

# Technical Information

## Turbimax CUS52D

Inline and immersion sensor for low to medium turbidity



### Application

The Turbimax CUS52D is a sensor for all drinking water and process water applications.

- Turbidity measurement at all stages of the water treatment process
- Final turbidity measurement in outlet of waterworks
- Turbidity measurement in inlet of waterworks
- Turbidity measurement for filter monitoring and filter backwashing
- Turbidity measurement in drinking water networks

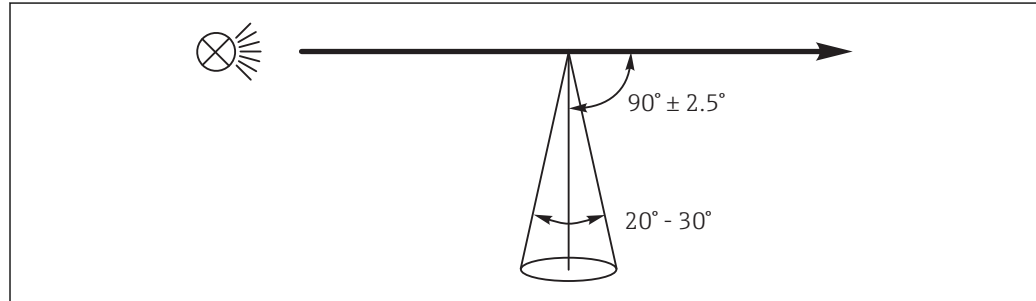
### Your benefits

- Turbidity measurement in accordance with ISO 7027
- The hygienic design with the 2" clamp means it can be mounted directly in pipes and fits into CUA252 (PE 100) and CUA262 (stainless steel) flow assemblies.
- Immersion version can be installed in open channels and basins.
- Replaces CUS31 sensor in existing CUS31 assemblies (E and S).
- Can be used at high temperatures and high pressures.
- Standardized communication (Memosens technology) enables "plug and play". Intelligent sensor - all characteristics and calibration values are stored in the sensor.
- Customer calibrations with 1 to 6 points - can be performed in the lab or at place of installation.
- Completely safe, as the optical source requires little power to operate.

## Function and system design

### Measuring principle

The sensor works using the 90° light scattering principle in accordance with ISO 7027 and meets all the requirements of this standard (no divergence and a maximum convergence of 1.5°). The ISO 7027 standard is obligatory for turbidity measurements in the drinking water sector.

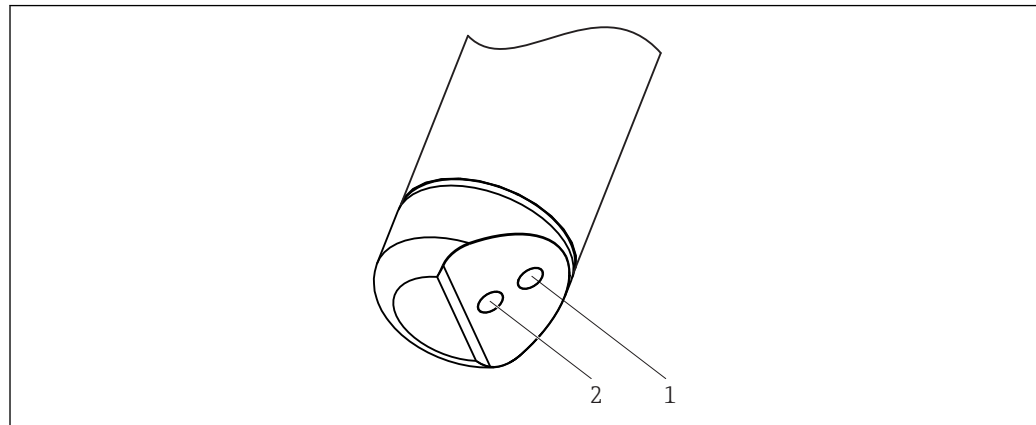


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1 Measurement in accordance with ISO 7027

Measurement is done using a wavelength of 860 nm.

### Sensor structure



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2 Arrangement of light source and light receiver

- 1 Light receiver
- 2 Light source

**Sensor monitoring**

The optical signals are continuously monitored and analyzed for plausibility. If inconsistencies occur, an error message is output via the transmitter.

**Solid state reference**

The function and accuracy of the CUS52D sensor can be checked using the **Calkit CUS52** solid state reference. During factory calibration, each solid state reference is aligned with a special CUS52D sensor and can be used only with this sensor. Therefore, the solid state reference and the CUS52D sensor are married (permanently assigned) to one another.

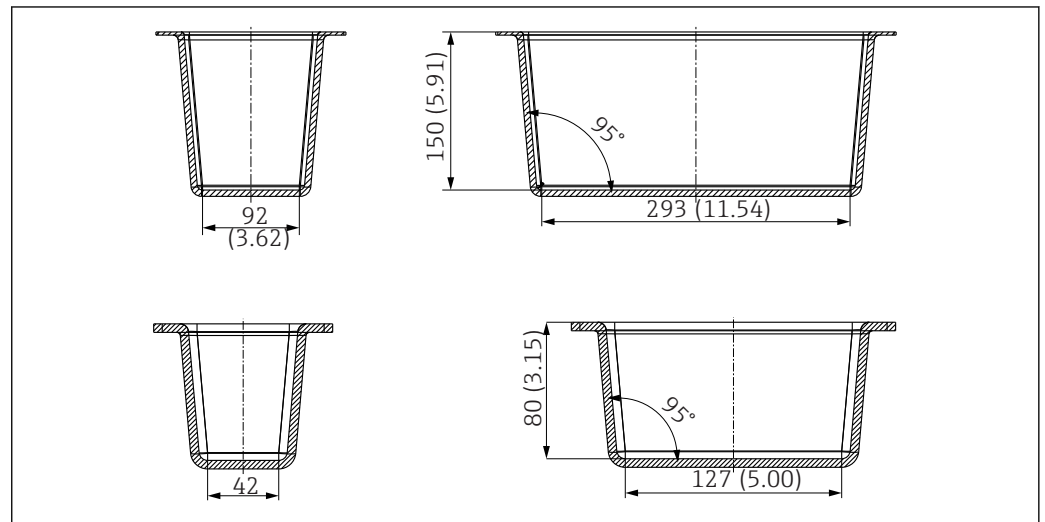
The following solid state references are available:

- 5 FNU (NTU)
- 20 FNU (NTU)
- 20 FNU (NTU)

The reference value indicated on the solid state reference is reproduced with an accuracy of  $\pm 10\%$  when the sensor is operating correctly.

