

Turbidity Sensor

TurbiMax W CUS 31

Installation and immersion sensor for drinking water and industrial water according to the 90° scattered light method



Application

- All phases of drinking water processing
- Coagulation and flocculation
- Filter rupture monitoring
- Filter backwash
- Control of clear rinsing cycles
- Monitoring of phase separation processes
- Boiler feedwater
- Monitoring of cooling water
- Monitoring of surface waters
- Outlet monitoring of sewage treatment plants
- Monitoring of industrial water discharge
- Recycling of industrial water

Your benefits

- Suitable as a drinking water sensor for every installation with a wall distance greater than 10 cm
- Commissioning without formazine, factory calibration ("plug and play")
- Measurement according to EN / ISO
- Measurement under pressure to avoid degassing
- Direct installation in water pipes
- Wiper unit can be retrofitted
- Self-monitoring and plausibility check
- Integrated temperature measurement
- Inclined plain sensor surface uses medium flow to increase the self-cleaning effect and repels air bubbles
- Scratch-resistant sapphire glass measuring window
- Permissible distance between sensor and transmitter 200 m

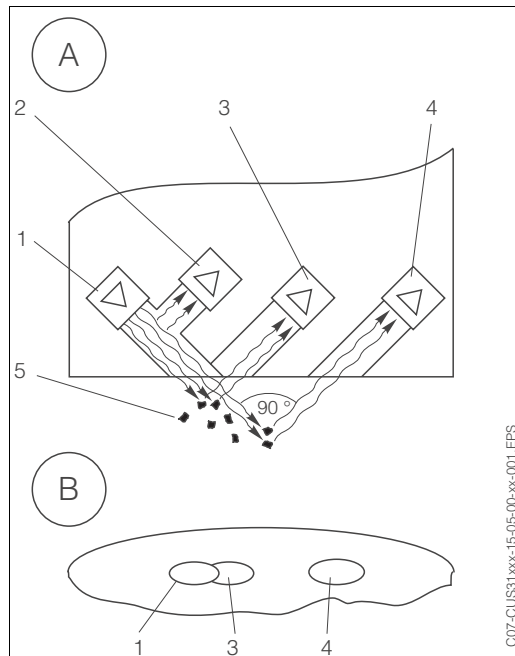
Function and system design

Measuring principle

Nephelometric measuring principle 90° NIR scattered light according to EN 27027

The 90° scattered light method with a wavelength in the near-infrared range (880 nm) according to ISO 7027 / EN 27027 records turbidity values under standardised, comparable conditions. A temperature signal is also recorded and transmitted in addition to the turbidity signal. The excitation radiation of an infrared transmitter (Fig., Item 1) strikes the medium at a defined angle of beam. The different refractions of light between the entrance window and the medium (water) are taken into account.

Particles in the medium (Item 5) create a scattered radiation which strikes the scattered light receivers (Items 3, 4) at a defined angle of beam. The measurement in the medium is constantly compared with the values of a reference receiver (Item 2). Digital filter functions with excellent interference signal suppression and sensor self-monitoring ensure additional measurement reliability.



- A Side view of the sensor (cutaway scheme)
 - 1 Infrared transmitter
 - 2 Reference diode
 - 3 Scattered light receiver 1
 - 4 Scattered light receiver 2
 - 5 Particles in the medium
-
- B Top view of the sensor surface with optical windows

Turbidity measurement according to ISO 7027 / EN 27027

Wavelength

880 nm

Radiation compensation

Using reference photodiodes

Factory calibration

Traceable to formazine standard and SiO₂

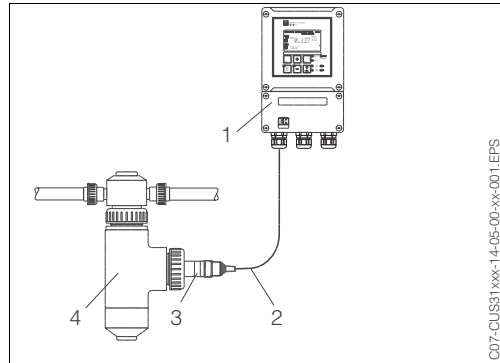
Measuring system

A measuring system consists of:

- Turbidity sensor CUS 31 in an assembly
- Transmitter, e.g. Liquisys M CUM 223/253

Optional:

