BIPM and CCQM activities under the Metre Convention

Metrological tools to underpin analytical measurements

Robert Wielgosz

BIPM, Head of Chemistry Section

Outline

- **BIPM: Role as an Intergovernmental Organization**

- **CIPM –MRA: International Metrology Infrastructure**
  - **National Metrology Institutes (NIST, LGC, NMIA…)**
  - **Metrology in Chemistry (CCQM)**
  - **Key Comparisons (Pilot studies)**
  - **Degrees of equivalence**
  - **Calibration and Measurement Capabilities (CMCs)**

- **Related activities:**
  - **IFCC and ILAC: JCTLM (Laboratory Medicine)**
  - **Codex Alimentarius (Food Analysis)**

Bureau International des Poids et Mesures (BIPM)

International Bureau of Weights and Measures

The task of the BIPM is to ensure world-wide uniformity of measurements and their traceability to the International System of Units (SI).

BIPM's Mission

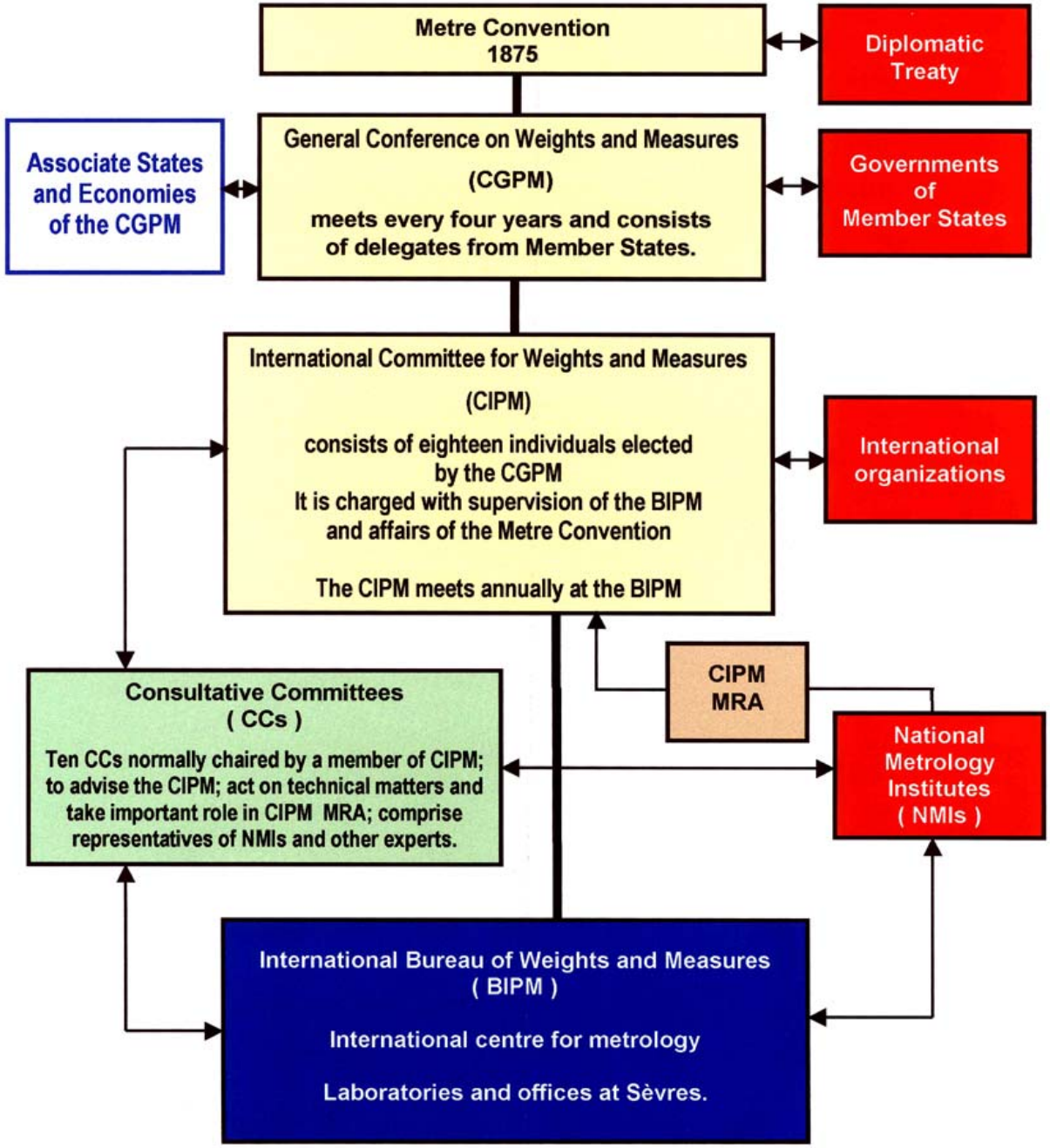
"THE GOAL OF THE BIPM IS WORLDWIDE UNFORMITY OF MEASUREMENT."

"It achieves this through providing the necessary scientific and technical basis for such uniformity and by collaborating with other institutions and organisations that have related missions."

General Conference on Weights and Measures, 2003.

METRE CONVENTION

- An intergovernmental treaty which, inter alia, established the BIPM
- Affirmed international support for the International System of Units- the SI
- Created the General Conference of Weights and Measures which meets every 4 years and is responsible for all major decisions affecting the SI, the BIPM and links with other intergovernmental bodies etc
- 51 full Member States
- 20 Associates of the General Conference of Weights and Measures


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 normally 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)
International Bureau of Weights and Measures
(BIPM)
International centre for metrology
Laboratories and offices at Sèvres.

BUREAU INTERNATIONAL DES POIDS ET MESURES TODAY

- On international territory at Sèvres with some 70 staff.
- €10M pa budget funded by 51 Member States and 20 Associates of the General Conference of the Metre Convention.

- Co-ordinates world metrology and maintains an up to date SI system to meet the needs of science and commerce.

- Compares national standards and coordinates international comparisons to ensure international equivalence and acceptability of measurement especially to meet regulatory and trade needs.

- Presses for SI traceability and consistency world-wide wherever measurements are made - new activities focus on areas outside traditional physics and engineering such as chemistry, medicine, food, the environment…..

THE INTERNATIONAL MEASUREMENT SYSTEM

BIPM

Accuracy

Number of measurements

NPL,UK

NIST, USA

KRISS, KOREA

Measurements for Industry, science, health and commerce

WORLD TRADE, INTERNATIONAL HEALTHCARE etc etc

National Metrology Institutes (NMIs)

Services provided by NMIs for analytical laboratories include:

- Certified Reference Materials (CRMs)
  - Pure substance calibrators
  - Calibration solutions
  - Matrix reference materials
    - as calibrators
    - for method validation
- Reference measurement services
- Calibrations

International Metrology

- **CCAUV**: Consultative Committee for Acoustics, Ultrasound and Vibration
- **CCEM**: Consultative Committee for Electricity and Magnetism
- **CCL**: Consultative Committee for Length
- **CCM**: Consultative Committee for Mass and Related Quantities
- **CCPR**: Consultative Committee for Photometry and Radiometry
- **CCQM**: Consultative Committee for Amount of Substance - Metrology in Chemistry
- **CCRI**: Consultative Committee for Ionizing Radiation
- **CCT**: Consultative Committee for Thermometry
- **CCTF**: Consultative Committee for Time and Frequency
- **CCU**: Consultative Committee for Units

- **Contact the Executive Secretary of a CC**
- **Directory of Consultative Committees**
- **Criteria for membership of a Consultative Committee**

Current CCQM Measurement Service Category Numbers and Categories

1 High Purity Chemicals
1.1 Inorganic Compounds
1.2 Organic Compounds
1.3 Metals
1.4 Isotopics
1.5 Other

2 Inorganic Solutions
2.1 Elemental
2.2 Anionic
2.3 Other

3 Organic Solutions
3.1 PAHs
3.2 PCBs
3.3 Pesticides
3.4 Other

4 Gases
4.1 High Purity
4.2 Environmental
4.3 Fuel
4.4 Forensic
4.5 Medical
4.6 Other

5 Water
5.1 Fresh Water
5.2 Contaminated Water
5.3 Sea Water
5.4 Other

6 pH

7 Electrolytic Conductivity

8 Metals and Metal Alloys
8.1 Ferrous Metals
8.2 Non-Ferrous Metals
8.3 Precious Metals
8.4 Other

9 Advanced Materials
9.1 Semiconductors
9.2 Superconductors
9.3 Polymers and Plastics
9.4 Ceramics
9.5 Other

10 Biological Fluids and Materials
10.1 Blood, Plasma, Serum
10.2 Urine Fluids
10.3 Hair
10.4 Tissues
10.5 Bone
10.6 Botanical Materials
10.7 Other

