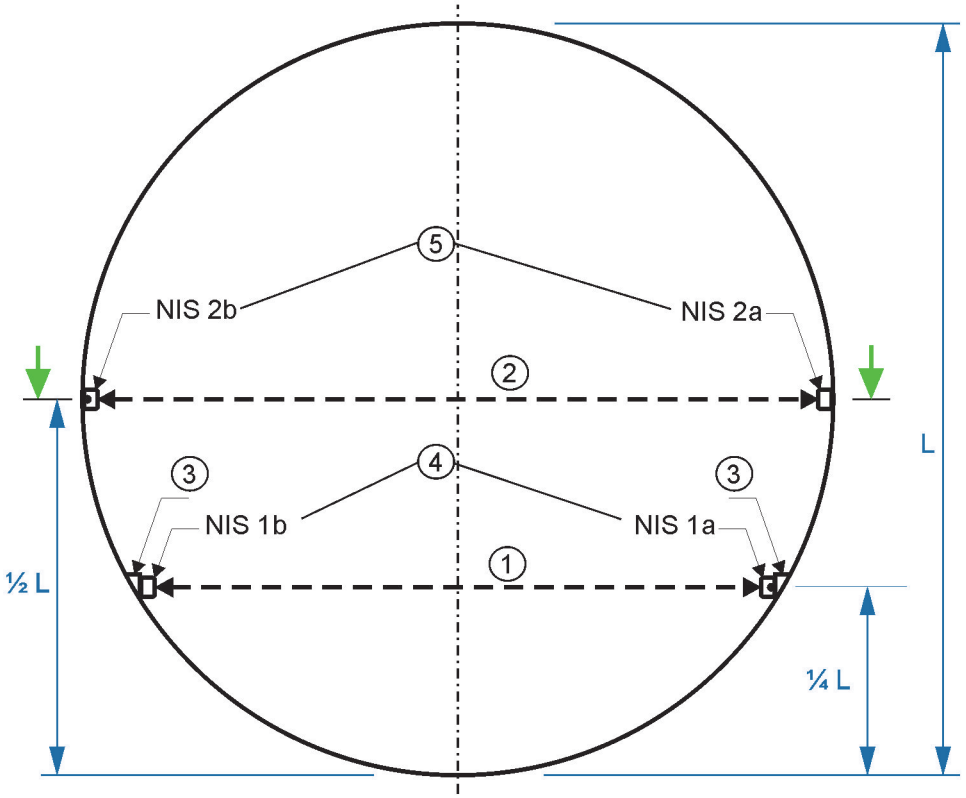


Fig. 13-17 2-path measuring in full pipe



1 Path 1
2 Path 2
3 Mounting wedge
4 Pair of sensors 1st path
5 Pair of sensors 2nd path

Fig. 13-18 2-path measuring in part filled pipe

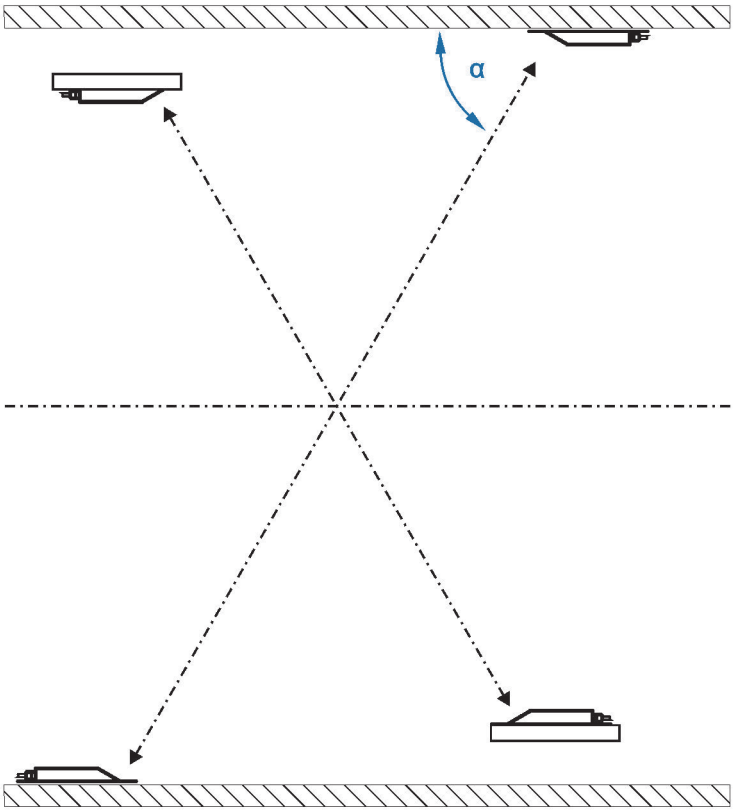
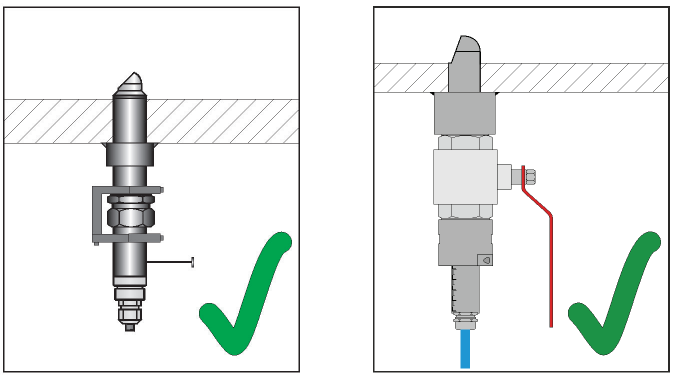


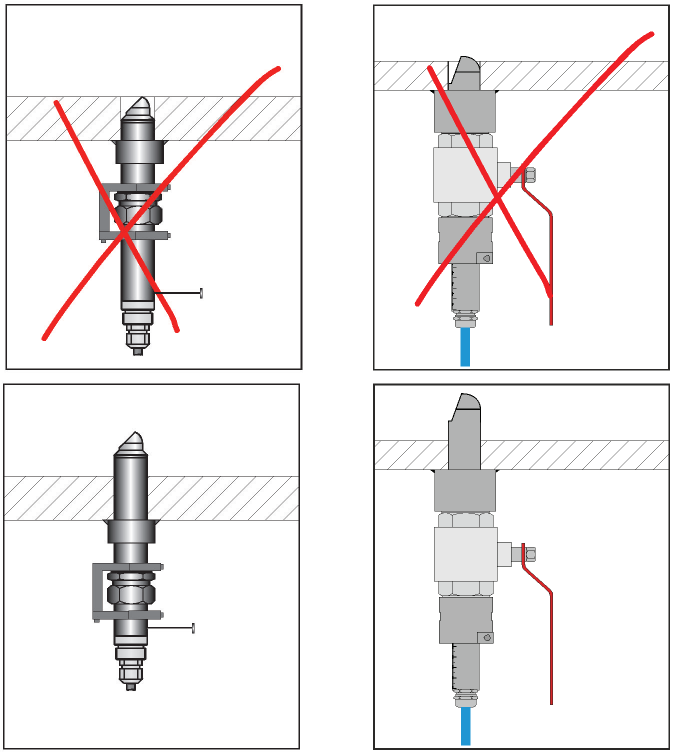
Fig. 13-19 2-path measuring in part filled pipe (sectional view)

13.7 Pipe sensors type NIS and type TSP0

The sensors have to be fastened hard and tight in a way that the bevelled side of the sensor 1 with its integrated flow velocity sensor must “look” (face) against the flow direction of the medium. The installation aid (see Fig. 19-2) shall look towards the flow direction. The flow velocity sensor integrated in sensor 2 must look exactly towards sensor 1 in flow direction.
Use only non-corrosive fastening material.
The pipe sensors type NIS and TSP0 are to be screwed tightly into the 1½” nozzle by using a gasket ring and the retaining element (additional option: ball valve for removal without pressure). It is important that the horizontal part of the sensor is installed flush with the pipe wall.



Correct installation



Error: faulty measurement values

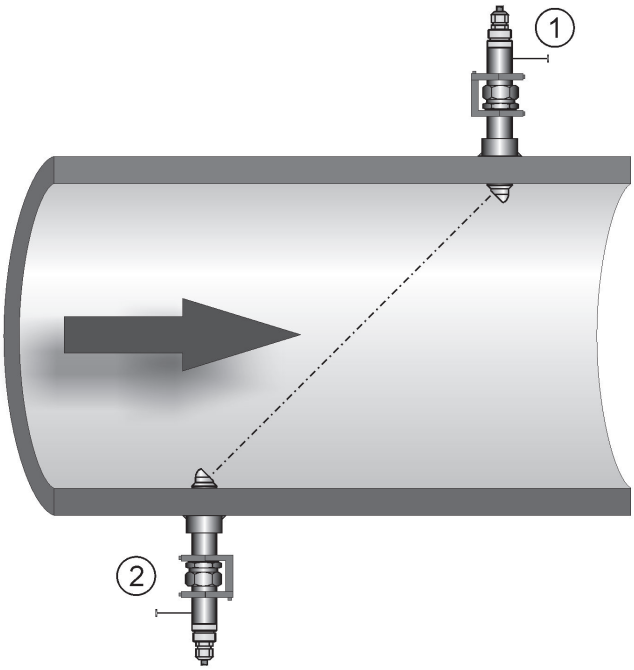
If nozzles should not be positioned exactly (installation slightly too narrow) this can be compensated by inserting the sensors a bit deeper.

Fig. 13-20 Hints on pipe sensor installation

NIS-/TSP0 sensors in full filled pipes

NIS- and TSP0 sensors generally are suitable for 1-path and 2-path applications only.

In full pipes always direct the measurement path(s) across the centre of the pipe.



1 Sensor 1: face towards the flow direction

2 Sensor 2: face in flow direction

Fig. 13-21 Hints on pipe sensor installation

Note whilst installation in pipes

- *Weld on the 1½" nozzle in an angle of 90°.*
- *Place the pipe sensors in a way that the bevelled side of sensor 1 is looking exactly towards the flow direction. Sensor 2 must be aligned in flow direction and towards sensor 1.*

The sensor block must be welded, depending on material (steel, stainless steel 1.4571), be glued on (PVC), welded on (HDPE) or laminated (PVC).

For upgrading purposes NIVUS recommend to use a tapping saddle (see chapter "18 Tapping Saddle for pipe sensor"). If using cast or concrete pipes it is possible to screw a steel or stainless steel clamp with weld-on nozzle and sealing onto the pipe.

If in doubt please contact the pipe manufacturer in order to install the sensor nozzles.
In order to drill into steel or stainless steel pipelines, NIVUS recommend to use a carbide hole cutter (diameter 38 mm for 1½" and 24 mm for 1") and a low-speed drilling machine with friction clutch. We furthermore recommend to additionally using cutting paste for drill bit cooling.

For thicker pipe walls use a longer drill bit

Check the maximum possible wall strength of the pipe prior to drilling. It might be necessary to use extended drill bits since standard drill bits might be too short to drill through the pipe wall.

Drilling into concrete ducts should be carried out by a specialised expert company if possible. Basically observe the hints below:

- The minimum diameter of the core bore must be 45 mm.
- The diamond tool used shall be cooled accordingly.
- Flush with a coolant to remove debris.
- If it is necessary to drill through a ball valve use a drill bit with a diameter of 36 mm as well as the accompanying extension (Fig. 20-1).

Drill bits, extensions and cutting paste may be purchased from NIVUS if required. Ideally weld, glue or laminate the welding nozzle **after** the hole has been drilled.

WARNING

Risk of accidents while drilling

Use only in a low pressure condition depending on pipe material and wall strength. A blocking of the drill can be possible.
Do not step over the indicated drill speed.

Disregarding may lead in personal injury.

WARNING

Use a mobile safety circuit breaker

Remember to always use a mobile safety circuit breaker in case of working in wet environs and/or drilling into filled pipes.

Disregarding may lead to electric shocks.

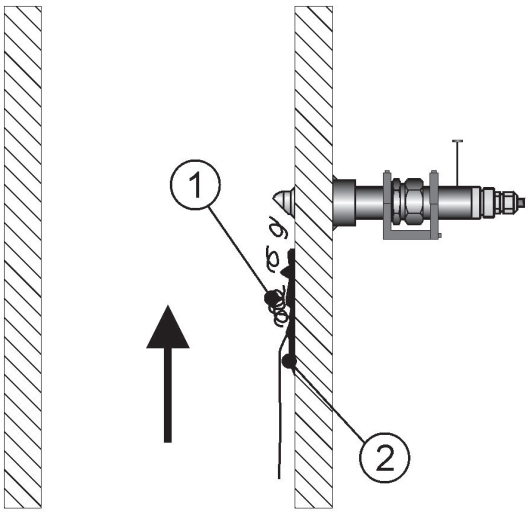
Ensure free evacuation of chips when drilling and remove drill burrs

Please observe unobstructed removal of turnings. If necessary, interrupt drilling and remove turnings before proceeding.

Remove burrs with a file after drilling.

Observe to not damage the pipeline when welding

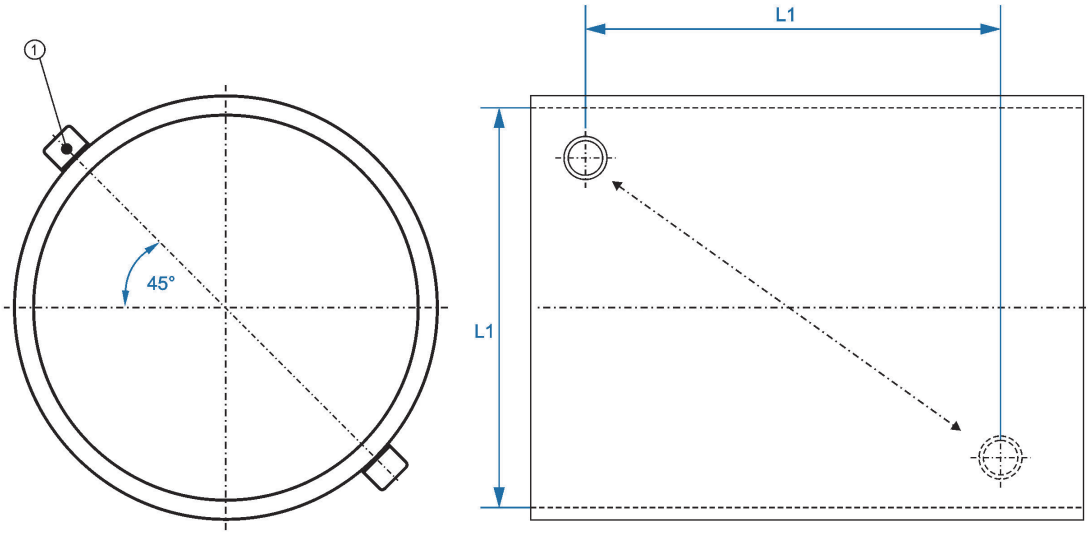
Weld seam burn may cause swirls and hence lead to measurement errors (Fig. 13-22).



