Bureau International des Poids et Mesures

Consultative Committee for Acoustics, Ultrasound and Vibration (CCAUV)

Report of the 8th meeting
(13–14 June 2012)
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 (October 2003), reports of meetings of the Consultative Committees are now published only on the BIPM website and in the form presented here.

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

Working documents for the meetings are listed at the end of the report and those which the Consultative Committee decides are for public use are also available on the website.

M. Kühne,
Director BIPM

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

as of 13 June 2012

President

J. Valdés, member of the International Committee for Weights and Measures.

Executive Secretary

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.

D.I. Mendeleyev Institute for Metrology (VNIIM), Rosstandart [VNIIM], St Petersburg.

Danish Fundamental Metrology Ltd [DFM], Lyngby.

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

Istituto Nazionale di Ricerca Metrologica [INRIM], Turin.

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

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

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/Ulusal Metroloji Enstitüsü [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.

Bulgarian Institute of Metrology [BIM], Sofia.

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

Centro Español de Metrología [CEM], Madrid.

Czech Metrological Institute [CMI], Brno.

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

Institute for Physical, Technical and Radiophysical Measurements [VNIIFTRI], Rostekhregulirovaniye of Russia, Moscow.

Instituto Português da Qualidade [IPQ], Caparica.

Institutul National de Metrologie [INM], Bucharest.

International Electrotechnical Commission [IEC], Geneva.

International Organization for Standardization [ISO], Geneva 20.

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

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

VSL [VSL], Delft.

1 OPENING OF THE MEETING AND WELCOME BY THE BIPM DIRECTOR

The Director of the BIPM, Prof. M. Kühne, welcomed the delegates to the 8th meeting of the CCAUV and announced that Dr T. Bruns had agreed to chair the meeting in the absence of the CCAUV president Dr J. Valdés.

2 WELCOME BY THE CCAUV PRESIDENT / INTRODUCTION OF PRESENTATIONS

In his role as chairman of the meeting, Dr T. Bruns welcomed the members to the meeting. A recommendation of the 7th meeting of the CCAUV (2010) was to hold a special technical session early in the meeting to allow discussion of the latest topics in the fields of acoustics, ultrasound and vibration. This technical session took place before commencing with the agenda for the 8th meeting of the CCAUV, and included a series of short presentations on selected topical themes.

3 PRESENTATIONS OF SELECTED SCIENTIFIC TOPICS

The presentations were as follows:

Application of optics to acoustical metrology

Sound field reconstruction and beam-forming based on measurements of the acousto-optic effect, presented by Salvador Barrera-Figueroa (DFM)

Optical system based on photon correlation spectroscopy for acoustic free-field particle velocity measurements, presented by Richard Barham (NPL)

Determining the pressure sensitivity of a microphone from measurements of the velocity of the membrane, presented by Salvador Barrera-Figueroa (DFM)

Calibrations for underwater sound level measurements

Laboratory free-field calibration of underwater SPL-receivers applied for noise measurements in the sea conditions, presented by Alexander Isaev (VNIIFTRI)

Development of characterisation methods of therapeutic ultrasound

Therapeutic ultrasound: current and future activities at the UK NPL,

presented by Bajram Zeqiri (NPL)

Acoustic and thermal characterization of high-intensity ultrasound fields,

presented by Christian Koch (PTB)

Abstracts for the above presentations are available on the CCAUV website (cf. Appendix 1).

4 WELCOME TO MEMBERS

The Consultative Committee for Acoustics, Ultrasound and Vibration (CCAUV)[*] held its 8th meeting at the International Bureau of Weights and Measures (BIPM) in Sèvres on Wednesday 13 and Thursday 14 June 2012.

The following delegates and experts were present: M. Balakhanov (VNIIFTRI), R. Barham (NPL), C. Bartoli (LNE), T. Bruns (PTB), S. Crocker (NIST-USRD), W.S. Cheung (KRISS), J.N. Durocher (LNE), D. Dobrowolska (GUM), J.S. Echeverría-Villagómez (CENAM), S. Barrera-Figueroa (DFM), C. Guglielmone (INRIM), A. Isaev (VNIIFTRI), T. Kikuchi (NMIJ/AIST), C. Koch (PTB), J. Kolasa (GUM), A. Konkov (VNIIFTRI), T.R. Licht (BKSV-DPLA), A. Paolero (NIST-USRD), G. Ripper (INMETRO), S. Robinson (NPL), D. Rodrigues (LNE), E. Sadikoğlu (UME), E. Sandermann-Olsen (BKSV-DPLA), A. Ota (NMIJ/AIST), A. Scott (NMIA), G. Silva-Pineda (CENAM), Q. Sun (NIM), T. Usuda (NMIJ/AIST), C.S. Veldman (NMISA), L. Wu (NRC-INMS), P. Yang (NIM), B. Zeqiri (NPL).

Observers: M. Blabla (CMI), I. Godinho (IPQ), C. Hof (METAS), R. Koops (VSL), M.N. Medina (CEM), M. Singh (NPLI).

Guests: A. Maina (KEBS).

Participants from the BIPM were: A.Ö. Altan (UME, on secondment to the BIPM as Executive Secretary of the JCRB), A. Henson (Director of the International Liaison and Communication Department), M. Kühne (Director of the BIPM), S. Picard (Executive Secretary), C. Thomas (Coordinator of the BIPM KCDB).

Apologies were received from: F.T. Alharbi (SASO), N. Bradfield (British Standards Institution), R. Edelmaier, E. Krivtsov (VNIIM), H.-J. von Martens (ISO), V. Nedzelnitsky (NIST), R. Nel (NMISA), V. Pozdeeva (BelGIM), K. Rasmussen (DFM), Prof. Valdés (UNSAM-INTI).

Dr T. Bruns added his welcome and invited the delegates to introduce themselves. A special welcome was extended to Mr A. Maina, representing the KEBS (Kenya Bureau of Standards) at this meeting as a guest on a one-off basis.

5 APPOINTMENT OF A RAPPORTEUR

Dr R. Barham and Mr S. Robinson from the NPL were proposed as *rapporteurs* for the meeting and this was approved. The *rapporteurs* agreed to prepare a summary of decisions and actions

[*] For a list of acronyms, click here.

for presentation at the end of the meeting, and to circulate a document confirming these soon afterwards.