11 Food
11.1 Nutritional Constituents
11.2 Contaminants
11.3 GMOs
11.4 Other

12 Fuels
12.1 Coal and Coke
12.2 Petroleum Products
12.3 Bio-mass
12.4 Other

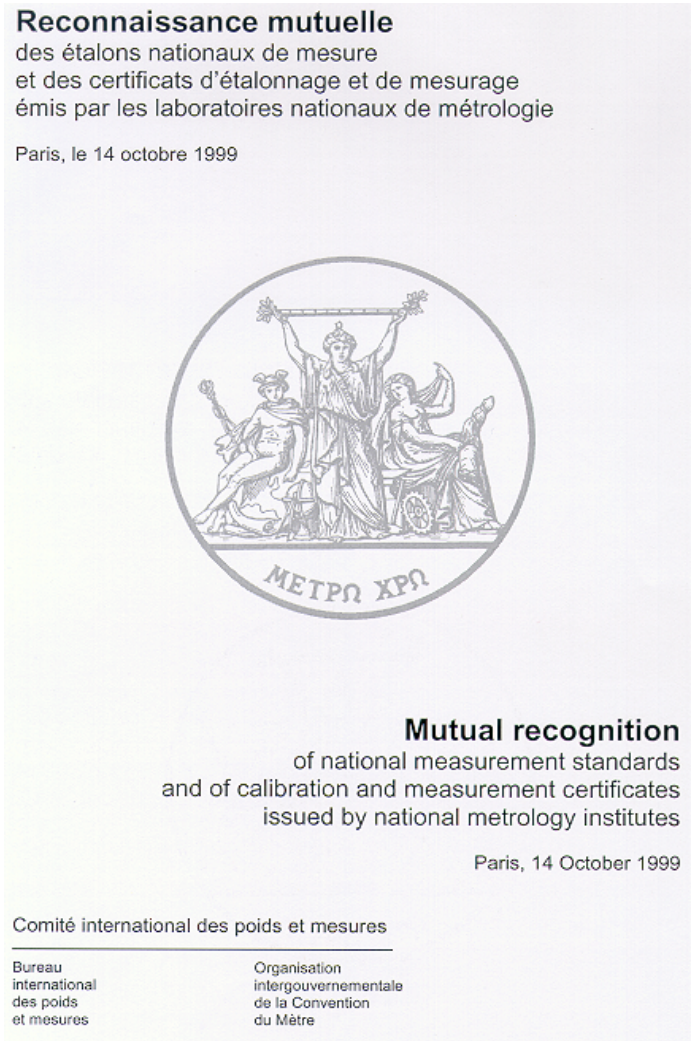
13 Sediments, Soils, Ores, and Particulates
13.1 Sediments
13.2 Soils
13.3 Ores
13.4 Particulates
13.5 Other

14 Other Materials
14.1 Cements
14.2 Paints
14.3 Textiles
14.4 Glasses
14.5 Thin Films
14.6 Coatings
14.7 Insulating Materials
14.8 Rubber
14.9 Adhesives
14.10 Other

15 Optical Properties

THE CHALLENGE FROM THE ACCREDITORS

“HOW DO NATIONAL METROLOGY INSTITUTES CONVINCE US THAT THEY ARE AS GOOD AS THEY SAY THEY ARE?”



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

ΜΕΤΡΩ ΧΡΩ

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

In 1999 the CIPM developed an MRA between NMIs to address technical barriers to trade caused by lack of traceability and equivalence.

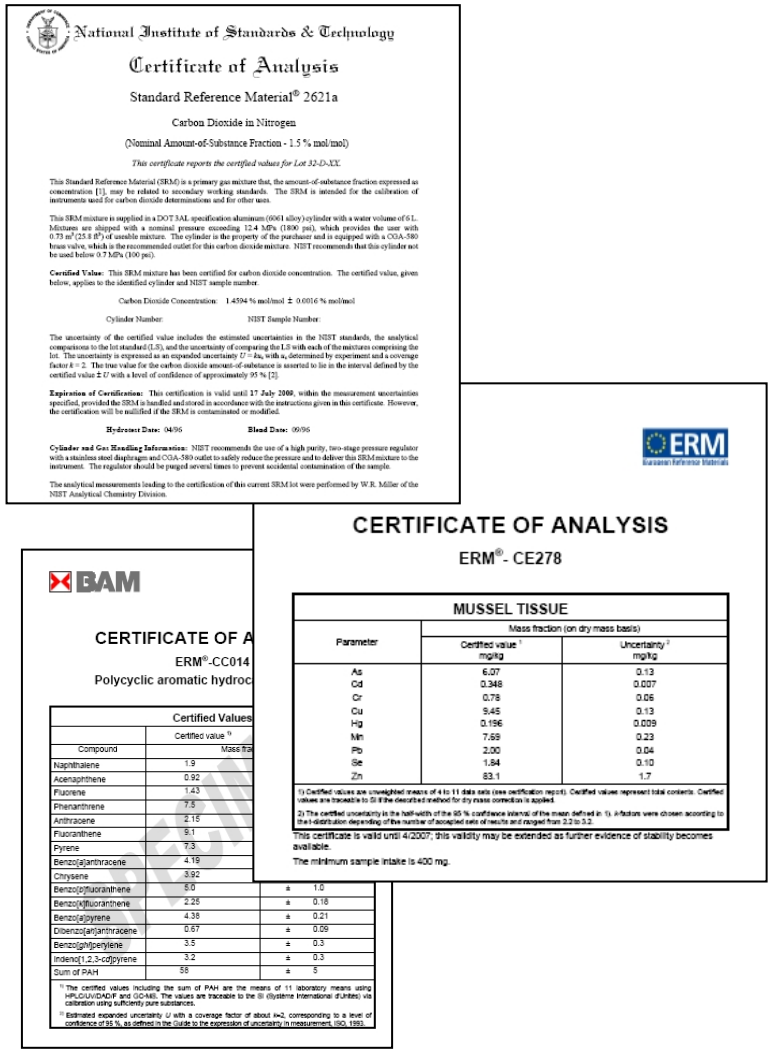
Complying with the MRA means that an NMI's calibration certificates are acceptable world-wide with a validated accuracy.

CIPM-MRA

Technical basis for:

-Determination of the degree of equivalence of measurement standards

-Mutual recognition of calibration and measurement certificates



National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 2621a

Carbon Dioxide in Nitrogen

(Nominal Amount-of-Substance Fraction - 1.5 % mol/mol)

This certificate reports the certified values for Lot 32-D-XX.

This Standard Reference Material (SRM) is a primary gas mixture that, the amount-of-substance fraction expressed as concentration [1], may be related to secondary working standards. The SRM is intended for the calibration of instruments used for carbon dioxide determinations and for other uses.

This SRM mixture is supplied in a DOT 3AL specification aluminum (6061 alloy) cylinder with a water volume of 6 L. Mixtures are shipped with a nominal pressure exceeding 12.4 MPa (1800 psi), which provides the user with 0.73 m^3 (25.8 ft^3) of useable mixture. The cylinder is the property of the purchaser and is equipped with a CGA-580 brass valve, which is the recommended outlet for this carbon dioxide mixture. NIST recommends that this cylinder not be used below 0.7 MPa (100 psi).

Certified Value: This SRM mixture has been certified for carbon dioxide concentration. The certified value, given below, applies to the identified cylinder and NIST sample number.

Carbon Dioxide Concentration: 1.4594 % mol/mol ± 0.0016 % mol/mol

Cylinder Number: NIST Sample Number:

The uncertainty of the certified value includes the estimated uncertainties in the NIST standards, the analytical comparisons to the lot standard (LS), and the uncertainty of comparing the LS with each of the mixtures comprising the lot. The uncertainty is expressed as an expanded uncertainty $U = ku_c$ with u_c determined by experiment and a coverage factor $k = 2$. The true value for the carbon dioxide amount-of-substance is asserted to lie in the interval defined by the certified value ± *U* with a level of confidence of approximately 95 % [2].

Expiration of Certification: This certification is valid until **17 July 2000**, within the measurement uncertainties specified, provided the SRM is handled and stored in accordance with the instructions given in this certificate. However, the certification will be nullified if the SRM is contaminated or modified.

Hydrostat Date: 04/96 **Blend Date:** 06/96

Cylinder and Gas Handling Information: NIST recommends the use of a high purity, two-stage pressure regulator with a stainless steel diaphragm and CGA-580 outlet to safely reduce the pressure and to deliver this SRM mixture to the instrument. The regulator should be purged several times to prevent accidental contamination of the sample.

The analytical measurements leading to the certification of this current SRM lot were performed by W.R. Miller of the NIST Analytical Chemistry Division.

ERM

CERTIFICATE OF ANALYSIS

ERM®- CE278

MUSSEL TISSUE

Parameter	Mass fraction (on dry mass basis)	
	Certified value [1] mg/kg	Uncertainty [2] mg/kg
As	6.07	0.13
Cd	0.348	0.007
Cr	0.78	0.06
Cu	9.45	0.13
Hg	0.196	0.009
Mn	7.69	0.23
Pb	2.00	0.04
Se	1.84	0.10
Zn	83.1	1.7

1) Certified values are unweighted means of 4 to 11 data sets (see certification report). Certified values represent total contents. Certified values are traceable to SI if the described method for dry mass correction is applied.

2) The certified uncertainty is the half-width of the 95 % confidence interval of the mean defined in 1). *k*-factors were chosen according to the *t*-distribution depending of the number of accepted sets of results and ranged from 2.2 to 3.2.

This certificate is valid until 4/2007; this validity may be extended as further evidence of stability becomes available.

The minimum sample intake is 400 mg.

BAM

CERTIFICATE OF A

ERM®-CC014

Polycyclic aromatic hydroc

Compound	Certified Values: Certified value [1] Mass fra	
Naphthalene	1.9	
Acenaphthene	0.92	
Fluorene	1.43	
Phenanthrene	7.5	
Anthracene	2.15	
Fluoranthene	9.1	
Pyrene	7.3	
Benzo[a]anthracene	4.19	
Chrysene	3.92	
Benzo[b]fluoranthene	5.0	± 1.0
Benzo[k]fluoranthene	2.25	± 0.18
Benzo[a]pyrene	4.38	± 0.21
Dibenzo[ah]anthracene	0.67	± 0.09
Benzo[ghi]perylene	3.5	± 0.3
Indeno[1,2,3-*cd*]pyrene	3.2	± 0.3
Sum of PAH	58	± 5

[1] The certified values including the sum of PAH are the means of 11 laboratory means using HPLC/UV/DAD/F and GC/MS. The values are traceable to the SI (Système International d'Unités) via calibration using sufficiently pure substances.

[2] Estimated expanded uncertainty *U* with a coverage factor of about *k*=2, corresponding to a level of confidence of 95 %, as defined in the Guide to the expression of uncertainty in measurement, ISO, 1993.

