

Bureau International des Poids et Mesures

Consultative Committee for Acoustics, Ultrasound and Vibration (CCAUV)

Report of the 12th meeting
(26-27 September 2019)
to the International Committee for Weights and Measures



Comité international des poids et mesures

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

as of 26 September 2019

President

Dr T. Usuda, Director General, National Metrology Institute of Japan, AIST [NMIJ/AIST],
Japan, CIPM Secretary.

Executive Secretary

Dr G. Panfilo, International Bureau of Weights and Measures [BIPM], Sèvres.

Members

Central Office of Measures/Główny Urząd Miar [GUM], Warsaw.

Centro Nacional de Metrología [CENAM], Querétaro.

D.I. Mendeleev Institute for Metrology [VNIIM], St Petersburg.

Danish Fundamental Metrology Ltd [DFM], Hørsholm.

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

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, AIST [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 [NMC, A*STAR], Singapore.

All-Russian Scientific Research Institute of Physical Technical Measurements, Rosstandart [VNIIFTRI], Moscow.

Bulgarian Institute of Metrology [BIM], Sofia.

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

Centro Español de Metrología [CEM], Madrid.

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

Czech Metrology Institute [CMI], Brno.

Industrial Technology Research Institute / Center for Measurement Standards [CMS/ITRI], Hsinchu.

Instituto Português da Qualidade [IPQ], Caparica.

Institutul National de Metrologie [INM], Bucharest.

Kenya Bureau of Standards [KEBS], Nairobi.

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

Liaisons

International Electrotechnical Commission [IEC], Geneva.

International Organization for Standardization [ISO], Geneva.

1 OPENING OF THE MEETING

The twelfth 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 26 to 27 September 2019.

The following were present: R. Allen (NIST), S. Barrera Figueroa (DFM), T. Bruns (PTB), A. Canu (LNE), A. Chijioke (NIST), W.H. Cho (KRISS), S. Crocker (NIST), D. Dobrowolska (GUM), G. Durando (INRIM), P. Hanes (NRC), C. Hof (METAS), R. Horiuchi (NMIJ/AIST), Y.-T. Kim (KRISS), C. Koch (PTB), A. Kozliakovskii (VNIIM), M.J.T. Milton (BIPM Director), R. Nel (NMISA), H. Nozato (NMIJ/AIST), E. S. Olsen (DFM), A. Ota (NMIJ/AIST), G. Ripper (INMETRO), S. Robinson (NPL), D. Rodrigues (LNE), E. Sadikoglu (UME), A. Schiavi (INRIM), Z. Siejda (GUM), A. Y. Smirnov (VNIIM), Q. Sun (NIM), C. Thomas (NMIA), T. Usuda (CIPM and NMIJ/AIST), C. Veldman (NMISA), L. Wu (NRC), P. Yang (NIM), J.H. Winther (BKSV-DPLA) and B. Zeqiri (NPL).

Observers: S. Cui (NMC, A*STAR), A. Enyakov (VNIIFTRI), S. Gacheru (KEBS), A. Isaev (VNIIFTRI), A. Nikolaenko (VNIIFTRI), L. Ribeiro (IPQ), P. Rosenkranz (BEV), H. Rotich (KEBS), S. Ruiz (CEM), M. Singh (NPLI), T.-H. Tu (CMS/ITRI).

Representatives from Member State invited to attend as Observer: F. Alsubaey (SASO, NMCC).

Invited by the President: M. Gaitan (NIST), A. Ivashchenko (SE "Ukrmetrteststandard"), O. Kosterov (DP NDI "Systema").

Also present: S. Bergstrand (JCRB Executive Secretary), G. Panfilo (BIPM, CCAUV Executive Secretary), S. Maniguet (BIPM, KCDB office), S. Picard (BIPM, KCDB Coordinator).

Sent regrets: A. Pérez Matsumoto (CENAM), A. Yankovsky (VNIIM).

2 WELCOME AND INTRODUCTION BY THE CCAUV PRESIDENT

The President, Dr Takashi Usuda, welcomed the delegates to the 12th meeting of the CCAUV and introduced the CCAUV.

All participants introduced themselves.

3 WELCOME BY THE DIRECTOR OF THE BIPM

The Director of the BIPM, Dr Milton, welcomed the delegates to the 12th meeting of the CCAUV. Dr Milton commented that the CCAUV president, Dr Usuda, was elected as CIPM Secretary during Session I of the 108th meeting of the CIPM (2019). Following this decision, Dr Usuda will be taking a new direction and will be stepping down as President of the CCAUV.

4 APPOINTMENT OF THE RAPPORTEUR

Dr Nozato from NMIJ and Dr Robinson from NPL were proposed as the Rapporteurs. This was approved by the participants.

5 APPROVAL OF THE AGENDA

Dr Usuda introduced the agenda and asked participants if any changes or modifications were required. No proposals were made and the agenda was approved.

6 REPORT OF THE 11TH MEETING OF THE CCAUV (2017), INCLUDING ACTIONS AND DECISIONS

The essential actions and decisions arising from the 11th meeting of the CCAUV (2017) are summarized below. The Executive Secretary, Dr Panfilo, presented the actions and decisions for the benefit of the meeting and presented the report of the 11th CCAUV meeting. All four actions arising from the previous meeting have been addressed by the CCAUV President, Dr Usuda.

CCAUV11/A1: The CCAUV President exchanged information with the KCDB manager (Dr Susanne Picard) regarding the units of AUV and it was confirmed that no problems had arisen from KCDB manager's point of view.

CCAUV11/A2: The CCAUV President informed the CIPM at its 106th meeting (2017) of the CCAUV's opinion on the revision of the SI and 9th SI Brochure (The future revision of the SI does not have an immediate impact on acoustic, ultrasound and vibration metrology; however, it will underpin future requirements for increase in accuracy). He remarked that logarithmic scales, the "neper" and the "bel", had been used in a specific technical area. The CCAUV welcomed the draft 9th edition of the SI Brochure, which included these non-SI units such as the conventional value of g_n (standard acceleration due to gravity).

CCAUV11/A3: The CCAUV President presented the current situation of the implementation of the CIPM MRA with regard to the CCAUV at the 107th meeting of the CIPM (2018). There is no significant work in progress for reviewing current CMCs but plans are to pursue a risk-based assessment approach towards reviewing these in the future. The planning process for key comparisons (KCs) involves careful deliberation to optimize the resource requirements needed to respond to the needs of the CCAUV's stakeholders. Some mature KCs have reached the stage where repeats of CC KCs, normally in a 10-year cycle, are being conducted to assess them as well as to extend their calibration range.

CCAUV11/A4: This was completed on 20 June 2018 by the CCAUV President, who consulted with the CCM President about the new service category including dynamic force. The CCM President officially approved the CCAUV's proposal.

