

EURAMET Guide on Comparisons

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Further information

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1 INTRODUCTION: SCOPE OF THE GUIDE

This document provides guidance on EURAMET specific aspects in the planning, initiation and conducting of measurement comparisons, with the aim of carrying out these comparisons consistently within EURAMET and, as far as reasonable, harmonised among Technical Committees.

This guide should always be used in combination with CIPM MRA-G-11 “Measurement comparisons in the CIPM MRA” [1] and, where applicable, with guiding documents of the relevant CIPM Consultative Committee (CC). Specific TC internal guidance documents might also be available.

The rules given in CIPM MRA-G-11 “Measurement comparisons in the CIPM MRA” [1], which is considered as a master document, are applicable to all Key and Supplementary Comparisons (KC/SC) carried out in EURAMET. They should also be applied to Pilot Studies (PS), in principle. However, some specific clauses might not be applicable in the same stringent form.

Some CCs have prepared specific guidelines for comparisons in their field. In case that these guidelines are in conflict with the rules of this EURAMET guide, the issues shall be discussed on a case-by-case basis between EURAMET Board of Directors and TC Chairs.

This guide is describing EURAMET-specific aspects. It is not intended to duplicate the content of [1]. Generally, reference to [1] is given, when applicable. Only for better readability and coherence of the text, information given already in [1] is repeated in this guide. **Please note that detailed descriptions made in this guide on KCs are referring to EURAMET KCs only**, and not to CC-KCs, even if this is not explicitly mentioned.

The current version of the Guide (2.0) refers to the requirements described in the new CIPM MRA-G-11 document [1]. In addition, the concept of hybrid comparisons has been introduced in the Guide in line with the JCRB resolution 40/1.

2 TYPES OF COMPARISONS

2.1 Categories of Comparisons and their purpose

CIPM MRA-G-11 [1] describes three categories of measurement comparisons within the CIPM MRA:

- 1) Key comparisons (KC)
- 2) Supplementary comparisons (SC)
- 3) Pilot studies (PS)

Note: In very special cases in which participation in the previous categories is not possible for an NMI or a DI seeking to support their Calibration Measurement Capabilities (CMC), the routine calibration services provided by NMIs or DIs that have appropriate CMCs registered in the KCDB could be used. This kind of comparisons are also known as Hybrid Comparisons (HC)¹.

¹ As **recommendation 40/1** The JCRB agrees that the Hybrid Comparison scheme proposed by APMP may be used as an example of “**other available knowledge and experience**” in Section 3 of CIPM MRA G-13, which underpins CMCs. It was noted that the use of Hybrid Comparisons is not an alternative to participation in key or supplementary comparisons when accessible.

Comparisons can be carried out:

- a) at an international level, organised by a CC or by the BIPM ²
- b) at a regional level, organised by a TC of an RMO

Key comparisons (KC) are selected by a Consultative Committee (CC) to test the principal techniques and methods in the field [1]. A KC carried out by a CC results in a key comparison reference value (KCRV) [1]. A KC can also be carried out by an RMO; it must follow the same protocol as a preceding CC-KC and will provide the link to the respective KCRV for the participants from the RMO (or other RMOs). It must be approved in advance as KC by the corresponding CC or CC Working Group. An RMO-KC may be launched while the corresponding CC-KC is still running.

For KCs, subsequent bilateral³ comparisons may be organised with the pilot laboratory or one of the participants. Such comparisons may be requested by an institute that considers its result in the KC as unrepresentative of its standards or if the participation of the institute at the time of the KC was not possible. Such comparisons should take place as soon as possible after the completion of the corresponding KC. Please note that the subsequent comparison is considered as a new and distinct comparison.

Subsequent comparisons cause an extra effort in organising and linking them to the results of a KC. If possible, a laboratory should try to avoid a subsequent comparison, whenever it has the possibility to join a KC or SC within a reasonable time. Also, the possibility to join a KC or SC of another RMO should be considered.

Supplementary comparisons (SC) are comparisons, usually carried out by CCs and RMOs to meet specific needs not covered by a KC, for instance measurement of specific artefacts, quantities, or measurements of parameters not within the “usual” scope of the CC ([1] sec. 2.). In particular, they may include laboratories which would not fulfil the requirements for participation in a KC.

Pilot studies (PS) are a third category of comparisons introduced in [1]. They are normally undertaken to establish confidence in measurement for a “new” field or instrument, or as a training exercise ([1] sec. 2).

The term ‘pilot study’ shall be used in EURAMET for all type of comparisons not being KCs or SCs.

Specific purposes of a pilot study may be:

- Testing of new instruments
- Testing of new methods or methods at an early stage
- Preparation of a KC
- Training for emerging NMIs
- Benchmarking of an NMI, in particular if it has never participated in a KC or SC before
- New metrology fields or quantities, where no CMCs are to be supported now or in near future.

While the results of KCs and SCs are directly used to support CMC claims of the participating NMIs ([3] sec. 3), the results of Pilot Studies alone are normally not considered

² International key comparisons according to [1] are called CIPM-KC. In this guide reference is made to CC-KCs only. Therefore, this term shall be used, rather than CIPM-KC.

