

Operating Instructions

OUSAF21

Optical sensor for low level color measurement



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1 About this document

1.1 Warnings

Structure, signal words and color coding of warning information are in compliance with ANSI Z535.6 specifications ("Product safety information in product manuals, instructions and other collateral materials").

Structure of information	Meaning
<p>⚠ DANGER Causes (/consequences) Possible consequences if ignored ▶ Corrective action</p>	<p>This symbol alerts you to a dangerous situation . Failure to avoid the situation will result in a fatal or serious injury.</p>
<p>⚠ WARNING Causes (/consequences) Possible consequences if ignored ▶ Corrective action</p>	<p>This symbol alerts you to a dangerous situation . Failure to avoid the situation can result in a fatal or serious injury.</p>
<p>⚠ CAUTION Causes (/consequences) Possible consequences if ignored ▶ Corrective action</p>	<p>This symbol alerts you to a dangerous situation . Failure to avoid this situation can result in minor or more serious injuries.</p>
<p>NOTICE Cause/situation Possible consequences if ignored ▶ Measure/note</p>	<p>This symbol alerts you to situations which may result in damage to property.</p>

1.2 Symbols

-  Additional information, tip
-  Permitted or recommended
-  Not permitted or not recommended

2 Basic safety instructions

2.1 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.

2.2 Designated use

The OUSAF21 sensor is used for color measurement at low level in the visible region of the electromagnetic spectrum. It is suitable for a variety of industries.

Color scale measurements: APHA/Hazen, Potassium Permanganate in water

Color measurement for:

- Quality control / Purity monitoring
- Color dosage
- Decolorization control
- Distillation monitoring

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.

2.3 Workplace safety

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

- Regulations for explosion protection
- Installation instructions
- Local standards and regulations

2.4 Operational safety

- ▶ Before commissioning the entire measuring point, make sure all the connections are correct. Ensure that the 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.

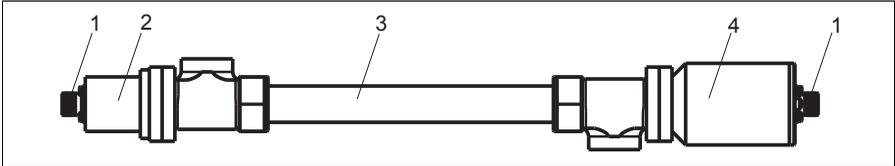
2.5 Product safety

The product is designed to meet state-of-the-art safety requirements, has been tested and left the factory in a condition in which it is safe to operate.

Relevant regulations and European standards have been observed.

3 Product description

3.1 Design of OUSA21



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Fig. 1: Design of OUSA21

1 Environmental connector
2 Lamp housing

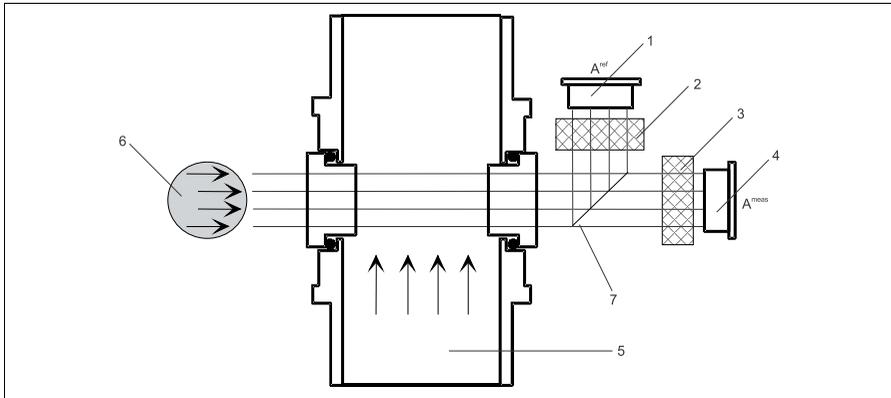
3 Flow assembly
4 Detector housing

Detector and lamp housings may vary depending on options ordered.

