

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.

2. Projects

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

As of February 2016 (the date of the TCT plenary meeting) there were 21 active projects, an additional 5 were completed and provided final reports. Updated project reports were received from all participants and passed to Jutta Bender for uploading onto the Euramet website.

Since the time of the plenary meeting four more projects have been proposed, including an interdisciplinary one involving TC-MC and TC-T on moisture metrology.

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: measurements completed. Five EURAMET laboratories are participating in this KC. The protocol for the regional extension of CCT-K9 (EURAMET.T-K9) has been agreed and most of the measurements have been completed. CNAM-LNE is the pilot of this comparison, INRIM, NPL, PTB and VSL are acting as sub-pilots.

CCT-K10 for Radiation Thermometry (Primary realization above Ag fixed point) in progress. NPL is the pilot. The protocol was agreed. The APMP measurement loop has been completed, KRIS have already supplied their report. Validation checks have been completed at NPL and the second loop in SIM has begun.

CCT-K6 (dew/frost point range -50 °C to +20 °C). Is published.

CCT- K6.1 NPL/NZ Comparison of humidity standards: dew and frost point temperatures: -50 °C to 20 °C - reporting in progress, Draft A

Planned CCT- K6.2: NIST/NMIJ Comparison of frost-point temperature standards: -70 °C to -30 °C – as far as aware no progress since last report in 2015

CCT-K8 (dew-point range +30 °C to +90 °C) is being started (reference measurements are in progress). Delayed due to initial transfer standards characterisation problems.

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

EURAMET.T-K1 realisations of the ITS-90 from 2.4 K to 24.6 K. Draft B report ready for submission to CCT-WG-KC.

EURAMET.T-K8 comparison (Dew-point temperature in the range 30 °C to 95 °C, Project 717) is close to completion: the measurements were completed and the Draft A report to be prepared by pilot (PTB) projected end June 2015. Since staff retired from PTB progress with the project has halted and the chair of the humidity sub-committee is seeking clarification from PTB about progressing this comparison to completion.

EURAMET.T-S3 (comparison of the calibration of Pt/Pd thermocouple) is progressing with a projected completion of the measurements anticipated end July 2016.

EURAMET Project 1352: relative humidity at temperatures in the range -40 °C to +20 °C to be started, piloted by INTA, Spain Not started

In addition a number of other comparisons have been initiated, as Euramet projects e.g. 1382, 1352, 1189, 1032, not registered on the cmc database, details 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). The experts are from SMD (BE), PTB (DE) (2 experts), CEM (ES), VTT (FI), LNE-CNAM (FR), INRIM (IT), VSL (NL), MIRS/LMQ (SI). The date for having cmcs considered was the end of February 2016, the cmc review group will respond to contact persons by May 2016 who then have a month to provide the required information.

The following CMCs were submitted for EURAMET review for the 2016 review cycle:

- 15 CMCs for humidity
- 11 CMCs for radiation thermometry
- 1 CMC for SPRTs

The following batches of EURAMET-approved CMCs were submitted to CCT WG-CMC for inter-RMO review in the 2015 to 2016 period (status as at 12 May 2016):

- EURAMET Temperature and Humidity Submission 2014
- EURAMET Submission 2015 batch 1
- EURAMET Submission 2015 batch 2

The following CMCs were approved by the inter-RMO review and published on the BIPM database in November 2015 (these also include those where there were only changes to the descriptive text):

- 33 CMCs for standard platinum resistance thermometers
- 14 CMCs for fixed points
- 10 CMCs for humidity (including air temperature sensors)
- 6 CMCs for thermocouples
- 2 CMCs for radiation thermometry
- 61 CMCs for industrial platinum resistance thermometers, thermistors, digital thermometers and liquid-in-glass thermometers

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 Farnicola (INRIM). At the TC-T plenary meeting in Feb 2016 it was agreed to appoint Domen Hudoklin (MIRS/UL-FE/LMK) as deputy convener.

