BA01846C/07/EN/04.23-00
71623200
2023-07-14

Operating Instructions
Turbimax CUS50D

Absorption sensor for turbidity and solids measurements

Endress+Hauser
People for Process Automation

Table of contents

1 About this document

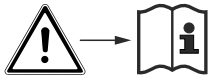
1.1 Safety information

Structure of information	Meaning
DANGER **Causes (/consequences)** If necessary, Consequences of non-compliance (if applicable) ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid the dangerous situation **will** result in a fatal or serious injury.
WARNING **Causes (/consequences)** If necessary, Consequences of non-compliance (if applicable) ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid the dangerous situation **can** result in a fatal or serious injury.
CAUTION **Causes (/consequences)** If necessary, Consequences of non-compliance (if applicable) ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or more serious injuries.
NOTICE **Cause/situation** If necessary, Consequences of non-compliance (if applicable) ▶ Action/note	This symbol alerts you to situations which may result in damage to property.

1.2 Symbols used

- Additional information, tips
- Permitted
- Recommended
- Forbidden or not recommended
- Reference to device documentation
- Reference to page
- Reference to graphic
- Result of a step

1.3 Symbols on the device

Symbol	Meaning
	Reference to device documentation
	Do not dispose of products bearing this marking as unsorted municipal waste. Instead, return them to the manufacturer for disposal under the applicable conditions.

1.4 Documentation

The following manuals, which complement these Operating Instructions, can be found on the product pages on the Internet:

Technical Information Turbimax CUS50D, TI01395C

2 Basic safety instructions

2.1 Requirements of the personnel

- Installation, commissioning, operation and maintenance of the measuring system may be carried out only by specially trained technical personnel.
- The technical personnel must be authorized by the plant operator to carry out the specified activities.
- The electrical connection may be performed only by an electrical technician.
- The technical personnel must have read and understood these Operating Instructions and must follow the instructions contained therein.
- Faults at the measuring point may only be rectified by authorized and specially trained personnel.

Repairs not described in the Operating Instructions provided must be carried out only directly at the manufacturer's site or by the service organization.

2.2 Intended use

The sensor is used to measure turbidity and solids and is specially designed for use in industrial wastewater and processes.

The sensor is particularly suited for use in the following applications:
- Turbidity measurements based on the principle of light attenuation (turbidimetry) in accordance with EN ISO 7027
- Absorption measurements in liquid, as well as highly absorbing media and sludges
- Measurement of concentration or solids content
- Measurement of solids content in process liquids

Use of the device for any purpose other than that described, poses a threat to the safety of people and of the entire measuring system and is therefore not permitted.

The manufacturer is not liable for damage caused by improper or non-designated use.

2.3 Workplace safety

As the user, you are responsible for complying with the following safety conditions:
- Installation guidelines
- Local standards and regulations
- Regulations for explosion protection

Electromagnetic compatibility
- The product has been tested for electromagnetic compatibility in accordance with the applicable international standards for industrial applications.
- The electromagnetic compatibility indicated applies only to a product that has been connected in accordance with these Operating Instructions.

2.4 Operational safety

Before commissioning the entire measuring point:

1. Verify that all connections are correct.
2. Ensure that electrical cables and hose connections are undamaged.
3. Do not operate damaged products, and protect them against unintentional operation.
4. Label damaged products as defective.

During operation:

▶ If faults cannot be rectified:
products must be taken out of service and protected against unintentional operation.

2.5 Product safety

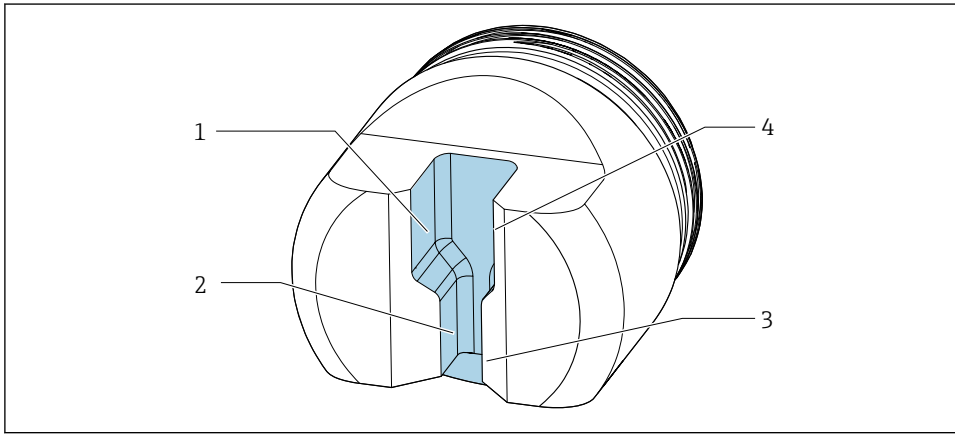
2.5.1 State-of-the-art technology

The product is designed to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate. The relevant regulations and international standards have been observed.

3 Product description

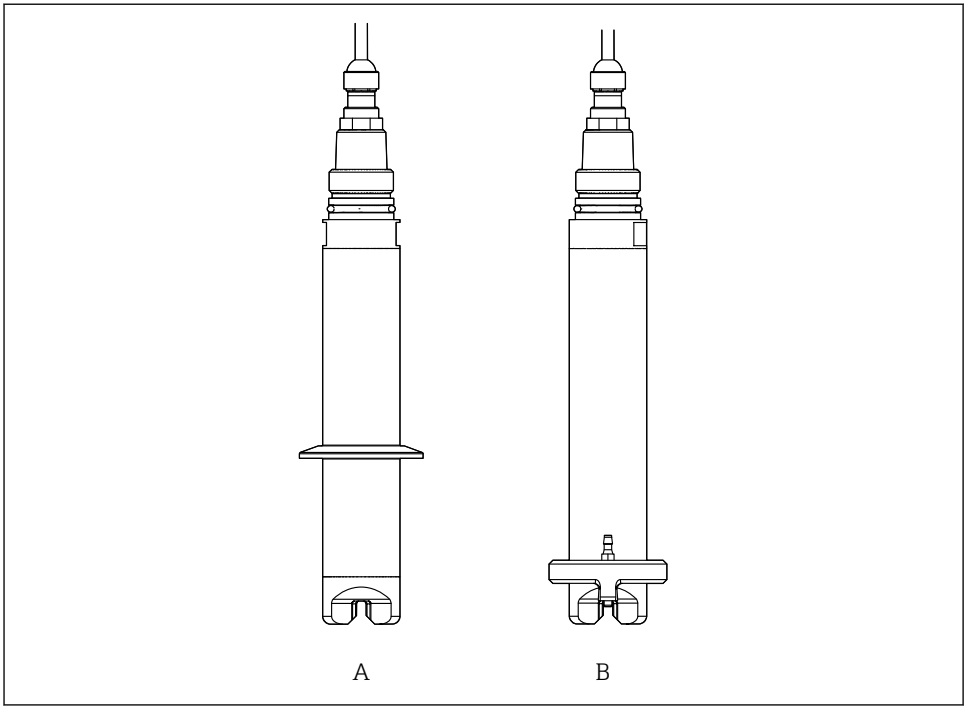
3.1 Product design

The sensor features a sensor head with 2 path lengths of 5 mm (0.2 in) and 10 mm (0.39 in).



1 CUS50D sensor head

1 Light sources 10 mm (0.39 in)
2 Light sources 5 mm (0.2 in)
3 Light receiver 5 mm (0.2 in)
4 Light receiver 10 mm (0.39 in)



2 Versions

A With clamp
B With compressed air cleaning

3.1.1 Measuring principle

The sensor operates on the principle of light attenuation in accordance with ISO 7027 and meets the requirements of this standard.

It is suitable for measurements in the average to high turbidity range and for the measurement of solids content.

4 Incoming acceptance and product identification

4.1 Incoming acceptance

1. Verify that the packaging is undamaged.
   ↳ Notify the supplier of any damage to the packaging.
   Keep the damaged packaging until the issue has been resolved.
2. Verify that the contents are undamaged.
   ↳ Notify the supplier of any damage to the delivery contents.
   Keep the damaged goods until the issue has been resolved.
3. Check that the delivery is complete and nothing is missing.
   ↳ Compare the shipping documents with your order.
4. Pack the product for storage and transportation in such a way that it is protected against impact and moisture.
   ↳ The original packaging offers the best protection.
   Make sure to comply with the permitted ambient conditions.

If you have any questions, please contact your supplier or your local Sales Center.

4.2 Product identification

4.2.1 Nameplate

The nameplate provides you with the following information on your device:
- Manufacturer identification
- Order code
- Extended order code
- Serial number
- Safety information and warnings

► Compare the information on the nameplate with the order.

4.2.2 Identifying the product

Product page

www.endress.com/cus50d

Interpreting the order code

The order code and serial number of your product can be found in the following locations:
- On the nameplate
- In the delivery papers

Obtaining information on the product

1. Go to www.endress.com.
2. Page search (magnifying glass symbol): Enter valid serial number.

3. Search (magnifying glass).
   ↳ The product structure is displayed in a popup window.
4. Click the product overview.
   ↳ A new window opens. Here you fill information pertaining to your device, including the product documentation.

