

Report from the CCT Task Group on Digitalization

11 April 2024

1) Background

The CCT Task Group on Digitalization (CCT-TG-Dig) was created at the previous CCT plenary meeting in 2022, at the behest of the CCT President and BIPM staff. As described in the Report of the 30th Meeting of the CCT, the primary goal of the TG was to examine what information in the documents related to the *Mise en pratique* for the definition of the kelvin in the SI (*MeP-K*) could usefully be made available in digital machine-readable form.

2) Terms of Reference

The general objectives of the CCT-TG-Dig are to:

- identify information that should be machine readable in the documents related to the *MeP-K*, such as the ITS-90 text, Guide, appendices, etc.
- recommend an indexing and archiving approach for the documents

Tasks:

- identify the relevant documents and advise BIPM staff on which documents need to be machine readable
- identify equations, tables, etc. in the documents that are commonly implemented in software applications
- recommend an indexing and archiving approach to make both current and former versions of the documents more findable, by internal and external search functions
- test beta versions of relevant documents and functions established by BIPM staff.

3) Current membership

CCT-TG-Dig currently has the following members:

- Dr Patrick Rourke, chair, NRC
- Prof Jovan Bojkovski, MIRS/UL-FE/LMK
- Dr Xiaojuan Feng, NIM
- Dr Christof Gaiser, PTB
- Dr Roberto Gavioso, INRIM
- Dr Yasuki Kawamura, NMIJ/AIST
- Dr Mohamed Sadli, LNE-LCM/Cnam
- Dr Peter Saunders, MSL
- Dr Shahin Tabandeh, MIKES
- Dr Radka Veltcheva, NPL
- Dr Inseok Yang, KRISS
- Dr Howard Yoon, NIST

And a co-opted member:

- Dr Ingmar Müller, PTB

Members of CCT-TG-Dig are also members of CCT-WG-CTh, CCT-WG-NCTh, CCT-WG-Hu, CCT-WG-KC, CCT-WG-CMC and CCT-WG-SP. They represent NMIs from SIM, EURAMET and APMP.

4) Activities

4.1 Machine-readable CCT data

Ten key CCT documents related to the *MeP-K* have been reviewed: the ITS-90 text & technical annex, PLTS-2000 text & supplementary information, AGT & DCGT review articles, 3 radiation thermometry *MeP-K* annexes, and the low-temperature JNT *MeP-K* annex. Seven of the documents were deemed to contain information that could usefully be made machine readable. TG members extracted, validated and delivered the data to the BIPM.

BIPM staff have begun converting the extracted data into web Application Programming Interface (API) functions for machine and human access. A beta-version API for the PLTS-2000 has been created as a simple test case, and is being tested by TG members. The next priority will be an ITS-90 API.

The TG had anticipated extracting data from several further documents in a second round of API creation. These could include digital functions for the difference between thermodynamic temperature T and ITS-90 temperature T_{90} , humidity-related calculations, etc. However, the TG has learned that BIPM digitalization priorities have shifted away from making APIs for the CCs.

4.2 *MeP-K*

The *MeP-K* itself has been restructured for improved machine (and human) readability. Core scientific content remains the same as in the present (2019) version, though several references have been updated to reflect current best practices. The new “digitalized” version is called *MeP-K-19D*, and has been uploaded as a separate working document for discussion by the CCT at its 31st plenary meeting.

4.3 Document indexing and archiving recommendation

The TG has prepared a recommendation to the CCT on an improved archiving, indexing and outreach approach for CCT documents. This has been uploaded as a separate working document for discussion by the CCT at its 31st plenary meeting.

4.4 Coordination with the BIPM

The BIPM expects to issue Digital Object Identifiers (DOIs) for CCT documents in the second half of 2024. CCT-TG-Dig has helped the BIPM to disambiguate temperature quantities, in order to support KCDB digital upgrades. At the request of the TG, the BIPM webmaster has placed prominent links to the *MeP-K*, *Temperature Scales* page and *Guides to Thermometry* page near the top of the main CCT page on the BIPM web. And through consultation with the TG, *Metrologia* has made the original ITS-90 definition paper by Preston-Thomas a free article, so that a journal subscription is no longer needed to access it.

5) Future

The existing CCT-TG-Dig Terms of Reference are very specific, as expected for a Task Group. The TG deems that these original objectives and tasks are now mostly complete, with the main exception of the “beta testing” task.

However, the digital transformation of thermometry is just beginning. The TG would like to bring forward draft new Terms of Reference for discussion by the CCT at its 31st plenary meeting. Since the proposed new Terms of Reference are more advisory/on-going in nature, the TG members ask the CCT to also consider whether such work is best accomplished in the format of a new Working Group rather than a Task Group.

5.1 Draft new Terms of Reference

The terms of reference of {CCT-TG-Dig/CCT-WG-Dig} are to advise and support the CCT, and its Working Groups and Task Groups, on digitalization, and to advise and support the BIPM on thermometry-related aspects of the Digital SI.

Tasks:

- provide thermometry-related digitalization guidance to the BIPM, CCT and other CCT Working Groups and Task Groups;
- liaise with other bodies active in thermometry digitalization, to encourage global digital harmonization and avoid unnecessary parallel work;
- monitor recent developments of Digital Calibration Certificates (DCCs) in the CCT subject areas and connect them in a harmonized approach;
- identify digital functions, data and guidance that would benefit the CCT and broader thermometry community;
- advise BIPM staff during the development and testing of digital functions and documents relevant to the CCT.