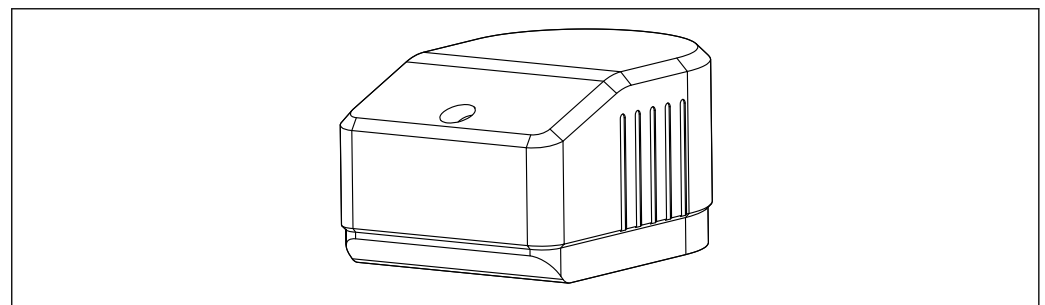
**Calibration tools**

The **CUY52** calibration tools allow the sensors to be validated quickly and reliably. This makes it easier to adapt to the actual measuring point by creating basic conditions that are reproducible (vessels with minimal backscattering, shade from interfering light sources etc.).



3 Large and small calibration vessel

The solid state reference with approx. 4.0 FNU / NTU is used to check the function of any CUS52D sensors. The standard is not assigned to a specific sensor and delivers measured values in the range of 4.0 FNU  $\pm$  1.5 FNU / NTU with all CUS52D sensors.



4 Solid state reference

**Applications**

Model name	Application	Unit
Formazin	Drinking water, process water	FNU; NTU; TE/F; EBC; ASBG
Kaolin	Drinking water, filterable matter, industrial water	mg/l; g/l; ppm

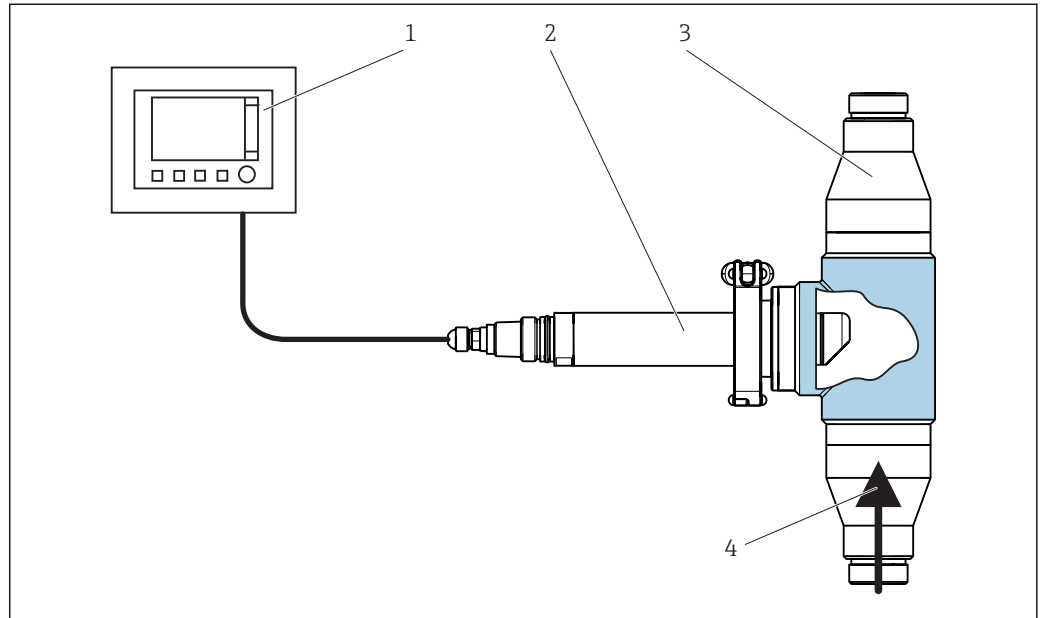
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<b>Model name</b>	<b>Application</b>	<b>Unit</b>
PSL	The calibration standard commonly used in Japan for drinking water turbidity	度 (dough)
Diatomite	Mineral-based solids (sand)	mg/l; g/l; ppm

**Measuring system**

A complete measuring system comprises:

- Turbimax CUS52D turbidity sensor
- Liquiline CM44x multi-channel transmitter
- Direct installation in a pipe connection (2" clamp or Varivent) or
- Assembly:
  - CUA252 flow assembly or
  - CUA262 flow assembly or
  - Flexdip CYA112 assembly and Flexdip CYH112 holder or
  - retractable assembly, e.g. Cleanfit CUA451



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5 Measuring system with CUA252 flow assembly

- 1 Liquiline CM44x multi-channel transmitter
- 2 Turbimax CUS52D turbidity sensor
- 3 CUA252 flow assembly
- 4 Direction of flow

