

Technical Information

Indumax CLS50D/CLS50

Inductive conductivity sensor for standard, Ex and high-temperature applications

Digital sensor with Memosens protocol or analog sensor

Application

Indumax CLS50D or CLS50 sensor is particularly suitable for use in the chemical and process technology sectors. The six-decade measuring range and the excellent chemical resistance properties of the materials in contact with the medium (PFA or PEEK) make it possible to use this sensor in a wide range of applications, such as:

- Concentration measurement of acids and bases
- Quality monitoring of chemical products in tanks and pipes
- Phase separation of product/product mixtures

The digital sensor CLS50D is used in conjunction with the Liquiline CM44x/R or Liquiline M CM42, while the analog sensor CLS50 is used with the Liquiline M CM42 or Liquisys CLM223/253.

Your benefits

- High durability
 - High chemical resistance thanks to PFA coating
 - PEEK version for temperatures up to 180 °C (356 °F)
- Low risk of soiling
 - Dirt-repellent PFA surface
 - Large sensor opening
- Easy installation
 - Can be installed in pipes \geq DN 80
 - Total cable length up to 55 m (180 ft)
- Large measuring range from 2 μ S/cm to 2000 mS/cm
- Integrated, coated Pt 100 temperature sensor, error class A
- Ex approval Ex ia IIC T4/T6

Other advantages of Memosens technology

- Maximum process safety
- Data security thanks to digital data transmission
- Very easy to use as sensor data saved in the sensor
- Recording of sensor load data in the sensor enables predictive maintenance

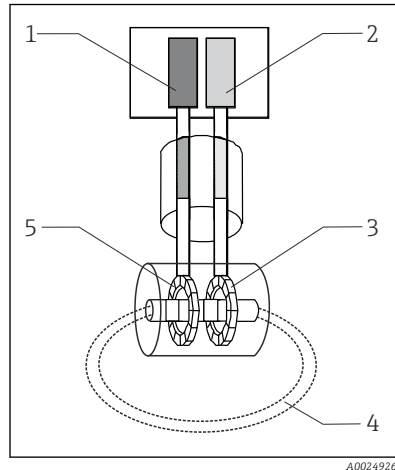


Function and system design

Measuring principle

Inductive conductivity measurement

An oscillator (1) generates an alternating magnetic field in the primary coil (5), which induces a current flow (4) in the medium. The strength of the current depends on the conductivity and thus on the ion concentration in the medium. The current flow in the medium, in turn, generates a magnetic field in the secondary coil (3). The resulting induced current is measured by the receiver (2) and used to determine the conductivity.



- 1 Oscillator
- 2 Receiver
- 3 Secondary coil
- 4 Current flow in the medium
- 5 Primary coil

Advantages of inductive conductivity measurement:

- No electrodes and therefore no polarization effects
- Accurate measurement in media with a high degree of pollution and a tendency to form buildup
- Complete galvanic isolation of the measurement and the medium

Measuring system

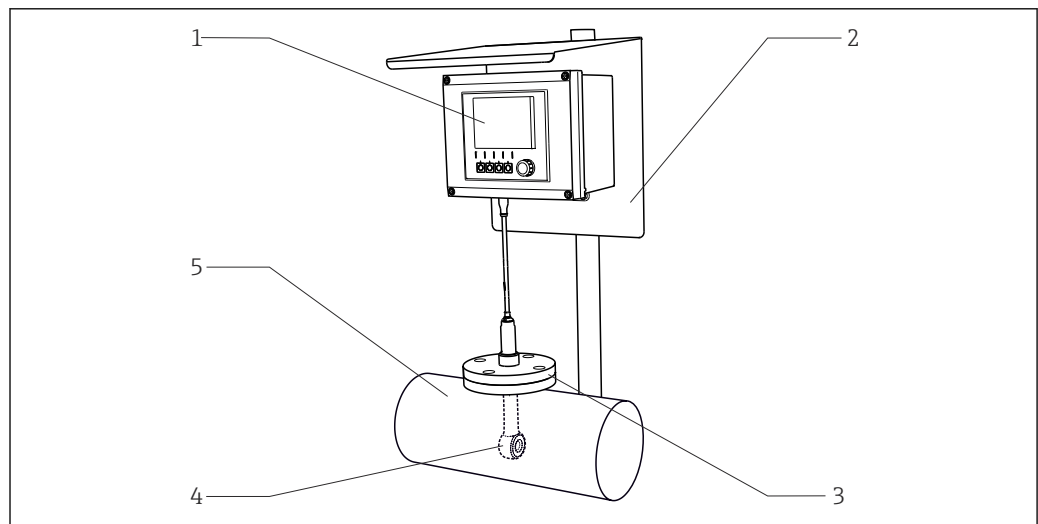
CLS50D

A complete measuring system comprises:

- A CLS50D inductively measuring conductivity sensor with fixed cable
- A transmitter, e.g. Liquiline CM44x

Optional:

- Weather protection for the field installation of the transmitter
- Assembly to install the sensor in vessels or pipes, e.g. CLA111



1 Example of a measuring system

- 1 Liquiline CM44x transmitter
- 2 Protective cover
- 3 Pipe nozzle with flange DN50 PN16
- 4 CLS50D sensor, version with flange DN50 PN16 and fixed cable with M12 connector
- 5 Pipe

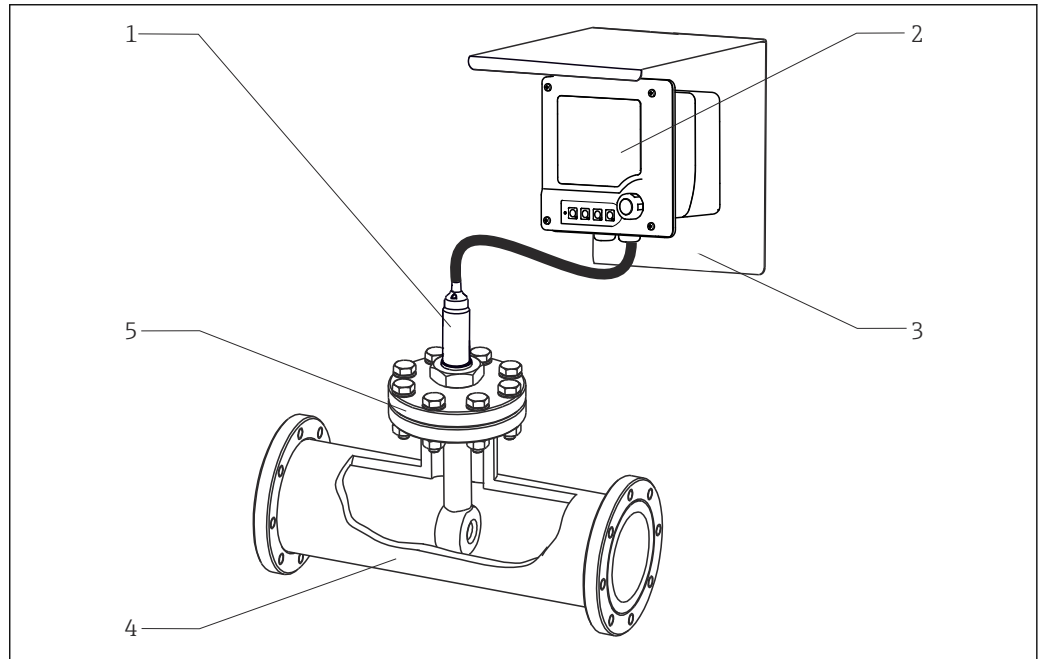
CLS50

A complete measuring system comprises:

- A CLS50 inductively measuring conductivity sensor with fixed cable
- A transmitter, e.g. Liquiline M CM42

Optional:

- Weather protection for the field installation of the transmitter
- Assembly to install the sensor in vessels or pipes, e.g. CLA111



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2 Example of a measuring system

- 1 CLS50 sensor, version with lap joint flange and fixed cable with ferrules
- 2 Liquiline CM42 transmitter
- 3 Protective cover
- 4 Pipe
- 5 Pipe nozzle with flange connection

Communication and data processing (only CLS50D)

Communication with the transmitter

 Always connect digital sensors with Memosens technology to a transmitter with Memosens technology. Data transmission to a transmitter for analog sensors is not possible.

Digital sensors can store measuring system data in the sensor. These include the following:

- Manufacturer data
 - Serial number
 - Order code
 - Date of manufacture
- Calibration data
 - Calibration date
 - Cell constant
 - Delta cell constant
 - Number of calibrations
 - Serial number of the transmitter used to perform the last calibration or adjustment
- Operating data
 - Temperature application range
 - Conductivity application range
 - Date of initial commissioning
 - Maximum temperature value
 - Hours of operation at high temperatures

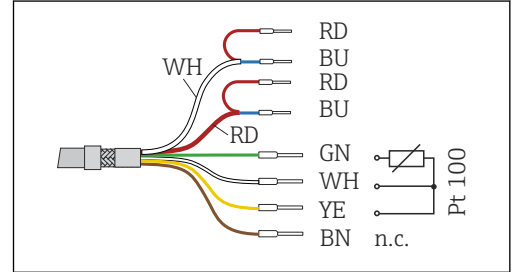
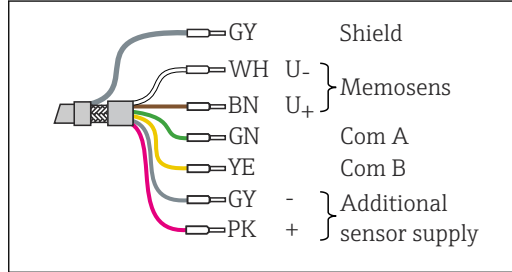
Input

Measured values	<ul style="list-style-type: none"> ▪ Conductivity ▪ Temperature 				
Measuring ranges	<table> <tr> <td>Conductivity</td> <td>2 µS/cm to 2000 mS/cm (uncompensated)</td> </tr> <tr> <td>Temperature</td> <td>-20 to +180 °C (-4 to +350 °F)</td> </tr> </table>	Conductivity	2 µS/cm to 2000 mS/cm (uncompensated)	Temperature	-20 to +180 °C (-4 to +350 °F)
Conductivity	2 µS/cm to 2000 mS/cm (uncompensated)				
Temperature	-20 to +180 °C (-4 to +350 °F)				
Cell constant	$k = 1.98 \text{ cm}^{-1}$				
Measuring frequency	2 kHz				
Temperature measurement	<p>CLS50D Pt1000 (Class A according to IEC 60751)</p> <p>CLS50 Pt100 (Class A according to IEC 60751)</p>				

Energy supply

Electrical connection

The sensor is supplied with a fixed cable. The cable between the sensor and transmitter can be extended using the measuring cable CYK11 (CLS50D) or CLK6 (CLS50) (not applicable for use in hazardous environments).



3 CYK11 for extension of CLS50D

4 CLK6 for extension of CLS50

Total cable length (max.): 100 m (330 ft)

Total cable length (max.): 55 m (180 ft)



CLS50 only:

The residual coupling of the sensor increases when the fixed cable is extended.

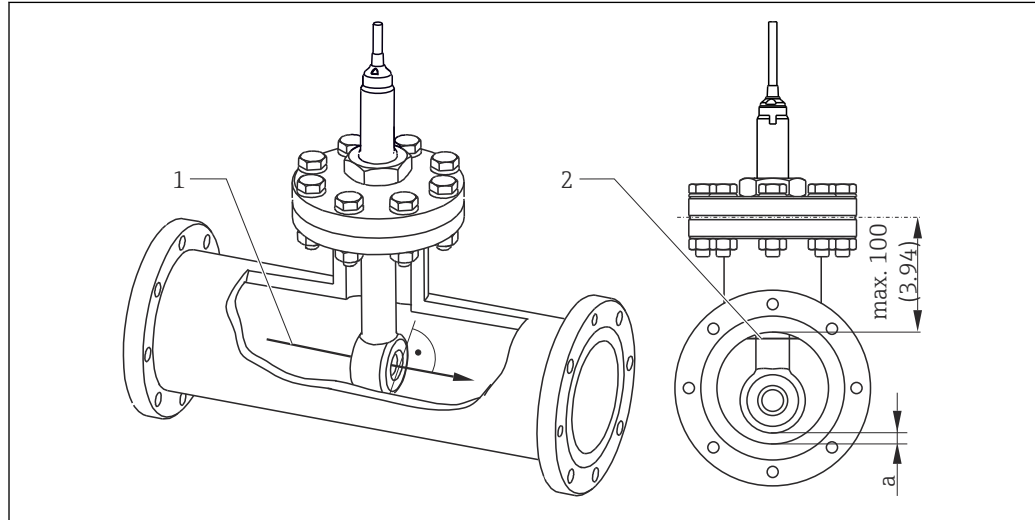
Performance characteristics

Conductivity response time	$t_{95} \leq 2 \text{ s}$	
Temperature response time	PEEK version:	$t_{90} \leq 7 \text{ min}$
	PFA version:	$t_{90} \leq 11 \text{ min}$
Measured error	-20 to 100 °C (-4 to 212 °F):	$\pm(5 \mu\text{S/cm} + 0.5 \% \text{ of reading})$
	> 100 °C (212 °F):	$\pm(10 \mu\text{S/cm} + 0.5 \% \text{ of reading})$
Repeatability	0.2% of reading	
Linearity	1.9 % (only applies in the 1 to 20 mS/cm measuring range)	

Installation

Orientation

- ▶ When installing, align the sensor in such a way that the medium flows through the flow opening of the sensor in the direction of medium flow.
 - ↳ The sensor head must be completely immersed in the medium.



