# Technical Information
# Memosens COS81E

Hygienic optical oxygen sensor with maximum measurement stability over multiple sterilization cycles

## Digital with Memosens 2.0 technology

### Application

Typical applications include:
- Oxygen control in fermenters, e.g. in the pharmaceutical or biotechnology sectors
- Quality control in the food industry
- Reliable monitoring of explosive atmospheres up to an $O_2$ concentration of $\geq 2\%$

With ATEX, IECEx, CSA C/US, NEPSI, JapanEx and INMETRO approval for use in hazardous areas Zone 0, Zone 1 and Zone 2 in the hazardous gas environment, and Zone 20, Zone 21 and Zone 22 in the hazardous dust environment

With CSA C/US approval also in hazardous areas Class I Division 1 in the hazardous gas environment, and Class II Division 1 in the hazardous dust environment

### Your benefits

- Accurate measurements with longterm stability and permanent self-monitoring
- Can be sterilized up to 140 °C (284 °F) and autoclavable
- Stainless steel 1.4435 (AISI 316L) meets the highest demands of the pharmaceutical industry
- IP68 protection
- Sensor certified in accordance with EHEDG
- Complies with the relevant sections of the ASME-BPE
- Available with a certificate of conformity for pharmaceutical requirements
- Available with inspection certificate EN 10204-3.1
- Materials compliant with FDA and/or USP class VI specifications

### Other advantages provided by Memosens technology

- Maximum process safety
- Data security thanks to digital data transmission
- Very easy to use as sensor data are saved in the sensor
- Predictive maintenance can be performed by recording sensor load data in the sensor

Endress+Hauser

People for Process Automation

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# Function and system design

| Measuring principle | **Sensor structure** |
|---|---|

**Sensor structure**
Oxygen-sensitive molecules (markers) are integrated into the optically active layer(luminescence layer).
The luminescence layer, an optical insulating layer and a cover layer are applied on top of one another on the carrier. The cover layer is in direct contact with the medium.
The sensor optics are directed at the rear of the carrier and therefore at the luminescence layer.

**Measurement process (principle of luminescence quenching)**

If the sensor is immersed in the medium, an equilibrium is very quickly established between the oxygen partial pressure in both the medium and the luminescence layer.

1. The sensor optics send orange light pulses to the luminescence layer.
2. The markers "respond" (luminesce) with darkred light pulses.
   ↳ The decay time and intensity of the response signals are directly dependent on the oxygen contents and oxygen partial pressure.

If the medium is free from oxygen, the decay time is long and the signal is very intense.

Any oxygen molecules present mask the marker molecules. As a result, the decay time is shorter and the signals are less intense.

**Measurement result**

▸ The sensor calculates the measurement result on the basis of the signal intensity and decay time using the Stern-Volmer equation.

The sensor provides measured values for temperature and partial pressure as well as a raw measured value. This value corresponds to the luminescence decay time and is approx. 14 µs in air and approx. 56 µs in oxygen-free media.

**For optimum measurement results**

1. During calibration, enter the current air pressure at the transmitter.
2. If the measurement is not performed at **Air 100% rh**:
   Enter the current humidity.
3. In the case of media with high salinity:
   Enter the salinity.
4. For measurements in the units %Vol or %SAT:
   Also enter the current operating pressure in the measuring mode.

   📖 ▪ Operating Instructions for Memosens, BA01245C
   For all transmitters, analyzers and samplers in the Liquiline CM44x/P/R, Liquiline System CA80XX and Liquistation CSFxx product families
   ▪ Operating Instructions for Liquiline CM42, BA00381C and BA00382C

