



Standard Practice for Fracture Toughness Testing of Aluminum Alloys¹

This standard is issued under the fixed designation B646; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 Fracture toughness is a key property for a number of aluminum alloys utilized in aerospace and process industries. Fracture toughness testing is often required for supplier qualification, quality control, and material release purposes. The purpose of this practice is to provide uniform test procedures for the industry, pointing out which current standards are utilized in specific cases, and providing guidelines where no standards exist. This practice provides guidance for testing (a) sheet and other products having a specified thickness less than 6.35 mm (0.250 in.), (b) intermediate thicknesses of plate, forgings, and extrusions that are too thin for valid plane-strain fracture toughness testing but too thick for treatment as sheet, such as products having a specified thickness greater than or equal to 6.35 mm (0.250 in.) but less than 25 to 50 mm (1 to 2 in.), depending on toughness level, and (c) relatively thick products where Test Method E399 is applicable.

1.2 This practice addresses both direct measurements of fracture toughness and screening tests, the latter recognizing the complexity and expense of making formal fracture toughness measurements on great quantities of production lots.

1.3 The values stated in SI units are to be regarded as the standard. The values in inch-pound units given in parenthesis are provided for information purposes only.

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:²

- B557 Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products
- B557M Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products (Metric)
- B645 Practice for Linear-Elastic Plane-Strain Fracture Toughness Testing of Aluminum Alloys
- E399 Test Method for Linear-Elastic Plane-Strain Fracture Toughness K_{Ic} of Metallic Materials
- E561 Test Method for $K-R$ Curve Determination
- E1304 Test Method for Plane-Strain (Chevron-Notch) Fracture Toughness of Metallic Materials
- E1823 Terminology Relating to Fatigue and Fracture Testing

3. Terminology

3.1 The terminology and definitions in the referenced documents, especially E1823, are applicable to this practice.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 For purposes of this practice, the following descriptions of terms are applicable in conjunction with Test Method E561:

3.2.2 $CMOD$ —crack mouth opening displacement; the measurement of specimen displacement between two points spanning the machined notch at locations specific to the specimen being tested.

3.2.3 K_{R25} —a value of K_R on the $K-R$ curve based on a 25 % secant intercept of the force- $CMOD$ test record from a C(T) specimen and the effective crack length a_e at that point that otherwise satisfies the remaining-ligament criterion of Test Method E561. If the maximum force is reached prior to the 25 % secant intercept point, the maximum force point shall be used instead to determine the K_{R25} value.

¹ This practice is under the jurisdiction of ASTM Committee B07 on Light Metals and Alloys and is the direct responsibility of Subcommittee B07.05 on Testing.

Current edition approved May 1, 2012. Published June 2012. Originally approved in 1978. Last previous edition approved in 2006 as B646 – 06a. DOI: 10.1520/B0646-12.

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.