



CIPM requirements and documentation in comparisons

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BIPM

Bureau
♦ **I**nternational des
♦ **P**oids et
♦ **M**esures



Comparisons in the CIPM MRA

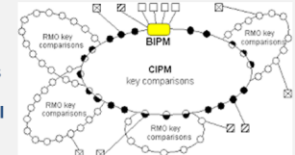
Essential requirements: Process

The objectives of the CIPM MRA are achieved through:

- ♦ International comparisons of measurements, to be known as **key comparisons**
- ♦ **Supplementary** international **comparisons** of measurements
- ♦ **Quality systems** and demonstrations of competence by NMIs
- ♦ International **peer evaluation** of CMC claims

Mechanisms of the CIPM MRA: *comparisons*

- ♦ A **fundamental mechanism** of the CIPM MRA
- ♦ Primary function is to **establish the degrees of equivalence of national measurement standards** which is the technical basis on which NMIs recognize each others national measurement standards
- ♦ Key and Supplemental comparisons are also **demonstrations of NMI measurement capabilities**
- ♦ **Registered in Appendix B of the KCDB**



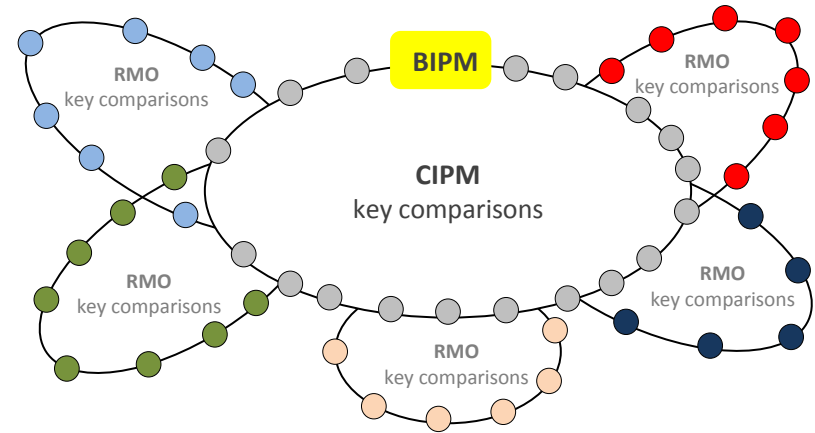
There are 3 basic categories

- ♦ CIPM key
- ♦ RMO key
- ♦ Supplementary

Comparisons in the CIPM MRA

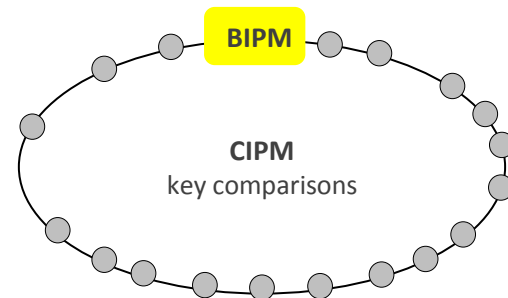
There are 3 basic categories of measurement comparisons:

- CIPM key
- RMO key
- Supplementary



Comparisons in the CIPM MRA: CIPM KC

- CIPM key
- RMO key
- Supplementary
- Executed in the framework of a Consultative Committee or by the BIPM
- Reference value is determined by consensus among the participants

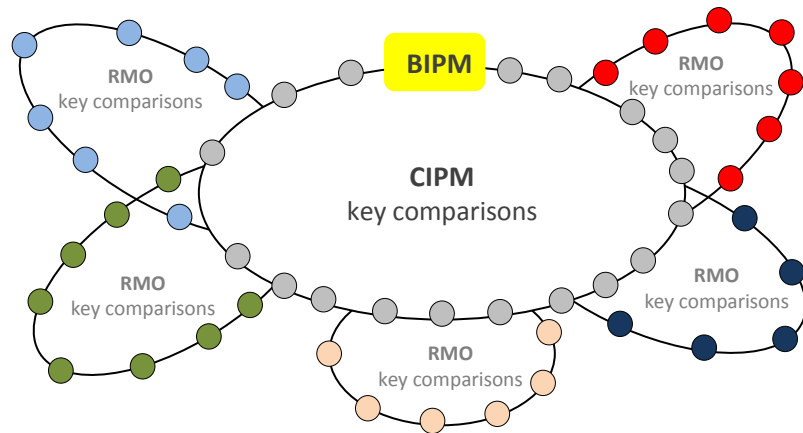


Participation

- *Participation in a CIPM key comparison is open to laboratories having the highest technical competence and experience, normally the member laboratories of the appropriate CCs.*
- *Specifically and in exceptional cases Associates may be invited to take part in CC comparisons (Section 4.1. CIPM MRA-D-05)*
- *The number of laboratories participating in CIPM key comparisons may be restricted for technical reasons.*

