

Turbidity and Solids Content Sensor *TurbiMax W CUS 65*

Installation and immersion sensor for low, medium and high concentrations using the four-beam pulsed light method



Application

The TurbiMax W CUS 65 sensor is used for optical turbidity and solids content measurement. Due to various sensor heads the sensor is suitable for use from low to high concentration ranges.

- Wastewater clarification / sludge treatment
- Boiler feedwater monitoring
- Condensate monitoring
- Service water monitoring

Your benefits

- Four-beam pulsed light method for compensation of sensor soiling and wearing of optical components
- Sensor body made of stainless steel
- No mechanically moving parts, therefore no sensor blocking
- Measured value processing in sensor resulting in low signal transmission sensitivity
- Aeration systems do not affect measurement
- Plug system for quick commissioning



Function and system design

Measuring principle

Turbidity measurement

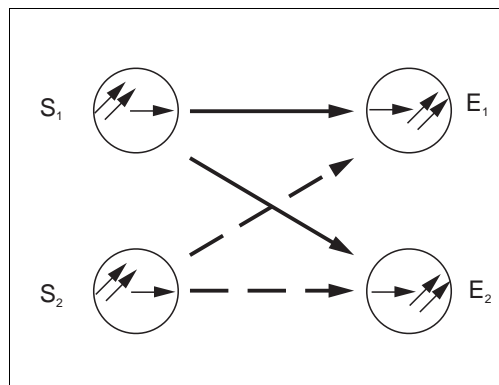
For turbidity measurement a light beam is sent through the medium and is diverted from its original direction by optically denser particles, e.g. solid matter particles.

Four-beam pulsed light method

The method is based on two light sources and two photo receivers. Long-life LEDs are used as monochromatic light sources. To eliminate interference from extraneous light sources, these LEDs are pulsed at a rate of several kHz.

Two measuring signals are detected at the two photo receivers. The four measuring signals are processed in the sensor and are converted into proportional frequencies. The transmitter assigns the frequencies to the appropriate turbidity units and solids concentrations.

The four-beam pulsed light method compensates the sensor soiling as well as the wearing of the optical components.



Four-beam pulsed light method

S = Light source
 E = Light receiver

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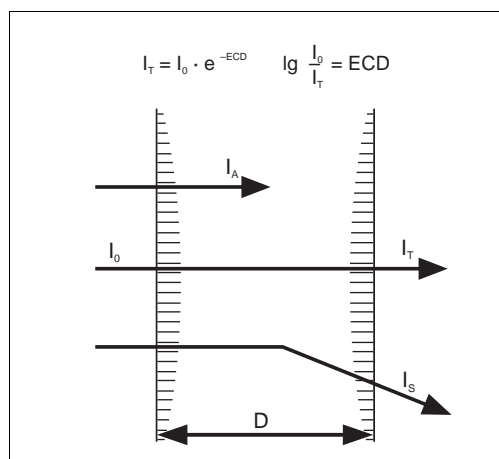
Measuring methods

Depending on the selected measuring range, the TurbiMax W CUS 65 sensor uses the absorption light method (CUS 65-A, -B, -C) or the scattered light method (CUS 65-D, -E).

Absorption light method

The measuring principle is based on the Lambert-Beer law. The turbidity of the medium is determined by the weakening of the light beam.

The sensor LEDs send a directed light beam to the light receivers. The light beam intensity is weakened by the solid matter particles in the medium.



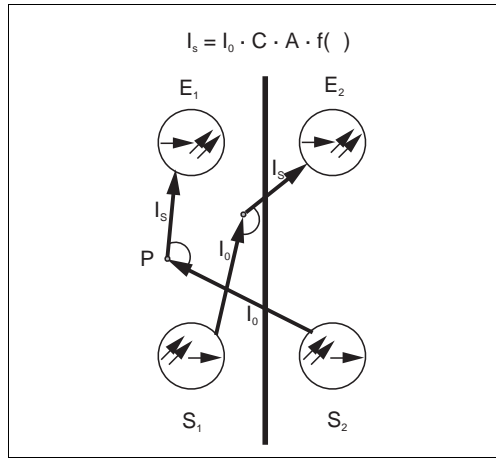
Absorption light method acc. to Lambert-Beer law

I_0 = Intensity of transmitted light
 I_A = Intensity of absorbed light
 I_T = Intensity of light transmitted
 I_S = Intensity of scattered light
 E = Extinction coefficient
 C = Concentration
 D = Optical path length

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90° scattered light method

The measurement uses the standardised 90° scattered light method acc. to ISO 7027 / EN 27027. The turbidity of the medium is determined by the amount of scattered light. The transmitted light beam is scattered by the solid matter particles in the medium. The scattered beams are detected by scattered light receivers which are arranged at an angle of 90 ° to the light sources.

