

CBKT

Technical evidence (comparisons)

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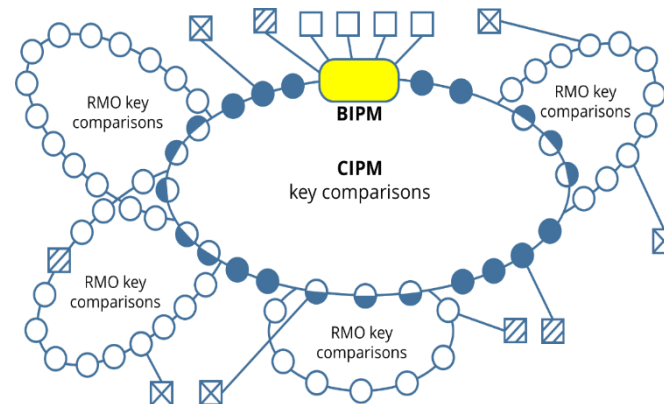


Bureau
International des
Poids et
Mesures

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BIPM

Comparisons

- A fundamental mechanism of the CIPM MRA.
- Providing the technical basis of the CIPM MRA.
- Establish the degrees of equivalence of national measurement standards.
- Demonstrate NMI measurement capabilities.
- Peer-evaluated by RMOs and CCs.
- Published in the KCDB.



There are 3 basic categories

- CIPM key
- RMO key
- Supplementary

CIPM key comparisons

- **CIPM key comparisons:** of international scope, are organized by Consultative Committees or the BIPM.
- Restricted to laboratories of Member States and normally members of the corresponding Consultative Committees.
- Deliver a “reference value” for the key quantity chosen.

Objective:

To test the principal techniques and methods in the field

RMO key comparisons

- Intended to provide RMO members with the means to link to the reference value established by the corresponding CIPM key comparison.
- Of regional scope, organized to cover the whole region.
- Deliver complementary information without changing the reference value derived from the CIPM key comparison.
- A degree of equivalence derived from an RMO key comparison has the same status as one derived from a CIPM key comparison.

Objective:

To extend the coverage of the CIPM key comparisons regionally

Supplementary comparisons

- Intended to cover areas or techniques not addressed by key comparisons.
- Complementary to key comparisons (not intended as second-level comparisons).
- Their final reports are published in the KCDB, but degrees of equivalence are not necessarily computed.
- *Although outside of the “normal” scope of the Consultative Committees, they may also organize supplementary comparisons.*

Objective:

To meet specific needs not covered by RMO key comparisons

Subsequent comparisons

- Key comparisons may be extended by subsequent key comparisons.
- **Subsequent comparisons** organized for one or several participants. These comparisons are normally carried out when:
 - after completing a comparison, an institute considers its result unrepresentative of its standards/capabilities;
 - an institute was not ready to participate at the time a comparison was conducted.

Pilot studies

- Normally undertaken to establish measurement parameters for a “new” field or instrument, or as a training exercise.
- The results of pilot studies alone are not normally considered sufficient support for CMCs.
- Not registered nor published in the KCDB.

CIPM MRA-G-11

6.2 Pilot studies run in conjunction with comparisons

It is important to note that an institute that has never taken part in a comparison may wish to acquire a benchmark of its performance before participating in a comparison. This can be achieved by running pilot studies in conjunction with a comparison or by participating in a comparison in “pilot study” mode. The results of participants seeking to benchmark their performance are not to be used to compute reference values, and the name of those institutes will not be published in the KCDB. Participation in “pilot studies” running in conjunction with comparisons shall be agreed before the comparison measurements start. Results from pilot studies are not considered sufficient support of CMCs. Such exercises should be organized such that any risk of delay is minimized for the publication of CMCs in the KCDB.

Technical Protocol

The technical protocol is an important part of the comparison and specifies in detail the procedure to be followed.

- The protocol shall specify the procedures necessary for the comparison, but not necessarily the procedures used for the realization of the standards,
- it shall specify the metrological parameters that need to be measured,
- the way to report participant results to the pilot,
- the method to establish the KCRV, and
- include a statement (HFTLS) which CMCs are intended to get support from the comparison.
- The approved technical protocol should be published in the KCDB.
- RMO key comparisons should follow the same protocol as the preceding CIPM key comparison and clearly identify the link to the CC KCRV.

