



Level



Pressure



Flow



Temperature



Analytics



Registration

Systems  
Components

Services



Solutions

## Technical Information

# Indumax CLS50/CLS50D

Inductive conductivity sensor for standard, hazardous and high-temperature applications, analog or digital with Memosens protocol



### Application

Indumax CLS50/CLS50D conductivity sensors are especially suitable for application in the chemical industry and process engineering. The six-decade measuring range and the high chemical resistance of the materials in contact with medium (PFA or PEEK) permit to use this sensor in a number of various applications, e.g.:

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

Digital CLS50D sensors are used with Liquiline CM44x or Liquiline CM42. Analog CLS50 sensors are used with the transmitters Liquiline CM42, Liquisys CLM223/253 or Mycom CLM153.

### Your benefits

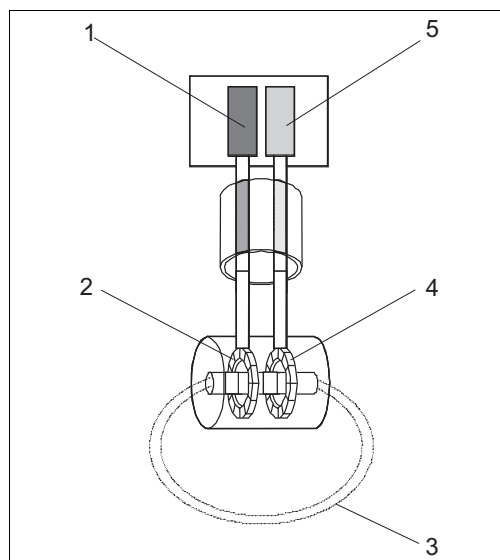
- High durability
  - High chemical resistance thanks to PFA coating
  - PEEK version for high temperatures up to 180 °C (356 °F)
- Low risk of soiling
  - Dirt-repellent PFA surface
  - Large sensor opening
- Easy installation
  - Can be installed in T-pieces  $\geq$  DN 80 with the outgoing diameter reduced to  $\geq$  DN 50
  - Total cable length up to 55 m (180 ft)
- Wide measuring range from 2  $\mu$ S/cm to 2000 mS/cm
- Integrated, coated Pt 100 temperature sensor, error class A
- Ex approval EEx ia IIC T6/T4

## Function and system design

### Measuring principle

#### Inductive conductivity measurement

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



#### Inductive conductivity measurement

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

#### Benefits of inductive conductivity measurement

- No electrodes, therefore no polarization
- Accurate measurement in media or solutions with a high soiling degree and a tendency to deposition
- Complete galvanic separation of measurement and medium

### Important properties

#### ■ Wide measuring range

The sensor's measuring range comprises six decades, from 2  $\mu\text{S}/\text{cm}$  to 2000  $\text{mS}/\text{cm}$ .

#### ■ Durability

The materials in contact with medium (PEEK, PFA) feature a very high chemical resistance. In addition, the PEEK version is suitable for application at high temperatures (CLS50 up to 180 °C (356 °F) and CLS50D up to 125 °C (260 °F)).

#### ■ Low risk of soiling

Thanks to its large opening, the sensor is not susceptible to soiling. The PFA version requires even less cleaning thanks to its dirt-repellent surface.

### Advantages of digital sensors with Memosens protocol (CLS50D only)

Digital sensors are able to store the following system data in the sensor:

- Manufacturing data
  - Serial number
  - Order code
  - Date of manufacture
- Calibration data
  - Calibration date
  - Cell constant
  - Change in cell constant
  - Number of calibrations
  - Serial number of the transmitter used for the last calibration
- Application data
  - Temperature application range
  - Conductivity application range
  - Date of first commissioning
  - Maximum temperature value
  - Operating hours at high temperatures

**Measuring system**

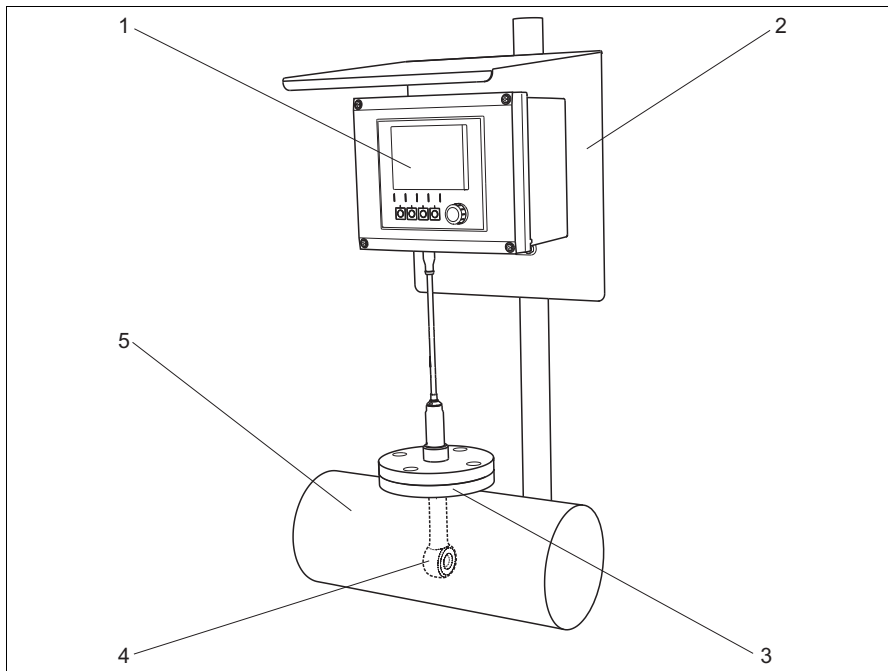
**CLS50D**

A complete measuring system comprises:

- a CLS50D conductivity sensor with fixed cable
- a transmitter, e.g. Liquiline CM44x

Optional:

- Weather protection cover for the field installation of the transmitter
- Assembly for sensor installation in tanks or in pipework, e.g. CLA111



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*Example of a measuring system*

- 1 Transmitter Liquiline CM44x
- 2 Weather protection cover
- 3 Pipe socket for flange DN50 PN/6
- 4 Sensor CLS50D, flange version DN50 PN/6, fixed cable with M12 plug

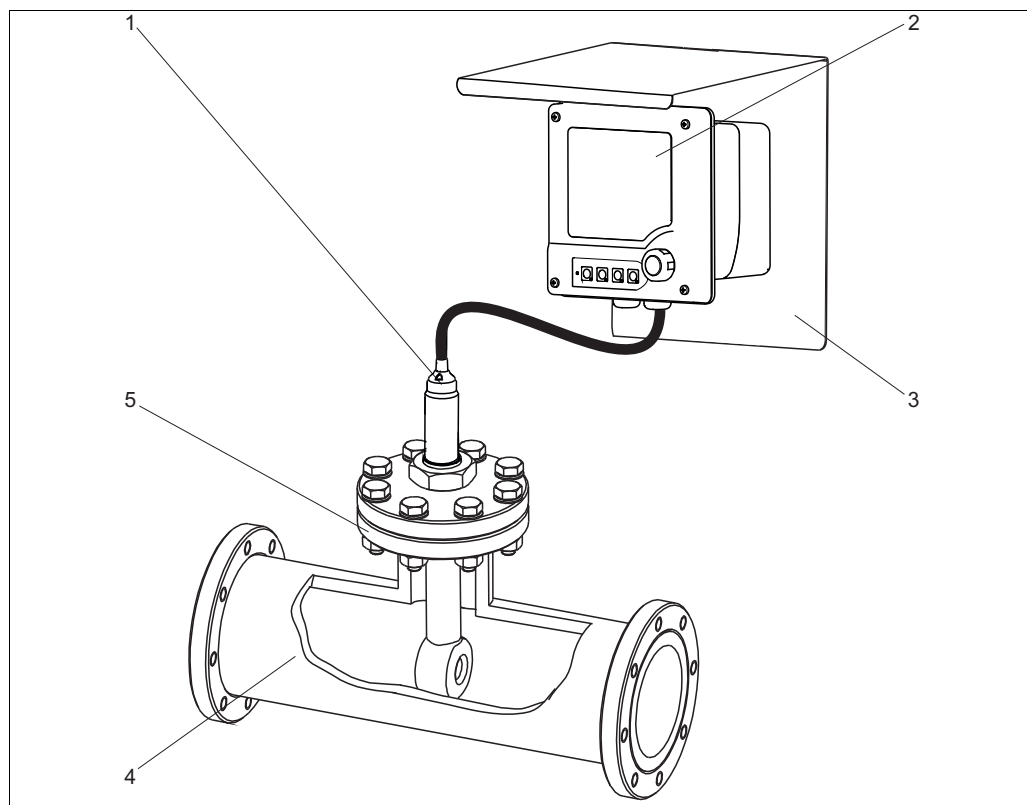
**CLS50**

A complete measuring system comprises:

- a CLS50 conductivity sensor with fixed cable
- a transmitter, e.g. Liquiline CM42

Optional:

- Weather protection cover for the field installation of the transmitter
- Assembly for sensor installation in tanks or in pipework, e.g. CLA111



Example of a measuring system

- 1 Indumax CLS50
- 2 Liquiline CM42 transmitter
- 3 Weather protection cover
- 4 Pipework
- 5 Pipe socket

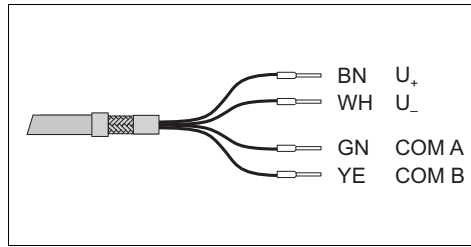
**Input**

<b>Measured variable</b>	<ul style="list-style-type: none"> <li>■ Conductivity</li> <li>■ Temperature</li> </ul>
<b>Cell constant</b>	$k = 1.98 \text{ cm}^{-1}$
<b>Measuring frequency</b>	2 kHz
<b>Measuring range</b>	Conductivity: 2 $\mu\text{S/cm}$ to 2000 $\text{mS/cm}$ (uncompensated) Temperature: -20 to +180 °C (-4 to +350 °F)
<b>Temperature measurement</b>	<b>CLS50D</b> Pt 1000 (class A acc. to IEC 60751) <b>CLS50</b> Pt 100 (class A acc. to IEC 60751)

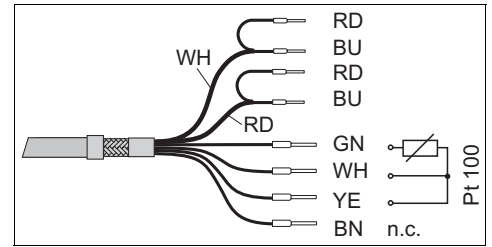
## Wiring

### Cable specification

The sensor is supplied with a fixed cable. The connection to the transmitter can be extended using the CYK81 (CLS50D) or the CLK5 (CLS50) special measuring cable.



