Bureau International des Poids et Mesures

Consultative Committee for Acoustics, Ultrasound and Vibration (CCAUV)

Report of the 5th meeting
(25-26 September 2006)
to the International Committee for Weights and Measures

Comité international des poids et mesures

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Note:

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

Full bilingual printed versions in French and English will no longer appear.

A.J. Wallard,
Director BIPM.

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

as of 25 September 2006

President

Dr J. Valdés, member of the International Committee for Weights and Measures, Instituto Nacional de Tecnología Industrial, San Martin.

Executive Secretary

Dr P.J. Allisy-Roberts, International Bureau of Weights and Measures [BIPM], Sèvres.

Members

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

Centro Nacional de Metrología [CENAM], Querétaro.

Conservatoire National des Arts et Métiers, Institut National de Métrologie [LNE-INM], La Plaine-Saint-Denis.

CSIR, National Measurement Laboratory [CSIR-NML], Pretoria.

D.I. Mendeleyev Institute for Metrology [VNIIM], Rostekhregulirovaniye of Russia, St Petersburg.

Danish Institute of Fundamental Metrology [DFM], Danish Primary Laboratory for Acoustics [DPLA], Naerum.

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

Istituto Nazionale di Ricerca Metrologica [INRIM], Turin.

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], West Lindfield.

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

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

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

Centro Español de Metrología [CEM], Madrid.

Czech Metrological Institute/Český Metrologický Institut [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], Lisbon.

International Electrotechnical Commission [IEC].

International Organization for Standardization [ISO].

National Metrology Institute of Turkey/Ulusal Metroloji Enstitüsü [UME], Gebze-Kocaeli.

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

Nederlands Meetinstituut, Van Swinden Laboratorium [NMi VSL], Delft.

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

Standards, Productivity and Innovation Board [SPRING Singapore], Singapore.

State Agency for Metrology and Technical Surveillance [SAMTS], Sofia.

1 OPENING OF THE MEETING; APPOINTMENT OF THE RAPPORTEUR; APPROVAL OF THE AGENDA

The Consultative Committee for Acoustics, Ultrasound and Vibration (CCAUV)* held its fifth meeting at the International Bureau of Weights and Measures (BIPM) Sèvres, on Monday 25 and Tuesday 26 September 2006.

The following were present: R. Barham (NPL), T. Bruns (PTB), W.S. Cheung (KRISS), J.N. Durocher (LNE-INM), J.S. Echeverría-Villagómez (CENAM), S. Forsythe (NUWC/USRD), E. Frederiksen (DPLA), C. Guglielmone (INRIM), T. Kikuchi (NMIJ/AIST), C. Koch (PTB), M. Lecollinet (LNE-INM), P. Narang (NMIA), K. Rasmussen (DFM/DPLA), G. Ripper (INMETRO), S. Robinson (NPL), G. Silva-Pineda (CENAM), Qiao Sun (NIM), M. Szelag (GUM), U. Takashi (NMIJ/AIST), J. Valdés (President of the CCAUV), C.S. Veldman (CSIR-NML), H.-J. von Martens (PTB and ISO TC108), A.J. Wallard (Director of the BIPM), G. Wong (NRC), Lixue Wu (NRC), B. Zeqiri (NPL), Yue Zhang (NIM).

Observers: M. Blabla (CMI), C. Casal (CEM), H.A. Chua (SPRING Singapore), A. Enyakov (VNIIFTRI), C. Hof (METAS), A.E. Isaev (VNIIFTRI), A. Konkov (VNIIFTRI), V. Mohanan (NPLI), M. Nunes (INETI-LME), E. Sadikoglu (UME), M. Sinojmeri (BEV), P. van Kan (NMi VSL).

Guests: A. Popescu (INM) and V. Pozdeeva (BelGIM for COOMET).

Also attending the meeting: P.J. Allisy-Roberts (Executive Secretary, BIPM), C. Thomas (Coordinator of the BIPM key comparison database).

Apologies were received from: P. Averlant (LNE), V. Nedzelnitsky (NIST), V. Smirnov (VNIIM) and J.F. Zalesak (NUWC/USRD).

Professor Wallard welcomed delegates to the CCAUV meeting, indicating that the activities of the CCAUV were of particular interest to him, as he had been involved in its establishment a number of years ago.

Dr J. Valdés reinforced the Director of the BIPM's welcome to Paris, and acknowledged the attendance at the Consultative Committee (CC) meeting of a new observer, Dr A. Popescu of Romania. He also brought to the attention of delegates the changes in Italy which had seen the joining of the two organizations, IMGC-CNR and IEN, resulting in the emergence of the organization INRIM.

Dr B. Zeqiri agreed to be the Rapporteur for the Consultative Committee meeting.

There were no changes or additions to the agenda.

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* For the list of acronyms, click here.

2 REPORT OF THE 4TH MEETING OF THE CCAUV 2004

The Secretary, Dr Allisy-Roberts, along with members of the CC, thanked Dr Zeqiri for his efforts in generating the written report of the 4th meeting. Dr Valdés produced a succinct verbal summary of the key points of this report for the benefit of the CC.

Dr Valdés also spent some time taking a forward look at the meeting agenda, singling out future needs for AUV metrology, suggesting the need to consider a more strategic approach to the planning of the CCAUV work programme, to try and identify where it is going and the key challenges ahead.

3 CCAUV KEY COMPARISONS

3.1 Published comparisons

Dr Allisy-Roberts indicated that, since the last Consultative Committee meeting held in 2004, three more key comparisons had been published, bringing the total number to six. The total list now reads: CCAUV.A-K1; CCAUV.A-K3; CCAUV.U-K1; CCAUV.U-K2; CCAUV.V-K1 and CCAUV.W-K1.

3.2 Reports: CCAUV.A-K2

Dr M. Sinojmeri described the current status of this key comparison, which began in January 2005 and finished in September 2006. Some problems had caused the end date to slip from the original of May 2006. In total, 9 laboratories had participated, with the NIST eventually withdrawing. It was envisaged that the NIST would take part in a future SIM regional comparison. A change in sensitivity of the microphones at low frequencies of 0.06 dB had been seen, which Dr J. Valdés indicated was not so unusual for this type of device. Overall, within the project, most of the data had now been obtained, although some minor details were still missing. Dr Sinojmeri indicated a wide range of quoted calibration uncertainties (0.09 dB to 0.23 dB), and suggested that participants should use the occasion of the CC meeting as an opportunity for a satellite meeting to discuss issues related to uncertainty budget formulation. This meeting was duly arranged at the end of the first day. Professor Wallard expressed concern at the idea that this could result in a revision of the submitted uncertainties, and strongly emphasized that final uncertainty values should be declared by the laboratories within in their individual reports. It is these values which should feed into the Draft A report. Dr Sinojmeri stated that the Draft A report should be ready in the next few weeks.