6 APPROVAL OF THE AGENDA

The agenda was approved without comment or change.

7 REPORT OF THE 7TH MEETING OF CCAUV, 2010

Dr S. Picard noted that the report of the 7th meeting of the CCAUV (2010) had been circulated to the CCAUV. No further comments had been received therefore the report was confirmed. Dr T. Bruns and Dr S. Picard thanked Dr R. Barham for his efforts as *rapporteur* for the previous meeting.

8 REPORTS FROM THE CCAUV WORKING GROUPS

8.1 Report from the CCAUV Working Group for RMO Coordination (CCAUV-RMOWG)

Mr C.S. Veldman reported that the members of the RMOWG (RMO Chairs) and other participants met on 11 June 2012. Eighteen participants were present and all Regional Metrology Organizations (RMOs) were represented.

The Working Group (WG) reviewed the Calibration and Measurement Capabilities (CMCs) currently being processed. There are currently no issues with the reviews and no actions resulted from the discussion.

It was noted that the Joint Committee of the Regional Metrology Organizations and the BIPM (JCRB) is organizing a workshop on "CMC review best practices" on 20 March 2013, and there was a suggestion that the RMOWG chair should attend.

A document has been prepared to collect information on individuals with capability and experience to undertake quality system and peer review. The documents will be allocated open access and the RMOWG request that members provide details as appropriate. [1]

The CMC check list will be supplemented with informative notes.

[1] Later it was shown that these documents cannot be made available for open access due to questions of confidentiality. For further information, please contact the CCAUV Executive Secretary.

The list of Service Categories was the subject of some discussion with a suggestion that CMCs be split into three sub-categories: sound in air, sound in water and vibration. It was proposed that each category has its own file, enabling individual files to be changed in future reviews, thereby reducing the burden on reviewers. There was no objection from the CCAUV.

8.2 Report from the CCAUV Working Group on Strategic Planning (CCAUV-SPWG)

Dr B. Zeqiri reported on the meeting of the SPWG which met on 12 June 2012, noting that the responsibilities of the WG are increasing.

The SPWG recently circulated a questionnaire to all NMIs to gather views on their vision of the AUV field during the next 5 years and beyond. Ten replies were received, covering the fields of acoustics, ultrasound, vibration and underwater acoustics which are being evaluated. One goal is to consider how future expectations will influence the work of the CCAUV, e.g. in terms of new requirements for pilot studies or key comparisons. Dr B. Zeqiri made a final request for contributions to be submitted within one month, before using the data to update the *Future Needs* document (now renamed the *CCAUV Strategy* document).

Mr A. Henson presented the work that the BIPM is undertaking on future strategy, which will require input to be gathered from the Consultative Committees. The BIPM Director, Prof. M. Kühne, explained the background to the requirement. One of the recommendations from the CGPM *ad hoc* Working Group, created in response to Resolution 10 of the 24th meeting of the CGPM (2011), was to review strategy to provide information for the development of the BIPM programme of work, but also to enable the BIPM to highlight strategically important Consultative Committee issues to senior management, the CGPM, representatives of Member States and NMI Directors. A key element of this will be an assessment of the requirement for future Key Comparisons. This is partly to give sufficient visibility to the BIPM Programme of Work and to assess budget commitments, but also to allow transparency for the NMIs within their fields of interest. To provide the required information in the field of acoustics, ultrasound, vibration and underwater acoustics, the CCAUV will use a template provided by Mr A. Henson.

The SPWG's review of its terms of reference was presented, the addition of a new advisory role to identify requirements for future pilot studies and key comparisons was noted.

8.3 Report from the CCAUV Working Group for Key Comparisons (CCAUV-KCWG)

Dr T. Bruns reported on the first meeting of the KCWG, which was established in February 2011, and has subsequently carried out its work by email correspondence. The terms of reference of the WG were described as:

1) Ensuring global consistency in measurement across the fields of the CCAUV;

2) Taking responsibility for the implementation of the CIPM MRA following CCAUV KCs.

Tasks of the KCWG were described as:

- identify the need and feasibility of CCAUV Key Comparisons and Supplementary Comparisons;

- review (and approve) technical protocols for all comparisons that are intended to be used for the subsequent support of CMC Claims (CIPM-KC, RMO-KC, SC);
- give advice on the analysis of KCs, calculation of KCRVs, linking procedures;
- review and commenting of Draft B reports prior to submission to and approval by the CCAUV;
- provide input to SPWG on matters of KCs;
- give advice in case of disagreement during comparisons.

Meetings of the KCWG will be arranged to precede CCAUV meetings. The meetings will be attended by members of the KCWG, BIPM Director, CCAUV President, CCAUV Executive Secretary, Chairs of other WGs, and TC Chairs of RMOs.

The KCWG will be made up of experts from the member NMIs and may include guests invited from outside of the community on a one-off basis, where their special expertise is needed (e.g. mathematicians and statisticians). It was noted that the field of underwater acoustics is currently under-represented.

Dr T. Bruns was appointed Chair of the KCWG for a period of 4 years.

The terms of reference of the KCWG were approved, including a proposal that the KCWG will in future review all types of technical protocols (including Supplementary Comparisons).

The next task of the KCWG is to draft advisory documents for:

- the preparation of Technical Protocols;
- KC analysis;
- linking of RMO KCs;
- report of KCs.

It was noted that all approved KC protocols should be posted in the KCDB while a KC is in progress.

9 CCAUV KEY COMPARISONS

9.1 Comparisons and reports in progress

9.1.1 CCAUV.A-K5

Dr R. Barham reported the progress of the key comparison on calibration of laboratory standard microphones. Eleven participants have completed their measurements and participation of the NMIJ/AIST has been re-scheduled to July 2012.

On this basis, the pilot laboratory (NPL) is expected to circulate a Draft A report for approval by December 2012.

Preliminary results for the stability of the travelling standard microphones were shown and plans for some innovative aspects being considered for reporting the results were discussed. These include a comparison of the component of the results derived from analytical processing and presentation of results by reference curves.

The unusual situation in Denmark was discussed, where two institutes have a capability and have made measurements. It was agreed that only results from the BKSV-DPLA shall appear in the reporting of the KC.

