Capacity Building & Knowledge Transfer

CIPM Requirements and documentation on CMCs

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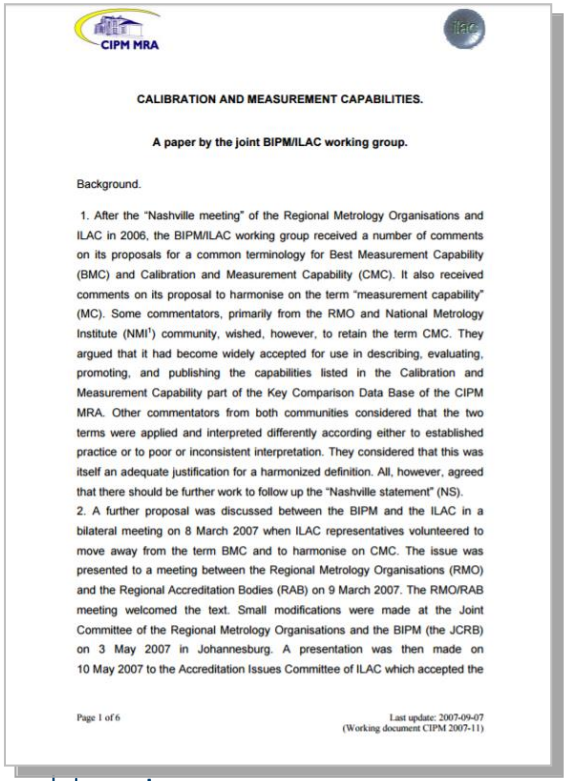
Bureau International des Poids et Mesures

CMCs in the CIPM MRA



CIPM MRA

CALIBRATION AND MEASUREMENT CAPABILITIES.

A paper by the joint BIPM/ILAC working group.

Background.

1. After the "Nashville meeting" of the Regional Metrology Organisations and ILAC in 2006, the BIPM/ILAC working group received a number of comments on its proposals for a common terminology for Best Measurement Capability (BMC) and Calibration and Measurement Capability (CMC). It also received comments on its proposal to harmonise on the term "measurement capability" (MC). Some commentators, primarily from the RMO and National Metrology Institute (NMI[1]) community, wished, however, to retain the term CMC. They argued that it had become widely accepted for use in describing, evaluating, promoting, and publishing the capabilities listed in the Calibration and Measurement Capability part of the Key Comparison Data Base of the CIPM MRA. Other commentators from both communities considered that the two terms were applied and interpreted differently according either to established practice or to poor or inconsistent interpretation. They considered that this was itself an adequate justification for a harmonized definition. All, however, agreed that there should be further work to follow up the "Nashville statement" (NS).
2. A further proposal was discussed between the BIPM and the ILAC in a bilateral meeting on 8 March 2007 when ILAC representatives volunteered to move away from the term BMC and to harmonise on CMC. The issue was presented to a meeting between the Regional Metrology Organisations (RMO) and the Regional Accreditation Bodies (RAB) on 9 March 2007. The RMO/RAB meeting welcomed the text. Small modifications were made at the Joint Committee of the Regional Metrology Organisations and the BIPM (the JCRB) on 3 May 2007 in Johannesburg. A presentation was then made on 10 May 2007 to the Accreditation Issues Committee of ILAC which accepted the

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Last update: 2007-09-07
(Working document CIPM 2007-11)

BIPM and ILAC joint definition on CMCs, 2007

"In the context of the CIPM MRA and ILAC Arrangement, and in relation to the CIPM-ILAC Common Statement, the following shared definition is agreed upon:

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. "**

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

- performed according to a *documented procedure* with an established uncertainty budget under the management system of the NMI
- *Performed on a regular basis*
- *Available to all clients*