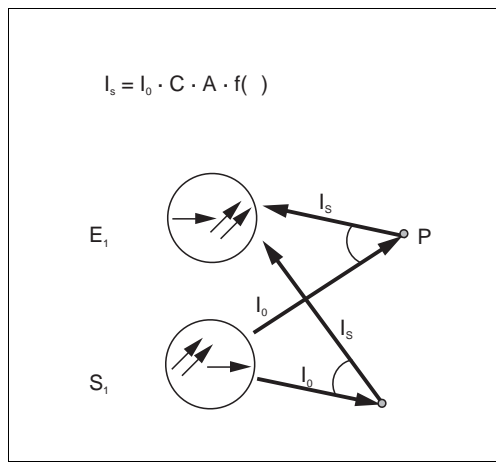


90° scattered light method

- I_0 = Intensity of transmitted light
- I_s = Intensity of scattered light
- A = Geometrical factor
- C = Concentration
- P = Particle
- $f(\alpha)$ = Angle correlation

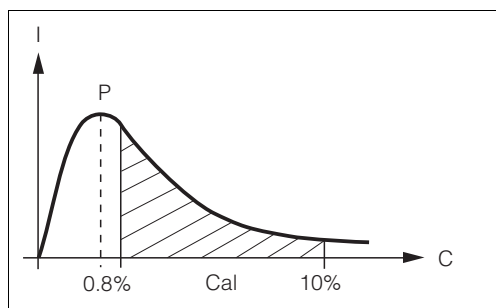
Backscattered light method

The measurement uses the backscattered light method. The turbidity of the medium is determined by the amount of backscattered light. The transmitted light beam is scattered by the solid matter particles in the medium. The backscattered beams are detected by scattered light receivers, which are arranged next to the light sources.



Backscattered light method

- I_0 = Intensity of transmitted light
- I_s = Intensity of scattered light
- A = Geometrical factor
- C = Concentration
- P = Particle
- $f(\alpha)$ = Angle correlation



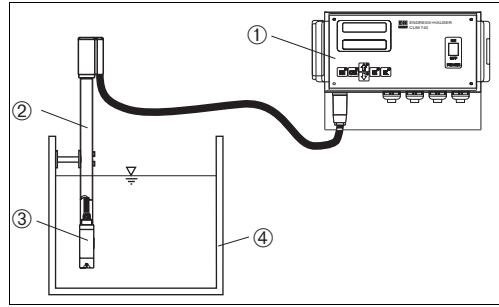
Note: The CUS 65-E sensor has a reversal point at approx. 0.8% of solid matter (as dry substance) and can thus not be calibrated with water. Therefore only use the sensor starting from a concentration > 10 g/l.

- I = Intensity of transmitted light
- C = Concentration
- P = Reversal point
- Cal = Calibration range

Measuring system

A complete measuring system comprises:

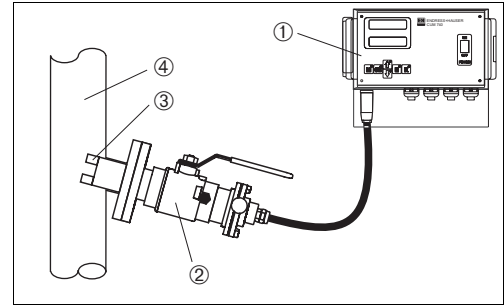
- Turbidity transmitter CUM 740
- Turbidity sensor TurbiMax W CUS 65
- Immersion pipe CYY 105 or
- Retractable assembly CleanFit CUA 451
- Extension cable (optional)
- Junction box (optional)



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Example for a measuring system CUS 65 with immersion pipe CYY 105

- 1 Turbidity transmitter CUM 740
- 2 Immersion pipe CYY 105
- 3 Turbidity sensor TurbiMax W CUS 65-C
- 4 Basin or channel



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Example for a measuring system CUS 65 with retractable assembly CleanFit CUA 451

- 1 Turbidity sensor CUM 740
- 2 Retractable assembly CleanFit CUA 451
- 3 Turbidity sensor TurbiMax W CUS 65-A
- 4 Pipe

