CCAUV-Key Comparison Working Group (KCWG)

Report to the CCAUV

G.P. Ripper / Inmetro

BIPM

Tuesday, 26 November 2015

Introduction – Brief history of the KCWG

- February 2011 - the KCWG was established as the third working group of CCAUV.
- The then president of CCAUV Prof. Joaquin Valdes nominated Dr. Thomas Bruns, delegated expert for the field of vibration of PTB, as 1st Chairman of this working group.
- October 2013 - Dr. Gustavo Ripper, delegated expert for the field of vibration of INMETRO was nominated as its 2nd Chairman.
- Dr. Susanne Picard is the current executive secretary of the KCWG and after this CCAUV meeting she will transfer this position to Dr. Gianna Panfilo and focus on the KCDB coordination.

List of participants (1/2)

Name	Affiliation	Status	Did attend?
Gustavo Ripper	INMETRO	KCWG chair	YES
Danuta Dobrowolska	GUM	KCWG member	NO
Peter Harris	NPL	KCWG member	NO
Ryuzo Horiuchi	NMIJ	KCWG member	YES
Maria Nieves Medina	CEM	KCWG member	YES
Lars Nielsen	DTU	KCWG member	NO
Akihiro Ota	NMIJ	KCWG member	NO
Guillermo Silva	CENAM / SIM MWG-9	KCWG member	NO
Sun Qiao	NIM	KCWG member	YES
Thomas Bruns	PTB	KCWG member	NO
Takashi Usuda	NMIJ	CCAUV president	YES
Susanne Picard	BIPM	CCAUV executive secretary	YES
Stéphanie Maniguet	BIPM	KCDB Assistant Coordinator	YES
Gianna Panfilo	BIPM	Next CCAUV exec. secretary	YES
Michael Gaitan	NIST	SPWG chair	YES
Ian Veldman	NMISA	RMOWG chair	YES

List of participants (2/2)

Name	Affiliation	Status	Did attend?
Bajram Zeqiri	NPL	guest / rapporteur	YES
Ping Yang	NIM	guest	YES
Christian Hof	METAS	guest	NO
Lixue Wu	NRC	guest	YES
Hideaki Nozato	NMIJ	guest	YES
Yu Chung Huang	CMS / APMP TC-AUV	guest	YES
Valentina Pozdeeva	BELGIM / COOMET TC-AUV	guest	NO
Alexander Enyakov	VNIIFTRI / COOMET TC-AUV	guest	YES
Richard Barham	NPL / EURAMET TC-AUV	guest	YES
Riaan Nel	NMISA / AFRIMETS TC-AUV	guest	YES
Bajram Zeqiri	NPL	guest	YES
Alexander Yankovsky	VNIIM	guest	YES
Salvador Barrera	DFM	guest	YES
Christian Koch	PTB	guest	YES
Stephen Robinson	NPL	guest	YES
Steven Crocker	NIST	guest	YES

Agenda for the meeting of the CCAUV-Key Comparison Working Group (P1)

WD CCAUV KCWG/15-00

1. Welcome to the BIPM (CCAUV President)
2. Opening of the meeting (KCWG chair)
3. Role call of the participants of the meeting
4. Appointment of a *Rapporteur* – Bajram Zeqiri/NPL
5. Confirmation of the agenda
6. Review of the CCAUV KCWG / ToR and Guideline proposal
7. Review of current KCWG members x expertise available
8. Report on the recent activities of the KCWG
9. Review of current KCWG reviewing process
10. Guidance documents available:
    a) *Guidance for carrying out key comparisons within the CCAUV*, October 2013
    b) *Rules of Procedure of the Key Comparison Working Group of CCAUV*, October 2013
11. Discussion of current issues with the sequence and hierarchy of key comparisons
12. Use of the KCDB archive for older comparisons
13. Authorship of comparisons according to the document CIPM MRA-G-04 version 1

Agenda for the meeting of the CCAUV-Key Comparison Working Group (P2)

14. Uncertainty budgets for comparisons and the inclusion of all relevant influences on the DUT during calibration - Document JCRB-8/9
15. Calculation of $u(D_i)$ for MOCS and non-MOCS
16. Identification of non-MOCS and outliers in comparison reports
17. Linking of RMO KCs to CCAUV KCs (multiple x single linking lab)
18. At what stage can a comparison be used to support a CMC?
19. Support of Pilot Studies to CMCs
20. Comparisons including laboratories that do not comply with the requirements of the MRA (NMI or DI)
21. Harmonization of the methods of planning, analysis and reporting – Can we use templates?
22. Any other business

