


| | | |
|---|--|--------------------------------|
|  | COOMET Recommendation | COOMET R/GM/11:2021 |
| | Regulations on Comparisons of Measurement Standards of COOMET National Metrology Institutes and Designated Institutes | |
| <p><i>Adopted at the 3rd COOMET Joint Committee for Measurement Standards meeting (13 May 2005, Minsk, Belarus); approved at the 15th COOMET Committee meeting (8-9 September 2005, Vilnius, Lithuania); updated at the 15th COOMET JCMS meeting (26 April 2017, Minsk, Belarus); approved at the 27th COOMET Committee meeting (27–28 April 2017, Minsk, Belarus); updated at the 20th COOMET JCMS meeting (3 June 2021, online). approved at the 31st COOMET Committee meeting (15-17 June 2021, online).</i></p> | | |

1. SCOPE

These Regulations establish objectives for comparisons of measurement standards of COOMET national metrology institutes (NMIs) and designated institutes (DIs) within the framework of the implementation of the Mutual Recognition Arrangement of National Measurement Standards and of Calibration and Measurement Certificates Issued by National Metrology Institutes (CIPM MRA), as well as procedures for their planning, organization and conduct. These Regulations are based on principles stated in CIPM MRA-G-11¹ and COOMET D2/2021.

Note – The Russian translation of CIPM MRA-G-11 is available at <https://www.coomet.net/ru/>.

Changes and additions to these Regulations can be made at the meetings of the Joint Committee for Measurement Standards.

2. REFERENCES

In these Regulations references are made to the following documents:

- CIPM MRA-G-11 Measurement Comparisons in the CIPM MRA: Guidelines for Organizing, Participating and Reporting;
- COOMET D2/2021 COOMET Rules of Procedure;
- COOMET R/GM/12:2021 Rules of Maintaining of the COOMET Comparisons Program;
- COOMET R/GM/14:2016 Guidelines for Evaluation of COOMET Key Comparison Data;
- COOMET R /GM/19:2016 Guidelines for Evaluation of COOMET Supplementary Comparison Data;
- ISO/IEC Guide 98-3:2008 Uncertainty of Measurement — Part 3: Guide to the Expression of Uncertainty in Measurement (GUM:1995);
- COOMET D5.17/2016 Regulations on the COOMET Board of Appeal for Issues Concerning Comparisons of National Standards and CMC Data Review.

3. DEFINITIONS

These Regulations use the following definitions and acronyms:

National metrology institute (NMI) is a metrology institute designated by a national government or another public authority responsible for national standards and participating in the implementation of the CIPM MRA.

¹ When using this publication it is appropriate to check the year of approval of referenced publications on the website www.coomet.org (section "COOMET publications") or on the portal www.coomet.net (section "Publications").

Designated institute (DI) is an institute responsible for national standards in the areas not covered by NMIs, which maintains CMC lines and participates in the implementation of the CIPM MRA.

Comparisons of measurement standards (comparisons) is a process of establishing a relation between measurement results when realizing and transferring a unit of measurement or a measurement scale by these measurement standards.

Notes:

1. Comparisons may involve measurement standards realizing and/or storing basic and derived units, as well as decimal multiples and sub-multiples of SI units.

2. Comparisons of two measurement standards are called bilateral comparisons.

Key comparison is one of a series of comparisons selected by the Consultative Committee to test the fundamental measurement techniques and methods in the measurement field.

Note: Key comparisons of national measurement standards establish degrees of equivalence of the measurement standards claimed by NMIs/DIs. The latter is an objective confirmation of the corresponding calibration and measurement capabilities (CMCs) of the NMI/DI.

CIPM key comparison is a key comparison carried out by the Consultative Committee (CC) or BIPM, which results in establishment of a key comparison reference value.

Note: Only the key comparisons carried out by CCs or BIPM provide a key comparison reference value.

Key comparison reference value is a reference value and its uncertainty resulting from a CIPM key comparison.

Degree of equivalence of a national standard is a degree to which national standards participating in a key comparison are consistent with the key comparison reference value and, therefore, with each other. It is expressed quantitatively by the deviation from the key comparison reference value and the uncertainty of this deviation.

Note: The degree of equivalence between two measurement standards is expressed as the difference between their respective deviations from the key comparison reference value and the uncertainty of this difference.