| Measuring system | A complete measuring system comprises: |
|---|---|

A complete measuring system comprises:
- a Memosens COS81E oxygen sensor
- Measuring cable CYK10
- A transmitter, e.g. Liquiline CM42, Liquiline CM44x/R, Liquiline CM44P, Liquiline Compact CM72/82, Liquiline Mobile CML18
- Optional: an assembly, e.g. Unifit CPA842 fixed installation assembly , Flowfit CYA21 flow assembly or Cleanfit CPA875 retractable assembly
- Optional: connection to an analog fermenter controller via the Memosens analog converter CYM17
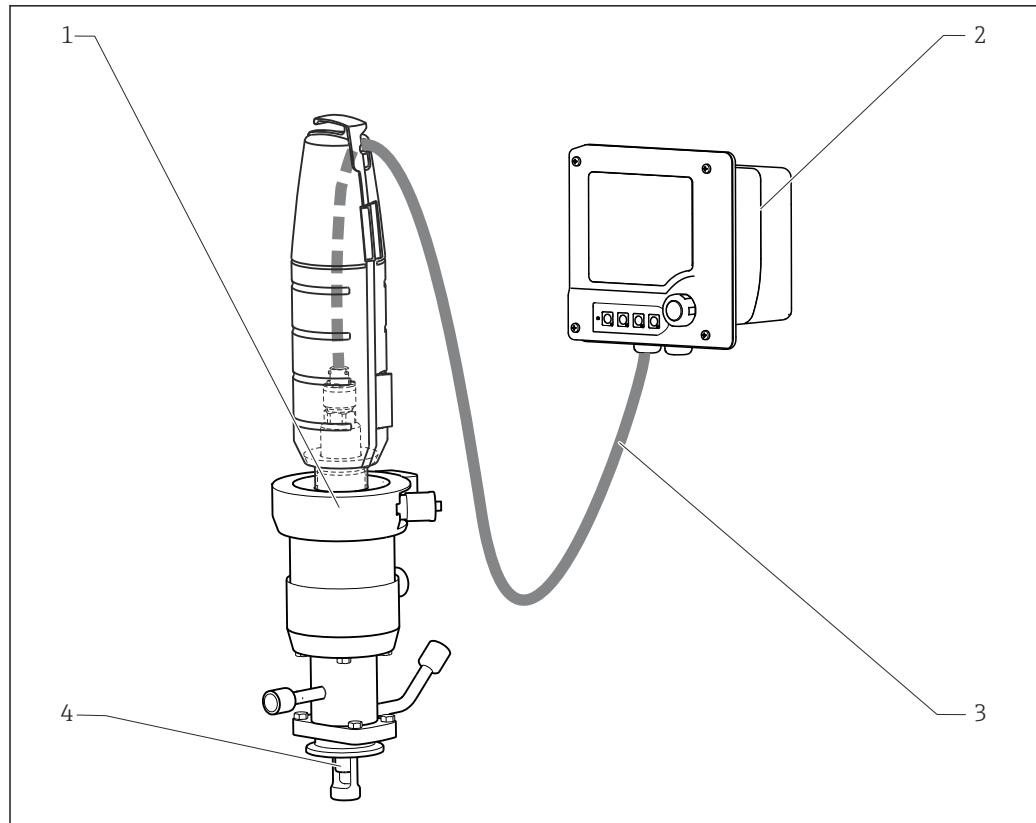
*☒ 1* *Example of a measuring system with Memosens COS81E*

*1* *Retractable assembly Cleanfit CPA875*
*2* *Liquiline CM42 transmitter*
*3* *Measuring cable CYK10*
*4* *Oxygen sensor Memosens COS81E*

# Dependability

**Reliability**

Memosens technology digitizes the measured values in the sensor and transmits the data to the transmitter via a . The result:
• If the sensor fails or there is an interruption in the connection between the sensor and transmitter, this is reliably detected and reported.
• The availability of the measuring point is reliably detected and reported.

**Maintainability**

**Easy handling**
Sensors with Memosens technology have integrated electronics that store calibration data and other information (e.g. total hours of operation or operating hours under extreme measuring conditions). Once the sensor has been connected, the sensor data are transferred automatically to the transmitter and used to calculate the current measured value. As the calibration data are stored in the sensor, the sensor can be calibrated and adjusted independently of the measuring point. The result:
• Easy calibration in the measuring lab under optimum external conditions increases the quality of the calibration.
• Pre-calibrated sensors can be replaced quickly and easily, resulting in a dramatic increase in the availability of the measuring point.
• Thanks to the availability of the sensor data, maintenance intervals can be accurately defined and predictive maintenance is possible.
• The sensor history can be documented with external data carriers and evaluation programs.
• Thus, the current application of the sensors can be made to depend on their previous history.

| Integrity | With inductive transmission of the measured value using a non-contact connection, Memosens guarantees maximum process safety and offers the following benefits:
• All problems caused by moisture are eliminated.
  • Plug-in connection remains free from corrosion
  • Measured value distortion from moisture is not possible.
  • The plug-in system can even be connected under water.
• The transmitter is galvanically decoupled from the medium.
• EMC safety is guaranteed by screening measures for the digital transmission of measured values. |

# Input

| Measured variables | Dissolved oxygen [mg/l, µg/l, ppm, ppb or %SAT or hPa]
Oxygen (gaseous) [hPa or %Vol]
Temperature [°C, °F] |

| Measuring ranges | Measuring ranges apply for 25 °C (77 °F) and 1013 hPa (15 psi) |

| c-shaped | u-shaped |
|---|---|
| 0.004 to 26 mg/l<br>0.05 to 285 % SAT<br>0.1 to 600 hPa | 0.004 to 30 mg/l<br>0.05 to 330 % SAT<br>0.1 to 700 hPa |

The sensor has an operational range up to 1000 hPa.

The measured errors indicated are reached in the measuring range, but not over the entire operational range.

# Power supply

| Electrical connection | The electrical connection of the sensor to the transmitter is established using measuring cable CYK10. |



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GY   GND
YE   Com B
GN   Com A
WH   –
BN   +
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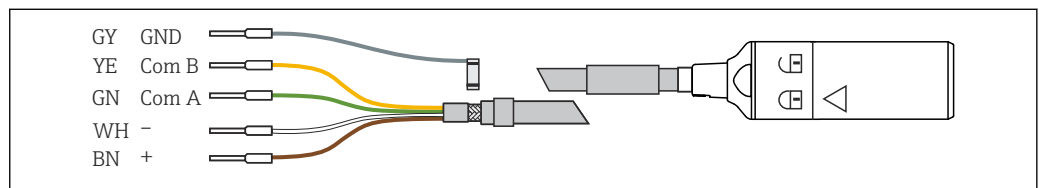
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🔲 *2    Measuring cable CYK10*

