

**APPENDIX 4**

**THE  $QDE_{95}$  AND DOE VALUES FOR THE FIXED-POINT AND VARIABLE TEMPERATURE BLACKBODY COMPARISON FOR THE LP5 THERMOMETER AND THE DIRECT COMPARISON OF THE FP AND COMBINED VTBB AND FP RESULTS FOR BOTH THERMOMETERS**

**EURAMET 658 EXTENSION PROJECT TO EXAMINE UNDERLYING PARAMETERS IN RADIANCE TEMPERATURE SCALE REALISATION FROM 156 °C TO 1000 °C**

**HELEN MCEVOY**

**JANUARY 2018**



## APPENDIX 4

The  $QDE_{95}$  and DOE Values for the Fixed-Point and Variable Temperature Blackbody Comparison for the LP5 Thermometer and the Direct Comparison of the FP and Combined VTBB and FP Results for both Thermometers

EURAMET 658 Extension Project to Examine Underlying Parameters in Radiance Temperature Scale Realisation from 156 °C to 1000 °C

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Engineering, Materials & Electrical Science

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Approved on behalf of NPL by  
Dr Stephanie Bell, Science Area Leader

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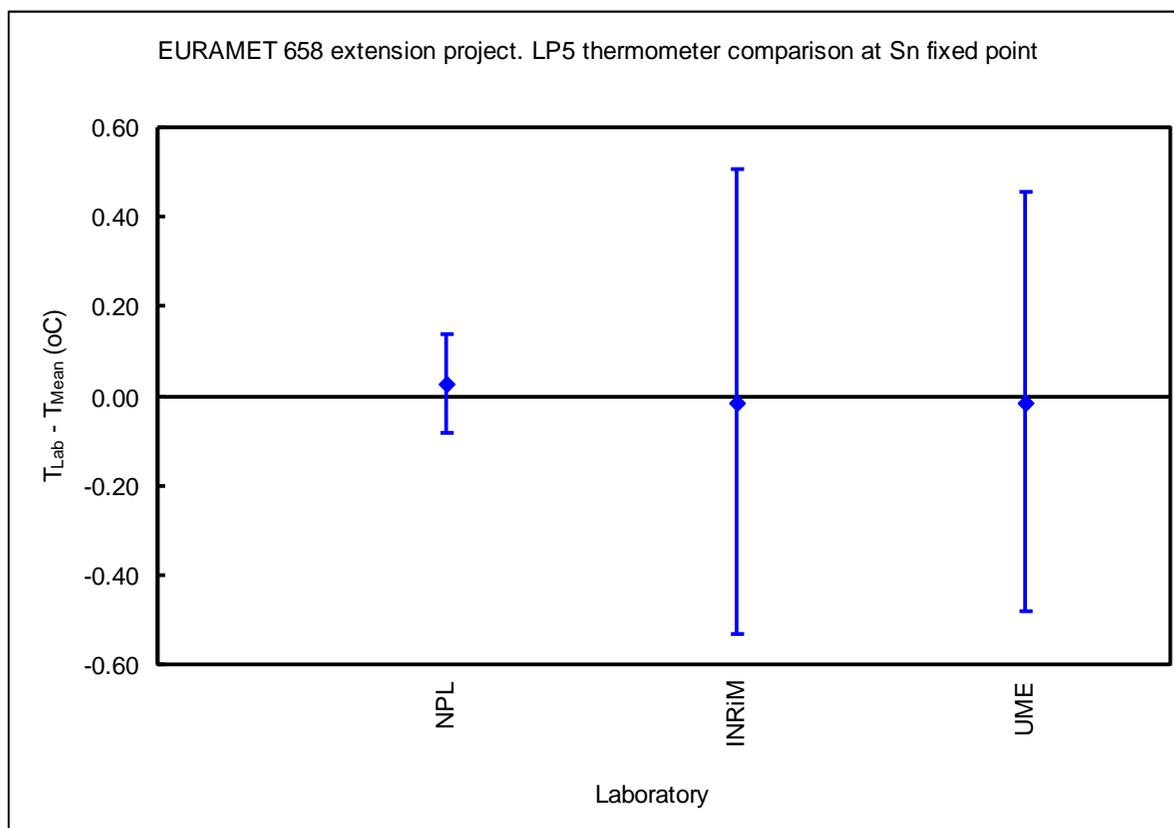
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# 1 THE DOE AND QDE95 RESULTS FOR THE LP5 THERMOMETER MEASUREMENTS USING THE FIXED POINTS ONLY

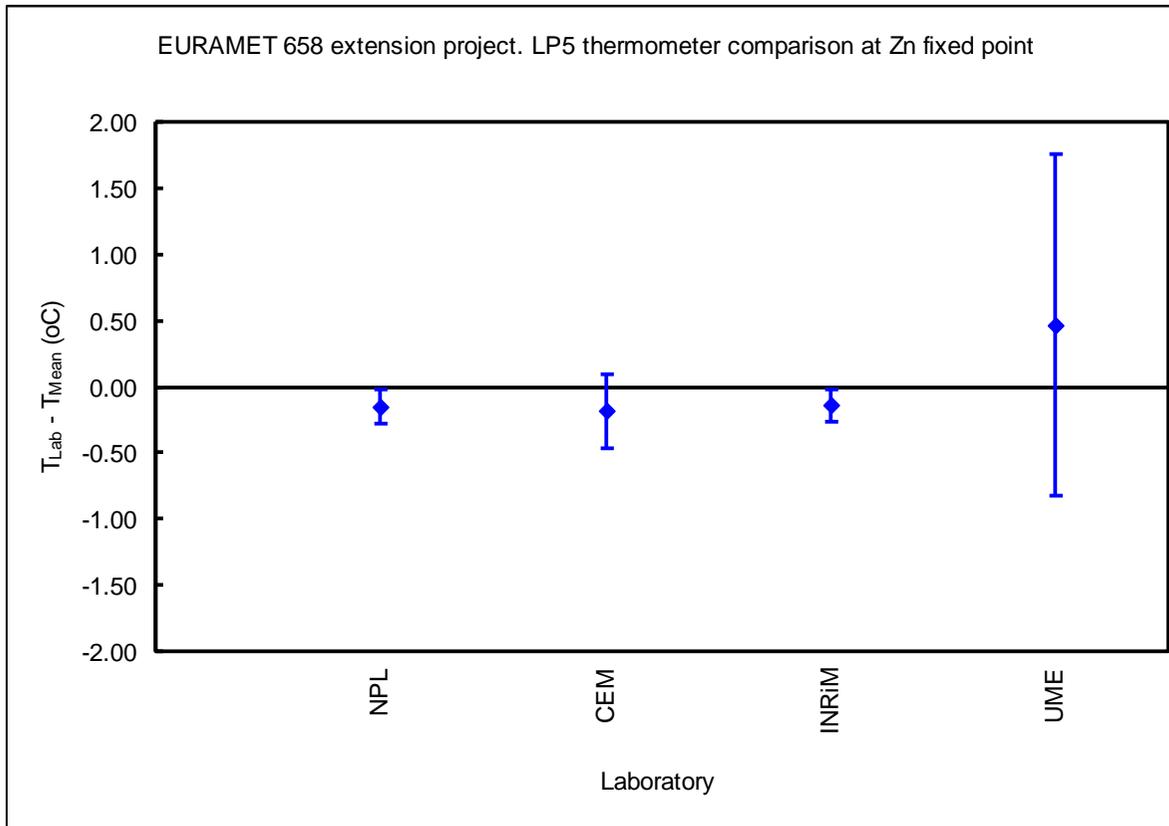
	NPL	INRiM	UME
NPL	-	$0.041 \pm 0.532$	$0.040 \pm 0.483$
INRiM	$0.525$	-	$-0.001 \pm 0.701$
UME	$0.478$	$0.692$	-

Table 1 – direct comparison of the results for the calibration of the LP5 thermometer at the Sn point



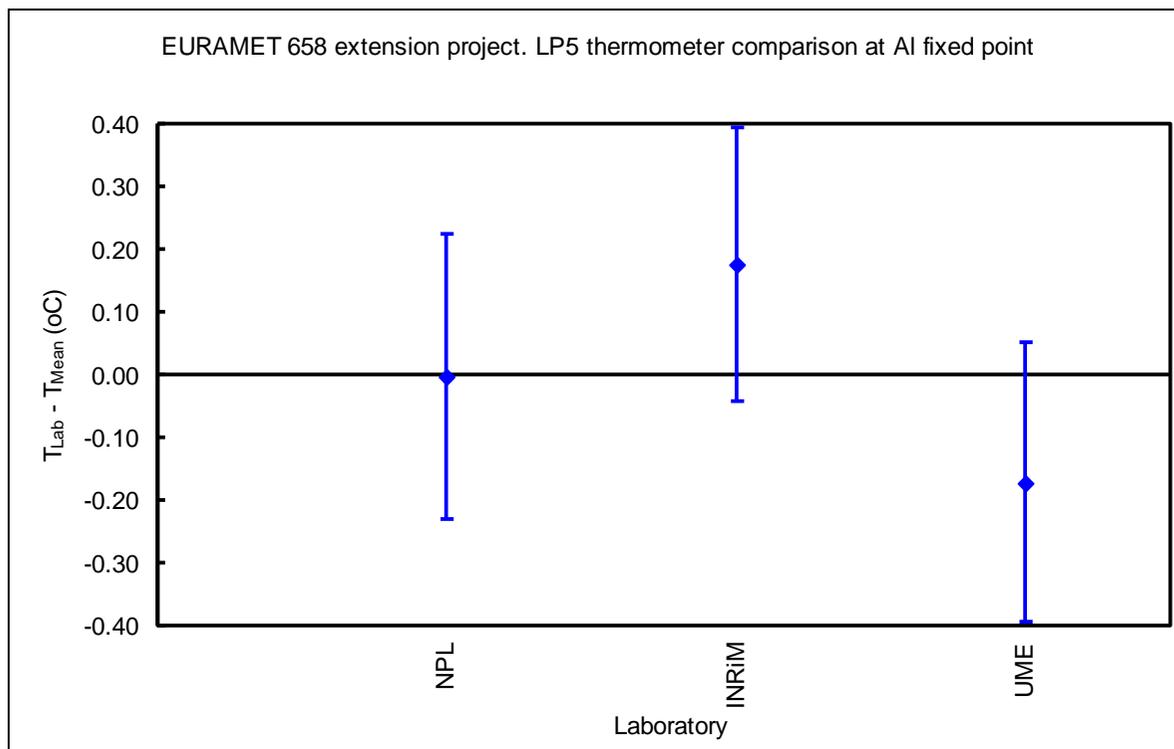
	NPL	CEM	INRiM	UME
NPL	-	$0.029 \pm 0.307$	$-0.014 \pm 0.175$	$-0.621 \pm 1.142$
CEM	$0.305$	-	$-0.043 \pm 0.305$	$-0.650 \pm 1.169$
INRiM	$0.173$	$0.310$	-	$-0.607 \pm 1.142$
UME	$1.563$	$1.614$	$1.549$	-

Table 2 - direct comparison of the results for the calibration of the LP5 thermometer at the Zn point with range R1



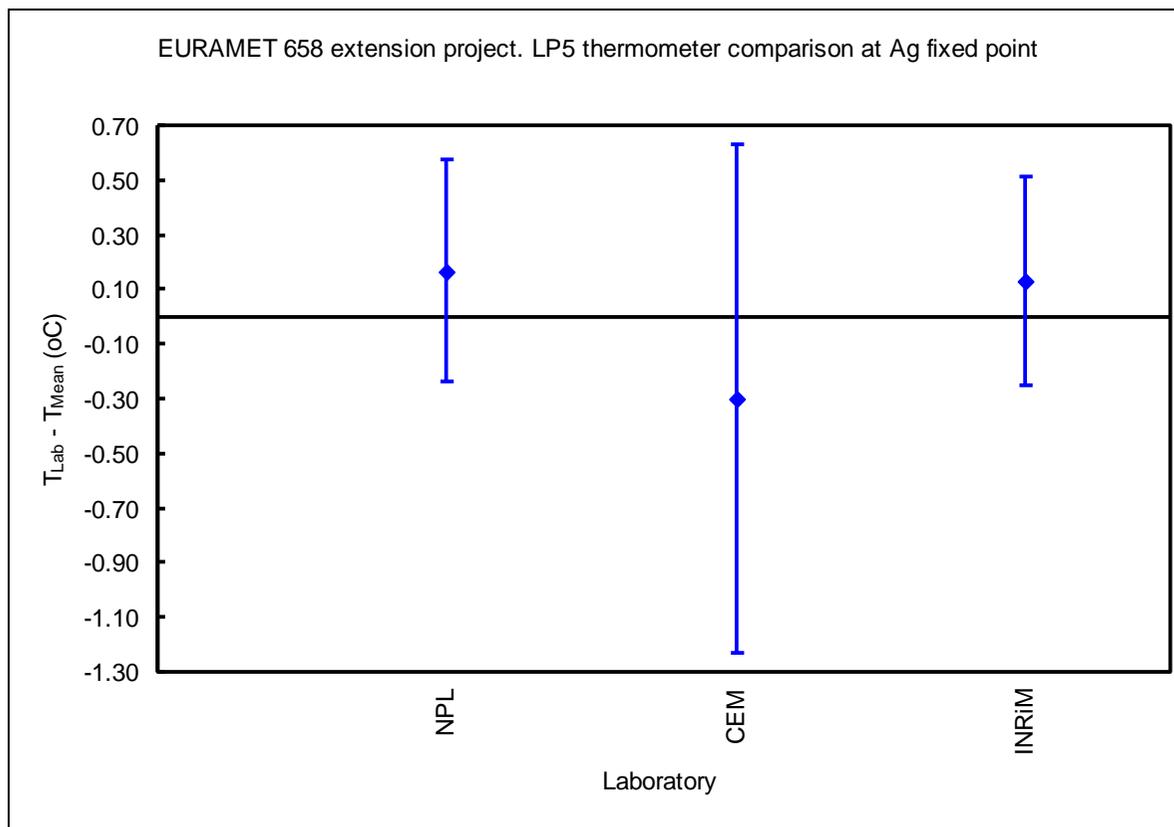
	NPL	INRiM	UME
NPL	-	$-0.180 \pm 0.316$	$0.168 \pm 0.319$
INRiM	$0.440$	-	$0.348 \pm 0.313$
UME	$0.431$	$0.605$	-

Table 3 – direct comparison of the results for the calibration of the LP5 thermometer at the Al point



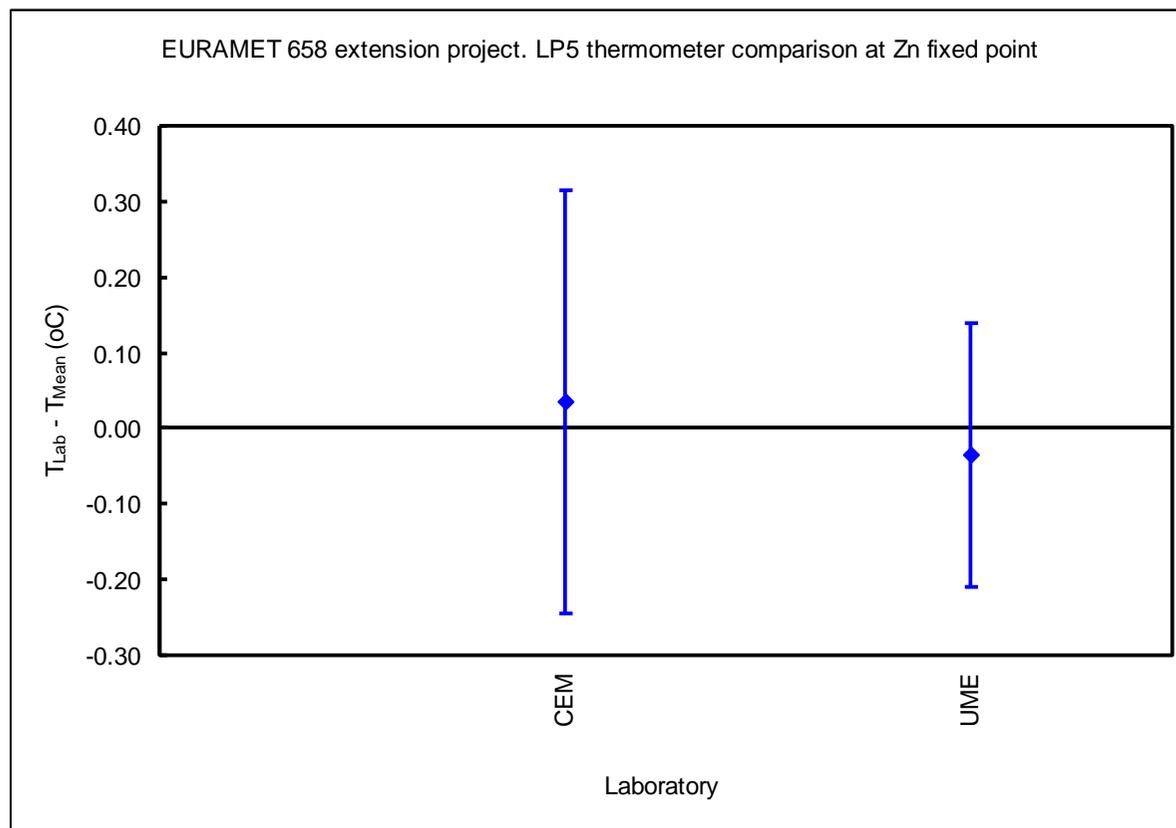
	NPL	CEM	INRiM
NPL	-	$0.468 \pm 1.014$	$0.037 \pm 0.556$
CEM	$1.306$	-	$-0.432 \pm 1.005$
INRiM	$0.548$	$1.264$	-

Table 4 – direct comparison of the results for the calibration of the LP5 thermometer at the Ag point



	CEM	UME
CEM	-	$0.070 \pm 0.330$
UME	$0.351$	-

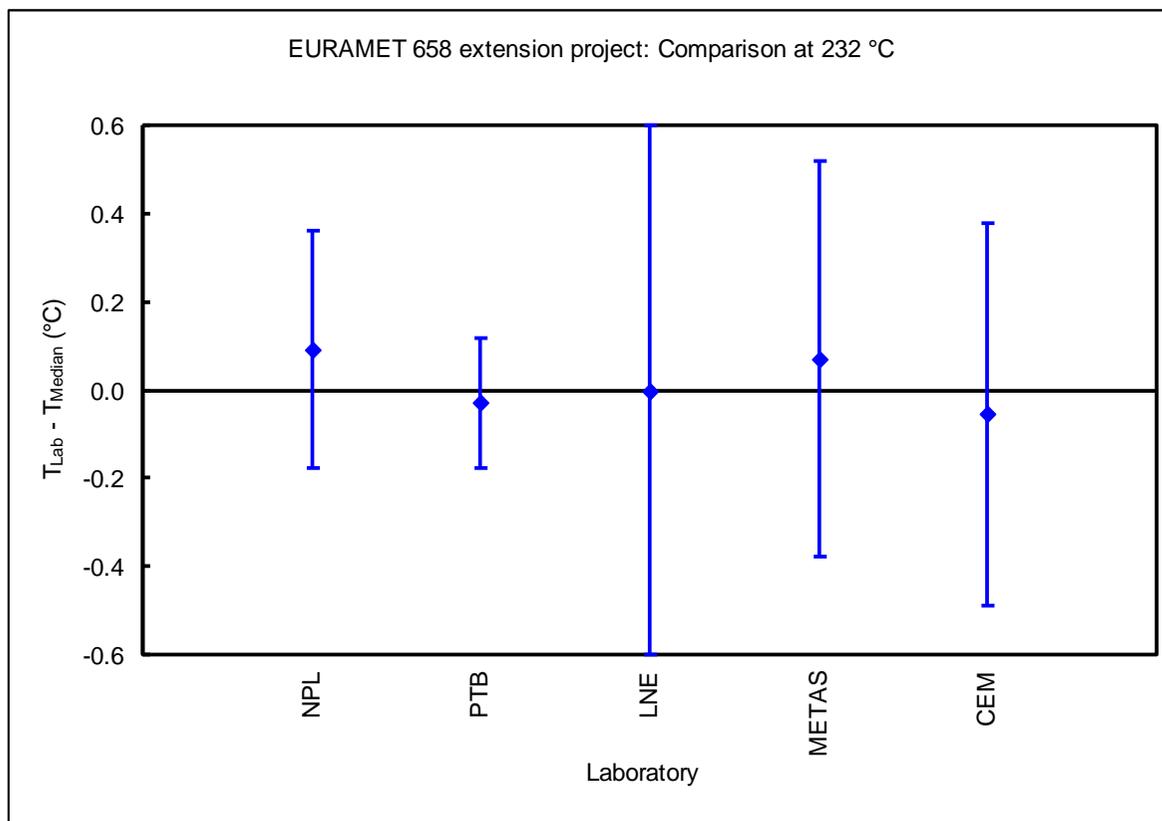
Table 5– direct comparison of the results for the calibration of the LP5 thermometer at the Zn point with range R2



2 THE DOE AND QDE<sub>95</sub> RESULTS FOR THE LP5 THERMOMETER MEASUREMENTS USING THE VTBBS

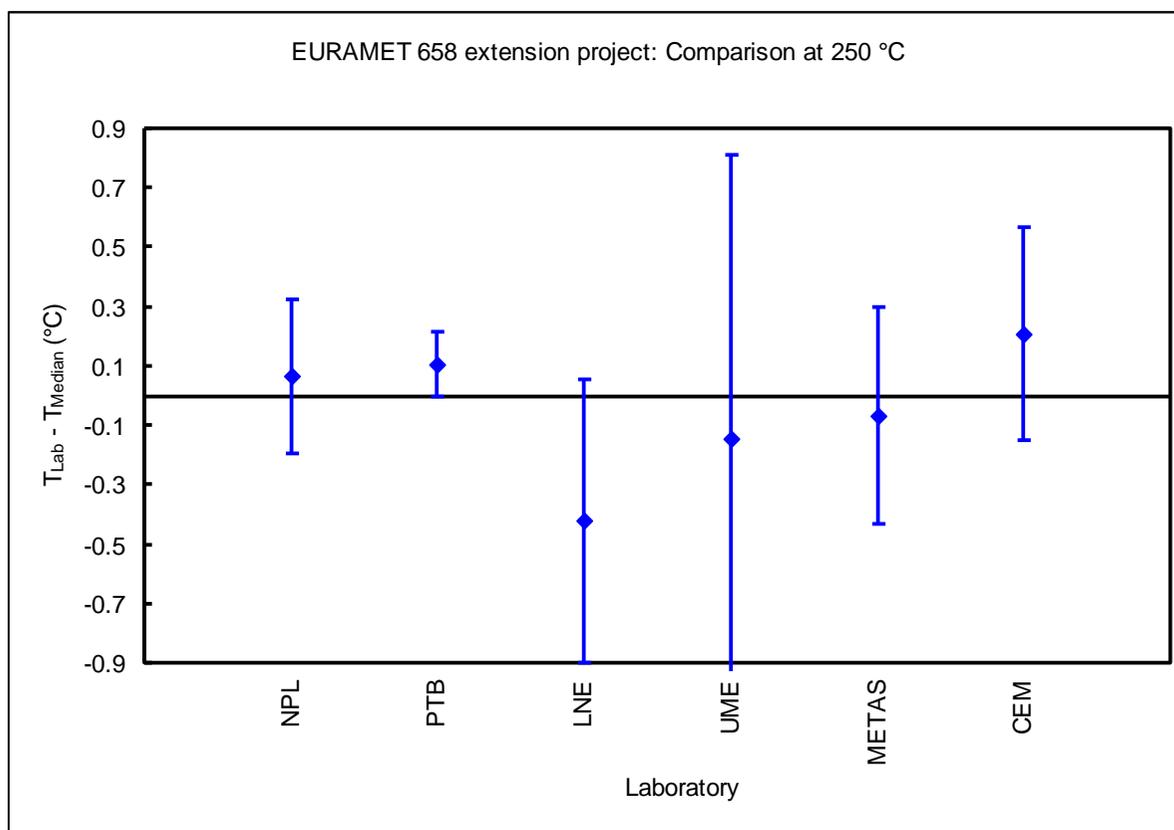
	NPL	PTB	LNE	METAS	CEM
NPL	-	0.12 ± 0.305	0.09 ± 0.657	0.02 ± 0.524	0.15 ± 0.511
PTB	0.37	-	-0.03 ± 0.618	-0.10 ± 0.473	0.03 ± 0.459
LNE	0.67	0.61	-	-0.07 ± 0.750	0.05 ± 0.741
METAS	0.51	0.50	0.75	-	0.13 ± 0.626
CEM	0.58	0.45	0.73	0.66	-

Table 6 – direct comparison of the results for the LP5 thermometer variable temperature blackbody measurements at 232 °C



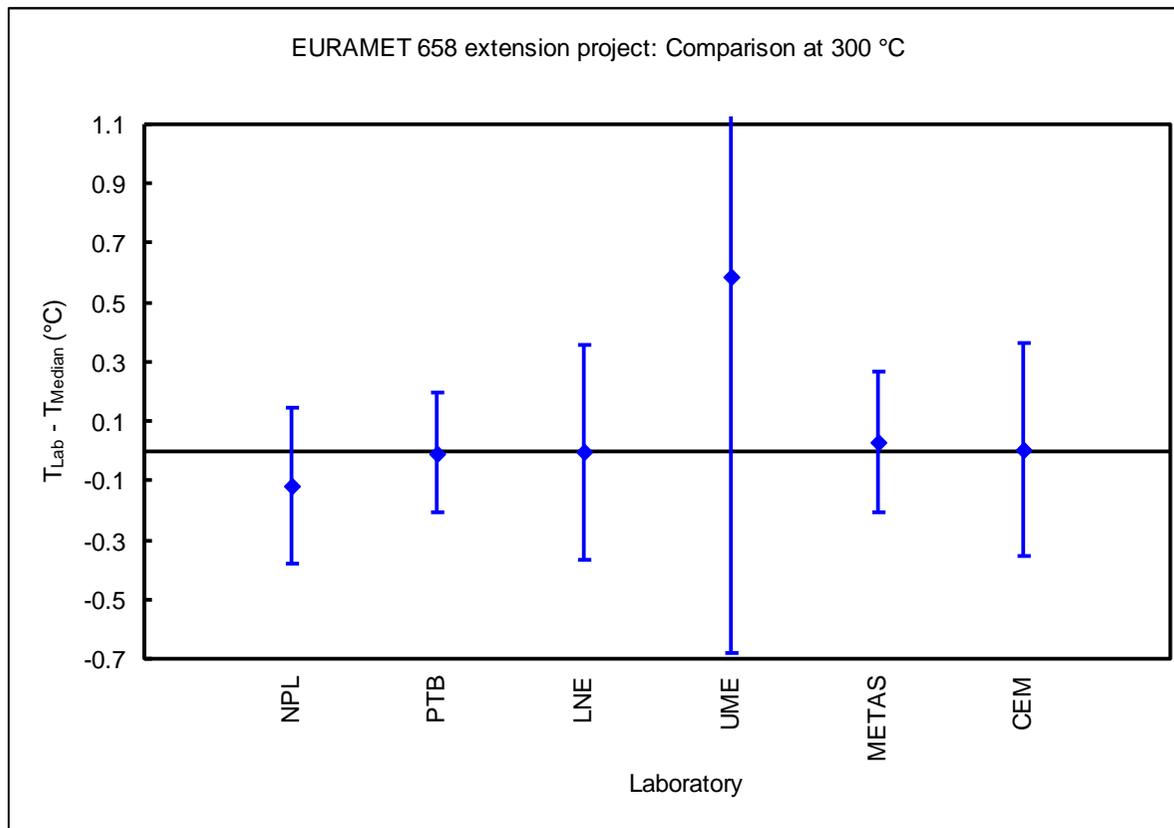
	<b>NPL</b>	<b>PTB</b>	<b>LNE</b>	<b>UME</b>	<b>METAS</b>	<b>CEM</b>
<b>NPL</b>	-	$-0.04 \pm 0.281$	$0.49 \pm 0.546$	$0.21 \pm 0.990$	$0.13 \pm 0.448$	$-0.14 \pm 0.442$
<b>PTB</b>	<i>0.29</i>	-	$0.53 \pm 0.492$	$0.25 \pm 0.962$	$0.17 \pm 0.381$	$-0.10 \pm 0.374$
<b>LNE</b>	<i>0.94</i>	<i>0.93</i>	-	$-0.28 \pm 1.069$	$-0.36 \pm 0.603$	$-0.63 \pm 0.598$
<b>UME</b>	<i>1.05</i>	<i>1.06</i>	<i>1.18</i>	-	$-0.08 \pm 1.023$	$-0.35 \pm 1.020$
<b>METAS</b>	<i>0.51</i>	<i>0.49</i>	<i>0.85</i>	<i>1.01</i>	-	$-0.28 \pm 0.511$
<b>CEM</b>	<i>0.51</i>	<i>0.42</i>	<i>1.12</i>	<i>1.20</i>	<i>0.70</i>	-

