



Level



Pressure



Flow



Temperature



Liquid
Analysis



Registration



Systems
Components



Services



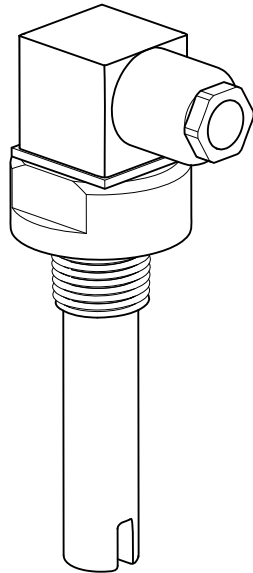
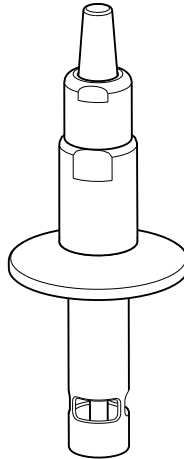
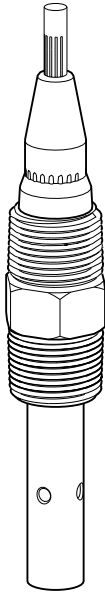
Solutions

Operating Instructions

Condumax CLS15/16/21

Analog sensors





For conductive measurement of conductivity in liquids



Documentation information

Warnings

The structure, signal words and safety colors of the signs comply with the specifications of ANSI Z535.6 ("Product safety information in product manuals, instructions and other collateral materials").

Safety message structure	Meaning
 DANGER Cause (/consequences) Possible consequences if ignored ▶ Preventive measures	This symbol alerts you to a dangerous situation. Failure to avoid the situation will result in a fatal or serious injury.
 WARNING Cause (/consequences) Possible consequences if ignored ▶ Preventive measures	This symbol alerts you to a dangerous situation. Failure to avoid the situation can result in a fatal or serious injury.
 CAUTION Cause (/consequences) Possible consequences if ignored ▶ Preventive measures	This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
 NOTICE Cause/situation Possible consequences if ignored ▶ Action/note	This symbol alerts you to situations that can result in damage to property and equipment.

Symbols used

→  1 This symbol indicates a cross reference to a defined page (e.g. p. 1).


→  2 This symbol indicates a cross reference to a defined figure (e.g. fig. 2).


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1 Basic safety instructions

1.1 Requirements for personnel

- ▶ Installation, commissioning, operation and maintenance of the measuring system must only be carried out by trained technical personnel.
- ▶ The technical personnel must be authorized by the plant operator to carry out the specified activities.
- ▶ The electrical connection may only be performed by an electrical technician.
- ▶ The technical personnel must have read and understood these Operating Instructions and must follow the instructions they contain.
- ▶ Measuring point faults may only be rectified by authorized and specially trained personnel.

 Repairs not described in the enclosed Operating Instructions may only be carried out directly at the manufacturer's or by the service organization.

1.2 Designated use

The conductivity sensors are designed for conductive measurement of the conductivity in liquids. They are applied in the following fields:

Sensor	Fields of application	Hazardous areas
Condumax CLS15	Measurements in pure and ultrapure water	approved for hazardous areas, zone 1
Condumax CLS16	Measurements in pure and ultrapure water hygienic processes	approved for hazardous areas, zone 1
Condumax CLS21	Measurements in media with medium or high conductivities	approved for hazardous areas, zone 1

Any other use than the one described here compromises the safety of persons and the entire measuring system and is not permitted.

The manufacturer is not liable for damage caused by improper or non-designated use.

1.3 Occupational safety

As the user, you are responsible for complying with the following safety conditions:

- Installation instructions
- Local prevailing standards and regulations.

1.4 Operational safety

- ▶ Before commissioning the entire measuring point, make sure all the connections are correct. Ensure that electrical cables and hose connections are not damaged.
- ▶ Do not operate damaged products, and safeguard them to ensure that they are not operated inadvertently. Mark the damaged product as defective.
- ▶ If faults cannot be rectified, the products must be taken out of service and secured against unintentional commissioning.

1.5 Product safety

1.5.1 State of the art

The sensor has been designed and tested according to the state of the art and left the factory in perfect functioning order.

Relevant regulations and European standards have been met.

1.5.2 Safety instructions for electrical equipment in hazardous locations

ATEX II 1G Ex ia IIC T3 / T4 / T6

- The CLSxx sensors have been developed and manufactured in accordance with European standards and directives and are suitable for use in hazardous areas.
- Compliance with the harmonized European standards for the use of the sensors in hazardous areas is confirmed by the EC type examination. The related EC declaration of conformity forms an integral part of this document.
- The electrical connection of the CLSxx sensors must correspond to the wiring diagram (see chapter "Wiring").
- The CLSxx sensors may only be operated at suitable intrinsically safe circuits. Ensure that the maximum permitted characteristic input values for the sensors and the maximum permitted inductivity L_i and capacities C_i in these circuits are not exceeded.
- The maximum permitted cable length is limited by the maximum characteristic values of the transmitter: The sum of maximum permitted inductivities L_i and capacities C_i of sensor and measuring cable must not exceed the maximum permitted inductivity L_o and capacity C_o of the transmitter.
- The maximum permitted cable length with the transmitter Mycom S CLM153 and the measuring cables CYK71 / CYK71-Ex resp. CPK9 is 16 m (52.5 ft). The maximum permitted length with the Liquiline M CM42 transmitter is 50 m (164 ft).
- The CLS21 sensor may only be used in fluids with a minimum conductivity of > 10 nS/cm.
- The regulations for electrical installations in hazardous areas (EN60079-14) must be observed for the use of the devices and sensors.

