SD01003F/00/EN/13.15
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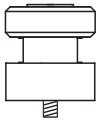
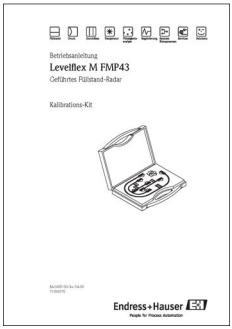
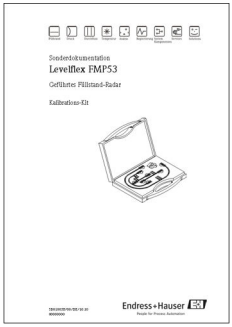
Special Documentation
Levelflex FMP53

Guided wave radar
Calibration kit

Endress+Hauser
People for Process Automation

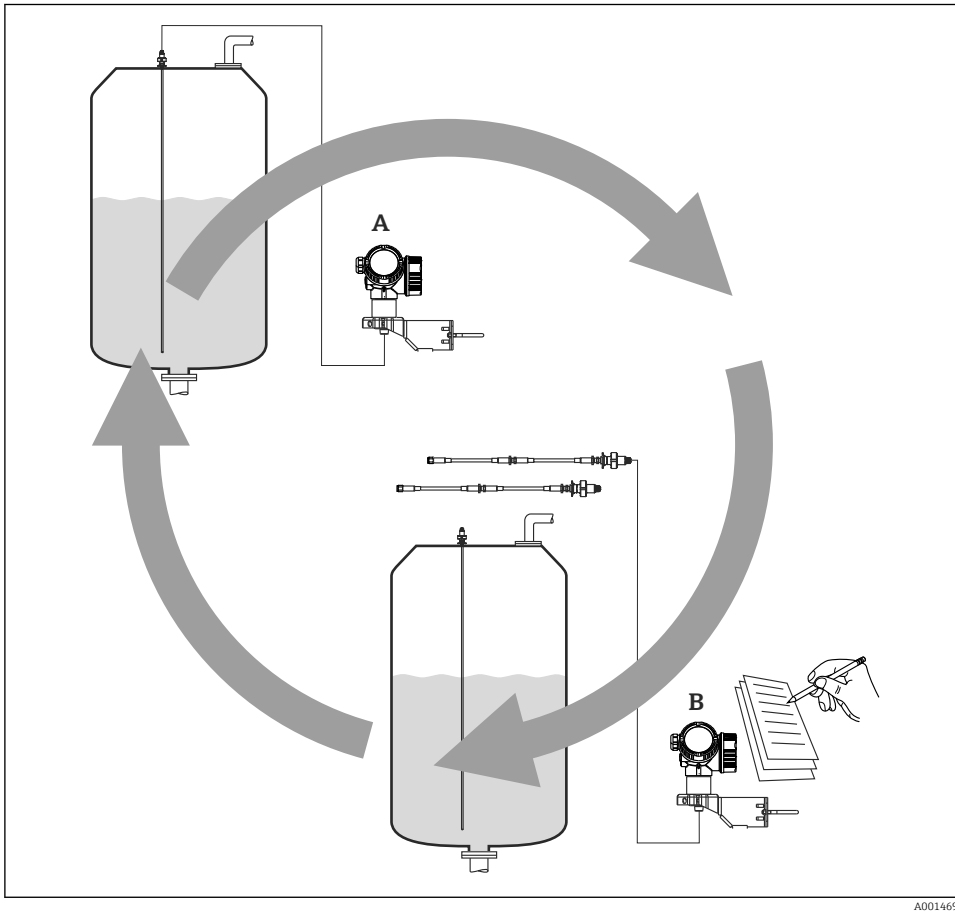
1 Scope of delivery

The calibration kit contains the following parts:

Amount	Designation	Description	Diagram
1	Reference adapter	Adapting the reference cables to the transmitter	 A0014683
1	SMA coaxial cable 126 mm (5.0 in)	Reference cable 1	 A0014684
1	SMA coaxial cable 196 mm (7.7 in)	Reference cable 2	
1	SMA coaxial cable 370 mm (14.6 in)	Reference cable 3	
1	SMA coaxial cable 719 mm (28.3 in)	Reference cable 4	
1	SMA line terminator	Short-circuit connector for terminating line at open end	 A0014685
1	BA00360F	Brief operating instructions for calibration of Levelflex M FMP43	 Betriebsanleitung Levelflex M FMP43 Geführtes Füllstand-Radar Kalibrations-Kit Endress+Hauser
1	SD01003F	Brief operating instructions for calibration of Levelflex FMP53	 Sonderdokumentation Levelflex FMP53 Geführtes Füllstand-Radar Kalibrations-Kit Endress+Hauser

2 Designated use

The calibration kit is used to regularly test the accuracy and reproducibility of the Levelflex FMP53 level measurement device. By using the calibration kit for testing, the need to remove the probe from the process is eliminated. It is not necessary to open highly sterile processes for repeat testing.