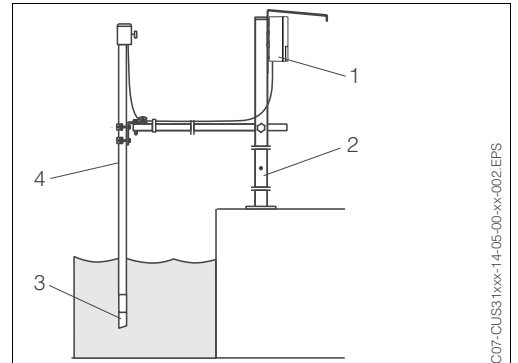
- CYH 101 universal suspended assembly holder for immersion operation
- DipFit W CYA 611 immersion assembly or FlowFit W CUA 250 flow assembly or ProbFit W CUA 461 retractable assembly
- VBM junction box
- ChemoClean automatic spray cleaning system



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Flow measurement

- | | |
|---|--------------------------------------|
| 1 | Transmitter, e.g. Liquisys M CUM 253 |
| 2 | Sensor cable |
| 3 | TurbiMax W CUS 31 |
| 4 | Flow assembly S, (see Page 6) |



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Measuring system with immersion assembly

- | | |
|---|--|
| 1 | Transmitter, e.g. Liquisys M CUM 253 |
| 2 | CYH 101 assembly holder
(with CYY 101 weather protection cover) |
| 3 | TurbiMax W CUS 31 |
| 4 | DipFit W CYA 611 immersion assembly |

Input

Measured variable

Turbidity

Measuring range

0.000 ... 9999 FNU / 0.00 ... 3000 ppm / 0.0 ... 3.0 g/l / 0.0 ... 200.0 %

Electrical connection

Cable connection

	Sensor	Pin CUM 2x3
	Screen	S
	Com A	96
	Com B	97
	-U _B	88
	+U _B	87

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CUS 31 cable assignment, for sensor and transmitter

Cable type

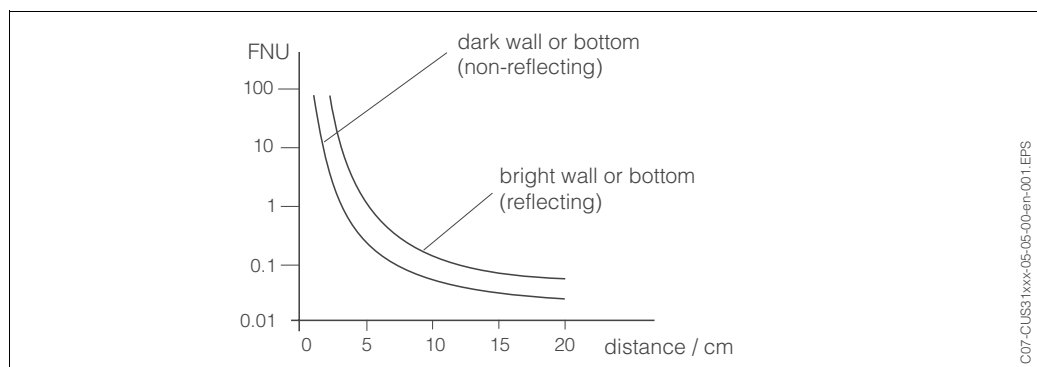
CYK 81, four-core, screened fixed cable (2x2 cores twisted) with free cable ends

Operating conditions (installation)

Installation instructions

- Each sensor is calibrated in the factory according to standard procedures (ISO 7027 / EN 27027).
- The calibration data are stored in the sensor.
- Customer-specific or material-specific calibrations can also be stored.
- The calibration values are listed in a quality certificate which is enclosed individually in the packaging with each sensor.
- Sensor systems with assemblies are available to meet the requirements of the drinking water sector. The sensor is already installed in the assembly and is calibrated with the assembly.
- Various assemblies are available for the industrial water sector.
- Installing the sensor in piping or very close to a wall can cause backscatter which results in a higher signal.

To compensate for this factor, an installation adjustment may have to be performed by means of the transmitter, (see Operating Instructions for Liquisys M CUM 2x3, BA 200C/07/en).