COOMET key comparison is a key comparison of national measurement standards organized by the COOMET Technical Committees.

Note: The purpose of key comparisons is to determine a key comparison reference value, to establish the degree of equivalence of national measurement standards with each other, and to provide an objective basis for confirming CMCs of the NMIs/DIs participating in the comparisons.

COOMET supplementary comparison is a comparison of national measurement standards organized by the COOMET Technical Committees, not included in the list of key comparisons.

Note: Generally, the purpose of a supplementary comparison is to establish degree of equivalence of national measurement standards with each other, and to provide an objective basis for confirming CMCs of the NMIs/DIs participating in the comparisons.

COOMET pilot comparison (study) is a comparison of national measurement standards organized by COOMET Technical Committees and generally carried out before COOMET key or supplementary comparisons to test measurement techniques and/or to study stability of transfer standards, as well as to assess possible discrepancies of the COOMET key comparison measurement results.

Transfer standard (travelling standard) is a measurement standard used in a comparison of measurement standards that, for one reason or another, cannot be compared directly.

Pilot NMI is a NMI/DI responsible for organizing and conducting a comparison and for processing measurement results obtained by participating NMIs/DIs.

BIPM key comparison database (BIPM KCDB) is a free web resource and web platform (www.bipm.org/kcdb) related to the implementation of the CIPM MRA.

Calibration and measurement capabilities (CMCs) represent the highest level of a calibration or measurement available to customers represented by ranges of measurands and associated expanded uncertainties at a 95 % level of confidence. CMCs are published in the BIPM KCDB (<https://www.bipm.org/kcdb/>).

4. GENERAL PROVISIONS

4.1. Comparisons of national measurement standards of COOMET NMIs/DIs are carried out in order to implement the CIPM MRA and promote international recognition of national measurement standards.

Note: Comparisons of national measurement standards of COOMET NMIs/DIs do not substitute for calibrations of national measurement standards of the COOMET NMIs/DIs.

4.2. Participation in COOMET key comparisons is open to all the COOMET NMIs/DIs and other institutes following COOMET rules (including institutes invited from outside the region) and exhibiting technical competence in relation to each specific comparison.

4.3. Comparisons of national measurement standards of COOMET NMIs/DIs are subdivided into key, supplemental, and pilot.

Notes:

1. COOMET key comparisons establish their connection to the corresponding CIPM comparisons through the measurement results of the liaison institutes.

2. Comparisons can be bilateral and multilateral.

4.4. COOMET Comparisons Program is formed based on COOMET projects database in accordance with COOMET R/GM/12:2021 "Rules of maintaining of the COOMET Comparisons Program".

4.5. The Program for the next year is approved by the COOMET President at the annual Presidential Council meeting.

5. GENERAL

5.1. Planning of comparisons

5.1.1. Proposals to carry out comparisons are put forward by COOMET NMIs/DIs. The initiating NMI/DI sends draft form for the proposed COOMET project to the TC Chair (see COOMET D2/2021).

5.1.2. The TC Chair includes the issue of conducting the proposed comparison in the agenda of the next TC meeting. By the time of the TC meeting, TC members should determine the possibility and degree of participation of their NMIs/DIs in the proposed comparison. In justified cases (generally for bilateral comparisons), such issues can be solved by TC Chairs through electronic vote or individually.

5.1.3. At the TC meeting, relevance and possibility of the proposed comparison are analyzed, as well as CMC positions ensured by its implementation (according to the international classification system).

After the discussion, the TC:

- makes a decision to open a COOMET project to carry out the comparison,
- makes a decision to organize the comparison,
- classifies the comparison (key, supplementary, pilot),
- defines range of the CMC provided by the comparison,
- lists the prospective participants,
- appoints a pilot NMI from among the participating NMIs/DIs to prepare the comparison protocol and schedule,
- appoints the comparison Coordinator (from the Pilot NMI specialists).²

5.2. Registration of comparisons

² In some cases, all the TC members can discuss these issues by correspondence with the direct participation of the TC Chair.

5.2.1. After making a decision to carry out the comparisons, the pilot NMI and the Coordinator send the form for the proposed project approved by the TC to the COOMET Committee member from their country for submission to the COOMET Secretariat (see COOMET D2/2021).