1 Whirls/chips

2 Weld seam burn

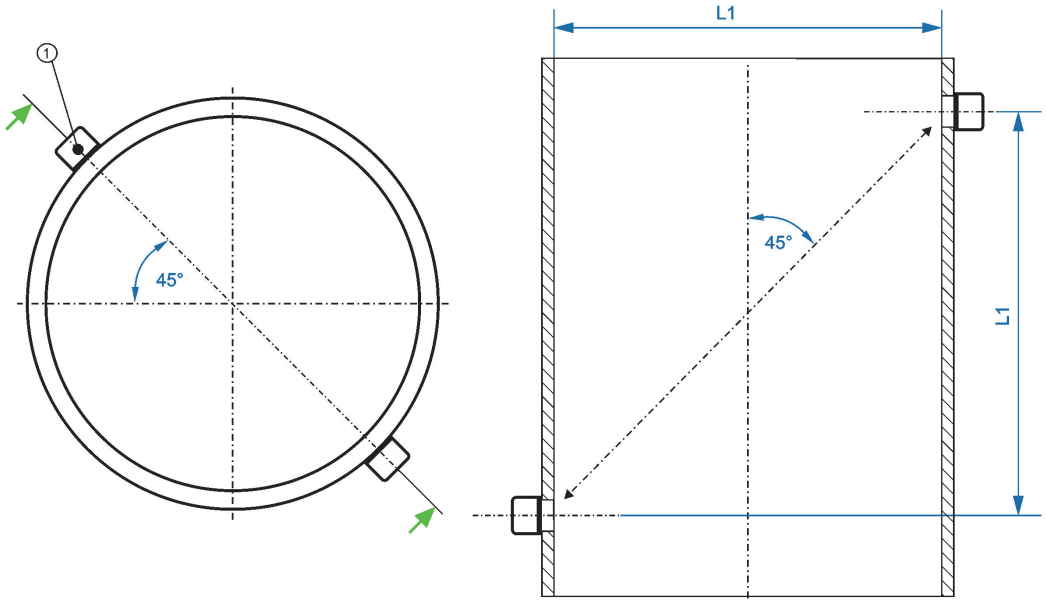
Fig. 13-22 Disturbances caused by weld seam burn



1 Inner thread 1” (type TSP0), 1¼” (type NOS) or 1½” (type NIS)

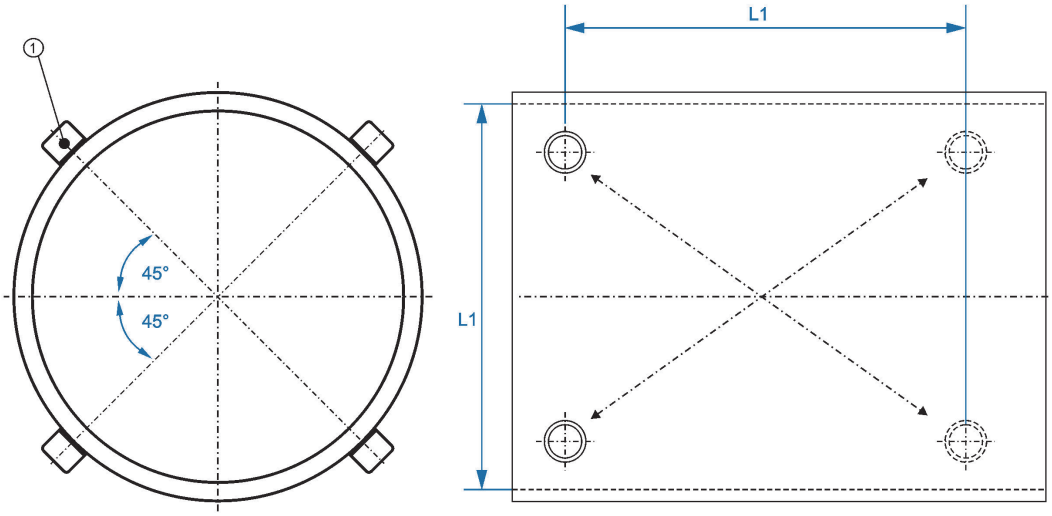
L1 Inside diameter / Sensor distance

Fig. 13-23 Example of an 1-path measuring in a pipe (>DN300) (side view)



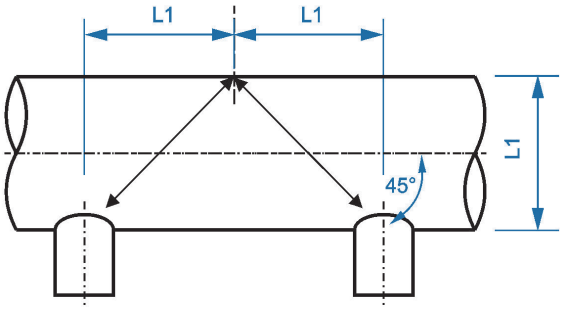
1 Inner thread 1” (type TSP0), 1¼” (type NOS) or 1½” (type NIS)
L1 Inside diameter / Sensor distance

Fig. 13-24 Example of an 1-path measuring in a pipe (sectional view)



1 Inner thread 1” (type TSP0), 1¼” (type NOS) or 1½” (type NIS)
L1 Inside diameter / Sensor distance

Fig. 13-25 Example of a 2-path measuring in a pipe (side view)



L1 Inside diameter;
sensor distance = 2x inside diameter

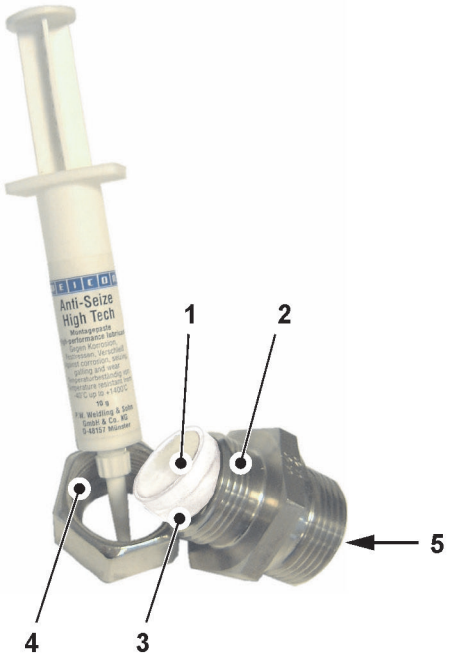
Fig. 13-26 Example of an 1-path reflection measurement in a small metal pipe

13.7.1 Pipe sensor type NIS

Grease the screw thread with grease paste

When assembling the insertion sensor, a special grease paste must be used for the stainless steel couplings, specified to DIN 2353.
The cap nut thread, threads and cone as well as the cutting ring of the pipe sensor type NIS must be slightly greased when pre-assembling the insertion sensor.

The screw joints are greased on delivery. Additional grease can be purchased from NIVUS.



1 Gasket ring
2 Thread
3 Inner cone
4 Inner thread of spigot nut
5 O-ring inside of sensor screw connections

Fig. 13-27 Using grease on sensors type NIS

➲ Grease all points of the screw joint marked in Fig. 13-27 prior to installation.

➲ Install the sensor according to DIN 3859-2:

1. Screw the screw joint into the welding nozzle, ball valve or the nozzle of the tapping saddle using a pipe wrench or an open-end wrench (width across flats 55 mm).
2. Push the spigot nut and the gasket ring over the flow velocity sensor.
3. Insert the sensor into the screw joint as deep as required (depending on application) (Fig. 13-21).
4. Put the gasket ring into the screw connection.
5. Tighten the spigot nut manually.
6. In order to be capable of controlling the number of turns apply a marker on the spigot nut.
7. Tighten the nut by approx. ½ turn using an open-end spanner with a spanner width of 50 mm.

The retaining element is an indispensable part of the pipe sensors. It safely retains the sensor in position and, if installed correctly, prevents the sensor from being thrown out.

WARNING

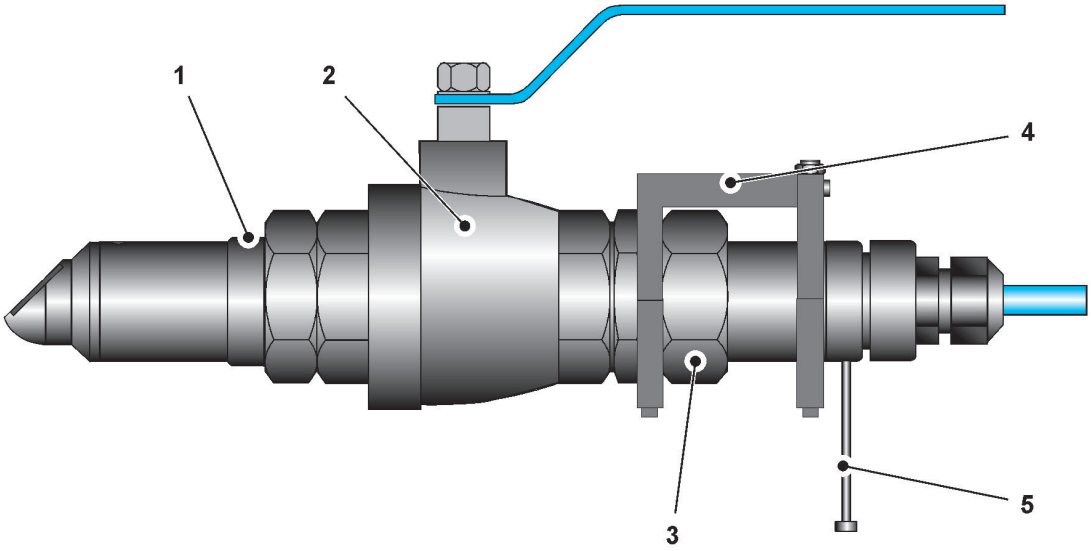
Always install the pipe sensor with retaining element

It is not allowed to operate the sensor without retaining element!
The gasket ring used is merely for sealing purposes and does not have any fastening capabilities at all.

Flow velocity sensors without retaining element may detach from the screw joint and hence may be dangerous to persons as well as to parts of the facility.

Disregarding may lead to personal injury due to ejected sensors.

Ejected sensors may cause the medium to flow out of the screw connection and flood the facility.



1 Welding nozzle
2 Stop ball valve
3 Sensor screw connection
4 Sensor retaining element
5 Installation aid (screw M4)

Fig. 13-28 Components of pipe sensor mounting

Clean and degrease the parts

Before starting installation in order to ensure safe clamping, degrease the rear area of the pipe sensor as well as the clamping area (half-round milling groove) of the upper and lower rear clamp elements by using appropriate means.
Sensor shaft and clamping area of the clamp elements must be dry.

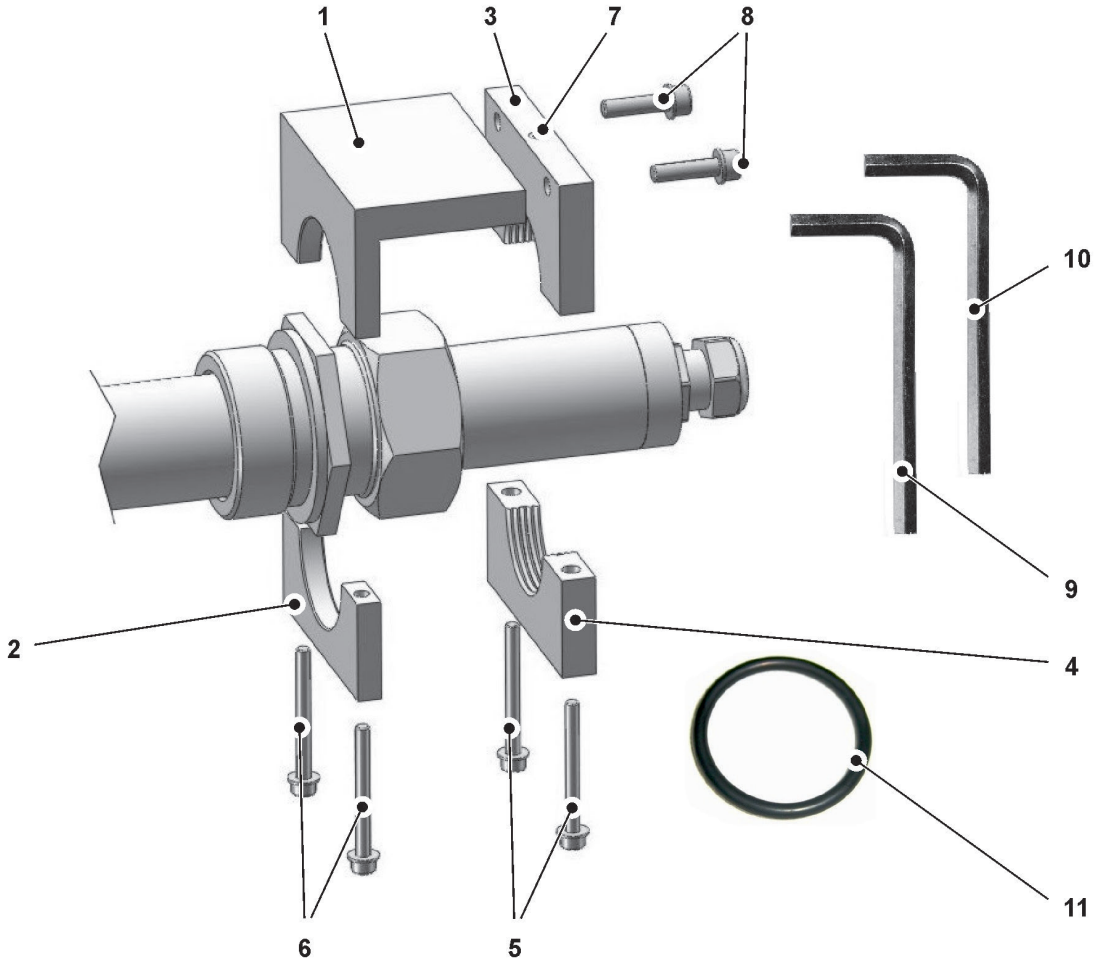
Without degreasing and drying both components and the sensor shaft, the stiction between sensor and sensor retaining element will reduce by an unknown extent.
In this case, it is no longer guaranteed to reliably secure the sensor.

Observe the maximum constant and impact load

The retaining element for pipe sensor as delivered by NIVUS has been tested by an independent testing laboratory using a long-term stress test applying 4 bar constant load and 8 bar impact load (30 sec.).

Higher pressures cannot be compensated safely.

The retaining element for pipe sensors consists of the parts below:



1 Upper front clamp element
2 Lower front clamp element
3 Upper rear clamp element
4 Lower rear clamp element
5 2x Allen head screw M5
6 2x Allen head screw M4
7 Welded headless screw as additional clamp lock
8 2x Allen head screw M5
9 Allen key 3 mm
10 Allen key 2,5 mm
11 O-ring, spare part for sensor screw connection

Fig. 13-29 Exploded assembly drawing of sensor retaining element

➲ **Mounting** procedure:

1. Apply a small amount of grease to the O-ring on the inside of the sensor screw connection.

Fig. 13-30 Greasing the sensor screw connection

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

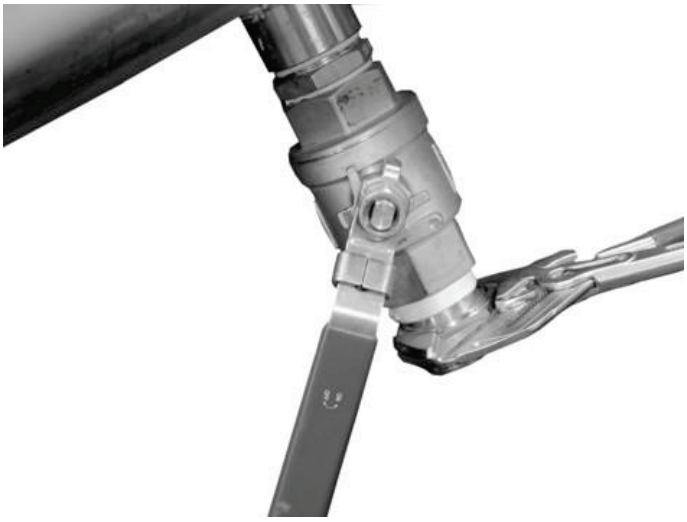


Fig. 13-31 Fixing the sensor screw connection to the stop ball valve

3. Put the pipe sensor in the correct position as described before in this chapter.

Fig. 13-32 Positioning the sensor

4. Fasten the sensor by slightly tightening the spigot nut manually (plus ½ turn).

Fig. 13-33 Fastening the sensor

5. Screw upper and lower front clamp elements together behind the spigot nut of the sensor screw connection by using two M4 Allen head screws (Fig. 13-29 no. 7).

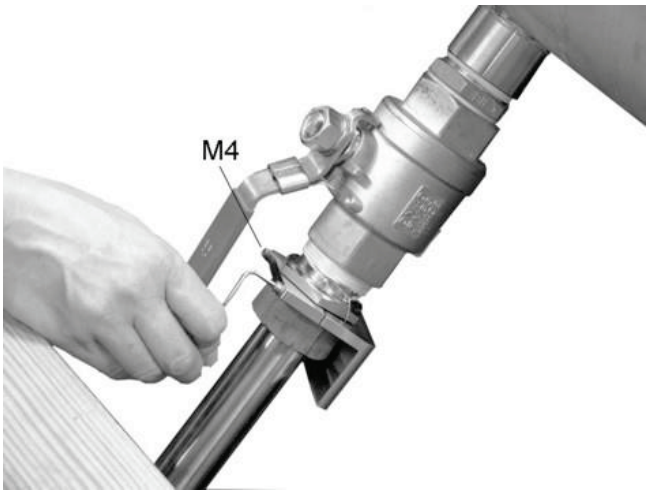


Fig. 13-34 Attaching lower front clamp element

6. Screw the upper rear clamp element (Fig. 13-29 no. 3) to the upper front clamp element using two M5 Allen head screws.

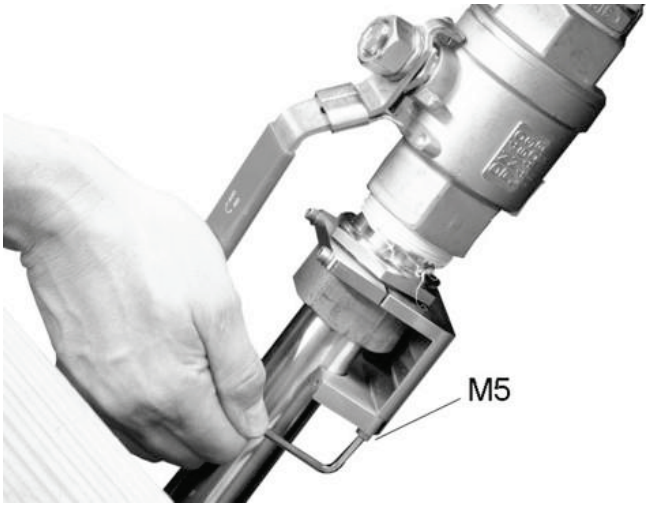


Fig. 13-35 Connecting upper rear and upper front clamp element

7. Attach the lower rear clamp element to the upper rear clamp element by using two other M5 Allen head screws.
   Use a minimum torque of 6 Nm to tighten the screws in order to ensure proven security.
8. Check the tightness of the complete screw joint. In case of liquids leaking under process conditions ensure proper tightening of the respective screw joints or shut down the entire facility if required and replace damaged gaskets, Teflon tapes and similar.

