Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Operating Instructions

Levelflex M FMP43

Guided Level Radar

Calibration kit



BA360F/00/en/08.07
71042416

Endress+Hauser

People for Process Automation

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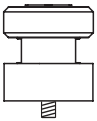
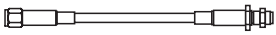
1 Contents

The calibration kit contains the following parts:

Amount	Designation	Description	Diagram
1	Reference adapter	Adapting the reference cables to the transmitter	 xxxxxxxx
1	SMA coaxial cable 126 mm	Reference cable 1	
1	SMA coaxial cable 196 mm	Reference cable 2	
1	SMA coaxial cable 370 mm	Reference cable 3	
1	SMA coaxial cable 719 mm	Reference cable 4	
1	SMA line terminator	Short-circuit connector for terminating line at open end	
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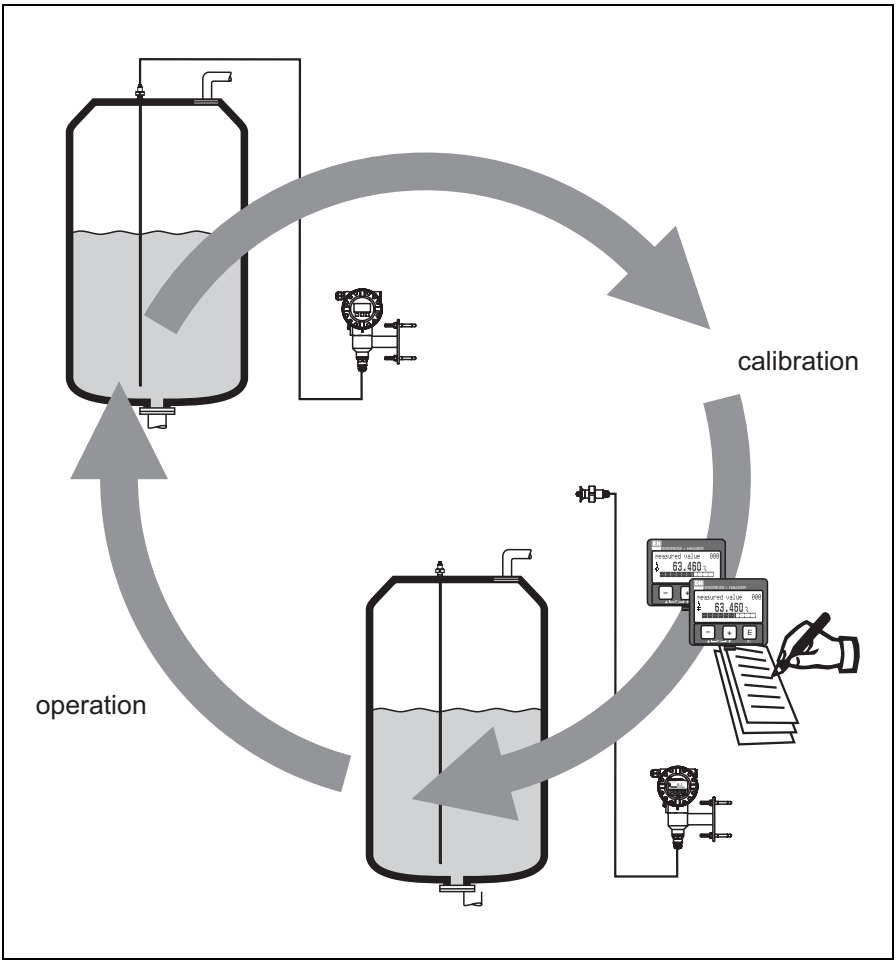
2 Designated use

The calibration kit is used to regularly test the accuracy and reproducibility of the Levelflex M FMP43 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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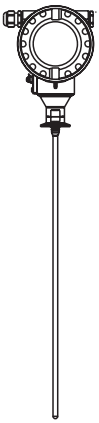
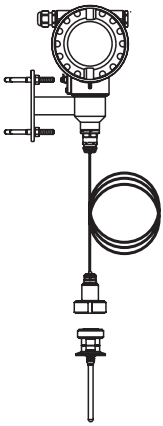
The versions which can be calibrated are those which allow the probe and transmitter to be separated by means of a slotted nut ("compact detachable" and "remote detachable").

