Bureau International des Poids et Mesures

Consultative Committee for Acoustics, Ultrasound and Vibration (CCAUV)

Report of the 9th meeting
(29–31 October 2013)
to the International Committee for Weights and Measures

Comité international des poids et mesures

Note:

Following a decision of the International Committee for Weights and Measures at its 92nd meeting in October 2003, Reports of meetings of Consultative Committees will henceforth be published only on the BIPM website in the form presented here.

Full bilingual printed versions in French and English are no longer published.

M. Milton,
Director BIPM

LIST OF MEMBERS OF THE CONSULTATIVE COMMITTEE FOR ACOUSTICS, ULTRASOUND AND VIBRATION

as of 29 October 2013

President

Prof. Dr J. Valdés, Member of the International Committee of Weights and Measures.

Executive Secretary

Dr S. Picard, International Bureau of Weights and Measures [BIPM], Sèvres.

Members

Central Office of Measures/Glówny Urzad Miar [GUM], Warsaw.

Centro Nacional de Metrología [CENAM], Querétaro.

All-Russian D.I. Mendeleyev Research Institute for Metrology, Rosstandart [VNIIM], St Petersburg.

Danish Fundamental Metrology Ltd [DFM], Lyngby.

Instituto Nacional de Metrologia, Normalizacao e Qualidade Industrial [INMETRO], Rio de Janeiro.

Istituto Nazionale di Ricerca Metrologica [INRIM], Turin.

Korea Research Institute of Standards and Science [KRISS], Daejeon.

Laboratoire National de Métrologie et d'Essais [LNE], Paris.

National Institute of Metrology [NIM], Beijing.

National Institute of Standards and Technology [NIST], Gaithersburg.

National Measurement Institute of Australia [NMIA], Lindfield.

National Metrology Institute of Japan, National Institute of Advanced Industrial Science and Technology [NMIJ/AIST], Tsukuba.

National Metrology Institute of South Africa [NMISA], Pretoria.

National Metrology Institute of Turkey [UME], Gebze-Kocaeli.

National Physical Laboratory [NPL], Teddington.

National Research Council of Canada [NRC], Ottawa.

Physikalisch-Technische Bundesanstalt [PTB], Braunschweig.

The Director of the International Bureau of Weights and Measures [BIPM], Sèvres.

Observers

Agency for Science, Technology and Research [A*STAR], Singapore.

Institute for Physical-Technical and Radiotechnical Measurements, Rosstandart [VNIIFTRI], Moscow.

Bulgarian Institute of Metrology [BIM], Sofia.

Bundesamt für Eich-und Vermessungswesen [BEV], Vienna.

Centro Español de Metrología [CEM], Madrid.

Czech Metrology Institute [CMI], Brno.

Federal Office of Metrology [METAS], Bern-Wabern.

Instituto Português da Qualidade [IPQ], Caparica.

Institutul National de Metrologie [INM], Bucharest.

International Electrotechnical Commission [IEC], Geneva.

International Organization for Standardization [ISO], Geneva.

National Physical Laboratory of India [NPLI], New Delhi.

Slovak Metrology Institute/Slovenský Metrologický Ústav [SMU], Bratislava.

VSL [VSL], Delft.

1 OPENING OF THE MEETING

The ninth meeting of the Consultative Committee for Acoustics, Ultrasound and Vibration (CCAUV) took place at the International Bureau of Weights and Measures (BIPM), Pavillon de Breteuil, Sèvres, from 29 to 31 October 2013.

The following were present:

K. Baik (KRISS), R. Barham (NPL), S. Barrera Figueroa (DFM), C.Bartoli (LNE), T. Bruns (PTB), S. Crocker (NIST), D. Dobrowolska (GUM), G. Durando (INRIM), J.S. Echeverría-Villagómez (CENAM), M. Gaitan (NIST), C. Guglielmone (INRIM), P. Harris (NPL), R. Horiuchi (NMIJ/AIST), C. Koch (PTB), J. Kolasa (GUM), H.S. Kwon (KRISS), T.R. Licht (BKSV-DPLA), M.J.T. Milton (Director of the BIPM), R. Nel (NMISA), A. Ota (NMIJ/AIST), G. Ripper (INMETRO), S. Robinson (NPL), D. Rodrigues (LNE), E. Sadikoglu (UME), E. Sandermann-Olsen (BKSV-DPLA), A. Scott (NMIA), G. Silva Pineda (CENAM), Q. Sun (NIM), J. Valdés (INTI), C. Veldman (NMISA), L. Wu (NRC), P. Yang (NIM), A. Yankovsky (VNIIM), and B. Zeqiri (NPL).

Observers: H.A. Chua (A*STAR), A. Enyakov (VNIIFTRI), I. Godinho (IPQ), C. Hof (METAS), A.E. Isaev (VNIIFTRI), M. Nieves Medina (CEM) and A. Nikolaenko (VNIIFTRI).

Sent apologies: M. Blabla (CMI), J.-N. Durocher (LNE), R. Eldelmaier (EV), R. Koops (VSL), V. Pozdeeva (BelGIM) and T. Usuda (NMIJ/AIST).

Invited by the President: A. Maina (KEBS) and L. Pitre (LNE-Cnam).

Also present: S. Picard (Executive Secretary of the CCAUV), C. Kuanbayev (Executive Secretary of the JCRB) and C. Thomas (Coordinator of the BIPM KCDB).

2 WELCOME AND INTRODUCTION OF TOPICS AND PRESENTATION OF SPEAKERS BY THE CCAUV PRESIDENT, PROF. DR JOAQUÍN VALDÉS

The president of the CCAUV, Prof. Dr Valdés welcomed all participants and opened the meeting at 2.00 p.m. on Tuesday, 29 October 2013. Apologies from Dr Milton were accepted; he took part in the meeting from Wednesday morning.

