CCT WG-KC
Report to the CCT

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Overview

- Terms of reference and tasks
- Chairmanship and membership
- Overview of performed reviews since last CCT Meeting 2014 and KCDB status
- Templates to guide the comparison pilots in preparing protocols/reports
- Checklists for reviewing protocols and reports
- Review process
- Meetings and Discussion Forum

Terms of Reference

- to oversee all aspects of key comparison documentation:
  - starting with the Technical Protocol and
  - ending with the Draft B Report and the KCDB entry

- including provision of advice to pilots on:
  - the calculation of DoE's,
  - KCRV and
  - linkage between RMO and CIPM key comparisons.

Tasks

1. Examining all relevant documents for each key comparison starting with the protocol and ending with the Draft B Report

2. Advising the pilot laboratory in preparing the text of the entry to Appendix B of the CIPM MRA as required, and to approve the Draft B Report on behalf of the CCT for inclusion into the BIPM key comparison database (KCDB)

3. ~~Advising the pilot laboratory about the preparation of a comparison status document~~

4. On request, review and comment on supplementary comparison Technical Protocols and Draft B reports.

Tasks

- Review initial protocol and its subsequent iterations until WG-KC approval
- Review Draft B report and its revisions until WG-KC approval
- Sometimes the WG-KC is consulted only in the final stage of a comparison (Draft B). This practice is discouraged because eventual flaws in the comparison design cannot be fixed at such late stage.
- Publication of SC Draft B Report in the KCDB must follow one of the following paths:
  - Draft B → RMO TC-T chair → RMO Approval → KCDB Coordinator → CCT (6 weeks) → Publication in the KCDB
  - Draft B → WG-KC Review → WG-KC Approval → KCDB Coordinator → Publication in KCDB

Chairmanship and membership

- K. Hill resigned during last CCT meeting (May 2014)
- In the same occasion, A. Peruzzi was nominated as new chair
- K. Hill carried out the duties of the chair for one additional year, until he retired from NRC in May 15th, 2015
- K. Hill substantially increased the efficiency of the WG-KC
- All WG-KC members thanked him for his contribution
- Due to increased workload, the recruitment of additional members was required:
  - Helen McEvoy (NPL) and Edgar Mendez-Lango (CENAM) recruited in 2015
  - Christopher Meyer (NIST) and Inseok Yang (KRISS) recruited in 2016

Current Membership

- Current membership:

• Stephanie Bell	NPL (UK)
• Robert Benyon	INTA (Spain)
• Helen McEvoy	NPL (UK)
• Edgar Mendez-Lango	CENAM (Mexico)
• Christopher Meyer	NIST (USA)
• Andrea Peruzzi	VSL (the Netherlands)
• Steffen Rudtsch	PTB (Germany)
• Richard Rusby	NPL (UK)
• Gregory Strouse	NIST (USA)
• Andrew Todd	NRC (Canada)
• Rod White	MSL (New Zealand)
• Yoshiro Yamada	NMIJ (Japan)
• Inseok Yang	KRISS (Korea)

Overview comparisons since last CCT meeting (May 2014)

- In the past 3 years,
  our services were requested by 50 different comparisons:

Completed comparisons since last CCT meeting (May 2014)

- 18 approved comparisons:
  - 3 CCT KCs
  - 10 RMO KCs
  - 1 CCT SC
  - 4 RMO SCs

- 2 declared “abandoned” on request of the pilot and RMO chair

Comparison ID	Type	Approval date
CCT-K6	KC	24-03-15
CCT-K2.5	KC	15-01-15
CCT-K3.2	KC	19-09-16
CCT-S1	SC	18-02-16
APMP.T-K3.4	KC	12-05-16
APMP.T-K6.1	KC	08-09-14
APMP.T-K7	KC	22-05-16
APMP.T-S6	SC	23-12-16
APMP.T-S7	SC	25-03-16
COOMET.T-K5	KC	25-06-15
COOMET.T-S1	SC	2-07-15
EURAMET.T-K1	KC	10-04-17
EURAMET.T-K3.2	KC	15-05-17
EURAMET.T-K3.5	KC	18-07-14
SIM.T-K6.1	KC	31-08-15
SIM.T-K6.2	KC	12-08-14
SIM.T-K6.3	KC	23-10-14
SIM.T-K6.5	KC	17-05-16
SIM.T-K9.1	KC	12-05-15
SIM.T-S5	SC	12-11-14

