INTERNATIONAL

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Standard Test Method for Abrasion Resistance of Refractory Materials at Room Temperature[1]

This standard is issued under the fixed designation C 704; 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.

~~ϵ^1 NOTE—Adjunct references were corrected editorially in April 2006.~~

1. Scope

1.1 This test method covers the determination of relative abrasion resistance of refractory brick at room temperature. This test method can also be applied to castable refractories (see Metric Dimensions, Practice C 861 and Practice C 865) and plastic refractories (see Practice C 1054).

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are provided 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 134 Test Methods for Size, Dimensional Measurements, and Bulk Density of Refractory Brick and Insulating Firebrick

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

C 861 Practice for Determining Metric Dimensions of Standard Series Refractory Brick and Shapes

C 862 Practice for Preparing Refractory Concrete Specimens by Casting

C 865 Practice for Firing Refractory Concrete Specimens

C 1036 Specification for Flat Glass

C 1054 Practice for Pressing and Drying Refractory Plastic and Ramming Mix Specimens

2.2 *ASTM Adjuncts:*

Abrasion Tester (1 dwg)[3]

3. Summary of Test Method

3.1 This test method measures the volume of material in cubic centimetres abraded from a flat surface at a right angle to a nozzle through which 1000 g of size-graded silicon carbide grain is blasted by air at 448 kPa (65 psi).

4. Significance and Use

4.1 This test method measures the relative abrasion resistance of various refractory samples under standard conditions at room temperature.

4.2 The abrasion resistance of a refractory material provides an indication of its suitability for service in abrasion or erosive environments.

4.3 The results obtained by this test method could be different than those obtained in service because of the different conditions encountered.

~~[1] This test method is under the jurisdiction of ASTM Committee C08 on Refractories and is the direct responsibility of Subcommittee C08.03 on Physical Tests and Properties.~~

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[1] This test method is under the jurisdiction of ASTM Committee C08 on Refractories and is the direct responsibility of Subcommittee C08.03 on Physical Properties . Current edition approved Oct. 1, 2007. Published November 2007. Originally published approved in 1972. Last previous edition approved in 2001 as C 704 – 01 $^{\epsilon1}$.

[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.

[3] Detailed prints for the construction of the test chamber are available at a nominal cost from ASTM International Headquarters. ~~Request~~ Order Adjunct No. ADJC0704. An acceptable test chamber can be made from a weatherproof electrical switch ~~box such as a Wiegmann B20167 continuous hinge~~ box.

5. Interferences (Factors known to Affect Results)

5.1 During development, a ruggedness test was performed using 114 by 114 by 12.7 mm (4½ by 4½ by ½ in.) float glass plates conforming to Specification C 1036. Several factors were found to cause statistically significant effects on measured results.[4]

5.1.1 *Nozzle Tube Inside Diameter*—variation in the inside diameter of the flint glass nozzle tube statistically affected the abrasion values obtained on the glass plate. Ideal glass tube inside diameter is 4.8mm. Glass tube lots purchased as 7 mm outside diameter tube with a nominal 1.1 mm wall thickness can have inside diameters ranging from 4.6 mm to 5.0 mm. For the ruggedness test, flint glass tube inside diameters of 4.7 mm and 4.9 mm were used. The statistically significant effect of this small tube inside diameter variation must be taken into consideration and all nozzle tube should be individually measured and chosen to conform to a specified 4.8 mm inside diameter.

5.1.2 *Air Pressure*—variation in the test air pressure statistically affected the abrasion values obtained on the glass plate. Air pressure as specified in the test method is 448 kPa (65 psi) measured by a gauge capable to ± 6.9kPa (± 1 psi). For the ruggedness test, air pressure was maintained at values of 441 kPa (64 psi) and 455 kPa (66 psi) by the use of a calibrated master series pressure gage. The statistically significant effect of this small air pressure variation must be taken into consideration and only calibrated gauges capable of maintaining 448 kPa (65 psi) air pressure be used. It is also recommended that air gauges be recalibrated at frequent intervals.

5.2 Factors which were found to be rugged during the test method evaluation were *(1)* particle size variation of the silicon carbide grain between sizings of grain composed of 25% 20mesh × 30mesh and 75% 30mesh × 50mesh silicon carbide to one composed of 15% 20mesh × 30mesh and 85% 30mesh × 50mesh silicon carbide sizing, *(2)* nozzle to sample distance varying between 200 mm (7⅞ in) to 206 mm (8⅛ in), *(3)* silicon carbide grit amount between 995 g and 1005 g, and *(4)* test operator.

