SMQ-ILC Temperature 2023:1 2025-03-18

Accred. no. 10436
Proficiency testing
ISO/IEC 17043

To participants

Report on an interlaboratory comparison on temperature (Rev 2)

The bag carrying the temperature sensors set for calibration.

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Content

Abstract

This report documents an interlaboratory comparison (ILC) on temperature calibration involving multiple laboratories. The comparison aimed to evaluate the calibration processes, assess measurement consistency, and determine uncertainties. It includes an overview of participating laboratories, calibration schemes, and conditions during the measurement period. Detailed calibration results are presented across a range of temperatures for two sensors.

Analysis methods, intercomparison reference values, and associated uncertainties are discussed. The report also highlights calibration principles, administrative details, and final conclusions, supported by annexes and appendices detailing the methodology, reporting formats, and references.

Specific observations:

This report covers all together calibrations of the temperature sensors made by 21 laboratories in 13 countries. Their calibration certificates were mostly in their local language but sometimes in English.

The summarized results from calibrations on sensor 1 have 5 results got En values above 1.

The summarized results from calibrations on sensor 2 have 12 results got En values above 1.

Purpose and implementation of the comparison

This interlaboratory comparison serves as a tool to verify results reported by calibration laboratories.

It is an effective method to demonstrate technical capacity of the participant and serves as a technical base for accreditation as required by ISO/IEC 17025:2017 (SS-EN ISO/IEC 17025:2018) as specified in point 7.7.2.

Advisory group

The intercomparison has followed the recommendations of the advisory group. The advisory group has defined the set-up of temperature sensors that should be included in the ILC temperature 2023:1.

The advisory group consisted of Magnus Holmsten National Metrology Institute (RISE) and Håkan Källgren Swedish Metrology and Quality (SMQ).

Information about the intercomparison

The information about the intercomparison was given in 3 different media:

- Linkedin
- The data base https://www.eptis.org
- On the web https://smquality.se/interlaboratory-comparisons-ilc

The information on the web was done in 2 steps. General information as ILC temperature 2023:1 published on smquality.se and enclosed to this report in annex 1.

Detailed information as a description of the intercomparison/ILC is published on smquality.se and enclosed with this report the reporting forms as annex 2.

Participating laboratories and measuring scheme for the comparison

Laboratory	Country
RISE, reference laboratory	**Sweden**
G+B Kalibriertechnik GmbH	Germany
Element Metech AB	Sweden
Pentronic AB	Sweden
Wessex Power Technology Limited	Great Britain
Bitos NV	Belgium
CALTECNICA INGENIEROS, S.L.	Spain
TPF Control BV	Netherlands
SAXE Hansen A/S	Denmark
Jormita Oy	Finland
THERMO ELECTRON SAS	France
Kamstrup A/S	Denmark
Jumo	Sweden
Nok9 AB	Sweden
Trescal Romania Srl	Romania
Nordtec instrument AB	Sweden
Max Sievert AS	Norway
Senseca Italy Srl—Temperature laboratory	Italy
MESA Meß- und Regeltechnik Vertriebs- und Service GmbH	Germany
Sartorom Impex SRL	Romania
EUROPE QUALITE ROMANIA	Romania
Elastocon AB	Sweden
RISE, reference laboratory	**Sweden**

The circulation started in week 10 in 2024 and ended in week 3 2025.

Several of the participants are accredited by NA, Cofrac, FINAS, DANAK, SWEDAC, UKAS, ENAC, ACCREDIA, DAkkS and RENAR.

The reference laboratory RISE, Sweden has the status as National Metrology Institute, NMI and did the reference calibrations.

Principles concerning the calibration in general.

The reference laboratory calibrated the temperature sensors at the beginning and after finishing the circulation.

During the whole exercise the preliminary reported results were used for checking possible drift behaviour of the sensors. The purpose was to maintain equal conditions for all participants over the total measurement period. In doubt the sensors were planned to be called back for a new reference calibration, which however was not necessary.

Conditions and transport during the measurement period

A special case was used for transport.

Calibration Point temperature	CMC values Reference laboratory	Possible reference uncertainty (U) Sensor 1*	Possible reference uncertainty (U) Sensor 2*	Resulted reference uncertainty (U) Sensor 1	Resulted reference uncertainty (U) Sensor 2
°C	°C	°C	°C		
-80	0,005		0,015		0,016
-40	0,005	0,015	0,015	0,012	0,014
-30	0,005	0,015	0,015	0,015	0,015
0	0,005	0,015	0,015	0,010	0,015
50	0,005	0,015	0,015	0,013	0,015
80	0,005	0,015	0,015	0,014	0,017
120	0,005	0,015	0,015	0,018	0,016
199	0,005	0,015	0,015	0,019	0,019
300	0,010		0,020		0,026
400	0,010		0,020		0,031
500	0,015		0,025		0,033

’ Including possible drift during circulation.

The resulted reference uncertainty on sensor 1 including drift was very close to the expected uncertainty except for 120 and 199ºC

The resulting reference uncertainty on sensor 2 including drift was very close to the expected uncertainty except for 199 to 500 ºC where the result was a bit higher.

Calibration instructions

The laboratories were allowed maximum 5 days for their calibration. In the call they were advised to use their own calibration and reporting procedures.

Planning and administrative details

Administrative information

Address to send the required documents:
Swedish Metrology and Quality AB Håkan Källgren Dragspelsgatan 21 SE-504 72 Borås, Sweden e-mail: hakan.kallgren@smquality.se Phone: +46 705 774 931

Summary of the timeline planning in the call:

- The preliminary results (excel-protocol) should be sent to the organiser when the parcel was sent to next participant.
- One week after the calibration/measurement the calibration certificate should be sent to the evaluator of the intercomparison.
- A draft report should be dispatched to the participants 2 weeks after receiving the last calibration certificates.
- Comments or feed-back on the draft report to the organiser were expected within 1 week.
- Final report should be finalized within 2 weeks after receiving all comments or feed-back from the participants.

Analysis of the calibration results

The evaluator used the principles of the ISO/IEC 17043:2023 in the reporting.

As an easy-to-understand measure to judge each participant result its distance to the assigned reference value is used, normalized with respect to the uncertainty in this difference. This measure the En-value is calculated for every calibrated sensor according to equation 1).

$$En_{i,j} = \frac{x_{i,j} - x_{ref,j}}{\sqrt{U_{i,j}^2 + U_{ref,j}^2}} \qquad \text{(eq. 1)}$$

$x_{i,j}$: Single measurement result (deviation from nominal value); index *i* and *j* count the various participants

$x_{ref,j}$: Assigned inter-comparison reference value for sensor *j*.

$U_{i,j}$: The estimated expanded uncertainty (k=2) stated by each laboratory *i* for respective sensor *j*.

$U_{ref,j}$: The estimated expanded uncertainty (k=2) of the assigned reference value for the same sensor *j*.

$En_{i,j}$: The calculated En-value for each participant i and each sensor *j*.

Inter-comparison reference value and its uncertainty

The reference values $x_{ref,j}$ are calculated as the average from the first and last calibration provided by the reference laboratory.

$$x_{ref,j} = \frac{R_{1,j}+R_{2,j}}{2} \qquad \text{(eq. 2)}$$

For each instrument

$x_{ref,j}$: The calculated inter-comparison reference value for sensor *j*.
j: Counting the different results.
$R_{1,j}$ & $R_{2,j}$: The assigned comparison reference values provided by the reference laboratory at start and end. In the result tables and the diagrams only the symbol REF is used for identifying the assigned reference result.