³ Bilateral or involving more than two participants. Only referred to after as „subsequent comparisons“.

as sufficient evidence ([1] sec. 2). They may, however, be used as additional information for supporting CMC claims, if the measurement results have been treated confidentially during the comparison.

A Hybrid Comparison can be used when the time interval between a KC or SC is very long or in the case of some simple calibration services where no KC or SC has ever been conducted. In the case of an HC the difference between the measurement result obtained by the NMI/DI submitting a CMC claim and the result of a routine calibration provided by the other NMI/DI can be used as supporting evidence in a similar way to the use of the degree of equivalence (DoE) from a comparison. These comparisons are not registered in the KCDB.

More information can be found in [4].

An overview on types of comparisons is given in the table below:

Type	Level	Objective(s)
Key Comparison (KC)	CC	<ul style="list-style-type: none"> • Generate KCRV • Support CMC claims
	RMO	<ul style="list-style-type: none"> • Link to a KCRV • Support CMC claims
Supplementary Comparison (SC)	CC RMO	<ul style="list-style-type: none"> • Meet specific needs not covered by a KC • Support CMC claims
Pilot Study (PS)	CC RMO	<ul style="list-style-type: none"> • Testing new methods or instruments • Training / benchmarking for NMIs • May be used as additional information for supporting CMC claims
Hybrid Comparison (HC)	RMO	<ul style="list-style-type: none"> • support CMC claims when a KC or SC is not available

2.2 Eligibility for participation in comparisons

Participation in CC comparisons is decided by the CIPM MRA rules. In general, participation is restricted to NMIs and DIs from countries being signatories to the CIPM MRA. Exceptions are possible.

Participation in EURAMET comparisons is open, in principle, to all members of EURAMET, National Metrology Institutes (NMI) or associated Designated Institutes (DI), provided the technical competence of the institute is appropriate for the particular comparison.

In the case of EURAMET KCs and SCs, the participation should, in general, be restricted to NMIs and DIs, in line with CIPM rules. For EURAMET Pilot Studies more flexibility is given.

With the consent of all participating members of EURAMET also NMIs or DIs from other RMOs as well as Liaison Organisations of EURAMET can be invited to participate.

In exceptional circumstances and in particular for Pilot Studies, participation of expert guest laboratories may be appropriate. Their participation should not be in conflict with the

national interest of the corresponding NMI or DI participating in the TC. For details please see [6].

For more information, consult [1] section 6.

3 ROLES AND RESPONSIBILITIES

In the preparation of comparisons, roles and responsibilities should be assigned in a way, that an effective implementation of the comparison is ensured, and that workload is shared among participants in a fair and the best possible way.

3.1 Technical Committees, Subcommittees, TC Chair

The Technical Committees (TC) have the responsibility to identify the needs for comparisons through consultation of the EURAMET members or by other means. They shall discuss relevance, priorities and modalities of the proposed comparisons and decide on those to be carried out and on their time schedule.

In many TCs, the specific needs for comparisons and their modalities are discussed by the relevant Subcommittees. The Subcommittees should bring forward their proposals to the plenary TC meeting for endorsement.

The TC Chair has the responsibility to coordinate and oversee the whole process and to ensure that the comparison is in line with EURAMET policies and properly agreed with the TC. In particular, the TC Chair should:

- receive proposals for new comparisons and initiate the required consultation process,
- bring proposals for comparisons on the agenda of the TC meeting,
- decide if in exceptional cases a proposal for a new comparison might be discussed and decided upon in between annual meetings of the TC via correspondence (the TC Chair might take the decision after consultation of the TC contact persons),
- register the comparison in the EURAMET TC project database, after it has been registered by the pilot in the KCDB,
- request the regular reporting on the progress of the comparison from the pilot laboratory,
- report to the BoD regularly on the progress of the comparisons, and in particular whenever specific issues with a comparison are identified,
- do the required steps for the approval of the report, as described in sections 6.2 and 6.4,
- submit the final report to EURAMET and the relevant CC via KCDB 2.0,
- in the case of comparisons that will not be registered in the KCDB: review the protocol and the final report before its publication in the EURAMET project database.

The TC Chair might delegate part of these responsibilities to a Subcommittee Convenor or another TC contact person, ensuring, however, their proper conductance. Registration of a comparison and submission of reports to a CC or a CC working group should in any case be done by the TC Chair. In the case on HCs, the TC Chair could act as the Third Party [4] or delegate this role to another TC / SC contact person not belonging to the applicant NMI or the issuing NMI.

3.2 Pilot laboratory

When agreeing on a comparison, one of the participant laboratories must be assigned the role of coordinator, in this guide called pilot laboratory⁴.