CYK81 for cable extension for CLS50D  
– max. total cable length: 100 m (330 ft)



CLK5 for cable extension for CLS50  
– max. total cable length: 55 m (180 ft)

**i** Please note that the residual coupling increases when the cable is extended.

## Performance characteristics

### Maximum measured error

- **-20 to 100 °C (-4 to 212 °F):**  
±(5 μS/cm + 0.5 % of the measured value)
- **> 100 °C (212 °F):**  
±(10 μS/cm + 0.5 % of the measured value)

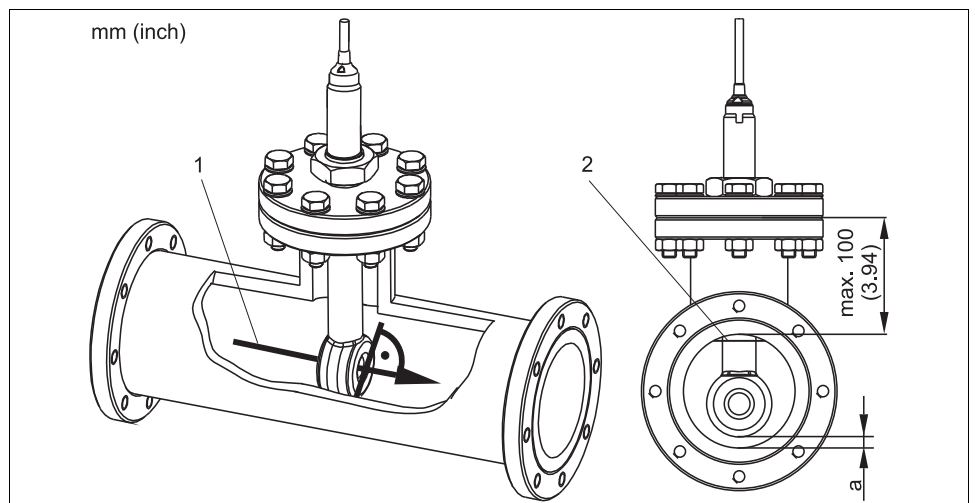
### Temperature response time

- **PEEK versions:**  
approx. 7 min
- **PFA versions:**  
approx. 11 min

## Installation conditions

### Installation position

Install the sensor in such a way that the sensor opening is oriented in the flow direction of the medium. The sensor head must be completely immersed in the medium.



Installation position of the sensor

- 1 Flow direction of medium
- 2 Minimum water level in the pipe
- a Sensor distance from the pipe wall

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**Installation factor**

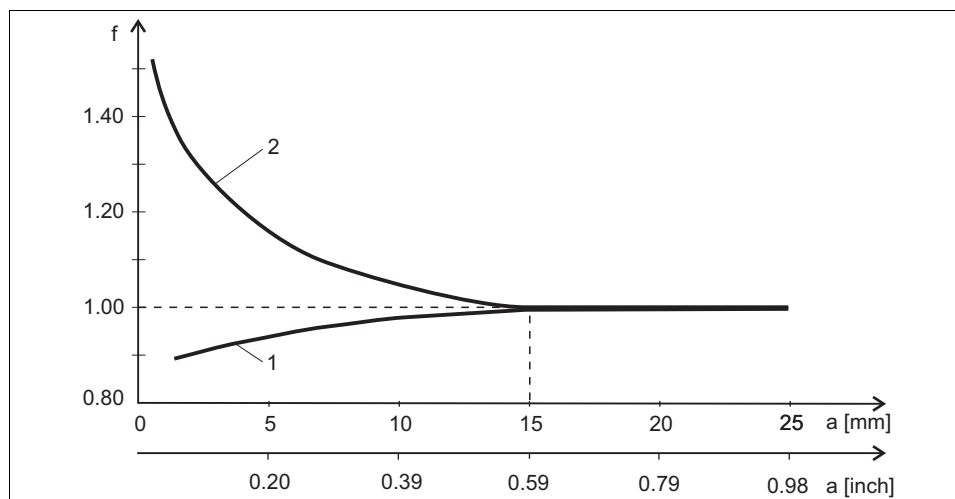
In narrow installation conditions, the conductivity measurement is affected by the pipe walls. This effect is compensated by the so-called installation factor. The transmitter corrects the cell constant by multiplication with the installation factor.

The value of the installation factor depends on the diameter and the conductivity of the pipe as well as the sensor's distance from the wall.

If the distance from the wall is sufficient ( $a > 15$  mm (0.59"), from DN 80), it is not necessary to consider the installation factor ( $f = 1.00$ ).

If the distance from the wall is smaller, the installation factor increases in case of electrically insulating pipes ( $f > 1$ ) and decreases in case of electrically conductive pipes ( $f < 1$ ).

The installation factor can be measured using calibration solutions or it can be approximately determined from the following diagram.