Decisions

CCAUV11/D1.	The CCAUV approved publication of the Strategy Document on the website shortly after the meeting.
CCAUV11/D2.	LNE (France) will pilot the key comparison CCAUV.A-K6 on calibration of LS2p microphones in the frequency range from 20 Hz to 25 kHz with an option to make calibrations down to 2 Hz.
CCAUV11/D3.	DFM (Denmark) will pilot the key comparison CCAUV.A-K7 on free – field calibration LS2p microphones in the frequency range from 1 kHz to

	40 kHz, which will start in 2020.
CCAUV11/D4.	The CCAUV confirmed the current membership of the committee.
CCAUV11/D5.	The next meeting of the CCAUV and its Working Groups will be scheduled for September 2019.

Actions

CCAUV11/A1.	An <i>ad hoc</i> group composed of RMO TC Chairs will discuss and make a decision on the way units used in the AUV field are presented on the KCDB and will provide feedback to the BIPM KCDB office by the end of October 2017.
CCAUV11/A2.	CCAUV President, Dr Usuda, to present the CCAUV positions regarding the CIPM MRA review and redefinition of the SI units to the CIPM.
CCAUV11/A3.	CCAUV President, Dr Usuda, to present the CCAUV position regarding the SI Brochure to the CIPM.
CCAUV11/A4.	CCAUV RMOWG to finalize the work on service categories and CCAUV President, Dr Usuda, to consult with relevant CCM WGs about services in dynamic force and pressure.

7 PRESIDENT'S REPORT

The CCAUV President, Dr Usuda, reported on the meetings of the CGPM and CIPM, and other liaison activities that had taken place since the last meeting of the CCAUV. In the 26th meeting of the CGPM (2018), the CCAUV President presented various activities concerning AUV (IMS, health issues; KCs, governance [strategic plan, KC planning]; other issues at the RMO level; CIPM MRA review; WG for KCDB 2.0; CC KCs, including the policy on the repeat cycle and travelling standards, which does not suffer significantly from inconsistency in the expression [matrix CMC]; hybrid comparisons in the KCWG.

The BIPM director, Dr Milton questioned the necessity of AUV standards and the liaison with the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO). The CCAUV President replied that the CTBTO had questioned the metrological traceability of measurements of infrasound and seismic activity. Dr Usuda stressed that cooperation with the CCAUV is required and this will be proposed by the SPWG.

Dr Bruns commented that the EU community welcomed the contribution to CTBTO activities. Dr Robinson noted the importance of international low-frequency infrasound comparisons, which cover the scope that the CTBTO is observing. The CCAUV President confirmed the necessity of the continuous negotiations with the CTBTO through the liaison.

8 KCDB 2.0

The KCDB coordinator, Dr Susanne Picard, presented progress with the KCDB 2.0 and gave a

short demonstration. The KCDB 2.0 is scheduled for launch at the end of October 2019. Some of the main functions are: individual user accounts, specified input quantities and matrix uncertainties. The CCAUV welcomed the progress with the KCDB 2.0 and appreciated the efforts by the staff at the BIPM. The KCDB 2.0 will include educational materials such as videos, instruction guides and opportunities for hands-on training.

Discussions and comments on the KCDB 2.0 were as follows.

The CCAUV President suggested that the future plan and schedule for the KCDB 2.0 should be shared with the stakeholders.

The BIPM director commented that users should try to share all the processes they use in order to help applicants in different fields register their own CMCs.

Dr Robinson commented that the KCDB 2.0 is user friendly. He asked what should be done by the TC chair when an applicant revises a CMC and when the TC chair manages the reviews. Dr Picard replied that the applicant simply fills in the relevant cells and it will be sent to the KCDB office; there is no extra effort for the TC Chairs.

9 REPORT FROM THE SPWG

Dr Michael Gaitan, chair of the CCAUV Strategic Planning Working Group (CCAUV-SPWG), reported on its activities. He began the presentation with an overview of the working group, its structure, mission and current membership. It was stated that the main efforts within the WG over the past four years have been focused on updating of the CCAUV Strategy Document. The draft document was prepared by a core group from the SPWG and had been submitted for discussion at the SPWG meeting, which was held on 24 September 2019. The draft document has been slightly revised, based on outcomes of discussions at the meeting.

The updated Strategy Document includes all important information to be provided by the CCAUV community to its external audience. This explicitly concerns CCAUV stakeholders. Much emphasis has been placed on the “Future Scan” to make it as detailed as possible for identification of drivers and research fields to be covered by the CCAUV. Fields such as: driving future KCs in all subject fields; inertial acceleration and digitization; and development of new sensors and new methodologies for underwater acoustics measurements are just a few of the subjects presented in the Strategy Document. The SPWG has made three recommendations:

- CCAUV should hold discussions at the general meeting to identify pilot laboratories for Key Comparisons that are currently listed as TBD or TBC in this report.
- CCAUV should form a liaison relationship with the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), similar to its relationships with the International Organization for Standardization (ISO), International Electrotechnical Commission (IEC) and International Measurement Confederation (IMEKO).
- CCAUV should consult with other CCs to examine the use of g_n , the physical constant for the standard acceleration of gravity defined in CODATA, expressing concern for its expanding use over the SI unit for acceleration (m/s^2).

After discussion, the CCAUV approved the draft SP document and reviewed it for publication; it will be submitted to the CIPM after 2021. Dr Gustavo Ripper commented on the importance to implement an international comparison of digital accelerometers. Dr Wu noted that there is a

problem of long-term stability (drift) of the accelerometer. The long-term stability within 10 ppm per year or six months will be an issue. It may be prohibited to export such accelerometers with excellent long-term stability, whether analogue or digital.

The presentation is available on the CCAUV webpage (CCAUV/19-08).

10 REPORT FROM THE KCWG

Dr Gustavo Ripper, chair of the CCAUV Key Comparison Working Group (CCAUV-KCWG), reported the outcomes from the KCWG meeting held on 24 September 2019. The KCWG meeting was attended by seven members of the WG, the CCAUV President and Executive Secretary, and the SPWG chair, as well as twelve guests from all RMOs. The agenda of the meeting included 22 items. Changes to membership were as follows: Dr Medina (CEM) and Dr Bartoli (LNE) left the KCWG in 2019 and Dr Kolasa retired from GUM in 2019. The status of all ongoing or planned comparisons was reported. Currently there are four CCAUV and five RMO comparisons in progress. All of them are progressing well.

The KCWG members confirmed the importance of considering the risks of technical protocols in advance. For example, CCAUV.V-K5, a comparison on accelerometer high-frequency calibration, uses a mechanical adapter with SE accelerometers to reduce the influence of the shaker and mounting effects. CCAUV.V-K4 uses a BTB accelerometer with a mass loading and requirement to measure acceleration at the centre of mass.

