

BUREAU INTERNATIONAL DES POIDS ET MESURES

LIST OF KEY COMPARISONS (April 1999)

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## LIST OF KEY COMPARISONS (April 1999)

### Introduction

Under the authority given to it in the Metre Convention, the Comité International des Poids et Mesures (CIPM) has drawn up an agreement for *Mutual recognition of national standards and of calibration and measurement certificates issued by national metrology institutes* [BIPM publication, 1999, 41 pages]. This agreement will be proposed for signature to the Directors of national metrology institutes at the time of the 21<sup>st</sup> Conférence Générale des Poids et Mesures, on 14 October 1999. The technical basis of this agreement will be the results of a number of key comparisons of national measurement standards, now being carried out by the Bureau International des Poids et Mesures (BIPM) and by the Consultative Committees, complemented by corresponding key comparisons carried out by the Regional Metrology Organisations (RMOs). This report lists the key comparisons and their status in April 1999. The tables given here will be published on the Web site of the BIPM ([www.bipm.fr](http://www.bipm.fr)) and maintained up-to-date in future. In due course these tables will be part of the key comparisons data base.

### Definition of 'key comparison'

The definition given in the *Mutual recognition of national standards and of calibration and measurement certificates issued by national metrology institutes* (page 41) is:

**Key comparison:** one of the set of comparisons selected by a Consultative Committee to test the principal techniques and methods in the field (note that key comparisons may include comparisons of multiples and sub-multiples of SI base and derived units and comparisons of artefacts).

In practice, selecting key comparisons means identifying a number of standards, or instruments kept by national metrology institutes, representative of their measurement capabilities. Carrying out such comparisons makes it possible to quantify the degree of equivalence between national laboratories. Note that for the purpose of quantifying degrees of equivalence, key comparisons carried out by an RMO have exactly the same status as those carried out by a Consultative Committee.

In addition to key comparisons, the *Mutual recognition of national standards and of calibration and measurement certificates issued by national metrology institutes* introduces the notion of 'supplementary comparisons' (page 32). Some other comparisons are carried out as simple studies. These are denoted 'pilot studies' and are not considered in this report.

### Characterization of a key comparison in this report

Each key comparison is characterized in this report by a number of pieces of information including:

- the standard or realization of a SI unit or instrument which is compared, referred to as '**Description**' in this report;
- the state of the comparison which may be (at a given date): planned, called for, ongoing, completed, report in progress draft A, report in progress draft B, approved, final publication, referred to as '**Status**';
- the name of the laboratory which pilots the comparison, referred to as '**Pilot**';

- the start date (optional if the comparison corresponds to a continuous activity), referred to as '**Start date**';
- the end date (optional if the comparison corresponds to a continuous activity, and not known if the comparison is not completed), referred to as '**End date**';
- the name of the contact person of the pilot laboratory, referred to as '**Contact**';
- the range, variable, parameters or any indication concerning the measurements, referred to as '**Range**', '**Parameters**', etc.;
- the transfer instruments or measuring methods which are used, referred to as '**Transfer instrument**', '**Measuring system**', etc.;
- the name of the laboratories participating in the comparisons, referred to as '**Participants**';
- additional notes or information of interest.

For each key or supplementary comparison, these different pieces of information evolve (for instance the status or list of participants) with time, except the standard or realization of a SI unit or instrument to be compared which is fixed by the Consultative Committee.

Address details of the pilot laboratories and of contact persons can generally be found in the BIPM Web site ([www.bipm.fr](http://www.bipm.fr)), specially by clicking on 'Directory of Consultative Committees' (last version dated January 1999).

### **Nomenclature of the key comparisons**

Each key or supplementary comparison is identified by a nomenclature which appears in this report under the headline '**Comparison**'. This nomenclature is that proposed by the Director of the BIPM; it is intended to be common to all Consultative Committees and is suggested also for the designation of the corresponding RMO key comparisons.

The nomenclature is composed of two parts. The first part identifies the comparison in a unique way and is written according to a standard procedure as follows.

- First is given the body under the auspices of which the comparison is carried out. It can be:
  - a Consultative Committee '**CC**';
  - the BIPM '**BIPM.**'<sup>\*</sup>;
  - a Regional Metrology Organisation designated by its acronym '**EUROMET.**', '**SIM.**', '**APMP.**', etc. (this case does not appear in this report).
 The dot '.' is added for the BIPM and for the acronym of a Regional Metrology Organization simply for clarity in the reading of the nomenclature.
- Second is given the field of measurements, designated as in the titles of Consultative Committees:
  - '**QM**', for Amount of substance;
  - '**EM**', for Electricity and Magnetism;
  - '**RI**', for Ionizing Radiation;
  - '**L**', for Length;
  - '**M**', for Mass and related quantities;
  - '**PR**' for Photometry and Radiometry;
  - '**T**' for Thermometry;

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\* Note that CC and BIPM key comparisons are designated as CIPM key comparisons. They lead to the determination of key comparison reference values, and associated uncertainties, transferred to the corresponding regional key comparison by means of joint participants. This organization makes it possible to determine degrees of equivalence, and associated uncertainties, between all pairs of national metrology institutes.

- ‘U’ for Units, ‘TF’ for Time and Frequency and ‘AUV’ for Acoustics, Ultrasound and Vibration are not used in this report since no key comparisons are yet defined in these fields.
- Third applies only when the comparison is specifically chosen by a given Working Group of a Consultatif Committee. In such a case, part or the totality of the acronym of the Working Group is written, preceded by a dot: ‘.RF’ for the Working Group on Radio Frequencies of the CCEM.
- Fourth is a hyphen ‘-’.
- Fifth is a capital letter, ‘K’ for key comparison, ‘S’ for supplementary comparison and ‘P’ for pilot studies (the last of these does not appear in this report).
- Sixth is a number, generally in the successive order ‘1’, ‘2’, ‘3’, etc.  
Two key comparisons corresponding to the same ‘Description’ but carried out over two different time intervals should not have the same number, though the rest of the nomenclature is the same.  
In the case of key or supplementary comparisons in the field of Ionizing Radiation, it is chosen to begin the number by ‘1’ for comparisons related to Section I, ‘2’ for Section II and ‘3’ for Section III (the last of these does not appear in this report).

