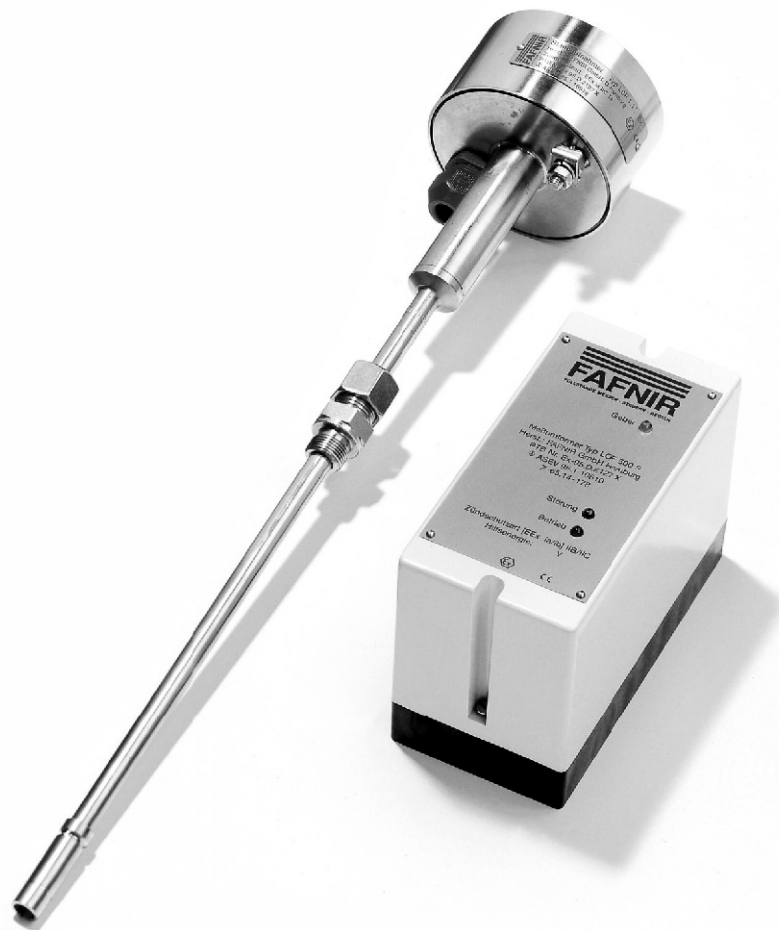


LOF 1.1 and LOF 500/NB 220

Fibre-optical Overfill Protection System



11/2005
Issue: 1

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Features of overfill protection system LOF 1.1 .. and LOF 500 ../NB 220 ..

The FAFNIR fibre-optical overfill protection systems are safety devices to prevent the overfilling of storage tanks and process containers. When working with water polluting liquids it is an essential element for protecting the environment.

The systems are used as a whole in countries where storage tanks with a volume of more than 1,000 litres must, by law, be equipped with an overfill protection system.

The overfill protection system consists of a level detector type LOF 1.1 .. inside the tank and a measuring transducer type LOF 500 .. or type NB 220 .. with alarm unit and switching output mounted on the tank wall or in a control unit.

There is a system version available for Ex-zone 0 which is composed of the level detector type LOF 1.1 .. Ex and the measuring transducer type LOF 500 ..

The alarm unit integrated into the transducer emits visual and in some versions also audible signals, depending on the operation state, e.g. if a certain level is reached.

The level detector can be easily adjusted as required to match the particular size of tank. The entire overfill protection system is maintenance-free.

Safety instructions

The overflow protection system has been developed, manufactured and tested in accordance with the state of the art and the recognised rules of safety engineering. Nevertheless, it could be hazardous. Therefore, please observe the following safety instructions.

1 Symbols in this operation manual

The safety instructions contained in this manual are highlighted as follows:



If you fail to observe these safety instructions, there will be a risk of an accident or the LOF 1.1 .., LOF 500 ../NB 220 .. overflow protection system may be damaged.



Useful information to ensure that the overflow protection system operates properly or make your work easier.

2 Correct use

The overflow protection system is used to monitor liquids in storage tanks and process containers. Use the overflow protection system solely for this purpose. The manufacturer accepts no liability for any damage resulting from abnormal use!

3 Basic safety instructions

- Never perform any modifications, attachments or conversions to the system without obtaining prior consent from the manufacturer.
- Installation, operation and maintenance of the overflow protection system may only be performed by skilled, authorised personnel. The overflow protection system may only be installed and serviced by experienced electricians. To maintain the level of expertise it is necessary to partake in regular training courses.
- Operators, setters and maintenance technicians must observe all the relevant safety regulations. This also applies to the local safety and accident prevention regulations which are not listed in this operation manual.
- The transducer must be installed in a closed room or in a housing which conforms to a certain protection class depending on the transducer version (see Chap. "Technical data").
- After completion of installation and when changing the storage liquid an expert from the specialised company or user must conduct a test to ensure that the equipment has been installed correctly and is operating properly.

- Electric circuits for horns and lamps which cannot be wired up as closed circuits must be easy to check to make sure they are in good working order.
- Before putting into operation, all the devices belonging to the overfill protection system must be checked to ensure that they have been connected up correctly and are operating properly. The power supply, including that of downstream equipment, must also be checked.
- Parts of the overfill protection system which are not checked must meet the certification requirements for overfill protection systems.
- If auxiliary power fails (if limits are exceeded) or if there is discontinuity in the cables connecting the various parts of the system, overfill protection systems must report the fault or indicate the maximum tank level.

Design and operation

The overflow protection system consists of a level detector (1) and a transducer (2) with a binary output (potential-free change-over contact). The switching signal is fed to the annunciator (3a) or the control device (3b) with actuator (3c) direct or via a signal amplifier (4) if necessary. (See Fig. 1)

1 Schematic diagram of the overflow protection system

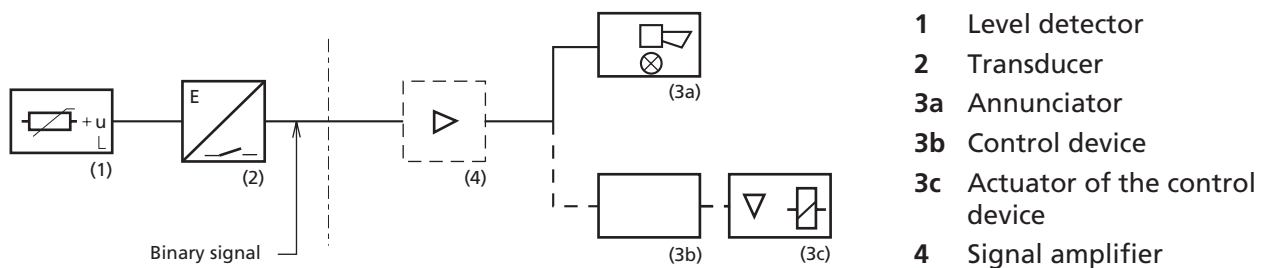


Fig. 1: Schematic diagram of the overflow protection system

2 The level detectors LOF

This section describes the level detectors'

- functional principle, and
- the design depending on the different detector versions.

2.1 Functional principle

The functional principle of the level detectors is based on the different refraction of light on a prism in a gaseous and in a liquid environment:

The light is transmitted from a transmitter (infrared LED) to the prism via an optical fibre, and from the prism to the receiver (phototransistor) via a second fibre. If the prism is not wet with liquid, the light beam is reflected and transmitted to the receiver. When the prism is submerged in liquid, only a very small amount of light reaches the receiver.

In order to prevent the system from being affected by external light, the level detector transmits pulsed infrared light. The receiver converts the light pulses into electrical pulses, amplifies the pulses, and compares them with the transmitter pulses. Only if both pulses are in phase, a release signal will be transmitted to the transducer. If there is external light, a fibre break or line break, no release signal will be transmitted.