Fig. 13-36 Attaching the final clamp element

➲ **Removal** procedure to clean and maintain the sensor:

WARNING

Pipeline must be pressureless

Prior to dismantling the sensor, make sure that the pipeline is empty or pressureless in order to avoid the medium blowing out to reduce the risk of injuries from flying parts.

1. Unscrew the two Allen head screws M5 (Fig. 13-35) and the spigot nut.

Fig. 13-37 Unscrew the spigot nut for sensor removal

2. Remove the sensor. The screwed rear clamp elements remain in their position on the pipe sensor body.

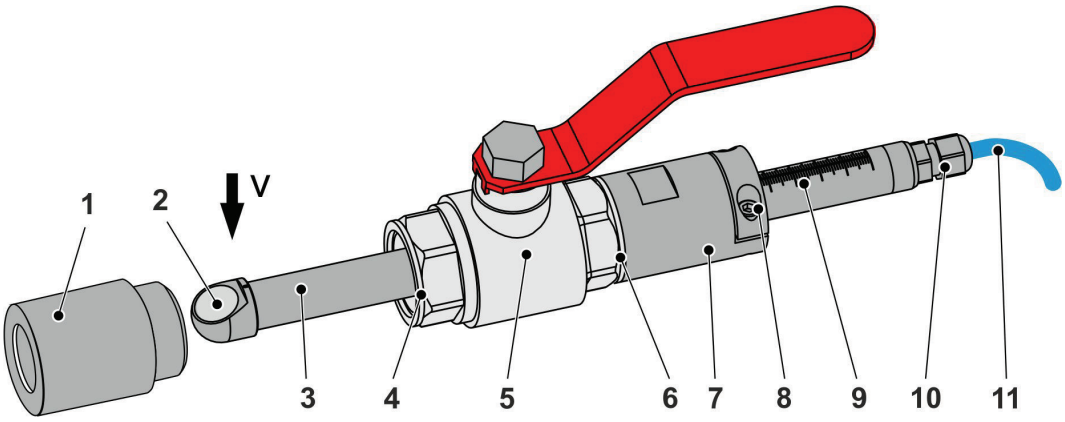
Fig. 13-38 Removing the sensor (maintenance/control)

3. Inspect and clean the sensor if required.
4. Replace the cutting ring and reinsert the sensor into the screw connection. Use the rear clamp elements left on the sensor body as detent or positioning aid (Fig. 13-38).
5. Tighten spigot nut and M5 Allen head screws again.

Fig. 13-39 Lock the sensor again after reinstallation

13.7.2 Pipe sensor type TSP0

13.7.2.1 Overview of components



1 Welding nozzle
2 Sensor face
3 Pipe sensor
4 Flat gasket

5 Stop ball valve G1", width across flats 39 mm

6 Flat gasket

7 Sensor clamping, width across flats 36 mm

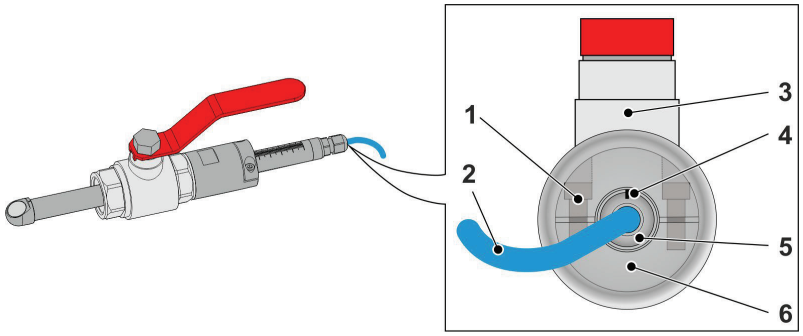
8 2x Screw joint M5 of sensor clamping

9 Scale for pipe wall strength (valid only when the accompanying welding nozzle G1", no. 1, is used)
Center line of scale = alignment aid: align center line to look upstream

10 Cable gland

11 Sensor cable

Fig. 13-40 Pipe sensor TSP0 with welding nozzle



1 2x Screw joint M5 of sensor clamping

2 Sensor cable

3 Stop ball valve

4 Scale

5 Pipe sensor TSP0

6 Sensor clamping

Fig. 13-41 Pipe sensor TSP0: view on cable side of sensor

13.7.2.2 Install pipe sensor TSP0 in empty pipeline

Use of stop ball valve is essential

The stop ball valve for pressureless removal is a part of the standard delivery and has to be used in any event.

The section below describes how to install the pipe sensor into an empty pipeline using the accompanying welding nozzle G1" (part of the standard delivery).

⇨ If you're using the NIVUS welding nozzle G1½" it is required to install a reduction double nipple. Factor the procedure to investigate the insertion depth in Sect. "13.7.2.4 Install pipe sensor TSP0 in customer welding nozzle or NIVUS welding nozzle G1½"" into the mounting procedure (see page 51 et seq.).

Tools required

- 1x spanner, width across flats 39 mm
- 1x torque spanner, width across flats 36 mm

- 1x torque spanner with hex-wrench bit, width across flats 4 mm (for Allen screws M5); torque required 3.4 Nm

Prerequisites

- The welding nozzle (Fig. 13-40 no. 7) is installed into the pipe line.
- A hole has been drilled into the pipeline.
- The screw joints (Fig. 13-40 no. 8) of sensor clamping are loose; the pipe sensor (Fig. 13-40 no. 3) is (movable) inserted into sensor clamping.

Mounting

➲ Procedure:

1. Investigate pipe wall strength.
2. Seal the junction:
   Make sure the flat gasket (Fig. 13-40 no. 6) is positioned exactly.
   Use the size 39 spanner, and the size 36 torque spanner to tighten the sensor clamping to the stop ball valve by a minimum of 10 Nm.

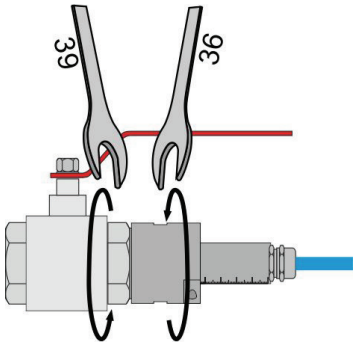


Fig. 13-42 Tighten sensor clamping

3. Insert the flat gasket (Fig. 13-40 no. 4) and screw the stop ball valve (Fig. 13-40 no. 5) into the nozzle manually.
4. Tighten the stop ball valve firmly with the size 39 spanner.

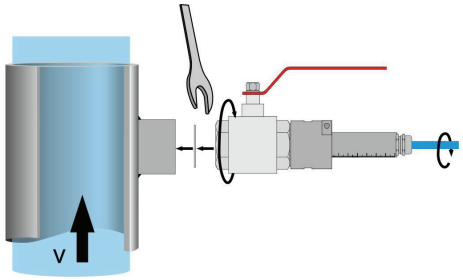


Fig. 13-43 Tighten stop ball valve

5. Insert the pipe sensor into the pipe until the scale reaches the earlier investigated pipe wall strength.
   As an example the following figure shows the pipe wall strength of 3.1 cm.

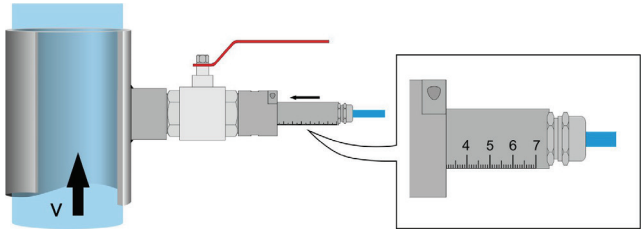


Fig. 13-44 Insert sensor (pipe wall strength)

6. Align the pipe sensor using the position of the center line (Fig. 13-45 no. 1) of the scale (Fig. 13-40 no. 9): the center line needs to be positioned vertical towards the flow direction.
   Tighten the screw joints (Fig. 13-40 no. 8) for sensor clamping loosely.

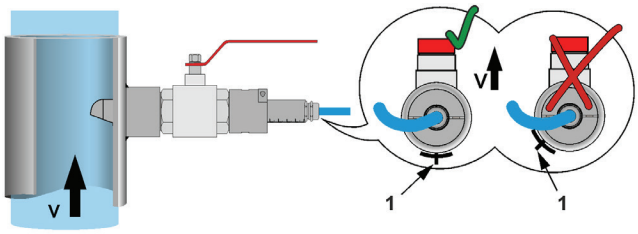


Fig. 13-45 Align pipe sensor towards flow direction

7. Finally tighten the two screw joints using the torque spanner with hex-wrench bit size 4 by 3.4 Nm.

13.7.2.3 Install pipe sensor TSP0 in part filled or full pipeline

Use of stop ball valve is essential

The stop ball valve for pressureless removal is a part of the standard delivery and has to be used in any event.

The section below describes how to install the pipe sensor into a part filled or full pipeline using the accompanying welding nozzle G1" (part of the standard delivery).

⇨ If you're using the NIVUS welding nozzle G1½" it is required to install a reduction double nipple. Factor the procedure to investigate the insertion depth in Sect. "13.7.2.4 Install pipe sensor TSP0 in customer welding nozzle or NIVUS welding nozzle G1½"" into the mounting procedure (see page 51 et seq.).

Tools required

- 1x spanner, width across flats 39 mm
- 1x torque spanner, width across flats 36 mm
- 1x torque spanner with hex-wrench bit, width across flats 4 mm (for Allen screws M5); torque required 3.4 Nm

Prerequisites

- The pipe wall strength is known.
- The welding nozzle (Fig. 13-40 no. 1) is welded to the pipeline.
- A hole is drilled into the pipeline.
- The stop ball valve (Fig. 13-40 no. 5) is removed from the sensor clamping (Fig. 13-40 no. 7) and, with the inserted flat gasket (Fig. 13-40 no. 4), screwed to the welding nozzle.
- The screw joints (Fig. 13-40 no. 8) of sensor clamping are loose; the pipe sensor (Fig. 13-40 no. 3) is (movable) inserted into sensor clamping.

Mounting

➲ Procedure:

1. Open stop ball valve (Fig. 13-40 no. 5).

Grease the screw thread with grease paste

When assembling the insertion sensor, a special grease paste must be used for the stainless steel couplings, specified to DIN 2353.
The thread of sensor clamping (to screw in the stop ball valve) of pipe sensors type TSP0 must be slightly greased.

The screw joints are greased on delivery. Additional grease can be purchased from NIVUS.

2. Grease the thread of sensor clamping (Fig. 13-40 no. 7) (to screw in the stop ball valve) using a special grease paste for stainless steel couplings.
3. Slide flat gasket onto pipe sensor (Fig. 13-40 no. 3) until it touches sensor clamping (Fig. 13-40 no. 7).
4. Insert pipe sensor with attached sensor clamping into stop ball valve (Fig. 13-40 no. 5) and welding nozzle (Fig. 13-40 no. 1).
5. Use the size 39 spanner, and the size 36 torque spanner to tighten the sensor clamping to the stop ball valve by a minimum of 10 Nm.

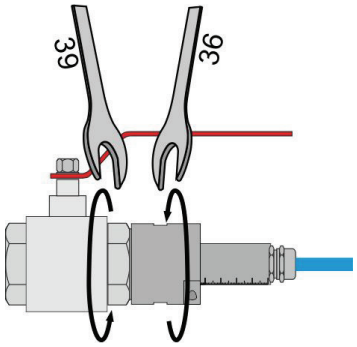


Fig. 13-46 Tighten sensor clamping

6. Insert the pipe sensor into the pipe until the scale reaches the earlier investigated pipe wall strength.
   As an example the following figure shows the pipe wall strength of 3.1 cm.

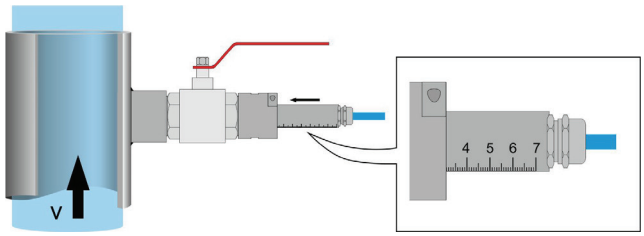


Fig. 13-47 Insert sensor (pipe wall strength)

7. Align the pipe sensor using the position of the center line (Fig. 13-48 no. 1) of the scale (Fig. 13-40 no. 9): the center line needs to be positioned vertical towards the flow direction.
   Tighten the screw joints (Fig. 13-40 no. 8) for sensor clamping loosely.

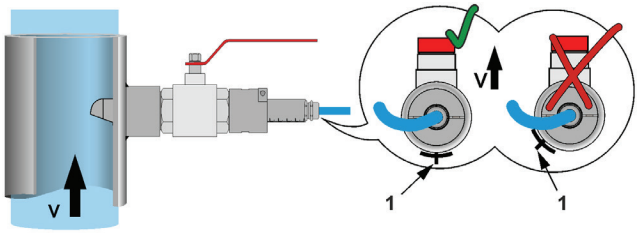


Fig. 13-48 Align pipe sensor towards flow direction

8. Finally tighten the two screw joints using the torque spanner with hex-wrench bit size 4 by 3.4 Nm.

13.7.2.4 Install pipe sensor TSP0 in customer welding nozzle or NIVUS welding nozzle G1½"

If you do not install the pipe sensor TSP0 by using the accompanying NIVUS welding nozzle G1" the scale on the pipe sensor does not correspond with the pipe wall strength. The insertion depth then must be investigated separately and considered during mounting procedure.

Using of customer welding nozzle

➲ Procedure:

1. In principle the mounting procedure for the customer welding nozzle is the same than described before in the two former mounting versions (depending on the situation onsite) in Sect. “13.7.2.2 Install pipe sensor TSP0 in empty pipeline” or “13.7.2.3 Install pipe sensor TSP0 in part filled or full pipeline”.
   You need to vary
   - in investigating the pipe wall strength (Sect. 13.7.2.2 - step 1)
   and
   - in inserting the pipe sensor (Sect. 13.7.2.2 - step 5; Sect. 13.7.2.3 - step 6),
   since the scale cannot be used as described.
   The insertion depth needs to be investigated according to Sect. “Detection of the insertion depth L” and applied to the respective step.

Using of NIVUS welding nozzle G1½" and reduction double nipple

Parts and auxiliary material required

- 1x reduction double nipple ZUB0 RED 15X1Z
- Teflon tape for sealing

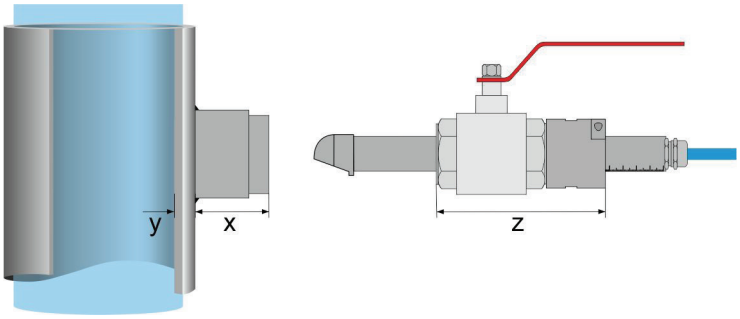
➲ Procedure:

1. In principle the mounting procedure for the NIVUS welding nozzle G1½" is the same than described before in the two former mounting versions (depending on the situation onsite) in Sect. “13.7.2.2 Install pipe sensor TSP0 in empty pipeline” or “13.7.2.3 Install pipe sensor TSP0 in part filled or full pipeline”.
   You need to vary
   - in investigating the pipe wall strength (Sect. 13.7.2.2 - step 1) (material strength of the reduction double nipple hexagon needs to be added) *[1]
   and
   - in inserting the pipe sensor (Sect. 13.7.2.2 - step 5; Sect. 13.7.2.3 - step 6),
   since the scale cannot be used as described.
   The insertion depth needs to be investigated according to Sect. “Detection of the insertion depth L” and applied to the respective step.

   *[1] Measure the material strength of the reduction double nipple hexagon ZUB0 RED 15X1Z and make a note of it. Wrap the two threads with Teflon tape and screw it into the welding nozzle G1½" before continuing mounting. The **material strength of the reduction double nipple hexagon** will then be applied to the calculation of the insertion depth.

