Strategy Document for Rolling Programme Development from 2025 to 2030+

The Consultative Committee for Thermometry

Version 05 March 2026

1. General Information on the Consultative Committee for Thermometry

Consultative Committee for Thermometry (CCT)

Established in 1937

25 members and 4 official observers

9 working groups and 2 task groups

CCT meetings every 2 to 3 years

Last meeting held from 13 to 17 May 2024

2. Terms of Reference

To be informed of technical developments and evolving stakeholder needs in different areas of metrology, the CIPM has Consultative Committees with agreed scopes and objectives.

The CCT has the following terms of reference, *in common with the other CCs*:

- to progress the state-of-the art by providing a global forum for NMIs to exchange information about the state-of-the-art and best practice,
- to define new possibilities for metrology to have impact on global measurement challenges by facilitating dialogue between the NMIs and new and established stakeholders, and - to demonstrate and improve the global comparability of measurements.

Particularly by working with the RMOs in the context of the CIPM MRA to:

1. plan, execute and monitor KCs, and to
2. support the process of CMC review.

Flowing from those high-level objectives agreed by the CGPM, the CCT has the following specific objectives:

1. To establish, maintain and improve global compatibility of thermal measurements through promotion of traceability to the International System of Units (the SI).
2. To ensure that the SI unit of temperature and derived quantities are realized and disseminated worldwide in a uniform and appropriate manner. Derived quantities include: humidity and moisture, thermophysical quantities and thermal energy (heat).

This is achieved by:

- Fulfilling the terms of reference relevant to thermal metrology as defined by the CIPM as stated in the "Rules of procedure for the Consultative Committees (CCs)."
- Providing recommendations to the International Committee for Weights and Measures (CIPM) for the realization and dissemination of the SI unit of temperature and derived quantities.
- Recommending research in thermal metrology to maintain and develop the SI in relation to the kelvin, including its realization, and that of the units of derived quantities.
- Supporting the National Metrology Institutes[1] (NMIs) provision of traceability to thermal metrology quantities, such as through provision of guidance documents & training materials.
- Encouraging NMIs to address emerging thermal metrology needs.
- Providing definitive guidance on thermal metrology to users.
- Maintaining liaison with relevant stakeholders to ensure deep awareness of their needs.

3. Stakeholders and stakeholder needs

Stakeholders' interests are identified at the top level of metrology from the document "CIPM strategy 2030+: responding to evolving needs in metrology[2]". The document identifies a series of thematic areas that will be the focus of the international metrology community in the next 30 to 50 years. It addresses the needs that arise for metrology from current global challenges as well as from fast developing new technologies.

The activities of CCT are profoundly cross-cutting and can certainly contribute to addressing the needs of all these stakeholders.

Metrology for global challenges

- **Climate change and environment** – Temperature and humidity are Essential Climate Variables (ECVs) and as such reliable traceable values of these parameters are key for monitoring global climate and for providing reliable data for environmental protection and climate change mitigation and adaptation policies. Measurement capabilities by CCT members undergird reliable measurements of ECVs in the three domains: atmosphere, land and oceans. For example, sea, ice, air and soil temperature, air relative humidity and soil moisture. There are still many aspects of these measurements that are not yet well understood (e.g. air temperature) whilst even the expression of relative humidity is not yet

[1] The term « NMI » includes also Designated Institutes in this document.
[2] The version of this document used in preparation of the CCT Strategy is May 2025.

standardised. On-going engagement with the relevant climate specialists, bodies and organisations e.g. WMO, through the WG for Environment, WG for Humidity, CIPM-STG-CENV and the Metrology for Meteorology and Climate conference, is essential and ensures that the input from CCT has significant influence and its activities are in line with identified needs.

Regarding environmental pollution, especially carbon dioxide emissions, this topic is strongly connected to the generation and use of energy, transport and advanced manufacturing: for e.g. improving industrial process efficiency optimizes energy use and minimizes emissions whilst improving building energy efficiency minimizes energy consumption contributing to reducing energy-loss from building envelopes, and hence, as a consequence reducing emissions and pollution.

- **Health and Life Sciences** – Temperature measurement is a key indicator to human health. One challenge for the CCT is to ensure "traceability to the SI for the calibration of regulated clinical devices" (that is, clinical thermometers) something that is not currently in place in many countries. More widely, an important key driver is the need to improve routine body temperature measurement practice, especially by non-contact thermometry, to improve diagnosis and treatment of diseases in both a clinical and non-clinical (e.g. home/public) setting. Standards for manufacture and testing of clinical thermometers vary across RMOs and clinical thermometry could be improved if harmonization of these standards could be achieved, including objective 3rd party testing of device clinical performance. Advanced traceable temperature measurements are required in hospitals for safe active thermal therapies (e.g. cancer ablation and improved diagnostics, the latter through e.g. truly quantitative thermal imaging). Improved non-contact thermometry and especially reliable fever screening is required to address the challenge of future pandemic preparedness (the inadequacy of current practice was highlighted by the COVID-19 pandemic) and for determining temperature thresholds for triggering treatment in conditions such as sepsis. Luminescence thermometry using molecular and nanoscale luminophores (such as NV nano-diamonds) is an emerging field requiring standardisation with huge potential for bio-medical research and clinical applications, particularly in diagnostics and therapy monitoring. Humidity and moisture as well as thermal quantities have a key role to play in medicines manufacture, wound care management, skin health assessment and humidity control in medical gases.
- **Food safety** – Temperature and humidity/moisture measurement and control, and hence ultimately the support of CCT, has a critical role to play in food safety. The safe transport and storage of food requires guaranteed temperatures for those that are both frozen and refrigerated (this is often regulated by national standards). Food needs to be properly cooked (which means attaining the right temperature) to ensure sterility and safety for consumers. Control of moisture transport through packaging is also essential to prevent food spoilage and contamination. Drying of foodstuffs (measurement and control of moisture levels in e.g. powders/grains) to low moisture levels to ensure long-term storage is also essential.
- **Energy** – The world is facing what is known as the "energy trilemma": that of reducing carbon emissions, maintaining affordable energy and securing supply. CCT has significant contribution to make in addressing the trilemma by supporting the temperature, humidity/moisture and thermal quantity measurements that underpin: low carbon generation of energy (nuclear, including established i.e. fission and potential i.e. fusion,

renewables, bio-fuels, hydrogen), energy efficiency at point of generation, relevant both for combustion-generated electricity, but also for renewables such as solar, and energy efficiency at point of use; transport, industry or in homes. The decommissioning and long term storage of nuclear waste and spent fuel associated with nuclear power generation requires reliable long term (multi-decadal) monitoring of key thermal quantities such as temperature and humidity both in stores and individual containers. Energy efficiency improvements are generally linked to thermal quantity measurements if the energy is used for heating and cooling, or temperature/humidity if thermal processing is involved; whilst the transport sector is moving to electrification, and thermal measurement and monitoring are critical for the efficient use and long life of batteries. Reliable measurement of moisture content of fuel gases at varying pressures is critical to their performance, safety and environmental impact and is a developing area for thermal metrology.