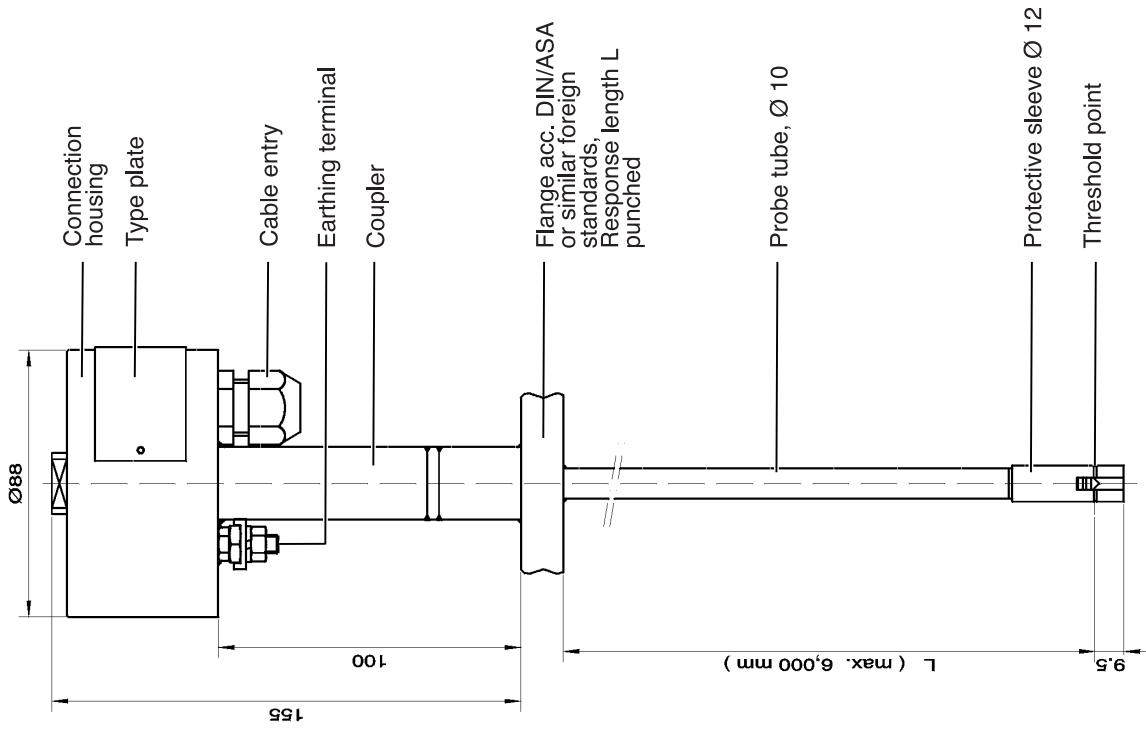


Fig. 2b: LOF 1.11 F

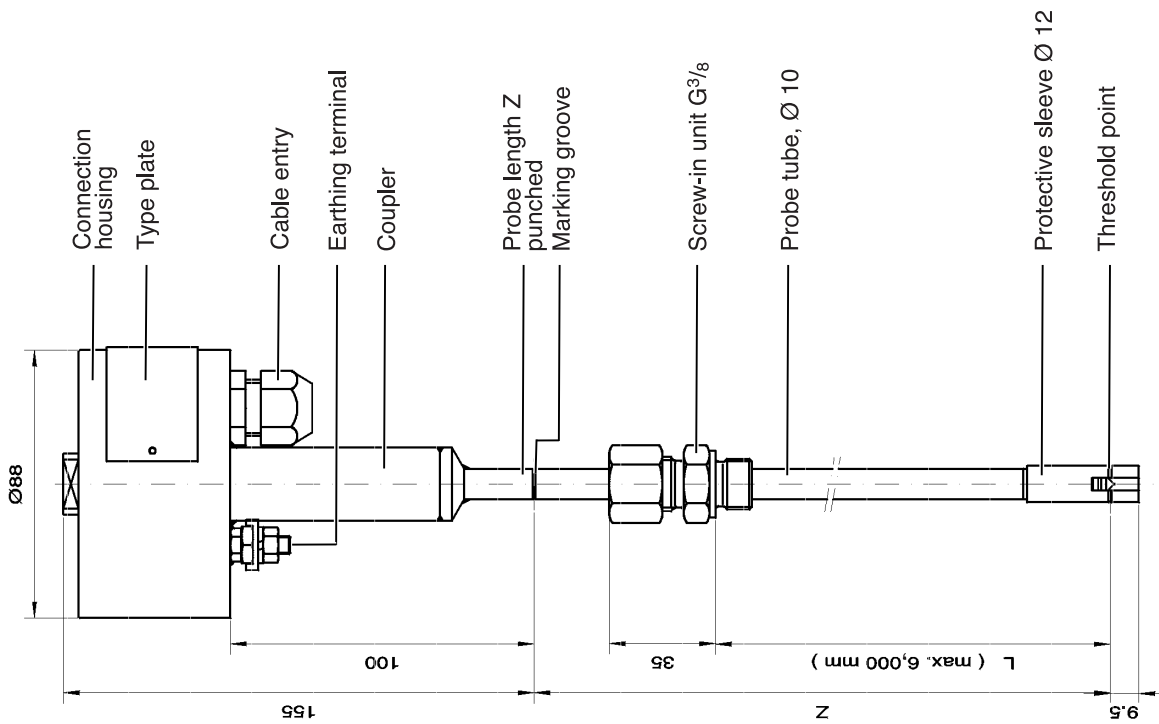


Fig. 2a: LOF 1.11 E

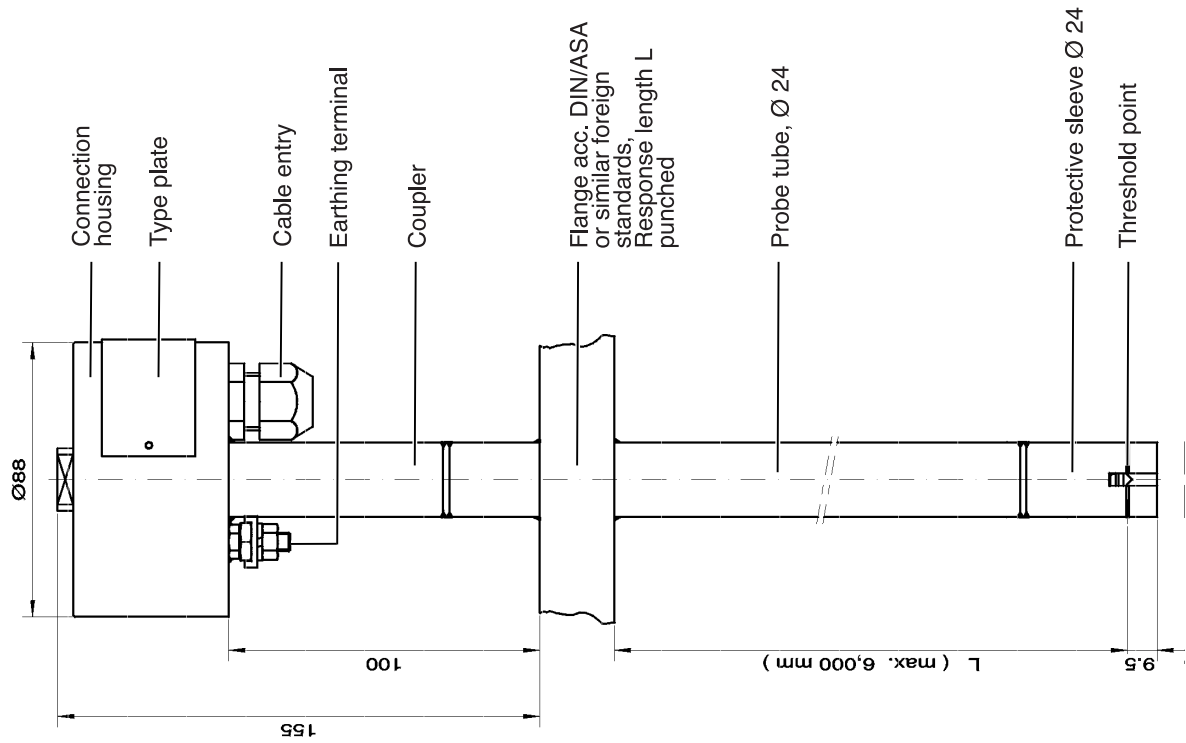


Fig. 2d: LOF 1.11 FS

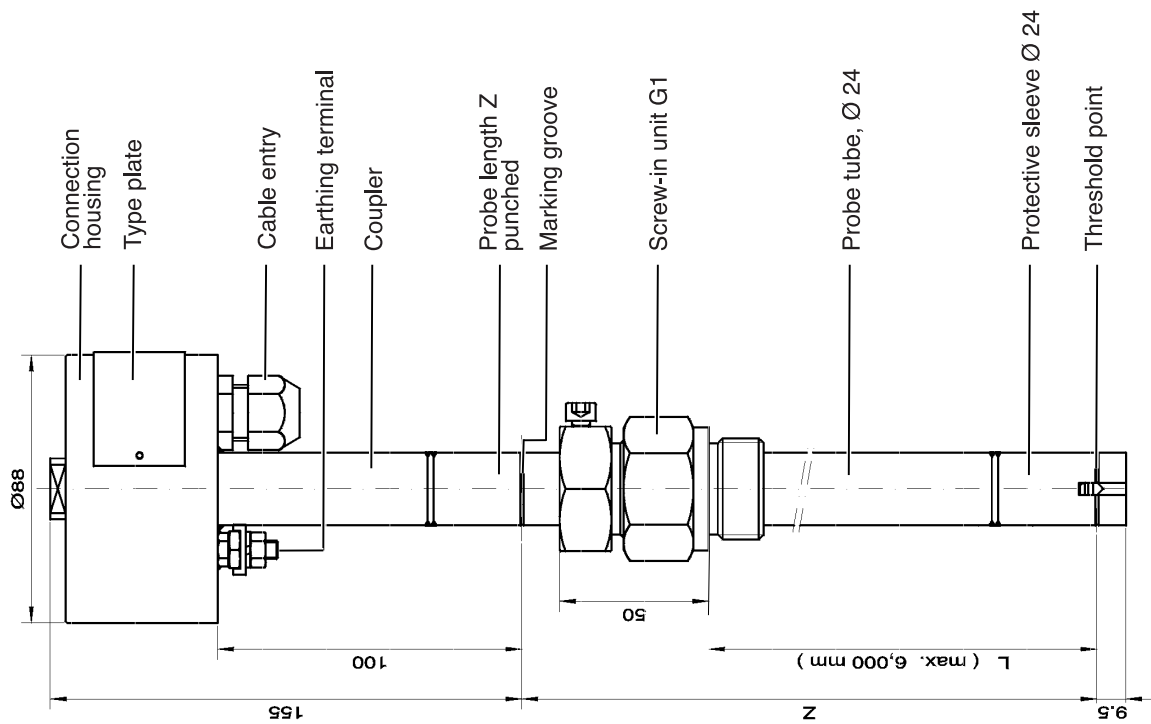


Fig. 2c: LOF 1.11 ES

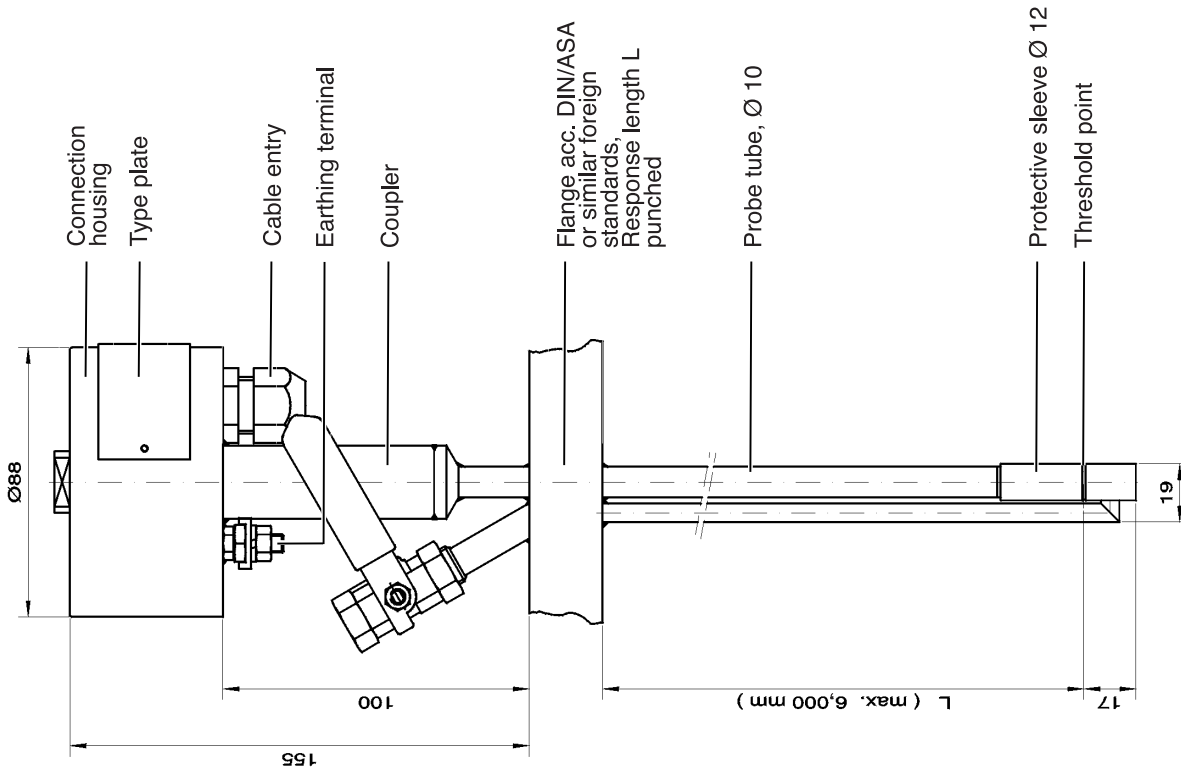


Fig. 2f: LOF .. FP

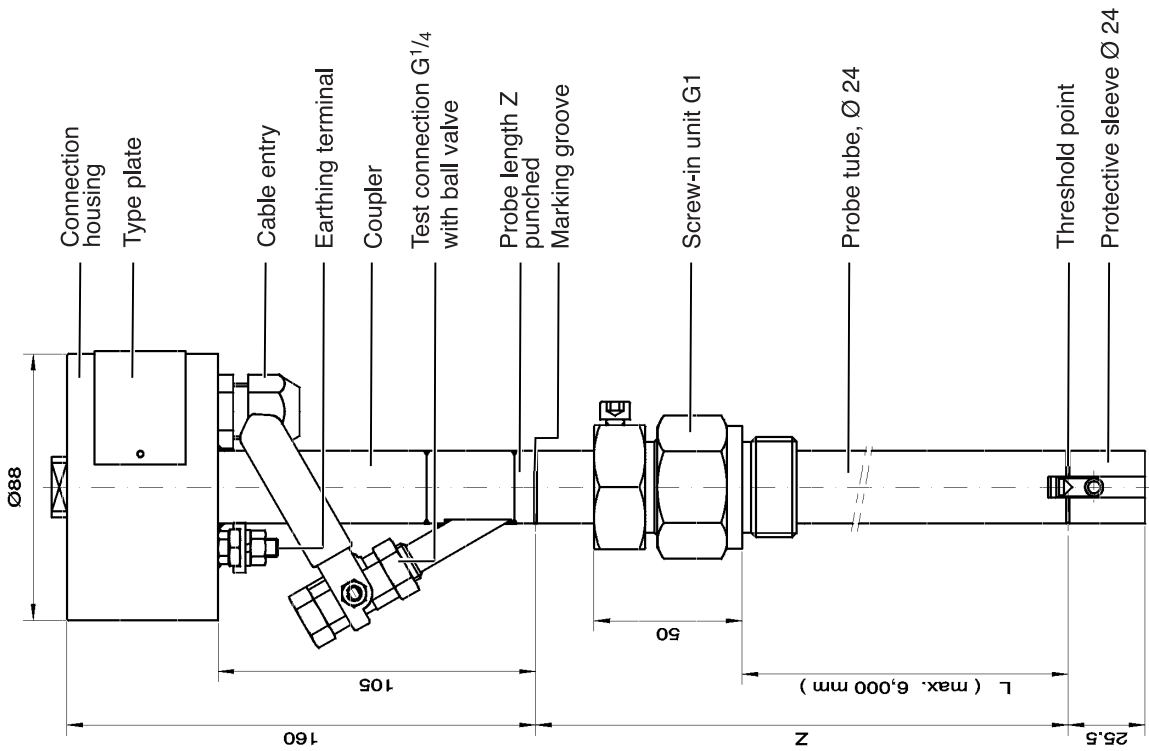


Fig. 2e: LOF .. ESP

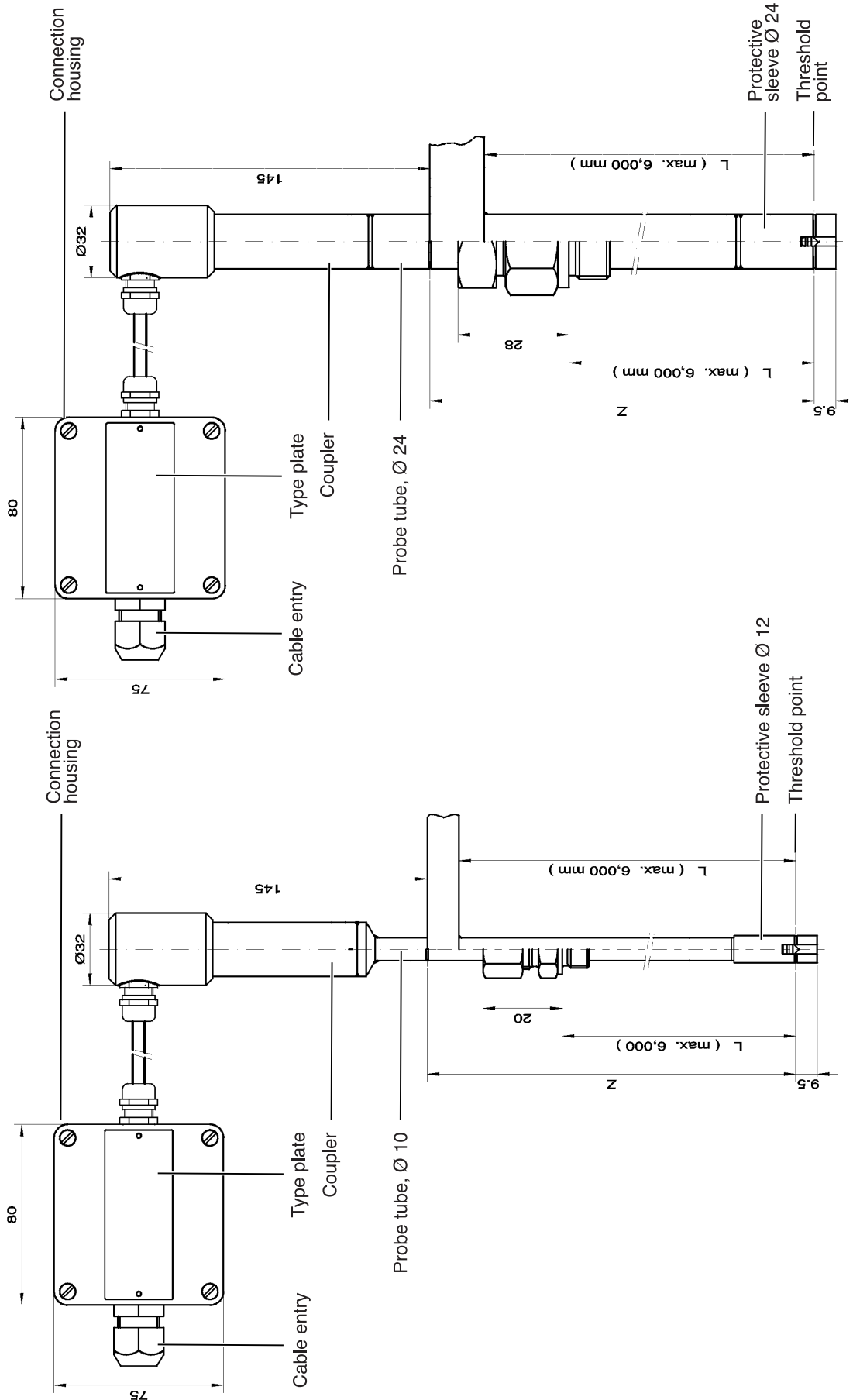


Fig. 2h: LOF 1.12 ES/FS/ESP

Fig. 2g: LOF 1.12 E/F

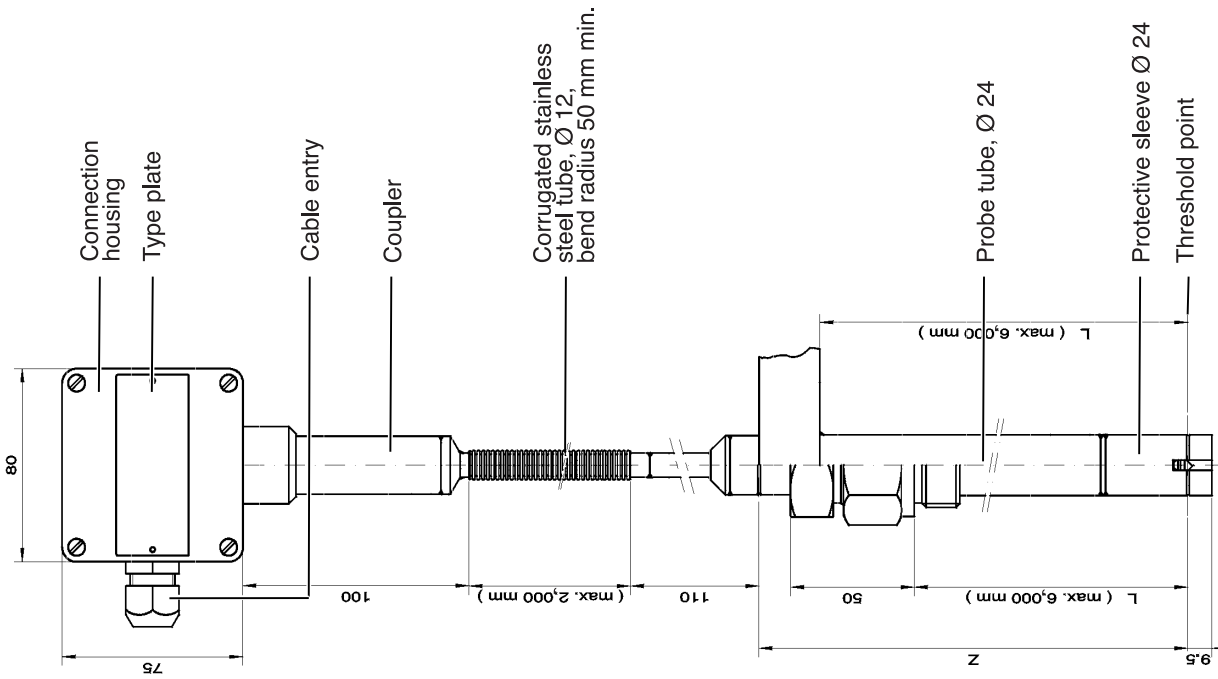


Fig. 2j: LOF 1.13 ES/FS/ESP

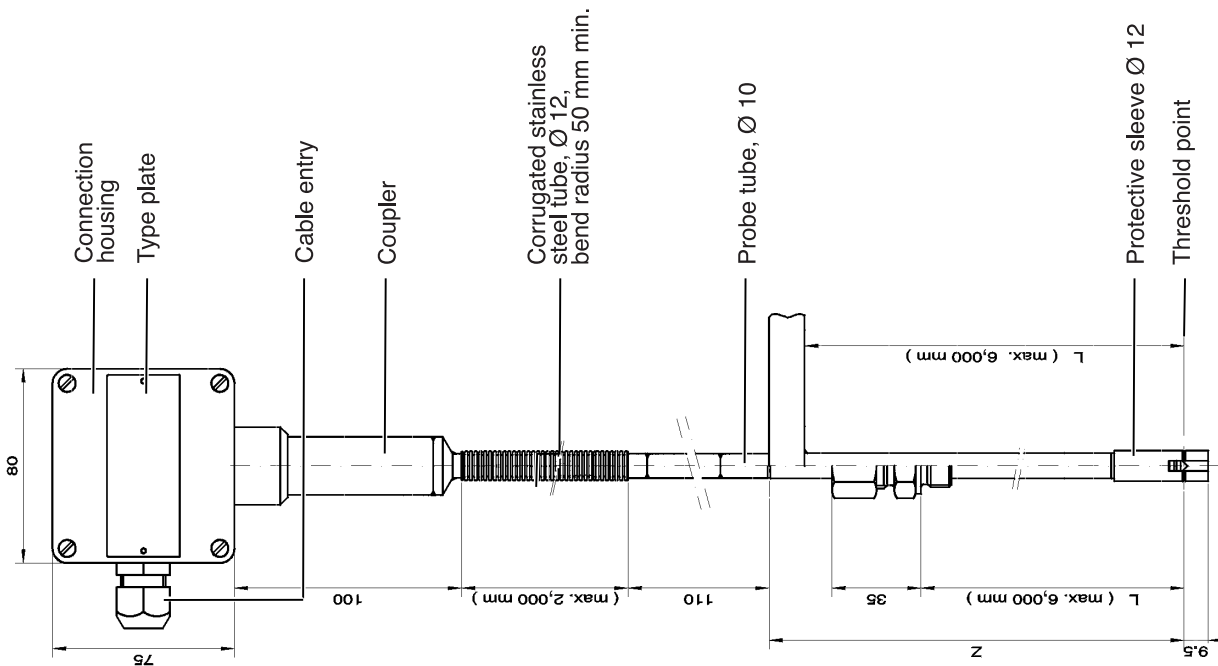


Fig. 2i: LOF 1.13 E/F/FP

2.2 General design

The level detectors consist of a probe tube, which reaches into the tank and carries a sensor, protected against mechanical damages, on its bottom end. The corresponding probe length is permanently imprinted at the top end of the probe.

2.2.1 Level detector LOF 1.11 ..

This level detector is the LOF standard version and can be used in almost all application areas. The transducer electronics are installed in a stainless steel housing located directly on the probe tube (see Fig. 2a–2d).

The level detector can optionally be equipped with an electric plug-in connection for a comfortable connection to the transducer.



The counter plug that is necessary for installation is not included in the scope of delivery and must be ordered additionally.

2.2.2 Level detector LOF 1.12 ..

With this level detector, the transducer electronics are separated from the level detector in a die-cast aluminium housing. The transducer electronics are connected to the opto-electric parts in the coupler housing using a cable (standard length: 1 m) (see Fig. 2g and 2h).

In this version the level detector is also suitable for restricted ambient conditions or high ambient temperatures, as the maximum temperature of the transducer electronics may be 70 °C and that of the coupler 120 °C.

2.2.3 Level detector LOF 1.13 ..

With this level detector, the coupler with the opto-electric parts and the transducer electronics are separated from the level detector. The connection is provided using a stainless steel tube (standard length: 1 m) with internal optical fibres (see Fig. 2i and 2j).

This version is suited for extremely low and high temperatures on the coupler and on the transducer electronics.

2.2.4 Level detector LOF .. Ex

LOF level detectors with the additional designation "Ex" are approved for Ex-zone 0, if they are connected to a transducer LOF 500 .. (see section 3 "The transducers LOF 500 and NB 220" and Annex)

2.2.5 Height-adjustable level detector LOF .. E with screw-in unit

LOF level detectors with the additional designation "E" are fitted with a screw-in unit, which is used to adjust the probe tube and the response length to a particular height depending on the tank size (see Fig. 2a, 2c, 2e).

2.2.6 Level detector LOF .. F with flange

With LOF level detectors with the additional designation "F" the probe tube is welded to the flange and thus can not be adjusted in height (see Fig. 2b, 2d, 2f).

2.2.7 Level detector LOF .. S with larger probe tube diameter

The probe tube of LOF level detectors with the additional designation "S" has a diameter of 24 mm (tube wall thickness: 2 mm) instead of the standard values of Ø 10 mm with a tube wall thickness of 1.5 mm (see Fig. 2c–2e, 2h, 2j).

