Bureau International des Poids et Mesures

Consultative Committee for Acoustics, Ultrasound and Vibration (CCAUV)

Report of the 6th meeting
(9–10 October 2008)
to the International Committee for Weights and Measures

Comité international des poids et mesures

Note:

Following a decision of the International Committee for Weights and Measures at its 92nd meeting (October 2003), reports of meetings of the Consultative Committees are now published only on the BIPM website and in the form presented here.

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

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

A.J. Wallard,
Director BIPM

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

as of 9 October 2008

President

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

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.

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], Lindfield.

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

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

National Physical Laboratory [NPL], Teddington.

National Research Council of Canada [NRC], Ottawa.

Physikalisch-Technische Bundesanstalt [PTB], Braunschweig.

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

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

Observers

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

Bulgarian Institute of Metrology [BIM], Sofia.

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

Centro Español de Metrología [CEM], Madrid.

Czech Metrological Institute/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 Physical Laboratory of India [NPLI], New Delhi.

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

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

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 6th meeting at the International Bureau of Weights and Measures (BIPM), Sèvres, on Thursday 9 and Friday 10 October 2008.

The following were present: Ph. Averlant (LNE-CMSI), R. Barham (NPL), T. Bruns (PTB), J.N. Durocher (LNE-INM), D. Dobrowolska (GUM), J.S. Echeverría-Villagómez (CENAM), S. Figueroa (DPLA), E. Frederiksen (DPLA), C. Guglielmone (INRIM), T. Kikuchi (NMIJ/AIST), C. Koch (PTB), H.-S. Kwon (KRISS), P. Narang (NMIA), V. Nedzelnitsky (NIST), R. Nel (NMISA), A. Paolero (Naval Undersea Warfare Center Newport), A. Pepelyshev (VNIIM), K. Rasmussen (DFM/DPLA), G. Ripper (INMETRO), S. Robinson (NPL), G. Silva-Pineda (CENAM), Q. Sun (NIM), U. Takashi (NMIJ/AIST), J. Valdés (President of the CCAUV), C.S. Veldman (NMISA), H.-J. von Martens (ISO TC108), A.J. Wallard (Director of the BIPM), L. Wu (NRC-INMS), B. Zeqiri (NPL), Y. Zhang (NIM).

Observers: M. Blabla (CMI), H.A. Chua (A*STAR), A. Enyakov (VNIIFTRI), C. Hof (METAS), A.E. Isaev (VNIIFTRI), A. Konkov (VNIIFTRI), A. Kumar (NPLI), M. Nieves Medina (CEM), E. Sadikoglu (UME), M. Sinojmeri (BEV).

Guests: V. Pozdeeva (BelGIM), A. Popescu (INM)

Also attending the meeting: P.J. Allisy-Roberts (Executive Secretary, BIPM), L. Érard (LNE and CIPM), L. Mussio (Executive Secretary, JCRB), C. Thomas (Coordinator of the BIPM KCDB).

Apologies were received from: P. Van Kan (NMi-VSL).

The Director of the BIPM, Prof. Wallard, welcomed delegates to the 6th meeting of the CCAUV, noting with satisfaction the many activities and the increasing membership of this Consultative Committee. He reminded delegates of the BIPM's safety rules.

The President of the CCAUV, Dr Valdés, added his welcome and introduced Mr L. Érard, member of the CIPM and Director of Scientific and Technological Research at the LNE, Paris, mentioning his participation at the recent CCM and CCEM meetings and his contribution to their discussions about redefinitions of the SI base units. At the 2008 meeting of the CIPM Dr Valdés gave a brief report on the activities of the CCAUV and advances in AUV at the international level; Dr Bennett, in particular, had been very enthusiastic about advances made at NPL.

The other delegates introduced themselves briefly. Apologies were received from P. Van Kan (NMi-VSL). The President noted that Maria Szelag (GUM) had retired and Dr Dobrowolska had replaced her as the delegate from the GUM.. He presented Mr Mussio, on secondment from the Laboratorio Tecnológico del Uruguay (LATU) as Executive Secretary of the JCRB, noting that this was the first time he had attended a meeting of the CCAUV.

---

* For the list of acronyms, click here.

Dr Allisy-Roberts and Dr Valdés proposed Dr Echeverría-Villagómez as rapporteur of the meeting, and this was agreed.

The agenda was adopted without changes or additions.

2 REPORT OF THE 5TH MEETING OF THE CCAUV 2006

Dr Valdés summarized the main points of the minutes of the 5th meeting of the CCAUV. There were no comments. Prof. Wallard and Dr Allisy-Roberts thanked Dr Bahram Zequiri for his work as rapporteur over the previous four years.

3 CCAUV KEY COMPARISONS

3.1 Published comparisons

Dr Allisy Roberts gave an overview of the status of CCAUV key comparisons in the BIPM key comparison database (KCDB). She highlighted the following:

- CCAUV.A-K4 (2006−2008): measurements completed and report in progress;
- CCAUV.V-K1.1 (2006−2007): report in progress;
- CCAUV.U-K3 (2008−2010): measurements in progress;
- CCAUV.V-K2 (2009−2010): protocol complete.

3.2 Reports

3.2.1 CCAUV.V-K1.1

Dr Bruns summarized the progress of key comparison CCAUV.V-K1.1, in which four laboratories were participating (see CCAUV/08-04). This comparison is of sinusoidal acceleration measurements (magnitude and phase) over an extended frequency range. He explained the analysis of the deviations observed. Some problems had arisen with one of the travelling standards and further investigations were required at about 5000 kHz. .Dr Valdés asked for action to be taken. Dr Bruns mentioned that a new CCAUV key comparison on vibration had been proposed to address this. Dr Narang (NMIA) asked about the causes of the drift. Dr Bruns drew attention to the atypical behaviour of one of the transducers. Mr Érard asked whether the problems encountered at the NPLI had any impact on their published CMCs. Dr Thomas confirmed that the NPLI had not declared any CMCs in this field.

