EUROMET Mass & Related Quantities TC Meeting  
INRIM Torino Italy  
Friday 3rd March 2006

Minutes

1. **Welcoming address**
Alberto Carpinteri, Deputy President, welcomed the participants and gave a short presentation about the Istituto Nazionale di Ricerca Metrologica (INRIM).

2. **Adoption of agenda**
The agenda was adopted.

3. **Minutes of the last meeting**
The revised minutes of the meeting held 3 March 2005 at EIM Greece were approved.

4. **Metrological situation in member states**

**AUSTRIA**
During 2006 the Austrian prototype of the kilogram was re-calibrated at BIPM. A new handling system for weights in the range 1 mg to 10 g has been introduced and evaluated. In addition a new handling system for 20 kg weights has been developed along with improvements to the centering system with the weights now suspended below the pan.
The solid/liquid density system has been fully automised and intercompared with OMH and PTB.
The Rockwell hardness machine has been reconstructed.
No major changes in force.
A new DHI pressure balance is in use with an automatic mass handling system.

**BELGIUM**
For the fields of force and pressure there were no major changes during the year 2005.
For the field of mass a new Sartorius susceptometer was put in place by the end of 2005. The second Pt-Ir (nr 28) mass standard of SMD has been re-determined by the BIPM, the previous determination having been made about 50 years ago.

**BULGARIA**
In the last year on the level of organization have been adopted “The Law of changes of the law of measurements”.
In the middle of year, to be established the Bulgarian Institute of Metrology based on the General directorate National Centre of Metrology and General directorate Measure and measurement instruments, according to this.
In connection with building the new metrological complex was carried out the competition for a preliminary design and were admitted a three projects.
The equipment in the scope of hardness, force, optics, temperature, acoustics, ionizing radiation and electric energy and high voltages measurements to be purchased under two FHARE projects that finished with success in this year. The standard laboratories in this areas are under repair.
It is planned some PTB experts to train NCM staff in drafting the Term of Referents for laboratories and to assess the construction plan for a national
metrological complex (in particular to evaluate specific environmental conditions like stability, low vibration and minimized magnetic and electromagnetic fields). Will be made peer-assessment of NCM quality system progress and to be organized and participate in seven international comparisons in the following areas of electric, physical and mechanical measurements.

**CROATIA**
The majority of laboratories in the mass and related quantities area are located in universities. The mass and density laboratory has been EA accredited – at present, a new laboratory is being constructed. The force and pressure laboratories are located at the University of Zagreb – both have been DKD accredited.

**CZECH REPUBLIC**
The situation in Czech Metrology Institute (CMI) is stable. The project to automate the calibration of barometers has been successfully completed. Two new projects have started: the development of an XHV standard in range to $10^{-9}$ (preferably $10^{-10}$) Pa, and the development of a weighing-in-vacuum facility.

**DENMARK**
On 24 February 2006 DFM was transformed into a limited company, with all shares being owned by the Danish Technical University. With this change DFM hopes to strengthen its relation to the Danish research community, whilst the Danish Technical University hopes to strengthen its knowledge transfer to the industry. In the autumn, DFM took over a primary facility for the calibration of microphones from an institute at the Danish Technical University. This facility is part of the national primary laboratory for acoustics and vibration operated in cooperation with the private company Brüel & Kjær. A transfer of a primary facility for measurement of pH from the private company Radiometer to DFM has just been agreed between the two parties. The transfer will take place this spring and will enable DFM to produce buffer solutions with certified pH values.

**EUROPEAN COMMUNITY**
There has been little change over the past year. Work is continuing to characterise the isotopic composition of new kilograms.

**ESTONIA (in-depth presentation)**
Servicing of the Mettler AT1006 comparator was carried out by a technician from Mettler-Toledo, who also upgraded some of the components. As a result, better reliability and repeatability of the comparator was achieved. Comparison of 1 kg weights is now giving a typical standard deviation of 0.5 microgram. Development of methods for the calibration of 500 kg weights by multiplication, and of a liquid density standard, are on-going.

**FINLAND**
MIKES moved to new laboratories at the end of 2005. The laboratories are functioning and they fulfil most of the set requirements. Mass has two underground clean rooms with specification M5.5 (10000 particles/cubic foot). Special attention has been paid to temperature and humidity control and vibration damping. The pressure laboratory of MIKES now has much more space in the new building with three laboratory rooms instead of one and also more than twice the area.
A new 1 kg mass comparator (AX1006) has been received for carrying out calibrations. Vacuum weighing with HK1000MC has been started. The purpose is to determine gas densities and to investigate stability of weights after vacuum.

The only major change in pressure is in the equipment. Last year we purchased a new pressure balance with the nominal effective area 20 cm². The dimensional measurements on the piston and cylinder will be carried out this spring.