Manufacturer's address

Endress+Hauser Conducta GmbH+Co. KG
Dieselstraße 24
70839 Gerlingen
Germany

4.3 Scope of delivery

The scope of delivery comprises:
- 1 sensor, version as ordered
- 1 x Operating Instructions

▶ If you have any queries:
Please contact your supplier or local sales center.

4.4 Certificates and approvals

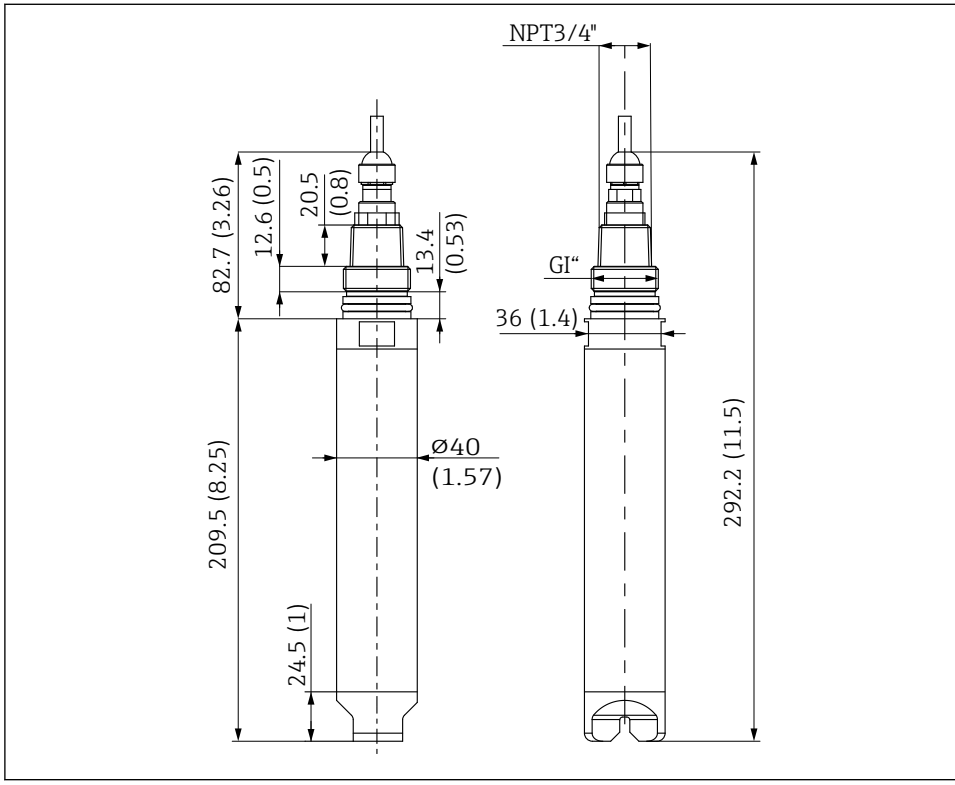
Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Downloads**.

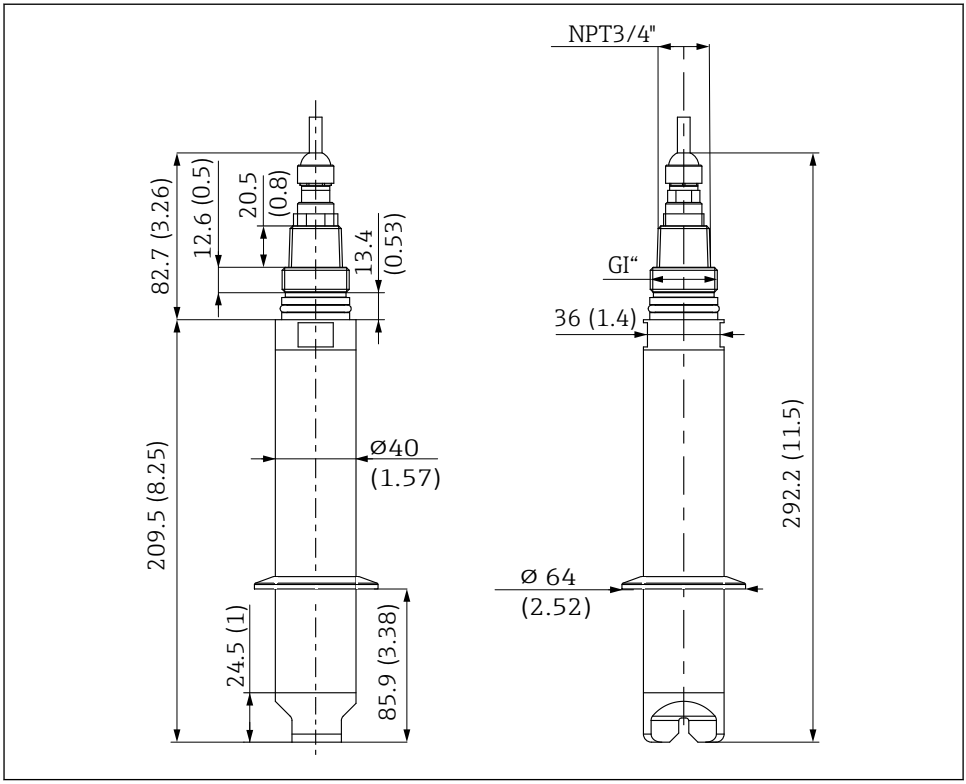
5 Mounting

5.1 Mounting requirements

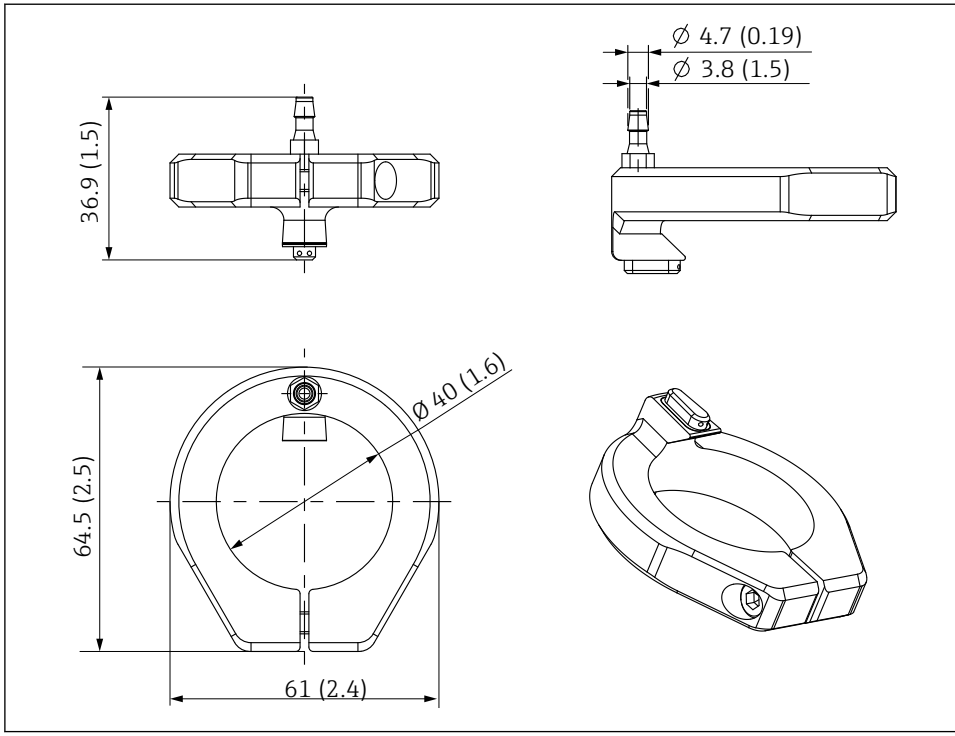
5.1.1 Dimensions



3 Dimensions. Dimensions: mm (in)



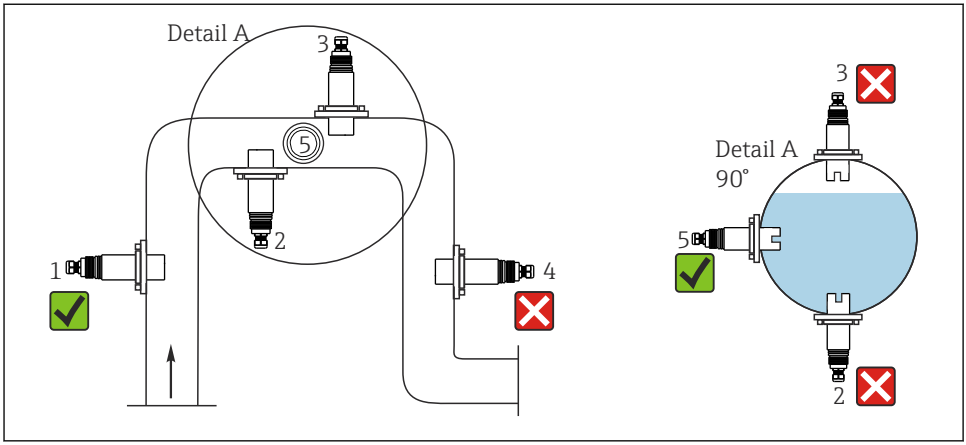
4 Dimensions with clamp. Dimensions: mm (in)