Table 7 – direct comparison of the results for the LP5 thermometer variable temperature blackbody measurements at 250 °C



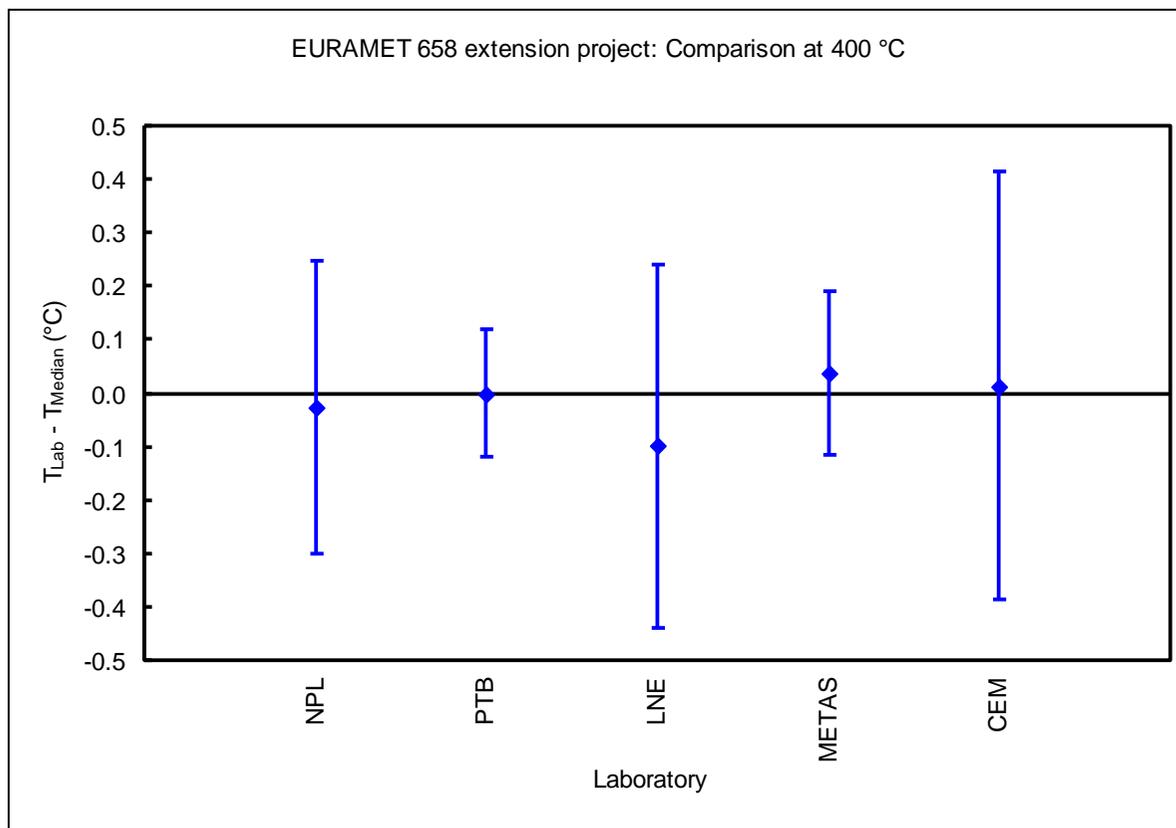
	<b>NPL</b>	<b>PTB</b>	<b>LNE</b>	<b>UME</b>	<b>METAS</b>	<b>CEM</b>
<b>NPL</b>	-	-0.11 ± 0.331	-0.11 ± 0.446	-0.70 ± 1.295	-0.14 ± 0.355	-0.12 ± 0.446
<b>PTB</b>	0.39	-	0.00 ± 0.412	-0.59 ± 1.284	-0.04 ± 0.312	-0.01 ± 0.413
<b>LNE</b>	0.49	0.41	-	-0.59 ± 1.318	-0.03 ± 0.432	-0.01 ± 0.510
<b>UME</b>	1.77	1.65	1.68	-	0.56 ± 1.290	0.58 ± 1.318
<b>METAS</b>	0.44	0.31	0.43	1.62	-	0.02 ± 0.433
<b>CEM</b>	0.50	0.41	0.50	1.67	0.43	-

Table 8 – direct comparison of the results for the LP5 thermometer variable temperature blackbody measurements at 300 °C



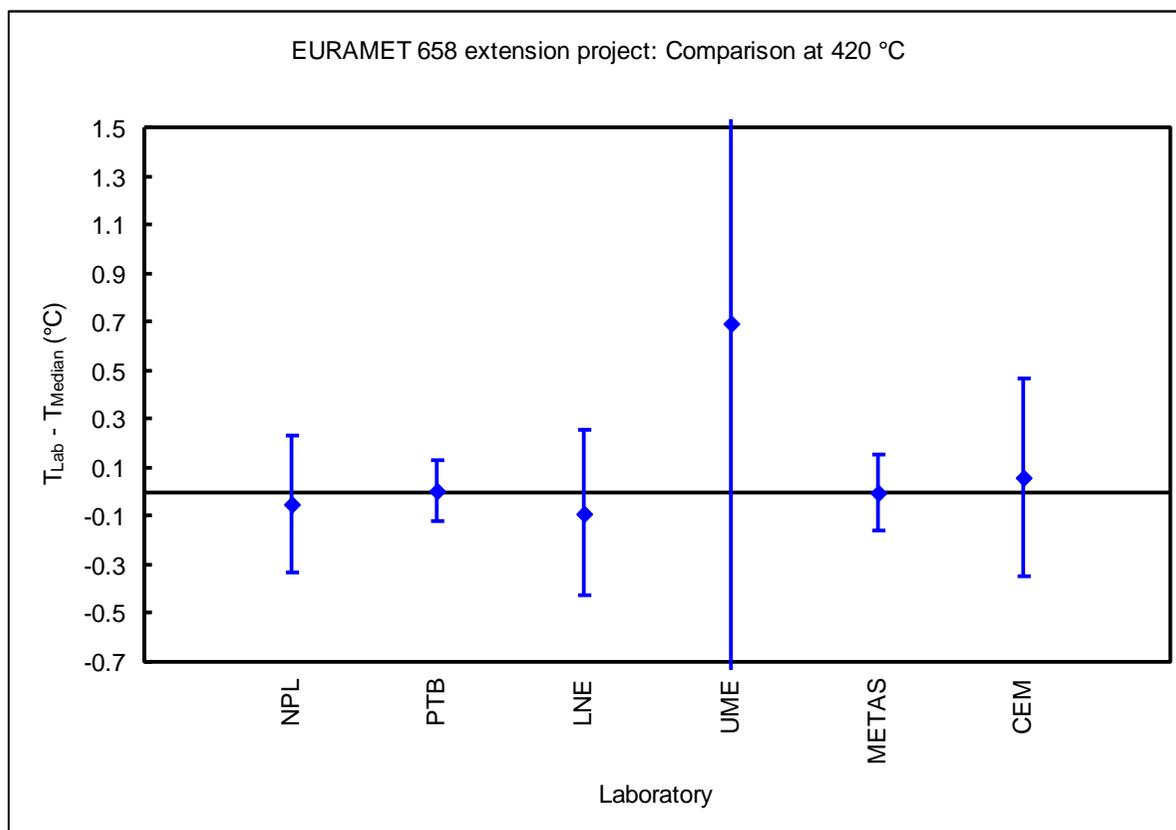
	NPL	PTB	LNE	METAS	CEM
NPL	-	$-0.03 \pm 0.299$	$0.07 \pm 0.437$	$-0.06 \pm 0.314$	$-0.04 \pm 0.484$
PTB	<i>0.30</i>	-	$0.10 \pm 0.360$	$-0.04 \pm 0.194$	$-0.01 \pm 0.416$
LNE	<i>0.45</i>	<i>0.40</i>	-	$-0.14 \pm 0.373$	$-0.11 \pm 0.524$
METAS	<i>0.33</i>	<i>0.20</i>	<i>0.45</i>	-	$0.02 \pm 0.427$
CEM	<i>0.48</i>	<i>0.41</i>	<i>0.56</i>	<i>0.42</i>	-

Table 9 – direct comparison of the results for the LP5 thermometer variable temperature blackbody measurements at 400 °C



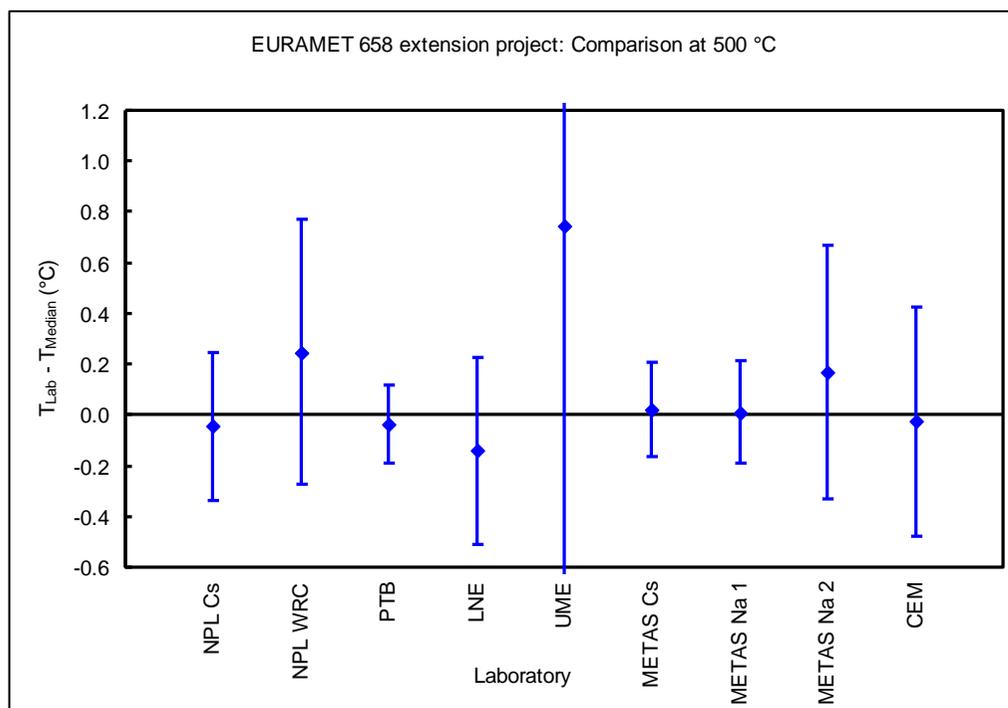
	<b>NPL</b>	<b>PTB</b>	<b>LNE</b>	<b>UME</b>	<b>METAS</b>	<b>CEM</b>
<b>NPL</b>	-	$-0.05 \pm 0.307$	$0.04 \pm 0.440$	$-0.74 \pm 1.566$	$-0.05 \pm 0.322$	$-0.11 \pm 0.495$
<b>PTB</b>	$0.32$	-	$0.09 \pm 0.362$	$-0.69 \pm 1.546$	$0.00 \pm 0.202$	$-0.05 \pm 0.427$
<b>LNE</b>	$0.44$	$0.40$	-	$-0.78 \pm 1.578$	$-0.09 \pm 0.375$	$-0.14 \pm 0.531$
<b>UME</b>	$2.04$	$1.97$	$2.09$	-	$0.70 \pm 1.549$	$0.64 \pm 1.594$
<b>METAS</b>	$0.33$	$0.20$	$0.40$	$1.98$	-	$-0.06 \pm 0.438$
<b>CEM</b>	$0.53$	$0.43$	$0.59$	$1.96$	$0.44$	-

Table 10 – direct comparison of the results for the LP5 thermometer variable temperature blackbody measurements at 420 °C



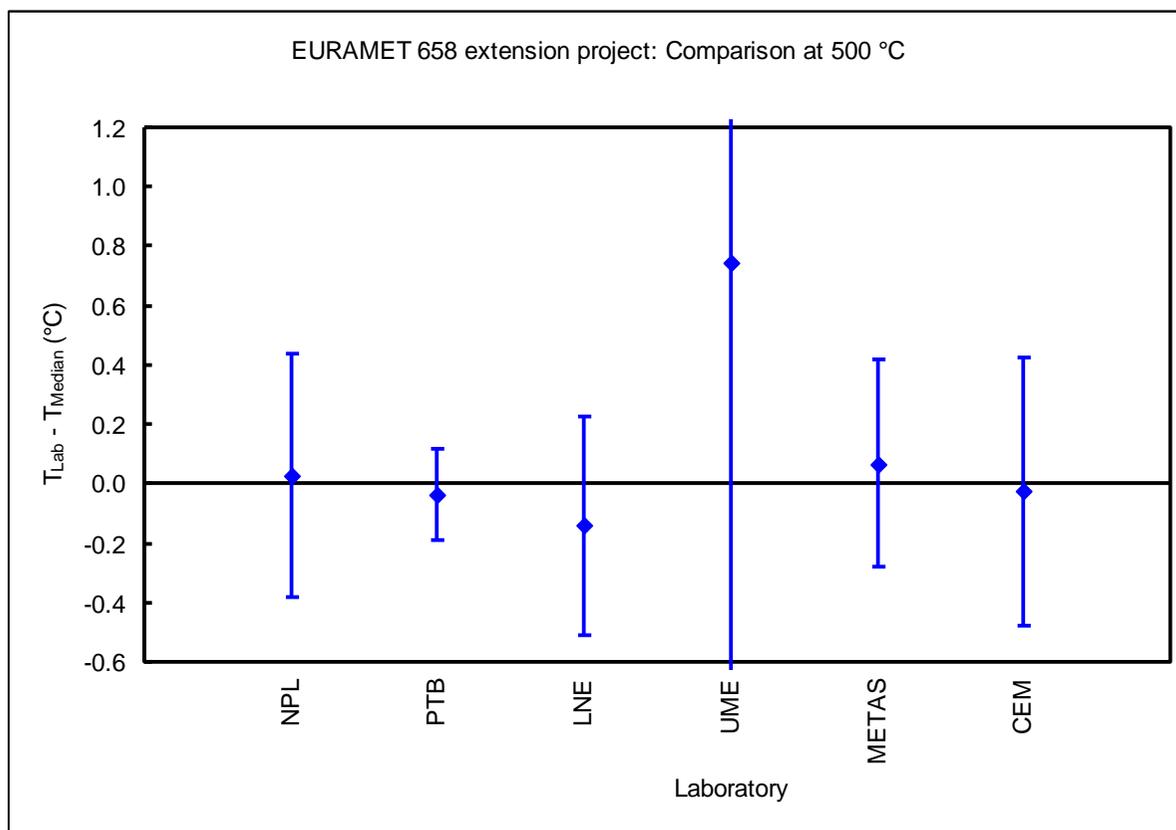
	NPL Cs	NPL WRC	PTB	LNE	UME	METAS Cs	METAS Na 1	METAS Na 2	CEM
NPL Cs	-	$-0.29 \pm 0.598$	$-0.01 \pm 0.330$	$0.10 \pm 0.471$	$-0.79 \pm 1.857$	$-0.07 \pm 0.346$	$-0.06 \pm 0.354$	$-0.22 \pm 0.579$	$-0.02 \pm 0.539$
NPL WRC	0.79	-	$0.28 \pm 0.544$	$0.39 \pm 0.640$	$-0.50 \pm 1.907$	$0.22 \pm 0.554$	$0.24 \pm 0.559$	$0.08 \pm 0.723$	$0.27 \pm 0.692$
PTB	0.32	0.73	-	$0.11 \pm 0.401$	$-0.78 \pm 1.841$	$-0.06 \pm 0.242$	$-0.05 \pm 0.254$	$-0.21 \pm 0.523$	$-0.01 \pm 0.480$
LNE	0.50	0.91	0.44	-	$-0.89 \pm 1.871$	$-0.16 \pm 0.414$	$-0.15 \pm 0.421$	$-0.31 \pm 0.622$	$-0.11 \pm 0.586$
UME	2.33	2.11	2.31	2.43	-	$0.72 \pm 1.844$	$0.74 \pm 1.845$	$0.58 \pm 1.901$	$0.77 \pm 1.890$
METAS Cs	0.36	0.68	0.26	0.51	2.25	-	$0.01 \pm 0.274$	$-0.15 \pm 0.533$	$0.05 \pm 0.491$
METAS Na 1	0.36	0.70	0.26	0.50	2.26	0.27	-	$-0.16 \pm 0.539$	$0.04 \pm 0.496$
METAS Na 2	0.70	0.72	0.64	0.82	2.17	0.59	0.61	-	$0.20 \pm 0.675$
CEM	0.53	0.85	0.47	0.62	2.34	0.49	0.49	0.76	-

Table 11– direct comparison of the results for the LP5 thermometer variable temperature blackbody measurements at 500 °C, with data from different sources



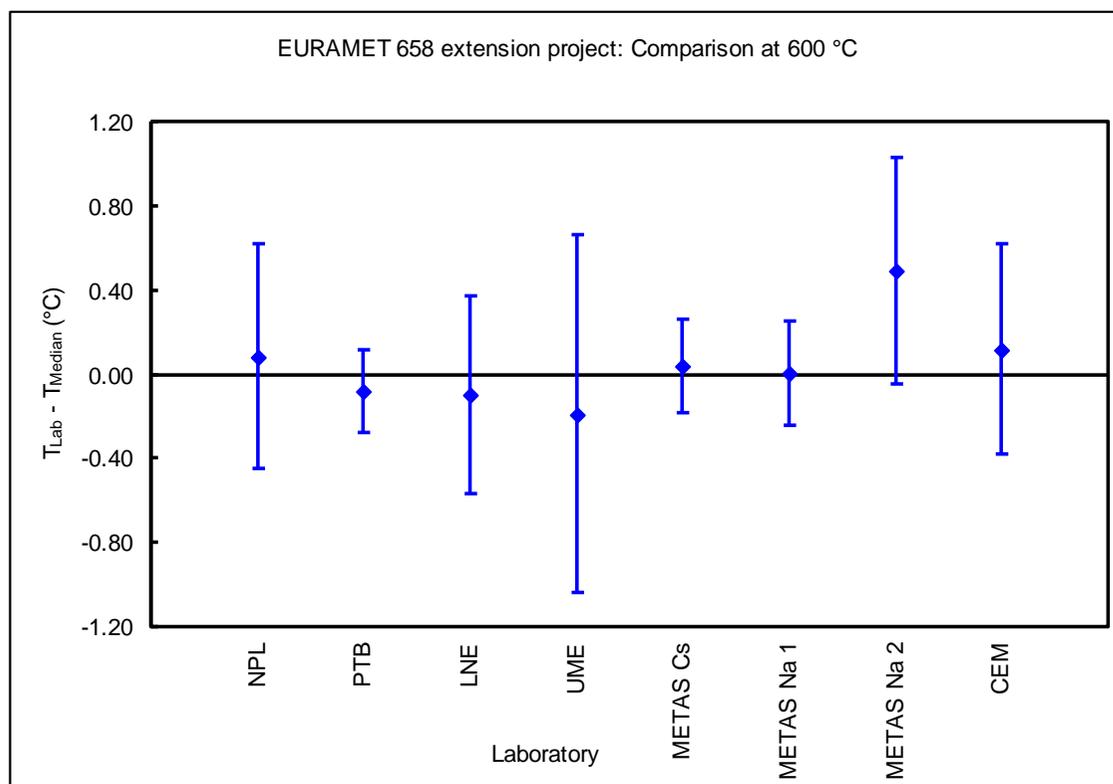
	<b>NPL</b>	<b>PTB</b>	<b>LNE</b>	<b>UME</b>	<b>METAS</b>	<b>CEM</b>
<b>NPL</b>	-	$0.06 \pm 0.438$	$0.17 \pm 0.552$	$-0.72 \pm 1.879$	$-0.04 \pm 0.539$	$0.05 \pm 0.612$
<b>PTB</b>	<i>0.45</i>	-	$0.11 \pm 0.401$	$-0.78 \pm 1.841$	$-0.10 \pm 0.383$	$-0.01 \pm 0.480$
<b>LNE</b>	<i>0.63</i>	<i>0.44</i>	-	$-0.89 \pm 1.871$	$-0.21 \pm 0.509$	$-0.11 \pm 0.586$
<b>UME</b>	<i>2.28</i>	<i>2.31</i>	<i>2.43</i>	-	$0.68 \pm 1.867$	$0.77 \pm 1.890$
<b>METAS</b>	<i>0.53</i>	<i>0.43</i>	<i>0.63</i>	<i>2.23</i>	-	$0.09 \pm 0.573$
<b>CEM</b>	<i>0.61</i>	<i>0.47</i>	<i>0.62</i>	<i>2.34</i>	<i>0.59</i>	-

Table 12 – direct comparison of the results for the LP5 thermometer variable temperature blackbody measurements at 500 °C – average data



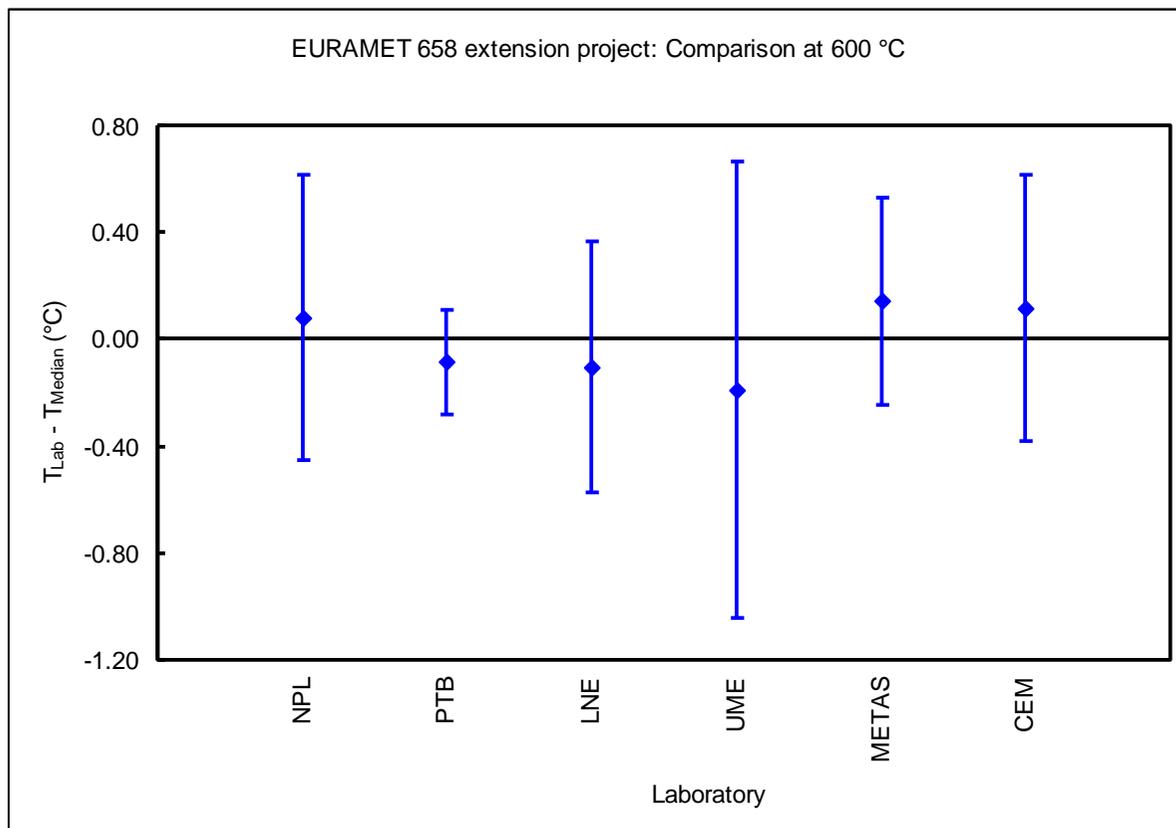
	<b>NPL</b>	<b>PTB</b>	<b>LNE</b>	<b>UME</b>	<b>METAS Cs</b>	<b>METAS Na 1</b>	<b>METAS Na 2</b>	<b>CEM</b>
<b>NPL</b>	-	$0.17 \pm 0.570$	$0.19 \pm 0.712$	$0.27 \pm 1.006$	$0.05 \pm 0.581$	$0.08 \pm 0.589$	$-0.41 \pm 0.761$	$-0.03 \pm 0.732$
<b>PTB</b>	$0.64$	-	$0.02 \pm 0.509$	$0.11 \pm 0.874$	$-0.12 \pm 0.299$	$-0.09 \pm 0.316$	$-0.57 \pm 0.576$	$-0.20 \pm 0.537$
<b>LNE</b>	$0.79$	$0.50$	-	$0.09 \pm 0.973$	$-0.14 \pm 0.521$	$-0.11 \pm 0.531$	$-0.59 \pm 0.717$	$-0.22 \pm 0.686$
<b>UME</b>	$1.12$	$0.88$	$0.97$	-	$-0.23 \pm 0.881$	$-0.19 \pm 0.887$	$-0.68 \pm 1.009$	$-0.31 \pm 0.987$
<b>METAS Cs</b>	$0.57$	$0.37$	$0.58$	$0.97$	-	$0.03 \pm 0.334$	$-0.45 \pm 0.586$	$-0.08 \pm 0.548$
<b>METAS Na 1</b>	$0.60$	$0.35$	$0.56$	$0.95$	$0.33$	-	$-0.49 \pm 0.595$	$-0.11 \pm 0.557$
<b>METAS Na 2</b>	$1.04$	$1.05$	$1.18$	$1.51$	$0.94$	$0.98$	-	$0.37 \pm 0.736$
<b>CEM</b>	$0.72$	$0.65$	$0.79$	$1.13$	$0.56$	$0.59$	$0.98$	-

Table 13 – direct comparison of the results for the LP5 thermometer variable temperature blackbody measurements at 600 °C, with data from different sources



