

Level Limit Switch *liquiphant FDL 30/31 and FDL 35/36*

**Safety sensor for all liquids.
The vibration limit switch Liquiphant II.
For Ex area (EEx ia) and with separate terminal
chamber for extremely rugged conditions.**



Liquiphant II
with aluminium
housing T3 having
separate terminal
chamber for extremely
rugged conditions
(FDL 35, FDL 36).

Liquiphant II
with aluminium,
plastic or
stainless steel
housing for standard
applications
(FDL 30, FDL 31):

- Level sensors
- As compact version or with extension tube
 - With various process connections

Safety Level Limit Switches

The safety Liquiphant FDL sensors are always used when increased safety is required, e.g. for limit detection in explosion hazardous areas. The sensors are connected to the switching units FTL 320 / 370 / 372.

Features and Benefits

- Operational safety: Monitoring signal cabling for short-circuits and breakage, function monitoring of the electronic insert, the piezocrystal unit and the sensor fork.
The tines are continuously monitored for corrosion.
- Universal application: Operates safely with no maintenance in all types of liquid and is independent of turbulence, electrical properties, solids and gas contents, foam or build-up.
- Accurate switching: A constant switchpoint with millimetre accuracy without the need for calibration.
- Vibration resistant: Thanks to its improved and patented drive electronics, the Liquiphant is unequalled in its tolerance to external vibrations.
- Proven in practice: One million vibration limit switches installed.

Application

Liquiphant FDL sensors are used for level detection in all types of liquid. The intrinsically safe sensor circuit (EEx ia) means that they are approved for use in explosion hazardous areas. When used with the Nivotester FTL switching unit, the sensors can monitor the upper and lower level limits in tanks and vessels and are suitable for all liquids

- with temperatures between -40 °C and $+150\text{ °C}$ (-40 °F and $+300\text{ °F}$)
- with viscosities up to $10,000\text{ mm}^2/\text{s}$ (cSt)
- with densities greater than 0.5 g/cm^3 .
The plastic-coated or Hastelloy versions are available for particularly corrosive liquids.

Endress + Hauser

Nothing beats know-how



Measurement Principle

Operating Principle of the Liquiphant

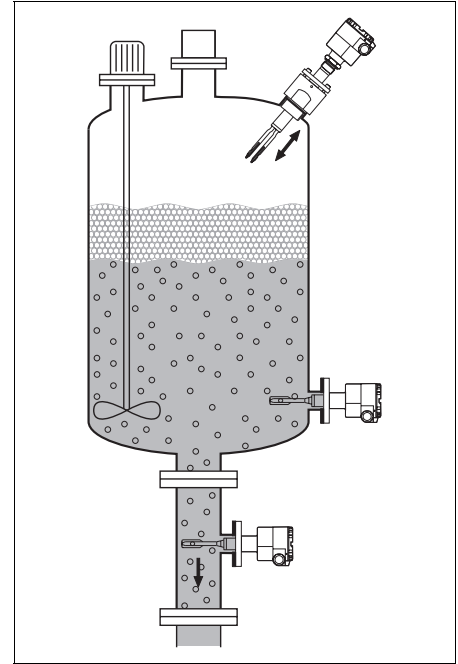
The sensor in the form of a tuning fork is made to vibrate at its resonant frequency by a piezocrystal drive unit. Its resonant frequency changes when the sensor is immersed in the liquid. This frequency change is detected and then converted into a switching signal by the Nivotester FTL switching unit. The switch-over mode for minimum or maximum detection enables the level limit switch to be used for each application in the required fail-safe mode.

Installation

A wide range of application-specific designs, process connections and high corrosion-resistant materials allows limit detection of all types of liquids in tanks and pipes.

A few examples are given here:

- Top mounting to monitor the maximum level.
With an optional sliding sleeve to set the switchpoint during commissioning.
- Side mounting to monitor the minimum level.
- Mounting in a pipe as dry-run protection for the pump.



The limit switch with greater operational safety, even for liquids which are adhesive, causing build-up, corrosive, agitated, sparkling or foaming.

Complete Measuring System

Housing F6/F10



Housing T3



Housing F8



The complete level limit switch consists of the sensor and the switching unit.

