Designation: C 604 – 02

# Standard Test Method for True Specific Gravity of Refractory Materials by Gas-Comparison Pycnometer[1]

This standard is issued under the fixed designation C 604; 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 the determination of the true specific gravity of solid materials, and is particularly useful for materials that easily hydrate which are not suitable for test with Test Method C 135. This test method may be used as an alternate for Test Method C 135, Test Method C 128, and Test Method C 188 for determining true specific gravity.

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:*

C 128 Test Method for Specific Gravity and Absorption of Fine Aggregate[2]

C 135 Test Method for True Specific Gravity of Refractory Materials by Water Immersion[3]

C 188 Test Method for Density of Hydraulic Cement[4]

## 3. Summary of Test Method

3.1 The sample is powdered to ensure permeation of gas into all pores. For practical purposes this is assumed to be true when the sample passes a No. 325 (45-μm) sieve. The volume of a carefully weighed powdered sample which has first been heated to drive off moisture and undesired combined water is measured by the gas-comparison pycnometer. Density is calculated from the sample weight in grams divided by its volume in cubic centimetres. This is also the specific gravity of the sample at room temperature compared to water at 4°C.

3.2 The principle of the gas-comparison pycnometer is as follows: There are two chambers and two pistons as sketched in Fig. 1. For purposes of illustration, the chambers are assumed to be equal in volume, and there is no sample in either cylinder. Under these conditions, with the coupling valve closed, any change in the position of one piston must be duplicated by an identical stroke in the other in order to maintain the same pressure on each side of the differential pressure indicator.

3.3 If a sample, $V_x$, is inserted into chamber *B*, the coupling valve closed and both pistons advanced the same amount from position *1* to position *2*, the pressures will not remain the same. However the pressures can be maintained equal if piston *B* instead is moved only to position *3*. Then the remaining displacement $d_x$, from position *3* to position *2*, is equal to the volume of the sample, $V_x$. If piston *A* always is advanced exactly the same distance each time a measurement is made, the distance that piston *B* differs from position *2*, when the pressures in both cylinders are equal, will always be proportional to the volume, $V_x$. The distance ($d_x$) between positions *2* and *3* can be calibrated and made to read directly in terms of cubic centimetres, employing a digital counter.

## 4. Significance and Use

4.1 The true specific gravity of a material is the ratio of its true density, determined at a specific temperature, to the true density of water, determined at a specific temperature. Thus, the true specific gravity of a material is a primary property which is related to chemical and mineralogical composition.

4.2 This test method is particularly useful for hydratable materials which are not suitable for test with Test Method C 135.

4.3 For refractory raw materials and products the true specific gravity is a useful value for: classification, detecting differences in chemical composition between supposedly like samples, indicating mineralogical phases or phase changes, calculating total porosity when the bulk density is known, and for any other test method that requires this value for the calculation of results.

4.4 This test method is a primary standard method which is suitable for use in specifications, quality control, and research and development. It can also serve as a referee test method in purchasing contracts or agreements.

4.5 Fundamental assumptions inherent in this test method are the following:

[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 Test and Properties.

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[2] *Annual Book of ASTM Standards*, Vol 04.02.

[3] *Annual Book of ASTM Standards*, Vol 15.01.

[4] *Annual Book of ASTM Standards*, Vol 04.01.