

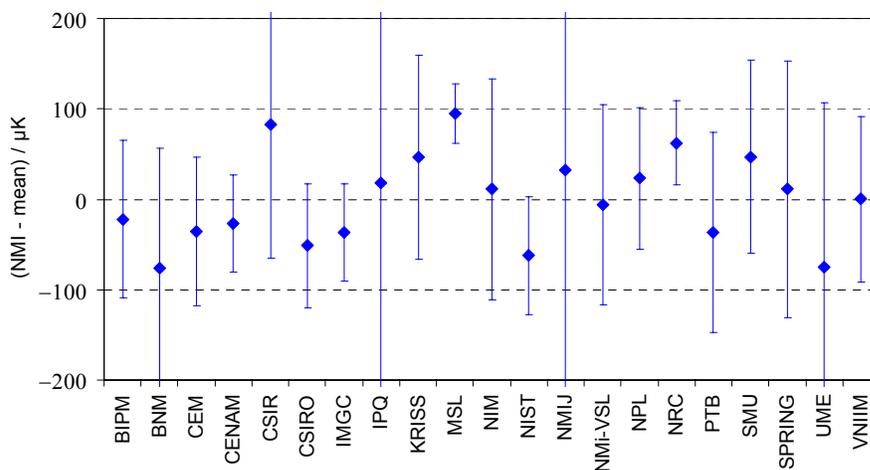
## International Equivalence of Thermometry Calibrations

The International Committee for Weights and Measures (CIPM) Mutual Recognition Arrangement (MRA) provides a framework for establishing the equivalence of thermometry calibrations worldwide. In practice, there are multiple steps in establishing equivalence: a) performing international and regional comparisons of thermometry artifact; b) establishing uniform categories of calibration service; and c) international review of calibration capabilities for acceptance under the MRA.

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In 2005, the final international key comparison in thermometry was completed under the auspices of the Consultative Committee for Thermometry (CCT): CCT-K7 on the realization of the triple point of water. The NIST Thermometry Group is now acting as the pilot laboratory for a series of regional comparisons that will extend the equivalence of thermometry calibrations throughout North, South, and Central America, and with a broader scope that includes industrial as well as standards-grade thermometers. We have completed the measurement phase of a comparison on calibrations of the industrially common type K thermocouple and of a comparison on liquid-in-glass thermometers. We have begun measurements for a comparison with standard platinum resistance thermometers, to establish equivalence over the range  $-194\text{ }^{\circ}\text{C}$  to  $660\text{ }^{\circ}\text{C}$ .

The results of K7 revealed that the existing definition of the kelvin, assigning 273.16 K to the triple point of water, is incomplete. NIST staff led the task group that provided a newly clarified definition incorporating isotopic corrections, and worked with US manufacturers of cells to provide cells with known isotopic composition. Using these new cells, the discrepancy shown in the figure is expected to decrease by approximately a factor of two.



The international and regional comparisons provide a basis for establishing the equivalence of temperature calibrations worldwide, reducing trade barriers, and giving global acceptance of NIST calibrations. This is the direct benefit anticipated when the MRA was first signed.

In hindsight, the comparison process has led to unexpected, indirect benefits of high value: a) technical flaws in calibration methods have been identified, b) a harmonized approach to calculation of uncertainties has emerged, c) gaps in our knowledge of thermometer properties have been identified and corrected, and d) the skills developed in conducting comparisons have led to optimized proficiency tests for determining the equivalence of thermometry calibrations of industrial laboratories to those of NIST. We are supporting the continued global competitiveness of US manufacturers of thermometry products by working closely with them as they incorporate the new Triple Point of Water (TPW) definition into their commercial products and they introduce the harmonized uncertainty calculations into their calibrations. The figure shows the results of CCT-K7 (Triple Point of Water Key Comparison).

NIST chairs the international Consultative Committee for Thermometry Working Group (CCT-WG8) that establishes service categories and reviews MRA entries. In 2005, WG8 completed the international harmonization of calibration service categories and produced guidelines for the review of industrial thermometers and humidity standards.

### Future plans:

NIST continues to work with several countries within the Americas to expand their technical expertise in thermometry and ensure that they have suitable temperature standards required for exporting temperature-sensitive products to the US (such as perishable foods, chemicals).