

## **CCT Working Group 6 on Humidity Measurements**

### **Activity report for May 2012 to May 2014**

#### **Membership of WG6 at May 2014**

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#### **Changes of representative**

C. Meyer has replaced P. Huang who has retired from NIST. M. Vinge replaces O. Podmurnaya due to family extended illness.

#### **Invited guests**

Also contributing to the activities of WG6 are: Rainer Feistel representing International Association for Properties of Water and Steam (IAPWS); and Helmut Mitter (BEV E+E, designated institute for humidity standards in Austria and participant in CCT-K8). Both have attended meetings of WG6 as invited guests.

#### **WG6 terms of reference**

The terms of reference of WG6 are:

- to advise the CCT on matters relating to humidity;
- to pursue harmonisation relevant to the field of humidity measurement
- To develop and maintain effective liaison with international humidity and moisture community.

#### **Tasks of WG6**

The tasks in progress are:

- operation of key comparisons CCT-K6 and CCT-K8;
  - strategic planning of ongoing and future key and supplementary comparisons in the field;
  - clarification of quantities, units, symbols and realisations relating to humidity measurement;
  - production of the document on uncertainty in humidity;
  - coordination with CCQM in areas of trace moisture in gases, and moisture in materials, as required
- and*
- to convene the International Symposium on Humidity and Moisture (ISHM).

## Meetings

Working Group 6 is scheduled to meet at BIPM on 19 May 2014, and members have progressed the work by e-mail between meetings. A subset of participants in CCT-K6 met alongside the TEMPMEKO 2013 conference, to discuss the next stage of reporting of the comparison.

## Progress of tasks

The status of the Working Group tasks as follows.

### CCT-K6

The Draft B report of dew-point key comparison CCT-K6 has been circulated to participants, and is in process of approval in the weeks running up to the CCT meetings. During this time, this document is also available to non-participant members of WG6 although no action is required of them, since they approved in 2012 the method of calculation of KCRV using weighted mean.

The exceptionally long running time of the comparison (approximately 7 years for measurements) was largely due to a high number of instrument breakdowns, repairs, and additional checks; plus (unconnected) queries from participants about suspected measurement problems. The analysis of results considers the estimates of travelling standard drift over such a long period and makes allowance for this in the comparison uncertainty. With this proviso, most participants achieved satisfactory equivalence with other participants, and with the KCRV. A small number of significantly outlying data were identified and excluded from the KCRV. Subject to agreement of the final version of the Draft B report, it will be submitted next to CCT/WG7 for approval. Linkages between CCT-K6 and other corresponding RMO comparisons are agreed to be the responsibility of the RMO pilots. There is a question over how to link comparison results that are significantly separated in time – this will be discussed.

## Other comparisons in progress or planned in humidity field

### Dew-point K6 (-50 °C to +20 °C):

CCT-K6.1 bilateral to K6 (MSL/NPL) measurements are completed and Draft A report is in preparation.

EURAMET.T-K6.1 (FSBLPM/MIKES) Draft B Report was approved by CCT/WG7 during this period.

SIM bilateral key comparison SIM.T-K6.4 (NIST/INMETRO) Draft B Report was approved by WG7 during this period. SIM.T-K6.2 (NIST/CENAM) and SIM.T-K6.3 (NIST/INMETRO) are in stages of review of Draft B Reports by WG7. SIM.T-6.1 (NIST/NRC) is in progress

In APMP a follow-up comparison to APMP.T-K6 is in progress: APMP.T- K6.2013 piloted by NMC. This is some 10 years after the original key comparison, and is the first of the “next generation” of RMO dew-point key comparisons. Bilateral APMP.T-K6.1 (NMC-NIMT) is in planning.

COOMET.T-K6 is in progress.

### **Dew-point K8 (+30 °C and above)**

CCT-K8 and corresponding RMO comparisons (EURAMET.T-K8, APMP-K8) were planned together with similar protocols.

CCT-K8 participants have been agreed and the comparison is at instrument evaluation and protocol development stage. Two transfer standards owned by CEM have been characterised by pilot INTA, and the protocol is almost completed. Delays have resulted in a slow start for this comparison

EURAMET.T-K8 measurements are completed and Draft A is in preparation.

APMP.T-K8 is in progress.

A SIM.T-K8 is has also been mentioned as a possibility.

### **Other humidity comparisons**

The need for a comparison covering humidity from dew-point below -50 °C down to trace range remains under discussion. In CCQM Gas Analysis Working Group, CCQM-K116, a key comparison using cylinders of water vapour nitrogen at nominally  $10 \mu\text{mol mol}^{-1}$ , is in planning.

### **Quantities, units, symbols and realizations relating to humidity measurement**

A first document has been completed summarizing the extent of agreement on terms and definitions for humidity quantities. This draws on several national published standards on this subject, which are not yet harmonised.

Several WG6 members, in cooperation with individuals from IAPWS, have contributed to drafting a position paper section on relative humidity (near-complete at May 2014) for submission to *Metrologia*. The paper discusses the concept of relative humidity; its several conventional definitions, and their limitations; the discrepancies between definitions; and other related issues. The finished paper (with a group of other co-authors) will also cover two other areas where metrological definitions or realisations are problematic; salinity and pH, especially in the context of seawater. This set of three problematic quantities represent variables central to studies of weather and climate, and the work includes inputs from collaborators active in meteorology.

The forthcoming revision of the SI brochure may offer an opportunity to propose the inclusion of some guidance on relative humidity which is not so far provided. This will be considered by members of WG6 in the coming months.

### **Production of document on uncertainty in humidity**

Work continues on producing detailed and authoritative guidance on evaluation of uncertainty for NMI-level humidity standards and calibrations. After some delays in progress (most members have been unable to find time to review the drafts), the document is now split into manageable sub-documents, and these will be finished sequentially.

**Coordination with CCQM in areas of trace moisture in gases, and moisture in materials, as required.**

Inter-CC coordination in the area of trace moisture in gases continues at an informal low level. A relevant key comparison CCQM-K116 is in planning, of measurements of water vapour in nitrogen at 10 µmol/mol.

In the area of moisture in materials, there has been some ongoing interaction between members of WG6 and CCQM IAWG. Measurement of grain moisture continues to be a subject of interest, with some NMIs expressing need for a key comparison and CMCs in this area. There is also growing level of activity on moisture in materials generally in some RMOs. In EURAMET, an EMRP-funded project on Metrology for moisture in materials (METefnet) will particularly focus on links between physical and chemical metrology.

**Convening of the International Symposium on Humidity and Moisture (ISHM).**

ISHM events have traditionally taken place every four years, or so. The last ISHM, in 2010, was held as part of a joint event with TEMPMEKO, in Slovenia. Discussion continues within WG6 about how and when to convene the next ISHM. Arguments are finely balanced between holding it as part of a joint event, and holding it independently. However the decision has been deferred in the short term, so there will be no joint ISHM alongside TEMPMEKO 2016. If a separate ISHM is convened, it will be carefully scheduled to avoid clashing with the TEMPMEKO three-year cycle. For the time being, a main obstacle to proposing a separate ISHM is the lack of any organisation willing to host the event.

**Liaison with other relevant bodies**

A delegate from IAPWS has attended meetings of WG6 since 2010. Several members of WG6 took part in a joint BIPM-IAPWS workshop on relative humidity, and in the International Conference on Properties of Water and Steam in London in 2013. Two WG6 members accepted an invitation to join the IAPWS Subcommittee on Thermophysical Properties of Water and Steam (TPWS). The *Metrologia* draft paper including relative humidity is part of this collaboration.

WG6 members are working with the meteorology community in several ways, including in EURAMET a significant EMRP project *MeteoMet – Metrology for Meteorology*.

Stephanie Bell  
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