3.2.2 CCAUV.A-K2

Dr Sinojmeri (BEV) presented the results of CCAUV.A-K2 and its link to CCAUV.A-K1 (see CCAUV/08-14). Prof. Wallard noted that, as the NIST had cancelled its participation in CCAUV.A-K2, there were no participants from the Inter-American Metrology System (SIM). Dr Nedzelnitsky (NIST) pointed that from the outset the NIST had made its participation in CCAUV.A-K2 conditional on the development of its new acoustic system. As the new system was not ready in time, the NIST had had to cancel its participation. He added that the NIST or another laboratory could carry out the linking when ready. Dr Narang (NMIA) asked how traceability down to 2 Hz could be achieved. Dr Sinojmeri commented that it was not practicable to go as low as 2 Hz. Dr Valdés asked Dr Barham (NPL) about the advantages of using laser-calibrated piston phones at such low frequencies. Dr Barham replied that the main advantage is to provide a link to another methodology. Dr Thomas queried the term "linking", pointing out that the two key comparisons are not linked by a single graph; she suggested that the term "linking" should be removed from the report. Dr Sinojmeri and Dr Allisy-Roberts confirmed that the main intention of the comparison had been verification, and Dr Valdés noted that this was mentioned in the report of the comparison.

Dr Nedzelnitsky noted that leakage was one factor of uncertainty, and other sources of error included dust and surface roughness. He drew attention to the consequences of using coupling grease or not, and asked about any developments on surface roughness and couplings. Dr Sinojmeri pointed out that the rules of the comparison indicated that grease should not be used. The comparison relied on the stability of the standards and the repeatability of the results. She offered to prepare a separate report indicating some of these considerations, and other contributions to the uncertainty such as deviations from flatness. Dr Nedzelnitsky and Dr Sinojmeri exchanged ideas on degrees of equivalence and laboratory capability. Dr Koch (PTB) thought that the report covered the most important aspects of the comparison and there was no point in asking for changes. He asked what could be learnt from the comparison, such as how critical is the role of grease.

Dr Valdés summed up the discussions and emphasized what had been learnt about the two methodologies - reciprocity and interferometry - used for microphone calibrations, particularly at low frequencies. Dr Nedzelnitsky pointed out that both methodologies are affected by surface roughness. Dr Valdés mentioned problems that might arise at 0.1 Hz, as there are already known to be problems at 1 Hz or 2 Hz and noted his own interest in research on $1/f$ noise, which he thought should be considered in the strategic planning of the CCAUV.

Dr Allisy-Roberts stressed a point made in Dr Sinojmeri's report, that every participant in a key comparison should provide a full uncertainty budget. Dr Bruns commented that such a requirement does not mean that these full uncertainty budgets should be included in the final report. Prof. Wallard reminded delegates that every participant should submit their results along with a complete uncertainty budget, and, for transparency, this information is normally published in the report.

3.3 Comparisons in progress

3.3.1 CCAUV.U-K3

Dr Koch presented the protocol, timetable and list of participants for key comparison CCAUV.U-K3 (see CCAUV.08-27). He explained the main characteristics of the comparison, noting the technical details, the loop organization, and the general logistics; the UME measurements were scheduled for November 2008. The protocol was accepted without comment. Dr Koch invited the participants to attend a brief meeting later in the day.

3.4 Future comparison proposals

3.4.1 CCAUV.V-K2

Dr Bruns presented the technical details and pointed out the advantages of another proposed key comparison, CCAUV.V-K2 (see CCAUV/08-27). Among the main technical aspects were a fixed set of frequencies in the range from 10 Hz to 10 kHz, and consideration of additional uncertainty components below 40 Hz. At least two laboratories would perform the data analysis independently to avoid error. He requested participation of NMIs from each regional metrology organization, preferably two or more NMIs from each. Other organizational details of the comparison included a star-type programme, transport of the accelerometers by courier services, and a strict measurement schedule allowing a measurement period of four weeks per laboratory (with six weeks in total per participant), giving a total measurement period of 18 months.

Dr Valdés highlighted the relevance of the comparison and asked for volunteers to participate. Representatives of the following NMIs agreed: PTB (pilot laboratory), BEV, DPLA, LNE, METAS, UME, KRISS, NIM, NMIA, NMIJ, CENAM, INMETRO, NMISA and VNIIM.

Dr Narang noted that the NMIA does not make phase measurements and asked if it would be possible to participate without these measurements. Dr Bruns said that the phase measurements could be made optional, although it was desirable that they be completed by more than half of the laboratories. Eight of the NMIs confirmed that they were able to measure phase, and it was agreed to make this part of the protocol optional.

Dr Usuda (NMIJ) asked about the artefacts to be used and specific uncertainty components due to triboelectric effects. Dr Bruns replied that better transducers would be used for the measurements and there would be no need to include triboelectric effects in the uncertainty budget.

Dr von Martens commented that the comparison involved measurements at a large number of frequencies (37) and NMIs (14). He suggested that the list of proposed frequencies be revised to avoid resonant effects, rocking motion, etc. Dr Bruns offered to review the set of frequencies, and said that once agreed the list of frequencies would be specified in the protocol.

Dr Sinojmeri commented that it might be difficult to perform all the measurements within four weeks. The suggestion was to evaluate progress every week and report the measured values and evaluate linearity.

Dr Ripper suggested considering the effects of temperature at higher frequencies.

Dr Valdés asked Dr von Martens how the frequency series in CCAUV.V-K1 had been decided, and what considerations had been taken into account. Dr von Martens replied that he had considered around 12.5 Hz as the lower end, as opposed to 10 Hz or 16 Hz but 40 Hz had finally been chosen for this first comparison.

Dr Valdés asked the participants to confirm their interest regardless of the list of frequencies chosen. All participants confirmed their decision.

3.4.2 CCAUV.W-K2

Dr Robinson (NPL) proposed a new key comparison on underwater acoustics (see CCAUV/08-31). The scope would be the low-frequency range, from 20 Hz to 1 kHz. He emphasized the need for different calibration techniques to be tested, besides free field and reciprocity. Some aspects of the protocol were still to be defined, such as which transfer standards to use.

Dr Valdés mentioned a previous comparison in underwater acoustics that had been carried out in the Ukraine. He asked for expressions of interest in the proposed new comparison. The NIST, NPL and VNIIFTRI declared an interest in participating, and possibly also the NIM and NPLI. Dr Robinson added that the Ukrainian NMI would like to participate, but is not allowed to because Ukraine is an Associate of the CGPM and not a Member State. Dr Valdés asked about INRIM, and Dr Guglielmone replied that the INRIM was not in a position to participate either.