## Input

<b>Measured values</b>	Turbidity
	Temperature

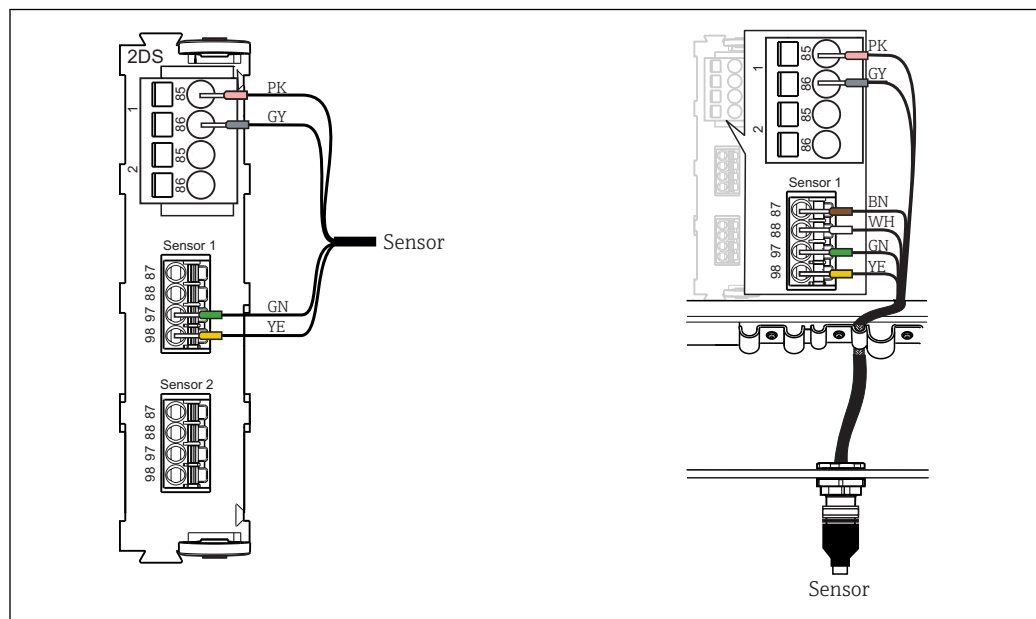
Measuring ranges	CUS52D	Application
	Turbidity	0,000 to 4000 FNU Display range up to 9999 FNU
Temperature	-20 to +85 °C (-4 to +185 °F)	

**i** For the measuring range up to 10 FNU, the sensor exhibits a limit of detection (LOD) of 0.0015 FNU (measured in accordance with ISO 15839).

## Power supply

You have the following connection options:


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



**6** Sensor connection to sensor input (left) or via M12 connector (right)

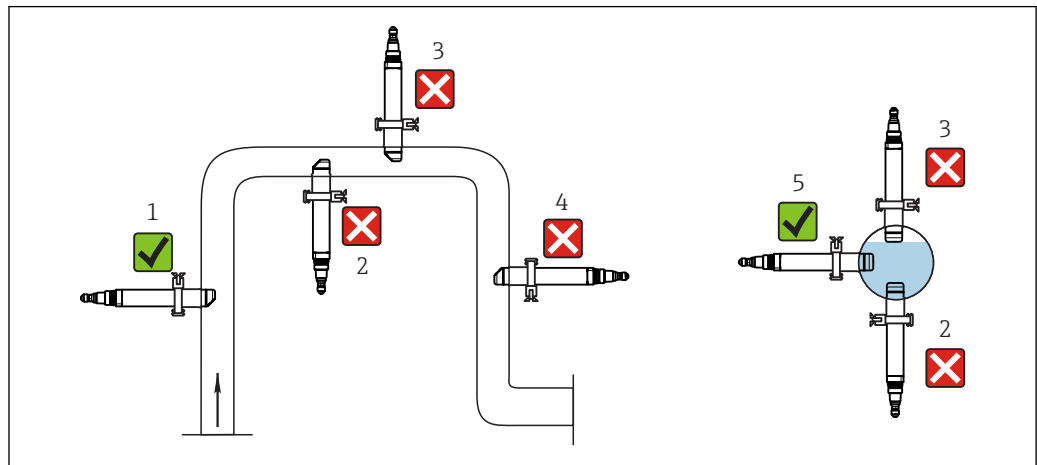
The maximum cable length is 100 m (328 ft).

## Performance characteristics

<b>Reference operating conditions</b>	20°C (68 °F), 1013 hPa (15 psi)																						
<b>Maximum measured error</b>	2 % ±0.01 FNU of the measured value; reference: measured value in recommended operating range, factory calibration.																						
	 The inaccuracy encompasses all inaccuracies of the measuring chain (sensor and transmitter). However, it does not include the inaccuracy of the reference material used for calibration.																						
<b>Wavelength</b>	860 nm																						
<b>Conformity</b>	Determining turbidity in accordance with ISO 7027																						
<b>Factory calibration</b>	The sensor has been calibrated in the factory for "formazine" applications. Basis: internal 20-point characteristic curve																						
<b>Applications</b>	The formazine factory calibration is used as the basis for precalibrating additional applications and optimizing them for the different media characteristics.																						
	<table border="1"> <thead> <tr> <th>Application: water</th> <th>Recommended operating range</th> <th>Working area</th> <th>Max. display range</th> </tr> </thead> <tbody> <tr> <td>Factory calibration for formazine</td> <td>0.000 to 1000 FNU</td> <td>0.000 to 4000 FNU</td> <td>0.000 to 9999 FNU</td> </tr> <tr> <td>Application: Kaolin</td> <td>0 to 150 mg/l</td> <td>0 to 600 mg/l</td> <td>0 to 3 g/l</td> </tr> <tr> <td>Application: PSL</td> <td>0 to 125 度</td> <td>0 to 500 度</td> <td>0 to 3000 度</td> </tr> <tr> <td>Application: diatomite</td> <td>0 to 550 mg/l</td> <td>0 to 2200 mg/l</td> <td>0 to 10 g/l</td> </tr> </tbody> </table>			Application: water	Recommended operating range	Working area	Max. display range	Factory calibration for formazine	0.000 to 1000 FNU	0.000 to 4000 FNU	0.000 to 9999 FNU	Application: Kaolin	0 to 150 mg/l	0 to 600 mg/l	0 to 3 g/l	Application: PSL	0 to 125 度	0 to 500 度	0 to 3000 度	Application: diatomite	0 to 550 mg/l	0 to 2200 mg/l	0 to 10 g/l
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	To adapt to a specific application, customer calibrations can be carried out with up to 6 points.																						
<b>Drift</b>	Working on the basis of electronic controls, the sensor is largely free of drifts.																						
<b>Detection limits</b>	Lower limit of detection (LOD) as per ISO 15839):																						
	<table border="1"> <thead> <tr> <th>Application</th> <th>Measuring range</th> <th>Detection limit</th> </tr> </thead> <tbody> <tr> <td>Formazine</td> <td>0 to 10 FNU (ISO 15839)</td> <td>0.0015 FNU</td> </tr> </tbody> </table>			Application	Measuring range	Detection limit	Formazine	0 to 10 FNU (ISO 15839)	0.0015 FNU														
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Formazine	0 to 10 FNU (ISO 15839)	0.0015 FNU																					
<b>Response time</b>	> 1 sec., adjustable																						
<b>Repeatability</b>	< 0.5 % of the measured value																						

## Installation

### Installation instructions



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7 Orientation and positions

- Install the sensor in places with consistent flow conditions.
- The best installation location is in the ascending pipe (item 1). Installation is also possible in the horizontal pipe (item 5).
- Do not install in places where air spaces or bubbles occur (item 3) or where sedimentation may occur (item 2).
- Avoid installation in the down pipe (item 4).
- Avoid fittings downstream from pressure reduction stages, as this may lead to outgassing.