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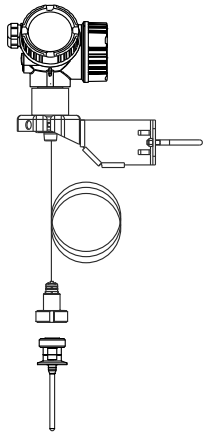
A Operation
B Calibration

In hazardous or contaminated areas, seal the adapter with the protective cover (order no.: 71041379) (20 Nm (14.75 lbf ft)) and include in local potential matching if necessary (see BA00362F).

2.1 Suitable versions of the Levelflex FMP53

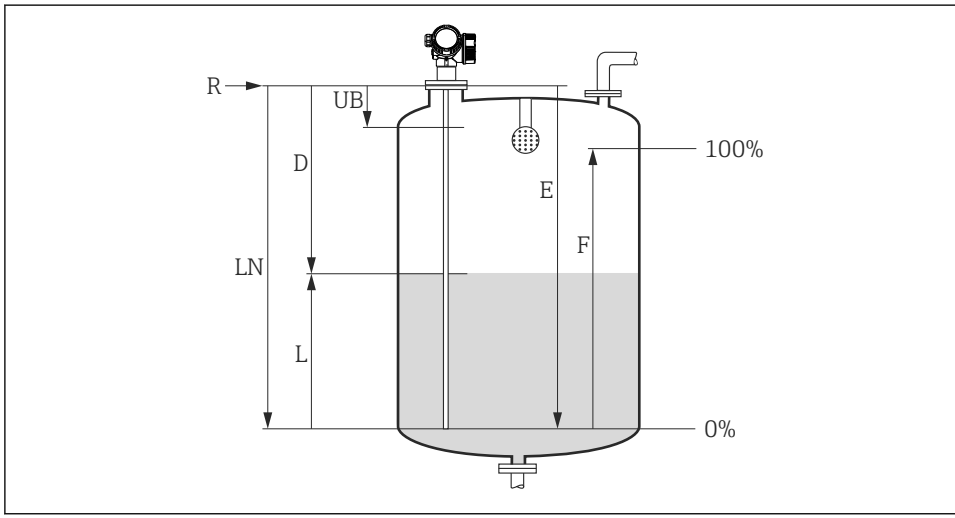
The versions which can be calibrated are those which allow the probe and transmitter to be separated by means of a slotted nut.

Feature 600	MA: Sensor compact, detachable	MB: Sensor remote, 3m/9ft cable, detachable+mounting bracket MC: Sensor remote, 6m/18ft cable, detachable+mounting bracket
Version	 A0014692	 A0014693

3 Function and system design

3.1 Operating principle (measuring principle)

The Levelflex is a "downward-looking" measuring system that functions according to the ToF method (ToF = Time of Flight). What is measured is the distance from the reference point to the product surface. High-frequency pulses are injected to a probe and led along the probe. The pulses are reflected by the product surface, received by the electronic evaluation unit and converted into level information. This method is also known as TDR (time domain reflectometry).