The second part of the nomenclature may be omitted, but is useful to distinguish between several sub-comparisons of a key or supplementary comparison, or between sub-fields in the field. It can take any form, the most usual cases being:

- ‘a’, ‘b’, ‘c’ for several sub-comparisons, corresponding to different ranges of measurements of the same quantity;
- ‘ $Xy-\alpha\beta\gamma$ ’ which appears in the field of Ionizing Radiation for identifying the measurement of a specific radionuclide  $\alpha\beta\gamma Xy$ ;
- ‘m’, ‘p’ and ‘f’ for the sub-fields mass, pressure and force of the field Mass and related quantities.

Dots ‘.’ can be added as desirable for clarity in this second part of the nomenclature.

### Examples of key and supplementary comparisons

To exemplify the above statements, typical key and supplementary comparisons are described in this section.

- CCL key comparison of gauge blocks:

Comparison	Description	Status	Start date	End date	Pilot	Contact	Participants
CCL-K1	gauge blocks	ongoing	Mar 98	Sep 99	OFMET	R. Thalmann	BNM-LNE CENAM CMI, etc.

- BIPM key comparison of measurements of the activity of the radionuclide  $^{22}\text{Na}$ :

Comparison	Description	Status	Start date	Measuring system	Contact	Participants
BIPM.RI-K21.Na-22	activity	ongoing	Nov 76	SIR	G. Ratel	NPL(77) PTB(80) ETL(93), etc.

This comparison is a continuous one, so no ‘End date’ is required. The numbers given with the participating laboratories are the years of the measurements.

This comparison receives the designation ‘K21’ since it is the first key comparison of activity measurements corresponding to the field covered by Section II of the CCRI.

- Key comparison of the Working Group on Radio-Frequencies of the CCEM concerning measurements of power in waveguides:

Comparison	Descrip.	Previous designation	Status	Start date	End date	Range	Transfer Instrument	Pilot	Particip.
CCEM.RF-K1a.W	Power in waveguide	GT-RF 92-4	completed	Apr94	1997	33 GHz	R 320	BNM-LCIE	KRISS, etc.
CCEM.RF-K1b.W	Power in waveguide	GT-RF 95-1	completed	1996	1998	62 GHz	R 620	BNM-LCIE	NIST, etc.
CCEM.RF-K1c.W	Power in waveguide	GT-RF 97-2	ongoing	1997	1999	45 GHz	R 400	NPL	NRC, etc.
CCEM.RF-K1d.W	Power in waveguide	GT-RF 97-3	ongoing	1998	2000	94 GHz	R 900	NPL	PTB, etc.

The ‘.W’ included in the nomenclature is optional. It indicates that the comparison is related to measurements in waveguides, by opposition with coaxial lines ‘.CL’.

This specific key comparison corresponds to four ongoing comparisons in the field of radio-frequencies. The ‘Previous designation’ indicates the nomenclature given to them before the establishment of the key comparisons nomenclature.

- CCPR supplementary comparison of cryogenic radiometers

Comparison	Description	Status	Start date	End date	Transfer instruments	Pilot	Contact	Participants
CCPR-S3	cryogenic radiometers	report in progress draft A	Jul 96	Mar 99	traps	BIPM	R. Goebel	NIST, NPL, etc.

This supplementary comparison is nearly in its final stage, the measurements being completed and the draft A of the report in circulation.

## Conclusions

At the reference date of this report (30 April 1999), in addition to 8 BIPM key comparisons, 52 key comparisons and 4 supplementary comparisons are identified as being carried out by Consultative Committees. Three key comparisons carried out by Consultative Committees have been approved:

- CCQM-K1, on gaz mixtures, approved by the CCQM at its 5th Meeting in February 1999,
- CCPR-K3, on luminous intensity and luminous responsivity, approved by the CCPR at its 15th Meeting in March 1999, and
- CCPR-K4, on luminous flux, approved by the CCPR at its 15th Meeting in March 1999.

Final publication of the results of these comparisons is on the way.

The situation is continuously evolving, specially each time a Consultative Committee meets. It is planned to update this report regularly.

## List of key comparisons:

Amount of substance	p. 7	Mass and related quantities	p. 35
Electricity and Magnetism	p. 11	Photometry and Radiometry	p. 37
Ionizing Radiation	p. 19	Thermometry	p. 41
Length	p. 31		

**AMOUNT OF SUBSTANCE, CCQM key comparisons (April 1999) 1/2**

Comparison	Description	Status	Start date	End date	Range	Transfer instruments	Pilot	Contact	Participants
CCQM-K1a	gaz mixtures	approved	Apr 93	mid 1998	CO in Nitrogen 0.06 mol/mol to 0.0001 mol/mol	calibrated gas cylinders	see K1f	see K1f	see K1f
CCQM-K1b	gaz mixtures	approved	Apr 93	mid 1998	CO <sub>2</sub> in Nitrogen 0.15 mol/mol to 0.0001 mol/mol	calibrated gas cylinders	see K1f	see K1f	see K1f
CCQM-K1c	gaz mixtures	approved	Apr 93	mid 1998	NO in Nitrogen 1 mmol/mol to 0.1 mmol/mol	calibrated gas cylinders	see K1f	see K1f	see K1f
CCQM-K1d	gaz mixtures	approved	Apr 93	mid 1998	SO <sub>2</sub> in Nitrogen 1 mmol/mol to 0.1 mmol/mol	calibrated gas cylinders	see K1f	see K1f	see K1f
CCQM-K1e	gaz mixtures	approved	Apr 93	mid 1998	natural gas; type I	calibrated gas cylinders	see K1f	see K1f	see K1f
CCQM-K1f	gaz mixtures	approved	Apr 93	mid 1998	natural gas; type II	calibrated gas cylinders	see K1f	see K1f	see K1f
CCQM-K1g	gaz mixtures	approved	Apr 93	mid 1998	natural gas; type III	calibrated gas cylinders	NMi	A. Alink	NPL      NIST      BAM      BNM-LNE KRISS    NRLM    NRCCRM    VNIIM OMH
CCQM-K2	Cd and Pb in natural water	completed	Avr 98	Feb 99	ca. 85 nmol/kg Pb; 62 nmol/kg Cd	sample from IMEP-9	IRMM	I. Papadakis	IRMM      KRISS      LGC      BNM-LNE NIMC    NIST    NMI-VSL    NRC
CCQM-K3	automotive emission gases	ongoing	Sep 98	Jun 99		calibrated gas cylinders	NMi	A. Alink	VNIIM      BNM-LNE      OMH      BAM NIST    NRLM    KRISS      SMU PTB      OFMET    NRCCRM    NPL
CCQM-K4	ethanol in air	ongoing	Apr 99			calibrated gas cylinders	NPL	M. Milton	NMI-VSL      NIST      NRLM      NRCCRM VNIIM    OMH    BNM-LNE    BAM
CCQM-K5	p,p' DDE in cod liver oil	planned					LGC	K. Webb	
CCQM-K6	butane, toluene and xyline in air (or nitrogen)	planned					NIST	F. Guenther	
CCQM-K7	elemental solution standards	planned					OFMET /EMPA	H. Felber	

