



Standard Test Method for Fracture Strength in Cleavage of Adhesives in Bonded Metal Joints¹

This standard is issued under the fixed designation D 3433; 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 method (1, 2, 5, 6, 9)² covers the determination of fracture strength in cleavage of adhesives when tested on standard specimens and under specified conditions of preparation and testing (Note 1).

1.2 This test method is useful in that it can be used to develop design parameters for bonded assemblies.

NOTE 1—While this test method is intended for use in metal-to-metal applications it may be used for measuring fracture properties of adhesives using plastic adherends, provided consideration is given to the thickness and rigidity of the plastic adherends.

1.3 The values stated in SI units are considered to be the standard. Values in parentheses are for information purposes.

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:

- A 167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip³
- A 366/A366M Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality³
- B 36 Specification for Brass Plate, Sheet, Strip, and Rolled Bar⁴
- B 152 Specification for Copper Sheet, Strip, Plate, and Rolled Bar⁴
- B 209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate⁵
- B 265 Specification for Titanium and Titanium Alloy Strip, Sheet, and Plate⁶

¹ This test method is under the jurisdiction of ASTM Committee D-14 on Adhesives and is the direct responsibility of Subcommittee D14.80 on Metal Bonding Adhesives.

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² The boldface numbers in parentheses refer to the references at the end of this test method.

³ *Annual Book of ASTM Standards*, Vol 01.03.

⁴ *Annual Book of ASTM Standards*, Vol 02.01.

⁵ *Annual Book of ASTM Standards*, Vol 02.02.

⁶ *Annual Book of ASTM Standards*, Vol 02.04.

D 907 Terminology of Adhesives⁷

E 4 Practices for Force Verification of Testing Machines⁸

E 399 Test Method for Plane-Strain Fracture Toughness of Metallic Materials⁸

3. Terminology

3.1 *Definitions:* Many of the terms used in this test method are defined in Terminology D 907.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *crack-extension force, G*,—the system isolated (fixed load-displacement) loss of stress field energy for an infinitesimal increase, dA , of separational area. In equation form,

$$GdA = -dU_T \quad (1)$$

where U_T = total elastic energy in the system (component or test specimen). In the test specimens of this method, the crack front is nearly straight through the specimen thickness, B , so that $dA = B da$, where da is an infinitesimal forward motion of the leading edge of the crack. Completely linear-elastic behavior is assumed in the calculations (See Annex A1) of G used in this method, an allowable assumption when the zone of nonlinear deformation in the adhesive is small relative to specimen dimensions and crack size.

3.2.1.1 When the shear stress on the plane of crack and forward to its leading edge is zero, the stress state is termed “opening mode.” The symbol for an opening mode G is G_I for plane-strain and G_{I1} when the connotation of plane-strain is not wanted.

3.2.2 *opening mode fracture toughness, G_{Ic}* —the value of G just prior to onset of rapid fracturing when G is increasing with time.

3.2.3 *opening mode crack arrest toughness, G_{Ia}* —the value of G just after arrest of a run-arrest segment of crack extension.

3.2.3.1 It is assumed that the dimensions of the part containing the crack are large compared to the run-arrest segment which precedes crack arrest and that the quasi-static stress field enclosing the crack tip just after crack arrest can be assumed in calculating G_{Ia} .

4. Summary of Test Method

4.1 This test method involves cleavage testing bonded specimens such that a crack is made to extend by a tensile force

⁷ *Annual Book of ASTM Standards*, Vol 15.06.

⁸ *Annual Book of ASTM Standards*, Vol 03.01.