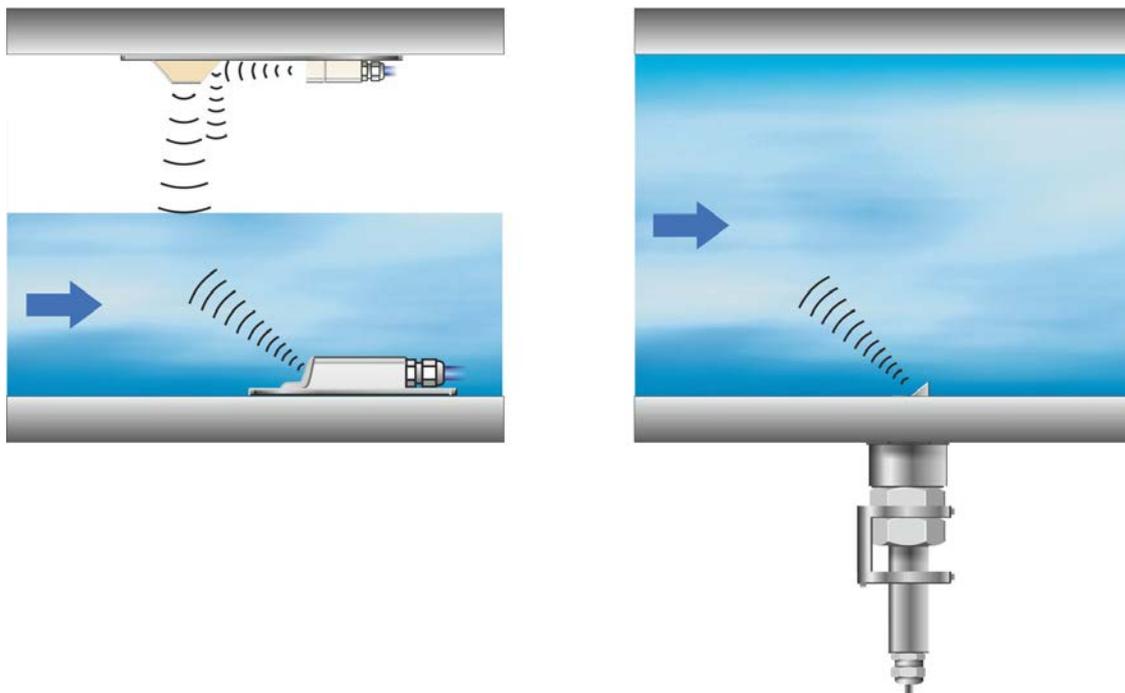


## Installation Instruction

### Correlation and Doppler Sensors



### Revised Manual

Document revision 07 / 09.07.2020

Original Manual: German, rev 07 as of 08.07.2020

**Nivus AG**

Burgstrasse 28  
8750 Glarus, Schweiz  
Tel.: +41 (0)55 6452066  
Fax: +41 (0)55 6452014  
swiss@nivus.com  
www.nivus.de

**NIVUS Austria**

Mühlbergstraße 33B  
3382 Loosdorf, Österreich  
Phone: +43 (0) 2754 567 63 21  
Fax: +43 (0) 2754 567 63 20  
austria@nivus.com  
www.nivus.de

**NIVUS Sp. z o.o.**

ul. Hutnicza 3 / B-18  
81-212 Gdynia, Polen  
Phone: +48 (0) 58 7602015  
Fax: +48 (0) 58 7602014  
biuro@nivus.pl  
www.nivus.pl

**NIVUS France**

67870 Bischoffsheim, France  
Phone: +33 (0) 388 9992 84  
info@nivus.fr  
www.nivus.fr

**NIVUS Ltd., United Kingdom**

Wedgewood Rugby Road  
Weston under Wetherley  
Royal Leamington Spa  
CV33 9BW, Warwickshire  
Phone: +44 (0)8445 3328 83  
nivusUK@nivus.com  
www.nivus.com

**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  
middle-east@nivus.com  
www.nivus.com

**NIVUS Korea Co. Ltd.**

#2502 M Dong, Technopark IT Center,  
32 Song-do-gwa-hak-ro, Yeon-su-gu,  
INCHEON, Korea 21984  
Phone: +82 32 209 8588  
Fax: +82 32 209 8590  
korea@nivus.com  
www.nivus.com

**NIVUS Vietnam**

21 Pho Duc Chinh, Ba Dinh  
Hanoi, Vietnam  
Phone: +84 12 0446 7724  
vietnam@nivus.com  
www.nivus.com

## Copyrights and Property Rights

This document and its contents are proprietary to NIVUS GmbH and are not to be reproduced or copied without the express written permission of NIVUS GmbH.

Violations oblige to compensation.



---

### **Important Note**

*This manual may exclusively - even in parts - be copied or translated in any other way with the express written consent of NIVUS GmbH.*

---

### **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 instruction manual (German) must be consulted or the NIVUS GmbH contacted for clarification.

### **Copyright**

No part of this publication may be reproduced, transmitted, sold or disclosed without prior permission. Damages will be claimed for violations. All rights reserved.

### **Names**

The use of general descriptive names, trade names, trademarks and the like in this manual 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.

## Change History

Rev.	Date	Changes	Editor
07	09.07.2020	Corrections: Fig. 5-25: Caption Chapt. 5.4.5.6: Investigation of insertion depth L Creation: Chapt. 1.4: Warrenty Removals: All chapters on "Drilling in full pipelines" upon instructions from TD; Chapt. 8.4 and chapt. 9: Drill bit Ø 36 mm and extension Changes: Chapt. 5.4.1, chapt. 5.4.4.2, chapt. 5.4.5.3 and chapt. 5.4.5.6: Adaptations to exclusive drilling in empty pipelines Chapt 10.2: Note "EC WEEE-Directive logo"	KG
06	01.10.2019	Complete Revision	KG

**Table of contents**

**Copyrights and Property Rights ..... 3**

**Change History..... 4**

**1 General..... 8**

    1.1 About this Manual .....8

    1.2 Required documentation.....8

    1.3 Signs and definitions used.....9

        1.3.1 Colour codes for conductors and wires .....9

        1.3.2 Article names .....9

    1.4 Warrenty .....10

**2 Safety Instructions .....11**

    2.1 Used symbols and signal words .....11

    2.2 Safeguards and precautions.....12

    2.3 Safety information on pipe sensors .....13

    2.4 Personnel requirements.....14

    2.5 Ex-Approval .....14

    2.6 Intended use .....15

    2.7 User’s responsibilities .....16

    2.8 Disclaimer .....17

**3 Sensor Overview .....18**

**4 Sensor Positioning within the Measuring Section.....19**

    4.1 Selecting the measuring section.....19

    4.2 Sensor positioning examples.....20

        4.2.1 In part filled flumes .....20

        4.2.2 In structured, part filled channels .....27

        4.2.3 In full pipelines .....29

**5 Sensor Mounting.....32**

    5.1 Principles of sensor mounting .....32

    5.2 Wedge sensors.....33

        5.2.1 Information on the installation of wedge sensors .....33

            5.2.1.1 Basics.....33

            5.2.1.2 Wedge sensor without built-in pressure measurement cell .....34

            5.2.1.3 Wedge sensor with integrated pressure measurement cell.....35

            5.2.1.4 Wedge sensor with integrated water-ultrasonic measurement.....37

        5.2.2 Tools and material needed .....37

5.2.3	Alignment of wedge sensors .....	38
5.2.4	Fastening wedge sensors.....	38
5.2.5	Laying cables.....	39
5.3	Air-ultrasonic sensors OCL and DSM.....	42
5.3.1	Notes on the installation of air-ultrasonic sensors.....	42
5.3.2	Construction of the mounting plate.....	43
5.3.3	Sensor positioning .....	44
5.3.4	Tools and material needed .....	44
5.3.5	Permanent fastening in pipe.....	45
5.3.6	Temporary fastening in pipe .....	45
5.4	Pipe sensors .....	46
5.4.1	Notes on pipe sensor mounting.....	46
5.4.2	Tools and material needed .....	47
5.4.3	Alignment of pipe sensors .....	47
5.4.4	Pipe sensors POA, CS2 KDA/KDO: Drilling in pipelines and mounting.....	49
5.4.4.1	Overview of components .....	49
5.4.4.2	Notes on drilling in pipelines .....	50
5.4.4.3	Drill into empty pipeline and fasten nozzle .....	51
5.4.4.4	Notes on sensor mounting .....	52
5.4.4.5	Prepare sensor mounting.....	52
5.4.4.6	Install pipe sensor .....	54
5.4.4.7	Fastening element: Overview of components.....	55
5.4.4.8	Prepare installation of the fastening element.....	56
5.4.4.9	Install fastening element .....	56
5.4.5	Pipe sensor CSM: Drilling in pipeline and mounting .....	58
5.4.5.1	Overview of components .....	58
5.4.5.2	Installation options .....	59
5.4.5.3	Notes on drilling in pipelines .....	59
5.4.5.4	Drill into empty pipeline and fasten nozzle .....	60
5.4.5.5	Install CSM pipe sensor in empty pipeline.....	61
5.4.5.6	Install CSM pipe sensor in customer nozzle.....	63
<b>6</b>	<b>Maintenance and Cleaning .....</b>	<b>64</b>
<b>7</b>	<b>Sensors in the Control Section .....</b>	<b>65</b>
7.1	General information regarding control technology .....	65
7.2	Construction of control section .....	65
7.2.1	With pipe measuring section .....	65
7.2.2	In channels .....	68

<b>8</b>	<b>Mounting Accessories and Tools .....</b>	<b>69</b>
	8.1 Welding nozzle .....	69
	8.1.1 Description.....	69
	8.1.2 Installation examples .....	70
	8.2 Tapping saddle .....	71
	8.2.1 Description.....	71
	8.2.2 Installation examples .....	73
	8.2.3 Installation.....	73
	8.3 Stop ball valve .....	78
	8.4 Drill bit .....	79
	8.5 Cutting paste.....	79
	8.6 Sensor cover.....	80
	8.7 Wedge base.....	80
	8.7.1 Description.....	80
	8.7.2 Installation examples .....	81
	8.8 Cable cover sheets.....	82
	8.9 Float .....	84
	8.9.1 Description.....	85
	8.9.2 Parallel rods.....	86
	8.9.2.1 Description .....	86
	8.9.2.2 Determination of the correct length.....	87
	8.9.2.3 Adjust length .....	87
	8.9.3 Information on float installation in agitated media .....	88
	8.9.4 Install pipe sensor.....	89
	8.9.5 Maintenance and cleaning.....	90
<b>9</b>	<b>Accessories and Spare Parts .....</b>	<b>91</b>
<b>10</b>	<b>Dismantling/Disposal.....</b>	<b>93</b>
	10.1 Dismantling .....	93
	10.2 Disposal .....	93
	<b>Index.....</b>	<b>94</b>

## 1 General

### 1.1 About this Manual



---

**Note**

*READ CAREFULLY BEFORE USE.*

*KEEP IN A SAFE PLACE FOR LATER REFERENCE.*

---

The installation instruction for cross correlation and Doppler sensors is for proper and correct installation or the intended use of the sensors as depicted in the overview (chapter 3). This manual is oriented exclusively to qualified expert personnel.

This installation instruction refers to installation and cable layout of the described sensor types exclusively. The wiring diagrams of sensors and the respective transmitters, specifications as well as certificates and approvals can be found in the according technical descriptions.

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

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

### 1.2 Required documentation

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

- Technical instructions for correlation sensors and external electronic box
- Technical instructions for doppler sensors
- Installation instructions for pipe mounting systems
- Transmitter instruction manual

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

### 1.3 Signs and definitions used

Image	Meaning	Remark
	Cross reference	Reference 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 accompanying documentation.

Tab. 1-1 Structural elements within the instruction manual

#### 1.3.1 Colour codes for conductors and wires

The abbreviations of colours used to identify conductors and wires follow the international code for designation of colours according to IEC 60757.

BK	black	BN	brown	RD	red
BU	blue	YE	yellow	GN	green
WH	white	PK	pink	GY	grey
GNYE	green/yellow	TR	transparent		

#### 1.3.2 Article names

- OCL air ultrasonic sensor
- KDA doppler sensor
- KDO doppler sensor
- POA cross correlation sensor
- CS2 cross correlation sensor
- CSP cross correlation sensor
- CSM cross correlation sensor
- DSM air ultrasonic sensor

## 1.4 Warranty

The device has been functionally tested before delivery. If it is used as intended (see Sect. 2.6 *Intended use*) and the operating instructions, the applicable documents (see Sect. 1.2 *Required 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 Sect. 2.8 *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 of companies reserve the right to limit the warranty.*

---

## 2 Safety Instructions

### 2.1 Used symbols and signal words



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 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



#### ***Check danger due to explosive gases***

*Make sure to observe all regulations regarding safety at work as well as danger due to explosive gases prior to beginning mounting, installation and maintenance works. Use a gas warner.*

*When working in channel systems make sure to avoid electrostatic charge:*

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

*Disregarding may lead to personal injury or damage your system.*

### WARNING



#### ***Germ contamination***

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

*Wear protective clothing.*

### WARNING



#### ***Observe occupational safety regulations***

*Before starting installation work, observing the work safety regulations need to be checked.*

*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 in personal injury.*

### WARNING



#### ***Danger through electric shock!***

*Drilling works in wet rooms or into full pipelines may cause dangerous fault currents which may lead to personal injury.*

- *Use electronic personal protection equipment.*

**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****Risk of equipment damage and malfunction**

Check whether sensors are suitable for the application.

The sensor specifications can be found in the *Technical Description for Correlation Sensors and Electronic Box* or in the *Technical Description for Doppler Sensors*

---

**Important Note**

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

---

### 2.3 Safety information on pipe sensors

---

**WARNING****Risk of personal injury**

The safety information on the pipe sensor is part of the delivery. Disregarding may lead to personal injury.

- Observe safety information
  - Do not remove the safety information
- 

**!!! Important Information – Please Note !!!**

- 1 Pipeline under pressure!**  
Relieve from pressure prior to sensor replacement
  - 2 Do not operate the pipe sensor without fastening element**
  - 3 Do not damage outer cable sheathing**
  - 4 Avoid kinks or sharp bends on sensor cables**
  - 5 Please refer to instruction manual prior to installation**
- 

Fig. 2-1 Safety hints on pipe sensor

## 2.4 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*
- 

## 2.5 Ex-Approval

### **CAUTION**



---

**Damages invalidate the Ex protection.**

*Damage might invalidate the Ex protection.*

*The sensor then is not allowed to be used in Ex zone 1 any longer.*

*Protect the sensor from shocks, drops or other damage.*

---

The Ex-version of the sensors is designed to be used in areas with explosive atmospheres (zone 1).

Approval ATEX / IECEx



II 2G Ex ib IIB T4 Gb / Ex ib IIB T4 Gb

### 2.6 Intended use



**Important Note**

*The sensors are exclusively intended to be used for purposes as described above. Modifying or using the sensors or mounting systems for other purposes without the written consent of NIVUS will not be considered as use in accordance with the requirements.*

*The legally associated companies and subsidiaries of NIVUS group cannot be held responsible for any damage resulting from improper use. The user alone bears any risk.*

Check whether the sensor is appropriate for use with your application. Observe the maximum permissible limit values.



*The sensor specifications can be found in the Technical Description for Correlation Sensors and Electronic Box or in the Technical Description for Doppler Sensors.*

The sensors are designed for the purposes below:

Sensor	Measurement	Medium	Area of use	Connection to transmitter
OCL	Level	Air	Part filled flow measurement places	NF750, PCM Pro, PCM 4, OCM Pro CF,
KDA / KDO	Flow velocity Level (optional)	Slight to heavily polluted	Part filled or full channels, pipes, flumes	OCM F, OCM FR
POA	Flow velocity Level (optional)	Slight to heavily polluted	Part filled or full channels, pipes, flumes	NF7, NFP, PCM Pro, PCM 4, OCM Pro CF
CS2	Flow velocity Level (optional)	Slight to heavily polluted	Part filled or full channels, pipes, flumes with larger dimensions	NF7, PCM Pro, PCM 4, OCM Pro CF
CSP	Flow velocity Level (optional)	Slight to heavily polluted	Part filled or full channels, pipes, flumes with larger dimensions	NFM750
CSM	Flow velocity Level (optional)	Slight to heavily polluted	Part filled or full channels, pipes, flumes with low filling levels	Without EBM: NFM750; With EBM: NF7, PCM Pro, PCM 4
DSM	Level	Air	Pipes with small dimensions	Without EBM: NFM750; With EBM: NF7, PCM Pro, PCM 4

**Tab. 2-1 Intendend use**

## 2.7 User's responsibilities



### **Important Note**

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

### **Store Instruction Manual**

Keep this installation instruction in a safe place and make sure it is available for the users of this product at any time.

### **Provide Instruction Manual**

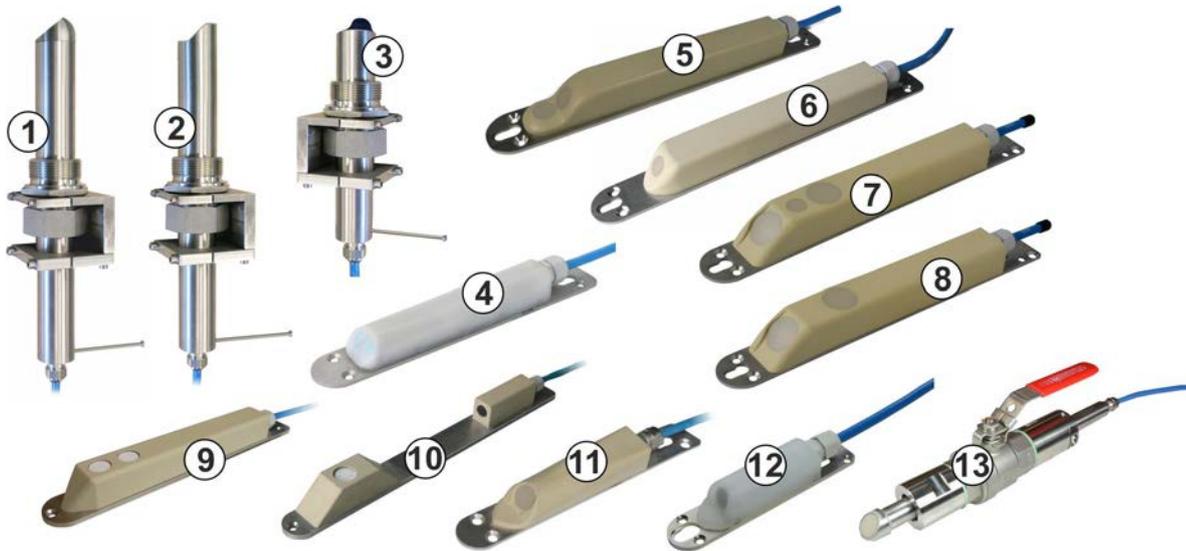
In case of selling the sensors this installation instruction shall be provided to the purchaser since it is a part of the standard delivery.

### 2.8 Disclaimer

**All 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 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**. For connection, commissioning and operation of the sensors all available information and higher local legal regulations (e.g. in Germany 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 from 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**.

### 3 Sensor Overview



	Sensor	Design	v-Measurement	h-Measurement	Installation
1	CS2-....R	Pipe sensor	Cross correlation	-	With nozzle in pipes from the outside <b>or</b> installation in float
2	POA-....R	Pipe sensor	Cross correlation	Optional: water ultrasonic	With nozzle in pipes from the outside <b>or</b> installation in float
3	KDA-R / KDO-R	Pipe sensor	Doppler	-	With nozzle in pipes from the outside
4	KDA-K / KDO-K	Wedge sensor	Doppler	Optional: pressure measurement	Screw on flume/channel wall or flume/channel bottom
5	POA-V2H1K / POA-V2VUK:	Wedge sensor	Cross correlation	Water ultrasonic or pressure measurement + water ultrasonic	Screw on flume/channel wall or flume/channel bottom
6	POA-V200K / POA-V2D0K	Wedge sensor	Cross correlation	Without or pressure measurement	Screw on flume/channel wall or flume/channel bottom
7	CS2-....K	Wedge sensor	Cross correlation	Without or pressure measurement or water ultrasonic or pressure measurement + water ultrasonic	Screw on flume/channel wall or flume/channel bottom
8	CSP	Wedge sensor	Cross correlation	Without or pressure measurement or water ultrasonic or pressure measurement + water ultrasonic	Screw on flume/channel wall or flume/channel bottom
9	OCL	Wedge sensor	-	Air ultrasonic	Fasten on top (e.g. in pipe crown)
10	DSM	Mini wedge sensor	-	Air ultrasonic	Fasten on top (e.g. in pipe crown)
11	CSM-V1D0K	Mini wedge sensor	Cross correlation	Pressure measurement	Screw on flume/channel wall or flume/channel bottom
12	CSM-V100K	Mini wedge sensor	Cross correlation	-	Screw on flume/channel wall or flume/channel bottom
13	CSM-V100R	Pipe sensor	Cross correlation	-	With nozzle in pipes from the outside

Fig. 3-1 Sensor overview

### 4 Sensor Positioning within the Measuring Section

#### 4.1 Selecting the measuring section

The installation of sensors on the measurement place depends extremely on the conditions on site.

Observe proper hydraulic conditions as well as a sufficient calming section upstream of the measurement spot.

##### Conditions for calming sections

- Avoid falls, bed jumps, components and profile changes upstream of the measurement place
- Avoid lateral intakes directly upstream or downstream of the measurement!
- **Sedimentation:** select the measuring section so that no sedimentation (sand, debris, sludge) can be found within or can build up later. Sedimentation is caused due to low shear stress within the flow profile and indicates too low slopes or structural shortcomings (sections with negative slope) within the measuring section. Observe the minimum flow velocity (DWA A110).
- **Part filled pipes:** never exceed filling levels higher than 80 % in the pipeline. Starting at a filling level of approx. 80 % of the nominal diameter pipelines tend to "pulse". In order to avoid pulsations within the measuring section select the diameter so as to not exceed a filling level higher than 80 % (independent of  $Q_{\min}$  or  $Q_{\max}$  with standard discharges;  $2 Q_{TW}$ ).
- **Changes of the slope** within the measuring section must be avoided.
- **Intake and outlet section:** the minimum length of the straight intake section must be  $5 * DN$ , the minimum length of the outlet section must be  $2 * DN$ . Longer calming sections are needed in case of profile changes or hydraulic disturbances and disturbed profiles.
- **Level measurements:** as installation place select the point with the lowest wave formation possible and make sure that the water surface is parallel to the channel bottom.

When uncertain regarding the choice or assessment of the planned measuring section please contact your NIVUS representative or NIVUS GmbH in Eppingen (e-mail: [info@nivus.com](mailto:info@nivus.com), phone +49 (0)7262 91910).

**In order to correctly assess the measuring section it is necessary to have sketches, drawings and / or photos available showing the construction situation at, upstream and downstream of the intended place of installation.**

## 4.2 Sensor positioning examples

The figures in the chapters 4.2.1 to 4.2.3 give examples of different applications to illustrate

- well suited measuring sections
- less suited measuring sections
- correct sensor positions in the measuring section
- difficult applications, also critical hydraulic conditions

The values specified in the examples are guidelines and recommendations based on many years of experience. Depending on the hydraulic conditions (roughness, additional hydraulic disturbances, high flow velocities and similar) remarkably higher distances may be required.



### Note

The following installation examples apply for wedge sensors and pipe sensors. The depicted sensors are merely examples.

### 4.2.1 In part filled flumes



### Note

As soon as a separate air-ultrasonic sensor is used to measure the level this sensor, as a basic principle, must be installed upstream of the flow velocity sensor. Reconcile possible changes with NIVUS.

Observe the following in order to measure the maximum flow velocity within the flow pattern:

- Install flow velocity sensors in the channel centre if possible (exception: pipe sensors in pipe measuring sections tending to sedimentation).
- With asymmetric installation: necessarily specify the sensor position in relation to the channel centre during programming.

