Designation: ~~D6289 – 08~~ D6289 – 13

Standard Test Method for Measuring Shrinkage from Mold Dimensions of Molded Thermosetting Plastics[1]

This standard is issued under the fixed designation D6289; 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 is intended to measure shrinkage from mold cavity to molded dimensions of thermosetting plastics when molded by compression, injection, or transfer under specified conditions.

1.2 This test method provides for the measurement of shrinkage of thermosetting plastics from their molds both initially (within 16 to 72 h of molding) and ~~as they age~~ after aging (post–shrinkage at elevated temperatures).

1.3 This method will give comparable data based on standard specimens and can not predict absolute values in actual molded parts with varying flow paths, wall thicknesses, pressure gradiants and process conditions. Differences in mold shrinkage generally is observed between the specimen geometries described in this test method.

1.4 Knowledge of the initial shrinkage of plastics is important for the construction of molds and knowledge of post molding shrinkage is important for determining the suitability of the molding material for manufacturing thermosetting plastic components with accurate dimensions.

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

1.6 *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—This test method and ISO 2577-1984 are equivalent when bars of 120 mm length, 15 mm width, and 10 mm thickness are used for compression molding; or flat, square plaques approximately 120 by 120 by 4 mm are used for injection molding.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D618 Practice for Conditioning Plastics for Testing

D796 Practice for Compression Molding Test Specimens of Phenolic Molding Compounds (Withdrawn 1992)[3]

D883 Terminology Relating to Plastics

D1896 Practice for Transfer Molding Test Specimens of Thermosetting Compounds

D3419 Practice for In-Line Screw-Injection Molding Test Specimens From Thermosetting Compounds

D5224 Practice for Compression Molding Test Specimens of Thermosetting Molding Compounds

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

2.2 *ISO Standards:*[4]

ISO 291 Plastics—Standard Atmospheres for Conditioning and Testing

ISO 295 Plastics—Compression Molding Test Specimens of Thermosetting Materials

ISO 10724 Plastics—Thermosetting Molding Materials—Injection Molding of Multipurpose Test Specimens

ISO 2577-1984 Plastics—Thermosetting Moulding Materials—Determination of Shrinkage

[1] This test method is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.09 on Specimen Preparation.
Current edition approved ~~April 15, 2008~~April 1, 2013. Published ~~May 2008~~April 2013. Originally approved in 1998. Last previous edition approved in ~~2003~~2008 as ~~D6289 - 03.~~D6289 - 08. DOI: ~~10.1520/D6289-08.~~10.1520/D6289-13.

[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.

[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

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

3. Terminology

3.1 *General*—Definitions of terms applying to this test method appear in Terminology D883.

3.2 *Definitions:*

3.2.1 For the purpose of this test method, the following definitions apply:

3.2.2 *molding shrinkage*—the difference in dimensions between a molding and the mold cavity in which it was molded, both the mold and the molding being at 23 ± 2°C when measured.

3.2.3 *post-shrinkage*—shrinkage of a plastic product after molding, during post-treatment, storage or use.

4. Significance and Use

4.1 *Compression Molding*—In compression molding, the difference between the dimensions of a mold and of the molded article produced therein from a given material vary according to the design and operation of the mold. It is probable that shrinkage will approach a minimum where design and operation are such that a maximum of material is forced solidly into the mold cavity or some part of it, or where the molded article is hardened to a maximum while still under pressure, particularly by cooling. In contrast, shrinkages are higher where the charge must flow in the mold cavity but does not receive and transmit enough pressure to be forced firmly into all its recesses, or where the molded article is not fully hardened when discharged. The plasticity of the material used affects shrinkage insofar as it affects the retention and compression of the charge.