3.2 Measuring principle

Dual beam absorption light method

The measuring principle is based on the Lambert-Beer law. There is a linear dependency between the absorption of light and the concentration of the absorbing substance. A light source emits radiation through the medium and the transmitted radiation is measured on the detector side. After passing a filter for wavelength selection, the intensity of light is determined by a photodiode and converted into a photo current. The final conversion into absorbance units (AU, OD) or application specific unit (e.g. APHA) is done by the related transmitter. We compare the intensity of light at the target frequency to the intensity at a reference frequency to compensate for particles, bubbles or lamp aging.



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Fig. 2: Double-wavelength absorption sensor with reference

- | | | | |
|---|----------------------|---|---------------|
| 1 | Reference detector | 5 | Medium |
| 2 | Reference filter | 6 | Light source |
| 3 | Measurement filter | 7 | Beam splitter |
| 4 | Measurement detector | | |

4 Incoming acceptance and product identification

4.1 Incoming acceptance

- Make sure the packaging is undamaged!
Inform the supplier about any damage to the packaging.
Keep the damaged packaging until the matter has been settled.
- Make sure the contents are undamaged!
Inform the supplier about damage to the contents. Keep the damaged products until the matter has been settled.
- Check that the order is complete and agrees with your shipping documents.
- The packaging material used to store or to transport the product must provide shock protection and humidity protection. The original packaging offers the best protection. Also, keep to the approved ambient conditions (see "Technical data").
- If you have any questions, please contact your supplier or your local sales center.

4.2 Product identification

4.2.1 Nameplate

Nameplates can be found:

- On the outside of the housing
- On the packaging (adhesive label, portrait format)

The nameplate provides you with the following information on your device:

- Order code
- Extended order code
- Serial number
- Protection class
- Environment

Compare the data on the nameplate with your order.

4.2.2 Product identification

The order code and serial number of your device can be found in the following locations:

- On the nameplate
-  To find out what device version you have, enter the serial number indicated on the nameplate in the search screen at the following address:
www.products.endress.com/OUSAF21

4.3 Scope of delivery

The scope of delivery depends on the ordered version.

- Lamp, detector and flow assembly (delivered assembled)
- Operating Instructions, English

If you have any questions, please contact your supplier or your local sales center.

4.4 Certificates and approvals

4.4.1 Ex approval

- ATEX II 2G EEx d IIC T5
- FM Cl.1, Div. 1, Group B, C, D

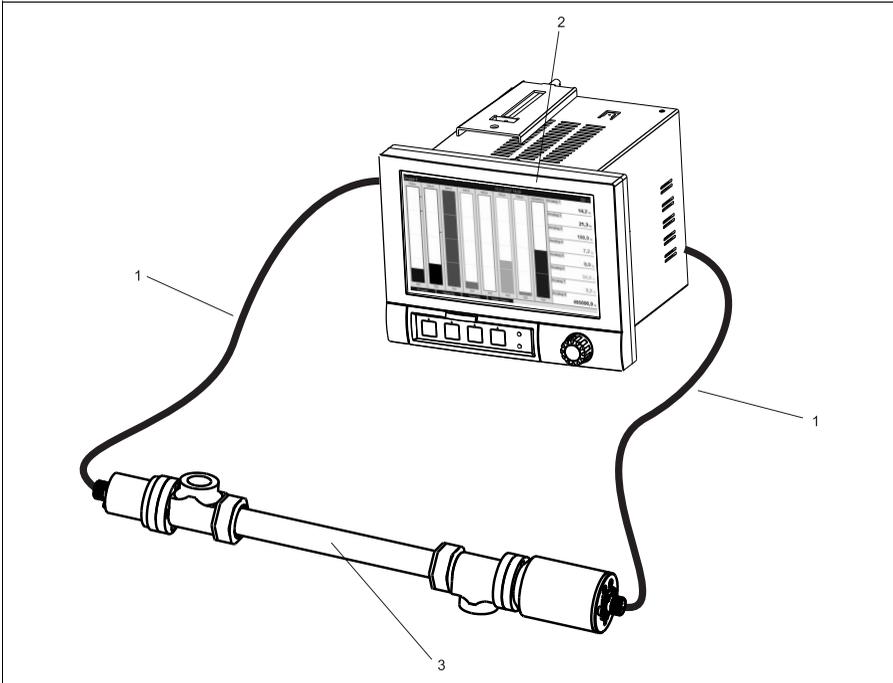
5 Mounting

5.1 Mounting conditions

5.1.1 Measuring system

A complete measuring system comprises:

- Transmitter Memograph CVM40
- Low level sensor OUSA21
- Cable set OUK20



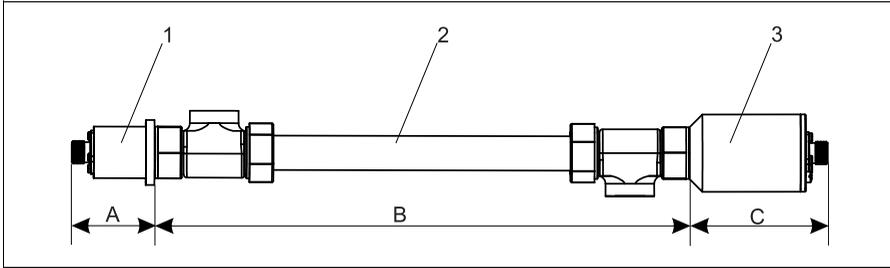
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Fig. 3: Example of a measuring system

- 1 Cable set OUK20
- 2 Transmitter Memograph CVM40
- 3 OUSA21 sensor

5.1.2 Dimensions

The sensor dimensions depend on the flow assembly.



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Fig. 4: General dimensions

- 1 Lamp assembly
- 2 Flow assembly
- 3 Detector assembly

Flow assembly	"B" Dimension
10 cm Path length	150 mm (5.9")
15 cm Path length	200 mm (7.9")
20 cm Path length	250 mm (9.8")
25 cm Path length	300 mm (11.8")

Lamp assembly type	"A" Dimension
High luminescence lamp	33.78 mm (1.33")
Gas filled lamp	33.78 mm (1.33")

Detector assembly	"C" Dimension
OUSAF21	102.8 mm (4.05")

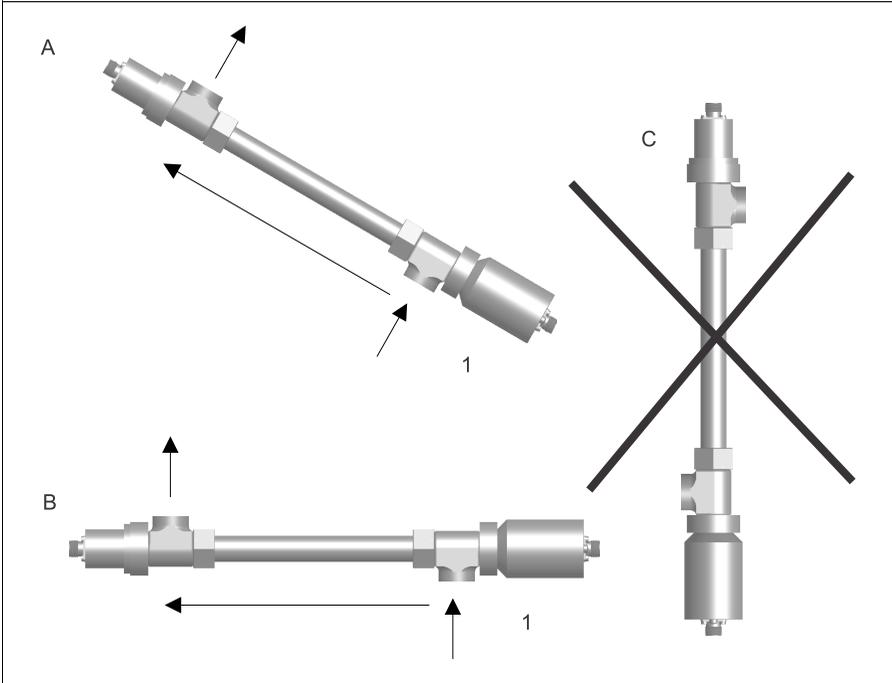
i Make sure to leave an additional clearance of approx. 5 cm (2") for installation of the sensor cable.

Detector and lamp may vary depending on options ordered.

5.1.3 Mounting angle

The OUSAF21 sensor includes an integrated flow assembly. The flow assembly can be installed either directly in a process line or in a by-pass line.

- Install the sensor upstream of pressure regulators.
- Allow adequate space for the connection of cables at the ends of the lamp and the detector housing.
- Operating sensors under pressure will help to avoid air or gas bubble evolution.