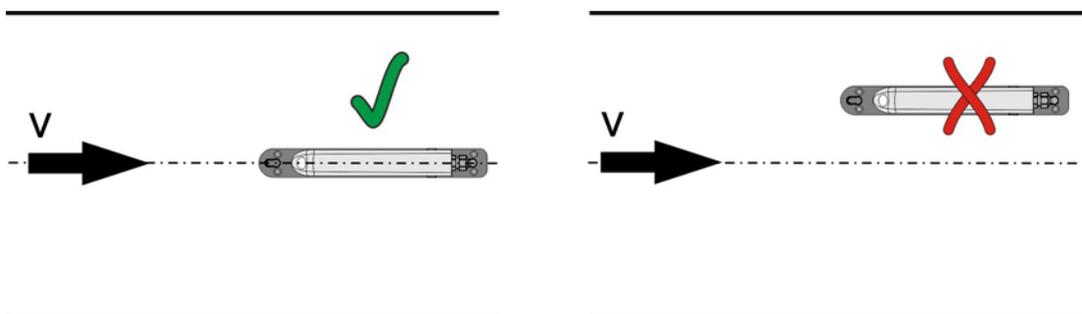


Fig. 4-1 Sensor position in the centre of the flume

## 4 Sensor Positioning within the Measuring Section

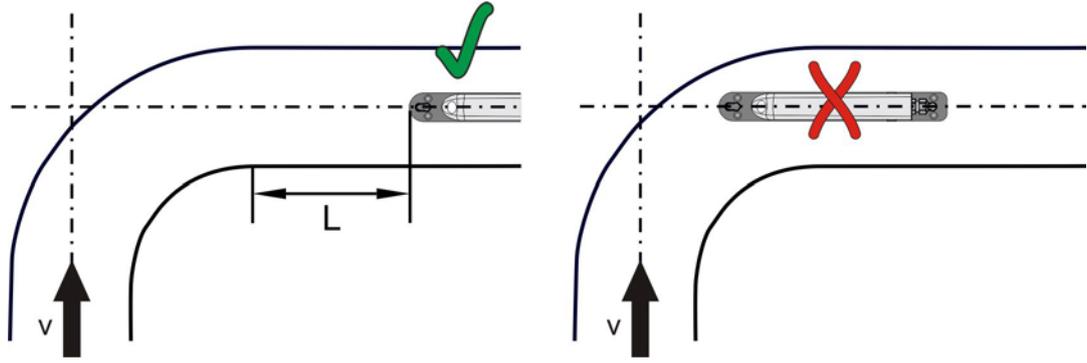
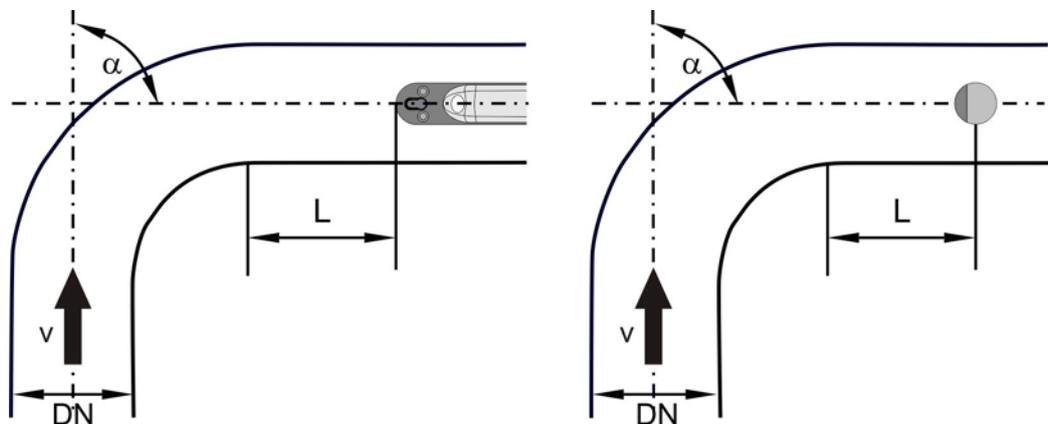


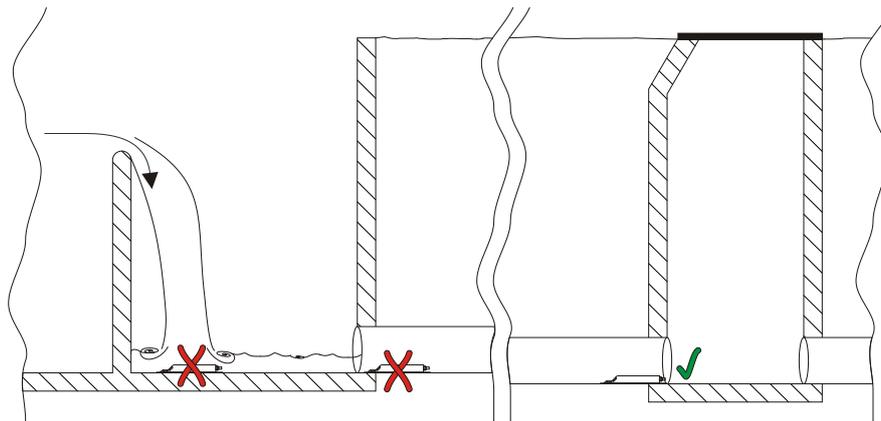
Fig. 4-2 Sensor position behind curves or elbows



$\alpha$  = Change of flow direction

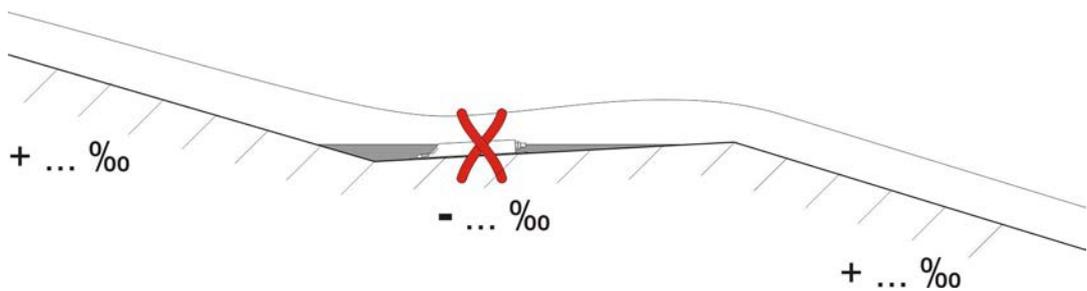
Sensor type	Change of flow direction	$v \leq 1 \text{ m/s}$	$v > 1 \text{ m/s}$
POA, CS2, CSP, KDA, KDO	$\alpha 0^\circ - 15^\circ$	$L \geq \text{min. } 3 * \text{DN}$	$L \geq \text{min. } 5 * \text{DN}$
	$\alpha 15^\circ - 45^\circ$	$L \geq \text{min. } 5 * \text{DN}$	$L \geq \text{min. } 10 * \text{DN}$
	$\alpha 45^\circ - 90^\circ$	$L \geq \text{min. } 10 * \text{DN}$	$L \geq \text{min. } 15 - 20 * \text{DN}$
CSM-V100	$\alpha 0^\circ - 15^\circ$	$L \geq \text{min. } 5 * \text{DN}$	$L \geq \text{min. } 10 * \text{DN}$
	$\alpha 15^\circ - 45^\circ$	$L \geq \text{min. } 8 * \text{DN}$	$L \geq \text{min. } 20 * \text{DN}$
	$\alpha 45^\circ - 90^\circ$	$L \geq \text{min. } 15 * \text{DN}$	$L \geq \text{min. } 30 - 40 * \text{DN}$
CSM-V1D0	$\alpha 0^\circ - 15^\circ$	$L \geq \text{min. } 4 * \text{DN}$	$L \geq \text{min. } 7 * \text{DN}$
	$\alpha 15^\circ - 45^\circ$	$L \geq \text{min. } 6 * \text{DN}$	$L \geq \text{min. } 15 * \text{DN}$
	$\alpha 45^\circ - 90^\circ$	$L \geq \text{min. } 12 * \text{DN}$	$L \geq \text{min. } 25 - 30 * \text{DN}$

Fig. 4-3 Sensor position behind curves or elbows



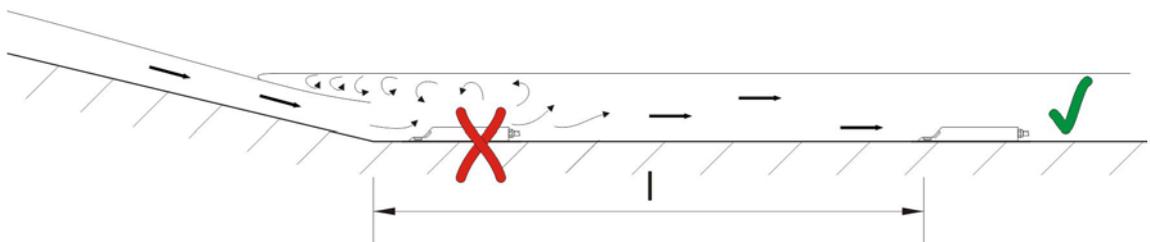
- ✘ Error! Indefinable flow conditions
- ✔ Sufficient distance to obtain straight flow  
(10 ... 50 \* diameter depending on application)

**Fig. 4-4 Discharge channel or fall - turbulence**



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

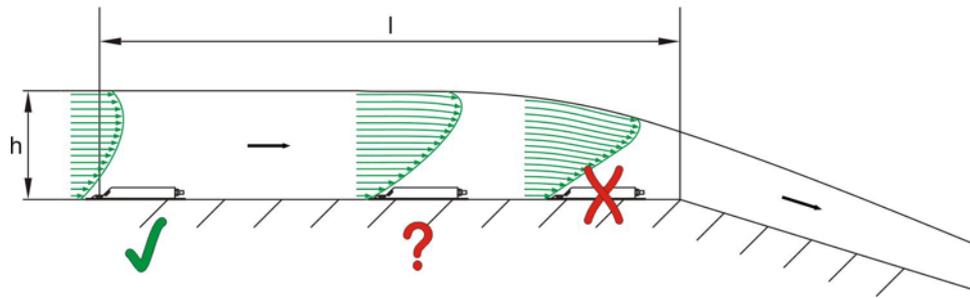
**Fig. 4-5 Negative slope – risk of silting-up**



- ✘ Error! Alternation of slope = alternation of flow profile
- ✔ Distance depending on slope and flow velocity value  
 $l = \text{min. } 20 * \text{diameter}$

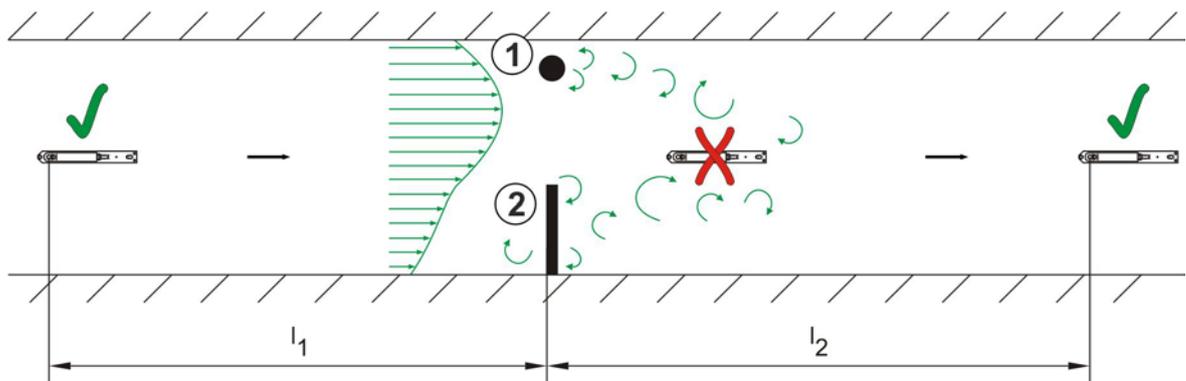
**Fig. 4-6 Error caused by alternation of slope**

## 4 Sensor Positioning within the Measuring Section



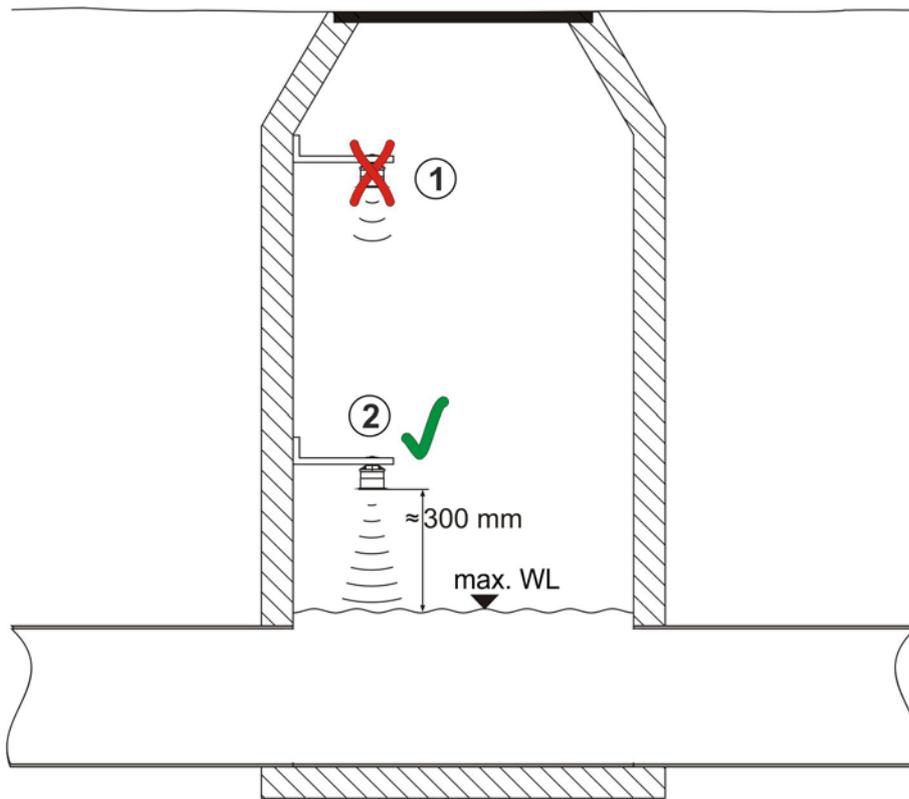
- ✘ Error! Transition from flowing to shooting  
Level measurement might fail + velocity and level measurement might be faulty
- ? Critical measurement point, not recommended! Begin of sinking flow
- ✓ Distance  $l = \min. 5 * h_{max}$  at place of installation

**Fig. 4-7 Error caused by alternation of flow profile in front of slope alternation or fall**



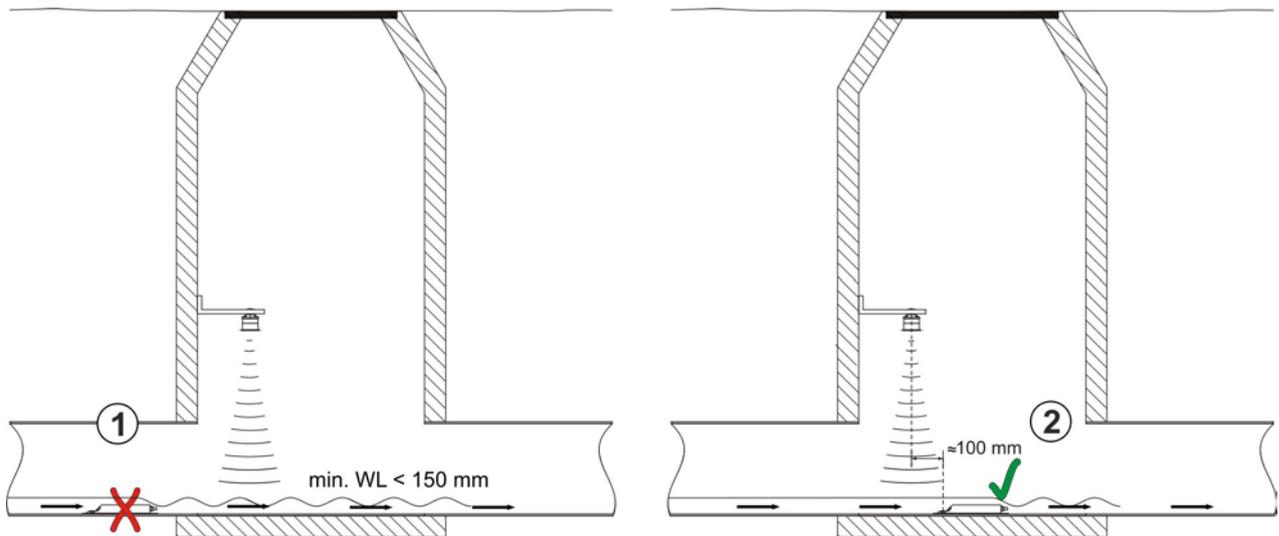
- 1 Fixtures such as samplers or similar
  - 2 Obstruction
- ✘ Error! Caused by vorticity, tangential and/or asymmetric flow
  - ✓ Distance  $l_1$  (upstream of obstruction) =  $\min. 5 * h_{max}$   
Distance  $l_2$  (downstream of obstruction) =  $\min. 10 * h_{max}$   
in case of flow velocities  $>1$  m/s

**Fig. 4-8 Errors caused by fixtures or obstructions (top view)**



- 1 Distance too large: edge of sensor bottom to max. water level
- 2 O.K.: best possible sensor position at max. water level (may be lower depending on sensor type)

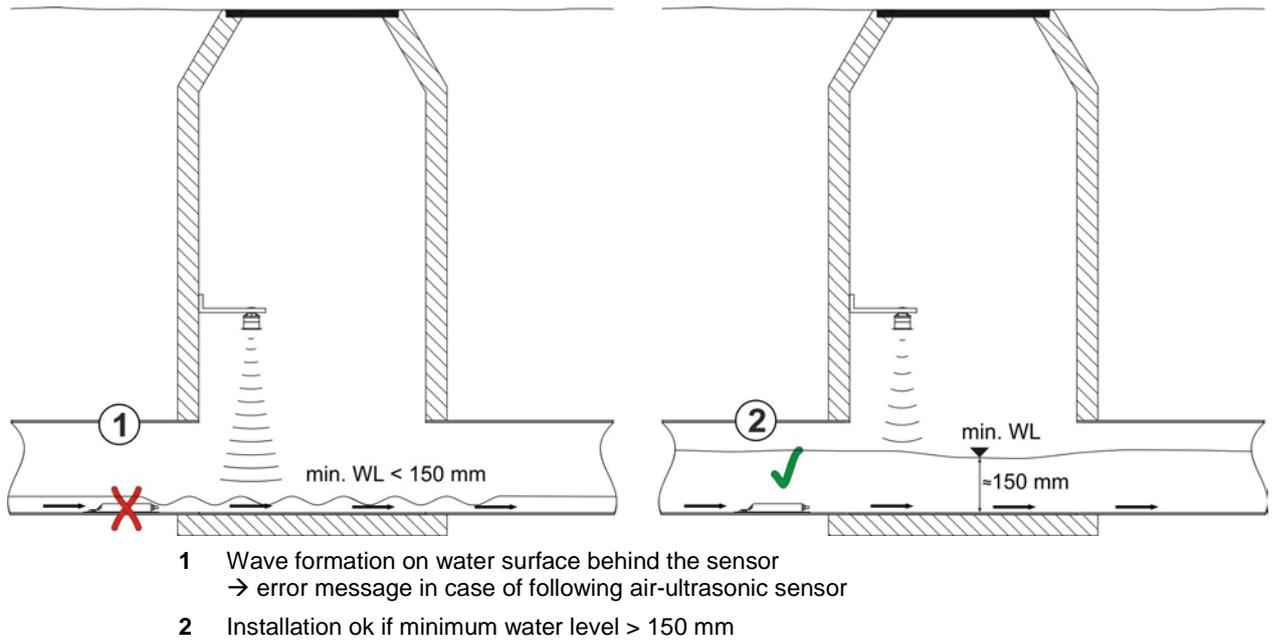
**Fig. 4-9 Installation of air-ultrasonic sensors**



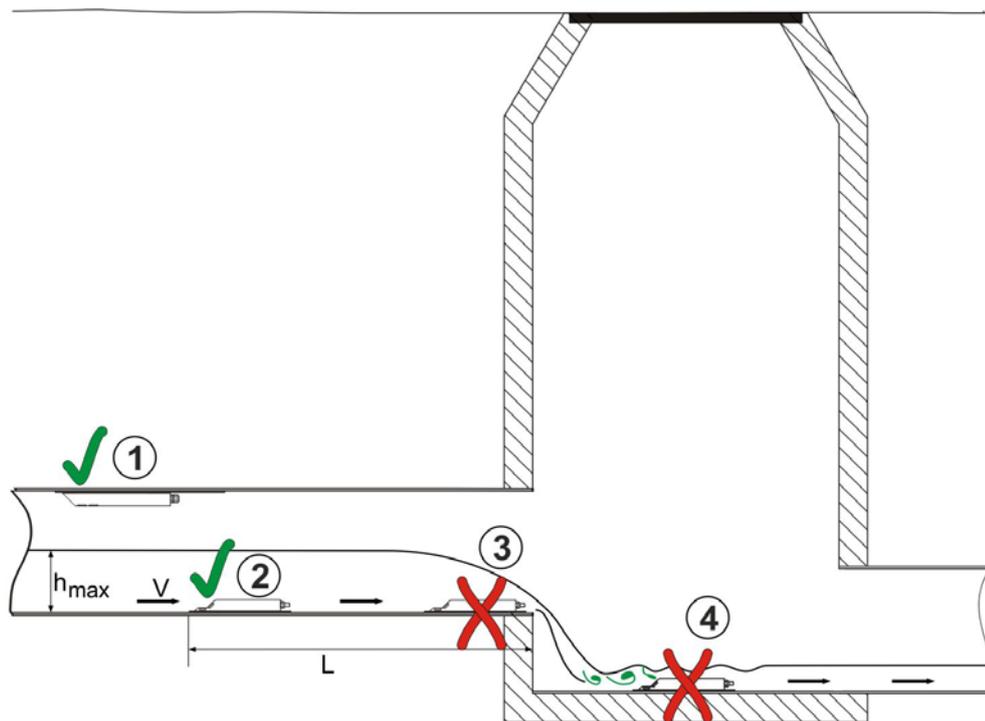
- 1 Wave formation on water surface behind the sensor  
→ error message in case of following air-ultrasonic sensor
- 2 O.K.; might have to be installed 10 mm (0.39 in) lower in case of low flow levels

**Fig.4-10 Installation in manholes with fill levels < 150 mm**

## 4 Sensor Positioning within the Measuring Section

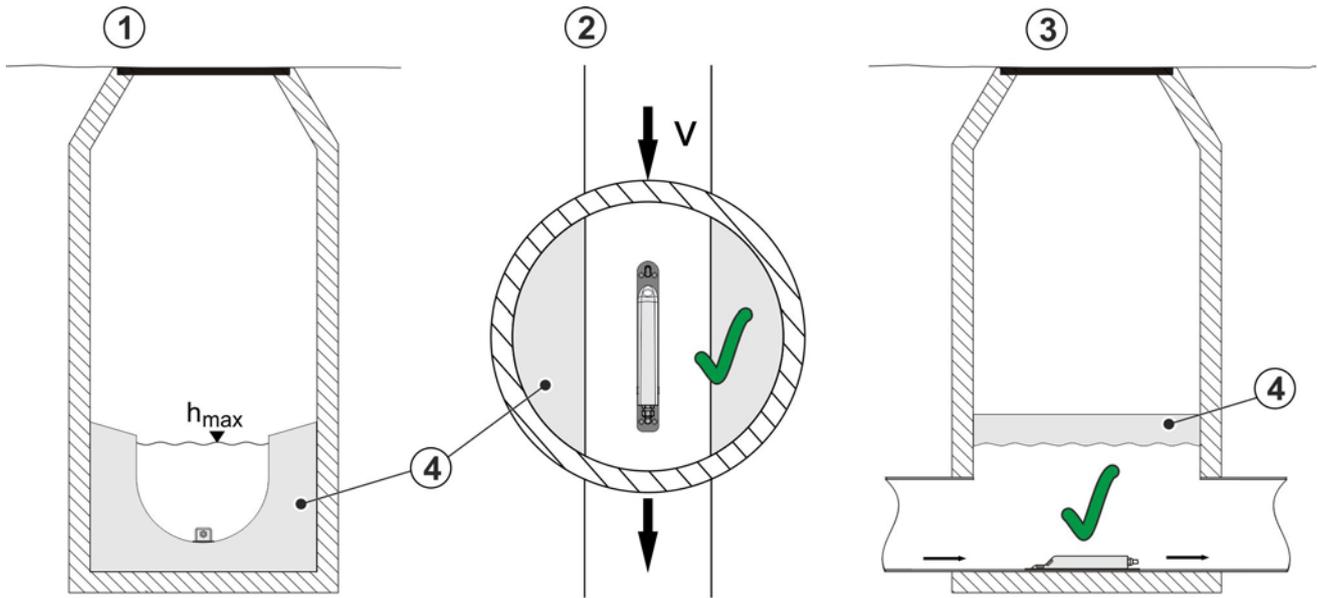


**Fig. 4-11 Installation in manholes with fill levels >150 mm**



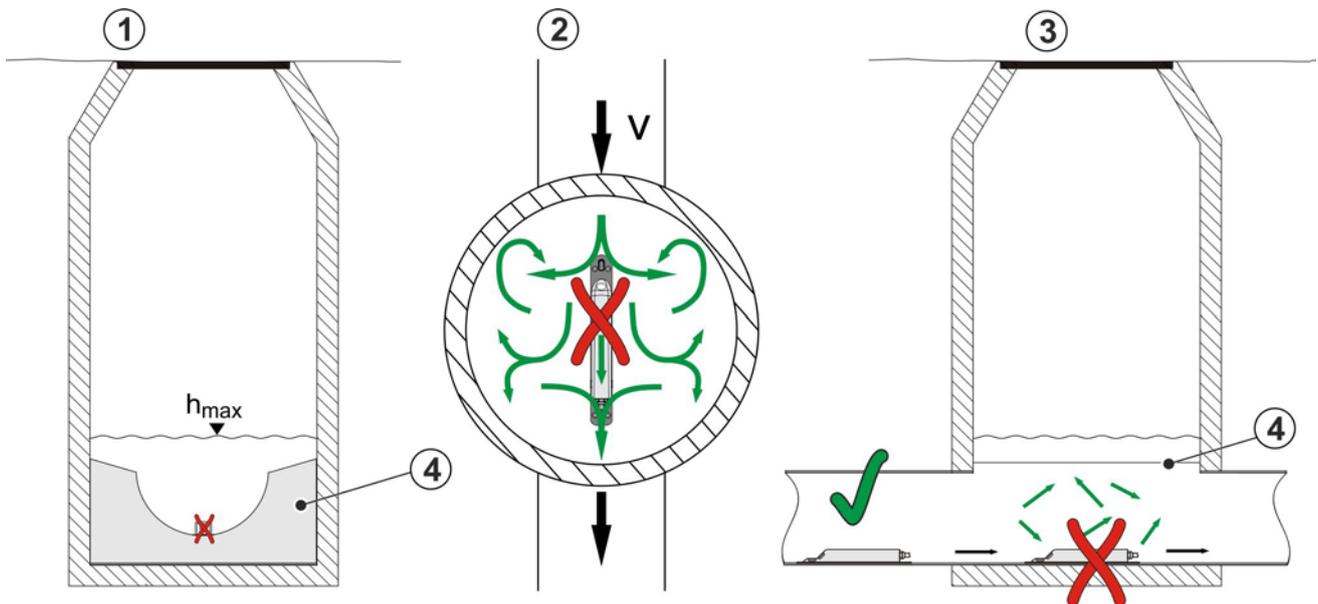
- 1 Installation ok: air-ultrasonic sensor upstream of flow velocity sensor
- 2 or sensor with pressure measurement cell  
 $L \geq 3 \cdot h_{\max}$   
 $h_{\max}$  = maximum water level in intake
- 3 Error! Transition from flowing to shooting  
 Faulty flow velocities and levels
- 4 Error! Caused by vorticity and wave formation behind fall  
 → Use other measurement place or renew manhole

**Fig. 4-12 Installation with fall or alternation of slope**



- 1 Front view of shaft
- 2 Top view on shaft
- 3 Side view of shaft
- 4 Berm:  $h_{\text{berm}} > h_{\text{max}}$

**Fig. 4-13** Sensor position in shafts featuring a high berm



- 1 Front view of shaft
- 2 Top view on shaft
- 3 Side view of shaft
- 4 Berm:  $h_{\text{berm}} < h_{\text{max}}$