The pilot laboratory has the principal responsibility for

- specifying the group of participants,
- drafting the technical protocol in consultation with the participants and the TC Chair,
- the registration of the comparison in the EURAMET TC database and in the KCDB (if applies), by filling the templates, and providing them to the TC Chair,
- organising the preparation of the transfer standard(s) and its/their circulation among the participants,
- collating the measurement results of the participants,
- giving follow-up at all stages and reminding delayed participants on their outstanding duties,
- consulting the TC Chair in case of major issues like significant delays, damage or loss of a standard, etc.,
- preparing annual progress reports for the TC meetings and the TC project database,
- evaluation of the comparison results,
- link of the results to the KCRV (in case of a KC),
- preparing the subsequent reports after concluding the measurements (Draft A, Draft B, Final Report, Executive Report if needed).
- uploading the final report of the comparison onto KCDB once this has been approved by the body in charge⁵.

3.3 Linking laboratories

In case of a EURAMET KC, at least two of the participants, where possible, should have participated in the preceding CC KC, in order to allow a proper link of the comparison results to the KCRV (see [1] sec. 6.). **CC recommendations might differ from this general rule in specific fields or sub-fields and should then be taken as reference.**

All EURAMET participants of the previous or current CC KC of the quantity have an obligation to serve as a link laboratory in the EURAMET KC, if requested.

The pilot laboratory does not necessarily need to be one of the linking laboratories.

3.4 Coordinating group

In order to release the pilot laboratory from workload, in particular in the case of comparisons with a high number of participants, one or several participants may support

⁴ In other documents the terms “coordinating laboratory” or “pilot institute” [1] are used.

⁵ Usually CC for KC and SC, and TC for PS and HC.

the pilot laboratory. An appropriate sharing of responsibilities in line with the specific interest and capabilities should be agreed.

A specific purpose of the coordinating group might be to prepare less experienced laboratories to the task for coordinating future comparisons.

3.5 Participants

Before agreeing to participate in a EURAMET comparison, the laboratory must make sure that

- it has the technical competence to handle the transfer standard and to do the measurements as described in the protocol,
- it has the capacity to carry out the measurements within the foreseen time schedule,
- resources are available for a proper transport of the transfer standard to the next laboratory.

A laboratory is expected to participate in a EURAMET KC (or alternatively in the corresponding CC KC), in case it has published CMCs related to this KC.

The participating laboratory must accept that their results are published in the final report of the comparison, even if they are not satisfactory for the laboratory.

The participants confirm that they accept these conditions by signing the corresponding EURAMET form [9].

3.6 EURAMET Secretariat

The EURAMET secretariat is in charge of maintaining and updating the EURAMET project database. The secretariat should:

- review the list of participants with respect to eligibility criteria and consult the TC Chair in case that laboratories not being NMI or DI are suggested to participate,
- register the comparison in the EURAMET TC project database, when requested by the TC-Chair,
- keep the database up to date,
- ask for annual updates of ongoing projects.

4 INITIATION OF A COMPARISON

The organisation of a EURAMET comparison is performed in a similar way as described in [1] section 3.

4.1 Proposing a comparison, discussion and agreement in the TC

EURAMET TCs set up and maintain a long-term plan of the KCs and SCs of their area, in line with the guide on “Strategic planning of comparisons in EURAMET TCs” [11].

On specific need, further EURAMET comparisons may be proposed by any contact person of a Technical Committee or Subcommittee. Proposals, in particular for SCs and Pilot Studies, representing the specific needs of emerging EURAMET members may also be brought into the TC from the BoD Working Group for Capacity Building (BoD-WGCB). The

proposals shall be sent to the TC Chair, who will inform all TC contact persons and will initiate further steps, if appropriate. The TC may have an internal practice to delegate this responsibility to concerned Subcommittee Convenors.

It is recommended to propose new comparisons in advance to the meeting of the TC, as this will enable the contact persons to consult the management of their institute prior to this meeting. This consultation is important to reach agreement about the involvement of the institute in the comparison and, if so, to guarantee that the required resources and time needed to undertake the work will be made available.

At their annual meetings, the TCs shall discuss and examine the actual needs for comparisons and priorities.

The decision on the comparisons as such and on their modalities is taken by the TC, normally at its plenary meeting. In exceptional cases and in particular for Pilot Studies, it might also be discussed and decided in between annual meetings by correspondence. It is the responsibility of the TC Chair to guide this process, to ensure that all interested laboratories or potential participants are informed properly and to take the respective decisions, if needed after consultation with the TC contact persons.

The TC Chair should inform the EURAMET Secretariat about the status of comparisons via the annual report:

- 'in progress': when a project was agreed by the respective TC and has started
- 'ongoing': project with continuous or periodic activities, without a fixed end
- 'completed': when the work programme has been carried out and results have been achieved
- 'concluded': when the project was terminated without being completed

By a long-term planning and appropriate comparison schedules, the TC ensures that the workload for the whole set of comparisons is not too high for the participating and pilot institutes, and that the comparisons can be completed within a reasonable time. Three years should not be exceeded from the start to the completion of the comparison.

