Designation: C 1054 – 03 (Reapproved 2008)

Standard Practice for Pressing and Drying Refractory Plastic and Ramming Mix Specimens[1]

This standard is issued under the fixed designation C 1054; 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 practice covers the pressing and drying of chemically and nonchemically bonded aluminum-silicate and high alumina plastic and ramming mix refractory specimens classified in accordance with Classification C 673.

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]

C 16 Test Method for Load Testing Refractory Shapes at High Temperatures

C 20 Test Methods for Apparent Porosity, Water Absorption, Apparent Specific Gravity, and Bulk Density of Burned Refractory Brick and Shapes by Boiling Water

C 113 Test Method for Reheat Change of Refractory Brick

C 133 Test Methods for Cold Crushing Strength and Modulus of Rupture of Refractories

C 179 Test Method for Drying and Firing Linear Change of Refractory Plastic and Ramming Mix Specimens

C 181 Test Method for Workability Index of Fireclay and High-Alumina Plastic Refractories

C 288 Test Method for Disintegration of Refractories in an Atmosphere of Carbon Monoxide

C 417 Test Method for Thermal Conductivity of Unfired Monolithic Refractories

C 577 Test Method for Permeability of Refractories

C 583 Test Method for Modulus of Rupture of Refractory Materials at Elevated Temperatures

C 673 Classification of Fireclay and High-Alumina Plastic Refractories and Ramming Mixes

C 704 Test Method for Abrasion Resistance of Refractory Materials at Room Temperature

C 830 Test Methods for Apparent Porosity, Liquid Absorption, Apparent Specific Gravity, and Bulk Density of Refractory Shapes by Vacuum Pressure

C 832 Test Method of Measuring Thermal Expansion and Creep of Refractories Under Load

C 874 Practice for Rotary Slag Testing of Refractory Materials

C 885 Test Method for Young's Modulus of Refractory Shapes by Sonic Resonance

C 914 Test Method for Bulk Density and Volume of Solid Refractories by Wax Immersion

3. Significance and Use

3.1 This practice is useful for producing uniform specimens of refractory plastics and ramming mixes for use in standard ASTM tests. Samples thus formed may be used for referee testing when setting specifications between producer and user. Forming parameters such as sample size, workability, and forming pressure should be agreed upon and specified in the report when referee testing.

3.2 This practice is applicable for preparing test specimens of various sizes. Note that 9 by 4½ by 2½ in. (228 by 114 by 64-mm) samples, because of their large cross-section, have a greater tendency to form flaws during pressing, handling, and drying than smaller cross-sectional samples.

3.3 Other tests for which these specimens may be used encompass, but are not limited to, the following ASTM standards: Method C 16, Test Methods C 20, Test Method C 113, Test Methods C 133, Test Method C 179, Test Method C 288, Test Method C 417, Test Method C 577, Test Method

[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.

C 583, Test Method C 704, Test Methods C 830, Test Method C 832, Practice C 874, Test Method C 885, and Test Method C 914.

3.4 A purpose of this practice is to minimize flaws in pressed specimens. It is not intended to duplicate all field installation conditions.

3.5 Variations in workability as determined by Test Method C 181 can significantly affect the number of flaws contained in a specimen. For comparison testing between two laboratories, the workability level should be established by mutual agreement.

3.6 This practice is not intended for preparing specimens of basic ramming mixes, anhydrous tap-hole mixes, nor resin bonded mixes.

4. Apparatus

4.1 *Power Press*, preferably of the hydraulic type, equipped with suitable molds for forming specimens of the required size (Note 1). The press should be capable of a minimum of 1500 psi (10.34 MPa) pressure when forming the largest cross-sectional area specimen.

NOTE 1—It may be advisable to have the molds slightly oversized so that, after drying, the specimens will be close to the required size for the specific test.

4.2 *Drying Oven*, preferably forced-draft rather than natural convection, capable of reaching 230°F (110°C) with a capacity to hold ten 9-in. (228-mm) straight brick.