Prof. Dr Valdés announced that the next General Conference on Weights and Measures (CGPM) will take place in November 2014. The envisaged change in the International System of Units

(SI) will be postponed until 2018 due to various concerns, most of them linked to the new definition of the kilogram. Although the CCAUV is not directly affected it should observe the matter carefully.

Another important potential change is the major revision of the Guide to the Expression of Uncertainty in Measurement (GUM). This was covered in the talk by Dr Peter Harris (NPL). In addition, several recent research topics were presented (see §3).

3 PRESENTATIONS ON SELECTED SCIENTIFIC TOPICS: APPLICATIONS IMPACTING HEALTH, ENVIRONMENT AND INDUSTRY

The following talks were presented:

Dr Peter Harris (NPL) **Revision of the guide to the expression of uncertainty in measurement – impact on national metrology institutes and industry**: This talk covered the technical and practical aspects of the planned changes to the GUM, an overview of the present GUM and Supplements, why the Bayesian approach is being taken, and the consequences for NMIs and industry; see CCAUV/13-37.

Dr Laurent Pitre (LNE-Cnam) **An acoustic / microwave determination of the Boltzmann constant at the LNE-Cnam with a 0.5 litre quasi-sphere**: Presently the kelvin is based on the triple point of water, but new work aims at fixing the value of the Boltzmann constant to define the kelvin. To date, the achieved uncertainty is 1.2 ppm; see CCAUV/13-38.

Dr Christian Koch (PTB) **Determination and modeling of temperature increase during phacoemulsification**: In cataract surgery the endothelium, which *inter alia* controls the water content of the cornea, may be damaged by the phacoemulsification technique. Experiments and modelling have shown that increases in temperature during this process are unlikely to cause damage, and that streaming and cavitation are more likely to be sources of damage; see CCAUV/13-39.

Dr Thomas Bruns (PTB) **EMRP IND09 Traceable dynamic measurement of mechanical quantities**: Areas which are being covered in this project include the dynamic effects of conditioning electronics and taking into account the interaction of the sensors with the monitored mechanical structure;[1] see CCAUV/13-40.

Dr Richard Barham (NPL) **Instrumentation facilitating a new interactive approach to urban noise management**: The NPL has successfully modified standard MEMS microphones such as those used in smartphones, to meet the frequency response specified in IEC 61672 for Class 1 microphones; see CCAUV/13-41.

[1] *Metrologia* 2013 **50** 580–585

4 WELCOME

The Director of the BIPM, Dr Milton welcomed the participants. He commented that this is his first meeting of the CCAUV and that he looked forward to learning its topics. He noted that while the CCAUV does not deal directly with the base units of the SI, its work concentrates on science and technology.

After an introduction by the participants, the CCAUV observed one minute's silence in memory of Prof. Dr Knud Rasmussen from Denmark, a former member of the CCAUV who had died since the previous meeting. He will be remembered as a significant contributor to AUV research and to the CCAUV in particular.

Prof. Dr Valdés reported on the International Committee of Weights and Measures (CIPM) meeting that took place at the BIPM the previous week. A planning process for the future strategy of the BIPM has started and the results are being considered. The CIPM considered new procedures for membership of the CIPM, for the appointment of chairpersons for the Consultative Committees and other positions. A sub-group of CIPM members will be formed to review the CIPM MRA. This group will present a report to the CIPM in 2014.

Prof. Dr Valdés stated that the CCAUV Strategic Planning Working Group (SPWG) now has a focus on the benefits of AUV to the health, environment and industrial sectors. There is also need for a new strategy for Key Comparisons (KCs) as their numbers are increasing. KCs should be more "key" and this topic was on the agenda of the CCAUV Key Comparison Working Group (KCWG) which met on 29 October. He noted that the KCWG, founded in 2011, is now active and all technical protocols and reports are checked by the group, and that some KCs are now in a second round.

5 APPOINTMENT OF THE RAPPORTEUR

Dr Scott and Dr Koch agreed to act as the rapporteurs.

6 CHANGES OR ADDITIONS TO THE AGENDA

The agenda was accepted as no changes were required. Although key comparison database (KCDB) matters were not specifically on the agenda, Dr Picard mentioned that Dr Thomas, the KCDB Coordinator, would assist during the meeting.

7 REPORT OF THE 8TH CCAUV MEETING 2012

The report had previously been approved by email.

The actions decided during the last meeting were checked:

CCAUV8/A1. **All participants** to consider if they have further inputs to the strategic planning process, to complete the pro-forma questionnaire circulated by the SPWG, and return it to Bajram Zeqiri, by **12 July 2012.** [October 2013: Accomplished]

CCAUV8/A2. **SPWG Chairman** to identify experts from within the CCAUV to collate responses from each of the areas, then the SPWG to compile and publish a Strategy document, by **12 December 2012**. [October 2013: Accomplished]

CCAUV8/A3. **All participants** capable of providing quality system peer review services to complete the pro-forma document available on the CCAUV website and submit to the Executive Secretary for inclusion in the technical assessor database. Ongoing. [October 2013: Accomplished]

CCAUV8/A4. **NIM** to prepare a questionnaire to gather input on the scope of a protocol for a future CCAUV key comparison on low frequency calibration of accelerometers, by **12 September 2012. [**October 2013: Accomplished]

CCAUV8/A5. **NPL** to prepare a questionnaire to gather input on the scope of a protocol for a future CCAUV key comparison on free-field calibration of hydrophones, by **12 September 2012.** [October 2013: Funding is available now and a questionnaire will soon appear]

CCAUV8/A6. **NPL** to prepare draft protocol for a new CCAUV key comparison on free-field calibration of ultrasonic hydrophones, by **12 December 2012**. [October 2013: In progress]

CCAUV8/A7. Any participant interested in attending the BIPM Workshop on *Challenges in Metrology for Dynamic Measurement* (15-16 November 2012), to liaise with their institute Director on availability of further places. [October 2013: Accomplished]

8 REPORT FROM THE CCAUV WORKING GROUP ON STRATEGIC PLANNING (SPWG)

Dr Zeqiri reported that the CCAUV Working Group on Strategic Planning (SPWG) had met before the CCAUV meeting, on Monday 29 October 2013. Mr Henson, Director of the International Liaison and Communication Department at the BIPM, presented a review at the meeting about strategic planning related to the CIPM. In particular, KC planning for the CCs is critical. Strategy planning is associated with a document which should be reviewed every two years with a general review every four years.

