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Special Documentation
Proline Prosonic Flow P 500

High-temperature applications
Assembly manual for the CH-050 and CH-100 sensors

Endress+Hauser
People for Process Automation

Table of contents

1 About this document

1.1 Document function

This manual is special documentation; it does not replace the Operating Instructions pertaining to the device. It serves as a reference for installing the CH-050 and CH-100 sensors in high-temperature applications.

1.2 Content and scope

This documentation contains the descriptions of the assembly instructions for the CH-050 and CH-100 sensors.

1.3 Symbols

1.3.1 Safety symbols

DANGER
This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

WARNING
This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

CAUTION
This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.

NOTICE
This symbol contains information on procedures and other facts which do not result in personal injury.

1.3.2 Symbols for certain types of information

Symbol	Meaning
	**Permitted** Procedures, processes or actions that are permitted.
	**Forbidden** Procedures, processes or actions that are forbidden.
	**Tip** Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
▶	Notice or individual step to be observed
1., 2., 3...	Series of steps
	Result of a step

1.3.3 Symbols in graphics

Symbol	Meaning
1, 2, 3 ...	Item numbers
A, B, C, ...	Views
A-A, B-B, C-C, ...	Sections

1.4 Documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:
- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

This Special Documentation and other documentation is available:
In the Download Area of the Endress+Hauser website: www.endress.com → Downloads

This documentation is an integral part of the following Operating Instructions:

Measuring device	Documentation code	
	HART	Modbus RS485
Prosonic Flow P 500	BA02025D	BA02026D

1.5 Registered trademarks

HART®
Registered trademark of the FieldComm Group, Austin, Texas USA

Modbus®
Registered trademark of SCHNEIDER AUTOMATION, INC.

2 Basic safety instructions

Application
To ensure that the high-temperature sensors remain in proper condition for the operation time:

- Keep within the specified pressure and temperature range.
- Check the range of application using the nameplates on the measuring instrument.
- Keep within the range of application specified on the nameplates.
- Observe the technical data in accordance with this manual and the measuring instrument documentation.

Operation in hazardous areas

- In hazardous areas, take precautions to ensure that the maximum permitted ambient temperature is not exceeded.

WARNING
Risk of injury when mounting the sensors and strapping bands!
- Due to the increased risk of cuts, wear suitable gloves and safety goggles.

DANGER
Risk of burns from hot surfaces!
- Wear suitable protective equipment such as temperature-resistant gloves, clothing or protective visors.

High-temperature applications (> 170 °C)
- "Process temperature" order code, options H, I, J
- Installation for high-temperature applications must be performed by Endress +Hauser staff or by individuals authorized and trained by Endress+Hauser.

3 Safety aspects for pipe preparation

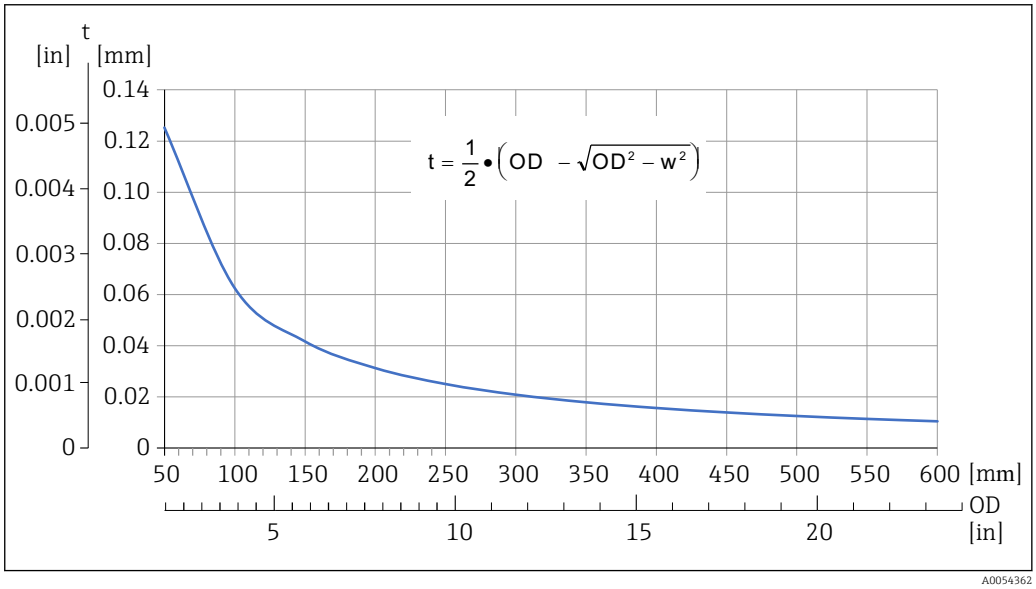
3.1 Introduction

The surfaces of the measuring pipe must be prepared in order to install the CH-050 and CH-100 ultrasonic high-temperature clamp-on sensors: A clean, smooth and even coupling surface must be worked into the external pipe wall to ensure that the sensors work properly. This document describes this preparation process.

3.2 Preparing the pipe surface

A clean, smooth and level coupling surface approx. 80 mm (3.14 in) long and 5 mm (0.19 in) wide must be worked into the external pipe wall.

The material quantity to be removed from the external pipe surface is specified in the diagram.



1 *Material to be removed depending on the external pipe diameter*

OD External pipe diameter
t Material to be removed
w Width of coupling surface

It shows the material to be removed t depending on the external pipe diameter OD at a coupling surface width w of 5 mm (0.19 in). Note that the wall thickness is usually reduced by less than 0.1 mm (0.0039 in) by the machining.

3.3 Information on compressive strength

According to ASTM A999/A999M, seamless and welded pipes may deviate by up to ±12.5% with regard to wall thickness. Forged and drilled pipes may deviate by a maximum of ±3.2 mm (±0.12 in), while cast pipes may deviate by a maximum of ±1.6 mm (±0.06 in). These fluctuations are still larger than the material required to be removed from the pipe wall by a factor of 10. In addition, the dimensioning of the pipe wall thickness is ensured in line with ASME B31.3 and/or EN 13480-3, which means that the described material removal will not impact the pipe's rigidity. This is ensured through calculation specifications for the minimum wall thickness, including safety factors, requirements of the pipe manufacturers for minimum wall thickness, and the short machining length in the pipe's longitudinal direction.

3.4 Machining process

The coupling surface is worked into the external pipe wall with a conventional machining tool (e.g trimmer) equipped with a carbide finishing and roughing cutter. The machine must be fitted with mechanical stops to prevent uncontrolled lowering of the trimmer into the pipe wall. The pipe machining must also only be carried out by trained Endress+Hauser personnel.

Machining tool:→ 11

Preparing the coupling surface on the measuring pipe (single-traverse assembly): → 13

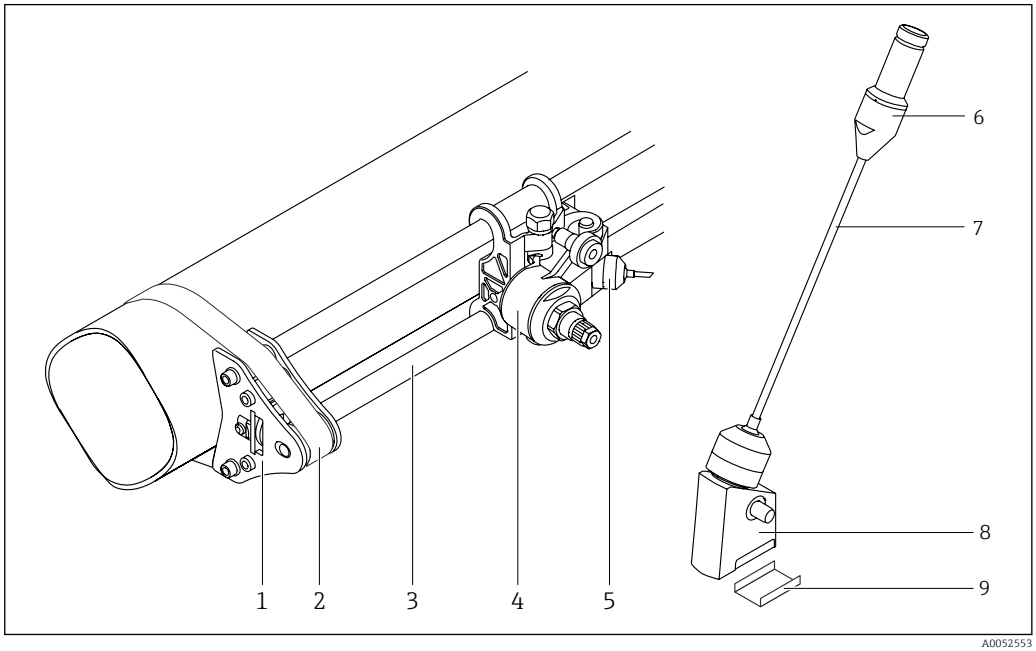
Preparing the coupling surface on the measuring pipe (double-traverse assembly): → 18

Checking the coupling surfaces:→ 24

4 Product features and availability

4.1 Product design

The system consists of a pair of ultrasonic sensors and an installation set, which is strapped onto the measuring pipe. Metal foil is used as the coupling media.