6. Apparatus

~~5.1~~

6.1 *Abrasion Tester*, used for measuring the abrasion resistance of refractory specimens, consisting of the following (Fig. 1 and Fig. 2):

~~5.1.1*Blast Gun*~~

6.1.1 *Blast Gun (Leitch Carco Gun Model LC-CG)*[5], modified for this equipment as shown in Fig. 3~~.~~

~~5.1.2~~. *Other sand blast gun models or types may affect test results.*

6.1.2 *Nozzle*—A piece of glass tubing is used to replace the steel nozzle supplied with the sand-blast gun to permit control of nozzle size through nozzle replacement after each determination. Flint-glass tubing, 115 mm (4½ in.) long, 7 mm ~~(¼~~(0.276 in.) in outside diameter, with a ~~nominal 1.1~~measured 4.8 mm ~~(1⁄16 in.) wall,~~inside diameter , is used. This piece of glass tubing is held in place by a 70 mm (2¾ in.) long piece of stainless steel or copper tubing. The I.D. (inside diameter) of this tubing, which should be flared at one end to sit snugly inside a 9.53 mm (⅜ in.) tubing nut, should be 7.15 to 7.75 mm (9⁄32 to ⅝ in.). The O.D. (outside diameter) should be 9.53 mm (⅜ ~~in.). This sleeve is glued in place along with a rubber grommet of proper size, inside the 9.53 mm (⅜ in.) tubing nut, and is used primarily to hold the glass tubing perpendicular to the test sample, assuring a proper vacuum within the gun. The end of the glass tube, through which the abrading media enters the nozzle in the venturi chamber, is placed at a distance of 2 mm (0.08 in.) from the air-generator nozzle. This is done by placing the glass tubing on a brass rod, 4.5 mm (0.175 in.) in diameter with a shoulder 7.9 mm (5⁄16 in.) in diameter, 117 mm (4.68 in.) from the tip. This will allow the operator to push the glass tubing up through the rubber grommet until the rod touches the nozzle, assuring a 2 mm (0.08 in.) gap between the nozzle and the glass tubing.~~

~~5.1.3~~*in.). This sleeve is glued or soldered in place inside the 9.53 mm (⅜ in.) tubing nut, and is used primarily to hold the glass tubing perpendicular to the test sample, assuring a proper vacuum within the gun. The end of the glass tube through which the abrading media enters the nozzle in the venturi chamber, is inserted in a 15.9 mm (⅝ in) outside diameter, 6.4 mm (¼ in.) inside diameter rubber grommet of a thickness between 4.75 to 6.4 mm (3⁄16 to ¼ in). The glass tube is placed through the sleeve in the tubing nut, snugging the grommet within the nut.. The nut is attached to the gun. If there is an insufficient fit between the groment, the tubing nut and the gun assembly, adequate vacuum draw (see 8.6) will be unattainable. The glass tube is then positioned at a distance of 2 mm (0.08 in.) from the air-generator nozzle. This is done by using a brass rod, 4.5 mm (0.175 in.) in diameter with a shoulder 7.9 mm (5⁄16 in.) in diameter, 117 mm (4.68 in.) from the tip and inserting this rod into the glass tube. This will allow the operator to push the glass tubing up until the rod touches the nozzle, assuring a 2 mm (0.08 in.) gap between the nozzle and the glass tubing.*

6.1.3 *Venturi*~~—The air-generator nozzle should have an inlet inside diameter of from 2.84 to 2.92 mm (0.112 to 0.115 in.) and an outlet inside diameter of from 2.36 to 2.44 mm (0.093 to 0.096 in.). The surface of the air-generator nozzle within the venturi chamber of the gun is protected from the abrading media with a 9.4 mm (⅜ in.) long piece of vinyl tubing 4.7 mm (3⁄16 in.) inside diameter with a 1.5 mm (1⁄16 in.) wall thickness. The inside diameter of the venturi chamber should not exceed 10 mm (⅜~~ —The