CIPM-MRA: relevance to analytical laboratories

ISO/IEC 17025: General requirements for the competence of testing and calibration laboratories

Measurement Standards and Certified Reference Materials

Measurement traceability

Measurement uncertainty

Method Validation

Comparability of measurements

ISO 17025 requirements: traceability and uncertainty

traceability

Property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties.

uncertainty of measurement

parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand

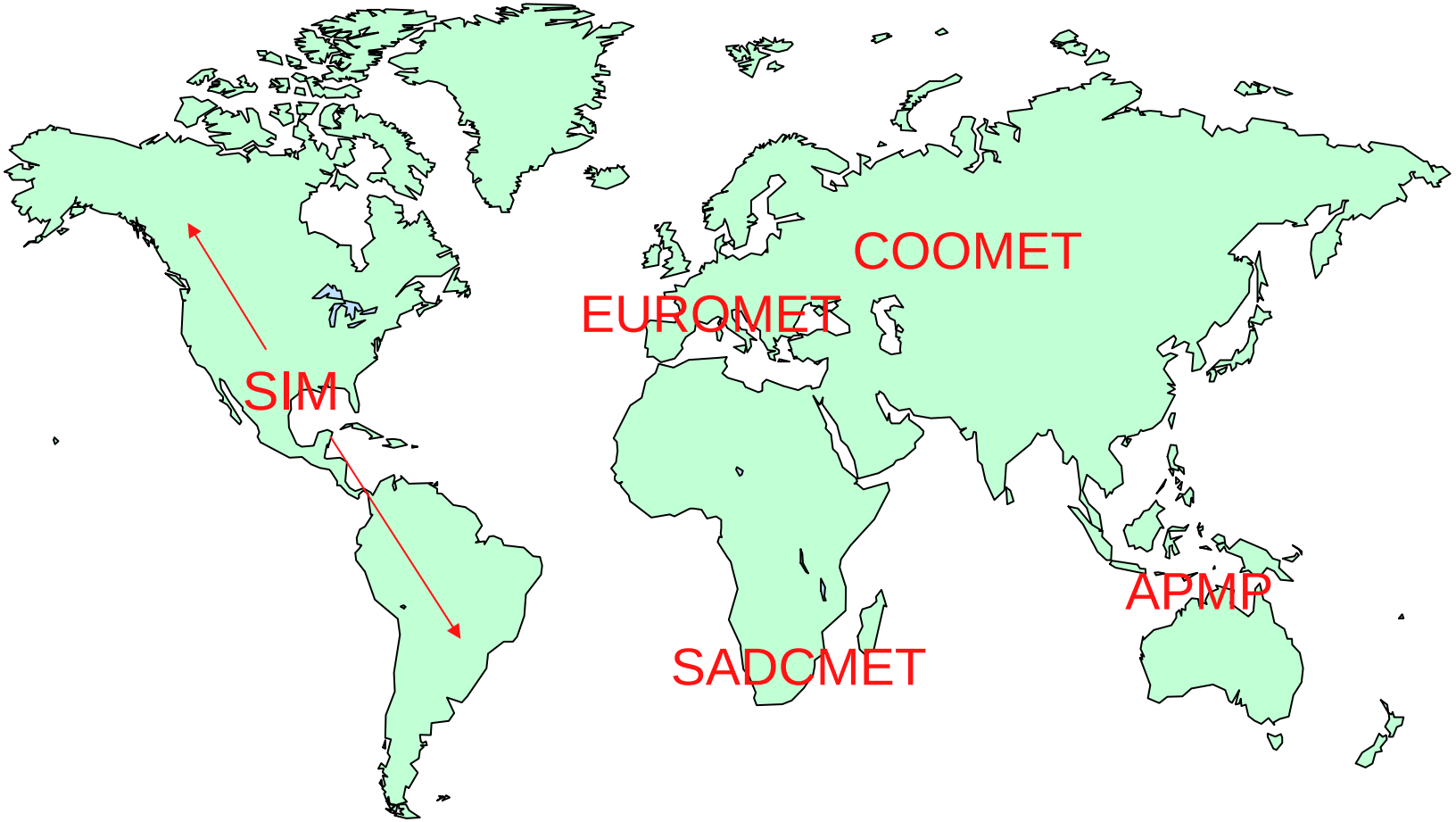
TO MEET THE REQUIREMENTS OF THE MRA, AN NMI WILL NEED:

- **To have its calibration and measurement capabilities (CMCs) validated by others based on objective evidence.**

- **To take part in key comparisons that give technical confidence in the day-to day measurements at the NMIs worldwide**

- **To implement a quality/management system - essentially ISO/IEC 17025 (and ISO Guide 34 for CRMs)**

Regional **M**etrology **O**rganizations



The BIPM key comparison database

KCDB

in support of the Mutual Recognition Arrangement (MRA) of national measurement standards and of calibration and measurement certificates issued by national metrology institutes

The BIPM key comparison database is defined in the text of the MRA as "the database maintained by the BIPM (Bureau International des Poids et Mesures) which contains Appendices A, B, C and D of the Mutual Recognition Arrangement".

Appendix A: MRA signatories

List of national metrology institutes that are signatories to the arrangement.

Appendix B: Key and supplementary comparisons

Information on CIPM (Comité International des Poids et Mesures) and RMO (Regional Metrology Organization) key and supplementary comparisons, together with results when they become available.

Appendix C: Calibration and Measurement Capabilities (CMCs)

Quantities for which calibration and measurements certificates are recognized by institutes participating in part two of the arrangement.

Appendix D: List of key comparisons

The KCDB website is best viewed using version 7.0 of **Netscape** or version 5.0 or higher of **IE**.

KCDB

- **KCDB home**
- KCDB news
- MRA
- JCRB
- Guidelines for key comparisons
- Nomenclature
- Metrologia
- Version française

What's new ?

- 16 February 2004
  Appendix C: Mass and Related Quantities (Fluid Flow)
- 16 February 2004
  Appendix B: Key comparison CCTF-K2001.UTC

Contact us

- BIPM.KCDB@bipm.org

KCDB Newsletter

- Subscribe

Metrology in Chemistry, CCQM

CCQM Working Groups

Key Comparisons and CMC Quality	NMIA
Organic Analysis	NIST
Inorganic Analysis	LGC
Gas Analysis	NMi
Electro-chemical Analysis	SMU
Surface Analysis	BAM
Bio-Analysis	LGC

CCQM Key Comparison Areas:

Health

- clinical diagnostic markers *(cholesterol/heart disease, diabetes/glucose, creatinine/kidney function, trace hormones)*
- electrolytes *(Na, K, Ca)*
- Pb in blood
- anabolic steroids in urine

Food

- pesticide residues
- antibiotics in meat
- growth hormones in meat
- vitamins and minerals
- drinking water *(EPA List)*

Environment

- air *(EPA HAPs List)*
- soil/sediments
- biological tissues
- waste water *(EPA List)*

General Studies

- pH
- electrolytic conductivity
- purity assessment
- calibration solutions mixtures

Advanced Materials

- semiconductors
- metal alloys
- polymers and plastics

Forensics

- drugs of abuse
- explosive residues
- breathalyzer *(ethanol-in-air, ethanol in water)*
- DNA profiling

Commodities

- emissions trading *(SO_2 in stack emissions)*
- sulfur in fossil fuels
- natural gas
- sucrose
- ethanol in wine
- cement *(Ca, Si, Al, S, Ti, Na, Mg)*
- source of origin/adulteration

Biotechnology

- DNA Quantitation
- GMO

CCQM Organic Analytical Working Group (OAWG)

Activities and Accomplishments:

Increasingly: Key comparison plans driven by customer needs for traceability/recognition of measurement capabilities

Health Sector

QM Comparison	Title	Study Period
CCQM-P6	**Cholesterol in serum**	1998-1999
CCQM-K6	**Cholesterol in human serum**	1999-2000
CCQM-K6-subsequent	**Cholesterol in human serum - subsequent**	2000-2001
CCQM-P8	**Glucose in Serum**	1999-2000
CCQM-K11	**Glucose in Human Serum**	2000
CCQM-P9	**Creatinine in Serum**	1999-2000
CCQM-K12	**Creatinine in Human Serum**	2000

Food / Environment

QM Comparison	Title	Study Period
CCQM-P2	p,p´-DDE in isooctane	1997-1998
CCQM-P4	p,p´-DDE in corn oil	1998-1999
CCQM-K5	pp'-DDE in fish oil	1999-2000
CCQM-P10	gamma-HCH in Fish Oil	1999
CCQM-P10.2	gamma-HCH in Fish Oil	2000
CCQM-P21	p,p'-DDT in Fish Oil	1999-2000
CCQM-K21	p,p' DDT in fish oil	2000-2001
CCQM-P40	Organic Contaminants in Tissue (PCB Congeners, PAHs, Chlorinated Pesticides)	2003-4
CCQM-P57	PCB Congeners in Mussel Tissue Extract	2005
CCQM-P67	PCB Congeners in Mussel Tissue	2005

Environmental

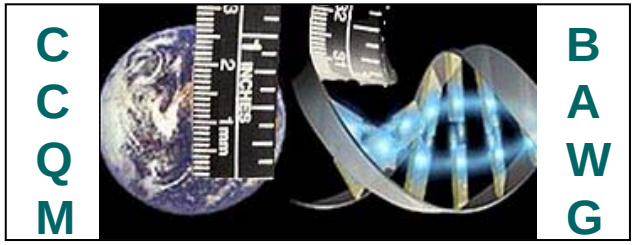
QM Comparison	Title	Study Period
CCQM-P17	**PCBs in Sediment**	2000
CCQM-K25	**PCBs in Sediment**	2001
CCQM-P18 (with AWG)	**Tributyl tin in Sediment**	2001-2002

