National Physical Laboratory

CCT WG NCTh activity report

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Chair of CCT WG NCTh

CCT 1 – 2 June 2017

Introduction

- **Terms of reference of CCT WG NCTh**
- **Members**
- **Meetings held in period May 2014 to May 2017**
- **Documents produced**
- **Task Groups of CCT WG NCTh**
  - *Task Group for primary radiometric temperature uncertainties*
  - *Task Group for Non-Contact Thermometry CMCs*
  - *Task Group for Non-Contact Thermometry HTFP Uncertainties*
- **Key comparison** KC10
- **Proposed 2018 meeting**

Terms of reference of WG NCTh I

- To study and advise the CCT on issues related to thermal radiation and other non-contact methods for temperature measurement.
- Working Group NCTh is tasked with:
  - ~~Evaluate thermodynamic measurement results obtained using non-contact thermometry methods;~~
  - Reviewing and reporting on measurements of T-T_{90} and fixed points by primary non-contact thermometry
  - Reviewing the research and application of non-contact thermometry primary thermometers to realise the kelvin
  - Coordinate activities related to high-temperature fixed points;
  - Provide appropriate input into the *mise en pratique* for the definition of the kelvin;

Terms of reference of WG NCTh II

NPL National Physical Laboratory

Provide, where required, updates for a) the supplementary information and b) approximating techniques for the ITS-90;

Provide definitive guidance, when required, on the use of secondary non-contact thermometry methods (e.g. phosphor, gold-cup thermometry);

Support world-wide efforts in standardization of radiation thermometer and thermal imager testing and calibrations;

Develop appropriate uncertainty budgets for radiation thermometry;

Recommend key comparisons relevant to WG-NCTh to the CCT;

Develop, when required, guidance for measurement best practices in novel non-contact thermometry techniques (e.g. plasma and flame thermometry).

Members - (As agreed at CCT, May 2014)

- A*STAR (Wang Li), CEM (Maria Jose Martin Hernandez), CENAM (Daniel Cardenas-Garcia), INMETRO (Renato Teixeira), INRIM (Ferruccio Girard), KRISS (Seon Do Lim), LNE-Cnam (Mohamed Sadli), MSL (Peter Saunders), NIM (Zundong Yuan), NIST (Howard Yoon), NMIA (Eric van der Ham), NMIJ (Yoshiro Yamada), NPL (Graham Machin, chair), NRC (Andrew Todd), PTB (Joerg Hollandt), UME (Ahmet Diril), VNIIM (Mikhail Matveyev), CCPR official representative (Nigel Fox)
- **Co-opted members**
- NIM (Tiejun Wang), NIM, formerly NMIJ and VSL, (Pieter Bloembergen), NPL (Emma Woolliams), PTB (Klaus Anhalt), VNIIOFI (Boris Khlevnoy). Observer status was accorded to NMSIA (Dr E. Ejigu).

Members - (Changes)

- **Membership changes**
- Five delegate changes:
  - Eric van der Ham replaced Mark Ballico (NMIA)
  - Yoshiro Yamada replaced Juntaro Ishii (NMIJ)
  - Peter Nemecek resigned from the WG as SMU delegate, no replacement formally proposed.
  - Seon Do Lim to be replaced by Dr. Yongshim Yoo (KRISS)
  - Edgar Moreno Vuelban resigned from the WG as VSL delegate, no replacement to be proposed.
- *Other changes to WG NCTh contributors*
  - CCPR liaison ceased, its objectives were deemed achieved.
  - Emma Woolliams (NPL) resigned as a co-opted member.

Meetings and document produced

- **Two meetings held in period May 2014 to May 2017**

  19th May 2014 at BIPM, Paris

  1st July 2016 at Zakopane, Poland (Tempmeko '16)

  "Declaration of CCT WG-NCTh concerning the realisation of thermodynamic temperature by primary radiometry".

  Two new task groups were established: *CCT NCTh Task Group for Non-Contact Thermometry CMCs* and *CCT NCTh Task Group for Non-Contact Thermometry HTFP Uncertainties.*

- **Documents produced**
- *Text for "Supplementary information"*

  TG of WG NCTh (members: MJMH, MM, AT, Helen McEvoy [NPL]) chaired by HY (NIST) lead development of new text for the *Sinf* (now the "Guide to the realisation of ITS-90") relating to radiation thermometry. Text complete and as Ch 6 of the "Guide".

Task Groups of CCT WG NCTh

- There are three task groups of the WG, each have a specific time limited task.

  NCTh Task Group for primary radiometric temperature uncertainties

  Task group led by Peter Saunders (MSL)

  CCT NCTh Task Group for Non-Contact Thermometry CMCs

  Chaired by Yoshiro Yamada (NMIJ) preparing a revision of the Radiation Thermometry CMC Review Protocol for approval by the CCT WG-CMC.

  CCT NCTh Task Group for Non-Contact Thermometry HTFP Uncertainties

  Chaired by Andrew Todd (NRC) objectives are: Construct comprehensive list of uncertainty components for determining *T* of HTFPs and their use as thermodynamic temperature references (or artefacts); categorize the items as either *well specified* or as *requiring further investigation*

CCT-K10

- Comparison of ITS-90 realisations from 962 °C to 3000 °C
- Will be used to justify radiation thermometry CMCs: previous key comparison had large uncertainties and did not extend above 1700 °C
- Comparison artefacts are:
  - two transfer radiation thermometers
  - HTFP blackbody cells: Ni-C and Co-C (~1330 °C, both doped to introduce some element of blindness), Ru-C (1953 °C), WC-C (2750 °C)
  - transfer Cu fixed point (for drift checks)

Participants and progress

Region	Laboratories	Status
APMP	NMIJ, NIM, KRISS	✓
SIM	NIST, NRC	✓
COOMET	VNIIM	In progress
EURAMET	NPL, CEM, PTB, LNE-Cnam	

Initial NPL measurements during ~Aug/ Sept 2014

APMP measurements completed

More NPL measurements from end July to Sept 2016

SIM measurements completed eventually

More NPL measurements ~Sept / Oct 2016

VNIIM measurements since early April

Current timescale to measurement completion

Original timescale from ~July 2014 to ~August 2016

At last TC-T meeting expected completion March 2017

Now expected completion is currently April 2018

- Proposed next meeting Sep 2018 to coincide with the IMEKO World Congress, Belfast, UK

- Questions?

- Short additional reports by

  Chair of CCT NCTh Task Group for Non-Contact Thermometry CMCs

  Chair of CCT NCTh Task Group for Non-Contact Thermometry HTFP Uncertainties