10. Maintenance and Dissemination of the International Temperature Scale of 1990 (ITS-90)

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Objective: Maintain the ITS-90 as it is defined over the range from 0.65 K to 1235 K, disseminate it to the user community, and investigate its non-uniqueness over this temperature range.

Problem:
The ITS-90 is fully realized in the Thermometry Group over the range 0.65 K to 1235 K. Work remains, however, in quantifying the non-uniqueness of the ITS-90, in improving the dissemination of the scale, in improving the efficiency with which we maintain the scale, and in characterizing the properties of instruments used to disseminate the scale.

Approach:
The non-uniqueness of the ITS-90, a measure of the lack of single-valued temperature definitions on the ITS-90, is being determined in the various temperature ranges from 13.8 K to 1235 K. The ITS-90 is maintained at NIST in several laboratories, and is disseminated through calibrations of various types of customer thermometers, certification of fixed-point cells, and through SRM materials and thermometers. Experiments on thermocouples and liq uid-in-glass thermometers are being conducted to determine the uncertainties of these types of thermometers.

Results and Future Plans: Measurements of the non-uniqueness of seven High-Temperature Standard Platinum Resistance Thermometers (HTSPRTs) in the range from 933 K to 1235 K have been completed in our high-temperature comparator in FY00, and these results will be published in FY01. All measurements obtained to date on our HTSPRTs indicate a non-uniqueness of

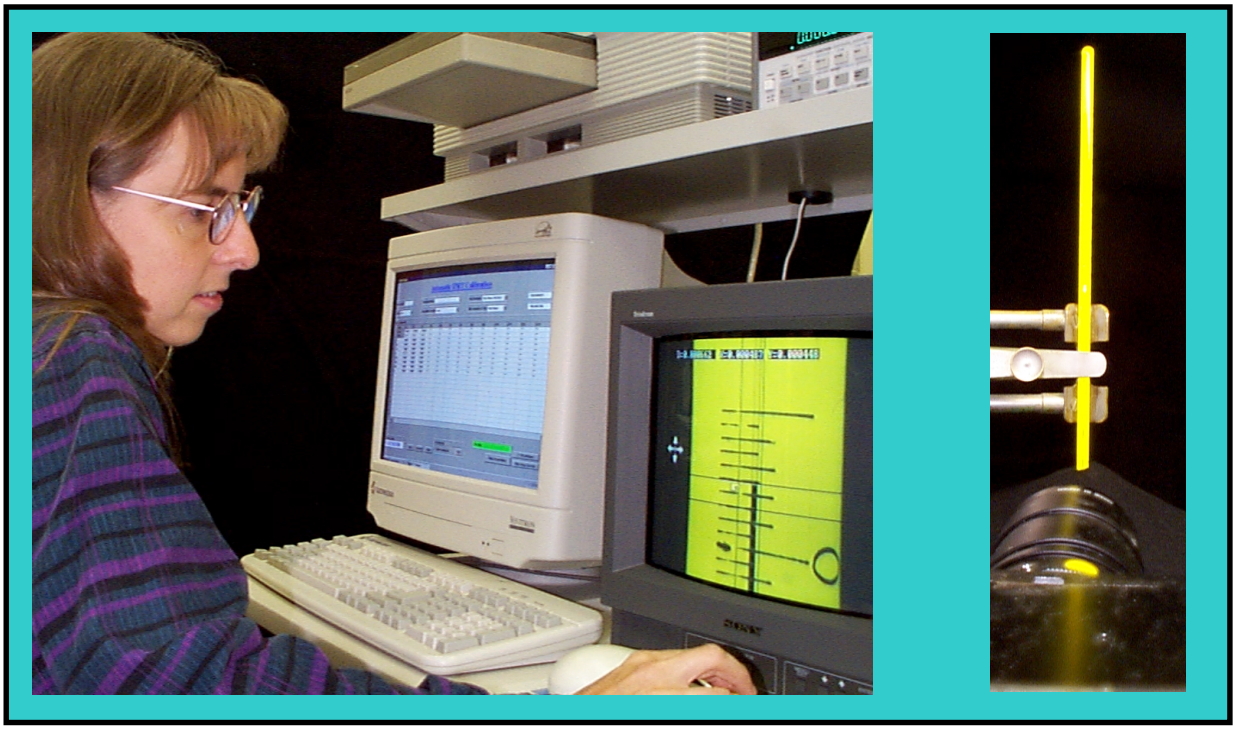

Figure 1. A new computerized, digital vision system for high-accuracy measurements of liquid-in-glass thermometers.

about 2 mK, significantly smaller than that observed at other NMIs. Data obtained in conjunction with the production of SRM 1750 will be useful in determining the device-dependent SPRT non-uniqueness in the range 13.8 K to 273 K.

In the area of maintenance of the ITS-90, variations in the ratio of deuterium to hydrogen have been identified as a very important source of uncertainty at the equilibrium hydrogen triple and vapor-pressure points. This effect may be the source of a minor discrepancy between NIST and other laboratories in Key Comparison 2 at 13.8 K, and new hydrogen fixed-point cells have been built to investigate this effect. A set of mercury fixed-point cells has been successfully fabricated and tested—the first such set since 1982. Some of these cells will solve a problem identified in the course of Key Comparison 2. New cells will also replace some older cells with stainless steel shells that may have leached small amounts of impurities into the mercury.

Measurements on the uncertainties of liquid-in-glass thermometers and on the uncertainties and long-term drift of base metal thermocouples continued in FY00. We continue to improve our measurement capabilities of industrial thermometers, with a program of laboratory automation.