The KCWG members pointed out some problems concerning a certain technical protocol. The example is that additional guidance information was included in the spreadsheet but not in the main text of the technical protocol. As a result, some participants probably saw only the additional guidance after the end of measurement period, at the time of reporting results. Some participants did not strictly follow the additional guidelines such as the pulse durations or the gain settings of the signal conditioner in CCAUV.V-K4. In order to avoid the above problem, the KCWG members suggested some comments and improvements for future technical protocols. In addition, the KCWG members discussed the strategic planning of CCAUV KCs with the scope and periodicity of KCs.

The KCWG members confirmed two points and one question regarding the hybrid comparison; first is that this subject is not directly related to the KCWG but with the KCDB because it acts on the level of “other technical evidence” to support CMCs. Secondly, it was agreed that this subject was to be discussed by the RMO WG. The question is whether there is a better name instead of “hybrid”. Dr Smirnov commented on the difference between inter-laboratory and hybrid comparisons. Dr Usuda answered that the hybrid comparison shall be discussed by the JCRB and the naming should be changed. As the name suggests, Dr Bruns commented on the ambiguity as evidence, including other international comparisons. The KCWG also noted that CMC submissions for hybrid comparison should be documented.

The CCAUV President confirmed the appointment of the Chairperson, Dr Ripper until 2021.

Dr Horiuchi was appointed as the KCWG Vice-Chair by the CCAUV President. The CCAUV welcomed these appointments.

The presentation is available on the CCAUV webpage (CCAUV/19-09).

11 REPORT FROM THE RMOWG

Dr Qiao Sun, chair of the CCAUV Working Group for RMO Coordination (CCAUV-RMOWG), reported on the activities of the WG. The report focused on discussion and outcomes from the WG meeting held on 25 September 2019. The meeting was attended by WG members, the CCAUV President and Executive Secretary, the KCDB Coordinator, as well as three guests from all of the RMOs. The agenda included 12 items, the most important of which were: hybrid comparisons and KCDB 2.0.

Hybrid comparisons were proposed by the Asia Pacific Metrology Programme (APMP) and reported at the 40th JCRB meeting. Hybrid comparisons have many advantages for developing NMIs and can be used as the evidence when registering CMCs. However, it cannot be used in key or supplementary comparisons.

A report on the demonstration of KCDB 2.0 was given. It has been found to be useful for intra- and inter-RMO review processes. Two recommendations were confirmed through the RMOWG members as follows:

1. Concerning the listing of comparisons as supporting evidence for CMCs, it is noted that only the most recent comparison is to be listed.
2. The JCRB is kindly requested, through the CCAUV, to reconsider the naming assigned to “hybrid comparisons”, mainly to avoid any possible confusion and subsequent misuse.

Dr Usuda noted that the hybrid comparison flow has been submitted to the working area. Hybrid comparisons will work in the future.

Dr Enyakov was appointed as the RMOWG Chairperson by the CCAUV President. Dr Sun was appointed as Deputy Chair for a two-year term to support the new chairperson. The CCAUV welcomed these appointments.

The CCAUV President thanked Dr Sun for his efforts to the WG as the Chairperson.

Dr Sun’s presentation is available on the CCAUV webpage (CCAUV/19-10).

12 CCAUV KEY COMPARISONS

Status of all AUV comparisons registered on the BIPM KCDB was reported by each coordinator.

12.1 COMPARISONS AND REPORTS: PUBLISHED/IN PROGRESS/PROPOSED

CCAUV.W-K2

Mr Robinson reported on progress with the key comparison on hydrophone free-field calibration. There are seven participants in the comparison: NPL (pilot), INMETRO, NMISA, NIM-HAARI, NIST (USRD), TUBITAK-MAM and VNIIFTRI. In addition, NIOT from India participates as a guest, (results not included in the KCRV). During the comparison, KRISS had to withdraw from the exercise after an internal reorganization. Measurements started at the beginning of 2016 and were now complete. However, it was noted that since two participants measured at higher water

temperatures than recommended in the protocol (which may have affected their results), NPL has undertaken to calibrate the devices over the ranges of temperatures using the NPL Acoustic Pressure Vessel, so that empirical corrections may be applied. Unfortunately, the NPL facility has been out of action for several months and requires repair; this has delayed the measurements. Currently, the status of the comparison is that it is waiting for circulation of the Draft A report.

CCAUV.V-K4

Dr Sun reported progress with CCAUV.V-K4, a comparison on accelerometer low-shock calibration. The comparison has nine participants: NIM (pilot), NMIJ/AIST (co-pilot), KRISS, CENAM, PTB, INMETRO, NMIA, NMISA, VNIIM. The comparison is piloted by NIM with NMIJ acting as co-pilot. The comparison is completed and the final report will be published in *Metrologia*.

CCAUV.V-K5

Dr Thomas Bruns reported on the status of CCAUV.V-K5, a comparison of calibrations of accelerometers in the frequency range from 10 Hz to 20 kHz. Three accelerometers, Brüel & Kjaer (B&K) type 8305 and type 8305-001 are used as transfer standards in the comparison. Participants in the comparison are: PTB (pilot), BKSVDPLA, CEM, METAS, NIST, CENAM, INMETRO, NIM, NMIJ, NMIA, NMC/A*STAR, NMISA, UkrMet and VNIIM. Measurements within the comparison started in spring 2016. The comparison was running smoothly. Currently the status is under analysis and the draft A will be circulated in December 2019.

CCAUV.A-K6

Dr Dominique Rodrigues reported the progress with CCAUV.A-K6, a comparison on primary pressure calibration of standard microphone LS2P. The comparison has thirteen participants including the pilot laboratories: LNE (pilot), BKSVDPLA, GUM, INMETRO, KRISS, METAS, NMIA, NMIJ, NMISA, NRC, UME and VNFITRI. Currently only half of the participants have completed the measurement. The artefact is stable.

Future comparisons

No proposals.

12.2 CCAUV SUPPLEMENTARY COMPARISONS: PUBLISHED / IN PROGRESS / PROPOSAL

Dr Horiuchi mentioned APMP.AUV.A-K5, a comparison on microphone. (See section 14.3.)

13 THE REVISION OF SI

SI 9th edition

BIPM director, Dr Milton, presented the publication of the 9th SI brochure. With minor editorial corrections, the 9th edition has been well received. Dr Milton discussed several important topics in the CCU agenda: One related to the definition of units, the other is the definition of angle. Others included, for example, the prefixes for bytes. Dr Usuda asked if there had been a discussion in the CCU about bel and neper, which are dimensionless quantities related to CCAUV as well as angles. Following Dr Milton's reply, the CCAUV confirmed there are no particular issues for discussion at the forthcoming CCU meeting concerning non-dimensional units such as bel or neper.

Experience of the revision of ISO/IEC 80000-8

Stephen Robinson reported on the revision of ISO/IEC 80000-8. The CCAUV is a liaison body with ISO TC12, which (along with IEC TC25) has responsibility for this standard. The standard attempts to implement the International System of Quantities and Units with regard to acoustics.