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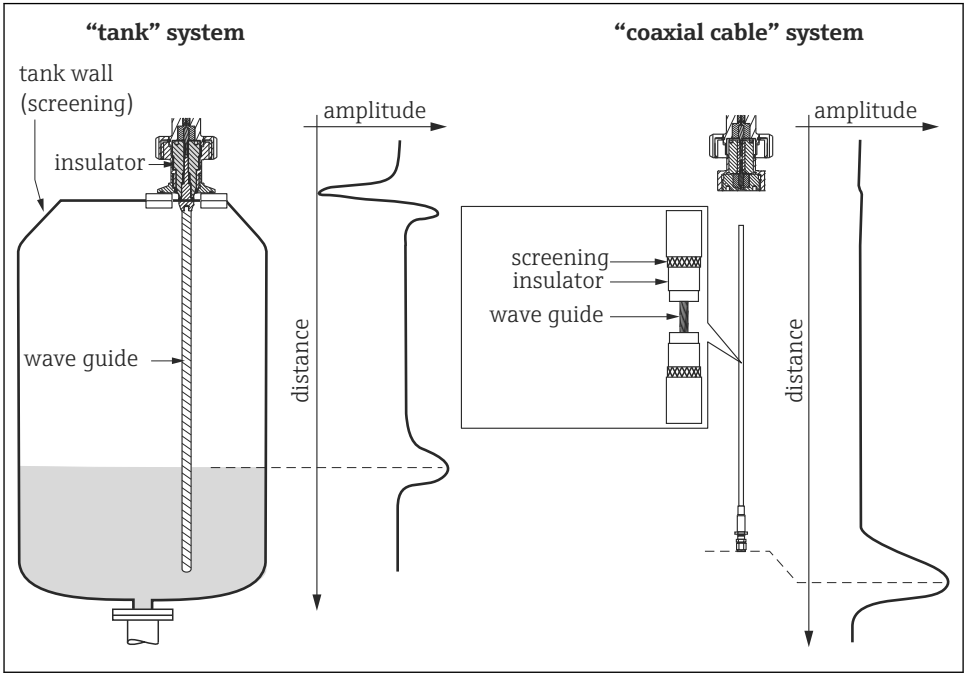
LN Length of probe
D Measured distance
L Measured level
R Reference point of the measurement (lower edge of the process connection)
E Empty calibration (= zero)
F Full calibration
UB Blocking distance

3.2 Systems "Tank" and "Coaxial cable"



The distance measured with the device is greater than the mechanical cable length (→ 🖹 7).

3.2.1 "Tank" system

The probe is a metal rod and, together with the tank, forms a closed system. The probe serves as a wave guide for the electromagnetic waves. The dielectric constant of the medium directly affects the degree to which the high-frequency pulses are reflected at the surface of the medium. Once the internal components of the tank remain unchanged and there is no heavy buildup on the internal wall of the tank and on the probe, this system is not subject to any additional influences.

3.2.2 "Coaxial cable" system

The closed "coaxial cable" system consists of a wave guide, an insulator and screening. The system is closed by means of a line terminator.

For calibration purposes, the coaxial cables are used as the measurement standard. The "coaxial cable" system is a closed system and is not subject to any external influences. Temperature coefficient, linear expansion and aging of the cables have already been taken into account in the overall tolerance of the calibration kit (see Technical Data, → 🖹 13).

3.2.3 Calibration

For calibration using the calibration kit, the closed system consisting of a probe and tank is replaced by another closed system (represented by a coaxial cable and a line terminator).

By using different cable lengths, 2 distance values can be set. This allows the entire measuring chain to be tested for inaccuracy, non-linearity, non-repeatability and hysteresis.

NOTICE

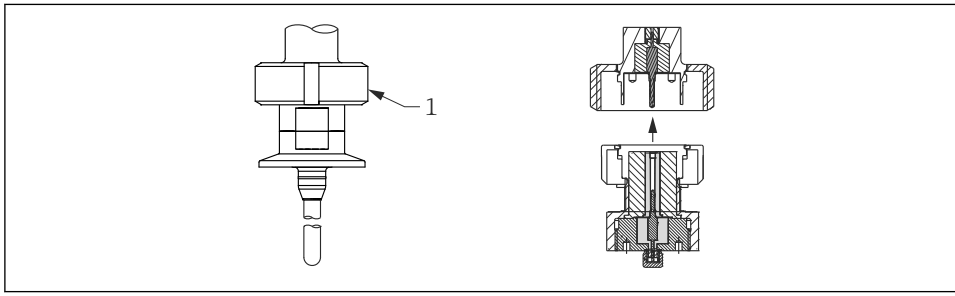
If there is no suppression or suppression is incorrect, the distance measured is distorted.

- Put the measuring point into operation prior to initial calibration (see Operating Instructions, Section "Commissioning).

4 Preparation for reference measurement

4.1 Connecting the calibration kit

For reference measurement using the calibration kit, the probe is disconnected at the separation point (see diagram). To do this, please use a hook spanner. When unscrewing the slotted nut, you must use a fork spanner to counterhold the process connection ring. Otherwise the adapter will become detached from the process connection. The reference adapter is then attached and tightened manually using the slotted nut.



