

How to Draw CMC File ?

Enver Sadıkoğlu

TÜBİTAK ULUSAL METROLOJİ ENSTİTÜSÜ

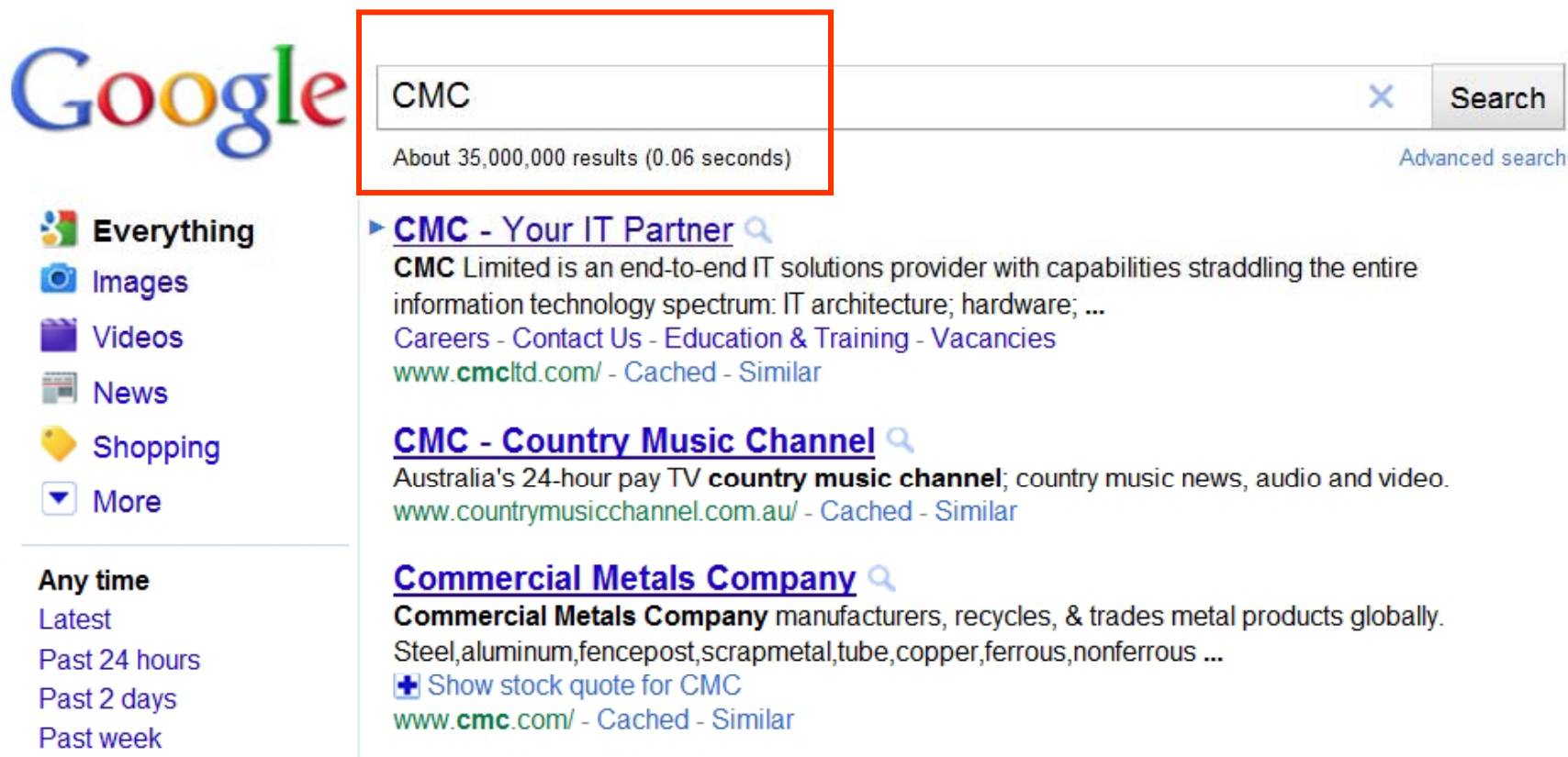
Contents

- What is CMC ? Definitions
- How to Draw CMC Table
- Intra and Interregional CMC Review
- Interlaboratory Comparisons as a Support for CMCs
- Practical Examples
- References

INTRODUCTION

What is CMC ?

What does external world know about CMCs ?



Google

CMC


About 35,000,000 results (0.06 seconds)


Search



Advanced search

Everything
Images
Videos
News
Shopping
More

Any time
Latest
Past 24 hours
Past 2 days
Past week

► **CMC - Your IT Partner** 
CMC Limited is an end-to-end IT solutions provider with capabilities straddling the entire information technology spectrum: IT architecture; hardware; ...
Careers - Contact Us - Education & Training - Vacancies
www.cmcltd.com/ - Cached - Similar

CMC - Country Music Channel 
Australia's 24-hour pay TV **country music channel**; country music news, audio and video.
www.countrymusicchannel.com.au/ - Cached - Similar

Commercial Metals Company 
Commercial Metals Company manufacturers, recycles, & trades metal products globally.
Steel,aluminum,fencepost,scrapmetal,tube,copper,ferrous,nonferrous ...
 Show stock quote for CMC
www.cmc.com/ - Cached - Similar

About 35 000 000 results just in 0.06 seconds
Looks impressive !

What is CMC ?

What does external world know about CMCs ?



CMC Entry

About 4,220,000 results (0.23 seconds)



Search

Advanced search

Everything

Images

Videos

News

Shopping

More

Show search tools

[Welcome to Continental Motorsport Club - Race with the Best - Entry ...](#)

The following is a copy of the current **CMC Entry** form and CMC License Application , both forms are in PDF form, if you don't have a program to open a PDF ...

www.cmcmotocross.com/entry.html - Cached

[PDF] [JCRB Rules of Procedure for CMC entry into Appendix C](#)

File Format: PDF/Adobe Acrobat - [Quick View](#)

JCRB Rules of Procedure for **CMC entry** into Appendix C. The Rules of Procedure of the JCRB were adopted at its 2nd meeting in February 1999, ...

staff.aist.go.jp/sakamoto.yasuhiko/APMP-TCEM/.../JCRB-13_06.pdf

[Confined Space Entry & Rescue | CMC Rescue Inc](#)

The quality and thoroughness of **CMC's** Confined Space **Entry** and Rescue Program was recognized when the State of California based the approved state curriculum ...

www.cmcrecue.com/cmcschoolconf.php - Cached - Similar

[Confined Space Entry Kit | CMC Rescue](#)

When you need to set up for a vertical **entry** into a confined space, this kit ...

www.cmcrecue.com/product.php?dept_id=1148 - Cached

[+ Show more results from cmcrecue.com](#)

Less results in more
time.

But still impressive !

What is CMC ?

What does external world know about CMCs ?



- Everything
- Images
- Videos
- News
- Shopping
- More

All results
Wonder wheel
Related searches
More search tools

Just some 63 000
results.

"Calibration and Measurement Capability"

About 62,700 results (0.24 seconds)



Search

Advanced search

[PDF]

[CALIBRATION AND MEASUREMENT CAPABILITIES. A paper by the joint ...](#)



File Format: PDF/Adobe Acrobat - [Quick View](#)

10 May 2010 ... a CMC is a **calibration and measurement capability** available ... The meanings of the terms **Calibration and Measurement Capability**, CMC, ...

www.bipm.org/.../CIPM11_OPEN_ACCESS_CMC_BMC_ACCEPTED.pdf

[PDF]

[PROCESS FOR VERIFICATION AND PUBLICATION OF CALIBRATION AND ...](#)

File Format: PDF/Adobe Acrobat - [Quick View](#)

Calibration and Measurement Capability (CMC) is listed in Appendix C of the ...

www.bipm.org/utis/en/pdf/WG2-P-03A.pdf - [Similar](#)

[+ Show more results from bipm.org](#)

[Agilent | BMC becomes CMC](#)

a CMC is a **calibration and measurement capability** available to customers under normal conditions: (a) as published in the BIPM key comparison database ...

www.agilent.com > ... > Technical Support > Metrology Forum - [Cached](#) - [Similar](#)



www.bipm.org

What is CMC ?

What does CMC stand for ?

Category filter:

Acronym	Definition
---------	------------

CMC	Canadian Music Centre (<i>University of Calgary</i>)
CMC	Claremont McKenna College (<i>California</i>)
CMC	Canadian Museum of Civilization
CMC	Carolinas Medical Center (<i>Charlotte, NC</i>)
CMC	Certified Management Consultant
CMC	Colorado Mountain College (<i>Glenwood Springs, Colorado, USA</i>)
CMC	Commandant of the Marine Corps
CMC	Computer-Mediated Communications
CMC	Command Master Chief
CMC	Chemistry, Manufacturing and Controls (<i>part of new pharmaceutical product application to the US Food and Drug Administration</i>)
CMC	Christian Medical College
CMC	Carboxymethylcellulose
CMC	Central Military Commission (<i>China</i>)
CMC	Colorado Mountain Club
CMC	Crime and Misconduct Commission (<i>Australia</i>)
CMC	Community Medical Center
CMC	Ceramic Matrix Composite
CMC	Canadian Microelectronics Corporation
CMC	Center for Marine Conservation
CMC	Canadian Meteorological Centre
CMC	Comcast Media Center
CMC	Catholic Medical Center (<i>Manchester, New Hampshire</i>)
CMC	Case Medical Center (<i>University Hospitals of Cleveland</i>)

What is CMC ?

What does CMC stand for ?

Category filter: Science & Medicine (43) ▾

Acronym

CMC	Most Common (0)
CMC	Technology (28)
CMC	Government & Military (35)
CMC	Science & Medicine (43)
CMC	Business (33)
CMC	Organizations (64)
CMC	Slang / Jargon (3)
CMC	Ceramic Matrix Composite
CMC	Canadian Microelectronics Corporation
CMC	Center for Marine Conservation
CMC	Catholic Medical Center (<i>Manchester, New Hampshire</i>)
CMC	Case Medical Center (<i>University Hospitals of Cleveland</i>)
CMC	Carpometacarpal (<i>joint</i>)
CMC	Common Mode Choke
CMC	Computer-Mediated Conversation
CMC	Certified Microbial Consultant (<i>American Indoor Air Quality Council</i>)
CMC	Conditional Moment Closure (<i>engineering</i>)
CMC	Criteria Maximum Concentration (<i>Water quality</i>)
CMC	Christian Medical Commission
CMC	Chronic Mucocutaneous Candidiasis
CMC	Calibration and Measurement Capability (<i>metrology</i>)
CMC	Certified Medical Coder (<i>Practice Management Institute</i>)

**Acronym CMC is under
category “Science &
Medicine”**

BIPM's Web-Site – Reference Source

→ Guidance on CMCs

Title	Doc. no.	Latest update
↙ <u>Calibration and Measurement Capabilities in the context of the CIPM MRA</u>	CIPM MRA-D-04	Jan. 2011
↙ <u>Additional instructions and templates for CMC excel files:</u> General EM PR QM RI		
↙ For the classification of services in the various fields, see: K C D B A U V E M L M P R Q M R I T T F		
↙ <u>Traceability in the CIPM MRA</u>	CIPM/2009-24	Oct. 2009
↙ <u>JCRB guidelines for the monitoring and reporting of the operation of quality systems by RMOs</u>	CIPM MRA-G-02	Jan. 2011
↙ <u>Guidelines for the review of CMCs and the monitoring and reporting of the operation of quality systems by international intergovernmental organizations who are signatories of the CIPM MRA</u>	CIPM MRA-G-03	Nov. 2008
↙ <u>Recommendations for on-site visits by peers and selection criteria for on-site visit peer reviewers</u>	CIPM/2007-25	Apr. 2008
↙ <u>Uncertainty contributions of the device under calibration or measurement</u>	JCRB-8/9	Feb. 2002
↙ <u>Subcontracting of measurements under the CIPM MRA</u>	CIPM/2005-09	