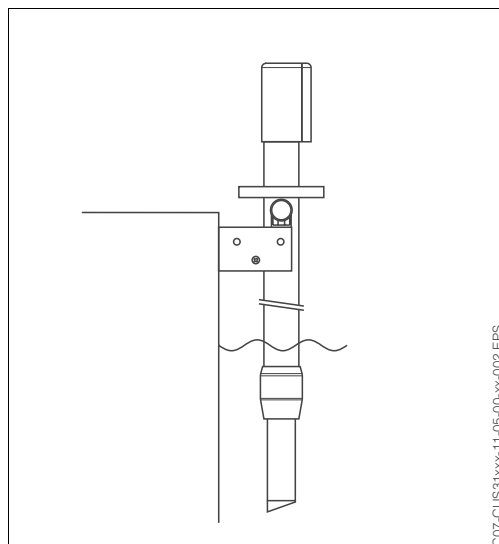


Effect of the distance from the wall or bottom

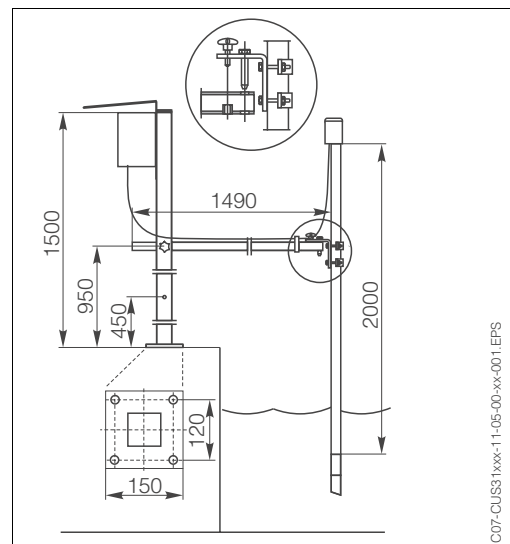
Installation in immersion assemblies

When installing the CUS 31 in immersion assemblies, such as CYA 611 with pendulum frame, please ensure that a sufficient wall distance is observed during operation. For this reason, select an installation location in which **a minimum wall distance of 15 cm** is observed even with varying levels or altered flow profiles. Mounting in a suspended assembly with chain must therefore be avoided.

The sensor must immerse at least 4 cm into the medium.



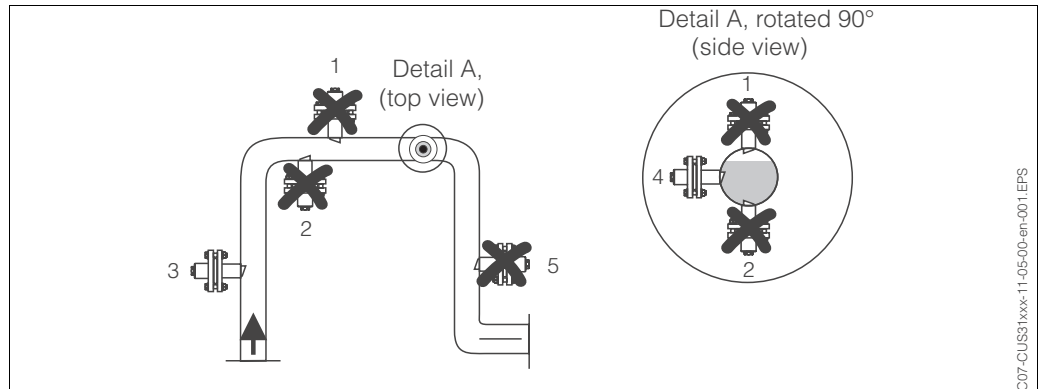
CUS 31 in CYA 611 assembly with pendulum frame



CYH 101 assembly holder with CYA 611 assembly

Pipe installation

The following diagram illustrates various installation positions in piping and indicates whether they are permitted or not.



Orientation and installation positions of CUS 31 with CUA 120-A/B adapter or with CUA 461 retractable assembly

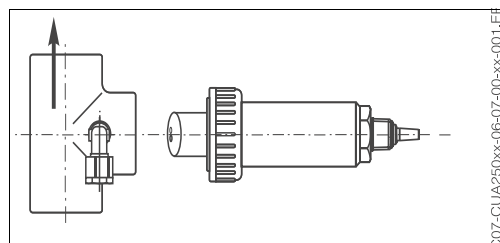
- The pipeline diameter must be at least DN 100 if reflective materials (e.g. stainless steel) are used.
- Install the sensor in places with uniform flow conditions and not in places where air may collect or foam bubbles form (1) or where suspended particles may settle (2).
- The best installation location is in the ascending pipe (3). Installation is also possible in the horizontal pipe (4), but should be avoided in the down pipe (5).
- Orientate the sensor surface against the medium flow ("self-cleaning effect").