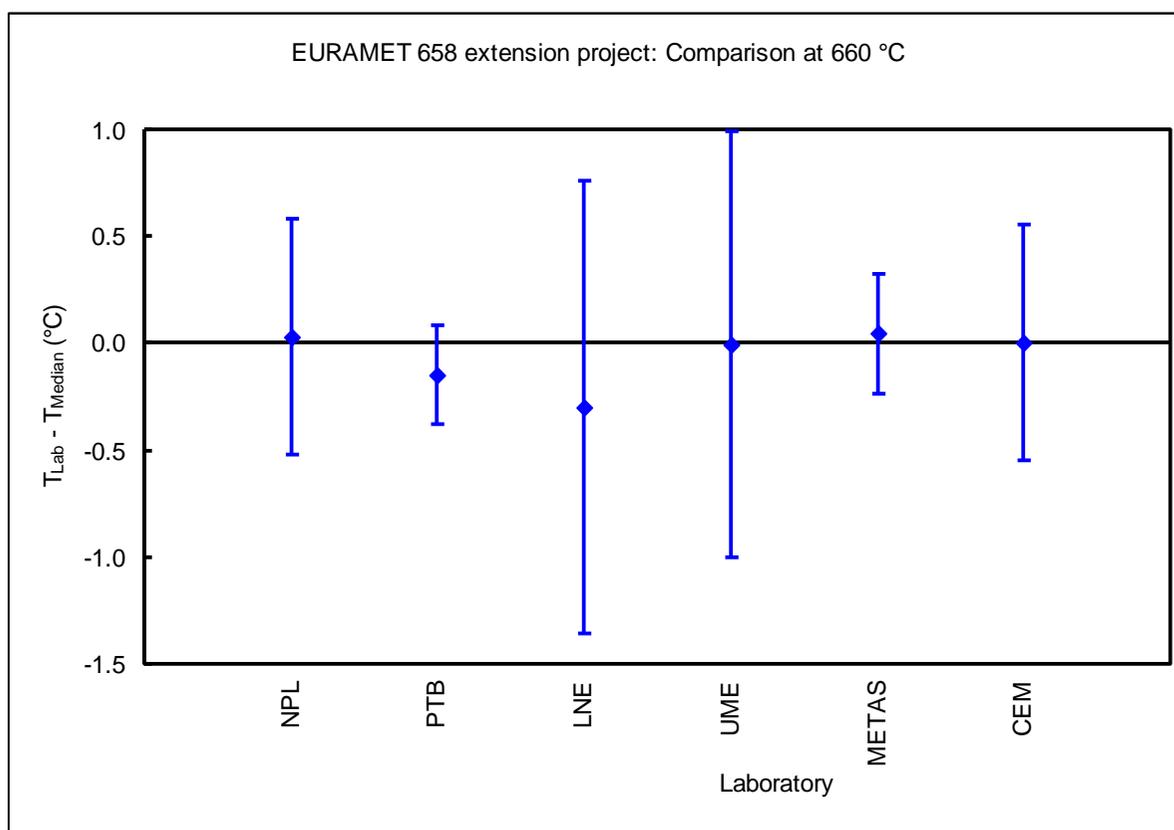
	<b>NPL</b>	<b>PTB</b>	<b>LNE</b>	<b>UME</b>	<b>METAS</b>	<b>CEM</b>
<b>NPL</b>	-	$0.17 \pm 0.570$	$0.19 \pm 0.712$	$0.27 \pm 1.006$	$-0.06 \pm 0.662$	$-0.03 \pm 0.732$
<b>PTB</b>	$0.64$	-	$0.02 \pm 0.509$	$0.11 \pm 0.874$	$-0.23 \pm 0.437$	$-0.20 \pm 0.537$
<b>LNE</b>	$0.79$	$0.50$	-	$0.09 \pm 0.973$	$-0.24 \pm 0.611$	$-0.22 \pm 0.686$
<b>UME</b>	$1.12$	$0.88$	$0.97$	-	$-0.33 \pm 0.937$	$-0.31 \pm 0.987$
<b>METAS</b>	$0.66$	$0.59$	$0.75$	$1.11$	-	$0.03 \pm 0.634$
<b>CEM</b>	$0.72$	$0.65$	$0.79$	$1.13$	$0.62$	-

Table 14 – direct comparison of the results for the LP5 thermometer variable temperature blackbody measurements at 600 °C - average data



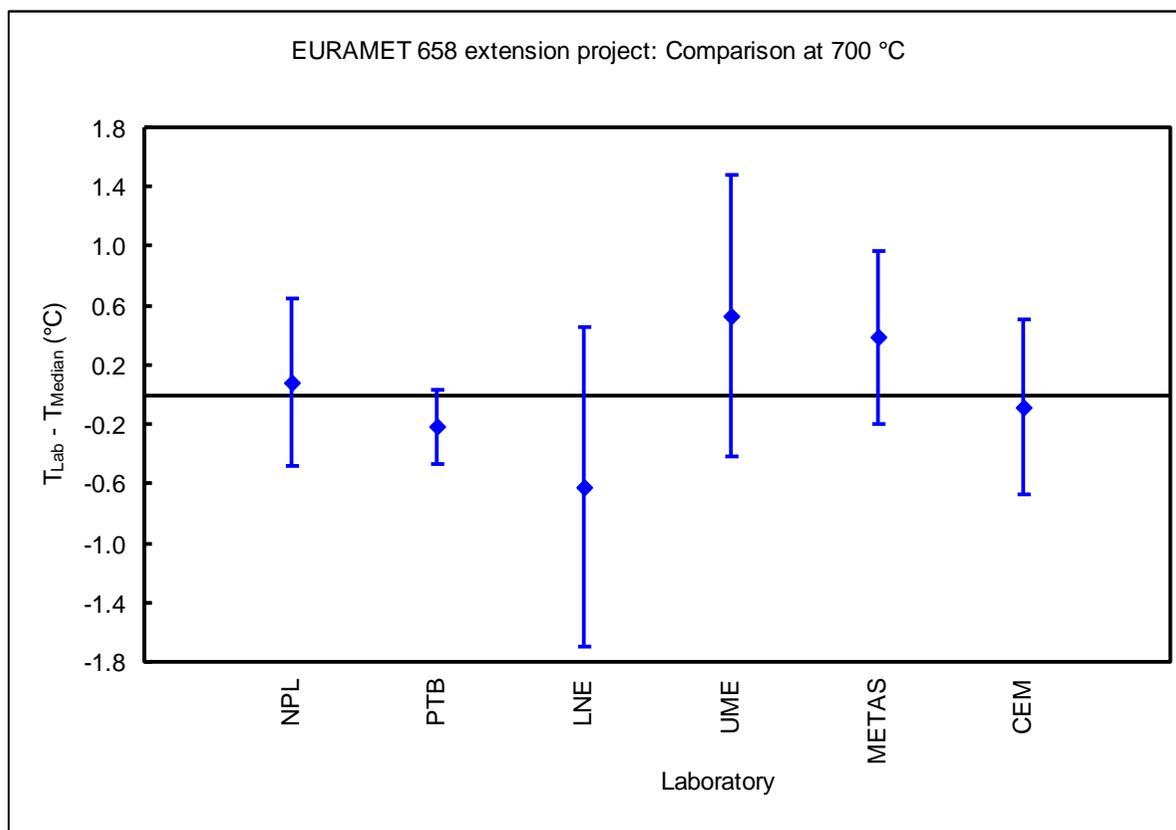
	<b>NPL</b>	<b>PTB</b>	<b>LNE</b>	<b>UME</b>	<b>METAS</b>	<b>CEM</b>
<b>NPL</b>	-	$0.18 \pm 0.600$	$0.33 \pm 1.196$	$0.04 \pm 1.138$	$-0.01 \pm 0.620$	$0.02 \pm 0.782$
<b>PTB</b>	$0.68$	-	$0.15 \pm 1.085$	$-0.14 \pm 1.020$	$-0.19 \pm 0.361$	$-0.15 \pm 0.598$
<b>LNE</b>	$1.34$	$1.10$	-	$-0.30 \pm 1.453$	$-0.34 \pm 1.096$	$-0.31 \pm 1.195$
<b>UME</b>	$1.12$	$1.04$	$1.54$	-	$-0.05 \pm 1.032$	$-0.01 \pm 1.136$
<b>METAS</b>	$0.61$	$0.49$	$1.26$	$1.01$	-	$0.04 \pm 0.618$
<b>CEM</b>	$0.77$	$0.66$	$1.31$	$1.12$	$0.61$	-

Table 15 – direct comparison of the results for the LP5 thermometer variable temperature blackbody measurements at 660 °C



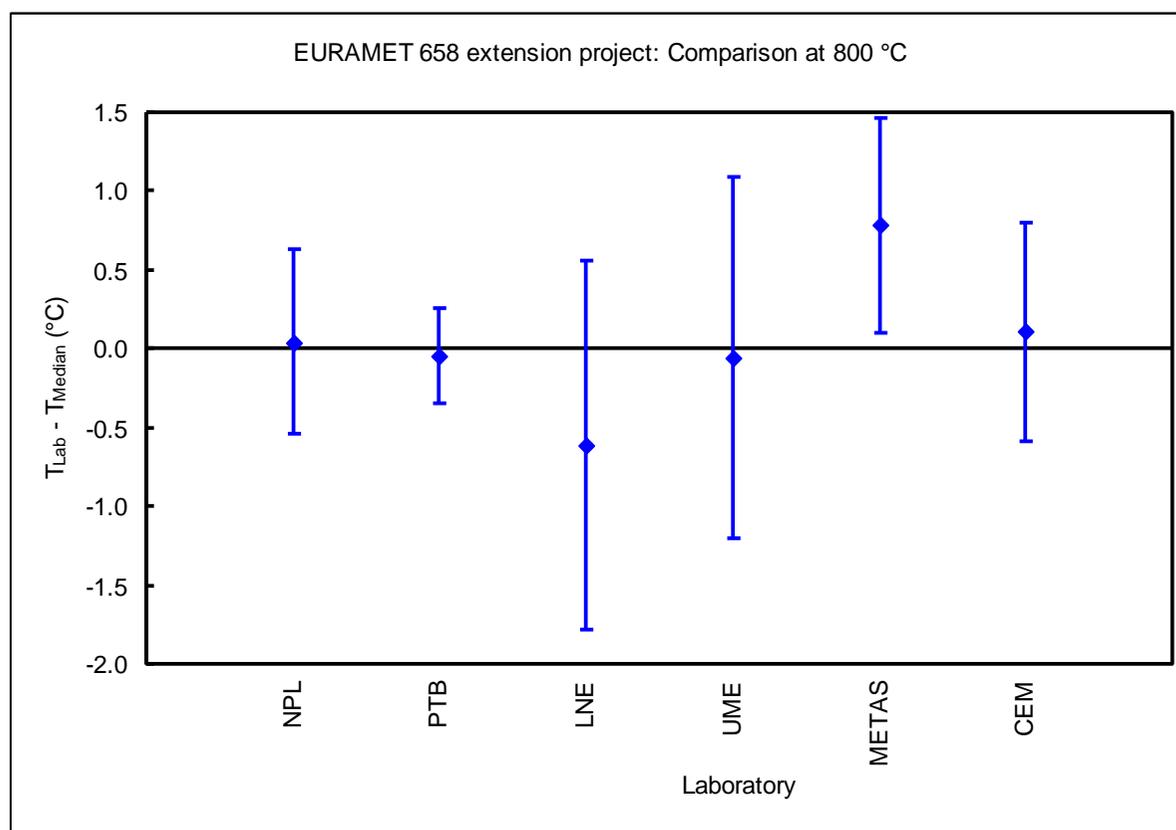
	<b>NPL</b>	<b>PTB</b>	<b>LNE</b>	<b>UME</b>	<b>METAS</b>	<b>CEM</b>
<b>NPL</b>	-	$0.30 \pm 0.615$	$0.71 \pm 1.218$	$-0.45 \pm 1.104$	$-0.30 \pm 0.811$	$0.17 \pm 0.815$
<b>PTB</b>	<i>0.81</i>	-	$0.41 \pm 1.108$	$-0.75 \pm 0.983$	$-0.60 \pm 0.635$	$-0.13 \pm 0.640$
<b>LNE</b>	<i>1.71</i>	<i>1.33</i>	-	$-1.15 \pm 1.439$	$-1.01 \pm 1.228$	$-0.53 \pm 1.231$
<b>UME</b>	<i>1.36</i>	<i>1.56</i>	<i>2.34</i>	-	$0.15 \pm 1.116$	$0.62 \pm 1.119$
<b>METAS</b>	<i>0.97</i>	<i>1.12</i>	<i>2.02</i>	<i>1.13</i>	-	$0.47 \pm 0.830$
<b>CEM</b>	<i>0.87</i>	<i>0.68</i>	<i>1.55</i>	<i>1.54</i>	<i>1.16</i>	-

Table 16 – direct comparison of the results for the LP5 thermometer variable temperature blackbody measurements at 700 °C



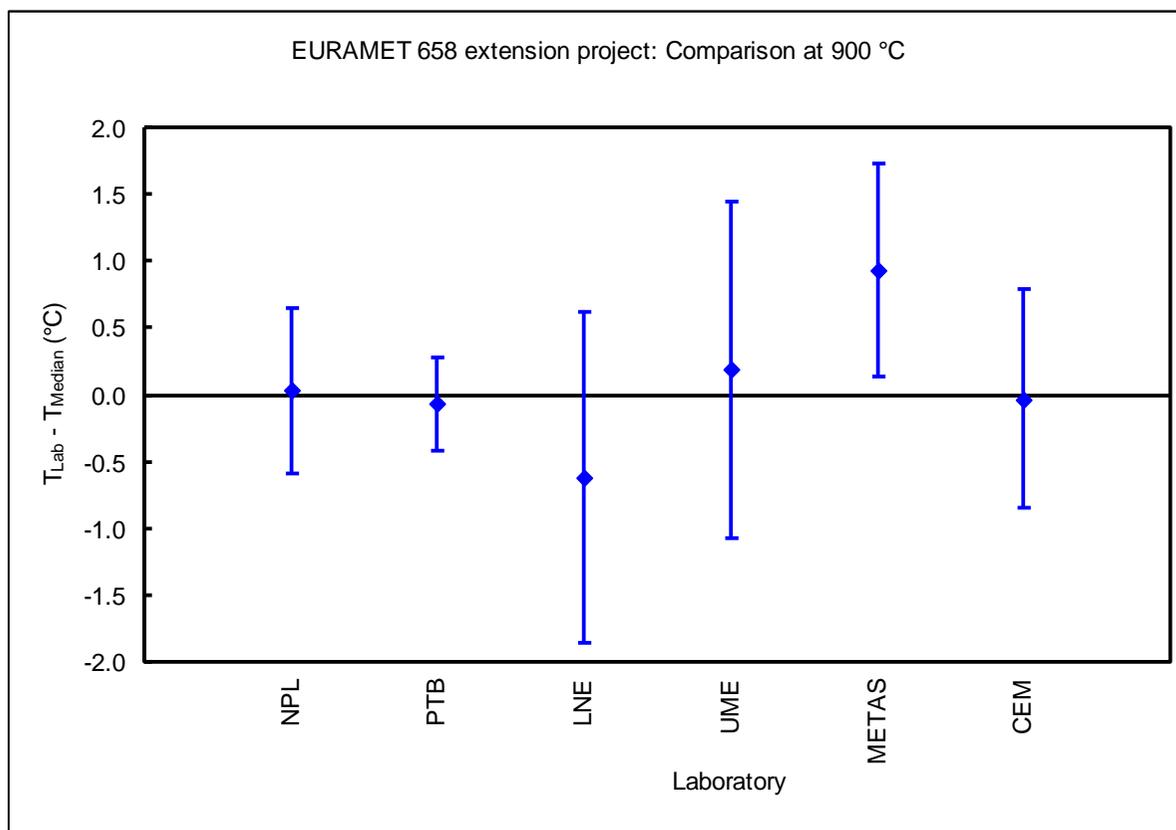
	<b>NPL</b>	<b>PTB</b>	<b>LNE</b>	<b>UME</b>	<b>METAS</b>	<b>CEM</b>
<b>NPL</b>	-	$0.09 \pm 0.654$	$0.66 \pm 1.307$	$0.10 \pm 1.283$	$-0.74 \pm 0.896$	$-0.06 \pm 0.907$
<b>PTB</b>	$0.66$	-	$0.57 \pm 1.208$	$0.01 \pm 1.182$	$-0.83 \pm 0.745$	$-0.15 \pm 0.757$
<b>LNE</b>	$1.74$	$1.57$	-	$-0.56 \pm 1.636$	$-1.40 \pm 1.354$	$-0.72 \pm 1.361$
<b>UME</b>	$1.27$	$1.16$	$1.92$	-	$-0.84 \pm 1.331$	$-0.16 \pm 1.338$
<b>METAS</b>	$1.48$	$1.44$	$2.51$	$1.94$	-	$0.68 \pm 0.974$
<b>CEM</b>	$0.89$	$0.80$	$1.85$	$1.35$	$1.48$	-

Table 17 – direct comparison of the results for the LP5 thermometer variable temperature blackbody measurements at 800 °C



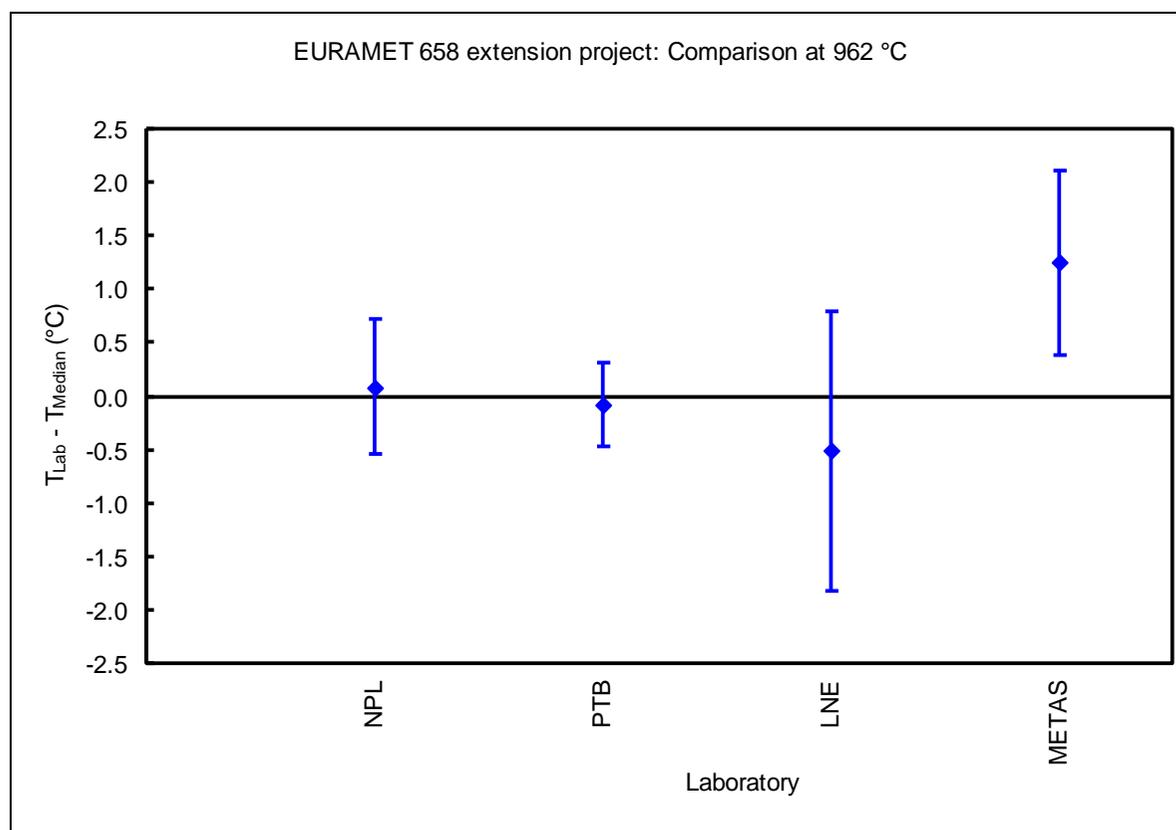
	<b>NPL</b>	<b>PTB</b>	<b>LNE</b>	<b>UME</b>	<b>METAS</b>	<b>CEM</b>
<b>NPL</b>	-	0.10 ± 0.708	0.65 ± 1.383	-0.16 ± 1.403	-0.91 ± 1.005	0.06 ± 1.019
<b>PTB</b>	0.72	-	0.55 ± 1.290	-0.26 ± 1.311	-1.01 ± 0.873	-0.04 ± 0.888
<b>LNE</b>	1.79	1.61	-	-0.80 ± 1.769	-1.56 ± 1.474	-0.59 ± 1.483
<b>UME</b>	1.40	1.38	2.27	-	-0.75 ± 1.493	0.21 ± 1.502
<b>METAS</b>	1.74	1.73	2.77	1.98	-	0.97 ± 1.139
<b>CEM</b>	1.00	0.87	1.82	1.53	1.90	-

Table 18 – direct comparison of the results for the LP5 thermometer variable temperature blackbody measurements at 900 °C



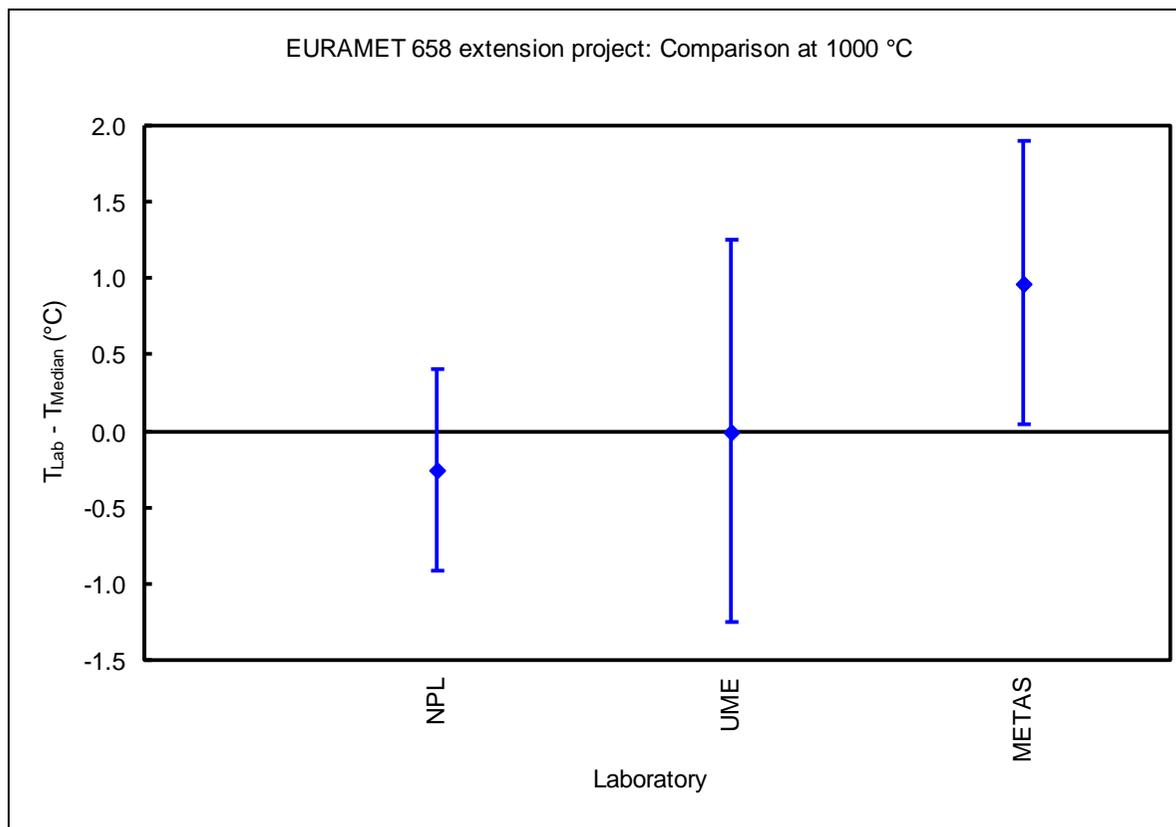
	<b>NPL</b>	<b>PTB</b>	<b>LNE</b>	<b>METAS</b>	<b>CEM</b>
<b>NPL</b>	-	$0.17 \pm 0.748$	$0.60 \pm 1.447$	$-1.16 \pm 1.074$	$-0.06 \pm 0.481$
<b>PTB</b>	$0.81$	-	$0.43 \pm 1.358$	$-1.34 \pm 0.950$	$-0.02 \pm 0.622$
<b>LNE</b>	$1.80$	$1.56$	-	$-1.77 \pm 1.561$	$0.23 \pm 0.497$
<b>METAS</b>	$2.05$	$2.12$	$3.05$	-	$-0.13 \pm 0.455$
<b>CEM</b>	$0.48$	$0.61$	$0.65$	$0.51$	-

Table 19 – direct comparison of the results for the LP5 thermometer variable temperature blackbody measurements at 962 °C



	NPL	UME	METAS
NPL	-	$-0.25 \pm 1.411$	$-1.22 \pm 1.137$
UME	1.47	-	$-0.97 \pm 1.553$
METAS	2.16	2.25	-

Table 20 – direct comparison of the results for the LP5 thermometer variable temperature blackbody measurements at 1000 °C



### 3 ANALYSIS OF THE COMBINED FIXED-POINT AND VARIABLE TEMPERATURE BLACKBODY MEASUREMENT RESULTS

The results were also analysed by combining the data using the fixed-point sources (FP) with the data from the variable temperature blackbody sources (VTBB) at the fixed-point temperatures, and performing a direct comparison of the results.