On the area of force measurement MIKES-Raute has the capacity up to 100 kN with dead weight standard machines and up to 1.1 MN with a hydraulic amplified standard machine. A research project is underway to explore the possibilities and need for extension of force calibration over 1.1 MN in Finland.

In the field of torque measurement MIKES-Raute has renewed the 2 kNm torque standard machine and made a comparison with PTB. The main change was a new construction of the shaft and the control of the position of the beam to horizontal level. The results indicate that with the mechanical ball bearing system and good control it is possible to get uncertainties clearly below $1 \times 10^{-4}$. The measurement results have shown uniformity with PTB on the level of $5 \times 10^{-5}$. The measurements have been made on nominal values from 100 Nm up to 2 kNm.

**FRANCE**

**Organisation of metrology**

After the new regulation devoting to LNE the management of French metrology, LNE changed its own organisation. All LNE's activities in the field of metrology have been put together in one new centre called “Centre of Scientific and Industrial Metrology”, CMSI.

This new centre includes five divisions:
- mechanical metrology (60 people, head : A. Gosset) including:
  - mass and derived quantities
  - length and dimensional nano-metrology
  - acoustics and accelerometry
- chemical metrology
- temperature and optical metrology
- applied electrical metrology
- fundamental electrical metrology

The Institut National de Métrologie, formerly BNM-INM and now LNE-INM, which is a French metrology institute depending on the LNE for its metrological activities and depending on the CNAM in terms of staff and building, is moving from the centre of Paris to its Northern suburbs in La Plaine Saint-Denis. LNE-INM is composed of four laboratories in the fields of mass, length, temperature and radio-photometry. Its permanent staff is of the order of 40 people. The move of LNE-INM began in September 2005 and will be finished in June 2006. The area reserved for the mass activities in the new building is between twice and three times larger than the area in the former one. Of course, the LNE-INM activities in mass field will be stopped for several months.

**Progress of activities:**

**Mass**

an A5 Mettler automatic comparator has been purchased and checked successfully.
the research program on the mass standards is continuing. The aim is to realise a mass standard of 500 g for the Watt balance and to develop a new alloy for the realisation of reference mass standards from 1 g to 10 kg.

**Force and Torque**
the new torque reference of capacity 50 Nm is under test and the development of a 5 kNm torque reference is on-going.

**Viscosity**
the new viscosimeter based on the method of the falling ball has been achieved and checked successfully. Its allows the enlargement of the range of reference to the high values of viscosity.

**Acceleration**
the French national references of accelerometry have been transferred from CEA-CESTA to LNE's new laboratory. This new activity has been joined to the Force and Torque activities (head Philippe Averlant).

**Pressure**
the range of the reference non-rotating piston manometer has been extended in absolute mode down to 0.5 Pa. the thermal transpiration correction of capacitance gauges has been definitely demonstrated to be specific to each transducer. the new range of the high-pressure reference constituted with three 2 cm² effective area piston cylinder assemblies has been installed on the 1000 kg load pressure balance. The operating range is 1.5 to 50 MPa. The effective area at low pressure has been determined by comparison with a gas-operated pressure balance up to 10 MPa. The new reference will be fully qualified using both finite element analysis (the elastic constants of the material have been measured on the three units) and the counter-pressure variation method.

**Watt balance experiment**
Several parts of this experiment are now operating, such as the magnetic circuit, translation system, prototype of the force comparator, programmable source of current and electrical references developed in collaboration with NPL and PTB. Now we expect to have an in air operating demonstrator (first prototype) before the end of 2006. As part of the project 734, the choice of a material having a volume magnetic susceptibility of the order of 10⁻⁵ in absolute value to be used for the realisation of the Watt balance transfer mass is not completed. There are some interesting materials which remain to be studied, such as pure iridium, quaternary gold alloys and metal glasses.

**Germany**
With the new German government PTB’s highest authority, the ministry for economics and industry, has been renamed to BMWI and became headed by a new minister. PTB is working under a restricted budget and restricted personnel employment until July. Prof. Peters became vice-president of PTB from 1 March and Dr. Schwartz is foreseen as new head of the mechanics division. The new CP for TCM is M. Glaeser replacing Prof. Peters. A new 1 kg vacuum mass comparator “m_one” (Mettler-Toledo AG) has been purchased, installed and is being tested. First comparison measurements were performed with stainless steel weights and a silicon sphere in air and vacuum. A scientific cooperation with Sartorius AG for testing their new 1 kg vacuum mass comparator together with BIPM has been set up.
PTB is further developing the facilities for dynamic force measurements and for small forces and torque to extend the measurement range and to reduce the uncertainty. The new 5 kPa mercury micromanometer is still under evaluation; first investments have been made into development of new 1.6 GPa pressure balances; a DRS-II device utilizing principle of resonant ultrasound spectroscopy for determining the elastic constants of pressure measuring piston-cylinder units has been purchased; an FRS-5 pressure balance has been evaluated in the pressure section and is now used by the vacuum section; investigations have been started with the aim to develop pressure standards with a standard uncertainty of 1 ppm in the 7 MPa range to be used for redetermination of the Boltzmann constant.

