Bureau International des Poids et Mesures

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

Report of the 11th meeting
(14– 15 April 2005)
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.

T.J. Quinn,
Director BIPM,
November 2003

LIST OF MEMBERS OF THE CONSULTATIVE COMMITTEE FOR AMOUNT OF SUBSTANCE: METROLOGY IN CHEMISTRY

as of 14 April 2005

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], Queretaro.

CSIR – National Measurement Laboratory [CSIR-NML], Pretoria.

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

Danish Institute of Fundamental Metrology [DFM], Lyngby.

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 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 Physical Laboratory [NPL]/Laboratory of the Government Chemist [LGC], Teddington.

National Research Centre for Certified Reference Materials [NRCCRM], Beijing.

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], Dublin.
Swedish National Testing and Research Institute [SP], Borås.
Swiss Federal Office of Metrology and Accreditation [METAS], Bern-Wabern.
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.
Istituto di Metrologia G. Colonnetti, Consiglio Nazionale delle Ricerche [IMGC-CNR], 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 Office of Measures/Országos Mérésügyi Hivatal [OMH], Budapest.
National Physical Laboratory of India [NPLI], New Delhi.
Standards, Productivity and Innovation Board [SPRING], Singapore.

1 OPENING OF THE MEETING; APPOINTMENT OF THE RAPPORTEUR; APPROVAL OF THE AGENDA

The Consultative Committee for Amount of Substance: metrology in chemistry (CCQM) held its eleventh meeting at the International Bureau of Weights of Measures (BIPM), at Sèvres on 14-15 April 2005.

The following were present: L. Besley (NMIA), A. Botha (CSIR-NML), B. Brady (SL), R. Cavanagh (NIST), P. Charlet (LNE), K. Chiba (NMIJ/AIST), P. De Bièvre (ISO REMCO), E.W.B. de Leer (NMi VSL), R. Dybkaer (IFCC), H. Emons (IRMM), H. Ent (NMi-VSL), A. Fajgelj (IAEA/IUPAC), B. Güttler (PTB), H.-P. Haerri (METAS), W. Hässelbarth (BAM), E. Hwang (KRISS), H.D. Jensen (DFM), R. Kaarls (President of the CCQM), Y. Kustikov (VNIIM), Hongmei Li (NRCCRM), W. Louw (CSIR-NML), L. Mackay (NMIA), B. Magnusson (SP), M. Máriássy (SMU), W.E. May (NIST), J. McLaren (NRC), M.J.T. Milton (NPL), Y. Mitani (CENAM), K. Okamoto (NMIJ/AIST), U. Panne (BAM), H. Parkes (LGC), M. Pérez-Urquiza (CENAM), M. Rocio Arvizu-Torres (CENAM), M. Sargent (LGC), M. Seah (NPL), L. Siekmann (RfB), H.-Y. So (KRISS), R. Sturgeon (NRC), P. Taylor (IRMM), A.J. Wallard (Director of the BIPM), S. Windsor (NPL), Fangdi WU (NRCCRM).

Observers: I. Akdag (UME), V. de Souza (INMETRO), E. Deák (OMH), M. Gallorini (IMGC-CNR), W. Kozlowski (GUM), M.T. López Esteban (CEM), J. Marques Rodrigues (INMETRO), E. Rizzio (IMGC-CNR).

Invited: A. Bristow (NIBSC), E. Gray (NIBSC), I. Kuselman (INPL), G. Massif (Fundacion Chile), V.M.L. Ponçano (IPT), W. Richter, A. Squirrell (ILAC), M. Walsh.

Also present: P. Giacomo, T.J. Quinn (Emeritus Directors of the BIPM); M. Esler, R. Josephs, P. Moussay, C. Thomas, J. Viallon, S. Westwood (BIPM), R. Wielgosz (Executive Secretary of the CCQM, BIPM).

Excused: Chuen Shing Mok (Government Laboratory, Hong Kong), A. Padilla (WHO).

The President said he had asked Dr Milton to act as rapporteur and was delighted that he had accepted. Dr Wielgosz would assist him.

The President welcomed participants to the eleventh meeting of the CCQM. He particularly welcomed representatives of the NIBSC, a WHO custodian laboratory for International Biological Reference Preparations. The Director said it was a pleasure for him to attend the CCQM, which was the largest consultative committee.

The President informed the committee that an additional agenda point, related to the possible redefinition of the kilogram, would be addressed immediately after approval of report of the previous CCQM meeting. The agenda was approved without further modification.

The President reported that the CCQM had had a good year during which a lot of progress had been made. Most of the working groups had met twice. He drew the attention of the meeting to a review entitled "Metrology in chemistry: considerations, approaches and developments on the applicability of methods of higher order" which had been written by a number of members of the CCQM and published in the *Comptes Rendus de Physique* of the French Academy of Sciences (*C. R. Physique*, 2004, **5**, 907-920).

2 REPORT OF THE TENTH MEETING

The report of the tenth meeting was approved, and the President thanked the rapporteur, Dr Milton.

The President drew the attention of the meeting to a draft recommendation on the redefinition of the kilogram that he had prepared for discussion. He explained that as a result of very small drifts in the value of the kilogram itself, there had been a long-standing debate on the feasibility of redefining it in terms of a fixed value for either the Planck constant or the Avogadro constant. A group of scientists was suggesting that a redefinition could occur at the next CGPM in 2007.

However, important experiments were underway in several laboratories. These could lead to the definition of the kilogram in terms of the value of Planck's constant (h). It was also possible to re-define the kilogram in terms of Avogadro's constant (N_A). At present, the two approaches were divergent at the level of 1 part in 10^6. Consequently, he proposed that it was timely for the CCQM to prepare a recommendation expressing its view on the issue. He recommended that members of the CCQM read a paper by Prof. Mills *et al*. in *Metrologia* (2005, **42**, 71-80). He suggested that the CCQM should recommend that any redefinition should not take place before the 24th CGPM in 2011, so that the results of experiments currently underway and being planned, notably the watt balance and x-ray crystal density/molar mass measurements, could be taken into account.

Dr Milton said that although the resulting change in the uncertainty in the value of the kilogram would be insignificant for chemistry, it was important that the CCQM expressed a view in how the definition was expressed. He suggested that a redefinition expressed in terms of N_A rather than h would be most widely acceptable to CCQM and the organizations it worked with. Prof. De Bièvre said it was an issue of interest but it would not have any effect on measurements of amount of substance. Dr de Leer said that it was important that N_A was fixed, but it should not subsequently be changed again. Prof. So agreed that any change should not be undertaken hastily.

The President proposed that he work with Dr Milton and Prof. De Bièvre to refine the draft recommendation. Recommendation Q 1 (2005), on the possible redefinition of the kilogram, was adopted by the CCQM.

3 CCQM RULES AND POLICY

The President introduced document CCQM/05-20. He said that he had discussed the need to document the rules and policies of the CCQM at the previous meeting. Subsequently, the issue had been discussed by the CIPM who believed that such a document should be applicable to all ten Consultative Committees. Consequently, he had prepared CCQM/05-20. He had placed some material that related specifically to the CCQM into Annex A. The terms of reference of all working groups would be included in Annex B.

He invited members to send any comments to him by 1 June 2005.

Prof. Emons referred to the discrepancy between clauses 14 and 15 of Annex A. These appeared to call for CCQM to address all of the process of chemical metrology but to focus on the development and comparison of high-purity CRMs. The President said that this apparent contradiction was not intended.

4 STRATEGIC DISCUSSION ON DELIVERING TRACEABILITY TO THE FOOD SECTOR

4.1 Report on the meeting held with stakeholders in September 2004

The President reported on discussions mediated by the BIPM on the delivery of traceability to the food sector (CCQM/05-02 and -36).

Following the successful meeting held in 2003 (CCQM/04-02), a small focus group meeting was held in September 2004 to take the conclusions forward. He observed that there was much regulation in the field related to measurements. He gave an example that had been presented by the Codex Alimentarius Commission, relating to the difficulty of making decisions based on analytical data that were close to a decision limit. He also showed the results of a combined CCQM/IMEP exercise relating to measurements of lead in wine and illustrated how the use of an SI-traceable value for a proficiency test on tin in tomato puree significantly changed the interpretation of the results. It was a priority to continue to promote the use of assigned traceable reference values in proficiency tests.

He said that much work was underway at the CCQM of relevance to the food community. Priorities for the CCQM should include: the development of further food-related activities by relevant CCQM working groups; the designation of expert food reference laboratories by NMIs or other responsible authorities, to act as an NMI in their field of expertise; and, if desirable, the possible establishment of a “joint committee” with stakeholders in the food sector.

4.2 and 4.3 Codex Alimentarius Commission and the Inter-agency Meeting

Dr Wielgosz reported that the BIPM had been accepted as an observer to the Codex Alimentarius Commission, which allowed the BIPM to attend and speak at all meetings of the Codex. The committee of specific interest was the CCMAS (Codex Committee on Methods of Analysis and Sampling) which is primarily responsible for developing quality standards for analysis and sampling of foods. He had submitted a number of Codex documents to the CCQM for the information of members (CCQM/05-11 to -14 and -17).

