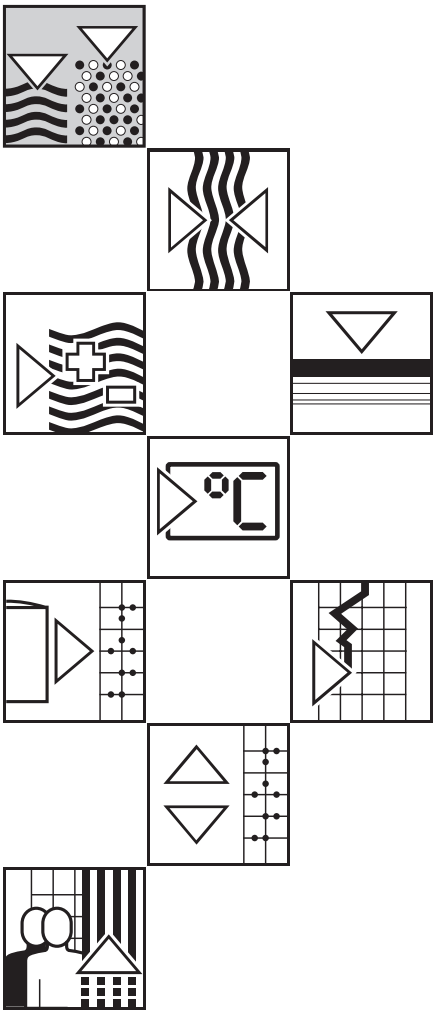
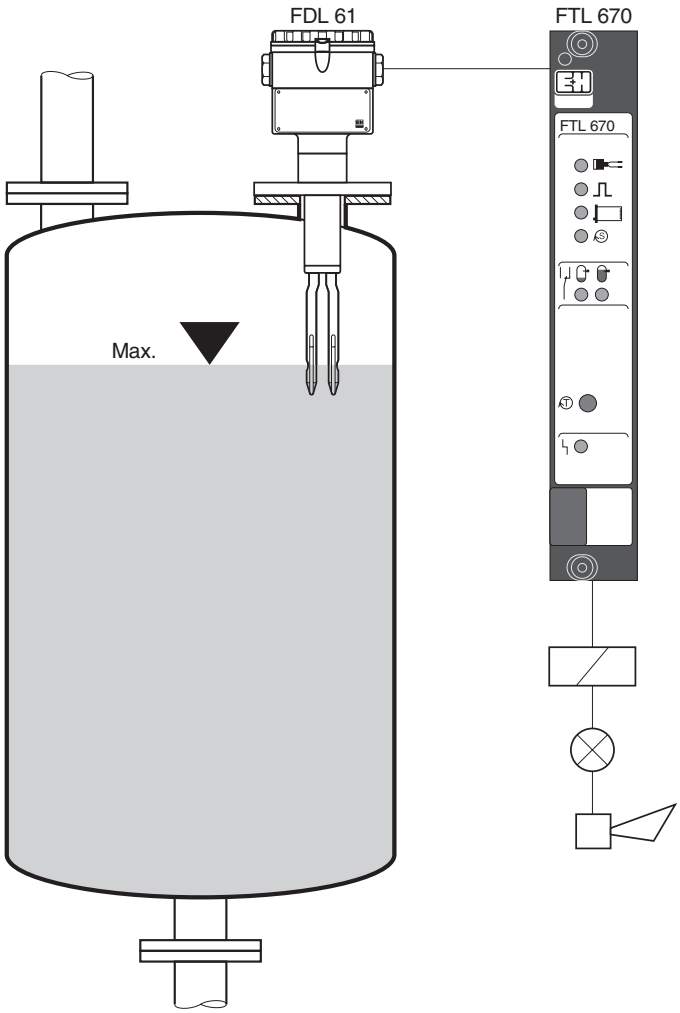
BA 140F/00/en/02.04
016343-1000

liquiphant S
FDL 60, FDL 61
nivotester
FTL 670
Limit Switch
Liquiphant FailSafe

Operating Instructions



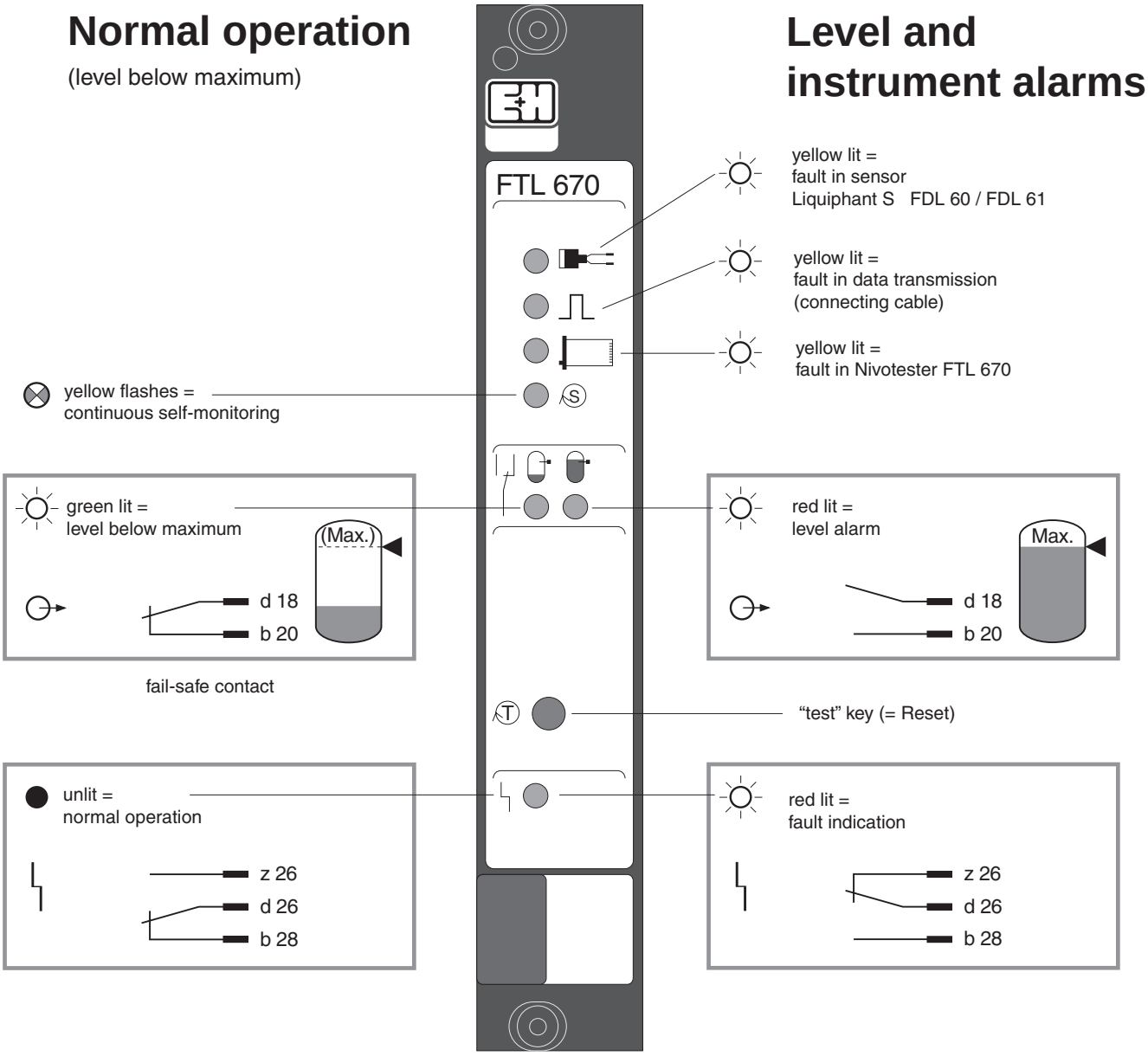


Endress+Hauser

The Power of Know How

Optical Signals

Significance of the optical signals displayed at the Nivotester FTL 670 front panel



The actions to be taken on an alarm are described in the Section "Trouble-Shooting" on Page 21.

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1 Notes on Safety

Icons for notes on safety

In order to highlight safety-relevant procedures,
the following conventions have been used, each indicated by a corresponding icon in the margin.


Note!

Note!
"Note" indicates actions or procedures which
- if not performed correctly -
may indirectly affect operation
or may lead to an instrument response which is not planned.


Caution!

Caution!
"Caution" indicates actions or procedures which
- if not performed correctly -
may lead to personal injury
or incorrect functioning of the instrument.


Warning!

Warning!
"Warning" indicates actions or procedures which
- if not performed correctly -
will lead to personal injury,
a safety hazard
or destruction of the instrument.

Standards and Regulations

Only trained personnel may install, connect, verify, start-up, service and repair this measuring system.
All local standards and regulations must be complied with in regard to overspill protection and explosion protection as well as all requirements given in the certificates.

For details concerning the certificates see page 5.

Overspill protection in Germany conforms to water conservation regulations:
With the installation, servicing, maintenance and cleaning of an overspill protection system, only those operations may be carried out which are covered by Section 19/1 of the water conservation regulations. This means that activities are done according to local regulations or the manufacturer of the level sensors and transmitters carries out the work with its own trained personnel.

Important instructions on overspill protection of liquefied gas tanks are to be found in the Section "Liquefied Gas".

2 Introduction

2.1 Application

- Fail-safe overspill protection of tanks with flammable and non-flammable water polluting liquids.

- Fail-safe overspill protection of tanks containing liquefied gases

The measuring system fulfils the requirements of Requirement Class AK 5 as per German Draft Standard DIN V 19250 (corresponding to SIL 3 to IEC 61508).

2.2 Measuring system

The measuring system consists of:

- Liquiphant S FDL 60 or FDL 61
- Nivotester FTL 670
- Monorack II (4 HP) or assembly rack with power unit
- Other electrical devices for control and signalling (contacters, magnetic valves, alarms, etc.)

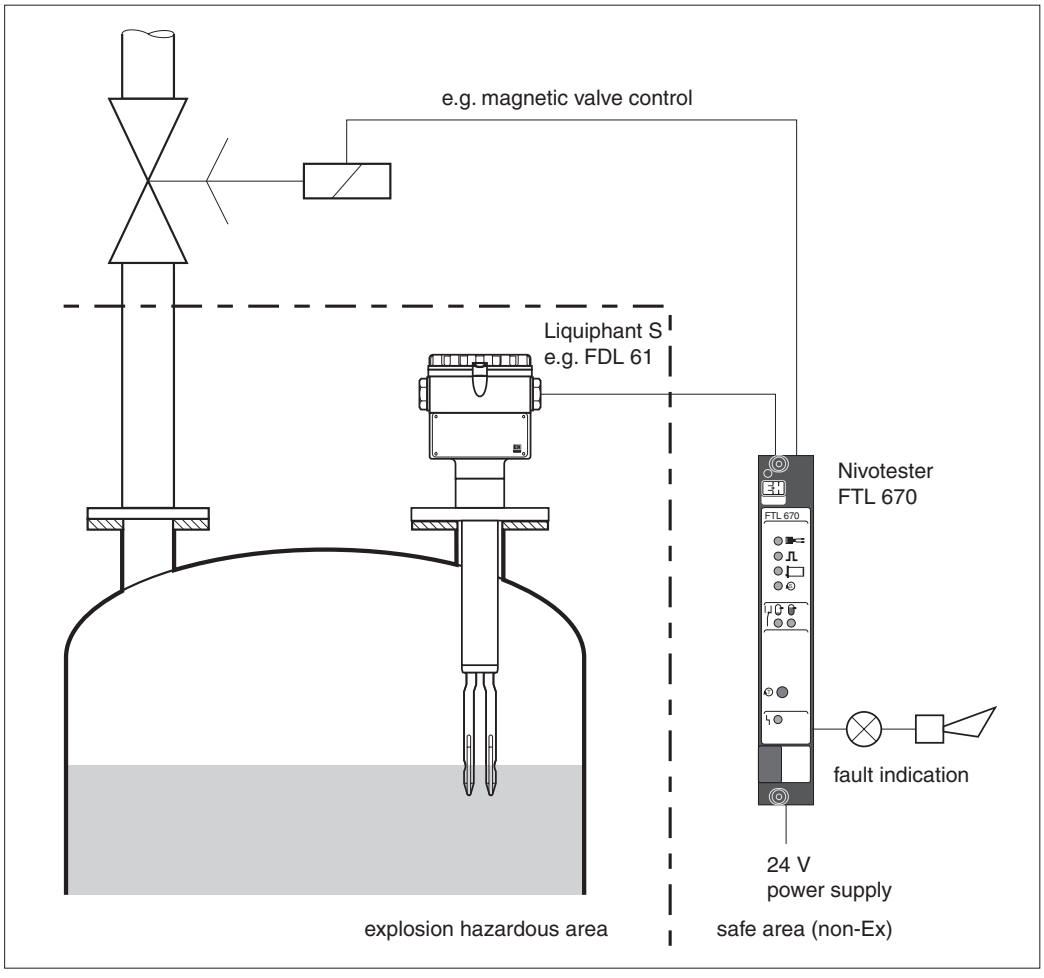


Fig. 1
Measuring system for overspill protection

2.3 Operating principle

Liquiphant S FDL 60, FDL 61

The fork of the Liquiphant S sensor is made to vibrate in air at its resonant frequency by piezo-electric elements. The frequency changes when the fork is submersed in a liquid. The frequency is converted to an interference-immune, pulse frequency modulated signal (PFM) and is transmitted over a two-wire cable to the Nivotester FTL 670. The complete system has an in-built redundancy and a continuous self-checking function. The sensor has two independent electronic sensing circuits which are given identification tags for correct evaluation at the Nivotester FTL 670.

Nivotester FTL 670

The Nivotester supplies the Liquiphant S with intrinsically safe power and receives from it on the same line a PFM signal (superimposed on the base current).
A redundant processor system evaluates and compares the signals from the two sensing circuits. At the same time the processors carry out an ongoing test of all safety relevant components. When the fork of the Liquiphant S is uncovered the safety contact of the switching output of the Nivotester is closed. When the fork is covered with liquid to the switch point the Nivotester breaks this potential-free output.
Should a fault occur in the system or power fail, this circuit is also broken (Safety contact in quiescent maximum fail-safe mode). Faults are also indicated by a separate relay contact. For simplified fault-diagnosis three yellow LEDs indicate the fault location.

The combination of redundant sensor and evaluating circuitry, dynamic signal analysis and continuous self-checking ensures that when the switch point is reached or a fault occurs the switching output fails-to safe every time.

Approved liquids

- Liquids with a viscosity ν max. 10000 mm^2/s, density ρ min. 0.5.
- Liquefied gas to DIN 51622, density ρ min. 0.44.
- Temperature and pressure, see Technical Data.
- For the Liquiphant “1.4571", all liquids against which 1.4571 steel is sufficiently resistant
- For Liquiphant “Alloy C” all liquids against which 2.4610 steel is sufficiently resistant.

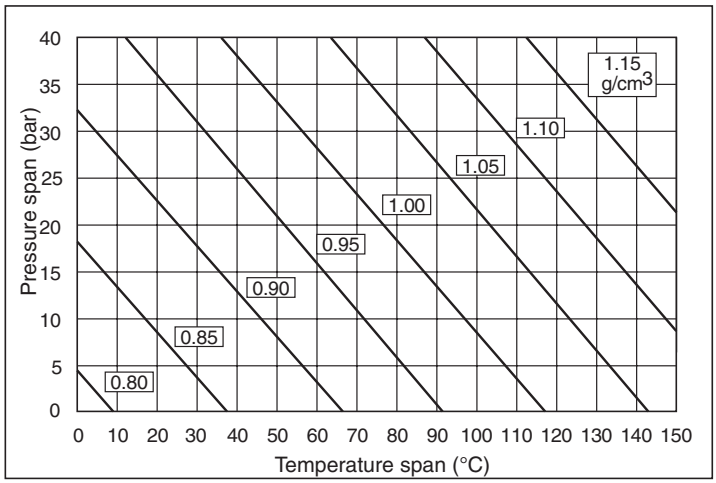
Also note:
The corrosion at the sensor caused by strongly corrosive liquids fully detected for those applications where pressures and temperatures are below the limit curves at particular densities in the nomogram at the top of Page 5.

In such cases the Nivotester FTL 670 must be operated **without** a bridge between connections d 12 and d 14 (see Page 17, Fig.18).

Proof of chemical resistance to the wetted parts of the sensor is required (e.g. acc. to DIN 6601) for applications with pressure and temperature spans exceeding the limit curves shown in the nomogram.

Corrosion due to strongly corrosive gaseous media is always detected without reservation.