- **Advanced manufacturing** – This strategic area is undergoing a rapid transformation through the digitalisation of industrial processes, leading to full-autonomous/semi-autonomous production. As nearly all industrial production requires some form of thermal processing, the need for always-right *in-situ* traceability for thermal quantities will become essential in the future. These *in-situ* traceable thermal sensors would in all probability form the reference sensors for larger embedded sensor networks monitoring and controlling complex industrial processes. It is anticipated that such developments may well flow out of metrology advances arising from kelvin redefinition[3]. A few examples of advanced manufacturing areas with specific metrology challenges are: semiconductor device production where very tight tolerances with very low moisture levels are required, additive manufacturing which has outstanding thermometry measurement challenges and next-generation advanced turbine engines for future civil and military aircraft. Additionally, materials with temperature-dependent properties are used for such applications, and new and innovative approaches for thermal quantity characterisation of, for example, powders and wires are required. However, it is important that, despite the current focus on digitalisation, the CCT must not neglect the on-going metrology requirements of more traditional industries, whose output currently forms the bulk of the world's economic activity and where reliable temperature and humidity sensing is essential. Incremental improvements in thermal sensing in these areas will reap benefits through optimising use of resources (raw materials and energy) and improving process control to facilitate "zero waste" manufacture, product quality and user benefits.

New technologies spawning new metrologies

- **Digital transformation and Artificial Intelligence** – There is some linkage between advanced manufacturing and digital transformation. In this case the focus is on the traceability and dissemination aspects of thermal quantities, e.g. providing measurement traceability to digital sensors, and the impact of digital transformation; whereas in the Advanced manufacturing part (immediately above) the focus was on applications and outcomes. The CCT is engaging with the key aspects of the digital NMI agenda that are relevant to our Consultative Committee, such as provision of digital calibration certificates,

[3] There is an open question here about the role of CCT in ensuring the reliability of *in-situ* traceability.

machine readable and actionable data, and the SI Digital Framework. A bedrock of trustworthy digital functions and reference data will be essential to underpin automated metrology workflows, including maintaining trust in workflows that leverage Artificial Intelligence tools. The CCT-WG-Dig advises and supports the CCT, and its Working Groups and Task Groups, on such topics, and it advises and supports the BIPM on thermometry-related aspects of the Digital SI.

- **System metrology** – Here the CIPM strategy identifies the importance to establish trustworthy references for data acquired from sensor systems as well as to understand the propagation of measurement uncertainties in sensor networks. This is linked to the growing use of low-cost uncalibrated and often interconnected sensors. It also highlights the need to develop practical methods for the metrological evaluation of interconnected sensors. Temperature and humidity sensors are essential components in most environmental and industrial sensor networks. The WG on Digitalization will discuss how the CCT could contribute to guarantee trust, reliability, interoperability and traceability of such distributed interconnected measurement systems in the future, including the possible establishment of a dedicated CCT TG to focus on the aspects of sensor networks relevant to the CCT.

- **Quantum revolution and thermometry–** When we talk about the relationship between quantum technologies and metrology, it is important to keep in mind that this is a two-sided coin. On the one hand, metrology plays a key supporting role in the development of quantum technologies. Accurate and traceable measurements are essential to characterize the performance of emerging quantum sensors and devices. For instance, precise temperature measurements are often required for the operation and optimization of second-generation quantum systems, such as those based on qubits, where even small thermal fluctuations can affect coherence and performance. On the other hand, quantum thermometry itself is a rapidly evolving research field. Novel approaches, such as Coulomb blockade thermometers, active ring resonators and optomechanical sensors, are being explored. These developments are not only advancing the science of thermometry but also expanding the broader landscape of quantum metrology. Both aspects—metrology supporting quantum technologies and quantum technologies enhancing metrology—are being actively addressed by the CCT-WG on Contact Thermometry.

New metrological developments to address new challenges

- **Perceptual metrology** – As climate change continues to exert its influence, elevating temperatures across the globe, the impact of extreme heat is increasingly felt. Heat stress, a condition arising from the body's struggle to regulate its temperature in the face of prolonged exposure to high temperatures and other factors, is emerging as a significant concern. Heat stress refers to the build-up of body heat generated either internally by muscle use or externally by the environment. It occurs when the heat a body absorbs from the environment exceeds the body's ability to dissipate it.

  A widely used metric for assessing heat stress is the Universal Thermal Climate Index (UTCI). This is a human thermal stress index that considers various environmental factors to assess a feels-like temperature and the physiological response of the human body to multiple levels of heat stress.

  The UTCI considers the following environmental parameters:

- Air temperature
- Radiant heat (solar and longwave radiation)
- Wind speed
- Humidity

By combining these factors, the UTCI provides an accurate representation of how the human body perceives and responds to the thermal environment. It is particularly useful in assessing thermal stress in various contexts, such as occupational settings, outdoor activities, and urban planning, where a more nuanced understanding of thermal stress is essential.

In its work plan, CCT WG ENV will consider the role of thermal metrology in addressing the evaluation of heat stress, which is growing in importance in the context of increasing temperature extremes.

- **Thermal measurements in space** – In this context, thermometry plays a crucial role, as precise temperature control and measurement are fundamental to many of these emerging applications. Space-based instruments, quantum sensors, and optical clocks all depend on accurate thermal management to maintain stability and performance in extreme environments. As we extend metrological activities beyond Earth, the ability to measure and control temperature in microgravity and harsh thermal conditions becomes increasingly important. Developing robust and traceable thermometric methods—capable of operating reliably in space or in quantum-limited regimes—will be essential to ensure the accuracy of future scientific missions and technologies. Thus, thermometry stands not only as a key enabling discipline for quantum technologies, but also as a cornerstone for the continued evolution of metrology in space and beyond. In addition, improving the thermometric accuracy of space-based earth observation systems is an important priority, the key to which is space deployable temperature references which facilitate in-situ (i.e. space-based) traceable calibrations for e.g. self-validating reference blackbodies used for calibrating EO radiometers on satellites.

- **Metrological self-traceability and shortened metrological traceability chains** – This challenge has been already identified by the CCT. The Task Group on Future Thermodynamic Temperature Traceability (CCT-TG-CTh-TTT) has focused on issues such as the evaluation of the recent research to facilitate traceability to thermodynamic temperature including possible new approaches, such as Johnson noise and Doppler broadening. It also examines what traceability actually means for in-situ practical primary thermometry and self-calibrating thermometers and how to demonstrate said traceability.