2 Identification

2.1 Nameplate

The nameplate can be found on the sensor.

The following information is provided on the nameplate:

- Order code
- Extended order code
- Serial number
- Cell constant (nominal value)
- Protection class
- Pressure specification at 20 °C
- Continuous service temperature
- Ex marking for versions with Ex approval

Compare the data on the nameplate with your order.

2.2 Order code interpretation

2.2.1 Product page links

www.products.endress.com/cls15

www.products.endress.com/cls16

www.products.endress.com/cls21

2.2.2 Product 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.
Use the radio buttons to configure the order code from the nameplate of your device.
4. Afterwards, you can export the order code as a PDF or Excel file.
To do so, click the appropriate button at the top of the page.

2.3 Temperature classes for hazardous locations

Name	Type						Process temperature T_a within Temperature class (T_n)	Cat.
			x_1	x_2	x_3	x_4		
Condumax	CLS15	-	*	**	*	A	-20 °C ≤ T_a ≤ +140 °C (T3) -20 °C ≤ T_a ≤ +115 °C (T4) -20 °C ≤ T_a ≤ +65 °C (T6)	II 1G
Condumax	CLS16	-	x	**	*	A	-5 °C ≤ T_a ≤ +150 °C (T3) -5 °C ≤ T_a ≤ +120 °C (T4) -5 °C ≤ T_a ≤ +70 °C (T6)	II 1G
	CLS16	-	x	**	*	B	-5 °C ≤ T_a ≤ +150 °C (T3) -5 °C ≤ T_a ≤ +115 °C (T4) -5 °C ≤ T_a ≤ +65 °C (T6)	II 1G
Condumax	CLS21	-	*	**	*	D	-20 °C ≤ T_a ≤ +135 °C (T3) -20 °C ≤ T_a ≤ +130 °C (T4) -20 °C ≤ T_a ≤ +80 °C (T6)	II 1G
	CLS21	-	*	**	*	A	-20 °C ≤ T_a ≤ +135 °C (T3) -20 °C ≤ T_a ≤ +115 °C (T4) -20 °C ≤ T_a ≤ +65 °C (T6)	II 1G

- x Position not existing
- x_1 Measuring range nad cell constant (no Ex relevance)
- x_2 Process connection / Material (no Ex relevance)
- x_3 Cable connection
- x_4 Temperature sensor: A = Pt100, B = Pt1000, D = without temperature sensor

- If the process temperatures indicated are observed, no impermissible temperatures for the temperature class in question occur at the equipment.
- Due to functional reasons, the CLS15 sensors may only be operated up to 120 °C (248 °F) during permanent operation / short-time operation up to 140 °C (284 °F).
- Due to functional reasons, the CLS16 sensors may only be operated up to 120 °C (248 °F) during permanent operation / short-time operation up to 150 °C (302 °F).

2.4 Certificates and approvals

2.4.1 CE conformity

Declaration of conformity

The product meets the requirements of the harmonized European standards. It thus complies with the legal requirements of the EC directives. The manufacturer confirms successful testing of the product by affixing the **CE** symbol.

2.4.2 EX approvals

- ATEX II 1G Ex ia IIC T3 / T4 / T6
- FM/CSA IS/NI CL I Div. 1 & 2 GP A - D in combination with the Liquiline CM42 and Mycom CLM153 transmitters

2.4.3 Test certificate acc. to EN 10204 3.1

available for clamp 1½" process connection

2.4.4 Notified body

Deutsche Montan Technologie GmbH

Bochum

3 Installation

Clamp connection: (all sensors)

Sensors with clamp connections can be fixed using sheet metal brackets or solid brackets.

Sheet metal brackets have a lower dimensional stability, uneven bearing surfaces causing point loads and sometimes sharp edges that can damage the clamp.

We strongly recommend to always use solid brackets because of their higher dimensional stability. Solid brackets may be applied over the total pressure-temperature range (see temperature-pressure load curve).

3.1 CLS15

The sensors are mounted directly via the thread NPT 1/2" or 3/4" or clamp 1 1/2" process connections. Optionally, the sensor can be installed in cross or T-pieces or in a flow chamber.