    22.1 APMP proposal of a shock KC – CCAUV.V-K4
23. Date of next meeting
24. Report of KCWG to the CCAUV
25. Closing of the meeting

Review of the CCAUV KCWG / ToR and Guideline proposal

WD CCAUV-KCWG/15-02 (submitted by Takasi Usuda)

DRAFT : ToR and Rules for the CCAUV KCWG

- Proposal for text for the CCAUV KCWG Terms of Reference
- Guidelines for Membership for the CCAUV Key Comparison Working Group

- The KCWG members may comment on the proposal and the chair will submit them to the CCAUV president

Draft Agenda, Item 6

Current KCWG members and their expertise

			A	U	W	V	S	M
#	name	Affiliation	Acoustics	Ultra sound	Under water	Vibration	Shock	Math / Statistics
1	D. Dobrowolska	GUM	X					
2	Peter Harris	NPL						X
3	Ryuzo Horiuchi	NMIJ	X					
4	M. Nieves Medina	CEM				X		
5	Lars Nielsen	DFM						X
6	Akihiro Ota	NMIJ				X	X	
7	Guillermo Silva	CENAM				X	X	X
8	Thomas Bruns	PTB				X	X	X
9	Sun Qiao	NIM				X	X	
10	Gustavo Ripper	INMETRO				X	X	X

Lack in: A, U, W

Draft Agenda, Item 7

Additional experts (Review board)

			A	U	W	V	S	M
#	name	Affiliation	Acoustics	Ultra sound	Under water	Vibration	Shock	Math / Statistics
1	Claire Bartoli	LNE				X		
2	Joanna Kolasa	GUM				X		
3	Bajram Zeqiri	NPL		X				
4	Sandro Miqueleti	INMETRO		X	X			
5	Rodrigo P Felix	INMETRO		X	X			
6	Zemar M Soares	INMETRO	X					
7	Lixue Wu	NRC	X	X		X	X	
8	Randall Wagner	NIST	X					
9	Stephen Robinson	NPL			X			
10	Richard Barham	NPL	X					

Report on the activities of the WG

- Review and approval of TPs
- Review of Draft B reports of KCs, SCs and PSs
- Review and pre-approval of final reports of KCs and SCs before submitting them to the CCAUV for final approval
- Review of final reports of Pilot Studies for publication in Metrologia

Draft Agenda, Item 8

Comparisons carried out within the frame of the CCAUV (published)

WD CCAUV-KCWG/15-01

CC comparisons, published:

- **CCAUV.A-K5** Metrologia, 2014, 51, Tech. Suppl. 09007
- **CCAUV.U-K3** Metrologia, 2014, 51, Tech. Suppl., 09001
- **CCAUV.V-K2** Metrologia, 2014, 51, Tech. Suppl. 09002
- **CCAUV.V-S1** Metrologia, 2014, 51, Tech. Suppl., 09006

RMO comparisons, published:

- **[1]AFRIMETS.AUV.V-S2** Metrologia, 2012, 49, Tech. Suppl., 09001
- **AFRIMETS.AUV.V-S3** Metrologia, 2014, 51, Tech. Suppl., 09003
- **APMP.AUV.A-S1** Metrologia, 2014, 51, Tech. Suppl., 09004
- **[1]APMP.AUV.V-K3** Metrologia, 2013, 50, Tech. Suppl., 09001
- **COOMET.AUV.A-S1** Metrologia, 2014, 51, Tech. Suppl., 09005
- **COOMET.AUV.W-S1** Metrologia, 2015, 52, Tech. Suppl., 09001
- **EURAMET.AUV.A-S1** Metrologia, 2013, 50, Tech. Suppl., 09002

[1] SCs to be upgraded to KC. Need the link to CCAUV.V-K3, which is still in progress

Comparisons in progress

WD CCAUV KCWG/15-01

CC comparisons, in progress:

- **CCAUV.U-K3.1** Review of report draft B by the KCWG is in progress
- **CCAUV.U-K4** Report draft A was circulated to participants
- **CCAUV.V-K3** Measurements were concluded
- **CCAUV.W-K2** Technical Protocol was approved by the KCWG

RMO comparisons, in progress:

- **AFRIMETS.AUV.A-S1** Final report circulated for approval during the CCAUV meeting
- [3]**AFRIMETS.AUV.A-K5**
- **APMP.AUV.V-K1.1** 1st Draft B report was reviewed by the KCWG
- **COOMET.A-K5**
- **COOMET.AUV.A-S2**
- **COOMET.AUV.U-K3**
- **COOMET.AUV.V-K1**
- [3]**EURAMET.AUV.A-K5**
- **EURAMET.AUV.A-S2**
- [1]**EURAMET.AUV.V-K3** Final report was approved by the CCAUV.
- [2]**EURAMET.AUV.V-S1** SC to be reclassified as pilot study EURAMET.AUV.V-P1

[2] SC to be reclassified as PS

[3] Comparisons using the same artifacts

Pilot studies

WD CCAUV KCWG/15-01

Pilot Study, published:

- **APMP.AUV.V-P1** Published

http://www.bipm.org/utils/common/pdf/final_reports/AUV/V-P1/APMP.AUV.V-P1.pdf

Pilot Study, in progress:

- **[2]EURAMET.AUV.V-P1** In progress

[2] SC to be reclassified as PS

Review of current KCWG reviewing process

- The Pilot laboratory sends document to be reviewed to the executive secretary of KCWG.
- The KCWG secretary submits the documentation to the KCWG chair with a suggested deadline for the review
- The KCWG chair circulates documentation for review by the KCWG members, and additional experts if necessary, establishing a deadline for comments
- The KCWG chair compiles all comments received from experts until the deadline and discusses meanwhile critical points with the secretary
- The KCWG reports the results of the review to the KCWG secretary
- The secretary communicate the results of the KCWG review to the pilot laboratory
- A revised document is submitted by the Pilot for approval by the KCWG chair

Typical time for analysis by the KCWG

Technical Protocols (TP):

- KCWG review and approval of TP
  - 2 working weeks

Draft B reports:

- KCWG review and report of compiled comments
  - 4 working weeks

Final reports:

- Approval of the final report by the KCWG chair
  - 2 working weeks

Guidance for carrying out key comparisons within the CCAUV

Proposal of review to include a new section 4.3

4.3 Autorship of the Final Report

Following the CIPM MRA Guidelines for authorship of Key, Supplementary and Pilot Study Comparison Reports [4], it is recommended to include in the front page of the final report not just one sole author, but also a co-author from each participating NMI/DI.

References

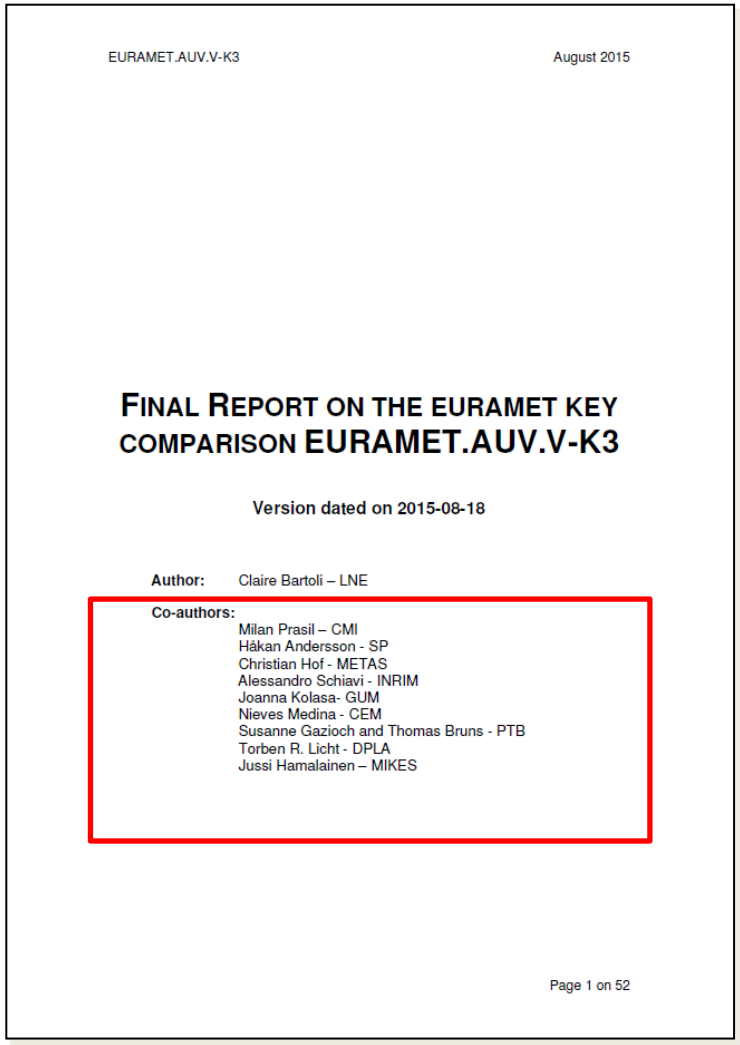
[4] CIPM MRA - G-04 VERSION 1, CIPM MRA Guidelines for Authorship of Key, Supplementary and Pilot Study Comparison Reports
http://www.bipm.org/utils/common/documents/CIPM-MRA/CIPM-MRA-G-04.pdf

