A Practical Test Method for Mode I Fracture Toughness of Adhesive Joints with Dissimilar Substrates

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ABSTRACT

Mode I fracture toughness defines a material's resistance to crack propagation while under tensile forces normal to the crack surface. Several standard methods exist for testing composites, metals and plastics in mode I fracture. However, these standard test methods have limitations that preclude their use when testing adhesive joints comprised of certain automotive materials. For example, typical composites used in the automotive industry have higher void content and lower fiber volume fraction than those used in the aerospace industry. Consequently, they have a lower flexural stiffness and are prone to substrate failures when tested with common fracture toughness geometries. Similarly, thin sheet metal used commonly in the automotive industry experiences plastic deformation of the substrates. To facilitate successful fracture toughness tests with the automotive materials, a modified testing geometry and test procedure have been developed. The test method can accommodate adhesive joints comprised of composite substrates, thin-section metal substrates, or their combination. To develop and validate the testing procedure, SRIM composite and e-coat steel were selected as substrates and a thixotropic epoxy was chosen for the adhesive. This paper discusses the development of the test procedure including simplifying approximations to make the test method practical for dissimilar materials. Data is presented to demonstrate the successful application of the method to the aforementioned materials.

*Managed by Lockheed Martin Energy Research Corporation for the U.S. Department of Energy under contract DE-AC05-90OR22464.