BIPM's Web-Site – Reference Source

KCDB Frequently-Asked-Questions - Vos questions sur la KCDB



Related links

- [KCDB Statistics](#)
- [KCDB FAQs](#)
- [CIPM MRA](#)
- [JCRB](#)
- [Find my NMI](#)
- [Metrologia](#)

Contact us

- BIPM.KCDB@bipm.org

KCDB FAQs

[I. What is the KCDB and who uses it?](#)

[II. What kind of electronic files may I find in the KCDB?](#)

[III. How can I find comparisons or CMCs in the KCDB?](#)

[IV. The acronym or the full name of my NMI has changed: how it this dealt with in the KCDB?](#)

[V. What is a "KCDB absolute URL address"?](#)

[VI. Where can I find information about Pilot Studies?](#)

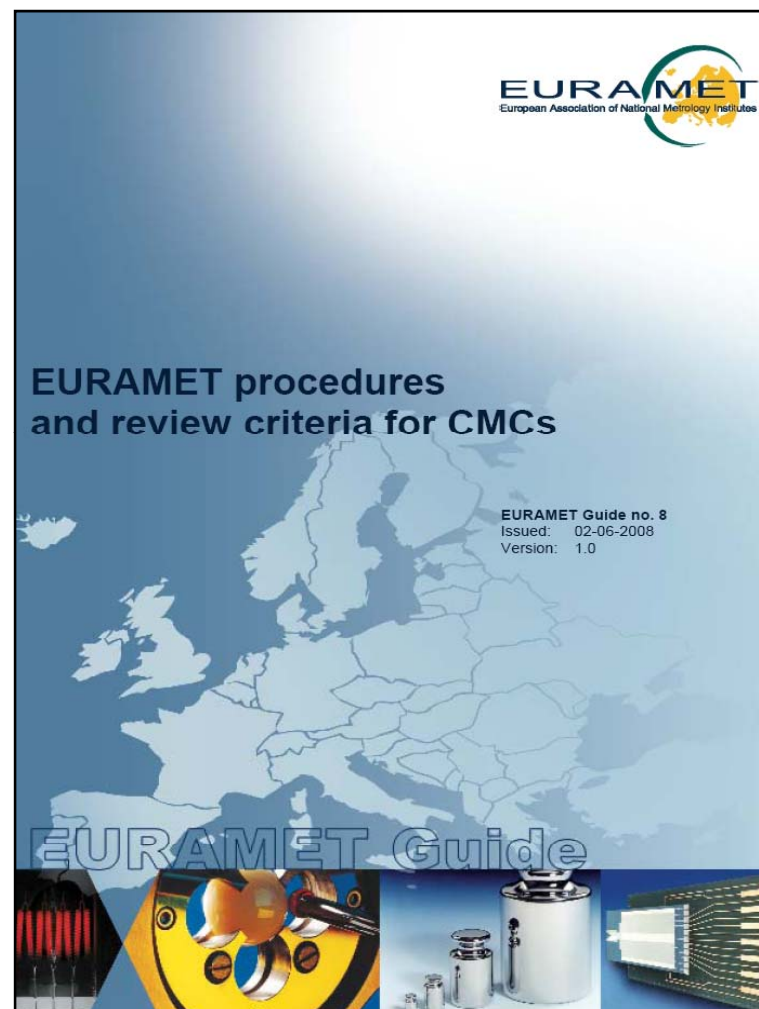
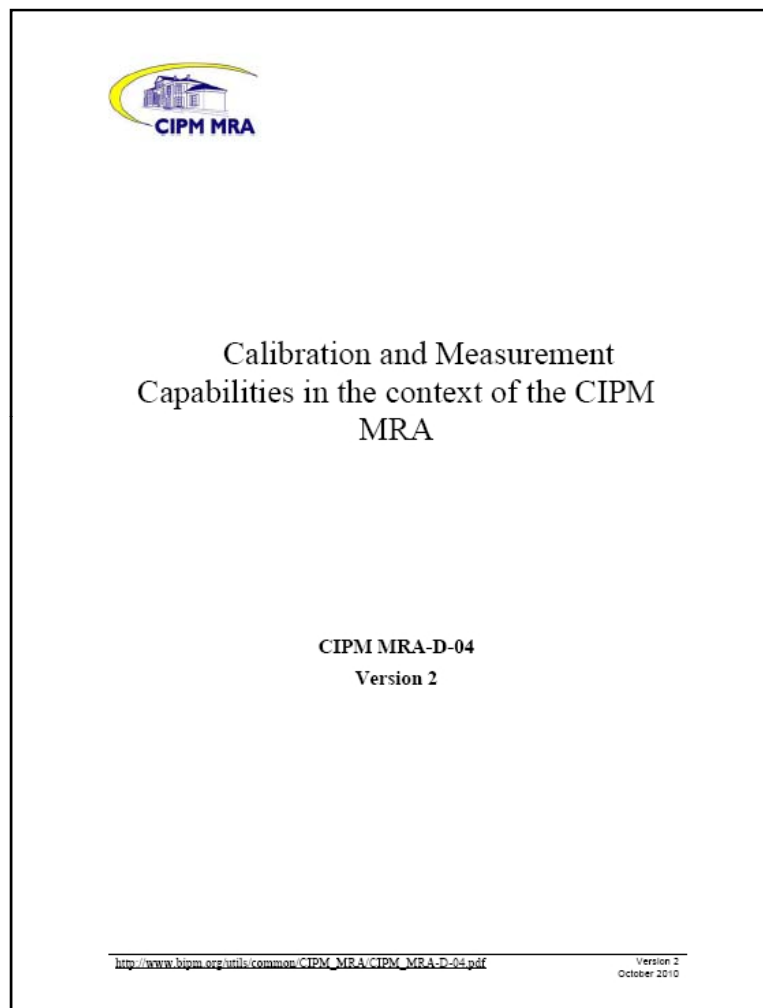
[VII. How can I publish the Final Report of a comparison in the Metrologia Technical Supplement?](#)

[VIII. How can I get statistics on the content of the KCDB?](#)

[IX. Example of the use of the KCDB text-free search engine: how can I make a diagram of the distribution of key comparisons according to their originating RMOs?](#)

[X. Where can I find EXCEL files of CMCs?](#)

Guidance Documents



Guidance Documents



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1. General policy
 2. Drawing up CMC Excel files
 3. CMC review criteria
 4. CMC review process
 5. Impact of comparison results on CMCs
- Appendix 1: Questionnaire for the Review of EURAMET CMCs
- Appendix 2: Intra-regional review process

DEFINITIONS

A CMC is a calibration and measurement capability available to customers under normal conditions:

- (a) **as published** in the BIPM **key comparison database (KCDB)** of the CIPM MRA; or
- (b) **as described** in the laboratory's **scope of accreditation** granted by a signatory to the ILAC Arrangement. "

Where the term NMI is used it is intended to include Designated Institutes (DIs) within the framework of the CIPM MRA."

CMC - Definitions

The meanings of the terms Calibration and Measurement Capability, CMC, (as used in the CIPM MRA), and Best Measurement Capability, BMC, (as used historically in connection with the uncertainties stated in the scope of an accredited laboratory) are identical. The terms BMC and CMC should be interpreted similarly and consistently in the current areas of application.

Under a CMC, the measurement or calibration should be:

- performed according **to a documented procedure** and have an established uncertainty budget **under the management system** of the NMI or the accredited laboratory;
- performed **on a regular basis** (including on demand or scheduled for convenience at specific times in the year); and **available to all clients**.

The ability of some NMIs to offer **“special” calibrations**, with exceptionally **low uncertainties** which are not “under normal conditions,” and which are usually offered only to a small sub-set of the NMI's clients for research or for reasons of national policy, is acknowledged.

These calibrations are not within the CIPM MRA, cannot bear the equivalence statement drawn up by the JCRB, and cannot bear the logo of the CIPM MRA.

Normally there are **four ways** in which a complete statement of uncertainty may be expressed (range, equation, fixed value and a matrix).

Examples: 0.4 to 0.8 μg
Q[0.2, 0.5 L], L in m
0.2 dB or 1.0%
Matrix 5.1



	10 Hz	20 Hz
100 mV / 200 mV	42	35
300 mV / 500 mV	20	18
1 V / 2 V	12	10
3 V / 4 V	14	12
10 V	16	12
20 V	25	20
30 V	25	20
100 V	40	32
300 V	-	35
500 V	-	45
1000 V	-	60

Uncertainties should always comply with the Guide to the Expression of Uncertainty in Measurement (GUM) and should include the components listed in the relevant **key comparison protocols** of the CIPM Consultative Committees. These can be found in the reports of comparisons published in the CIPM MRA KCDB as a key or supplementary comparison.

Is not it better to state that an estimation of uncertainty should always comply with the GUM ?

CMC - Definitions

The NMI CMCs which are published in the KCDB **provide a unique, peer reviewed traceability route to the SI** or, where this is not possible, to agreed - upon stated references or appropriate higher order standards.

Assessors of accredited laboratories are encouraged always to consult the KCDB (<http://kcdb.bipm.org>) when reviewing the uncertainty statement and budget of a laboratory in order to ensure that the claimed uncertainties **are consistent** with those of the NMI through which the laboratory claims traceability.