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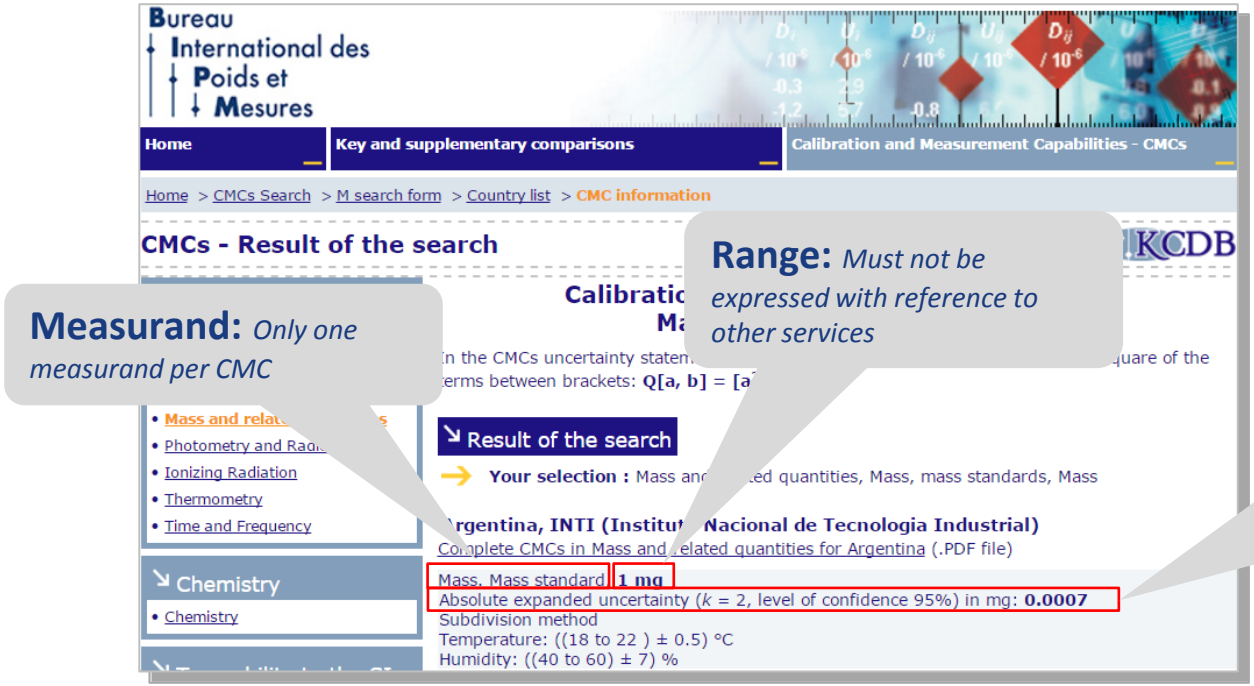
CMCs in the CIPM MRA

- Under the CIPM MRA, the Calibration and Measurement Capabilities (CMCs) of signatory NMIs are the fundamental object of mutual recognition.
- CMCs are described in terms of **measurand**, the **method** used, the **range**, the **uncertainty**, and if necessary, the influence **parameters.**
- CMCs declared by NMIs within the CIPM MRA undergo a **review process** at RMO and inter-RMO level
- CMCs are published in **Appendix C of the KCDB**

CMCs in the CIPM MRA



Measurand: *Only one measurand per CMC*

Range: *Must not be expressed with reference to other services*

Uncertainty: *There must be no doubt as to the uncertainty that can be expected of a CMC. May be expressed in a number of ways (single value, range, matrix, function)*