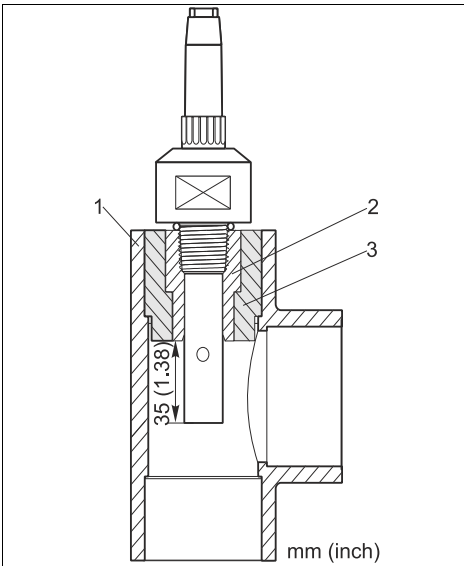


Fig. 1: With NPT 1/2" installed in T- or cross piece

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- 1 T- or cross piece (DN 32, 40 or 50)
- 2 PVC-threaded coupling for cementing (NPT 1/2" for DN 20, see Accessories)
- 3 Adapter coupling for cementing (for DN 32, 40 or 50, see Accessories)

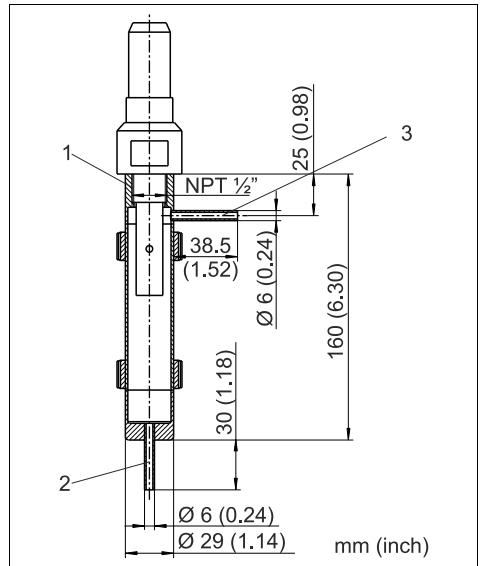


Fig. 2: With NPT 1/2" installed in flow assembly 71042405

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- 1 Sensor support NPT 1/2"
- 2 Inlet
- 3 Outlet



The measuring surfaces of the sensor must be completely immersed in the medium during operation. Minimum immersion depth is 32 mm (1.26").

When working in ultrapure water, ingress of air must be prevented since dissolved air, particularly CO₂, may increase conductivity by up to 3 µS/cm.

3.2 CLS16

The sensors are mounted directly via the process connection.
When installing the sensor in pipes, note the flow direction of the medium (see figure below).

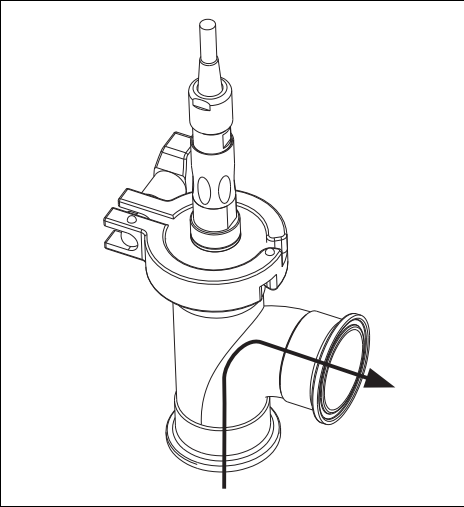


Fig. 3: Permissible flow direction

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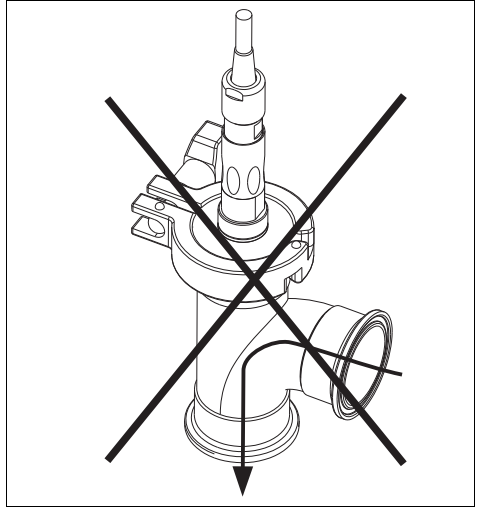


Fig. 4: Non-permissible flow direction

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i The measuring surfaces must be completely immersed in the medium during operation. When working in ultrapure water, ingress of air must be prevented since dissolved air, particularly CO₂, may increase conductivity by up to 3 μS/cm.

3.3 CLS21

The sensors are mounted directly via the process connection. Optionally, they can be installed in flow assemblies.