Initiated comparisons since last CCT meeting (May 2014)

- 27 comparisons:
  - 3 CCT KCs
  - 12 RMO KCs
  - 12 RMO SCs
- 2 of them from GULFMET

Comparison ID	Type	Protocol submitted	Protocol approved
CCT-K6.2	KC	24-10-14	7-01-15
CCT-K8	KC	26-11-16	22-02-17
CCT-K10	KC	22-07-14	22-09-14
APMP.T-K6.2013	KC	29-04-15	23-10-15
APMP.T-K9	KC	2-06-15	2-12-16
APMP.T-S9	SC	8-05-14	1st review sent 16-07-15
APMP.T-S13	SC	29-04-15	2nd review sent 23-10-15
APMP.T-S14	SC	9-11-16	1st review sent 22-02-17
APMP.T-S15	SC	23-03-17	1st review sent 19-04-17
APMP.T-S16	SC	16-03-17	1st review sent 04-04-17
COOMET.T-S2	SC	11-03-16	27-05-16
EURAMET.T-K6.2	KC	5-05-17	1st review due 29-05-17
EURAMET.T-K7.4	KC	29-02-16	20-09-16
EURAMET.T-K8.1	KC	5-05-17	1st review due 29-05-17
EURAMET.T-K9	KC	25-11-14	18-02-15
EURAMET.T-K9.1	KC	6-09-16	3-05-17
EURAMET.T-K9.2	KC	6-03-17	1st review sent 11-04-17
EURAMET.T-S5	SC	1-03-16	12-05-16
EURAMET.T-S6	SC	18-05-16	1st review sent 01-08-16
SIM.T-K6.5	KC	5-12-14	25-03-15
SIM.T-K6.6	KC	12-10-16	2nd review sent 13-08-17
SIM.T-K6.7	KC	9-05-17	1st review due 29-05-17
SIM.T-S7	SC	26-08-15	2nd review sent 11-07-16
SIM.T-S9	SC	12-10-16	1st review sent 16-12-16
SIM.T-S10	SC	22-03-17	1st review sent 19-04-17
GULFMET.T-K9	KC	18-01-17	2nd review due 22-05-17
GULFMET.T-S1	SC	3-05-17	2nd review due 22-05-17

Other comparisons reviewed since last CCT meeting (May 2014)

Comparison ID	Type	Protocol submitted	Protocol approved	Draft B submitted	Draft B approved
AFRIMETS.T-S4	SC	19-02-13	no	14-09-15	no (issues)
AFRIMETS.T-S5	SC	13-12-16	no	13-12-16	no (issues)
APMP.T-K7.1	KC	21-11-11	6-02-12	7-11-16	not yet
EURAMET.T-S4	SC	3-03-14	no	4-03-14	not yet

- AFRIMETS.T-S4:
  - WG-KC comments on protocol not followed up
  - Final report already published in IJTP
  - Final report not suitable for KCDB publication (missing uncertainty budgets, unclear traceability route)

- AFRIMETS.T-S5:
  - Protocol never submitted to WG-KC
  - No full uncertainty budgets
  - Analysis of results not appropriate (E_n values)

“Silent” comparisons since last CCT meeting (May 2014)