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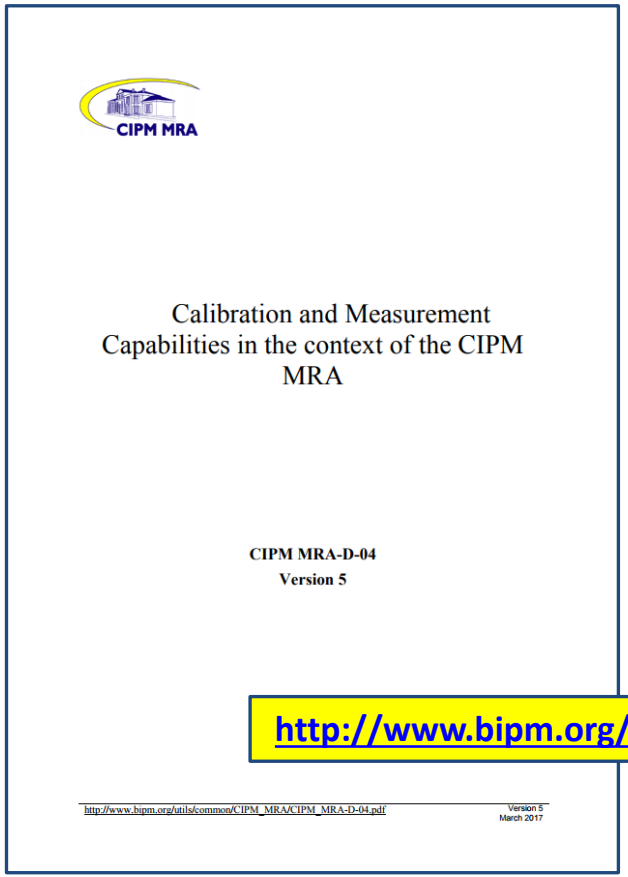
Documents to support the review process



CIPM MRA-D-04: Guide for CMCs in the context of the CIPM MRA for:

- preparation
- acceptance
- submission
- review processes
- publication
- monitoring
- greying-out

http://www.bipm.org/utils/common/documents/CIPM-MRA/CIPM-MRA-D-04.pdf

CMCs in the CIPM MRA

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

KCDB

Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty						
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?	NMI internal identifier	Comments
Absolute pressure gas medium	Vacuum gauge	Spinning rotor gauge	1.00E-04	1	Pa	Temperature	23 °C	0.003		2	95%	Yes	30029C, 30030C	Uncertainty includes unit under test. Approved on 09 September 2008
						Gas species	nitrogen							
						Gas purity	99.9 or better							
Absolute pressure gas medium	Vacuum gauge	Spinning rotor gauge	1	30	Pa	Temperature	23 °C	[(0.003) + (6.00E-05)*p*], *p* pressure in Pa		2	95%	Yes	30032S	Uncertainty includes unit under test. Approved on 09 September 2008
						Gas species	nitrogen							
						Gas purity	99.9 or better							
Absolute pressure gas medium	Vacuum gauge	Ionization gauge	1.00E-07	3.00E-06	Pa	Temperature	23 °C	[(0.012) + (5.00E-10)/*p*], *p* pressure in Pa		2	95%	Yes	30036C	Uncertainty increased to include unit under test. Approved on 09 September 2008
						Gas species	nitrogen							
						Gas purity	99.9 or better							
Absolute pressure gas medium	Vacuum gauge	Ionization gauge	3.00E-06	9.00E-05	Pa	Temperature	23 °C	[(0.0048) + (2.00E-08)/*p*], *p* pressure in Pa		2	95%	Yes	30036C	Uncertainty increased to include unit under test. Approved on 09 September 2008
						Gas species	nitrogen							
						Gas purity	99.9 or better							
Absolute pressure gas medium	Vacuum gauge	Ionization gauge	9.00E-05	3.00E-03	Pa	Temperature	23 °C	[(0.0042) + (7.00E-08)/*p*], *p* pressure in Pa		2	95%	Yes	30035C, 30036C	Uncertainty increased to include unit under test. Approved on 09 September 2008
						Gas species	nitrogen							
						Gas purity	99.9 or better							
Absolute pressure gas medium	Vacuum gauge	Ionization gauge	3.00E-03	0.1	Pa	Temperature	23 °C	0.0042		2	95%	Yes	30034C	Uncertainty increased to include unit under test. Approved on 09 September 2008
						Gas species	nitrogen							
						Gas purity	99.9 or better							