Sensor versions

- Liquiphant FDL 30
Sensor as a compact version
- Liquiphant FDL 31
Sensor with extension tube

Polyester housing (F10)
Aluminium housing with epoxy resin coating (F6) or stainless steel housing (F8).
Protection: IP 66

- Liquiphant FDL 35
Sensor as a compact version
- Liquiphant FDL 36
Sensor with extension tube

Aluminium housing with separate terminal chamber (T3)

- Electronics chamber and terminal chamber are completely separated from one another to ensure operation under extremely rugged conditions.
- Interference-immune to electromagnetic fields up to 30 V/m.

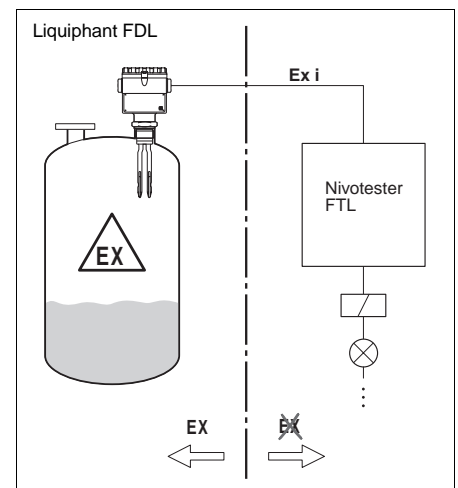
An overspill protection to VbF or WHG (Germany) consists of:
Sensor Liquiphant FDL 30 / 31 / 35 / 36 and
Switching unit Nivotester FTL 320 / 370 / 372

Switching units with intrinsically safe EEx ia sensor circuits in Racksyst format:

- Nivotester FTL 370, single channel unit
 - Nivotester FTL 372, two-channel unit
- In Minipac format:
- Nivotester FTL 320

Liquiphant sensors
FDL 30/31 or
FDL 35/36

Nivotester switching
units FTL 320/370/372



Versions

Process Connections

Application-specific process connections and designs ensure an ideal adaptability to the mounting requirements

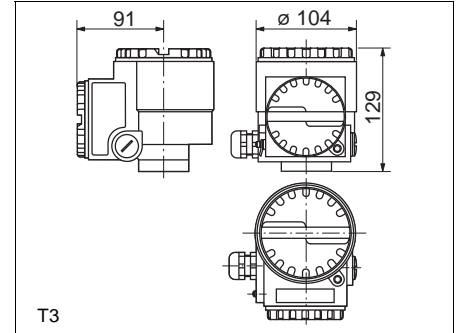
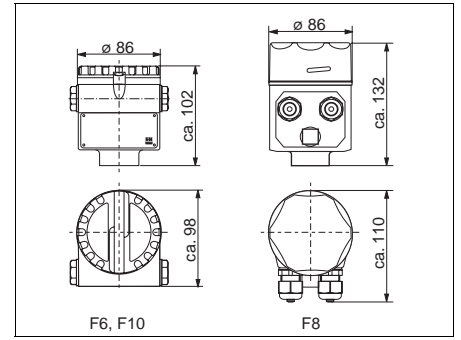
- Threaded boss G 1 A or 1" NPT
- Flanges according to various standards: DIN, ANSI, JIS.
Nominal diameters from DN 32 or 1 1/4"

For particularly hygienic requirements, e.g. food processing:

- Milk pipe coupling
- Triclamp® coupling
- Weld-in socket for flush mounting
Polished fork and extension tube.

Process connection materials
Stainless steel 316 Ti (1.4571) or Hastelloy C (2.4610), the flange version is also available with an ECTFE- (Halar®) coating, extension tube up to 6 m (with PFA up to 1 m).

Note: The threaded boss and Triclamp process connections (and weld-in socket) are also approved for explosion hazardous areas (except for Zone 0 in Germany).



Above:
Housing dimensions
for FDL 30, 31

Below:
Dimensions of housing
with separate
connection
compartment
for FDL 35, 36.