Participation

- CIPM key comparison is open to laboratories (Member States) having the highest technical competence and experience, normally the member NMIs/DIs of an appropriate Consultative Committee.
- RMO key comparisons are open to all RMO members (Member States and Associates) and to other institutes that meet the rules of the regional organization (may include participants from other regions).

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

Associates in CIPM comparisons

Specifically, and in exceptional circumstances, Associates may be invited to take part in comparisons organized by Consultative Committees and pilot studies where:

- this adds scientific or other value to the work or to the results obtained by other participants;
 - reference samples are only produced for the purposes of the Consultative Committee comparison and no linked RMO comparisons are possible;
 - their participation increases the efficiency or adds effectiveness to the relevant activity.
- Reports of these comparisons may be published in the KCDB.
 - These reports shall make clear which results come from Associates.
 - Their results shall not contribute to the key comparison reference value unless it can be shown to be of significant scientific value to other participants.

Reports

Participant reports shall be written to reflect the experiment that was actually performed; individual reports from all participants are part of the comparison report. *A result from a participant is not considered complete without its associated measurement uncertainty; yet will this participant's result not be included in the draft report.*

Comparison reports shall include, or give reference to, most of the information specified in the Technical protocol:

- a) measurement results identified for the individual participants
- b) the key comparison reference value (reference value for supplementary comparisons) with a description how it was calculated (if applicable), or how the linking to the key comparison reference value was carried out;
- c) the degrees of equivalence and how these were evaluated (not mandatory for supplementary comparisons).

- Draft A being available only to the participants in the comparison;
- Draft B being available to the relevant Consultative Committee;
- Final Report being publicly available.

Reports

If on examination of the complete set of results, *anomalous results* can be indicated to the corresponding participant *to check* for any error but without being informed about the sign and magnitude of the apparent anomaly. If no *numerical error* is found the result of this participant stands and the complete set is sent in the draft-A report to all participants, including:

- a) measurement results identified for the individual participants
- b) the key comparison reference value (reference value for supplementary comparisons) with a description how it was calculated (if applicable), or how the linking to the key comparison reference value was carried out;
- c) the degrees of equivalence and how these were evaluated (not mandatory for supplementary comparisons).

- Draft A being available only to the participants in the comparison;
- Draft B being available to the relevant Consultative Committee;
- Final Report being publicly available.

Reports — Approvals

- Draft A is approved by the participants (all must consent);
- Draft B is examined by the CC working group (on key comparisons / delegated WG) and approved by the CC according to CC-specific procedures;
- Then Final Report sent to the KCDB Office for ➡ ***publication in the KCDB***

- Draft A being available only to the participants in the comparison;
- Draft B being available to the relevant Consultative Committee;
- Final Report being publicly available.

Outcomes

- Only CIPM key comparisons generate a **key comparison reference value (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 this statement of a *“Degree of Equivalence”* which provides 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 is consistent with the KCRV (and supports a CMC claimed on the comparison result). The CCs establish specific guidance on how to interpret results for supporting CMCs.

- For key comparisons: approved Draft B versions might be used to support CMC claims;
- For supplementary comparisons: Final Report published on the KCDB can be used to support CMC claims.

Monitoring the comparison results

- If the results of a comparison are inconsistent with CMCs already published in the KCDB, appropriate action shall be taken with these CMCs according to CIPM MRA-G-13.
- If a participant in a comparison detects a discrepancy between its result in a comparison and related CMCs published in the KCDB after Draft B has been approved, that institute shall inform the corresponding RMO TC/WG and RMO TC/WG on QS.
- If the pilot institute or any other participant detects a discrepancy, they shall write to the institute alerting them to any potential problems in their results for the comparison (communication shall be copied to the RMO TC/WG and RMO TC/WG on QS).
- *In both cases, the communication shall also be copied to the Consultative Committee working group on CMCs, the JCRB Executive Secretary and the President of the Consultative Committee.*

CIPM MRA documents

... plus relevant CC-specific procedures:

<https://www.bipm.org/en/cipm-mra/cipm-mra-documents>

Thank you

Measurement comparisons in the CIPM MRA

Guidelines for organizing, participating
and reporting

CIPM MRA-G-11

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