9.1.2 CCAUV.U-K3

Dr C. Koch (PTB) described the progress of the comparison. Two factors have hindered progress:

- A reference transducer malfunctioned due to a bad connection and required repair. After repair, the transducer has shown a small but still significant step change in output.
- The facility at the NMIJ/AIST had been badly affected by the earthquake and subsequent tsunami on 11 March 2011 preventing its calibrations from being completed on time.

All calibration data was submitted to the coordinator (PTB) by the end of 2011 (although some participants undertook some recalculation of results in February 2012). It was also noted that some of the participant data appeared to contain discrepancies. A meeting was held for participants earlier in the day to discuss the way forward. Dr C. Koch reported that a decision had been taken to accept the suggestions made by the coordinator to correct for the step change in output after repair using the correction factor calculated by the PTB (along with its associated uncertainty).

Dr C. Koch estimated that the Draft A report would be completed by June 2012.

9.1.3 CCAUV.V-K2

Dr T. Bruns reported that all participants have completed their measurements and that the final stability measurements were carried out in February 2012. However, some unexplained findings have prevented a preliminary Draft A report from being circulated among participants.

The stability of the back-to-back transducer shows a linear drift. This type of problem is not uncommon in KCs and a way to deal with it is documented in *Metrologia*. However, a more detailed analysis concluded that this established approach was not providing a sensible outcome, and it has consequently been decided to simply publish the results without calculating a KCRV or Degrees of Equivalence.

The KC includes measurements on a single-ended device, and it was argued that the calibration techniques are similar enough that performance in this measurement is sufficient to support CMCs for back-to-back devices.

A Draft A report is in preparation.

9.2 Future comparison proposals

9.2.1 APMP.AUV.V-S1 and CCAUV.V-K3

Mr Q. Sun briefly reviewed the drivers and technical solutions developed for APMP.AUV.V-S1 before making a new proposal. Much of the motivation for measurements at these frequencies is linked to seismometry and earthquake detection. It was noted by the meeting that there is strong industrial support for such measurements in Japan and Australia. Mr Q. Sun also reported that all measurements in the project have been completed and that this supplementary regional comparison has highlighted a need for a KC within the CCAUV.

The proposed KC extends capabilities already demonstrated in other KCs, into the low-frequency region. It was then noted that there were already three supplementary comparisons, with 18 participants, covering the proposed low frequency range. Therefore the linking process would need to be reversed in this instance to enable results produced in RMOs to be linked to an eventual KCRV coming from this KC.

Mr Q. Sun asked the CCAUV if a KC should be initiated. Key questions were

- What frequency range would be covered?
- What devices would be used?

NIM agreed to circulate a questionnaire to gather recommendations for the scope and schedule in order to draft a technical protocol.

9.2.2 CCAUV.U-K4

Dr B. Zeqiri noted that the last ultrasonic hydrophone KC was completed in 2003 and it was therefore timely to consider a repeat. The NPL offered to pilot a new KC but is not in a position to begin at this time.

The NPL proposes to circulate a technical protocol in December 2012. It was confirmed that the PTB, the NMIJ/AIST and the NIM are interested in participating and that no additional NMIs requested to be included.

9.2.3 CCAUV.W-K2

Mr S. Robinson (NPL) noted that the last Key Comparison for underwater acoustics was completed in 2003 (reported in 2004) and it was therefore timely to consider a repeat. The previous comparison (CCAUV.W-K1) covered free-field calibration of hydrophones in the frequency range 1 kHz to 500 kHz. At the 7th meeting of the CCAUV (2010), there had been a discussion of the likelihood of a low frequency comparison for pressure calibration of hydrophones in the range 20 Hz to 2 kHz. However, there are only three NMIs that are able to participate in the low-frequency comparison. Since there are more NMIs with the capability of free-field calibration, and since a number of these NMIs are able to undertake free-field calibration at frequencies below 1 kHz (thus partially covering the low frequency range), a repeat free-field comparison is more technically desirable and cost effective. The new Key Comparison would be designated CCAUV.W-K2.

The NPL has offered to pilot the new KC but is not in a position to begin at this time. The NPL will circulate a questionnaire and draft protocol to potential NMI participants during the third quarter of 2012, with a view to begin the Key Comparison early in 2013.

It was noted that potential participants include the NPL, the NIST-USRD, the VNIIFTRI, the INMETRO, the UME and the KRISS. The NIM stated that China will soon recognize another institute (HAARI) as a Designated Institute (DI), and this institute should be able to represent China as a participant.

10 REGIONAL KEY COMPARISONS

10.1 Published comparisons

10.1.1 APMP.AUV.A-K3.1

A final report has been published (*Metrologia*, 2011, **48,** *Tech. Suppl.*, 09001)

10.1.2 COOMET.AUV.A-K2

A final report has been published (*Metrologia*, 2011, **48,** *Tech. Suppl.*, 09002)

10.1.3 EURAMET.AUV.V-K1.2

This bi-lateral comparison between the METAS and the PTB was intended to underpin reduced uncertainty capability at the METAS. However, the METAS is currently taking part in CCAUV.V-K2 which will serve the same purpose. Thus the linking process envisaged under EURAMET.AUV.V-K1.2 is not being pursued (*Metrologia*, 2011, **48,** *Tech. Suppl.*, 090023).

A discussion took place on whether to retain the key comparison designation of this project. It was agreed not to change anything as the project has essentially been completed.

10.2 Comparisons and reports in progress

10.2.1 APMP.AUV.V-K1.1

Participants in this comparison include the NMIJ/AIST, the NIMT, the NMC, the A*STAR, with Chinese Taipei as a late entrant. Dr T. Usuda reported on the difficulties encountered with this comparison, which required a third attempt to complete. In the first attempt (reported in 2010) a significant change in the sensitivity of a reference back-to-back accelerometer was experienced. Alternative devices were then circulated, however, additional participants joining the project required a second round of measurements to be carried out, which again experienced significant instabilities in a reference transducer.

On the third attempt measurements were completed successfully, using a modified protocol where the reference devices were hand-carried.

A Draft B report is being prepared.

10.3 Future comparison proposals

10.3.1 SIM.AUV.V-K2

A draft protocol has been circulated for comment, but further progress is dependent on CCAUV.V-K2.

The protocol currently proposes the specification of an adapter to facilitate the mounting of a single-ended transducer, thereby removing the influence of different configurations that may be used by individual participants.

The protocol will be finalized and submitted to the KCWG for approval.

