

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

MEASURAND : Temperature

NOMINAL TEMPERATURE : $T_{\text{nom}} = 1600 \text{ }^\circ\text{C}$

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>i</i>	T_i / °C	u_i / °C
VSL	1602.854	0.19
NMIA	1602.984	0.03
KRISS	1602.914	0.21
NIM	1602.964	0.27
A*STAR	1601.974	0.30
NMIJ	1603.364	0.27
VNIIM	1602.904	0.86

Lamp S/N C681

Lab <i>i</i>	T_i / °C	u_i / °C
VSL	1603.051	0.19
NMIA	1603.251	0.03
KRISS	1603.271	0.21
NIM	1603.641	0.27
A*STAR	1601.891	0.30
NMIJ	1603.651	0.27
VNIIM	1602.071	0.86

Lamp S/N C860

Lab <i>i</i>	T_i / °C	u_i / °C
NPL	1600.304	0.37
NIST	1601.604	0.49
CENAM	1600.884	0.60
LNE-INM	1599.904	0.34
INRIM	1601.084	0.18
PTB	1600.984	0.29

Lamp S/N C864

Lab <i>i</i>	T_i / °C	u_i / °C
NPL	1600.227	0.37
NIST	1601.187	0.49
CENAM	1600.717	0.60
LNE-INM	1600.477	0.34
INRIM	1600.777	0.18
PTB	1600.627	0.29

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	$T_{\text{NRC}} = 1600.61 \text{ }^\circ\text{C}$	Lamp 644C	$T_{\text{NRC}} = 1600.69 \text{ }^\circ\text{C}$
	$u_{\text{NRC}} = 0.45 \text{ }^\circ\text{C}$		$u_{\text{NRC}} = 0.45 \text{ }^\circ\text{C}$

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, APMP.T-K5 and EUROMET.T-K5

Key comparison CCT-K5

MEASURAND : Temperature

NOMINAL TEMPERATURE : $T_{\text{nom}} = 1600 \text{ }^\circ\text{C}$

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 $T_i(k, T_{\text{nom}})$. Its standard uncertainty, $u(T_R)$, is obtained as the standard uncertainty of the median.

Lamp	$T_R / ^\circ\text{C}$	$u(T_R) / ^\circ\text{C}$
C564	1603.020	0.049
C681	1603.110	0.078
C860	1600.910	0.192
C864	1600.700	0.103

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 to 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 : $T_{nom} = 1600 \text{ }^\circ\text{C}$

Degrees of equivalence relative to the CCT-K5 key comparison reference value

Labi



	D_i	U_i
	/ K	
VSL	-0.113	0.452
NPL	-0.540	0.781
NMIA	0.053	0.262
KRISS	0.028	0.502
NIM	0.238	0.660
A*STAR	-1.133	0.652
NMIJ	0.443	0.599
VNIIM	-0.578	1.797
NIST	0.591	1.014
CENAM	-0.005	1.224
LNE-INM	-0.615	0.820
INRIM	0.126	0.436
PTB	0.001	0.433
NRC	0.121	1.146
A*STAR	0.36	0.98
CMS/TRI	-1.25	1.42

Lamp S/N C564

	D_i	U_i
	/ K	
CEM	-0.12	1.64
IPQ	-0.54	1.44
UME	-2.11	0.71
MKEH	-2.92	2.70
SMU	-1.45	0.49
SP	-0.36	1.60
MIKES	-1.04	1.92
VSL	-0.07	0.39

Lamp S/N C681

	D_i	U_i
	/ K	
CEM	0.14	0.74
IPQ	-1.20	1.53
UME	-2.33	0.74
MKEH	-3.12	3.04
SMU	-1.21	0.53
SP	-0.65	1.61
MIKES	-1.62	2.29
VSL	-0.15	0.41

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 : $T_{nom} = 1600 \text{ }^\circ\text{C}$

