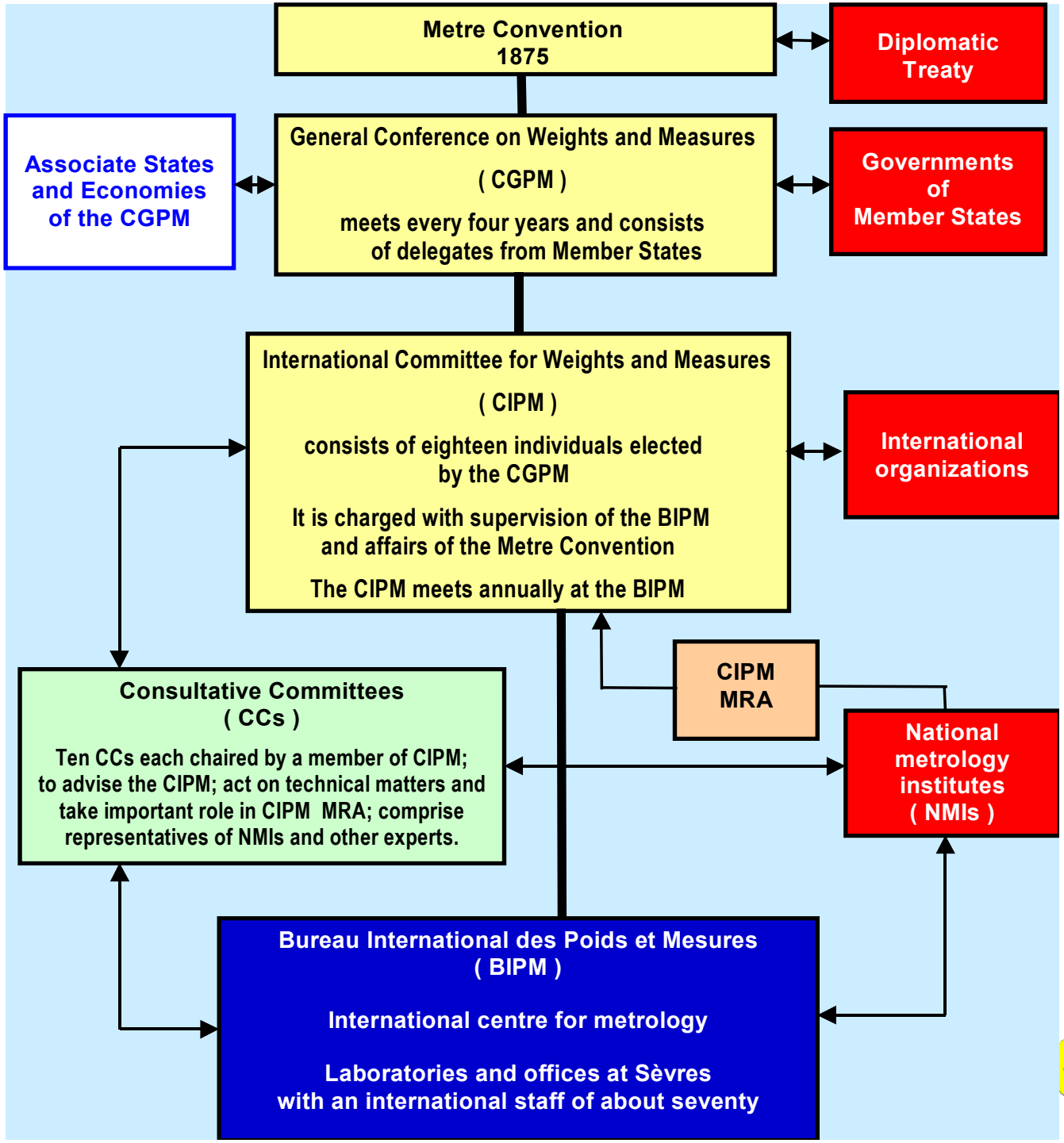
The BIPM and the Metre Convention

Bureau International des Poids et Mesures

The Pavillon de Breteuil

The Pavillon de Breteuil


Metre Convention
1875
Diplomatic Treaty
Associate States and Economies of the CGPM
General Conference on Weights and Measures
(CGPM)
meets every four years and consists of delegates from Member States
Governments of Member States
International Committee for Weights and Measures
(CIPM)
consists of eighteen individuals elected by the CGPM
It is charged with supervision of the BIPM and affairs of the Metre Convention
The CIPM meets annually at the BIPM
International organizations
CIPM MRA
Consultative Committees
(CCs)
Ten CCs each chaired by a member of CIPM; to advise the CIPM; act on technical matters and take important role in CIPM MRA; comprise representatives of NMIs and other experts.
National metrology institutes
(NMIs)
Bureau International des Poids et Mesures
(BIPM)
International centre for metrology
Laboratories and offices at Sèvres
with an international staff of about seventy
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Member states of the Metre Convention, June 2002

Argentina, Australia,Austria,Belgium, Brazil, Bulgaria, Cameroon, Canada, Chile, china, Czech republic, Denmark, Dominican Republic, Egypt, Finland, France, Germany, Greece, Hungary, India, Indonesia, Iran, Ireland, Israel, Italy, Japan, Korea (Dem. P. Rep), Korea (Rep), Malaysia, Mexico, Netherlands, New Zealand, Norway, Pakistan, Poland, Portugal, Romania, Russian Federation, Singapore, Slovakia, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, United Kingdom, United States, Uruguay, Venezuela, Yugoslavia.

Associates of the CGPM, June 2002

Chinese Taipei, Cuba, Ecuador, Hong Kong China, Latvia, Lithuania, Malta

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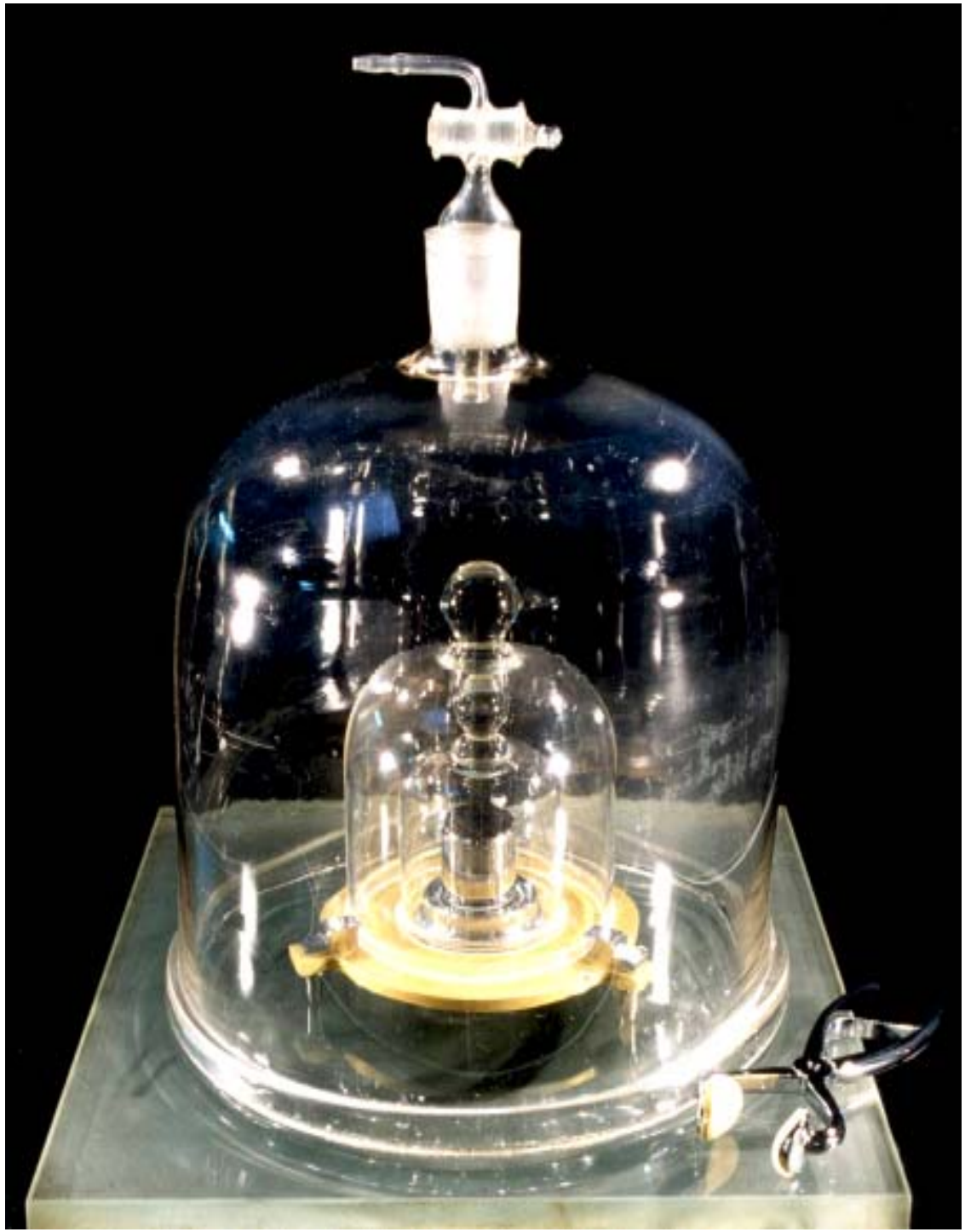
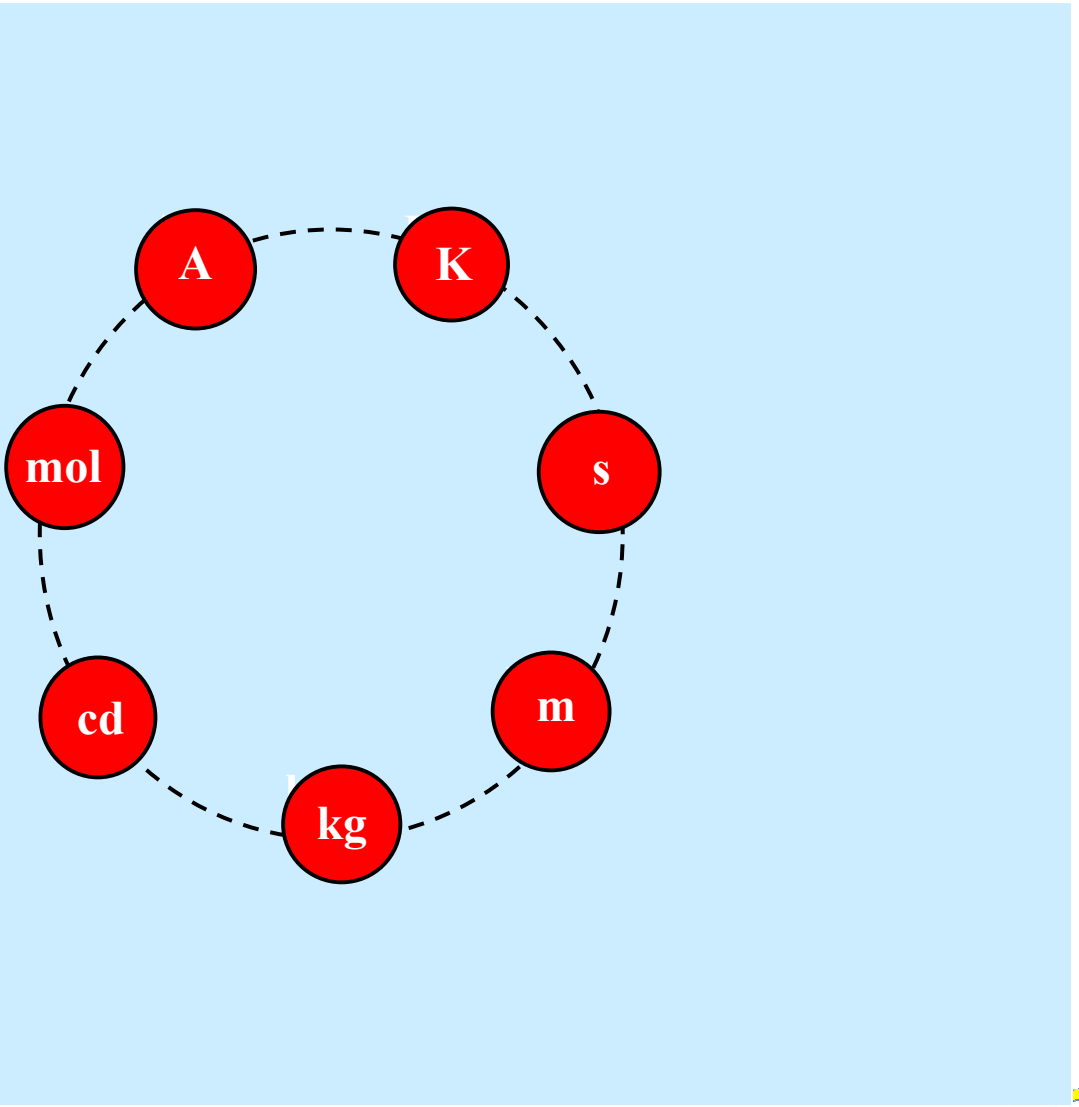
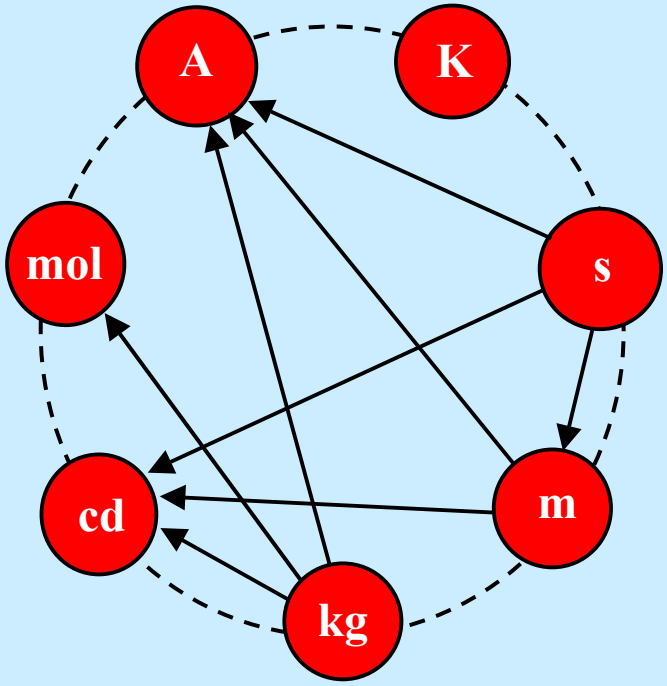
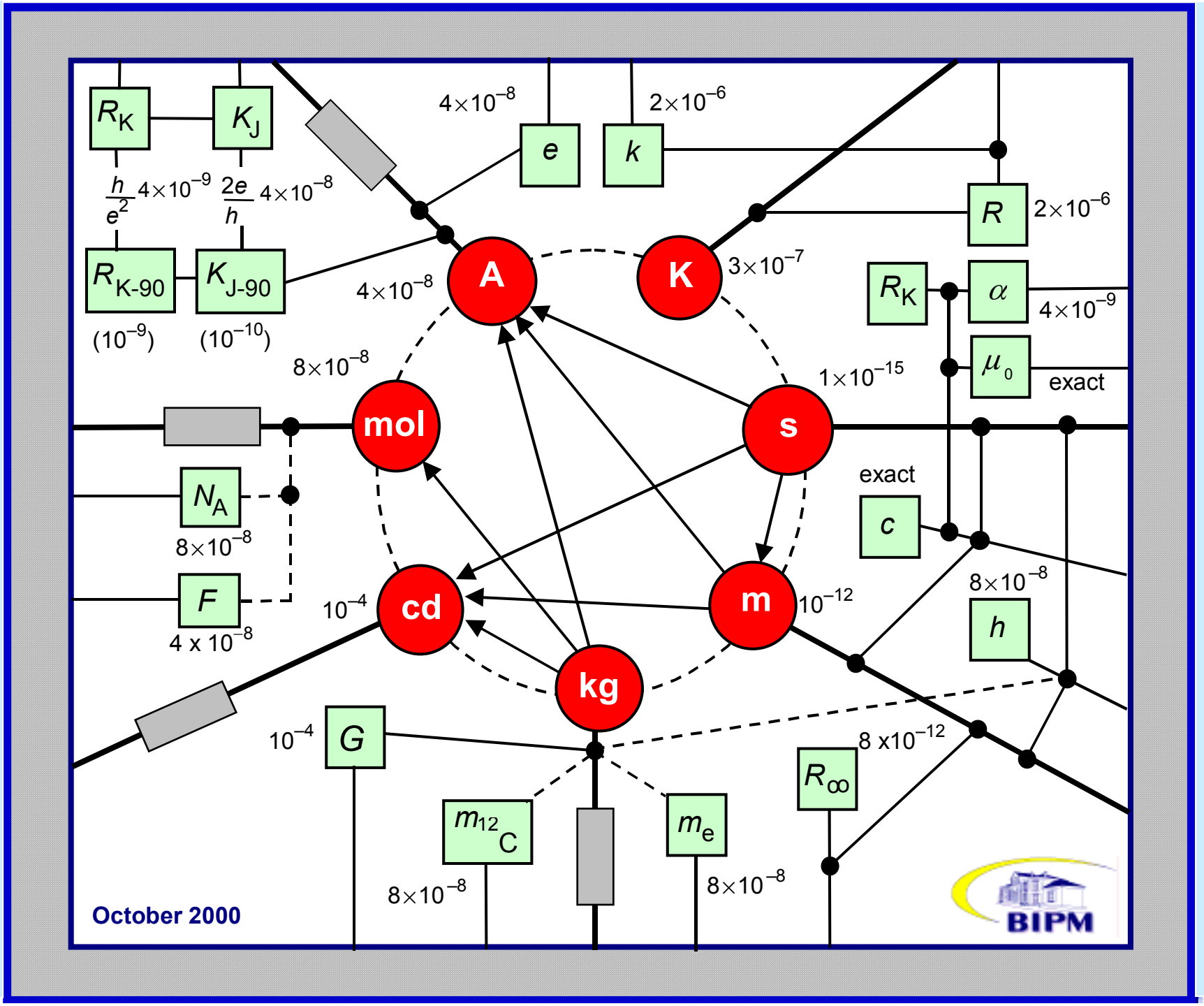