4.3 *Balance*, 15 lb (6.8 kg) capacity with sensitivity of 0.02 lb (9 g).

4.4 *Thermometer*, with a range of 0° to 180 ± 0.1°F (−18° to 80°C ± 0.05°C).

4.5 *Measuring Device*, a 12-in. (305-mm) graduated in 0.02-in. (0.5-mm) increments.

4.6 *Mold Lubricant*—Either paraffin or silicone-based oils can be used as a parting agent for coating mold and die surfaces.

4.7 *Non-Porous Blocks*—(Two required) ½-in. (13-mm) thick. The cross-sectional dimensions of these pieces will vary, depending on the side dimensions of the bar being pressed.

5. Sampling

5.1 The container or package should not be opened prior to testing to ensure that the contents do not dry out.

5.2 At the time of the test, the sample should be between 65 and 75°F (18 and 24°C). Measure the temperature by inserting the full length of the thermometer stem into the material. Note and record temperature when the reading is constant.

6. Procedure

6.1 *Workability Index Measurement (Note 2)*—Determine and report workability of plastics at the time of pressing in accordance with the procedure described in Test Method C 181 (Note 3).

NOTE 2—A workability index between 17 and 23 is the optimum range for pressing samples with a minimum amount of flaws. If higher workability material is used in referee tests between two or more laboratories, the workability should be the same, (±3 %), for the material being tested.

NOTE 3—Since no suitable standard test exists for gaging the workability of ramming mixes, participants in a referee test should agree that samples of similar formability are being tested.

6.2 *Molding of Specimens*—Use the power press to form the test specimens. In order to facilitate filling the mold, break the material into pieces that vary in size, the largest dimension being 1-in. (25-mm). Carefully pack these pieces into the mold, in order to achieve uniform distribution of material.

6.2.1 Do not expose the material being pressed to the atmosphere for periods longer than 15 min. *Cover with an impermeable material if longer periods of air exposure are expected* (Note 4).

NOTE 4—Exposure in air may lead to a change in workability.

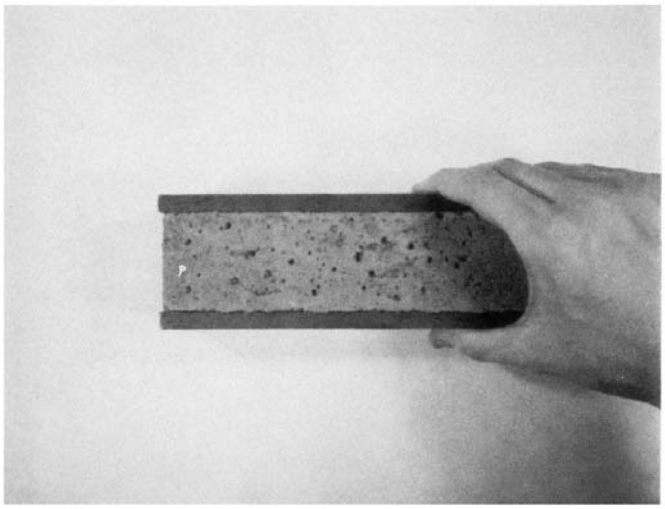
6.3 *Pressing of Specimens*—Apply a pressure sufficient to achieve a well-consolidated specimen (typically 750 to 1250 psi (5.17 to 8.62 MPa) for plastics, higher pressures may be necessary for ramming mixes) (Note 5). This pressure should not be so high that a portion of the mix is forced out of the mold by extrusion through the clearance space located between the plunger of the mold and the walls of the die cavity (Note 6). To eliminate possible entrapped air, apply an initial load of approximately 250 psi (1.72 MPa). *Relieve this pressure, and then increase to the selected pressure.*

NOTE 5—Single- and double-action presses may produce differing degrees of consolidation when pressing some ramming mixes.

NOTE 6—The total clearance space between the plunger and the walls should not exceed 1/16 in. (1.6 mm).