DRAWING UP CMCs

Drawing up CMCs

Two different cases:

New CMCs: CMCs files from a institute that has not previously submitted CMCs in a particular area

Modified CMCs: CMCs files than imply the modification or expansion of already approved

Drawing up CMCs

All necessary information on JCRB web-site:

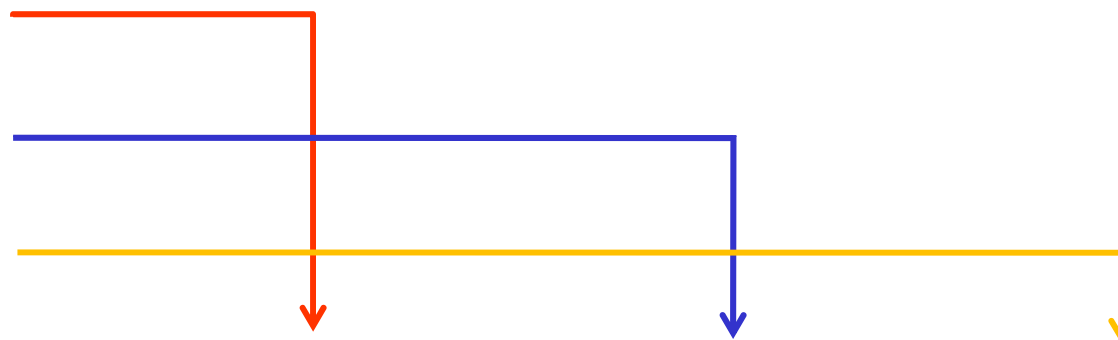
“Instructions for drawing up CMC excel files”:

- Basic Excel template
- Excel template with uncertainty matrices and closely related CMCs
- Excel template for CMCs in chemistry
- Instructions for closely related CMCs
- Additional instructions for CMCs files in EM
- Instructions for uncertainty matrices in CMC files
- International rules for filling in the CMC tables for ionizing radiation

Drawing up CMCs

CMC Table consists of three different parts:

- “White” part
- “Blue” part
- “Yellow” part



Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					Reference Standard used in calibration		List of Comparisons supporting this measurement/calibration service	Comments to be published via the web page	Administration				
Quantity/Class	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Standard	Source of traceability			NMI Service Identifier	Service Category	NMI	Review Status	Review Comments

Drawing up CMCs

CMC Table - “White” part

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	CIPM MRA Appendix C Calibration and Measurement Capability (CMC) Declarations												
2													
3	<u>Calibration or Measurement Service</u>			<u>Measurand Level or Range</u>			<u>Measurement Conditions/Independent Variable</u>		<u>Expanded Uncertainty</u>				
4	<u>Quantity/ Class</u>	<u>Instrument or Artifact</u>	<u>Instrument Type or Method</u>	<u>Minimum value</u>	<u>Maximum value</u>	<u>Units</u>	<u>Parameter</u>	<u>Specifications</u>	<u>Value</u>	<u>Units</u>	<u>Coverage Factor</u>	<u>Level of Confidence</u>	<u>Is the expanded uncertainty a relative one?</u>
5													
6													

Quantity: **Mass**

Instrument Type or Method:
Comparison in Air

Instrument or Artefact:
Mass standards

Drawing up CMCs

CMC Table - “White” part

Confidence Level: **95 %**

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	CIPM MRA Appendix C Calibration and Measurement Capability (CMC) Declarations												
2													
3	Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty				
4	Quantity/ Class	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?
5													
6													

Minimum
value: **1**

Maximum
value:
100

Units: **mg**

Units: **µg**

Coverage Factor: **2**

No

Value: **0.4 to 0.8**

Drawing up CMCs

CMC Table - “White” part

M	N		O	P	Q	R	S
	<u>Reference Standard used in calibration</u>		<u>List of Comparisons supporting this measurement/calibration service</u>	<u>Comments to be published via the web page</u>			
<u>Is the expanded uncertainty a relative one?</u>	<u>Standard</u>	<u>Source of traceability</u>			<u>NMI Service Identifier</u>	<u>Service Category</u>	

Any specific comments related to the service:
Uncertainty scales with measure and level. The volume of the mass standards is known.

Drawing up CMCs

CMC Table - “White” part

Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					Comments
Class	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	
Mass	Mass standards	Comparison in air	1	100	mg			0.4 to 0.8	µg	2	95%	No	Uncertainty scales with measurand level. The volume of the mass standards is known.
Mass	Mass standards	Comparison in air	0.1	1	g			0.8 to 0.9	µg	2	95%	No	Uncertainty scales with measurand level. The volume of the mass standards is known.
Mass	Mass standards	Comparison in air	1	10	g			0.9 to 1.5	µg	2	95%	No	Uncertainty scales with measurand level. The volume of the mass standards is known.

Drawing up CMCs

CMC Table - “Blue” part

N		O	P
<u>Reference Standard used in calibration</u>		<u>List of Comparisons supporting this measurement/calibration service</u>	
<u>Standard</u>	<u>Source of traceability</u>		

List of Comparisons:
EUROMET Project No 441

Standard used as a reference in calibration:
Stainless steel mass standard

Source of traceability:
NPL, PTB, etc.

Drawing up CMCs

CMC Table - “Yellow” part

<u>Administration</u>				
<u>NMI Service Identifier</u>	<u>Service Category</u>	<u>NMI</u>	<u>Review Status</u>	<u>Review Comments</u>

NMI Service Identifier:
Code of the service



Each laboratory can choose how to identify its internal service identifiers. The NMI internal service identifiers are often given by a simple number (for instance “10”).

Drawing up CMCs

CMC Table - “Yellow” part

<u>Administration</u>					
<u>NMI Service Identifier</u>	<u>Service Category</u>	<u>NMI</u>		<u>Review Status</u>	<u>Review Comments</u>

Cells used during review process

Service Category:
Code from the
Classification of Services

Prepared by WG under the relevant CC. Approved by the relevant CC.

Drawing up CMCs

CMC Table - “White” part

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	CIPM MRA Appendix C Calibration and Measurement Capability (CMC) Declarations												
2													
3	<u>Calibration or Measurement Service</u>			<u>Measurand Level or Range</u>			<u>Measurement Conditions/Independent Variable</u>		<u>Expanded Uncertainty</u>				
4	<u>Quantity/ Class</u>	<u>Instrument or Artifact</u>	<u>Instrument Type or Method</u>	<u>Minimum value</u>	<u>Maximum value</u>	<u>Units</u>	<u>Parameter</u>	<u>Specifications</u>	<u>Value</u>	<u>Units</u>	<u>Coverage Factor</u>	<u>Level of Confidence</u>	<u>Is the expanded uncertainty a relative one?</u>
5													
6													

Class:
End standards

Instrument Type or Method:
Mechanical Comparison to gauge block

Instrument or Artefact:
Length bar (long gauge blok): central length L

Drawing up CMCs

CMC Table - “White” part

Confidence Level: **95 %**

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	CIPM MRA Appendix C Calibration and Measurement Capability (CMC) Declarations												
2													
3	<u>Calibration or Measurement Service</u>			<u>Measurand Level or Range</u>			<u>Measurement Conditions/Independent Variable</u>		<u>Expanded Uncertainty</u>				
4	<u>Quantity/ Class</u>	<u>Instrument or Artifact</u>	<u>Instrument Type or Method</u>	<u>Minimum value</u>	<u>Maximum value</u>	<u>Units</u>	<u>Parameter</u>	<u>Specifications</u>	<u>Value</u>	<u>Units</u>	<u>Coverage Factor</u>	<u>Level of Confidence</u>	<u>Is the expanded uncertainty a relative one?</u>
5													
6													

Minimum value:
400

Maximum value:
1000

Units: **mm**

Parameter:
horizontal

Parameter:
Orientation

Units: **mm**

Value: **Q[56,0.4 L], L in mm**

Coverage Factor: **2**

No

Drawing up CMCs

CMC Table - “White” part

M	N		O	P	Q	R	S
	<u>Reference Standard used in calibration</u>		<u>List of Comparisons supporting this measurement/calibration service</u>	<u>Comments to be published via the web page</u>			
<u>Is the expanded uncertainty a relative one?</u>	<u>Standard</u>	<u>Source of traceability</u>			<u>NMI Service Identifier</u>	<u>Service Category</u>	

Any specific comments
related to the service:
According to ISO 3650

Drawing up CMCs

CMC Table - “Blue” part

N		O	P
<u>Reference Standard used in calibration</u>		<u>List of Comparisons supporting this measurement/calibration service</u>	
<u>Standard</u>	<u>Source of traceability</u>		

Standard used as a reference in calibration:
reference gauge blocks

Source of traceability:
PTB

List of Comparisons:
None

Drawing up CMCs - Traceability

A National Metrology Institute (NMI) or other Designated Institute (DI) publishing Calibration and Measurement Capabilities (CMCs) in the BIPM Key Comparison Database (KCDB) **has two choices** for establishing its **traceability** route to the SI:

Traceability in the CIPM MRA.

A National Metrology Institute (NMI) or other Designated Institute (DI) publishing Calibration and Measurement Capabilities (CMCs) in the BIPM Key Comparison Database (KCDB) has two choices for establishing its traceability route to the SI.

1. via a primary realization or representation of the unit of measurement concerned, in which case traceability must be declared to its own demonstrable realization of the SI;
2. via another NMI or DI having relevant CMCs with appropriate uncertainty published in the KCDB or through calibration and measurement services offered by the BIPM, in which case traceability must be declared through the laboratory providing the service.

In exceptional cases, where neither of these two routes can be strictly applied, alternative paths for establishing the traceability to recognized standards may be proposed to the CIPM through the corresponding Consultative Committee. The list of these exceptions is maintained by the BIPM and is available in the CIPM MRA documents part of the BIPM website. The list of exceptions for each field should be periodically reviewed by the corresponding Consultative Committee.

Note 1: In order for a primary realization or representation of the unit of measurement to be considered valid, it requires the approval of the relevant Consultative Committee.

Note 2: The NMI or DI must make available a full assessment of the uncertainty budget and the traceability route for its measurement activity when submitting CMCs for intra- and inter-Regional review.

Note 3: For auxiliary influence quantities, not part of the main traceability path to the SI for a particular measurand and with uncertainties that can be shown to make only a minor contribution to the total combined uncertainty of the CMC, an NMI or other DI is free to use measurement services provided by laboratories accredited by a signatory to the ILAC Arrangement.

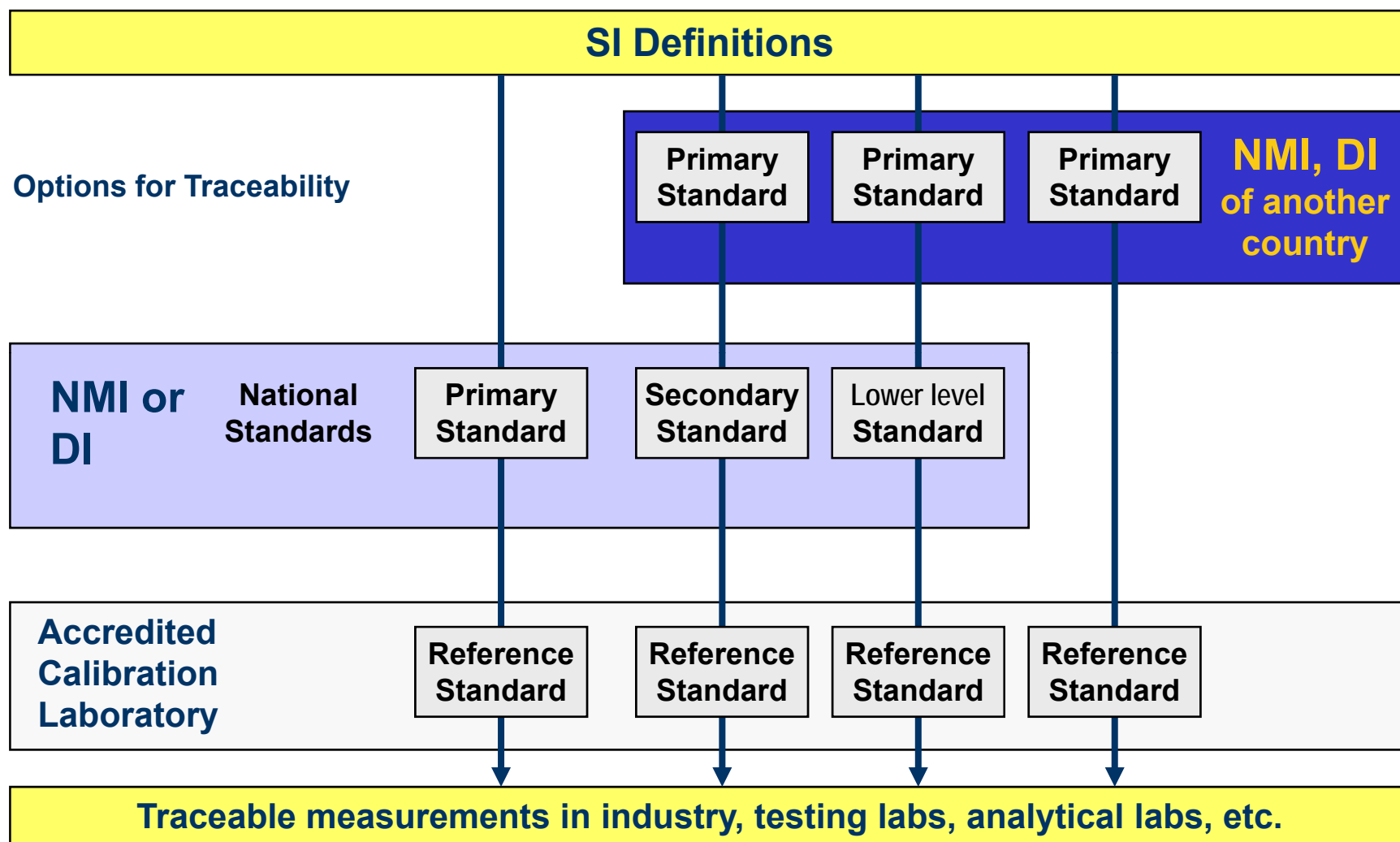
Note 4: Traceability route 1 includes the case of NMIs or DIs using certified reference materials (CRMs) or high-purity primary chemical reference materials that have been value-assigned by applying their own measurement capabilities as described and recognized within published CMCs.