Installation in flow assemblies

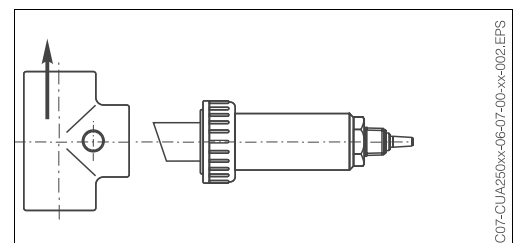
Install the sensor according to the instructions provided in the Technical Information of the FlowFit W CUA 250 flow assembly (TI 096C/07/en).

- If possible, install the flow assembly vertically so that the medium flows to the sensor from below. Alternatively, the assembly can also be installed horizontally.
- Two sensor orientations are possible for horizontal installation, (Figure):
 - parallel to the medium flow
 - against the medium flow
- Orientation *parallel* to the medium flow is required when using the CUR 3 spray head.
- Orientation *against* the medium flow is used to increase the self-cleaning effect in heavily-soiled media (> 15 FNU). The wall reflection is negligible here due to the high absorption tendency.

We recommend the CUS 31-xxE or CUS 31-xxS sensor version be used for turbidities < 5 FNU.



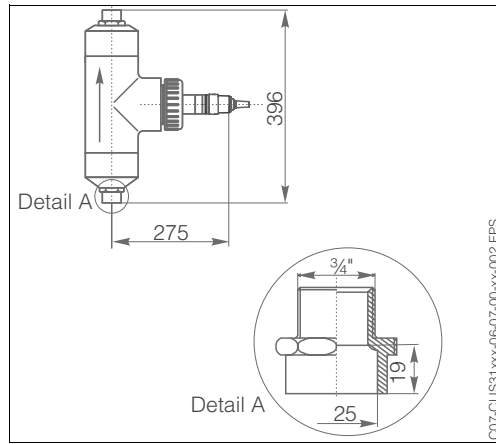
Parallel sensor orientation
 ↑ Medium flow direction



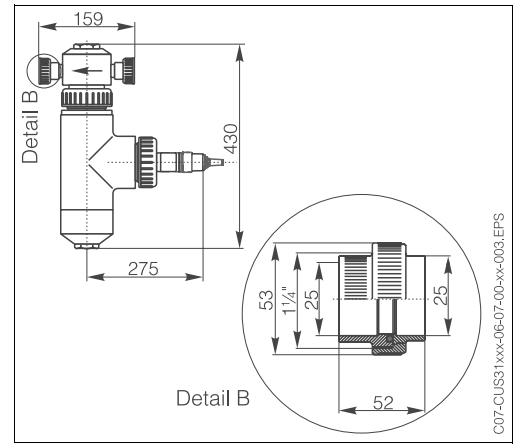
Sensor orientation against the medium flow

Use in the drinking water sector with specific calibration

When the CUS 31 sensor is ordered with assembly E or S, the sensor is **individually calibrated** in the factory with the assembly ordered. Therefore, no initial calibration on site is necessary.



