

Ultrasonic Level Measurement *nivopuls FDU 10 C*

**Non-invasive limit switch for liquids
Suitable for use in explosion hazardous areas**



Nivopuls FDU 10 C

Application

The Nivopuls FDU 10 C is a level limit switch for thin liquids, suspensions and emulsions, which is attached externally to a vessel wall. It is not suitable for liquids which tend to build-up and applications in which a gas film adheres to the inside wall. Gas bubbles within the liquid have no effect on measurement. The measurement method is suitable for metal, enamelled, glass and plastic vessels, not, however, vessels made of PVDF or PTFE, with double walls or with plastic linings.

Features and Benefits

- Limit detection through the vessel wall:
 - simple installation
 - no process connection
 - measurement independent of process pressure
- No contact with the product:
 - no corrosion
 - suitable for sanitary applications, e.g. foodstuffs and pharmaceuticals
- For thin liquids:
 - viscosity up to 100 mm²/s (cSt),
 - temperature up to 130 °C
- Certificate:
 - EEx ia II C
 - FM/CSA Class 1, Div. 1, Group A-D

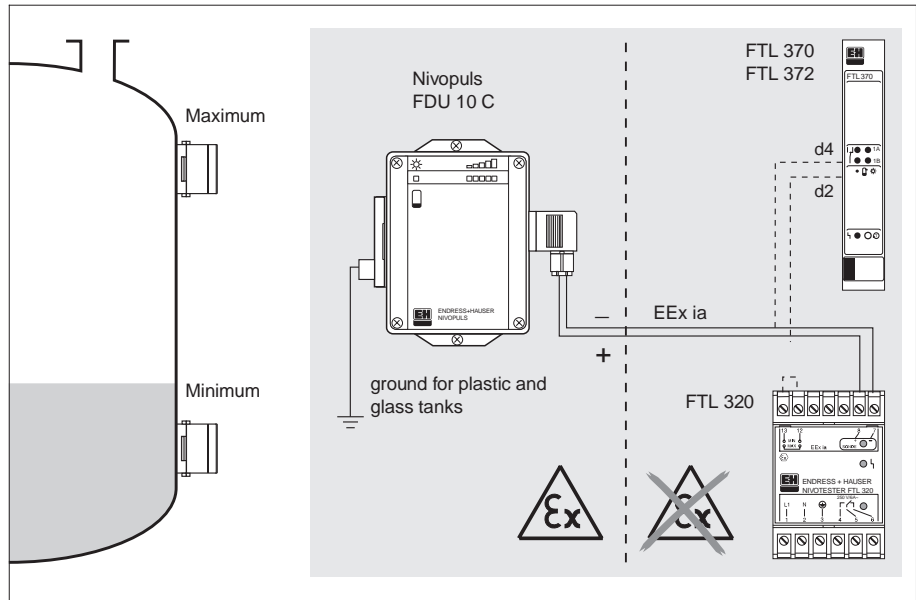
Endress + Hauser

The Power of Know How



Measuring System

Measuring system and electrical connection



Components

The measuring system comprises the Nivopuls FDU 10 C, attached to the vessel at a position suitable for minimum or maximum level detection as well as a Nivotester FTL 320 or FTL 370/372 switching unit with relay.

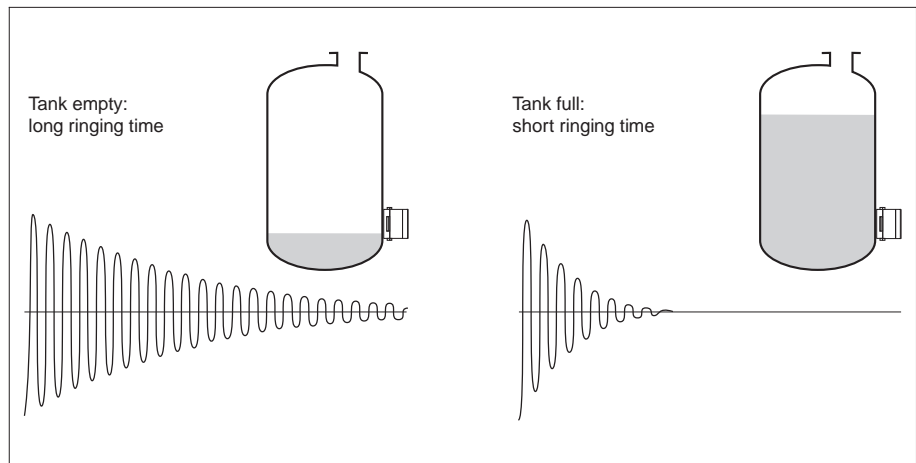
Nivopuls units with certificate can be used in explosion hazardous areas; the Nivotester must always be installed in a safe area.

