E U R O M E T A N N U A L R E P O R T

ACOUSTICS, ULTRASOUND AND VIBRATION

April 2001 to March 2002

1 Projects

Eighteen projects or proposals have been under consideration within the TC AUV during the year. Two projects were completed. Details of the status of each project are given in the separate Excel file.

Planned but not yet proposed projects:
- Microphone calibration with electrostatic actuators (sound in air).
- Extension of project C400 (completed in 2000), namely the use of signal processing for free field comparison calibration (sound in air).
- Phase calibration of hydrophones (underwater acoustics).
- Transfer standard devices for ultrasonic therapy machines (ultrasound) - project funded by the EC is ready for signing except some problems with the Australian partner. The project will last 3 years.
- Thermal assessment (ultrasound) - the EoI for projects that deal with the assessment of thermal effects in diagnostic ultrasound equipment failed to get funding from the EC.
- Assessment of cleaning baths (ultrasound) – all participants expressed their interest in common activities in this field.
- Investigation of load mass influence on the characteristics of different standard accelerometers (vibration-acceleration).

2 General aspects

For several years the subject field of Acoustics, Ultrasound and Vibration has been divided into four working groups: sound in air (19 members), underwater acoustics (6 members), ultrasound (9 members) and acceleration and vibration (15 members).
While the groups were being formed it was convenient to appoint hosts for individual meetings but leave the coordinating role to the rapporteur. In practice it appeared to be not too easy the rapporteur alone to coordinate the works of all groups because of his/her many duties relevant to the implementation of the Mutual Recognition Arrangement. A discussion has been held on how the working groups should be coordinated in the future. During the last year Contact Persons meeting it was decided to appoint coordinators for each group for longer period.
The proposal of new organisation of TC AUV sent by TC AUV Chairperson to EUROMET Chairman has been submitted to vote by EUROMET delegates.
Within this new organisation TC AUV consists of four subcommittees coordinated by permanent convenors as follows:

TC **Subject Field** **Sub-Field**	**Name** **Address**	**Telephone** **Telefax** **E-mail**
TC-AUV **Acoustics, Ultra-sound** **and Vibration**	Maria Szelag GUM P.O. Box 10 ul. Elektoralna 2 PL - 00-950 Warszawa	+48 22 620 42 59 +48 22 620 83 78 acoustics@gum.gov.pl
Sound in air	Dr Claudio Guglielmone Istituto Elettrotecnico Nazionale Galileo Ferraris Strada Delle Cacce 91 I-10135 Torino Italy	+390 11 3919 626 +390 11 346 384 guglielm@ac.ien.it
Underwater acoustics	Mr. Stephen Robinson National Physical Laboratory Queens Road Teddington TW11 OLW United Kingdom	+44 208 943 7152 stephen.robinson@npl.co.uk
Ultrasound	Dr Christian Koch Physikalisch –Technische Bun-desanstalt Postfach 3345 D-38023 Braunschweig Germany	+49 53 1592 1430 +49 53 1592 1015 christian.koch@ptb.de
Acceleration and Vibration	Dr Hans-Jürgen von Martens Physikalisch-Technische Bundesanstalt 38116 Braunschweig Postfach 3345 Germany	+49 531 592 1220 +49 531 592 1241 Hans-Juergen.v.Martens@ptb.de

3 Meetings

The Contact Persons meeting held at UME, Istanbul, in May 2001 was attended by 24 people from 18 countries; the further one is planned at GUM (Poland) on the10th May 2002.
Meeting of experts in sound air measurements was held in Istanbul in May 2001; the further one is planned at GUM (Poland) on the 9th May 2002.
Meeting of experts in ultrasound was held at PTB in November 2001; the further one is planned in Spain in November 2002.
Meeting of experts in acceleration & vibration was held at SP (Sweden) in April 2001 and the next one in SIRA (United Kingdom) on the 25th and 26th March 2002.
Meeting of experts in underwater acoustics is planned in the autumn 2002.

4 Mutual Recognition Arrangement

Details of the status of CIPM Key Comparisons and EUROMET Key and Supplementary Comparisons registered on the KCDB are given in the separate Excel file.
There are 6 KCs currently in progress:

- 2 KCs in sound in air (the measurements have been completed, the final reports will be published by September 2002,
- 1 KC in underwater acoustics (the measurement stage should be completed in spring 2002 and the project should be reported at the next CCAUV meeting in September 2002,
- 2 KCs in ultrasound (the measurement stage completed, the reports should be ready before September 2002),
- 1 KC in vibration (the measurements have been completed, the final report will be ready by September 2002).