CIPM 2009-04

Drawing up CMCs - Traceability

- **via a primary realization or representation of the unit** of measurement concerned, in which case traceability must be declared to its own demonstrable realization of the SI;
- **via another NMI or DI having relevant CMCs** with appropriate uncertainty published in the KCDB or through calibration and measurement services offered by the BIPM, in which case traceability must be declared through the laboratory providing the service.

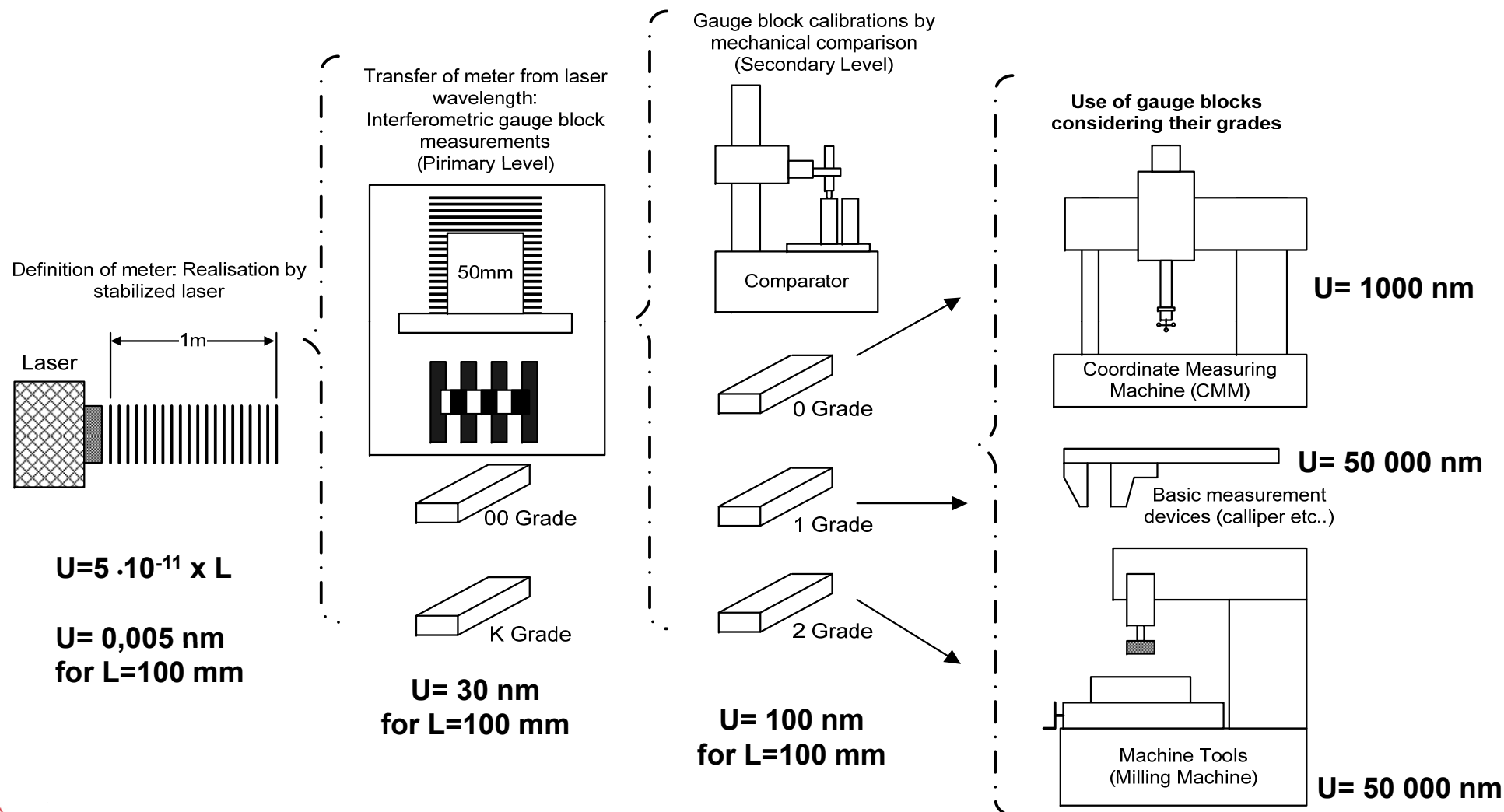
Drawing up CMCs - Traceability



Drawing up CMCs - Traceability

For auxiliary influence quantities, not part of the main traceability path to the SI for a particular measurand and with uncertainties that can be shown to make only a minor contribution to the total combined uncertainty of the CMC, an NMI or other DI is free to use measurement services provided by laboratories accredited by a signatory to the ILAC Arrangement.

Example of Traceability



Drawing up CMCs

CMC Table - “White” part

End standards	Gauge block: central length L	Mechanical comparison	0.5	100	mm	Orientation	vertical	$Q[56, 0.7 L], L$ in mm	nm	2	95%	No
End standards	Length bar (long gauge block): central length L	Interferometry, exact fractions	100	300	mm	Orientation	vertical	$Q[35, 0.40 L], L$ in mm	nm	2	95%	No
End standards	Length bar (long gauge block): central length L	Mechanical comparison to gauge block	125	300	mm	Orientation	horizontal	$Q[56, 0.6 L], L$ in mm	nm	2	95%	No
End standards	Length bar (long gauge block): central length L	Mechanical comparison to gauge block	400	1000	mm	Orientation	horizontal	$Q[56, 0.4 L], L$ in mm	nm	2	95%	No

Drawing up CMCs

CMC Table - “Yellow” part

<u>Administration</u>				
<u>NMI Service Identifier</u>	<u>Service Category</u>	<u>NMI</u>	<u>Review Status</u>	<u>Review Comments</u>

Service Category:
Code from the
Classification of Services



Prepared by WG under the relevant CC. Approved by the relevant CC.

Drawing up CMCs

Examples of “Service Categories”

CLASSIFICATION OF SERVICES IN MASS AND RELATED QUANTITIES

21 October 2003

METROLOGY AREA: MASS AND RELATED QUANTITIES

BRANCH: MASS

1. Mass
- 1.1 Mass standard
- 1.1.1 Mass standard¹: mass standard

BRANCH: DENSITY

2. Density
- 2.1 Density of solid
- 2.1.1 Density of solid: solid density artefact
- 2.1.2 Volume of solid: solid artefact
- 2.2 Density of liquid
- 2.2.1 Density of liquid: density measuring device, standard volume vessel

BRANCH: PRESSURE

3. Pressure
- 3.1 Absolute pressure
- 3.1.1 Gas medium: pressure measuring device, standard pressure generator, vacuum gauge, pressure gauge, piston manometer, pressure balance
- 3.1.2 Liquid medium: pressure measuring device, standard pressure generator, pressure gauge, pressure balance
- 3.2 Gauge pressure
- 3.2.1 Gas medium: pressure measuring device, standard pressure generator, pressure gauge, digital piston manometer, pressure balance
- 3.2.2 Liquid medium: pressure measuring device, standard pressure generator, pressure gauge, pressure balance, pressure multiplier
- 3.3 Differential pressure
- 3.3.1 Gas medium: pressure measuring device, standard pressure generator, pressure gauge, digital piston manometer, pressure balance, pressure divider
- 3.3.2 Liquid medium: pressure measuring device, standard pressure generator, pressure gauge, pressure balance
- 3.4 Dynamic pressure
- 3.4.1 Gas medium: pressure measuring device, standard pressure generator, pressure gauge
- 3.4.2 Liquid medium: pressure measuring device, standard pressure generator, pressure gauge

BRANCH: FORCE

4. Force
- 4.1 Tension
- 4.1.1 Tension: force measuring device
- 4.2 Compression
- 4.2.1 Compression: force measuring device
- 4.3 Tension and compression
- 4.3.1 Tension and compression: force measuring device

¹ The instrument or artefact is indicated in italic characters for each service.

CLASSIFICATION OF SERVICES IN LENGTH

Version dated 12 September 2005

Click [here](#) to get the Classification of services in other languages

METROLOGY AREA: LENGTH

BRANCH: LASER

1. Radiations of the mise en pratique
- 1.1 Laser radiations
- 1.1.1 Stabilized laser of the mise en pratique¹: vacuum wavelength, optical frequency
- 1.1.2 Other stabilized lasers: vacuum wavelength, optical frequency
- 1.2 Lamp radiations
- 1.2.1 Spectral lamp: vacuum wavelength, optical frequency

BRANCH: DIMENSIONAL METROLOGY

2. Linear dimensions
- 2.1 Length instruments
- 2.1.1 Laser length interferometer (system, optics, refractometer): error of indicated displacement, wavelength compensation
- 2.1.2 Electronic Distance Measuring Interferometer: error of indicated distance
- 2.1.3 One-dimension measuring instrument: error of indicated size or displacement
- 2.1.4 Height measuring instrument: error of indicated vertical size or displacement
- 2.1.5 One-dimension displacement transducer or actuator (LVDT, PZT, etc.): error of indicated displacement
- 2.1.6 Gauge block comparators: error of indicated displacement
- 2.1.7 Dial-indicator tester: error of indicated displacement
- 2.2 End standards
- 2.2.1 Gauge block: central length, variation in length, thermal expansivity
- 2.2.2 Length bar (long gauge block): central length, variation in length, thermal expansivity
- 2.2.3 Plane or thread micrometer setting rod: length
- 2.2.4 Step gauge: face spacing
- 2.2.5 Gap gauge: face spacing
- 2.2.6 Feeler (thickness) gauge: thickness
- 2.3 Line standards
- 2.3.1 Precision line scale: line spacing
- 2.3.2 Stage micrometer: line spacing
- 2.3.3 Grid plate: grid point coordinates
- 2.3.4 One-dimension grating: pitch
- 2.3.5 Two-dimension grating: pitch, orthogonality
- 2.3.6 Line width standard: linewidth, spacewidth, pitch
- 2.3.7 (Surveyor, engineer, pit tape, (geodetic) wire: line spacing
- 2.3.8 Surveyor levelling rod: line spacing
- 2.3.9 Engineer or machinist scale, steel: line spacing
- 2.4 Diameter standards
- 2.4.1 External cylinder (plug, piston, pin, wire): diameter
- 2.4.2 Internal cylinder (ring): diameter
- 2.4.3 Sphere (ball): diameter
3. Angle
- 3.1 Angle by circle dividers
- 3.1.1 Optical polygon: face angle, pyramid error, face flatness
- 3.1.2 Index table: index angle

¹ For each service, the instrument or artefact is indicated in roman characters, and the measurand(s) in italic characters.