2.2.8 Level detector LOF .. P with testing unit

LOF level detectors with the additional designation "P" are equipped with a testing unit, which can be used to test the function of the entire overflow protection system, from the detector tip to the annunciator or control device, without having to dismount the level detector (see Fig. 2e and 2f).

3 The transducers LOF 500 and NB 220

This section describes the transducers'

- functional principle, and
- the design depending on the different transducer versions.

3.1 Functional principle

In the transducer the release signal of the level detector is converted into a binary output signal (relay). The transducer distinguishes two operating states: Normal mode and malfunction. Malfunction means both, the sensor tip is submerged in liquid (alarm) and the level detector is defective, e.g. corrosion, short circuit, line breakage. In any case of a malfunction the relay in the transducer releases. The malfunction is signalled optically and depending on the transducer version also acoustically.

3.2 General design

The transducers LOF 500 .. and NB 220 .. are equipped with evaluation electronics, that evaluate the signals transmitted by the level detector. A potential-free change-over contact is used to connect the transducer to an annunciator or control device. The operating mode or a malfunction is signalled by means of LEDs:

- The green LED indicates that the transducer is electrically ready to operate.
- The yellow LED
 - is lit during normal operation, i.e. if there is no malfunction.
 - goes out, if the liquid level has reached or exceeded the maximum permissible height, or if there is an overflow protection system error.

3.2.1 Transducer LOF 500 19" Duo with two transducers

These devices have two transducers set up separately on a European standard-size printed circuit board.

3.2.2 Transducer LOF 500 T/LOF 500 19" T with dry running protection

The output relay of these transducers is activated when the sensor tip is submerged in liquid. A relay release occurs when the sensor tip emerges from the liquid, as well as in the case of a short circuit or breakage in the cable between the level detector and the transducer. This is signalled by the extinguishing of the yellow LED.

3.2.3 Transducer LOF 500 S/LOF 500 19" S with additional alarm indicator

These transducers are fitted with an additional alarm relay and a red LED indicating an interruption or short circuit of the signal line between level detector and transducer.

3.2.4 Transducer LOF 500 Z/LOF 500 19" Z with two change-over contacts

These transducers provide two potential-free change-over contacts for alarm-signalling purposes.

3.2.5 Transducer NB 220 QS

Apart from the green and the yellow LED the NB 220 QS is equipped with a further red lamp, a buzzer, and an acknowledge key for indicating and confirming malfunctions:

- The red alarm lamp
 - is lit, if the liquid level has reached or exceeded the maximum permissible height, or if there is an overflow protection system error.
 - goes out, if the cause of the malfunctions has been corrected, i.e. the level detector has re-emerged out of the liquid or the overflow protection system error has been corrected.