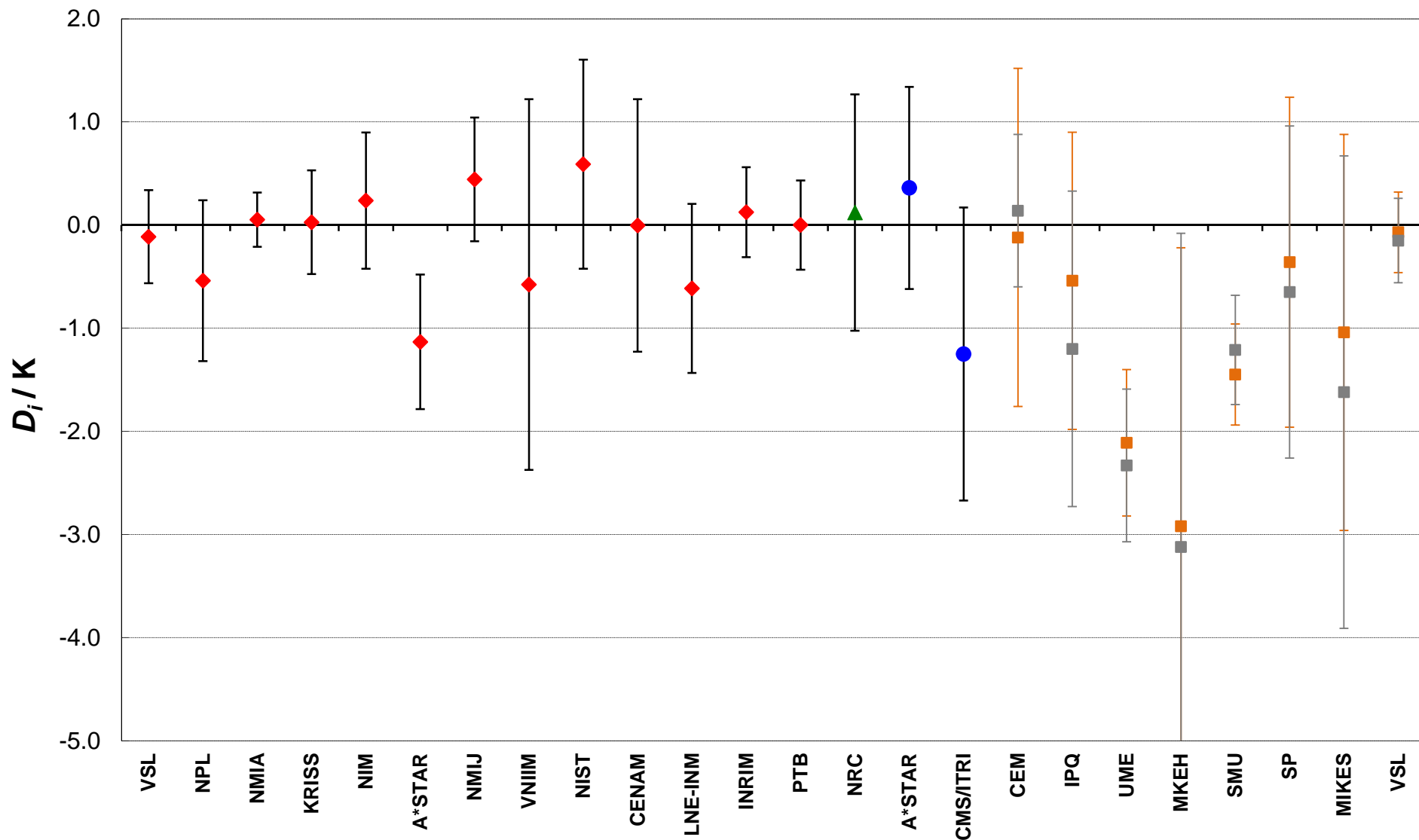
Matrix of equivalence

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

Lab _i	D_i / K		VSL		NPL		NMIA		KRISS		NIM		A*STAR		NMIJ		VNIIM	
	U_i	$/K$	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}
VSL	-0.113	0.452			0.427	0.853	-0.165	0.387	-0.140	0.572	-0.350	0.702	1.020	0.724	-0.555	0.662	0.465	1.835
NPL	-0.540	0.781	-0.427	0.853			-0.592	0.768	-0.567	0.875	-0.777	0.951	0.593	0.972	-0.982	0.938	0.038	1.901
NMIA	0.053	0.262	0.165	0.387	0.592	0.768			0.025	0.426	-0.185	0.580	1.185	0.628	-0.390	0.543	0.630	1.807
KRISS	0.028	0.502	0.140	0.572	0.567	0.875	-0.025	0.426			-0.210	0.702	1.160	0.764	-0.415	0.685	0.605	1.868
NIM	0.238	0.660	0.350	0.702	0.777	0.951	0.185	0.580	0.210	0.702			1.370	0.892	-0.205	0.788	0.815	1.955
A*STAR	-1.133	0.652	-1.020	0.724	-0.593	0.972	-1.185	0.628	-1.160	0.764	-1.370	0.892			-1.575	0.828	-0.555	1.860
NMIJ	0.443	0.599	0.555	0.662	0.982	0.938	0.390	0.543	0.415	0.685	0.205	0.788	1.575	0.828			1.020	1.888
VNIIM	-0.578	1.797	-0.465	1.835	-0.038	1.901	-0.630	1.807	-0.605	1.868	-0.815	1.955	0.555	1.860	-1.020	1.888		
NIST	0.591	1.014	0.703	1.069	1.130	1.240	0.538	1.002	0.563	1.086	0.353	1.148	1.723	1.167	0.148	1.137	1.168	2.007
CENAM	-0.005	1.224	0.108	1.272	0.535	1.411	-0.057	1.217	-0.032	1.287	-0.242	1.340	1.128	1.355	-0.447	1.330	0.573	2.122
LNE-INM	-0.615	0.820	-0.502	0.833	-0.075	1.056	-0.667	0.744	-0.642	0.854	-0.852	0.932	0.518	0.955	-1.057	0.918	-0.037	1.892
INRIM	0.126	0.436	0.238	0.557	0.665	0.831	0.073	0.413	0.098	0.589	-0.112	0.696	1.258	0.726	-0.317	0.678	0.703	1.787
PTB	0.001	0.433	0.113	0.720	0.540	0.950	-0.052	0.616	-0.027	0.745	-0.237	0.832	1.133	0.858	-0.442	0.817	0.578	1.845