- **Nanobiometrology and characterization of biological systems** – Understanding and controlling temperature at the nanoscale is fundamental to studying complex biological systems. Accurate thermal characterization enables the investigation of processes such as protein folding, enzyme kinetics, and cellular metabolism, while ensuring non-destructive and real-time analysis of biological samples under physiologically relevant conditions. A particularly promising approach in this area is luminescence thermometry using molecular and nanoscale luminophores, which allows for highly sensitive and non-invasive temperature mapping at the cellular and subcellular levels. This technique, already discussed in the health section, exemplifies how optical methods are reshaping nanoscale thermometry by combining spatial resolution, biocompatibility, and in particular traceability. Advancements in such nanoscale thermal measurement techniques are also essential for evaluating the potential thermal and biological impacts of nanomaterials on human health and the environment.

Beyond the high-level stakeholders identified by the CIPM document and more generally, the CCT identifies stakeholder needs through the NMI national representatives. These can range from instrument manufacturers to industrial, research base (e.g. universities), healthcare and other users. There are also many possible stakeholders represented by other CCs, within or known to regional metrology organization technical committees for thermometry (RMO TC-Ts), institutions, organizations, standardization bodies and committees, scientific communities, users' associations, manufacturers and others.

Finally, there is a growing need for education in thermal metrology. There is a lack of understanding among many stakeholders of uncertainties, sensor selection and use, of traceability and accreditation. There is a rising generation of thermal metrologists in the NMIs who would benefit from such training. The CCT guides are a good starting point but additional ways should be explored such as the BIPM e-learning platform, RMO training in thermal metrology (such as the EURAMET Summer School) and the development of focused seminars or documentation.

4. Structure of the CCT

The field of thermometry covers a wide range of temperature and therefore a wide range of techniques is necessary for its realization. Humidity and thermophysical quantities are closely related fields and they are therefore integrated in the CCT activity. The CCT relies on seven different working groups, covering the different fields and aspects of its responsibility:

WG-SP	Strategic Planning
WG-CTh	Contact Thermometry
WG-NCTh	Non-contact thermometry
WG-Env	Environment
WG-Hu	Humidity
WG-ThQ	Thermophysical quantities
WG-Dig	Digitalisation
WG-KC	Key comparisons
WG-CMC	Calibration and measurement capabilities

The CCT is also supported by flexible Task Groups. These are created to carry out a distinct mission and are hence limited in time. When this revision of the CCT Strategic Planning was prepared there were three Task Groups:

TG-Env-AirT	Air temperature
TG-NCTh-IRT	Guide on industrial radiation thermometry

TG-CTh-TTT	Future thermodynamic temperature traceability

The key distinction between a Working Group and a Task Group is that Working Groups act on a long term basis, while a Task Group carries out a limited-time restricted mission. The CCT interacts also with other Consultative Committees, as well as with international organizations and bodies where appropriate.

5. Achievements from 2021 to 2025 and future scan from 2025 to 2030+

The achievements of the CCT and its working groups and the future scan are summarized below. The different fields have been separated to facilitate the identification of each.

Achievements 2021-2025	Future Scan 2025-2030+
Definition of the kelvin and *MeP*-K	
ITS-90 remains one of the key outputs of the CCT and the backbone of global traceable temperature measurement. Non-uniqueness studies have helped clarify the magnitude of this key uncertainty.	The operation of the MeP-K-19 to be reviewed by the CCT. The review should examine as a minimum whether ITS-90 and PLTS-2000 are still fit-for-purpose and continue to meet stakeholder needs (including examining cost of implementation and need), describe and agree how to incorporate thermodynamic temperature dissemination, and whether other thermodynamic temperature measurement approaches should be included.
Collation of updated low-uncertainty T-T_{90} data below 335 K has been performed and published.	CCT recommendation (T1 2021) “Requirement for new determinations of thermodynamic temperature above 400 K” is still current and these values are urgently required to help inform the deliberations about future temperature dissemination routes.
Demonstration and establishment of traceability directly to the redefined kelvin from ~1300 K to ~3000 K via low uncertainty thermodynamic temperatures of four new HTFPs (WC-C, Ru-C, Pd-C and Fe-C). New values HTFP Fe-C, Pd-C, Ru-C and WC-C. This completes the HTFP additions to the MeP-K annex in May 2024.	Launch new collaborative project, through a new task Group, in WG-NCTh about realising and disseminating the kelvin by primary thermometry in the temperature range above 505 K to 1235 K: primary thermometry capability by non-contact thermometry (especially by relative primary radiometry) between 505 K (tin freezing point) to 1235 K (silver fixed point). Link to parallel TG in CCT WG CT in high temperature acoustic gas thermometry for temperatures above 303 K (gallium fixed point) with the target of up to 700 K. The objective is to obtain coherent weighted values for T-T_{90} and T, including full uncertainty characterisation.
The redefinition of the kelvin has stimulated research into practical primary approaches to establish traceability at the point of measurement; the most advanced of these are Johnson Noise Thermometry (JNT), Doppler Broadening Thermometry (DBT) and Ring Resonator Thermometry (RRT) – but there are other approaches.	Research into these more novel practical primary thermometry approaches – in principle capable of providing in-situ traceability – will continue in the second half of this decade. By 2030 it will be clear how successful these approaches might be, but it is likely that the JNT, DBT and RRT (or variant) will all have been demonstrated at a high TRL.

Achievements 2021-2025	Future Scan 2025-2030+
Working Group for Contact Thermometry	
With the DireK-T project first tests with both recently produced RhFe and platinum-cobalt thermometers have been conducted.	Continuous work is needed in testing new scale carriers as alternatives to the hardly available rhodium-iron resistance thermometers for the range below 25 K.
New experiments with primary thermometers in the temperature range above 400 K have been started to clarify the discrepancies between different primary thermometer results. New work supported by agreed CCT recommendation 2021. A new appendix of the Guide to the Realization of the ITS-90 dealing with the application of SMFPCs was prepared in 2021. The non-uniqueness of the SPRT part of the ITS-90 was investigated both theoretically and experimentally at NRC and in the Real-K project. A sub-group working on an update of the guide on secondary reference points was established.	Different primary thermometers can approximate the ITS 90 below 4 K and 25 K. Recommendations for the approximation of the scale applying them should be prepared. Further tests with new HTSPRTs can overcome the problem of the realization of ITS-90 via contact thermometry above 933 K. An approximation with pure-metal thermocouples will be investigated. Furthermore, the general problem with the variable quality of the presently produced SPRTs in the whole range should be quantified and if needed, feedback to the manufacturers should be provided. New findings on the non-uniqueness of the SPRT part of the ITS-90 should be included in the Guide. An improved version of the SPRT reference function should be developed with a goal of reducing the non-uniqueness. It is a permanent task of the CCT Working Group for Contact Thermometry to collate crystallographic and other data necessary for estimating the uncertainty component due to chemical impurities. An update of the guide on secondary reference points must be provided. Some of the high-quality secondary reference points like e.g. the lambda point of helium-4, together with the fixed-points of the ITS-90 and the most recent T-T_{90} estimates, can lead to an appendix of the MeP-K containing reference points for relative primary thermometry. New thermodynamic temperature data above 400 K, obtained with new or improved primary thermometry methods, will lead to much better estimates of T-T_{90} and, therefore, facilitate the access to T via T_{90} for the users. It should be checked if new results (below and above 400 K) allow for an update of the Mise en pratique for the definition of the kelvin. One or more viable alternatives to the Hg-TP to be established for use with LSPRTs and CSPRTs. The PLTS-2000 problem at the low-temperature end (unknown deviation from thermodynamic