Magnetic flotation apparatus for water density measurements is now working; first results of measurements for temperatures between 0 °C and 40 °C have been obtained. For hydrostatic weighing a new balance AX1006 has been installed which provides improved accuracy and volume determination in combination with a mass comparison apparatus. For the determination of mercury density the polishing of a new tantalum sphere is nearly finished: its volume will be determined by a spherical interferometer and new relative uncertainty will probably be below 1 ppm.

GREECE
The National Metrology System has been extended by the founding of two new national laboratories in the fields of ionizing radiation and chemical/analytic metrology. The legal framework has been approved and the laboratories have been integrated within the operations of the Hellenic Atomic Energy Committee, the National Research Center “Demokritos” and the State Chemical Laboratory respectively. Both laboratories will be supervised by EIM. The laboratories have submitted CMC tables which are under review and are in the process of evaluation of their Quality Systems within the QS-forum.

The first national metrology conference was held successfully at the Research Center “Demokritos” in November with over 200 participants. The conference was organized by EIM in cooperation with the Hellenic Association of Laboratories (Hellaslab). It was agreed that this will be a bi-annual event and it is hoped that it will evolve to an international forum for metrological issues.

EIM’s staffing problems seem to be taking a turn for the better since it is anticipated that 10 now staff members under a two year contract will be added within 2006. Funding will be provided through the national competitiveness program “EPAN” under the 5th Framework.

The two new FSM, 5 kN deadweight and hydraulic 5 MN with built up system, which were installed in 2004 have been extensively tested and evaluated. It is anticipated that within 2006 EIM will acquire a new liquid flow primary standard. The range of 6-30000 L/h will be covered with expanded uncertainty <0.1%. The procurement of the new facility was initiated in 2005 under EU funding.

HUNGARY
The budget of the laboratory has been increased, but 40% needs to be repaid to the government. This has resulted in a reduction in staff numbers through retirement although a replacement has been obtained in density. There is now 1 person in each area except force where there are 3.

A project to determine the density of 20 kg stainless steel weights has been completed.
INTERNATIONAL – BIPM
There have been heavy and ongoing discussions regarding the redefinition of the kilogram. BIPM has been active in developing its own Watt balance and in the Avogadro project.
A new vacuum balance has been acquired from Sartorius and a laboratory is being renovated to put it in.
Internal comparisons have been carried out with a DHI piston gauge as well as a supplemental comparison with LNE.
A worker from DFM has been writing software for the mass area based on that developed by Lars Nielsen.

IRELAND
Some purchases have been made in the last year including standards for the range 20 kg to 1 mg and a mass comparator. Further funding has been promised.
A new software package – specifically geared towards software writing – has been introduced.
There is currently no force reference machine with calibrations up to 400 kN being carried out using load cells and mass standards.
Pressure standards are currently maintained over the ranges 3.5 kPa to 7 Mpa (gauge and absolute), 0 to 20 MPa (differential) and 0 to 140 Mpa (gauge) with traceability coming from NPL and DKD.
There is a plan to transfer the laboratories to a new organisation – talks on this are on-going.

ITALY
The INRIM was born on January 1st 2006. Although many steps are still needed towards a full integration between the two merged institutes, the process is going on in a satisfactory way.
In the relevant field of Mass & RQ, two artefacts having the same nominal mass of 2 kg and volumes of 256 cm$^3$ and 1043 cm$^3$, respectively, have been designed and constructed. They are intended for the direct measurement of air density using a 10 kg balance.
An innovative dead-weight force standard up to 1.3 kN has been designed and is under construction.
A non-rotating pressure balance (FPG-DHI) was ordered at the end of 2005. This instrument will work in the range 1 Pa to 15 kPa in both absolute and gauge modes.
The last generation absolute gravimeter has participated in a BIPM comparison.
INRIM know-how in the field of hardness has been transferred to a number of foreign NMIs.
The thruster for satellite applications is now in the space qualification phase. This requires a range of tests to check the compliance to a number of severe specifications. The thruster has passed the tests so far carried out. A new balance for the accurate measurement of the thrusts (in the range from 2 µN to 1 mN) has been designed and is under development.
The activity concerning the Avogadro international project has proceeded according to the scheduled roadmap.

LATVIA
The laboratory of mass measurement has expanded the accreditation sphere in the field of
-calibration of weights up to 2 tons
-calibration of non-automatic scales up to 200 tons and
-calibration of laboratory glassware up to 2 litres.

The European Commission has given to the Latvian National Metrology centre the institution number according to conformance evaluation - notified body number 1693.

The laboratory of mass measurement is authorized to proceed to the conformance evaluation according to the directive 90/384/EEC- non-automatic weighing instruments EC verification and EC unit verification.

The Calibration and Measurement Capabilities (CMC) of the laboratory of Mass measurement have been included in a database (KCDB) of the International Bureau of Weights and Measures (BIPM).

The mass measurement laboratory is preparing for the expansion of accreditation sphere in the field of calibration of automatic weighing instruments and calibration of standard test measures.

**LITHUANIA**

The laboratory has extended the range of its accreditation from 1 mg to 10 kg up to 1 mg to 20 kg. Calibrations of M1 class 500 kg weights have also now been started.

**NORWAY**

No major changes have taken place during the last year.

**POLAND**

**General information**

22 laboratories of the Central Office of Measures and most laboratories of the Regional Verification Offices applied for and obtained accreditation as calibrating laboratories, including three laboratories of Mass and Force Division:

- Mass Laboratory – for calibration of mass standards and weighing instruments of accuracy class 1.
- Pressure Laboratory – for absolute and reference pressure measurements and calibrating of pressure gauges with elastic sensing element and electronic pressure gauges.
- Viscosity Laboratory – for calibration of liquid standards and capillary glass viscometers.

The accreditation certificates were issued by the Polish Centre for Accreditation in December, 2005.

Due to the accreditation, some organizational changes had to take place, among others Weighing Instruments and High Capacity Mass Standards Laboratory was transferred to the Testing Laboratory Department (now there are two departments: for testing and for calibrating laboratories).

The further modernization of the GUM building is in progress, at the end of the year 2005 major improvements were done in the viscosity laboratory.

**Mass Laboratory**

No major changes of measurement facilities have taken place during the last year. The mass laboratory participated as the reference laboratory in bilateral comparisons with 12 laboratories of the regional verification offices and one accredited laboratory.

**Viscosity Laboratory**

The viscosity laboratory has taken part in the international comparison D02.07.A under the ASTM Cooperative Kinematic Viscosity Program with good results. An additional SPRT sensor was purchased for the temperature bridge. Now the laboratory is finishing the modernization mentioned above.
Force Laboratory
New equipment has been acquired: one force transducer up to 5 MN for compressive forces and one up to 50 kN for compressive and tensile forces. Further investments are planned for this year. The force laboratory participated as the reference laboratory for comparisons for 5 laboratories: 4 in regional verification offices and one accredited.

Pressure Laboratory
The pressure laboratory participated, and provided the reference, in two comparisons for 18 laboratories of regional verification offices of pressure standards in the range 0-60 MPa, with several pressure gauges used as transfer standards. The results of the comparisons were estimated under Guide 43-1 Part 1: “Development and operation of proficiency testing schemes”. The pressure laboratory was equipped with new oil pressure balance in range from 0.4 MPa to 100 MPa, calibrated by PTB. The ring-weights were calibrated by GUM’s mass laboratory. This enabled changes to be submitted to GUM’s CMC data for pressure (formerly accepted by EUROMET in February 2001) and published in the recently updated BIPM KCDB. In 2005, a new mass-comparator of capacity 5 kg was purchased to calibrate pressure balance weights.

Density Laboratory
The density laboratory continues to improve the hydrostatic weighing reference standard. A new support, made exclusively of stone, was constructed for the AT 1005 comparator-balance, to perform measurements of solid and liquid density by means of the 1 kg silicon sphere and a new set of hydrostatic vessels. Due to organizational reasons the density laboratory had to cease accreditation process.

PORTUGAL
A new system for the measurement of liquid density has been installed.

ROMANIA (in-depth presentation)
INM is a part of the Romanian Bureau of Legal Metrology (BRML). The mass laboratory maintains standards from 1 mg to 1000 kg. The national standard kilogram (No 2) was calibrated at BIPM in 2005 and disseminated to secondary standards using an environmentally controlled 1 kg mass comparator with a resolution of 1 µg and a standard deviation of 2 µg. Other activities within the mass area include the standard mass per storage volume of grain, an area where INM are looking to take part in a bilateral comparison. The pressure standards are maintained using Ruska 2400 pressure balances traceable to PTB and Ruska 2465 pressure balances traceable to NIST. Standards are maintained for kinematic viscosity, Rockwell hardness scale and density. The force area has three deadweight machines covering the ranges up to 10 kN, 50 kN and 100 kN. Over the range 100 kN to 1000 kN a comparison machine using a force transducer traceable to PTB is used.

SERBIA AND MONTENEGRO
In the field of mass and pressure there have been no major investments or improvements during the last year. Mass laboratory was equipped with a new 500 kg mass standard class M1 and a Mettler 600 kg mass comparator. The new laboratory for mass is under construction. The laboratory should be finished this year. Some delay is however expected.
New equipment for the measurement of mass will be acquired this year also.

**SLOVENIA**

In the field of mass one of laboratory staff members left the laboratory but we were fortunately allowed to employ a new one. Therefore our important concern was training and knowledge transfer to the new member. We started to design an automatic weight handler for our 5 g manual comparator. We also did an additional study and data analysis of the mass scale dissemination process. In the field of pressure the CMCs for pressure were accepted into the BIPM database. Capabilities cover a range from $10^{-5}$ Pa to 200 MPa. All reference standards are currently traceable to PTB.

**SLOVAKIA**

No major changes to report.

**SPAIN**

During the last year minor changes have happened in our Organisation.

From the technical point of view we can summarize the situation as follows:

- In mass and density field there have been no major investments or improvements during this period. There have been some problems with the uncertainty of the reference density standard of CEM 1 kg silicon sphere S1 due to results of the CCM.D-K1 comparison. To resolve this matter the S1 standard has been sent to NMIJ to make dimensional measurement of the diameter. We hope the S1 will be back to CEM by April 2006. In addition, a bilateral comparison on hydrostatic weighing with NMIJ, probably in 1 kg Si sphere, has been progressing.

- In the field of pressure, the work on design and development of a mercury column primary standard in absolute, gauge and differential mode in the pressure range from 0.1 kPa up to 130 kPa is continuing. It is planned to finish in 2008. The automation of the dynamic expansion system of the pressure laboratory is on-going. A new pressure balance, DH Instruments FPG8601, for the pressure range from 0.1 Pa to 15 kPa has been acquired.

- In force, a 10 MN force standard machine has been ordered and it is expected to be installed this year.

- In torque, the tests for BIPM key comparison have been carried out and the results are awaited.

All CEM´s laboratories have dedicated a lot of effort to supply traceability to national calibration laboratories and pilot some comparisons. During this year the following comparisons have been pilot:
- National comparison in gauge pressure range from 1 MPa to 280 MPa in oil medium with 11 laboratories.
- National comparison in absolute pressure range from 0.1 Pa to 1000 Pa in gas medium with 5 laboratories.
- National comparison on force transducer in tension and compression at the nominal values of 50 kN, 200 kN, and 2 MN with 17 laboratories.
The comparison of OIML E2 masses started in 2004, for the values 1 kg, 100 g, 20 g, 5 g and 100 mg, with national laboratories of metrology of Comunidad Andina (SENCAMER, INEN, SIC, INDECOPI, IBMETRO) in the frame of Technical Assess and Cooperation Program of EU (AECR/B7-31/IB/96/0188) piloted by CEM (Spain) and co-piloted by CENAM (Mexico) has finished and the satisfactory results will be presented during the IMEKO XVIII World Congress next September, in Rio de Janeiro.

**SWEDEN**
In the mass area there have been no major changes in the past year. The pressure area have moved to new laboratories within SP. The design of a new pressure shock tube is being planned. A new force testing machine working standard is being delivered in 2 months, with new facilities covering the range 2 MN to 6 MN being ready this summer. Two new deadweight torque testers have been introduced and the design of a new 5 kNm⁻¹ reference is underway.

**SWITZERLAND**
According to the European interpretation of new international requirements, accreditation services can no longer be under the responsibility of a national metrology institute. That's the reason why the Swiss Accreditation Service will leave METAS on the 1st of April 2006 and move under the responsibility of the State Secretariat for Economic Affairs within the Federal Department of Economic Affairs. METAS as the national metrology institute will continue to stay within the Federal Department of Justice and Police, but will lose accreditation in its name.

In the mass laboratory, the project "combined methods" (new 1 kg vacuum mass comparator coupled to surface analysis with angle resolved X-Ray Photoelectron Spectroscopy) is efficiently going forward. Both the comparator and the XPS system are operational and presently under intensive testing and validating. As the XPS can accommodate 1 kg mass standards of 1 kg silicon spheres, collaboration with the international Avogadro project was initiated.

For calibrations, the METAS mass laboratory is now equipped with four mass comparators working at constant and regulated pressure. The mass range from 10 g to 10 kg can be realized at exactly the same air density.

Christian Wuethrich, head of the pressure laboratory is now also responsible for force, torque and pressure since last December.

In the pressure laboratory, a 20 cm² absolute pressure balance with automated mass handling was installed this month. This new pressure balance will slowly replace the mercury barometer, which is still working for the moment.

The new METAS static expansion system is now fully characterized and operational. The relative uncertainty of measurement for 1.0 · 10⁻³ Pa is below 1 %. Calibration service for reference vacuum gauges is already offered by the pressure laboratory.
THE NETHERLANDS
The mass laboratory has moved to a new laboratory, where the major change has seen the introduction of an automatic weight handling system for use with the mass comparators.

TURKEY
In torque, 1 kNm dead weight type torque standard machine with air-bearing has been completed: its performance tests are on-going.
In pressure, a calibration system for quasi-static-dynamic pressure transducers up to 800 MPa has been established. Two bi-lateral comparisons piloted by UME Pressure Laboratory are on-going, one with France and one with Romania.
In hardness, we purchased two systems from LTF -a company from Italy. One system is for the characterisation of Rockwell and Vickers diamond indenters and one system is to measure the size of Brinell and Vickers indentations. Also, we are establishing two dead weight type hardness standard machines: one for Rockwell and one for Brinell hardness scales.
UME has been involved in preparation for accreditation during 2005 and it is going to be accredited by TURKAK (Turkish Accreditation Agency) within a short period of time.

UNITED KINGDOM
In pressure, the construction of a new mercury manometer is continuing.
In force there have been no major developments.
The new torque machine has been commissioned.
No major developments in mass – moving to the new NPL building continues to be imminently expected!
The design of a new Watt balance (mark 3) has been completed, and a new team has been established to investigate the requirements for standards of dynamic measurement.

5. EUROMET Project reports
The Chairman reminded that coordinators should submit their annual progress reports for the ongoing projects to the EUROMET Secretariat with a copy to the chairman. The content of the progress reports will be inserted in the EUROMET Projects database (http://www.euromet.org/cgi-bin/projectsearch.pl). The following brief status reports were given for all projects, including EUROMET key and supplementary comparisons:

Mass subfield:
351: The project is ongoing with a meeting held prior to the TC-M meeting.
402: It was decided to drop this project as an appropriate guide has already been produced.
445: The draft-B report for this project has been circulated and comments received. These will be incorporated in the final report to be published this year.
461: The report has been prepared and will be circulated.
509: A draft report has been circulated to the participants for comment and to agree the method of presentation of results. A meeting was held prior to the TC-M meeting
510: The draft-B report for this project has been circulated and comments received. These will be incorporated in the final report to be published this year.

519: The report on this project is still awaited.

697: Ongoing, but activity in mass has slowed.

702: This comparison is ongoing with details of the progress to date presented to the participants at a meeting held prior to the TC-M meeting.

734: A short meeting was held prior to the TC-M meeting where it was agreed the project should continue at least until the next TC-M meeting.

786: The transfer standards are currently circulating according to the agreed timetable.

832: This project is ongoing with 5 participants. The measurements have been finished and the report is underway.

837: This on-going project is to study the surface effects on mass standards. A meeting was held prior to the TC-M meeting where a presentation was made of results obtained so far.

839: Supplementary (to project 461) comparison at 500 kg. No report made.

**Force subfield:**

113: The project is ongoing. A meeting was held prior to the TC-M meeting.

285/286: The project is ongoing. A meeting was held prior to the TC-M meeting where results were presented.

505: This comparison will start upon completion of the CIPM comparison.

518: This comparison will start upon completion of the CIPM comparison, due to be finished in 2006.

535: A meeting was held prior to the TC-M meeting where Draft-A of the report was discussed.

769: The project is ongoing.

838: The project, a comparison between UME Turkey and INM Romania, is ongoing.

887: A meeting was held prior to the TC-M meeting where it was agreed that this project, to update the EA document EA10/04, will go forward.

**Pressure subfield:**

439: The final report is due to be completed by the end of April.

442: The comparison has been completed and the results published in Metrologia.

463: The project has been completed and results summarised in Metrologia and presented at the CCM Pressure Conference.

499: It was proposed, and accepted, that this project should now end.

534: This project is ended and the final report is due.

788: The measurements have been made and the initial report completed.

803: The project is ongoing. A meeting was held prior to the TC-M meeting where an additional three participants were included.
834: All measurements have been completed and the report is currently being produced.
855: The measurements have been made and the initial report completed.
861: The project is ongoing. The measurements in LNE have been completed.
881: The project is ongoing. A meeting was held prior to the TC-M meeting. Five of the seven participants have completed their measurements and it is anticipated that it will be completed by the end of the year.
884: The measurements have been completed.

6. Proposed EUROMET projects
The following projects were proposed:

Mass: To investigate the properties of materials used in the Watt balance experiments.
Pressure: To carry out a bilateral comparison between MIRS (Slovenia) and CMI (Czech Republic) over the pressure range 50 MPa to 200 MPa.
To carry out a comparison of vacuum standards using a SRG (pilot CMI).
To carry out a comparison of pressure distortion at 1GPa.
Force: To carry out a comparison at 500 kN.
To carry out a calibration of strain cylinders comparing the three different methods of calibration NPL (UK), PTB (Germany) and LNE (France).
Dynamic: Cooperate in research in dynamic force measurement, establishing the needs and procedures.

The chairman requested the proposers to send in proposed or agreed project forms to the EUROMET Secretariat.

