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.

Designation: D5045 – 14 (Reapproved 2022)

Standard Test Methods for Plane-Strain Fracture Toughness and Strain Energy Release Rate of Plastic Materials[1]

This standard is issued under the fixed designation D5045; 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 These test methods are designed to characterize the toughness of plastics in terms of the critical-stress-intensity factor, K_{Ic}, and the energy per unit area of crack surface or critical strain energy release rate, G_{Ic}, at fracture initiation.

1.2 Two testing geometries are covered by these test methods, single-edge-notch bending (SENB) and compact tension (CT).

1.3 The scheme used assumes linear elastic behavior of the cracked specimen, so certain restrictions on linearity of the load-displacement diagram are imposed.

1.4 A state-of-plane strain at the crack tip is required. Specimen thickness must be sufficient to ensure this stress state.

1.5 The crack must be sufficiently sharp to ensure that a minimum value of toughness is obtained.

1.6 The significance of these test methods and many conditions of testing are identical to those of Test Method E399, and, therefore, in most cases, appear here with many similarities to the metals standard. However, certain conditions and specifications not covered in Test Method E399, but important for plastics, are included.

1.7 This protocol covers the determination of G_{Ic} as well, which is of particular importance for plastics.

1.8 These test methods give general information concerning the requirements for K_{Ic} and G_{Ic} testing. As with Test Method E399, two annexes are provided which give the specific requirements for testing of the SENB and CT geometries.

1.9 Test data obtained by these test methods are relevant and appropriate for use in engineering design.

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

NOTE 1—This standard and ISO 13586 address the same subject matter, but differ in technical content.

1.11 *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]

D638 Test Method for Tensile Properties of Plastics

D4000 Classification System for Specifying Plastic Materials

E399 Test Method for Linear-Elastic Plane-Strain Fracture Toughness of Metallic Materials

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

3. Terminology

3.1 *Definitions:*

3.1.1 *compact tension, n*—specimen geometry consisting of single-edge notched plate loaded in tension. See 3.1.5 for reference to additional definition.

3.1.2 *critical strain energy release rate, G_{Ic}, n*—toughness parameter based on energy required to fracture. See 3.1.5 for reference to additional definition.

3.1.3 *plane-strain fracture toughness, K_{Ic}, n*—toughness parameter indicative of the resistance of a material to fracture. See 3.1.5 for reference to additional definition.

3.1.4 *single-edge notched bend, n*—specimen geometry consisting of center-notched beam loaded in three-point bending. See 3.1.5 for reference to additional definition.

3.1.5 Reference is made to Test Method E399 for additional explanation of definitions.

[1] These test methods are under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.10 on Mechanical Properties.

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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.

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

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