3.3 Comparisons in progress: CCAUV.A-K4

Professor Rasmussen described progress made on generating the protocol document for key comparison CCAUV.A-K4, which related to the free-field calibration of laboratory standard microphones of type LS2P. Professor Rasmussen referred delegates to the draft of the protocol provided for the meeting. It was originally planned to run the key comparison in parallel with CCAUV.A-K3, although this had proved to be impossible as few of the participating laboratories were prepared to do this. To date, the PTB, NPL, CENAM and the DPLA had re-affirmed their intention to participate, although there had been no feedback from the LNE, NIST and the NMIJ. Professor Rasmussen underlined the need to know the intentions of potential participants, so that firm time-schedules could be developed. The microphones used for the CCAUV.A-K3 key comparison would be re-cycled. Professor Rasmussen said that although participants will know the sensitivities of these devices, this data would be two years old, so this was not envisaged to be a problem. He described the various merits of transportation of the microphones by hand and courier. Professor Rasmussen highlighted a few additions to the protocol document:

- the specification of the results should be to 3 decimal places as this had proved to be useful in previous key comparisons, with the consequent reduction of rounding differences;
- the actual distances used should be stated;
- the same acoustic centre should be used.

Dr Allisy-Roberts invited the CC to indicate those willing to participate. The NMIJ and LNE agreed, whilst Dr S. Forsythe said that he would check the situation with Dr Nedzelnitsky to clarify NIST's position regarding participation. Dr Valdés asked if any other NMI's were interested. Dr G. Ripper stated that the INMETRO might potentially be interested.

3.4 Future comparison proposals

3.4.1 Ultrasound power comparison

Dr C. Koch outlined plans for repeating key comparisons in the area of ultrasound. A potential time-table had been discussed and agreed at the recent EUROMET Ultrasound Subcommittee meeting held at the INRIM, Turin. For the ultrasound power key comparison, details were:

Power range	10 mW to 15 W
Frequency range	2 MHz to 11 MHz
Start date	2008

The PTB was willing to be the pilot laboratory.

Dr Enyakov asked about low frequencies ≤ 1 MHz. Dr Koch stated that transducer stability was critical in organizing a successful key comparison in this area, and the transducers used by the PTB as sources were driven at over-tones, making it impossible to achieve the lower frequencies.

3.4.2 Hydrophone comparison

For the hydrophone key comparison (realization of the acoustic pascal), the details were:

Hydrophone active element diameter	0.5 mm or 1.0 mm
Frequency range	1 MHz to 20 MHz
Start date	2010

The NPL was willing to be the pilot laboratory.

Mr S. Robinson noted the lower limit of 1 MHz, which meant there was no link up with the underwater acoustics key comparison CCAUV.W-K1. He asked whether it could not be extended down to 0.5 MHz. Dr Koch said that this was not possible due to the different calibration methods employed.

Dr Allisy-Roberts asked which NMIs would be interested in taking part in these prospective key comparisons. The responses were:

- For ultrasound power: CENAM, INMETRO, INRIM, NIM, NMIA, NMIJ, NPL, PTB, UME, and VNIIFTRI.
- For hydrophone calibration: INMETRO, NIM, NMIJ, NPL, and PTB.

The KRISS would clarify their position.

During the meeting, through discussions between Dr Koch and Dr Zeqiri, it was decided that a questionnaire would be the most appropriate mechanism of gathering information about participants, capability and the preferred timing of their participation.

Leading on from the comment made in 3.2, Professor Wallard strongly encouraged all potential pilot laboratories to follow rigorously the Key Comparison Guidelines published on the BIPM website. Returning to the issue of reporting uncertainties, he indicated that, in the protocol, the pilot laboratory may give some guidance on the anticipated components of measurement uncertainty which would appear in the uncertainty budget.

Dr Allisy-Roberts requested that the regional metrology organizations (RMOs) let the Executive Secretary know about any regional key comparisons, as these are crucial in underpinning the CIPM MRA.

4 REGIONAL KEY COMPARISONS

4.1 Reports

APMP.AUV.A-K1 Draft B

Dr T. Kikuchi presented the report on behalf of Dr S. Sato. The regional comparison involved the calibration of LS1P microphones over the frequency range 63 Hz to 8 kHz, nine NMIs participated,

including the pilot laboratory, the NMIJ. The Draft B report had been produced in August 2006. Dr Kikuchi described the methodology adopted in terms of preparation of the two devices utilized and their transportation. The microphones exhibited good stability, with 0.01 dB being the maximum change observed. A graphical representation for the degrees of equivalence at 2.5 kHz was shown and described as being typical. Dr Kikuchi described the linkage of the results to CCAUV.A-K1, with the NMIJ and the KRISS being common participants of the two key comparisons. The Draft B was formally approved by the CCAUV.

COOMET.AUV.A-K1 and COOMET.AUV.A-K1.1

Dr C. Koch presented a report on these two key comparisons. COOMET.AUV.A-K1 was a comparison of LSP1 microphones conducted by COOMET, which occurred between 2002 and 2003. A revised version of the Draft A was generated in August 2006, and the document was discussed at a meeting in Minsk and accepted by the participants to include their comments. The results were still confidential and consequently no results were presented at the CCAUV meeting by Dr Koch. The comparison COOMET.AUV.A-K1.1 constituted a bilateral comparison between the PTB and the DNDI (Ukraine) organized specifically due to discrepancies arising from COOMET.AUV.A-K1.

COOMET.AUV.A-K3

The COOMET.AUV.A-K3 was a key comparison of laboratory standard LS2P microphones, and its current status was described by Professor Rasmussen. Two microphones had been circulated, and a shift in sensitivity of 0.06 dB had been observed in the sensitivity of one of them mid-way through the process. Fortunately, the shift proved to be permanent and the device was stable thereafter. The Draft A had been discussed in August 2006, with the participants being generally happy with the results. The report would be finalised within a month or so. The results had demonstrated an improvement by the GUM, but the VNIITRI only just agreed within the combined uncertainties. Professor Rasmussen suggested that this might be due to the use of a new coupler whose dimensions had not yet been characterized. The systematic difference observed at all frequencies seemed to support this. As VNIIFTRI would have been one of the linking laboratories, the problem now arose of how to link the two comparisons to the KCRV value from the CCAUV key comparison.

Following on from previous observations, Dr Valdés enquired of Professor Rasmussen the precise mechanism which leads to the often observed jumps in microphone sensitivity. Dr Frederikson said that it probably related to a tensioning of the microphone diaphragm, and parts of the microphone might relax or move relative to one another, potentially caused by temperature variations and the differential expansions of the materials used, or mechanical shock. However, the microphones were specifically designed to keep these changes to a minimum.

EUROMET.AUV.A-K3 Draft B

Dr C Guglielmone described the schedule for this key comparison where the number of participants had been reduced form 9 to 8, due to the withdrawal of the NMi (The Netherlands). The Draft A had been produced in January 2005, with approval of the participants in May 2005. The Draft B had

been produced in June 2006. Again, there appeared to be a difference at low frequencies of 0.0025 dB. The comparison had been split into two, and one laboratory had shown an off-set in results. The overall conclusion was that there was a slight issue with measurements at low frequencies. The CCAUV approved the Draft B report.