4.2 *Injection Molding*—In injection molding, as in compression molding, the differences between the dimensions of the mold and of the molded article produced therein from a given material vary according to the design and operation of the mold. The differences vary with the type and size of molding machine, the thickness of molded sections, the degree and direction of flow or movement of material in the mold, the size of the nozzle, sprue, runner, and gate, the cycle on which the machine is operated, the temperature of the mold, and the length of time that follow-up pressure is maintained. As in the case of compression molding, shrinkages will approach a minimum where design and operation are such that a maximum of material is forced solidly into the mold cavity and where the molded article is hardened to a maximum while still under pressure as a result of the use of a runner, sprue, and nozzle of proper size, along with proper dwell. As in compression molding, shrinkages are higher where the charge must flow in the mold cavity but does not receive and transmit enough pressure to be forced firmly into all of the recesses of the mold. The plasticity of the material used affects shrinkage indirectly, in that the more readily plasticized material will require a lower molding temperature.

4.3 *Transfer Molding*—In transfer molding, as in compression or injection molding, the difference between the dimensions of the mold and of the molded article produced therein from a given material vary according to the design and operation of the mold. It is affected by the size and temperature of the pot or cylinder and the pressure on it, as well as on mold temperature and molding cycle. Direction of flow is not as important a factor.

4.4 *Materials Standards*—Always refer to material standards for special treatment prior to molding, molding conditions and special handling of the test specimens after molding. In the event the material standard is unavailable, contact the manufacturer for these recommendations.

4.5 *Utility*—Measurement of batch-to-batch consistency in initial shrinkage from mold to molded dimensions is useful for evaluating the quality of thermosetting plastics.

5. Sample Preparation

5.1 Some materials require special treatment before they are molded. Materials to be tested shall be prepared for molding in accordance with the relevant material standard or the manufacturer's recommendations. The preparation given to the material prior to molding shall be recorded and reported.

6. Apparatus

6.1 *Mold, Press, etc.,* suitable for molding the test specimens specified in Section 8. For transfer or compression molding, a positive or a semi-positive mold with single or multiple cavities shall be used. For injection molding, the type of mold is defined.

6.1.1 If required, marks are engraved in the mold near opposite ends of the specimen to facilitate the accurate measurement of the length of the cavity and the specimens.

NOTE 2—If multiple cavities are used with a positive mold, it is possible that resulting variations in test specimen density ~~may~~can be sufficient to produce inconsistent shrinkage.

6.2 *Equipment,* suitable for measuring the lengths of the test specimen and the corresponding cavity of the mold to within 0.02 mm.

6.3 *Oven,* for post-shrinkage only, a forced draft type is recommended.

7. Sampling

7.1 A representative sample shall be taken from the molding material and be kept at room temperature in airtight containers, without any conditioning, until molded into test specimens.

8. Test Specimen

8.1 *Compression-Molding Materials*—For mold shrinkage of compression-molding materials, the test specimens shall be bars 120 by 15 by 10 mm, bars 12.7 by 12.7 by 127 mm (½ by ½ by 5 in.), or disks 3.2 mm (⅛ in.) in thickness and 102 mm (4 in.) in diameter made in a positive mold in such a way as to minimize lateral movement of the plastic during the molding.

8.2 *Injection-Molding Materials*—For mold shrinkage of injection-molding materials, the test specimens shall be bars 12.7 by 3.2 by 127 mm (½ by ⅛ by 5 in.) gated at the end, bars 12.7 by 12.7 by 127 mm (½ by ½ by 5 in.) disks 3.2 mm (⅛ in.) in thickness and 102 mm (4 in.) in diameter gated radially at a single point in the edge, plaques 120 by 120 by 4 mm or plaques 60 by 60 by 2 mm gated with a full edge gate.

8.3 *Transfer-Molding Materials*—For shrinkage of transfer-molding materials, specimens 12.7 by 12.7 by 127 mm (½ by ½ by 5 in.) gated at the end or at the top near one end, so as to provide flow throughout their entire length or disk specimen 3.2 mm (⅛ in.) in thickness and 102 mm (4 in.) in diameter gated radically at a single point in the edge.

8.4 The specimens shall be molded to shape by compression, transfer or injection molding using a mold with single or multiple cavities.