7. Status on EUROMET Key Comparisons
Updates on the comparisons were presented in Section 5. The current status of the comparisons are given in Table 1 and Table 2 of Appendix A.

8. Status on Mass CMC Tables for Appendix C
The last submission from the EUROMET TC-M, EUROMET.M.4.2004, was submitted in November 2004. SIM, APMP, and COOMET all reviewed and approved the submission in August 2005. Submissions were published in the BIPM KCDB on 17 October 2005.

Current submissions

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Density
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PTB Density
MIKES Torque Gravity
UME Mass
INRIM Density

Instructions for modifying already published CMC tables are given in the document JCRB-8/10:
http://www.bipm.org/utils/common/documents/jcrb/modifying_cmcs.pdf,

Instructions for drawing up new CMC excel files are given in the following document:

The CMC review team consists of the following persons:

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<tbody>
<tr>
<td>Mass</td>
<td>Ulf Jacobsson (IRMM)</td>
</tr>
<tr>
<td>Solid density and gravity</td>
<td>Philippe Richard (METAS)</td>
</tr>
<tr>
<td>Liquid density</td>
<td>Horst Bettin (PTB)</td>
</tr>
<tr>
<td>Pressure</td>
<td>Wladimir Sabuga (PTB)</td>
</tr>
<tr>
<td>Force</td>
<td>Rolf Kumme (PTB)</td>
</tr>
<tr>
<td>Torque</td>
<td>Diedert Peschel (PTB)</td>
</tr>
<tr>
<td>Viscosity</td>
<td>Henning Wolf (PTB)</td>
</tr>
<tr>
<td>Hardness</td>
<td>Alessandro Germak (IMGC)</td>
</tr>
</tbody>
</table>

Ulf Jacobsson of IRMM then presented a review of CMC-Tables. His summary is as follows:
- A CMC review is not supposed to discourage any laboratory from their strive to obtain the lowest possible uncertainties
- Laboratories need to be confident in the services that re provided to customers, the CMC foundation.
- Once approved within EUROMET the claims will be circulated among all other RMOs for further review.
- The aim of this presentation is thus to create an understanding for the criteria and review process for CMC claims.

9. The role of TC-M in the iMERA project and Roadmap review

The Chairman presented the background to the iMERA project (Appendix B). He stressed that iMERA is inclusive of all laboratories, so there is an opportunity for everyone to get involved and indeed they should all be involved. The area coordinators (see Appendix B) will take on the role of reviewing the roadmaps.
Rolf Kumme presented the 2nd draft version of the Force and Dynamic roadmaps. Additional roadmaps were also proposed for conventional force and torque, multi-component measurements and for compression/tension. The Chairman stressed the need to limit the number of roadmaps in the area of mass and related quantities, suggesting that six was the probable maximum.

Wladimir Sabuga then presented the 2nd draft of the pressure roadmap – this was produced from the 1st draft prepared by NPL in December 2005. He had received proposals for modifications from 7 institutes and agreement had been reached in the modifications to be made to the roadmap. It was stressed that having more than 4 targets was not really possible.

The mass roadmap was then presented by Ulf Jacobsson. The main driver for this roadmap is the re-definition of the kilogram and any suggestions for modifications were asked to be forwarded to Ulf.

It was then proposed by the Chairman that EUROMET projects be established to match the goals of the roadmap, and also that this is a long-term project with the framework being put in place by November of this year.

10. **EUROMET adoption of the EA Special Calibration Documents**

The status of the following documents was discussed:

- **EA-10/03 Calibration of pressure balances** (1997): This has been converted to EUROMET format. Jean Claude Legras and Jos Verbeek agreed to update the section on evaluation of uncertainty.

- **EA-10/04 Uncertainty of Calibration Results in Force Measurements** (1996): This is out of date and needs to be revised in line with the new ISO document. It should also be increased in scope to include uncertainty determinations of non-ISO calibrations.

- **EA-10/14 EA Guidelines on the Calibration of Static Torque Measuring Devices** (2000): This document has been converted to EUROMET format.

- **EA-10/16 EA Guideline on the Estimation of Uncertainty in Hardness Measurements** (2001): This document has been converted to EUROMET format.

- **EA-10/17 EA Guidelines on the Calibration of Electromechanical Manometers** (2002): This document has been converted to EUROMET format.

- **EA-10/18 Guidelines on the calibration of nonautomatic weighing instruments** (2005): It was proposed by the Chairman that a project be set up under the leadership of Ivan Kriz to produce a condensed version of this guide.

11. **Redefinition of the kilogram**

A report on the status of the redefinition of the kilogram was presented by Richard Davis of BIPM. The International Committee for Weights and Measures (CIPM) has published a recommendation, CIPM/05-RECOM1, available at www.bipm.fr/cci/CIPM/Allowed/94/CIPM-Recom1CI-2005-EN.pdf.

