



Standard Guide for Use of Water Triple Point Cells¹

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INTRODUCTION

The triple point of water is an important thermometric fixed point common to the definition of two temperature scales of science and technology, the Kelvin Thermodynamic Temperature Scale (KTTS) and the International Temperature Scale of 1990 (ITS-90). The ITS-90 was designed to be as close to the KTTS as the experimental data available at the time of the adoption of the ITS-90 would permit. The temperatures (T) on the KTTS are defined by assigning the value 273.16 K to the triple point of water, thus defining the thermodynamic unit of temperature, kelvin (K), as $1/273.16$ of the thermodynamic temperature of the triple point of water (**1**, **2**).² The triple point of water, one of the fixed points used to define the ITS-90, is the temperature to which the resistance ratios $W(T) = R(T)/R(273.16 \text{ K})$ of the standard platinum resistance thermometer (SPRT) calibrations are referred.

The triple points of various materials (where three distinct phases, for example, their solid, liquid, and vapor phases, coexist in a state of thermal equilibrium) have fixed pressures and temperatures and are highly reproducible. Of the ITS-90 fixed points, six are triple points. The water triple point is one of the most accurately realizable of the defining fixed points of the ITS-90; under the best of conditions, it can be realized with an expanded uncertainty ($k=2$) of less than $\pm 0.00005 \text{ K}$. In comparison, it is difficult to prepare and use an ice bath with an expanded uncertainty ($k=2$) of less than $\pm 0.002 \text{ K}$ (**3**).

1. Scope

1.1 This guide covers the nature of two commercial water triple-point cells (types A and B, see Fig. 1) and provides a method for preparing the cell to realize the water triple-point and calibrate thermometers. Tests for assuring the integrity of a qualified cell and of cells yet to be qualified are given. Precautions for handling the cell to avoid breakage are also described.

1.2 The effect of hydrostatic pressure on the temperature of a water triple-point cell is discussed.

1.3 Procedures for adjusting the observed SPRT resistance readings for the effects of self-heating and hydrostatic pressure are described in Appendix X1 and Appendix X2.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the*

responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 *ASTM Standards*:³

E344 Terminology Relating to Thermometry and Hydrometry

E1594 Guide for Expression of Temperature

3. Terminology

3.1 *Definitions*—The definitions given in Terminology E344 apply to terms used in this guide.

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *inner melt, n*—a thin continuous layer of water between the thermometer well and the ice mantle of a water triple-point cell.

¹ This guide is under the jurisdiction of ASTM Committee E20 on Temperature Measurement and is the direct responsibility of Subcommittee E20.07 on Fundamentals in Thermometry.

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² The boldface numbers in parentheses refer to the list of references at the end of this standard.

³ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.