Detection of the insertion depth L

Variables influencing the insertion depth L



x Length of the customer components (e.g. welding nozzle, sleeve etc.);
alternative: NIVUS welding nozzle G1½" + reduction double nipple ZUB0 RED 15X1Z

y Pipe wall strength

z Length (= stop ball valve + sensor clamping + 2 pcs. flat gasket = 137 mm);
alternative: stop ball valve + sensor clamping + 1 pc. flat gasket

Fig. 13-49 Variables influencing the insertion depth L

Calculating the insertion depth L

$L = x + y + z$

$L = x + y + 137\ mm$

➲ Investigate the insertion depth and add mark

1. Measure the length x of the components (if using the reduction double nipple ZUB0 RED 15X1Z add its hexagon strength).
2. Investigate the pipe wall strength y.
3. Calculate the insertion depth L (see previous calculation).
4. Mark the insertion depth L on the pipe sensor (Fig. 13-50) to adjust the sensor at the end of the mounting procedure.

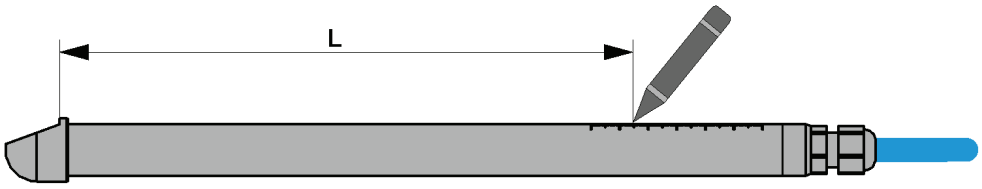


Fig. 13-50 Mark of insertion depth L on pipe sensor

13.8 Screw-in and plug-in sensors type NOS

Positioning of the sensors on the pipe

In order to determine the pipe center it is necessary to have a spirit level with additional spacers available. Put the level onto the pipe perpendicular to the pipe run (Fig. 13-51).
The spacers on both sides of the spirit level shall be positioned as far as possible towards the ends of the level so that the level does not touch the pipe anymore. Now only the spacers touch the pipe.
Now exactly level the water level and assign the respective markings to the pipe. Use a pencil, chalk, crayon or similar.
Repeat this procedure in a distance of pipe diameter x2 or x3 and connect the resulting marks. The pipe axis is located along this mark. To obtain higher accuracy repeat the procedure described above on the other side of the pipe.

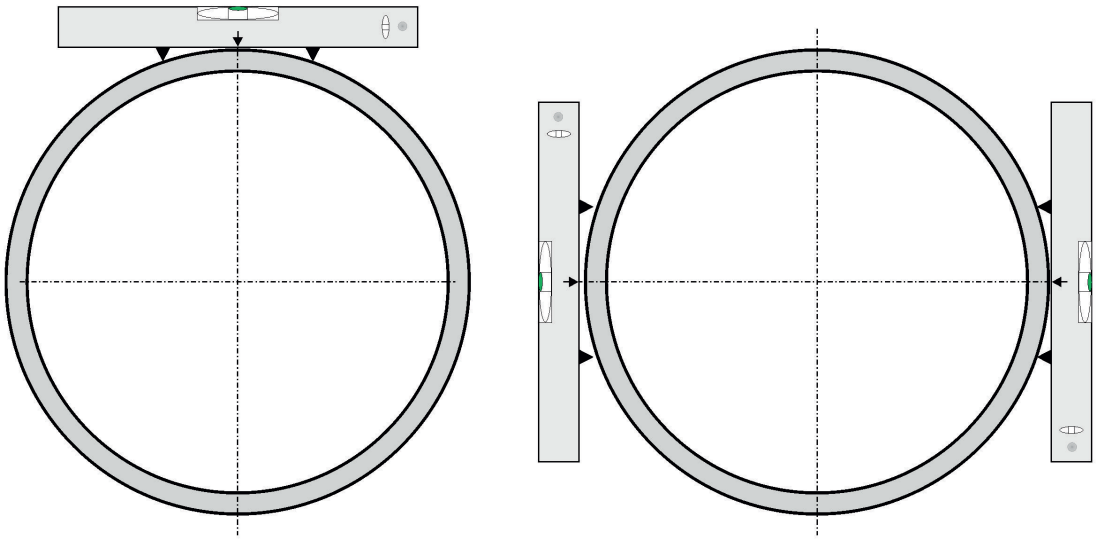


Fig. 13-51 Determining the center of the pipe

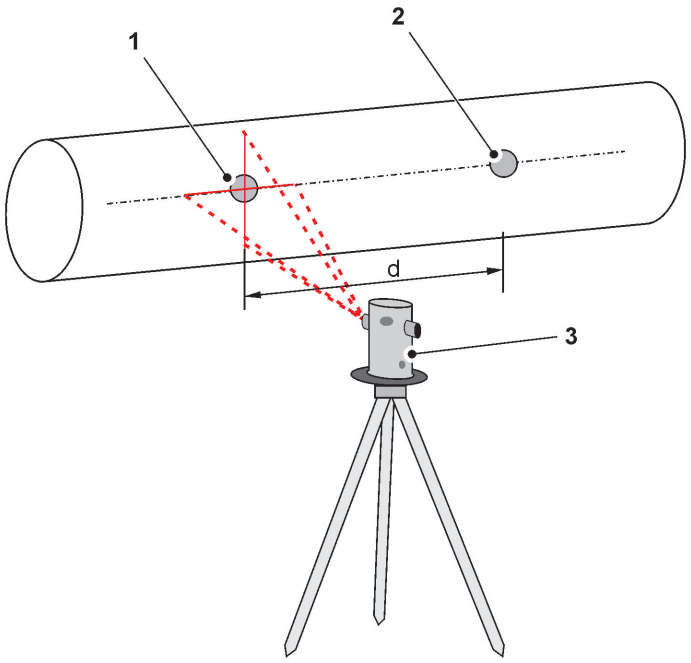
Determine the sensor positions by using a laser level such as “Lasermark Gizmo-Lite” or similar.

Position 1 (front side)

Point the laser to the horizontal line (pipe center) (Fig. 13-52) and draw the vertical line onto the pipe. The topmost point is important to allocate the vertical line to the reverse pipe half.

Position 2 (front side)

Use the pipe diameter d as distance from position 1 to mark position 2 on the horizontal line. Here it is important as well to allocate the topmost point of the vertical line to the reverse pipe half.



1 Sensor position 1

2 Sensor position 2

3 Laser level

Fig. 13-52 Determining the sensor positions 1 and 2 (front side / rear side)

Position 1 (rear side)

Point the laser to the previously drawn horizontal and vertical lines and draw the vertical line.

Position 2 (rear side)

See position 1 (rear side). Between position 1 and position 2 the distance d (diameter) must be measured.

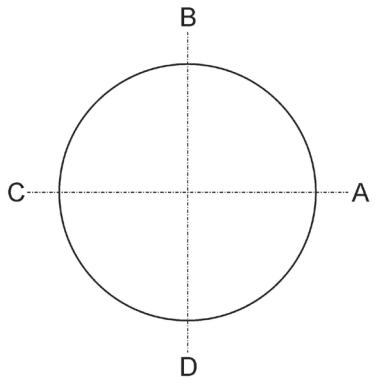


Fig. 13-53 Distances verification of the sensor positions

The distances of the circumference between AB and CB must be identical.
As soon as this should not be the case the procedure described above must be repeated.

If the pipe is accessible from all sides, additionally check whether the distances between AD and CD are the same as between AB and CB.
If not, repeat the measurement as described before.

Positioning of a multi-path measuring inside the pipe

Using a multi-path measurement featuring more than 2 paths within the pipe and multiple levels, the screw-in or plug-in sensors need to be installed in appropriate angles of 18°, 30°, 45° and 54°.

The following example presents the different sensor distances of each path in a pipe with a diameter of 508 mm.

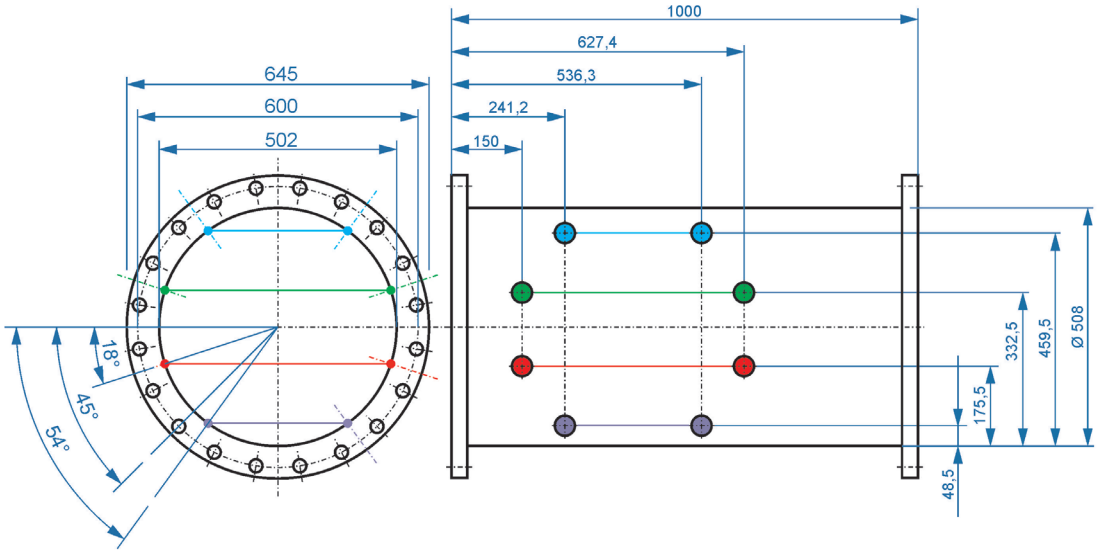


Fig. 13-54 Example of a multi-path measurement

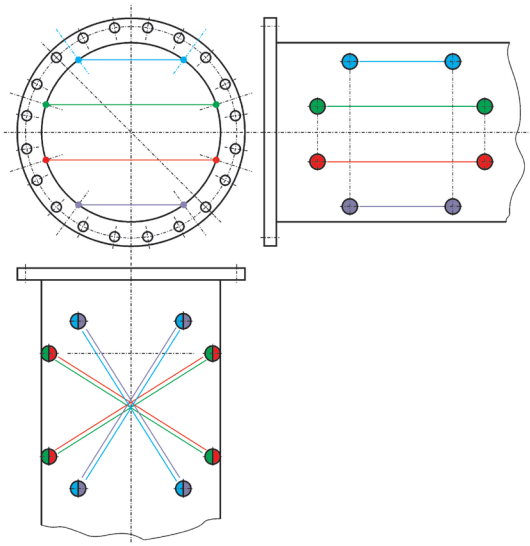


Fig. 13-55 Paths within the above example

When using type NOS screw-in and plug-in sensors the same selection criteria are valid as described for type NIS and type TSP0 pipe sensors (see chapter “13.7 Pipe sensors type NIS and type TSP0”).
Type NOS screw-in and plug-in sensors are installed and adjusted by using 1¼” nozzles. The drill hole shall not be smaller than 43 mm.
NIVUS recommend to wrap Teflon cord or Teflon tape around the sensor thread and to apply assembly paste prior to screwing in.
This avoids the sensor to “corrode” into the nozzle and moreover ensures sealing.

Fig. 13-56 Preparation for installing screw-in sensor

Grease screw thread with grease paste

When assembling the screw-in or plug-in sensor, a special grease paste must be used for the stainless steel couplings, specified to DIN 2353.
This paste shall be used to slightly grease the thread.

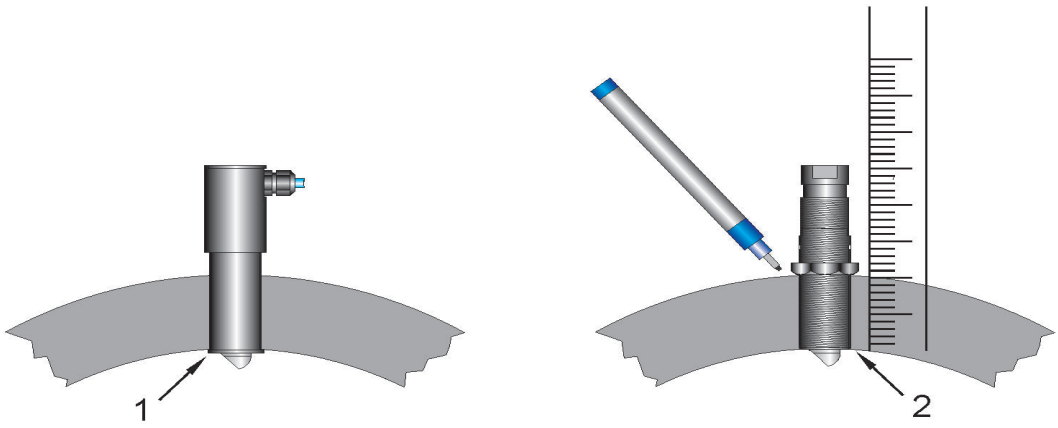
Additional grease can be purchased from NIVUS.

When installing the screw-in or plug-in sensors please observe that the sensors are flush with the inner pipe wall. To achieve this e.g. use a yardstick and respectively mark the sensor thread (Fig. 13-57).

After screwing in protect the sensor from getting loose by using a lock nut.

First completely align the sensor, then connect

Do not connect the sensor before it is completely adjusted (as shown in Fig. 13-60).



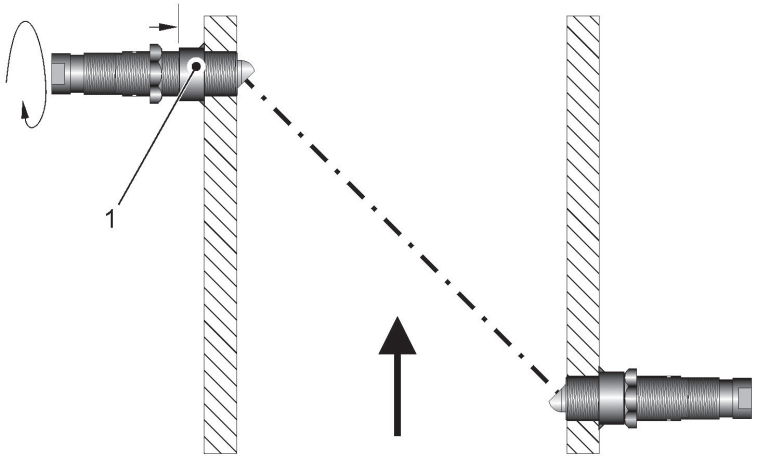
1 Plug-in sensor with position ring (to be installed from the inside)

2 Screw-in sensor flush with inner pipe wall

Fig. 13-57 Determination of the sensor position - plug-in and screw-in sensors

➲ Procedure:

1. Screw in the sensor all the way to the stop or to the mark and bring it into a suitable position for radiating. Then for the time being adjust the sensor head to an approximate position in or towards the flow direction (Fig. 13-58).



1 1¼” nozzle

Fig. 13-58 Positioning the screw-in sensor

2. A longitudinal slot can be found on the bottom of the sensor. This slot is aligned exactly parallel to the sensor head and can be used to adjust the sensor head direction by e.g. using a soft tip marker.

