

# Submersible pressure sensor

## For superior applications

### Model LF-1

WIKA data sheet LM 40.04



#### Applications

- Level measurement in vessel and storage systems
- Overfilling and no-load operation monitoring
- Level measurement in rivers and lakes
- Deep well and groundwater monitoring
- Battery-operated level measuring systems

#### Special features

- Suitable for measurements in contaminated and aggressive media
- An optimised discharge behaviour and a large pressure port prevent the instrument from clogging and ensure a minimum maintenance effort
- Can be used in explosion-protected areas
- Developed for wireless applications



**Fig. left:** With conduit and FEP cable  
**Fig. right:** With PUR cable

#### Description

##### Permanently reliable

Extensive test cycles not only guarantee a permanent resistance and long service life in all commonly used oils and fuels, including aggressive crude oils and biofuels, but also in flowing and stagnant waters and in wastewater treatment applications.

Thanks to newly developed special cables, components made of high-alloyed stainless steel and an optional overvoltage protection against lightning, the submersible pressure sensor is perfectly suited for the measurement of liquid levels, also in the outdoor area.

##### Precise level and temperature measurement with HART® communication

A measurement uncertainty of max. 0.5 %, a long-term drift of 0.1 % and slight temperature errors make the LF-1 a reliable measurement solution for the monitoring of storage tanks and bodies of water.

The additional analogue temperature output facilitates the compensation of a temperature-induced density error especially at temperatures of up to  $-40 \dots +80 \text{ °C}$  [ $-40 \dots +176 \text{ °F}$ ].

The integrated HART® communication can be used for scaling the measuring range and for the parameterisation of unit, error signal, and others.

##### Optimised electronics for battery operation

The modern electronic system guarantees not only a high accuracy in the long term but also ensures a very long battery life thanks to low power supply, low current consumption, fast response time and low-power output signals.

##### Safety also in hazardous areas

The optional intrinsically safe electronic system is authorised according to the common international standards and allows a safe worldwide application in explosive gases and vapours.

## Measuring ranges

Gauge pressure							
bar	0 ... 0.1	0 ... 0.16	0 ... 0.25	0 ... 0.4	0 ... 0.6	0 ... 1	0 ... 1.6
	0 ... 2.5	0 ... 4	0 ... 6				
inWC	0 ... 50	0 ... 100	0 ... 150	0 ... 250			
psi	0 ... 5	0 ... 10	0 ... 15	0 ... 25	0 ... 50	0 ... 100	
mH <sub>2</sub> O	0 ... 1	0 ... 1.6	0 ... 2.5	0 ... 4	0 ... 6	0 ... 10	0 ... 16
	0 ... 25	0 ... 40	0 ... 60				

Absolute pressure							
bar	0 ... 1.6	0 ... 2.5	0 ... 4	0 ... 6			
psi	0 ... 25	0 ... 50	0 ... 100				

The given measuring ranges are also available in mbar, kPa and MPa.

### Overload safety

≥ 3 times

## Temperature measurement (option)

Measuring ranges	
Option 1	-10 ... +50 °C [14 ... 122 °F]
Option 2	-40 ... +80 °C [-40 ... +176 °F]

The temperature output signal corresponds to the selected medium temperature (see operating conditions).

## Output signals

Without temperature measurement	
Standard	4 ... 20 mA (2-wire)
Option 1	4 ... 20 mA + HART® (2-wire)
Option 2	DC 0.1 ... 2.5 V (3-wire, low power) <sup>1)</sup>

With temperature measurement	
Standard	2 x 4 ... 20 mA (2 x 2-wire, galvanically isolated)
Option 1	2 x DC 0.1 ... 2.5 V (3-wire, low power) <sup>1)</sup>

<sup>1)</sup> Shortening the cable always results in a modification of the voltage signal (see accuracy specifications).