4 REGIONAL KEY COMPARISONS AND LINKS

4.1 General aspects

Dr Bruns suggested that eight years was an appropriate length of time after which key comparisons should be repeated. It was now eight years since CCAUV.A-K1 and it was therefore due to be repeated. Dr Valdés suggested circulating a questionnaire on changes in NMI standards and measurement systems, their set-ups, CMC declarations, etc. Dr Barham mentioned that as IEC written standards were being revised this may be an opportune time to review the situation. Dr Narang suggested waiting until the new written standards were published, to make sure the CCAUV and IEC were aligned. Dr Allisy-Roberts proposed a consultation on this question in advance of the next CCAUV meeting.

Dr Nedzelnitsky reflected on the relationship between material standards and documentary standards. Prof. Rasmussen said that the new IEC standard should be ready for January 2009. He suggested including phase measurements in the next comparison, taking the exact frequencies, in 1/6ths or 1/8ths of an octave, instead of the standard frequencies from 2 Hz to 10 kHz.

Dr Narang insisted that the lower limit of 2 Hz may limit the participation of many NMIs. Dr Barham accepted that this was possible, but said that the key comparison was not necessarily appropriate for all NMIs. Dr Koch suggested that the NMIs be consulted about each specific aspect: phase, lowest frequency, etc. Dr Barham volunteered to draft the suggested questionnaire.

4.2 Reports

4.2.1 CCAUV.A-K4 (CCAUV/08-34)

Prof. Rasmussen informed the meeting that the first Draft A report of this key comparison had been circulated to the participating NMIs so that they could review their results, particularly in cases where unexpected values were obtained. The final report should be ready by mid-November 2008.

4.3 Comparisons in progress

4.3.1 EUROMET.AUV-V-K1.1 (CCAUV/08-04)

Dr Bruns reported on the progress of the key comparison EUROMET.AUV-V-K1.1, covering the technical aspects, motivation and list of participating NMIs. He gave the results of the comparison and outlined its relationship with CCAUV.V-K1. He noted that the comparison had been generally successful, although it was performed under non-optimal conditions; some of the problems and challenges presented had already been solved.

Dr Thomas commented this was not a supplementary comparison, but a complementary comparison at the same level as the previous CCAUV.V-K1. Some doubts were expressed about the degrees of equivalence, so Dr Bruns agreed to send a draft for her to review.

Dr Valdés asked Dr Bruns to go over the arguments about service categories for vibration measurements. These were given as accelerometers, laser vibrometers and measurement chains.

A discussion followed on the following topics: What is the frontier line? To have a direct reading? What else? Dr Valdés asked the participants to keep these questions in mind for discussion under agenda item 11.2, on CMCs.

4.3.2 COOMET.AUV.A-K1 and COOMET.AUV.A-K1.1 (CCAUV/08-05)

Dr Koch reported on the status of the key comparisons COOMET.AUV.A-K1 and COOMET.AUV.A-K1.1 (see CCAUV/08-05). These comparisons were of LS1P microphones in the frequency range 63 Hz to 10 kHz, and there were five participants. There were no comments.

4.3.3 SIM.AUV.V-K1 (CCAUV/08-30)

Dr Nedzelnitsky spoke about the status of the key comparison SIM.AUV.V-K1 (see CCAUV/08-30), which represented the status of the NMI capabilities at the time of the comparison (1997-1999). Dr Thomas mentioned an additional bilateral comparison SIM.AUV.V-K1.1 between the CENAM and the INMETRO, and there were no other comments.

4.3.4 Other SIM comparisons

Dr Ripper then described the bilateral comparison on vibrations between CENAM and INMETRO (SIM.AUV.V-K1.1). The scope of the comparison is low frequencies, in the range 10 Hz to 10 kHz. A report is being drafted.

4.3.5 APMP.AUV.A-K1.1

Dr Narang gave an update on the bilateral key comparison APMP.AUV.A-K1.1. There were no further comments.

4.3.6 APMP.AUV.A-K3.1

The report of this comparison is at Draft B stage and will soon be published.

4.3.7 COOMET.AUV.A-K1

Dr Pepelyshev (VNIIM) confirmed that the Draft B report for this acoustics comparison was complete and would soon be published.

4.4 Future comparisons

4.4.1 EURAMET.AUV.V-K1.2

Dr Bruns described a future EURAMET comparison in vibration.

4.5 Linking regional comparisons

Dr Sinojmeri reflected on methods for linking the results of comparisons. She mentioned a review of the literature and referred to the implications of three methods: those of von Martens, Allisy-Roberts and Sutton. She suggested a review of the linking procedures used in different CCAUV comparisons by updating the Allisy-Roberts method. Dr Allisy-Roberts noted that her paper CCAUV/04-27, "Brief guidelines for linking RMO key comparisons to the CIPM KCRV", which had originally been written as a guide for CCRI comparisons, had now been superseded. Dr Narang supported the idea of discussing the methods already used and of choosing a preferred method. Dr Nedzelnitsky said that the ideal solution would not necessarily lead to a single method, as each situation has different characteristics. Another valid approach would be to minimize the expected uncertainty values. A paper by Rukhin and Strawderman on the statistical aspects of linkage analysis[1] would make a useful contribution to the debate. Dr

[1] A.L. Rukhin and W.E. Strawderman, 2007, Statistical aspects of linkage analysis in interlaboratory studies, *Journal of Statistical Planning and Inference*, 137, pp. 264–78. www.elsevier.com/locate/jspi

Bruns said he did not wish to change the methods used in his report, as every method has its drawbacks. Sutton's paper[2] linking the laboratory results to the key comparison reference value (KCRV) had been used by Dr Sinojmeri, but the uncertainty of its KCRV was not considered. However, the equations in her analysis, following the Sutton paper, do take the KCRV into account. Dr von Martens discussed the conditions of his analysis in the CCAUV.V-K1 comparison. The situation of each of the laboratories that had produced very stable measurements was considered and it was debated whether to take the PTB values as reference. Dr Allisy-Roberts noted that, while the von Martens method worked well in this situation and his report showed an excellent comparison among methods, taking such a decision should not necessarily set a precedent. The complexity of linking comparisons was reflected by the fact that about 300 papers refer to this issue. Dr Nedzelnitsky emphasized the convenience of using different methods for different situations, Dr Bruns emphasized the relevance of using methods that are as objective as possible, and Dr Valdés highlighted the correlation between the values to be linked. Many papers also treat the way in which variance should be considered, such as several by T.J. Witt on electrical metrology.

