

Instrument calibration sheet

Certificate N° 000162
Client ENEL Produzione

Date of issue 09/12/2019
Work order 8000000591

Instrument specification

Type	Thermometer	Manufacturer	Endress-Hauser	Max capacity	30
Model	-	Serial number	-	Readability	0,01
Description	C1 Itar Thermometer			Unit of measure	°C

Test ambient conditions

Location	ENEL - C1 Itar		Date of test	09/12/2019	10:00
Temperature	23°C	Humidity	75%	Pressure	1021hPa

Standard certificates used

Name	Number	Issuer	Date of issue
MICROCAL 20 DPC + PT100	LAT 188_0160_CT_19	Metra	26/06/2019

Calibration summary

Test	Certificate name	Uncertainty	Temperature	Humidity	Pressure
Repeatability	MICROCAL 20 DPC + PT100	0,002887°C	23°C	75%	1021hPa
Linearity	MICROCAL 20 DPC + PT100	0,100789°C	23°C	75%	1021hPa
Expanded uncertainty					0,201577°C

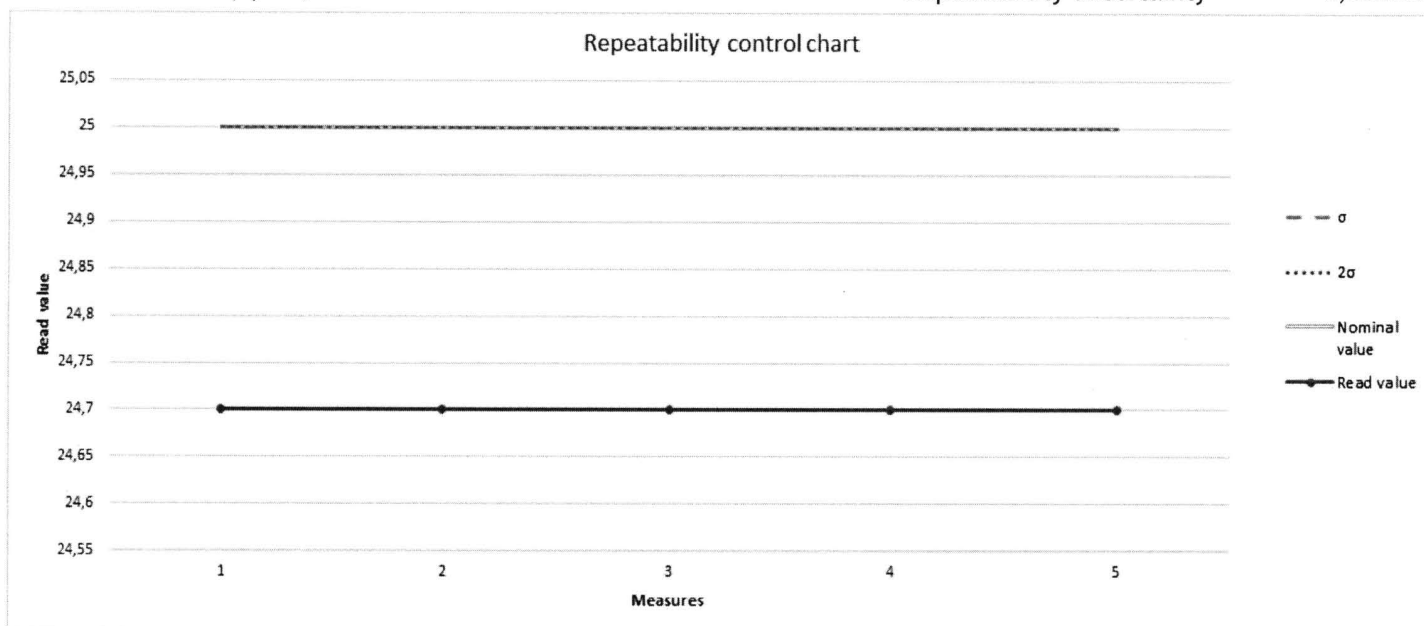
Notes

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Repeatability

Measure	Nominal value	Conventional value	Read value	Deviation	Standard reference		
					Serial	Uncertainty	OIML
1	25	25	24,7	-0,299999	E06P255	0,08	
2	25	25	24,7	-0,299999	E06P255	0,08	
3	25	25	24,7	-0,299999	E06P255	0,08	
4	25	25	24,7	-0,299999	E06P255	0,08	
5	25	25	24,7	-0,299999	E06P255	0,08	

Min value 24,7 Max value 24,7 Average value 24,7
Standard deviation (σ) 0,000001 Repeatability uncertainty 0,002887



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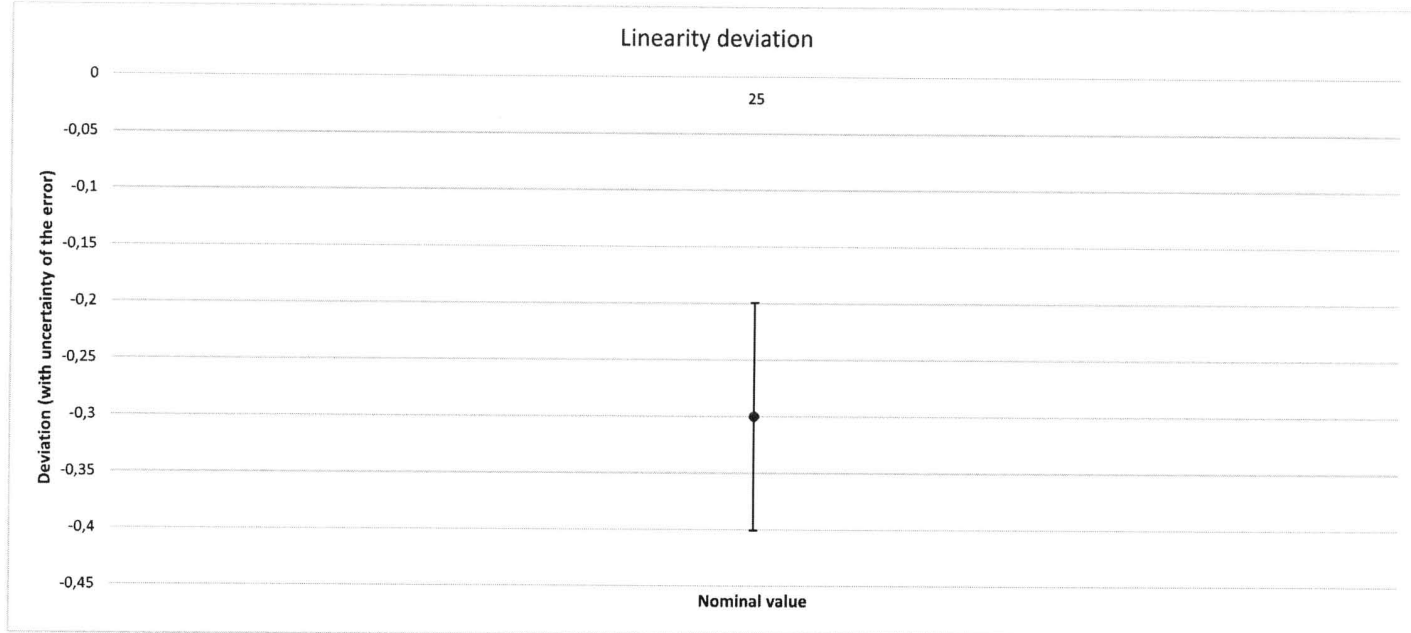
Linearity

Measure	Nominal value	Conventional value	Read value	Error	Uncertainty of error	Standard reference
						Uncertainty OIML
1	25	25	24,7	-0,299999	0,100789	0,08

Min value 24,7 Max value 24,7 Average value 24,7

Standard deviation 0,299999 k-Factor: 2 (95,45%) Expanded uncertainty 0,201577

Linearity deviation



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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%