# Performance characteristics

| Response time | From air to nitrogen at reference operating conditions:
• $t_{90}$ : < 10 s
• $t_{98}$ : < 20 s |

| Reference operating conditions | Reference temperature: | 25 °C (77 °F) |
|---|---|---|
| | Reference pressure: | 1013 hPa (15 psi) |

| Maximum measured error [1] | ±1 % or ±8 µg/l (ppb) of the measured value (the higher value is relevant in each case) |

| LOD (limit of detection) | LOQ (limit of quantification) |
|---|---|
| 4ppb | 10ppb |

| Repeatability | 2ppb |

# Installation

| Mounting instructions | Must be installed in a suitable assembly (depending on the application). |

**NOTICE**

**Installing the unit without an assembly carries the risk of cable breakage or sensor loss!**

▸ Do not install the sensor freely suspended from the cable!

| Orientation | **COS81E-*****C*** (c-shaped)** |
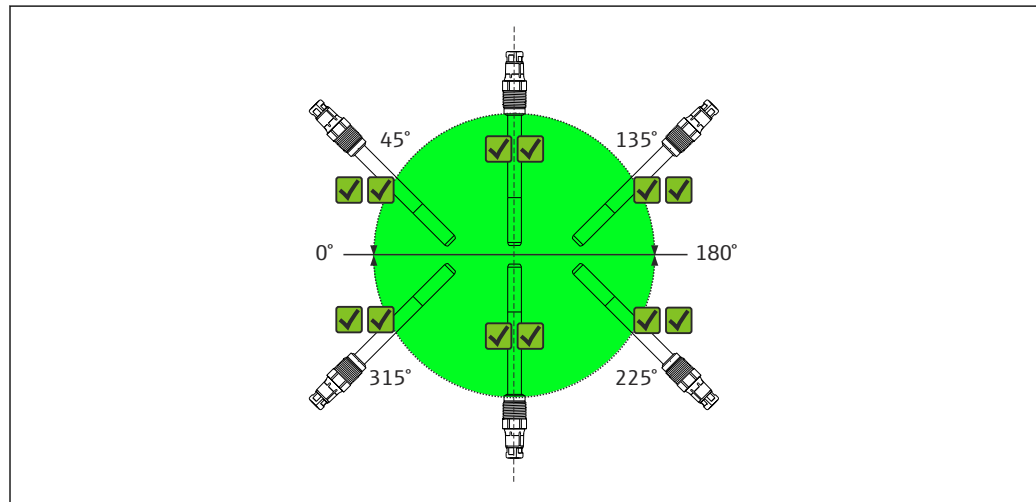


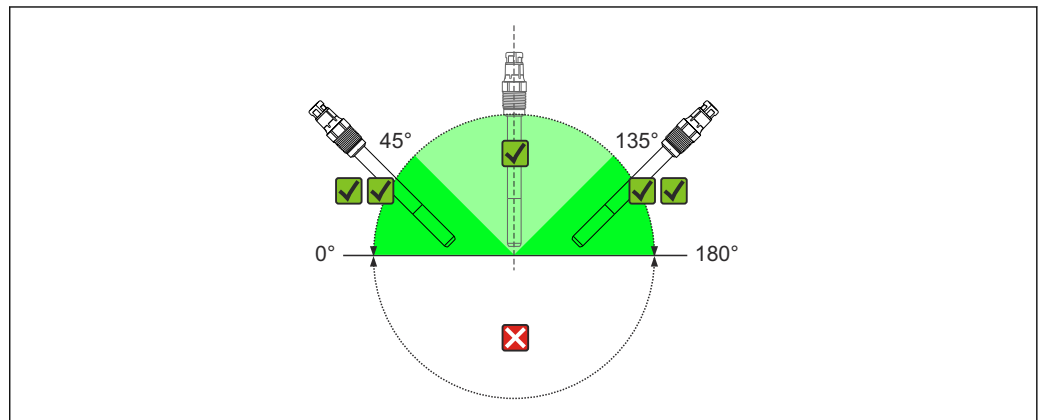*3 Installation angle for Memosens COS81E-*****C*** (c-shaped spot cap)*

*The sensor can be installed at any installation angle (0 to 360 °).*

✓✓ *Recommended installation angle*

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1) In accordance with IEC 60746-1 at rated operating conditions

The sensor with the c-shaped spot cap is self-draining in the recommended installation angles and can therefore be used for hygienic applications.

**COS81E-*****U*** (u-shaped)**



🖼 4    *Installation angle for Memosens COS81E-*****U*** (u-shaped spot cap)*

✓✓    *Recommended installation angle*

✓    *Possible installation angle*

✗    *Inadmissible installation angle*

The sensor with the u-shaped spot cap must be installed at an angle of inclination of 0 to 180° in an assembly, holder or a corresponding process connection. Recommended angle: 0 to 45° or 135 to 180° to prevent the attachment of air bubbles. At angles of inclination of 45 to 135°, air bubbles at the oxygen-sensitive membrane may increase the measured value.