5 SUPPLEMENTARY COMPARISONS: PROGRESS AND REPORTS

5.1 SIM.AUV.A-S1

Dr Silva-Pineda described the SIM pistonphone comparison. The Draft B report was in preparation and was expected to be ready by the end of 2008. Dr Nedzelnitsky asked for the report to be circulated among members of the SIM working group before publication.

6 REPORTS FROM THE WORKING GROUPS

6.1 CIPM *ad hoc* Working Group on Materials Metrology

Prof. Wallard reported on the CIPM discussion on materials and testing and their decision to set up an *ad hoc* Working Group on Materials Metrology (WGMM), mentioning also the activities of the Versailles Project on Advanced Materials and Standards (VAMAS). A report by S. Bennett on the *Evolving Need for Metrology in Material Property Measurements* has been made available at: http://www.bipm.org/utils/common/pdf/WGMM2008.pdf.

The report includes a recommendation to set up a Working Group within the CCAUV to address AUV properties of materials, to establish discussions with the VAMAS groups, as well as the corresponding ISO an IEC committees, and to address such issues as traceability of materials' properties, testing methods and other relevant topics.

---

[2] C.M. Sutton, 2004, Analysis and linking of international measurement comparisons, *Metrologia*, 41, pp. 272–77, eq. 9.

The VAMAS will be asked to nominate a specific contact person for each of the Consultative Committees. The VAMAS delegate will make a presentation to the new CC Working Group on how VAMAS is approaching the question of metrology in material property measurement, and will encourage networking of the NMIs working in specific areas. The Working Group will define its own Terms of Reference and areas on which to focus, following the example of the CCM and CCT, which have already established their own such Working Groups.

Dr Valdés mentioned the discussion on the denomination of "Metrology for Materials", or "Metrology for Materials Testing". The second version was favoured by the NPL, among others, but it was argued that testing is a very broad activity. There is an artificial distinction between calibration and testing laboratories, although both are metrology laboratories. This discussion also affects accreditation processes, in which testing laboratories do not always declare their uncertainties. The task of the CCAUV was to promote development on this issue.

Prof. Wallard proposed forming a CCAUV Working Group on Materials Metrology. Dr Nedzelnitsky asked about the scope of such a group. Prof. Wallard noted that this was addressed in the Bennett report (http://www.bipm.org/utils/common/pdf/WGMM2008.pdf) and added that proficiency testing would be included, among other issues. Dr Nedzelnitsky commented that at the NIST an entire laboratory is devoted to materials science.

Dr Valdés noted that research on materials properties can be a very interdisciplinary activity, citing as an example work on polyurethane and its properties as a fire retardant. He asked for volunteers for the group, to be known as the CCAUV Working Group on Metrology for Materials. Delegates from the following NMIs agreed to serve: BEV, CENAM, INMETRO, NIM, NIST (A. Paolero), NMIJ, and NPL.

6.2 Strategic Planning Working Group: Future needs in AUV metrology

Dr Zeqiri (NPL) drew attention to an earlier report, which did not include vibration metrology, and said that a reassessment was now necessary. He gave examples of new key areas of work from acoustics, acceleration and vibration. Given that strategic roadmapping is being adopted widely, and that strategy is about making choices through prioritization and as such it affects outputs (which must go beyond key comparison planning), he said it was important to consider what strategic planning meant for the CCAUV. Dr Valdés then reflected on the goals of the CCAUV: strategic planning was required in metrology at the nanoscale, for example.

Prof. Wallard asked how the staff of NMIs can best use the guidance of the CCAUV to define their research programmes at national level.

Dr Valdés asked Dr Sadikoglu about ways of defining AUV roadmaps in Europe. The approach focused on social priorities and quality of life: health, environment and safety. Dr Sadikoglu said that a document was already available on the restricted-access EURAMET web page, and he would make it available to CCAUV members via the BIPM website.

Dr Narang drew attention to the relevance of health aspects of metrology.

Dr Nedzelnitsky noted that some of these issues are already addressed by standardization bodies such as ANSI, IEC and ISO, which deal with processing techniques.

Dr Echeverría-Villagómez mentioned the discussions held at the CENAM on the subject of strategic planning in AUV. The lines of work covered were:

- science: the special characteristics of elastic waves in different media;

- technology: sensors (e.g. vibrometers, MEMS, new materials); techniques (e.g. refined interferometry methods, signal processing, image processing); improved calibration methods (e.g. traceability to time and frequency);
- user tendencies (e.g. regulations in acoustics, vibrometry in aviation monitoring, medical ultrasound).

Dr Nedzelnitsky gave examples of various ultrasound techniques.

6.3 Key Comparison Working Group proposal

Dr Valdés and Dr Allisy-Roberts emphasized the relevance of creating a Key Comparison Working Group (KCWG), particularly in the light of problems that had arisen in many Consultative Committees linked to the analysis and interpretation of data. Many issues could and should be addressed by such a Working Group, and the BIPM could organize a workshop if appropriate.

Dr Bruns agreed that such a Working Group would be very helpful. Prof. Wallard added that further benefit would accrue by encouraging analysis of how the results of each key comparison affect other areas of metrology. Dr Narang thought it would be useful to have guidelines for KC Working Groups, giving criteria for decisions about artefacts, outliers, and so on. Dr Silva-Pineda thought that the group should also address the traceability of AUV measurements to time and frequency standards.

The members of the CCAUV KCWG (PTB, CENAM, BEV, DPLA, CEM, NIST) will consider the proposal.

6.4 CMC's Working Group

Dr Veldman reported on CMC criteria and some of the problems faced by the CCAUV. Dr Valdés outlined the experience in the CCTF which had decided to take specific actions by declaring the whole frequency range and then defining scopes.

Dr Bruns mentioned discussions in EURAMET about how key comparison results should be considered in CMC reviews, and asked whether those rules could apply to the CCAUV. Dr Veldman replied that he had not considered those rules, but the discussion is ongoing and he will take the information into account.

7 REPORTS FROM THE NMI

7.1 PTB (CCAUV/08-09)

Dr Koch gave an introduction to sound and vibration in life and followed this by giving a brief description of AUV standards and calibrations at the PTB. He presented developments in the following areas: phase calibration of hydrophones; hearing threshold and thresholds of auditory evoked potentials of click and chirp stimuli; measurement of output power of high-intensity

ultrasound; time delay spectrometry techniques; the principle of pulse calibration; phase calibration of hydrophones; auditory evoked potentials; and high intensity therapeutic ultrasound (HITU).

In response to a question from Dr Barham, Dr Koch explained the reasons for the different effects of click and chirp in hearing.