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A Separation point (slotted nut)

Reference cable no. + Adapter (combinations)	Cable length mm (in)	Echo position [1), 2)]		Application
		Ingold process connection mm (in)	Others Process connections mm (in)	
1	126 (4.96)	150 (5.91)	110 (4.33)	All lengths (pay attention to upper blocking distance)
2	196 (7.72)	250 (9.84)	210 (8.27)	All lengths (pay attention to upper blocking distance)
3	370 (14.6)	500 (19.7)	460 (18.1)	Probe length (E) > 550 mm (21.7 in)
2 + 3	566 (22.3)	780 (30.7)	740 (29.1)	Probe length (E) > 830 mm (32.7 in)
4	719 (28.3)	1000 (39.4)	960 (37.8)	Probe length (E) > 1050 mm (41.3 in)
2 + 4	915 (36.0)	1280 (50.4)	1240 (48.8)	Probe length (E) > 1330 mm (52.4 in)
3 + 4	1089 (42.9)	1530 (60.2)	1490 (58.7)	Probe length (E) > 1580 mm (62.2 in)
2 + 3 + 4	1285 (50.6)	1810 (71.3)	1770 (69.7)	Probe length (E) > 1860 mm (73.2 in)

1) Due to the cable's manufacturing tolerances, the actual echo position measured can deviate by ±5 mm (0.2 in).
2) Calculate the actual electrical distance per measurement.

NOTICE

The measuring signal generated (electrical distance) must not be within the configured blocking distance.

▶ Omit measuring point.

4.1.1 Procedure

Prior to each measurement, the SMA line terminator must be screwed on to the end.

1. Select 2 measuring points within the measuring range. These should be as far apart from each other as possible.

2. Perform the reference measurements one after the other using the appropriate cables or cable combinations.

- Disconnect the power supply between measurements. This ensures that echo tracking functions correctly.
- Both measuring points must be within the active measuring range between the upper blocking distance and empty calibration → 🖹 5.
- The cables and the SMA line terminator must be fastened tightly. Care must be taken not to exceed 1 Nm (0.73 lbf ft)of torque.

Example

- Probe length: 1000 mm
- Empty calibration (E): 950 mm
- Full calibration (F): 700 mm
- Upper blocking distance: 200 mm

→ Screw reference cables no. 1 for the upper measuring point.

→ Screw reference cables no. 2+3 tightly together and use them for the lower measuring point.

4.2 Configuring the blocking distance

Prior to the reference measurement, the signal evaluation must be adjusted to ensure that signals are not evaluated by mistake in the area of the reference adapter. To do this, the upper blocking distance must be set to 150 mm (5.91 in).

In the operating menu: **Setup → Advanced setup → Blocking distance**

- For nozzle length >50 mm (1.97 in): Select blocking distance = nozzle length + 100 mm (3.94 in). Cable 1 can no longer be used as it is within the blocking distance.
- It is essential that you take note of the previously configured blocking distance. This must be restored following calibration.

5 Reference measurement

5.1 Reading out distance values

- During calibration, the distance values measured from the reference point of the device are examined.
- The distance values are shown in the Setup menu: **Setup → Distance**

5.2 Reference measurement

- Once the cable or cables have been connected, the device must settle at the reference value. The settling time depends on the time constants configured.
  In the operating menu: **Setup → Advanced setup → Display → Display damping**
  The device is settled if the measured value does not change for a period of 10 sec.
- The measured values are then logged in a calibration report (see master copy at the end of this document).

5.3 Initial calibration / repeat calibration

5.3.1 Initial calibration

Initial calibration is fundamentally different to repeat calibration. In the case of initial calibration, the reference values are determined which will be used as comparison values for repeat calibration. Repeat calibration is therefore based on initial calibration, and its inaccuracies are observed and logged.

