Bureau International des Poids et Mesures

Consultative Committee for Amount of Substance: metrology in chemistry (CCQM)

Report of the 13th meeting
(19– 20 April 2007)
to the International Committee for Weights and Measures

Comité international des poids et mesures

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Note:

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

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

A.J. Wallard,
Director BIPM

LIST OF MEMBERS OF THE CONSULTATIVE COMMITTEE FOR AMOUNT OF SUBSTANCE: METROLOGY IN CHEMISTRY
as of 19 April 2007

President

Dr R. Kaarls, member of the International Committee for Weights and Measures.

Executive Secretary

Dr R. Wielgosz, International Bureau of Weights and Measures [BIPM], Sèvres.

Members

Centro Nacional de Metrología [CENAM], Querétaro.

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

Danish Institute of Fundamental Metrology [DFM], Lyngby.

Federal Office of Metrology [METAS], Bern-Wabern.

Institute for Reference Materials and Measurements [IRMM].

International Atomic Energy Agency [IAEA].

International Federation of Clinical Chemistry and Laboratory Medicine [IFCC].

International Organization for Standardization, Committee on Reference Materials [ISO REMCO].

International Union of Pure and Applied Chemistry [IUPAC].

Korea Research Institute of Standards and Science [KRISS], Daejeon.

Laboratoire National de Métrologie et d'Essais [LNE], Paris.

National Institute of Metrology [NIM], Beijing.

National Institute of Standards and Technology [NIST], Gaithersburg.

National Measurement Institute, 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]/Laboratory of the Government Chemist [LGC], Teddington.

National Research Council of Canada Institute for National Measurement Standards [NRC-INMS], Ottawa.

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

Physikalisch-Technische Bundesanstalt [PTB]/Bundesanstalt für Material-forschung und -prüfung [BAM]/Federal Institute for Materials Research and Testing, Braunschweig and Berlin.

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

State Laboratory [SL], Co. Kildare.

SP Technical Research Institute of Sweden [SP], Borås.

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

Observers

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

Centro Español de Metrología [CEM], Madrid.

Hungarian Trade Licensing Office [MKEH], Budapest.

Istituto Nazionale di Ricerca Metrologica [INRIM], Turin.

National Institute of Metrology, Standardization and Industrial Quality [INMETRO], Rio de Janeiro.

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

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

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

1 OPENING OF THE MEETING

The Consultative Committee for Amount of Substance: metrology in chemistry (CCQM)* held its thirteenth meeting at the International Bureau of Weights of Measures (BIPM), at Sèvres on 19-20 April 2007.

The following were present: H. Andres (METAS), L. Besley (NMIA), A. Botha (NMISA), G. Carroll (SL), P. Charlet (LNE), K. Chiba (NMIJ/AIST), E.W.B. de Leer (NMi VSL), R. Dybkaer (IFCC), O. Efremova (VNIIM), H. Emons (IRMM), H. Ent (NMi VSL), A. Fajgelj (IAEA/IUPAC), N. Gonzalez-Rojano (CENAM), B. Güttler (PTB), J.S. Kim (KRISS), H.D. Jensen (DFM), R. Kaarls (President of the CCQM), I. Kojima (NMIJ/AIST), A. Krylov (VNIIM), Hongmei LI (NIM), L. Mackay (NMIA), B. Magnusson (SP), M. Máriássy (SMU), W.E. May (NIST), J. McLaren (NRC), M.J.T. Milton (NPL), Y. Mitani (CENAM), D.W. Moon (KRISS), U. Panne (BAM), H. Parkes (LGC), S. Prins (NMISA), M. Sargent (LGC), L. Siekmann (RfB), T. Steiger (BAM), R. Sturgeon (NRC), W. Unger (BAM), A.J. Wallard (Director of the BIPM), S. Windsor (NPL), Yadong YU (NIM).

Observers: V. Cunha (INMETRO), V. de Souza (INMETRO), T. Fernández Vicente (CEM), P.K. Gupta (NPLI), D. Karakas (UME), W. Kozlowski (GUM), B. Martín (CEM), M.P. Sassi (INRIM), M. Sega (INRIM).

Invited: D. Greg (SM), P. De Bièvre (SM, IUPAC), S. Doyran (SM, FAO), J.-B. Finidori (SM, AFNOR), I. Kuselman (INPL), W. Moens (SM, EC-JRC), V.M.L. Ponçano (IPT), D.W.M. Sin (SM, Government Laboratory, Hong Kong), A. Squirrell (SM, ILAC, NATA), T.L. Ting (SM, Government Laboratory, Hong Kong), R. Verdugo Castillo (INN).

Also present: A. Daireaux, E. Flores, R. Josephs, S. Maniguet, P. Moussay, C. Thomas (Coordinator of the KCDB), J. Viallon, S. Westwood (BIPM), R. Wielgosz (Executive Secretary of the CCQM, BIPM).

Sent regrets: C. Bertier (SM), A. Bristow (NIBSC), C. Cherdchu (NIMT), Y. Kustikov (VNIIM), Z. N. Szilágyi (MKEH), A. van der Veen (NMi VSL, ISO REMCO), M. Walsh (SM).

Dr Kaarls, the President, welcomed participants and observers to the 13th meeting of the CCQM. Professor Wallard also welcomed participants and said he had enjoyed being able to participate in some of the working group meetings earlier in the week.

The President reported that there had been meetings of all of the working groups in the days before the CCQM. There had also been a workshop held the day before the meeting. This workshop had addressed the calculation of the key comparison reference value (KCRV) and its uncertainty and also new approaches to the efficient and effective testing of the competencies of national metrology institutes (NMIs). He suggested that some guidance on best practice might be developed from the outputs of the workshop during the coming year. This would be done by two *ad hoc* task forces: one

* For the list of acronyms, click here.

addressing the evaluation of KCRVs and the other addressing future strategy for key comparisons and the validation of calibration and measurement capabilities (CMCs).

2 APPOINTMENT OF A RAPPORTEUR

Dr Kaarls proposed that Dr Milton act as rapporteur for the meeting. He agreed, and Dr Wielgosz would assist him.

3 APPROVAL OF THE AGENDA

Dr Wielgosz reported that the representative from the ENFSI was unable to attend.

The agenda was approved.

4 REPORT OF THE TWELFTH MEETING

The report of the previous meeting was approved without correction.

5 THE POSSIBLE RE-DEFINITION OF THE MOLE

The President reported that the CCQM had passed a recommendation in 2005 relating to the re-definition of the kilogram. This recommendation had emphasised the importance of resolving any outstanding discrepancies between available values of Planck's constant as derived from measurements made with moving-coil watt balances and that derived from the "Avogadro experiment" involving X-ray crystal diffraction on a silicon artefact. In 2006, the CCQM had received a comprehensive presentation from Prof. Ian Mills, the President of the CCU, in which he had elucidated many of the options for wording possible re-definitions of the kilogram, the kelvin, the ampere and the mole. The CCQM and the other Consultative Committees had been asked to give its views on these proposals.

At the last meeting of the CCQM it was clear that there was no objection, in principle, to a re-definition of the mole by reference to a fixed value for the Avogadro constant. This might even be implemented independently of a re-definition of the kilogram. He drew the attention of the meeting to several papers submitted to the CCQM on the topic (CCQM/07-04, -05, -08, -11, -12, -17, -18, on restricted access), and the Recommendation CCQM 1 (2007) on the possible redefinition of the mole and the kilogram, which had been circulated to delegates.

Dr Milton presented his view that there was no fundamental objection to moving to a definition of the mole based on a fixed value for the Avogadro constant. He explained that there were several ways that this could be done, and that no firm choice had been made between them. He highlighted the need to ensure that any possible modifications to widely-used equations was communicated clearly, so that the large number of scientists who depended on measurement results expressed in amount of substance units were clear as to how any change should be handled. Professor De Bièvre agreed that this was important.

Dr Mitani asked whether there would be any consequences for the uncertainty of amount of substance measurements due to the proposed re-definition of the kilogram? The President said that there would be no effect at the practical level of uncertainty.

The President agreed that it was important to consider such changes in advance. He concluded that a careful approach was needed that would lead to a considered opinion to be discussed at the next meeting. He asked Dr Milton to chair a working group, and asked Dr Besley, Dr de Leer, Prof. De Bièvre and Dr Wielgosz to participate. He also asked the working group to respond to a request from the CCU to re-draft the text concerning the mole in Appendix 2 of the SI Brochure. Dr Besley suggested that the working group should also consider how a possible re-definition of the mole might change the way scientists viewed “traceability” to the mole in the future.

Recommendation CCQM 1 (2007) “On the possible redefinition of the mole and the kilogram” was approved (see pp. 26-27).

6 REPORTS OF THE CCQM WORKING GROUPS

6.1 Inorganic analysis

Dr Sargent presented his review of the work of the CCQM Working Group on Inorganic Analysis (IAWG). The group had met twice since the last CCQM, one of which had included workshops on the XRF reconstitution method and isotopic ‘delta’ values. He reported the results of two key comparisons, both of which had been carried out with parallel pilot studies:

- CCQM-K30 (Pb in wine). In addition to the study of Pb as a key comparison, three elements in the same samples (Fe, Cu and Cd) were the subject of a pilot study (CCQM-P12.1). The method used most widely was IDMS using ICP-MS although a variety of methods had been used to prepare the samples. The results showed good agreement, although further work was required on

the estimation of the uncertainty amongst those NMIs that had followed best practice in the preparation of the sample. The key comparison reference value was based on a mixture-model median. The measurements of cadmium in the pilot study presented a particular problem because of the very low levels and possible isobaric interferences.

- CCQM-K49 (Seven "essential" or toxic elements in bovine liver). This key comparison was based on a material which would subsequently be certified as a NIST SRM and was run in parallel to a pilot study (CCQM-P85). He reported that the results were satisfactory. Agreement was better for those elements (for example Fe and Zn) that were most straightforward to analyse. The dispersion of results for Se, Cd and Pb was poorer, although the results from NMIs within the CCQM were better. He said that the IAWG considered this to be "exemplary" key comparison for Fe and Zn that expected all members to participate. He expected that Draft A of the comparison report would be ready by July 2007.

