EURAMET Project 'Report'

Document: G-OPS-TMP-025 Version: 2.0
Approved: Head of Secretariat 2012-02-01

1	**Report**	☐ progress report ☒ final report	2	**Reference No**:	1236
3	**Subject Field**	T - Temperature			
4	**Type of collaboration**	Comparison of Measurement Standards			
4A	**In the case of a comparison** Registered as Key comparison (KC) or Supplementary Comparison (SC) in the KCDB: ☐no ☒ yes If yes: No. of KC/SC:				
5	**Coordinator** Institute/Country: Metrology Institute of the Republic of Slovenia/University of Ljubljana-Faculty of Electrical Engineering/Laboratory of Metrology and Quality (MIRS/UL-FE/LMK) Name: Jovan Bojkovski Phone: +386 1 4768 798 E-mail: jovan.bojkovski@fe.uni-lj.si				
6	**Participating Partners**				
6A	EURAMET members or associates (Institute's standard acronym with country code in brackets) as registered on EURAMET website. • BOM (MK) • MIRS/UL-FE/LMK (SI)				
6B	Institutes not being EURAMET members or associates (Institute's full name and country in brackets)				
6C	Change of projects partners: (Please indicate here changes of project partners compared to the previous report) New project partners Removed project partners				
7	**Title of project** Comparison of the realisations of the ITS-90 over the range of 234.3156 K to 692.677 K				
8	**Progress/Final** The bilateral comparison itself was divided in three phases. In the first phase (performed in October and November of 2011), one metal sheathed standard platinum resistance thermometer was calibrated at fixed points (mercury, tin and zinc) at MIRS/UL-FE/LMK (SI). In the second phase (performed in the period between January and March of 2012), the same measurements were performed by BOM (MK). After its return, the standard platinum resistance thermometer was recalibrated (measurements performed in April and May 2012) at MIRS/UL-FE/LMK (SI). The values of W were compared. The procedure followed was the same procedure as for EURAMET 552 project.				

It was recommended that the participants use their standard procedure during the temperature calibration and if possible avoid making extra time-consuming measurements.
The circulating item was Fluke HartScientific 25 Ω standard platinum resistance (SPRT) thermometer, metal sheathed, type 5699, and serial number 0370. The diameter of the metal sheath probe is Ø 5.6 mm. Probe should be immersed in the fixed point at least 170 mm.
After the transport, the measurement at the triple point of water, to check stability, was performed and reported to the pilot laboratory. Prior to the start of measurements, annealing was performed. The SPRT was carefully inserted into an annealing furnace at 470 °C, and then annealed for two hours at 470 °C. After thermal treatment, the SPRT was carefully removed from the annealing furnace directly to the room environment. The resistance value at the triple point of water was measured. If the resistance at triple point of water was increasing, the pilot laboratory had to be contacted immediately. If the decrease in the triple point of water resistance of the SPRT after annealing was equivalent to 0.5 mK or larger, the annealing procedure was repeated. If the decrease is less than 0.5 mK laboratory continued with measurements at fixed points.
If the decrease in the triple point of water resistance of the SPRT after second annealing was larger than 0.2 mK, the pilot laboratory was contacted for further instructions. Otherwise, laboratory continued with measurements at fixed points.
Prior to the calibration at fixed points in each laboratory, test measurement at the TPW was done in order to assess stability of the instruments. After the annealing, the SPRT was calibrated at all of the fixed points in the range of comparison, i.e., measurements at TPW, Zn, TPW, Sn, TPW, Hg, TPW in that order. Existing techniques as used by the participating laboratory were used
In order to not increase the uncertainty on the comparison of the results the RT values given by the different participants approximately corresponded to the same percentage of metal in liquid phase, as described in the protocol of comparison.
For each metal fixed point the W=RT/RTPW was calculated. RTPW is the TPW resistance measured immediately after the measurement of RT. All the measurements at the fixed points had been corrected for self-heating, hydrostatic head and, if any, the pressure effect. At least 3 different phase transitions (3 freezing for Zn, Sn, and 3 triple points for Hg) were performed. All three measurements for each fixed point were reported in the Excel spreadsheet including the calculated mean.
MIRS/UL-FE/LMK performed measurements at the beginning of the interlaboratory comparison and at the end. In the report form, the participants were also asked to fill in details about the applied method, uncertainty sources, equipment and traceability.

Fixed point	W MIRS/UL-FE/LMK	Uncertainty MIRS/UL-FE/LMK (mK)	W BOM	Uncertainty BOM (mK)
Hg	0.844153731	0.6	0.844155892	2.9
Sn	1.892692908	1.0	1.892696135	3.8
Zn	2.568717035	1.5	2.568738847	6.3

Uncertainty sources for the calibration of SPRT at the freezing point of zinc, in mK

Uncertainty source	BOM	MIRS/UL-FE/LMK
Repeatability of readings	1.0	0.03
Uncertainty linked with purity	0.56	0.4
Uncertainty linked Hydrostatic pressure correction	0.018	0.012
Uncertainty linked with perturbing heat exchanges	0.25	0.1
Uncertainty linked with self-heating correction	0.2	0.03
Uncertainty linked with bridge linearity	0.67	0.05
Uncertainty linked with AC/DC current	0	0
Uncertainty linked with gas pressure	0	0.05

Repeatability of readings	1.1	0.02			
Repeatability of temperature realized by cell			0.44	0.05	
Short repeatability of calibrated SPRT	0.29	0.15			
Uncertainty linked with purity and isotopic composition			0.29	0.05	
Uncertainty linked Hydrostatic pressure correction			0.16	0.005	
Uncertainty linked with perturbing heat exchanges			0.058	0.01	
Uncertainty linked with self-heating correction			0.15	0.03	
Uncertainty linked with bridge linearity	1.72	0.05			
Uncertainty linked with AC/DC current	0	0			
Uncertainty linked with internal insulation leakage			0	0	
Uncertainty linked with stability of RS	0.15	0			
Uncertainty linked with temperature of RS	0.15	0.005			
Wt scatter	1.75	0.59			
Combined uncertainty	3.15	0.75			
Expanded uncertainty					
k=2	6.3	1.50			

Further details are avaiable in paper Comparison of The Realisations of The ITS-90 Over The Range of -38.8344 °C to 419.527 °C J.Bojkovski and O.Petrusova, presented at TEMPMEKO 2013 and submitted for publication in IJT

9	**In the case of a KC/SC comparison & final report**	
	Final report sent to the appropriate CC WG	☒ no ☐ yes
	Report endorsed by the CC WG	☒ no ☐ yes
10	**Expected completion date** 2013-06-01	11 **Date** 2014-03-21

Notes for completion of the form overleaf