Key comparisons CCT-K5, CCT-K5.1, APMP.T-K5 and EUROMET.T-K5

MEASURAND : Temperature
NOMINAL TEMPERATURE : T_{nom} = 1500 °C

Key comparison CCT-K5

Four Tungsten-strip lamps were used as transfer standards for radiance temperature measurements at specific currents corresponding to each nominal temperature T_{nom}. To shorten the measurement time significantly the set of transfer standards was split in two sets of two lamps for simultaneous comparisons in two loops. The pilot of each loop measured both lamp sets in order to establish a linkage mechanism described on page 19 of the CCT-K5 Final Report.

T_i : temperature value measured by laboratory i
u_i : standard uncertainty of T_i

Lamp S/N C564

Lab$i$	T_i / °C	u_i / °C
VSL	1502.581	0.17
NMIA	1502.671	0.03
KRISS	1502.601	0.19
NIM	1502.671	0.24
A*STAR	1501.821	0.26
NMIJ	1502.991	0.24
VNIIM	1502.161	0.73

Lamp S/N C860

Lab$i$	T_i / °C	u_i / °C
NPL	1500.242	0.32
NIST	1501.312	0.44
CENAM	1500.872	0.50
LNE-INM	1499.922	0.30
INRIM	1501.042	0.16
PTB	1500.882	0.26

Lamp S/N C681

Lab$i$	T_i / °C	u_i / °C
VSL	1503.015	0.17
NMIA	1503.205	0.03
KRISS	1503.215	0.19
NIM	1503.515	0.24
A*STAR	1501.835	0.26
NMIJ	1503.475	0.24
VNIIM	1501.775	0.73

Lamp S/N C864

Lab$i$	T_i / °C	u_i / °C
NPL	1500.239	0.32
NIST	1500.939	0.44
CENAM	1500.709	0.50
LNE-INM	1500.499	0.30
INRIM	1500.829	0.16
PTB	1500.649	0.26

Key comparison CCT-K5.1

This is a bilateral comparison between the PTB and the NRC.
T_{NRC}: temperature value measured at the NRC
u_{NRC}: standard uncertainty of T_{NRC}

Lamp C598 T_{NRC} = 1500.50 °C   **Lamp 644C** T_{NRC} = 1500.59 °C
           u_{NRC} = 0.40 °C u_{NRC} = 0.40 °C

Key comparison APMP.T-K5

Laboratory individual measurements of APMP.T-K5 participants are given in Appendix B of the APMP.T-K5 Final Report both in tabulated and in graphical forms. There were taken between 1997 and 2000.

Key comparison EUROMET.T-K5

This comparison involved eight participants and was carried out from October 1999 to February 2001.
The two transfer standards were Lamp S/N C564 and Lamp S/N C681 already used in CCT-K5.
The individual laboratory measurements and their uncertainties are given in Tables 5 to 11 of the EUROMET.T-K5 Final Report.

Key comparisons CCT-K5, CCT-K5.1 and APMP.T-K5

Key comparison CCT-K5

MEASURAND : Temperature
NOMINAL TEMPERATURE : T_{nom} = 1500 °C

The key comparison reference value T_R for each nominal temperature T_{nom} and each lamp k is calculated on the basis of the median of measured radiance temperatures $T_i(k, T_{nom})$. Its standard uncertainty, $u(T_R)$, is obtained as the standard uncertainty of the

Lamp	T_R / °C	$u(T_R)$ / °C
C564	1502.720	0.073
C681	1503.040	0.061
C860	1500.850	0.154
C864	1500.730	0.067

For each temperature T_{nom} the degree of equivalence of laboratory i with respect to the key comparison reference value is given by a pair of terms: D_i and its expanded uncertainty U_i (k = 2) both expressed in K. The computation of D_i and U_i is explained in the Addendum of the CCT-K5 Final Report.

For each temperature T_{nom} the pair-wise degree of equivalence between laboratory i and j is given by two terms: D_{ij} and its expanded uncertainty U_{ij} (k = 2).The computation of D_{ij} and U_{ij} is also explained in the Addendum of the CCT-K5 Final Report.

Linking key comparison CCT-K5.1 to CCT-K5

The linkage is made through the common participation of PTB in both key comparisons, and is detailed in the CCT-K5 and CCT-K5.1 Linkage Report.