EUROMET.AUV.U-K2 Final report

Dr B. Zeqiri described progress within this bilateral comparison between the NPL and the PTB, which covered the calibration of membrane hydrophones over the frequency range 15 MHz to 40 MHz. This had been organized as EUROMET Project 745. A variety of difficulties had been encountered during the comparison, the major one had been one of the two circulating hydrophones fail irreversibly, due to water ingress. This meant that only one hydrophone could be used for the comparison. Agreement between the NPL and the PTB was not as good as had been expected, being just within the combined uncertainties at frequencies above 30 MHz. Both the NPL and the PTB agreed that it was important to repeat this process with two hydrophones within the next two years. Consequently, this comparison was postponed

EUROMET.AUV.V-K1 Final report

Dr H. von Martens reminded the CC that this regional key comparison had taken place between July 2003 and March 2005, and had involved the circulation of three accelerometers provided by the PTB to 16 laboratories. The linking procedure adopted was that described previously, and the weighted mean method had been used to derive the KCRV. Dr Silva-Pineda asked how it was possible to deal with any differences observed in the way that the KRCV was calculated. Dr von Martens replied that for the CCAUV.V-K1, various methods had been tried to calculate the KCRV, with the results being approximately independent of the method used (within 0.05 %). The weighted mean method was the BIPM recommended procedure but clearly was dependent on participants providing reliable uncertainty assessments. Dr von Martens thanked Dr C. Thomas of the BIPM for the input she had provided. The Draft B report was approved by the CCAUV. Dr Valdés brought the CC's attention to the last issue of *Metrologia*, which provided a state-of-the art description on analysing key comparison data.

SIM.AUV.A-K1 Draft B

This was a regional key comparison of LS1P microphones, and involved 5 participating laboratories in the SIM region: the CENAM, INMETRO, INTI, NIST, and the INMS-NRC. Three B&K 4160 microphones were used within the exercise, two of which were circulated, the final device being kept in reserve. The key comparison had begun in August 1997 and so pre-dated the CIPM MRA. Measurements were completed in March 2000. Three linking laboratories were used, with the methodology of C.M. Sutton (2004) being applied (Dr Wong acknowledged the additional guidance provided by the BIPM). The Draft B report had been approved by the five key comparison participants. It was also formally approved by the CCAUV. Dr G. Ripper pointed out that the

uncertainty estimates for the INMETRO given the Draft B report in the graph at 250 Hz should be larger, in line with those given by Dr Wong in his presentation.

SIM.AUV.V-K1 Draft B

Dr D. Evans was not present to describe the latest position on this report, although the participants in the regional key comparison were able to give their views. There remained a difference in opinion regarding the method used to calculate the KCRV, with Dr Evans, from the NIST, preferring the maximum likelihood method, whereas the CENAM had suggested the weighted mean in line with the BIPM guidelines. This comparison had been started in 1997, again pre-dating the CIPM MRA, and there was an urgent need to produce the report. In the interests of doing this, and if the method of deriving the KCRV was genuinely not dependent on the method of calculation, it was suggested that the report and the method of calculation as presented were accepted. In a comment related to the relative merits of the calculation methods, Dr von Martens indicated that the maximum likelihood method required measurements over protracted periods, typically a few days and this made it very difficult for participants to implement. Dr Ripper made the suggestion that, in order to pre-empt these problems in future, both the linking methodology and the method used to calculate the KCRV, should be identified very early within the key comparison process, i.e. within the protocol itself. The CCAUV duly approved the methodology used within the report to calculate the KCRV.

4.2 Measurements in progress

SIM.AUV.V-K1.1

This bilateral comparison between the INMETRO and the CENAM was described by Dr G. Ripper. It involved the sensitivity determination of the sensitivity of B&K Type 8305 accelerometers over the frequency range 10 MHz to 10 kHz. The comparison had taken place, the measurements completed, results exchanged and the data were currently under analysis. Future actions involved the finalization of the Draft B report and the linking of the results to the CCAUV key comparison.

4.3 Future comparisons

APMP.AUV.A-K3

Dr H.S. Kwon presented an outline of this APMP regional comparison which involved the calibration of LS2P microphones. Ten laboratories were involved in the process with the KRISS acting as the pilot laboratory. There would be four linking laboratories: the KRISS, NIM, NMIA, and NMIJ. Dr Allisy-Roberts raised the issue of the linking mechanism to be used and emphasized that this should be agreed in any final version of the protocol. Dr Narang of the NMIA said that this comment was noted and would be taken into account.

COOMET.AUV.V-K1

Dr A. Enyakov gave the current status of preparation for this COOMET key comparison in the area of vibration using pure sinusoidal excitation over the frequency range from 20 Hz to 5 kHz. There were four participants, the BelGIM, DNDI, GUM and the VNIIFTRI. The draft technical protocol was currently being considered.

EUROMET.AUV.V-K1.1

Dr T. Bruns described the technical protocol for this EUROMET regional comparison related to vibration. Five European laboratories were involved, the BEV, INETI, LNE, NCM (Bulgaria), and the PTB. The comparison had been agreed as EUROMET Project 987. The key comparison involved the calibration of two accelerometer artefacts, using pure sinusoidal excitation, over the frequency range 40 Hz to 5 kHz. Participants would be asked to provide the magnitude of the complex sensitivity. Dr Bruns outlined the schedule and the measurement period was now over, having been completed in September 2006. The technical protocol was approved by the CCAUV.

5 SUPPLEMENTARY COMPARISONS: PROGRESS AND REPORTS

SIM.AUV.A-S1

Dr G. Ripper indicated that the pilot laboratory, the CENAM, was currently working on the Draft B report.

6 DEVELOPMENTS

6.1 AUV metrology for materials: CIPM Working Group

Dr J. Valdés introduced this new item to the agenda. Metrology, he explained, is the science of measurement whatever the measurement uncertainty and field of application, and the BIPM CCs had traditionally confined their activities and attention to issues such as the means of realization of the primary quantities and calibrations. In contrast, testing was sometimes seen as a lower grade activity, with increased uncertainties. Dr Valdés argued that this should not be the case and that metrology and testing should be seen as intimately linked. One example lay in the type testing approval of metrological instruments. His basic hypothesis to the CC was that the activities of the CC should not be restricted to key comparisons and calibration, but should be widened to encompass AUV testing activities, for example, the testing of materials. He invited comments from the CC as to their views.

However, before widening the discussion, Professor Wallard provided some background to the issue. It had been suggested by Dr Seton Bennett of NPL that a CC responsible for materials should be established, and the CIPM had approved the setting up of an *ad hoc* group. It was not entirely clear whether there was a requirement for such a group to become a CC, as it could be argued that the activities concerning materials could be best dealt with within the relevant CCs. For this reason, the *ad hoc* group was given a life-time of two years, after which the recommendations for the future were to be made to the CIPM (in 2007).

Several members of the CC described their NMI's activities in the area of materials testing. Mr S. Robinson described the techniques to determine the acoustic properties of panel materials used at sonar frequencies in underwater acoustics at the NPL. Dr B. Zeqiri (NPL) described the measurements applied in the area of ultrasound for characterization of the acoustic properties of tissue-like and acoustic absorbing materials. Dr Bruns described work at the PTB on the dynamic influences on force transducers and the traceable dynamic calibration of force transducers. This is with the aim to improve measurement accuracy in safety and materials testing.

Dr S. Echeverria-Villagomez cited issues that the CENAM had encountered in the automotive industry, related to the visco-elastic properties of materials. Differences demonstrated between laboratories had a real economic impact, and he felt that the activity within the Consultative Committee should reside where the key technical expertise resided, i.e. where the knowledge of acoustics etc. existed. Dr Usuda (NMIJ) felt that testing and metrology should be merged, and he mentioned the determination of engineering properties such as Young's modulus.