For ISO FDIS 8000-8:2019 ‘Quantities and units – Acoustics’, the FDIS was not approved in April 2019, having received twelve negative votes, and eight positive. The main reason for the non-approval was the changes made to the DIS to introduce nepers into the formulae for level quantities, which are conventionally expressed in decibels. A joint “Task Force” was formed by ISO, which contained varied membership from the acoustics community including ISO TC12, ISO TC43, IEC TC29, IEC TC87, IEC TC25, and the CCAUV (many of these committees, including CCAUV, have a liaison relationship with ISO TC12). During the summer of 2019, five teleconferences were held to discuss a proposed revision, and consensus was reached on a second FDIS, which was endorsed by the Task Force. A ballot was passed (a “Q-ballot” required by IEC rules) to decide on whether to have a second FDIS, and a final ballot is now due to approve/not approve the second FDIS in late 2019.

The CCAUV agreed with the recommendation of the President and Stephen Robinson that the CCAUV would support the second FDIS in the ballot. The CCAUV President reminded delegates to watch out for the ballot in their own national committees (and to bear in mind that the national mirror committees for ISO TC12 may not be the same as those for the acoustics committees in ISO and IEC).

Stephen Robinson commented that there are several improvements in ISO 80000-8 over the previous 2007 version, including corrected definitions of sound pressure level and sound power level, and inclusion of reference levels for underwater acoustics. He mentioned that there are several technical issues covered by the standard where, in spite of the consensus reached by the Task Force, there are implications for definitions of quantities and units in acoustics. These include: (i) whether to include dB units in equations or not, (ii) use and definitions of logarithmic frequency range (differences between base 10 decadal calculations and base 2 octave calculations and the confusing nomenclature often used in acoustics for frequency bands and fractional octave bands), and (iii) the qualification of units, which is forbidden in the SI brochure and ISO 80000-1 but which are in common use in acoustics (for example for dB(A), etc). Erling Sandermann-Olsen pointed out that the difference between base 10 and base 2 fractional frequency bands becomes even more significant for smaller fractions of an octave (for example one sixth and one twelfth octave).

The presentation to the CCAUV is available on the webpage: (CCAUV/19-12.2 and 19-12.3).

14 REGIONAL METROLOGY ORGANIZATIONS

14.1 JCRB MATTERS

Dr Sten Bergstrand presented progress in the Joint Committee of the Regional Metrology Organizations and the BIPM (JCRB) and the RMO chairs presented their activities. The presentation mentioned not only the status of the APMP AUV CMC registrations status and inter RMO review performances, but also the issues with CMC submissions without QMS evidence. The JCRB Chair has already accepted the concept of hybrid comparisons, and APMP is requested to submit its revised guidelines for the operation before the next meeting of the JCRB.

The CCAUV discussed hybrid comparisons and accepted the concept favourably. It understands that it is an external and more self-responsible scheme. Dr Usuda enquired about the risks that can be expected by the operation of a hybrid comparison. Dr Bergstrand replied that in the near future, an institute will register the CMC, so its contents can be checked using the KCDB 2.0. He confirmed that the review was done by multiple people and that the content of the review was openly available, so that the information can be shared.

The presentation is available on the CCAUV webpage (CCAUV/19-13).

14.2 REPORTS FROM REGIONAL METROLOGY ORGANIZATIONS

14.2.1 Inter-American Metrology System (SIM)

Dr Ripper, chair of the SIM MWG-9, reported on the activities of SIM, which is active in all fields of AUV. Currently, SIM has ten NMIs with an interest in AUV. Five of them have CMCs published in the BIPM KCDB. However, ten SIM members, including NMIs from Bolivia, Colombia, Costa Rica, Peru and Paraguay do not yet have any CMCs in the AUV field. SIM members are currently involved in four ongoing CIPM or RMO key and supplementary comparisons. Dr Gaitan (NIST) will take over as Chair of SIM MWG-9 after the 12th CCAUV meeting.

The following cooperative activities have been developed by SIM members to disseminate technical knowledge and exchange experiences during the last two years.

1. Three workshops were held
2. An ongoing interlaboratory comparison (SIM.AUV.A-S2, a calibration on sound pressure level), current status is Draft A.
3. Four CMC revisions and two CMCs under review

The written report and the presentation are available on the CCAUV webpage (CCAUV/19-13.21).

14.2.2 Intra-Africa Metrology System (AFRIMETS)

Mr Riaan Nel, chair of AFRIMETS's TC-AUV Working Group presented progress within AFRIMETS. Three NMIs are active in the AUV field: KEBS, Kenya (acoustics and vibration), NIS, Egypt (acoustics), and NMISA, South Africa (acoustics and vibration).

Members of the AFRIMETS TC-AUV Working Group are currently involved in six ongoing CIPM or RMO key and supplementary comparisons. Two additional AFRIMETS supplementary comparisons are planned for the future.

The presentation is available on the CCAUV webpage (CCAUV/19-13.22).

14.2.3 Asia Pacific Metrology Programme (APMP)

Dr Horiuchi, chairperson of the APMP TC-AUV, reported on the APMP, highlighting activities in a variety of key comparisons. A total of 12 countries are active in the AUV field: NMIA (Australia), NIM (China), CMS (Chinese Taipei), SCL (Hong Kong), NPLI (India), KIM-LIPI (Indonesia), NMIJ (Japan), KRISS (Republic of Korea), NML-SIRIM (Malaysia), NIMT (Thailand), NMC/A*STAR (Singapore) and VMI (Viet Nam). In addition, NIS (Egypt) and NMISA (South Africa) have the status of associate members in APMP TC-AUV. Currently, ten

APMP TC-AUV members have a total of 306 CMCs published in the BIPM KCDB. The reported contents are summarized as follows.

1. A new CMC approved. (NIMT, vibration)
2. Seven inter RMO reviews
3. Two ongoing APMP TCAUV comparisons (APMP.AUV.U-K3, a comparison of on ultrasonic power and APMP.AUV.V-K3.1, a comparison on accelerometer)
4. Seven peer review assessments done
5. A TC initiative project (workshop, research comparison between KRISS, NIM and NMIJ)
6. Two MEDEA (Metrology-Enabling Developing Economies in Asia, funded by Germany) projects under review (Medical ultrasound metrology [technical training and workshop], reliable noise measurement on sound level meter [workshop and inter-comparison]).

The presentation is available on the CCAUV webpage (CCAUV/19-13.23).

14.2.4 Euro-Asian Cooperation of National Metrological Institutions (COOMET)

Dr Alexander Enyakov, COOMET TC-AUV deputy chairperson, presented progress within the COOMET TC-AUV. The NMIs from thirteen COOMET member countries are represented in AUV. There are eight NMIs, (Azerbaijan, Armenia, Belarus, Cuba, Georgia, Russian Federation, Uzbekistan and Ukraine) that submit their AUV CMCs via COOMET, and seven NMIs (Bulgaria, Germany, Lithuania, Slovakia, Romania, Turkey and KDPR) that submit through other RMOs. Only three countries to date: Belarus, Russian Federation and Ukraine have published their CMCs in AUV until now. The reported contents are summarized as follows.