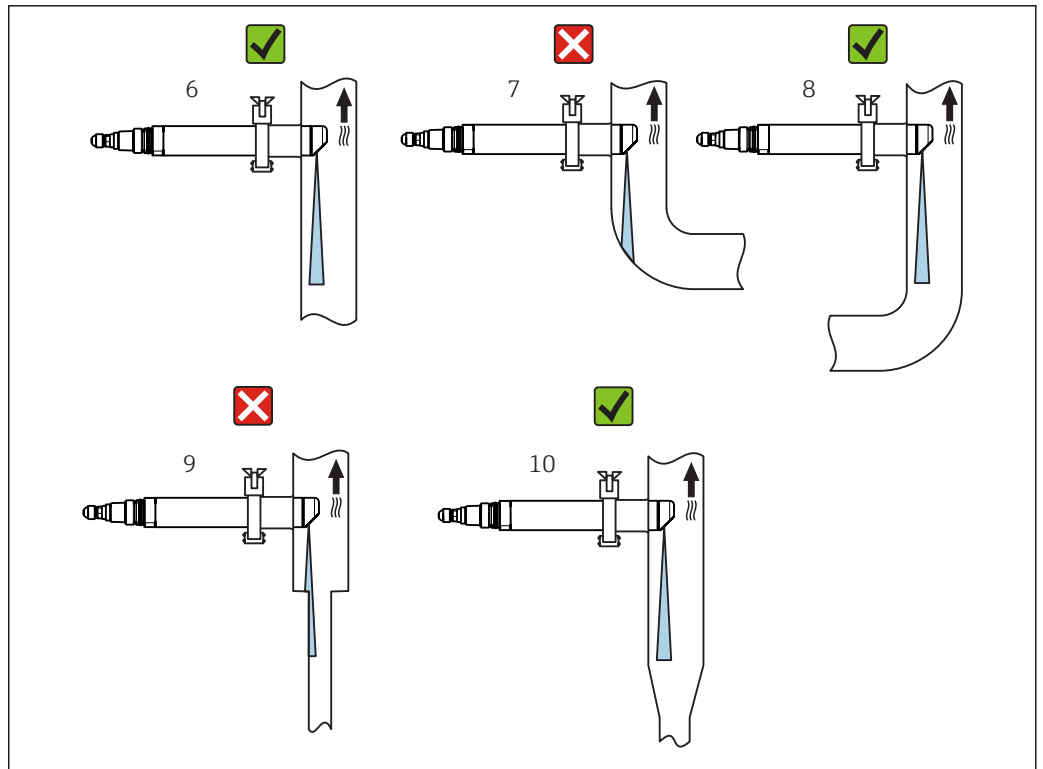
#### Wall effects:

Backscattering on the pipe wall may result in the distortion of measured values in the case of turbidity values < 200 FNU. Assembly adjustment is recommended.

Black plastic pipes with diameter > DN 60 exhibit hardly any wall effects (<0.05 FNU). For this reason, the use of black plastic pipes is recommended.

Additional information on avoiding wall effects:





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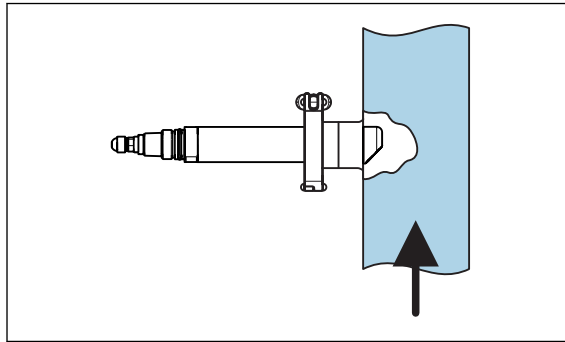
8 Orientations for pipes and assemblies

- Install the sensor in such a way that the light beam is not reflected (item 6).
- Avoid sudden changes in cross-section (item 9). Changes in cross-section should be gradual and located as far away as possible from the sensor (item 10).
- Do not install the sensor directly downstream from a bend (item 7). Instead position it as far away as possible from the bend (item 8).
- When using reflective materials (e.g. stainless steel), the pipe diameter must be at least 100 mm (4"). An assembly adjustment onsite is recommended.
- Pipes made of stainless steel with diameter >DN 300 exhibit hardly any wall effects.

#### Installation options

Installation options:

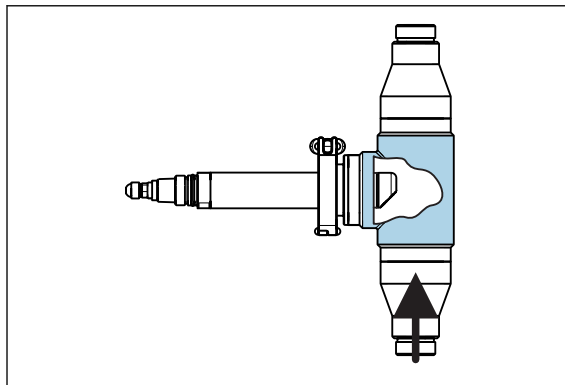
- with clamp connection
- with Flowfit CUA252 flow assembly
- mit Flowfit CUA262 flow assembly
- with Cleanfit CUA451 retractable assembly
- with Flexdip CYA112 immersion assembly and Flexdip CYH112 holder
- with "E" or "S" flow assembly from CUS31
- with Varivent connection



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9 Installing with 2" clamp connection

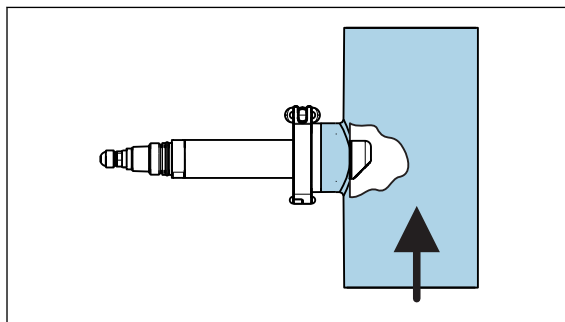
The installation angle is 90°. The arrow points in the direction of flow. The optical windows in the sensor must be aligned against the direction of flow.