Comparisons in the CIPM MRA: RMO KC

- CIPM key
- RMO key
- Supplementary
 - Undertaken by Regional Metrology Organizations
 - 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)

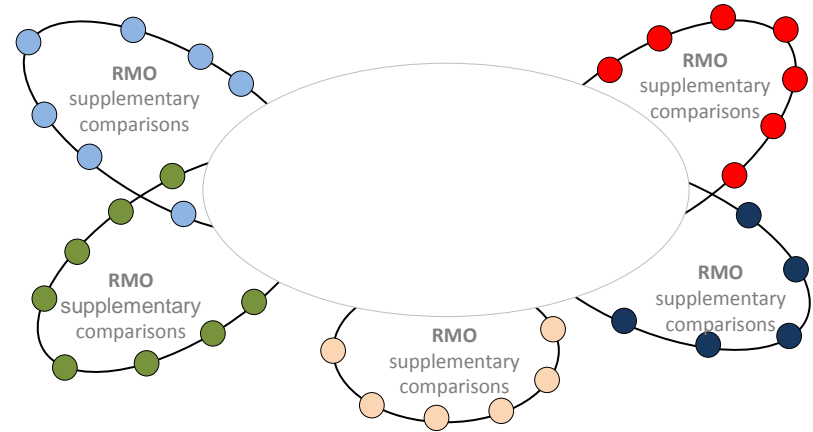


Participation

- *Participation in RMO key comparisons is decided by the corresponding committees of the RMO, but only the results corresponding to NMIs/ DIs from Member States of the BIPM or Associate States of the CGPM that have signed the CIPM MRA will appear in the KCDB.*
- *Results corresponding to participants that do not come from a Member State of the BIPM or an Associate State or Economy of the CGPM may appear in reports published by the RMO.*

Comparisons in the CIPM MRA: RMO SC

- CIPM key
- RMO key
- **Supplementary**
 - Usually takes place in regions
 - Covers areas not covered by Key Comparisons – lower accuracy measurements and different techniques
 - Consultative Committees may however decide to run a supplementary comparison when
 - *there are only few participants capable of measuring the required quantity*
 - *no link can be made to an RMO comparison or*
 - *the distribution of samples to measure is a constraint (for instance: measurements of radioactive matrix reference materials).*