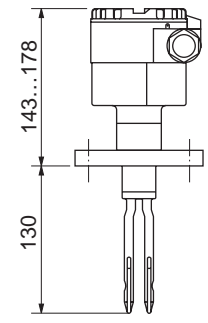
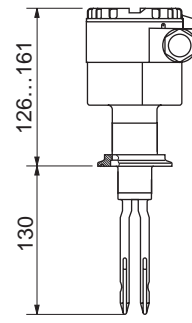
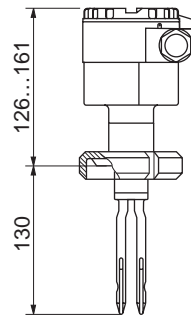
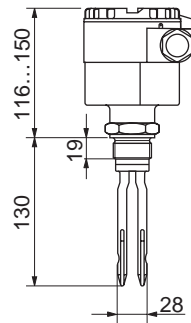
Threaded boss
G 1 A or
1 - 1 1/2 NPT

Pipe coupling
DIN 11851, DN 50

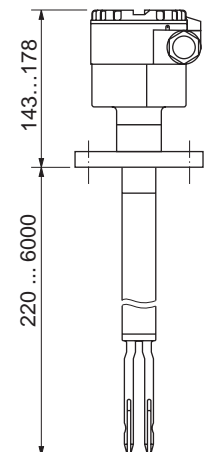
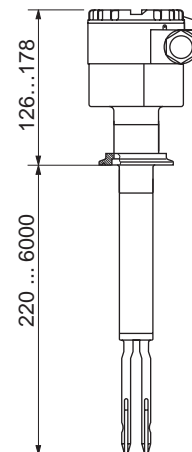
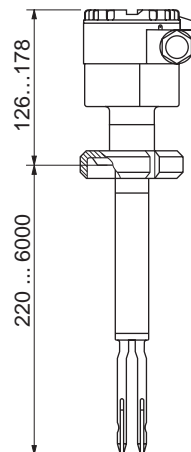
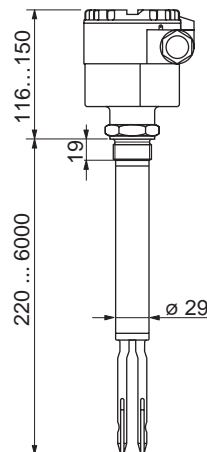
Triclamp coupling
ISO 2852, 2"

Flange version
DIN, ANSI, JIS

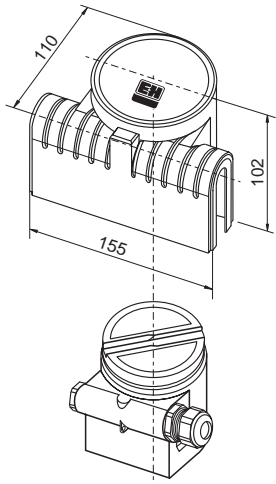
FDL 30 / FDL 35
Compact versions



FDL 31 / FDL 36
Extension tube version

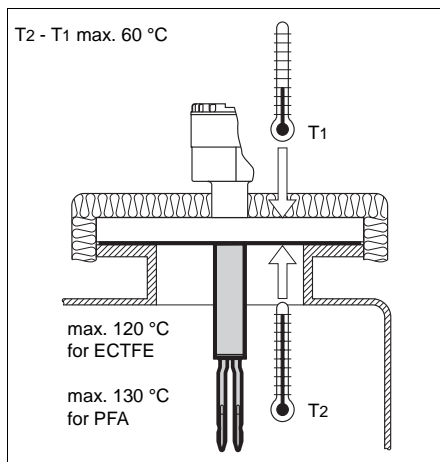


Installation



All-Weather Hood for housing F6, F10;
Made of polyamide. The all-weather hood protects the sensor from excessive temperature and from condensation forming in the housing which can occur with wide temperature variations.

Liquiphant with plastic coating (ECTFE or PFA).



When mounting the Liquiphant note that:

- Vibration of the tines must not be blocked, e.g. due to adhering material.
- If build-up occurs, then ensure a sufficient distance to the tank or pipe wall.

Nozzle Mounting

When mounting the sensor in a nozzle, the viscosity of the liquid should be taken into account:

1. Generally:
The process connection should be flush with the tank wall.
2. With low viscosity liquids:
mount the sensor so that the liquid can flow out of the nozzle and uncover the tines.
3. With high viscosity liquids
nozzle max. 60 mm long (with a 1"-nozzle).
Recommended: A nozzle with a larger diameter should be used.
4. Tuning fork in pipe:
min. DN 50 with low viscosity liquids.

