



Standard Test Method for Thermal Flow, Cure, and Behavior Properties of Pourable Thermosetting Materials by Torque Rheometer¹

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1. Scope*

1.1 This test method covers the apparatus, and a specific test method, including the evaluation of results required for the determination of the thermal flow and cure behavior properties of pourable thermosetting materials.

1.2 This test method can be used:

1.2.1 As a control for the development and production of pourable thermosetting materials and to measure the different properties (for example, melting behavior, cure behavior, etc.) as well as the influence of various additives and fillers in any given formulations, and

1.2.2 Verify the uniformity of different production batches of the same formulation.

1.3 The values are stated in SI units.

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.* Specific precautions are given in Section 7.

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

2. Referenced Documents

2.1 *ASTM Standards:*²

D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

D883 Terminology Relating to Plastics

D1898 Practice for Sampling of Plastics (Withdrawn 1998)³

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

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.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.

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 For the purpose of this test method, the following definitions apply, (see Fig. 1):

3.1.2 *flow and cure behavior*—the flow behavior is represented by the recorded torque curve from the loading peak (Point t_1), to the torque minimum (Point t_5). The cure behavior is represented by the recorded torque curve from the torque minimum (Point t_5) to the torque maximum (Point t_4). The rate of curing is represented by the slope of the torque curve.

3.1.3 *time*—the residence time at torque $t_5 \times X$, where X is a factor (preferably 1.3) is t_v (s). To determine t_v , draw a line at $t_5 \times X$ parallel with the time axis. The intersection of this line with the left branch of the curve is t_2 . The intersection of this line with the right branch of the curve is t_3 :

$$t_v = t_3 - t_2 \text{ units are seconds (s)} \quad (1)$$

3.1.3.1 *Discussion*—Depending on the manufacturer of the equipment, the software analysis program for the designated values in this test method may differ (t_1 , t_2 , etc....).

3.1.3.2 *Discussion*—Upon agreement between interested parties, the value of X may be changed and be listed in any report.

3.1.4 *residence time or duration of plastic life ($t_2 - t_3$)*—the residence time is represented by a section of the recorded torque curve in which the molten material causes the lowest torque, s.

3.1.5 *total cure time ($t_4 - t_0$)*—time from when the material is loaded into the mixer chamber up to complete cure, s.

3.1.6 *torque:*

3.1.6.1 *initial torque (t_1)*—the initial high torque peak once material is loaded into the mixer chamber. Sometimes referred to as the loading peak, Nm (Newton-meters).

3.1.6.2 *minimum torque (t_5)*—the lowest point on the torque curve representing maximum fluxing of material, Nm.

3.1.6.3 *final torque or cure peak (t_4)*—the final maximum torque value representing the final cure of material, Nm.

4. Summary of Test Method

4.1 A sample of thermosetting material is charged into the temperature controlled mixer/measuring head in which the

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