The SC Humidity meets annually in conjunction of the TC-T meeting. On average, 30 to 40 experts attend the SC Humidity meetings most of them being the NMI TC-T delegate.

The SC Humidity promotes key and supplementary comparisons on humidity, along the line of the corresponding WG-Hu of CCT, and actively contributed to the preparation of the strategic planning



and the review protocols in humidity under the CCT WG-Hu. A member of the TCT SC Humidity (Stephanie Bell, NPL) chairs the CCT WG-Hu.

The SC also contributed to the EURAMET SRA through membership in relevant Task Groups (Environment and Energy). In addition two recent position papers on essential climate variables were published by Metrologia with strong contributions from this sub-committee. A number of comparisons are also being run in this field (see Section 3).

The SC is also active in a number of EMRP and EMPIR projects e.g. METefnet and METEOMET 2, others are listed below.

6. Participation in EMRP/ EMPIR

During 2015 three projects directly related to the TC-T activities started: EMPRESS, HIT (Metrology for Humidity at High Temperatures and Transient Conditions) and Eura-Thermal. The first two projects are funded within the first EMPIR industry call (2014) and the second one in the RPot. At the same time the two projects funded in the 2011 SI call InK and NOTED finished. It is important to highlight the high impact of the outputs of both projects on the international thermometry community through the contributions to the future *Mise-en-Pratique* for the definition of the kelvin and to documents like the "Supplementary Information for the ITS-90". In addition these projects resulted in numerous publications in peer review journals. Special mention should be given to the event organized at the Royal Society, UK "Towards implementing the new kelvin". This event gathered together most of the leading international scientists in the field of primary thermometry. Papers from the meeting have been published in a special edition of *Philosophical Transactions A* in March 2016.

The TC-T has continued to develop a coordinated approach to the EMPIR calls. The 2015 TC-T meeting was brought forward to allow the organization of a workshop to collate all the ideas for the formulation of the PRTs. In the 2015 EMPIR call, the TC-T was involved in the formulation of 1 PRT in HLT, 5 in SIB, 3 in NORM and 2 in RPot. No PRTs were selected in HLT or NORM, 2 were selected in SIB and RPot. Finally 1 JRP in each call will be funded: InK2 (SIB) and HUMEA [Expansion of European research capabilities in humidity measurement] (RPot).

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

The TC-T is a technical committee whose members have been working in close cooperation for many years. This is reflected in the successful outcome of the two first RPot calls with one JRP funded in each one: Eura-Thermal and HUMEA.

However the needs for capacity building in activities linked to the TC-T are far from being covered. Other EMRP projects have devoted particular attention for capacity building. In this sense NOTED should be specially mentioned. Within this project 11 mobility grants for young and senior researchers were hosted, a number significantly higher than other projects. Furthermore a workshop and a practical training course was held in Brussels the 4th May 2015. It was focused on training new recruits NMI/DI contact thermometry laboratories in Europe. The course was based on some of the main and more practical improvements achieved in NOTED and the classes were given by some of the most recognized and respected temperature metrologists in the field. The course attendance was limited to 15 participants but due to the large number of requests it was extended to 22. This kind of activity is really necessary among the European thermometry community.

In response to a call by the BoD, identifying CB in the technical area of TC-T, has become a specific task of the TC-T WG Best Practice. This WG will work in close cooperation with the TC-T WG

Strategy to identify needs for capacity building and foster knowledge transfer activities such as staff exchange, workshops or training courses. A workshop on identifying TC-T capacity building requirements will be held during the 2017 TC-T meeting.

A number of TC-T delegates were nominated to participate in the BIPM CBKT Training “Leaders of Tomorrow” course.

8. Meetings

The TC-T Annual Meeting 2016 took place in Valletta (MT) 23-26th Feb 2016. This was the second meeting chaired by Graham Machin. The minutes; meeting reports and presentations can all be viewed on the restricted part of the TC-T webpages.