### Permissible load in Ω

Current output:  $\leq (U_+ - (U_{+min} - 0.5 \text{ V})) / 0.023 \text{ A}$

Voltage output:  $\leq 1 \text{ mA}$

Additional load of the cable:

$\leq \text{cable length in m} \times 0.084 \text{ } \Omega$

$[\leq \text{cable length in ft} \times 0.0256 \text{ } \Omega]$

For voltage outputs, the load must be specified so that the output current does not exceed 1 mA.

## Voltage supply

The power supply depends on the selected output signal and the intrinsically safe electronics (Ex approval).  
When being operated in hazardous areas, the submersible pressure sensor must be powered via a repeater power supply (see accessories).

### Power supply

Output signal	Standard	With Ex approval
4 ... 20 mA (2-wire)	DC 8 ... 36 V	DC 9 ... 30 V
4 ... 20 mA + HART® (2-wire)	DC 12 ... 36 V	DC 12 ... 30 V
DC 0.1 ... 2.5 V (3-wire, low power)	DC 3.6 ... 36 V	-
2 x 4 ... 20 mA (2 x 2-wire, galvanically isolated)	DC 8 ... 36 V	DC 9 ... 30 V
2 x DC 0.1 ... 2.5 V (3-wire, low power)	DC 3.6 ... 36 V	-

Low power is optimised for the battery operation.

### Current consumption

Current output: max. 25 mA per output

Voltage output: max. 5 mA

## Reference conditions (per IEC 61298-1)

### Temperature

15 ... 25 °C [59 ... 77 °F]

### Atmospheric pressure

860 ... 1,060 mbar [86 ... 106 kPa /12.5 ... 15.4 psig]

### Air humidity

45 ... 75 % r. h.

### Power supply

- DC 24 V with current output
- DC 5 V with voltage output

### Mounting position

Calibrated in vertical mounting position with process connection facing downwards.

## Accuracy specifications

### Accuracy at reference conditions (pressure sensor)

	Accuracy <sup>1)</sup>	Non-linearity (per IEC 61298-2) BFSL
Standard	≤ ±1 % of span	≤ ±0.5 % of span
Option	≤ ±0.5 % of span	≤ ±0.25 % of span

1) Including non-linearity, hysteresis, zero offset and end value deviation (corresponds to measured error per IEC 61298-2).

During the adjustment of the voltage signals, the cable length will be compensated. Every shortening of the cable at a later stage results in an offset error of approx. 0.14 % / 10 m [0.13 % / 30 ft].

### Accuracy after turndown 5:1 via HART®

Standard	≤ ±1.25 % of scaled span
Option	≤ ±0.75 % of scaled span

By setting a turndown of greater than 5:1, a higher measuring deviation applies.

### Accuracy (temperature sensor)

-10 ... +80 °C [14 ... 176 °F]: ≤ ±1.8 K

-30 ... -10 °C [-22 ... +14 °F]: ≤ ±3.0 K

-40 ... -30 °C [-40 ... -22 °F]: ≤ ±4.5 K

### Non-repeatability

≤ 0.1 % of span

≤ 0.2 % of span (with voltage output and cable length > 100 m [325 ft])