Forensics / Commodities

Customer Sector	QM Comparison	Title	Study Period
Forensics / Commodities	CCQM-P35	**Ethanol in Aqueous Matrix**	2001
Commodities	**CCQM-27b**	**Ethanol in aqueous matrix, commodity level**	2002
Forensics	**CCQM-K27a**	**Ethanol in aqueous matrix, forensic levels**	2002
Forensics / Commodities	**CCQM-K27 subsequent**	**Ethanol in Aqueous Matrix**	2003-2004
Forensics	CCQM-P27	**LSD in Human Urine**	2001

General analytical applications

QM Comparison	Title	Study Period
CCQM-P3	**NMR study**	1998-1999
CCQM-P3.2	**NMR study**	1999-2000
CCQM-P5	**Organic Purity Assessment Series: Acetanilide, benzoic acid, and naphthalene**	1998
CCQM-P20a	**Organic Purity Assessment Series: Tributyl tin**	2001-2002
CCQM-P20b	**Organic Purity Assessment Series: *o*-xylene**	2002
CCQM-P20c	**Organic Purity Assessment Series: Atrazine (2 levels)**	2003-2004
CCQM-P20d	**Organic Purity Assessment Series: Chlorpyrifos (Organophosphate pesticide)**	2003-2004
CCQM-P31.a	**Organic Solutions: PAH Solution**	2004
CCQM-P31.b	**Organic Solutions: PCB Congener Solution**	2004
CCQM-P31.c	**Organic Solutions: Chlorinated Pesticide Solution**	2004
CCQM-K40 CCQM-P31.a.1	**Organic Solutions: PCB Congener Solution**	2005
CCQM-P61	**Organic Solutions: Volatile Organic Compounds (VOCs) in Organic Solvent**	2005



CCQM BIOANALYSIS WG: Towards An International Biometrology Infrastructure

Reference No.	Description	Coordinating Laboratory
CCQM-P44	DNA Quantification	NIST/LGC
CCQM-P44.1	Q-PCR (repeat)	NIST/LGC
CCQM-P53	AFLP DNA Profiling	NARL
CCQM-P54	DNA primary quantification	LGC
CCQM-P54.1	DNA quantification	LGC
CCQM-P55	Peptide / protein quantification	LGC
CCQM-P58	Fluorescence in ELISA	NPL/NIST
CCQM-P59	Protein structural measurements by CD	NPL/NIST
CCQM-P60	DNA extraction - reference method	IRMM
CCQM-P94	Quantification of DNA methylation	KRISS

CCQM Key Comparisons (and pilot studies)

Key Comparisons: International Comparisons – formal part of the CIPM-MRA (restricted participation)

Pilot studies: International Comparisons – expert laboratories can be invited to participate

1996-2007: 63 Key comparisons; 100 Pilot studies

Examples:

- CCQM-K27: Ethanol in water (0.8 mg/g)
- CCQM-K4: Ethanol in air (120 µmol/mol)
- CCQM-P12: Pb in Wine
- CCQM-P68: 19- Norandrosterone in Urine

CCQM-K27: Ethanol in water (Forensic level: Blood alcohol testing)

ID/GC/MS- based methods

Measurement equation:

$$C_X = C_Z \times \frac{M_Y}{Mx} \times \frac{M_{Zc}}{M_{Yc}} \times \frac{R_Z - R_{Bc}}{R_{Bc} - R_Y} \times \frac{R_Y - R_B}{R_B - R_Z}$$

where:

C_Z = is the mass fraction of ethanol in the calibration solution in mg g^{-1}
M_Y = Mass of spike Y added to the sample X to prepare the blend B
M_{Zc} = Mass of calibration solution Z added to the spike Y to make calibration blend Bc
M_X = Mass of sample X added to the spike Y to prepare the blend B
M_{YC} = Mass of spike Y added to the calibration solution Z to make calibration blend Bc
R_Y = Ratio of unlabelled/labelled ion in spike solution
R_Z = Ratio of unlabelled/labelled ion in sample/calibration solution
R_B = Ratio of unlabelled/labelled ion in sample blend B
R_{Bc} = Ratio of unlabelled/labelled ion in calibration blend Bc

CCQM-K27: Ethanol in water (Forensic level: Blood alcohol testing)

GC-FID- based methods

Measurement equation:

$$C_X = \frac{C_Z \times A_S \times f_D}{A_C} \qquad (1)$$

where:

C_Z	is the mass fraction of ethanol in the calibration solution in mg g^{-1};
A_S	is the area of the ethanol peak in the chromatogram of the sample;
A_C	is the area of the ethanol peak in the chromatogram of the calibration standard solution;
f_D	is the sample dilution factor

CCQM-K27: Results

CCQM-K27.a

Results

Laboratory individual measurements | Equivalence statements | Degrees of equivalence | Graph(s) of equivalence

MEASURAND : Mass fraction of Ethanol in aqueous matrix, Sample A
NOMINAL VALUE : ~ 0.8 mg/g

x_i : result of measurement carried out by laboratory *i*
u_i : standard uncertainty of x_i
U_i : expanded uncertainty of x_i at a 95% level of confidence

Lab *i*	x_i / (mg/g)	u_i / (mg/g)	U_i / (mg/g)	Date of measurement
BAM	0.8029	0.0025	0.0049	Oct 2002
KRISS	0.8013	0.0050	0.010	Oct 2002
LGC	0.8034	0.0004	0.0008	Aug 2002
BNM-LNE	0.8227	0.0070	0.014	Oct 2002
NARL	0.8045	0.0015	0.0034	Sep - Oct 2002
NIST	0.8180	0.0027	0.0087	Sep - Oct 2002
NMIJ	0.8029	0.0011	0.0030	Sep - Oct 2002
NRCCRM	0.8048	0.0018	0.0036	Oct 2002
VNIIM	0.780	0.004	0.008	Oct - Nov 2002

Unless otherwise stated, in the final numbers presented here, rounding has been applied according to ISO-31-0 Annex B Rule B.

CCQM-K6: Uncertainty Budget

Table 9a LGC – Sample A

Parameter	Uncertainty Type	Variance	Degrees of Freedom
Isotope ratio primary standard	B	5.05E-10	Large
Isotope ratio of spike	B	1.77E-10	Large
Isotope ratio calibration blend (gravimetric value)	A	1.65E-13	Large
Isotope ratio sample blend (measured value)	A	2.11E-08	9
Isotope ratio calibration blend (measured value)	A	6.35E-08	9
Mass of sample	B	6.09E-09	Large
Mass of spike added to sample	B	9.11E-09	Large
Mass of spike added to standard	B	3.98E-09	Large
Mass of standard	B	2.66E-09	Large
Mass fraction primary standard solution	B	4.18E-08	Large
Between blend variation	A	1.32E-08	7
Combined standard uncertainty (sq. rt. of sum of variances)		0.0004 mg g^{-1}	
Coverage factor	2		
Combined expanded uncertainty		0.0008 mg g^{-1}	
Mean value of result		0.8034 mg g^{-1}	

CCQM-K27: Degree of Equivalence

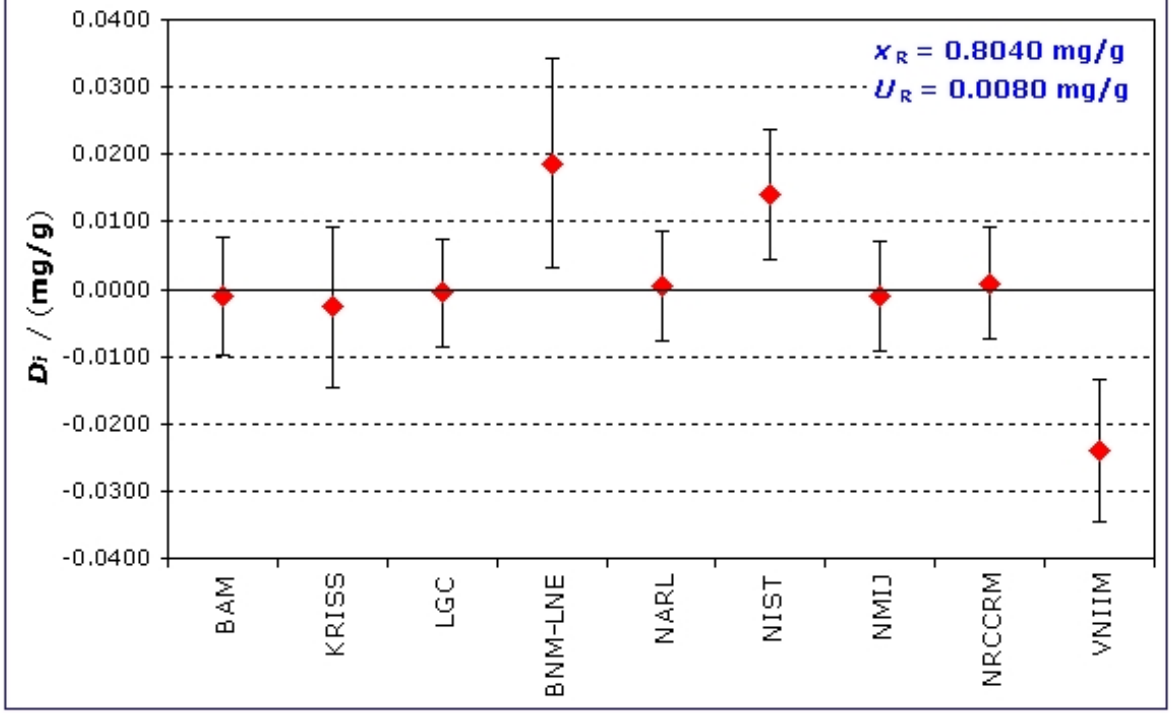
CCQM-K27.a

Results

Laboratory individual measurements | Equivalence statements | Degrees of equivalence | **Graph(s) of equivalence**

