Technical Description

Z-65.11-185

Level Detector 76 ... and Measuring Transducer NB 220 ...

Edition: 06.2018

1 Design of the overfill prevention device

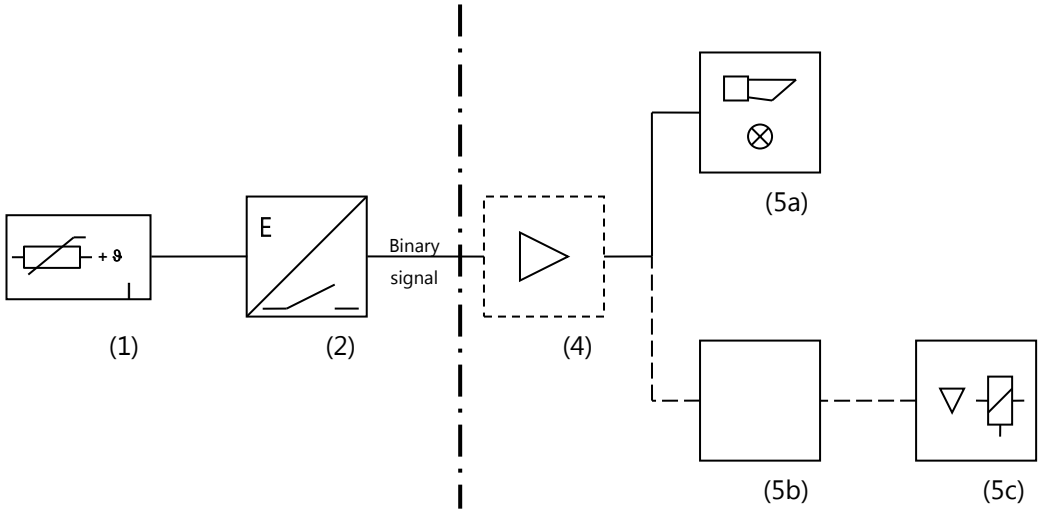
The overfill prevention device comprises a level detector (1) and a measuring transducer (2) with output (relay contact).

The switching signal is supplied to signalling device (5a) or to control device (5b) with actuator (5c) either directly or, where necessary, by way of a signal amplifier (4).

Unchecked parts of the overfill prevention device, such as signalling device (5a), control device (5b), actuator (5c) and signal amplifier (4) must satisfy the requirements of sections 3 and 4 of the German approval guidelines for overfill prevention devices.

1.1 Concept of the overfill prevention device

Overfill prevention device with level limit switch.



1 Level detector 76 ...
2 Measuring transducer NB 220 ...
4 Signal amplifier
5a Signalling device
5b Control device
5c Actuator

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1.2 Function description

Level detector 76 ...

The operating principle of the level detector exploits the difference in thermal conductivity between gases and liquids. A PTC resistor encapsulated in the tip of the level detector is heated by the signal current of the measuring transducer to the point at which a sudden increase in its electrical resistance occurs. As soon as this tip becomes immersed in a liquid, the resulting drop in temperature causes a drop in resistance to the original value. The signal current is limited in such a way that, in this condition (immersed), the resistor cannot be reheated. In a gaseous environment, the PTC resistor takes between 15 seconds (at +60 °C ambient temperature) and 2 minutes (at -20 °C ambient temperature) to heat up.

Measuring transducer NB 220 ...

In the measuring transducer, the changes in resistance of the PTC resistor are converted to relay switching signals with binary signal output. The PTC resistor operation is continuously monitored by a scanner integrated in the measuring transducer. The characteristics of the PTC resistor (heating and cooling behaviour) are checked several times each second without effect on the measuring process. This ensures that any PTC resistor that is no longer operationally reliable, e.g. due to external causes (corroded probe sleeve), can be detected instantly and signalled by a response of the overfill prevention device's alarm system. Accurate regulation of the energy supplied to the PTC resistor by the scanner guarantees optimum reliability of operation and the maximum possible service life.

A relay de-energize occurs as soon as the level detector tip is cooled or in the event of a power failure, short circuit or line break in the connection between the level detector and measuring transducer. The power ON state of the measuring transducer is indicated by a green LED.

Measuring transducer NB 220 H

A relay de-energize is indicated on the measuring transducer by the extinguishing of a yellow LED.

Measuring transducer NB 220 QS

A cooled-down tip of the level detector is indicated on the measuring transducer by an audible and visual alarm. The audible signal can be stopped by pressing the acknowledge button; the visual signal is permanently active and indicated in form of a red signal lamp (a relay de-energize is additionally indicated by the extinguishing of a yellow LED). As soon as the liquid level drops and exposes the level detector to gas, the visual signal is extinguished and the system reverts to being on alert. In addition, the alarm signalling devices above support external connections.

Measuring transducer NB 220 QSF

A cooled-down tip of the level detector is indicated on the measuring transducer by an audible and visual alarm. The audible signal can be stopped by pressing the acknowledge button; the visual signal is permanently active and indicated in form of a red signal lamp. As soon as the liquid level drops and exposes the level detector to gas, the visual signal is extinguished and the system reverts to being on alert. The power ON state of the measuring transducer is indicated by a green LED. In addition, the alarm signalling devices above support external connections.