#### 3.1 THE LP5 RESULTS.

$t_{nom}$ / °C	FP or VTBB	Range used	$t_{BB}$ / °C	Bgrd corrected signal/ A	Required range	Signal at required range/ A	Drift from Zn point check/ °C	Signal corrected for Zn point drift/ A	dt ( $t_{nom}$ - $t_{BB}$ ) / °C	Signal corrected to $t_{nom}$ / A	u ( $k=2$ ) with range ratio & drift uncertainty* / °C
231.93	FP	R1	231.93	3.04800E-12	R1	3.04800E-12	-0.003	3.04770E-12	0.00	3.04770E-12	0.11
231.93	VTBB	R1	232.03	3.06186E-12	R1	3.06186E-12	-0.003	3.06156E-12	-0.10	3.05057E-12	0.27
419.53	FP	R1	419.53	4.14357E-10	R1	4.14357E-10	-0.005	4.14317E-10	0.00	4.14317E-10	0.13
419.53	VTBB	R1	419.42	4.12869E-10	R1	4.12869E-10	-0.005	4.12830E-10	0.11	4.13661E-10	0.28
660.32	FP	R2	660.32	1.25937E-08	R2	1.25937E-08	-0.009	1.25925E-08	0.00	1.25925E-08	0.23
660.32	VTBB	R2	660.04	1.25680E-08	R2	1.25680E-08	-0.009	1.25668E-08	0.28	1.26042E-08	0.55
961.78	FP	R2	961.78	1.38800E-07	R2	1.38800E-07	-0.016	1.38787E-07	0.00	1.38787E-07	0.40
961.78	VTBB	R2	961.78	1.38637E-07	R2	1.38637E-07	-0.016	1.38624E-07	0.00	1.38624E-07	0.64

Table 21 – the combined NPL measurements at the fixed-point temperatures, using fixed-point and variable temperature blackbody sources for the LP5

$t_{nom}$ / °C	FP or VTBB	Range used	$t_{BB}$ / °C	Bgrd corrected signal/ A	Required range	Signal at required range/ A	Drift from Zn point check/ °C	Signal corrected for Zn point drift/ A	dt ( $t_{nom}$ - $t_{BB}$ ) / °C	Signal corrected to $t_{nom}$ / A	u ( $k=2$ ) with range ratio & drift uncertainty* / °C
231.93	VTBB	R1	231.946	3.03946E-12	R1	3.03946E-12	0	3.03946E-12	-0.016	3.03774E-12	0.128
419.53	VTBB	R1	419.530	4.14019E-10	R1	4.14019E-10	0	4.14019E-10	0.000	4.14019E-10	0.125
660.32	VTBB	R2	660.312	1.25796E-08	R2	1.25796E-08	0	1.25796E-08	0.008	1.25806E-08	0.230
961.78	VTBB	R2	961.748	1.38461E-07	R2	1.38461E-07	0	1.38461E-07	0.032	1.38488E-07	0.393
231.93	VTBB	R1	231.947	3.03869E-12	R1	3.03869E-12	0	3.03869E-12	-0.017	3.03689E-12	0.147
231.93	VTBB	R1	419.512	4.13968E-10	R1	4.13968E-10	0	4.13968E-10	0.018	4.14109E-10	0.125
961.78	VTBB	R2	961.696	1.38400E-07	R2	1.38400E-07	0	1.38400E-07	0.084	1.38470E-07	0.393

Table 22 – the PTB measurements at the fixed-point temperatures, using variable temperature blackbody sources for the LP5

$t_{nom}$ / °C	FP or VTBB	Range used	$t_{BB}$ / °C	Bgrd corrected signal/ A	Required range	Signal at required range/ A	Drift from Zn point check/ °C	Signal corrected for Zn point drift/ A	dt ( $t_{nom}$ - $t_{BB}$ ) / °C	Signal corrected to $t_{nom}$ / A	u ( $k=2$ ) with range ratio & drift uncertainty* / °C
231.93	VTBB	R1	231.76	2.99090E-12	R1	2.99090E-12	0.293	3.02238E-12	0.17	3.04049E-12	0.60
419.53	VTBB	R1	419.63	4.09805E-10	R1	4.09805E-10	0.551	4.14118E-10	-0.10	4.13359E-10	0.34
419.53	VTBB	R2	660.06	1.23955E-08	R2	1.23955E-08	1.000	1.25259E-08	0.26	1.25605E-08	1.06
660.32	VTBB	R2	961.63	1.36561E-07	R2	1.36561E-07	1.751	1.37998E-07	0.15	1.38124E-07	1.30

Table 23 – the LNE measurements at the fixed-point temperatures, variable temperature blackbody sources for the LP5

$t_{nom}$ / °C	FP or VTBB	Range used	$t_{BB}$ / °C	Bgrd corrected signal/ A	Required range	Signal at required range/ A	Drift from Zn point check/ °C	Signal corrected for Zn point drift/ A	dt ( $t_{nom}$ - $t_{BB}$ ) / °C	Signal corrected to $t_{nom}$ / A	u ( $k=2$ ) with range ratio & drift uncertainty* / °C
231.93	FP	R1	231.93	3.03065E-12	R1	3.03065E-12	0.136	3.04541E-12	0.00	3.04541E-12	0.47
419.53	FP	R2	419.53	4.11979E-10	R1	4.17417E-10	0.255	4.19450E-10	0.00	4.19450E-10	1.29
419.53	VTBB	R2	417.73	3.98655E-10	R1	4.03899E-10	0.224	4.05635E-10	1.80	4.19619E-10	1.54
660.32	FP	R2	660.32	1.25181E-08	R2	1.25181E-08	0.463	1.25791E-08	0.00	1.25791E-08	0.22
660.32	VTBB	R2	655.68	1.19562E-08	R2	1.19562E-08	0.405	1.20076E-08	4.64	1.25996E-08	0.99

Table 24 – the combined UME measurements at the fixed-point temperatures, using fixed-point and variable temperature blackbody sources for the LP5

$t_{nom}$ / °C	FP or VTBB	Range used	$t_{BB}$ / °C	Bgrd corrected signal/ A	Required range	Signal at required range/ A	Drift from Zn point check/ °C	Signal corrected for Zn point drift/ A	dt ( $t_{nom}$ - $t_{BB}$ ) / °C	Signal corrected to $t_{nom}$ / A	u ( $k=2$ ) with range ratio & drift uncertainty* / °C
231.93	VTBB	R1	231.913	3.02060E-12	R1	3.02060E-12	0.237	3.04632E-12	0.020	3.04820E-12	0.450
419.53	VTBB	R1	419.500	4.10290E-10	R1	4.10290E-10	0.446	4.13790E-10	0.030	4.14031E-10	0.158
419.53	VTBB	R2	660.335	1.25020E-08	R2	1.25020E-08	0.810	1.26081E-08	-0.020	1.26061E-08	0.278
660.32	VTBB	R2	961.678	1.38340E-07	R2	1.38340E-07	1.417	1.39516E-07	0.100	1.39601E-07	0.865

Table 25 – the METAS measurements at the fixed-point temperatures, using variable temperature blackbody sources for the LP5

$t_{nom}$ / °C	FP or VTBB	Range used	$t_{BB}$ / °C	Bgrd corrected signal/ A	Required range	Signal at required range/ A	Drift from Zn point check/ °C	Signal corrected for Zn point drift/ A	dt ( $t_{nom}$ - $t_{BB}$ ) / °C	Signal corrected to $t_{nom}$ / A	u ( $k=2$ ) with range ratio & drift uncertainty* / °C
231.93	VTBB	R1	231.91	3.02262E-12	R1	3.02262E-12	0.02	3.02522E-12	0.02	3.02740E-12	0.43
419.53	FP	R1	419.53	4.14927E-10	R1	4.14927E-10	0.045	4.15284E-10	0.00	4.15284E-10	0.28
419.53	FP	R1	419.53	4.12569E-10	R1	4.12569E-10	0.045	4.12924E-10	0.00	4.12924E-10	0.28
419.53	VTBB	R1	419.55	4.14299E-10	R1	4.14299E-10	0.045	4.14655E-10	-0.02	4.14497E-10	0.41
660.32	VTBB	R2	660.35	1.25941E-08	R2	1.25941E-08	0.08	1.26049E-08	-0.03	1.26010E-08	0.55
961.78	FP	R2	961.78	1.38577E-07	R2	1.38577E-07	0.143	1.38696E-07	0.00	1.38696E-07	0.93
961.78	FP	R2	961.78	1.38002E-07	R2	1.38002E-07	0.143	1.38121E-07	0.00	1.38121E-07	0.89

**Table 26 - the combined CEM measurements at the fixed-point temperatures, using fixed-point and variable temperature blackbody sources for the LP5**

$t_{nom}$ / °C	FP or VTBB	Range used	$t_{BB}$ / °C	Bgrd corrected signal/ A	Required range	Signal at required range/ A	Drift from Zn point check/ °C	Signal corrected for Zn point drift/ A	dt ( $t_{nom}$ - $t_{BB}$ ) / °C	Signal corrected to $t_{nom}$ / A	u ( $k=2$ ) with range ratio & drift uncertainty* / °C
231.93	FP	R1	231.93	3.01309E-12	R1	3.01309E-12	0.281	3.04348E-12	0.00	3.04348E-12	0.520
419.53	FP	R1	419.53	4.10363E-10	R1	4.10363E-10	0.528	4.14502E-10	0.00	4.14502E-10	0.122
660.32	FP	R2	660.32	1.24922E-08	R2	1.24922E-08	0.959	1.26182E-08	0.00	1.26182E-08	0.219
961.78	FP	R2	961.78	1.37398E-07	R2	1.37398E-07	1.678	1.38784E-07	0.00	1.38784E-07	0.383

**Table 27 – the INRiM measurements at the fixed-point temperatures, using fixed-point sources for the LP5**

$t_{nom}/\text{ }^{\circ}\text{C}$	Average signal/A	$U(k=2)/\text{ }^{\circ}\text{C}$
231.93	3.04914E-12	0.19
419.53	4.13989E-10	0.20
660.32	1.25983E-08	0.39
961.78	1.38705E-07	0.52
Sn FP	3.04770E-12	0.11
VTBB at Sn	3.05057E-12	0.27
Zn FP	4.14317E-10	0.13
VTBB at Zn	4.13661E-10	0.28
Al FP	1.25925E-08	0.23
VTBB at Al	1.26042E-08	0.55
Ag FP	1.38787E-07	0.40
VTBB at Ag	1.38624E-07	0.64

**Table 28 - the average NPL results**

$t_{nom}/\text{ }^{\circ}\text{C}$	Average signal/A	$U(k=2)/\text{ }^{\circ}\text{C}$
231.93	3.03731E-12	0.147
419.53	4.14064E-10	0.125
660.32	1.25806E-08	0.230
961.78	1.38479E-07	0.393

**Table 29 – the average PTB results**

$t_{nom}/\text{ }^{\circ}\text{C}$	Average signal/A	$U(k=2)/\text{ }^{\circ}\text{C}$
231.93	3.04049E-12	0.60
419.53	4.13359E-10	0.34
660.32	1.25606E-08	1.06
961.78	1.38124E-07	1.30

**Table 30 – the average LNE results**

$t_{nom}/\text{ }^{\circ}\text{C}$	Average signal/A	$U(k=2)/\text{ }^{\circ}\text{C}$
231.93	3.04541E-12	0.47
419.53	4.19535E-10	1.42
660.32	1.25893E-08	0.61
Zn FP	4.19450E-10	1.29
VTBB at Zn	4.19619E-10	1.54
Al FP	1.25791E-08	0.22
VTBB at Al	1.25996E-08	0.99

**Table 31 – the average UME results**

$t_{nom}/\text{ }^{\circ}\text{C}$	Average signal/A	$U(k=2)/\text{ }^{\circ}\text{C}$
231.93	3.04820E-12	0.45
419.53	4.14031E-10	0.16
660.32	1.26061E-08	0.28
961.78	1.39601E-07	0.87

**Table 32 – the average METAS results**

$t_{nom}/\text{ }^{\circ}\text{C}$	Average signal/A	$U(k=2)/\text{ }^{\circ}\text{C}$
231.93	3.03450E-12	0.43
419.53	4.14235E-10	0.34
660.32	1.26010E-08	0.55
961.78	1.38408E-07	0.91
Zn FP	4.14104E-10	0.28
VTBB at Zn	4.14497E-10	0.41

**Table 33 – the average CEM results**

$t_{nom}/\text{ }^{\circ}\text{C}$	Average signal/A	$U(k=2)/\text{ }^{\circ}\text{C}$
231.93	3.04348E-12	0.52
419.53	4.14502E-10	0.12
660.32	1.26182E-08	0.22
961.78	1.38784E-07	0.38

**Table 34 – the average INRiM results**

$t_{nom}/\text{ }^{\circ}\text{C}$	Mean signal/A	Median signal/A	Weighted signal/A
231.93	3.04265E-12	3.04348E-12	3.04185E-12
419.53	4.14816E-10	4.14064E-10	4.14178E-10
660.32	1.25934E-08	1.25983E-08	1.26003E-08
961.78	1.38684E-07	1.38592E-07	1.38684E-07

**Table 35– mean, median and weighted mean values for all the LP5 measurements**

$t_{nom}/^{\circ}\text{C}$	NPL – mean/ A	NPL – median/ A	equiv dT* from median / $^{\circ}\text{C}$	NPL- wghted mean/ A	PTB – mean/ A	PTB – median/ A	equiv dT* from median / $^{\circ}\text{C}$	PTB- wghted mean/ A	LNE – mean/ A	LNE – median/ A	equiv dT* from median / $^{\circ}\text{C}$	LNE – wghted mean/ A
231.93	6.4907E-15	5.6608E-15	0.05	7.2900E-15	-5.3368E-15	-6.1667E-15	-0.06	-4.5374E-15	-2.1548E-15	-2.9847E-15	-0.03	-1.3554E-15
419.53	-8.2723E-13	-7.4891E-14	-0.01	-1.8881E-13	-7.5234E-13	0.0000E+00	0.00	-1.1392E-13	-1.4574E-12	-7.0510E-13	-0.09	-8.1902E-13
660.32	4.9094E-12	0.0000E+00	0.00	-1.9521E-12	-1.2840E-11	-1.7750E-11	-0.13	-1.9702E-11	-3.2890E-11	-3.7800E-11	-0.29	-3.9752E-11
961.78	2.1952E-11	1.1325E-10	0.14	2.1786E-11	-2.0455E-10	-1.1325E-10	-0.14	-2.0471E-10	-5.5945E-10	-4.6815E-10	-0.56	-5.5961E-10
Sn FP	5.0582E-15	4.2283E-15	0.04	5.8575E-15	-	-	-	-	-	-	-	-
VTBB -Sn	7.9232E-15	7.0933E-15	0.06	8.7226E-15	-	-	-	-	-	-	-	-
Zn FP	-4.9912E-13	2.5322E-13	0.03	1.3929E-13	-	-	-	-	-	-	-	-
VTBB -Zn	-1.1553E-12	-4.0300E-13	-0.05	-5.1692E-13	-	-	-	-	-	-	-	-
Al FP	-9.4082E-13	-5.8502E-12	-0.04	-7.8024E-12	-	-	-	-	-	-	-	-
VTBB -Al	1.0760E-11	5.8502E-12	0.04	3.8981E-12	-	-	-	-	-	-	-	-
Ag FP	1.0345E-10	1.9475E-10	0.23	1.0329E-10	-	-	-	-	-	-	-	-
VTBB -Ag	-5.9548E-11	3.1750E-11	0.04	-5.9714E-11	-	-	-	-	-	-	-	-

Table 36 - differences of the laboratory results from the mean, median and weighted mean values for the LP5 thermometer – table 1 of 3

$t_{nom}/^{\circ}\text{C}$	UME – mean/ A	UME - median/ A	equiv dT* from median / $^{\circ}\text{C}$	UME- wghted mean/ A	METAS - mean/ A	METAS- median/ A	equiv dT* from median / $^{\circ}\text{C}$	METAS- wghted mean/ A	CEM - mean/ A	CEM- median/ A	equiv dT* from median / $^{\circ}\text{C}$	CEM – wghted mean/ A
231.93	2.7646E-15	1.9347E-15	0.02	3.5639E-15	5.5532E-15	4.7233E-15	0.04	6.3526E-15	-8.1468E-15	-8.9767E-15	-0.08	-7.3474E-15
419.53	4.7183E-12	5.4707E-12	0.69	5.3567E-12	-7.8534E-13	-3.3000E-14	0.00	-1.4692E-13	-5.8149E-13	1.7085E-13	0.02	5.6930E-14
660.32	-4.1097E-12	-9.0192E-12	-0.07	-1.0971E-11	1.2660E-11	7.7502E-12	0.06	5.7981E-12	7.5597E-12	2.6502E-12	0.02	6.9810E-13
961.78	-	-	-	-	9.1745E-10	1.0088E-09	1.21	9.1729E-10	-2.7537E-10	-1.8407E-10	-0.22	-2.7553E-10
Zn FP	4.6340E-12	5.3863E-12	0.68	5.2724E-12	-	-	-	-	-7.1256E-13	3.9781E-14	0.01	-7.4143E-14
VTBB -Zn	4.8027E-12	5.5550E-12	0.70	5.4411E-12	-	-	-	-	-3.1934E-13	4.3300E-13	0.05	3.1908E-13
Al FP	-1.4379E-11	-1.9289E-11	-0.15	-2.1241E-11	-	-	-	-	-	-	-	-
VTBB -Al	6.1597E-12	1.2502E-12	0.01	-7.0190E-13	-	-	-	-	-	-	-	-

Table 37 - differences of the laboratory results from the mean, median and weighted mean values for the LP5 thermometer – table 2 of 3

$t_{nom}/ ^\circ\text{C}$	INRiM - mean/ A	INRiM - median/ A	equiv dT* from median/ $^\circ\text{C}$	INRiM -wghted mean/ A
231.93	8.2987E-16	0.0000E+00	0.00	1.6292E-15
419.53	-3.1447E-13	4.3787E-13	0.06	3.2395E-13
660.32	2.4712E-11	1.9802E-11	0.15	1.7850E-11
961.78	9.9957E-11	1.9125E-10	0.23	9.9790E-11

Table 38 - differences of the laboratory results from the mean, median and weighted mean values for the LP5 thermometer – table 3 of 3

3.2 THE INRIM THERMOMETER RESULTS

$t_{nom} / ^\circ\text{C}$	FP or VTBB	Gain used	$t_{BB} / ^\circ\text{C}$	Bgrd corrected signal/ V	Required gain	Signal at required gain / V	Drift from Zn point check/ $^\circ\text{C}$	Signal corrected for Zn point drift/ V	dt ( $t_{nom} - t_{BB}$ ) / $^\circ\text{C}$	Signal corrected to $t_{nom}$ / V	u ( $k=2$ ) with range ratio & drift uncertainty* / $^\circ\text{C}$
156.60	FP	10 <sup>10</sup>	156.60	0.775825	10 <sup>9</sup>	0.084166	-0.025	0.084062	0.00	0.084062	0.09
156.60	VTBB	10 <sup>10</sup>	156.63	0.777632	10 <sup>9</sup>	0.084362	-0.025	0.084258	-0.03	0.084127	0.20
231.93	FP	10 <sup>9</sup>	231.93	1.836495	10 <sup>9</sup>	1.836495	-0.035	1.834224	0.00	1.834224	0.07
231.93	VTBB	10 <sup>9</sup>	232.05	1.841034	10 <sup>9</sup>	1.841034	-0.035	1.838757	-0.12	1.830977	0.20
419.53	FP	10 <sup>7</sup>	419.53	1.984784	10 <sup>7</sup>	1.984784	-0.066	1.982329	0.00	1.982329	0.07
419.53	VTBB	10 <sup>7</sup>	419.43	1.976805	10 <sup>7</sup>	1.976805	-0.066	1.974360	0.10	1.978075	0.21
660.32	FP	10 <sup>6</sup>	660.32	5.488178	10 <sup>6</sup>	5.488178	-0.120	5.481389	0.00	5.481389	0.13
660.32	VTBB	10 <sup>6</sup>	660.03	5.477611	10 <sup>6</sup>	5.477611	-0.120	5.470836	0.30	5.487479	0.50
961.78	FP	10 <sup>5</sup>	961.78	5.653369	10 <sup>5</sup>	5.653369	-0.210	5.646376	0.00	5.646376	0.23
961.78	VTBB	10 <sup>5</sup>	961.78	5.656693	10 <sup>5</sup>	5.656693	-0.210	5.649696	0.00	5.649696	0.54

Table 39 – the combined NPL measurements at the fixed-point temperatures, using fixed-point and variable temperature blackbody sources

$t_{nom}$ / °C	FP or VTBB	Gain used	$t_{BB}$ / °C	Bgrd corrected signal/ V	Required gain	Signal at required gain / V	Drift from Zn point check/ °C	Signal corrected for Zn point drift/ V	dt ( $t_{nom}$ - $t_{BB}$ ) / °C	Signal corrected to $t_{nom}$ / V	u ( $k=2$ ) with range ratio & drift uncertainty* / °C
156.60	VTBB	10 <sup>10</sup>	156.566	0.771526	10 <sup>9</sup>	0.083684	0.00	0.083684	0.034	0.083824	0.07
231.93	VTBB	10 <sup>9</sup>	231.947	1.837326	10 <sup>9</sup>	1.837326	0.00	1.837326	-0.017	1.836253	0.08
419.53	VTBB	10 <sup>7</sup>	419.519	1.983355	10 <sup>7</sup>	1.983355	0.00	1.983355	0.011	1.983756	0.08
660.32	VTBB	10 <sup>6</sup>	660.328	5.483683	10 <sup>6</sup>	5.483683	0.00	5.483683	-0.008	5.483208	0.15
961.78	VTBB	10 <sup>5</sup>	961.728	5.647521	10 <sup>5</sup>	5.647521	0.00	5.647521	0.052	5.649249	0.24
419.53	VTBB	10 <sup>7</sup>	419.516	1.983341	10 <sup>7</sup>	1.983341	0.00	1.983341	0.014	1.983862	0.08
961.78	VTBB	10 <sup>5</sup>	961.693	5.646728	10 <sup>5</sup>	5.646728	0.00	5.646728	0.087	5.649622	0.24

Table 40 – the PTB measurements at the fixed-point temperatures, using variable temperature blackbody sources

$t_{nom}$ / °C	FP or VTBB	Gain used	$t_{BB}$ / °C	Bgrd corrected signal/ V	Required gain	Signal at required gain / V	Drift from Zn point check/ °C	Signal corrected for Zn point drift/ V	dt ( $t_{nom}$ - $t_{BB}$ ) / °C	Signal corrected to $t_{nom}$ / V	u ( $k=2$ ) with range ratio & drift uncertainty* / °C
156.60	VTBB	10 <sup>8</sup>	156.53	0.007810	10 <sup>9</sup>	0.085053	-0.002	0.085046	0.07	0.085340	0.21
231.93	VTBB	10 <sup>7</sup>	231.76	0.016235	10 <sup>9</sup>	1.779335	-0.002	1.779202	0.17	1.790126	0.28
231.93	VTBB	10 <sup>8</sup>	231.76	0.167536	10 <sup>9</sup>	1.824540	-0.002	1.824403	0.17	1.835372	0.28
419.53	VTBB	10 <sup>7</sup>	419.68	1.984168	10 <sup>7</sup>	1.984168	-0.004	1.984019	-0.15	1.978393	0.35
660.32	VTBB	10 <sup>6</sup>	660.02	5.447661	10 <sup>6</sup>	5.447661	-0.007	5.447253	0.30	5.463960	1.09
961.78	VTBB	10 <sup>5</sup>	961.62	5.618921	10 <sup>5</sup>	5.618921	-0.013	5.618499	0.16	5.623788	1.55

Table 41– the LNE measurements at the fixed-point temperatures, using variable temperature blackbody sources

$t_{\text{nom}}$ / °C	FP or VTBB	Gain used	$t_{\text{BB}}$ / °C	Bgrd corrected signal/ V	Require d gain	Signal at required gain / V	Drift from Zn point check/ °C	Signal corrected for Zn point drift/ V	dt ( $t_{\text{nom}}$ - $t_{\text{BB}}$ ) / °C	Signal corrected to $t_{\text{nom}}$ / V	u ( $k=2$ ) with range ratio & drift uncertainty* / °C
156.60	FP	10 <sup>10</sup>	156.60	0.772745	10 <sup>9</sup>	0.083847	-0.02	0.083782	0.000	0.083782	0.076
231.93	FP	10 <sup>9</sup>	231.93	1.834863	10 <sup>9</sup>	1.834863	-0.02	1.833453	0.000	1.833453	0.042
419.53	FP	10 <sup>7</sup>	419.53	1.983950	10 <sup>7</sup>	1.983950	-0.04	1.982426	0.000	1.982426	0.075
419.53	VTBB	10 <sup>7</sup>	417.73	1.923257	10 <sup>7</sup>	1.923257	-0.04	1.921779	1.796	1.986788	0.86
660.32	VTBB	10 <sup>6</sup>	655.68	5.281204	10 <sup>6</sup>	5.281204	-0.07	5.277146	4.640	5.532395	0.83

Table 42 – the combined UME measurements at the fixed-point temperatures, using fixed-point and variable temperature blackbody sources

$t_{\text{nom}}$ / °C	FP or VTBB	Gain used	$t_{\text{BB}}$ / °C	Bgrd corrected signal/ V	Required gain	Signal at required gain / V	Drift from Zn point check/ °C	Signal corrected for Zn point drift/ V	dt ( $t_{\text{nom}}$ - $t_{\text{BB}}$ ) / °C	Signal corrected to $t_{\text{nom}}$ / V	u ( $k=2$ ) with range ratio & drift uncertainty* / °C
156.60	VTBB	10 <sup>10</sup>	156.604	0.777185	10 <sup>9</sup>	0.084247	0.002	0.084254	-0.004	0.084238	0.43
231.93	VTBB	10 <sup>9</sup>	231.915	1.833114	10 <sup>9</sup>	1.833114	0.002	1.833251	0.015	1.834219	0.45
419.53	VTBB	10 <sup>7</sup>	419.485	1.980357	10 <sup>7</sup>	1.980357	0.004	1.980506	0.045	1.982182	0.12
660.32	VTBB	10 <sup>6</sup>	660.174	5.508215	10 <sup>6</sup>	5.508215	0.007	5.508628	0.146	5.516949	0.22
961.78	VTBB	10 <sup>5</sup>	961.861	5.705270	10 <sup>5</sup>	5.705270	0.013	5.705697	-0.081	5.702984	0.81

Table 43 – the METAS measurements at the fixed-point temperatures, using variable temperature blackbody sources

$t_{nom}$ / °C	FP or VTBB	Gain used	$t_{BB}$ / °C	Bgrd corrected signal/ V	Required gain	Signal at required gain / V	Drift from Zn point check/ °C	Signal corrected for Zn point drift/ V	dt ( $t_{nom}$ - $t_{BB}$ ) / °C	Signal corrected to $t_{nom}$ / V	u ( $k=2$ ) with range ratio & drift uncertainty* / °C
156.60	VTBB	10 <sup>9</sup>	156.57	0.084268	10 <sup>9</sup>	0.084268	0.009	0.084306	0.03	0.084429	0.45
231.93	VTBB	10 <sup>9</sup>	231.88	1.838722	10 <sup>9</sup>	1.838722	0.013	1.839550	0.05	1.842792	0.30
231.93	VTBB	10 <sup>9</sup>	232.02	1.842625	10 <sup>9</sup>	1.842625	0.013	1.843454	-0.09	1.837608	0.30
419.53	FP	10 <sup>7</sup>	419.53	1.982037	10 <sup>7</sup>	1.982037	0.024	1.982929	0.00	1.982929	0.09
419.53	FP	10 <sup>6</sup>	419.53	0.198307	10 <sup>7</sup>	1.982041	0.024	1.982932	0.00	1.982932	0.09
419.53	VTBB	10 <sup>7</sup>	419.49	1.983845	10 <sup>7</sup>	1.983845	0.024	1.984738	0.04	1.986226	0.31
660.32	VTBB	10 <sup>6</sup>	660.29	5.480883	10 <sup>6</sup>	5.480883	0.044	5.483348	0.03	5.485046	0.31
961.78	FP	10 <sup>5</sup>	961.78	5.642604	10 <sup>5</sup>	5.642604	0.076	5.645142	0.00	5.645142	0.30
961.78	FP	10 <sup>4</sup>	961.78	0.570133	10 <sup>5</sup>	5.643423	0.076	5.645962	0.00	5.645962	0.30

Table 44 – the combined CEM measurements at the fixed-point temperatures, using fixed-point and variable temperature blackbody sources

$t_{nom}$ / °C	FP or VTBB	Gain used	$t_{BB}$ / °C	Bgrd corrected signal/ V	Required gain	Signal at required gain / V	Drift from Zn point check/ °C	Signal corrected for Zn point drift/ V	dt ( $t_{nom}$ - $t_{BB}$ ) / °C	Signal corrected to $t_{nom}$ / V	u ( $k=2$ ) with range ratio & drift uncertainty* / °C
156.60	FP	10 <sup>9</sup>	156.60	0.083746	10 <sup>9</sup>	0.083746	-0.003	0.083733	0.00	0.083733	0.031
231.93	FP	10 <sup>9</sup>	231.93	1.833878	10 <sup>9</sup>	1.833878	-0.004	1.833603	0.00	1.833603	0.040
419.53	FP	10 <sup>7</sup>	419.53	1.982461	10 <sup>7</sup>	1.982461	-0.008	1.982164	0.00	1.982164	0.072
660.32	FP	10 <sup>6</sup>	660.32	5.481196	10 <sup>6</sup>	5.481196	-0.015	5.480374	0.00	5.480374	0.129
961.78	FP	10 <sup>5</sup>	961.78	5.645096	10 <sup>5</sup>	5.645096	-0.025	5.644250	0.00	5.644250	0.224

Table 45 – the INRiM measurements at the fixed-point temperatures, using fixed-point blackbody sources

$t_{nom}/^{\circ}\text{C}$	Average signal/V	$U(k=2)/^{\circ}\text{C}$
156.60	0.084094	0.14
231.93	1.832600	0.14
419.53	1.980202	0.14
660.32	5.484434	0.31
961.78	5.648036	0.39
In FP	0.084062	0.09
VTBB at In	0.084127	0.20
Sn FP	1.834224	0.07
VTBB at Sn	1.830977	0.20
Zn FP	1.982329	0.07
VTBB at Zn	1.978075	0.21
Al FP	5.481389	0.13
VTBB at Al	5.487479	0.50
Ag FP	5.646376	0.23
VTBB at Ag	5.649696	0.54

**Table 46 – the average NPL results**

$t_{nom}/^{\circ}\text{C}$	Average signal/V	$U(k=2)/^{\circ}\text{C}$
156.60	0.083824	0.07
231.93	1.836253	0.08
419.53	1.983809	0.08
660.32	5.483208	0.15
961.78	5.649436	0.24

**Table 47 – the average PTB results**

$t_{nom}/^{\circ}\text{C}$	Average signal/V	$U(k=2)/^{\circ}\text{C}$
156.60	0.085340	0.21
231.93	1.812749	0.28
419.53	1.978393	0.35
660.32	5.463960	1.09
961.78	5.623788	1.55

**Table 48 – the average LNE results**

$t_{nom}/^{\circ}\text{C}$	Average signal/V	$U(k=2)/^{\circ}\text{C}$
156.60	0.083782	0.08
231.93	1.833453	0.04
419.53	1.984607	0.47
660.32	5.532395	0.83
Zn FP	1.982426	0.07
VTBB at Zn	1.986788	0.86