Subsequent comparisons may be proposed by a laboratory which requires link to a KC. The TC Chair can initiate the comparison after informing the TC accordingly. The TC should have the opportunity to oppose to the Subsequent comparison for good reasons. In general, the possibility to open the comparison to further laboratories with the same need should be considered, having in mind that subsequent comparisons are usually causing extra effort and complications in linking to KCs. The alternative to join a KC in another RMO should also be considered.

4.2 Agreement on participants

In principal, participation in a EURAMET comparison is open to all member NMIs of EURAMET and associated DIs, provided the technical competence of the institute is appropriate for the particular comparison.

In some comparisons the number of participants can be limited for technical or logistics reasons. If this is the case, it should be envisaged to repeat the comparison as soon as possible to give all interested members the opportunity to participate within a reasonable timeframe.

Participation of laboratories further to EURAMET NMIs or DIs is possible, following the eligibility criteria described in section 2.2. In particular, the TC should be open to the participation of NMIs or DIs from other RMOs in the frame of the CIPM MRA, if this is not strongly affecting the conductance of the comparison.

If a member of EURAMET or an external laboratory expresses interest in participating in a comparison that has already started, the pilot laboratory must consider the effect of this participation on the time schedule. The a priori assumption should be that the additional participant should not extend considerably the duration of the comparison. If all the participants agree then the new participants' entry can be accepted.

Otherwise, it is left to the pilot laboratory or to any other interested participant to go to a bilateral comparison with this laboratory once the comparison is completed.

4.3 Technical protocol and preparation of the comparison

The pilot laboratory has the responsibility to submit the technical protocol, which can be drafted by a member of the coordinating group in consultation with the participants and the TC Chair and supported by the coordinating group.

The technical protocol has to be drawn up in line with [1] sections 3 and 4. It must contain at least the following information (when applicable):

- a) Introduction on the subject and exact definition of the measurand(s) of the comparison
- b) Description of the scheme/topology ⁶ of the comparison
- c) Stability / homogeneity check of the transfer standard, i.e. via measuring the standard at least in the beginning and the end by the same laboratory⁷
- d) Time schedule, in particular starting date and envisaged date of completion
- e) Description of the transfer standard(s): make, type, serial number, technical data needed for operation, stability statement, etc. In the case of a HC the transfer standard is chosen to assure that the applicant NMI/DI (i.e. the NMI/DI seeking for CMC evidence) has no previous information about its performance,
- f) Advice on handling and organising the transport of the transfer standard
- g) Tests to be carried out before measurements
- h) Handling precautions of the transfer standard(s) at receipt and during measurements
- i) Description of the used calibration method, measurement conditions and calibration points
- j) Indications for the presentation of the results (e.g., format, conformity with published CMCs)
- k) List of the principal components of the uncertainty budget with indication of the final combined uncertainty
- l) Timetable for communicating the results

⁶ A comparison may range from the simple circulation of a single transfer standard around all the participants to the sending of an individual transfer standard directly to each participant from the pilot institute, or from each participant to the pilot institute or any combination of these ([1] sec. 4. & 4.1).

⁷ In case of "Certified Reference Materials" (CRMs) in some fields, "standard" may refer to "sample", "solution", "material" or "source".

- m) Principle of evaluation of the results and linkage mechanism to the corresponding KCRV, if applicable. For HC in which the applicant NMI/DI has traceability to the issuing NMI/DI (the NMI/DI which performs the comparison based on its routine calibration service) a study of the correlations between measurements should be performed.
- n) Financial aspects, e.g. transportation or costs for transfer standard if applicable.
- o) Reference to useful documents.

Furthermore, possible customs issues should be discussed before starting a comparison and custom documents to accompany the transfer standard should be described in the protocol, if applicable.

A EURAMET key comparison must basically follow the same protocol as a preceding CC key comparison. A restricted scope for individual participants is admissible, if the participant is not able to deliver all measurement points of the protocol.

The circulation time of transfer standards or transfer instruments must be fixed and may exceed eighteen months only in exceptional circumstances. Options to cope with a large group of participants in case of round-robin comparisons should be analysed, for example organising two or multiple parallel loops with linking laboratories measuring the transfer standards of both loops.

In case of key and supplementary comparisons to be registered in the KCDB, the pilot laboratory shall send the draft protocol via the TC Chair to the appropriate CC working group for approval (in case of KC) or information (in case of SC). The KC must be compatible and linkable to the parent CC comparison.

The pilot laboratory sends a formal invitation to all members of the TC and concerned Subcommittees and the envisaged external participants, with a deadline for confirmation of the participation, using the template [9]. Having received the confirmations from the participating laboratories, the pilot laboratory draws up the final circulation scheme for the transfer standards and the time schedule.

In the case of comparisons not registered in the KCDB, the comparison protocol should be reviewed by the TC Chair.

4.4 Registration in the EURAMET project database

Each EURAMET comparison shall be registered in the TC project database on the EURAMET website.

