

Instruction Manual



optek sensors AF16

optek-Manual--1004-2001-02--AF16-US-2020-12-07

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Preface

This instruction manual is written to assist the user in proper procedures for trouble-free operation.

It is explicitly pointed out that optek-Danulat GmbH assumes no responsibility for loss or damage caused due to improper use of this instruction manual or products described herein.

This manual is protected by copyright. However, the user may produce copies and translations if required for correct operation of the products.

On request, this manual is available in other languages as well as on a digital medium (Acrobat® Reader 7.0).

Our products are being continuously improved. Technical data is subject to change without notice.

Essen, November 2020

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1 Using the instruction manual

1.1 Validity of the instruction manual

This instruction manual is valid for the following sensors and their variants:

AF16-F, **AF16-N**, AF16-P.

There are the following variants:

- HT
- VB
- PV
- HT-VB
- VB-PV
- VB-P

Abbreviations mean the following sensor options:

- F: color (NIR) sensor with application specific wavelength measurement
- N: near infrared sensor with range of wavelengths 730 – 970 nm
- P: sensor for particle measurement
- HT: high temperature
- VB: filter adapter FH03 (detector side) for calibration filter used for sensor verification
- PV: purge Varivent (air purge connections at sensor)

Follow the instruction manual for every operation. If the product is not used as described in this instruction manual, your safety and the product function may be affected.

To keep up reliability of the product, enhance its life cycle, and avoid down times, follow the instructions given in this manual.

Furthermore, please follow local accident prevention and environmental protection instructions, as well as recognized technical regulations for safe and professional operation.

1.2 Pictograms and signal words

Important information in this instruction manual is marked with the following pictograms:



DANGER!

This pictogram indicates immediate danger to life and health of persons.
The text next to the symbol gives information on how to avoid bodily injuries.

If the possible cause of risk can be specified, the corresponding pictogram precedes instructions:



DANGER!

Electrical voltage.
This pictogram indicates danger due to electrical voltage.



ATTENTION!

This pictogram indicates information on how to avoid material damage.



NOTICE!

This pictogram indicates instructional or general advice.

2 Returns and disposal

2.1 Declaration of decontamination

For the safety of our employees and because of legal regulations we require a signed "declaration of decontamination" before your return can be handled.

This signed declaration must be included with the shipping documents on the outside of the packaging.

Any returns which were exposed to hazardous substances and were not professionally decontaminated are not accepted and will be sent back at your cost.

optek's declaration of decontamination and contact information can be found on our website www.optek.com.

2.2 Disposal

Special legal regulations apply to the return and disposal of industrial waste equipment. However, manufacturer and user can contractually agree on which party is to fulfill these legal obligations.

Observe current national disposal regulations. For disposing of packaging material, please separate materials:

- paper / cardboard
- plastic

For disposal, disassemble the system components and separate them according to different material groups.

Dispose of materials according to national and local regulations.

If no agreement has been made, products may be shipped to optek for disposal.

3 Intended use

The sensor and its variants are to be applied only as absorption sensors for liquids and gases in inline applications according to the technical data.

The sensor may only be operated when fully installed.

This converter is not intended for use in hazardous areas.

You can purchase flameproof sensors for hazardous locations from optek. For these sensors, special instruction manuals are delivered with the sensor.

Unauthorized constructional changes, additional fittings or rebuildings regarding the sensor are prohibited. The only exception are rebuildings into one of the variants listed in the chapter "Validity of the instruction manual". Changes to and interference with the converter program are prohibited as well.

Burying sensor cables underground without protection is prohibited.

The manufacturer is not liable for damage resulting from use contrary to the intended use.

Following this instruction manual is part of the intended use.

The content of all serial number plates on optek products is model-specific and refers to the time of delivery.

4 Description of AF16-F / AF16-N / AF16-P sensors

This sensor is a high precision absorption sensor.

It measures attenuation of light passing through the process medium. The sensor was designed for direct installation into pipelines.



Fig. 1: AF16-F / AF16-N / AF16-P

The following are the main sensor components:

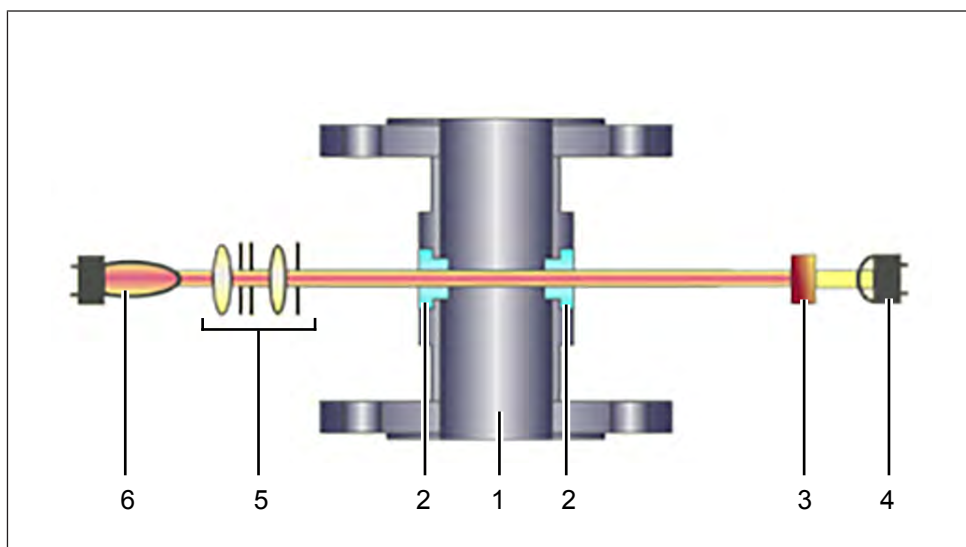


Fig. 2: Schematic AF16-F / AF16-N / AF16-P

1	Sensor body	2	Windows
3	Filter (VIS or NIR)	4	Detector
5	Optics module	6	Lamp module

Its modular construction offers maximum flexibility in adapting to the process, without affecting the property of measurement. The process medium is penetrated by a precisely focused, constant light beam.

A hermetically sealed silicon photodiode measures intensity of incoming and optically filtered light and supplies the converter with it in form of photocurrent.

Attenuation of light intensity, as a result of absorption and / or scattering of substances in the process medium, is described by the Lambert-Beer Law. It states that the logarithm of the transmission loss is proportional to the concentration of the substance. This is true for dissolved substances and undissolved material. Depending on the particular material properties, concentrations can be detected in ppm as well as in %.

According to this law, the extinction coefficient, defined through ingredient and wavelength, affects the logarithm of the transmission loss, too. Therefore, the choice of wavelength or range of wavelengths is of decisive importance for the measurement and is defined for each measurement type with the help of optical filters.

The third factor of influence in the Lambert-Beer Law is the path length of light passing through the process medium. Equally proportional, the path length, too, is an important aspect with regard to specification of a photometer. The distance to be covered by light is defined through the optical path length (OPL), that is the distance between the windows of a sensor body. In the technical data, OPL is always given corresponding to window combination A-A.

5 Technical data and exploded views

Tab. 1: Technical data AF16-N/-F/-P (subject to changes) *

Technical data	AF16-N (valid for all options)	AF16-F (valid for all options)	AF16-P (valid for all options)
	Measurement		
Measurement principle:	1-Channel Absorption of light		
Measurement wavelength(s):	730 nm - 970 nm	385, 400, 430, 525, 750, 1000 nm, others on request	730 nm - 970 nm
Detector:	1 silicon photodiode (hermetically sealed)		
Measuring range:	any measuring range between 0 - 0.05 to 6 CU 0 - 50 to 40,000 ppm (DE) 0 - 20 to 16,000 FTU 0 - 5 to 4,000 EBC	any measuring range between 0 - 0.05 to 2.8 CU (dependent on used filter)	any measuring range between 0 - 0.05 to 4 CU
Optical path length:	1 - 1000 mm		1 - 160 mm
Calibration:	CU (concentration units) application specific calibration		
Light source:	special incandescent tungsten lamp 5.0 V DC, 970 mA typical life span: 3 to 5 years (25,000 to 40,000 hours)		
Resolution:	< ± 0.05 % of respective measuring range		
Repeatability:	< ± 0.5 % of respective measuring range		
Linearity:	< ± 1 % of respective measuring range (specific to application)		
Protection:	IP65		
	Sensor body		
Material:	Stainless steel 1.4435 (SS 316L), 1.4539, 1.4571 (SS 316Ti), 1.4462, Titanium 3.7035 (Grade 2), Hastelloy 2.4602 (C22), Plastic TFM4215, ... others on request		
Line size:	1/8 in. to 6 in., (DN 6 to DN 150), ... others on request		
Process connection:	Flanges (ASME, DIN, JIS), Clamps (TC, ISO, DIN), Female Threads (NPT, DIN), Sanitary Threads (DIN 11851), Tube Ends (DIN, ISO, OD), DIN 11864-1/-2/-3 (DIN, ISO, OD), Varivent (DIN, IPS, OD), ... others on request		
Process pressure:	0 to 100 bar (0 to 1450 psi), higher on request depending on process connection, materials and design		
Windows:	1-Pyrex®, 2-Sapphire, 3-Sapphire Biotech		
Window gaskets:	Silicone (FDA), Viton® (FDA), EPDM (FDA / USP Class VI), Kalrez® 6230 (FDA / USP Class VI), Kalrez® 4079, ... others on request		
Airpurge:	connectors available as standard, air purge pressure 0.5 bar max.		