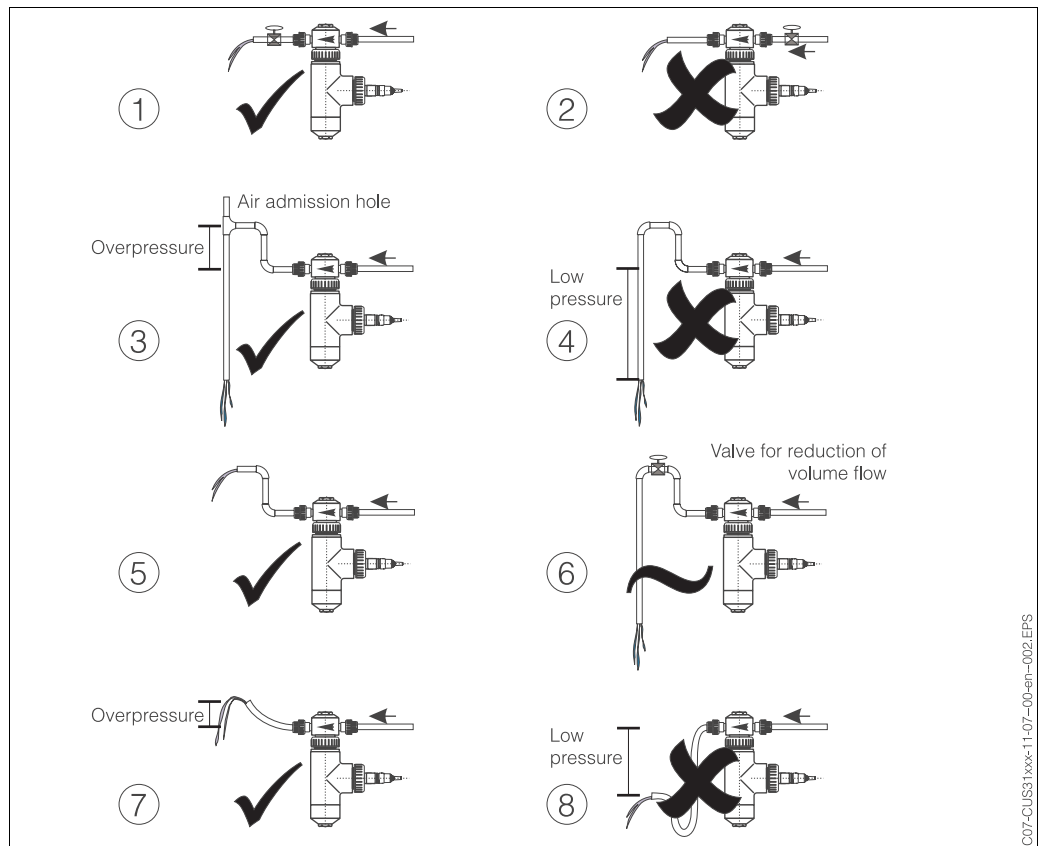
Flow assembly E
(without gas bubble trap)



Flow assembly S
(with gas bubble trap)

- In-flow and out-flow is vertical if **assembly E** is installed, (flow direction from bottom to top, see left-hand diagram), and horizontal if **assembly S** is installed (right-hand diagram).
- The inlet and outlet pipes (nominal diameter DN 20) are each glued into the PVC adhesive threaded joints. A wall support can be mounted if necessary.
- The minimum flow for assembly S is 50 l/h.

Recommended installation with assembly E or S



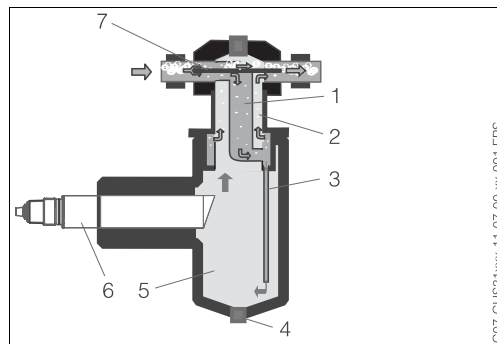
Permissible and impermissible sensor installation positions in flow assembly E or S

Gas bubble elimination

Conventional turbidity measurements are carried out in an unpressurised sample. When the pressure on a sample (which was pressurised beforehand) is released, fine bubbles are produced which distort the turbidity measurement.

There are several methods of eliminating these gas bubbles:

- Pressurised measurement in the bypass (pressure is not released until after the measurement).
- For measurements without overpressure or with slight overpressure:
Free medium flow above the assembly level. The mounting location should be as low as possible to take advantage of the maximum possible pressure.
- Unpressurised measurement and gas bubble elimination using wiper cleaning.
The wiping duration and interval can be programmed for optimum results.
- Reduction of the flow to the lowest possible value (50 l/h, CUS 31-xxS).
Slight flow prolongs the period in which the medium is in the assembly. This means that gas bubbles have more time to rise to the top. The sensor response time increases slightly due to the lower flow.
- Flow assembly S with integrated gas bubble trap (Figure below)
Most of the gas bubbles are sent directly to the assembly outlet in the upper half of the separated inlet (7). The other half of the medium flows into a ring channel (1) by means of the central pipe. The remaining bubbles rise here and are conveyed out of the measuring chamber by means of holes in the outlet (2) located in the centre of the assembly. Bubble-free medium (3) is pushed down into the measuring chamber (5). This also leads to a high flow which results in a quick response time. In addition, this almost completely prevents dirt particles settling.