Example:
Density ρ of liquid = 1.05 giving:
max. pressure rating = 12 bar with max. temperature rating of 120°C
or
max. pressure rating = 37 bar with max. temperature rating of 70°C



1 bar = 14.5 psi X °C = (1.8 · x + 32) °F

Nomogram for approved pressure rating (vertical scale) and temperature rating (horizontal scale) as a function of density ρ of the liquid (curves) when using the Liquiphant in especially corrosive liquids

2.4 Supplementary documentation

Certificates

TÜV certificate No. U 95 04 20451 001
for fail-safe overspill protection with
the Liquiphant FailSafe
Certificate ZE 129F/00/en

TÜV approval
TÜV.ÜSX.XX-XXX.Liquefied gas.PN40
for overspill protection with
the Liquiphant FailSafe
Certificate ZE 126F/00/en

Other certificates
(special German certificates)
on request

Notes on Safety to ATEX
(KEMA 97 ATEX 4490 (II 1/2 G))
for Liquiphant S FDL 60, FDL 61
Operating instructions XA 027F/00/a3

Notes on Safety to ATEX
(PTB 00 ATEX 2008)
for Nivotester FTL 670
Operating instructions XA 069F/00/a3

Accessories

Monorack II
Technical Information TI 183F/00/en
Operating manual BA 090F/00/a3

Monorack Protective Housing
Technical Information TI 099F/00/en

19" Assembly Rack
System Information Racksyst SI 008F/00/en
Project Information SD 041F/00/en

Racksyst Field Housing
Technical Information PI 026
Project Information PI 003

Overvoltage Protector HAW 261, 262
Technical Information TI 108F/00/en

Overvoltage Protector HAW 262
For explosion hazardous areas
Technical Information TI 092F/00/en

Other accessoried on request

3 Mounting the Liquiphant S FDL 60 and FDL 61

3.1 Installation hints

FDL 60 and FDL 61

See Section “Technical Data” for permissible operating conditions such as temperature, pressure, viscosity and density.
See the appropriate installation regulations for the different process connections.
For low viscosity fluids, the Liquiphant can be installed in any position.
For other process conditions, e.g. higher viscosity or build-up, the recommended mounting position is shown in Figs. 4 and 5.

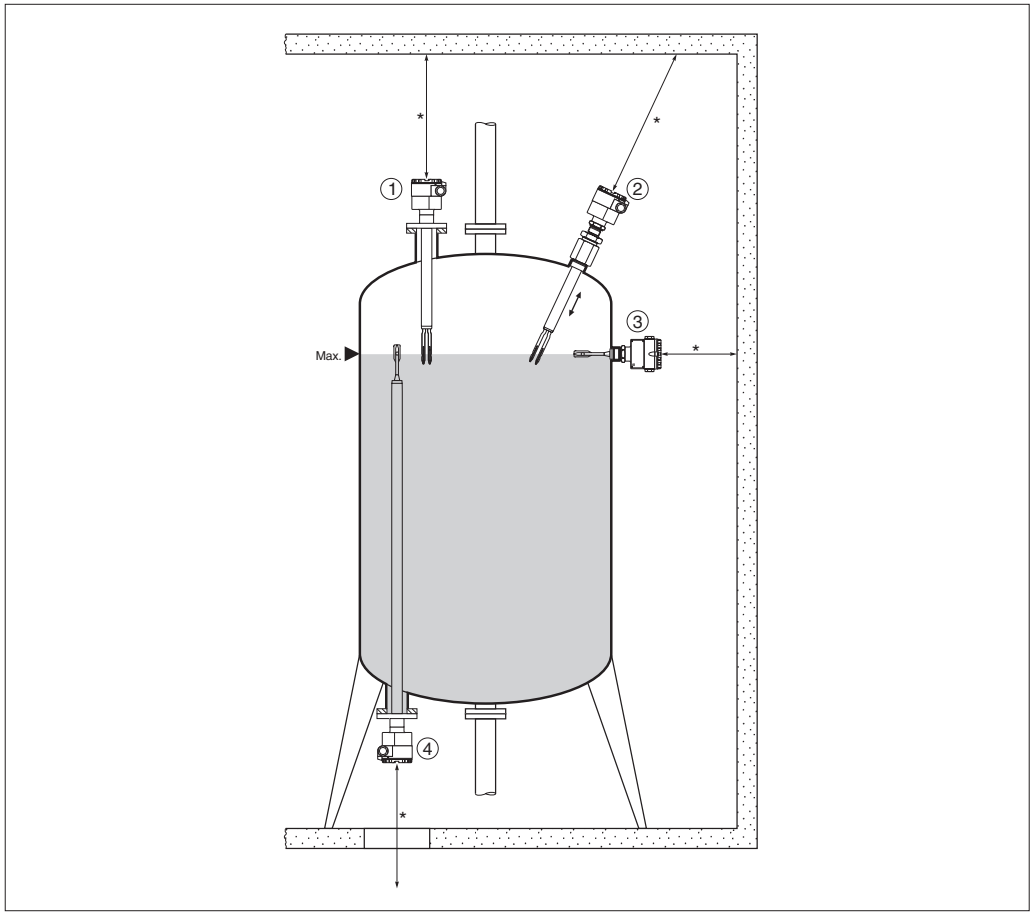


Fig. 2
Mounting in any orientation
1) FDL 61 from above
2) FDL 61 with sliding sleeve
3) FDL 60 from the side
4) FDL 61 from below

** ensure sufficient room for mounting!*

The position of the switchpoint in relationship to the mounting position is shown in Fig. 3.

Also note the position of the switchpoint in the tank with regard to:

- thermal expansion of the liquid,
- residual flow when the inlet valve is shut,
- sensor length tolerances,
- switchpoint tolerances,
- thickness of seals,
- if appropriate, thickness of intermediate flanges, e.g. when using a nozzle,
- and with an open tank, the thickness of any foam layer, as the Liquiphant detects the surface of the liquid and is not affected by foam.

Switchpoint as a function of mounting position (shown in Fig. 3)
Please note that the switchpoint is dependent on:
– product density
– pressure
– temperature
– sensor tolerances

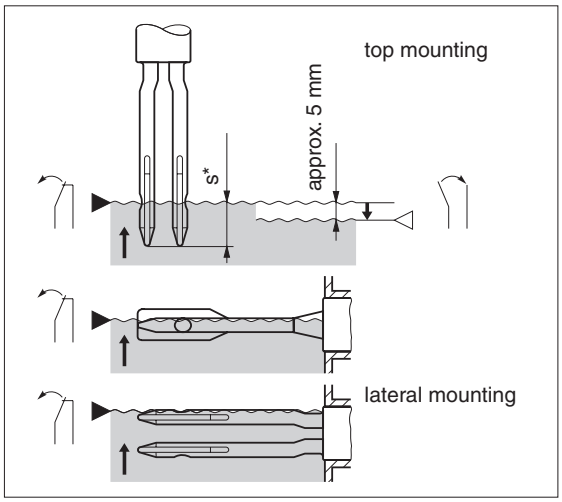
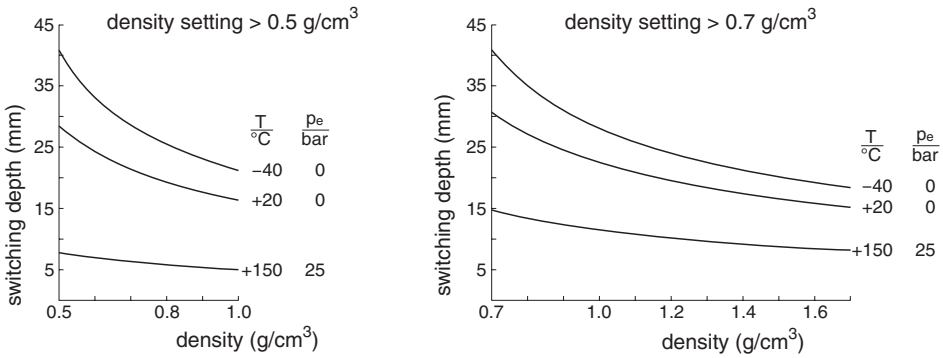


Fig. 3
** height **s** of the switchpoint above the sensor tips for top mounting*

Typical value:
For water:
***s** = approx. 15 mm*
density setting > 0,5,
***s** = approx. 20 mm*
density setting > 0,7
(T = 20°C, p_e = 0 bar)
For liquefied gas:
***s** = approx. 30 mm*
density setting > 0.5,
e.g. propane, 10°C, 6.5 bar
or 20°C, 9.0 bar
e.g. butane, 10°C, 1.5 bar
or 20°C, 2.0 bar



Example: Setting > 0.5 g/cm³, density 0.5 g/cm³, T = – 40°C, p_e = 0 bar —-> **s** max. 41 mm
Setting > 0,7 g/cm³, density 1.5 g/cm³, T = +150°C, p_e = 25 bar —-> **s** min. 8 mm

Fig. 3 a
*Maximum height of the switchpoint **s** as a function of density setting, pressure and temperature. **s** can also be lower at higher pressures or temperatures and dependent upon the sensor tolerance*

General mounting conditions

There must be sufficient clearance outside the tank for mounting, i.e. at least the total length of the instrument plus housing (Fig. 2).

The safe function of the Liquiphant S can only be guaranteed when the following mounting conditions are met.


Caution!

The fork must oscillate freely until the liquid has reaches the switchpoint.
Ensure that there is sufficient clearance for the fork so that:
- highly viscous liquids quickly flow off the fork (Fig. 4)
- the fork does not come into contact with the wall of the tank or any internal fitting
- the fork does not come into contact with any build-up on the tank wall (Fig. 5)
- inflowing liquid does not flow directly onto the fork.

FDL 60

The switchpoint of the Liquiphant S FDL 60 is determined by the mounting position: the fork is usually laterally on the tank (Fig. 3 and 4).

FDL 61

- For the Liquiphant S FDL 61 the required length L (see Figs. 6 and 7) is the distance from the upper edge of the tank process connection to the switchpoint at the surface of the liquid + **s** mm (Fig. 3).
- For a Liquiphant S FDL 61 with high pressure sleeve, the switchpoint can be adjusted to the millimetre when commissioning the plant (Fig. 6).
- If a long Liquiphant S FDL 61 is subject to strong and continuous lateral load, e.g. due to vibration of the tank or liquid surges by agitator blades, then the extension tube should be supported. Types of support are, e.g. a rugged supporting pipe (accessory) which can be passed through the nozzle with flange, or a side-mounted bracket near to the fork (Fig. 7).

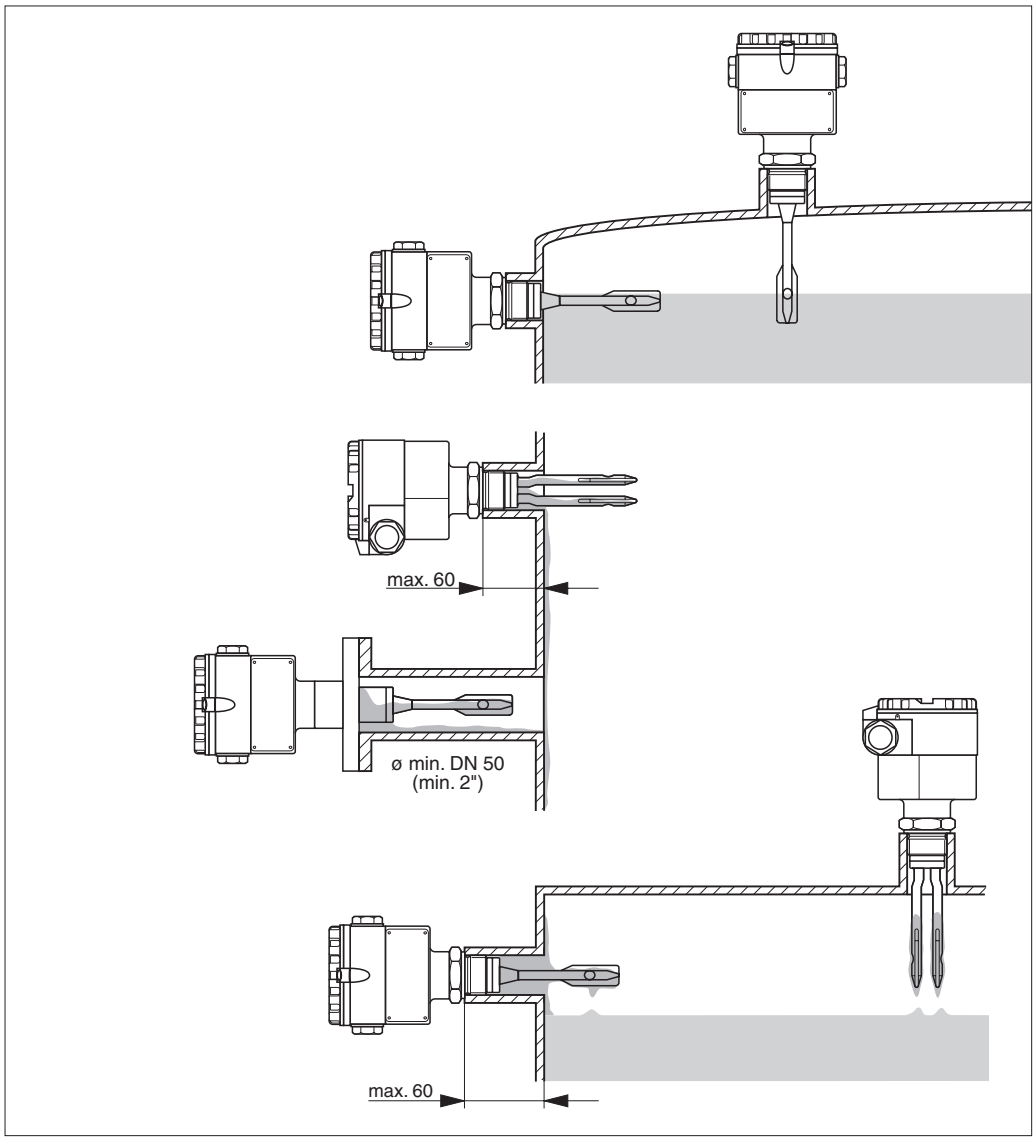


Fig. 4
Suggestions for installation in viscous liquids, viscosity ν;

above: not dependent on viscosity

centre: ν up to 2000 mm²/s

below: ν above 2000 mm²/s

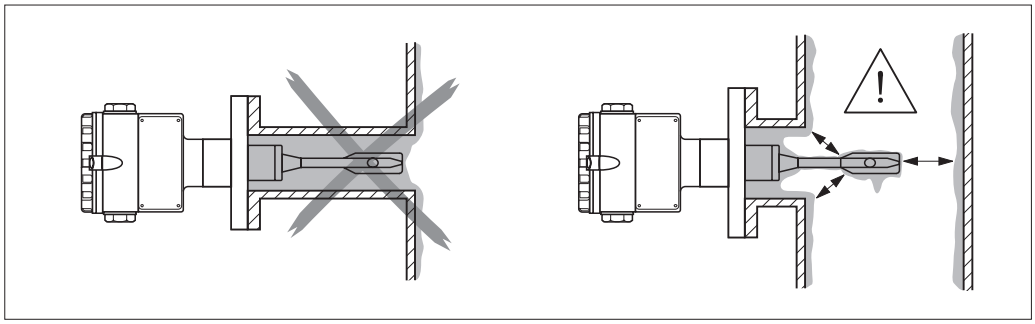
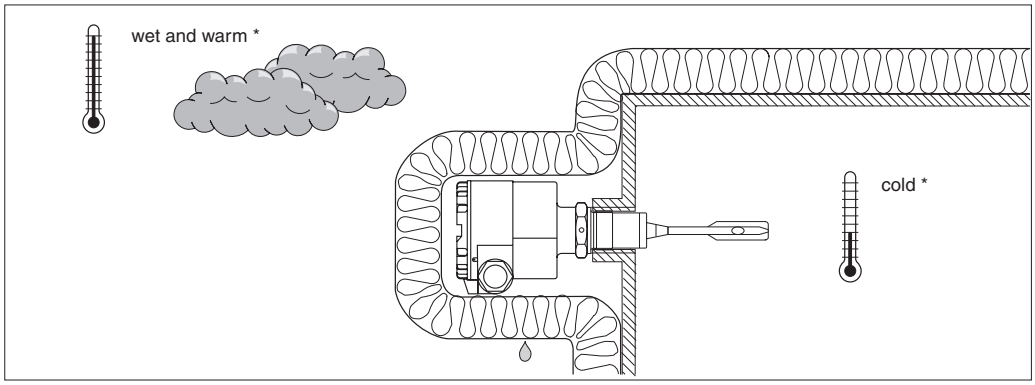


Fig. 5
Ensure sufficient clearance for the fork when material build-up is expected



** For humid environments and cold media, to avoid condensate forming within the housing:*
- *Insulate the housing or*
- *Install a FDL 61, min. length 301 mm.*