When EURAMET is coordinating comparisons with participants from other RMOs, they shall be registered in the EURAMET project database.⁸

Examples for comparisons which should not be registered in the TC project database are:

- One or several EURAMET laboratories are participating in a comparison organised by another RMO. This comparison should be registered by the other RMO.
- Comparisons, in particular Pilot Studies, where a EURAMET NMI is providing technical assistance or knowledge transfer to NMIs beyond EURAMET.

⁸ the initiative comes from EURAMET with external participants being invited by EURAMET and the comparison being under control of a EURAMET TC. The comparison shall serve in first instance the interest of EURAMET members to demonstrate their technical capabilities.

Once the comparison is agreed by the TC and, in the case of KCs and SCs, confirmed by the corresponding CC working group, the TC Chair is registering the comparison in the TC project database, by sending the filled form [7] to the EURAMET Secretariat. The pilot laboratory shall provide the filled form to the TC Chair.

4.5 Registration in the KCDB

Once the appropriate CC working group has approved the technical protocol of a EURAMET KC or SC, the pilot laboratory shall register the comparison in the KCDB. In case the CC working group had agreed in its last meeting a specific registration number for the comparison, this should be communicated through the existing online registration form of the KCDB 2.0. Once it is registered, the pilot laboratory shall provide or confirm the registration number to the EURAMET Secretariat for its entry into the TC project database.

The nomenclature for KCs and SCs registered in the KCDB is described in [1] sec. 5.1.

EURAMET Pilot Studies for the cases described in Section 2.1 are not registered in the KCDB. Once a comparison has started as PS, it cannot be “upgraded” to a KC or SC.

Please note that Hybrid Comparisons are not registered in the KCDB⁹.

4.6 Comparison Toolbox

EURAMET maintains a webportal (see [12]) to support TCs and pilot laboratories in the organisation and management of measurement comparisons: registration of participants, provision of relevant documents for the comparison, setting up the time schedule, communication with participants, keeping control of the status, collation of the measurement data and basic evaluation of results. It is up to the pilot to use this “comparison toolbox”. The EURAMET Secretariat provides information and support in the use of the toolbox.

5 CONDUCTING A COMPARISON

5.1 Performing the measurements

The pilot laboratory is responsible for organising the transport of the transfer standards or instruments and has to ensure that the participants make proper arrangements for local customs formalities. This includes also handling instructions for the equipment at the customs office.

For circulating the transfer standard, there are several options, for example:

- a) Each participant organises the transport to the next participant on his own responsibility and costs.
- b) A company is hired to organise the circulation centrally. A corresponding fee should be paid by the participants to cover the costs. Hence, in this way administrative complications are avoided for the participants.

The measurements must be performed by the participants of the comparisons strictly following the technical protocol. If for some technical reasons, an institute cannot perform

⁹ Like any other comparison project, full documentation related to HC is kept openly available in the EURAMET project database

the measurements according to this protocol and still wishes to participate, proper consultation with the pilot laboratory must take place before measurements are made.

If after the start of the comparison, a participant is unavailable to perform the measurements in its allocated time slot, the pilot laboratory should try to re-arrange the schedule with the agreement of the concerned participants, in an attempt to maintain the comparisons within the initial timeframe. If this is not possible, it is left to the pilot laboratory or other participant to organise a subsequent comparison after the EURAMET comparison is completed.

The participating laboratories must submit the results of the comparison to the pilot laboratory as soon as possible and at the latest six weeks after the measurements are completed (See for more details [1] sec. 8 (8.1)). A laboratory may be excluded from the comparison if the six weeks' deadline for reporting the results is not kept.

For complete transparency, the pilot laboratory may consider submitting their results to some independent party, e.g., the Secretariat, ahead of receiving results from other participants.

5.2 Monitoring the progress and regular reporting

Each participating laboratory shall inform the pilot laboratory immediately when the transfer standard is received, and when the transfer standard is sent to the next participant. Whenever an issue occurs, like arrival of the standard in an inappropriate form or inability to carry out the measurements within the time schedule, the pilot laboratory must be informed immediately.

The status of the comparison (who has measured already, location of the artefact, etc.) should be known to the pilot laboratory at any moment. The pilot laboratory shall inform the TC Chair accordingly.

The progress of the comparison is reported at the annual TC meeting using the template for the TC project progress report [8]. After the TC meeting, the TC Chair¹⁰ shall forward the project report to the EURAMET Secretariat for publication in the TC project database.

In the case of KCs and SCs registered in the KCDB, the progress shall also be reported to BIPM, whenever the next stage is achieved. Whenever an update in the project is performed on KCDB 2.0, related TC Chairs shall be informed.

Related information should as well be part of annual project or progress¹¹ reports communicated to EURAMET Secretariat by TC-Chairs

5.3 Dealing with delays and other issues

The overall objective is that a EURAMET comparison should not take more than 3 years from start of the measurements to Draft B report being available. In justified cases, in particular when unexpected problems occur after the start of the comparison, the period can be expanded with approval of the TC Chair.

The general practice when a delaying laboratory does not respond to reminders is to enter into the following “escalation chain”:

¹⁰ When agreed with the TC Chair, the pilot could forward the project report to the EURAMET Secretariat for publication in the TC project database.