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Fig. 5: Sensor installation

- A Preferred
- B Acceptable

1 Process flow

5.2 Mounting the sensor

The OUSAF21 sensor is shipped assembled and ready for commissioning.

 The lamp and detector can be mounted and removed without affecting process line integrity.

When installing, allow adequate space for the connection of cables at the ends of the lamp and detector housings. Access to these areas is also important for connection/disconnection purposes.

NOTICE

External forces

Make sure to leave enough space when installing the sensor to prevent sensor damage. The cable will be twisted.

- ▶ Ensure that sensor bodies are protected against damage caused by external forces such as carts on adjacent walkways.
- ▶ Remove the cable before screwing the lamp or detector onto the flow assembly.
- ▶ Avoid exerting excessive tensile force on the cable (e. g. from jerky pulling).

 When using metallic assemblies and installation equipment, comply with national grounding regulations.

5.3 Post-mounting check

- Sensor and cable undamaged?
- Compliance with permissible sensor installation position?

6 Electrical connection

⚠ WARNING

Device is energized

Inappropriate connection can cause serious injuries 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.

6.1 Connecting the sensor

The OUSAF21 sensor is connected to the transmitter via the pre-terminated and labeled cable set OUK20 (to be ordered separately). Terminals and labeling might vary with the transmitter in use.

i Cable length should only be extended using original cables from manufacturer.

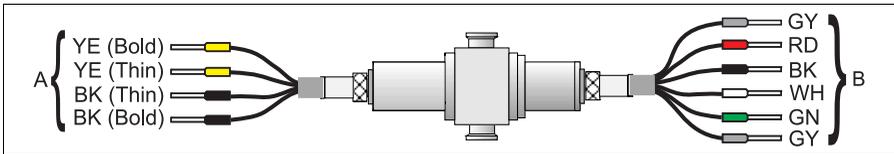


Fig. 6: Connecting cable for OUSAF21

A Power supply for lamp B Signal transmission of measurement detector and reference detector

Terminal CVM40	Cable OUK20 for sensor OUSAF21	
	Core	Assignment
S1.S	GY	Shield
S1.1	RD	Sensor Mea +
S1.2	BK	Sensor Mea -
S2.S	GY	Shield
S2.1	WH	Sensor Ref +
S2.2	GN	Sensor Ref -
V1.1	YE (Bold)	Lamp voltage +
V1.3	YE (Thin)	Lamp sense +
V1.4	BK (Thin)	Lamp sense -
V1.2	BK (Bold)	Lamp voltage -

6.2 Post-connection check

Instrument status and specifications	Remarks
Are the sensor, assembly or cable damaged?	Visual inspection
Electrical connection	Remarks
Are the installed cables strain-relieved and not twisted ?	
No loops and cross-overs in the cable run?	Check seating (pull slightly)
Are the signal cables correctly connected according to the wiring diagram?	
Are all screw terminals tightened?	
Are all cable entries installed, tightened and sealed?	
Are the PE distributor rails grounded (if present)?	Grounding at place of installation

7 Commissioning

7.1 Function check

Before first commissioning, check if:

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

7.2 Sensor calibration

A liquid solution of a known optical density (at the wavelength of the sensor) must be used for instrument calibration. The following procedure is used in factory. Calibration liquid can be chosen by user depending on application. When preparing solutions, it is very important to measure the optical absorbance of every solution prepared (at the wavelength of the sensor) on a certified laboratory spectrophotometer.

-  Before calibration, the unit has to be powered up for at least 30 minutes.

7.2.1 Liquid calibration procedure

A liquid solution of a known optical density (at the wavelength of the sensor) must be used for instrument calibration. Calibration liquid can be chosen by user in field depending on application.

-  When preparing solutions, it is very important to measure the optical absorbance of every solution prepared (at the wavelength of the sensor) on a certified laboratory spectrophotometer.