MEASURAND : Mass fraction of Ethanol in aqueous matrix, Sample A
NOMINAL VALUE : ~ 0.8 mg/g

Degrees of equivalence D_i and expanded uncertainty U_i (95% level of confidence) expressed in mg/g



CCQM-K4: Ethanol in air (Breath alcohol testing)

CCQM-K4

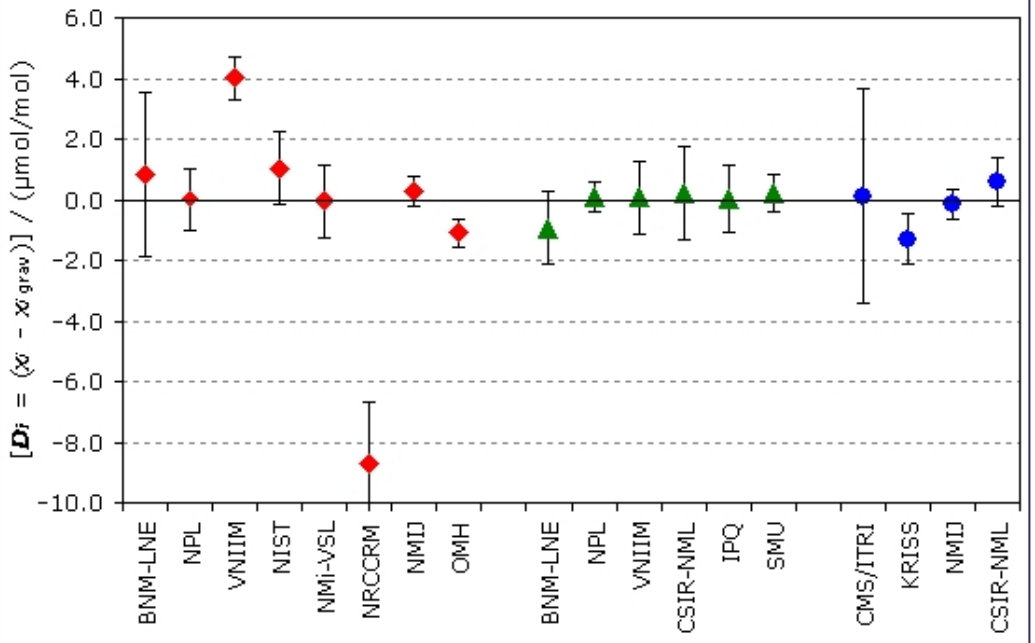
Results

Laboratory individual measurements | Equivalence statements | Degrees of equivalence | **Graph(s) of equivalence**

MEASURAND : Amount-of-substance fraction of ethanol in air
NOMINAL VALUE : 120 µmol/mol

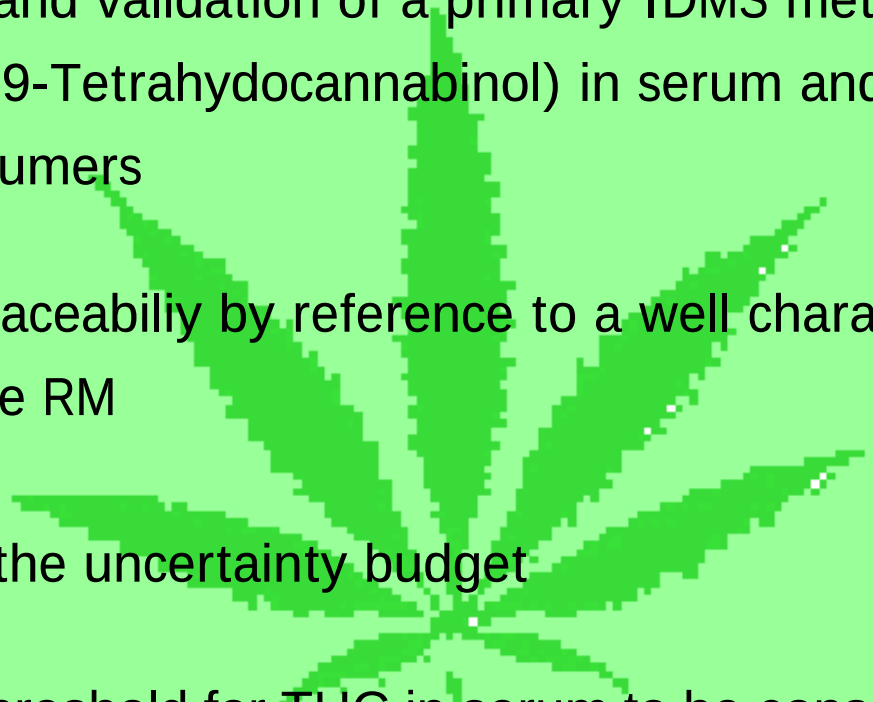
Degrees of equivalence D_i and expanded uncertainty U_i (k = 2) expressed in µmol/mol

Please click onto the graph to get an enlarged version



Red diamonds : participants in **CCQM-K4**
Green triangles : participants in **EUROMET.QM-K4**

Development of CRMs and Reference methods at NMIs for Forensic Analysis



- Development and validation of a primary IDMS method for analysis of THC (delta-9-Tetrahydocannabinol) in serum and urine of cannabis consumers
- Establishing traceabiliy by reference to a well characterized THC pure substance RM
- Evaluation of the uncertainty budget
- Backround: Threshold for THC in serum to be considered an offence set to **1 ng/ml** by german legislation (Dec. 2004)

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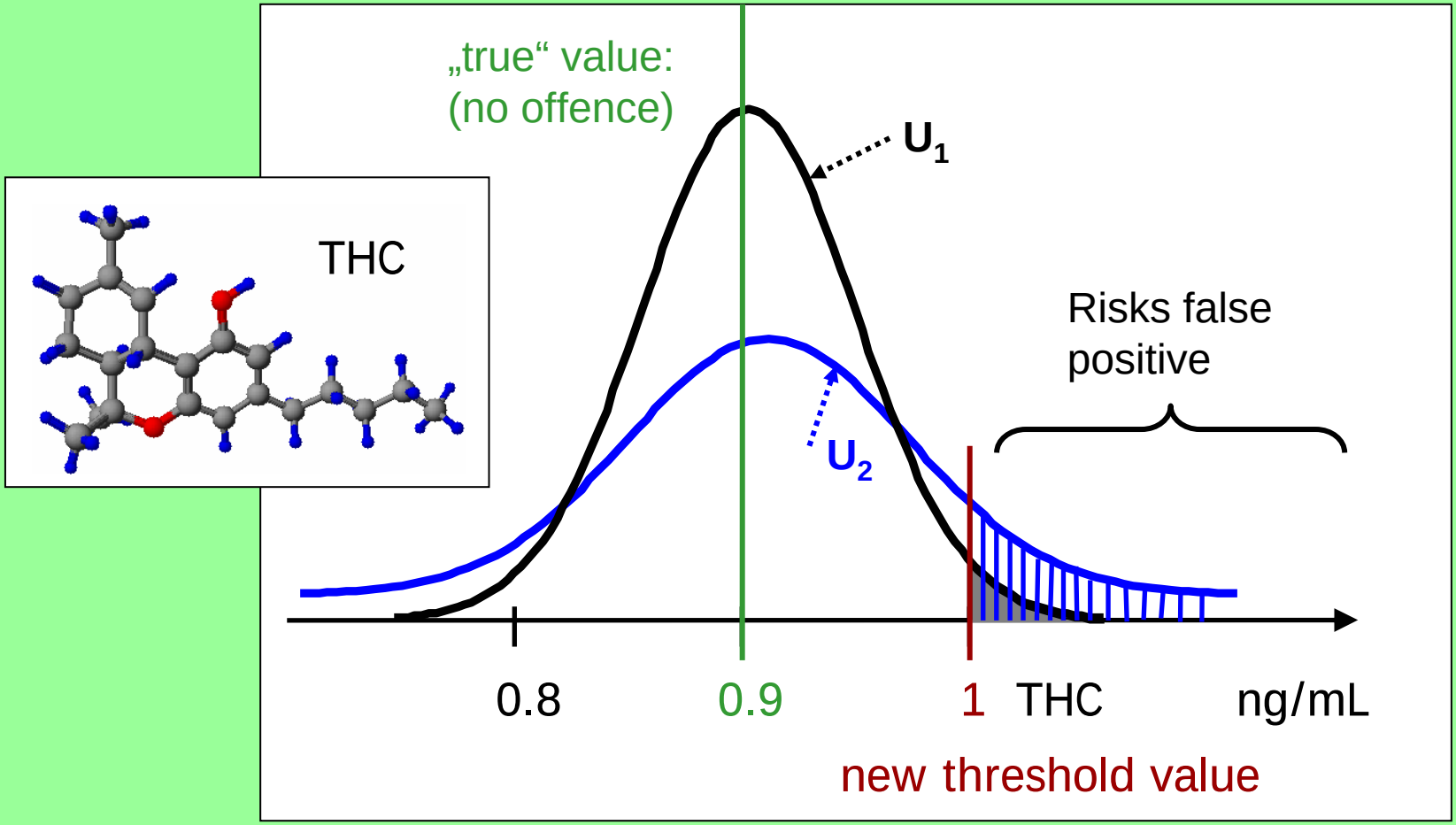
Need for high precision:

Reduction of the risks for false positive/ false negative outcome of tests in forensic routine



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NMI coordinated Proficiency Studies with Reference Values