## AMOUNT OF SUBSTANCE, CCQM key comparisons (April 1999) 2/2

Comparison	Description	Status	Start date	End date	Range	Transfer instruments	Pilot	Contact	Participants
CCQM-K8	pH measurement standards	planned				phosphate buffer solutions	PTB	P. Spitzer	DFM VNIIIFTRI CENAM      NIST SMU      KRISS GUM      NIMC OMH

### Notes

- CCQM-K1e** see the final report for the description of Type I gaz mixture  
**CCQM-K1f** see the final report for the description of Type II gaz mixture  
**CCQM-K1g** see the final report for the description of Type III gaz mixture  
**CCQM-K2** VNIIM participated but withdrew its results because of evidence that samples were tampered with during transportation

## ELECTRICITY and MAGNETISM, CCEM key comparisons (April 1999) 1/2

Comparison	Description	Previous designation	Status	Start date	End date	Range	Transfer instruments	Pilot	Contact	Participants				
CCEM-K1	resistance		completed	Jan 90	Mar 91	1 Ω and 10 kΩ	wirewound resistors	BIPM	F. Delahaye	ASMW VNMM JV PTB	CSIRO BNM-LCIE NPL SP	ETL	IEN NIM NRC NMI-VSL	NIST OFMET VTT
CCEM-K2a	resistance	CCE 95-1	ongoing	Sep 96	Oct 99	10 MΩ and 1GΩ	wirewound and film resistors	NIST	R. Dziuba	NRC CSIRO-NML OFMET VNIIM	BNM-LCIE MSL IEN	NPL SP NIM	PTB NMI-VSL KRISS	
CCEM-K3	inductance	CCE 88-1	completed	1989	1994	10 mH at 1000 Hz	inductor	ASMW	H. Eckardt	NIM NPL NIST	VNIIM BNM-LCIE EAM	PTB	SP IEN	
CCEM-K4a	capacitance	CCE 92-1	report in progress draft A	Jan 96	Jun 98	10 pF	NIST 10 pF capacitors	NIST	A.-M. Jeffery	CSIRO-NML VNIIM NIM	NPL IRL BNM-LCIE	NRC BIPM	NMI-VSL PTB	
II	CCEM-K5	AC power and energy	CCE 92-2	ongoing		50 Hz to 60 Hz		NIST	N. Oldham	NRC CRI KRISS CSIR	PTB NPL NMI-VSL PSB	SP IEN INTI	CSIRO-NML NIM VNIIM BNM-LCIE	
	CCEM-K6a	AC/DC transfer	CCE 92-3	completed	Jan 94	May 96	3 V 1 kHz; 20 kHz	multi-junction thermal voltage converters	PTB	M. Klontz	NPL VTT INETI CSIRO-NML CMS	IEN SP CEM KRISS INTI	NMI-VSL OFMET NRC NPLI NIM	BNM-LCIE BEV NIST CSIRO NIM
CCEM-K6b	AC/DC transfer	CCE 92-4	ongoing	Apr 95	1999	50 kHz to 100 kHz	single-junction thermal voltage converters	BNM-LCIE	A. Poletaeff	BEV SP INETI NOM NIM	PTB NMS VTT OFMET CSIRO-NML VNIIM	NMI-VSL IEN CEM NIST NRC	DFM NPL CEM KRISS CSIRO-NML	
CCEM-K6c	AC/DC transfer	CCE 92-5	completed	Aug 95	Jan 98	1 MHz to 50 MHz	single junction thermal voltage converters	NMI-VSL	J. de Vreede	PTB NPL SP NPLI	VNIIM BNM-LCIE CEM KRISS	OMH AREPA NIST	SIQ OFMET CSIRO-NML	
CCEM-K7	AC voltage ratio	CCE 97-1	ongoing	Sep 98		40 Hz to 5 kHz (selected frequencies)	inductive voltage divider	NPL	I. Robinson					

## ELECTRICITY and MAGNETISM, CCEM key comparisons (April 1999) 2/2

Comparison	Description	Previous designation	Status	Start date	End date	Range	Transfer instruments	Pilot	Contact	Participants				
CCEM-K8	DC voltage ratio	CCE 97-2	ongoing	1998	2000	1000 V : 10 V and 100 V : 10 V	resistive voltage divider	IEN	G. Marullo-Reedtz	CSIR IRL KRISS NIM	NIST SP	NPL	BNM-LCIE CEM	NRC VNIIM

### Notes

Previous designation given to the comparison before the establishment of the key comparisons nomenclature  
 see *Report of the 21st Meeting of the CCE*, 1997, p. 104

## ELECTRICITY and MAGNETISM, BIPM key comparisons (April 1999)

Comparison	Description	Status	Start date	End date	Range	Transfer instruments	Pilot	Contact	Participants			
BIPM-K1a	DC voltage, Josephson standards	ongoing	Jan 91		1.018 V	Josephson standard	BIPM	D. Reymann	DFM(91) NIST(91) ETL(92) KRISS(95) SP(96)	PTB(91) NRC(91) OFMET(92)	DFM(91) NPL(91) NMI-VSL(93)	BNM-LCIE(91) BNM-LCIE(91) CSIRO-NML(95)
BIPM-K1b	DC voltage, Josephson standards	ongoing	Jan 91		10 V	Josephson standard	BIPM	D. Reymann	BNM-LCIE(94)	PTB(98)	SP(98)	
BIPM-K2a	DC voltage, Zener diode	completed	Jan 94	May 96	1.018 V	Zener diode-based electronic standards	BIPM	D. Reymann	NML-FORBAIRT(97) SMU(98)	IEN(96) VNIIM(98)	JV(97)	NML-FORBAIRT(98)
BIPM-K2b	DC voltage, Zener diode	completed	Jan 94	May 96	10 V	Zener diode-based electronic standards	BIPM	D. Reymann	NML-FORBAIRT(97) NML-FORBAIRT(98)	PSB(98)	SMU(98)	NIST(98)
BIPM-K3	quantum Hall resistance standards and resistance ratios	ongoing	Dec 93		R <sub>H</sub> (2) / 100 Ω 10 kΩ / 100 Ω 100 Ω / 1 Ω	BIPM quantum Hall standard and resistors	BIPM	F. Delahaye	BNM-LCIE(93) NIST(99)	OFMET(94)	PTB(95)	NPL(97)

