



Designation: D 4883 – 99

Standard Test Method for Density of Polyethylene by the Ultrasound Technique¹

This standard is issued under the fixed designation D 4883; 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 density of polyethylene through the utilization of ultrasound equipment.

1.2 This test method is based on the distinct behaviors of the amorphous and crystalline phases of polyethylene in response to ultrasound. Polyethylene can be viewed as a composite structure where high-density crystalline regions are connected by lower-density amorphous material. The ratio of crystalline to amorphous material determines the final density of the material. The amorphous and crystalline phases exhibit very distinct behaviors with regard to the propagation of sound waves. The propagation characteristics in the composite will depend on the relative amount of the two phases (the degree of crystallinity).

1.3 Inorganic materials increase density as measured by Test Methods D 792 and D 1505, but they have little or no effect on ultrasonic density. The ultrasonic measurement is basically a base resin density.

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

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

NOTE 1—There is no similar or equivalent ISO standard.

2. Referenced Documents

2.1 ASTM Standards:

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing²

D 792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement²

D 883 Terminology Relating to Plastics²

D 1505 Test Method for Density of Plastics by the Density-Gradient Technique²

D 1898 Practice for Sampling of Plastics²

D 4703 Practice for Compression Molding Thermoplastic Materials into Test Specimens, Plaques, or Sheets³

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method⁴

3. Terminology

3.1 *Definitions:* The definitions given in Terminology D 883, as well as in Test Methods D 792 and D 1505, are applicable to this test method.

4. Significance and Use

4.1 The density of polyethylene is a conveniently measurable property which is frequently useful as a means of following physical changes in a sample, as an indication of uniformity among samples, and as a means of identification.

4.2 This test method is designed to yield results with a precision of $\pm 0.08\%$ or better.

5. Apparatus

5.1 Use an instrument which utilizes a sonic technique to evaluate the density of polyethylene. The Tecrad instrument⁵ utilizes a sonic sensing head (transducer) which measures the velocity of sound in a molded specimen, approximately 1.9 mm in thickness. Because sonic velocity is positively correlated to density in polyethylene, a measurement of this velocity can be used to determine specimen density. The information from this transducer then must be electronically evaluated; in the Tecrad instance this is done with a computer, and the result is reported either through a display or printout.

5.2 Equipment specified in Test Method D 1505.

5.3 Equipment specified in Test Methods D 792.

5.4 Equipment specified in Practice D 618.

5.5 Equipment specified in Annex A1 of Practice D 4703.

NOTE 2—The equipment specified in 5.2 or 5.3 is required for the initial calibration of the sonic equipment. Once the sonic equipment is calibrated, this additional equipment is no longer required. It is recommended that the standards used for the initial calibration be retained for any additional calibration which may be required. It is also recommended that one or more of the calibration standards be evaluated on a routine basis for

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² *Annual Book of ASTM Standards*, Vol 08.01.

³ *Annual Book of ASTM Standards*, Vol 08.03.

⁴ *Annual Book of ASTM Standards*, Vol 14.02.

⁵ The Tecrad instrument can be obtained from Tecrad U.S.A., 132 Boston Post Rd., East Lyme, CT 06333.

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