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10 Installing with CUA252 flow assembly

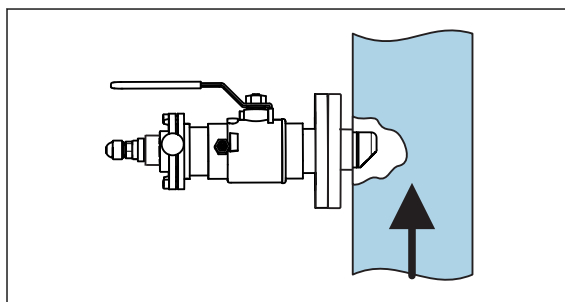
The installation angle is 90°. The arrow points in the direction of flow. The optical windows in the sensor must be aligned against the direction of flow.



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11 Installing with CUA262 flow assembly

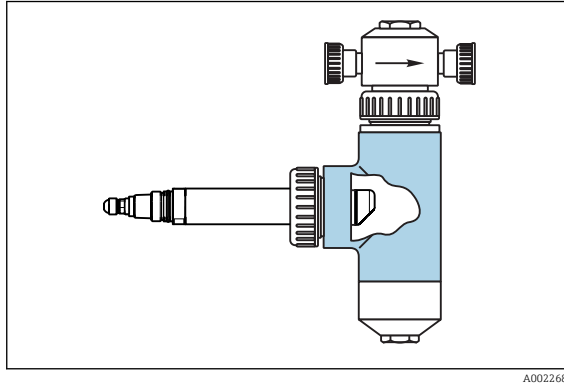
The installation angle is 90°. The arrow points in the direction of flow. The optical windows in the sensor must be aligned against the direction of flow.



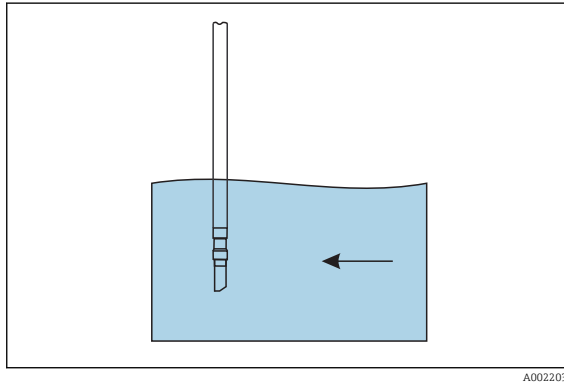
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12 Installing with CUA451 retractable assembly

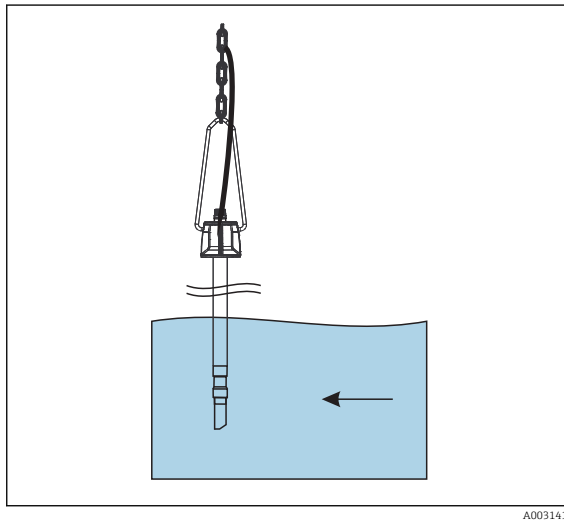
The installation angle is 90°. The arrow points in the direction of flow. The optical windows in the sensor must be aligned against the direction of flow. For manual insertion/retraction of the assembly, the medium pressure must not exceed 2 bar (29 psi).



13 Installing in CUS31-S flow assembly



14 Installing with immersion assembly

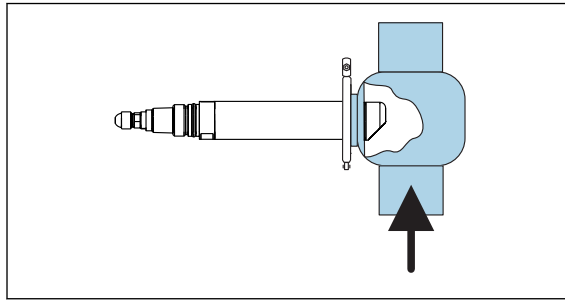


15 Installing with immersion assembly on chain holder system

The installation angle is 90°. The alignment of the sensor depends on the medium. In the case of media with little outgassing and with a tendency to form deposits, the optical windows face downwards (as shown in the graphic). In the case of media with strong outgassing and with no tendency to form deposits, the optical windows face upwards.

The installation angle is 0°. The arrow points in the direction of flow. If you are using the sensor in open basins, install the sensor in such a way that bubbles cannot accumulate on it.

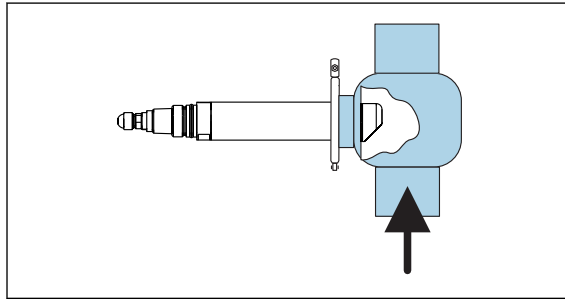
The installation angle is 0°. The arrow points in the direction of flow. If you are using the sensor in open basins, install the sensor in such a way that bubbles cannot accumulate on it.



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16 Installing with Varivent connection (long)

The installation angle is 90°.  
The arrow points in the direction of flow.  
The optical windows in the sensor must be aligned against the direction of flow.



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17 Installing with Varivent connection (long)

The installation angle is 90°.  
The arrow points in the direction of flow.  
The optical windows in the sensor must be aligned against the direction of flow.

For automatic sensor operation in pipe fittings or flow assemblies, there is the option of using the ultrasonic cleaning system CYR52 (see Accessories).

Bubbles result in errors in turbidity measurements. This effect of this interference can be minimized by using a bubble trap (see Accessories).