Version:	**FMP43-######1###**	**FMP43-######5###**	**FMP43-######6###** (3 m) **FMP43-######7##**# (6 m)
			
Probe type:	Rod probe, compact Standard version	Rod probe, compact Slotted nut for separation from housing	Rod probe, remote Slotted nut for separation from housing
Options:		■ Reference probe can be connected (calibration set FMP43 - order no.: 71041382) ■ Autoclavable (protective cover FMP43 - order no.: 71041379)	

3 Function and system design

3.1 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).

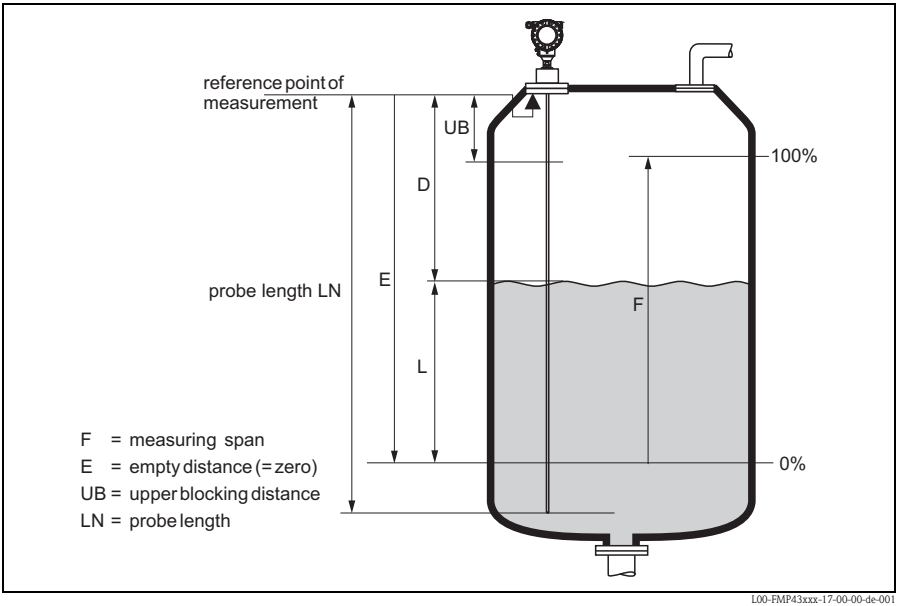
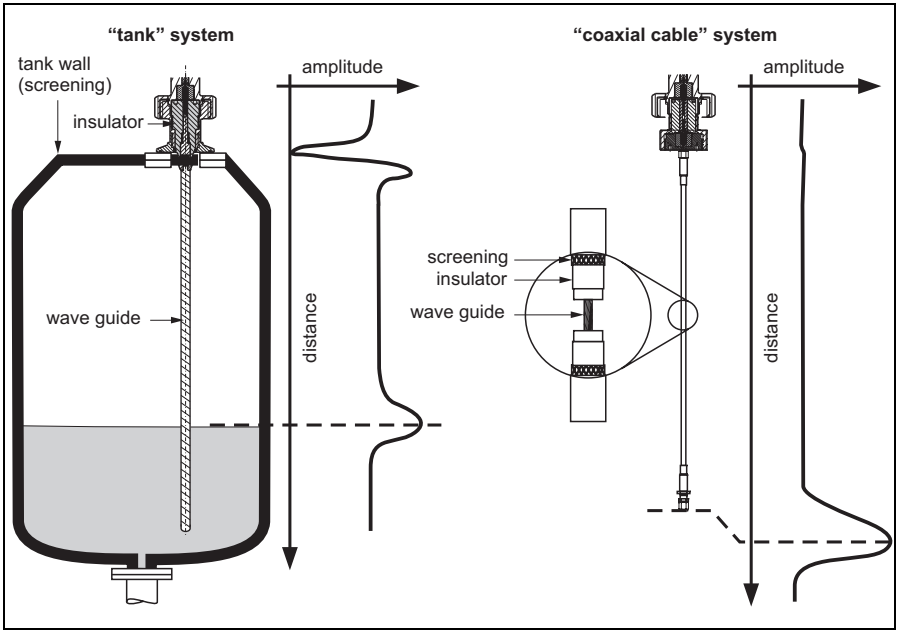


