Designation: D 569 – 90

Standard Test Method for Measuring the Flow Properties of Thermoplastic Molding Materials[1]

This standard is issued under the fixed designation D 569; 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 test method has been approved for use by agencies of the Department of Defense to replace Method 2041 of Federal Test Method Standard 406. Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

1. Scope

1.1 This test method covers the measurement of the following flow properties of thermoplastic molding materials:

1.1.1 *Procedure A*—The temperature at which a thermoplastic material attains a defined degree of flow when subjected to a prescribed pressure for a prescribed time in a specified extrusion mold, or

1.1.2 *Procedure B*—The degree of flow that a thermoplastic material attains when subjected to a prescribed pressure and temperature for a prescribed time in a specified extrusion mold.

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

1.3 *This standard does not purport to address the safety problems 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 Document

2.1 *ASTM Standard:*

D 883 Definitions of Terms Relating to Plastics[2]

3. Terminology

3.1 *Definition:*

3.1.1 For definitions of some of the technical terms used in this standard refer to Definitions D 883.

4. Significance and Use

4.1 The equilibrium state of the material in this test is not necessarily representative of the state at which the material is molded commercially. The indicated temperature of the heat-transfer medium in an injection or extrusion machine cylinder generally is in excess of that of the material itself and of the flow temperature of the material. Thus, the chief use of this test is for control and identification purposes rather than for prediction of molding conditions or physical properties.

5. Apparatus

5.1 The apparatus for the flow test (see Fig. 1) shall be a constant-force, vertical-orifice type machine[3] consisting essentially of the following:

5.1.1 *Orifice*—A vertical orifice 3.18 ± 0.013 mm (0.125 ± 0.0005 in.) in diameter and 38 mm (1½ in.) in length, *1*, Fig. 1 into which the material flows. The orifice is machined into a split cone 25.4 mm (1 in.) in diameter at the base which is clamped into a steam-heated block, *3*. A thermometer well 4.76 mm (3/16 in.) in diameter and 32 mm (1¼ in.) in depth is drilled into the split cone. Temperature readings are taken at this point.

5.1.2 *Thermometer*—A 32-mm (1¼-in.) immersion mercury thermometer having a diameter just under 4.76 mm (3/16 in.) and a temperature scale of not more than 20°C/in. of length.

5.1.3 *Charge Chamber*—Below the orifice and concentric with it is the charge chamber, *2*, 9.5 mm (⅜ in.) in diameter and 19 mm (¾ in.) in length.

5.1.4 *Block*—A steam-heated block, *3*. Heat is supplied by steam at a line pressure of 620 to 1030 kPa (90 to 150 psi), passing through an accurate reducing valve; if the line pressure fluctuates too widely, two reducing valves in series may be used. The temperature is controlled by regulating the steam pressure.

5.1.5 *Ram*—A steam-heated ram, *4*, so arranged that it applies pressure to the charge chamber from the bottom, forcing the material into the orifice. The steam line is so arranged that the steam passes through the reducing valve, the ram, the block, and finally through a suitable trap or small vent.

5.1.6 *Pressure System*—A mechanical system, *5*, for applying a net pressure of 10.3 MPa (1500 psi) to the ram. The pressure system illustrated in Fig. 1 is built so that any pressure up to 20.7 MPa (3000 psi) may be applied in increments of 690 kPa (100 psi).

5.1.7 *Flow Measuring Device*—Means for measuring the flow of material into the orifice. Measurements shall be accurate to ±0.25 mm (±0.01 in.). The following measuring systems are suitable:

5.1.7.1 A follower rod, guided by loose bearings in a swing arm, rests on the material in the orifice. A flexible chain attached to the upper part of the follower rod is passed part way around and fastened to the small diameter of a two-step pulley having a 3:1 ratio and mounted on the swing arm. A second flexible chain passing part way around and fastened to the larger diameter is attached to a sliding indicator and a counterweight. The indicator travels over a calibrated scale

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[1] This test method is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.30 on Thermal Properties (Section D20.30.08).

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

[3] Rossi-Peakes flow tester as described in U. S. Patent 2,066,016.