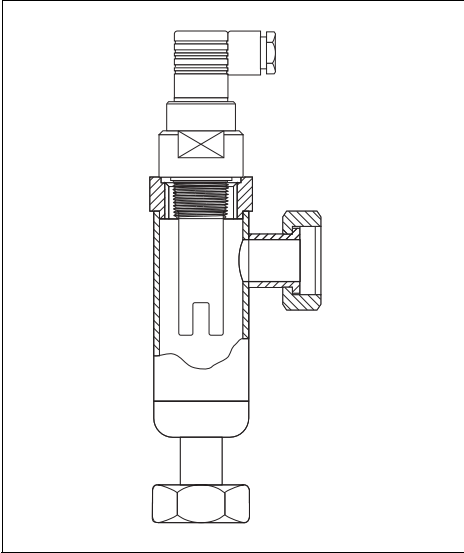


Fig. 5: Installation in the CLA751 flow assembly

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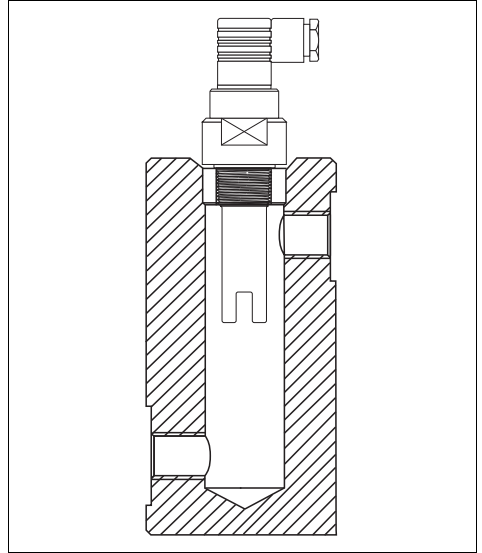


Fig. 6: Installation in the CLA752 flow assembly

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For installation of sensors with G1 thread in tanks, the CLA111 immersion and process assembly is available (see Accessories).

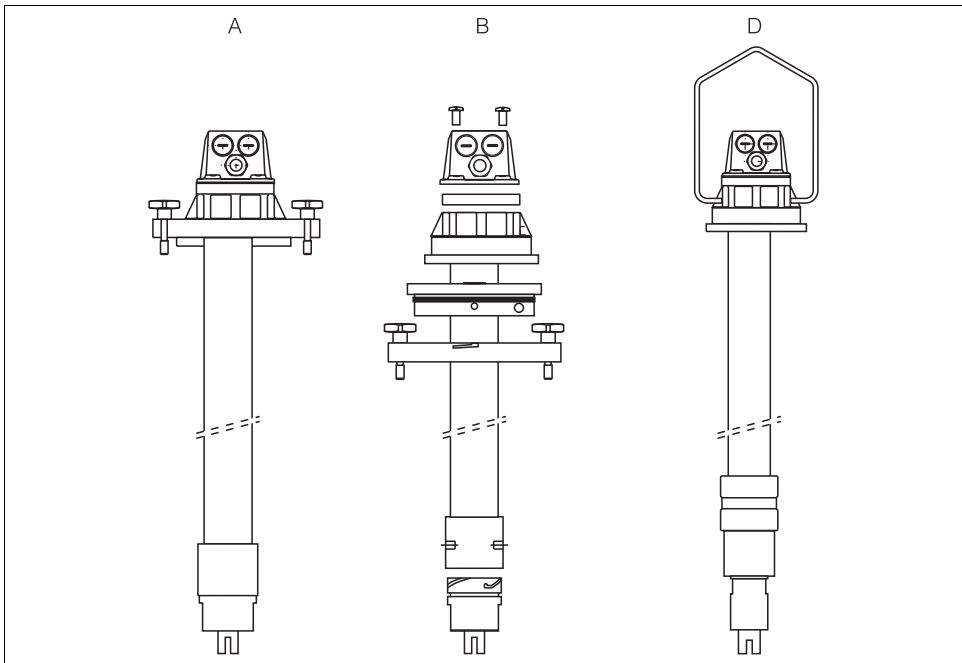


Fig. 7: Dipfit CLA111, mounting versions A, B and D

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i The measuring surfaces must be completely immersed in the medium during operation.

3.4 Post-installation check

- ▶ Are sensor and cable undamaged?
- ▶ Is the sensor installed via process connection and not suspended from the cable?

4 Wiring

⚠ WARNING

Device is energized

Improper connection can cause injury or death.

- ▶ The electrical connection must only be carried out by a certified electrician.
- ▶ Technical personnel must have read and understood the instructions in this manual and must adhere to them.
- ▶ **Prior to beginning** any wiring work, make sure voltage is not applied to any of the cables.

4.1 Connection to the transmitter

4.1.1 CLS15, CLS21

The sensor is connected via the fixed cable or via the CYK71 measuring cable with shield. For the wiring diagram, refer to the Operating Instructions of the used transmitter.

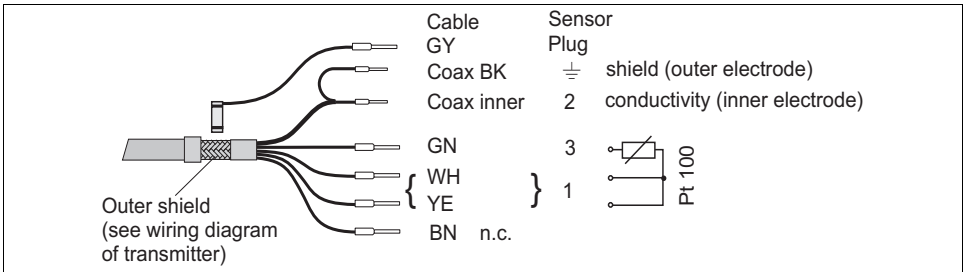


Fig. 8: CYK71 measuring cable

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To extend the cable, a VBM junction box and a CYK71 extension cable is required.