Inclination angles other than those mentioned are not permitted. In order to avoid buildup and condensation on the spot, do **not** install the COS81E-*****U *** sensor upside down.

Follow the instructions for installing sensors in the Operating Instructions for the assembly used.

# Installation examples

**Permanent installation assembly Unifit CPA842**

The permanent installation assembly CPA842 enables easy adaptation of a sensor to nearly any process connections from Ingold nozzles to Varivent or Tri-Clamp connections. This kind of installation is very well suited for tanks and larger pipes. This enables a defined immersion depth of the sensor into the medium in the simplest way.
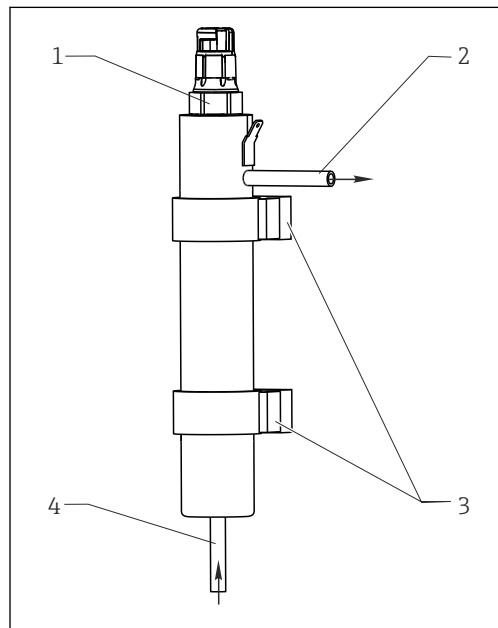
**Flow assembly CYA680**

The flow assembly is available in various nominal diameters and materials. It can be installed both in horizontal and vertical pipes. The assembly can be operated with 1 or 2 sensors.
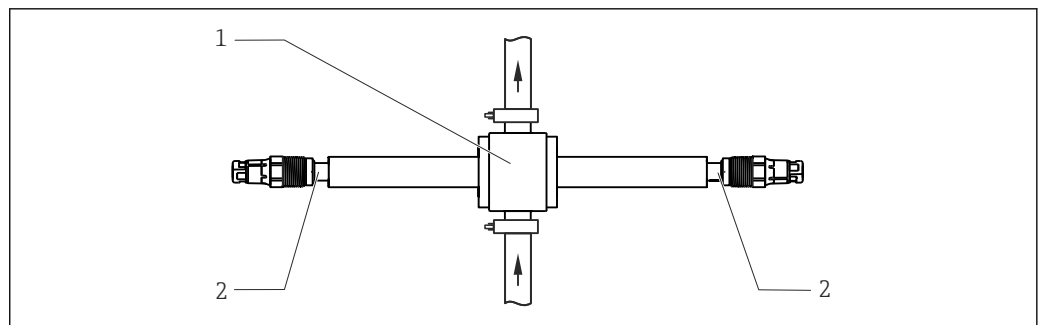


🖼 5    *Flow assembly CYA680*

*1    Flow chamber of assembly*
*2    Installed sensor Memosens COS81E*

**Flow assembly Flowfit CYA21 for water treatment and processes**

The compact stainless steel assembly offers space for a 12-mm sensor with a length of 120 mm. The assembly has a low sampling volume and, with the 6-mm connections, it is best suited for residual oxygen measurement in water treatments and boiler feedwater. The flow comes from below.



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🖼 *6      Flow assembly*

*1      Installed sensor Memosens COS81E*
*2      Drain*
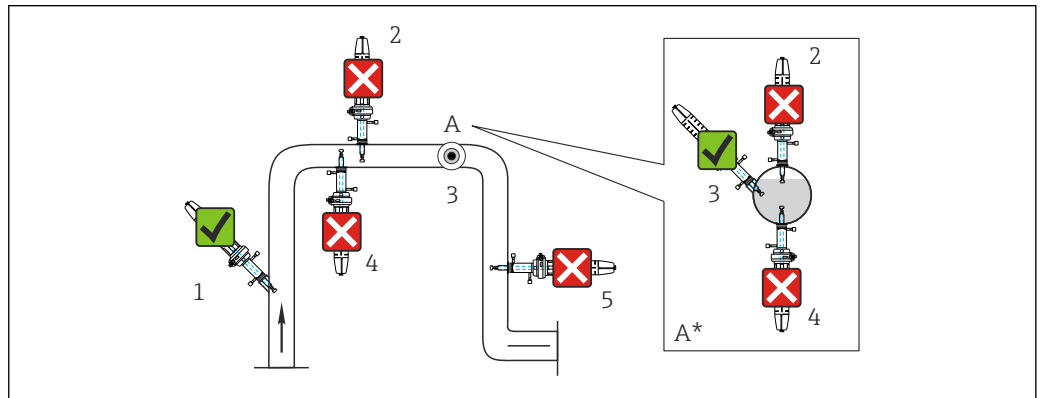*3      Wall mount (clamp D29)*
*4      Inflow*

**Retractable assembly Cleanfit CPA875 or Cleanfit CPA450**

The assembly is designed for installation on vessels and pipes. Suitable nozzles must be available for this.