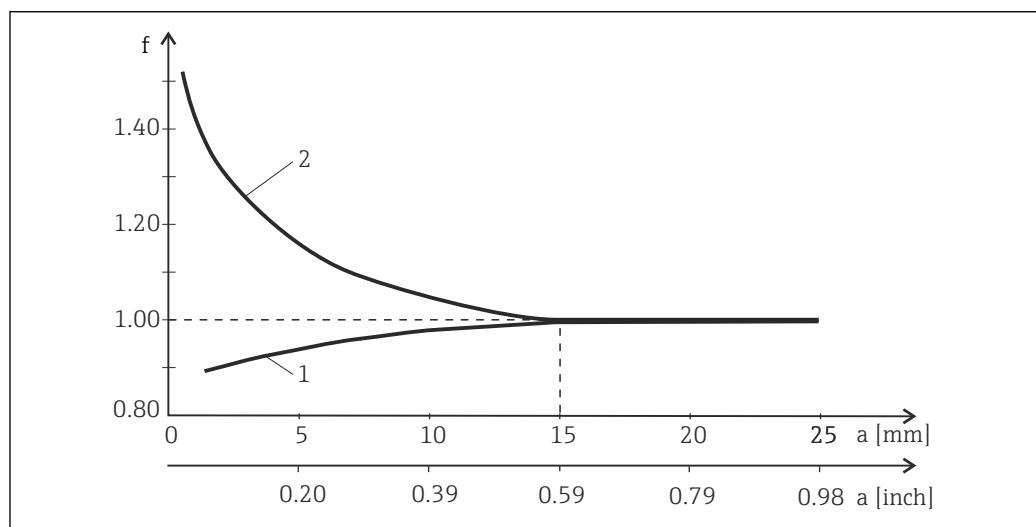
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5 Sensor orientation, dimensions in mm (in)

- 1 Direction of medium flow
- 2 Minimum water level in the pipe
- a Distance from pipe wall

Installation factor

In confined installation conditions, the conductivity measurement is affected by the pipe walls. The installation factor compensates for this effect. The transmitter corrects the cell constant by multiplying by the installation factor. The value of the installation factor depends on the diameter and the conductivity of the pipe nozzle as well as the sensor's distance to the wall. The installation factor f can be disregarded ($f = 1.00$) if the distance to the wall is sufficient ($a > 15 \text{ mm}$ (0.59")), from DN 80). If the distance to the wall is smaller, the installation factor increases for electrically insulating pipes ($f > 1$) and decreases for electrically conductive pipes ($f < 1$). It can be measured using calibration solutions, or a close approximation determined from the following diagram.



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6 Relationship between installation factor f and wall distance

- 1 Electrically conductive pipe wall
- 2 Electrically insulating pipe wall

Air set

CLS50D

The digital sensor has already been adjusted at the factory. Onsite compensation is not required.

CLS50

To compensate residual coupling in the cable and between the two sensor coils, zero adjustment in air ("air set") must be performed before installing the sensor. Follow the instructions provided in the Operating Instructions of the transmitter used.

Installation with flange

The sensor is suitable for installation in T-pieces \geq DN 80, with the outgoing diameter reduced to \geq DN 50.

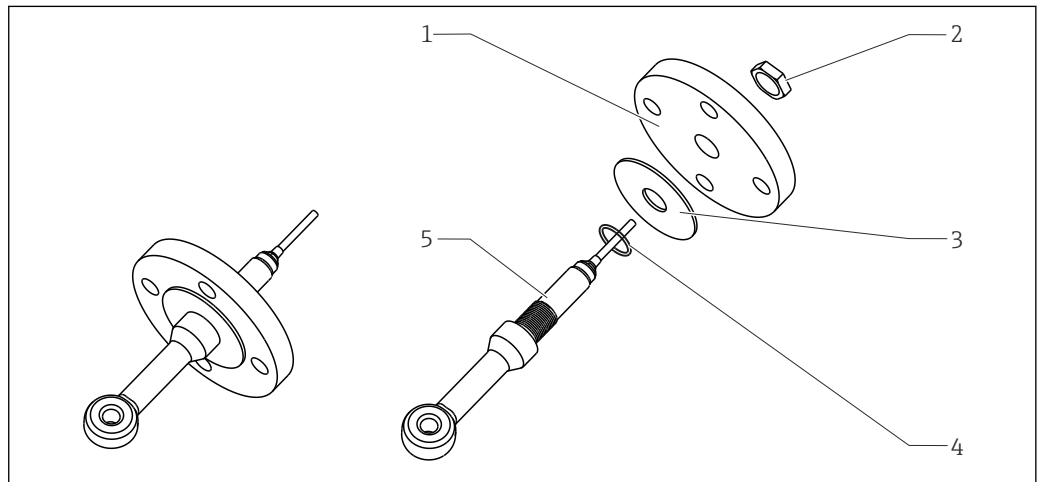
⚠ WARNING

Leakage

Risk of injury if medium escapes!

- ▶ Tighten sensor nut using a torque of 20 Nm.
- ▶ To avoid leakages, regularly check the tightness of the nut.

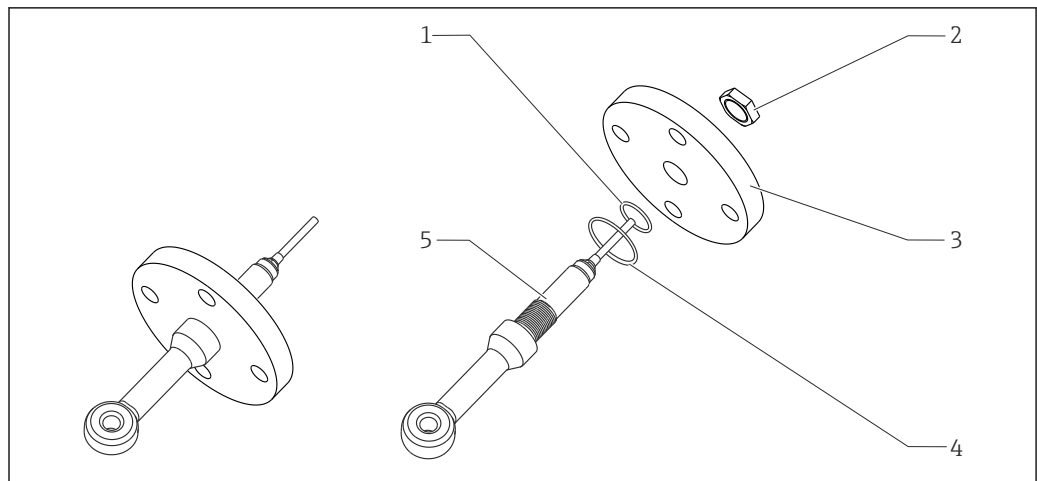
Flange, not in contact with medium



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7 Fixed flange, not in contact with medium (for order option: "Process connection" = 5, 6, 7)