NRC	0.121	1.146	0.233	1.232	0.660	1.387	0.068	1.175	0.093	1.251	-0.117	1.322	1.253	1.318	-0.322	1.293	0.698	2.131

Lab _i	D_i / K		NIST		CENAM		LNE-INM		INRIM		PTB		NRC	
	U_i	$/K$	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}
VSL	-0.113	0.452	-0.703	1.069	-0.108	1.272	0.502	0.833	-0.238	0.557	-0.113	0.720	-0.233	1.232
NPL	-0.540	0.781	-1.130	1.240	-0.535	1.411	0.075	1.056	-0.665	0.831	-0.540	0.950	-0.660	1.387
NMIA	0.053	0.262	-0.538	1.002	0.057	1.217	0.667	0.744	-0.073	0.413	0.052	0.616	-0.068	1.175
KRISS	0.028	0.502	-0.563	1.086	0.032	1.287	0.642	0.854	-0.098	0.589	0.027	0.745	-0.093	1.251
NIM	0.238	0.660	-0.353	1.148	0.242	1.340	0.852	0.932	0.112	0.696	0.237	0.832	0.117	1.322
A*STAR	-1.133	0.652	-1.723	1.167	-1.128	1.355	-0.518	0.955	-1.258	0.726	-1.133	0.858	-1.253	1.318
NMIJ	0.443	0.599	-0.148	1.137	0.447	1.330	1.057	0.918	0.317	0.678	0.442	0.817	0.322	1.293
VNIIM	-0.578	1.797	-1.168	2.007	-0.573	2.122	0.037	1.892	-0.703	1.787	-0.578	1.845	-0.698	2.131
NIST	0.591	1.014			0.595	1.554	1.205	1.292	0.465	1.045	0.590	1.139	0.470	1.530
CENAM	-0.005	1.224	-0.595	1.554			0.610	1.428	-0.130	1.255	-0.005	1.336	-0.125	1.677
LNE-INM	-0.615	0.820	-1.205	1.292	-0.610	1.428			-0.740	0.886	-0.615	1.008	-0.735	1.409
INRIM	0.126	0.436	-0.465	1.045	0.130	1.255	0.740	0.886			0.125	0.683	0.005	1.226
PTB	0.001	0.433	-0.590	1.139	0.005	1.336	0.615	1.008	-0.125	0.683			-0.120	1.225
NRC	0.121	1.146	-0.470	1.530	0.125	1.677	0.735	1.409	-0.005	1.226	0.120	1.225		

CCT-K5, CCT-K5.1, APMP.T-K5 and EUROMET.T-K5 Nominal temperature, $T_{nom} = 1600\text{ °C}$
 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)