Relationship between installation factor  $f$  and distance from wall  $a$

- 1 Electrically conductive pipe wall  
2 Insulating pipe wall

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**Air set****CLS50**

To compensate residual coupling in the cable and between the two sensor coils, you must perform a zero calibration in air ("air set") before installing the sensor.

For further information, refer to the Operating Instructions of your transmitter.

**CLS50D**

The digital sensor is already adjusted at the factory, an on-side compensation is not necessary.

**Installation of sensors with flange**

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

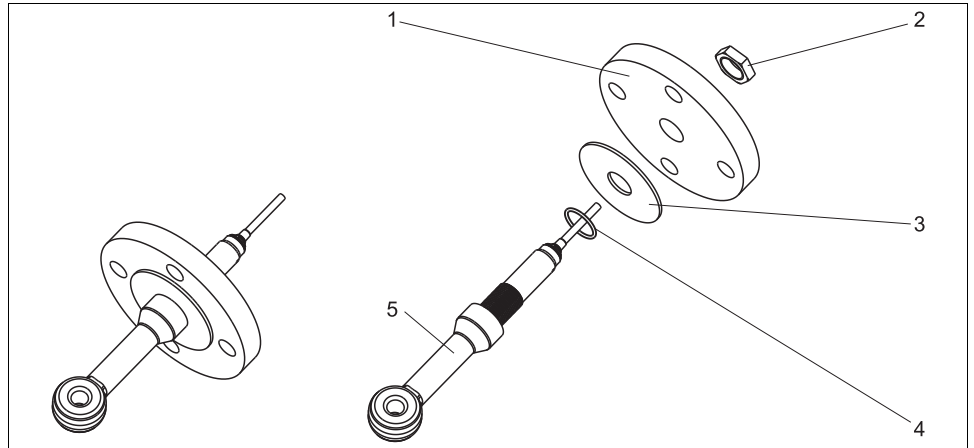
**▲ WARNING**

**Leakages**

Danger of injuries by leaking medium

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

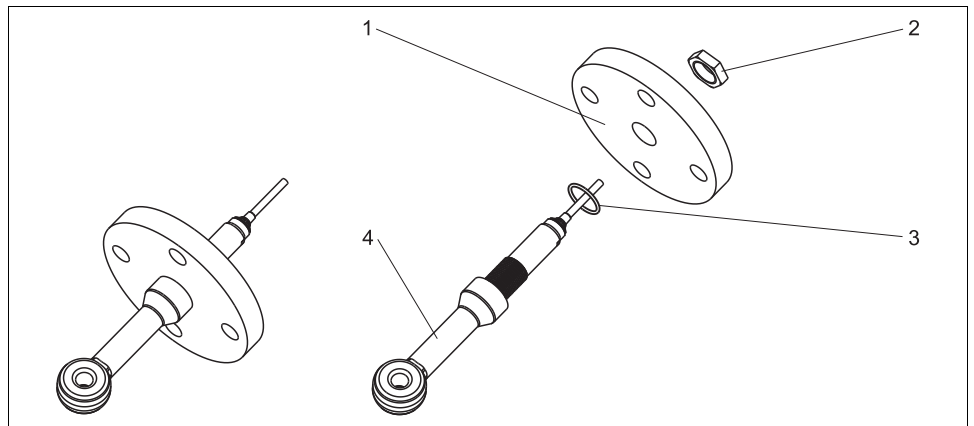
**Flange, not in contact with medium**



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

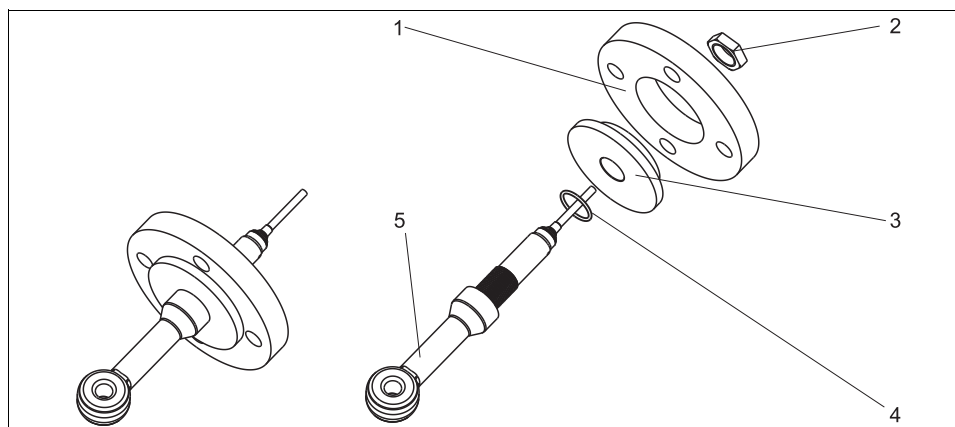
- |   |                          |   |        |
|---|--------------------------|---|--------|
| 1 | Flange (stainless steel) | 4 | O-ring |
| 2 | Nut                      | 5 | Sensor |
| 3 | Sealing disk (GYLON)     |   |        |

**Flange, in contact with medium**



Fixed flange, in contact with medium (order option "process connection": 3, 4)