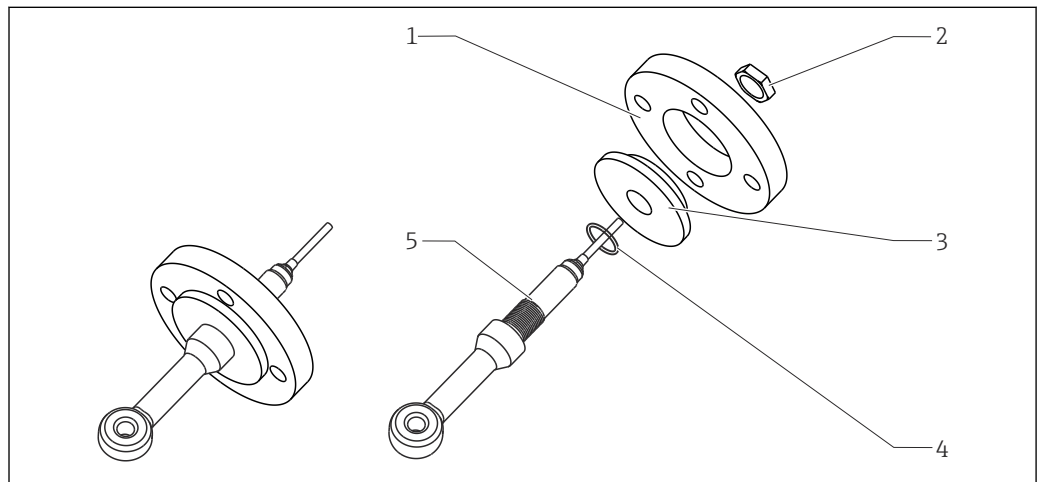
- 1 Flange (stainless steel)
- 2 Nut
- 3 Sealing disk (GYLON)
- 4 O-ring
- 5 Sensor

Flange, in contact with medium

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8 Fixed flange, in contact with medium (for order option: "Process connection" = 3, 4, P)

- 1 O-ring
- 2 Nut
- 3 Flange (stainless steel)
- 4 Radial seal (only for version "Process connection" = P)
- 5 Sensor

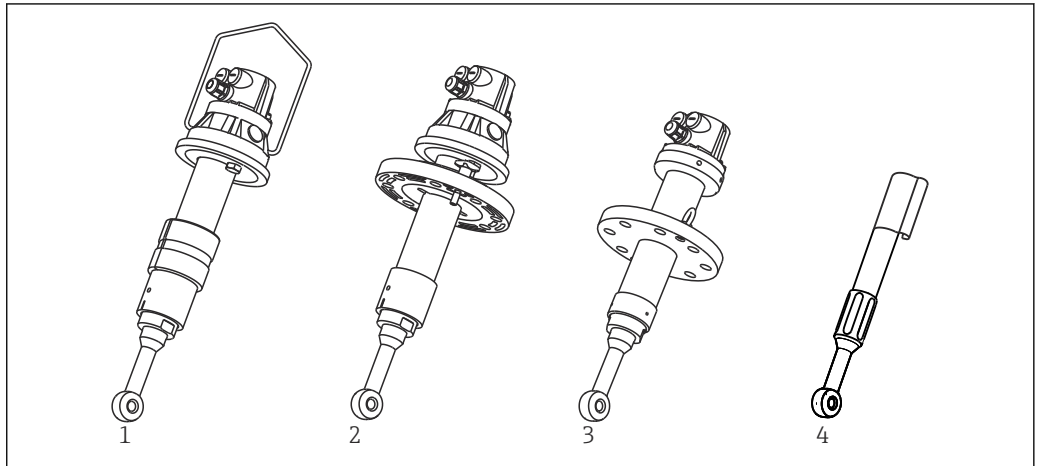
Lap joint flange, not in contact with medium

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9 Lap joint flange, not in contact with medium (for order option: "Process connection" = A, B, C)

- 1 Lap joint flange (PP-GF)
- 2 Nut (stainless steel)
- 3 Flange (PVDF)
- 4 O-ring
- 5 Sensor

Installation in assembly



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10 Installation of sensor with assembly

- 1 CLA111 with suspension bracket
- 2 CLA111 with flange connection
- 3 CLA140 with flange connection
- 4 CYA112

Environment

Ambient temperature **CLS50D**
 -10 to +60 °C (+10 to +140 °F)

CLS50
 -10 to +70 °C (+10 to +160 °F)

Storage temperature -20 to +80 °C (0 to +180 °F)

Degree of protection IP 68 / NEMA type 6 (sensor in installed state with genuine seal)

Process

Process temperature **CLS50D**

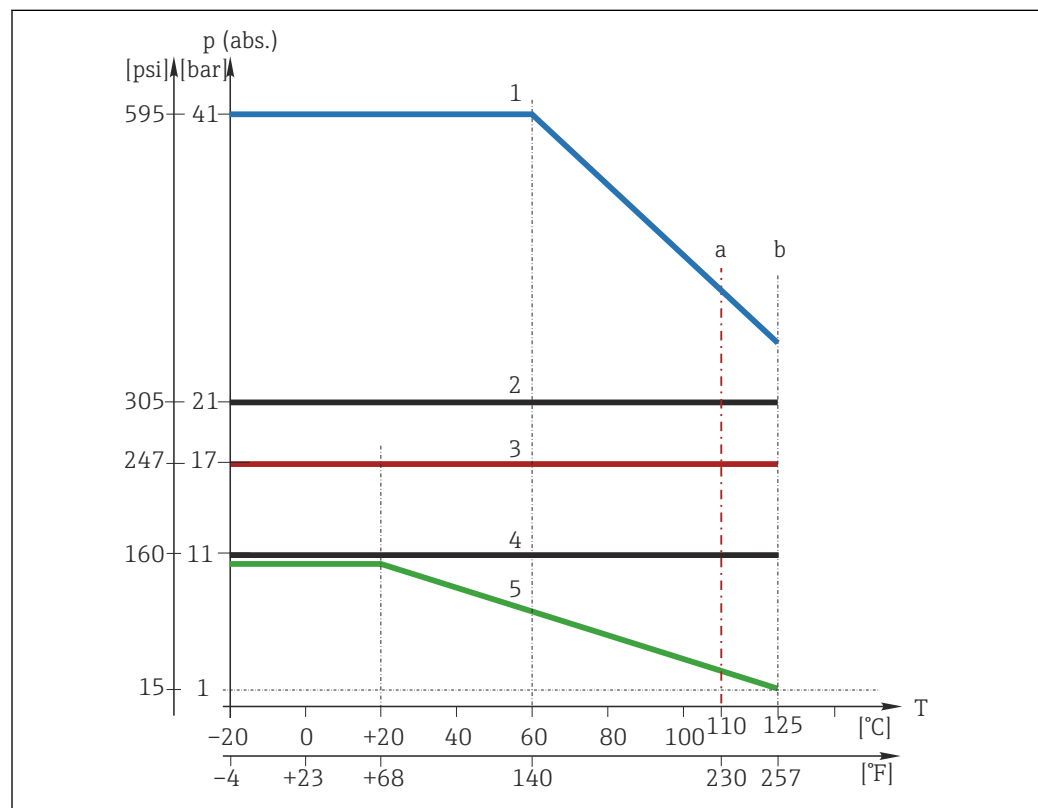
	CLS50D-**1/2	CLS50D- **3/4/5/6/8	CLS50D-**7	CLS50D-**A/B/C	CLS50D-**P
Sensor material	Without flange	DN50 PN16, ANSI 2"	JIS	Lap joint flange	DN50 PN40
PEEK	-20 to 125 °C (-4 to 260 °F)	-20 to 125 °C (-4 to 260 °F)	-20 to 125 °C (-4 to 260 °F)	-20 to 125 °C (-4 to 260 °F)	-20 to 125 °C (-4 to 260 °F)
PFA	-20 to 110 °C (-4 to 230 °F)	-20 to 110 °C (-4 to 230 °F)	-20 to 110 °C (-4 to 230 °F)	-20 to 110 °C (-4 to 230 °F)	n.a.