In the event of blown device fuses or a power failure, the green power LED on the measuring transducer goes out and the changeover relay contact is de-energized.

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1.3 Model codes

Level detector 76 ...

Type	Version 1	Tempera-ture range	Version 2	
			Duo 1	Process connection G $1^1/_2$; both welded
			Duo 2	Process connection G 2; both adjustable
			Duo 3	Process connection G 2; one welded, one adjustable
			Trio 1	Process connection G 2; all welded
			Trio 3	Process connection G 2; two welded, one adjustable
			F	Process connection flange, at least DN 25
			X	Process connection, e.g. dairy fitting
			Liquid temperature -25 °C ... +50 °C	
		H	Liquid temperature -25 °C ... +80 °C	
	A	With connection housing		
	B*n*	Cable end 1 m long (standard); without Process connection; *n* = probe diameter, e.g. B6 = Ø 6 mm		
	C	Cable end 3 m long (standard); with brass fitting		
	E	Cable end 3 m long (standard); with plastic fitting		
	M	Cable end 3 m long (standard); fixed response length		
	MA	Connection housing and fixed response length		
	N	All wetted parts are made of stainlesssteel		
76	Calorimetric level detector; standard probe diameter 16 mm and process connection G $^3/_4$			

Measuring transducer NB 220 ...

NB 220 H	Visual alarm, one potential-free changeover contact
NB 220 QS	Visual and audible alarm, acknowledge button, external terminals connected to power supply
NB 220 QSF	Visual and audible alarm, acknowledge and test button, two potential-free changeover contacts

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1.4 Dimension sheets and technical data

Level detector 76 ...

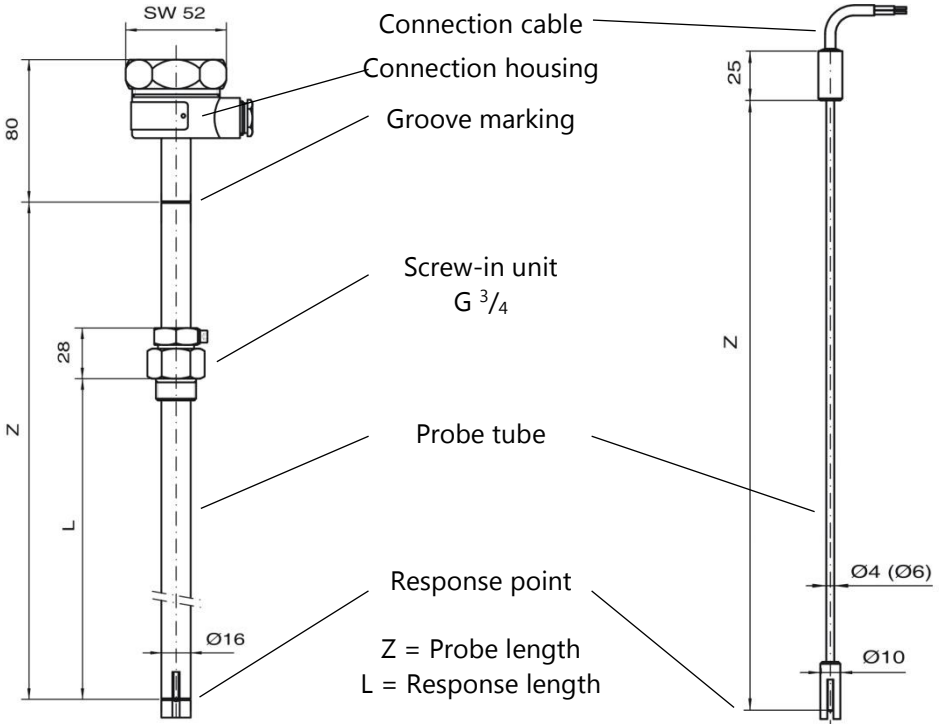

Figure 1: 76 A

Figure 2: 76 B...

