TC-Chair Annual Report 2009/2010
TC-M

12 March 2010

1. General Aspects

The EURAMET Mass and Related Quantities Technical Committee, TC-M, is characterized, as well as its international counterpart, the CCM, by the number of related quantities and by the diversity of techniques employed in the realization of the corresponding units. Nevertheless, the dominant topic nowadays is for sure the re-definition of the kilogram which, since the 2005 first proposal, has largely conditioned the activity of many NMIs. Actually, several EURAMET NMIs are actively involved in this task, often through co-operative research which is also reflected in EURAMET projects.

A second, although not exclusive of TC-M, circumstance characterizing this period is certainly the EMRP. Either individually or through personal contacts, many Potential Research Topics have been submitted by EURAMET scientists, which implies that a lot of time and energy have been devoted to this task.

Possibly as a consequence of these two facts, the number of new proposals, both in comparisons and research, is showing some decrease. Symmetrically, a good number of projects were completed during the considered period.

Stuart Davidson's period as TC-M chairman went to an end in summer 2009. The author of this report, Walter Bich from INRiM, Italy, succeeded.

2. Projects

In the period under review (Mar 2009 – Feb 2010) in TC area of the numbers of proposed, agreed and completed projects in the various categories are shown in the table below. The previous year's numbers are shown in brackets.

	Comparison	Research	Traceability	Consultation	Total
Proposed	4 (11)	3 (6)	-	-	7 (17)
Agreed	15 (18)	9 (12)	3 (3)	/ (1)	27 (34)
Completed	43 (32)	33 (29)	6 (6)	15 (11)	97 (78)
Total	**62 (61)**	**45 (47)**	**9 (9)**	**15 (12)**	**131 (129)**

The projects can be broken down by technical area as follows:

	Proposed	Agreed	Completed	Total
Density		3	7	**10**
Force	2	7	5	**14**
Hardness			1	**1**
Mass		7	39	**46**
Pressure	5	6	39	**50**
Torque		2	1	**3**
Viscosity		1	4	**5**
Gravimetry		1	1	**2**

Three completed projects dealing with general issues were placed under Mass for simplicity.

3. Comparisons

There are 27 registered European key comparison in the area of Mass and Related Quantities, of which 10 are active, 4 have provisional equivalence, 12 have been approved for equivalence. One was a bilateral key comparison between PTB (EURAMET) and CENAM (SIM). Details are given in Table 1.

Comparison ID	Project no.	Title/Range	Subfield	Pilot	Contact	Status	Years
EUROMET.M.M-K1	215	Kilogram	Mass	NPL	Ian Severn	Approved for equivalence	1992-1999
EUROMET.M.M-K2	445	(Sub-)multiples	Mass	SP	Michael Perkin	Approved for equivalence	2001-2003
EUROMET.M.M-K2.1	786	(Sub-)multiples	Mass	SP	Michael Perkin	Approved for equivalence	2004-2008
EUROMET.M.M-K4	510	Kilogram	Mass	NPL	Stuart Davidson	Approved for equivalence	1999-2003
EUROMET.M.M-K4.1	510	Kilogram	Mass	MIRS	Matej Grum	Approved for equivalence	2007-2008
EUROMET.M.D-K1	339	Solid (3 Si spheres)	Density	METAS	Philippe Richard	Provisional equivalence	1998-1999
EUROMET.M.D-K1.1	1031	Solid (3 ceramic sph.)	Density	PTB	Horst Bettin	In progress	2008-2010
EUROMET.M.D-K2	627	Liquid density	Density	PTB	Horst Bettin	Report in progress, Draft B	2001-2002
EURAMET.M.D-K2	1019	Liquid density	Density	BEV	Christian Buchner	In progress,Draft A	2007-
EUROMET.M.D-K4.Prev	236	Hydrometers	Density	IMGC	Salvatore Lorefice	Provisional equivalence	1993-1994
EUROMET.M.D-K4	702	Hydrometers	Density	IMGC	Salvatore Lorefice	Approved for equivalence	2003-2006
EUROMET.M.P-K1.a	442	0.1 Pa to 1000 Pa	Pressure	BNM-LNE	J.C. Legras	Approved for equivalence	1999-2002
EUROMET.M.P-K1.b	442	0.3 mPa to 9 Pa	Pressure	BNM-LNE	J.C. Legras	Approved for equivalence	2000-2002
EUROMET.M.P-K2	305	1 MPa to 4 MPa	Pressure	PTB	Wladimir Sabuga	Approved for equivalence	1994-1995
EUROMET.M.P-K3.a	439	0.05 MPa to 1 MPa	Pressure	LNE/NPL	J.C. Legras	Approved for equivalence	1999-2001
EUROMET.M.P-K3.b	439	0.05 MPa to 1 MPa	Pressure	NPL	Ian Severn	Report in progress, Draft B	1999-2001
EUROMET.M.P-K4	389	10 MPa to 100 MPa	Pressure	NPL	Ian Severn	Approved for equivalence	1998-1999
EUROMET.M.P-K5	045	50 MPa to 500 MPa	Pressure	BNM-LNE	J.C. Legras	Provisional equivalence	1993-1995
EUROMET.M.P-K6	110	100 MPa - 1000 MPa	Pressure	BNM-LNE	J.C. Legras	Provisional equivalence	1992-1994
EURAMET.M.P-K7	881	50 MPa to 500 MPa	Pressure	MIKES	Markku Rantanen	Report in progress, Draft B	2005-2007
EURAMET.M.P-K8	1041	25 kPa to 200 kPa		METAS	Christian Wuethrich	In progress	2007-
EURAMET.M.P-K13	1091	50 MPa to 500 MPa	Pressure	UME	Ilknur Kocas	In progress	2009-
EUROMET.M.F-K1	535	5 kN to 10 kN	Force	MIKES	Aimo Pusa	Report in progress, Draft B	2002-2004
EUROMET.M.F-K2	518	50 kN to 100 kN	Force	NPL	Andy Knott	In progress,Draft A	2003-
EUROMET.M.F-K3	505	500 kN to 4 MN	Force	PTB	Rolf Kumme	Proposed	2005-2007
SIM-EUROMET.M.P-BK3		3 mPa to 0.9 Pa	Pressure	PTB/CENAM	Karl Jousten	Approved for equivalence	2001-2002
SIM-EUROMET.M.P-BK4		10 MPa to 100 MPa	Pressure	PTB/CENAM	Wladimir Sabuga	Approved and Published	2002

Table 1: Status of EURAMET Key Comparisons

There are also 18 supplementary comparisons. Among these comparisons, twelve have been published and six are in progress.

Comparison ID	Project no.	Title/Range	Subfield	Pilot	Contact	Status	Years

EUROMET.M.V-S1	273	(0.989-4600) mm^2/s	Viscosity	PTB	Henning Wolf	Published	1992-1993
EUROMET.M.V-S2	303	(0.4- 67743 mm^2/s	Viscosity	PTB	Henning Wolf	Published	1993-1996
EUROMET.M.V-S3	415	(190- 774000 mm^2/s	Viscosity	PTB	Henning Wolf	Published	1997-2000
EUROMET.M.V-S4	415	(0.33-144000) mm^2/s	Viscosity	PTB	Henning Wolf	Published	1997
EUROMET.M.M-S1	461	500 kg	Mass	CMI	Ivan Kriz	Report in progress, Draft B	2001-2005
EURAMET.MM-S2	1054	0.1 mg to 100 g	Mass	NPL	Stuart Davidson	In progress	2008-
EUROMET.M.P-S1	788	0.05 MPa to 1 MPa	Pressure	METAS	Christian Wuethrich	Approved and Published	2004-2006
EUROMET.M.P-S2	922	30 Pa to 7 kPa	Pressure	PTB	Karl Jousten	Approved and Published	2006-2007
EUROMET.M.P-S3	884	80 kPa to 110 kPa	Pressure	LNE	Pierre Otal	Approved and Published	2006-2008
EUROMET.M.P-S4	861	40 kPa to 1.75 MPa	Pressure	UME	Ilknur Kokas	Approved and Published	2005-2006
EURAMET.M.P-S5	931	50 MPa to 500 MPa	Pressure	PTB	Sabuga	Report in progress, Draft B	2007-2008
EURAMET.M.P-S7	1040	0.1 mPa to 1 Pa	Pressure	METAS	Christian Wuethrich	In progress	2007-
EURAMET.M.P-S8	1131	-100 kPa to +100 kPa	Pressure	MIKES	Sari Saxholm	Approved and Published	2009-2010
EURAMET.M.T-S1	1055	1 N.m to 1000 N.m	Torque	PTB	Dirk Roeske	Report in progress, Draft B	2008-
EURAMET.M.T-S2	1141	100 N m	Torque	PTB	Dirk Roeske	In progress	2008-
EURAMET.M.G-S1	1093	*g*	Gravimetry	METAS	Henri Baumann	Approved and Published	2008-2009
EURAMET.M.P-S6		1.5 kPa to 300 kPa	Pressure	PTB	Wladimir Sabuga	Approved and Published	2007-2008
EURAMET.M.F-S1		5 kN to 5 MN	Force	NPL	Andy Knott	Approved and Published	2005-2006

Table 2: Status of EURAMET Supplementary Comparisons

4. CMCs

Over the last year eight CMCs from other RMOs have been approved, four are currently under review.

As concerns EURAMET submissions, this is an update since March 2009

Approved EURAMET CMC revisions or new submissions

EURAMET.M.9.2008 (PTB, Germany, CMC revision for pressure)
EURAMET.M.10.2008 (METAS, Swiss, CMC revision for pressure)
EURAMET.M.10.2009 (NIS, Egypt, new CMCs for pressure)
EURAMET.M.13.2009 (NIS, Egypt, new CMCs for force)
EURAMET.M.14.2009 (NIS, Egypt, new CMCs for viscosity)
EURAMET.M.15.2009 (CEM, Spain, CMC revision for torque)
EURAMET.M.16.2009 (NCM, Bulgaria, new CMCs for viscosity)

EURAMET CMCs currently under review

EURAMET.M.11.2009 (NIS, Egypt, new CMCs for mass, approval pending)
EURAMET.M.17.2010 (ZMDM, Serbia, new CMCs for mass, under review). This submission occasioned a debate with SIM on an important issue, concerning the capability to adequately determine influence quantities, such as the volume (or density) of the standard under measurement. This capability is not requested by EURAMET, whereas it is considered necessary by SIM. A harmonization of criteria in this field is deemed necessary, probably at the JCRB level.
EURAMET.M.18.2010 (EIM, Greece, revision of mass CMCs, under review)
EURAMET.M.19.2010 (VSL, The Netherlands, extension of the temperature range for viscosity, under review)
EURAMET.M.20.2010 (IPQ, Portugal, a slight extension of the range in pressure, under review)

GUM, Poland, corrected its force CMCs with no need for inter-regional review.

Walter Bich carried out a peer review of the INTI (Argentina) mass and density laboratories, after a similar, previously unreported exercise in 2008 at CENAM (Mexico).

An issue had been raised to WB by Chris Sutton (Chair CCM WG CMC) concerning the will of CENAM to declare CMCs in the field of magnetic properties of mass standards. The issue was debated and it appeared that EURAMET NMIs do not show a particular interest in establishing CMCs in this field. In addition, the general opinion was that it might not be advisable to go in this direction.

5. Activities of the Sub-Committees

Mass, Force, Pressure and Density sub-committees meet annually before the TC-M Contact Persons meeting. At this year's technical meetings the following subjects were discussed.

Mass Sub-Committee
Convenor: Ulf Jacobsson, IRMM

- Reports were presented on the status of the following comparisons:
  - 1120, a comparison among seven laboratories from Countries of southern Europe, with BEV-EIM as pilots. This project is on schedule.
  - 1054, a comparison of sub-milligram mass standards between LNE, NPL and PTB. Preliminary results are available.
  - 1110, a comparison (classified as research) on magnetic properties of mass standards, with 20 participants and PTB as pilot. The project is on schedule.
  - CCM.M.K-3.1a 50 kg comparison between LNE and CEM. Preliminary results are available.

- Project 351 is an ongoing activity intended as a forum in which to present and discuss topics relevant to mass standards. This year, presentations were given on "Stability of sub mg mass standards", (in connection with project 1054); "New materials for mass standards" (on new alloys which facilitate better control of surface properties and mass standard density); "Calibration of Si spheres in vacuum and air for the Avogadro project" (in connection with the redefinition of the kilogram).

- The Roadmap for Mass was discussed and it was decided that an update would be appropriate. A revised roadmap is currently under discussion.
- The issue raised by Chris Sutton and mentioned in the preceding section 4 of this report was discussed.

- A specific item of the agenda was devoted to the EMRP. A proposal from VSL, the Netherlands, concerning
- "Better, faster and more accurate weighing of aircraft" was discussed and eventually presented as a PRT
- A second possible topic on "Calibration of AWI for industry" was considered better suited for the next EMRP

Pressure Sub-Committee
Convenor: Wladimir Sabuga, PTB

During the pressure technical meeting the following topics were discussed :

- Announcement of the Joined 5th CCM pressure and vacuum & 4th IMEKO TC16 conference - 2011 Berlin, May 2-5, 2011, info at http://ccmp-5.ptb.de, ccmp-5@ptb.de.

- Project 1039: "FEA calculation of pressure distortion coefficients of gas-operated pressure balances". The project was closed successfully.

- Project 911: "Study of standard leaks' performance for different gases, in the transition regime", ongoing.
- Project 1131: "Comparison in the negative gauge pressure range".This project was declared concluded and it was decided to organize a further supplementary comparison with a larger number of participants.
- Project 1115: "R-134a leak comparison in atmospheric pressure". This is a new proposal.
- Project 1091: "EURAMET.M.P-K13: Comparison in the range (50 to 500) MPa of liquid pressure" A KC which is expected to be finished in May 2010 and be linked to CCM.P-K13.
- Status of other key comparisons, progress, new need
- Project 1125: "Evaluation of cross-float measurements with pressure balances". A proposal, aimed at-comparing different calculation techniques by circulating common sets of data.
- EURAMET CG 03 "Calibration of Pressure Balances" overview of main changes in the last CG version.
- Information from NMIs
- EMRP PRTs "Industry"
- Pressure roadmap

Force Sub-Committee
Convenor: Rolf Kümme, PTB

- Report not available

Density Sub-Committee
Convenor: Christian Buchner, BEV

- Presentation on hydrometer Key Comparisons, with an overview to link EURAMET project 702, SIM.M.D-K4 KC (both completed) and APMP.M.D- K4 (finish July 2010) with the new CCM.D.K4 (start 2010; expect to finish 2015).
- EURAMET.M.D-K2 (project 1019) on liquid density. Ongoing. Interest was shown by about 15 potential participants for a comparison on Densitymeter (vibration tubes) . The new comparison could start in 2011.
- Presentations from some NMIs on their relevant activities.
- EURAMET key comp. 1031 on solid density. Ongoing.
- There were no suggestions for ERMP projects from density. A general interest was shown for a future revival of viscosity work.

6. Participation in and EMRP

The TC-M membership is involved with two iMERA-Plus Joint Research Projects under Theme 1 **"**SI and Fundamental Metrology", namely;

- T1.J1.1 "e-MASS" The watt balance route towards a new definition of the kilogram

- T1.J1.2 “NAH” Avogadro and molar Planck constants for the redefinition of the kilogram

In addition, the TC-M is involved in aspects of T1.J1.4 “Boltzmann constant” Determination of the Boltzmann constant for the redefinition of the Kelvin.

As concerns the EMRP call 2010, membership of TC-M has presented several Potential Research Topics (PRTs) under the topic area “Metrology for industry”: The following list details those PRT with co-authors from more than one EURAMET NMI.

- Better, faster and more accurate weighing of aircraft (VSL + eight co-authors)
- Improved Traceable Force and Torque Metrology up to Highest Nominal Values (PTB + eight co-authors)
- Traceable Dynamic Measurement of Mechanical Quantities (PTB + eight co-authors)
- Traceable pressure measurement for high-pressure technologies (PTB + 5 co-authors)

7. Meetings

The Mass and related quantities TC Contact Persons meeting was held in Istanbul on 5th March and, as usual, was preceded by technical meetings for the various subfields to review progress in projects in mass, force, pressure, density. A summary of these meetings is given above. A preliminary joint session was devoted to EMRP.

The meeting was again very successful and was attended by over 70 delegates from 31 countries, also including representatives from the European Commission (IRMM) and the BIPM.

The next EURAMET TC-M Contact Persons meeting will take place from 2nd to 4th March 2011 in San Anton, Malta.

8. Issues

EURAMET Calibration Guidance Document

As it is well known, all EA Calibration Guidance Documents had been transferred across to EURAMET. Among those relevant to TC-M, EURAMET Calibration Guide 18 “Guidelines on the Calibration of Non-Automatic Weighing Instruments” had been revised and version 02 had been produced. It appears that this document needs some minor editorial amendments. The amended version is expected by next Summer.

The outstanding revisions concerned Calibration Guide 03 “Calibration of Pressure Balances” and cg 04 “Uncertainty of Calibration Results in Force Measurements”. The latter has been finalised and adopted on the occasion of the TC-M CP last meeting. The former was extensively modified and a new, final draft was presented at the same meeting.

Inter-RMO CMC review

Some discrepancy in the vision concerning CMC declaration and review, respectively, were made evident in the past months. Examples are the magnetic properties of mass standards for the former issue and capability of measuring input quantities (such as volume for mass) for the latter. It is suspected that these are only two among many similar cases. Harmonization of these presently different viewpoints is necessary.

Redefinition of the kilogram

The target date for the redefinition is still the 2011 CGPM, although during the CCM meeting last March some doubts arose about the real chances to meet this target date. The CCM reviewed the status of the various redefinition projects and drafted its report to the CIPM. A recommendation was also drafted, based on previous CCM documents. Great care is taken to minimize impact of the redefinition on stakeholders in the field of mass metrology.

9. Outlook for 2010/2011

Next year's activity will be largely dominated by work on the kilogram redefinition, especially concerning its *mise en pratique*, and by preparation of JRP proposals for the EMRP Calls 2010 and PRTs for the EMRP Calls 2011.

Walter Bich, INRiM,
TC-M Chairman
2010-05-19