



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 April 2017 (the date of the TCT plenary meeting) there were 18 active projects, an additional 4 were completed and 3 proposed. Updated project reports were received from all participants were uploaded onto the Euramet website.

At the Euramet TC-T plenary meeting the projects 1234 and 1235 (both involving thermophysical quantity measurements) were both deemed unlikely to achieve their objectives and were concluded, the Euramet Secretariat was informed.

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. It is envisaged that there will be a report on the status of this comparison at CCT at the end of May 2017. The regional extension of CCT-K9 (EURAMET.T-K9) is well underway. All measurements are now complete and writing of draft A is underway. 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 APMP and SIM loop are complete. The artefacts are now in COOMET (VNIIM) region. Anticipated measurement completion April 2018.

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 – to be reviewed at CCT

CCT-K8: INTA coordinator: Dew point temperature 30-95°C. Two loops one instrument each.

About 2/3 the way through the measurements. No appreciable drift observed so far. Final set of measurements in Aug 17, draft A before end 2017.

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. This comparison was completed in this reporting period.

EURAMET.T-K8 comparison (Dew-point temperature in the range 30 °C to 95 °C, Project 717) progress with this comparison had halted in 2016 and early 2017 since staff retired from PTB.

However new staff has now been recruited by PTB and a clear plan for completing the comparison agreed, target end date last quarter 2018.

EURAMET.T-S3 (comparison of the calibration of Pt/Pd thermocouple) is progressing. Completion is delayed from Jul 2016 to 31 July 2017. BEV (AT) and VSL (NL) voluntarily removed themselves from the project because they were unable to perform the measurements. All measurements have now been completed, however the data analysis have not yet started because two participants still have to send their results to the coordinator: MIRS/UL-FE/LMK (SI) and CMI (CZ).

EURAMET Project 1352: relative humidity at temperatures in the range -40 °C to +20 °C piloted by INTA, Spain. Extensive characterization of the transfer standards has been performed. It is expected the protocol will be finalized and the comparison launched Autumn 2017 with two loops to reduce the total time of the comparison. Target completion date August 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). 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 2017. The CMC review group will respond to contact persons by the end of May 2017 who then have a month to provide the required information.

The following CMCs were submitted for EURAMET review for the 2017 review cycle (note that these figures include those CMCs where there were only textual changes and also deletions):

- 18 CMCs for the humidity/ air temperature sensor category
- 25 CMCs for radiation thermometry
- 11 CMCs for the industrial platinum resistance thermometer/ thermistor/ digital thermometer and liquid-in-glass thermometer category
- 1 CMC for contact thermometry fixed points
- 8 CMCs for thermocouples

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.21.2016
EURAMET.T.22.2017

The following CMCs were approved by the inter-RMO review and published on the BIPM database during 2016 in two batches – one published in June 2016 and one in September 2016 (note that these figures also include those CMCs where there were only textual changes):

- 16 CMCs for standard platinum resistance thermometers
- 9 CMCs for fixed points
- 6 CMCs for humidity (including air temperature sensors)
- 37 CMCs for thermocouples
- 35 CMCs for the industrial platinum resistance thermometer/ thermistor/ digital thermometer/ liquid-in-glass thermometer category

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 April 2017. Over 60 people attended the SC.

The SC Humidity promotes key and supplementary comparisons on humidity, in support of cmcs. Besides the comparisons described above others in this field, run as Euramet projects are:

Euramet P1352: (LMK): bilateral dew point -40 to 20 °C between LMK and IMBIH. Final report presented.

Euramet P1189: (LMK): relative humidity 10% to 95% -10 – 70 °C. Have all results. More than 20 participants. Each participant made 30 measurements and 240 by pilots, a large amount of data was processed. No significant damage of traveling standards reported. Some of the hygrometers had up to 2% drift over the measurements. Preliminary results presented and Draft A planned for end of 2017.

In addition the following comparison was proposed. Euramet 1403: MBW coordinator: Dew point 30 – 95 °C. Draft protocol 04/2017. Trilateral comparison (CH, ES and IT). For linkage to K8. T-K8.1. recent addition is CETIAT.

