Report presented to the CCT by the Task Group for the Realization of the Kelvin (CCT TG-K): May 2017

1. Membership

CCT TG-K members are: Bernd Fellmuth (chairman, PTB), Wukchul Joung (KRISS), Ken Hill (NRC), Murat Kalemci (UME), Edgar Mendez-Lango (CENAM), Tohru Nakano (NMIJ/AIST), Jonathan Pearce (NPL), Andrea Peruzzi (VSL), Anatoly Pokhodun (VNIIM), Fernando Sparasci (LNE-Cnam), Peter Steur (INRIM), Gregory Strouse (NIST), Jianping Sun (NIM)

Co-opted specialists are providing assistance: Pieter Bloembergen (VSL), Susanne Picard (BIPM), Takeshi Shimazaki (NMIJ/AIST), Weston Tew (NIST)

Changes of the membership after the last CCT meeting: Patrick Rourke (NRC)

Members of the Task Group for updating the text of the *mise en pratique of the realization of the kelvin* are: Bernd Fellmuth (chairman, PTB), Graham Machin (chairman WG-NCTh, NPL), Susanne Picard (executive secretary of CCT, BIPM), Peter Steur (INRIM)

Chairmen of Task Groups for preparing appendices of the *mise en pratique of the realization of the kelvin*: Christof Gaiser (PTB, polarising gas thermometry), Jost Engert (PTB, noise thermometry at low temperatures using SQUIDs), Horst Rogalla (NIST, noise thermometry using a Josephson quantised voltage source)

2. Terms of Reference

The terms of reference of CCT TG-K are to document the techniques for using defining fixed points and interpolating instruments of the realizing the base unit kelvin.

Tasks:
- Update of the *Guide to the Realization of the ITS-90 and the PLTS-2000*;
- Update of the *mise en pratique of the definition of the kelvin* (MeP-K);
- Update of data necessary for estimating the influence of impurities on fixed-point temperatures.

3. Activities Since the last CCT Meeting

3.1 Meetings

Since the last CCT meeting, CCT TG-K has met once in Zakopane, Poland, on 1 July 2016, after TEMPMEKO 2016, the 13th *Symposium on Temperature and Thermal Measurements in Industry and Science*.

One meeting of CCT TG-K is planned at BIPM in preparation of the next meeting of the CCT this year on 29 May.

3.2 Updating the *Guide to the Realization of the ITS-90*

The concept for the publication of the *Guide to the Realization of the ITS-90* on the BIPM website (http://www.bipm.org/en/committees/cc/cct/guide-its90.html) approved by the CCT

at its 26th meeting in 2012 has been further realized. The following revised parts of the *Supplementary Information for the ITS-90* have already been posted on the website since the 27th meeting in 2014 (the prior to this posted parts are listed in Document CCT/14-24):

- Section 2.1 *Influence of Impurities*,
- Section 2.3 *Cryogenic Fixed Points*,
- Section 2.4 *Metal Fixed Points for Contact Thermometry*,
- Chapter 5 *Platinum Resistance Thermometry*.

A draft has been prepared for the last missing part of the *Guide to the Realization of the ITS-90*:

- Chapters 3 *Vapour pressure scales and pressure measurements* (CCT/17-XX).

Updates of parts of the *Guide to the Realization of the ITS-90* that were already revised:

- Based on new data for the dependence of the temperature of the triple point of water (TPW) on the isotopic composition that are summarized in Document CCT/17-06, Section 2.2 *Triple Point of Water* has been updated (CCT/17-05). In accordance with this, the equations specified in the Technical Annex of the *Mise en Pratique for the Definition of the Kelvin* have been changed (CCT/17-07).
- Using the aggregate values of liquidus-line slope values published by Pearce *et al.* [*Metrologia* **53** (2016) 1101-1114], Appendix 2 of Section 2.1 *Influence of Impurities* has been updated (CCT/17-08).

3.3 *Mise en Pratique of the Realization of the Kelvin*

As a basis for defining the base unit kelvin by fixing the value of the Boltzmann constant, see the report of the 26th meeting of the CCT, Sections 3.1.1 and 3.4.1, a second version of the *Mise en Pratique of the Definition of the Kelvin*, called provisionally MeP-K-14, has been prepared by the task group for the MeP-K (TG-MeP-K) and approved by the CCT in May 2013 via e-mail voting. MeP-K-14 has been posted on the BIPM website with restricted access (Document CCT/TEMP-10: MeP-K-14_DRAFT_Dec_2015.pdf). Important details concerning its preparation are described in Document CCT/14-24. Together with its four appendices, the MeP-K-14 was submitted by the CCT to the CCU for discussion at its 21st meeting in June 2013.

Considering the progress achieved after the 27th meeting of the CCT, the second version of the *Mise en Pratique of the Realization of the Kelvin* has been updated by the task group mentioned above. The update (CCT/17-04) is called here provisionally MeP-K-19. The following details concerning the preparation of the MeP-K-19 should be emphasised:

- Some terms, e.g. "*Guide*" instead of "*Supplementary Information*", were changed and a slight rewording in line with the paper "The kelvin redefinition and its *mise en pratique*" (Phil. Trans. R. Soc. A **374** (2016) 20150037) was performed.
- Brief descriptions of two further primary thermometry methods are included: Johnson noise thermometry and polarising (dielectric-constant and refractive index) gas thermometry. Three drafts of appendices describing these methods in detail have also been prepared and submitted as CCT working documents: (i) refractive-index gas thermometry, (ii) noise thermometry at low temperatures using SQUIDs (low-temperature Johnson noise thermometry), and (iii) noise thermometry using a Josephson quantised voltage source (electronic temperature measurement by Johnson noise thermometry).

Bernd Fellmuth, May 2017