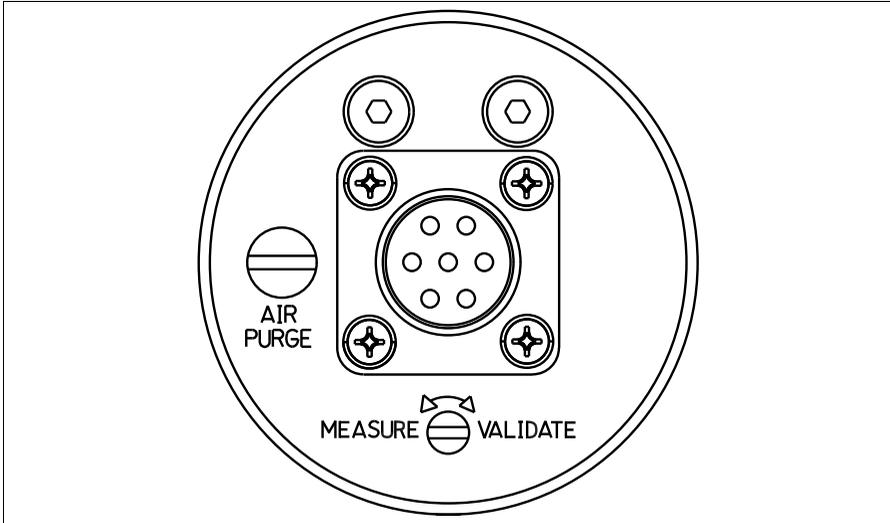


Fig. 7: Verification filter housing and controls

7.3 Filter check

A verification filter is supplied with each standard sensor to perform a function check of the instrument without requiring the use of calibration solutions. The filter can be rotated into the sensor light path to simulate absorbance in the optical chain.

When used in conjunction with an initial liquid standard calibration procedure, the verification filter can be used for routine system checking. Calibration can be traced to the controlled standard used to verify the original calibration solutions and can therefore satisfy validation procedures.

During initial calibration of a sensor/transmitter pair, liquid standards must be used to calibrate the full-scale response of the system. After calibration, by filling the sensor with DI water and ensuring the analyzer reads zero, a value for the verification filter can be obtained by inserting the verification filter into the light path and noting the analyzer display reading. At any time in the future, reinserting the verification filter and checking that the analyzer reads the same with the sensor filled with DI water can check the analyzer calibration.

8 Maintenance

8.1 Maintenance schedule

Certain maintenance needs to be performed for OUSAF21 sensor. The service and maintenance interval time is application dependent.

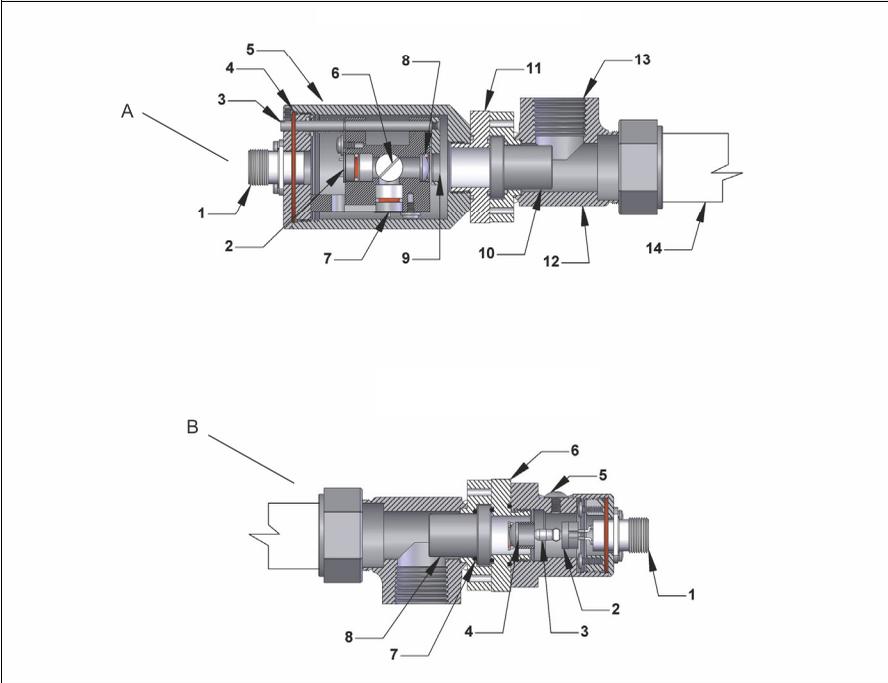
Maintenance check list	
Lamp replacement	Typical lamp replacement is 8,000 to 10,000 hours
Sensor window and gasket replacement	Window replacement is only required when the windows become damaged
Wetted O-rings replacement	Wetted O-rings have to be replaced based on specific needs of process. Do not re-use O-rings.

