

Instrument calibration sheet

Certificate N°	000015/2021	Date of issue	21.06.21
Client	ENEL Produzione	Work order	8000000591

Instrument specification

Type	Thermometer	Manufacturer	Endress-Hauser	Serial number	-
Min capacity	0	Max capacity	30	Model	-
Readability At 0	0,01	Readability	0,01	Unit of measure	°C
Description	SF1 Thermometer	Next Calibration	17.03.21		

Test ambient conditions

Location	ENEL - SF1	Date of test	21.06.21	00:00	
Temperature	22°C	Humidity	71%	Pressure	1020hPa

Standard certificates used

Name	Number	Issuer	Date of issue
MICROCAL 20 DPC + PT100	LAT_150_0468_MT_2020	A.S.I.T.	07.07.20

Calibration summary

Test	Certificate name	Uncertainty	Temperature	Humidity	Pressure
Repeatability	MICROCAL 20 DPC + PT100	0,057808°C	28°C	71%	1020hPa
Linearity	MICROCAL 20 DPC + PT100	0,085538°C	23°C	75%	1021hPa
Expanded uncertainty					0,171077°C

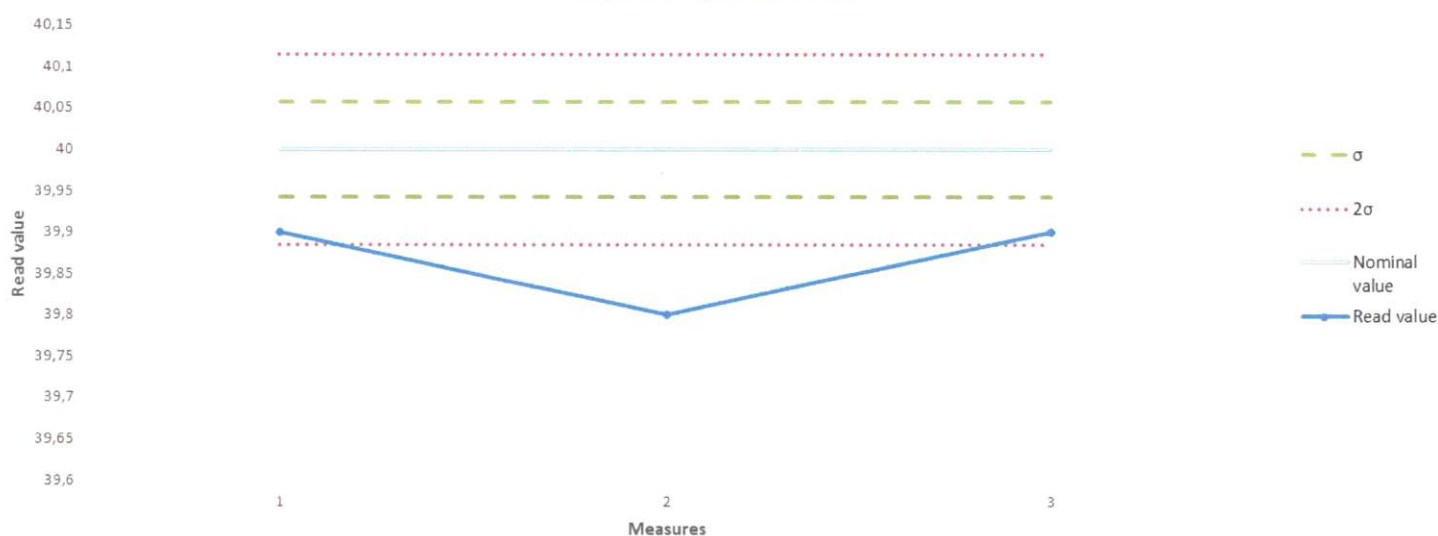
Notes

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Repeatability

Measure	Nominal value	Conventional value	Read value	Deviation	Serial	Uncertainty	OIML
1	40	40	39,9	-0,1	105286	0,05	
2	40	40	39,8	-0,2	105286	0,05	
3	40	40	39,9	-0,1	105286	0,05	
Min value		39,8	Max value		Average value		39,86667
Standard deviation (σ)		0,057736		Repeatability uncertainty		0,057808	