Electrical Connection

The Nivotester provides the Nivopuls with intrinsically safe power via a two-wire connection, max. length 900 m or 25 Ω per core. An empty/full indication in the form of a PFM-signal is returned along the same line.

Measurement Principle

Basic principle of ultrasonic resonance method



Ultrasonic Resonance Principle

The Nivopuls FDU 10 C operates on the ultrasonic resonance principle. The sensor, which is acoustically coupled to the vessel wall by means of a coupling paste, generates a short ultrasonic pulse, which causes a local resonance in the vessel wall. When the pulse ends, the resonance dies away, whereby the ringing time depends upon whether or

not liquid is to be found immediately behind the sensor. The sensor, which now operates as a receiver, measures the ringing time and generates an empty or full signal as appropriate.

The signal is evaluated by a Nivotester FTL switching unit.

Operating and Display Elements

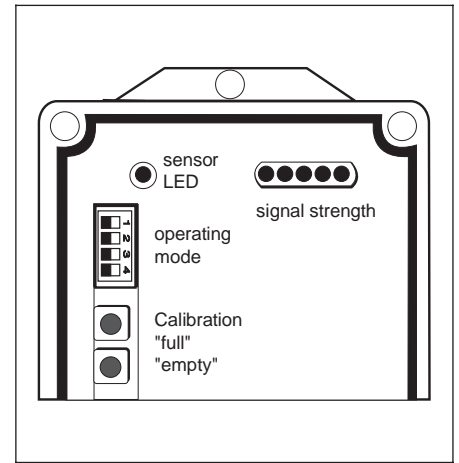
Operation

The user interface of the Nivopuls is of simple design. The operating elements include:



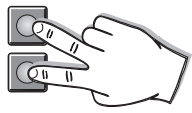























- Two keys within the housing, which allow an empty and full calibration, in any order, when the vessel is filled to the appropriate level.
- A DIP switch which determines the evaluation mode and function of the LED display.

The display elements are clearly visible, even with closed housing.

- A yellow sensor LED indicates the state of the sensor: on = uncovered, off = covered
- A green LED chain indicates the signal strength in normal operation or the calibration status during



Operating and display elements

Step	Key	LEDs
 <p>1 Reset</p>	<p>5 s</p>  	  <p>after 5 s</p> 
 <p>2 Empty calibration</p>	<p>1s</p>  	    <p>1-2 min.</p> 
 <p>3 Full calibration</p>	<p>1s</p>  	    <p>3-4 min.</p> 
 <p>4 Operation</p>		 

Calibration sequence



calibration.