Autorship of comparison final reports

Document CIPM MRA-G-04 v. 1

- CIPM MRA Guidelines for Authorship of Key, Supplementary and Pilot Study Comparison Reports

- “Applying these criteria means that there will not be just one sole author, but that from every participating NMI/DI at least one person will qualify as a co-author, inasmuch as at least one person has carried out the measurements and by that has contributed substantially in the execution of the comparison.”



EURAMET.AUV.V-K3 August 2015

FINAL REPORT ON THE EURAMET KEY COMPARISON EURAMET.AUV.V-K3

Version dated on 2015-08-18

Author: Claire Bartoli – LNE

Co-authors:
Milan Prasil – CMI
Håkan Andersson - SP
Christian Hof - METAS
Alessandro Schiavi - INRIM
Joanna Kolasa- GUM
Nieves Medina - CEM
Susanne Gazioch and Thomas Bruns - PTB
Torben R. Licht - DPLA
Jussi Hamalainen – MIKES

Page 1 on 52

Draft Agenda, Item 13

Change of status of comparisons

From SC to PS

- EURAMET.AUV.V-S1 - first results did not support properly CMCs, corrective actions were implemented by KIM-LIPI and new measurements were included

From SC to KS

- Example 1: All Low frequency vibration RMO comparisons which can be linked to CCAUV.V-K3
  - APMP.AUV.V-K3 (published, already upgraded from APMP.AUV.V-S1 in the KCDB)
  - EURAMET.AUV.V-K3 (to be published as KC)
  - AFRIMETS.AUV.V-S2 (published, can be upgraded to AFRIMETS.AUV.V-K3)

Who will provide these links?

Draft Agenda, Item 11

Low-frequency vibration comparisons

- **APMP.AUV.V-K3** - Final report was already published
  (**WAS** upgraded from APMP.AUV.V-S1)

⇒ frequencies: 0.5 Hz to 20 Hz, to link: magnitude from 0.5 Hz to 20 Hz

⇒ participants: NIM, NIMT, CMS, NMIA, NMISA, NMIJ, KRISS

- **AFRIMETS .AUV.V-S2** – Final report was already published
  (**CAN BE** upgraded to AFRIMETS.AUV.V-K3)

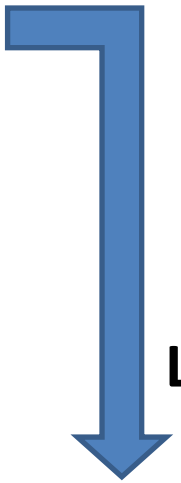
⇒ frequencies: 0.4 Hz to 50 Hz, to link: magnitude from 0.4 Hz to 40 Hz

⇒ participants: INMETRO, NMISA

- **EURAMET.AUV.V-K3** – Final report to be published
  (**WAS** upgraded from EURAMET.AUV.V-S1)