A discussion had occurred on the usefulness of the document, which had been found to be of help and support by several participants when national strategies and planning are discussed within NMIs.

Mr Henson is responsible for strategic planning at the BIPM. A template for a strategy document was communicated to each Consultative Committee in April 2012. In the case of the CCAUV, the strategic document has followed the template format and is based on a questionnaire which was addressed to the CCAUV in 2012 and the contributions of selected experts. A 20-page document was prepared and accompanied by a condensed one-page version as an executive summary. This was sent to all CCAUV members for comment. The revised document is now complete and will be published on the CCAUV web page.

Dr Picard commented that the CCAUV will be represented at next the CGPM through a poster session. The CCAUV was invited to think about how AUV matters could be presented. Dr Picard asked for input for the poster; photographs, pictures or facts for the poster may be submitted to her.

A discussion about the management of KCs followed and Dr Zeqiri proposed merging the KCWG and the SPWG as they work in similar fields and have many subjects in common. In addition, both working groups consist of almost the same people. Dr Milton explained that many activities are underway in Consultative Committees to reduce the number of WGs and that this is a general trend. He pointed out that many of the KCWGs in other Consultative Committees fulfil only an editorial role in the KCs. Dr Bruns commented that the CCAUV-KCWG addresses many technical issues such as statistics, mathematical methods, or performance of KCs. This advantage would be diluted if the two groups were merged, and the focus of the KCWG will drift away. Dr Ripper said that the focus of the two groups is very different and he recommended that both are retained. Dr Barrera Figueroa agreed that the focus of the two groups is different. He suggested the setting up of an *ad hoc* SPWG group when a revision of the strategic planning document is necessary. Dr Koch emphasized that the KCWG adds great value by keeping the technical details correct, and perhaps should select more specialist members to address technical problems. Dr Picard suggested further reflection on the question of merging and populating the working groups.

Finally, Dr Milton explained that the strategic planning documents have not yet been published on the website, but that all documents are available within the NMIs via their respective directors.

Prof. Dr Valdés discussed and compared the terms of reference of the SPWG and the KCWG. It became apparent that most of the terms of reference for the SPWG do not explicitly deal with

key comparisons but with science and technology matters. The terms of reference of the KCWG have two points which together make it clear that input should be given into the SPWG with respect to future needs of key comparisons. Prof. Dr Valdés proposed that both working groups be maintained and that a common working space be created where both groups overlap. Dr Bruns thanked Prof. Dr Valdés for making this so clear. Dr Zeqiri accepted this as a decision.

Prof. Dr Valdés encouraged all members to read the NPL document on metrology for the 2020s which covers metrology incorporated into machines ("self-calibration") but stresses the need to have them as close as possible to the primary standards.

9 REPORT FROM THE CCAUV WORKING GROUP FOR KEY COMPARISONS (KCWG)

Dr Bruns introduced two new draft documents. The first document, entitled "Guidance for carrying out key comparisons within the CCAUV", covers rules and procedures of the KCWG. It summarizes the basic rules of working within the KCWG. Dr Bruns explained that the procedures for submitting a report or a protocol may now be based on a clearly written process. In particular, a response on the comments made by the KCWG is required from the pilot laboratory. The procedure was accepted by the CCAUV and will be published on the website.

The second document, entitled "KC Rules and Procedure of the CCAUV-KCWG", concerns guidance on the performance of KCs in the CCAUV. It follows the basic rules of the BIPM and collects together all issues which should be kept in mind while running KCs. It is a practical document to be read in conjunction with the BIPM guidelines, and it aims to help avoid basic and common mistakes.

Dr Thomas informed the CCAUV that most Consultative Committees have decided that it is no longer necessary to calculate bilateral degrees of equivalence (DoE). However, the equations and information to allow this practice to continue will be provided. Dr Bruns agreed that bilateral DoEs are no longer required, especially as CMCs are based on unilateral rather than bilateral DoEs. He said that the pilot laboratories have the option to calculate them but that this is not mandatory.

Dr Bruns resigned as the chairman of the KCWG for personal reasons. Dr Ripper was appointed as the new chairperson of the KCWG. The President thanked Dr Bruns for his excellent work.

10 CCAUV KEY COMPARISONS

10.1 Key Comparisons and reports in progress

10.1.1 CCAUV.A-K5

Dr Barham presented an update on CCAUV.A-K5. He explained a new approach to represent the data by reference curves, although this concept is still being developed due to some problems with data analysis. He raised the question of whether the Draft B should present the reference data in terms of discrete data (the traditional method) or as continuous data (a new method). In the ensuing discussion it became clear that it is presently more advantageous to use the traditional method. The use of reference curves could be the subject of an ongoing project; there still remain questions on aspects such as the statistical methods of fitting curves to the data and the identification by participant laboratories on correlated components in their uncertainty calculations (as these will affect the fitting algorithm). The incorporation of reference curves in the KCDB was another issue; the presentation of results, while complete in the report, may be limited to third-octaves in the KCDB.