CLS50

Sensor material	CLS50-**1/2	CLS50- **3/4/5/6/8	CLS50-**7	CLS50-**A/B/C	CLS50-**P
	Without flange	DN50 PN10, ANSI 2"	JIS	Lap joint flange	DN50 PN40
PEEK	-20 to 180 °C (-4 to 360 °F)	-20 to 180 °C (-4 to 360 °F)	-20 to 180 °C (-4 to 360 °F)	-20 to 125 °C (-4 to 260 °F)	-20 to 125 °C (-4 to 260 °F)
PFA	-20 to 125 °C (-4 to 260 °F)	-20 to 125 °C (-4 to 260 °F)	-20 to 125 °C (-4 to 260 °F)	-20 to 125 °C (-4 to 260 °F)	n.a.

Process pressure (absolute) Max. 41 bar (595 psi), depending on sensor version, → temperature-pressure chart

Temperature-pressure chart CLS50D-***B/C/F (version with PEEK sensor material)

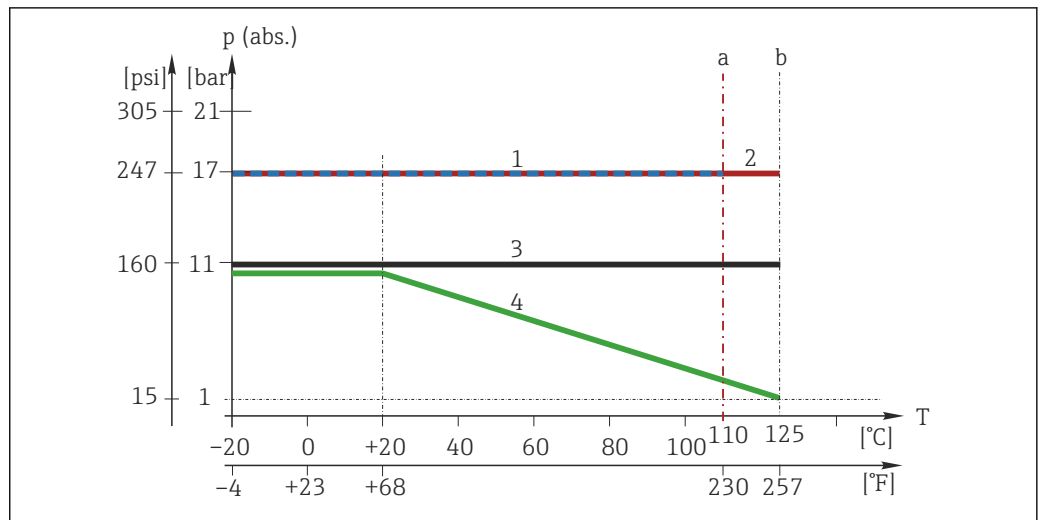


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11 Pressure-temperature ratings

- 1 (blue) version with flange EN 1092-1 DN50 PN40 (CLS50D-**P)
- 2 (black) versions without flange (CLS50D-**1/2)
- 3 (red) versions with flange DN50/ANSI 2" (CLS50D-**3/4/5/6)
- 4 (black) versions with flange JIS (CLS50D-**7)
- 5 (green) versions with lap joint flange (CLS50D-**A/B/C)
- a Temperature limit for versions in hazardous areas
- b Temperature limit for versions in non-hazardous areas

CLS50D-***D (version with PFA sensor material)

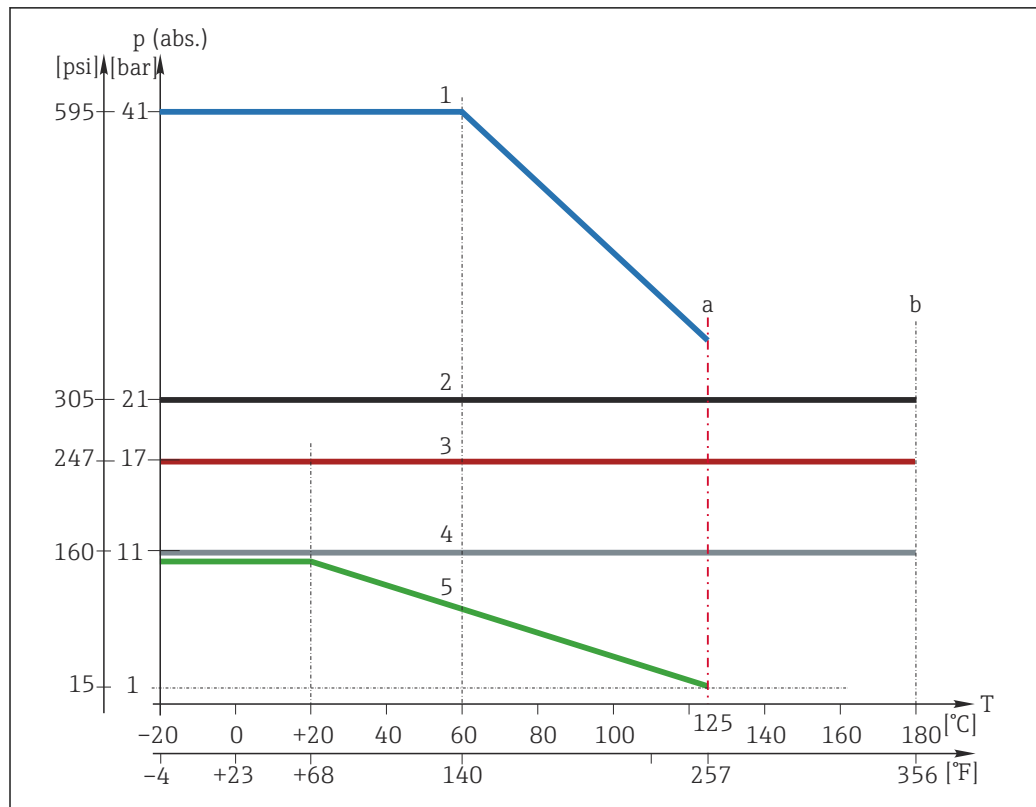


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12 Pressure-temperature ratings