**Table 49 – the average UME results**

$t_{nom}/^{\circ}\text{C}$	Average signal/V	$U(k=2)/^{\circ}\text{C}$
156.60	0.084238	0.43
231.93	1.834219	0.45
419.53	1.982182	0.12
660.32	5.516949	0.22
961.78	5.702984	0.81

**Table 50 – the average METAS results**

$t_{nom}/^{\circ}\text{C}$	Average signal/V	$U(k=2)/^{\circ}\text{C}$
156.60	0.084429	0.45
231.93	1.840200	0.30
419.53	1.984029	0.20
660.32	5.485046	0.31
961.78	5.645552	0.30
Zn FP	1.982931	0.09
VTBB at Zn	1.986226	0.31

**Table 51 – the average CEM results**

$t_{nom}/^{\circ}\text{C}$	Average signal/V	$U(k=2)/^{\circ}\text{C}$
156.60	0.083733	0.03
231.93	1.833603	0.04
419.53	1.982164	0.07
660.32	5.480374	0.13
961.78	5.644250	0.22

**Table 52 – the average INRiM results**

$t_{nom}/^{\circ}\text{C}$	Mean signal/ V	Median signal/ V	Weighted signal/ V
156.60	0.084208	0.084094	0.083801
231.93	1.831907	1.833878	1.833813
419.53	1.982240	1.982461	1.982662
660.32	5.492455	5.484434	5.487614
961.78	5.652482	5.646794	5.648236

**Table 53 – mean, median and weighted mean values for all the INRiM thermometer measurements**

$t_{nom}/^{\circ}\text{C}$	NPL – mean/ V	NPL – median/ V	equiv dT* from median/ $^{\circ}\text{C}$	NPL-wgthed mean/ V	PTB – mean/ V	PTB – median/ V	equiv dT* from median/ $^{\circ}\text{C}$	PTB-wgthed mean/ V	LNE – mean/ V	LNE – median/ V	equiv dT* from median/ $^{\circ}\text{C}$	LNE – wgthed mean/ V
156.60	-0.000113	0.000000	0.00	0.000294	-0.000384	-0.000271	-0.07	0.000023	0.001132	0.001246	0.30	0.001539
231.93	0.000693	-0.001278	-0.02	-0.001213	0.004345	0.002374	0.04	0.002439	-0.019159	-0.021130	-0.33	-0.021064
419.53	-0.002039	-0.002259	-0.06	-0.002461	0.001569	0.001348	0.04	0.001147	-0.003847	-0.004068	-0.11	-0.004269
660.32	-0.008022	0.000000	0.00	-0.003180	-0.009247	-0.001226	-0.02	-0.004406	-0.028495	-0.020474	-0.36	-0.023654
961.78	-0.004446	0.001242	0.04	-0.000200	-0.017273	-0.000082	0.00	-0.002724	-0.028694	-0.023006	-0.69	-0.024447
In FP	-0.000146	-0.000033	-0.01	0.000261	-	-	-	-	-	-	-	-
VTBB -In	-0.000081	0.000033	0.01	0.000326	-	-	-	-	-	-	-	-
Sn FP	0.002316	0.000345	0.01	0.000410	-	-	-	-	-	-	-	-
VTBB -Sn	-0.000931	-0.002902	-0.04	-0.002837	-	-	-	-	-	-	-	-
Zn FP	0.000089	-0.000132	0.00	-0.000333	-	-	-	-	-	-	-	-
VTBB -Zn	-0.004166	-0.004386	-0.12	-0.004588	-	-	-	-	-	-	-	-
Al FP	-0.011067	-0.003045	-0.05	-0.006225	-	-	-	-	-	-	-	-
VTBB -Al	-0.004977	0.003045	0.05	-0.000135	-	-	-	-	-	-	-	-
Ag FP	-0.006106	-0.000418	-0.01	-0.001860	-	-	-	-	-	-	-	-
VTBB -Ag	-0.002786	0.002902	0.09	0.001460	-	-	-	-	-	-	-	-

Table 54 - differences of the laboratory results from the mean, median and weighted mean values for the INRiM thermometer – table 1 of 3

$t_{nom}/^{\circ}\text{C}$	UME – mean/ V	UME – median/ V	equiv dT* from median/ $^{\circ}\text{C}$	UME-wgthed mean/ V	METAS – mean/ V	METAS-median/ V	equiv dT* from median/ $^{\circ}\text{C}$	METAS-wgthed mean/ V	CEM – mean/ V	CEM-median/ V	equiv dT* from median/ $^{\circ}\text{C}$	CEM – wgthed mean/ V
156.60	-0.000425	-0.000312	-0.08	-0.000018	0.000030	0.000144	0.04	0.000437	0.000221	0.000334	0.08	0.000628
231.93	0.001545	-0.000425	-0.01	-0.000360	0.002311	0.000340	0.01	0.000405	0.008293	0.006322	0.10	0.006387
419.53	0.002366	0.002146	0.06	0.001944	-0.000059	-0.000279	-0.01	-0.000481	0.001789	0.001568	0.04	0.001367
660.32	0.039940	0.047962	0.85	0.044781	0.024494	0.032515	0.57	0.029335	-0.007409	0.000612	0.01	-0.002568
961.78	-	-	-	-	0.050502	0.056190	1.69	0.054748	-0.006930	-0.001242	-0.04	-0.002684
Zn FP	0.000185	-0.000035	0.00	-0.000237	-	-	-	-	0.000690	0.000470	0.01	0.000268
VTBB -Zn	0.004547	0.004327	0.12	0.004125	-	-	-	-	0.003985	0.003765	0.10	0.003563

Table 55 - differences of the laboratory results from the mean, median and weighted mean values for the INRiM thermometer – table 2 of 3

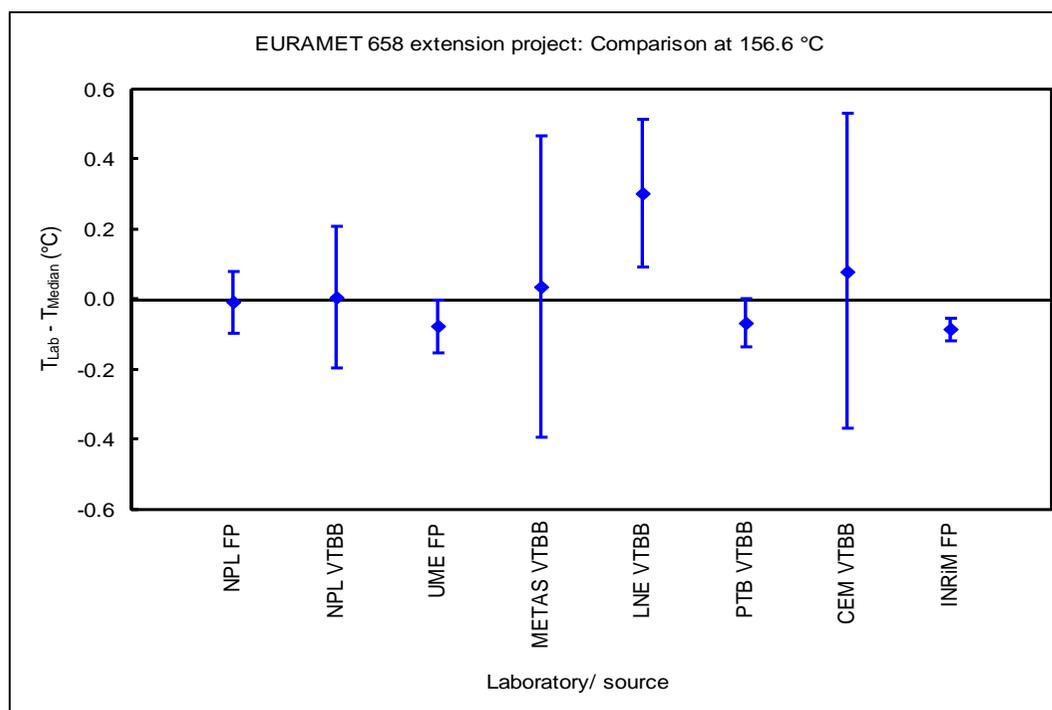
$t_{nom}/^{\circ}\text{C}$	INRiM – mean/ V	INRiM – median/ V	equiv dT* from median/ $^{\circ}\text{C}$	INRiM - wghted mean/ V
156.60	-0.000462	-0.000348	-0.09	-0.000055
231.93	0.001971	0.000000	0.00	0.000065
419.53	0.000221	0.000000	0.00	-0.000201
660.32	-0.011260	-0.003238	-0.06	-0.006418
961.78	-0.007386	-0.001698	-0.05	-0.003139

**Table 56 - differences of the laboratory results from the mean, median and weighted mean values for the INRiM thermometer – table 3 of 3**

**4 ALL THE INRIM THERMOMETER MEASUREMENTS AT THE FIXED-POINT TEMPERATURES USING FIXED-POINT (FP) AND VARIABLE TEMPERATURE BLACKBODY SOURCES (VTBB)**

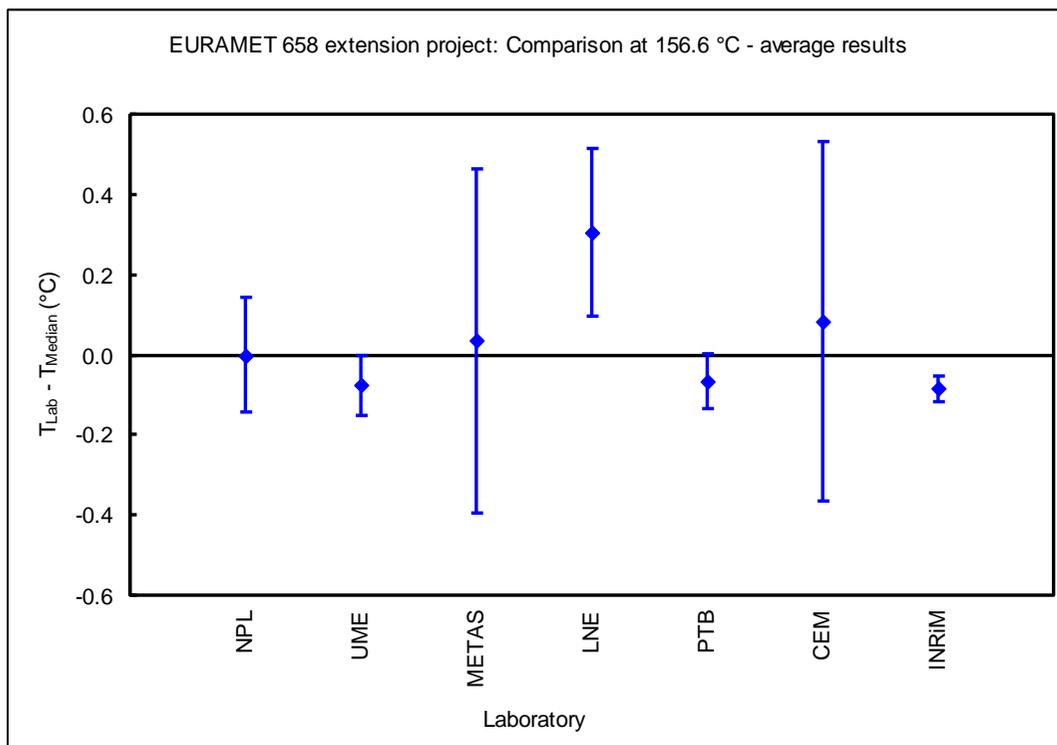
	NPL FP	NPL VTBB	UME FP	METAS VTBB	LNE VTBB	PTB VTBB	CEM VTBB	INRiM FP
NPL FP	-	$-0.02 \pm 0.22$	$0.07 \pm 0.12$	$-0.04 \pm 0.44$	$-0.31 \pm 0.23$	$0.06 \pm 0.11$	$-0.09 \pm 0.46$	$0.08 \pm 0.09$
NPL VTBB	<i>0.22</i>	-	$0.08 \pm 0.22$	$-0.03 \pm 0.48$	$-0.30 \pm 0.29$	$0.07 \pm 0.21$	$-0.07 \pm 0.49$	$0.09 \pm 0.20$
UME FP	<i>0.16</i>	<i>0.26</i>	-	$-0.11 \pm 0.44$	$-0.38 \pm 0.22$	$-0.01 \pm 0.10$	$-0.16 \pm 0.46$	$0.01 \pm 0.08$
METAS VTBB	<i>0.44</i>	<i>0.47</i>	<i>0.48</i>	-	$-0.27 \pm 0.48$	$0.10 \pm 0.44$	$-0.05 \pm 0.62$	$0.12 \pm 0.43$
LNE VTBB	<i>0.50</i>	<i>0.54</i>	<i>0.56</i>	<i>0.66</i>	-	$0.37 \pm 0.22$	$0.22 \pm 0.50$	$0.39 \pm 0.21$
PTB VTBB	<i>0.15</i>	<i>0.25</i>	<i>0.10</i>	<i>0.47</i>	<i>0.55</i>	-	$-0.15 \pm 0.45$	$0.02 \pm 0.08$
CEM VTBB	<i>0.48</i>	<i>0.50</i>	<i>0.54</i>	<i>0.61</i>	<i>0.63</i>	<i>0.53</i>	-	$0.17 \pm 0.45$
INRiM FP	<i>0.15</i>	<i>0.26</i>	<i>0.08</i>	<i>0.48</i>	<i>0.56</i>	<i>0.08</i>	<i>0.54</i>	-

**Table 57 – direct comparison of the results for the INRiM thermometer measurements at the In fixed-point temperature**



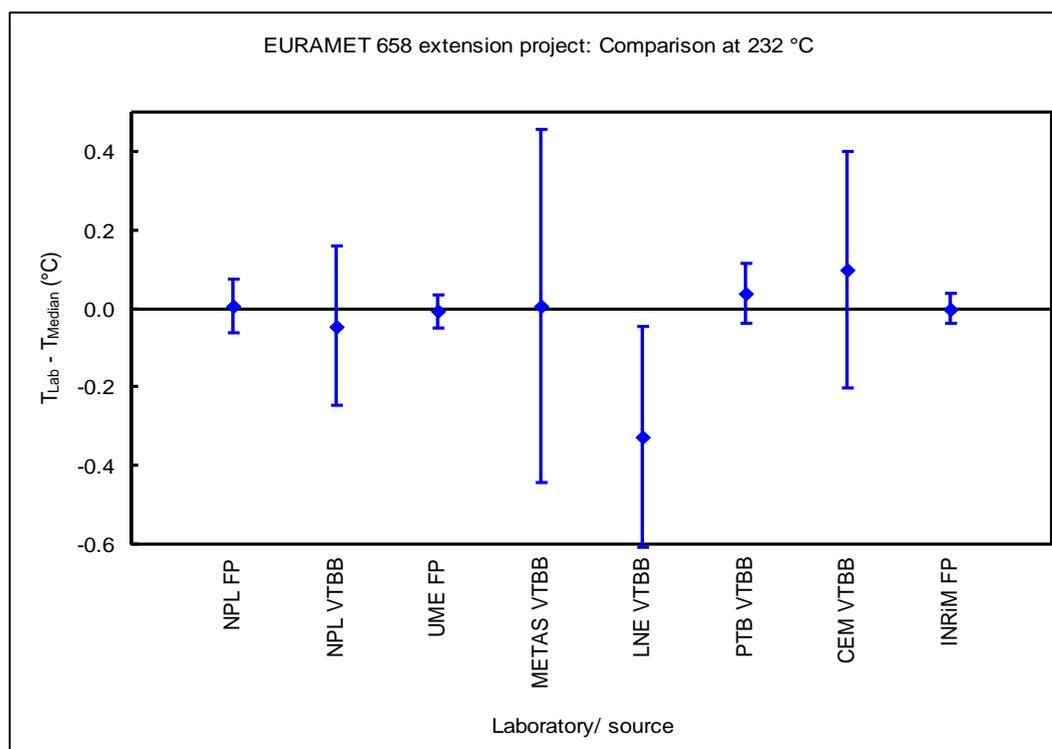
	NPL	UME	METAS	LNE	PTB	CEM	INRiM
NPL	-	0.08 ± 0.16	-0.04 ± 0.45	-0.30 ± 0.26	0.07 ± 0.16	-0.08 ± 0.47	0.09 ± 0.15
UME	0.21	-	-0.11 ± 0.44	-0.38 ± 0.22	-0.01 ± 0.10	-0.16 ± 0.46	0.01 ± 0.08
METAS	0.45	0.48	-	-0.27 ± 0.48	0.10 ± 0.44	-0.05 ± 0.62	0.12 ± 0.43
LNE	0.51	0.56	0.66	-	0.37 ± 0.22	0.22 ± 0.50	0.39 ± 0.21
PTB	0.20	0.10	0.47	0.55	-	-0.15 ± 0.45	0.02 ± 0.08
CEM	0.49	0.54	0.61	0.63	0.53	-	0.17 ± 0.45
INRiM	0.21	0.08	0.48	0.56	0.08	0.54	-

Table 58 – direct comparison of the results for the INRiM thermometer measurements at the In fixed-point temperature – average data



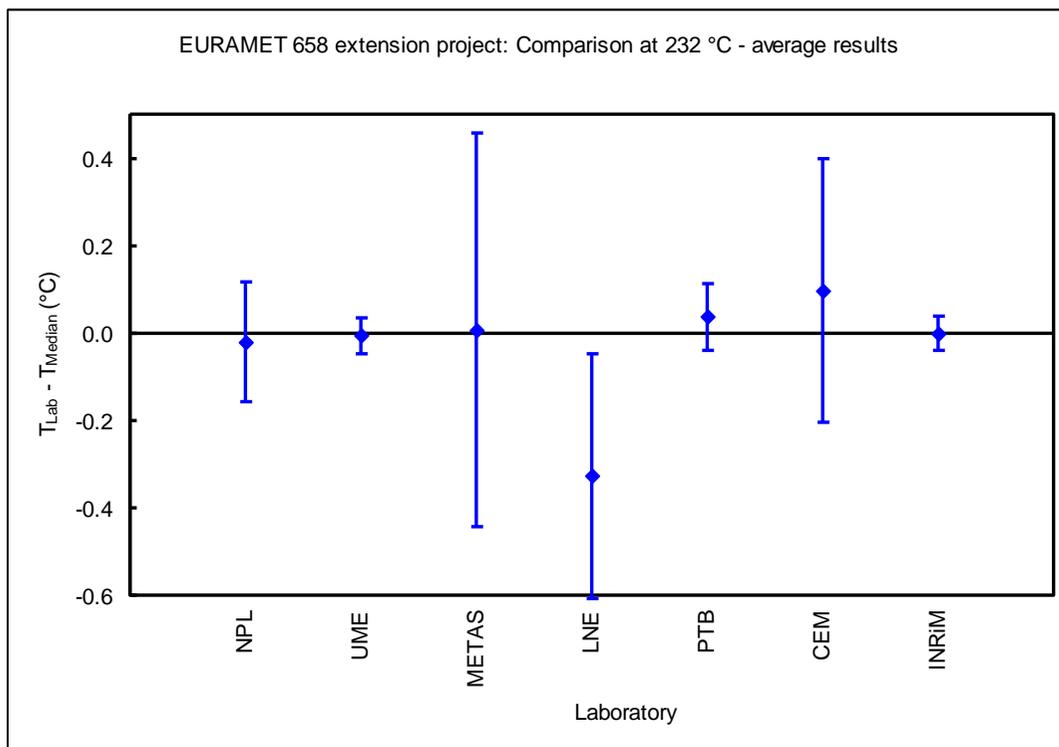
	NPL FP	NPL VTBB	UME FP	METAS VTBB	LNE VTBB	PTB VTBB	CEM VTBB	INRiM FP
NPL FP	-	$0.05 \pm 0.22$	$0.01 \pm 0.08$	$0.00 \pm 0.46$	$0.33 \pm 0.29$	$-0.03 \pm 0.10$	$-0.09 \pm 0.31$	$0.01 \pm 0.08$
NPL VTBB	$0.23$	-	$-0.04 \pm 0.21$	$-0.05 \pm 0.49$	$0.28 \pm 0.35$	$-0.08 \pm 0.22$	$-0.14 \pm 0.36$	$-0.04 \pm 0.21$
UME FP	$0.08$	$0.22$	-	$-0.01 \pm 0.45$	$0.32 \pm 0.28$	$-0.04 \pm 0.09$	$-0.10 \pm 0.30$	$-0.01 \pm 0.06$
METAS VTBB	$0.45$	$0.49$	$0.44$	-	$0.33 \pm 0.53$	$-0.03 \pm 0.46$	$-0.09 \pm 0.54$	$0.01 \pm 0.45$
LNE VTBB	$0.57$	$0.57$	$0.55$	$0.77$	-	$-0.36 \pm 0.29$	$-0.42 \pm 0.41$	$-0.33 \pm 0.28$
PTB VTBB	$0.12$	$0.26$	$0.12$	$0.45$	$0.60$	-	$-0.06 \pm 0.31$	$0.04 \pm 0.09$
CEM VTBB	$0.35$	$0.44$	$0.36$	$0.56$	$0.76$	$0.33$	-	$0.10 \pm 0.30$
INRiM FP	$0.08$	$0.22$	$0.06$	$0.44$	$0.56$	$0.11$	$0.35$	-

Table 59 – direct comparison of the results for the INRiM thermometer measurements at the Sn fixed-point temperature



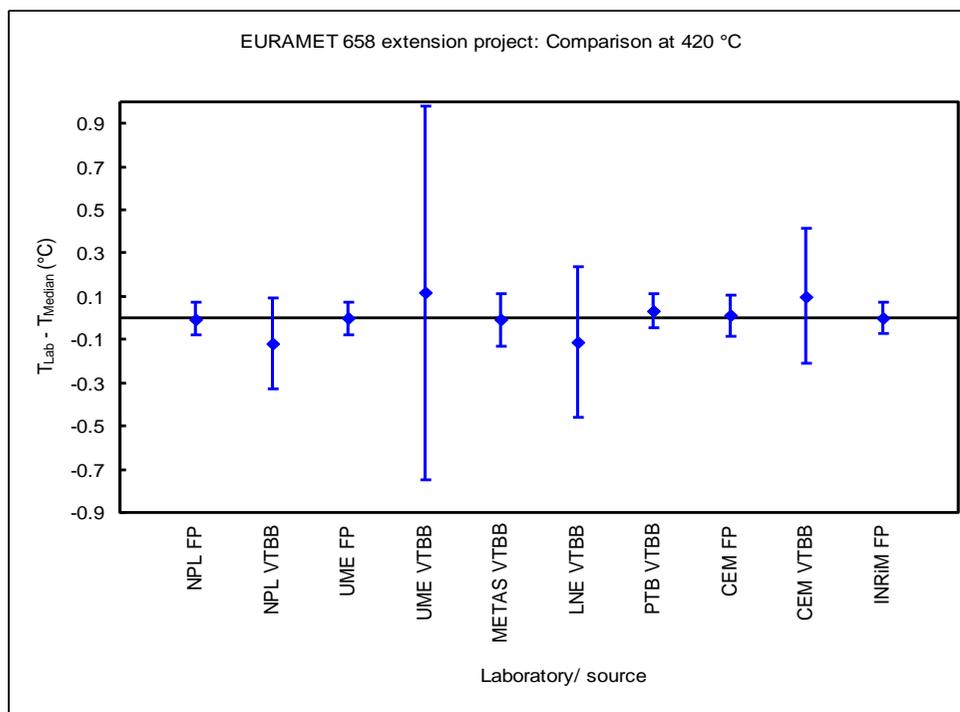
	<b>NPL</b>	<b>UME</b>	<b>METAS</b>	<b>LNE</b>	<b>PTB</b>	<b>CEM</b>	<b>INRiM</b>
<b>NPL</b>	-	-0.01 ± 0.14	-0.03 ± 0.47	0.31 ± 0.31	-0.06 ± 0.16	-0.12 ± 0.33	-0.02 ± 0.14
<b>UME</b>	0.14	-	-0.01 ± 0.45	0.32 ± 0.28	-0.04 ± 0.09	-0.10 ± 0.30	-0.01 ± 0.06
<b>METAS</b>	0.46	0.44	-	0.33 ± 0.53	-0.03 ± 0.46	-0.09 ± 0.54	0.01 ± 0.45
<b>LNE</b>	0.56	0.55	0.77	-	-0.36 ± 0.29	-0.42 ± 0.41	-0.33 ± 0.28
<b>PTB</b>	0.19	0.12	0.45	0.60	-	-0.06 ± 0.31	0.04 ± 0.09
<b>CEM</b>	0.39	0.36	0.56	0.76	0.33	-	0.10 ± 0.30
<b>INRiM</b>	0.14	0.06	0.44	0.56	0.11	0.35	-

Table 60 – direct comparison of the results for the INRiM thermometer measurements at the Sn fixed-point temperature – average data



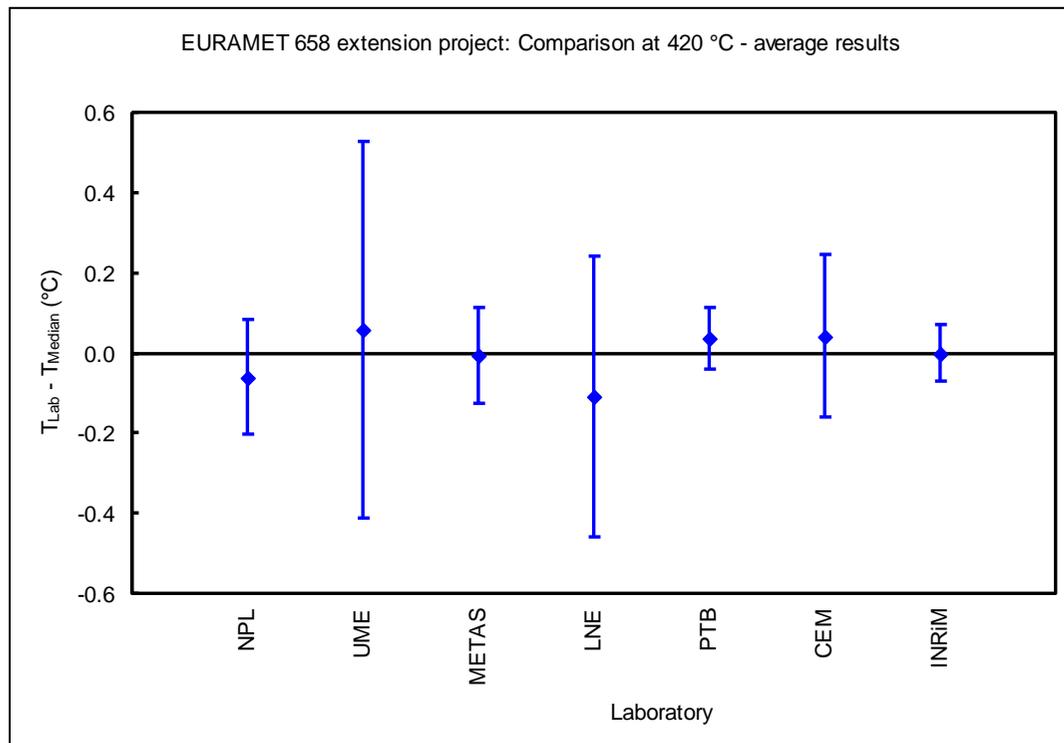
	NPL FP	NPL VTBB	UME FP	UME VTBB	METAS VTBB	LNE VTBB	PTB VTBB	CEM FP	CEM VTBB	INRiM FP
NPL FP	-	0.11 ± 0.23	0.00 ± 0.11	-0.12 ± 0.87	0.00 ± 0.14	0.11 ± 0.36	-0.04 ± 0.11	-0.02 ± 0.12	-0.10 ± 0.32	0.00 ± 0.10
NPL VTBB	0.30	-	-0.12 ± 0.23	-0.23 ± 0.89	-0.11 ± 0.24	-0.01 ± 0.41	-0.15 ± 0.23	-0.13 ± 0.23	-0.22 ± 0.38	-0.12 ± 0.22
UME FP	0.10	0.30	-	-0.12 ± 0.87	0.01 ± 0.14	0.11 ± 0.36	-0.04 ± 0.11	-0.01 ± 0.12	-0.10 ± 0.32	0.00 ± 0.10
UME VTBB	0.88	0.98	0.88	-	0.12 ± 0.87	0.23 ± 0.93	0.08 ± 0.87	0.10 ± 0.87	0.02 ± 0.92	0.12 ± 0.87
METAS VTBB	0.14	0.31	0.14	0.89	-	0.10 ± 0.37	-0.04 ± 0.14	-0.02 ± 0.15	-0.11 ± 0.33	-0.01 ± 0.14
LNE VTBB	0.41	0.40	0.41	1.01	0.41	-	-0.15 ± 0.36	-0.12 ± 0.36	-0.21 ± 0.47	-0.11 ± 0.36
PTB VTBB	0.13	0.34	0.13	0.86	0.16	0.44	-	0.02 ± 0.12	-0.07 ± 0.32	0.04 ± 0.11
CEM FP	0.12	0.32	0.12	0.87	0.15	0.42	0.13	-	-0.09 ± 0.33	0.01 ± 0.12
CEM VTBB	0.37	0.53	0.37	0.90	0.39	0.60	0.34	0.36	-	0.10 ± 0.32
INRiM FP	0.10	0.30	0.10	0.88	0.14	0.41	0.13	0.12	0.37	-