One EUROMET KC in vibration has been approved for provisional equivalence.
There are 6 KCs planned: 3 in sound in air, 2 in ultrasound and 1 in vibration.

Status of EUROMET AUV CMCs
First batch of data consisting of 331 entries from 12 European countries (Czech Republic, Denmark, Finland, France, Germany, Italy, Poland, Sweden, Switzerland, The Netherlands, Turkey, and United Kingdom) was approved by the JCRB in March 2001. The CMCs were published by the BIPM in May 2001.
During the Euromet Contact Persons Meeting held on 4th May 2001 in Istanbul, new and revised or updated entries (total number 55) that had been reviewed by the working groups were agreed for submission to the JCRB for their October 2001 meeting, particularly:

- entries submitted earlier and delayed for revision: 6 entries from SMU (Slovakia) and 17 from IMGC-IEN (Italy);
- 9 new entries from PTB (Germany);
- revised entries: 4 entries from NPL (United Kingdom), 4 from GUM (Poland) and 15 from DPLA (Denmark).

These entries named EUROMET AUV.part 2 were sent to EUROMET Chairman before the end of May and forwarded by Dr. Terry Quinn to Chairmen of other RMOs for interregional opinion. These CMCs have received the positive opinion from APMP, COOMET and SIM but they cannot be posted for approval due to the lack of SADCMET opinion.
Next part of entries EUROMET AUV.part 3 (total number 44) reviewed by TC AUV members was forwarded for interregional opinion on the 26th November 2001. Until now only APMP has given the opinion on these CMCs. SIM has acknowledged their reception setting review date the 31st January 2002 but has not yet submitted its opinion.
This batch of CMCs consists of:

- entries submitted earlier and delayed for revision: 17 entries from BEV (Austria), 8 from HIM (Greece) and 6 entries OMH (Hungary);
- new entries: 6 from NMi VSL (The Netherlands) and 3 entries from UME (Turkey);
- 4 revised entries from GUM (Poland).

In September 2001 TC AUV reviewed the COOMET AUV submission containing big amount of CMCs (117 entries) from Russia. As a result of EUROMET revision and further discussion between Russian specialists and EUROMET reviewers on December 4, 2001 COOMET Chairman submitted to the international review a new version of Russian CMCs reduced to 68 entries only. These entries have been approved by EUROMET.

At the end of October TC AUV reviewed also the SIM AUV CMCs (153 entries) from Argentina, Brazil, Canada, Mexico and Unites States of America. These data were approved by JCRB and published in November 2001.

In general last year the work to collect and review the CMCs within EUROMET TC AUV for the Mutual Recognition Arrangement (MRA) was well advanced but coordination with the other RMOs appeared to rather weak and so approval has been delayed. The AUV RMOs do not pay proper attention to the tables in the protected JCRB website.

Maria Szelag, GUM (Poland)
EUROMET AUV TC Chairman

Acoustics, ultrasound and vibration - Key Comparisons

Comparison identifier	Type	Part. country	Status	Years	Subject	Pilot Laboratory
CCAUV.A-K1	Key	APMP (AU, JP, KR), COOMET (RU), EUROMET (GB, DE,DK,PL), SADCMET (ZA), SIM (CA, MX, US)	Report in progress	1999-2000	**Sound in air: Sound pressure at frequency 63 Hz to 8 kHz** CCAUV.A-K1 concerns the calibration of type LS1P laboratory standard microphones. Twelve NMIs from five regional metrology organisations are involved with NPL piloting the project. The measurement phase has been completed and a Draft A report discussed at the meeting of CCAUV in Oct-01. A plan has been established to produce a Draft B report early in 2002 and this project is expected to be complete by the next meeting of CCAUV in Sep-02.	NPL
CCAUV.A-K2	Key	APMP (AU, JP, KR), EUROMET (GB, DE,DK, IT, NL), SADCMET (ZA), SIM (CA, MX, US)	Planned	2002	**Sound in air** CCAUV.A-K2 concerns the calibration of type LS1P laboratory standard microphones pressure at frequency 1 Hz to 63 Hz. Twelve NMIs from four regional metrology organisations expressed an interest in the project. The measurement will start in 2002.	NIST
CCAUV.A-K3	Key	APMP (AU, JP, KR, IN), COOMET (RU), EUROMET (AT, CZ, GB, DE,DK, FR, IT, PL, CH, TR), SADCMET (ZA), SIM (CA, MX, US)	Planned	2003 - 2005	**Sound in air** CCAUV.A-K3 concerns the calibration of type LS2P laboratory standard microphones pressure at frequency 31,5 Hz to 31,5 kHz. Nineteen NMIs from five regional metrology organisations expressed an interest in the project. The measurement will start in 2003.	CENAM with technical assistance given by DPLA
CCAUV.A-K4	Key	APMP (JP), EUROMET (AT,GB, DE,DK, FR), SIM (MX, US)	Planned	2003 - 2005	**Sound in air** CCAUV.A-K4 concerns the free field calibration of type LS2P laboratory standard microphones at frequency range 1 Hz to 40 kHz. Eight NMIs from three regional metrology organisations expressed an interest in the project. The measurement will start in 2003.	CENAM with technical assistance given by DPLA
EUROMET.AUV.A-K1	Key	EUROMET (AT, CZ, DE, DK, PL, ES, IT, FI, NL, GB, CH, HU, SK, SE, TR)	Report in progress	1997-1999	**Sound in air: Euromet project 399 An intercomparison of sound pressure standards** The measurement phase of the project has been completed and results have been reported to the contact persons. A draft of paper was distributed for comments to members of SC sound in air in June 2001. Publication of this paper will be postponed until the CCAUV key comparison is complete (forecast for Sept. 2002) so that the data can be linked to the reference value.	NPL

