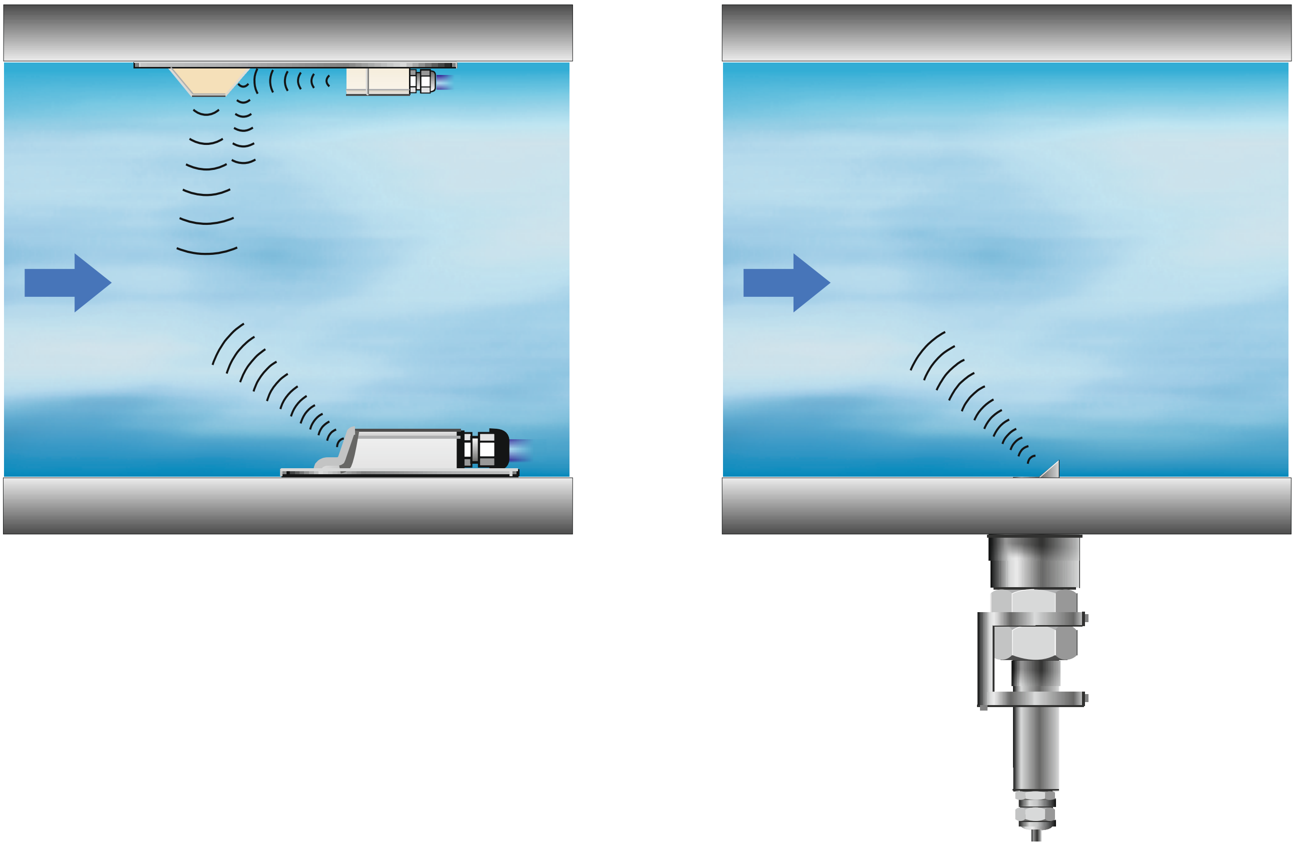
Installation Instruction for
Correlation and Doppler Sensors

(Original Installation Instruction – German)



NIVUS GmbH
Im Taele 2
75031 Eppingen, Germany
Phone +49 72 62 - 91 91 - 0
Fax +49 72 62 / 91 91 - 999
E-Mail: info@nivus.com
Internet: www.nivus.com

NIVUS AG
Hauptstrasse 49
8750 Glarus, Switzerland
Phone: +41 (0)55 6452066
Fax: +41 (0)55 6452014
E-Mail: swiss@nivus.com
Internet: www.nivus.de

NIVUS Austria
Mühlbergstraße 33B
3382 Loosdorf, Austria
Phone: +43 (2754) 567 63 21
Fax: +43 (2754) 567 63 20
E-Mail: austria@nivus.com
Internet: www.nivus.de

NIVUS France
14, rue de la Paix
67770 Sessenheim, France
Phone: +33 (0)3 88071696
Fax: +33 (0)3 88071697
E-Mail: france@nivus.com
Internet: www.nivus.com

NIVUS U.K.
Wedgewood Rugby Road
Weston under Wetherley
Royal Leamington Spa
CV33 9BW, Warwickshire
Phone: +44 (0)1926 632470
E-Mail: info@nivus.com
Internet: www.nivus.com

NIVUS U.K.
1 Arisaig Close
Eaglescliffe
Stockton on Tees
Cleveland, TS16 9EY
Phone: +44 (0)1642 659294
E-Mail: info@nivus.com
Internet: www.nivus.com

NIVUS Sp. z o.o.
ul. Hutnicza 3 / B-18
81-212 Gdynia, Poland
Phone: +48 (0) 58 7602015
Fax: +48 (0) 58 7602014
E-Mail: poland@nivus.com
Internet: www.nivus.pl

NIVUS Middle East (FZE)
Building Q 1-1 ap. 055
P.O. Box: 9217
Sharjah Airport International
Free Zone
Phone: +971 6 55 78 224
Fax: +971 6 55 78 225
E-Mail: Middle-East@nivus.com
Internet: www.nivus.com

NIVUS Korea Co. Ltd.
#411 EZEN Techno Zone,
1L EB Yangchon Industrial Complex,
Gimpo-Si
Gyeonggi-Do 415-843,
Phone: +82 31 999 5920
Fax: +82 31 999 5923
E-Mail: korea@nivus.com
Internet: www.nivus.com

Translation

If the device is sold to a country in the European Economic Area (EEA) this instruction handbook must be translated into the language of the country in which the device is to be used.
Should the translated text be unclear, the original instruction handbook (German) must be consulted or the manufacturer contacted for clarification.

Names

The use of general descriptive names, trade names, trademarks and the like in this handbook does not entitle the reader to assume they may be used freely by everyone. They are often protected registered trademarks even if not marked as such.

1 Contents

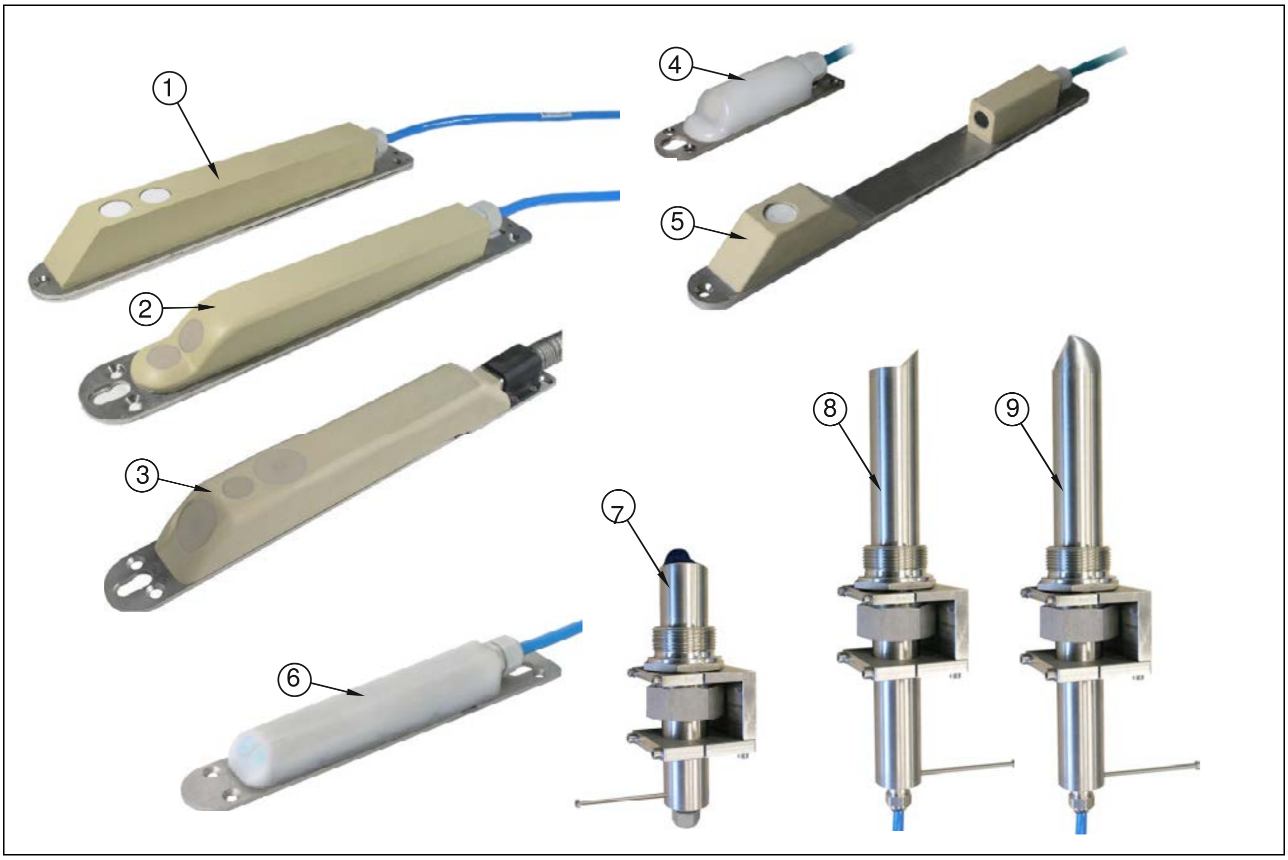
1.1 Table of Contents

2 Sensor Overview

This installation instruction is an addendum to the Instruction Manuals of the respective flow measurement transmitters or sensors. It solely relates to the mounting of the sensors and cable layout. Following sensors are described:

- POA Wedge and Pipe sensor (OCM Pro CF, NFP, PCM Pro, PCM 4)
- OCL Wedge sensor (OCM Pro CF, PCM Pro, PCM 4)
- KDA Wedge and Pipe sensor (OCM F, OCM FR)
- CS2 Wedge and Pipe sensor (OCM Pro CF)
- CSM Wedge sensor (OCM Pro CF, PCM Pro, PCM 4)
- DSM Wedge sensor (OCM Pro CF, PCM Pro, PCM 4)

Please find connection drawings as well as specifications and Ex approvals (ATEX) of sensors and transmitters in the respective instruction manuals.



1 OCL- Air ultrasonic sensor
2 POA- Wedge sensor
3 CS2- Wedge sensor
4 CSM- Wedge sensor
5 DSM- Air ultrasonic sensor
6 KDA- Wedge sensor
7 KDA- Pipe sensor with retaining element and installation help
8 POA- Pipe sensor with retaining element and installation help
9 CS2- Pipe sensor

Fig. 2-1 Sensor overview

3 General Notes on Safety and Danger

3.1 Danger Notes

Cautions
are framed and labelled with a warning triangle.

Notes
are framed and labelled with a "hand".

Danger by electric voltage
is framed and labelled with the Symbol on the left.

Warnings
are framed and labelled with a "STOP"-sign.

3.2 Special Danger Notes

Please note that due to the operation in the waste water field transmitter, sensors and cables may be loaded with dangerous disease germs. Respective precautionary measures must be taken to avoid damage to one's health.

For installation in explosive areas appropriate protection measures shall be taken (gas warning device, sufficient ventilation, anti-spark tools etc.).

3.3 Markings

The safety hints on the pipe sensor are part of the delivery and must not be removed due to reasons of risk prevention!

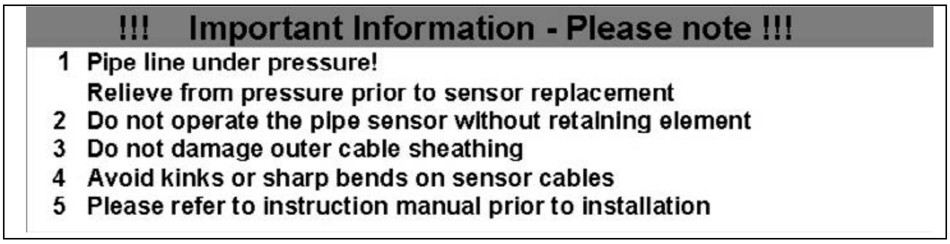


Fig. 3-1 Safety hints on pipe sensor

3.4 User's Responsibilities

In the EEA (European Economic Area) national implementation of the framework directive 89/391/EEC and corresponding individual directives, in particular the directive 89/655/EEC 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 the Industrial Safety Ordinance must be observed.

The customer must (where necessary) obtain any local **operating permits** required and observe the provisions contained therein.
In addition to this, he must observe local laws and regulations on

- 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)
- environmental protection.

4 Installation and Fastening of the Sensors

STOP

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 security measures shall be taken if required.

The sensors have to be fastened hard and tight. The inclined side of the velocity sensor must “look“ (face) against the flow direction of the medium.
Use only non-corrosive fastening material!

4.1 Choosing Sensor Position and Calming Sections

4.1.1 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.

- Strictly avoid falls, steps or obstructions, fittings, profile change of channels or supplies from the side upstream as well as downstream of the measurement point!
- Measurement sections have to be selected in a way that there is no sedimentation (sand, grit, sludge) arising under standard operating conditions. Sedimentation is caused by low tractive forces within the flow profile indicating too low slopes or structural shortcoming (negative partial slope) within the measurement section (please note the required minimum flow velocities in order to compensate frictional wall forces ensuring sufficient transport of sedimentation according to German ATV-DVWK A 110!).
- 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 Q_{TW}).
- 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.

The drawings Fig. 4-1 to Fig. 4-10 give an example of appropriate, ill-suited and problematic applications. In case of being uncertain regarding choice or assessment of planned measurement sections please send your drawings/photos and contact your representative or the flow department at NIVUS GmbH in Eppingen.

4.1.2 Sensors in part filled applications

Examples described apply for wedge sensors and pipe sensors.

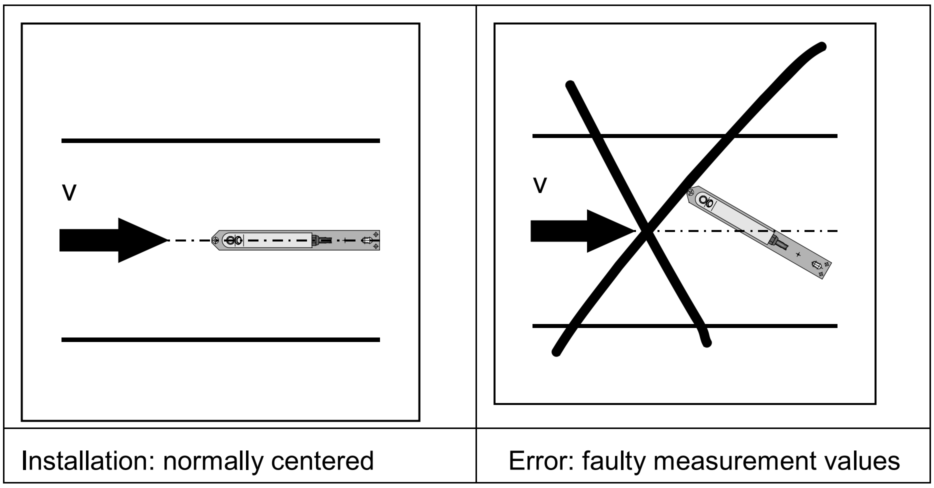
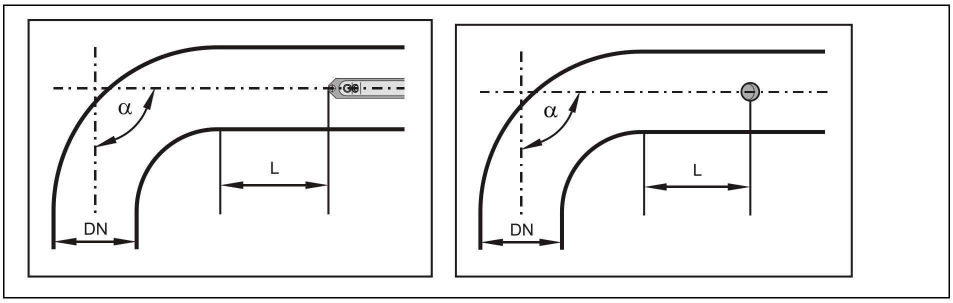
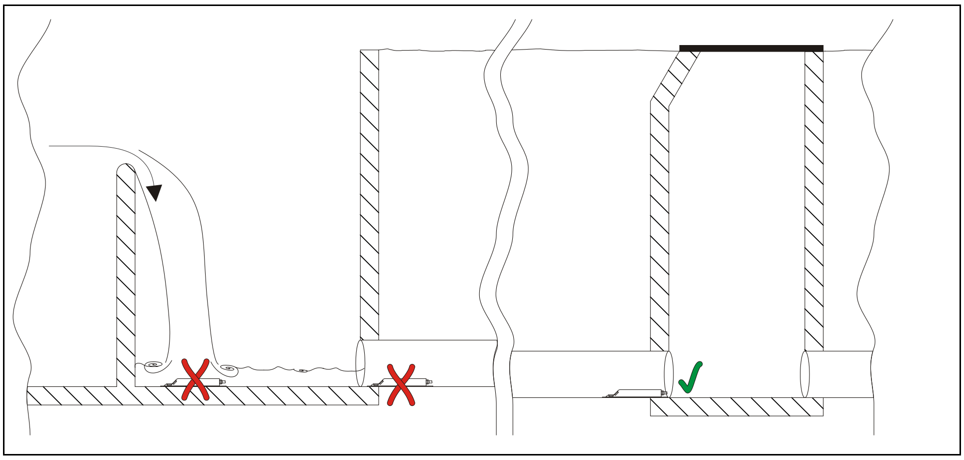


Fig. 4-1 Sensor adjustment



	v £ 1 m/s	v > 1 m/s
α £15°	L ³ min. 3 x DN	L ³ min. 5 x DN
α £45°	L ³ min. 5 x DN	L ³ min. 10 x DN
α £90°	L ³ min. 10 x DN	L ³ min. 15-20 x DN

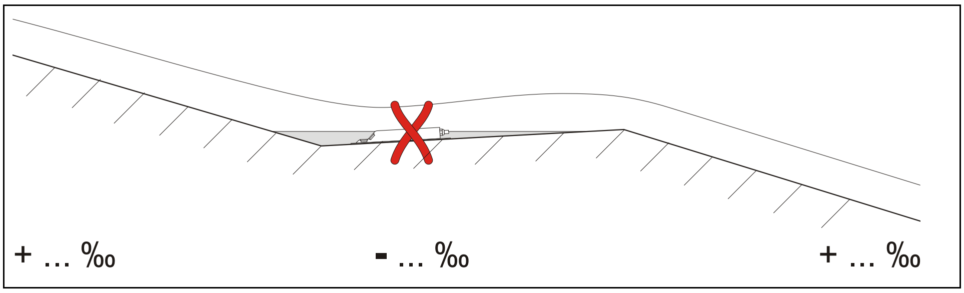
Fig. 4-2 Sensor position behind curves or elbows



r = Error! Indefinable flow conditions

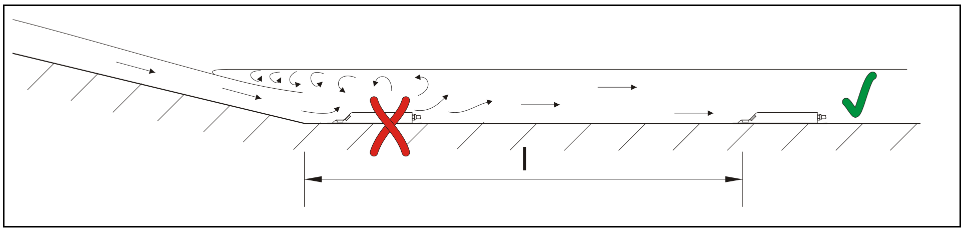
a = Sufficient distance to obtain straight flow
(10 ... 50 x diameter depending on application)

Fig. 4-3 Overflow channel or fall error caused by indefinable flow conditions



r = Error!
Risk of silting-up / sludge accumulation caused by negative slope

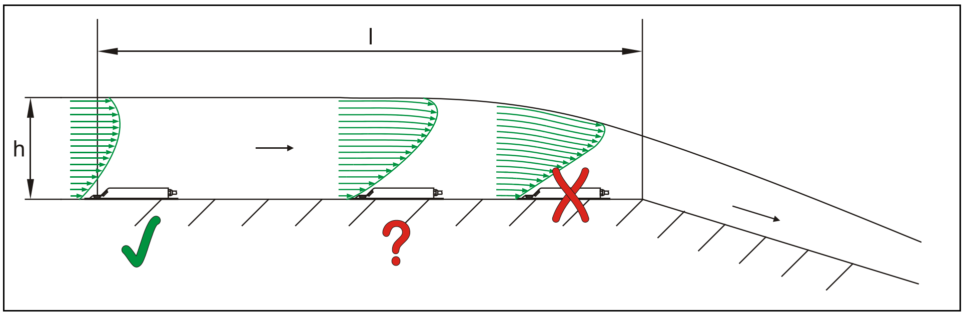
Fig. 4-4 Negative slope – risk of silting-up



r = Error! Alternation of slope = alternation of flow profile

a = Distance depending on slope and flow velocity value
l = min. 20 x diameter

Fig. 4-5 Error caused by alternation of slope

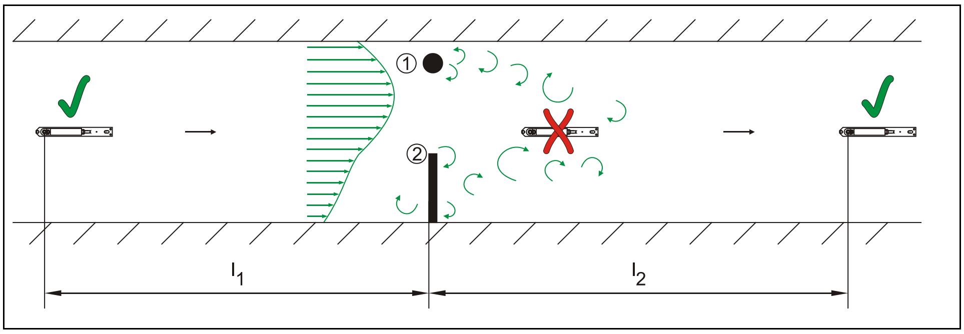


r = Error! Transition from flowing to shooting
Level measurement might fail + velocity and level measurement might be faulty

? = Critical measurement point, not recommended! Begin of sinking flow

a = Distance l = min. 5 x h_{max} at place of installation

Fig. 4-6 Error caused by alternation of flow profile in front of slope alternation or fall