- 1 (blue) version without flange (CLS50D-**1)
- 2 (red) versions with flange DN50/ANSI 2" (CLS50D-**3/4/5/6/8)
- 3 (black) versions with flange JIS (CLS50D-**7)
- 4 (green) versions with lap joint flange (CLS50D-**A/B/C)
- a Temperature limit for versions in hazardous areas
- b Temperature limit for versions in non-hazardous areas

CLS50-***B/C/F (version with PEEK sensor material)

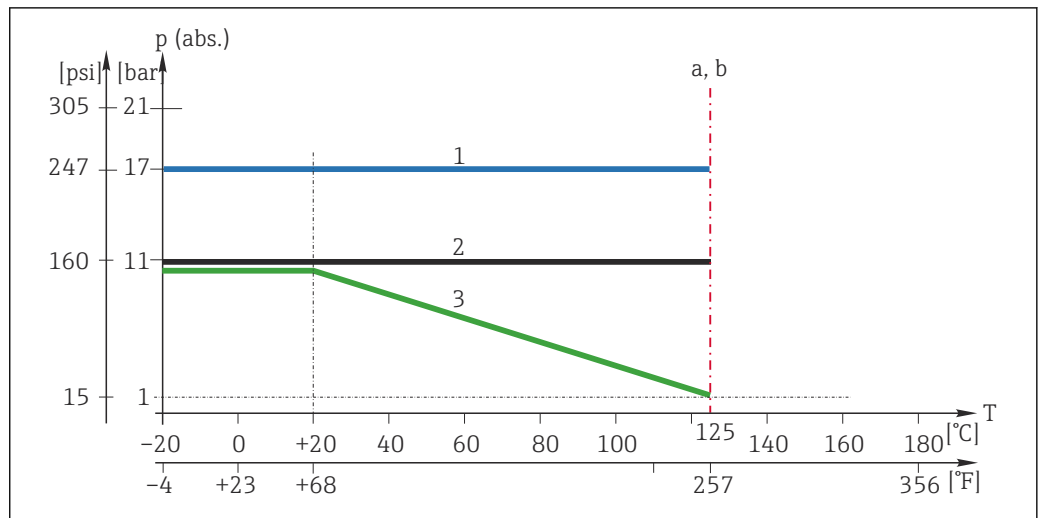


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13 Pressure-temperature ratings

- 1 (blue) version with flange EN 1092-1 DN50 PN40 (CLS50-**P)
- 2 (black) versions without flange (CLS50-**1/2)
- 3 (red) versions with flange DN50/ANSI 2" (CLS50-**3/4/5/6)
- 4 (gray) version with flange JIS (CLS50-**7)
- 5 (green) versions with lap joint flange (CLS50-**A/B/C)
- a Temperature limit for 1 and 5 and for all versions in hazardous areas
- b Temperature limit for 2, 3 and 4 in non-hazardous areas

CLS50-***D (version with PFA sensor material)



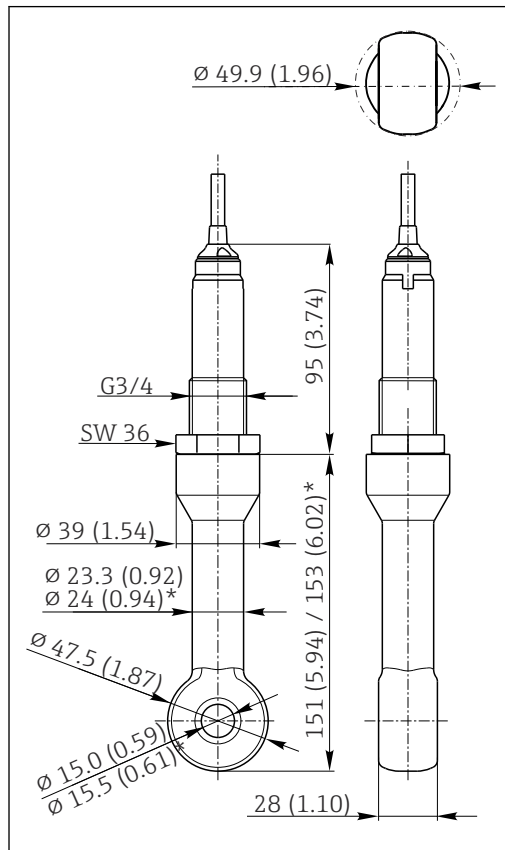
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14 Pressure-temperature ratings

- 1 (blue) versions without flange or with flange DN50/ANSI 2" (CLS50-**1/3/4/5/6/8)
- 2 (black) version with flange JIS (CLS50-**7)
- 3 (green) versions with lap joint flange (CLS50-**A/B/C)
- a Temperature limit for versions in hazardous areas
- b Temperature limit for versions in non-hazardous areas