10.1.2 CCAUV.U-K3

Dr Koch presented the results of the CCAUV.U-K3 Draft B report. The revised comparison report has been submitted to the KCWG. Once accepted, Dr Picard will send the report to all CCAUV members for formal approval. A new comparison, CCAUV.U-K3.1, will start after approval of the report. The INRIM will take part as a second linking lab, along with the PTB (pilot), INMETRO, NPLI, NMIJ/AIST and KRISS. One transducer has been selected and it is hoped that the comparison will begin in early 2014. Dr Bruns reminded the CCAUV of the rules for participation in KCs, and emphasized that participants should be willing and available to participate in subsequent supplementary, RMO or linking comparisons.

10.1.3 CCAUV.V-K2

Dr Bruns commented that many difficulties had occurred with CCAUV.V-K2. A Draft B report had been submitted to the KCWG which has provided comments that are now under review by the pilot laboratory. Dr Ripper is willing to assist in this assessment as a co-pilot since Dr Bruns, being the pilot, is also the chairperson of the KCWG.

10.2 Key Comparison proposals

10.2.1 CCAUV.V-K3

Mr Sun commented that a questionnaire to prepare the comparison was established in September 2012 and seventeen replies had been received. Fourteen participants will take part in the comparison and all preliminary problems concerning the protocol had been solved. Dr Thomas pointed out that this comparison had not yet been registered. Mr Sun will provide a revised final version of the technical protocol containing only minor modifications. The technical protocol was therefore approved by the CCAUV.

Dr Picard commented that, as agreed, the regional supplementary comparisons APMP.AUV.V-S1 and EURAMET.AUV.V-S1 which both cover the same topic as CCAUV.V-K3 had already been launched. They will be upgraded as key comparisons once the CCAUV.V-K3 has been included in the KCDB and will be renamed APMP.AUV.V-K3 and EURAMET.AUV.V-K3, respectively.

10.2.2 CCAUV.U-K4

Dr Zeqiri informed the CCAUV about the upcoming comparison of laboratory reference ultrasonic hydrophone calibrations. It is an enhanced update of CCAUV.U-K2 but with an extended scope. There will be four participants; INMETRO has also been invited to take part. Calibration of two hydrophones at frequencies from 0.5 MHz to 20 MHz is required. The comparison can start in April 2014. The technical protocol is being drafted and will be submitted to the participants (presently NPL, PTB, NMIJ/AIST, NIM and INMETRO) for review. Optical interferometry rather than reciprocity will be the preferred method.

10.2.3 CCAUV.W-K2

Dr Robinson explained that funding is now available for this comparison within the NPL. A questionnaire is ready and will be sent out shortly after the CCAUV meeting. It covers all the technical issues. The following institutes are interested in receiving the questionnaire: NPL, NIST, VNIIFTRI, HAARI[2], UME, INMETRO, and KRISS. A draft protocol should be ready by February 2014.

10.3 CCAUV supplementary comparisons

CCAUV.V-S1 is a bilateral comparison between the PTB and the KRISS on angular acceleration measurement. Two artefacts were used and a good agreement was found in the results. The question arose on which other institutes are able to measure angular acceleration. It appeared that the CENAM is able to calibrate angular velocity by interferometry. The Draft B report is presently under review by the KCWG. The possible extrapolation of linear to angular vibration CMCs remains on the agenda of topics to be discussed by the CCAUV.

11 REGIONAL METROLOGY ORGANIZATIONS

11.1 Report from the RMOWG

Mr Veldman presented the outcomes from the CCAUV Working Group for RMO Coordination (RMOWG) meeting held on 29 October 2013. The CCAUV was informed that Mr Veldman accepted chairmanship of the RMOWG for another term.

[2] Designated institute by the NIM

The nineteen participants in the meeting represented all RMOs and the BIPM. All action points from the previous meeting had been completed or were dealt with in this meeting. Mr Henson provided guidance on handling accreditation. The Joint Committee of the Regional Metrology Organizations and the BIPM (JCRB) had updated its procedures for the CMC review process; these were discussed at the meeting.

CCAUV guidance for Calibration and Measurement Capabilities (CMCs), a supplement to CIPM documents, was updated and hyperlinks to the existing CIPM rules were included.

The issue of the life span of CMCs had been discussed. The RMOs should have a review process for those CMCs no longer covered by a key comparison.

The list of service categories was also thoroughly discussed. Changes to the service categories "Sound in water" and "Vibration" were made. A new branch "Auxiliary Equipment" was proposed and comments were invited. The RMO chairs will circulate the new document.

A resulting discussion on the measurement of auxiliary equipment emerged, mainly discussing charge amplifiers. This is an electrical task but is often carried out by the acoustic laboratories themselves. Several NMIs offer this as a service to industry. Therefore it is useful to have a service category in this field. Mr Veldman will circulate a document on these matters for comment via the RMO chairs.

11.2 JCRB matters

Mr Kuanbayev, the Executive Secretary of the JCRB, reported on new developments in the JCRB. All documents are available on the website, and particular reference was made to the documents CIPM MRA-D-04 and CIPM MRA-D-05. A workshop on '*Best Practices in CMC Reviews*' was held in March 2013. Many deadlines have been shortened and the rules made stricter. The JCRB made several recommendations for future work, in particular that the BIPM web forum should be used as a tool (http://www.bipm.org/jforum/forums/) and that the fast track procedures for CMC reviews should be applied more frequently.

Dr Thomas explained the options available on the JCRB website.

11.3 Reports from regional metrology organizations

11.3.1 SIM

Dr Silva Pineda, chairperson of the SIM TC-AUV, reported on the SIM which is active in all fields of AUV, and which has participated in several key comparisons. A number of projects and collaborations are ongoing. A written report is available on the CCAUV restricted website. There are now seven NMIs participating in SIM: NRC (Canada), NIST (USA), CENAM (Mexico), INM(CO) (Colombia), INDECOPI (Peru), INMETRO (Brazil) and INTI (Argentina).

11.3.2 AFRIMETS

Mr Veldman, chairperson of the AFRIMETS TC-AUV, reported that Kenya has been working to prepare CMCs in acoustics and vibration. Two AFRIMETS comparisons have begun (one on secondary accelerometer calibration, and one on LS2P microphones by primary methods).

