CCQM Quick Reference Guide

Organisation, participation, and reporting on CCQM comparisons

Contents

1. Introduction and Background

The document CIPM-MRA-G-11 “Measurement comparisons in the CIPM MRA” provides guidelines for organising, participating, and reporting measurement comparisons in the CIPM MRA. The CCQM has added to these via: decisions recorded within its plenary meeting; guidelines developed by individual technical WGs; and CC-specific forms developed for CCQM comparison and pilot studies and comparison registration.

This document provides a summary of current CCQM approaches for comparisons, to ensure that all parties dependent on CCQM activities including the KCWG, RMOs and NMIs are fully aware of the practices followed.

2. Quick Reference Guide

This Quick Reference Guide is prepared to give more specific harmonised guidance to CCQM technical WGs for the organisation of, participation in and reporting on CCQM comparisons in accordance with the guidance provided in CIPM MRA-G-11 (see **Figure 1** for a schematic presentation of the process flow).

2.1 Organisation

- CIPM key comparisons, including BIPM on-going comparisons, are usually approved and initiated at a Consultative Committee (CC) meeting after discussions and decisions made by the relevant WGs in accordance with their strategic planning. RMO key comparisons or supplementary comparisons may be initiated by individual RMOs.
- All key comparisons and supplementary comparisons (i.e., all comparisons that will be published in the KCDB) shall be approved in advance by the corresponding Consultative Committee.
    - RMO key and supplementary comparisons are usually approved by the RMOs and presented to the respective CCQM WG for technical vetting by the CCQM WG Chair.
- The organisation of a CIPM key comparison, RMO key comparison or supplementary comparison is the responsibility of the pilot institute[1].

[1] A pilot institute is the institute or group of institutes responsible for the organisation of a comparison study and is usually called the coordinating laboratory/group in the CCQM. Within CCQM the phrase Coordinating Institute is often used as the word pilot is already used for pilot studies.