Mechanical construction

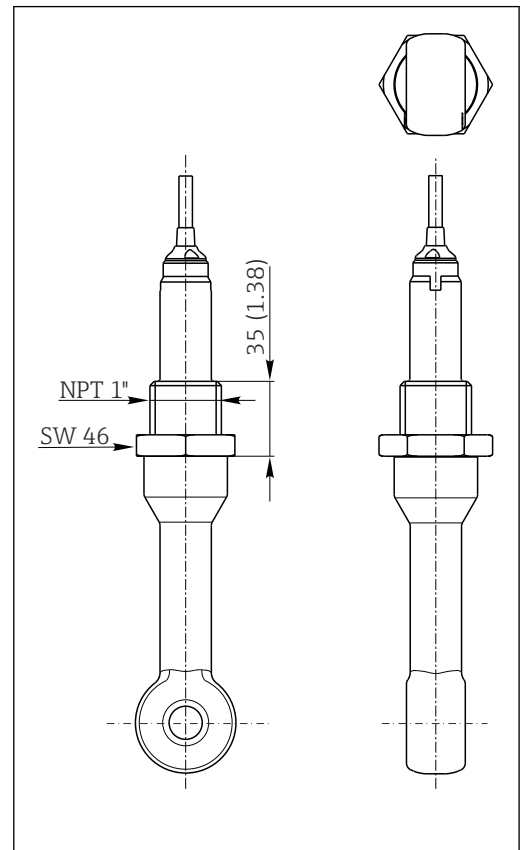
Dimensions



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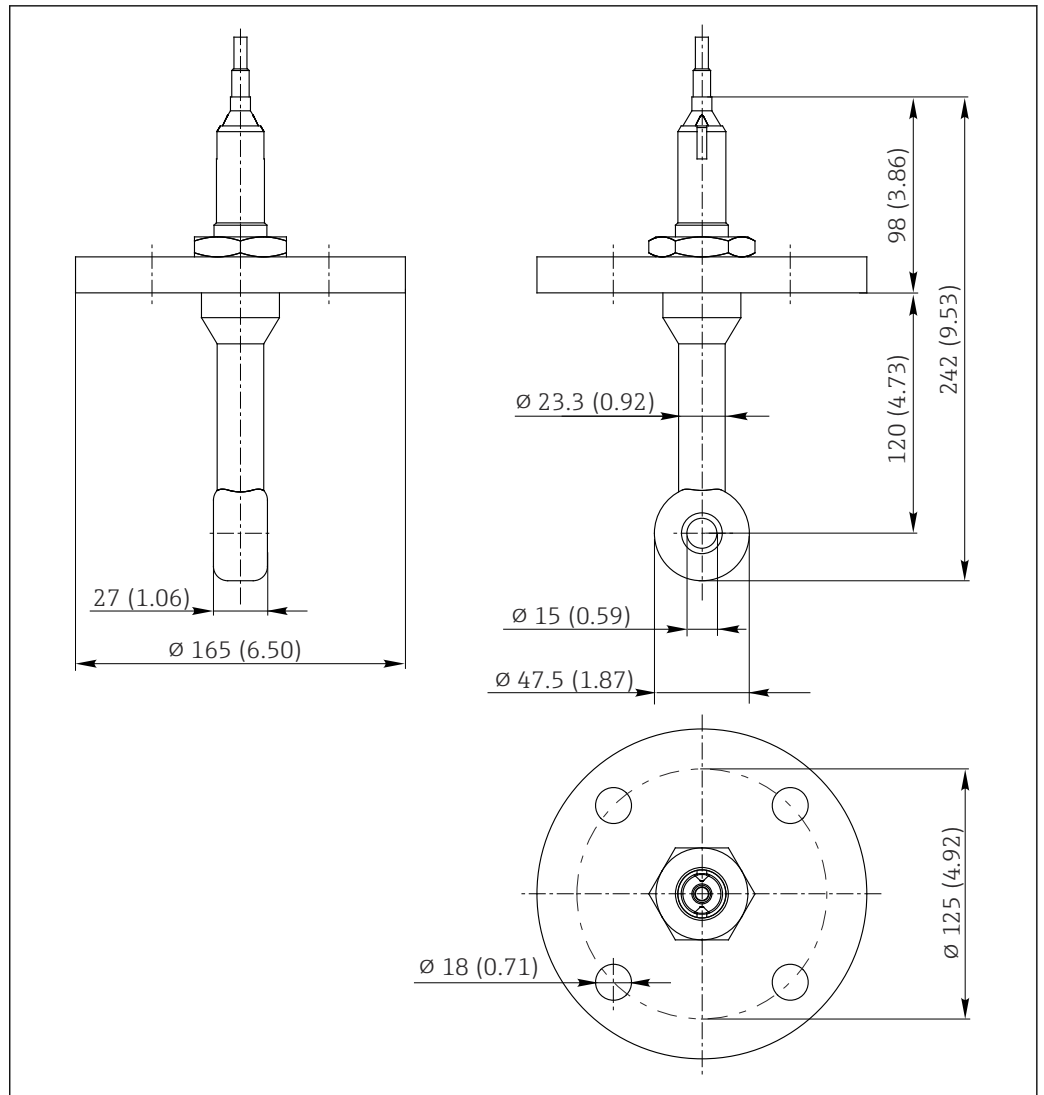
15 Version with G $\frac{3}{4}$ thread. Unit of measurement mm (in)

* Dimension for PEEK version



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16 Version, NPT 1" thread. Unit of measurement mm (in)



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17 Version, flange EN1092-1 DN50 PN16, 316L welded PFA sensor sealing plate. Unit of measurement mm (in)

Weight Approx. 0.65 kg (1.43 lbs)

Materials

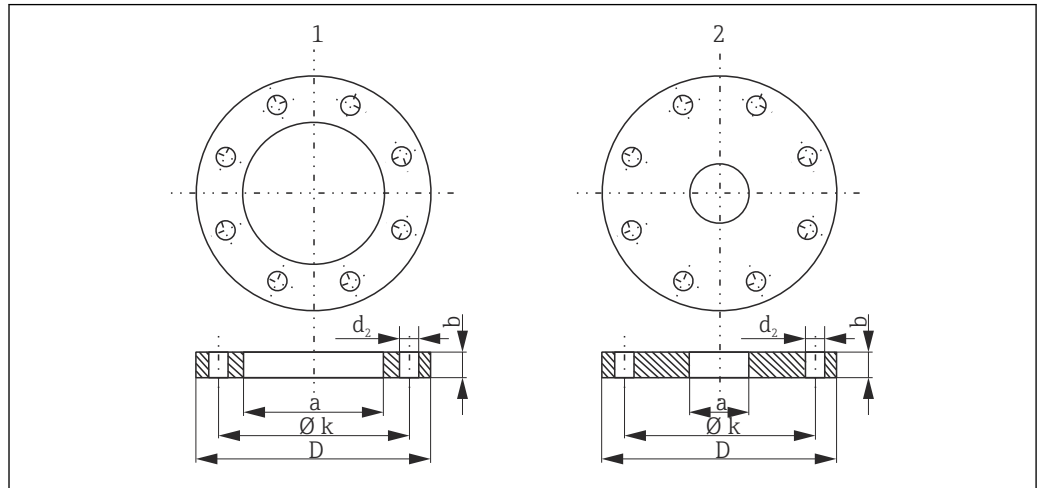
Sensor	PEEK, PFA (depending on version)
Sensor seal	VITON, CHEMRAZ (depending on version)
Radial seal ¹⁾	EPDM
Process connections	
G ³ / ₄	CLS50D-*1B/C***: PEEK GF30 CLS50D-*1D***: stainless steel (AISI 316Ti) CLS50-*1A*: stainless steel 1.4571 (AISI 316Ti) CLS50-*1B/C/1/2/3: PEEK GF30 CLS50-*1B/C5/6: stainless steel 1.4571 (AISI 316Ti)
NPT 1"	PEEK
Fixed flange	Stainless steel 1.4404 (AISI 316L)
Gasket	GYLON (PTFE ceramic-filled)
Lap joint flange	PP-GF
Flange combined with lap joint flange	PVDF

1) Only version with "process connection" = P

Process connections

- Thread G³/₄
- NPT 1" thread
- Lap joint flange EN 1092 DN50 PN10
- Lap joint flange ANSI 2" 150 lbs
- Lap joint flange JIS 10K 50A
- Flange EN 1092-1 DN50 PN16
- Flange EN 1092-1 DN50 PN40
- Flange ANSI 2" 300 lbs
- Flange JIS 10K 50A