## ELECTRICITY and MAGNETISM, CCEM GT-RF key comparisons (April 1999)

Comparison	Description	Previous designation	Status	Start date	End date	Range	Transfer instrument	Pilot	Contact	Participants			
CCEM.RF-K1a.W	power in waveguide	GT-RF 92-4	completed	Apr 94	end 97	33 GHz	R 320	BNM-LCIE		CSIRO-NML NPL	KRISS NRC	NIST	NMi-VSL PTB
CCEM.RF-K1b.W	power in waveguide	GT-RF 95-1	completed	1996	1998	62 GHz	R 620	BNM-LCIE		NIST	NPL	SSIA	
CCEM.RF-K1c.W	power in waveguide	GT-RF 97-2	ongoing	1997	1999	45 GHz	R 400	NIST		BNM-LCIE NPL	ETL NRC	IEN	KRISS VNIIM
CCEM.RF-K1d.W	power in waveguide	GT-RF 97-3	ongoing	1998	2000	94 GHz	R 900	NPL		BNM-LCIE NIST	ETL NRC	IEN	KRISS PTB VNIIM
CCEM.RF-K2.W	noise power in waveguide	GT-RF 78-13	completed	Sep 85	Dec 97		R 100	NPL		BNM-LCIE	CSIRO-NML	NIM	NIST
CCEM.RF-K3.W	antenna gain	GT-RF 92-1	ongoing	1997	1999	26.5 GHz, 33 GHz, 40 GHz	R 320	NPL		BNM-LCIE NMI-VSL	CSIRO-NML	KRISS	NIST
CCEM.RF-K4.CL	voltage	GT-RF 92-6	ongoing	Oct 97	1999	1 V 1 MHz to 300 MHz, 1 GHz (option)	50 Ω coax	NMi-VSL		AREPA CSIRO-NML NRC	BNM-LCIE IEN PTB	CEM or INT CMI KRISS SMU	NIST SPTT VNIIM
CCEM.RF-K5a.CL	reflection coefficient / S parameters	GT-RF 83-4	completed	May 91	Oct 97	2 GHz to 18 GHz	coax	NPL		BNM-LCIE NMI-VSL	CSIRO-NML PTB	FFV	NIST SPTT
CCEM.RF-K5b.CL	reflection coefficient / S parameters	GT-RF 92-3	ongoing	Nov 97	1999	2 GHz to 18 GHz	coax, type N connector	NPL		BNM-LCIE NRC	CSIRO-NML PTB	KRISS	NIST
CCEM.RF-K5c.CL	reflection coefficient / S parameters	GT-RF 97-1	ongoing	1997	1999	50 MHz to 26.5 GHz	coax, PC-3.5 connector	BNM-LCIE		CSIRO-NML NRC	KRISS	NIST	NPL
CCEM.RF-K6.CL	noise power in coax	GT-RF 92-2	completed	Jan 96	end 97	30 MHz and 4 GHz	coax, type N connector	NIST		BNM-LCIE	NPL	PTB	KRISS
CCEM.RF-K7a.CL	electromagnetic field/ antenna	GT-RF 86-1	completed	1991	1997	power flux density: 2.45 GHz and 10 GHz electric field strength: 300 MHz to 1000 MHz	coax, type N connector	NIST		ARCS IEN NMI-VSL	BNM-LCIE JQA NPL	CRL KEC	ETL KRISS PTB
CCEM.RF-K8.CL	electromagnetic field/ antenna antenna factor	GT-RF 92-7	ongoing	Nov 97	1999	10 kHz, 100 kHz, 1 MHz, 30 MHz	one active antenna and one passive antenna	NPL		BNM-LCIE KRISS	CSIRO-NML NIST	ETL NMi-VSL	IEN PTB

### Notes

CCEM.RF-KnW  
CCEM.RF-KnCL  
Previous designation

W stands for 'waveguide'  
CL stands for 'coaxial line'  
designation given to the comparison before the establishment of the key comparisons nomenclature  
see Report of the 21st Meeting of the CCE, 1997, p. 104

**IONIZING RADIATION, CCRI key comparisons (April 1999)**

Comparison	Description	Status	Start date	End date	Parameters	Measuring system	Pilot	Contact	Participants			
CCRI-K22.Cs-134	activity	completed	Oct 78	Jul 81	radionuclide Cs-134	radioactive solution	BIPM	G. Ratel	AAEC BARC IBJ INPE NBS OMH	AECL BCMN IEA IRK NIM PTB	AIEA BIPM IER LMRI NPL SCK	ASMW ETL IMM NAC NRC UVVVR
CCRI-K22.Cs-137	activity	completed	May 82	May 84	radionuclide Cs-137	radioactive solution	BIPM	G. Ratel	AAEC BIPM LMRI NPL PTB	AECL ETL NAC NRC SCK	BARC IFIN NBS OMH UVVVR	BCMN NIM PDS
CCRI-K22.Ba-133	activity	completed	Mar 84	Dec 91	radionuclide Ba-133	radioactive solution	BIPM	G. Ratel	AAEC BIPM IPEN NAC OMH	AECL ETL IRK NBS PTB	ASMW IMM KSRI NPL UVVVR	BCMN LMRI NRC
CCRI-K22.Cd-109	activity	completed	Mar 86	Jan 94	radionuclide Cd-109	radioactive solution	BIPM	G. Ratel	AECL IEA IPEN NBS PTB	BIPM IER KSRI NIM UVVVR	CBNM IFIN LMRI NPL OMH	ETL IMM NAC OMH
CCRI-K22.I-125	activity	completed	Jun 86	Apr 95	radionuclide I-125	radioactive solution	BIPM	G. Ratel	AECL ENEA LMRI NPL PTB	BIPM ETL NAC NRC UVVVR	CBNM IEA NIM OMH VNIIM	CNEN KSRI NIST PSPKR
CCRI-K22.Se-75	activity	report in progress	Jun 93		radionuclide Se-75	radioactive solution	BIPM	G. Ratel	AECL ETL KRISS NIM NRC VNIIM	BARC IEA LNMR NIRH OMH	BIPM IFIN LPRI NIST PSPKR PTB	CNEA IIR NAC NPL PTB
CCRI-K22.Ir-192	activity	completed	Mar 96	Nov 98	radionuclide Ir-192	radioactive solution	BIPM	G. Ratel	BIPM IRMM OMH	ETL KRISS VNIIM	IIR LPRI	IRA-OFMET NPL
CCRI-K22.Tl-204	activity	report in progress	Apr 97		radionuclide Tl-204	radioactive solution	BIPM	G. Ratel	BIPM IFIN LNMR NIST RC	CIEMAT IRA LPRI NPL VNIIM	ENEA IRMM NAC OMH	ETL KRISS NIM PTB
CCRI-K22.Sr-90	activity	report in progress	Feb 97		radionuclide Sr-90	radioactive solution	BIPM	G. Ratel	CIEMAT ENEA OMH	ETL IRMM PTB	IRA NIST RC	BNM-LPRI NPL
CCRI-K22.Eu-152	activity	ongoing	Mar 99		radionuclide Eu-152	radioactive solution	BIPM	G. Ratel	BNM-LPRI PTB	ETL	NRC	OMH