Comparison ID	Pilot	Starting year	Status in KCDB	Last communication WG-KC/Pilot
CCT-K1.1	NIST	2006	Report in progress, Draft A	Comments on protocol sent to pilot in 2006
CCT-K2.2	INRIM	2005	In progress	WG-KC not contacted
CCT-K4.1	NMIA	2012	In progress	Protocol approved in 2012
CCT-K6.1	NPL	2005	Report in progress, Draft A	Status report received in 2011 (measurement completed)
CCT-K9	NIST	2011	Measurements completed	Protocol approved in 2012
CCT-S2	LNE/CNAM	2007	Report in progress, Draft A	WG-KC not contacted (but strictly not required)
CCT-S3	NMIJ	2007	Report in progress, Draft A	WG-KC not contacted (but strictly not required)
AFRIMETS.T-S1	NMISA	2009	Report in progress, Draft B	Comments on report sent to pilot in 2012
AFRIMETS.T-S2	NMISA	2012	In progress	Comments on protocol sent to pilot in 2012
AFRIMETS.T-S3	NMISA	2012	In progress	WG-KC not contacted (but strictly not required)
APMP.T-K3.5	KRISS	2011	Measurements completed	Protocol submitted in 2011 but not equivalent to K3
APMP.T-K3.6	NIM	2013	Planned	Protocol approved in 2013
APMP.T-K4.1	NIM	2013	Planned	Protocol approved in 2013
APMP.T-K8	NMIJ	2012	In progress	Comments on protocol sent to pilot in 2012
APMP.T-S8	NML Philippines	2013	In progress	Comments on protocol sent to pilot in 2013
APMP.T-S11	NMIJ	2013	In progress	Protocol approved in 2013
APMP.T-S12	NMIJ	2013	In progress	Protocol approved in 2013
COOMET.T-K3.3	VNIIM	2014	Planned	Protocol approved in 2013
EURAMET.T-K3.4	MIRS/UL-FE/LMK	2011	Report in progress, Draft A	Comments on protocol sent to pilot in 2013
EURAMET.T-K8	PTB	2013	Report in progress, Draft A	Protocol approved in 2013
EURAMET.T-S3	CEM	2013	In progress	Protocol approved in 2014
SIM.T-S3	LCPNT Chile	2012	Report in progress, Draft B	Comments on report sent to pilot in 2012
SIM.T-S4	PTB	2012	Report in progress, Draft B	Comments on report sent to pilot in 2012
SIM.T-S6	NIST	2012	Report in progress, Draft A	WG-KC not contacted (but strictly not required)
SIM.T-S8	INN Chile (?)	2014	In progress	WG-KC not contacted (but strictly not required)

- 25 comparisons: RMO TC-T chairs asked to contact the pilots of these comparisons (cc to Susanne Picard)

KCDB overview

- In the past 3 years, our services were requested by 50 different comparisons:
  - 18 approved in the past 3 years
  - 2 abandoned in the past 3 years
  - 26 initiated in the past 3 years (27 – 1 already completed)
  - 4 initiated before May 2014 and not yet completed

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50 comparisons handled by the WG-KC in the past 3 years