7.2 INRIM (CCAUV/08-13)

Dr Guglielmone described developments on the INRIM force balance for ultrasound power measurements and INRIM's recent acquisition of new apparatus. He explained some of the advantages as well as the problems encountered (frequency dependence of load cell sensitivity, much higher noise, etc.). Work on comparisons was also described.

In response to a question from Dr Koch, Dr Guglielmone explained that the frequency dependency of the load cell sensitivity was related to the measurement of the first harmonic of the repetition frequency.

Dr Valdés asked for more details related to the sound characterization of materials. Dr Guglielmone replied that the INRIM was carrying out studies on the speed of sound in, and the absorption properties of, materials under different pressures.

7.3 NMISA (CCAUV/08-17)

Dr Veldman described the activities of the NMISA in view of its reaccreditation, including an expanded scope of vibration and acoustic work and the upgrading of equipment and systems.

7.4 DPLA (CCAUV/08-19)

Prof. Rasmussen reported that the DPLA had been granted resources to establish a Centre of Excellence for Acoustic Metrology. The main objectives of the Centre are: to develop a five-year strategy; to cooperate with leading institutions in research on acoustic metrology; to participate in the international interchange of knowledge; and to support Danish society. A number of pilot projects and other studies of interest will run up to the end of 2009. These will include: calibration of microphones at low frequencies; calibration of acoustic transducers at high frequencies (ultrasound); diffuse field calibration; and technical issues.

7.5 LNE (CCAUV/08-20)

Dr Durocher presented the work of the LNE in the field of acoustics. This included improved accuracy in microphone calibrations and a new coupler designed for the measurement of input impedance with four open tubes at its end. In the field of vibrations, he described an improved interferometric method for accelerometer calibrations and a new system for low- and medium-frequency calibrations.

7.6 NMIA (CCAUV/08-21)

Dr Narang presented the work of the NMIA on the free-field calibration of microphones and new software for the automated measurement of free-field response microphones. The software was written using Agilent's VEE Pro. In the field of ultrasound, Dr Narang presented a new power balance built by the NPL, UK, using a Sartorius balance of 0.01 mg resolution, for transducers of 1 MHz, 3 MHz and 15 MHz. Estimated expanded uncertainties ($k = 2$) are about 5 % to 8 % below 20 mW.

Dr Valdés asked how the software was validated. Dr Narang replied that the NPL had its own protocols for software validation. Validation was best achieved by comparison of results step-by-step. Dr Zeqiri and Dr Robinson added that to test the results known data is entered into the software. Dr Narang mentioned that the NMIA also has a working group on software validation and they also use system signals of known distortion to verify the results. He recommended that each NMI should have a working group on software validation. Dr Ripper suggested that this issue should be discussed by the KCWG, since software validation is an important part of key comparisons.

7.7 CENAM (CCAUV/08-22)

Dr Silva-Pineda reported on work at CENAM, including: vibrations with MEMS accelerometers; calibration of vibration transducers at low frequencies; and secondary systems for back-to-back accelerometer calibration from 50 Hz. He explained the interferometry system for accelerometer calibration and the ranges achieved at CENAM, as compared with ISO 160. He also demonstrated the coincidence method by laser interferometry to achieve lambda/4 measurements. Dr Silva-Pineda thanked Dr von Martens for his support of the CENAM vibrations group. He outlined collaborative work with industry on non-destructive testing techniques using ultrasound and work under way on acoustic properties of materials, he then summarized CENAM's projects in the fields of noise, vibrations and hardness.

Dr Usuda asked about the quality systems ISO 9001 and ISO 17025. Dr Silva-Pineda described the checklist of requirements for the two ISO standards, and the use of ISO 9001 for administrative aspects and ISO 17025 for technical matters. Dr Valdés asked about the MEMS accelerometers. Dr Silva-Pineda highlighted their advantages of size, price, and stability as well as their potential for further developments. Dr Valdés recommended that the CCAUV Strategic Planning Working Group should take this work into account. In response to a question from Dr Zeqiri, Dr Silva-Pineda described the application of ultrasound cleaning in the automotive industry.

7.8 NMIJ (CCAUV/08-20)

Dr Usuda briefly presented the management structure of the NMIJ within the Japanese Agency of Science and Technology (AIST). He described their four accelerometer calibration systems: 0.1 Hz to 2 Hz; 1 Hz to 200 Hz; 20 Hz to 5 kHz; and 5 kHz to 10 kHz. Dr Usuda described other projects at the NMIJ including two portable calibration systems, one for accelerometers and another for charge amplifiers. He also demonstrated a system for shock calibration of accelerometers and a system for vibrometer calibrations according to the ISO method. Dr Usuda

went on to explain the operation of the laser Doppler vibrometer and highlighted various aspects relevant to the classification of services.

Dr Kikuchi described the development of new calibration systems in acoustics for infrasound (1 Hz to 20 Hz). He reported on the calibration system for the laser pistonphone and a small anechoic chamber for microphone calibration. Dr Kikuchi described the capabilities of the NMIJ for calibrations of ultrasonic power and hydrophone sensitivity, and measurements of ultrasonic field parameters and sound velocity. He mentioned new research in ultrasonic measurement and calibrations, including power measurements by calorimetric methods (1 MHz, up to 20 W), and a robust hydrophone for high intensity ultrasound (up to 20 MHz).

Dr Robinson queried Dr Kikuchi's statement that there was 'no need for polarization' in the fabrication of hydrophones. They agreed to discuss this issue further. Dr Kumar asked about the external validation of the ultrasound measurements. Dr Usuda regretted that there were no comparisons planned for these measurements and asked the KCWG to consider this.

7.9 METAS (CCAUV/08-25)

Dr Hof gave a presentation on the work of the acoustics and vibrations laboratory at METAS, and the ongoing discussions about new regulations for limiting vibrations in homes. He described the calibration and verification services for sound level meters, sound calibrators, and audiometers, and conformity of hearing aids, and outlined research on accelerometer calibrations along different axes and the calibration of artificial mastoids.

Dr Narang asked how METAS deals with the whole range of validation for sound level meters. Dr Hof replied that METAS carries out some verifications at the PTB. Dr Koch asked about the legal basis for verification of audiometers. Dr Hof said that in Switzerland there is an agreement for METAS to establish the conditions for verification.