Table 61 – direct comparison of the results for the INRiM thermometer measurements at the Zn fixed-point temperature



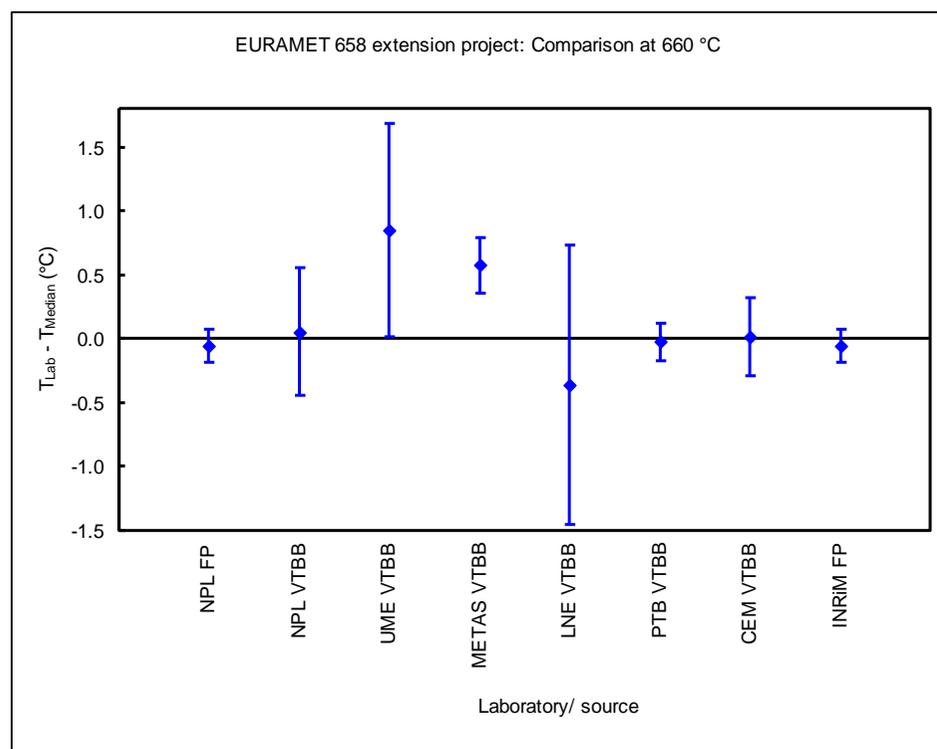
	<b>NPL</b>	<b>UME</b>	<b>METAS</b>	<b>LNE</b>	<b>PTB</b>	<b>CEM</b>	<b>INRiM</b>
<b>NPL</b>	-	-0.12 ± 0.49	-0.05 ± 0.19	0.05 ± 0.38	-0.10 ± 0.16	-0.10 ± 0.25	-0.06 ± 0.16
<b>UME</b>	0.53	-	0.07 ± 0.48	0.17 ± 0.59	0.02 ± 0.48	0.02 ± 0.51	0.06 ± 0.47
<b>METAS</b>	0.21	0.49	-	0.10 ± 0.37	-0.04 ± 0.14	-0.05 ± 0.24	-0.01 ± 0.14
<b>LNE</b>	0.38	0.66	0.41	-	-0.15 ± 0.36	-0.15 ± 0.41	-0.11 ± 0.36
<b>PTB</b>	0.23	0.47	0.16	0.44	-	-0.01 ± 0.22	0.04 ± 0.11
<b>CEM</b>	0.31	0.50	0.25	0.49	0.21	-	0.04 ± 0.22
<b>INRiM</b>	0.19	0.48	0.14	0.41	0.13	0.23	-

Table 62 – direct comparison of the results for the INRiM thermometer measurements at the Zn fixed-point temperature – average data



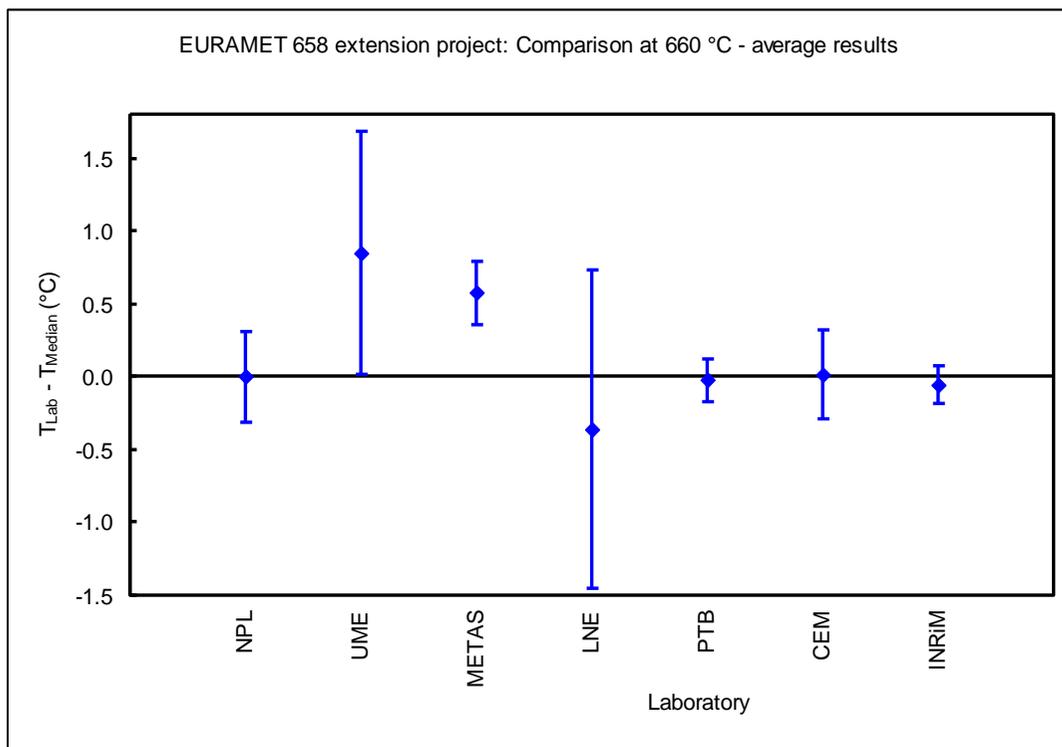
	NPL FP	NPL VTBB	UME VTBB	METAS VTBB	LNE VTBB	PTB VTBB	CEM VTBB	INRiM FP
NPL FP	-	$-0.11 \pm 0.51$	$-0.90 \pm 0.84$	$-0.63 \pm 0.26$	$0.31 \pm 1.10$	$-0.03 \pm 0.20$	$-0.06 \pm 0.33$	$0.00 \pm 0.18$
NPL VTBB	0.55	-	$-0.79 \pm 0.97$	$-0.52 \pm 0.54$	$0.42 \pm 1.20$	$0.08 \pm 0.52$	$0.04 \pm 0.58$	$0.11 \pm 0.51$
UME VTBB	1.59	1.59	-	$0.27 \pm 0.86$	$1.21 \pm 1.37$	$0.87 \pm 0.85$	$0.84 \pm 0.89$	$0.90 \pm 0.84$
METAS VTBB	0.84	0.97	0.99	-	$0.94 \pm 1.11$	$0.60 \pm 0.26$	$0.56 \pm 0.38$	$0.63 \pm 0.26$
LNE VTBB	1.23	1.41	2.34	1.85	-	$-0.34 \pm 1.10$	$-0.37 \pm 1.13$	$-0.30 \pm 1.10$
PTB VTBB	0.20	0.53	1.56	0.81	1.26	-	$-0.03 \pm 0.34$	$0.04 \pm 0.20$
CEM VTBB	0.35	0.58	1.57	0.87	1.32	0.34	-	$0.07 \pm 0.33$
INRiM FP	0.18	0.55	1.60	0.84	1.23	0.20	0.35	-

Table 63 – direct comparison of the results for the INRiM thermometer measurements at the Al fixed-point temperature



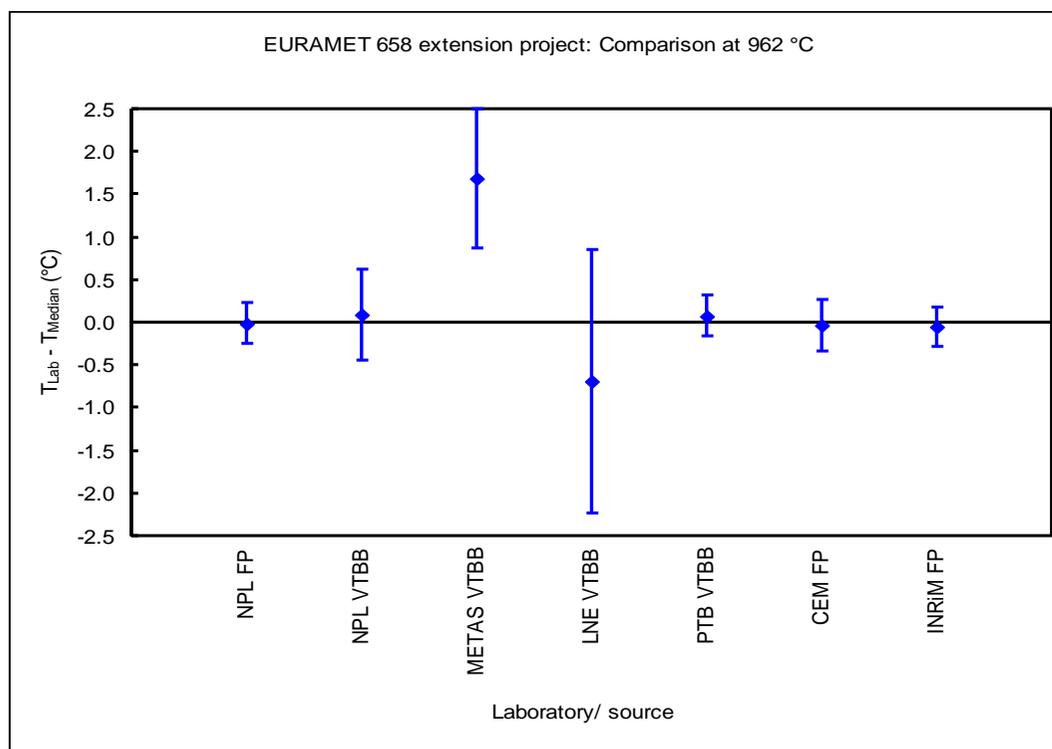
	<b>NPL</b>	<b>UME</b>	<b>METAS</b>	<b>LNE</b>	<b>PTB</b>	<b>CEM</b>	<b>INRiM</b>
<b>NPL</b>	-	$-0.85 \pm 0.89$	$-0.57 \pm 0.38$	$0.36 \pm 1.13$	$0.02 \pm 0.35$	$-0.01 \pm 0.44$	$0.06 \pm 0.34$
<b>UME</b>	$1.58$	-	$0.27 \pm 0.86$	$1.21 \pm 1.37$	$0.87 \pm 0.85$	$0.84 \pm 0.89$	$0.90 \pm 0.84$
<b>METAS</b>	$0.89$	$0.99$	-	$0.94 \pm 1.11$	$0.60 \pm 0.26$	$0.56 \pm 0.38$	$0.63 \pm 0.26$
<b>LNE</b>	$1.31$	$2.34$	$1.85$	-	$-0.34 \pm 1.10$	$-0.37 \pm 1.13$	$-0.30 \pm 1.10$
<b>PTB</b>	$0.34$	$1.56$	$0.81$	$1.26$	-	$-0.03 \pm 0.34$	$0.04 \pm 0.20$
<b>CEM</b>	$0.43$	$1.57$	$0.87$	$1.32$	$0.34$	-	$0.07 \pm 0.33$
<b>INRiM</b>	$0.35$	$1.60$	$0.84$	$1.23$	$0.20$	$0.35$	-

Table 64 – direct comparison of the results for the INRiM thermometer measurements at the AI fixed-point temperature – average data



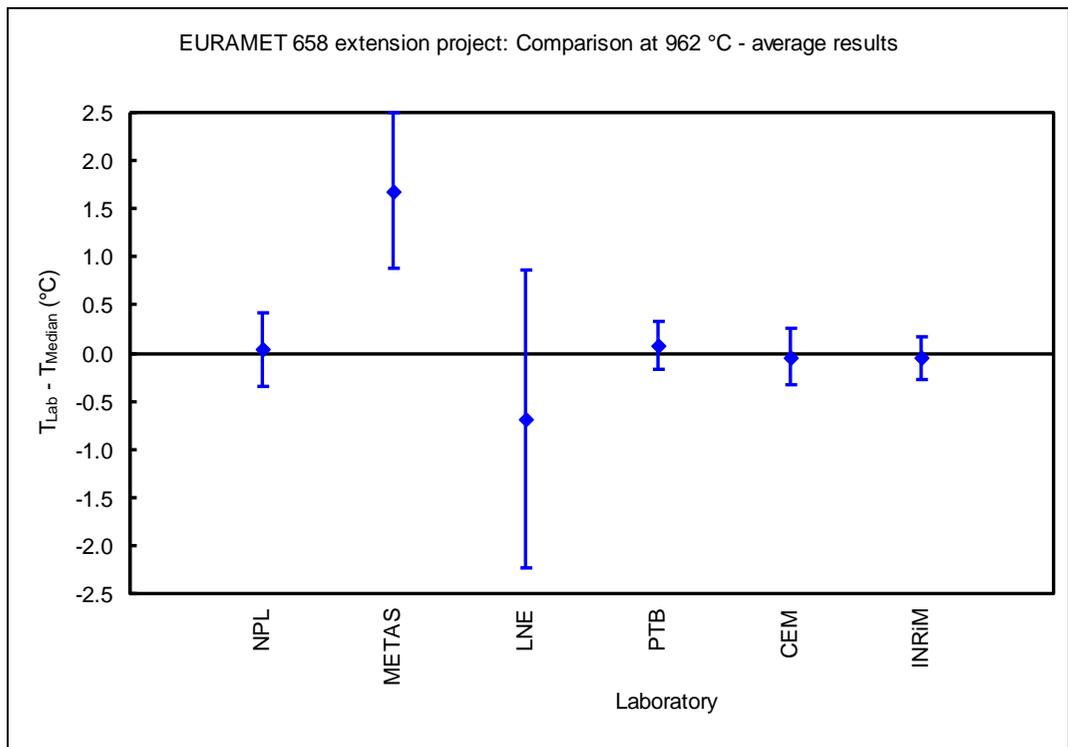
	<b>NPL FP</b>	<b>NPL VTBB</b>	<b>METAS VTBB</b>	<b>LNE VTBB</b>	<b>PTB VTBB</b>	<b>CEM FP</b>	<b>INRiM FP</b>
<b>NPL FP</b>	-	$-0.10 \pm 0.59$	$-1.70 \pm 0.84$	$0.68 \pm 1.57$	$-0.09 \pm 0.34$	$0.02 \pm 0.38$	$0.04 \pm 0.32$
<b>NPL VTBB</b>	<i>0.61</i>	-	$-1.60 \pm 0.97$	$0.78 \pm 1.64$	$0.01 \pm 0.59$	$0.12 \pm 0.62$	$0.14 \pm 0.58$
<b>METAS VTBB</b>	<i>2.39</i>	<i>2.40</i>	-	$2.38 \pm 1.75$	$1.61 \pm 0.85$	$1.72 \pm 0.86$	$1.74 \pm 0.84$
<b>LNE VTBB</b>	<i>1.98</i>	<i>2.13</i>	<i>3.82</i>	-	$-0.77 \pm 1.57$	$-0.65 \pm 1.58$	$-0.64 \pm 1.57$
<b>PTB VTBB</b>	<i>0.37</i>	<i>0.58</i>	<i>2.30</i>	<i>2.07</i>	-	$0.12 \pm 0.39$	$0.13 \pm 0.33$
<b>CEM FP</b>	<i>0.37</i>	<i>0.65</i>	<i>2.44</i>	<i>1.96</i>	<i>0.44</i>	-	$0.01 \pm 0.37$
<b>INRiM FP</b>	<i>0.33</i>	<i>0.63</i>	<i>2.43</i>	<i>1.94</i>	<i>0.40</i>	<i>0.37</i>	-

Table 65 – direct comparison of the results for the INRiM thermometer measurements at the Ag fixed-point temperature



	<b>NPL</b>	<b>METAS</b>	<b>LNE</b>	<b>PTB</b>	<b>CEM</b>	<b>INRiM</b>
<b>NPL</b>	-	-1.65 ± 0.90	0.73 ± 1.60	-0.04 ± 0.46	0.07 ± 0.49	0.09 ± 0.45
<b>METAS</b>	2.39	-	2.38 ± 1.75	1.61 ± 0.85	1.72 ± 0.86	1.74 ± 0.84
<b>LNE</b>	2.05	3.82	-	-0.77 ± 1.57	-0.65 ± 1.58	-0.64 ± 1.57
<b>PTB</b>	0.45	2.30	2.07	-	0.12 ± 0.39	0.13 ± 0.33
<b>CEM</b>	0.50	2.44	1.96	0.44	-	0.01 ± 0.37
<b>INRiM</b>	0.47	2.43	1.94	0.40	0.37	-

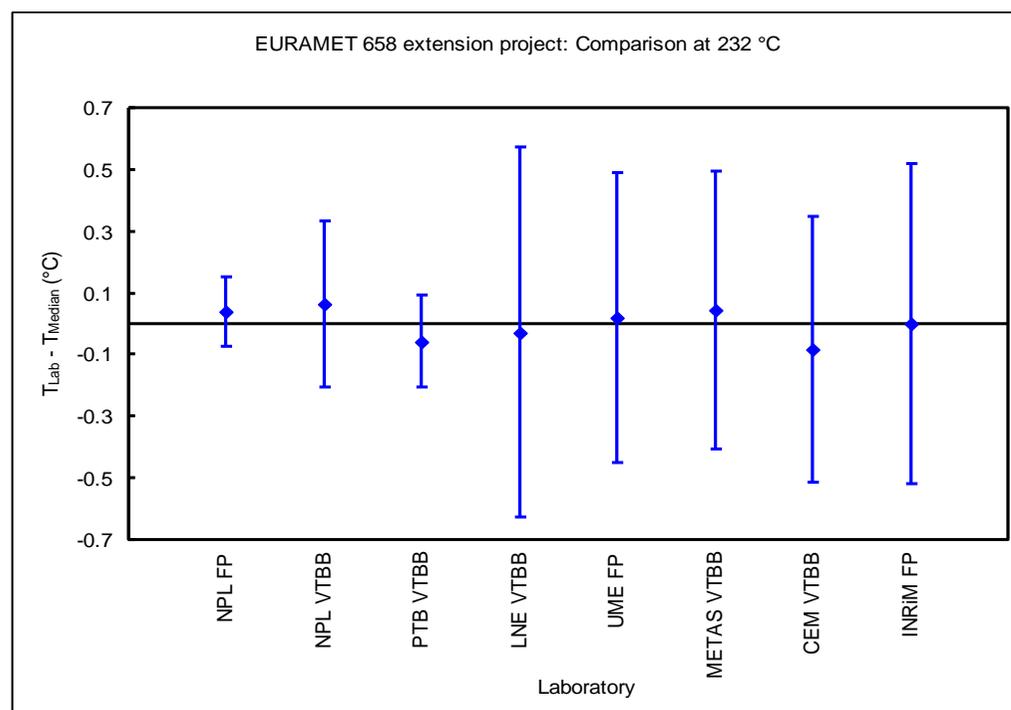
Table 66 – direct comparison of the results for the INRiM thermometer measurements at the Ag fixed-point temperature – average data



## 5 ALL THE LP5 THERMOMETER MEASUREMENTS AT THE FIXED-POINT TEMPERATURES USING FPS AND VTBBS

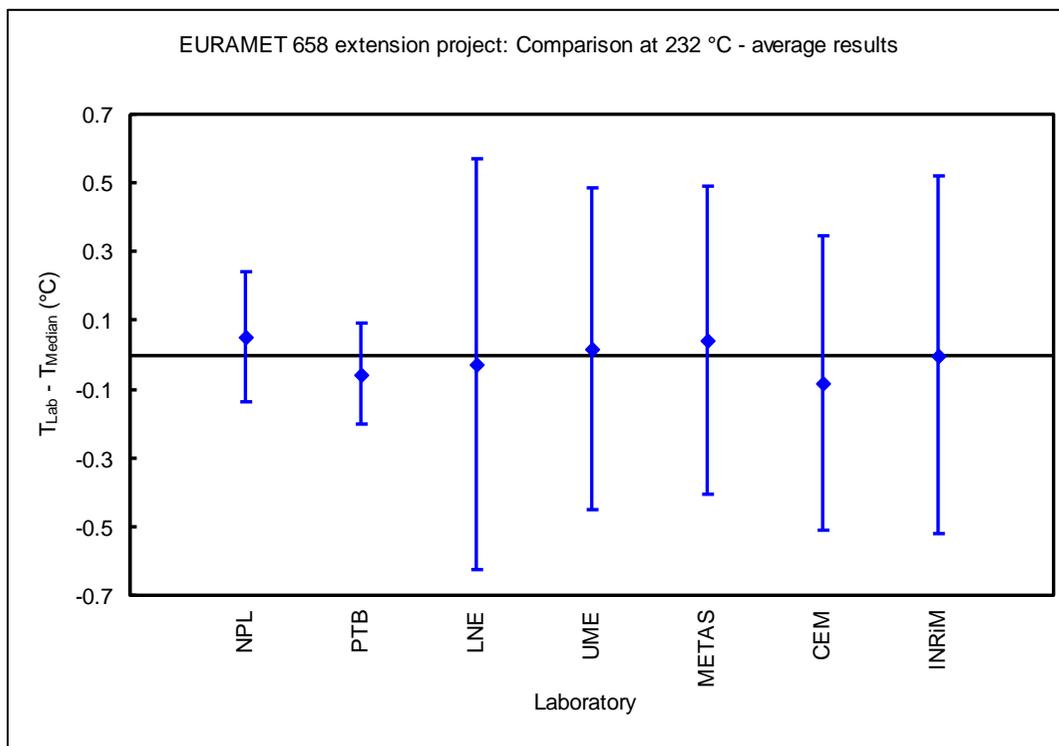
	NPL FP	NPL VTBB	PTB VTBB	LNE VTBB	UME FP	METAS VTBB	CEM VTBB	INRiM FP
NPL FP	-	$-0.03 \pm 0.292$	$0.10 \pm 0.185$	$0.07 \pm 0.610$	$0.02 \pm 0.483$	$0.00 \pm 0.464$	$0.12 \pm 0.444$	$0.04 \pm 0.532$
NPL VTBB	<i>0.29</i>	-	$0.12 \pm 0.307$	$0.09 \pm 0.658$	$0.05 \pm 0.542$	$0.02 \pm 0.525$	$0.15 \pm 0.508$	$0.06 \pm 0.586$
PTB VTBB	<i>0.25</i>	<i>0.38</i>	-	$-0.03 \pm 0.618$	$-0.07 \pm 0.493$	$-0.10 \pm 0.473$	$0.03 \pm 0.454$	$-0.06 \pm 0.540$
LNE VTBB	<i>0.61</i>	<i>0.67</i>	<i>0.61</i>	-	$-0.04 \pm 0.762$	$-0.07 \pm 0.750$	$0.05 \pm 0.738$	$-0.03 \pm 0.794$
UME FP	<i>0.47</i>	<i>0.54</i>	<i>0.50</i>	<i>0.75</i>	-	$-0.03 \pm 0.651$	$0.10 \pm 0.637$	$0.02 \pm 0.701$
METAS VTBB	<i>0.46</i>	<i>0.52</i>	<i>0.50</i>	<i>0.75</i>	<i>0.64</i>	-	$0.13 \pm 0.622$	$0.04 \pm 0.688$
CEM VTBB	<i>0.49</i>	<i>0.57</i>	<i>0.45</i>	<i>0.73</i>	<i>0.65</i>	<i>0.66</i>	-	$-0.08 \pm 0.675$
INRiM FP	<i>0.52</i>	<i>0.59</i>	<i>0.54</i>	<i>0.78</i>	<i>0.69</i>	<i>0.68</i>	<i>0.68</i>	-

Table 67 - direct comparison of the results for the LP5 thermometer measurements at the Sn fixed-point temperature



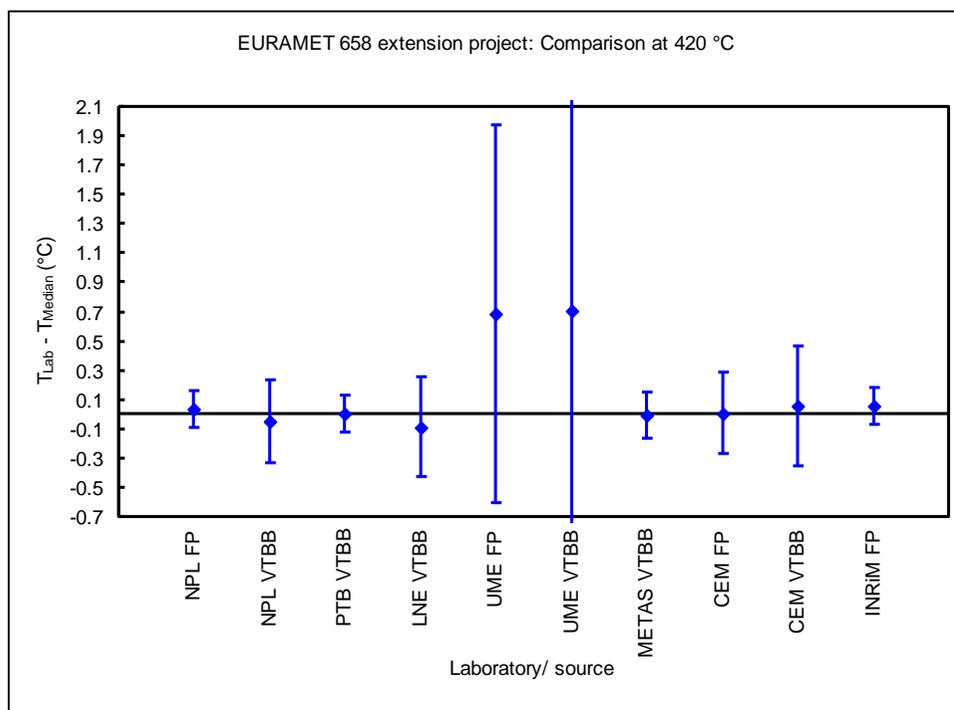
	NPL	PTB	LNE	UME	METAS	CEM	INRiM
NPL	-	$0.11 \pm 0.241$	$0.08 \pm 0.630$	$0.03 \pm 0.508$	$0.01 \pm 0.489$	$0.13 \pm 0.470$	$0.05 \pm 0.554$
PTB	<i>0.31</i>	-	$-0.03 \pm 0.618$	$-0.07 \pm 0.493$	$-0.10 \pm 0.473$	$0.03 \pm 0.454$	$-0.06 \pm 0.540$
LNE	<i>0.63</i>	<i>0.61</i>	-	$-0.04 \pm 0.762$	$-0.07 \pm 0.750$	$0.05 \pm 0.738$	$-0.03 \pm 0.794$
UME	<i>0.50</i>	<i>0.50</i>	<i>0.75</i>	-	$-0.03 \pm 0.651$	$0.10 \pm 0.637$	$0.02 \pm 0.701$
METAS	<i>0.48</i>	<i>0.50</i>	<i>0.75</i>	<i>0.64</i>	-	$0.13 \pm 0.622$	$0.04 \pm 0.688$
CEM	<i>0.53</i>	<i>0.45</i>	<i>0.73</i>	<i>0.65</i>	<i>0.66</i>	-	$-0.08 \pm 0.675$
INRiM	<i>0.55</i>	<i>0.54</i>	<i>0.78</i>	<i>0.69</i>	<i>0.68</i>	<i>0.68</i>	-