25 comparisons that did not request WG-KC action in the past 3 years

KCDB overview

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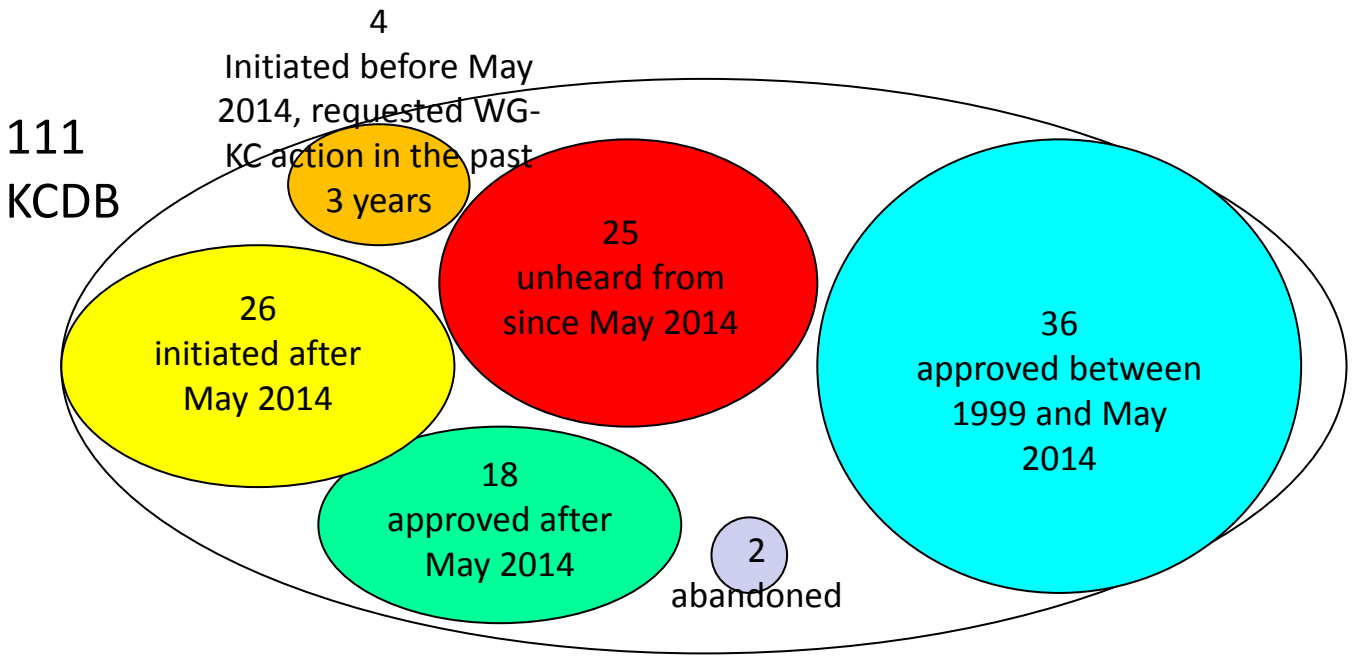
50 comparisons handled by the WG-KC in the past 3 years

25 comparisons that did not request WG-KC action in the past 3 years



Consistency of RMO KC protocols with parent CIPM KC protocol

- CIPM MRA-D-05:
"*The RMO key comparison must follow the same protocol as a preceding CIPM key comparison…*"

- the requirement to comply with all aspects of the parent CIPM comparison has the effect of freezing-in historical practices that may be obsolete

- Protocols should reflect current practice rather than historical practice

- Protocols of RMO KCs do not have to be identical to the parent CIPM KC

- Only limitation: changes that jeopardize the link cannot be accepted

Templates to guide the comparison pilots in preparing protocol/report

"Acronym (CCT-KX, RMO.T-KX.Y, RMO.T-SX)"
Comparison of ...
Technical Protocol[i]
Main authors and affiliations[ii]
Date:
Version:

1. Introduction
- Initiator of the comparison[iii]
- Objectives, quantity and range of the comparison
- Reference documents followed in drawing the technical protocol

2 Participants:
- List of participant laboratories (contact persons, their mailing and electronic addresses can be placed in a separate appendix)
- Roles (coordinating group preparing the technical protocol, pilot(s), co-pilot(s), sub-pilot(s), ...)

3 Comparison methodology
- Topology of the comparison (loops, circulation scheme, ...)
- Starting date and detailed timetable[iv v]

4. Travelling standard(s)
- Detailed description of the device(s) (make, type, serial number, size, weight, packaging, ... and technical data needed for its operation)
- Advice on handling the travelling standard(s), including unpacking, subsequent packing and shipping to the next participant[vi]
- Tests to be carried out on the travelling standard(s) upon receipt before measurement
- Conditions of use of travelling standard(s) during measurement
- Final tests before packaging the travelling standard(s) and ship it to the next laboratory
- Procedure in the case of failure of the travelling standard(s)

5. Organizational aspects
- Procedure in the case of unexpected delay at participating institute
- Customs formalities and documents to accompany the travelling standard(s) (ATA carnet or others)[vii]
- Financial aspects: responsibility for travelling standard(s) costs, transport costs, customs charges, damage costs[viii]
- Insurance on travelling standard(s)[ix]