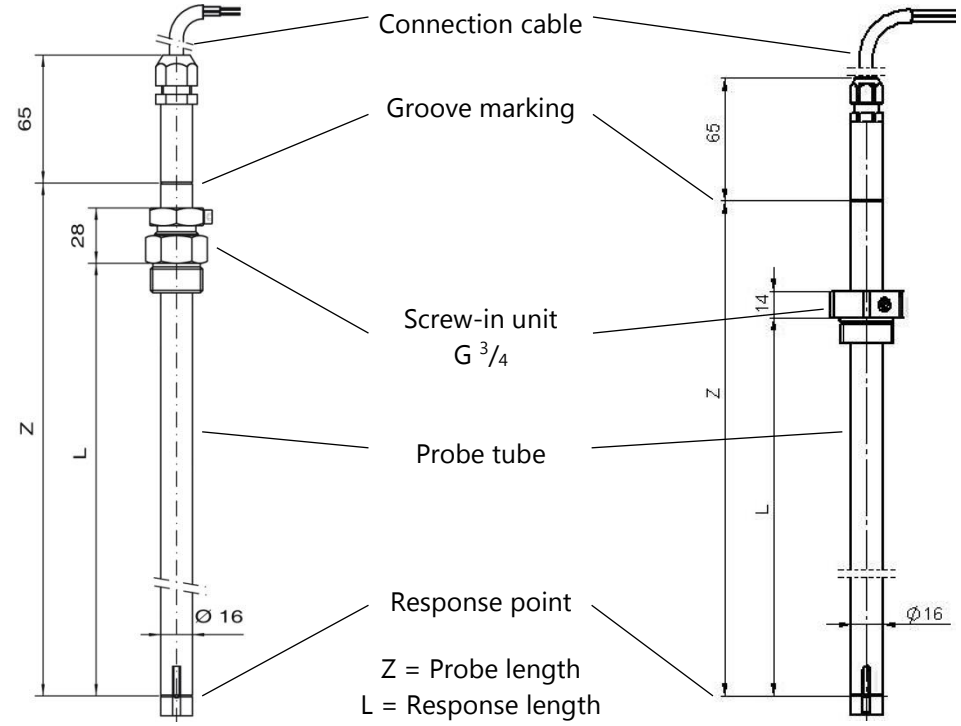

Figure 3: 76 C

Figure 4: 76 E

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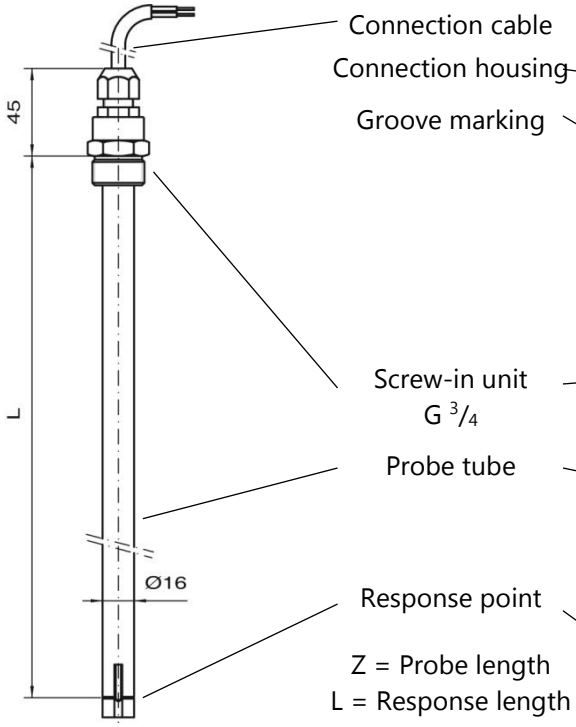