Table 68 – direct comparison of the results for the LP5 thermometer measurements at the Sn fixed-point temperature – average data



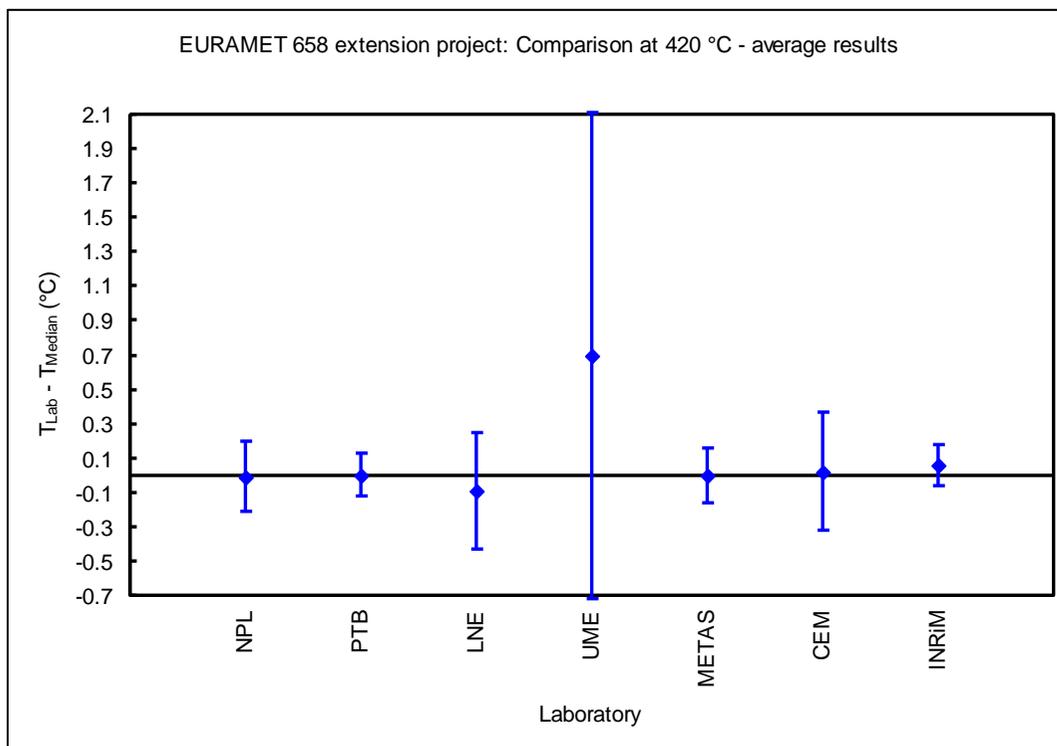
	NPL FP	NPL VTBB	PTB VTBB	LNE VTBB	UME FP	UME VTBB	METAS VTBB	CEM FP	CEM VTBB	INRiM FP
NPL FP	-	$0.08 \pm 0.307$	$0.03 \pm 0.177$	$0.12 \pm 0.362$	$-0.65 \pm 1.298$	$-0.67 \pm 1.545$	$0.04 \pm 0.202$	$0.03 \pm 0.307$	$-0.02 \pm 0.429$	$-0.02 \pm 0.175$
NPL VTBB	<i>0.34</i>	-	$-0.05 \pm 0.307$	$0.04 \pm 0.440$	$-0.73 \pm 1.322$	$-0.75 \pm 1.565$	$-0.05 \pm 0.322$	$-0.06 \pm 0.396$	$-0.11 \pm 0.496$	$-0.11 \pm 0.305$
PTB VTBB	<i>0.18</i>	<i>0.32</i>	-	$0.09 \pm 0.362$	$-0.68 \pm 1.298$	$-0.70 \pm 1.545$	$0.00 \pm 0.201$	$-0.01 \pm 0.307$	$-0.05 \pm 0.429$	$-0.06 \pm 0.175$
LNE VTBB	<i>0.42</i>	<i>0.44</i>	<i>0.40</i>	-	$-0.77 \pm 1.336$	$-0.79 \pm 1.577$	$-0.08 \pm 0.375$	$-0.09 \pm 0.440$	$-0.14 \pm 0.533$	$-0.14 \pm 0.361$
UME FP	<i>1.72</i>	<i>1.82</i>	<i>1.75</i>	<i>1.87</i>	-	$-0.02 \pm 2.010$	$0.69 \pm 1.301$	$0.68 \pm 1.322$	$0.63 \pm 1.355$	$0.63 \pm 1.298$
UME VTBB	<i>1.95</i>	<i>2.05</i>	<i>1.98</i>	<i>2.09</i>	<i>1.98</i>	-	$0.71 \pm 1.548$	$0.70 \pm 1.565$	$0.65 \pm 1.594$	$0.65 \pm 1.545$
METAS VTBB	<i>0.21</i>	<i>0.33</i>	<i>0.20</i>	<i>0.40</i>	<i>1.76</i>	<i>1.99</i>	-	$-0.01 \pm 0.321$	$-0.06 \pm 0.439$	$-0.06 \pm 0.200$
CEM FP	<i>0.30</i>	<i>0.40</i>	<i>0.30</i>	<i>0.47</i>	<i>1.77</i>	<i>1.99</i>	<i>0.32</i>	-	$-0.05 \pm 0.496$	$-0.05 \pm 0.305$
CEM VTBB	<i>0.42</i>	<i>0.53</i>	<i>0.43</i>	<i>0.59</i>	<i>1.75</i>	<i>1.97</i>	<i>0.44</i>	<i>0.49</i>	-	$0.00 \pm 0.428$
INRiM FP	<i>0.18</i>	<i>0.36</i>	<i>0.20</i>	<i>0.44</i>	<i>1.70</i>	<i>1.93</i>	<i>0.23</i>	<i>0.31</i>	<i>0.42</i>	-

Table 69 – direct comparison of the results for the LP5 thermometer measurements at the Zn fixed-point temperature



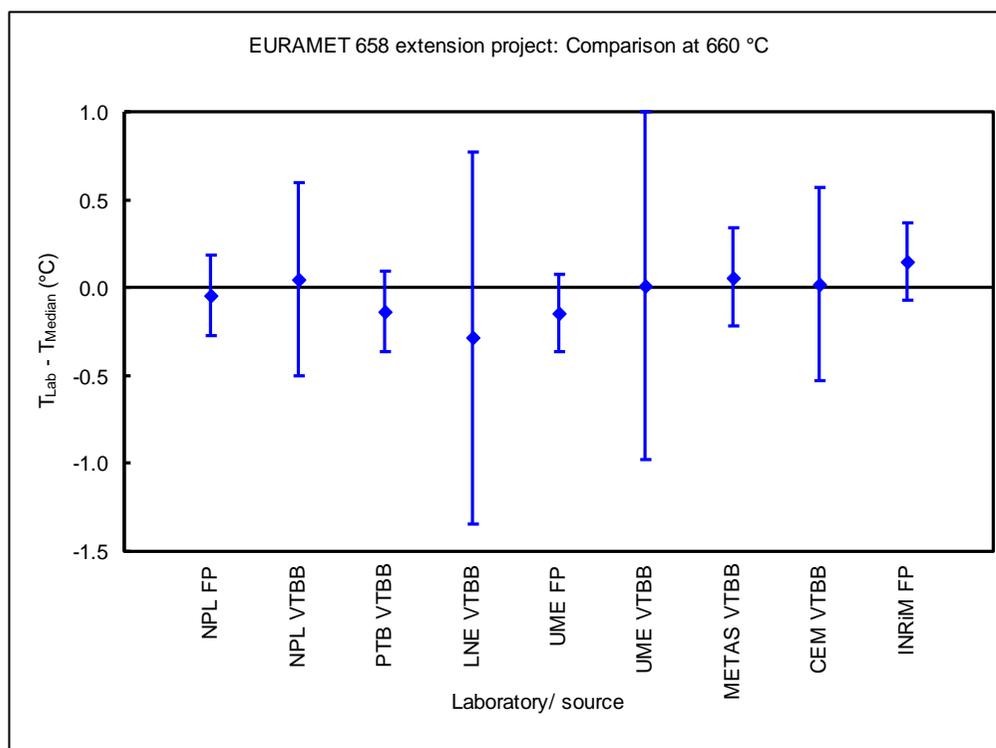
	<b>NPL</b>	<b>PTB</b>	<b>LNE</b>	<b>UME</b>	<b>METAS</b>	<b>CEM</b>	<b>INRiM</b>
<b>NPL</b>	-	-0.01 ± 0.238	0.08 ± 0.396	-0.70 ± 1.430	-0.01 ± 0.257	-0.03 ± 0.399	-0.06 ± 0.237
<b>PTB</b>	0.23	-	0.09 ± 0.362	-0.69 ± 1.421	0.00 ± 0.201	-0.02 ± 0.366	-0.06 ± 0.175
<b>LNE</b>	0.42	0.40	-	-0.78 ± 1.456	-0.08 ± 0.375	-0.11 ± 0.484	-0.14 ± 0.361
<b>UME</b>	1.88	1.87	1.98	-	0.70 ± 1.425	0.67 ± 1.457	0.64 ± 1.421
<b>METAS</b>	0.25	0.20	0.40	1.87	-	-0.03 ± 0.379	-0.06 ± 0.200
<b>CEM</b>	0.39	0.36	0.52	1.87	0.37	-	-0.03 ± 0.365
<b>INRiM</b>	0.26	0.20	0.44	1.81	0.23	0.36	-

Table 70 – direct comparison of the results for the LP5 thermometer measurements at the Zn fixed-point temperature – average data



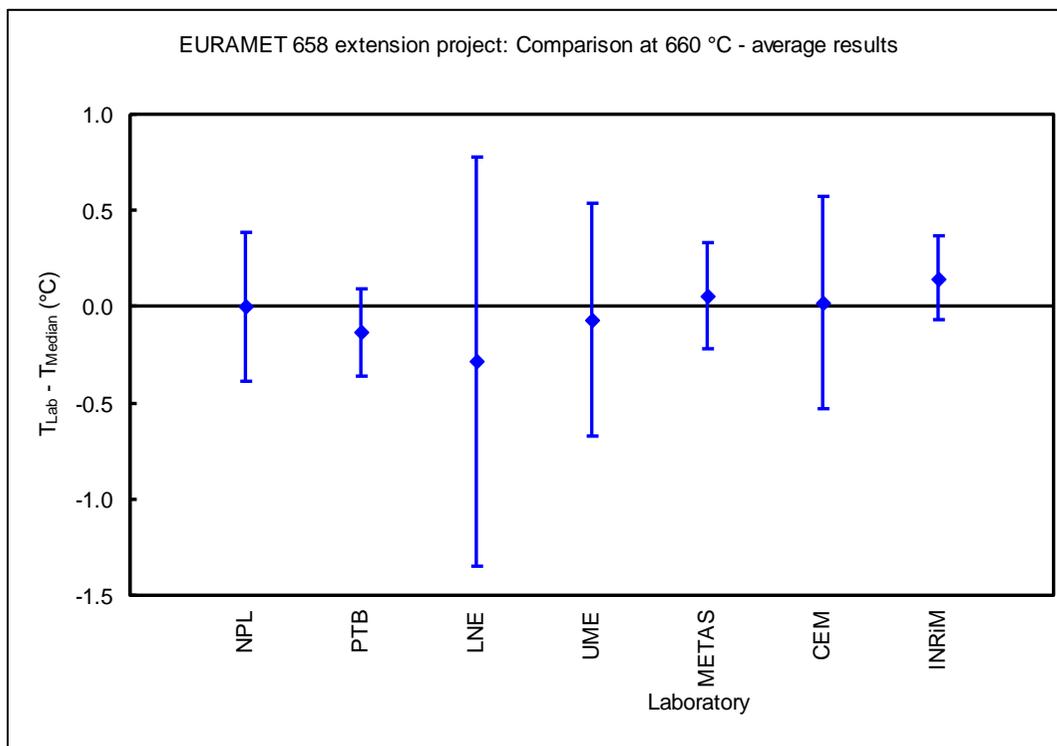
	<b>NPL FP</b>	<b>NPL VTBB</b>	<b>PTB VTBB</b>	<b>LNE VTBB</b>	<b>UME FP</b>	<b>UME VTBB</b>	<b>METAS VTBB</b>	<b>CEM VTBB</b>	<b>INRiM FP</b>
<b>NPL FP</b>	-	$-0.09 \pm 0.595$	$0.09 \pm 0.323$	$0.24 \pm 1.084$	$0.10 \pm 0.319$	$-0.05 \pm 1.016$	$-0.10 \pm 0.359$	$-0.06 \pm 0.595$	$-0.19 \pm 0.316$
<b>NPL VTBB</b>	<i>0.61</i>	-	$0.18 \pm 0.596$	$0.33 \pm 1.194$	$0.19 \pm 0.594$	$0.03 \pm 1.133$	$-0.01 \pm 0.616$	$0.02 \pm 0.778$	$-0.11 \pm 0.592$
<b>PTB VTBB</b>	<i>0.36</i>	<i>0.68</i>	-	$0.15 \pm 1.085$	$0.01 \pm 0.321$	$-0.14 \pm 1.016$	$-0.19 \pm 0.361$	$-0.15 \pm 0.596$	$-0.28 \pm 0.317$
<b>LNE VTBB</b>	<i>1.16</i>	<i>1.33</i>	<i>1.10</i>	-	$-0.14 \pm 1.083$	$-0.29 \pm 1.450$	$-0.34 \pm 1.096$	$-0.31 \pm 1.194$	$-0.43 \pm 1.082$
<b>UME FP</b>	<i>0.37</i>	<i>0.69</i>	<i>0.31</i>	<i>1.09</i>	-	$-0.16 \pm 1.015$	$-0.20 \pm 0.357$	$-0.17 \pm 0.594$	$-0.30 \pm 0.313$
<b>UME VTBB</b>	<i>1.00</i>	<i>1.11</i>	<i>1.03</i>	<i>1.53</i>	<i>1.04</i>	-	$-0.05 \pm 1.028$	$-0.01 \pm 1.133$	$-0.14 \pm 1.014$
<b>METAS VTBB</b>	<i>0.40</i>	<i>0.61</i>	<i>0.49</i>	<i>1.26</i>	<i>0.50</i>	<i>1.01</i>	-	$0.04 \pm 0.616$	$-0.09 \pm 0.354$
<b>CEM VTBB</b>	<i>0.59</i>	<i>0.76</i>	<i>0.66</i>	<i>1.31</i>	<i>0.66</i>	<i>1.12</i>	<i>0.61</i>	-	$-0.13 \pm 0.592$
<b>INRiM FP</b>	<i>0.45</i>	<i>0.62</i>	<i>0.54</i>	<i>1.33</i>	<i>0.55</i>	<i>1.03</i>	<i>0.39</i>	<i>0.63</i>	-

Table 71 – direct comparison of the results for the LP5 thermometer measurements at the Al fixed-point temperature



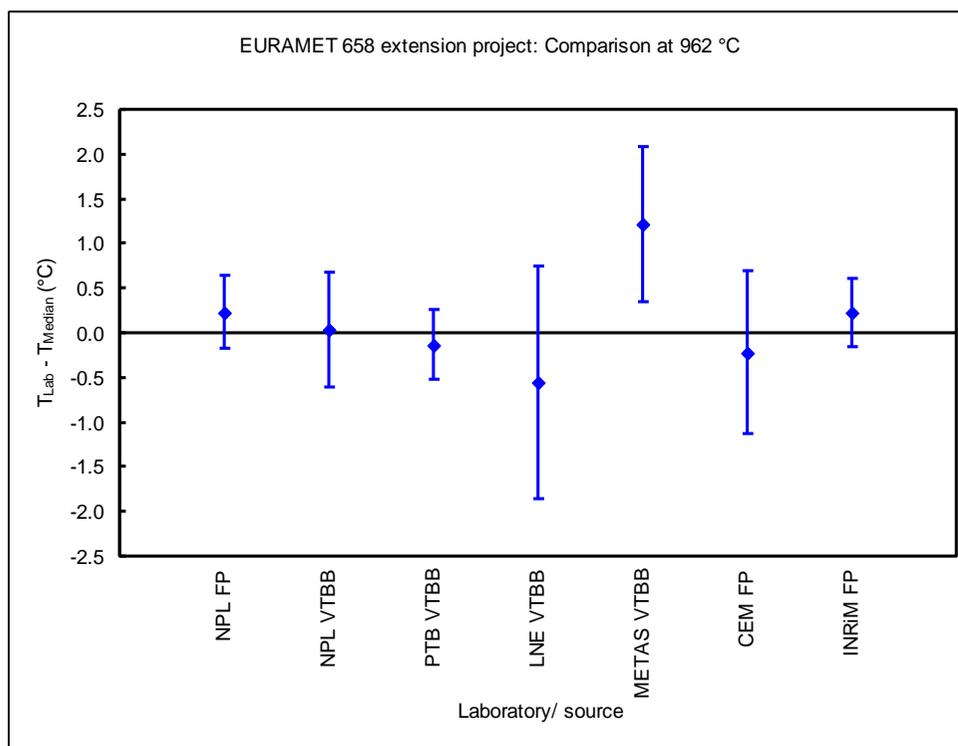
	<b>NPL</b>	<b>PTB</b>	<b>LNE</b>	<b>UME</b>	<b>METAS</b>	<b>CEM</b>	<b>INRiM</b>
<b>NPL</b>	-	0.13 ± 0.452	0.29 ± 1.129	0.07 ± 0.721	-0.06 ± 0.478	-0.02 ± 0.674	-0.15 ± 0.446
<b>PTB</b>	0.51	-	0.15 ± 1.085	-0.07 ± 0.649	-0.19 ± 0.361	-0.15 ± 0.596	-0.28 ± 0.317
<b>LNE</b>	1.24	1.10	-	-0.22 ± 1.221	-0.34 ± 1.096	-0.31 ± 1.194	-0.43 ± 1.082
<b>UME</b>	0.72	0.65	1.27	-	-0.13 ± 0.667	-0.09 ± 0.819	-0.22 ± 0.645
<b>METAS</b>	0.48	0.49	1.26	0.70	-	0.04 ± 0.616	-0.09 ± 0.354
<b>CEM</b>	0.66	0.66	1.31	0.82	0.61	-	-0.13 ± 0.592
<b>INRiM</b>	0.52	0.54	1.33	0.75	0.39	0.63	-

Table 72 – direct comparison of the results for the LP5 thermometer measurements at the AI fixed-point temperature – average data



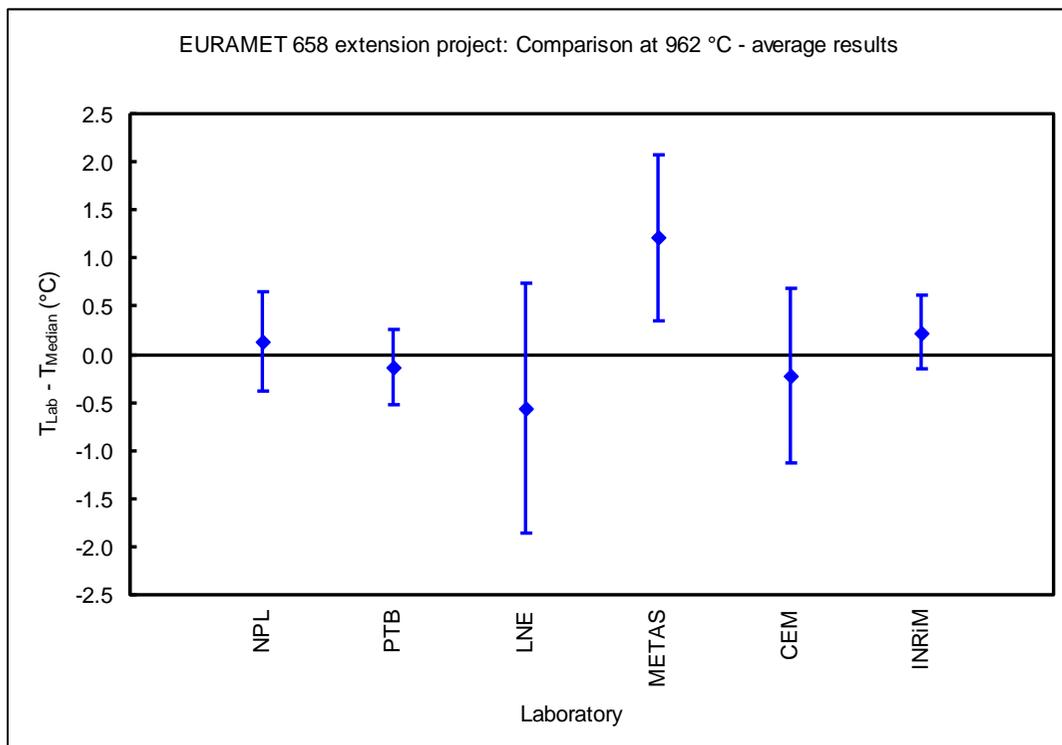
	NPL FP	NPL VTBB	PTB VTBB	LNE VTBB	METAS VTBB	CEM FP	INRiM FP
NPL FP	-	$0.20 \pm 0.757$	$0.37 \pm 0.564$	$0.80 \pm 1.361$	$-0.98 \pm 0.955$	$0.45 \pm 0.998$	$0.00 \pm 0.556$
NPL VTBB	$0.83$	-	$0.17 \pm 0.751$	$0.60 \pm 1.449$	$-1.17 \pm 1.076$	$0.26 \pm 1.114$	$-0.19 \pm 0.746$
PTB VTBB	$0.83$	$0.81$	-	$0.43 \pm 1.358$	$-1.35 \pm 0.950$	$0.09 \pm 0.993$	$-0.37 \pm 0.548$
LNE VTBB	$1.92$	$1.80$	$1.56$	-	$-1.77 \pm 1.561$	$-0.34 \pm 1.588$	$-0.79 \pm 1.355$
METAS VTBB	$1.76$	$2.06$	$2.13$	$3.06$	-	$1.43 \pm 1.257$	$0.98 \pm 0.946$
CEM FP	$1.28$	$1.20$	$0.98$	$1.69$	$2.47$	-	$-0.45 \pm 0.989$
INRiM FP	$0.55$	$0.82$	$0.82$	$1.91$	$1.76$	$1.27$	-

Table 73 – direct comparison of the results for the LP5 thermometer measurements at the Ag fixed-point temperature

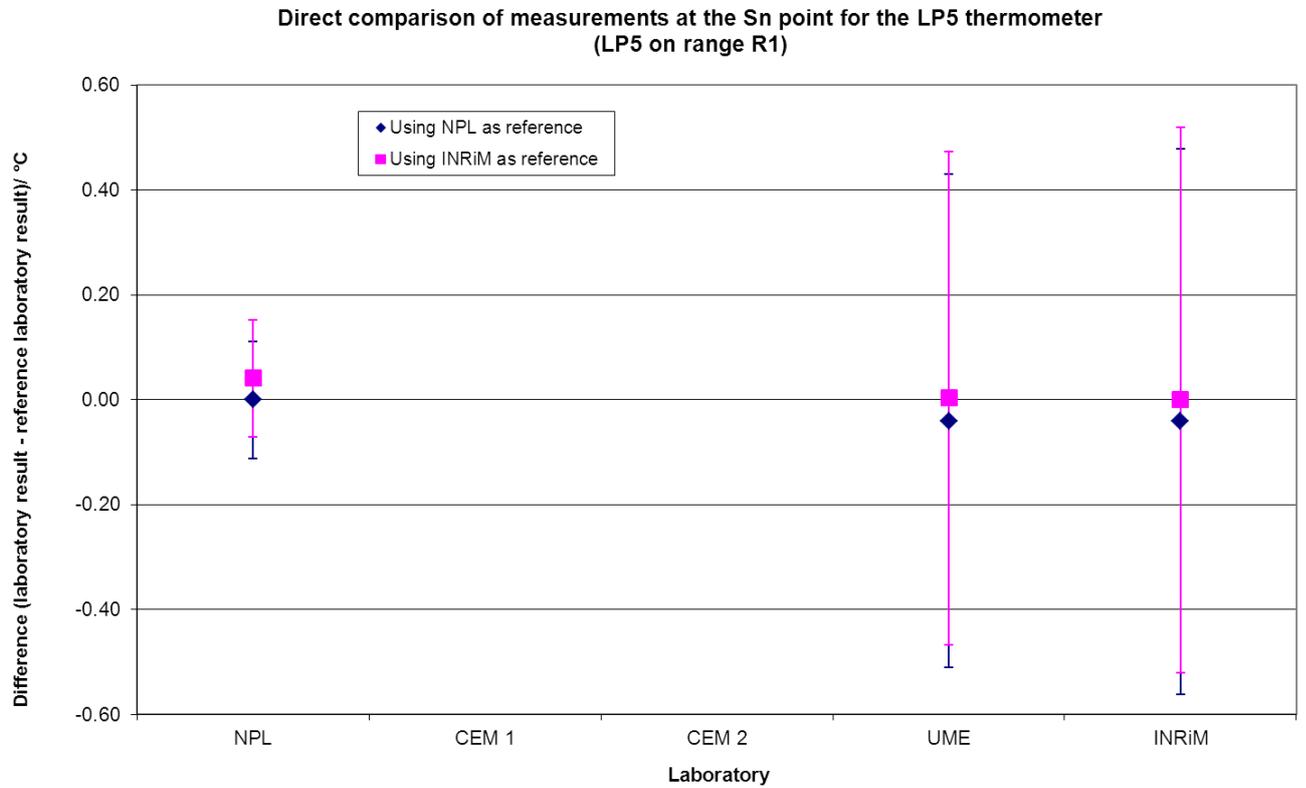


	<b>NPL</b>	<b>PTB</b>	<b>LNE</b>	<b>METAS</b>	<b>CEM</b>	<b>INRiM</b>
<b>NPL</b>	-	$0.27 \pm 0.653$	$0.70 \pm 1.401$	$-1.08 \pm 1.010$	$0.36 \pm 1.051$	$-0.09 \pm 0.647$
<b>PTB</b>	<i>0.81</i>	-	$0.43 \pm 1.358$	$-1.35 \pm 0.950$	$0.09 \pm 0.993$	$-0.37 \pm 0.548$
<b>LNE</b>	<i>1.85</i>	<i>1.56</i>	-	$-1.77 \pm 1.561$	$-0.34 \pm 1.588$	$-0.79 \pm 1.355$
<b>METAS</b>	<i>1.91</i>	<i>2.13</i>	<i>3.06</i>	-	$1.43 \pm 1.257$	$0.98 \pm 0.946$
<b>CEM</b>	<i>1.23</i>	<i>0.98</i>	<i>1.69</i>	<i>2.47</i>	-	$-0.45 \pm 0.989$
<b>INRiM</b>	<i>0.66</i>	<i>0.82</i>	<i>1.91</i>	<i>1.76</i>	<i>1.27</i>	-