Pipe Mounting

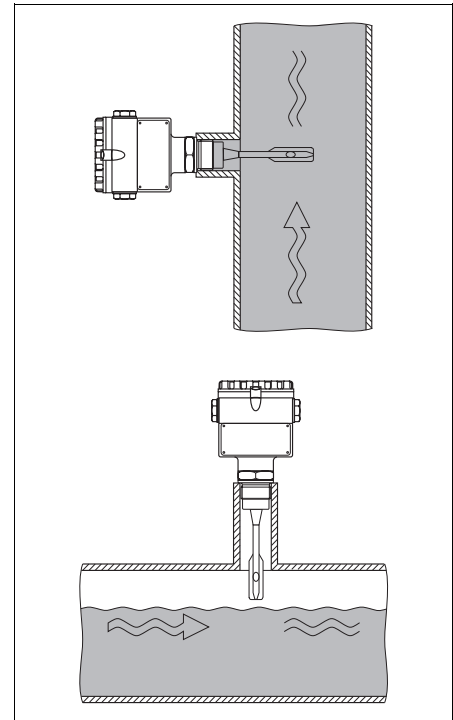
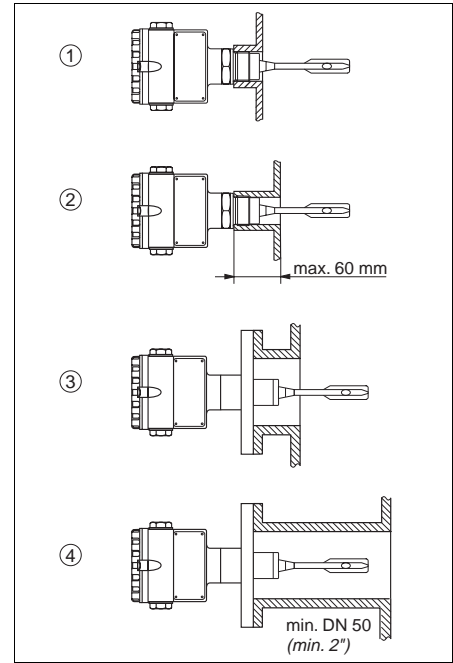
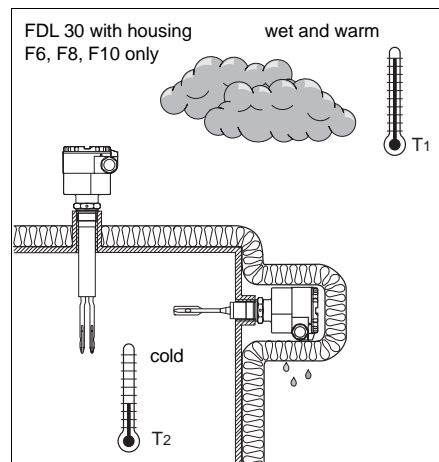
- When used for dry-run protection of pumps, the Liquiphant should be mounted in a vertical pipe.
- When determining the length of the nozzle, take the pipe diameter into account.
- When mounted in a horizontal pipe, partial pipe filling can be detected if the correct nozzle length is chosen.

Liquiphant with plastic coating

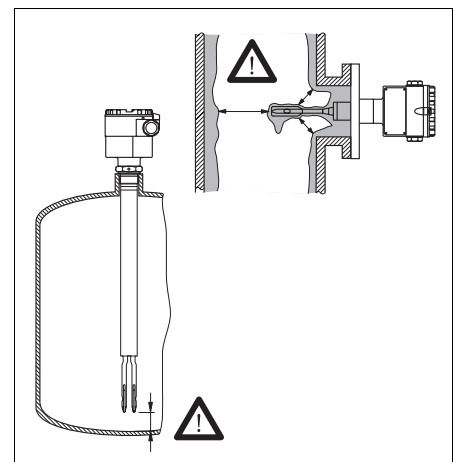
- Maximum operating temperature for ECTFE 120 °C (250°F) and for PFA 130 °C (270 °F).
- The temperature difference $T_2 - T_1$ between the inner and outer surfaces of the flange must not exceed 60 °C (140 °F). If necessary, insulate the outer surface of the flange.

For humid environments or cold media, to avoid condensate forming within the housing:

install a FDL 31, min. length 220 mm, or insulate the housing.



The fork tines may not touch the tank or pipe wall or any build-up



Connection

CE Mark

The device fulfils the legal requirements of the following EC Guidelines:
 Guideline 89/336/EC (Electromagnetic compatibility),
 Guidelines 73/23/EC and 93/68/EC (Low Voltage Appliances).