## IONIZING RADIATION, CCRI supplementary comparisons (April 1999)

Comparison	Description	Status	Start date	End date	Parameters	Measuring system	Pilot	Contact	Participants			
CCRI-S12	absorbed dose to water	report in progress	Sep 98	Jan 99	Co-60, high dose	alanine	BIPM	D.T. Burns	BIPM NIST	ENEA NPL	IAEA PTB	NIM

## IONIZING RADIATION, BIPM key comparisons (April 1999) 1/4

Comparison	Description	Status	Start date	End date	Parameters	Measuring system	Pilot	Contact	Participants			
BIPM.RI-K11a	air kerma	ongoing	May 75		Co-60 ( $\gamma$ )	ionization chambers	BIPM	P.J. Allisy	PTB(89) OMH(94) NIST(96) VNIIM(97)	SZMDM(92) LNMR(95) NMi(96) NRC(98)	UDZ(92) BEV(95) NPL(97) ENEA(98)	BNM-LPRI(93) GUM(96) ARL(97) BARC(99)
BIPM.RI-K11b	air kerma	ongoing	Jun 66		10 kV to 50 kV (x)	free air chamber	BIPM	D.T. Burns	NRC(66) GUM(94) OFMET(98)	ETL(72) NMI(96) ENEA(98)	CIEMAT(79) NPL(97) VNIIM(98)	OMH(88) NIST(98) PTB(99)
BIPM.RI-K11c	air kerma	ongoing	May 75		100 kV to 250 kV (x)	ionization chambers	BIPM	D.T. Burns	CSIR(76) NMi(91) OMHC(98)	BEV(82) GUM(94) NRC(98)	ARL(88) NPL(97) VNIIM(98)	NIST(91) ENEA(98) PTB(99)
BIPM.RI-K11d	air kerma	ongoing	Jun 94		Cs-137 ( $\gamma$ )	ionization chambers	BIPM	P.J. Allisy	NIST(94) VNIIM(97)	OMH(94) NPL(97)	BEV(95) ENEA(98)	BNM-LPRI(95)
BIPM.RI-K12a	absorbed dose to water	ongoing	Jun 94		Co-60, therapy	ionization chambers	BIPM	P.J. Allisy	PTB(89) ENEA(94) NRC(98)	BNM-LPRI(93) ARL(97)	NMi(93) NIST(97)	BEV(94) NPL(97)
BIPM.RI-K13a	absorbed dose to graphite	ongoing	Jul 77		Co-60, therapy	ionization chambers	BIPM	P.J. Allisy	NIST(77) NMi(93) NPL(97)	PTB(77) BNM-LPRI(93)	OMH(86) ENEA(94)	IRA(89) BEV(94)
BIPM.RI-K21.Na-22	activity	ongoing	Nov 76		radionuclide Na-22	SIR	BIPM	G. Ratel	NPL(77) NAC(84) LPRI(93)	UVVR(79) OMH(85)	PTB(80) ETL(93)	NBS(83) ANSTO(93)
BIPM.RI-K21.Na-24	activity	ongoing	Jun 82		radionuclide Na-24	SIR	BIPM	G. Ratel	PTB(82)	LMRI(83)		
BIPM.RI-K21.Sc-46	activity	ongoing	Nov 76		radionuclide Sc-46	SIR	BIPM	G. Ratel	ETL(76) OMH(88)	AAEC(78) BARC(94)	NPL(81)	NBS(82)
BIPM.RI-K21.Sc-47	activity	ongoing	Oct 83		radionuclide Sc-47	SIR	BIPM	G. Ratel	BCMN(83)			
BIPM.RI-K21.Cr-51	activity	ongoing	Jan 77		radionuclide Cr-51	SIR	BIPM	G. Ratel	NPL(80) OMH(89) PTB(98)	BCMN(81) ETL(93)	NBS(81) LPRI(94)	UVVR(82) ANSTO(94)
BIPM.RI-K21.Mn-54	activity	ongoing	Sep 75		radionuclide Mn-54	SIR	BIPM	G. Ratel	NPL(76) NBS(79) LPRI(92)	BIPM(76) UVVR(79) ETL(93)	AAEC(77) OMH(82) OMH(98)	PTB(79) IER(89)
BIPM.RI-K21.Co-56	activity	ongoing	Feb 80		radionuclide Co-56	SIR	BIPM	G. Ratel	LMRI(80)	NPL(91)	PTB(95)	LPRI(98)
BIPM.RI-K21.Mn-56	activity	ongoing	Apr 78		radionuclide Mn-56	SIR	BIPM	G. Ratel	BIPM(78) BIPM(78) BIPM(78) BIPM(94)	BIPM(78) BIPM(78) BIPM(78) BIPM(94)	BIPM(78) BIPM(78) BIPM(86)	BIPM(78) BIPM(78) BIPM(86)

