

CCT-K7.2021: CIPM Key Comparison of Triple Point of Water cells

29th Meeting of CCT – Session 1

20 October 2020



Summary

- Background
- Provisional list of participants
- Roles (pilot and coordinating group)
- Objectives of the key comparison
- Topology (collapsed star or other)
- Timeline
- Transport of the cells
- Analysis of key comparison results

Background

- 2002-2004: Previous CIPM KC of TPW cells (CCT-K7) carried out
- 2017: In last CCT Meeting, a new KC of TPW cells was considered as a first priority in the planning of the second cycle of CCT KCs
- May 2020:
 - NRC offered to act as pilot
 - Consultation with CCT WG-SP and RMO TC-T chairs → confirmed the interest
- June 2020: all CCT members officially asked to:
 - Express interest in participating → 17 members expressed interest
 - Accept/object to NRC acting as pilot → NRC unanimously accepted as pilot
- September 2020:
 - Kick-off meeting → major features of the KC already agreed, draft Technical Protocol completed (to be distributed this week)

Do we need it?

- New definition of the kelvin no longer relies on TPW cells for the realization of the kelvin
- TPW cells continue to play a fundamental role in the realization of the ITS-90
- Since the “*Clarification of the definition of the kelvin*” (2005), many NMIs have revised their national reference for the TPW temperature

Provisional list of participants

Institute	Country	Contact person	Contact email
CEM	Spain	Dolores del Campo	ddelcampo@cem.es
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Last week IPQ
requested to
participate

Number of participants per RMO

- AFRIMETS (1): NMISA
- APMP (5): KRISS, MSL, NIM, NMIA, NMIJ/AIST
- COOMET (1): VNIIM
- EURAMET (6): CEM, INRiM, LNE/CNAM, NPL, PTB, UME
- SIM (4): CENAM, INMETRO, NIST, NRC

→ **17 participants**

Roles

- Pilot: NRC
- Coordinating group:
 - Function:
 - Harmonization of uncertainty budgets
 - Methods for analyzing the key comparison results
 - Software tools for analysis of key comparison results
 - Members:
 - A. Peruzzi, NRC
 - S. Dedyulin, NRC
 - R. White, MSL
 - A. Possolo, NIST

Objectives

Primary objective:

A comparison, mediated by the transfer cells, of the national realizations of the TPW temperature of the participants

→ Expected reduced differences between the national references, due to improved measurement capabilities and all participants applying isotopic corrections

By-products:

a) A comparison of TPW cells (one transfer cell from each participant) of the highest quality

→ Expected reduced differences between the cells, due to improved measurement capabilities and production of cells closer to VSMOW

b) A linkage to the previous KC, mediated by cells that were used by the participants in CCT-K7 and that are still available

Topology

- Collapsed star:
 - Each participating laboratory:
 - Selects one of its TPW cells for use as transfer cell
 - Compares the selected transfer cell to its TPW national reference
 - Compares the CCT-K7 cell (if available) to TPW national reference
 - Delivers the transfer cell and the measurement results to the pilot
 - The pilot laboratory:
 - Compares all transfer cells
 - Each participating laboratory:
 - Retrieves its transfer cell from the pilot laboratory
 - Re-compares its transfer cell to its TPW national reference
 - Re-compares CCT-K7 cell (if available) to national reference

Accepted timeline

Date	Activity
April 1 st , 2021	Start date: the participants select the transfer cell and compare it to the national reference (if available, compare CCT-K7 to national reference)
June 30 th , 2021	Deadline for the delivery of the transfer cell and the corresponding measurement results to the pilot
June 30 th , 2021 to December 31 st 2021	The pilot compares all transfer cells
January 1 st , 2022	From this date the participants can retrieve their transfer cell
March 31 st , 2022	Deadline for the completion of the return measurements at the participant laboratories and for the delivery of the return measurement results to the pilot
June 30 th , 2022	Deadline for the preparation of the Draft A report

Transport of the cells

- Best way of packing before shipping the cells?
- MSL Technical Guide 44, “*Shipping TPW Cells*”
- Ask advice from Isotech/Fluke
- Each participant is responsible for the transport of the transfer cell to and from NRC (and will take out insurance for the transport of the cell, if deemed necessary)

Analysis of key comparison results

- Approach discussed within the Coordinating Group
- Isotopic and impurity effects in the national reference ensembles generate a one-sided distribution of errors in the national references
- **KCRV: only national references applying isotopic corrections and using fused silica cells will contribute**

Data reduction

- An approach based on a statistical model for the measurement results will be adopted
- Reliance on an explicit statistical model allows assessing the fitness of the model to the data, and selection of the most appropriate model.
- “Decision Tree for Key Comparison data reductions”, A. Koepke and A. Possolo (2020), in preparation for publication:
 - Random effects models of different kinds, able to recognize, evaluate, and propagate (to the KCRV and to the DoEs), uncertainty contributions in excess of those reported by the participants that become apparent only once independent results are compared (“dark uncertainty”).
 - Other models, which may prove best when there is no significant dark uncertainty.
- The selected model will:
 - Be validated using established statistical diagnostics
 - Ultimately determine the algorithm for data reduction in accordance with best statistical practices.

THANK YOU

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