7.10 NPL (CCAUV/08-26)

Dr Barham presented the NPL's updated primary standard for sound in air, its new ISO 17025 accredited services and its research on ear simulator impedance, including finite element modelling being carried out in association with the Technical University of Madrid. He then described the NPL's work on MEMS measurement microphones with a noise floor below 30 dB A, a 5 % total harmonic distortion (THD) limit and a frequency response beyond 20 kHz. He also described the DREAM Sys for noise mapping, developed in collaboration with other organizations, and a system for optical measurement of sound in air.

Dr Robinson outlined the NPL's work on acousto-optical tomography, using techniques of optical tomography and sensing changes in the refractive index. Dr Robinson also reported on underwater radiated noise measurements related to offshore marine regulations and sediment acoustics.

Dr Zeqiri reported on a system for the pyroelectric measurement of ultrasound power. He described the thermoacoustic properties of tissue mimics and the relevance of materials metrology in this area. Dr Zeqiri also spoke about the development of reference methods for acoustic cavitation with a 25 kHz limit reference vessel.

In response to a question from Dr Bruns, Dr Robinson explained that the temperature is kept constant during laser scanning of the ultrasound field.

Dr Nedzelnitsky asked about the chemical composition and other characteristics of the smoke used in the NPL's acoustics research, and possible negative effects such as toxicity. Dr Barham stated that this work had previously been carried out at Edinburgh University and they had encountered no problems with it.

Dr Kwon asked about the parametric array source in ultrasound experiments and the power, which is usually low. Dr Robinson replied that there are other methods for producing ultrasound fields, but they require a directional source in order to discriminate between different directions. They also need to produce pulses, which are well controlled by this type of array.

Dr Valdés mentioned a possible problem with MEMS microphones designed by Lucent Technologies, in that they measure in different directions. Dr Barham will investigate the matter although no problems have been reported.

7.11 KRISS (CCAUV/08-29)

Dr Kwon presented the work at KRISS on acoustics, ultrasound, vibration, acoustic emission and underwater acoustics. He described bilateral comparisons with the Indonesian laboratory in the field of acoustics and the development of an optical microphone. He also outlined a new power measurement system for ultrasound, and work on the estimation of phase lags for a linear accelerometer. Dr Kwon also reported on development of an angular acceleration measurement system, collaboration with the company Brüel & Kjær (B&K), and a new angular acceleration exciter. He described a calibration system for acoustic emission sensors and the transmit voltage response (TVR) measurement of underwater transducers using time window methods.

In response to a question from Dr Robinson, Dr Kwon replied that the highest frequency reached in underwater acoustics was about 6 MHz. Dr Barham asked about production of MEMS microphones. Dr Kwon stated that KRISS has some capabilities for producing MEMS, although they are limited.

7.12 INMETRO (CCAUV/08-33)

Dr Ripper reported on INMETRO's work on CCAUV.A-K4, a new 2.5 m^3 anechoic chamber, and improvements in the digital signal processing system. He reported on work carried out to suppress cross-talk in microphone calibrations using the subtraction technique and suppression of multiple back-scattering using time-selective techniques. Dr Ripper outlined INMETRO's work in the field of vibrations, including participation in CCAUV.V-K1.1 and work on improving the measurements and the new shock calibration system for accelerometers. He also described work in the area of ultrasound, including the hydrophone calibration system, a radiation force balance, and a field mapping system.

7.13 GUM

Dr Dobrowolska reported on GUM's low frequency pressure chamber for sound level meters with the G-frequency weighting characteristic defined according to ISO 7196.

8 RESEARCH AREAS

8.1 PTB

Dr Bruns presented recent developments in shock calibration devices at the PTB. He described a system for shock calibration devices with three different Hopkinson bars for different shock spectra and PTB's collaboration with industrial calibration laboratories. He demonstrated the model equation and its solution, identification by sine excitation measurement, identification by shock excitation measurement and the prediction of output based on identified parameters. The presentation emphasized the benefit of the model-based parameter identification (MBPI) and prediction. Dr Bruns presented conclusions on MBPI with sine and shock excitation and the advantages of MBPI for comparability of measurements.

Dr Valdés asked about the shapes of the frequency spectra used by the PTB and the SPEKTRA company, since they had different scales. Dr Bruns confirmed that although the scales are different, the shape of the spectra were as shown. Dr Usuda asked about the linearity of the system. Dr Bruns explained that an algorithm within the system carries out a fit analysis to define whether or not a linear model applies. Dr von Martens commented on shock sensitivity in peak values, noting that the standard ISO 16063-13 has one part for the time description, which is defined by the peak values, and another defined in terms of the spectra description with their uncertainties. The analysis presented did not appear to consider part 14 of the standard.

8.2 **VNIIFTRI** (CCAUV/08-02)

Dr Isaev presented two approaches used at VNIIFTRI for hydrophone calibrations. He talked about the problem of reflections that occur during hydrophone free-field calibrations. He mentioned the traditional approach of using tone-burst radiation with time selection (TDS) and the alternative method of complex moving weighted averaging (CMWA) of projector-hydrophone transfer impedance (TI) frequency dependence. He explained the theory of the CMWA method and the advantages that it has for attenuation of reflections.

Dr Robinson asked about the robustness of the method for more than three reflections. Dr Isaev replied that attenuation of three reflections is sufficient.

9 REGIONAL METROLOGY ORGANIZATIONS

9.1 JCRB

Mr Mussio gave a report on the work of the JCRB related to the CIPM MRA, including in particular the requirements for peer reviews and demonstration of quality systems. He reported on, the 18th meeting of the JCRB, held in South Africa, and its 19th meeting, held in Ottawa, Canada. Mr Mussio provided details of the requirements for the declaration of CMCs within the CIPM MRA.

He mentioned that at the JCRB meetings in May 2008 and September 2008, modifications had been made to the recommendations agreed in Wellington, New Zealand. These modifications concern the conditions for establishing traceability of CMCs to other NMIs that have CMCs already approved.

9.2 APMP (CCAUV/08-15)

Dr Narang reported on the work of the APMP Technical Committee for AUV (TCAUV). He mentioned the regional comparisons: SIM.AUV.A-K1, SIM.AUV.A-K3 and SIM.AUV.A-S1 and other bilateral comparisons. He reported on the approval process for CMCs, an APMP AUV workshop on microphone calibration and, efforts to assist developing economies with a low-cost system for calibration of sound levels.

