



Standard Test Method for Measurement of Fatigue Crack Growth Rates¹

This standard is issued under the fixed designation E 647; 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 This test method² covers the determination of steady-state fatigue crack growth rates from near-threshold to $K_{\max}$ controlled instability using either compact tension, C(T), (Fig. 1) middle-tension, M(T), (Fig. 2) or eccentrically loaded single edge crack tension, ESE(T), (Fig. A4.1) specimens. Results are expressed in terms of the crack-tip stress-intensity factor range (ΔK), defined by the theory of linear elasticity.

1.2 Several different test procedures are provided, the optimum test procedure being primarily dependent on the magnitude of the fatigue crack growth rate to be measured.

1.3 Materials that can be tested by this test method are not limited by thicknesses or by strength so long as specimens are of sufficient thickness to preclude buckling and of sufficient planar size to remain predominantly elastic during testing.

1.4 A range of specimen sizes with proportional planar dimensions is provided, but size is variable to be adjusted for yield strength and applied load. Specimen thickness may be varied independent of planar size.

1.5 Specimen configurations other than those contained in this method may be used provided that well-established stress-intensity factor calibrations are available and that specimens are of sufficient planar size to remain predominantly elastic during testing.

1.6 Residual stress/crack closure may significantly influence the fatigue crack growth rate data, particularly at low stress-intensity factors and low stress ratios, although such variables are not incorporated into the computation of ΔK .

1.7 Values stated in SI units are to be regarded as the standard. Values given in parentheses are for information only.

1.8 *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:

¹ This test method is under the jurisdiction of ASTM Committee E-8 on Fatigue and Fracture and is the direct responsibility of Subcommittee E08.06 on Crack Growth Behavior.

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² For additional information on this test method see RR: E 24 – 1001. Available from ASTM Headquarters, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

- E 4 Practices for Force Verification of Testing Machines³
- E 6 Terminology Relating to Methods of Mechanical Testing³
- E 8 Test Methods for Tension Testing of Metallic Materials³
- E 337 Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures)⁴
- E 338 Test Method for Sharp-Notch Tension Testing of High-Strength Sheet Materials³
- E 399 Test Method for Plane-Strain Fracture Toughness of Metallic Materials³
- E 467 Practice for Verification of Constant Amplitude Dynamic Loads on Displacements in an Axial Load Fatigue Testing System³
- E 561 Practice for R-Curve Determination³
- E 616 Terminology Relating to Fracture Testing³
- E 813 Test Method for J_{IC} , A Measure of Fracture Toughness³
- E 1012 Practice for Verification of Specimen Alignment Under Tensile Loading³
- E 1150 Definitions of Terms Relating to Fatigue³

3. Terminology

3.1 The terms used in this test method are given in Terminology E 6, Definitions E 1150, and Terminology E 616. Whenever these terms are not in agreement with one another, use the definitions given in Terminology E 616 which are applicable to this test method.

3.2 Definitions:

3.2.1 *crack length, $a[L]$, n* —See *crack size*.

3.2.2 *crack size, $a[L]$, n* —a linear measure of a principal planar dimension of a crack. This measure is commonly used in the calculation of quantities descriptive of the stress and displacement fields and is often also termed crack length or depth.

3.2.2.1 *Discussion*—In the C(T) specimen, a is measured from the line connecting the bearing points of load application; in the M(T) specimen, a is measured from the perpendicular bisector of the central crack; in the ESE(T) specimen, a is measured from the specimen front face.

3.2.2.2 *Discussion*—In fatigue testing, crack length is the physical crack size. See *physical crack size* in Terminology E 616.

³ *Annual Book of ASTM Standards*, Vol 03.01.

⁴ *Annual Book of ASTM Standards*, Vol 11.03.