NOTICE

Sensitive optical components

If not handled carefully optical components can be damaged or contaminated.

- ▶ The procedures described in this section should only be carried out by qualified maintenance staff.
 - ▶ Clean all optical components with a suitable lint free lens cleaning tissue and ethanol.
-  Refer to EXP-1 lamp instructions to replace lamp for hazardous area versions.



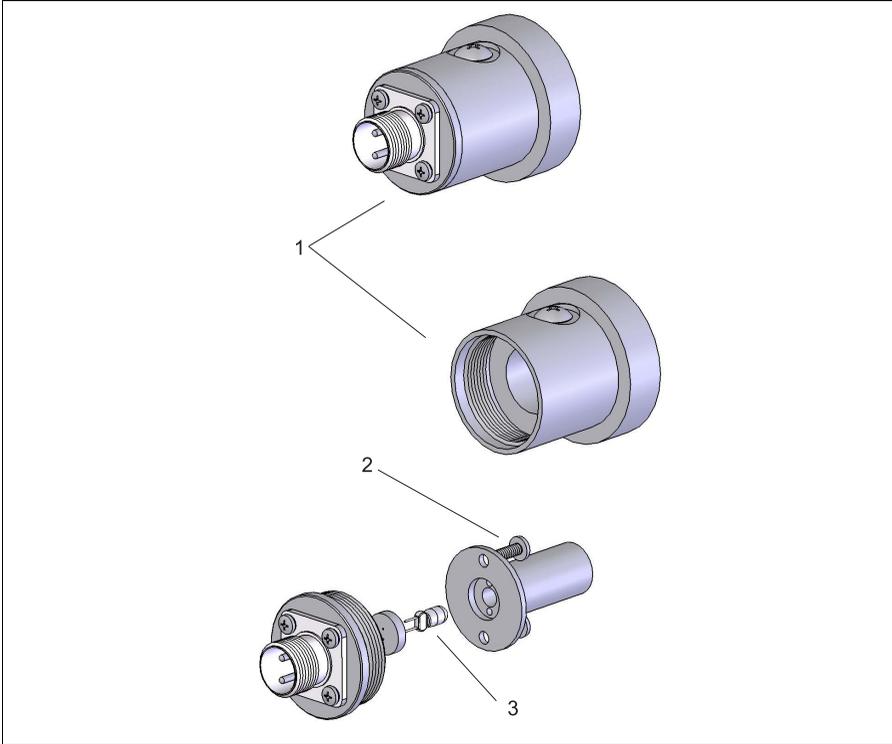
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Fig. 8: Cross-sectional view of a typical OUSAF21 sensor

- A OUSAF21 Detector assembly
- 1 Watertight connector
- 2 Measure detector/filter
- 3 Validation filter actuator
- 4 O-ring
- 5 Detector housing
- 6 Beam splitter
- 7 Reference detector/filter
- 8 Lens
- 9 Calibration filter
- 10 Window
- 11 Window ring
- 12 Sensor body
- 13 3/4" NPT
- 14 1" 316 SS tube

- B OUSAF21 Lamp assembly
- 1 Watertight connector
- 2 Lamp socket
- 3 Halogen lamp
- 4 Lens
- 5 Air purge
- 6 Window ring
- 7 O-rings
- 8 Window