Input

Measured variables

Turbidity
Solids content

Measuring ranges

0 ... 12 g/l (ppm)	Activated sludge, centrate
0 ... 40 g/l (ppm)	Return sludge
0 ... 50 g/l (ppm)	Primary sludge, digested sludge
1 ... 1000 FNU	Wastewater outlet, service water, condensate, boiler feedwater
10 ... 150 g/l (ppm)	Centrifuge inlet, press inlet

Performance characteristics

Measuring light

Infrared light at 880 nm

Reference

by four-beam pulsed light method

Measured error

< 1% of measuring range end

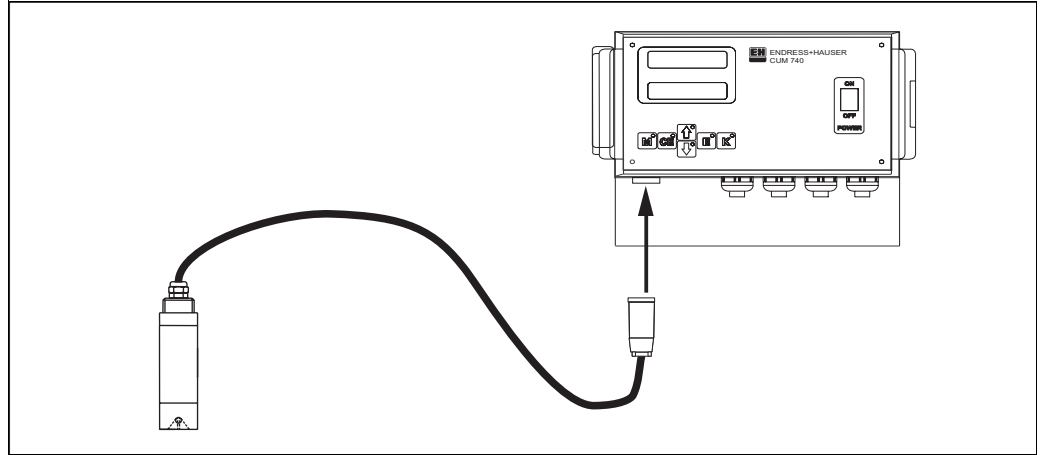
Factory calibration

SiO ₂	CUS 65-A, -B, -C, -E
Formazine acc. to ISO 7027 / EN 27027	CUS 65-D

Electrical connection

Cable connection

The CUS 65 sensor is connected to the CUM 740 transmitter by the sensor cable with SXP plug. Simply plug the SXP plug into the socket of the transmitter. The extension cables (version CUS 65-xxx3) are also terminated with SXP plugs ex factory.



Cable connection CUS 65

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Cable lengths

15m / 49.2 ft
 7m / 23.0 ft
 1m / 3.3 ft + 10m / 32.8 ft extension cable
 max. cable length: 200m / 656.2 ft

recommended for immersion
 recommended for immersion
 recommended for installation
 cable diameter up to 50m / 164.1 ft: 5 x 0.35 mm²
 cable diameter up to 100m / 328.1 ft: 5 x 0.5 mm²
 cable diameter up to 200m / 656.2 ft: 5 x 1.0 mm²

Installation

Installation instructions

You can install the CUS 65 sensor in two different ways:
 Installation with retractable assembly CUA 451 and installation with immersion pipe CYY 105.



Note!

- Observe the required mounting clearance for the installation mode selected. Installing the sensor in pipes or close to a wall can lead to backscattering resulting in signal increase, mainly with measurements in low turbidity ranges (<100 FNU).
- Make sure the sensor is completely immersed at changing water levels.

Installation

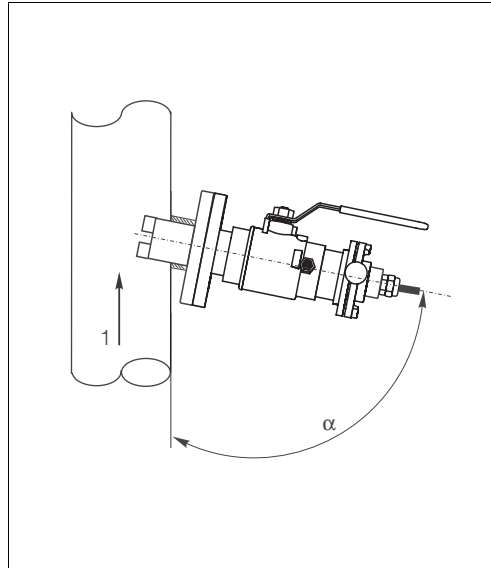
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- Make sure the sensor is completely immersed at changing water levels.

