



Standard Test Method for Determination of Resistance to Stable Crack Extension under Low-Constraint Conditions¹

This standard is issued under the fixed designation E2472; 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.

^{ε1} NOTE—3.2.5 and 3.2.6 were editorially revised in March 2013.

1. Scope

1.1 This standard covers the determination of the resistance to stable crack extension in metallic materials in terms of the critical crack-tip-opening angle (CTOA), ψ_c and/or the crack-opening displacement (COD), δ_5 resistance curve (1).² This method applies specifically to fatigue pre-cracked specimens that exhibit low constraint (crack-size-to-thickness and uncracked ligament-to-thickness ratios greater than or equal to 4) and that are tested under slowly increasing remote applied displacement. The test specimens are the compact, C(T), and middle-crack-tension, M(T), specimens. The fracture resistance determined in accordance with this standard is measured as ψ_c (critical CTOA value) and/or δ_5 (critical COD resistance curve) as a function of crack extension. Both fracture resistance parameters are characterized using either a single-specimen or multiple-specimen procedures. These fracture quantities are determined under the opening mode (Mode I) of loading. Influences of environment and rapid loading rates are not covered in this standard, but the user must be aware of the effects that the loading rate and laboratory environment may have on the fracture behavior of the material.

1.2 Materials that are evaluated by this standard are not limited by strength, thickness, or toughness, if the crack-size-to-thickness (a/B) ratio and the ligament-to-thickness (b/B) ratio are greater than or equal to 4, which ensures relatively low and similar global crack-front constraint for both the C(T) and M(T) specimens (2, 3).

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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.

2. Referenced Documents

2.1 ASTM Standards:³

- E4 Practices for Force Verification of Testing Machines
- E8/E8M Test Methods for Tension Testing of Metallic Materials
- E399 Test Method for Linear-Elastic Plane-Strain Fracture Toughness K_{Ic} of Metallic Materials
- E561 Test Method for $K-R$ Curve Determination
- E647 Test Method for Measurement of Fatigue Crack Growth Rates
- E1290 Test Method for Crack-Tip Opening Displacement (CTOD) Fracture Toughness Measurement (Withdrawn 2013)⁴
- E1820 Test Method for Measurement of Fracture Toughness
- E1823 Terminology Relating to Fatigue and Fracture Testing
- E2309 Practices for Verification of Displacement Measuring Systems and Devices Used in Material Testing Machines

2.2 ISO Standards:⁵

- ISO 22889:2007 Metallic Materials—Method of Test for the Determination of Resistance to Stable Crack Extension Using Specimens of Low Constraint
- ISO 12135 Metallic Materials—Unified Method of Test for the Determination of Quasistatic Fracture Toughness

3. Terminology

3.1 Terminology E1823 is applicable to this test standard.

3.2 Definitions:

3.2.1 *crack extension*, Δa [L], n —an increase in crack size.

¹ This test method is under the jurisdiction of ASTM Committee E08 on Fatigue and Fracture and is the direct responsibility of Subcommittee E08.07 on Fracture Mechanics.

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² The boldface numbers in parentheses refer to the list of references at the end of this standard.

³ 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.

⁴ The last approved version of this historical standard is referenced on www.astm.org.

⁵ Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, <http://www.iso.ch>.