**Fig. 4-14** Sensor position in shafts featuring a low berm

## 4 Sensor Positioning within the Measuring Section

### 4.2.2 In structured, part filled channels

For sensor installation make sure to:

- place the sensor mounting plates as horizontal as possible

In rectangular and almost rectangular channel shapes place the flow velocity sensors according to the Gauss quadrature:

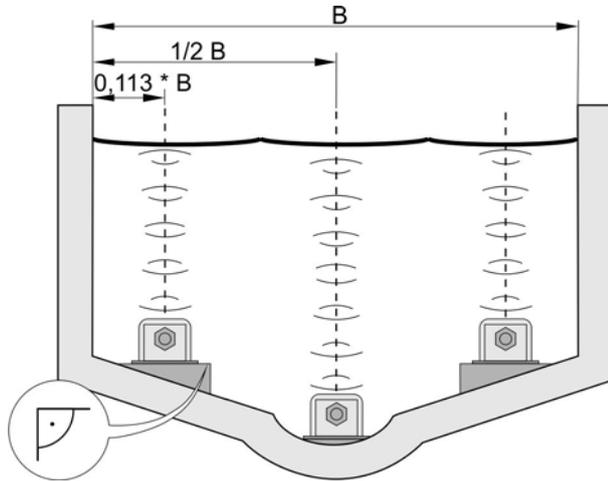


Fig. 4-15 Placement of multiple sensors following the Gauss quadrature

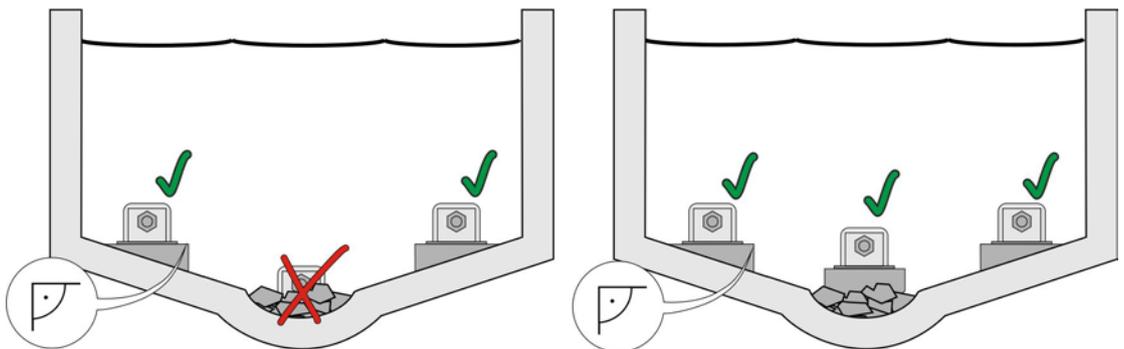
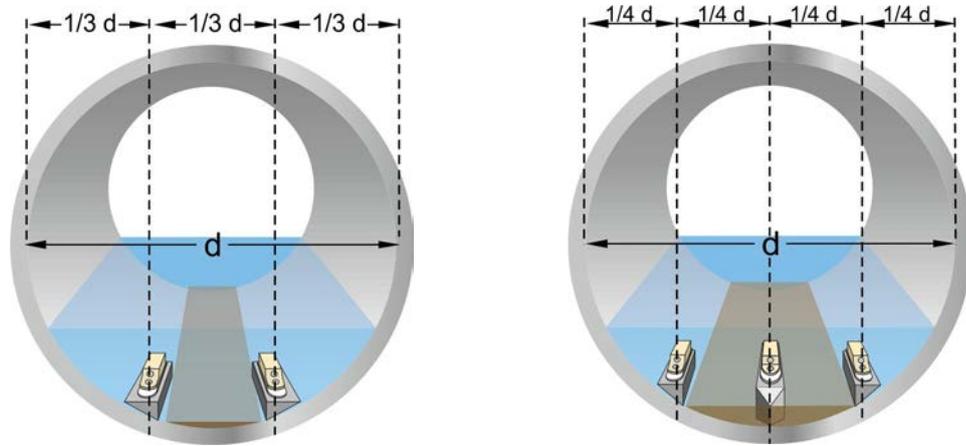
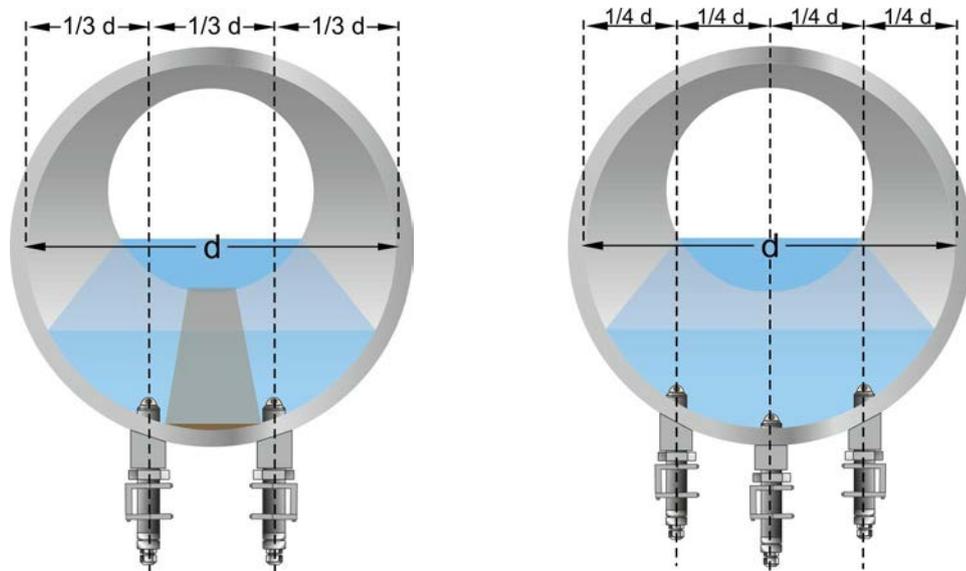


Fig. 4-16 Position in case of sedimentation in the dry weather flume

Place flow velocity sensors in pipes as follows:



**Fig. 4-17 Placement of multiple wedge sensors in pipes**

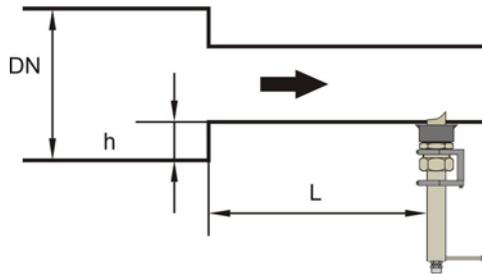


**Fig. 4-18 Placement of multiple pipe sensors**

For other profiles request the correct sensor positions from NIVUS. Please add dimensional drawings.

## 4 Sensor Positioning within the Measuring Section

### 4.2.3 In full pipelines



Sensortyp	h	L
<b>POA, CS2, KDA, KDO, CSM-V100R7</b>	$h \leq 5\%$ von DN	$L \geq \min \quad 3 * DN$
	$h > 5\%$ von DN	$L \geq \min \quad 5 * DN$
	$h \geq 30\%$ von DN	$L \geq \min \quad 10 * DN$
<b>CSM-V100R3</b>	$h \leq 5\%$ von DN	$L \geq \min \quad 5 * DN$
	$h > 5\%$ von DN	$L \geq \min \quad 10 * DN$
	$h \geq 30\%$ von DN	$L \geq \min \quad 30 * DN$

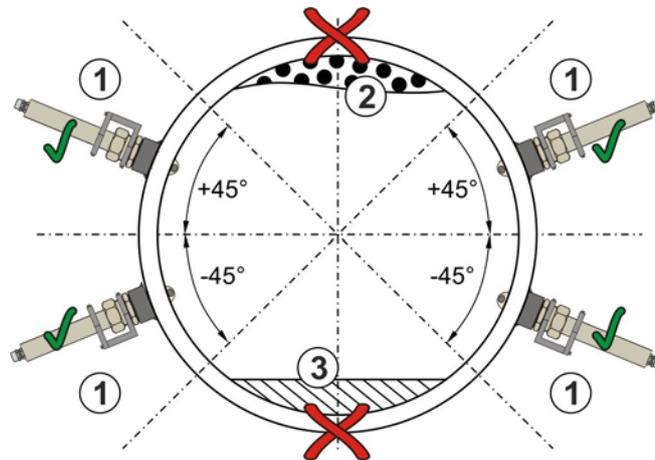
**Fig. 4-19 Sensor position after change of profile**

In horizontal pipelines sedimentation may build up on the channel bottom depending on the measurement medium and the flow velocity.

#### **Avoid pipe crown and pipe bottom as installation place.**

There is a risk of silting or a risk of air bubbles.

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

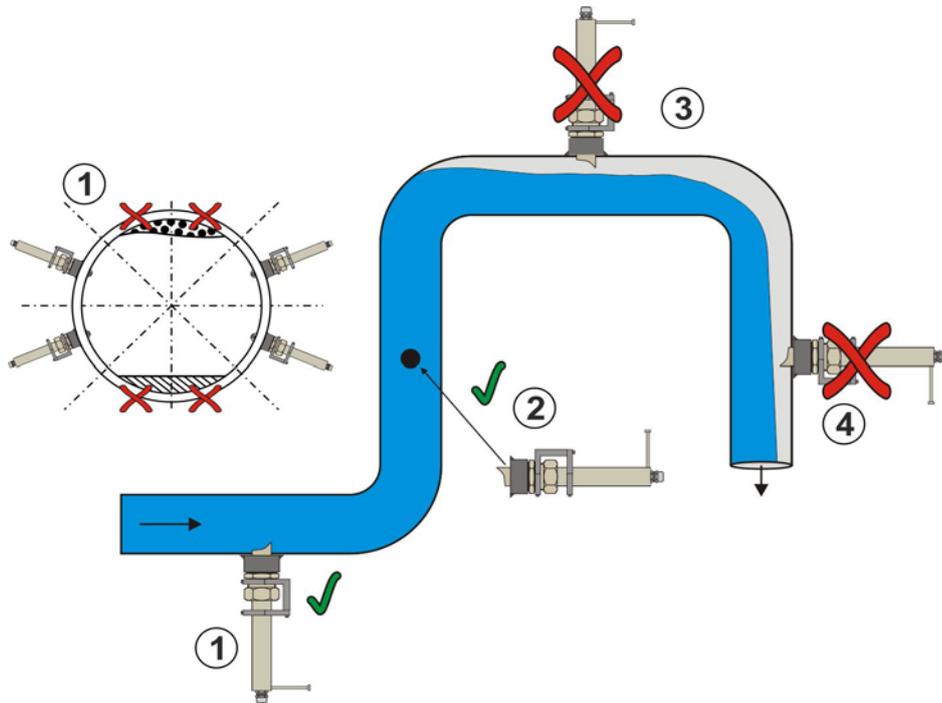


- 1 Recommended sensor installation positions
- 2 Risk of air-bubbles
- 3 Risk of sludge deposits

**Fig. 4-20 Recommended installation angles**

In pipelines running vertically upwards there is no risk of silting or formation of air bubbles on the sensor so that any place can be used for installation.

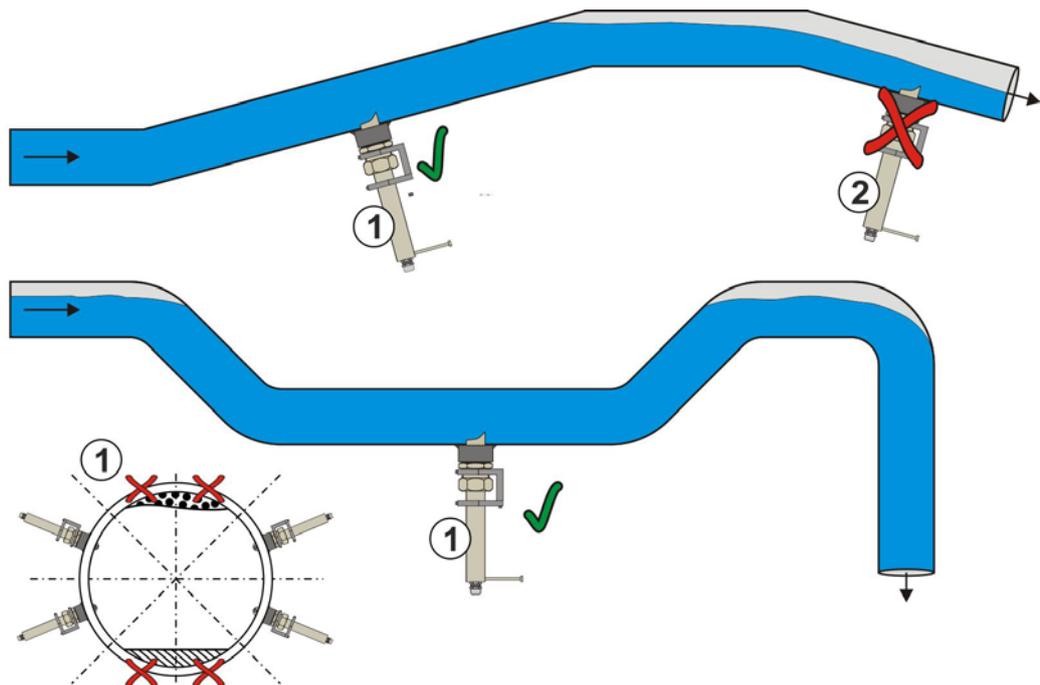
A correct and reliable measurement can be performed only in full filled pipes. For this reason do not install measurements in downpipes or at the highest point of the pipeline (see Fig. 4-21).



- 1 Recommended range in almost horizontal position (installation angle  $-45^{\circ}$  to  $+45^{\circ}$  to the horizontal)
- 2 Recommended range in vertical pipe
- 3 Not recommended due to part filling/idling
- 4 Measuring impossible due to idling

**Fig. 4-21 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.4-22).

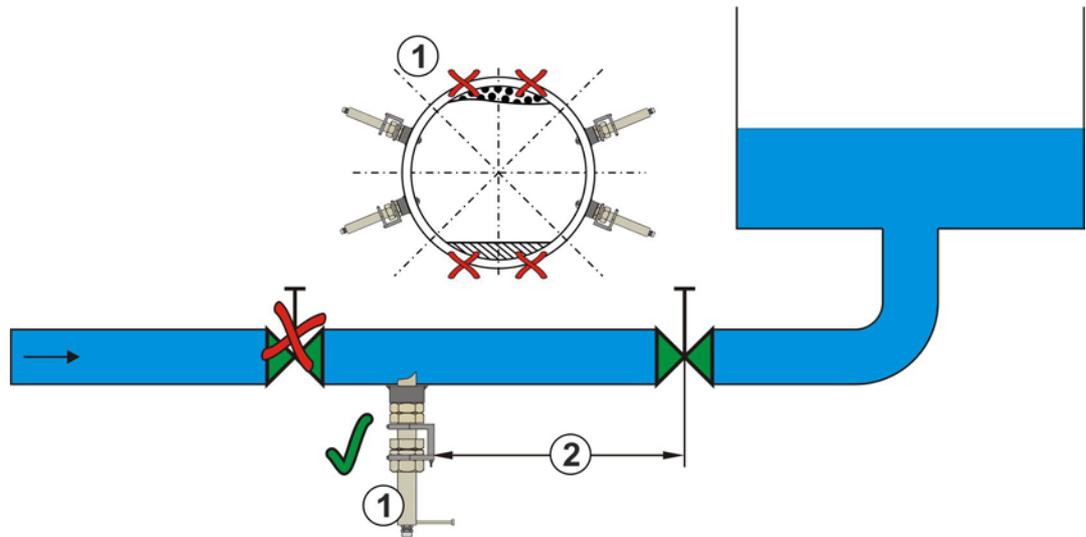


- 1 Recommended range (installation angle  $-45^{\circ}$  to  $+45^{\circ}$  to the horizontal)
- 2 Installation not recommended

**Fig.4-22 Horizontal pipe with inverted siphon**

## 4 Sensor Positioning within the Measuring Section

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



- 1 Recommended range (installation angle  $-45^{\circ}$  to  $+45^{\circ}$  to the horizontal)
- 2 Min.  $3 * DN$

**Fig.4-23 Using shut-off valves and control fittings**

## 5 Sensor Mounting

### 5.1 Principles of sensor mounting

---

**WARNING*****Danger of explosion in an environment with explosive gases***

*Persons may be injured.*

- *Prior to beginning installation works use a gas warner to check potential danger through explosive gases.*
  - *Observe regulations on safety at work.*
  - *During installation make sure to avoid the risk of electrostatic charge.*
  - *If necessary take the required security measures.*
- 

**WARNING*****Danger through electric shock!***

*Drilling works in wet rooms or into full pipelines may cause dangerous fault currents which may lead to personal injury.*

- *Use electronic personal protection equipment.*
- 

**CAUTION*****Risk of equipment damage and malfunction***

- *Verify whether sensors are appropriate for the application regarding pressure, temperature and measurement principle.  
The sensor specifications can be found in the "Technical Description for Correlation Sensors and Electronic Box" or in the "Technical Description for Doppler Sensors".*
- 

#### **Sensor mounting in dirty media**

Dirty media very quickly may lead to sedimentation on the channel bottom in channels and flumes featuring very low slopes or backwater formation. The result is a silted sensor on the channel bottom which may lead to measurement failure or unstable measurement.

Optional countermeasures:

- Elevate the sensor with a wedge-shaped support (see chapter 8.7)
- Install the sensor on the channel wall on the side
- Install the pipe sensor by using a float (see chapter 8.9)

## 5.2 Wedge sensors

### 5.2.1 Information on the installation of wedge sensors

#### 5.2.1.1 Basics

- Do not remove any parts from the wedge sensor. Loosening or removing ground plate or cable gland of the sensor will result in leakage allowing water to leak into the sensor which destroys the electronic components. This will lead to measurement failure.
- Do not widen the mounting holes in the mounting plate.
- Do not bend the sensor mounting plate.
- Install fastening components for wedge sensors plane with the ground plate. Screws or other parts reaching out into the medium may cause trespassing in the wastewater sector. Trespassing leads to disturbances or measurement failure.
- Install the wedge sensor on a perfectly plane surface. Uneven surfaces may lead to sensor body break.

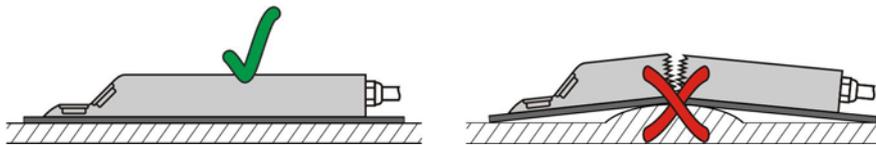


Fig. 5-1 Overview wedge sensor installation on plane surface

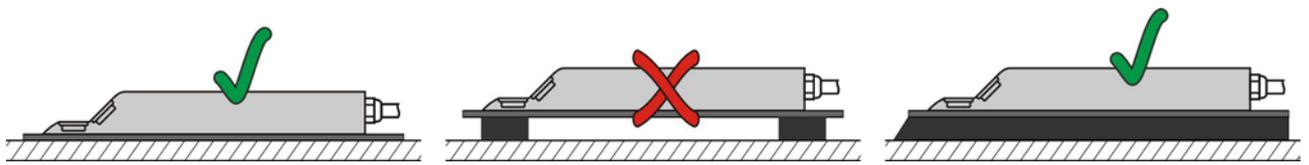
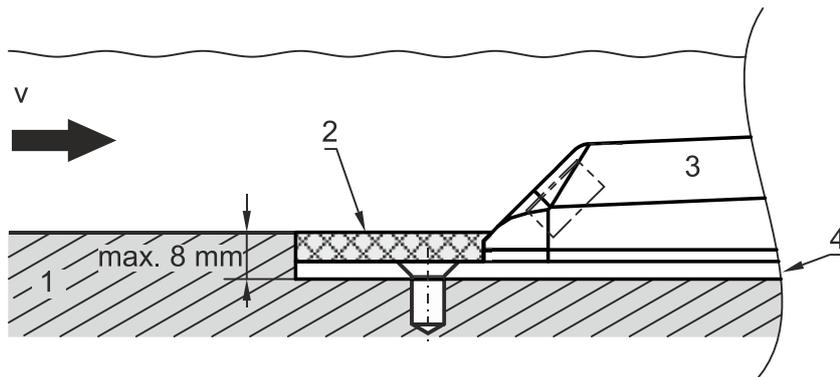


Fig. 5-2 Elevated wedge sensor

### 5.2.1.2 Wedge sensor without built-in pressure measurement cell

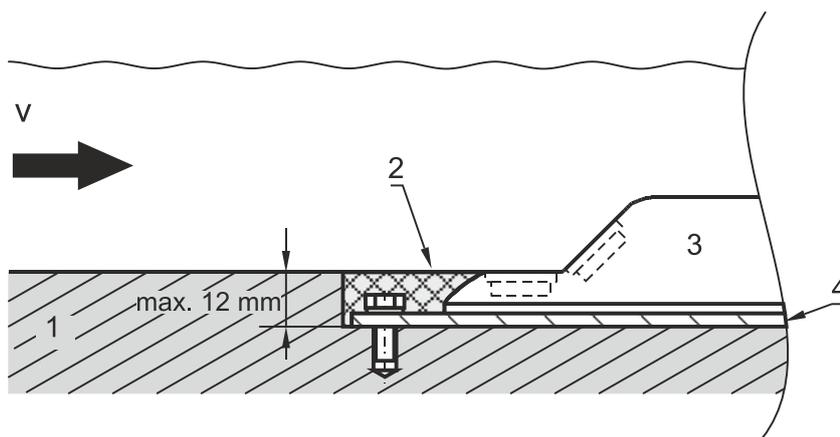
**Observe during sensor installation:**

- Install wedge sensor **without pressure measurement cell** in a depression if possible. This depression must be created prior to installation.
- Depression for KDA, KDO and CS2 sensors: max. 8 mm (see *Fig. 5-3*)
- Depression POA sensor: max. 12 mm (see *Fig. 5-4*).
- After finishing installation works seal the remaining gaps with permanently elastic material (silicone or similar).



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

**Fig. 5-3 Countersunk wedge sensor (KDA, KDO or CS2)**



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

**Fig. 5-4 Countersunk wedge sensor (POA)**

## 5.2.1.3 Wedge sensor with integrated pressure measurement cell

### Observe when installing and operating the sensors:

- **Do not countersink** combi sensors with **integrated pressure measurement cell** into the mounting place. Sealing or pollution lead to faulty level measurements. The measurement is inaccurate or fails completely.
- Do not remove the cover on the pressure measurement cell. This cover protects the cell from external influence. Removing the cover will invalidate the warranty.
- Do not touch the pressure measurement cell. Do not use a water jet for cleaning. Touching with fingers, brushes, water jets etc. will damage the pressure measurement cell and hence leads to measurement failure.
- Always operate sensors with built-in pressure measurement cell with a pressure compensation element. Moisture leaking in may destroy the electronic components of sensors with integrated pressure cell.

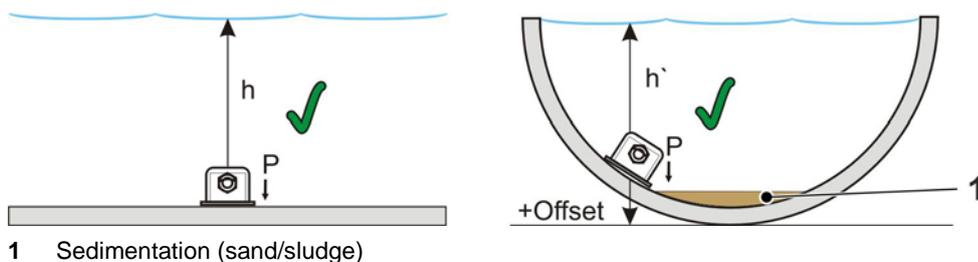


### Note

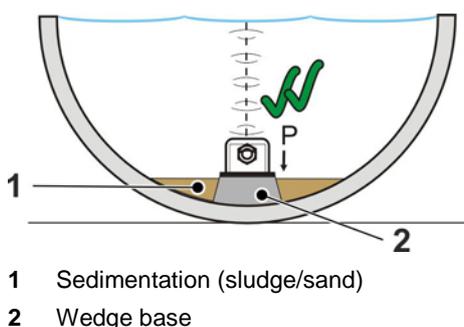
*If you use a combi sensor with pressure measurement cell please note that in case of high flow velocities and low filling levels measurement errors might arise due to physical reasons (Bernoulli effect).*

### With the risk of soiling or silting

- Install sensors with integrated pressure measurement cell out of the centre. The pressure cell detects the filling level above the sensor.
- **Or** elevate the sensor by using a wedge-shaped support.



**Fig. 5-5** Sensor with integrated pressure measurement cell: installation out of centre



**Fig. 5-6** Sensor with integrated pressure measurement cell: installation with wedge base

### Cable with integrated air hose

The cables of wedge sensors with integrated pressure measurement cell are equipped with an air hose which compensates fluctuations in atmospheric air pressure.

Observe when handling the air hose:

- Do not kink cable and air hose.
- Do not close the air hose.
- Do not extend cable end using a hermetically closed junction box.
- Do not use any other air filters than the original ones.

The pressure measurement cell cannot measure the filling level correctly if the notes above are disregarded.