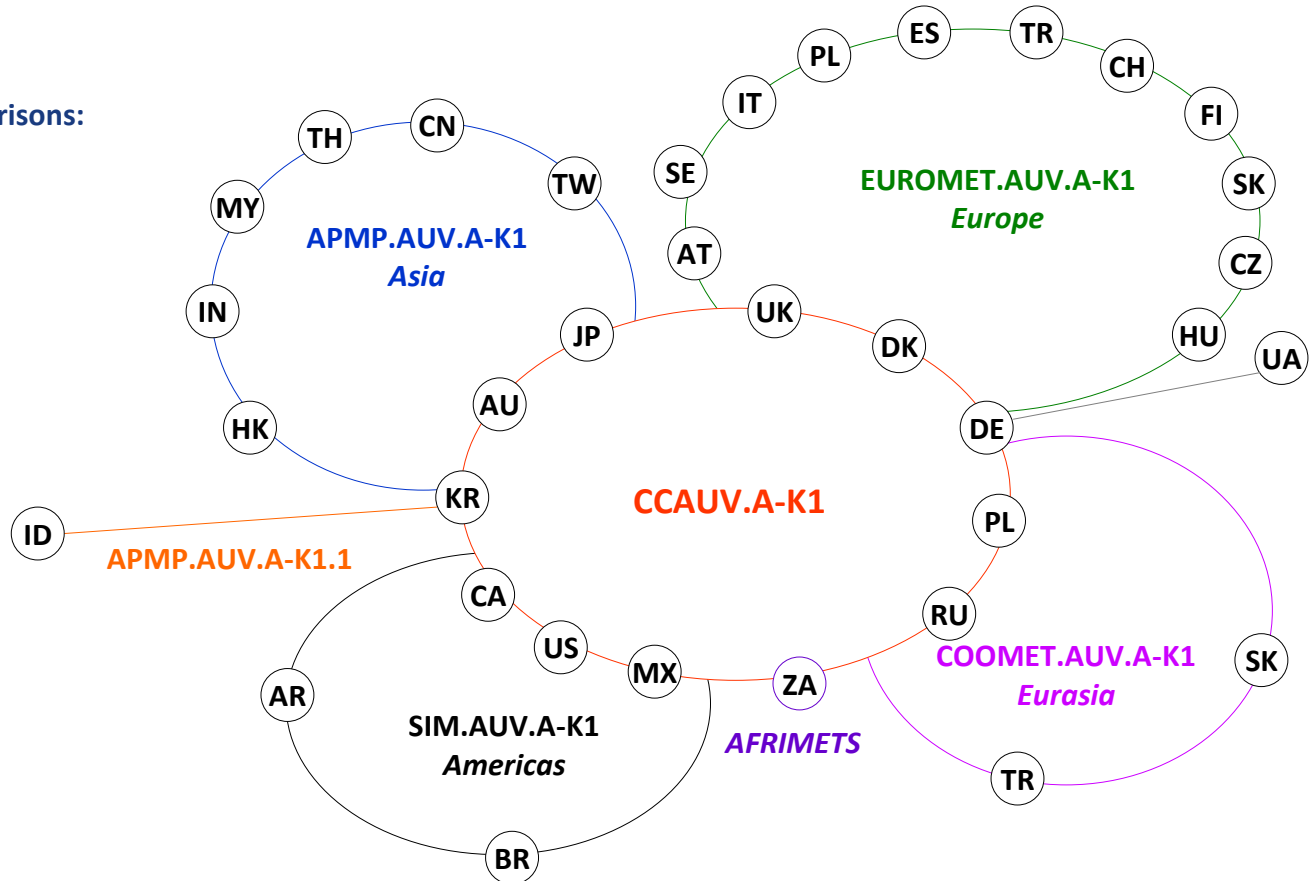


Participation

- *The rules for the participation in CIPM and RMO key comparisons also apply to CIPM and RMO supplementary comparisons*

Comparisons in the CIPM MRA: Example

Example of 7 linked Key Comparisons:
AUV.A-K1: LS1P Microphones



Comparisons in the CIPM MRA: bilateral key comparisons

Subsequent bilateral key comparisons: normally carried out because:

- An institute considers its KC result unrepresentative of its standards/capabilities
- An institute was not ready to participate at the time of the KC

No recalculation of the KCRV for CIPM bilateral KC

The results of subsequent key comparisons may be added to the data for the previous key comparison in the KCDB, with a note specifying that these results correspond to the subsequent comparison.

Subsequent bilateral key comparisons should be organized immediately after or in parallel to particular comparison

Comparisons in the CIPM MRA: Pilot studies

Pilot studies: normally undertaken to:

- Establish measurement parameters in a new field or instrument

Results alone are not normally considered sufficient to support CMCs

Fields such as chemistry have special purpose for pilot studies, and will be discussed under those lectures

CIPM MRA-D-05

It is important to note that a national metrology institute (NMI) or designated institute (DI) that has never participated in a comparison may wish to acquire a benchmark of its performance before participating in a key comparison. This can be achieved by running pilot studies in parallel to a key or supplementary comparison or by participating in a key or supplementary comparison in “pilot study” mode. The results of the NMIs or DIs participating in the pilot study are not to be used to compute reference values, and the name of the institute will not be published in the KCDB. Participation in “pilot studies” run in parallel to comparisons must be agreed before the comparison measurements starts. Results from pilot studies are not considered sufficient support of CMCs.