A
K
mol
s
cd
m
kg



The base units of the SI


R_K
K_J
$\frac{h}{e^2}$ 4×10^{-9}
$\frac{2e}{h}$ 4×10^{-8}
$R_{K\text{-}90}$
$K_{J\text{-}90}$
(10^{-9})
(10^{-10})
4×10^{-8}
e
2×10^{-6}
k
R
2×10^{-6}
A
K
3×10^{-7}
4×10^{-8}
R_K
α
4×10^{-9}
μ_0
exact
8×10^{-8}
1×10^{-15}
mol
s
N_A
8×10^{-8}
exact
c
F
4×10^{-8}
10^{-4}
cd
m
10^{-12}
8×10^{-8}
h
kg
10^{-4}
G
8×10^{-12}
R_∞
m_{12_C}
m_e
8×10^{-8}
8×10^{-8}
October 2000
BIPM

Metrology in Chemistry

•National Measurement Institutes (NMIs) have historically provided Chemical Standards (NIST, LGC, NPL, BAM, PTB, IRMM…..)

•**1971** SI unit of amount of substance, the mole, introduced as a base unit

•**1993** Comité Consultatif pour la Quantité de Matière (CCQM) created (BIPM provides Executive Secretary)

•**1999** Mutual Recognition Arrangement (MRA) signed

•**2000 +** Key comparison results and Calibration and Measurement Capabilities of NMIs available o the web: www.bipm.org

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CCQM

- Terms of reference
  - Advise on matters relating to the accuracy of quantitative chemical measurements and traceability to the SI
  - Raise awareness of the concept of measurement uncertainty
  - Co-ordinate activities of the NMIs in establishing traceability to the highest level

- Primary Methods
  - ‘A method having the highest metrological qualities, whose operation can be completely described and understood, and for which a complete uncertainty statement can be written down in terms of SI units’
- Key Comparisons and Pilot studies (Mutual Recognition Arrangement)

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CCQM Organizational Structure

CCQM
President: Dr R Kaarls (CIPM)
Executive Secretary: Dr R I Wielgosz (BIPM)

WG on Gas Analysis
Chairman: Dr E de Leer (NMi)

WG on Inorganic Analysis
Chairman: Dr M Sargent (LGC)

WG on Organic Analysis
Chairman: Dr W E May (NIST)

WG on Electrochemical Analysis
Chairman: Dr W Richter (PTB)

WG on Biotechnology
Chairpersons:
Dr G Gilliland (NIST)
Dr H Parkes (LGC)

***ad hoc* WG on Surface Analysis**
Chairman: Dr M Seah (NPL)

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METROLOGY IN CHEMISTRY

- International comparability of measurements
- Traceability to the SI - an efficient tool
- Infrastructure for realizing traceability to the SI in the field of Chemistry
- National Measurement Institutes and the BIPM
- ‘Measured once, accepted everywhere’ (MRA)

BIPM

Reconnaissance mutuelle

des étalons nationaux de mesure
et des certificats d'étalonnage et de mesurage
émis par les laboratoires nationaux de métrologie

Paris, le 14 octobre 1999

Mutual recognition

of national measurement standards
and of calibration and measurement certificates
issued by national metrology institutes

Paris, 14 October 1999

Comité international des poids et mesures

Bureau international des poids et mesures

Organisation intergouvernementale de la Convention du Mètre

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Objectives of the MRA are to:

establish the degree of equivalence of measurement standards maintained by NMIs;

provide for the mutual recognition of calibration and measurement certificates issued by NMIs; thereby to

provide governments and other parties with a secure technical foundation for wider agreements related to international trade, commerce and regulatory affairs

Mutual recognition of national measurement standards and of calibration and measurement certificates issued by national metrology institutes

Outcome

Statements of the measurement capabilities of each NMI in the BIPM key comparisons and calibration database publicly available on the web; included are:

the results of the key comparisons

(some 300 now underway)

lists of calibration and measurement capabilities of each participating NMI (some ten thousand lines of data now on the web)

www.bipm.org

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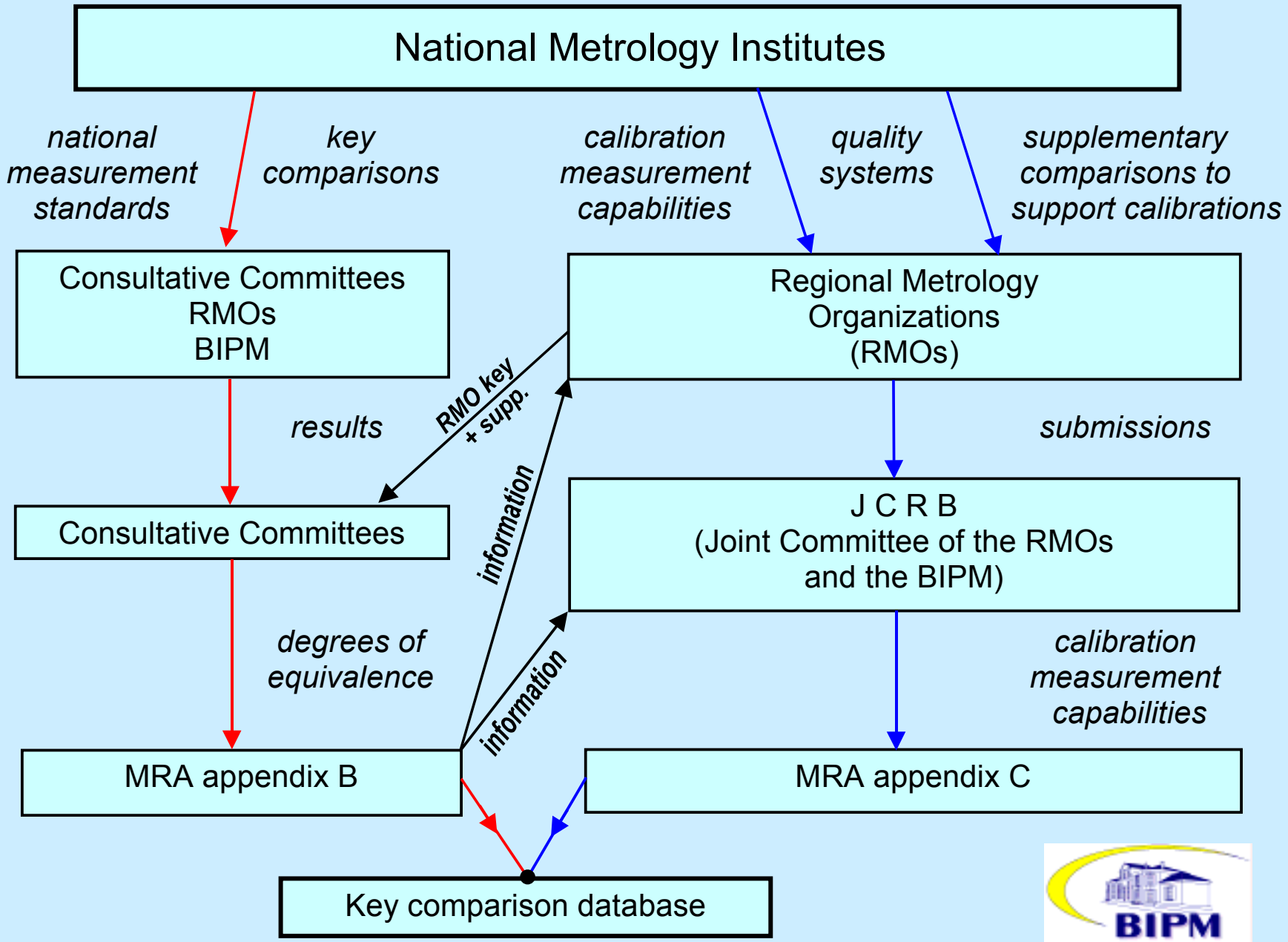
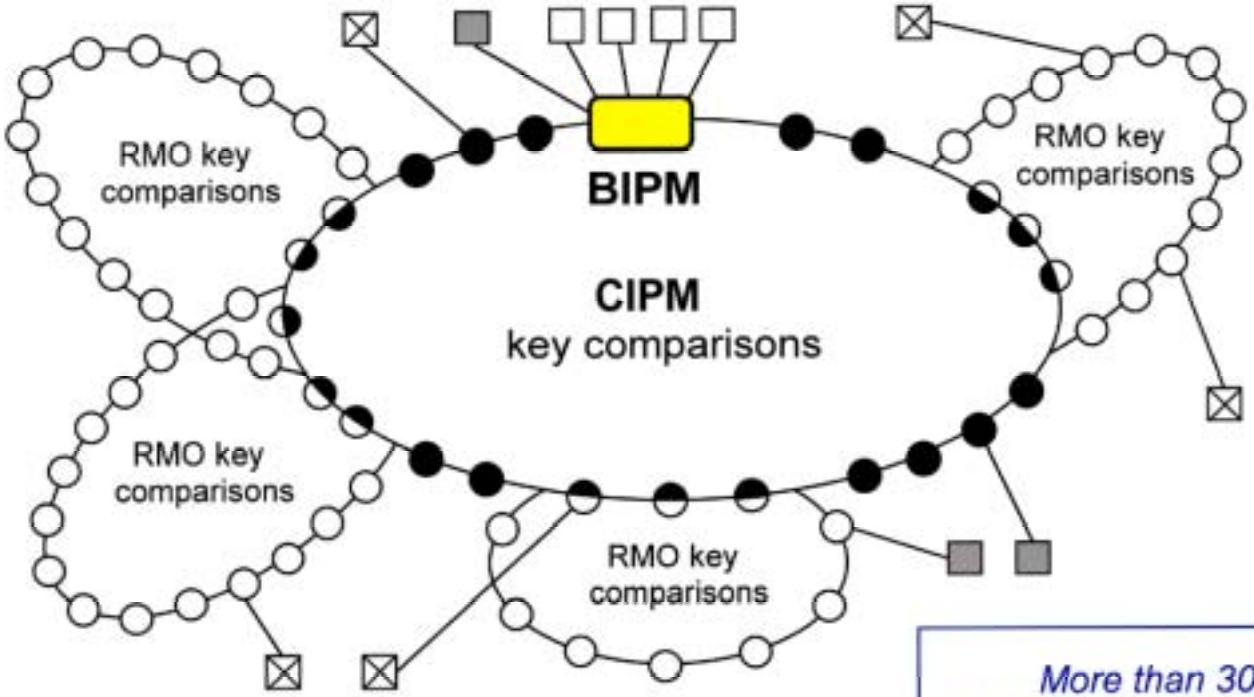
Mutual Recognition Arrangement



Scheme for key comparisons



More than 300 key comparisons are in progress

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- NMI participating in CIPM key comparisons.
- NMI participating in CIPM key comparisons and in RMO key comparisons.
- NMI participating in RMO key comparisons.
- NMI participating in ongoing BIPM key comparisons.
- NMI participating in a bilateral key comparison.
- International organization signatory to MRA.