2

1 *Strapping band bracket*
2 *Strapping band*
3 *Mounting rail with scale*
4 *Sensor bracket*
5 *High-temperature sensor*
6 *Plug adapter for sensor cable*
7 *Cable protection pipe*
8 *Wedge*
9 *Coupling foil*

4.2 Availability

The high-temperature sensors described in this manual can be ordered as an option for the following nominal frequencies.
- 0.5 MHz: "Sensor version" order code, option AG "CH-050"
- 1.0 MHz: "Sensor version" order code, option AH "CH-100"

The options can be selected directly when ordering the device. Detailed information on the relevant order code is available from your local Endress+Hauser sales organization or on the product page of the Endress+Hauser website: www.endress.com.

The coupling foil material depends on the process medium temperature range:

Medium temperature range	Material	"Process temperature" order code option
+150 to +220 °C (302 to +428 °F)	Tin	H
+210 to +370 °C (410 to +698 °F)	Zinc	I
+350 to +550 °C (+662 to +1022 °F)	Aluminum	J

5 Mounting procedure

5.1 Mounting requirements

5.1.1 Pipe materials

Only use the sensors on metallic pipes, preferably made from stainless or carbon steel in the appropriate alloys. The pipes must not have an internal lining.

5.1.2 Removing the thermal insulation

In case of insulated pipes, the insulation must be removed across a length of at least 70 cm (28 in) before mounting the device.

NOTICE

Measuring pipe cooling down during mounting and deposits or caking inside the measuring pipe.

In high-temperature applications, there are some media that harden or crystallize when they drop below a certain temperature. This process may be irreversible. Deposits or caking inside the pipe can stop the ultrasonic signal from being received.

- Make sure that the measuring pipe does not cool down excessively during the mounting process, e.g. by keeping the mounting time brief.
- Please contact your responsible Endress+Hauser Serviceorganisation

5.1.3 Sensor selection

The sensor selection does not depend on the wall thickness. The CH-100 sensor is used as standard; in case of very strongly attenuating media, the CH-050 must be used.

For sensor selection: Product design in the Applicator

5.1.4 Mounting the sensor system

The measuring paths for a high-temperature measurement are preferably mounted with one traverse on the pipe. Mounting with two traverses is also possible depending on the application and access to the pipelines.

5.1.5 Determining the sensor distance

The sensor distance must be calculated prior to starting the mounting process, either by entering the mounting conditions in the device or in the applicator.

5.1.6 Flow direction

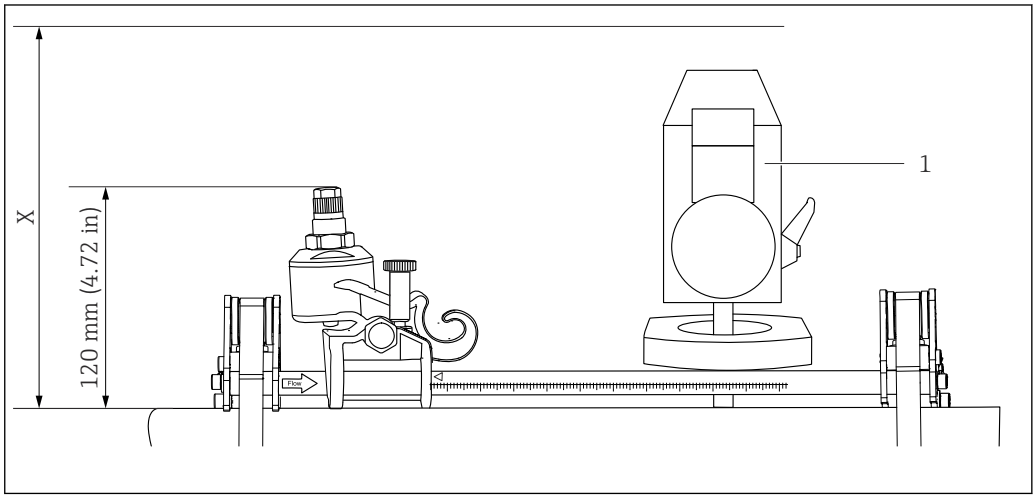
Install the mounting rails in the direction of flow.

Observe the direction of the arrow on the mounting rails.

5.1.7 Determining the mounting location

A smooth and even coupling surface is required on the measuring pipe in order to ensure optimum acoustic coupling of the high-temperature sensors. The pipe's surface roughness is insufficient in many applications (manufacturing tolerances or corrosion) and the pipe must be mechanically machined (smoothed) at the sensor mounting position → 11.

The measuring point should fulfill the following requirements:
- Observe inlet and outlet runs. Detailed information on the inlet and outlet runs. Operating Instructions for the device → 5
- The sensor system requires a minimum installation height of 120 mm (4.72 in). Additional space (X) may be required to machine the measuring pipe surface with a machining tool. → 3, 11
- To keep machining of the measuring pipe surface to a minimum, find a mounting location with as little unevenness as possible in the longitudinal direction. This can be evaluated visually with a straightedge or similar tool.



3

1 Machining tool (e.g. trimmer)
X Space for machining with a machining tool.

5.1.8 Machining tool for the coupling surface

Simply cleaning the surface is not sufficient in most cases.

To ensure good acoustic coupling of the sensors, the measuring pipe surface must have a smooth and even coupling surface:
- Length: Approx. 60 mm (2.36 in)
- Width: 3 to 5 mm (0.12 to 0.20 in)

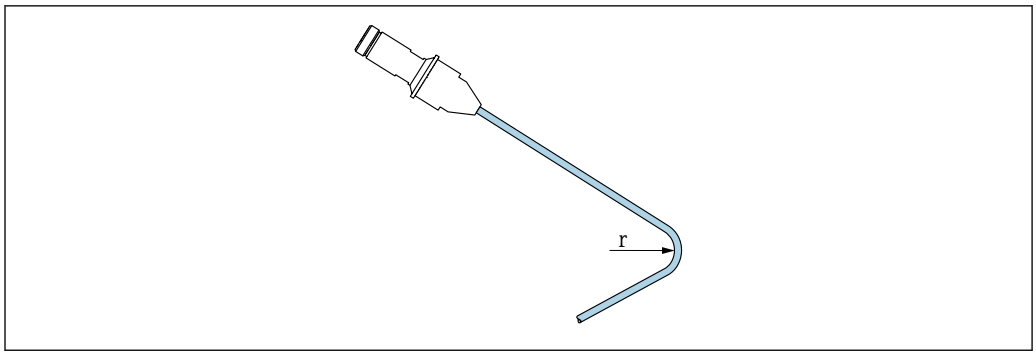
We recommend using a trimmer (e.g. Makita RT0700CX) as the machining tool. It should have the following properties:
- Minimum power: 700 W
- Adjustable parallel guide
- Carbide finishing and roughing cutter, diameter 8 mm (0.31 in), length 50 to 70 mm (2 to 2.8 in)
- Adjustable speed control

The machining tool is not included in the scope of delivery.