Drawing up CMCs

Examples of “Service Categories”

MASS and RELATED QUANTITIES

CLASSIFICATION OF SERVICES IN MASS AND RELATED QUANTITIES

21 October 2003

METROLOGY AREA: MASS AND RELATED QUANTITIES

BRANCH: MASS

1. Mass
 - 1.1 Mass standard
 - 1.1.1 Mass standard¹: *mass standard*

BRANCH: DENSITY

2. Density
 - 2.1 Density of solid
 - 2.1.1 Density of solid: *solid density artefact*
 - 2.1.2 Volume of solid: *solid artefact*

Drawing up CMCs

Examples of “Service Categories”

MASS and RELATED QUANTITIES

Calibration or Measurement Service			Measurand Level or Range		
Class	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units
Mass	Mass standards	Comparison in air	1	100	mg

Administration		
NMI Service Identifier	Service Category	NMI
	1.1.1	NPL

Drawing up CMCs

Examples of “Service Categories”

LENGTH

2.2 End standards

2.2.1 Gauge block: *central length, variation in length, thermal expansivity*

2.2.2 Length bar (long gauge block): *central length, variation in length, thermal expansivity*

2.2.3 Plane or thread micrometer setting rod: *length*

2.2.4 Step gauge: *face spacing*

2.2.5 Gap gauge: *face spacing*

2.2.6 Feeler (thickness) gauge: *thickness*

Calibration or Measurement Service			Measurand Level or Range		
Class	Instrument or Artifact: Measurand	Instrument Type or Method	Minimum value	Maximum value	Units
End standards	Length bar (long gauge block): central length L	Mechanical comparison to gauge block	400	1000	mm

CCL Services Administration		
NMI Service Identifier	CCL Service Category	NMI
15	2.2.2	UME

Drawing up CMCs

Rules for formatting:

All words in **English**

Decimal separator: period “.”, not comma “,”

Format of all cells: “**Center**” and “**Wrap text**”

Default font : “**Arial 10**”, not “**Times New Roman**”

Italics should be used for quantities: for instance **L** for **length**

Avoid abbreviations: “**relative**” instead of “**rel.**”

Do not use the semicolon “;” inside a cell

Drawing up CMCs

Rules for formatting:

Superscripts and subscripts can be used, but not for numbers (m/s^2)

Use as often as possible the scientific notation "YE-XX"

Do not use " \pm " in the uncertainty column

Use the ISO standard presentation for value ranges

"10-20 Hz" should be written as "10 Hz to 20 Hz"

The level of confidence should be written as a percentage (such as "95%") and not as the number "0.95".

Rules for formatting:

Multiple entries in a single cell must be separated vertically into separate cells and cells must not be merged vertically. This holds specially when the description of one CMC is valid for different measurand ranges and/or includes several parameters with their specifications. In these cases:

- use only one measurand range per CMC and repeat all other relevant information;
- place each parameter and specification in its own cell.

Drawing up CMCs

Modifications to already published CMCs

Go to the web-site: www.bipm.org/JCRB

[Version française](#)

Joint Committee of the Regional Metrology Organizations and the BIPM

→ Log on to the JCRB CMC website:

Login name

guest

Password

●●●●●●●●

← **guest2001**

VALIDATE

CANCEL

Drawing up CMCs

Modifications to already published CMCs

Home | Map of the site | Contact us Search:

BIPM
Bureau International des Poids et Mesures

My account is: GUEST on webapp1

> You are here: [JCRB](#) > [JCRB CMC site](#) > Home

JCRB Website (Restricted access)

Summary

- CMC site home
- RMO actions pending
- Complete list of CMCs
- Get published CMCs
- KCDB statistics
- View my profile
- Log off

Welcome GUEST ((You are welcome to look at this site but it is readonly))

→ Your last connection was the: 2011/04/20 19:00:00 (BIPM local time)

Please note that your session will be timed out after two hours of inactivity. You will then have to reconnect.

To view the site and look at the latest situation regarding submitted CMCs, please use the menu on the left to:

Get Published CMCs

Modifications to already published CMCs

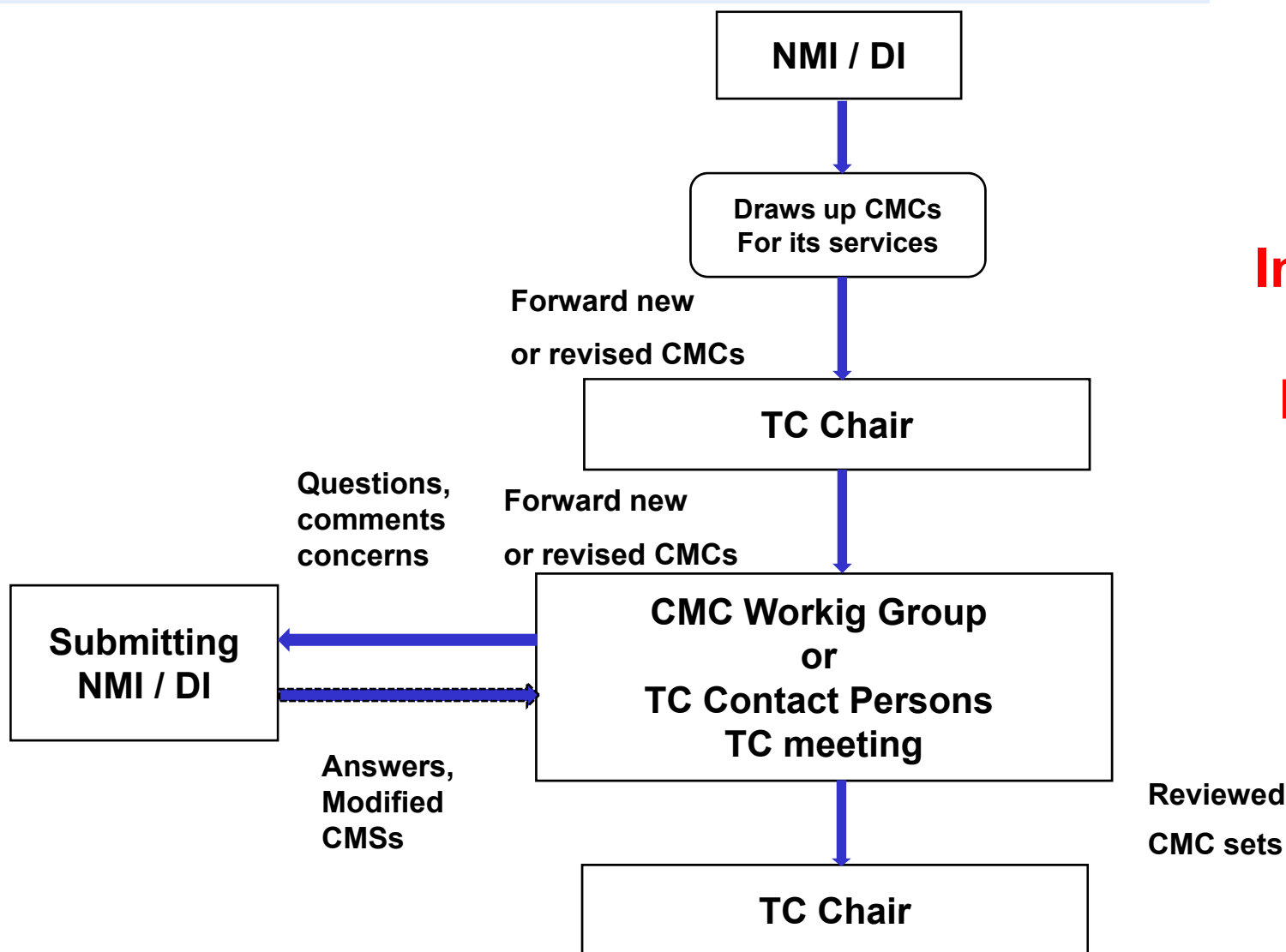
Modifications must be made clearly visible by the use of the following color code:

- a. bold red characters for corrections to be brought to a published CMC and for presenting a new CMC not yet published
- b. highlighting with a light pink background a CMC that should be deleted, the words “to be deleted from the KCDB” should also be placed in the “comments” column of the CMC.