Repeatability control chart



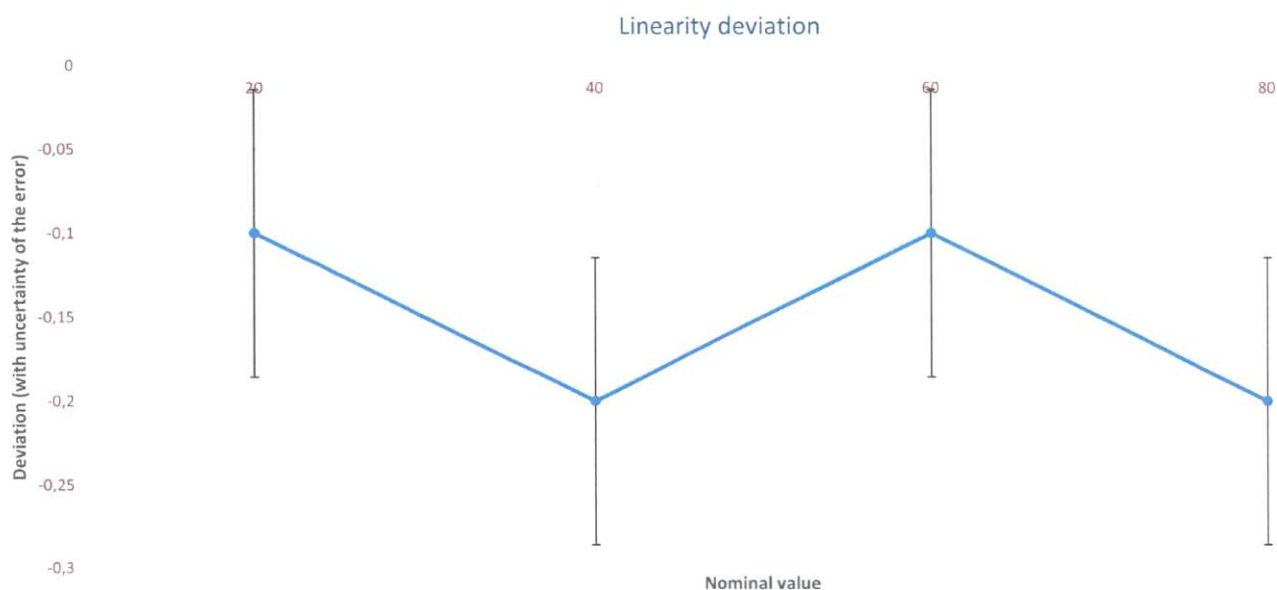
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Linearity

Measure	Nominal value	Conventional value	Read value	Error	Uncertainty of error	Standard reference	
						Uncertainty	OIML
1	20	20	19,9	-0,1	0,085538	0,05	
2	40	40	39,8	-0,2	0,085538	0,05	
3	60	60	59,9	-0,1	0,085538	0,05	
4	80	80	79,8	-0,2	0,085538	0,05	

Min value 19,9 Max value 79,8 Average value 44,84

Standard deviation 0,2 k-Factor: 2 (95,45%) Expanded uncertainty 0,171077



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Formulas

Repeatability

The test consists in the repeated measure of the same reference value, under identical conditions of handling the reference and the instrument, and under constant test conditions, both as far as possible

Standard deviation is computed to allow an appraisal of the instrument's performance.

$$s(I) = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (I_i - \bar{I})^2} \quad \bar{I} = \frac{1}{n} \sum_{i=1}^n I_i$$

Repeatability standard uncertainty has been computed with the following formula, taking into account instrument's scale interval (d)

$$u_{rep} = \sqrt{s(I)^2 + \left(\frac{d_I^2}{12}\right)}$$

Linearity

This test is performed with different test values distributed fairly evenly over the normal measuring range. The purpose of this test is an appraisal of the performance of the instrument over the whole measuring range.

The uncertainty of the error is computed with the following formula and takes into account repeatability and eccentricity uncertainty when applicable:

$$u(E) = \sqrt{u^2(I_{dig0}) + u^2(I_{dig1}) + u^2(I_{rep}) + u^2(I_{ecc}) + u^2(I_{mc}) + u^2(I_{mb}) + u^2(I_{md}) + u^2(I_{mconv})}$$

The terms relative to air buoyancy (mb) and convection effects (mconv) are considered negligible due to enough acclimatisation allowed to the instrument.

Expanded uncertainty has been computed with the following formula:

$$U = u(E)_{max} k$$

For this report a coverage factor of 2 as been considered giving an overall confidence level of 95,45%