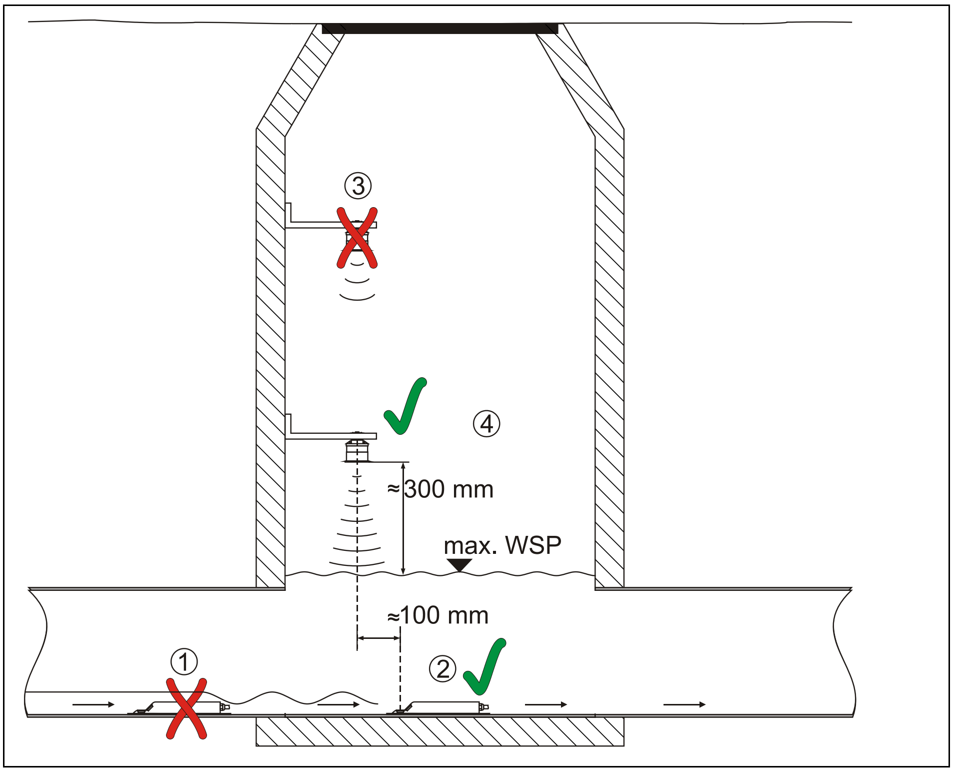


(1) = Fixtures such as samplers or similar
(2) = Obstruction

r = Error!
Caused by vorticity, tangential and/or asymmetric flow

a = Distance l1 (upstream of obstruction) = min. 5 x h_{max}
Distance l2 (downstream of obstruction) = min. 10 x h_{max}
in case of flow velocities >1 m/s

Fig. 4-7 Errors caused by fixtures or obstructions



(1) = Wave formation on water surface behind the sensor
à error message in case of following air-ultrasonic sensor

(2) = O.K. (might have to be installed 10 mm (0.39 in) lower in case of low flow levels)

(3) = Distance too large: edge of sensor bottom to max. water level

(4) = O.K.: best possible sensor position at max. water level

Fig. 4-8 Installation in manholes with fill levels < 150 mm

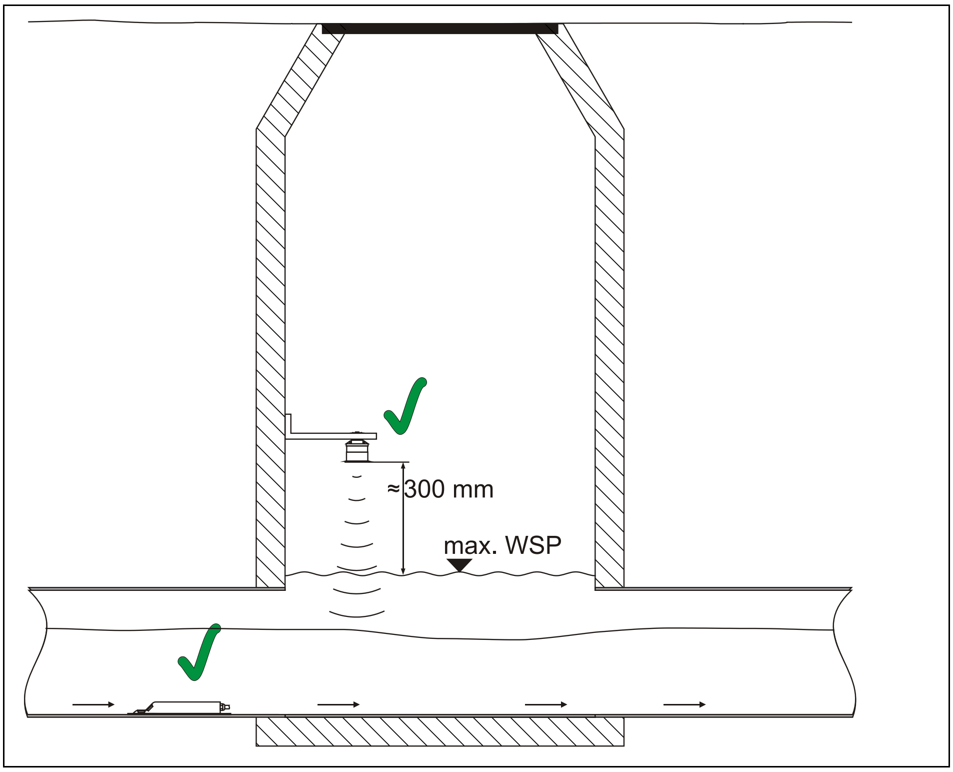
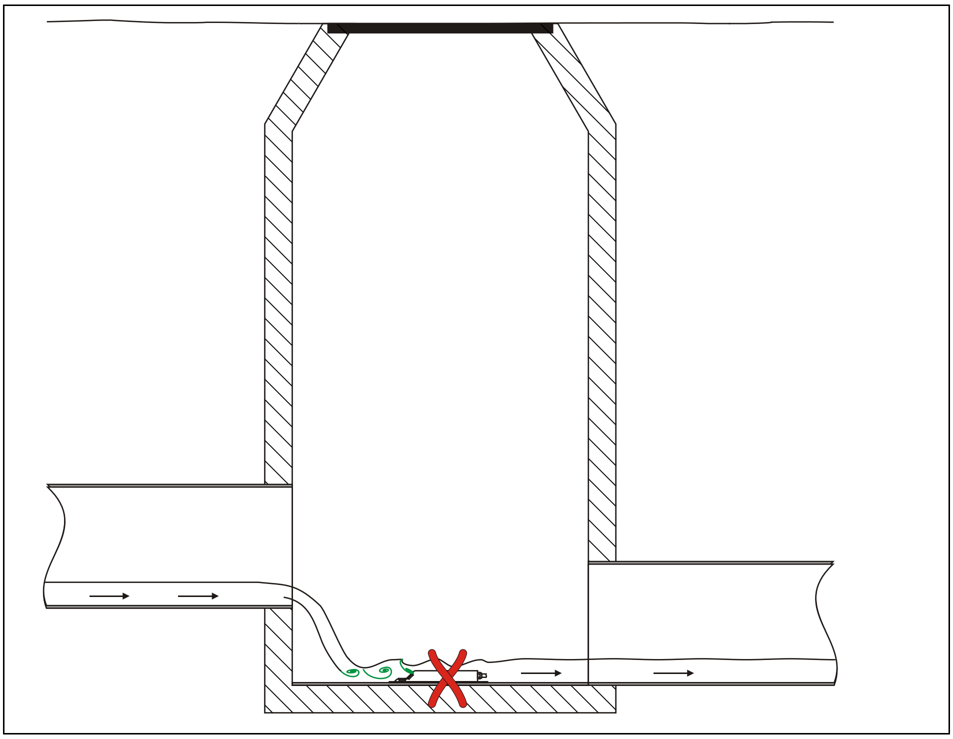


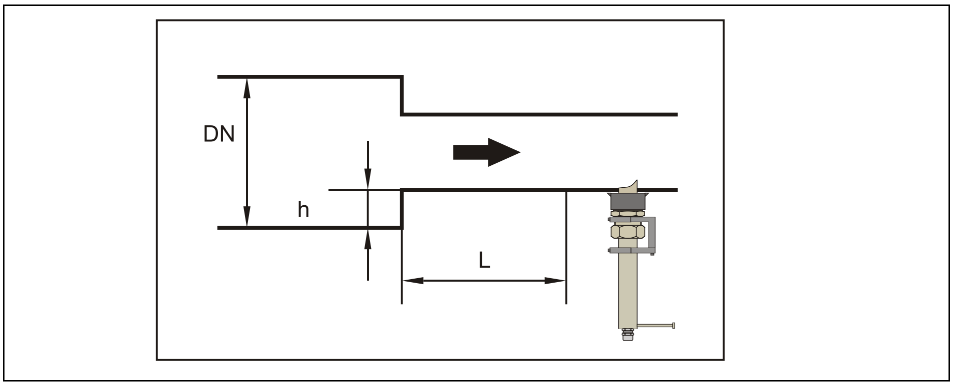
Fig. 4-9 Installation in manholes with fill levels >150 mm



r = Error! Caused by vorticity and wave formation behind fall
à Use other measurement place or renew manhole

Fig. 4-10 Error caused by fall or alternation of slope

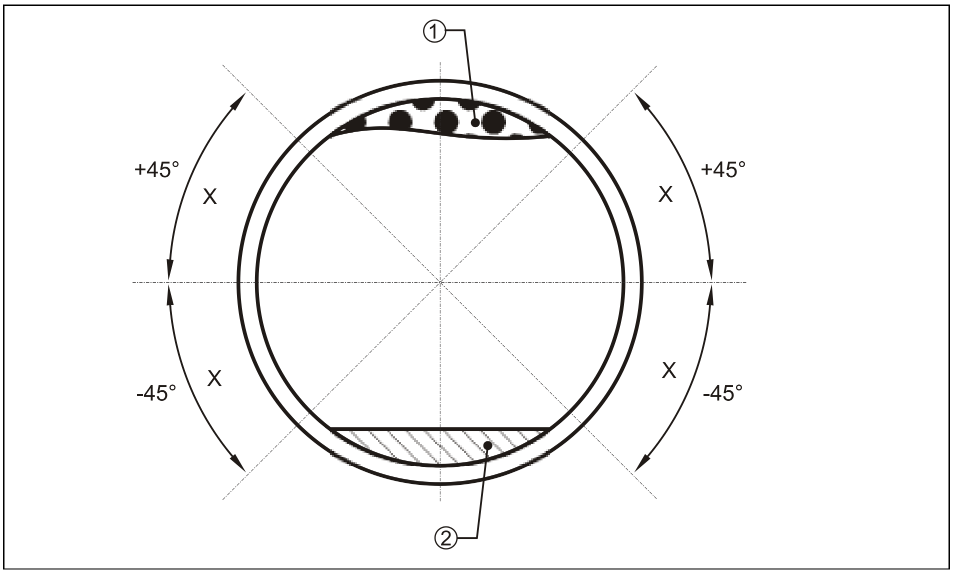
4.1.3 Sensors in full channels, pipes or similar



h £ 5% von DN	L ³ min. 3x DN
h > 5% von DN	L ³ min. 5x DN
h ³ 30% von DN	L ³ min. 10x DN

Fig. 4-11 Sensor position after change of profile

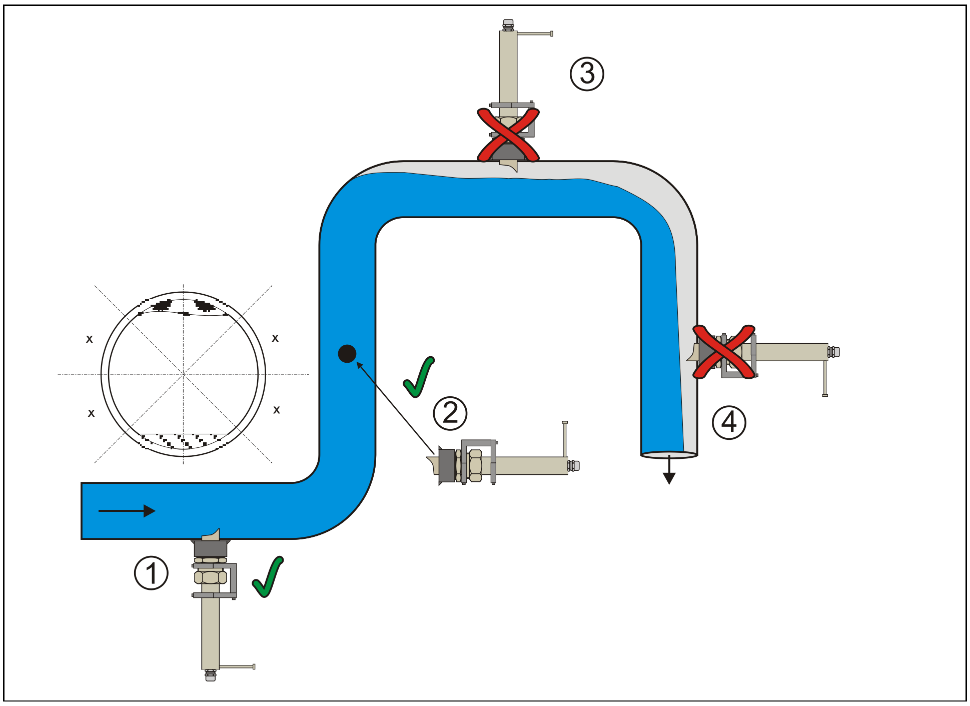
In case of horizontally laid pipes avoid pipe top and pipe bottom as mounting place (risk of soiling or air bubbles resulting in measurement failure).
NIVUS recommends a mounting position of -45° ... +45° to the horizontal.



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

Fig. 4-12 Recommended installation angles

At pipes laid vertically the danger of swamping / air doesn't 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 (see Fig. 4-13).



1 =	recommended range in almost 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. 4-13 Comparison of installation places

In case of planning measurements in horizontal pipelines we recommend to consider a slightly inclined section or an inverted siphon (sensor installation as depicted in Fig. 4-12).

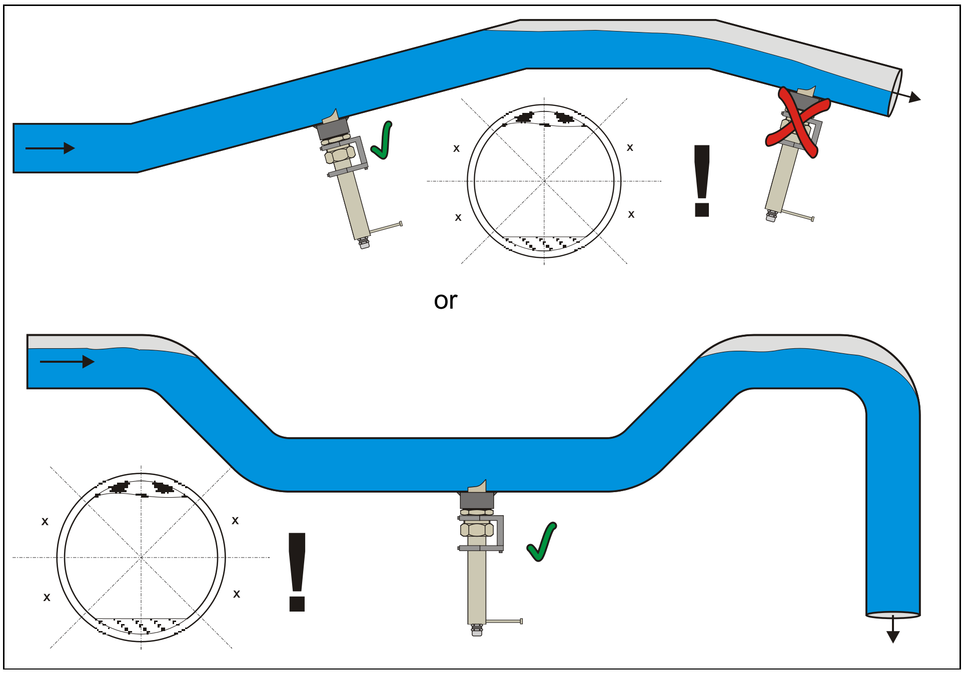


Fig. 4-14 Horizontal pipe with inverted siphon

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

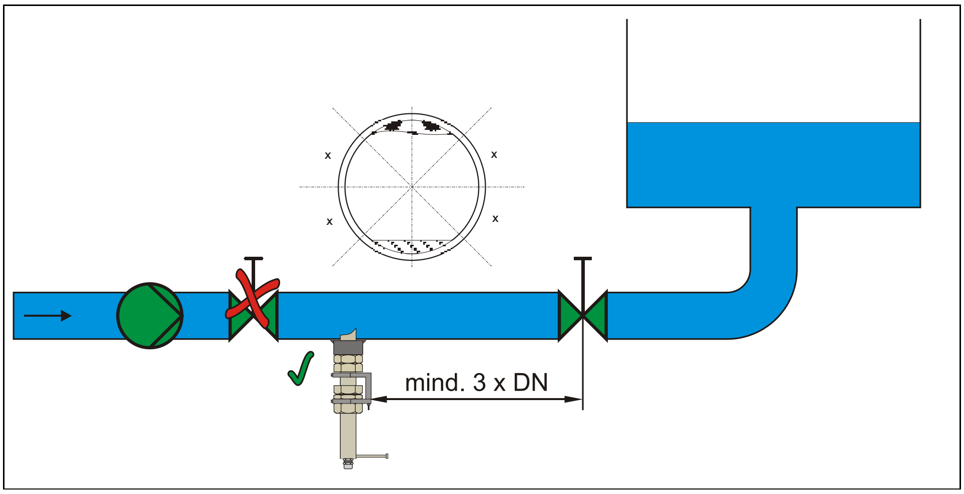


Fig. 4-15 Using shut-off valves and control fittings

Never install sensors on vibrating pipe lines since this may result in measurement errors!

4.2 Sensor Installation

4.2.1 Wedge Sensor

To install the wedge sensor on the channel bottom 4 appropriate stainless steel screws with a countersunk 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 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.

Sensor fastening elements should be as flush as possible with the mounting plate.

In the waste water area there is a risk of build-up and hence the risk of measurement failure if any screws or other fastening parts should extend into the measurement medium.

The sensor must be installed exactly in the channel centre if there is no other agreement with NIVUS; the bevelled side is looking towards the flow direction. To reduce the risk of build-up the 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).

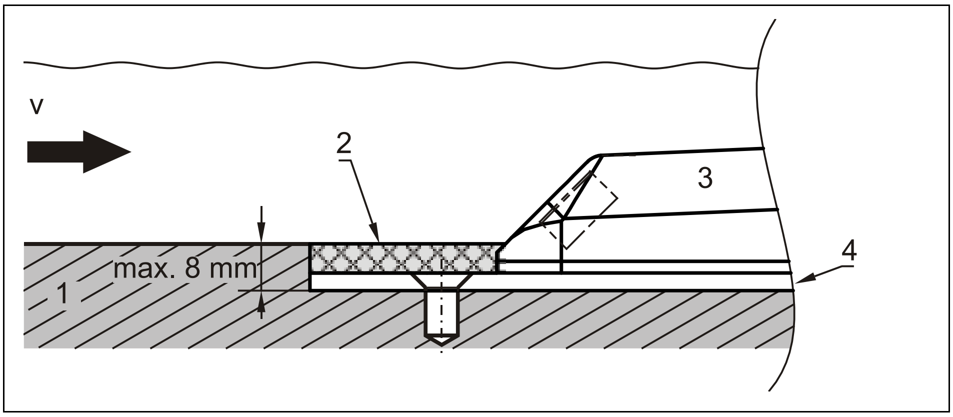
Do not deform the ground plate neither during installation nor dismantling.
Never enlarge installation boreholes.
Always use an appropriate screwdriver for sensor dismantling. Never use prybars, chisels, hammers, levers, crowbars, hammer drills or similar tools).
It is not allowed to use any kind of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

Removing or loosening ground plate and/or cable glands on the sensor results in leakage and causes a failure in the measurement / the sensor.

No *sensor parts are allowed to be removed on principle!*

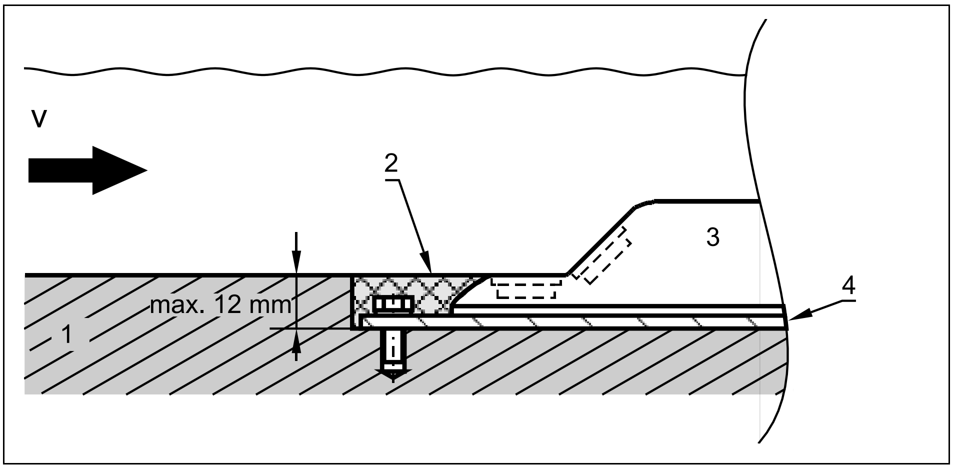
In case of using **wedge sensors without** integrated pressure element it is reasonable to install the sensor in a recess (reduction of lowest measurable filling level, additional reduction of risk of build-up) which has to be created with a maximum depth of 8 mm (KDA and CS2 sensor) or 12 mm (0.47 in) (POA sensor). After the installation has been finished, fill up the remaining gaps and seams with permanently elastic material (silicone or similar).

*Never countersink combi sensors **with** integrated pressure measurement cell. The sealing on the sides of the countersunk sensor or pollution otherwise will lead to measurement errors and/or failure of the pressure measurement cell.*



1 Channel bottom
2 Silicone or similar
3 Sensor body
4 Mounting plate

Fig. 4-16 Installation suggestion for countersunk wedge sensors (KDA and CS2)



1 Channel bottom
2 Silicone or similar
3 Sensor, Type POA
4 Mounting plate

Fig. 4-17 Installation suggestion for countersunk wedge sensors (POA)

To avoid the risk of echo loss and failure of the level measurement, always install sensors with integrated water ultrasound in a way that the ultrasound is hitting the interface between medium and air at a right angle.

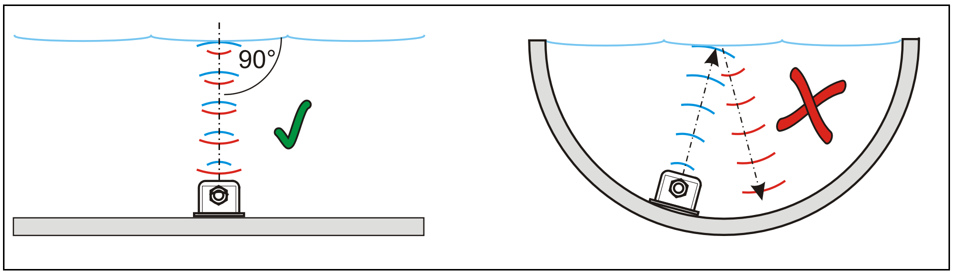


Fig. 4-18 Installation: sensor with integrated water-ultrasound measurement

4.2.2 Wedge sensor with integrated pressure measurement cell

In order to compensate atmospheric pressure sensors with integrated pressure measurement cell come with an air hose within the cable. Neither buckle or seal this air hose nor clamp it into hermetically sealed connection sockets without air pressure compensation.
Otherwise the flow level cannot be measured correctly by using pressure!

Operating sensors with integrated pressure measurement cell without pressure compensation element for a longer period of time may lead to irreversible damage of sensor electronics.

Please not that in the event of high flow velocities and low flow levels measurement errors due to physical reasons may occur if using a combi sensor with pressure measurement cell.