Comparison identifier	Type	Part. country	Status	Years	Subject	Pilot Laboratory
CCAUV.W-K1	Key	APMP (CN), EUROMET (GB, DE), COOMET (RU), SIM (CA, US)	In progress	1999-2001	**Underwater acoustics: Sound pressure in water** Calibration of three hydrophones at frequency 1 kHz to 500 kHz. The phase of measurements will be soon completed. The project should be reported at the CCAUV meeting in September 2002.	NPL
CCAUV.U-K1	Key	APMP (AU,CN, IN), EUROMET (GB, DE, NL), COOMET (RU), SIM (CA, US)	Report in progress	1999-2001	**Ultrasound: Ultrasonic power** Measurement of the ultrasonic output power of an ultrasonic source transducer in water at frequencies 2, 6 and 10 MHz at several power levels. The measurement phase has been completed.	PTB
CCAUV.U-K2	Key	APMP (CN), EUROMET (GB, DE, DK, NL)	In progress	1999-2001	**Ultrasound: Ultrasonic pressure** Calibration of membrane hydrophones at frequency 1 MHz to 5 kHz. The measurement phase has been completed.	NPL
EUROMET.AUV.U-K1	Key	EUROMET (GB, DE, DK, NL, ES, TR)	Planned	2004	**Ultrasound** During the EUROMET Ultrasound Subcommittee meeting held on 5 November 2001 it has was agreed that the key comparisons EUROMET.U-K1 and EUROMET.U-K2 would be postponed to 2004. The reason is that the participants would almost be the same as for the CCAUV key comparisons. Only two potential participants (Spain and Turkey) do not participate in the current CCAUV key comparisons. For both these NMIs bilateral solutions will be found.	PTB
EUROMET.AUV.U-K2	Key	EUROMET (GB, DE, DK, NL, ES, SE, TR)	Planned	2004	**Ultrasound** See above	NPL
CCAUV.V-K1	Key	APMP (AU, KR, JP), EUROMET (DE, FR, CZ, NL), COOMET (RU), SIM (MX, CA, US), SADCMET (ZA)	Report in progress Draft A	2000-2001	**Acceleration & Vibration** Calibration of piezoelectric accelerometers by absolute method with laser interferometry at frequency 40 Hz to 5 kHz. The measurement phase of the project has been completed and the results have been discussed at the meeting of CCAUV in Oct-01.	PTB

Comparison identifier	Type	Part. country	Status	Years	Subject	Pilot Laboratory
EUROMET.AUV.V-K1	Key	CH, CZ, DE, DK, FR, HU, NL, ES, PL, PO, SE, TR	Planned	2003-	**Acceleration & Vibration: EUROMET project P579 European Key Comparison in accelerometer calibration** Project is expected to start in July 2003. For the NMIs providing primary vibration calibration (by absolute method) it will be a copy of the running CC key comparison, i.e. two accelerometers, B&K 8305 without dummy mass and B&K WH 2335, to be calibrated in the range 40-5000 Hz. For the NMIs using the comparison method, the mass represented by the NMI's (single-ended) standard accelerometer when calibrating the back-to-back accelerometer B&K 8305 will be taken into account as dummy mass. The pilot laboratory (PTB) will provide two accelerometers type 8305: one with optically reflecting top surface for primary calibration and the second one with top surface accessible for mounting the NMI's standard accelerometer.	PTB
EUROMET.AUV.V-K1. Prev.	Key	EUROMET (DE, DK, FR, IT, SE)	Approved for provis. equiv.	1991-1995	**Acceleration & Vibration** Calibration of piezoelectric accelerometers by absolute method with laser interferometry at frequency 40 Hz to 5 kHz.	BNM/CESTA