### Long-term stability (per DIN 16086:2006-01)

Measuring range > 0 ... 0.1 bar: ≤ ±0.1 % of span/year

Measuring range ≤ 0 ... 0.1 bar: ≤ ±0.2 % of span/year

### Switch-on time

Output signals without HART®: ≤ 150 ms

Output signals with HART®: ≤ 250 ms

### Settling time

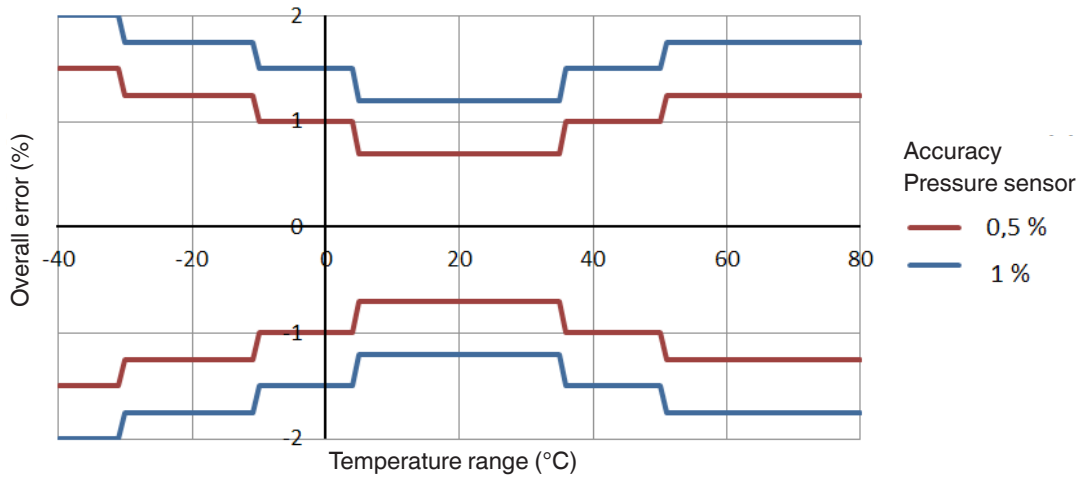
Output signals without HART®: ≤ 100 ms

Output signals with HART®: ≤ 250 ms

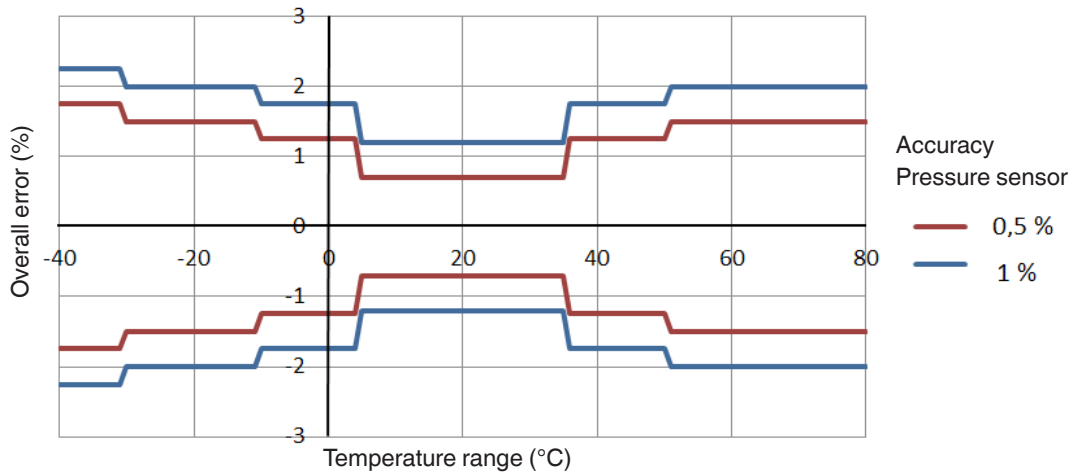
**Overall error**

Including non-linearity, hysteresis, zero point and span error, temperature error and temperature hysteresis.

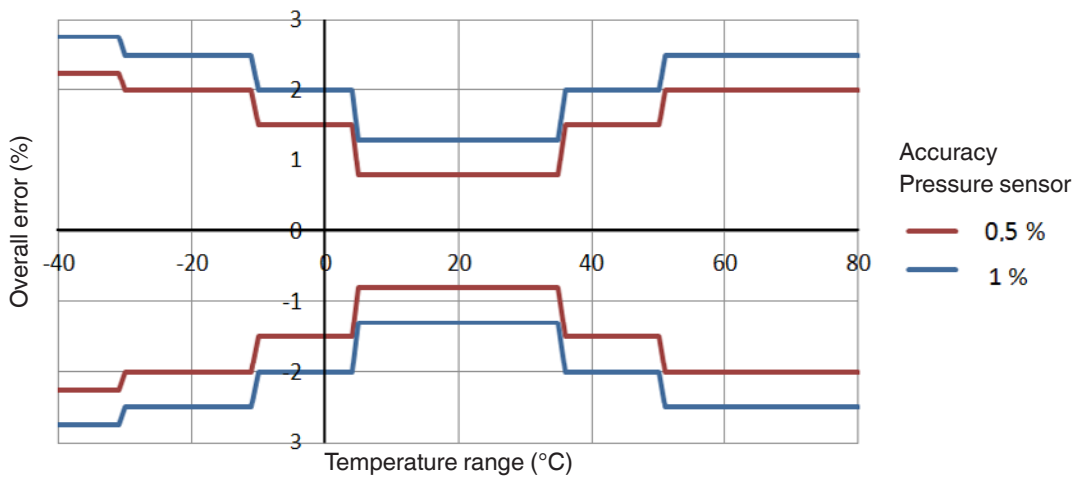
■ **Measuring range  $\geq 0.6$  bar,  $\geq 250$  inWC,  $\geq 10$  psi,  $\geq 6$  mH<sub>2</sub>O**