Comparisons in the CIPM MRA: Pilot studies

Requirements: *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

Pilot studies can be used to underpin CMC claims with these technical evidences

CIPM MRA – D-04

Comparisons: registration in the KCDB

- Once a new comparison is decided by the CC or RMO, it should be registered in the KCDB Office;
Details on planning, organizing, conducting, reporting of comparisons covered in following lectures
- Fillable registration form is available on BIPM website, to be submitted to the KCDB coordinator and others designated on form*
- KCDB Coordinator registers comparison and posts form;
- The Pilot laboratory should regularly update the form and re-submit as the comparison progresses through the stages of the comparison**
- Status of comparisons regularly reported to CCs, RMOs, and CIPM

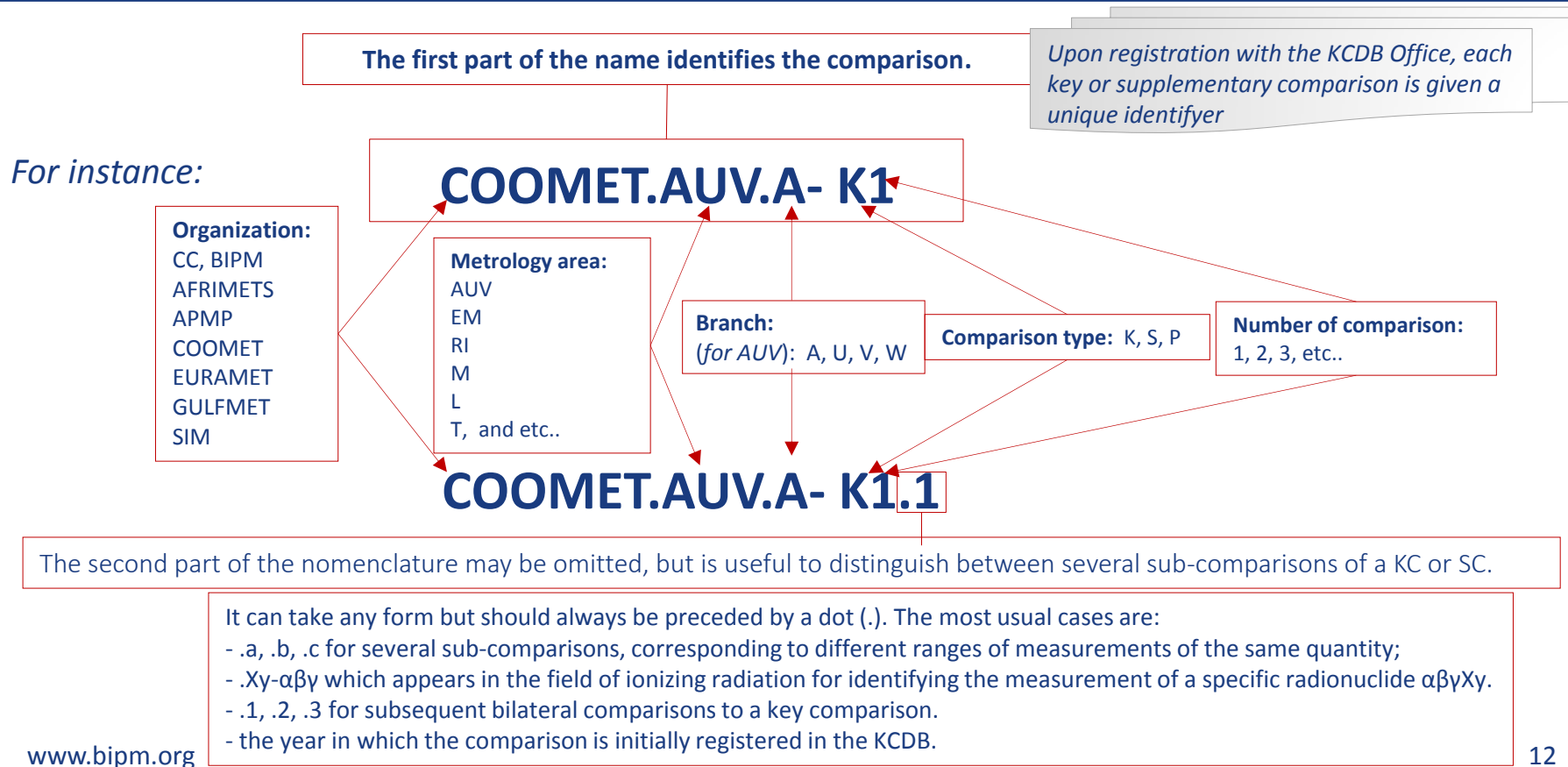
*Completed form should be sent to:

- CCXX Executive Secretary;
- relevant CC Key Comparison WG Chairman;
- Regional coordinator as appropriate;
- KCDB Coordinator (BIPM.KCDB@bipm.org)

Key and supplementary comparisons (and pilot studies) - registration and progress form			
Comparison conducted by		In	Date:
1. Subfield:		RMO internal identifier	
2. KCDB identifier:			
3. Type of comparison:		4. Short description:	
Key <input type="checkbox"/> Supplementary <input type="checkbox"/> Pilot study <input type="checkbox"/>			
5. Measurand and nominal value(s):		Special characters for copying (if required)	
		α β γ δ ε ζ η θ ι κ λ μ	
6. Parameter(s):			
7. Transfer device(s)/sample(s):			
8. Pilot laboratory(ies) (acronyms and countries):			
9. Participating institutes (acronyms and countries):			
10. Progress: (please note date and tick appropriate box to indicate current status)			
Date	Status	Pilot	Supplementary
	Planned	<input type="checkbox"/>	<input type="checkbox"/>
	Protocol complete	<input type="checkbox"/>	<input type="checkbox"/>
	In progress	<input type="checkbox"/>	<input type="checkbox"/>
	Measurement completed	<input type="checkbox"/>	<input type="checkbox"/>
	Report in progress	<input type="checkbox"/>	<input type="checkbox"/>
	Report submitted to	<input type="checkbox"/>	<input type="checkbox"/>
	Results approved	<input type="checkbox"/>	<input type="checkbox"/>
	Approved for equivalence	<input type="checkbox"/>	<input type="checkbox"/>
	Abandoned	<input type="checkbox"/>	<input type="checkbox"/>
Comments:		Publication reference:	
11. Measurement start date:		12. (Expected) measurement completion date:	
13. Contact person's name:			
Address:		Tel.:	
		Fax:	
		e-mail:	
		Web:	

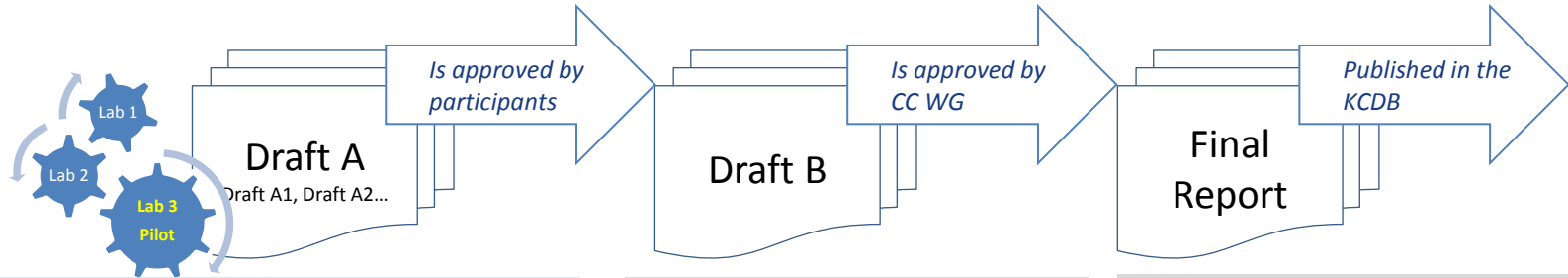
Key Comparison WG Chairman;
Regional coordinator as appropriate;
KCDB Coordinator (except Pilot studies): BIPM.KCDB@bipm.org

Comparisons in the CIPM MRA: Nomenclature



Report of a **CIPM** key comparison

The pilot institute is responsible for writing the report of the key comparison (*Draft A, Draft B and Final Report*)



- First calculation of the KCRV
- Available for comments
- Report may be modified if there were errors
- Withdrawal of results is not allowed
- Individual values and uncertainties may be changed or removed or the complete comparison abandoned, only with the agreement of all participants and on the basis of a clear failure of the travelling standard or some other phenomenon that renders the comparison or part of it invalid.
- *must be considered confidential and cannot be used as support for claiming CMCs.*

- KCRV and DoE must be considered confidential until they are approved by the CC and published in the KCDB.
- **the results can be used to support CMCs if usage agreed by WG**
- **can be used for presentations and publications**

Report must be sent to Executive Secretary of CC.