Acoustics, ultrasound and vibration - projects

Nr.	Coll. type	Status	Part. country	Subject	Coordinator
198	Traceability	agreed	CH DE GB PL	**Accelerometry** The project provides traceability by primary vibration calibration in accordance with ISO 16063-11: 1999 but with higher accuracy. The project was initially set up between GB and DE and in addition to the UKAS accredited laboratories Endevco and SIRA; UKAS itself and some nonaccredited laboratories of GB have been supplied with primary calibrations by the PTB. Now the project also provides traceability for NMIs and accredited or non-accredited laboratories of other countries, which joined the project later. The partners make use of the improved calibration capabilities available at the PTB (e. g. absolute phase calibrations).	Dr H.-J. von Martens
284	Traceability	agreed	DE DK IT	**Angular acceleration measurement** The increasing need of ensuring traceability for measurements of rotational motion quantities (angular acceleration, angular velocity, rotation angle) has been emphasised at the TC 108/SC3 meeting in Minden/Nevada (Sept. 2000) and taken into account by extending the calibration standard series to rotational calibrations: New work items ISO 16063-15 (Primary vibration calibration of angular transducers using laser interferometry) and ISO 16063-23 (angular vibration calibration by comparison).	Dr H.-J. von Martens
294	Cooperation	agreed	DE DK GB	**Datafiles for pressure reciprocity calibrations** A draft report was circulated among the participants in 2000 and discussed at the meeting of the EUROMET Acoustics group in May 2001.The data files have been tried at DPLA and PTB successfully. There is an interest to link this project to project A493 by providing new data for radial wave motion correction. The data from this project will be downloadable from the EUROMET website.	Dr Knud Rasmussen
302	Cooperation	proposed	DK DE GB	**Calibration of artificial ears** The project has not yet been agreed because of lack of resources. The main problem is the fact that the relevant IEC standard does not take into account transfer impedance measurements. An agreement to start the project has not obtained yet.	Dr Knud Rasmussen
368	Traceability	agreed	DE GB DK SE CZ	**Shock acceleration measurement** The increasing need of ensuring traceability for shock acceleration measurements has resulted in the accreditation of many laboratories for shock calibration, the development of the relevant international Standards, and increasing use of the primary shock calibration capabilities at PTB. The extended and improved primary shock calibration capabilities achieved at the PTB are in compliance with ISO 16063-13 but fulfil even higher requirements.	Dr H.-J. von Martens

Nr.	Coll. type	Status	Part. country	Subject	Coordinator
399	Comparison	agreed	AT CH CZ DE DK FI ES GB HU IT NL PL SE SK TR	**An intercomparison of sound pressure standards** The measurement phase of the project has been completed and results have been reported to the contact persons. A draft of paper was distributed for comments to members of SC sound in air in June 2001. Publication of this paper will be postponed until the CCAUV key comparison is complete (forecast for Sept. 2002) so that the data can be linked to the reference value.	Dr Richard Barham
401	Cooperation	agreed	CH DK DE GB	**Harmonisation of audiometry measurements within the EC** Results for the sensitivity of the mechanical coupler are available from the 4 laboratories that participated in this part of the project. The device suffered a change in sensitivity part way through the project, but can be linked by the measurements at the pilot laboratory. Results for the measurements on the bone vibrator have not been received from all participants and some are experiencing difficulty in completing the measurements. Therefore the report will be split in two parts to speed up the availability of the results for the mechanical coupler measurements. This project is not to be considered an intercomparison; therefore it was agreed that it would be better to publish the results not in Metrologia but in some general acoustic journal, more likely to be read by people interested in the subject.	T R Sherwood
477	Consultation	agreed	GB ES DE SE RU	**Meeting of experts in underwater acoustics** A meeting was held at NPL in February 2001 and a further one is planned in the autumn 2002.	Dr Stephen P Robinson
478	Consultation	agreed	GB TR ES NL DE SE DK RU	**Meeting of experts in ultrasonics** A meeting was held at PTB in November 2001 and a further one is planned in Spain in November 2002.	Dr Christian Koch
479	Consultation	agreed	AT DK FR DE HU NL PL PT ES SE CH CZ IT GB TR	**Meeting of experts in accelerometry** A meeting was held at SP (Sweden) in April 2001 and a next one in SIRA (United Kingdom) on March 25 and 26, 2002.	Dr H.-J. von Martens
493	Cooperation	agreed	DK GB DE	**Radial wave motion correction for microphone calibration** A draft report for the project is under preparation. Integration with project A294 is proposed, but it is feared that it will cause a delay in the completion of project A493 and it would be better to start a new project instead.	Dr Thomas Fedtke