Linking key comparison APMP.T-K5 to CCT-K5

The linkage is made through the common participation of NMIJ, NIM, KRISS and NMIA in both key comparisons, and is detailed in the Addendum to the APMP.T-K5 Final Report.

Linking key comparison EUROMET.T-K5 to CCT-K5

The measurements of the EUROMET.T-K5 participants are directly linked to the key comparison reference value obtained in CCT-K5 as the protocols of the two key comparisons are identical and the transfer standards are the same (see in Chapter VII of the EUROMET.T-K5 Final Report).

Degrees of equivalence relative to the CCT-K5 key comparison reference values are computed for each of the transfer standards.
Pair-wise degrees of equivalence inside EUROMET.T-K5 are available in the EUROMET.T-K5 Final Report (Tables 15 to 36).

Key comparisons CCT-K5, CCT-K5.1, APMP.T-K5 and EUROMET.T-K5

MEASURAND : Temperature
NOMINAL TEMPERATURE : T_{nom} = 1500 °C
Degrees of equivalence relative to the CCT-K5 key comparison reference value

	D_i	U_i
	/ K	
VSL	**-0.082**	0.414
NPL	**-0.550**	0.683
NMIA	**0.058**	0.259
KRISS	**0.028**	0.467
NIM	**0.213**	0.593
A*STAR	**-1.052**	0.588
NMIJ	**0.353**	0.538
VNIIM	**-0.912**	1.520
NIST	**0.336**	0.918
CENAM	**0.000**	1.026
LNE-INM	**-0.580**	0.730
INRIM	**0.146**	0.396
PTB	**-0.025**	0.394
NRC	**0.211**	1.055
KIM-LIPI	**2.15**	2.64
CMS/ITRI	**-0.86**	1.28

Lamp S/N C564

	D_i	U_i
	/ K	
CEM	**0.19**	0.46
IPQ	**-0.37**	1.27
UME	**-1.80**	0.64
MKEH	**-2.37**	2.38
SMU	**-1.45**	0.45
SP	**-1.03**	1.43
MIKES	**-0.86**	1.75
VSL	**-0.01**	0.37

Lamp S/N C681

	D_i	U_i
	/ K	
CEM	**0.03**	0.65
IPQ	**-0.89**	1.33
UME	**-1.93**	0.65
MKEH	**-2.51**	2.68
SMU	**-1.20**	0.50
SP	**-1.22**	1.43
MIKES	**-1.29**	1.92
VSL	**-0.16**	0.36

Black: participants in CCT-K5
Green: participant in CCT-K5.1
Blue: participants in APMP.T-K5
Orange: participants in EUROMET.T-K5 (measurements with Lamp S/N C564)
Grey: participants in EUROMET.T-K5 (measurements with Lamp S/N C681)

