CCT Task Group on Digitalization (CCT-TG-Dig)

Dr. Patrick Rourke, *Online Briefing on the establishment of a Forum for Metrology and Digitalization*, 22 May 2023
Creation

30th meeting of the CCT, February 2022

Purpose

To support the Digital SI efforts of the BIPM within the purview of CCT

- Machine-readability of the SI Brochure, its associated *Mises en Pratiques*, and further key documents of the Consultative Committees
- Advisory role to the CCT and BIPM
- Wider “new metrology” issues such as “in-situ traceability”, “self-calibrating sensors” and “points of truth” in sensor networks are not in the scope of this TG (MRA / traceability / equivalence) ⇒ Another CCT TG may be established to consider them
CCT-TG-Dig: Support the Digital SI efforts of the BIPM within the purview of CCT

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
Present CCT-TG-Dig membership

Chair
• Dr. Patrick Rourke, NRC Canada (member: CCT-WG-CTh, CCT-WG-SP)

Members
• Prof. Jovan Bojkovski, MIRS/UL-FE/LMK Slovenia (chair: CCT-WG-CMC; member: CCT-WG-SP)
• Dr. Christof Gaiser, PTB Germany (chair: CCT-WG-CTh; member: CCT-WG-SP)
• Dr. Roberto Gavioso, INRiM Italy (member: CCT-WG-CTh)
• Dr. Yasuki Kawamura, NMIJ/AIST Japan (chair: CCT-WG-NCTh; member: CCT-WG-SP, CCT-TG-CTh-ET)
• Prof. Graham Machin, NPL UK (chair: CCT-TG-NCTh-IRT; member: CCT-WG-NCTh)
• Dr. Mohamed Sadli, LNE-LCM/Cnam (member: CCT-TG-NCTh-IRT, CCT-WG-NCTh)
• Dr. Peter Saunders, MSL New Zealand (member: CCT-WG-Hu, CCT-TG-Env-AirT)
• Dr. Shahin Tabandeh, MIKES Finland (member: CCT-WG-CTh)
• Dr. Inseok Yang, KRISS Korea (member: CCT-WG-CTh)
• Dr. Jintao Zhang, NIM China (member: CCT-WG-CTh)

Co-opted members
• Dr. Ingmar Müller, PTB Germany

Broad expertise & connections across CCT areas
CCT-TG-Dig 1\textsuperscript{st} year done

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CCT-TG-Dig 1\textsuperscript{st} year done

Digital data identification, extraction and validation from top priority CCT documents:
• The International Temperature Scale of 1990 (ITS-90)
• The Provisional Low Temperature Scale from 0.9 mK to 1 K (PLTS-2000)
• Technical Annex for the International Temperature Scale of 1990
• Supplementary Information for the Realization of the PLTS-2000
• MeP-K Annex: Absolute Primary Radiometric Thermometry
• MeP-K Annex: Relative Primary Radiometric Thermometry
• MeP-K Annex: Uncertainty Estimation in Primary Radiometric Temperature Measurement
• MeP-K Annex: Low Temperature Johnson Noise Thermometry
• Review article supporting the MeP-K: Moldover \textit{et al.}, Acoustic Gas Thermometry \textit{Metrologia} (2014)
• Review article supporting the MeP-K: Gaiser \textit{et al.}, Dielectric-Constant Gas Thermometry \textit{Metrologia} (2015)

Began restructuring \textit{MeP-K} to improve its machine readability
Example: ITS-90 coefficients

Why digitalize?

- Coefficients used for all standard platinum resistance thermometers calibrated on the ITS-90 worldwide
- Scanned PDF
- Many coefficients, many digits
- Transcription errors could be hard to detect

### Table IV

<table>
<thead>
<tr>
<th>Platinum resistance thermometer</th>
</tr>
</thead>
<tbody>
<tr>
<td>The constants $A_0, A_1, B_0, B_1, C_0, C_1, D_0$ and $D_1$ in the reference function of equations (9a); (9b); (10a); and (10b) respectively</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$A_0$</th>
<th>$A_1$</th>
<th>$A_2$</th>
<th>$A_3$</th>
<th>$A_4$</th>
<th>$A_5$</th>
<th>$A_6$</th>
<th>$A_7$</th>
<th>$A_8$</th>
<th>$A_9$</th>
<th>$A_{10}$</th>
<th>$A_{11}$</th>
<th>$A_{12}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,135 347 29</td>
<td>3,183 247 20</td>
<td>1,801 435 97</td>
<td>0,717 272 04</td>
<td>0,503 440 27</td>
<td>0,618 993 95</td>
<td>0,053 323 22</td>
<td>0,280 213 62</td>
<td>0,107 152 24</td>
<td>0,293 028 65</td>
<td>0,044 598 72</td>
<td>0,118 686 32</td>
<td>0,052 481 34</td>
</tr>
<tr>
<td>$B_0$</td>
<td>$B_1$</td>
<td>$B_2$</td>
<td>$B_3$</td>
<td>$B_4$</td>
<td>$B_5$</td>
<td>$B_6$</td>
<td>$B_7$</td>
<td>$B_8$</td>
<td>$B_9$</td>
<td>$B_{10}$</td>
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<td>$B_{12}$</td>
</tr>
<tr>
<td>0,183 324 722</td>
<td>0,240 975 303</td>
<td>0,209 108 771</td>
<td>0,190 439 972</td>
<td>0,142 648 498</td>
<td>0,077 993 465</td>
<td>0,012 475 611</td>
<td>0,032 267 127</td>
<td>0,075 291 522</td>
<td>0,056 470 670</td>
<td>0,076 201 285</td>
<td>0,123 893 204</td>
<td>0,029 201 193</td>
</tr>
<tr>
<td>$C_0$</td>
<td>$C_1$</td>
<td>$C_2$</td>
<td>$C_3$</td>
<td>$C_4$</td>
<td>$C_5$</td>
<td>$C_6$</td>
<td>$C_7$</td>
<td>$C_8$</td>
<td>$C_9$</td>
<td>$D_0$</td>
<td>$D_1$</td>
<td>$D_2$</td>
</tr>
<tr>
<td>2,781 572 54</td>
<td>1,646 509 16</td>
<td>0,137 143 90</td>
<td>0,006 497 67</td>
<td>0,002 344 44</td>
<td>0,005 118 68</td>
<td>0,001 879 82</td>
<td>0,002 044 72</td>
<td>0,000 461 22</td>
<td>0,000 457 24</td>
<td>439,932 854</td>
<td>472,418 020</td>
<td>37,684 494</td>
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<tr>
<td>$D_3$</td>
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<tr>
<td>7,472 018</td>
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<td>0,188 732</td>
<td>0,191 203</td>
<td>0,049 025</td>
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</table>
CCT-TG-Dig 2nd year plans

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Future of CCT-TG-Dig

31st meeting of the CCT, May 2024

Anticipate current TG tasks to be complete by May 2024.

• Report and recommendations to the CCT

• Beyond May 2024 – CCT discussion:
  • Should CCT-TG-Dig be renewed with new Terms of Reference?
  • What digitalization activities within the purview of CCT and aligned with CCT-TG-Dig expertise would be most helpful to stakeholders?
  • Evolving BIPM Digital SI priorities?
  • Interaction with the Forum?
Thank you

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