Designation: C1371 – 15 (Reapproved 2022)

Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers[1]

This standard is issued under the fixed designation C1371; 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 a technique for determination of the emittance of opaque and highly thermally conductive materials using a portable differential thermopile emissometer. The purpose of the test method is to provide a comparative means of quantifying the emittance of materials near room temperature.

1.2 This test method does not supplant Test Method C835, which is an absolute method for determination of total hemispherical emittance, or Test Method E408, which includes two comparative methods for determination of total normal emittance. Because of the unique construction of the portable emissometer, it can be calibrated to measure the total hemispherical emittance. This is supported by comparison of emissometer measurements with those of Test Method C835 (**1**).[2]

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

C168 Terminology Relating to Thermal Insulation

C680 Practice for Estimate of the Heat Gain or Loss and the Surface Temperatures of Insulated Flat, Cylindrical, and Spherical Systems by Use of Computer Programs

C835 Test Method for Total Hemispherical Emittance of Surfaces up to 1400°C

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E408 Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 *Definitions*—For definitions of some terms used in this test method, refer to Terminology C168.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *diffuse surface*—a surface that emits or reflects equal radiation intensity, or both, in all directions (**2**).

3.2.2 *emissive power*—the rate of radiative energy emission per unit area from a surface (**2**).

3.2.3 *emissometer*—an instrument used for measurement of emittance.

3.2.4 *Lambert's cosine law*—the mathematical relation describing the variation of emissive power from a diffuse surface as varying with the cosine of the angle measured away from the normal of the surface (**2**).

3.2.5 *normal emittance*—the directional emittance perpendicular to the surface.

3.2.6 *radiative intensity*—radiative energy passing through an area per unit solid angle, per unit of the area projected normal to the direction of passage, and per unit time (**2**).

[1] This test method is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.30 on Thermal Measurement.

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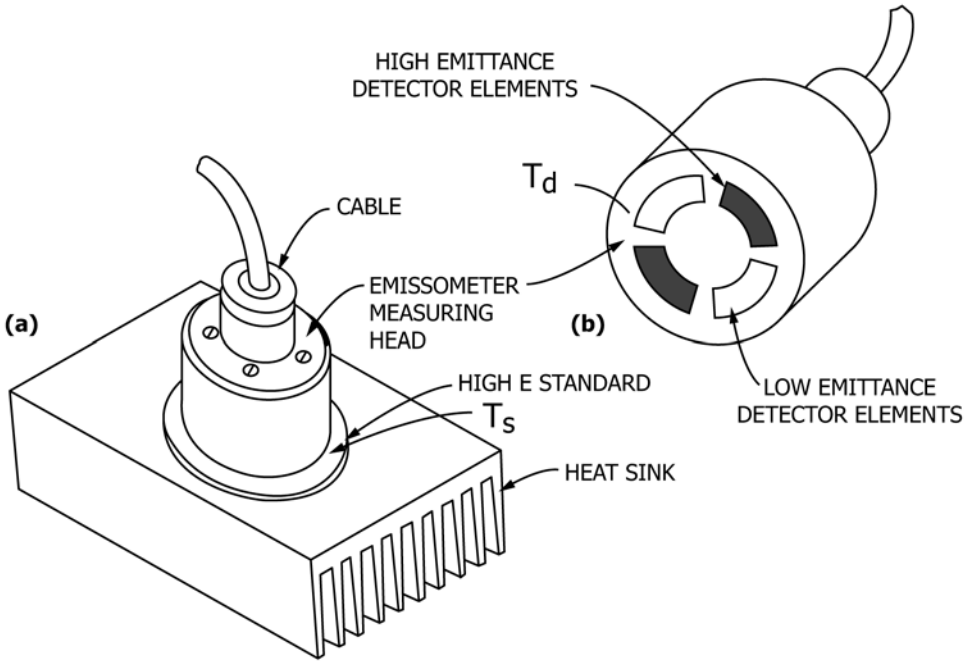
[2] The boldface numbers in parentheses refer to the list of references at the end of this standard.

[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.



NOTE 1—(a) Emissometer measuring head on high-emittance standard during calibration, showing heat sink and cable to readout device. (b) Bottom view of emissometer measuring head showing high- and low-emittance detector elements. The diameter of the emissometer measuring head is about 50 mm and the detector elements are recessed about 3 mm into the measuring head.

FIG. 1 Schematic of Emissometer

3.2.7 *spectral*—having a dependence on wavelength; radiation within a narrow region of wavelength (**2**).

3.2.8 *specular surface*—mirrorlike in reflection behavior (**2**).

3.3 *Symbols:*

3.3.1 For standard symbols used in this test method, see Terminology C168. Additional symbols are listed here:

α = total absorptance, dimensionless

α_λ = spectral absorptance, dimensionless

ε_{hi} = total emittance of the high-emittance calibration standard, dimensionless

ε_{low} = total emittance of the low-emittance calibration standard, dimensionless

ε_{spec} = apparent total emittance of the test specimen, dimensionless

ε = apparent total emittance of the surface, dimensionless

ε_1 = apparent total emittance of the surface 1, dimensionless

ε_2 = apparent total emittance of the surface 2, dimensionless

ε_d = apparent total emittance of the surface of detector, dimensionless

ε_s = apparent total emittance of the surface of specimen, dimensionless

ε_λ = spectral emittance, dimensionless

λ = wavelength, μm

ρ = total reflectance, dimensionless

σ = Stefan-Boltzmann constant, 5.6696×10^{-8} W/m^2 · K^4

τ = total transmittance, dimensionless

A = area of surface, m^2

k = proportionality constant, V·m^2/W

Q_{rad} = radiation heat transfer, W

q_{rad} = radiative heat flux, W/m^2

T_1 = temperature of the test surface, K

T_2 = temperature of the radiant background, K

T_d = temperature of the detector, K

T_s = temperature of the surface of specimen, K

V_{hi} = voltage output of the detector when stabilized on high-emittance calibration standard

V_{low} = voltage output of the detector when stabilized on low-emittance calibration standard

V_{spec} = voltage output of the detector when stabilized on test specimen

4. Summary of Test Method

4.1 This test method employs a differential thermopile emissometer for total hemispherical emittance measurements. The detector thermopiles are heated in order to provide the necessary temperature difference between the detector and the surface.[4] The differential thermopile consists of one thermopile that is covered with a black coating and one that is covered with a reflective coating. The instrument is calibrated using two standards, one with a high emittance and the other with a low emittance, which are placed on the flat surface of a heat sink (the stage) as shown in Fig. 1. A specimen of the test material is placed on the stage and its emittance is quantified by comparison to the emittances of the standards. The calibration shall be checked repeatedly during the test as prescribed in 7.2.

[4] The sole source of supply of emissometers known to the committee at this time is Devices & Services Co., 10024 Monroe Drive, Dallas, TX 75229. If you are aware of alternative suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.