Figure 5: 76 M

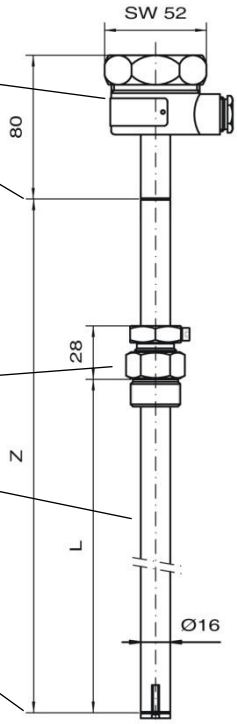

Figure 6: 76 N

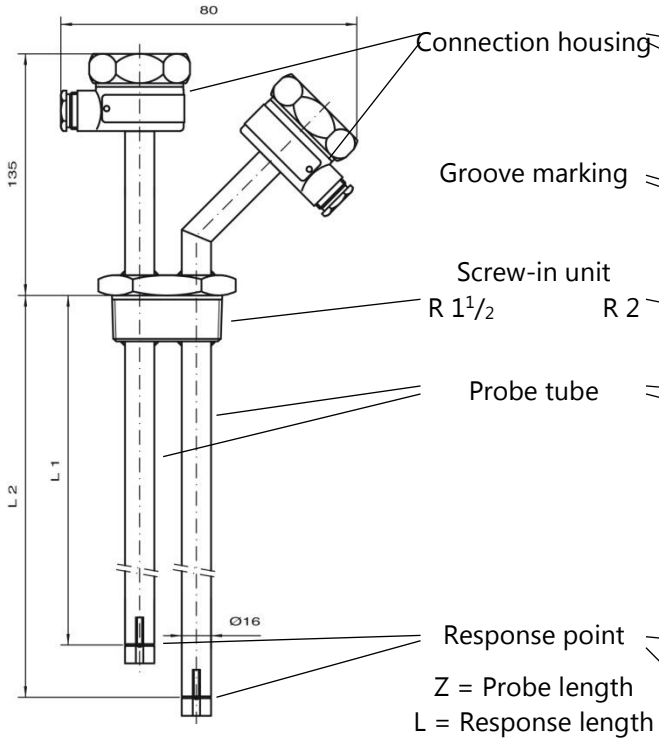

Figure 7: 76 A Duo 1

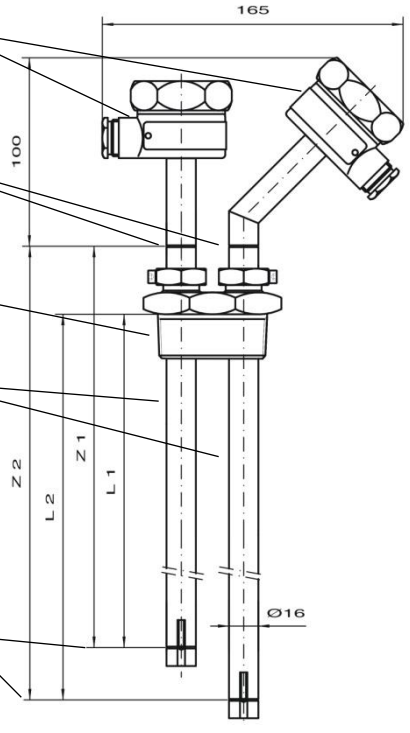

Figure 8: 76 A Duo 2

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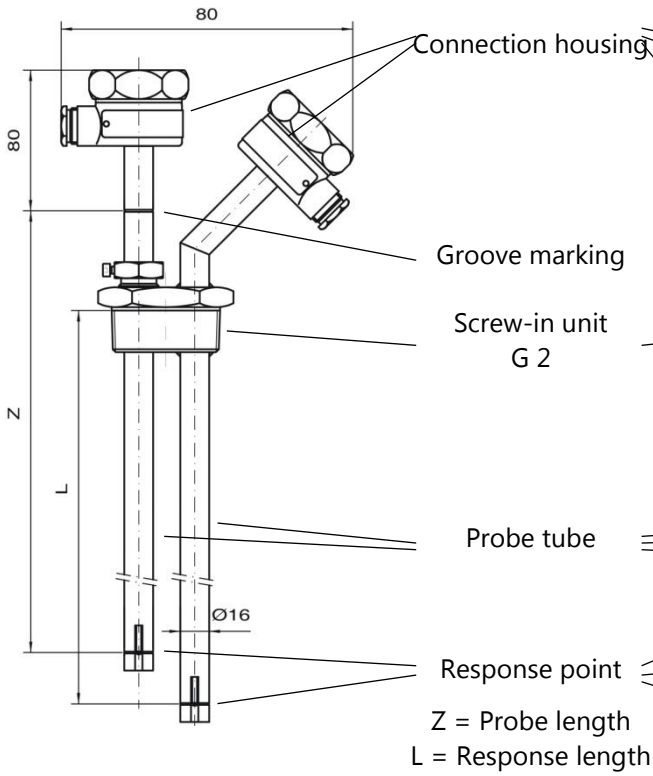