1. Three comparisons completed in 2018
2. Two comparisons in progress
3. Two comparison planned
4. Six inter RMO reviews.

Two COOMET TC-AUV meetings have been held since the 11th CCAUV meeting. The 13th TC-AUV meeting was held in Istanbul (Turkey) in September 2018 and 14th meeting in Moscow (Russian Federation) in August 2019.

The written report and the presentation are available on the CCAUV webpage (CCAUV/19-13.24).

14.2.5 European Association of Metrology Institutes (EURAMET)

The report was presented by Mr Robinson, Chair of EURAMET TC-AUV. Three Sub-Committees (SCs) are organized under the EURAMET TC covering three technical areas: SC-A “Sound in Air”, SC-U “Ultrasound and Underwater Acoustics”, and SC-V “Vibration and Acceleration”. There are 24 members of EURAMET TC-AUV, and 20 NMIs and DIs have a total of 510 CMC entries approved and published in the BIPM KCDB. There was a slight decrease in the number of published CMCs, mainly due to the consolidation of the CMC entries for Germany. EURAMET TC-AUV members are involved in six CIPM or RMO key and supplementary comparisons.

TC-AUV participates in the European Metrology Programme for Innovation and Research

(EMPIR). There were four active projects in 2019 involving TC-AUV members: “Metrology for modern hearing assessment and protecting public health from emerging noise sources” (EARS II), “Underwater acoustic calibration standards for frequencies below 1 kHz” (UNAC-LOW), “Metrology for the Factory of the Future” (Met4FoF) and “Reliable metrology framework for the evaluation of a class of radiation-based therapies coupled with hyperthermia induced by Therapeutic Ultrasound” (RaCHy).

In 2019, a number of Potential Research Topics (PRTs), as follows, were submitted with AUV content:

“Sound insulation of facades - new standardized measurement procedure for low frequencies”

“Development of expanded metrological capability for medical ultrasound”

“Metrology for low-frequency sound and vibration for disaster warning and global environmental monitoring of nuclear testing and climate change”

“European metrology network on environmental monitoring”

“European network for medical device metrology”

The TC-AUV and the three Sub-Committees meet typically on a yearly basis. The 2019 meetings were held at the PTB (Germany) on 4-5 April 2019.

The written report and the presentation are available on the CCAUV website (CCAUV/19-13.25).

14.2.6 GULFMET

No presentation.

14.3 Regional key comparisons and links to CCAUV comparisons: published / in progress / proposed

NMISA is preparing a comparison for the linking of AFRIMETS to CCAUV.V-K5, a comparison on accelerometer.

APMP.AUV.A-K5, a comparison on microphone, was discussed by the participants. It is not currently registered in the KCDB.

14.4 Regional supplementary comparisons: published / in progress / proposed

Nothing to report.

15. CCAUV MEMBERSHIP

Report from the Ukraine’s DP NDI “Systema” – National Acoustical standards of Ukraine

DP NDI “Systema” is one of four NMIs in the Ukraine and is the designated Institute of the Ukraine in the field of acoustics, ultrasound and vibration (sound in air and sound in water). It maintains three State primary standards for the Ukraine in the field of acoustics, which were

approved as State reference standards by the Ministry of Economic Development and Trade of Ukraine. Its calibration laboratory employs eight people.

DP NDI “Systema” calibrates about 50 microphones, 20 sound calibrators, 20 sound level meters, ten hydrophones, ten ultrasound power meters and ten ultrasound transducers annually.

DP NDI “Systema” has taken part in four regional and two supplementary key comparisons in the field of acoustic in the air. It is now participating in the COOMET.AUV.A-S3 supplementary comparison.

Its laboratory was accredited to meet the requirements of ISO/IEC 17025 and its quality management system was approved by COOMET peer review.

The presentation is available on the CCAUV website (CCAUV/19-27).

Report from the Ukraine’s SE Ukrmetrteststandart – Vibro-Acoustics laboratory

SE “Ukrmetrteststandart” is another of the four NMIs of the Ukraine. It owns the state primary standard of Ukraine in the field of vibration. The Ministry of Economic Development and Trade of Ukraine approved this reference standard as a State reference standard in 2018.

It is the largest calibration laboratory in the field of vibro-acoustic measurements in Ukraine, with seven employees.

SE “Ukrmetrteststandart” calibrates about 20 vibration reference transducers, 600 sound level meters, 500 vibrometers and vibration transducers, 100 audiometers, 200 ultrasonic flaw detectors and ultrasonic reference blocks (for Non-Destructive Testing) and 800 ultrasonic medical diagnostic systems annually.

Its laboratory participated in the COOMET.AUV.V-K1 comparison in the field of vibration, which is not yet finished. SE “Ukrmetrteststandart” is participating in the CCAUV.V-K5 comparison and Pilot COOMET 706/RU/16 comparison (measurement of velocity of ultrasonic waves in different solid media).

SE “Ukrmetrteststandart” has been accredited to meet the requirements of ISO/IEC 17025 and its quality management system was approved by COOMET peer review.

The presentation is available on the CCAUV website (CCAUV/19-22).

The CCAUV president thanked the two institutes for their attendance as guests and their presentations.

The CCAUV president recalled the criteria for membership. He 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>). He emphasized that each member of the CCAUV has to submit a report for the meeting about their recent activities. In addition, members and observers have to provide an update of their bibliography to the CCAUV Executive Secretary on a regular basis. Using these criteria, the CCAUV president commented that he expects their further activities to be submitted for future application for membership. He also requested the members to support the applications from both Ukrainian institutes.

Decision (CCAUV12/D1): The CCAUV welcomed Ukraine to take part actively in the activities organized under auspices of the CCAUV for future application to observer status.

16 REPORTS FROM INTERNATIONAL OBSERVERS

16.1 IEC TC29

Dr Barrera-Figueroa (for Dr Barham) presented an update of activities of IEC TC29. The Technical Committee IEC TC29: Electroacoustic was established in 1953 and the current scope is: “To prepare International Standards related to instrumentation and methods of measurement in the field of electroacoustics”. IEC TC29 includes the following Working Groups and Maintenance Teams: MT 4 Sound-level meters; WG 5 Measurement microphones; WG 10 Audiometric equipment; WG 13 Hearing aids; MT 17 Sound calibrators; and WG 21 Head and ear simulators. WG24 Modular Instrumentation for acoustics measurements was established recently.

IEC TC29 held its last plenary session, together with meetings of its Working Groups and Maintenance Teams in Ottawa (Canada) on 24-28 September 2018. The next plenary meeting will be held in Warsaw (Poland) on 23-27 March 2020. IEC TC 29 in collaboration with ISO TC 43 made a representation to ISO TC 12 on the publication of ISO/FDIS 80000-8, objecting to several technical aspects that had been introduced, in particular the use of the neper to express acoustic level quantities, and to the general lack of consultation with the acoustical user community in the preparation of the document.