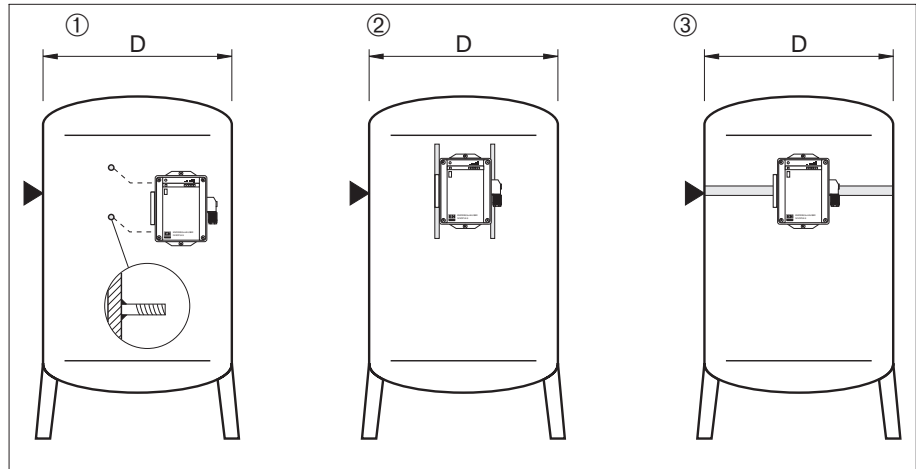
Installation

The sensor can be attached to the vessel wall or pipe by the following methods:

- ① welded bolts
- ② rails
- ③ tension band.

The most suitable mounting method for each application can be found in the table below. All are suitable for both standing and horizontal cylinders

Three fixing methods:
 ① Welded bolts
 ② Rails
 ③ Tension band



Selection table for possible fixing methods

Pipe/vessel dimensions		Material	Typical fixing method		
			① Bolts	② Rails	③ Band
	D		① Bolts	② Rails	③ Band
Pipe	≥ NW 200	Steel	yes	no	yes
Pipe	≥ NW 200	Plastic	no	no	yes
Vessel	to Ø 1600	Steel	yes	yes	yes
Vessel	to Ø 1600	Plastic	no	yes	yes*
Vessel	Ø > 1600	Steel	yes	yes	no
Vessel	Ø > 1600	Plastic	no	yes	no
Vessel	Ø 200...1600	Glass	no	no	yes

*Tanks which bulge on filling may cause the tension band to snap

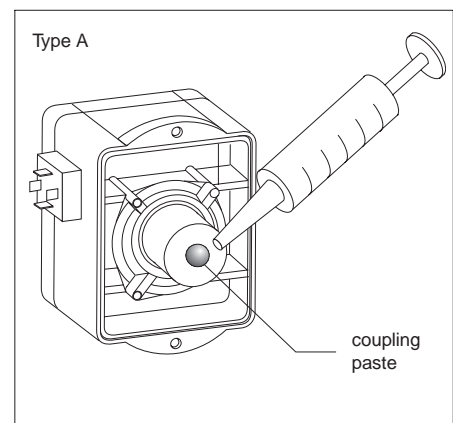
Coupling Paste

The better the acoustic coupling, the better the measurement. The coupling is produced by a paste:

- Type A for temperatures from -20 to +60 °C
- Type B for temperatures from -20 to +100 °C

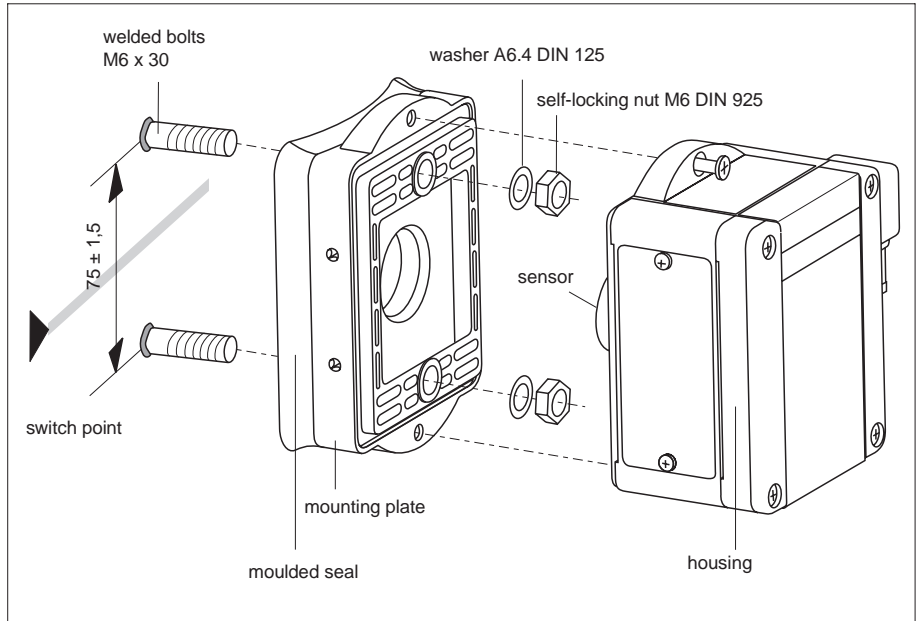
Type A coupling paste is supplied in a dispenser. There is enough paste for 3 – 5 trials.

