Designation: D3123 – 09 (Reapproved 2017)

Standard Test Method for Spiral Flow of Low-Pressure Thermosetting Molding Compounds[1]

This standard is issued under the fixed designation D3123; 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 a procedure for measuring the spiral flow of thermosetting molding compounds (soft or very soft) designed for molding pressures under 6.9 MPa (1000 psi). It is especially suited for those compounds used for encapsulation or other low pressure molding techniques. It involves the use of a standard spiral flow mold in a transfer molding press under specified conditions of applied temperature and pressure with a controlled charge mass.

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

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.*

NOTE 1—There is no known ISO equivalent to this test method.

1.4 *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 Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D883 Terminology Relating to Plastics

D958 Practice for Determining Temperatures of Standard ASTM Molds for Test Specimens of Plastics (Withdrawn 1995)[3]

E105 Practice for Probability Sampling of Materials

3. Terminology

3.1 *Definitions*—Definitions in this test method are consistent with Terminology D883.

4. Significance and Use

4.1 The spiral flow of a thermosetting molding compound is a measure of the combined characteristics of fusion under pressure, melt viscosity, and gelation rate under specific conditions.

4.2 This test method is useful as a quality control test and as an acceptance criterion.

4.3 This test method, by itself, is not a valid means for comparing the moldability of similar or different molding compounds because it cannot duplicate actual conditions prevalent in different types of production molds.

4.4 This test method is presently intended for use at a transfer pressure of 6.9 MPa (1000 psi) and a mold temperature of 423 ± 3 K (150 ± 3°C (302 ± 5°F)).

5. Apparatus

5.1 *Transfer Molding Press* with a minimum 150 by 150-mm (6 by 6-in.) platen area, transfer piston pressure potentially greater than 6.9 MPa (1000 psi), sufficient clamp pressure to prevent flashing, and a minimum plunger speed of 25.4 mm (1 in.)/s without load. It is recommended that the plunger be equipped with at least one peripheral sealing groove. It is recommended that a pot diameter between 31.75 and 44.45 mm (1.25 and 1.75 in.) be used whenever a choice is possible.

NOTE 2—Preliminary evidence indicates that, in many cases, reasonable correlations may be achieved between laboratories using presses with different pot diameters. Typical examples are presses with pot diameters of 31.750, 38.100, and 44.450 mm (1.250, 1.500, and 1.750 in.). However, a few well-documented cases are recorded where differences in pot diameters, even within this listed range, have caused large differences in flow-length readings. Therefore, for best interlaboratory correlation it is recommended that identical pot diameters be used.

5.2 *Standard Spiral-Flow Mold* shown in Fig. 1 shall be utilized.

[1] This test method is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.30 on Thermal Properties (Section D20.30.08).

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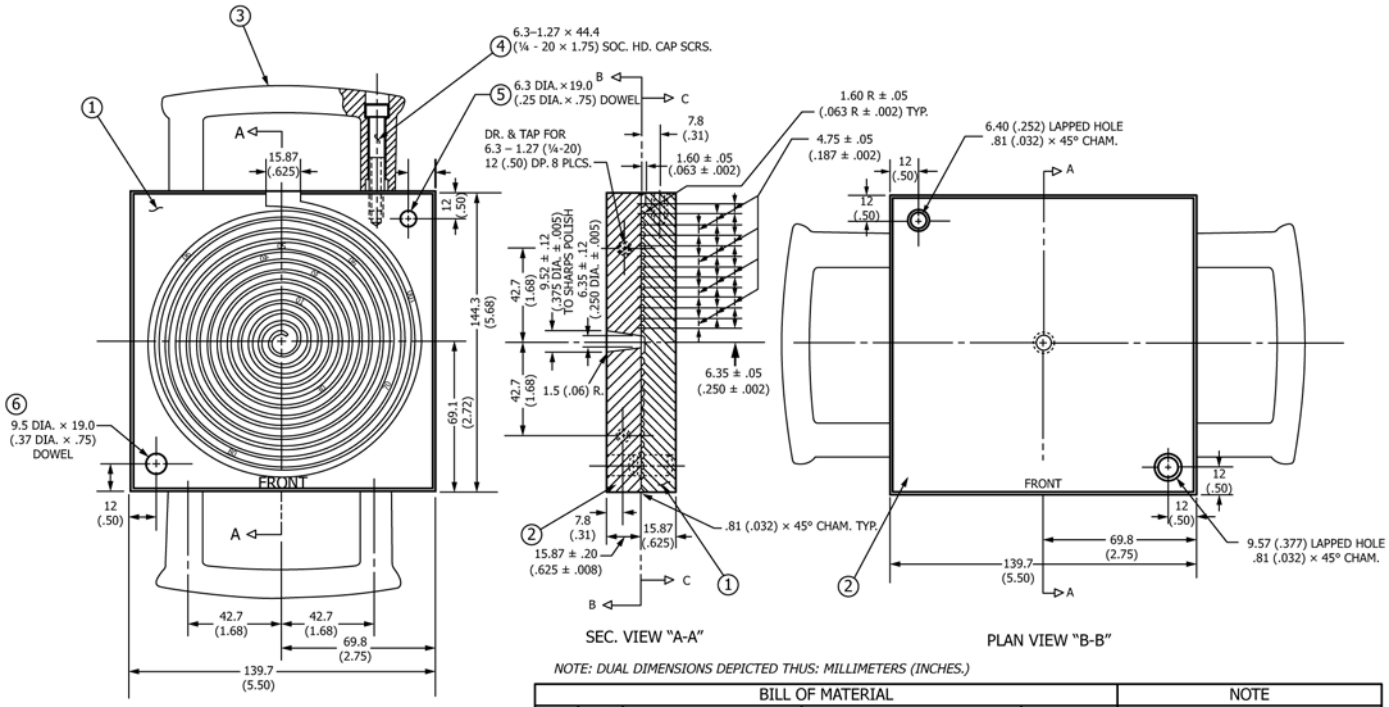
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.