Technical data	AF16-N (valid for all options)	AF16-F (valid for all options)	AF16-P (valid for all options)
	Temperature ratings (Data is only valid for appropriate choice of material of sensor body and gaskets! No ice formation on sensor!)		
Process temperature:	permanent: 0 - 120 °C (32 - 248 °F) / peak 15 min/day: 0 – 150 °C (32 – 302 °F)		
Process temperature OPTION HT:	permanent: -30 - 240 °C (-22 - 464 °F) / peak 15 min/day: -30 – 260 °C (-22 – 500 °F)		
Ambient temperature:	Elevated or reduced ambient temperatures may require restrictions to the admissible process temperature! operation: 0 - 40 °C (32 - 104 °F) operation: -30 - 40 °C (-22 - 104 °F) with options HT transport: -20 – 70 °C (-4 – 158 °F)		
	Calibration		
Calibration adapter VB	Filter adapter FH03 (detector side) for calibration filter used for sensor verification		
	option (recommended)	standard	
	Cables		
Cable length:	standard: 2, 3, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100 m (7, 10, 16, 33, 49, 66, 82, 98, 115, 131, 148, 164, 197, 230, 262, 295, 328 ft.), cable sets length > 100 m (328 ft.) on request		
Cable material:	non-metallic sheathed cable with finely stranded copper conductor according to IEC 228 CL.5, insulation PVC (-40 °C ... +70 °C, -40 °F ... +158 °F)		
Plug connection:	plastic connector or SS plug protector		
Cable weights:	Lamp cable (1.5 mm²): 0.9 kg / 10 m Lamp cable (2.5 mm²): 1.2 kg / 10 m Detector cable (0.5 mm²): 0.6 kg / 10 m		
Cable diameter:	Lamp cable (1.5 mm²): approx. 7 mm / approx. 8 mm with shrink hose Lamp cable (2.5 mm²): approx. 8 mm / approx. 9 mm with shrink hose Detector cable (0.5 mm²): approx. 6 mm / approx. 8 mm with shrink hose and shield connection		
	Certificates		
	ISO 9001:2015, ATEX, FM, PED, CE, HP0		

** Pressure and temperature ratings specified herein may be subject to limitations.
 The appropriate choice of material for all wetted parts is the sole responsibility of the user.*

Detailed technical information about the armature is given in the armatures instruction manual and the sensor body data sheet of your sensor body.

5.1 Exploded view of AF16-F / AF16-N sensor

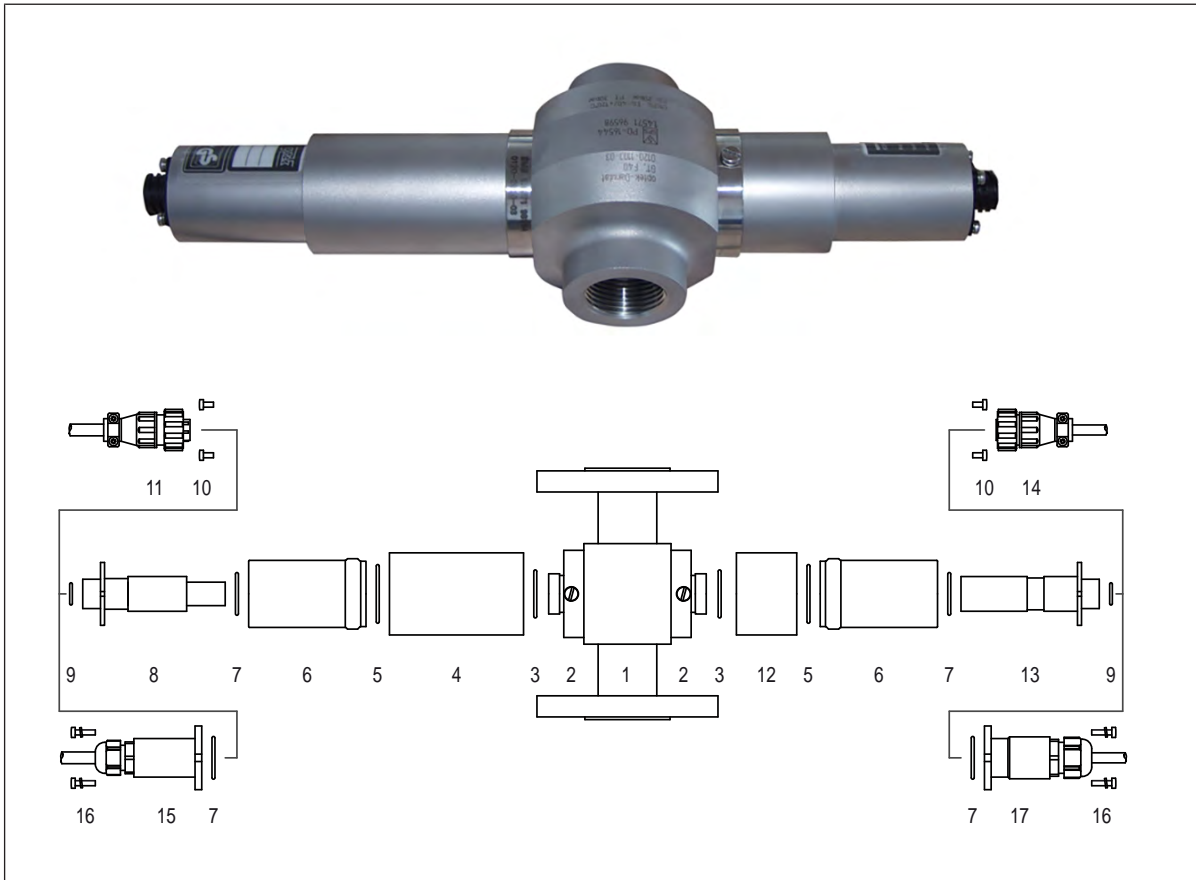


Fig. 3: Photo and exploded view of AF16-F / AF16-N

1	Sensor body	2	Window ring M24 x 1.5, incl. 8 screws M5
3	O-ring 25.12 x 1.78, Viton®	4	Lamp adapter AF16, 1.4571 (316 Ti), incl. optics module AF VN
5	O-ring 31.47 x 1.78, Viton®	6	Optical housing OP06, 1.4571 (316Ti)
7	O-ring 21.95 x 1.78, Viton®	8	Lamp module AF16
9	O-ring 10.10 x 1.60, Viton®	10	4 screws M3 x 6 (DIN 7985), 1.4571 (316Ti)
11	Lamp cable AF16	12	Detector adapter AF16, 1.4571 (316 Ti)
13	Detector module AF16-F or AF16-N	14	Detector cable AF16
15	Lamp cable with SS plug protector	16	4 screws M3 x 12 (DIN 7985), 1.4571 (316Ti), incl. washer
17	Detector cable with SS plug protector		