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February 2001

Measurement Service Categories (Appendix C)

- 01: High Purity Chemicals
- 02: Inorganic Solutions
- 03: Organic solutions
- 04: Gases
- 05: Water
- 06: pH
- 07: Electrolytic Conductivity
- 08: Metals and Metal Alloys
- 09: Advanced Materials
- 10: Biological Fluids and Materials
- 11: Food
- 12: Fuels
- 13: Sediments, Soils, Ores and Particulates
- 14: Other Materials

CCQM Working Group on Gas Analysis

Reference Number	Description	Pilot Laboratory	Start date
CCQM-K1a	CO in N_2	NMi	1998
CCQM-K1b	CO_2 in N_2	NMi	1998
CCQM-K1c	NO in N_2	NMi	1998
CCQM-K1d	SO_2 in N_2	NMi	1998
CCQM-K1e,f,g	Natural gases (Types 1,2,3)	NMi	1998
CCQM-K3	CO, CO_2, propane in N_2	NMi	1998
CCQM-K4	Ethanol in air	NPL	1999
CCQM-K7	Benzene/toluene/xylene (BTX) in N_2/Air	NIST	1999
CCQM-K10	BTX in Air (low conc 10-30 ppb)	NIST/NPL	2001
CCQM-K14	CO_2, CH_4 - ambient levels	NMi	2002
CCQM-K15	SF_6, CFCs - emission levels	NIST/NPL	2002
CCQM-K16	Natural Gas (Types 4,5))	BAM/NMi	2001
CCQM-K22	VOCs in Air	NMIJ	2002
CCQM-K23	Natural Gas (Repeat)	NMi	2003
CCQM-P23	CO in Nitrogen (50000,1000, 10 ppm) Gravimetry	NMi	2000
CCQM-P24	Dynamic Mixing Methods	LNE	2001
CCQM-P28	Ozone - ambient levels	NIST/NPL	2002
CCQM-P?	NO2 in Air (10 ppm)	NIST	2003
EURO-QM-K1	(Euromet)	NMi	
EURO-QM-K3	(Euromet 485)	NMi	2000
EURO-QM-K4	(Euromet 580)	NPL	2000
APMP-QM-K3	(APMP Comp.)	KRISS	2000
APMP-QM-K4	(APMP Comparison)	NMIJ	2000

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Gas Analysis Key Comparison

Key comparison CCQM-K1.b

MEASURAND : Amount-of-substance fraction of Carbon dioxide (CO_2) in Nitrogen (N_2)
NOMINAL VALUE : 150 mmol/mol

x_i: result of measurement carried out by laboratory *i*
u_i: combined standard uncertainty of x_i
$x_{i\,grav}$: gravimetric value of the CO_2 amount-of-substance fraction in the cylinder received by laboratory *i*
$u_{i\,grav}$: combined standard uncertainty of $x_{i\,grav}$

Lab *i*	x_i mmol/mol	u_i mmol/mol	$x_{i\,grav}$ mmol/mol	$u_{i\,grav}$ mmol/mol	Date of measurement
NPL	150.30	0.15	150.110	0.005	93-10
NIST	149.95	0.19	149.950	0.004	93-11
NMi	149.70	0.15	149.530	0.004	93-06
BAM	149.90	0.22	149.950	0.004	94-01
BNM-LNE	150.30	0.30	150.170	0.005	93-09
KRISS	150.03	0.19	149.980	0.004	93-08
NRLM	150.00	0.38	150.030	0.005	93-10
NRCCRM	150.20	0.25	150.080	0.005	93-07
VNIIM	149.60	0.25	150.130	0.005	93-09
OMH	150.15	0.05	150.080	0.005	94-03

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Gas Analysis Key Comparison

Key comparison CCQM-K1.b

MEASURAND : Amount-of-substance fraction of Carbon dioxide (CO_2) in Nitrogen (N_2)
NOMINAL VALUE: 150 mmol/mol

Key comparison reference value: there is no single reference value for this comparison, the value $x_{i\,grav}$ is taken as the reference value for laboratory *i*.

The degree of equivalence of each laboratory with respect to the reference value is given by a pair of numbers:
$D_i = (x_i - x_{i\,grav})$ and U_i, its expanded uncertainty ($k = 2$), both expressed in mmol/mol
$$U_i^2 = 2^2(u_i^2 + u_{i\,grav}^2)$$

The degree of equivalence between two laboratories is given by a pair of numbers:
$D_{ij} = D_i - D_j = (x_i - x_{i\,grav}) - (x_j - x_{j\,grav})$ and U_{ij}, its expanded uncertainty ($k = 2$), both expressed in mmol/mol
$$U_{ij}^2 = 2^2(u_i^2 + u_j^2 + u_{i\,grav}^2 + u_{j\,grav}^2)$$
The approximation $U_{ij}^2 \sim 2^2(u_i^2 + u_j^2)$ is used in the Matrix of equivalence.

Gas Analysis Key Comparison

Lab *j* ⟹

Lab *i* ⇩	D_i mmol/mol	U_i mmol/mol	NPL D_{ij} mmol/mol	NPL U_{ij} mmol/mol	NIST D_{ij} mmol/mol	NIST U_{ij} mmol/mol	NMi D_{ij} mmol/mol	NMi U_{ij} mmol/mol	BAM D_{ij} mmol/mol	BAM U_{ij} mmol/mol	BNM-LNE D_{ij} mmol/mol	BNM-LNE U_{ij} mmol/mol	KRISS D_{ij} mmol/mol	KRISS U_{ij} mmol/mol	NRLM D_{ij} mmol/mol	NRLM U_{ij} mmol/mol	NRCCRM D_{ij} mmol/mol	NRCCRM U_{ij} mmol/mol	VNIIM D_{ij} mmol/mol	VNIIM U_{ij} mmol/mol	OMH D_{ij} mmol/mol	OMH U_{ij} mmol/mol
NPL	**0.19**	0.30			**0.19**	0.48	**0.02**	0.42	**0.24**	0.54	**0.06**	0.67	**0.14**	0.48	**0.22**	0.81	**0.07**	0.58	**0.72**	0.58	**0.12**	0.32
NIST	**0.00**	0.37	**-0.19**	0.48			**-0.17**	0.48	**0.05**	0.59	**-0.13**	0.71	**-0.05**	0.53	**0.03**	0.84	**-0.12**	0.62	**0.53**	0.62	**-0.07**	0.39
NMi	**0.17**	0.30	**-0.02**	0.42	**0.17**	0.48			**0.22**	0.54	**0.04**	0.67	**0.12**	0.48	**0.20**	0.81	**0.05**	0.58	**0.70**	0.58	**0.10**	0.31
BAM	**-0.05**	0.45	**-0.24**	0.54	**-0.05**	0.59	**-0.22**	0.54			**-0.18**	0.75	**-0.10**	0.59	**-0.02**	0.87	**-0.17**	0.67	**0.48**	0.67	**-0.12**	0.46
BNM-LNE	**0.13**	0.60	**-0.06**	0.67	**0.13**	0.71	**-0.04**	0.67	**0.18**	0.75			**0.08**	0.71	**0.16**	0.96	**0.01**	0.78	**0.66**	0.78	**0.06**	0.61
KRISS	**0.05**	0.38	**-0.14**	0.48	**0.05**	0.53	**-0.12**	0.48	**0.10**	0.59	**-0.08**	0.71			**0.08**	0.84	**-0.07**	0.62	**0.58**	0.62	**-0.02**	0.39
NRLM	**-0.03**	0.75	**-0.22**	0.81	**-0.03**	0.84	**-0.20**	0.81	**0.02**	0.87	**-0.16**	0.96	**-0.08**	0.84			**-0.15**	0.90	**0.50**	0.90	**-0.10**	0.76
NRCCRM	**0.12**	0.50	**-0.07**	0.58	**0.12**	0.62	**-0.05**	0.58	**0.17**	0.67	**-0.01**	0.78	**0.07**	0.62	**0.15**	0.90			**0.65**	0.70	**0.05**	0.50
VNIIM	**-0.53**	0.49	**-0.72**	0.58	**-0.53**	0.62	**-0.70**	0.58	**-0.48**	0.67	**-0.66**	0.78	**-0.58**	0.62	**-0.50**	0.90	**-0.65**	0.70			**-0.60**	0.50
OMH	**0.07**	0.10	**-0.12**	0.32	**0.07**	0.39	**-0.10**	0.31	**0.12**	0.46	**-0.06**	0.61	**0.02**	0.39	**0.10**	0.76	**-0.05**	0.50	**0.60**	0.50		

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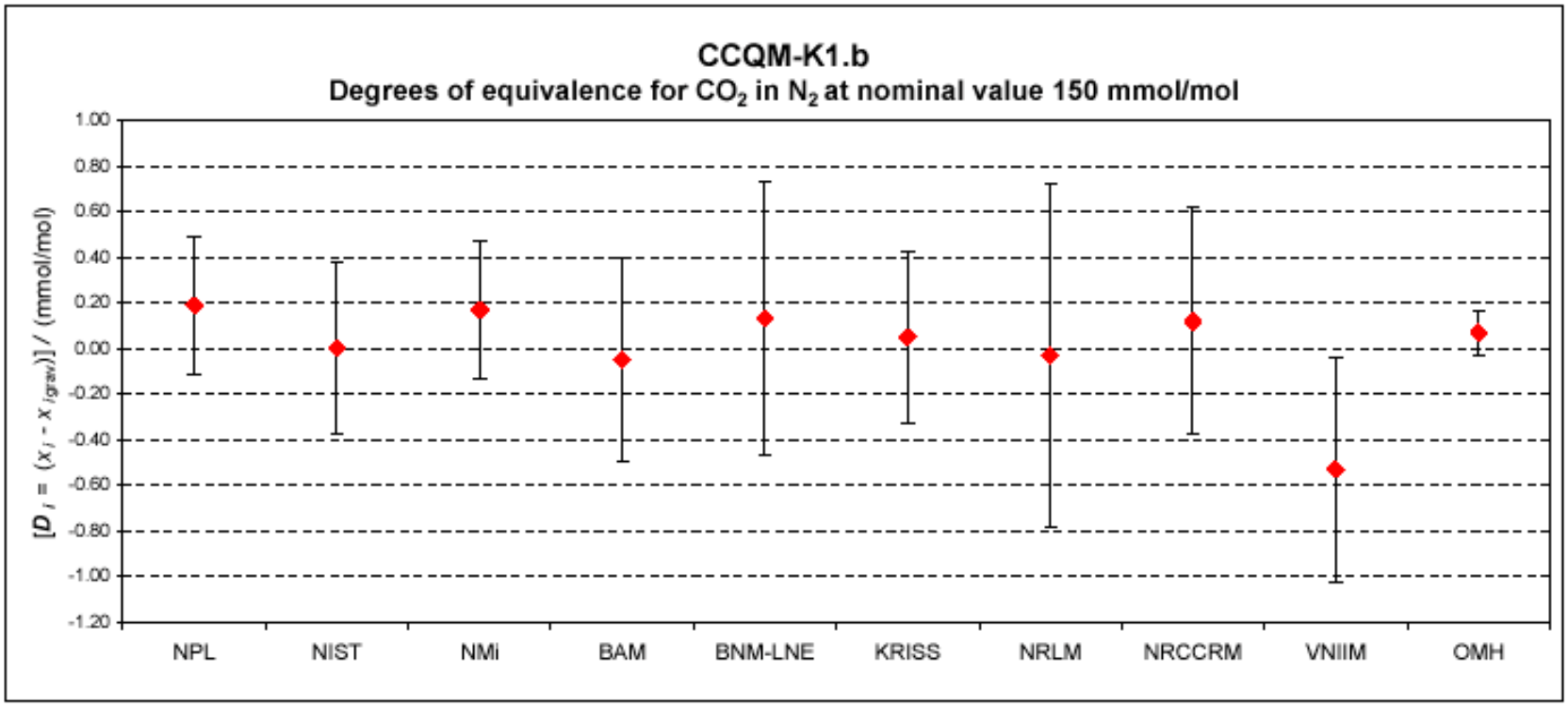
Gas Analysis Key Comparison