10.3.2 Other proposals

Mr C.S. Veldman reported that a protocol is being drafted for a new KC within AFRIMETS on the calibration of type LS2P microphones. The NMISA will pilot the project, which is anticipated to start early in 2013.

Dr S. Barrera-Figueroa reported that a KC within EURAMET has been discussed, on the calibration of type LS1P microphones, to enable the numerous EURAMET NMIs that could not be accommodated in CCUAV.A-K5, to link with the latter. The NPL has offered to pilot the KC which is anticipated to start mid-2013.

10.4 Linking regional comparisons

10.4.1 APMP.AUV.A-K3

This KC has now been linked to CCAUV.A-K3 and the final report approved and published (*Metrologia*, 2012, **49,** *Tech. Suppl.*, 09002).

11 SUPPLEMENTARY COMPARISONS

11.1 Published comparisons

11.1.1 AFRIMETS.AUV.V-S2

The final report has been published (*Metrologia*, 2012, **49,** *Tech. Suppl.*, 09001)

11.2 Comparisons and reports in progress

11.2.1 APMP.AUV.A-S1

A Draft B report had been sent to the KCWG, but because the pilot laboratory had made changes since the submission a new Draft B was completed in April 2012, which will be re-submitted to the KCWG for approval.

11.2.2 APMP.AUV.V-S1

See 8.2.1

11.2.3 COOMET.AUV.A-S1

A Draft B report is in preparation.

11.2.4 COOMET.AUV.W-S1

A pilot study has been carried out (*Metrologia*, 2011, **48,** *Tech. Suppl.*, 09004). Dr A. Isaev (VNIIFTRI) reported progress on this bilateral comparison between the VNIIFTRI and the HAARI (China). Dr A. Isaev commented that an RMO comparison on this subject is planned. However, it was noted that the HAARI is not yet officially recognized as a DI. The NIM agreed to undertake the registration formalities for the HAARI.

11.2.5 EURAMET.AUV.A-S1

A Draft A report has been approved and a Draft B is in preparation. It will be submitted to the KCWG for approval in the next few months.

11.2.6 EURAMET.AUV.V-S1

Measurements are in progress. Seven out of ten laboratories have completed their measurements with the remainder due to complete by April 2013. A Draft A report is anticipated in late 2013. Stability measurements on the reference device are currently indicating good performance.

11.2.7 SIM.AUV.A-S1

A Draft B report has been sent to the KCWG and comments are under review.

11.2.8 SIM.AUV.V-K1.1

Results and reference values from this project have been published by IMEKO. The project covers accelerometer calibration in the range 10 Hz to 10 kHz. A Draft B is in preparation and comments from the KCWG are being considered.

11.3 Future comparison proposals

11.3.1 AFRIMETS.AUV.V-S3

The KEBS is proposing to pilot this comparison and a protocol has been submitted for approval. Preliminary measurements have started.

12 PROGRESS/STATUS OF NATIONAL STANDARDS

12.1 NMIA

Dr A. Scott reported on typical activities undertaken by the AUV Group of the NMIA, which has three members of staff.

All services offered by the group, including a new service for ultrasonic instrumentation, were subject to full quality assessment in 2011.

A new vibration calibration capability has been developed, including facilities for phase calibration and low frequency calibration. A new service for calibration of mechanical couplers was reported.

As part of the NMIA's participation in CCAUV.U-K3 some improvements were made to the radiation force balance used to measure ultrasonic radiation power.

A new project in APMP being led by the KRISS will consider free-field reciprocity calibration and the NMIA will contribute by providing results from comparison calibrations.

A full report on activities has been submitted (cf. Appendix 1).

12.2 INRIM

Dr C. Guglielmone reported on the development of two new services: one for phase calibration of microphones that was used for participation in CCAUV.A-K5, a second involves an extension of the range of ultrasound power measurement.

A full report on activities has been submitted (cf. Appendix 1).

12.3 NIM

Dr P. Yang reported on developments in acoustics and ultrasound. These included:

- an acoustic chamber for low frequency calibration of microphones in the frequency range from 0.01 Hz to 20 Hz, at sound pressure levels up to 140 dB;
- a hemi-spherical microphone array for the calibration of reference sound power sources and other sound power measurements in the frequency range from 50 Hz to 20 kHz;
- extensions in the frequency range and power range of ultrasound power measurement
- ultrasound hydrophone calibration in the frequency range from 0.5 MHz to 15 MHz;
- measurement standards for acoustic emission in the frequency range from 100 kHz to 1 MHz;
- measurement standard for air-conduction and bone-conduction audiometry.

Mr Q. Sun presented developments in the field of vibration and shock by the NIM. These included:

- improvements in distortion of sinusoidal vibration stimuli;
- developments in low frequency calibration using both horizontal and vertical excitation.

A full report on activities has been submitted (cf. Appendix 1).

12.4 PTB

Dr C. Koch reported the significant research activity covered in the report submitted by the PTB (cf. Appendix 1). Recent research activities included the first steps towards a quantitative characterization of ultrasonic cleaning vessels, new ways to elicit otoacoustic emission, monitoring of the formation of lesions in HIFU treatments on the basis of radiated shear waves, characterization of measurement amplifiers, calibration of impulse hammers, and a proposal for single number descriptors in building acoustics.

12.5 NMIJ/AIST

Dr Kikuchi reported on the impact of the 2011 earthquake on the facilities operated by the NMIJ/AIST. He informed that while all personnel were safe, there had been significant damage to instrumentation and infrastructure. The recovery has typically taken a year to complete; all research activities were interrupted during this time.

Nevertheless, there have been some developments to report in the acoustics and ultrasound field: a laser piston-phone for microphone calibration has been developed and a new sound power standard is in preparation.

There are also plans:

- to develop standards for high-frequency hydrophone calibration (up to 40 MHz);

- to develop techniques for the measurement of HITU fields;
- to develop a quantitative measurement technique of cavitation fields.

Dr T. Usuda summarized the activities in the vibration and acceleration fields. There were no new developments in linear vibration to report, but new services to industry covering shock acceleration have been launched.

Current research activity includes:

- transportable systems for in-situ acceleration calibration in collaboration with commercial manufacturers;
- angular vibration standards.

A full report on activities has been submitted (cf. Appendix 1).