5.2 Exploded view of AF16-HT-F / AF16-HT-N sensor

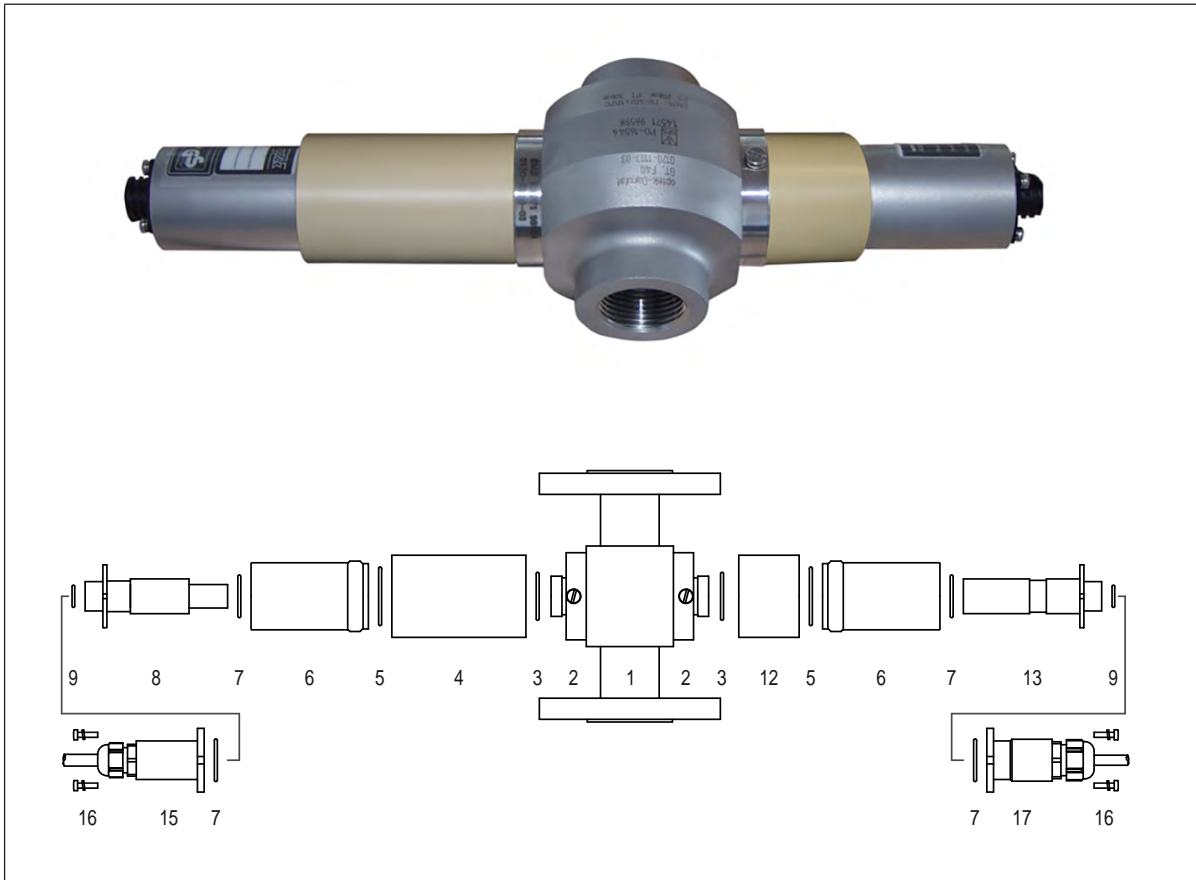


Fig. 4: Photo and exploded view AF16-HT-F / AF16-HT-N

1	Sensor body	2	Window ring M24 x 1.5, incl. 8 screws M5
3	O-ring 25.12 x 1.78, Viton®	4	Lamp adapter AF16-HT, PEEK, incl. optics module AF VN-HT
5	O-ring 31.47 x 1.78, Viton®	6	Optical housing OP06, 1.4571 (316Ti)
7	O-ring 21.95 x 1.78, Viton®	8	Lamp module AF16
9	O-ring 10.10 x 1.60, Viton®	10	-
11	-	12	Detector adapter AF16-HT, PEEK
13	Detector module AF16-HT-F or AF16-HT-N	14	-
15	Lamp cable with SS plug protector	16	4 screws M3 x 12 (DIN 7985), 1.4571 (316Ti), incl. washer
17	Detector cable with SS plug protector		



NOTICE!

For AF16-HT-F / AF16-HT-N, the cable set always has to be equipped with plug protector.

5.3 Exploded view of AF16-VB-F / AF16-VB-N / AF16-VB-P sensor

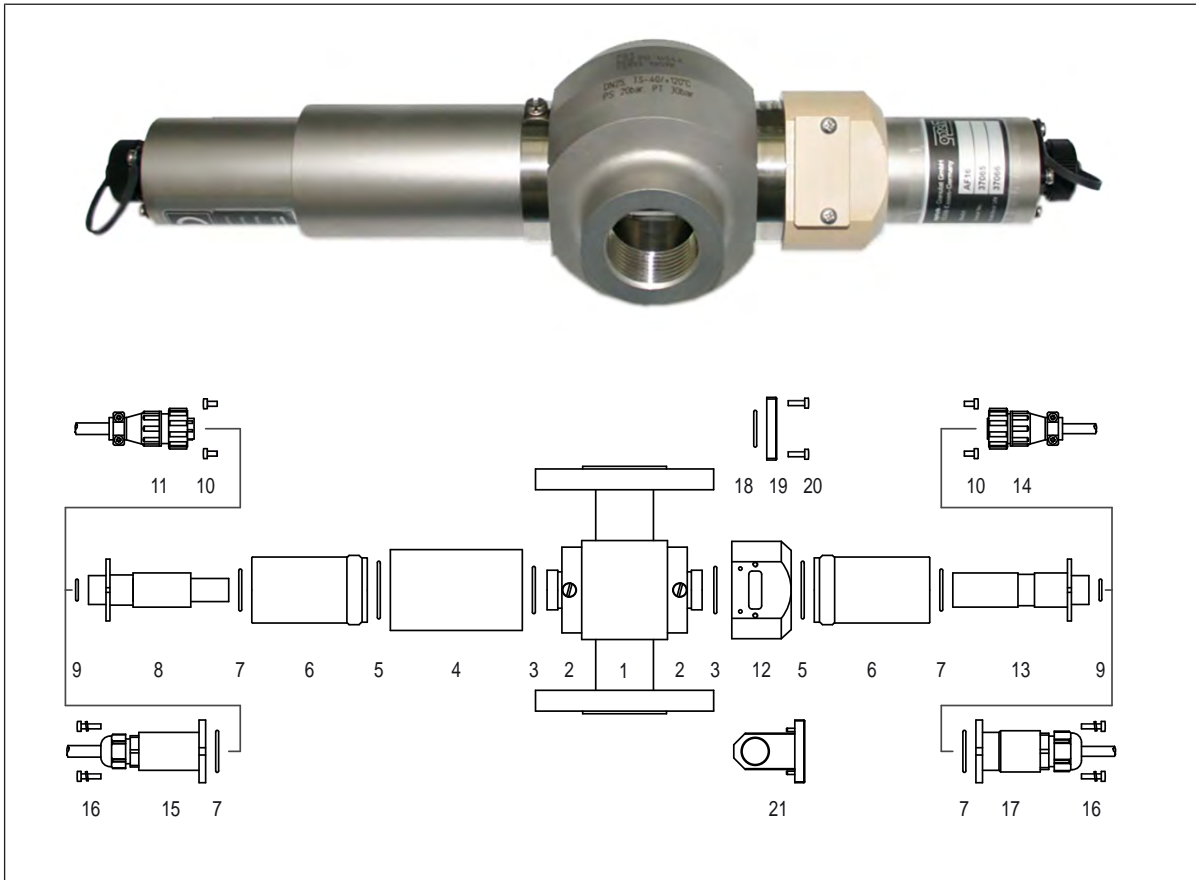


Fig. 5: Photo and exploded view AF16-VB-F / AF16-VB-N / AF16-VB-P

1	Sensor body	2	Window ring M24 x 1.5, incl. 8 screws M5
3	O-ring 25.12 x 1.78, Viton®	4	Lamp adapter AF16 / AF16-P, 1.4571 (316 Ti), incl. optics module AF VN / AF VN-P
5	O-ring 31.47 x 1.78, Viton®	6	Optical housing OP06, 1.4571 (316Ti)
7	O-ring 21.95 x 1.78, Viton®	8	Lamp module AF16
9	O-ring 10.10 x 1.60, Viton®	10	4 screws M3 x 6 (DIN 7985), 1.4571 (316Ti)
11	Lamp cable AF16	12	Detector adapter AF16-HT-VB, PEEK
13	Detector module AF16-F / AF16-N / AF16-P	14	Detector cable AF16
15	Lamp cable with SS plug protector	16	4 screws M3 x 12 (DIN 7985), 1.4571 (316Ti), incl. washer
17	Detector cable with SS plug protector	18	O-ring 18.77 x 1.78, Viton®
19	Sealing cover FH03	20	2 screws M3 x 10 (DIN 7985), 1.4571 (316Ti), (M3 x 12 permitted)
21	Calibration filter in FH03		