Install the assembly in a place with uniform flow conditions. The minimum pipe diameter is DN 80.
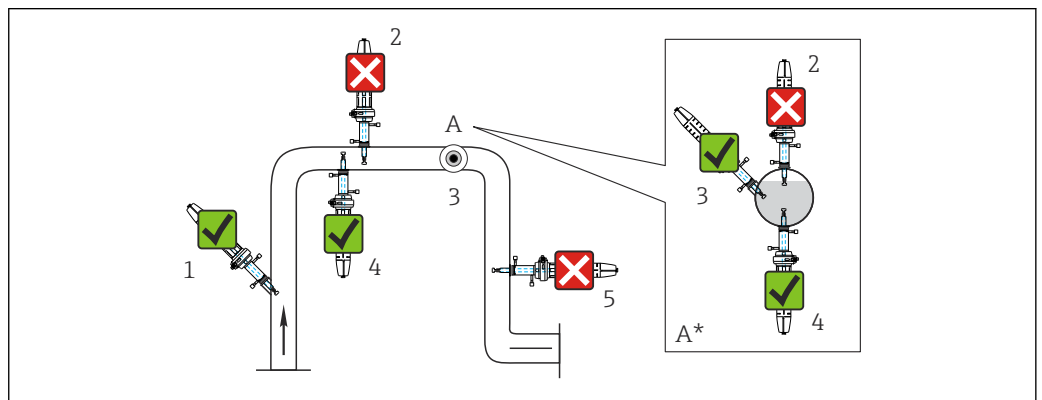
Installation position for COS81E-****U*** (with u-shaped spot cap)



🖼 *7   Suitable and unsuitable installation positions for Memosens COS81E with u-shaped spot cap and retractable assembly*

*1   Ascending pipe, best position*
*2   Horizontal pipe, sensor top down, impermissible due to air cushion or foam bubble forming*
*3   Horizontal pipe, lateral installation, with suitable installation angle*
*4   Upside-down installation, unsuitable*
*5   Down pipe, impermissible*
*A   Detail A (top view)*
*A*  Detail A, turned by 90° (side view)*

☑   *Possible installation angle*

☒   *Inadmissible installation angle*

Installation position for COS81E-****C*** (with c-shaped spot cap)



🖼 *8   Suitable and unsuitable installation positions for Memosens COS81E with c-shaped spot cap and retractable assembly*

*1   Ascending pipe, best position*
*2   Horizontal pipe, sensor top down, impermissible due to air cushion or foam bubble forming*
*3   Horizontal pipe, lateral installation with permissible installation angle (acc. to sensor version)*
*4   Upside-down installation, only in conjunction with c-shaped spot cap*
*5   Down pipe, impermissible*

☑   *Possible installation angle*

☒   *Inadmissible installation angle*

**NOTICE**

**Sensor not in the medium all the way, buildup, upside-down installation**
These can all cause incorrect measurements!
▸ Do not install assembly at points where air pockets or bubbles may form.
▸ Avoid or regularly remove buildup on the spot cap.
▸ Do not install the sensor COS81E-****U (u-shaped) upside down.

# Environment

| | |
|---|---|
| **Ambient temperature range** | −5 to +100 °C (23 to 212 °F) |
| **Storage temperature range** | -25 to 50 °C (77 to 120 °F) <br> at 95% relative air humidity, non-condensing |
| **Degree of protection** | IP68 <br> IP69 |

# Process

**Process temperature range**

| Sensor | Min. and max. process temperature | Permanent process temperature |
|---|---|---|
| COS81E-****1* (EPDM) | -10 to +140 °C (15 to 280 °F) | |
| COS81E-****3* (FFKM) | 0 to +140 °C (32 to 280 °F) | |
| COS81E-**C*** (c-shaped) | | 0 to 60 °C (32 to 140 °F) |
| COS81E-**U*** (u-shaped) | | 0 to 80 °C (32 to 175 °F) |