4.1.2 CLS16

The sensor is connected via the CPK9 measuring cable. For the wiring diagram, refer to the Operating Instructions of the transmitter used.

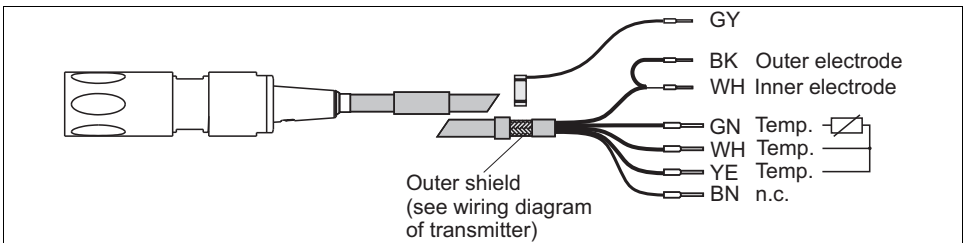


Fig. 9: CPK9 measuring cable

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To extend the cable, a VBM junction box and a CYK71 extension cable is required.

4.2 Wiring diagram for explosion-hazardous areas

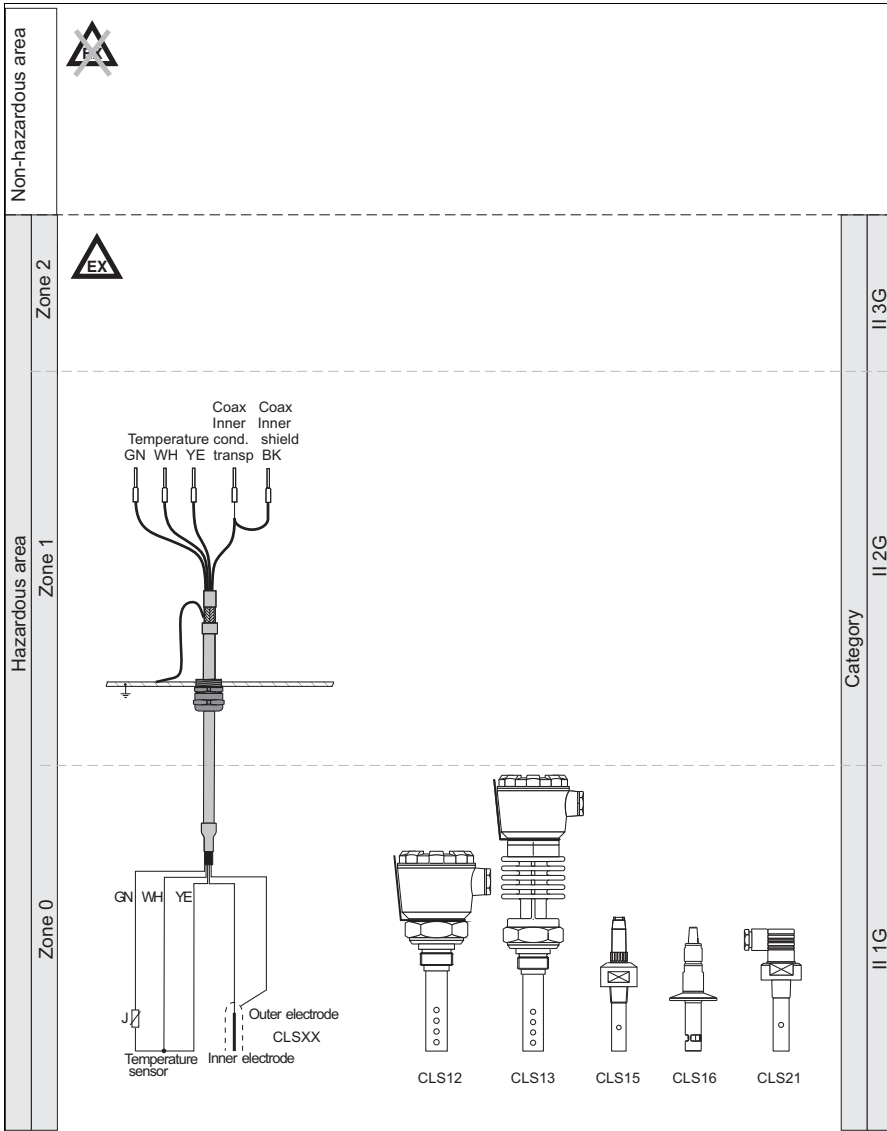


Fig. 10: Electrical connection CLSxx

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5 Commissioning

Before first commissioning, check if:

- the sensor is correctly installed
- the electrical connection is correct.