5.4 Exploded view of AF16-HT-VB-F / AF16-HT-VB-N / AF16-HT-VB-P sensor

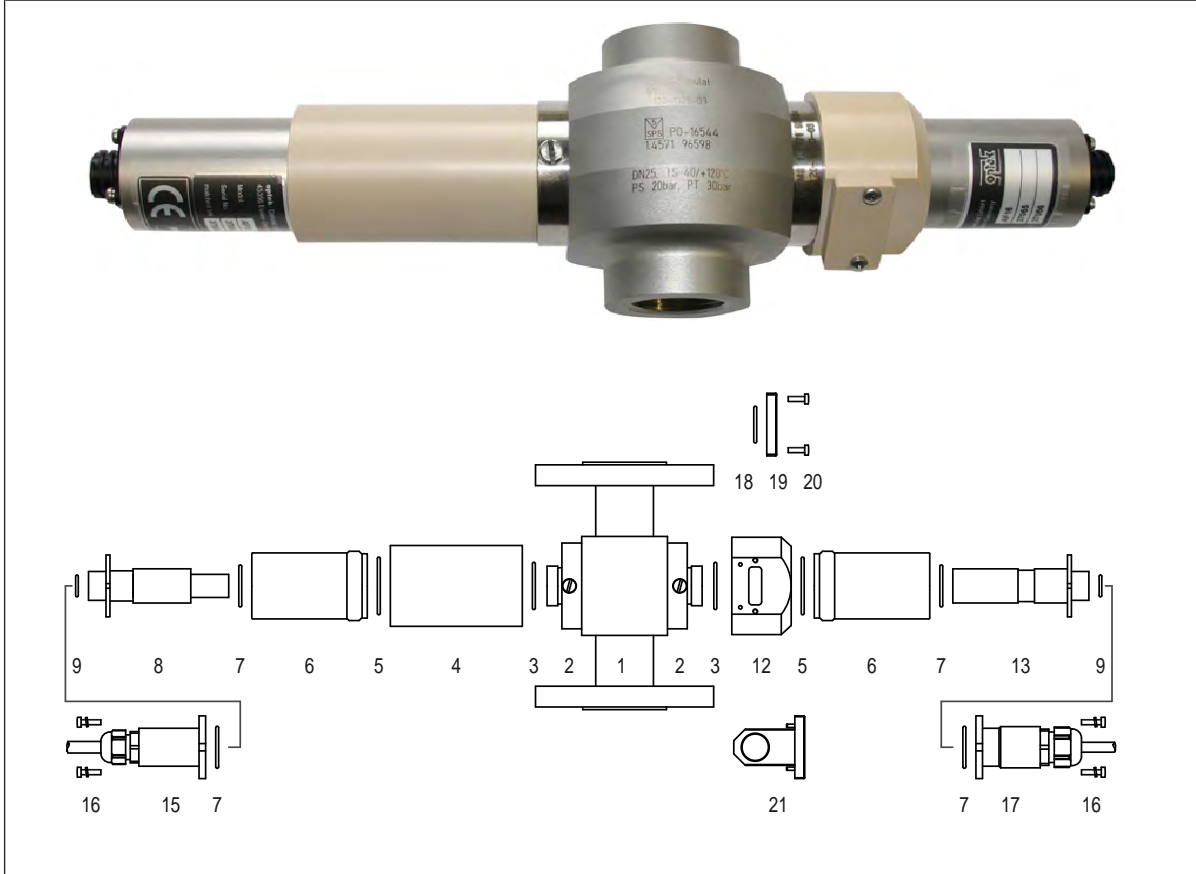


Fig. 6: Photo and exploded view AF16-HT-VB-F / AF16-HT-VB-N / AF16-HT-VB-P

1	Sensor body	2	Window ring M24 x 1.5, incl. 8 screws M5
3	O-ring 25.12 x 1.78, Viton®	4	Lamp adapter AF16-HT, PEEK, incl. optics module AF VN-HT
5	O-ring 31.47 x 1.78, Viton®	6	Optical housing OP06, 1.4571 (316Ti)
7	O-ring 21.95 x 1.78, Viton®	8	Lamp module AF16
9	O-ring 10.10 x 1.60, Viton®	10	-
11	-	12	Detector adapter AF16-HT-VB, PEEK
13	Detector module AF16-HT-F / AF16-HT-N / AF16-HT-P	14	-
15	Lamp cable with SS plug protector	16	4 screws M3 x 12 (DIN 7985), 1.4571 (316Ti), incl. washer
17	Detector cable with SS plug protector	18	O-ring 18.77 x 1.78, Viton®
19	Sealing cover FH03	20	2 screws M3 x 10 (DIN 7985), 1.4571 (316Ti), (M3 x 12 permitted)
21	Calibration filter in FH03		



NOTICE!

For AF16-HT-VB-F / AF16-HT-VB-N / AF16-HT-VB-P, the cable set always has to be equipped with plug protector.

5.5 Exploded view of AF16-PV-F / AF16-PV-N sensor

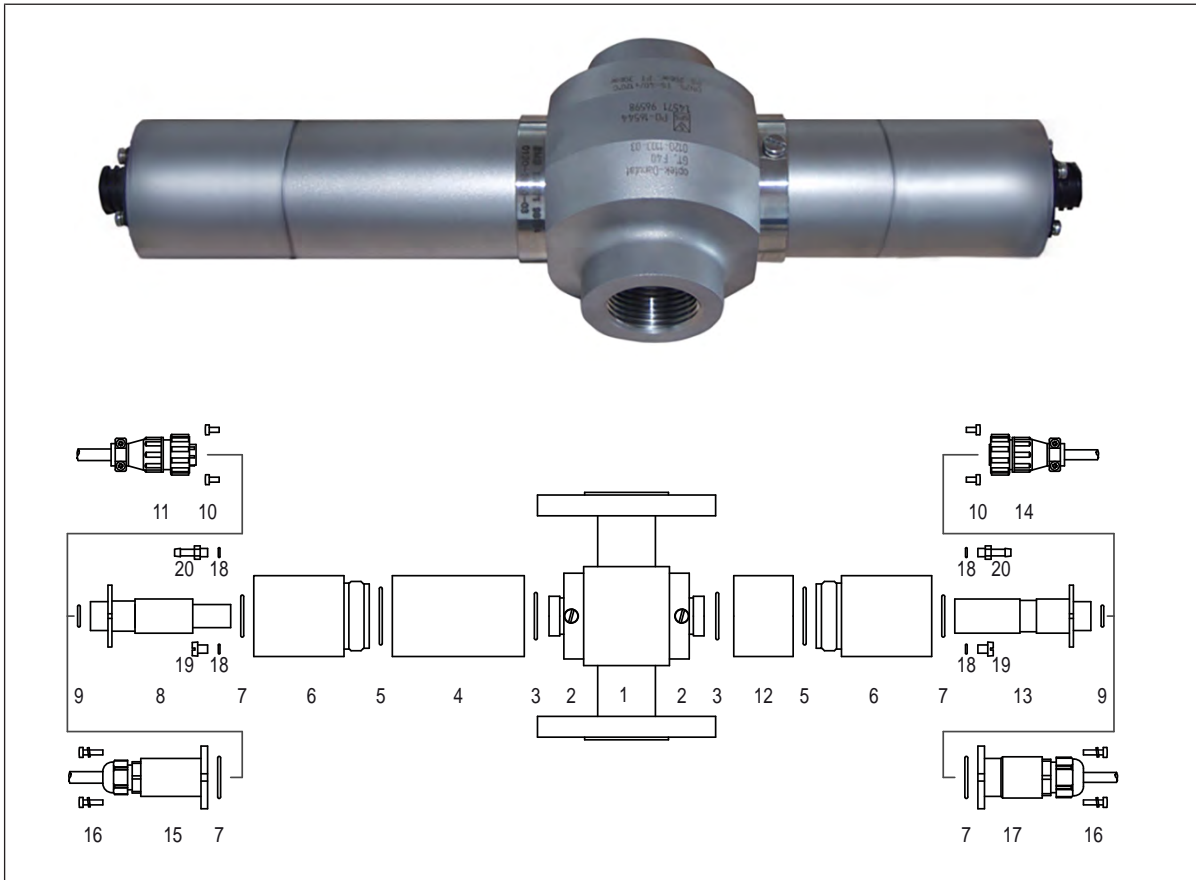


Fig. 7: Photo and exploded view AF16-PV-F / AF16-PV-N

1	Sensor body	2	Window ring M24 x 1.5, incl. 8 screws M5
3	O-ring 25.12 x 1.78, Viton®	4	Lamp adapter AF16, 1.4571 (316 Ti), incl. optics module AF VN
5	O-ring 31.47 x 1.78, Viton®	6	Optical housing OP06, 1.4571 (316Ti)
7	O-ring 21.95 x 1.78, Viton®	8	Lamp module AF16
9	O-ring 10.10 x 1.60, Viton®	10	4 screws M3 x 6 (DIN 7985), 1.4571 (316Ti)
11	Lamp cable AF16	12	Detector adapter AF16, 1.4571 (316 Ti)
13	Detector module AF16-F or AF16-N	14	Detector cable AF16
15	Lamp cable with SS plug protector	16	4 screws M3 x 12 (DIN 7985), 1.4571 (316Ti), incl. washer
17	Detector cable with SS plug protector	18	O-ring 4.00 x 1.00, Viton®
19	Screw M5 x 6 (DIN 84), 1.4571 (316Ti)	20	Purge connection M5, Ms / Ni