### Installation of the required pressure compensation element

- Choose installation place of the pressure compensation element for easy access in case of maintenance
- Install it in an area without overflow
- **Note:** Overflow protection prevents intrusion of water into the air filter of the pressure compensation element as well as the pressure sensor, but distorts the measuring in case of overflow

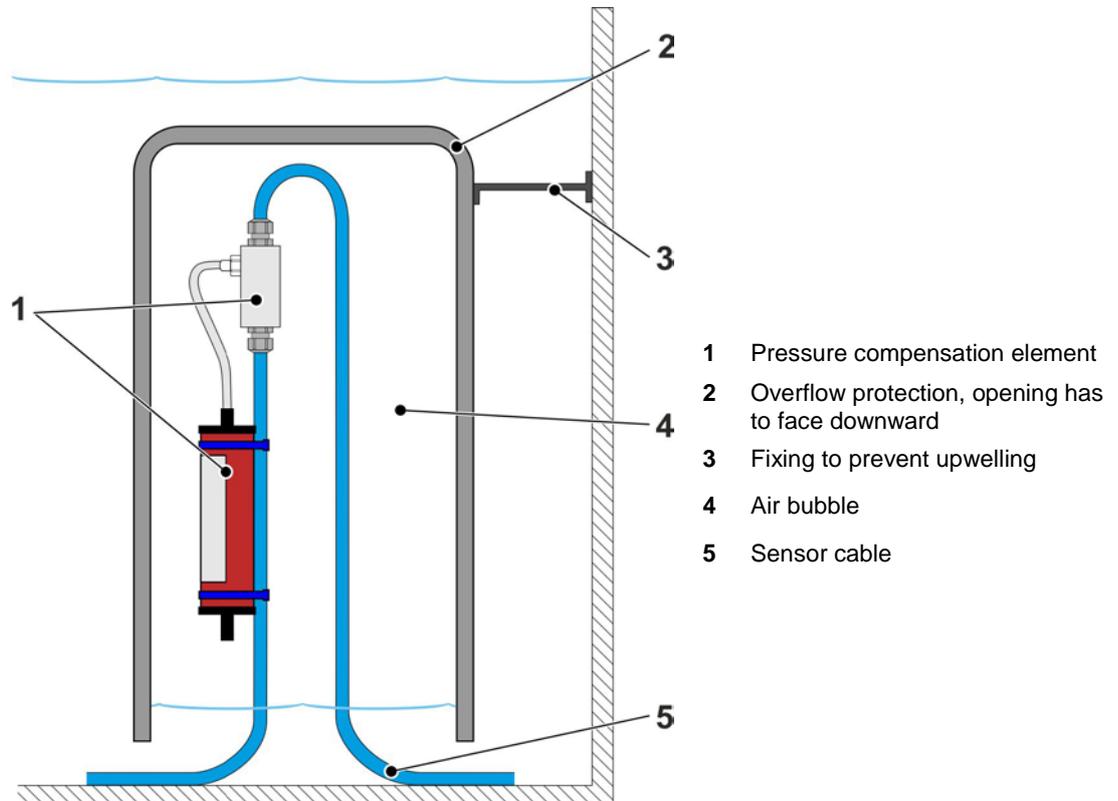


Abb. 5-7 Proposal for overflow protection



Any information on the pressure compensation element (description, installation, maintenance) can be found in the Technical Instructions for Correlation Sensors an external Electronic Box.

### 5.2.1.4 Wedge sensor with integrated water-ultrasonic measurement

#### Observe when installing the sensors:

- Install sensors with integrated water-ultrasonic measurement so that the ultrasound hits the contact area between the medium and air perpendicularly. Slanted angles lead to echo loss and hence to failure of the level measurement.

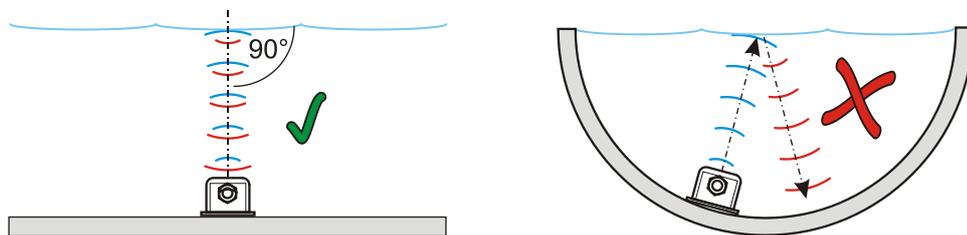


Fig. 5-8 Installation of sensor with integrated water-ultrasonic measurement

### 5.2.2 Tools and material needed

#### To install wedge sensors you need:

- (Impact) drill with (masonry) drill bit
- 4 stainless steel screws with countersunk head (size M5, length 30 - 70 mm)
- 4 appropriate dowels
- Screwdrivers (to fit the screws)
- Cable cover sheets or similar

**Do not use:** stud bolts or similar fastening material.

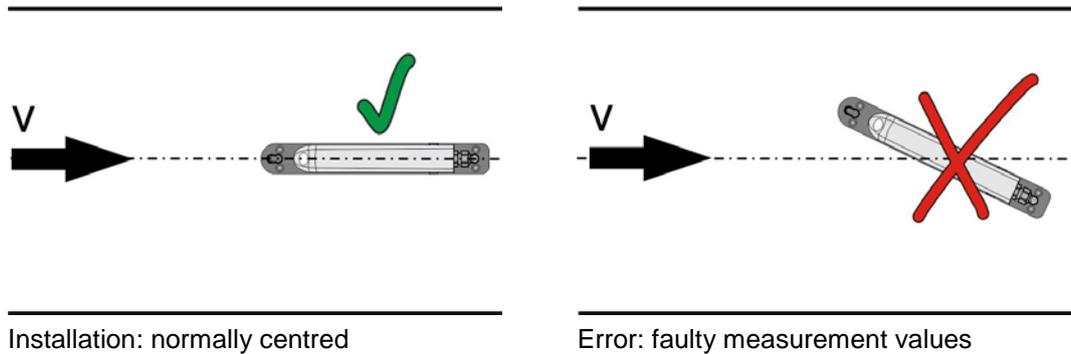
For special applications other particular tools and materials maybe required.

**Tools and materials are not part of the standard delivery!**

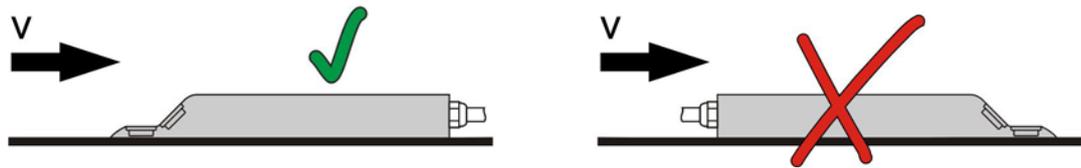
⇒ Tools and mounting accessories see chapters 8 and 9.

### 5.2.3 Alignment of wedge sensors

The standard installation place of wedge sensors is exactly in the centre of the channel bottom. The bevelled side of the sensor is looking towards the flow direction.



**Fig. 5-9** Sensor alignment

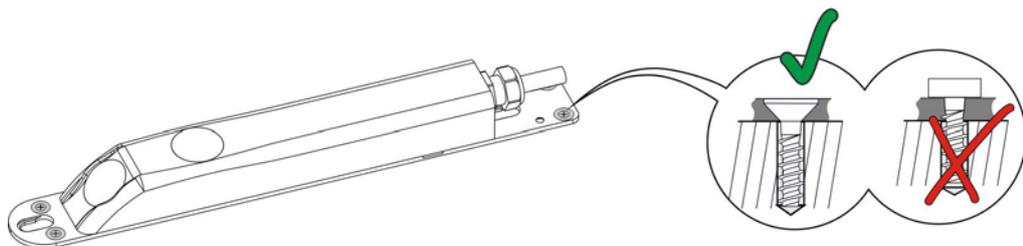


**Fig. 5-10** Sensor alignment towards the flow direction

### 5.2.4 Fastening wedge sensors

**Procedure:**

1. Provide screws and the appropriate dowels: select the length of the screws so as to ensure safe and durable sensor fastening.
2. Drill holes in the desired place of installation according to the size of the dowels.
3. Insert dowels into the drilled holes.
4. Screw the sensor on so that the screws are completely countersunk in the mounting plate/ground plate. This helps to avoid vortex formation and tressing.
5. Seal possible gaps on the mounting plate/ground plate using silicone or other appropriate material. No gaps must remain between mounting plate/ground plate and the bottom!



**Fig. 5-11** Wedge sensor mounting

### 5.2.5 Laying cables

#### Observe when laying the cables:

- Do **not** lay the sensor cable loosely, unprotected or crosswise to the flow direction since pollutants carried with the medium may build up trespassing on the cable. Result: damaged sensor or cable break.
- To avoid disturbances from electrical interferences do not lay sensor cables close to engine (motor) supply lines and main power lines.
- The bending radius of the cable shall not be less than 10 cm (cable with protective FEP jacket 15 cm).
- Run the cable out of the channel on the same side as the sensor. Do not lay the cable across the channel bottom or through the medium (see figure below).

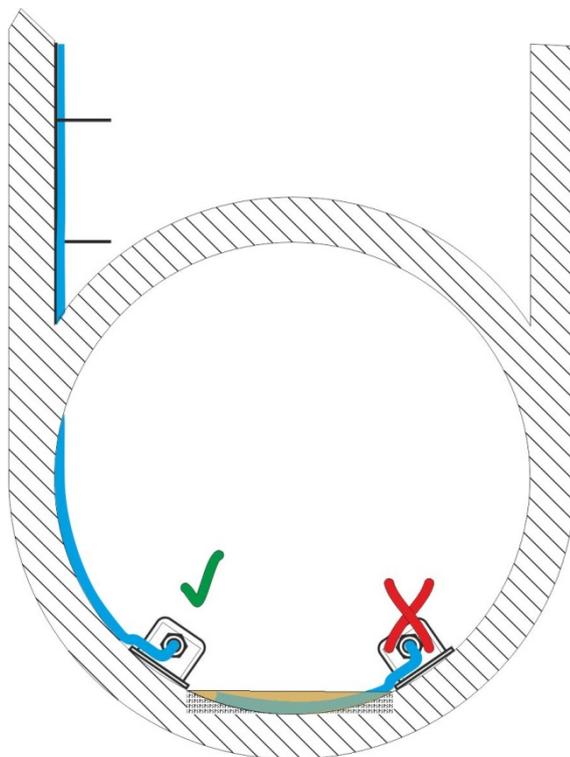


Fig. 5-12 Laying the wedge sensor cable

#### Cable with protective FEP jacket:

The connection cables of the high-resistant wedge sensors are coated with an additional transparent protective FEP jacket. This protective FEP cable jacket guarantees resistance to organic solvents, acids and lye.

#### Observe when handling FEP-coated cables:

- Treat highly resistant sensors with extra protective FEP cable jacket very carefully. Do not damage or remove the protective FEP cable jacket under any circumstances.

- The minimum bending radius for connection cables with protective FEP jacket is 15 cm. Using a radius less than will damage the protective FEP jacket.
- The protective FEP cable jacket is not suitable for being bent frequently or for movable cable installation.

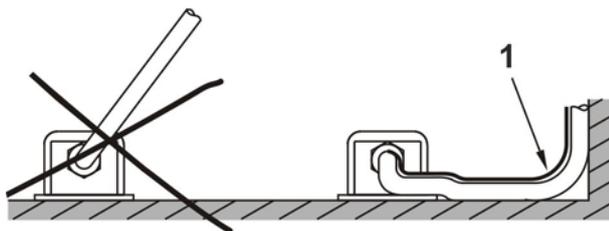
### Cable laying:

- Run the cable on the channel bottom behind the sensor until the channel wall. The bending radius of the cable shall not be less than 10 cm (cable with protective FEP jacket 15 cm).

### To avoid tressing:

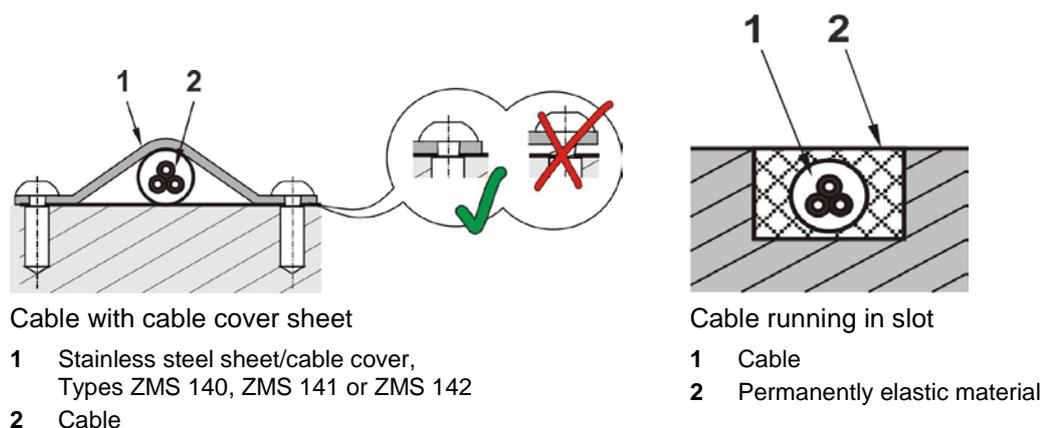
- Use a thin and medium-resistant stainless steel sheet to cover the cable.
- **or** lay the cable in a slot and then seal it by using permanently elastic material.
- Fasten cable bends on the ground additionally by using cable clamps.

⇒ Cable cover sheets see chapter 8.8



1 Protective cover / cable cover

**Fig. 5-13 Laying the cable within the medium**



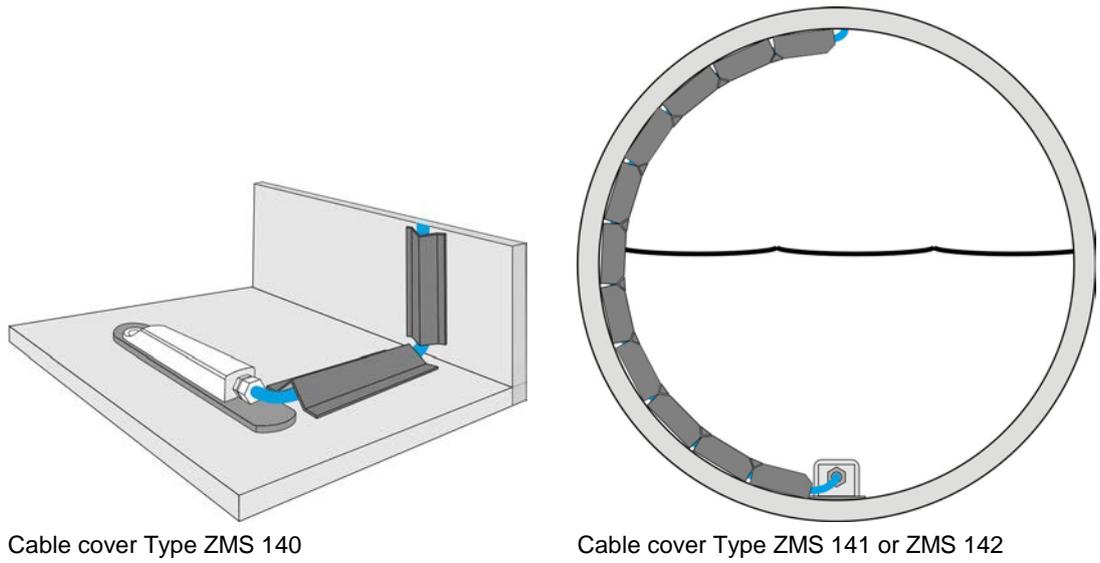
Cable with cable cover sheet

- 1 Stainless steel sheet/cable cover, Types ZMS 140, ZMS 141 or ZMS 142
- 2 Cable

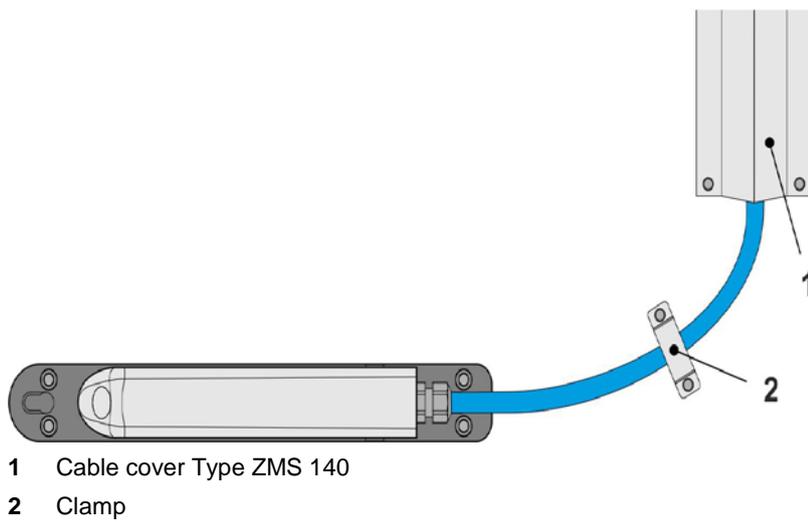
Cable running in slot

- 1 Cable
- 2 Permanently elastic material

**Fig. 5-14 Mounting examples for cable laying**



**Fig. 5-15** Cable laying with cable cover



**Fig. 5-16** Cable laying with cable cover and clamp

## 5.3 Air-ultrasonic sensors OCL and DSM

### 5.3.1 Notes on the installation of air-ultrasonic sensors

#### Observe when installing the sensors:

- Do not remove any parts from the wedge sensor (exceptions see chapter 5.3.2). Loosening or removing ground plate or cable gland of the sensor will result in leakage allowing water to leak into the sensor which destroys the electronic components. This will lead to measurement failure
- Do not widen the holes in the mounting plate.
- Do not bend the sensor mounting plate.
- Install the sensor on a perfectly plane surface. Uneven surfaces lead to sensor body break.
- Install sensor fastening parts plane with the mounting plate.

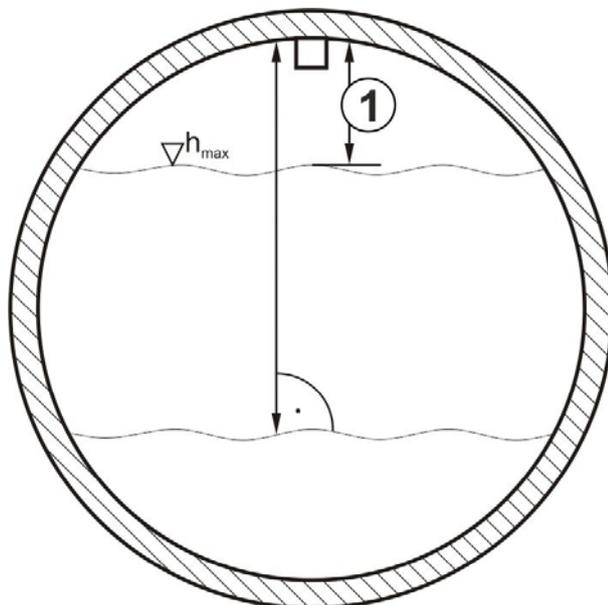
#### Notes on flooding OCL or DSM sensors:

The level cannot be measured within the so-called >dead zone<.

In the dead zone area or when the air-ultrasonic sensor is flooded the ultrasonic signal is erroneously transmitted into the measurement medium.

- The dead zone of OCL sensors is 14 cm
- The dead zone of DSM sensors is 4 cm

Coupling ultrasound into water leads to faulty measurements in such a case.



1 Dead zone

Fig. 5-17 Dead zone of OCL or DSM sensors

#### Adjust dead zone in transmitter:

1. When setting the transmitter parameters hide the flooding range.
2. Deactivate the sensor in this range.

### 5.3.2 Construction of the mounting plate

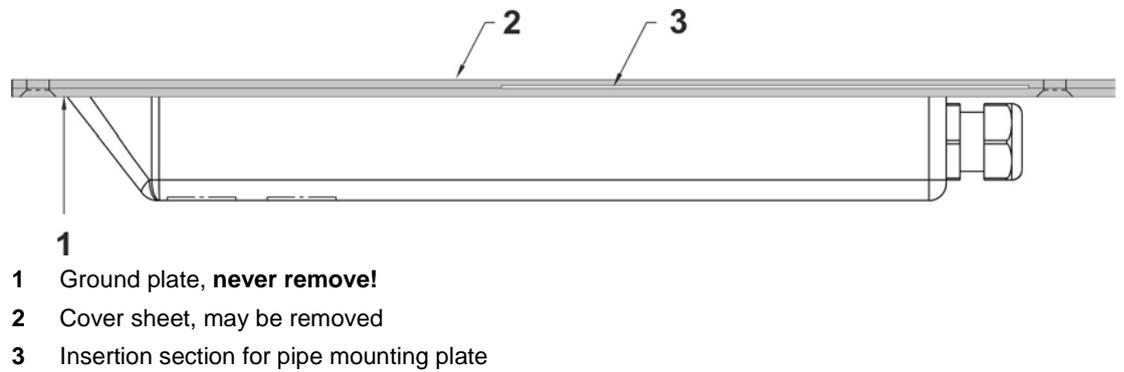


Fig. 5-18 Sensor OCL: construction of the mounting plate

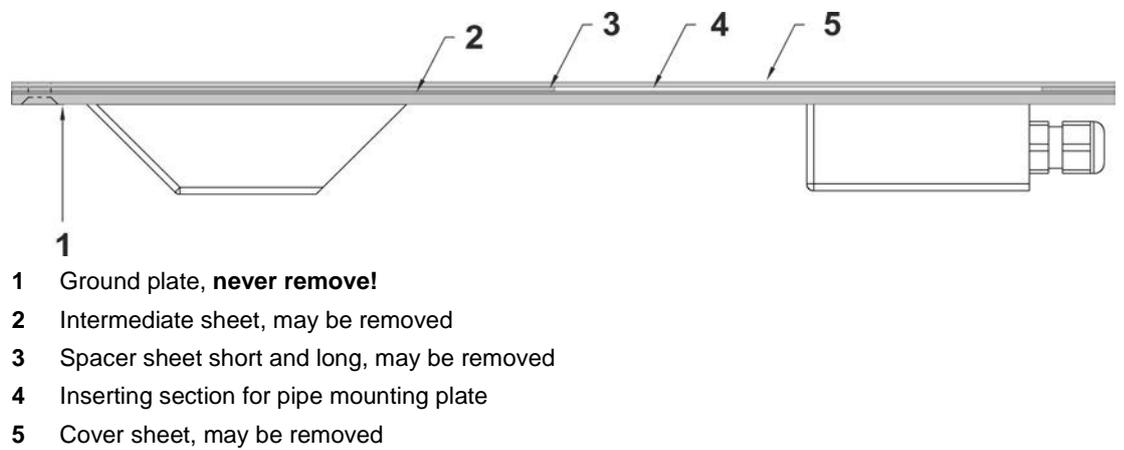


Fig. 5-19 Sensor DSM: construction of the mounting plate

### 5.3.3 Sensor positioning

Looking towards the flow direction the OCL or DSM sensor must be installed in a minimum distance of 10 cm upstream of the wedge sensor (see figure below). Otherwise there is a risk of detecting too high filling levels particularly in case of low levels.

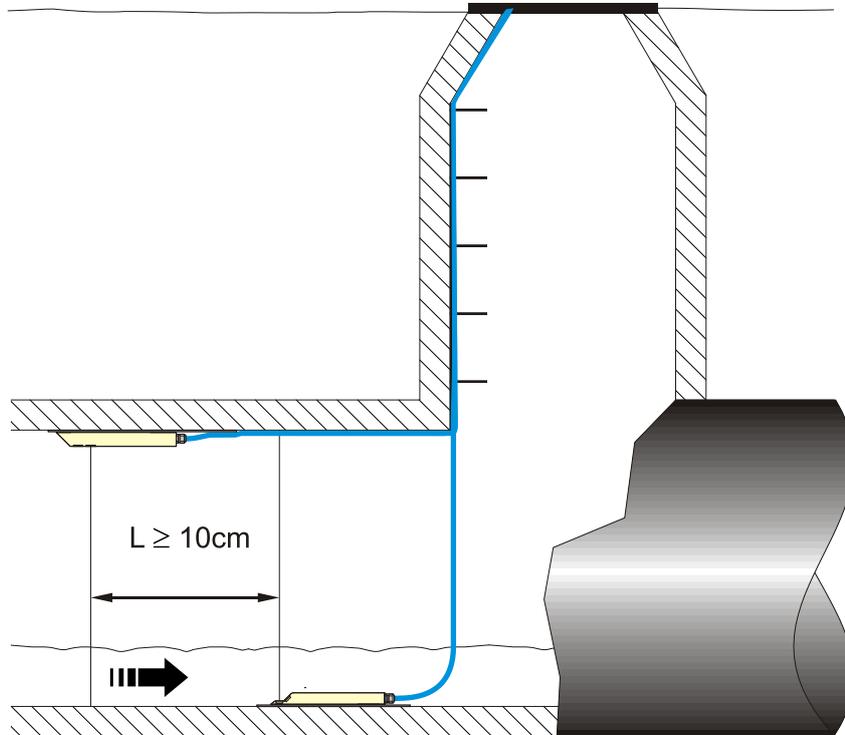


Fig. 5-20 Mounting example for OCL or DSM sensors

### 5.3.4 Tools and material needed

**For permanent installation of OCL and DSM air-ultrasonic sensors in the channel crown you need:**

- (Impact) drill with (masonry) drill bit
- 3 stainless steel screws with countersunk head (size M5, length 30 - 70 mm)
- 3 appropriate dowels
- Screwdrivers (to fit the screws)
- Cable cover sheets or similar if required

**Additionally required for DSM air-ultrasonic sensor:**

- NIVUS fastening shoe (Art.-No. E-GES-LUSBFSCH)

**Tools and materials are not part of the standard delivery!**

⇒ Tools and mounting accessories see chapter 9

### 5.3.5 Permanent fastening in pipe

Observe correct sensor position (see *Fig. 5-20*).

---

**WARNING*****Danger through electric shock!***

*Drilling works in wet rooms or into full pipelines may cause dangerous fault currents which may lead to personal injury.*

- *Use electronic personal protection equipment.*
- 

**Installing air-ultrasonic sensor in channel crown:**

1. Provide screws and the appropriate dowels.
2. Drill holes in the desired place of installation according to the size of the dowels
3. Insert dowels into the drilled holes.
4. Screw the sensor on so that the screws are completely countersunk in the mounting plate/ground plate.

### 5.3.6 Temporary fastening in pipe

For temporary sensor fastening uses a NIVUS pipe mounting system.



---

*Refer to the Installation Instruction for pipe mounting systems.  
The instruction is a part of the respective standard delivery.*

---

## 5.4 Pipe sensors

### 5.4.1 Notes on pipe sensor mounting

The sensors can be installed in

- Empty pipelines/flumes/channels

Never install sensors on vibrating pipe lines!

Observe when installing the sensors:

- Pipe sensors must be installed in pipes permanently (exception: sensor installation using a float, see chapter 8.9). The fastening element is a part of the standard delivery and has to be used in any event.
- To install the pipe sensor it is necessary to drill a hole into the pipe wall. Never burn pipes with welding torches. Deposited welding beads may cause swirls in front of the sensor (see Fig. 5-21) which impair the measurement values.
- Use only corrosion-free fastening material.