5.1.9 Connecting cable with protection pipe

NOTICE

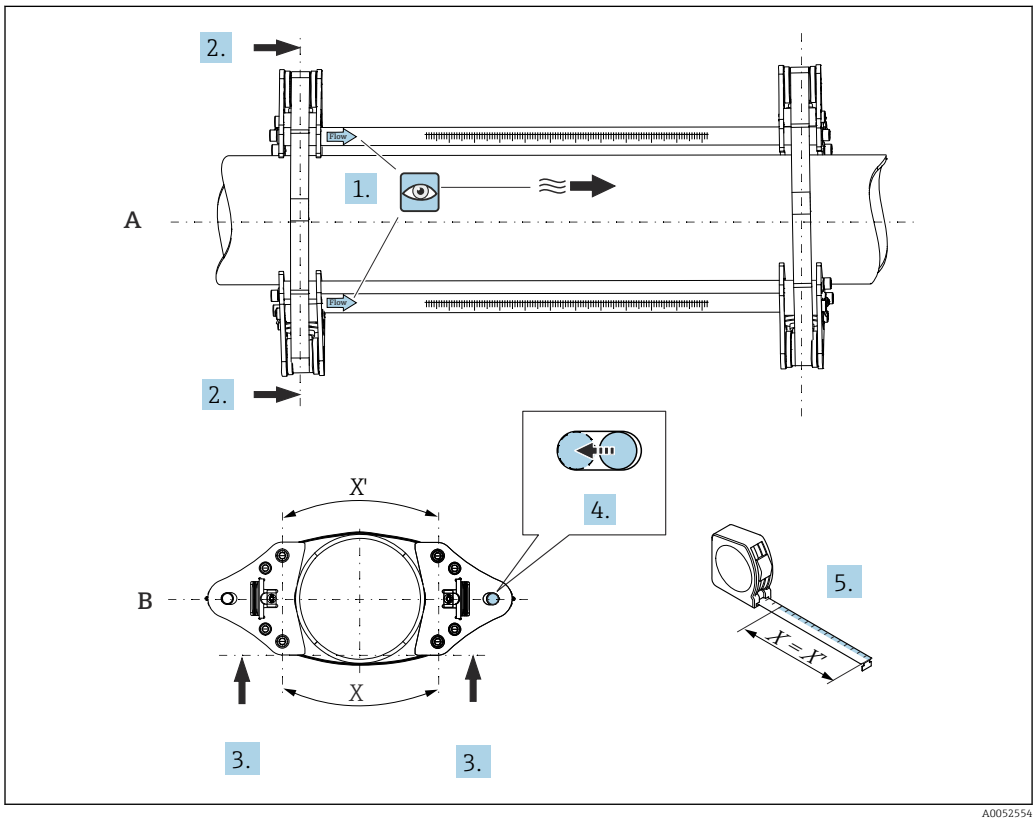
Damage to the connecting cable and consequential damage caused by not observing the minimum bending radius of the protection pipe.
- ▶ You must observe the minimum bending radius r of 20 mm (0.8 in).
- ▶ The protection pipe must not be bent directly on the transition between the protection pipe to the sensor and plug adapter.



4 *Minimum bending radius r: 20 mm (0.8 in)*

5.2 Single-traverse assembly

5.2.1 Mounting the sensor rail



A Top view
B Side view

The mounting rails are secured to the measuring pipe with the strapping bands. Two sensor rails are mounted on opposite sides as standard.

1. Place the mounting rails on opposite sides of the measuring pipe in the flow direction and loosely secure them with the strapping bands.
2. Align the sensor rails to each other so that they are straight.
3. Align the sensor rails to each other radially (+/-5°).
4. Tighten the strapping bands until the clamping screw is in contact with the pipe-side edge of the slotted hole.

5. Check the parallel alignment with a tape measure.

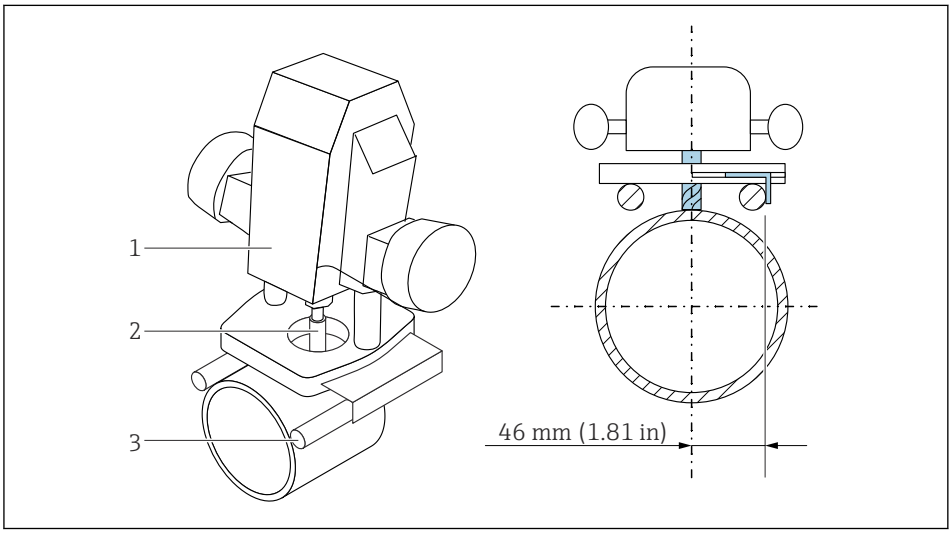
We always recommend mounting both sensor rails.

5.2.2 Preparing the coupling surface on the measuring pipe

A machining tool is used to prepare the coupling surface; see the specifications in "Machining tool for the coupling surface" (→ 11).

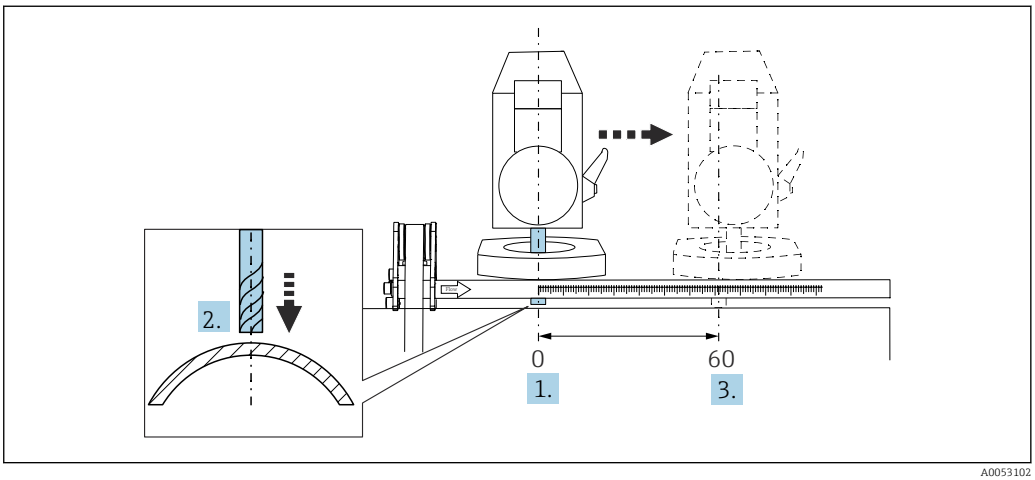
Centering the machining tool

- Adjust the side stop so that the trimmer is centered between the two bars of the sensor rail.



1 *Machining tool*
2 *Trimmer*
3 *Sensor rail*

Machining the pipe surface on the upstream side

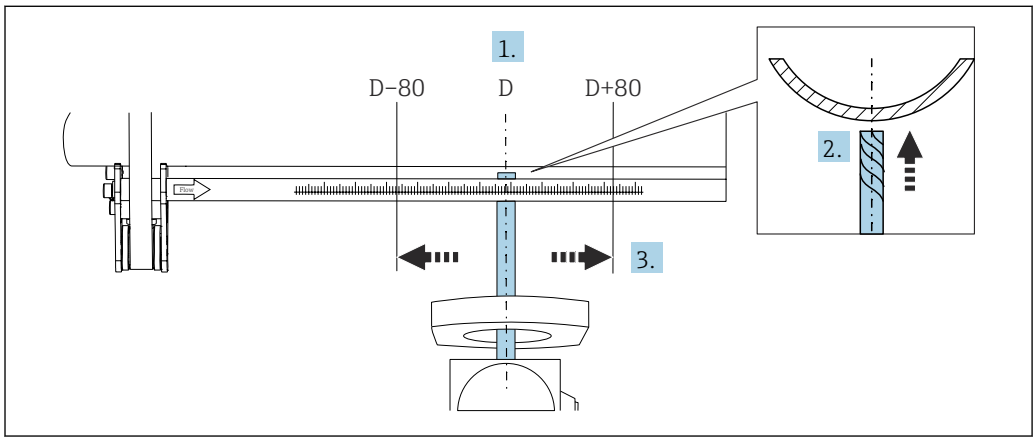


We recommend having the pipe surface machined by Endress+Hauser staff or by individuals authorized and trained by Endress+Hauser.

1. Move the machining tool to position 0. The trimmer does not touch the pipe surface yet.
2. Start up the machining tool in line with its operating instructions. Slowly and carefully lower the trimmer until the trimmer just scratches the pipe surface.

