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# Traceability, KCs, KCDB

**SPEAKER**

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Instituto Nacional de Tecnología Industrial (INTI)

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Organized by

**INM** Instituto Nacional  
de Metrología  
de Colombia



# CIPM Mutual Recognition Arrangement

## (CIPM MRA)



The CIPM Mutual Recognition Arrangement (CIPM MRA) is the framework through which National Metrology Institutes demonstrate the international equivalence of their measurement standards and the calibration and measurement certificates they issue.

The outcomes of the Arrangement are the internationally recognized (peer-reviewed and approved) Calibration and Measurement Capabilities (CMCs) of the participating institutes. Approved CMCs and supporting technical data are publicly available from the CIPM MRA database (the KCDB).



# CIPM Mutual Recognition Arrangement

## (CIPM MRA)

### The CIPM MRA is open to:

- NMIs of the Member States of the BIPM
- certain international and intergovernmental organizations (IGO) invited by the CIPM
- NMIs of Associate States and Economies of the General Conference

### Designated institutes (DIs)

The CIPM MRA also introduced the concept of "designated institutes" as responsible for certain national standards and associated services that are not covered by the activities of the "traditional" NMI.

Designated institutes (DIs)

# CIPM Mutual Recognition Arrangement (CIPM MRA)

**By signing the CIPM MRA, an NMI agrees to:**

- accept the process specified in the CIPM MRA for establishing the database;
- recognize the results of key and supplementary comparisons as stated in the database;
- recognize the calibration and measurement capabilities of other participating NMIs as stated in the database.



# CIPM Mutual Recognition Arrangement (CIPM MRA)

## Participating NMI/DI agrees to:

- recognize the degree of equivalence of national measurement standards, derived from the results of key comparisons;
- recognize the validity of calibration and measurement certificates issued by other participating NMIs/Dis.



# Calibration and Measurement Capabilities (CMCs)

- Under the CIPM MRA, CMCs of signatory NMIs are the fundamental object of mutual recognition.
- CMCs are made available in the KCDB in open access, under the form of html pages.
- CMCs are published in Appendix C of the KCDB.



# CIPM Mutual Recognition Arrangement (CIPM MRA)

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.





# Quality Systems



**CIPM MRA requires that all signatory NMIs establish and maintain an appropriate Quality System (QS) as the basis of establishing confidence in each others calibration and measurement activities.**

- NMIs have a choice between accreditation and self-declaration of their QS.
- RMOs are responsible for oversight and approval of the QSs of their member NMIs.
- RMOs must conduct full review of member NMI QSs at least every five years.





# CIPM Mutual Recognition Arrangement (CIPM MRA)

The outcomes of the Arrangement are the internationally recognized (peer-reviewed and approved) Calibration and Measurement Capabilities (CMCs) of the participating institutes. Approved CMCs and supporting technical data are publicly available from the CIPM MRA database (the KCDB).



# Comparisons

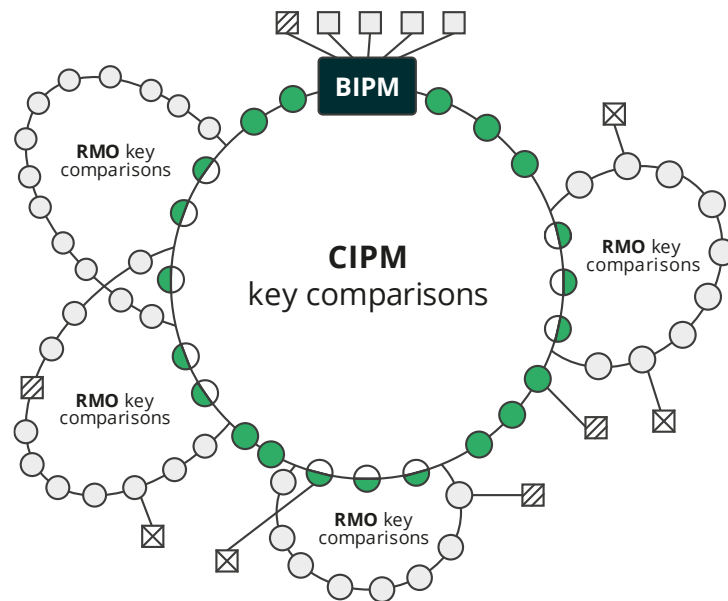
## Fundamental mechanism of the CIPM MRA