Flange dimensions



18 Flange dimensions

- 1 Lap joint flange (PVDF)
- 2 Fixed flange (stainless steel)

Dimensions in mm

Lap joint flange	DN50 PN10	ANSI 2" 150 lbs	JIS 10K 50A
D	165	165	152
Ø k	125	121	120
d ₂	4 x 18	8 x 19	4 x 19
b	18	18	18
a	78	78	78
Screws	M16	M16	M16

Dimensions in mm

Fixed flange	DN50 PN16	DN50 PN40	ANSI 2" 300 lbs	JIS 10K 50A
D	165	165	165.1	155
Ø k	125	125	127	120
d ₂	4 x 18	4 x 18	8 x 19	4 x 19
b	18	20	22.2	16
a	27	27	27	27
Screws	M16	M16	M16	M16

Chemical resistance

Medium	Concentration	PEEK	PFA	CHEMRAZ	VITON
Sodium hydroxide solution NaOH	0 to 50 %	20 to 100 °C (68 to 212 °F)	20 to 50 °C (68 to 122 °F)	0 to 150 °C (32 to 302 °F)	Not suitable
Nitric acid HNO ₃	0 to 10 %	20 to 100 °C (68 to 212 °F)	20 to 80 °C (68 to 176 °F)	0 to 150 °C (32 to 302 °F)	0 to 120 °C (32 to 248 °F)
	0 to 40 %	20 °C (68 °F)	20 to 60 °C (68 to 140 °F)	0 to 150 °C (32 to 302 °F)	0 to 120 °C (32 to 248 °F)
Phosphoric acid H ₃ PO ₄	0 to 80 %	20 to 100 °C (68 to 212 °F)	20 to 60 °C (68 to 140 °F)	0 to 150 °C (32 to 302 °F)	0 to 120 °C (32 to 248 °F)
Sulfuric acid H ₂ SO ₄	0 to 2.5 %	20 to 80 °C (68 to 176 °F)	20 to 100 °C (68 to 212 °F)	0 to 150 °C (32 to 302 °F)	0 to 120 °C (32 to 248 °F)
	0 to 30 %	20 °C (68 °F)	20 to 100 °C (68 to 212 °F)	0 to 150 °C (32 to 302 °F)	0 to 120 °C (32 to 248 °F)
Hydrochloric acid HCl	0 to 5 %	20 to 100 °C (68 to 212 °F)	20 to 80 °C (68 to 176 °F)	0 to 150 °C (32 to 302 °F)	0 to 120 °C (32 to 248 °F)
	0 to 10 %	20 to 100 °C (68 to 212 °F)	20 to 80 °C (68 to 176 °F)	0 to 150 °C (32 to 302 °F)	0 to 120 °C (32 to 248 °F)

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**.

Hazardous area approvals

CLS50D-BA** and CLS50-G******

ATEX II 1G Ex ia IIC T4/T6 Ga

CLS50D-BV****

ATEX / NEPSI Ex ic IIC T3 T4/T6 Gc

CLS50D-IA****

IECEx Ex ia IIC T4/T6 Ga

CLS50-V****

ATEX II 3G Ex ic IIC T4/T6 Gc + NEPSI Ex ic IIC T4/T6 Gc

CLS50D-NA** and CLS50-H******

NEPSI Ex ia IIC T4/T6 Ga

CLS50D-FB** and CLS50-O******

FM IS NI Cl.I Div.1&2, G. A-D

CLS50D-C2** and CLS50-S******

CSA IS NI Cl.I Div.1&2, Gr. A-D

CLS50D-JA****

JPN Ex ia IIC T4 Ga

CLS50-T****

TIIS Ex ib IIC T4 Gb

CLS50D-UA** and CLS50-U******

UK Ex II 1G Ex ia IIC T6...T4 Ga

CLS50D-GB** and CLS50-K******

EAC Ex, OEx ia IIC T6/T4 Ga X

Marine approvals

A selection of the devices and sensors have type approval for marine applications, issued by the following classification societies: ABS (American Bureau of Shipping), BV (Bureau Veritas), DNV-GL (Det Norske Veritas-Germanischer Lloyd) and LR (Lloyd's Register). Details of the order codes of the

approved devices and sensors, and the installation and ambient conditions, are provided in the relevant certificates for marine applications on the product page on the Internet.


Order information

Product page

www.endress.com/cls50d

www.endress.com/cls50

Product Configurator

1. **Configure:** Click this button on the product page.
 2. Select **Extended selection**.
 - ↳ The Configurator opens in a separate window.
 3. Configure the device according to your requirements by selecting the desired option for each feature.
 - ↳ In this way, you receive a valid and complete order code for the device.
 4. **Accept:** Add the configured product to the shopping cart.
-  For many products, you also have the option of downloading CAD or 2D drawings of the selected product version.
5. **CAD:** Open this tab.
 - ↳ The drawing window is displayed. You have a choice between different views. You can download these in selectable formats.

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.

Measuring cable

For CLS50D

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

For CLS50

Measuring cable CLK6

- Extension cable for inductive conductivity sensors, for extension via VBM junction box
- Sold by the meter, order number: 71183688

VBM


- Junction box for cable extension
- 10 terminal strips
- Cable entries: 2 x Pg 13.5 or 2 x NPT ½"

- Material: aluminum
- Degree of protection: IP 65
- Order numbers
 - Cable entries Pg 13.5 : 50003987
 - Cable entries NPT ½": 51500177

Assemblies


Dipfit CLA111

- Immersion assembly for open and closed vessels with flange DN 100
- Product Configurator on the product page: www.products.endress.com/cla111

 Technical Information TI00135C


Dipfit CLA140

- For the CLS50/CLS50D inductive sensor
- Immersion assembly with flange connection for very demanding processes
- Product Configurator on the product page: www.products.endress.com/cla140

 Technical Information TI00196C

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

Calibration solutions

Conductivity calibration solutions CLY11

Precision solutions referenced to SRM (Standard Reference Material) by NIST for qualified calibration of conductivity measuring systems in accordance with ISO 9000

- CLY11-B, 149.6 µS/cm (reference temperature 25 °C (77 °F)), 500 ml (16.9 fl.oz)
Order No. 50081903
- CLY11-C, 1.406 mS/cm (reference temperature 25 °C (77 °F)), 500 ml (16.9 fl.oz)
Order No. 50081904
- CLY11-D, 12.64 mS/cm (reference temperature 25 °C (77 °F)), 500 ml (16.9 fl.oz)
Order No. 50081905
- CLY11-E, 107.00 mS/cm (reference temperature 25 °C (77 °F)), 500 ml (16.9 fl.oz)
Order No. 50081906

 Technical Information TI00162C



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www.addresses.endress.com