3. Machine the pipe surface from the stop on the strapping band bracket to approx. position 60 on the rail scale in the flow direction.
4. If necessary, lower the trimmer again just barely (approx. 0.1 mm (0.004 in)) and repeat the process until you have achieved a finely structured surface approx. 3 to 5 mm (0.12 to 0.20 in) wide on the entire length until position 60.

Machining the pipe surface on the downstream side



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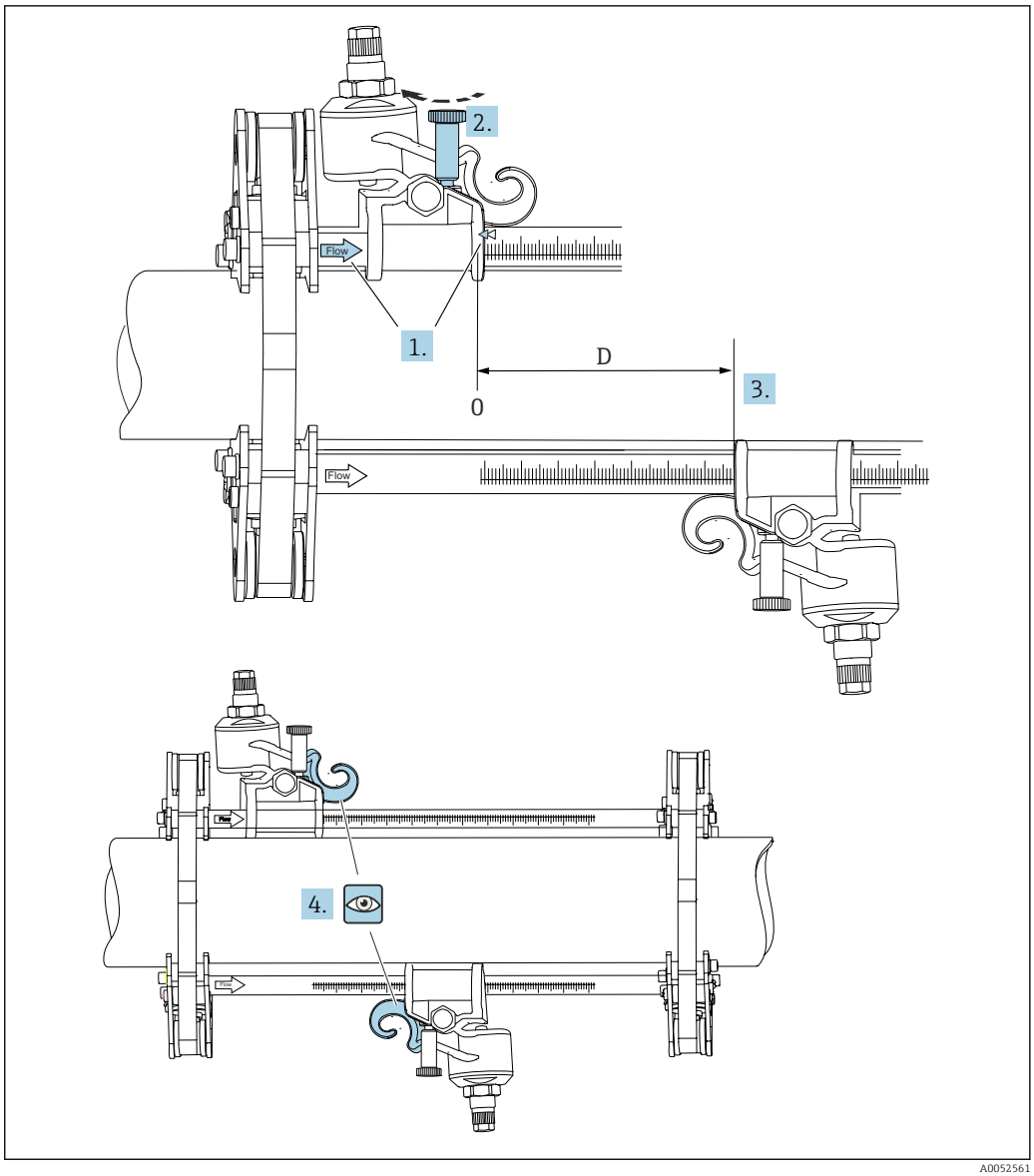
1. Move the machining tool to position D (calculated sensor distance). The trimmer does not touch the pipe surface yet.
2. Start up the machining tool in line with its operating instructions. Slowly and carefully lower the trimmer until the trimmer just scratches the pipe surface.
3. Machine the pipe surface in an area of ±80 around the calculated sensor distance D.
4. If necessary, lower the trimmer again just barely (approx. 0.1 mm (0.004 in)) and repeat the process until you have achieved a finely structured surface approx wide on the entire length D ±80.

5.2.3 Mounting the sensor brackets

The sensor distance D is set using the scales on the sensor rail.



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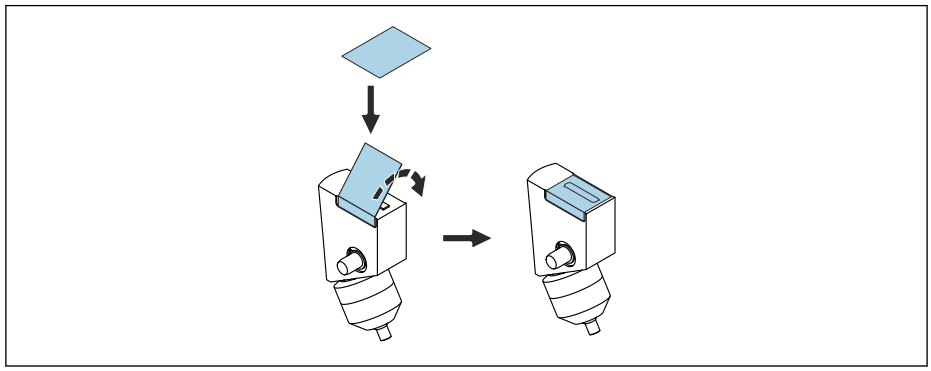
1. Attach the first sensor bracket in the opposite flow direction (upstream) between the marking arrows (between flow arrow and triangle symbol).
2. Secure the sensor bracket with a fixing screw.
3. Attach the second sensor bracket in the flow direction (downstream) at the calculated sensor distance D on the scale of the opposite sensor rail.
4. View of complete assembly: Please make sure that the sensor brackets are correctly aligned with each other!

The sensor brackets can be moved as needed on the sensor rail while maintaining the sensor distance.

5.2.4 Selecting and mounting the coupling foil

The coupling foil is included in the scope of delivery and matches the temperature specifications provided when ordering the measuring system. The coupling foil must be attached to the relevant sensor before mounting the sensors.

1. Fold the foil over the slightly angled surface of the sensor body.



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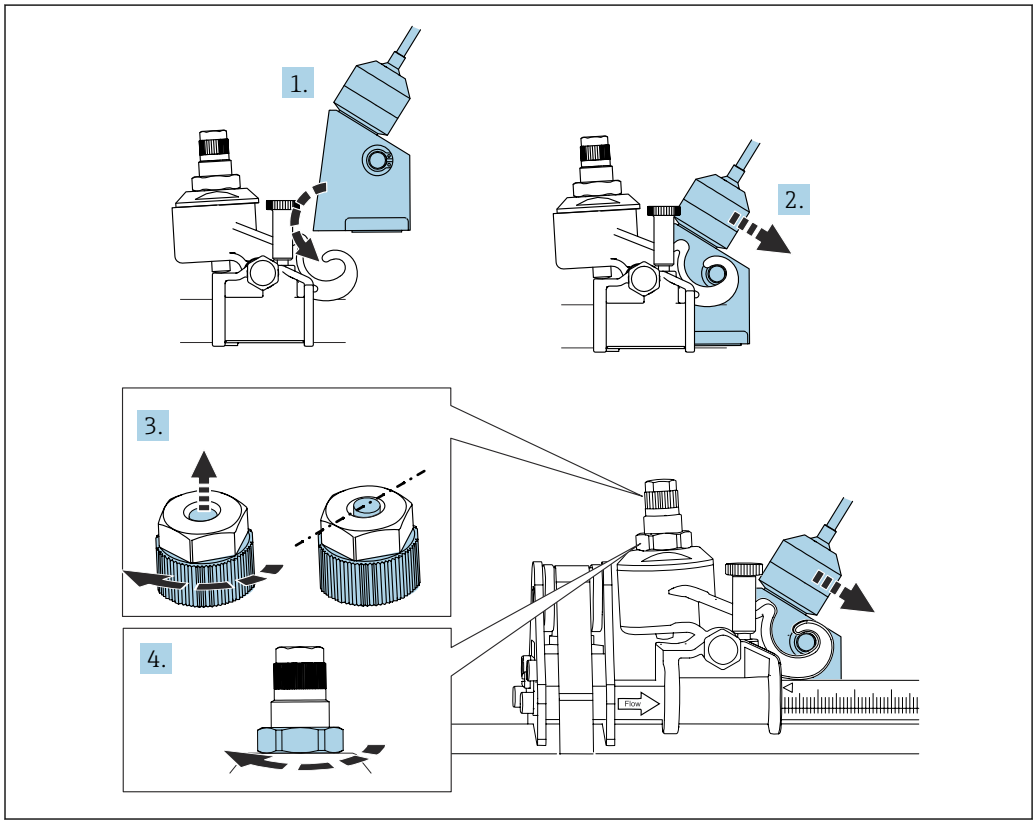
2. Equip all sensors used with coupling foil!