6. Communication flows[x]
- From participant to pilot: informing the pilot of the arrival of the travelling standard(s)
- From participant to pilot: communicating measurement delays to the pilot
- From participant to participant informing the next participant when shipping the travelling standard(s)
- From participant to pilot: communicating the measurement results to the pilot
- Due dates and consequences when failing to comply with due dates

7. Measurement instructions and procedures
- Measurement instructions (state if there are any specific instructions)
- Measurement procedures (state if there are any specific procedures)

8. Reporting the results[xi]
- Instructions for reporting the results of tests carried out on the travelling standard(s) upon receipt before measurement
- Instructions for reporting the measurement results (Excel® sheet)
- Instructions for reporting the uncertainties (Excel® sheet)[xii]
- Instructions for reporting additional information

9. KCRV and Linkage mechanism
- For CIPM KCs: method for calculating the KCRV and its uncertainty
- For RMO KCs: method for linking to the KCRV of the parent CIPM KC

10. Document revision history[xiii]

"Acronym (CCT-KX, RMO.T-KX.Y, RMO.T-SX)"
Comparison of ...
Report (Draft A)[i]
Authors[ii]
Date:
Version:

1. Introduction
- Objectives, quantity and range of the comparison
- Short history of the comparison (the comparison was initiated on..., the protocol was approved on..., the measurements were performed between... and..., ...)

2 Participants:
- List of participant laboratories (contact persons, their mailing and electronic addresses can be placed in a separate appendix)
- Roles (coordinating group preparing the technical protocol, pilot(s), co-pilot(s), sub-pilot(s), ...)

3 Comparison Pattern
- Topology of the comparison (loops, circulation scheme, ...)

4. Travelling standard(s)
- detailed description of the device(s) (make, type, serial number, size, weight, packaging, ... and technical data needed for its operation)

5. Equipment and measuring conditions at participating laboratories
- Specific measurement instructions or procedures (if any)
- Detailed description of equipment and measuring conditions at participating laboratories

6. Measurement results
- Measurement results at each participating laboratory, including uncertainty of each participating laboratory (the full uncertainty budgets must be reported but can be placed in a separate appendix)

7. Analysis of the results
- Determination of the bilateral equivalence between the participating laboratories (for all comparisons)
- Determination of the KCRV (only for CIPM KCs) and its uncertainty
- Determination of the DoE's (for CIPM KCs and RMO KCs the DoE's must be explicitly reported)
- Linkage to the parent CIPM KC (for RMO KCs)

8. Conclusions
- Concluding remarks (were the objectives achieved?)
- Lessons learned: recommendations for future comparisons

9. Appendices
- Approved protocol
- Document control history (changes applied to the report to address reviewers' comments, ...)

[i] In accordance with CIPM MRA-D-05, Section 4.7, 5.3 or 7.2, as appropriate.
[ii] The pilot institute is responsible for writing the report. For authorship of the report, see CIPM MRA-G-04.

Dutch Metrology Institute

Checklist of items to be included in the protocol (from CIPM MRA-D-05)

1. Detailed description of the devices: make, type, serial number, size, weight, packaging, etc., and technical data needed for their operation
2. Advice on handling the travelling standards, including unpacking and subsequent packing and shipping to the next participant. This should include a complete list of the content of the package including handbooks, etc., and the weight and size of the whole package.
3. Action to be taken on receipt of the standards in a participating institute.
4. Any test to be carried out before measurement.
5. Conditions of use of travelling standards during measurement.
6. Instructions for reporting the results.
7. Proposal for the method of determination of the key comparison reference value.
8. List of the principal components of the uncertainty budget to be evaluated by each participant, and any necessary advice on how uncertainties are estimated (this is based on the principles laid out in the ISO *Guide to the Expression of Uncertainty in Measurement*). In addition to the principal components of the uncertainty, common to all participants, individual institutes may add any others that they consider appropriate. Uncertainties are evaluated at a level of one standard uncertainty and information must be given on the number of effective degrees of freedom required for a proper estimation of the level of confidence.
9. Timetable for communicating the results to the pilot institute. Early communication helps to reveal problems with the travelling standard during the comparison.
10. Financial aspects of the comparison, noting that in general each participating institute is responsible for its own costs for the measurements, transport and any customs charges as well as any damage that may occur within its country. Overall costs of the organization of the comparison, including the supply of the transfer devices, are normally borne by the pilot institute.
11. Insurance of transfer devices is decided by agreement among the participants taking account of the responsibility of each participant for any damage within its country.