Figure 9: 76 A Duo 3

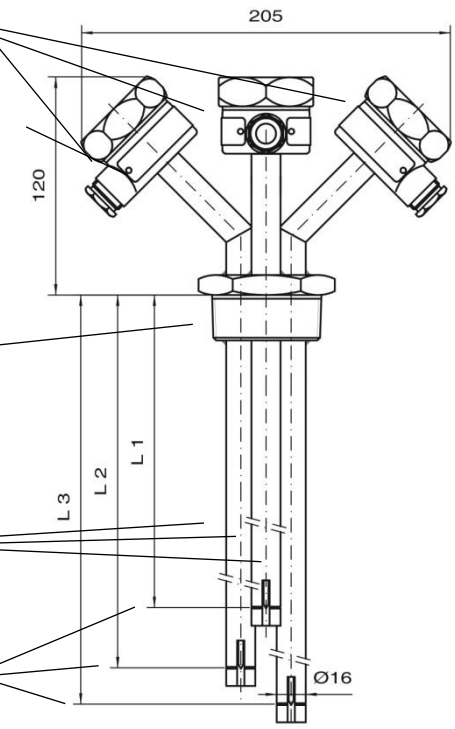

Figure 10: 76 A Trio 1

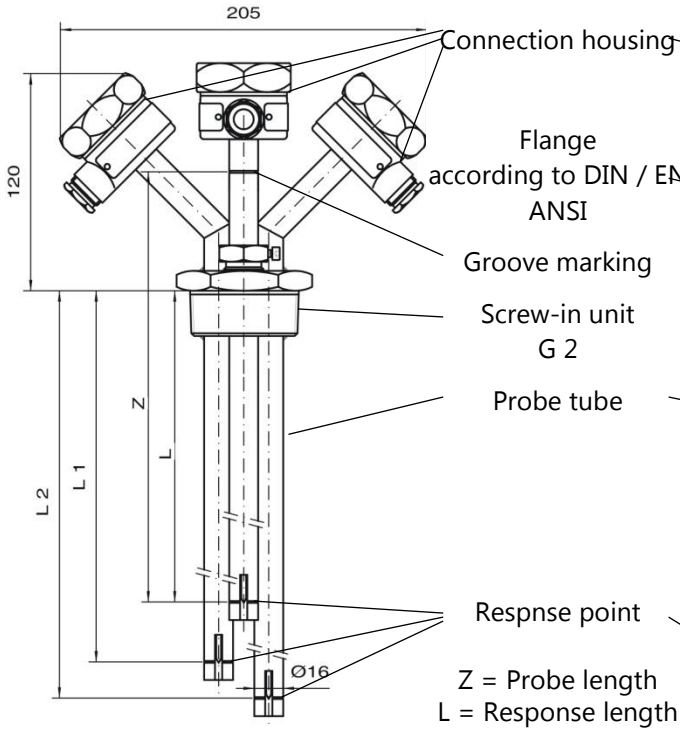

Figure 11: 76 A Trio 3

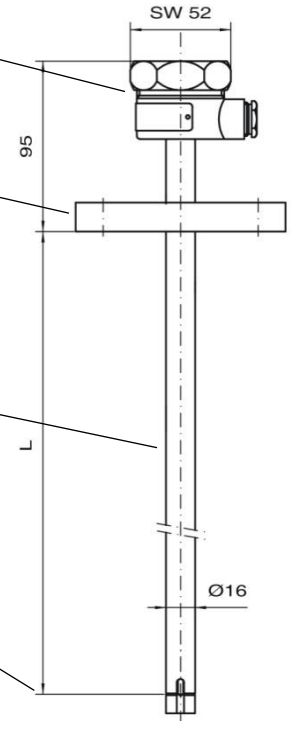

Figure 12: 76 A F

Temperatures

Ambient	-25 °C ... +80 °C
Medium, standard	-25 °C ... +50 °C
Medium, H sensor	-25 °C ... +80 °C

Pressures

Process pressure	0 bar ... 2 bar

Heat-up times

at T_a = -20 °C	< 2 minutes
at T_a = +60 °C	< 15 seconds

Degree of protection provided by enclosure (according EN 60529:1991 + A1:2000)

76 ...	IP67

Measuring transducer NB 220 ...

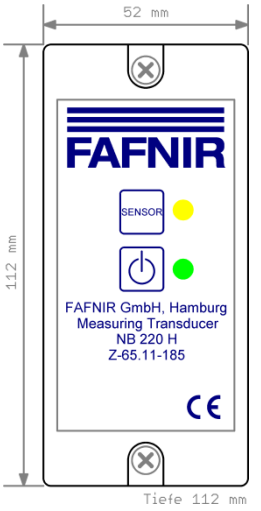

Figure 13: NB 220 H

Figure 14: NB 220 QS

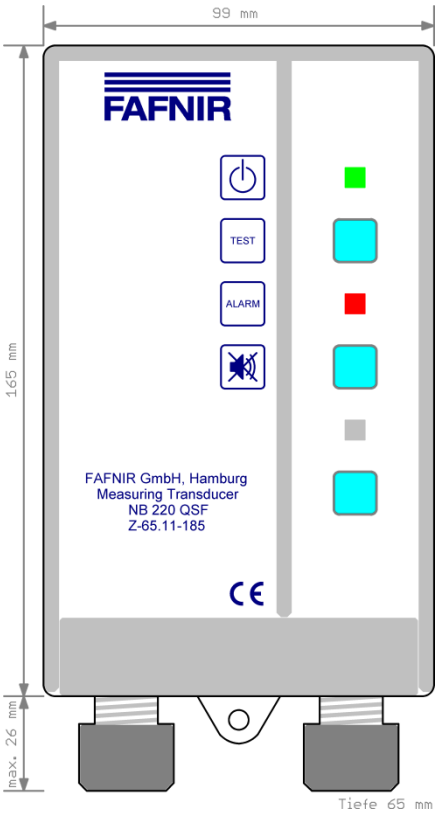

Figure 15: NB 220 QSF

Power supply

Voltage	24 $V_{AC/DC}$ or 230 V_{AC}, 50 Hz	
Input power (max)	NB 220 H:	2.2 W resp. 3.9 VA
	NB 220 QS:*	4.1 W resp. 7.2 VA
	NB 220 QSF:	2.1 W resp. 3.7 VA

Sensor circuit

Voltage	< 22 V
Current	< 130 mA
Power	< 650 mW

Acknowledgement circuit

Voltage	NB 220 H:	not available
	NB 220 QS:	= power supply
	NB 220 QSF:	5 V
Current	< 20 mA	

Output circuits NB 220 H

Changeover contacts	1, potential-free, not acknowledgeable
AC	$U_{AC} \leq 250$ V; $I_{AC} \leq 4$ A; cos $\varphi \geq 0.7$; $P_{AC} \leq 500$ VA
DC	$U_{DC} \leq 250$ V; $I_{DC} \leq 250$ mA; $P_{DC} \leq 50$ W

Output circuits NB 220 QS

Changeover contacts	1, potential of power supply, not acknowledgeable
Normally open contacts	1, potential of power supply, acknowledgeable

All outputs are protected with one 2 A fuse (slow, but faster ones can also be used).