STOP

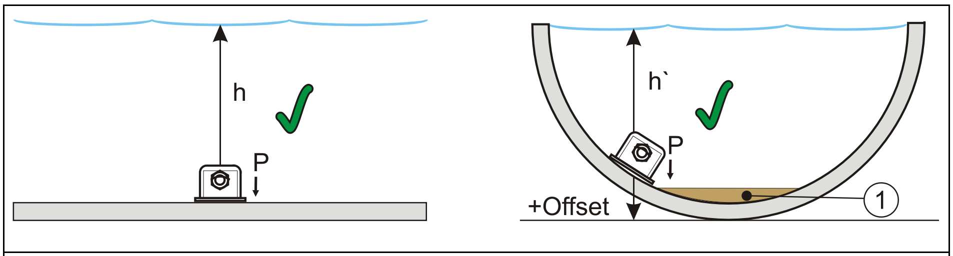
Never touch the pressure element with fingers, brushes, tools, water jets or similar!

Otherwise the pressure element might be damaged resulting in measurement failures.

STOP

Never remove the cover of the pressure measurement cell during installation! The cover protects the cell from external causes.

Given the risk of silting or sedimentation, sensors with integrated pressure measurement cell may be installed out of the center. The pressure measurement cell will continue to detect the fill level above the sensor anyway. The resulting offset must be entered into the transmitter (parameter – sensor installation level).

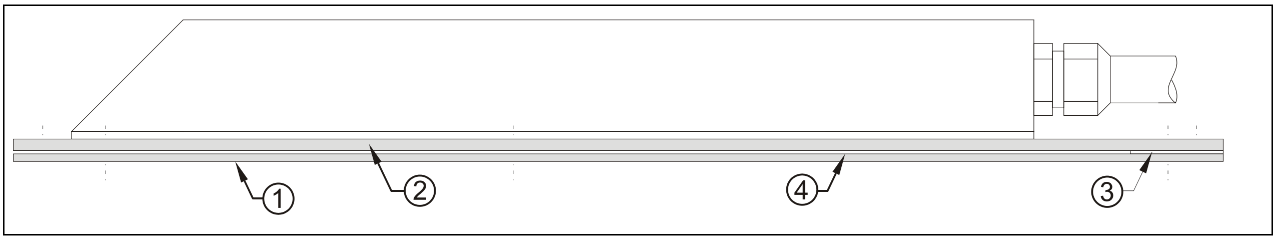


1 Sedimentation (sand / sludge)

Fig. 4-19 Installation: sensor with integrated pressure measurement cell

4.2.3 Air-ultrasonic Sensors

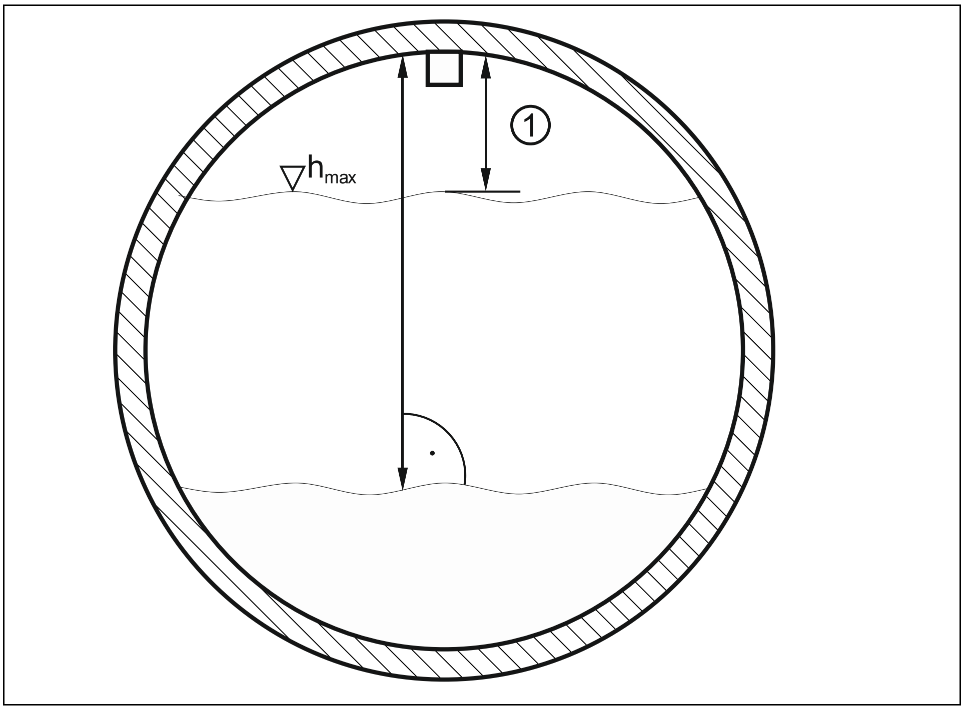
On delivery the air-ultrasonic sensor Type OCL is designed for clamping installation using a pipe mounting system Type RMS.
For installation using the RMS the mounting sheet located in the pipe vertex must be put through cut-out (4) of the air-ultrasonic sensor prior to complete assembly (see Fig. 4-20).



1 Ground plate 1
2 Ground plate 2
3 Ground plate 3
4 Cut-out for pipe mounting plate

Fig. 4-20 Air-ultrasonic sensor for fastening on pipe mounting system

Before clamping the system into the pipe adjust the sensor exactly parallel to the water surface. Looking towards flow direction it should be located at least 10 cm (4 in) in front of the flow velocity sensor located on the bottom (Fig. 6-4 to Fig. 6-6).



1 Dead zone

Fig. 4-21 Installation of air-ultrasonic sensor

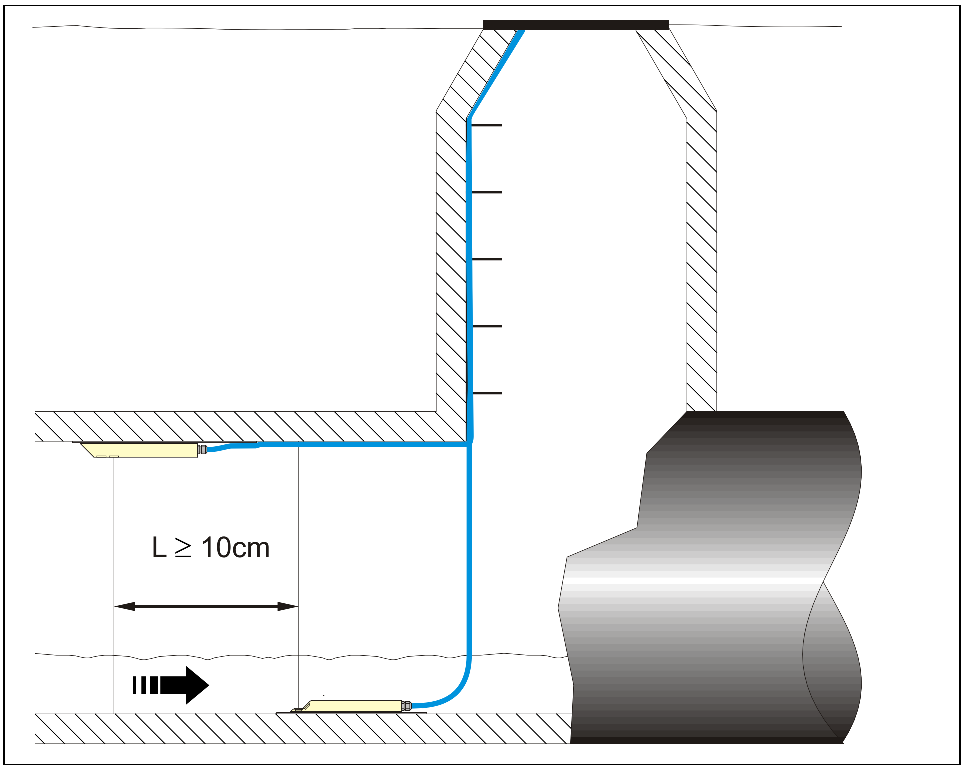


Fig. 4-22 Arranging the sensors

For permanent installation the air-ultrasonic sensor Type OCL can be fixed on the channel vertex by using 3 appropriate stainless steel screws M5 and appropriate dowels.
To permanently fasten the air-ultrasonic sensor Typ DSM use the accompanying mounting shoe.

Use screws with a proper length ensuring safe and durable sensor fastening under all operational conditions.

The dead zone of the air-ultrasonic sensor Type OCL is 10 cm, the dead zone of Type DSM is 4 cm. Fill levels within this dead zone (

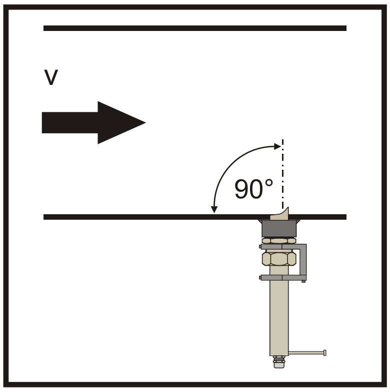
1	*Dead zone*

Fig. 4-21) cannot be measured.

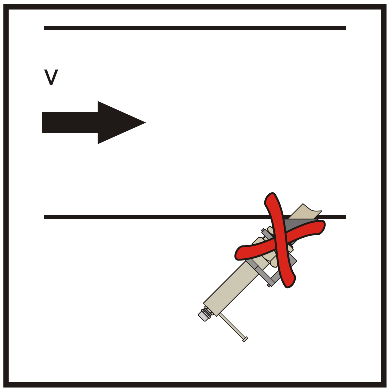
Flooding the air-ultrasonic sensor will cause the sound to be coupled into the measurement medium. Due to significantly higher sound velocities contrary to air, this will result in the risk of faulty level measurement. This is why the flood area of the air-ultrasonic sensor has to be avoided on programming. The air-ultrasonic sensor must ***NOT*** *be activated within this range!*

4.2.4 Pipe sensors

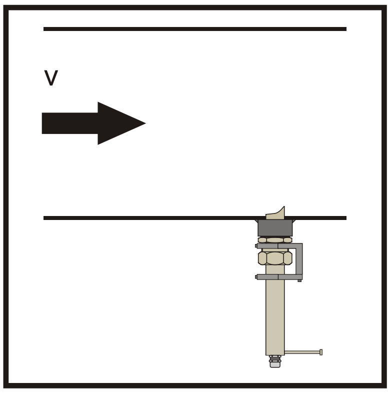
The sensors have to be fastened hard and tight. The inclined side of the velocity sensor must “look“ (face) against the flow direction of the medium. The installation aid (see Fig. 6-43) shall look towards the flow direction.
Use only non-corrosive fastening material!
The pipe sensor is going to be screwed 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.

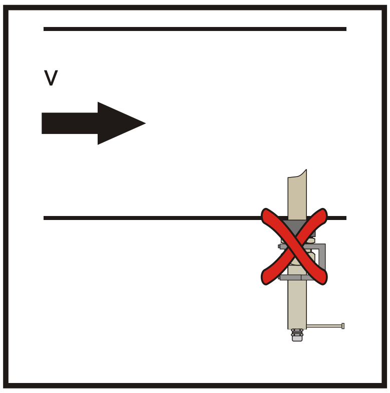


Correct installation



Error: faulty measurement values





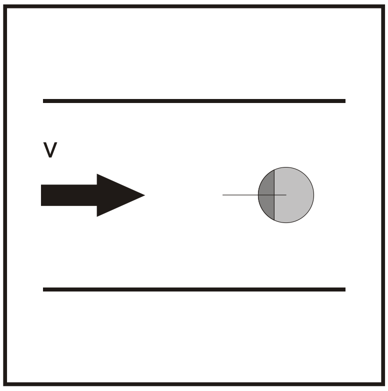
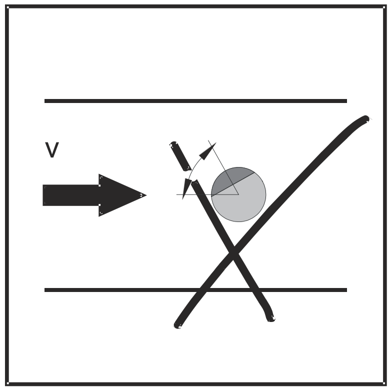
Error: build-up	Error: faulty measurement values or measurement failure
	
Sensor face to flow direction	Error: faulty measurement values

Fig. 4-23 Hints on pipe sensor installation

Please note whilst installation in pipes:

- *weld on the 1½“ nozzle in an angle of 90°.*
- *Place the sensor in a way that the bevelled side is looking exactly towards the flow direction.*

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 we recommend to use a tapping saddle (see chapter 6.9).
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 with a diameter of 38 mm and a low-speed drilling machine with friction clutch. We furthermore recommend to additionally use cutting paste for drill bit cooling.

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 (see Fig. 4-30).
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.

Risk of accident!

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!.

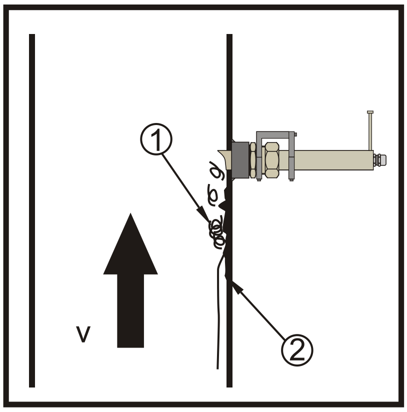
Risk of accident!

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

Please observe unobstructed removal of turnings. If necessary, interrupt drilling and remove turnings before proceeding. Remove burrs with a file after drilling since otherwise measurement errors might occur.

Never burn pipes with welding torches!

Weld seam burn may cause swirls and hence lead to measurement errors (see Fig. 4-24).

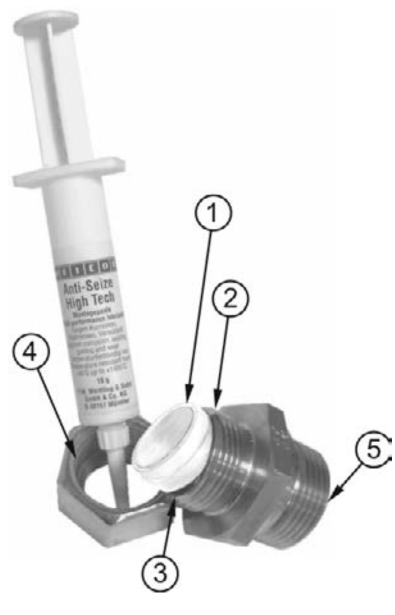


Error: faulty measurement values

1 = whirls/chips
2 = weld seam burn

Fig. 4-24 Disturbances caused by weld seam burn

When assembling the insertion sensor, a special grease paste must be used for the stainless steel couplings, specified to DIN 2353 (or equivalent).
The cap nut thread, threads and cone as well as the cutting ring 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

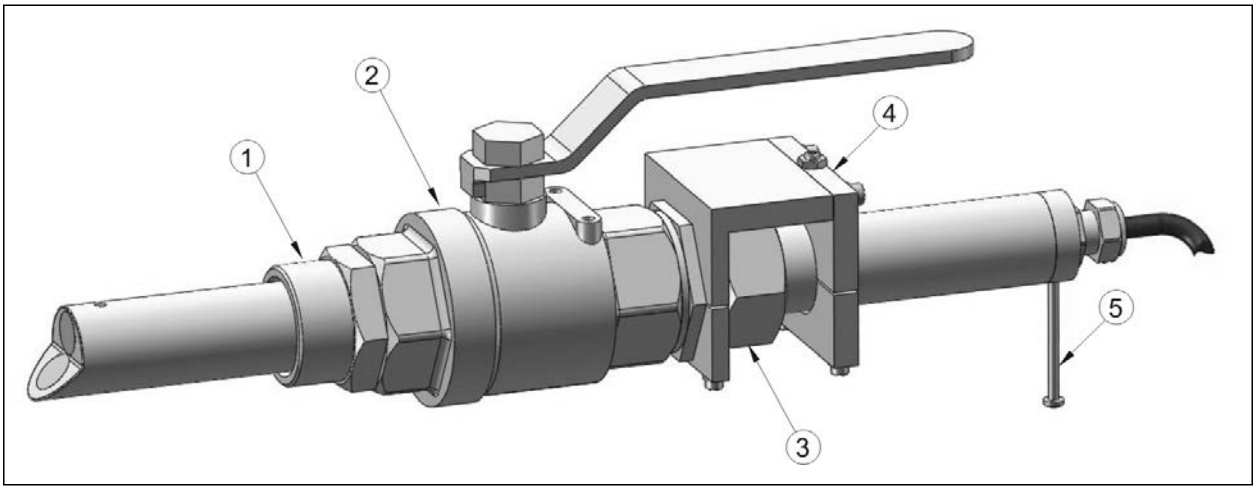
Fig. 4-25 Using grease on cutting ring screw joint

The screw joint shall be greased on all points shown in Fig. 4-25 prior to installation.
Install the sensor according to DIN 3859-2.
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).
Subsequently pull spigot nut and gasket ring over the flow velocity sensor and insert the sensor into the screw joint as deep as required (depending on application) (see Fig. 4-23).
Afterwards put he gasket ring into the screw connection, tighten the spigot nut manually. Then (in order to be capable of controlling the number of turns) apply a marker on the spigot nut and tighten the nut by approx. 0.5 turns.

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.

Risk of accident!

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.



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

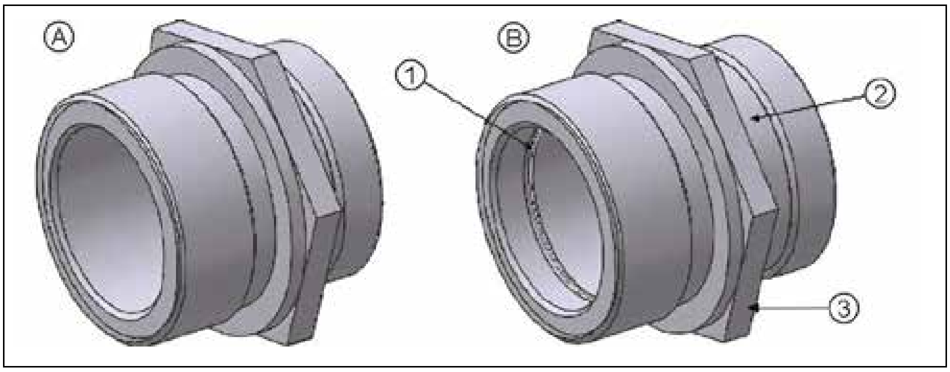
Fig. 4-26 Components of pipe sensor mounting

Risk of accident!

Increased pressure or pressure surges may cause unsecured flow velocity sensors to become unscrewed and hence may be dangerous to persons as well as to parts of the facility!

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

Sensor retaining elements are included in the sensor delivery and have to be used in conjunction with the appropriate sensor screw connections which can be identified from the extended thread run-out as well as from the O-ring on the inside (see Fig. 4-28).



A Sensor screw connection (old version)
B New sensor screw connection
1 Slot for O-ring
2 Extended thread run-out
3 hexagon strength reduced from 9 mm to 6 mm

Fig. 4-27 Comparison between both sensor screw connections

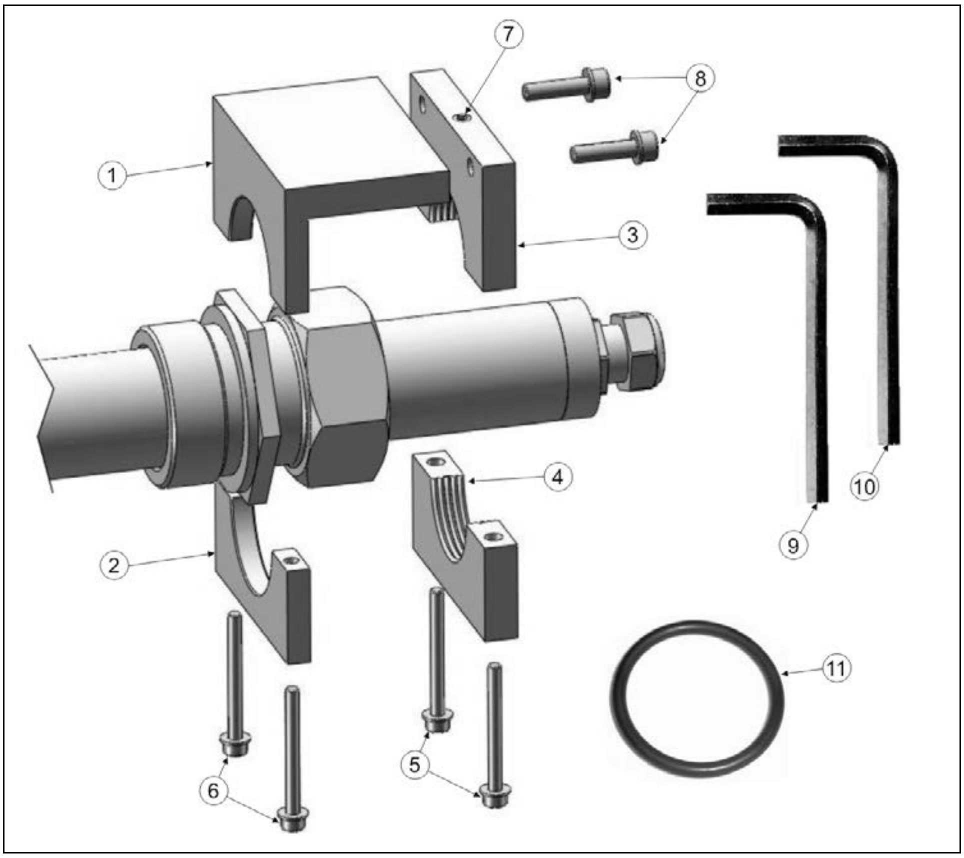
The rear clamp element (2) cannot be guaranteed to safely sit on the screw connection as soon as the sensor retaining element is used in conjunction with an older sensor screw connection (A)!

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.