9.3 COOMET (CCAUV/08-12)

Dr Pozdeeva reported on new CMCs within the COOMET region and other activities regarding the implementation of the CIPM MRA. There are two projects relating to key comparisons, COOMET.AUV.A-K1 and COOMET.AUV.V-K1, and three bilateral comparisons on sound pressure in air and water. A further two comparisons are planned, one of which is on velocity of sound in solid media.

9.4 EURAMET (CCAUV/08-34)

Dr Sadikoglu reported on the confirmation of EURAMET e.v. as a legal entity. He also reported the work of the EURAMET TCAUV and its sections in each field, briefly describing the 13 comparison projects, 16 cooperation projects and 3 traceability projects under way. He emphasized the importance of the cooperation projects and noted the challenges facing the TCAUV.

9.5 SIM (CCAUV/08-32)

Dr Ripper summarized the status of the SIM.AUV comparisons: A-K1, V-K1, A-S1 (pistonphones), V-S2 (low frequencies), and V-K1.1 (complex sensitivity). He also described the future comparison, V-K2. There were no requests for CMC reviews and he referred to the agreements of the last meeting. Dr Nedzelnitsky discussed the revision of the protocol for a proposed SIM.AUV.A-S2 comparison, which has not been circulated; he pointed out that NMIs could only decide on their participation after the revised protocol had been circulated.

9.6 AFRIMETS (CCAUV/08-16)

Dr Veldman reported on AFRIMETS: its background, rationale, and organizational structure as the RMO of Africa. Some of the standard functions of an RMO, such as peer reviews and CMC approval had not been performed by SADCMET itself due to a lack of independent expertise; other RMOs had been used. The project TC5: "Metrology support for Small and Medium-sized Enterprises (SMEs)" had been replaced by "Metrology awareness". Dr Allisy-Roberts and Prof. Wallard explained the reasons for expanding the structure in Africa, and the precautions taken to allow an AFRIMETS vote on the JCRB. Dr Veldman emphasized that AFRIMETS is the complete RMO. Dr Allisy-Roberts agreed and mentioned that SADCMET continues to exist as a sub-region. All CMCs from the region will now be processed through AFRIMETS.

10 REPORTS FROM INTERNATIONAL MEETINGS

10.1 IMEKO TC 22

Dr Bruns reported on the meeting of IMEKO TC 22 in November 2007. The meeting, which was held at Merida, Mexico, was well attended and papers were presented by I. Veldman, H. Nozato, Y.J. Huang, C. Hof, T. Usuda, G. Ripper, W.S. Cheung, A. Oota, M.I. Schiefer, S. Rushnakova, P. Rattangangkul, and T. Bruns. The presentations are available on the IMEKO TC-22 website. Dr Bruns issued a general invitation to the next IMEKO Congress, to be held in Lisbon, Portugal, from 6-11 September 2009.

10.2 ACOUSTICS 08

Dr Robinson reported on the Acoustics 08 meeting, which consisted of three conferences in one. The proceedings of the conference are available on the internet and the Acoustical Society of America (ASA) abstracts can be found on their own website at http://asa.aip.org/.

11 REPORTS FROM INTERNATIONAL OBSERVERS

11.1 IEC TC 87, WG 6 and WG 15

In the absence of Dr Bradfield, the IEC representative, Dr Zeqiri reported on the work of WG 6, "*High Intensity Therapeutic Ultrasound (HITU) and Focusing transducers*", and Dr Robinson reported on the work of WG 15 "*Underwater Acoustics*". Dr Robinson mentioned that a new IEC Standard had been published for underwater acoustics.

11.2 IEC TC 29 (CCAUV/08-18)

Prof. Rasmussen reported on the work of IEC TC 29. In 2004 it was agreed that all new standards and technical documents should refer to exact base 10 frequencies. A recommendation followed that all new key comparisons should be carried out with exact base 10 frequencies. Up until now, filters and instrumentation denominated as 3rd octaves, are in fact 10th decades, and 10th decades are approximated by 3rd octaves.

Dr Valdés and Dr Allisy-Roberts suggested that this should be discussed and might lead to a CCAUV recommendation.

Dr Narang asked for more background. Prof. Rasmussen described the historical development of analogue filters, the 3rd octaves (base 2) and the frequency gaps they allowed. Starting from 1 Hz, 1000 Hz was not a centre frequency. With base 10 filters there is no problem whatever frequency range is chosen. Dr Robinson asked about implications for the IEC *International Electrotechnical Vocabulary* (IEV). Prof. Rasmussen replied that the issue had been discussed some time ago, but nothing had been done and the vocabulary was now out of date. Dr Allisy-Roberts asked what the AUV metrology community wished to do about this. Prof. Rasmussen and Dr Nedzelnitsky believed that it would be best simply to ignore the outdated parts. Dr Allisy-Roberts suggested CCAUV collaboration with the IEC. Prof. Rasmussen commented that defining vocabulary is a very time-consuming task, particularly in some groups. Dr Robinson mentioned the existence of an 'electropedia'. Dr Nedzelnitsky pointed out that the IEC has a Technical Committee on vocabulary (IEC TC1), including a specific group for every field. The group on electro-acoustics would be the most suitable group to deal with this.

Prof. Wallard said the consensus seems to be that the vocabulary is wrong and that the BIPM and Dr Thomas could take this opportunity for the Joint Committee of Guides in Metrology to draw attention to the need to update this on the website. Prof. Rasmussen mentioned that the problem is that the vocabulary covers a very wide area and numerous fields. However, the recommendation of IEC TC 43 overlaps with the area of interest of IEC TC 29. Dr Nedzelnitsky said the most recent IEC and ISO standards cover most of the terminology needed by the CCAUV. Dr Allisy-Roberts suggested that there are two possibilities: simply to make a statement in the minutes about the issue; or draft a note or letter to the IEC and ISO TCs drawing their attention to this matter. No further action was proposed.

11.3 ISO TC 108 (CCAUV/08-01)

Dr von Martens presented the work carried out by ISO TC 108 on the ISO series 16063 renumbered from 5347. He outlined the contents of the series to be published: *Methods for the calibration of vibration and shock transducers, part I "Calibration basic concepts"* that covers primary calibration, secondary calibration, calibration in severe environments and other calibration methods.

He gave a report on future projects including ISO 16063-31 *"Testing of transverse vibration sensitivity"* and ISO 16063-41 *"Calibration of laser vibrometers"*, in this case with the prerequisite of proving the applicability of the specified interferometry methods up to high frequencies of 100 kHz. This was achieved by Dr Silva-Pineda at CENAM in 2007. He stated that the two standard series of ISO TC 108 have allowed the standardization of metrology work to advance steadily.