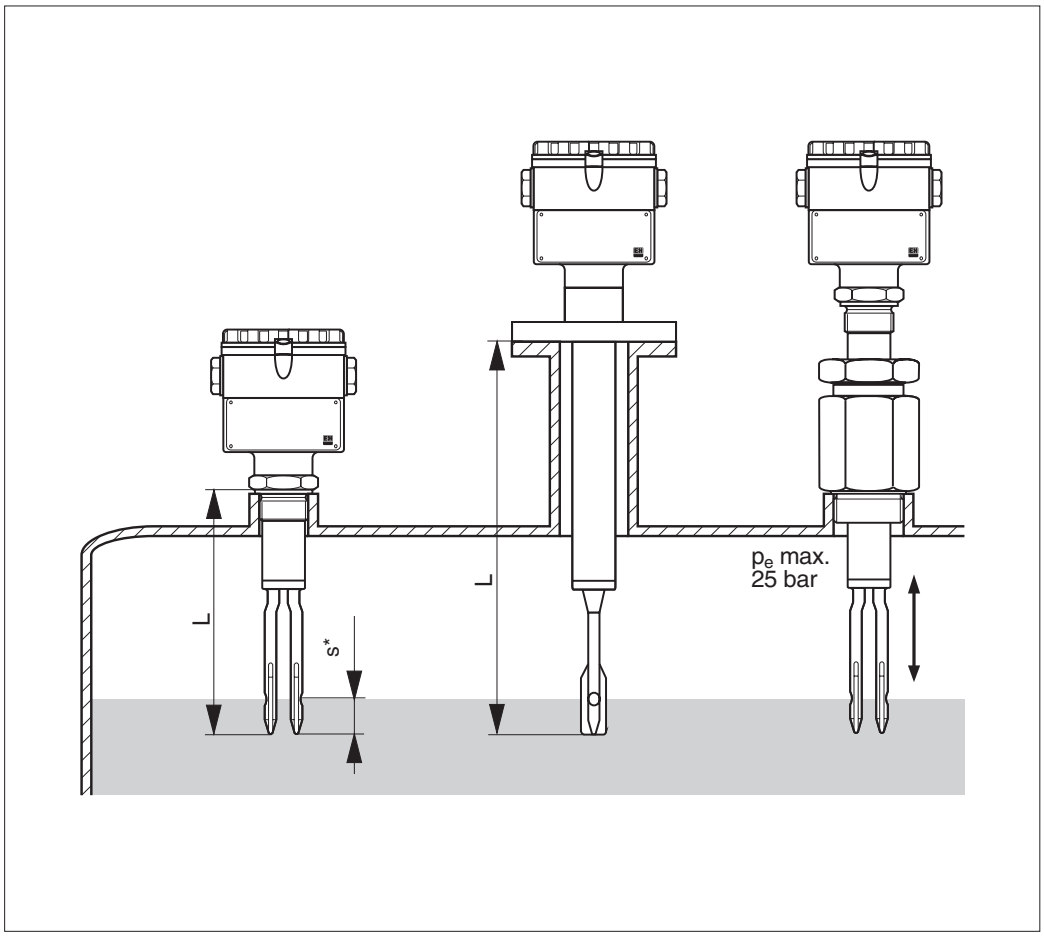


Fig. 6
Installing the Liquiphant S FDL 61

left: with thread connection G1 or 1" NPT

centre: with flange connection from DN 32

right: with sliding sleeve G 1½ or 1½" NPT

**s = position of switchpoint, see Fig. 3 on page 7*

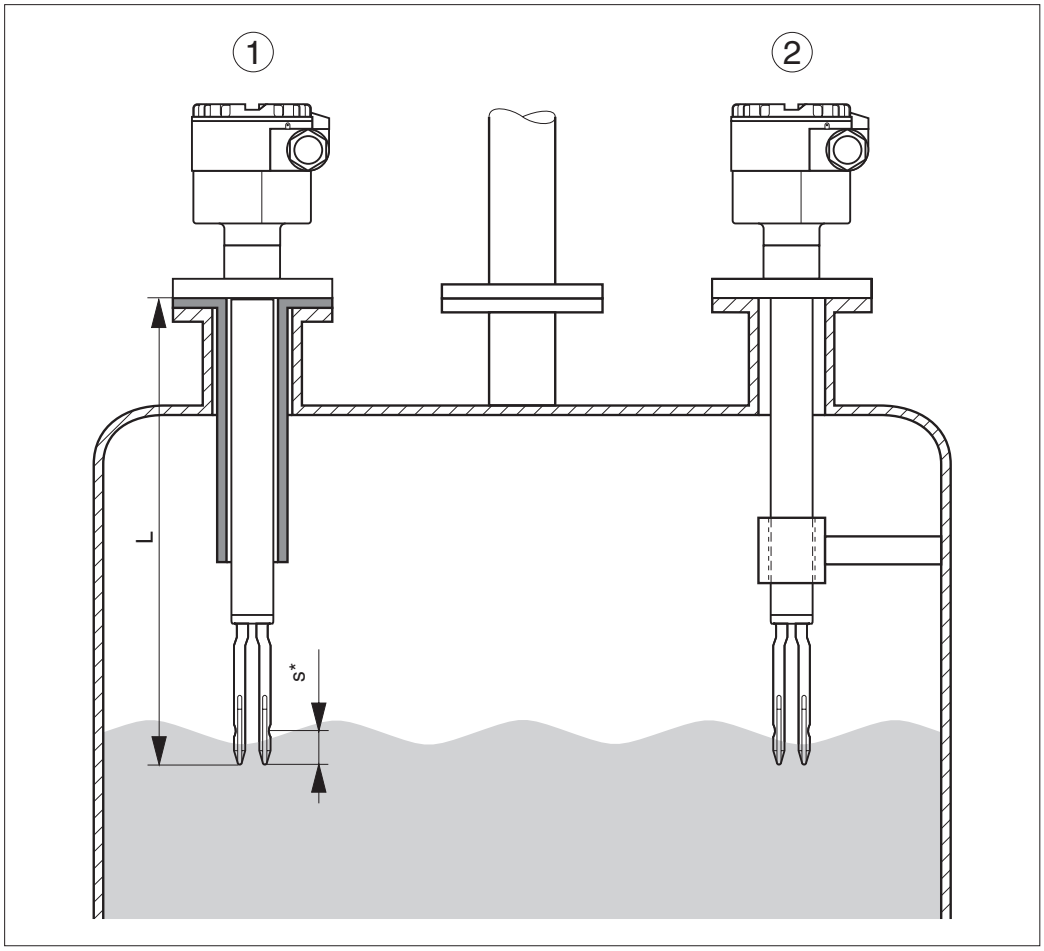


Fig. 7
Installation with heavy dynamic load:

1) FDL 61 with supporting tube (accessory)

2) FDL 61 with side support

**s = position of switchpoint, see Fig. 3 on page 7*

3.2 Mounting

Unpacking the Liquiphant S

The fork is packed in a styropore mould to protect it in transit. Do not remove this mould until immediately before mounting.

Caution!

Caution!
The fork of the Liquiphant S FDL 60, FDL 61 is a sensor and should be handled with care:
- When carrying the Liquiphant S, pick it up by the housing, the process connection or the extension tube, not by the fork itself.
- Do not squeeze the tines of the fork together, pull them apart or drop the fork on the ground.
- Do not shorten, lengthen or otherwise alter the dimensions of the fork.

See Section “Disposal” for disposing of the packaging.

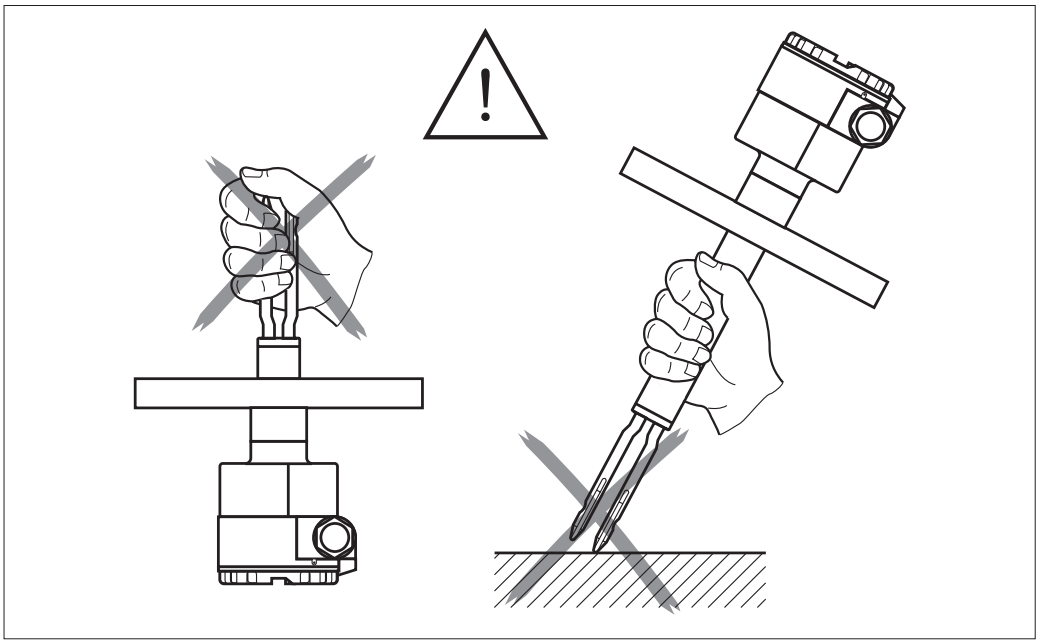


Fig. 8
The fork is a sensor and must therefore be handled with care

Instrument identification

Before installing, check to see if you have the correct instrument.
Information about the product is given on the nameplate.
Compare the product designation with that given in the product structure in Section “Technical Data” on Page 26.
In the case of the Liquiphant S FDL 61, check the length against the available space in the tank. When installing, the fork should touch neither any internal fittings nor the wall of the tank itself.

Tools

The tools required depend on the process connection. See dimensional sketches given with the technical data.
Also required: Phillips screwdriver (PZD 1)

Positioning the fork

Note the position of the fork with *lateral* mounting.
With highly viscous liquids or those which form a material build-up, the fork should be positioned so that the liquid can drip off easily.

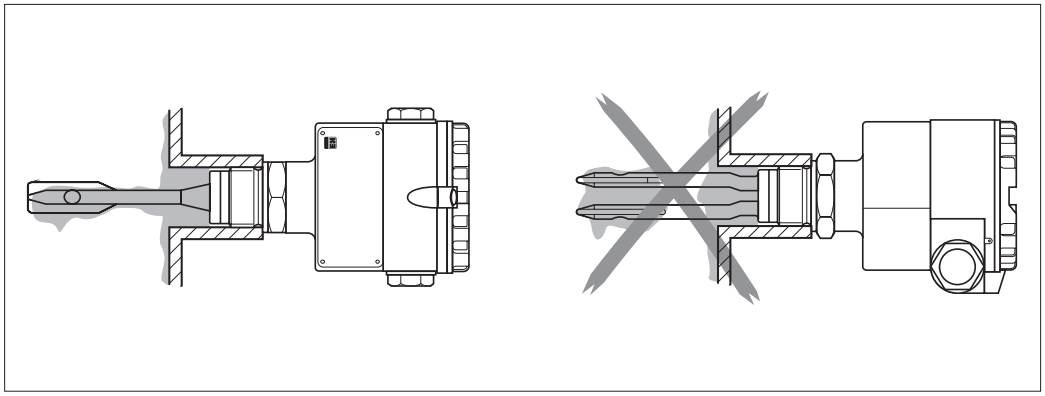


Fig. 9
The fork must be correctly positioned in tanks containing highly viscous material

Liquiphant S with flange or Triclamp

Use a seal suitable for the application. Also note all explosion regulations with regard to materials and gap widths.
The flange is marked with vertical marks to indicate the position of the fork.
When mounting from the side, the fork is correctly positioned when the marks are uppermost.

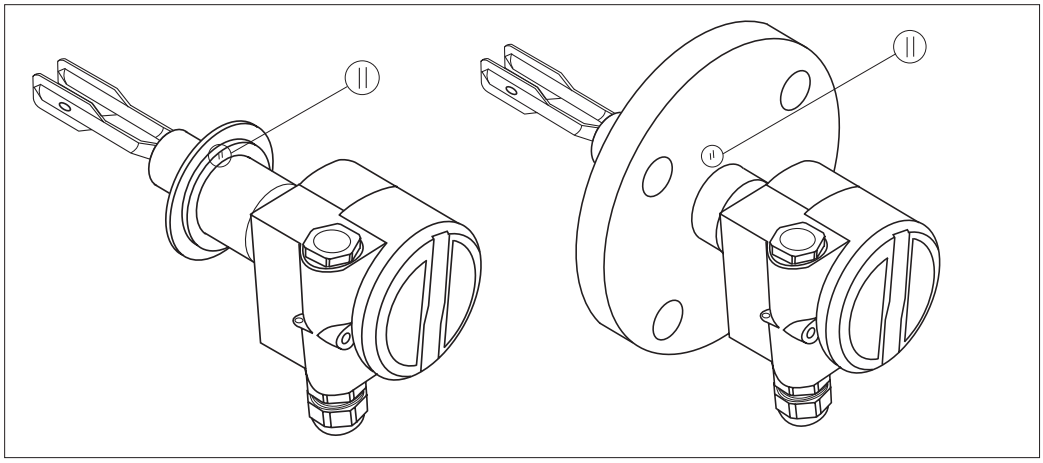


Fig. 10
The vertical marks show the position of the fork

Liquiphant S with sanitary coupling

On the flange are vertical marks showing the position of the fork.
When mounting from the side, the fork is correctly positioned when the marks are uppermost.

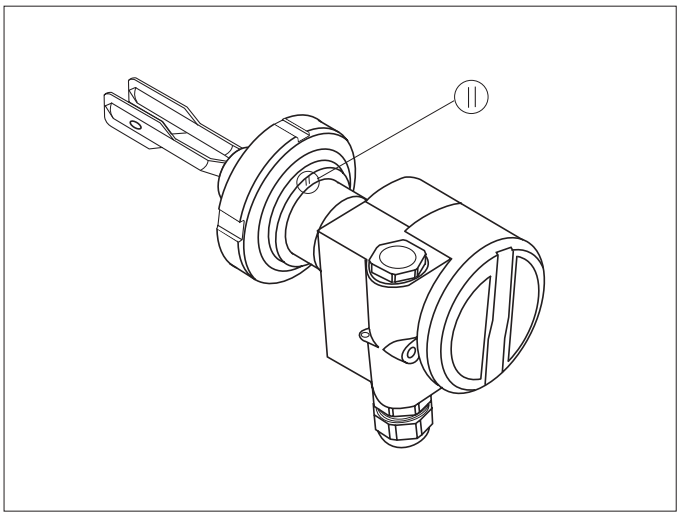
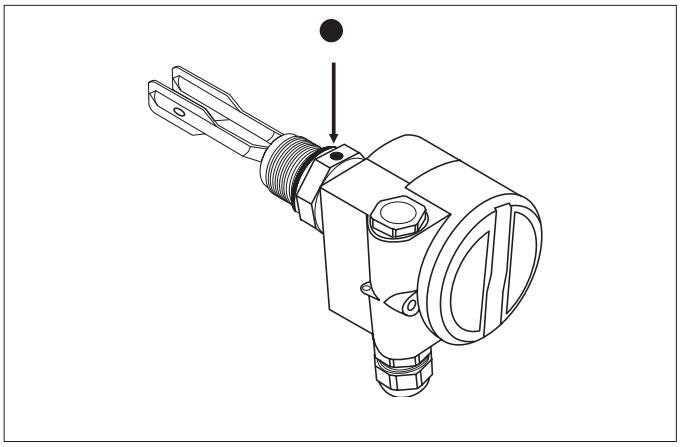


Fig. 11
The vertical marks show the position of the fork

Liquiphant S with threaded connection



Two raised points on the hexagonal nut indicate the position of the fork. When mounting laterally the fork is correctly positioned when the raised marks are above and below.

Fig. 12
The raised marks on two flats of the hexagonal nut show the position of the fork

Thread 1 - 11½ NPT

If necessary and if permitted, wrap suitable sealing material around the tapered thread.
Screw the Liquiphant S into the threaded sleeve by using a 41 AF wrench at the hexagonal nut.
Do not screw in by turning the housing!

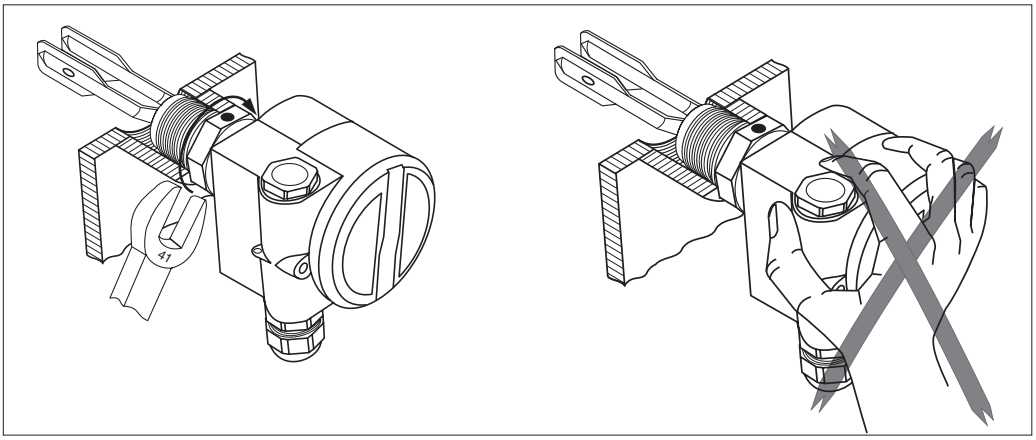


Fig. 13
Screw in the hexagonal nut using a 41 AF wrench and position the fork.
Do not turn by the housing!