If using an assembly with automatic cleaning, check the correct connection of the cleaning agent (e.g. water or air).

⚠ WARNING

Incorrect connection of a cleaning unit to an assembly

Danger of medium leaking off

- ▶ Before applying compressed air to an assembly with cleaning facility, make sure the connections are correctly fitted. Otherwise, the assembly may not be inserted into the process.

6 Maintenance

6.1 Cleaning

⚠ WARNING

Burning chemicals

Danger of chemicals burns to the eyes and skin. Danger of damage to clothing and equipment.

- ▶ It is absolutely essential to protect the eyes and hands properly when working with acids, bases and organic solvents!
- ▶ Wear protective goggles and safety gloves.
- ▶ Clean away splashes on clothes and other objects to prevent any damage.
- ▶ Pay particular attention to the information provided in the safety data sheets for the chemicals used.

Clean away fouling on the sensor as follows depending on the particular type of fouling:

- Oily and greasy films:
Clean with grease remover, e.g. alcohol, acetone, as well as hot water and dishwashing detergent if necessary.
- Lime and metal hydroxide buildup:
Dissolve buildup with diluted hydrochloric acid (3 %) and then rinse thoroughly with plenty of clear water.
- Sulfidic buildup (from flue gas desulfurising or sewage treatment plants):
Use a mixture of hydrochloric acid (3 %) and thiocarbamide (commercially available) and then rinse thoroughly with plenty of clear water.
- Buildup containing proteins (e.g. food industry):
Use a mixture of hydrochloric acid (0.5 %) and pepsin (commercially available) and then rinse thoroughly with plenty of clear water.

6.2 Seal replacement (CLS16 only)

6.2.1 Checking the sensors

Intact seals are a prerequisite for safe and accurate measurement.

To ensure highest operational reliability and complete hygiene of the sensor according to 3-A Standard 74-, the seal should be replaced at regular intervals.

The actual maintenance intervals can only be determined by the operator since they strongly depend on the operating conditions such as:

- type and temperature of the medium
- type and temperature of the cleaning solution
- number of cleanings
- number of sterilizations
- ambient conditions

Recommended intervals for seal replacement

Application	Seal replacement (recommended interval)
Medium temperature from 50 up to 100 °C (122 to 212 °F)	approx. every 18 months
Medium temperature below 50 °C (122 °F)	approx. every 36 months
Sterilization cycles, max. 145 °C (293 °F), 30 min	approx. 400 cycles

Replacement of seals and recalibration

If the sensor is exposed to very high loads, you can have it regenerated at the Endress+Hauser Service (see Accessories). Regeneration includes replacement of seals and recalibration of the sensor. Send the sensor to the responsible Endress+Hauser sales center.

6.2.2 Seal replacement

- Factory replacement of seals and factory recalibration of sensors;
order no. 51505585

6.3 Return

The device must be returned if repairs or a factory calibration are required, or if the wrong device has been ordered or delivered. According to legal regulations, Endress+Hauser, as an ISO-certified company, is required to follow certain procedures when handling returned products that are in contact with medium.

To ensure swift, safe and professional device returns, please read the return procedures and conditions on the internet site:

www.services.endress.com/return-material

7 Technical data

7.1 Input

7.1.1 Measured variable

- Conductivity
- Temperature

7.1.2 Measuring range

Conductivity (referenced to water at 25 °C (77 °F))

CLS15-A 0.04 to 20 µS/cm

CLS15-B 0.10 to 200 µS/cm

CLS16 0.04 to 500 µS/cm

CLS21 10 µS/cm to 20 mS/cm

valid in the specified temperature range

specified measuring accuracy up to 100 °C (212 °F)

Temperature

specified measuring accuracy up to 100 °C (212 °F)

7.1.3 Cell constant

CLS15-A

$k = 0.01 \text{ cm}^{-1}$

CLS15-B

$k = 0.1 \text{ cm}^{-1}$

CLS16

$k = 0.1 \text{ cm}^{-1}$

CLS21

$k = 1.0 \text{ cm}^{-1}$, nominal

7.1.4 Temperature compensation

Pt 100(class A acc. to IEC 60751)

7.2 Performance characteristics

7.2.1 CLS15

Each individual sensor is factory measured in a solution of approx. 5 $\mu\text{S}/\text{cm}$ for cell constant 0.01 cm^{-1} or approx. 50 $\mu\text{S}/\text{cm}$ for cell constant 0.1 cm^{-1} on a reference measuring system referred to NIST or DKD. The accurate cell constant is entered in the supplied quality certificate. The maximum measured error in cell constant determination is 1.0%.

7.2.2 CLS16

Each individual sensor is factory-measured in a solution of approx. 5 $\mu\text{S}/\text{cm}$ with a reference system traceable to NIST or DKD. The exact cell constant is entered into the supplied quality certificate. The maximum measured error in cell constant determination is 1.0 %.

7.2.3 CLS21

Each individual sensor is factory measured in a solution of approx. 5 mS/cm on a reference measuring system referred to NIST or DKD. The accurate cell constant is entered in the supplied quality certificate. The maximum measured error in cell constant determination is 1.0 %.