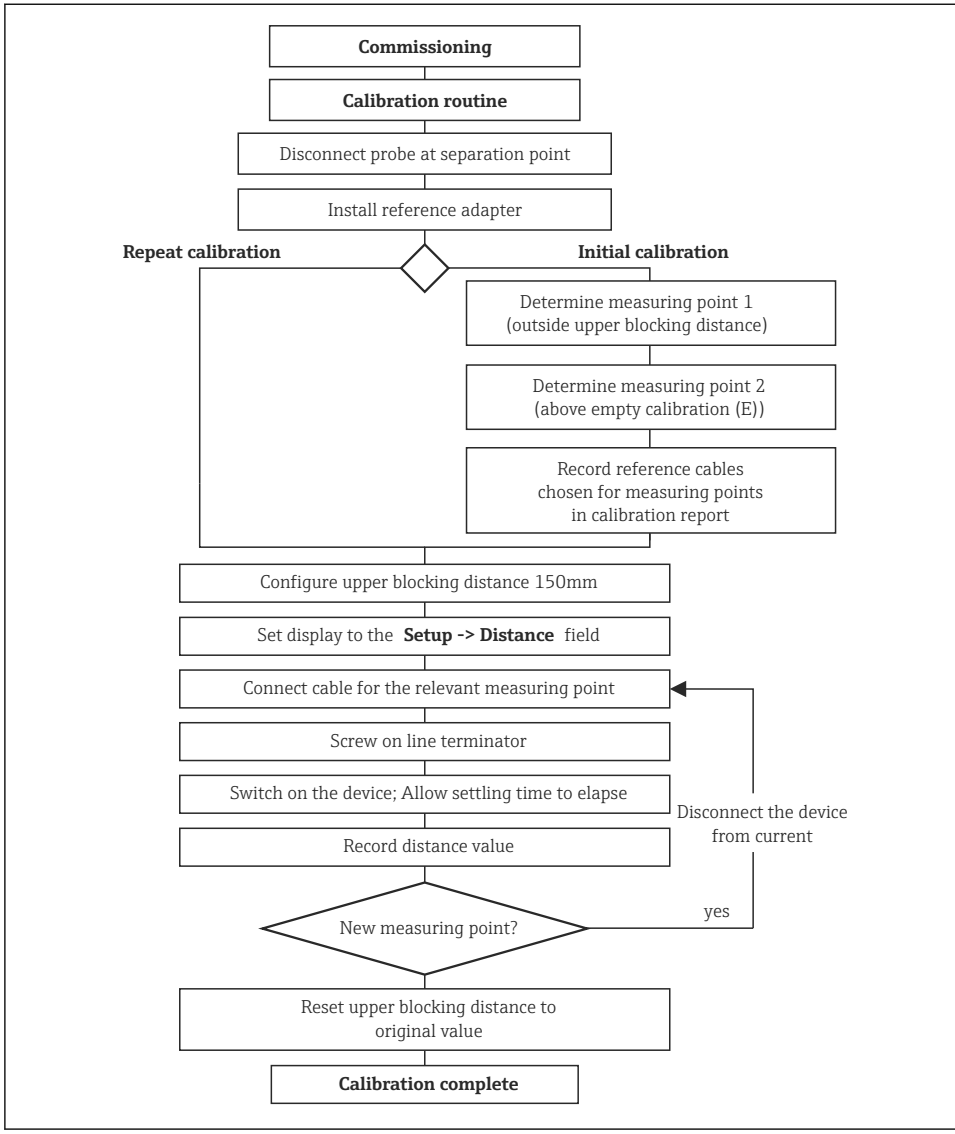
5.3.2 Repeat calibration

For repeat calibration, the cable with the same serial number as for initial calibration must be used. The deviation between the measured distance from initial calibration and repeat calibration must not exceed 2 mm (0.08 in).

Initial calibration must be carried out again if

- electronic/mechanical components are replaced
- the device configuration is changed
- changes are made to the tank internals.