**Process pressure range**  0.02 to 13 bar (0 to 190 psi) abs.

**Temperature/pressure ratings**
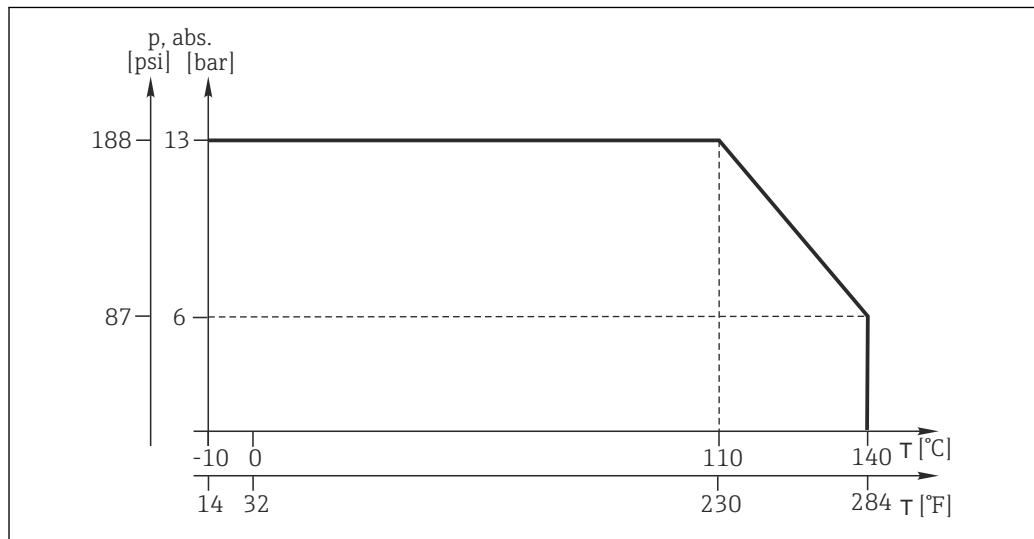


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**Chemical resistance**

> **NOTICE**
>
> **Halogen-containing solvents, ketones and toluene**
> Halogen-containing solvents (dichloromethane, chloroform), ketones (e.g. acetone, pentanone) and toluene have a cross-sensitive effect and result in decreased measured values or, at worst, in the complete failure of the sensor!
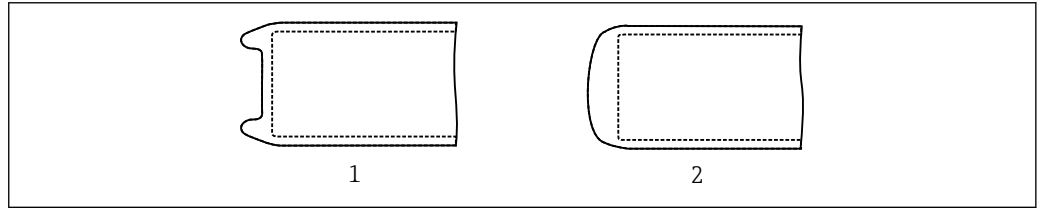> ▶ Use the sensor only in media that are free from halogens, ketones and toluene.

**CIP compatibility**  Yes

**Autoclavability**  Yes, max. 140 °C (284 °F)

# Mechanical construction

**Design**

The sensor's spot cap can have either a c-shaped or u-shaped design.



*🖾 9    Design of spot cap*

*1    u-shaped*
*2    c-shaped*
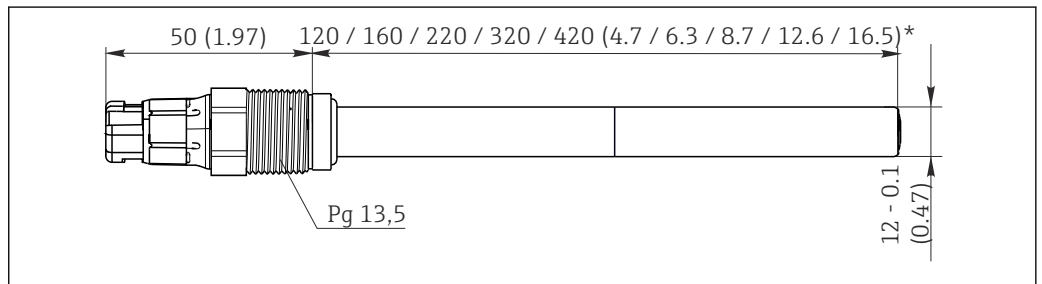
**Dimensions**



*🖾 10    Dimensions in mm (inch)*

**Optional flow assembly CYA21 for sensors with Ø 12 mm (accessories)**



*🖾 11    Dimensions in mm (inch)*

**Weight**

Depending on the design (length)
Example: 0.1 kg (0.20 lbs) for version with 120 mm length