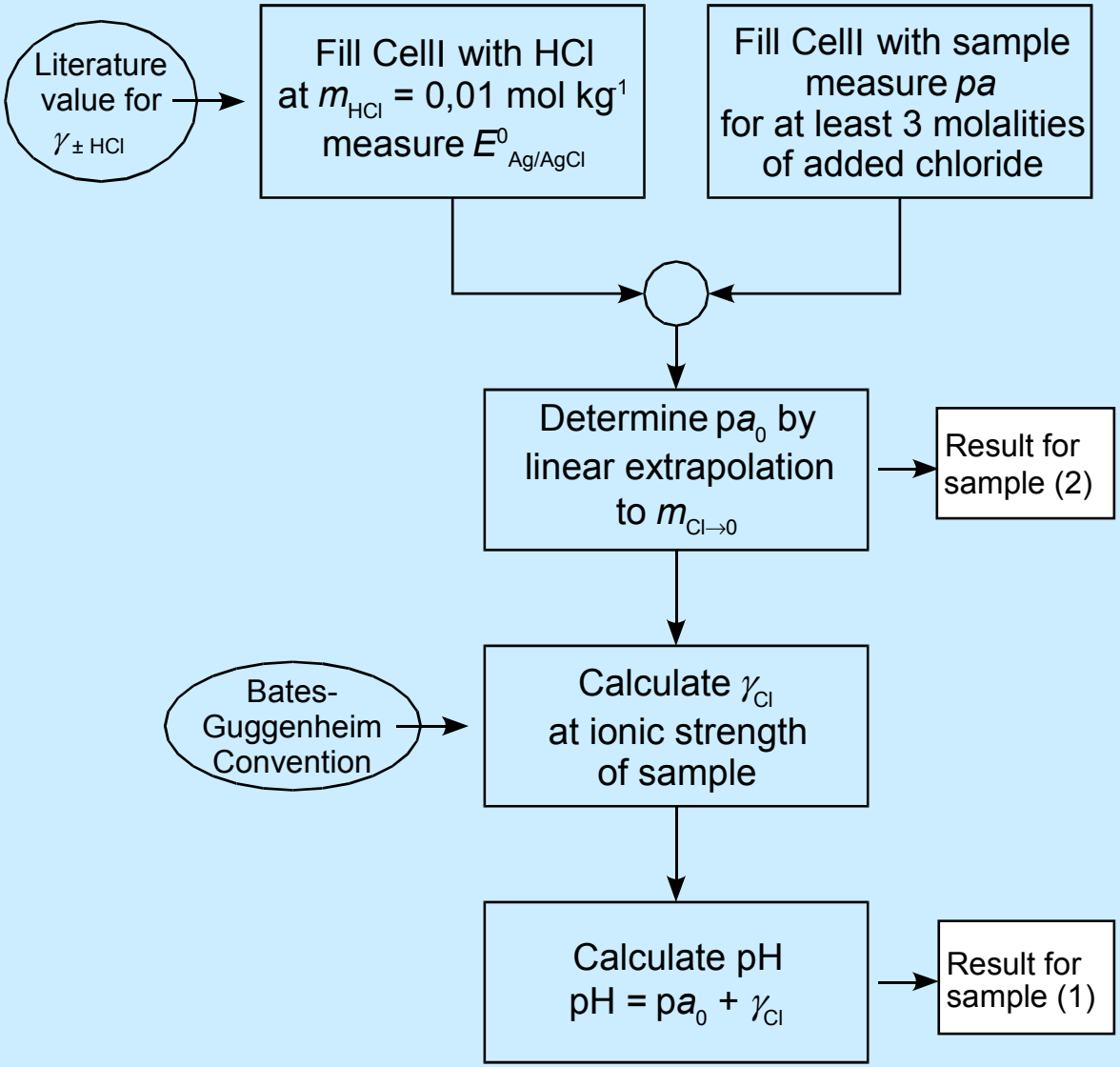


CCQM Working Group on Electrochemical Analysis

Reference Number	Description	Pilot Laboratory	Start date
CCQM-K9	pH 7.0 (Phosphate)	PTB	1999
CCQM-K17	pH 4.1 (Phthalate)	PTB	2001
CCQM-K18	pH 10.1(Carbonate)	SMU	2002
CCQM-K19	pH 9.2 (Borate)	?	
CCQM-K20	pH 1.7 (Tetroxalate)	?	
CCQM-P22	Electrolytic Conductivity	DFM	2001
CCQM-P36	Assay of Potassium hydrogen phthalate (KHP)	SMU/NIST	2002
CCQM-P37	Fundamental Studies of pH Stnds	SMU	2001

CCQM-K9

Pt | H_2 | buffer, Cl^- | AgCl | Ag



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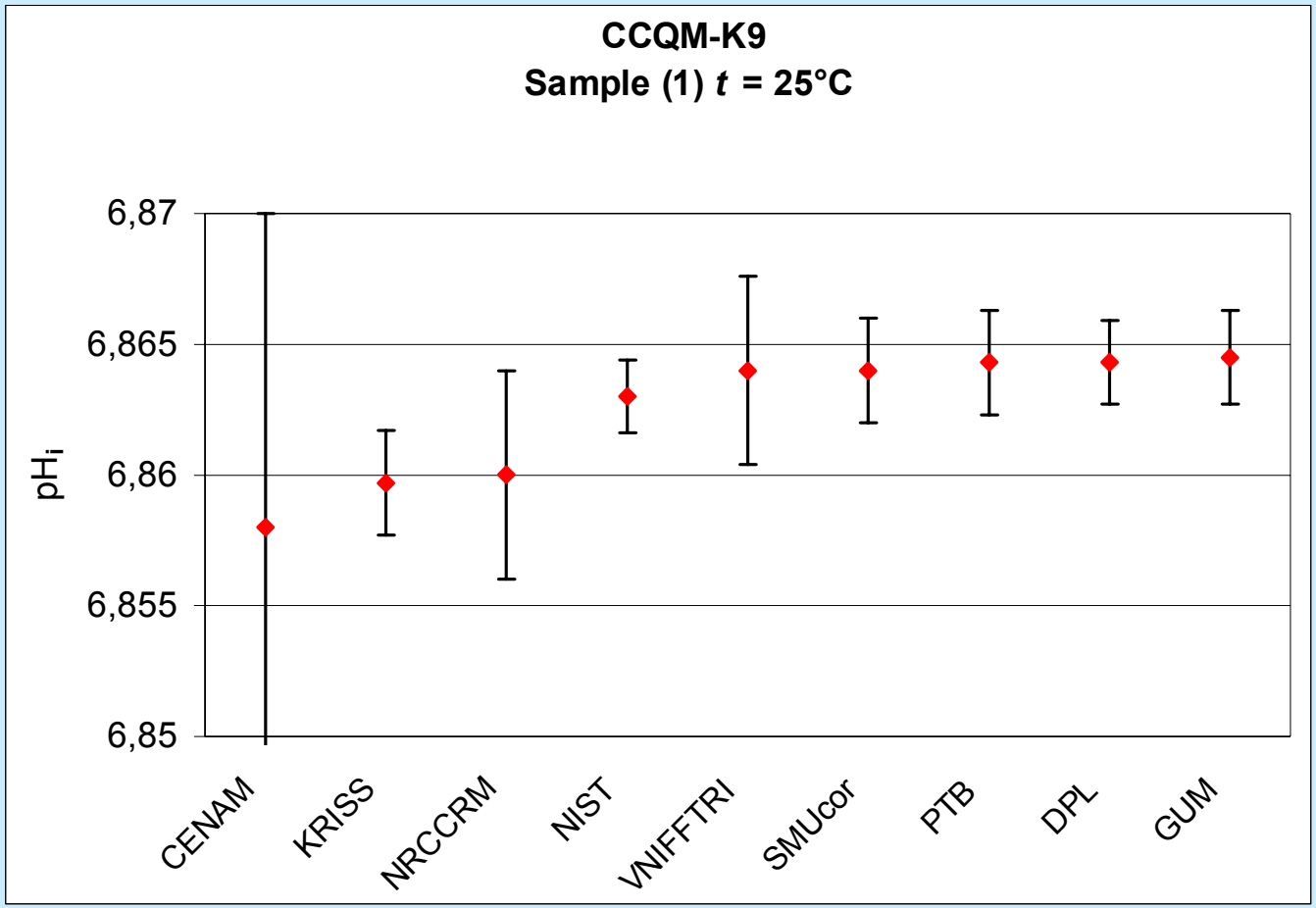
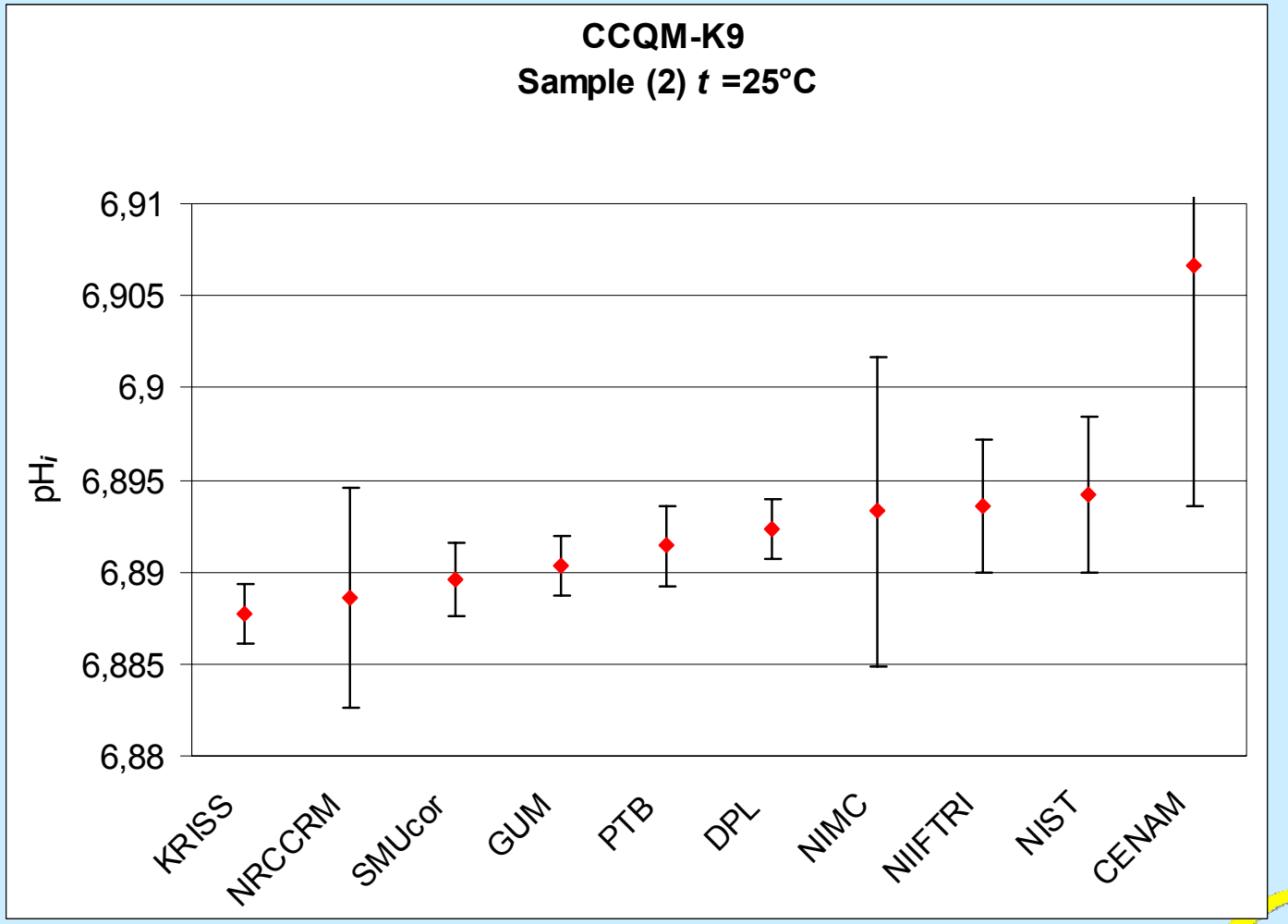
CCQM-K9

Sample 1: 0.025 mol·kg^{-1} KH_2PO_4 + 0.025 mol·kg^{-1} Na_2HPO_4



CCQM-K9

Sample (2): 0.02 mol·kg^{-1} KH_2PO_4 + 0.02 mol·kg^{-1} Na_2HPO_4



CCQM Working Group on Inorganic Analysis

Reference Number	Description	Pilot Laboratory	Start date
CCQM-K2	Cd and Pb in natural water	IRMM	1998
CCQM-K8	Elemental solution standards (Al,Cu,Fe,Mg)	EMPA/LNE	1999
CCQM-K13	Pb/Cd in Sediments	IRMM	2000
CCQM-K24	Cd in Rice	IRMM/NMIJ	2001
CCQM-K?	Cu, Pb in Wine	INTEC/IRMM	2002
CCQM-P1	Trace elements in water Pb	NIST	1997
CCQM-P7	KCl, NaCl, $K_2Cr_2O_7$	NIST	1998?
CCQM-P11	As in shellfish	NIST	2001
CCQM-P12	Pb in wine	IRMM	2000
CCQM-P12.1	Cu in Wine	IRMM	2001
CCQM-P13	Metals in synthetic food digest	LGC	2001
CCQM-P14	Trace elements (Pb, Se) in serum	NIST/LGC	1999
CCQM-P14	Ca in Serum	IRMM/SP	2001
CCQM-P15	Pb/Cd in Sediments	IRMM	1999
CCQM-P16	Elements in synthetic digest sol'ns	NMi	1999
CCQM-P25	Minor Elements in Steel	NMIJ/NIST	2001
CCQM-P26	Sulfur in Fuels	IRMM/NIST	2001
CCQM-P29	Cd, Zn in rice	IRMM/NMIJ	2001
CCQM-P30	Elemental Solution Standards (Al,Cu,Fe,Mg)	EMPA/LNE	1999
CCQM-P32	Anions in Calibration Solutions	EMPA	2001
CCQM-P33	Boron in Si	PTB	2002
CCQM-P34	Constituents in Al Alloy	BAM	2001
CCQM-P19	Hydrochloric acid	NIST	1999
CCQM-P19.1		NIST	2001

Inorganic Analysis WG, Pb and Cd measurements

- **CCQM-K2 Cadmium and lead content in natural water**

- **International Measurement Evaluation Programme**

IMEP-9 (181 participants - 22 labs 50% different from certified value)

- **Regulatory requirements of measurement quality ± 10%**

- **Complex matrix study**

  - **CCQM-P15**
  - **IMEP-14**
  - **CCQM-K13 - Cd and Pb amount content in sediment**