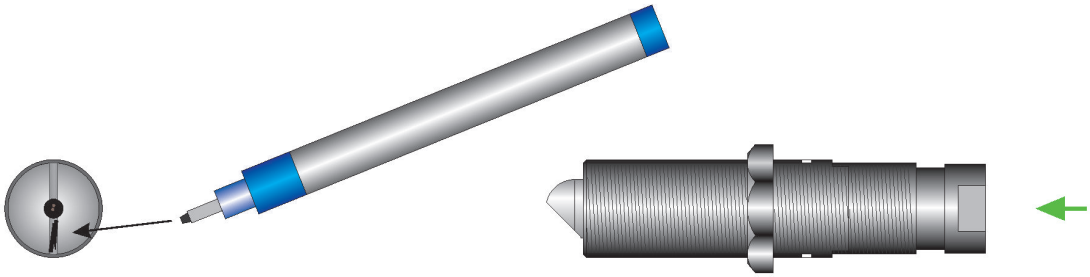
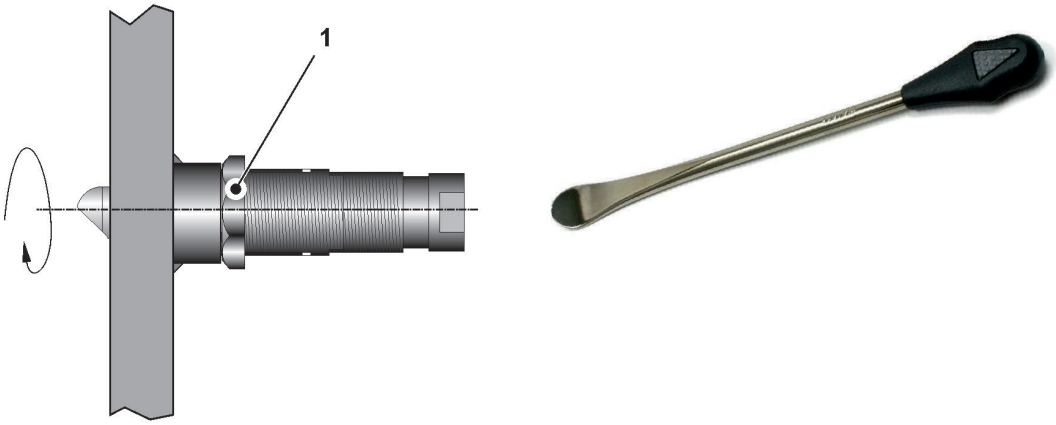


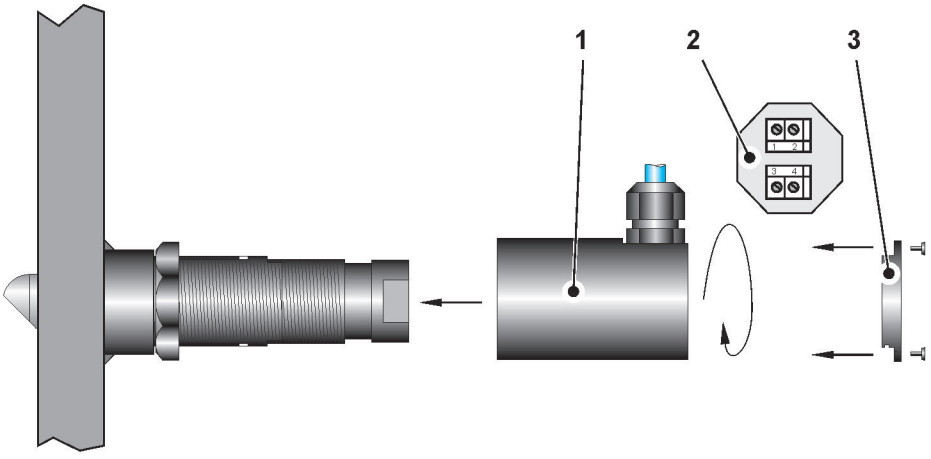
Fig. 13-59 Mark the alignment aid on the screw-in sensor

3. Then align the sensor head by using a lever or similar. During this procedure please observe to accurately adjust the sensors facing each other. To do so slightly loosen the screw nut (Fig. 13-60 no. 1) again if required.



1 Screw nut for adjustment and fixation

Fig. 13-60 Sensor alignment screw-in sensor



1 Conductor barrel

2 Connection board

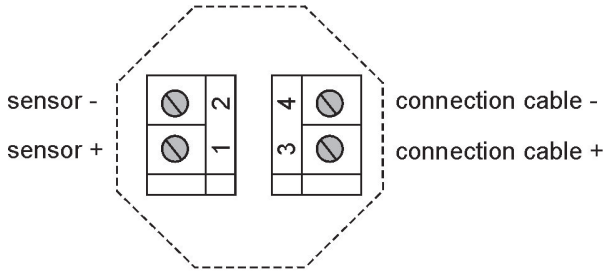
3 Cover plate

Fig. 13-61 Screwing-on the conductor barrel

4. Screw the conductor barrel (without lock lid) onto the sensor all the way down to the stop. Connect the sensor cables to the connection board as depicted in Fig. 13-63.

Fig. 13-62 Cable in sensor conductor barrel

5. Lead the sensor cable through the cable gland.



Clamp 1 = sensor + (RD/BK)
Clamp 2 = sensor – (BK)
Clamp 3 = Connection cable + (silver) – to the measurement transmitter
Clamp 4 = Connection cable – (copper) – to the measurement transmitter

Fig. 13-63 Connection board

6. Put the connection board into the conductor barrel and fasten the lock lid by using the two screws on the barrel (Fig. 13-61).

13.9 Clamp-On Sensors Type NIC-CO01

13.9.1 General

The Clamp-On Sensors have to be fastened hard and tight. Use only noncorrosive fastening material.
To ensure proper coupling of the acoustic signal into the medium it is necessary to use appropriate acoustic coupling paste. This paste must be applied between the sensor surface and the outer pipe wall. The sensors are shipped with a tube of coupling paste.
The coupling paste can be purchased from NIVUS.

Layers of paint, zinc coating, corrosion space or similar can disturb the safe signal coupling and shall be removed completely using an orbital sander and sandpaper, grinding brush, grinding wheels or similar appropriate tools prior to installation.
Before installing the sensor, please check material and wall thickness of the pipe. The material should be cast steel, steel or stainless steel. These materials can be selected directly from the menu of the measurement transmitter.
Before starting up please check with NIVUS if other pipe materials shall be used.

Set transmitter parameters previously

The transmitter parameters must be set before the clamp-on sensors are installed.

The required sensor distance will be calculated by the transmitter. This sensor distance must be pre-set for the sensor installation.

13.9.2 Clamp-On Sensors

Fig. 13-64 Clamp-On sensor pair NIC-CO01

For sensor fastening use the optional tensioning belts/the metal tape or the NIVUS ruler (see chapter “22 Fastening System for NIC-CO01 Clamp-On Sensors”). The ruler can be used only as soon as both clamp-on sensors are fastened on the same side of the pipe (V-mounting).

The fastening system can be ordered from NIVUS at extra costs.

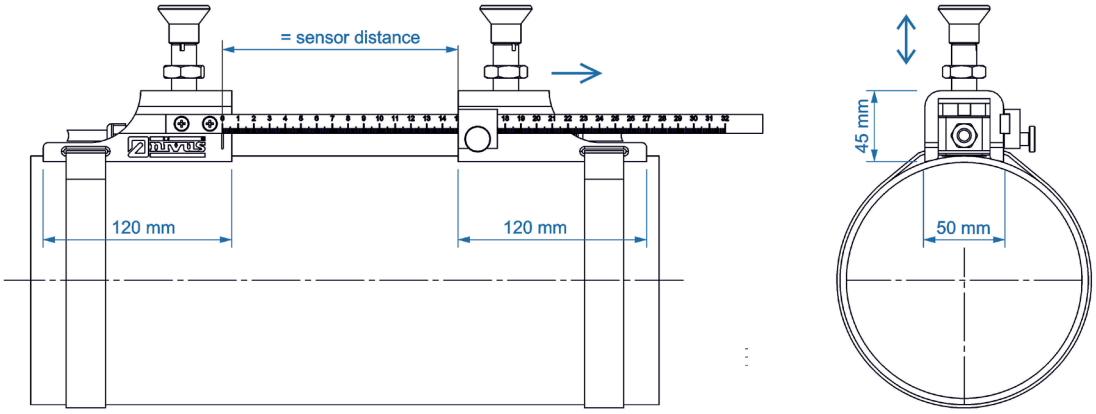


Fig. 13-65 Fastening system dimensions

Mounting

➲ Requirements:

- The sensors are connected.
- The transmitter/measurement place parameters have been set.
- The sensor positions are determined.

➲ Procedure:

1. Determine outside pipe diameter/circumference and make sure to have tensioning belts or metal tape with appropriate length(s) available.
   For the metal tape the appropriate length is approx. 60 mm longer than the determined pipe circumference.
2. Screw in the threaded sleeve (Fig. 13-66 no. 1) on the locking bolt until it is visibly flush (1…2 mm) underneath the inside rim (Fig. 13-66, green line) of the sensor shoe (Fig. 13-66 no. 3).
3. Put lock nut (Fig. 13-66 no. 2) onto sensor shoe by hand.

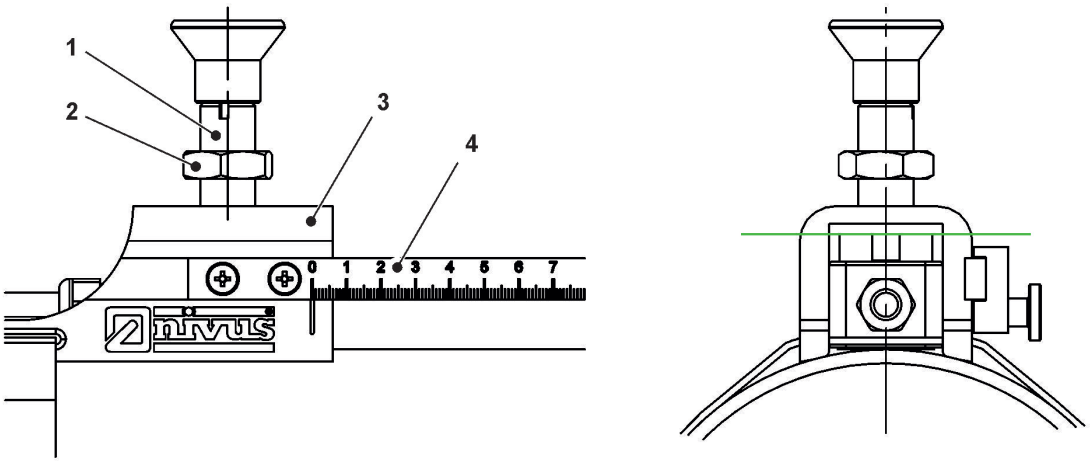
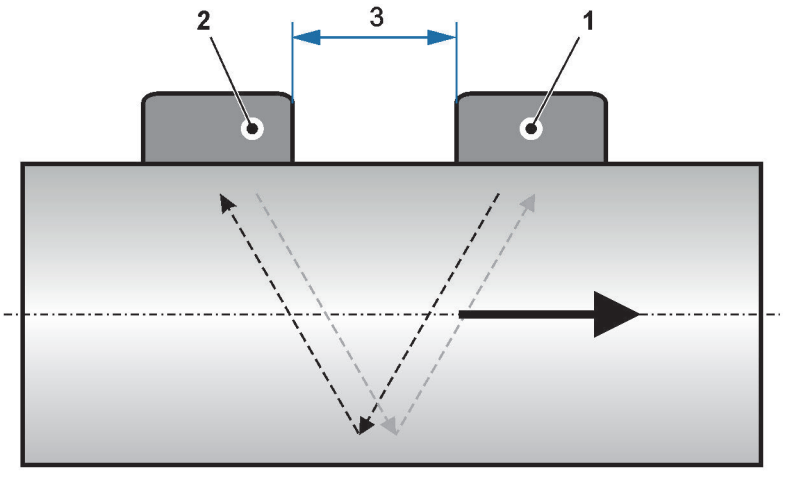


Fig. 13-66 Install fastening system

4. Hold first sensor shoe to the determined sensor position and pull the tensioning belt/metal tape through the guide of the sensor shoe.
5. Lock and tighten tensioning belt or metal tape:
   - Insert tensioning belt into the turnbuckle and tighten by using the ratchet function.
   - Bend metal tape backwards on one end by approx. 30 mm and it hook into the turnbuckle. Insert the other end into the screw and tighten firmly by using a slot screwdriver or a spanner (width across flats 10 mm). Bend the open end to the inside to avoid injury (previously shorten by some amount if necessary).
   The sensor shoe will align itself on the pipe lengthwise due to its shape.
6. Grease sensor face (contact area) with coupling paste.
7. Pull up locking bolt and insert sensor into sensor shoe until it stops.
8. Let go the locking bolt. The sensor is clamped by spring pressure in the groove on the sensor top.
9. Install the second sensor shoe parallel to the pipe analogous to the procedure as described above. The required distance (Fig. 13-67/Fig. 13-68 no. 3) between the sensors will be determined by the transmitter according to the adjusted parameters and needs to be confirmed by carrying out a test measurement prior to sensor installation.
   When using **V-mounting** the distance can be read from the ruler (Fig. 13-66 no. 4). The ruler is mounted so that the front edge of sensor shoe 2 is exactly equal to the distance to set on the ruler (Fig. 13-65).
   With a **\-mounting** the distance must be determined without the ruler (Fig. 13-66 no. 4) since both sensors are installed on opposite sides of the pipe (Fig. 13-68).
10. Insert the second sensor and execute measurement test once more. Loosen sensor shoe and adjust position if required.

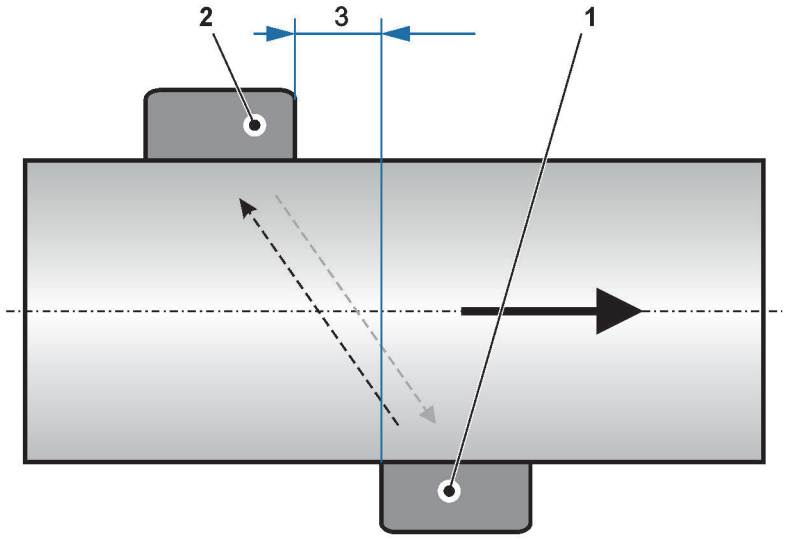


1 Sensor 1

2 Sensor 2

3 Required distance of the sensors to each other

Fig. 13-67 1-path measuring, path arrangement: next to each other (V-mounting)



1 Sensor 1

2 Sensor 2

3 Required distance of the sensors to each other

Fig. 13-68 1-path measuring, path arrangement: diagonal (\-mounting)

Cleaning/Maintenance

For cleaning and maintenance lift the according locking bolt and pull back the sensor out of the sensor shoe. After cleaning completely grease again with coupling paste and reinsert until it stops. Position and alignment of the sensors remain unchanged.

14 Sensor alignment

14.1 General

A precise sensor alignment is very important for a correct function of the transit time measurement.
The transmitting surfaces of the respective sensors have to “see” each other in both directions (with and against the flow direction).

Align sensors precisely

The flow velocity sensors of each path must be precisely aligned with each other.

In case of measurement places where the sensor’s point of radiation is accessible it is recommended to use a laser distance meter (such as Bosch DLE) or a theodolite system to align the sensors.

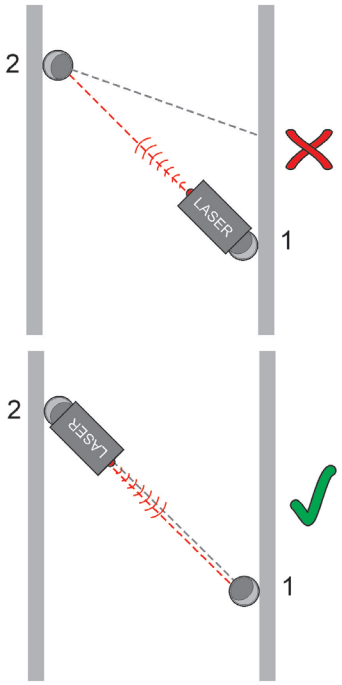
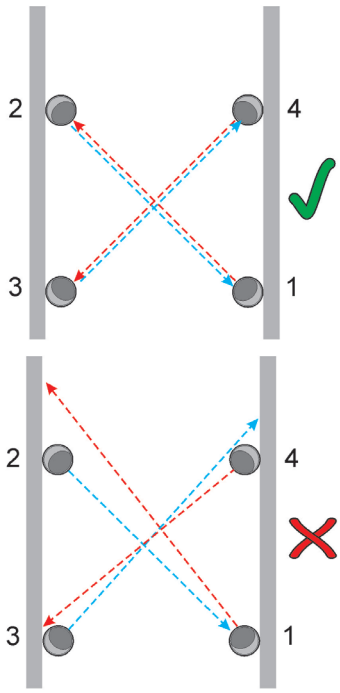


Fig. 14-1 Laser distance meter for sensor alignment

The laser distance meter must be placed exactly to the sensor face to make sure that the laser beam can be adjusted accurately to the sensor located at the opposite.

Fig. 14-2 Put the laser distance meter exact on the sensor face

Repeat the same procedure for the 2nd sensor. This is the only way to ensure the sensors to accurately face each other.



Correct:
All 4 sensors are aligned with one another

Error:
Sensors are not aligned with one another

Fig. 14-3 Schematic diagram sensor alignment

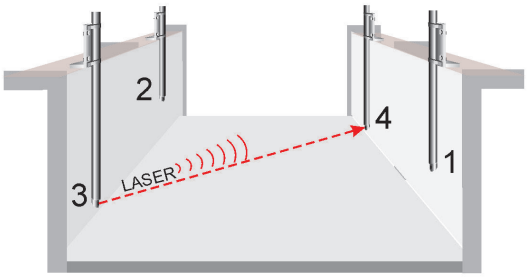


Fig. 14-4 Example of sensor alignment

At measurement places where the sensor's point of radiation is not accessible, the measurement place must be measured very exactly and the sensor holders shall be installed very accurately.

14.2 Rod Sensors

Rod sensors can be aligned to each other by slightly rotating or moving them up and down from above and by simultaneously observing the signal strength on the transmitter display.