In summary, whilst it approves, in principle, the preparation of the new definitions as requested by the CCU, it sets out conditions to be met before a redefinition is introduced and recommends that National Metrology Institutes should pursue vigorously their work presently underway aimed at providing the best possible values of the fundamental constants needed for the redefinitions.
now being considered and should prepare for the long term maintenance of those experiments that will, in due course, be necessary for the practical realization of the new definitions.

It also invites all Consultative Committees, particularly the CCM, CCEM, CCQM and CCT, to consider the implications of changing the definitions of the above-mentioned base units of the SI, and to submit a report to the CIPM not later than June 2007.

There will be no redefinition in 2007, only an announcement that the definition will be changed no earlier than 2011. This is compatible with the timescale laid down on the iMERA roadmap for mass.

12. Date and place of next meeting

The date of the next meeting was agreed as being 1-2 March 2007. The location has yet to be decided.

13. Any other business

Lars Nielsen reported that the EUROMET mass website (http://volt.dfm.dtu.dk/mass/) hasn't been updated in over a year. Unless a new webmaster is found to update it the link to the EUROMET website should be cut.

It was suggested that iMERA roadmaps should be drafted for other areas, eg hardness, density and viscosity. The technical contacts were asked to consider barriers to uncertainties in these areas and see if there are issues that would require a roadmap showing what is needed to be achieved by 2020.

The Chairman reiterated the need for as few as possible roadmaps, and suggested that these roadmaps could be dovetailed into existing roadmaps.
Appendix A. EUROMET key and supplementary comparisons

<table>
<thead>
<tr>
<th>Comparison ID</th>
<th>Project no.</th>
<th>Subfield</th>
<th>No. of partic.</th>
<th>Pilot</th>
<th>Status</th>
<th>Years</th>
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<tr>
<td>EUROMET.M.M-K2.1</td>
<td>786 A</td>
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<td>Force</td>
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<td>NPL</td>
<td>Planned</td>
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<table>
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<tr>
<th>Comparison ID</th>
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<th>Pilot</th>
<th>Status</th>
<th>Years</th>
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<td>EUROMET.M.V-S1</td>
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<td>EUROMET.M.M-S1</td>
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<td>2</td>
<td>METAS</td>
<td>Report in progress, Draft B</td>
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Table 1. The status of the EUROMET Key Comparisons Feb 2006

Table 2. The status of the EUROMET Supplementary Comparisons Feb 2006
Appendix B: The role of TC-M in the iMERA project and Roadmap review

Implementing metrology in the European Research Area

Following on from the successful MERA project, the proposal for a follow on project "Implementing Metrology in the European Research Area" (iMERA) has been successfully evaluated by the European Commission and negotiations are under way with the aim of starting the new project in Spring 2005.

iMERA will enable the national Governments from participating countries to significantly increase the national and European impact of their investment in R&D in metrology. This investment underpins expenditure of more than €83 billion per year, or nearly 1% of EU GDP, on measurement activity from directly quantifiable sources alone, generating almost €230 billion of directly estimable benefits.

iMERA proposes a step-by-step approach. Exchange of information between the national programmes will enable best practice to be identified and adopted - increasing the impact from the national programmes. Building on this a substantial increase in project level collaboration is foreseen. Strategic activities will lead to the launching of joint research projects, with defined work plans, resources, responsibilities and time scales - funded by the existing national programmes. Access to special metrological facilities available in just a single or few countries will be opened and the viability of joint investments in new facilities explored.

The final aim of the project is very ambitious - a joint metrology R&D programme. Scope, stakeholder needs, national funding contributions, legal issues, obstacles for national participation and appropriate organisational structures will all be addressed. This phase culminates in the preparation of a European Metrology Research Programme (EMRP) with the prospect of launching the initiative in a joint action between the European Commission and interested countries utilising Article 169 of European Treaty. Care will be taken to ensure the changes are sustainable beyond the time of any financial support of the Commission.

The role of TC-M in the iMERA project and Roadmap review

Area coordinators

- Force: Rolf Kumme (PTB, Germany)
- Pressure: Vladimir Sabuga (PTB, Germany)
- Mass: Ulf Jacobsson (IRMM, European Commission)

Timetable

1st – 3rd March 06    Review of roadmaps at TC-M meeting
14th – 15th March 06  Presentation of roadmaps AT IMERA review (9th EUROMET Technical Committee Chairpersons Meeting)
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>December 06</td>
<td>First European Metrology Research Programme (EMRP) structure agreed</td>
</tr>
<tr>
<td>July 07</td>
<td>Procedure for implementation of EMRP agreed</td>
</tr>
<tr>
<td>December 07</td>
<td>European structure for First EMRP established</td>
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</tbody>
</table>