Thread G 1 A

Use either the 33 x 39 elastomer-fibre DIN 7603 sealing ring supplied or a seal which is suitable for the application.
Screw the Liquiphant S into the threaded sleeve using a 41 AF wrench at the hexagonal nut.
Do not screw in by turning the housing!
If the fork cannot be aligned correctly, wrap suitable sealing material around the parallel thread. This will ease the adjustment.

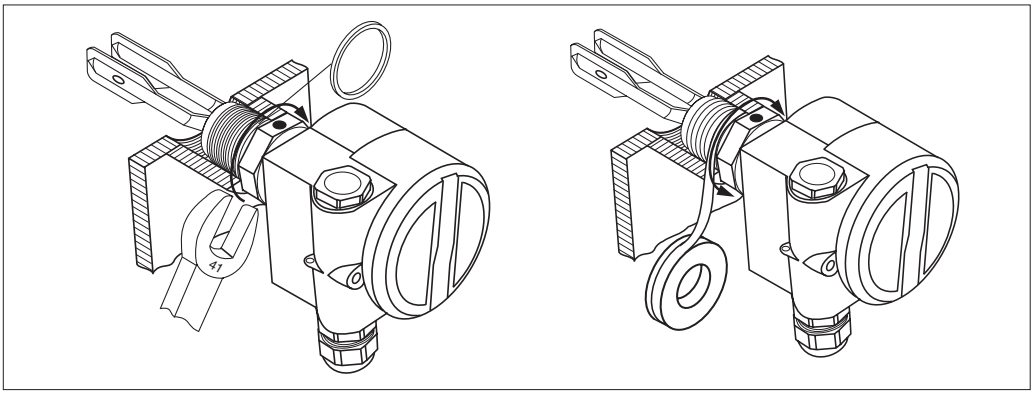


Fig. 14
Screw in the hexagonal nut using a 41 AF wrench and position the fork.
Do not turn by the housing!

Liquiphant S FDL 61 with sliding sleeve

- Thread 1½ - 11½ NPT: If necessary and if permitted, wrap suitable sealing material around the sliding sleeve.
- Thread G 1½ A: Use either the 48 x 55 elastomer-fibre DIN 7603 sealing ring supplied or a seal which is suitable for the application.
- Screw the sliding sleeve into the threaded sleeve of the tank at the long 60 AF hexagonal nut.

Adjustment

Before filling the tank:
- If the switchpoint for overspill protection is accurately determined, slide the Liquiphant S FDL 61 the corresponding distance into the sliding sleeve.
- If the position of the switchpoint cannot yet accurately be determined, slide the Liquiphant S FDL 61 into the sliding sleeve as far as it will go – the switchpoint for overspill protection is now at the lowest point.
- If there is no possibility of releasing pressure under normal operating conditions, the switchpoint must be accurately set now.

Warning!

1. Danger: if the screws are not correctly tightened, the pressure in the vessel may push out the Liquiphant.
   For this reason, the switchpoint of the Liquiphant S FDL 61 with sliding sleeve must always be adjusted with an unpressurised tank!

2. Sealing: if the grub screws (4 AF Allen screws) in the hexagonal pressure screw are too tight, the extension pipe of the Liquiphant may be dented. Should the switchpoint be then altered (downwards), the packing of the sliding sleeve will no longer be pressure-tight.

Tightening

- Tighten the pressure screw of the sliding sleeve at the short 60 AF hexagonal nut with a torque of between 100 Nm and 120 Nm.
- Tighten the three grub screws (4 AF Allen screws) in the hexagonal nut of the pressure screw with a torque of between 17 Nm and 20 Nm.

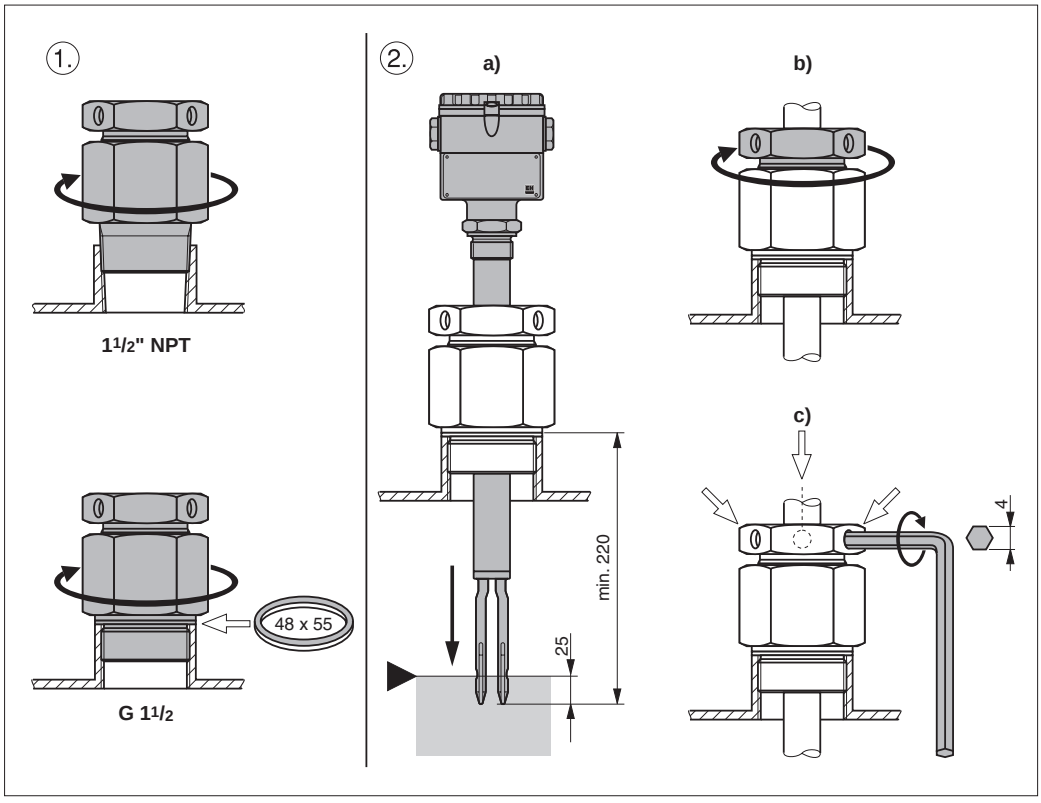


Fig. 15
1) Screw in sliding sleeve
2) Adjust the Liquiphant to correct switchpoint height and tighten securely according to the instructions above

Turning the housing

The housing can be turned in order to position the cable gland correctly:
1) Unscrew the cover
   Loosen the Phillips screw in the base of the housing 3 or 4 turns
2) The housing can now be turned through 300° from one stop to the other.
   When the Liquiphant S is mounted laterally in a tank, then the cable gland should point downwards in order to prevent the entry of moisture.
3) Tighten the Phillips screw in the base of the housing.

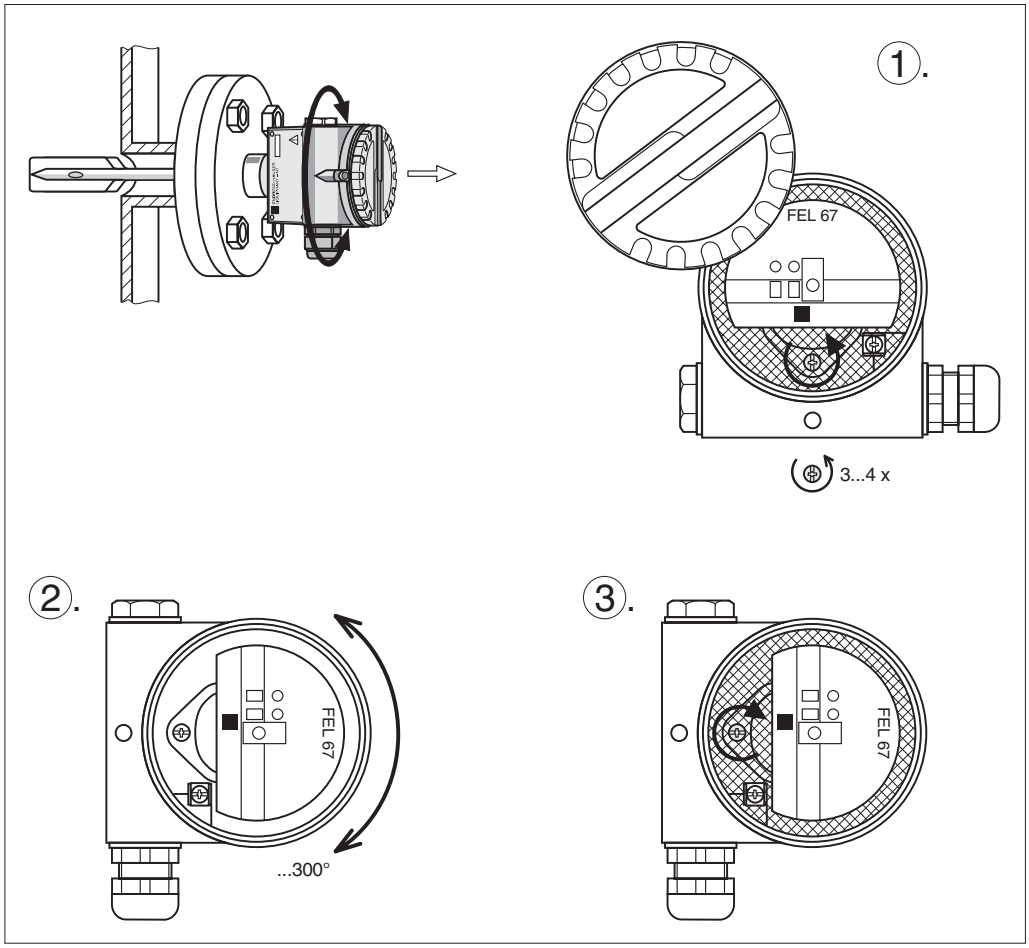


Fig. 16
Turning the housing

Sealing the Liquiphant S

Ensure that the housing cover and the cable glands are screwed in tightly so that no moisture can enter the connection compartment.
On delivery the O-ring in the housing cover and the aluminium thread have been lubricated.
Should this lubricant be removed, it must be replaced immediately with another, e.g. graphite or silicone, so that the cover can be sealed tightly and aluminium thread does not bind during tightening.
Do not use mineral oil based greases, these will destroy the O-ring!

Mounting the Liquiphant in the field:
Attach a weather-proof cover on the housing (Order No. 942262-0000).
It protects the electronics from excessive temperatures and from condensation which can occur with wide temperature variations in the housing.

4 Installing the Nivotester FTL 670

4.1 Installation hints

Installation and environmental conditions

The Nivotester FTL 670 Racksyst plug-in card must be installed outside the explosion hazardous area in a Monorack II housing or in an assembly rack.
A protective housing with IP 55 is available for mounting in the field, e.g. Monorack protective housing or Racksyst field housing.
See Section “Supplementary Documentation”.

The permitted ambient temperature is dependent on the type of installation.
Avoid aggressive atmospheres or excessive humidity which can lead to corrosion of contacts or condensation on the printed circuit board.

Installing the Liquiphant S in explosion hazardous areas

If the Liquiphant S is to be installed in an explosion hazardous area and the Nivotester in an assembly rack not supplied by Endress+Hauser, then a suitable female multipoint connector should be ordered for the Nivotester FTL 670.
(See Page 24, Accessories for the Nivotester FTL 670).
The connector is only partially fitted with connections, has an isolatiing cap for intrinsically safe signal cables and has the required creep and air gaps.
Also supplied are the required coding pins.
If no parts supplied by E+H are used, then local explosion protection regulations for installation and connection of the Nivotester must be strictly observed.

4.2 Mounting

Coding pins

Plug the coding pins into multipoint connector in the assembly rack or Monorack II housing at the positions indicated in Fig. 17.
The coding pins ensure that only a Nivotester FTL 670 can be plugged into this slot.
This prevents damage and faulty operation of your plant.

Slide the Nivotester into its slot only after the rack, field housing or Monorack II has been completely wired.

See section “Start-up”.

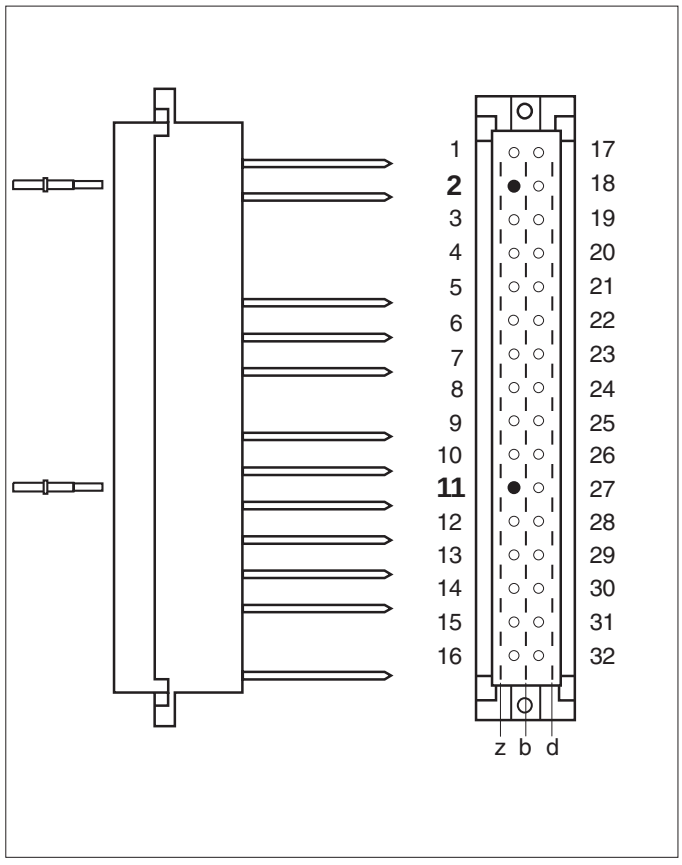


Fig. 17
Assigning the coding pins in the multipoint connector for the Nivotester FTL 670 level limit switch

left: side view

right: seen from the plug side of the multipoint connector

5 Connection

Tools

These depend on the type of multipoint connector used in the assembly rack.
Also required: usual tools for connecting electrical devices.

5.1 Connecting the Liquiphant S to the Nivotester

Normal operating conditions

- The two-wire connecting cable between the FEL 67 electronic insert in the Liquiphant S FDL 60 or FDL 61 and the Nivotester FTL 670 can be either standard unscreened or screened installation cable or two wires in a standard multicore cable. Cable diameter max. 2.5 mm^2 (wires with end sleeves). Cable resistance max. 25 Ω per wire.

- Observe all local regulations covering explosion protection when selecting, laying and grounding intrinsically safe signal cabling. Max. permissible values for capacitance and inductance are given in the certificate of conformity and in the Notes on Safety XA.

Voltage peaks and surges

If voltage peaks or surges are to be expected on the signal line, e.g., because it runs outdoors, we recommend that an overvoltage protector, e.g. HAW 262, be installed in the signal line immediately before both the Liquiphant and the Nivotester.
For connections, see the Technical Information sheet of the overvoltage protector.

5.2 Connecting signalling and control systems to the Nivotester FTL 670

Density setting

Caution!
A correct density setting is critical for operational safety.

- For liquefied gas with a density ρ of 0.44 (kg/l or g/cm^3) or more: do not short-circuit Terminals d 12 and d 14 of the Nivotester
- For liquids with a density ρ between 0.5 and 0.7 (kg/l or g/cm^3): do not short-circuit Terminals d 12 and d 14 of the Nivotester


Caution!

- For liquids with a density ρ greater than 0.7 (kg/l or g/cm^3), which is generally the case:
  connect a jumper between Terminals d 12 and d 14 of the Nivotester multipoint connector or Monorack II terminal strip.
  Short-circuiting the terminals ensures that the measuring system is more insensitive *to build-up of material*.

Switch off the power to the Nivotestor before changing the density setting!

Test (Reset)

A switch for remote control of the test procedure can be connected to Terminals z 12 and z 14 to run in parallel with the “Test” key on the front panel.
The test prodedure allows the entire measurement system, including all control and signalling systems to be checked.
The test procedure is also run on reset after correction of a fault.

Level alarm

The level alarm is fail-safe to Requirement Class AK 5, DIN V 19250 (corresponding to SIL 3 to IEC 61508).
If the level in the tank exceeds the limit, then the potential-free contact between Terminals d 18 and b 20 (fail-safe contact) opens.
The contact also opens on an instrument alarm or on loss of power.
Follow-up control devices should therefore be connected so that they are in the fail-safe position when this contact opens.