5.2.5 Mounting the sensors

The sensors equipped with coupling foil are positioned in the pre-assembled sensor brackets and bolted in place.



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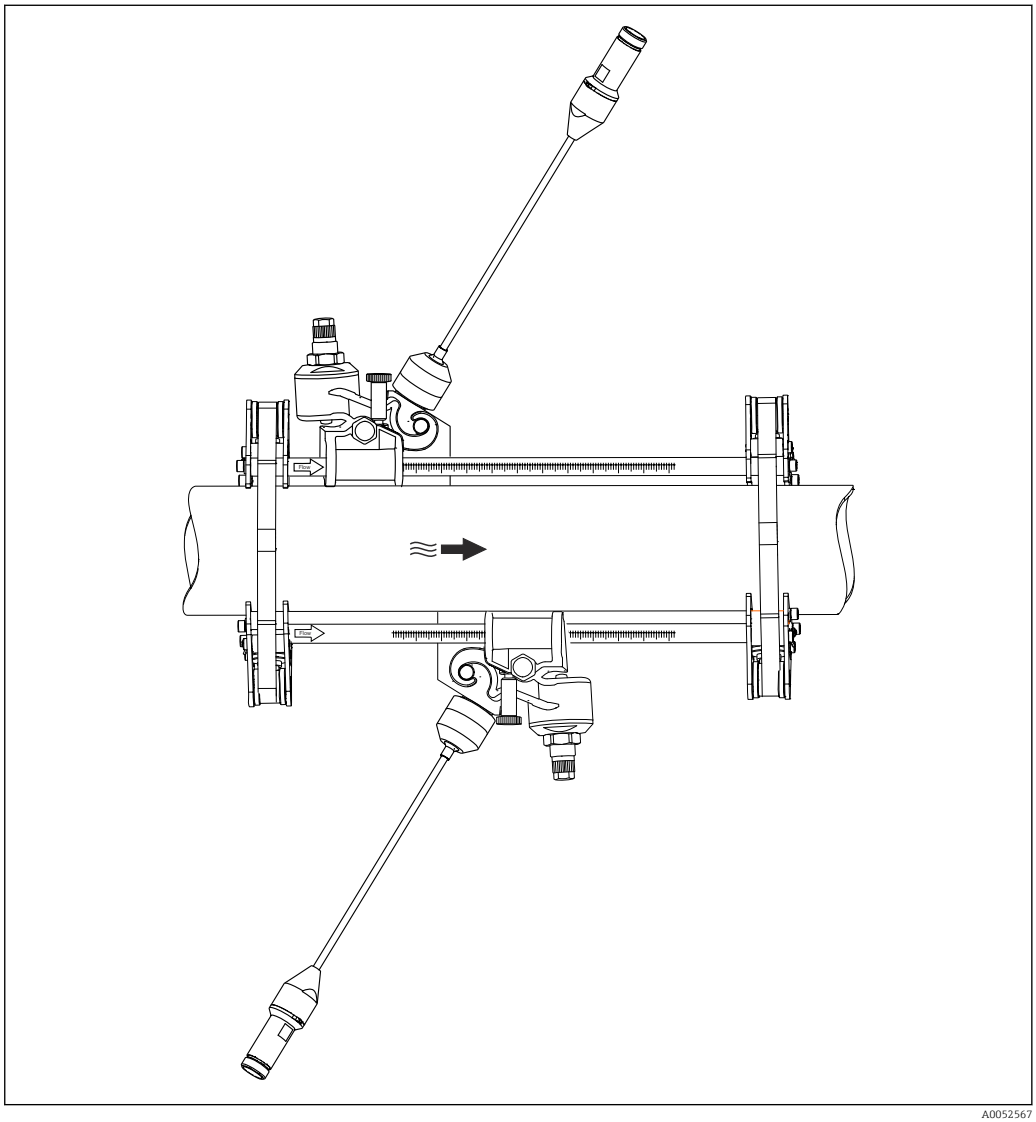
1. Guide the sensor into the sensor bracket fork with the mounting screws. Make sure that the sensors are correctly aligned!
2. Align the sensor so that it is level and push it into the bracket.
3. Tighten the clamping screw until the index bolt is flush with the top of the tightening nut.

4. Tighten the counter nut to at least 14 Nm to protect the clamping screw against loosening.
5. Repeat steps 1 to 4 for all other sensors.

5.2.6 Top view of correct installation with one traverse



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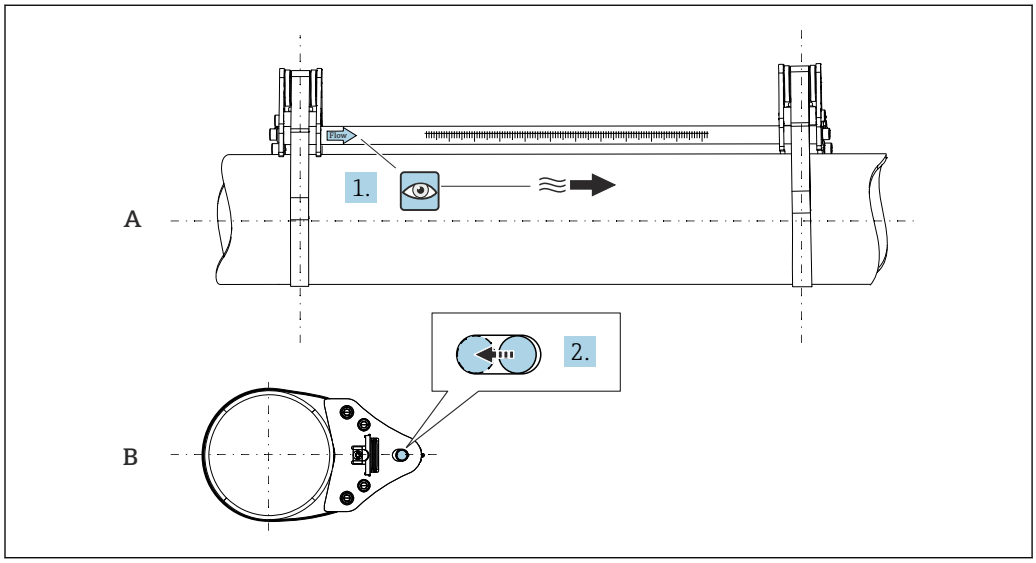
5.3 Double-traverse assembly

5.3.1 Mounting the sensor rail



A Top view
B Side view

The mounting rails are secured to the measuring pipe with the strapping bands.