- 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 of measurement comparisons:

- CIPM key
- RMO key
- Supplementary

[www.bipm.org/utls/common/documents/CIPMMRA/CIPM-MRA-D-05.pdf](http://www.bipm.org/utls/common/documents/CIPMMRA/CIPM-MRA-D-05.pdf)



- NMI/DI participating in CC key comparisons
- ◐ NMI/DI linking RMO key comparisons to CIPM key comparisons
- NMI/DI participating in RMO key comparisons
- NMI/DI participating in ongoing BIPM key comparisons
- ⊠ NMI/DI participating in a bilateral key comparison
- ▨ International organization signatory to the CIPM MRA

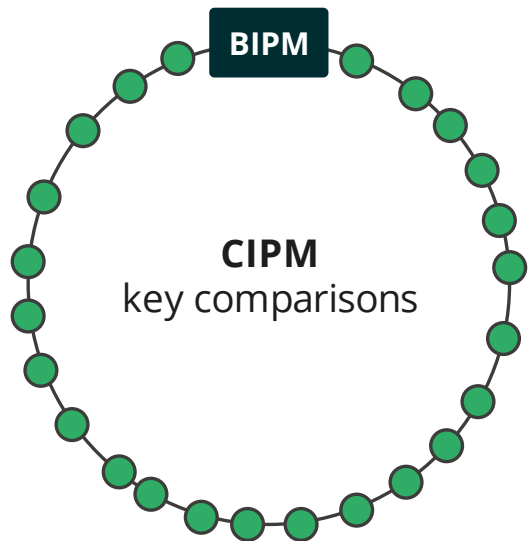


# CCs key comparisons

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.



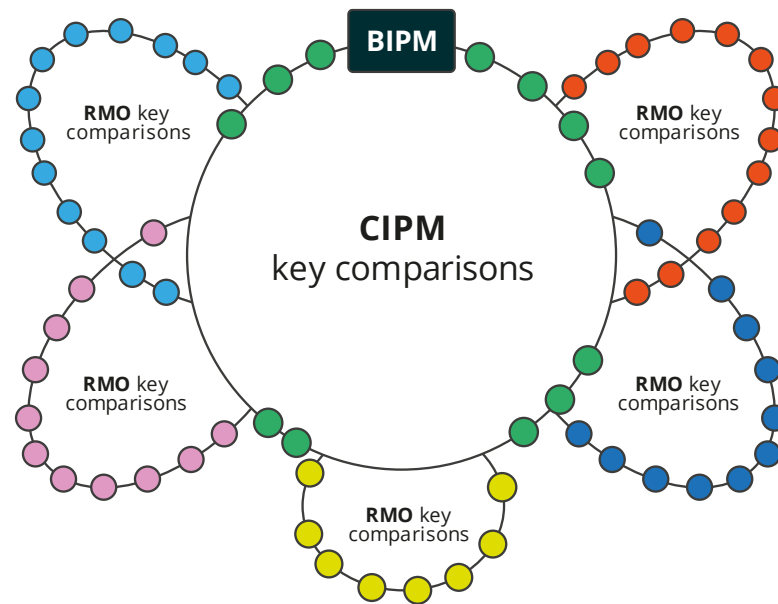
# RMO key comparisons

## 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.



# RMO supplementary comparisons

Usually takes place in regions

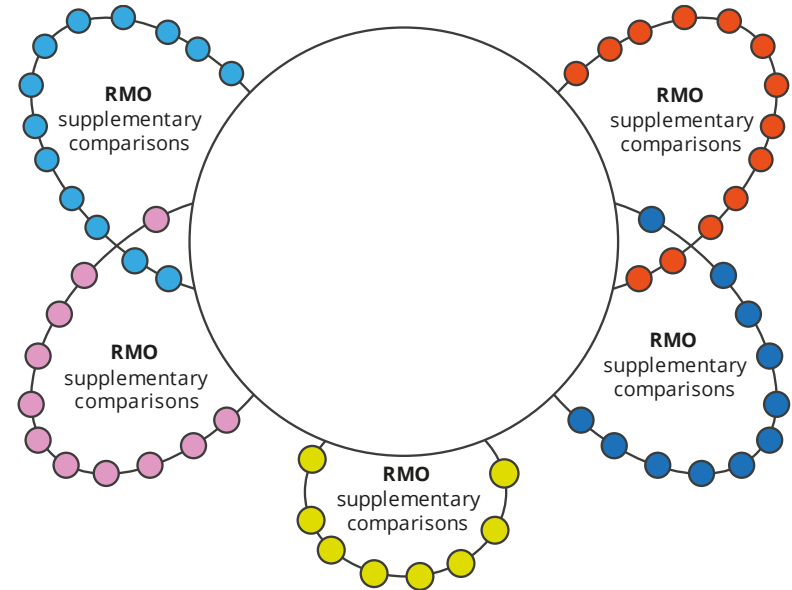
Covers areas not covered by Key Comparisons – lower accuracy measurements and different techniques

