



1219 West Main Cross St., Suite 201
Findlay, Ohio 45840 USA
(419) 957 0543
www.endurica.com

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Contact: Ben Beutler
Phone: 419 957 0543
Email: bjbeutler@endurica.com

RUBBER'S FATIGUE ENDURANCE LIMIT OBTAINED VIA A NEW ENDURICA SERVICE

Breakthrough procedure significantly reduces measurement complexity and cost

FINDLAY, OHIO, - A new service developed by Endurica LLC and implemented at Axel Products, Inc. now provides engineers with the capability to measure an elastomer's fatigue endurance limit. This limit marks the point below which cyclic loads may be endured indefinitely without incurring damage. Developers need to know this limit in order to maximize durability and avoid failure. Although the endurance limit has been studied for decades by researchers interested in fatigue performance, measuring it has previously required either exceptionally long testing periods (months via a direct method of observation), or the use of inconvenient and potentially unsafe solvents (via an indirect method that involves swelling the elastomer and possibly changing the properties of interest).

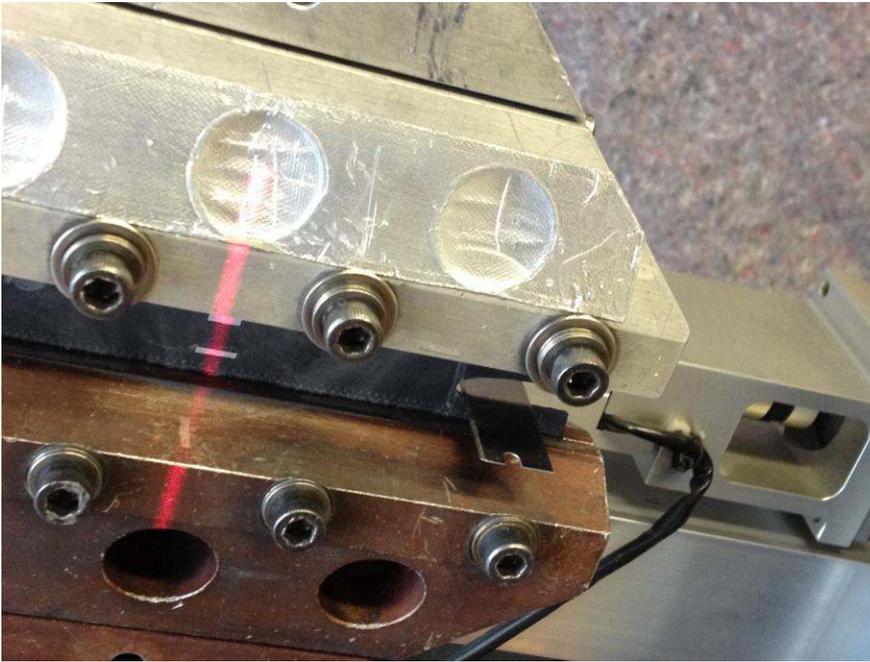
The new test is motivated by the principle that the endurance limit is set by the intrinsic strength of an elastomer's individual polymer network chains. Growing a crack requires that a sufficient quantity of energy be provided to rupture each polymer chain that is reached by the crack tip. The purpose of the new test is to determine this minimum rupture energy, and its associated critical stress and strain levels. Under most experimental conditions, the minimum energy cannot be observed directly. It is obscured by a large amount of additional energy that is consumed simultaneously in viscoelastic processes occurring near the crack tip. However, following a procedure originally applied in a 1978 study by pioneering scientists Graham Lake and Oon Hock Yeoh, the crack tip can be probed directly for the intrinsic strength, and the effects of extraneous dissipated energy can be readily distinguished. The measurement uses a series of carefully controlled cutting experiments, each made with a highly sharpened, instrumented blade. The procedure executes in less than a day, without the use of solvents. Results from the new procedure have been compared to results obtained via the direct method, with better than 93% correlation.

The test becomes part of a larger family of experiments already available from Endurica, under the name Fatigue Property Mapping™. These experiments are used to measure the fundamental behaviors that govern fatigue performance. The family of experiments now includes 5 modules: 1) stress-strain behavior (prerequisite), 2) core fatigue behavior (required), 3) strain crystallization behavior (for cases with non-relaxing cycles), 4) thermal behavior (for cases with significant self-heating or thermal gradients), and 5) endurance limit behavior (for cases involving target life greater than one million cycles).