12.6 NMISA

Mr C.S. Veldman reported that the NMISA reciprocity system for the calibration of microphones has been updated in line with the new requirements of IEC 61094-2 and includes the determination of phase. This system was used for the NMISA measurements for the CCAUV.A-K5. However, a new commercial system has also been procured and will be set up during 2012.

In the vibration field, low frequency calibration has been extended down to 0.4 Hz. New facilities for transverse vibration are in development and a new air-bearing exciter table has been designed.

A full report on activities has been submitted (cf. Appendix 1).

12.7 KRISS

Dr W.S. Cheung presented recent activity at the KRISS in the areas of acoustics (in air and water), ultrasound, and linear and angular vibration. In air acoustics, the KRISS has a new system for free-field sensitivity calibration, and in ultrasound a new primary calibration for the calibration of hydrophones is under development. In linear vibration, a new calibration system for reference seismometers was developed between 2010 and 2012, and angular vibration is being extended to the low-frequency calibration range.

Dr W.S. Cheung reported that the field of underwater acoustics is increasing in importance at the KRISS, and reported plans for a new hydrophone calibration facility that will implement both reciprocity and comparison calibration of hydrophones using its new test tank facility which has dimensions of 2 m × 2 m × 2.5 m. Uncertainties are estimated at 1 dB for frequencies < 40 kHz, and 0.3 dB for frequencies > 40 kHz.

A full peer review has recently been carried out, including new capabilities on angular acceleration.

A full report on activities of KRISS has been submitted (cf. Appendix 1).

12.8 NPLI

Dr M. Singh reported that a peer review assessment within the APMP had been carried out with assessment support from the NMISA.

The NPLI is active in acoustics, ultrasound and vibration and updated CMCs reflecting recent extensions in frequency range have been added to the KCDB.

A full report on activities has been submitted (cf. Appendix 1).

12.9 DFM

Dr S. Barrera-Figueroa presented the combined activities of the DFM and the BKSV-DPLA. Highlights included recent research to extend the frequency range over which primary standards for airborne sound pressure exist, i.e. up to 100 kHz. This capability is achieved from developments of free-field reciprocity calibration of type WS3 (quarter inch) microphones and will underpin new EURAMET research on human perception of airborne ultrasound.

Dr S. Barrera-Figueroa reported that all services are covered by DANAK accreditation, the national accreditation body in Denmark.

A full report on the combined activities of DFM and BKSV-DPLA activities has been submitted (cf. Appendix 1).

12.10 LNE

Dr D. Rodrigues reported two new developments at the LNE.

The first was a new facility for the secondary calibration of microphones by comparison. The facility is based on a hemi-anechoic chamber where the sound source is mounted in the floor of the chamber.

A second topic concerned the calibration of vibration dosimeters where a new accredited calibration service is pending

A full report on activities at LNE has been submitted (cf. Appendix 1).

12.11 CENAM

Dr J.S. Echeverría-Villagómez gave an overview of AUV work at CENAM. He presented the industrial drivers resulting in the calibration capabilities that have been established and reviewed the associated CMCs. He presented recent changes in the fields of acoustics and ultrasound, including developments in primary vibration standards, high-frequency calibration of vibrometers, shock calibration, angular vibration calibration and developments in medical ultrasound.

The full report on the CENAM activities is available (cf. Appendix 1).

12.12 NPL

Representing the NPL, Dr B. Zeqiri, Dr R. Barham and Mr S. Robinson briefly described its activities, focusing on recent research. In air acoustics, recent research work has concentrated on phase calibration of microphones, photon correlation spectroscopy for microphone calibration, diffuse-field reciprocity calibration of microphones and improvement in the performance and characterization of MEMS microphones. In underwater acoustics, recent research has focused on optical interferometry for hydrophone calibration, acoustic characterization of materials and methodologies for measurement of underwater radiated noise from ships and offshore construction. In medical and industrial ultrasound, recent highlights include the development of a new acoustic sensor measuring time-averaged intensity, modelling of acoustic fields and detection of cavitation onset for HIFU fields, power measurement using a novel pyroelectric sensor, and characterization of cavitation in reference cleaning vessels and pumps.

A full report on these activities has been submitted (cf. Appendix 1).

12.13 GUM

Mrs D. Dobrowolska reported that there had been no significant changes in the standards maintained at the GUM. However, she noted that the network of accredited laboratories is evolving in Poland, resulting in an increase in the number of devices being submitted to the GUM for calibration.

13 REGIONAL METROLOGY ORGANIZATIONS

13.1 Reports from regional representatives

13.1.1 AFRIMETS

Mr C.S. Veldman gave an overview of the developments within the RMO, stating that in the AUV field in particular, the two most active members are the NMISA and the KEBS. Although the NIS (Egypt) does have capabilities in acoustics, it is less involved in AFRIMETS activities. The NMISA has been actively involved in training activities with staff from KEBS, providing its staff with an introduction to international activities relating to the CIPM MRA as well as practical training in the fields of acoustics and vibration metrology.

13.1.2 APMP

Mr Q. Sun, the Chair of APMP TCAUV, reported on activities in the region.

Mr Q. Sun described the structure and membership of APMP TCAUV which includes twelve full and three associate members.

He reported that there is now funding available from APMP for 'Initiative Projects', and that TCAUV had been successful in securing a project in 2011 on shock acceleration calibration by laser interferometry, and a further project in 2012 on primary free-field calibration of microphones. The strategy being followed in these projects is to learn from NMIs that have experience in such measurements and to use this as a basis for developing expertise in the region.

A review on current comparison activities was presented together with a summary of CMCs.

Mr Q. Sun reported that a TC-workshop was held in December 2011 in Kobe (Japan), consisting of a series of lectures and laboratory tours. The full APMP activity report is available (cf. Appendix 1).

13.1.3 COOMET

Dr A. Isaev presented the activities of the COOMET region on behalf of the COOMET TC chair Ms V. Pozdeeva. The membership and structure is as follows: COOMET TCAUV currently has fifteen members with nine submitting CMCs via COOMET and six via other RMOs. KCs with participation from COOMET members were also presented.

COOMET has established a series of TC meetings held every 2 years, the next being scheduled for May 2013, and will be hosted by the BKSV-DPLA.

A series of regional comparisons and pilot studies supporting the implementation of the CIPM MRA were highlighted, together with a summary of CMCs. A full report on COOMET activities is available (cf. Appendix 1).