**Materials**

**Parts in contact with medium**

| | |
|---|---|
| Sensor shaft | Stainless steel 1.4435 (AISI 316L) |

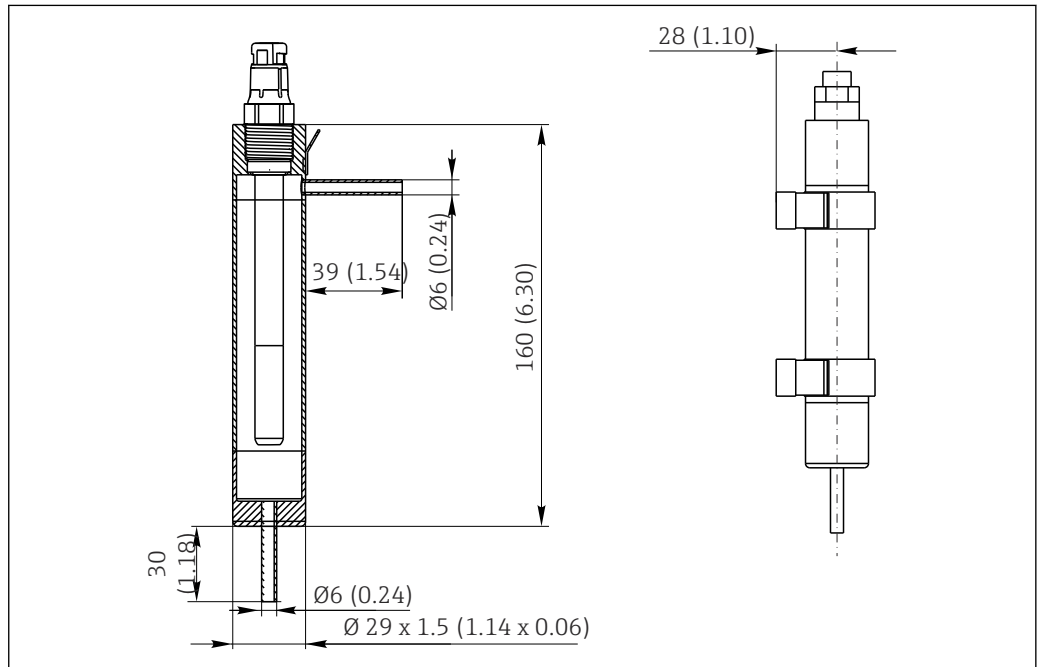|  | Process seal | FKM (USP<87>, <88> Class VI and FDA) |
|---|---|---|
|  | Process seal for Ex versions | FKM (not FDA-compliant) |
|  | Seals/O-rings | EPDM, FFKM (USP<87>, <88> Class VI and FDA) |
|  | Spot cap | Stainless steel 1.4435 (AISI 316L) or titanium or Hastelloy |
|  | Spot layer | Silicone (USP<87>, <88> Class VI and FDA) |

| **Process connection** | Pg 13.5<br>Torque max. 3 Nm |
|---|---|

| **Surface roughness** | $R_a$ < 0.38 μm |
|---|---|

| **Temperature sensor** | Pt1000 (Class A according to DIN IEC 60751) |
|---|---|

# Certificates and approvals

ℹ️ Certificates and approvals are optional, i.e. they depend on the product version.

| **C€ mark** | 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 C€ mark. |
|---|---|

| **Ex approvals** | **COS81E-BG**<br>ATEX II 1G Ex ia op is IIC T6... T3 Ga |
|---|---|
|  | **COS81E-B4**<br>ATEX II 1G Ex ia op is IIC T6... T3 Ga<br>ATEX II 1D Ex ia op is IIIC T90℃... T200℃ Da |
|  | **COS81E-IF**<br>IECEx Ex ia op is IIC T6... T3 Ga |
|  | **COS81E-I5**<br>IECEx Ex ia op is IIC T6... T3 Ga<br>IECEx Ex ia op is IIIC T90℃... T200℃ Da |
|  | **COS81E-NG**<br>NEPSI Ex ia op is IIC T6/T4/T3 Ga |
|  | **COS81E-N5**<br>NEPSI Ex ia op is IIC T6/T4/T3 Ga<br>NEPSI Ex iaD op is 20 T90/T135/T200 |
|  | **COS81E-MG**<br>INMETRO Ex ia op is IIC T6 ... T3 Ga |
|  | **COS81E-M5**<br>INMETRO Ex ia op is IIC T6 ... T3 Ga<br>INMETRO Ex ia op is IIIC T90℃... T200℃ Da |
|  | **COS81E-JF**<br>JPN Ex ia op is IIC T6...T3 Ga |
|  | **COS81E-J5**<br>JPN Ex ia op is IIC T6...T3 Ga<br>JPN Ex ia op is IIIC T90℃... T200℃ Da |
|  | **COS81E-CI**<br>CSA C/US IS Class I Division 1 Groups A, B, C and D T6...T4<br>CSA C/US Ex ia IIC T6...T4 Ga<br>CSA C/US Class I Zone 0 AEx ia IIC T6...T4 Ga |

| | |
|---|---|
| **Hygienic compatibility** | **Regulation (EC) No. 1935/2004**<br><br>Meets the requirements of Regulation (EC) No. 1935/2004<br>The product therefore meets the requirements for materials that come into contact with food.<br><br>**EHEDG**<br><br>The hygienic sensor is certified according to EHEDG Type EL-Class I. |
| **Pharmaceutical compatibility** | **ASME BPE**<br><br>Produced according to the criteria of the ASME BPE that is currently valid.<br><br>**Compliance with requirements derived from cGMP**<br><br>Certificate of conformity for pharmaceutical requirements, confirms conformity with biological reactivity test USP 87, USP 88 Class VI, FDA material conformity, TSE-/BSE-free, surface roughness<br><br>**FDA compatibility**<br><br>All parts in contact with medium comply with the relevant regulations of the FDA.<br><br>ℹ️ **Hazardous area versions**<br><br>For operation in FDA processes, another FDA-approved seal must be installed before the process seal (for example Unifit CPA842). Doing so will sufficiently separate the process from the Ex connection. |
| **Additional certification** | **Inspection certificate in accordance with EN 10204 3.1**<br><br>A test certificate 3.1 in accordance with EN 10204 is supplied depending on the version (→ Product Configurator on the product page). |
| **Other standards and guidelines** | **EAC**<br><br>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.<br><br>**CRN approval**<br><br>As the sensor can be operated at a nominal pressure greater than 15 psi (approx. 1 bar), it has been registered according to CSA B51 ("Boiler, pressure vessel, and pressure piping code"; category F) with a CRN (Canadian Registration Number) in all Canadian provinces. |
| **Test reports** | **Manufacturer's certificate**<br>Stating the individual final test data<br><br>**Surface roughness test**<br>Stainless steel surfaces in contact with medium tested to $\leq R_a$ 0.38 µm. |

# Ordering information

| | |
|---|---|
| **Product page** | www.endress.com/cos81e |
| **Product Configurator** | On the product page there is a **Configure** button to the right of the product image.<br>1. Click this button.<br>   ↳ The Configurator opens in a separate window.<br>2. Select all the options to configure the device in line with your requirements.<br>   ↳ In this way, you receive a valid and complete order code for the device. |

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.