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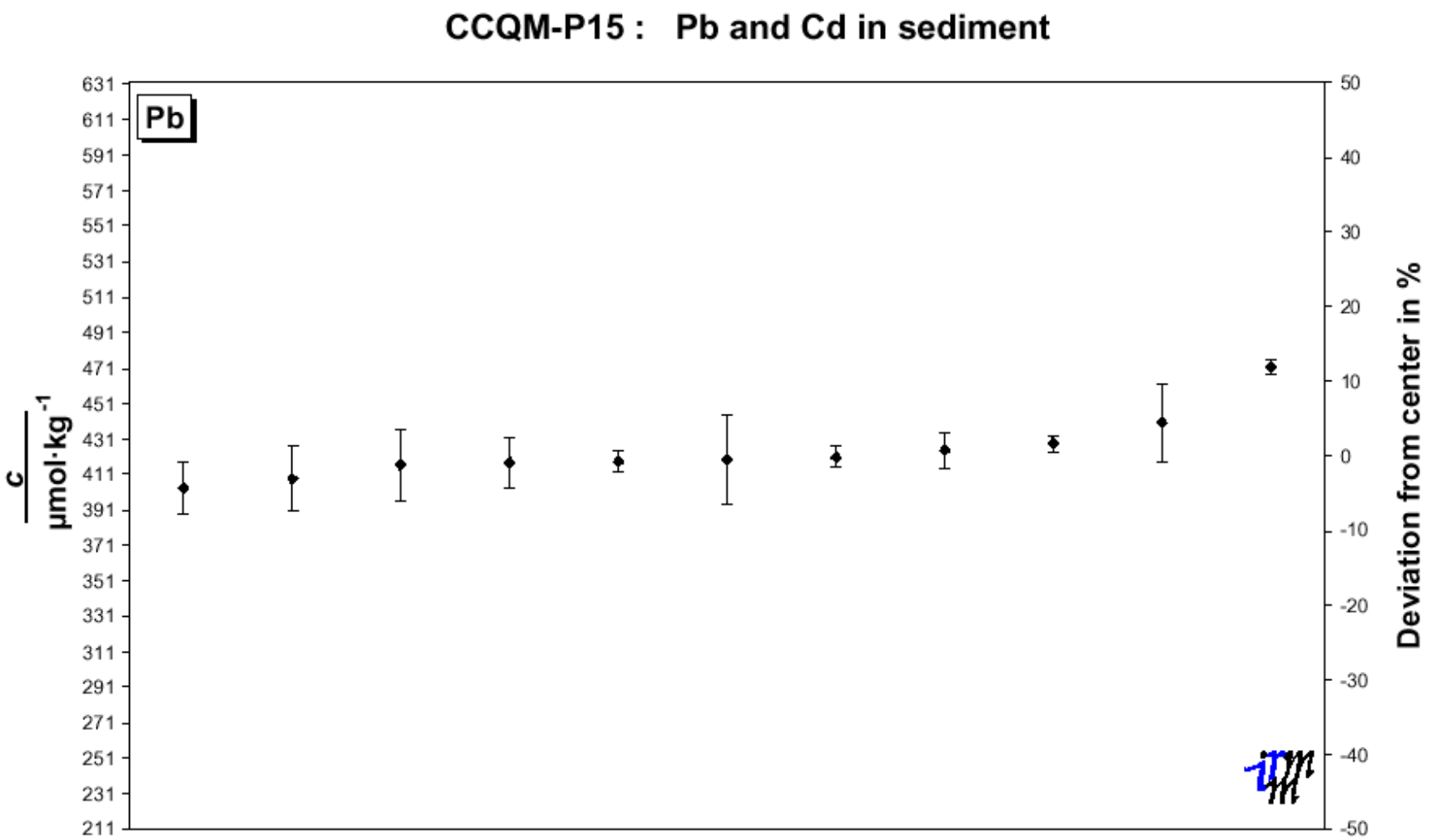
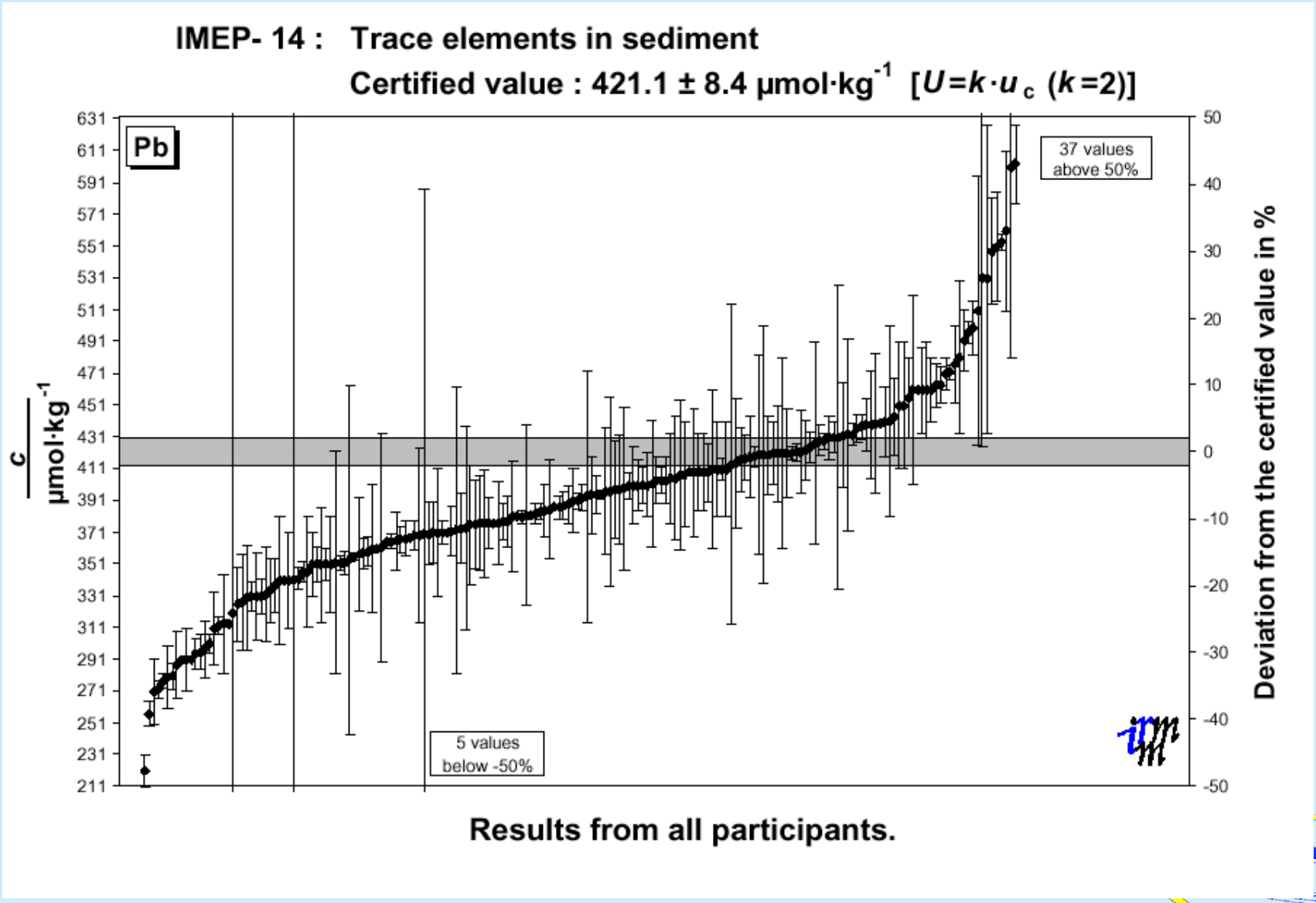
CCQM Pilot Study CCQM-P15, Pb and Cd in Sediment



CCQM Pilot Study CCQM-P15, Pb and Cd in Sediment



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CCQM Working Group on Organic Analysis

Reference Number	Description	Pilot Laboratory	Start date
CCQM-K5	p,p´-DDE in Fish oil	LGC	1999
CCQM-K6	Cholesterol in serum	NIST	1999
CCQM-K11	Glucose in serum	NIST	2001
CCQM-K12	Creatinine in serum	NIST	2001
CCQM-K21	p,p'-DDT in Fish Oil	LGC	2000
CCQM-K25	PCBs in sediments (PCBs 28,101,153,170)	NIST/NRC	2001
CCQM-K?	Cholesterol bilateral?	NIST	
CCQM-P2	p,p´-DDE in isooctane	LGC	1997
CCQM-P3	NMR study	BAM	1998
CCQM-P3.2	NMR study	BAM	1999
CCQM-P4	p,p´-DDE in corn oil	LGC	1998
CCQM-P5	Acetanilide, benzoic acid	NIST	1998
CCQM-P6	Cholesterol in serum	NIST	1998
CCQM-P8	Glucose in serum	NIST	1999
CCQM-P9	Creatinine in serum	NIST	1999
CCQM-P10	Gamma-HCH in Fish Oil	LGC	1999
CCQM-P10.2	Gamma-HCH in Fish Oil 74 ng/g, 240 ng/g	LGC	2000
CCQM-P17	PCBs in sediments	NRC/NIST	2000
CCQM-P18	TriButylTin in sediment	LGC/NRC	2001
CCQM-P20	Purity of Compounds (glucose,DDE,xylene,TBT)	NIST/NARL	1999
CCQM-P21	p,p'-DDT in Fish Oil	LGC	1999
CCQM-P27	LSD in Urine	LGC	2000
CCQM-P31	Organic Calibration Solutions (PCBs,PAHs,Pesticides)	NIST	2002?
CCQM-P35	Ethanol in aqueous matrix (for. & commod. levels)	BAM/LGC	

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Organic Analysis WG - Health status markers

- Traceability of measurements used to assess health status
- EU Directive on In-vitro Diagnostic (IVD) devices
- IVD devices must be traceable to higher order standards
- Internationally recognized reference system for health status markers

- Key comparisons:

- Cholesterol: ID-MS procedure
- Glucose, highly water soluble, associates strongly with proteins
- Creatinine, much lower levels than cholesterol, requires separation from creatine

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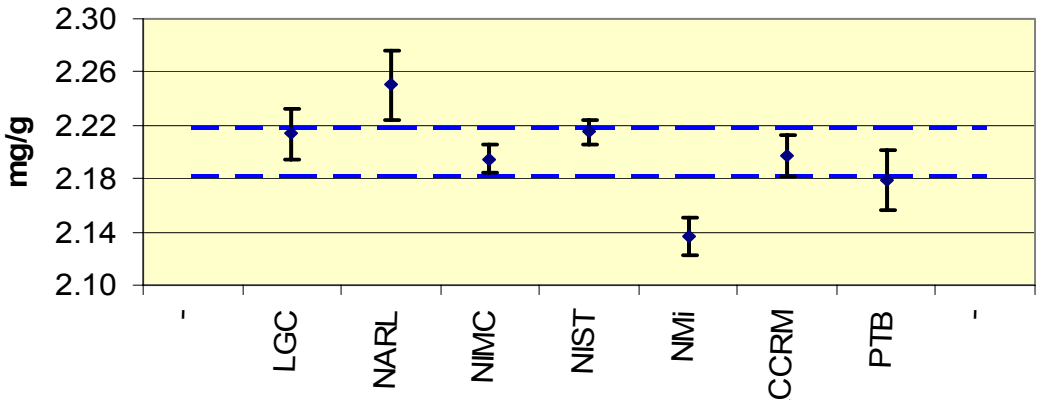
CCQM-K6 Cholesterol in Human Serum

- Results reported CCQM Meeting 2000 April 6-7
- Samples sent to participants: January 2000
- Participants: LGC, NARL, NIMC, NIST, NMi, NRCCRM, PTB (All NMIs receiving samples reported results.)
- Correlation between cholesterol concentration and cardiovascular disease
- Cholesterol Mass Fraction 1.5 to 2.5 mg/g (physiological range)
- Study contained two samples (each laboratory received three discrete aliquots of each for analysis); CVs for both samples ~1%
- KCRV and associated uncertainty: Recommend that the KCRV be assigned as the mean $\pm$ U of the eligible results (excluding the one statistical outlier for Material A).
- Material A: KCRV of 2.200 $\pm$ 0.019 mg/g corresponding to a 95% confidence interval of 2.181 to 2.219 mg/g.
- Material B: KCRV of 1.726 $\pm$ 0.015 mg/g, corresponding to a 95% confidence interval of 1.711 to 1.741 mg/g.)

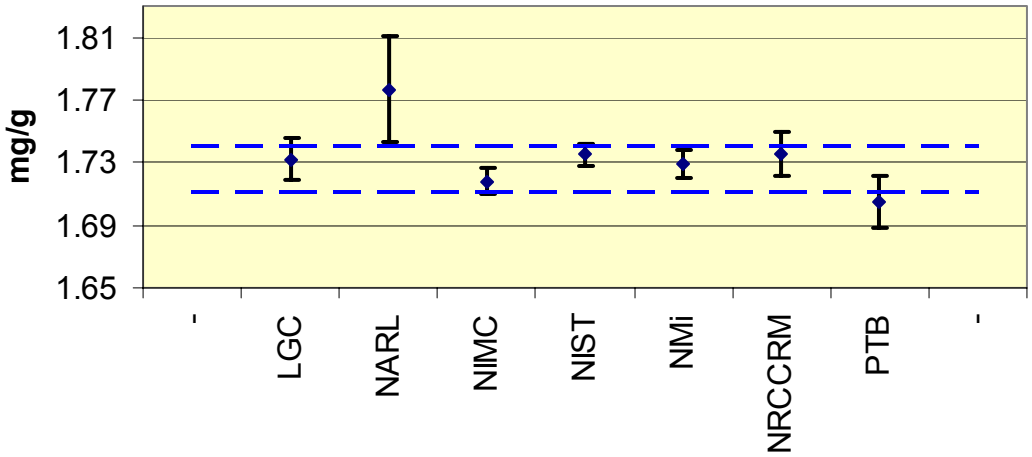
BIPM

CCQM-K6 Cholesterol in Human Serum



CCQM-K6 Cholesterol in Serum: Material A

Material A: KCRV - the mean ± U of the eligible results*, excluding the one statistical outlier.
KCRV of 2.200 ± 0.019 mg/g corresponding to a 95% confidence interval of 2.181 to 2.219 mg/g.



CCQM-K6 Cholesterol in Serum: Material B

Material B, KCRV - the mean ± U of all of the eligible results*. KCRV 1.726 ± 0.015 mg/g, corresponding to a 95% confidence interval of 1.711 to 1.741 mg/g.

