

CCT WG NCTh presentation and report

Graham Machin, Chair WG-NCTh

CCT: 21 May 2026

Overview

- Membership and changes
- Terms of reference
- Activities and achievements since CCT May 2024
- Proposed new task group
- Summary

Membership and changes

CCT WG NCTh – members – May 2024

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

CCT WG NCTh – members – May 2026

- Nao Sasajima (NMIJ) retired from NMIJ – replaced by Yukiko Shimizu
- Klaus Anhalt (PTB) moved roles within PTB – replaced by Ingmar Mueller
- Humbert Nasibli (UME) – was invited expert – now becomes full member
- Mikhail Matveyev (VNIIM) – retiring from VNIIM and is replaced by Viktor Fuksov
- Boris Khlevnoy (VIINOFI, invited expert in HTFPs) – work now complete and Boris has stood down from the WG
- Eric van der Ham (NMIA) – resigned from NMIA – no replacement currently proposed by NMIA

Terms of Reference – minor revision

Terms of reference of WG-NCTh - from Jan 2021 – needs minor revision

- 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 May 2026 proposed revision

- 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 **both absolute and relative** primary non-contact thermometry;
 - Review research and application of non-contact thermometry primary thermometers to realise the kelvin;
 - Review and, **where necessary**, 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 – needs minor revision

- 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

Terms of reference of WG-NCTh - from May 2026 – proposed revision

- 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 thermometers, **including dual wavelength radiation thermometers**, and thermal imager testing and calibration;
- Develop appropriate uncertainty budgets for radiation thermometry;
- **Recommend to the CCT key comparisons relevant to WG-NCTh** ~~and to the CCT~~;
- ~~Develop, when required, guidance for~~ Provide metrology support, as required, 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~~

Activities and achievements since CCT 2024

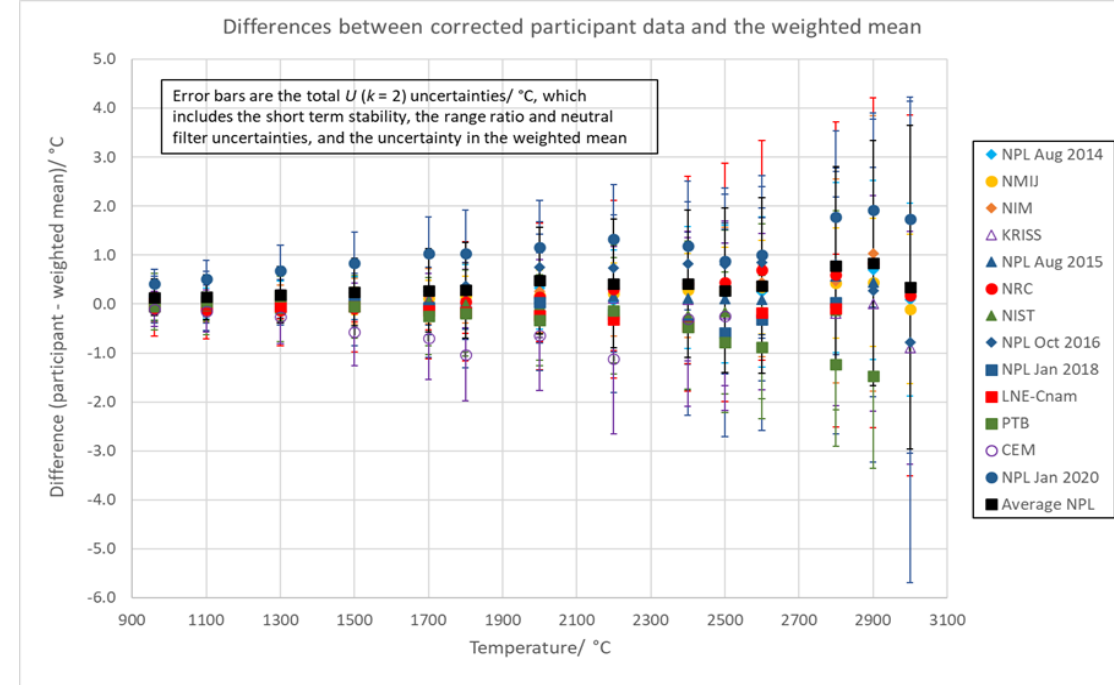
Activities and achievements since CCT 2024



- Completion of CCT KC10
- Progressed KC of Body Temperature Calibrators
- Addition of four more definitive HTFP temperature values to *MeP-K* annex
- Industrial Radiation Thermometry Guide
- Contributed to IEC standardisation activities in thermal imaging and dual wavelength thermometry
- Contributions to CCT WG DIG and CCT Strategy update
- WG meeting at Tempmeko Oct 2025
- Liaison and cooperation with CCT WG CT on
 - CCT recommendation for future ITS
 - Determining $T-T_{90}$ between Sn and Ag point – proposal for new Task Group
- Working through whether CCT KC10 results can be used to substantiate CMCs in thermodynamic temperature