The sub-committee for humidity 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 a half day technical workshop on surface temperature measurement by contact sensors was held, organised by Emese Turzo-Andras (Hungary). All the ppts can be found on the restricted part of the TC-T webpages.

An introductory guide for new comers to TC-T was prepared by Age Olsen (JV) and Peter Pavlásek (SMU) and launched at the TC-T plenary.

A deputy chair was appointed for WG TQ (Peter Pavlásek (SMU)) and WG BP elected a new chair (Miruna Dobre (SMD)). The previous chair of the WP BP (Martti Heinonen (VTT)) has moved onto new duties in VTT, he was thanked by chair of TC-T and WG members for his excellent leadership of the WG BP, and for many other contributions to TC-T.

The TC-T developed and issued a formal statement “**EURAMET TC T expression of concern about uncertainty statements of accredited laboratories**” concerning unrealistic uncertainties in commercial laboratories being accredited, this was sent to the Euramet BoD for discussion and action. This will be discussed further at the TCC workshop in Oslo in May 2016.

The chair of TC-T gave an invited presentation on Temperature Metrology at the International Summer School on Metrology at Kloster Drübeck, Germany, in 25-28 Aug 2015.

A meeting was held during the CIM conference 21-24 Sep 2015, where the WG TQ held a scoping workshop with industry to identify requirements for TQ measurements and standards. The outcome of this was discussed at the TC-T meeting in Feb 16.

9. Issues

CCT-KC9 concerning the calibration of platinum resistance thermometers, led by NIST, is making very slow progress. The associated Euramet regional linkage comparison (led by LNE-Cnam) may be complete before the CCT KC. This will be discussed with the coordinator of K9 at Tempmeko Jun 2016.

Integrating the TQ of Materials diaspora, spread across DIs, other institutes and universities is vital to grow the outreach and impact of TC-T. This activity is to be strengthened in the coming year through the appointment of vice-chair of the TQ of Materials WG.

New convenor/chair elected for the WG on Best Practice as Martti Heinonen (VTT) stands down. This is an opportunity to examine the objectives and refresh the membership of this important WG of TCT.

Although thermal imaging is clearly a standardization issue the community has been unsuccessful in securing EMPIR funds for this activity.

The issue of commercial accredited laboratories having very low uncertainties is detailed in Section 8.

The TC-T continues to be strongly opposed to commercial calibration laboratories taking part in Key or Supplementary comparisons, only the NMI or DI in each country should take part. If there are commercial laboratories with very low accredited uncertainties then they should demonstrate competence through a round-robin with their local NMI/DI.

10. Strategic Planning

The WG on Strategy is in charge of the strategic planning of the TC-T. The following actions were taken in the past year:

- Review of the final wording of the strategic agenda.
- Attendance to all meeting/workshops linked to the EMPIR calls.
- Collection and distribution of ideas and proposals for the corresponding EMPIR call related to the TC-T activities.
- Collaboration in organizing a satellite workshop during CIM-2015 to landscape the thermophysical quantities field in order to identify the societal and industrial needs.

11. Outlook for 2016/2017

In 2016/2017 TC-T activities will include:

- Major contribution to Tempmeko 2016 (TC-T chair is also IPC co-chair)
- Initiating the EMPIR InK-2 project – important international project leading the temperature community to a successful redefinition of the kelvin
- The next TC-T meeting is to be held 25-28 April 2017 in Madrid
- Hold TCT workshop on capacity building at 2017 plenary meeting (organised by Miruna Dobre, chair of WG Best Practice)
- Hold TC-T technical workshop on air temperature measurement (to be organised by Stephanie Bell (UK) and Davor Zvizdic (HR)).
- Contribute to appropriate EMPIR JRPs (2016) and PRTs (2017).

Graham Machin
TC-T chairperson