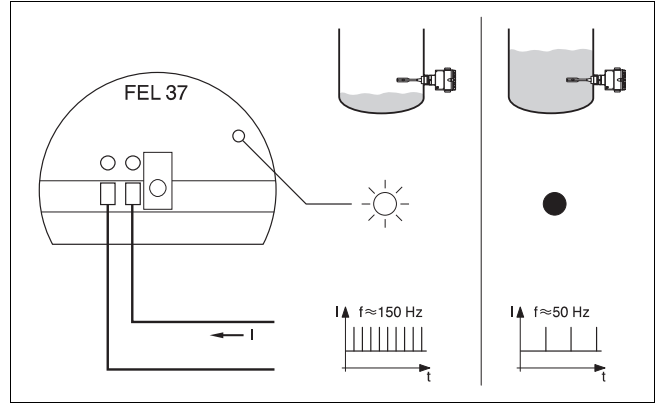
Electromagnetic compatibility (EMC):
 Immunity to EN 50082-2 and industrial standard NAMUR, at field strength 10 V/m (FDL 30, 31), at field strength 30 V/m (FDL 35, 36).
 Emission to EN 50081-1.

For general information on electromagnetic compatibility (test methods, installation hints) see TI 241F/00/en.

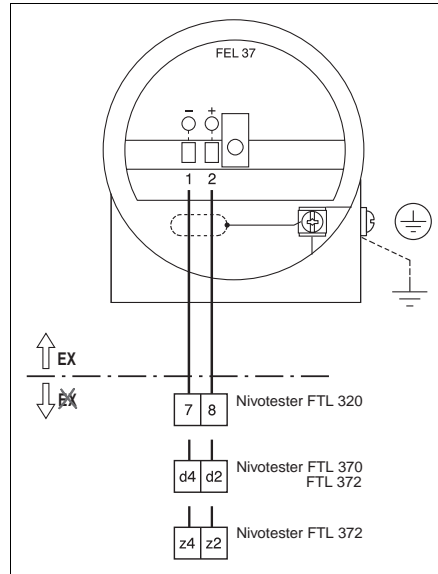
The Nivotester FTL switching unit and the FEL 37 electronic insert in the Liquiphant FDL sensor are electrically connected via commercially available two-core installation cable or via two cores of a multicore cable. Pulse Frequency Modulation (PFM) confers high interference immunity on signal transmission.

All appropriate regulations must be observed when laying intrinsically safe cabling in explosion hazardous areas!

Transmission frequency with covered and exposed tines.



Electrical connection of the Nivotester FTL switching unit to the FDL sensor.



Electrical Data

Connection terminals: for max. 2.5 mm²
 Cable entry: see product structure
 Cable resistance: max. 25 Ω per core
 Power supply: approx. 11.4 V
 Operating current: approx. 4 ... 10 mA
 Signal transmission: Pulse Frequency Modulation (PFM)
 Pulsed current: approx. 10 mA, superimposed on the operating current
 Explosion protection: EEx ia II C T3...T6

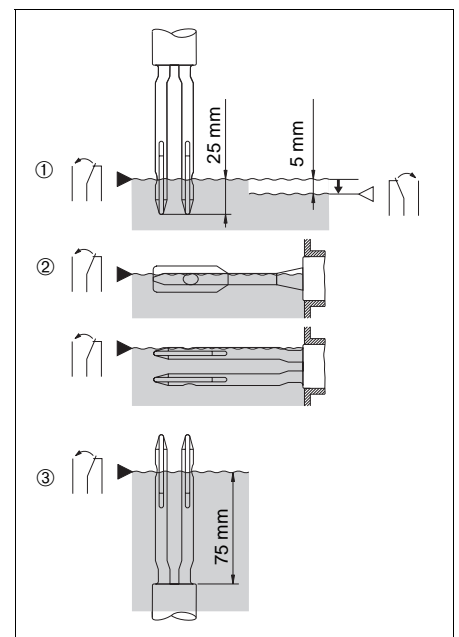
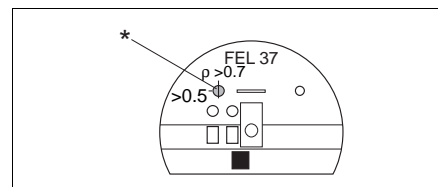
Setting the Switchpoint

If the switchpoint is to be set with millimetre accuracy, then please refer to the diagram opposite:

1. Top mounting
2. Side mounting with the tines next to each other or above one another
3. Mounting from below

Switchpoint data are related to water (density 1 g/cm³). For use in extremely light liquids (liquefied gas - LPG), the switch on the Liquiphant should be set to "Density 0.5".