Stephanie Bell gave some News from CCT WG-Hu and from other RMOs. CCT comparisons were described, including RMO linkage activities. Definition of humidity terms were outlined eg RH has different versions of definition and how to appropriately use, or even introduce, thermodynamic quantity fugacity instead of RH.

Reports were given on the running EMPIR projects HIT and HUMEA
HIT introduced by EG (CETIAT) "Metrology for Humidity at high temperatures (above 100 °C) and transient conditions" 14IND11. The project has five technical objectives, contained within three workpackages: WP1 New humidity calibration techniques, WP2 improved measurement techniques and methods WP3 demonstration and validation in industry.
HUMEA introduced (IMBIH). Expansion of European research capabilities in humidity measurement 15RPT03. KO meeting June 2016. Improvements in RH and dew point are envisaged as well as development of a coherent strategy for RH/DP capability requirements for the region. Progress and activities were described; especially noteworthy were training for the project participants; and RMGs to INRIM from JV and to CMI from DPM Albania. In the discussion EIM indicated that they would like to take part in the project as a collaborator.

6. Participation in EMRP/ EMPIR

The 2015 EMPIR call was not entirely successful for the EURAMET Thermal quantities community. As a result only two projects including activities related to those areas started in 2016:

"Implementing the new kelvin 2" (InK2, SI call) and "Expansion of European research capabilities in humidity measurement" (HUMEA, RPot call).

There are ongoing difficulties for thermal community to find a place in EMPIR health projects which is odd as many medical measurements are thermal related.

Regarding the projects completed during 2016 it is important to highlight two of them selected during the 2012 SIB call that came to their end in 2016: "Metrology for thermal protection materials" (Thermo) in the field of thermophysical quantities and "Metrology for moisture in materials" (METfnet) in the field of humidity. Both projects have filled a void in the traceability of these quantities to the SI units with a clear practical orientation, the first building confidence in

novel thermal protection materials and the second facilitating more reliable measurement of moisture and so enabling the development of new products, instruments and services in industry.

The TC-T has continued to develop a coordinated approach to the EMPIR calls. However this was not particularly successful in the 2016 call, especially when compared to the similar 2013 call. In 2016 the thermal community was very active launching double the number of PRTs in energy and about the same number in environment compared to 2013. However most of the PRTs were not converted into SRTs by the EMPIR committee. While in 2013 73 % and 67 % of the proposals in energy and environment respectively were selected as SRTs in 2016 this proportion had fallen to 42 % and 20 % of the PRTs, despite the proposed objectives being fully in line with the SRA. These results were considered by the TCT Strategy Working Group and also discussed during the 2017 TC-T Plenary Meeting. Two main conclusions were drawn, it could be possible that the PRTs were not well constructed or the proposals of the thermal community were not in line with the EMPIR committee priorities. To decide between the two, and to improve the TCT EMPIR PRTs, the TCT request that the EMPIR committee give explicit reasons for not selecting a PRT.

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

Capacity building is a standing item on the Best Practice WG and is also discussed by the Strategy Group as well.

It was clear that TC-T is fully engaged with CB initiatives (grants, RPOT projects and training – both receiving and giving). One proposal was the establishment of a Thermometry Summer School in 2018 for new thermal metrologists in NMLs. This was enthusiastically endorsed by the BP WG members at the chair of the BP WG will lead formulation of the ideas for a 2018 Summer School in thermal metrology.

A number of TC-T contact persons took part in the BIPM CBKT Training “Leaders of Tomorrow” course, whilst the chair of TC-T gave a talk about leadership.

8. Meetings

The TC-T Annual Meeting 2017 took place in Madrid (ES) 25-28th April 2017. This was the third 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 (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 organised and run.

- A technical workshop on air temperature measurement organised and run by Stephanie Bell (NPL) and Davor Zvizdic (FSB).
- An engagement workshop where the chairs of all the EMPIR task groups, STAIR and capacity building gave short presentations followed by discussion with the TC-T contact persons. The aim was to stimulate engagement between TC-T and these various groupings.