The measurement uncertainty for the sensors was calculated as the uncertainty of their mean (equation 3).

At some calibration points the reported uncertainties differed slightly between the calibration at the beginning and the end. Thus, the measurement uncertainty for each calibration level was calculated as the uncertainty of the mean (equation 3).

$$U_j = \frac{\sqrt{U_{1,j}^2+U_{2,j}^2}}{\sqrt{2}} \qquad \text{(eq. 3)}$$

U_j: The combined uncertainty from two calibrations (at different levels *j*).
Index 1: Refers to the calibration prior the circulation.
Index 2: Refers to the calibration at the end of circulation.

Given the same uncertainty for a level at start and at the end the uncertainty of the reference value is identical with that stated by the laboratory in one of the calibrations. Otherwise, the reference uncertainty lies close to the middle of both.

The data supplied by the reference laboratory indicated a small drift that was considered. The uncertainty of the inter-comparison reference value was then composed by adding half of the detected drift over the time for the total exercise, see equation 4.

$$U_{ref,j} = U_j + \frac{1}{2} abs\left(R_{2,j} - R_{1,j}\right) \qquad \text{(eq. 4)}$$

The change in the temperature results on the sensors between first and final calibration half of this difference is added to the combined uncertainty to catch this possible drift. However, the differences found are far below the stated calibration uncertainties and do not contribute much to the uncertainty of the reference values.

The principle of the intercomparison

An absolute value of E_n of less than |1| is often used as a criterion for an acceptable measurement quality, according to ISO/IEC 17043:2023, B.4.1.3.e. It means a reported deviation x_i from the nominal mass value by a participant does not deviate more from the assigned reference comparison value x_{ref} than what can be expected from the calculated uncertainty in this difference.

$$E_n < 1: \quad \left|x_i - x_{ref}\right| < \sqrt{U_i^2 + U_{ref}^2} \qquad \text{(eq. 4)}$$

However, to make this measure a reliable one for an inter-comparison the reference U_{ref} must be small enough not to contribute significantly to the right side of equation 4. Due to the quadratic combination ideally U_{ref} should be in the range of 1/3 of U_i. This is not always easy to achieve in relation to all laboratories, which means that relatively high En-values although between -1 and +1 must not be regarded totally reliable if U_{ref} and U_i are of the same size or if $U_{ref} > U_i$.

Measuring results on calibration in the ILC

The following tables present the found deviations from the reference value along with the stated measurement uncertainty for each sensor.

The error and uncertainty are listed in the following tables. This presentation is chosen to allow the participants to compare the tabled data in this report with their own documentation.

Together with the estimated uncertainty $U_{ref,j}$ these two values are used for calculating each participants E_n-value displayed in the last column.

It was the ambition of the organizer to incorporate directly the excel-protocols from participants into the evaluation calculations for reporting the outcome of the comparison measurements after first having checked all data against those in the calibration certificates delivered in a separate calibration certificate. This worked quite well.

The values from the calibration certificates were used if there were differences. Some laboratories asked to use the calculated uncertainties, U from the excel sheets as they intend to ask the accreditation organisations to improve their CMC values.

The following tables are built with increasing participant identity numbers and list at the bottom the belonging reference value based on the average of two calibrations denoted as REF. The identity numbers are not following the logistic scheme. The participants are informed in separate emails about their number.

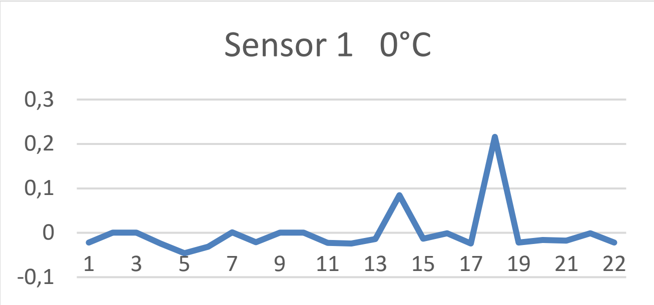
Calibration certificates RISE

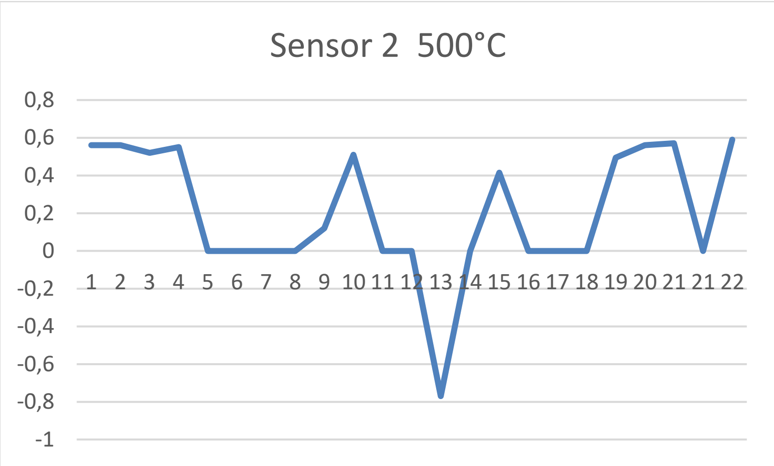
Before calibration 105103-1248203-K01
After calibration 105103-1298922-K01

Stability checks of the sensors

The stability on the sensors were followed up during the circulation and there was not a significant drift.

Below you find examples from the monitoring of drift.





Result of the temperature sensors

Observe that the results for the laboratories are not in chronological order.

The resulting reference value including drift is marked Ref at the bottom of the tables and resulting expanded uncertainty is marked U.

The red lines indicate the reference values multiplied by 2 times the reference uncertainty.

Table 1 Calibration results sensor 1 at -40 °C

Identification	Error	Uncertainty	En value
1	-0,093	0,020	1,03
6	-0,056	0,050	0,25
8	-0,076	0,015	0,36
9	-0,07	0,12	0,01
10	-0,066	0,060	0,05
12	-0,074	0,015	0,26
13	-0,069	0,015	0,00
14	-0,051	0,150	0,12
18	-0,227	0,400	0,39
19	-1,689	0,12	13,43
21	-0,192	0,65	0,19
	Ref	**U**	
	-0,069	**0,012**	

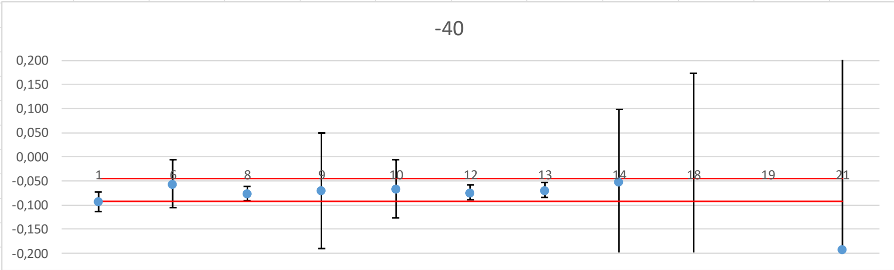


Table 2 Calibration results sensor 1 at -30 °C

Identification	Error	Uncertainty	En value
1	-0,078	0,020	0,63
6	-0,041	0,050	0,41
7	0,046	0,23	0,47
8	-0,062	0,015	0,02
9	-0,05	0,12	0,10
10	-0,069	0,060	0,11
12	-0,063	0,015	0,02
13	-0,059	0,015	0,17
14	-0,049	0,150	0,09
16	-0,039	0,100	0,23
18	-0,193	0,400	0,33
19	-1,329	0,12	10,48
21	-0,102	0,65	0,06
	Ref	**Ref U**	
	-0,063	**0,015**	