5.3.3 Flow diagram



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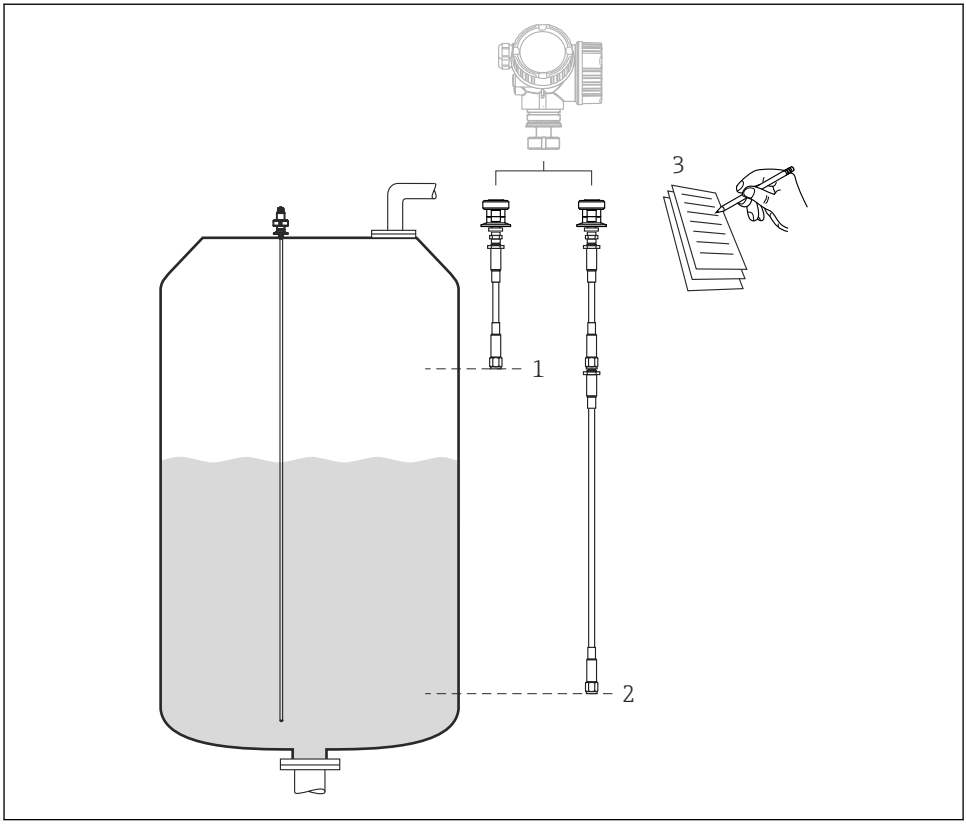
5.3.4 Overview: Calibration



1 Reference measurement 1
2 Reference measurement 2
3 Documentation (see master copy at the end of this document)

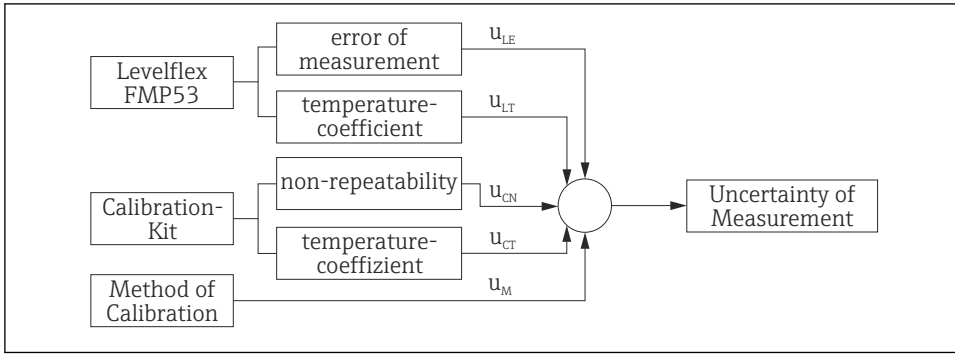
6 Maintenance

By type testing the components in use, the technical data have been verified, and the specified accuracy can be guaranteed for the entire life cycle. Therefore, regular maintenance/testing of the calibration kit is not necessary.

7 Technical data

7.1 Uncertainty of calibration

Calculation of the Uncertainty of Measurement to EAL-R2 "GUM" (Guide to the Expression of Uncertainty of Measurement):



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Estimated uncertainty of calibration: ±2 mm (0.08 in)

The measuring uncertainty has been estimated taking into account the specifications of the instrument and the calibration kit as well as a contribution for the calibration method under standard conditions.

7.2 Ambient conditions during calibration

- Rel. humidity max. 80 %; condensation is not permitted.
- Temperature range: +10 to 40 °C (+50 to 104 °F)
- Temperature change relative to preceding calibration: max ±5 K

7.3 Permitted storage conditions

- Storage temperature: −40 to +80 °C (−40 to +176 °F)
- Rel. humidity: max 80 %; condensation is not permitted.

Endress+Hauser

People for Process Automation

Customer Data

	Logo

Levelflex		**Calibration Kit**	
Instrument Type		Order Code	
Order Code		Serial Number	
Probe Length			
Serial Number			
Tag			

Initial Calibration

Reference No.	Date	Time	Cable Nr. 1	Cable Nr. 2	Cable Nr. 3	Cable Nr. 4	Reference Value (measured distance)	Person in Charge
1								
2								

Recurrent Test

No.	Date	Time	Recurrent Test Values		Test result	Person in Charge
			Reference- No. 1	Reference- No. 2		
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						

Uncertainty of measurement: ±2 mm

Ambient conditions:

- Rel. humidity max. 80%; condensation not permissible
- Temperature range: +10 to 40 °C (+50 to 104 °F)
- Temperature variation to preceding calibration: ±5K

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