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 8.0 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 (1x)
2 Lower front clamp element (1x)
3 Upper rear clamp element (1x)
4 Lower rear clamp element (1x)
5 Allen® head screw M5 (2x)
6 Allen® head screw M4 (2x)
7 Welded headless screw (as additional clamp lock)
8 Allen® head screw M5 (2x)
9 Allen key® – 1 x 2.5 mm
10 Allen key® – 1 x 3 mm
11 O-Ring, spare part for sensor screw connection, see Fig. 4-27

Fig. 4-28 Exploded assembly drawing of sensor retaining element

For installation proceed as follows:

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

Fig. 4-29 Greasing the sensor screw connection

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

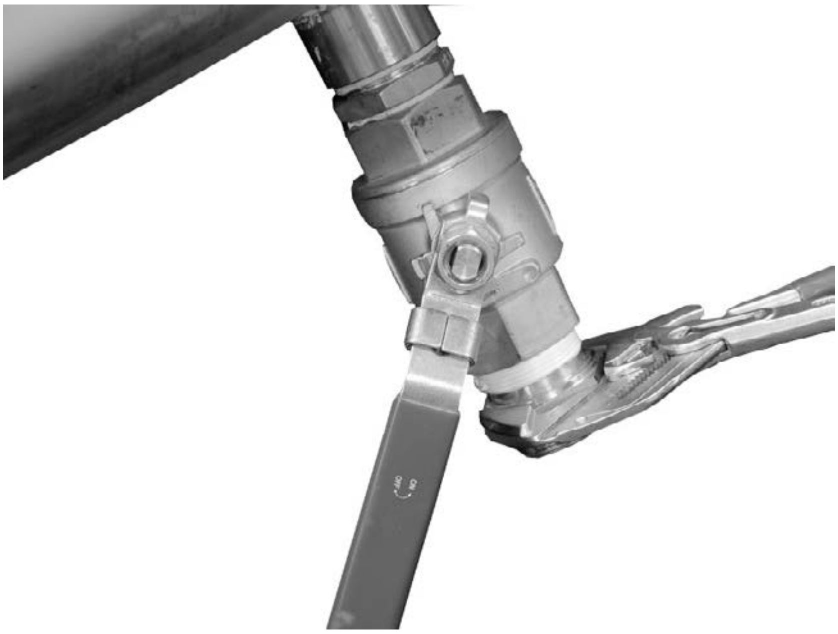


Fig. 4-30 Fixing the sensor screw connection to the stop ball valve

3. Put the pipe sensor in the correct position.

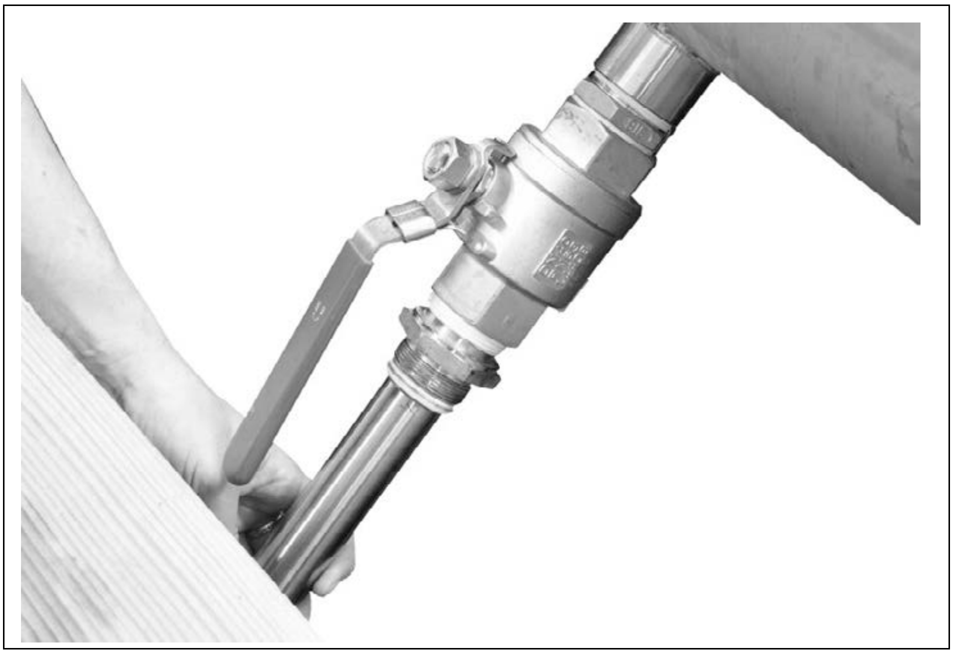


Fig. 4-31 Positioning the sensor

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

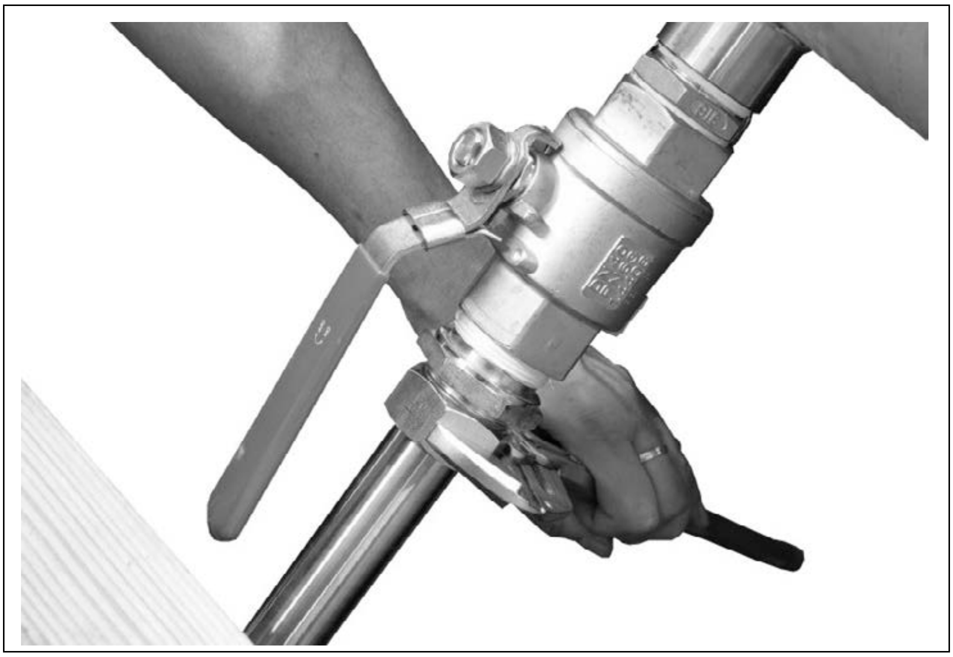


Fig. 4-32 Fastening the sensor

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 (see Fig. 4-28, No 7).

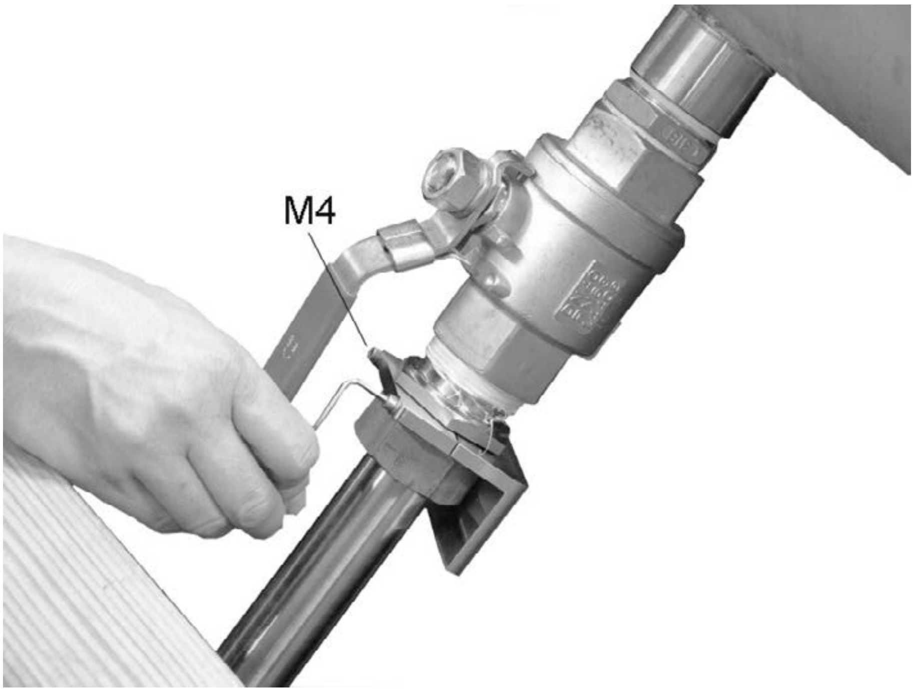


Fig. 4-33 Attaching lower front clamp element

6. Screw the upper rear clamp element (see Fig. 4-28, No 3) to the upper front clamp element using both M5 Allen® head screws.

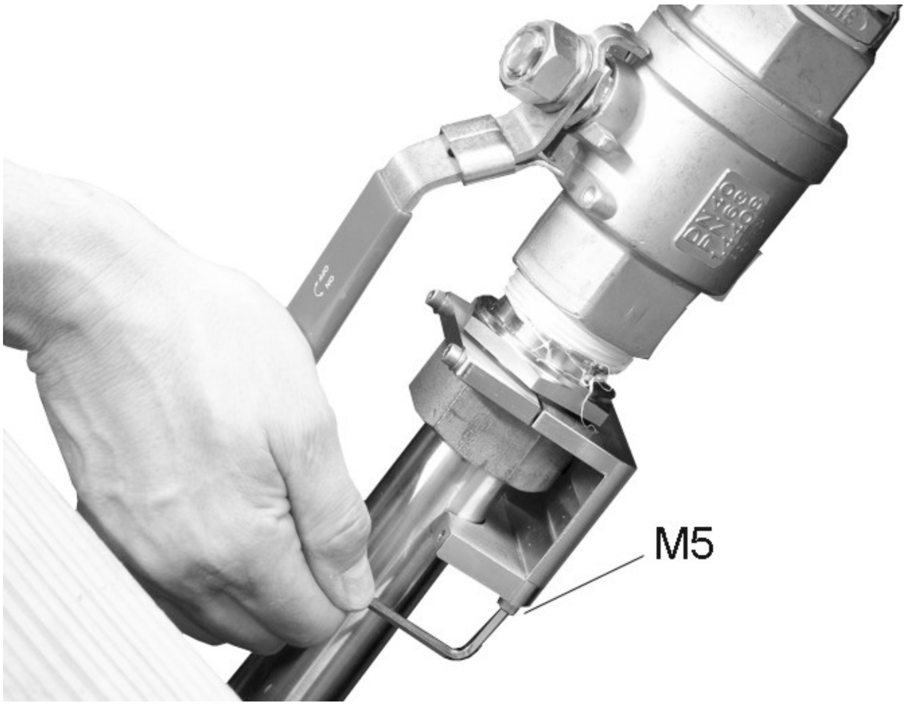


Fig. 4-34 Connecting upper rear and upper front clamp element

7. Subsequently attach the lower rear clamp element to the upper rear clamp element by using the two remaining M5 Allen® head screws. Please use a minimum torque of 6 Nm to tighten the screws in order to ensure proven security.
   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. 4-35 Attaching the final clamp element

8. The sensor retaining element furthermore facilitates to exactly reposition the sensors after maintenance or control measures.
9. To do this, first unscrew the spigot nut as well as both hexagon socket screws (Allen screws) M5 (see Fig. 4-34).

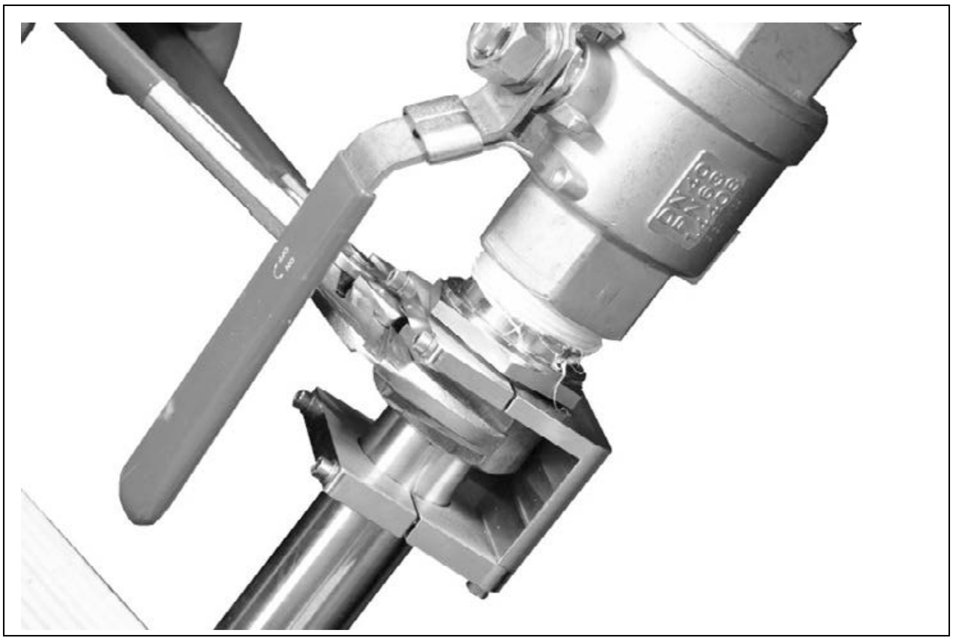


Fig. 4-36 Unscrewing procedure for sensor removal

10. Then remove the sensor. The screwed rear clamp elements remain in their position on the pipe sensor body.

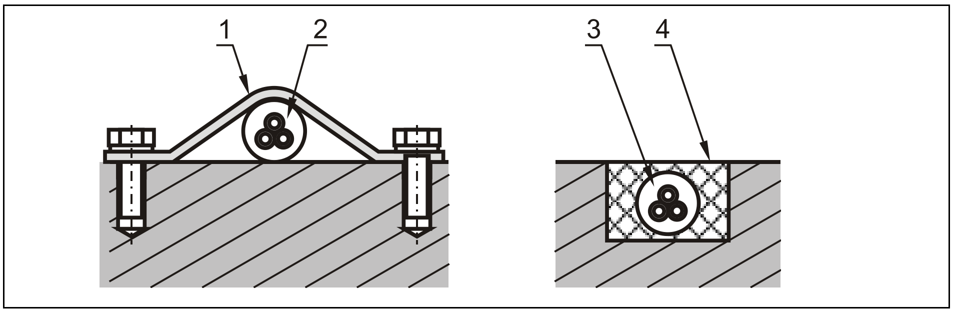
Fig. 4-37 Removing the sensor (maintenance/control)

11. Now it is possible to clean or to inspect the sensor if necessary. The sensor can be reinserted into the screw connection again as soon has the cutting ring has been replaced. Use the rear clamp elements left on the sensor body as detent or positioning aid (see Fig. 4-37).
12. Subsequently tighten spigot nut and M5 Allen® head screws again.

Fig. 4-38 Lock the sensor again after reinstallation

4.3 Cable layout

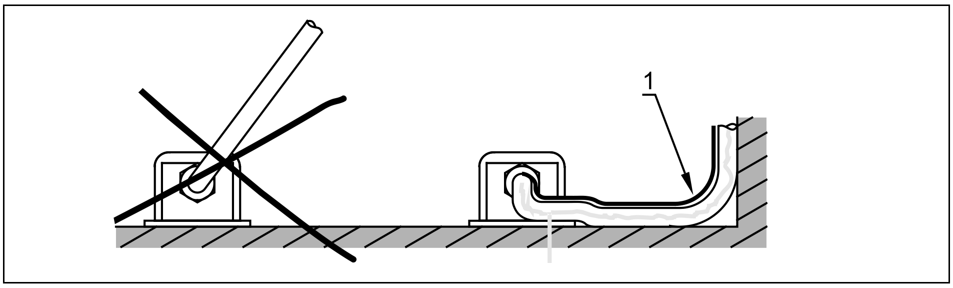
The sensor cable must be laid on the channel ground from behind the wedge sensor to the channel wall. In order to avoid the risk of build-up cover the cable with a thin stainless steel sheet or lays it into a slot which has to be sealed with permanently elastic material subsequently.
Appropriate covers are available from NIVUS (e.g. type ZMS 140).



1 Stainless steel sheet/cable cover, e.g. Type ZMS 140
2 Cable
3 Cable
4 Permanently elastic material

Fig. 4-39 Suggested cable layout

Never run the cable slackly, uncovered or across the medium! Risk of build-up, sensor or cable tear-off!



1 Protective cover

Fig. 4-40 Hints on cable layout

The minimum bending radius of the standard signal cable is 10 cm (3.94 in). Smaller radii may result in cable break!

The cables of high-resistant sensors (special models) are coated with an additional transparent FEP jacket which ensures the cables to be resistant to organic solvents, acids and lye. Under no circumstances damage (cut, stab, crush or similar) or remove this protective jacket.

High-resistant sensors with additional protective jacket (cables with FEP jacket) have to be treated very carefully. The protective jacket is not allowed to be damaged or crushed in any way.

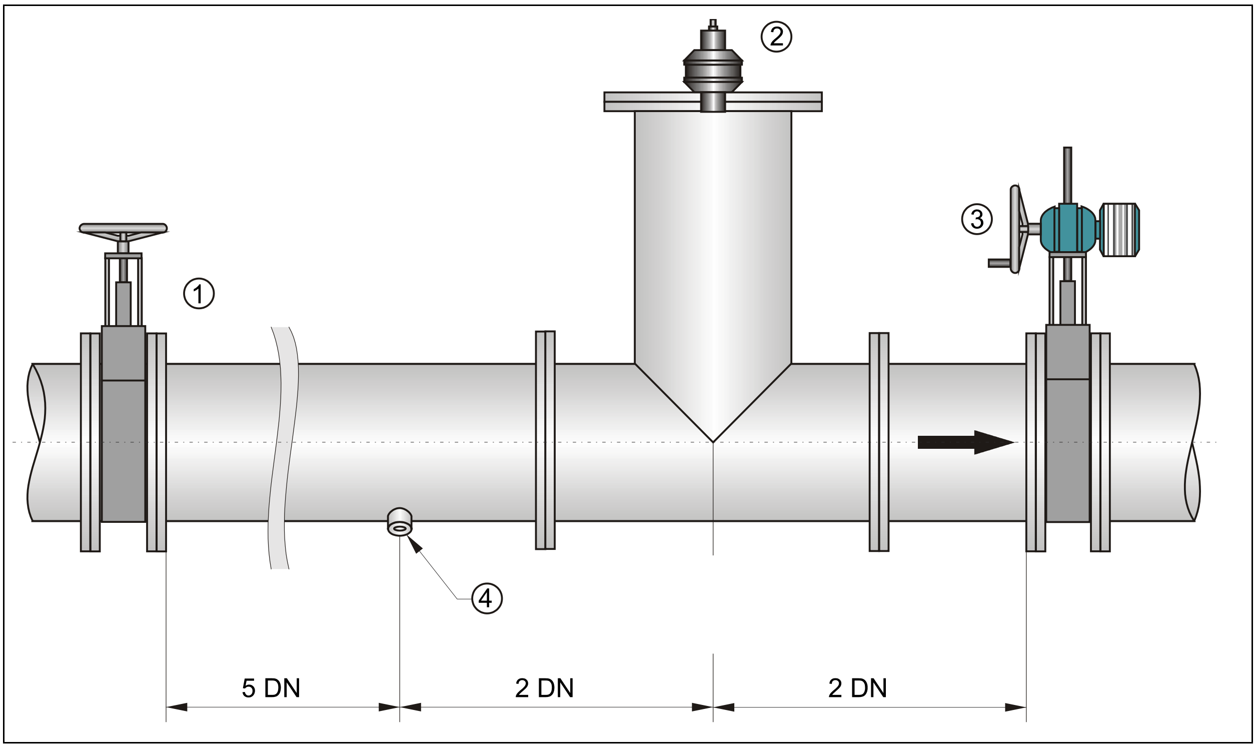
The minimum bending radius of cables with protective FEP jacket is 15 cm (5.91 in). Smaller radii may result in damage of the protective jacket which consequently loses its function.

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.

5 Construction of Measurement Section

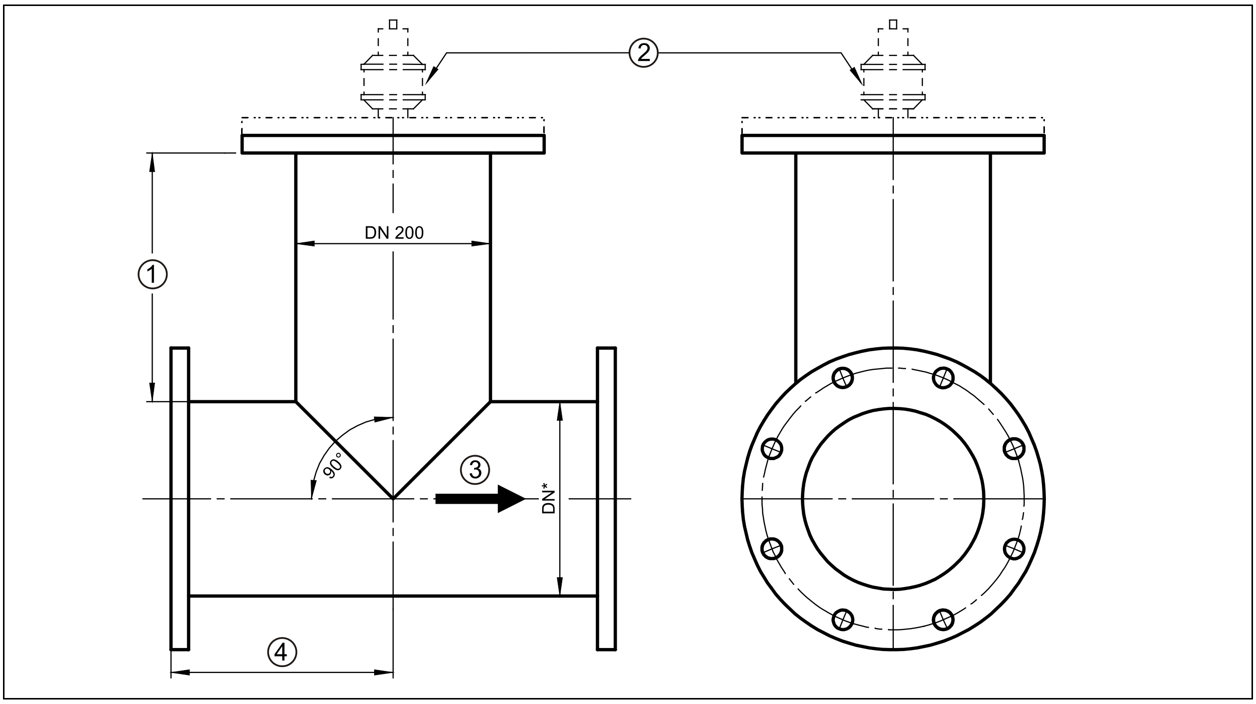
In contrast to usual conditions install the measurement in front of the regulating unit (not behind) if possible.
This setup may neither detect nor consider the time response of the controlled system. Hydraulic problems caused by external vorticity downstream of the regulating unit are going to be avoided or reduced however that way.

Nominal diameters from 200 to 1000 mm allow to use a pipe section with dome as measuring section. The length of the pipe sections corresponds with the dimensions of most magnetic flow meters (EMF). The flow velocity sensor is going to be installed upstream of the pipe section either using a tapping saddle (see chapter 6) or by welding (see Fig. 5-1).