**IONIZING RADIATION, BIPM key comparisons (April 1999) Cont. 2/4**

Comparison	Description	Status	Start date	End date	Parameters	Measuring system	Pilot	Contact	Participants				
BIPM.RI-K21.Co-57	activity	ongoing	Dec 76		radionuclide Co-57	SIR	BIPM	G. Ratel	NPL(76) NAC(85) PSPKR(92) ETL(96)	AAEC(78) NBS(85) VNIIM(92) IRA(96)	PTB(83)	NIRH(85) IRD(91) LPRI(95) BEV(98)	UVVVR(91) OMH(96) KRIS(99)
BIPM.RI-K21.Co-58	activity	ongoing	Apr 78		radionuclide Co-58	SIR	BIPM	G. Ratel	UVVVR(80) PTB(95)	OMH(86)	NPL(91)	LPRI(92)	
BIPM.RI-K21.Fe-59	activity	ongoing	May 76		radionuclide Fe-59	SIR	BIPM	G. Ratel	NPL(79) NBS(87) BARC(98)	AAEC(80) LMRI(89) KRISS(99)	OMH(83) PTB(95)	UVVVR(84) ETL(97)	
BIPM.RI-K21.Co-60	activity	ongoing	Nov 75		radionuclide Co-60	SIR	BIPM	G. Ratel	BIPM(76) NIM(78) PDS(84) ENEA(91) BARC(94)	ETL(76) IER(79) IPEN(84) CNEA(92) KRISS(95)	NPL(77) OMH(79) LMRI(86) ANSTO(92) NIST(97)	UVVVR(78) IFIN(83) PTB(88) NAC(92) BEV(98)	
BIPM.RI-K21.Zn-65	activity	ongoing	Oct 77		radionuclide Zn-65	SIR	BIPM	G. Ratel	AAEC(77) PTB(87)	NPL(79) PSPKR(93)	UVVVR(80) ETL(94)	LMRI(82) OMH(95)	
BIPM.RI-K21.Ga-67	activity	ongoing	Mar 78		radionuclide Ga-67	SIR	BIPM	G. Ratel	UVVVR(81) NAC(86)	LMRI(81)	NPL(82) OMH(95)	NIRH(83) NIST(98)	
BIPM.RI-K21.Se-75	activity	ongoing	Nov 76		radionuclide Se-75	SIR	BIPM	G. Ratel	PTB(76) LMRI(89)	UVVVR(80) NAC(90)	NBS(88)	OMH(88)	
BIPM.RI-K21.Sr-85	activity	ongoing	Dec 75		radionuclide Sr-85	SIR	BIPM	G. Ratel	BIPM(75) NPL(81) OMH(94) NIRH(96)	UVVVR(82) PTB(94) ETL(94)	NBS(83) LPRI(95)		
BIPM.RI-K21.Y-88	activity	ongoing	Nov 76		radionuclide Y-88	SIR	BIPM	G. Ratel	ETL(76) NBS(80) OMH(93)	NPL(77) UVVVR(86) LPRI(94)	AAEC(77) PTB(88) LNMR(99)	IER(79) VNIIM(93)	
BIPM.RI-K21.Nb-95	activity	ongoing	Aug 77		radionuclide Nb-95	SIR	BIPM	G. Ratel	NPL(77)	UVVVR(80)	LMRI(90)		
BIPM.RI-K21.Mo-99	activity	ongoing	Apr 78		radionuclide Mo-99	SIR	BIPM	G. Ratel	UVVVR(81)	LMRI(86)	NIST(98)		
BIPM.RI-K21.Tc-99m	activity	ongoing	Oct 83		radionuclide Tc-99m	SIR	BIPM	G. Ratel	PTB(85)	IRA(93)	LPRI(98)		
BIPM.RI-K21.Ru-103	activity	ongoing	Jun 78		radionuclide Ru-103	SIR	BIPM	G. Ratel	UVVVR(78)	LMRI(80)	OMH(88)		
BIPM.RI-K21.Ru-106	activity	ongoing	Jan 86		radionuclide Ru-106	SIR	BIPM	G. Ratel	OMH(86)	LMRI(88)	PTB(95)		
BIPM.RI-K21.Cd-109	activity	ongoing	Apr 78		radionuclide Cd-109	SIR	BIPM	G. Ratel	NPL(80) UVVVR(86)	NAC(82) PTB(94)	Comp.(84) ETL(96)	BIPM(86) LPRI(98)	
BIPM.RI-K21.Ag-110m	activity	ongoing	Dec 83		radionuclide Ag-110m	SIR	BIPM	G. Ratel	IFIN(83)	NBS(88)	NPL(93)		
BIPM.RI-K21.In-111	activity	ongoing	Sep 79		radionuclide In-111	SIR	BIPM	G. Ratel	LMRI(81) NIST(98)	NPL(82)	NIRH(85)	UVVVR(90)	
BIPM.RI-K21.Sn-113	activity	ongoing	Sep 75		radionuclide Sn-113	SIR	BIPM	G. Ratel	NBS(80) LPRI(92)	UVVVR(81)	OMH(88)	PTB(89)	

**IONIZING RADIATION, BIPM key comparisons (April 1999) Cont. 3/4**

Comparison	Description	Status	Start date	End date	Parameters	Measuring system	Pilot	Contact	Participants
BIPM.RI-K21.I-123	activity	ongoing	Apr 81		radionuclide I-123	SIR	BIPM	G. Ratel	NIRH(83) PTB(85)
BIPM.RI-K21.Sb-124	activity	ongoing	Apr 92		radionuclide Sb-124	SIR	BIPM	G. Ratel	OMH(92)
BIPM.RI-K21.I-125	activity	ongoing	Aug 77		radionuclide I-125	SIR	BIPM	G. Ratel	LMRI(80) ETL(97)
BIPM.RI-K21.I-131	activity	ongoing	May 77		radionuclide I-131	SIR	BIPM	G. Ratel	NAC(80) UVVVR(86) BARC(94) OMH(98)
BIPM.RI-K21.Ba-133	activity	ongoing	May 77		radionuclide Ba-133	SIR	BIPM	G. Ratel	AAEC(78) PTB(81) ETL(86) OMH(96)
BIPM.RI-K21.Xe-133	activity	ongoing	Apr 92		radionuclide Xe-133	SIR	BIPM	G. Ratel	NIST(92)
BIPM.RI-K21.Cs-134	activity	ongoing	Nov 75		radionuclide Cs-134	SIR	BIPM	G. Ratel	NPL(76) UVVVR(78) IRD(87) BARC(96)
BIPM.RI-K21.Cs-137	activity	ongoing	Nov 76		radionuclide Cs-137	SIR	BIPM	G. Ratel	NPL(77) NBS(83) ANSTO(94) OMH(97)
BIPM.RI-K21.Ce-139	activity	ongoing	Mar 76		radionuclide Ce-139	SIR	BIPM	G. Ratel	Comp(76) OMH(84) LPRI(97)
BIPM.RI-K21.Ba-140	activity	ongoing	Nov 96		radionuclide Ba-140	SIR	BIPM	G. Ratel	LPRI(96)
BIPM.RI-K21.Ce-141	activity	ongoing	May 79		radionuclide Ce-141	SIR	BIPM	G. Ratel	AAEC(79)
BIPM.RI-K21.Ce-144	activity	ongoing	Jun 78		radionuclide Ce-144	SIR	BIPM	G. Ratel	UVVVR(78) OMH(90)
BIPM.RI-K21.Eu-152	activity	ongoing	Oct 81		radionuclide Eu-152	SIR	BIPM	G. Ratel	NBS(82) IRA(93) VNIIM(98)
BIPM.RI-K21.Gd-153	activity	ongoing	Jun 88		radionuclide Gd-153	SIR	BIPM	G. Ratel	NIRH(88)
BIPM.RI-K21.Sm-153	activity	ongoing	Jun 98		radionuclide Sm-153	SIR	BIPM	G. Ratel	NIST(98)
BIPM.RI-K21.Eu-154	activity	ongoing	Nov 80		radionuclide Eu-154	SIR	BIPM	G. Ratel	NBS(80)
BIPM.RI-K21.Eu-155	activity	ongoing	Jun 93		radionuclide Eu-155	SIR	BIPM	G. Ratel	NPL(93)

