



## Standard Test Method for Total Hemispherical Emittance of Surfaces up to 1400°C<sup>1</sup>

This standard is issued under the fixed designation C 835; 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 calorimetric test method covers the determination of total hemispherical emittance of metal and graphite surfaces and coated metal surfaces up to approximately 1400°C. The upper-use temperature is limited only by the characteristics (for example, melting temperature, vapor pressure) of the specimen and the design limits of the test facility. This test method has been demonstrated for use up to 1400°C.

1.2 *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.* For specific hazard statements, see Section 7.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

C 168 Terminology Relating to Thermal Insulating Materials<sup>2</sup>

E 230 Temperature-Electromotive Force (EMF) Tables for Standardized Thermocouples<sup>3</sup>

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method<sup>4</sup>

### 3. Terminology

3.1 *Definitions*—The terms and symbols are as defined in Terminology C 168 with exceptions included as appropriate.

#### 3.2 Symbols:

- $e_i$  = error in the variable  $i$ ,  $\pm$  %,  
 $\epsilon_1$  = total hemispherical emittance of heated specimen, dimensionless,  
 $\epsilon_2$  = total hemispherical emittance of bell jar inner surface, dimensionless,

- $\sigma$  = Stefan-Boltzmann constant,  
=  $5.669 \times 10^{-8} \text{ W/m}^2 \cdot \text{K}^4$ ,  
 $Q$  = heat flow rate, W,  
 $T_1$  = temperature of heated specimen, K,  
 $T_2$  = temperature of bell jar inner surface, K,  
 $A_1$  = surface area of specimen over which heat generation is measured,  $\text{m}^2$ ,  
 $A_2$  = surface area of bell jar inner surface,  $\text{m}^2$ ,  
 $F$  = the gray body shape factor, which includes the effect of geometry and the departure of real surfaces from blackbody conditions, dimensionless, and  
 $P_a$  = absolute pressure, pascal ( $\text{N/m}^2$ ). One pascal is equivalent to 0.00750 mm Hg.

### 4. Summary of Test Method

4.1 A strip specimen of the material, approximately 13 mm wide and 250 mm long, is placed in an evacuated chamber and is directly heated with an electric current to the temperature at which the emittance measurement is desired. The power dissipated over a small central region of the specimen and the temperature of this region are measured. Using the Stefan-Boltzmann equation, this power is equated to the radiative heat transfer to the surroundings and, with the measured temperature, is used to calculate the value of the total hemispherical emittance of the specimen surface.

### 5. Significance and Use

5.1 The emittance as measured by this test method can be used in the calculation of radiant heat transfer from surfaces that are representative of the tested specimens, and that are within the temperature range of the tested specimens.

5.2 This test method can be used to determine the effect of service conditions on the emittance of materials. In particular, the use of this test method with furnace exposure (time at temperature) of the materials commonly used in all-metallic insulations can determine the effects of oxidation on emittance.

5.3 The measurements described in this test method are conducted in a vacuum environment. Usually this condition will provide emittance values that are applicable to materials used under other conditions, such as in an air environment. However, it must be recognized that surface properties of materials used in air or other atmospheres may be different. In addition, preconditioned surfaces, as described in 5.2, may be altered in a vacuum environment because of vacuum stripping

<sup>1</sup> 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 Measurements.

Current edition approved Nov. 10, 2001. Published January 2002. Originally published as C 835 – 76. Last previous edition C 835 – 00.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 04.06.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 14.03.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 14.02.