

# CCT Working Group for Humidity

Report to the CCT 2020  
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# CCT Working Group for Humidity

## Terms of reference:

- to advise the CCT on matters relating to humidity;
- to pursue harmonization relevant to the field of humidity measurements;
- to develop and maintain an effective liaison with the international humidity and moisture community.

## Tasks:

- operation of CCT-K6 and CCT-K8;
- strategic planning of ongoing and future key and supplementary comparisons in the field;
- clarification of quantities, units, symbols and realizations relating to humidity measurement;
- draft a document on uncertainty in humidity.

# CCT Working Group for Humidity



Membership 20 (up 2 since last CCT)

CETIAT, CENAM, INRIM, INTA, KRISS, MIKES, MSL, NIM, NIST, NMC  
A-STAR, NMIJ-AIST, NMISA, NPL (Chair), PTB, VSL, UME, VNIIFTRI,  
IAPWS

and new members NMIA (Australia), INMETRO (Brazil)

New role of vice chair: Hisashi Abe (NMIJ)

## Meetings:

- June 2019 in Chengdu, in association with TEMPMEKO & TEMPBEIJING and MMC
- Web meeting December 2020

# Humidity KCs/ RMO KCs /SCs - progress 2014 to 2020

Comparison	Status and date
<b>AFRIMETS.T-S4</b>	Rep. "approved" on Aug. 23 <sup>rd</sup> , 2017
<b>APMP.T-K6.2013</b>	Comments on rev. prot. sent Oct. 23 <sup>rd</sup> , 2015
<b>APMP.T-K8</b>	Comments on rep. sent Mar. 3 <sup>rd</sup> , 2020
<b>APMP.T-S13</b>	Comments on rev. prot. sent Oct. 23 <sup>rd</sup> , 2015
<b>APMP.T-S14</b>	Comments on rev. prot. sent Feb. 20 <sup>th</sup> , 2020
<b>APMP.T-S17</b>	Prot. Approved Sep. 6 <sup>th</sup> , 2019
<b>CCT-K6.2</b>	Approved Feb 24 <sup>th</sup> , 2020
<b>CCT-K8</b>	Prot. approved Feb. 22 <sup>th</sup> , 2017
<b>COOMET.T-S3</b>	Approved Mar. 11 <sup>th</sup> , 2020
<b>EURAMET.T-K6.2</b>	Comments on protocol sent Jan. 2 <sup>nd</sup> , 2018
<b>EURAMET.T-K8</b>	Comments on prot. sent May 13 <sup>nd</sup> , 2013
<b>EURAMET.T-K8.1</b>	Comments on protocol sent Jan. 2 <sup>nd</sup> , 2018
<b>GULFMET.T-S1</b>	Prot. approved Aug. 27 <sup>th</sup> , 2018
<b>SIM.T-K6.1</b>	Approved Aug. 31 <sup>st</sup> , 2015
<b>SIM.T-K6.2</b>	Approved Aug. 12 <sup>th</sup> , 2014
<b>SIM.T-K6.3</b>	Approved Oct. 23 <sup>rd</sup> , 2014
<b>SIM.T-K6.5</b>	Approved May 17 <sup>th</sup> , 2016
<b>SIM.T-K6.6</b>	Comments on rep. sent Feb. 24 <sup>th</sup> , 2020.
<b>SIM.T-K6.7</b>	Approved October. 7 <sup>th</sup> , 2019
<b>SIM.T-S10</b>	Comments on rep. sent Aug. 21 <sup>st</sup> , 2020
<b>SIM.T-S9</b>	Comments on prot. sent Dec. 16 <sup>th</sup> , 2016

# Humidity KCs – current status

## CCT-K6 – was completed 2015

- Dew point -50 °C to +20 °C, 10 participants, measurements ended 2009
- Next CCT-K6: ready to begin planning, ***subject to CCT approval***
  
- CCT-K6.1 – MSL-NPL Draft report submitted for RMO review 2020
- CCT-K6.2 – NIST-NMIJ Draft B approved 2020

## CCT-K8 – in progress

- Dew point, 30 °C to 95 °C, 10 participants
- Coordinator INTA, assistant pilots NIST, BEV E+E
- Participant measurements in 2016 and 2017, plus drift checks (acceptably small)
- Draft A in preparation – full results not yet circulated but “no anomalies”

# Strategic planning of future KCs/SCs

- Propose repeat CCT-K6
  - Repeat APMP.T-K6.2013 already well advanced
- Considering
  - How to reduce effort of humidity KCs
  - Frequency, speed of completion
  - Linkage of comparisons staggered in time
  - Alignment of KCs to humidity CMC review protocols

# CMC review protocols

Some emerging problems with humidity CMC review process:

- Submissions of uncertainty analysis in varied formats, with varied supporting materials
- Especially hard for “individual review” in absence of comparison result, and/or for small claimed uncertainty
- Humidity CMC submissions without comparison results, that do not satisfy the criteria of the Review Protocol, are sometimes mistakenly approved in Intra-RMO Review processes.

Planning of future humidity KCs/SCs is also related to CMC review protocol:

- currently, review protocol for dew-point CMCs allows only small interpolations/ extrapolations
- forces humidity KCs to be made at many values, some small intervals

WG-Hu asked by CCT WG-CMC to review and propose amendments to review protocols for dew point and relative humidity.

# Humidity quantities, units, symbols and realizations ...

## Humidity terms and definitions

- Document in development
- Proposal to make list of relevant references available via BIPM website

## Relative humidity definitions

- Previous work: Metrologia papers
  - 2015 review papers on RH (alongside pH and salinity)
  - 2017 paper on RH definition based on fugacity (water activity)
- Alternative definitions (relative fugacity) under consideration.
- Relative humidity in the SI: TEMPMEKO 2019 plenary presentation – paper in preparation for *Metrologia*

## Draft document on uncertainty in humidity realisations

- Near completion, document with selected WG-members for review

## Humidity realisations

- New work item document, at outline stage

# Coordination and collaboration: The International Association for the Properties of Water and Steam (IAPWS)



## ■ IAPWS-BIPM Humidity Workshop at the 17th ICPWS in Prague 2018:



- Introduction & summary of aims *Olaf Hellmuth (TROPOS Leibniz Institute for Tropospheric Research, GE)*
  - State-of-the-art of a generalised RH definition & key items of official ICCP position on RH definition *Jeremy-Lovell Smith (MSL)*
  - How a new definition might fit in with SI metrology and NMI practices in realisation of humidity standards *Stephanie Bell (NPL)*
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- J Lovell-Smith and S Bell joined *Humidity Working Group of The Joint Committee on the Properties of Seawater (IAPSO/SCOR/IAPWS) “JCS”*
  - Already on *Working Group - Thermophysical Properties of Water and Steam (TPWS) 2013 to date*

# Coordination and collaboration

- Collaboration with CCQM on trace moisture in gases
  - CCQM-K116 H<sub>2</sub>O in N<sub>2</sub> at 10 μmol/mol (cylinders) completed 2018: KRISS, METAS, NPL, VNIIM, VSL, NMIJ, NIM, INMETRO
  - Results of NPL (frost point) and NOAA reported 2020 as aligned pilot comparison
  - All results demonstrated satisfactory equivalence

# Other actions

## International Symposium on Humidity and Moisture (ISHM)

- Agreed to hold ISHM jointly with TEMPMEKO (was planned for 2023), location France
- But all international events are re-scheduling - will be reviewed.