Fig. 1: Reference point of measurement

Systems "Tank" and "coaxial-cable"



"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.

"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.

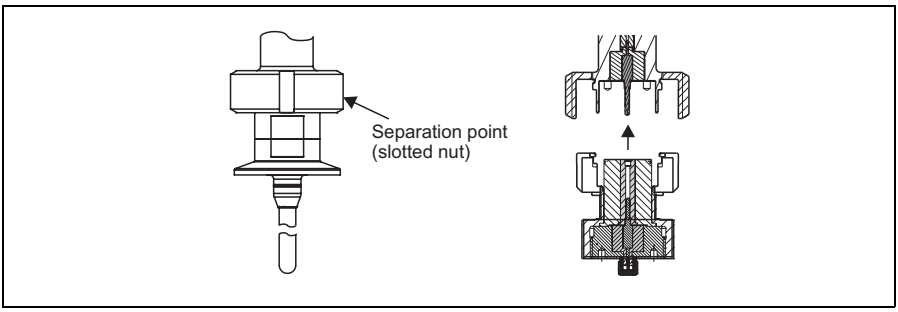
For calibration purposes, the coaxial cables are used as the measurement standard. The "coaxial cable" system is a closed system and is not subject to any external influences. Temperature coefficient, linear expansion and aging of the cables have already been taken into account in the overall tolerance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

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.

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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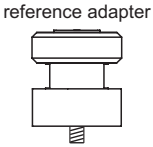








Reference cable no.	Application
1	All lengths (note upper blocking distance)
2	All lengths (note upper blocking distance)
3	Probe length (E) ≥ 550 mm
2 + 3	Probe length (E) ≥ 830 mm
4	Probe length (E) ≥ 1050 mm
2 + 4	Probe length (E) ≥ 1330 mm
3 + 4	Probe length (E) ≥ 1580 mm
2 + 3 + 4	Probe length (E) ≥ 1860 mm

Procedure
- Select 2 measuring points within the measuring range. These should be as far apart from each other as possible.
- Perform the reference measurements one after the other using the appropriate cables or cable combinations.
- Prior to each measurement, the SMA line terminator must be screwed on to the end.

Notes!
- Both measuring points must be within the active measuring range between the upper blocking distance and empty calibration (see Measuring principle on → 6)
- The cables and the SMA line terminator must be fastened tightly.

Example:

Probe length: 1000 mm

Empty calibration: 950 mm

Full calibration (span): 700 mm

Upper blocking distance: 200 mm

→ Use reference cable no. 1 for the upper measuring point.

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

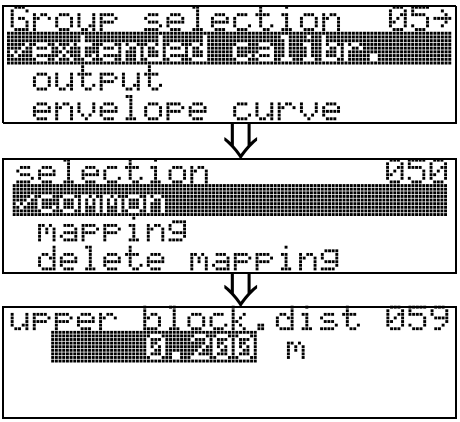
Note!
Prior to each measurement, the SMA line terminator must be screwed on to the end.
The SMA line terminator must be screwed on tightly to the reference cable.