Output circuits NB 220 QSF

Changeover contacts	2, potential-free, one is not acknowledgeable and one is acknowledgeable
AC	$U_{AC} \leq 250$ V; $I_{AC} \leq 4$ A; cos $\varphi \geq 0.7$; $P_{AC} \leq 500$ VA
DC	$U_{DC} \leq 250$ V; $I_{DC} \leq 250$ mA; $P_{DC} \leq 50$ W

Temperatures

Ambient temperature	-25 °C … +60 °C

Degree of protection provided by enclosure (according EN 60529:1991 + A1:2000)

NB 220 H	IP40
NB 220 QS	IP40
NB 220 QSF	IP40

*Without outputs

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2 Material of level detectors

Type	Material	Designation
76 A 76 C	Stainless steel Elastomer Elastomer (seal in screw-in unit) Spring steel Plastic Brass (screw-in unit)	1.4301 to 1.4571 Viton Vulkollan 1.1248, zinc-plated POM GF 25 % 2.0380
76 AF 76 A Duo 1 76 A Trio 1	Stainless steel Elastomer Spring steel Plastic	1.4301 to 1.4571 Viton 1.1248, zinc-plated POM GF 25 %
76 A Duo 2 76 A Duo 3 76 A Trio 3	Stainless steel Elastomer Elastomer (seal in screw-in unit) Spring steel Plastic	1.4301 to 1.4571 Viton Vulkollan 1.1248, zinc-plated POM GF 25 %
76 B... 76 NF 76 N Duo 1 76 N Trio 1	Stainless steel	1.4301 to 1.4571
76 E	Stainless steel Elastomer Elastomer (seal in screw-in unit) Plastic Plastic (screw-in unit)	1.4301 to 1.4571 Viton NBR POM GF 25 % PE-HD
76 M	Elastomer Spring steel Plastic Brass	Viton 1.1248, zinc-plated POM GF 25 % 2.0380
76 N 76 N Duo 2 76 N Duo 3 76 N Trio 3	Stainless steel Elastomer (seal in screw-in unit)	1.4301 to 1.4571 Vulkollan

Table 1: Material of level detectors (parts which come in contact with media)

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3 Range of application

The level limit switches, which comprise the 76 … level detector and the NB 220 … measuring transducer, are suitable for use in stationary tanks or tanks that are stationary during use for storage of the following liquids. The pressures and temperatures listed under 1.4 Dimension sheets and technical data must not fall below or exceed those specified.

The level detector 76 N can be used with liquids to which stainless steel (1.4301) is resistant.

The level detectors 76 N and 76 E are particularly suitable for urea solutions of 32.5 %.

Flammable water-polluting liquids

Fuel oil EL (DIN 51603) and diesel according to DIN EN 590 (DIN 51601), biodiesel according to DIN EN 14214 (DIN 51606), diesel / biodiesel mixtures (DIN 51628), used gear and engine oils.

The level limit switch must not be used with potentially explosive liquids.

Hexanol 1	Nitrobenzene
Ethyl acetoacetate (acetoacetic ester)	1.2-Dichlorobenzene
Acrylic acid-2-Ethylhexyl ester (2-Ethyhexyl acrylate)	2.4-Dimethylaniline (N,N- Dimethylaniline)
Cyclohexyl acetate	n-Octanol (n-Octyl-alcohol)
Benzaldehyde	Diethyl oxalate
Methyl acetate	Aniline

as well as all similar flammable water-polluting liquids with equivalent thermal conductivity.

Non-flammable water-polluting liquids

Unused engine, gear und hydraulic oils	Transformer oils
Vegetable oils (also according to DIN EN 51605)	Anti-freeze
Oil-water mixtures (e.g. drilling and lubricating oils)	Water-based cleaning agent
Per- and trichloroethylene	Urea solution (32.5 %)

as well as all similar non-flammable water-polluting liquids with equivalent thermal conductivity.

4 Fault and failure notifications

In the event of a power failure or failure of device fuses, non-functioning sensor element, interruption respectively short circuit in the signal line between the level detector and the measuring transducer, or a malfunction of the measuring transducer, it switches to the state "Response level reached".

The signal "Response level reached" is indicated on the measuring transducer (except NB 220 H) by means of an audible or visual alarm, unless a power supply failure or device fuse failure is responsible for it (the green power LED on the measuring transducer is inactive).

External signalling and control devices for monitoring the operability according to ZG-ÜS, Section 4.1 must be connected on measuring transducer NB 220 QS between terminals 4 and 8.

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5 Installation notes

During all work on the tank, all applicable technical safety regulations must be observed. The level limit switch is not suitable for use with potentially explosive liquids.

The level detector must be installed in the tank in a position where no liquid splashes or strong vapour flows would cause the overfill prevention device to respond prematurely. The level detectors should be installed as vertically as possible so that residual liquid can drip easily from the probe. At an installation length of over 3,000 mm the level detector is to be secured against being bent and to be equipped with a supporting device every 3,000 mm.