	temperature below 8 mK) must be solved convincingly to include the PLTS-2000 in any future scale. The recommendations for the estimation of the uncertainty of fixed-point realizations and the validation of fixed-point cells must be updated. This should be based on the experience gained and might include the determination of the overall impurity content by e.g. measuring the residual resistance ratio of the fixed-point materials.
Task Group on Future Thermodynamic Temperature Traceability	
The group prepared an Open Access peer-reviewed publication https://doi.org/10.1098/rsta.2024.0453 summarizing the formalism associated with traceability to the SI kelvin for new practical thermometry methods capable of providing traceability in situ. The state of the art of two main types of thermometry which can potentially provide in situ traceability has been presented, namely self-validating thermometers and practical primary thermometers. It has been shown that relative primary thermometry is more likely to become a day-to-day reality than absolute primary thermometry, and that this has a significant bearing on what the formalism might look like regarding metrological traceability and demonstrations of equivalence.	Continue to monitor developments in practical primary thermometry and self-validation. Study the evolution of T-T_{90} measurements in the temperature range being developed in other WGs e.g. WG-NCTh and report back to WG-CTh.

Achievements 2021-2025	**Future Scan 2025-2030+**
Working Group for Non-Contact Thermometry	
Low uncertainty high temperature fixed point (HTFP) thermodynamic temperature values have now been established from the Fe-C to the WC-C. These can now be used to realise low uncertainty temperatures, T or T_{90}, in NMIs and advanced calibration laboratories, to perform key comparisons and to confirm veracity of local realizations of radiance temperatures above the Ag point Two recent papers giving the details are: • D. Lowe, G. Machin, "Low uncertainty thermodynamic temperature measurement using relative primary radiometry setting up n=2 scale using copper and rhenium-carbon with uncertainties", AIP Conf. Proc. 3230, 100002 (2024) https://doi.org/10.1063/5.0234817 • M. J. Martin, J. M. Mantilla "The transition from ITS-90 to primary thermometry above 1235 K" Phil. Trans. R. Soc. A 384, 20240448 (2026) https://doi.org/10.1098/rsta.2024.0448	HTFPs to become embedded into high temperature metrology with realization and dissemination of thermodynamic temperature above the Ag point to become increasingly common, with ITS-90 supplanted in this temperature region.
The CCT key comparison of temperature above the silver point (CCT-K10) has been completed. This demonstrated good equivalence among all the partners and could be used as a basis to substantiate CMCs. It was the first key comparison to combine the use of non-contact thermometers and HTFPs. This comparison substantiated CMCs in ITS-90, but can also be used as a basis for substantiating CMCs in thermodynamic temperature as well.	RMOs will undertake KCs above the Ag point, linked to CCT-K10, to underpin the veracity of non-contact thermometry scale realization at high temperatures on a global basis. Data from CCT-K10 will be used to substantiate CMCs above the Ag point in T_{90} and T for CCT participants.

Supported development of CCT T1 2021 “Requirement for new determinations of thermodynamic temperature above 400 K”	These measurements are still urgently required. Propose to set up a TG within CCT WG NCTh in 2026 on how best to address this requirement through radiometric measurements of T-T_{90} above the Sn point, to report on best technical approaches by the subsequent CCT (2028?).
We have interacted with standards bodies on industrial thermometers. We have established formal links to provide metrology input into two standards, two colour pyrometers and thermal imagers.	The WG contact persons (CMI [two colour], CEM [thermal imaging]) will work in the IEC standard committee SC65B/WG5 (chair Masahiko Gotoh, NRC, Canada) to ensure that the industrial standards in these two non-contact thermometry approaches incorporate sound metrology to ensure the best performance from these devices. This work is, in part, in response to the need to put thermal imaging on a firmer metrological footing.
The WG has been active in support of the digitalization agenda. Input was provided to develop the digital version of the *MeP*-K-19 (designated -19D).	Support will be given to CT WG Dig to enable development of an API for digital access to (T-T_{90}) and u(T-T_{90}) above the Ag point
In support of the global response to the COVID-19 pandemic, CCT WG NCTh established a TG to make recommendations to improve fever screening. We prepared and published guides in tympanic, forehead and thermal imaging for fever screening – in English and Spanish. We also started a KC of calibrators for tympanic and forehead thermometers	This task group achieved its work and was dissolved. The remaining activity, the KC of body temperature calibrators, led from NIM, is underway and should be complete by CCT 2028.

Achievements 2021-2025	Future Scan 2025-2030+
Working Group for Thermophysical Quantities	
The main activities carried out have been related to the development of several comparisons and the publication of CMC review protocols: • CCT-S1; Infrared spectral normal emissivity: Results have been published and CMC review protocol has been approved • CCT-S2; Thermal Conductivity: Results have been published and CMC review protocol is in an approval process. • CCT-S3; Thermal Diffusivity: Draft B has to be revised and results are in modification process before final approval and publishing of the final version of the results on bipm.org. In parallel, CMC review protocol has been approved.	• Infrared spectral normal emissivity: With respect to the time schedule agreed, CMCs should be submitted, approved and uploaded according to the ad-hoc process • Thermal Conductivity: With respect to the time schedule agreed, CMCs should be submitted, approved and uploaded according to the ad-hoc process • Thermal Diffusivity: With respect to the time schedule agreed, CMCs should be submitted, approved and uploaded according to the ad-hoc process New actions: Initiate writing of guideline(s); preparing the protocol of potential future Key comparison(s), measuring and assessing uncertainties for limited quantities to be selected among radiative properties, transport properties and caloric quantities A Summer School focused on Thermophysical quantities measurements and open to European countries members and if possible to non-European countries will be held to train new and recent entrants to the field of thermal metrology and to provide networking opportunities with global experts in the field.