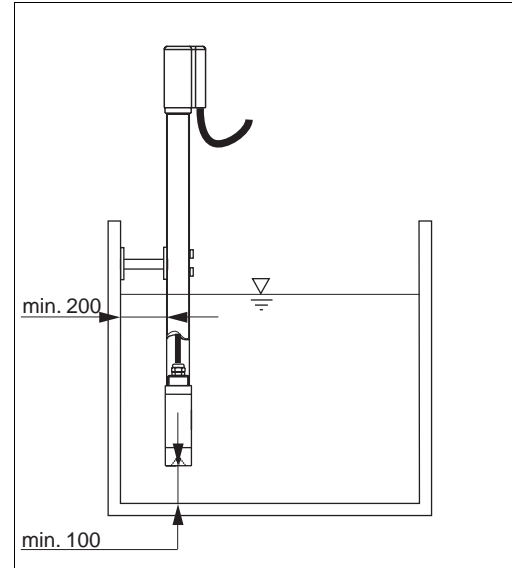


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Mounting of CUS 65 sensor with CUA 451 assembly

The arrow shows the flow direction of the medium
Installation angle α dependent on sensor version:

CUS 65-A	$\alpha = 80^\circ$ from pipe wall
CUS 65-B	$\alpha = 90^\circ$ from pipe wall
CUS 65-C, E	$\alpha = 100^\circ$ from pipe wall
CUS 65-D	$\alpha = 110^\circ$ from pipe wall



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Mounting of CUS 65 sensor with CYY 105 immersion pipe

Minimum wall distance:	20 cm / 7.9"
Minimum ground distance:	10 cm / 3.9"
Immersion pipe angles:	
CUS 65-A	45°
CUS 65-D	90°
CUS 65-B, -C, -E	180° (straight)

Environment

Ambient temperature -20 ... +60 °C / 68 ... 140 °F

Storage temperature -20 ... +60 °C / 68 ... 140 °F

Relative humidity 5 ... 95 %

Ingress protection IP 68 / NEMA 6

Process

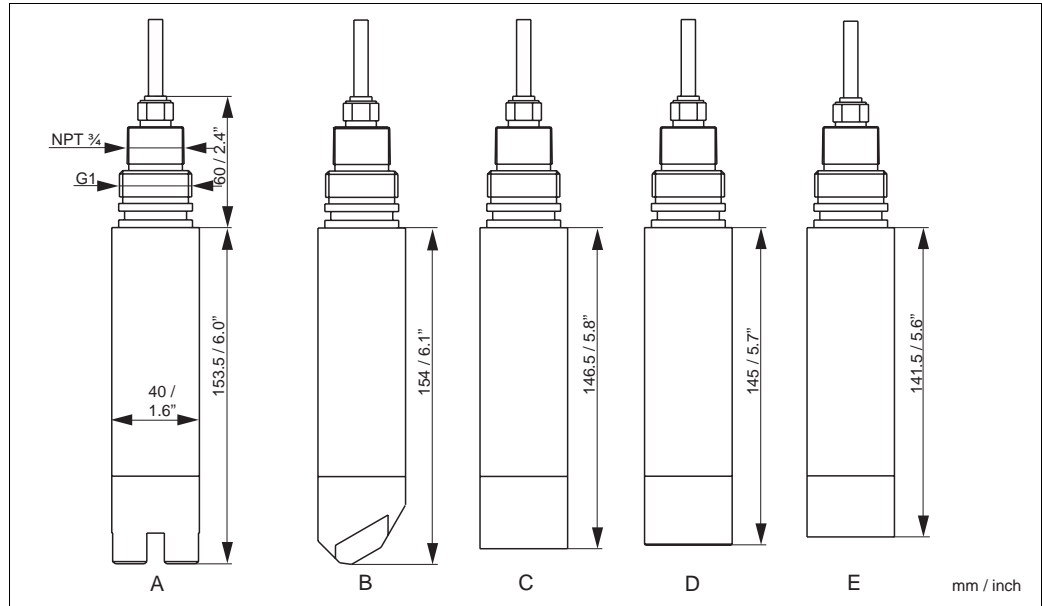
Process temperature 0 ... +50 °C / 32 ... 122 °F