5.6 Exploded view of AF16-VB-PV-F / AF16-VB-PV-N / AF16-VB-PV-P sensor

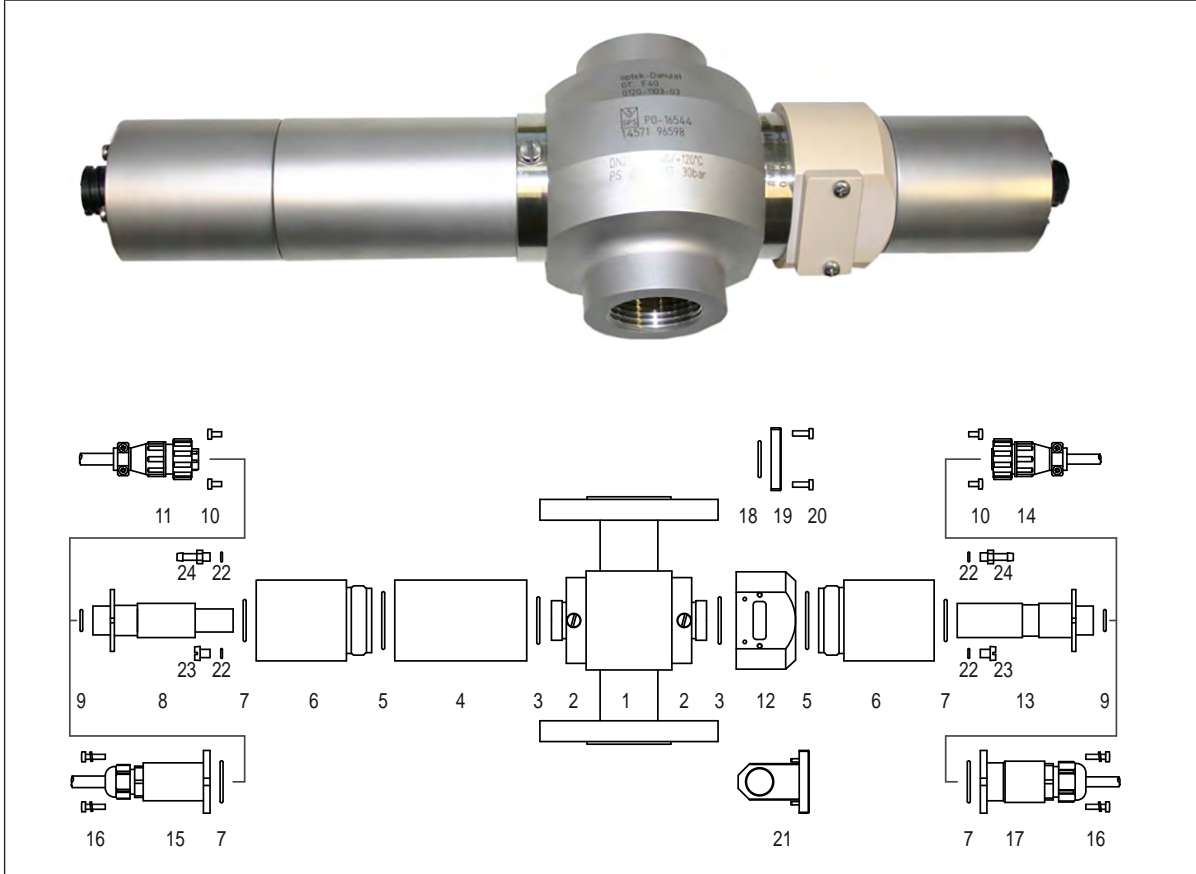


Fig. 8: Photo and exploded view AF16-VB-PV-F / AF16-VB-PV-N / AF16-VB-PV-P

1	Sensor body	2	Window ring M24 x 1.5, incl. 8 screws M5
3	O-ring 25.12 x 1.78, Viton®	4	Lamp adapter AF16, 1.4571 (316 Ti), incl. optics module AF VN
5	O-ring 31.47 x 1.78, Viton®	6	Optical housing OP06, 1.4571 (316Ti)
7	O-ring 21.95 x 1.78, Viton®	8	Lamp module AF16
9	O-ring 10.10 x 1.60, Viton®	10	4 screws M3 x 6 (DIN 7985), 1.4571 (316Ti)
11	Lamp cable AF16	12	Detector adapter AF16-HT-VB, PEEK
13	Detector module AF16-F / AF16-N / AF16-P	14	Detector cable AF16
15	Lamp cable with SS plug protector	16	4 screws M3 x 12 (DIN 7985), 1.4571 (316Ti), incl. washer
17	Detector cable with SS plug protector	18	O-ring 18.77 x 1.78, Viton®
19	Sealing cover FH03	20	2 screws M3 x 10 (DIN 7985), 1.4571 (316Ti), (M3 x 12 permitted)
21	Calibration filter in FH03	22	O-ring 4.00 x 1.00, Viton®
23	Screw M5 x 6 (DIN 84), 1.4571 (316Ti)	24	Purge connection M5, Ms / Ni

6 Installation

6.1 Standard sensor bodies — installation instructions

Installation instructions are provided in the armatures instruction manual.

6.2 Installation of the sensor

**NOTICE!**

O-Rings are delivered separately and are not installed at delivery.

Assemble the sensor as described below:

Tool

☞ not needed

1. Check that there are O-rings for the sensor assemblies.
2. Place one O-ring each into the groove of the window rings (see figure below).

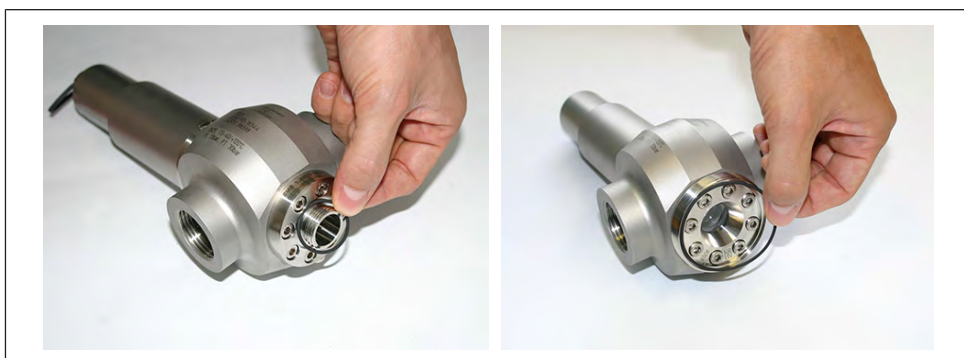


Fig. 9: O-ring at window ring

**DANGER!**

Isopropanol is irritating!

Observe the safety regulations when handling Isopropanol!

3. Make sure that the windows of the sensor body are clean. If not, clean them with Isopropanol.
4. Check the window ring threads for damage and soiling and clean them if necessary.

5. Screw on sensor assemblies for detector and lamp sides to the sensor body hand-tight (right-hand thread, figure below). It is recommended to use the supplied installation paste.



Fig. 10: Installed sensor, example AF16-N / AF16-F / AF16-P sensor

6.3 Airpurge

Should the temperature of the process medium be too low, the temperature of the air inside the sensor might fall below dew point. This leads to condensation deposits on the window surfaces. For that case, there are airpurge connections on the window rings of the sensor body or on the sensor.



NOTICE!

Always connect airpurge if the product is more than 10 °C (18 °F) cooler than the ambient temperature.

At delivery, the drill hole(s) of the air purge connection(s) is / are sealed with O-ring and sealing screws M5 x 6 (DIN 84).

Tool

- ☞ Screwdriver ●
- ☞ Wrench 7 mm

1. Remove the sealing screws and O-rings.
2. Check if there are O-rings on air purge connections.
3. Install air purge connections (2 in the figure below) screwing.

4. Place the air purge hoses on the air purge connections (2).

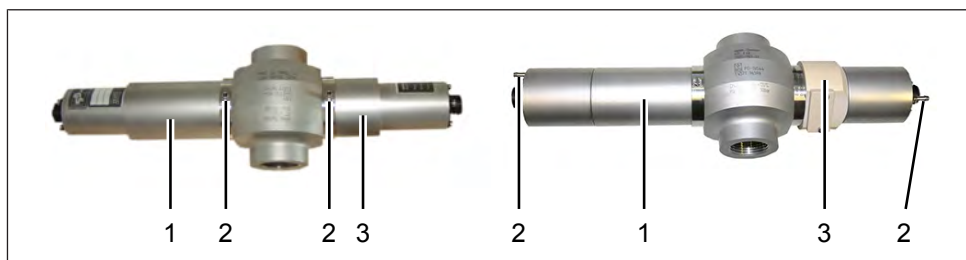


Fig. 11: Air purge connections

After connecting the sensor to the power supply and putting it into operation, rinse it as described below:

1. Loosen the sensor assemblies (1, 3 in Fig. 11) turning each 2–3 turns anticlockwise.
2. Rinse the sensors by aerating them with dry, oil and dust free air for approx. 10 minutes at a maximum of 0.5 bar gauge pressure.
If you do not have air purge supply of appropriate quality, feel free to contact us or one of our distributing partners.
3. Reduce air pressure to approx. 0.1 bar.
4. Retighten the sensor assemblies. Keep up the gauge pressure. Air consumption in this operational state is minimal.
5. Make sure the O-rings are fitted correctly.

7 Wiring

For connecting the sensor cables, observe the following basic conditions:

- Bring the sensor cable to the cable entry from underneath.
- Form a loop with the sensor cable close to the cable entry.
- Do not lay sensor cables in ducts of current-carrying lines.
- Observe cable specifications (see technical data).
- To lay sensor cables underground without protection is prohibited.