- The buzzer
 - sounds, if the liquid level has reached or exceeded the maximum permissible height, or if there is an overflow protection system error.
 - goes out after having pressed the acknowledge key.
- Use the acknowledge key to acknowledge a malfunction. The buzzer's acoustic signal is switched off.



The alarm indicators listed can also be connected externally.

Installation



When installing the overflow protection system please observe the following safety instructions:

- During all work on the overflow protection system always observe the national safety and accident prevention regulations as well as the generally recognised rules of engineering and all the safety instructions in this manual.
- Wiring may only be carried out when the equipment is disconnected from the mains.
- The transducer must be installed in closed rooms or in a housing with IP 54 protection. The housing protection class for closed rooms differs depending on the transducer version (see Chap. "Technical data").
- Only level detector LOF 1.1 .. Ex .. in combination with transducer LOF 500 .. may be operated in tanks used for the storage of non-combustible and combustible, water-endangering liquids of the hazard class A I, A II, B and of the temperature class T1 to T6.
- For use in areas subject to explosion hazards an overvoltage protection must be installed.

1 Alignment dimensions of the level detector (see Fig. 3)

Tank height (H):	Height of the tank.
Stub/sleeve height (S):	Height of the tank's stub or sleeve.
Response level (A):	Permissible filling level in the tank. Take into account the immersion switch delay time of up to one second (see Chap. "Technical data").
Probe length (Z):	Permanently marked with a punch above the marking groove at the top of the probe. It is the distance between the marking groove and the threshold point of the level detector.
Response length (L):	Distance between the hexagonal support of the screw-in unit and the marking groove on the protective sleeve of the sensor at the bottom of the level detector. For the LOF 1.1 E level detectors, the length must be individually adjusted on the level detector according to the tank dimensions (H and S) and the response level (A). For the LOF 1.1 F level detectors, the length cannot be varied and has been individually calculated before ordering. The response length is permanently marked on the flange.

Reference dimension (Y): Reference dimension between the marking groove at the top of the probe tube and the hexagonal support of the screw-in unit to check the correct adjustment of the response length (L), when the level detector is already mounted.

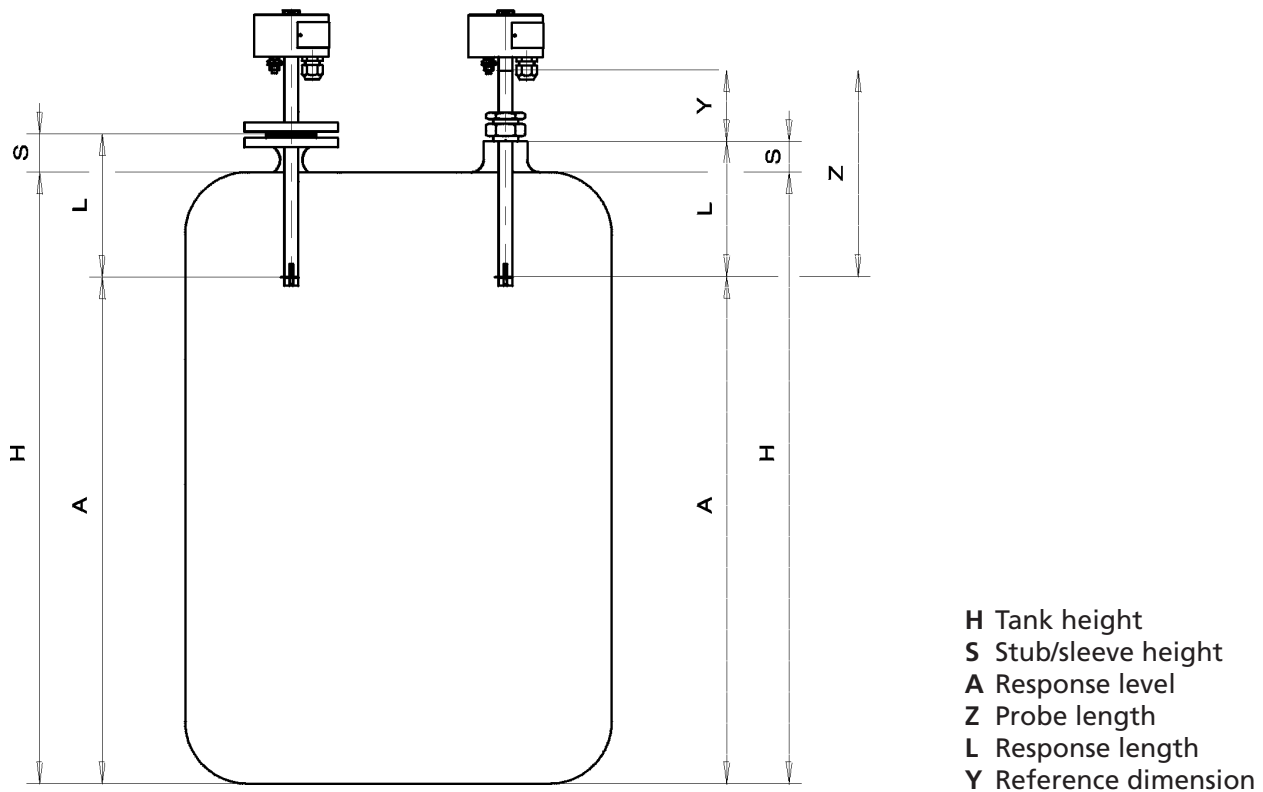


Fig. 3: Alignment dimensions of the level detector

2 Adjusting the response length (only level detectors LOF 1.1 .. E ..)

1. Calculate the response length (L) depending on the tank dimensions (H and S) and the response level (A).

$$L = (H - A) + S$$

2. Adjust the calculated response length (L) on the level detector.

3 Installing the level detector in the tank



The potentiometer in the level detector electronics is set by default and is not to be modified by the operator.