Review Criteria for KC protocols

The intention of review of protocols is to provide advice to the pilot to ensure that the comparison is successful and fit for purpose. Suggested criteria are:

1. An assurance from the pilot is received that the protocol has been formally approved by all of the participants.
2. Suitable for the purposes of the MRA (e.g. blindness, etc.)
3. For linking comparisons, the protocol and comparison are substantially equivalent to the relevant CCT-KC comparison (i.e. a similar measurand and similar experimental techniques being "proficiency-tested".
4. The linkage mechanism is satisfactory and explicit (uncertainty, reliability and suitability of the link lab) and link laboratory to the CIPM KC results has a sufficiently low uncertainty to support CMC claims of the participants.
5. Consideration of the comparison topology and artifacts.
6. Will have high probability of likely success using the proposed methodology.
7. Will not face any foreseeable problems in draft-B review stage.
8. The protocol should contain a suggested uncertainty template addressing the known components.

Review Criteria for KC Draft B reports

1. An assurance from the pilot is received that the draft-B has been formally approved by all of the participants.
2. Basic editorial comments: Ensure that the text is unambiguous and clear (not worrying too much about English, grammar and formatting).
3. Completeness: the draft-B report should contain enough technical detail of the methodology to allow future use and re-evaluation of the data, potentially 15 years or more.
4. The comparison satisfies the requirements of the MRA (i.e. blindness, no modification of the uncertainties or measurement values without comments in the report, etc).
5. For linked comparisons, the protocol and comparison are substantially equivalent to the relevant CCT-KC comparison (i.e. a similar measurand and similar experimental techniques being "proficiency-tested").
6. The linkage mechanism is satisfactory and explicit (uncertainty, reliability and suitability of the link lab).
7. Sufficient detail of link-lab standards to allow linking the KC (of same family), and to facilitate forward to subsequent KCs. For example in the K7 and K3 comparisons we need to pay attention to the possibility that labs have made step-changes in their national definition of the TPW between the CC-KC and RMO-KC. In K3 and K4, perhaps cells were different between CC and RMO KCs.
8. The draft-B acknowledges and discusses any significant-unresolved-differences (SUDs) (e.g. by discussion, extra-analysis, comments from the participants, etc.) to facilitate later CMC review.
9. The mathematical analysis of both the lab-lab and lab-KCRV differences and their uncertainties are correct and makes sense, particularly with respect to the uncertainties of linkage and artefact stability, etc. A large linkage uncertainty may mask potentially scientifically important SUDs.
10. Bilateral DOE tables are optional for KCs, but it is required to provide the equations to calculate it from the tabulated data in the report.

Review process

- Number of WG-KC reviewers per document:
  - In the past 3 reviewers per document (protocol or report) were appointed
  - Sustainability of maintaining 3 reviewers per document?
  - Preferred number of reviewers per document remains 3
  - Some flexibility is allowed (for example, 2 reviewers is acceptable for SCs)

- Level of scrutiny in reviewing final reports:
  - Sometimes the WG-KC review has a relevant impact on the final reports
  - Proficiency-testing element of the comparison may be no longer reflected in the final report published in the KCDB

Meetings and Discussion Forum

- The WG-KC convened twice:
  - On June 29th, 2016 in Zakopane, Poland (during TEMPMEKO2016)
  - On May 30th, 2017 at BIPM, France (prior to CCT Meeting 2017)

- The core of the WG-KC work is carried out by uploading/downloading documents and comments from the Discussion Forum in the BIPM website

- When needed, a more direct email exchange between members takes place