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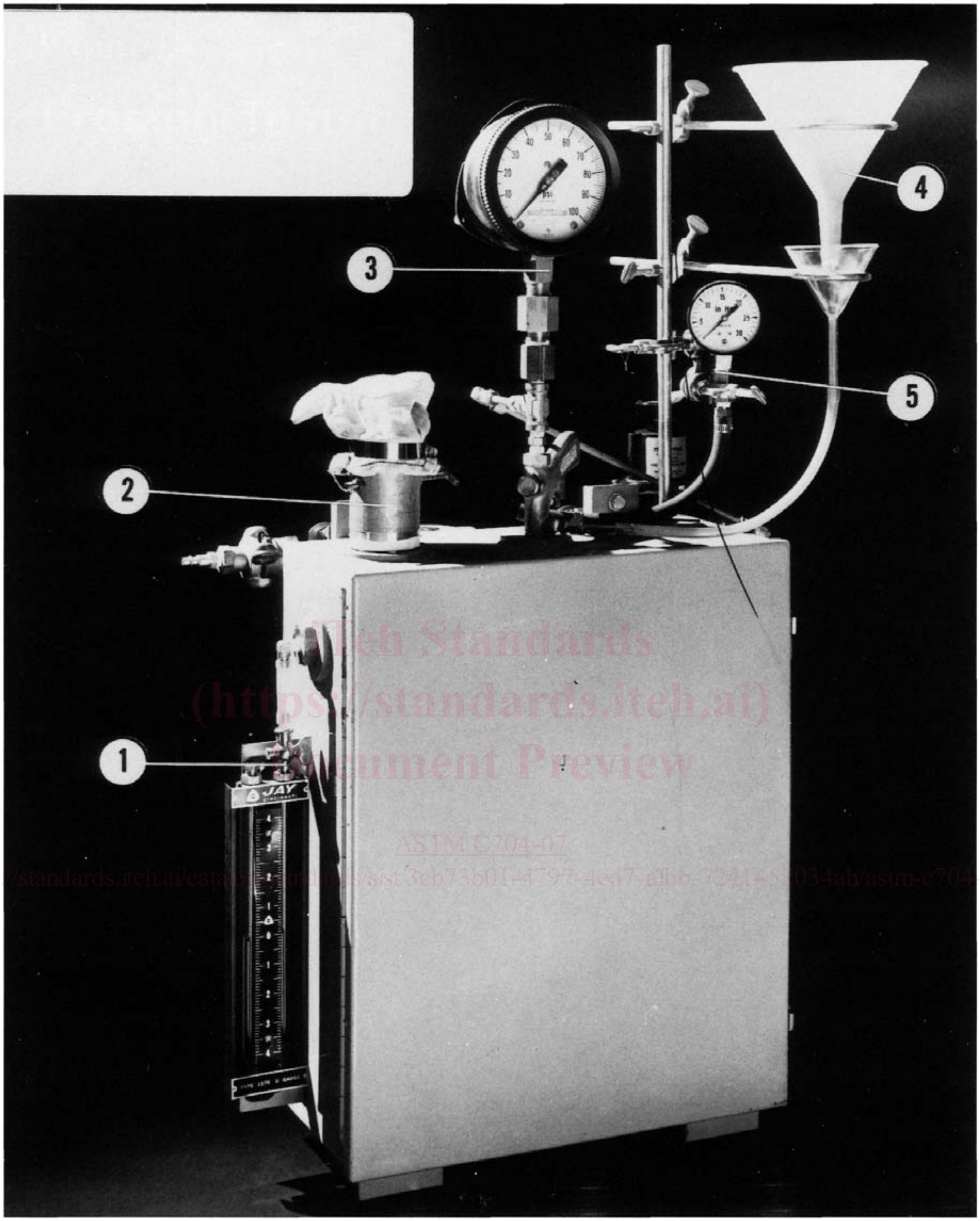
~~[4] The sand blast gun shown in Fig. 3, available from Leitch and Company, 971 Howard St., San Francisco, CA, has been found suitable for use in this test method.~~

[4] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR: **C08–1019** .

[5] The sole source of supply of the apparatus known to the committee at this time is Leitch & Company, 106 Abram Court, San Leandro, CA 64577. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.



