Designation: E 452 – 02

Standard Test Method for Calibration of Refractory Metal Thermocouples Using a Radiation Thermometer[1]

This standard is issued under the fixed designation E 452; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the calibration of refractory metal thermocouples using a radiation thermometer as the standard instrument. This test method is intended for use with types of thermocouples that cannot be exposed to an oxidizing atmosphere. These procedures are appropriate for thermocouple calibrations at temperatures above 800 °C (1472 °F).

1.2 The calibration method is applicable to the following thermocouple assemblies:

1.2.1 *Type 1*—Bare-wire thermocouple assemblies in which vacuum or an inert or reducing gas is the only electrical insulating medium between the thermoelements.

1.2.2 *Type 2*—Assemblies in which loose fitting ceramic insulating pieces, such as single-bore or double-bore tubes, are placed over the thermoelements.

1.2.3 *Type 2A*—Assemblies in which loose fitting ceramic insulating pieces, such as single-bore or double-bore tubes, are placed over the thermoelements, permanently enclosed and sealed in a loose fitting metal or ceramic tube.

1.2.4 *Type 3*—Swaged assemblies in which a refractory insulating powder is compressed around the thermoelements and encased in a thin-walled tube or sheath made of a high melting point metal or alloy.

1.2.5 *Type 4*—Thermocouple assemblies in which one thermoelement is in the shape of a closed-end protection tube and the other thermoelement is a solid wire or rod that is coaxially supported inside the closed-end tube. The space between the two thermoelements can be filled with an inert or reducing gas, or with ceramic insulating materials, or kept under vacuum.

1.3 *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:*

E 344 Terminology Relating to Thermometry and Hydrometry[2]

E 563 Practice for Preparation and Use of Freezing Point Reference Baths[2]

E 988 Temperature-Electromotive Force (EMF) Tables for Tungsten-Rhenium Thermocouples[2]

E 1256 Test Methods for Radiation Thermometers (Single Waveband Type)[2]

E 1751 Guide for Temperature Electromotive Force (EMF) Tables for Non-Letter Designated Thermocouple Combinations[2]

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this test method see Terminology E 344.

3.1.2 *radiation thermometer*, *n*—radiometer calibrated to indicate the temperature of a blackbody.

3.1.2.1 *Discussion*—Radiation thermometers include instruments having the following or similar names: (*1*) optical radiation thermometer, (*2*) photoelectric pyrometer, (*3*) single wavelength automatic thermometer, (*4*) disappearing filament pyrometer, (*5*) dual wavelength pyrometer or ratio radiation thermometer, (*6*) visual optical thermometer, (*7*) infrared thermometer, (*8*) infrared pyrometer, and permutations on the terms above as well as some manufacturer-specific names.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *automatic radiation thermometer*, *n*—radiation thermometer whose temperature reading is determined by electronic means.

3.2.2 *disappearing filament pyrometer*, *n*—radiation thermometer that requires an observer to match visually the brightness of a heated filament mounted inside the radiation thermometer to that of the measured object.

3.2.3 *equalizing block*, *n*—object, usually metal, that when placed in a nonuniform temperature region, has greater temperature uniformity (due to its relatively high thermoconductivity and mass) than the medium surrounding the object.

3.2.4 *spectral emissivity*, *n*—ratio of the spectral radiance at a point on a particular specimen and in a particular direction

[1] This test method is under the jurisdiction of ASTM Committee E20 on Temperature Measurementand is the direct responsibility of Subcommittee E20.04 on Thermocouples.

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[2] *Annual Book of ASTM Standards*, Vol 14.03.

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