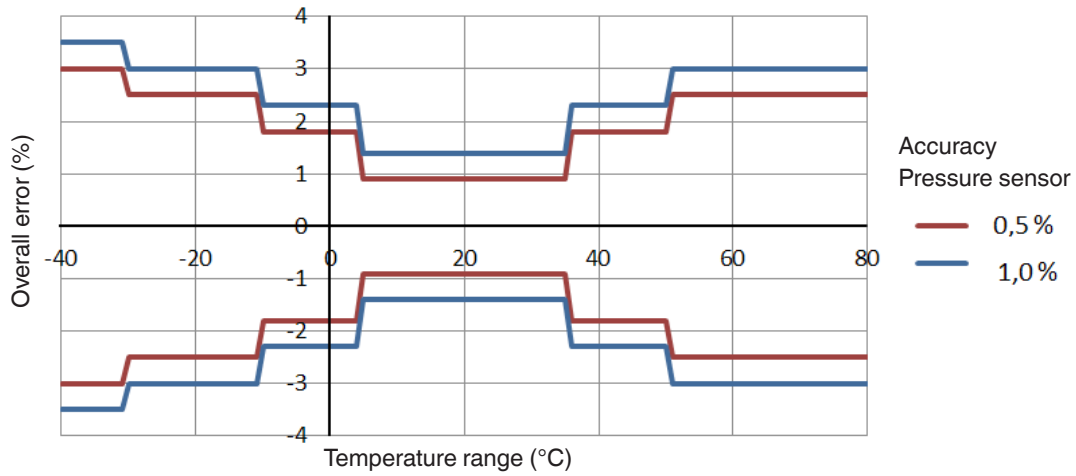
■ **Measuring range 0.4 bar, 150 inWC, 4 mH<sub>2</sub>O**



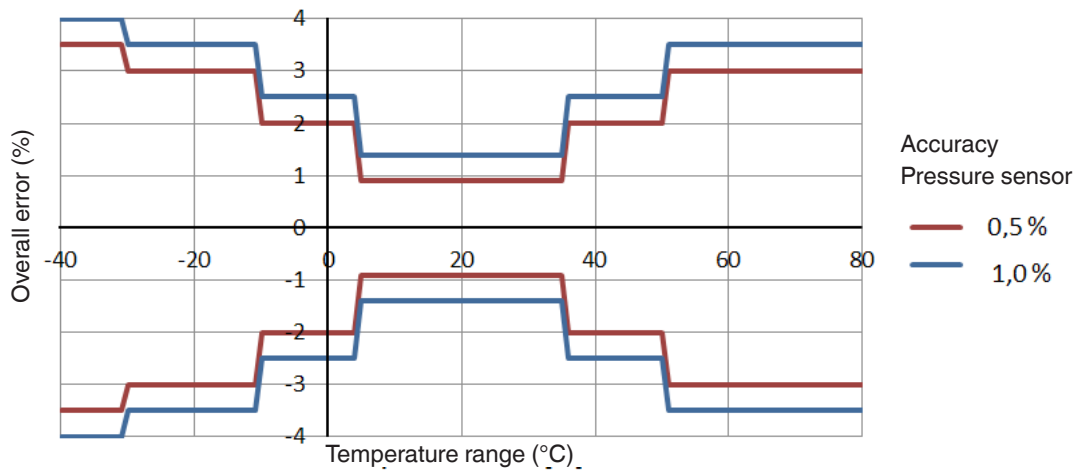
■ **Measuring range 0.25 bar, 100 inWC, 5 psi, 2.5 mH<sub>2</sub>O**