1 Manual gate valve
2 Ultrasonic sensor
3 Electric gate valve
4 Mounting of the pipe sensor via welding nozzle or tapping saddle

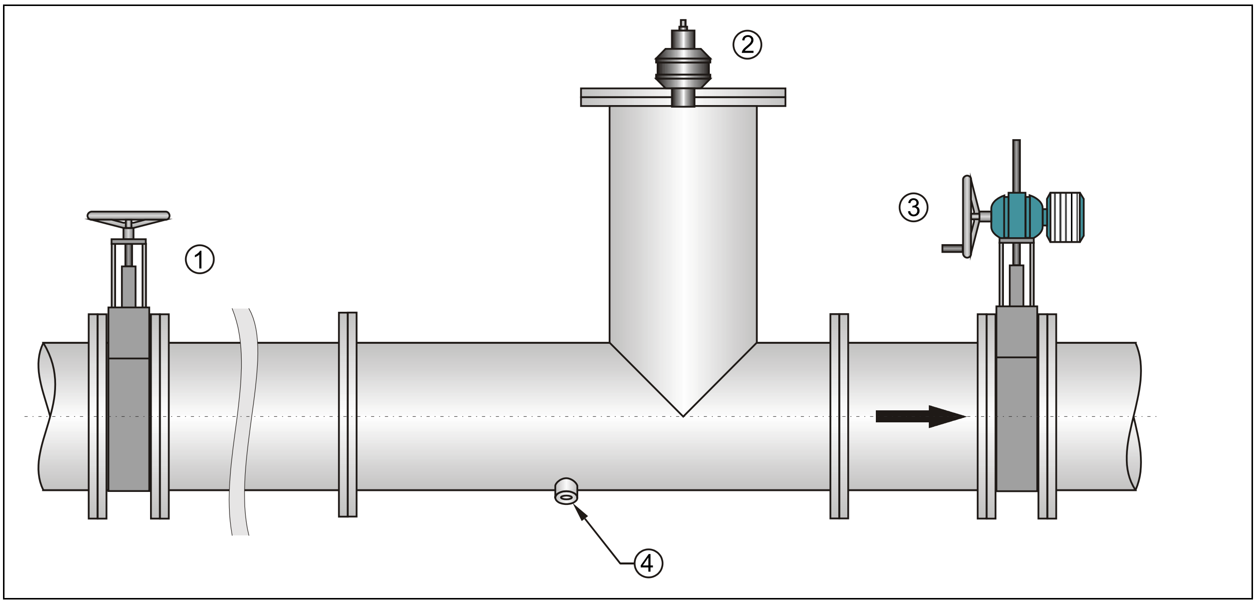
Fig. 5-1 Construction of measurement section such as a discharge control with pipe section and tapping saddle (short measurement section)



1 Min. 300 mm (dome to be extended by 30 mm per meter water column upstream of slide valve)
2 Ultrasonic sensor
3 Flow direction
4 Dome placed in centre

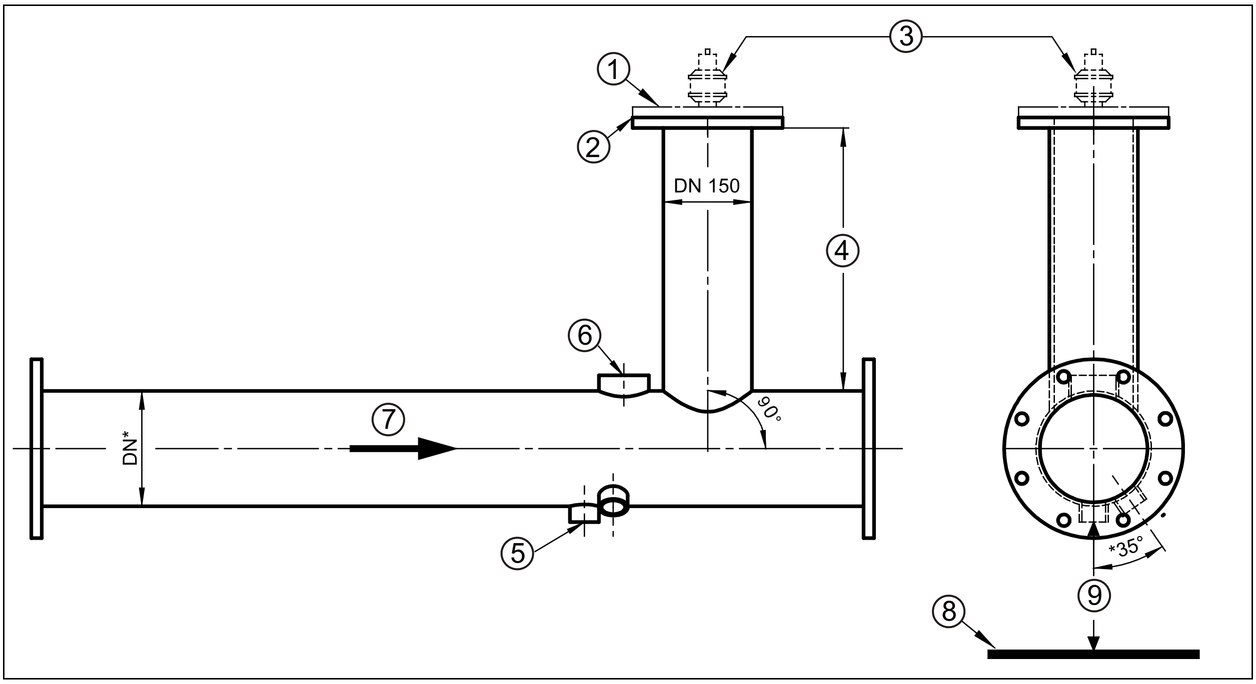
Fig. 5-2 Short measurement section

A long pipe measuring section with sensor nozzle for nominal diameters between 200 and 400 mm can be purchased from NIVUS (see Fig. 5-3).



1 Manual gate valve
2 Ultrasonic sensor
3 Electric gate valve
4 Install pipe sensor by using a nozzle

Fig. 5-3 Construction of Measurement Section such as a discharge control (long measurement section)



1 Flange DN 150 with R 1“ inner thread
2 Flange gasket
3 Ultrasonic sensor
4 500 mm (dome available up to 700 mm, depending on pressure)
5 Nozzle with G1½“ inner thread for Doppler pipe sensor
6 Cleaning opening Rp3“
7 Flow direction
8 Bottom
9 Distance min. 550 mm with ball valve
Distance min. 350 mm without ball valve

Fig. 5-4 Long measurement section

*If this installation cannot be carried out, the measurement must be installed in a **minimum** distance of 12 times the maximum height behind the slide valve (see Fig. 5-5). Please check the hydraulic conditions at the measurement place before installation and extend the calming section or install power-breaking constructions (deflectors or similar) downstream of the gate valve if required in order to obtain appropriate measurement conditions.*

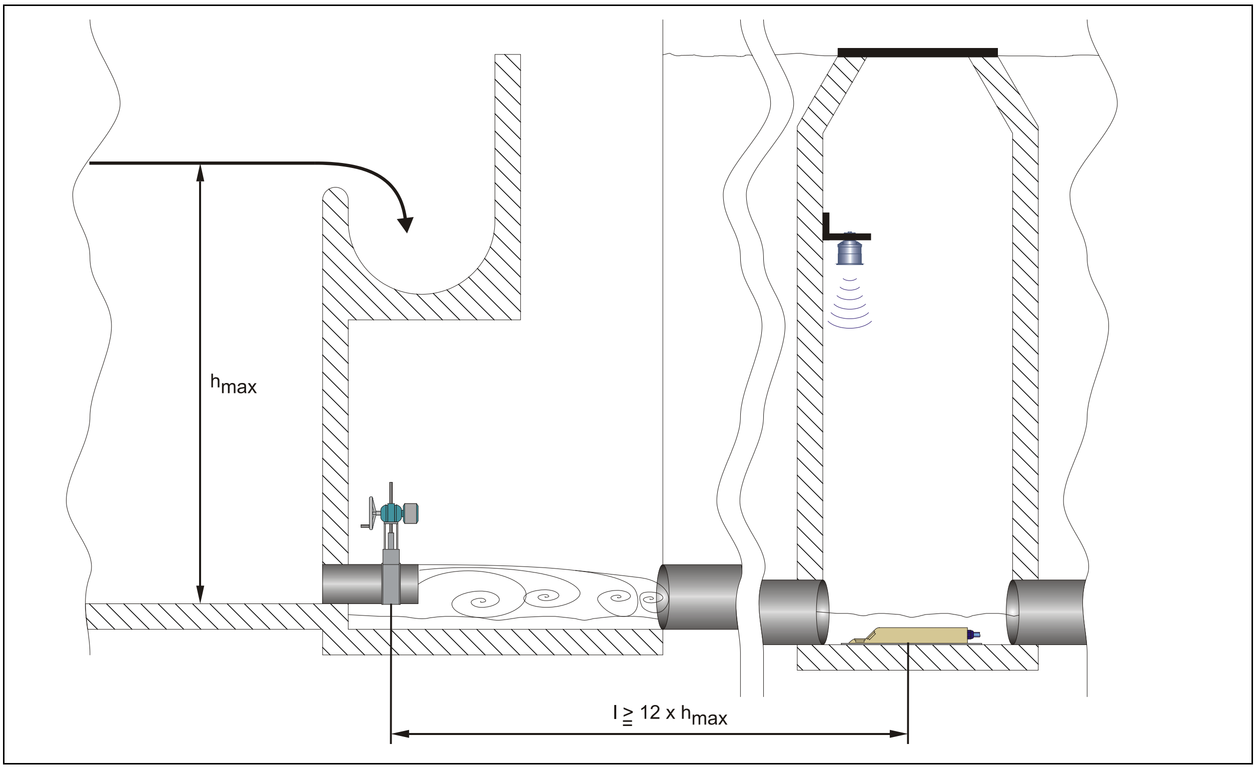


Fig. 5-5 Arranging the measurement behind the slide valve / wedge or pipe sensor

In case of installation behind the control unit please observe that extended run times cause measurement and control to react delayed. Hence, the control must be programmed to react very sluggish.
If the required minimum distances (12 x impounding level) cannot be kept, power-breaking elements like rebounding surfaces, returns or similar must be installed. These installations must be designed according to the application. In this case, please contact NIVUS.

More Hints on Control Systems:

The gap between flow velocity sensor and the following control slide valve should be according to default flow value, nominal diameter and preliminary pressure at least 4 x DN, better are up to 5 x DN (DN = internal diameter). Flow velocities in the control distance normally should not fall below 30 cm/s (0.98 fps) to ensure sufficient selectivity according to ATV/DVWK.

The pipe measuring distance used and the slide valve must have exactly the same inside diameters for the incoming and outgoing pipe. Hydraulic jumps, ledges, weld seams, rising flange densities and the like have to be avoided always.
Insertion pipe sensors have to be installed slightly out of the centre in case of sludge/silt deposits.

6 Accessories and Installation aids

6.1 Pipe Mounting System (RMS)

The pipe mounting system is an installation aid for wedge sensors (POA, CS2, CSM or KDA) and air-ultrasound sensors Type OCL and DSM primarily for use with portable measurements.

There are 3 different pipe mounting systems available.

- RMS 2 – pipe mounting system for pipes with inner diameters between 200 and 800 mm
- RMS 3 – pipe mounting system for pipes with inner diameters between 160 and 300 mm
- RMS 4 – combination of RMS 2 and RMS 3. Pipe mounting system for pipes with inner diameters between 160 and 800 mm

The pipe mounting system consists of the components below

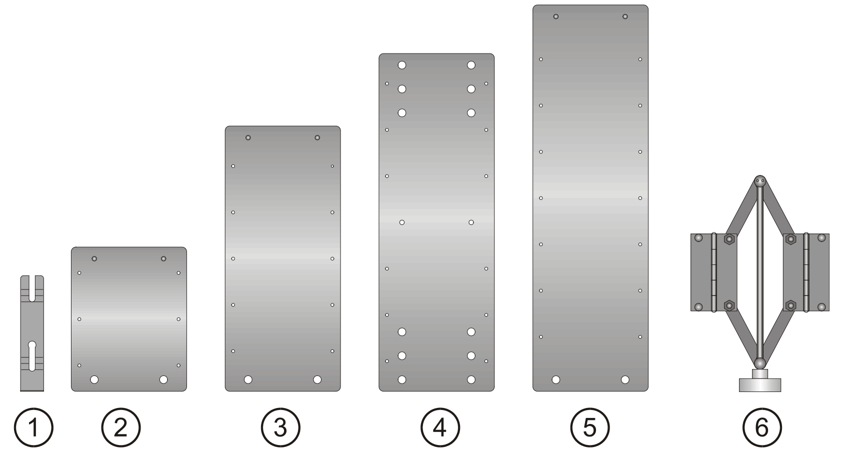
- scissors jack
- base plate
- fastening clips
- extension sheets (optional)

All parts of the different pipe mounting systems are compatible with each other.

6.2 RMS 2

Fig. 6-1 Pipe mounting system RMS 2

Select the required elements according to Fig. 6-2 and Fig. 6-3, and the existing pipe diameter.



1 Fastening clip
2 Extension sheet V5
3 Extension sheet V10
4 Base plate
5 Extension sheet V15
6 Scissors jack with clamp handle

Fig. 6-2 Components of the pipe mounting system

I.D. (inside diameter) in mm (")	BST base plate	SPV scissors jack	V5 extension plate	V5 extension plate	V10 extension plate	V10 extension plate	V15 extension plate	V15 extension plate
200 (8")	x inner hole	x						
250 (10")	x inner hole	x	x	x				
300 (12")	x outer hole	x	x	x				
350 (14")	x inner hole	x			x	x		
400 (16")	x outer hole	x			x	x		
450 (18")	x inner hole	x	x	x	x	x		
500 (20")	x outer hole	x	x	x	x	x		
600 (24")	x outer hole	x	x	x			x	x
700 (28")	x outer hole	x			x	x	x	x
800 (32")	x outer hole	x	x	x	x	x	x	x

Fig. 6-3 List of required mounting sheets for different pipe diameter

During assembly please observe to always locate the scissors jack at the pipe vertex and the base plate on the channel bottom. If air-ultrasonic and wedge sensors are used simultaneously, the air-ultrasonic sensor shall be installed on the pipe crown, the scissors jack in immediate proximity.

Extension sheets which might be required shall be put on the right-hand side and on the left-hand side between scissors jack and base plate.
The fastening clips serve for quick installation. They must be put flush onto the mounting plate against the flow direction (see Fig. 6-4; far right).

The plates are sharp-edged due to being made of light-gauge metal sheets. Please always wear protective gloves to install or dismantle the pipe mounting system!

		
Assemble base plate and extension sheet	Put the pins into the holes	Lock pins by using fastening clip (must sit flush to mounting plate against flow direction)

Fig. 6-4 Installation with fastening clips

Snap the flow velocity sensor with the both slotted holes on the rear onto the base plate (see Fig. 6-4, far left)
Rotate the clamp handle of the scissors jack clockwise until the scissors are closed. After that put the entire system into the pipe, adjust it and fix it in the pipe by rotating the clamp handle counter-clockwise.

		
Put the sensor with the cut-outs (slotted holes) onto the plate	Push back...	... until it is locked (flush to plate)

	
Fix the scissors jack on both sides of the final plate by using the fastening clip	Close the scissors completely by rotating the clamp handle before installing in the channel

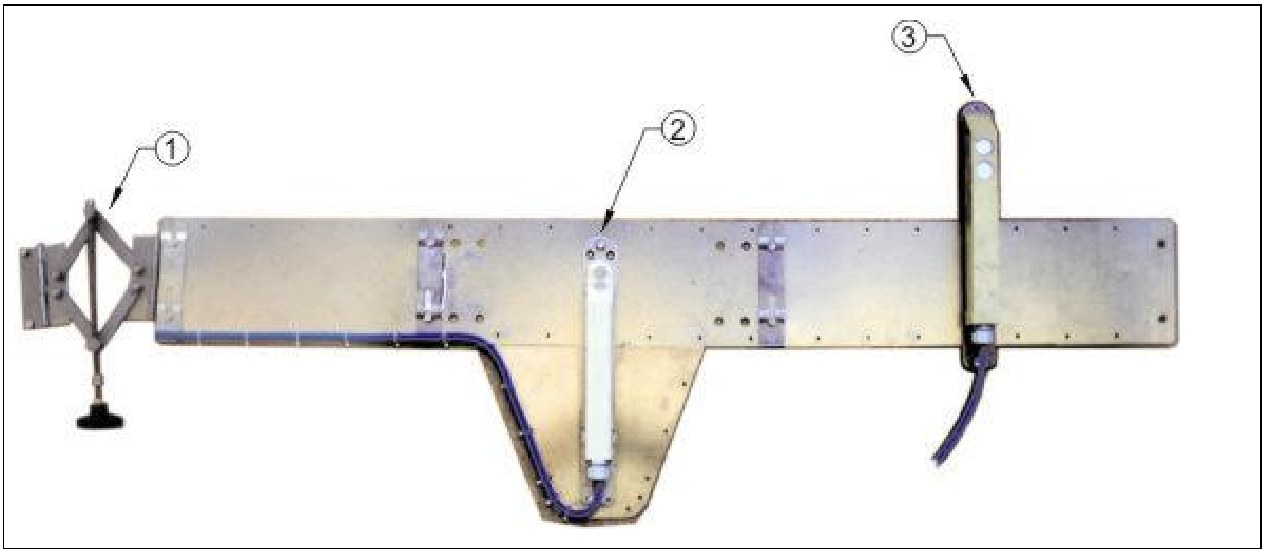
Fig. 6-5 Assembly of Pipe Mounting System

Furthermore please observe the following regarding temporary installation by using the pipe mounting system:

- Sufficient contact pressure to the channel wall in order to prevent the pipe mounting system from getting loose. This is important especially in large channel diameters and high flow levels.
  If necessary the system must be secured additionally in order to protect it from being washed away (e.g. by putting additional stainless steel screws into the channel wall)
- Mount parallel to the channel wall to minimize the risk of build-up. No gap between mounting plate and sensor or channel bottom may remain.
- The sensor cable shall be laid to the upside along the mounting system by using cable fasteners.
- Always lay the sensor cable close along the channel wall and fix it with clamps if necessary.
- Please refer to the list of mounting sheets (Fig. 6-3)
- If air-ultrasonic and wedge sensors are used simultaneously (Type POA, CS2, or KDA) the extension sheet (Art.-No. PCP0 ZRMS 2Z00 000) shall be used (Fig. 6-6). Here the wedge sensor is fastened on the base plate with both the slotted holes on the sensor front. The support plate serves to ensure proper cable layout as well as to correctly place the combi sensor behind the air-ultrasonic sensor.
- The air-ultrasonic sensor is clamped to the extension plates by using its double mounting plate. It shall be installed exactly plane parallel to the water surface (see also chapter 4.2.3,

- 1 Dead zone

- Fig. 4-21).

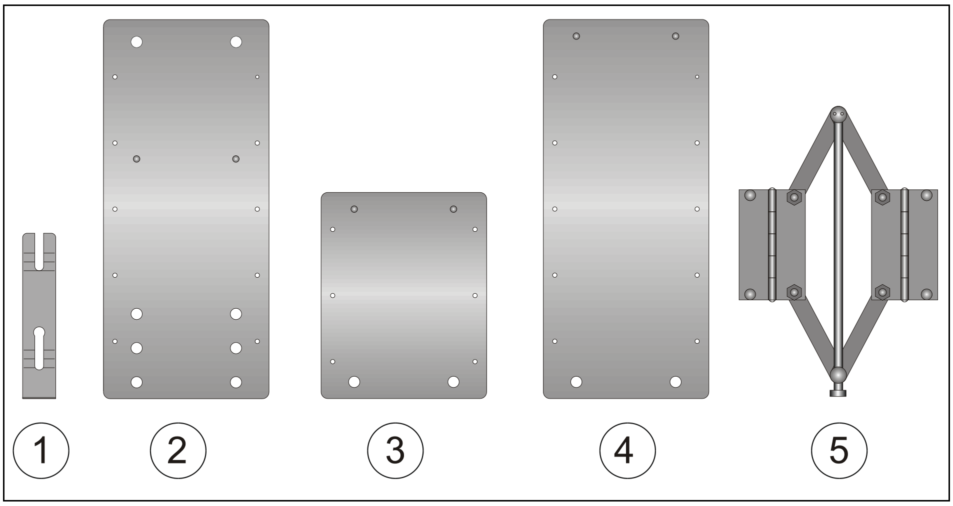


1 Scissors jack
2 Wedge sensor (POA, CS2, CSM or KDA)
3 Air-ultrasonic sensor (OCL or DSM)

Fig. 6-6 Sensor fastening on pipe mounting system

Fig. 6-7 Pipe mounting system with extension sheet for combined installation of wedge sensor and air-ultrasonic sensor

6.3 RMS 3



1 Fastening clip
2 Base plate BST
3 Extension sheet V5
4 Extension sheet V10
5 Scissors jack

Fig. 6-8 Components of the pipe mounting system RMS 3

ø Inside diameter in mm	BST base plate	SPV scissors jack	V5 extension plate	V10 extension plate
160	x inner hole	x	x	
200 (8”)	x inner hole	x		x
250 (10”)	x inner hole	x	x	x
300 (12”)	x outer hole	x	x	x

Fig. 6-9 RMS 3 List of required mounting sheets for different pipe diameter

During assembly please observe to always locate the scissors jack at the pipe vertex and the base plate on the channel bottom. If air-ultrasonic and wedge sensors are used simultaneously, the air-ultrasonic sensor shall be installed on the pipe crown, the scissors jack in immediate proximity. Extension sheets which might be required shall be put on the right-hand side and on the left-hand side between scissors jack and base plate.
The fastening clips serve for quick installation (see Fig. 6-8). They must be put flush onto the mounting plate against the flow direction (see Fig. 6-10; far right).

The plates are sharp-edged due to being made of light-gauge metal sheets. Please always wear protective gloves to install or dismantle the pipe mounting system!

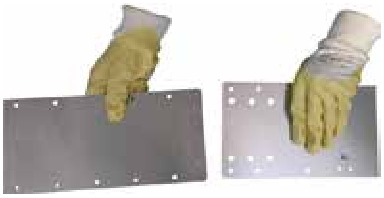
		
Assemble base plate and extension sheet	Put the pins into the holes	Lock pins by using fastening clip (must sit flush to mounting plate against flow direction)

Fig. 6-10 Assembly using fastening clips

		
Put the sensor with the cut-outs (slotted holes) onto the plate	Push back...	... ... until it is locked

	
Install the air-ultrasonic sensor (DSM) using its double mounting plate	….by putting the extension sheet into the cut-out between mounting plates 1 and 2 (see Fig. 6-13)

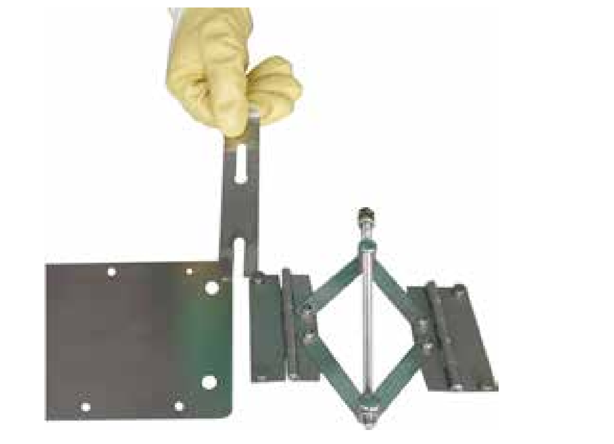
	
Fix the scissors jack on both sides of the final plate by using the fastening clip.	Turn the scissors jack clockwise all the way until it is closed before installation in the channel.

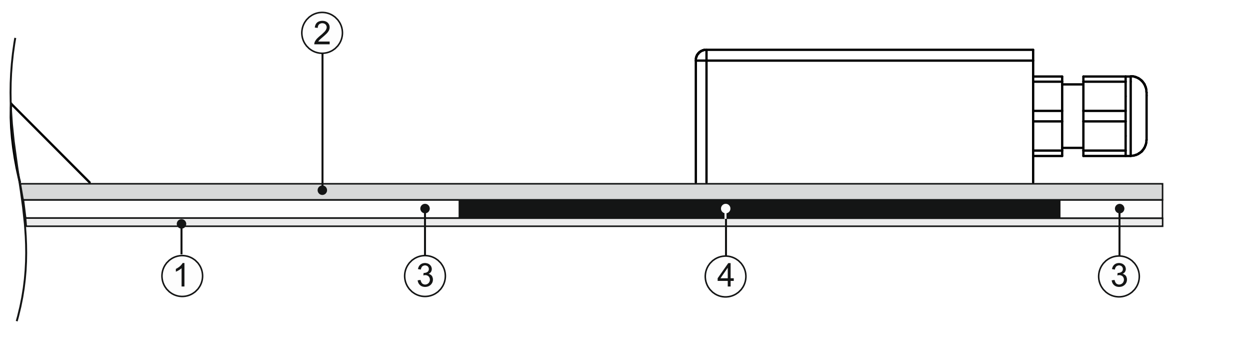
Fig. 6-11 Assembly of Pipe Mounting System RMS 2

Rotate the clamp handle of the scissors jack clockwise all the way until the scissors are closed. Then insert the entire system into the pipe, align it and tighten the clamps by rotating the clamp handle counter-clockwise

Furthermore please observe the following regarding temporary installation by using the pipe mounting system:

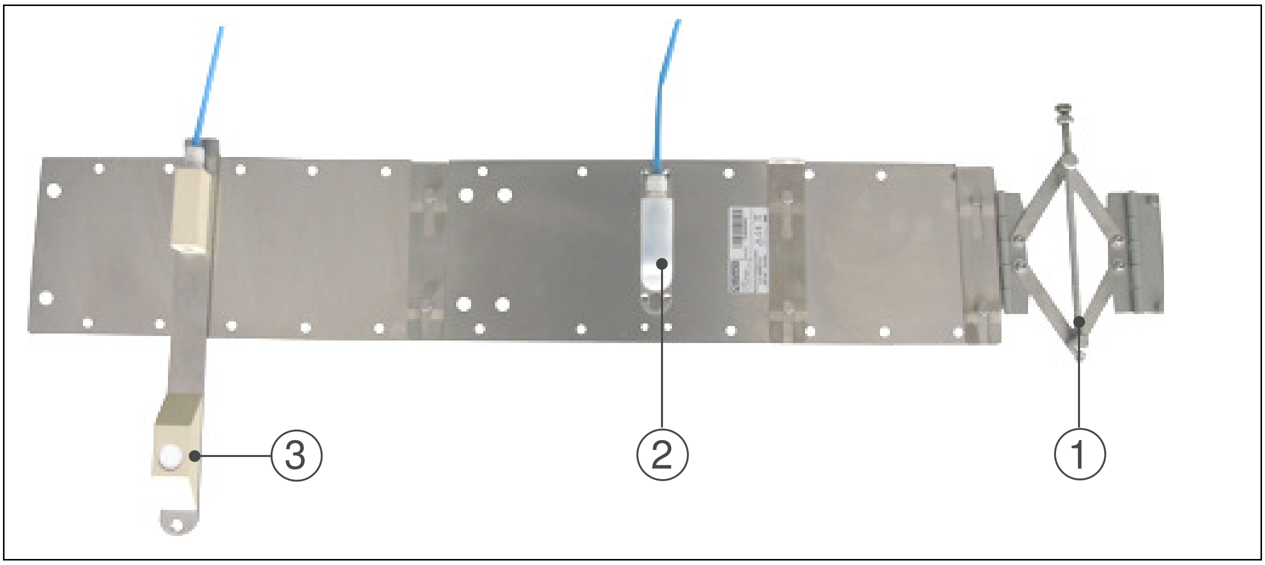
- Sufficient contact pressure to the channel wall in order to prevent the pipe mounting system from getting loose.
- Mount parallel to the channel wall to minimize the risk of build-up. No gap between mounting plate and sensor or channel bottom must remain.
- The sensor cable shall be laid to the upside along the mounting system by using cable fasteners.
- Please refer to the list of mounting sheets (Fig. 6-9).