## IONIZING RADIATION, BIPM key comparisons (April 1999) Cont. 4/4

Comparison	Description	Status	Start date	End date	Parameters	Measuring system	Pilot	Contact	Participants
BIPM.RI-K21.Ho-166m	activity	ongoing	Nov 89		radionuclide Ho-166m	SIR	BIPM	G. Ratel	LMRI(89)
BIPM.RI-K21.Yb-169	activity	ongoing	Mar 78		radionuclide Yb-169	SIR	BIPM	G. Ratel	NBS(80) PTB(82) LPRI(98) IRA(98)
BIPM.RI-K21.Ta-182	activity	ongoing	Apr 79		radionuclide Ta-182	SIR	BIPM	G. Ratel	PTB(79)
BIPM.RI-K21.Ir-192	activity	ongoing	Jan 79		radionuclide Ir-192	SIR	BIPM	G. Ratel	UVVVR(79) LMRI(81) BCMN(90) PTB(92) Comp.(96) ETL(97) OMH(84) NPL(90) IRA(95) RC(96)
BIPM.RI-K21.Au-195	activity	ongoing	Feb 86		radionuclide Au-195	SIR	BIPM	G. Ratel	NBS(80)
BIPM.RI-K21.Tl-201	activity	ongoing	Jul 79		radionuclide Tl-201	SIR	BIPM	G. Ratel	PTB(81) NIRH(82) ANSTO(94) OMH(97)
BIPM.RI-K21.Hg-203	activity	ongoing	Nov 76		radionuclide Hg-203	SIR	BIPM	G. Ratel	NPL(77) OMH(82) NIRH(85) PTB(99)
BIPM.RI-K21.Pb-203	activity	ongoing	Nov 78		radionuclide Pb-203	SIR	BIPM	G. Ratel	NBS(78)
BIPM.RI-K21.Bi-207	activity	ongoing	Jun 82		radionuclide Bi-207	SIR	BIPM	G. Ratel	PTB(82) VNIIIM(91)
BIPM.RI-K21.Th-228	activity	ongoing	Jul 86		radionuclide Th-228	SIR	BIPM	G. Ratel	NBS(86)
BIPM.RI-K21.Am-241	activity	ongoing	Mar 77		radionuclide Am-241	SIR	BIPM	G. Ratel	AAEC(77) PTB(78) NPL(80) PSPKR(89)
BIPM.RI-K21.Am-243	activity	ongoing	Dec 93		radionuclide Am-243	SIR	BIPM	G. Ratel	NPL(93)

Note

**BIPM.RI-K21.n**

SIR: Système international de référence of the BIPM  
 Comp(*nm*): global comparison carried out in year 19*nm*

## LENGTH, CCL key comparisons (April 1999)

Comparison	Description	Status	Start date	End date	Range	Transfer instruments	Pilot	Contact	Participants
CCL-K1	gauge blocks	ongoing	Mar 98	Sep 99			OFMET	R. Thalmann	BNM-LNE CENAM CMI CSIR IMGC KRISS NIST NIM NMI-VSL CSIRO-NML NPL NRC NRLM OFMET PTB SMU VNIIM
CCL-K2	long gauge blocks	planned	Oct 99	Oct 01			NPL	K. Berry	BNM-LNE CENAM IMGC KRISS NIST NIM NMI-VSL NML NPL NRC NRLM OFMET PTB SMU VNIIM
CCL-K3	optical polygons	ongoing	Jul 98	Dec 99			CSIR	O. Kruger	BNM-LNE CENAM CMI CSIR IMGC KRISS NIST NIM NMI-VSL CSIRO-NML NPL NRC NRLM OFMET PTB SMU VNIIM
CCL-K4	cylindrical diameter standards	ongoing	Sep 98	Sep 00			NIST	J. Spoua	BNM-LNE CENAM CSIR IMGC NIST NIM NMI-VSL CSIRO-NML NPL NRC NRLM OFMET PTB VNIIM
CCL-K5	CMM step gauge and ball bar	ongoing	Mar 98	Mar 00			PTB	O. Jusko	BNM-LNE CENAM CMI IMGC KRISS NIST NIM CSIRO-NML NPL NRC NRLM OFMET PTB VNIIM
CCL-K6	CMM 2D ball plate	planned	Jan 00	Jan 02			CENAM	M. Viliesid	BNM-LNE CENAM CMI CSIR IMGC KRISS NIST NIM CSIRO-NML NPL NRC OFMET PTB NRLM

## LENGTH, BIPM key comparisons (April 1999)

Comparison	Description	Status	Start date	End date	Range	Transfer instruments	Pilot	Contact	Participants
BIPM.L-K1	Comparison of the frequency of He-Ne lasers at $\lambda = 633$ nm	ongoing				portable iodine-stabilized laser	BIPM	J.-M. Chartier	BNM-INM CENAM CMI CSIR IMGC KRISS NIST NIM NMI-VSL CSIRO-NML NPL NRC NRLM OFMET PTB SMU VNIIM CEM DFM GUM HUT IGM IPQ JILA MSL OMH PSB SP UME BNM-INM NMS NILPRP NCM BEV