Instrument alarm

The potential-free contact between Terminals d 26 and b 28 is closed during normal operation. On an instrument alarm or loss of power:
- the contact between Terminals d 26 and b 28 opens,
- the contact between Terminals d 26 and z 26 closes.

Connect follow-up devices for fault indication as is usual in your plant.

Contact protection

The contact for level alarm is protected from welding on short-circuiting by a fine-wire fuse (3.15 A, slow-blow).
If a contact is also connected to a low-voltage circuit with safe isolation, then the relay contacts may have ratings as given in Chapter 9, Technical Data.

5.3 Power supply

Note the tolerances given in the technical data for direct voltage and residual ripple. These conditions are already satisfied if you install the Nivotester in the Monorack II or in an assembly rack with an Endress+Hauser power unit.
The Nivotester has polarity protection as well as a fine-wire fuse, so that there is no need to connect a fuse in the circuit.

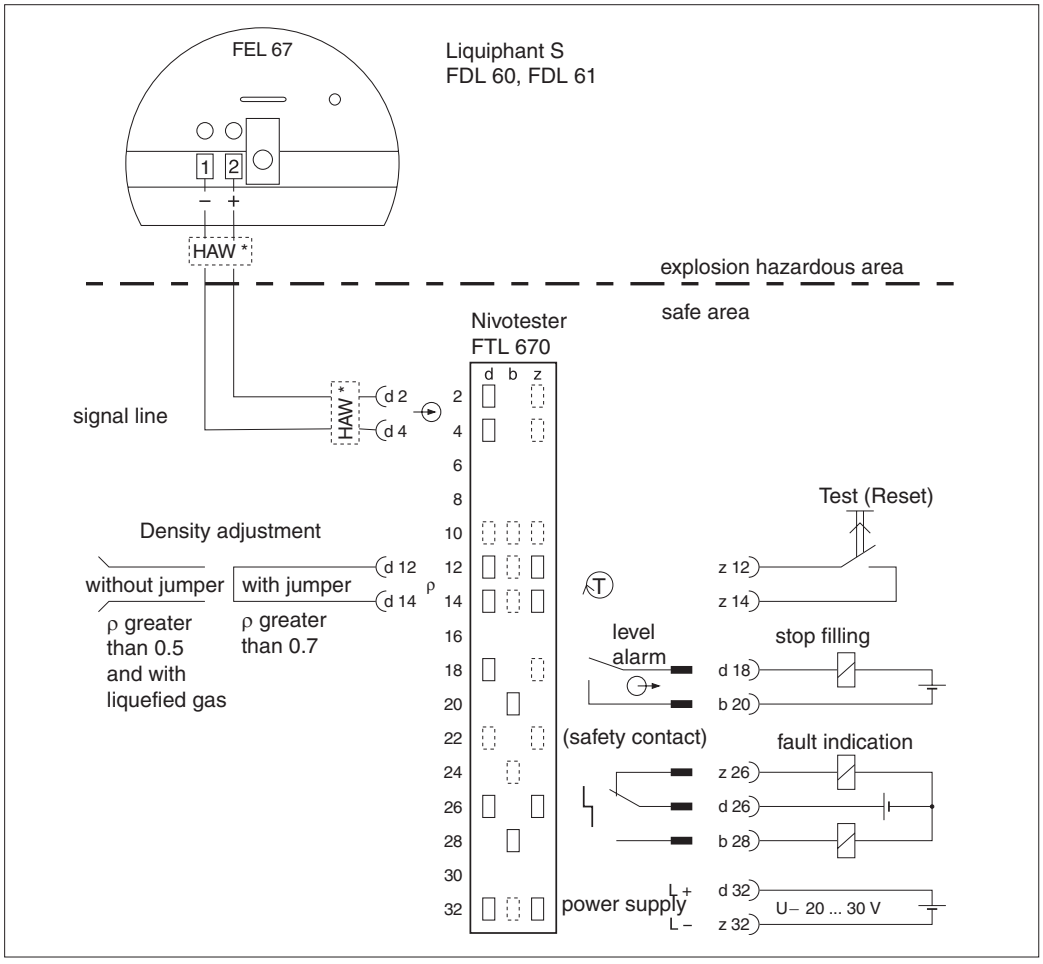


Fig. 18
Connection;
view of the connection side of the multipoint connector for the Nivotester FTL 670
** If required, overvoltage protection unit HAW 262*

6 Start-up

6.1 Installation and wiring check

- Check for correct installation of the Liquiphant S
  (tight fit to the process connection, tight fitting housing cover and cable glands).
- Check for correct wiring - *including density setting* -
  (at the Liquiphant S, the multipoint connector or the Monorack terminal block for the Nivotester and other devices).
- Check if the coding pins are correctly plugged into the multipoint connector of the Nivotester FTL 670.

6.2 Installing the Nivotester FTL 670

Unpacking


Caution!

Caution!
Electronic components on the circuit board can be damaged by electronic discharge.
If you pick up an electrostatic charge, e.g. by walking on insulated floors,
then this should first be discharged before unpacking the instrument.

Plugging into the rack

Ensure that the instrument is plugged into the correct slot in the assembly rack.
This is automatically the case if you have used multipoint connectors with coded pins.

6.3 Functional testing of the system

Self-testing

Switch on all power supplies.
A self-test procedure for the entire measuring line is automatically run on power up.
This test can be repeated by pressing the “Test” key on the Nivotester FTL 670.
The level alarm relay remains de-energised and the contact opens for as long as this key is pressed. After releasing the key, the self-test program is concluded, as shown in Fig. 18.

If the red “fault” LED lights up again, then see Section “Troubleshooting”.

Initial start-up

On initial start-up, you can check the function of the entire plant, by filling the tank to the limit value level.
Follow-up devices can be checked by simply pressing the “Test” key on the Nivotester FTL 670.

In Germany specific regulations are to be observed for checking the function of overspill protection. Note the appropriate instructions in the certificates.

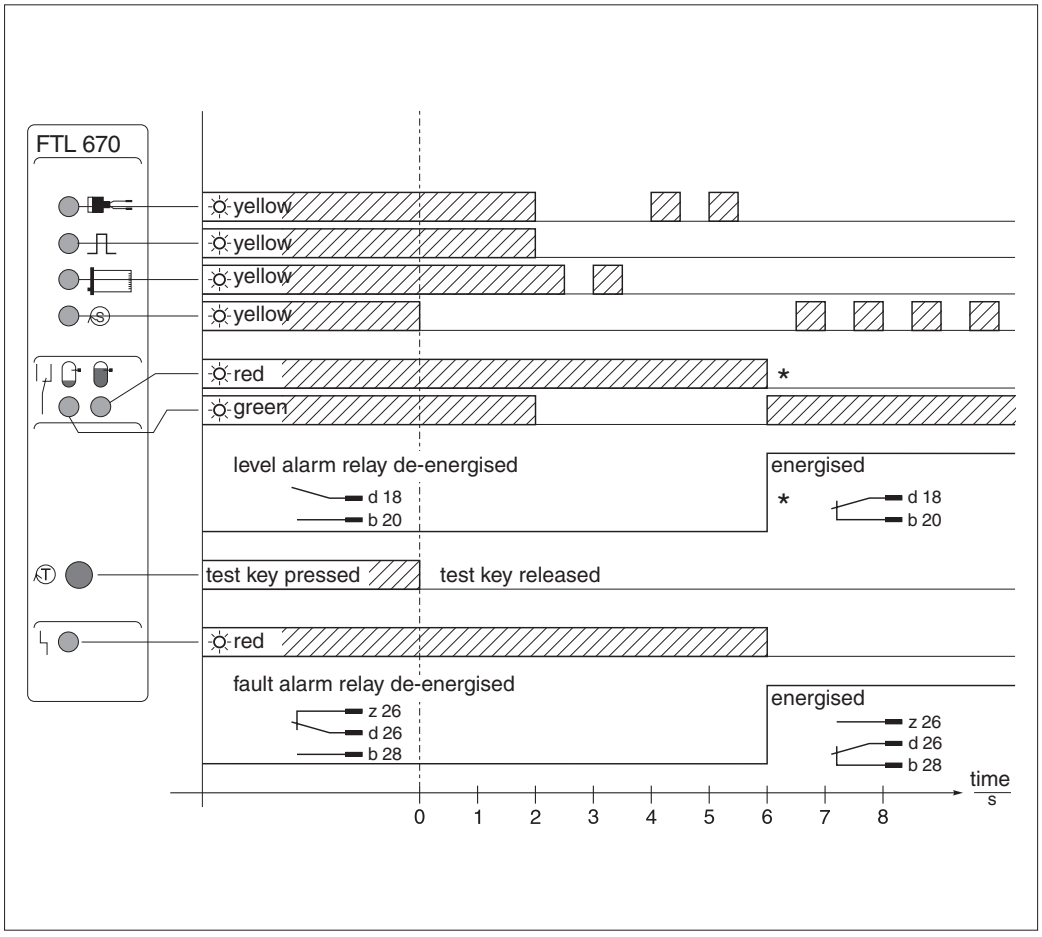


Fig. 19
Flow diagram of function test

** with covered fork (= level alarm) the red LED stays lit, the green stays unlit, the contact remains open*

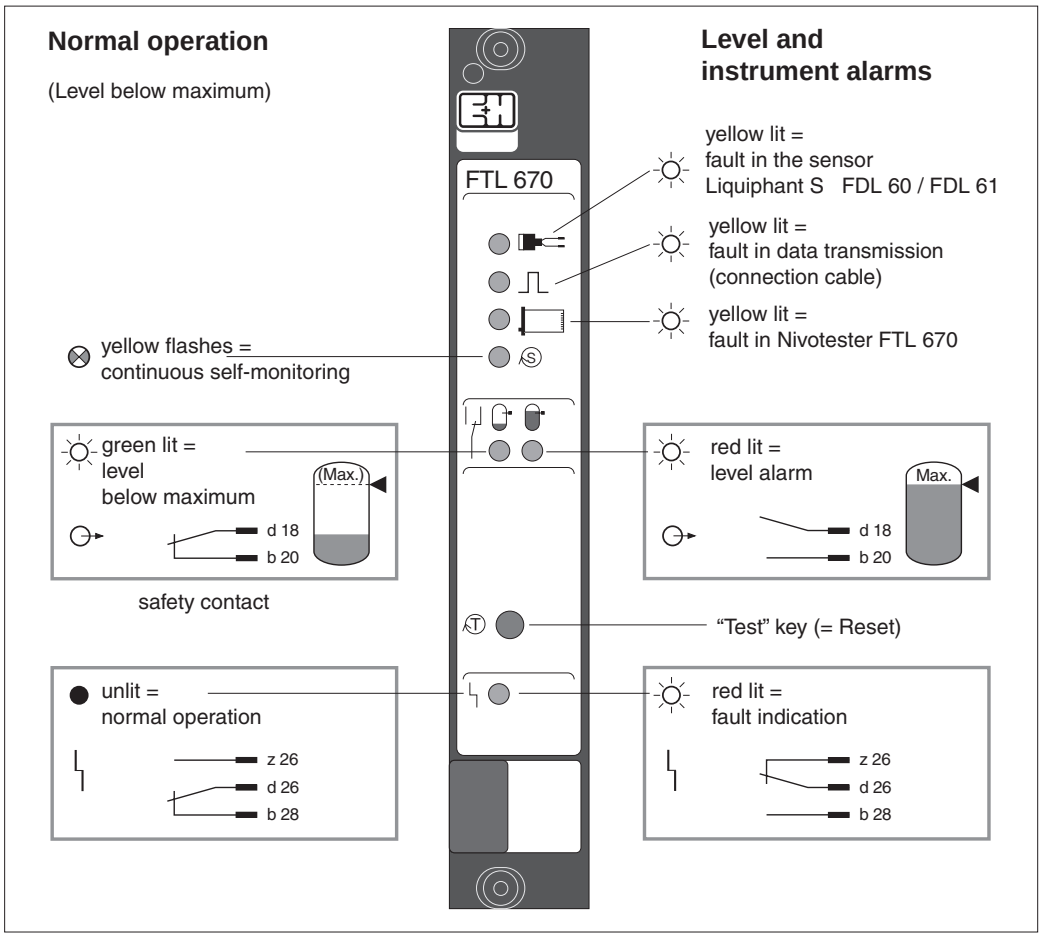


Fig. 20
Significance of the optical signals on the front panel of the Nivotester FTL 670

What to do in on an alarm is described in "Trouble-Shooting" on Page 21

6.4 Adjusting the switchpoint of a Liquiphant S FDL 61 with sliding sleeve

(Required only if the switchpoint was not adjusted when first mounted.)

Warning!
Danger: The Liquiphant S can be blown out of the sliding sleeve if the screws are loosened while the vessel is still under pressure.

Adjust the switchpoint only when you are sure that the tank is not under pressure!

Adjusting

- Fill the tank to the required limit.
- Ensure that the tank is *not under pressure*.
- Loosen the screws of the sliding sleeve.
- Slide the Liquiphant S far enough out of the tank for the fork to be free. The red LED for level alarm on the Nivotester FTL 670 goes out.
- Slide the Liquiphant slowly into the tank until the red LED for level alarm on the Nivotester FTL 670 lights up again.
- If residual flow and expansion of the liquid are also to be included in overspill protection, then push the Liquiphant S downwards by the required length.

Warning!
1. Danger: if the screws are not correctly tightened, the pressure in the vessel may blow out the Liquiphant.

2. Sealing: if the grub screws (4 AF Allen screws) in the hexagonal pressure screw *are too tight*, the extension pipe of the Liquiphant may be dented. Should the switchpoint be then altered (downwards), the packing of the sliding sleeve will no longer be pressure-tight.

Tightening

- Tighten the pressure screw of the sliding sleeve at the short 60 AF hexagonal nut with a torque of between 100 Nm and 120 Nm.
- Tighten the three grub screws (4 AF Allen screws) in the hexagonal nut of the pressure screw with a torque of between 17 Nm and 20 Nm.

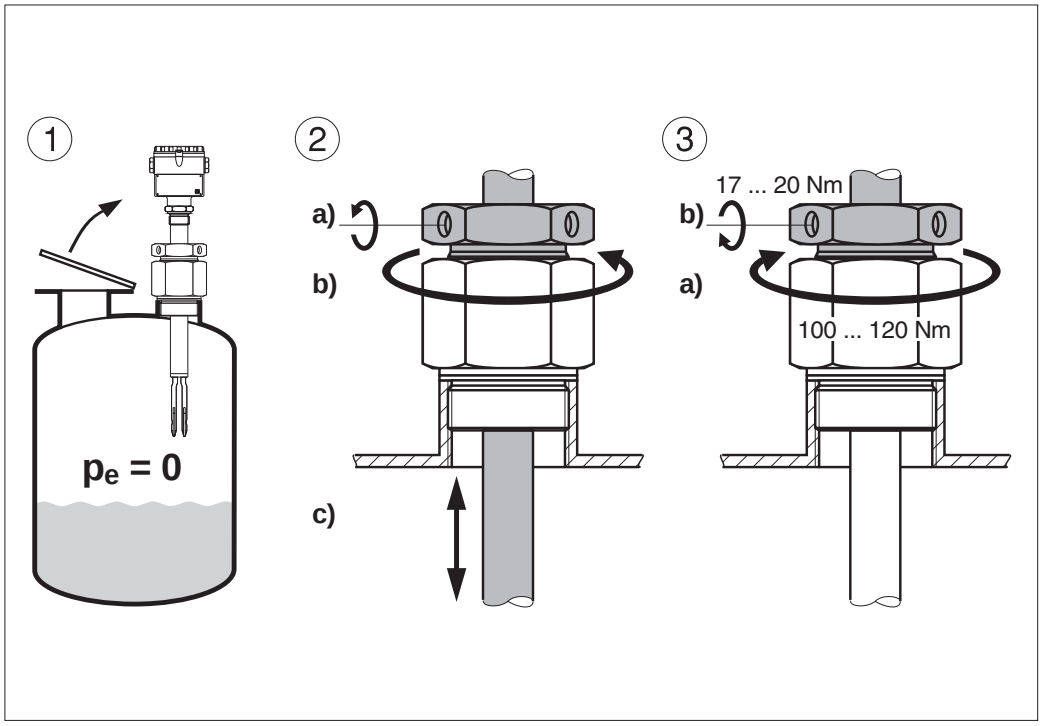


Fig. 21
Liquiphant S FDL 61
with sliding sleeve

Adjusting the switchpoint:
1) Release any pressure in tank
2) Loosen the screws in the sliding sleeve
3) Tighten the screws in the sliding sleeve correctly

7 Maintenance

Self-monitoring

The *"Liquiphant FailSafe"* measuring system consists of
- Liquiphant S FDL 60 or FDL 61 with the FEL 67 electronic insert,
- Nivotester FTL 670
- and signal transmission cabling

This system continuously monitors and immediately indicates any fault occurring.
Regular servicing is therefore not required.