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 (see…) must be set to 150 mm.

Procedure:





In the group selection, select the function group "extended calibration" (05) using "ENTER".

In the "selection" (50) function, select "common" using "ENTER".

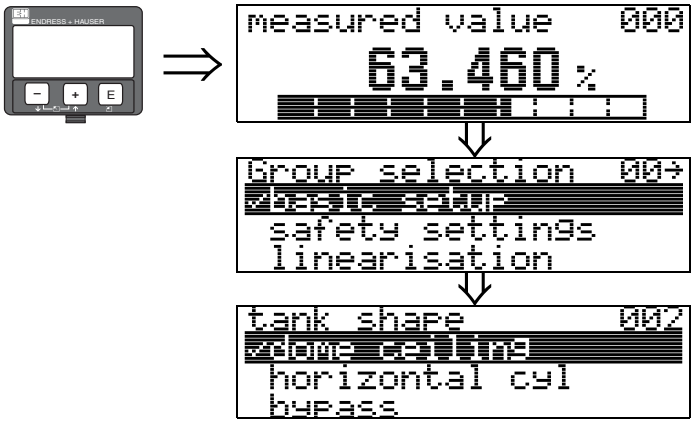
Use "ENTER" to page to "upper block. dist". Using the "–" and "+" keys, set to 0.150 m and confirm your entry using "ENTER".

Note!
Note: It is essential that you take note of the previously configured blocking distance. This must be restored following calibration.

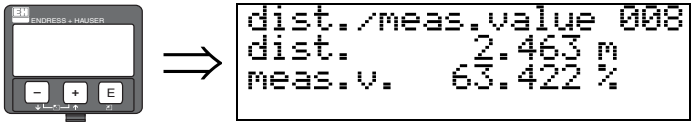
5 Reference measurement

5.1 Reading out distance values

- During calibration, the distance values measured from the reference point of the device (see Measuring principle on → 6) are examined.
- The distance values are shown in the device display under "basic setup". To access them, page through "basic setup" using "ENTER" until you reach "dist./meas.value".