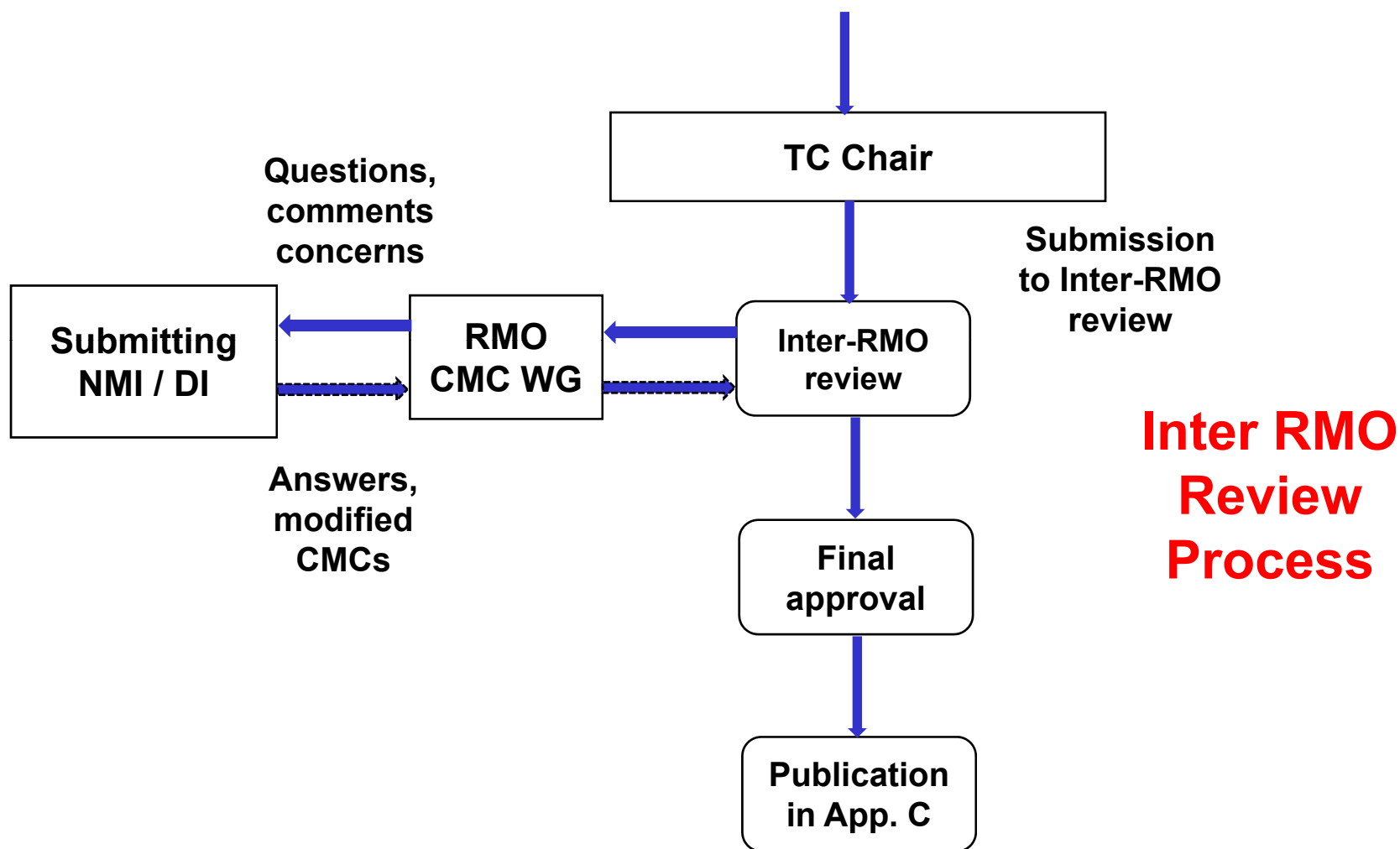
INTRA and INTER RMO CMC REVIEW PROCESS

Flowchart of the CMC Review

Intra RMO Review Process



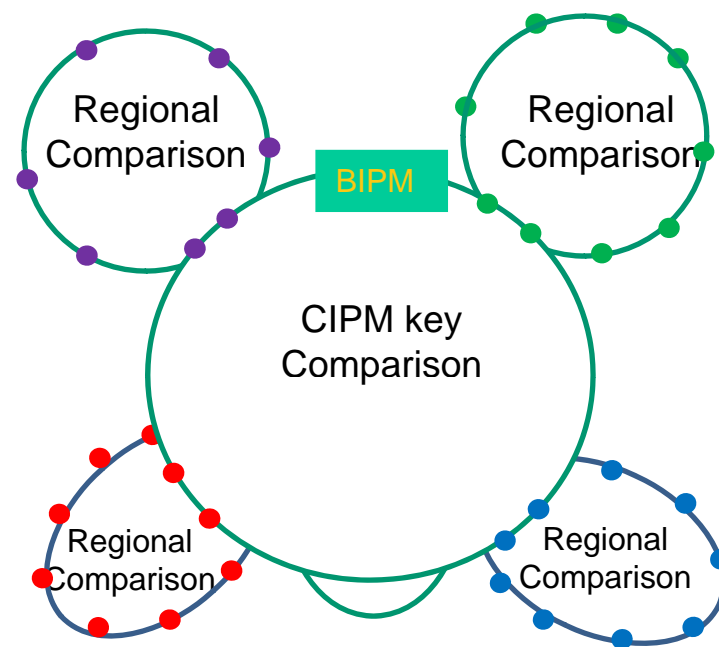
Flowchart of the CMC Review



INTERLABORATORY COMPARISONS AS A SUPPORT FOR CMCs

Comparisons in the CIPM MRA

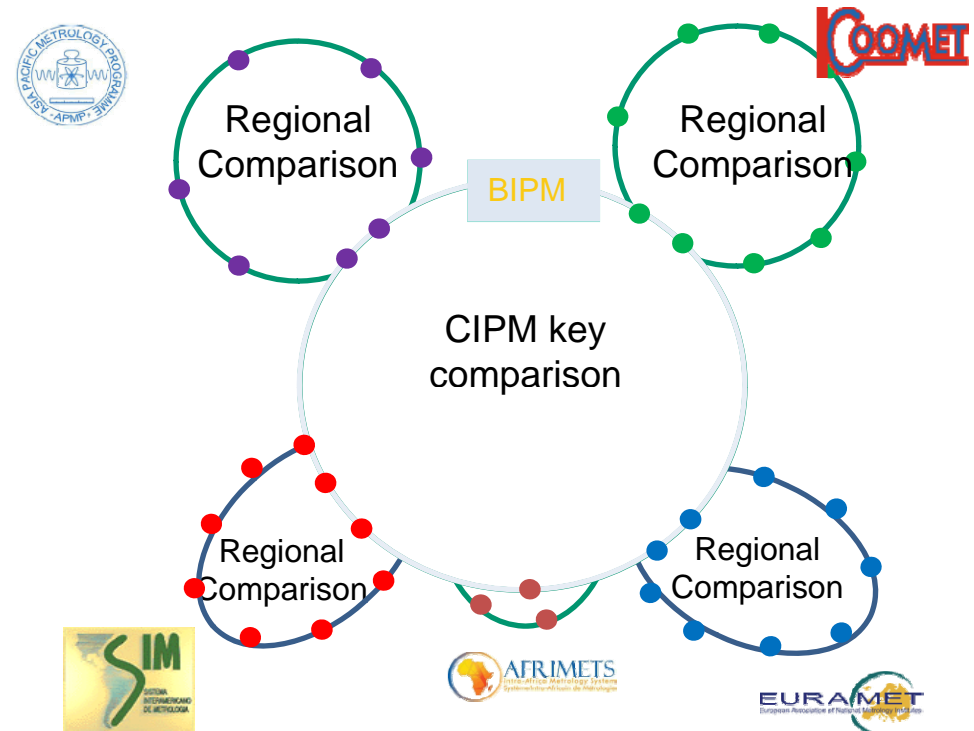
- **CIPM key**
- **RMO key**
- **Supplementary**



- **Highest level** of accuracy, usually close to the “mise en pratique” of the units (primary methods)
- Participation is **limited to members** of the Consultative Committees
- **Reference value** is determined by consensus among the participants

Comparisons in the CIPM MRA

- CIPM key
- RMO key
- Supplementary



- Follow the same protocol of the CIPM Key Comparisons
- The reference value is linked to the CIPM KC through the NMIs that participate in both comparisons (at least two NMIs)

Comparisons in the CIPM MRA



Key Comparison

Comparison on the key subject within specific metrology subject field, typically concerned with the primary realization of standards.

Supplementary Comparison

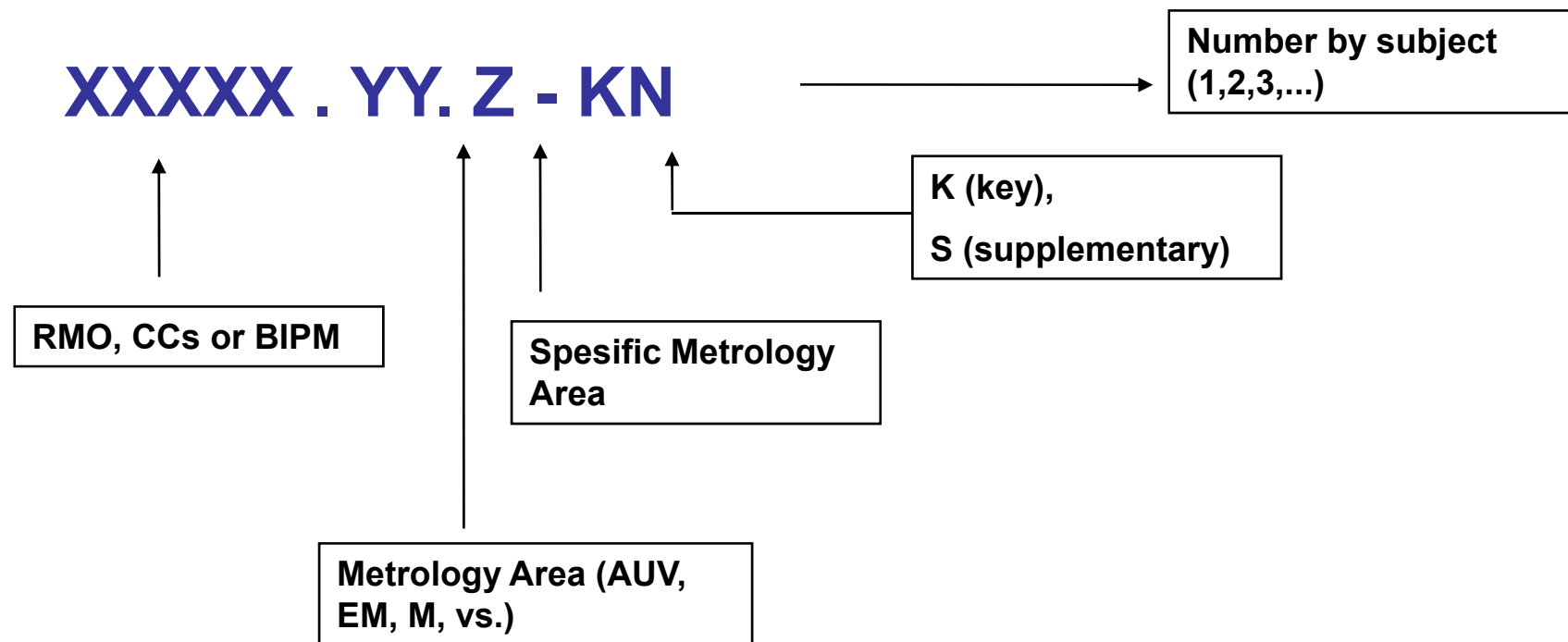
Comparison for supporting any specific CMC entry, apart of the primary realization of standard.

Cover areas not covered by the Key Comparisons (e.g., **lower accuracy** measurements, different techniques)

Comparisons in the CIPM MRA

COMPARISON CODES

See “nomenclature” on the BIPM web-site



Comparisons in the CIPM MRA



Examples of Comparison Codes

CCAUV.A-K3

Comparison on calibration of LS2p microphones in the frequency range from 20 to 31500 Hz

EUROMET.M.F-K1

Comparison on calibration of force transducers in the range from 5 kN to 10 kN

Comparisons in the CIPM MRA



COMPARISON STEPS

Determination of participants and a pilot

Preparation of technical protocol

Measurement stage

Reporting of the measurement results by participants

Checking the results by pilot for consistency

Preparation of Draft A of comparison report and discussion

Preparation of Draft B of comparison report and discussion

Approval of the comparison report by related Consultative Committee

Publication of comparison report

Comparisons in the CIPM MRA

Definitions

X_i	Participant's Result
U_i	Expanded Uncertainty declared by Participant
X_{ref}	Key Comparison Reference Value (KCRV)
U_{ref}	Uncertainty of Key Comparison Reference Value
$D_i = X_i - X_{\text{ref}}$	Degree of equivalence with respect to KCRV
U_{D_i}	Uncertainty of Degree of equivalence
$D_{ij} = X_i - X_j$	Mutual Degree of Equivalence
$U_{D_{ij}}$	Uncertainty of Mutual Degree of equivalence

Comparison Results for CMC Support

Home > Comparisons Search > Results of the search > **CCM.M-K2 results**

Key and supplementary comparisons - Results



CCM.M-K2

- [Information](#)
- [Effect / Contact](#)
- [Participants](#)
- **[Results](#)**
 - 10 kg
 - 500 g
 - 20 g
 - 2 g
 - 100 mg
- [Print out](#)

CCM.M-K2

Results

CCM.M-K2 results published on 25 November 2003

Comparison of multiples and submultiples of the kilogram

[APMP.M.M-K6](#) and [APMP.M.M-K2.1](#) results are linked to those of CCM.M-K2 for nominal values 500 g, 20 g, 2 g, and 100 mg.