Dr Valdés asked the CC members to provide their written views to the BIPM, as well as to Dr Seton Bennett, so that they can be taken into account during the decisions to be made in 2007. The CCAUV was not the only CC affected. Professor Wallard gave the examples of the CCEM, CCM, CCT, with the technical fields of thermometry, radiometry and photometry and there was already some overlap between work areas.

6.2 Status of national standards

PTB (CCAUV/06-02)

Dr C. Koch described a few of the key activities at the PTB in two main areas. The first related to air-borne ultrasound, with the free-field calibration of ¼" microphones. The justification behind this work was that, despite a growing number of applications at these high frequencies (< 20 kHz), there were currently no limits on exposure and no measurement standards in place. Dr Koch described work involving extending the reciprocity calibration method up to higher frequencies. Uncertainties in the calibration of microphones were 0.2 dB at 40 kHz and 0.4 dB at 160 kHz, with Type B uncertainty components being: voltage measurement, cross-talk, standing-waves, acoustic centre determination and environmental conditions. The calibrations, in particular, the dependence on distance, had demonstrated that the free-field room performed reasonably at the frequencies of interest.

The second work area involved the construction of a new membrane hydrophone manufactured from 9 micron pvdf whose active element diameter was 200 μm. The thickness resonance of the device

was 105 MHz, and the electrode structure included a guard-ring to improve signal-to-noise. The noise-equivalent pressure was 11 kPa, or 560 Pa (with 200 averages), determined with a bandwidth of 250 MHz. Dr Koch showed calibration results up to 140 MHz. These hydrophones had not been manufactured for commercial purposes, but could be ideal candidates for key comparisons.

Within the vibration area, there was work at the PTB, undertaken in collaboration with the relevant department working on dc and low frequency, on extending the traceable calibration of voltage standards used for accelerometer calibration down to 0.1 Hz.

VNIIFTRI (CCAUV/06-04)

Dr A. Isaev gave a presentation entitled "Modern measurement techniques in the Russian underwater acoustics standards". In particular, he described the activities and responsibilities of the State Metrological Institute for Underwater Acoustics Measurements (GMIGI) which is one of the major departments of the VNIIFTRI. Dr Isaev described the range of primary methods of hydrophone calibration providing coverage in the frequency range 0.01 Hz to 1 MHz. Improvement in standards related to the application of new technologies in the development of instruments for precise measurements of pressure in closed couplers, and in using the information on acoustic field amplitude and phase distribution in free-field measurements. He gave an example of improved uncertainty in free-field hydrophone calibration which related correcting for the effects of scattering from the mount and body of the hydrophone.

CSIR-NML (CCAUV/06-07)

Mr I. Veldman provided a report of developments at the CSIR-NML since the last CC meeting. This related to activities in the area of accreditation, where the A and V Laboratory had successfully negotiated its full re-assessment by the South African National Accreditation System (SANAS), with the NMI of Taiwan (ITRI) providing the external technical assessor. The scope of accreditation was extended in both the acoustics and vibration areas. In what Mr Veldman called an exciting development, the laboratory was in the process of developing sound intensity standards. In the area of vibration, the laser interferometric systems, based on ISO 16063-11 Method 3, have been successfully implemented over the frequency range 10 Hz to 10 kHz. Directly from this, new CMCs have been submitted and indeed accepted for inclusion in the KCDB Appendix C database.

NIM (CCAUV/06-08)

The rapid developments in China in the area of vibration metrology were described in detail by Mr Q. Sun. He sub-divided the scientific research in support of this development into three frequency bands: low, medium and high. Various laser interferometric technologies (homodyne and heterodyne) and two main primary calibration methods (phase demodulation and frequency demodulation) have been applied to the determination of the complex sensitivity of transducers. Detailed work in the three frequency ranges was described: low frequency vibration from 0.1 Hz to 120 Hz; medium frequency from 10 Hz to 10 kHz and high frequency from 2 kHz to 20 kHz. These developments have been instrumental in enabling the NIM to propose a comparison with the PTB,

the INMETRO and the NPLI over the frequency range 10 Hz to 10 kHz[1]. In March 2005, Dr Suh (KRISS) conducted a successful peer review of the vibration and shock work at the NIM. The NIM CMCs in vibration have been submitted to the secretariat of APMP.

DPLA (CCAUV/06-14)

Professor K. Rasmussen described the organization of the activities of the Danish Primary Laboratory of Acoustics (DPLA). In particular, he informed the CC of the organizational changes which occurred in January 2006 and that saw the responsibilities of one of the partners, Oersted Institute, Acoustic Technology transferred to the Danish Fundamental Metrology (DFM). Simultaneously, the DFM became a limited company owned by the Technical University of Denmark. The DPLA maintains and disseminates basic field quantities for acoustics in gases and solids. Its focus is on primary calibration, or, sometimes, comparison calibrations where the measurements are unique or the number of customers is too small for the work to be commercially viable for secondary laboratories. Routine secondary calibrations, along with performance testing of acoustical measuring instruments, are undertaken by Danish accredited laboratories. Professor Rasmussen described an impending development: the offering of an accredited free-field calibration service to customers of LS1 and LS2 microphones. Current research activities involved an investigation of diffuse field calibrations of measurement microphones.

INETI (CCAUV/06-17)

As this was the first meeting of the CCAUV attended by Dr M. Nunes (INETI), he described a little of the history behind the organization of the INETI, where activity in the area of vibration was a little over 30 years old. The INETI was first invited to take part in the Vibration Working Group meeting in Berlin (March 1999), but demonstration of its capabilities was established with the participation of the laboratory in the EUROMET.AUV.V-K1 comparison. In September 2006, it was planned that the relevant entries on the CMC database would be completed. Dr Nunes described the interferometric systems used by the INETI, with homodyne and heterodyne interferometric systems providing capabilities at low and high frequencies respectively. In contrast, in the area of airborne acoustics, the INETI's capabilities are still being developed. It is planned that a primary method of microphone calibration will be established in 2007, with supporting procurement having already been started.

LNE (CCAUV/06-18)

Dr M. Lecollinet described the structural changes which had taken place in the organization of French metrology. Previously, this was the responsibility of the Bureau National de Métrologie (BNM) which comprised a group of primary laboratories and other associated laboratories. In January 2005, the French Government transferred these metrological responsibilities to a body

[1] This comparison was subsequently approved by the CCAUV as an extension to the CCAUV.V-K1 comparison, namely CCAUV.V-K1.1.

renamed the Laboratoire National de Métrologie et d'Essais (LNE). At the same time, an advisory committee (Comité National de Métrologie) was created to provide guidance to the LNE on metrology. Since 2002, the LNE has been involved in the field of acoustical metrology, with the major elements of its work being the improvement of the uncertainty of microphone calibrations and the development of methods of measuring the acoustical impedance of elements such as the capillary ducts built into the artificial ear. There has also been a re-structuring in the way accelerometry standards are provided within France. From 1974, CEA-CESTA had been the reference laboratory, but in 2005 it took a decision to cease this activity. The LNE has taken over this function, installing a new laboratory at its site at Trappes. The move has been made, with accelerometers having been calibrated on the old and new sites. The facilities at the LNE have subsequently been accredited by COFRAC. As a consequence of this change, the CEA-CESTA CMC has been deleted from the KCDB. The EUROMET Project 897 involved a comparison in the vibration area and this will be used to support CMCs re-proposed by the LNE in 2007.