He reported that the IAWG had discussed a strategy that would extend the range of CMCs that these two key comparisons might underpin. He also reported that the IAWG had reviewed the results of three pilot studies:

- CCQM-P75 (Stable isotope delta values of ^{2}H, ^{13}C, ^{15}N, ^{18}O and ^{34}S in methionine).
- CCQM-P76 (Analysis of copper alloy).
- CCQM-P86 (Total Se and Se-speciation analysis of pharmaceutical supplements).

He reported that the IAWG was planning three new key comparisons:

- CCQM-K43.1 (As, Hg, Se and methyl-mercury content in marine fish), coordinated by the NMIJ.
- CCQM-K44 (Assay of chloride content of KCl), coordinated by the NIM.
- CCQM-K60 (Total Se and Se-speciation analysis of Se-rich wheat flour), coordinated by the LGC and the NRC.

In addition, a key comparison (CCQM-K64) of the analysis of a copper alloy to be coordinated by the BAM was under discussion. Five pilot studies were in progress and four new pilot studies had been confirmed by the working group:

- CCQM-P104 (Trace elements in phosphogypsum), coordinated by the IAEA.
- CCQM-P105 (Sr isotopic ratio measurements), coordinated by the IRMM and the NRC.
- CCQM-P106 (Cd, Cr, Hg, Pb in polypropylene for the European RoHS Directive), coordinated by the KRISS, NIM and NMIJ.
- CCQM-P107 (Purity of zinc), coordinated by the BAM.

He presented the outcome of discussions held by the IAWG on neutron-activation analysis (NAA). He said that several laboratories had demonstrated the effective use of this technique in several key comparisons and felt that they had proved its potential to be used as a primary method of measurement. Dr Fajgelj added his opinion that the potential of NAA should be noted formally by the CCQM. The President said that although the CCQM had not discussed the list of 'potentially primary methods' during recent years, it was recognised that NAA had claims to a similar status to that of the five methods listed originally by the CCQM and that NAA will be added to that list. He

gave clarification that any view expressed about methods having the potential to be primary did not apply to their use indiscriminately.

Dr Milton suggested that it was important to consider the context for primary methods which was to answer the underlying question of "how do we make measurements that are traceable to the SI?" The President agreed that there was a need for greater clarity on the criteria that might be used.

Dr Sargent continued by explaining that the IAWG considered some of its key comparisons to be "exemplary", some members of the group preferred the word "pivotal". These are key comparisons that members of the IAWG are strongly encouraged to participate in. Dr Wielgosz reminded the CCQM of the need to harmonise the use of such new terminology. He explained that it was important to capture such intentions in the statement of "how far the light shines" associated with any key comparison.

The President asked whether a so-called "exemplary" key comparison was intended to be a combination of a key comparison with a pilot study, or not? The Director said that other CCs generally expected that NMIs should participate in every key comparison in an area where they have capability.

6.2 Organic analysis

Dr May presented his report of progress made by the CCQM Working Group on Organic Analysis (OAWG), which had met twice since the last meeting of the CCQM. They had also held joint sessions with the BAWG. He outlined the terms of reference of the group and emphasised the importance of benchmarking the capabilities of the NMIs. He noted that the completed study CCQM-P68 (19-norandrosterone in urine) had resulted in papers to be published in a special issue of *Accreditation and Quality Assurance*, including an overview from WADA. He reported that five key comparisons were in progress at the time of the meeting. He presented results from two key comparisons:

- CCQM-K47 (Volatile organic compounds in a solution of methanol). The reference for this key comparison was based on data from the gravimetric preparation from pure materials. The results were not consistent within the estimated uncertainties; he said that problems might have arisen because of the volatility of these pure materials, and that the OAWG may need to consider abandoning part of the comparison.

Dr Wielgosz commented that the comparison had been designed to underpin CMC claims for calibration solutions, and a new comparison of this type would be needed if CCQM-K47 was abandoned. Dr de Leer said there was scope for collaboration with the GAWG on the handling of volatile materials of this type.

- CCQM-K27.2 (Ethanol in aqueous matrix). This "subsequent" key comparison was held at two different levels (one corresponding to forensic levels, and the other to a commodity level). The results had been linked to those of CCQM-K27.

He also presented the results from some pilot studies:

- CCQM-P77.a and .b (Cortisol and progesterone in human serum). This pilot study was designed to underpin work on clinical diagnostics. The methods had used deuterium or ^{13}C-labelled standards and the participants had also included an expert laboratory using an immunoassay technique. With the exception of the low level of progesterone in the male serum, agreement among the laboratories using IDMS-based methods was generally good. The immunoassay method gave higher results than IDMS-based methods for cortisol, and gave variable results for progesterone.
- CCQM-P78 (nutrients in infant formula). The analytes were vitamin-A, niacin and folic acid. Although there was only limited agreement between the results, he proposed that the OAWG might carry out a key comparison during 2008 on these analytes. Dr Wielgosz commented on the limited agreement amongst participants in CCQM-P78 and asked whether subsequent work had elucidated any additional contributions to the uncertainty? Dr Mackay suggested that great consideration be given to defining the range of CMCs that might be underpinned by any further exercise in this area.

Dr May explained that the BIPM was taking a leading role in the OAWG plans for purity analysis. He presented the results of CCQM-P20.e (theophylline) using one 'pure' sample, and one that had been spiked. He said that Dr Wielgosz would give greater detail during his report on the work of the Chemistry section at the BIPM.

- CCQM-P54.1 was a joint study involving the OAWG and the BAWG. This was because the application of the work was largely of interest to participants in the BAWG, but the expertise on the instrumentation required for the measurements was within the OAWG. Dr Mackay commented that there had been particular difficulty defining the measurand for this study. Dr May said that a workshop would be organised to share expertise in this area.

Dr May finished by describing the strategy being developed by the OAWG to rationalise the future workload of the working group. This would include the identification of the most important capabilities that all NMIs should be able to demonstrate.

6.3 Gas analysis

Dr de Leer presented his report of progress made by the CCQM Working Group on Gas Analysis (GAWG), which had met twice since the last meeting of the CCQM. He observed that the group had continued to grow and had organized two workshops, one on "Optical Spectroscopy" in Turin and the other with the WMO Global Atmosphere Watch's VOC group in Garmisch-Partenkirchen. He reported that Dr Smeulders had taken over from Dr Milton as secretary to the group.

He said that the results of CCQM-P73 and CCQM-P87 had both been discussed at the CCQM workshop held on the previous day because they provided interesting examples of methods for calculating reference values.

He described work being undertaken to plan CCQM-K51 (carbon monoxide in nitrogen). This would involve 23 participants, which would make it the largest exercise undertaken by the GAWG. Some of this preparation work had been presented as part of EUROMET Project N^{o} 900.

He presented the results of three key comparisons:

- CCQM-K52 (Carbon dioxide in air at the atmospheric level of 360 µmol/mol), which had involved 20 participants. With one exception, all of the participants had uncertainties that overlapped the KCRV defined independently by gravimetry. The coordinating laboratory had investigated the reason for the single exception, which was unexpected and remained unexplained. Since it was believed to be due to a problem with the travelling standard, it would be repeated on a bilateral basis. An expert laboratory from the NMIA (the former CSIRO) which operated as part of the WMO network had also taken part and had achieved good results using an independent method.
- CCQM-K53 (Preparative comparison of oxygen in nitrogen). This had been coordinated by the KRISS, which had developed a very high accuracy comparison method based on GC-TCD. The results indicated agreement between all eleven participants to within 0.2 %.
- CCQM-K54 (Preparative comparison of hexane in methane). The results were very good, except for one participant who had produced a standard with some impurities that had interfered with the analytical method used by the coordinating laboratory.

Dr de Leer went on to describe a proposal for a key comparison of measurements of the purity of methane (CCQM-K66), to be coordinated by the NMIJ. The number of participants would be limited to ten because of the difficulty of preparing samples with sufficient homogeneity. A proposal for a key comparison of a multi-component mixture representing typical industrial stack-emission gases (NO, SO_2, CO, CO_2, propane in nitrogen) was also under consideration. Finally, he reported that preparatory work was underway on a comparison of mercaptans in methane (CCQM-K65), required to underpin CMCs relating to the odourisation of natural gas.

Dr Wielgosz commented now that as many as 23 participants wanted to participate in a key comparison that perhaps it would be timely to revert to the model of linked comparisons proposed by the MRA? Dr Milton asked if there was scope for judicious use of the “preparative” model for key comparisons in place of the “analytical” model in more cases, in order to reduce costs? Dr de Leer said this would be a topic to be considered by a strategy group being established by the GAWG.

He concluded by describing a workshop organised by the GAWG on “Optical Spectroscopy” in Turin at the time of the Conference on Precision Electromagnetic Measurements in July 2006. This had addressed the difficulties with measuring and providing standards for species at trace levels typical of environmental measurements. He drew the attention of the meeting to a particularly good presentation made by Dr van Zee from the NIST. He reported that a questionnaire had been circulated to determine the scope of interest for further work in the area. This had led to an agreement by the GAWG to initiate two projects:

- one project on a stable species (e.g. CO_2) which would be coordinated by the PTB and organised within the framework of EURAMET;
- one project on a reactive species (e.g. NO_2) to be coordinated by the BIPM.

The initiation of a sub-group or task force to discuss further work in the area was also being considered.

6.4 Electrochemical analysis

Dr Máriássy presented his report of the work of the CCQM Working Group on Electrochemical Analysis (EAWG), which had met twice since the last meeting of the CCQM. He presented the results of three key comparisons.

- CCQM-K18 (Carbonate buffer) had a number of outliers, which reflected the difficulty of working at the extreme alkaline end of the range of pH measurements. There would be a subsequent comparison to resolve these issues.
- CCQM-K9.2 (Phosphate buffer) was a repeat of the first key comparisons carried out by the EAWG. It was organised to accommodate some new laboratories as well as a move of location for the primary facilities in Denmark. One result was an outlier, and the laboratory concerned had been asked to look at their measurement report again.
- CCQM-K59 and CCQM-P89 (Nitrate and nitrite in calibration solutions and natural water). This key comparison was motivated by the importance of providing traceability for these analytes in food chemistry, water analysis and agriculture. He reported that the spread of results was larger than in previous comparisons. The President observed that the preliminary results suggested that there was scope for more work on the uncertainty of measurements of these measurands.