He noted that Codex had recently moved from an approach based on prescribed methods to performance-based methods and that the CCMAS was involved in defining suitable criteria for the performance of such methods. Recent issues included the definition of limit of detection and limit of quantification. They were awaiting the revised version of the *International Vocabulary of Basic and General Terms in Metrology* (VIM) and were debating the estimation of measurement uncertainty for recovery.

He had also attended the Inter-agency meeting that BIPM had been invited to join. Issues being discussed were: the use of reference values (rather than consensus) for proficiency testing (PT) schemes, measurement uncertainty and traceability, and the exchange of work plans and updating the list of methods endorsed by Codex.

Dr Walsh said that the presentations by the President and Executive Secretary had summarized progress very well. She gave some additional information about the work of AOAC. She said that the two workshops hosted by the BIPM had played a useful role in convincing the food community that the NMIs could bring some benefit to them. She said there would be great benefit in preparing a database of pure materials available for use in this area.

Prof. Emons said that the EU's system of community reference laboratories would shortly be expanded. He also said that there was a mismatch between the timing of CCQM activities and the timescales being requested by some regulators.

Mr Squirell commented that ILAC welcomed cooperation in this area.

4.4 CCQM activities in support of the food sector

Mrs Parris gave an overview of the work programme of the CCQM as it related to food (CCQM/05-35). In particular, the Organic Analysis Working Group had discussed how it could develop a strategy to support this community.

She reported that thirteen NMIs have CMCs relating to food of which 41 were organic and 47 inorganic. These covered nutritional constituents (for example, vitamin E), contaminants (for example, aflatoxins, PCBs and metals) and other components (for example, ethanol in wine).

The President said that it was important for the CCQM to develop a strategy for work in the area of food. In the future, the CCQM would have to use a similar strategic approach in supporting other sectors, such as forensics.

Dr May reported that the OAWG had reviewed the requirements of the food sector at its last meeting. They had developed plans for comparisons on:

- non-chlorinated pesticides in fruit,
- growth hormones in meat,
- antibiotics and contaminants in fish,
- proximates in food,
- butyric acid in milk,
- vitamins (A, E and folates), and
- dietary supplements (for example, green tea).

The President commented that the area of proximates should be addressed by the CCQM even though traceability to the SI would not be readily achieved.

Dr Sargent said the Inorganic Analysis Working Group had discussed the requirements of the food sectors at its meeting in October 2004. They had concluded that particular requirements were for: a study on nitrates and nitrites, and the provision of reference values for PT schemes (for example, lead in wine, tin in tomato paste and trace elements in wheat flour).

The President asked the CCQM for views on how it should set priorities, including how it should consult regulators and other types of sectoral body?

Dr de Leer said that the discussion had not covered microbiology, which was one of the biggest measurement issues in the food sector. Prof. Emons said that much of this requirement was qualitative rather than quantitative and therefore might be beyond the scope of the CCQM. Dr Ellison observed that the work of the Bio-analysis Working Group was focussed on macro-molecules and not micro-organisms.

Dr Besley said that microbiology was not well addressed by the SI and perhaps the CIPM should initiate a new activity should it wish to address this area. The President said that the BAWG should consider the issue.

The President summarized the discussions on delivering traceability to the food sector. He said that measurement in the food area is driven by regulatory and trade requirements. The CCQM must address the key techniques of relevance to the field, which would require considerable attention to the issue of “how far the light shines” from its activities. Occasional meetings with relevant sectoral organizations were valuable. Finally, the CCQM working groups should develop appropriate work programmes and should include a discussion on microbiology.

5 REPORTS OF THE WORKING GROUPS

5.1 Organic analysis

Dr May reported on the work of the Organic Analysis Working Group (OAWG) (CCQM/05-22) which had met twice since the last meeting of the CCQM and had held workshops on purity assessment and the assessment of uncertainties in the measurement of PCB congeners.

He presented a draft set of terms of reference that had been discussed by the group:

"The primary focus of the OAWG is on the critical evaluation and benchmarking of NMI capabilities for the execution of "higher order" measurement procedures for well-defined organic molecular entities for which the SI-traceable amount of substance is to be determined. The group will also consider, on a selective basis, similar activities for selected method-dependent analyses (such as for proximates in foods)."

This text emphasized work on "higher-order" methods as well as work on method-dependent analysis when justified.

He summarized progress on the OAWG work programme. Final reports were complete or in progress for three comparisons:

- CCQM-K27-subsequent, ethanol in aqueous matrix,
- CCQM-P31.a, .b and .c, organic solutions (PAHs, PCBs and chlorinated pesticides), and
- CCQM-P40, organic contaminants in tissue.

Results had been reported and discussed for six comparisons:

- CCQM-P20.c, purity assessment of atrazine,
- CCQM-P20.d, purity assessment of chlopyrifos,
- CCQM-P31.b.1, PCB congeners in solution,
- CCQM-P57, PCB congeners in mussel tissue extract and dichloroethane solution,
- CCQM-P67, PCB congeners in mussel tissue,
- CCQM-P61, VOCs in organic solvent.

He presented the results of the subsequent comparison, CCQM-K27-subsequent, for ethanol in an aqueous matrix.

The results of P20.c and .d had been re-analysed by Drs Ulberth and Westwood. This had generated a number of practical conclusions and had raised the question of how best to organize a key comparison of purity assessment?

A suite of exercises aimed at evaluating the uncertainty of measurements of PCBs in mussel tissue (CCQM-K40 and P31.b.1 and P57 and P67) had been undertaken. Most laboratories showed a consistent relationship for the mussel extract to the tissue sample, which indicated that the study was internally consistent. No difference in comparability was observed between K40 and P31.b.1 and

P31.b. There was also no difference in the comparability of results between P67 (tissue) and P40 (tissue).

He showed the results of CCQM-P61 (VOCs in solution), which had been based on a calibration solution prepared by the NIST. The pilot study involved a number of laboratories from SIM. Since the results of the pilot study were satisfactory, the OAWG proposed to organize a key comparison based on the same analytes (CCQM-K47).

The OAWG had come to a strategic decision about how it should link its work on clinical diagnostics to the IFCC-EQAS scheme of ring-trial studies being organized by the Deutsche Gesellschaft für Klinische Chemie und Laboratoriumsmedizin eV (DGKL). They proposed to use the DGKL samples, when needed, for OAWG activities. The President agreed that this approach was acceptable.

Nine other comparisons were planned:

- CCQM-K38 (PAHs in organic solution) coordinated by the NIST. The samples would contain five target PAHs (phenanthrene, fluoranthene, benz[a]anthracene, benzo[a]pyrene and benzo[ghi]perylene) in a solution of hexane or toluene as well as five to ten other relevant PAHs.
- CCQM-K39 (Chlorinated pesticides in solution) coordinated by the NIST. The samples would contain four target pesticides (4,4'-DDE, 4,4'-DDT, lindane and trans-nonachlor) in iso-octane solution as well as additional relevant chlorinated pesticides.
- CCQM-P68 (19-norandrosterone in freeze-dried human urine).19-norandrosterone is the major metabolite of nandrolone, which is one of the anabolic steroids tested for in sports drug testing, as well as being one of the steroids screened for in livestock in some countries. Participation in this pilot study would be restricted to signatories to the MRA. The coordinating laboratory would be the NMIA.
- CCQM-P69 (PAHs in soil and sediment) coordinated by the BAM and the CENAM. The target measurands would be: phenanthrene, fluoranthene, benz[a]anthracene, benzo[a]pyrene and benzo[ghi]perylene.
- He also proposed that two "subsequent" key comparisons be held. CCQM-K12.1 (Glucose in serum) and CCQM-K11.1 (Creatinine in serum) would follow CCQM-K12 and CCQM-K11 both of which had been completed in 2002. The coordinating laboratory for both of them would be the KRISS.
- Comparisons of cortisol/progesterone in serum (CCQM-P77), VOCs in solution (CCQM-K47 and P61.1) and nutrients in infant formula (CCQM-P78) were also planned.

He concluded by reporting that the next meeting of the OAWG would be held in conjunction with the JCTLM Working Group 1 at the IRMM, and that a number of comparisons in the food area, which had been described previously, were being formulated.

Dr de Leer commented on the performance of participants in CCQM-P61 (VOC's in solution) and asked whether, against the backdrop of such results, it was wise to address such a sensitive issue as doping-related compounds? Dr Besley said that the materials to be used in the study had been developed in a contract for the World Anti-Doping Agency (WADA), and it would finally be

WADA's decision whether or not they would allow their materials to be used in the study. WADA would assess the risks and benefits of the exercise from their own perspective. He suggested that formal discussions should be held with the WADA about the issue. After asking for views from members of the CCQM, the President proposed that the exercise should go ahead, subject to permission from the WADA, and the protocol of the study should clearly describe circumstances under which the results could be published.

Dr McLaren asked for advice from the OAWG on the specification of PCB congeners in the Calibration and Measurement Capabilities (CMCs). Dr May said that the answer would depend on the way that the different NMIs delivered their services.

5.2 Inorganic analysis

Dr Sargent presented his report of the work of the Inorganic Analysis Working Group (IAWG) (CCQM/05-28), which had met twice since the last CCQM.

Final values for the KCRV had been agreed for three key comparisons:

- CCQM-K28 (TBT in sediment) – the KCRV would be based on the median of six results, after exclusion of one outlier. The results in the parallel pilot study CCQM-P43 (DBT in sediment) had been better than expected, but there would not be a proposal for a key comparison.
- CCQM-K33 and P56 (minor elements in steel) all participants had presented results for Cr, Mn, Mo and Ni. The KCRV would be based on the median of the results, after exclusion of two outliers for Ni.
- CCQM-K35 and P26.1 (sulphur at 40 μg/g in fuel) the KCRV would be based on the results from just four participants.

Results had also been discussed for three key comparisons:

- CCQM-K42 and P34.1 (metals in aluminium alloy) the five target metals were Cu, Fe, Mn, Zn and Cr. Results had been received from six participants in K42 and eight in P34.1.
- CCQM-K43 and P39.1 (metals and methyl-mercury in salmon) the four target metals were As, Se, Hg, and Pb. The measurement of As was of particular interest because it is mono-nuclidic and therefore not susceptible to measurement by IDMS. There were 19 participants from the members of the IAWG as well as six invited expert laboratories. Only one of the participants had reported results for all five target analytes.
- CCQM-K29.1 (anions in solution) – this subsequent key comparison was a bilateral between the CENAM and the SMU.

Results from a number of pilot studies had also been discussed:

- CCQM-P46 (preparative study for inorganic solutions) – this pilot study tested the ability of participants to prepare an elemental solution (of Cu, Mg or Rh) in the range 1 to 10 mg/g.
- CCQM-P48 (isotopic signature of U in simulated urine) – this pilot study involved five members of the IAWG together with five invited expert laboratories from the nuclear sector and

five from the geochemistry community. It was the first CCQM comparison focused on isotopic ratio measurements.

- CCQM-P62 (purity analysis of nickel based on six metals) - the six target metals were Ag, Al, Cu, Fe, Pb and Zn in the range 0.1 to 5 mg/kg. This pilot study was only expected to have six participants.
- CCQM-P65 (chemical composition of clay) the five target analytes were Si, Ca, Fe, K and Ti each expressed as their respective oxide. There were eight participants.

He presented proposals for three pilot studies that would emphasise industrial requirements more strongly than the programme had previously:

- CCQM-P74 (composition of fine ceramics) coordinated by the NMIJ. This proposal was the first that would address fine ceramics. All of the elements chosen for analysis were relevant to the properties of silicon nitride.
- CCQM-P75 (stable isotope delta values) ($\delta^{13}C$, $\delta^{15}N$ and $\delta^{18}O$) in methionine (proposed by the IAEA and IRMM). Methionone had been chosen as the analyte because it was not synthesized by the body and could only be obtained from food. This proposal would underpin measurements made by laboratories investigating food authenticity.
- CCQM-P76 (metals in copper alloy) coordinated by the BAM. These alloys were important in the manufacture of some consumer goods.

Dr Sargent brought the attention of the CCQM to a recent publication in *Metrologia* (2005, **42**, 21-24) by Dr Hill of the NRC and Dr Rudtsch of the PTB. It related to the needs of the thermometry community for accurate analysis of impurities in the pure materials used to define the fixed points of the ITS-90. He said that the IAWG could offer expertise, but needed the highest priorities to be identified by the thermal community. The President said he would welcome some effective cooperation in this area. Dr Haerri observed that there were also significant isotopic effects that needed to be quantified. Dr Besley said that the issues were generally well understood, but that improved measurement capabilities were still required.

He concluded that the IAWG was making good progress. A total of sixteen key comparisons had been completed or were in progress and the results of twenty pilot studies had been reviewed or completed during the year.

5.3 Gas analysis

Dr de Leer reported on the work of the Gas Analysis Working Group (GAWG) (CCQM/05-21), which had met twice since the last CCQM meeting.

He reported that the results of one key comparison (CCQM-K16) had been entered on the BIPM Key Comparison Database (KCDB) since the last CCQM meeting. A report was being prepared for CCQM-K15 and P51 (SF_6 and CF_4 at emission levels). Some difficulties with the stability of three species (including 1, 2-dichloroethane) in CCQM-K22 and P71 (VOCs in nitrogen) had been overcome and the report was being prepared.

He presented the results of four key comparisons:

- CCQM-K23.a and .c (natural gas) – this comparison repeated CCQM-K1.e, .f and .g, with the addition of i-butane. Some reports had been received with results in inconsistent units. With a few exceptions, the results were very close to the reference value.
- CCQM-K26.a (and P50.a) (NO in nitrogen) – this comparison was carried out at 720 nmol/mol and involved some newly-designated institutes. The cylinder could not be exported to Japan because of customs regulations and the NPL, the coordinating laboratory, had organized a bilateral comparison with the NMIJ to overcome this. The coordinating laboratory had carried out a lot of work to overcome the influence of drift in the amount fraction in the travelling standards.
- CCQM-K26.b (and P50.b) (sulphur dioxide in air) – this comparison made use of commercially-prepared travelling standards, which were certified with respect to a gravimetric permeation method. The drift of each travelling standard had been characterised by the coordinating laboratory.
- CCQM-K41 (H_2S in nitrogen) – the travelling standards were prepared commercially and their stability was verified against a stable reference cylinder held by the coordinating laboratory (NIST).

The pilot study on ozone at ambient levels (CCQM-P28) had been completed, and would be followed by a key comparison (BIPM.QM-K1). Dr Wielgosz would give more information during his report to the meeting.

Dr de Leer listed some key comparisons being planned:

- Ammonia in nitrogen,
- Ozone at ambient levels,
- CO and CO_2 in nitrogen,
- Hexane in methane (preparative study),
- Mercaptans in methane,
- Purity analysis.

Some pilot studies were underway:

- Preparation of CO standards (CCQM-P23),
- Dynamic blending methods (CCQM-P24),
- CO_2 and CH_4 in air (CCQM-P41).

He listed some studies that were being planned:

- Preparative study of NO in nitrogen (CCQM-P73),
- Multi-component preparative study based on natural gas taking advantage of the "harmonisation" method developed at NPL.

He highlighted some trends in the work of the GAWG. There was an increased focus on high precision analysis (typically < 0.1 %) and the work was moving toward lower concentrations to reach environmental levels. He said that the GAWG was developing a strategy to address its future

workload, and that it would have to agree an acceptable frequency for repeating key comparisons in the future.

The President thanked Dr de Leer for his presentation.

5.4 Electrochemical analysis

Dr Máriássy reported on progress of the Electrochemical Analysis Working Group (EAWG) (CCQM/05-25), which had met twice since the last CCQM. He reported the results of CCQM-K34 (purity of KHP). A problem with contamination of the samples sent to one participating laboratory had been identified and subsequently resolved. It had been agreed to use a KCRV based on the median of all six participants.

He reported the results of two pilot studies:

- CCQM-P52 (pH of carbonate buffer) – this pilot study was performed following the working group's decision to delay CCQM-K18 planned to cover the same buffer system. The results indicated that some participants had difficulty determining the standard potential – possibly related to the purity of the HCl.
- CCQM-P47 (electrolytic conductivity) for both samples at different nominal electrolytic conductivities, most participants were comparable with the agreed reference value. The overall performance was better than in CCQM-P22, which had been carried out at 100 mS/m.

He listed the activities that were underway or being planned:

- CCQM-K34.1 (assay of KHP),
- CCQM-K19 and P82 (pH close to 9.2),
- CCQM-K36 (electrolytic conductivity),
- CCQM-P83 (electrolytic conductivity (0.5 mS/m),
- CCQM-K18 (pH of carbonate),
- CCQM-K20 (pH close to 1.7), and
- CCQM-K48 (assay of KCL and $K_2Cr_2O_7$).

He described a programme of collaborative work being undertaken by members of the group to improve the fundamental understanding of both pH and electrolytic conductivity. The group was also considering preparing some published advice for institutes initiating work in the area.

5.5 Bio-analysis

Dr Ellison gave a brief summary of the progress made by the Bio-analysis Working Group (BAWG). He said the group was focussing its work on macro-molecules in biological science. Mrs Parkes had planned a work programme in consultation with the working group, resulting in two principal streams of activity, in DNA/gene measurements and proteins. He reported that a number of comparisons were underway:

- CCQM-P44.1 (relative DNA concentration) – the results were a considerable improvement on the previous study, and could now proceed to a key comparison. There would be further work on the measurement uncertainty.
- CCQM-P53 (DNA profiling by AFLP) – technical issues had arisen during preliminary work at the NMIA and would be discussed at the next meeting.
- CCQM-P54 (absolute quantitation of DNA) – the study had been successful, but some difficulties associated with purity had arisen. A repeat comparison was planned (CCQM-P54.1).
- CCQM-P55 (protein and peptide quantification) – this study was based on a collaboration between three laboratories and would involve the quantification of a peptide in solution.
- CCQM-P58 (fluorescence comparability) – this material for the study would be distributed and a report available at the next meeting.
- CCQM-P59 (circular dichroism comparability) – the materials have been distributed and the results will be discussed at the next meeting.
- CCQM-P60 (reference extraction method for DNA) – this study will address the question of whether the quantification of a DNA target is affected by the extraction method. It would use a sample of a genetically-modified maze.

The President thanked Dr Ellison for his summary.

Mrs Parkes also presented an overview of the work of the BAWG during the year. In particular, she welcomed the contribution made by the NIBSC. The group had spent time developing a future strategy. They had developed schematic “roadmaps” for reference measurement systems for DNA/gene measurements, protein measurements and bio-measurement. Each of these identified objectives for the group as far ahead as 2015. They had also identified which activities of the BAWG were relevant to the food sector and the WHO.

She said that there was considerable discussion about suitable units in the area and the harmonization of terminology. She proposed the establishment of a joint project between the BAWG, the BIPM and the IUPAC to review and document information about units used in the area.

5.6 Surface analysis

Dr Seah presented his report on the work of the Surface Analysis Working Group (SAWG) which had met before the CCQM.

He reported that the pilot study CCQM-P38 had been completed and it would be followed by CCQM-K32 together with a parallel pilot study (CCQM-P84). The work had generated a lot of interest from the surface analysis community and several peer-reviewed publications had been generated.

CCQM-K32 would use different samples to CCQM-P38. In some cases, laboratories were re-planning their traceability chains following the results of CCQM-P38. Three NMIs were considering the designation of institutes to participate in CCQM-K32. The BAM and the PTB would both participate, but would use the comparison to underpin different measurement capabilities.

Proposals for a number of pilot studies were being developed by the SAWG:

- CCQM-P80 (carbon amount in precipitates in iron) coordinated by the NPL. This pilot study would confirm the protocol required for sample handling and data analysis as well checking whether there were any weaknesses in the theory or the calibration of the detectors.
- CCQM-P81 (nitrogen in surface layers of Fe) coordinated by the NPL. This pilot study would use samples of a vanadium nitride coating on steel from the BAM which were known to be uniform to within 1 %. Nitrogen poses similar analytical problems to carbon in this type of sample.

Additionally, a pilot study on "standards free" quantitation in micro regions, as well as nine other possible projects, were being discussed.

Dr Seah said that SAWG had been asked to review some CMCs submitted by the BAM in: BET surface area analysis, which concerns the volume absorbed per unit mass of substrate (expressed as an area) and mercury porosimetry which concerns the mercury volume intruded per unit mass of substrate (expressed as a pore volume or pore radius). In both cases, the conversion to the volume basis is carried out according to a convention for which no uncertainty is allowed.

The SAWG had also discussed the requirements for activities under the CIPM in materials metrology. He observed that members of the SAWG were widely involved in materials metrology as well as the VAMAS. Materials measurements are often of quantities for which full traceability to the SI is not available. Some of the difficulties of materials metrology arose because materials required measurements covered by different Consultative Committees. It may not always be best to take these issues separately and there may be some issues not covered at all by any of the Consultative Committees. Therefore, there was broad support for a Joint Committee for Traceability in Materials Metrology to be established for a trial period. This could evaluate the requirement and report back on possible issues requiring coordination and those not covered by any of the existing Consultative Committees.

Dr Seah said that following his retirement from NPL he would stand down from the chair of the SAWG, but would continue to lead CCQM-K32.

The President thanked him for his work in establishing the SAWG to a point where it could be a full working group of the CCQM. He said that the suggestion that Dr Wolfgang Unger from the BAM should take over the chair of the SAWG had the support of his management and the SAWG. The CCQM approved the appointment of Dr W. Unger as chair of the CCQM Working Group on Surface Analysis.

5.7 Key comparisons and CMC quality

Dr McLaren reported on the work of the Working Group for Key Comparisons and CMC Quality (KCWG), which had met prior to the CCQM. He explained the composition of the group, which included representatives from the RMOs as well as the CCQM working groups.

He reminded the CCQM that the role of the KCWG was "to verify, at the global level, that the CMC review process within all RMOs is uniformly comprehensive and adequately thorough".

The last meeting had reviewed 417 CMCs in 12 measurement service categories as part of Cycle VI as well as resolving some issues from previous CMC cycles.

The review process is based on the results of key comparisons. When there are no such results available, evidence is sought from pilot studies or RMO comparisons. A particular issue arose when CMCs were based on the results of a pilot study operated in parallel to a key comparison. The KCWG took the view that it was not acceptable for a laboratory to base CMCs on participation in a pilot study when a key comparison was available. The President confirmed this policy.

Dr McLaren concluded by explaining the proposed timetable for completing the Cycle VI review of CMCs.

The President thanked Dr McLaren and his working group for the enormous amount of work they had completed. Dr de Leer made the observation that the measurement service categories used for the CMCs of the CCQM grouped the vast majority of claims for the GAWG into a single category. Dr McLaren replied that he was open to proposals that would make the process easier.

5.8 Reports from the RMOs

5.8.1 APMP

Prof. So reported on the work of the TCQM committee of the APMP. It has 22 full members and five Associates. They had held workshops on gas analysis for young scientists and to discuss the results of APMP.QM-P2 (cadmium in rice). Four studies and key comparisons were underway and three were being planned:

- APMP.QM-P05 (cadmium in oyster tissue) coordinated by the KRISS,
- APMP.QM-P06 (trace elements in soybean powder) coordinated by the NRCCRM, and
- APMP.QM-07 (SiO_2 thickness on silicon) coordinated by the NMIJ.

A peer review was carried out at the NRCCRM in October 2004 and of pH work at the NMIJ in December 2004. He said there was still a desire to increase the level of involvement of NMIs from developing countries, although this had been delayed by the work involved in implementing the CIPM MRA.

5.8.2 COOMET

Dr Kustikov reported on the work of the COOMET technical committee on “Physical chemistry”. The group had been involved in the review of CMCs and the preparation of COOMET CMCs. The VNIIM had submitted a document reporting that all recommended actions, of a CCQM expert peer review team that had carried out a peer review of the VNIIM Physico-Chemical Department in October 2003, had been undertaken and completed. A programme of regional comparisons was underway:

- The COOMET comparison 289/RU/03 (reference materials for gas mixtures of H_2, CO, CH_4 and O_2) had been completed. The participants were BelGIM (Belarus) and the VNIIM (Russian Fed.).
- COOMET.QM-K3 (automotive emission gases), coordinated by the VNIIM, was on-going. Participants were the BAM, BelGIM, Ukrmetrteststandart (Ukraine), and the VNIIM.
- Comparisons in the field of natural gas, proposed by BelGIM and the VNIIM, and in the field of pH, proposed by the VNIIFTRI, were being planned.
- Comparisons between the VNIIM and five speciality gas companies in Russia had been undertaken, with good agreement of results for certified reference materials for a number of gas mixtures (H_2/Ar, CO_2/N_2, CO/N_2).

The COOMET Technical Committee had welcomed the involvement of the KazInMetr Institute from Kazakhstan in its meeting held in St Petersburg on 24-25 March 2005. This had been the first meeting in which an institute from Kazakhstan had participated.

5.8.3 EUROMET

Dr Charlet reported on the work of the EUROMET METCHEM working group and its four sub-committees. It is one of 11 technical committees of EUROMET. During the last year, the terms of reference for METCHEM have been reviewed and ratified. This had resulted in a change in the rules allowing any delegate from a EUROMET NMI or from a designated institute to chair the committee.

The most recent meeting had representatives from 24 countries. In addition to comparisons, EUROMET had a strong emphasis on collaborative research activities as well as arrangements to cooperate on the provision of traceability. They had discussed whether METCHEM should include bio-analysis amongst its activities. The consensus was that this was not yet necessary.

EUROMET was carrying out a project called I-MERA that was intended to implement a European research area in metrology in order to coordinate research activities amongst the NMIs. This would start by launching joint projects and then lead to a joint research and development programme amongst NMIs in Europe.

5.8.4 SADCMET

Dr Louw spoke about progress in SADCMET. They have assessed the metrology facilities of member countries on a scale from “non-existent” through to “recognized”. South Africa remained the only country within the SADCMET with comprehensive facilities for metrology in chemistry. They had organized proficiency tests on neutron activation and water testing. They will be constructing a mobile metrology laboratory for use in Nigeria, and a project to establish basic metrology facilities in Lesotho was on-going. SADCMET has a total of 350 CMCs covering all areas.

5.8.5 SIM

Dr May presented his report about the SIM, which has 13 technical working groups including one for metrology in chemistry. They had set a long-term goal to improve capabilities in chemical metrology in the region and to increase participation in the CCQM and CIPM MRA-related activities. Their strategy is to focus on providing training and organizing proficiency tests. They had also started providing training on the preparation of CMCs. A number of pilot studies were underway.

6 UPDATE ON THE BIPM KEY COMPARISON DATABASE

Dr Thomas from the BIPM briefed the CCQM about recent progress with the development of the BIPM key comparison database (KCDB). It held 17 000 CMCs in Appendix C of which approximately 3000 relate to the CCQM. She thanked members of the CCQM for their help and kindness during the year.

The Director encouraged members to pay attention to the acronyms used for the NMIs, particularly when they had been changed. It was also necessary to ensure that designated institutes had been designated formally. He said that much effort had gone into the KCDB, and that it was now important to promote its use amongst potential user communities. It was also useful for the BIPM to receive feedback about successes with it and any problems.

7 SUBCONTRACTING AND COLLABORATING LABORATORIES

The President informed the CCQM that documents CCQM/04-10 (Subcontracting of measurements under the CIPM Mutual Recognition Arrangement) and CCQM/04-11 (Criteria for the acceptance of certified reference materials in Appendix C of the CIPM MRA), which had both been discussed at the previous meeting, had been approved by the CIPM.

8 BIPM PROGRAMME ON METROLOGY IN CHEMISTRY

Dr Wielgosz reported that the BIPM programme had expanded into organic analysis with the recruitment of Dr Steven Westwood and Dr Ralf Josephs.

The pilot study CCQM-P28 on ambient ozone had been coordinated by Drs Esler and Viallon at the BIPM in collaboration with Dr Bremser from the BAM and Mr Norris from the NIST. It had involved comparisons being carried at the BIPM with 23 participants. The results of the study were discussed at a workshop held at the BIPM. Amongst other issues, the workshop had discussed how the results of the study should be presented. This study would now be succeeded by an on-going BIPM comparison. The BIPM were also developing a protocol for a proposed pilot study on the measurement of nitrogen monoxide in nitrogen.

Dr Wielgosz also gave a detailed description of the new BIPM programme on organic analysis. They were planning to lead pilot studies as part of the P20 series of purity analyses on theophylline and digoxin. Both of these would be particularly relevant to the work of the JCTLM. The BIPM is collaborating with the NMIJ on the purity of steroid hormones – this work will form the basis of a proposal to the OAWG for a pilot study or a key comparison.

He outlined the opportunity for scientists to undertake a secondment for three months or a one-year research fellowship within the gas or organic analysis programmes of the BIPM. He said he would be preparing a ten-year plan for chemistry at the BIPM, which would be available for discussion at the next meeting of the CCQM.

9 JOINT COMMITTEE FOR TRACEABILITY IN LABORATORY MEDICINE

Dr Wielgosz gave an overview of the JCTLM and the rationale for its formation. The joint committee was established to help the IVD industry and other stakeholders meet the requirements of the EU *In Vitro* Diagnostic Directive, which stated that “the traceability of values assigned to calibrators and control materials must be assured through available reference measurement procedures and/or reference materials of a higher order”.

Much of the work of the JCTLM is based on implementing the model for traceability described in ISO 17511 (“*In vitro* diagnostic medical devices – Measurement of quantities in biological samples – Metrological traceability of values assigned to calibrators and control materials”). He indicated that further information was available from the BIPM website and showed how two databases under development were being structured.

Mr Squirell asked what the "hit rate" on the website was? Dr Wielgosz replied that this information was not yet available.

Mrs Parkes asked how the JCTLM was linked to the European Union, which had been responsible for the IVD? Prof. Emons replied that there were no formal links and no legal endorsement in effect at that time. The President commented that EU legislation originated centrally, but that implementation depended on national parliaments. Dr May commented that the issues had spread widely beyond the EU itself.

9.1 JCTLM WG1

Dr May, who co-chaired Working Group 1 along with Dr Schimmel from the IRMM, reviewed the terms of reference for the group. These covered "reference materials and reference measurement procedures". Approximately 75 methods and 300 reference materials had been nominated for review by the working group. It had initially established eight review teams to carry out this process, and had subsequently established a further five. The results of the review process were lists of higher order reference materials and reference measurement procedures that were now published on the BIPM and IFCC websites.

He stated that it was the policy of WG1 to carry out its evaluation by an openly distributed and transparent process. These procedures were documented in a quality manual which could be downloaded from the BIPM website.

9.2 JCTLM WG2

Prof. Siekmann described progress in the work of Working Group 2, which is involved in the identification of reference laboratories. Various criteria were used in the assessment of the measurement services of reference laboratories:

- according to the metrological level of the reference procedure applied,
- on the basis of accreditation according to ISO 17025 and ISO 15195, and
- on the basis of their ability to demonstrate their performance in regular inter-laboratory comparisons ("ring trials").

A problem had arisen because many ring trials were only organized occasionally and were only open to a limited range of organizations. Consequently, the IFCC had launched a new framework of ring trials for reference laboratories. All results were available at http://www.dgkl-rfb.de/. He concluded by showing the results of several ring trials and said that such results served to indicate the competence of different laboratories as well as the comparability of different methods.

10 WORLD HEALTH ORGANIZATION

The President welcomed Dr Bristow from the NIBSC to the meeting. Dr Bristow said it was a great pleasure for them to be involved in the work of the CCQM.

He explained that the NIBSC worked with the World Health Organization (WHO) to provide biological standards. He gave a number of examples of quantities and units in use in biological medicine. These included the measurement of the activity of pharmaceuticals such as erythropoietin in International Units (IU) per millilitre (IU/ml), of toxins in terms of LD50 or ED50 and growth hormone in g/l.

The active component of biological medicines is generally known and this distinguished them from chemical medicines. Biological standardization as a discipline began as a way of assigning a numerical value to the strength of a medicine without any knowledge of what the nature of the active principle. The standardization of biological medicines was initiated by Paul Ehrlich by his work on anti-diptheria and Sir Henry Dale by his work on insulin. Subsequently, the WHO has defined a biological substance as "a substance which cannot be completely characterized by physico-chemical means alone, and which therefore requires the use of some form of a bioassay".

The context within which the metrological principles originally developed by Ehrlich and Dale has progressed from one where there was no information about the quantity being measured other than its effect, to one where there is an increasing understanding at a molecular level of the quantity being measured. Consequently, in many cases, this understanding is now complete, and the old definition of a "biological" no longer holds. He concluded by saying that the approach taken towards biological standardization had been extremely successful.

A meeting between the biological and the chemical and physical standardization communities held in 2000 by the WHO highlighted the difference between the approaches. He said that the WHO and the NIBSC had an ongoing commitment to work with the metrological community through the CCQM.

The President thanked Dr Bristow for his overview.

11 REPORT FROM THE ISO REMCO, IAGRM AND COMAR

Dr Westwood and Prof. Emons gave a brief summary on progress at the ISO REMCO. There had been considerable discussion about the draft of ISO Guide 35 and the work programme was now focussing on "quality control" (or non-certified) reference materials and traceability issues. They said that attempts to make liaison with the World Customs Organization (WCO) to facilitate the

trans-border transport of reference materials had not yet been successful, but that a number of international organizations, including the BIPM, would be continuing these discussions with the WCO.

Dr de Leer presented a brief summary of the work of International Advisory Group on Reference Materials (IAGRM). He described the use of different standards for the accreditation of reference material producers around the world. He suggested that the global potential for accreditation in this area might be as many as 200 organizations. A resolution passed by the ILAC general assembly in 2005 had opened the possibility for reference material producers to be accredited to ISO 17025 and ISO Guide 34 in combination.

The President invited Dr Hässelbarth to provide some information about the development of the COMAR database. He reported that the primary aim of the database is to assist users in finding suitable reference materials. Access is available through the internet (www.comar.bam.de) and is free of charge. Information is updated by national coding centres. There are presently a total of 10 884 reference materials in the database from 25 countries.

12 LIAISON WITH THE INTERNATIONAL ATOMIC ENERGY AGENCY

Dr Fajgelj said that following his presentation to the previous meeting of the CCQM, the International Atomic Energy Agency (IAEA) were pleased to continue cooperating with the CCQM, and this year would be acting as a coordinating laboratory for a CCQM pilot study for the first time.

13 LIAISON WITH THE WORLD METEOROLOGICAL ORGANIZATION

Dr de Leer explained how the GAWG had cooperated with the Global Atmosphere Watch (GAW) programme of the World Meteorological Organization (WMO). Two pilot studies carried out by the GAWG – CCQM-P28 (ozone) and CCQM-P41 (atmospheric gases) were of direct interest to laboratories within the GAW. The results from CCQM-P41 for methane had led to a review of the standards they used.

The President thanked Dr de Leer for describing a good example of international collaboration.

14 COOPERATION WITH THE ILAC

Mr Squirell presented his report on developments at the ILAC. There are 47 signatories to the ILAC Arrangements covering approximately 20 000 laboratories worldwide. ILAC believed that metrology played an essential role in accreditation. There had been a workshop with ILAC and the RMOs to discuss *inter alia* terminology, assessors and peer reviews.

The Director said that there was a need to maintain regular dialogue between the NMIs and the National Accreditation Bodies.

15 MATERIALS METROLOGY

The President said that the directors of a number of the NMIs had initiated a debate on how the needs of materials metrology might be met through the activities of the CIPM. Discussions had focussed on whether these needs were driven by the need for measurements of new quantities that might justify the establishment of a new Consultative Committee.

A meeting held earlier in 2005 had identified examples of measurement required in materials metrology, such as: structural measurement, dielectric properties, surface properties, shape, thermodynamics properties, impact and tribology. However, these did not appear to need the use of new quantities.

The CIPM was also soliciting opinions from the Consultative Committees. Possible outcomes might include: the establishment of a new Consultative Committee, or a new joint committee or extending the scope of an existing committee.

Prof. Emons said there was a need for a structured discussion because it was difficult to understand how to classify the field and to identify the requirements. Dr Seah commented that the consultation process did not seem to have yielded the best examples of the requirements for, and difficulties within, materials metrology. For example, roughness is a measurement of length, but practical samples with a white spectrum of roughness were not generally a focus of attention for metrologists working in the field of length. Similarly, nanotechnology required measurements of force, but these may not necessarily be best accessed through traceability to the Newton and so issues for materials metrology may be split between Consultative Committees and need coordinating. He said that there was a case to be made, but it needed formulating better than it had been, in particular, materials scientists should focus the list of issues more tightly.

Prof. Wallard replied that the BIPM had requested a detailed review of measurements in certain areas including nanotechnology and the strength of materials. Dr Kavanagh agreed with previous

speakers, that many topics could be addressed through existing mechanisms, and that the discussion needed better structure. Dr May suggested that the advocates of the proposal be asked to document the requirements comprehensively, and then identify which of them could be met through the existing Consultative Committees. Prof. Emons agreed that this could be a way to structure the discussion.

Prof. So agreed with Dr Seah that the existing Consultative Committees could carry out much of the work, but it might not appear to be a priority for them. Dr Chiba said that groups within the NMIJ were very interested in materials metrology, and Dr Mitani said there was no common agreement on the issue within the CENAM.

The President thanked participants for their contributions and concluded that it was too early to come to any firm conclusions.

16 CCQM WORKSHOPS

The President asked members of the CCQM to send any suggestions for future CCQM workshops to him. Dr de Leer suggested “optical spectroscopy” and Dr May suggested “Vocabulary” and “Quality Systems for the production and dissemination of CRMs”.

17 CCQM RECOMMENDATIONS

Recommendation Q 1 (2005), on the possible redefinition of the kilogram, was adopted.

18 ANY OTHER BUSINESS

There was none.

19 DATE OF THE NEXT MEETING

It was agreed that the next meeting of the CCQM would be held at the BIPM during the week of 3rd April 2006.

M.J.T. Milton, rapporteur

19 August 2005

Table 1. A framework for CCQM key comparisons and pilot studies

Description	Reference No.	Pilot laboratory	Start date	Status (as of 15/04/2005)	Comments	Working Group
Health						
Clinical diagnostic markers						
Cholesterol in serum	CCQM-P6	NIST	1998	Completed; progression to key comparison proposed		OAWG
Cholesterol in serum	CCQM-K6	NIST	1999	Approved for equivalence		OAWG
	CCQM-K6 subsequent	NIST	2001	Approved for equivalence		OAWG
Glucose in serum	CCQM-P8	NIST	1999	Completed; progression to key comparison proposed		OAWG
Glucose in serum	CCQM-K11	NIST	2001	Approved for equivalence		OAWG
Creatinine in serum	CCQM-P9	NIST	1999	Completed; progression to key comparison proposed		OAWG
Creatinine in serum	CCQM-K12	NIST	2001	Approved for equivalence		OAWG
Glucose in serum	CCQM-K11.1	KRISS	2005	Planned		OAWG
Creatinine in serum	CCQM-K12.1	KRISS	2005	Planned		OAWG
Cortisol/Progesterone in serum	CCQM-P77	NIST	2005	Planned		OAWG
Electrolyte elements, steroids and hormones in serum and urine						
Trace elements (Pb, Se) in serum	CCQM-P14	NIST/LGC	1999	Abandoned (see next)		IAWG
Ca in serum	CCQM-P14	IRMM/SP	2001	Completed; progression to key comparison proposed		IAWG
Ca in serum	CCQM-K14	IRMM	2003	Approved for equivalence		IAWG
Anabolic steroids in urine	CCQM-P68	NARL	2005	Planned		OAWG
Cortisol/Progesterone in serum	CCQM-P77	NIST	2005	Planned		OAWG
Food						
As in shellfish	CCQM-P11	NIST	2001	Completed; progression to key comparison proposed		IAWG
As in fish or shellfish	CCQM-K31	NIST	2002	Approved for equivalence		IAWG
Pb in wine	CCQM-P12	IRMM	2000	Completed		IAWG
Pb in wine	CCQM-K30	IRMM	2003	Protocol complete	Run in parallel to CCQM-P12.1	IAWG
Elements (e.g., Cu, Cd, Zn) in wine	CCQM-P12.1	IRMM	2003	Protocol complete	Run in parallel to CCQM-K30	IAWG
As, Se, Hg, Pb, methyl-Hg in tuna fish	CCQM-P39	IRMM	2003	Protocol complete		IAWG
Cd, Zn in rice	CCQM-P29	IRMM/ NMIJ	2001	Completed	Run in parallel to CCQM-K24	IAWG
Cd in rice	CCQM-K24	IRMM	2001	Completed	Run in parallel to CCQM-P29	IAWG
Metals in synthetic food digest	CCQM-P13	LGC	2001	Completed		IAWG

Organic contaminants in mussel tissue	CCQM-P40	NIST	2003	Report in progress		OAWG
Methyl-mercury in salmon fish	CCQM-K43	IRMM	Nov. 2004	Report in progress - draft A	Run in parallel to CCQM-P39.1	IAWG
PCB congeners in solution	CCQM-P31.b.1	NIST	2004	Report in progress	Run in parallel to CCQM-K40	OAWG
PCB congeners in tissue extract	CCQM-P57	NIST	2004	Report in progress		OAWG
PCBs congeners in tissue	CCQM-P67	NIST	2004	Report in progress		OAWG
Methyl-mercury in salmon fish	CCQM-P39.1	IRMM	Nov. 2004	Report in progress	Run in parallel to CCQM-K43	IAWG
Trace elements in soybean powder	CCQM-P64	NRCCRM	Sept. 2004	In progress		IAWG
Toxic metals in food (tin in tomato paste)	CCQM-K45	LGC	2005	Planned	Run in parallel to CCQM-P72	IAWG
Toxic metals in food (tin in tomato paste)	CCQM-P72	LGC	2005	Planned	Run in parallel to CCQM-P45	IAWG
Stable isotope delta values in methionine	CCQM-P75	IRMM/ IAEA	Jan. 2006	Planned		IAWG
Nutrients in infant formula	CCQM-P78	NIST		Planned		OAWG
Antibiotics in meat						
Growth hormones in meat						
Vitamins and minerals						
GMO's (DNA, proteins)						
Pesticide residues						
p,p´-DDE in isooctane	CCQM-P2	LGC	1997	Completed		OAWG
p,p´-DDE in corn oil	CCQM-P4	LGC	1998	Completed; progression to key comparison proposed		OAWG
p,p´-DDE in fish oil	CCQM-K5	LGC	1999	Approved for equivalence		OAWG
Gamma-HCH in fish oil	CCQM-P10	LGC	1999	Repeated (see next)		OAWG
Gamma-HCH in fish oil 74 ng/g, 240 ng/g	CCQM-P10.2	LGC	2000	Completed		OAWG
p,p'-DDT in fish oil	CCQM-P21	LGC	1999	Completed; progression to key comparison proposed		OAWG
p,p'-DDT in fish oil	CCQM-K21	LGC	2000	Approved for equivalence		OAWG
Drinking water						
Organics (EPA list)						
Trace elements						
Microbiological						
Environment *Water*						
Waste water (EPA list)						
Cd and Pb in natural water	CCQM-K2	IRMM	1998	Completed		IAWG

Atmospheric pollutants						
Greenhouse gases CO_2, CH_4 - ambient levels	CCQM-P41	NMi	2002	Report in progress		GAWG
SF_6, CFCs - emission levels	CCQM-K15	KRISS	2003	Report in progress - draft B	Run in parallel to CCQM-P51	GAWG
SF_6, CFCs - emission levels	CCQM-P51	KRISS	2003	Report in progress - draft B	Run in parallel to CCQM-K15	GAWG
Ozone - ambient levels	CCQM-P28	BIPM	2003	Report in progress - draft A		GAWG
Ozone - ambient levels	BIPM.QM-K1	BIPM	2006	Planned		GAWG
Primary standard gas mixtures						
CO in N_2	CCQM-K1.a	NMi	1998	Approved for equivalence		GAWG
CO2 in N_2	CCQM-K1.b	NMi	1998	Approved for equivalence		GAWG
NO in N_2	CCQM-K1.c	NMi	1998	Approved for equivalence		GAWG
SO_2 in N_2	CCQM-K1.d	NMi	1998	Approved for equivalence		GAWG
Natural gases (Types 1,2,3)	CCQM-K1.e,f,g	NMi	1998	Approved for equivalence		GAWG
NO in N_2 (EUROMET)	EURO-QM-K1.c	NMi	2002	Approved for equivalence		GAWG
Natural gas (Types IV)	CCQM-K16.a	BAM/NMi	2001	Approved for equivalence	Run in parallel to CCQM-P49.a	GAWG
Natural gas (TypesV)	CCQM-K16.b	BAM/NMi	2001	Approved for equivalence	Run in parallel to CCQM-P49.b	GAWG
Natural gas (Types IV)	CCQM-P49.a	BAM/NMi	2001	Completed	Run in parallel to CCQM-K16.a	GAWG
Natural gas (Types V)	CCQM-P49.b	BAM/NMi	2001	Completed	Run in parallel to CCQM-K16.b	GAWG
Natural gas (Repeat)/LPG	CCQM-K23.a,b,c	NMi	2004	In progress		GAWG
CO, CO_2, propane in N_2	CCQM-K3	NMi	1998	Approved for equivalence		GAWG
CO, CO_2, propane in N_2 (EUROMET)	EURO-QM-K3	NMi	2000	Approved for equivalence		GAWG
CO, CO_2, propane in N_2 (APMP)	APMP-QM-K3	KRISS	2000	Approved for equivalence		GAWG
CO, CO_2, propane in N_2 (COOMET)	COOMET-QM-K3	VNIIM	2004	In progress		GAWG
CO in nitrogen (50 000 $\times 10^{-6}$, 1000 $\times 10^{-6}$, 10 $\times 10^{-6}$) - Gravimetry	CCQM-P23	NMi	2000	Complete		GAWG
Benzene/toluene/xylene (BTX) in N_2/Air	CCQM-K7	NIST	1999	Approved for equivalence		GAWG
BTX in N_2 (low conc $10 \times 10^{-9} - 30 \times 10^{-9}$)	CCQM-K10	NIST	2001	Approved for equivalence		GAWG
Dynamic mixing methods	CCQM-P24	LNE	2002	Complete		GAWG
NO_2 in air (10×10^{-6})		NIST	2003	Abandoned		GAWG
VOCs in air	CCQM-K22	NMIJ	2003	Report in progress - draft B	Run in parallel to CCQM-P71	GAWG

Reactive gases-ambient levels - NO in N_2	CCQM-K26.a	NPL	2003	Report in progress - draft B	Run in parallel to CCQM-P50.a	GAWG
Reactive gases-ambient levels - SO_2 in air	CCQM-K26.b	NPL	2003	Report in progress - draft B	Run in parallel to CCQM-P50.b	GAWG
Reactive gases-ambient levels - NO in N_2	CCQM-P50.a	NPL	2003	Report in progress	Run in parallel to CCQM-K26.a	GAWG
Reactive gases-ambient levels - SO2 in air	CCQM-P50.b	NPL	2003	Report in progress	Run in parallel to CCQM-K26.b	GAWG
H_2S in nitrogen	CCQM-K41	NIST		Measurements completed		GAWG
VOCs in air	CCQM-P71	NMIJ	2003	Report in progress - draft B	Run in parallel to CCQM-K22	GAWG
Ammonia in nitrogen	CCQM-K46	NMi	2005	Planned		GAWG
NO in nitrogen (preparative study)	CCQM-P73	BIPM	2006	Planned		GAWG
Contaminants in soils/sediments/incinerator ash						
Pb/Cd in sediments	CCQM-P15	IRMM	1999	Completed; progression to key comparison proposed		IAWG
Pb/Cd in sediments	CCQM-K13	IRMM	2000	Approved for equivalence		IAWG
Pb/Cd in sediments	CCQM-K13 subsequent	NIST	2000	Approved for equivalence		IAWG
Elements in synthetic digest solutions	CCQM-P16	NMi	1999	Abandoned		IAWG
PCBs in sediments	CCQM-P17	NRC/NIST	2000	Completed; progression to key comparison proposed		OAWG
PCBs in sediments (PCBs 28,101,153,170)	CCQM-K25	NIST/NRC	2001	Approved for equivalence		OAWG
TriButylTin in sediment	CCQM-P18	LGC/NRC	2001	Completed; progression to key comparison proposed		IAWG/ OAWG
TriButylTin in sediment	CCQM-K28	LGC/NRC	2003	Approved for equivalence		IAWG
DiButylTin in sediment	CCQM-P43	LGC/NRC	2003	Complete		IAWG
Metals in hard rock mine wastes						
Trace metals in sewage sludge	CCQM-K44	IRMM	Dec. 2004	In progress	Run in parallel to CCQM-P70, EUROMET 784 and IMEP	IAWG
PAHs in soils/Sediments	CCQM-P69	CENAM/ BAM	2004/2005	Planned		OAWG
Trace metals in sewage sludge	CCQM-P70	IRMM	Dec. 2004	In progess	Run in parallel to CCQM-K44, EUROMET 784 and IMEP	IAWG

Metals in biological tissues *Toxic metals in recycled plastics PET* **Advanced Materials** *Semiconductors*						
Ultratrace metals in high-purity semiconductors GaAs						
Boron in Si	CCQM-P33	PTB	2003	Planned		IAWG
SiO_2 on Si film thickness	CCQM-P38	NPL	2002	Completed; progression to key comparison proposed		SAWG
SiO_2 on Si film thickness	CCQM-K32	NPL		Planned	Run in parallel to CCQM-P84	SAWG
SiO_2 on Si film thickness	CCQM-P84	NPL		Planned	Run in Parrallel to CCQM-K32	SAWG
Metals/Metal alloys						
Minor elements in steel	CCQM-P25	NMIJ/NIST /BAM	2002	Report in progress; progression to key Comparison proposed		IAWG
Minor elements in steel	CCQM-K33	NMIJ/NIST /BAM	2003	Approved for equivalence	Run in parallel to CCQM-P56	IAWG
Constituents in Al alloy	CCQM-P34	BAM	2001	Report in progress		IAWG
Constituents of an aluminium alloy	CCQM-K42	BAM	Oct. 2004	Report in progess - draft A	Run in parallel to CCQM-P34.1	IAWG
Constituents of an aluminium alloy	CCQM-P34.1	BAM	Oct. 2004	Report in progress	Run in parallel to CCQM-K42	IAWG
Trace analysis of high purity nickel	CCQM-P62	BAM	June 2004	Report in progess		IAWG
Minor elements in steel	CCQM-P56	NMIJ/NIST /BAM	2003	Complete	Run in parallel to CCQM-K33	IAWG
Major and minor elements in copper alloy	CCQM-P76	BAM	Oct. 2005	Planned		IAWG
Carbon in preciptates in Fe	CCQM-P80	NPL	2005	Planned		SAWG
N in surface layers of Fe	CCQM-P81	NPL	2005	Planned		SAWG
Polymers and plastics						
Leachates						
Trace metals						

Catalysts						
Pt, Rh in vehicle exhaust catalysts						
Platinum group elements in an automotive catalyst	CCQM-P63	LGC	Aug. 2004	Planned		IAWG
Commodities						
Industrial SO_2 in stack emissions see	CCQM-K1.d					
Moisture in fossil fuels						
Sulfur in fuels	CCQM-P26	IRMM/ NIST	2001	Completed		IAWG
Sulfur in fuels (lower levels)	CCQM-P26.1	NIST	2003	Completed		IAWG
Sulfur in fuels (lower levels)	CCQM-K35	NIST	2003	Approved for equivalence		IAWG
Metals in lubricating oils						
Natural gases see	CCQM-K1.e,f,g	CCQM-K16.a,b				
Sucrose						
Cement - Ca, Si, Al, S, Ti, Na, Mg						
Ore composition						
Rare-earth elements						
Precious metals						
Source of origin/Adulteration						
Determination of metals in fertilizer	CCQM-P66	NIST	Oct. 2004	Planned		IAWG
Composition of fine ceramics	CCQM-P74	NMIJ	Jul. 2005	Planned		IAWG
Alcohol content						
Ethanol in aqueous matrix (forensic and commodity levels)	CCQM-P35	BAM/LGC	2001	Completed; progression to key comparison proposed		OAWG
Ethanol in aqueous matrix (forensic level 1×10^{-6})	CCQM-K27.a	LGC/BAM	2002	Approved for equivalence		OAWG
Ethanol in aqueous matrix (forensic level 1×10^{-6})	CCQM-K27.a subsequent	NIST	2003	Approved for equivalence	Run in parallel with SIM pilot study	OAWG
Ethanol in aqueous matrix (commodity level 100×10^{-6})	CCQM-K27.b	LGC/BAM	2002	Approved for equivalence		OAWG
Forensics						
LSD in urine	CCQM-P27	LGC	2001	Completed		OAWG
Drugs of abuse in urine	CCQM-P27.1	NARL	2004	Abandonned		OAWG
Explosives residues						
Ethanol in air	CCQM-K4	NPL	1999	Approved for equivalence		GAWG

Ethanol in air (EUROMET)	EURO-QM-K4	NPL	2000	Approved for equivalence		GAWG
Ethanol in air (APMP)	APMP-QM-K4	NMIJ	2000	Approved for equivalence		GAWG
Pharmaceuticals **Biotechnology** *Genomics, proteomics*						
DNA quantification	CCQM-P44	NIST/LGC	2002	Complete: repeat study		BAWG
DNA profiling	CCQM-P53	NARL	2003	Planned		BAWG
DNA primary quantification	CCQM-P54	LGC	2004	Complete: repeat study		BAWG
Peptide/Protein quantification	CCQM-P55	LGC	2004	Planned		BAWG
Q-PCR (repeat)	CCQM-P44.1	NIST/LGC	2004	Report in progress		BAWG
Fluorescence in ELISA	CCQM-P58	NPL/NIST	2004/2005	In progress		BAWG
Protein structural measurements by CD	CCQM-P59	NPL/NIST		In progress		BAWG
DNA extraction - reference method	CCQM-P60	IRMM	2004/2005	Planned		BAWG
DNA quantification	CCQM-P54.1			Planned		BAWG
General analytical applications *Purity of materials metals, salts, organics, etc.*						
KCl, NaCl, $K_2Cr_2O_7$	CCQM-P7	NIST				
Hydrochloric acid	CCQM-P19	NIST	1999	Completed 2001		EAWG/ IAWG
Purity of HCl	CCQM-P19.1	NIST	2002	Complete		EAWG/ IAWG
Acetanilide, benzoic acid, and naphthalene	CCQM-P5	NIST	1998	Completed 1999		OAWG
TBT chloride	CCQM-P20.a	NARL	2001	Completed		OAWG/ IAWG
o-xylene	CCQM-P20.b	NIST	2002	Completed		OAWG
Atrazine	CCQM-P20.c	NARL	2004	Report in progress		OAWG
Chlorpyrifos	CCQM-P20.d	NARL	2004	Report in progress		OAWG
Theophylline	CCQM-P20.e	BIPM/LGC	2006	Planned		OAWG
Digoxin	CCQM-P20.f	BIPM/LGC	2006/2007	Planned		OAWG
Purity analysis of parent gases including H_2O	CCQM-P45	LNE	2002	Planned	EUROMET workshop	GAWG
NMR study	CCQM-P3	BAM	1998	Completed 1999		OAWG
NMR study	CCQM-P3.2	BAM	1999	Completed 2000		OAWG
Assay of potassium hydrogen phthalate (KHP)	CCQM-P36	SMU/NIST	2002	Report in progress; progression to key comparison proposed		EAWG/ IAWG
Assay of potassium hydrogen phthalate (KHP)	CCQM-K34	SMU	2003	In progress		EAWG/ IAWG