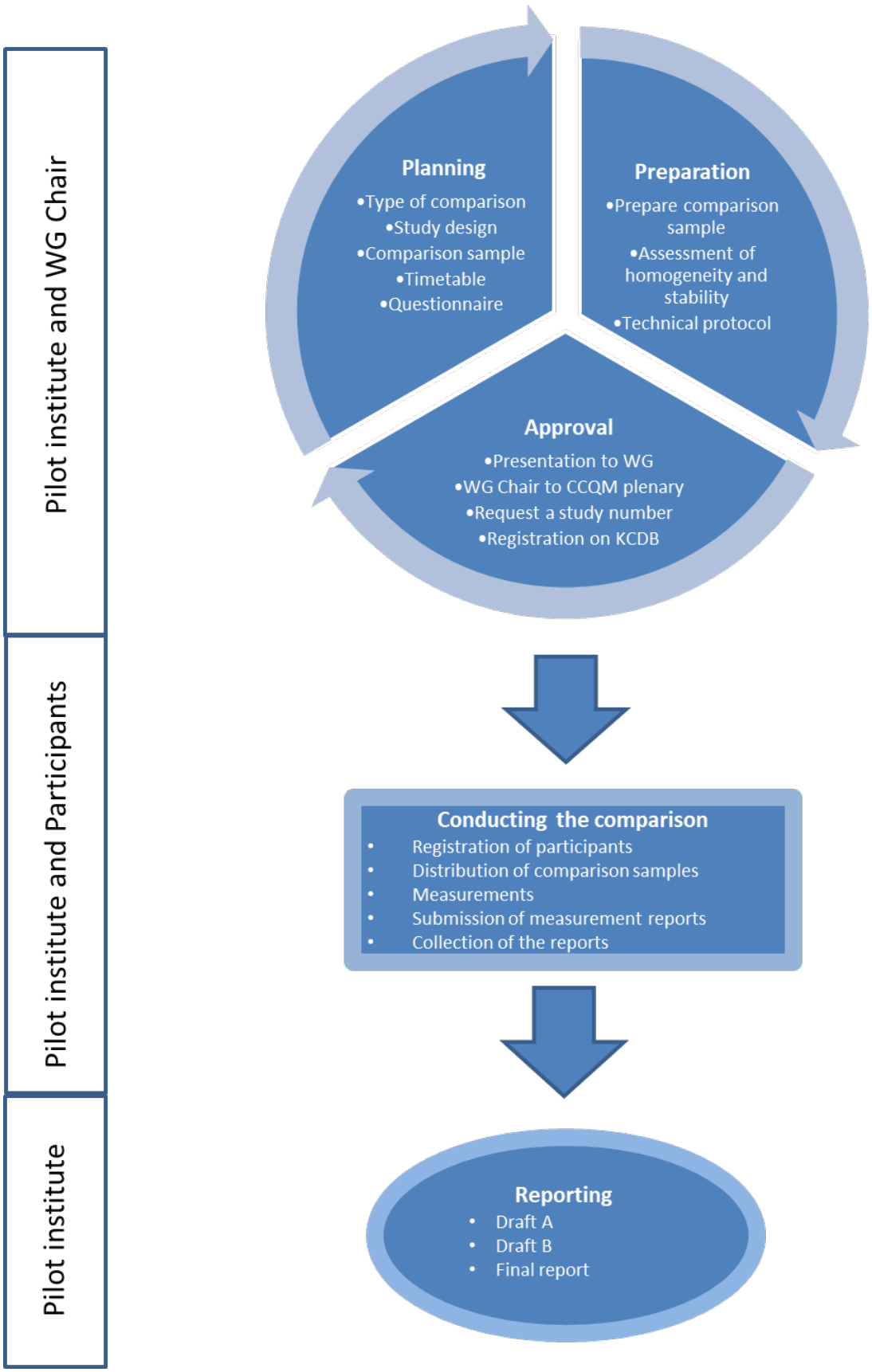

Figure 1: Schematic flow diagram to show the organisation of a CCQM comparison.

2.1.1 Roles and responsibilities of the pilot institute

- Preparation of the technical protocol with the timetable of the comparison.
- The technical protocol must be sent to the Chair of the relevant WG.
- The protocol as agreed by the technical WG could be published in the KCDB 2.0.
- The pilot institute is responsible for registering the comparison in the KCDB 2.0 when it is approved by the CCQM. Before registration the pilot institute/WG Chair must complete the form (CCQM-F02 “Request Form for a CCQM Study Number”) and send it to the Chair of the KCWG to get the CCQM study number (with the WG Chair in copy).
- The pilot institute is also responsible for the running of the comparison and keeping the progress of the comparison updated in the KCDB. It may be helped by a coordinating group.
    - *The KCDB sends automatic notifications to remind pilot institutes to update the status of comparisons every 6 months*
- The pilot institute is also responsible for writing the comparison report.
- Arrangements for the distribution of the comparison samples are usually the responsibility of the pilot institute.

2.2 Planning of the comparison and the technical protocol

- The planning of the comparison includes:
    - agreeing with the WG Chair and WG on how the proposed comparison fits into the CCQM and CCQM WG Strategy and comparison plans
    - a call for participation/ invitation to participants
    - preparing a list of participants;
        - *Proposed standard practice/suggestion for CCQM: gauge the interest in the planned comparison at WG meetings and possibly with a questionnaire;*
        - *Formal registration of participants when the comparison is ready to start;*
        - *Official publication of the list of registered participants in the KCDB (by the WG) before the comparison starts (to be considered by the pilot institute);*
        - *Review of number of participants per analyte/to be discussed with participants.*

- selecting and preparing the (transfer standard)[2] comparison sample to be used, including the assessment of the homogeneity and stability of the comparison sample;
- whether a parallel pilot comparison will be required;
- the pattern/format/intent/mode of the comparison, e.g., comparison of analytical capability, comparison of CRMs.
- arrangements for the distribution of the comparison samples, and
- the timetable.