5 Dimensions for compressed air cleaning. Dimensions: mm (in)

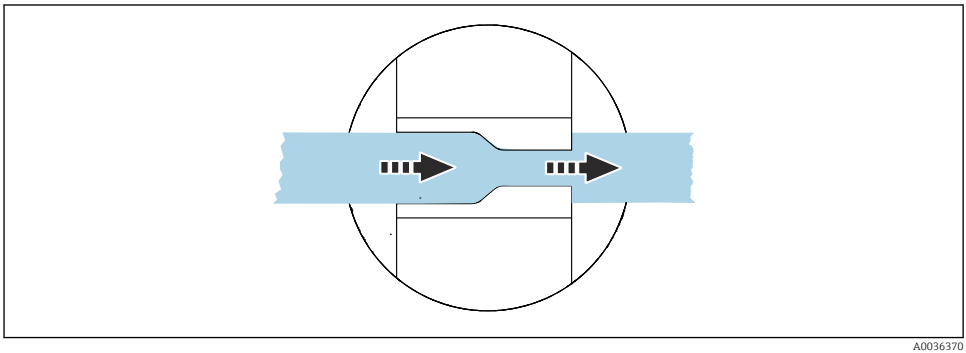
Compressed air cleaning: 2 bar (29 psi) maximum pressure

5.1.2 Orientation in pipes



6 *Permitted and unacceptable orientations in pipes*

- The pipeline diameter must be at least 50 mm (2 in).
- Install the sensor in places with consistent flow conditions.
- The best installation location is in the ascending pipe (item 1).

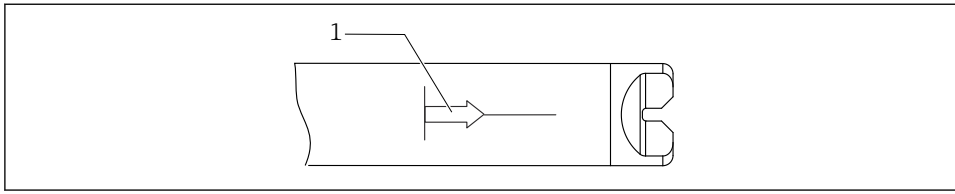


7 *Direction of flow*

► Align the sensor in such a way that the medium flows through the measuring gap (self-cleaning effect).

The arrow indicates the flow direction; it runs from the 10 mm (0.39 in) path to the 5 mm (0.2 in) path.

5.1.3 Installation marking



8 Installation marking for sensor alignment

1 Installation marking

The installation marking shows the inlet to the 10 mm (0.39 in) measuring path.

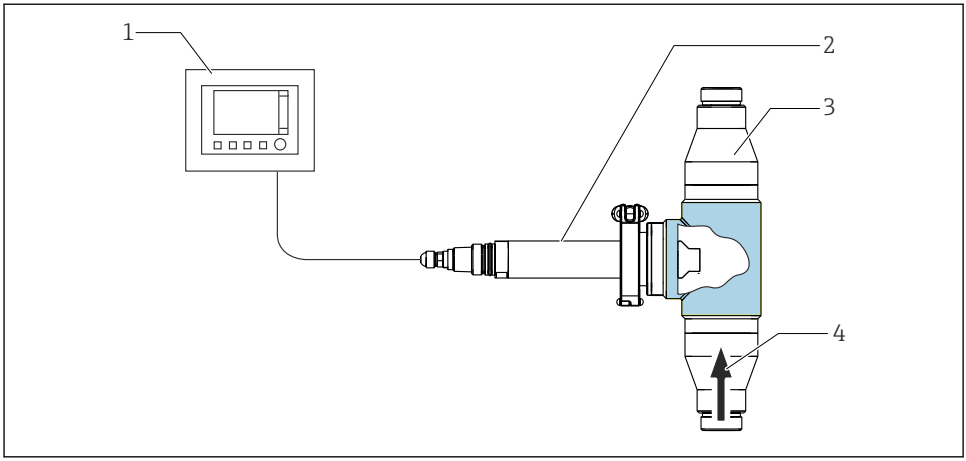
▶ Using the installation marking, align the sensor against the flow direction.

5.2 Mounting the sensor

The sensor can be installed with different assemblies or directly in a pipe connection. However, the CYA112 immersion assembly must be used for continuous operation of the sensor under water.

5.2.1 Measuring system

A complete measuring system comprises:
- Turbimax CUS50D turbidity sensor
- Liquiline CM44x multi-channel transmitter
- Direct installation in a pipe connection (Clamp 2") or
- Assembly:
  - Flow assembly e.g. Flowfit CUA252 or CUA120 or
  - Assembly e.g. Flexdip CYA112 and holder e.g. Flexdip CYH112 or
  - Retractable assembly, e.g. Cleanfit CUA451

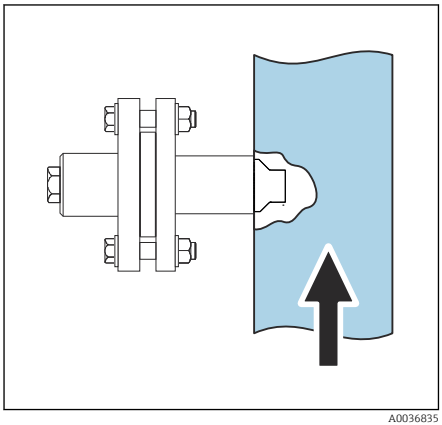


9 *Measuring system with CUA252 flow assembly*

1 *Liquiline CM44x multi-channel transmitter*
2 *Turbimax CUS50D turbidity sensor*
3 *CUA252 flow assembly*
4 *Direction of flow*

5.2.2 Mounting options

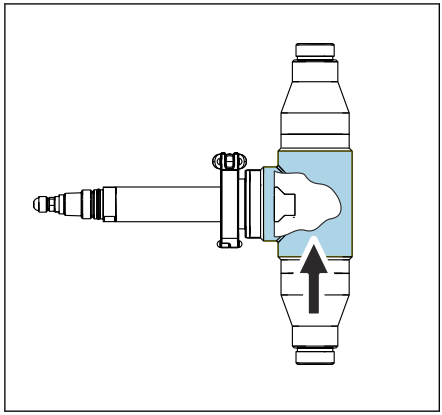
Installing with CUA120 flow assembly



10 *Installing with CUA120 flow assembly*

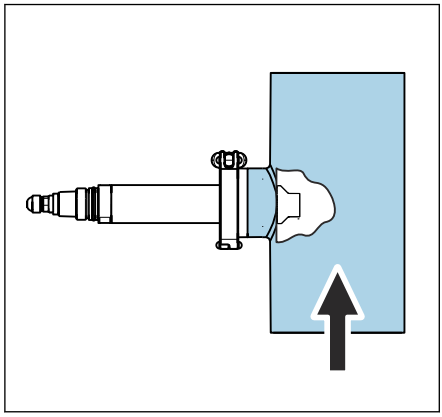
The installation angle is 90°.
The arrow indicates the flow direction; it runs from the 10 mm (0.39 in) path to the 5 mm (0.2 in) path.

Installing with CUA252, CUA262 or CYA251 flow assembly



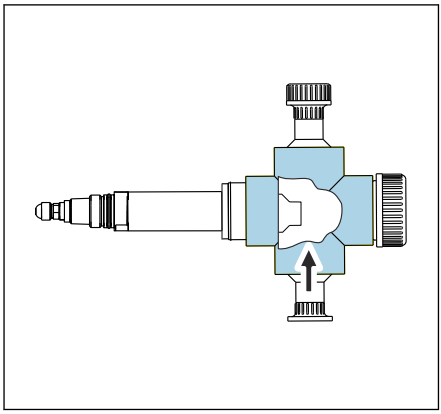
11 *Installing with CUA252 flow assembly*

The installation angle is 90°.
The arrow indicates the flow direction; it runs from the 10 mm (0.39 in) path to the 5 mm (0.2 in) path.



12 *Installing with CUA262 flow assembly*

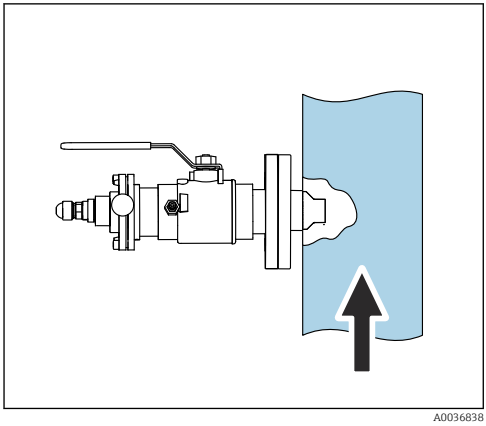
The installation angle is 90°.
The arrow indicates the flow direction; it runs from the 10 mm (0.39 in) path to the 5 mm (0.2 in) path.



The installation angle is 90°.
The arrow indicates the flow direction; it runs from the 10 mm (0.39 in) path to the 5 mm (0.2 in) path.