The presentation is available on the CCAUV website (CCAUV/19-15.7).

16.2 IEC TC87, ISO TC43 SC3 AND ISO TC12

Mr Robinson reported recent activities within IEC TC87, ISO TC43 SC3 and ISO TC12.

The scope of IEC TC 87 is to prepare standards related to the characteristics, methods of measurement, safety, and specifications of fields, equipment and systems in the domain of ultrasonics. Close liaison is maintained with TC 62 and TC 29 in fields of common interest. IEC TC87 is chaired by Volker Wilkens (PTB) and has eight active Working Groups. They are: WG3: High power transducers, WG6: High Intensity Therapeutic Ultrasound (HITU) and Focusing transducers, WG7: Surgical and therapeutic devices, WG8: Ultrasonic field measurement, WG9: Pulse-echo diagnostic equipment, WG13: Terminology, WG 14: Determination of ultrasound exposure parameters and WG15: Underwater Acoustics. IEC TC87 held its last plenary session, together with meetings of its Working Groups, in June 2018 in Olomouc (Czech Republic). Interim Working Group meetings were held in Rio de Janeiro (Brazil) in February 2019, and the next plenary meeting is due in Shanghai (China) in October 2019. It was reported that IEC60050-8-1-32: International Electrotechnical Vocabulary - Part 32 has passed the CDV stage and the two parts of IEC 60565 (calibration of hydrophones) should be published in the next few months. New work item proposals include standards on calibration of autonomous recorders and digital hydrophones, and calibration of vector sensors (particle motion sensors).

The written report and the presentation are available on the CCAUV website (CCAUV/19-19-15.3 and CCAUV/19-15.6).

ISO TC43 SC3 (Underwater Acoustics) has four Working Groups: WG1: Measurement of noise radiated by ships, WG2: Underwater acoustic terminology, WG3: Measurement of radiated noise from marine piling and WG4: Standard target of calibrating active sonar. ISO TC43 SC3 held its last meeting at Woods Hole Oceanographic Institute (USA) in October 2017. Since then, progress has been slow, with the meeting in October 2018 in China being cancelled. A new Secretary has been provided by ANSI/ASA (USA), and the next meeting will coincide with a meeting of TC43 SC1 and SC2 in June 2021 in Paris (France). Recently published standards include ISO 17208-2 (determination of source levels of ships from measurements in deep water). Ongoing projects include ISO 17208-3 (determination of ship source levels in shallow water).

The written report and the presentation are available on the CCAUV website (CCAUV/19-15.2 and CCAUV/19-15.6).

ISO TC12 deals with the standardization of units and symbols for quantities and units (and mathematical symbols) used within the different fields of science and technology. It is chaired by Leslie Pendrill, RISE (Sweden). It was emphasized that the most important news from the TC is the revision of ISO 80000-8 Quantities and units - Part 8: Acoustics. This is reported in Section 13 of these minutes (Revision of the SI). It was noted that the removal of the definition of “decibel” from the latest edition of ISO 80000-3 leaves no formal ISO definition. However, this will now be defined in a new part 15 of ISO 80000 which will be prepared by IEC TC25.

Mr Sandermann-Olsen questioned how the scope of work of IEC TC87 and ISO TC43 SC3 were defined and whether there was any overlap. Mr Robinson explained that the situation was similar to IEC TC29 and ISO TC43 SC1 in that the IEC committee covers calibration and measurements on electrical instrumentation (for example hydrophones) and the ISO committee covers physical measurements of sound (for example measurement of ship noise, etc).

Dr Usuda questioned the meaning of “calibration of vector sensors”. Mr Robinson explained that such sensors are used to measure acoustic wave vector quantities such as sound particle velocity. Commercial devices are now being produced in response to the need to measure these quantities, for example when determining the noise exposure of fish (which respond to particle motion rather than sound pressure).

16.3 ISO TC108

Mr Ian Veldmann reported on recent activities of ISO TC108 Mechanical vibration, shock and condition monitoring. The scope of activities of ISO TC 108 covers standardization in the fields of mechanical vibration and shock and the effects of vibration and shock on humans, machines, vehicles (air, sea, land and rail) and stationary structures, and of condition monitoring of machines and structures, using multidisciplinary approaches. The last plenary meeting of ISO/TC108 “Mechanical vibration, shock and condition monitoring” took place in Berlin (Germany) in March 2019. A number of ISO/TC108 sub-committees (SC) and working groups (WG) also met during this period. The meetings were hosted by DIN. Dr Michael Gaitan (NIST) will act as the chairperson of ISO TC108.

It was noted that the work programme of WG 34 “Use and calibration of vibration and shock measuring instruments” is the most relevant to the CCAUV. The convenor of ISO TC108 WG34 is Dr Thomas Bruns (PTB). It was noted that work on a number of other standards is currently in progress. They are: ISO 16063-44 (DIS stage), ISO 16063-34 (DIS stage), ISO 16063-21:2003

Amd.2, Revision of ISO 5347-8:1998, ISO/WD 19665, ISO 16063-1:1998 Amd., Revision of ISO 5348, ISO 16063-31:2009 Amd., ISO/PWI 16063-18, ISO/PWI 16063-46 and ISO/PWI 16063-19.

Dr Bruns mentioned issues in the current state of conditioning amplifier calibration for dynamic measurements (ISO/WD 19665). It was already standardized by DKD in German, so the intention was to make it an ISO document. However, it is copyright free in the German version, but its English version is in conflict with the copyright.

The written report and presentation are available on the CCAUV website (CCAUV/19-15.1 and CCAUV/19-15.5).

17 REPORTS FROM INTERNATIONAL MEETINGS

17.1 IMEKO TC22

Dr Ota, deputy chairperson of TC22, reported on the TC22 of the IMEKO. IMEKO World Congress held in Belfast (UK) from 3 to 6 September 2018. He presented an overview of TC22 with 16 oral presentations and two posters. TC22 is composed of 28 experts from 23 countries. TC22 is chaired by Gustavo Ripper (INMETRO) and Michael Gaitan (NIST) is the scientific secretary of the committee.

At the end of the presentation Dr Ota recalled that the next joint TC 3, TC 5, TC 16 and TC 22 conference will be held in Dubrovnik (Croatia) on 5-7 May 2020 and invited the CCAUV community to contribute to the conference. The IMEKO World Congress in 2021 will held in Yokohama (Japan) from 30 August to 3 September 2021. Dr Ota's presentation is available on the CCAUV webpage (CCAUV/19-16.1).

17.2 INTERNOISE AND ICA

Dr Barrera-Figueroa reported on the Internoise 2019 conference which was held in Madrid (Spain) from 16 to 19 June 2019. He presented an overview of Internoise 2019, which hosted 100 technical sessions, 17 topics and had more than 60 participating countries.