Consultative Committees may however decide to run a supplementary comparison when

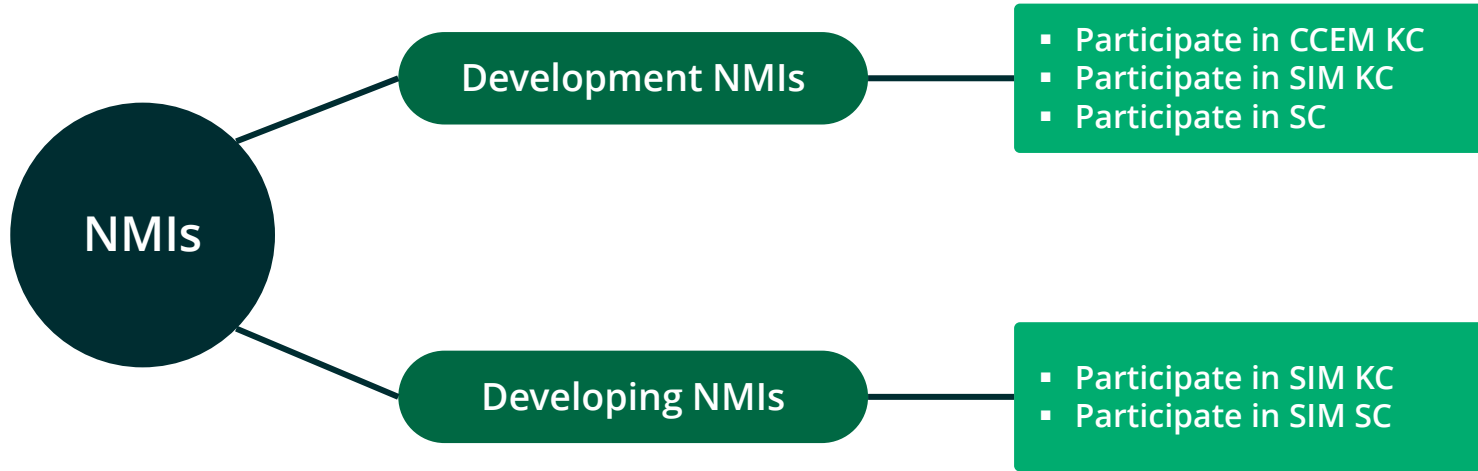
- there are only few participants capable of measuring the required quantity
- no link can be made to an RMO comparison or
- the distribution of samples to measure is a constraint

## Participation

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

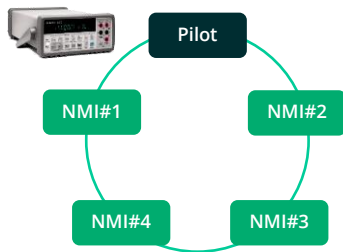


# Comparisons

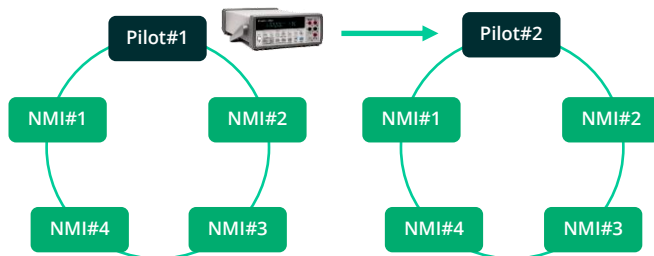


# Types of comparisons

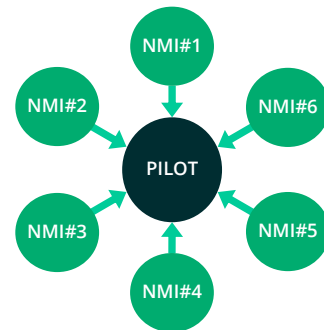
**LOOP  
COMPARISON**



**TWO LOOPS  
COMPARISON**



**STAR  
COMPARISON**



# Comparisons

## Protocol

- Description of the standard
- Parameters to be measure
- Participants
- Timetable
- KCRV determination
- Advice on handling the standard
- Instruction to report the results
- Template of the uncertainty Budget