*Switch for liquid density:
 ρ > 0.5 e.g. for liquefied gas
 ρ > 0.7 standard setting



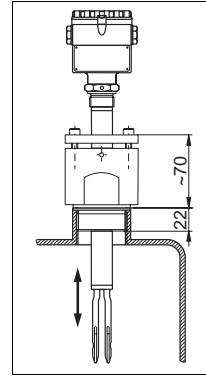
Accessories

Sliding Sleeve

High pressure sleeve for Liquiphant with extension tube FDL 31 / 36.
Internal pressure in vessels up to 40 bar.
For infinitely variable setting of the switchpoints during commissioning.
Up to 6000 mm extension tube (without coating).

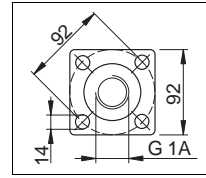
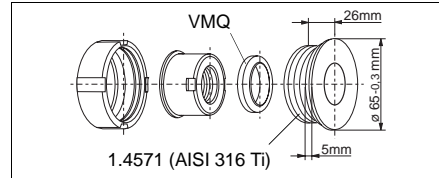
Length tolerances

max. 1 m tube length: + 0 mm / - 5 mm
max. 3 m tube length: + 0 mm / - 10 mm
max. 6 m tube length: + 0 mm / - 20 mm



High pressure sleeve for FDL 31, FDL 36. with G1 1/2A or 1 1/2 - 11 1/2 NPT threaded boss and bright pipe.

Weld-in socket for FDL 30/35 with G 1A thread for flush mounting.
Order No. 215159-0000



Loose flanges for FDL 30/31 or FDL 35/36

Technical Data

Operating Data

Operating data in tank:
max. 40 bar (600 psi), see fig. below
Test pressure: max. 60 bar (900 psi)
Operating temperature in tank:
-40 °C...+150 °C (-30 °F ... +300 °F)
Ambient housing temperature:
-20 °C...+70 °C (-4 °F ... +158 °F)
Liquid viscosity: max. 10000 mm²/s
Minimum density of liquid: 0.5 g/cm³
Switching hysteresis: approx. 5 mm
Switching delay:
when covered approx. 0.4 s,
when exposed approx. 1 s
Fail-safe mode : min./max. selectable
Switching display:
LED on the electronic insert

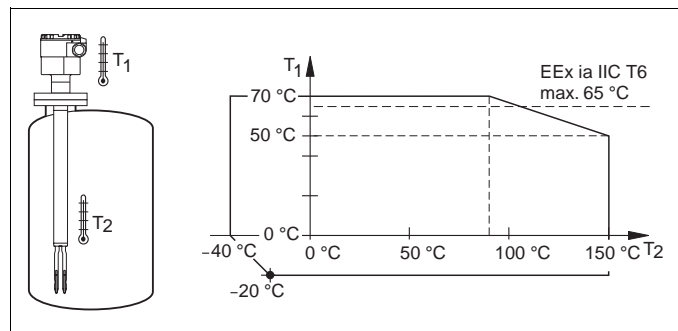
Sensor Materials

- Stainless steel 1.4581 (~AISI 316 Ti), polished as required
- Stainless steel 1.4581 (~AISI 316 Ti), with ECTFE or PFA coating, together with coated flanges
- Hastelloy C (2.4610)

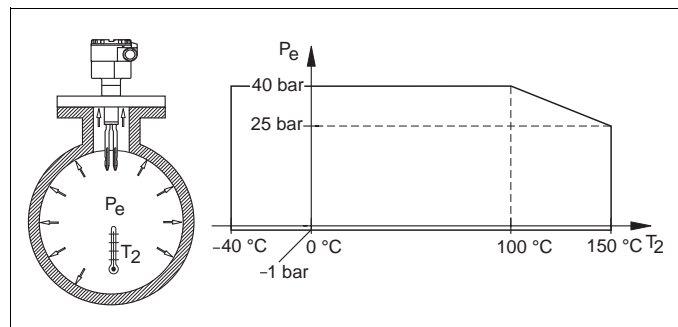
Certificates

- Certificate of conformity (CENELEC) KEMA No. Ex - 92.C.8494
- German national test certificate: (Zone 0, overspill protection to VbF) PTB No. III B/S 2243 F
- General type approval (DIBt) Z-65.11-16