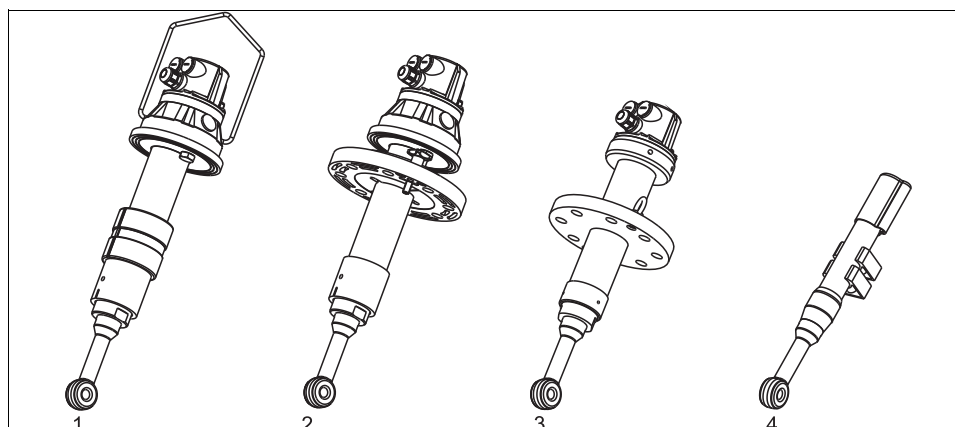
- |   |                          |   |        |
|---|--------------------------|---|--------|
| 1 | Flange (stainless steel) | 3 | O-ring |
| 2 | Nut                      | 4 | Sensor |

**Lap-joint flange, not in contact with medium**

Lap-joint flange, not in contact with medium (order option "process connection": A, B, C)

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

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**Installation of sensor assembly**

Installation of sensor with assembly

- |   |                                |   |                               |
|---|--------------------------------|---|-------------------------------|
| 1 | CLA111 with suspension bracket | 3 | CLA140 with flange connection |
| 2 | CLA111 with flange connection  | 4 | CYA611                        |

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**Environment**

<b>Ambient temperature range</b>	<b>CLS50D</b>
	-10 to +60 °C (+10 to +140 °F)
	<b>CLS50</b>
	-10 to +70 °C (+10 to +160 °F)

<b>Storage temperature</b>	-20 to +80 °C (-4 to +180 °F)
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<b>Ingress protection</b>	IP 68 / NEMA 6 (installed with original sealing)
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## Process

### Process temperature

#### CLS50D

Sensor	Without flange	DN50, ANSI 2"	JIS	PVDF lap-joint flange
PEEK	CLS50D-*1/2	CLS50D-*3/4/5/6/8	CLS50D-*7	CLS50D-*A/B/C
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)
PFA	-20 to 110 °C (-4 to 230 °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)

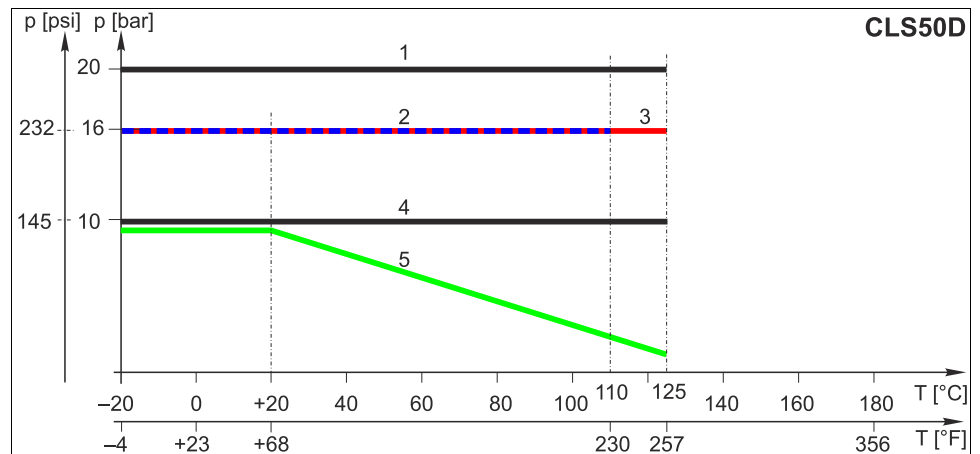
#### CLS50

Sensor	Without flange	DN50, ANSI 2"	JIS	PVDF lap-joint flange
PEEK	CLS50-*1/2	CLS50-*3/4/5/6/8	CLS50-*7	CLS50-*A/B/C
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)
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)

### Process pressure

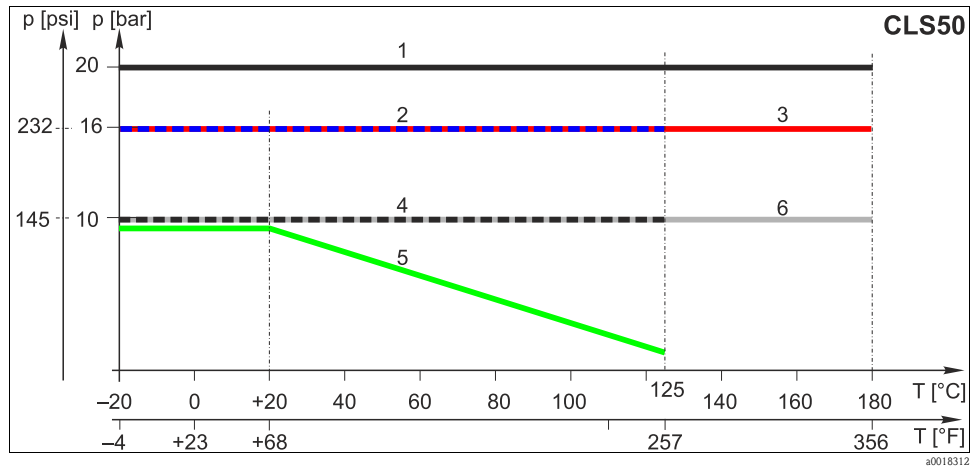
max. 20 bar (290 psi), acc. to the sensor version, see pressure-temperature diagram