7.3 Environment

7.3.1 Ambient temperature

-20 to +60 °C (-4 to +140 °F)

7.3.2 Storage temperature

-25 to +80 °C (-10 to +180 °F)

7.3.3 Humidity

5 to 95%

7.3.4 Protection degree

CLS15 IP 67 / NEMA 6

CLS16
 Fixed cable version IP 67 / NEMA 6
 TOP68 plug system IP 68 / NEMA 6

CLS21
 Fixed cable version IP 67 / NEMA 6
 Plug-in head version IP 65 / NEMA 4X

7.4 Process

7.4.1 Process temperature

CLS15

Thread version w. fixed cable -20 to 100 °C (-4 to 212 °F)

Thread version with plug-in head, clamp version

Normal operation: -20 to 120 °C (-4 to 248 °F)

Sterilization (max. 1 h): max. 140 °C (284 °F)

CLS16

Normal operation: -5 to 120 °C (23 to 248 °F)

Sterilization (max. 45 min): max. 150 °C (302 °F) at 5 bar (73 psi)

CLS21

-20 to +135 °C (-4 to 275 °F) at 2.5 bar (36 psi)

7.4.2 Process pressure

CLS15

12 bar (170 psi) at 20 °C (68 °F)

CLS16

12 bar (170 psi) at 20 °C (68 °F)

8 bar (120 psi) at 120 °C (248 °F)

0.1 bar abs. (1.5 psi abs. (depression)) at 20 °C (68 °F)

CLS21

16 bar (230 psi) at 20 °C (68 °F)

7.4.3 Pressure/temperature load curves

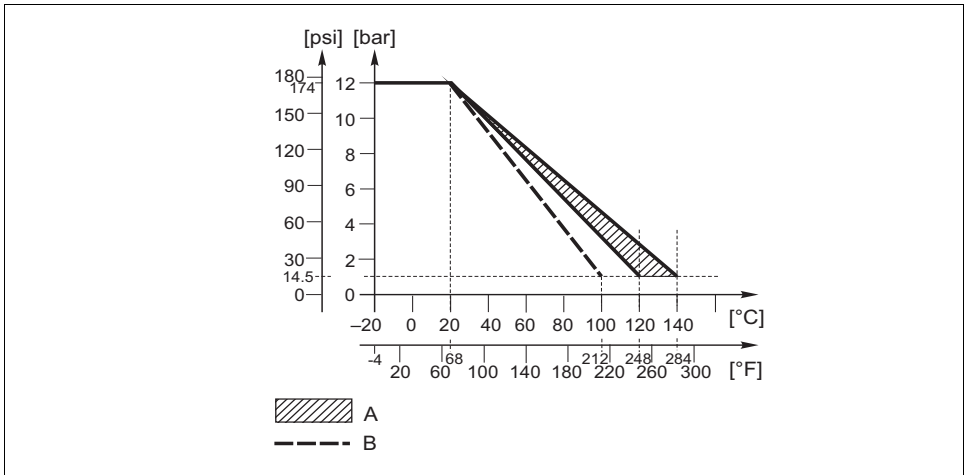


Fig. 11: Mechanical pressure-temperature stability of CLS15

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- A Short-time sterilizable (1 h)
- B Thread version with fixed cable

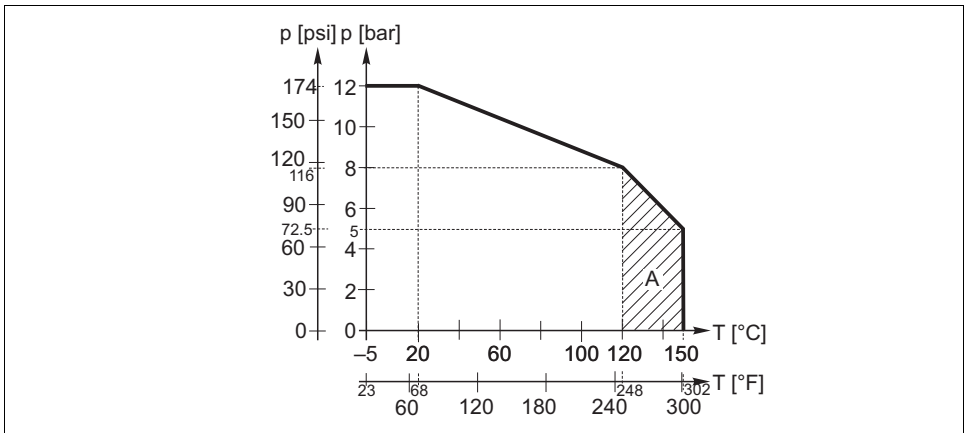


Fig. 12: Mechanical pressure-temperature stability of CLS16

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- A Short-time sterilizable (45 min)