He also gave an overview of the 23rd International Congress on Acoustics (ICA 2019) held in Aachen (Germany) from 9 to 13 September 2019. There were 147 structured sessions and a further 14 general sessions (CCAUV/19-16.2).

17.3 UNDERWATER AND ULTRASOUND

Mr Robinson described recent meetings in the field of underwater acoustics and ultrasound. These included two major international conferences held in July 2019: Aquatic Noise held in Den Haag (the Netherlands), which covered the effects of anthropogenic noise on marine life; and The Underwater Acoustic Conference and Exhibition (UACE2019) held in Crete (Greece).

18 PUBLICATIONS

All reports issued for the 12th CCAUV meeting as well as presentations from the meeting and

workshop will be made available on the CCAUV webpage. However, Dr Panfilo will contact authors for confirmation as to whether documents can be made available as open access.

19 RECOMMENDATIONS TO THE INTERNATIONAL COMMITTEE FOR WEIGHTS AND MEASURES (CIPM)

The CCAUV President confirmed that the mutual liaison between the CTBTO and the CCAUV members will continue.

20 OTHER ITEMS

The CCAUV President welcomed presentations from the following institutes.

A*STAR

Dr Shan presented the calibration facilities and its specification of AUV. The calibration facilities are for secondary calibration and cover acoustic, underwater acoustics and ultrasound and linear vibration. Recent research activity has mainly focused on the local leakage detection for natural gas transmission pipelines by using acoustic sensors

The presentation is available on the CCAUV webpage (CCAUV/19-30).

METAS

Dr Hof presented the organization of METAS and the status of the Swiss national standards in AUV. The laboratory has continuously developed new measurement capabilities or improved methods that are already implemented in the laboratory. Recent activities include

1. Research towards an improved tackling of emerging noise sources (developing measurement capabilities for characterizing measuring equipment to assess ultrasound in air, EMPIR, 15HLT03 Ears II project)
2. Research, towards a patient tailored hearing assessment (contributing to the development of the “universal ear simulator” concept, EMPIR, 15HLT03 Ears II project)
3. Improvement of the measurement uncertainty evaluation in the area of accelerometer calibration using scanning techniques (1000 measuring points). Evaluation of alternative types of laboratory standard microphones for the primary pressure reciprocity technique.
4. Development of a calibration method to characterize a reference impact source for the assessment of user-generated noise in residential buildings

The presentation is available on the CCAUV webpage (CCAUV/19-31).

DFM+BKSV-DPLA

Dr Barrera-Figueroa reported the calibration framework of microphones and accelerometers by DFM and Brüel & Kjaer. The issue of free-field sensitivity determined as a combination of the response of the microphone determined using an electrostatic actuator is typically only traceable to the given frequency.

The presentation is available on the CCAUV webpage (CCAUV/19-19.4).

NPL

Mr Robinson presented the work of an ongoing European project (JOMOPANS) which aims to monitor the noise in the North Sea using a combination of measurements (made at 14 monitoring stations) and modelling (using AIS data for ship locations, ship source models and validated acoustic propagation models) to produce noise maps in support of the EU Marine Strategy Framework Directive).

Dr Zeqiri delivered a short presentation on the latest developments in ultrasound metrology, some of which centred around difficulties posed by the increasing number of low frequency applications. Issues were related to the availability of new radiation force balance materials for power measurement and application below 500 kHz, and difficulties in hydrophone calibration. He described activity in a new area: Photoacoustic (PA) imaging and presented the results of a study of the material properties of a potential new PA phantom material and the point spread function characterization of a combined Acoustic/PA microscope operating at 350 MHz.

The presentation is available on the CCAUV webpage (CCAUV/19-19.3).

21. DATE OF NEXT MEETING

It was proposed that 13th CCAUV meeting, and meetings of the CCAUV Working Groups would be held from 5-8 October 2021. This was agreed by the participants. (Decision CCAUV12/D2)

Dr Usuda thanked the participants for their valuable contributions and expressed the great pleasure it has been to chair the CCAUV. He stated that CCAUV is not responsible for any fundamental units, although the equivalence of measurements in AUV have been increasingly requested from society in terms of (among others) safety, environmental assessment, medical applications and productivity.

Dr Usuda said that he will be pleased to support the future CCAUV President who will have many important tasks to fulfil for the various applications. He invited participants to continue to welcome future members, as he recognizes that CCAUV activities continue to be very diverse.

Dr Usuda finished by expressing his thanks to the previous Executive Secretaries, Dr P.J. Allisy-Roberts and Dr S. Picard, and the current Executive Secretary, Dr G. Panfilo. He asked Dr Milton to give his best regards to all the BIPM staff who made the meeting so efficient.

The meeting closed at 12:30 on 27 September 2019.

Hideaki Nozato, *Rapporteur*

Stephen Robinson, *Rapporteur*

APPENDIX 1

Working documents submitted to the CCAUV at its 12th meeting

Below are listed all working documents submitted to the CCAUV at its 12th meeting.

Document

CCAUV/

- 19-01 CCAUV Draft agenda 2019, T. Usuda
- 19-02 Agenda of the Workshop Diagnosis and inspection by AUV measurement, T. Usuda
- 19-03 Summary of CCAUV comparisons, G. Panfilo
- 19-05.1 Report of the 11th CCAUV meeting, E. Sadikoglu and S. Barrera-Figueroa
- 19-05.2 Actions and decisions of 11th CCAUV meeting, E. Sadikoglu and S. Barrera-Figueroa
- 19-05.3 Actions and decisions of 10th CCAUV meeting, R. Barham and S. Robinson
- 19-05.4 Actions and Decisions - Presentation, G. Panfilo
- 19-06.1 APMP guideline for using Hybrid Comparisons as CMC evidences, APMP
- 19-06.2 APMP guideline for the use of Hybrid Comparisons as Evidence Supporting CMC Claims, Chu - Shik Kang
- 19-08 Report from the SPWG, M. Gaitan
- 19-08.1 Draft of the Strategic Planning Document (2019-2029), SPWG
- 19-09 Report from the KCWG, G. Ripper
- 19-10 Report from the RMOWG, S. Qiao
- 19-12.2 CCAUV liaison with ISO TC12 - Progress with revision of ISO 80000-8, S. Robinson
- 19-12.3 Summary of the comments on the FDIS, the actions, and the new draft (the 2nd FDIS), S. Robinson
- 19-13 JCRB matters: AUV CMC submissions statuses and Hybrid Comparisons, S. Bergstrand
- 19-13.21 Report of RMO: SIM, G. Ripper
- 19-13.22 Report of RMO: AFRIMET, R. Nel
- 19-13.23 Report of RMO: APMP, R. Horiuchi