Put the air-ultrasonic sensor onto the extension plate by using its double mounting plate (see Fig. 6-13).
It shall be installed exactly plane parallel to the water surface.



1 Mounting plate 1
2 Mounting plate 2 (base plate)
3 Mounting plates 3 (spacer plates)
4 Insertion area for the pipe mounting sheet

Fig. 6-12 Construction of air-ultrasonic sensor mounting plates, Type DSM



1 Scissors jack
2 Wedge sensor (CSM)
3 Air-ultrasonic sensor (DSM)

Fig. 6-13 Sensor fastening on pipe mounting system RMS 3

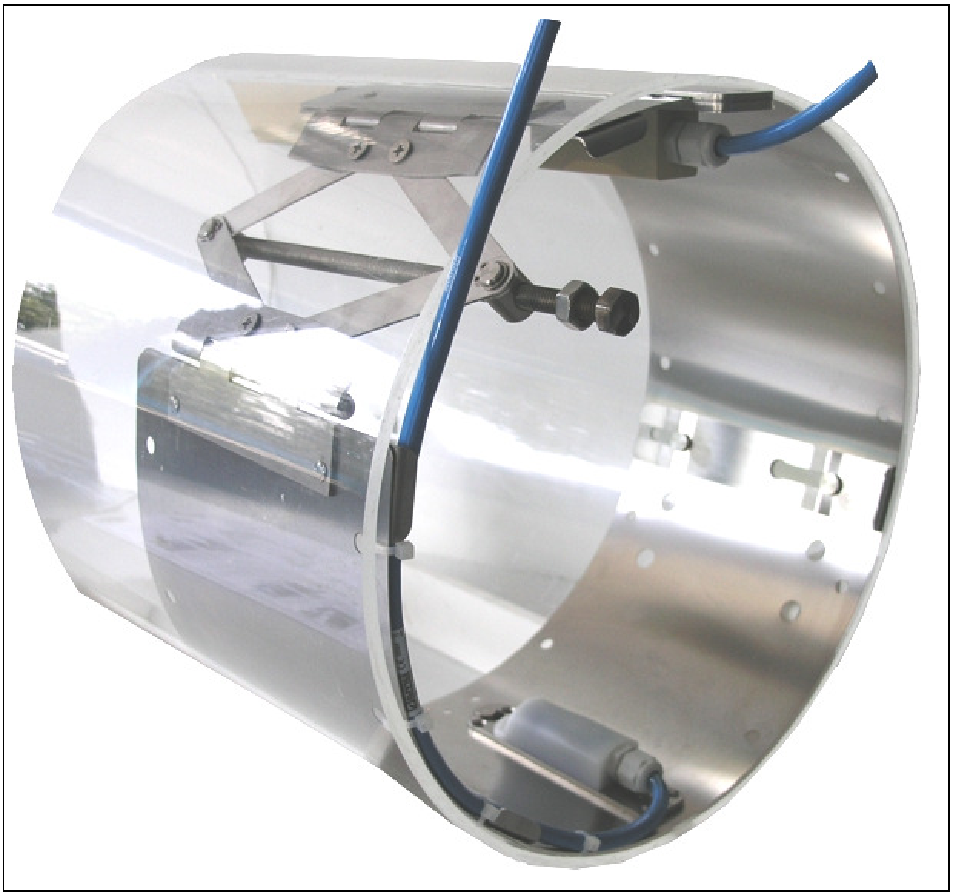


Fig. 6-14 Installed RMS 3 with wedge sensor CSM and air-ultrasonic sensor DSM

6.4 Dam-up element

In case of very low flow levels and/or high flow velocities an adjustable so-called dam-up element may create better flow conditions.

Functional principle:

The water is going to be dammed up in the area around the sensor by reducing the cross-sectional area. Resulting in a higher fill level and a reduced flow velocity this measure will optimise the flow behaviour.
The dam-up element is going to be installed approximately in the middle of the channel between approach and discharge section. This does not reduce the cross-sectional areas of the pipes. Larger amounts of water are able to flow over the dam-up element.

Fig. 6-15 Dam-up element

These Dam-up elements are available from NIVUS in various diameters.
These special backwater systems should preferably be installed by experienced and qualified personnel however.

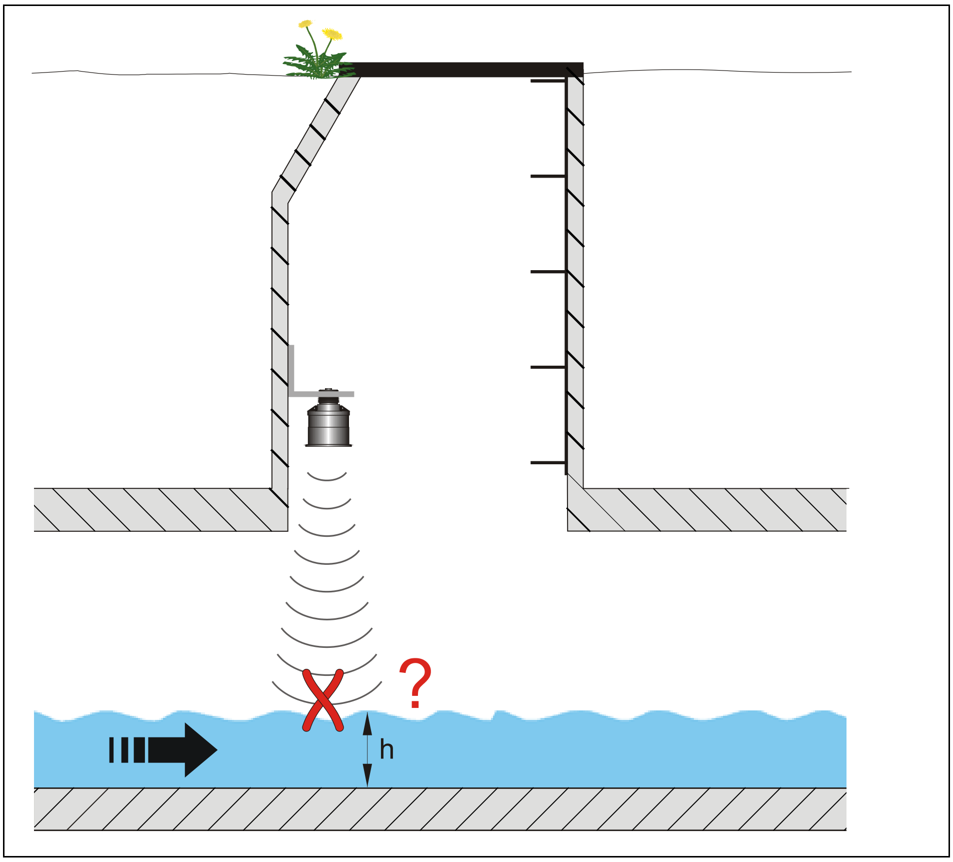
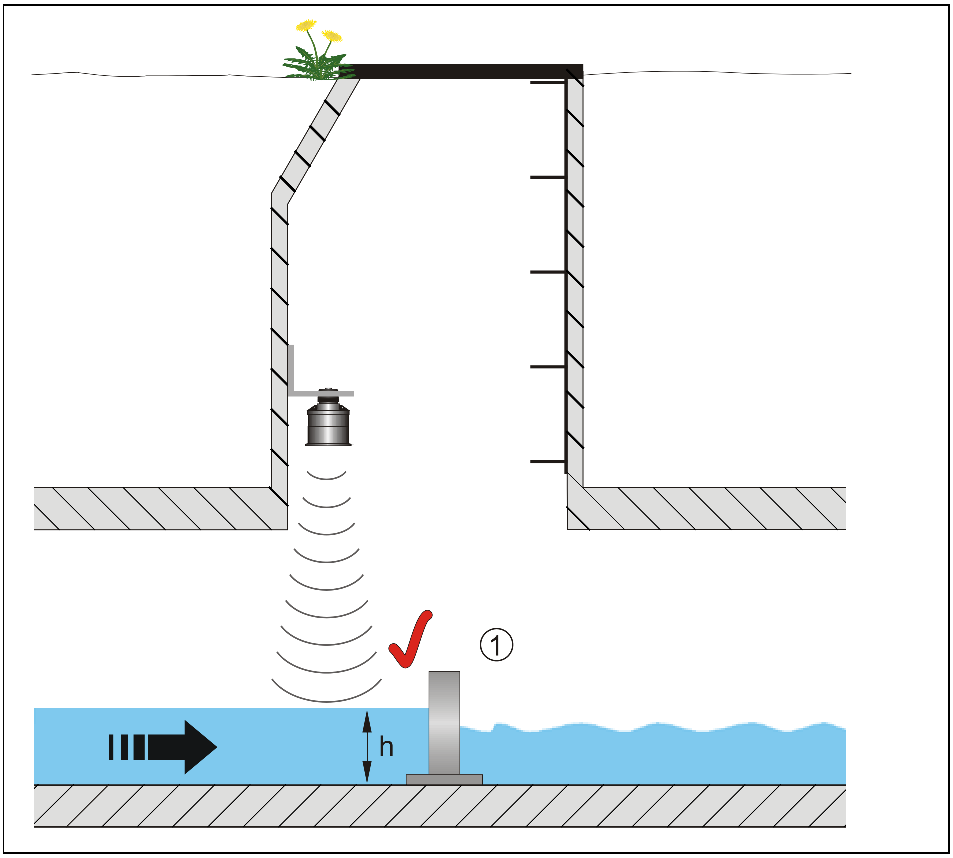


Fig. 6-16 Application without Dam-up element



1 Dam-up element

Fig. 6-17 Application with Dam-up element

The angle of the dam-up element can be modified and adjusted depending on the application:

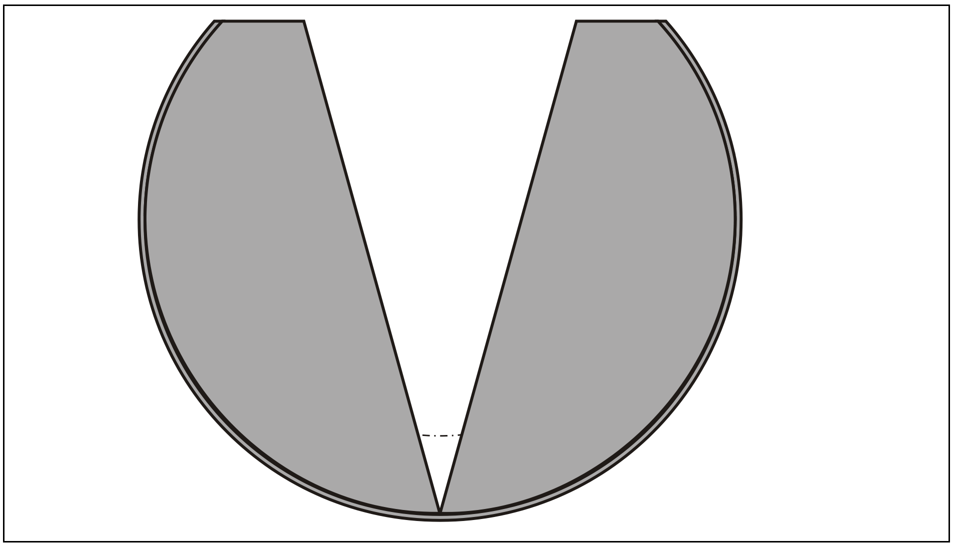


Fig. 6-18 Adjustment in lower amounts of water

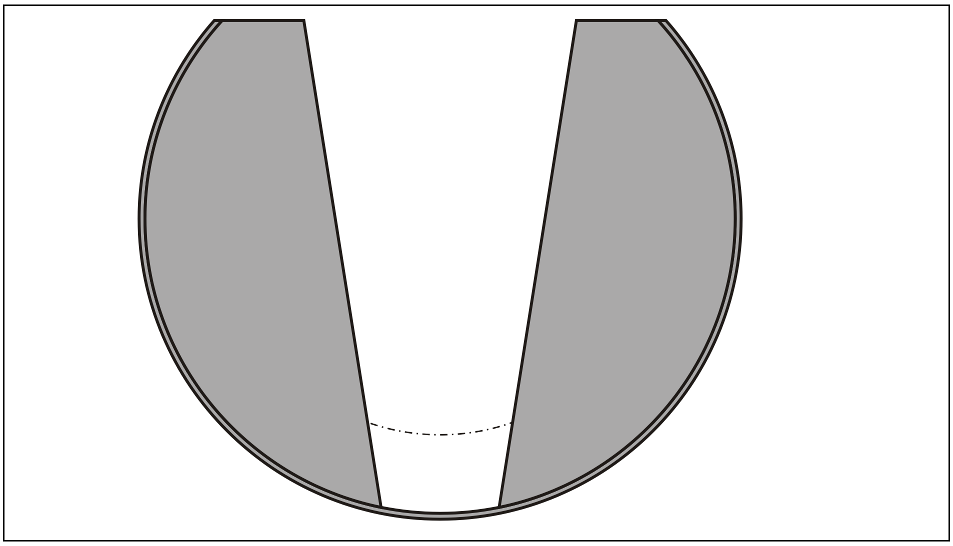


Fig. 6-19 Adjustment in larger amounts of water

6.5 Sensor Cover

If used in media with high grit or stone contents and high flow velocities there is a risk of damage of the sensor body. The sensor cover is to avoid the impact of large objects, to reduce mechanical stress of the sensor body and therefore to reduce the risk of sensor damage.
If used in slowly flowing wastewater there is a high risk of build-up. Cleaning must be carried out more and more frequently if required.

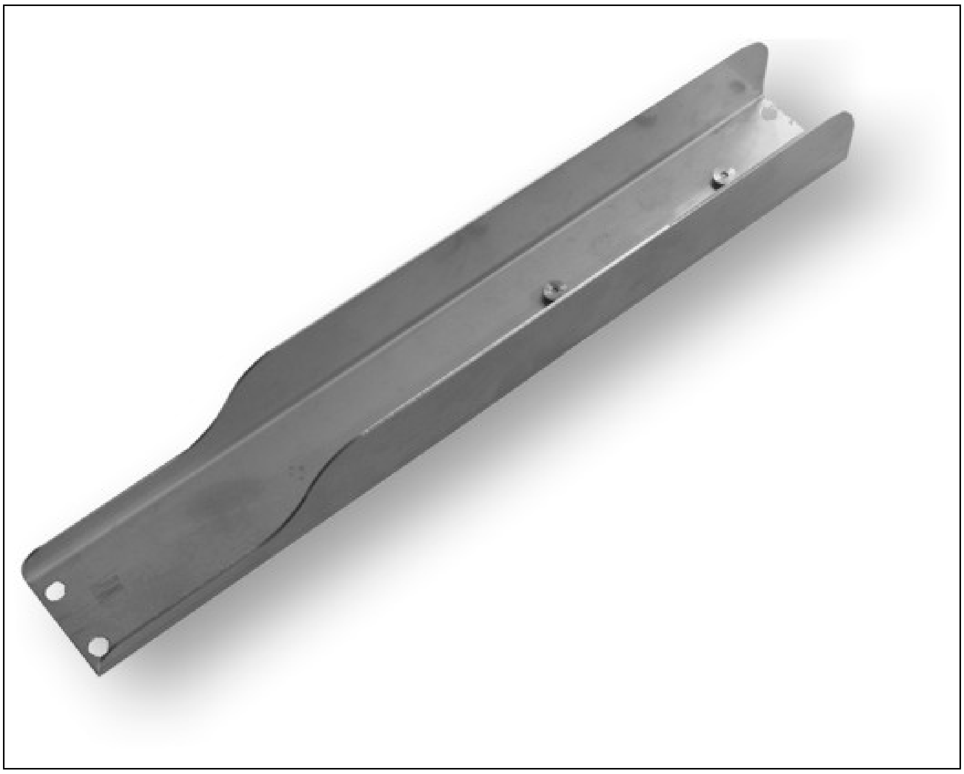
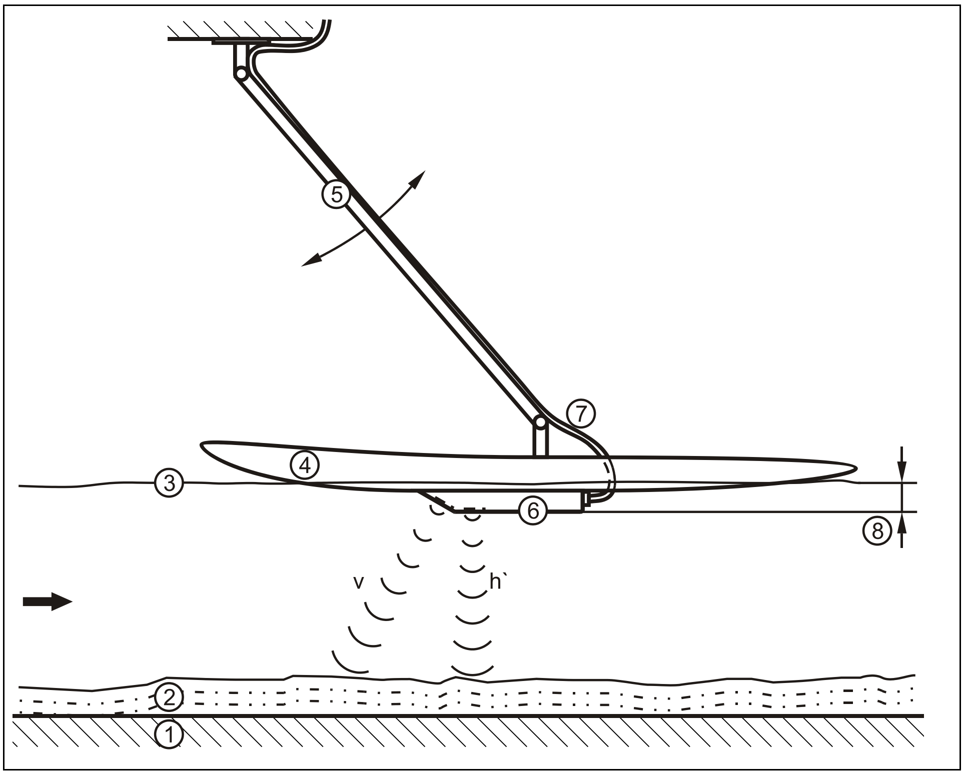


Fig. 6-20 Sensor Cover

6.6 Float

After a certain period of time sensors installed on the bottom of channels tending to sedimentation lead to measurement failures due to getting covered with sludge and other sedimentation. In this case it is reasonable to install sensors on the side of the channel wall or from the top down by using a floating pontoon. This way of installation enables to lift the entire measurement out of the channel for maintenance and cleaning purposes.

If using floats please observe to frequently clean sensor and float.
The required cleaning cycle depends on the floating objects contained in the medium and the construction of the float. Each application requires individual cycles.



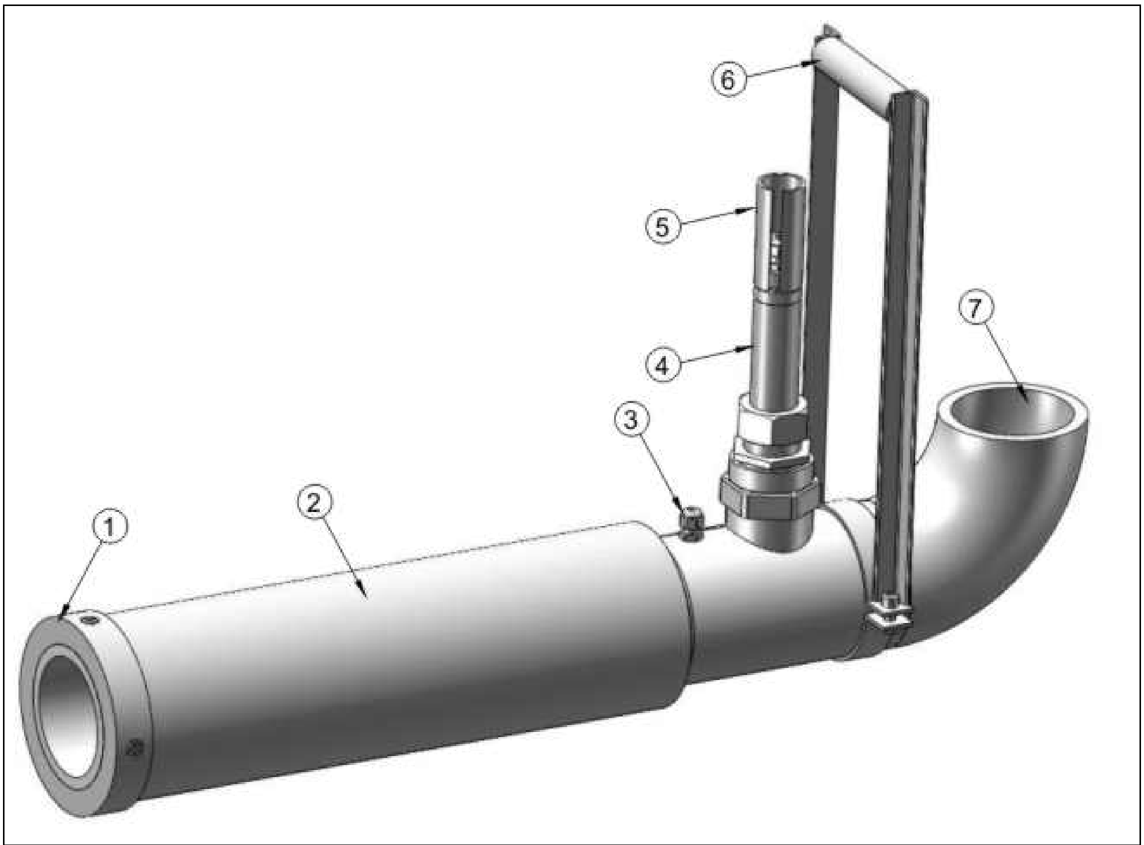
1 Channel bottom
2 Variable sedimentation layer
3 Water surface
4 Float
5 Movable holder
6 Combi sensor
7 Sensor cable
8 Level offset due to constructional reasons

Fig. 6-21 Installation suggestion for floating measurements

Various kinds of floats are available from NIVUS as special constructions.