Achievements 2021-2025	**Future Scan 2025-2030+**
Working Group for Humidity	
Quantities, units, symbols and realizations relating to humidity measurement: Work has continued on humidity terms and definitions, and consideration of a fugacity-based rigorous definition of relative humidity.	Work towards definition of suitable unambiguous terminology and units for humidity quantities, working with relevant partners such as CCU, IAPWS, WMO, IUPAC, and ISO. Continue development of rigorous definitions of relative humidity, together with options for realization within the SI. Continue work on equations for evaluation of, and interconversion between, the wide set of humidity quantities, in cooperation with IAPWS and others. Definition of relative humidity agreed by CCT and core partners.
Guidance Guidance on evaluating uncertainty in humidity metrology in support of KCs and CMC reviews is under review and revision. A document on humidity primary realisations has been drafted.	Guidance document to be published, available.
Collaboration and stakeholders Coordination and collaboration with IAPWS. Liaison with CCQM in areas of trace moisture in gases and moisture in materials. WG-Hu representation on CCT-WG-ENV to maintain interests in the key field of environment, including climate. Development of metrological infrastructure for trace-moisture measurement in gases to meet growing demand from the semiconductor industry (by EMPIR project, PROMETH$_2$O)	WG-Hu participation CCT-WG-ENV in keeping with significance of humidity variables and soil moisture as identified Essential Climate Variables. Active role in the Task Group for Air Temperature: air temperature is critical to humidity realisations of dew point and relative humidity. Consider contributions to humidity metrology especially related to climate and net-zero emissions, such as through guidance, training, support for uncertainty evaluation. Continued collaboration on humidity metrology, especially related to climate and net-zero emissions.
The **International Symposium on Humidity and Moisture** was successfully held jointly with the Tempmeko in 2025.	Future ISHM events to be sought at intervals of 5 to 10 years.

Emerging or developing techniques for humidity metrology have been monitored: • Extended NMI capabilities for humidity realisations in varied gas species, pressure, and temperature ranges relevant to energy and industrial needs • Moisture in materials • Hygrometers based on laser spectroscopy • Compact humidity generators • Evaluations of water vapour enhancement factor	Continue monitoring and response where developments are relevant to SI metrology and traceability, with collaboration across consultative committees as required. Emerging needs for establishing international equivalence or CMCs to be considered. Develop and support metrology infrastructure for moisture in materials. Digital information services on humidity metrology. Further developments in water vapour enhancement factors, both theoretical and experimental, for a range of gases and pressures.

Achievements 2021-2025	Future Scan 2025-2030+
Working Group for Environment	
Established formal collaborations with national meteorological and hydrological services, universities, research centres and manufacturers have been increased Joint Research projects such as MINKE, INCIPIT, CRS, COAT, SoMMet, A2TM, and others facilitated scientific studies and technical research on improving calibration and measurement procedures and uncertainty evaluation. The newly approved and funded COST Action CA24155 "Climate Reference Instruments and Measurements" creates a tool for improved networking among thermal metrologists and meteorological, hydrological services and climatological experts. WG-ENV members are formally participants and in some cases chairs of expert teams in the WMO INFCOM and SERCOM, in the Global Cryosphere Watch, the GCOS AOPC, GRUAN and Task Teams, such as TT-GSRN and TT-Rationalization of the ECV, and the BSRN. The interaction has been growing in the period. WG-ENV members have supported official WMO worldwide laboratory intercomparisons in Europe, Asia, Latin America and Africa. Final reports are being published for such a unique and first worldwide WMO calibration laboratory intercomparison.	CCT-WG-ENV members will continue to contribute as experts in WMO, GCO and GCW. The pilot phase of the GSRN, with the nomination of stations and refinement of measurement requirements and uncertainty evaluation, will be a core topic in the interaction between CCT WG ENV and GCOS GSRN. Under the indication of the CIPM-STG-CENV, a new initiative on Capacity Building and Knowledge transfer will be initiated by the CCT WG ENV The "WMO Lead Center on Traceability and Field Metrology", hosted by an NMI is planning a large intercomparison of thermometers and solar shields for the GSRN. It will also constantly support the WMO in research and studies to understand and minimize measurement uncertainty, through laboratory and field activities. Under the framework of the COST Action CA24155 "Climate Reference Instruments and Measurements" enhanced networking for extension of reference grade techniques to wider baseline applications are expected. Ground based stations, radiosondes and GNSS systems are the key topic addressed by this Action lasting up to 2029. Participants from the metrology community, National Meteorological and Hydrological Services, Climate research centers and Academia will collaborate under this networking joint effort. More widely: • The WG-ENV will continue to facilitate networking and building of consortia able to respond to project proposals for funding and joint activities among the members on activities.

Reference test sites with the highest quality SI-traceable measurements of ECVs have been established including prototypes of climate reference stations and research infrastructures to support the implementation plan of the GSRN. The newly nominated "WMO Lead Center on Traceability and Field Metrology" was completed and is now in full operational status, to support WMO, the GCOS and wider research activities in improving data quality and uncertainty evaluation with focus on thermal measurements. CCT-WG-ENV, together with operational meteorologists, climatologists and metrologists, strongly contribute with studies and activities for the definition of the key aspects of GSRN measurement procedures and uncertainty evaluation in terms of station features, data characteristics and target uncertainties and to the production of the document "GSNR temperature data product" Support in the validation of records associated with extreme events with main focus on the extreme values of temperature has continued. The work supported the validation of the highest air temperature ever measured in Europe (WMO Region VI), being the 48.8 °C recorded in Sicily on 11 August 2021. The work done and methods adopted also contributed to the writing and publication of the WMO guide on extreme records evaluation. A further guide has been published with key support from the thermal metrologists involved: the WMO guide No.8 (GIMO) chapter 4 – Cryosphere – Permafrost best practice. The guide is strongly based on the studies and results achieved under the MeteoMet	• WG-ENV members will continue studying and characterizing temperature, humidity and radiation sensors for ocean applications, ground based systems and radiosondes. Provide roadmap to address needs of data quality arising from possible new climate evolution scenarios. This will include the impact of AI in metrology for climate and the environment. • The CCT-WG-ENV will promote and contribute to interdisciplinary initiatives, worldwide and at regional level, to create forums and expert teams, to address the stakeholder's needs under coordinated efforts with other areas of metrology, also under future CIPM initiatives Impact: CCT members continue to organize events, meetings, workshops, conferences and training to discuss and plan common activities with the climate and environmental communities.

projects. e-learning certified training course on “Metrology, Calibration, Terminology and Uncertainty” has been provided to the WMO by members of WG ENV. The course is now available online openly and with attendance certification for staff of meteorological and hydrological services. Course: Training Course on Calibration | ETRP Moodle Site The “Metrology for Meteorology and Climate” – MMC Conference series and associated workshops and satellite events continued to be fully participated in and endorsed by CCT WG ENV members, with increased participation by WMO and GCOS experts, and represent world top level events for increasing the collaboration between thermal metrologists and the stakeholder communities. Other events such as the WMO TECO and Tempmeko are constantly participated by members of the WG ENV, covering the intersection of thermal metrology/meteorology and climate. CCT WG ENV members participated actively in the WMO-BIPM workshop “Metrology for Climate Action”, taking the role of the rapporteur on the Cryosphere Monitoring topic in the derived workshop report. In addition, CCT WG ENV members took part in the 1st CIPM-STG-CENV Stakeholder meeting.	
Task Group for Air Temperature	