NMIA (CCAUV/06-20)

Dr P. Narang described the status of standards in the area of acoustics, ultrasound and vibration at the NMIA. In the 1980's, a three-port coupler reciprocity system was established for the calibration of 1″ and ½″ microphones at 250 Hz, 500 Hz and 1000 Hz. More recently, a two-port reciprocity calibration system, based on a B&K type 5998 and various other equipment, has been commissioned, allowing the calibration of LS1 and LS2 microphones with a best expanded calibration uncertainty of 0.04 dB. To replace the B&K supplied couplers, four plane-wave couplers have been built by the NMIA Workshops and characterised by the length group. The NMIA possesses a small anechoic chamber. In order to demonstrate traceability of free-field calibrations performed at the NMIA, a new B&K LS2P microphone was purchased, with a request made to supply values for a free-calibration carried out at the DPLA. Calibrations at the NMIA using the two-port reciprocity calibration system, were used to derive free-field correction for the microphone. In response to an enquiry from Dr Valdés, Dr Narang indicated that the volume of the NMIA free-field chamber was less than 50 m^3.

NMIJ (CCAUV/06-21)

Dr T. Kikuchi described the status of national standards and research activities for the NMIJ, covering the areas of acoustics and ultrasound. Within the field of acoustics, the NMIJ had developed calibration systems for realization of the acoustic pascal. These were: primary pressure calibration of LS1P and LS2P microphones using reciprocity (CMCs now ready); primary free-field calibration of LS1P and LS2P microphones using reciprocity and comparison calibration of working standard microphones using an anechoic chamber. New standards were being developed, involved calibration of microphones at low frequencies (using a laser pistonphone), covering the range 1 Hz to 100 Hz, and high frequencies (using reciprocity in an anechoic chamber), covering the frequency range 20 kHz to 100 kHz. Dr R. Barham asked what devices would be used at these elevated frequencies, and Dr Kikuchi replied that they would be ¼″ microphones.

Dr Kikuchi went on to describe progress made in the area of ultrasound, where calibration services for hydrophone sensitivity and ultrasound power began in 2006. The primary calibration method for membrane hydrophones was based on optical interferometry and covered the frequency range 0.5 MHz to 20 MHz, although there were plans to extend this range from to 0.1 MHz to 40 MHz within a couple of years. Typical expanded uncertainties were given of their present capability. Dr C. Koch asked how the frequency response of the photodiode had been calibrated, and Dr Kikuchi indicated that a new method had been developed and he identified a reference for this within the NMIJ report. The primary standard for power is based on radiation force, and the existing capability lies in the frequency range 0.5 MHz to 20 MHz with powers between 1 mW and 500 mW. Dr Kikuchi outlined NMIJ's future programme in ultrasound which included measurements for HIFU systems and cavitation detection. He described an "Ultrasound Club" run by the NMIJ which met once or twice a year and provided a forum for discussing developments and requirements of industry.

Dr T. Usuda described the NMIJ activities in the area of vibration, with four calibration systems having been developed covering the frequency range 0.1 Hz to 10 kHz. Their CMCs had been published for calibrations within the intermediate frequency range, covering 1 Hz to 5 kHz. The various systems were described, particularly the high and low frequency systems. The former is based on a combination of a Michelson laser interferometer for the fringe-counting method (in compliance with ISO-16063-11) and an electrodynamic vibrator with airborne slider. The high frequency system is based on a homodyne Michelson laser interferometer and an electrodynamic vibrator with airborne slider; vibrator motion being in the vertical direction. In order to increase the resolution of the laser interferometer, the NMIJ has developed a modified Michelson interferometer with a multiple optical path which can be applied using the sine-approximation method. Both these new systems which have allowed an extension in the frequency range will underpin the calibration services launched in 2006. The NMIJ also plans to develop a shock acceleration calibration facility.

NPL (CCAUV/06-22)

Dr R. Barham presented highlights from the NPL's research activities in airborne acoustics which included: the development of the laser pistonphone and its use in the CCAUV.A-K2 comparison; progress made within a project to evaluate the properties of free-field rooms and the initiation of work within ISO on this topic; research to establish a measurement method for artificial ear impedance and collaborative work within the EUROMET to provide normative data for the IEC and research for determining the impulse response of artificial ears. Dr Barham provided an update on an NPL project to develop a new generation of measuring instruments based on MEMS and wireless technology. Starting with the rationale that many present measurement problems related to noise can be solved with distributed measurements using low-cost sensors, the presentation described results of acoustical and environmental testing of early prototype devices, whose sensitivity was the order of 100 mV Pa^{-1}. The importance of industrial involvement in the project was also highlighted. In response to a question from Dr Valdés, Dr Barham outlined the NPL's current thinking on the strategy behind the way in which the MEMS microphone development will be taken forward.

Mr S. Robinson gave a presentation describing some of the current research areas in underwater acoustical metrology at NPL. These included the use of optical techniques to provide an absolute

calibration of a hydrophone, and also to make non-invasive measurements of the field generated by sonar transducers operating at hundreds of kHz, by either scanning the transducer surface or implementing optical tomographic techniques. Mr Robinson also described the work to develop standards for measurement of underwater acoustics noise in support of marine environmental impact assessment.

Recent developments in the area of ultrasound metrology were described by Dr B. Zeqiri. A major highlight of the previous year was the rapid and efficient move of their facilities into the new NPL laboratories. The NPL is currently going through a process of evaluating a range of commercially available ultrasonic hydrophones in terms of a number of key performance properties. This is being undertaken in order to secure the long-term provision of the measurement services it provides, which are underpinned by Marconi devices which are no longer available. Significant progress has been made in the development of power measurement methods for HIFU fields, with a new buoyancy method allowing powers in excess of 300 W to be measured. A project which involved the industrial trialling of a cavitation sensor for high power industrial ultrasonic fields was also described. Dr Enyakov asked what hydrophones were used to characterize lithotripter fields. Dr Zeqiri replied that NPL has used membrane and needle-type hydrophones, but for application by the clinical user to test the effectiveness of operation of the lithotripter, a more direct erosion test, involving chalk or similar substance, was more appropriate.

KRISS (CCAUV/06-23)

Dr W.S. Cheung described recent activities at the KRISS in the area of acoustics, ultrasound and vibration. The 5th APMP TCAUV meeting had been held on Jeju Island, where the KRISS played host to 22 countries with approximately 300 registered members of the APMP. In the area of acoustics, the free-field determination of microphone sensitivity could be determined in the frequency range 1 Hz to 20 kHz, with calibration uncertainties in the range 0.06 dB to 0.2 dB. Present research focussed on methods of cross-talk reduction and determination of the acoustic centre. The KRISS is the pilot laboratory for the APMP.AUV.A-K3 comparison, involving 10 countries (see Section 4.3). Capability in the ultrasound area related to the measurement of power, and the existing range of CMCs were described, with uncertainties of 4 % to 12 % being specified for power in the range 10 mW to 20 W and frequencies up to 15 MHz. An informal bilateral ultrasound power comparison had been completed between the KRISS and the NIMJ in December 2005. In the field of vibration, research in the area of linear acceleration focussed on an extension of the frequency range to 20 kHz, and an investigation of the feasibility of using a PZT exciter. Activities in the area of angular motion, including a new primary calibration system, and the measurement of linear shock, were described in detail.