13 Installing with CYA251 flow assembly

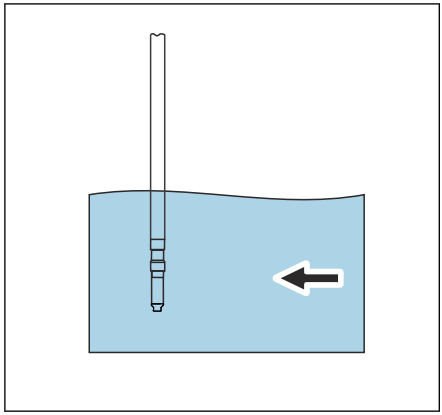
Installing with CUA451 retractable assembly



The installation angle is 90°.
The arrow indicates the flow direction; it runs from the 10 mm (0.39 in) path to the 5 mm (0.2 in) path.
The medium pressure may not exceed 2 bar (29 psi) for manual assembly retraction.

14 Installing with CUA451 retractable assembly

Installing with Flexdip CYA112 immersion assembly and Flexdip CYH112 holder



The installation angle is 0°.
The arrow indicates the flow direction; it runs from the 10 mm (0.39 in) path to the 5 mm (0.2 in) path.
If the sensor is used in open basins, install the sensor in such a way that air bubbles cannot accumulate on it.

15 Installing with immersion assembly

5.3 Mounting the compressed air cleaning unit

- ▶ Fit the compressed air cleaning unit onto the sensor head to the end stop.
  - ↳ The nozzle of the compressed air cleaning unit must be located on the side of the wider 10 mm (0.39 in) measurement gap → 2, 8.

5.4 Post-mounting check

Put the sensor into operation only if the following questions can be answered with "yes":
- Are the sensor and cable undamaged?
- Is the orientation correct?
- Has the sensor been installed in the process connection, and does not suspend freely from the cable?

6 Electrical connection

⚠ WARNING

Device is live!

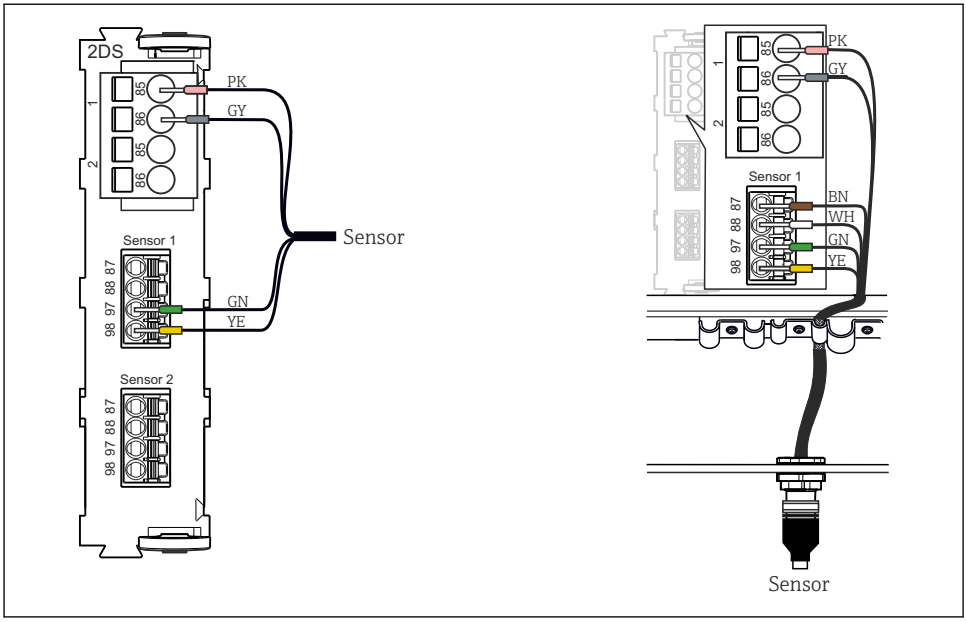
Incorrect connection may result in injury or death!

- The electrical connection may be performed only by an electrical technician.
- The electrical technician must have read and understood these Operating Instructions and must follow the instructions contained therein.
- **Prior** to commencing connection work, ensure that no voltage is present on any cable.

6.1 Connecting the sensor

The following connection options are available:

- Via M12 plug (version: fixed cable, M12 plug)
- Via sensor cable to the plug-in terminals of a sensor input on the transmitter (version: fixed cable, end sleeves)



16 *Sensor connection to sensor input (left) or via M12 plug (right)*

The maximum cable length is 100 m (328.1 ft).

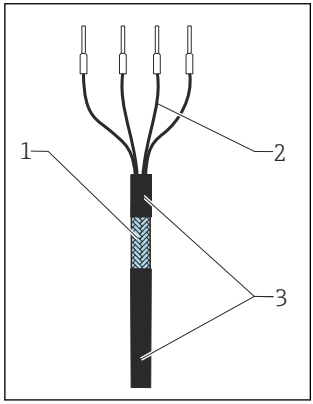
6.1.1 Connecting the cable shield

Device cable must be shielded cables.

Only use terminated original cables where possible.

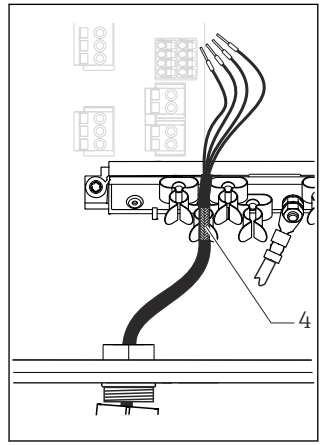
Clamping range of cable clamps: 4 to 11 mm (0.16 to 0.43 in)

Cable sample (does not necessarily correspond to the original cable supplied)



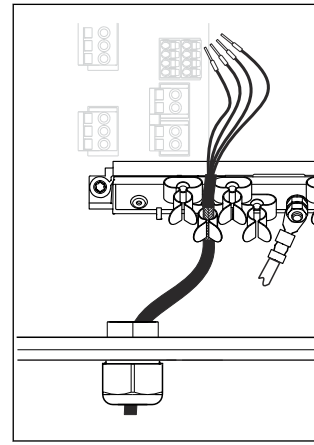
17 *Terminated cable*

1 *Outer shield (exposed)*
2 *Cable cores with ferrules*
3 *Cable sheath (insulation)*



18 *Connect the cable to the grounding clamp*

4 *Grounding clamp*



19 *Press the cable into the grounding clamp*

The cable shield is grounded using the grounding clamp [1)]

1) Please note the instructions in the "Ensuring the degree of protection" section

1. Loosen a suitable cable gland on the bottom of the housing.
2. Remove the dummy plug.
3. Attach the gland to the cable end, making sure the gland is facing the right direction.
4. Pull the cable through the gland and into the housing.
5. Route the cable in the housing in such a way that the **exposed** cable shield fits into one of the cable clamps and the cable cores can be easily routed as far as the connection plug on the electronics module.
6. Connect the cable to the cable clamp.
7. Clamp the cable.
8. Connect cable cores as per the wiring diagram.
9. Tighten the cable gland from outside.

6.2 Ensuring the degree of protection

Only the mechanical and electrical connections which are described in these instructions and which are necessary for the required, designated use, may be carried out on the device delivered.

► Exercise care when carrying out the work.

Individual types of protection permitted for this product (impermeability (IP), electrical safety, EMC interference immunity) can no longer be guaranteed if, for example :

- Covers are left off
- Different power units to the ones supplied are used
- Cable glands are not sufficiently tightened (must be tightened with 2 Nm (1.5 lbf ft) for the permitted level of IP protection)
- Unsuitable cable diameters are used for the cable glands
- Modules are not fully secured
- The display is not fully secured (risk of moisture entering due to inadequate sealing)
- Loose or insufficiently tightened cables/cable ends
- Conductive cable strands are left in the device

6.3 Post-connection check

Device health and specifications	**Action**
Is the outside of the sensor, assembly or cable free from damage?	► Perform a visual inspection.
Electrical connection	**Action**
Are the mounted cables strain-relieved and not twisted?	► Perform a visual inspection. ► Untwist the cables.
Is a sufficient length of the cable cores stripped, and are the cores positioned in the terminal correctly?	► Perform a visual inspection. ► Pull gently to check they are seated correctly.
Are the power supply and signal lines connected correctly?	► Use the transmitter wiring diagram.
Are all screw terminals tightened?	► Tighten the screw terminals.
Are all cable entries mounted, firmly tightened and leak-tight?	► Perform a visual inspection. In the case of lateral cable entries:
Are all cable entries mounted on the side or pointing downwards?	► Point cable loops downward so that water can drip off.

7 Commissioning

7.1 Function check

Prior to initial commissioning, ensure that:
- The sensor is correctly installed
- The electrical connection is correct

▶ Before commissioning, check the chemical material compatibility, the temperature range and the pressure range.

8 Operation

8.1 Adapting the measuring device to the process conditions

8.1.1 Applications

The "Absorption" and "Formazine" applications are calibrated at the factory. The absorption factory calibration is used as the basis for precalibrating additional applications and optimizing them for the different media characteristics.

Application	Specified operating range
Factory calibration for absorption	0.000 to 5.000 AU or 0.000 to 10.000 OD
Factory calibration for formazine	40 to 4,000 FAU
Application: Kaolin	0 to 60 g/l
Application: Sludge	0 to 25 g/l
Application: Auto sludge	0 to 25 g/l
Product loss	0 to 100 %

To adapt to a specific application, it is possible to perform customer calibrations with up to 10 points.