### Pressure-temperature diagram



Pressure-temperature-diagram of CLS50D

- 1 PEEK sensor, without flange
- 2 PFA sensor, without flange (blue line)
- 3 PEEK or PFA sensor, with DN50/ANSI 2" flange (red line)
- 4 PEEK or PFA sensor, with JIS flange
- 5 PEEK or PFA sensor, with lap-joint flange PVDF (green line)

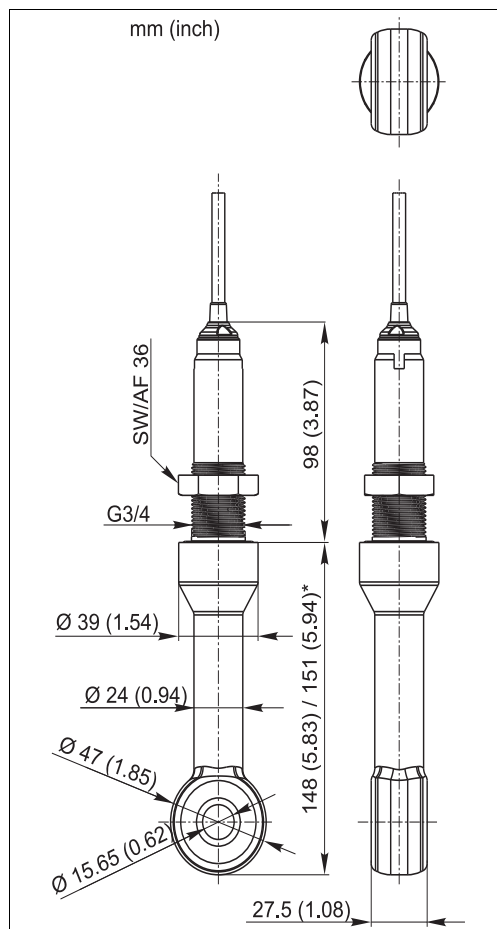


Pressure-temperature-diagram of CLS50

- 1 PEEK sensor, without flange
- 2 PFA sensor, without flange or with DN50/ANSI 2" flange (blue line)
- 3 PEEK sensor, with DN50/ANSI 2" flange (red line)
- 4 PFA sensor, with JIS flange (black line)
- 5 PEEK or PFA sensor, with lap-joint flange PVDF (green line)
- 6 PEEK sensor, with JIS flange (grey line)

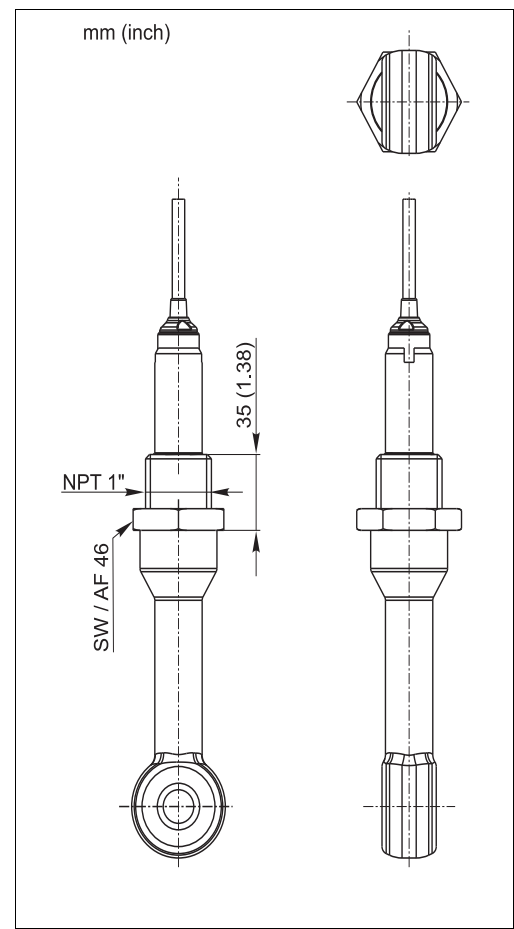
## Mechanical construction

### Sensor dimensions



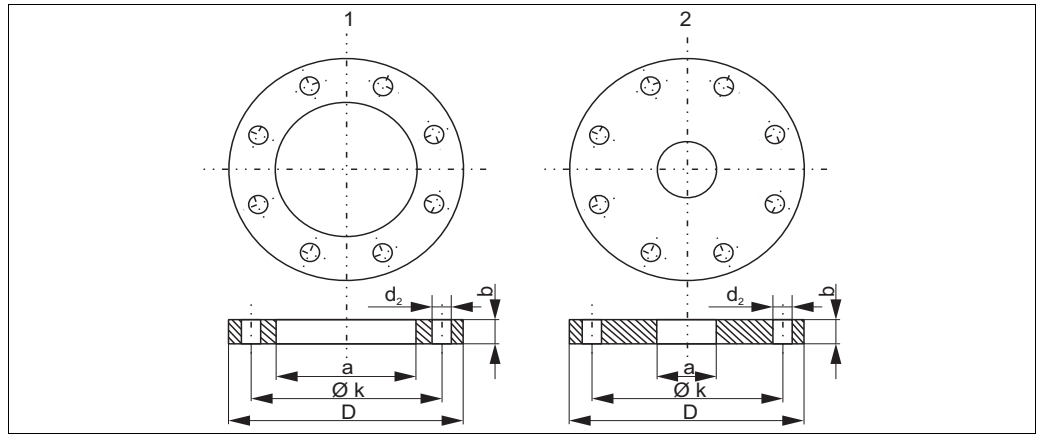
Dimensions of sensor version with G 3/4 thread