¹¹ in reference to Draft A, Draft B, Final Report, ... of CC KCs.

- Pilot laboratory informs TC Chair
- TC Chair informs/consults TC contact persons
- TC Chair informs Secretariat and Member Service Manager (MSM); that will give a follow-up. In case of no resolution EURAMET Chairperson and BoD will be informed.
- BoD informs/consults EURAMET Delegate of the delayed laboratory and, in case of a DI, the DI representative.
- Exclusion of the laboratory from the comparison: BoD decides, following a proposal from the TC Chair (as accepted in [9])

As guidance, the following corrective measures should be taken:

Issue	Corrective measures
Measurements are not performed properly, but issue is reported by the laboratory	<ul style="list-style-type: none"> • Laboratory gets the opportunity to repeat measurements at the end of the loop, if feasible and if all other participants agree. • Exclusion of the laboratory from the comparison, if issue cannot be resolved.
Measurements are not performed within time schedule / transfer standard is not sent to the next participant	<ul style="list-style-type: none"> • Pilot laboratory sends reminder. • If laboratory is not responding, it will be excluded from the comparison after a final alert to laboratory and Delegate.
Transfer standard is damaged or shows stability issues	<ul style="list-style-type: none"> • Replacement and link to original standard, if possible. • Replacement of standard and repetition of all measurements. • Conclusion of the comparison if no solution is found
Measurement results are not sent to the pilot laboratory within deadline	<ul style="list-style-type: none"> • Pilot laboratory sends reminder. • If laboratory is not responding, it will be excluded from the comparison after a final alert to laboratory and Delegate.
Pilot laboratory is delayed in preparing the report	<ul style="list-style-type: none"> • Coordinating group offers support to pilot laboratory. • TC Chair consults TC if a further participant can support. • TC Chair suggests, after consultation of the participants, to pass the responsibility for preparing the report to another participant.

6 REPORTING

The principal scheme of reporting via Draft A, Draft B and Final Report is described in [1] Section 8.

An overview on the steps for reporting of KC, SC and PS carried out by EURAMET TCs is presented in appendix C.

6.1 Preparing Draft A report of a EURAMET comparison

After all participants have sent the results, the pilot laboratory has 8 weeks for preparing Draft A report¹².

The report of key and supplementary comparisons must include at least (when applicable):

- a) Introduction on the subject and exact definition of the measurand(s) of the comparison
- b) Description of scheme/topology of the comparison
- c) Participants
- d) Description of the transfer standard(s) and the handling of the equipment
- e) Description of the used calibration method and calibration points
- f) Measurement conditions and equipment of each participant
- g) The stability determination of the transfer standard(s) and required corrections (if applicable)
- h) The participants' results, including uncertainties
- i) Calculation of a reference value of the comparison (in case of a SC) or description of the linkage to a KCRV (in case of a KC)
- j) The degree of equivalence (DoE) of each participant with respect to the reference value
- k) Uncertainty budget of each participant with indication of the resulting combined uncertainty
- l) Appropriate analysis to verify if uncertainty claims correspond to those of published CMCs¹³ and why not, if this is not the case
- m) First conclusions
- n) References

In the case of EURAMET KCs, the results have to be linked to the KCRV of the corresponding CC-KC, and the DoE with respect to the KCRV needs to be calculated by an appropriate method (as mentioned in [1] section 7).

In case of an SC, DoE relative to the SC reference value may be computed, but this is not mandatory.

Reference values of a comparison must be determined by appropriate statistical methods [10], or methods described in corresponding CC guidelines.

If, at the moment when a EURAMET KC is finalised, the KCRVs are not yet available, the stated reference values of this comparison must be made available for third parties via the official report published in "Metrologia". In such cases, it must be mentioned in the report that the stated reference values are not KCRVs.

When Draft A is submitted to the participants, the pilot laboratory must also give a proposal, in accordance with [1] sec. 8 (8.1 & 8.2), in which form the results of the comparison should be published.

¹² In some CCs a "pre-draft A" is prepared in a first step.

¹³ This CMC monitoring process may be done in an alternative way beyond the protocol of the comparison. If this is the case, it should be mentioned in the report.

Participants should comment on the Draft A report as soon as possible¹⁴. The corrections and amendments which are possible at that stage are described in [1] section 8 (8.2). Draft A must be considered confidential and distributed among the participants only.

The Draft A report, once approved by all the participants, is considered as Draft B report and is sent to the relevant TC Chair.

6.2 Draft B and Final report of a EURAMET comparison

The TC Chair has the responsibility to initiate and supervise the steps required for approval of the Draft B report and publication of the Final report. In any case, as first step an internal approval or endorsement of the Draft B report by the TC is required. It is responsibility of the TC to establish an appropriate procedure for that. This responsibility may be delegated to a dedicated expert group within the TC.