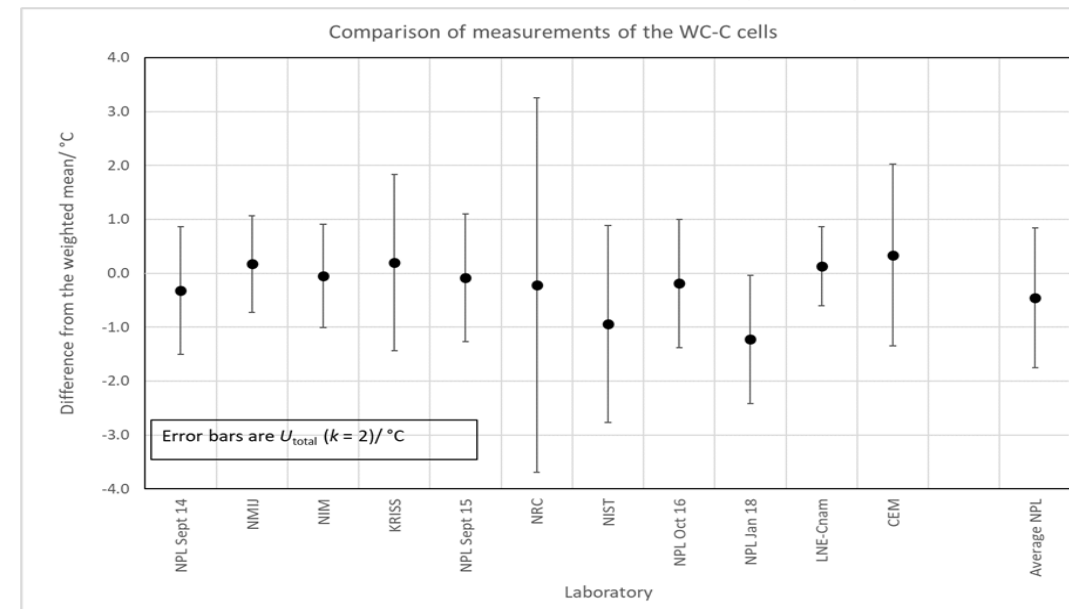
Completion of CCT KC10

- CCT KC10
 - Key comparison of ITS-90 above the Ag point
 - Comparison artefacts were standard radiation thermometers (LP3 and Chino) *and* HTFPs
 - HTFP stability allowed low uncertainty probing of claimed CMC values, significantly more stable than radiation thermometers
- Comparison successfully completed
- Published as Metrologia Technical Supplement
- Now being used to substantiate CMC entries



Differences of each participant from the weighted mean value using the LP3

Differences from the weighted mean for the WC-C (3020 K) cell results



Progress KC11 “Body Temperature Calibrators” NPL

- Xiaofeng Lu (NIM) is the pilot of the KC, split into two loops:
- Euramet: PTB (Co-pilot), INRiM, TUBITAK UME, CEM, LNE-Cnam
- APMP: NIM (Pilot), NMC, A*STAR, NMIA, KRISS, NMISA
- The European loop (led by PTB) has been completed, data initially evaluated by PTB’s digital metrology expert tool
- There were delays with the APMP loop because the transfer artefact did not perform satisfactorily. PTB transfer artefact now being circulated within APMP. NMC A*STAR finished measurements, now at KRISS (then NMISA and NMIA)
- It is hoped to get the comparison measurements completed by end 2026.

Four more definitive HTFP temperature values to MeP-K annex

- HTFP for non-contact thermometry research effectively complete (hence change in ToR text)
- In 2024 questions raised by WG member were resolved (how to treat uncertainties)
- Values now incorporated within MeP-K annex [MeP-K for primary high temperature scale realisation](#)

HTFP	Thermodynamic temperature (poi) /K	Uncertainty (poi) ($k=2$) /K	Thermodynamic temperature (elq) /K	Uncertainty (elq) ($k=2$)/K
Fe-C	1426.92	0.14	1427.02	0.16
Co-C	1597.39	0.13	1597.48	0.14
Pd-C	1765.05	0.16	1765.18	0.18
Pt-C	2011.43	0.18	2011.50	0.22
Ru-C	2226.99	0.24	2227.08	0.24
Re-C	2747.84	0.35	2747.91	0.44
WC-C	3020.85	0.40	3020.92	0.40

Industrial Radiation Thermometry Guide



- Discussion and abandonment of Industrial Radiation Thermometry Guide
- At May 2024 meeting reported that “activity was paused as considered potentially not needed and more impactful to contribute to IEC standards”
- Peter Saunders agreed on behalf of the WG to examine the need for a guide in radiation thermometry and to report back finding to the WGas to whether CCT WG NCTh :
 - Having considered the requirements for a comprehensive guide to industrial radiation thermometry, it is my opinion that our WG couldn't do it justice – we don't have sufficient expertise
 - While we could provide general comments on issues such as determination of emissivity, evaluation or elimination of reflections errors, atmospheric absorption/emission and scattering problems, and SSE, each of these issues manifests itself quite differently in different industrial applications
 - **This is because all these problems are environmental in nature, rather than instrumental, so understanding just the instrument gives you only a small part of the solution. This can be contrasted with the industrial thermocouple guide, where understanding the thermocouples themselves largely solves the whole problem**
 - On the other hand, there exist a multitude of published articles and manufacturers' guides describing specific solutions for particular applications, and a number of books outlining general principles.
 - His recommendation was not to proceed with preparing a guide.
- At the meeting in Reims, 20 Oct 2025 the WG discussed his findings and his recommendation. **Our conclusion was to endorse his recommendation and not proceed with a guide for industrial radiation thermometry**