*Exclusions from KCRV calculation: NARL results not eligible for KCRV calculation as NARL did not participate in Pilot Study

CCQM-K6 Cholesterol in Human Serum

Tables of Equivalence

Material A			KCRV		LGC		NARL		NIMC		NIST		NMi		NRCCRM		PTB	
	Mean	U	D_I	U_I	D_U	U_U	D_U	U_U	D_U	U_U	D_U	U_U	D_U	U_U	D_U	U_U	D_U	U_U
NMI	mg/g		mg/g		mg/g		mg/g		mg/g		mg/g		mg/g		mg/g		mg/g	
LGC	2.214	0.019	0.014	0.024			0.036	0.032	-0.019	0.021	0.001	0.021	-0.077	0.023	-0.017	0.025	-0.035	0.030
NARL	2.250	0.026	0.050	0.029	-0.036	0.032			-0.055	0.028	0.035	0.027	-0.113	0.029	-0.053	0.030	-0.071	0.034
NIMC	2.195	0.010	-0.005	0.019	0.019	0.021	0.055	0.028			0.020	0.013	-0.058	0.017	0.002	0.019	-0.016	0.025
NIST	2.215	0.009	0.015	0.019	-0.001	0.021	0.035	0.027	-0.020	0.013			-0.078	0.016	-0.018	0.018	-0.036	0.024
NMi	2.137	0.014	-0.063	0.021	0.077	0.023	0.113	0.029	0.058	0.017	0.078	0.016			0.060	0.021	0.042	0.027
NRCCRM	2.197	0.016	-0.003	0.022	0.017	0.025	0.053	0.030	-0.002	0.019	0.018	0.018	-0.060	0.021			-0.018	0.028
PTB	2.179	0.023	-0.021	0.027	0.035	0.030	0.071	0.034	0.016	0.025	0.036	0.024	-0.042	0.027	0.018	0.028		
KCRV	**2.200**	**0.019**																

Material B			KCRV		LGC		NARL		NIMC		NIST		NMi		NRCCRM		PTB	
	Mean	U	D_I	U_I	D_U	U_U	D_U	U_U	D_U	U_U	D_U	U_U	D_U	U_U	D_U	U_U	D_U	U_U
NMI	mg/g		mg/g		mg/g		mg/g		mg/g		mg/g		mg/g		mg/g		mg/g	
LGC	1.732	0.013	0.006	0.018			0.045	0.036	-0.014	0.015	0.003	0.015	-0.003	0.016	0.004	0.019	-0.027	0.021
NARL	1.777	0.034	0.051	0.036	-0.045	0.036			-0.059	0.035	-0.042	0.035	-0.048	0.035	-0.041	0.037	-0.072	0.038
NIMC	1.718	0.008	-0.008	0.016	0.014	0.015	0.059	0.035			0.017	0.010	0.011	0.012	0.018	0.016	-0.013	0.019
NIST	1.735	0.007	0.009	0.016	-0.003	0.015	0.042	0.035	-0.017	0.010			-0.006	0.011	0.001	0.016	-0.030	0.018
NMi	1.729	0.009	0.003	0.017	0.003	0.016	0.048	0.035	-0.011	0.012	0.006	0.011			0.007	0.017	-0.024	0.019
NRCCRM	1.736	0.014	0.010	0.019	-0.004	0.019	0.041	0.037	-0.018	0.016	-0.001	0.016	-0.007	0.017			-0.031	0.022
PTB	1.705	0.017	-0.021	0.021	0.027	0.021	0.072	0.038	0.013	0.019	0.030	0.018	0.024	0.019	0.031	0.022		
KCRV	**1.726**	**0.015**																

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CCQM-P8 Glucose in Serum

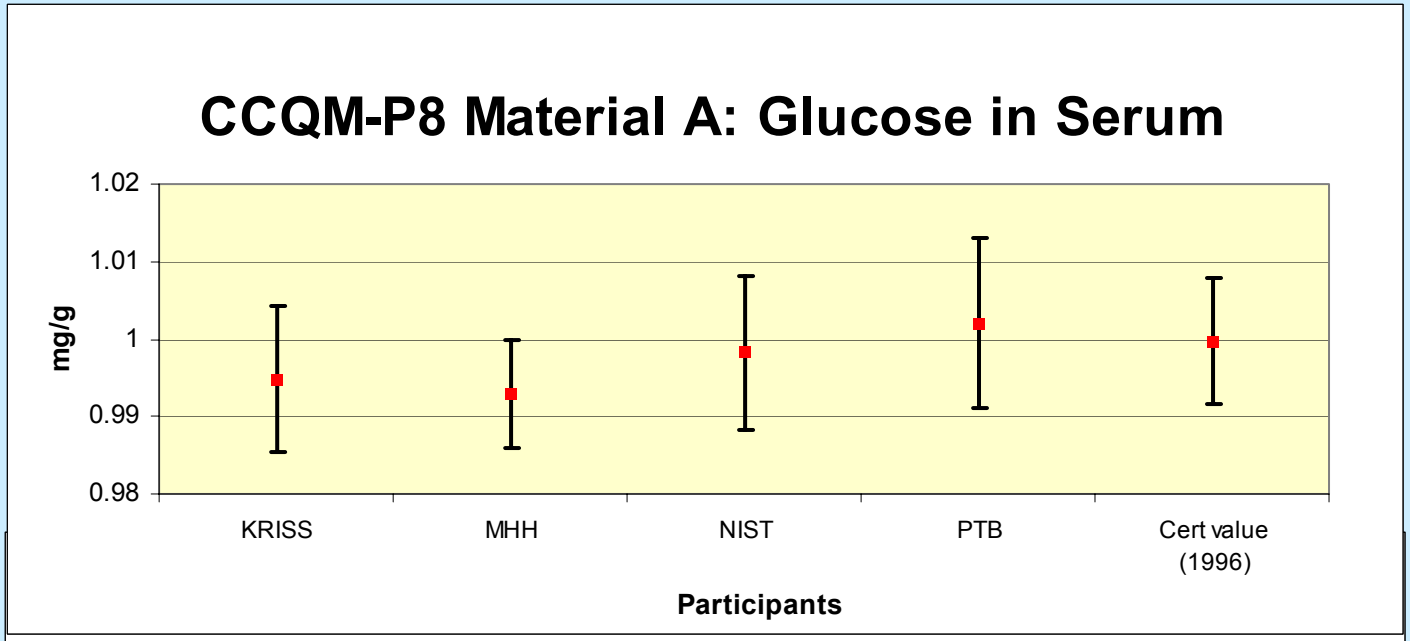
- **Participants: KRISS, MHH, NIST, PTB**

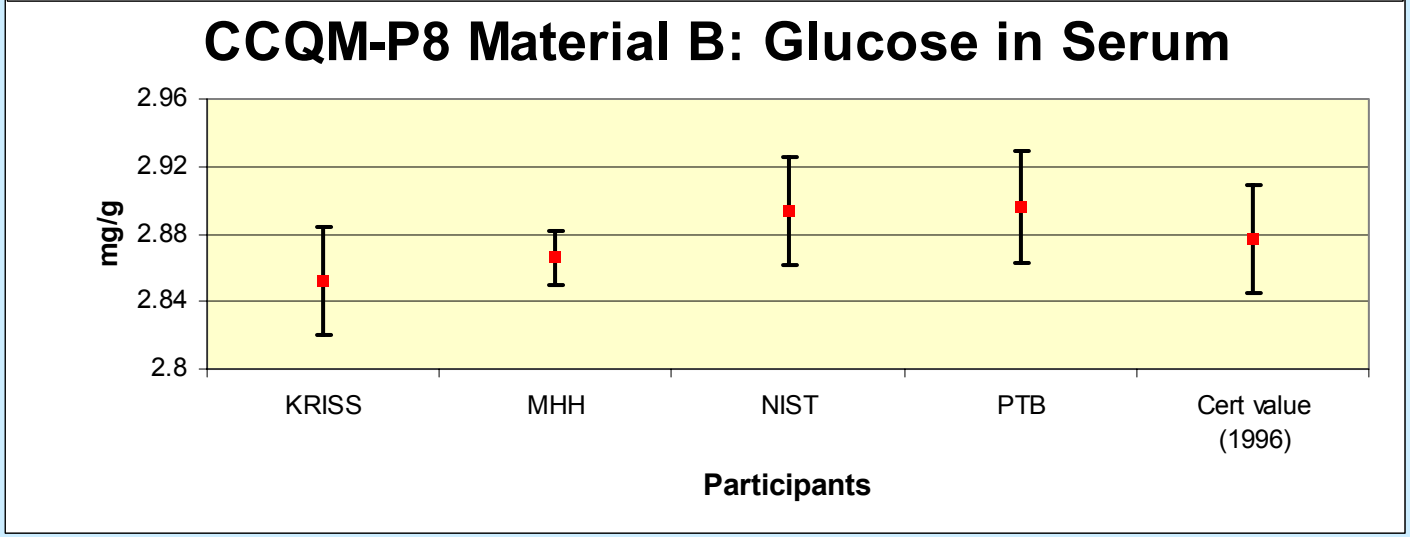
- **Glucose - blood sugar levels - diabetes**
- **Clinical labs - enzymatic procedures -variability**

- **Materials sent February 2000:**
  - Two NIST frozen sera (relabeled SRM 965, Glucose in Frozen Human Serum, Levels I (unfortified) and II (fortified))
  - NIST SRM 917, Glucose, provided as calibration compound
- **Results:**
  - **Material A: ~ 1 mg/g (level in medically desirable range); CV 0.4%**
  - **Material B: ~ 3 mg/g (representative of medically elevated level); CV 0.8%**

- **Action: Propose to proceed to Key Comparison using IMEP-17 samples (~0.7 and ~1.4 mg/g)**
  - ID-GC/MS to be used in Key Comparison (only method used/validated)
  - Data Quality Objective: CV ≤1 %

BIPM





CCQM-P8 Glucose in Serum

Material A (level in medically desirable range); Mean 0.998 mg/g, CV 0.4 %; Material B (representative of medically elevated level); Mean 2.88 mg/g, CV 0.8 %

BIPM

CCQM-P9 Creatinine in Serum

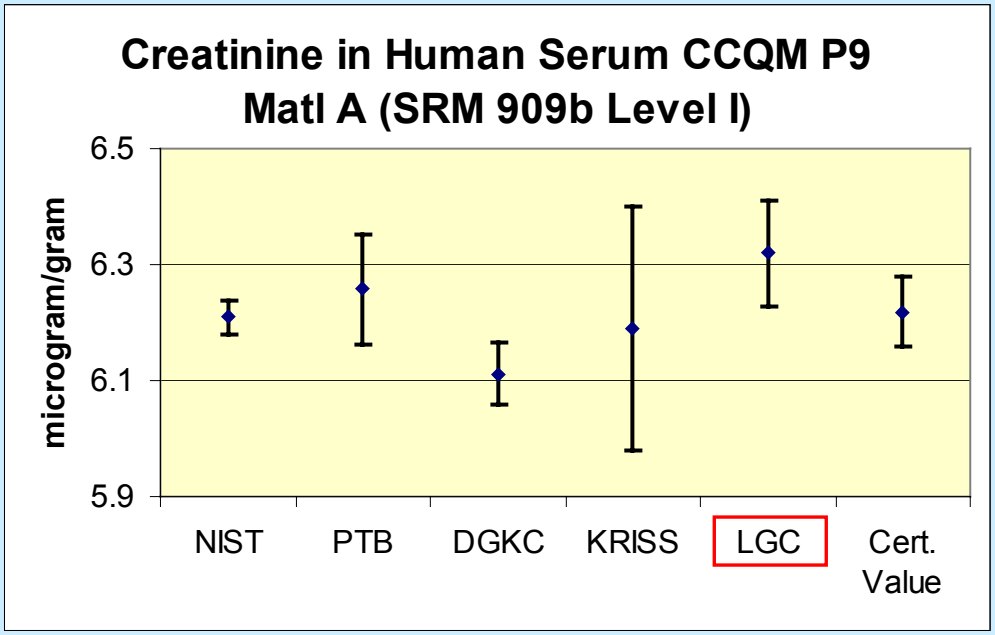
- **Participants: DGKC, KRISS, LGC, NIST, PTB**

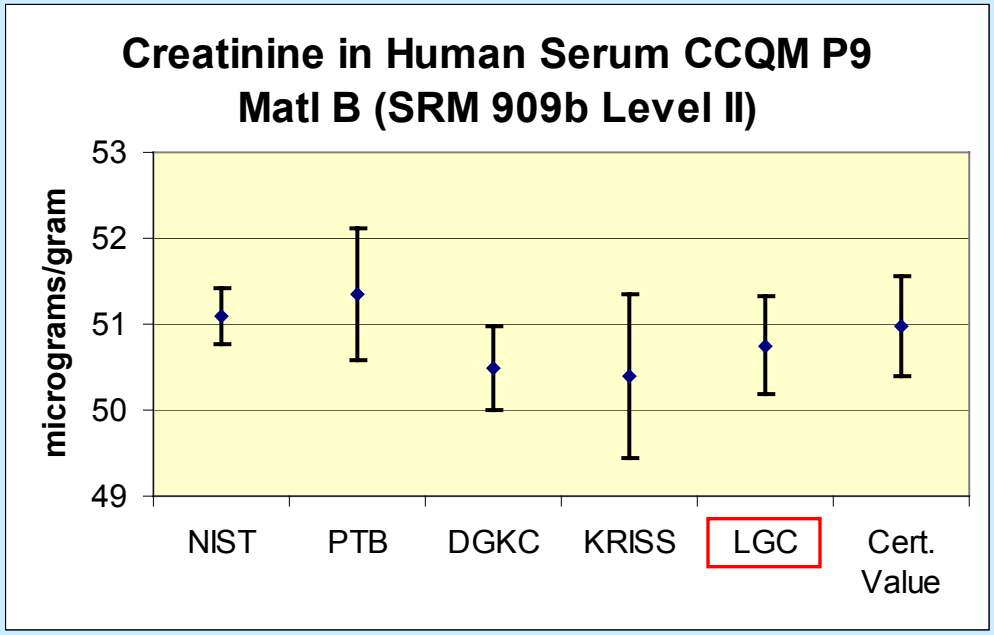
- **Creatinine measured to determine renal function**
- **Clinical laboratories - Jaffe reaction - enzymatic procedures - variability**

- **Materials sent February 2000:**
  - Two NIST lyophilized sera (relabeled SRM 909b, Human Serum, Levels I and II)
  - NIST SRM 914a, Creatinine, provided as calibration compound
- **Results:**
  - **Material A: ~ 6 μg/g (level in medically desirable range); CV 1.3%**
  - **Material B: ~ 50 μg/g (representative of medically elevated level); CV 0.8%**

- **Action: Propose to proceed to Key Comparison using IMEP-17 samples (~10 and ~20 μg/g)**
  - ID-GC/MS or LC/MS (LGC) to be used in Key Comparison (methods used/validated)
  - Data Quality Objective: CV ≤1.5 %

CCQM-P9 Creatinine in Serum





CCQM Comparisons for Small Molecule Health Status Markers

- Small molecule health marker surrogates used: cholesterol, creatinine, glucose
- Matrix: human sera
- Studies conducted:

	Mean	~CV
CCQM-K6 Cholesterol in serum		
• Material A (level in medically desirable range)	~ 2.2 mg/g	0.3 %
• Material B (representative of medically elevated level)	~ 2.7 mg/g	0.3 %
CCQM-K11 Glucose in serum (proposing to proceed)		
CCQM-K12 Creatinine in serum (proposing to proceed)		
CCQM-P6 Cholesterol in serum		
• Material A (level in medically desirable range)	~ 1.7 mg/g	1.8 %
• Material B (representative of medically elevated level)	~ 2.7 mg/g	1.4 %
CCQM-P8 Glucose in serum		
• Material A (level in medically desirable range)	~ 1 mg/g	0.4 %
• Material B (representative of medically elevated level)	~ 3 mg/g	0.8 %
CCQM-P9 Creatinine in serum		
• Material A (level in medically desirable range)	~ 6 μg/g	1.3 %
• Material B (representative of medically elevated level)	~ 50 μg/g	0.8 %

Future comparison: Cortisol (very polar, lower levels) in serum
Reference range for cortisol in serum or plasma: 50 - 230 ng/g

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Bureau International des Poids et Mesures

Pavillon de Breteuil, F-92312 Sèvres Cedex

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info@bipm.org

Welcome to the BIPM Internet server

Continue in English

These pages introduce the Bureau International des Poids et Mesures (BIPM), the heart of the International System of Units (SI).