Key comparisons CCT-K5 and CCT-K5.1

MEASURAND : Temperature

NOMINAL TEMPERATURE : T_{nom} = 1500 °C

Mtrix of equivalence

**Pair-wise degrees of equivalence involving APMP.T-K5 participants are not computed.**

Lab$j$ ⟹

Lab$i$	D_i	U_i / K	VSL D_{ij}	U_{ij} / K	NPL D_{ij}	U_{ij} / K	NMIA D_{ij}	U_{ij} / K	KRISS D_{ij}	U_{ij} / K	NIM D_{ij}	U_{ij} / K	A*STAR D_{ij}	U_{ij} / K	NMIJ D_{ij}	U_{ij} / K	VNIIM D_{ij}	U_{ij} / K
VSL	-0.082	0.414			0.467	0.747	-0.140	0.349	-0.110	0.518	-0.295	0.623	0.970	0.656	-0.435	0.589	0.830	1.554
NPL	-0.550	0.683	-0.467	0.747			-0.607	0.671	-0.577	0.770	-0.762	0.834	0.503	0.849	-0.902	0.822	0.363	1.617
NMIA	0.058	0.259	0.140	0.349	0.607	0.671			0.030	0.387	-0.155	0.508	1.110	0.584	-0.295	0.485	0.970	1.532
KRISS	0.028	0.467	0.110	0.518	0.577	0.770	-0.030	0.387			-0.185	0.623	1.080	0.710	-0.325	0.615	0.940	1.590
NIM	0.213	0.593	0.295	0.623	0.762	0.834	0.155	0.508	0.185	0.623			1.265	0.821	-0.140	0.702	1.125	1.655
A*STAR	-1.052	0.588	-0.970	0.656	-0.503	0.849	-1.110	0.584	-1.080	0.710	-1.265	0.821			-1.405	0.746	-0.140	1.563
NMIJ	0.353	0.538	0.435	0.589	0.902	0.822	0.295	0.485	0.325	0.615	0.140	0.702	1.405	0.746			1.265	1.597
VNIIM	-0.912	1.520	-0.830	1.554	-0.363	1.617	-0.970	1.532	-0.940	1.590	-1.125	1.655	0.140	1.563	-1.265	1.597		
NIST	0.336	0.918	0.418	0.963	0.885	1.104	0.278	0.905	0.308	0.981	0.123	1.032	1.388	1.044	-0.017	1.022	1.248	1.728
CENAM	0.000	1.026	0.083	1.072	0.550	1.190	-0.057	1.020	-0.027	1.088	-0.212	1.134	1.053	1.144	-0.352	1.125	0.913	1.791
LNE-INM	-0.580	0.730	-0.497	0.741	-0.030	0.924	-0.637	0.663	-0.607	0.764	-0.792	0.828	0.473	0.843	-0.932	0.816	0.333	1.615
INRIM	0.146	0.396	0.228	0.502	0.695	0.724	0.088	0.377	0.118	0.535	-0.067	0.623	1.198	0.643	-0.207	0.606	1.058	1.519
PTB	-0.025	0.394	0.058	0.648	0.525	0.833	-0.082	0.557	-0.052	0.674	-0.237	0.746	1.028	0.763	-0.377	0.732	0.888	1.574
NRC	0.211	1.055	0.293	1.133	0.760	1.257	0.153	1.086	0.183	1.154	-0.002	1.210	1.263	1.208	-0.143	1.184	1.123	1.850

Lab$j$ ⟹

Lab$i$	D_i	U_i / K	NIST D_{ij}	U_{ij} / K	CENAM D_{ij}	U_{ij} / K	LNE-INM D_{ij}	U_{ij} / K	INRIM D_{ij}	U_{ij} / K	PTB D_{ij}	U_{ij} / K	NRC D_{ij}	U_{ij} / K
VSL	-0.082	0.414	-0.418	0.963	-0.083	1.072	0.497	0.741	-0.228	0.502	-0.058	0.648	-0.293	1.133
NPL	-0.550	0.683	-0.885	1.104	-0.550	1.190	0.030	0.924	-0.695	0.724	-0.525	0.833	-0.760	1.257
NMIA	0.058	0.259	-0.278	0.905	0.057	1.020	0.637	0.663	-0.088	0.377	0.082	0.557	-0.153	1.086
KRISS	0.028	0.467	-0.308	0.981	0.027	1.088	0.607	0.764	-0.118	0.535	0.052	0.674	-0.183	1.154
NIM	0.213	0.593	-0.123	1.032	0.212	1.134	0.792	0.828	0.067	0.623	0.237	0.746	0.002	1.210
A*STAR	-1.052	0.588	-1.388	1.044	-1.053	1.144	-0.473	0.843	-1.198	0.643	-1.028	0.763	-1.263	1.208
NMIJ	0.353	0.538	0.017	1.022	0.352	1.125	0.932	0.816	0.207	0.606	0.377	0.732	0.143	1.184
VNIIM	-0.912	1.520	-1.248	1.728	-0.913	1.791	-0.333	1.615	-1.058	1.519	-0.888	1.574	-1.123	1.850
NIST	0.336	0.918			0.335	1.336	0.915	1.166	0.190	0.939	0.360	1.024	0.125	1.398
CENAM	0.000	1.026	-0.335	1.336			0.580	1.223	-0.145	1.050	0.025	1.128	-0.210	1.472
LNE-INM	-0.580	0.730	-0.915	1.166	-0.580	1.223			-0.725	0.786	-0.555	0.891	-0.790	1.283
INRIM	0.146	0.396	-0.190	0.939	0.145	1.050	0.725	0.786			0.170	0.611	-0.065	1.127
PTB	-0.025	0.394	-0.360	1.024	-0.025	1.128	0.555	0.891	-0.170	0.611			-0.235	1.126
NRC	0.211	1.055	-0.125	1.398	0.210	1.472	0.790	1.283	0.065	1.127	0.235	1.126		