Fig. 14-5 Sensor alignment of rod sensors horizontal and vertical

14.3 Wedge Sensors

Wedge sensors **cannot be aligned anymore** once they have been installed. Such sensors hence must be installed in a way that the sensors accurately are facing each other. To achieve this it is recommended to use a laser distance meter as adjustment aid during installation.

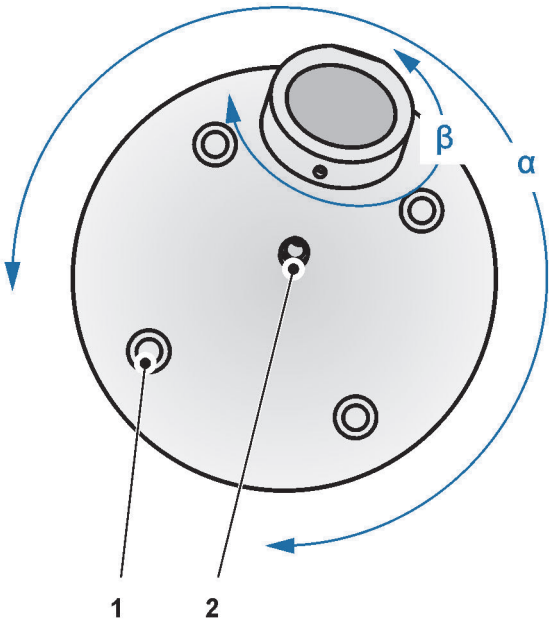
14.4 Hemispheres

Sensor on mounting plate

To adjust angle α loosen the four screws (Fig. 14-6 no. 1) using a 5 mm Allen key and tighten again after adjustment.

Sensor head

To adjust angle β loosen the screw (Fig. 14-6 no. 2) using a 4 mm Allen key and tighten again after adjustment.

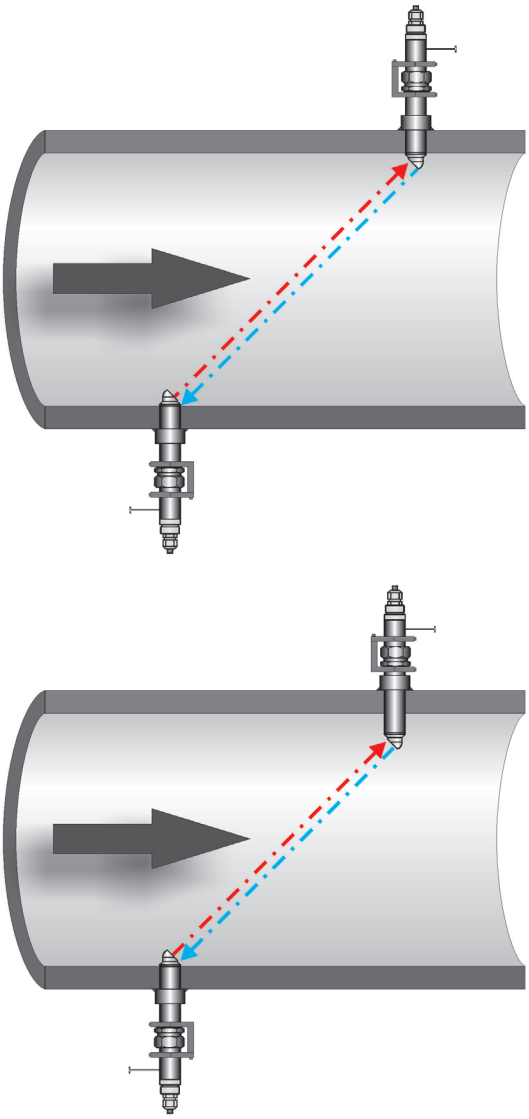


α = Revolving sensor on ground plate
β = Rotary sensor head
1 = 4x screw to tighten the sensor – loosen to adjust the angle α
2 = 1x screw to tighten the sensor head on the sensor – loosen to adjust the angle β

Fig. 14-6 Sensor alignment of Hemisphere

14.5 Pipe sensors, screw-in and plug-in sensors

In closed pipelines both sensors of each path shall be aligned by slightly rotating them. If nozzles should be installed slightly too close to each other (distance too short) it may be possible to increase the signal strength by moving the sensor slightly deeper into the pipe (may compensate the inappropriate sensor distance).



Sensor alignment with appropriately installed nozzles

Sensor alignment with inappropriately installed nozzles

Fig. 14-7 Sensor alignment in pipes by inserting

Accessories and Installation Aids

15 Holder brackets and protective sheet for rod sensors

There are two holder bracket versions for fastening the NOS Rod Sensors available:

- fastening to a vertical wall (NOZ00 HAL0)
- mounting on a horizontal wall crown with a minimum width of 400 mm (NOZ00 HAL90)

The following mounting material is included with the holder bracket delivery:

- 4x hex head screw M12x30
- 4x dowel SX12x60
- 4x washer

To fasten the sensors safely:

- 4x adjusting screw M12
- 4x counter nut M12

Install holder brackets vertically

Use a spirit level in order to install the holder brackets exactly vertically.

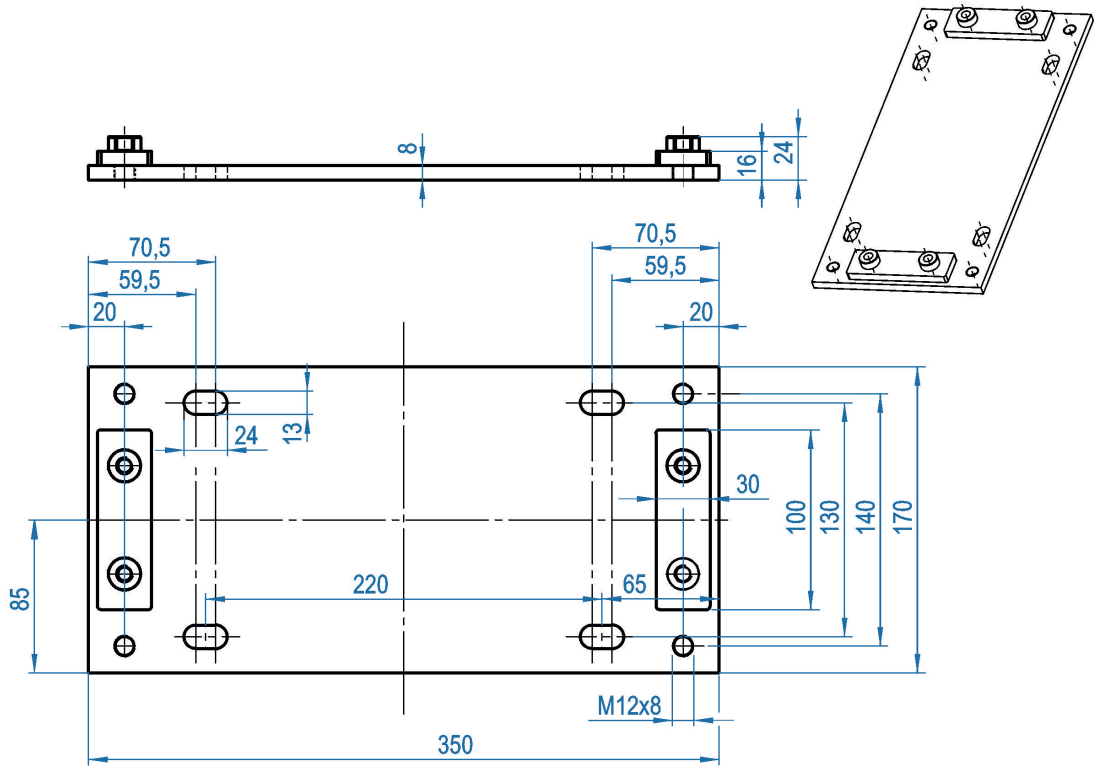


Fig. 15-1 Holder bracket (NOZ00 HAL0) for rod sensors

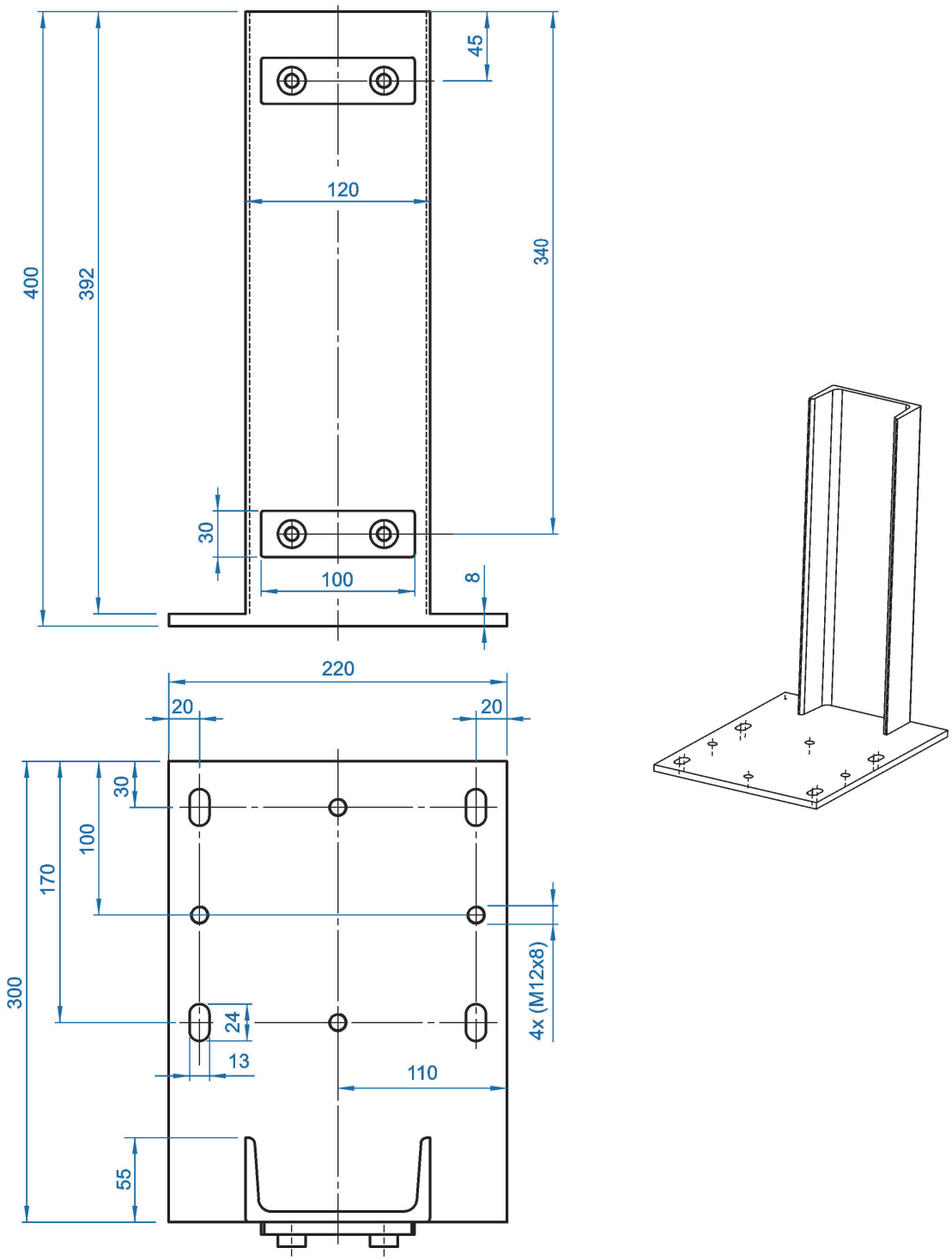


Fig. 15-2 Holder bracket (NOZ00 HAL90) for rod sensors

Protective sheet for rod sensors

There are flow-optimised protective sheet for rod sensors, length 1300/3000 mm available. In case of expecting heavy flow conditions we recommend to install a protective sheet for rod sensors at the sensor holder. This may avoid sensor vibration as well as damage caused by debris/flotsam or similar.
Fasten the sheet by using M8 hammer set anchors and an appropriate inserting tool.