BILL OF MATERIAL					NOTE
ITEM NO.	NO. REQ.	DESCRIPTION	SIZE	MATERIAL	1. SPIRAL IS A GENERATED SPIRAL. NO OFFSET.
1	1	SPIRAL MOLD PLATE	16 (⅝) × 138 (5 7⁄16) × 140 (5½)	A.H.T.S.	2. MOLD SURFACES ARE HIGH POLISH & FLASH CHROME PLATE.
2	1	SPRUE PLATE	16 (⅝) × 138 (5 7⁄16) × 140 (5½)	"	3. INDENTATION AT SPIRAL ENTRY IS ZERO MM (INCHES). INDENTATIONS EVERY 25.4 (1.00) ALONG ℄ OF SPIRAL ARE NUMBERED AT LEAST EVERY 254 MM (10 IN.)
3	4	HULL STD. HANDLES		PLASTIC	
4	8	SOC. HD. CAP. SCREWS	6.3– 1.27 (¼ -20) × 44.4 (1¾)	STEEL	
5	1	DOWEL PIN	6.3 (¼) DIA. × 19 (¾)	"	
6	1	DOWEL PIN	9.5 (⅜) DIA. × 19 (¾)	"	

FIG. 1 Standard Spiral-Flow Mold

6. Materials

6.1 *Molding Compound:*

6.1.1 Any thermosetting molding compound with a spiral flow between 762 and 1270 mm (30 and 50 in.) as determined at the standard temperature and pressure of this test can be evaluated.

NOTE 3—Since the only commercially available molds are calibrated in inches, spiral-flow length will be reported in these units. Conversion to SI units can readily be made by multiplying the flow length, in inches, by the appropriate conversion factor, 25.4 mm/in.

NOTE 4—There is considerable evidence that the test is usable over a wider range of flow lengths, but this has not yet been confirmed by interlaboratory testing.

6.1.2 *Form*—The form of the molding compound shall be loose powder or granules at 296 ± 2 K (23 ± 2°C (73.4 ± 3.6°F)).

NOTE 5—Preforms or pellets may be used if found necessary; however, flow length may be affected by their use.

7. Sampling

7.1 Unless otherwise agreed upon between the seller and purchaser, sampling shall be in accordance with Practice E105. Sampling, based on engineering principles, prior to packaging shall be considered an acceptable alternative.

8. Conditioning

8.1 *Conditioning*—All molding compounds shall be tested in "as-received" condition. For referee testing, all material shall be shipped and stored in moisture-barrier containers. They shall be stored for a minimum of 24 h at the standard laboratory temperature, before breaking the seal on the container. Take care to preserve the "as-received" moisture content and tests shall be made as soon as possible once the container has been opened. Alternative methods of conditioning samples shall be mutually agreed upon between manufacturer and purchaser.