INRIM (CCAUV/06-24)

Dr C. Guglielmone described the formation of the Istituto Nazionale di Ricerca Metrologica (INRIM), which is the result of the merging of two Italian metrology institutes (IMGC-CNR and IEN). The new organization began operation in January 2006. Dr Guglielmone described work being undertaken in the Acoustics and Ultrasound Division. Activity in the area of vibration is currently in

the process of being reorganized. Several fundamental areas of research were described: measurement of the Boltzmann constant, measurement of speed of sound in liquids, the effects of cavitation and sonoluminescence with regard to chemical reactions and the comparison calibration of microphones in hemi-anechoic environments. Within the airborne sound arena, present INRIM activities deal primarily with improvements in the reciprocity method for primary calibration of laboratory standard microphones. Recent developments include an improved environmental control and measurement of the electrical transfer function. Dr Guglielmone described the network of accredited laboratories which take their traceability from the INRIM. Within the ultrasound area, CMCs related to power measurement had been submitted to the EUROMET for regional evaluation, supported by a bilateral comparison with the PTB. Early calibrations of ultrasonic watt meters have been carried out for users.

METAS (CCAUV/06-25)

Dr C. Hof described the activities in the area of acoustics and vibration, at the Swiss Federal Office of Metrology (METAS), where the laboratory of acoustics, which has been active for several decades, has two permanent staff. Due to the implementation of new legislation, the present activity lay mainly in the area of vibration, where METAS has responsibility for ensuring reliable measurements of vibration in buildings. Dr Hof gave an outline of the number of primary level calibrations undertaken by METAS, and the network of five verification laboratories it supports. Due to limited resources, and the concentration of this effort on supplying services for industry, the research activities have been limited. METAS successfully took part in the key comparison EUROMET.AUV.V-K1, which has underpinned their CMC entries.

BEV (CCAUV/06-26)

Dr M. Sinojmeri described the legislative changes which had taken place within Austria, which allowed private bodies to be accredited for carrying out the tests which verify measurement devices. This had started in the area of acoustics and vibration, and would eventually mean that the BEV would be able to concentrate on standardization and research activities. Dr Sinojmeri provided information to the CC on progress in primary methods of microphone calibration, and in the provision of vibration standards using a laser technique at the BEV. She also summarized the position on the BEV participation in key comparisons and its CMC entries. Research activities involved low frequency vibration standards and an investigation of the use of laser techniques for primary acoustical standard calibration methods. In response to a question from Dr Barham, Dr Sinojmeri, described the background and aims behind her reference to laser techniques as being an area of future research interest. This relates to both free-field techniques and the development of a laser pistonphone.

INMETRO (CCAUV/06-27)

Dr G. Ripper described the structure of the Acoustics and Vibration Metrology Division (DIAVI) of the INMETRO. Activities started in 1984, and the organizational structure is such that there are three

distinct laboratories: the Electroacoustics Laboratory (LAETA), the Vibration Laboratory (LAVIB) and the Acoustics Testing Laboratory (LAENA). A fourth laboratory, the Ultrasound Laboratory (LABUS), is newly developed, and is expected to be operational in 2007. Facilities and capabilities of each of the laboratories along with the rationale behind their work, were described in detail by Dr Ripper. One interesting area of work was the assessment of the acoustic performance of class-rooms, essentially to establish speech intelligibility. This related to the poor design of schools, and consequent poor acoustic performance. Dr Wong commented that there was an ANSI standard related to the design of schools. Future research in the area of vibration would address the development of a primary system for shock calibration.

CENAM (CCAUV/06-31)

Dr G. Silva-Pineda described the structure of the Acoustics and Vibration Division of the CENAM, giving the breakdown of resource in each of the three technical areas. In the vibration area, the measurement capabilities for accelerometers were the subject of a peer review undertaken by Dr von Martens. Recent developments included the development of a low frequency system (2 Hz to 50 Hz). In September 2005, the shock calibration system was officially declared as a national standard. Another measurement service being developed was one to measure energy, and a system to calibrate optical velocity transducers is currently under development, whose requirement comes mainly from the automotive industry. In the ultrasound area, there has been an interest in developing calibration methods for hydrophones, with comparisons and reciprocity methods having been successfully implemented. Currently, the frequency range is 10 kHz to 100 kHz, although work is under way to extend this down to 3 kHz. One initiative being taken is the formation of an Ibero-American network for medical ultrasound metrology. A first meeting of the group was due to be held shortly after the CC meeting, but its aim is to develop a more robust measurement infrastructure to ensure patient safety. It was pointed out that the FDA had recalled a number of faulty medical ultrasound devices which were deemed to be a risk to patients. The building of a free-field chamber at the CENAM represented a key development in the area of acoustics. Also, the free-field reciprocity calibration of condenser microphones has been developed, and is being considered for implementation as a national standard. The working frequency range is 3 kHz to 20 kHz. Work in the acoustics area was the subject of peer-review by Professor K. Rasmussen and an update of the KCDB Appendix C measurement capabilities is currently in progress.

GUM (CCAUV/06-39)

Dr M. Szelag provided a detailed description of the current state of activities within the areas of vibration and acoustics within Poland. The Central Office of Measures (GUM) was being restructured to include the Acoustics and Vibration Laboratory as part of the testing laboratories but this had not changed the activity of the laboratory. A major development had seen the accreditation of the Acoustics and Vibration Laboratories by the Polish Centre of Accreditation, using the technical expertise of assessors from the NPL (Acoustics) and the PTB (Vibration). Dr Szelag described the services which had been submitted for accreditation. She also gave figures for the number of calibrations carried out, both primary, and for end users, in the two technical areas. One

interesting development has been the initiation of inter-laboratory comparisons within Poland, the first one being for vibration, which has involved five laboratories. Addressing, the research activities of the GUM, the most important area had been the implementation of a low frequency pressure chamber for determination of the pressure response of microphones within the infrasonic frequency range. The GUM's involvement in EUROMET Project 791 "Measurement of the acoustical impedance of artificial ears", was also described. Dr Valdés commended Dr Szelag for the significant technical progress made by the GUM in the two years since the last meeting.

NPLI (CCAUV/06-37)

Dr V. Mohanan described the remit of the NPLI within India, which was to establish, maintain and improve continuously by research, national standards of measurements and calibration, and to realize the key units of the International System. Acoustical research has always been a part of the NPLI's work since it was established in 1947. The scope of the work has evolved over the years, such that it also currently offers consultancy in building acoustics, noise and vibration control, environmental impact assessment studies, ultrasonic and SODAR applications. Dr Mohanan gave a detailed description of the status of the national standards, within the areas of acoustical standards and ultrasonic standards, the calibration, testing and evaluation activities, and the research projects of the NPLI.

6.3 Presentations on research areas

PTB

Dr C. Koch described a selective snap-shot of the research activities in the area of acoustics and ultrasound at the PTB. The first of these related to the establishment of the reference zero (RETSPL) for the calibration of air-conduction audiometric equipment using 'tone-bursts' as test signals. This was relevant to the screening of all new-born children for hearing defects that had been introduced in the last 2 to 3 years within Germany. The second and third areas of research were both in the ultrasound area. The first of these related to a study to investigate methods of characterizing the effectiveness of fields applied for ultrasonic therapy, through measurements of the acoustic properties. The final area related to the use of a thermo-acoustic sensor for determining the spatial distribution of time-average acoustic intensity within medical ultrasound fields. These measurements are required by the US FDA, for example, and the thermo-acoustic probe offers a fast and relatively low cost means of establishing the maximum output levels generated by equipment. Good agreement had been observed with measurements made using hydrophones.