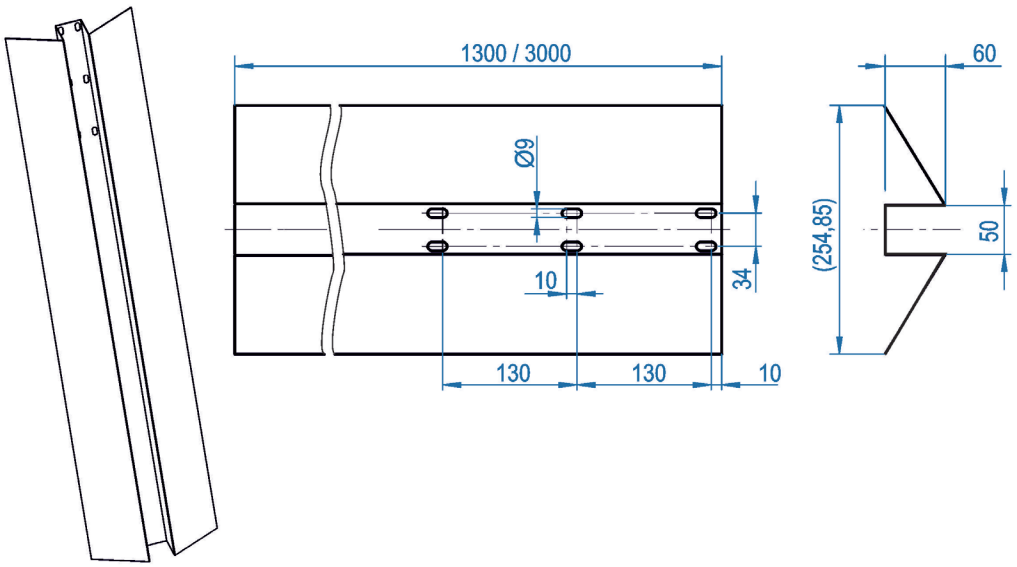


Fig. 15-3 Protective sheet for rod sensors

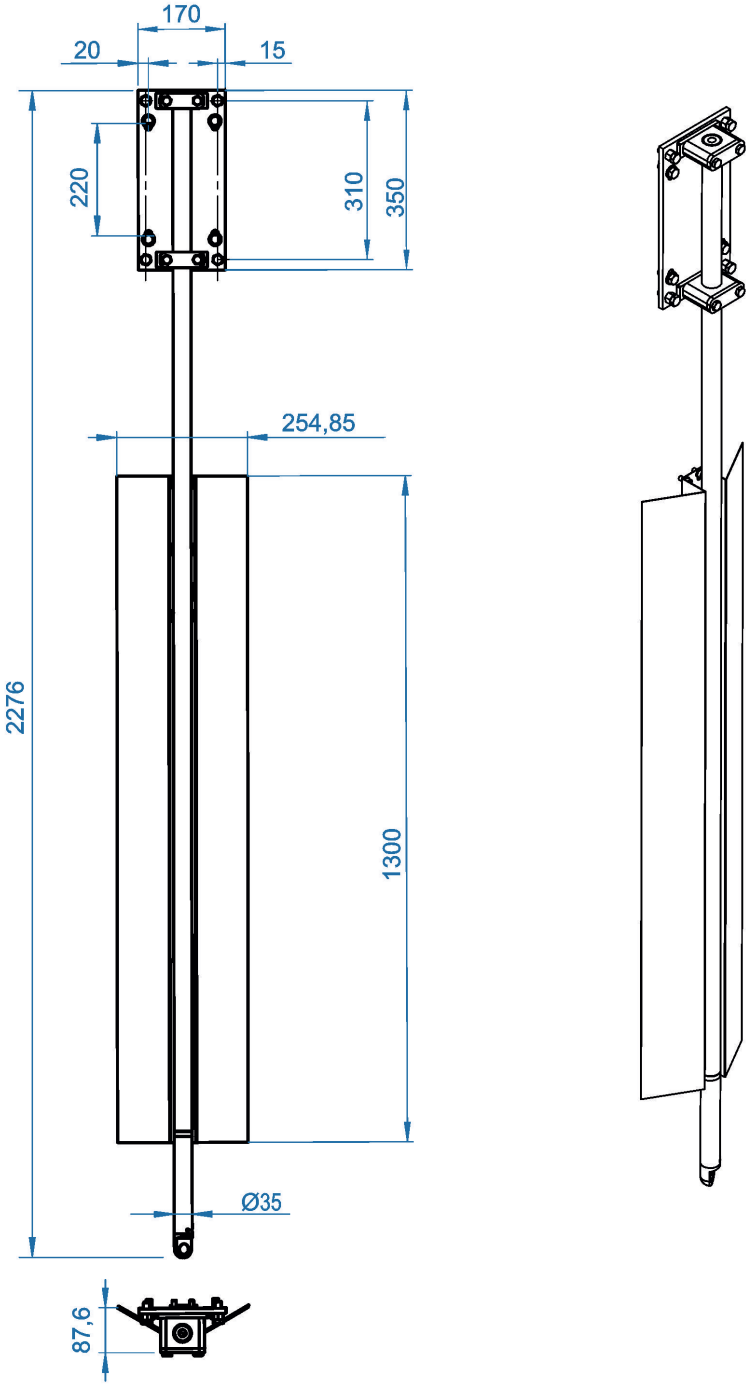


Fig. 15-4 Holder bracket (NOZ00 HAL0) with protective sheet

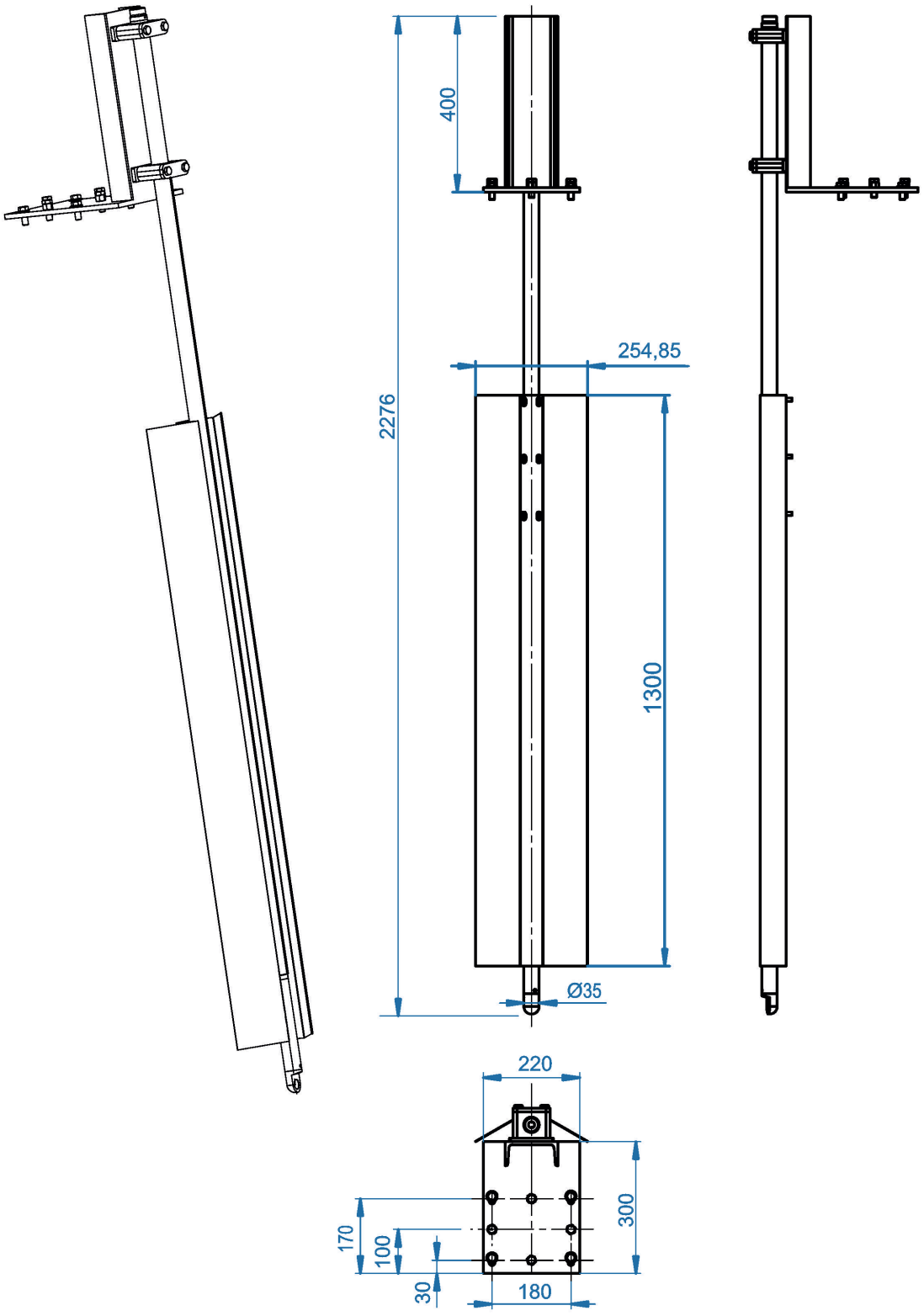


Fig. 15-5 Holder bracket (NOZ00 HAL90) with protective sheet

16 Holder bracket for Hemisphere sensors

There are holder brackets with optimised flow conditions for hemispheres available. For fastening the standard delivery includes cylinder head screws M8x40 with hexagon socket and flat heads made of stainless steel.
For use as cable ducts, pre-punched cutouts can be found on two sides of the holder (remove with pliers or similar).
Then fasten the accompanying edge protection on the removed parts of the holder.

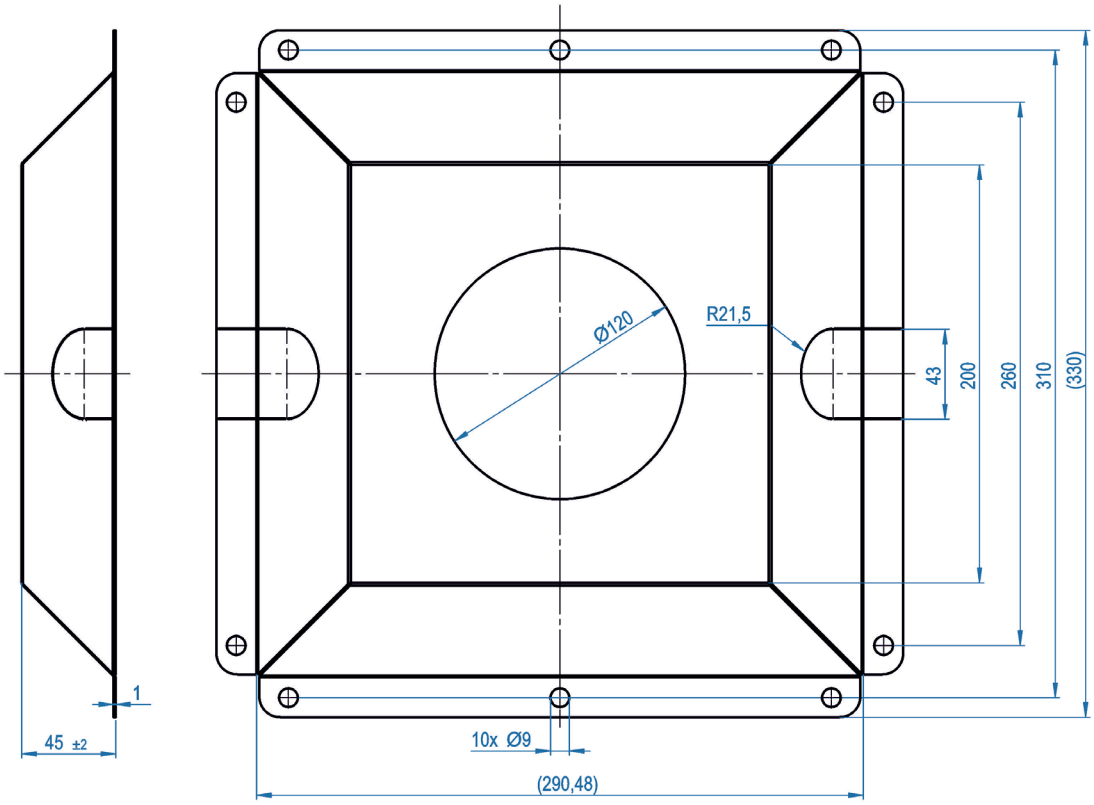


Fig. 16-1 Holder bracket (NOZ00 HALHK) for hemisphere sensors

17 Welding Nozzle for pipe sensors

There are welding nozzles made of steel or stainless steel available for mounting pipe sensors type NIS and TSP0.
For special applications (e.g. very few space at place of installation) there is a welding nozzle with outer thread available on which a stop ball valve can be screwed on directly.

Fig. 17-1 Welding nozzle

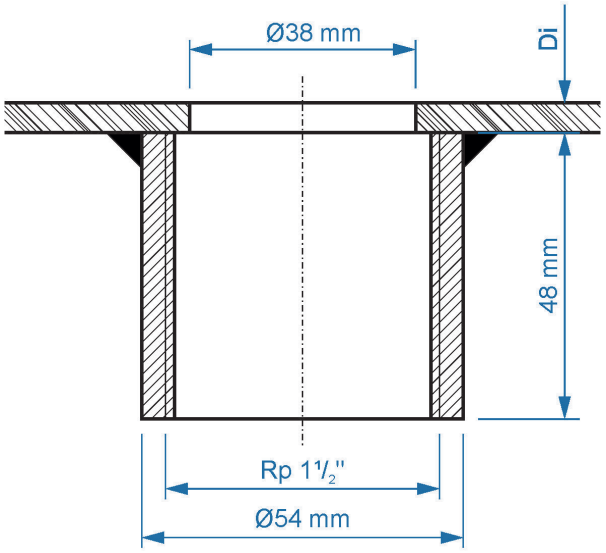


Fig. 17-2 Welding nozzle installation

18 Tapping Saddle for pipe sensors

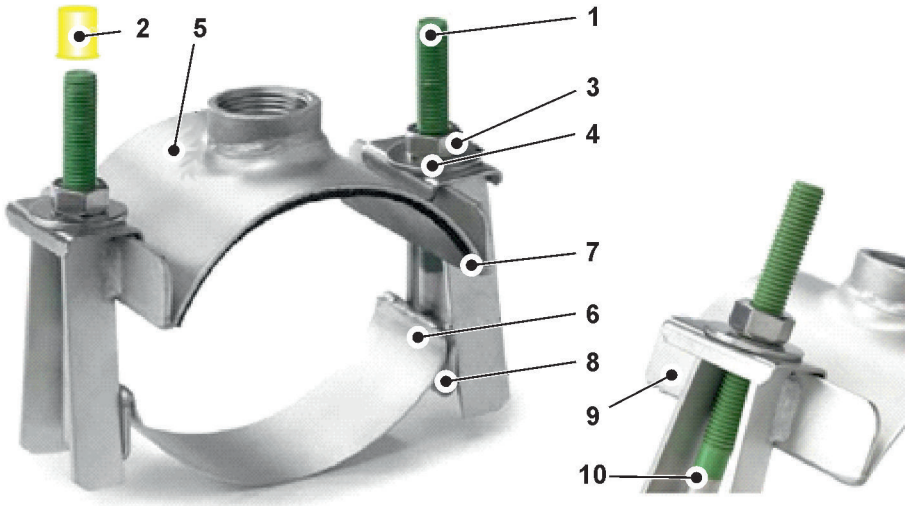
General

A tapping saddle can be purchased from NIVUS for upgrading by using a pipe sensor type NIS and TSP0. This saddle is available in two versions:

- for pipe diameters DN100…DN400 (Fig. 18-1)
- for pipe diameters DN450…DN1000 (Fig. 18-3)

DN100…DN400

All metal parts of the tapping saddle are made of stainless steel 1.4301/V2A. The clamp is completely white pickled to avoid material corrosion and to restore original resistance to corrosion.
The bolts are coated with Teflon to avoid cold-welding fusion.
A rubber gasket ensures reliable sealing. The rubber gasket is treated with antioxidant/antiozonant, to increase lifetime.



1 Thread bolt M12/M14/M16, Teflon coated

2 Thread protection cap

3 Nut

4 Washer
5 Saddle part with 1½” inner thread for cutting ring screw joint
6 Saddle part with thread bolt
7 Rubber gasket
8 Side bracket
9 Mounting bracket (holder)
10 Screw yoke

Fig. 18-1 Overview tapping saddle DN100…DN400

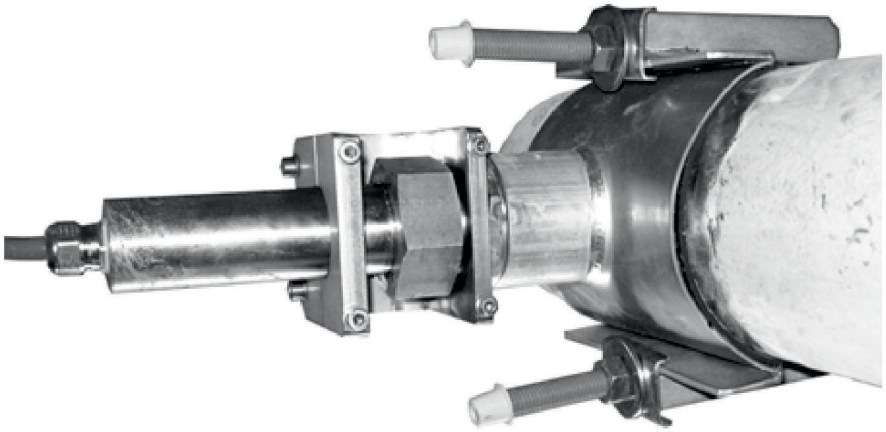
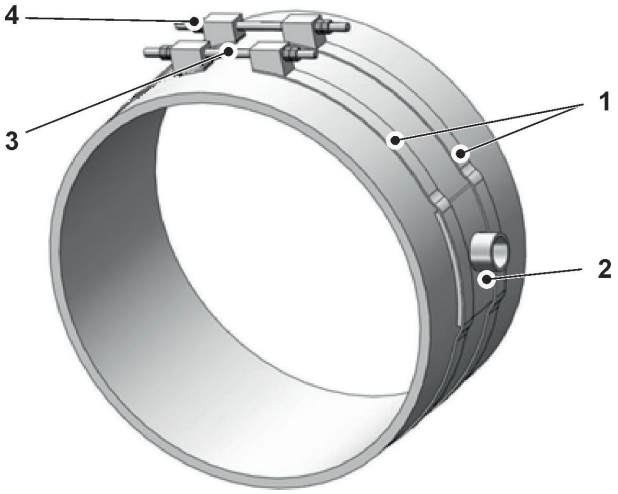


Fig. 18-2 Installation example with tapping saddle DN100…DN400

DN450…DN1000



1 2x Tensioning belt
2 1x Mounting plate with welding nozzle with 1½” inner thread and O-ring on the inside
3 2x Clamping bolt
4 2x Nut/counter nut

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

Fig. 18-3 Overview tapping saddle DN450…DN1000

Fig. 18-4 Installation example with tapping saddle DN450…DN1000

➲ Preparation of installation:

1. Check pipe/mounting place for possible damaging.
2. Clean pipe (dirt, grease etc.).
3. Check pipe diameter and dimensions of tapping saddle.
4. Grease the nozzle thread using appropriate paste for stainless steel screw joints.
   Anti-seize such as soft soap (not at any time oil or grease) can be used for the rubber gasket.

➲ Installation of tapping saddle DN100…DN400:

1. Drill a hole with Ø38 mm into the pipe section. Use cutting paste for drill bit cooling (see chapter “20 Drill bit and extension for pipe sensors”).
2. To remove burrs from the drilling hole, use a rasp and remove chippings/turnings.
3. Remove thread protection from the thread bolts.
4. Loose/drive the nuts back to the end of the thread bolts. However do not remove them.

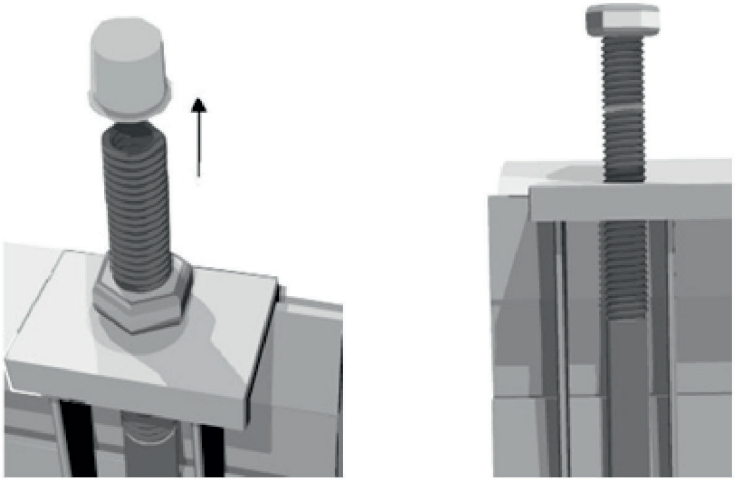


Fig. 18-5 Remove thread protection and loose the nut

5. Unfold the saddle parts.

Fig. 18-6 Unfold the saddle parts

6. Screw in the sensor screw joint into the greased nozzle manually.
7. Insert the sensor and put the sensor screw joint in hand-tight condition.
8. Put the upper saddle part with the sensor onto the pipe and insert the sensor through the hole. Then put the other saddle part around the pipe.