In the case of a KC, the Draft B report is endorsed by the TC and is sent by the TC Chair to the Executive Secretary of the relevant CC and to the Chair of the appropriate CC key comparison working group with the request for approval by the CC. Normally the CC decides on the approval within six months after the submission of the report. Yet, in line with [1] sec. 8.2) *"each Consultative Committee will set its own procedures for approving the results of key comparisons in the most efficient and timely way possible"*.

In the case of an SC, the Draft B report is approved by the TC and is sent by the TC Chair to the Executive Secretary of the relevant CC and to the Chair of the appropriate CC key comparison working group to allow for a six-week period of comment and editorial control ([1] sec. 8.2). If no feedback is received from the CC working group within six weeks, the report can be considered as approved and a final version can be prepared.

Exceptions from this approval procedure of the draft B report of an SC are possible, in line with [1], sec. 8.2: *"Those CCs that wish to discuss RMO SC reports and approve them at the meetings of their relevant CC working groups may do so."*

Once endorsed by the TC, the Draft B report is not considered as confidential anymore and the results can be used to support CMC claims ([1] sec. 8.2).

Once Draft B report is approved by the CC (KC) or comments from the CC-WGKC have been considered (SC), the report is considered as the final report¹⁵. The pilot laboratory informs the TC Chair; the TC Chair sends the final report to the participants of the comparison, to all relevant contact persons (e.g. participants), and to the Executive Secretary of the corresponding CC and the Chair of the relevant Working Group. In parallel, the Executive Secretary or the Working Group Chair informs the KCDB Office ([1] 8.2).

The Pilot uploads the Final report onto KCDB 2.0. for publication ([1] Section 10). The TC Chair also sends the updated EURAMET TC project progress report [8] and the link to the published results in the KCDB to the EURAMET Secretariat in order to inform it of the change of status of the corresponding project to "completed". The Draft B report will not be published in the EURAMET TC project database, however.

In the case of a pilot study (PS), Draft B report requires only the approval by the TC; the final report is sent by the TC Chair to the Secretariat for publication in the TC project

¹⁴ To support progress, it is recommended to send comments within 8 weeks.

¹⁵ In the report, "Draft B" must be replaced by "Final" before the report is further disseminated in a portable document format (pdf).

database. In the case of comparisons not registered in the KCDB, the final report should be reviewed by the TC Chair and published in the EURAMET web page.

6.3 Dealing with results inconsistent with published CMCs

“If the results of a comparison are inconsistent with CMCs already declared in the KCDB, appropriate action shall be taken with these CMCs according to CIPM MRA-G-13 [3]” ([1] Section 11). In particular, the first and principal responsibility to identify that the results of a comparison are inconsistent with published CMCs is within the participating NMI or DI. In that sense, the participants should give a written statement as they communicate their measurement reports indicating if their results are consistent with the CMC claims or not see 5.1 of the current documents and [1] sec. 8.1). If not, corrective actions should be described in case the inconsistency is not due to the circulated artefact. Depending on this statement, the TC should decide if any action on CMCs should be asked for.

The TC Chair should take next steps, in particular inform the TC Quality Chair about inconsistent results. The TC-Q decides if CMCs should be modified or greyed-out until corrective actions are applied and takes the respective measures (as accepted in [9]).

For more information regarding the monitoring of comparison results, please refer to [1] Section 11.

6.4 Entry into the KCDB

The results of KCs and SCs are published by the Pilot in the KCDB, uploading the final report and relevant datasets onto KCDB 2.0 (see [1] Section 10 for details). Regarding SCs, this publication steps requires as well that the RMO TC Chair informs the KCDB office with a statement that the report has been approved ([1] sec. 8.2).

6.5 Good practice for evaluating comparisons and preparing reports

In order to facilitate the evaluation of comparisons and the preparation and review of their reports, it is recommended that the TCs establish permanent expert groups and a set of tools and templates.