Process pressure max. 6 bar / 87 psi

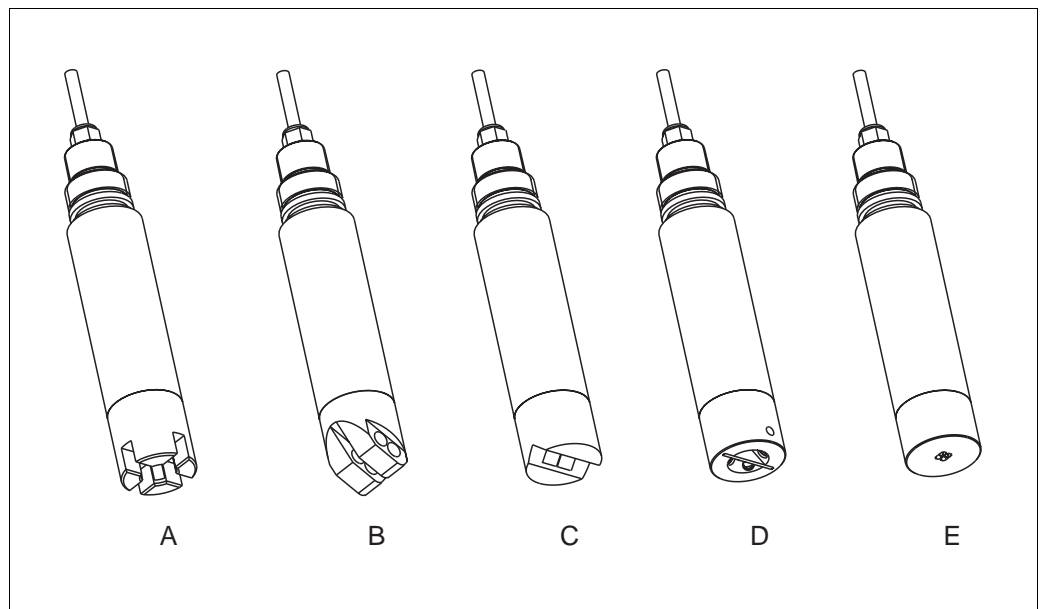
Flow no minimum flow required
Make sure that there is a sufficient turbulence for solids with a tendency to sedimentation.

Mechanical construction

Design, dimensions



TurbiMax W CUS 65: Dimensions of sensor versions (versions see Ordering Information)



TurbiMax W CUS 65: View of measuring surface (versions see Ordering Information)

Weight

approx. 1 kg / 2.2 lb.

Materials in contact with medium

Sensor	Stainless steel 1.4404 (AISI 316L)
Optical windows	CUS 65-A, -C, -E: Epoxy resin CUS 65-B, -D: Polyoxymethylene (POM)
O-rings	Viton®

Ordering information

Product structure
TurbiMax W CUS 65

		Measuring range / Application	
	A	0 ... 12 g/l (ppm):	Activated sludge, centrate
	B	0 ... 40 g/l (ppm):	Return sludge
	C	0 ... 50 g/l (ppm):	Primary sludge, digested sludge
	D	1 ... 1000 FNU:	Wastewater effluent, service water, condensate, boiler feedwater
	E	10 ... 150 g/l (ppm):	Centrifuge inlet, press inlet
		Certificates	
	1	Factory calibration certificate	
		Process connection	
	A	Process connection G1 + NPT 3/4 thread	
	Y	Special version acc. to customer specification	
		Connecting cable	
	1	Connecting cable 7m / 23.0 ft, SXP plug	
	2	Connecting cable 15m / 49.2 ft, SXP plug	
	3	Connecting cable 1m / 3.3 ft + extension cable 10m / 32.8 ft, both with SXP plug	
		Seal	
	A	Viton	
	Y	Special version acc. to customer specification	
CUS 65-			complete order code

Scope of delivery

Scope of delivery

The scope of delivery comprises:

- 1 CUS 65 sensor, cable length depending on version
- 1 extension cable (only version CUS 65-xxx3)
- 1 Quality Certificate
- 1 Technical Information TI 370C/07/en