\* Dimensions of PEEK version



Dimensions of sensor version with NPT 1" thread

**Flange dimensions**



Flange dimensions

- 1 Lap-joint flange (PP-GF)
- 2 Fixed flange (stainless steel)

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

Fixed flange SS 316 L	DN50 PN16	ANSI 2" 300 lbs	JIS 10K 50A
<b>D</b>	165	165.1	155
<b>Ø k</b>	125	127	120
<b>d<sub>2</sub></b>	4 x 18	8 x 19	4 x 19
<b>b</b>	18	22.2	16
<b>a</b>	27	27	27
<b>Screws</b>	M16	M16	M16

**Weight** approx. 650 g (1.43 lbs)

**Material**

Sensor: PEEK, PFA (depending on ordered version)  
 Sensor seal: VITON, CHEMRAZ (depending on ordered version)  
 Process connections:  
     G ¾: CLS50-\*\*A: stainless steel 1.4571 (AISI 316Ti)  
           CLS50-\*\*B/C: PEEK GF30  
           CLS50D-\*\*D: stainless steel 1.4571 (AISI 316Ti)  
           CLS50D-\*\*B/C: PEEK GF30  
     NPT 1": PEEK  
     Fixed flange: stainless steel 1.4404 (AISI 316 L)  
     Sealing disk: GYLON (ceramic-filled PTFE)  
     Lap-joint flange: PP-GF  
     Flange combined with lap-joint flange: PVDF

**Chemical durability**

Medium	Concentration	PEEK	PFA	CHEMRAZ	VITON
Sodium hydroxide solution NaOH	0 to 50 %	20 to 100 °C (68 to 212 °F)	not suitable	0 to 150 °C (32 to 302 °F)	not suitable
Nitric acid HNO <sub>3</sub>	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 <sub>3</sub> PO <sub>4</sub>	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)
Sulphuric acid H <sub>2</sub> SO <sub>4</sub>	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)

No responsibility is taken for the correctness of this information.

## Ordering information

**Product page**

You can create a complete and valid order code by using the configurator on the internet product page.

Enter the following address to access the product page:

[www.products.endress.com/cls50](http://www.products.endress.com/cls50)

[www.products.endress.com/cls50d](http://www.products.endress.com/cls50d)

**Online configurator**

1. You can choose from the following options on the product page located on the right:

Product page function
:: Add to product list
:: Price & order information
:: Compare this product
:: Configure this product

2. Click "Configure this product".
3. The configurator opens in a separate window. You can now configure your device and receive the complete order code that applies for the device.
4. Afterwards, export the order code as a PDF or Excel file. To do so, click the appropriate button at the top of the page.

**Product structure**

**i** The following product structure represents the status of printing. You can create a complete and valid order code on the Internet using the configurator tool.

**CLS50D**

<b>Approval</b>	
AA	Non-hazardous area
BA	ATEX II 1G Ex ia IIC T3/T4/T6
BV	ATEX II 3G Ex nL IIC T4/T6 + NEPSI Ex nL IIC T4/T6
C2	CSA IS NI Cl. I, II, III, Div. 1&2, Group A-G
FB	FM IS NI Cl. I, II, III, Div. 1&2, Group A-G
NA	NEPSI Ex ia IIC T4/T6

<b>Process connection</b>	
A	Lap joint flange DN 50 PN 10, PP-GF
B	Lap joint flange ANSI 2" 150 lbs, PP-GF
C	Lap joint flange JIS 10 K 50 A, PP-GF
1	Thread G ¾
2	Thread NPT 1", PEEK
3	Flange DN 50 PN 16, stainless steel 1.4404 (AISI 316 L)
4	Flange ANSI 2" 300 lbs, stainless steel 1.4404 (AISI 316 L)
5	Flange DN 50 PN 16, stainless steel 1.4404 (AISI 316 L), PTFE sealing disk
6	Flange ANSI 2" 300 lbs, stainless steel 1.4404 (AISI 316 L), PTFE sealing disk
7	Flange JIS 10 K 50 A, stainless steel 1.4404 (AISI 316 L), PTFE sealing disk
8	Flange DN 50 PN 16, stainless steel 1.4404 (AISI 316 L), welded PFA sealing plate sensor

<b>Material: sensor , seal, adapter</b>	
B	PEEK, VITON, PEEK
C	PEEK , CHEMZRAZ, PEEK
D	PFA, CHEMRAZ, stainless steel 1.4571 (AISI 316 Ti)

<b>Cable length</b>	
1	3 m (9.84 ft)
2	7 m (23 ft)
3	15 m (49 ft)
7	... m fixed cable, max. 50 m
8	... ft fixed cable, max. 164 ft