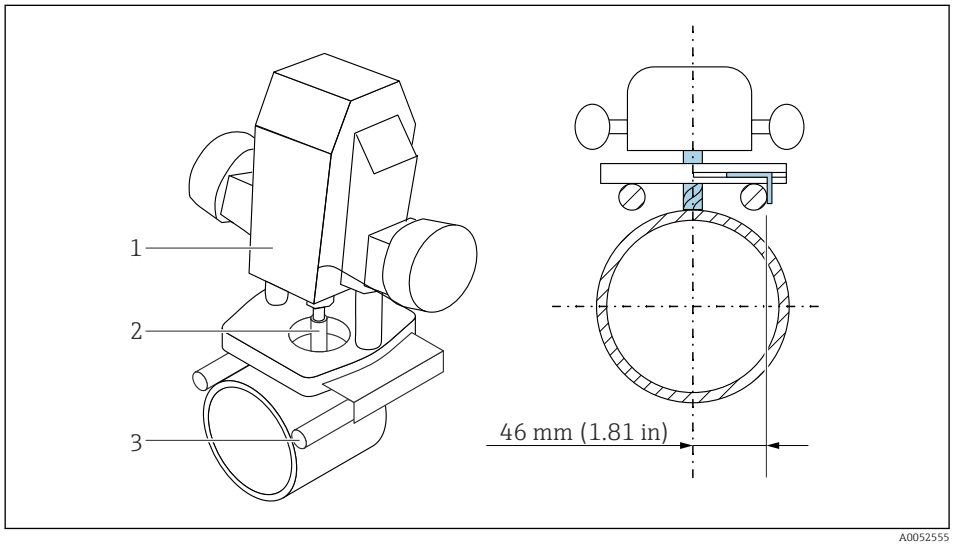
1. Place the mounting rails on the measuring pipe in the flow direction and loosely secure them with the strapping bands.
2. Tighten the strapping bands until the clamping screw is in contact with the pipe-side edge of the slotted hole.

5.3.2 Preparing the coupling surface on the measuring pipe

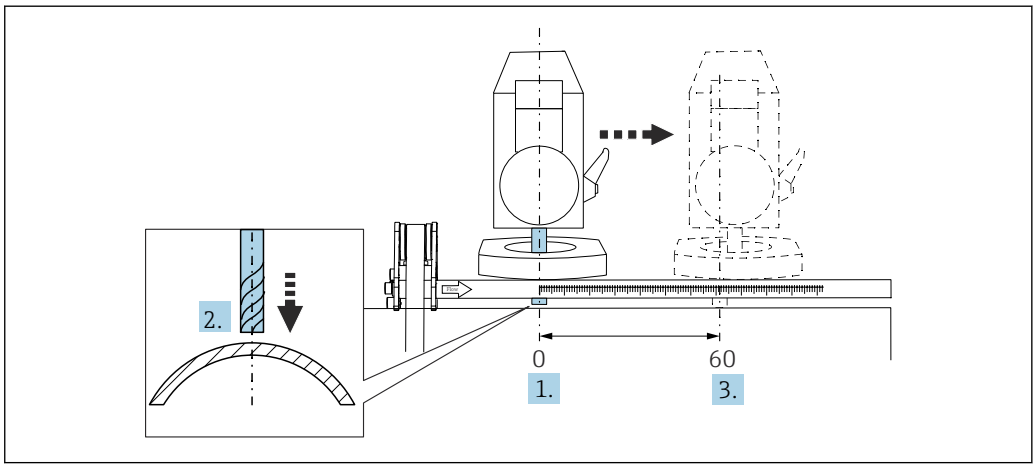
A machining tool is used to prepare the coupling surface; see the specifications in "Machining tool for the coupling surface" (→ 11).

Centering the machining tool

- Adjust the side stop so that the trimmer is centered between the two bars of the sensor rail.



Machining the pipe surface on the upstream side



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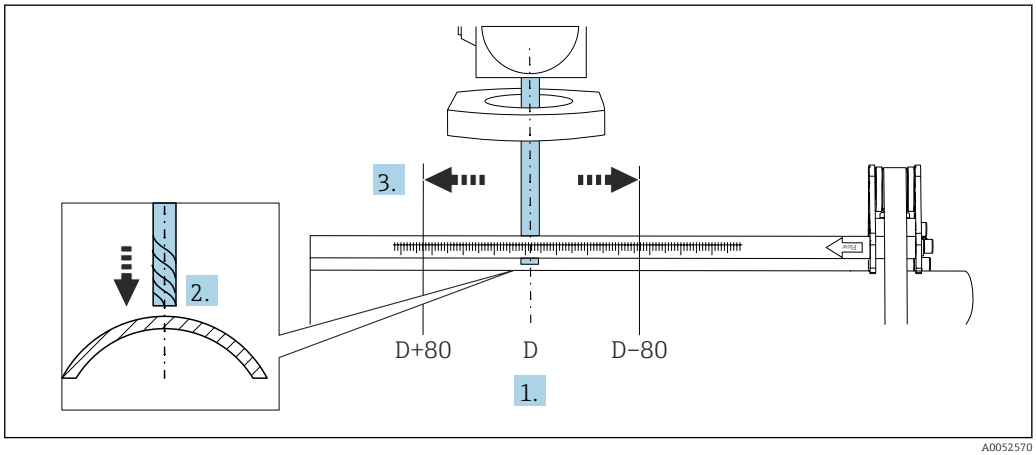
We recommend having the pipe surface machined by Endress+Hauser staff or by individuals authorized and trained by Endress+Hauser.

1. Move the machining tool to position 0. The trimmer does not touch the pipe surface yet.
2. Start up the machining tool in line with its operating instructions. Slowly and carefully lower the trimmer until the trimmer just scratches the pipe surface.
3. Machine the pipe surface from the stop on the strapping band bracket to approx. position 60 on the rail scale in the flow direction.
4. If necessary, lower the trimmer again just barely (approx. 0.1 mm (0.004 in)) and repeat the process until you have achieved a finely structured surface approx. 3 to 5 mm (0.12 to 0.20 in) wide on the entire length until position 60.

Machining the pipe surface on the downstream side



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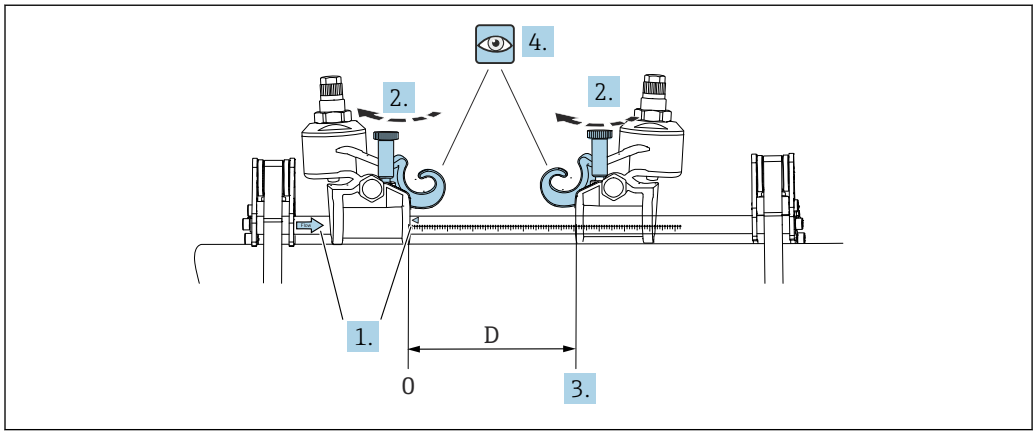
1. Move the machining tool to position D (calculated sensor distance). The trimmer does not touch the pipe surface yet.
2. Start up the machining tool in line with its operating instructions. Slowly and carefully lower the trimmer until the trimmer just scratches the pipe surface.
3. Machine the pipe surface in an area of ±80 around the calculated sensor distance D.
4. If necessary, lower the trimmer again just barely (approx. 0.1 mm (0.004 in)) and repeat the process until you have achieved a finely structured surface approx. 3 to 5 mm (0.12 to 0.20 in) wide on the entire length D ±80.

5.3.3 Mounting the sensor brackets

The sensor distance D is set using the scales on the sensor rail.



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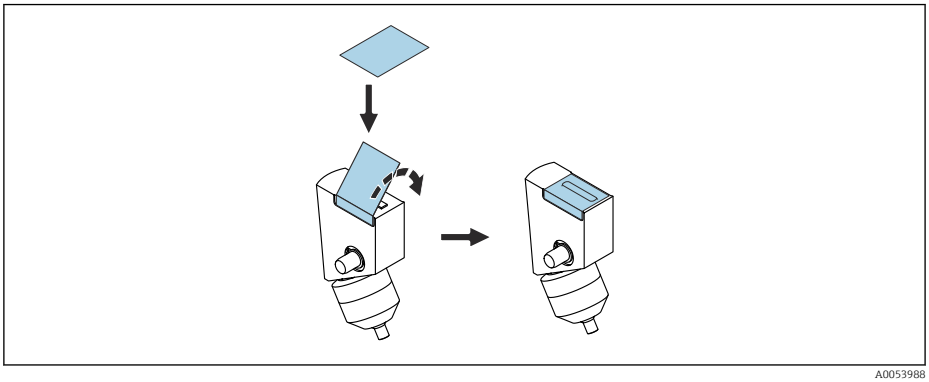
1. Attach the first sensor bracket in the opposite flow direction (upstream) between the marking arrows (between flow arrow and triangle symbol).
2. Secure the sensor bracket with a fixing screw.
3. Attach the second sensor bracket in the flow direction (downstream) at the calculated sensor distance D.
4. View of complete assembly: Please make sure that the sensor brackets are correctly aligned with each other!