In 2020 a new Task Group on "Air temperature" was formed, tasked: • To work towards and propose a practical definition of air temperature • To work towards and propose how to evaluate the uncertainty contributions in air temperature measurements • To develop guidelines for the calibration of thermometers in air. The work on the definition of air temperature measurand started, by drafting a scientific paper on the issues related to the measurand and its system-dependent definition: In particular, the sensor dependent heat transfer with the surrounding air, the issue of non-uniformity, and how to define the medium, air. An overview of different physical mechanisms of heat transfer was compiled, and a rudimentary uncertainty budget established. The present state of the art in air thermometer calibration was established via a survey among NMIs and accredited laboratories. The need for a comparison was also established. Work started on developing a suitable traveling standard in the comparison.	A worldwide intercomparison of methods for the calibration of thermometers in air will be planned and possibly started within the reference period. The practical definition of the air temperature measurand will be proposed, based on the publication of a scientific paper, in consultation with key stakeholders. If accepted, the practical definition of air temperature will be proposed to the CCT in collaboration with key stakeholders, and in an approach suitable for uptake by them. A method will be proposed on how to evaluate the uncertainty contributions in air temperature measurements in practical situations. The method may have an impact on recommendations for calibration methods of air thermometers, which may have to be more elaborate than a regular thermometer calibration. A guide for the calibration of thermometers in air will be written and published on CCT website. Research on innovative and improved methods for non-contact measurements of air temperature will be considered as relevant and recommended.

Achievements 2021-2025	Future Scan 2025-2030+
Working Group on Digitalization	
Developed and published a restructured machine-readable “2019D” version of the *MeP*-K on the BIPM website. Collaborated with the BIPM to develop Application Programming Interfaces (APIs) for machine and human readable and actionable access to digital functions and reference data related to the *MeP*-K.	Complete open beta test and publication of *MeP*-K-related APIs. Identify needs for additional APIs that would support the global thermal metrology community to build new capabilities more easily and to automate workflows. For example, digital functions and reference data related to humidity, thermophysical quantities, primary thermometry, and CCT guidance documents.
Reviewed NMI progress on implementing thermometry Digital Calibration Certificates (DCCs), and the state of DCC schema, templates and tools.	Evaluate the expansion of DCCs to integrate connections with digital functions and reference data such as CCT APIs (for example, the ITS-90 SPRT reference function), CMCs in the KCDB, and the SI Digital Framework, ensuring version control of the values used in each DCC. In consultation with external stakeholders such as instrument manufacturers and the QI Digital initiative, advance the possibility to leverage the digital workflow enabled by DCCs so that calibration results can be automatically updated into end user measurement devices without requiring them to be manually entered.
Developed and raised a document indexing and archiving suggestion to the CCT and CIPM, for possible implementation by the BIPM and use across all CCs. Advised BIPM during the development and testing of the SI Digital Framework.	Engage with and advise the BIPM on upcoming development of the cross-CC document repository and website redesign, to ensure these meet the needs of the CCT and thermometry community. Collaborate with the BIPM on solutions to the problems of external web searches surfacing old versions of important CCT documents, and poor usability of the BIPM website internal search function.
	In consultation with CCT-WG-KC, explore the use of the PTB Digital Metrology Expert (DME) software for analysis of CCT key comparisons, supplementary comparisons, etc.; and the expansion of DME to incorporate resources such as the NIST Decision Tree and other APIs.

Achievements 2021-2025	**Future Scan 2025-2030+**
Communication/education	
As part of the CCT response to the COVID-19 pandemic, prepared and published guides in tympanic, forehead and thermal imaging for fever screening – in English and Spanish. These are available for free download from the BIPM website.	Other guides will be prepared and updated as appropriate. For example, the *MeP*-K-19D will undergo a full revision in the second half of the 2020s.
A workshop “The redefined kelvin – progress and prospects” was held under the auspices of the UK Science Academy (The Royal Society) in Feb 2025 in Glasgow to commemorate the bicentenary of the birth of Lord Kelvin	A focused edition of Phil Trans Roy Soc A on “The redefined kelvin – progress and prospects” will be published in 2026.
A EURAMET Summer School on temperature and humidity measurements was held in Sep 2023 to train new and recent entrants to the field of thermal metrology and to provide networking opportunities with global experts in the field.	In 13-15 May 2026 a high-level workshop on “Contemporary issues in Primary Thermometry” will be held under the auspices of EPM IEM project DireK-T and Universidad Internacional Menéndez Pelayo (UIMP), Santander, Spain
	2027 marks the centenary of the introduction of the first defined temperature scale. Possible event/s could be organized to highlight the importance of reliable temperature measurement to modern life which have been facilitated by the work of CCT and the introduction of the defined scales.

6. Required Key comparisons and pilot studies 2025-2030+ with indicative repeat frequency

The status of past, and progress of currently active, key comparisons are discussed separately below for the 3 technical fields of the CCT: Thermometry (Section 6.1), Humidity (Section 6.2) and Thermophysical Quantities (Section 6.3). Section 6.4 closes this section with recommendations for future comparisons that are not just repeats of previous comparisons (the latter are discussed in the relevant section).

Finally it should be noted that the classification of services in thermometry was updated in 2022 as well as the CMC review protocols for calibration of fixed point cells (excluding the TPW), and for calibration of SPRTs at fixed points (2024), and the ITS-90 SPRT Subranges (2024) and a new CMC review protocol for thermodynamic temperature above the Ag point was introduced.

The development of guidelines to assist the pilots of key comparisons in the analysis of the results is under preparation by the CCT-WG-KC.

6.1 Thermometry

The first round of the six thermometry CCT key comparisons (CCT-K1, CCT-K2, CCT-K3, CCT-K4, CCT-K5 and CCT-K7) was completed in 2008.

The second round of thermometry CCT key comparisons was initiated in 2012 and three of them have been already completed: 1) CCT-K9, which was the repetition of CCT-K3 and covered the ITS-90 temperature range from 84 K to 693 K, completed in 2023; CCT-K7.2021, which was the repeat of CCT-K7 key comparison of triple-point-of-water cells, completed in 2023; and CCT-K10, which was a comparison of ITS-90 above the silver point, completed in 2024. In principle CCT-K10 was similar to CCT-K5 but nearly all technical aspects were different, the range was wider (up to 3000 ^{o}C) and the transfer artefacts were different (this time radiation thermometers, more in keeping with industrial practice, and also quasi-unknown-temperature high-temperature fixed points were circulated).

CCT-K11, a comparison of non-contact clinical thermometer calibration systems, was started in 2021 as a response to the COVID-19 pandemic and to the poor clinical thermometry being undertaken around the world, and is expected to be finalized by the end of 2026.