Connection diagram

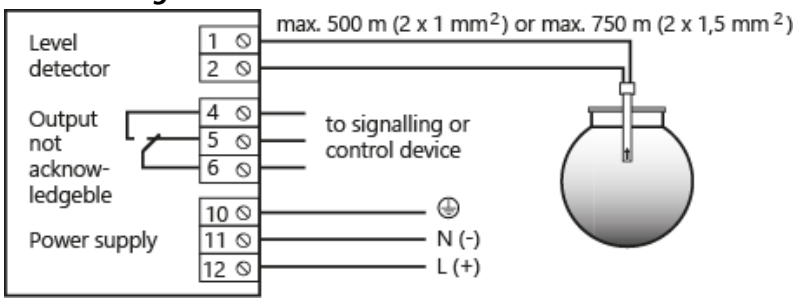

Figure 16: NB 220 H connection diagram

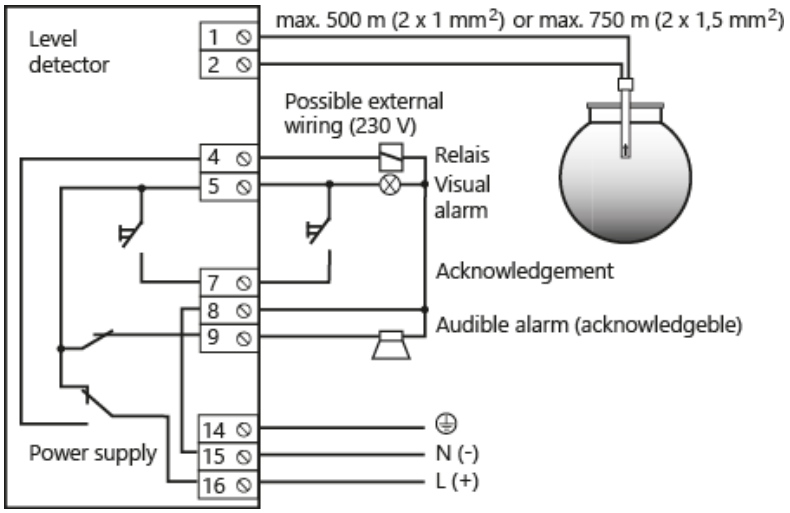

Figure 17: NB 220 QS connection diagram

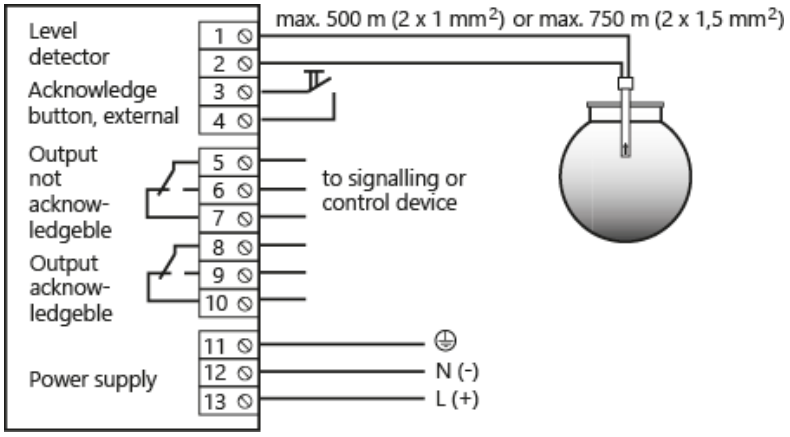

Figure 18: NB 220 QSF connection diagram

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6 Setting notes

Based on the permissible filling ratio in the tank, the response level (A) of the overfill prevention device must be determined in accordance with Appendix 1 of the approval guidelines for overfill prevention devices. The switch delay time of two seconds must be taken into consideration here.

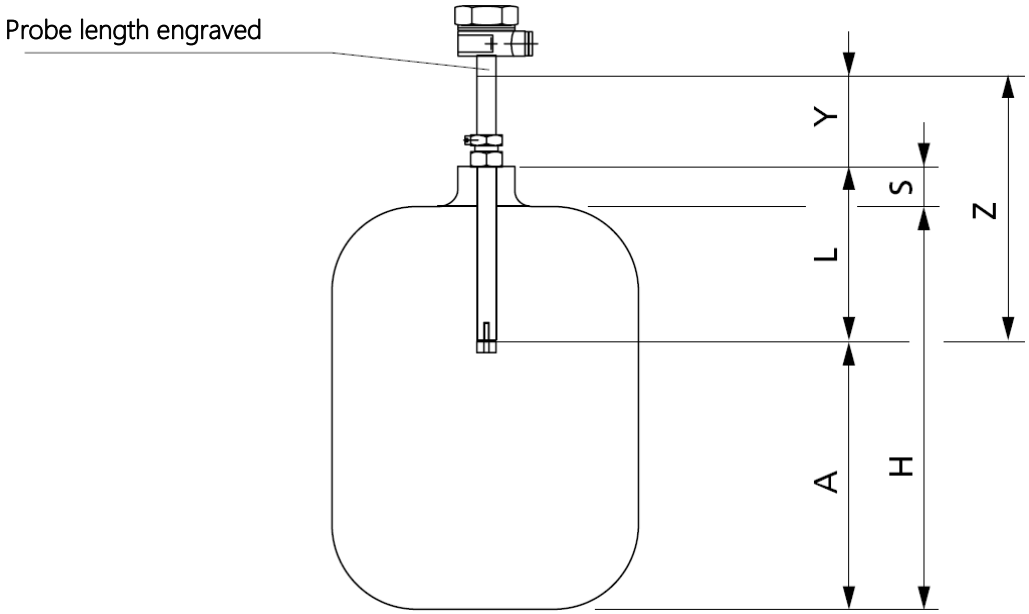

Figure 19: Setting notes

A =	Response level	S =	Fitting resp. bushing height
L =	Response length	Y =	Check dimension
H =	Tank height	Z =	Probe length

The response length (L) is calculated with

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

For a check, response length (L) can be calculated without removing the level detector

$$L = Z - Y$$

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Level detector 76 ...

