



Designation: D7779 – 20

Standard Test Method for Determination of Fracture Toughness of Graphite at Ambient Temperature¹

This standard is issued under the fixed designation D7779; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope*

1.1 This test method covers and provides a measure of the resistance of a graphite to crack extension at ambient temperature and atmosphere expressed in terms of stress-intensity factor, K , and strain energy release rate, G . These crack growth resistance properties are determined using beam test specimens with a straight-through sharp machined V-notch.

1.2 This test method determines the stress intensity factor, K , from applied force and gross specimen deflection measured away from the crack tip. The stress intensity factor calculated at the maximum applied load is denoted as fracture toughness, K_{Ic} , and is known as the critical stress intensity factor. If the resolution of the deflection gauge is sensitive to fracture behavior in the test specimen and can provide a measure of the specimen compliance, strain energy release rate, G , can be determined as a function of crack extension.

1.3 This test method is applicable to a variety of grades of graphite which exhibit different types of resistance to crack growth, such as growth at constant stress intensity (strain energy release rate), or growth with increasing stress intensity (strain energy release rate), or growth with decreasing stress intensity (strain energy release rate). It is generally recognized that because of the inhomogeneous microstructure of graphite, the general behavior will exhibit a mixture of all three during the test. The crack resistance behavior exhibited in the test is usually referred to as an “R-curve.”

NOTE 1—One difference between the procedure in this test method and test methods such as Test Method E399, which measure fracture toughness, K_{Ic} , by one set of specific operational procedures, is that Test Method E399 focuses on the start of crack extension from a fatigue precrack for metallic materials. This test method for graphite makes use of a machined notch with sharp cracking at the root of the notch because of the nature of graphite. Therefore, fracture toughness values determined with this method may not be interchanged with K_{Ic} as defined in Test Method E399.

¹ This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.F0 on Manufactured Carbon and Graphite Products.

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1.4 This test method gives fracture toughness values, K_{Ic} and critical strain energy release rate, G_{Ic} for specific conditions of environment, deformation rate, and temperature. Fracture toughness values for a graphite grade can be functions of environment, deformation rate, and temperature.

1.5 This test method is divided into two major parts. The first major part is the main body of the standard, which provides general information on the test method, the applicability to materials comparison and qualification, and requirements and recommendations for fracture toughness testing. The second major part is composed of annexes, which provide information related to test apparatus and test specimen geometry.

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1.6 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6.1 Measurement units expressed in these test methods are in accordance with IEEE/ASTM SI 10.

1.7 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

*A Summary of Changes section appears at the end of this standard