Type B is a two-component paste that is supplied in a pot and dispenser. It is not suitable for plastic vessels. Since the pot life is 15 min., two sets are supplied.

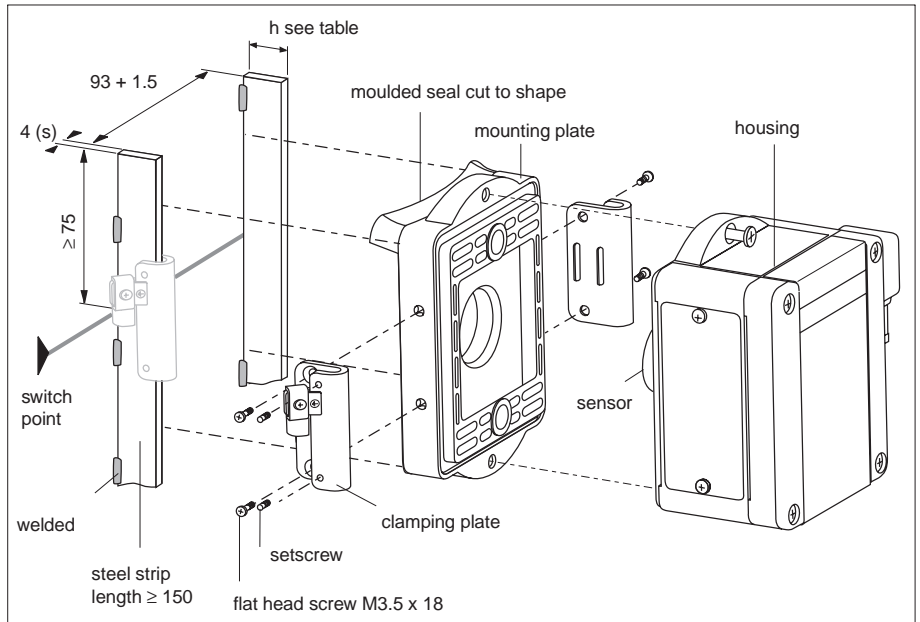


A pea-sized blob is sufficient for good acoustic coupling

Installation



Fixing with welded bolts (provided by customer)