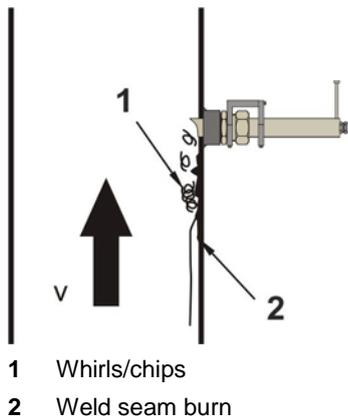


Fig. 5-21 Disturbances caused by weld seam burn

**NIVUS recommendations:** charge an expert company with drilling work in pipelines and with the installation of the sensor nozzles.

### 5.4.2 Tools and material needed

**For the installation of all pipe sensors you need:**

- Drilling machine with slipping clutch
- Cutting paste
- Teflon tape if required
- Suitable core drill bit with extension if required
- Pipe wrench or appropriate spanners

**Additionally required to install the CSM pipe sensor:**

- Allen key 4 mm

Special applications may require other particular tools and materials.

**Tools and materials are not part of the standard delivery!**

⇒ Tools and mounting accessories see chapters 8 and 9.

### 5.4.3 Alignment of pipe sensors

**Observe when fastening sensors in pipes:**

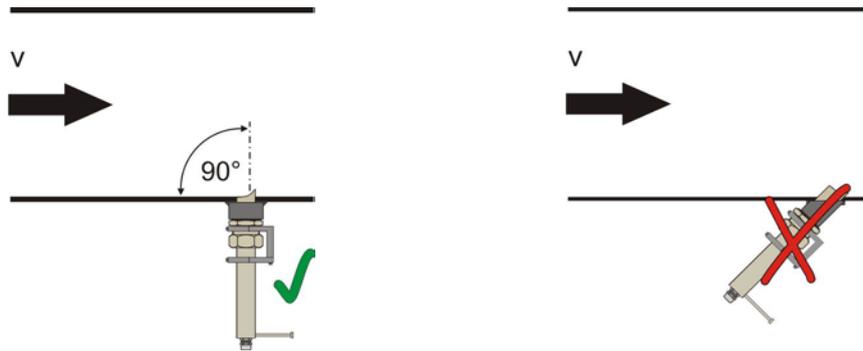
Place the pipe sensor so that the bevelled side of the sensor (= sensor face) is accurately looking upstream.

- **POA, CS2, KDA/KDO pipe sensors:** the alignment aid (see *Fig. 5-25*) must be looking downstream.
- **CSM pipe sensor:** centre line of the scale (see *Fig. 5-29*) = alignment aid: align the centre line in upstream direction.



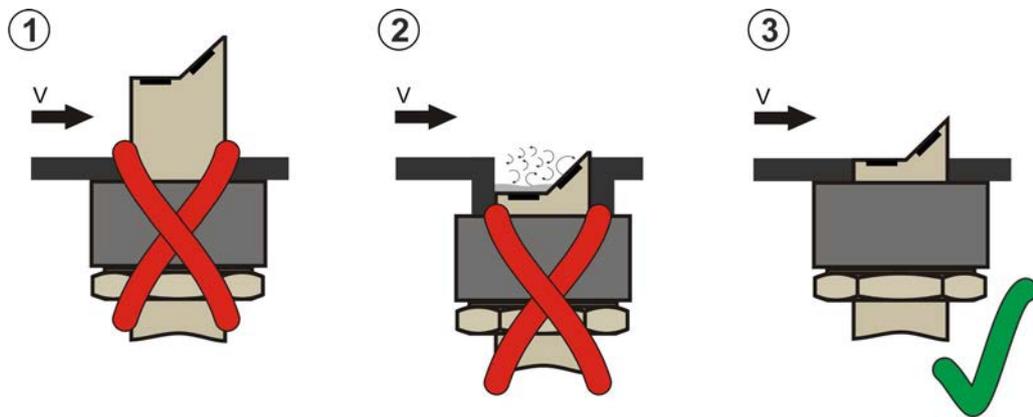
**Fig. 5-22** Sensor face looking upstream

Fasten the welding nozzle in an angle of 90° to the pipe.



**Fig. 5-23** Pipe sensor 90° to pipe wall

Position the pipe sensor so that the horizontal part of the sensor head is perfectly flush with the pipe wall.

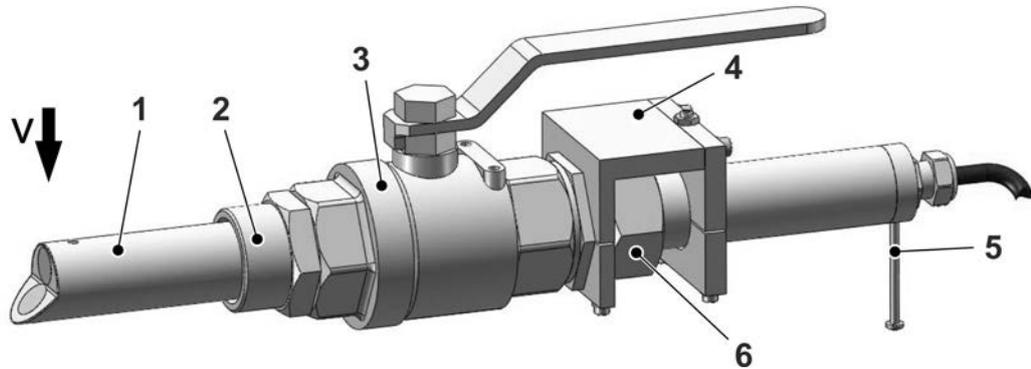


- 1 Sensor reaching too far into the medium: Faulty measurement values
- 2 Sensor too low: sedimentation and swirls lead to faulty measurements
- 3 Correct installation

**Fig. 5-24** Sensor position in the pipe wall

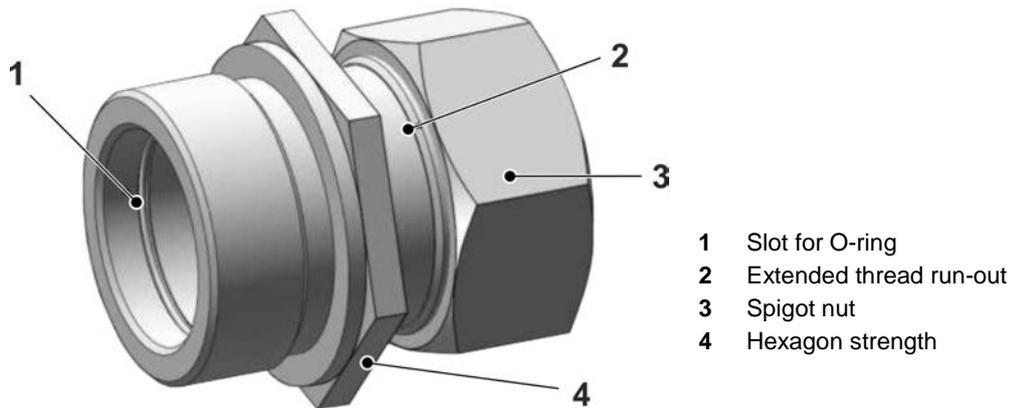
### 5.4.4 Pipe sensors POA, CS2 KDA/KDO: Drilling in pipelines and mounting

#### 5.4.4.1 Overview of components



- 1 Pipe sensor
- 2 Welding nozzle
- 3 Stop ball valve (optional)
- 4 Fastening element
- 5 Screw, alignment aid, 180° to flow direction
- 6 Sensor screw connection, detailed description see *Fig. 5-26*

**Fig. 5-25 Pipe sensors POA, CS2 and KDA/KDO**



**Fig. 5-26 Sensor screw connection**

## 5.4.4.2 Notes on drilling in pipelines

### WARNING



#### ***Danger through electric shock!***

*Drilling works in wet rooms or into full pipelines may cause dangerous fault currents which may lead to personal injury.*

- *Use electronic personal protection equipment.*

### CAUTION



#### ***Danger of injury!***

*The drill machine may block if you exert too much contact pressure. This may lead to personal injury.*

- *Observe contact pressure. The contact pressure depends on pipe material and wall strength.*
- *Do not use other drilling speeds than specified by the manufacturer of the core drill bit.*

The following information is applicable for pipes made of

- steel
- stainless steel
- plastic

Should your pipes be made of other materials (such as concrete or cast iron) consult a piping construction company or contact NIVUS.

**Precondition for the installation of pipe sensors is an empty pipeline.**

**Prior to installation make sure the pipe or the pipeline is empty.**

**NIVUS recommendation:** use a slow drill machine with a slipping clutch.

⇒ Tools and mounting accessories for pipe sensor mounting see chapter 8.

### 5.4.4.3 Drill into empty pipeline and fasten nozzle

#### Prepare drilling:

1. Plug in electronic personal protection equipment.
2. Mark the sensor installation spot on the pipe.
3. Fix the Ø 38 mm core drill bit into the drill machine
4. Set the drilling speed.

The drilling speed depends on the core drill bit used and the pipe material. To set the drilling speed, refer to information as specified by the manufacturer of the core drill bit.

#### Drilling:

1. Drill and
  - a) observe the contact pressure of the drill machine,
  - b) observe unhindered chip removal,
  - c) use cutting paste to cool down the core drill bit.
2. Interrupt drilling procedure if required and remove chips.

#### Fasten nozzle:

1. Remove chips.
2. Deburr hole using a file.
3. Fasten nozzle. The fastening method depends on the pipe material, e.g.:
  - a) Welding (steel, stainless steel)
  - b) Using a tapping saddle
  - c) Gluing (PVC)
  - d) Plastic welding (HDPE)
  - e) Laminating

#### Next step:

- Prepare sensor installation (see chapter 5.4.4.5)

#### 5.4.4.4 Notes on sensor mounting

**CAUTION**



***Danger of personal injury!***

*Installing POA, CS2 and KDA/KDO pipe sensors without fastening element may cause the sensors to work loose and to be ejected from the screw joint. As a result, media can escape uncontrollably, which may lead to personal injury or equipment damage.*

- *Do not use POA, CS2 and KDA/KDO pipe sensors without fastening element!*

**Observe when installing:**

- Fasten the pipe sensor by using a fastening element (see chapter 5.4.4.7). The fastening element is a part of the standard delivery and has to be used in any event.
- Optionally use a stop ball valve (see chapter 8.3) for pressureless removal.

#### 5.4.4.5 Prepare sensor mounting

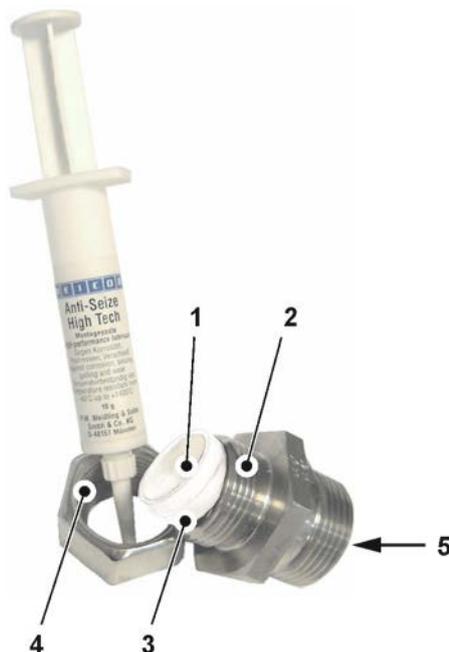
A special grease paste for stainless steel screw joints according to DIN 2353 must be used for sensor mounting.

**Screw joints are greased per default.**

Possibly required grease paste can be ordered from NIVUS.

**Slightly grease the below parts of the screw joint prior to sensor installation:**

- Thread of the screw joint (*Fig. 5-27, Pos. 2*)
- Inner cone of the screw joint (*Fig. 5-27, Pos. 3*)
- Inner thread of spigot nut (*Fig. 5-27, Pos. 4*)



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

**Fig. 5-27 Grease sensor screw connection**

### Install sensor screw joint

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



2. Screw the sensor screw connection into the welded nozzle or into the stop ball valve.
3. Tighten by using a pipe wrench or a size 55 spanner.



### Next step:

- Install pipe sensor (see chapter 5.4.4.6)

### 5.4.4.6 Install pipe sensor



#### **Important Note**

*Install the pipe sensor according to DIN 3859-2.*

#### **Prerequisite:**

- Nozzle or tapping saddle is installed and a hole has been drilled into the pipeline (see chapter 5.4.4.3).

#### **Procedure:**

1. Pull spigot nut and sealing ring over the pipe sensor.
2. Optional: open the stop ball valve.
3. Insert pipe sensor with sealing ring into the sensor screw joint.
4. Insert the pipe sensor so far into the screw joint that only the sensor head reaches into the medium (see chapter 5.4.3).
5. Align the sensor (see chapter 5.4.3).



6. Tighten the spigot nut only by hand.
7. Then use a size 50 spanner to tighten the spigot nut to a maximum of half a turn.



#### **Next steps:**

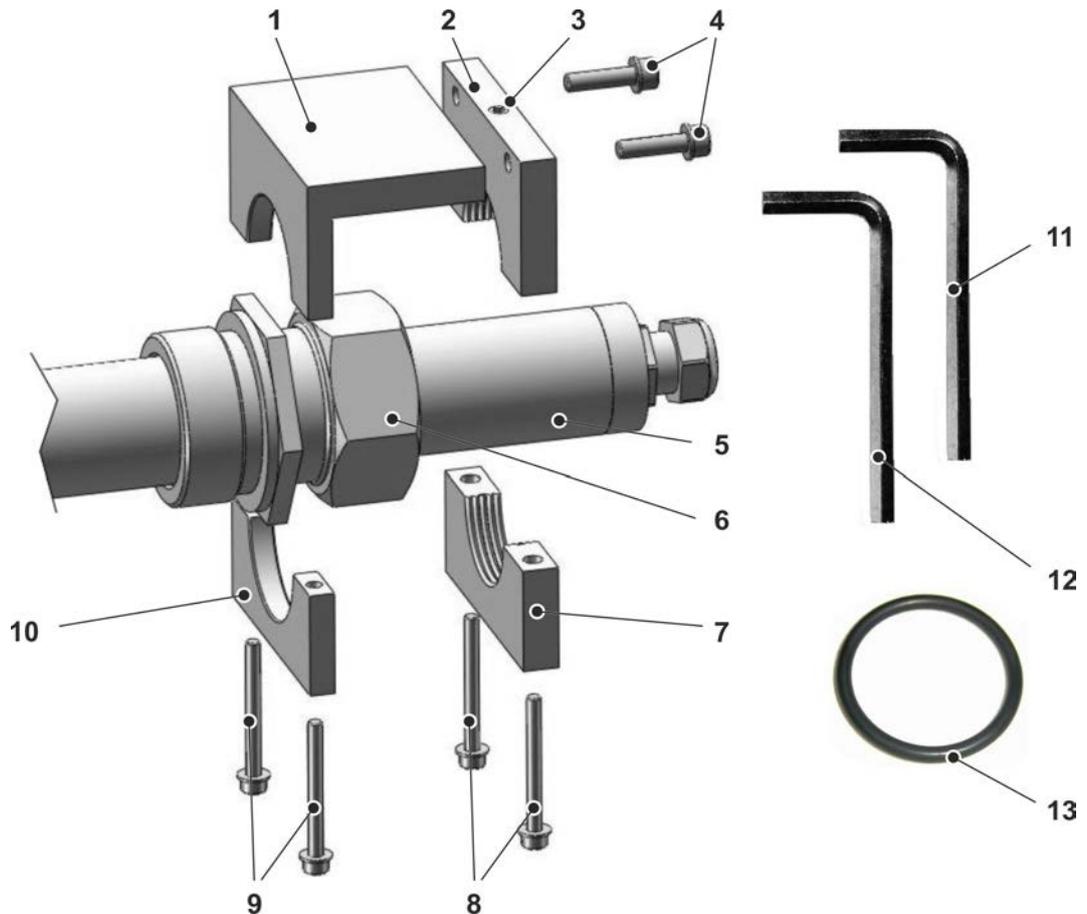
- Prepare the installation of the fastening element (see chapter 5.4.4.8)
- Install the fastening element (see chapter 5.4.4.9)

### 5.4.4.7 Fastening element: Overview of components

The fastening element is a part of the standard sensor delivery and has to be used in connection with the appropriate sensor screw joint.

The fastening element

- safely holds the sensor in place and, if installed correctly, avoids the sensor to be ejected.
- facilitates accurate sensor reinstallation after cleaning or verification measures.



- 1 Upper front clamp element (1x)
- 2 Upper rear clamp element (1x)
- 3 Welded headless screw (as additional clamp lock)
- 4 Allen® head screw M5 (2x)
- 5 Pipe sensor
- 6 Sensor screw joint
- 7 Lower rear clamp element (1x)
- 8 Allen® head screw M5 (2x)
- 9 Allen® head screw M4 (2x)
- 10 Lower front clamp element (1x)
- 11 Allen key® – 1 x 2.5 mm
- 12 Allen key® – 1 x 3 mm
- 13 O-ring, spare part for sensor screw connection, see *Fig. 5-26*

**Fig. 5-28 Fastening element for pipe sensors**



### Note

*The fastening element has been tested by an independent test centre with a continuous load of 4 bar as well as with an impact load (30 seconds) of 8.0 bar.*

*Higher pressures cannot be compensated safely!*

### 5.4.4.8 Prepare installation of the fastening element

#### Procedure:

1. To ensure safe clamping grease the rear area of the pipe sensor and the rear clamp elements of the fastening element (*Fig. 5-28, Pos. 2 and 7*).
2. Observe to keep sensor shaft as well as the clamping area of the clamp elements dry.

### 5.4.4.9 Install fastening element



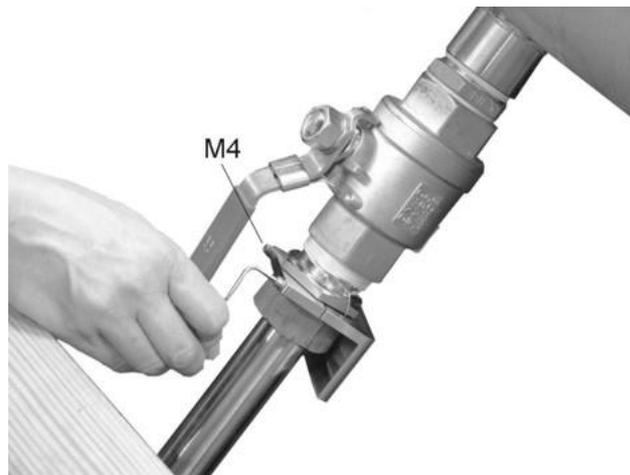
#### Important Note

*To ensure the tested safety:*

- *tighten all screws by a minimum of 6 Nm.*
- *check the tightness of the entire screw joint.*

#### Procedure:

1. Connect the upper front clamp element (see *Fig. 5-28, Pos. 1*) with the lower front clamp element (Pos. 10) of the sensor screw joint by using both M4 hexagon socket screws (Pos. 9).



2. Use both M5 hexagon socket screws (see *Fig. 5-28*, Pos. 4) to screw the upper rear clamp element (Pos. 2) to the upper front clamp element (Pos. 1).



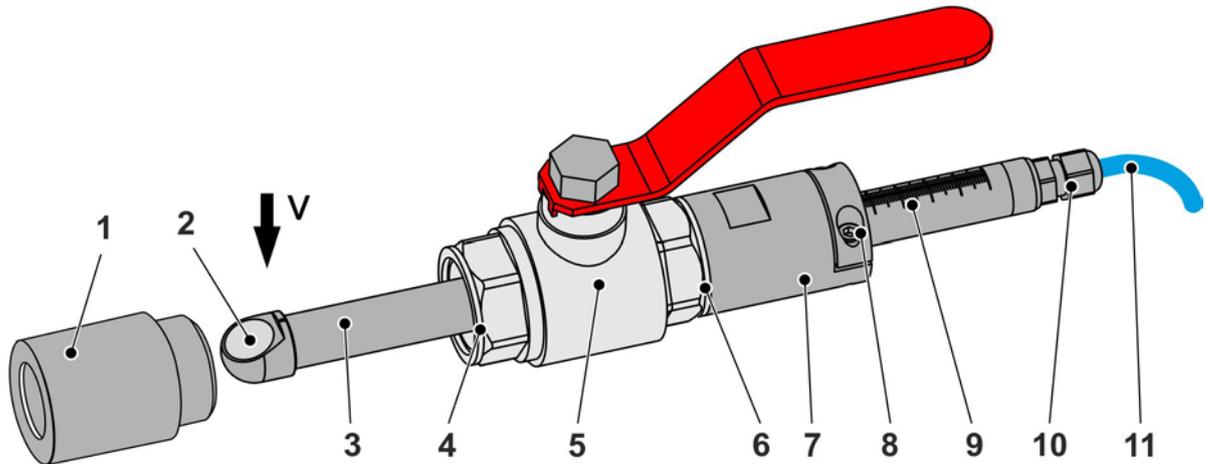
3. Use both M5 hexagon socket screws (see *Fig. 5-28*, Pos. 8) to screw the lower rear clamp element (Pos. 7) to the upper rear clamp element (Pos. 2).



4. Check the tightness of the entire screw joint.
5. If liquid should leak under operating conditions:
  - a) re-tighten the according screws.
  - b) If necessary, shut down the entire system and renew defective gaskets, Teflon tapes and similar.

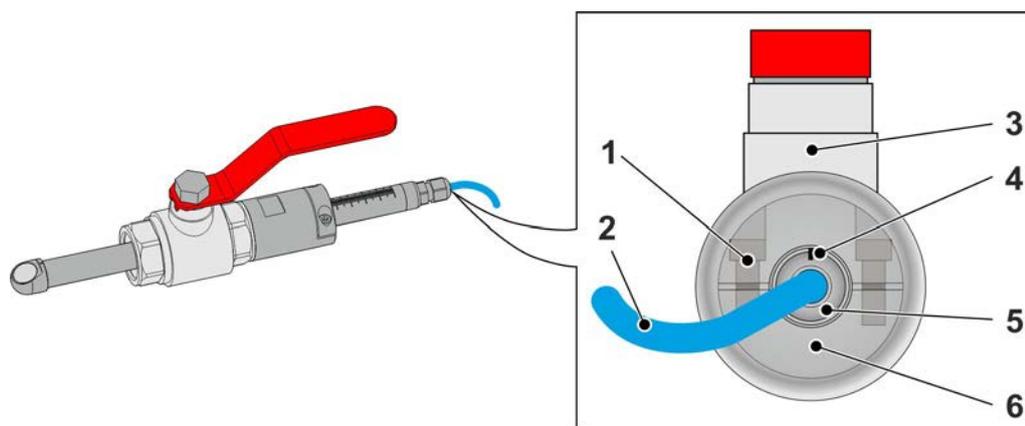
### 5.4.5 Pipe sensor CSM: Drilling in pipeline and mounting

#### 5.4.5.1 Overview of components



- 1 Welding nozzle
- 2 Sensor face
- 3 Pipe sensor
- 4 Flat gasket
- 5 Stop ball valve G1", SG 39
- 6 Flat gasket
- 7 Sensor clamping, SG 36
- 8 Screw joint of sensor clamping
- 9 Scale for pipe wall strength (valid only when the accompanying welding nozzle (1) is used)  
Centre line of scale = alignment aid: align centre line to look upstream
- 10 Cable gland
- 11 Sensor cable

**Fig. 5-29** Pipe sensor CSM with welding nozzle



- 1 Sensor cable
- 2 Screw
- 3 Stop ball valve
- 4 Scale
- 5 Pipe sensor CSM
- 6 Sensor clamping

**Fig. 5-30** Pipe sensor CSM, top view on cable side of sensor

### 5.4.5.2 Installation options

The CSM pipe sensor can be installed as follows:

- Using the accompanying G1" welding nozzle. **Installation method recommended by NIVUS**, since the scale (*Fig. 5-29*, Pos. 9) is matched to that nozzle and hence indicates the insertion depth (= pipe wall strength).
- Using a G1½" nozzle and a ZUB0RED15X1Z reducer double nipple. **Observe**: if this installation method is used the scaling (*Fig. 5-29*, Pos. 9) does not correspond to the pipe wall strength. Investigate the insertion depth of the CSM pipe sensor see chapter 5.4.5.6.

### 5.4.5.3 Notes on drilling in pipelines

#### WARNING



---

#### **Danger through electric shock!**

*Drilling works in wet rooms or into full pipelines may cause dangerous fault currents which may lead to personal injury.*

- *Use electronic personal protection equipment.*
- 

#### CAUTION



---

#### **Danger of injury!**

*The drill machine may block if you exert too much contact pressure. This may lead to personal injury.*

- *Observe contact pressure. The contact pressure depends on pipe material and wall strength.*
  - *Do not use other drilling speeds than specified by the manufacturer of the core drill bit.*
- 

The following information is applicable for pipes made of steel or stainless steel.

**Precondition for the installation of pipe sensors is an empty pipeline.**

**Prior to installation make sure the pipe or the pipeline is empty.**

**NIVUS recommendation:** use a slow drill machine with a slipping clutch.

⇒ Tools and mounting accessories for pipe sensor mounting see chapter 8.

### 5.4.5.4 Drill into empty pipeline and fasten nozzle

#### Prepare drilling:

1. Plug in electronic personal protection equipment.
2. Mark the sensor installation spot on the pipe.
3. Fix the Ø 24 mm core drill bit into the drill machine:
4. Set the drilling speed.

The drilling speed depends on the core drill bit used and the pipe material. To set the drilling speed refer to information as specified by the manufacturer of the core drill bit.

#### Drilling:

1. Drill and
  - a) observe the contact pressure of the drill machine,
  - b) observe unhindered chip removal,
  - c) use cutting paste to cool down the core drill bit.
2. Interrupt drilling procedure if required and remove chips.

#### Fasten nozzle:

1. Remove chips.
2. Deburr hole using a file.
3. Weld on the accompanying welding nozzle safely  
**or** safely attach tapping saddle.
4. Only when using a G1½" nozzle: install ZUB0RED15X1Z reducer double nipple and seal with Teflon tape.

#### Next Step:

- Install CSM pipe sensor (see chapter 5.4.5.5)

### 5.4.5.5 Install CSM pipe sensor in empty pipeline

**Observe when installing:**

*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 provides information on how to install the pipe sensor into an empty pipeline by using the accompanying welding nozzle.