- The technical protocol includes:
  - a physical and/or chemical description of the comparison sample;
  - the definition of the measurand/metrological parameters to be measured;
  - actions to be taken by the participants upon receipt of the comparison sample
  - the HFTLS-statement and/or, if appropriate, which service categories will be supported;
  - instructions for the reporting of results (could include a reporting template);
  - how the comparison fits in the relevant WG(s) strategy also regarding broader scope claims;
  - for key comparisons and supplementary comparisons, a description of the method intended to be used to determine the reference value;
  - for RMO key comparisons that are not supplementary comparisons, the method to be used to link to the CIPM key comparison reference value;
  - reference to the CCQM rules for the establishment of metrological traceability and when necessary, a list of available certified calibration materials and matrix certified reference materials for the comparison.
  - the list of principal components of the uncertainty budget to be evaluated by each participant;
  - the timetable; and
  - financial aspects.
  - handling of the comparison sample, including storage conditions;
  - any tests to be carried out before measurement; and
  - conditions of use of the comparison sample during measurement as well as insurance arrangements (if applicable).

[2] In CCQM the transfer standard is usually the comparison sample that is prepared to be send to all the participants in the comparison study. In the CCQM the term measurement standard would usually apply to the measurement methods that the participants would use in the comparison study.

2.3 Rules for participation in RMO comparisons (including key and supplementary comparisons as well as pilot studies)

- Participation in RMO key and supplementary comparisons is open to:
  - members of the RMO;
  - members of other RMOs and the CCQM, if the pilot laboratory has sufficient resources for this.

2.4 CCQM Pilot studies

- Parallel pilot studies are usually organised for participants who are less experienced in the relevant measurements and who want to test how well their measurement capabilities compare with other CC members.
- The results from the parallel pilot studies are not included in the calculation of the reference values and the names of the institutes that participate in the parallel pilot study are not published in the KCDB.
- Participants must decide whether they are going to participate in the key comparison/supplementary comparison or the parallel pilot study before measurements start and indicate how they will participate when they register for the comparison.
- Results from parallel pilot studies (to a key comparison or a supplementary comparison) may not be used to support CMCs.
- Participants are allowed to participate in the key and parallel pilot study with two different methods, if they want to test their measurement capability with new methods compared to their established methods.
- The method used in the key comparison or supplementary comparison must be the method of highest metrological order available in the participating institute.
- On registration, the participant must indicate which will be the higher-order method/approach that will be used in the key comparison or supplementary comparison.
- Results from stand-alone pilot studies are usually not considered sufficient support for CMCs, but a WG may decide to allow it for additional support.
  - *Additional requirements for stand-alone pilot studies to be used for CMC support include the calculation of a reference value and differences from the reference value for the participants.*
  - The CCQM has a form (CCQM-F-01) for the registration of expert or guest laboratories to participate in pilot comparisons.

2.5 Reference value (KCRV/SCRV)

- The reference value and its uncertainty (normally the standard uncertainty) is considered to be a close approximation of the true value of the measurand.
- RMO key comparisons link to the CIPM key comparison through the participants that participated in both comparisons.
- The degrees of equivalence (DoEs) from an RMO key comparison or RMO supplementary comparison have the same status as those from a CIPM key comparison.
- Only one DoE is calculated per measurand for each participant.
- The DoE is defined as the deviation from the KCRV or SCRV and its expanded uncertainty (e.g., k=2).
- Only one result from each participant to be included in the calculation of the KCRV or SCRV.
- In the rare cases where a reference value and differences from that value are calculated for a standalone pilot study, the same guidance applies.

2.6 Comparison reports

- Comparison reports contain:
  - o most of the information from the technical protocol;
  - o the measurement results from the individual participants;
  - o the key comparison reference value (KCRV) or supplementary comparison reference value (SCRV) and how it was calculated;
  - o the degrees of equivalence (DoEs) and how they were calculated.
- These reports are drafted in three stages, i.e.
  1) Draft A, which is only available to participants;
  2) Draft B, which is available to the WG and the CC; and
  3) the final report that becomes publicly available upon publication.

2.6.1 The Draft A report

- The Draft A report is prepared as soon as the results have been confirmed by the participants.
  - o ***Recommendation****: It is recommended that the pilot institute prepares the first draft of the Draft A report within three (3) months of the submission deadline of the comparison.*
- In the case of outliers, the results must not be communicated until the concerned participants have been contacted to check their results for arithmetic, typographical or transcription errors.