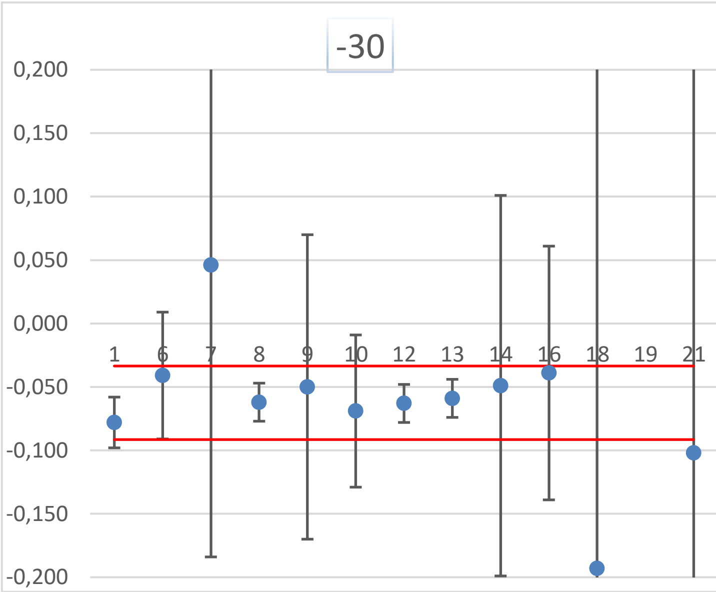


Table 3 Calibration results sensor 1 at 0 °C

Identification	Error	Uncertainty	En value
1	-0,045	0,020	1,03
4	0,086	0,12	0,90
5	-0,016	0,050	0,12
6	-0,001	0,050	0,41
7	-0,030	0,23	0,03
8	-0,025	0,015	0,17
9	-0,01	0,12	0,10
10	-0,022	0,030	0,00
11	-0,030	0,14	0,06
12	-0,025	0,015	0,17
13	-0,024	0,015	0,11
14	-0,022	0,020	0,00
16	0,02	0,10	0,42
17	-0,018	0,05	0,08
18	-0,064	0,400	0,10
19	-0,046	0,12	0,20
20	-0,014	0,10	0,08
21	-0,016	0,4	0,01
	Ref	**Ref U**	
	-0,022	**0,01**	

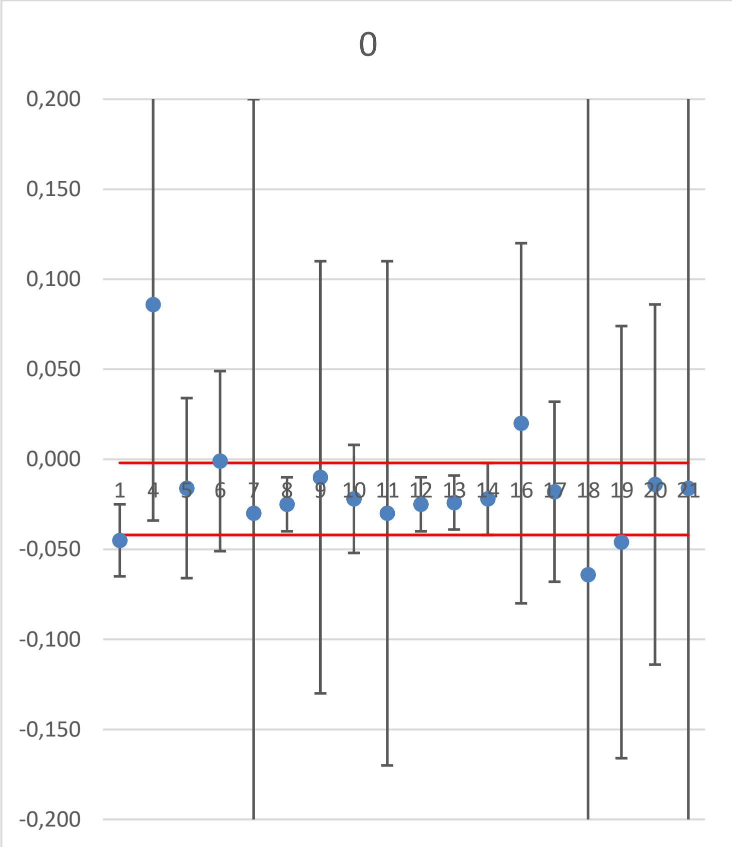


Table 4 Calibration results sensor 1 at 50 °C

Identification	Error	Uncertainty	En value
1	-0,013	0,045	0,70
4	-0,024	0,12	0,36
5	0,011	0,100	0,09
6	0,022	0,050	0,04
7	0,054	0,23	0,15
8	0,013	0,015	0,35
9	0,02	0,12	0,00
10	0,016	0,060	0,07
11	-0,100	1,00	0,12
12	0,013	0,015	0,35
13	0,015	0,015	0,25
14	0,017	0,060	0,05
16	0,02	0,10	0,00
17	0,022	0,10	0,02
18	0,094	0,400	0,18
19	-0,007	0,12	0,22
20	0,027	0,15	0,05
21	0,023	0,4	0,01
	Ref	**Ref U**	
	0,020	**0,013**	

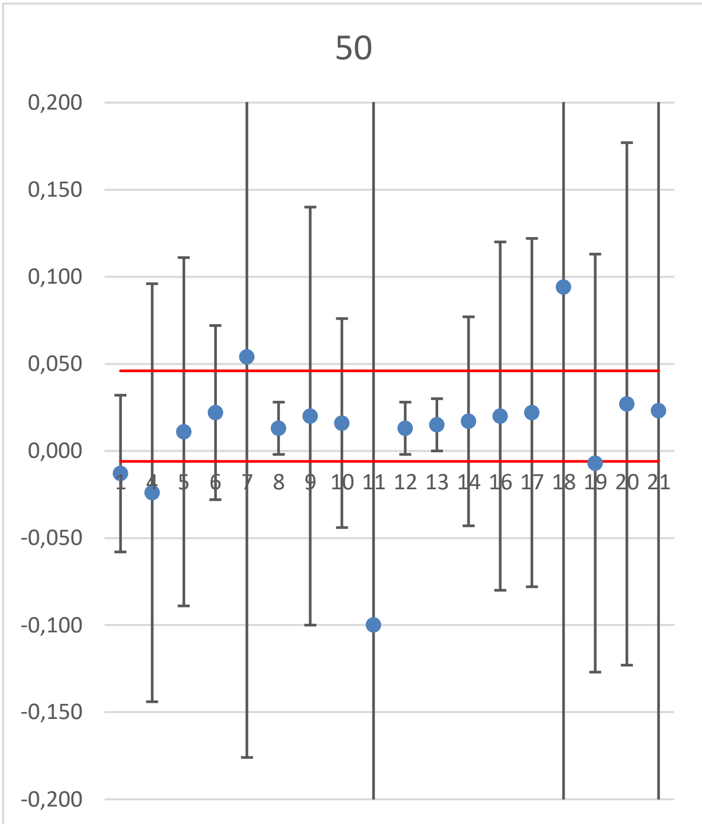


Table 5 Calibration results sensor 1 at 80 °C

Identification	Error	Uncertainty	En value
1	-0,002	0,045	0,74
4	-0,089	0,12	1,01
5	0,026	0,100	0,07
6	0,030	0,050	0,06
7	0,054	0,23	0,09
8	0,031	0,015	0,10
9	0,02	0,12	0,11
10	0,029	0,060	0,06
11	-0,180	1,00	0,21
12	0,025	0,015	0,39
13	0,022	0,015	0,54
14	0,029	0,060	0,06
16	0,04	0,10	0,07
17	0,032	0,10	0,01
18	0,025	0,400	0,02
19	0,000	0,12	0,27
20	0,030	0,15	0,02
21	-0,029	0,4	0,15
	Ref	**Ref U**	
	0,033	**0,014**	

