Designation: C863 − 00 (Reapproved 2016)

Standard Test Method for Evaluating Oxidation Resistance of Silicon Carbide Refractories at Elevated Temperatures[1]

1. Scope

1.1 This test method covers the evaluation of the oxidation resistance of silicon carbide refractories at elevated temperatures in an atmosphere of steam. The steam is used to accelerate the test. Oxidation resistance is the ability of the silicon carbide (SiC) in the refractory to resist conversion to silicon dioxide (SiO_2) and its attendant crystalline growth.

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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C20 Test Methods for Apparent Porosity, Water Absorption, Apparent Specific Gravity, and Bulk Density of Burned Refractory Brick and Shapes by Boiling Water

C830 Test Methods for Apparent Porosity, Liquid Absorption, Apparent Specific Gravity, and Bulk Density of Refractory Shapes by Vacuum Pressure

C914 Test Method for Bulk Density and Volume of Solid Refractories by Wax Immersion

3. Significance and Use

3.1 The oxidation of silicon carbide refractories at elevated temperatures is an important consideration in the application of these refractories. The product of oxidation is amorphous silica or cristobalite, depending upon the temperature at which oxidation takes place. This oxide formation is associated with expansion and degradation of strength. The quantity of water vapor in the atmosphere greatly affects the rate of oxidation.

3.2 The test, which creates and measures the expansion, is suitable for guidance in product development and relative comparison in application work where oxidation potential is of concern. The variability of the test is such that it is not recommended for use as a referee test.

4. Apparatus

4.1 *Heated Chamber*—The chamber shall be muffled (Note 1) to confine the atmosphere. The size of the chamber and the heat source are optional. The temperature capability within the chamber shall be at least 1200°C (2190°F) with an allowable deviation of ±15°C (27°F) measured across the hearth.

NOTE 1—Silicon carbide refractory material is recommended for use as the muffle but other suitable refractory materials may be used.

4.2 *Instrument*—Control and record the temperature of the chamber by a suitable instrument capable of maintaining the requirements in 4.1. Recommended thermocouple location is within 1 in. (25 mm) of the top of the specimens and over the center of the same assemblage.

5. Test Specimen

5.1 *Specimen Size*—Obtain a quarter-brick size from a 229-mm (9-in.) straight by cutting the brick along planes parallel to both the 229 by 64-mm (9 by 2½-in.) and the 114 by 64-mm (4½ by 2½-in.) faces. Alternative specimens may be tile, 165 by 114 by 22 mm (6½ by 4½ by 7⁄8 in.), or other convenient shapes.

5.2 Three specimens are required for each set of conditions.

6. Conditions

6.1 *Atmosphere*—Steam is passed into the chamber (4.1) at the rate of 32 kg/m^3 (2 lb/ft^3) of chamber volume per hour. Provisions should be made to uniformly distribute steam within the chamber.

6.2 The standard test temperatures are as follows with new samples used at each temperature. Each temperature constitutes a test.

800°C	(1470°F)
900°C	(1650°F)
1000°C	(1830°F)
1100°C	(2010°F)
1200°C	(2190°F)

[1] This test method is under the jurisdiction of ASTM Committee C08 on Refractories and is the direct responsibility of Subcommittee C08.04 on Chemical Behaviors.

Current edition approved June 1, 2016. Published June 2016. Originally approved in 1977. Last previous edition approved in 2010 as C863 – 00 (2010). DOI: 10.1520/C0863-00R16.

[2] 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.

The test temperature is selected on the basis of the specific needs that relate to the environment in which the product is to serve. The use of at least the three test temperatures 900°C, 1000°C, and 1100°C is recommended when characterization of the product is desired.

6.3 *Duration*—Hold at the specified temperature for 500 h.

7. Procedure

7.1 Measure the weight and volume of each specimen to ±0.1 g and ±0.1 cm^3, respectively, in accordance with Test Methods C20, C830, or C914, especially recommended for friable samples.

7.2 Place the specimens in the chamber and seal the chamber. Bring the chamber to the specified test temperature and then introduce steam at the prescribed rate (6.1).

7.3 Upon completion of the 500-h period at the prescribed temperature, shut off the steam supply and then the heat source. When specimens are cool, measure the weight and volume using the same method used for 7.1, and calculate the bulk density.

TABLE 1 Example of Critical Difference Values[A]

	Number of Observations in Each Average	Critical Difference Between Averages, Units of Measure	
		Single-Operator	Between-Laboratory
Frit Bonded SiC	3	3.26	18.11
Clay Bonded SiC	3	32.13	31.34
Fines Bonded SiC	3	0.39	0.81
Silicon Oxynitride Bonded SiC	3	1.91	7.25
Silicon Nitride Bonded SiC	3	0.27	0.56

[A] This table is excerpted from RR:C08-1004, available from ASTM Headquarters.

8. Report

8.1 The average percent volume change based on the original volume is reported as the prime variable with weight, bulk density, and length changes included as supplementary information. The percent volume change equals 100 times the difference between the new and original volume all divided by the original volume, or

$$\text{Volume Change, \%} = \frac{(V_n - V_o)}{V_o} \times 100$$

where:

V_n = new volume and
V_o = original volume.

9. Precision and Bias

9.1 *Interlaboratory Test Data and Analysis*—Three specimens each of five different materials were tested by five laboratories. The test data and analyses used in establishing this precision statement are filed as a round robin.[3] The variable measured is percent volume expansion, the test temperature 1100°C (2010°F).

9.2 *Precision*—Two averages of observed values should be considered significantly different at the 95 % probability level if the difference equals or exceeds the critical differences listed in Table 1.

9.3 *Bias*—No justifiable statement on bias can be made since the true or standard value of volume expansion for these materials cannot be established by an accepted reference method.

10. Keywords

10.1 oxidation; refractories; silicon carbide

[3] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:C08-1004.