



Designation: D6093 – 97 (Reapproved 2003)

Standard Test Method for Percent Volume Nonvolatile Matter in Clear or Pigmented Coatings Using a Helium Gas Pycnometer¹

This standard is issued under the fixed designation D6093; 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 percent volume nonvolatile matter of a variety of clear and pigmented coatings. The approach used should provide faster and more accurate results than the use of the liquid displacement technique in Test Method [D2697](#), particularly for coatings that are difficult to wet or that contain voids, cracks or other defects. The improvement in accuracy stems from the superior ability of helium gas under pressure to penetrate very small pores and surface irregularities in dried films. This provides a more accurate determination of void volumes than can be obtained via liquid displacement.

1.2 The technique will provide results under the following constraints:

1.2.1 The stability of the helium gas pycnometer is greater than $\pm 0.005 \text{ cm}^3$

1.2.2 Test specimen weights are greater than 1 g.

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *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

[D1475](#) Test Method For Density of Liquid Coatings, Inks, and Related Products

[D2369](#) Test Method for Volatile Content of Coatings

[D2697](#) Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings

¹ This test method is under the jurisdiction of ASTM Committee [D01](#) on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee [D01.21](#) on Chemical Analysis of Paints and Paint Materials.

Current edition approved March 10, 2003. Published May 2003. Originally approved in 1997 as D6093 – 97. DOI: 10.1520/D6093-97R03.

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.

[D3960](#) Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings

[D4708](#) Practice for Preparation of Uniform Free Films of Organic Coatings

[E180](#) Practice for Determining the Precision of ASTM Methods for Analysis and Testing of Industrial and Specialty Chemicals

2.2 *Other Documents:*

2.2.1 Directions for obtaining appropriate instruction manuals on the use, care, and operation of the instruments and equipment are listed in Section [5](#), (Apparatus).

3. Summary of Test Method

3.1 This procedure measures the volume of nonvolatile material in a dried or baked coating film. A helium gas pycnometer is used to determine the volume occupied by a film by measuring the reduction of gas capacity in the pycnometer sample chamber caused by the presence of the test specimen. (The actual measurement is accomplished with a pressure transducer that measures the difference in pressure between the empty sample compartment and when loaded. The volume occupied by the coating sample is then calculated from the Ideal Gas Law.) The weight of the specimen is also measured and the two values are used to calculate the dry film density.

3.2 The percent volume nonvolatile content of a coating is calculated using the dry film density, liquid coating density, and the weight percent nonvolatile content of the coating.

4. Significance and Use

4.1 This test method measures the volume of dry coating obtainable from a given volume of liquid coating. This value is useful for calculating the volatile organic content (VOC) of a coating and could be used to estimate the coverage (square feet of surface covered at a specified dry film thickness per unit volume) obtainable with different coating products.

NOTE 1—In Practice [D3960](#) paragraph 10.3.1, the equation for calculating the VOC content using the percent volume nonvolatile is given. Prior to this method a satisfactory procedure for measuring percent volume nonvolatile did not exist (see Note 11 in Practice [D3960](#)).

NOTE 2—Since the actual coverage of a coating includes the void volume and the porosity of the film, the coverage value calculated from this method will be inaccurate by that amount, that is, the actual coverage will be greater. The higher the pigment to binder ratio (P/B) of a coating