The level detector is to be mounted in the tank as perpendicular as possible, so that residual liquid can drip off the sensor easily.

3.1 Mounting level detector LOF 1.1 .. E

Mount the level detector according to Fig. 3:

1. Tighten up the cap nut of the cutting ring union firmly.
2. Provide the screw-in thread with suitable, resistant sealing material and screw it into the tank sleeve.
3. Check the adjustment of the response length (L) using the reference dimension (Y):
 $L = Z - Y$

3.2 Mounting level detector LOF 1.1 .. ES

Mount the level detector according to Fig. 3:

1. Tighten up the upper gland screw and the locking screw of the screw-in unit firmly.
2. Provide the screw-in thread with suitable, resistant sealing material and screw it into the tank sleeve.
3. Check the adjustment of the response length (L) using the reference dimension (Y):
 $L = Z - Y$

3.3 Mounting level detector LOF 1.1 .. F

Flange the level detector to the tank (see. Fig. 3).

3.4 Electrical connection

For the electrical connection of plug-on detectors, no additional wiring is required. For detectors with long-distance installation, a two-core connecting cable (at least 2 x 1 mm², max. 500 m) must be laid between the level detector and the fittings.

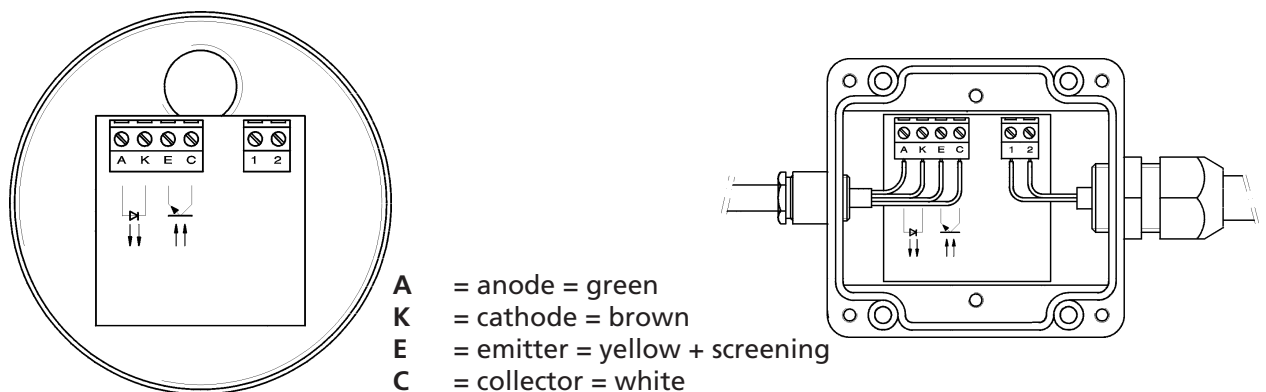


Fig. 4a: Connecting the level detector

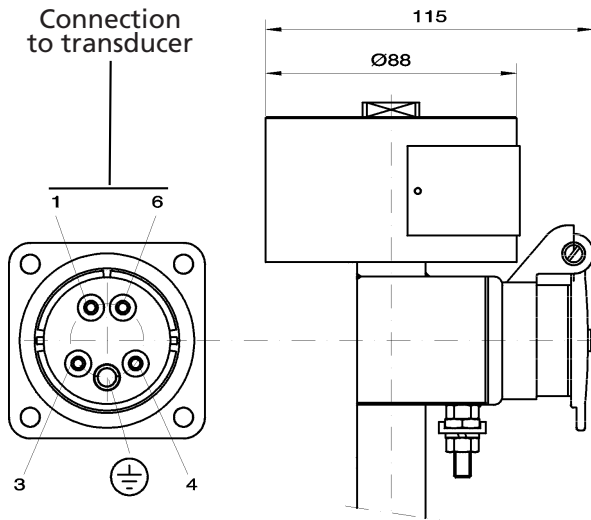


Fig. 4b: Connecting level detector LOF .. Steck DD 28 plug (counter plug not included in scope of delivery)

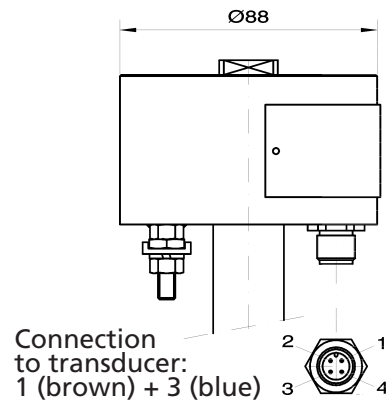


Fig. 4c: Connecting level detector LOF .. M12 plug (counter plug not included in scope of delivery)

4 Installing the transducer



The transducer may only be set up outside the area subject to explosion hazards. The housing protection class differs depending on the transducer version (see Chap. "Technical data").

The length of cable from the level detector to the transducer must not be more than:

- 250 m in the case of 0.5 mm²
- 500 m in the case of 1 mm²
- 750 m in the case of 1.5 mm².



For the LOF 1.1 .. Ex .. level detectors, the cable must be labelled intrinsically safe, and if coloured labelling is used, then light-blue.

1. Install the transducer according to the wiring diagrams in Fig. 4a–h.
2. Before putting the system into operation check all the devices in the overflow protection system to make sure they have been connected up correctly and are operating properly. Also check the power supply, including that to the downstream devices. For this, please observe the appropriate operation manuals for the respective devices.

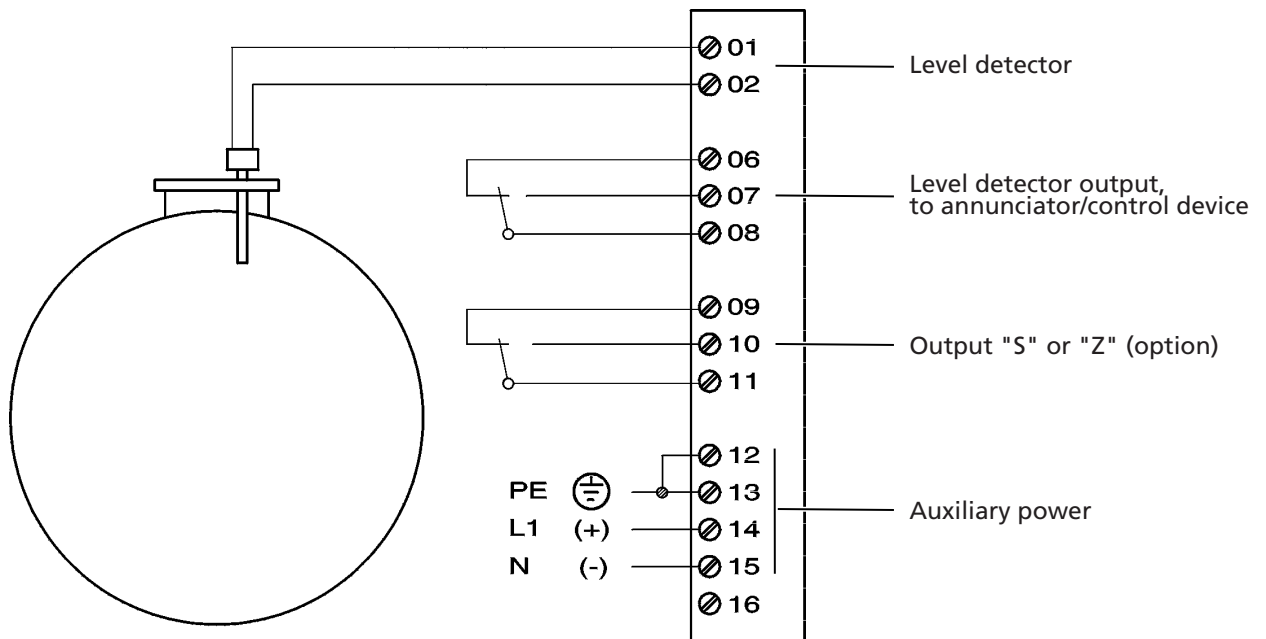


Fig. 4d: Connecting the transducer LOF 500

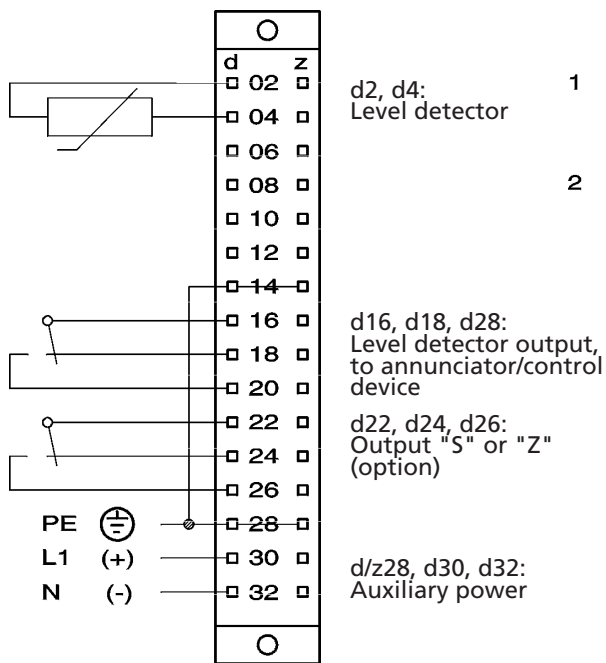


Fig. 4e: Connecting the transducer LOF 500 19"