Nr.	Coll. type	Status	Part. country	Subject	Coordinator
576	Cooperation	com-pleted	CZ DE DK FR GB GR HU IT PL PT SE SK TR	**Comparison of measurement uncertainty budgets for calibration of sound calibrators** The project is completed with thirteen national measurement laboratories participated. The budgets are numerically correct, and generally follow the recommendations of the relevant ISO Guide. For almost all the participants, the greatest contribution to the measurement uncertainty is the uncertainty of calibration of the reference device. Few omissions of significant sources of uncertainty were identified. The reported expanded uncertainties exceed the maximum permitted uncertainties for class 0 calibrators that are specified in IEC 60942:1997 in only one case. The report gives recommendations to the participants for improving clarity and obtaining better mutual agreement.	Dr Peter Hanes
577	Cooperation	withdrawn	GB	**Calibration of impedance heads for measurements on mechanical couplers** Initially the proposal generated some discussion and formulation of ideas. However the issue of how to proceed has come to depends very much on the requirements of the user community. Without this information, further progress cannot be made. During AUV Acceleration and Vibration meeting held in March 2002 it was therefore agreed that this proposal be withdrawn and be replaced by a new proposal to the AUV Sound-in-Air to specify the requirements for the calibration of impedance heads in consultation with the users of audiometric bone conduction measurements. On completion of this exercise a new proposal to develop a calibration method will be made to the acceleration-working group in due course.	
579	Comparison	proposed	CH CZ DE DK FR ES HU IT NL PL PO SE TR	**European Key Comparison in accelerometer calibration (EUROMET AUV.V-K1)** Project is expected to start in July 2003. For the NMIs providing primary vibration calibration (by absolute method) it will be a copy of the running CC key comparison, i.e. two accelerometers, B&K 8305 without dummy mass and B&K WH 2335, to be calibrated in the range 40-5000 Hz. For the NMIs using the comparison method, the mass represented by the NMI's (single-ended) standard accelerometer when calibrating the Back-to-back accelerometer B&K 8305 will be taken into account as dummy mass. The pilot laboratory (PTB) will provide two accelerometers type 8305: one with optically reflecting top surface for primary calibration and the second one with top surface accessible for mounting the NMI's standard accelerometer.	Dr H.-J. von Martens
585	Cooperation	agreed	DE IT	**Bilateral comparison of a piezoelectric charge amplifier transfer function in the range 1 to 10000 Hz** The calibration of a charge amplifier was carried out in IMGC, then in PTB and again in IMGC. Results showed an excellent agreement between the two laboratories and a reproducibility of results within 0.1% (modulus) and 0.1° (phase). During the time period taken for the comparison the charge amplifier showed a very good stability, making it possible to demonstrate the capabilities of two laboratories without the disturbing effect of long-term instabilities. The charge amplifiers were subsequently checked for few months and results show that the stability is about 0.2%. Final report has bee completed and circulated to members of EUROMET AUV TC Sc Vibration & Acceleration.	Dr Giuseppe Basile

Nr.	Coll. type	Status	Part. country	Subject	Coordinator
615	Consultation	agreed	AT CZ DK FI FR DE GR HU IE IT NL PL PT SK ES SE CH TR GB RU	**Meeting of experts in air-borne sound measurements** A meeting was held in Istanbul in May 2001 and a further one is planned at GUM (Poland) in May 2002.	Dr Claudio Guglielmone
616	Cooperation	proposed	GB	**Collaboration on uncertainties in the calibration of underwater acoustic transducers** The project is a collaboration to establish better estimates of uncertainties in calibration of hydrophones and underwater acoustic transducers, and to increase awareness of the best measurement practice among the underwater acoustic community.	Dr Stephen P Robinson
617	Cooperation	proposed	GB	**Responses of reference hydrophones under real ocean conditions** The project is collaboration between interested parties to determine the variation in the response of hydrophones when used under real ocean conditions, in particular how the responses vary with water temperature and depth of immersion.	Dr Stephen P Robinson