Test

A function test of other devices can be carried out at any time by pressing the "Test" key.

Note!
The output relay and alarm relay are de-energised as long as the "Test" key is pressed and for an additional approx. 6 seconds.
This allows any follow-up devices to respond appropriately.


Note!

Checking or cleaning the tank

Caution!
The forks of the Liquiphant S can be damaged if they are used as handholds or footholds when inspecting the tank from the inside! (Fig. 22)


Caution!

If material built-up is found on the fork when the tank is cleaned it can be removed by using, e.g. a brush or solvents (Fig. 22 a).
Replace the fork if the Liquiphant S is damaged.

Check the Liquiphant S FDL 61 with sliding sleeve to ensure that the screws have been tightened to the correct torque.

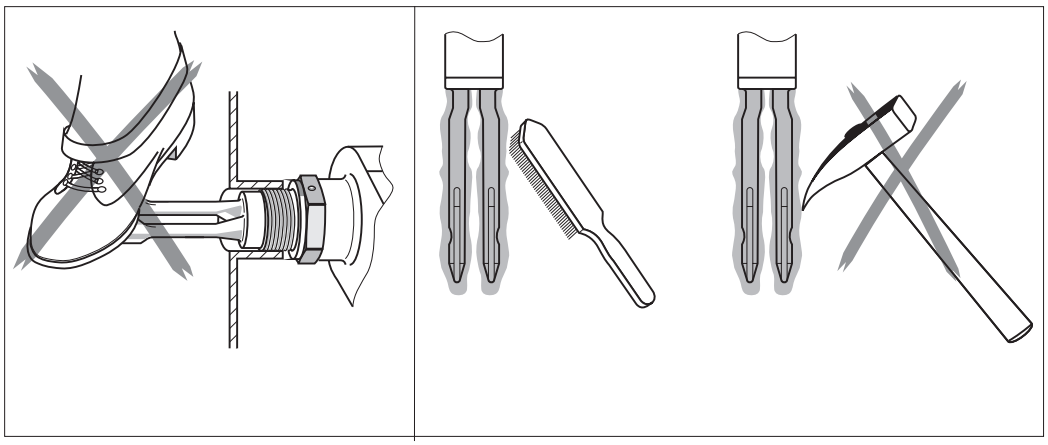


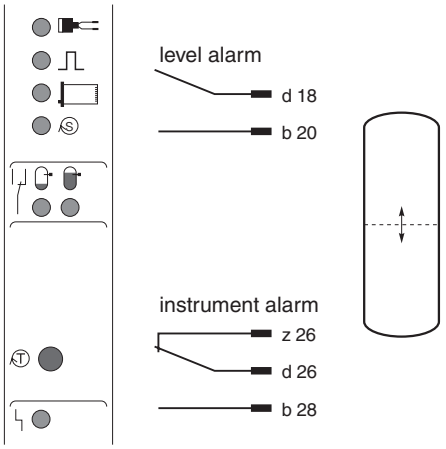
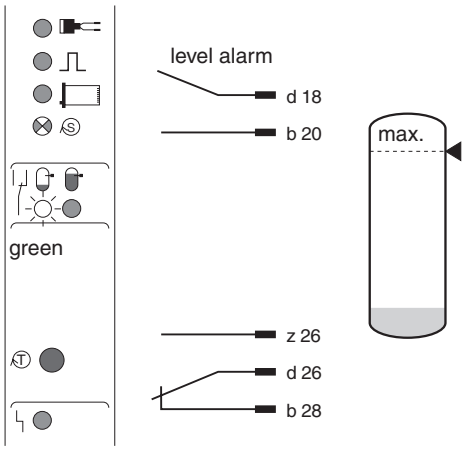
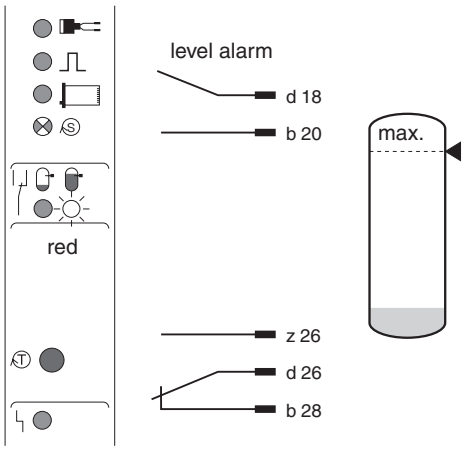
Fig. 22 (left)
Do not tread on the fork!

Fig. 22 a (right)
Clean the fork carefully!

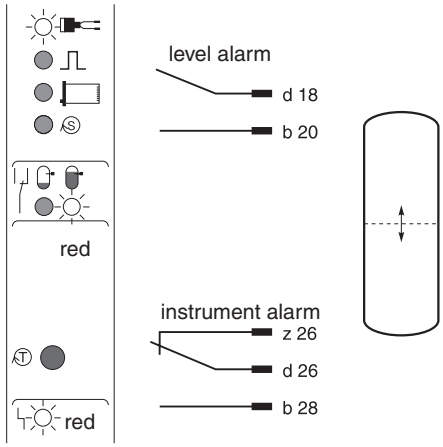
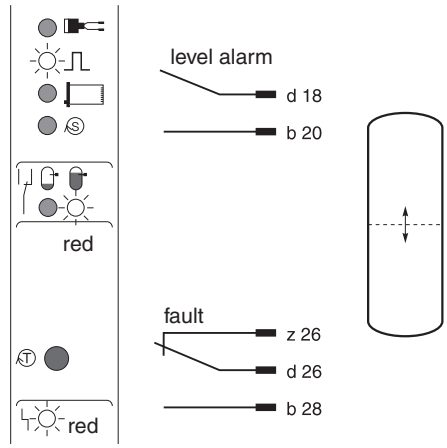
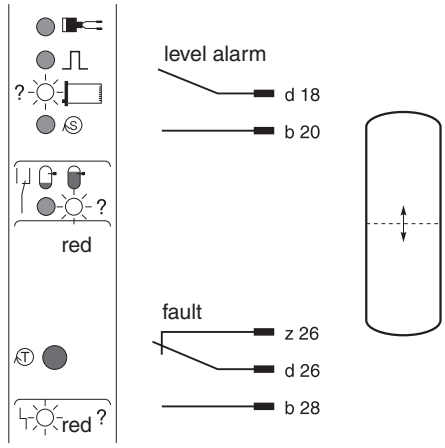
8 Trouble-Shooting

Every fault or incorrect functioning of the "Liquiphant FailSafe" measuring line causes the fail-safe level alarm circuit between Terminals d 18 and b 20 to open.
Alarms are also indicated by the optical signals on the front panel (see alarm table for exceptions).
The tables on the following pages will help in trouble-shooting.

8.1 Alarm table

FTL 670 / Contacts / Vessel	Alarm / display	Possible cause	Remedial action
	Level and instrument alarm no indication on the Nivotester FTL 670	Power failure (failure in power supply or power supply < 9 V)	Check power supply
		Defective fuse in power supply circuit of the FTL 670	Replace fuse 2; if fuse blows again, then replace FTL 670
	With display red on the FTL 670	Low power supply voltage (approx. 9 ... 19 V)	Check power supply
	Level alarm (contact open), but green LED still lit; max. limit level not reached	Defective fuse in level alarm circuit of the FTL 670	Look for fault in electrical circuits or other devices and replace Nivotester FTL 670 (all relay contacts must be checked).
	Level alarm, red LED lit, but max. limit not reached	Solid deposits on the fork tines	Free the fork
		Material does not flow off the mounting support	Free the fork; modify installation

LED out LED lit LED flashes

FTL 670 / Contacts / Vessel	Error function / Display	Possible cause	Remedial action
	Level alarm and instrument alarm, both red LEDs lit, yellow LED “FDL” lit	Fork damaged	Replace Liquiphant S (identical type, identical length); electronic insert can still be used.
		Housing cover or cable gland not sealed	Replace Liquiphant S (identical type, identical length); tighten seal
		Electronic insert FEL 67 defective	Replace FEL 67
	Level alarm and instrument alarm, both red LEDs lit, yellow LED “Signal” lit. (LED in Liquiphant S does not flash).	Connection cable broken or short-circuited	Check signal cabling between Liquiphant S and Nivotester
		Defective fuse in input circuit of the FTL 670	Replace fuse 1
		Defective input circuit of the FTL 670	Replace Nivotester FTL 670
	Level alarm and instrument alarm both red LEDs lit, yellow LED “FTL” lit	Nivotester FTL 670 defective	Replace Nivotester FTL 670

LED out LED lit LED flashes ? depending on alarm, also out

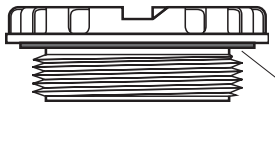
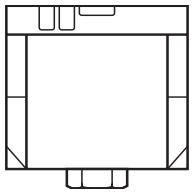
Checking

If an error has been remedied but the alarm is still present, then press the “Test” key. When the test run is carried out correctly, the measuring system is again fully operational.

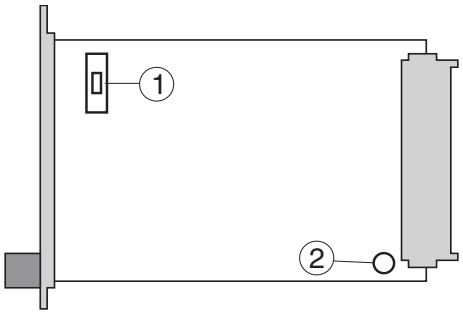
8.2 Spare parts and accessories

When replacing parts, observe all local regulations concerning overspill protection and explosion protection.
Parts may be replaced by authorised and trained personnel only.

Replacement parts for Liquiphant S FDL 60 and FDL 61

Diagram	Description	Order No.
	Cover for aluminium housing	19278-0000
	Cover for plastic housing	919229-0000
	Transparent cover for plastic housing	919229-0001
	O-ring 73 x 3 (the O-ring must be lubricated)	014850-0000
	Plug-in electronic insert FEL 67 (is secured by central screw in housing)	919908-0067

Replacement parts for Nivotester

Diagram	Description	Order No.
	1) Fuse in input circuit 50 mA, slow-blow	013499-0000
	2) Fuse in power supply circuit 1 A, slow-blow	016110-0000
	Complete plug-in card Nivotester FTL 670	016501-0040

Accessories for Nivotester FTL 670:

Plug-in point kit 25/2,
consists of the multipoint connector, coding pins, isolating cap, guide rails

Connection:	Order No.:
Wire-wrap 1 x 1	918365-2500
Solder connection	918365-2530
Maxi-Termipoint 2.4 x 0.8	918365-2520
Mini-Termipoint 1.6 x 0.8	918365-2510

Other Accessories

See Section on “Supplementary Documentation”
for the Nivotester FTL 670 and Liquiphant S FDL 60, FDL 61.

8.3 Returning for repair

When returning a Liquiphant S FDL 60 or FDL 61 to Endress+Hauser for repair, please note the following:

Cleaning

Remove all residue which may be present.
This is especially important if the medium is dangerous to health, e.g. corrosive, poisonous, carcinogenic, radioactive, etc.
No instrument should be returned to us without first completely removing all dangerous material as it can, e.g. penetrate into scratches or diffuse through plastic.

Information on material and its defect

Please enclose with the instrument:
- an exact description of the material in which the Liquiphant was used
- a description of the properties of the material
- a brief description of the fault.

This information enables us to diagnose the error and therefore reduce your costs.

When sending back a Nivotester FTL 670 for repair, a description of the fault is sufficient.

Thank you for your co-operation.

8.4 Disposal

Packaging

All sales and transportation packaging used by Endress+Hauser complies with the German packaging regulations covering its re-use and recycling.

Instruments

For a small charge, Endress+Hauser will accept all instruments originally produced by its product centres for recycling as specified by German regulations on the disposal of electronic waste.
Before returning, please carefully remove any residue from the sensors if the material is dangerous to health.
Delivery, carriage paid, to Endress+Hauser, Hauptstraße 1, 79689 Maulburg, Germany.

9 Technical Data

Operational safety of the measuring system

- Error safety: AK 5 to DIN V 19250 (corresponding to SIL 3 to IEC 61508).
- Electromagnetic Compatibility:
  Interference Emission to EN 61326; Electrical Equipment Class B
  Interference Immunity to EN 61326; Annex A (Industrial) and
  NAMUR Recommendation NE 21 (EMC).
  For general information on EMC (test procedures, installation hints)
  see TI 241F/00/en.
- See certificates for further information

9.1 Liquiphant S FDL 60, FDL 61

Product structure for Liquiphant S FDL 60

FDL 60 **Compact version**

Certificate

B	ATEX II 1/2 G, EEx ia IIC T6, VdTÜV100 (Liquified gas)
F	ATEX II 1/2 G, EEx ia IIC T6, overspill protection to WHG
G	ATEX II 1/2 G, EEx ia IIC T6
R	For non-hazardous areas
Y	Special version

Process connection, material

GN2	1" NPT,	Thread	ANSI,	316Ti
GN5	1" NPT,	Thread	ANSI,	Alloy C
GR2	G 1 A,	Thread	ISO228,	316Ti
GR5	G 1 A,	Thread	ISO228,	Alloy C
ME2	DN 50, PN 25, Hygienic connection		DIN11851,	316Ti
TE2	DN 40-51 (2"), Tri-Clamp connection		ISO2852,	316Ti
. . .	Flange see table on page 28			
YY9	Special version			

Fork surface finish

A	Standard finish, Ra < 3,2 µm / 80 grid
B	Polished version, Ra < 1,5 µm / 120 grid
Y	Special version

Electronic insert

7	FEL 67, 2-wire PFM transmission
9	Special version

Housing

K	Polyester F10, IP66, Pg 16 entry
L	Polyester F16, IP66, NPT ½" entry
M	Polyester F10, IP66, G ½" entry
O	Polyester F10, IP66, M20 gland
P	Polyester F10, IP66, HNA24x1,5 gland
T	Aluminium F6, IP66, NPT ½" entry
U	Aluminium F6, IP66, G ½" entry
V	Aluminium F6, IP66, M20 gland
W	Aluminium F6, IP66, HNA24x1,5 gland
Y	Special version

FDL 60 –				7	

Product designation on the nameplate

Complete product structure for FDL 60

Extract for use in liquefied gases see Page 34

Product structure for Liquiphant S FDL 61

FDL 61 **Version with extension tube**

Certificate

B	ATEX II 1/2 G, EEx ia IIC T6, VdTÜV100 (Liquified gas)
F	ATEX II 1/2 G, EEx ia IIC T6, overspill protection to WHG
G	ATEX II 1/2 G, EEx ia IIC T6
R	For non-hazardous areas
Y	Special version

Process connection, material

GN2	1" NPT,	Thread	ANSI,	316Ti
GN5	1" NPT,	Thread	ANSI,	Alloy C
GR2	G 1 A,	Thread	ISO228,	316Ti
GR5	G 1 A,	Thread	ISO228,	Alloy C
ME2	DN 50, PN 25, Hygienic connection		DIN11851,	316Ti
SN2	1 ½" NPT, Thread sliding sleeve		ANSI,	316Ti
SN5	1 ½" NPT, Thread sliding sleeve		ANSI,	Alloy C
SR2	G 1½ A, Thread sliding sleeve		ISO228,	316Ti
SR5	G 1½ A, Thread sliding sleeve		ISO228,	Alloy C
TE2	DN 40-51 (2"), Tri-Clamp connection		ISO2852,	316Ti
. . .	Flange see table on page 28			
YY9	Special version			

Fork surface finish

A	Standard finish, Ra < 3,2 µm / 80 grid
B	Polished version, Ra < 1,5 µm / 120 grid
Y	Special version

Probe length, material

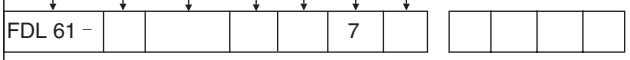
A	.....mm (220 mm...6000 mm),	316Ti
C	.....mm (220 mm...6000 mm),	Alloy C
G	.....mm (220 mm...6000 mm),	316Ti polished, Ra < 1,5 µm
Y	Special version	
1	.....inch (8,7 in...236,2 in),	316Ti
3	.....inch (8,7 in...236,2 in),	Alloy C
4	.....inch (8,7 in...236,2 in),	316Ti polished, Ra < 1,5 µm

Electronic insert

7	FEL 67, 2-wire PFM transmission
9	Special version

Housing

K	Polyester F10, IP66, Pg 16 entry
L	Polyester F16, IP66, NPT ½" entry
M	Polyester F10, IP66, G ½" entry
O	Polyester F10, IP66, M20 gland
P	Polyester F10, IP66, HNA24x1,5 gland
T	Aluminium F6, IP66, NPT ½" entry
U	Aluminium F6, IP66, G ½" entry
V	Aluminium F6, IP66, M20 gland
W	Aluminium F6, IP66, HNA24x1,5 gland
Y	Special version