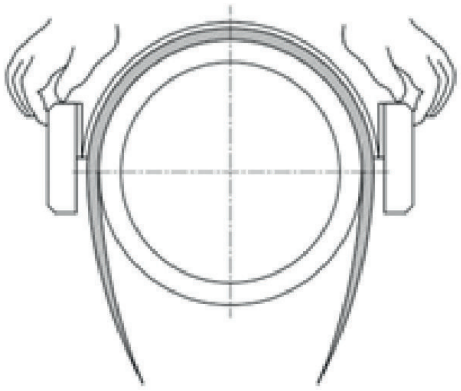


Fig. 18-7 Attach the saddle piece

9. Put the mounting bracket (holder) on one side over the screw yokes and tighten the screws manually. The holder will hook into the side bracket by tightening the bolts firmly (Fig. 18-8).

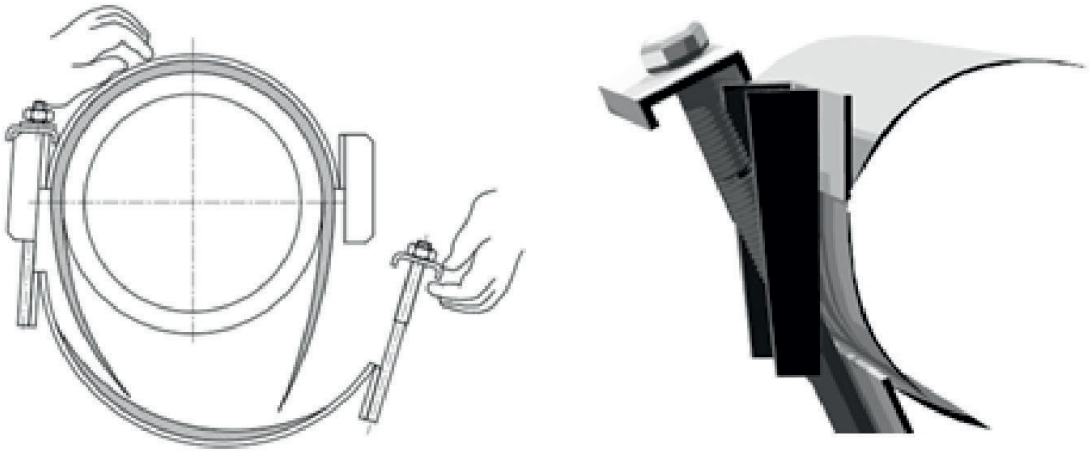


Fig. 18-8 Hook the mounting bracket (holder)

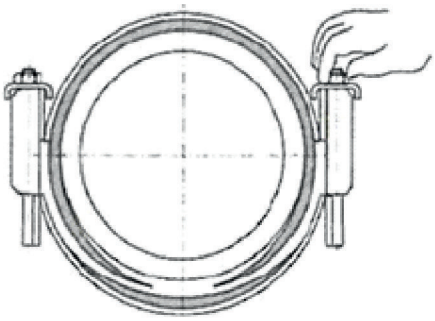


Fig. 18-9 Tighten screws

10. Before tightening the tapping saddle please make sure that the pipe sensor is not wedged and can be slightly inserted into the pipe. Tighten all nuts smoothly using a wrench (length 300 mm) or a torque wrench (Fig. 18-10).
    Tightening the bolts will automatically press the mounting bracket (holder) into the side bracket.
    The following **maximum torques** are valid (if using a torque wrench):
    - Bolt M12, wrench size 19 mm: torque 65 Nm
    - Bolt M14, wrench size 22 mm: torque 85 Nm
    - Bolt M16, wrench size 24 mm: torque 110 Nm

    At plastic pipes the torque shall be decreased (ask the pipe manufacturer about the maximum rate).

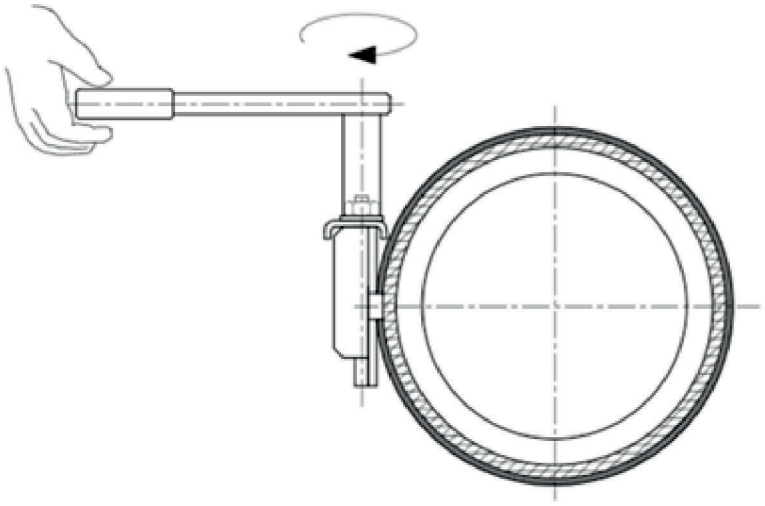


Fig. 18-10 Tighten the nuts

11. After fastening the tapping saddle, adjust the pipe sensor according to chapter “13.7 Pipe sensors type NIS and type TSP0” and tighten the screw joint.

CAUTION

Parts loosening caused by vibration

In case of installation on vibrating facility parts such as pipelines from adjacent pumps or similar observe to secure the nuts of the fixing bolts and clamping bolts by using counter nuts.

Otherwise vibrations may loosen the nuts with the risk of personal injury caused by loosened parts.

19 Stop ball valve for pipe sensors

Using a corrosion-proof straight stop ball valve additionally enables to quickly and easily lock the sensor installation place after the pipe sensor type NIS and TSP0 has been removed from a pressureless pipeline.

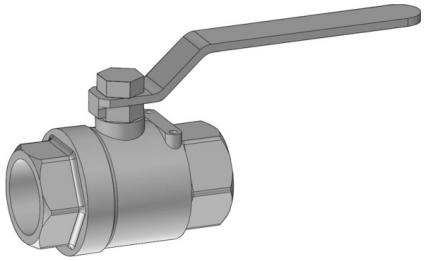
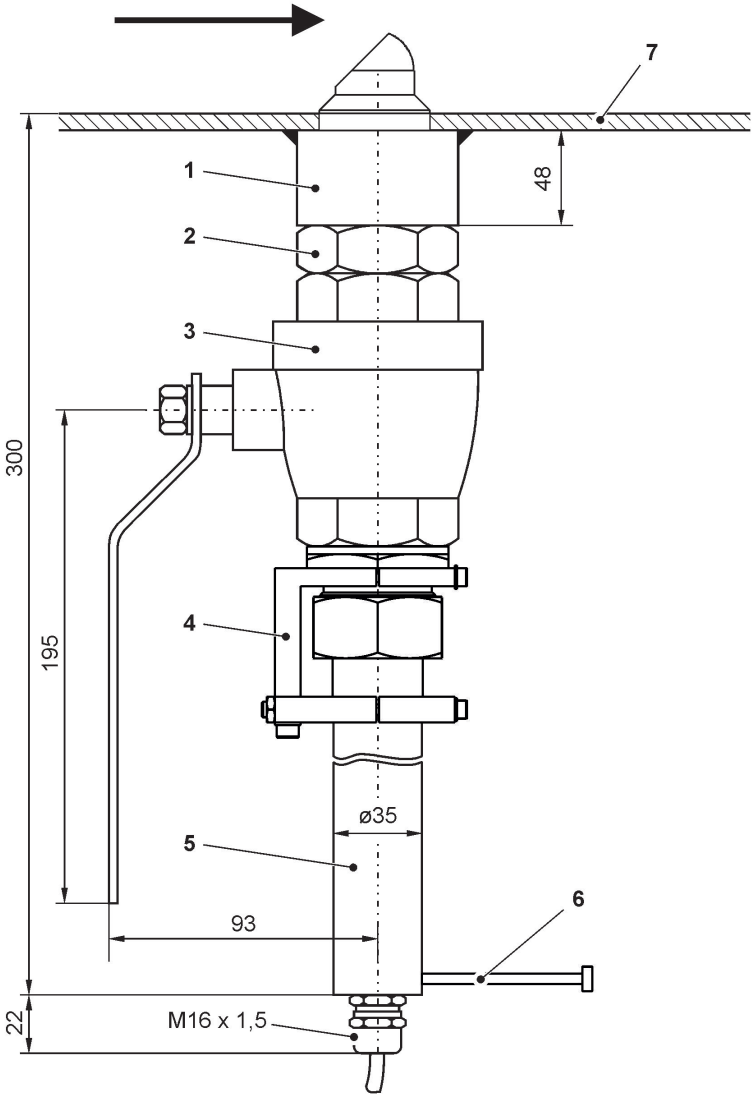


Fig. 19-1 Stop ball valve



1 Weld-on nozzle
2 Hexagonal double nipple, wrench size 50 mm
3 Stop ball valve
4 Retaining element
5 Pipe sensor

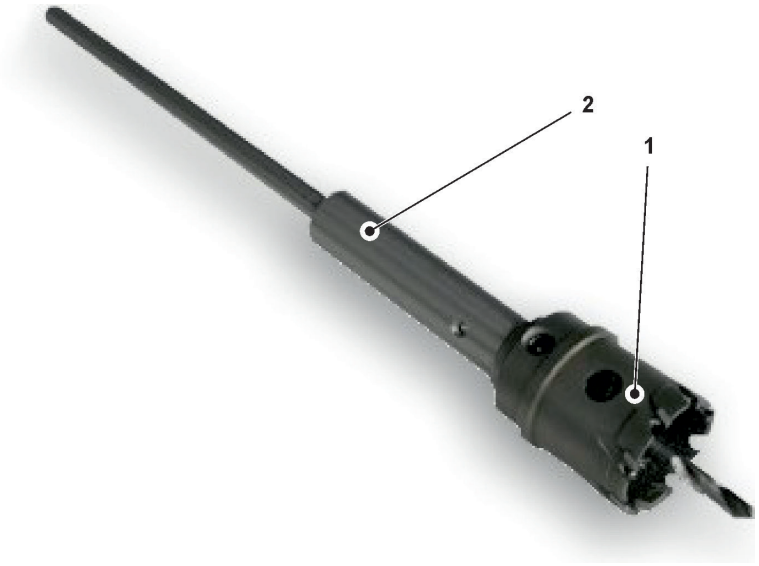
6 Installation aid

7 Pipe wall

Fig. 19-2 Sensor installation using retaining element, ball valve and welding nozzle

20 Drill bit and extension for pipe sensors

To prepare the installation of type NIS pipe sensors in steel or stainless steel pipelines, a drill bit with Ø36 mm and Ø38 mm is available.
If it is necessary to drill through a ball valve use a drill bit with a diameter of Ø36 mm as well as the accompanying extension.



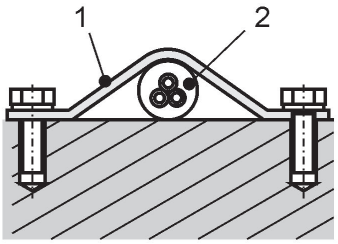
1 Drill bit Ø36 mm

2 Extension for drill bit

Fig. 20-1 Extended drill bit

21 Cable Cover

In order to avoid the risk of build-up, cover the cable with a thin stainless steel sheet (1.4571). Appropriate covers of one meter length are available from NIVUS. Use these covers to safely fasten sensor cables on horizontal surfaces.



1 Stainless steel sheet/cable cover, e.g. type ZMS0 140

2 Cable

Fig. 21-1 Cable layout with cable cover

22 Fastening System for NIC-CO01 Clamp-On Sensors

For the fastening of NIC-CO01 clamp-on sensors NIVUS provides a fastening system containing the following components:

- 1x pre-assemble fastening system, consisting of
  - 2x sensor shoe
  - ruler (length 32 or 78 cm depending on order)
  - ruler fastening material (2x screw, 1x holding block and 1x pressure screw)
  - 2x locking bolts, adjustable (for sensor clamping)
- 1x coupling grease, tube 6 g
- 2x tensioning belt or 1x metal tape with 2x clamping element (depending on order)

The fastening system is suitable for full pipes up to a max. diameter of DN2500 and various measuring arrangements. It can be varied according to these application features. The table below gives an overview on the different versions.

ZUB-	Fastening system			
	Version			
	CO	for Clamp-on sensors		
		Type		
		RA00100	2x Sensor shoe for sensor installation (Type NIC-CO01), incl. tube with coupling paste (6 g)	
		RA00101	2x Sensor shoe for sensor installation (Type NIC-CO01), ruler 32 cm, incl. tube with coupling paste (6 g)	
		RA00102	2x Sensor shoe for sensor installation (Type NIC-CO01), ruler 78 cm, incl. tube with coupling paste (6 g)	
			Tensioning elements/belts	
			00	Without tensioning belts
			01	2x tensioning belt, length 3.5 m
			02	2x tensioning belt, length 6.5 m
			03	2x tensioning belt, length 10 m
			04	Metal tape, width 12.7 mm, length 30 m, incl. 2x clamping elements
ZUB-	**CO**			

Table 5 Type key / versions overview

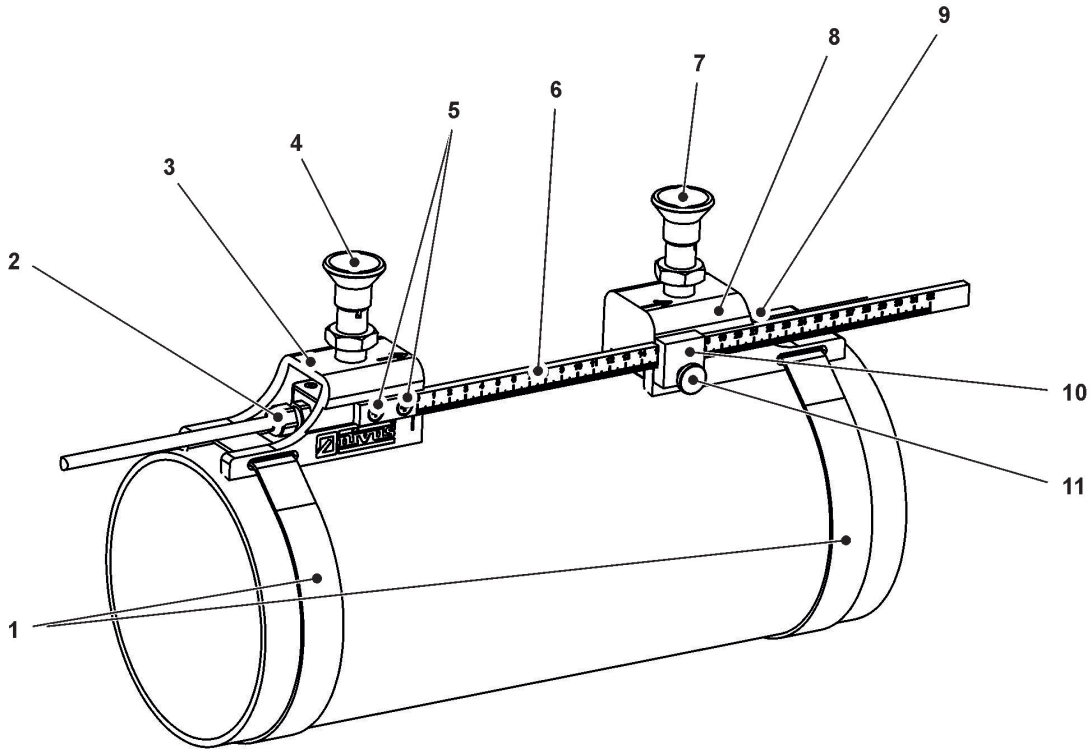
The available device version can be identified from the article number found on the nameplate on the original packaging.

The 32 cm ruler is suitable for pipes DN80…DN500, the ruler 78 cm for pipes DN80…DN1000.
In addition, the sensor distance must be set using other measuring tools. Sensor shoes and tensioning belts or metal tape, however, are used for sensor fastening in any case.

The different tensioning belts are used depending on the pipe diameter:

- Length 3.5 m – up to DN1000
- Length 6.5 m – up to DN2000
- Length 10 m – up to DN2500

Alternatively the 30 m metal tape can be shortened accordingly.



1 Tensioning belts with locks or metal tapes with clamping elements / turnbuckles
2 Clamp-on sensor NIC-CO01 (not part of ZUB-CO fastening system)
3 Sensor shoe, left
4 Locking bolt, adjustable (for sensor clamping)
5 Screws (for ruler fastening)
6 Ruler
7 Locking bolt, adjustable (for sensor clamping)
8 Sensor shoe, right
9 Clamp-on sensor NIC-CO01 (not part of ZUB-CO fastening system)
10 Holding block (for ruler fastening)
11 Pressure screw (for ruler fastening)

Note: positions 3, 4, 5, 6, 7, 8, 10 and 11 are pre-assembled on delivery.

Fig. 22-1 Fastening system for Clamp-on sensors NIC-CO01

The **installation** is carried out according to chapter “13.9.2 Clamp-On Sensors”.

Bibliography

The following standards and regulations have been used as sources to create this instruction manual:

- DIN EN ISO 748
- DIN EN ISO 6416
- Construction and operation of ultrasonic flow metering equipment (LfU)

Index