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

Yves Hermier (CNAM and coordinator of Euramet K9) and Jan Otocha (CMI) announced they were retiring from their institutes in 2017 and this was their last TC-T. GM thanks them both on behalf of TC-T for their decadal contributions to thermal metrology and CEM kindly provided a momento for them by way of thanks.

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 official nomination from TC-T as the next chair. Her proposed nomination was unanimously endorsed by the TC-T.

9. Issues

The opaqueness of decision making of which EMPIR PRTs are selected or not was of concern. GM is to raise this at the TCC meeting in May to see if it is a broader issue, and if so, urge the EMPIR committee to provide feedback on rejected PRTs.

The statement in the VIM concerning traceability is ambiguous and contradictory – this is going to be raised at the May TCC meeting for discussion between TCCs.

There is a dearth of suitable specialist training in Europe for the next generation of temperature and thermal metrologists. A Summer School in Thermal Metrology is going to be proposed under the capacity building programme – to be developed by Miruna Dobre – this could act as a pilot for other TC.

The issue of effecting closer integration of the Thermal Quantities community in the Euramet region into TC-T activities remains. The chair of the TQ WG will promote Euramet TC-T and Euramet more widely at the European TQ conference at Graz Austria in 2017.

A number of issues have been identified with the thermocouple guide cg-8 and a TG under Jon Pearce of NPL has been established to revise the guide.

The need for guides in surface temperature and air temperature measurement has been identified. A guide is in preparation for the former (by Soren Lindholt Andersen (DTI) and a TG established for the latter (led by Andrea Merlone, INRIM), part of whose remit is to prepare a guide on air temperature measurement.

The current TCT chair term expires next Summer. Proposed new chair identified at and endorsed by the TC-T plenary; the recommendation has been made to the Euramet Secretariat.

10. Strategic Planning

The WG on Strategy is in charge of the strategic planning of the TC-T. It met on 27 April 2017 in conjunction with the plenary TC-T meeting in Madrid. The full minutes of the meeting can be found on the TCT website (restricted access). The following topics were discussed:

EMPIR JRP 2016 outcomes and PRT/SRT prospects for 2017/8. The TC-T roadmaps were thought to be dated and one of the tasks of the new chair is to update the roadmaps and accompanying text. The Optimat study on coordination in metrology was discussed and GM subsequently circulated a copy to WG-S. The outcomes of the two workshops held earlier in the week was discussed, and a Task Group on air temperature measurement was proposed (to be led by Andrea Merlone of INRIM). Capacity building was discussed (as well as in the Best Practice WG) and the idea of developing a 2018 Summer School for new thermometrists was endorsed by (Tanasko T). TC-T activity in developing a Summer School could be used as a pilot for other TCs. Miruna Dobre (SMD) agreed to take a lead on this. The dates and location of the next annual meeting were given. Finally the next chair of TC-T was proposed and WG-S enthusiastically endorsed the current chair of the Strategy Group as the favoured candidate to succeed GM.

11. Outlook for 2017-2018

In 2017-2018 TC-T activities will include:

- The next TC-T meeting is to be held 24-27 April 2018 in Sweden

- Hold workshops on: EMPIR SI call 8 Dec 2017 (hosted by CNAM). Two technical workshops to be organised and held at the TC-T plenary meeting in Apr 2018: Thermal imaging (organised by LMK) and Sea and Ice Temperature Measurement (organised by INRIM/PTB).
- Propose CB Thermometry Summer School for summer 2018 (Miruna Dobre to lead)
- Two invited presentations by TCT chair to Spanish Metrology Congress (June 2017) and Metrologie (Sep 2017) on the redefined kelvin.
- Agree and make transition arrangements for effective handover to next TC-T chair – from Autumn 2017
- Contribute to appropriate EMPIR JRPs (2017) and PRTs (2018).
- It was agreed that the TC-T area roadmaps need updating and this would probably be initiated in the first year of the next chair in Q3 2018

Graham Machin
TC-T chairperson