Dr Sinojmeri asked how to achieve fringe counting up to 100 kHz. Dr von Martens answered that it was achieved by measuring on quarter wavelengths, as had been done by Dr Silva-Pineda, and also with other methods that are being studied. Dr Sinojmeri asked what exciter was used. Dr von Martens replied that Dr Silva-Pineda had used, among others, a piezoelectric exciter made by Beverly Payne at the former NBS. Dr von Martens recommended contacting Dr Silva-Pineda for further details.

12 PUBLICATIONS AND MEMBERSHIP OF THE CCAUV

12.1 CAUV web pages, links and members bibliographies

Dr Allisy-Roberts showed the information that is available on the CCAUV pages of the BIPM website, including members' bibliographies. These lists of recent publications can be found at http://www.bipm.org/en/committees/cc/ccauv/publications_cc.html.

12.2 Criteria for membership of the CCAUV

Dr Allisy-Roberts recalled the criteria for membership of the CCAUV and emphasized the necessity of recording publications and comparisons.

12.3 Proposals for new Members/Observers

Dr Allisy-Roberts asked for proposals for new members and/or observers. Dr Valdés mentioned the possibility of involving other organizations that deal with materials metrology related to the AUV field. Dr Nedzelnitsky asked for clarification. Dr Valdés mentioned the example of testing institutions such as the BAM in Germany.

Dr Valdés and Dr Allisy-Roberts reported that the INM, Romania, has applied to be an observer. There were no objections to this application and it was agreed that the application would be presented to the CIPM by the President.

13 OTHER ITEMS

13.1 BIPM Workshop on Physiological Quantities and SI Units

Prof. Wallard talked about the activities of the CCU, in cooperation with other organizations such as the ILAC, to discuss issues related to physiological quantities. The CCU is working to define which quantities are relevant to humans, their effects on the body, and what is relevant to

metrology. The BIPM is organizing a workshop on these issues, to be held in November 2009. An invitation to nominate delegates will be sent to NMIs and relevant organizations.

13.2 Availability of presentations

Dr Ripper asked about the availability of presentations that have not been uploaded to the website, such as comparisons reports. Dr Allisy-Roberts asked everybody that had presented additional material if they had any objections to the material being made available on the website. All attendees agreed to make their material available on the CCAUV's restricted-access site. Dr Allisy-Roberts will upload the available documents in PDF format. The Draft B reports will be published after their approval by the KCWG and the CCAUV.

13.3 Date of next meeting

Dr Valdés will propose to the CIPM that the next meeting of the CCAUV be held in October 2010.

APPENDIX 1.
WORKING DOCUMENTS SUBMITTED TO THE CCAUV AT ITS 6TH 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

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

Document CCAUV/	
08-00	Draft agenda, P.J. Allisy-Roberts, 3 pp.
08-01	Report of the ISO TC 108 Observer, H.-J. von Martens, 10 pp.
08-02	Two approaches to hydrophone free-field calibration, A.E. Isaev, 11 pp.
08-03	Draft B Report on the CCAUV.V-K1.1 Comparison, T. Bruns, 90 pp.
08-04	Draft B report on the EUROMET.AUV.V-K1.1 comparison – revised, T. Bruns, 52 pp.
08-05	Status of the COOMET.AUV.A-K1 and COOMET.AUV.A.-K1.1 comparisons, T. Fedtke, 2 pp.
08-06	Draft B report of the COOMET.AUV.A-K1 comparison, T. Fedtke, 31 pp.
08-07	Draft B report on bilateral comparison COOMET.AUV.A-K1.1, T. Fedtke, 17 pp.
08-08	Key areas of metrological importance for the CCAUV, B. Zeqiri, 2 pp.
08-09	PTB summary report, C. koch, 7 pp.
08-10	Status of Ultrasound Power key Comparison CCAUV.U-K3, C. Koch, 8 pp.
08-11	IEC TC Working Group 15 Report, A. Hurrell, 4 pp.
08-12	Report of the COOMET TC AUV, V. Pozdeeva, 4 pp.
08-13	Short report on INRiM activities in AUV, C. Guglielmone, 3 pp.
08-14	Draft B Technical report for key comparison CCAUV.A-K2, M. Sinojmeri, 45 pp.
08-15	Report from APMP TC AUV, P. Narang, 3 pp.
08-16	The Intra Africa System for Metrology, C.S. Veldman, 7 pp.
08-17	Brief report from the NMISA, C.S. Veldman, 2 pp.
08-18	IEC TC 29 Electroacoustics Status report, K. Rasmussen, 4 pp.
08-19	DPLA Short report, K. Rasmussen, 4 pp.
08-20	Primary metrology in France in acoustic and vibration field, J.-N. Durocher, 5 pp.
08-21	Report on the NMIA national standards – revised, P. Narang, 2 pp.
08-22	Status Report of CENAM. Mexico to the CCAUV 2008, G. Silva-Pineda, 7 pp.

08-23	The Current Status of AUV measurements standards at AIST/NMIJ, T. Usuda, 11 pp.
08-24	IEC / Technical Committee 87 : Ultrasonics, N. Bradfield, 9 pp.
08-25	METAS short report for CCAUV October 2008, C. Hof, 3 pp.
08-26	Overview of Acoustical Metrology Research at the NPL, B. Zeqiri, 20 pp.
08-27	Proposal for a CIPM Key Comparison in vibration CCAUV.V-K2, T. Bruns, 3 pp.
08-28	Report on IMEKO Technical Committee 22 "Vibration Measurement", T. Bruns, 2 pp.
08-29	Recent Activities in AUV for KRISS, H.-S.Kwon, 11 pp.
08-30	Draft report for SIM.AUV.V-K1, D.J. Evans, 97 pp.
08-31	Proposal for a low frequency key comparison for underwater acoustics, S. Robinson, 1 p.
08-32	SIM Report, G. Ripper, 3 pp.
08-33	Brief report from the INMETRO, G. Ripper, 4 pp.
08-34	EURAMET Report, E. Sadikoglu, 5 pp.
08-35	Report from Poland, D. Dobrowolska, 5 pp.
08-36	Present status of CCAUV comparisons, P.J. Allisy-Roberts, 7 pp.
08-37	Linking the results of an RMO comparison to a CIPM comparison, M. Sinojmeri, 10 pp.