5.2 Reference measurement



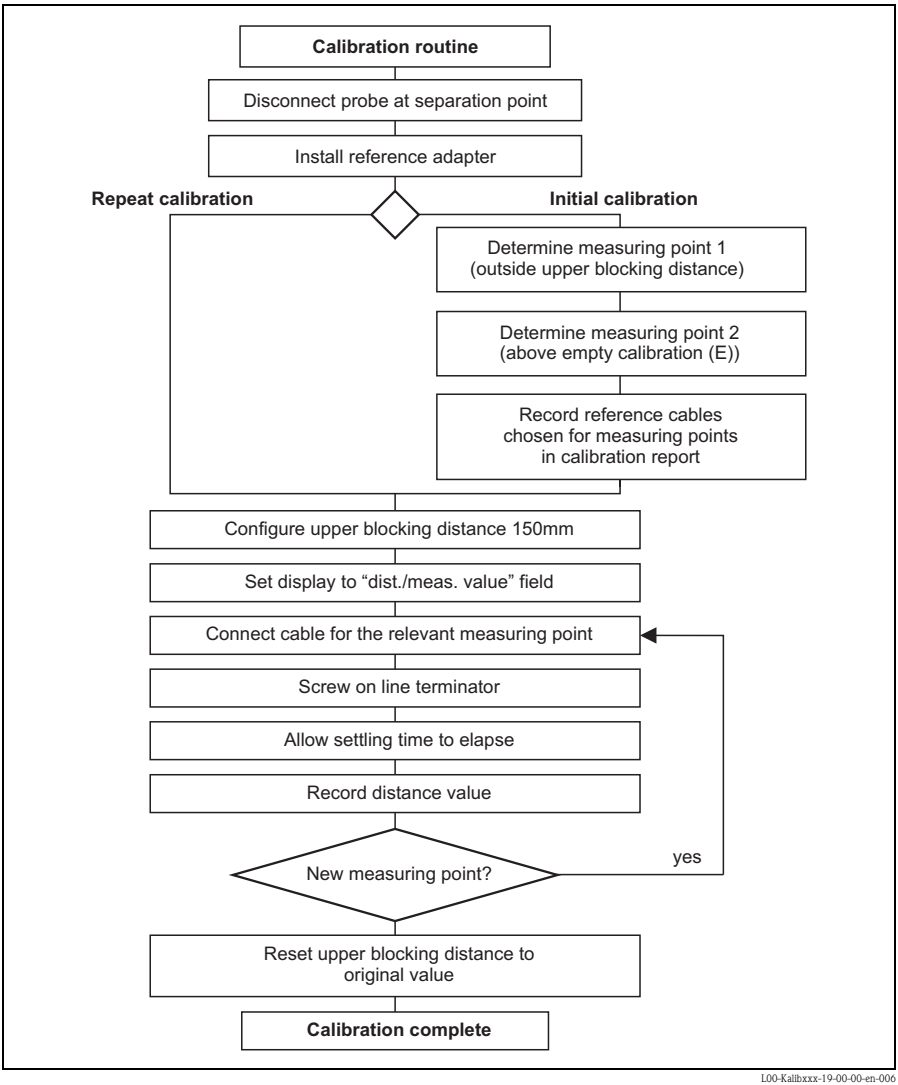
- Once the cable or cables have been connected, the device must settle at the reference value. The settling time depends on the time constants configured (basic calibration → process conditions and extended calibration → output damping). The device is settled if the measured value does not change for a period of 10 sec.
- The measured values are then logged in a calibration report (see also "Example of a calibration report" on → 14).

5.3 Initial calibration / repeat 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. See also "Example of a calibration report" on → 14.

Note!
Initial calibration must be carried out again if
- electronic/mechanical components are replaced
- the device configuration is changed or
- changes are made to the tank internals.

5.3.1 Flow diagram



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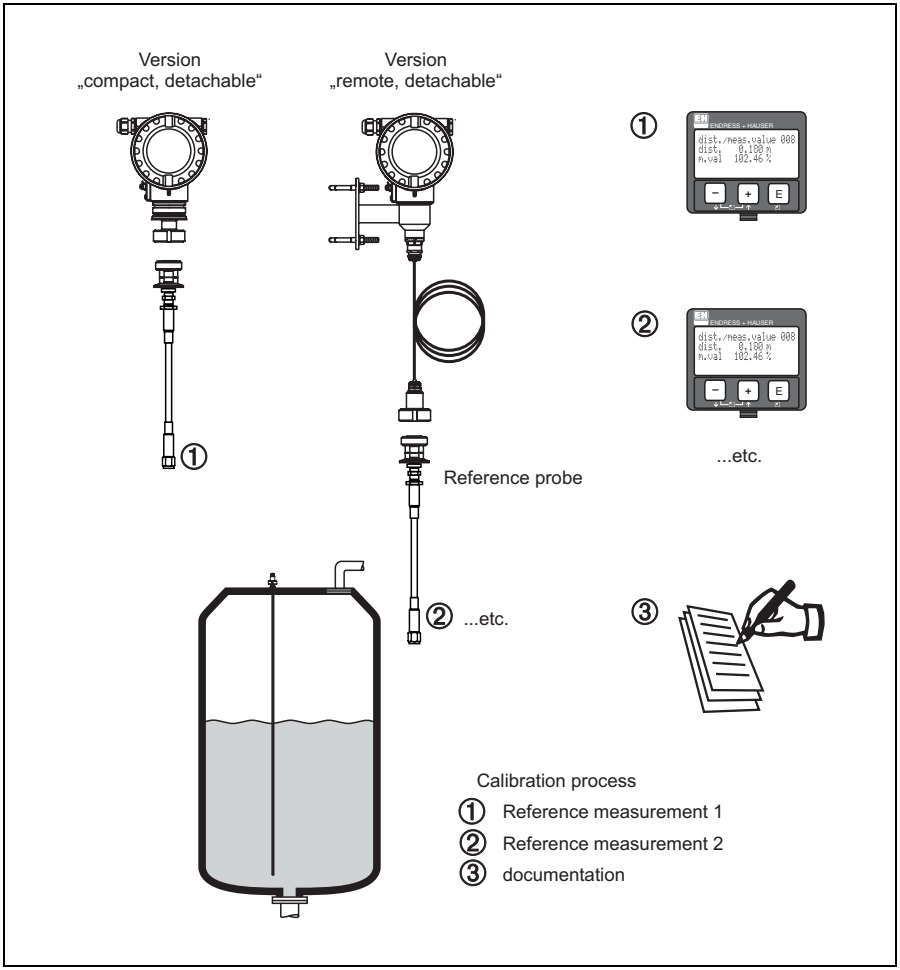
5.3.2 Overview: Calibration