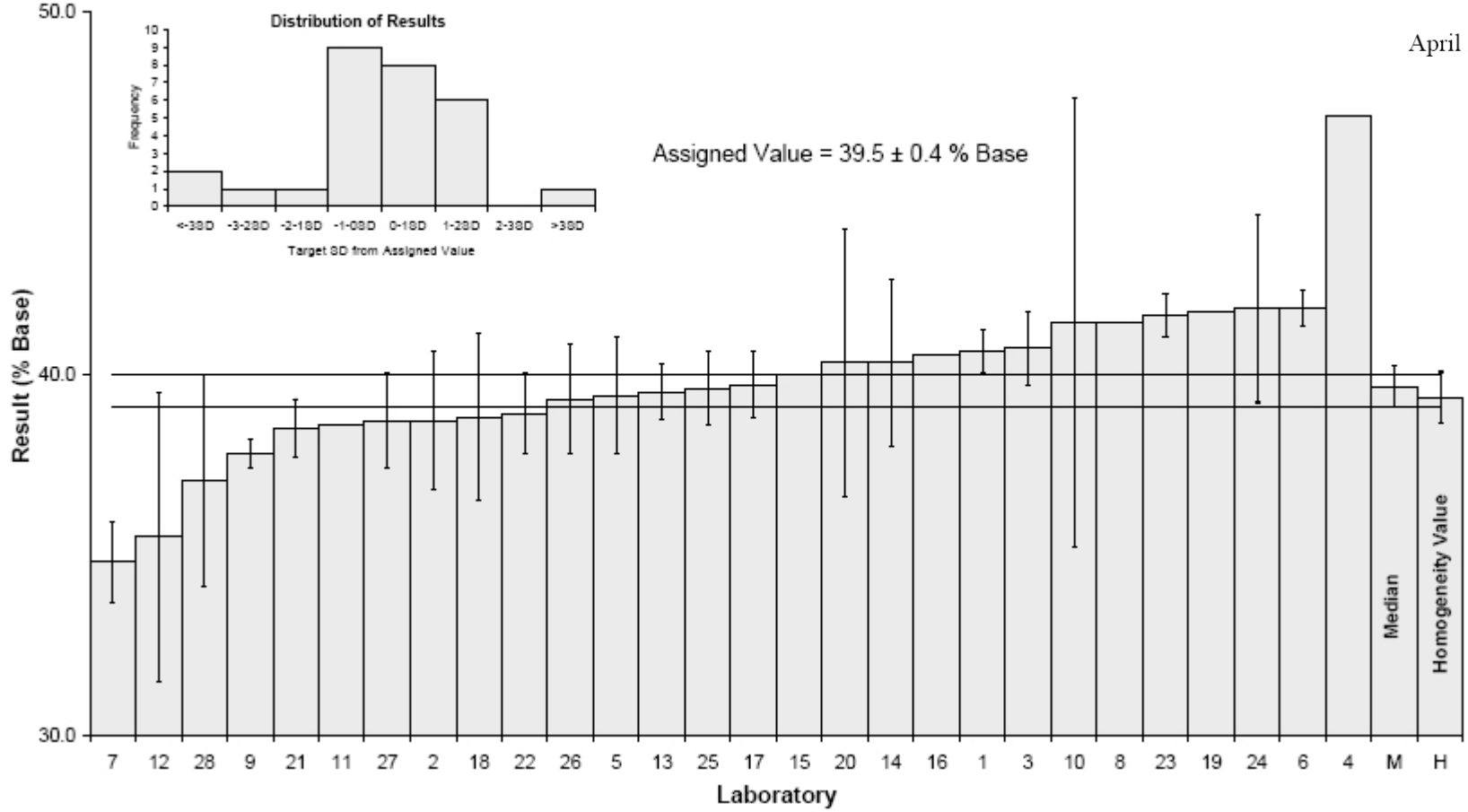
Australian Government
National Measurement Institute

Proficiency Study
No. 05-01

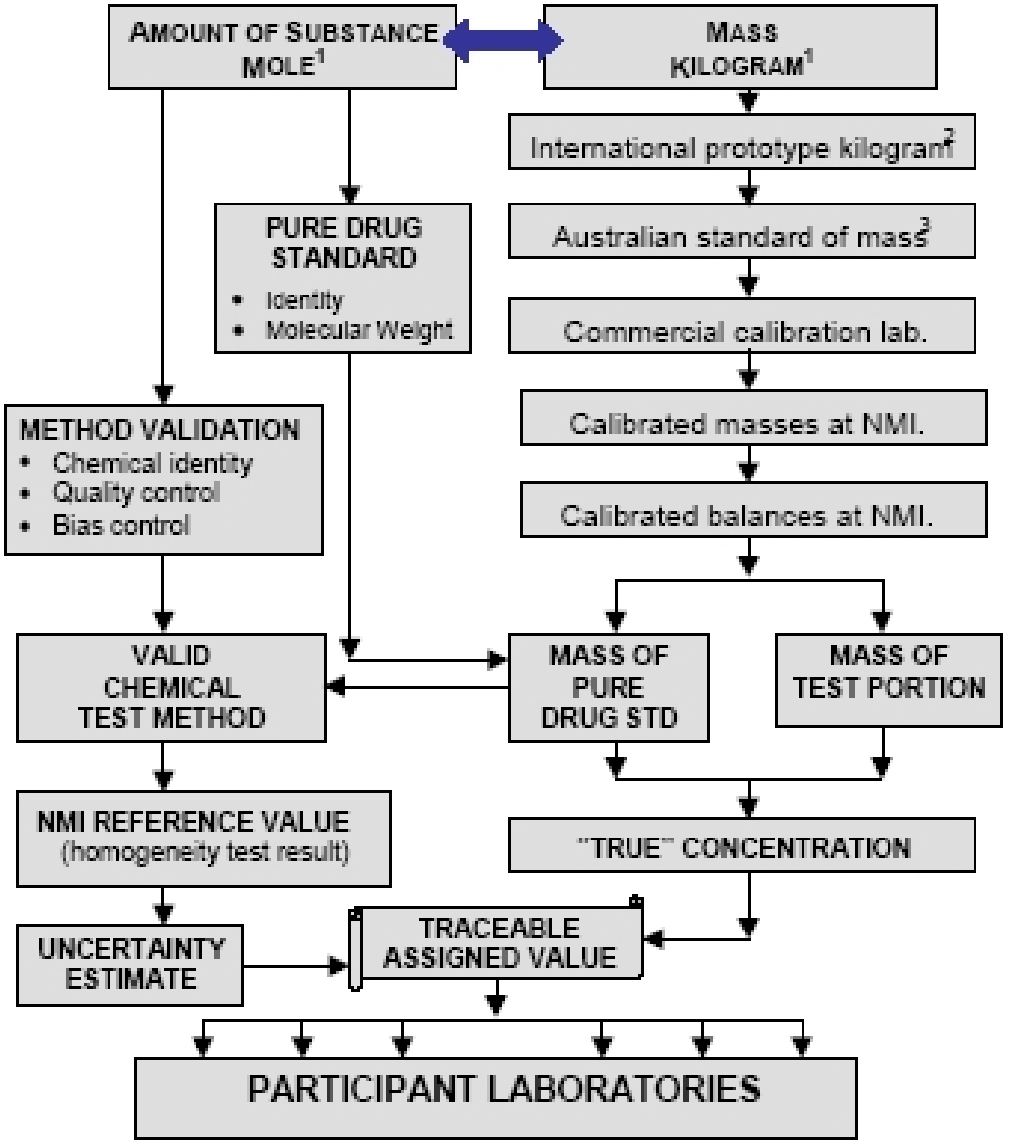
AQA 05-01
Analysis of Heroin

April 2005

Results: Sample S1 - Heroin



Traceability of Reference Values



Linking CCQM studies and comparisons to other national and international activities

Codex Alimentarius Commission

CIPM / BIPM CCQM

Codex Committees (CCMAS)