For the connection of the sensor to the converter, there are sensor cables with plug protector on the sensor side (2, 3 in the figure below) or without plug protector (1, 4).

Connection to the sensor

On the sensor side, mixing up sensor cables is not possible, as connectors are distinctive:

- 9-pin connector on the detector side (1, 2)
- 4-pin connector on the lamp side (3, 4)



Fig. 12: Connector with and without plug protector

Connection of the sensor cable *without* plug protector on the detector and lamp side:

Tool

🔧 not needed

1. Loosen the connection cover of the sensor.
2. Plug in the sensor cable.
3. Screw-tighten the protection cover.



Fig. 13: Connection of the sensor cable without plug protector

Connection of the sensor cable *with* plug protector on the detector and lamp side:

Tool

☞ Screw driver 

1. Loosen the connection cover of the sensor.
2. Ensure there is an O-ring (5 in the figure below) for the plug protector.
3. Connect the sensor cable.
4. Fasten each of the four screws of the plug protector (2) with washer.

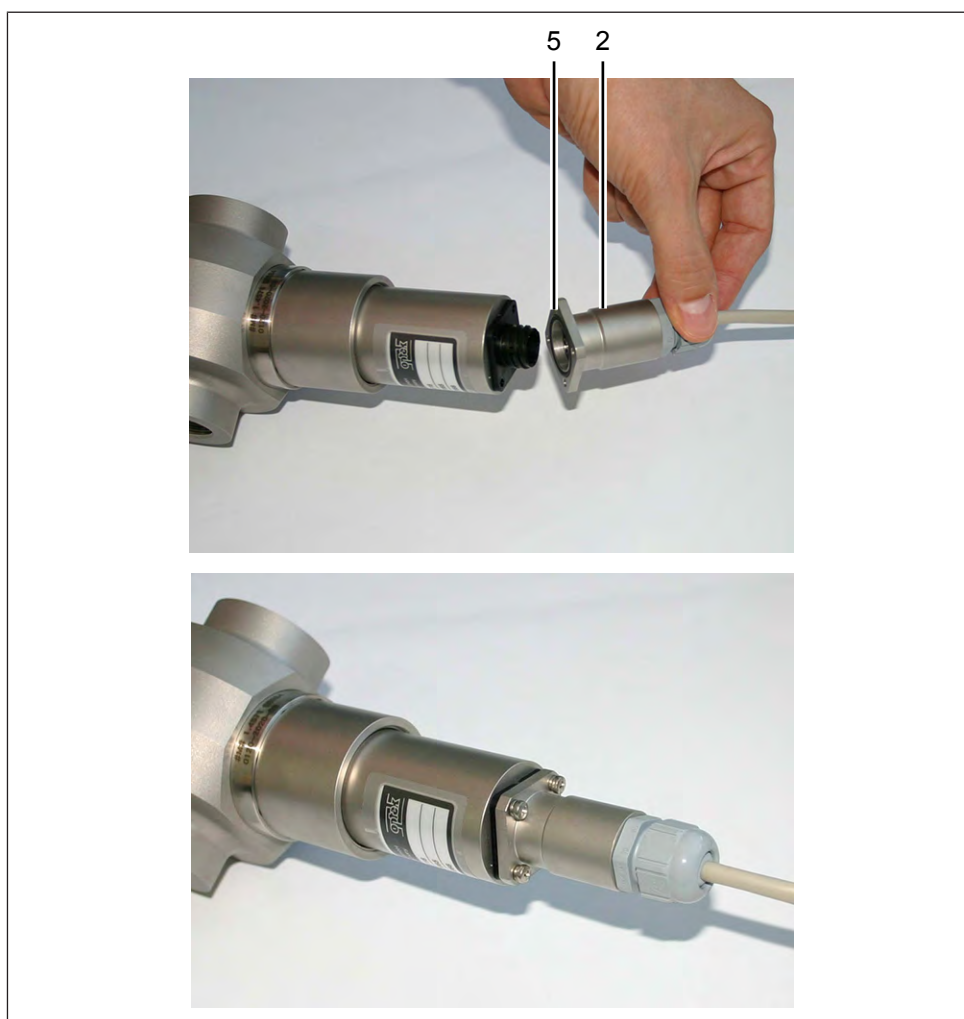


Fig. 14: Connection of the sensor cable with plug protector

**NOTICE!**

Exact information about the connection of a sensor to a converter is given in the instruction manual of the respective converter. There you can as well find the corresponding wiring plans.

8 Faults

Among other possibilities, you can detect faults whenever an error message on the converter appears. Try to clear the fault using the following table and the instructions given in the chapter "Software" in the instruction manual of the converter. Should you have any difficulty clearing the fault, feel free to contact our customer service.

See chapter 12, page 34 for our contact data.

Tab. 2: Possible faults and remedies

Possible fault	Possible remarks	Cause	Remedy
Failure of lamp module	<ul style="list-style-type: none"> "Lamp failure" LED of converter flashes. Signal loss 	Lamp cable between sensor and converter defective	<ul style="list-style-type: none"> Continuity test of lamp cable Exchange lamp cable for new one.
		Lamp module defective	Exchange lamp module.
Detector failure	-	Detector cable between sensor and converter defective	<ul style="list-style-type: none"> Continuity test of detector cable Exchange detector cable for new one.
		Detector defective	Exchange detector.
Condensate formation	Unrealistic, random measuring results	Humidity gets into optical housing and forms condensation deposits on windows.	Use air purge.
		O-ring missing or defective	Disassemble sensor assemblies and check O-rings, exchange if necessary.
Wrong results	<ul style="list-style-type: none"> Results are fluctuating. Zero point is drifting. 	<ul style="list-style-type: none"> Sensor body windows are dirty. Sensor body windows are corroded. Lamp module near failure, lamp module near the end of its life. 	<ul style="list-style-type: none"> Clean sensor body window. Exchange sensor body window for sapphire window. Exchange lamp module.
Connection error	<ul style="list-style-type: none"> No function No "Lamp failure" LED message 	Detector cable between sensor and converter defective	<ul style="list-style-type: none"> Continuity test of detector cable Exchange detector cable for new one.
		Sensor cable incorrectly connected to converter	Check and revise connections.
Measuring range exceeded	↑ - ↑ - ↑ flashing at the converter	Process conditions	<ul style="list-style-type: none"> Amplify measuring range. If the measuring range cannot be amplified, reduce optical path length.
		Wavelength-dependent detector module reduces the dynamic measuring range, optical filters reduce wanted signal.	<ul style="list-style-type: none"> Reduce optical path length and / or change measuring wavelength. Exchange lamp module.

Possible fault	Possible remarks	Cause	Remedy
Lower measuring range exceeded	↓ - ↓ - ↓ flashing at the converter	<ul style="list-style-type: none"> • Zero point was established with dirty or contaminated zero solution. • Zero point for a liquid process stream was adjusted based on air (i.e. empty armature) 	Use pure zero solution (DI water or respective solvent for liquid process streams) and re-zero instrument.
mA-signal (output)	mA-output delivers correct current results if measuring results are low and too low current results if measuring results are high.	Connected load > 600 ohms	<ul style="list-style-type: none"> • Check resistance of wiring. • Use appropriate mA-input.
	Smaller deviations in the % range	Poor calibration of the receiving mA-input	Compensation by adjusting calibration of the sending mA-output.
mA-signal (input)	Smaller deviations in the % range	Poor calibration of the sending mA-output	Compensation by adjusting calibration of the receiving mA-input.
Converter defective	None of the above mentioned errors can be detected.	-	Send system (converter and sensor) to optek for checking purposes. If necessary, the sensor body can remain in the pipeline so that only the optical arms and the converter have to be sent.

9 Maintenance

9.1 Preventive maintenance

Tab. 3: Preventive maintenance

Component	Maintenance activity	Maintenance interval	Information
Wetted parts	inspection with regard to leakages	as part of standard installation maintenance	Possible damaged sealing faces of the sensor body can lead to leakages.
Lamp module	exchange	1 - 2 years	Operation of the lamp below its nominal voltage (4.8 V DC instead of 5.0 V DC) enhances lamp life. Strong vibrations, high temperatures or frequent on and off switching of the system can have negative effects on the service life. Statistical service life is 3 years.

**NOTICE!**

The used detector is not subjected to measurable aging when used properly.

9.2 Exchange of the lamp module

Tool

☞ Screw driver 

1. Switch the converter voltage-free.
2. Loosen the sensor cable from the lamp module.
3. Loosen the four screws connecting the lamp module to the stainless steel housing.
4. Pull out the lamp module (1 in Fig. 15).
5. Check if there is an O-ring (2) for the lamp module.
6. Insert the new lamp module into the sensor.
7. Fasten the four screws.
8. Re-connect the sensor cable.
9. Switch on the converter.
10. Follow the instructions given in chapter 9.4, page 25.