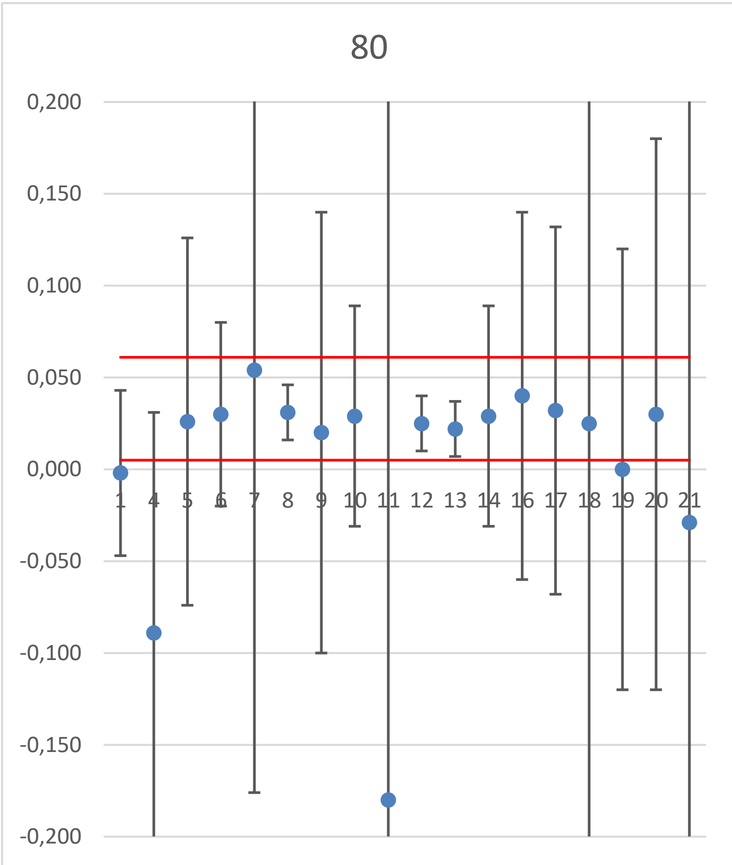


Table 6 Calibration results sensor 1 at 120 °C

Identification	Error	Uncertainty	En value
1	0,004	0,045	0,84
4	-0,172	0,12	1,79
5	0,035	0,100	0,09
6	0,040	0,050	0,08
8	0,037	0,015	0,33
9	0,02	0,12	0,20
10	0,042	0,080	0,03
11	-0,340	1,00	0,38
12	0,037	0,015	0,33
13	0,037	0,015	0,33
14	0,026	0,100	0,18
16	0,06	0,10	0,15
17	0,041	0,10	0,03
18	0,091	0,400	0,12
19	0,053	0,12	0,07
20	0,034	0,15	0,07
21	-0,087	0,65	0,20
	Ref	**Ref U**	
	0,045	**0,018**	

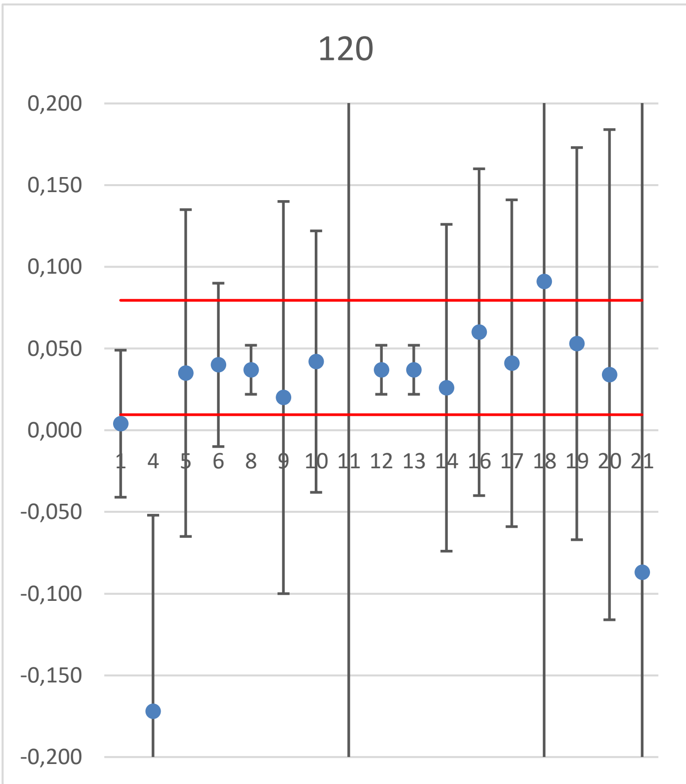


Table 7 Calibration results sensor 1 at 199 °C

Identification	Error	Uncertainty	En value
1	0,039	0,037	0,24
5	0,040	0,100	0,09
6	0,077	0,050	0,52
8	0,046	0,015	0,12
9	0,03	0,12	0,16
10	0,046	0,080	0,04
11	-0,610	1,00	0,66
13	0,059	0,200	0,05
14	0,042	0,100	0,07
17	-0,020	0,10	0,68
18	0,186	0,400	0,34
20	-0,036	0,15	0,56
21	0,171	0,8	0,15
	Ref	**Ref U**	
	0,049	**0,019**	

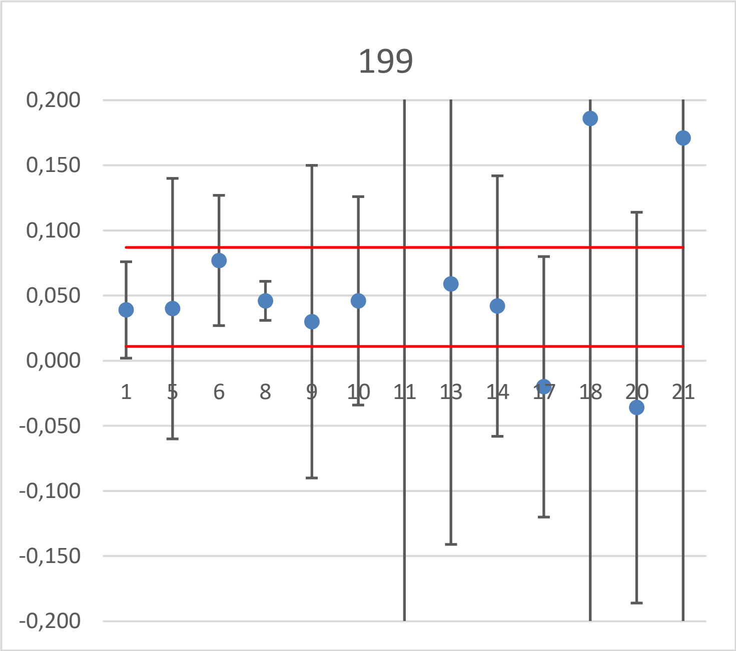


Table 8 Calibration results sensor 2 at -80 °C

Identification	Error	Uncertainty	En value
1	-0,178	0,020	0,66
3	-0,154	0,024	0,24
6	-0,075	0,10	0,85
8	-0,151	0,015	0,46
9	-0,15	0,12	0,09
10	-0,135	0,060	0,42
13	0,077	0,100	2,35
14	-0,152	0,150	0,06
18	0,010	0,400	0,43
	Ref	**Ref U**	
	-0,161	**0,016**	

