Designation: C329 – 88 (Reapproved 2016)

Standard Test Method for Specific Gravity of Fired Ceramic Whiteware Materials[1]

This standard is issued under the fixed designation C329; 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 specific gravity of fired ceramic whiteware materials under prescribed conditions.

NOTE 1—This test method is not applicable to materials attacked by water.

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:*[2]

D153 Test Methods for Specific Gravity of Pigments

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

3. Significance and Use

3.1 Measurement of specific gravity is a tool for determining the degree of maturation of a ceramic body.

4. Apparatus and Materials

4.1 *Analytical Balance and Weights.*

4.2 *Pycnometers,* of 50-mL capacity, consisting of suitable bottles with capillary tube stoppers.

4.3 *Thermometer,* calibrated at 0.5°C intervals in the room temperature range.

4.4 *Drying Oven.*

4.5 *Weighing Bottle.*

4.6 *Desiccator.*

4.7 *Vacuum Source*—A suitable apparatus to produce a vacuum equivalent to an absolute pressure of less than 1.0-in. (25.4-mm) Hg.

4.8 *Distilled Water,* that has been freshly evacuated, or boiled and cooled, to remove dissolved air.

5. Sample Preparation

5.1 When possible, the sample for test shall consist of at least two pieces totaling 100 to 150 g taken from different portions of the material in such a way as to exclude skin surfaces in so far as possible. The sample shall be selected so as to be representative of the material to be tested.

5.2 The pieces shall be crushed, if necessary, between hardened steel surfaces. The specimen shall then be reduced to 25 to 50 g by quartering, and any magnetic material introduced by crushing shall be removed. This specimen shall be ground in a suitable mortar so that it will pass a 150-μm (No. 100) sieve, conforming to Specification E11, or its equivalent. Care shall be taken at all stages of the crushing, grinding, and quartering to minimize the introduction of impurities and retain all material even though difficult to grind.

6. Procedure

6.1 Make all determinations in duplicate. Determine all weights in this procedure to the nearest 0.0001 g.

6.2 Place the ground specimen in a glass weighing bottle and dry to constant weight at 105 to 110°C. Close the bottle with a glass stopper immediately upon removal from the oven.

6.3 Dry the pycnometer and stopper at 105 to 110°C, cool to room temperature in a desiccator, weigh on an analytical balance, and record the weight as p. Fill the pycnometer bottle with distilled water at room temperature, t_1, insert the stopper, and remove the excess water on the tip of the capillary by means of filter paper. Weigh the pycnometer and contents and record the weight as W_1. Empty and dry the pycnometer.

6.4 Place about 8 to 12 g of the dried specimen in the dry pycnometer; weigh the pycnometer, stopper, and specimen and record the weight as W. Add distilled water until the bottle is approximately one half full, and, to remove entrapped air, first stir the specimen and water thoroughly with a glass rod. Then remove the glass rod, using a small quantity of distilled water to wash back into the pycnometer any particles of specimen

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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.

TABLE 1 Absolute Density of Water

Temperature, °C	Absolute Density, g/cm³									
	0	1	2	3	4	5	6	7	8	9
0	0.999 841	0.999 900	0.999 941	0.999 965	0.999 973	0.999 965	0.999 941	0.999 902	0.999 849	0.999 781
10	0.999 700	0.999 605	0.999 498	0.999 377	0.999 244	0.999 099	0.998 943	0.998 774	0.998 595	0.998 405
20	0.998 203	0.997 992	0.997 770	0.997 538	0.997 296	0.997 044	0.996 783	0.996 512	0.996 232	0.995 944
30	0.995 646	...	...	...	...	...	...	...	...	...

TABLE 2 Absolute Density of Dry Air at 760-mm Hg

Temperature, °C	Absolute Density, g/cm³									
	0	1	2	3	4	5	6	7	8	9
0	0.001 293	0.001 288	0.001 284	0.001 279	0.001 274	0.001 270	0.001 265	0.001 261	0.001 256	0.001 252
10	0.001 247	0.001 243	0.001 239	0.001 234	0.001 230	0.001 226	0.001 221	0.001 217	0.001 213	0.001 209
20	0.001 205	0.001 201	0.001 196	0.001 192	0.001 188	0.001 184	0.001 180	0.001 176	0.001 173	0.001 169
30	0.001 165	...	...	...	...	...	...	...	...	...

adhering to the rod. Finally subject the specimen and water to a reduced air pressure of less than 1.0-in. (25.4-mm) Hg (abs).

NOTE 2—A suitable method for evacuation of gas is described in 5.5 of Test Methods D153.

6.5 Fill the bottle, after evacuation with distilled water at room temperature, t_2, insert the stopper, and remove the excess water on the tip of the capillary by means of filter paper. Weigh the pycnometer and contents, and record the weight as W_2.

6.6 Temperatures t_1 and t_2 shall be reported to the nearest 0.5°C and shall not differ by more than 5°C.

7. Calculation

7.1 Calculate the specific gravity with respect to water at 4°C, as follows:

$$\text{Specific gravity} = \frac{d_1 d_2 (W - p)}{0.999973\left[d_2(W_1 - p) - d_1(W_2 - W)\right]} \quad (1)$$

where:

d_1 = absolute density of water (from Table 1) at temperature t_1 (6.3),
d_2 = absolute density of water (from Table 1) at temperature t_2 (6.5),
p = weight of the stoppered pycnometer (6.3),
W = weight of the stoppered pycnometer and specimen (6.4),
W_1 = weight of the stoppered pycnometer filled with water (6.3), and
W_2 = weight of the stoppered pycnometer, specimen, and water (6.5).

7.2 The absolute density of the specimen may be determined by following the directions in Section 6, but making certain that all weighings are made at identical temperatures and in a dry atmosphere. If this precaution is taken, the absolute density may be calculated as follows:

$$G = (W - p)/\left[(W_1 - p) - (W_2 - W)\right] \quad (2)$$

$$\text{Absolute density} = \left[G(d - a)\right] + a$$

where:

G = specific gravity with respect to water at temperature t,
d = absolute density of water (from Table 1) at temperature t,
a = absolute density of air (from Table 2) at temperature t, and
t = temperature at which all weighings were made.

8. Report

8.1 Report the following information:

8.1.1 Designation of the material tested,

8.1.2 Data sheet showing all weights and water temperatures. If the absolute density is required, air temperatures shall also be shown, and

8.1.3 Specific gravity (or absolute density, if required). Duplicate determinations shall be reported to the nearest 0.001.

9. Precision and Bias

9.1 It is generally accepted that duplicate determinations should not differ by more than 0.005. Additional specific information to support a precision and bias statement is not yet available.

10. Keywords

10.1 fired ceramic whiteware materials; specific gravity