

**SIM.T-K6.3 NIST / INMETRO  
Final Report**

**APPENDIX TO THE REPORT:  
BILATERAL KEY COMPARISON SIM.T-K6.3 ON HUMIDITY STANDARDS  
IN THE DEW/FROST-POINT TEMPERATURE RANGE FROM  $-30\text{ }^{\circ}\text{C}$  TO  $20\text{ }^{\circ}\text{C}$**

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**Appendix: Linkage of SIM.T-K6.3 to the CCT-K6 KCRV**

This is an appendix to the report for SIM.T-K6.3 [1].

Because NIST participated in the CCT-K6 multilateral key comparison [2], some of the results of this bilateral comparison may be linked to the CCT-K6 key comparison reference value (KCRV) for  $T_{\text{DP/FP}}$ . The degree of equivalence between  $T_{\text{DP/FP}}$  realized by a NMI and the KCRV,  $D_{\text{NMI/KCRV}}$ , is defined as

$$D_{\text{NMI/KCRV}}(T_{\text{DP/FP}}) \equiv [\Delta T_{\text{DP/FP}}]_{\text{NMI}} - [\Delta T_{\text{DP/FP}}]_{\text{KCRV}}. \quad \text{A1)}$$

Since INMETRO did not participate in CCT-K6, Eq. 5 and Eq. A1 may be used to determine  $D_{\text{INMETRO/KCRV}}$ :

$$D_{\text{INMETRO/KCRV}}(T_{\text{DP/FP}}) = D_{\text{INMETRO/NIST}}(T_{\text{DP/FP}}) + D_{\text{NIST/KCRV}}(T_{\text{DP/FP}}). \quad \text{A2)}$$

with corresponding uncertainty

$$U^2(D_{\text{INMETRO/KCRV}}) = U^2(D_{\text{INMETRO/NIST}}) + U^2(D_{\text{NIST/KCRV}}) \quad \text{A3)}$$

The CCT-K6 comparison was performed at  $T_{\text{DP/FP}}$  values of  $+20\text{ }^{\circ}\text{C}$ ,  $1\text{ }^{\circ}\text{C}$ ,  $-10\text{ }^{\circ}\text{C}$ ,  $-30\text{ }^{\circ}\text{C}$ , and  $-50\text{ }^{\circ}\text{C}$ . The last two values will not be considered here because the NIST HHG was not used at those points in CCT-K6. While the CCT-K6 comparison was performed at  $1\text{ }^{\circ}\text{C}$  and the NIST/INMETRO comparison was performed at  $0\text{ }^{\circ}\text{C}$ , we consider these values acceptably close for linkage and assume that

$$D_{\text{INMETRO/NIST}}(1\text{ }^{\circ}\text{C}) = D_{\text{INMETRO/NIST}}(0\text{ }^{\circ}\text{C}). \quad \text{A4)}$$

The relevant values of  $D_{\text{NIST/KCRV}}$  and  $U(D_{\text{NIST/KCRV}})$  from [2] are given in Table A1:

**Table A1.** Degree of equivalence between  $T_{DP/FP}$  realized by NIST and the KCRV,  $D_{NIST/KCRV}$ , and its expanded uncertainty ( $k = 2$ ),  $U(D_{NIST/KCRV})$ , at  $T_{DP/FP}$  values of +20 °C, 1 °C, and -10 °C, as given by Tables 7.3 and 7.4 in [2].

Nominal $T_{DP/FP}$ (°C)	$D_{NIST/KCRV}$ (°C)	$U(D_{NIST/KCRV})$ (°C)
20	-0.006	0.050
1	-0.011	0.060
-10	-0.039	0.043

Combining the results of Table 7 from [1] and Table A1 using Eqs. A2-A3 yields the values of  $D_{INMETRO/KCRV}$  and  $U(D_{INMETRO/KCRV})$ :

**Table A2.** Degree of equivalence between  $T_{DP/FP}$  realized by INMETRO and the KCRV,  $D_{INMETRO/KCRV}$ , and its expanded uncertainty ( $k = 2$ ),  $U(D_{INMETRO/KCRV})$ , at  $T_{DP/FP}$  values of +20 °C, 1 °C, and -10 °C.

Nominal $T_{DP/FP}$ (°C)	$D_{INMETRO/KCRV}$ (°C)	$U(D_{INMETRO/KCRV})$ (°C)
20	0.012	0.21
1	0.039	0.21
-10	0.044	0.20

The values of  $D_{INMETRO/KCRV}$  are all within the  $k=2$  uncertainty values  $U(D_{INMETRO/KCRV})$ .

## References

- [1] P.H. Huang, C.W. Meyer, J.D Brionizio, “Bilateral Key Comparison SIM.T-K6.3 on Humidity Standards in the Dew/Frost-point Temperature Range from -30 °C to 20 °C”, *Metrologia* **52**, Tech. Suppl., 03001 (2015).
- [2] S. Bell et al., “Final report to the CCT on key comparison CCT-K6 – Comparison of local realisations of dew-point temperature scales in the range -50 °C to +20 °C”, *Metrologia* **52**, Tech. Suppl., 03005 (2015).