Mr Nel was elected to be the new chairperson of the AFRIMETS at its most recent meeting in October 2013.

11.3.3 APMP

Mr Sun, chairperson of the APMP TC-AUV, reported on the APMP, which is active in a variety of key comparisons. A project for comparison of artificial mastoids is ongoing. Several pilot comparisons are continuing and an accredited laboratory is one of the participants (this is allowed in a pilot study). Dr Bruns said that there is no problem with having non-NMIs in pilot studies as the objective of such studies is to prove technical feasibility.

11.3.4 COOMET

Dr Enyakov reported on behalf of Ms Pozdeeva who is the COOMET TC-AUV chairperson. COOMET includes twelve member countries. Nine NMIs submit CMCs via COOMET; six NMIs submit via other RMOs; three NMIs have published CMCs. The COOMET has participated in ten CCAUV comparisons, four RMO comparisons are in progress and four NMIs have QMS recognition.

11.3.5 EURAMET

Dr Barham commented that twenty-four members are incorporated into the EURAMET TC-AUV. Six projects are running in addition to several KCs. The European Metrology Research Programme (EMRP) finances large cooperative projects. Four projects are running with participants mainly from EURAMET. One project is dealing with dosimetry for therapeutic ultrasound, a second investigates non-audible sound and developments in a new universal ear simulator, and a third is on dynamic measurements. A newly started project is developing a new primary standard for the measurement of acoustic power. New project proposals deal with low-frequency noise, sensor networks and carbon dioxide sensing.

11.4 Regional key comparisons and links to CCAUV comparisons

11.4.1 Published comparisons

APMP.AUV.A-K3 — Dr Kwon reported that the comparison has been linked to CCAUV.A-K3 and had been published in *Metrologia* in 2012[3].

11.4.2 Comparisons and reports in progress

SIM.AUV.V-K1.1 — Dr Ripper commented that this is a bilateral comparison between INMETRO and CENAM. Linking to CCAUV.V-K1 has been accomplished and a discussion is underway on the subject of whether linking should be made to the upcoming CCAUV.V-K2 key comparison.

[3] *Metrologia* 2012 **49** 09002

APMP.AUV.V-K1.1 Dr Ota reported that the comparison had four participants. A Draft B has been submitted to the KCWG and the comments of the KCWG are now under discussion.

COOMET.AUV.V-K1 The Draft B has been written but an intensive discussion had occurred about the results. A decision was reached at a meeting in September 2013. Suggestions for participants and by the KCWG will now need to be incorporated into the report. New calculations are necessary and the report requires editing. The next step will be the circulation of the report to the participants. Dr Yankovsky is the new contact person for this comparison.

EURAMET.AUV.A-K5 Dr Barham presented the basic scheme of this regional comparison. Eleven participants are taking part after the protocol was agreed by the KCWG. The comparison started in September 2013. Results are expected in January 2015.

11.4.3 Future comparison proposals

SIM.AUV.V-K2 Dr Ripper presented this regional comparison which follows CCAUV.V-K2 using a similar protocol, which was approved at the previous CCAUV meeting. The INMETRO has made the first measurements concerning adapters designed to minimize the effects of the armature material. There is a delay because of delayed finalization of the CCAUV.V-K2 comparison; the work is planned to start in 2015.

11.5 Regional supplementary comparisons

11.5.1 Published comparisons

APMP.AUV.V-S1 Mr Sun reported that the comparison has been published. See also 10.2.1.

EURAMET.AUV.A-S1 Dr Barrera Figueroa explained that the report is published and that the KCWG has decided it will remain as a supplementary comparison and hence no link to the CCAUV-K3 or CCAUV-K4 should be made.

11.5.2 Comparisons and reports in progress

SIM.AUV.A-S1 Dr Ripper said that some comments from the KCWG had been received including suggestions to check the records. Two pistonphones were measured and perhaps the report should refer to one reference value. It is difficult to make a link and the matter is still under discussion.

AFRIMETS.AUV.V-S3 Mr Veldman explained that details about this comparison are given in the AFRIMETS report.

AFRIMETS.AUV.A-S1 Mr Veldman explained that details about this comparison are given in the AFRIMETS report.

APMP.AUV.A-S1 Mr Sun reported that this comparison will be finished (resubmission of the Draft B report) at the end of 2013.

COOMET.AUV.A-S1 Mr Nikolaenko reported that the Draft B report has been accepted by the participants.

COOMET.AUV.W-S1 Dr Isaev explained that this comparison was carried out between the VNIIFTRI and the HAARI. It was delayed because of problems with customs clearances. The report will be completed in 2014.

EURAMET.AUV.V-S1 Ms Bartoli reported that a QA-700 transducer was used at low frequencies with ten participants. All measurements are complete including monitoring. Two incidents had occurred. Firstly, one incident occurred during transport but without consequences. Secondly, the electronic part of a sensor was damaged while being handled. It was repaired by the DPLA and had no influence on the sensor sensitivity. Good agreement can be found at medium frequencies, but there were problems at the frequency extremes where discrepancies occurred. The aim is to circulate the Draft A to participants before the end of 2013. See also 10.2.1.

11.5.3 Regional comparison proposals

EURAMET.AUV.A-S2 Dr Rodrigues presented this new comparison with six participants for secondary free-field microphone calibration. The protocol was accepted and permission given for the measurements to start.

12 CCAUV MEMBERSHIP AND OTHER MATTERS

In 2013, the BIPM received a request from the Kenyan Bureau of Standards (KEBS) to obtain observer status at the CCAUV. Subsequently, the KEBS was invited to the 9th CCAUV meeting by Prof. Dr Valdés to give a presentation to support its request. Mr Maina, representing the AUV activity at the KEBS, presented a talk entitled "Acoustic and vibration laboratory KEBS, Kenya", and had formerly submitted a written report which is available.