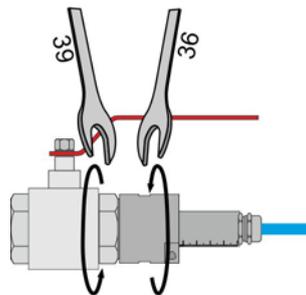
If you are using a G1½" nozzle refer to chapter 5.4.5.6

**Prerequisite:**

- Nozzle or tapping saddle is installed and a hole has been drilled into the pipeline (see chapter 5.4.4.3).

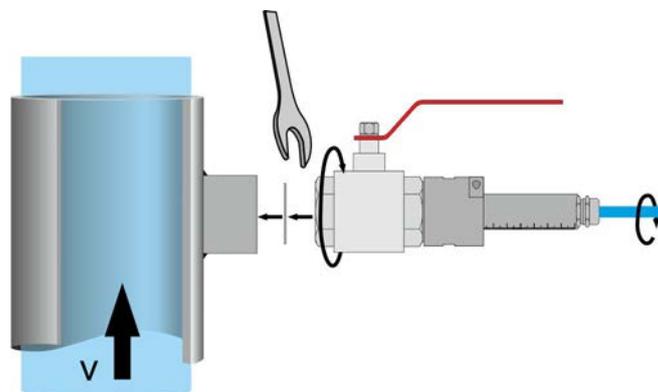
**Procedure:**

1. Investigate pipe wall strength.
2. Use 2 spanners (size 36 and 39) to tighten the sensor clamping on the stop ball valve by a minimum of 10 Nm. Observe to have the flat gasket inserted correctly.

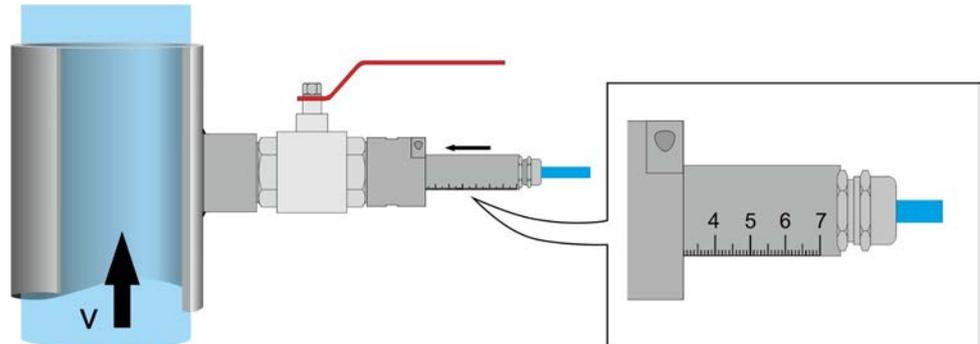


→ The joint is tight.

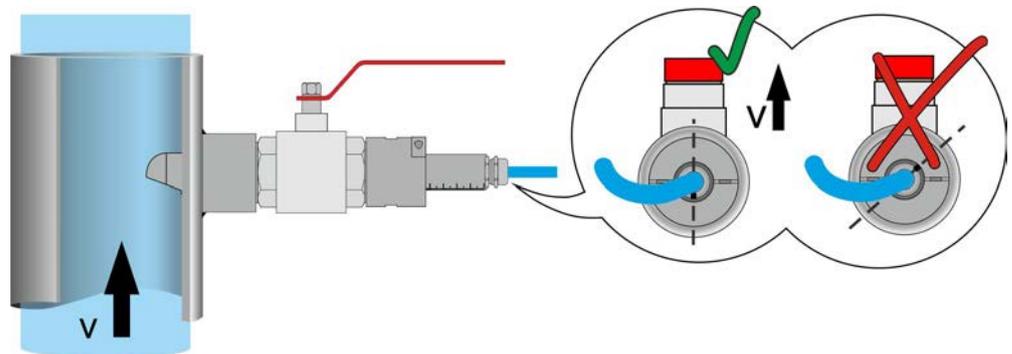
3. Screw the stop ball valve into the nozzle:
  - a) Insert the flat gasket and screw the stop ball valve into the nozzle manually. Make sure to turn the cable too.
  - b) Tighten the stop ball valve firmly with a size 39 spanner. Make sure to turn the cable too.



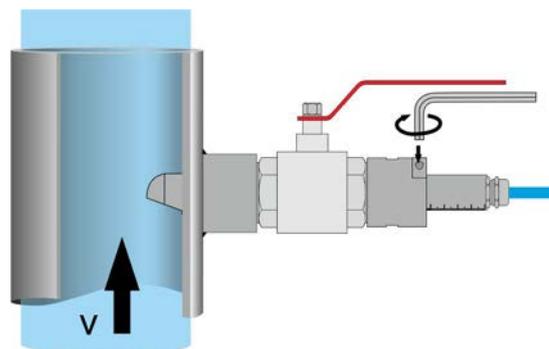
4. Insert the pipe sensor into the pipe:  
The scale on the sensor indicates the wall strength once the welding nozzle is installed correctly. Push the pipe sensor into the pipe until the pipe wall strength has been reached on the scale.



5. Pipe sensor alignment: align the centre line to look upstream of the flow direction.



6. Use a 4 mm Allen® key to tighten both screws on the sensor clamping by approx. 3.4 Nm.



→ The pipe sensor is installed firmly.

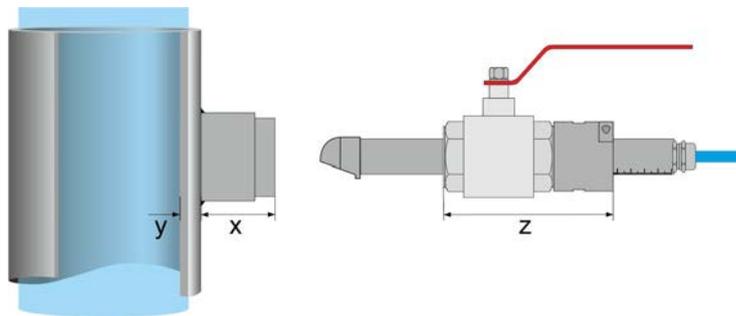
### 5.4.5.6 Install CSM pipe sensor in customer nozzle

If you do not install the CSM pipe sensor by using the accompanying welding nozzle the scale on the pipe sensor does not correspond with the pipe wall strength. The insertion depth then must be investigated separately.

#### Observe when installing:

- Install CSM pipe sensor in emptied pipeline
- When using a G1½" nozzle use a ZUB0RED15X1Z reducer double nipple and seal with Teflon tape.
- Investigate insertion depth and add a corresponding mark on the sensor (see description below).
- Install CSM pipe sensor (see chapter 5.4.5.5)

#### Variables influencing the insertion depth



- x** Length of the customer components (e.g. nozzle, sleeve)  
Here: nozzle + ZUB0RED15X1Z reducer double nipple
- y** Pipe wall strength
- z** Length of stop ball valve + sensor clamping + 2 flat gaskets = 137 mm

**Fig. 5-31 Variable influencing the insertion depth (L)**

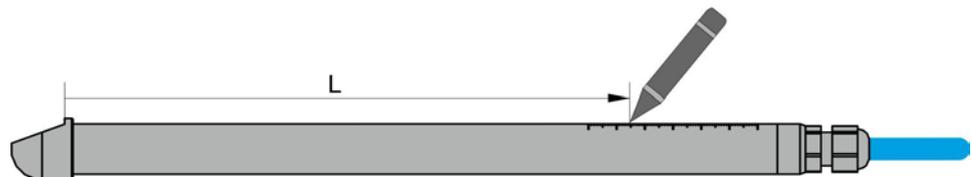
#### Calculating the insertion depth L:

$$L = x + y + z$$

$$L = x + y + 137 \text{ mm}$$

#### Investigate the insertion depth and add mark:

1. Measure the length of the components x
2. Investigate the pipe wall strength y
3. Calculate the insertion depth L ( $L = x + y + 137 \text{ mm}$ )
4. Measure the insertion depth L on the pipe sensor and add corresponding mark



## 6 Maintenance and Cleaning



---

*Any information on maintenance and cleaning of the sensors can be found in the* Technical Instructions for Correlation Sensors and external Electronic Box *and in the* Technical Instructions for Doppler Sensors.

---

## 7 Sensors in the Control Section

### 7.1 General information regarding control technology

#### Prerequisites:

- The distance between the flow velocity sensor and the gate valve behind the sensor should be at least  $4 \cdot DN$ , better  $5 \cdot DN$ .
- Flow velocities within the control section should not be lower than 30 cm/s in order to achieve appropriate selectivity of the system according to DWA.
- Pipe measuring section and gate valve must have the same inside diameter as the incoming and the outgoing pipeline.
- Gate valves must have full bore. Gate valves with a built-in valve plate to improve the Cvs-value in case of low levels in combination with wastewater containing sediment suspensions lead to silting and hence are not allowed.

#### Avoid upstream and downstream of the control section:

- bed jumps
- steps
- weld seams
- flange gaskets reaching in

## 7.2 Construction of control section

### 7.2.1 With pipe measuring section

For pipe diameters from DN 200 to DN 1000 NIVUS provide the following pipe measuring sections:

	Short pipe measuring section	Long pipe measuring section
Description	Fitting piece with dome, dimensions adapted to the most common electromagnetic flow meters (EMF)	
Available for pipe diameter	DN 200 to DN 1000	DN 200 to DN 400
Installation flow velocity sensor (pipe sensor)	With welding nozzle or tapping sleeve upstream of pipe measuring section; with risk of silting/soiling: install pipe sensor slightly out of centre	Direct installation in integrated nozzle

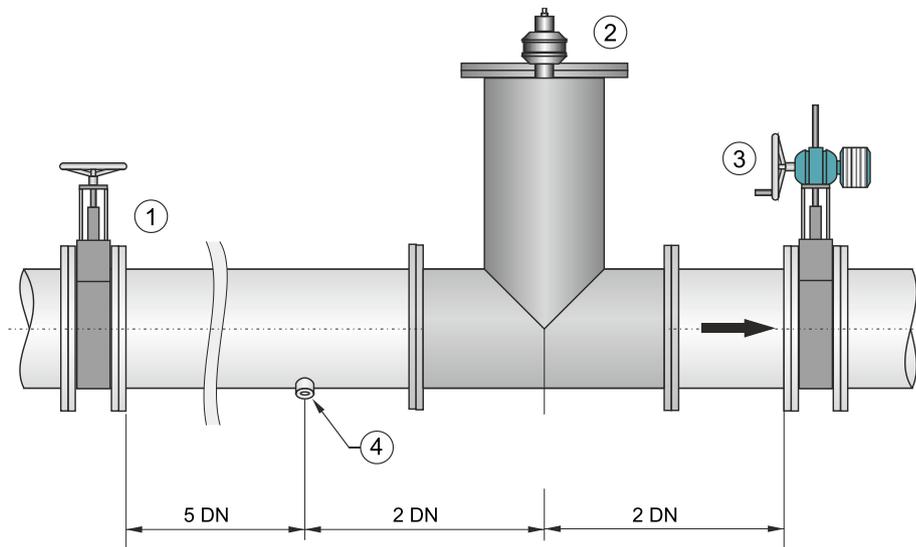
⇒ Pipe measuring sections can be found in Chapter 9.

In contrast to common principles regarding control technology, the measurement is installed preferably upstream and not downstream of the gate valve. This setup may not detect and

consider the time response of the control section, but helps to avoid or to reduce hydraulic problems caused by external turbulences downstream of the gate valve.

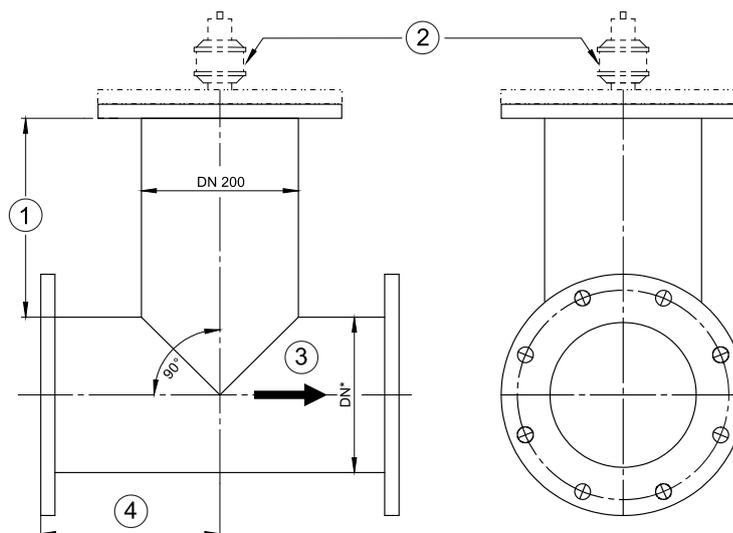
### Short measurement section

Example: construction of a discharge control with nozzle/tapping sleeve for V-sensor **upstream** of the pipe measuring section.



- 1 Manual gate valve (must be fully opened)
- 2 Ultrasonic sensor
- 3 Electric gate valve
- 4 Mounting of the pipe sensor via welding nozzle/tapping sleeve

**Fig. 7-1 Setup of a control section: discharge control with fitting piece (short pipe measuring section) and nozzle/tapping sleeve**

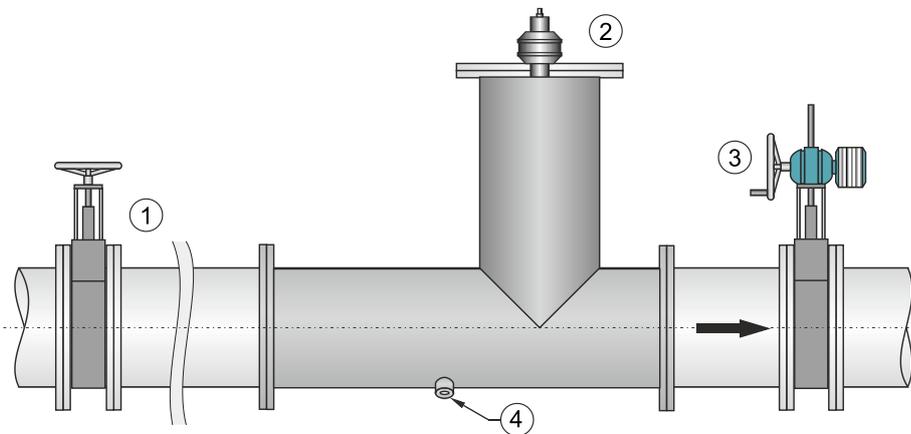


- 1 Min. 300 mm (dome to be extended by 30 mm per meter water column upstream of slide valve)
- 2 Ultrasonic sensor
- 3 Flow direction
- 4 Dome placed in centre

**Fig. 7-2 Short measurement section**

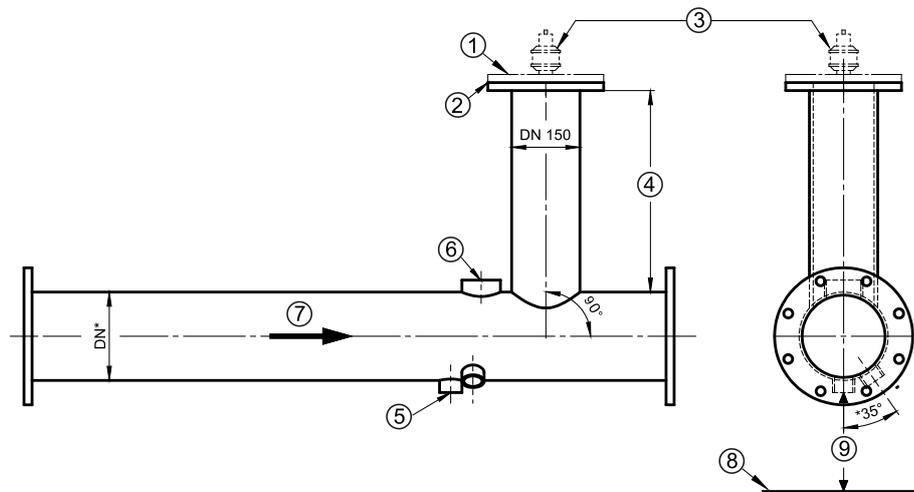
### Long measurement section

Example: structure of a discharge control with nozzle for V-sensor in the pipe measuring section.



- 1 Manual gate valve (must be fully opened)
- 2 Ultrasonic sensor
- 3 Electric gate valve
- 4 Mounting position for pipe sensor

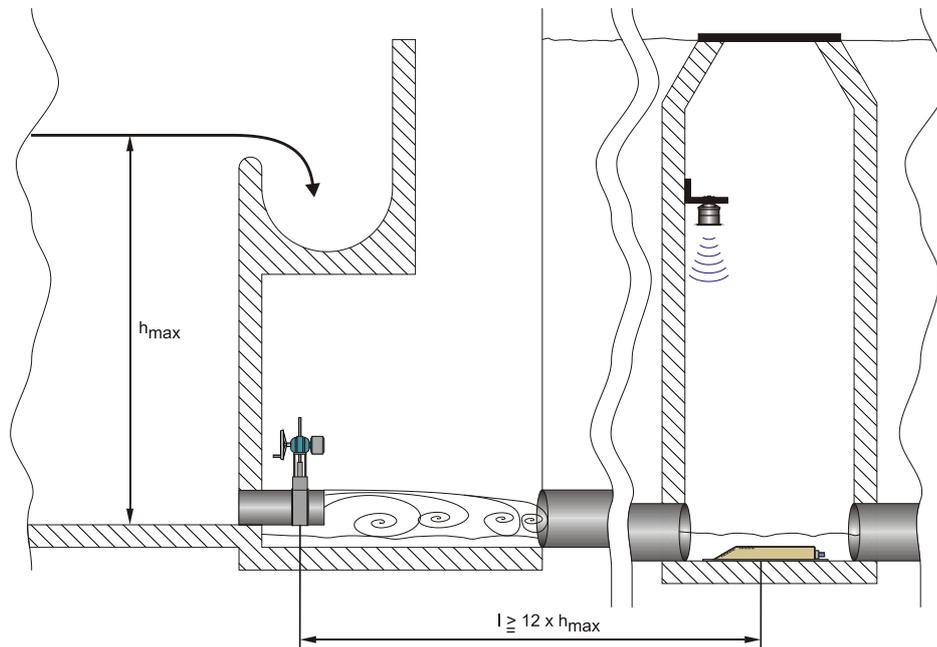
**Fig. 7-3 Discharge control setup with long pipe measuring section and welding nozzle**



- 1 Flange DN 150 with R 1" inner thread
- 2 Flange gasket
- 3 Ultrasonic sensor
- 4 Dome (available 500 mm up to 700 mm, depending on pressure)
- 5 Nozzle with G1½" inner thread for 1½" 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. 7-4 Long measurement section**

### 7.2.2 In channels



**Fig. 7-5 Arranging the measurement behind the slide valve**

The measurement must be installed downstream of the gate valve if it is not possible to install a pipe measuring section. The distance to the gate valve must be at least 12 \* maximum dam-up level in such a case.

First of all, check the hydraulic conditions on the measurement palace.

**Observe when installing the sensor downstream of the gate valve:**

- Due to extended run times the measurement and hence the control will respond with a considerable delay. Program the control adapted to the application considering the respective long delay.
- When the required minimum distances of 12 \* maximum dam-up level cannot be kept it is necessary to install energy-breaking elements such as impact walls, deflections or similar. Such elements are to be designed depending on the respective application. Contact NIVUS in such cases.

## 8 Mounting Accessories and Tools

### 8.1 Welding nozzle

#### 8.1.1 Description

There are welding nozzles made of steel or stainless steel 1.4571 available for the installation of 1½" pipe sensors.

##### Versions:

- Straight
- Angled 20°
- Angled 30°
- For special applications (very little space on the installation place): welding nozzle with outside thread. This welding nozzle allows you to directly screw on a stop ball valve.

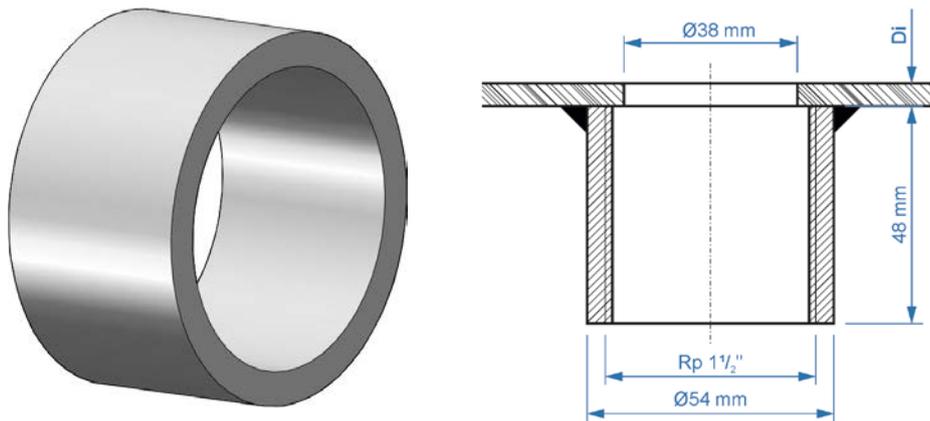
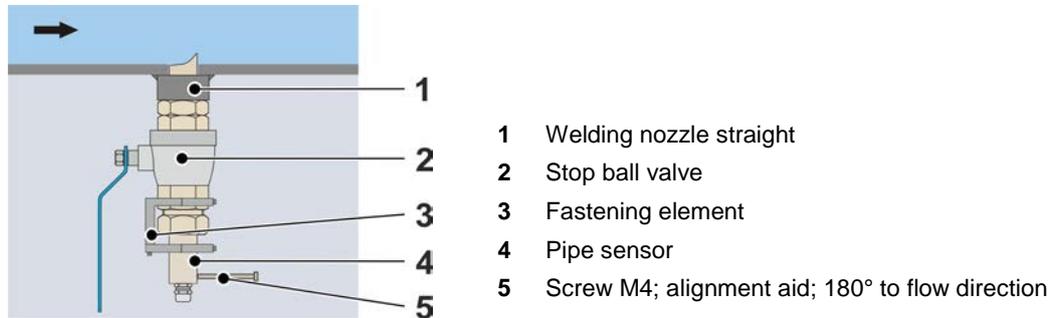


Fig. 8-1 View and dimensions of straight welding nozzle

### 8.1.2 Installation examples

The straight welding nozzle is conceived for measurements using only one flow velocity sensor. This sensor is normally installed on the pipe bottom or, with the risk of sedimentation building up, slightly out of the centre.

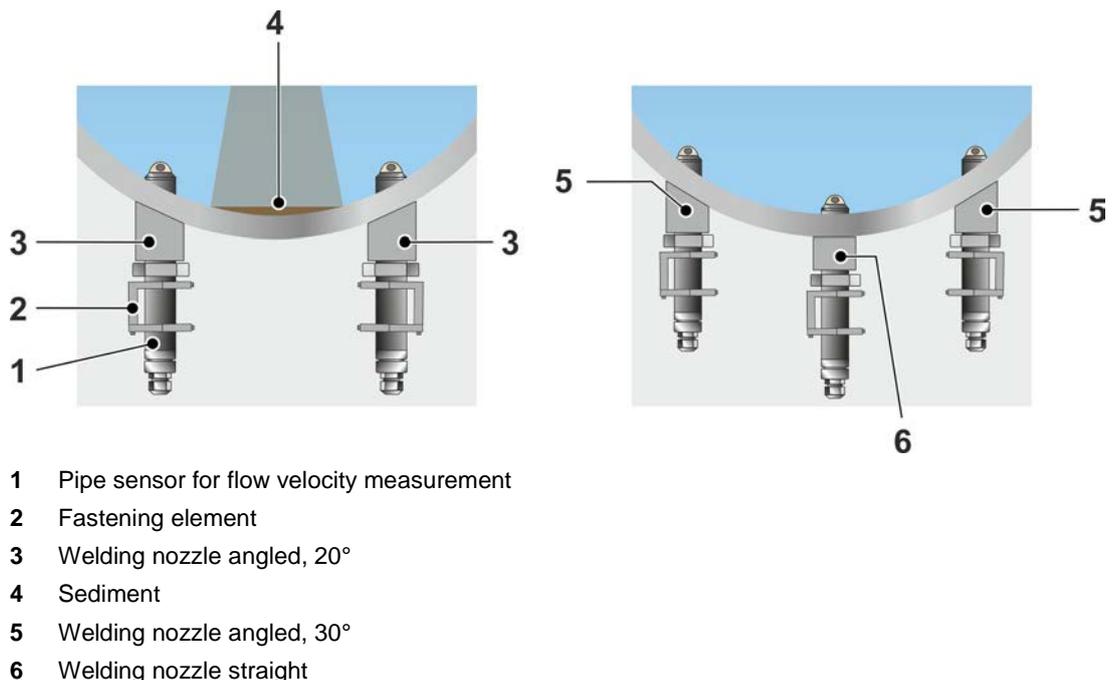


**Fig. 8-2 Installation example: 1 pipe sensor with straight welding nozzle**

In very large pipe diameters or in hydraulically heavily distorted flow profiles very often 2 or 3 flow velocity sensors are used (distribution see *Fig. 4-18*). The installed pipe sensors must measure vertically upwards. To ensure this use the welding nozzle as follows:

Number of pipe sensors with V-measurement per measurement place	Number of welding nozzles	Installation angle
2	2	angled 20°
3	2	angled 30°
	1	straight

**Tab. 8-1 Use of welding nozzles**



**Fig. 8-3 Installation examples: 2 or 3 pipe sensors with welding nozzles**

### 8.2 Tapping saddle

#### 8.2.1 Description

A tapping saddle can be purchased from NIVUS for upgrading by using a pipe sensor. This saddle is available in 2 versions for outside pipe diameters from 100 mm to 2000 mm (see *Fig. 8-4* and *Fig. 8-5*).

Versions for outside pipe diameters from 100 mm – 400 mm are made of the following materials:

- All metal parts of the tapping saddle are made of stainless steel, material no. 1.4301 (AISI 304).
- The saddle piece is completely pickled and passivated to avoid corrosion of the basic material.
- The threaded bolts are Teflon-covered to prevent cold weldability.
- The rubber gasket is treated with antioxidant/antiozonant to increase life-time. The rubber gasket guarantees proper sealing.