The level detector comprises a probe tube, which projects into the tank and, at the bottom end, is equipped with a probe with protection against mechanical damage.

At level detectors with variable response length the respective probe length is permanently marked. The probe length is a measure of the distance between the groove marking on the top end of the probe tube and the response point of the level detector.

On level detectors with fixed response length, the length is permanently imprinted and specifies the distance between the hexagon nut seat or flange underside to the groove marking on the protective sleeve of the probe at the bottom end of the level detector.

The response length (L) is calculated from the tank dimensions and the response level. With the probe tube fitted, correct adjustment of the response level can be checked by means of check dimension (Y). Check dimension(Y) is measured as distance between the groove marking on the top end of the probe tube and the hexagon nut seat of the screw-in unit. Subtracting check dimension (Y) from the imprinted probe length gives response length (L).

Level detector with screw-in unit (adjustable) 76 ... / 76 A Duo 2

The response length is determined from the tank data and adjusted accordingly. To fix the probe tube, it is necessary to tighten the upper gland screw and the locking screw of the screw-in unit. The screw-in thread must then be provided with a suitable resistant sealing material and screwed into the existing tank coupling.

Level detector with fixed screw-in unit 76 M...

As the response length (L) of the level detector is invariable (probe tube rigidly connected to the screw-in unit), this dimension must be accurately determined from the tank dimensions and specified before the device is ordered. The screw-in thread must be provided with a suitable resistant sealing material and screwed into the existing tank coupling.

Level detector with flange 76 AF

As the response length (L) of the level detector is invariable (probe tube rigidly connected to the flange), this dimension must be accurately determined from the tank dimensions and specified before the device is ordered.

Level detector 76 A (N) Duo 1 / 76 A Trio 1

As the response lengths of the level detectors are invariable (probe tubes rigidly connected to the screw-in unit), this dimension must be accurately determined from the tank dimensions and specified before the device is ordered. The response lengths are permanently imprinted on each level detector. The screw-in thread must be provided with a suitable resistant sealing material and screwed into the existing tank coupling.

Level detector 76 A Duo 3 / 76 A Trio 3

The response length for the adjustable level detector is determined from the tank data and adjusted accordingly. To fix the probe tube, it is necessary to tighten the upper gland bolt and the retaining screw of the screw-in unit. The response lengths of the other level detectors are invariable (probe tubes rigidly connected to the screw-in unit) and must be accurately determined from the tank dimensions and specified before the device is ordered. The response lengths are permanently imprinted on each level detector. The screw-in thread must be provided with a suitable resistant sealing material and screwed into the existing tank coupling.

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7 Operating instructions

The level limit switch is generally maintenance-free provided if installed and operated in accordance with its intended purpose. The signalling and control device is to be connected downstream from the approved system parts, next to the signal amplifier, if necessary. The general operating instructions for the devices being used must be observed in accordance with the installation and operating guideline for overfill prevention devices according to Appendix 2 of the ZG-ÜS.

Before commissioning, all system parts of the overfill prevention device must be checked to determine that they are correctly connected and working properly. The system and downstream devices must be checked for correct operation.

8 Repeat testing

The operability of the overfill prevention device must be tested at reasonable intervals, but at least once a year. The operator shall be responsible for the type and frequency of inspection within the specified period.

The test must be conducted in such a way that proof is obtained of correct operation of the overfill prevention device with all components interacting. This condition can be satisfied by allowing the liquid to reach the response level during a controlled filling process. If filling to the response level is not practicable, the level detector should be caused to respond through simulation of the fill level or physical measuring effect by suitable means.

For the level detectors, the function test can be performed as follows:

a) Remove the level detector and immerse it in the stored liquid.

   Shortly after the immersion (≤ 2 s) the relays in the measuring transducer must de-energize and thereby activate the signalling device.

b) By filling the tank up to response level A.

   The filling process must be very closely monitored! The overfill prevention device and the downstream signalling devices must respond.

The test to determine whether the alarm system of the overfill prevention device works in accordance with the closed-circuit principle or whether the monitoring of the sensor element functions, can be performed as follows:

a) Interrupt the power supply of the measuring transducer.

   The green LED of the measuring transducer must go out and the downstream signalling devices must respond.

b) Interrupt or short-circuit the signal line between the level detector and measuring transducer.

   The level limit switch and the downstream signalling devices must respond.

Measuring transducer NB 220 QSF

The entire overfill prevention device can be checked using the test button. Whenever this button is pressed, the heat output of the PTC resistor is reduced to such an extent that the resistor cools (equivalent of an immersed sensor) and the alarm system is triggered. The alarm must occur no more than two seconds after the button has been pressed. As soon as the test button is released, the PTC resistor continues to be heated. Once the resistor has heated up (> five seconds), the overfill prevention device is back on alert. If no alarm occurs after the test button has been pressed or immediately after its release, the overfill prevention device must be checked immediately.

The selected test method and the result must be documented.

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