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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Test Method for Density of Glass by the Sink-Float Comparator[1]

This standard is issued under the fixed designation C 729; 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—Section 11 was added editorially in April 1995.

1. Scope

1.1 This test method covers the determination of the density of glass or nonporous solids of density from 1.1 to 3.3 g/cm^3. It can be used to determine the apparent density of ceramics or solids, preferably of known porosity.

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 693 Test Method for Density of Glass by Buoyancy[2]

D 1217 Test Method for Density and Relative Density (Specific Gravity) of Liquids by Bingham Pycnometer[3]

E 12 Terminology Relating to Density and Specific Gravity of Solids, Liquids, and Gases[4]

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specification[5]

E 77 Test Method for Inspection and Verification of Thermometers[6]

F 77 Test Method for Apparent Density of Ceramics for Electron Device and Semiconductor Application[2]

3. Summary of Method

3.1 The specimen of unknown density is compared with a reference standard of known density. The specimen to be measured is placed in a test tube containing a solution whose density at 35°C is within 0.0200 g/cm^3 of the density of the specimen at 25°C. The solution is prepared using miscible liquids of known densities bracketing the desired range. The tube also contains a glass density reference standard whose density at 35°C is close to that of the solution at 35°C; the tube is immersed in a variable-temperature comparator bath. Initially the solutions, specimen, and standard are at a temperature near 25°C, and both the standard and the specimen float in the solution. The temperature of the system is raised at a uniform rate. Because the expansion coefficient of the solution is higher than that of the glass standard and specimen, both the standard and the specimen will sink (settle) in the solution. The temperatures at which the specimen and standard reach the mid-point of the test tube are noted and by use of special tables, the density of the specimen is obtained.

3.2 *Range of a Given Density Solution*—A given density solution can be used to measure specimens whose density is within ± 0.0200 g/cm^3 of the density of the solution at 35°C, by operating the comparator bath in the range 25 to 45°C.

4. Significance and Use

4.1 The sink-float comparator method of test for glass density provides the most accurate (yet convenient for practical applications) method of evaluating the density of small pieces or specimens of glass. The data obtained are useful for daily quality control of production, acceptance or rejection under specifications, and for special purposes in research and development.

4.2 Although this test scope is limited to a density range from 1.1 to 3.3 g/cm^3, it may be extended (in principle) to higher densities by the use of other miscible liquids (Test Method F 77) such as water and thallium malonate-formate (approximately 5.0 g/cm^3). The stability of the liquid and the precision of the test may be reduced somewhat, however, at higher densities.

5. Apparatus

5.1 *Single Tube and Multiple-Tube Comparators* (Method E 77)—A single-tube comparator can be constructed from materials readily available in a typical laboratory, and useful if one wishes to measure the density of materials within a fairly narrow range, or if only a few tests need to be run each day. The multiple-tube comparator can be purchased commercially.[7] It is useful if materials with a wide range of density must be tested or if many specimens must be tested each day. The comparators shall consist of the following:

[1] This test method is under the jurisdiction of ASTM Committee C-14 on Glass and Glass Products and is the direct responsibility of Subcommittee C14.04 on Physical and Mechanical Properties.

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[2] *Annual Book of ASTM Standards*, Vol 15.02.

[3] *Annual Book of ASTM Standards*, Vol 05.01.

[4] *Annual Book of ASTM Standards*, Vol 15.05.

[5] *Annual Book of ASTM Standards*, Vol 14.02.

[6] *Annual Book of ASTM Standards*, Vol 14.03.

[7] A multiple-tube comparator is available from American Glass Research, Inc., Box 149, Butler, PA 16001.