6.7 NPP - NIVUS Pipe Profiler

The NPP is a pipe measuring section as extension of the portable measurement systems PCM Pro and PCM 4. The flexible measurement system ensures high accurate flow determination even under difficult conditions such as low discharge volumes or disadvantageous hydraulic flow conditions.



1 Clamp ring
2 Balloon
3 Ventilation
4 Sensor retaining element
5 Pipe sensor
6 Cable protection cover
7 Handhold
8 Pressure pipe

Fig. 6-22 Overview NPP - NIVUS Pipe Profiler

Inflating the balloon (2) of the NPP with max. 1.5 bars are only allowed by using a safety filling valve (Fig. 6-23)!

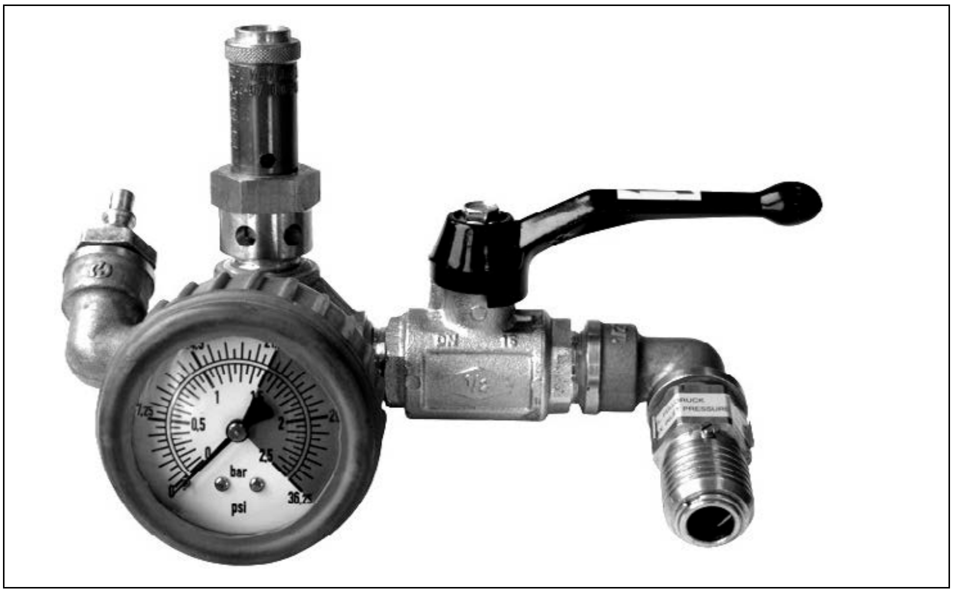


Fig. 6-23 Safety filling valve

For installing a NIVUS Pipe Profiler (as usual with channel works), two persons are necessary for mounting (see Fig. 6-24).

Please observe the following points before installation

- inspection of the measurement place
- examination of channel condition (dirt such as sludge or pieces of broken glass, faulty connections etc.)

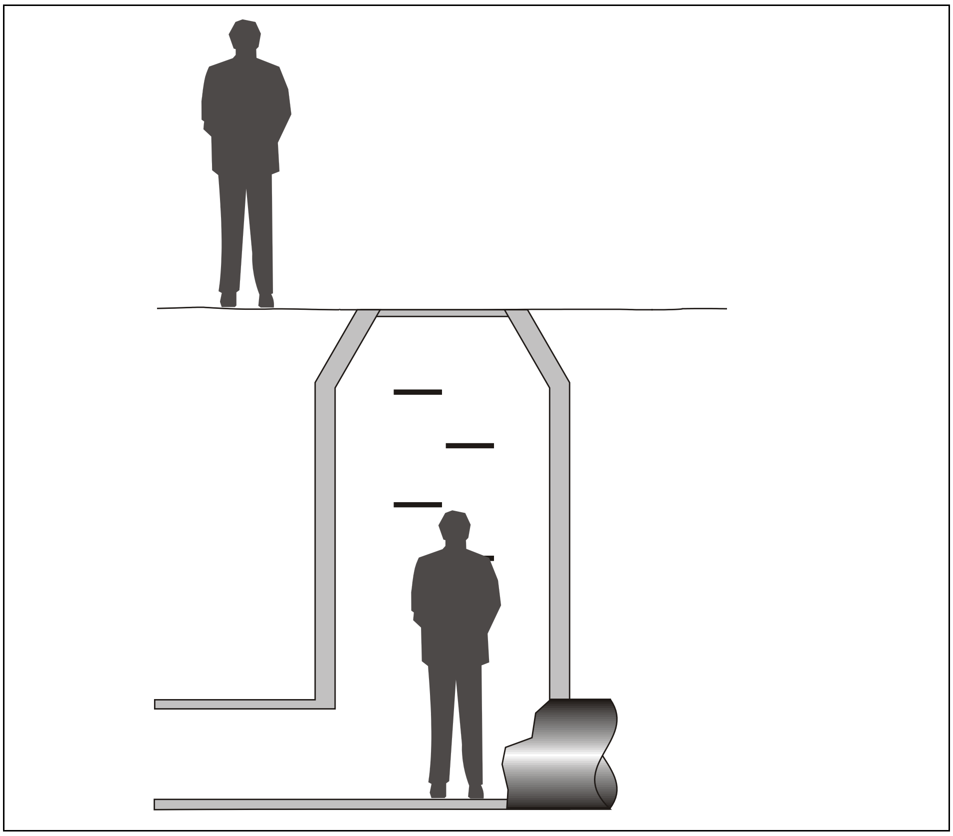
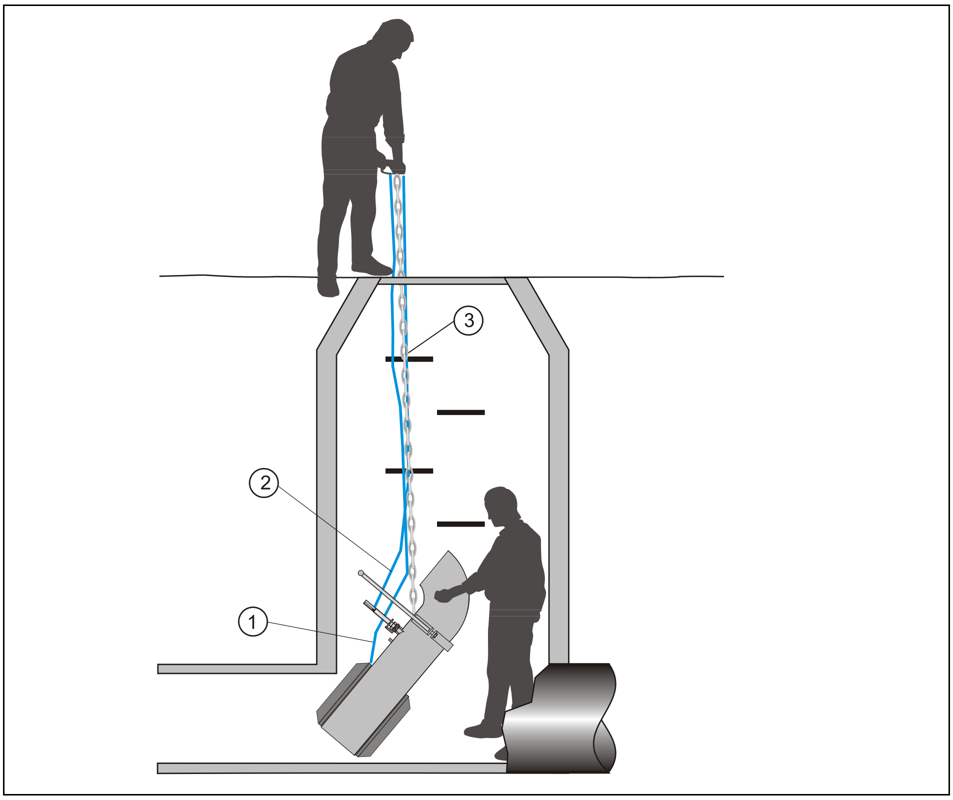


Fig. 6-24 Installation step 1: two persons necessary for mounting

Lower the NPP into the channel on a chain.
Please absolutely avoid strain on cable or air hose.



1 Air hose
2 Sensor cable
3 Chain

Fig. 6-25 Lower NPP into shaft using chain

Insert and adjust the NPP in the channel in a way that the opening of the pressure pipe (Fig. 6-22, 8) looks vertically upwards.
Add a little pressure into the balloon using the safety valve (Fig. 6-23). Widen the balloon wide enough to fix the NPP on the channel walls first. Observe the NPP to be adjusted vertically!

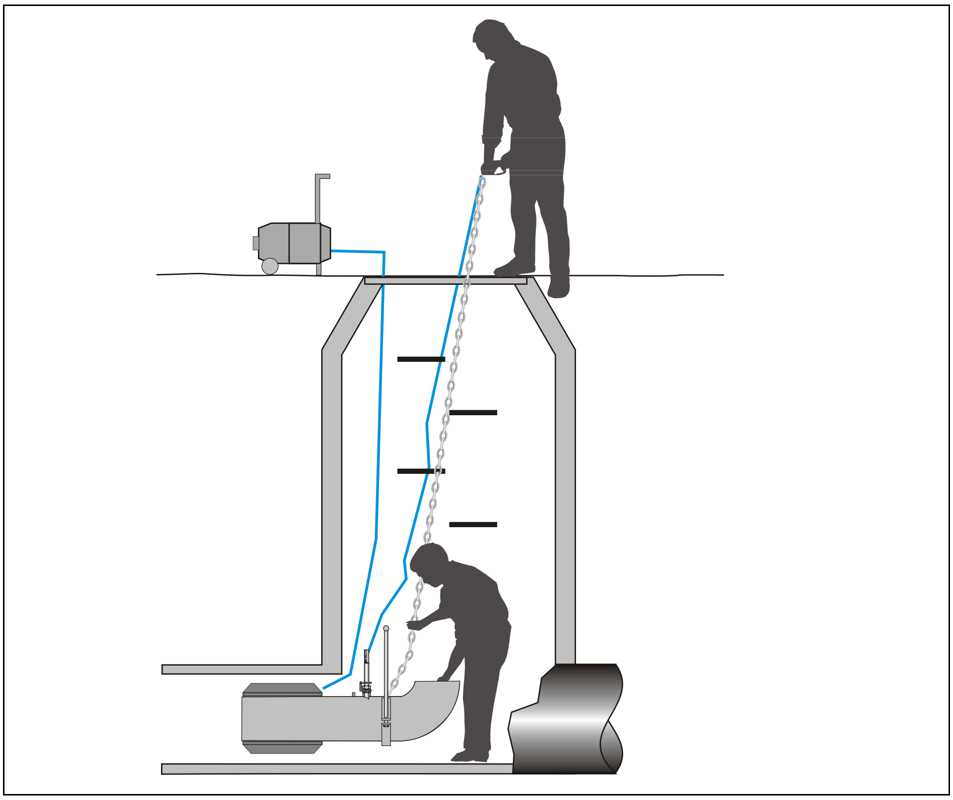


Fig. 6-26 Insert and adjust NPP

Leave the manhole before you finally inflate the balloon!

Now fill up the balloon completely with a pressure of 1.5 bars.

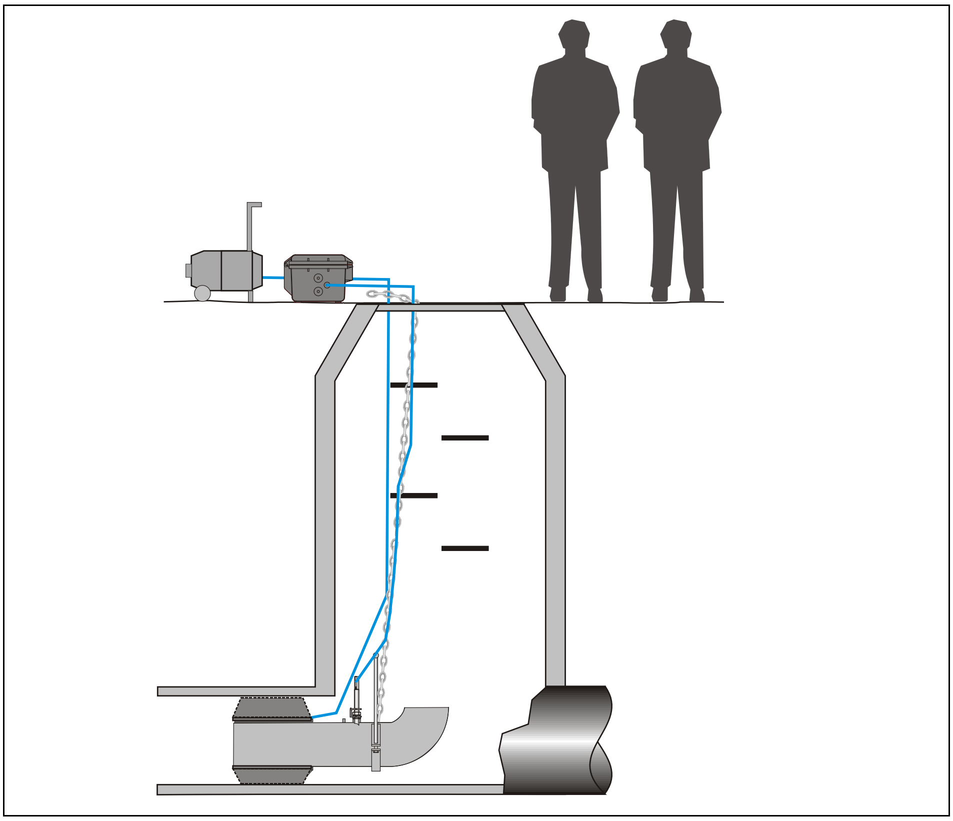
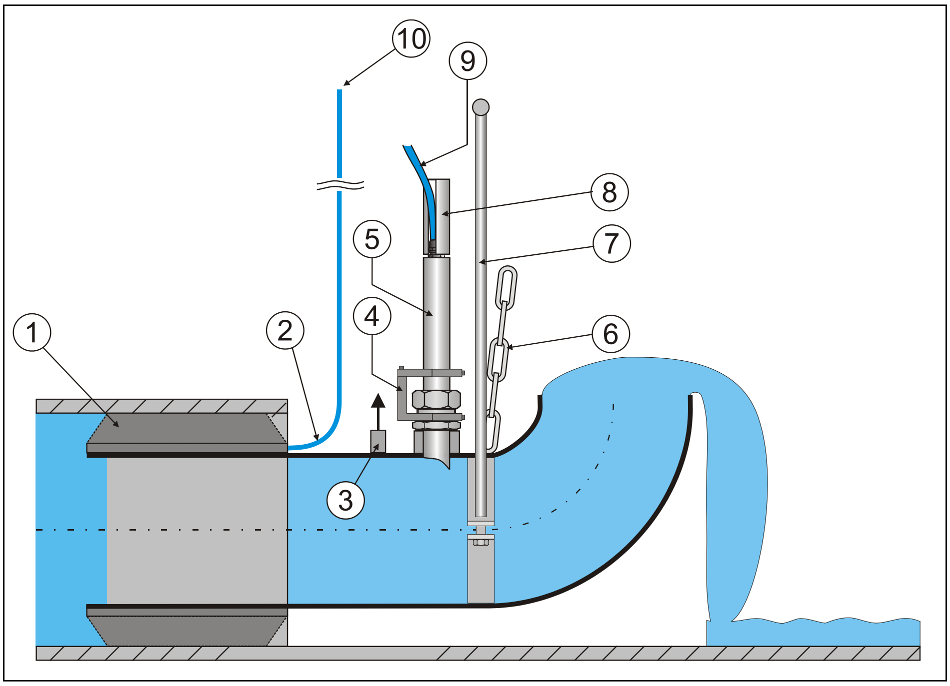


Fig. 6-27 Final filling with 1.5 bar air pressure

No persons are allowed in the manhole/shaft during balloon inflation to 1.5 bars!

Persons might get injured due to flying parts or the blast wave due to balloon explosion (e.g. caused by overpressure)!



1 Balloon expansion
2 Air hose for pumping up
3 Ventilation
4 Sensor retaining element
5 Pipe sensor
6 Chain
7 Hand hold
8 Cable protection jacket
9 Sensor cable
10 Air vent plug

Fig. 6-28 Schematic construction NPP

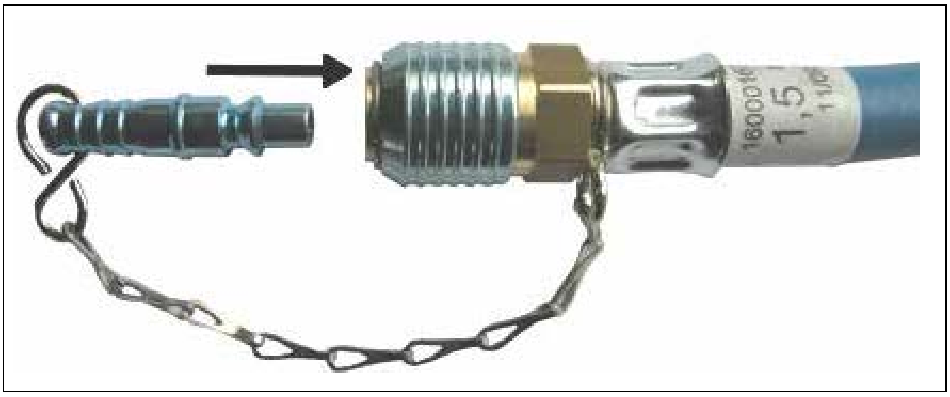


Fig. 6-29 Air vent plug for NPP

An air vent plug is fixed at the air hose on the end which is connected to the compressor (Fig. 6-28, No. 10).
This plug is required to dismantle the NPP. For dismantling proceed as follows:

- Prior to dismantling prevent the NPP from floating away using the chain (e.g. tie to step iron).
- Make sure to stand safely at the rim of the manhole and expect high tractive forces which might occur (e.g. caused by water pressure).
- The balloon must be deflated. Carefully press the air vent plug into the connection valve at the end of the air hose to accomplish (see Fig. 6-29).

Air is going to escape from the balloon slowly and the water dammed upstream will press the NPP out of the pipe.

Air escapes with a pressure of up to 1.5 Bar.

In case of high dam pressure, blocked NPP etc. high forces may occur. Under such circumstances sufficient measures shall be taken to secure the chain (such as a tripod and karabiner or similar)prior to deflating.

Pull up the NPP on the chain. Please observe varying weights depending on various NPP diameters.
Use sufficient tools such as pulleys or other lifting devices.

6.8 Welding Nozzle

There are welding nozzles made of steel or stainless steel available for sensor mounting. For special applications (very few space at place of installation) there is a welding nozzle with outer thread available on which a ball valve can be screwed on directly.

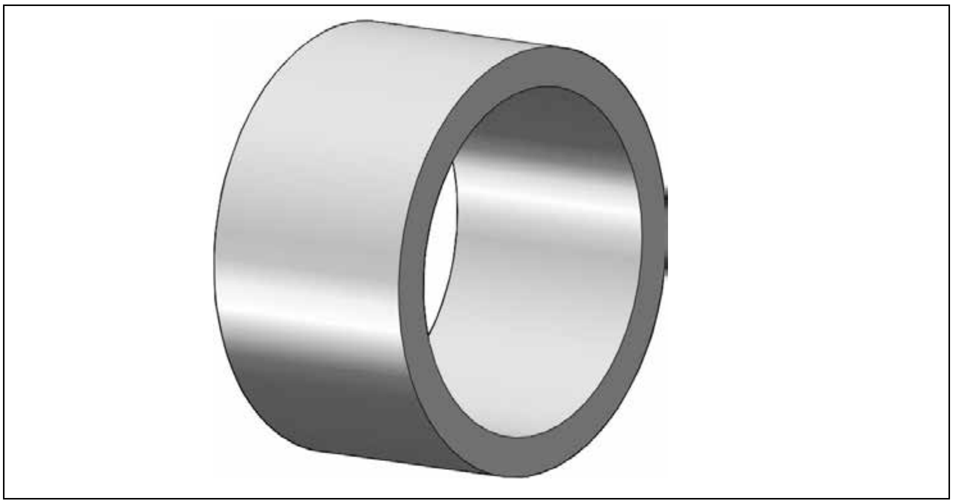


Fig. 6-30 Welding nozzle

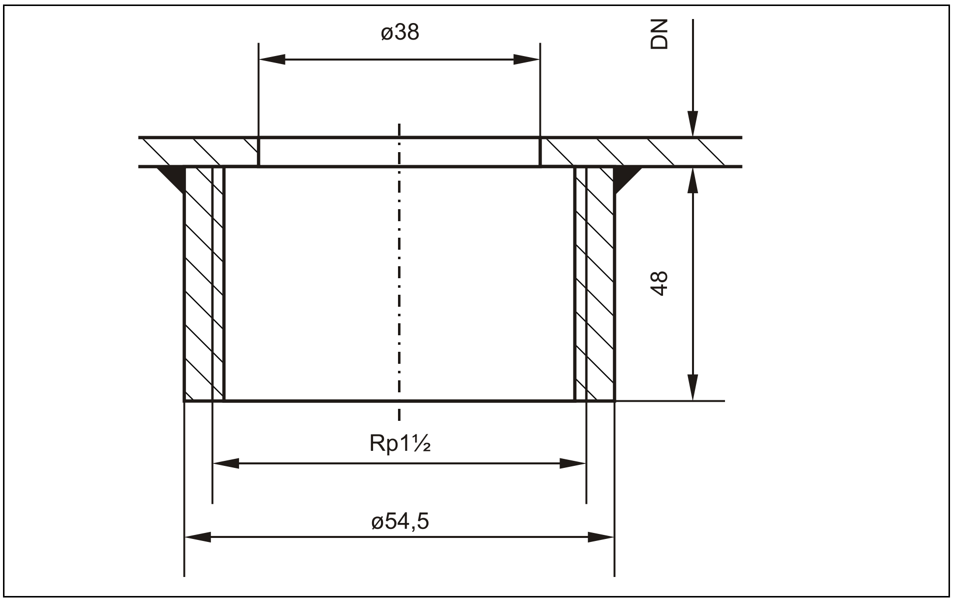
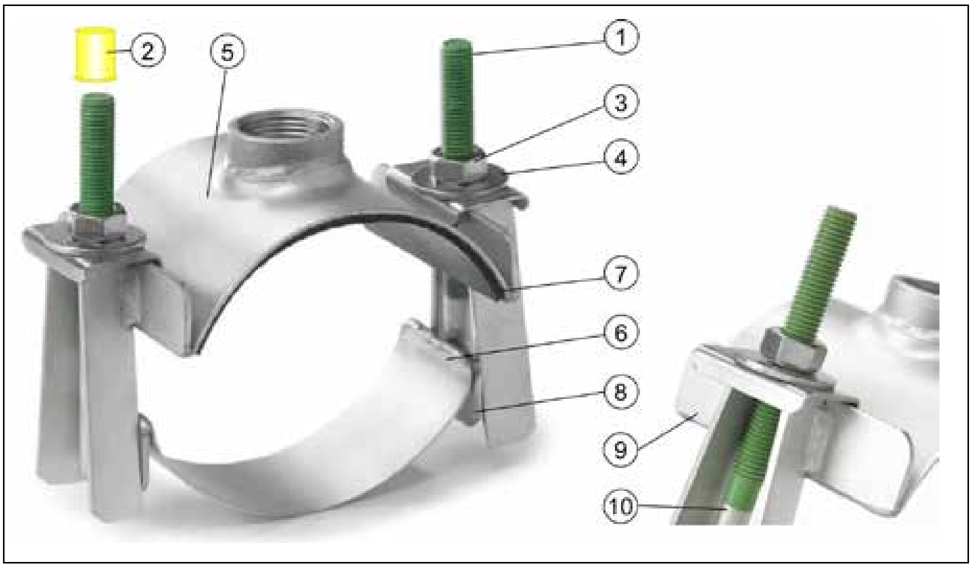


Fig. 6-31 Welding nozzle installation

6.9 Tapping Saddle

General

A tapping saddle can be purchased from NIVUS for upgrading by using a pipe sensor. This saddle is available in 2 versions for pipe diameters from 100 mm to 1000 mm (see Fig. 6-32 and Fig. 6-33).
At Fig. 6-32 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.