## Environment

<b>Ambient temperature</b>	-20 to +85 °C (0 to 185 °F)
<b>Storage temperature</b>	-20 to +70 °C (0 to 160 °F)
<b>Degree of protection</b>	IP 68 (1.8 m (5.91 ft) water column over 20 days, 1 mol/l KCl)

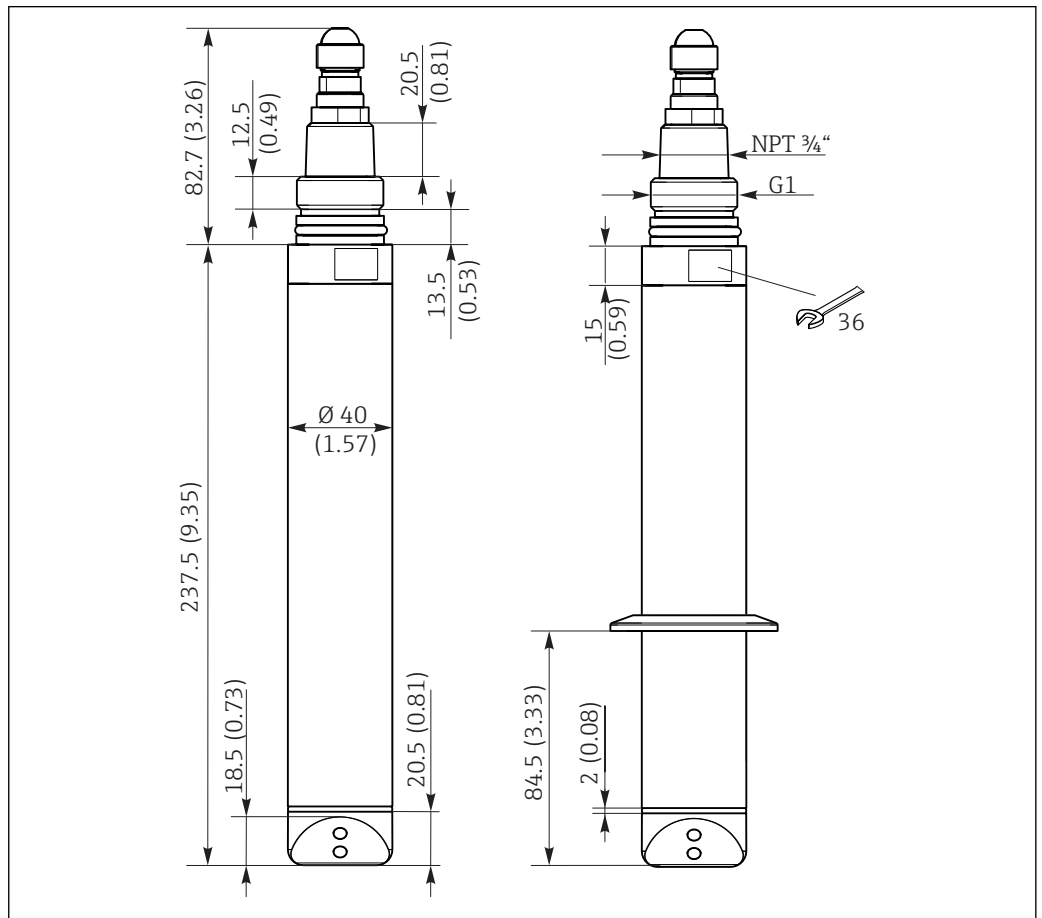
## Process


Process temperature	-20 to +85 °C (0 to 185 °F)
Process pressure (absolute)	0.5 to 10 bar (7 to 145 psi) absolute
Minimum flow	No minimum flow required.