8.2 OUSA21 gas filled lamp replacement

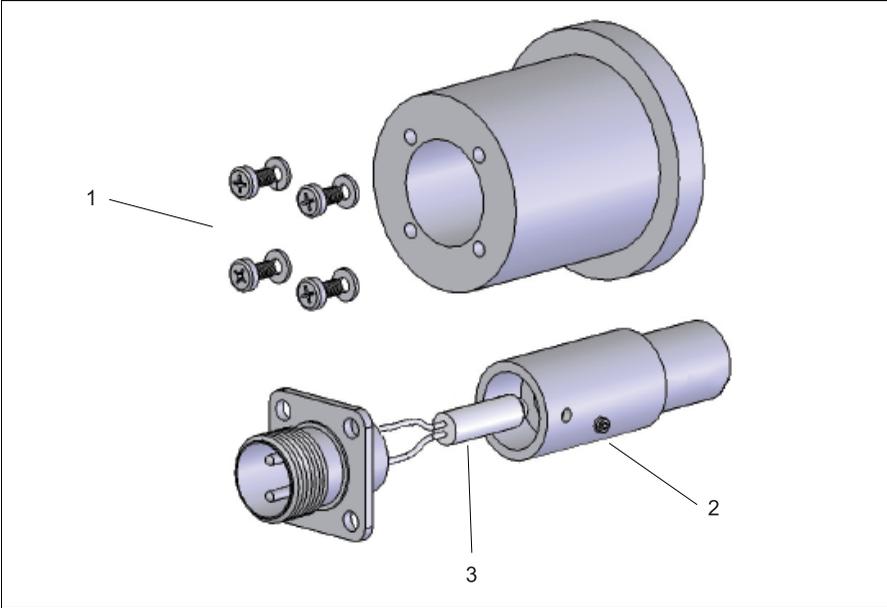


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Fig. 9: Illustrative standard lamp replacement procedure for gas filled lamps

1. To replace the lamp, remove the lamp assembly from the flowcell by turning it counterclockwise.
2. Remove the back of the lamp assembly from the lamp housing (1 in Figure 9) by pulling it out.
 -  Use a wrench or pliers on the square mounting plate.
3. Remove the two 6-32 screws and carefully remove the lens assembly (2 in Figure 9).
4. Carefully remove the halogen lamp and spacer and install the new lamp in reverse order. Clean with alcohol before re-assembly (3 in Figure 9).
 -  Do not touch the lamp with your bare hands!
5. Replace the lamp O-rings.
6. Reinstall the lamp assembly onto the flowcell by turning it clockwise.
7. After lamp replacement zero point adjustment is needed.

8.3 OUSAF21 high luminescence lamp replacement



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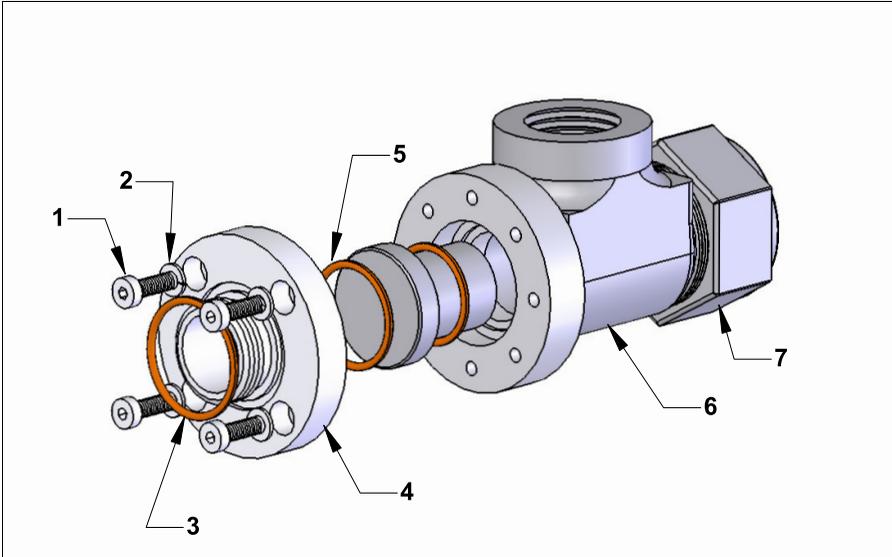
Fig. 10: Illustrative standard lamp replacement procedure for high luminescence lamps

1. To replace the lamp, remove the lamp assembly from the flowcell by turning it counterclockwise.
2. Remove the 4 screws and washers that hold the connector in place (1 in Figure 10).
3. Pull the connector out of the lamp housing.
4. Remove the lamp's cover by unscrewing the 2 set screws (2 in Figure 10).
5. Replace the lamp/connector assembly (3 in Figure 10).
 -  Do not touch the lamp with your bare hands!
6. Clean the lamp with lint free tissue.
7. Follow steps 2 to 4 in reverse order using the new lamp assembly.
8. Replace the lamp O-rings.
9. Reinstall the lamp assembly onto the flowcell by turning it clockwise.
10. After lamp replacement zero point adjustment is needed.