Application: Formazine

Factory calibration for the formazine application is carried out with the formazine turbidity standard.

Sensor measured values in the unit [FAU] are only comparable to the measured values of any other sensor e.g. scattered light sensor with the unit [FNU] or [NTU] in this standard medium. In any other medium, the measured values will be different to those obtained when measuring with another scattered light sensor.

8.1.2 Calibration

The absorption and formazine applications are calibrated at the factory. All other applications are merely precalibrated and must therefore be adapted to the corresponding application and medium.

The sensor has 8 data records. Six of these are prepopulated at the factory with sample data records, i.e. typical settings, for all available applications:
- Absorption
- Formazine
- Kaolin
- Sludge
- Auto sludge
- Product loss

The desired data record is activated by selecting the corresponding application. It can be adapted to that application using the following options:
- Calibration (1 to 10 points)
- Entering of a factor (multiplication of measured values by a constant factor)
- Entering of an offset (addition/subtraction of a constant factor to/from the measured values)
- Duplication of factory calibration data records

Further data records can be created in the sensor and adapted to the application by means of calibration or by entering a factor or offset. Two free, unused data records are available for this. The number of free data records can be increased if necessary by deleting (sample) data records that are not required. The sample data records are restored to factory status when the sensor is reset.

The factory calibrations of the individual applications (e.g. absorption or formazine) are each based on 20 calibration points.

Application selection

► During initial commissioning and calibration, at the transmitter select the application that suits your field of application .

Model name	Application	Unit
Absorption	Absorption measurement in any liquid media (dosing of flocculant)	AU; OD
Formazine	Absorption turbidity measurement in any liquid media (e.g. turbidity in process applications)	FAU
Kaolin	Turbidity measurements in liquid media based on kaolin (e.g. turbidity in process applications)	mg/l; g/l; ppm
Sludge	Solids measurement in sludges in the wastewater sector; optimized for activated sludge, return activated sludge and waste activated sludge	mg/l; g/l; ppm
Auto sludge	General model for solids measurement in any sludges and liquids	mg/l; g/l; ppm
Product loss	Monitoring of product loss in applications with liquid media (e.g. milk in water)	%

1 to 10 points can be calibrated for all applications.

Configuring measuring path lengths

The sensor has 2 different measuring path lengths (5 mm (0.2 in) and 10 mm (0.39 in)). In the sample data records stored at the factory, the optimum measuring path length is preconfigured for the application in such a way that it cannot be modified.

You can select the following measuring path lengths when creating a new data record:

Application	Measuring path lengths		
	5 mm (0.2 in)	10 mm (0.39 in)	Automatic
Absorption	X	X	X
Formazine		X	

Application	Measuring path lengths		
	5 mm (0.2 in)	10 mm (0.39 in)	Automatic
Kaolin	X	X	X
Sludge	X	X	X
Auto sludge			X
Product loss	X	X	

Generally, a longer measuring path (10 mm (0.39 in)) is recommended for measuring lower absorption values and thus for low-viscosity or watery liquids.

Higher absorption values, on the other hand, can be measured with a shorter measuring path (5 mm (0.2 in)). This path length is thus suitable for measuring liquids with a high solids content (e.g. sludges) or highly absorbing, dark media.

Measuring path	Measuring range (absorption of medium)
5 mm (0.2 in)	0 to 10 OD
10 mm (0.39 in)	0 to 5 OD

Configuring the unit

For each application, (e.g., absorption, formazine or kaolin), the most common units are stored and can be selected in the data record (e.g., "Sludge" application; units: g/l, mg/l, ppm).

In addition, you can also select "User unit" as the unit. In this case, any unit name or string can be assigned to the base unit OD. The system can be calibrated to this unit.

There are many options if the "Calibration table" function is used:
- Enter measured values in the OD unit (left column).
- Enter measured values normalized to the measuring path length 10 mm (0.39 in) in the AU unit (left column).
- Measured values determined with the measuring path length 5 mm (0.2 in) in the AU unit:
  - Multiply values manually by a factor of 2.
  - Enter values in the left column of the calibration table.
  - Example: 1 AU (with measuring path length 5 mm (0.2 in)) = 1 AU x 2 = 2 AU (with measuring path length 10 mm (0.39 in)) = 2 OD

1-point and multipoint calibration

- Before the calibration, clean the sensor's measuring gap and remove fouling and deposit buildup.
- During calibration, immerse the sensor in the medium in such a way that the two measuring gaps are completely filled with the medium. All air bubbles and air pockets must be cleaned out of the measuring gap during immersion.
- In the calibration table, the actual values can be edited as well as the set points (right and left columns).
- Additional pairs of calibration values (actual values and set points) can be added, if required, even without measurement in a medium.
- Lines interpolate between the calibration points.

1-point calibration to the current operating point is generally sufficient since the zero point of the sensor is precalibrated at the factory for all available applications.

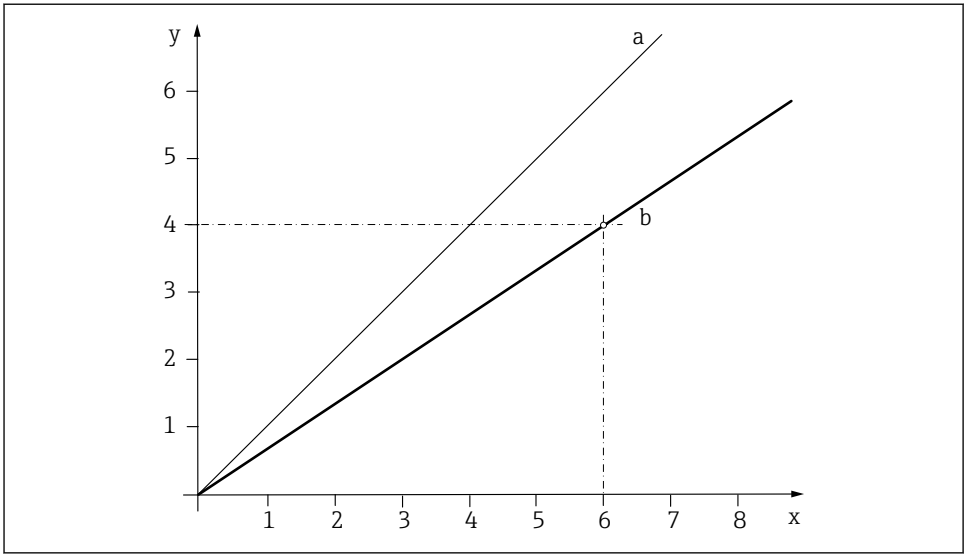
The sensor does not need to be taken out of the medium for calibration; it can be calibrated directly on-site in the application.

Before the calibration, ensure that the measuring gap is not fouled with deposit buildup.

If calibration takes place directly near the zero point, a new zero point is calculated based on this calibration point. The original zero point is overwritten.

1-point calibration

The measured error between the measured value of the device and the laboratory measured value is too large. This is corrected by a 1-point calibration.



20 Principle of a 1-point calibration

x Measured value
y Target sample value
a Factory calibration
b Application calibration

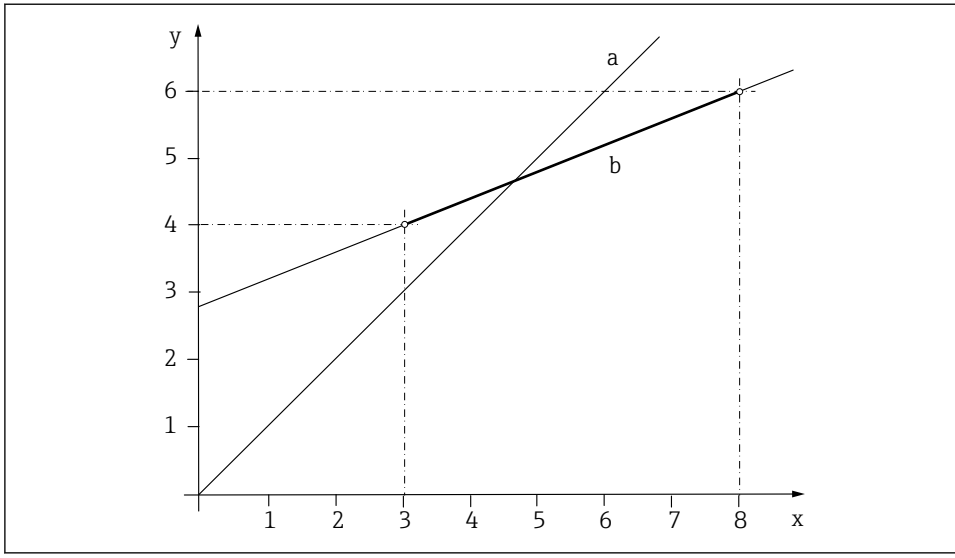
1. Select data record.
2. Set the calibration point in the medium and enter the target sample value (laboratory value).