The KEBS is the national standards body in Kenya and was founded in 1981. It provides the standards for the country and some standards for neighbouring Tanzania. Kenya signed the CIPM MRA in 2002 and has been a full member of the BIPM since 2010. The acoustics and vibration laboratory commenced operations in 2006 with two staff members. The laboratory performs primary calibration of microphones, calibration of sound level meters and sound calibrators. A vibration laboratory will be established in the near future. The laboratory takes part in workshops, seminars and knowledge exchange, and it is an active member of AFRIMETS.

Several questions about its facilities and on the interaction by the KEBS with other institutes were addressed. Prof. Dr Valdés asked if any member of the CCAUV was opposed to observer

status for the KEBS. There were no objections. Prof. Dr Valdés invited the CCAUV to address a recommendation to the CIPM to approve observer status for the KEBS.

Prof. Dr Valdés introduced the issue of reviewing and updating the CIPM MRA. The Consultative Committees have been asked for input and comments and therefore he asked for the opinion of the CCAUV members. He mentioned that it would be useful to shorten KC reports and to decrease the number of frequency points within comparisons. He recommended caution when repeating KCs so that it does not lead to a situation whereby some NMIs lose their CMCs. One way to avoid this would be to offer, within repeat comparisons, the original range so that laboratories do not have to meet extended ranges if these are superfluous to their needs.

Dr Scott explained that omitting the bilateral degrees of equivalence will reduce the amount of work and the length of the report. However, he considered that the inclusion of experimental descriptions and explanations of uncertainty budgets should be encouraged, as these additions to the reports involve no extra work for the pilot laboratory and are valuable to the users of the reports.

Dr Silva Pineda drew attention to the fact that some NMIs have capabilities which are not reflected within the CMCs, mainly because their capabilities improve between key comparisons.

Dr Bruns noted that the CCAUV key comparisons are efficiently managed. He agreed with Dr Silva Pineda, but emphasized that there are several other possibilities to underpin CMCs rather than just by key comparisons. Prof. Dr Valdés considered that regional metrology organizations (RMOs) are the appropriate organizations to determine participation and linking of key comparisons.

Dr Milton explained that CMCs should span the areas of CCAUV, and that the main view should be focused on the benefits of this work for industry.

13 PROGRESS AND STATUS OF NATIONAL STANDARDS

Dr Isaev, VNIIFTRI, Russian Federation, gave a presentation on “Uncertainty relation as a criterion of free-field conditions for sound receiver calibration” where the question of the quality of free-field conditions was raised. Different methods for ensuring free-field conditions during hydrophone calibration were discussed, such as time-delay spectroscopy, homomorphic time-selective post-processing, and moving-weighted averaging of the transmitter-receiver response. He described methods of measuring the contributions of reflections to the uncertainties using time- and frequency-selective techniques. A factor for quantitative determination of free-field quality was proposed. A written report is available.

Dr Zeqiri, Dr Barham and Dr Robinson, NPL, UK, presented a variety of results of recent research topics at their institute including: diffuse-field calibration of microphones; further development of optical techniques for sound field measurements; new application possibilities of MEMS microphones; standards in underwater acoustics; measurement methods and standards for underwater noise; ultrasound computer tomography using phase-insensitive ultrasound detectors; a cavitation based method for avoiding crystallization in honey; and a thermo-chromic

measurement technique for characterization of physiotherapy systems. A written report is available.

Dr Scott reported on the activities of the AUV group of the NMIA, Australia, over the last two years. In vibration, a comparative study between several interferometers had been made. A six-axis scanning system for measurement of ultrasonic output was established. A new service for artificial mastoids was put into place. A written report is available.

Dr Horiuchi reported on activities in acoustics at the NMIJ/AIST, Japan. A system for the determination of sound power has been established for which business equipment manufacturers are the main customers. The calibration range of ultrasonic measurement will be expanded for both power measurement and hydrophone calibration. Dr Ota reported on the field of vibration. An angular vibration standard has been developed and the range for shock calibration has been extended. Strain gauge accelerometer calibration was evaluated. A written report is available.

Dr Yang presented the AUV activities of the NIM, China. The measurement of particle velocity using laser Doppler accelerometer techniques will be extended to measure sound fields optically. A service for the measurement of the modulus d_{33} of piezoelectric materials with an uncertainty of 1 % has been introduced. A commercially available interferometer is used for high-frequency ultrasound calibration. Ultrasonic power is determined by using a reciprocity technique for both plane-piston and focused transducers. A written report is available.

Dr Kwon described recent activities at the KRISS, Republic of Korea. The ultrasonic laboratory has been moved to the Centre for Medical Metrology. Free-field reciprocity calibration has been extended down to lower frequencies by a novel filtering method. Dr Barham was interested in the possibility of using this work to contribute to the literature on the pressure-to-free-field correction factors. In vibration, a successful bilateral comparison with the PTB on angular acceleration was presented. A written report is available.

Dr Silva Pineda reported on work at the CENAM, Mexico. A new user interface has been developed for ultrasound power measurement. Material evaluation by ultrasound is of interest to industry, as well as in ultrasonic welding systems. For shock calibration, the shock shape can be adapted to requirements. The calibration of laser interferometers was investigated; about 10 LDVs per year are calibrated by CENAM (up to 350 kHz) for the automotive industry. A written report is available.

Dr Rodrigues reported on the activities at the LNE, France. The LNE is active in a variety of fields and is heavily involved in EMRP-funded projects (JRP IND09 on dynamic quantities, JRP SIB56 on the unit watt for airborne sound, and JRP HLT01 on universal ear simulators). In particular, the LNE is providing significant design input into a new ear simulator.