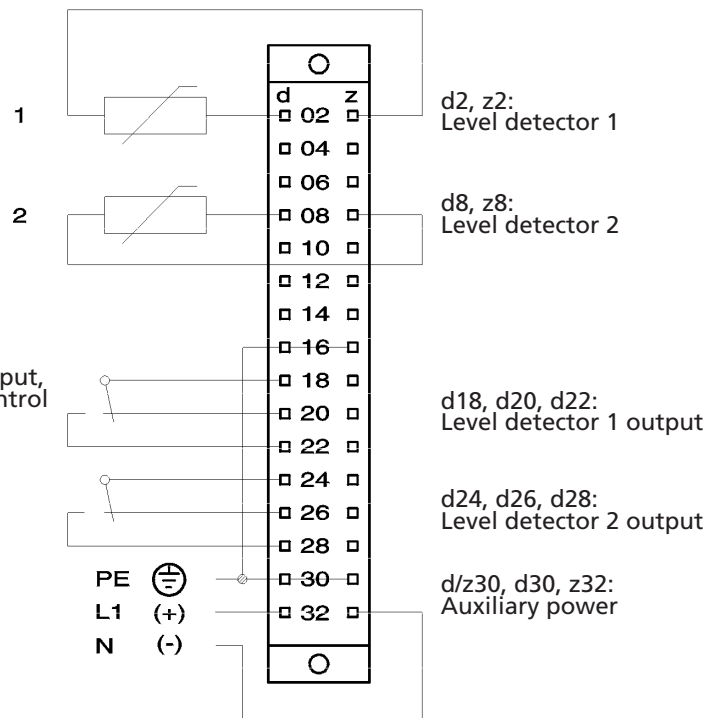


Fig. 4f: Connecting the transducer LOF 500 19" Duo

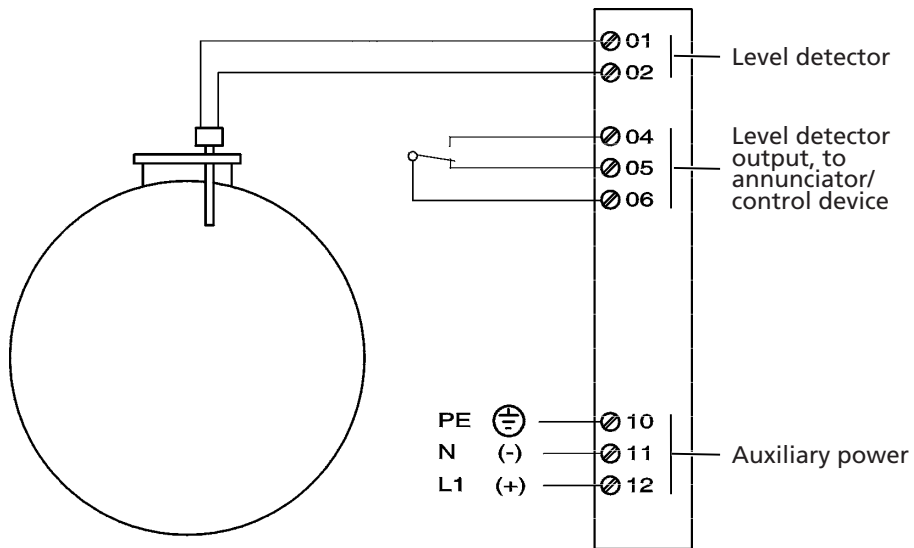


Fig. 4g: Connecting the transducer NB 220 H

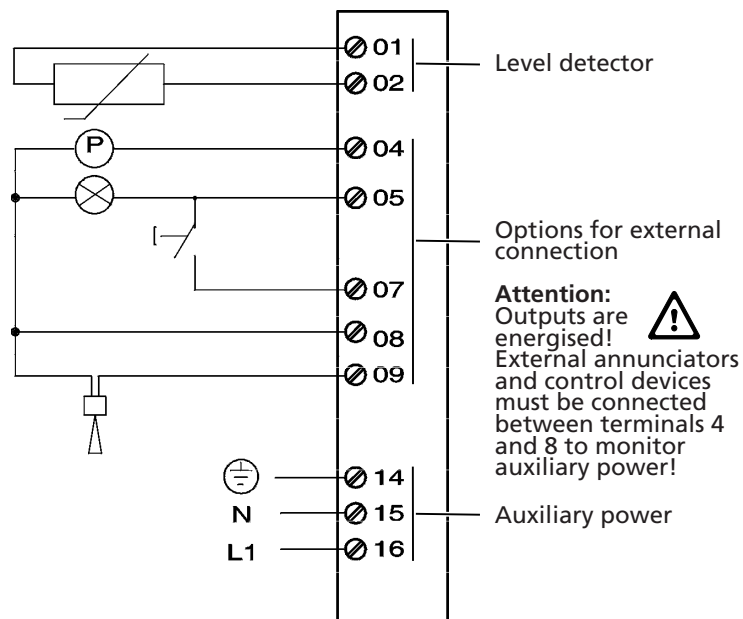


Fig. 4h: Connecting the transducer NB 220 QS

5 Mounting overvoltage protection (only level detectors LOF 1.1 .. Ex ..)

If the level detector is installed in tanks outside buildings, an overvoltage protection is to be provided in the detector signal line, unless the detector signal line is guided in a metal tube or a metal cable conduit, that is connected to tank potential or integrated into the equipotential bonding system.

To install the overvoltage protection:

1. Mount the overvoltage protection of type BA 350 in a distance of approx. 50 cm to the level detector.
2. Connect the overvoltage protection housing to the tank using a 4-mm²-cable and the external earthing terminal.

Maintenance

If the overflow protection system is operated correctly, then the system is basically maintenance-free.

However, the performance of the overflow protection system must be tested at regular intervals.

1 Regular testing



Check the overflow protection system at regular intervals (at least once a year) to ensure that it is in good working order. It is the user's responsibility to choose the type of test and the intervals.

Perform the test in such a way that evidence is provided that the overflow protection system operates properly when all its components interact with one another.

This interaction takes place when the response level is reached during a filling procedure. If it is not practicable to fill up to response level, the level detector must be made to respond by means of a suitable simulation of the filling level or the physical measuring effect.



For further information about methods of testing, please refer to VDI/VDE Guideline 2180, Sheet 4.

Troubleshooting

1 Fault diagnosis

	Standard	NB 220 QS
green LED is not lit	power failure	power failure
yellow LED is not lit	<ul style="list-style-type: none"> - max. permissible liquid level reached/ exceeded - system error (corrosion, short circuit, line breakage, etc.) 	<ul style="list-style-type: none"> - max. permissible liquid level reached/ exceeded - system error (corrosion, short circuit, line breakage, etc.)
red LED is lit (option)	system error (interruption/short circuit of signal line between detector and transducer)	<ul style="list-style-type: none"> - max. permissible liquid level reached/ exceeded - system error (corrosion, short circuit, line breakage, etc.)
buzzer sounds (option)	–	<ul style="list-style-type: none"> - max. permissible liquid level reached/ exceeded - system error (corrosion, short circuit, line breakage, etc.)

2 Eliminating faults

1. On the NB 220 QS transducer, press the acknowledge button.
The fault was confirmed, and the buzzer is no longer outputting a signal. The red alarm lamp is still lit because the cause of the fault has not been rectified yet.
2. Notify the specialist company responsible for the overflow protection system.
After the cause of the fault has been rectified by the specialist company, the yellow LED is again lit or the red lamp goes out.

Technical data

1 Level detectors

Temperature range:	Ambient temperature: -25 °C .. +60 °C Media temperature: -25 °C .. +60 °C
Immersion switch delay:	≤ 1 second
Temperat./pressure range:	-25 °C to +20 °C, max. 110 bar -25 °C to +120 °C, max. 95 bar -25 °C to +180 °C, max. 80 bar -200 °C to +250 °C, atmospheric pressure cond.
Dimensions, probe tube:	LOF .. E/F/FP: Ø 10 x 1.5 LOF .. ES/FS/ESP: Ø 24 x 2

Materials

(medium-contacted parts):	Material no.	Designation
	1.4301 to 1.4571 (exception 1.4305)	stainless steel (DIN 17 440)
	aluminium oxide 99,9%	industrial sapphire
	FFKM	perfluoroelastomer
	2.4602, 2.4610, 2.4617	stainless steel (DIN 17 744)



Standard materials: 1.4571, FFKM, aluminium oxide 99%.
In case of flange versions, the flanges can also be made of steel with clad sealing surfaces from the materials mentioned above; all medium-contacted, metallic materials can be coated with E-CTFE (Halar).

2 Transducers

Auxiliary power circuit:

Auxiliary power:	LOF 500 ..: 24 V, 110 V, 230 V, 50 Hz or 24 V DC NB 220 H: 24 V, 110 V, 230 V, 50 Hz or 24 V DC NB 220 QS: 230 V, 50 Hz
------------------	--

Power input:	LOF 500 ..: max. 4 VA/5 W, except for LOF 500 19" Duo: max. 8 VA/10 W NB 220 ..: max. 4 VA/6 W
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Detector signal circuit:	LOF 500 .. [Ex ia]: U ≤ 15.8 V, I ≤ 26 mA, P ≤ 150 mW NB 220 ..: U ≤ 19 V, I ≤ 150 mA, P ≤ 600 mW
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Output:	<p>LOF 500/LOF 500 19"': 1 potential-free change-over contact (level detector)</p> <p>LOF 500 S/LOF 500 19" S: 1 potential-free change-over contact (level detector) 1 potential-free change-over contact (system)</p> <p>LOF 500 Z/LOF 500 19" Z: 2 potential-free change-over contacts (level detectors)</p> <p>LOF 500 19" Duo: 2 potential-free change-over contacts (level detector)</p> <p>NB 220 H: 1 potential-free change-over contact</p> <p>Change-over contact carrying capacity: AC: $\leq 250\text{ V}, \leq 4\text{ A}, \cos\varphi \leq 0.7, 500\text{ W max.}$ DC: $\leq 250\text{ V}, \leq 0.25\text{ A}, 50\text{ W max.}$</p> <p>NB 220 QS: Pump, solenoid valve, etc. (terminal 4, 8): 230 V, 50 Hz, 50 W max. External lamp (terminal 5, 8): 230 V, 50 Hz, 100 W max. External acknowledge key (terminal 5, 7): 230 V, 50 Hz External horn (terminal 9, 8): 230 V, 50 Hz, 50 W max.</p>
Ambient temperature:	-25 °C to +50 °C
Housing protection class:	<p>In enclosed rooms: LOF 500, LS 500 S/Z, NB 220 H/QS: IP 40 LOF 500 19" ..: IP 20 In the field: IP 54</p>
Dimensions:	<p>LOF 500, LS 500 S, LS 500 Z: 150 x 75 x 110 LOF 500 19" ..: 160 x 100, 7TE, 3HE, DIN 41612 F, European PCB</p> <p>NB 220 H: 110 x 51 x 110 NB 220 QS: 150 x 75 x 110</p>