21st CGPM:
RESOLUTIONS ADOPTED

Bienvenue sur le serveur Internet du BIPM

Continuer en français

Ces pages vous présentent le Bureau international des poids et mesures (BIPM), et le Système international d'unités (SI).

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metrologia

Job vacancy at the BIPM... loo

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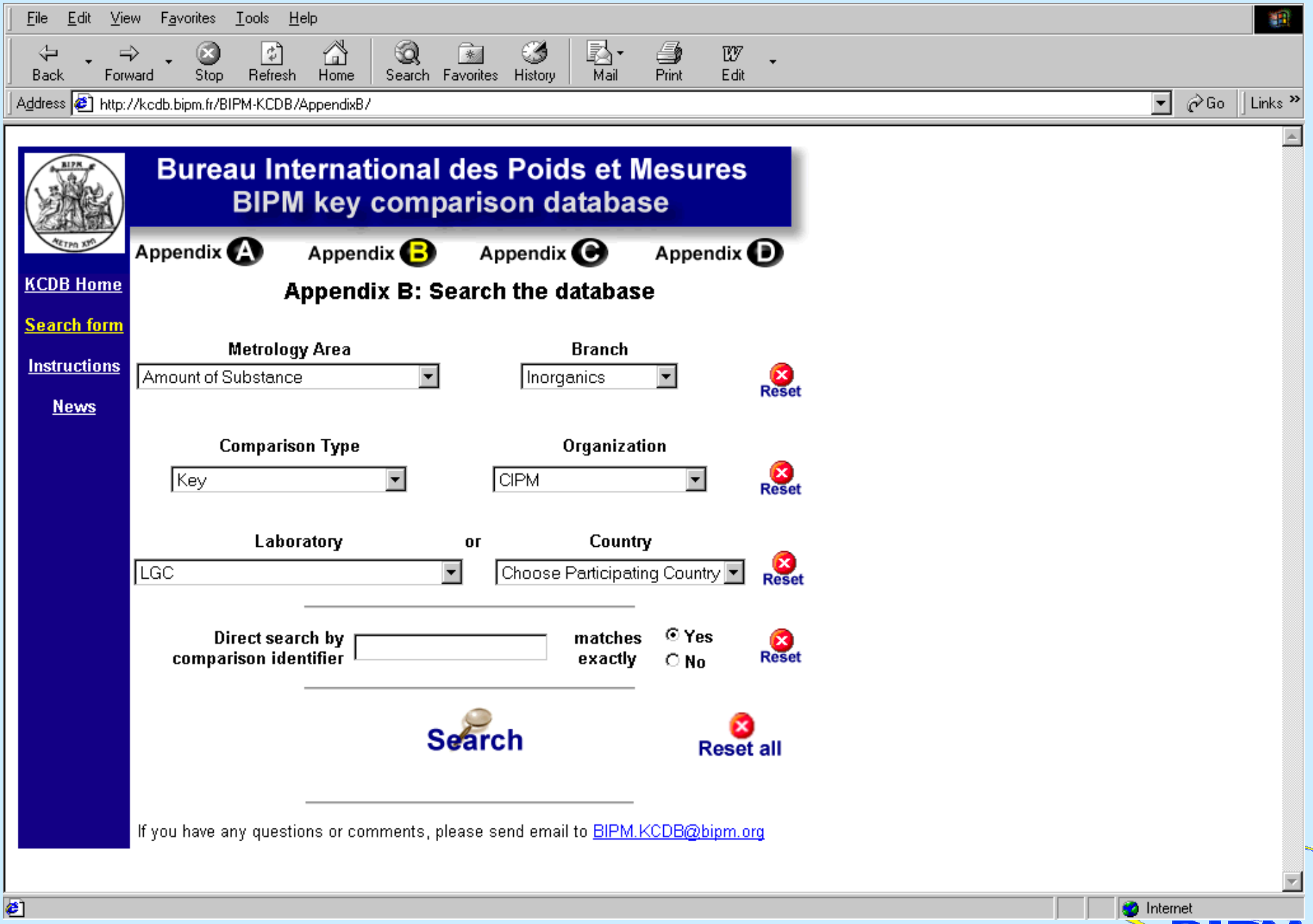
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Bureau International des Poids et Mesures
BIPM key comparison database
Appendix A Appendix B Appendix C Appendix D
KCDB Home
Search form
Instructions
News
Appendix B: Search the database
Metrology Area
Amount of Substance
Branch
Inorganics
Reset
Comparison Type
Key
Organization
CIPM
Reset
Laboratory
or
Country
LGC
Choose Participating Country
Reset
Direct search by comparison identifier
matches exactly
Yes
No
Reset
Search
Reset all
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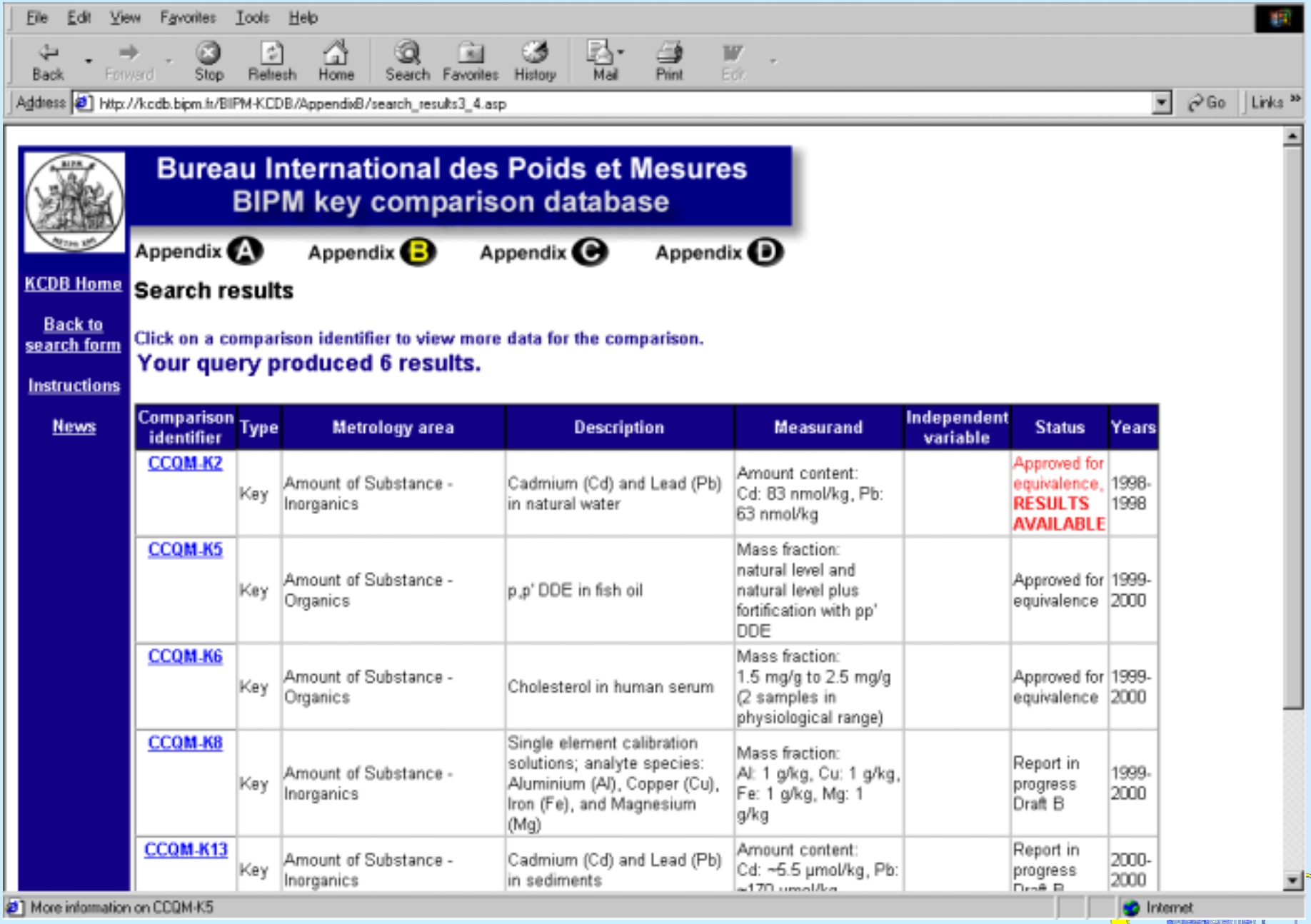
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Back Forward Stop Refresh Home Search Favorites History Mail Print Edit
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Go Links
Bureau International des Poids et Mesures
BIPM key comparison database
Appendix A Appendix B Appendix C Appendix D
KCDB Home
Back to search form
Instructions
News
Search results
Click on a comparison identifier to view more data for the comparison.
Your query produced 6 results.
Comparison identifier | Type | Metrology area | Description | Measurand | Independent variable | Status | Years
CCQM-K2 | Key | Amount of Substance - Inorganics | Cadmium (Cd) and Lead (Pb) in natural water | Amount content: Cd: 83 nmol/kg, Pb: 63 nmol/kg | | Approved for equivalence, RESULTS AVAILABLE | 1998-1998
CCQM-K5 | Key | Amount of Substance - Organics | p,p' DDE in fish oil | Mass fraction: natural level and natural level plus fortification with pp' DDE | | Approved for equivalence | 1999-2000
CCQM-K6 | Key | Amount of Substance - Organics | Cholesterol in human serum | Mass fraction: 1.5 mg/g to 2.5 mg/g (2 samples in physiological range) | | Approved for equivalence | 1999-2000
CCQM-K8 | Key | Amount of Substance - Inorganics | Single element calibration solutions; analyte species: Aluminium (Al), Copper (Cu), Iron (Fe), and Magnesium (Mg) | Mass fraction: Al: 1 g/kg, Cu: 1 g/kg, Fe: 1 g/kg, Mg: 1 g/kg | | Report in progress Draft B | 1999-2000
CCQM-K13 | Key | Amount of Substance - Inorganics | Cadmium (Cd) and Lead (Pb) in sediments | Amount content: Cd: ~5.5 µmol/kg, Pb: | | Report in progress | 2000-2000
More information on CCQM-K5
Internet