The following sample values for the calibration of the CUS50D sensor can be derived from the graphic → 20, 28:

- Measured value on the x-axis: 6 g/l
- Target sample value on the y-axis: 4 g/l

2-point calibration

Measured value deviations are to be compensated for at 2 different points in an application (e.g. the maximum and minimum value of the application). This aims to ensure a maximum level of accuracy between these two extreme values.



21 Principle of a 2-point calibration

x Measured value
y Target sample value
a Factory calibration
b Application calibration

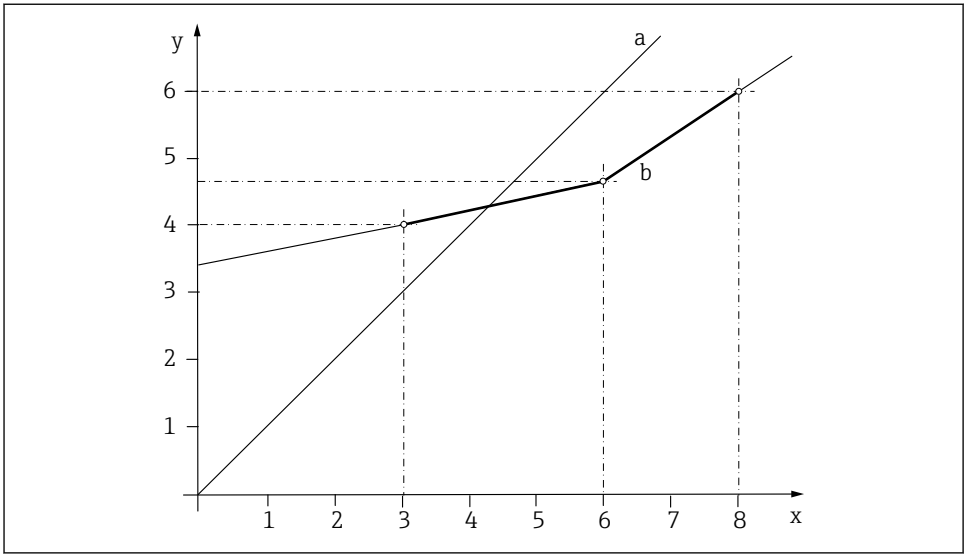
1. Select a data record.
2. Set 2 different calibration points in the medium and enter the corresponding set points.

A linear extrapolation is performed outside the calibrated operational range (gray line).
The calibration curve must be monotonically increasing.

The following sample values for the calibration of the CUS50D sensor can be derived from the graphic → 21, 29:

- Measured values on the x-axis: 3 g/l, 8 g/l
- Target sample values on the y-axis: 4 g/l, 6 g/l

3-point calibration



22 Principle of multipoint calibration (3 points)

x Measured value
y Target sample value
a Factory calibration
b Application calibration

1. Select data record.
2. Set 3 different calibration points in the medium and specify the corresponding set points.

A linear extrapolation is performed outside the calibrated operational range (gray line).
The calibration curve must be monotonically increasing.

The following sample values for the calibration of the CUS50D sensor can be derived from the graphic → 22, 30:

- Measured values on the x-axis: 3 g/l, 6 g/l, 8 g/l
- Target sample values on the y-axis: 4 g/l, 4.7g/l, 6 g/l

Stability criterion

During calibration, the measured values provided by the sensor are checked to ensure they are constant. The maximum deviations that may occur in measured values during a calibration are defined in the stability criterion.

The specifications comprise the following:
- The maximum permitted deviation in temperature measurement
- The maximum permitted deviation in measured value as a %
- The minimum time frame in which these values must be maintained

The calibration resumes as soon as the stability criteria for signal values and temperature have been reached. If these criteria are not met in the maximum time frame of 5 minutes, no calibration is performed - a warning is issued.

The stability criteria are used to monitor the quality of the individual calibration points in the course of the calibration process. The aim is to achieve the highest possible calibration quality in the shortest possible time frame while taking external conditions into account.

For calibrations in the field in adverse weather and environmental conditions, the measured value windows selected can be suitably large and the time frame selected can be suitably short.

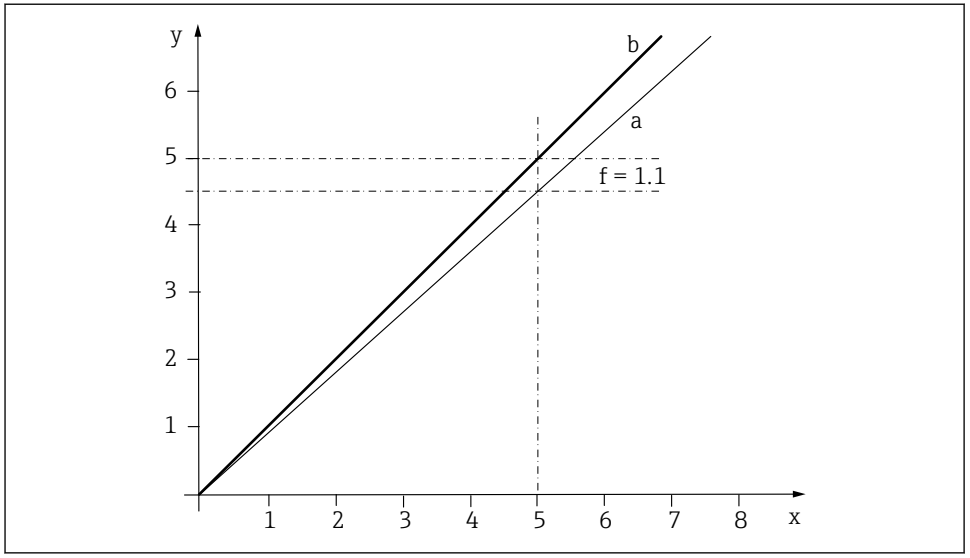
Factor

With the "Factor" function, the measured values are multiplied by a constant factor. The functionality corresponds to that of a 1-point calibration.

Example:

This type of adjustment can be selected if the measured values are compared to the laboratory values over a longer period of time and all values are too low by a constant factor, e.g. 10%, in relation to the laboratory value (target sample value).

In the example, the adjustment is made by entering the factor 1.1.

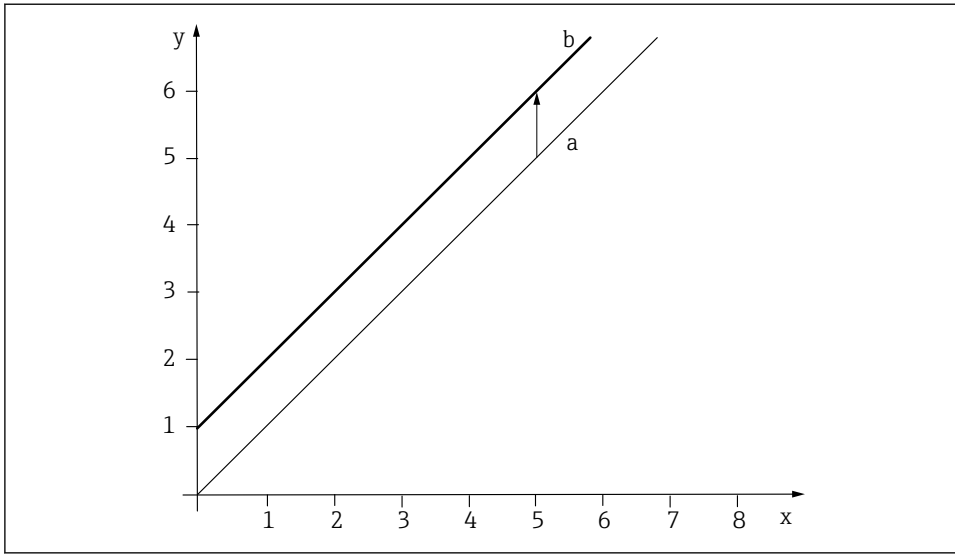


23 Principle of factor calibration

x Measured value
y Target sample value
a Factory calibration
b Factor calibration

Offset

With the "Offset" function, the measured values are offset by a constant amount (added or subtracted).



24 Principle of an offset

x Measured value
y Target sample value
a Factory calibration
b Offset calibration

8.1.3 Cyclic cleaning

For cyclic cleaning, compressed air is the most suitable option. The cleaning unit is either supplied or can be retrofitted, and is attached to the sensor head. The following settings are recommended for the cleaning unit:

Type of fouling	Cleaning interval	Cleaning duration
Severe fouling with rapid buildup of deposits	5 minutes	10 seconds
Low degree of fouling	10 minutes	10 seconds

8.1.4 Signal filter

The sensor is fitted with an internal signal filter function in order to adapt the measurement flexibly to different measuring requirements. Turbidity measurements based on the principle of scattered light may have a low signal-to-noise ratio. In addition, there may be disturbances from air bubbles or contamination for example.

It is not practicable to even out these disturbances using a high level of damping. This would counteract the sensitivity of the measured value required in the applications.

Measured value filter

The following filter settings are available:

Measured value filter	Description
Weak	Low filtering, high sensitivity, fast response to changes (2 seconds)
Normal (default)	Medium filtering, 10-second response time
Strong	Strong filtering, low sensitivity, slow response to changes (25 seconds)
Specialist	This menu is designed for the Endress+Hauser Service Department.
Off	None

Air bubble trap

In addition to the measured value filter, the sensor also features a filter function to suppress the measured errors caused by air bubbles.