[APMP.M.M-K2](#), [EUROMET.M.M-K2](#) and [EUROMET.M.M-K2.1](#) results are linked to those of CCM.M-K2 for nominal values 500 g, 20 g, 2 g, 100 mg and 10 kg.

Click on one of the following links to access results:

[10 kg](#)
[500 g](#)
[20 g](#)
[2 g](#)
[100 mg](#)

Links are provided to the following .PDF files:

Related links

- [KCDB Statistics](#)
- [KCDB FAQs](#)
- [CIPM MRA](#)
- [ICRP](#)
- [Min of econ - VIM 2](#)

Comparison Results for CMC Support

Key and supplementary comparisons - Results

CCM.M-K2

- [Information](#)
- [Pilot / Contact](#)
- [Participants](#)
- [Results](#)
 - 10 kg
 - 500 g
 - **20 g**
 - 2 g
 - 100 mg
- [Print out](#)

Related links

- [KCDB Statistics](#)
- [KCDB FAQs](#)
- [CIPM MRA](#)
- [JCRB](#)
- [Find my NMI](#)
- [Metrologia](#)

Contact us

CCM.M-K2

Results

Laboratory individual measurements

Equivalence statements

Degrees of equivalence

Graph(s) of equivalence

CCM.M-K2, APMP.M.M-K6, EUROMET.M.M-K2, EUROMET.M.M-K2.1, APMP.M.M-K2, and APMP.M.M-K2.1

MEASURAND : Mass
NOMINAL VALUE : 20 g

Note: all values are expressed in mg

• Key comparison CCM.M-K2

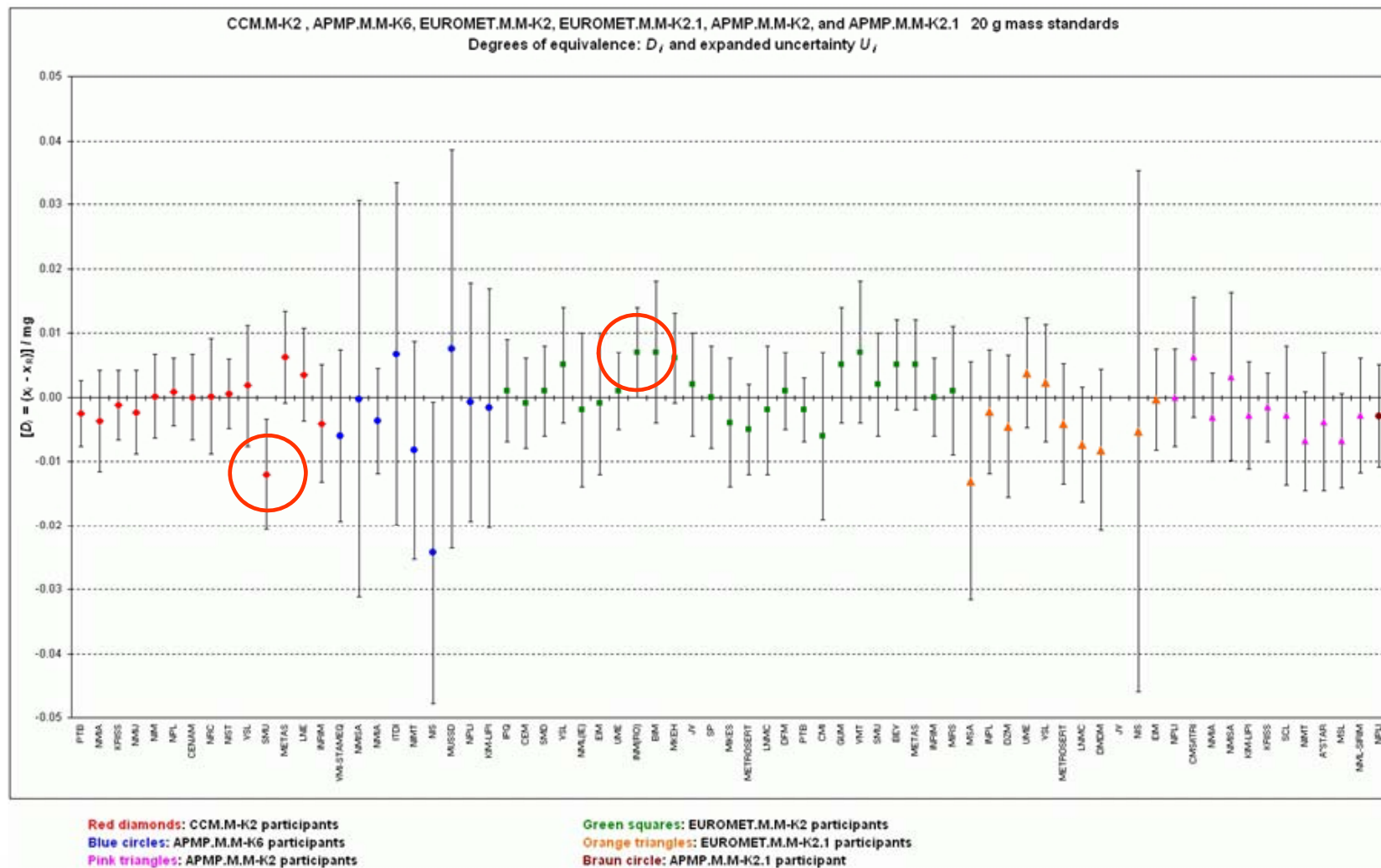
$x_{(\text{rep})i}$: reported result obtained as the difference between the measurement of the mass standard carried out by laboratory i and its nominal value

u_i : combined standard uncertainty of $x_{(\text{rep})i}$

Three sets of mass standards, designated as **CA**, **CB** and **CC**, were circulated. For each set of mass standards the Pilot Laboratory, **PTB**, carried out two measurements: the first one before the circulation and the second one after the circulation, as indicated respectively by **(1)** and **(2)**.

x_i : difference between the mass determined by laboratory i , $x_{(\text{rep})i}$, and that determined by the Pilot Laboratory.

Comparison Results for CMC Support



Comparison Results for CMC Support

Lab <i>i</i> ↓	D_i	U_i
	/ mg	
PTB	-0.0026	0.0051
NMIA	-0.0037	0.0079
KRISS	-0.0013	0.0054
NMIJ	-0.0024	0.0065
NIM	0.0001	0.0065
NPL	0.0008	0.0053
CENAM	0.0000	0.0066
NRC	0.0001	0.0090
NIST	0.0005	0.0054
VSL	0.0018	0.0094
SMU	-0.0121	0.0086
METAS	0.0062	0.0072
LNE	0.0035	0.0072
INRIM	-0.0041	0.0091
VMI-STAMEQ	-0.0060	0.0133
NMISA	-0.0003	0.0309
NMIA	-0.0037	0.0082
ITDI	0.0067	0.0267
NIMT	-0.0083	0.0170
NIS	-0.0243	0.0235
MUSSD	0.0075	0.0311
NPLI	-0.0008	0.0185
KIM-LIPI	-0.0017	0.0186

MUSSD	0.0075	0.0311
NPLI	-0.0008	0.0185
KIM-LIPI	-0.0017	0.0186
IPQ	0.001	0.008
CEM	-0.001	0.007
SMD	0.001	0.007
VSL	0.005	0.009
NML(IE)	-0.002	0.012
EIM	-0.001	0.011
LIME	0.001	0.006
INM(RO)	0.007	0.007
BIM	0.007	0.011
MKEH	0.006	0.007
JV	0.002	0.008
SP	0.000	0.008

Comparison Results for CMC Support

Key and supplementary comparisons - Information

➤ CCL-K1

- [Information](#)
- [Pilot / Contact](#)
- [Participants](#)
- [Results](#)
- [Print out](#)

➤ Related links

- [KCDB Statistics](#)
- [KCDB FAQs](#)
- [CIPM MRA](#)
- [JCRB](#)
- [Find my NMI](#)
- [Metrologia](#)

➤ Contact us

- BIPM.KCDB@bipm.org

CCL-K1

➤ Information

Metrology area, branch

Length, Dimensional Metrology

Description

Gauge blocks by interferometry

Time of measurement

1998 - 1999

Status

Approved for equivalence, [Results available](#)

Reference(s)

[Metrologia, 2002, 39, 165-177](#)
[CCL-K1 Technical Protocol](#)

Measurand

Central length: 0.5 mm to 100 mm

Transfer device(s)

Steel and tungsten carbide gauge blocks

Comparison type

Key comparison

Consultative Committee

CCL (Consultative Committee for Length)

Conducted by

CCL (Consultative Committee for Length)

Comments

The central length of gauge blocks is measured by interferometry according to ISO 3650.

Comparison Results for CMC Support

Key and supplementary comparisons - Results



↘ CCL-K1

- [Information](#)
- [Pilot / Contact](#)
- [Participants](#)
- **[Results](#)**
 - Steel gauge blocks
 - Tungsten carbide gauge blocks
- [Print out](#)

↘ Related links

- [KCDB Statistics](#)
- [KCDB FAQs](#)
- [CIPM MRA](#)
- [JCRB](#)
- [Find my NMI](#)
- [Metrologia](#)

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- BIPM.KCDB@bipm.org

CCL-K1

↘ Results

Results published on 31 August 2001

Gauge blocks by interferometry

Click on the following links to access results:

[Steel gauge blocks](#)
[Tungsten carbide gauge blocks](#)

Note that at the time of the comparison NMIJ (National Metrology Institute of Japan) was designated as NRLM (National Research Laboratory of Metrology) and METAS (Metrology and Accreditation Switzerland) as OFMET (Office Fédéral de Métrologie).

Links are provided to the following .PDF files:

- Summary Results of both [steel](#) and [tungsten carbide](#) gauge blocks (summary of the results)
- [Final Report](#) (Final Report of the comparison).