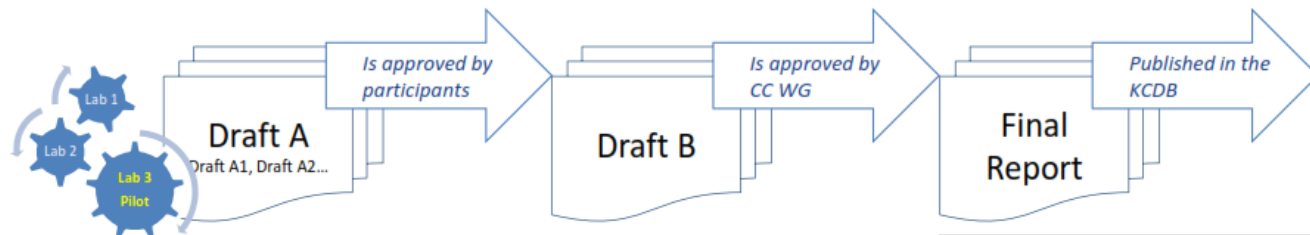
## Report

- Measurement results indentified by participant
- KCRV
- Most of the information in the protocol
- Real Timetable
- Participants reports



# 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.

# Key Comparison Reference Value (KCRV)

OPEN ACCESS

IOF Publishing | Bureau International des Poids et Mesures

Metrologia

Metrologia 52 (2015) S200–S212

doi:10.1088/0026-1394/52/3/S200

## Determination of a reference value and its uncertainty through a power-moderated mean

S Pommé<sup>1</sup> and J Keightley<sup>2</sup>

<sup>1</sup> European Commission, Joint Research Centre, Institute for Reference Materials and Measurements, Retieseweg 111, B-2440 Geel, Belgium

<sup>2</sup> National Physical Laboratory, Hampton Road, Teddington, Middlesex TW11 0LW, UK

IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT, VOL. 52, NO. 2, APRIL 2003

## Statistical Uncertainty Analysis of Key Comparison CCEM-K2

Nien Fan Zhang, Nell Sedransk, and Dean G. Jarrett, *Senior Member, IEEE*

INSTITUTE OF PHYSICS PUBLISHING

METROLOGIA

Metrologia 41 (2004) 231–237

PII: S0026-1394(04)78515-1

## Statistical analysis of key comparisons with linear trends

Nien Fan Zhang<sup>1</sup>, Hung-kung Liu<sup>1</sup>, Nell Sedransk<sup>1</sup> and William E Strawderman<sup>2</sup>

<sup>1</sup> Statistical Engineering Division, National Institute of Standards and Technology, Gaithersburg, MD, USA

<sup>2</sup> Faculty Visitor, Statistical Engineering Division, National Institute of Standards and Technology and Department of Statistics, Rutgers University, New Brunswick, NJ, USA

metrologia

## The evaluation of key comparison data

*M. G. Cox*

**Abstract.** Guidelines containing two procedures are proposed for the evaluation of key comparison data. They apply to the simple circulation of a single travelling standard around all the participants. The application of the procedures to a specific set of key comparison data provides a key comparison reference value (KCRV) and the associated uncertainty, the degree of equivalence of the measurement made by each participating national institute and the degrees of equivalence between measurements made by all pairs of participating institutes. Procedure A is based on the use of the weighted mean, together with consistency checks based on classical statistics regarding its applicability. Should the checks fail, action to remedy the situation is suggested. If the remedy is inappropriate, Procedure B can be applied instead. It is based on the use of the median (or any another informed choice) as a more robust estimator in the circumstances.