## MASS and RELATED QUANTITIES, CCM key comparisons (April 1999)

Comparison	Description	Status	Start date	End date	Range	Transfer instruments	Pilot	Contact	Participants			
CCM-K?m	mass comparisons	completed	May 95	May 98	1 kg	stainless steel standards	BIPM	R. Davis	NMi-VSL NRLM VNIIM NIM	NIST NRC PTB CENAM	NPL IMGC SMU	BNM-INM KRISS CSIRO-NML
CCM-K?m	mass comparisons	ongoing	May 98		10 kg; 500 g; 20 g; 2 g; 100 mg	stainless steel standards	PTB	M. Glaser	BNM-LNE KRISS NPL NMI-VSL	CENAM NIM NRLM	CSIRO-NML NIST OFMET	IMGC NRC SMU
CCM-K?p	effective area of a piston (phase A1)	completed	Jun 95	Oct 98	0.05 MPa to 1 Mpa gauge mode	piston-cylinder units	PTB	W. Sabuga	IMGC	BNM-LNE	NIST	NPL
CCM-K?p	pressure measurements (phase A2)	completed	Sep 95	Oct 98	0.05 MPa to 1 Mpa gauge mode	piston-cylinder units	BNM-LNE	J.C. Legras	IMGC	NIST	PTB	
CCM-K?p	pressure measurements (phase B)	ongoing	Dec 97		0.08 MPa to 7 Mpa gauge mode	piston-cylinder units	IMGC	G. Molinar	BNM-LNE	NIST	PTB	NRLM
CCM-K?p	pressure measurements	ongoing	Jun 98		10 kPa to 120 kPa	pressure balance	NPL	M. Perkin	BIPM PTB CSIRO-NML	NMI-VSL IMGC NRC	OFMET NIST	BNM-INM NIM VNIIM
CCM-K?p	pressure measurements	ongoing	May 98		1 Pa to 1 kPa		NIST	A. Müller	PTB KRISS	NPL CSIRO-NML	IMGC	NPL
CCM-K?p	differential pressure measurements (relative to 100 kPa)	ongoing	Sep 98		1 Pa to 10 kPa		NIST	A. Müller	NPL	IMGC	MSL	CSIRO-NML
CCM-K?p	absolute pressure measurements (ultra-high vacuum)	planned	Jan 98		0.001 mPa to 1 mPa		NIST	P. Looney	PTB KRISS	NPL	IMGC	NPL
CCM-K?f												

35

### Notes

CCM-K?p phases A1, A2 and B: see *Report of the 6th Meeting of the CCM*, 1996, G35-36

CCM-K?p effective area of a piston: NPL carried out only dimension measurements

CCM key comparisons about force measurements, to be defined at the CCM Meeting in May 1999

## PHOTOMETRY and RADIOMETRY, CCPR key comparisons (April 1999)

Comparison	Description	Status	Start date	End date	Range	Transfer instruments	Pilot	Contact	Participants
CCPR-K1a	spectral irradiance	planned	Jun 99	Jun 00	250 nm to 2500 nm	QTH lamps	NPL	N. Fox	
CCPR-K1b	spectral irradiance	planned			200 nm to 400 nm	deuterium lamps	PTB	J. Metzdorff	
CCPR-K2a	spectral responsivity	ongoing	Jan 99	May 00	900 nm to 1600 nm	InGaAs	NIST	S. Brown	NPL CSIR ETL NRC
CCPR-K2b	spectral responsivity	called for	Jan 00	Jan 01	300 nm to 1000 nm	Si traps and diodes	BIPM	R. Köhler	ETL OMH CSIRO-NML NPL
CCPR-K2c	spectral responsivity	planned	Jun 00	Jun 01	100 nm to 400 nm	PtSI	PTB		HUT IFAC BNM-INM SMU
CCPR-K3a	luminous intensity/ luminous responsivity	approved	Oct 97	Jun 98		lamps	PTB	G. Sauter	BIPM ETL NIM OFMET UME
CCPR-K3b	luminous intensity/ luminous responsivity	approved	Mar 97	Dec 98		photometers	BIPM	R. Köhler	BNM-INM MSL NPL PTB
CCPR-K4	luminous flux	approved	Oct 97	Jun 98		lamps	PTB	G. Sauter	BIPM ETL NIM OFMET UME
CCPR-K5	spectral diffuse reflectance	planned	Oct 99				NIST	E. Early	
CCPR-K6	spectral regular transmittance	called for					BNM-INM	J. Bastie	

L7

### Notes

CCPR-K2a  
CCPR-K2c

status: ongoing, 1st round started  
transfer instruments to be confirmed

## PHOTOMETRY and RADIOMETRY, CCPR supplementary comparisons (April 1999)

Comparison	Description	Status	Start date	End date	Range	Transfer instruments	Pilot	Contact	Participants		
CCPR-S1	spectral radiance	called for					VNIIOFI	V. Sapritski			
CCPR-S2	aperture area	planned					NIST	J. Fowler			
CCPR-S3	cryogenic radiometers	report in progress draft A	Jul 96	Mar 99		traps	BIPM	R. Goebel	CSIRO-NML HUT SP MSL NIM PTB(2)	NIST DFM ETL KRISS NRC PTB(1)	NPL IEN IFA

### Notes

Participants PTB(1): PTB -Thermometry

PTB(2): PTB - Radiometry

CCPR-S3 NIM has received the traps but has not yet carried out measurements

## THERMOMETRY, CCT key comparisons (April 1999)

Comparison	Description	Status	Start date	End date	Range	Transfer instruments	Pilot	Contact	Participants			
CCT-K1	realizations of the ITS-90 from 0.65 K to 24.6 K	completed			0.65 K to 24.6 K	Rh-Fe resistance thermometers	NPL	R. Rusby	NIST NRLM	PTB	NMi-VSL NRC	
CCT-K2	realizations of the ITS-90 from 13.8 K to 273.16 K	ongoing			13.8 K to 273.16 K	capsule-type SPRTs	NRC	A. Steele	BNM-INM KRISS	NMi-VSL IMGC	PTB NIST	NPL VNIIFTRI
CCT-K3	realizations of the ITS-90 from 83.8 K to 933.5 K	ongoing			83.8 K to 933.5 K	long stem SPRTs	NIST	B. Mangum	IMGC PTB NPL KRISS	NRC VNIIM CSIRO-NML	NMi-VSL BNM-INM MSL	BIPM SMU NRLM
CCT-K4	comparisons of Al-Ag fixed points	ongoing				Al-Ag cells	PTB	H. Nubbemeyer	NIST IMGC BNM-INM	NPL CSIRO-NML NMI-VSL	KRISS NRLM VNIIM	NRC
CCT-K5	realizations of the ITS-90 between the silver point and 1700 °C	ongoing			1000 °C to 1700 °C	tungsten strip lamps	NMI-VSL	M. de Groot	CSIRO-NML NMC NRC NMI-VSL	KRISS NPL CENAM VNIIM	NIM PTB BNM-INM	NRLM NIST IMGC

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