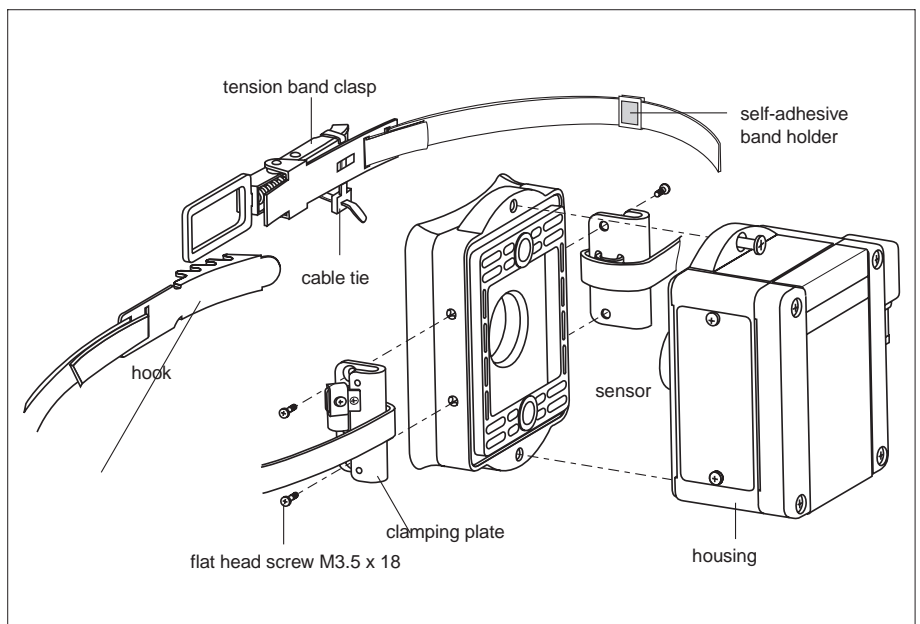


Fixing with 4 (5) mm rail (provided by customer) and mounting set Part No. 942 676-0000

Steel strip (DIN 174)

Tank \varnothing	height
200	32
400	30
500	30
600	28
800	28
1000	28
≥ 1200	25

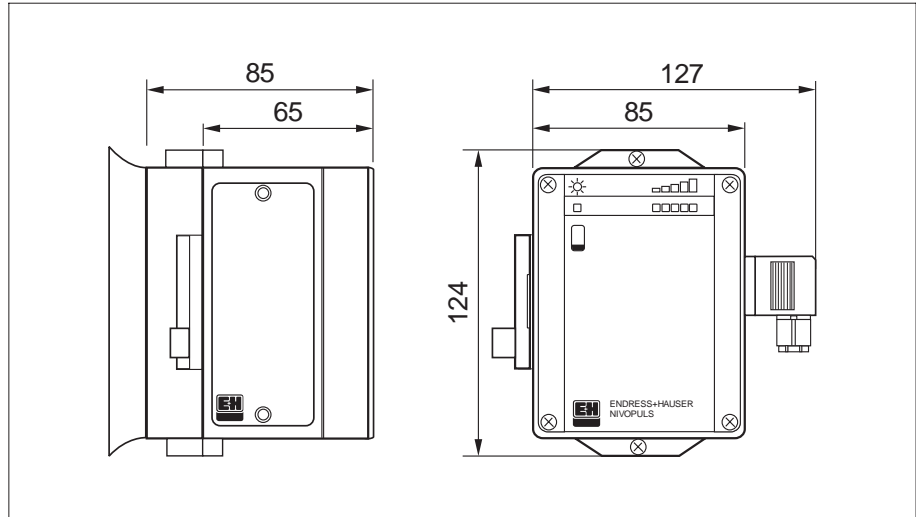
Dimensions in mm
1" = 25.4 mm



Fixing with tension band Part No. 942 676-0000

Technical Data

Dimensions in mm
1" = 2.54 mm



Application

Manufacturer	Endress+Hauser
Designation	Nivopuls FDU 10 C
Application	Non-invasive level limit switch for thin liquids, suspensions, or emulsions

Function and System Design

Measurement principle	Ultrasonic resonance principle
Measuring system	Nivopuls ultrasonic sensor with switching unit Nivotester FTL 320 or Nivotester FTL 370/372
Operating frequency	Type 1: 0.9...1.6 MHz; Type 2: 0.7...1.2 MHz; Type 3: 0.25...0.45 MHz, see Product Structure

Input

Measured variable	Level limit detected by the ringing time of a short ultrasonic pulse, compared to one obtained with empty and full vessel.
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Output

Output signal	Status "full" or "empty" as pulse frequency modulated signal for switching unit
Output on alarm	PFM signal adopts alarm status (recognised by Nivotester).