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

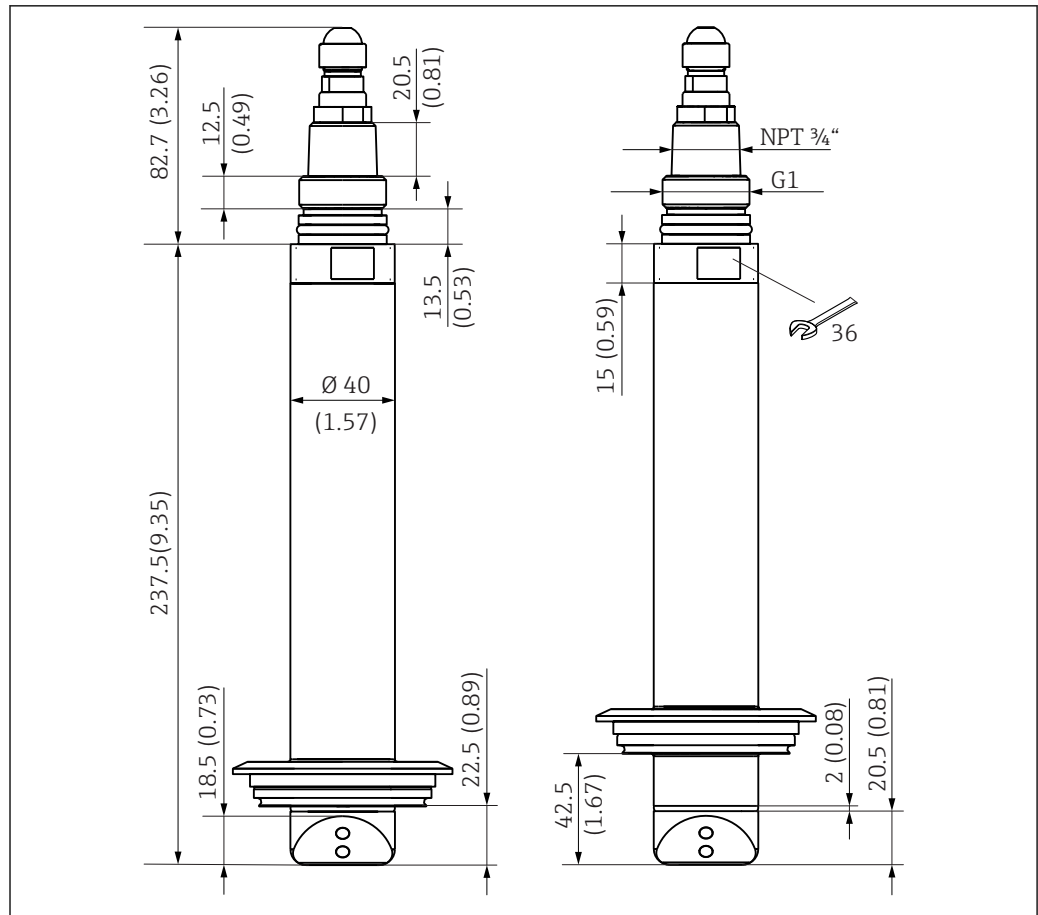
## Mechanical construction

### Design, dimensions



 18 Sensor and sensor with clamp connection, dimensions in mm (in)

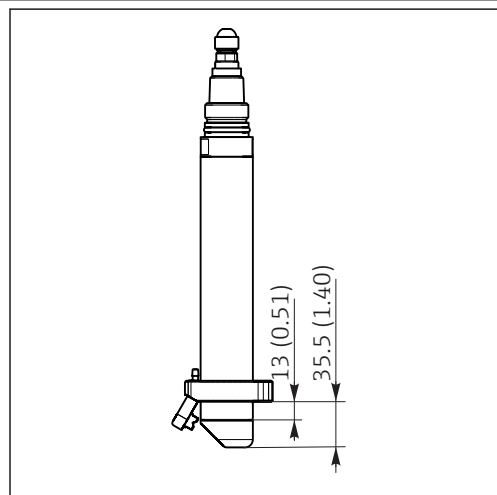
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19 Sensor with standard Varivent connection and extended shaft, dimensions in mm (in)

Compressed air cleaning

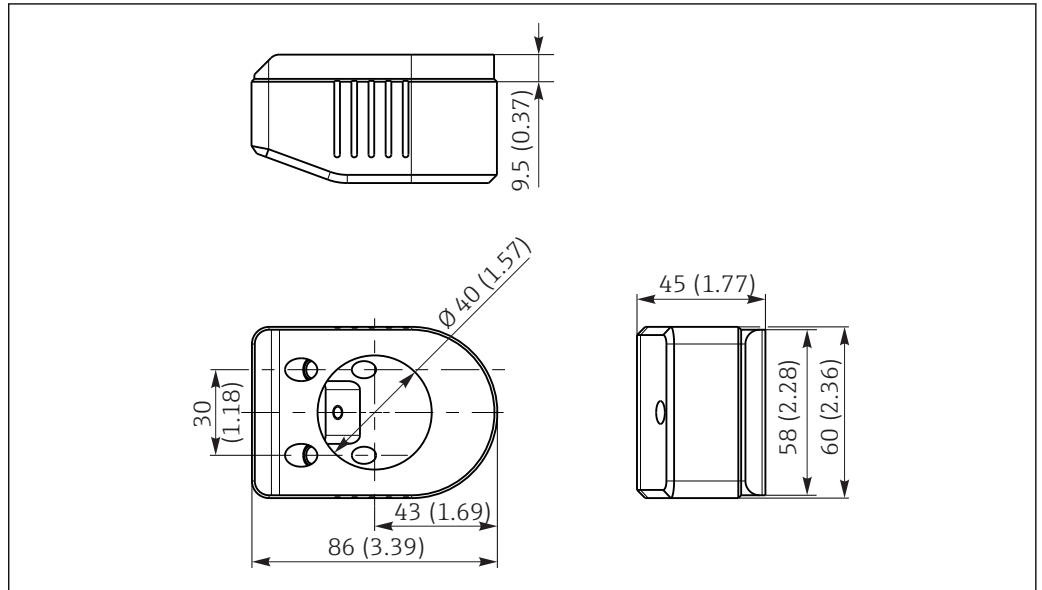


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20 CUS52D with compressed air cleaning

Compressed air cleaning  
 Consumption: 50 l/min (13.2 gal/min)  
 Pressure: 1.5 to 2 bar (22 to 30 psi)  
 Connection: 6/8 mm or 6.35 mm (1/4")

**Solid state reference**



21 Calkit CUS52 solid state reference, dimensions in mm (inch)

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**Weight**

Sensor with 7 m cable

With clamp

Approx. 1.56 kg (3.44 lbs)

Without clamp

Approx. 1.48 kg (3.26 lbs)

**Materials**

Sensor

Stainless steel 1.4404 (AISI 316 L)

Optical windows

Sapphire

O-rings

EPDM

**Process connections**

G1 and NPT 3/4"

Clamp 2" (depending on sensor version)/ DIN 32676


Varivent N DN 65 - 125 standard immersion depth 22.5 mm

Varivent N DN 65 - 125 immersion depth 42.5 mm

## Certificates and approvals

<b>Electromagnetic compatibility</b>	Interference emission and interference immunity as per <ul style="list-style-type: none"> <li>▪ EN 61326-1:2013</li> <li>▪ EN 61326-2-3:2013</li> <li>▪ NAMUR NE21: 2012</li> </ul>
<b>ISO 7027</b>	The measuring method used with the sensor complies with the ISO 7027-1:2016 standard.
<b>CE mark</b>	The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EU directives. The manufacturer confirms successful testing of the product by affixing to it the <b>CE</b> mark.
<b>EAC</b>	The product has been certified according to guidelines TP TC 004/2011 and TP TC 020/2011 which apply in the European Economic Area (EEA). The EAC conformity mark is affixed to the product.

## Ordering information

<b>Product page</b>	<a href="http://www.endress.com/cus52d">www.endress.com/cus52d</a>
<b>Product Configurator</b>	<p>On the product page there is a <b>Configure</b> button to the right of the product image.</p> <ol style="list-style-type: none"> <li>1. Click this button. <ul style="list-style-type: none"> <li>↳ The Configurator opens in a separate window.</li> </ul> </li> <li>2. Select all the options to configure the device in line with your requirements. <ul style="list-style-type: none"> <li>↳ In this way, you receive a valid and complete order code for the device.</li> </ul> </li> <li>3. Export the order code as a PDF or Excel file. To do so, click the appropriate button on the right above the selection window.</li> </ol> <p> For many products you also have the option of downloading CAD or 2D drawings of the selected product version. Click the <b>CAD</b> tab for this and select the desired file type using picklists.</p>
<b>Scope of delivery</b>	<p>The delivery comprises:</p> <ul style="list-style-type: none"> <li>▪ 1 Turbimax CUS52D sensor, version as ordered</li> <li>▪ 1 set of Operating Instructions BA01275C/07/EN</li> </ul>



## Accessories

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

- ▶ For accessories not listed here, please contact your Service or Sales Center.

