



Standard Test Method for Determining Plane-Strain Crack-Arrest Fracture Toughness, K_{Ia} , of Ferritic Steels¹

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1. Scope

1.1 This test method employs a side-grooved, crack-line-wedge-loaded specimen to obtain a rapid run-arrest segment of flat-tensile separation with a nearly straight crack front. This test method provides a static analysis determination of the stress intensity factor at a short time after crack arrest. The estimate is denoted K_a . When certain size requirements are met, the test result provides an estimate, termed K_{Ia} , of the plane-strain crack-arrest toughness of the material.

1.2 The specimen size requirements, discussed later, provide for in-plane dimensions large enough to allow the specimen to be modeled by linear elastic analysis. For conditions of plane-strain, a minimum specimen thickness is also required. Both requirements depend upon the crack arrest toughness and the yield strength of the material. A range of specimen sizes may therefore be needed, as specified in this test method.

1.3 If the specimen does not exhibit rapid crack propagation and arrest, K_a cannot be determined.

1.4 The values stated in SI units are to be regarded as the standards. The values given in parentheses are provided for information only.

1.5 *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

E8 Test Methods for Tension Testing of Metallic Materials

E23 Test Methods for Notched Bar Impact Testing of Metallic Materials

E208 Test Method for Conducting Drop-Weight Test to Determine Nil-Ductility Transition Temperature of Ferritic Steels

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E616 Terminology Relating to Fracture Testing (Discontinued 1996) (Withdrawn 1996)³

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 Definitions:

3.1.1 Definitions in Terminology **E1823** are applicable to this test method.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *conditional value of the plane-strain crack-arrest fracture toughness, K_{Qa} ($FL^{-3/2}$)*—the conditional value of K_{Ia} calculated from the test results and subject to the validity criteria specified in this test method.

3.2.1.1 *Discussion*—In this test method, side-grooved specimens are used. The calculation of K_{Qa} is based upon measurements of both the arrested crack size and of the crack-mouth opening displacement prior to initiation of a fast-running crack and shortly after crack arrest.

3.2.2 *crack-arrest fracture toughness, K_A ($FL^{-3/2}$)*—the value of the stress intensity factor shortly after crack arrest as determined from dynamic methods of analysis.

3.2.2.1 *Discussion*—The in-plane specimen dimensions must be large enough for adequate enclosure of the crack-tip plastic zone by a linear-elastic stress field.

3.2.3 *crack-arrest fracture toughness, K_a ($FL^{-3/2}$)*—the value of the stress intensity factor shortly after crack arrest, as determined from static methods of analysis.

3.2.3.1 *Discussion*—The in-plane specimen dimensions must be large enough for adequate enclosure of the crack-tip plastic zone by a linear-elastic stress field.

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 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.