ANNEX

1 EC declarations of conformity

EG – Konmitätserklärung EC – Declaration of Conformity

In Übereinstimmung mit EN 45 014; 1998 - *In accordance with EN 45 014; 1998*

**FAFNIR GmbH
Bahrenfelder Str. 19
D 22765 Hamburg**

erklärt in eigener Verantwortlichkeit, daß das Produkt
declare under sole responsibility that the product

Überfüllsicherung / *Overfill Prevention*

LOF 1. ... / NB 220 ...

in Übereinstimmung mit nachfolgenden Richtlinien:
in accordance with the following directives:

EMV-Richtlinie; *EMC Directive 89/336/EWG/IEEC*

nach folgenden Vorschriften (Normen) entwickelt und gefertigt wurden:
has been designed and manufactured to the following specifications:

EN 61 000-4-2; 10.94

EN 50 081-1 03.93

EN 61 000-4-4; 10.94

EN 60 950 -1997

EN 61 000-4-5, 03.95

Hamburg, 12.06.2003
Ort, Datum / Place, Date



Geschäftsführer / Managing Director: S. Kunter

EG – Konmitätserklärung EC – Declaration of Conformity

In Übereinstimmung mit EN 45 014; 1998 - *In accordance with EN 45 014; 1998*

FAFNIR GmbH
Bahrenfelder Str. 19
D 22765 Hamburg

erklärt in eigener Verantwortlichkeit, daß das Produkt
declare under sole responsibility that the product

Überfüllsicherung / *Overfill Prevention*

LOF 1. ... / LOF 500 ...

in Übereinstimmung mit nachfolgenden Richtlinien:
in accordance with the following directives:

EMV-Richtlinie; *EMC Directive 89/336/EWG/EEC*
Ex-Richtlinie; *Ex Directive 94/9/EG/EC*

nach folgenden Vorschriften (Normen) entwickelt und gefertigt wurden:
has been designed and manufactured to the following specifications:

EN 50 014; 1997	EN 61 000-4-4; 10.94
EN 50 020; 1994	EN 61 000-4-5, 03.95
EN 50 284; 1999	EN 50 081-1 03.93
EN 61 000-4-2; 10.94	

Das Produkt entspricht der EG-Baumusterprüfbescheinigung
The above mentioned product is in conformity with EC-Type Examination Certificate

TÜV 01 ATEX 1772 X

Die Prüfung erfolgte durch die benannte Stelle Nr.: 0032
The inspection was carried out by the notified body No 0032

TÜV Hannover/Sachsen-Anhalt e.V.
TÜV Cert-Certification Body
Am TÜV 1
D 30519 Hannover

Hamburg, 12.06.2003
Ort, Datum / Place, Date



Geschäftsführer / *Managing Director: S. Kunter*

2 EC type examination certificate incl. instruction manual – Level detector LOF 1.1 .. Ex ..

Translation

- (1) **EC-Type Examination Certificate**



- (2) Equipment and protective systems intended
for use in potentially explosive atmospheres
- Directive 94/9/EC



- (3) EC-Type Examination Certificate Number

TÜV 03 ATEX 2171

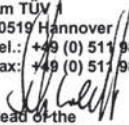
- (4) Equipment: Level detector type LOF 1.1...EX
(5) Manufacturer: FAFNIR GmbH
(6) Address: Bahrenfelder Strasse 19
D-22765 Hamburg

- (7) This equipment or protective system and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.
(8) The TÜV NORD CERT GmbH & Co. KG, TÜV CERT-Certification Body, notified body number N° 0032 in accordance with Article 9 of the Council Directive of the EC of March 23, 1994 (94/9/EC), certifies that this equipment or protective system has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in Annex II to the Directive.

The examination and test results are recorded in the confidential report N° 03YEX550487-2.

- (9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:
EN 50 014:1997 EN 50 020:1994 EN 50 284:1999
- (10) If the sign "X" is placed after the certificate number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate.
(11) This EC-type examination certificate relates only to the design, examination and tests of the specified equipment in accordance to the Directive 94/9/EC. Further requirements of the Directive apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.
(12) The marking of the equipment or protective system must include the following:

 II 1/2 G EEx ia IIC T6 bzw. II 2 G EEx ia IIC T6

TÜV NORD CERT GmbH & Co. KG
Am TÜV
30519 Hannover
Tel.: +49 (0) 511 986-1455
Fax: +49 (0) 511 986-1590

Head of the
Certification Body

Hanover, 2005-07-07

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Excerpts or changes shall be allowed by the TÜV NORD CERT GmbH & Co. KG

page 1/3

(13) **SCHEDULE**

(14) **EC-Type Examination Certificate N° TÜV 03 ATEX 2171**

(15) Description of equipment

The level detector type LOF 1.1... Ex – consisting of the sensor, the probe tube, the screw-in unit or flange and the connection socket – is connected to the measuring transducer LOF 500 ... This level detector is installed on tanks and pipes. A short circuit or breakage of the connecting cable between the level detector and the measuring transducer is indicated.

Use as category 1/2 operating equipment

These level detectors are installed in areas subject to explosion hazards that require category 1/2 operating equipment.

The permissible ambient temperature range, depending on the temperature class, is shown in the following table:

Temperature class	Ambient temperature range	Medium temperature
T3	+180 °C	-20 °C to +60 °C
T4	+110 °C	-20 °C to +60 °C
T6	+60 °C	-20 °C to +60 °C

In the presence of explosive mixtures of vapour and air, the process pressure of the media must be between 0.8 bar and 1.1 bar. If explosive mixtures are not present, the devices may also be operated beyond this range in compliance with their manufacturer's specifications.

Use as category 2 operating equipment

These level detectors are installed in areas subject to explosion hazards for category 2 operating equipment.

The permissible ambient temperature range, depending on the temperature class, is shown in the following table:

Temperature class	Ambient temperature range	Medium temperature
T3	-25 °C to 180 °C	+180 °C
T4	-25 °C to 110 °C	+130 °C
T6	-25 °C to 60 °C	+80 °C

Electrical data

Type LOF 1.1... Ex

Signal generator circuit(s) in the type of protection intrinsic safety EEx ia IIB/IIC only for connection to the respective measuring transducer of the type LOF 500... in accordance with EC prototype test certificate no. TÜV 03 ATEX 2172

The signal generator circuits are DC-isolated from one another and from the earth connection.

Schedule EC-Type Examination Certificate N° TÜV 03 ATEX 2171

(16) The test documents are listed in the test report no. 03YEX550487-2.

(17) Special conditions for safe use

none

(18) Essential Health and Safety Requirements

no additional ones

Instruction manual – Level detector type LOF 1.1 .. Ex ..

As of: 02.2003

1 Application

When used in connection with a measuring transducer of the series LOF 500 .., the level detector detects liquid levels.

The prism and the probe tube can be set up in Zone 0.

2 Function

The functional principle of the level detector is based on the different refraction of light in a prism located in a gaseous or liquid environment.

The light is transmitted from a transmitter (infrared LED) via an optical fibre to the prism, and from there via a second fibre to the receiver (phototransistor). If the prism is not wetted with liquid, the light beam is reflected and transmitted to the receiver. When the prism is submerged in water, only a very small amount of light reaches the receiver.

3 Device versions

Level detector type LOF 1.1. Ex .SP

The level detector with the additional designation "P" is equipped with a testing unit that enables a true inspection of the functional efficiency of the total overflow prevention system, from the sensor tip to the signalling and controlling unit, without having to remove the level detector first.

Level detector type LOF 1.11 Ex .

The level detector type LOF 1.11 Ex . is the standard device and covers virtually all application cases. The probe electronics are installed in a stainless steel housing located directly on the probe tube.

Level detector type LOF 1.12 Ex .

With this level detector, the probe electronics are separated from the level detector in a die-cast aluminium housing. The connection is provided using a standard 1-metre-long cable.

This version is selected whenever confined space conditions exist or the probe electronics could become too hot (max. temperature of the probe electronics = 60 °C).

Level detector type LOF 1.13 Ex .

With this level detector, the coupler and the probe electronics are separated from the level detector. The connection is provided using a standard 1-m-long stainless steel tube with internal optical fibres.

This version is selected whenever very low or very high temperatures could occur at the coupler or at the probe electronics (max. temperature of the coupler electronics = 120 °C).

3.1 Type code

Type designation	Probe tube	Type designation	Probe tube
LOF 1.11 Ex E	Ø 10 x 2	LOF 1.12 Ex FS*	Ø 24 x 2
LOF 1.11 Ex ESP	Ø 24 x 2	LOF 1.12 Ex ESP	Ø 24 x 2 1
LOF 1.11 Ex FP	Ø 10 x 1.5	LOF 1.12 Ex FP	Ø 10 x 1.5
LOF 1.11 Ex F*	Ø 10 x 1.5	LOF 1.13 Ex E	Ø 10 x 1.5
LOF 1.11 Ex ES	Ø 24 x 2	LOF 1.13 Ex F*	Ø 10 x 1.5
LOF 1.11 Ex FS*	Ø 24 x 1.5	LOF 1.13 Ex ES	Ø 24 x 2
LOF 1.12 Ex E	Ø 10 x 1.5	LOF 1.13 Ex FS*	Ø 24 x 2
LOF 1.12 Ex F*	Ø 10 x 1.5	LOF 1.13 Ex ESP	Ø 24 x 2
LOF 1.12 Ex ES	Ø 24 x 2	LOF 1.13 Ex FP	Ø 10 x 1.5

* E-CTFE (Halar) coating possible

all level detectors type LOF 1.11 Ex . can also be manufactured with an electric plug-in connection; the type designation is then supplemented by the additional term "Plug-in", e.g. LOF 1.11 E Ex . Plug-in.

Type code explanation:

- E = screw-in unit
- F = flange
- S = probe tube Ø 24 x 2
- P = test connection

Plug-in = pluggable electric connection, the necessary counter plug type S-28 is not included in the scope of delivery.

4 Application

The level detectors may, under the following conditions, be part of the equipment included in tanks used for the storage of flammable liquids of the hazard class A1, AII and B and of the temperature class T1 to T6.

The probe tube and the prism can be set up in Zone 0. The connection and the electronics are located in Zone 1.

Use in case of non-atmospheric conditions

II 1/2 G EEx

TA	T _{Medium}	Temperature class
+60 °C	+60 °C	T6
+110 °C	+60 °C	T4
+180 °C	+60 °C	T3

II 2 G EEx

TA	T _{Medium}	Temperature class
+60 °C	+80 °C	T6
+110 °C	+130 °C	T4
+180 °C	+180 °C	T3

Pressure

Standard pressure range: 0 to 4 bar

Special version: 0 to 400 bar

5 Materials

Materials of the level detectors (medium-contacted parts)

Material no.:	Designation:
1.4301 to 1.4571	stainless steel in accordance with DIN 17 440
aluminium oxide 99,9%	industrial sapphire
FFKM	perfluoroelastomer
2.4602, 2.4610, 2.4617	stainless steel in accordance with DIN 17 744

Flanges can also be made of steel with clad sealing surfaces from the materials mentioned above.