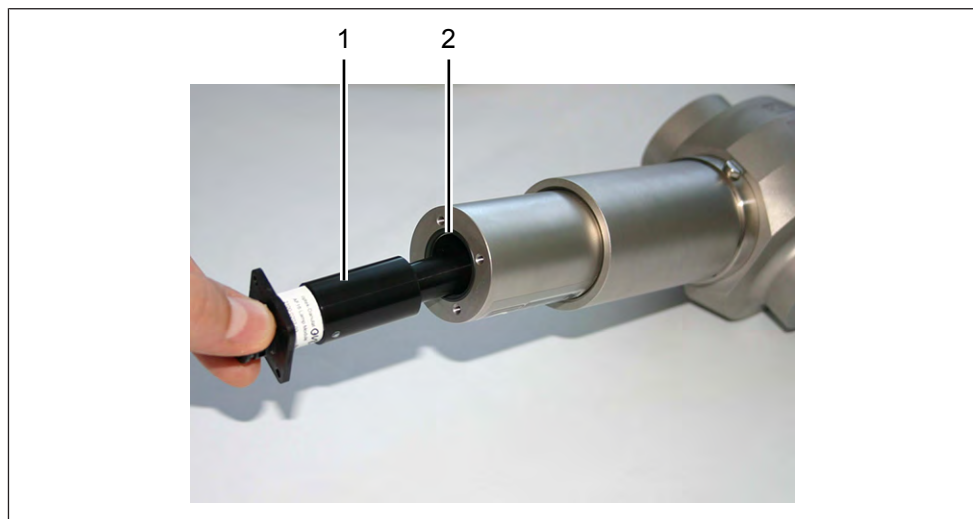


Fig. 15: Exchange of the lamp module

9.3 Exchange of detector module

ToolScrew driver 

1. Switch the converter voltage-free.
2. Loosen the sensor cable from the detector module.
3. Loosen the four screws connecting the detector module to the stainless steel housing.
4. Pull out the detector module (2 in Fig. 16).
5. Check if there is an O-ring (1) for the detector.
6. Insert the new detector module into the sensor.
7. Fasten the four screws.
8. Re-connect the sensor cable.
9. Switch on the converter.
10. Follow the instructions given in chapter 9.4, page 25.

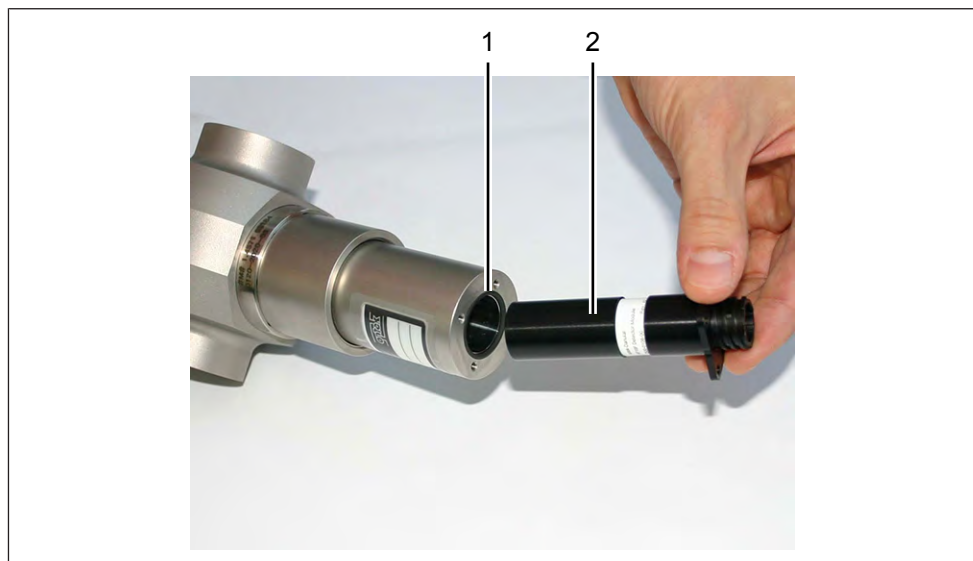


Fig. 16: Exchange of the detector module

9.4 Return to operation after the exchange of lamp module and detector module

Before return to operation of the entire measuring system, undertake the following activities:

1. Switch on the converter.
2. Wait for approx. 15 minutes, until the converter has reached the working temperature.
3. Check the system's zero-point (see instruction manual of the converter).
4. Document your settings using the form (see instruction manual of the converter).
5. Check the measuring results with regard to plausibility.
6. If the settings and measuring results are correct, enable measuring.

9.5 Calibration filters for VB option



NOTICE!

Using the calibration filters, it is possible to check the entire measuring chain, consisting of sensor, cable and converter, with respect to photometric accuracy. For more information please refer to the instruction manual Calibration Handbook UV or VIS / NIR.

The measuring system's functionality can be checked at the installation site without disassembly if the sensor is equipped with the VB option (filter adapter FH03).

For this check, a calibration filter causing an attenuation of the light beam and simulating absorption inside the measuring gap is inserted into the beam path.

The check is carried out in three steps:

- a) Check of the system's zero point
- b) Absorption measurement with and without calibration filter
- c) Evaluation of the results

If the measuring system works correctly, the difference between the measuring results with and without calibration filter corresponds to the nominal value given in the calibration certificate.

Check of the system's zero point

Check the system's zero point, following the instructions given in the instruction manual of the converter. The system's zero point should be within the range between 0.000 to +/- 0.004 CU. If the results are too high, the process medium inside the measuring gap and the windows should be checked for soiling. If the result is too low, there probably was a contamination at the time of a preceding zeroing and another zeroing can be carried out instantly.

Always document the zero value before and after the zeroing!

If it is not possible to set the zero point, check the process medium, measuring segment, windows, lamp module, wiring as well as the serial numbers and repeat the procedure.

Absorption measurement with calibration filter

To measure the absorption value with calibration filter, carefully insert the calibration filter into the optical beam path of the sensor. At the factory, the calibration filter has been installed into a filter holder to make this procedure possible. This filter holder and the calibration filter fit into the sensor. Two pilot pins allow exact positioning of the filter holder and thus very good reproducibility of the measuring results.

Proceed as follows:

1. Loosen the two screws of the adapter's sealing cover.
2. Remove the sealing cover with screws and O-ring (3 in the figure below).
3. Take the filter holder (2) out of the filter protector (1).



Fig. 17: The adapter's filter protector, filter holder and sealing cover

4. Visually inspect the calibration filter for dust or other soiling (e.g. fingerprints) and clean it if necessary.

5. Insert the filter holder into the adapter. The pilot pins have to enter the alignment holes.



Fig. 18: Inserting the calibration filter's filter holder

6. Check the correct fitting of the filter holder.
7. Screw the filter holder into the sensor.
8. Protocol the measuring result with calibration filter installed.
9. Remove the filter holder.
10. Install the sealing cover with the O-ring.
11. Screw-tighten the sealing cover.
12. Protocol the measuring result without calibration filter.

The measuring results *without* calibration filter should be the same before and after validation! Differences bigger than ± 0.002 CU indicate gas bubbles or other impurities!

Evaluation of the results

Evaluation example (all data given in CU):

The following values are given in the calibration certificate:

- Certified value: 0.869 CU
- Tolerance: ± 0.03 CU

Thus, the admissible range is:

$$0.869 - 0.03 \text{ to } 0.869 + 0.03 = 0.839 - 0.899 \text{ CU}$$

Tab. 4: Evaluation example

Measuring value without calibration filter (zero value)	Measuring value with calibration filter	Difference between the measuring values with and without calibration filter	Admissible range	Evaluation
0.002	0.879	0.877	0.839 - 0.899	OK

The measured value coincides with the admissible value within the tolerance.

There is no indication of a sensor or converter malfunction.

If the measuring results are too high, the calibration filter is dirty or the filter holder is not installed correctly!

10 Spare parts and accessories

10.1 Lamp modules / optics modules / detector modules

Tab. 5: Spare parts – lamp modules / optics modules / detector modules

Description	Name / type	Part number	Old part number
Lamp module*	Lamp module AF16 / AF16-HT	1426-3131-0801-03	1426-3131-0801-01
Installation kit optics module	Installation kit optics module AF	1414-3131-4006-00	
	Installation kit optics module AF-HT	1414-3131-4007-00	
Detector module AF16-N (NIR)	Detector module AF16-N	1414-3131-8001-00	
	Detector module AF16-HT-N	1414-3131-8002-00	
	Detector module AF16-P	1414-3129-8001-00	
	Detector module AF16-HT-P	1414-3129-8002-00	
Detector module AF16-F (choose wavelength module from table wavelength modules)	Detector module AF16-F	1414-3133-8001-00	
	Detector module AF16-HT-F	1414-3133-8002-00	

* Recommended spare part for 2-3 years of operation.