- 19-13.24 Report of RMO: COOMET, A. Enyakov
- 19-13.25 Report of RMO: EURAMET, S. Robinson
- 19-14.1 Current activities of Ukrmetrteststandart in the field of acoustics and vibration measurements, A. Ivashchenko
- 19-14.2 Primary national standards of Ukraine in the field of acoustic and ultrasound, A. Kosterov
- 19-15.1 Report from ISO TC 108, I. Veldman
- 19-15.2 Report from ISO TC 43 SC3, S. Robinson
- 19-15.3 Report from IEC TC 87, S. Robinson
- 19-15.4 Report of IC TC 29, S. Barrera Figueroa and R. Barham
- 19-15.5 Report from ISO TC 108 (presentation), I. Veldman
- 19-15.6 Report from ISO TC 43 SC3 & ISO TC12 & IECTC 87 (presentation), S. Robinson and B. Zeqiri
- 19-15.7 Report of IC TC 29 (presentation), S. Barrera Figueroa and R. Barham
- 19-16.1 Report from IMEKO TC 22, A. Ota
- 19-16.2 Internoise 2019 and ICA 2019, S. Barrera-Figueroa
- 19-19.1 Status report of LNE - Presentation, D. Rodrigues
- 19-19.2 Ultrasound Metrology at NPL, B. Zeqiri
- 19-19.3 Standards for project JOMOPANS: ocean noise monitoring for the North Sea, S. Robinson
- 19-19.4 DFM + BKSVDPLA: current research activities, S. Barrera-Figueroa
- 19-20 Laboratory report of NIST USRD, S. Crocker
- 19-21 Laboratory report of NMISA, I. Veldman
- 19-22 Laboratory report of SE UKRMETRTESTSTANDART (Ukraine), A. Ivashchenko
- 19-23 Laboratory report of PTB, C. Koch
- 19-24 Laboratory report of CENAM, A. E. Perez Matsumoto
- 19-25 Laboratory report of NMIA, C. Thomas
- 19-26 Laboratory report of NMIJ/AIST, R Horiuchi

- 19-27 Laboratory report of DP NDI SYSTEMA (Ukraine), A. Kosterov
- 19-28 Laboratory report of GUM, D. Dobrowolska
- 19-29 Laboratory report of NIST, A. Chijoke
- 19-30 Laboratory report of NMC A*STAR, S. Cui
- 19-31 Laboratory report of METAS, G. Hof
- 19-32 Laboratory report of DFM and BKSVDPLA, S. B. Figueroa
- 19-33 Laboratory report of NPL, B. Zeqiri
- 19-34 Laboratory report of LNE, D. Rodrigues
- 19-35 Laboratory report of KRISS, W.H. Cho
- 19-36 Laboratory report of UME, E. Sadikoglu
- 19-37 Laboratory report of INRIM, G. Durando
- 19-40 Quantification of hardened layer thickness in carbon steel using ultrasound metrology, A. E. Perez Matzumoto (CENAM)
- 19-41 Acoustic transfer impedance in plane wave couplers for reciprocity calibration, E. S. Olsen (BKSVDPLA)
- 19-42 Environmental vibration measurements to protect the premises and work of an NMI, T. Bruns (PTB)
- 19-43 Phase Insensitive Ultrasound Computed Tomography: Breast Phantom Imaging, C. Baker (NPL)
- 19-44 Acoustic transfer admittance of cylindrical cavities in infrasonic frequency range, D. Rodrigues (LNE)
- 19-45 Non-destructive inspection by visualization of laser-induced ultrasonic waves, N. Toyama (NMIJ)
- 19-46 Probing biological systems with ultrasound, S. Lori Bridal and P. Dargent
- 19-47 Resonant Ultrasound Spectroscopy (RUS) for measurement of Stiffness Tensor of Anisotropic and Attenuative Materials, P. Dargent
- 19-48 ICUA2020 - International Conference on Underwater Acoustics, NPL

APPENDIX 2

LIST OF ACTIONS AND DECISIONS RECORDED FOR THE MEETING

Dr Usuda went through the list of actions and decisions from the meeting, as recorded by the Rapporteurs.

Decision of the 12th meeting of CCAUV

CCAUV12/D1.	The CCAUV welcomed Ukraine to take part actively in the activities organized under auspices of the CCAUV for future application to observer status.
CCAUV12/D2.	The next meeting of the CCAUV and its working groups will be scheduled from 5th to 8th October 2021.
CCAUV12/D3.	CCAUV confirmed that the choice of CMCs format in either tabular or matrix form is the decision of the NMI decision (CCAUV allows either format).

Actions of the 12th meeting of CCAUV

CCAUV12/A1.	CCAUV President to propose a liaison relationship with the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) to the CIPM.
CCAUV12/A2.	CCAUV President to propose further monitoring of the Hybrid Comparison operation including consideration of its naming to the JCRB.
CCAUV12/A3.	CCAUV President to re-iterate to relevant CCs to examine the use of g_n , the physical constant for the standard acceleration of gravity defined in CODATA, expressing concern of its expanding use over the SI unit.
CCAUV12/A4.	CCAUV President to report to the CCU and CIPM about the needs of systematic communication with ISO TC 12 and IEC TC 25 for future revision of relevant standards for units.
CCAUV12/A5.	CCAUV President to inform to CIPM about the appointments of CCWG Chairpersons and Deputy Chairpersons.

APPENDIX 3

PROGRAMME OF WORKSHOP “DIAGNOSIS AND INSPECTION BY AUV MEASUREMENT”

A special workshop on “Diagnosis and inspection by AUV measurement” was held separately from the 12th CCAUV meeting. This technical session took place before proceeding with the agenda, and included a series of short presentations with selected topical themes. A copy of each presentation is available on the CCAUV website. The presentations were as follows:

<p>Introduction: Aim of the workshop <i>Takashi Usuda, CCAUV President, NMIJ (Japan).</i></p>
<p>Probing biological systems with ultrasound <i>S. Lori Bridal, Sorbonne Universite (France).</i></p>
<p>Quantitative Ultrasonic Attenuation Imaging of Breast Phantoms <i>Christian Baker, NPL (United Kingdom).</i></p>
<p>Non-destructive inspection by visualization of laser-induced ultrasonic waves <i>Nobuyuki Toyama, NMIJ (Japan).</i></p>
<p>Environmental vibration measurements in order to protect the premises and work of a national metrology institute <i>Thomas Bruns, PTB (Germany).</i></p>
<p>Vibration Measurement and Analysis Experience on Rail Transporting in TAIWAN. <i>Tsung-Hsien Tu, CMS-ITRI (Chinese Taipei).</i></p>
<p>Quantification of hardened layer thickness in steels using ultrasound metrology <i>Andres Esteban Perez Matsumoto, CENAM (Mexico).</i></p>
<p>Calculation of acoustic transfer impedance in couplers for reciprocity calibration <i>Erling Sandermann Olsen, BKSV-DPLA (Denmark)</i></p>
<p>Acoustic transfer admittance of cylindrical cavities in infrasonic frequency range <i>Dominique Rodrigues, LNE (France)</i></p>