NMI or designated institute

Standards setting organisations

Methods meeting Codex criteria approach

Reference Measurement Procedure basis of a CMC in the BIPM KCDB

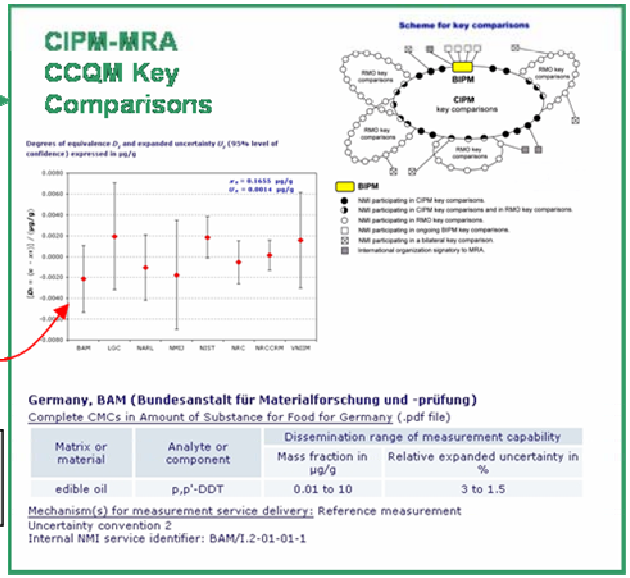
Certified Reference Materials

Reference Value assignment

PT scheme material with reference value assigned

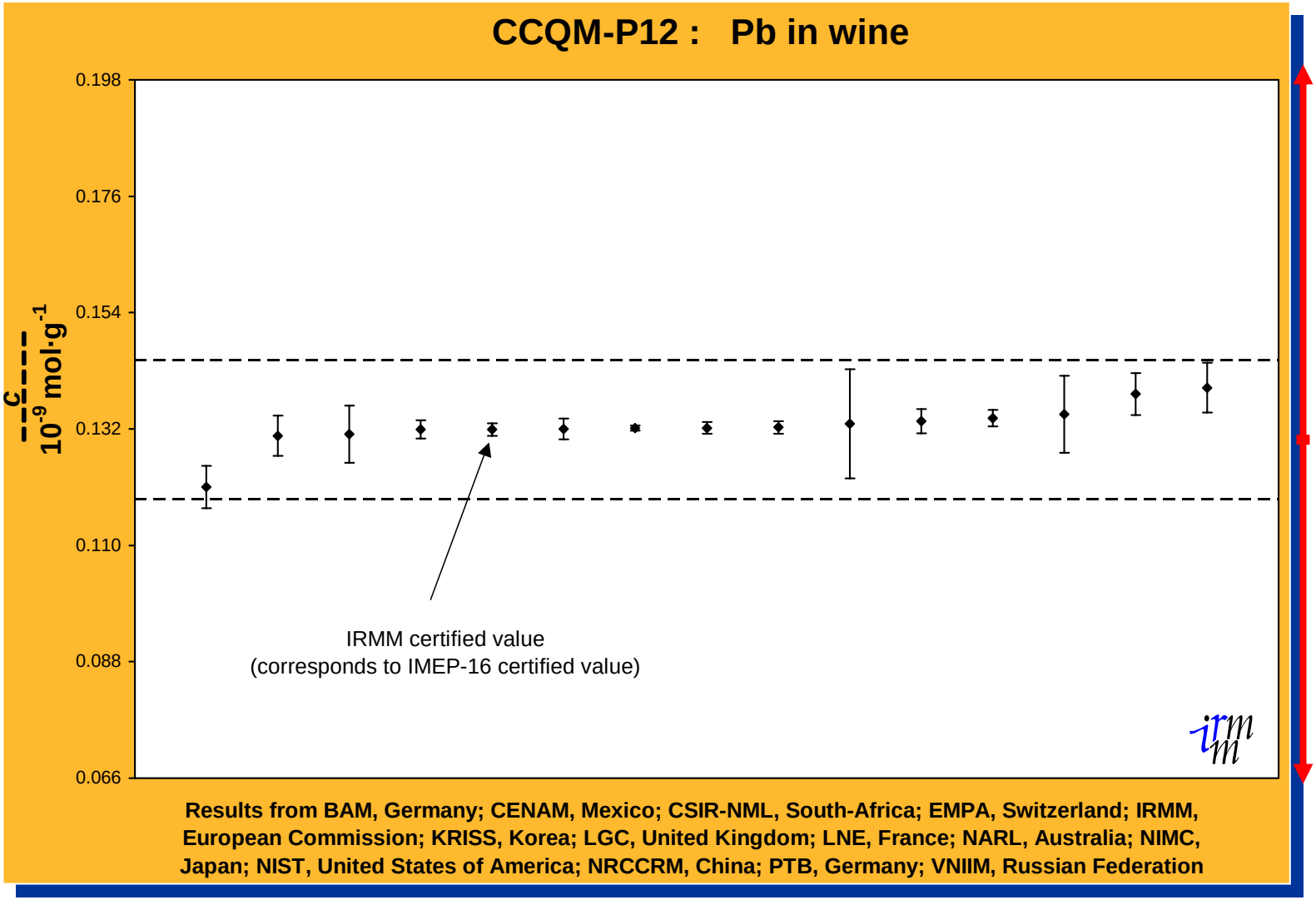
Food Analysis Laboratory (ISO 17025)

Comparable, traceable measurement results with stated uncertainty: providing reliable data for decisions on trade, regulation and risk assessment for foods and feed stuffs

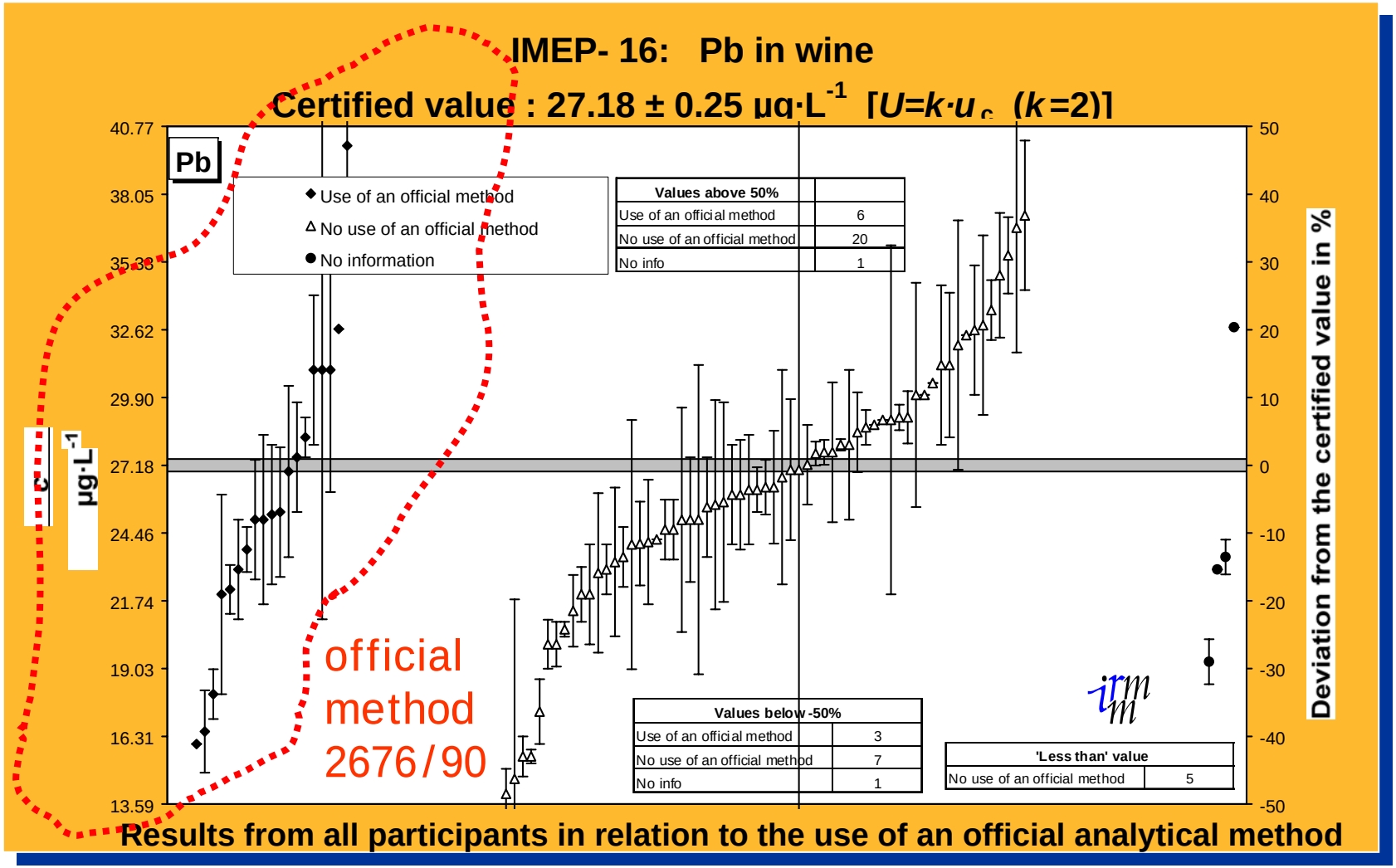


Underpinning measurements in food analysis

CCQM-P12 Pb in Wine



Assessing the quality of results of measurements : IMEP-16



CCQM-P68
19-Norandrosterone
in Freeze Dried Human Urine

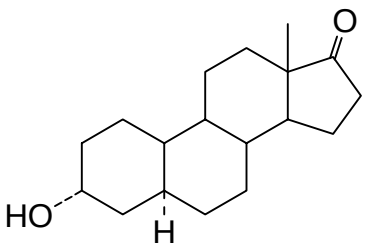
CCQM interactions with WADA

•Measurand

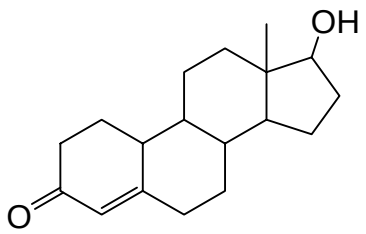
•WADA Technical Document - TD2004 prescribes how testing laboratories should report adverse analytical findings for norandrosterone

- "only the … quantification of 19-norandrosterone and its glucuronide (calculated as the total following hydrolysis of the glucuronide)" are used to report findings

19-Norandrosterone



Nandrolone



•Defined measurand for CCQM-P68

- The total mass fraction of the free and glucronide forms of 19-norandrosterone, reported as equivalents of free 19-norandrosterone

WADA statistics 2004 – Adverse analytical findings reported by accredited laboratories

	Substance Group	Number*	% of all adverse analytical findings
S4.	Anabolic Agents	1,191	36.0%
S9.	Glucocorticosteroids	548	16.6%
S3.	Cannabinoids	518	15.7%
S1.	Stimulants	382	11.6%
S6.	Beta-2-Agonists	381	11.5%
S8.	Masking Agents	157	4.8%
S5.	Peptide Hormones	78	2.4%
P2.	Beta-blockers	25	0.8%
S2.	Narcotics	15	0.5%
S7.	Agents with Anti-oestrogenic Activity	8	0.2%
M1.	Enhancement of Oxygen Transfer	2	0.1%
	TOTAL	**3,305**	

* Some adverse analytical findings may correspond to multiple measurements on the same athlete, including cases of longitudinal studies on testosterone.

S4. Anabolic Agents	Occurences	% within drug class
Testosterone	392	32.9%
Nandrolone	339	28.5%
Stanozolol	226	19.0%
Methandienone	63	5.3%
Methyltestosterone	32	2.7%
Methenolone	22	1.8%
DHEA	20	1.7%
Boldenone	19	1.6%
Mesterolone	18	1.5%
Androsterone	17	1.4%
Clostebol	10	0.8%
delta1-androsten-3,17-dione	9	0.8%
Drostanolone	5	0.4%
delta-1-Testosterone	4	0.3%
Oxymetholone	4	0.3%
Androstenedione	3	0.3%
Boldione	3	0.3%
Oxandrolone	3	0.3%
Methandriol	1	0.1%
Trenbolone	1	0.1%
TOTAL*	**1,191**	

* Some adverse analytical findings correspond to multiple findings on the same athlete, including cases of longitudinal studies on testosterone.