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CMCs in the CIPM MRA: Drawing up of CMC

Additional instructions and templates for CMC excel files

→ For the classification of services in the various fields, see:

CIPM MRA Appendix C Calibration and Measurement Capability (CMC) Declarations

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

Click on a heading to see its description.
Follow the recommendations provided in worksheets "Formatting Instructions" and "Formatting Examples"
Also see additional instructions for Ionizing Radiation at the following link:
International Rules for Filling in the CMC Tables for Ionizing Raidation

Template | Field descriptions | Links to service categories | Formatting Instructions | Formatting Examples | Sheet1

RI	International rules for filling in the CMC tables for ionizing radiation		Oct. 2009

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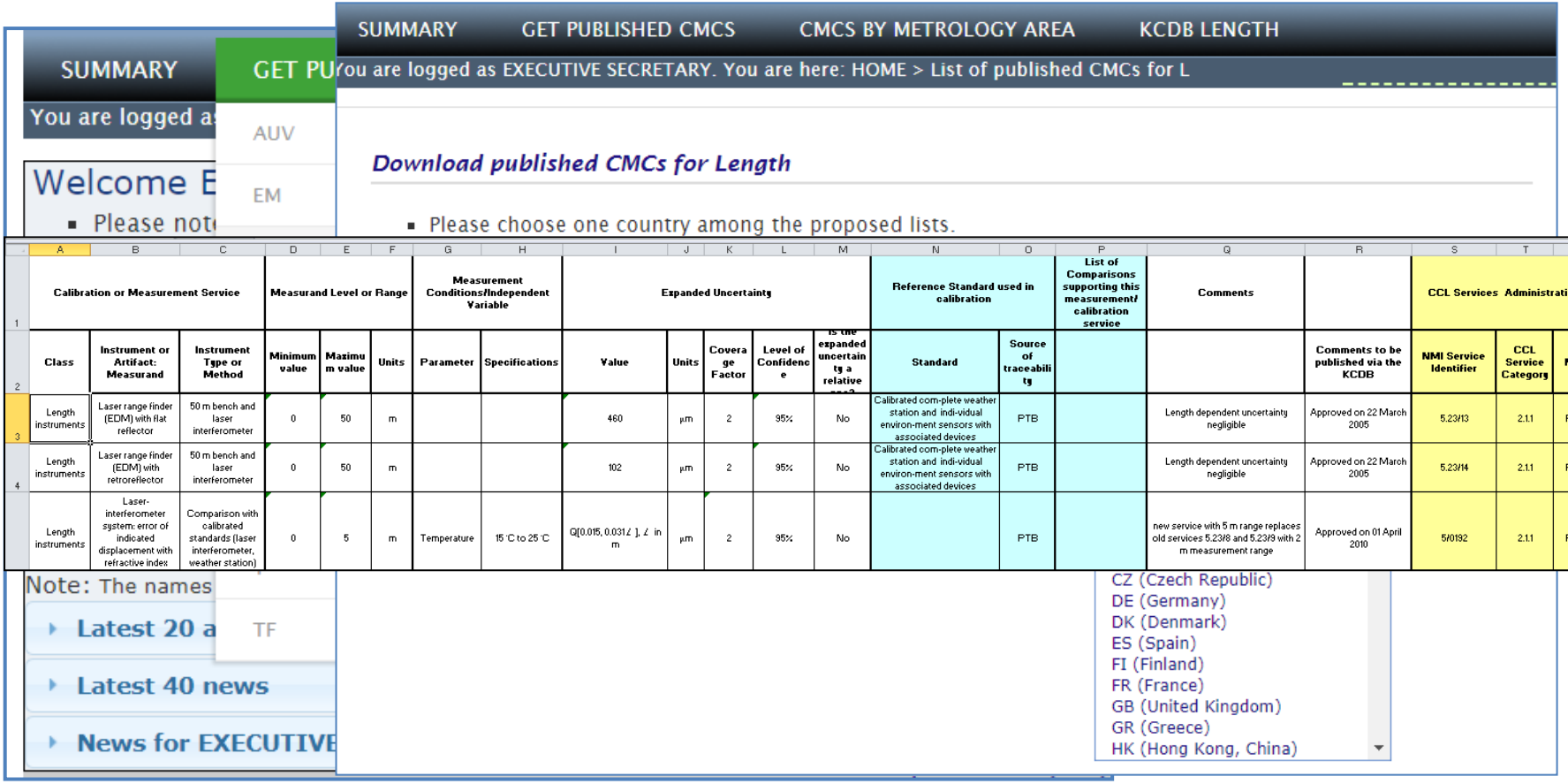
CMCs in the CIPM MRA: Drawing up of CMC