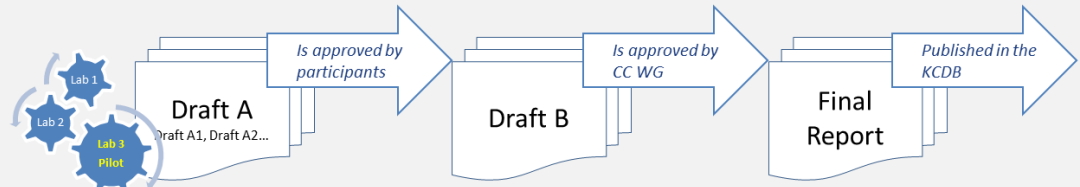
After approval must be sent to the KCDB office for publication with clear statement that it was approved.

Report of a RMO key comparison

- The procedure for reporting an RMO key comparison is basically the same as that described for CC key comparisons.
- Only key comparisons carried out by a Consultative Committee or the BIPM (CIPM key comparisons) lead to a key comparison reference value.

Report of a CIPM key comparison

The pilot institute is responsible for writing the report of the key comparison (*Draft A, Draft B and Final Report*)



~~First calculation of the KCRV~~

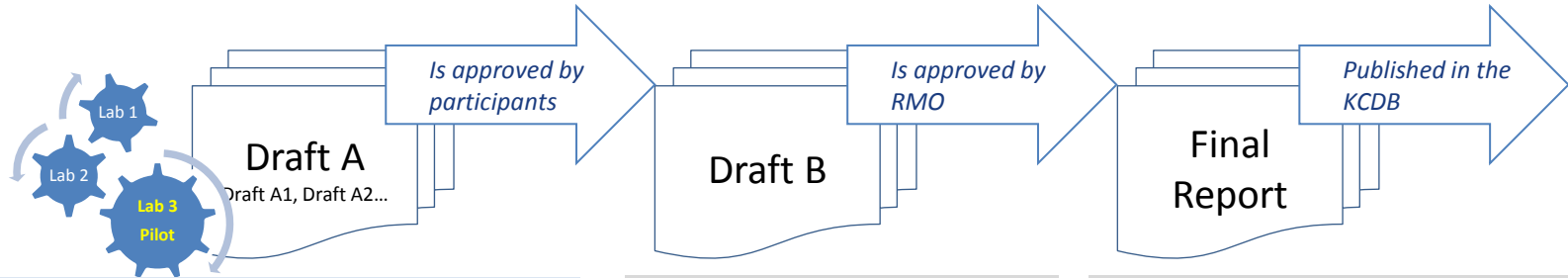
- Available for comments
- Report may be modified if there were errors
- Withdrawal of results is not allowed
- Individual values and uncertainties may be changed or removed or the complete comparison abandoned, only with the agreement of all participants and on the basis of a clear failure of the travelling standard or some other phenomenon that renders the comparison or part of it invalid.
- *must be considered confidential and cannot be used as support for claiming CMCs.*

- KCRV and DoE must be considered confidential until they are approved by the CC and published in the KCDB.
- **the results can be used to support CMCs if usage agreed by WG**
- **can be used for presentations and publications**

Report must be sent to Executive Secretary of CC.
After approval must be sent to the KCDB office for publication with clear statement that it was approved.

Report of a CC & RMO supplementary comparison

The pilot institute is responsible for writing the report of the comparison (*Draft A, Draft B and Final Report*)



- Available for comments
- Report may be modified if there were errors
- Withdrawal of results are not allowed
- Individual values and uncertainties may be changed or removed or the complete comparison abandoned, only with the agreement of all participants and on the basis of a clear failure of the travelling standard or some other phenomenon that renders the comparison or part of it invalid.
- *must be considered confidential and cannot be used as support for claiming CMCs.*

- RMO TC/WG approves report
- Approved by RMO report must be sent to the CC Executive Secretary and the CC WG for a 6 weeks period of comment and editorial control.

Becomes final after acceptance by CC.
If within 6 weeks no objections from CC WG, acceptance is automatic and the final report will be sent to the KCDB Office.

To be used as support for CMCs the Final Reports should be published in the KCDB.