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### Assemblies

#### Flowfit CUA252

- For CUS52D
- Product Configurator on the product page: [www.endress.com/cua252](http://www.endress.com/cua252)



Technical Information TI01139C

#### Flowfit CUA262

- For CUS52D
- Product Configurator on the product page: [www.endress.com/cua262](http://www.endress.com/cua262)



Technical Information TI01152C

#### 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](http://www.endress.com/cua451)



Technical Information TI00369C

#### FlexdipCYA112

- 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](http://www.endress.com/cya112)



Technical Information TI00432C

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### Holder

#### Flexdip CYH112

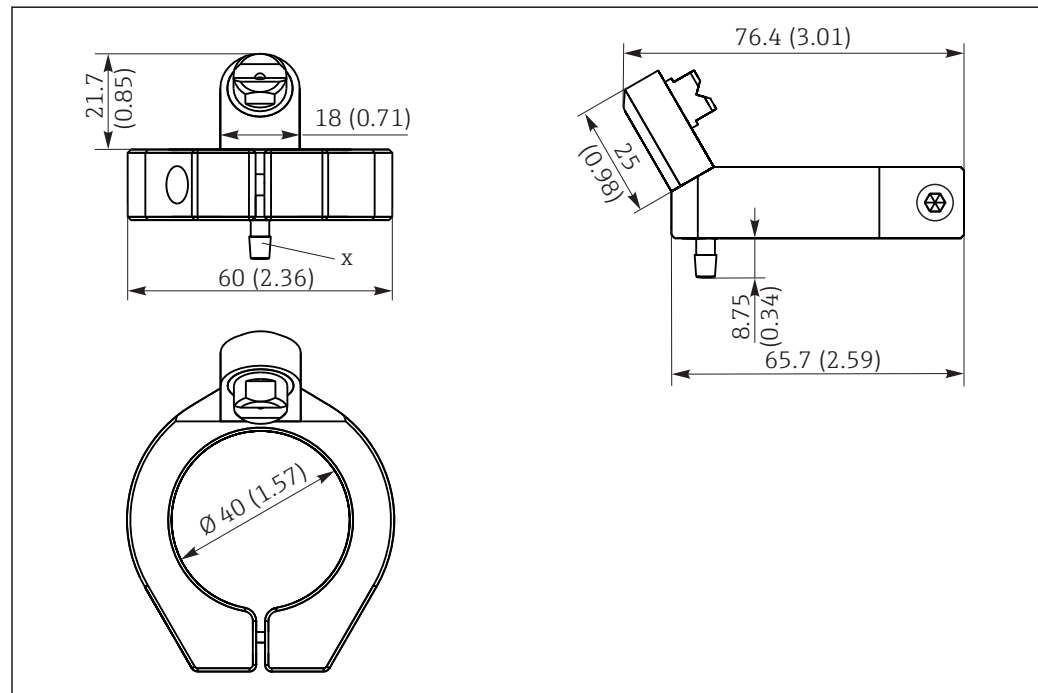
- Modular holder system for sensors and assemblies in open basins, channels and tanks
- For Flexdip CYA112 water and wastewater assemblies
- Can be affixed anywhere: on the ground, on the capstone, on the wall or directly onto railings.
- Stainless steel version
- Product Configurator on the product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



Technical Information TI00430C

**Compressed air cleaning****Compressed air cleaning for CUS52D**

- Connection: 6 mm
- Materials: POM black
- Order No.: 71242026



22 Compressed air cleaning system, dimensions in mm (inch)

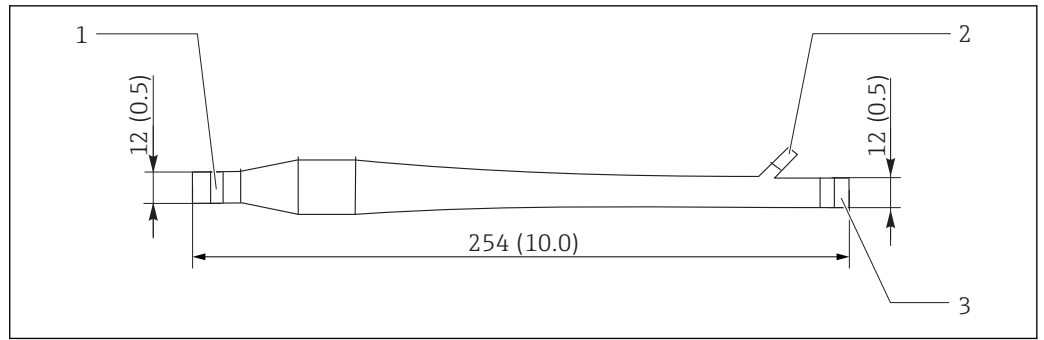
X 6 mm hose barb

**Compressor**

- For compressed air cleaning
- 230 V AC order no. 71072583
- 115 V AC order no. 71194623

**Bubble trap****Bubble trap**

- For sensor CUS52D
- Process pressure: up to 3 bar (43.5 psi)
- Process temperature: 0 to 50 °C (32 to 122 °F)
- D 12 adapter with connection for degassing line (upper connection on the CUA252) is included in the scope of delivery.
- Orifice plates for the following volume flows:
  - < 60 l/h (15.8 gal/hr)
  - 60 to 100 l/h (15.8 to 26.4 gal/hr)
  - > 100 l/h (26.4 gal/hr)
- The degassing line is fitted with a PVC hose, backpressure hose valve and luer lock adapter.
- Order number, suitable for CUA252 assembly: 71242170
- Order number, suitable for assembly S of CUS31: 71247364



23 Bubble trap, dimensions in mm (in)

- 1 Inlet for medium (without hose system)
- 2 Outlet for bubbles (hose system is included in scope of delivery)
- 3 Outlet for medium (without hose system)

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### Calibration kit

#### CUY52

- Calibration tool for turbidity sensor CUS52D
- Easy and reliable validation, calibration and adjustment of CUS52D turbidity sensors.
- Product Configurator on the product page: [www.endress.com/cuy52](http://www.endress.com/cuy52)

 Technical Information TI01154C

[www.addresses.endress.com](http://www.addresses.endress.com)

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