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AMERICAN SOCIETY FOR TESTING AND MATERIALS  
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## Standard Test Method for Apparent Density of Ceramics for Electron Device and Semiconductor Application<sup>1</sup>

This standard is issued under the fixed designation F 77; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This test method covers the determination of the apparent density of ceramic parts, used in electron device and semiconductor applications, with a maximum dimension of 25 mm (1 in.) and having zero or discontinuous porosity.

1.2 The values stated in SI units are to be regarded as the standard. The values in parentheses are 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:*

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specification<sup>2</sup>

### 3. Apparatus

3.1 *Specific Gravity Balance*, sensitivity of 0.1 mg (Note 1).

3.2 *Tweezers*.

3.3 *Glass Stirring Rod*.

3.4 *Thermometer*.

3.5 *Reference Standard* (Note 2).

NOTE 1—Balances of types other than those designed specifically for the determination of specific gravity may be used as agreed upon between the purchaser and the seller.

NOTE 2—A reference standard may be calibrated and used by the purchaser and the seller if desired. The calibration should be completed and its accuracy determined before this test method is used to establish the density of any purchased parts.

### 4. Materials

4.1 *High-Density Liquids*, namely, thallium malonate-formate solutions (Note 3) and

4.2 *Boiled, Gas-Free Distilled Water*.

NOTE 3—**Precaution:** Thallium malonate-formate solution is highly toxic and must be handled in a safe manner at all times only by competent

personnel. Instructions on how to mix solutions from these salts and the methods of handling them are best obtained from competent chemical manufacturing companies or qualified chemical laboratories.

### 5. Procedure

5.1 Before using the specific gravity balance, be sure that it has been properly calibrated according to manufacturer's instructions or to methods agreed upon between the purchaser and the seller.

5.2 Hang the plummet on the left side of the balance and set the beam rider and the vernier at zero reading. Adjust the balance to null by turning the nut at the extremities of the beam of the balance or the adjusting knob of the vernier.

5.3 Fill the cylinder provided with the balance with boiled distilled water to about 25 mm (1 in.) from the top and place it on the platform directly under the plummet. Immerse the plummet in the water by raising the platform until the top of the plummet is approximately 13 mm (0.5 in.) below the surface of the liquid. Be sure that no air bubbles stick to the sides of the plummet. Note and record the temperature of the water,  $T_w$ . Manipulate the rider and vernier to bring the needle to zero. (No attempt should be made to arrive at the final reading by oscillating the needle.) Record this reading as  $S_w$ . Remove the water from the cylinder and dry the plummet and the cylinder thoroughly.

5.4 Using tweezers, immerse the specimen of ceramic, properly cleaned and dried, in a beaker of high density liquid on which the specimen will float. The volume of liquid should not be less than 50 mL and should be large enough for the specimens to float freely.

5.5 Lower the specific gravity of the liquids slowly by adding water, drop by drop, to the beaker until the density of liquid equals that of the specimen. (Each drop of water should not lower the specific gravity of the solution by more than 0.003 g/cm<sup>3</sup>.) This condition is indicated when the specimen starts to suspend in the liquid (sink below the surface of the liquid) and will remain stationary when placed in any position within the volume of the liquid. Remove the specimen from the liquid as soon as this condition is reached.

5.6 Pour the liquid from the beaker into the cylinder of the balance. Immerse the plummet in the liquid and place the counter-poise weight (marked 2 S.G.) provided, at the place from which the plummet is suspended. Obtain the null point by manipulating the rider and the vernier as in 5.2. Record the temperature of the liquid,  $T_{fh}$ , and the rider and vernier

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee C-21 on Ceramic Whitewares and Related Products and is the direct responsibility of Subcommittee C21.03 on Fundamental Properties.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 14.02.