- The CCQM maintains the rule that original results are used to calculate DoEs and amended results (after an investigation was done) can be noted in the comparison report.
- The Draft A report includes the results transmitted by the participants, identified by name, the degrees of equivalence (DoEs) and the proposed key comparison reference value (KCRV) or supplementary comparison reference value (SCRV).
- Once the results have been confirmed by the participants, they are not allowed to withdraw discrepant results.
- The Draft A report is completed only when all the participants have agreed on the report; more than one revision of Draft A are possible, such as Draft A.1, Draft Month/Year, etc.
- The report is considered confidential amongst the participants and shall not be used to support CMC claims.

2.6.2 The Draft B report

- The draft report moves to the Draft B stage once the final version of the Draft A report has been approved by the participants and the calculation of the KCRV and its associated uncertainty has been discussed and agreed by the participants and the WG members.
- The Draft B report is circulated to the entire WG for comment, and any resulting changes are made.
    - ***Recommendation****: Appoint at least one reviewer (a WG member who did not participate in the comparison) to review the draft B report.*
- The Draft B report is submitted to the CCQM President, Executive Secretary and all CCQM WG Chairs for final review and approval on behalf of the CCQM,and can be used to support CMCs.
    - ***Recommendation****: It is recommended that the final report is published within three (3) months of the approval of the Draft B report.*
- The participant may now use their own measurement results for presentations and publications.

2.6.3 Supplementary comparison reports

- For RMO supplementary comparisons, approval is given by the RMO technical committee.
- DoEs are usually calculated for RMO supplementary comparisons but are not mandatory.
- Once the final report is approved by the RMO, it is submitted to the CC Executive Secretary and the technical WG Chair for a 6-week comment period.
- The RMO TC Chair shall then inform the KCDB Office that the report has been approved for publication.

- Only the final published report can be used to support CMCs.

2.6.4 Pilot study reports

- Pilot study reports normally follows the same three stages as other comparison reports (Draft A, Draft B, and final report).
- The rules for the Draft A report are the same.
- The Draft B report is where the results are available to all the WG members and can be discussed freely to advance the state-of-knowledge for the measurements.
- Sometimes it is during the Draft B stage that the WG can decide to calculate reference values for the results and make the report available for CMC support.
- The final report must be completed and at least available in the working area of the WG or the WG may decide to publish the data in an appropriate journal with the consent of all the participants. In some cases, both a final report and a corresponding publication can be produced.

2.6.5 Authorship of reports

- Following the criteria for authorship of a comparison report, at least one person from every participating institute will qualify as an author, because at least one person will have carried out measurements and thereby contributed substantially to the execution of the comparison.
- The participating institutes may recognise the contribution of more than one participant to the comparison as authors.
- The comparison report could also include the contributions from other members of the working group (WG) under the section Acknowledgements in the comparison report.

3 Additional resources

CCQM-F-04 Comparison registration template

CCQM-F-05 Template for Questionnaire on a proposed CCQM/RMO key/supplementary comparison

Key comparison Technical Protocol Template for the IAWG:
https://www.bipm.org/en/committees/cc/ccqm/wg/ccqm-iawg

Key comparison Final Report Template for the IAWG:
https://www.bipm.org/en/committees/cc/ccqm/wg/ccqm-iawg

Template for OAWG Key Comparison Protocol

Template for OAWG Key Comparison Report

4 Glossary of Terms/Acronyms

CC	Consultative Committee
CCQM	Consultative Committee for Amount of Substance
CGPM	General Conference for Weights and Measures
CIPM	International Committee for Weights and Measures
CMC	Calibration and Measurement Capability
CRM	Certified Reference Material
DoE(s)	Degree of Equivalence(s)
GAWG	Gas Analysis Working Group
HFTLS	How Far Does The Light Shine-statement
KCDB	Key Comparison Database
KCRF	Key Comparison Reference Function
KCRV	Key Comparison Reference Value
KCWG	Working Group for Key Comparisons and CMC Quality
MRA	Mutual Recognition Arrangement
NMI	National Metrology Institute
RMO	Regional Metrology Organization
SCRV	Supplementary Comparison Reference Value
SPWG	Strategic Planning Working Group
TC	Technical Committee
WG	Working Group