Dr Koch highlighted recent work at the PTB, Germany. The measurement of airborne ultrasound from a commercial ultrasonic cleaner has been measured, demonstrating that the audible noise increases when internal cavitation is present. Measurements of high-intensity ultrasound power have been extended to 400 W (from 0.8 MHz to 5 MHz) and measurements of ultrasonic sound pressure up to 50 MPa (from 0.8 MHz to 50 MHz) have been made.

14 REPORTS FROM INTERNATIONAL OBSERVERS

International Electrotechnical Commission, TC87: Dr Zeqiri reported that several working groups had met during the previous week. WG 8 maintained three standards for hydrophone calibration and one for the power standard. A new work item proposal for physiotherapy devices down to very low frequencies (10 kHz) had been established. WG 15 has eight members and met in Berlin in 2013. Two standards in underwater acoustics had been revised. A written report is available.

International Electrotechnical Commission, TC29: Dr Barham reported that the TC29 will meet in February 2014 in South Africa. Four new standards have been published including one for sound level meters. A written report is available.

International Organization for Standardization, TC108: Mr Veldman reported that documents had been considered and new work items were discussed at the previous meeting of the ISO TC108 in October 2013 in Seoul, Republic of Korea. A new work item on calibration of charge amplifiers had been raised. The use and calibration of vibration/shock-measuring instruments was covered in detail. A written report is available.

International Organization for Standardization, TC43: Dr Robinson reported on the new sub-committee (SC3) which has the scope of promoting calibration and metrology for underwater acoustics. Ship noise in deep water, standards and radiated noise from marine pile-driving are the main topics of research. Future work will include impulsive sources, the effect of noise on divers, and the calibration of active sonars. A written report is available.

15 REPORTS FROM INTERNATIONAL MEETINGS

Dr Bruns, a member of the scientific steering committee of the workshop “Challenges in Metrology for Dynamic Measurement” that was held on 15 to 16 November 2012 at the BIPM gave a short report on this event on behalf of its chairman Dr Usuda (NMIJ/AIST). The workshop was divided into four sessions which covered mechanical quantities, fluid and flowmetry, thermo-physical quantities, and system identification and calibration topics. In the mechanical session, the role played by acceleration and shock measurement and its importance to industry was discussed.

16 PUBLICATIONS

A special issue was published in the *Journal of Metrological Society of India* (MAPAN) on "AUV metrology for safety and health" in 2012 with Dr Usuda and Dr Kikuchi (NMIJ/AIST) as the guest editors. The aim of this issue was to promote discussion between experts within metrology institutes. A written report is available.

17 RECOMMENDATIONS TO THE CIPM

Dr Picard presented a draft recommendation to the CIPM on observer status for the KEBS:

"As a response to the request expressed by the Kenya Bureau of Standards (KEBS) for observer status at the Consultative Committee for Acoustics, Ultrasound and Vibration (CCAUV), the KEBS was invited to the CCAUV at its 9th meeting where it gave a presentation on its activities within the AUV field. The CCAUV is favourable to the request from the KEBS and therefore recommends the CIPM to approve observer status of the KEBS at the CCAUV."

18 OTHER ITEMS

Dr Barrera Figueroa announced that a metrology session will be organized during the inter.noise 2014 conference to be held in Melbourne, Australia in November 2014. He also commented that a bilateral free-field comparison between the DFM and the KRISS for LS2 microphones is planned. Dr Barrera Figueroa invited participation. The INMETRO and the CENAM declared their interest.

19 DATE OF NEXT MEETING

There has been a request from the CCAUV members that the meeting should take place in October and should revert to a meeting being held once every two years. The next CCAUV meeting is proposed for October 2015. Prof. Dr Valdés explained that a new procedure to elect the membership of the CIPM will come into effect in 2014 and as a result it is not known who the members of the CIPM will be in the future. Prof. Dr Valdés said goodbye to all members of the CCAUV, in case he is not re-elected.

Dr Picard was thanked for organizing and managing the meeting.

The meeting closed at 12:45 on Thursday 31 October 2013.

20 ACTIONS AND DECISIONS

The actions and decisions taken at the meeting were identified and will be posted on the CCAUV web page as they become available.

Actions:

CCAUV9/A1. To provide contributions for a poster on the CCAUV to be presented at the next CGPM in **November 2014**, including photographs, drawings, examples of impact, or other material.

CCAUV9/A2. The KCWG and the SPWG will continue working as two separate working groups. **An occasion for a joint meeting should be managed** and good communication between both groups should be encouraged and ensured.

CCAUV9/A3. **Terms of Reference on a review of the CIPM MRA** are expected to be drafted by the CIPM at the end of 2013. Once issued, these **will be communicated to the CCAUV for comments and discussion**.

Decisions:

CCAUV9/D1. The explicit calculation of bilateral Degrees of Equivalence (DoE) in future Key Comparison reports is, from now on, voluntary. However, it is mandatory to give the equations and other necessary information so that the bilateral DoEs may be calculated. This also holds for RMO comparisons.

CCAUV9/D2. Dr Bruns stepped down as the chairman of the Key Comparison Working Group (KCWG). Dr Ripper will now chair the KCWG.

CCAUV9/D3. The Draft B report of CCAUV.A-K5 should present data in the traditional way by giving discrete data. The method of using reference curves will be discussed within the community on a broader basis.

CCAUV9/D4. The Final report of CCAUV.U-K3 is awaiting approval from the KCWG. It will be sent to the CCAUV for formal approval before the 28 November 2013.

CCAUV9/D5. The INRIM has volunteered as second linking participant for the planned CCAUV.U-K3.1 comparison.

CCAUV9/D6. The commencement of key comparison CCAUV.V-K3 was formally agreed.

CCAUV9/D7. The commencement of key comparison CCAUV.U-K4 was formally agreed.

CCAUV9/D8. The preparation of key comparison CCAUV.W-K2 was agreed. A questionnaire will be sent to potential participants during 2014.