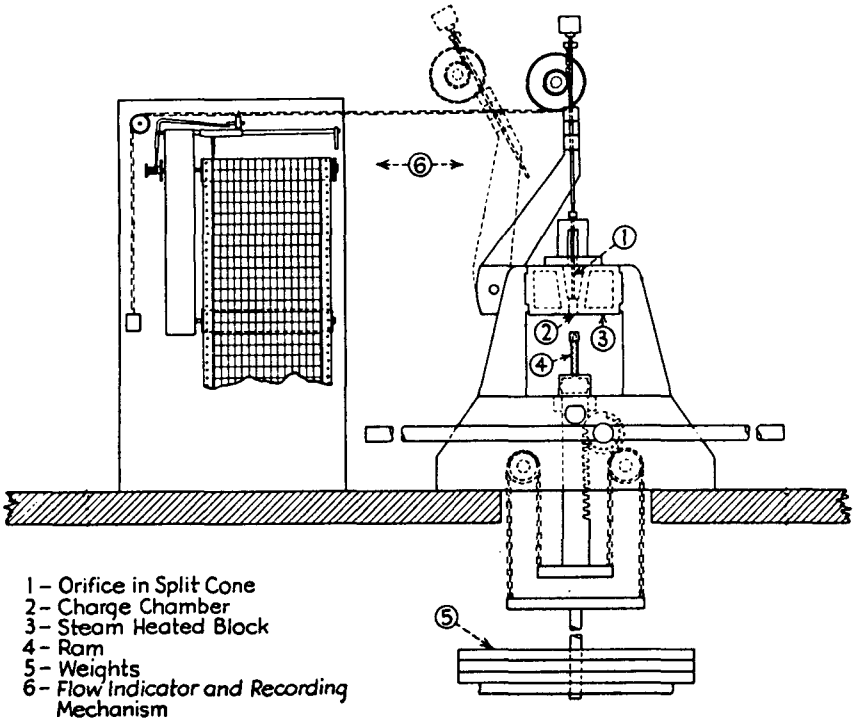

FIG. 1 Flow Test Apparatus

so that the amount of flow in the orifice is shown on the scale, magnified three times. The weight of the flow-indicating mechanism is such that a pressure of 275 kPa (40 psi) is exerted on the material in the orifice; this however, is counterbalanced by sufficient additional weight on the pressure system, *5*.

5.1.7.2 *Optional*—The flow measuring device illustrated in Fig. 1 may be equipped with a time clock, a recording pen, and suitable graph paper with the scale as one axis and time as the other so that the flow behavior over any given time period may be recorded.

6. Test Specimens

6.1 The test specimens shall be molded, machined, or preformed cylinders 9.5 mm (⅜ in.) in diameter and ⅜ in. in height. They shall be free of air bubbles and they shall be as free as possible of strains.

7. Conditioning

7.1 *Preferred Method*—Test specimens shall be conditioned at room temperature in a desiccator over anhydrous calcium chloride for 72 h.

7.2 *Alternative Method*—Test specimens shall be conditioned in an oven at 50°C for 24 h.

PROCEDURE A

8. Procedure

8.1 Use a working pressure of 10.3 MPa (1500 psi).

8.2 The unit of flow time shall be 2 min ± 1 s as measured with a stop watch or timer.

8.3 Insert the test specimens at room temperature in the hot charge chamber and test immediately.

8.4 If poisoning of the orifice occurs, clean it with acetone, benzene, or other suitable solvent before each test.

8.5 Test each material at three or more temperatures at which the flow will be within the interval of 12.7 to 38.1 mm (0.50 to 1.50 in.) with at least one measurement above and one below 25.4 mm (1 in.). Control temperatures within ±0.50°C. Make all temperature measurements at the split cone after it has come to equilibrium with the block.

NOTE 1—The split cone and the ram should be at the same temperature, and both temperatures should be held as near constant to any chosen temperature as possible. In order to ensure this, it is essential that the condensate be bled from the steam lines in such a manner that a minimum fluctuation of steam pressure is introduced. This may be accomplished by the use of an orifice rather than a trap in the efflux steam line. Approximate orifice sizes suggested are:

Temperature, °C	Orifice Size, mm (in.)
100 to 120	4.76 (3/16)
120 to 140	3.57 (9/64)
140 to 160	2.38 (3/32)
160 to 180	1.19 (3/64)

8.6 At the beginning of each series or at least once a day, check the flow tester against a sample of predetermined flow. At least two readings shall check within ±0.13 mm (±0.05 in.) or ±5 % of the predetermined value, whichever is greater.

9. Plotting Results

9.1 The linear flow shall be plotted against temperature or semilogarithmic paper. With the flow measurements plotted on the logarithmic coordinate and temperature on the linear coordinate, a straight line will usually result. The temperature at which the flow is exactly 25.4 mm (1.0 in.) shall be read from the graph and reported as the flow temperature.

10. Report

10.1 The report shall include the following: