

1. General Aspects

The TC-T is structured around a sub-committee on humidity and moisture and four WGs: WG on CMC Review, WG on Strategy, WG on Best Practice and WG on Thermophysical Quantities of Materials. Each of these five groupings have clear objectives and these are listed on the TC-T website. Graham Machin's four year term (2014-2018) as chair of TCT comes to an end at the 2018 EURAMET General Assembly, he will be succeeded by Dolores del Campo of CEM.

2. Projects

The status of all TC-T projects can be viewed on the TC-T project database.

In the reporting period May 2017 to April 2018 there were 24 active projects, 5 of which were completed during the reporting period. Updated project reports were received from all participants and were uploaded onto the Euramet website.

3. Comparisons

A number of KC involving TC-T but led from CCT in Thermometry and the related field of Humidity are in progress:

CCT-K9: Comparison of SPRTs calibration at fixed points from Ar to Zn: There has been little progress with the main CCT key comparison in the year between TCTs. Fernando Sparasci (LNE-CNAM) described the progress with the Euramet linkage comparisons to CCT-K9. Good progress had been made with four of the five loops with all the measurements completed. The fifth loop required a number of participants to complete their measurements and they were given a deadline of Sep 2018 to complete these. Full analysis of the data will then begin. CNAM-LNE is the pilot of this comparison, INRIM, NPL, PTB and VSL are acting as sub-pilots.

CCT-K10: Radiation Thermometry (Primary realization above Ag fixed point) in progress. NPL is the pilot. The APMP, SIM and COOMET loops are complete. The artefacts are now in the EURAMET region. Anticipated measurement completion September 2018 with preliminary analysis of data by next TCT.

CCT- K6.1: NPL/NZ Comparison of humidity standards: dew and frost point temperatures: -50 °C to 20 °C. There has been no progress since the last reporting period.

CCT-K8: dew-point temperature range, 30 °C to 95 °C, by Robert Benyon, INTA. Status: Measurements completed in Nov. 2017. Draft A in preparation; circulation expected by June 2018. Although very delayed in kick-off, measurements performed rapidly once started. Reference measurements at INTA (before and after) show no appreciable drift on the transfer standards.

In addition there are a number of Euramet comparisons underway or almost complete.

EURAMET.T-K8, P717, dew-point range 30 °C to 95 °C, by Regina Deschermeier, PTB. The comparison is on-going. Measurements are finished. Calculation of ERV in progress. Draft A to be finalized by June 2018, completed, and agreed by December 2018. PTB math and statistics dept. is supporting RB.

EURAMET P1403, comparison EURAMET-K8.1, dew-point temperature range, from 30 °C to 95 °C, by Robert Benyon, INTA. Protocols agreed and submitted to CCT-WG KC. Comparison already started. MBW and CETIAT completed their measurements. Timetable amended, some delay due to problems with INTA environmental conditions in high-range laboratory. INRIM currently performing the measurements. Expected time of completion end 2018.

EURAMET P1189, relative humidity @ air temperature between -10 °C and 70 °C, by Domen Hudoklin, UL. Draft A results were presented. Discussion on drift analysis and ERV was held. Draft B to be finalized by the end of 2018.

EURAMET P1352, relative humidity @ air temperature between -40 °C and 20 °C, by Robert Benyon, INTA. The pre-conditioning procedure and number of cycles were determined for all instruments. A new chamber has been designed and characterized down to -40 °C. Comparison to be launched in Q3 2018; two loops were anticipated. Nominal temperature points are: (+1, -40, -20 and +1) °C at nominal RH: (0, 10/15, 50, 90 or 95) %rh

EURAMET P1442, very recently started relative humidity @ air temperature between -10 °C and 50 °C, by Daniel Sestan, FSB. Comparison within the scope of JRP HUMEA. Circulation of RH probes together with a specially designed sub-chamber. Initial measurements started in April 2018 at HMI/FSB-LPM. Comparison to be finalized by March 2019.

EURAMET.T-S3: DdC (CEM) described the great progress that had been made with the Pt/Pd thermocouple comparison. The analysis of the data required taking into account correlations and required a full covariance analysis of the uncertainties. The final outcome so far is that nearly all participants agreed within $k=1$ uncertainties even up to the Pd-C point. Draft A is envisaged before the end of 2018.

In addition a number of other comparisons have been initiated not registered on the cmc database, details of progress can be found on the Euramet project database.

4. CMCs

The review of EURAMET CMCs is performed cyclically (yearly) by a team of EURAMET TC-T experts (typically two experts for each group of services), coordinated by the chairman of the WG on CMC review. The chair of the review group is currently Helen McEvoy of NPL (UK). As of May 2018 the experts are from PTB (DE) (2 experts), CEM (ES) (2 experts), LNE-CNAM (FR), NPL (GB), INRIM (IT), VSL (NL), MIRS/LMQ (SI) (2 experts). This year the cut-off date for having CMCs considered is the end of May 2018. It is expected that the CMC review group will respond to contact persons by the end of August 2018 who then have a month to provide the required information.

Currently no CMCs have been submitted for EURAMET review in the 2018 review cycle.

The following new batches of EURAMET-approved CMCs were submitted to CCT WG-CMC for inter-RMO review in the 2016 to 2017 period (status as at 26 May 2017): EURAMET.T.23.2017

The following CMCs were approved by the inter-RMO review and published on the BIPM database during 2017/ 2018 in two batches – one published in September 2017 and one in February 2018 (note that these figures also include those CMCs where there were only textual changes and also deletions):

- 8 CMCs for standard platinum resistance thermometers
- 2 CMCs for fixed points
- 21 CMCs for humidity (including air temperature sensors)
- 1 CMC for thermocouples
- 4 CMCs for infrared thermometry

5. Activities of the Subcommittees

The TCT has one sub-committee regarding Humidity and moisture. The Sub-Committee Humidity is concerned with all issues of measurement of humidity and moisture, as well as with standards and references necessary for developing the metrology in the field.

The convener is Vito Fericola (INRIM) with Domen Hudoklin (MIRS/UL-FE/LMK) as sub-convener. The SC met at the TC-T plenary meeting in 26 April 2018.

The SC Humidity promotes key and supplementary comparisons on humidity, in support of cmcs. These are mainly described in Section 3 of this report.

New EMPIR PRTs were presented

Air temperature metrology (SIB TEMP 039), led by Stephanie Bell, NPL, co-authored by 20+ institutions. Rationale: under-recognised challenges in measuring air temperature (deviations by 0.1 K or more, exceeding the CMCs of many NMIs); significant for wider temperature-critical metrology fields. Unfortunately, the PRT was not selected, but a wide interest pointed out to reconsider it for the next ENV call.

Metrology for ultra-trace water measurements in pure gases (SIB TEMP 051), led by Vito Fernicola, INRIM, co-authored from 15 institutions (NMIs, universities and industry). Rationale: to underpin the metrology for ultra-trace water vapour measurements in pure gases; water vapour is the single largest matrix contaminant when amount fractions below 10-8 mol/mol are considered. The PRT was unofficially selected as SRT s14 with the partnering meeting at Torino July 10th.

Progress on running EMPIR JRPs on humidity.

Eric Georgin (CETIAT) presented status of the project 14IND11 HIT “Metrology for Humidity at High Temperatures and Transient Conditions”, which ends in August 2018. 3rd newsletter released. In April 2018 training at DTI was held. Final meeting and workshop will be held in Torino from July 11th to 13th, 2018. More at www.empir-hit.eu

Nedzadeta Hodzic (MBiH) presented the status of 15RPT03 HUMEA “Expansion of the European research capabilities in humidity measurements”. Iska Kolaveri awarded an RMG. A mid-term review has successfully passed. Projects ends in May 2019.

News from CCT WG-Hu was presented by Stephanie Bell (NPL)

Last meeting 29 May 2017 at BIPM, Sèvres, in association with the meeting of CCT. Reported activities on KCs in hand and in planning: under development a comparison strategic planning (incl. trace water range); draft document on humidity terms and definitions; a guideline for humidity realisations; consideration of humidity definitions, seeking relative humidity definition applicable in all ranges and for real-gas conditions. Liaison with WMO and IAPWS.

Other EURAMET projects

EURAMET 1400 Moisture metrology development, presented by Stephanie Bell, NPL. Collaboration in research (unfunded) type project. Continuation of Metefnet research. Report has been given on liaison and networking activities.

6. Participation in EMRP/ EMPIR

A preparatory SI call workshop with around 40 attendees from 16 NMIs was organized by CNAM in December 2017. The main focus was to discuss several proposals in order to develop a TC-T coordinated approach to the 2018 SI call. The workshop was organized in two parallel sessions: one for temperature and humidity and another one for thermophysical quantities with a final joint session in which the coordinators made a summary of the different ideas. Finally 4 PRTs, as the result of this workshop, of a total of 7 PRTs on thermal quantities, were submitted, being 2 of them selected to become SRTs.

With regard the 2017 call, the thermal community was particularly successful in the Industry topic, with 44 % of the PRTs selected and 100 % of the JRPs proposed getting funding. On the other hand, the results of the first Fundamental was disappointing as there were quite a number of PRTs

but with only a success rate of 14 % and just 1 thermometry related JRP approved for funding. In the case of the Normative and Research Potential topics with no successful JRPs were proposed.

7. Capacity Building: Activities of the last year and future needs

Capacity building is a standing item on the Best Practice WG is discussed by the Strategy Group and there is a slot on the TCT agenda for the Euramet CB Officer to give a presentation. It was clear that TC-T is fully engaged with CB initiatives (grants, RPOT projects and training – both receiving and giving).

The Thermal Metrology Summer School in Sep 2018 for new thermal metrologists in NMIs is in the advanced stage of planning. It will be hosted by EIM in Thessaloniki. There are about 35 EURAMET registered participants with a number from outside the EURAMET expressing interest. The programme has contributions from the leading thermal metrology practitioners from around Europe and will include both taught and laboratory sessions.

8. Meetings

On 8th Dec a TCT sponsored workshop, held to identify possible PRTs for submission into the SI Broader scope call, was hosted by Mohamed Sadli (LNE-CNAM) in Paris. A number of possible SRTs were identified and subsequently submitted.

The TC-T Annual Meeting 2018 took place in Boras (Sweden) 24-27th April 2018. This was the fourth meeting chaired by Graham Machin. The minutes; meeting reports and presentations can all be viewed on the restricted part of the TC-T webpages. One of the highlights of the meeting in Sweden was an update of activities from COOMET by the chair of that regions TCT, A. Pokhudon.

The sub-committee for humidity (section 5 of this report) and all four working groups met during the plenary meeting. Reports can be found on the restricted part of the TC-T webpages, but summary details for the cmc and Strategy Group activities are given in section 4 and 10 of this report respectively.

Prior to the plenary meeting two half day workshops were held.

- Thermal imaging metrology organised and run by Rob Simpson (NPL) and Igor Pusnik (UL).
- Sea water metrology organised and run by Andrea Merlone (INRIM) and Steffen Rudtsch (PTB).

All the ppts of the workshops can be found on the restricted part of the TC-T webpages.

At the end of the TC-T meeting it was announced that Dolores del Campo (chair of the TC-T Strategy Group) would be the next chair of TCT.

9. Issues

European Metrology Networks: A decision was taken at the TCT Strategy Group to withdraw the EMN proposal on “Integrated Thermal Metrology” and leave on stand-by “Thermal and optical metrology for advanced materials”. GM to informed Duncan Jarvis about the decision.

The TCT roadmaps are significantly out of date – however it was decided to postpone revising them until issues concerning EMNs are clearer. This will be discussed again at the next TCT.

There are some problems concerning the critical issue of traceability in the proposed revised ISO17025. This is going to be raised at the TCC meeting at the Euramet GA to see if this issue is a problem for other TCCs and if a coordinated approach from the TCs is possible.

The issue of effecting closer integration of the Thermal Quantities community in the Euramet region into TC-T activities remains and this will be one of the ongoing tasks for the TCT next chair. The current TCT chair term expires May 2018 at the EURAMET GA. The new chair will be Dolores del Campo of CEM for the term 2018-2020 (extendable to 2022).

10. Strategic Planning

The WG on Strategy is in charge of the strategic planning of the TC-T. It met on 25 April 2018 in conjunction with the plenary TC-T meeting in Borås. The full minutes of the meeting can be found on the TCT website (restricted access). The following topics were discussed:

EMPIR JRP 2017 outcomes and PRT/SRT prospects and coordination for 2018/9. After some discussions it was finally decided to postpone the update of the TC-T roadmaps as it was thought sensible to wait until the EMNs start operating as one of their main roles is to formulate their respective strategy agendas. The EMNs were also extensively discussed. DdC informed about the development of the one on "Climate and Ocean Observation" which merges four different proposals related to the measurement of essential climate and ocean variables, one of them being proposed by the TC-T itself. The whole group fully supported its federal structured and expressed the likely high involvement of the group in its activities. On the other hand it was also decided to withdraw the EMN proposal "Integrated Thermal Metrology" as it was made clear that most of the activities proposed fall within the responsibilities of the TC. The proposal "Thermal and optical metrology for advanced materials" would be kept on stand-by in view of a possible merger with others on advanced manufacturing in the future.

Regarding the 2018 workshops their success was undoubtedly and two new workshops for 2019 were agreed: "MeP-K-19" (coordinated by GM) and "Humidity Challenges" (Coordinated by SB and VF). TT reported on the latest developments about the Summer School, with most of the details fixed and almost fully booked. The WG expressed their disagreement with the new ISO 17025 standard and the non-clear establishment of the traceability requirements and fully supported the preparation of a TC-T agreed document to be submitted to the BoD. The request by EA for assessors was discussed and it was decided that the WG-S chair will respond to any request received, a short protocol has made available to all TC-T members and a call for volunteers made during the TC-T plenary. Finally the contribution of the TC to digitalization was discussed and it was concluded that the group does not find a special contribution from our field, however a watching brief is to be kept.

11. Outlook for 2017-2018

In 2018-2019 TC-T activities will include:

- Handover to next TC-T chair (Dolores del Campo (CEM)) at EURAMET General Assembly (May 2018)
- Hold the first EURAMET Thermometry Summer School which will be held in 17-20 Sep 2018 in Thessaloniki, hosted by EIM, supported by EMPIR CB.
- Contribute to appropriate EMPIR JRPs (2018) and PRTs (2019), including active participation in the Environment and Energy joint workshops that will take place at LNE 22-24 October 2018
- The next TC-T meeting will be held 9-12 April 2019 in Turin
- Two technical workshops to be organised and held at the TC-T meeting in Turin: "The MeP-K-19" (organised by NPL) and "Challenges in humidity measurement" (organised by INRIM/NPL).

Graham Machin
TC-T chairperson