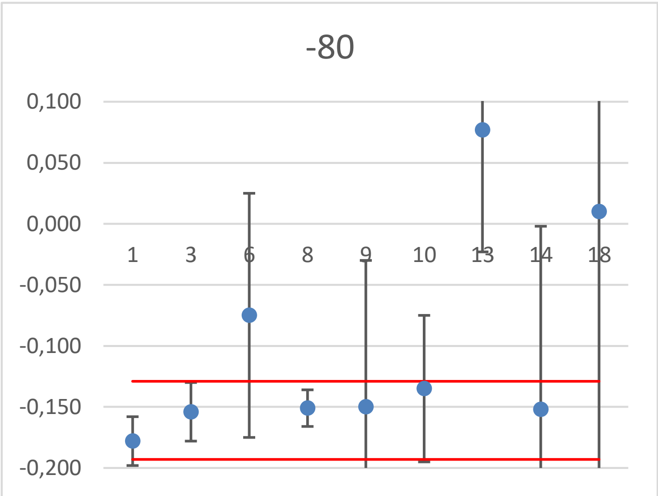


Table 9 Calibration results sensor 2 at -40 °C

Identification	Error	Uncertainty	En value
1	-0,138	0,020	0,85
3	-0,116	0,024	0,05
6	-0,033	0,050	1,63
8	-0,115	0,015	0,12
9	-0,12	0,12	0,02
10	-0,112	0,060	0,09
13	-0,104	0,015	0,67
14	-0,103	0,150	0,10
17	-0,100	0,0150	0,87
18	-0,014	0,400	0,26
19	-1,689	0,12	13,01
21	-0,064	0,65	0,08
	Ref	**Ref U**	
	-0,118	**0,014**	

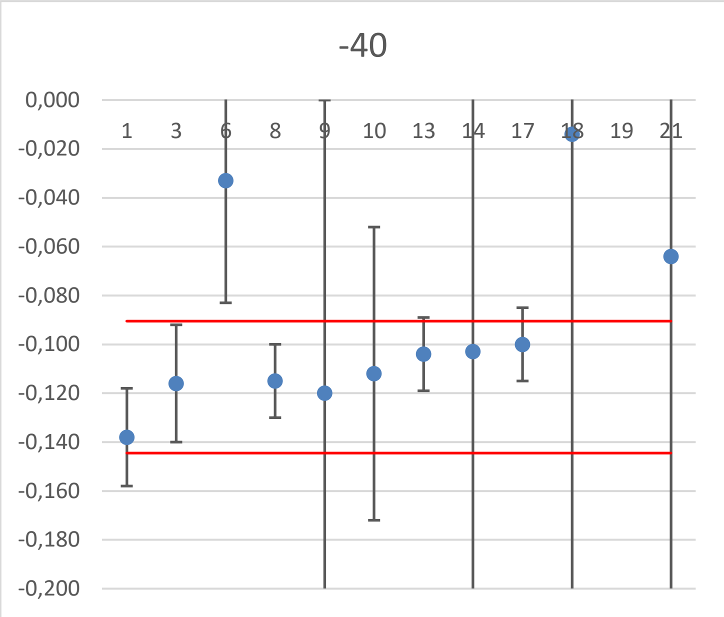


Table 10 Calibration results sensor 2 at -30 °C

Identification	Error	Uncertainty	En value
1	-0,127	0,020	0,92
2	0,000	0,250	0,42
3	-0,103	0,024	0,04
6	-0,027	0,050	1,48
7	-0,003	0,23	0,44
8	-0,101	0,015	0,14
9	-0,10	0,12	0,03
10	-0,108	0,060	0,06
13	-0,101	0,015	0,14
14	-0,100	0,150	0,03
16	-0,108	0,060	0,06
18	0,007	0,400	0,28
19	-1,329	0,12	10,13
21	-0,049	0,65	0,08
	Ref	**Ref U**	
	-0,104	**0,015**	

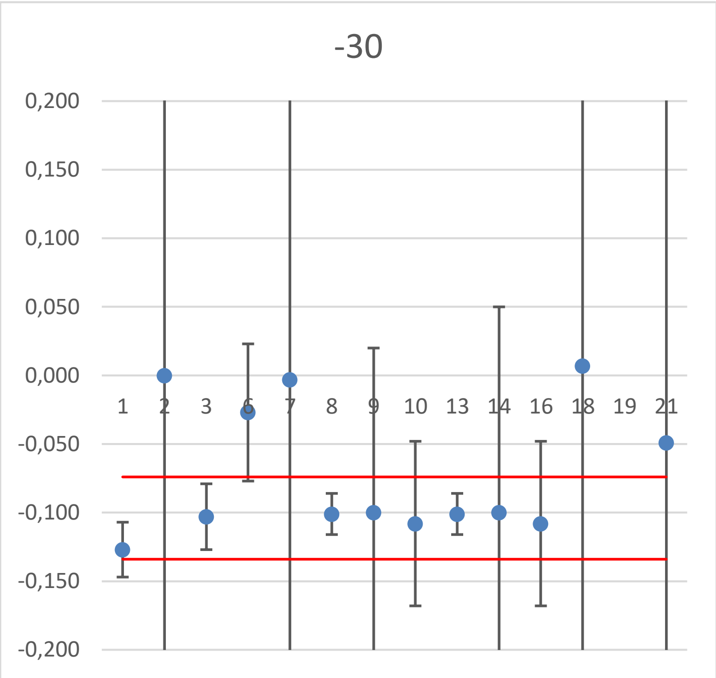


Table 11 Calibration results sensor 2 at 0 °C

Identification	Error	Uncertainty	En value
1	-0,088	0,020	0,95
2	-0,056	0,250	0,03
3	-0,061	0,024	0,12
4	0,141	0,12	1,70
5	-0,053	0,050	0,22
6	-0,013	0,050	0,99
7	0,048	0,23	0,49
8	-0,062	0,015	0,12
9	-0,05	0,12	0,12
10	-0,060	0,030	0,14
11	-0,06	0,14	0,03
13	-0,061	0,015	0,17
14	-0,068	0,020	0,14
15	-0,055	0,020	0,38
17	-0,046	0,050	0,36
18	-0,006	0,400	0,15
19	-0,046	0,12	0,15
20	-0,054	0,10	0,10
21	-0,048	0,4	0,04
	Ref	**Ref U**	
	-0,065	**0,015**	

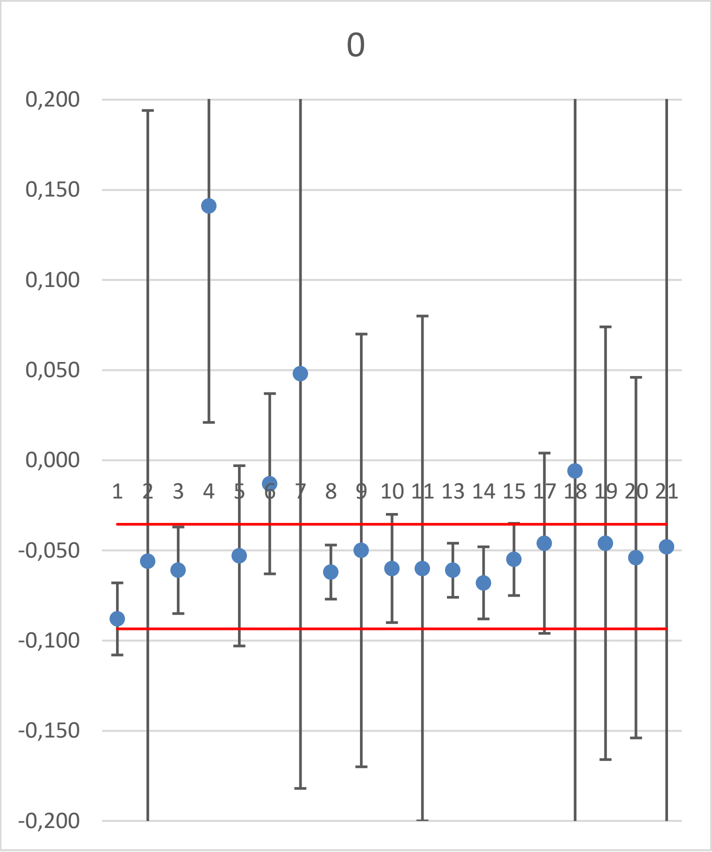


Table 12 Calibration results sensor 2 at 50 °C

Identification	Error	Uncertainty	En value
1	-0,040	0,045	0,67
2	-0,031	0,250	0,09
3	-0,005	0,024	0,11
4	-0,140	0,12	1,09
5	-0,003	0,100	0,05
6	0,022	0,050	0,57
7	0,032	0,23	0,17
8	-0,012	0,015	0,19
9	0,00	0,12	0,07
10	-0,015	0,060	0,11
11	-0,07	0,80	0,08
13	-0,012	0,015	0,19
14	-0,013	0,060	0,08
15	0,040	0,020	1,92
16	-0,004	0,50	0,01
17	-0,002	0,10	0,06
18	-0,090	0,400	0,20
19	-0,007	0,12	0,01
20	-0,026	0,15	0,12
21	-0,105	0,4	0,24
	Ref	**Ref U**	
	-0,008	**0,015**	

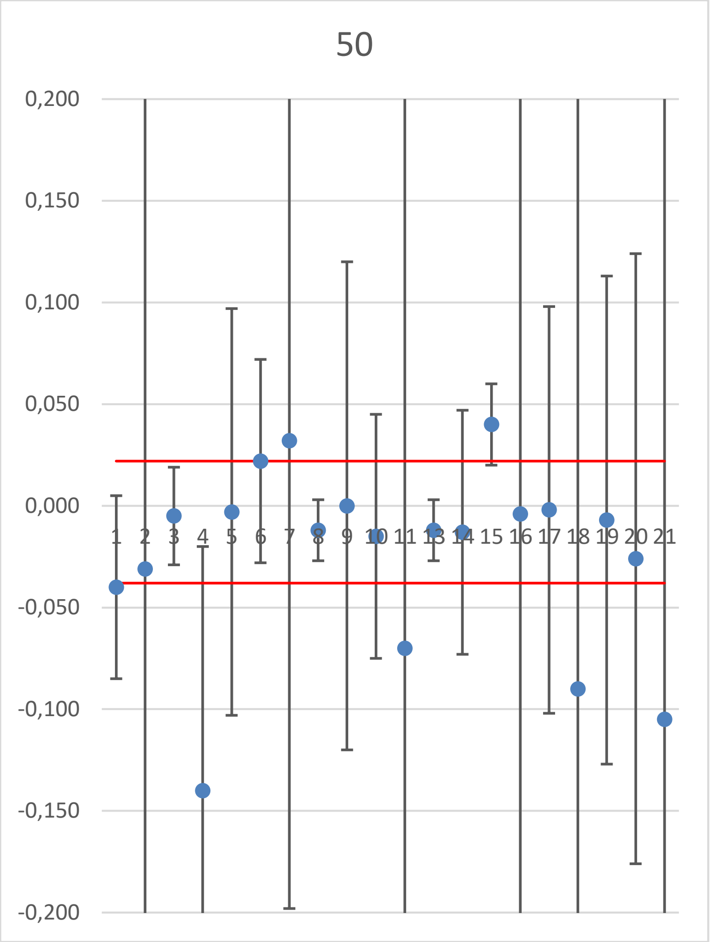


Table 13 Calibration results sensor 2 at 80 °C

Identification	Error	Uncertainty	En value
1	-0,018	0,045	0,76
2	-0,016	0,250	0,14
3	0,019	0,024	0,02
4	-0,251	0,12	2,22
5	0,021	0,100	0,02
6	0,017	0,050	0,03
7	0,088	0,23	0,30
8	0,016	0,015	0,11
9	0,01	0,12	0,07
10	0,012	0,060	0,10
11	-0,10	0,80	0,15
13	0,010	0,015	0,38
14	0,010	0,060	0,14
15	0,000	0,020	0,71
16	0,024	0,50	0,01
17	0,021	0,10	0,02
18	-0,160	0,400	0,45
19	0,000	0,12	0,15
20	-0,010	0,15	0,19
21	-0,043	0,4	0,15
	Ref	**Ref U**	
	0,019	**0,017**	

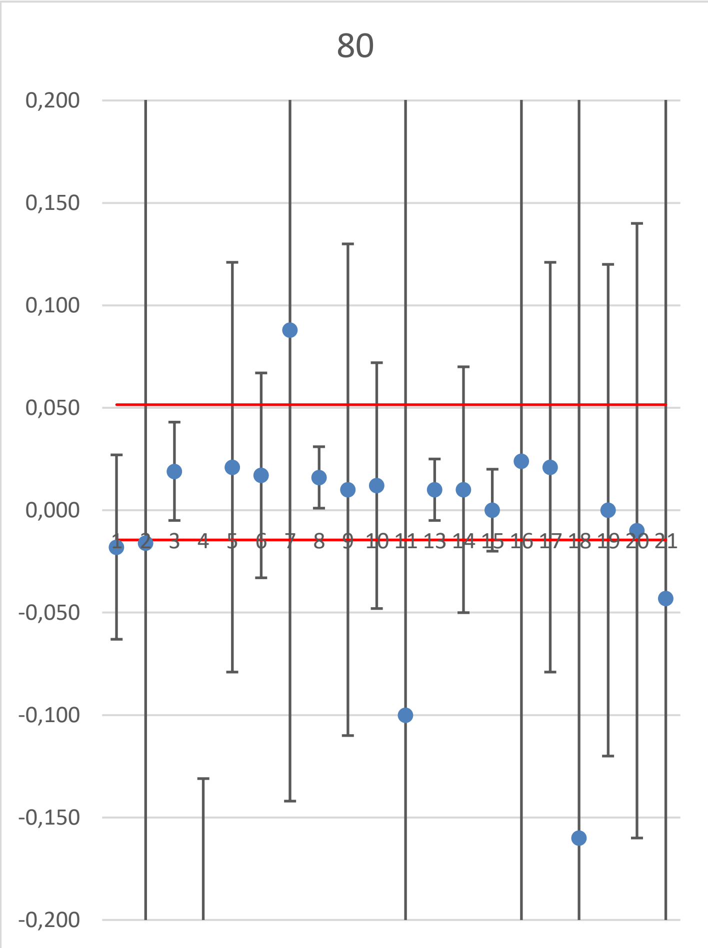


Table 14 Calibration results sensor 2 at 120 °C

Identification	Error	Uncertainty	En value
1	0,004	0,045	0,86
2	0,010	0,250	0,14
3	0,038	0,029	0,21
4	-0,084	0,12	1,07
5	0,046	0,100	0,01
6	0,039	0,050	0,11
8	0,042	0,015	0,14
9	0,02	0,12	0,21
10	0,040	0,080	0,06
11	-0,12	0,80	0,21
13	0,035	0,015	0,46
14	0,024	0,100	0,21
15	0,028	0,020	0,66
16	0,056	0,50	0,02
17	0,052	0,10	0,07
18	-0,246	0,400	0,73
19	0,530	0,12	4,01
20	0,027	0,15	0,12
21	-0,048	0,65	0,14
	Ref	**U**	
	0,045	**0,016**	

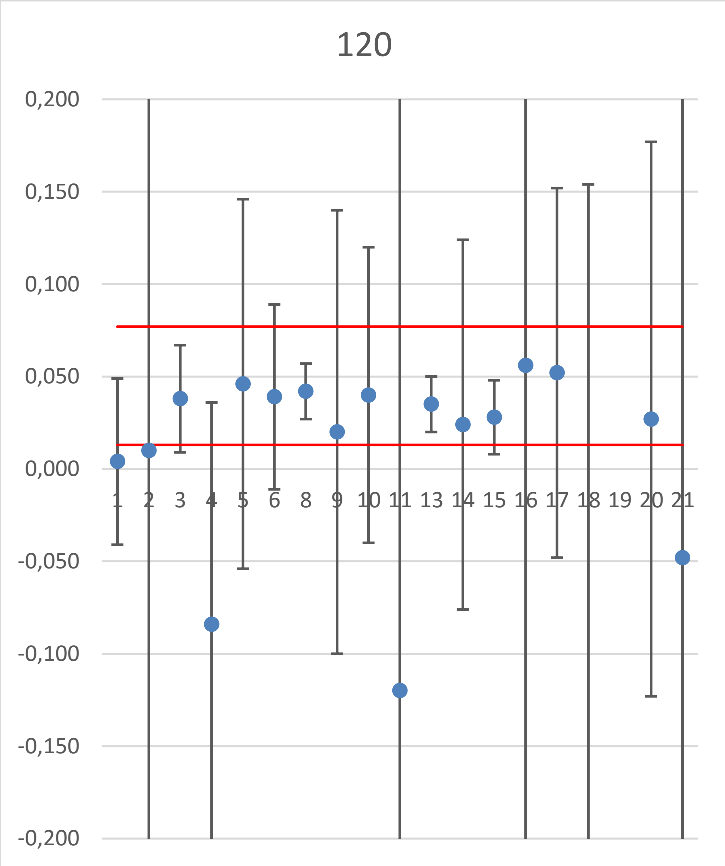


Table 15 Calibration results sensor 2 at 199 °C

Identification	Error	Uncertainty	En value
1	0,084	0,037	0,43
2	0,007	0,500	0,19
3	0,093	0,029	0,26
5	0,093	0,100	0,09
6	0,046	0,050	1,05
8	0,096	0,015	0,25
9	0,07	0,12	0,26
10	0,088	0,080	0,17
11	-0,13	0,80	0,29
13	0,088	0,200	0,07
14	0,085	0,100	0,17
15	0,091	0,020	0,40
16	0,108	0,50	0,01
17	0,086	0,10	0,16
18	0,236	0,400	0,33
20	-0,010	0,17	0,65
21	-0,040	0,8	0,18
	Ref	**U**	
	0,102	**0,019**	

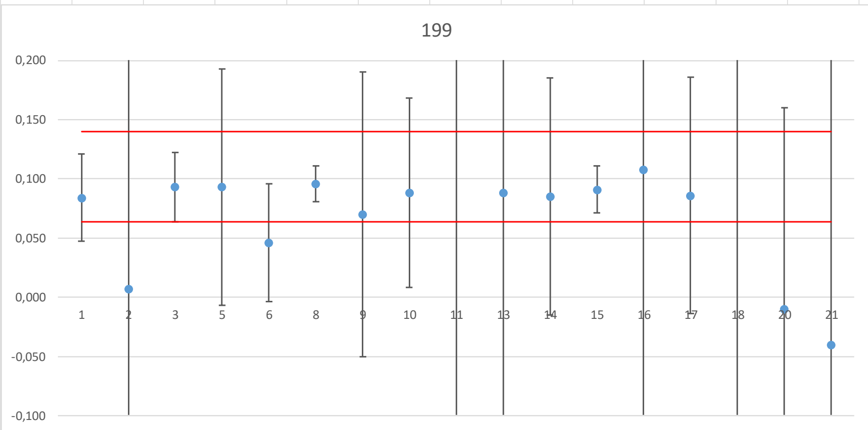


Table 16 Calibration results sensor 2 at 300 °C

Identification	Error	Uncertainty	En value
2	0,120	0,500	0,16
3	0,16	0,24	0,17
5	0,180	0,300	0,07
8	0,20	0,03	0,00
11	-0,10	0,80	0,37
13	0,19	0,200	0,05
14	0,18	0,200	0,10
15	0,21	0,20	0,05
16	0,20	0,50	0,00
17	0,23	0,20	0,15
20	0,01	0,20	0,94
21	0,034	1,05	0,16
	Ref	**Ref U**	
	0,20	**0,026**	

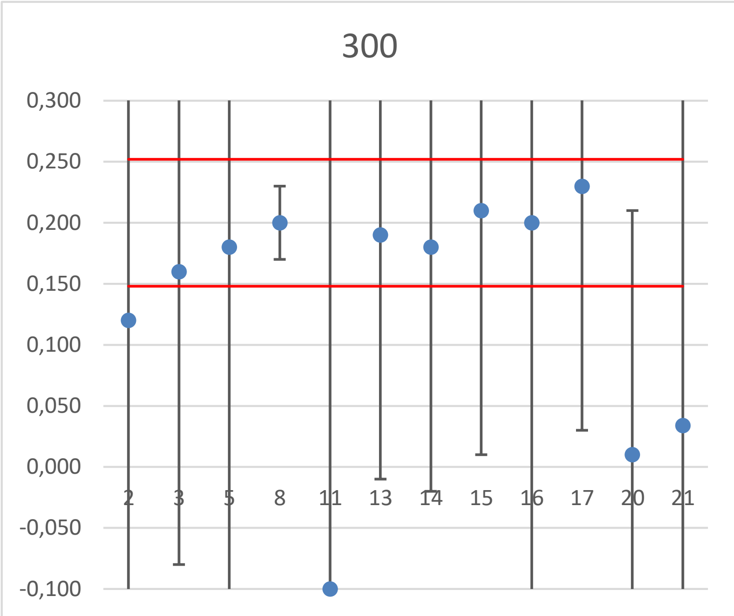


Table 17 Calibration results sensor 2 at 400 °C

Identification	Error	Uncertainty	En value
2	0,330	1,000	0,03
3	0,32	0,28	0,16
5	0,350	0,300	0,05
8	0,35	0,03	0,35
11	-0,02	0,80	0,48
13	0,35	0,200	0,07
14	0,33	0,200	0,17
15	0,36	0,20	0,02
16	0,37	0,50	0,01
17	0,45	0,50	0,17
20	-1,08	3,34	0,43
21	0,192	1,3	0,13
	Ref	**Ref U**	
	0,365	**0,031**	