■ Measuring range 0.16 bar, 1.6 mH<sub>2</sub>O



■ Measuring range 0.1 bar, 50 inWC, 1 mH<sub>2</sub>O



## Operating conditions

### Ingress protection

IP68

### Increased overvoltage protection for lightning strikes (option)

Nominal discharge current:  $\geq 10$  kA

Rise time: 8/20  $\mu$ s

### Immersion depth

max. 100 m (325 ft)

### Max. tension force of the cable

1,000 N

### Weight

Submersible pressure sensor: approx. 300 g [0.661 lbs]

Cable: approx. 80 g/m [0.538 lbs / 10 ft]

Additional weight: approx. 300 g [0.661 lbs]

### Permissible temperature ranges

Medium	Standard	-10 ... +50 °C [14 ... 122 °F]
	Option	-40 ... +80 °C [-40 ... +176 °F]
Ambient	Standard	-40 ... +80 °C [-40 ... +176 °F]
Storage	Standard	-30 ... +80 °C [-22 ... +176 °F]

## Explosion protection (option)

Approval	Marking
ATEX	Zone 0 gas [II 1G Ex ia IIC T4/T5/T6 Ga] Zone 1 gas [II 2G Ex ia IIC T4/T5/T6 Gb]
IECEX	Zone 0 gas [Ex ia IIC T4/T5/T6 Ga] Zone 1 gas [Ex ia IIC T4/T5/T6 Gb]
CSA	Class I, division 1, groups A, B, C, D Class I, zone 0; A/Ex ia IIC; T6 ... T4 Ga Class I, zone 1; A/Ex ia IIC; T6 ... T4 Gb Class I, zone 2; A/Ex ic IIC; T6 ... T4 Gc (see control drawing 14136138)
FM	Class I, division 1, groups A, B, C, D Class I, zone 0, AEx ia IIC, T6 ... T4 Ga Class I, zone 1, AEx ia IIC, T6 ... T4 Gb Class I, zone 2, AEx ic IIC, T6 ... T4 Gc (see control drawing 14136138)
EACEX	Zone 0 Gas [0ExiaIICT6...T4 X] Zone 1 Gas [1ExiaIICT6...T4 X]

### Permissible temperature ranges in hazardous areas (ATEX, IECEX, EACEX)

Ambient and media temperature range (Pi = 600 mW)	Ambient and media temperature range (Pi = 800 mW)	Temperature code
$-40 \leq T_a \leq +59$ °C	$-40 \leq T_a \leq +52$ °C	T6
$-40 \leq T_a \leq +74$ °C	$-40 \leq T_a \leq +67$ °C	T5
$-40 \leq T_a \leq +80$ °C	$-40 \leq T_a \leq +76$ °C	T4 - T1

## Permissible temperature ranges in hazardous areas (FM, CSA)

Ambient and media temperature range (Pi = 600 mW)	Temperature code
$-40 \leq T_a \leq +59 \text{ }^\circ\text{C}$	T6
$-40 \leq T_a \leq +74 \text{ }^\circ\text{C}$	T5
$-40 \leq T_a \leq +80 \text{ }^\circ\text{C}$	T4 - T1

## Materials (wetted)

	Standard	Option (high-resistance)
Case	316L	318LN
Sensor element	316L	Hastelloy C276
Cable	PUR	FEP
Sealing	FKM	FKM
Protection cap	PVDF	PVDF

## Electrical connection

Cable outlet	
Standard	Cable outlet without conduit
Option	Cable outlet with conduit

Cable lengths										
Standard	Metres (m)	3	5	10	15	20	25	30	40	50
	Feet (ft)	10	20	30	40	50	75	100	125	150
Option	Metres (m)	For current output, freely definable up to 1,000 m								
		For voltage output, freely definable up to 200 m								
	Feet (ft)	For current output, freely definable up to 3,250 ft								
		For voltage output, freely definable up to 650 ft								