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		CCL Services Administration		
Class	Instrument or Artifact: Measurand	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			Comments to be published via the KCDB	NMI Service Identifier	CCL Service Category	NMI
Length instruments	Laser range finder (EDM) with flat reflector	50 m bench and laser interferometer	0	50	m			460	µm	2	95%	No	Calibrated com-plete weather station and indi-vidual environ-ment sensors with associated devices	PTB		Length dependent uncertainty negligible	Approved on 22 March 2005	5.23/13	2.1.1	PTB
Length instruments	Laser range finder (EDM) with retroreflector	50 m bench and laser interferometer	0	50	m			102	µm	2	95%	No	Calibrated com-plete weather station and indi-vidual environ-ment sensors with associated devices	PTB		Length dependent uncertainty negligible	Approved on 22 March 2005	5.23/14	2.1.1	PTB
Length instruments	Laser-interferometer system: error of indicated displacement with refractive index	Comparison with calibrated standards (laser interferometer, weather station)	0	5	m	Temperature	15 °C to 25 °C	Q[0.015, 0.031 L], L in m	µm	2	95%	No		PTB		new service with 5 m range replaces old services 5.23/8 and 5.23/9 with 2 m measurement range	Approved on 01 April 2010	5/0192	2.1.1	PTB

Traceability requirements

All CMCs must include information on traceability of the measurements to the SI. According to the CIPM MRA, there are two routes to establish traceability:

1. via a **primary realization** of the unit of measurement concerned, in which traceability is 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 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.

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.

Technical evidence for CMC declarations

CMC declarations must be backed by **evidence**. Acceptable evidence includes:

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

Technical review criteria *and* ***guidance on the range of CMCs supported by particular comparisons****, is the role of the CC Working Group on CMCs.*

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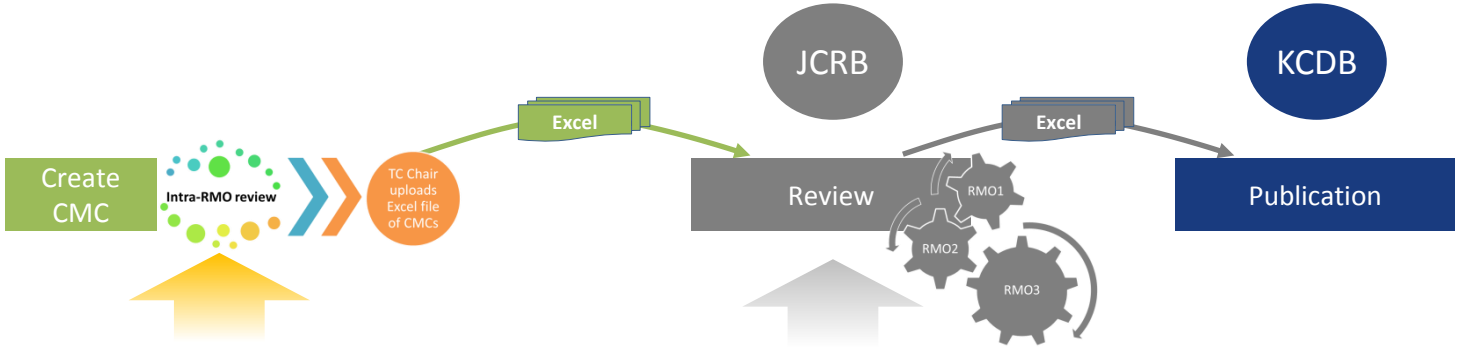
CMCs in the CIPM MRA