<b>Cable connection</b>	
1	Fixed cable, terminated cable cores
2	Fixed cable, M12 plug

CLS50D-						<b>order code</b>
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<b>Calibration (single choice only)</b>	
F1	Cell constant

<b>Dienstleistung (multiple choice possible)</b>	
HC	LABS free (LABS = paint-wetting impairment substances)

<b>TAG (multiple choice possible)</b>	
1	TAG, see additional specification
2	Feldbus TAG

**CLS50**

<b>Approval</b>	
A	Non-hazardous area
G	ATEX II 1G Ex ia IIC T4/T6 Ga
H	NEPSI Ex ia IIC T4/T6
L	Non-hazardous area, PWIS free
O	FM IS NI Cl. I, II, III, Div. 1&2, Group A-G
S	CSA IS NI Cl. I, II, III, Div. 1&2, Group A-G
T	TIIS
V	ATEX II 3G Ex nL IIC T4/T6 + NEPSI Ex nL IIC T4/T6
<b>Process connection</b>	
A	Lap joint flange DN 50 PN 10, PVDF
B	Lap joint flange ANSI 2" 150 lbs, PVDF
C	Lap joint flange JIS 10 K 50 A, PVDF
1	Thread G 3/4
2	Thread NPT 1", PEEK
3	Flange DN 50 PN 16, stainless steel 1.4404 (AISI 316 L)
4	Flange ANSI 2" 300 lbs, stainless steel 1.4404 (AISI 316 L)
5	Flange DN 50 PN 16, stainless steel 1.4404 (AISI 316 L), PTFE sealing disk
6	Flange ANSI 2" 300 lbs, stainless steel 1.4404 (AISI 316 L), PTFE sealing disk
7	Flange JIS 10 K 50 A, stainless steel 1.4404 (AISI 316 L), PTFE sealing disk
8	Flange DN 50 PN 16, stainless steel 1.4404 (AISI 316 L), welded PFA sealing plate sensor
<b>Material: sensor, seal, adapter</b>	
A	PFA, CHEMRAZ, stainless steel 1.4571 (AISI 316 Ti)
B	PEEK, VITON, PEEK
C	PEEK, CHEMZRAZ, PEEK
<b>Cable length and temperature range</b>	
1	5 m (16 ft) fixed cable, max. 125 °C (257 °F)
2	10 m (32 ft) fixed cable, max. 125 °C (257 °F)
3	20 m (65 ft) fixed cable, max. 125 °C (257 °F)
4	fixed cable of specific length, max. 55 m (180 ft), max. 125 °C (257 °F)
5	5 m (16 ft) fixed cable, max. 180 °C (356 °F) (PEEK only, version for non-hazardous areas only)
6	10 m (32 ft) fixed cable, max. 180 °C (356 °F) (PEEK only, version for non-hazardous areas only)
CLS50-	<b>complete order code</b>

## Certificates and approvals

**Ex approvals****CLS50D**

- ATEX II 1G Ex ia IIC T4/T6 Ga

**CLS50**

- ATEX II 1G Ex ia IIC T4/T6 Ga
- ATEX II 3G Ex nL IIC T4/T6 + NEPSI Ex nL IIC T4/T6
- FM/CSA IS NI Cl. I, II, III, Div. 1 & 2; Group A - G in connection with a Liquiline CM42 or Mycom CLM153 transmitter
- NEPSI Ex ia IIC T4/T6

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## Accessories

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**Measuring cables****For CLS50D**

CYK11 Memosens data cable

- Extension cable for digital sensors with Memosens protocol
- Ordering as per product structure (→ Online configurator, [www.products.endress.com/cyk11](http://www.products.endress.com/cyk11))

**For CLS50**

Extension cable CLK6

- For inductive conductivity sensors, for extension via the VBM junction box, sold by the meter
- Order no.: 71183688

Junction box VBM

- For cable extension
- 10 terminals
- Cable entries: 2 x Pg 13.5 or 2 x NPT ½"
- Material: aluminum
- Ingress protection: IP 65 (≅ NEMA 4X)
- Order numbers:
  - cable entries Pg 13.5: 50003987
  - cable entries NPT ½": 51500177

**Assemblies**

Dipfit CLA111

- Immersion assembly for open and closed tanks with flange DN 100
- Ordering acc. to product structure, → online configurator: [www.products.endress.com/cla111](http://www.products.endress.com/cla111)
- Technical Information TI00135C/07/EN

Dipfit CLA140

- For the inductive sensors CLS50/CLS50D
- Immersion assembly with flange connection for highly demanding processes
- Ordering acc. to product structure, → online configurator: [www.products.endress.com/cla140](http://www.products.endress.com/cla140)
- Technical Information TI00196C/07/EN

Immersion assembly Dipfit CYA611

- For sensor immersion in basins, open channels and tanks, PVC
- Ordering acc. to product structure, → online configurator: [www.products.endress.com/cya611](http://www.products.endress.com/cya611)
- Technical Information TI00166C/07/EN

**Calibration solutions**

Precision solutions, traceable to SRM (standard reference material) by NIST, for qualified calibration of conductivity measurement systems according to ISO 9000, with temperature table

- 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  
107.0 mS/cm (reference temperature 25 °C / 77 °F), 500 ml / 16.9 fl.oz  
Order no. 50081906

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