6.4 *Removal of Specimens from Mold*—When removing the bar specimen from the mold, use the two support pieces against the sides of the bar (as shown in Fig. 1) in order to pick up the bar and move it subsequently for measuring, weighing, and drying (Note 7).

NOTE 7—Use of the supports uniformly distributes the force of gripping the bar and prevents the bar from flexing during the critical handling stage. This prevents a major source of induced flaws (cracks) that cause damage to the bar. Bars made from high workability plastics are especially



NOTE 1—Two support pieces are used against the sides of the bar during the lifting and moving operation to prevent flexing.

FIG. 1 Removal of Specimen from Mold

susceptible to this damage. Distortion of the samples may also be caused by handling.

6.5 *Measurement of Weight and Dimensions*—Immediately upon removal from the mold, place each bar on the balance (using waxed paper to prevent sticking to the pan surface) and weigh to the nearest 0.02 lb (9 g). With the steel rule, measure the bar (5.2 of Test Method C 179) for all dimensions to the nearest 0.02 in. (0.5 mm) and record the results. Label and make reference marks to indicate the exact length measurement points (Note 8).

6.6 *Drying of Specimens*:

6.6.1 *Placement in Dryer*—Using the handling procedure described in 6.4, move the bars to the dryer and place on a non-stick ventilated surface (Note 8).

NOTE 8—Plastic film or waterproof paper is not recommended for this surface. They inhibit movement of moisture out of the bottom of the bar. Flat expanded metal grids, ceramic fiber paper, or similar materials are preferred because they do not act as vapor barriers.

6.6.2 *Standard Drying Schedule*—(Note 9):

6.6.2.1 *Drying Step (230°F (110°C))*—Raise the temperature of the drying oven to 230°F (110°C) in 1 h. Hold for at least 18 h.

NOTE 9—This drying schedule described in 6.6.2.1 is suitable for plastics and ramming mixes utilizing clay and /or organic or inorganic chemical binder systems and many plastic and ramming mixes based on phosphate binder systems. If excessive flaws are found after drying phosphate bonded plastics and ramming mixes, one of the alternate drying procedures outlined in 6.6.3 which have been found effective in minimizing flaws should be used.

6.6.3 *Alternate Drying Procedures, Phosphate-Bonded Materials*:

6.6.3.1 *Alternate Procedure 1*—Immediately after forming and measuring the specimen, place on a wire or metal mesh grid and allow the specimen to air dry for a minimum of 24 h. The wire or metal mesh grid should also be of sufficient strength and supported so as to not bend or sag under the weight of the specimens. The wire or metal mesh grid should be supported a minimum of 1-in. (25-mm) above the table top to allow air circulation. After the air drying is complete, the procedure outlined in 6.6.2.1 can be followed.

6.6.3.2 *Alternate Procedure 2*—Immediately after forming and measuring the specimen, place in the oven and raise the temperature of the drying oven from ambient to 170°F (75°C) in 1 h. Hold at least 12 h. Raise the temperature of the drying oven to 230°F (110°C) in 1 h. Hold for at least 18 h.

6.6.4 *Cooling*—Cool the bars at the natural cooling rate of the drying oven.

6.7 *Measurement of Weight and Dimensions of the Dried Specimens*—After the bars are dried, remeasure and reweigh them at room temperature as described in 6.5 and record the data.

NOTE 10—*Storage of Specimen*—If more than 8 h will elapse before other tests described in 3.3 are performed on the bars, they should be kept dry by replacing them in a drying oven, sealing them in plastic bags, or some other suitable procedure.

7. Report

7.1 Report the workability and material temperature at time of test, pressing pressure used, drying schedule used, green and dried specimen size and weight.

7.2 Identify by a suitable marking the original pressed surface of the specimen.

7.3 Referee testing should specify the exact procedure used by both parties.

8. Precision and Bias

8.1 This practice is intended to prepare test specimens for testing under other procedures. Therefore, no statement is required regarding test results, only information on the specimen preparation parameters used.

9. Keywords

9.1 drying; forming; pressing; refractory plastics; refractory ramming mixes