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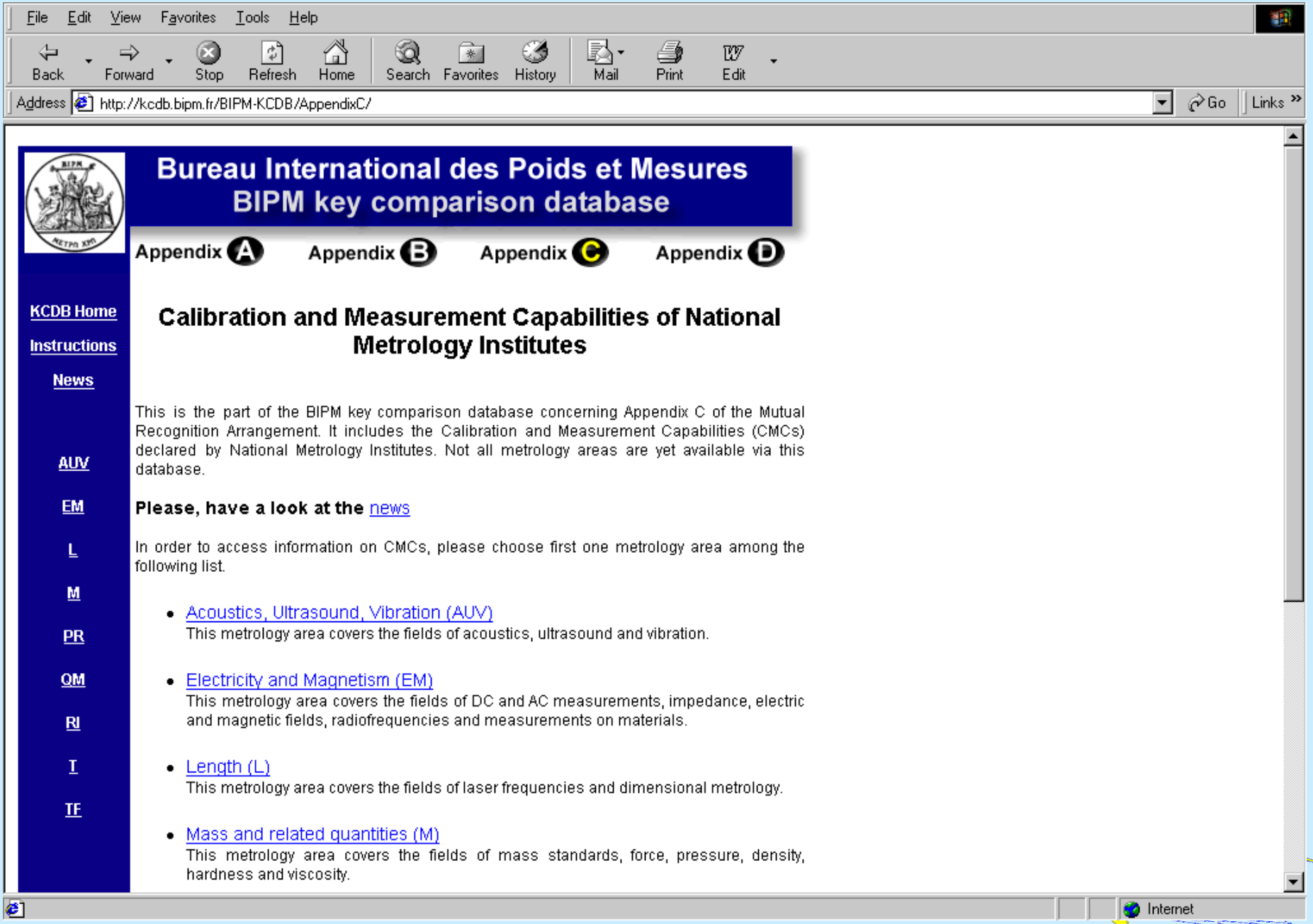
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Back Forward Stop Refresh Home Search Favorites History Mail Print Edit
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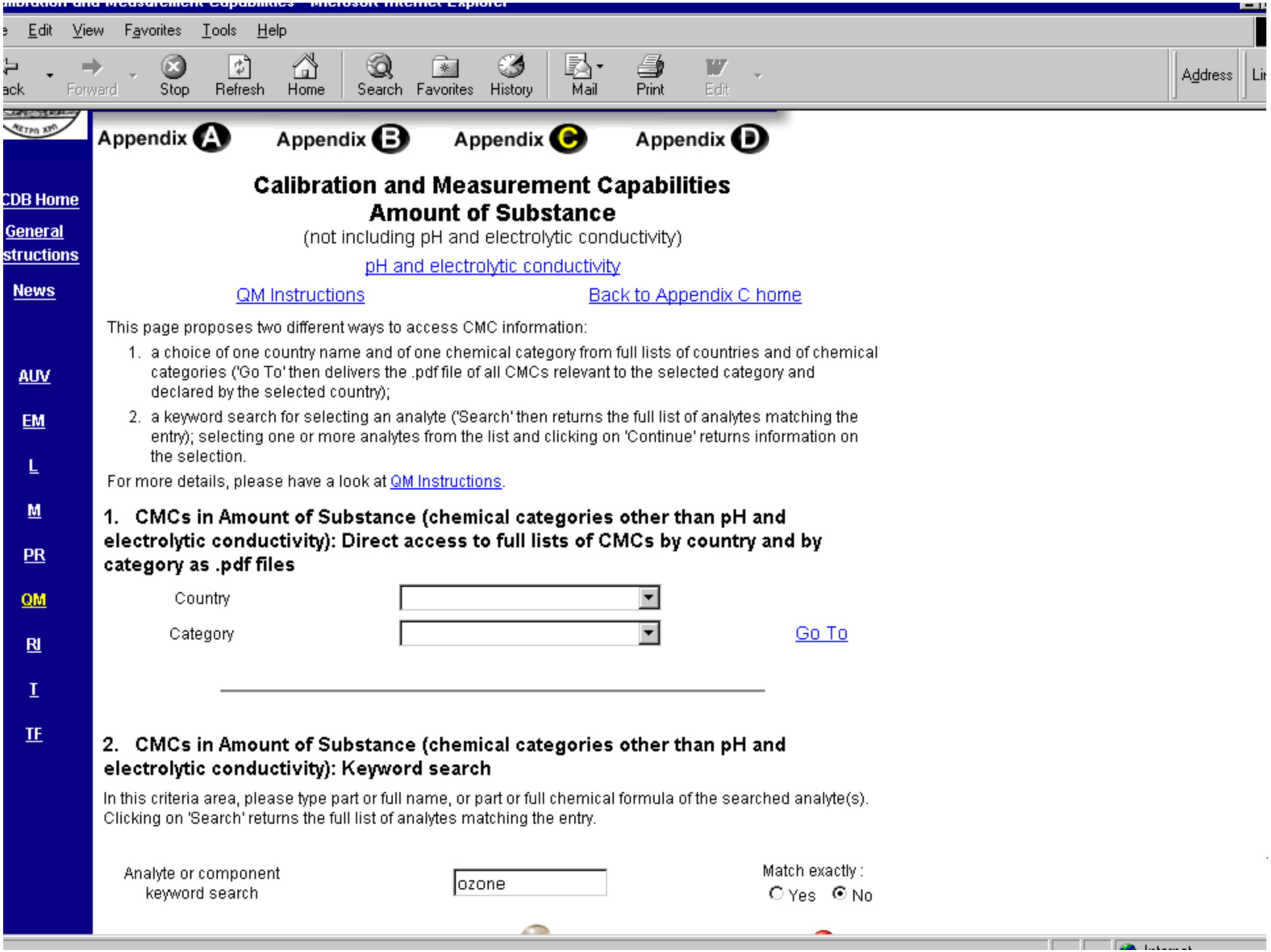
Go Links
Bureau International des Poids et Mesures
BIPM key comparison database
Appendix A Appendix B Appendix C Appendix D
KCDB Home
Instructions
News
AUV
EM
L
M
PR
QM
RI
T
TF
Calibration and Measurement Capabilities of National Metrology Institutes
This is the part of the BIPM key comparison database concerning Appendix C of the Mutual Recognition Arrangement. It includes the Calibration and Measurement Capabilities (CMCs) declared by National Metrology Institutes. Not all metrology areas are yet available via this database.
Please, have a look at the news
In order to access information on CMCs, please choose first one metrology area among the following list.
Acoustics, Ultrasound, Vibration (AUV)
This metrology area covers the fields of acoustics, ultrasound and vibration.
Electricity and Magnetism (EM)
This metrology area covers the fields of DC and AC measurements, impedance, electric and magnetic fields, radiofrequencies and measurements on materials.
Length (L)
This metrology area covers the fields of laser frequencies and dimensional metrology.
Mass and related quantities (M)
This metrology area covers the fields of mass standards, force, pressure, density, hardness and viscosity.
Internet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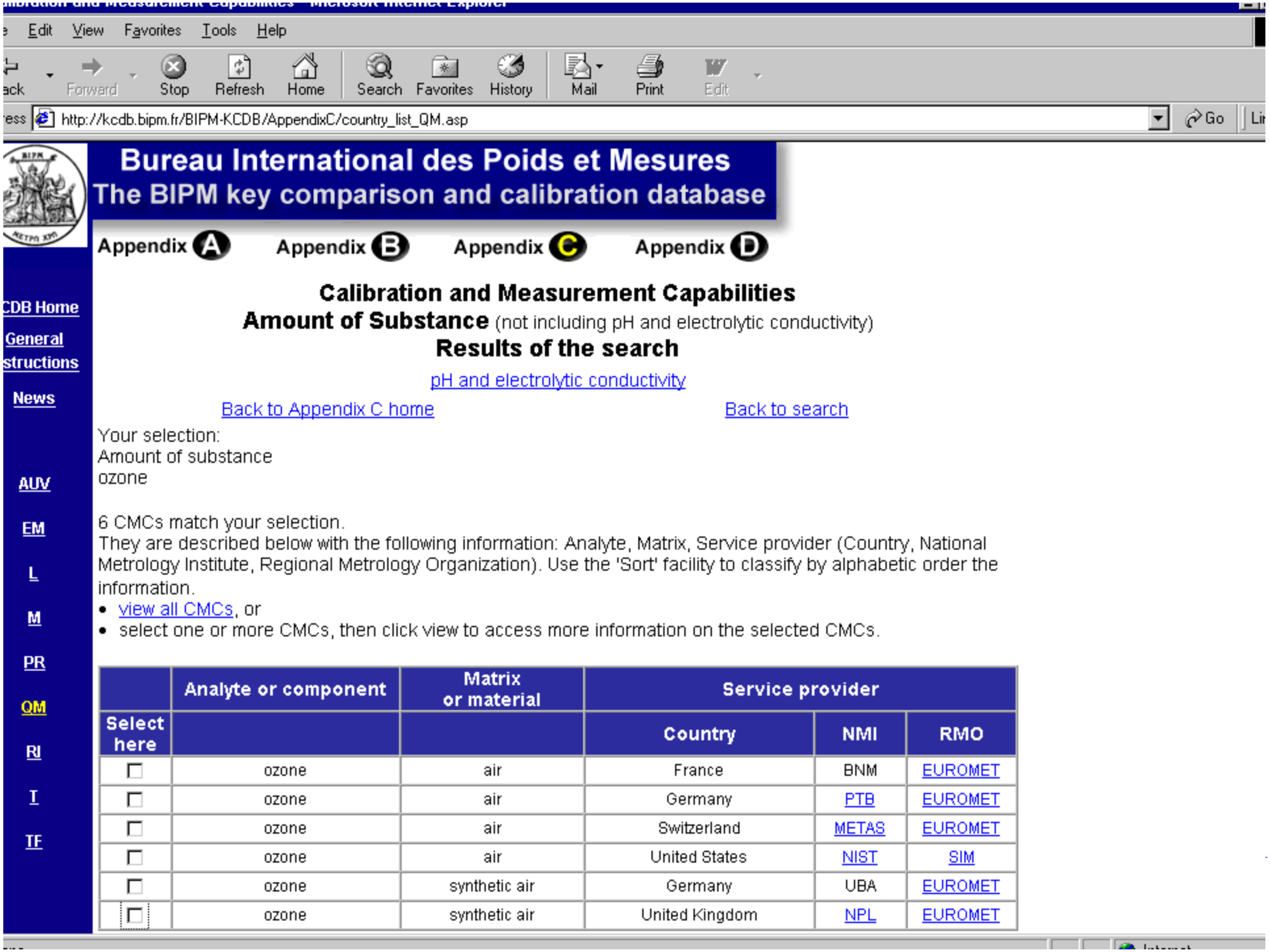
Back Forward Stop Refresh Home Search Favorites History Mail Print Edit Address
CDB Home
General structions
News
AUV
EM
L
M
PR
QM
RI
T
TF
Appendix A Appendix B Appendix C Appendix D
Calibration and Measurement Capabilities
Amount of Substance
(not including pH and electrolytic conductivity)
pH and electrolytic conductivity
QM Instructions
Back to Appendix C home
This page proposes two different ways to access CMC information:
1. a choice of one country name and of one chemical category from full lists of countries and of chemical categories ('Go To' then delivers the .pdf file of all CMCs relevant to the selected category and declared by the selected country);
2. a keyword search for selecting an analyte ('Search' then returns the full list of analytes matching the entry); selecting one or more analytes from the list and clicking on 'Continue' returns information on the selection.
For more details, please have a look at QM Instructions.
1. CMCs in Amount of Substance (chemical categories other than pH and electrolytic conductivity): Direct access to full lists of CMCs by country and by category as .pdf files
Country
Category
Go To
2. CMCs in Amount of Substance (chemical categories other than pH and electrolytic conductivity): Keyword search
In this criteria area, please type part or full name, or part or full chemical formula of the searched analyte(s). Clicking on 'Search' returns the full list of analytes matching the entry.
Analyte or component keyword search
ozone
Match exactly :
Yes
No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Go
Bureau International des Poids et Mesures
The BIPM key comparison and calibration database
Appendix A Appendix B Appendix C Appendix D
CDB Home
General
structions
News
AUV
EM
L
M
PR
QM
RI
T
TF
Calibration and Measurement Capabilities
Amount of Substance (not including pH and electrolytic conductivity)
Results of the search
pH and electrolytic conductivity
Back to Appendix C home
Back to search
Your selection:
Amount of substance
ozone
6 CMCs match your selection.
They are described below with the following information: Analyte, Matrix, Service provider (Country, National Metrology Institute, Regional Metrology Organization). Use the 'Sort' facility to classify by alphabetic order the information.
view all CMCs, or
select one or more CMCs, then click view to access more information on the selected CMCs.
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Matrix or material
Service provider
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RMO
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ozone air Germany PTB EUROMET
ozone air Switzerland METAS EUROMET
ozone air United States NIST SIM
ozone synthetic air Germany UBA EUROMET
ozone synthetic air United Kingdom NPL EUROMET

Gases, environmental

United States, NIST (National Institute of Standards and Technology)

Complete CMCs in Amount of Substance for Gases for United States (. pdf file)

Matrix or material	Analyte or component	Dissemination range of measurement capability	
		Amount-of-substance fraction in nmol/mol	Absolute expanded uncertainty in nmol/mol
air	ozone	1 to 100	1

Mechanism(s) for measurement service delivery : Standard reference photometer
No range of certified values in reference material has been declared
Internal NMI service identifier: NIST/8393131

Gases, environmental

United States, NIST (National Institute of Standards and Technology)

Complete CMCs in Amount of Substance for Gases for United States (. pdf file)

Matrix or material	Analyte or component	Dissemination range of measurement capability	
		Amount-of-substance fraction in nmol/mol	Relative expanded uncertainty in %
air	ozone	100 to 1000	1

Mechanism(s) for measurement service delivery : Standard reference photometer
No range of certified values in reference material has been declared
Internal NMI service identifier: NIST/8393132

Back to top of the page
Back to CMCs list
Back to search
Back to Appendix C home

Conclusions

- MRA - chemical standards and measurement capabilities compared internationally
- Amount of Substance entries Appendix B and C
- Comparability of data
- Underpin other agreements (e.g. ILAC MRA)
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