Dr T. Bruns described the activities of the PTB in the area of vibration, particularly in the area of shock calibration. Research in this area is targeted at formal recognition of key parameters to eliminate the spectral dependence of shock sensitivity. The PTB is also strongly engaged in the exploitation of the emerging field of laser-vibrometer calibration, for the purposes of primary and secondary calibrations. Another field of interest related to the shock area is the impact calibration of force transducers, to which a working group within PTB is devoted.

INMETRO (CCAUV/06-28)

Dr G. Ripper gave a detailed account of research in the area of vibration which involved the development of a quadrature homodyne interferometric system for determining the complex sensitivity of accelerometers. He provided an overview of a presentation recently given at the AIVELA conference in Ancona, describing the use of digital high-pass filtering to reduce the influence of LF noise on the calibration of accelerometers. The system was used to carry out measurements for the comparison SIM.AUV.V-K1.1. Future vibration projects include the development of a vibration shaker and a primary shock calibration system. In acoustics, the main activity has seen the development of microphone calibration methods which utilize the impulse response. The strength of this method is that it is not reliant on an anechoic chamber. The method has recently been compared with the PTB with good agreement. A second major area of activity within acoustics has been research in support of sound power measurement, with the INMETRO playing a key role in the Brazilian Noise Labelling Program. Ultrasound activities are still relatively young at the INMETRO, but research has included studies of the likely demand of metrology services for medical ultrasound, calibration of hydrophones using sweeps, coded pulse excitation and acoustic pressure field mapping.

Dr Valdés thanked all of the participants for their extensive presentations but indicated that, in future, to allow adequate time for discussion, material presented on the NMI activities should be restricted to new developments.

7 REGIONAL METROLOGY ORGANIZATIONS

7.1 Reports from regional representatives

APMP (CCAUV/06-16)

Dr Narang (NMIA) described the outcome of the last APMP meeting, held in Jeju island, on 5-6 September 2005. He presented the results of the regional key comparison, APMP.AUV.A-K1, whose Draft B report had been released in May 2006. The APMP.AUV.A-K3 comparison had started in June 2006, with measurements due to be completed in June 2007. The NMIA, NMIJ, NIM and the KRISS would form the linking labs with the CCAUV key comparison. A future regional comparison of ultrasound power measurements was planned, involving 4 or 5 NMIs. The ‘power’ artefact to be circulated, which will be fabricated by the NPLI, would be ready soon. A peer review of the NMIJ was planned, and the training requirements of several regional laboratories had been identified. The NIM CMCs, following the successful negotiation of the intra-region review, had now been put forward for inter-RMO Review.

COOMET (CCAUV/06-38)

Dr A. Enyakov presented the COOMET report on behalf of Dr Pozdeeva. The number of nations involved in the COOMET now stood at 13, with the recent addition of Georgia. Good relations had been established with the Romanian NMI, the INM, who participated in the COOMET sound-in-air key comparison, COOMET.AUV.A-K3. Dr Enyakov provided an update of the status of CMCs and outlined co-operation with other RMOs. For example, Dr Enyakov had attended two meetings of the EUROMET Ultrasound Sub-Committee.

EUROMET (CCAUV/06-15)

Dr E. Sadikoglu presented the report for the EUROMET. The current number of EUROMET active projects varied with the particular technical field, these being: airborne sound (6), vibration (6), ultrasound (2) and underwater acoustics (1). Dr Sadikoglu provided an extensive description of the iMERA (implementing Metrology in the European Research Area) Programme, and the basic concept of a research programme involving European NMIs. The work programme was underpinned by a series of metrology roadmaps, which indicated key requirements for metrology development over the next 15 to 20 years. For the EUROMET in the area of AUV, there were currently 6 roadmaps: 2 for airborne sound, 2 for ultrasound, 1 for underwater acoustics and 1 for vibration. The strategic thinking underpinning these roadmaps in the areas of AUV might be a useful resource for the CC.

SIM (CCAUV/06-30)

Dr G. Ripper described the current status of comparisons as they related to the SIM. Most discussion centred on the SIM.AUV.V-K1.1 comparison, which involved the determination of the complex sensitivity of accelerometers over the frequency range 10 Hz to 10 kHz. This was a bilateral comparison between the INMETRO and the CENAM involving the measurements of two 'back-to-back' accelerometers. The results are currently being analysed, and it was planned to link the results for the magnitude sensitivity to the CCAUV.V-K1 comparison. Dr Ripper questioned whether the classification of the comparison underpinning the recent NIM (China) CMC entries (APMP.AUV.2.2006) was really a CCAUV comparison, as it appeared to be very similar to the SIM.AUV.V-K1.1, which was identified as a regional comparison. Dr Allisy-Roberts outlined the reasons behind carrying out a comparison. Firstly, it could be a pilot study, to test whether or not a comparison using a particular measurement method was feasible. Secondly, it could be deemed to be a supplementary comparison designed to provide support for CMCs. Finally, it could be a key comparison if the CC agreed that it was a comparison of a key quantity. It was the responsibility of the CC to decide which of these was most suitable. It was noted that it is important to declare what type the comparison is, before it started. When the protocol is circulated, there is always the possibility, if sufficient interest is expressed, to develop a pilot study into a supplementary comparison.

It was then proposed to run a pilot study for acceleration at low frequency (2 Hz to 160 Hz). The accelerometers were ready to be sent to the participants. The following NMIs expressed an interest:

CENAM, INMETRO, NRC, BEV (in 2007), CSIR (in late 2007), NIM (would like to consider); PTB (to be decided) and NMIJ (in 2007). There ensued an extensive discussion related to issues of the types of devices to be used in a more extensive comparison and that using a courier service would add considerably to the costs of being a participant. Dr Wong indicated that potential participants should indicate from the outset whether they were willing to hand carry the devices as this may affect decisions about transport. Mr Veldman said he would support this as a supplementary comparison. In summary, Dr Echeverria-Villagomez indicated that the most appropriate way forward would be to organize the comparison as a supplementary SIM comparison, but to expand to other NMIS, using courier transportation of the devices. The CENAM would complete a registration form on this basis.

SADCMET

Mr I. Veldman described key developments within the SADCMET. One of these saw the Kenyan Bureau of Standards (KEBS) receiving funding to establish measurement standards for acoustics and vibration. The project to set up these facilities should be completed in October 2006. Another exciting project was the development of the Inter Africa Metrology System (AFRIMETS) which would stand as an umbrella body for coordinating and stimulating collaborative metrological research within Africa. It was likely that the AFRIMETS would be formed by an agglomeration of regional African organisations such as the EAMET (East Africa Metrology Cooperation), the NAMET (North Africa Metrology Cooperation), the WESTAMET (West Africa Metrology Cooperation), as well as the SADCMET, although the issue of Central Africa was currently unresolved.

7.2 Working Group on CMCs

The Working Group was due to meet the day after the CC meeting, and the CC was asked whether they would be interested in receiving minutes of the meeting. There was general agreement that it would be useful to circulate these minutes.