5.3.4 Selecting and mounting the coupling foil

The coupling foil is included in the scope of delivery and matches the temperature specifications provided when ordering the measuring system. The coupling foil must be attached to the relevant sensor before mounting the sensors.

1. Fold the foil over the slightly angled surface of the sensor body.



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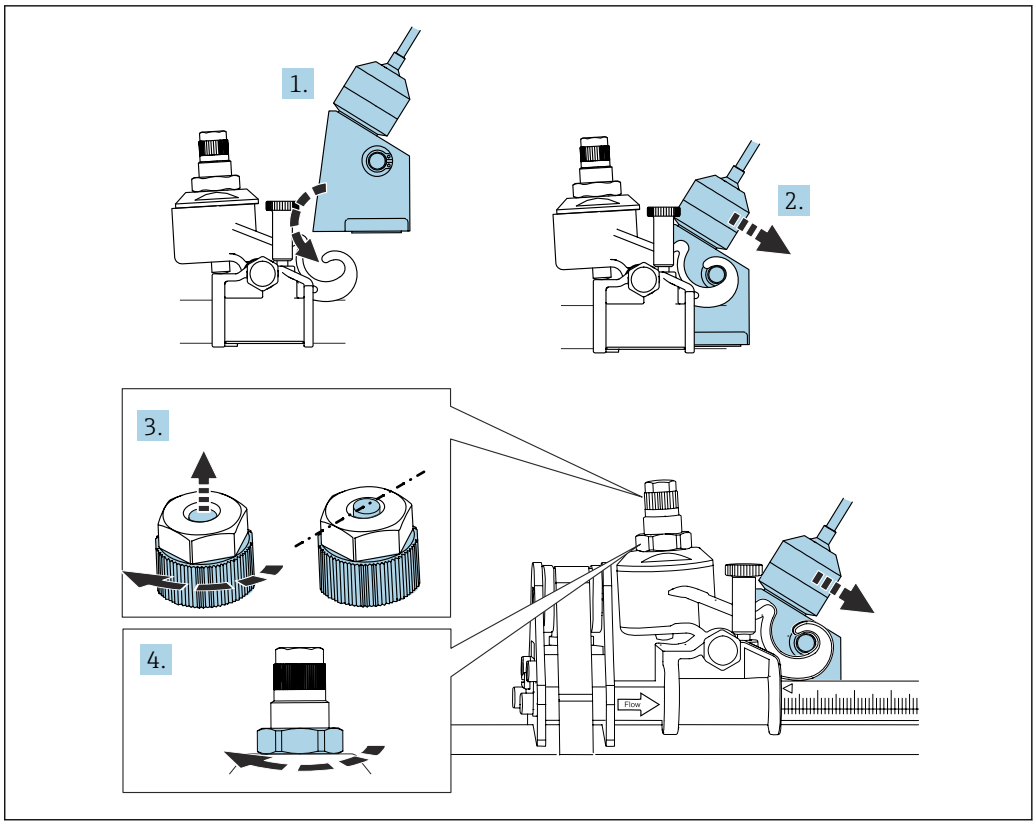
2. Equip all sensors used with coupling foil!

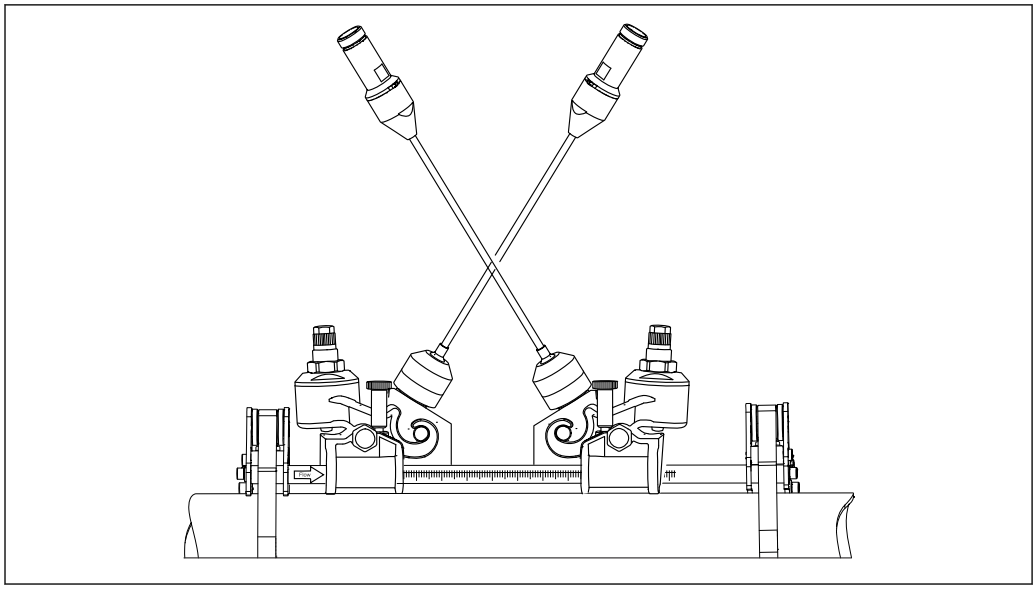
5.3.5 Mounting the sensors

The sensors equipped with coupling foil are positioned in the pre-assembled sensor brackets and bolted in place.



1. The sensor mounted in the opposite flow direction (upstream) is guided into the sensor bracket fork with the mounting screws. Make sure that the sensors are correctly aligned!
2. Align the sensor so that it is level and push it into the bracket.
3. Tighten the clamping screw until the index bolt is flush with the top of the tightening nut.
4. Tighten the counter nut to at least 14 Nm to protect the clamping screw against loosening.
5. Repeat steps 1 to 4 for the opposite sensor.

5.3.6 Top view of correct installation with two traverses



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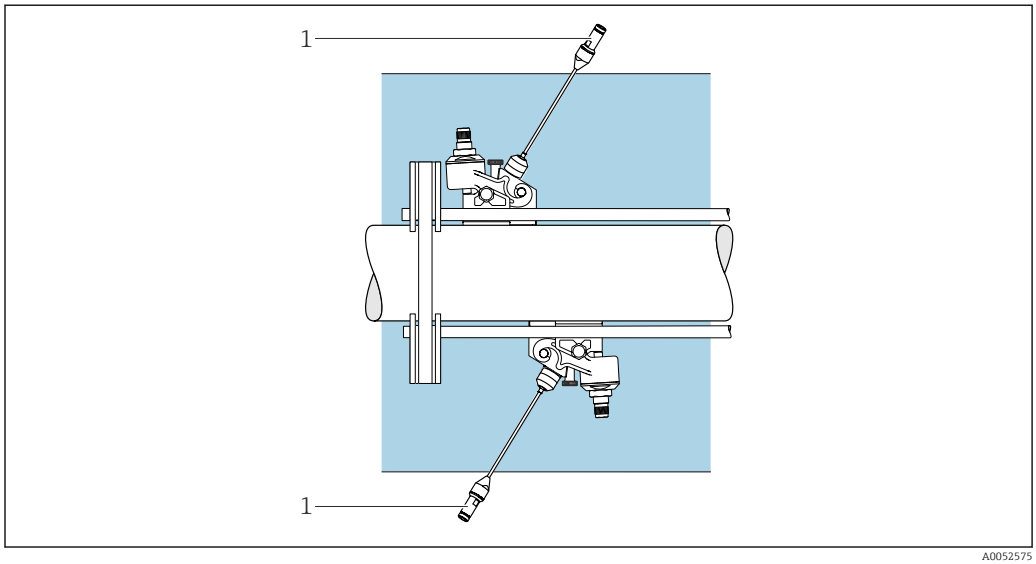
5.4 Thermal insulation

NOTICE

Damage to the connection board in the plug adapter due to overheating.

▶ Keep the plug adapter completely clear. The insulation must go no further than the plug adapter.

The exposed pipe section should be re-insulated as quickly as possible after mounting to prevent any build-up inside the pipe → 10. The sensor system may be completely insulated up to the transition between the cable protection pipe and the plug adapter.