# Key Comparison Data Base (KCDB)

KCDB  
All data listed in the KCDB have been reviewed and approved within the CIPM Mutual Recognition Arrangement

Home CMCS **COMPARISONS** NEWS STATISTICS

Result for: SIM.EM

Home > CMCS Search

Home

39 results  
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Select Metr

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Thermometry

Time and Frequenc

Metrology area

- electricity and magnetism (35)
- chemistry and biology (4)

Keywords

Sub-field

- ac voltage, current, power, and ac/dc transfer (13)
- ac voltage and current (6)
- resistance (6)

**SIM.EM-K1** COMPARISON OF RESISTANCE STANDARDS 2006 - 2007

Electricity and Magnetism

Resistance

Approved for equivalence

Key Comparison

**SIM.EM-K2** COMPARISON OF RESISTANCE STANDARDS 2006 - 2007

Electricity and Magnetism

Resistance

Approved for equivalence

Key Comparison

**SIM.EM-K3** COMPARISON OF INDUCTORS

STATISTICS





# Intra RMO Review Flowchart

[SIM-05-3.6-21Aug2022.pdf](#)





## How to support CMCs

The reviewers will then check the range and uncertainty of the submitted CMCs for consistency with information from some or all of the following sources as described in Section 3.3 of CIPM MRA-G-13:

- Results of key and supplementary comparisons
- Publicly available information on technical activities including publications
- On-site peer-assessment reports, including those from accreditation assessment with appropriate technical peers
- Active participation in RMO projects
- The minutes of the QSTF meeting, the Certificate of Approval of the QMS for this measurement area, and the CMC file that was submitted for the QSTF review
- Other evidence of knowledge and experience, as agreed by the appropriate Consultative Committee

While the results of key and supplementary comparisons are the ideal supporting evidence, all other sources listed above may be considered to underpin CMCs.



# SIM webpage

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**2024 WORLD METROLOGY DAY- SIM PRESIDENT MESSAGE +VIDEO OF SIM ACTIVITIES RELATED TO SDGs**

VERSION DEL VIDEO EN ESPAÑOL

**BIPM Young metrologists' 2050+ vision**

Dear young metrologists, As future leaders in metrology, we are inviting you to participate in this foresighting exercise to seek your vision of what metrology will look like in the future. Foresighting helps us to...

## Official Documents

- [Bylaws](#) (Approved 2022)
- [Strategic Plan 2023-27](#) (Approved 2022)
- [Rules of Order](#) (Approved 2023)

### TECHNICAL COMMITTEE DOCUMENTS

- [SIM D-01 v2.0](#)
- [SIM 05 SIM Procedure for Review of Calibration and Measurement Capabilities](#)
- [SIM\\_06\\_Electronic\\_voting](#)
- [SIM 07 Procedure for Registration and Disposition of SIM Comparisons](#)
- [Funding request form 20240509](#)
- [eLearning approval template 20240326](#)

### QUALITY SYSTEM TASK FORCE

- [SIM 09 Procedure for Review of the Quality Management System of National Metrology Institutes and Designated Institutes](#)




# References

## BIPM

- [www.bipm.org/kcdb/](http://www.bipm.org/kcdb/)
- [www.youtube.com/thebipm](http://www.youtube.com/thebipm)
- [www.bipm.org/en/cipm-mra/kcdb-help](http://www.bipm.org/en/cipm-mra/kcdb-help)
- [www.bipm.org/utils/common/pdf/KCDB\\_2.0/Getting\\_started\\_KCDB\\_platform.pdf](http://www.bipm.org/utils/common/pdf/KCDB_2.0/Getting_started_KCDB_platform.pdf)

## SIM

- [sim-metrologia.org/wp-content/uploads/2023/02/SIM-05-3.6-21Aug2022.pdf](http://sim-metrologia.org/wp-content/uploads/2023/02/SIM-05-3.6-21Aug2022.pdf)
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  - [sim-metrologia.org/wp-content/uploads/2023/12/Strategic-Plan-2023-27.pdf](http://sim-metrologia.org/wp-content/uploads/2023/12/Strategic-Plan-2023-27.pdf)
  - [sim-metrologia.org/wp-content/uploads/2024/01/Rules-of-Order\\_-V3-06\\_2023.pdf](http://sim-metrologia.org/wp-content/uploads/2024/01/Rules-of-Order_-V3-06_2023.pdf)
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# Thanks.

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