13.1.4 EURAMET

Dr S. Barrera-Figueroa summarized the EURAMET TCAUV activities and statistics. TCAUV has twenty-five members and covers three sub-committees covering the fields of sound-in-air, ultrasound, underwater acoustics, vibration and acceleration.

For the first time, all sub-committees met together in conjunction with the main TCAUV meeting. These meetings were hosted by LNE, France, and the format proved to be effective.

A key development in EURAMET in recent years has been the introduction of a dedicated research programme, the European Metrology Research Programme (EMRP). TCAUV has been successful in securing a number of projects under this programme.

Dr S. Barrera-Figueroa presented the participants, objectives and work package structure of two examples.

- "Traceable dynamic measurement of mechanical quantities" is a project from the *Industry* theme which started in 2011;
- "Metrology for a universal ear simulator and perception of non-audible sound" is a project from the *Health* theme which started in 2012.

Two further project proposals focusing on the application of optical techniques for acoustic measurements are due to be submitted under the 2012 theme on *SI - Broader Scope*.

Dr S. Barrera-Figueroa stated that Dr R. Barham of the NPL will take over as TCAUV Chair in 2013. Dr S. Barrera-Figueroa's report on the EURAMET is available (cf. Appendix 1).

13.1.5 SIM

A presentation was given by CENAM which covered:

- membership and comparisons including a new member from Peru;
- participation in international standardization;
- ongoing activities and collaborations.

13.2 JCRB matters

Mr Ö. Altan (JCRB Executive Secretary) gave an update on JCRB activity since the 7th meeting of the CCAUV (2010) (cf. Appendix 1). He reported that there have been three meetings of the JCRB in the interim.

Highlights of the 26th Meeting of the JCRB were:

- *Designation Scope of DIs*: Noting the proliferation in institutes requesting to become DIs, the BIPM is to advise new DIs of expectations for active participation in the CIPM MRA.
- *Authorship of Comparison Reports*: requires "substantial intellectual contribution" to various aspects of the comparison rather than inclusion of all participants.
- *Procedure for Deletion of Greyed-Out CMCs*: A new procedure approved by JCRB became effective in April 2011.

Highlights of the 27th Meeting of the JCRB were:

- *Rules for Modifying Existing CMCs*: specified in document CIPM MRA-D-04 (Guidelines for CMC Submission and Review).
- *Deletion of CMCs Belonging to Former DIs (Resolution 27/2)*: CMCs that belong to an institute that has its designation rescinded will be automatically deleted from the KCDB.
- *Designated Institutes*: the BIPM will collect information on the designation areas of the DIs currently listed in Appendix A and draft a document on expectations for participation in activities of the CIPM MRA.
- *Draft Authorship Guidelines*: The guidelines are posted as CIPM MRA-G-04 in the CIPM MRA documents section of the BIPM website.

Highlights of the 28th Meeting of the JCRB were:

- *Designated Institutes*: The JCRB approved a proposed procedure for the registration of DIs in Appendix A of the KCDB.

- *Workshop on Best Practices in CMC Reviews*: A workshop to take place in conjunction with the 30th meeting of the JCRB in March 2013 was approved.
- *Change in Procedure for Approval of Supplementary Comparison Reports in Doc CIPM MRA-D-05, Section 7.2*: Reports approved by the RMO must be forwarded to the CCAUV Executive Secretary and the Chair of the KCWG, for a three-week period of comment and editorial control.

Mr Ö. Altan concluded by presenting the nine new signatories to the CIPM MRA.

14 REPORTS FROM INTERNATIONAL OBSERVERS

14.1 IEC TC 87

Dr B. Zeqiri reported on recent activities of the IEC TC 87, which held a full meeting in Buzios, Rio de Janeiro, Brazil, from 23 to 27 April 2012. Progress and status of all the documents in preparation or under review can be found at www.iec.ch (TC Dashboard). Since its previous meeting in Seattle, USA, TC 87 has published one Standard, one Technical Specification, seven CDVs, one NP, one CD, one DTR and one DC. As a result of the work done during the week, the 7 CDs have moved to the FDIS which should result in a further seven published standards by the end of the 2012. WG 6 and WG 8 continue their close cooperation with IEC SC 62D ensuring that the IEC delivers integrated standards to the many users of therapeutic ultrasound products. A full report is available (cf. Appendix 1).

The next TC 87 meeting will be in Delhi, India, with the IEC General Meeting in October 2013.

14.2 IEC TC 29

Dr R. Barham presented a report prepared by Ms S. Dowson, Chair of IEC TC 29 (Electro-acoustics), (cf. Appendix 1). The TC 29 produces standards relating to the specification, calibration and test methods for electroacoustic measurement instrumentation such as microphones, sound level meters, sound calibrators, filters, audiological equipment, hearing aids and ear simulators, including the recent addition of instrumentation for the measurement of aircraft noise.

The IEC TC 29 and each of its WGs met in London, UK, in March 2011. Progress and status of all the documents in preparation or under review can be found at www.iec.ch (TC Dashboard). In summary five new or revised standards have been published since the previous report to the CCAUV, and a further eleven drafts circulated for comment.

TC 29 has prepared a Strategic Business Plan, which considered technical trends and their impact on objectives and strategy for the next 3 to 5 years. Two points in the TC 29 action plan which have particular synergies with the CCAUV are:

- the investigation of emerging technologies and their impact on the IEC TC 29;

- the preparation of guidance on implementing uncertainty analysis in IEC documents.

The next meeting of IEC TC 29 will be held in Copenhagen, Denmark, in September 2012.

14.3 ISO TC 108

Mr C.S. Veldman presented highlights from an extensive report on the ISO TC 108 (Mechanical vibration, shock and condition monitoring) which was prepared by Dr H. von Martens, providing an overview of ISO TC 108 activities (cf. Appendix 1). Of particular note were:

- an update on the ISO 5347 and ISO 16063 series of standards, including the status of each of the document parts, noting that these documents are under continuous development;
- standards covering an extended frequency range of 0.4 Hz to higher than 100 kHz;
- specification of calibration methods that have been adopted in CCAUV KCs;
- acknowledgement of the role of the CCAUV and the impact of KCs are having on the ISO 16063 series.

It was agreed that Mr C.S. Veldman would now adopt the liaison role between the ISO TC108 and CCAUV.