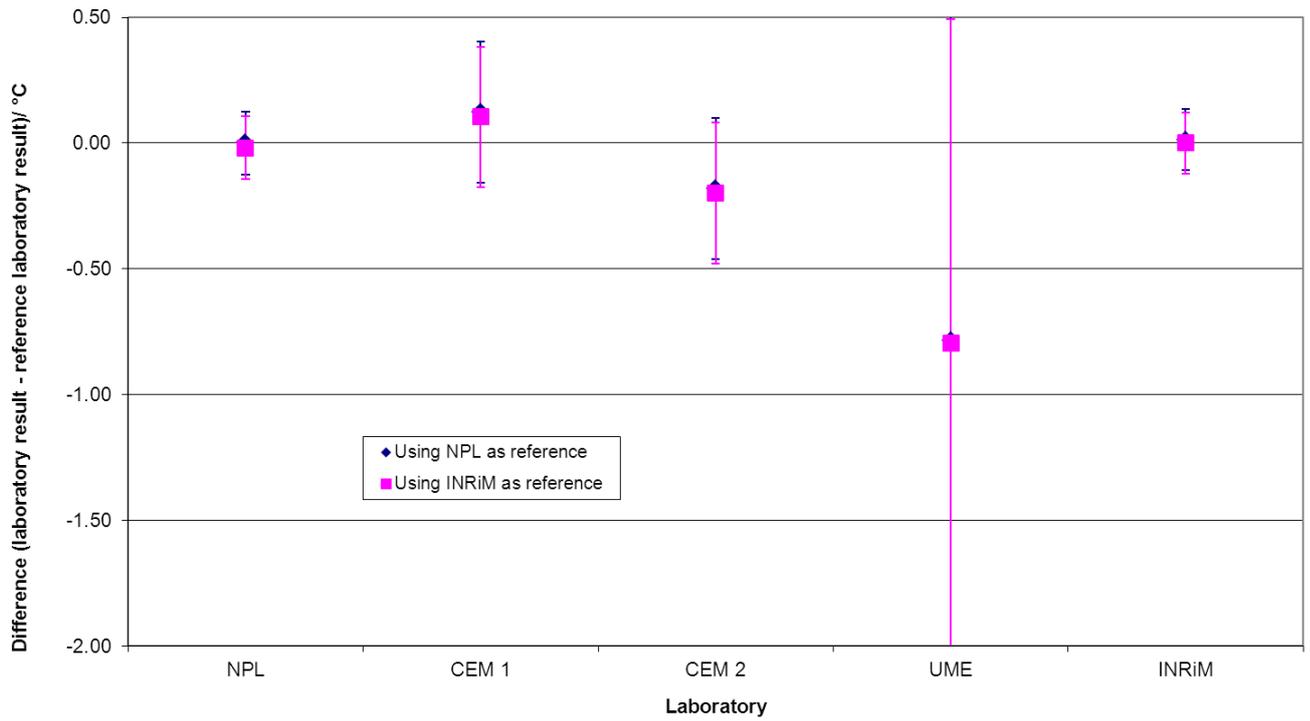
Table 74 – direct comparison of the results for the LP5 thermometer measurements at the Ag fixed-point temperature – average data



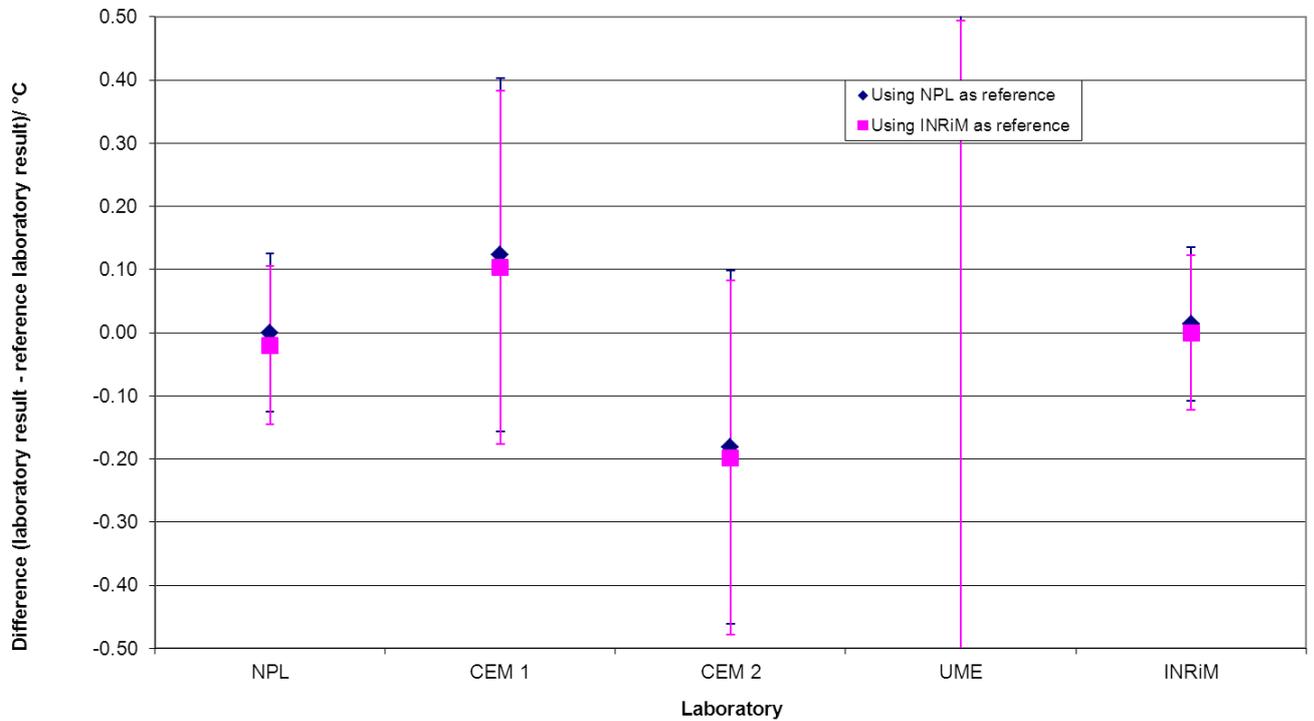
**6 PLOTS OF RESULTS OF THE DIRECT COMPARISON OF THE MEASUREMENTS WITH THE FIXED-POINTS FOR THE LP5 THERMOMETER AND INRIM THERMOMETERS**

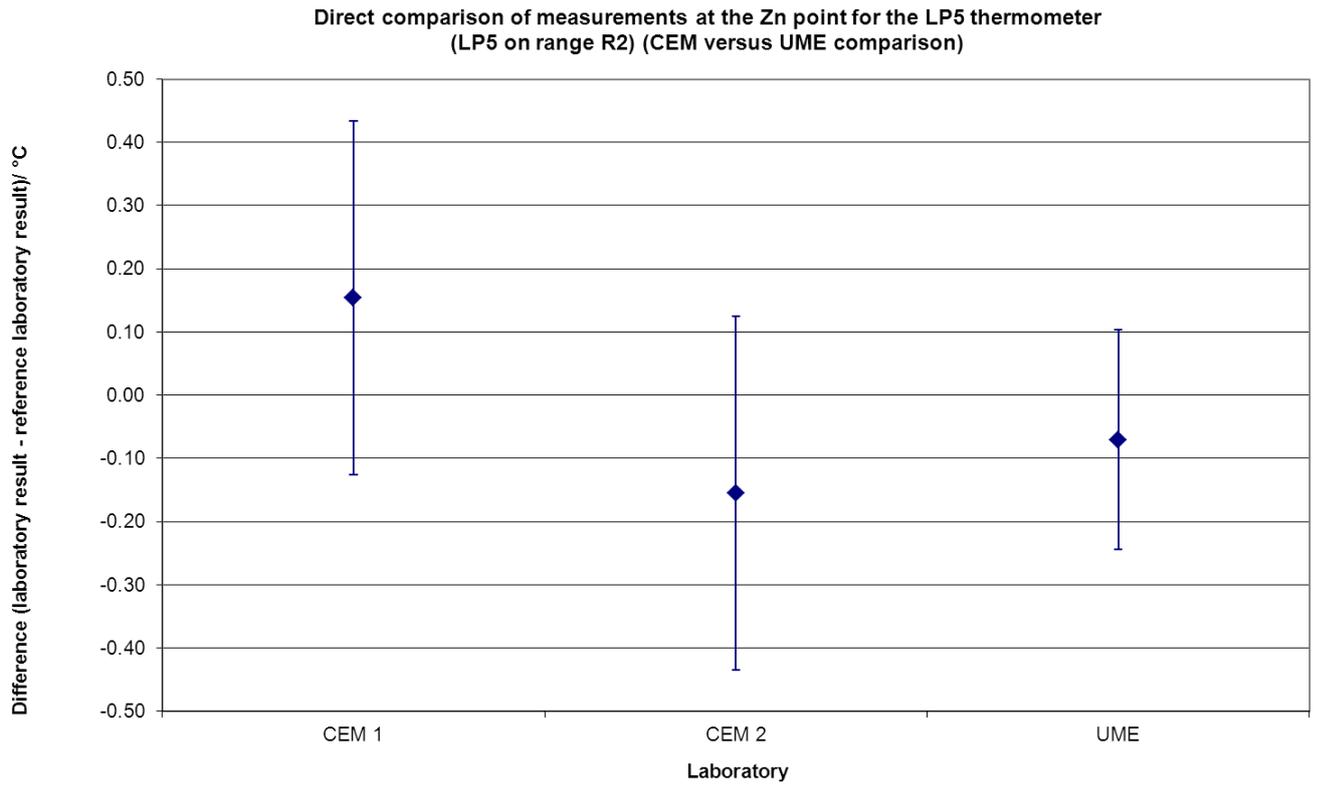


Direct comparison of measurements at the Zn point for the LP5 thermometer  
(LP5 on range R1) (all data points displayed)

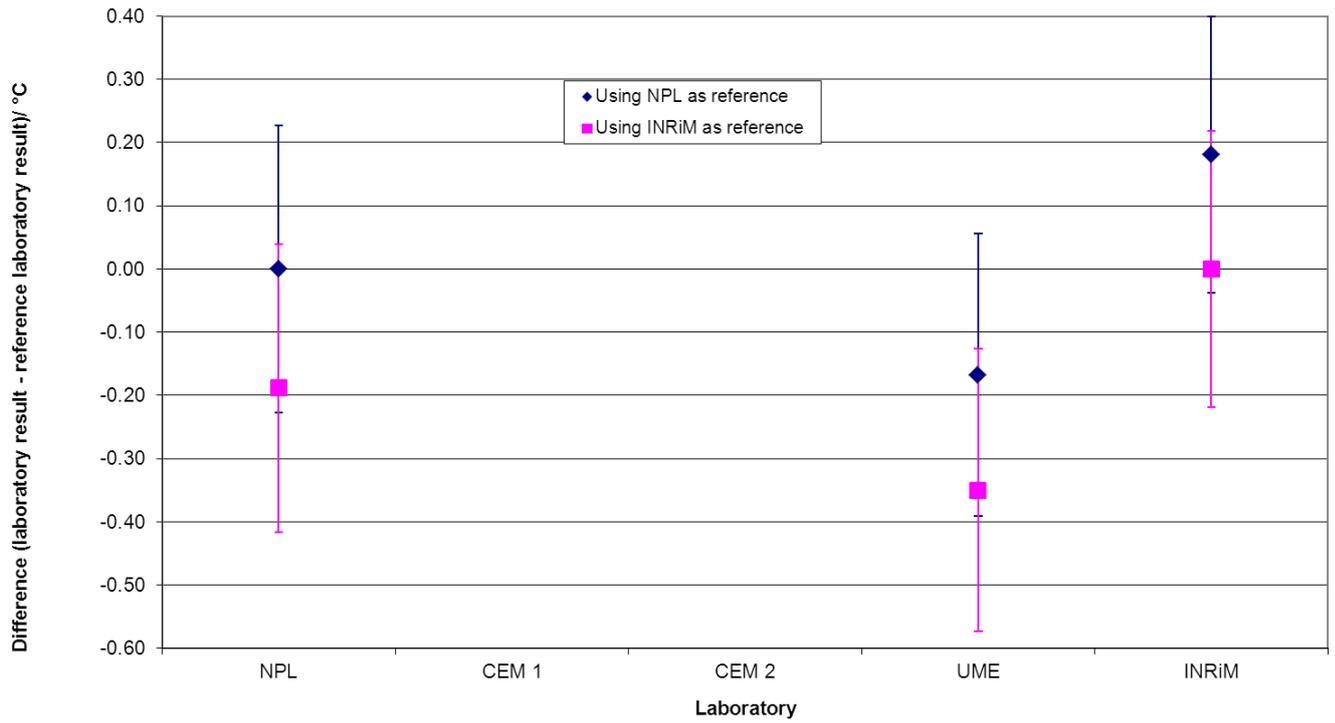


Direct comparison of measurements at the Zn point for the LP5 thermometer  
(LP5 on range R1) (zoomed in)

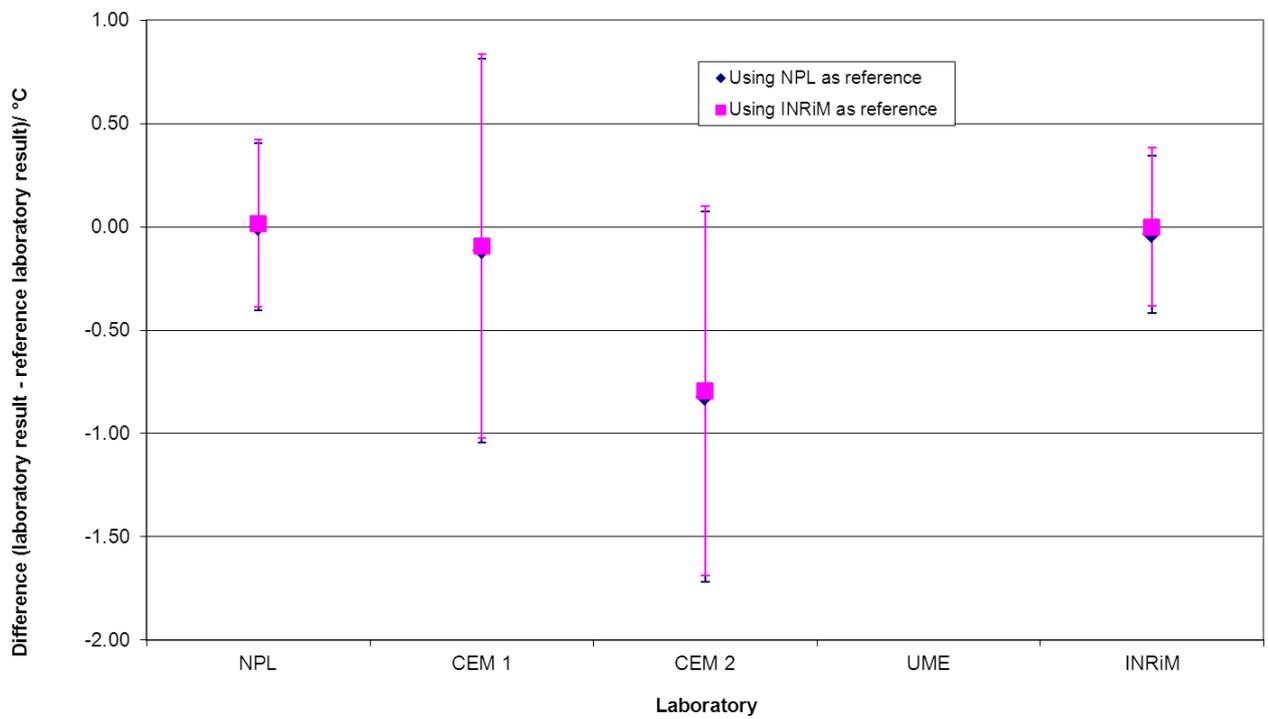




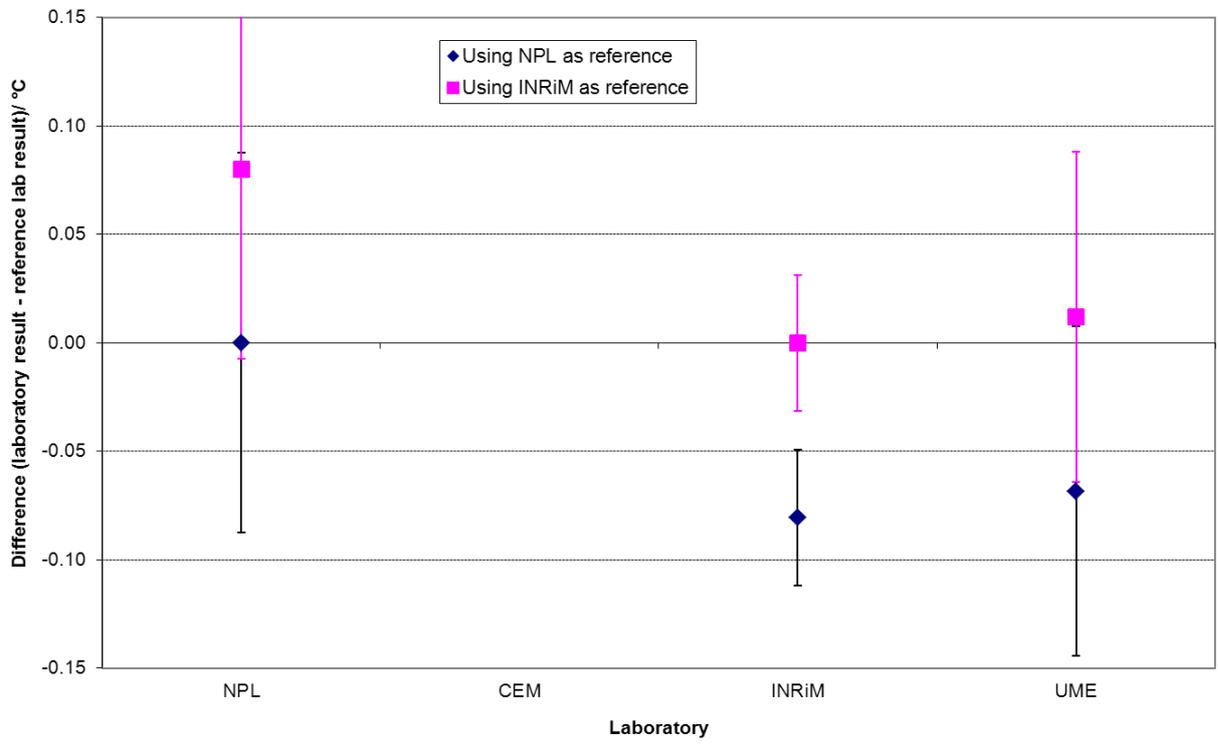
Direct comparison of measurements at the Al point for the LP5 thermometer  
(LP5 on range R2)



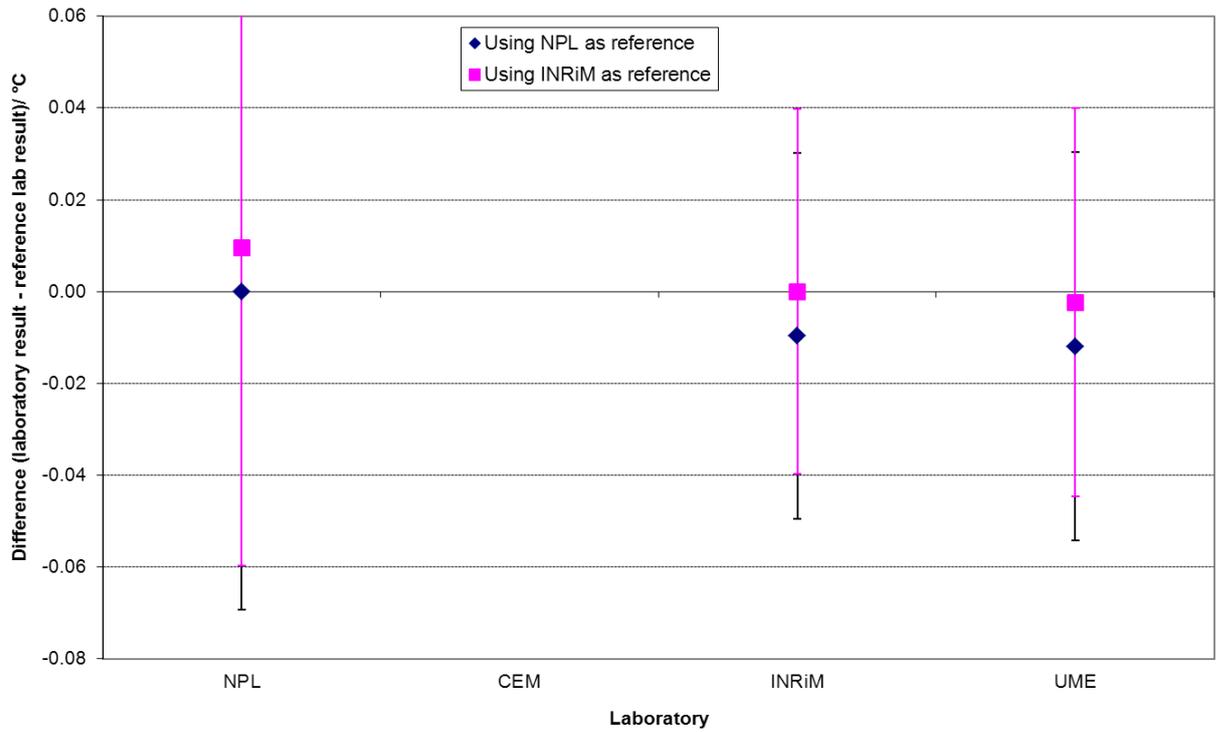
Direct comparison of measurements at the Ag point for the LP5 thermometer  
(LP5 on range R2)



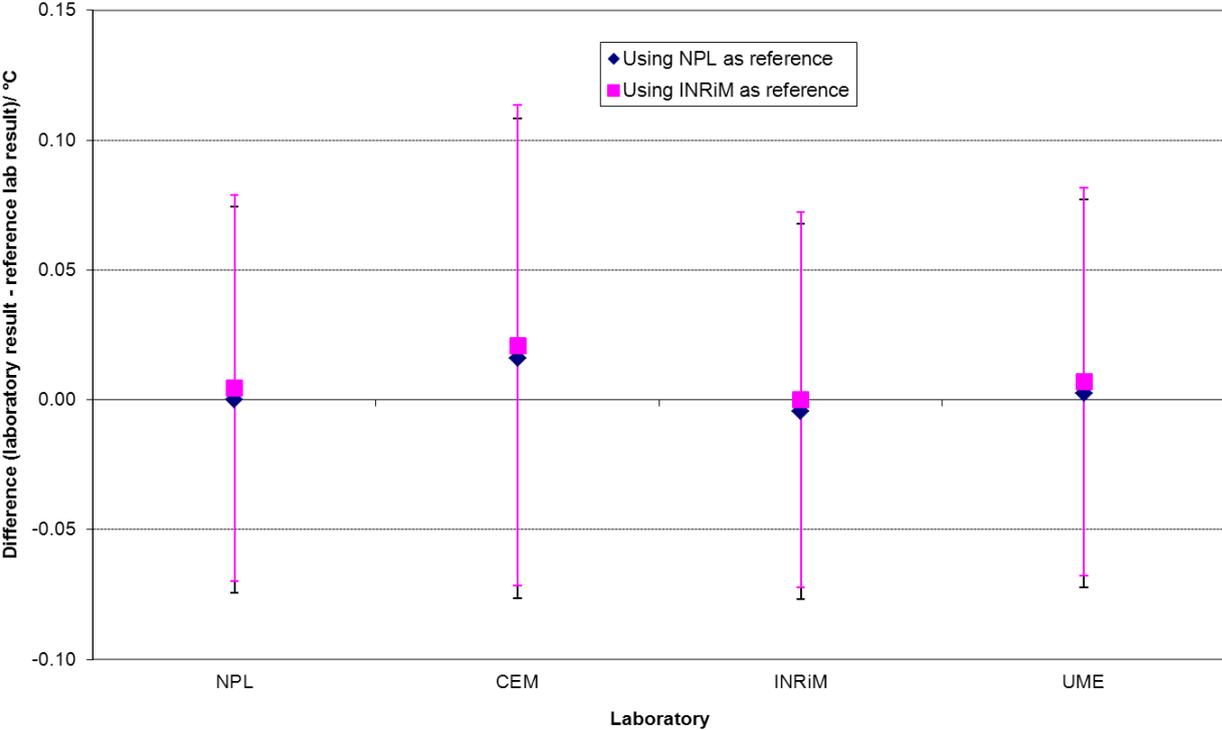
Direct comparison of measurements at the In point for the INRiM thermometer



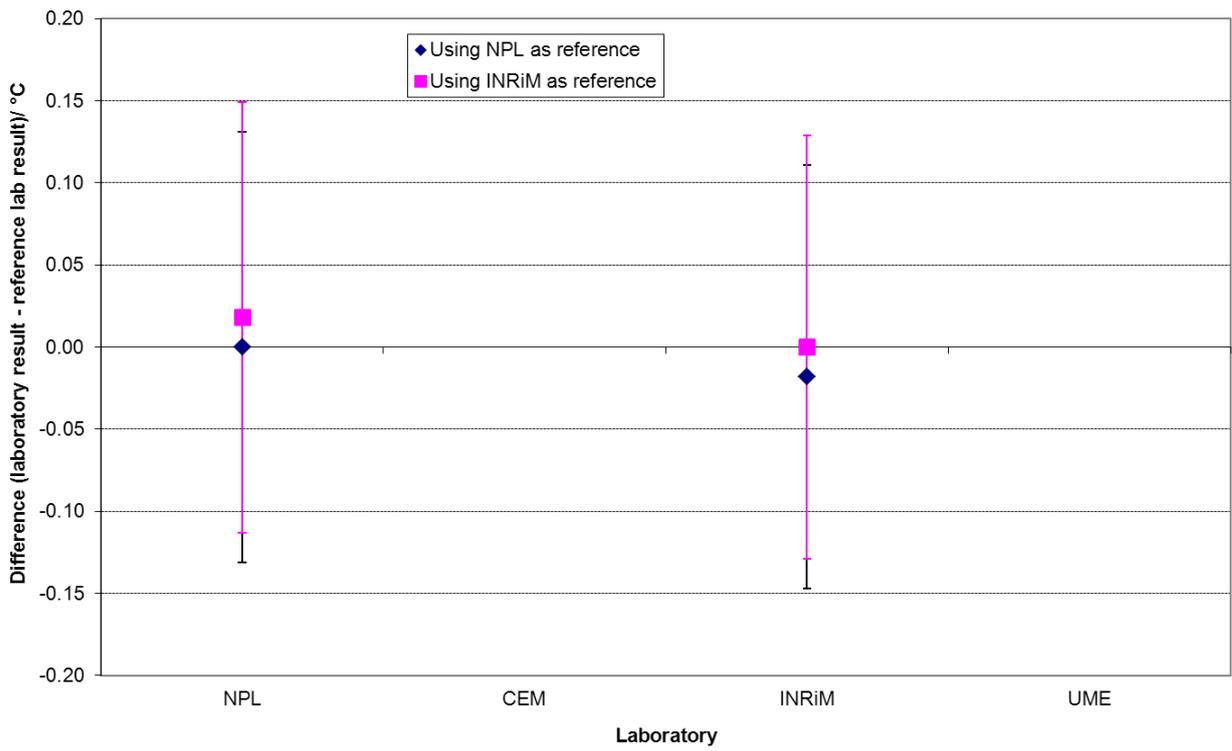
Direct comparison of measurements at the Sn point for the INRiM thermometer



Direct comparison of measurements at the Zn point for the INRiM thermometer



Direct comparison of measurements at the AI point for the INRiM thermometer



Direct comparison of measurements at the Ag point for the INRiM thermometer