Other lengths on request

### Short-circuit resistance

S+ vs. U-

### Reverse polarity protection

U+ vs. U-

### Resistance to overvoltage

DC 40 V

### Insulation voltage

Standard: DC 850 V

Increased overvoltage protection  
for lightning strikes:

DC 50 V



## Connection diagrams

4 ... 20 mA, 4 ... 20 mA + HART® (2-wire)	
U+	brown (BN)
U-	blue (BU)
Shield	grey (GY)

DC 0.1 ... 2.5 V (3-wire, low power)	
U+	brown (BN)
U-	blue (BU)
S+	black (BK)
Shield	grey (GY)






2 x 4 ... 20 mA (2 x 2-wire, galvanically isolated)	
U+ (pressure sensor)	brown (BN)
U- (pressure sensor)	blue (BU)
U+ (temperature sensor)	green (GN)
U- (temperature sensor)	white (WH)
Shield	grey (GY)

2 x DC 0.1 ... 2.5 V (3-wire, low power)	
U+	brown (BN)
U-	blue (BU)
S+ (pressure sensor)	black (BK)
S+ (temperature sensor)	green (GN)
Shield	grey (GY)

### Legend

U+ Positive power supply terminal  
 U- Negative power supply terminal  
 S+ analogue output

## Approvals (option)

Logo	Description	Country
	<b>EU declaration of conformity</b> <ul style="list-style-type: none"> <li>■ EMC directive EN 61326 emission (group 1, class B) and immunity (industrial application)</li> <li>■ RoHS directive</li> <li>■ ATEX directive <sup>1)</sup> <ul style="list-style-type: none"> <li>- Ex i Zone 0 gas [II 1G Ex ia IIC T4/T5/T6 Ga]</li> <li>Zone 1 gas [II 2G Ex ia IIC T4/T5/T6 Gb]</li> </ul> </li> </ul>	European Union
	<b>IECEx <sup>1)</sup></b> Hazardous areas - Ex i Zone 0 gas [Ex ia IIC T4/T5/T6 Ga] Zone 1 gas [Ex ia IIC T4/T5/T6 Gb]	International
	<b>FM <sup>1)</sup></b> Hazardous areas Class I, division 1, groups A, B, C, D Class I, zone 0, AEx ia IIC, T6 ... T4 Ga Class I, zone 1, AEx ia IIC, T6 ... T4 Gb Class I, zone 2, AEx ic IIC, T6 ... T4 Gc (see control drawing 14136138)	USA
	<b>CSA</b> <ul style="list-style-type: none"> <li>■ Safety (e.g. electr. safety, overpressure, ...)</li> <li>■ Hazardous areas <sup>1)</sup> <ul style="list-style-type: none"> <li>Class I, division 1, groups A, B, C, D</li> <li>Class I, zone 0; A/Ex ia IIC; T6 ... T4 Ga</li> <li>Class I, zone 1; A/Ex ia IIC; T6 ... T4 Gb</li> <li>Class I, zone 2; A/Ex ic IIC; T6 ... T4 Gc</li> </ul> </li> </ul> (see control drawing 14136138)	USA and Canada
	<b>EAC</b> <ul style="list-style-type: none"> <li>■ EMC directive</li> <li>■ Hazardous areas (see approval)</li> </ul>	Eurasian Economic Community

1) Only available with output signals 4 ... 20 mA, 2 x 4 ... 20 mA and 4 ... 20 mA + HART®.