Assay of KCl	CCQM-K48			Planned		EAWG/ IAWG
Calibration solutions						
Trace elements in water Pb	CCQM-P1	NIST	1997	Completed 1998		
Elemental solution standards (Al,Cu,Fe,Mg)	CCQM-P30	EMPA/LNE	1999	Completed 2000		IAWG
Elemental solution standards (Al,Cu,Fe,Mg)	CCQM-K8	EMPA/ LNE	1999	Approved for equivalence		IAWG
Anions in calibration solutions	CCQM-P32	EMPA	2001	Completed; progression to key comparison proposed		IAWG
Anions in calibration solutions	CCQM-K29	EMPA	2003	Report in progress - draft B		IAWG
Anions in calibration solutions - subsequent	CCQM-K29.1	SMU	2004	Report in progress - draft B		IAWG
Organic calibration solutions (PAHs)	CCQM-P31.a	NIST	2003	Report in progress		OAWG
Organic calibration solutions (PCBs)	CCQM-P31.b	NIST	2003	Report in progress		OAWG
Organic calibration solutions (chlorinated pesticides)	CCQM-P31.c	NIST	2003	Report in progess		OAWG
Preparation of inorganic calibration solutions	CCQM-P46	NIST	2003	Report in progress		IAWG
Volatile organic compounds (VOCs) in organic solvents	CCQM-K37	KRISS/ NIST	2003	Planned		OAWG
PAHs in solution	CCQM-K38	NIST	Nov. 2004	Planned		OAWG
Chorinated pesticides in solution	CCQM-K39	NIST	Nov. 2004	Planned		OAWG
PCB congeners in solution	CCQM-K40	NIST	2004	Planned	Run in parallel to CCQM-P31.b.1	OAWG
PCB congeners in solution	CCQM-P31.b.1	NIST	2004	Planned	Run in parallel to CCQM-K40	OAWG
Volatile organic compounds (VOCs) in solution	CCQM-P61	CENAM/ NIST	2004/2005	Planned		OAWG
Volatile organic compounds (VOCs) in solution	CCQM-K47	CENAM/ NIST	2005	Planned	Run in parrallel to CCQM-P61.1	OAWG
Volatile organic compounds (VOCs) in solution	CCQM-P61.1	CENAM/ NIST	2005	Planned	Run in parrallel to CCQM-K47	OAWG
pH standards						
pH 7.0 (Phosphate)	CCQM-K9	PTB	1999	Approved for equivalence		EAWG
pH 7.0 (Phosphate) PTB-SMU bilateral	CCQM-K9 subsequent	PTB	2002	Approved for equivalence		EAWG
pH 4.1 (Phthalate)	CCQM-K17	PTB	2001	Approved for equivalence		EAWG
pH 10.1 (Carbonate)	CCQM-K18	SMU	2003	Start after completion of CCQM-P52	Run in parallel to CCQM-P52	EAWG

pH 10.1 (Carbonate)	CCQM-P52	SMU	2003	Report in progress	Run in parallel to CCQM-K18	EAWG
pH 9.2 (Borate)	CCQM-K19	PTB	2004	Planned	Run in parallel to CCQM-P82	EAWG
pH 1.7 (Tetroxalate)	CCQM-K20			Planned		EAWG
Fundamental studies of pH standards	CCQM-P37	SMU	2002	Completed		EAWG
pH 9.2 (Borate)	CCQM-P82	PTB	2005	Planned	Run in parallel to CCQM-K19	EAWG
Electrolytic conductivity	CCQM-P22	DFM	2001	Completed		EAWG
Electrolytic conductivity (low level)	CCQM-P47	NMi	2003	Report in progress		EAWG
Electrolytic conductivity (0.5 S/m)	CCQM-K36.a	DFM	2005	Planned		EAWG
Electrolytic conductivity (0.005 S/m)	CCQM-K36.b	DFM	2005	Planned		EAWG
Electrolytic conductivity (0.5 mS/m)	CCQM-P83	DFM	2005	Planned		EAWG
New proposals						
Uranium isotope ratio in synthetic saline matrix	CCQM-P48	IRMM	2003	Report in progress		EAWG
Chemical compoistion of clay	CCQM-P65	CENAM	Oct. 2004	Report in progress		IAWG

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

RECOMMANDATION Q 1 (2005) : Sur une éventuelle nouvelle définition du kilogramme

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

considérant

- la proposition récente d'établir, au moment de la 23e Conférence générale en 2007, une nouvelle définition du kilogramme fondée sur une valeur fixée, soit pour la constante de Planck, soit pour la constante d'Avogadro,
- que la réalisation de la définition du kilogramme exprimée en ces termes impliquerait obligatoirement la disponibilité permanente de techniques de mesure permettant de mesurer une masse en fonction de constantes fondamentales,
- les avantages qu'une telle définition apporterait à la communauté scientifique, liés à la réduction significative des incertitudes attachées aux valeurs, en unités SI, de nombreuses constantes fondamentales,
- qu'une nouvelle définition du kilogramme, fondée sur une valeur fixée pour la constante d'Avogadro aurait d'autres avantages pour la communauté scientifique, en particulier pour la métrologie en chimie,

rappelant la Résolution 7 de la 21e Conférence générale (1999) qui recommandait que les laboratoires nationaux continuent à perfectionner les expériences qui permettent de relier l'unité de masse à des constantes fondamentales ou atomiques, en vue d'une nouvelle définition du kilogramme,

notant

- l'écart relatif actuel d'environ un millionième entre les valeurs obtenues à l'aide de la balance du watt et celles résultant des mesures de masse volumique ou molaire de monocristaux à l'aide de rayons x,
- le fait que cet écart a une importance pratique significative et ne semble pas pouvoir être éliminé d'ici 2007,

recommande que

- toute décision en vue d'une nouvelle définition du kilogramme soit reportée jusqu'à la 24e Conférence générale en 2011, après consultation de tous les utilisateurs et décideurs concernés,
- les laboratoires poursuivent leurs efforts pour fournir des données en vue de l'ajustement des valeurs des constantes fondamentales par CODATA en 2010, afin d'étayer une éventuelle nouvelle définition du kilogramme au moment de la 24e Conférence générale,

- à cette occasion, on envisage de fixer la valeur, soit de la constante de Planck, soit de la constante d'Avogadro, en tenant compte des intérêts de la communauté de la métrologie en chimie au moment du choix,
- la nouvelle définition du kilogramme soit, si possible, facile à comprendre par le grand public.

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

RECOMMENDATION Q 1 (2005):
On the possible redefinition of the kilogram

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

considering

- the recent proposal to redefine the kilogram in terms of a fixed value for either the Planck constant or the Avogadro constant at the 23rd General Conference in 2007,
- that the realization of a definition of the kilogram in these terms necessarily requires the permanent availability of measurement techniques that relate mass measurements to fundamental constants,
- the advantages that such a redefinition would bring to the scientific community through the significant reduction in the uncertainties of the SI values of many fundamental constants,
- that a redefinition based on a fixed value for the Avogadro constant would have further benefits for the scientific community, particularly for metrology in chemistry,

recalling Resolution 7 of the 21st General Conference (1999), which recommended that national laboratories continue their efforts to refine experiments that link the unit of mass to fundamental or atomic constants with a view to a future redefinition of the kilogram,

noting

- the existing discrepancy of about 1 part in 10^6 between the results from watt balance and x-ray crystal density/molar mass measurements,
- the fact that this discrepancy is significant at the practical level and is unlikely to be resolved by 2007,

recommends that

- any decision on redefining the kilogram be deferred until the 24th General Conference in 2011, and should be based on consultation with all users and stakeholders that would be affected,
- laboratories continue to make their best efforts to produce data for the 2010 CODATA adjustment of the values of the fundamental constants in order to support a possible redefinition of the kilogram at the 24th General Conference,
- at that time, full consideration be given to fixing the values of either the Planck constant or the Avogadro constant, and the interests of the chemical metrology community in this choice,
- any new definition of the kilogram should, if possible, be easily understood by the general public.

APPENDIX Q 1.
WORKING DOCUMENTS SUBMITTED TO THE CCQM AT ITS 11TH MEETING

Working documents submitted to the CCQM at its 11th meeting are on restricted access.