For many products you also have the option of downloading CAD or 2D drawings of the selected product version. Click the **CAD** tab for this and select the desired file type using picklists.

| Scope of delivery | **The scope of delivery comprises:**
• 1 sensor, version as ordered
• 1 x Brief Operating Instructions
• Safety instructions for the hazardous area (for sensors with Ex approval)
• Supplement for optional certificates that have been ordered |

# 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.

| Device-specific accessories | **Assemblies (selection)**

COS81E with 220 mm length is suitable for all assemblies requiring an installation length of 225 mm.

**Cleanfit CPA875**
• Retractable process assembly for sterile and hygienic applications
• For in-line measurement with standard sensors with 12 mm diameter, e.g. for pH, ORP, oxygen
• Product Configurator on the product page: www.endress.com/cpa875

Technical Information TI01168C

**Flowfit CPA240**
• pH/redox flow assembly for processes with stringent requirements
• Product Configurator on the product page: www.endress.com/cpa240

Technical Information TI00179C

**Unifit CPA842**
• Installation assembly for food, biotechnology and pharmaceutics
• With EHEDG and 3A certificate
• Product Configurator on the product page: www.endress.com/cpa842

Technical Information TI00306C

**Cleanfit CPA450**
• Manual retractable assembly for installing sensors with a diameter of 12 mm and a length of 120 mm in tanks and pipes
• Product Configurator on the product page: www.endress.com/cpa450

Technical Information TI00183C

**Flowfit CYA21**
• Universal assembly for analysis systems in industrial utilities
• For sensors with Ø 12 mm and length 120 mm
• Compact stainless steel assembly with low sampling volume
• Product Configurator on the product page: www.endress.com/CYA21

Technical Information TI01441C |

### CYA680
- Flow assembly for hygienic sensors
- For sensor installation in pipes
- Suitable for cleaning in place (CIP) and sterilization in place (SIP)
- Certified biocompatibility as per USP Class VI, FDA-listed seals and hygienic, electropolished surfaces Ra=0.38 µm (15 µinch)
- Product Configurator on the product page: www.endress.com/cya680

📖 Technical Information TI01295C

### Measuring cable

### Memosens data cable CYK10
- For digital sensors with Memosens technology
- Product Configurator on the product page: www.endress.com/cyk10

📖 Technical Information TI00118C

### 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

### Memosens laboratory cable CYK20
- For digital sensors with Memosens technology
- Product Configurator on the product page: www.endress.com/cyk20

### Zero-point gel

### COY8
Zero-point gel for oxygen and disinfection sensors
- Oxygen-free and chlorine-free gel for the verification, zero point calibration and adjustment of oxygen and disinfection measuring points
- Product Configurator on the product page: www.endress.com/coy8

📖 Technical Information TI01244C

### Transmitter

### Liquiline CM44
- Modular multi-channel transmitter for hazardous and non-hazardous areas
- Hart®, PROFIBUS, Modbus or EtherNet/IP possible
- Order according to product structure

📖 Technical Information TI00444C

### Liquiline CM42
- Modular two-wire transmitter for hazardous and non-hazardous areas
- Hart®, PROFIBUS or FOUNDATION Fieldbus possible
- Order according to product structure

📖 Technical Information TI00381C

### Liquiline Mobile CML18
- Multiparameter mobile device for laboratory and field
- Reliable transmitter with display and app connection
- Product Configurator on the product page: www.endress.com/CML18

📖 Operating Instructions BA02002C

### Liquiline Compact CM82
- Configurable 1-channel multiparameter transmitter for Memosens sensors
- Ex- and non-ex applications possible in all industries
- Product Configurator on the product page: www.endress.com/CM82

📖 Technical Information TI01397C

**Liquiline Compact CM72**
- 1-channel single parameter field device for Memosens sensors
- Ex- and non-ex applications possible in all industries
- Product Configurator on the product page: www.endress.com/CM72

📖 Technical Information TI01409C

**Memosens analog converter CYM17**
- Converter for Memosens sensors
- Enables the simple use of digital Memosens sensors in fermentation applications in the laboratory
- Product Configurator on the product page: www.endress.com/cym17

📖 Operating Instructions BA01833C

**Memobase Plus CYZ71D**
- PC software to support laboratory calibration
- Visualization and documentation of sensor management
- Sensor calibrations stored in database
- Product Configurator on the product page: www.endress.com/cyz71d

📖 Technical Information TI00502C

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www.addresses.endress.com

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