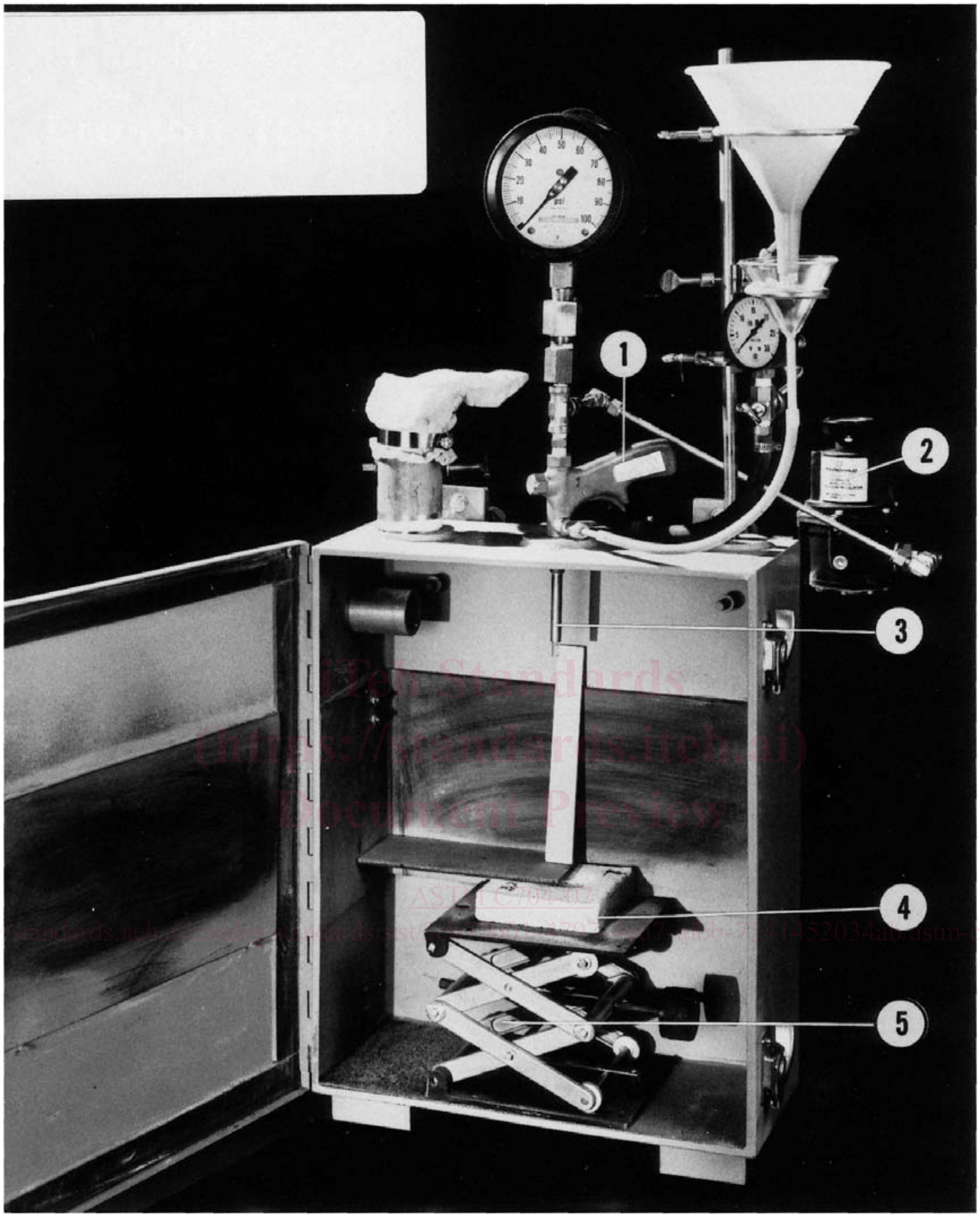
NOTE 1—Identified by number in this figure are: (1) cabinet pressure manometer, (2) dust collector vent, (3) test pressure gage, (4) grit feed tunnel, and (5) vacuum gage.

FIG. 1 Abrasion Tester

air-generator nozzle shall have an inlet inside diameter of from 2.84 to 2.92 mm (0.112 to 0.115 in.) and an outlet inside diameter of from 2.36 to 2.44 mm (0.093 to 0.096 in.). The air generator nozzle should be inspected for wear before any test series and replaced as necessary. The inside diameter of the venturi chamber should not exceed 10 mm (3⁄8 in.) and should be checked periodically for wear.

5.1.4

6.1.4 *Air Supply*—The air line pressure shall be maintained at the desired pressure at the gun through the use of a standard



NOTE 1—Identified by number in this figure are: (1) sand blast gun, (2) air pressure regulator, (3) glass tube and metal stabilizing sleeve, (4) test sample, and (5) adjustable platform.

FIG. 2 Abrasion Tester

calibrated master series suppressed range air gage indicating 6.9 kPa (±1 psi) mounted as close to the gun as possible. Only clean dry air should be used.

5.1.56.1.5 *Abrading Media*—No. 36 grit silicon carbide having a screen analysis as shown in Table 1.

5.1.6

6.1.6 *Feeding Mechanism*—Two acceptable mechanisms for feeding the abrading media are shown in Fig. 4. The feed funnel must contain a suitable orifice to obtain a flow time of 450± 15 s while delivering 1000 g of abrading media into the gun supply funnel. Metal, glass, or plastic orifices can be used to regulate the flow. There must be an air gap between the orifice and the gun supply funnel to allow secondary air to enter with the abrading media.

5.1.7