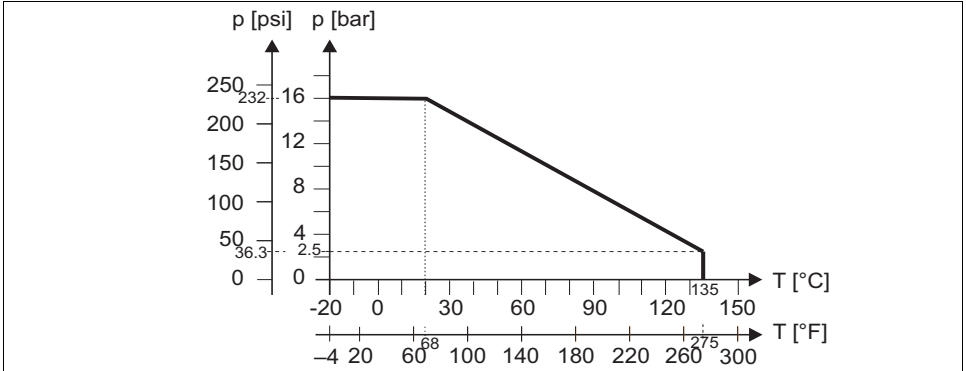


Fig. 13: Mechanical pressure-temperature stability of CLS21

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7.5 Mechanical construction

7.5.1 Weight

CLS15 and CLS21

Depending on version, approx. 0.3 kg (0.7 lb.)

CLS16

Depending on version, approx. 0.13 to 0.75 kg (0.3 to 1.7 lb.)

7.5.2 Material

CLS15

Electrodes:	polished, stainless steel 1.4435 (AISI 316L)
Sensor shaft:	polyether sulfone (PES-GF20)
O-ring, in contact with medium: (clamp version only)	EPDM

CLS16

Electrodes:	electro-polished, stainless steel 1.4435 (AISI 316L)
Seal:	molded seal ISOLAST (FFKM), listed with FDA

CLS21

Electrodes:	graphite
Sensor shaft:	polyether sulfone (PES-GF20)
Thermal conductivity socket for temperature sensor:	titanium 3.7035

7.5.3 Surface roughness**CLS15**

$R_a \leq 0.8 \mu\text{m}$
 ($R_a \leq 0.4 \mu\text{m}$ available as TSP C-LS020130-02)

CLS16

$R_a \leq 0.8 \mu\text{m}$, electro-polished
 $R_a \leq 0.4 \mu\text{m}$, electro-polished, optional

7.5.4 Process connections**CLS15**

Fixed-cable versions:
 Thread NPT $\frac{3}{4}$ "
 Clamp $1\frac{1}{2}$ " acc. to ISO 2852

Plug-in head versions:
 Thread NPT $\frac{1}{2}$ "
 Clamp $1\frac{1}{2}$ " acc. to ISO 2852

CLS16

Clamp 1", $1\frac{1}{2}$ ", 2" acc. to ISO 2852 (also suitable for TRI-CLAMP, DIN 32676)
 Tuchenhausen VARIVENT N DN 50 to 125
 NEUMO BioControl D50

CLS21

Fixed cable version:
 Thread NPT 1"
 Clamp 2" acc. to ISO 2852
 SMS DN 38 ($1\frac{1}{2}$ ")

Plug-in head version:
 Thread G 1
 Clamp 2" acc. to ISO 2852
 Dairy fitting DN 25 or DN 40 acc. to DIN 11851
 SMS DN 38 ($1\frac{1}{2}$ ")

8 Declaration of conformity

EG-Konformitätserklärung EC Declaration of Conformity CE Déclaration de Conformité



Endress+Hauser Conducta
Gesellschaft für Mess- und Regeltechnik mbH+Co.KG
Dieselstraße 24, D-70839 Gerlingen
 erklärt in alleiniger Verantwortung, dass die Produkte
 declares under its sole responsibility that the products
 déclare sous sa seule responsabilité que les produits

ConduMax CLSxx / CLSxxG

EG-Baumusterprüfbescheinigung: **EX5 02 12 30266 006**
 EC type-examination certificate:
 Certificat de l'examen CE de type:

mit den Vorschriften folgender Europäischen Richtlinien übereinstimmen:
 are in conformity with the regulations of the following European Directives:
 sont conformes aux prescriptions et Directives Européennes ci-dessous:

94/9/EG (Geräte zur Verwendung in explosionsgefährdeten Bereichen)
 (Equipment for use in potentially explosive atmospheres)
 (Appareils et systèmes de protection en atmosphère explosive)

Angewandte harmonisierte Normen oder normative Dokumente:
 Applied harmonized standards or normative documents:
 Normes harmonisées ou documents normatifs appliqués:
EN 50014:1997 + Corrigendum 1998 + A1:1999 + A2:1999
EN 50020:1994, EN 50284:1999

Benannte Stelle für QS-Überwachung:
 Notified body for QA control:
 Organisme notifié pour l'assurance qualité:

Deutsche Montan Technologie GmbH
 Kennummer / Identification number /
 Numéro d'identification (0158)

Gerlingen, 10. März 2003

Dr. Wolfgang Babel
 (Geschäftsführer / Managing Director / P.D.G.)

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People for Process Automation

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