The maximum permissible temperature T_1 at the housing depends on the operating temperature T_2 in the tank.
 $x \text{ } ^\circ\text{C} = (1.8x + 32) \text{ } ^\circ\text{F}$



The maximum permissible pressure p_e in the vessel depends on the temperature T_2 in the vessel.
1 bar = 14.5 psi



Product Structure for Flanges

DIN flanges to DIN 2527, Form B (Hastelloy-clad flanges in Form C)		ANSI flanges to B 16.5 (RF)	
BA2 *	DN 32, PN 6, AISI 316 Ti	AA2 *	1 1/4", 150 psi, AISI 316 Ti
CA5 *	DN 32, PN 6, Hastelloy-clad	AC2 *	1 1/2", 150 psi, AISI 316 Ti
BB2 *	DN 32, PN 40, AISI 316 Ti	AC7 *	1 1/2", 150 psi, AISI 316 Ti/ECTFE
BC2 *	DN 40, PN 6, AISI 316 Ti	AE2	2", 150 psi, AISI 316 Ti
BD2 *	DN 40, PN 40, AISI 316 Ti	AE7	2", 150 psi, AISI 316 Ti/ECTFE
BD7 *	DN 40, PN 40, AISI 316 Ti/ECTFE	AE5	2", 150 psi, Hastelloy-clad
BE2	DN 50, PN 6, AISI 316 Ti	AG2	2", 300 psi, AISI 316 Ti
BE7	DN 50, PN 6, AISI 316 Ti/ECTFE	AG7	2", 300 psi, AISI 316 Ti/ECTFE
CE5	DN 50, PN 6, Hastelloy-clad	AG5	2", 300 psi, Hastelloy-clad
BG2	DN 50, PN 40, AISI 316 Ti	AK2	2 1/2", 300 psi, AISI 316 Ti
BG7	DN 50, PN 40, AISI 316 Ti/ECTFE	AL2	3", 150 psi, AISI 316 Ti
CG5	DN 50, PN 40, Hastelloy-clad	AL7	3", 150 psi, AISI 316 Ti/ECTFE
CG2	DN 50, PN 40, AISI 316 Ti with raised face	AN2	3", 300 psi, AISI 316 Ti
NG2	DN 50, PN 40, AISI 316 Ti with groove	AP2	4", 150 psi, AISI 316 Ti
FG2	DN 50, PN 40, AISI 316 Ti with tongue	AR2	4", 300 psi, AISI 316 Ti
BK2	DN 65, PN 40, AISI 316 Ti	AV2	6", 150 psi, AISI 316 Ti
BM2	DN 80, PN 16, AISI 316 Ti	A12	6", 300 psi, AISI 316 Ti
BN2	DN 80, PN 40, AISI 316 Ti	JIS flanges to JIS B 2210	
BN7	DN 80, PN 40, AISI 316 Ti/ECTFE	KE2	10 K, 50, AISI 316 Ti
CN5	DN 80, PN 40, Hastelloy-clad	KE7	10 K, 50, AISI 316 Ti/ECTFE
CN2	DN 80, PN 40, AISI 316 Ti with raised face	KE5	10 K, 50, Hastelloy-clad
BQ2	DN 100, PN 16, AISI 316 Ti	YY9	Other flanges and materials on request
BQ7	DN 100, PN 16, AISI 316 Ti/ECTFE		
CQ5	DN 100, PN 16, Hastelloy-clad		
CQ2	DN 100, PN 16, AISI 316 Ti with raised face		
BR2	DN 100, PN 40, AISI 316 Ti		

Flanges for Liquiphant
FDL 30/31 and
FDL 35/36

* Flange for FDL 30,
FDL 31 only

Supplementary Documentation

- Nivotester FTL 320
Switching unit in Minipac format
for connecting one sensor
Technical Information TI 203F/00/en
- Nivotester FTL 370 / FTL 372
Switching units in Racksyst format
for connecting 1 or 2 sensors
Technical Information TI 198F/00/en
- Separate housing HTL 10 E
For electronic insert FEL;
higher ambient temperature range
for the sensor housing and easier
operation in tight spaces of a
Liquiphant FDL 30/31.
Technical Information TI 274F/00/en

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