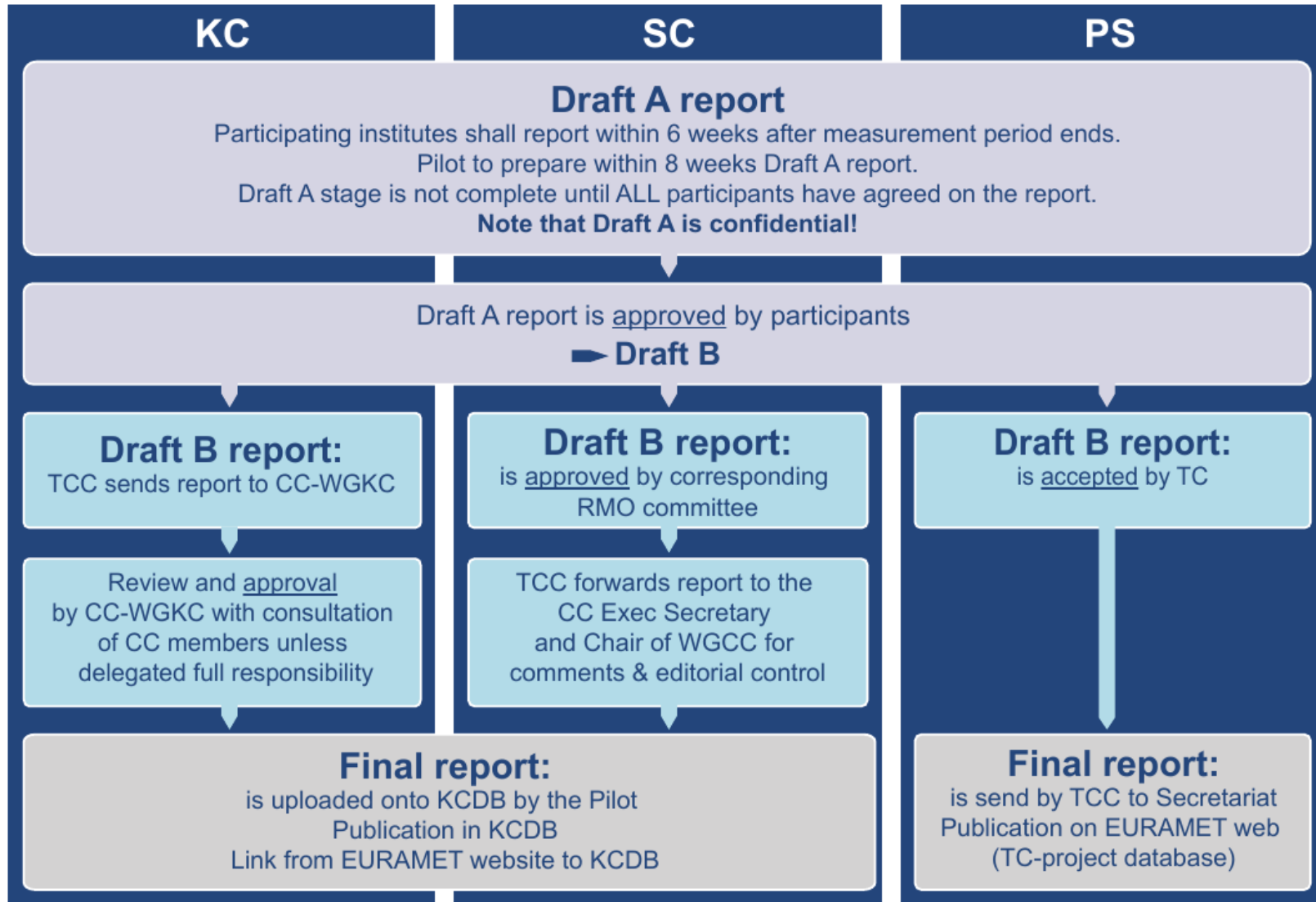
APPENDIX A: References

- [1] CIPM MRA-G-11: Measurement comparisons in the CIPM MRA
- [2] CIPM MRA – Technical supplement to the arrangement
- [3] CIPM MRA-G-13: Calibration and Measurement Capabilities in the context of the CIPM MRA
- [4] APMP Guideline for using HCs as CMC Evidence
- [5] EURAMET Guide 3: EURAMET Procedures and Review Criteria for CMCs
- [6] G-GNP-POL-006: Eligibility Criteria for Participation in EURAMET TC projects
- [7] G-OPS-FRM-009: EURAMET Project Form - Registration of Agreed and Starting Projects
- [8] G-OPS-FRM-010: EURAMET Project Report – Progress and Final Report
- [9] G-OPS-FRM-012: Participation in EURAMET Comparison: Participation form to be signed by participants
- [10] M.G. Cox, The evaluation of key comparison data, Metrologia, 2002, Vol. 39, 589-595.
- [11] G-TCG-PRC-001: Strategic planning of comparisons in EURAMET TCs
- [12] EURAMET Comparison TOOLBOX - Interested users should contact the EURAMET Secretariat.
- [13] QUICK START: Comparisons → <https://www.bipm.org/en/cipm-mra/kcdb-help>
- [14] “Getting started on the KCDB web platform” → <https://www.bipm.org/en/cipm-mra/kcdb-help>

APPENDIX B: Glossary

BIPM	Bureau International des Poids et Mesures - International Bureau of Weights and Measures
BoD	EURAMET Board of Directors
CC	Consultative Committee of the Metre Convention
CC-KC	Key comparison organised by a Consultative Committee
CC-WGKC	Key Comparison Working Group organised by a Consultative Committee
CIPM	International Committee for Weights and Measures of the Metre Convention
CIPM MRA	Mutual Recognition Agreement of the CIPM
DI	Designated Institute
DoE	Degree of Equivalence
KC	Key Comparison
KCDB	Key Comparison Data Base
KCRV	Key Comparison Reference Value
MSM	Member Service Manager
NMI	National Metrology Institute
PS	Pilot Study
RMO	Regional Metrology Organisation
SC	Supplementary Comparisons
TC	Technical Committee
TCC	TC Chair
TC-Q	Technical Committee for Quality

APPENDIX C: Flow Chart describing a EURAMET comparison process.



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