



Standard Test Method for Determining *J-R* Curves of Plastic Materials¹

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1. Scope

1.1 This test method covers the determination of the *J*-integral versus crack growth resistance (*J-R*) curves for polymeric materials.

1.2 This test method is intended to characterize the slow, stable crack growth resistance of bend-type specimens in such a manner that it is geometry insensitive within limits set forth in this test method.

1.3 The recommended specimens are the three-point bend (*SE(B)*) and pin-loaded compact tension (*C(T)*) specimens. Both specimens have in-plane dimensions of constant proportionality for all sizes. Specimen configurations other than those recommended in this test method may require different procedures and validity requirements.

1.4 This test method describes a multiple specimen method that requires optical measurement of crack extension from fracture surfaces. It is not recommended for use with materials in which the crack front cannot be distinguished from additional deformation processes in advance of the crack tip.

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

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—There is no equivalent ISO standard.

2. Referenced Documents

2.1 *ASTM Standards*:²

D618 Practice for Conditioning Plastics for Testing

D4066 Classification System for Nylon Injection and Extrusion Materials (PA)

D5045 Test Methods for Plane-Strain Fracture Toughness and Strain Energy Release Rate of Plastic Materials

E399 Test Method for Linear-Elastic Plane-Strain Fracture Toughness K_{Ic} of Metallic Materials

E616 Terminology Relating to Fracture Testing (Discontinued 1996) (Withdrawn 1996)³

E1152 Test Method for Determining *J-R* Curves

E1737 Test Method for *J*-Integral Characterization of Fracture Toughness (Withdrawn 1998)³

F1473 Test Method for Notch Tensile Test to Measure the Resistance to Slow Crack Growth of Polyethylene Pipes and Resins

3. Terminology

3.1 *Definitions*—Terminology related to fracture testing contained in Terminology E616 is applicable to this test method.

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *J*-integral, J (FL^{-1})—a mathematical expression, a line or surface integral over a path that encloses the crack front from one crack surface to the other, used to characterize the local stress-strain field around the crack front. See Terminology E616 for additional discussion.

3.2.2 *J-R curve*—a plot of resistance to stable physical crack extension, Δa_p .

3.2.3 *net thickness*, B_N (L)—the distance between the roots of the side grooves in side grooved specimens.

3.2.4 *original crack size*, a_0 (L)—the physical crack size at the start of testing.

3.2.5 *original uncracked ligament*, b_0 (L)—the distance from the original crack front to the back edge of the specimen ($b_0 = W - a'_0$).

3.2.6 *physical crack extension*, Δa_p (L)—an increase in physical crack size ($\Delta a_p = a_p - a_0$).

3.2.7 *physical crack size*, a_p (L)—the distance from a reference line to the observed crack front. The distance may be a calculated average of several measurements along the crack front. The reference line depends on the specimen geometry

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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.