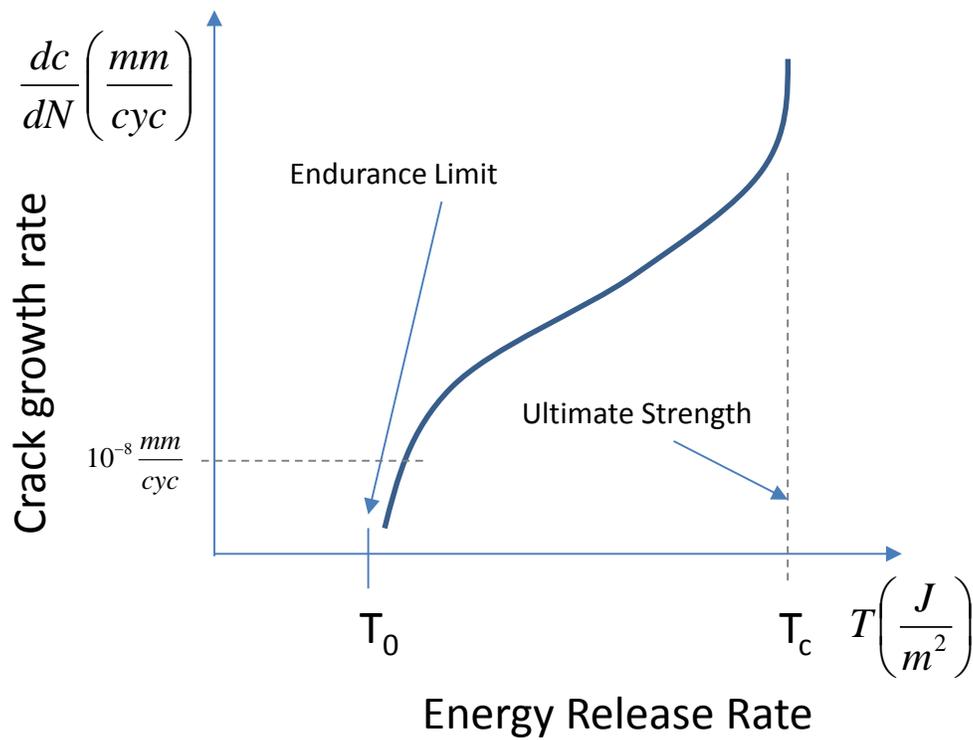
The testing service is aimed at developers and analysts who are responsible for product durability, and at users of Endurica's fatigue analysis software fe-safe/Rubber™. Dr. William Mars, founder and CEO of Endurica, explains that "we are very proud to offer these powerful characterization methods. They give developers probing and efficient diagnostic tools, and unprecedented options for managing fatigue performance early in a development program. Developers can use these measurements directly with our software solutions to numerically simulate fatigue performance under real-world conditions, and to better navigate design decisions involving complex material, geometry and loading issues".

About Endurica LLC. Endurica LLC provides pre-prototype solutions for developers seeking durability in elastomer applications. Endurica is focused on durability and elastomers, and has developed the world's first numerical fatigue life solver for elastomers. Our solver is used to predict fatigue life based on the results of Finite Element Analysis. Our solutions include characterization, software and training for engineers and analysts. The company was founded in 2008. (www.endurica.com)

About Axel Products. Axel Products provides testing services for engineers and analysts. The focus is on the characterization of nonlinear materials such as elastomers and plastics. Data from the Axel laboratory is often used to develop material models in finite element analysis codes such as ABAQUS, Endurica, MSC.Marc, ANSYS and LS-Dyna. Testing services are also provided to examine sealing and fatigue problems, long term thermal mechanical testing and high strain rate testing. The company was founded in 1994. (www.axelproducts.com)



Carefully controlled cutting of a pre-strained elastomer specimen with an instrumented blade provides an effective way to observe the material's endurance limit.



The endurance limit is the minimum energy release rate T_0 at which a crack can possibly grow. At loads below T_0 , the material can endure an indefinite number of cycles without incurring fatigue damage. At loads between T_0 and the ultimate strength T_c , fatigue crack growth occurs at a rate depending on the energy release rate.