Reference: [Metrologia, 2002, 39, 165-177](#)

Comparison Results for CMC Support

Key and supplementary comparisons - Results



➤ CCL-K1

- [Information](#)
- [Pilot / Contact](#)
- [Participants](#)
- [Results](#)
 - Steel gauge blocks
 - **Tungsten carbide gauge blocks**
- [Print out](#)

➤ Related links

- [KCDB Statistics](#)
- [KCDB FAQs](#)
- [CIPM MRA](#)
- [JCRB](#)
- [Find my NMI](#)
- [Metrologia](#)

➤ Contact us

- BIPM.KCDB@bipm.org

CCL-K1

➤ Results

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

MEASURAND : Central length of tungsten carbide gauge blocks measured by interferometry according to ISO 3650

NOMINAL VALUES : 9 gauge blocks from 0.5 mm to 100 mm

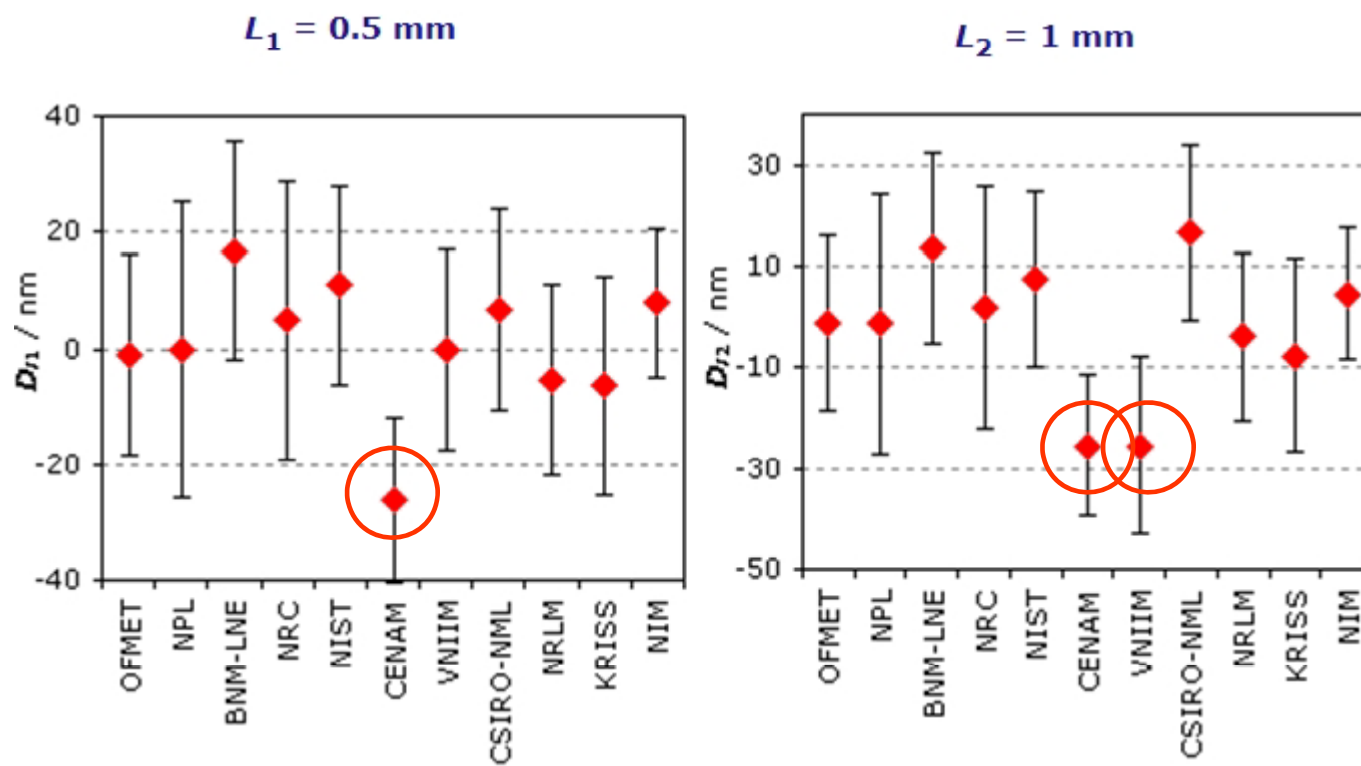
x_{ik} : result of measurement carried out by laboratory i for gauge block with nominal length L_k expressed as the deviation from nominal length in nm

u_{ik} : combined standard uncertainty of x_{ik} reported by laboratory i

nominal length L_k ($k = 1$ to 5) ➡

Lab i	0.5 mm		1 mm		1.01 mm		1.1 mm		6 mm		Date of measure
	x_{i1}	u_{i1}	x_{i2}	u_{i2}	x_{i3}	u_{i3}	x_{i4}	u_{i4}	x_{i5}	u_{i5}	
	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	
OFMET	23	9	15	9	24	9	-54	9	-50	8	Mar 98 - Aug 99
NPL	24	14	15	14	23	14	-51	14	-48	14	May 98
BNM-LNE	41	10	30	10	37	10	-36	10	-34	10	Jun 98
NRC	29	13	18	13	29	13	-51	13	-48	14	Aug 98

Comparison Results for CMC Support



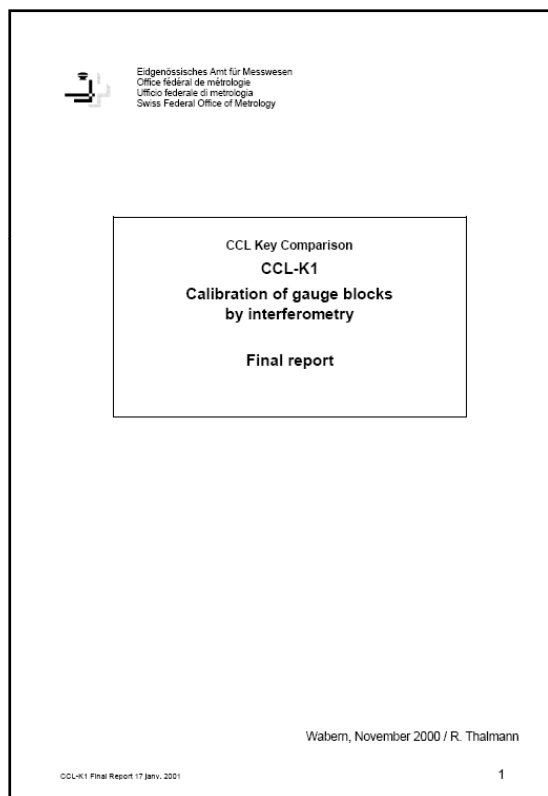
Comparison Results for CMC Support

Degrees of Equivalence

Lab <i>i</i>	nominal length L_k ($k = 1$ to 5)									
	0.5 mm		1 mm		1.01 mm		1.1 mm		6 mm	
	D_{i1}	U_{i1}	D_{i2}	U_{i2}	D_{i3}	U_{i3}	D_{i4}	U_{i4}	D_{i5}	U_{i5}
	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm
OFMET	-1	17	-1	17	-4	17	-3	17	-3	16
NPL	0	26	-1	26	-5	26	0	26	-1	26
BNM-LNE	17	19	14	19	9	19	15	19	13	19
NRC	5	24	2	24	1	24	0	24	-1	26
NIST	11	17	8	17	4	17	13	17	6	18
CENAM	-26	14	-25	14	-18	14	-21	14	-14	14
VNIIM	0	17	-25	17	-40	17	-31	17	-49	17
CSIRO-NML	7	17	17	17	11	17	19	17	18	17
NRLM	-5	17	-4	17	7	17	-15	19	-4	17
KRISS	-6	19	-8	19	-8	18	-11	18	-11	19
NIM	8	13	5	13	0	13	1	13	-1	13

Comparison Results for CMC Support

Example of Comparison Final Report



- Two laboratories did not apply any phase correction. It must be outlined that the application of such corrections, prescribed in the international standards, is most important, not only to take into account any differences in the material, but also the different surface roughness of the gauge blocks and the platens.

measurand. According to chapter 5, phase corrections were also not applied by VNIIM for steel and by NIM for both, steel and tungsten carbide, although with a much smaller effect on the results, since the material of the platens used was the same. The WGDM therefore decided, that these laboratories were consequently to be excluded from the determination of the reference value for both materials.

Comparison Results for CMC Support



It must be ensured that CMC claims made by an NMI are consistent with the results obtained in key and supplementary comparisons.

A measurement of a key comparison is considered to be discrepant when the degree of equivalence represented by the difference $d_i = x_i - x_{KCRV}$ and the expanded uncertainty $U(d_i) = k \cdot u(d_i)$ do not fulfil the condition $|d_i| < U(d_i)$. The NMI making the CMC claim has primary and principal responsibility, i.e., it must check the comparison results against its CMC claims and state whether or not these claims are supported by the comparison results. If not, it must take appropriate measures to remove this inconsistency.

Statement from EURAMET Guide 8

Comparison Results for CMC Support

What Kind of Comparisons Are Acceptable ?

CC Key Comparisons

RMO Key Comparisons

Supplementary Comparisons

Bilateral Comparisons

Requirements:

- Technical protocol clearly specifies measurand, method, range, etc.
- Comparison is officially registered
- Results are publicly available

PRACTICAL EXAMPLES

Practical Examples

Parameters and Specifications

Calibration or Measurement Service			Measurand level or Range			Measurement Conditions/Independent Variable		Expanded uncertainty				
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of Confidence	Is the expanded uncertainty a relative one?
Encapsulated source strength	Radioactive source	Ionization chamber	0	0,1	Gy/s	Temperature Pressure Relative humidity	22.0 °C 101.325kPa 20% to 80%	0,01	WRONG	2	95%	Yes

Practical Examples

Parameters and Specifications

Calibration or Measurement Service			Measurand level or Range			Measurement Conditions/Independent Variable		Expanded uncertainty				
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of Confidence	Is the expanded uncertainty a relative one?
Encapsulated source strength	Radioactive source	Ionization chamber	0	0,1	Gy/s	Temperature	22.0 °C	0,01		2	95%	Yes
						Pressure	101.325 kPa					
						Relative humidity	20% to 80%					

CORRECT

Each parameter and specification in its own

Practical Examples

Different measurand range

Calibration or Measurement Service			Measurand level or Range			Measurement Conditions/Independent Variable		Expanded uncertainty				
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of Confidence	Is the expanded uncertainty a relative one?
Luminous intensity	Tungsten lamp	Network of lamps & photometers, photometric bench	0.001 1 1000 -	1 1000 100000	cd	Distribution temperature	2000 K to 3200 K	1.5 to 0.4 0.4 0.4 to 1.5 with measurand	%	2	95%	Yes

WRONG

Practical Examples

Different measurand range

Calibration or Measurement Service			Measurand level or Range			Measurement Conditions/Independent Variable		Expanded uncertainty				
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of Confidence	Is the expanded uncertainty a relative one?
Luminous intensity	Tungsten lamp	Network of lamps & photometers , photometric bench	0,001	1	cd	Distribution temperature	2000 K to 3200 K	1.5 to 0.4	%	2	95%	Yes
Luminous intensity	Tungsten lamp	Network of lamps & photometers , photometric bench	1	1000	cd	Distribution temperature	2000 K to 3200 K	0,4	%	CORRECT		
Luminous intensity	Tungsten lamp	Network of lamps & photometers , photometric bench	1000	100000	cd	Distribution temperature	2000 K to 3200 K	0.4 to 1.5	%	2	95%	Yes

Frequently Asked Questions

- When NMI/DI has to submit CMCs ?

Theoretically at any time. Some TCs have installed a Working Group for CMC review and set a fixed date for submission.

- Can I submit CMCs when just Draft A of the comparison is circulated ?

Yes. But approval of CMCs will be delayed until Draft B is circulated.

Frequently Asked Questions

- Are results of comparison the only technical evidence supporting CMCs ?

No. According to the text of CIPM MRA-D-04:

“...the range and uncertainty of the CMCs submitted be consistent with information from some or all of the following sources:

- Results of key and supplementary comparisons
- Documented results of past CC, RMO or other comparisons (including bilateral)
- Knowledge of technical activities by other NMIs, including publications
- On-site peer-assessment reports
- Active participation in RMO projects
- Other available knowledge and experience

Frequently Asked Questions

- How long does CMC review process last ?

Hard to estimate. In general, one year time scale is a realistic estimation.

- Who uses CMCs ?

Theoretically all customers over the world.

References

- Calibration and Measurement Capabilities Capabilities in the context of the CIPM MRA, CIPM MRA-D-04, ver.2, October 2010, BIPM
- EURAMET Procedures and Review Criteria for CMCs, EURAMET Guide 8, EURAMET e.V., 2008
- Calibration and Measurement Capabilities, A paper by the joint BIPM/ILAC working group, CIPM 2007-11, November 2007, BIPM
- Traceability in the CIPM MRA, October 2010, BIPM