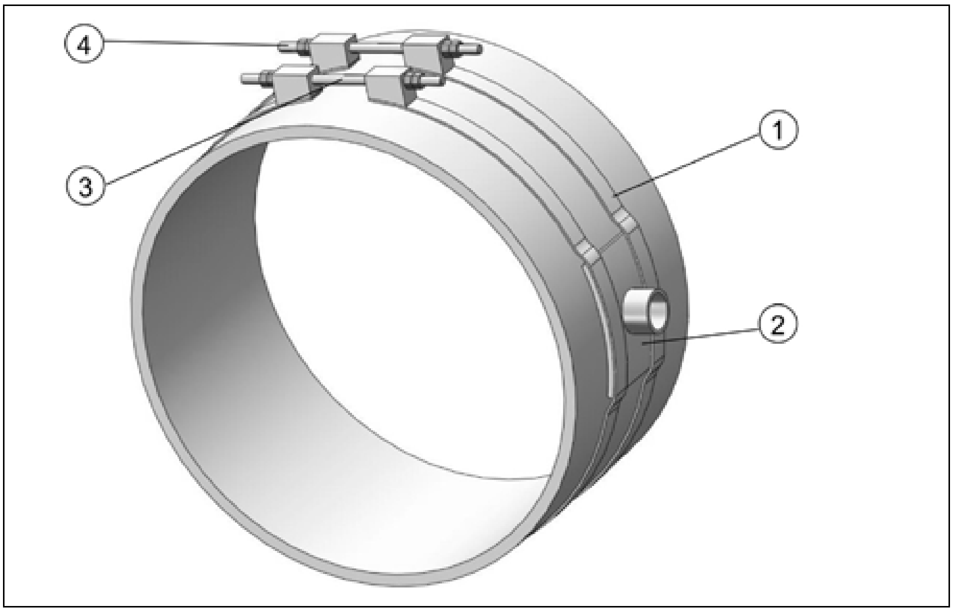
1 Thread bolt M12, (M14, M16) Teflon coated
2 Thread protection cap
3 Nut
4 Washer
5 Saddle part with 1½“ inner thread for cutting ring screw joint
6 Saddle part with thread bolt
7 Rubber gasket
8 Side bracket
9 Mounting bracket (holder)
10 Screw yoke

Fig. 6-32 Overview Tapping saddle DN 100 – DN 400

Versions for diameters of 400 mm upwards consist of the components below:

- Two tensioning belts with clamping bolts and nuts
- A mounting plate with welded sensor nozzle with 1½“ inner thread. This plate additionally has an O-ring to seal it from the pipe wall.

All metal parts of the system are made of stainless steel, 1.4301 (V2A).



1 Tensioning belts
2 Mounting plate with welding nozzle and O-ring on the inside
3 Clamping bolt
4 Nut and counter nut

Fig. 6-33 Overview Tapping saddle DN 450 – DN 1000

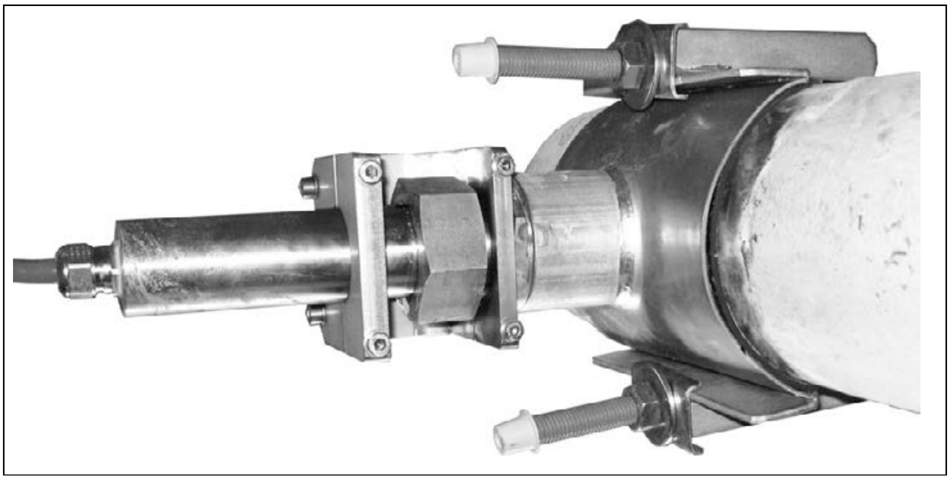


Fig. 6-34 Installation example with tapping saddle DN 100 to DN 400

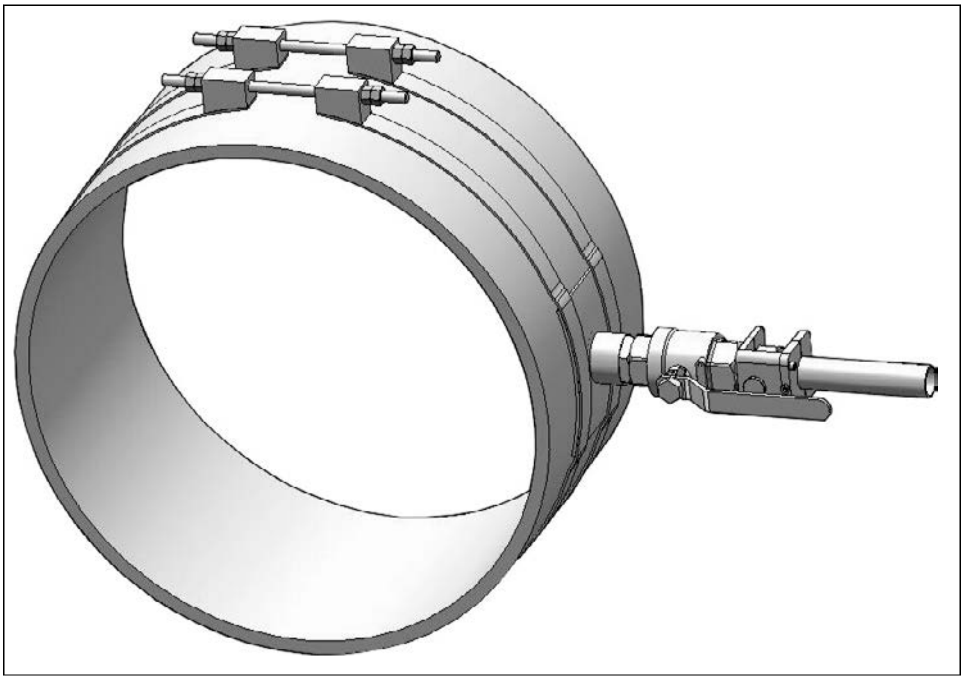


Fig. 6-35 Installation example with tapping saddle DN 450 to DN 1000

Preparation of installation

- Test pipe / mounting place for damaging
- Clean pipe from pollution / dirt such as grease
- Check pipe diameter and dimensions of tapping saddle
- Grease the nozzle thread using appropriate paste for stainless steel screw joints
- anti-seize such as soft soap (no oil or grease!) can be used for the rubber gasket

Installation of tapping saddle up to DN400

1. Drill a hole with ø38 mm into the pipe section. We furthermore recommend to additionally use cutting paste for drill bit cooling (see chap. 6.11).
2. to remove burs 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.

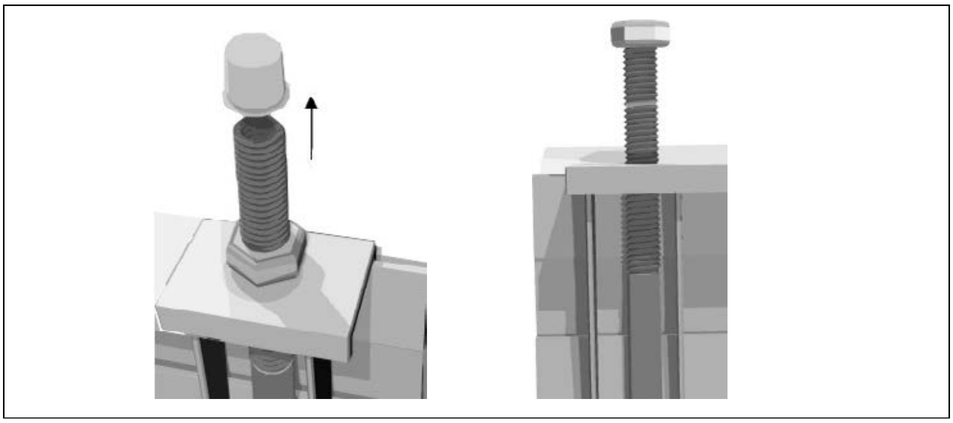


Fig. 6-36 Remove thread protection and loose the nut

5. unfold the saddle parts

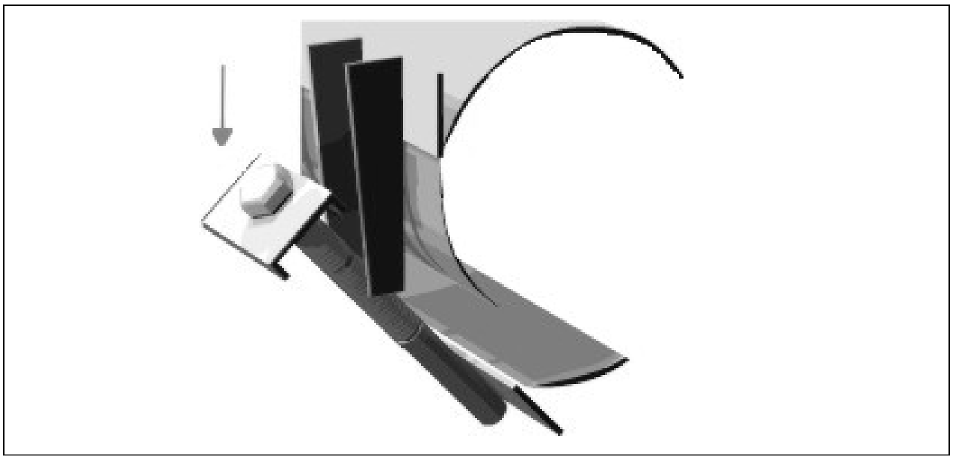


Fig. 6-37 Unfold the saddle parts

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.

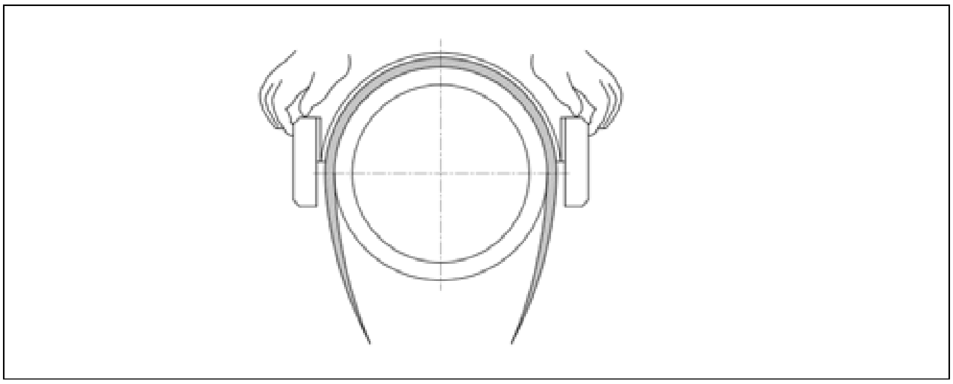


Fig. 6-38 Attach the saddle piece

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. 6-29).

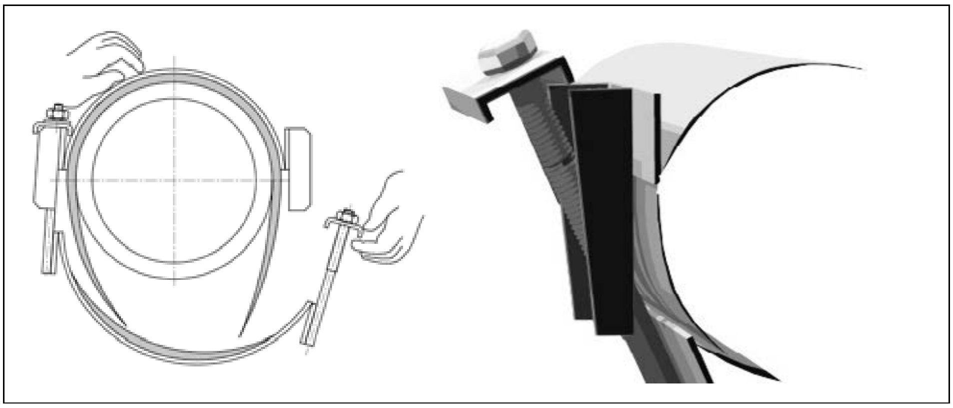


Fig. 6-39 Hook the mounting bracket (holder)

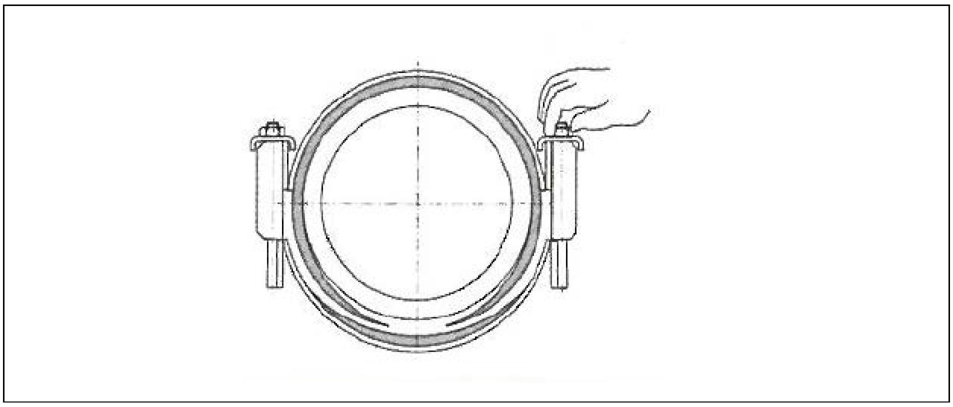


Fig. 6-40 Tighten screws

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 with a length of approx. 300 mm (see Fig. 6-41). Tightening the bolts will automatically press the mounting bracket (holder) into the side bracket.

Following torques are valid, if a dynamometric key is used:

- Bolt M12, width across flat 19 mm: torque 65 Nm
- Bolt M14, width across flat 22 mm: torque 85 Nm
- Bolt M16, width across flat 24 mm: torque 110 Nm

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

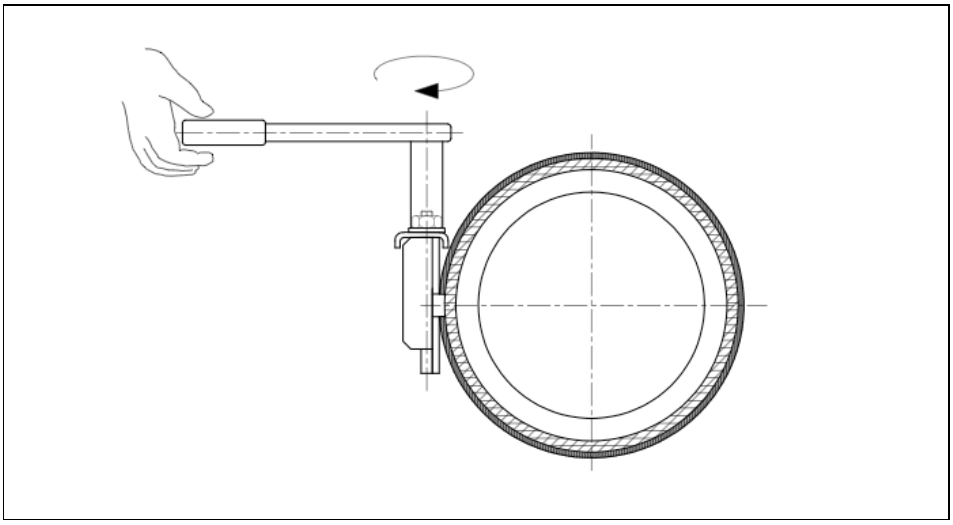


Fig. 6-41 Tighten the nuts

11. After fastening the tapping saddle, adjust the pipe sensor and tighten the screw joint (see chapter 4.2.4).

In case of installation on vibrating facility parts such as pipe lines from adjacent pumps etc. observe to secure the nuts of the fixing bolts and clamping bolts by using counter nuts. Otherwise nuts might loosen due to vibration.

6.10 Stop ball valve

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

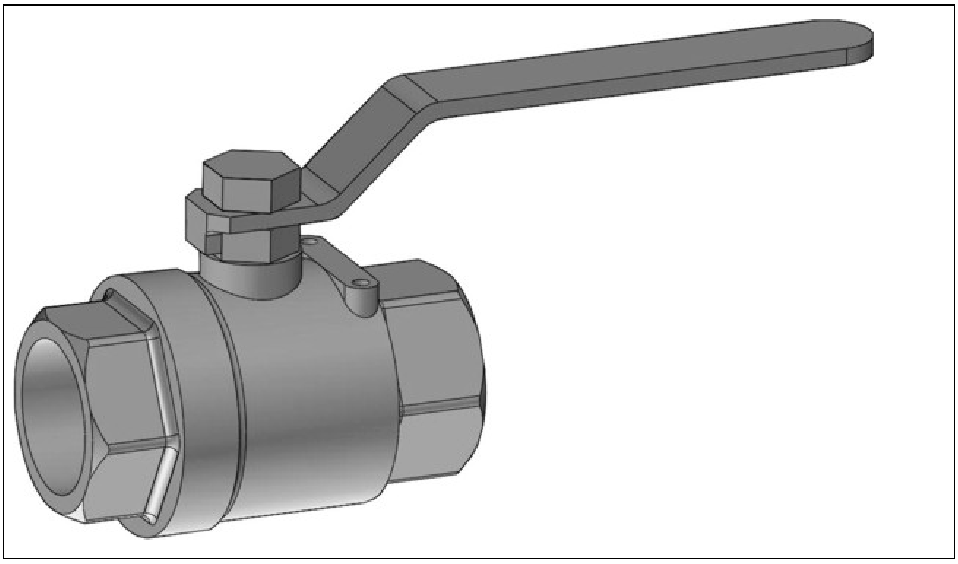


Fig. 6-42 Stop ball valve

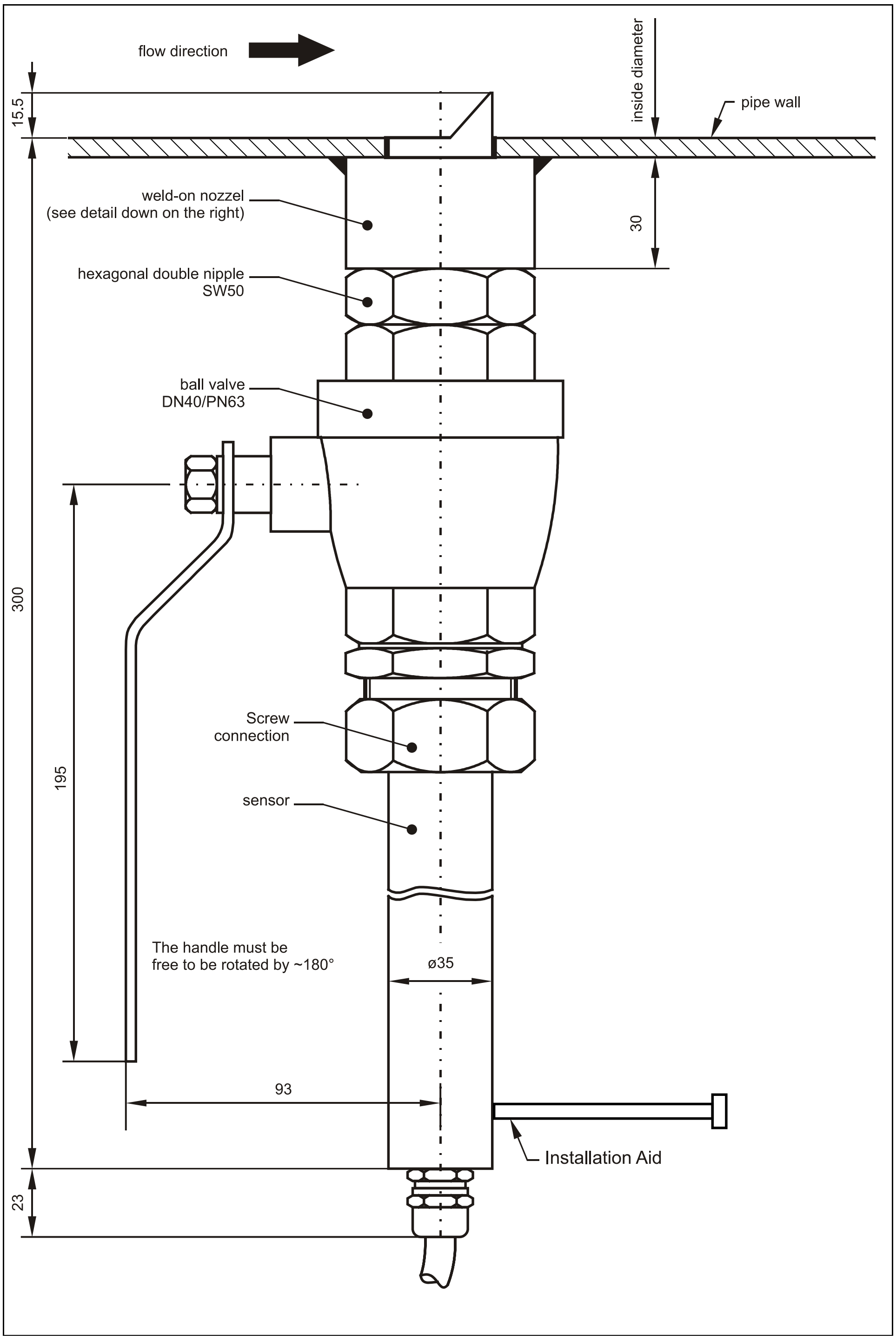


Fig. 6-43 Sensor installation (not installation aid) using retaining element, ball valve and welding nozzle

6.11 Drill Bit and Extension

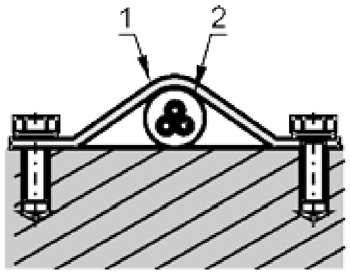
In order to drill into steel or stainless steel pipelines, a drill bit with a diameter of 36 and 38 mm is available. If it is necessary to drill through a ball valve use a drill bit with a diameter of 36 mm as well as the accompanying extension.

Fig. 6-44 Drill bit and extension

Fig. 6-45 Extended drill bit

6.12 Cable Cover

In order to avoid the risk of build-up cover the cable with a thin stainless steel sheet 1.4571 (V4A). 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 ZMS 140
2 Cable

Fig. 6-46 Cable layout with cable cover

7 Table of Pictures

8 Index