- CMC should always be related to an existing or proposed services.
- CMCs ensure “dissemination“ of traceability through the calibration and reference materials.
- The service can be on the primary, secondary (or even below) level of the metrological hierarchy, but it has to be primary at the national level.
- CMCs are reviewed in accordance with the requirements described in the CIPM MRA, as well as the criteria and guidance provided by the JCRB and approved by the CIPM.
- CMCs, declared by NMI /DI within the CIPM MRA are subject to two-tier review:
  - Intra-regional
  - Inter-regional

CMC Submissions and Reviews



INTRA-REGIONAL CMC REVIEW:

- Lead by the RMO TC Chair of the relevant area
- Checks CMC declarations against required evidence and criteria specified by the Guidelines
- NMI must respond to comments and questions submitted by reviewers
- Quality System of the NMI must be approved and cover the CMCs under review

INTER-REGIONAL CMC REVIEW:

- Conducted via dedicated JCRB website
- RMOs participate through their TCs
- Checks against technical criteria only
- NMI must respond to comments submitted by reviewers, and if necessary revise the CMC submission
- Evidence of Quality System must be submitted with CMC File

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CMCs: Modifications of existing CMCs

Category of modification	Intra-RMO review	Inter-RMO review	Actions
– material or editorial errors and improvements to the explanatory text for a quantity, instrument, method etc.;	-	-	The NMI will send its proposal for change to the TC chair of its RMO, who will contact the KCDB coordinator BIPM.KCDB@bipm.org
– increase of the uncertainty or reduction in scope, decided by the NMI or following a comparison result;	-	-	
– change of the method of measurement or reduction of the uncertainty or increase in scope.	+	+	Full review

Process:
- Download existing CMCs from the tool **"Get published CMCs"** http://www.bipm.org/JCRBCMCs/)
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" must also be placed in the "comments" column of the CMC.

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CMC Modifications: Grey out or deletions

Greyed out CMCs: Temporary suspension with intent to reinstate. Not visible in open KCDB, but CMC records are retained

- Due to non-compliance of acceptance criteria: e.g., QS no longer supports CMCs; results of comparisons contradict CMC claims; temporary lack of capability (equipment, staff, facilities, etc.)
- Request for grey-out comes from NMI/RMO to BIPM
- Maximum period for grey-out is 5 years
- At 5 years, NMI receives notice and has one year to reinstate or permanently delete
    - Reinstatement plan must be submitted and successfully carried out
    - **Successful reinstatement does not require intra- or inter-RMO review**

Permanent Deletions: NMI can request at any time, or as part of modification of existing CMC file.