Contributed to IEC standardisation activities in thermal imaging and dual wavelength thermometry



- Support to industry is through IEC standardisation
- At request of Masahiko Gotoh [IEC] WG provides experts into two IEC standards in early stages of preparation
- Dual wavelength thermometry led by Lenka Kňazovická (CMI)
- Thermal imaging led by Maria-Jose Martin (CEM)

Contributions to CCT WG DIG and CCT Strategy update



- WG NCTh (Peter Saunders) supplied CCT WG DIG the equations on which to base the API for $(T-T_{90})$ and $u(T-T_{90})$ above the Ag point
- WG NCTh chair acted as WG focal point for revision of CCT strategy to CCT WG, WG input prepared and contributed to the revised CCT Strategy document

Held WG meeting at Tempmeko Oct 2025



Agenda CCT Working Group Non-Contact Thermometry

20 Oct 2025: 15:45-17:45

Reims, France


1. Opening of meeting
2. Introduction of participants
3. Review of members, terms of reference, actions of previous meeting (14 May 2024)
4. Progress of KC in body temperature calibrators (draft A?) (XF)
5. Standardisation of dual wavelength thermometers (LK)
6. Standardisation of thermal imagers (MJM)
7. CMC review criteria for thermodynamic temperatures (KA, HY)
8. Progress towards a Key Comparison of thermodynamic temperature above the silver point technical approaches/possible participants/possible coordinator (all)
9. Discussion on use of InGaAs and other non-contact thermometers below the silver point possible formation of TG (intro GM, presentation EPM DireK-IT)
10. Outcome of Euramet TC-T RMO discussion of lower temperature non-contact comparison (MS)
11. Discussion of possible TG to improve uncertainties on lower temperature non-contact thermometry, draft ToR (DC)
12. Possible guide in radiation thermometry? (PS)
13. Request from CCT WG Dig: Development of API for an API for digital access to (T-T₉₀) and u(T-T₉₀) (PS)
14. AOB
 - a. Multifixrad (MS)
 - b. 2026 Summer School on Thermometry (MJM)
 - c. Input into CCT Strategy revision (GM)

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Now reviewed by
Mohamed Sadli and
Frederic Bourson –
presented to and
agreed by WG NCTh
20/05/2026

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Can CCT KC10 results can be used to substantiate CMCs in thermodynamic temperature?

- 8 Progress towards a Key Comparison of thermodynamic temperature above the silver point technical approaches/possible participants/possible coordinator
- Discussion led to the conclusion by the WG that the results of CCT KC10 could be used to substantiate CMCs in thermodynamic temperature
- Peter Saunders prepared discussion paper “CMCs for Thermodynamic Temperature Above the Silver Point”, reinforced by presentation yesterday
- Which concluded it could, supporting documents now with chairs of WG CMC and KC
- Raised question about Fischer’s Ag, Au and Cu point uncertainties – this will be investigated by WG and outcome reported to CCT (GM to lead)

- 9. Discussion on use of InGaAs and other non-contact thermometers below the silver point (for determining $T-T_{90}$) and possible formation of TG
- Liaised and worked with CCT WG CT on
 - [Recommendation on acceptance criteria for future ITS (Christof)]
 - Determining $T-T_{90}$ between Sn and Ag point – acoustic thermometry.. Possibly to 700 K, **but** are non-contact thermometry approaches feasible from 505 K upwards?
 - mini-workshop at WG NCTh meeting 20 May on possible approaches
 - New possible TG

Proposed new Task Group

Proposed new Task Group – “On the feasibility of using non-contact thermometry to measure $T-T_{90}$ between Sn and Ag point with <10 ppm uncertainty”

- Establishment of possible TG on $T-T_{90}$ below Ag point, to Sn point development of ToR – GM chair – and liaison contact with CCT WG CT
- Key areas that require investigation to minimise uncertainty ($\ll 10$ ppm)
 - fixed point construction and characterisation (MS, CNAM)
 - radiometer design (HY, NIST)
 - IR SSE characterisation (MJM, CEM)
 - detector characterisation (IM/DT, PTB)
 - uncertainty analysis and data fitting (PS, MSL)
- Initial aim is to establish the feasibility of attaining such low uncertainties, and the key technical challenges - discussion paper by end of 2026 – then develop plan of activities – first quarter 2027

- Completed KC10 and HTFP temperature work
- Progressing KC Body Temperature Calibrators
- Supporting industry through standardisation bodies
- Working on CMC validation of T at high temperatures
- Propose TG to establish how to determine $T - T_{90} < 10$ ppm between Sn and Ag points