Accuracy

Reference conditions	Temperature T = +20 °C, operating pressure p _e = 1 bar, flat, vertical metal wall
Response time	Less than 3 s for liquids with viscosity approx. 50 mm ² /s (cSt); less than 1 s for liquids with viscosity approx. 5 mm ² /s (cSt)
Switch point	Determined by mounting position of sensor, however, always in lower half of sensor head.
Measured error	± 5 mm of absolute position
Reproducibility	± 3 mm of absolute position
Effect of ambient temperature	± 7 mm of absolute position over operating temperature range

Operating Conditions

Installation

Position	Vertical on flat walls or standing cylinders Horizontal on horizontal cylinders Sensor head in contact with wall (welded bolts, rails or tension band) Acoustic coupling through paste
Vessel material	Metal, enamelled metal, glass and plastic vessels, however, not for materials PVDF and PTFE, double-walled vessels and vessels with plastic linings.
Wall thickness	Metal and glass: 2...12 mm; Plastic and fibreglass-reinforced plastic 1...10 mm

Environment

Ambient temperature	-20 °C...+80 °C, dependent upon coupling paste; for sensor for plastic vessels -20 °C...+60 °C
Limiting temperature range	-20 °C...+80 °C
Storage temperature	-40 °C...+100 °C
Climatic class	IEC 68, Part 2-38 as Fig. 2a
Ingress protection	IP 65 with housing closed, IP 20 with housing open for calibration
Vibrational strength	IEC 68, Part 2-6
Electromagnetic compatibility	Interference emission to EN 50 081-1, Interference immunity to EN 50 082-2 and NAMUR industrial standard

Medium

Limiting product temperature	-20 °C...+130 °C, 150 °C for short periods during CIP -20 °C...+60 °C for sensor version for plastic vessels
Viscosity	Thin liquids, emulsions, suspensions and liquefied gas, up to 100 cSt

Mechanical Construction

Design	See diagram, page 6
Weight	Approx. 0.5 kg
Material	Plastic PBT Tension band: stainless steel 1.4301
Electrical connection	Two-wire cable with plug connection, max. length 900 m and/or max. resistance 25 Ω pro Ader

User Interface

Display	1 status LED for empty and full indication 1 LED chain comprising LEDs for signal strength
Operation	2 keys for "empty" and "full" calibration DIP switches for evaluation mode and LED control

Power

Power supply	Provided by Nivotester FTL 320 or 370/372 switching unit
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Certificates and Approvals

Explosion protection (all in preparation)	Europe: Cenelec EEx ia II C North America: FM Class 1, Div. 1, Group C, D, in preparation CSA Class 1, Div. 1, Group C, D in preparation
CE Mark	By attaching the CE Mark, Endress+Hauser confirms that the Nivopuls FDU 10 C fulfils all legal requirements of the relevant EU directives

Ordering Information

Ordering information	See Product Structure, page 8
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Product Structure

Nivopuls FDU 10 C

Certificate

- 1 No certificate
- 2 Cenelec EEx ia IIC T6
- 3 CSA Class I, Div. 1 Groups C, D (in preparation)
- 4 FM Class I, Div. 1 Groups C, D (in preparation)

Housing

- 1 Plastic housing
- 9 Other housing

Mounting Plate

- 1 Plastic PPS, Ø min. 200 mm
- 9 Other mounting plate

Sensor: Vessel Material and Wall Thickness

- 1 Metal and glass, 2...3 mm and 4...7 mm¹⁾
- 2 Metal and glass, 3...4 mm and 7...12 mm¹⁾
- 3 Plastic, 1...10 mm²⁾
- 9 Other sensor

FDU 10 C - [] [] [] [] []

Product designation

- ¹⁾ Versions 1 and 2 supplied with 2 packs of two-component paste for acoustic coupling up to 100°C
²⁾ Version 3 supplied with dispenser with paste for acoustic coupling up to 60°C

Accessories

Part No.

Tension band set (hook and clasp, clamping plates and band), also required for rail mounting	942 676-0000
Coupling paste in dispenser (for temperatures up to 60°C)	942 679-1000
Two component paste (for temperatures up to 100°C; not for plastic)	942 679-0000

Supplementary Documentation

- Nivopuls FDU 10 System-Information SI 025/00/e
- Switching Unit Nivotester FTL 370/372 Technical Information TI 198/00/e
- Switching Unit Nivotester FTL 320 Technical Information TI 203/00/e

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