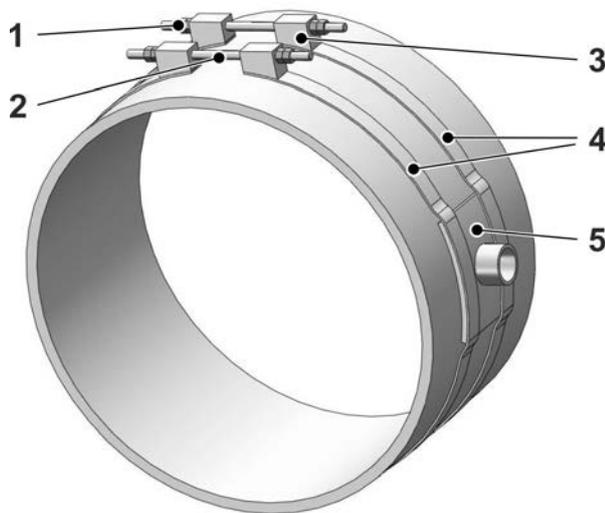
- 1 Thread protection cap
- 2 Saddle part with 1½" inner thread for sensor screw joint
- 3 Thread bolt M12, (M14, M16) Teflon coated
- 4 Nut and lock nut
- 5 Washer
- 6 Rubber gasket
- 7 Saddle part with thread bolt
- 8 Side bracket
- 9 Mounting bracket (holder)
- 10 Screw yoke

**Fig. 8-4 Overview tapping saddle for outside diameters from 100 mm – 400 mm**

Versions for outside pipe diameters from 400 mm to 2000 mm consist of the components below:

- For outside pipe diameters 400 mm – 600 mm: 2 tensioning belts with clamping bolts and nuts  
For outside pipe diameters 625 mm – 1300 mm: 4 half-round tensioning belts with clamping bolts and nuts  
For outside pipe diameters starting with 1300 mm: 6 third-round tensioning belts with clamping bolts and nuts
- 1 mounting plate with welded sensor nozzle with 1½" inner thread. This plate additionally has an O-ring to seal it from the pipe wall.

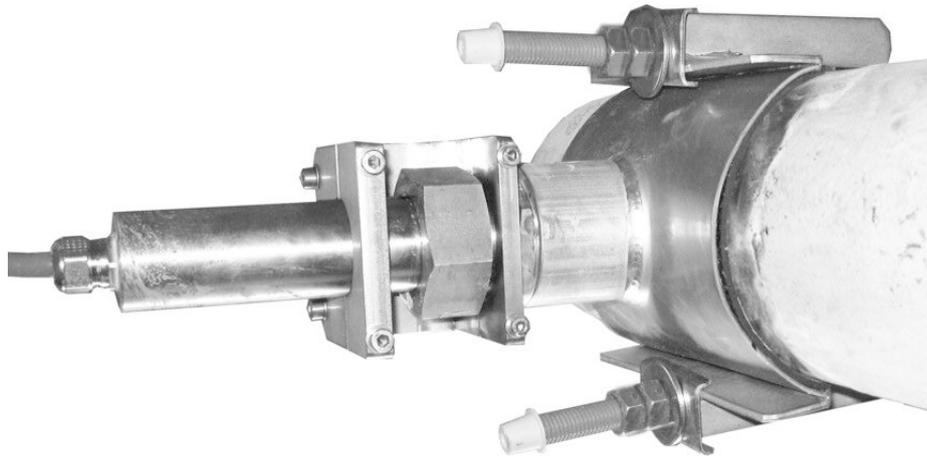
All metal parts of the system are made of stainless steel, 1.4301 (V2A).



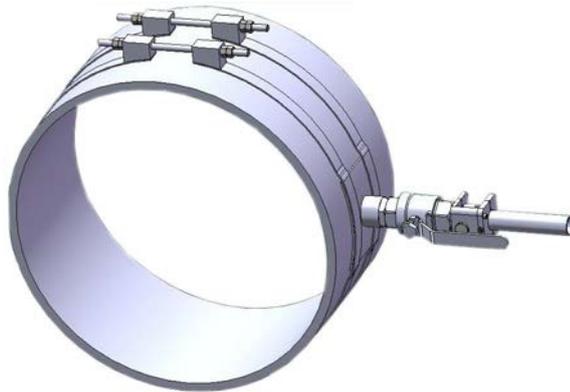
- 1 Nut and counter nut
- 2 Clamping bolt
- 3 Guiding block for tensioning bolt
- 4 Tensioning belts
- 5 Mounting plate with welding nozzle and O-ring on the inside

**Fig. 8-5 Overview tapping saddle for outside diameters 400 mm – 600 mm**

### 8.2.2 Installation examples



**Fig. 8-6** Installation example with tapping saddle for outside diameters 100 mm – 400 mm



**Fig. 8-7** Installation example with tapping saddle for outside diameters 400 mm – 600 mm

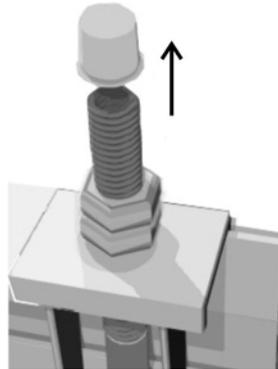
### 8.2.3 Installation

#### Prepare installation:

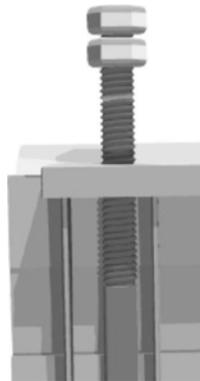
- Test pipe/mounting place for damaging
- Clean pipe from pollution/dirt such as grease
- Check pipe diameter and dimensions of tapping saddle
- Grease the nozzle thread using appropriate paste for stainless steel screw joints
- With tapping saddles for outside diameters up to 400 mm use soft soap as lubricant for the rubber gasket if necessary (no oil or grease!)

## Install pipe sensor with tapping saddle for outside diameters up to 400 mm:

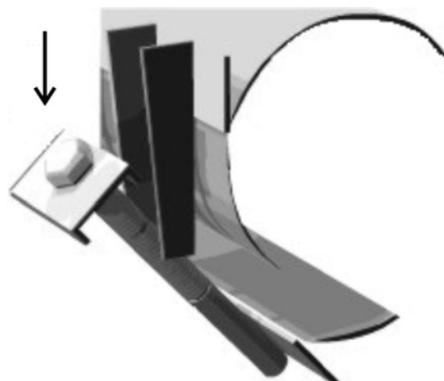
1. Drill a hole with a minimum diameter of  $\varnothing$  38 mm into the pipe section.  
Use cutting paste for metal pipes to cool down the core bit (see chapter 8.4).
2. To deburr the drill hole use a file and remove chippings/turnings.
3. Remove thread protection from the thread bolts.



4. Loose/drive the nuts and lock nuts back to the end of the thread bolts. However do not remove them.



5. Unfold the saddle parts.

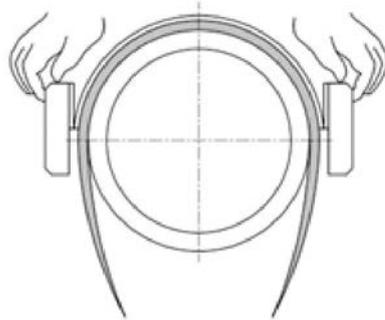


6. Screw in the sensor screw joint into the greased nozzle manually.
7. Insert the sensor and put the sensor screw joint in hand-tight condition.

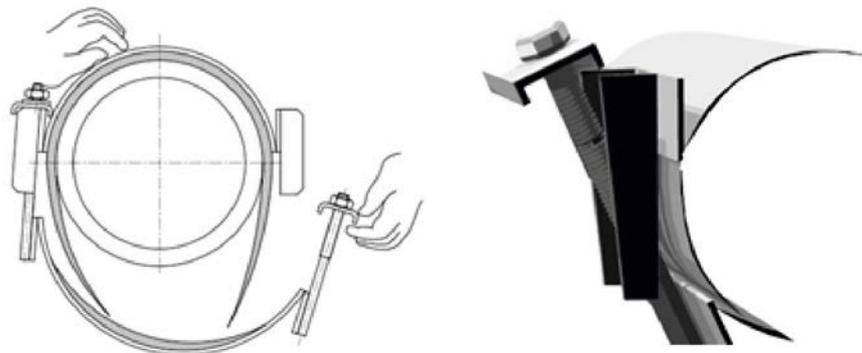
## 8 Mounting Accessories and Tools

---

- 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.

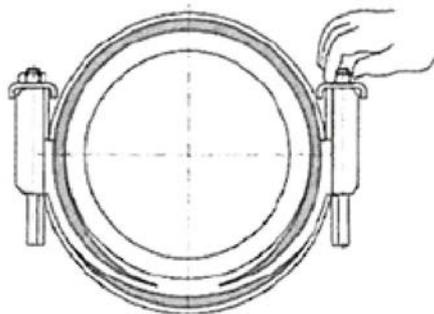


- Put the mounting bracket (holder) on one side over the screw yokes and tighten the screws manually.



→ The holder will hook into the side bracket by tightening the bolts firmly.

- Tighten bolts

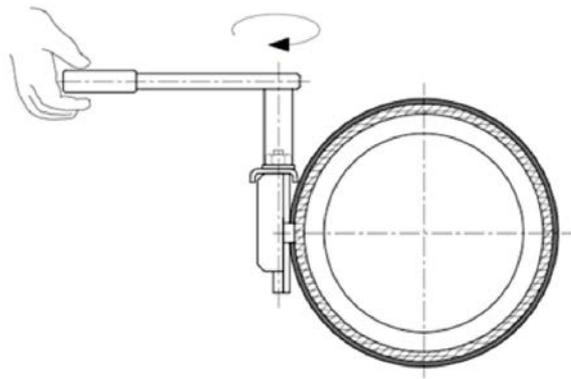


11. Make sure not to tilt or jam the sensor while inserting and that it can be inserted into the pipe further! Tighten all nuts smoothly using a wrench with a length of approx. 300 mm.

**Following torques are valid for metal and concrete pipes 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

With plastic pipes the torque shall be lower (ask the pipe manufacturer for maximum rates).



- Tightening the bolts will automatically press the mounting bracket (holder) into the side bracket.
12. Tighten lock nuts.

### CAUTION



#### ***Danger of damage to property***

*Vibrating plant parts such as pipelines coming from adjacent pumps may cause the nuts to loosen.*

- *Necessarily secure the nuts on the threaded bolts by using a lock nut always.*

13. Once the tapping saddle is fixed align the pipe sensor and tighten the screw joint. (see chapter 5.4.4.6 or 5.4.5.5)



### **Important Note**

*At least 2 persons are needed to install the tapping saddle greater than 400 mm.*

---

### **Install pipe sensor with tapping saddle for outside diameters from 400 mm to 600 mm:**

1. Drill a hole with a minimum diameter of  $\varnothing$  38 mm into the pipeline.  
Use cutting paste for metal pipes to cool down the core bit (see chapter 8.4).
2. Deburr the hole with a file if required and remove chips/turnings (depending on pipe material).
3. Loosen nuts and lock nuts on the clamping bolts (*Fig. 8-5*, Pos. 1) and remove them from one side of each.  
→ Tensioning belts can be opened.
4. Check whether the O-ring on the inside of the mounting plate (*Fig. 8-5*, Pos. 2) is correctly inserted into the groove and correct if required.
5. Person 1: put the mounting plate onto the drill hole in the pipeline.
6. Other person(s): place both tensioning belts (*Fig. 8-5*, Pos. 4) around the mounting plate and the pipe.
7. Reinsert the clamping bolts (*Fig. 8-5*, Pos. 1) through the guiding blocks (*Fig. 8-5*, Pos. 3) on the tensioning belts, screw on nuts and lock nuts loosely.
8. Screw the sensor screw joint into the greased nozzle of the tapping saddle hand tight.
9. Insert the sensor and tighten the screw joint manually (hand tight).
10. Tighten all nuts and lock nuts (*Fig. 8-5*, Pos. 1) on the tensioning belts.
11. Once the tapping saddle is fixed align the pipe sensor and tighten the screw joint (see chapter 5.4.4.6 or 5.4.5.5).

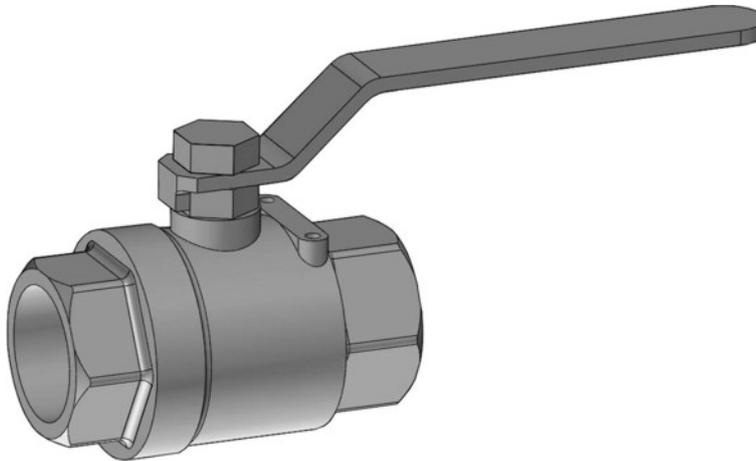
### **Install pipe sensor with tapping saddle for outside diameters greater than 600 mm:**

Tensioning belts for pipelines with outside diameters greater than 600 mm consist of 2 or 3 parts. To install the tapping saddle proceed as described in the section about installing tapping saddles for outside diameters from 400 mm to 600 mm. However, observe the information below:

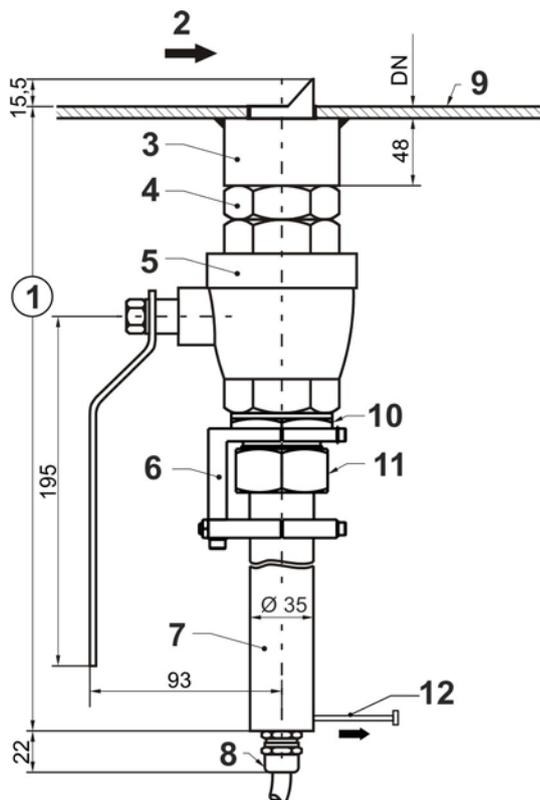
- Put the tensioning belts around mounting plate and pipe and tighten all connection points loosely.
- Insert the sensor and tighten the sensor screw joint hand tight. Then, tighten nuts and lock nuts on all connection points of the tensioning belts evenly.

### 8.3 Stop ball valve

The complementary use of a corrosion-proof stop ball valve with straight bore (Art.-Nr. ZUB0 HAHN R15) allows for quick and easy locking of the sensor installation place after removing a 1½" sensor from a pressureless pipeline.



**Fig. 8-8 Stop ball valve**

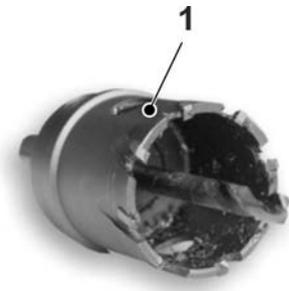


- 1 Min. 300 mm
- 2 Flow direction
- 3 Welding nozzle
- 4 Hexagon double nipple SW50
- 5 Stop ball valve DN40 / PN63
- 6 Fastening element
- 7 Pipe sensor 1½"
- 8 Cable gland M16 x 1.5
- 9 Pipe wall
- 10 Screw thread SW55
- 11 Spigot nut SW50
- 12 Screw; alignment aid; along flow direction

**Fig. 8-9 Dimensional drawing pipe sensor 1½" with fastening element, stop ball valve and welding nozzle**

### 8.4 Drill bit

For the installation of pipe sensors in pipelines made of steel, stainless steel and plastic there are 38 mm drill bits available.



1 Drill bit

Fig. 8-10 Drill bit

---

### 8.5 Cutting paste

**NIVUS recommendation:** use cutting paste to drill into steel and stainless steel in order to

- avoid premature wear of the core bit,
- reduce friction when drilling.



Fig. 8-11 Cutting paste

---

## 8.6 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. There is a cover for the sensors POA, KDA, KDO and KDS available. This is to avoid the impact of large objects, to reduce mechanical stress of the sensor body. By using the cover the risk of sensor damage is reduced.

Do not use the sensor cover in slowly flowing media containing wastewater (risk of tressing).



---

Fig. 8-12 Sensor cover

## 8.7 Wedge base

### 8.7.1 Description

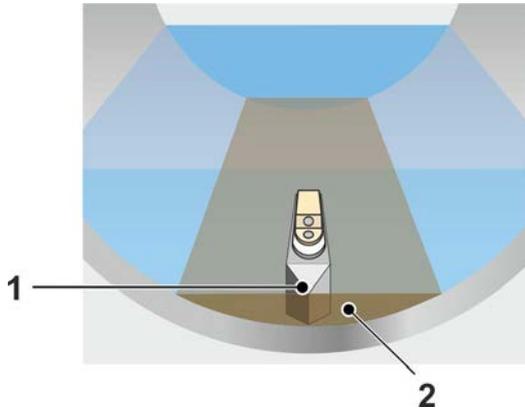
Wedge bases are conceived for the installation of POA, CS2, CSP, KDA and KDO wedge sensors with strong sedimentation. Such wedge-shaped supports elevate the mounting position of the wedge sensors so that the sensors can protrude above sedimentation deposits to measure the flow velocity.

#### Versions:

- Straight, height: 30 mm, 50 mm, 100 mm, 150 mm or 200 mm.  
The height of the wedge base depends on the expected sedimentation level.
- Angled left or right 20°
- Angled left or right 30°

## 8.7.2 Installation examples

Straight wedge bases are conceived to elevate wedge sensors above horizontal channel bottoms and the deepest point of pipes.



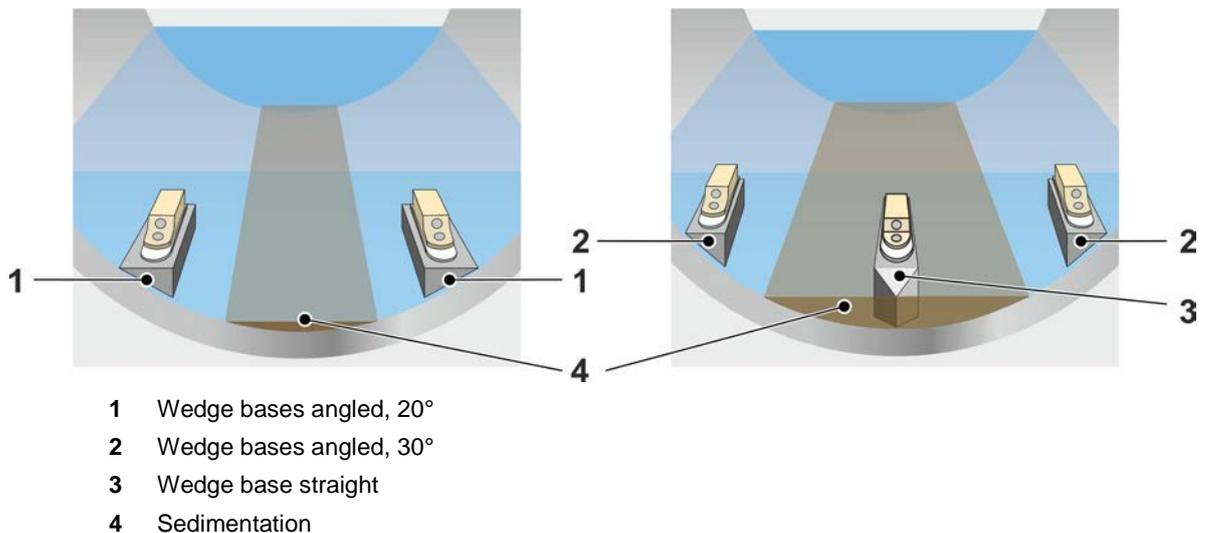
- 1 Straight wedge base
- 2 Sedimentation

**Fig. 8-13 Installation example: 1 wedge sensor with straight wedge base**

In very large pipe diameters 2 or 3 flow velocity sensors are used frequently (distribution see Fig. 4-17). The wedge sensors must be installed vertically. Use the wedge bases as follows to ensure this kind of installation:

Number of wedge sensors with V-measurement on a measurement place	Number of wedge bases	Installation angle
2	1	Angled left 20°
	1	Angled right 20°
3	1	Angled left 30°
	1	Angled right 30°
	1	Straight

**Tab. 8-2 Use of wedge bases**



- 1 Wedge bases angled, 20°
- 2 Wedge bases angled, 30°
- 3 Wedge base straight
- 4 Sedimentation

**Fig. 8-14 Installation examples: 2 or 3 wedge sensors with wedge bases**

### 8.8 Cable cover sheets

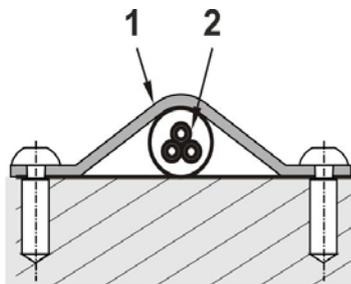
Cable cover sheets are to avoid tressing on sensor cables. Cable cover sheets made of stainless steel 1.4571 (AISI 316 Ti, length 1 m each) can be purchased from NIVUS.

Versions:

Type	Description	Use
ZMS 140	stiff	To cover 1 sensor cable. For plane surfaces and straight cable sections.
ZMS 141	bendable	To cover up to 3 sensor cables. For plane and slightly curved surfaces such as the insides of concrete pipes and built, arched canals. Suitable to lay larger cable radii.
ZMS 142	bendable	To cover 1 sensor cable with max. $\varnothing$ 12 mm or 2 sensor cables with max. $\varnothing$ 8.5 mm. For plane and slightly curved surfaces such as the insides of concrete pipes and built, arched canals. Suitable to lay larger cable radii.

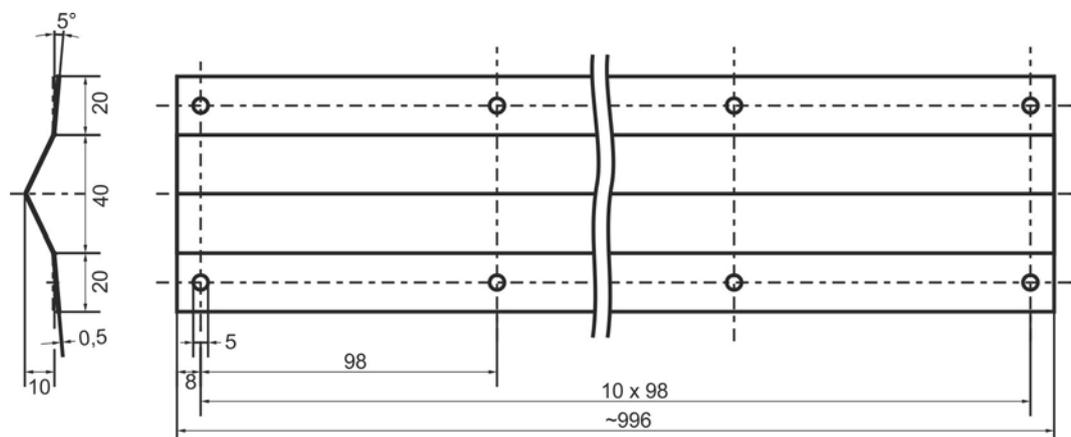
**Tab. 8-3 Overview cable cover sheets**

Cable cover sheets are delivered including the appropriate corrosion-free fastening material.

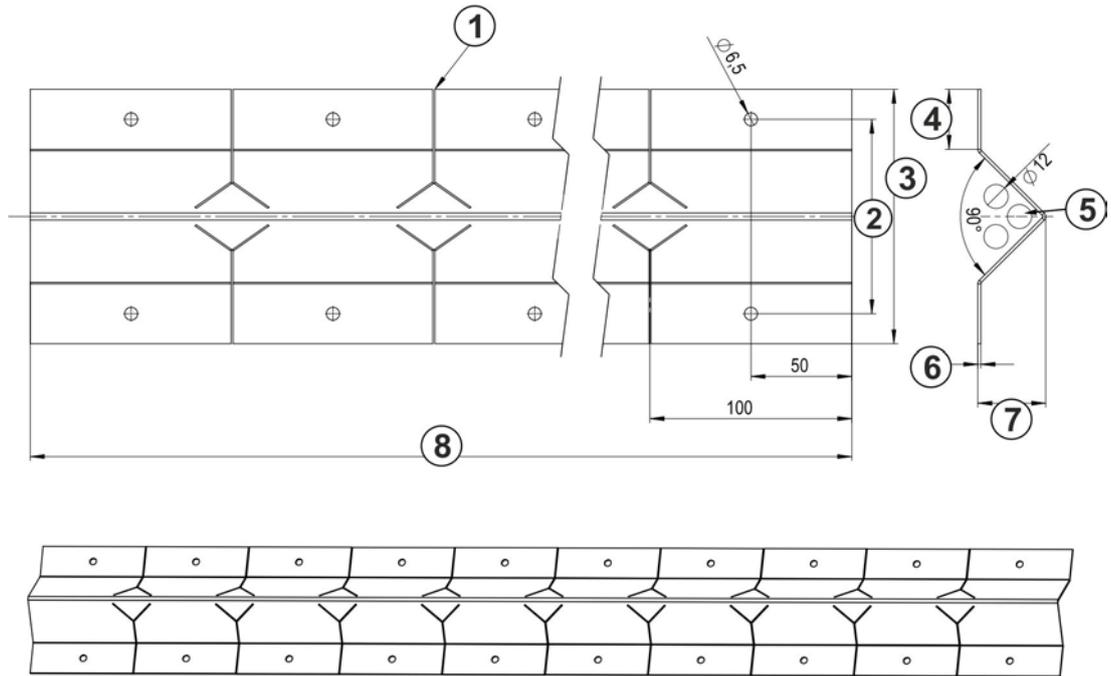


- 1 Cable cover
- 2 Cable

**Fig. 8-15 Cable layout with cable cover sheet**



**Fig. 8-16 Dimensional drawing cable cover sheet Type ZMS 140**



	<b>ZMS 141</b>	<b>ZMS 142</b>
1	Y bending edges 100 mm each	Y bending edges 100 mm each
2	97 mm	47 mm
3	127 mm	62 mm
4	30 mm	15 mm
5	For max. 3 sensor cables	For max. 2 sensor cables
6	1.5 mm	1 mm
7	34 mm	16 mm
8	1000 mm	996 mm

**Fig. 8-17** Dimensional drawing cable cover sheet Types ZMS 141 and ZMS 142

### 8.9 Float

Low flow velocities and the resulting sedimentation lead to soiling and silting of sensors on the channel bottom within a very short time. This may lead to measurement failure unstable detection of measurement values. In such cases sensors should be installed on a wedge base on the channel wall or from the top by using a float.