Product designation on the nameplate

Length in mm
for production tolerances of length
see Fig. 25, Page 31

Complete product structure for FDL 61

Extract for use in liquefied gases see Page 34

Flanges for Liquiphant S FDL 60, FDL 61

Process connection, material (continued)

AA2	1 ¼“,	150 lbs,	RF,	ANSI B16.5,	316Ti
AC2	1 ½“,	150 lbs,	RF,	ANSI B16.5,	316Ti
AE2	2",	150 lbs,	RF,	ANSI B16.5,	316Ti
AE5	2",	150 lbs,		ANSI B16.5,	Alloy C >316Ti
AG2	2",	300 lbs,	RF,	ANSI B16.5,	316Ti
AG5	2",	300 lbs,		ANSI B16.5,	Alloy C >316Ti
AK2	2 ½“,	300 lbs,	RF,	ANSI B16.5,	316Ti
AL2	3",	150 lbs,	RF,	ANSI B16.5,	316Ti
AN2	3",	300 lbs,	RF,	ANSI B16.5,	316Ti
AP2	4",	150 lbs,	RF,	ANSI B16.5,	316Ti
AR2	4",	300 lbs,	RF,	ANSI B16.5,	316Ti
AV2	6",	150 lbs,	RF,	ANSI B16.5,	316Ti
A12	6",	300 lbs,	RF,	ANSI B16.5,	316Ti
BA2	DN 32,	PN 6 B,		DIN 2527,	316Ti
BB2	DN 32,	PN 25/40 B,		DIN 2527,	316Ti
BC2	DN 40,	PN 6 B,		DIN 2527,	316Ti
BD2	DN 40,	PN 25/40 B,		DIN 2527,	316Ti
BE2	DN 50,	PN 6 B,		DIN 2527,	316Ti
BG2	DN 50,	PN 25/40 B,		DIN 2527,	316Ti
BK2	DN 65,	PN 25/40 B,		DIN 2527,	316Ti
BM2	DN 80,	PN 10/16 B,		DIN 2527,	316Ti
BN2	DN 80,	PN 25/40 B,		DIN 2527,	316Ti
BQ2	DN 100,	PN 10/16 B,		DIN 2527,	316Ti
BR2	DN 100,	PN 25/40 B,		DIN 2527,	316Ti
CA5	DN 32,	PN 6,		DIN 2527,	Alloy C >316Ti
CE5	DN 50,	PN 6,		DIN 2527,	Alloy C >316L
CG2	DN 50,	PN 25/40 C,		DIN 2527,	316Ti
CG5	DN 50,	PN 25/40,		DIN 2527,	Alloy C >316Ti
CN2	DN 80,	PN 25/40 C,		DIN 2527,	316Ti
CN5	DN 80,	PN 25/40,		DIN 2527,	Alloy C >316L
CQ2	DN 100,	PN 10/16 C,		DIN 2527,	316Ti
CQ5	DN 100,	PN 10/16,		DIN 2527,	Alloy C >316Ti
CR2	DN 100,	PN 25/40 C,		DIN 2527,	316Ti
FG2	DN 50,	PN 40 F,		DIN 2512,	316Ti
FN2	DN 80,	PN 40 F,		DIN 2512,	316Ti
FR2	DN 100,	PN 40 F,		DIN 2512,	316Ti
KE2	10 K 50A,		RF,	JIS B2210,	316Ti
KE5	10 K 50A,			JIS B2210,	Alloy C >316Ti
NG2	DN 50,	PN 40 N,		DIN 2512,	316Ti
NN2	DN 80,	PN 40 N,		DIN 2512,	316Ti
NR2	DN 100,	PN 40 N,		DIN 2512,	316Ti
YY9	Special version				

Complete product structure for flanges

Extract for use in liquefied gases
see Page 34

Operating Data

- Operating temperature and pressure: see Fig. 23
- Ambient temperature for housing: see Fig. 24
- Climatic class to DIN 40040: GSD
- Viscosity ν of product: max. 10 000 mm^2/s
- Minimum density ρ of liquid: 0.5, switchable to 0.7
- Minimum density ρ of a liquefied gas to DIN 51622: 0.44
- Switching hysteresis: approx. 5 mm,
  (density range 0.5 = without jumper, density of material 0.5
  or density range 0.7 = with jumper, density of material 1.0)
- Switching delay (entire measuring system):
  with fork covered approx. 0.5 s
  with fork uncovered approx. 1 s
  on alarm: max. 3 s safety time
- Function indication: flashing green LED on integral electronic insert

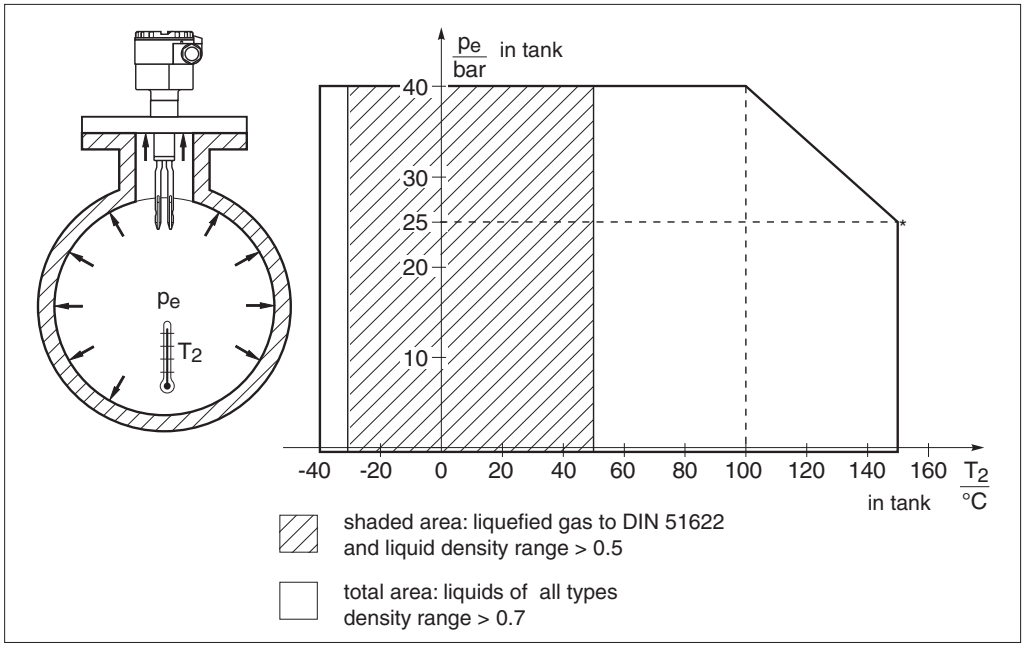


Fig. 23
The maximum permissible pressure in the vessel p_e is a function of the medium and the temperature T_2 in the tank

** maximum pressure for FDL 61 with sliding sleeve: 25 bar*

1 bar = 14.5 psi
x°C = (1.8 · x + 32)°F

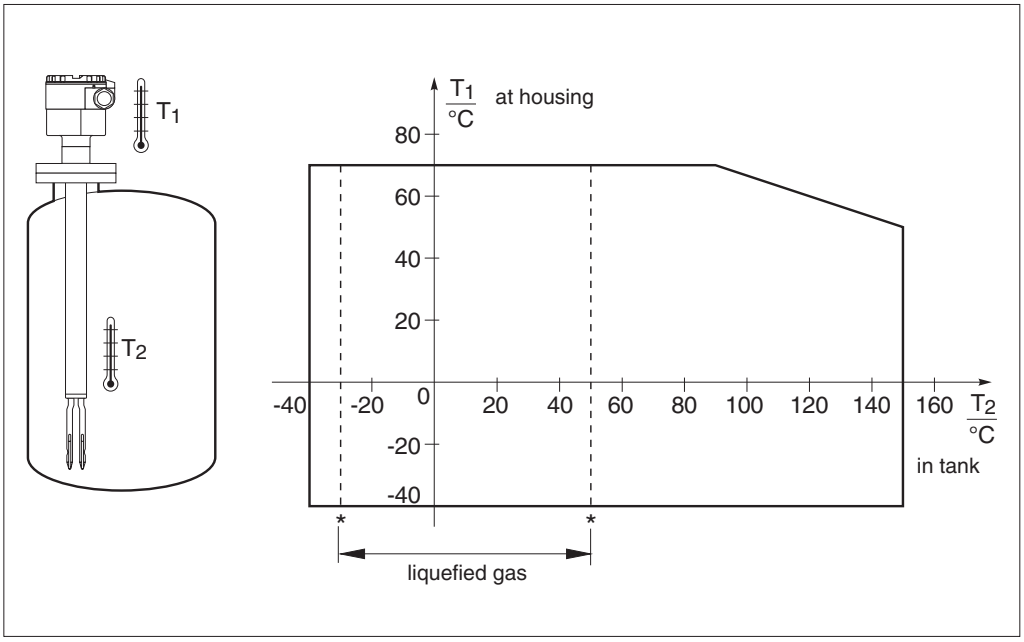


Fig. 24
The maximum permissible temperature T_1 at the housing is a function of the operating temperature T_2 in the tank.

** limit values for liquefied gas to DIN 51622*

Material

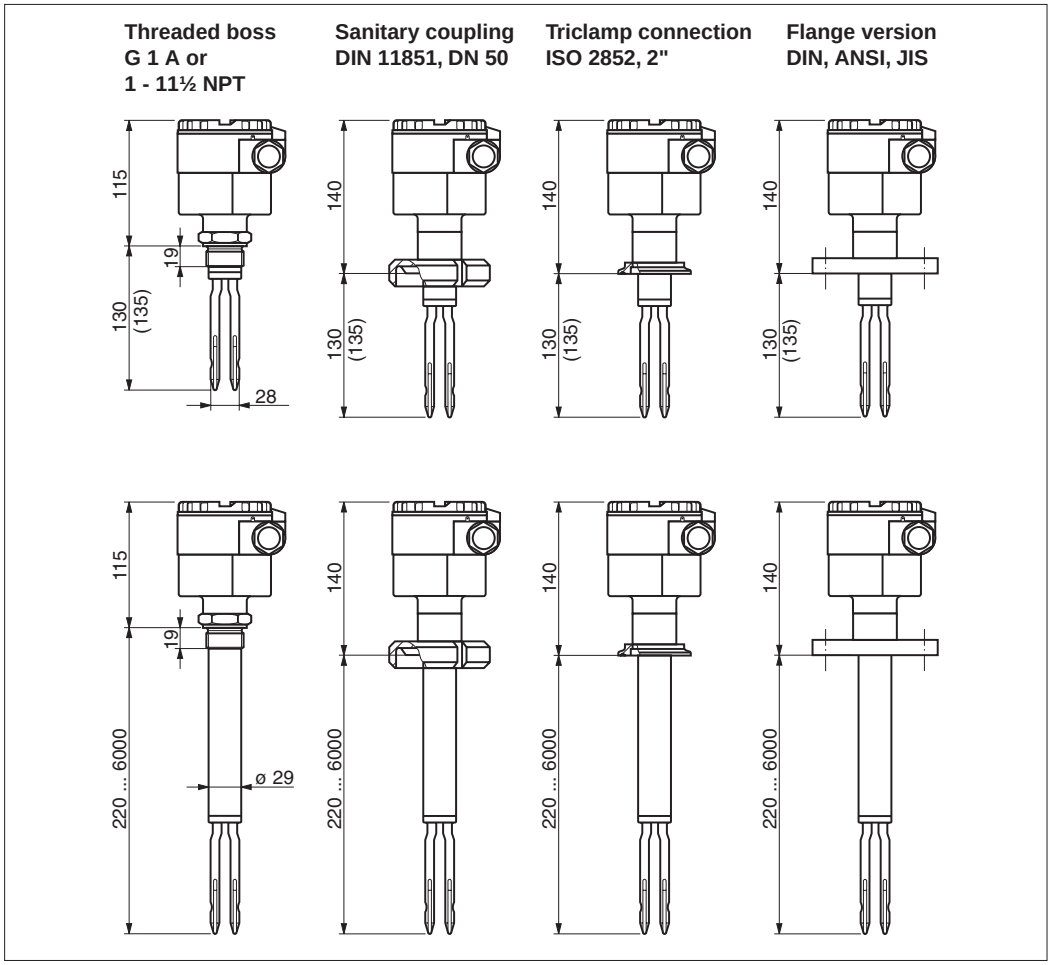
- Process connection and fork: see Product Summary
- Aluminium housing: GD-Al Si 12 Mg, DIN 1725, with blue plastic coating
- Plastic housing: fibre-glass reinforced polyester (blue)
- Seal for housing cover: O-ring in EPDM (elastomer)
- Cable gland IP66 for cable entry Pg 16: polyamide with neoprene CR seal for cable diameters 5 ... 12 mm
- Sealing ring for process connection G 1: elastomer-thread, asbestos-free, resistant to oils, solvents, steam, weak acids and lyes
- Packing of pressure screw in sliding sleeve: graphite

Process connection standards

- Parallel thread G 1 A: DIN ISO 228/I, with flat gasket ring 33 x 39 to DIN 7603
- Parallel thread G 1½ A (sliding sleeve): DIN ISO 228/I, with flat gasket ring 48 x 55 to DIN 7603
- Tapered thread 1 - 11½ NPT: ANSI B 1.20.1
- Tapered thread 1½ - 11½ NPT (sliding sleeve): ANSI B 1.20.1
- DIN flanges: see table
- ANSI flanges: ANSI B 16.5
- JIS flanges: JIS B 2210 (RF)
- Triclamp connection 2": ISO 2852
- sanitary coupling DN 50: DIN 11851

Electronics

- Integrated electronic insert: FEL 67, plug-in, replaceable without calibration
- Switching unit: Nivotester FTL 670
- Connection: two-wire cable, max. 25 Ω per wire
- Connection terminals: for max. 2.5 mm^2 strands with end sleeves A 2.5 - 7 to DIN 46228
- Power supply from Nivotester
- Polarity protection: integrated
- Signal transmission: PFM; current pulses superimposed on base current from Nivotester
- Function indication: green LED flashes during self-checking procedure



Dimensions

Dimensions in mm
100 mm = 3.94 “
1" = 25.4 mm

Fig. 25
Dimensions of
the Liquiphant S sensor;

Production tolerances of length

length	tolerances	
up to 1 m	+0 mm,	-7 mm
up to 3 m	+0 mm	-10 mm
up to 6 m	+0 mm	-20 mm

NPT-thread:

length	tolerances	
up to 1 m	+2 mm,	-7 mm
up to 3 m	+2 mm,	-10 mm
up to 6 m	+2 mm,	-20 mm

top row: FDL 60

(dimensions in brackets for version with Alloy fork)

bottom row FDL 61

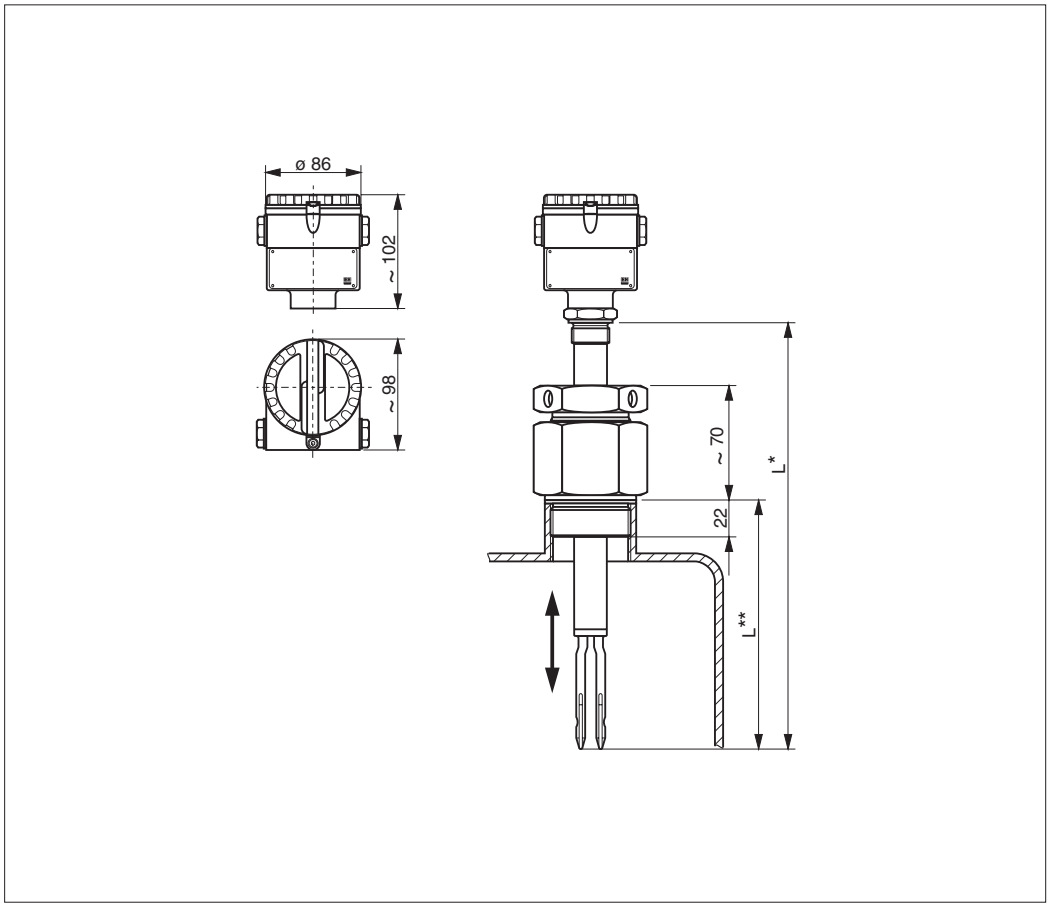


Fig. 26
left: dimensions of housing

right: FDL 61 with sliding sleeve

For applications
ElexV (Germany):
L min. 320 mm*
*L** min. 220 mm*

9.2 Nivotester FTL 670

Product designation

The product designation for the standard version is: FTL 670.