Standard materials of the medium-contacted parts

Material no. 1.4571, FFKM and aluminium oxide 99 %

In the case of level detectors in the flange version, all medium-contacted, metallic materials can be coated with E-CTFE (Halar).

6 Installation regulations

During any work carried out on the level detectors, the relevant technical safety regulations, in particular the BetrSichV (German plant safety directive) regulations, and the VDE (German association of electricians) regulations for electrical connection work must be observed.

6.1 Electrical connection

For overflow prevention sensors with plug-on sensors, no additional wiring is required. For overflow prevention sensors with long-distance installation, a two-core connecting cable (at least 2 x 1 mm², max. 500 m) must be laid between the overflow protection sensor and the fittings.

6.2 Technical data

Temperature range:	Ambient temperature -25 ... +60 °C Media temperature -25 ... +60 °C
Inductance (outward acting):	negligibly small
Capacitance (outward acting):	negligibly small
Connection data:	The level detector may only be connected to certified circuits and to the following "Ex"-related maximum values: U ₀ : 24 V I ₀ : 150 mA P ₀ : 600 mW

7 Labelling

EC prototype certificate no: TÜV 03 ATEX 2171

In compliance with

EC Guideline 94/9:  0032,  II 1/2 G EEx ia IIB/IIC T6
II 2 G EEx ia IIB/IIC T6

For level detector with E-CTFE (Halar) coating:

In compliance with

EC Guideline 94/9:  0032,  II 1/2 G EEx ib IIB T6

3 EC type examination certificate incl. instruction manual – Measuring transducer LOF 500 ..

Translation

(1) **EC-Type Examination Certificate**



- (2) Equipment and protective systems intended for use in potentially explosive atmospheres
- Directive 94/9/EC



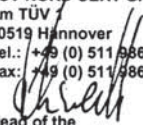
- (3) EC-Type Examination Certificate Number

TÜV 03 ATEX 2172

- (4) Equipment: Transducer type LOF 500 ...
(5) Manufacturer: FAFNIR GmbH
(6) Address: Bahrenfelder Strasse 19
D-22765 Hamburg

- (7) This equipment or protective system and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.
- (8) The TÜV NORD CERT GmbH & Co. KG, TÜV CERT-Certification Body, notified body number N° 0032 in accordance with Article 9 of the Council Directive of the EC of March 23, 1994 (94/9/EC), certifies that this equipment or protective system has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in Annex II to the Directive.
- The examination and test results are recorded in the confidential report N° 03YEX550487-1.
- (9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:
EN 50 014:1997 **EN 50 020:1994**
- (10) If the sign "X" is placed after the certificate number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate.
- (11) This EC-type examination certificate relates only to the design, examination and tests of the specified equipment in accordance to the Directive 94/9/EC. Further requirements of the Directive apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.
- (12) The marking of the equipment or protective system must include the following:

 II (1) G [EEx ia] IIC

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Hanover, 2005-07-07

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(13)

SCHEDULE

(14) **EC-Type Examination Certificate N° TÜV 03 ATEX 2172**

(15) Description of equipment

In connection with the respective level detector type LOF 1.1... Ex, the measuring transducer type LOF 500 ... transmits signals from gas and liquid tanks.

The measuring transducer type LOF 500 ... is installed in a housing; the type LOF 500 19" ... is designed as a plug-in printed circuit board.

Electrical data

Supply circuit
(connections d30 and d32,
or d32 and z32
or terminals 14 and 15)

$U = 24/110/230 \text{ V AC}, \pm 15 \%, 40...60 \text{ Hz},$
approx. 4 or 8 VA
or
 $U = 24 \text{ V DC}, \pm 20 \%, \text{ approx. } 5 \text{ or } 10 \text{ W}$

Signal generator circuit
(connections d2 and d4
or d2 and z2
or d8 and z8
or terminals 1 and 2)

in the type of protection intrinsic safety EEx ia IIC

Maximum values: $U_o = 15.8 \text{ V}$
 $I_o = 26 \text{ mA}$
 $R = 980 \Omega$
 $P_o = 147 \text{ mW}$

Characteristic: trapezoidal

$C_i = 1.2 \text{ nF}$
 L_i negligibly small

The maximum permissible value pairs for the outer inductances (L_o) and capacitances (C_o) are shown in the following table:

L_o	1 mH	5 mH	10 mH
C_o	200 nF	150 nF	110 nF

Output circuits
(connections d18, d20 and d22
or d24, d26 and d28
or d16, d18, d20, d22, d24
and d26
or terminals 6 to 11)

Alternating voltage	Direct voltage
$\leq 250 \text{ V}$	$\leq 250 \text{ V}$
$\leq 4 \text{ A}$	$\leq 0.25 \text{ A}$
$\leq 500 \text{ VA}$	$\leq 50 \text{ W}$
$\cos \varphi \geq 0.7$	

The signal generator circuits are safely DC-isolated from the supply and output circuits up to a peak voltage value of 375 V.

Schedule EC-Type Examination Certificate N° TÜV 03 ATEX 2172

(16) The test documents are listed in the test report no. 03YEX550487-1.

(17) Special conditions for safe use

none

(18) Essential Health and Safety Requirements

no additional ones

Instruction manual – Measuring transducer type LOF 500 ..

As of: 02.2003

1 Application

When used in connection with a level detector of the series LOF 1.1 .. Ex, the measuring transducer detects liquid levels.

2 Function

The signal of the level detector is converted into a binary output signal (relay) in the measuring transducer.

The electrical readiness for operation of the measuring transducer is indicated by the green LED.

2.1 Measuring transducer type LOF 500 ..

When the sensor tip of the level detector is not submerged in liquid, the output relay is activated. This is indicated by a yellow LED. Submerging the sensor tip (alarm) is signalled by the extinguishing of the yellow LED and results in a relay release in the measuring transducer. A relay release also occurs in the case of a power, in the case of a short circuit or breakage in the cable between the level detector and the measuring transducer.

2.2 Measuring transducer type LOF 500 19" Duo

Like 2.1, but with two measuring transducers set up separately on a European standard-size printed circuit board.

2.3 Measuring transducer LOF 500 .. T (dry running protection not for LOF 500 .. S and LOF 500 19" Duo)

When the sensor tip is submerged in liquid, the output relay of the measuring transducer is activated. A relay release occurs when a sensor tip emerges from the liquid, as well as in the case of a short circuit or breakage in the cable between the level detector and the measuring transducer. This is signalled on the measuring transducer by the extinguishing of the yellow LED.

2.4 Measuring transducer type LOF 500 .. S

An alarm relay with a red LED is available as an option (not for the LOF 500 .. T and LOF 500 19" Duo). In the case of an interruption or short circuit of the signal cable from the level detector to the measuring transducer, the relay responds and the red LED "Error" lights up.

2.5 Measuring transducer type LOF 500 .. Z

When the type designation is supplemented by a "Z" (not for the LOF 500 .. S and LOF 500 19" Duo), this means that two potential-free change-over contacts are available for alarm-signalling purposes.

2.6 Type code

Alarm signalling with submerged sensor tip (relay released):

LOF 500, LOF 500 19"	1 x potential-free change-over contact alarm
LOF 500 S, LOF 500 19" S	1 x potential-free change-over contact alarm; 1 x potential-free change-over contact fault
LOF 500 S, LOF 500 19" S	2 x potential-free change-over contact alarm
LOF 500 19" Duo	2 x potential-free change-over contact alarm; each channel 1x

Alarm signalling with emerged sensor tip (relay released):

LOF 500 T, LOF 500 19" T	1 x potential-free change-over contact alarm
LOF 500 TZ, LOF 500 19" TZ	2 x potential-free change-over contact alarm

3 Technical data

3.1 Electrical data

Auxiliary power circuit

Auxiliary power	24 V, 110 V, 230 V, 50 Hz or 24 V DC
Power input	max. 4 VA or 5 W, (LOF 500 19" Duo max. 8 VA or 10 W)

Level detector circuit

Type of protection	[EEx ia] IIC
Voltage	$U_o \leq 15.8 \text{ V}$,
Current	$I_o \leq 26 \text{ mA}$,
Power	$P_o \leq 147 \text{ mW}$

Maximum permissible value pairs of the outer inductance and capacitance:

L_a	10 mH	5 mH	1 mH
C_a	110 nF	150 nF	200 nF

Electrical data of the change-over contacts

Alternating voltage:	$\leq 250 \text{ V}, \leq 4 \text{ A}, \cos \varphi \geq 0.7, \leq 500 \text{ VA}$
Direct voltage:	$\leq 250 \text{ V}, \leq 0.25 \text{ A}, \leq 50 \text{ W}$

3.2 Terminal assignment of the individual circuits

	LOF 500 ..	LOF 500 19" ..	LOF 500 19" Duo
Auxiliary power			
L	14	d30	d32
N	15	d32	z32
PE/PA	13, 12	d + z28, d + z14	d + z30, d + z16
Output circuit			
Output level detector (1)	6, 7, 8	d16, d18, d20	d18, d20, d22
Output „S“ or „Z“	9, 10, 11	d22, d24, d26	
Output level detector (2)			d24, d26, d28
Signal generator circuit			
Level detector (1)	1 + 2	d2 + d4	d2 + z2
Level detector (2)			d8 + z8

4 Installation instructions

During any work carried out on the measuring transducers, the relevant technical safety regulations, in particular the BetrSichV (German plant safety directive) regulations, the ExVO (German explosion protection directive) regulations, and the VDE (German association of electricians) regulations for electrical connection work must be observed.

The measuring transducer type LOF 500 must be installed in splash-proof form. The housing protection type is IP 40.

The measuring transducer type LOF 500 19" .. or type LOF 500 19" Duo must be installed so that at least protection class IP 20 is achieved.

Wiring work may only be carried out with the equipment in de-energised condition.

The cable from the level detector to the measuring transducer must be labelled intrinsically safe; if coloured labelling is used, then light-blue. The cable is not allowed to exceed 250 m with 0.5 mm², 500 m with 1 mm², and 750 m with 1.5 mm².

If the measuring transducer is set up in the field, the housing protection type must be at least IP 54.

The plug-in printed circuit board version of the measuring transducer type LOF 500 19" .. must be installed in a housing (at least IP 20).

Measuring transducers may only be set up outside the area subject to explosion hazards.

The ambient temperature range is -25 °C to +50 °C.

5 Labelling

EC prototype certificate no: TÜV 03 ATEX 2172

In compliance with

EC Guideline 94/9: CE 0032,  II (1) G [EEx ia] IIC