#### **Float installation is particularly appropriate when**

- canals and flumes are to be cleaned regularly. Thanks to using a float it is possible to quickly remove the sensor system from the channel or flume without the need for tools,
- the filling level fluctuates heavily and the sensor cannot be installed appropriately in a lateral position (optimal sensor position related to the average filling level: sensor protrudes above medium at minimum level),
- the sedimentation level is unknown or fluctuating heavily and a sufficient wedge base therefore cannot be chosen.

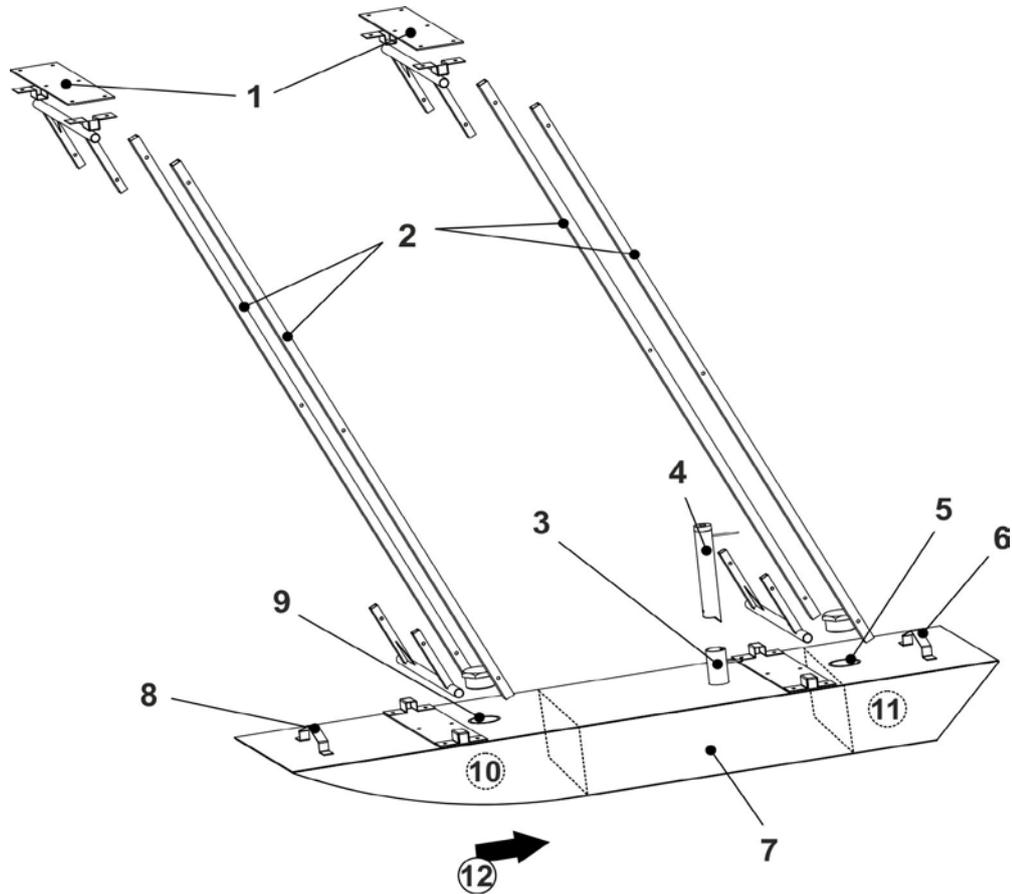
#### **Using a float is inappropriate**

- when the medium in the channel or flume carries large objects such as tree branches and trunks and similar or large floating structures of matted substances such as grass, fibres or similar on the surface,
- in application with fast flowing media ( $V > \text{approx. } 1 \text{ m/s}$ ),
- in applications with strong wave formation,
- in too low flow levels.  
Sensor POA: min. water level without sediment 20 cm  
Sensor CS2: min. water level without sediment 30 cm

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

### 8.9.1 Description

In practical use flat floats with parallel rods and the pipe sensor inserted from above have proven to be successful (see *Fig. 8-18*).



- 1 Ceiling holder for fastening on channel ceiling, channel crown or 2 crossbeams
- 2 Parallel rods
- 3 Pipe sensor holder
- 4 Pipe sensor (not part of the standard delivery of the float)
- 5 Rear filling nozzle
- 6 Rear grip
- 7 Float
- 8 Front grip
- 9 Front filling nozzle
- 10 Front ballast tank
- 11 Rear ballast tank
- 12 Flow direction

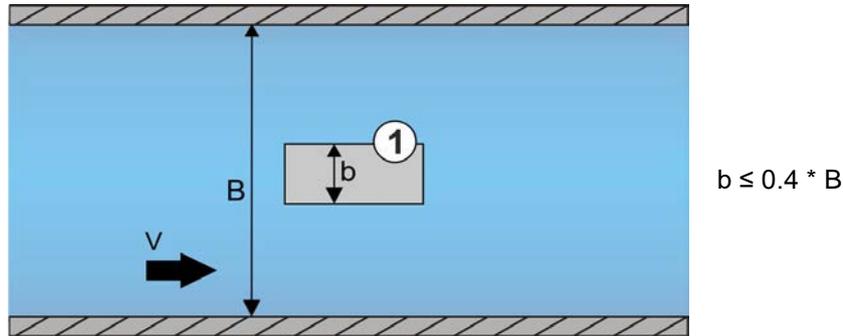
**Fig. 8-18 Overview Float**

The shape guarantees reliable and stable contact between sensor and medium to measure up to average flow velocities of approx. 100 cm/s and a minimum filling level of approx. 15 cm.

The float is designed for use with Type POA and CS2 pipe sensors. Only sensors with a pipe length of 20 cm will directly fit into the sensor seat integrated in the float body.

Thanks to loading the sensor from the top it is possible to remove, to control/clean and to re-insert the sensor at exactly the same position within a few minutes without the need to use any mounting tools.

The float width should not be greater than 40 % of the channel width to avoid hydraulic effects (lateral turbulence and transverse flow, unstable immersion and similar) (see Fig. 8-19).



1 Float

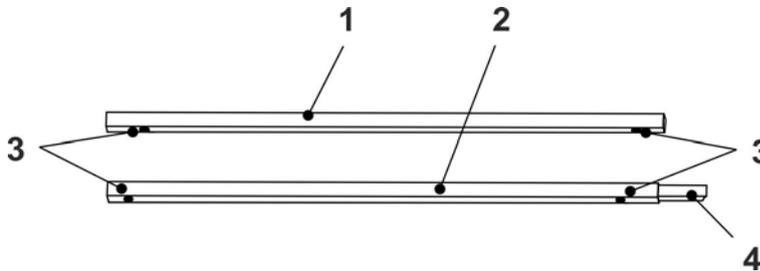
**Fig. 8-19** Float width, top view on channel

## 8.9.2 Parallel rods

### 8.9.2.1 Description

The standard delivery of the parallel rods comprises 8 square rods + connection elements (see Fig. 8-20). 4 bars serve as base rods (Pos. 1). The other 4 bars (Pos. 2) can be used to extend the linkage for deep channels or for applications with strongly fluctuating filling levels.

An additional set of extensions consisting of 4 pieces of 1m-rods can be purchased from NIVUS if required. Use such extensions only for floats with a width of 40 cm.



- 1 Base rods (4x)
- 2 Extension rods (4x)
- 3 Fastening holes
- 4 Square bar for adaptation, welded-in

**Fig. 8-20** Components of the parallel rods

### 8.9.2.2 Determination of the correct length

The length of the parallel rods depends on the maximum and minimum medium levels occurring in the application. This is why a mounting place must be determined first and both limit levels must be investigated subsequently.

With maximum filling level the angle of the parallel rods to the horizontal shall not be lower than  $18^\circ$  (see Fig. 8-21).

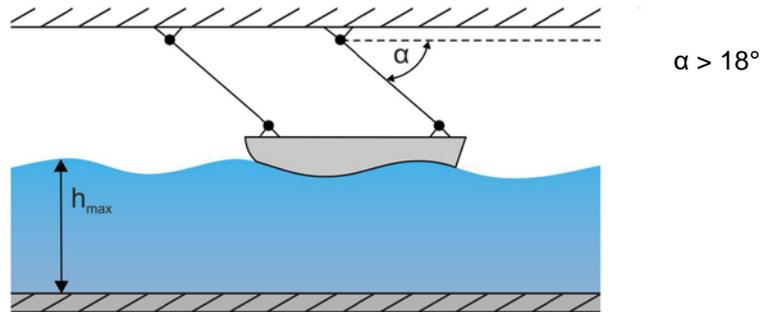


Fig. 8-21 Length of parallel rods with maximum filling level

The float should reliably rest on the medium surface even at minimum filling level. This requires observing an angle of von  $80^\circ$  or lower (see Fig. 8-22).

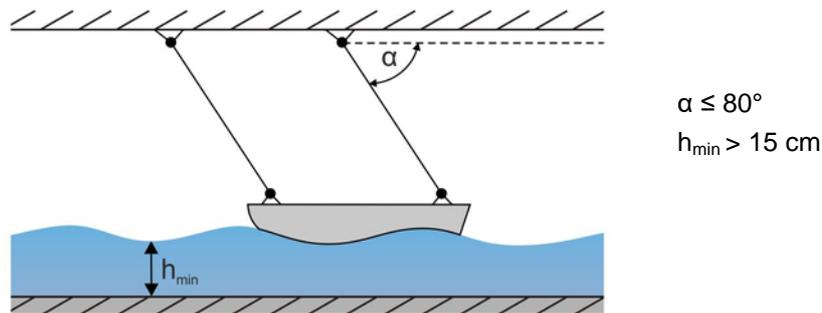


Fig. 8-22 Length of parallel rods with minimum filling level

### 8.9.2.3 Adjust length

#### Shorten parallel rods:

1. Drop the extension rods.
2. Shorten one set of rods (base rods) to the same length and replace the removed fastening holes by drilling new holes with a diameter of 6.5 mm into the shortened rods using a drill bit sufficient for stainless steel.



#### Important Note

Cut the base rods (see Fig. 8-20, Pos. 1), if you wish to shorten the parallel rods in order to keep the square bars for adaptation.

### Extend parallel rods:

- Extend by using an extension set (see 8.9.2.1).



### Important Note

Over-long parallel rods cause instability.

- Extend parallel rods by max. 3 m.

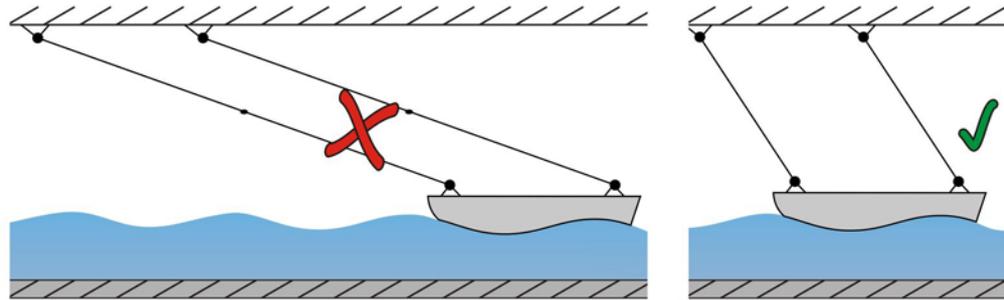


Fig. 8-23 Optimal length of parallel rods

### 8.9.3 Information on float installation in agitated media

Strong wave formation on surfaces will cause the float to oscillate. Due to this air may get underneath the float body resulting in sporadic measurement failures.

#### Countermeasures:

- Calm the water surface upstream of float.
- Weigh down the float for calming: fill small quantities of a dry and granulated filling material (sand, grit or similar) through the front or rear filling nozzle into the rear or front ballast tank (Fig. 8-18, Pos. 10 + 11).



### Important Note

The quantity of the filling material in the ballast tanks shall not be such as to cause the tip of the float to dive into the medium or to let waves overflow the float body.

After filling relock the filling nozzles watertight.

The measurement may fail too if surface waves should overflow parts of the float body.

#### Countermeasures:

- Calm the water surface upstream of float.
- Select other installation place with calm surface.

### 8.9.4 Install pipe sensor

#### Procedure:

#### CAUTION



#### **Danger of damage to property**

*The sensor head will be damaged once the float body with the sensor installed is put on the ground.*

- *Do not install the pipe sensor before the float has been put into the medium.*

1. Screw the accompanying M4 alignment screw into the thread at the end of the pipe sensor. Tighten the screw hand-tight.



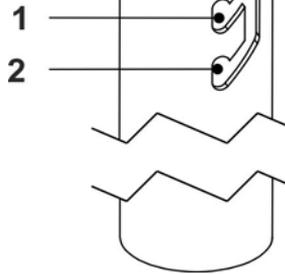
#### **Important Note**

*The POA pipe sensor will not protrude into the medium or the CS2 pipe sensor will be subject to trespassing very quickly if the positions of POA and CS2 sensors are switched.*

- *Observe correct sensor positions.*

2. Insert the pipe sensor into the sensor holder by using the screw.

Pipe sensor CS2: Position 1  
Pipe sensor POA: Position 2



#### **Important Note**

*Air bubbles may build up below the sensor body pushing the sensor out of the sensor seat as soon as the water surface is very troubled and the float body is "dancing" on the surface.*

- *Secure pipe sensor (elastic wedge, glue or similar).*

3. Secure pipe sensor if necessary.

## 8.9.5 Maintenance and cleaning



### **Important Note**

*Deposits on the surface of the float, the grips, the sensor seat and the hinge supports of the rods lead to uncontrolled increase in weight of the float causing the float body to deeply dive or to even immerse into the medium resulting in system failure.*

- *Clean float body and sensors regularly.  
The cleaning interval depends on the floating substances within the medium and on the construction of the float body.*

### **The following maintenance and cleaning measures must be executed regularly:**

- The rods of the float are movable using sliding joints. These joints must be inspected and greased or oiled regularly.
- Check float body and rods for wear, deformation/bending, loose connections, firmly locked filler caps, body damage as well as for wear of the movable sliding joints.
- Remove dirt and tressing from float body and rods.

An increased percentage of grease, oil or substances tending to deposit may build up dirt on the underside of the float body as well as on the protruding sensor nose. Such contamination and deposits may disturb the measurement or even lead to measurement failure. In such cases operators should lay down cyclic cleaning intervals for sensor body and flow velocity sensor. Here, the cleaning interval will depend on the degree of contamination occurring and shall be determined from operational experience. Once it turns out that cyclic cleaning intervals are required the installation of a winch should be taken into consideration.

### **When lifting the float body out of the medium observe the information below:**

- At least 2 persons are needed to lift the float out.
- Use the grips fastened on the float body (*Fig. 8-18, Pos. 6 + 8*).



### **Important Note**

*Risk of deformation.*

- *Do not use the parallel rods to lift the float out of the medium.*

## 9 Accessories and Spare Parts

Additional accessories for the installation of sensors can be found in our current price list.

<b>Pipe sensor installation</b> ZUB0 SCHNEID 15PT E-PMA-ORING35 E-VGM-ANTISEIZE	Sensor gasket made of PTFE for pipe sensor screw joint O-ring for pipe sensor screw joint Anti-Seize grease paste, 10 ml in syringe for pipe sensor screw joint
<b>Pipe measuring section</b> OCM0 ZDN0 ...  OCM0 ZCRD N..	Pipe measuring sections with varying nominal diameters (up to DN 800), galvanised or stainless steel 1.4571 (AISI 316 Ti)  Pipe measuring sections with varying nominal diameters (up to DN 400), galvanised or stainless steel 1.4571 (AISI 316 Ti), dome height 500 mm
ZUB0 DN150 STD	Gasket ring with steel insert DN 150 for flange of the long pipe measuring section
ZUB0 DN200 STD	Gasket ring with steel insert DN 200 for flange of the short pipe measuring section (fitting piece)
<b>Drill bit</b> ZUB0 BOHR K38	Drill bit Ø 38 mm for steel and stainless steel
<b>Cutting paste</b> ZUB0 SCHNEID	High-performance cutting paste for stainless steel and titanium, 125 g
<b>Welding nozzle</b> ZUB0 STU15...	For pipe sensors made of steel or stainless steel
<b>Stop ball valve</b> ZUB0 HAHNR15	To remove pipe sensors from pressureless pipelines
<b>Tapping saddle</b> ZUB0 ABS01.../ to...03	For installation of 1½" pipe sensors in pipelines
<b>Mounting plates</b> ZUB0 ABP15...	For installation of pipe sensors on GRP and concrete pipes
<b>Extraction tool</b> ZUB0 AA	To manually insert and extract 1½" pipe sensors under process conditions, pressure-proof up to 4 bar (not suitable for installation or dismantling)
<b>Pipe mounting system</b> ZUB0 RMS2... ZUB0 RMS3... ZUB0 RMS4...	For temporary, non-permanent installation of POA, CSM, and DSM wedge sensors in pipelines from DN 200 to max. DN 800 Material: stainless steel 1.4571 (AISI 316 Ti)
<b>Wedge bases</b> ZUB0 KS00 L30V4A ZUB0 KS00 R30V4A	Wedge base left 30° / wedge base right 30° For POA and CS2 sensor; for horizontal sensor installation in pipes. Material: stainless steel 1.4571 (AISI 316 Ti)
<b>Cable cover sheets</b> ZMS0 140 ZMS0 141  ZMS0 142	Cable cover sheet for one sensor cable, length 1000 mm Bendable cable cover sheet length approx. 1000 mm, to cover up to 3 sensor cables  Bendable cable cover sheet length approx. 1000 mm, to cover 1 sensor with max. Ø 12 mm or 2 sensor cables with max. Ø 8.5 mm.

<b>Sensor cover</b> ZUB0 SEN SCHU1	Sensor cover for all KDA-, KDO- and KDS-wedge sensors; material: 1.4571
ZUB0 SEN SCHU2	Sensor cover for all POA-wedge sensors; material: 1.4571

**Tab. 9-1 Accessories and spare parts**

## 10 Dismantling/Disposal

### 10.1 Dismantling

#### Prepare dismantling:

- Drain the measurement place if possible.

#### Dismantle sensors:

1. Disconnect measurement system from mains power.
2. Use appropriate tools to disconnect cables from the transmitter.
3. Remove sensors from the flume or the pipeline.
4. For pipelines: seal the sensor opening.

When dismantling wedge sensors with and without pressure measurement cell observe the information below.



#### **Important Note**

*Improper handling will damage the wedge sensor.*

- *Use appropriate screwdriver for dismantling.*
- **Never** use a crowbar, chisel, lever or similar tools.

### 10.2 Disposal

Improper disposal may be harmful to the environment.

Always dispose sensors as well as accessories and mounting parts according to applicable local regulations on environmental standards for electronic products



#### **EC WEEE-Directive logo**

*This symbol indicates that the Directive 2012/19/EU on waste electrical and electronic equipment requirements shall be observed on the disposal of the equipment. NIVUS GmbH supports and promotes the recycling and environmentally friendly, separate collection/disposal of waste electrical and electronic equipment in order to protect the environment and human health. Observe the local disposal regulations and laws.*

*NIVUS GmbH is registered with the EAR, therefore public collection and return points in Germany can be used for disposal.*

### Index

<b>A</b>	<ul style="list-style-type: none"> <li>Accessories .....91               <ul style="list-style-type: none"> <li>Cable cover sheet ..... 82</li> <li>Cutting paste..... 79</li> <li>Drill bit..... 79</li> <li>Sensor cover..... 80</li> <li>Stop ball valve..... 78</li> <li>Tapping saddle ..... 71</li> <li>Wedge base..... 80</li> <li>Welding nozzle..... 69</li> </ul> </li> <li>Air-ultrasonic sensor               <ul style="list-style-type: none"> <li>Fastening permanent ..... 45</li> <li>Fastening temporary ..... 45</li> <li>Position ..... 44</li> <li>Sensor mounting ..... 42</li> </ul> </li> <li>Alignment               <ul style="list-style-type: none"> <li>Pipe sensors ..... 47</li> <li>Wedge sensors ..... 38</li> </ul> </li> <li>Article names.....9</li> </ul>	<b>G</b>	<ul style="list-style-type: none"> <li>Parallel rods ..... 86</li> <li>Grease paste ..... 52, 91</li> </ul>
<b>C</b>	<ul style="list-style-type: none"> <li>Cable               <ul style="list-style-type: none"> <li>With integrated air hose ..... 35</li> <li>With protective FEP jacket ..... 39</li> </ul> </li> <li>Cable cover sheet .....82, 91</li> <li>Calming section conditions..... 19</li> <li>Cleaning .....64</li> <li>Colour code for conductors and wires..... 9</li> <li>Control section .....65               <ul style="list-style-type: none"> <li>Construction..... 65</li> <li>General information..... 65</li> <li>In channels..... 68</li> <li>With pipe measuring section ..... 65</li> </ul> </li> <li>Copyright .....3</li> <li>Copyrights and property rights .....3</li> <li>Cutting paste ..... 79, 91</li> </ul>	<b>I</b>	<ul style="list-style-type: none"> <li>Intended use .....15</li> </ul>
<b>D</b>	<ul style="list-style-type: none"> <li>Dead zone .....42</li> <li>Disclaimer..... 17</li> <li>Dismantling.....93</li> <li>Disposal.....93</li> <li>Drill bit.....79</li> </ul>	<b>M</b>	<ul style="list-style-type: none"> <li>Maintenance .....64</li> <li>Measurement section               <ul style="list-style-type: none"> <li>Long..... 67</li> <li>Short ..... 66</li> </ul> </li> <li>Measuring section selection .....19</li> <li>Mounting accessories.....69</li> <li>Mounting plate .....91</li> </ul>
<b>E</b>	<ul style="list-style-type: none"> <li>Ex-Approval..... 14</li> </ul>	<b>N</b>	<ul style="list-style-type: none"> <li>Names .....3</li> </ul>
<b>F</b>	<ul style="list-style-type: none"> <li>Fastening element.....55</li> <li>Float.....84               <ul style="list-style-type: none"> <li>Description ..... 85</li> <li>Install pipe sensor ..... 89</li> <li>Installation in agitated media..... 88</li> <li>Maintenance and cleaning ..... 90</li> </ul> </li> </ul>	<b>P</b>	<ul style="list-style-type: none"> <li>Parallel rods.....86</li> <li>Personnel requirements ..... 14</li> <li>Pipe measuring section .....91</li> <li>Pipe mounting system .....91</li> <li>Pipe sensor CSM               <ul style="list-style-type: none"> <li>Align..... 62</li> <li>Alignment..... 47</li> <li>Alignment aid ..... 58</li> <li>Components..... 58</li> <li>Drill into empty pipeline ..... 60</li> <li>Drilling in pipeline..... 59</li> <li>Insertion depth ..... 62, 63</li> <li>Install in empty pipeline..... 61</li> <li>Installation options ..... 59</li> <li>Investigate the insertion depth ..... 63</li> <li>Scale for pipe wall strength..... 58</li> </ul> </li> <li>Pipe sensors POA, CS2, KDA/KDO               <ul style="list-style-type: none"> <li>Alignment..... 47</li> <li>Components..... 49</li> <li>Drill into empty pipeline ..... 51</li> <li>Drilling in pipelines ..... 50</li> <li>Fasten nozzle..... 51</li> <li>Install ..... 54</li> <li>Install fastening element ..... 56</li> <li>Prepare sensor mounting..... 52</li> <li>Sensor screw connection ..... 49</li> </ul> </li> <li>Positioning .....19</li> <li>Precautions.....12</li> </ul>
		<b>S</b>	<ul style="list-style-type: none"> <li>Safety instructions ..... 11</li> <li>Safety measures.....12</li> <li>Sensor cover ..... 80, 92</li> </ul>

Sensor mounting .....	32	Stop ball valve	
Air-ultrasonic sensor .....	42, 45	Pipe sensor CSM .....	58
In dirty media .....	32	Pipe sensors POA, CS2, KDA/KDO..	78, 91
Pipe sensor .....	46	<b>T</b>	
Pipe sensor CS2 .....	49	Tapping saddle .....	91
Pipe sensor CSM .....	58	Description .....	71
Pipe sensor KDA/KDO .....	49	Installation .....	73
Pipe sensor POA .....	49	Installation examples .....	73
Principles .....	32	Translation .....	3
Wedge sensor .....	33	Tressing	
Wedge sensor with integrated		Avoid .....	40
pressure measurement cell .....	35	<b>U</b>	
Wedge sensor with integrated water-		User's responsibilities .....	16
ultrasonic measurement .....	37	<b>W</b>	
Wedge sensor without built-in		Wedge base .....	91
pressure measurement cell .....	34	Description .....	80
Sensor overview .....	18	Installation examples .....	81
Sensor position .....	20	Wedge sensor	
After change of profile .....	29	Alignment .....	38
Air-ultrasonic sensor .....	20, 24, 44	Fastening .....	38
Alternation of slope .....	22	Laying cables .....	39
Behind curves or elbows .....	21	Welding nozzle .....	91
Fall .....	22, 23, 25	Description .....	69
Fixtures .....	23	Installation examples .....	70
In part filled flumes .....	20	Wires	
In shafts featuring a high berm .....	26	Colour code .....	9
In shafts featuring a low berm .....	26		
In structured channels .....	27		
Manhole .....	24, 25		
Negative slope .....	22		
Spare parts .....	91		