Construction

- Racksyst plug-in board: DIN 41494, d = 160 mm, h = 100 mm (Eurocard format)
- Front panel: black plastic with embossed blue field, handle and tag field
- Width: 4 HP (20.3 mm)
- Height: 3 VP (128.4 mm)
- Plug connection: multipoint connector to DIN 41612, Part 3, Type F, (reduced) 25-pole assembly for “Monorack II” (“Racksyst II”)
- Coding holes in the multipoint connector: Pos. 2 and 11
- Protection to DIN 40050: Front panel IP20, plug-in board IP00
- Weight: 200 g

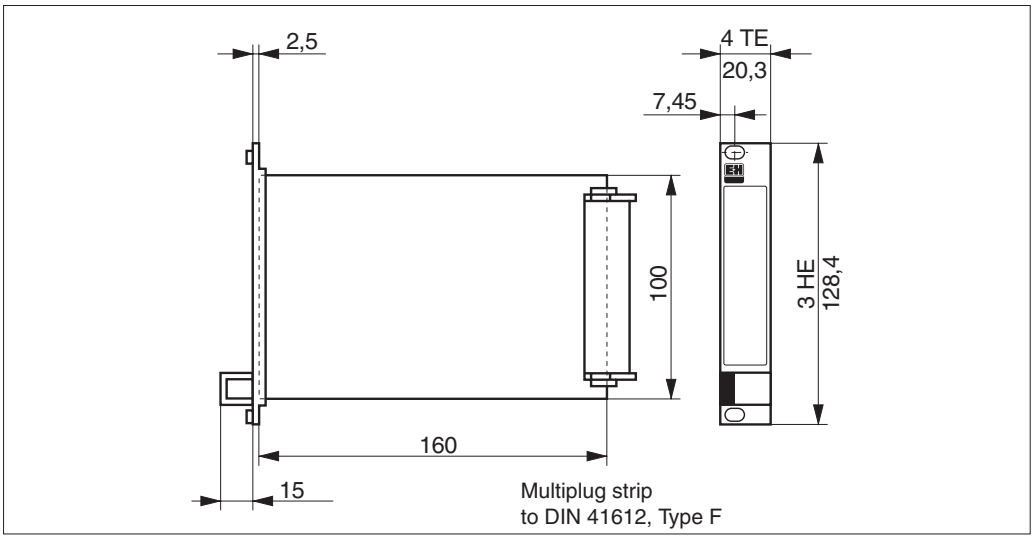


Fig. 27
Dimensions of Racksyst
Plug-in board Nivotester FTL 670

Operating data

- Permissible ambient temperatures:
  - Nominal operating range: -25 °C ... +70 °C (-10 °F ... +160 °F)
  - Storage: -40 °C ... +85 °C
- Climatic class to DIN 40040: HSE

Power supply

- DC voltage: 24 V (20 ... 30 V)
  Permissible residual ripple within tolerance: $U_{pp} < 2$ V
- Current consumption: max. 105 mA
  Power consumption at 24 V: max. 2.5 W
  Power consumption at 30 V: max. 3.2 W
- Fine-wire fuse and polarity protection: integrated

Signal Input

- Input FTL 670: electrically isolated from other circuits
- Sensors: Liquiphant S FDL 60, FDL 61
  with electronic insert FEL 67
- Power supply for sensor: from the Nivotester
  - voltage: 10.5 ... 12.5 V
  - base current: approx. 7 ... 11 mA
- Connection cable: two-wire, screening not required
- Cable resistance: max. 25 Ω per wire
- Signal transmission: Pulse Frequency Modulation
  - frequency range: 120 ...450 Hz
  - pulse current: approx. 16 ... 23 mA, superimposed on base current
- Spark protection: intrinsic safety [EEx ia] IIC, ATEX II (1) G, [EEx ia] IIC
  Further information: see certificates and Notes on Safety XA

Output

- Instrument alarm: one relay with a potential-free change-over contact
- Level alarm: three relays each with one potential-free contact connected in series
- Fail-safe circuit for level alarm: maximum fail-safe
- Switching delay (entire measuring system):
  with fork covered approx. 0.5 s
  with fork uncovered approx. 1 s
  with fault occurring: max. 3 s safety time
- Switching capacity of relay contacts:
  - with AC current max. 230 V, max. 2.5 A, max. 600 VA at cos φ = 1,
    max. 300 VA at cos φ ≥ 0,7
  - with DC current max. 120 V, max. 2.5 A, max. 75 W
- Simultaneous connection to low voltage circuits to DIN VDE 0160/5.88,
  Section 5.5.2.1: up to a max. switching consumption of the relay contacts
- Function and alarm indicators on front panel: 7 LEDs

10 Liquefied Gas - Special Instructions

Product structure

Compare the product designation on the nameplate of the Liquiphant S sensor with the following product structure. If the designation begins with FDL60-**B**... or FDL61-**B**... then the instrument may be used for liquefied gas.

Product structure for Liquiphant S FDL 60, FDL 61

FDL 60 **Compact version**
FDL 61 **Version with extension tube**

Certificate

B ATEX II 1/2 G, EEx ia IIC T6, VdTÜV100 (Liquified gas)

Process connection, material

AG2	2",	300 lbs,	RF,	ANSI B16.5,	316Ti
AK2	2 ½“,	300 lbs,	RF,	ANSI B16.5,	316Ti
AN2	3",	300 lbs,	RF,	ANSI B16.5,	316Ti
AP2	4",	150 lbs,	RF,	ANSI B16.5,	316Ti
AR2	4",	300 lbs,	RF,	ANSI B16.5,	316Ti
A12	6",	300 lbs,	RF,	ANSI B16.5,	316Ti
BB2	DN 32,	PN 25/40 B,		DIN 2527,	316Ti
BD2	DN 40,	PN 25/40 B,		DIN 2527,	316Ti
BG2	DN 50,	PN 25/40 B,		DIN 2527,	316Ti
BK2	DN 65,	PN 25/40 B,		DIN 2527,	316Ti
BN2	DN 80,	PN 25/40 B,		DIN 2527,	316Ti
BR2	DN 100,	PN 25/40 B,		DIN 2527,	316Ti
CG2	DN 50,	PN 25/40 C,		DIN 2527,	316Ti
CN2	DN 80,	PN 25/40 C,		DIN 2527,	316Ti
CR2	DN 100,	PN 25/40 C,		DIN 2527,	316Ti
FG2	DN 50,	PN 40 F,		DIN 2512,	316Ti
FN2	DN 80,	PN 40 F,		DIN 2512,	316Ti
FR2	DN 100,	PN 40 F,		DIN 2512,	316Ti
GN2	1” NPT,	Thread		ANSI,	316Ti
GR2	G 1 A,	Thread		ISO228,	316Ti
NG2	DN 50,	PN 40 N,		DIN 2512,	316Ti
NN2	DN 80,	PN 40 N,		DIN 2512,	316Ti
NR2	DN 100,	PN 40 N,		DIN 2512,	316Ti

Fork surface finish

A Standard finish, Ra < 3,2 µm / 80 grid

Probe length, material

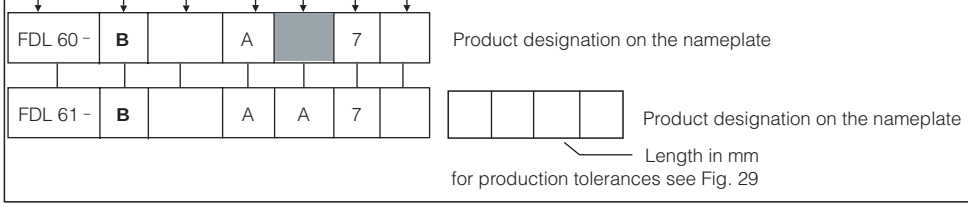
A	.....mm (220 mm...6000 mm),	316Ti
G	.....mm (220 mm...6000 mm),	316Ti polished, Ra < 1,5 µm
1	.....inch (8,7 in...236,2 in),	316Ti
4	.....inch (8,7 in...236,2 in),	316Ti polished, Ra < 1,5 µm

Electronic insert

7 FEL 67, 2-wire PFM transmission

Housing

K	Polyester F10, IP66, Pg 16 entry
L	Polyester F16, IP66, NPT ½” entry
M	Polyester F10, IP66, G ½“ entry
O	Polyester F10, IP66, M20 gland
P	Polyester F10, IP66, HNA24x1,5 gland
T	Aluminium F6, IP66, NPT ½” entry
U	Aluminium F6, IP66, G ½“ entry
V	Aluminium F6, IP66, M20 gland
W	Aluminium F6, IP66, HNA24x1,5 gland



Product structure for FDL 60 and FDL 61

Extract for use in liquified gases

Application

Liquefied gas to DIN 51622 with a density r of min. 0.44 (kg/l or g/cm³); temperature and pressure range see Fig. 28

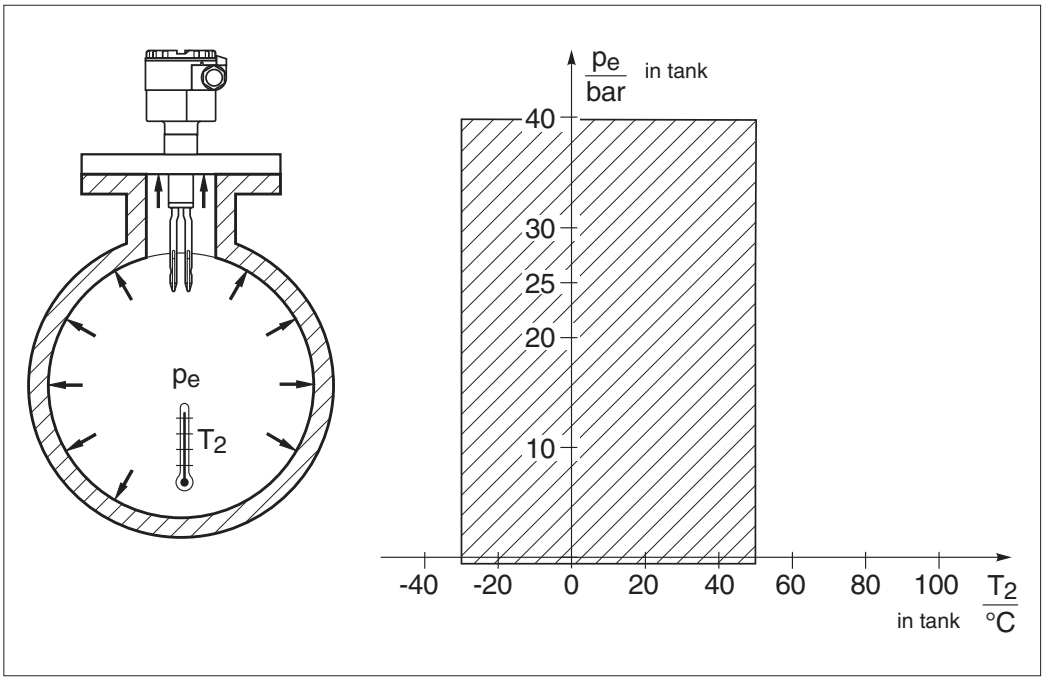


Fig. 28
The maximum permissible pressure in the vessel p_e is a function of the temperature T_2 in the tank
1 bar = 14.5 psi
x°C = (1.8 · x + 32)°F

Technical data

Switching delay (entire measuring system):
- with fork covered: approx. 0.5 s
- with fork uncovered: approx. 1 s
- on alarm: max. 3 s fail-safe response time

Installation

Note the appropriate standards for determining the maximum limit for overspill protection of a tank containing liquefied gas. When determining the switchpoint take into consideration all component tolerances, accessories and switchpoint deviations due to operating conditions.

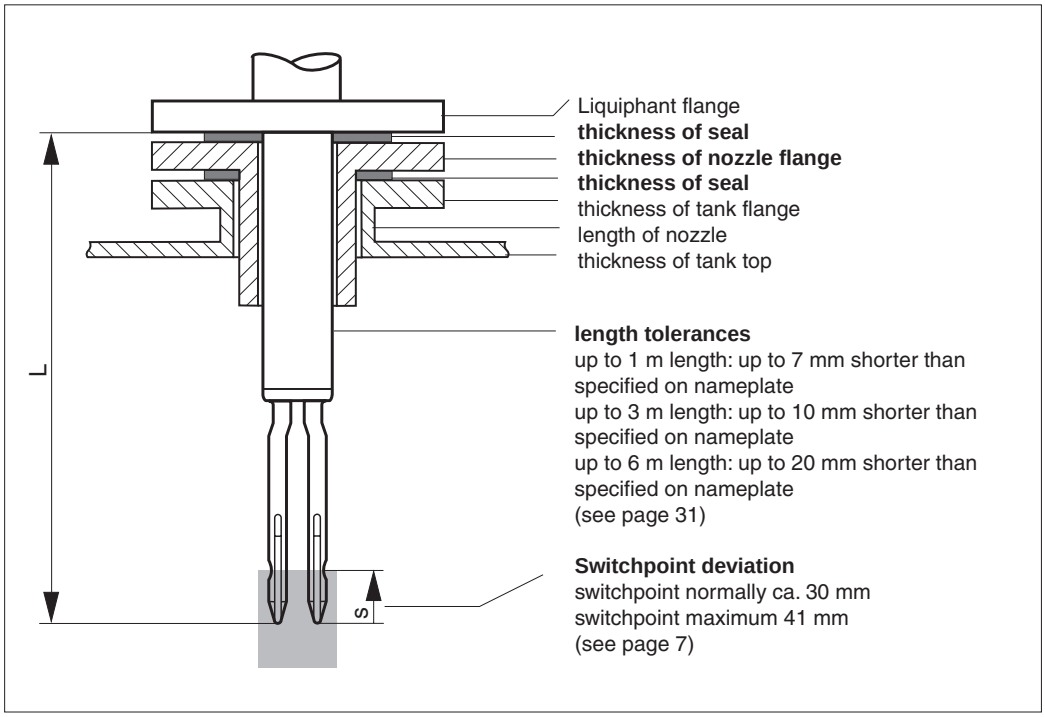


Fig. 29
Consideration of accessories and component tolerances as well as determination of the switchpoint for Liquiphant with flange

Connection

Caution!

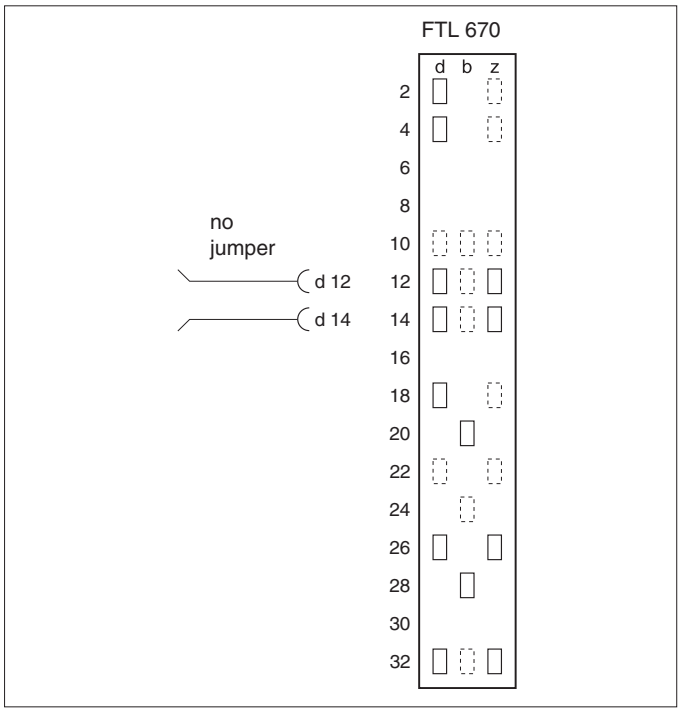


Fig. 30
Density setting:
no jumper is to be used
for limit detection in liquefied gases

Density setting

Caution!
The correct density setting is essential for operational safety.

For limit detection in liquified gases with a density ρ from 0.44 (kg/l or g/cm³) the terminals d 12 and d 14 of the Nivotester FTL 670 must not be connected.

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