## Manufacturer's information and certificates

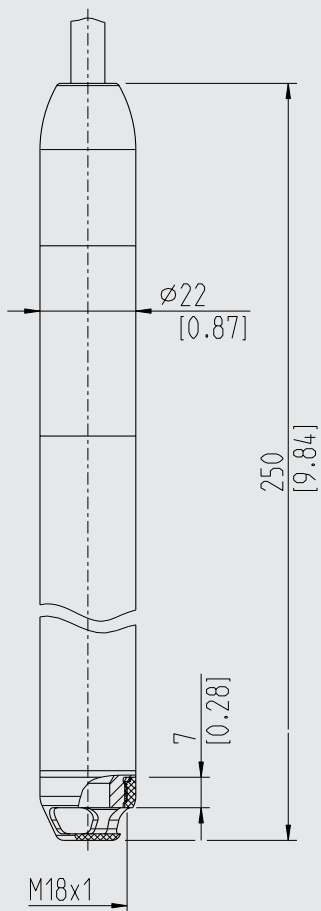
China RoHS conformity

SJ/T 11364-2014

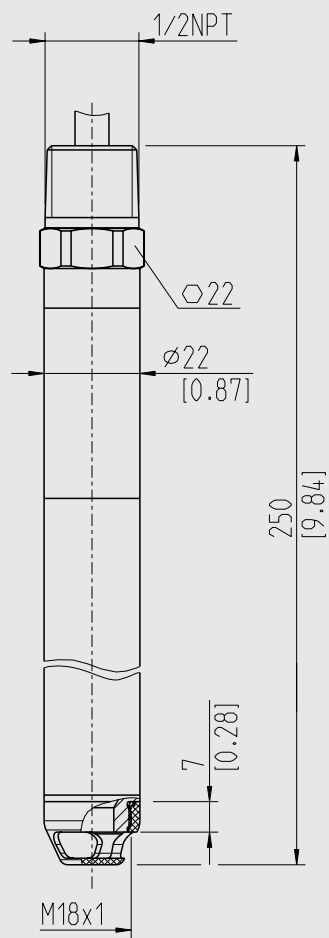
Approvals and certificates, see website

## Dimensions in mm [in]

Cable outlet without conduit



Cable outlet with conduit



## Accessories

	Description	Order number
	<p><b>Additional weight</b> The additional weight increases the dead weight of the submersible pressure sensor. It simplifies the lowering in monitoring wells, narrow shafts and deep wells. It effectively reduces negative environmental influences of the measuring medium (e.g. turbulent flows) on the measuring result.</p> <p>Stainless steel 316L, approx. 300 g [0.661 lbs], length 115 mm [4.53 in]</p>	14131008
	<p><b>Cable strain relief clamp</b> The cable strain relief clamp ensures easy and secure mechanical fastening of the submersible pressure sensor's cable. It serves to guide the cable to prevent mechanical damage and to reduce the action of tensile stresses.</p>	14052336
	<p><b>Cable box</b> The cable socket, with IP67 ingress protection and waterproof ventilation element, provides a moisture-free electrical termination for the submersible pressure sensor. It should be mounted in a dry environment, outside any shafts or vessels, or directly in the switch cabinet.</p> <p>Not suitable for hazardous areas!</p>	14052339
	<p><b>Intrinsically safe repeater power supply, model IS Barrier</b> Input 0/4 ... 20 mA, supplying and non-supplying Bidirectional HART® signal transmission</p> <p>For details see data sheet AC 80.14</p>	14117118
	<p><b>Indication and programming module HART® DIH50 and DIH52</b> 5-digit display, 20-segment bar graph, without separate power supply, with additional HART® functionality. Automatic adjustment of measuring range and span. "Secondary-master" functionality: Setting the measuring range and unit of the connected transmitter using HART® standard commands possible. Optionally explosion protection per ATEX.</p>	on request
	<p><b>HART® modem with USB, RS-232 or Bluetooth® interface</b> For scaling the measuring range using a PC via the HART® protocol, a HART® modem with USB, RS-232 or Bluetooth® interface is available. The modem communicates with all registered HART® field instruments and can be used with the most popular HART®-compatible software programs.</p>	7957522 (RS-232 interface)
		11025166 (USB interface)
		11364254 (Bluetooth® interface)

### Ordering information

Model / Measuring range / Output signal / Accuracy / Case material / Cable outlet / Cable material / Cable length / Overvoltage protection / Medium temperature / Approval / Accessories

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