Comparisons in the CIPM MRA: Degree of Equivalence

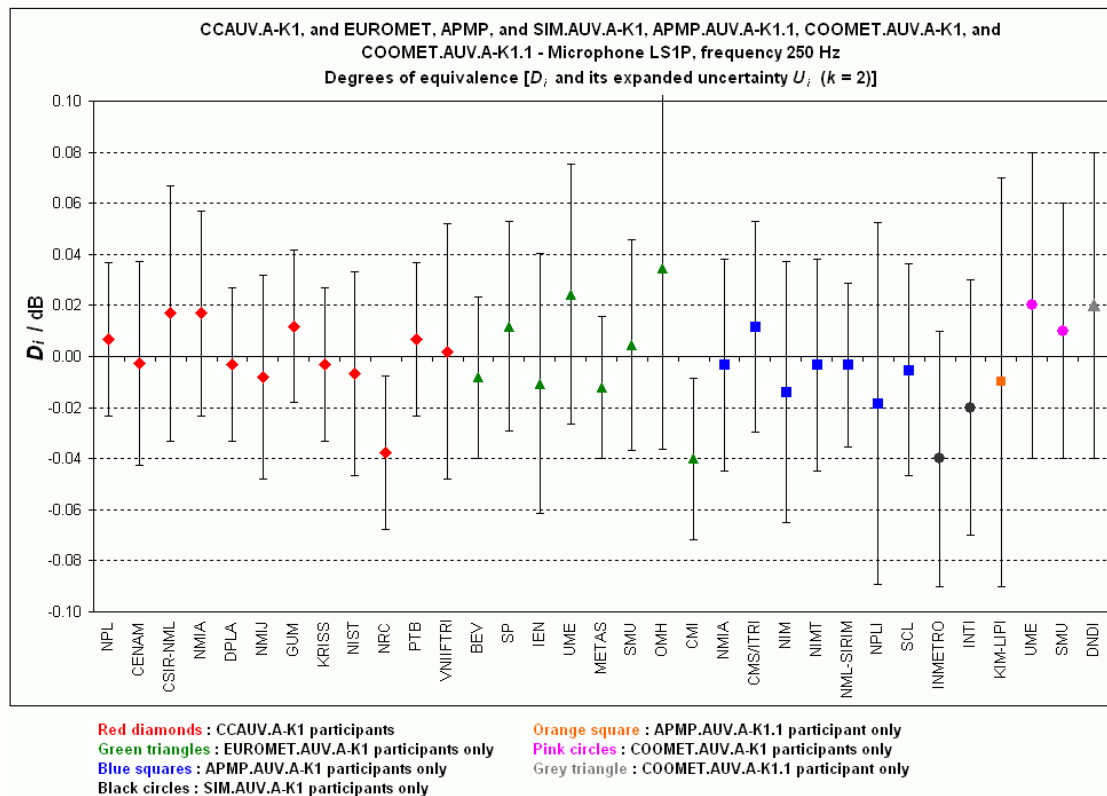
- KCRV
- All CIPM and RMO Key Comparisons result in a statement of whether the measured value of each participant is consistent with the KCRV.
- It is these statements of “*Degree of Equivalence*” which are evidence to support CMCs

A degree of equivalence is expressed quantitatively by two numbers:

- The deviation of the participants result from the KCRV, or $D_i = x_i - x_R$
- The expanded uncertainty of the deviation $U(D_i) = 2u(x_i - x_R)$

In general, if $D_i < U(D_i)$, the result supports the CMC. The CCs establish specific guidance on how to interpret results for supporting CMCs.

Comparisons in the CIPM MRA: Degree of Equivalence



Publication of comparisons in the KCDB

- Final reports are sent in pdf format to corresponding CC executive secretary
- After approval, send to KCDB office for posting on the KCDB website
- For key comparisons, send excel file containing data and graphs of results and equivalence
 - *Only results of signatory NMIs and DIs can be included in the tables and graphs*

Recent updates from 34th JCRB:

Non-signatory participants' names will not be listed in the summary data (drop-down menus) of the KCDB website. However, because their results are listed in the openly available reports, these reports can be used as evidence to support CMCs should the institutes become signatories in the future.

It is recommended that the Final Reports of all comparisons are published in a technical journal such as the Technical Supplement of *Metrologia*, or any other publicly available publication

Publication of a Final Report in *Metrologia's* Technical Supplement

To submit your final report for publication in *Metrologia's* Technical Supplement, please complete the following form and send it by e-mail to the Consultative Committee Executive Secretary or appropriate contact person.