5.2.2. The COOMET Secretariat registers the proposal and sends the form to all COOMET Committee members, as well as to the corresponding TC Chair and JCMS Chair.

5.2.3. The pilot NMI prepares a detailed technical protocol (including schedule for the comparison and report). It is possible to consult the COOMET TC Chairs and CIPM Consultative Committees or its working groups on these issues.

Key comparison technical protocol is approved by the corresponding CIPM Consultative Committee. The approved protocol is sent to the relevant TC Chair.

5.2.4 The pilot NMI sends the approved technical protocol and the comparison schedule directly to the participating NMIs/DIs.

5.2.5 Before the comparisons start, the Coordinator registers it in the BIPM KCDB. Only key and supplementary comparisons can be registered in the BIPM KCDB. On the BIPM KCDB external website only the CIPM MRA participants will be listed according to the national distribution of measurements areas.

5.2.6. When conducting a comparison registered in the BIPM KCDB, it is important that up-to-date information on its progress is easily accessible. The pilot NMI will receive regular automatic reminders to update the comparison status in the BIPM KCDB. At the same time, the pilot NMI is responsible for updating the comparison status. The updated status is displayed automatically as soon as the comparison progress is reported to the BIPM KCDB.

5.3. Organization of comparisons

5.3.1. The pilot NMI is responsible for preparing the comparison protocol, which, in accordance with the TC decisions, should reflect the following:

- list of participating NMIs/DIs, including their postal and email addresses,
- transfer standard(s),
- need to conduct pilot comparisons or preliminary study of transfer standards' characteristics,
- the comparison scheme; ongoing comparisons should be indicated separately,
- starting date of the comparison, detailed work schedule, means and routes for transportation of each transfer standard,
- procedure in case of transfer standard failure, as well as in case of delays by one of the participating NMIs/DIs.

5.3.2. Participating NMIs/DIs are responsible for transportation of the transfer standard to the next participant in accordance with the established comparison scheme within the time specified in the schedule. In case of delay, the pilot NMI responsible for the circulation of the transfer standard must revise the schedule and inform other participants.

5.3.3. The Coordinator informs the TC Chair and the participants on the comparisons progress at TC meetings.

5.4. Technical protocol

A technical protocol should contain a detailed description of the comparison procedure. It includes the following:

- comparison schedule,
- deadline for submitting the report,
- detailed description of the transfer standard relevant to the comparison: model, type, serial number, uniformity and stability of samples, country of production, size, weight, packaging, etc., as well as technical data required for its operation,

- metrological characteristics to be measured,
- declaration on which services/CMCs can be confirmed by the comparison or criteria for determining these services/CMCs (how far the light shines),
- recommendations for handling the transfer standard, its unpacking, subsequent packing, and transportation to the next participant. This must include a complete list of package contents, as well as manuals, etc., and the package's weight and size,
- procedure for receiving the transfer standard by the participating institute,
- any tests conducted prior to measurements,
- use conditions for the transfer standard during measurements,
- instructions for submitting results,
- CIPM key comparison technical protocol should include proposals for a method to determine the key comparison reference value. Technical protocols of RMO key comparisons should include ways to connect the results to the corresponding CIPM key comparison reference value,
- list of main contributors to the uncertainty budget that each participant should estimate, as well as any necessary recommendations for uncertainty estimation based on the principles established in the Guide to the Expression of Uncertainty of Measurement (GUM). In addition to the basic components of uncertainty that are common for all the participants, individual institutes can add any other components they deem appropriate. Measurement uncertainties are presented as standard uncertainties, and information on the number of effective degrees of freedom should be provided,
- deadlines for sending the results to the pilot NMI. Fast communication helps to solve issues related to the transfer standard during comparisons,
- financial aspects of the comparison, including transportation and customs expenses, as well as expenses for any damages reparation; however, please note, that, in general, each participating institute is responsible for its own measurement expenses. Full cost of organizing the comparison including transportation are usually borne by the pilot NMI. Consensually, any other agreement on sharing the costs by participants can be made,
- issues of insurance of the transfer standard are resolved by agreement between the participants, taking into account responsibility that each participant bears for any damages that may occur within their country.