JOINT COMMITTEE for TRACEABILITY in LABORATORY MEDICINE (JCTLM)

Declaration of co-operation

establishing

A framework for the international recognition of available higher-order reference materials, measurement procedures and reference measurement laboratories

".... the traceability of values assigned to calibrators and control materials must be assured through available reference measurement procedures and/or reference materials of a higher order ..."

Annex 1 (3) 2nd para

IVD Manufacturers have requested that NMIs develop internationally recognized reference methods and CRMs to meet this assist them in meeting this traceability requirement.

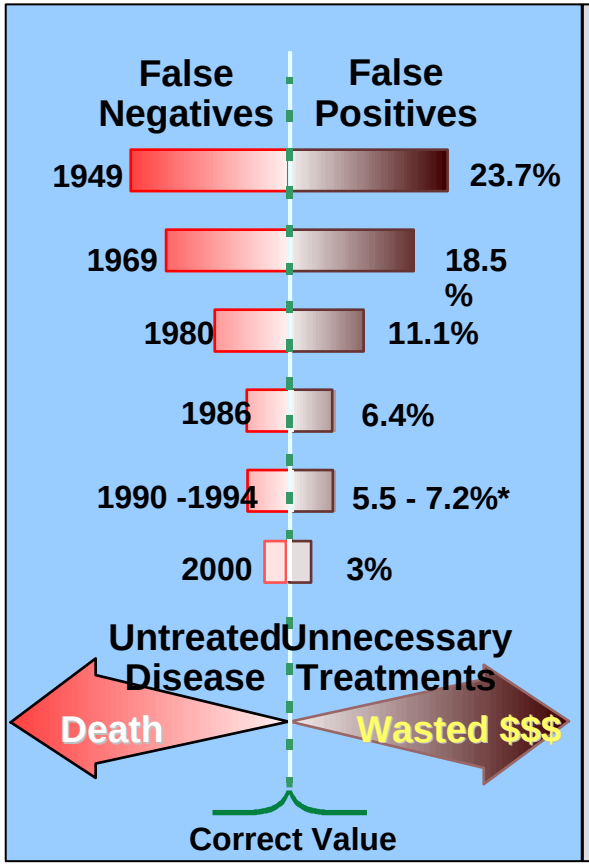
Sponsoring Organizations

Intergovernmental Treaty Organization for Measurement Standards

International NGO for Professionals in Laboratory Medicine

International NGO for Accreditation Bodies

Improved Cholesterol Measurement Accuracy Reduces Health Care Costs and Improves Patient Care



NIST Contributions to National Reference System for Cholesterol

1967 – Pure Cholesterol SRM *(SRM 911)*

1980 – Cholesterol in Serum Definitive Method

1981 – First Cholesterol in Human Serum SRM *(SRM 909)*

1988 – New Suite of Cholesterol in Serum SRMs at Medical Decision Points

1997 – New Suite of Fresh-Frozen Serum SRMs designed to address clinical analyzer commutability issues; Total-, HDL-, and LDL-Cholesterol and Triglyceride Values

Improvement in precision since 1968 has been estimated to save $100M/yr in treatment costs

Data from U.S. Government Accounting Office and College of American Pathologists

What has JCTLM delivered?

A Quality assured database of:

a) Higher Order Reference Materials
b) Reference Measurement Procedures
c) Laboratory Reference Measurement Services (2007)

http://www.bipm.org/jctlm/

For use by (primarily)

a) IVD industry
b) Regulators

List of analytes by category

JCTLM-DB

- JCTLM-DB home
- Search form
- Preamble for JCTLM Lists
- Reference materials no longer listed
- Contact us

JCTLM

- JCTLM
- JCTLM Working Group 1
- JCTLM Working Group 2

You are able to view all analytes sorted by specific category for higher-order reference materials and to select an analyte.

- **Blood gases**
- **Blood groupings**
- **Coagulation factors**
- **Drugs**
- **Electrolytes**

  calcium
  chloride
  lithium
  magnesium
  potassium

- **Enzymes**
- **Metabolites and substrates**
- **Microbial serology**
- **Non-electrolyte metals**
- **Non-peptide hormones**
- **Nucleic acids**

Result of the search: list of reference measurement methods/procedures

JCTLM-DB

- JCTLM-DB home
- Search form
- Preamble for JCTLM Lists
- Reference materials no longer listed
- Contact us

JCTLM

- JCTLM
- JCTLM Working Group 1
- JCTLM Working Group 2

Your search criteria: Reference measurement methods/procedures; Analyte: cholesterol; Analyte category: -; Matrix category: -

Save as PDF file | Modify your selection

Results of the search

Isotope dilution mass spectrometry method for cholesterol in blood plasma

▸ DGKC definitive method for serum cholesterol

Applicable matrice(s)	lyophilized, fresh, or frozen human serum or plasma
Full description of technique(s)	ID/GC/MS
Quantity	Amount-of-substance concentration
Applicable range	2 mmol/l to 10 mmol/l
Expected uncertainty (level of confidence 95%)	0.5 % to 1.5 %
Reference(s)	Siekmann et al., *Z. anal. Chem.*, 1976, **279**, 145-146
Comparability assessment study(ies)	*Metrologia*, 2004, **39**, *Tech. Suppl.*, 08001
Comment(s)	The expanded uncertainty is relative
JCTLM DB identification number	NRMeth 46

Spectrophotometry method for cholesterol in blood serum

▸ CDCAbell-Kendall method for cholesterol

Applicable matrice(s)	lyophilized, fresh, or frozen human serum
Full description of technique(s)	Spectrophotometry
Quantity	Amount-of-substance concentration
Applicable range	0.65 mmol/l to 10.3 mmol/l
Expected uncertainty (level of confidence 95%)	0.12 % to 0.66 %

Result of the search: list of higher-order reference materials

JCTLM-DB

- JCTLM-DB home
- Search form
- Preamble for JCTLM Lists
- RMs no longer listed
- Contact us

JCTLM

- JCTLM
- JCTLM Working Group 1
- JCTLM Working Group 2

Your search criteria : Higher-order reference materials; Analyte: glucose; Analyte category: - ; Matrix category: -

Save as PDF file

Modify your selection

Results of the search

glucose in human serum

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

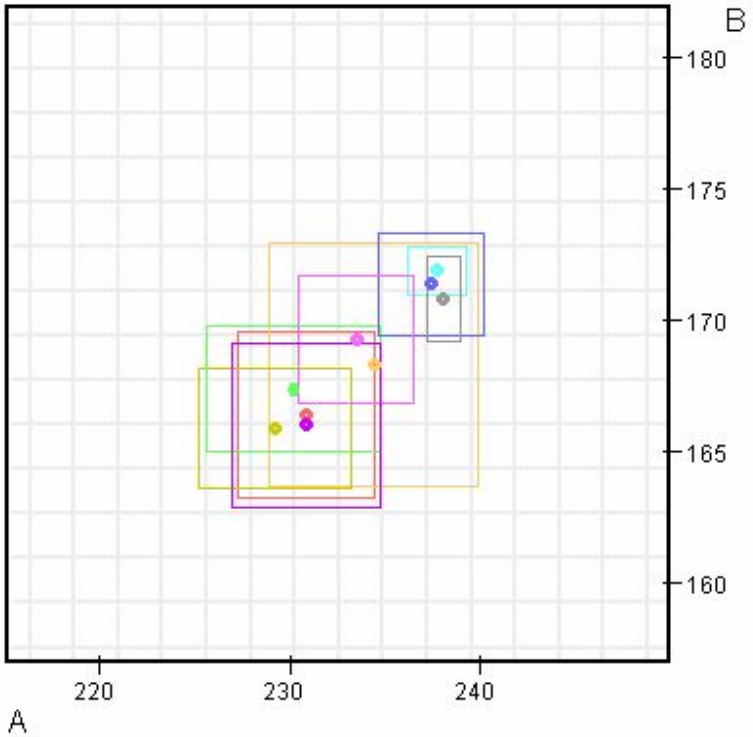
Phone: +1 301 975 6776
Fax: +1 301 948 3730
Email: srminfo@nist.gov
Web: http://www.nist.gov/srm

Name of the reference material	SRM 965a, glucose in frozen human serum
Quantity	Amount-of-substance concentration
Analyte certified/assigned value	1.918 mmol/l to 16.24 mmol/l
Expanded uncertainty (level of confidence 95%)	0.02 mmol/l to 0.19 mmol/l
Other relevant publication(s)	Method used for certification: *Biomed. Mass Spectrom.*, 1982, **9**, 395-405
Traceability	SI
CRM listing	List I

IFCC EQAS, Inter-laboratory comparisons for Reference Measurement Laboratories

RELA 1/2003

Total cholesterol [mg/dl]



Lab	A	p.e.u.	B	p.e.u.	method
01	230,888	3,572	166,409	3,175	ID-MS
05	234,43	5,523	168,31	4,641	ID-MS
08	229,227	4,028	165,907	2,262	ID-MS
11	230,2	4,613	167,4	2,369	ID-MS
12	237,8	1,558	171,9	0,890	spectrometry (Abell-Kendall)
16	237,490	2,764	171,389	1,962	spectrometry (Abell-Kendall)
18	233,5	3,08	169,3	2,42	HPLC
19	238,1	0,860	170,8	1,610	spectrometry (Abell-Kendall)
27	230,888	3,919	166,023	3,105	ID-MS

http:/www.dgkl-rfb.de:81