Accessories

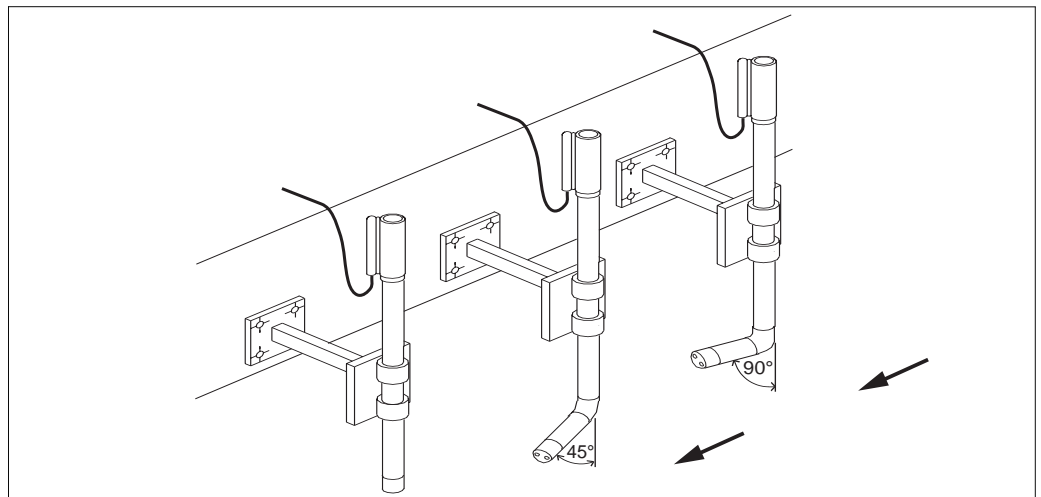
Immersion pipes

Immersion pipe CYY 105

- Immersion pipe for sensor immersion in basins. Material: stainless steel 1.4404 (AISI 316L) (pipe), stainless steel 1.4571 (AISI 316Ti) (fitting).

Version	
A	Length 2.0m / 6.6 ft, straight (CUS 65-B, -C, -E)
B	Length 3.5m / 11.5 ft, straight (CUS 65-B, -C, -E)
C	Length 2.0m / 6.6 ft, 45° angle (CUS 65-A)
D	Length 3.5m / 11.5 ft, 45° angle (CUS 65-A)
E	Length 2.0m / 6.6 ft, 90° angle (CUS 65-D)
F	Length 3.5m / 11.5 ft, 90° angle (CUS 65-D)

CYY105-	complete order code
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Immersion pipe CYY 105: straight, 45° angle, 90° angle
The arrows show the flow direction.

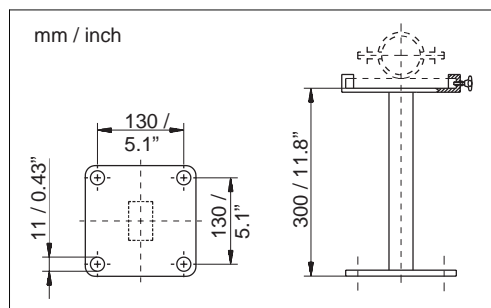
Attachment

Wall attachment for immersion pipes

- Wall attachment for immersion pipe attachment to basins or channels. Material: stainless steel 1.4301 (AISI 304)
Order No.: 51503581

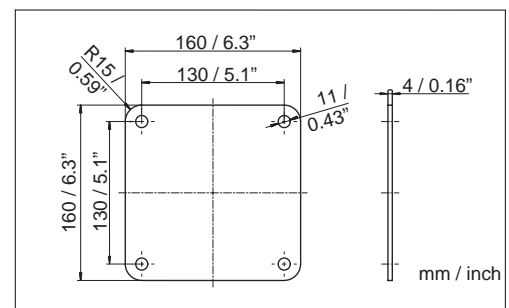
Counter plate

- Counter plate to fix the immersion pipe attachment. Material: stainless steel 1.4301 (AISI 304).
Order No.: 51512992



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Wall attachment



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Counter plate

Measuring and monitoring

Transmitter

- CUM 740
Transmitter for turbidity and solids content measurement
see Technical Information

Assemblies

Installation assembly

- CleanFit CUA 451
Retractable assembly with ball valve for pipe installation
Material: stainless steel 1.4404 (AISI 316L)
see Technical Information

Connection accessories

Extension cable

- Extension cable length 10m / 32.8 ft, shielded, with SXP plug and SXX coupling.
Ingress protection IP 67.
Order No.: 51503633

Plugs

- SXP plug, 7-pole
Order No.: 51504027
- SXX coupling, 7-pole
Order No.: 51504025

Junction box

- Junction box for extension of cable connection between sensor and instrument. Sensor cable input SXB socket, cable output Pg 11 cable gland. Material: Makrolon®. Ingress protection IP 67.
Order No.: 51503632

Supplementary documentation

- CUM 740, Technical Information TI 232C/07/en; Order No. 51504297
- CleanFit CUA 451, Technical Information TI 396C/07/en; Order No. 51512836

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