Air bubbles cause the measured value to increase in liquids with low turbidity (with a low solids content). The filter function cuts off these measured value peaks by outputting the minimum value within a specified time interval. This time interval can be configured using a numerical value from 0 to 180 seconds. The bubble suppression filter is disabled (value 0) in the default configuration.

It is not recommended to enable the bubble suppression filter in liquids with a high level of turbidity (with a high solids content). Air bubbles do not cause the measured value to increase in media of this type and thus cannot be eliminated with the minimum filter.

Both signal filters (measured value filter and bubble suppression filter) can be configured directly in the calibration menu of the relevant data record.

8.1.5 Calibration kit

The calibration kit can be used to check the functional integrity of the sensor.

Two different calibration kits are available ("Reference tool" and "Solid state reference"):

Reference tool

During factory calibration, the reference tool is matched specifically to a special sensor and can be used only with this sensor. Therefore, the reference tool and the sensor are permanently assigned (married) to one another.

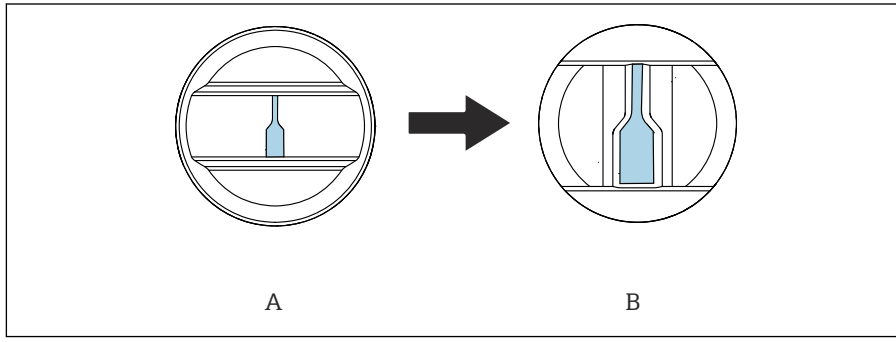
Solid state reference, CUS50D kit

The CUS50D kit, which is available as an accessory, is not assigned to a specific sensor but rather can be used for any CUS50D sensor. Its tolerance range is thus greater.

Measuring path length	Reference tool and solid state reference
5 mm	0.5 AU (1 OD)
10 mm	1 AU (1 OD)

Before checking the sensor, the sensor head with the two measuring gaps must be carefully cleaned and then dried.

Preparatory steps for the function check with the calibration kit

1. Clean the sensor and dry it → 38.
2. Fix the sensor in place (e.g. with a laboratory stand).
3. 

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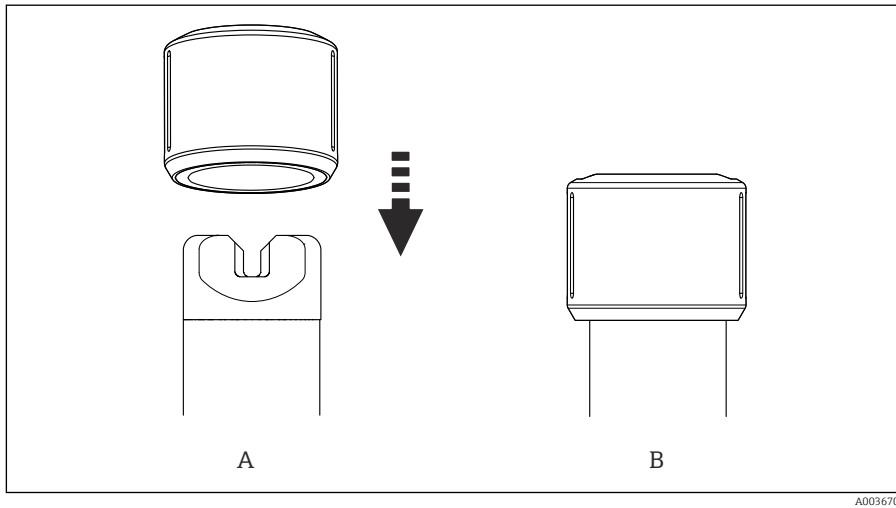
   Fit the calibration kit (A) in the correction direction on the sensor head (B). The direction is specified on the calibration kit.

4. 

A0036702

   Slide the calibration kit (A) into the final position until the limit stop (B).

Function check

The sensor raw values are used as the basis for this check.

1. By activating the control dial several times, the transmitter is switched to raw value display (raw value 5 mm and raw value 10 mm).
2. Read the raw measured values on the transmitter (raw value 5 mm and raw value 10 mm).

3. Compare the measured value with the reference value on the calibration kit.
   ↳ The function check is positive if the deviation is within the permitted tolerances (see → 📄 34).

	Reference tool	Solid state reference, CUS50D kit
Tolerance	± 5%	± 10%

If the measured values of a calibration data record are displayed instead of the raw values, the measured values may differ due to the calibration, offset or factor.

9 Diagnostics and troubleshooting

9.1 General troubleshooting

When troubleshooting, the entire measuring point must be taken into account:
- Transmitter
- Electrical connections and cables
- Assembly
- Sensor

The possible causes of error in the following table refer primarily to the sensor.

Problem	Check	Remedial action
Blank display, no sensor reaction	▪ Line voltage at transmitter? ▪ Sensor connected correctly? ▪ Buildup on optical windows?	▶ Connect mains voltage. ▶ Establish correct connection. ▶ Clean sensor.
Display value too high or too low	▪ Buildup on optical windows? ▪ Sensor calibrated?	▶ Clean device. ▶ Calibrate device.
Display value fluctuating greatly	Is the mounting location correct?	▶ Select a different mounting location. ▶ Adjust measured value filter.

Pay attention to the troubleshooting information in the Operating Instructions for the transmitter. Check the transmitter if necessary.

10 Maintenance

⚠ CAUTION

Acid or medium

Risk of injury, damage to clothing and the system!

- ▶ Switch off cleaning before the sensor is removed from the medium.
- ▶ Wear protective goggles and safety gloves.
- ▶ Clean away splashes on clothes and other objects.

- ▶ You must perform maintenance tasks at regular intervals.

We recommend setting the maintenance times in advance in an operations journal or log.

The maintenance cycle primarily depends on the following:

- The system
- The installation conditions
- The medium in which measurement takes place

10.1 Maintenance tasks

NOTICE

Disassembly at sensor head

Sensor can leak!

- ▶ Turn by the shaft only.
- ▶ Never turn by the sensor head!

10.1.1 Cleaning the sensor

Sensor fouling can affect the measurement results and even cause a malfunction.

- ▶ To ensure reliable measurements, clean the sensor at regular intervals. The frequency and intensity of the cleaning depend on the medium.

Clean the sensor:

- As specified in the maintenance schedule
- Before every calibration
- Before returning it for repairs

Type of fouling	Cleaning measure
Lime deposits	▶ Immerse the sensor in 1 to 5% hydrochloric acid (for several minutes).
Dirt particles in the measuring gaps of the sensor head	▶ Clean the measuring gaps with the cleaning brush that is available as an option.

After cleaning:

- ▶ Rinse the sensor thoroughly with water.

11 Repair

11.1 Spare parts

Order number	Description
71241882	Clamp seal, DN 50, FDA, 2 pcs
71242180	Dummy cover Clamp 2"

For more detailed information on spare parts kits, please refer to the "Spare Part Finding Tool" on the Internet:

www.products.endress.com/spareparts_consumables

11.2 Return

The product must be returned if repairs or a factory calibration are required, or if the wrong product was ordered or delivered. As an ISO-certified company and also due to legal regulations, Endress+Hauser is obliged to follow certain procedures when handling any returned products that have been in contact with medium.

To ensure the swift, safe and professional return of the device:

- Refer to the website www.endress.com/support/return-material for information on the procedure and conditions for returning devices.

11.3 Disposal

The device contains electronic components. The product must be disposed of as electronic waste.

- Observe the local regulations.

12 Accessories

The following are the most important accessories available at the time this documentation was issued.

Listed accessories are technically compatible with the product in the instructions.

1. Application-specific restrictions of the product combination are possible.
   Ensure conformity of the measuring point to the application. This is the responsibility of the operator of the measuring point.
2. Pay attention to the information in the instructions for all products, particularly the technical data.
3. For accessories not listed here, please contact your Service or Sales Center.

