National Physical Laboratory

CCT WG NCTh update

Graham Machin; WG NCTh chair

CCT Plenary: 16 May 2024

CCT WG NCTh - members

- Chair: Graham Machin (NPL)
- Maria-Jose Martin (CEM), Daniel Cardena (CENAM), Lenka Kňazovická (CMI), Mohamed Sadli (LNE, CNAM), Ricardo Sohn (INMETRO), Ferruccio Girard (INRIM), Y S Yoo (KRISS), Peter Saunders (MSL), Xiaofeng Lu (NIM), Howard Yoon (NIST), Wang Li (NMC, A*STAR), Nao Sasajima (NMIJ), Eric van der Ham (NMIA), Helen McEvoy (NPL, co-opted), Andrew Todd (NRC), Klaus Anhalt (PTB), Humbert Nasibli (UME), Mikhail Matveyev (VNIIM), Boris Khlevnoy (VIINOFI, invited expert) [also Masahiko Gotoh IEC standards, invited expert]

Terms of reference of WG-NCTh - from Jan 2021

- To study and provide definitive advice to the CCT on issues related to thermal radiation and other approaches underlying non-contact temperature measurements
- WG-NCTh is tasked with:
  - Review and report on measurements of T-T_{90} and associated fixed points by means of primary non-contact thermometry;
  - Review research and application of non-contact thermometry primary thermometers to realise the kelvin;
  - Review and advise CCT on research related to high-temperature fixed points;
  - Provide appropriate input, including revisions, into the *mise en pratique* for the definition of the kelvin;

Terms of reference of WG-NCTh - from Jan 2021

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- Provide, where required, updates for a) the supplementary information and b) approximating techniques as regards the ITS-90;
- Support world-wide efforts in standardization of radiation thermometer and thermal imager testing and calibration;
- Develop appropriate uncertainty budgets for radiation thermometry;
- Recommend key comparisons relevant to WG-NCTh and to the CCT;
- Develop, when required, guidance for measurement best practice for secondary/novel non-contact thermometry techniques (e.g. phosphor, gold-cup thermometry, flame and plasma thermometry);
- Provide definitive guidance on the practice of Body Temperature Measurement (TG BTM)

CCT WG NCTh - meetings

- Since CCT in 2021 had one formal meeting in conjunction with ITS-10 in Los Angeles April 2023
- Next planned meeting in conjunction with Tempmeko 2025

WG actions before CCT 2024 - I

- Completion and publication CCT K10 results
- Completion and publication on BIPM website of fever screening guide by thermal imaging
- Completion and publication of medic focused guides for ear, forehead and thermal imaging for body temperature measurement and fever screening
- Completion of measurements for KC of clinical thermometer calibrators – underway [target Mar 2025, draft A]

Future WG plans before CCT 2024 - II

- Completion of industrial thermometry guide [paused]
- Consideration given to best practice guide for temperature measurement by thermal imaging

Effort redirected to supporting IEC standardisation in non-contact thermometry

- KC for high temperatures, *T* – actively discussed at WG meeting to continue at next meeting
- CMC T review protocol requires updating – agreed at WG to be done by next Tempmeko 25
- KC mid temperatures – RMO responsibilty

Current status of CCT K10 - I

- Led by Helen McEvoy (NPL)
- CCT-K10 covered the temperature range from 962 °C to 3000 °C
- The comparison was carried out by circulating:

  Two radiation thermometers

  A set of high temperature fixed-point cells (HTFPs)
- The comparison measurements were completed in January 2022

Current status of CCT K10 - II

- The data is currently being processed by BIPM prior to it being uploaded to the KCDB the final report has just been published as a Metrologia Technical Supplement
- https://iopscience.iop.org/article/10.1088/0026-1394/61/1A/03003

TG Body Temperature Measurement – complete and dissolved

- Core group of: Graham Machin (chair), Maria-Jose Martin (CEM), Igor Pusnik (UL), Xiaofeng Lu (NIM) and Wang Li (A*STAR)
- Published BTM focused guides for ear, forehead and thermal imaging thermometry on the BIPM website, Shortened clinical focused guides produced for first two.
- Key Comparison of IR clinical thermometer calibrators underway [NIM] – now incorporated into main WG activity
- Provided on-going metrology input into clinical thermometer standards

TG for guide on industrial radiation thermometry

- Activity paused as considered *potentially not needed and more impactful to contribute to IEC standards*
- Link through Masahiko Gotoh (IEC invited expert)
- Contributing to two IEC standards
  - Two-colour thermometry (LK)
  - Thermal imaging (MJM)

New HTFP values and *MeP*-K annex

- New low uncertainty HTFP temperature values Fe-C, Pd-C, Ru-C and WC-C
- *MeP*-K annex relative primary thermometry (radiometry) revised to include these new low uncertainty HTFP values
- Approved by CCT WG NCTh by email

  WG member raised issues about U analysis (14 05 2024)

  – being investigated will revise *MeP*-K annex if required

- <u>Will seek CCT approval by email once U issue resolved</u>

New HTFP values

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HTFP	Thermodynamic temperature (poi) /K	Uncertainty (poi) (*k*=2) /K	Thermodynamic temperature (elq) /K	Uncertainty (elq) (*k*=2)/K
Fe-C	1426.92	0.15	1427.02	0.15
Co-C	1597.39	0.13	1597.48	0.14
Pd-C	1765.05	0.16	1765.18	0.16
Pt-C	2011.43	0.18	2011.50	0.22
Ru-C	2226.99	0.22	2227.08	0.24
Re-C	2747.84	0.35	2747.91	0.44
WC-C	3020.85	0.25	3020.92	0.27

Possible future KC

- Thermodynamic temperature KC from Ag or possibly Al point
- Probably through *MeP*-K annex relative primary radiometry approach
- To be discussed at next WG meeting

- Possible ITS-90 non-contact KC <Ag point

Key activities for 24-25

- Revise CMC review protocol for non-contact thermodynamic temperature dissemination
- Progress to draft A clinical thermometer KC
- Finalise and approve *MeP*-K relative radiometry annex
- Input into IEC guides two-colour and thermal imaging
- Decide whether CCT guide on industrial non-contact thermometry required
- Begin preparation for KC of non-contact thermodynamic temperatures above Al or Ag point