Designation: C865 – 13

Standard Practice for Firing Refractory Concrete Specimens[1]

This standard is issued under the fixed designation C865; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This practice covers the firing of specimens made from refractory concretes (castable refractories) in accordance with Practice C862 for cast specimens. The procedure is also recommended for heating rates to be used for high-temperature test methods such as Methods C16, C583, etc., when these methods are used to test refractory concretes.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

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:*[2]

C16 Test Method for Load Testing Refractory Shapes at High Temperatures

C583 Test Method for Modulus of Rupture of Refractory Materials at Elevated Temperatures

C862 Practice for Preparing Refractory Concrete Specimens by Casting

E230 Specification and Temperature-Electromotive Force (EMF) Tables for Standardized Thermocouples

3. Significance and Use

3.1 This practice is used to standardize the firing conditions of refractory concrete specimens prepared in accordance with Practice C862. The standards are set down to minimize laboratory-to-laboratory variation and do not attempt to duplicate any particular field applications.

4. Apparatus

4.1 *Kiln,* equipped with instruments capable of controlling the heating rate of the kiln at 100 to 700°F (55 to 380°C)/h (see 6.5) and holding the soak temperature to ±10°F (5.5°C) of the nominal soak temperature. For temperatures up to 2500°F (1370°C) an electrically heated kiln is preferred, but gas- or oil-fired kilns can be used for all temperatures, provided the heating rates specified can be maintained, the flame of the burners does not impinge directly on any specimen, and the furnace atmosphere contains a minimum of 0.5 % oxygen with 0 % combustibles.

5. Preparation of Samples

5.1 Samples are prepared by casting in accordance with Methods C862. If the sample size of the cast specimen is the same as that specified for the test, it can be used directly. However, cutting samples of the required size from larger cast blocks will often be necessary (Note 1). In this case, it is recommended that the samples be cut with a diamond saw. After cutting, the samples should be dried at 230°F (110°C) for a minimum of 18 h. All cut samples should have sharp edges and corners and should not show pull-out of grains on the cut surfaces. For some low-strength castables, drying prior to cutting may be needed to increase their strength and resistance to pull-outs.

NOTE 1—Specimens cut from the interior of large cement bonded castables shapes may be stronger than specimens cut from small cast shapes because the interior of large cast shapes are exposed to high pressure steam during dryout which causes more complete hydration of the cement.

5.2 Some types of castables, especially those containing aggregates of a relatively low hardness (such as lightweight castables), may be cut on a dry saw. This procedure is acceptable provided that specimens with sharp corners and edges, which show no signs of grain pull-out at the cut surfaces, are obtained.

6. Procedure

6.1 Label all specimens with ceramic ink or ceramic crayons.

6.2 Place the specimens in the kiln so that each specimen will rest on the surface formed by its longest and smallest

[1] This practice is under the jurisdiction of ASTM Committee C08 on Refractories and is the direct responsibility of Subcommittee C08.09 on Monolithics.

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[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.

dimension (that is, the 9 by 2½-in. (230 by 65-mm) surface for 9-in. straight, or the 6 by 1-in. (152 by 25-mm) surface for 6 by 1 by 1 in. samples). Support each specimen on a flat supporting brick, which does not soften or shrink at the intended soak temperature. Place between the test specimens and the supporting brick a layer of suitable refractory material that is nonreactive under the test conditions and passes a No. 16 (1.18-mm) sieve and is retained on a No. 40 (425-µm) sieve.

6.3 The following maximum heating rates at temperatures below 1500°F (815°C) are recommended:

Cross Section of Specimen		Maximum Heating Rate	
in.	mm	°F/h	°C/h
4½ by 3	114 by 76	100	55
4½ by 2½	114 by 65	100	55
2 by 2	228 by 64	300	170
1 by 1	25 by 25	700	380

At temperatures over 1500°F a heating rate up to 700°F (390°C)/h is permissible. Generally, a slower heating rate does not affect the properties of the specimens adversely. Thus, when smaller and larger specimens are fired together, the heating rate applicable to the larger specimens should be used.

NOTE 2—Different heating rates are specified for various samples to ensure that the difference in temperature between the center and the surface of the specimen does not exceed 45°F (25°C). Experimental evidence indicates that cracking may occur when a castable sample is heated too rapidly. The safe heat-up rate increases with decreasing sample size.

6.4 Hold the specimens at the specified temperature for 5 h. During the holding period a furnace atmosphere containing a minimum of 0.5 % oxygen with 0 % combustibles should be maintained. For special high-temperature tests, a longer or shorter holding time may be required. Please refer to the appropriate test method for details.

6.5 Measure the temperature within the kiln by means of an appropriate calibrated thermocouple. Refer to E230, tables 1 and 2, for tolerances and upper temperature limits for use of various thermocouples. An alternative method is the use of a calibrated optical pyrometer where applicable. Make temperature readings at intervals of 15 min or less when the temperature is not recorded and controlled automatically. The use of cone plaques is advised as a guide to temperature uniformity within the kiln.

6.6 After completion of the firing, cool the specimens in a closed kiln at a cooling rate not exceeding 500°F (280°C)/h.

7. Keywords

7.1 castables; refractory concrete