10.2 Wavelength modules

Tab. 6: Spare parts – wavelength modules*

Description	Name / type	Part number
Wavelength module AF16-F - Wavelength: 385 nm - Full Width Half Maximum (FWHM): 10 nm	WLM AF16-F: 385 nm (10)	1430-3133-0385-00
Wavelength module AF16-F - Wavelength: 400 nm - Full Width Half Maximum (FWHM): 10 nm	WLM AF16-F: 400 nm (10)	1430-3133-0400-00
Wavelength module AF16-F - Wavelength: 430 nm - Full Width Half Maximum (FWHM): 10 nm	WLM AF16-F: 430 nm (10)	1430-3133-0430-00
Wavelength module AF16-F - Wavelength: 525 nm - Full Width Half Maximum (FWHM): 10 nm	WLM AF16-F: 525 nm (10)	1430-3133-0525-00
Wavelength module AF16-F - Wavelength: 750 nm - Full Width Half Maximum (FWHM): 10 nm	WLM AF16-F: 750 nm (10)	1430-3133-0750-00
Wavelength module AF16-F - Wavelength: 1000 nm - Full Width Half Maximum (FWHM): 10 nm	WLM AF16-F: 1000 nm (10)	1430-3133-1000-00

* Other wavelength modules on request.

10.3 Installation Kit

Tab. 7: Spare parts – installation kit

Description	Name / type	Part number
Consisting of: 1 x (0217-0014-00) Klueber paste UH1 96-402 12 g 2 x (0203-0016-02) O-ring 25.12 x 1.78 Viton 1 x (0203-0021-02) O-ring 50.52 x 1.78 Viton 2 x (0220-0019-00) Purge connection M5 2 x (0203-0001-02) O-ring 4.00 x 1.00 Viton	Installation Kit AF/TF	1201-3131-0004-00
Consisting of: 12 x (0220-0077-01) Screw M3 x 12 DIN 7985 12 x (0220-0011-01) Washer M3 DIN 7980 3 x (0203-0015-02) O-ring 21.95 x 1.78 Viton 1 x (0203-0018-02) O-ring 31.47 x 1.78 Viton	Installation Kit SS-Cable	1201-3131-0003-00

10.4 Gaskets

Tab. 8: Spare parts – gaskets (not wetted)

Description	Name / type	Part number
4 x (0203-0008-02) O-ring 10.10 x 1.60 Viton	O-ring 10.10 x 1.60 Viton	1203-0004-0008-02
4 x (0203-0013-02) O-ring 18.77 x 1.78 Viton	O-ring 18.77 x 1.78 Viton	1203-0004-0013-02
4 x (0203-0015-02) O-ring 21.95 x 1.78 Viton	O-ring 21.95 x 1.78 Viton	1203-0004-0015-02
4 x (0203-0016-02) O-ring 25.12 x 1.78 Viton	O-ring 25.12 x 1.78 Viton	1203-0004-0016-02
4 x (0203-0018-02) O-ring 31.47 x 1.78 Viton	O-ring 31.47 x 1.78 Viton	1203-0004-0018-02

10.5 Screw sets

Tab. 9: Spare parts – screw sets

Name / type	Part number
10 x (0220-0023-03) Screw M3 x 6 DIN 7985	1206-0010-0023-03

10.6 Calibration retrofit sets

Tab. 10: Spare parts – calibration retrofit sets

Description	Name / type	Part number
Filter adapter FH03 (detector side) for calibration filter used for sensor verification (recommended)	Calibration retrofit set AF16-VB	1414-3131-8003-00

10.7 Accessories – calibration filter for calibration adapter VB (filter adapter FH03)

Tab. 11: Accessories – calibration filter for calibration adapter VB (filter adapter FH03)

Description	Name / type	Part number
Cal filter NIR-L for absorption 0.45 CU	Cal Filter NIR-L045	1442-0025-0213-13
Cal filter NIR-L for absorption 0.9 CU	Cal Filter NIR-L090	1442-0025-0213-23
Cal filter NIR-L for absorption 1.8 CU	Cal Filter NIR-L180	1442-0025-0213-33
Cal filter VIS-L for absorption 0.45 CU	Cal Filter VIS-L045	1442-0025-0223-13
Cal filter VIS-L for absorption 0.9 CU	Cal Filter VIS-L090	1442-0025-0223-23
Cal filter VIS-L for absorption 1.8 CU	Cal Filter VIS-L180	1442-0025-0223-33
FH03 calibration cuvette	Cal Cuvette FH03	1448-0102-0000-03

10.8 Accessories – cable sets plastic connector

Tab. 12: Accessories – cable sets plastic connector*

Length	Name / type	Part number
2 m (7 ft)	Cable Set AF16 002 m ST-1.5	2311-0115-0002-00
3 m (10 ft)	Cable Set AF16 003 m ST-1.5	2311-0115-0003-00
5 m (16 ft)	Cable Set AF16 005 m ST-1.5	2311-0115-0005-00
10 m (33 ft)	Cable Set AF16 010 m ST-1.5	2311-0115-0010-00
15 m (49 ft)	Cable Set AF16 015 m ST-1.5	2311-0115-0015-00
20 m (66 ft)	Cable Set AF16 020 m ST-1.5	2311-0115-0020-00
25 m (82 ft)	Cable Set AF16 025 m ST-1.5	2311-0115-0025-00
30 m (98 ft)	Cable Set AF16 030 m ST-1.5	2311-0115-0030-00
35 m (115 ft)	Cable Set AF16 035 m ST-1.5	2311-0115-0035-00
40 m (131 ft)	Cable Set AF16 040 m ST-1.5	2311-0115-0040-00
45 m (148 ft)	Cable Set AF16 045 m ST-1.5	2311-0115-0045-00
50 m (164 ft)	Cable Set AF16 050 m ST-1.5	2311-0115-0050-00
60 m (197 ft)	Cable Set AF16 060 m ST-1.5	2311-0115-0060-00
70 m (230 ft)	Cable Set AF16 070 m ST-1.5	2311-0115-0070-00
80 m (262 ft)	Cable Set AF16 080 m ST-1.5	2311-0115-0080-00
90 m (295 ft)	Cable Set AF16 090 m ST-1.5	2311-0115-0090-00
100 m (328 ft)	Cable Set AF16 100 m ST-1.5	2311-0115-0100-00

* Also applies to AF56.

10.9 Accessories – cable sets SS plug protector

Tab. 13: Accessories – cable sets SS plug protector
(Installation Kit SS-Cable – PN: 1201-3131-0003-00 included)*

Length	Name / type	Part number
2 m (7 ft)	Cable Set AF16 002 m SS-1.5	2311-0315-0002-00
3 m (10 ft)	Cable Set AF16 003 m SS-1.5	2311-0315-0003-00
5 m (16 ft)	Cable Set AF16 005 m SS-1.5	2311-0315-0005-00
10 m (33 ft)	Cable Set AF16 010 m SS-1.5	2311-0315-0010-00
15 m (49 ft)	Cable Set AF16 015 m SS-1.5	2311-0315-0015-00
20 m (66 ft)	Cable Set AF16 020 m SS-1.5	2311-0315-0020-00
25 m (82 ft)	Cable Set AF16 025 m SS-1.5	2311-0315-0025-00
30 m (98 ft)	Cable Set AF16 030 m SS-1.5	2311-0315-0030-00
35 m (115 ft)	Cable Set AF16 035 m SS-1.5	2311-0315-0035-00
40 m (131 ft)	Cable Set AF16 040 m SS-1.5	2311-0315-0040-00
45 m (148 ft)	Cable Set AF16 045 m SS-1.5	2311-0315-0045-00
50 m (164 ft)	Cable Set AF16 050 m SS-1.5	2311-0315-0050-00
60 m (197 ft)	Cable Set AF16 060 m SS-1.5	2311-0315-0060-00
70 m (230 ft)	Cable Set AF16 070 m SS-1.5	2311-0315-0070-00
80 m (262 ft)	Cable Set AF16 080 m SS-1.5	2311-0315-0080-00
90 m (295 ft)	Cable Set AF16 090 m SS-1.5	2311-0315-0090-00
100 m (328 ft)	Cable Set AF16 100 m SS-1.5	2311-0315-0100-00

* Also applies to AF56.

11 EU declaration of conformity

EU declaration of conformity

Herewith we,

optek-Danulat GmbH, Emscherbruchallee 2, 45356 Essen, Germany,

declare in sole responsibility that the following measuring systems each comprising one converter of the series

Control 4000 (C4XXX mit X=0..6);

Control 8000 (C8XXX mit X=0..8);

Haze Control (HC 4XXX, X=0..6)

and one or several sensors of the series

AF16, AF26, AF45, AF46, TF16-N, DTF16, ASD12, ASD25, AS16,
AS56, ACF60, ACS60

have been developed, constructed and manufactured in conformity with the requirements of the European directives of 2014/30/EU and 2014/35/EU (published in L96 of 29 March 2014) and 2011/65/EU (published in L174 of 1st July 2011).

The assessment is based on the application of the standards:

EN 61326-1:2013

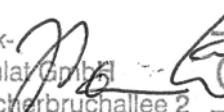
EN 61326-2-3:2013

EN 61010-1:2010

EN 61326-2-5:2013

EN IEC 63000:2018

Essen, 22.09.2020

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