TITLE OF REPORT	
CONTACT PERSON NAME(S)	
CONTACT PERSON(S) E-MAIL	
FIELD	Choose field.
COMPARISON TYPE	Choisissez un élément.
COMPARISON IDENTIFIER	e.g. CCT-K11
APPROVING BODY	Choisissez un élément.
FINAL REPORT URL	TO BE COMPLETED BY THE KCDB OFFICE

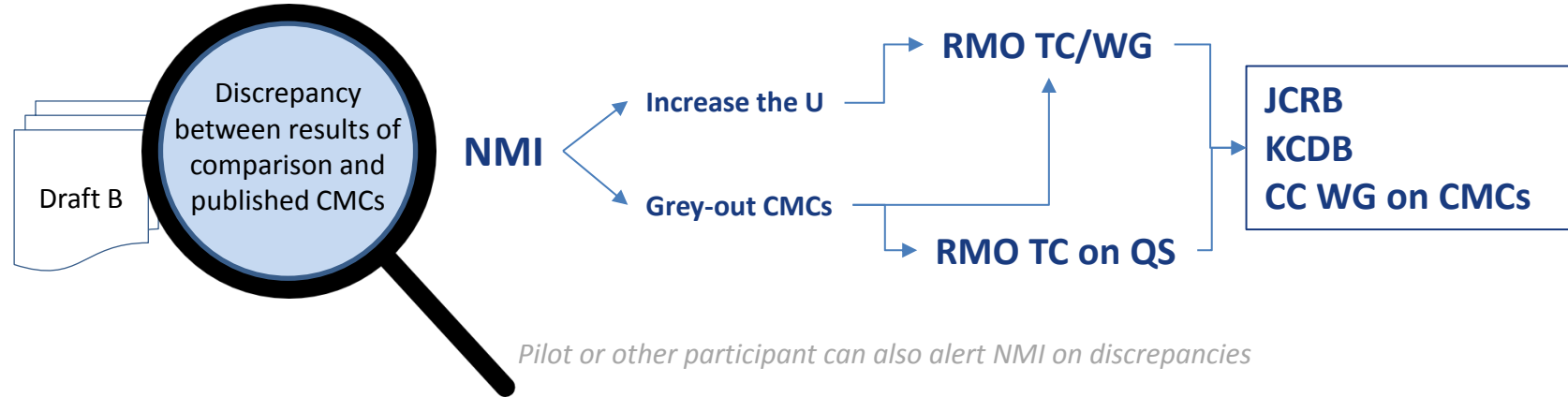
ABSTRACT	
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<https://www.bipm.org/utls/common/documents/CIPM-MRA/MET-Technical-Supplement.docx>

Monitoring the impact of comparison results

The chain of responsibility that CMCs of NMI are consistent with the comparison results:

- The NMI making the CMC claim has primary and principal responsibility
- RMO should monitor the impact of comparison results on CMCs
- CC WG on CMCs (provide guidance on the range of CMCs, identify areas where comparisons are needed, coordinate the review of existing CMCs in the context of new results of comparisons)



Technical supplement to the CIPM MRA

T.7 For calibration and measurement certificates, the quantities, ranges and calibration and measurement capabilities expressed as an uncertainty (normally at a 95 % level of confidence but in some cases it may be at a higher, specified, level), are listed for each participating institute in Appendix C. They must be consistent with the results given in Appendix B, derived from the key comparisons. If, as a result of a key comparison, a significant unresolved deviation from the key comparison reference value persists for the standard of a particular participating institute, the existence of this deviation is noted in Appendix C. [The same applies for significant inconsistencies resulting from a supplementary comparison.](#) In this case, the institute has the choice of either withdrawing from Appendix C one or more of the relevant calibration and measurement services or increasing the corresponding uncertainties given in Appendix C. The calibration and measurement capabilities listed in Appendix C

Guideline document on comparisons

CIPM MRA – D -05

<https://www.bipm.org/utils/common/documents/CIPM-MRA/CIPM-MRA-D-05.pdf>



Measurement comparisons in the CIPM MRA

CIPM MRA-D-05

Version 1.6



Thank you!

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