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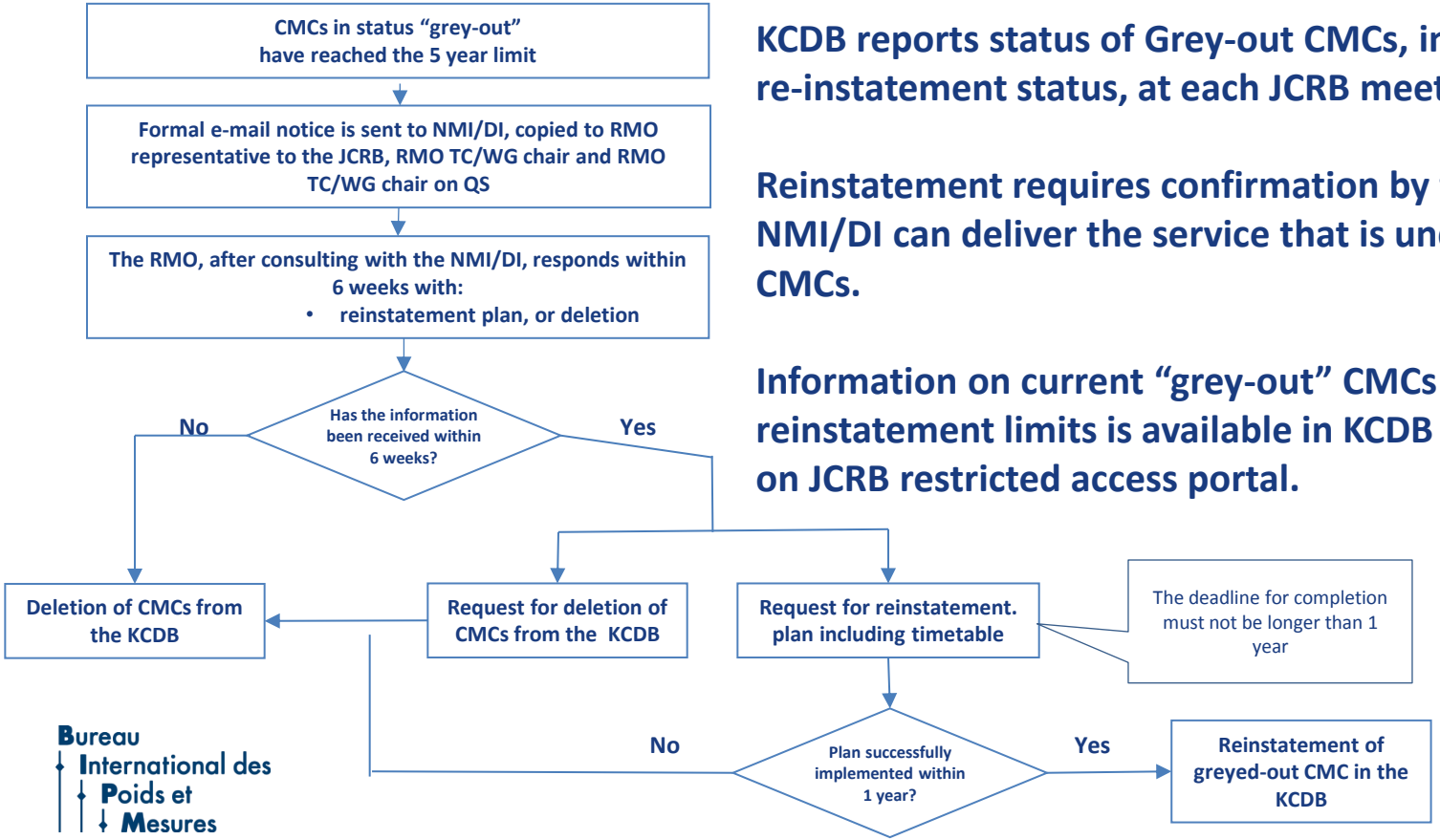
CMCs: Reinstatement of Grey-outs



KCDB reports status of Grey-out CMCs, including those in re-instatement status, at each JCRB meeting

Reinstatement requires confirmation by the RMO that the NMI/DI can deliver the service that is underpinned by CMCs.

Information on current "grey-out" CMCs and reinstatement limits is available in KCDB statistics xls files on JCRB restricted access portal.

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CC Working Groups for CMCs (or equivalent)

- 2002 –JCRB created a *Terms of Reference* to allow Consultative Committees to create a Working Group to
  - Establish and maintain CMC Service Category Lists, and where necessary rules for preparation of CMC entries
  - Agree on detailed technical review criteria
  - Coordinate and where possible conduct the CMC review process
  - Provide guidance on range of CMCs supported by particular comparisons
  - Identify future need for Key and Supplemental Comparisons
  - Monitor review of existing CMCs in context of results of comparisons
- RMO TC/WG chairs are members of the working group

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Thank you!

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