Dr Máriássy summarised the plans made by the EAWG for future comparisons. These included comparisons of: electrolytic conductivity (CCQM-K36.1), the pH of carbonate (CCQM-K18.1) and oxalate (CCQM-K20) buffers and the assay of potassium chloride with the IAWG (CCQM-K48). He also summarised some presentations made to the group on modelling the pH of carbonate buffer, on the potential for stripping voltametry to perform as a primary method and activity measurements in complex mixtures.

Dr de Leer asked whether the EAWG would address the issue of measuring pH in organic solutions such as biofuels? The President said that any such requirements should be investigated.

6.5 Surface analysis

Dr Unger presented his report of progress of the CCQM Working Group on Surface Analysis (SAWG), which had met the day before the CCQM. He reviewed the terms of reference of the group and reported that around 25 scientists were involved in the group from nine NMIs.

The only key comparison currently underway within the group was CCQM-K32 (Silicon dioxide on silicon). It had nine participants and three in a parallel pilot study (CCQM-P84). The results had been discussed previously at meetings in 2006 and 2007. However, it was still the case that five results of measurements made by XPS were in good agreement, whilst there was poorer agreement amongst results from four other methods. Investigations had identified the existence of an effect in some results due to the existence of hydrocarbon and water layers on the samples. It had been agreed that this lack of agreement was due to the presence of ultra-thin surface contamination that was not detected by XPS and that some new science was needed to resolve these differences before a KCRV could be established.

Professor Wallard recommended that the report of the comparison should describe how the traceability of each measurement result had been established, and that the working group was expected to propose a KCRV in order to complete the report.

The SAWG had received a report of a pilot study on the same system as CCQM-K32 carried out as APMP-P08. This had involved more different methods, and had led to similar results.

Dr Unger also reported on the results of several pilot studies:

- CCQM-P80 (C and N concentrations in coatings on steel) and CCQM-P81 (C in bulk steel). Both studies had used EPMA and the results had shown much larger differences than the expanded uncertainties. It was proposed to establish protocols to improve performance in this area.
- CCQM-P95 (Nitrogen concentration in a 'diamond-like' carbon film). This had involved seven NMIs and one expert laboratory and involved analysis by EPMA. It was concluded from this and the previous two pilot studies that the EPMA method was not yet well-enough developed to be used in a key comparison.
- CCQM-P98 (Fe-Ni concentration in alloy films on silicon). A set of traceable Fe-Ni alloys had been prepared and certified by the KRISS which were ideal for this study. The results were very encouraging. It is planned to develop a key comparison (CCQM-K67) and parallel pilot study (CCQM-P108) using a similar unknown alloy sample.

He concluded by proposing that the work of the group should be extended to encompass work on organic layers on surfaces.

6.6 Bioanalysis

Mrs Parkes presented her report of the progress made by the CCQM Working Group on Bioanalysis (BAWG), which had met twice since the last CCQM. She reported that they had held useful discussions with the OAWG and the SAWG during their meetings.

She presented the results of one key comparison (CCQM-K61), which would underpin many applications of the polymerase chain-reaction (PCR) method. It had made use of a reference sample prepared by gravimetric dilution. She illustrated how the key comparison was carried out at concentration levels 4 to 5 orders of magnitude lower than those used for the pilot study CCQM-P55. In both parts of the comparison, the results from participants showed a bi-modal distribution and the estimated uncertainties were insufficient to explain the observed variability. Further information was being obtained from participants to complete the report.

She also presented the results of four pilot studies:

- CCQM-P59.1 (Protein structural measurements by circular dichroism). The results of CCQM-P59 had been received and a further pilot study (CCQM-P59.1) would be carried out to improve aspects of sample handling. There had been some discussion about the range of calibration and measurement capabilities for CD measurements that a key comparison based on this study might underpin. One possibility was through the dissemination of a "molar" CD spectrum.

- CCQM-P55 (Protein quantification). This pilot study would involve a “step-by-step” approach working from the quantification of peptides up to proteins and would eventually underpin the work of the JCTLM.
- CCQM-P94 (Quantification of DNA methylation), which addressed a measurand that was important for the identification of cancerous tissue. Samples were being prepared and results would be presented at the next meeting.
- CCQM-P58.1 (Assay by ELISA). This study followed CCQM-P58 which had evaluated various instrumental effects in the ELISA assay. The next phase of the study would investigate the utility of the ELISA assay to transfer SI-traceable measurements of a protein reference material from a high concentration stock to one at the nanogram per litre level. It would study a clinically-relevant human myocardial infarction marker. The scope of possible calibration and measurement capabilities that might be underpinned by a key comparison in this area had also been discussed.

She also proposed some new pilot studies:

- Glycan species measurement in digested glycoprotein mixture (CCQM-P101). This topic is of great importance to the bio-pharmaceutical industry. The proposed pilot study would be coordinated by the NIBSC with NPL and would involve scientists from the US Pharmacopoeia. Calibration and measurement capabilities that might be underpinned by this study included “glycan species present in a mixture typical of that released from therapeutic glycoproteins”.
- Quantification of cells with specific phenotypic characteristics (CCQM-P102). This study would measure the fraction of cells of a given phenotype by flow cytometry. It would use a NIST fluorescent bead SRM as well as well characterised quantified reference cells.
- Multiplexed RNA gene-expression bio-markers (CCQM-P103). This would build on experience gained from CCQM-K61 with DNA and demonstrate capabilities for RNA. The first stage would measure a single RNA transcript with a matched calibrant.

She also reported a proposal that was being developed for a pilot study to work on genomic DNA quantification was also under consideration. She observed that the results of some studies carried out by the BAWG were leading to peer-reviewed publications.

She concluded by describing the discussions held by the group on its future work programme. Many NMIs were developing capability in bio-measurement. The roadmaps developed in previous years had been reviewed and the present set of pilot studies and key comparisons fitted in with them. In the future, the group would also consider regional requirements. The group was still considering how to deal with reference materials that had properties on a nominal scale.

Dr May commented that the expertise for all of the CCQM working groups at the NIST was held in one division, except for the BAWG for which it was distributed over the NIST. The President said that this was typical and presented a challenge for internal coordination. Dr Moon asked if the BAWG would address the issue of the safety of nanoparticles. Professor Emons said that safety and toxicology issues were not the responsibility of CCQM. The President said that nevertheless, there were some metrology issues that required solutions.

6.7 Key comparisons and CMC quality

Dr Mackay presented her report on the work of CCQM Key Comparison Working Group (KCWG). She said that the workshop held the previous day had been an important opportunity for the KCWG to initiate a discussion about strategy with the other WGs. She presented the proposed timescale for the CMC review process to be used during 2007. She emphasised that if deadlines were not adhered to, then claims would be excluded, and also that where required supporting information must be supplied.

She reported that there were 3736 CMCs relating to the work of the CCQM in April 2007. She hoped that useful discussions with Dr Thomas and Dr McLaren would lead to some new proposals on how to deal with the relationship between CMCs and KCs in the areas covered by CCQM and to take forward the conclusions of the workshop held the previous day.

She commented that the re-review of approved CMCs was not specifically the responsibility of the KCWG, but that they would contact the RMOs and ask them to remind the NMIs that this should be underway. There was also a problem with the large number of claims for "calibration services". More information would be required about these in the future. She noted that 24 claims in the category "organic solutions" were underpinned by CCQM-K47, which had poor results. The KCWG would investigate this.

Mr Squirrel asked how the reports of on-site audits of NMI Quality Systems fed into the processes of the KCWG? Dr Mackay said this was largely the responsibility of the RMOs.

7 UPDATE ON THE KCDB

Dr Thomas reported that the Appendix B website was receiving a steady number of 3500 visits per month, which were believed to originate mainly from the NMIs. Nearly three times as many visits were received by the Appendix C website and this number was increasing rapidly.

She reported that various changes were being made to make the website more usable by visitors from outside the NMIs. For example: fewer clicks were required to access material, revised terminology had been used and wider access was available by use of a search engine.

Mr Squirrel said that the improvements represented a great step forward and Dr Thomas and her colleagues were to be congratulated.

8 BIPM PROGRAMME ON METROLOGY IN CHEMISTRY

Dr Wielgosz presented his report on the work carried out during the year by the Chemistry section at the BIPM. He thanked four seconded scientists for their contribution to the work: Dr Shimizu (from the NMIJ), Dr Perez (from the CENAM), Dr Rakowska (from the GUM) and Dr Sega (from the INRIM). He went on to summarise the key comparisons and pilot studies being coordinated by the BIPM.

- CCQM-P20e (Purity of theophylline). Two comparison samples had been prepared – one (-P20e.1) by the LGC, which was characterised by the BIPM, and one (-P20e.2) of a spiked material that was both prepared and characterised by the BIPM. There was an impurity present in this second sample at extremely low levels that was not identified by the BIPM or any of the participants. The homogeneity of the material was studied in detail. For the spiked material, larger samples were used to minimise the uncertainty from this source.

The reference value for P20e.1 was based on a weighted mean after the exclusion of two outliers whose results did not include full consideration of all possible sources of error. The reference value for P20e.2 was based on the gravimetric reference value and the uncertainty due to preparation and non-homogeneity had been combined to calculate the uncertainty of the reference value. He commented that several participants had submitted uncertainties that would lead to the erroneous conclusion that the physical constraint of 100 % purity could be exceeded, and that this should be avoided in future comparisons. He concluded that there was good agreement, in part because the material under study was ideally suited to the LC-MS method.

- CCQM-20.f (Digoxin) would be the last pilot study in the organic purity series. The OAWG had developed a model based on "molecular mass versus polarity space'' as a way of classifying measurement capabilities for the characterization of pure organic materials. The BIPM would coordinate a series of key comparisons to span these capabilities starting with CCQM-K55.a (steroid hormones). Planning was underway at the BIPM.
- BIPM.QM-K1 (Ozone) is the first "on-going" key comparison to be organised by the CCQM. The protocols have been agreed and published. Following work reported at the last CCQM, a kit from the NIST had been used to upgrade one of the standard reference photometers at the BIPM.
- CCQM-P73 (NO in nitrogen). Eleven participants in this pilot study had submitted two standards. In addition, three primary standards from an NMI were used as control standards. Two different analytical methods had been used. Seven of the twenty-two results appeared to be displaced below the regression curve. Six of these were found to have excess N_2O and HNO_3. Consequently, the regression curve was re-calculated excluding these points. He demonstrated that these results were consistent with other CCQM key comparisons (e.g. CCQM-K1.a**)** on the same analyte, but with noticeably improved uncertainties for the analytical values.

He concluded by describing plans for work on nitrogen dioxide, which might also meet the requirement from the GAWG for a study that tested the capability of spectroscopic methods to measure gases. He described the dynamic permeation standard for nitrogen dioxide used at the BIPM. At present, it appeared to lead to levels that were biased high with respect to the values of

standards purchased from two NMIs, which were biased with respect to each other by a similar order of magnitude.

Dr Wielgosz concluded by summarising the work carried out by Mlle Maniguet to support the database of the JCTLM. The database receives approximately 700 visits each month, including many from companies and laboratories in the IVD industry.

9 REPORTS ON RMO ACTIVITIES

9.1 APMP

Dr Sin presented a report on behalf of herself and Dr Yu Yadong, the Chairman of the TCQM of the APMP. At the end of 2006, the APMP had 32 members from 21 countries and 5 associate members. The APMP has signed a Memorandum of Understanding with their regional accreditation cooperation (APLAC) and has developed a strategy to use its resources more effectively.

Two key comparisons in the area of gas analysis have been completed by the TCQM and two supplementary comparisons were underway in the same area. She also gave details of a series of bi- and tri-lateral comparisons in gas analysis. Nine pilot studies had been completed in organic and inorganic analysis, two were underway and three were being proposed.

A workshop on gas analysis was being planned for May 2007 in Xian. Also an international conference on metrology in chemistry was being organised in June 2007 in Xian and a Symposium on the same topic in Hong Kong.

9.2 COOMET

Dr Efremova presented a report on behalf of Prof. Konopelko, the Chairman of the Physical Chemistry Committee of the COOMET. She described the main objectives of COOMET activity in the area, and showed how the CMCs submitted by the group were distributed across the different areas. There were eight comparisons being organised by the COOMET committee on ‘physical chemistry’. A subcommittee on electrochemistry chaired by Dr Karpov from the VNIIFTRI had been established.

9.3 EUROMET

Dr Charlet summarised the work of the MetChem committee of EUROMET. The committee has four sub-committees. The last plenary meeting had been held at the IPQ in Portugal and had incorporated a workshop with local laboratories and a presentation from EURACHEM. He announced that Dr Güttler from the PTB would take over from him at the end of May.

He also provided an update on the iMERA project being carried out by EUROMET, which had involved the development of detailed 'road-maps' for their work. One outcome was that EUROMET had established a new legal body – EURAMET, which would take over from it. It had also led to an application to the EU for funding a large programme of collaborative research between NMIs within EURAMET. This was hoped to be for 273 million euro over 7 years. A bridging programme funded as an ERA-NET project would precede this. This would focus on health and several other areas.

9.4 SADCMET

Mrs Prins presented a review on behalf of Dr Louw, the chair of the SADCMET Working Group on Quantity of Matter. SADCMET involved 14 countries and was collaborating with other African metrology organisations under AFRIMETS.

CSIR-NML is still the only NMI within SADCMET to have participated in key comparisons and to have submitted CMCs covered by the CCQM. Four other NMIs have some capability in chemical metrology (Mauritius, Namibia, Tanzania, and Zimbabwe).

She concluded by informing the meeting that the CSIR-NML will be renamed National Metrology Institute of South Africa (NMISA) and would soon operate under a new legal basis.

9.5 SIM

Dr May presented his report on the chemical metrology working group of the SIM. The principal activities of the group involve outreach and awareness, proficiency assessment activities and training in CMC preparation and review. He explained the format developed by the group for its seminars, and explained how they planned to change them in the future.

He reported that the most recent proficiency assessment carried out by the SIM had covered vehicle emission gas standards and PAHs in soil. He also showed the results of a comparison held subsequently to CCQM-K47 for laboratories in SIM. He reported that SIM was responsible for more than 25 % of all CCQM CMCs, but that they all originated from four laboratories.

The President concluded that it was encouraging to see an increasing level of activities in the regional metrology organisations and a greater level of cooperation.

10 THE JOINT COMMITTEE FOR TRACEABILITY IN LABORATORY MEDICINE (JCTLM)

10.1 JCTLM WG 1

Dr May presented an update on the work of WG 1 of the JCTLM. Its mandate was to develop quality criteria for higher-order reference materials and methods, and to publish a list of those that met them. A number of technical review teams, including one dealing with Quality Systems carry out the work of WG 1. The list of materials is divided into two parts – one for which SI traceability is available, and one for which it is not.

He concluded by describing the challenges faced by the working group. These include: the need to address reference materials labelled or certified for properties on a nominal or ordinal scale; the fact that the JCTLM lists only covered 75 out of the 400 quantities routinely measured in the clinical laboratory; and the need for more commitment to participation in comparability studies.

Dr Wielgosz asked if it was known how the EC would use the JCTLM database? Professor Emons said that the EC expert group on medical devices would make use of it, but the details of how this might be done had not yet been agreed.

10.2 JCTLM WG 2

Professor Siekmann described the work of WG 2 of the JCTLM, which is concerned with reference measurement laboratory services. Criteria for listing reference measurement service providers in the JCTLM database included the 'metrological level' of the reference procedure performed and the accreditation status of the laboratory. He described the information that reference laboratories were asked to submit to the working group. He reported that 190 services from 21 laboratories had been nominated and 104 had been recommended for approval by the review teams for listing on the JCTLM database. These covered a total of 32 measurands. He highlighted the importance of the availability of an external quality assurance system for laboratories working in this area.

He presented the results of ring trials amongst laboratories carrying out measurements of cholesterol, potassium and the enzyme ALT in human serum. He also showed how the results of some of these reference laboratories compared with routine laboratories. These results reflected well on those laboratories registered by the JCTLM. The results of these comparisons were available from the DGKL website.

Dr Besley observed that the uncertainties reported by different laboratories were sometimes quite different. Professor Siekmann said that further work and harmonization was necessary in this area.

The President thanked Dr May and Prof. Siekmann for their presentations and encouraged NMIs to continue to collaborate with clinical laboratories and the IFCC and support the review processes undertaken by the JCTLM working groups.

11 WORLD METEOROLOGICAL ORGANIZATION

Dr de Leer described progress in the collaboration between the GAWG and the WMO-GAW. The collaboration principally concerns the provision of standards for volatile organic compounds, which are of interest to the GAW because of their role in the generation of ozone in the troposphere. A Memorandum of Cooperation between those NMIs that were active in the provision of low concentration VOC gas standards (KRISS, NIST, NMi, and NPL) and the WMO-GAW was under preparation.

He explained that measurements of such VOC species were required to be stable to better than 1 % per year. He listed the compounds required, and noted that some of them fell within the established capabilities of the NMIs whilst others did not. In particular, further research would be required to provide standards of formaldehyde and dimethyl sulphide. He concluded by offering the support of the GAWG in organising a joint BIPM-WMO workshop in 2008.

Dr Güttler informed the meeting about work being undertaken to support measurements of ocean salinity. This collaboration was being organised as a EUROMET project coordinated by the PTB. A practical scheme known as PPS-78 was in use, but it did not lead to results being traceable to the SI. The collaboration was intended to remedy this.

12 ISO REMCO

Professor Emons provided a report on behalf of Dr van der Veen, the chairman of ISO REMCO.

The committee had been reorganised and had established sub-groups devoted to international harmonisation and technical guidance. He reported that two technical reports would be published. These concerned the categorisation of reference materials (RMs) and recommendations for the transport of Certified Reference Materials (CRMs). A new guide on quality-control reference materials (ISO Guide 80) was close to completion together with revisions of ISO Guides 33 (Use of RMs) and 30 (Terminology). They were preparing for a limited review of Guide 34, which would not change the principles or rules, but would provide more explanation following its use around the world.

Dr Wielgosz asked if ISO REMCO was involved in the revision of ISO Guide 43 (Proficiency testing by interlaboratory comparisons). Professor Emons said this was being managed by ISO CASCO, although it was relevant to the proposed ISO Guide 80.

There was some discussion about the need for collaboration between the JCGM in its revision of the VIM and the ISO REMCO. It had been agreed that the revised version of the VIM would introduce a note recognising that the ISO REMCO included a different definition for “reference material”.

The President said that the CIPM was not content with this outcome, which was far from ideal. Mr Squirrel said that the ILAC was also not pleased with the outcome.

13 INTERNATIONAL ATOMIC ENERGY AGENCY

Dr Fajgelj reported that the Quality System at the IAEA Dosimetry Laboratory had been reviewed and approved by a panel of quality experts from various RMOs on 5 October 2006. For this purpose the JCRB prepared “Guidelines for the Review of CMCs and the Monitoring and Reporting of the Operation of Quality Systems by International Intergovernmental Organizations who are Signatories of CIPM MRA”. These guidelines and the established per review process might now also be used by the other parts of the Agency's Laboratories, namely those which participate in the CCQM.

14 INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

Professor de Bièvre provided some information about the work of the Commission on Isotope Abundance and Atomic Weights (CIAAW). He also reported that an IUPAC project entitled, “Metrological traceability” was underway. It would describe what exactly is traceability and explain how it might be achieved in practice.

15 INTERNATIONAL LABORATORY ACCREDITATION COMMITTEE

Mr Squirell provided some information about the ILAC including the revised ILAC Guide 13 on proficiency testing. He reported that it had 58 full members who were signatories to its multi-lateral agreement. A meeting had been held between the regional accreditation bodies and the BIPM to discuss the dissemination of traceability.

He repeated his view that Best Measurement Capabilities (BMCs) and Calibration and Measurement Capabilities (CMCs) should be considered to be the same. He concluded by discussing the collaboration between the ILAC, the BIPM and other international stakeholders on the accreditation of proficiency test providers (CCQM/07-14, on restricted access).

16 CODEX ALIMENTARIUS COMMISSION AND THE INTER-AGENCY COMMISSION

The President welcomed Dr Doyran from the Codex Alimentarius Commission to the meeting. She outlined the background to the Codex Alimentarius Commission and explained that it was a joint organisation involving the Food and Agriculture Organisation (FAO) and the WHO. She then described the remit of the Committee on Methods of Analysis and Sampling. She explained that at its latest session it had worked on:

- Guidelines for evaluating acceptable methods,
- Guidelines for settling disputes over analytical results,
- Guidelines on "Analytical Terminology",
- The conversion of methods for trace elements to criteria,
- Criteria for the Identification of foods derived from biotechnology.

They were also considering the application of measurement uncertainty including appropriate allowance for sampling uncertainty. Their work on analytical terminology would take into account the work of ISO and of the *International Vocabulary of Metrology, Basic and General Concepts and Associated Terms* (VIM). She explained how the Codex organisation was assessing the safety and labelling of biotechnology products.

A workshop was being planned on measurement uncertainty in March 2008. Dr Wielgosz confirmed that the BIPM was involved in the organisation of this workshop.

17 ISO TC 34

The President welcomed Mr Finidori from the AFNOR who was secretary to Working Group 7 of ISO TC 34. He explained ISO TC 34 is the main ISO technical committee responsible for food products. It has 13 active sub-committees, each dealing with a type of food product. Six working groups relate directly to the technical committee and have 'horizontal' responsibilities such as GMOs.

Working Group 7 covers "Genetically modified organisms and derived products". It has published six standards and one technical specification. These cover DNA-based methods (eg ISO 21570) and protein-based methods (ISO 21572), together with general requirements and definitions and an overarching document covering sampling strategies (ISO 24276).

He concluded by saying that all of the standards developed by Working Group 7 follow the same general structure, and they all take into account the need for the validation of methods and the use of reference materials.

18 EUROPEAN NETWORK OF GMO LABORATORIES

The President welcomed Dr Moens from the Institute of Health and Consumer Protection (IHCP) at the EU-JRC in Ispra. He was invited in his role of deputy chair of the European Network for GMO Laboratories (ENGL).

Dr Moens explained that the ENGL was inaugurated in 2002 to solve technical issues in the area of GMO measurement and included many laboratories that were active in the ISO TC 34. All EU Member States participate in ENGL. The ENGL laboratories operate within the EU Framework Directive on GMOs and its derived vertical Regulations. ENGL promotes (*inter alia*) the harmonisation and standardisation of measurement methods and Quality Systems for GMO Detection.

He outlined some of the difficulties involved in the testing of GMOs in foodstuffs. These involved taking samples from extremely large batches – possibly containing as many as 10^9 kernals from which as few as 10^3 molecules needed to be extracted. An investigation published by the IHCP indicated that batches were rarely stratified randomly, so conventional sampling strategies could not be applied. Analytical strategies are largely based on nucleic acid methods although protein methods are expected to be important in the future.

Dr Moens finished by describing the European Union's Community Reference Laboratory which was located at the IHCP. He described its mandate and explained that this included: managing the supply of positive and negative control samples, the validation of methods as well as contributing to EU food control policy.

Dr Besley asked how laboratories from outside the EU might be able to interact with the ENGL. Dr Moens said that any interested parties should write directly to the ENGL.

The President thanked Dr Moens and said he looked forward to further discussion.

19 PRESENTATION BY CROPLIFE INTERNATIONAL

The President welcomed Mr Dana from CropLife International (CLI). He said that there was much rigorous work going on within the plant biotech industry, but he also foresaw various difficulties in the future, which could be addressed by a greater emphasis on analysis and references.

Mr Dana explained that CLI was an organisation formed by three European companies (Syngenta, BASF and Bayer) and three US companies (Du Pont, Monsanto and Dow). He gave some background to the industry they represented. Currently, 22 countries have biotech-based crops. The total area covered by biotech crops has doubled over the last five years. The most widely planted is soya bean, followed by maize, cotton and canola. The majority of these crops are used for animal feed and they now account for 16 % of global crop market by value.

He went on to describe the role of standardisation. There are no globally-harmonised regulations, and some countries lack any policy on definitions. Methods based on PCR play an important role and many trade decisions were made on the basis of results from non-standardised PCR methods. He described the extent of requirements for reference materials and explained that the IRMM and the US-AOCS have provided RMs for CLI.

He stated that the potential for the disruption of trade due to independent adoption of methods and materials is real. One such example occurred, but at a low level, in 2006 between suppliers in the US and customers in the EU. He concluded that this had happened despite good work on ISO standards and effective communication of them.

He expected that the independent development of regulations, methods and RM supplies would all continue. He asked if there was a means by which the CCQM and the NMIs could help with this problem? He suggested that industry would be pleased to collaborate and offered collaboration with CropLife International to achieve this.

Professor Emons said there was a gap in understanding, since both documentary and measurement standards are available – but it was not clear in the presentation what else was required? Mrs Parkes said it was important to identify the true role for NMIs in this area. Mr Dana said he welcomed further dialogue on these areas.

20 CCQM WORKSHOPS

There were a number of suggestions, and the President welcomed further suggestions.

21 CCQM RECOMMENDATIONS

Recommendation CCQM 1 (2007) was adopted (see pp. 26-27).

22 ANY OTHER BUSINESS

The President reminded the CCQM that the results of CCQM pilot studies could be published for the benefit of a wider audience, if all the participants agreed.

The President proposed that two *ad hoc* working groups be established to develop proposals based on the ideas discussed at the CCQM Workshop held on the 18th April. He suggested that Prof. Cox chair a group involving the people who presented papers in the first session (Dr Milton, Dr Sargent or a deputy, Mrs Parris, Dr Mitani, Prof. Yu Yadong or a deputy, Dr Ellison, Dr Duewer, Dr Wielgosz and Dr Bremser) and that Dr Turk chair a group involving the five people who presented in the second session (Dr Sargent, Dr Woods, Dr de Leer, Dr May, Prof. Yu Yadong or a deputy and Dr Mackay). He suggested that both groups should draft some terms of reference.

The Director said he was continuing discussions with the World Customs Organisation, which he hoped would result in a workshop and would also involve the BIPM and the IAEA. He hoped that they might make progress in the development of special arrangements for the transfer of comparison samples.

23 DATE OF NEXT MEETING

The next meeting of the CCQM was fixed for 3-4 April 2008 at the BIPM.

M.J.T. Milton, rapporteur

September 2007

Revised November 2007

RECOMMANDATION DU COMITÉ CONSULTATIF POUR LA QUANTITÉ DE MATIÈRE : MÉTROLOGIE EN CHIMIE PRÉSENTÉE AU COMITÉ INTERNATIONAL DES POIDS ET MESURES

RECOMMANDATION Q 1 (2007) : Sur les éventuelles redéfinitions de la mole et du kilogramme

Le Comité consultatif pour la quantité de matière : métrologie en chimie (CCQM),

considérant

- les récentes propositions de redéfinitions de la mole, fondée sur une valeur fixée de la constante d'Avogadro, et du kilogramme, fondée sur une valeur fixée de la constante de Planck ou de la constante d'Avogadro,
- les avantages que ces redéfinitions apporteraient à la communauté scientifique, liés à la réduction significative des incertitudes sur les valeurs de nombreuses constantes fondamentales,
- que l'adoption d'une valeur fixée de la constante d'Avogadro apporterait d'autres avantages à la communauté scientifique,

prenant acte de la différence relative actuelle d'environ 1×10^{-6} entre la valeur de la constante de Planck obtenue à partir des mesures effectuées avec la balance du watt et celle fondée sur les mesures de masses molaire et volumique associées à l'interférométrie par rayons x d'un cristal,

recommande que

- la décision de redéfinir le kilogramme soit différée jusqu'à ce que la différence entre les résultats obtenus à partir des mesures effectuées avec la balance du watt et ceux fondés sur les mesures de masses molaire et volumique associées à l'interférométrie par rayons x d'un cristal soit résolue,
- le moment venu, on examine avec soin la possibilité de redéfinir le kilogramme et la mole en fixant la valeur de la constante d'Avogadro, et que l'on tienne pleinement compte des intérêts de la communauté de la métrologie en chimie,
- que les nouvelles définitions du kilogramme et de la mole soient faciles à expliquer à la communauté scientifique et soient compréhensibles du grand public,
- que les laboratoires et organisations en communication avec le CCQM consultent largement leur communauté afin de s'assurer que les définitions proposées et leur mise en pratique soient universellement acceptées.

RECOMMENDATION OF THE CONSULTATIVE COMMITTEE FOR AMOUNT OF SUBSTANCE: METROLOGY IN CHEMISTRY SUBMITTED TO THE INTERNATIONAL COMMITTEE FOR WEIGHTS AND MEASURES

RECOMMENDATION CCQM 1 (2007): On the possible redefinition of the mole and the kilogram

The Consultative Committee for Amount of Substance: Metrology in Chemistry (CCQM),

considering

- the recent proposals to redefine the mole in terms of a fixed value of the Avogadro constant and the kilogram in terms of a fixed value for either the Planck constant or the Avogadro constant,
- the advantages that such redefinitions would bring to the scientific community through the significant reduction in the uncertainties of the values of many fundamental constants,
- that the adoption of a fixed value for the Avogadro constant would have further benefits for the scientific community,

noting the existing discrepancy of about 1 part in 10^6 between the value of the Planck constant arising from the watt balance and x-ray crystal density/molar mass measurements,

recommends that

- any decision on redefining the kilogram be deferred until the discrepancy between results from watt balance and x-ray crystal density/molar mass measurements has been resolved,
- at that time, full consideration be given to redefining the kilogram and the mole by fixing the value of the Avogadro constant, and to the interests of the chemical measurement community,
- any new definition of the kilogram and the mole should be straightforward to explain to the scientific community and understandable by the general public,
- laboratories and organizations in communication with the CCQM, should consult widely within their communities to ensure the universal acceptance of the proposed definitions and their implementations.

Table 1. CCQM key comparisons and pilot studies (as of 26 June 2007)

CCQM Bioanalysis Working Group key comparisons and pilot studies						
WG	Reference No.	Description	Coordinating laboratory	Start date	Status	Comments
BAWG	CCQM-K61	Quantitative PCR	NIST/LGC	2007	Planned	
BAWG	CCQM-P44	DNA quantification	NIST/LGC	2002	Completed: repeat study	
BAWG	CCQM-P44.1	Q-PCR (repeat)	NIST/LGC	2004	Report in progress	
BAWG	CCQM-P53	DNA profiling	NARL	2003	Completed	
BAWG	CCQM-P54	DNA primary quantification	LGC	2004	Completed: repeat study	
BAWG	CCQM-P54.1	DNA quantification	LGC	2006	Planned	
BAWG	CCQM-P55	Peptide/protein quantification	LGC	2004	Planned	
BAWG	CCQM-P58	Fluorescence in ELISA	NPL/NIST	2004/2005	In progress	
BAWG	CCQM-P58.1	Fluorescence in ELISA (Stage 2)	NPL/NIST	2007	Planned	
BAWG	CCQM-P59	Protein structural measurements by CD	NPL/NIST		Report in progress	
BAWG	CCQM-P60	DNA extraction – reference method	IRMM	2004/2005	Report in progress	
BAWG	CCQM-P94	Quantification of DNA methylation	KRISS		Planned	
BAWG	CCQM-P101	Glycan species measurement in digested glycoprotein mixture	NIBSC/USP/ NPL	2007	Planned	
BAWG	CCQM-P102	Quantification of cells with specific phenotypic characteristics	NIST/NIBSC		Planned	
BAWG	CCQM-P103	Measurement of multiplexed biomarker panel of RNA transcripts	LGC/NIST		Planned	
CCQM Electrochemical Analysis Working Group key comparisons and pilot studies						
WG	Reference No.	Description	Coordinating laboratory	Start date	Status	Comments
EAWG	CCQM-K9	pH 7.0 (Phosphate)	PTB	1999	Approved for equivalence	
EAWG	CCQM-K9 subsequent (CCQM-K9.1)	pH 7.0 (Phosphate) PTB-SMU bilateral	PTB	2002	Approved for equivalence	

EAWG	CCQM-K9.2	Phosphate buffer solution; nominal value pH = 6.9	PTB	2006	In progress	Subsequent to CCQM-K9
EAWG	CCQM-K17	pH 4.1 (Phthalate)	PTB	2001	Approved for equivalence	
	EUROMET.QM-K17	pH 4.1 (Phthalate)	PTB	2004	Approved for equivalence	
EAWG	CCQM-K18	pH 10.1 (Carbonate)	SMU	2003	Completed	
EAWG	CCQM-K18.1	pH 10.1 (Carbonate) – subsequent	SMU	2004	Running	Subsequent to CCQM-K18
EAWG	CCQM-K19	pH 9.2 (Borate)	PTB	2004	Approved for equivalence	
EAWG	CCQM-K20	pH 1.7 (Tetroxalate)			Planned	
EAWG/IAWG	CCQM-K34	Assay of potassium hydrogen phthalate (KHP)	SMU	2003	Approved for equivalence	
EAWG/IAWG	CCQM-K34.1	Assay of potassium hydrogen phthalate (KHP)	SMU		Approved for equivalence	BAM/SMU bilateral comparison
EAWG	CCQM-K36.a	Electrolytic conductivity (0.5 S/m)			Approved for equivalence	
EAWG	CCQM-K36.b	Electrolytic conductivity (0.005 S/m)			Approved for equivalence	
EAWG	CCQM-K36.1	Electrolytic conductivity – subsequent			Planned	Subsequent to CCQM-K36
EAWG/IAWG	CCQM-K48	Assay of KCl			Planned	
EAWG/IAWG	CCQM-P19	Hydrochloric acid	NIST	1999	Completed 2001	
EAWG/IAWG	CCQM-P19.1	Purity of HCl	NIST	2002	Completed	
EAWG	CCQM-P22	Electrolytic conductivity	DFM	2001	Completed	
EAWG/IAWG	CCQM-P36	Assay of potassium hydrogen phthalate (KHP)	SMU/NIST	2002	Completed; progression to key comparison proposed	
EAWG	CCQM-P37	Fundamental studies of pH standards	SMU	2002	Completed	
EAWG	CCQM-P47	Electrolytic conductivity (low level)	NMi	2003	Completed	
EAWG	CCQM-P52	pH 10.1 (Carbonate)	SMU	2003	Completed	Run before CCQM-K18 (separately)
EAWG	CCQM-P82	pH 9.2 (Borate)	PTB	2005	Completed	Run in parallel to CCQM-K19
EAWG	CCQM-P83	Electrolytic conductivity (0.5 mS/m)	DFM	2005	Planned	
EAWG	CCQM-P93	pH 7 preparation study		2008	Planned	

CCQM Gas Analysis Working Group key comparisons and pilot studies

WG	Reference No.	Description	Coordinating laboratory	Start date	Status	Comments
GAWG	BIPM.QM-K1	Ozone at ambient level	BIPM	2006	Planned	
GAWG	CCQM-K1.a	CO in N_2	NMi	1998	Approved for equivalence	
GAWG	CCQM-K1.b	CO_2 in N_2	NMi	1998	Approved for equivalence	
GAWG	CCQM-K1.c	NO in N_2	NMi	1998	Approved for equivalence	
GAWG	CCQM-K1.d	SO_2 in N_2	NMi	1998	Approved for equivalence	
GAWG	CCQM-K1.e, .f, .g	Natural gases (Types 1,2,3)	NMi	1998	Approved for equivalence	
GAWG	CCQM-K3	CO, CO_2, propane in N_2	NMi	1998	Approved for equivalence	
GAWG	CCQM-K4	Ethanol in air	NPL	1999	Approved for equivalence	
GAWG	CCQM-K7	Benzene/toluene/xylene (BTX) in N_2/air	NIST	1999	Approved for equivalence	
GAWG	CCQM-K10	BTX in N_2 (low concentration $10 \times 10^{-9} – 30 \times 10^{-9}$)	NIST/NPL	2001	Approved for equivalence	
GAWG	CCQM-K15	SF_6, CFCs – emission levels	KRISS	2003	Approved for equivalence	Run in parallel to CCQM-P51
GAWG	CCQM-K16.a	Natural gas (Types IV)	BAM/NMi	2001	Approved for equivalence	Run in parallel to CCQM-P49.a
GAWG	CCQM-K16.b	Natural gas (Types V)	BAM/NMi	2001	Approved for equivalence	Run in parallel to CCQM-P49.b
GAWG	CCQM-K22	VOCs in air	NMIJ	2003	Approved for equivalence	Run in parallel to CCQM-P71
GAWG	CCQM-K23.a	Natural gas (Repeat)/LPG (Type I)	NMi	2004	Approved for equivalence	
GAWG	CCQM-K23.b	Natural gas (Repeat)/LPG (Type II)	NMi	2004	Report in progress Draft B	
GAWG	CCQM-K23.c	Natural gas (Repeat)/LPG (Type III)	NMi	2004	Approved for equivalence	
GAWG	CCQM-K26.a	Reactive gases – ambient levels – NO in N_2	NPL	2003	Approved for equivalence	Run in parallel to CCQM-P50.a
GAWG	CCQM-K26.b	Reactive gases – ambient levels – SO_2 in air	NPL	2003	Approved for equivalence	Run in parallel to CCQM-P50.b

GAWG	CCQM-K41	H_2S in nitrogen	NIST		Approved for equivalence	
GAWG	CCQM-K46	Ammonia in nitrogen	NMi	2005	Planned	
GAWG	CCQM-K51	CO in nitrogen (5 µmol/mol)	NMi/CSIR-NML	2006	Planned	
GAWG	CCQM-K52	CO_2 in air (360×10^{-6} – 400×10^{-6})	NMi/CSIR-NML	2006	Planned	
GAWG	CCQM-K53	O_2 in nitrogen – preparative capabilities	KRISS	2006	Report in progress	
GAWG	CCQM-K54	n-hexane in methane – preparative capabilities	NMi VSL	2006	Report in progress	
GAWG	CCQM-K65	Mercaptans in methane	VNIIM		Planned	
GAWG	CCQM-K66	Purity analysis	NMIJ		Planned	
GAWG	CCQM-P23	CO in nitrogen ($50\,000 \times 10^{-6}$,1000×10^{-6}, 10×10^{-6}) – Gravimetry	NMi	2000	Completed	
GAWG	CCQM-P24	Dynamic mixing methods	LNE	2002	Completed	
GAWG	CCQM-P28	Ozone – ambient levels	BIPM	2003	Completed	
GAWG	CCQM-P41	Greenhouse gases CO_2, CH_4 – ambient levels	NMi	2002	Completed	
GAWG	CCQM-P45	Purity analysis of parent gases incl. H_2O	LNE	2002	Planned	EUROMET workshop
GAWG	CCQM-P49.a	Natural gas (Types IV)	BAM/NMi	2001	Completed	Run in parallel to CCQM-K16.a
GAWG	CCQM-P49.b	Natural gas (Types V)	BAM/NMi	2001	Completed	Run in parallel to CCQM-K16.b
GAWG	CCQM-P50.a	Reactive gases – ambient levels – NO in N_2	NPL	2003	Completed	Run in parallel to CCQM-K26.a
GAWG	CCQM-P50.b	Reactive gases – ambient levels – SO_2 in air	NPL	2003	Completed	Run in parallel to CCQM-K26.b
GAWG	CCQM-P51	SF_6, CFCs – emission levels	KRISS	2003	Completed	Run in parallel to CCQM-K15
GAWG	CCQM-P71	VOCs in air	NMIJ	2003	Completed	Run in parallel to CCQM-K22
GAWG	CCQM-P73	Nitogen monoxide in nitrogen	BIPM	2006	Report in progress	
GAWG	CCQM-P87	Multicomponent preparative capability study	NPL		Report in progress	