9. Test Conditions

9.1 *Spiral-Flow Mold*—The mold shall be clean and free from any mold-release agents or lubricants. Several preliminary moldings shall be made with the material to be tested to purge the helical runner before beginning the test. This procedure is essential when changing from one compound to another and is recommended as a routine practice.

9.2 *Molding Conditions:*

9.2.1 *Temperature*—A temperature of 423 ± 3 K (150 ± 3°C (302 ± 5°F)) shall be maintained on the mold and transfer plunger. Measure the temperature in accordance with the procedures described in Practice D958 or by thermocouples

attached to the mold and plunger. The temperature shall be allowed to reach equilibrium by waiting at least 3 min between moldings.

9.2.2 *Transfer Pressure*—The actual pressure applied to the compound at the base of the pot shall be 6.90 ± 0.17 MPa (1000 ± 25 psi). In most presses, the gage pressure is not sufficiently accurate for determining transfer pressure. Therefore, the force exerted by the plunger shall be measured by some means such as an accurately calibrated direct-reading force gage or proving ring. The actual transfer pressure is then calculated as pascals (or pounds per square inch) by dividing the force in newtons (or pounds-force) by the plunger area in square metres (or square inches).

9.2.3 *Charge Mass*—The mass of the compound shall be determined empirically so that the thickness of the molded cull (cured compound on top of the sprue plate of the mold), after test, is between 3 and 3.5 mm (0.12 and 0.14 in.). The relationship between the amount of compound and the dimensions of the transfer pot is critical in obtaining meaningful, reproducible spiral-flow values. The use of excessive amounts of compound will result in shorter, inconsistent spiral flows. For transfer pots 31.75 to 44.45 mm (1.25 to 1.75 in.) in diameter, 20 g of compound is suggested as the starting charge mass.

9.2.4 *Transfer Plunger Speed*—The transfer plunger speed without load (as described in 5.1) shall be controlled between 25 and 100 mm/s (1 and 4 in./s). The elapsed time between insertion of the charge into the pot and the development of pressure on the charge by the plunger shall be no more than 5 seconds. Too long a dwell time before transferring will cause erratic results.

9.2.5 *Press Cure Time*—Sufficient cure time shall be used to facilitate easy removal of the spiral from the mold. This time will vary with the compound under test. Follow the manufacturer's recommendations for cure when possible.

9.2.6 *Transfer Plunger Grooves*—If the transfer plunger is equipped with grooves, they must be cleaned before each new molding.

9.3 *Flow Length*—Flow length shall be the farthest point at which the material completely fills the cross section of the helix runner.

10. Procedure

10.1 Heat the mold and transfer the plunger to 423 ± 3 K (150 ± 3°C (302 ± 5°F)).

10.2 Plungers equipped with sealing grooves must be cleaned free of compound before each molding.

10.3 Using a force gage or proving ring, adjust the transfer pressure to 6.90 ± 0.17 MPa (1000 ± 25 psi).

10.4 Weigh out the compound to the nearest 0.1 g as previously determined to yield a 3 to 3.5-mm (0.12 to 0.14-in.) molded cull.

10.5 Place the compound in the transfer pot and activate the transfer cycle immediately. Cure the compound as recommended for easy removal.

10.6 Open mold and remove the cured material. Read the spiral flow length directly from the molded specimen at the point of farthest continuous flow to the nearest 0.25 in. (Note 3).

10.7 Repeat 10.4 to 10.6 until three consecutive flow readings agree to within ±5 % of their average.

11. Report

11.1 Report the following information:

11.1.1 The accurate identity of the sample tested,

11.1.2 Average spiral-flow length reported to the nearest 6.35 mm (0.25 in.),

11.1.3 The temperature and pressure used for the test,

11.1.4 The form of the material (granulated, preformed, etc.),

11.1.5 The average cull thickness and charge mass used, and

11.1.6 The ram diameter and speed.

12. Precision and Bias

12.1 Statistical analysis of round-robin data[4] indicates that within a given laboratory the averages of three flow length determinations on a typical material will not differ from each other by more than 1.29 in. at a 95 % confidence level. Attempts to develop a full precision and bias statement for this test method have not been successful. For this reason, data on precision and bias cannot be given. Because this test method does not contain a round-robin-based numerical precision and bias statement, it shall not be used as a referee test method in case of dispute. Anyone wishing to participate in the development of precision and bias data should contact the Chairman, Subcommittee D20.30 (Section 20.30.08), ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

13. Keywords

13.1 spiral flow; thermosets

[4] Round-robin data for this test method are available from ASTM Headquarters. Request RR:D20-1028.