



Standard Test Method for Permeability of Refractories¹

This standard is issued under the fixed designation C577; 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 test method covers determination of the permeability of refractory brick and monoliths, from which suitable specimens can be cut, at room temperature.

1.2 *Units*—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.2.1 *Exceptions*—The apparatus used in this standard is only available in SI units (Section 4). Also, some of the calculations must use SI units 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

C1095 Practice for Calculating Precision Data on Refractories (C08) From Interlaboratory Test Results (Withdrawn 1998)³

3. Significance and Use

3.1 This test method is used to measure the rate of flow of air or nitrogen through refractory brick and monoliths and to thus determine the permeability of tested products.

3.2 This test method is useful in research and development for establishing the relative permeability of products within comparable classes. It may also be used to identify acceptable products for design purposes and to establish permeability criteria for specification acceptance.

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.

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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.

³ The last approved version of this historical standard is referenced on www.astm.org.

3.3 It must be recognized that permeability can vary in different directions and different parts of a refractory due to factors such as forming procedure, grain size and distribution, and heat treatment.

4. Apparatus

4.1 The apparatus shall provide a leakproof system for testing 2 in. (51 mm) cubes held in a pressurized rubber gasket, with means for controlling gas pressure and measuring gas flow. Figs. 1-3 illustrate a suitable apparatus.⁴ The apparatus consists of the following components:

4.1.1 *Permeating Medium*, air or nitrogen with regulator-controlled inlet pressure.

4.1.2 *Drier Tubes*, each filled with a desiccant and strainer; used to remove any water or dirt from the gas before entering the flowmeters.

4.1.3 *Flowmeters*—They will measure the flow of permeating media in the range from 0 to 9000 cm³/min. The flowmeters may be calibrated to read the flow directly of either air or nitrogen. The range for each flowmeter is shown in Fig. 1.

4.1.4 *Manometer*—A multiple scale digital manometer shall be used to measure the differential pressure across the specimen.

4.1.5 *Rubber Specimen-Sealing Gasket*—The gasket (Fig. 2) is made to fit tightly around a 2 by 2 by 2 in. (51 by 51 by 51 mm) test specimen. The two tapered metal-gasket holders (Fig. 3) enclose the rubber gasket, and are compressed with a hydraulic jack (Fig. 4) to seal the gasket tightly against the test specimen.

5. Specimen Preparation

5.1 One 2 by 2 by 2 in. (51 by 51 by 51 mm) specimen shall be cut from each of four pieces constituting the sample of material to be tested. The specimen should be cut in such a manner as to fit snugly into the gasket.

5.2 The specimens shall be cut so that three original surfaces are retained. In cases where it is desirable to determine the permeability of specimens that show directional differences in permeability, the original surfaces shall be identified, and the values determined separately for each direction of gas flow.

⁴ The apparatus is described in Eusner, G. R., and Shapland, J. T., "Permeability of Blast-Furnace Refractories," *Journal*, Am. Ceramic Soc., Vol. 42, No. 10, 1959, pp. 459–464.



FIG. 1 Permeability Apparatus

5.3 The specimens shall be dried for 16 h at 220 to 230°F (105 to 110°C) and cooled to room temperature before testing. After drying, all specimen surfaces shall be blown free of dust with clean dry air and tested within 4 h.

6. Procedure

6.1 Check the system for leaks. This may be accomplished by taking readings with an impermeable material in the specimen holder or by utilizing flowmeters in the line ahead of the test specimen.

6.2 Place the specimen in the rubber gasket, and enclose it between the two halves of the gasket holder. Force the halves of the gasket holder together to seal the specimen in the gasket.

6.3 Pass dried air (or nitrogen) through the specimen to produce a differential pressure across the specimen of 240 mm Hg (32.0 kPa) and measure the rate of air (or nitrogen) flow. Measure the differential pressure with the mercury manometer