The repeat of the key comparisons in the low temperature range of the ITS-90 (CCT-K1 in the range 0.65 K to 24.6 K and CCT-K2 in the range 13.8 K to 273.16 K), was attributed a frequency of 20 years or more, based on the demonstrated long-term stability of cryogenic fixed-point cells. Given the limited number of original realizations in the world, the significant workload required by classical vapour pressure and interpolating gas thermometry, and the advancement of low-temperature primary thermometry methods, a repeat of CCT-K1 and CCT-K2 is not foreseen in the coming years. Specific issues related to the ITS-90 in this range will be addressed by the CCT-WG-CTh. At the same time, the investigations on alternatives to the mercury fixed point (Xe, SF_6 and CO_2) have yielded significant results in recent years and a dedicated pilot study is likely to be undertaken before 2030.

The results of CCT-K9, the repeat of CCT-K3, were not completely satisfactory for many laboratories, but, given the required workload, the limited resources foreseen in the coming years and the lack of more stable transfer artefacts, a repeat of CCT-K9 is not expected in the short term. The laboratories with unsatisfactory results were asked to take appropriate actions to solve the inconsistencies and, when necessary, to revise their corresponding CMCs.

As more than 20 years passed since CCT-K4 was carried out (1998-2000), a repeat of CCT-K4 (660 ^{o}C and 962 ^{o}C) is considered a priority for the coming years.

The thermometry key comparisons, carried out in the first round and being repeated in the second round, were designed to compare the dissemination of different ITS-90 realizations. This was appropriate because, although the definition of the kelvin refers to the thermodynamic temperature T, for all practical measurements the ITS-90 temperature T_{90} (or the temperature T_{2000} of the other defined scale PLTS-2000) was used. In the years to come, an increase in the realization and dissemination of the thermodynamic temperature T is expected, particularly in the low- and high-temperature ranges, and the design and execution of key comparisons in terms of T will be required. Some preliminary work in this direction is already being done for the low-temperature range by the currently running European project Direk-T, which is a first attempt to compare the local thermodynamic temperature scales using capsule SPRTs as transfer artifacts. However, for the high temperature range by non-contact thermometry, the CCT will need to clarify the exact purpose of thermodynamic temperature key comparisons. If the goal is to compare how thermodynamic temperature is disseminated by different NMIs, then the use of a radiation thermometer as a transfer artifact will be appropriate. If the goal is probing the different thermodynamic temperature realizations, then HTFPs should be used instead. CCT-K10 performed a KC of ITS-90 that included HTFPs. In principle that data could be used post hoc to provide some level of validation of NMI thermodynamic temperature realization capability. Whether it is sufficient to justify CMCs would have to be assessed by CCT-WG-NCTh and CCT.

Concerning the other defined scale, PLTS-2000, only two European National Metrology Institutes in the world maintain it. These two European NMIs have resolved the longstanding problem of discrepancies between the PLTS-2000 and the ITS-90 in their range of overlap (0.65 K to 1 K). In the coming years, the main activities should be directed to promote the use of low-temperature primary thermometry methods and to extend the range of reliable thermometry to even lower temperatures according to the growing demand resulting from intensifying research work in this field.

Air temperature measurements are relevant for both relative humidity measurements and climate monitoring. An RMO supplementary comparison of air temperature has already been initiated and a CCT supplementary comparison in the same field can be foreseen in the coming decade (2030+).

6.2 Humidity

In the humidity field, two key comparisons were carried out in the first round: CCT-K6 covering dewpoint temperatures from -50 ^{o}C to 20 ^{o}C and CCT-K8 covering dew-point temperatures from 30 ^{o}C to 95 ^{o}C. CCT-K6 was completed in 2015 and CCT-K8 was completed in 2024.

A repeat of CCT-K6, formally approved during the CCT meeting 2020, was registered in KCDB in 2023 as CCT-K6.2021. It is expected that CCT-K6.2021 will be carried out in the late 2020s. In CCT-K6.2021, a reduction of the effort and duration will be considered. Aligned with this, a revision of the CMC review protocol for humidity is currently in progress, because in its current form it forces dew-point comparisons to be at close intervals and therefore requires many comparison points. The technical protocol of the CCT-K6.2021 comparison is under preparation and is expected to incorporate lessons learned from CCT-K8, including a well-defined methodology for data analysis and robust procedures for the identifications of outliners.

A repeat of CCT-K8 will likely be needed at the beginning of the 2030s (ten years from the end of CCT-K8).

Below -50 ^{o}C dew-point, it has been agreed that, if there would be a CIPM comparison, it would be a supplementary comparison. Concerning the trace moisture range, some members of the WG-Hu have participated in a pilot comparison (EURAMET 1002, 10 nmol·mol-1 to 2 µmol·mol-1 of water vapor in nitrogen) and a CCQM comparison (CCQM-K116 and associated pilot study, 10 µmol·mol-1 of water vapour in nitrogen). In Europe, as a result of the PROMETH2O project, the number of NMIs that established trace-moisture standards below -80°C dew-point increased. Due to the growing demand for trace-moisture measurements in the semiconductor industry, the need for international comparisons in the trace-moisture region is expected to increase in the near future.

Relative humidity is being addressed through supplementary comparisons and non-CIPM comparisons at RMO level.

6.3 Thermophysical Quantities

Thermophysical Quantities, being the newest field of the CCT, launched at the beginning of the century and encompassing a large number of quantities, is in a stage in which a coherent system of comparisons is being developed.

Three major comparisons, formally categorized as CCT supplementary comparisons but in fact representing the best capabilities available in the world for the respective quantities, were completed: CCT-S1 (spectral normal emissivity), CCT-S2 (thermal conductivity) and CCT-S3 (thermal diffusivity).

However, we have to mention that CCT-S3 results have not been published yet. In order to respect its commitment to the other participants, a precise schedule was expressly requested to the pilot of CCT-S3, to bring this comparison very quickly to conclusion.

It is expected that the next major comparison(s), enthalpy of fusion, at least, and thermal expansion coefficient (as soon as it is possible for this last quantity), would be launched and carried out during the present decade.

6.4 Recommendation for future comparisons

It is recommended that any Calibration and Measurement Capability (CMC) entry submitted for inclusion in the Key Comparison Database (KCDB), be supported by results from an appropriate key comparison (KC) or supplementary comparison (SC). To ensure technical relevance and continued confidence in the declared capabilities, the comparison used as evidence should not be older than 20 years, unless there is clear technical justification demonstrating continued validity.

Maintaining this time limitation helps ensure that CMC claims reflect current measurement standards, methodologies, instrumentation performance, and traceability chains. Over time, measurement techniques, reference standards, and uncertainty evaluation methods evolve, and older comparison results may no longer adequately demonstrate present competence without additional supporting evidence.