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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 Appendix

7.1 Example of a calibration report

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Customer Data

	Logo

Levelflex M		**Calibration Kit FMP43**	
Instrument Type	FMP43	Order Code	5200-9785
Order Code	ATSTDJB21A4A	Serial Number	5804032014A
Probe Length	950mm		
Serial Number	7806420104E		
Tag	LI200A		

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	07.03.2007	11:43	x				152 mm	
2	07.03.2007	11:50		x	x		783 mm	

Recurrent Test

No.	Date	Time	Recurrent Test Values		Test result	Person in Charge
			Reference- No. 1	Reference- No. 2		
1	09.08.2007	9:37	151 mm	784 mm	o.k.	
2	06.12.2007	14:54	152 mm	785 mm	o.k.	
3	03.03.2008	8:32	150 mm	780 mm	o.k.	
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						

Uncertainty of measurement: ±6 mm

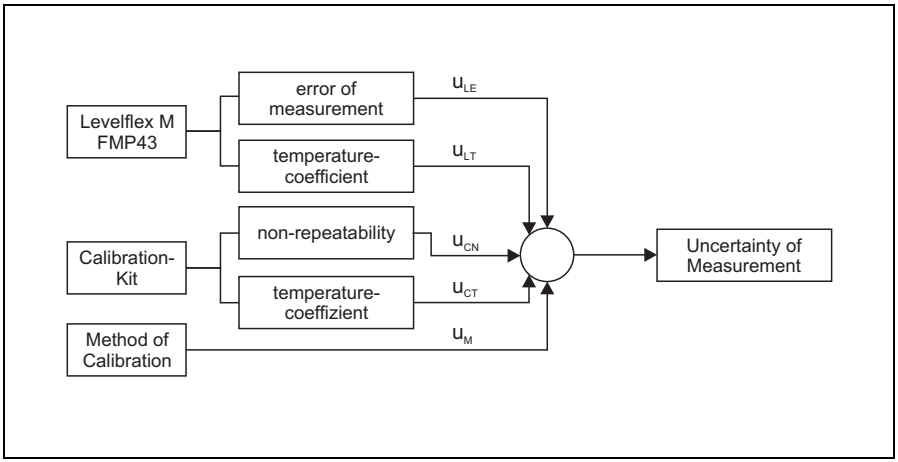
Ambient conditions:

- Rel. humidity max. 80%; condensation not permissible
- Temperature range: 10…40°C
- Temperature variation to preceding calibration: ±5K

8 Technical data

8.1 Uncertainty of calibration

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



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Measuring uncertainty of calibration: ±5 mm

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.

8.2 Ambient conditions during calibration

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

8.3 Permitted storage conditions

-40 to 80°C
Rel. humidity max. 80%; condensation is not permitted.

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