12.1 Device-specific accessories

12.1.1 Assemblies

FlowFit CUA120
- Flange adapter for mounting turbidity sensors
- Product Configurator on the product page: www.endress.com/cua120

Technical Information TI096C

Flowfit CUA252
- Flow assembly
- Product Configurator on the product page: www.endress.com/cua252

Technical Information TI01139C

Flowfit CUA262
- Weld-in flow assembly
- Product Configurator on the product page: www.endress.com/cua262

Technical Information TI01152C

Flexdip CYA112
- Immersion assembly for water and wastewater
- Modular assembly system for sensors in open basins, channels and tanks
- Material: PVC or stainless steel
- Product Configurator on the product page: www.endress.com/cya112

Technical Information TI00432C

Cleanfit CUA451
- Manual retractable assembly made of stainless steel with ball valve shut-off for turbidity sensors
- Product Configurator on the product page: www.endress.com/cua451

Technical Information TI00369C

Flowfit CYA251
- Connection: See product structure
- Material: PVC-U
- Product Configurator on the product page: www.endress.com/cya251

Technical Information TI00495C

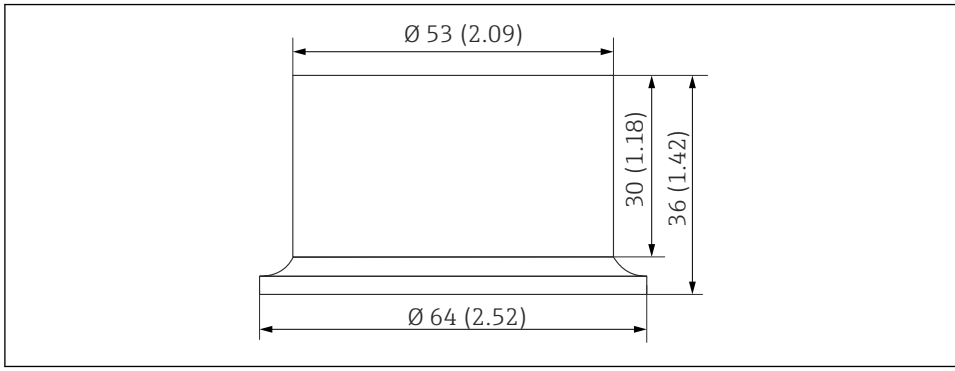
12.1.2 Holder

Flexdip CYH112
- Modular holder system for sensors and assemblies in open basins, channels and tanks
- For Flexdip CYA112 water and wastewater assemblies
- Can be affixed anywhere: on the ground, on the coping stone, on the wall or directly onto railings.
- Stainless steel version
- Product Configurator on the product page: www.endress.com/cyh112

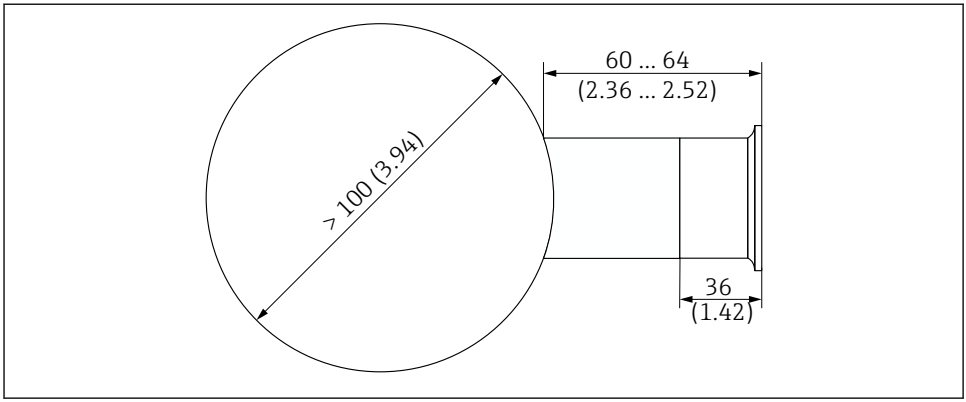
Technical Information TI00430C

12.1.3 Mounting material

Weld-in adapter for clamp connection DN 50
- Material: 1.4404 (AISI 316 L)
- Wall thickness 1.5 mm (0.06 in)
- Order number: 71242201



25 Weld-in adapter. Dimensions: mm (in)



26 Pipe connection with weld-in adapter. Dimensions: mm (in)

12.1.4 Compressed air cleaning

Compressed air cleaning for CUS50D
- Connection: 6 mm (0.24 in)
- Pressure: 1.5 to 2 bar (21.8 to 29 psi)
- Materials: POM, PE, PP, PA 6.6 30% glass fiber, titanium
- Order number: 71395617

Compressor
- For compressed air cleaning
- 230 V AC, order number: 71072583
- 115 V AC, order number: 71194623

12.1.5 Calibration kit

CUS50D kit, solid state reference
- Calibration tool for CUS50D turbidity sensor
- Easy and reliable inspection of CUS50D turbidity sensors
- Order number: 71400898

12.1.6 Cable

Memosens data cable CYK11
- Extension cable for digital sensors with Memosens protocol
- Product Configurator on the product page: www.endress.com/cyk11

Technical Information TI00118C

13 Technical data

13.1 Input

13.1.1 Measured variables

- Turbidity
- Absorption
- Solids content
- Product loss
- Temperature

13.1.2 Measuring range

Application	Specified operating range	Maximum operating range
Absorption factory calibration	0.000 to 5.000 AU or 0.000 to 10.000 OD	
Factory calibration for formazine	40 to 4,000 FAU	10000 FAU
Application: Kaolin	0 to 60 g/l	500 g/l
Application: Sludge	0 to 25 g/l	500 g/l
Application: Auto sludge	0 to 25 g/l	500 g/l
Product loss	0 to 100 %	1000%

Measuring range with solids content:

For solids, the achievable ranges depend very much on the media that are actually present and may differ from the recommended operating ranges. Extremely inhomogeneous media may cause fluctuations in measured values, thus narrowing the measuring range.

13.2 Energy supply

13.2.1 Power consumption

24V DC (-15 %/+ 20 %), 1.8 watt

13.3 Performance characteristics

13.3.1 Reference operating conditions

20 °C (68 °F), 1013 hPa (15 psi)

13.3.2 Measured error

Absorption	0.5 % of the upper range value (corresponds to ± 50 mOD)
Formazine	10 % of the measured value or 10 FAU (the greater value applies in each case)
Kaolin	5 % of the upper range value; applies to sensors that are calibrated for the observed measuring range
Sludge/auto sludge	10 % of the measured value or 5 % of the upper range value (the greater value applies in each case); applies to sensors that are calibrated for the observed measuring range
Product loss	Not specified; very much depends on the condition of the measuring medium used

For solids, the achievable measured errors depend very much on the media that are actually present and may differ from the specified values. Extremely inhomogeneous media cause the measured value to fluctuate and increase the measured error.

The measured error encompasses all inaccuracies of the measuring chain (sensor and transmitter). However, it does not include the inaccuracy of the reference material used for calibration.

13.3.3 Drift

Working on the basis of electronic controls, the sensor is largely free of drifts.

- **Formazine**: drift 0.04% per day (for 2000 FAU)
- **Absorbtion**: drift 0.015% per day (for 5 OD)

13.3.4 Detection limits

Application	Detection limit
Absorption	0.004 OD for 0.5 OD
Formazine	10 FAU

For kaolin, sludge/autosludge and product loss, the detection limit depends very much on the media that are actually present. It is therefore not possible to specify general values.

13.3.5 Repeatability

Application	Repeatability
Absorption	0.001 OD or 0.2% of measured value (the greater value applies in each case)
Formazine	10 FAU for 800 FAU

For kaolin, sludge/autosludge and product loss, the repeatability depends very much on the media that are actually present. It is therefore not possible to specify general values.

13.4 Environment

13.4.1 Ambient temperature range

–20 to 60 °C (–4 to 140 °F)

13.4.2 Storage temperature

–20 to 70 °C (–4 to 158 °F)

13.4.3 Relative humidity

Humidity 0 to 100 %

13.4.4 Operating height

3 000 m (9 842.5 ft) maximum

13.4.5 Fouling

Degree of fouling 2 (micro environment)

13.4.6 Ambient conditions

- For use in indoor and outdoor areas
- For use in wet environments

For continuous operation underwater → 15

13.4.7 Degree of protection

- IP 68 (1.83 m (6 ft) water column over 24 hours)
- IP 66
- Type 6P

13.5 Process

13.5.1 Process temperature range

–20 to 85 °C (–4 to 185 °F)

13.5.2 Process pressure range

0 to 5 bar (0 to 73 psi) absolute

13.5.3 Minimum flow

No minimum flow required.

For solids which have a tendency to form deposits, ensure that sufficient mixing is performed.

13.6 Mechanical construction

13.6.1 Dimensions

→ Section "Installation"

13.6.2 Weight

Cable length	Plastic sensor	Metal sensor	Metal sensor with clamp
3 m (9.84 ft)	0.46 kg (1.5 lbs)	1.15 kg (2.54 lbs)	1.21 kg (2.67 lbs)
7 m (23 ft)	0.68 kg (1.5 lbs)	1.37 kg (3.81 lbs)	1.43 kg (3.15 lbs)
15 m (49.2 ft)	1.15 kg (2.54 lbs)	1.83 kg (4.03 lbs)	1.9 Kg (4.19 lbs)

13.6.3 Materials

	Plastic sensor	Metal sensor
Sensor head:	PCTFE	PCTFE
Sensor housing:	PPS/GF40%	1.4571/AISI 316Ti
Sensor threaded connection:	PPS/GF40%	1.4404/AISI316L
O-rings:	EPDM	EPDM

The data refer to the wetted materials when the sensor is installed correctly in Endress+Hauser assemblies.

13.6.4 Process connections

- G1 and NPT ¾'
- Clamp 2" (depending on sensor version)/DIN 32676

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