CCT-K5, CCT-K5.1, APMP.T-K5 and EUROMET.T-K5   Nominal temperature, T_{nom} = 1500 °C
Degrees of equivalence, D_i, and expanded uncertainties (k = 2) U_i, expressed in K
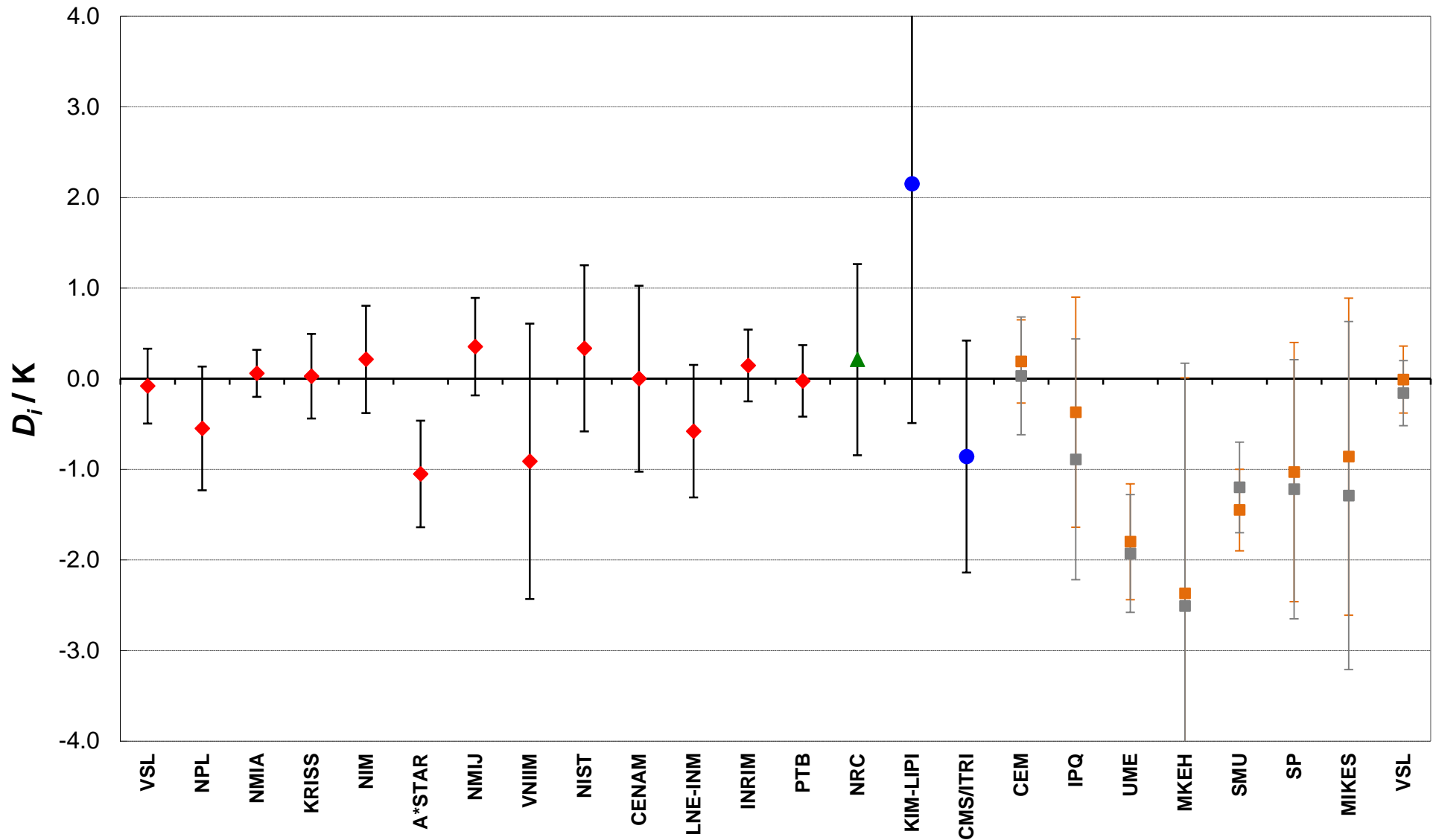
Red diamonds: participants in CCT-K5
Green triangle: participant in CCT-K5.1
Blue circles: participants in APMP.T-K5

Orange squares: participants in EUROMET.T-K5 (measurements with Lamp S/N C564)
Grey squares: participants in EUROMET.T-K5 (measurements with Lamp S/N C681)