7.3 JCRB matters

Dr Espina and Dr Allisy-Roberts informed the CC of how to gain access to key parts of the JCRB web-pages. The JCRB would meet the following month, and Professor Wallard indicated that one of the key issues they would be discussing was the difference in definition of best measurement capability (BMC) and calibration and measurement capability (CMC). It was possible that there would be a move towards use of the simple term measurement capability (MC) but that this should be done in a way which minimizes the impact of any change. Dr Valdés offered the view that the use of the term measurement capability, was more inclusive, especially with the extensive discussions which had taken place on the widening in the scope of work included under the CC.

8 REPORTS FROM INTERNATIONAL OBSERVERS

8.1 IEC

TC 87 (CCAUV/06-35)

Dr B. Zeqiri presented a summary of the activities of the IEC TC 87. The most significant development has been a revision in its scope, which has been adjusted to remove issues of safety standards for medical electrical equipment and systems. Close liaison between TC 87 and TC 62 would be maintained. The last TC 87 meeting had been held over the period 15 to 19 May 2006, in New Orleans, Louisiana. A significant topic at the meeting was how to proceed with developing a suitable set of standards for the emerging high intensity focused ultrasound (HIFU) equipment which was finding more therapeutic applications. A recent review of the requirements for measurements in the field and a summary of existing practices, would form the basis of an IEC Technical Report. Currently, two standards were at the FDIS stage, with five at CDV. The next TC 87 meeting was likely to take place in Japan, in autumn 2007, although this was subject to an invitation by the Japanese National Committee.

WG 15 (CCAUV/06-36)

As newly appointed convenor of WG 15 – Underwater Acoustics, Mr S. Robinson provided a review of activity. Progress has been made in the revision of IEC 60565, Ed. 1, 1977: Calibration of hydrophones. This has now passed the FDIS stage with a vote expected shortly. The intention is to replace IEC 60500, Ed. 1, 1974: IEC Standard Hydrophone, with a more general standard whose suggested title is “Underwater Acoustics – Hydrophones – Properties”.

TC 29 (CCAUV/06-19)

Dr Rasmussen gave a summary of the current work programme of TC 29: Electroacoustics. He referred to the written report for the CC, and concentrated on changes. Currently, there were eight preliminary work items, with three documents at FDIS (IEC 61672-3), 2nd CD (IEC 60318-1) or CDV (IEC 60318-6) stages.

8.2 ISO

TC 108 (CCAUV/06-05)

Dr H.-J. von Martens described progress made within the TC 108 of the ISO, and, in keeping with the previous speakers, he concentrated on new developments. This included the first international standards related to the angular vibration calibration (ISO 16063-15:2006) and the calibration of laser vibrometers (16063-41). Mr S. Robinson asked for more details related to 16063-41. Dr von

Martens indicated that it covered frequencies up to 50 kHz, and that calibration was carried out using laser interferometry.

Dr von Martens then went on to describe the ISO view on some of the issues touched on under the CCAUV agenda which covered the question of whether the scope of the CC should be extended to cover testing, materials or otherwise. He indicated that the ISO view a very pragmatic one. Measurements were required to make a decision, and it was key that the whole traceability chain should be considered, from primary standards through field calibrations to customer measurements. Consequently, he would personally welcome a widening of the scope of the CC to encompass testing of materials and structures.

8.3 IMEKO

TC 22

Dr T. Bruns (PTB) provided the first report on the IMEKO TC 22, after describing the function of the IMEKO (International Measurement Konfederation), and its organization for vibration metrology. The journal for the IMEKO is called *Measurement*, and Dr Bruns described the background behind his proposal to form a new Committee, TC 22, of which he is Chairman. The Vice-Chairman is Dr T. Usuda (NMIJ, Japan), and the Secretary is Dr I. Veldman (CSIR, SA). He pointed to the website www.imeko.org/tc22 for those interested in having more details. Dr Bruns described a recent successful meeting in Rio de Janeiro which took place over the period 17 to 22 September, the XVIII IMEKO World Congress on Metrology for a Sustainable Development.

9 PUBLICATIONS

9.1 CCAUV web-pages and links

The Executive Secretary provided a practical demonstration of how to navigate around the BIPM CCAUV website.

9.2 CCAUV members bibliographies

The lists of publications provided by members of the CC were highlighted by the Executive Secretary.

9.3 Future needs of NMIs working in AUV

Dr Allisy-Roberts highlighted the AUV "Future Needs" Report which had been published on the BIPM website, but which was now 4 years old. There was a need to renew the evaluation of future strategy within the CCs and this would be discussed under item 11.1.

10 MEMBERSHIP OF THE CCAUV

10.1 Criteria for membership

Dr Allisy-Roberts re-iterated the criteria for membership of the CC that are available on the CC web pages. These were that the institute:

- should be a formally recognised institute of national level;
- be taking part in comparisons, undertaking research and publishing in peer-reviewed international journals;
- must participate actively in the meetings.

The Executive Secretary welcomed new members from the GUM (Poland) and the INRIM (Italy), as well as new observers from the CEM (Spain) and the IPQ/INETI (Portugal). With the agreement of the CC, it was agreed that the LNEC would be removed from the membership list, as they had been replaced in Portugal by the INETI.

10.2 Proposals for new members and observers

Dr Allisy-Roberts indicated that any Member States of the Metre Convention seeking to change from observer status to member status, should apply in the period June to July, for the change in status to be accepted by the CIPM the following October.

11 PROPOSALS REGARDING CCAUV WORKING GROUPS

11.1 Future needs in AUV metrology

The Director, President and Executive Secretary suggested that a small sub-group should be formed from the CC, whose remit would be to look at strategic planning, especially for the future metrology needs in AUV. The Director pointed to activities within other CCs, citing in particular the CCEM, where this kind of strategic thinking was being actively considered. It was agreed that the CCAUV

should monitor what was going on in other Committees, and to generate terms of reference for such a CCAUV Working Group, identifying its task in a clear way. These terms of reference, should be circulated to the CCAUV for comment.

11.2 CCAUV Working Group on Key Comparisons

The need for a CCAUV Working Group on Key Comparisons was considered. It was felt that, as the were no real issues relating to key comparisons within the CC, there was no real need to form such a group at this stage.

12 OTHER ITEMS

Under item 3.4, Dr C. Koch from the PTB had outlined the plans for future key comparisons in the ultrasound area. Following discussions, and in view of the interest in participation indicated by a number of laboratories, Dr Koch suggested the circulation of a questionnaire, which would be aimed at gathering more precise information about those countries that were interested, when they would feel willing to participate in either the power or the pressure key comparisons, as well as their comments on the recommended scope of the comparisons. The questionnaire would be prepared for circulation in December 2006.

Dr E. Sadikoglu brought the attention of the CCAUV members, to the InterNoise 2007 meeting, which would be held in Istanbul, over the period 28 to 31 August 2007.

13 DATE OF NEXT MEETING

This would be held in 2008, around the same time of year. Dr Allisy-Roberts requested that members of the Committee keep her informed of upcoming scientific conferences, to assist in making the final choice for the date of the next meeting.

B. Zequiri, *Rapporteur*

May 2007

Appendix A 1.
WORKING DOCUMENTS SUBMITTED TO THE CCAUV AT ITS 5TH MEETING

Open working documents of the CCAUV 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).

Document CCAUV/	
06-00	BIPM. — Draft agenda (revised), P.J. Allisy-Roberts, 3 pp. (not open access)
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