Furthermore, it is the joint responsibility of the Working Group on CMC (WG CMC) and the Working Group on Key Comparisons (WG KC), together with other CCT WGs to evaluate and determine which specific CMC categories are effectively supported by the results of the relevant key or supplementary comparison. Through this coordinated review process, the WG CMC and WG KC ensure that CMC entries published in the KCDB remain technically justified, internationally comparable, and aligned with the framework of the Mutual Recognition Arrangement (CIPM MRA).

Annex 1: Published guides in thermometry from CCT: 2022-2025

Guide to Secondary Thermometry

Guide to Secondary Thermometry - Specialized Fixed Points above 0 °C
https://www.bipm.org/documents/20126/41773843/Specialized-FPsabove-0C.pdf/10265617-c79f-0ea5-8da9-8d359e21c6be?version=1.3&download=true

Guide to Secondary Thermometry - Thermocouple Thermometry Part 2
https://www.bipm.org/documents/20126/41773843/Thermocouple_Thermometry_Part2.pdf/42e4ec36-5602-e696-31df-d1cb10ebf7cc?version=1.1&t=1700234278871&download=true

Other guides

Best Practice Guide Use of Thermal Imagers to Perform Traceable Non-Contact Screening of Human Body Temperature

https://www.bipm.org/documents/20126/41773843/Best_Practice_Guide_human_body_temp_measurement_thermal_imager_screening.pdf/0d8f88c1-9ef6-2e26-0d95-b4fa47f87e43?version=2.0&t=1693300587635&download=true

Short version

https://www.bipm.org/documents/20126/41773843/Short_BPG_BTM_themal%20imagers.pdf/de84d5a0-b7ae-be25-d1d6-652d8ba98974?version=1.2&t=1652455549953&download=true

Best Practice Guide Use of Infrared Forehead Thermometers to Perform Traceable Non-Contact Measurements of Human Body Temperature

https://www.bipm.org/documents/20126/41773843/Best%20Practice%20Guide%20for%20Forehead%20Thermometers.pdf/7550747b-1344-7416-3e7a-ec54f863ed5c?version=1.3&t=1652455631920&download=true

Short version

https://www.bipm.org/documents/20126/41773843/Short_BPG_BTM_forehead_thermometers.pdf/21f6f2f9-7587-9d57-63c4-bab2d0a3ac78?version=1.2&t=1652455567733&download=true

Best Practice Guide Use of Infrared Ear Thermometers to Perform Traceable Non-Contact Measurements of Human Body Temperature

https://www.bipm.org/documents/20126/41773843/Best%20Practice%20Guide%20for%20Infrared%20Ear%20Thermometers.pdf/52e3d750-f282-beca-8b5d-bfb0d748d304?version=1.6&t=1652452565611&download=true

Short version

https://www.bipm.org/documents/20126/41773843/Short_BPG_BTM_ear_thermometers.pdf/4c02ddf1-0fc6-feb8-84df-1efca00cb603?version=1.2&t=1652455582858&download=true

Annex 2: CCT Strategy document glossary

AGT	Acoustic Gas Thermometry
AI	Artificial Intelligence
APMP	Asia Pacific Metrology Partnership
ATM	Air Temperature Metrology
ATPC	Asian Thermophysical Properties Conference
BIPM	International Bureau of Weights and Measures
BSRN	Baseline Surface Reference Network
BTM	Body Temperature Measurement
CC	Consultative Committee
CBT	Coulomb Blockade Thermometry
CCT	Consultative Committee for Thermometry
CCQM	Consultative Committee for Amount of Substance: Metrology in Chemistry and Biology
CCU	Consultative Committee for Units
CEN	European Committee for Standardisation
CIM	International Metrology Conference
COAT	EMPIR project Increasing the Comparability of extreme Air Temperature measurements for meteorology and climate studies
Co-C	Cobalt carbon eutectic
CODATA	Committee on Data for Science and Technology
CRS	Climate Reference Station
CSPRTs	Capsule Standard Platinum Resistance Thermometers
CGPM	General Conference on Weights and Measures
CIPM	International Committee of Weights and Measures
CMC	Calibration Measurement Capability
DBT	Doppler Broadening Thermometry
DCGT	Dielectric Constant Gas Thermometry
DML	Deep Machine Learning
ECTP	European Conference on Thermophysical Properties
ECV	Essential Climate Variable
EMPIR	European Metrology Programme for Innovation and Research
EMRP	European Metrology Research Programme
EURAMET	European Association of National Metrology Institutes
Fe-C	Iron carbon eutectic
GCOS	Global Climate Observing System

GRUAN	GCOS Reference Upper Air Network
GSRN	GCOS Surface Reference Network
IAPWS	International Association for the Properties of Water and Steam
ICVGT	Interpolating Constant Volume Gas Thermometer
IEC	International Electrotechnical Commission
IMEKO	International Measurement Confederation
InGaAs	Indium Gallium Arsenide (detectors)
InK	EMRP/EMPIR Implementing the new kelvin 1/2
ISHM	International Symposium on Humidity and Moisture
INCIPIT	European project on 'Calibration and accuracy of non-catching instruments to measure liquid/solid atmospheric precipitation'
INFCOM	WMO Infrastructure Commission
ISO	International Standards Organization
ITS-10	the 10th International temperature symposium
ITS-90	International Temperature Scale of 1990
ITS-XX	Proposed future temperature scale
IUPAC	International Union of Pure and Applied Chemistry
JNT	Johnson Noise Thermometry
KC	Key Comparison
KCDB	Key Comparison Data Base
LSPRTs	Long Stem Standard Platinum Resistance Thermometers
HTFP	High temperature fixed points (generally those above the freezing point of copper)
HTPRTs	High Temperature Platinum Resistance Thermometers
MeP-K	*Mise en Pratique* for the definition of the kelvin
MeteoMet	Metrology for Meteorology
MMC	Metrology for Meteorology and Climate
MRA	Mutual Recognition Arrangement
NIM	National Institute of Metrology, China
NMI	National Metrology Institute
NRC	National Research Council (of Canada)
PGT	Polarizing Gas Thermometry
Pd-C	Palladium carbon eutectic
Pt-C	Platinum carbon eutectic
PLTS-2000	Provisional Low Temperature Scale of 2000
RIGT	Refractive Index Gas Thermometry
RH	Relative Humidity

RMO	Regional Metrology Organization
Re-C	Rhenium carbon eutectic
Ru-C	Ruthenium carbon eutectic
SERCOM	WMO Service Commission
SI	International System of Units
SMFPC	Sealed Metal Fixed Point Cell
SMSI	Sensor and Measurement Science conference series
SPRT	Standard Platinum Resistance Thermometer
T	thermodynamic temperature
T_{90}	ITS-90 temperature
T_{2000}	PLTS-2000 temperature
TC-T	[RMO] Technical Committee for Thermometry
Tempmeko	triennial conference of thermal metrology held under the auspices of IMEKO
TG	Task Group
TP	triple point
TS	Technical Specification
WC-C	Tungsten carbide carbon peritectic
WG	Working Group
WMO	World Meteorological Organization