Introduction

The purpose of this publication is to bring together in one readily available document of some degree of permanence, several of the major articles documenting the evolution of the International Practical Temperature Scale of 1968 (IPTS-68), to summarize the reasons for the continuing revision of temperature scales, and to assess their impact on the industry.

The ideal temperature scale, which defines temperature, has not changed since it was first introduced in 1854 by Lord Kelvin. It is based on the gas laws which relate temperature ratios to pressure ratios in ideal gases. It has several important limitations: (1) no physical gas is ideal, or even nearly ideal except over a narrow range of temperature; (2) there is no device based on this scale which can be used satisfactorily to measure real temperatures; and (3) since it defines only temperature *ratios*, it must be tied to a fixed temperature in order to be useful. Hence, the International Practical Temperature Scales have been successively adopted, each representing the best approximations available to the current technology, using practical instruments.

These approximations include the selection and definition of benchmarks as well as practical laboratory instruments for interpolation between the benchmarks. New International Practical Temperature Scales were adopted in 1927, 1948, 1960, and 1968 as these benchmarks were redefined in the light of new technology.

The present fixed point used to define the scale is the triple point of water at 273.16 K, adopted in IPTS-48. The benchmarks which define IPTS-68 are the carefully measured equilibrium temperatures of hydrogen, neon, oxygen, water, zinc, silver, and gold.

Practical scale definition in segments defined by fixed points and interpolated by physical instruments lead to, at best, complexity and compromise to avoid discontinuities in the scale and its derivatives at the transition points. These problems are minimized by reducing the number of interpolating instruments used in defining the scale. One proposal for a future scale eliminates the Type S thermocouple by extending the range of the platinum resistance thermometer to the gold point. Ideally, a single interpolation instrument would cover the whole range with good agreement with the thermodynamic scale, but such an instrument does not presently exist.

It should be recognized that the differences between the International Practical Temperature Scale of 1948 and 1968 are subtle—within the experimental error of any but the most exacting measurements. They are less than 1°C below 900°C, rising to about 5°C at 3000°C. Changes in the temperature versus emf tables for several common thermocouples are somewhat more significant but are beyond the scope of this publication.

Much more detail on this evolutionary process is included in the appended papers, which are presented in inverse chronological order.

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