⇒ frequencies: 0 Hz to 200 Hz, to link: magnitude and phase from 0.1 Hz to 40 Hz

⇒ participants: CMI, SP, METAS, INRIM, GUM, CEM, PTB, DPLA, MIKES



MUST BE LINKED

- **CCAUV.V-K3** – Measurements concluded, Report Draft A is in progress

⇒ frequencies: 0.1 Hz to 40 Hz (sensitivity magnitude and phase)

⇒ participants: NIM, LNE, PTB, DPLA, GUM, METAS, NMISA,INMETRO, CENAM, NMIA,NMIJ, KRISS, VNIIM, A*STAR

Discussion of current issues with the sequence and hierarchy of key comparisons

Link of a RMO KC to multiple CIPM KCs

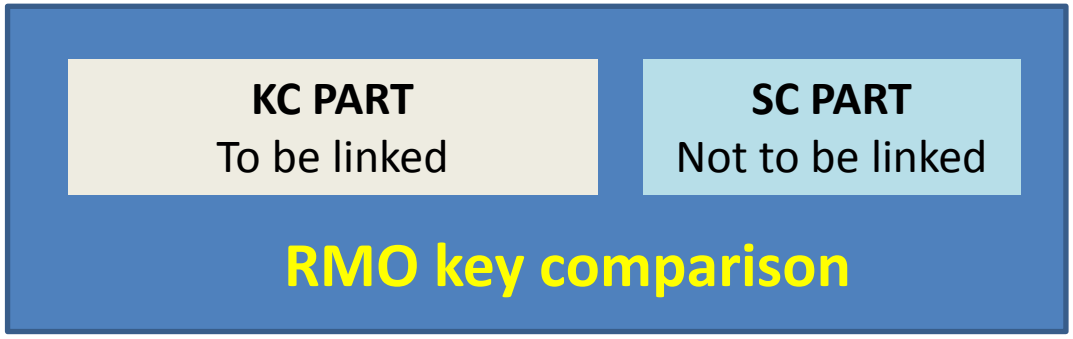
- APMP.AUV.V-K1.1 draft B report
  - BTB – linked to CCAUV.V-K1
  - SE – linked to CCAUV.V-K2

The KCWG will discuss with APMP a solution during this week

1. Link both accelerometers to CCAUV.V-K2
2. Change the acronym of the comparison to APMP.AUV.V-K2
3. Link using only NMIJ results in CCAUV and APMP comparisons

Considerations

- Many RMO comparisons are a mix of KC and SC.
- The RMO KC part must be linked to the CIPM KC and the SC part not.



- Proposal: Identify in the TP what will be the KC part and to which CIPM KC it will be linked to and by which participants.

CIPM MRA Revision was launched in October

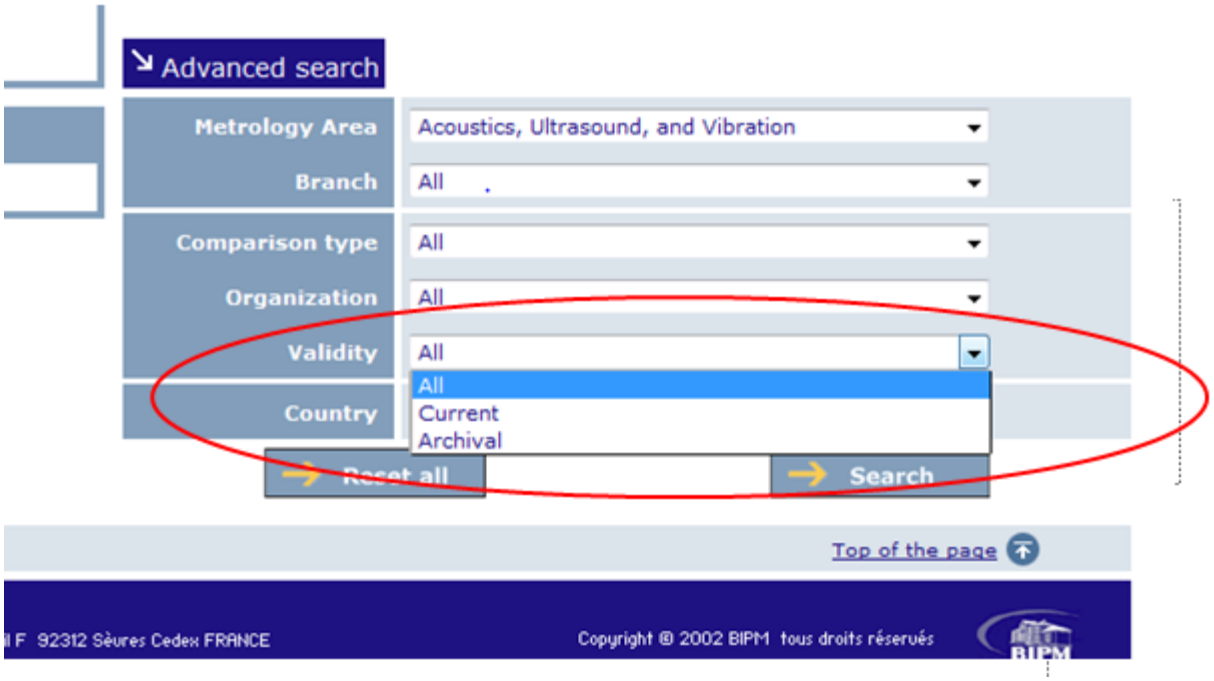
Topics for reflection by the KCWG:

1. NAMING: Consider if the naming of KCs may be altered, to keep the trace of repeats. For example, the repeat of the CCAUV.A-K5 could be named CCAUV.A-K5.2022 if repeated in 2022 and if covering roughly the same purpose. Such numbering system has been more and more adopted by other CCs. The idea is of course not to alter already existing registered KCs, but to apply a possible new way to number in future.
2. VALIDITY: How long a KC or SC may be considered to be a basis for traceability. Either in terms of time, or based on some other criteria.
3. ARCHIVES: Consider if some KCs and SCs are of such age that their inclusion in the "active" KCDB is not justified. These comparisons could hence be transferred to the "Archives", a facility already existing on the KCDB but not yet used.

("Validity" in Appendix B http://kcdb.bipm.org/appendixB/KCDB_ApB_search.asp)

Use of the KCDB archive for older comparisons

- Transference of older Comparisons to the “Archival”
- The objective is to give a truer picture on the KCDB statistics, in this case on the comparisons



Draft Agenda, Item 12

Uncertainty budgets for comparisons

Document JCRB-8/9: Uncertainty contributions of the device under calibration or measurement

- Uncertainty shall include all relevant influences on the DUT during calibration

- For example: All participants of next vibration comparisons should consider the effect of shaker or mounting conditions at high frequencies

Linking between KCs & correlation

- The linking laboratories are chosen because their “performance” in the two comparisons is expected to be consistent, and so some correlation will exist.

- It is important to consider the correlation associated with the measurements made by the same laboratory.

- Necessity of an understanding of the supporting uncertainty budgets to identify those components describing effects that do not change between the measurements. (not always easy)

- Proposal: Ask to the participants to separate reported (combined) uncertainties into components (roughly aligned with random and systematic effects) that can be used to quantify the correlation.

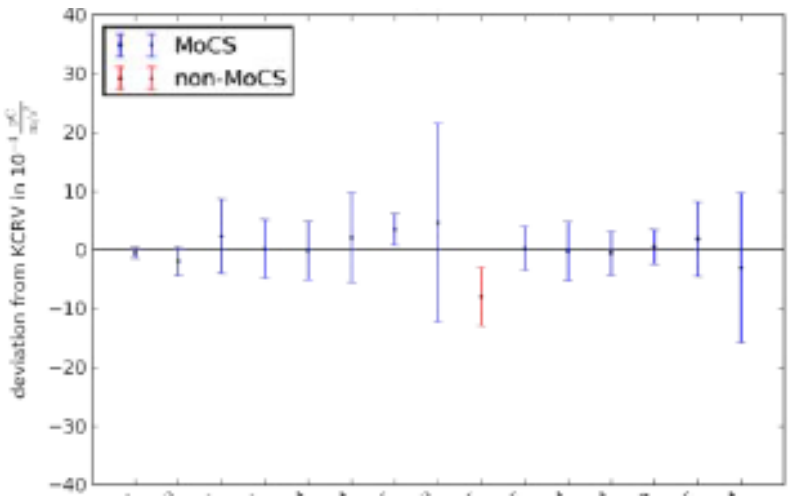
Identification of non-MOCS and outliers in CCAUV.V-K2

Result Tables:

- Non-MOCS → asterisk (*)
- results with $|d_i| > 2u(d_i)$ → yellow background

2000	0.128362	0.978	0.360	-0.2	1.0	3.4	5.1	-2.2	10.2	-0.3	5.1
2500	0.128686	1.081	0.564	0.0	1.1	5.1	5.1	-2.6	10.2	-0.9	5.1
3000	0.129073	1.234	0.816	-0.4	1.2	6.3	5.2	-3.0	10.3	-0.5	5.1
3150	0.129178	1.321	0.901	-0.3	1.2	7.2*	5.4*	-2.6	10.3	-0.2	5.2
3500	0.129544	1.480	1.117	-0.0	1.4	6.6*	5.4*	-3.4	10.4	-1.0	5.2
4000	0.130063	1.752	1.468	-0.6	1.7	8.4	5.4	-3.6	10.4	-0.5	5.3
4500	0.130684	2.106	1.871	-0.5	2.1	8.2	5.5	-4.1	10.5	-0.3	8.0
5000	0.131377	2.552	2.329	-0.6	2.5	6.2	5.7	-4.9	15.8	0.4	8.2
5500	0.132313	3.533	2.846	-1.9	4.4	4.9	5.7	-6.7	15.9	-1.7	8.2
6000	0.133076	4.019	3.418	-1.6	4.8	2.2	6.0	-6.6	16.1	-1.7	8.4

Graphs:



→ Non-MOCS color identified

Analysis of results obtained in comparisons

Adequate results: $|d_i| \leq U(d_i)$

- Provide an objective evidence to support CMCs
  - Current CMCs
  - New CMCs

Discrepant results: $|d_i| > U(d_i)$

- Require actions from the pilot institute
  - Communication of discrepancies to the NMI and its RMO with copies to the RMO-WG chair, JCRB and president of the CC

- Require actions from both participating NMI/DI and RMO
  - Follow the procedure for monitoring the impact of comparisons
    - Analysis of impact on current CMCs
    - Define action plan and take corrective actions if necessary
    - RMO report the result of corrective actions in its annual report on status of QMS

Linking of RMO and CIPM key comparisons

- The RMO key comparisons must be linked to the corresponding CIPM key comparisons by means of joint participants. This is mandatory to demonstrate global equivalence. To achieve this, it is recommended that at least two of the participants in the preceding CIPM key comparison participate also in the RMO key comparison.

Important to be considered:

- Number of linking labs
- Uncertainty of linking labs

Support of pilot studies to CMCs

CIPM MRA-D-05, page 6:

- The results of pilot studies alone are not normally considered sufficient support for calibration and measurement capability (CMC)

The final report of APMP.AUV.P-S1 included the following sentence:

- "The results of this APMP pilot comparison may serve as indirect supporting evidence for the registration of 'calibration and measurement capabilities' (CMCs) in the framework of the CIPM MRA."

CIPM-MRA: 6. Participation in key and supplementary comparisons

- 6.1 Participation in a CIPM key comparison is open to laboratories having the highest technical competence and experience, normally the member laboratories of the appropriate Consultative Committee.
- Those laboratories that are not members of a Consultative Committee and not NMIs must be nominated by the designated national metrology institute referred to in paragraph 1.4 as being responsible for the relevant national measurement standards

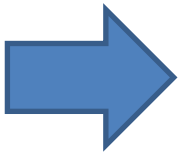
Participants that do not comply with the requirements of the MRA

- The CIPM MRA-D-05 claims that participating non-CC members are DIs

- Important: DI status is a national decision

CCAUV.W-K2 (underwater acoustics):

- India - NIOT
- Italy - CNR-IDASC
- Germany - WTD71
- Sweden - FOI
- South Africa - NMISA or IMT



Many labs are not yet an officially designated institute

Harmonization of the analysis and reporting

- Harmonization of the methods of planning, analysis and reporting
- Can we use templates in a near future?

- Circulation of spreadsheets used for analysis of comparisons data and linking of KCs?
  - Helpful for new pilot institutes
  - Helpful for the review by the KCWG

Any other business

- Proposals of future comparisons
  - APMP proposal of a low-intensity shock KC – CCAUV.V-K4
  - Repeat CCAUV-V-K2 taking actions to minimize the influence of mouting conditions for the SE accelerometer

Thank you!