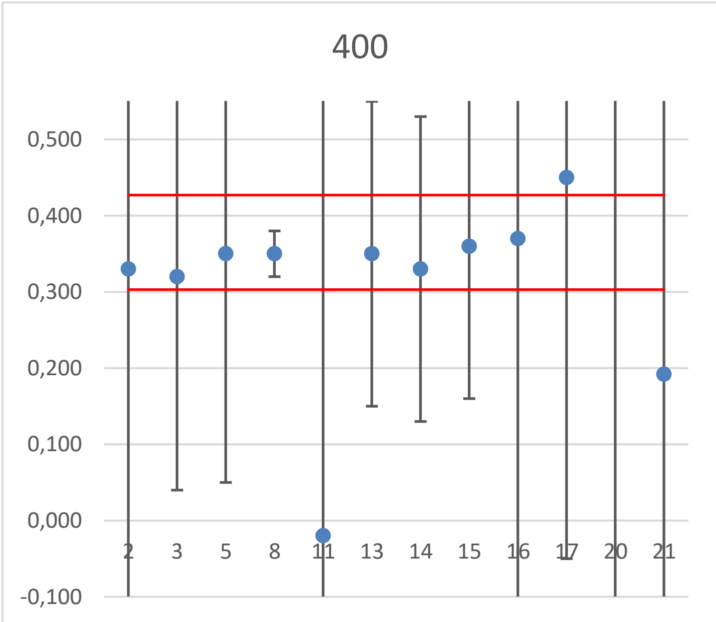
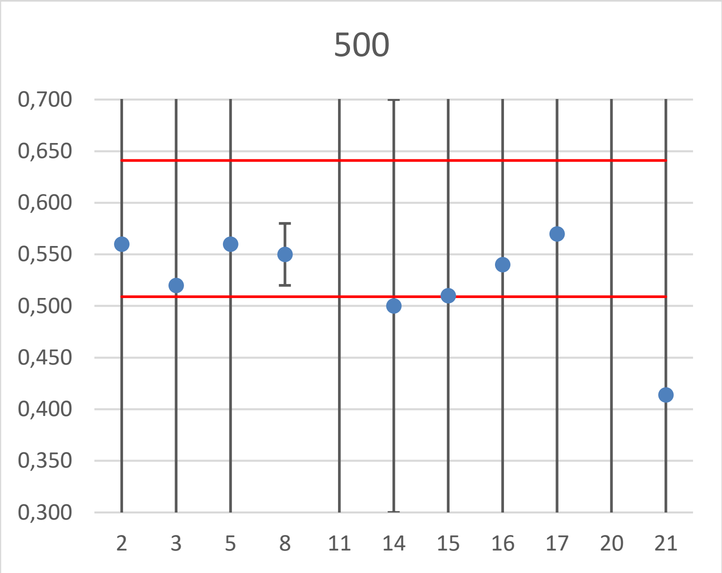


Table 18 Calibration results sensor 2 at 500 °C

Identification	Error	Uncertainty	En value
2	0,560	1,000	0,01
3	0,52	0,34	0,16
5	0,560	0,500	0,03
8	0,55	0,03	0,56
11	0,12	0,80	0,57
14	0,50	0,200	0,37
15	0,51	0,30	0,22
16	0,54	0,50	0,07
17	0,57	0,70	0,01
20	-0,77	3,88	0,35
21	0,414	1,55	0,10
	Ref	**Ref U**	
	0,575	**0,033**	



Comments on the calibration certificates

-- not a part of the intercomparison

General:

Several laboratories report all repetitions and the mean result.

The laboratories report measurement errors, deviation or correction.

Some laboratories are clearly identifying the reference equipment used.

Most of the laboratories are referring to EA publication EA-4/02 on uncertainty

Additions and changes to the DRAFT reports

Redactional changes and a number of changes in input values such as the number of digits in the results, but that is not giving considerable changes of the En values.

Adding one missing diagram.

Final conclusions

In this inter comparison most of the participants could demonstrate a capacity to calibrate and give relevant values in relationship to their uncertainties.

The summarized results from all calibrations have 17 results got En values above 1.

Evaluation of the results

The participants shall evaluate their results according to ISO/IEC 17025:2017 7.7.3

It is then recommended to evaluate according to descriptions above including the fact where:

- The size of En-values
- En- values in relation to their CMC values

Acknowledgement

We acknowledge the primary calibrations by RISE Sweden that supported the ILC with reference calibrations.

We acknowledge Magnus Holmsten that supported on the setup and evaluation on this ILC

Annex 1 ILC temperature 2023:1

Published on https://smquality.se/

Annex 2 *D*escription of the intercomparison/ILC

Published on https://smquality.se/

Appendix 1 Reporting form

Intercomparison ILC Temperature 2023:1

Reporting form for preliminary calibration results

		CODE för lock: **504**
Laboratory:		Comparison ID
Name:		
e-mail:	-	Filled by organiser
Date of reporting:		

Observe that adjustments are not allowed
Just fill in the green fields

Date of calibration

Sensor 1 — **Serial no 431297-1** — **Fill in the green fields**

Nominal temperature	Actual temperature	Actual measured temperature	Stated error	Measurement uncertainty
°C	°C	°C	°C	°C
0 before cal			0,000	
-40			0,000	
-30			0,000	
0			0,000	
50			0,000	
80			0,000	
120			0,000	
199			0,000	
0 after cal			0,000	

Sensor 2 — **Serial no 431297-2** — **Fill in the green fields**

Nominal temperature	Actual temperature	Actual measured temperature	Stated error	Measurement uncertainty
°C	°C	°C	°C	°C
0 before cal			0,000	
-80			0,000	
-40			0,000	
-30			0,000	
0			0,000	
50			0,000	
80			0,000	
120			0,000	

199			0,000	
300			0,00	
400			0,00	
500			0,00	
0 after cal			0,000	

Explanations/comments

Observe that you do not need to calibrate all points if you have limited possibilities

199 degee is used because that gives reasonable resolution in the reading

You can give additional information here such as used dry well calibratior or used liquid

References:

- ISO/IEC 17043:2023 Conformity assessment – General requirements for proficiency testing
- ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories
- ISO 13528:2022 Statistical methods for use in proficiency testing by interlaboratory comparison.
- Evaluation of measurement data – Guide to the expression of uncertainty in measurement, GUM (JCGM 100:2008)
- EA-4/02 M:2022 Evaluation of Uncertainty of Measurement in Calibration
- International Vocabulary of Metrology – Basic and General Concepts and Associated Terms (VIM)