- 1 Ring channel
- 2 Outlet from the measuring chamber
- 3 Bubble-free medium
- 4 Drain screw
- 5 Measuring chamber
- 6 CUS 31 sensor
- 7 Separated inlet

Flow assembly S with integrated gas bubble trap
(assembly S)

Performance characteristics

Maximum measured error < 5 % (min. 0.02 FNU) of the measured value
(system measured error related to the primary formazine standard / tracing according to ISO 5725 and ISO 7027 / EN 27027)

Repeatability < 1 % (min. 0.01 FNU) of the measured value

Operating conditions (environment)

Storage temperature -20 ... +60 °C

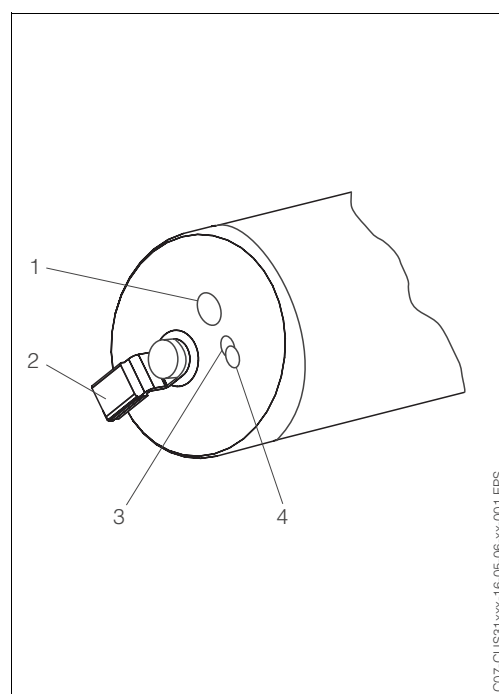
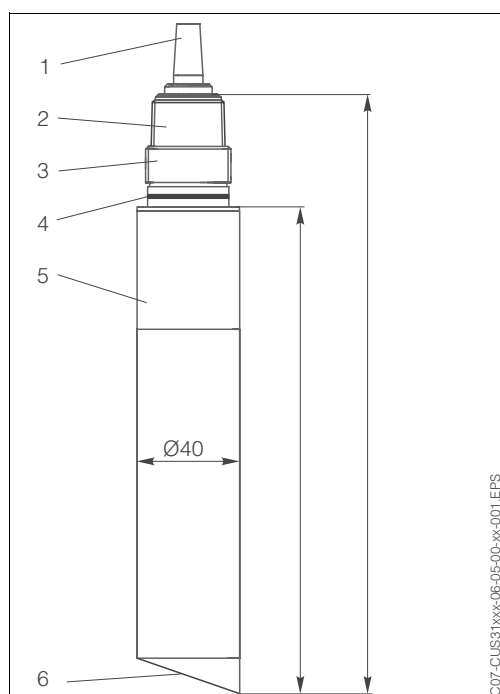
Ingress protection IP 68

Operating conditions (process)

Process temperature range	-5 ... +50 °C
Process pressure range (temperature-dependent)	1 bar (50 °C) ... 6 bar (25 °C)
Process connection	G1 and NPT ¾"

Mechanical construction

Design, dimensions



CUS 31 sensor

- 1 Fixed cable
- 2 NPT ¾" - thread
- 3 G1 - thread
- 4 O-ring
- 5 Sensor shaft
- 6 Sensor surface with optical windows

Sensor surface with optical windows

- 1 Photodiode (receiver diode)
- 2 Wiper (optional)
- 3 Photodiode (receiver diode)
- 4 LED (IR transmitter diode)

Wiper cleaning (optional)

The CUS 31-W sensor is equipped with a rubber wiper for removing deposits from the sensor carrier plate. The cleaning times and intervals are controlled by means of the transmitter (Liquisys M CUM 223/253).

Temperature sensor NTC-resistance 30K at 25 °C

Materials	Sensor carrier plate, shaft	PVC / PPS GF 40 (polyphenylene sulfide with 40 % glass-fibre)
	Optical windows	Sapphire
	Flow assemblies E and S	PVC
	Cable	TPEO -40 ... 130 °C (elastomer on polyolefine base)

Certificates and approvals

Quality certificate

Each sensor has an individual quality certificate with information on the sensor identification and calibration according to ISO 7027 / EN 27027.

The quality certificate is enclosed with each sensor in the packaging.

Ordering information

Product structure TurbiMax W CUS 31

Sensor	
A	Sensor in standard version
W	Sensor with integrated wiper

Cable length	
2	Connecting cable 7 m
4	Connecting cable 15 m
9	Connecting cable to customer's specifications

Assembly	
A	Without assembly
E	Assembly for bubble-free media
S	Assembly with integrated gas bubble elimination

CUS 31-				Complete order code
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