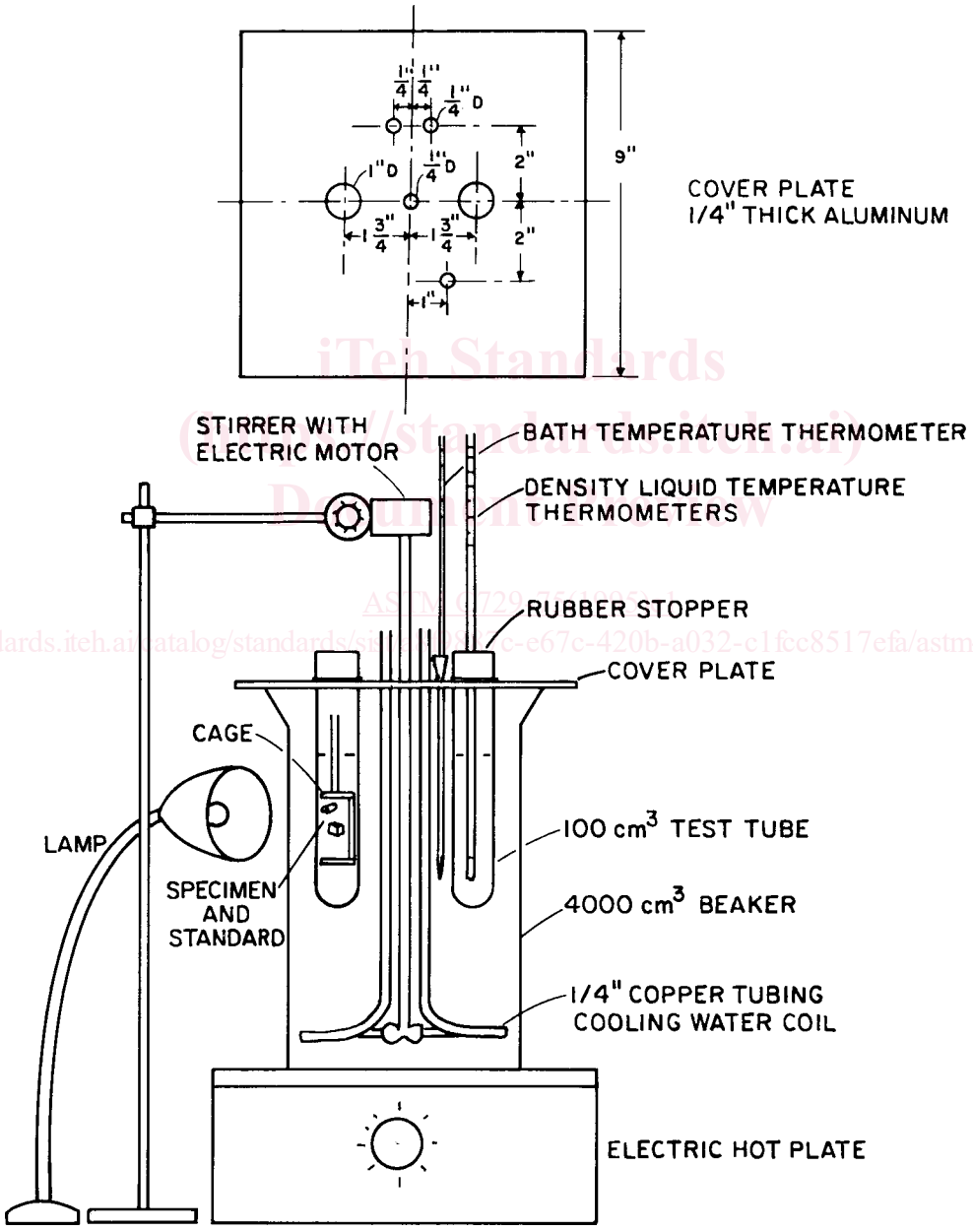
5.1.1 *Single-Tube Comparator* (Fig. 1):

5.1.1.1 *Circulating Water Bath*, consisting of a 4000-cm^3 beaker, a cover plate supporting test tubes and thermometer, a cooling water coil made from copper tubing, an electrically driven stirrer, and containing an immersion heater with rheostat for controlling heating rate, or heated by an external heat source such as a hot plate.

5.1.1.2 *Test Tubes*, two, 100-cm^3 capacity. The cover plate supports the test tubes, which extended into the water bath. One tube contains the density solution, the test specimen, the standard, and a glass or TFE-fluorocarbon cage (Fig. 2) that keeps the specimens immersed in the solution. The second test tube contains density solution and a thermometer; both test tubes employ rubber stoppers for supporting the cage or thermometer.

5.1.1.3 *Thermometers*, two, mercury, readable to 0.1°C between 20 and 50°C. One thermometer passes through a rubber stopper supported by the cover plate into the water bath. The second thermometer passes through a rubber stopper into the test tube that contains density solution only. Thermistor thermometers can be used instead of mercury thermometers, if desired.

5.1.2 *Multiple-Tube Comparator*—The commercially obtainable multiple-tube comparator employs the same principle



Metric Equivalents

in.	¼	½	1	1¾	2	9
mm	6.4	12.7	25.4	44.4	51	229

FIG. 1 Single Tube Sink-Float Density Apparatus