CCAUV9/D9. The CCAUV supports observer status at the CCAUV to the Kenyan Bureau of Standards (KEBS), and a recommendation will be addressed to the CIPM before the end of 2013.

CCAUV9/D10. The next meeting of the CCAUV is scheduled for October 2015.

Dr Christian Koch, *Rapporteur*

Dr Andrew Scott, *Rapporteur*

APPENDIX 1
WORKING DOCUMENTS SUBMITTED TO THE CCAUV AT ITS 9TH MEETING

Document CCAUV/	
13-00	Draft agenda, updated, J. Valdés, 3 pp.
13-01	CCAUV Strategic Planning of 1 July 2013, CCAUV, 25 pp.
13-02	CCAUV Strategic Planning of 1 July 2013 – 1-pager, CCAUV, 1 p.
13-03	Draft: Technical protocol for CCAUV.V-K3, Q. Sun, 5 pp.
13-04	Annex 1 for TP CCAUV.V-K3, Q. Sun, 2 pp.
13-05	Annex 2 for TP CCAUV.V-K3, Q. Sun, 2 pp.
13-06	Programme of Presentations CCAUV 2013
13-07	The time-frequency uncertainty relationship as criterion..., A. Isaev, 1 p.
13-08	NMIA Status Report, A. Scott, 4 pp.
13-09	Report to the CCAUV on BIPM-WS on challenges in Metrology for Dynamic measurement, T. Usuda, 18 pp.
13-10	On the MAPAN Special Issue on AUV Metrology for Safety and Health, T. Usuda, 6 pp.
13-11	Activity report from the APMP 2013, Q. Sun, 12 pp.
13-12	Brief report on the preparation of the TP for CCAUV.V-K3, Q. Sun, 16 pp.
13-13	INRIM Status Report, C. Gugliemone, 30 pp.
13-14	NIM Status Report, Y. Ping, 9 pp.
13-15	Activity report from the IEC TC29 2013, S. Dowson, 4 pp.
13-16	Activity report from the EURAMET 2013, R. Barham, 4 pp.
13-17	Activity report from the COOMET 2013, V. Pozdeeva, 3 pp.
13-18	KEBS Status Report, A. Maina, 4 pp.
13-19	NMIA Status Report, A. Scott, 13 pp.
13-20	Presentation of the KEBS, A. Maina, 16 pp.
13-21	NPL Status Report, B. Zequin, 20 pp.
13-22	DFM and BKSV-DPLA Status Report, S.B. Figueroa, 4pp.
13-23	GUM Status Report, D. Dobrowolska, 4 pp.
13-24	PTB Status Report, C. Koch, 7 pp.
13-25	Draft B Report on CCAUV.V.S1, A. Täubner and T. Bruns, 36 pp.
13-26	KRISS Status – Presentation, H.-S. Kwon, 9 pp.
13-27	CCAUV.U-K3 Draft B Report, C. Koch, 75 pp.
13-28	Response to KCWG comments on CCAUV.U-K3, C. Koch, 2 pp.
13-29	CENAM Status Report, G. Silva Pineda, 19 pp.
13-30	Activity report from the SIM 2013, G. Silva Pineda, 2 pp.
13-31	Activity report from the ISO TC43 SC3, S. Robinson, 3 pp.
13-32	NIST-USRD Status Report, S. Crocker, 2 pp.
13-33	COOMET proposal for CMCs, A. Isaev, 7 pp.

13-34 The time-frequency uncertainty relationship as a criterion…Presentation, A. Isaev, 13 pp.

13-35 NMC Status Report, H.A. Chua, 2 pp.

13-36 NMIJ Status Report, A. Ota, 16 pp.

13-37 Revision of the GUM, P. Harris, 22 pp.

13-38 An acoustic-microwave determination of the Boltzmann constant, L. Pitre, 39 pp.

13-39 Determination and modelling of temperature increase during phacoemulsification, C. Koch, 29 pp.

13-40 The European research initiative on traceable dynamic measurements, T. Bruns, 32 pp.

13-41 Instrumentation facilitating a new inter-active approach to urban noise management, R. Barham, 18 pp.

13-42 NPL Status – Presentation, NPL, 13 pp.

13-43 Activity report from ISA TC43 SC3, S. Robinson, 9 pp.

13-44 Activity report from IEC TC87, B. Zeqiri, 2 pp.

13-45 Activity report from ISO TC108, C. Veldman, 10 pp.

13-46 Minutes of the SPWG meeting, S. Barrera-Figueroa, 6pp.

13-47 RMOWG Report – Presentation, I. Veldman and R. Barham, 6 pp.

13-48 NMIJ Status Report – Acoustics and Ultrasound, A. Ota and R. Horiuchi, 8 pp.

13-49 NMIJ Status Report – Vibration, T. Usuda *et al.*, 6 pp.

13-50 PTB Status Report, C. Koch, 7 pp.

13-51 CCAUV.A-K5 Status Report, R. Barham, 13 pp.

13-52 APMP.AUV.V-K1.1, T. Usuda and A. Ota, 4 pp.

13-53 CCAUV.U.K3 Status Report, C. Koch, 12 pp.

13-54 CENAM Status Report, G. Silva Pineda, 21 pp.

13-55 Activity report from the COOMET 2013 – Presentation, V. Pozdeeva, 10 pp.

13-56 Activity report from EURAMET 2013 – Presentation, R. Barham, 12 pp.

13-57 LNE Status Report – Presentation, J.N. Durocher and al., 9 pp.

13-58 Future CCAUV.U-K4, B. Zeqiri, 2 pp.

13-59 CCAUV rules and guidelines for intra-regional review, I. Veldman, 2 pp.

13-60 Highlights from the JCRB, C. Kuanbayev, 10 pp.

13-61 Status Report on EURAMET.AUV.V-S1, C. Bartoli, 16 pp.