8.4 Sensor window and gasket replacement

Windows must be replaced with the same type to maintain path length. The illustration below is a typical flowcell assembly. Replacement of windows or window seals or other maintenance requiring the disassembly of the sensor uses the following procedure:

i To replace the windows and seals, the sensor must be removed from the process line.



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Fig. 11: Typical flow assembly/window replacement

1	M4 x 12 mm	5	O-ring 2-020 window gasket
2	M4 SS split washer	6	OUSAf21 lamp/detector sensor body
3	O-ring 2-0022 body gasket	7	1" swagelock tubing fitting
4	Window ring		

1. Remove the lamp and the detector housings from the sensor body.
2. Remove the 4 socket head screws from each window retaining ring and remove the rings. Be careful to loosen the screws evenly and alternately around the window retaining ring. If the window is 'stuck', apply Acetone to the window seal area and let soak for several minutes. This may assist in freeing the windows from the seals.
3. Gently push/ease the windows out of the sensor.
4. Inspect the window area and clean as necessary. Inspect the windows for any signs of abrasive wear or chipping. If any is apparent, replace the windows. Discard the O-rings and replace with new ones of the same material type. Reassemble the sensor in the reverse order, taking care to cross-tighten the window retaining ring screws evenly to prevent uneven seating. After every re-assembly of an OUSAf21 sensor, it is necessary to carry out a liquid calibration with its associated transmitter.

9 Repair

9.1 List of spare parts OUSAF21 Sensor

Order no.	Identifier
71136331	KIT OUSAFxx Inter. Filter 400nm
71136333	KIT OUSAFxx Inter. Filter 420nm
71136334	KIT OUSAFxx Inter. Filter 430nm
71136337	KIT OUSAF21/22 Inter. Filter 520nm
71136342	KIT OUSAF21/22 Inter. Filter 720nm
71142978	KIT OUSAFxx Gas Filled Lamp
71136395	KIT OUA260 Window Quartz 24mm
71136360	KIT OUA260 Window O-rings Viton (USP)
71136358	KIT OUA260 Window O-rings Kalrez
71136359	KIT OUA260 Window O-rings Silicone
71136357	KIT OUA260 Window O-rings EPDM (USP)
71142621	KIT OUA260 Window Pyrex 24mm
71142623	KIT OUA260 Window Sapphire 24mm
71142977	Kit OUSAFxx High Luminescence Lamp
71210161	KIT OUSxFxx Connector Dust Cover

9.2 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

9.3 Disposal

The device contains electronic components and must therefore be disposed of in accordance with regulations on the disposal of electronic waste.

Please observe local regulations.

10 Accessories



In the following sections, you find the accessories available at the time of issue of this documentation. For information on accessories that are not listed here, please contact your local service or sales representation.

10.1 Transmitters

CVM40 Memograph

- Graphic transmitter for inline photometers and data manager
- Ordering according to product structure, see Technical Information TI457C/07/EN

10.2 Cables

OUK20 cable set

- Pre-terminated or labeled cables for connection of OUSAF2x sensors
- Ordering according to product structure

11 Technical data

11.1 Input and Output

Measured input variable	Process absorption and optical density
Output signal	Photo detector current (100 pA to 500 µA)
Wavelengths	Measurement 400 nm, 420 nm, 490 nm, 520 nm; Reference 720 nm

11.2 Environment

Ambient temperature	0 to 55 °C (32 to 131 °F)
Storage temperature	-20 to 70 °C (-4 to 158 °F)
Relative humidity	5 to 95 %
Ingress protection	IP 65 (NEMA 4) for all optical parts

11.3 Process

Process temperature	0 to 90 °C (32 to 194 °F) continuous max. 130 °C (266 °F) for 2 hours
Process pressure	up to 6 bar (84 psi), depending on material, line size and process connection of flow assembly

11.4 Mechanical construction

Dimensions	See section "Installation".
Weight	1.225 kg (flow cell not included)
Materials	Sensor housing: Stainless steel 316L
Light source	High Luminescence Lamp (Wavelength filter 450nm and above) Gas Filled High Output Lamp (Wavelength filter below 450nm)
	Lamp Life: 10,000 hours typical
Detectors	Silicon detectors, hermetically sealed
Filters	Multilayer narrow passband interference filter

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