14.4 ISO TC 43 SC 3

Mr S. Robinson reported that a new Sub-Committee has been formed within the ISO TC 43: Sub-Committee 3 titled: “Underwater Acoustics” (cf. Appendix 1).

The Scope of TC 43 SC 3 is: “Standardization in the field of underwater acoustics (including natural, biological, and anthropogenic sound), including methods of measurement and assessment of the generation, propagation and reception of underwater sound and its reflection and scattering in the underwater environment including the seabed, sea surface and biological organisms, including all aspects of the effects of underwater sound on the underwater environment, humans and marine aquatic life”.

Participating countries are as follows: Australia, Canada, Denmark, Germany, Italy, Japan, Netherlands, Norway, Russian Federation, United Kingdom, and USA. The secretariat is held by the ANSI (USA).

The committee has already published one document (ISO PAS 17028, a modified version of ANSI S12.64) which describes techniques for measuring radiated noise from ships in deep water. This is a Publically Available Specification, valid for two years, and is already under review by WG 1 of TC 43. Topics of two new work items are ‘definitions and terminology’, and ‘measuring radiated noise from marine piling’. Other topics likely to be the subject of future work include measurement of ship noise in shallow water, measurement of ambient noise, and measurement of other impulsive sources such as air-guns.

The first full meeting of TC 43 SC 3 coincided with the 8th CCAUV meeting, from 11 to

13 June 2012, at Woods Hole Ocean Institute, USA. Mr S. Robinson has agreed to be the liaison person between the TC 43 SC 3 and the CCAUV.

15 HIGHLIGHTS ON TRAINING AND TEACHING EVENTS IN THE AUV FIELD

15.1 BIPM workshop on metrology challenges for dynamic measurements

Dr T. Usuda presented details of the BIPM workshop on metrology challenges for dynamic measurements to be held on 15 and 16 November 2012 at the BIPM headquarters.

Significant progress over the last 25 years with instrumentation and equipment has provided new opportunities and new challenges. For example, typical sample rates have increased more than 40 times, resolution by 4 times (2 bits), and bandwidth by more than 50 times. There are increasing challenges to metrology from industry, with emerging needs in force, torque, dynamic measurements (including material properties) and flow measurement. The agenda of the meeting addresses these issues and includes mechanical measurements, fluid flow, thermo-physical properties and system identification. The objective of the meeting is to establish the real needs, and develop road maps for dynamic measurements. Those wishing to attend the workshop should contact their NMI Directors to obtain a nomination.

15.2 Acceleration as a fundamental unit in dynamic measurements: EMRP project IND09

Dr T. Bruns presented some work originating in the EMRP project IND09, which proposes acceleration as a fundamental quantity (and unit) for dynamic measurements (cf. Appendix 1). Quantities such as force, torque and pressure in dynamic systems may all be related back to acceleration via mass and relationships of Newtonian physics, with the quantities described as a function of frequency. While mass is a fixed value for the system, acceleration is the dynamic quantity through which traceability may be provided. Traceability to these new areas will require new challenges to be overcome, and collaboration between the CCAUV and the CCM.

16 REPORTS FROM INTERNATIONAL MEETINGS

16.1 IMEKO TC 22 activities

Dr T. Usuda and Dr T. Bruns gave a short report on the activities of the IMEKO TC 22 on vibration measurements (cf. Appendix 1).

The IMEKO 20th World Congress was held in Thailand in November 2010 which included twelve contributions and a TC 22 meeting. Dynamic measurement of mechanical quantities and its relationship to human safety was a particular topic of discussion.

Access to the proceedings is available at www.IMEKO.org.

The next meeting will be held in Busan, Republic of Korea, from 9 to 14 September 2012, where all the TCs will meet.

17 MEMBERSHIP OF THE CCAUV

Dr S. Picard noted that the membership criteria are fully described in a document on the BIPM website (http://www.bipm.org/en/committees/cc/cc_criteria.html).

No new requests have been received regarding member or observer status.

Dr S. Barrera-Figueroa reported that the status of the DPLA, Denmark, is becoming more defined as a NMI + DI structure. The DPLA was not a distinct entity as it was originally defined. However, the BKSV-DPLA has been registered as a DI; Mr E. Sandermann-Olsen and Mr T.R. Licht, representing the BKSV-DPLA, are members of the delegation from Denmark. The new designations have no impact on the current arrangements for sharing and coordinating work.

18 OTHER ITEMS

Dr S. Picard reminded participants that the BIPM website includes a large collection of publications produced by members and observers, and invited further entries to the list.

Mr A. Paolero (NIST-USRD) asked about the reporting of informal comparisons, for example the current exercise being undertaken between UK and USA on testing the acoustic properties of materials for underwater acoustics. The meeting agreed that future meetings might include presentations on outputs from informal comparisons, and the participants were encouraged to present the results at the next meeting.

Finally, Dr R. Barham presented the following list of actions and decisions[2] which arose during the course of the meeting:

Actions:

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

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

[2] The CCAUV web page presents a revised version.

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 Exec. Sec. for including in the technical assessor database. **Ongoing**.

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.**

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.**

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

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.

Decisions:

CCAUV8/D1. Terms of reference for the KC and RMO CCAUV working groups were approved by the CCAUV.

CCAUV8/D2. Appointment of Chairmen for two of the three CCAUV working groups were approved by the CCAUV:

Bajram Zeqiri (NPL) will continue to chair the SPWG

Thomas Bruns (PTB) will continue to chair the KCWG

CCAUV8/D3. CCAUV agreed that all documents for circulation (e.g. questionnaires, approved protocols, reports) shall be passed to the CCAUV Executive Secretary for distribution to appropriate recipients.

CCAUV8/D4. CCAUV agreed that the completed EURAMET.AUV.V-K1.2 shall retain its designation even though the results will not be linked to the KCRV (being superseded by pending data from CCAUV.V-K2).

CCAUV8/D5. The proposal that Ian Veldman (NMISA) shall henceforth act as the liaison between ISO TC 108 and CCAUV, was approved by CCAUV and the decision will now be proposed to ISO TC 108.

CCAUV8/D6. The presentations of selected research topics at the start of the meeting were considered successful and this feature should be retained for the next CCAUV meeting.

CCAUV8/D7. The listing of CMCs is now divided into three separate parts: “sound in air”, “sound in water” and “vibration”, to facilitate the handling, approved by the CCAUV.