5.5. Preparation of a comparison report

5.5.1 The pilot NMI is primarily responsible for preparation of the comparison report.

5.5.2. Measurement results submitted to the pilot NMI are not disclosed until all the participants send their measurement results. Measurement results are not complete without the uncertainty and its components in accordance with the comparison protocol.

5.5.3. The pilot NMI analyzes the measurement results. If participant's data is significantly different, the pilot NMI informs the NMI/DI about the inconsistency and suggests checking the results for arithmetic, typographical, or data errors. If this check does not reveal any errors, measurement results of this participant are left unchanged.

5.5.4. After that, the pilot NMI (or a working group, if it was created) prepares a draft report (Draft A) and sends it to the participants for discussion and comments. Draft A contains the participants' results and standard combined uncertainties. If necessary, Draft A is prepared in cooperation with the corresponding CIPM Consultative Committee. Draft A is confidential for the comparison participants.

5.5.5. Taking into account comments and proposals of the participating NMIs/DIs, the pilot NMI informs the participants and sends them a revised version of Draft A. Certain values and uncertainties can be changed or deleted or the comparison in whole canceled only with the consent of all the participants based on a clear failure of a transfer standard or any other event that invalidates the comparison or its part. There can be several consecutive versions of the Draft A report (A1, A2, etc.),

but the Draft A stage is not complete until all the participants have approved it. After the participants agreed on final Draft A, the report becomes Draft B.

5.5.6. For COOMET key comparisons, Draft B should be submitted for approval to the corresponding Consultative Committee.

5.5.7. After the Consultative Committee approved Draft B, it becomes the Final Report. At this point “Draft B” in the report title and table of contents is changed to “Final Report”. Draft B of the COOMET key and supplementary comparisons can be used to support CMCs. At this stage, measurement results are no longer confidential and can be used for presentations and publications. However, degrees of equivalence are confidential before the Consultative Committee approval and publication of the Final Report in the BIPM KCDB.

5.5.8. When preparing reports for the COOMET supplementary comparisons, the same three-stage procedure is to be followed: Draft A, Draft B, Final Report. Differences with key comparisons are as follows:

- approval of the COOMET supplementary comparison report is done by the COOMET Technical Committee,
- degrees of equivalence related to the supplementary comparison reference value can be calculated, but it is not compulsory,
- Final Reports must be published in the KCDB to be used as support for CMCs.

5.5.9. The report must contain an algorithm for processing the data submitted by the participants. In addition,

- key comparison report should provide an algorithm to connect to the CIPM key comparison reference value, establish degree of equivalence of each participant’s measurement standard, and provide means to confirm the claimed CMCs,
- supplementary comparison report should provide a data processing algorithm and means to confirm the claimed CMCs,
- pilot comparison report should analyze the declared estimates of the uncertainty components and the actual level of reproducibility of measurement results in the participating NMIs/DIs.

5.5.10. If necessary, Draft B can be sent for review to the COOMET Board of Appeal for issues concerning comparisons of national standards and CMC data review. After that, Draft B is approved at the corresponding TC meeting, taking into account the Board of Appeal conclusions.

5.5.11. The pilot NMI must make the Final Report publically available on the BIPM KCDB web platform, but graphs of equivalence and degrees of equivalence (if any) should include only the results of the CIPM MRA participants according to the national distribution of measurements areas. After publication on the BIPM KCDB web platform, key and supplementary comparison results can be used in other articles or oral presentations. Results of pilot comparisons are not published on the BIPM KCDB web platform, and can be used in articles or oral presentations recognizing confidentiality of the participants. Results of pilot comparisons indicating the participants can be made publically available only with consent of all the participants.

5.5.12. Upon completion of key or supplementary comparisons, the Coordinator sends the form of the completed COOMET project to the COOMET Secretariat only after the Final report was published in the BIPM KCDB (see COOMET D2/2021).

5.5.13. Upon completion of pilot comparisons, the Coordinator sends the form of the completed COOMET project to the COOMET Secretariat together with a pilot comparisons report to be published in the COOMET projects database (see COOMET D2/2021).

Information

1. Organization, coordinating the development: Joint Committee for Measurement Standards;
2. COOMET project: 828/RU/21;
3. The updated recommendation was approved at the 31st COOMET Committee meeting (15 – 17 June 2021, online).