CCQM Inorganic Analysis Working Group key comparisons and pilot studies

WG	Reference No.	Description	Coordinating Laboratory	Start date	Status	Comments
IAWG	CCQM-K2	Cd and Pb in natural water	IRMM	1998	Completed	
IAWG	CCQM-K8	Elemental solution standards (Al,Cu,Fe,Mg)	EMPA/LNE	1999	Approved for equivalence	
IAWG	CCQM-K13	Pb/Cd in sediments	IRMM	2000	Approved for equivalence	

IAWG	CCQM-K13.1	Pb/Cd in sediments	NIST	2000	Approved for equivalence	
IAWG	CCQM-K14	Ca in serum	IRMM	2003	Approved for equivalence	
IAWG	CCQM-K24	Cd in rice	IRMM	2001	Approved for equivalence	Run in parallel to CCQM-P29
IAWG	CCQM-K28	TriButylTin in sediment	LGC/NRC	2003	Approved for equivalence	
IAWG	CCQM-K29	Anions in calibration solutions	EMPA	2003	Approved for equivalence	
IAWG	CCQM-K29.1	Anions in salibration solutions	SMU		Approved for equivalence	SMU/CENAM bilateral
IAWG	CCQM-K30	Pb in wine	IRMM	2003	Protocol complete	Run in parallel to CCQM-P12.1
IAWG	CCQM-K31	As in fish or shellfish	NIST	2002	Approved for equivalence	
IAWG/EAWG	CCQM-K33	Minor elements in steel	NMIJ/NIST/BAM	2003	Approved for equivalence	Run in parallel to CCQM-P56
IAWG/EAWG	CCQM-K34	Assay of potassium hydrogen phthalate (KHP)	SMU	2003	Approved for equivalence	
IAWG	CCQM-K34.1	Assay of potassium hydrogen phthalate (KHP)	SMU	2003	Report in progress Draft B	BAM/SMU bilateral
IAWG	CCQM-K35	Sulfur in fuels (lower levels)	NIST	2003	Approved for equivalence	Run in parallel to CCQM-P26.1
IAWG	CCQM-K42	Constituents of an aluminium alloy	BAM	Oct. 2004	Report in progress Draft B	Run in parallel to CCQM-P34.1
IAWG	CCQM-K43	Methyl-mercury in salmon fish	IRMM	Nov. 2004	Approved for equivalence	Run in parallel to CCQM-P39.1
IAWG	CCQM-K43.1	As, Hg, Se and methylmercury content in marine fish	NMIJ	June 2000	Planned	
IAWG	CCQM-K44	Trace metals in sewage sludge	IRMM	Dec. 2004	Report in progress Draft B	Run in parallel to CCQM-P70, EUROMET 784 and IMEP
IAWG/ EAWG	CCQM-K45	Toxic metals in food (Tin in tomato paste)	LGC	2005	Approved for equivalence	Run in parallel to CCQM-P72
IAWG	CCQM-K48	Assay of KCl			Planned	
IAWG	CCQM-K49	Toxic and essential elements in bovine liver	NIST	2006	Planned	Run in parallel to CCQM-P85
IAWG	CCQM-K56	Trace elements in soybean powder	NIM	2006	Planned	Run in parallel to CCQM-P64.1

IAWG	CCQM-K57	Chemical composition of clay	CENAM	2006	Planned	Run in parallel to CCQM-P65.1
IAWG	CCQM-K58	Nitrogen and trace elements in silicon nitride powder	NMIJ/BAM	2006	Planned	Run in parallel to CCQM-P74.1
IAWG	CCQM-K59	Determination of nitrite and nitrate in calibration solutions and natural water	SMU/NRC	2006-2007	Planned	Run in parallel to CCQM-P89
IAWG	CCQM-K60	Total Se and Se speciation analysis of Se-rich wheat flour	LGC/NRC	2007	Planned	Run in parallel to CCQM-P86.1
IAWG	CCQM-K64	Analysis of a copper alloy	BAM	2007	Planned	The level of interest in the KC and the possibility of a parallel pilot study is being evaluated
IAWG	CCQM-P1	Trace elements in water Pb	NIST	1997	Completed 1998	
IAWG	CCQM-P7	KCl, NaCl, $K_2Cr_2O_7$	NIST			
IAWG	CCQM-P11	As in shellfish	NIST	2001	Completed; progression to key comparison proposed	
IAWG	CCQM-P12	Pb in wine	IRMM	2000	Completed	
IAWG	CCQM-P12.1	Elements (e.g., Cu, Cd, Zn) in wine	IRMM	2003	Protocol complete	Run in parallel to CCQM-K30
IAWG	CCQM-P13	Metals in synthetic food digest	LGC	2001	Completed	
IAWG	CCQM-P14	Trace elements (Pb, Se) in serum	NIST/LGC	1999	Abandoned (see next)	
IAWG	CCQM-P14	Ca in serum	IRMM/SP	2001	Completed; progression to key comparison proposed	
IAWG	CCQM-P15	Pb/Cd in sediments	IRMM	1999	Completed; progression to key comparison proposed	
IAWG/OAWG	CCQM-P16	Elements in synthetic digest solutions	NMi	1999	Abandoned	
IAWG/EAWG	CCQM-P18	TriButylTin in sediment	LGC/NRC	2001	Completed; progression to key comparison proposed	
IAWG/EAWG	CCQM-P19	Hydrochloric acid	NIST	1999	Completed 2001	

IAWG/OAWG	CCQM-P19.1	Purity of HCl	NIST	2002	Completed	
IAWG	CCQM-P20.a	TBT chloride	NARL	2001	Completed	
IAWG	CCQM-P25	Minor elements in steel	NMIJ/NIST/BAM	2002	Completed; progression to key comparison proposed	
IAWG	CCQM-P26	Sulfur in fuels	IRMM/NIST	2001	Completed	
IAWG	CCQM-P26.1	Sulfur in fuels (lower levels)	NIST	2003	Completed	Run in parallel to CCQM-K35
IAWG	CCQM-P29	Cd, Zn in rice	IRMM/NMIJ	2001	Completed	Run in parallel to CCQM-K24
IAWG	CCQM-P30	Elemental solution standards (Al, Cu, Fe, Mg)	EMPA/LNE	1999	Completed 2000	
IAWG	CCQM-P32	Anions in calibration solutions	EMPA	2001	Completed; progression to key comparison proposed	
IAWG	CCQM-P33	Boron in Si	PTB	2003	Planned	
IAWG	CCQM-P34	Constituents in Al alloy	BAM	2001	Completed	
IAWG/EAWG	CCQM-P34.1	Constituents of an aluminium alloy	BAM	Oct. 2004	Report in progress	Run in parallel to CCQM-K42
IAWG	CCQM-P36	Assay of potassium hydrogen phthalate (KHP)	SMU/NIST	2002	Completed; progression to key comparison proposed	
IAWG	CCQM-P39	As, Se, Hg, Pb, methyl-Hg in tuna fish	IRMM	2003	Completed	
IAWG	CCQM-P39.1	Methyl-mercury in salmon fish	IRMM	Nov. 2004	Completed	Run in parallel to CCQM-K43
IAWG	CCQM-P43	DiButylTin in sediment	LGC/NRC	2003	Completed	
IAWG	CCQM-P46	Preparation of inorganic calibration solutions	NIST	2003	Report in progress	
IAWG	CCQM-P48	Uranium isotope ratio in synthetic saline matrix	IRMM	2003	Report in progress	
IAWG	CCQM-P56	Minor elements in steel	NMIJ/NIST/BAM	2003	Completed	Run in parallel to CCQM-K33
IAWG	CCQM-P62	Trace analysis of high purity nickel	BAM	June 2004	Report in progress	
IAWG	CCQM-P63	Platinum group elements in an automotive catalyst	LGC	Aug. 2004	Report in progress	
IAWG	CCQM-P64	Trace elements in soybean powder	NRCCRM	Sept. 2004	Report in progress	
IAWG	CCQM-P64.1	Trace elements in soybean powder	NIM	2006	Planned	Run in parallel to CCQM-K56
IAWG	CCQM-P65	Chemical composition of clay	CENAM	Oct. 2004	Report in progress	

IAWG	CCQM-P65.1	Chemical composition of clay	CENAM	2006	Planned	Run in parallel to CCQM-K57
IAWG	CCQM-P66	Determination of metals in fertilizer	NIST	Oct. 2004	Planned	
IAWG	CCQM-P70	Trace metals in sewage sludge	IRMM	Dec. 2004	Report in progress	Run in parallel to CCQM-K44, EUROMET 784 and IMEP
IAWG	CCQM-P72	Toxic metals in food (Tin, lead and cadmium in tomato paste)	LGC	2005	Report in progress	Run in parallel to CCQM-K45
IAWG	CCQM-P74	Composition of fine ceramics	NMIJ	Jul. 2005	Measurements complete	
IAWG	CCQM-P74.1	Nitrogen and trace elements in silicon nitride powder	NMIJ/BAM	2006	Planned	Run in parallel to CCQM-P58
IAWG	CCQM-P75	Stable isotope delta values in methionine	IRMM/IAEA	Jan. 2006	In progress	
IAWG	CCQM-P76	Major and minor elements in copper alloy	BAM	Oct. 2005	In progress	
IAWG	CCQM-P85	Toxic and essential elements in bovine liver	NIST	2006	Planned	Run in parallel to CCQM-K49
IAWG	CCQM-P86	Analysis of total Se and Se methionine in pharmaceutical supplements	LGC/NRC	2006	In progress	
IAWG	CCQM-P86.1	Total Se and Se speciation analysis of Se-rich wheat flour	LGC/NRC	2007	Planned	Run in parallel to CCQM-K60
IAWG	CCQM-P89	Determination of nitrite and nitrate in calibration solutions and natural water	SMU/NRC	2006-2007	Planned	Run in parallel to CCQM-K59
IAWG	CCQM-P96	As and arsenobetaine content in marine fish	NMIJ/NIM	2007	Planned	
IAWG	CCQM-P97	Cd and Pb in herb	Gov. Lab HK	2006	Planned	Run in parallel to APMP study
IAWG	CCQM-P100	Hg in pure and natural water	PTB	2007	Planned	Run in parallel to EUROMET 924
IAWG	CCQM-P104	Trace element in phosphogypsum	IAEA		Planned	
IAWG	CCQM-P105	Sr isotopic ratio measurements	IRMM/NRC		Planned	
IAWG	CCQM-P106	Cd, Cr, Hg and Pb in polypropylene	NIM/NMIJ/ KRISS		Planned	
IAWG	CCQM-P107	Purity of zinc	BAM		Planned	

