



Designation: D792 – 20

Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement¹

This standard is issued under the fixed designation D792; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 These test methods describe the determination of the specific gravity (relative density) and density of solid plastics in forms such as sheets, rods, tubes, or molded items.

1.2 Two test methods are described:

1.2.1 *Test Method A*—For testing solid plastics in water, and

1.2.2 *Test Method B*—For testing solid plastics in liquids other than water.

1.3 The values stated in SI units are to be regarded as the standard.

1.4 **Warning**—*Mercury has been designated by many regulatory agencies as a hazardous substance that can cause serious medical issues. Mercury, or its vapor, has been demonstrated to be hazardous to health and corrosive to materials. Use caution when handling mercury and mercury-containing products. See the applicable product Safety Data Sheet (SDS) for additional information. The potential exists that selling mercury or mercury-containing products, or both, is prohibited by local or national law. Users must determine legality of sales in their location.*

1.5 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—This standard is not equivalent to ISO 1183–1 Method A. This test method provides more guidelines on sample weight and dimension. ISO 1183–1 allows testing at an additional temperature of $27 \pm 2^\circ\text{C}$.

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recom-*

mendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

2. Referenced Documents

2.1 *ASTM Standards:*²

D618 Practice for Conditioning Plastics for Testing

D891 Test Methods for Specific Gravity, Apparent, of Liquid Industrial Chemicals

D4968 Practice for Annual Review of Test Methods and Specifications for Plastics

D6436 Guide for Reporting Properties for Plastics and Thermoplastic Elastomers

E12 Terminology Relating to Density and Specific Gravity of Solids, Liquids, and Gases (Withdrawn 1996)³

E456 Terminology Relating to Quality and Statistics

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

E2251 Specification for Liquid-in-Glass ASTM Thermometers with Low-Hazard Precision Liquids

E2935 Practice for Conducting Equivalence Testing in Laboratory Applications

IEEE/ASTM SI-10 Practice for Use of the International System of Units (SI) (the Modernized Metric System)

3. Terminology

3.1 *General*—The units, symbols, and abbreviations used in these test methods are in accordance with IEEE/ASTM SI-10.

3.1.1 For terms relating to precision and bias and associated issues, the terms used in this test method are in accordance with the definitions in Terminology E456.

3.2 *Definitions:*

3.2.1 *specific gravity (relative density)*—the ratio of the mass of a given volume of the impermeable portion of the material at 23°C to the mass of an equal volume of gas-free

¹ These test methods are under the jurisdiction of ASTM Committee D20 on Plastics and are the direct responsibility of Subcommittee D20.70 on Analytical Methods (Section D20.70.01).

Current edition approved July 1, 2020. Published July 2020. Originally approved in 1944. Last previous edition approved in 2013 as D792 - 13. DOI: 10.1520/D0792-20.

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.

*A Summary of Changes section appears at the end of this standard

distilled or de-mineralized water at the same temperature; the form of expression shall be:

Specific gravity (relative density) 23/23°C
(or sp gr 23/23°C)

NOTE 2—This definition is essentially equivalent to the definition for apparent specific gravity and apparent density in Terminology E12, because the small percentage difference introduced by not correcting for the buoyancy of air is insignificant for most purposes.

3.2.2 *density*—cubic metre of impermeable portion of the material at 23°C. The form of expression shall be:

$D^{23}, \text{kg/m}^3$

NOTE 3—The SI unit of density, as defined in IEEE/ASTM SI-10, is kg/m^3 . To convert density in g/cm^3 to density in kg/m^3 , multiply by 1000.

NOTE 4—To convert specific gravity 23/23°C to density 23°C, kg/m^3 , use the following equation:

$$D^{23^\circ\text{C}}, \text{kg/m}^3 = \text{sp gr } 23/23^\circ\text{C} \times 997.5$$

Where 997.5 kg/m^3 is the density of water at 23°C.

4. Summary of Test Method

4.1 Determine the mass of a specimen of the solid plastic in air. It is then immersed in a liquid, its apparent mass upon immersion is determined, and its specific gravity (relative density) calculated.