19 DATE OF NEXT MEETING

There was a suggestion that the next meeting should revert to being held in October as had been the case previously; however the final decision is subject to acceptance by the CIPM. The date of the next meeting was therefore not confirmed, but an announcement can be expected before the end of 2012.

Dr T. Bruns asked whether the meeting format should be repeated, with the selected in-depth presentations trialled for the first time in 2012. The general consensus was that the technical session at the start of the meeting was worthwhile, and that it should feature in the next meeting.

Dr T. Bruns thanked Dr S. Picard for her efforts in organizing and ensuring the smooth running of the meeting.

The meeting closed at 14:45 on Thursday 14 June 2012.

Dr R. Barham, *Rapporteur*
Dr S. Robinson, *Rapporteur*

APPENDIX 1
WORKING DOCUMENTS SUBMITTED TO THE CCAUV AT ITS 8TH MEETING

Open working documents of the CCAUV are underscored and can be obtained from the BIPM in their original version, or can be accessed on the BIPM website:

http://www.bipm.org/cc/AllowedDocuments.jsp?cc=CCAUV

Documents restricted to Committee members can be accessed on the restricted-access CCAUV website.

Document CCAUV/	
12-00	Draft agenda – updated, S. Picard, 3pp.
12-01	Technical Protocol SIM.AUV.V-K2 – preliminary draft, G. Ripper, 7pp.
12-02	Progress Report ISO: ISO TC 108/SC3, H.-J. von Martens, 14pp.
12-03	Technical Protocol COOMET.AUV.W-S1, A.E. Isaev, 25pp.
12-04	Activity Report NMIA, A. Scott, 5pp.
12-05	Activity Report APMP, Q. Sun, 13pp.
12-06	Proposal: VCCAUV.V-K3, Q. Sun, 12pp.
12-07	Progress RreportAPMP.AUV.V-S1, Q. Sun, 16pp.
12-08	National Standards at NIM, Q. Sun, 14pp.
12-09	Current INRIM Activities, C. Guglielmone, 17pp.
12-10	Technical Protocol AFRIMETS.AUV.V-S3, A.K. Maina, 9pp.
12-11	Presentation: Report ISO TC 108, H.-J. von Martens, 10pp.
12-12	Draft of Technical protocol for a Bilateral CCAUV.V Comparison, T. Bruns, 5pp.
12-13	Status Report CCAUV.U-K3, C. Koch, 6pp.
12-14	Status Report NMIJ/AIST, T. Usuda, 26pp.
12-15	Status Report AUV NMISA - 2012, C.S. Veldman, 6pp.
12-16	Status Report AUV PTB - 2012, C. Koch, 6pp.
12-17	Activity Report KCWG - 2012, T. Bruns, 2pp.
12-18	Activity Report of the COOMET TC - 2012, V. Pozdeeva, 6pp.
12-19	Activity Report of the KRISS – 2012, W.-S. Cheung, 8pp.
12-20	Presentation: NMIA Report, A. Scott, 15pp.
12-21	Status Report IEC TC 29, S. Dowson, 3pp.
12-22	JCRB Report to the CCAUV, A. Ö. Altan, 10pp.
12-23	Status Report NPLI, M. Singh, 5pp.
12-24	Joint Activity Report DFM and BKSV/DPLA 2012, S. Barrera-Figueroa, 5pp.
12-25	EURAMET TC AUV – Activity Report 2012, S. Barrera-Figueroa, 4pp.
12-26	Report of the RMOWG Meeting 2012, S. Barrera-Figueroa, 4pp.

12-27 Strategic Planning Template April 2012, A. Henson, 2pp.

12-28 Status Report TC 87 / ISO: Ultrasonics, J. Abbot, 7pp.

12-29 Status Report NPL: Acoustical Metrology Research, B. Zeqiri, 16 pp.

12-30 Status Report CENAM, G. Silva Pineda, 13p.

12-31 Status Report and Publications NIST-USRD 2012, A.E. Paolero, 3pp.

12-32 Abstracts of Special Topics – Wednesday 13 June 2012 / CCAUV, S. Picard, 3pp.

12-33 Sound field reconstruction and beam-forming based on measurements of the acousto-optic effect, S. Barrera-Figueroa, 40pp.

12-34 Optical system based on photon correlation spectroscopy for acoustic free-field particle velocity measurements, R. Barham, 7pp.

12-35 Determining the pressure sensitivity of a microphone from measurements of the velocity of the membrane S. Barrera-Figueroa, 13pp.

12-36 Laboratory free-field calibration of underwater SPL-receivers applied for noise measurements in the sea conditions, A.E. Isaev, 15pp.

12-37 Therapeutic Ultrasound: current and future activities at the UK NPL, B. Zeqiri, 23pp.

12-38 Acoustic and thermal characterisation of high-intensity ultrasound fields, C. Koch, 27pp.

12-39 Status Report ISO TC 43, S. Robinson, 2pp.

12-40 Status Report CCAUV.V-K2, T. Bruns, 11pp.

12-41 Report of IMEKO 2012, T. Usuda, 7pp.

12-42 Acceleration as a “fundamental unit” (EMRP-IND09), T. Bruns, 8pp.

12-43 Presentation: Activity Report COOMET, V. Pozdeeva, 10pp.

12-44 Presentation: Activity Report EURAMET, S. Barrera-Figueroa, 12pp.

12-45 Presentation: APMP.AUV.V-S1 (and proposal for CCAUV.V), Q. Sun, 26pp.

12-46 Status Report EURAMET.AUV.V-S1, C. Bartoli, 6pp.

12-47 Status Report CCAUV.A-K5, R. Barham, 8pp.

12-48 Status Report LNE, C. Bartoli, 12pp.

12-49 Presentation: Activity Report NMIJ/AIST, T. Usuda, 11pp.

12-50 Report of the KCWG Meeting 2012, T. Bruns, 9pp.

12-51 Report of the SPWG Meeting 2012, B. Zeqiri, 7pp.

12-52 CCAUV-SPWG/12-00: Draft agenda of the SPWG/CCAUV meeting 12 June 2012, B. Zeqiri, 1pp.

12-53 CCAUV-SPWG/12-00: Minutes of the SPWG/CCAUV meeting 2010, SPWG, 7pp.