CCQM Organic Analysis Working Group key comparisons and pilot studies

WG	Reference No.	Description	Coordinating Laboratory	Start date	Status	Comments
OAWG	CCQM-K5	p,p´-DDE in fish oil	LGC	1999	Approved for equivalence	
OAWG	CCQM-K6	Cholesterol in serum	NIST	1999	Approved for equivalence	
OAWG	CCQM-K6 subsequent		NIST	2001	Approved for equivalence	
OAWG	CCQM-K11	Glucose in serum	NIST	2001	Approved for equivalence	
OAWG	CCQM-K11.1	Glucose in serum (subsequent comparison)	KRISS	2005	Report in progress Draft B	
OAWG	CCQM-K12	Creatinine in serum	NIST	2001	Approved for equivalence	
OAWG	CCQM-K12.1	Creatinine in serum (subsequent comparison)	KRISS	2005	Report in progress Draft B	
OAWG	CCQM-K21	p,p'-DDT in fish oil	LGC	2000	Approved for equivalence	
OAWG	CCQM-K25	PCBs in sediments (PCBs 28, 101, 153, 170)	NIST/NRC	2001	Approved for equivalence	
OAWG	CCQM-K27.2	Ethanol in water (subsequent)	NIST	2006	Planned	Subsequent comparison
OAWG	CCQM-K27.a	Ethanol in aqueous matrix (forensic level 1×10^{-6})	LGC/BAM	2002	Approved for equivalence	
OAWG	CCQM-K27.a subsequent (CCQM-K27.1)	Ethanol in aqueous matrix (forensic level 1×10^{-6})	NIST	2003	Approved for equivalence	Run in parallel with SIM pilot study
OAWG	CCQM-K27.b	Ethanol in aqueous matrix (commodity level 100×10^{-6})	LGC/BAM	2002	Approved for equivalence	
OAWG	CCQM-K37	VOCs in organic solvents	KRISS/NIST	2003	Planned	
OAWG	CCQM-K38	PAHs in solution	NIST	Nov. 2004	Approved for equivalence	
OAWG	CCQM-K39	Chorinated pesticides in solution	NIST	Nov. 2004	Approved for equivalence	
OAWG	CCQM-K40	PCB congeners in solution	NIST	2004	Approved for equivalence	Run in parallel to CCQM-P31.b.1

OAWG	CCQM-K47	VOCs in solution	CENAM/NIST	2006	Planned	Run in parallel to CCQM-P61.1
OAWG	CCQM-K50	PAHs in soils/sediments	CENAM/BAM	2006	Planned	Run in parallel to CCQM-P69.1
OAWG	CCQM-K55.a	Purity assessment of high purity organic materials	BIPM	2007-2008	Planned	
OAWG	CCQM-K62	Nutrients in infant formula	NIST		Planned	
OAWG	CCQM-K63	Cortisol and progesterone in serum	NIST		Planned	
OAWG	CCQM-P2	p,p´-DDE in isooctane	LGC	1997	Completed	
OAWG	CCQM-P3	NMR study	BAM	1998	Completed 1999	
OAWG	CCQM-P3.2	NMR study	BAM	1999	Completed 2000	
OAWG	CCQM-P4	p,p´-DDE in corn oil	LGC	1998	Completed; progression to key comparison proposed	
OAWG	CCQM-P5	Acetanilide, benzoic acid, and naphthalene	NIST	1998	Completed 1999	
OAWG	CCQM-P6	Cholesterol in serum	NIST	1998	Completed; progression to key comparison proposed	
OAWG	CCQM-P8	Glucose in serum	NIST	1999	Completed; progression to key comparison proposed	
OAWG	CCQM-P9	Creatinine in serum	NIST	1999	Completed; progression to key comparison proposed	
OAWG	CCQM-P10	Gamma-HCH in fish oil	LGC	1999	Repeated (see next)	
OAWG	CCQM-P10.2	Gamma-HCH in fish oil 74 ng/g, 240 ng/g	LGC	2000	Completed	
OAWG	CCQM-P17	PCBs in sediments	NRC/NIST	2000	Completed; progression to key comparison proposed	
OAWG/IAWG	CCQM-P18	TriButylTin in sediment	LGC/NRC	2001	Completed; progression to key comparison proposed	
OAWG/IAWG	CCQM-P20.a	TBT chloride	NARL	2001	Completed	
OAWG	CCQM-P20.b	o-xylene	NIST	2002	Completed	
OAWG	CCQM-P20.c	Atrazine	NARL	2004	Completed	

OAWG	CCQM-P20.d	Chlorpyrifos	NARL	2004	Completed	
OAWG	CCQM-P20.e.1, CCQM-P20.e.2	Purity series: theophylline (2 samples)	BIPM/LGC	2006	Completed	
OAWG	CCQM-P20.f	Digoxin (purity assessment series)	BIPM/LGC	2006/2007	Planned	
OAWG	CCQM-P21	p,p'-DDT in fish oil	LGC	1999	Completed; progression to key comparison proposed	
OAWG	CCQM-P27	LSD in urine	LGC	2001	Completed	
	CCQM-P27.1	Drugs of abuse in urine	NARL	2004	Planned	
OAWG	CCQM-P31.a	Organic calibration solutions (PAHs)	NIST	2003	Completed	
OAWG	CCQM-P31.a.1	Organic calibration solutions (PAHs)	NIST	2004	Completed	Run in parallel to CCQM-K38
OAWG	CCQM-P31.b	Organic calibration solutions (PCBs)	NIST	2003	Completed	
OAWG	CCQM-P31.b.1	PCB congeners in solution	NIST	2004	Completed	Run in parallel to CCQM-K40
OAWG	CCQM-P31.c	Organic calibration solutions (Chlorinated pesticides)	NIST	2003	Completed	
OAWG	CCQM-P31.c.1	Organic calibration solutions (Chlorinated pesticides)	NIST	2004	Completed	Run in parallel to CCQM-K39
OAWG	CCQM-P35	Ethanol in aqueous matrix (forensic and commodity levels)	BAM/LGC	2001	Completed; progression to key comparison proposed	
OAWG	CCQM-P40	Organic contaminants in mussel tissue	NIST	2003	Planned	
OAWG	CCQM-P57	PCB congeners in tissue extract	NIST	2004	Report in progress	
OAWG	CCQM-P61	Volatile organic compounds (VOCs) in solution	CENAM/ NIST	2004/2005	Completed	
OAWG	CCQM-P61.1	VOCs in solution	CENAM/NIST	2006	Planned	Run in parallel to CCQM-K47
OAWG	CCQM-P67	PCBs congeners in tissue	NIST	2004	Report in progress	
OAWG	CCQM-P68	Anabolic steroids in urine	NARL	2004/2005	Report in progress	
OAWG	CCQM-P69	PAHs in soils/sediments	CENAM/BAM	2004/2005	Report in progress	
OAWG	CCQM-P69.1	PAHs in soils/sediments	CENAM/BAM	2006	Planned	Run in parallel to CCQM-K50
OAWG	CCQM-P77.a	Progesterone in serum	NIST	2006	Planned	
OAWG	CCQM-P77.b	Cortisol in serum	NIST	2006	Planned	
OAWG	CCQM-P78	Nutrients in infant/adult formula	NIST	2006	Planned	
OAWG	CCQM-P88	Malachite green in fish	LGC	2006	Planned	
OAWG	CCQM-P90	Chloramphenicol in food	PTB	2007	Planned	

OAWG	CCQM-P91	Pyrethroids in apple juice	NIM			
OAWG	CCQM-P92	Moisture in grain (method dependent)	NIST/NMIA			
OAWG	CCQM-P99	Organic component and contaminants in alcoholic beverage mix	INMETRO		Planned	

CCQM Surface Analysis Working Group key comparisons and pilot studies

WG	Reference No.	Description	Coordinating Laboratory	Start date	Status	Comments
SAWG	CCQM-K32	SiO_2 on Si film thickness	NPL		Report in progress Draft B	
SAWG	CCQM-K67	Quantitative analysis of Fe-Ni alloy	KRISS	2008	Planned	Run in parallel to CCQM-P108
SAWG	CCQM-P38	SiO_2 on Si film thickness	NPL	2002	Completed; progression to key comparison proposed	
SAWG	CCQM-P80	Carbon in precipitates in Fe	NPL	2005	Report in progress	
SAWG	CCQM-P81	N in surface layers of Fe	NPL	2005	Report in progress	
SAWG	CCQM-P84	SiO_2 on Si, surface analysis	NPL		Report in progress	Run in parallel to CCQM-K32
SAWG	CCQM-P98	Quantitative analysis of Fe-Ni alloy	KRISS	2007	Planned	
SAWG		Determination of Fe and N in doped DLC films	BAM	2006	Planned	
SAWG	CCQM-P95	Standard free quantification in EPMA		2006	Planned	
SAWG	CCQM-P108	Quantitative analysis of Fe-Ni alloy	KRISS	2008	Planned	Run in parallel to CCQM-K67

APPENDIX Q 1.
Working documents submitted to the CCQM at its 13th meeting

Working documents submitted to the CCQM at its 13th meeting are on restricted access.