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5 Top view of correct thermal insulation

1 Plug adapter

6 Post-mounting checks and possible error sources

6.1 Post-mounting checks

Is the measuring instrument undamaged (visual check)?	❑
Does the measuring instrument conform to the measuring point specifications? For example: ▪ Inlet run conditions ▪ Ambient temperature ▪ Measuring range	❑
Has the correct orientation been selected for the sensor? ▪ According to sensor type ▪ According to process medium temperature ▪ According to process medium properties (outgassing, with entrained solids)	❑
Are the sensors correctly connected to the transmitter (upstream/downstream)?	❑
Are the sensors correctly mounted (distance, alignment, one traverse, two traverses)?	❑

6.2 Possible error sources

6.2.1 Checking the Installation status

The **Installation status** parameter shows the device status after mounting in line with the displayed measured values.

1. Open the menu: Setup → Installation status
2. Check the Installation status.

For detailed information on the Installation status, see the Operating Instructions for the device.→ 5

6.2.2 Sound velocity of the medium not known

With high process medium temperatures, the medium's sound velocity is often unknown and would prevent correct positioning. The correct sound velocity/sensor distance can be determined with the following procedure.

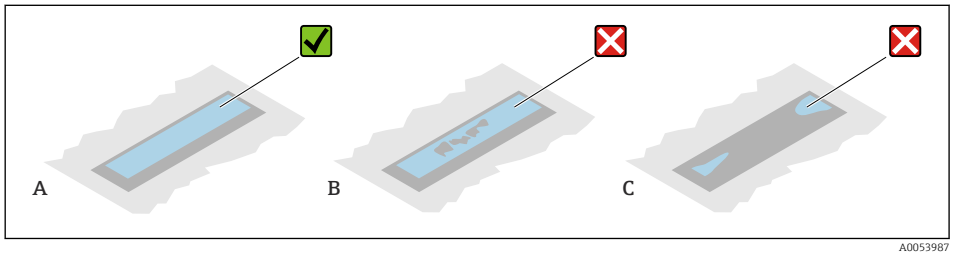
1. Parameterize the device using the best known estimate of the sound velocity and set the sensor distance accordingly.
2. Read off the measured sound velocity with the sensor distance set above.
3. Parameterize the device with the measured sound velocity and position the sensors at the newly calculated sensor distance.
4. If necessary, repeat steps 2 and 3 until the entered sound velocity matches the measured sound velocity.

6.2.3 Insufficient signal strength and/or signal-to-noise ratio (SNR)

Coupling surface too uneven or too rough

A reliable measurement is only guaranteed with a minimum signal strength and signal-to-noise ratio. The reason for the insufficient signal values (check Installation status) can also be the sensor installation.

- The mechanical quality of the coupling surfaces can be evaluated by examining the marks left on the coupling foil from pressing on the sensors.



6 *Typical impressions on the coupling foil*

A Good coupling: Well machined, continuous surface.
B Poor coupling: Surface interrupted in the center.
C Poor coupling: Coupling only achieved at the ends.

Too strongly attenuating medium

- A lower-frequency sensor (CH-050) is available for very strongly attenuating media. This sensor must be parameterized accordingly in the device, but the mounting process is identical to the 1 MHz sensor (CH-100): The sensor distance is identical for both sensor types.

Build-up inside the pipe

Build-up inside the pipe can significantly impair the ultrasonic signal → 10.

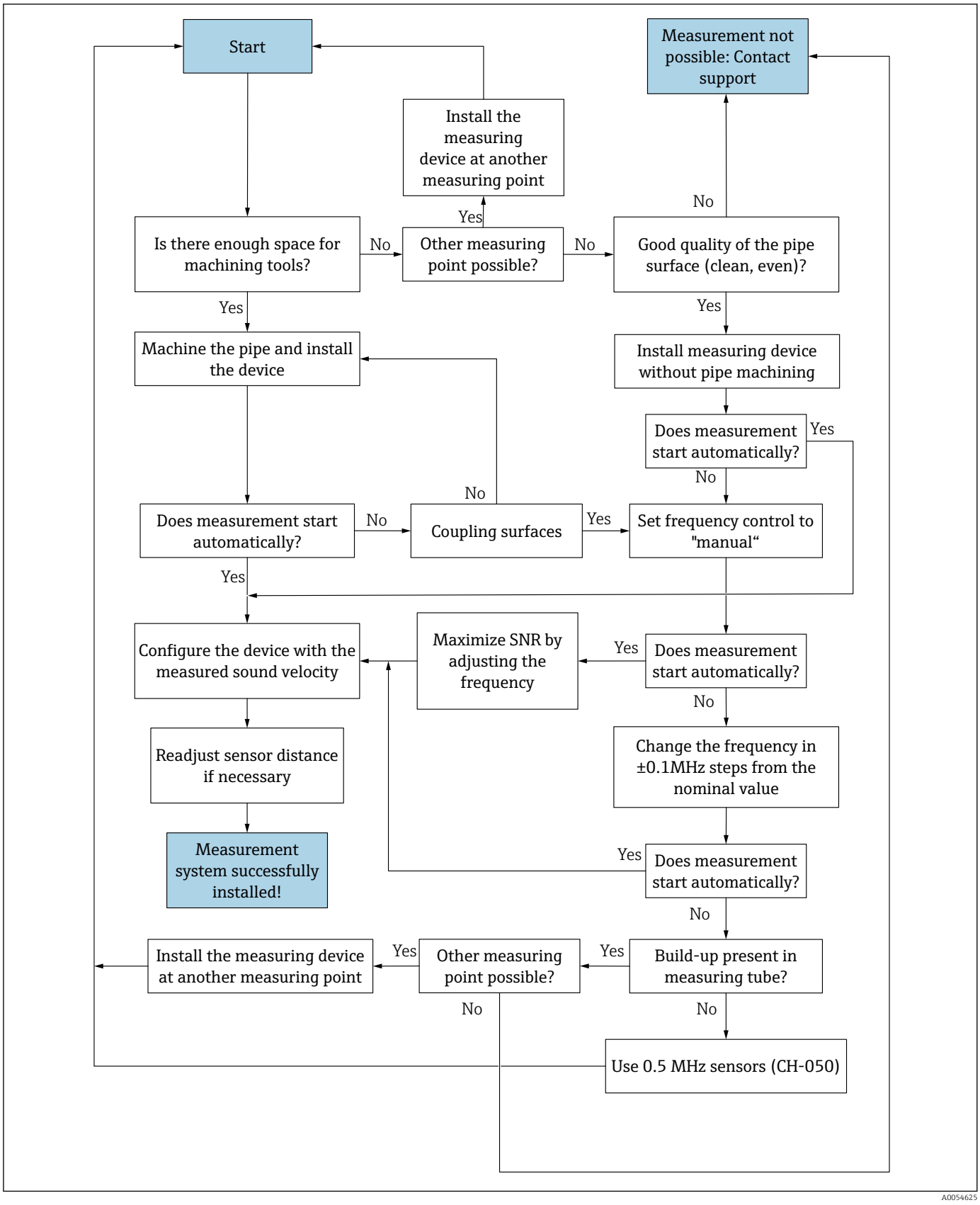
1. Make sure that the measuring pipe does not cool down excessively during installation.
2. Select a new measuring point at a different location on the measuring pipe.

6.2.4 The system gets stuck in the start-up phase for several minutes

If the system gets stuck in the start-up phase for several minutes (status signal S019), it is possible to bypass this calibration phase.

1. Open the menu:Expert → Sensor → Sensor control → Signal path control 1 to n
2. In the **Excitation Frequency Mode** parameter, select the **Manual** option.
   → The system adjusts to the nominal sensor frequency and starts measuring.
3. The frequency can be set to the best possible installation status in the **Excitation frequency** parameter.

6.3 Workflow for mounting the sensors



7 Technical data

Additional information for the "CH-050" and "CH-100" sensors

"Sensor version" order code		
Option	**AG "CH-050"**	**AH "CH-100"**
Nominal frequency	0.5 MHz	1.0 MHz
Medium	Strongly attenuating process media that cannot be measured with the 1 MHz sensor	Liquid process media
Medium temperature range	+150 to +550 °C (302 to 1022 °F)	
Nominal diameter	DN 50 to 600 (2 to 24")	
Pipe material	Metallic pipes, preferably made from stainless or carbon steel in the appropriate alloys	
Wall thickness	2.0 to 25.4 mm (0.04 to 1 in)	
Electromagnetic compatibility (EMC)	As per IEC/EN 61326.	

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