5. Significance and Use

5.1 The specific gravity or density of a solid is a property that is conveniently measured to identify a material, to follow physical changes in a sample, to indicate degree of uniformity among different sampling units or specimens, or to indicate the average density of a large item.

5.2 Changes in density of a single material are due to localized differences in crystallinity, loss of plasticizer, absorption of solvent, or to other causes. It is possible that portions of a sample differ in density because of their differences in crystallinity, thermal history, porosity, and composition (types or proportions of resin, plasticizer, pigment, or filler).

5.3 Density is useful for calculating strength-weight and cost-weight ratios.

6. Sampling

6.1 The sampling units used for the determination of specific gravity (relative density) shall be representative of the quantity of product for which the data are required.

6.1.1 If it is known or suspected that the sample consists of two or more layers or sections having different specific gravities, either complete finished parts or complete cross sections of the parts or shapes shall be used as the specimens, or separate specimens shall be taken and tested from each layer. The specific gravity (relative density) of the total part shall not be obtained by adding the specific gravity of the layers, unless relative percentages of the layers are taken into account.

7. Conditioning

7.1 *Conditioning*—Condition the test specimens at $23 \pm 2^\circ\text{C}$ and $50 \pm 10\%$ relative humidity for not less than 40

h prior to test in accordance with Procedure A of Practice D618, unless otherwise specified by the contract or relevant material specifications. In cases of disagreement, the tolerances shall be $\pm 1^\circ\text{C}$ and $\pm 5\%$ relative humidity.

7.2 *Test Conditions*—Conduct tests in the standard laboratory atmosphere of $23 \pm 2^\circ\text{C}$ and $50 \pm 10\%$ relative humidity, unless otherwise specified in this specification or by the contract or relevant material specification. In cases of disagreement, the tolerances shall be $\pm 1^\circ\text{C}$ and $\pm 5\%$ relative humidity.

TEST METHOD A FOR TESTING SOLID PLASTICS IN WATER (SPECIMENS 1 TO 50 g)

8. Scope

8.1 This test method involves weighing a one-piece specimen of 1 to 50 g in water, using a sinker with plastics that are lighter than water. This test method is suitable for plastics that are wet by, but otherwise not affected by water.

9. Apparatus

9.1 *Analytical Balance*—A balance with a precision of 0.1 mg or better is required for materials having densities less than 1.00 g/cm^3 and sample weights less than 10 grams. For all other materials and sample weights, a balance with precision of 1 mg or better is acceptable. The balance shall be equipped with a stationary support for the immersion vessel above the balance pan (“pan straddle”).

9.1.1 The balance shall provide the precision that all materials tested have three significant figures on density. In case that materials with different densities are tested on one single balance, use the balance that provides at least three significant figures for all materials concerned.

NOTE 5—To ensure that the balance meets the performance requirements, check on zero point and sensitivity frequently and perform periodic calibration.

9.2 *Sample Holder*, corrosion-resistant (for example, wire, gemholder, etc.).

9.3 *Sinker*—A sinker for use with specimens of plastics that have specific gravities less than 1.00. The sinker shall: (1) be corrosion-resistant; (2) have a specific gravity of not less than 7.0; (3) have smooth surfaces and a regular shape; and (4) be slightly heavier than necessary to sink the specimen. The sinker shall have an opening to facilitate attachment to the specimen and sample holder.

9.4 *Immersion Vessel*—A beaker or other wide-mouthed vessel for holding the water and immersed specimen.

9.5 *Thermometer*—A thermometer readable to 0.1°C or better.

10. Materials

10.1 *Water*—The water shall be substantially air-free and distilled or de-mineralized water. If this solution does not wet the specimen, Method B shall be used.

NOTE 6—Air in water can be removed by boiling and cooling the water, or by shaking the water under vacuum in a heavy-walled vacuum flask. (Warning—Use gloves and shielding.) If the water does not wet the