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GB/T 47409-2026

**Test method for the mixed mode I-mode II interlaminar fracture
toughness of carbon fibre reinforced composites - Double
cantilever beam with uneven bending moment**

碳纤维增强复合材料 I 型- II 型混合层间断裂韧性的测定 双悬臂梁非对称弯曲法

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Foreword

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part

1. Structure and Drafting Rules of Standardization Documents". Drafting. Please note that some content in this document may involve patents. The issuing organization of this document assumes no responsibility for identifying patents. This document was proposed and is under the jurisdiction of the National Technical Committee on Carbon Fiber Standardization (SAC/TC572). This document was drafted by: Beijing Civil Aircraft Technology Research Center, Commercial Aircraft Corporation of China, Ltd. (COMAC), and Nanjing Fiberglass Research and Design Institute. Institute Co., Ltd., Taiyuan University of Technology, Sinopec Shanghai Petrochemical Co., Ltd., China Huaneng Group Clean Energy Technology Research Institute Limited Liability Company, Wuhan Textile University, Zhongfu Shenying Carbon Fiber Co., Ltd., CRRC Qingdao Sifang Locomotive & Rolling Stock Co., Ltd., Modern Textile Weaving Technology Innovation Center (Jianhu Laboratory), Jiangsu Aosheng Composite Materials Technology Co., Ltd., Zhejiang Sci-Tech University, Chongqing Chengfei New Materials Joint-stock company, Shandong Xinlongsheng Rail Transit Co., Ltd., Beijing Institute of Technology, AVIC Composite Materials Co., Ltd., Yangtze River Delta Carbon Fiber and... Composite Materials Technology Innovation Center, Sichuan Xinwanxing Carbon Fiber Composite Materials Co., Ltd. The main drafters of this document are. Xu Jifeng, Wang Yan, Duan Mufeng, Ma Dan, Qian Zhongyan, Feng Rongxin, Wang Han, Li Yongcun, Feng Yubo, Cao Yong, and Wu Sanhua. Zhang Lu, Qin Zhiwen, Li Xinkai, Liao Caicai, Sun Jiuxiao, Wang Zhihua, Li Zhiqiang, Guo Pengzong, Chen Yanrong, Zhang Renhang, Xu Lu, Qi Dunyou, Dai Hongbo Zhong Huping, Zhang Fei, Ye Jinrui, Liu Kai, Chen Chaozhong, Fan Yunxing. Carbon fiber reinforced composite type I-II hybrid layer Determination of intermittent fracture toughness using the double cantilever beam asymmetric bending method

1 Scope

GB/T 47409-2026 is the Chinese national standard covering delamination under combined opening and shear - which is how composites actually delaminate, rather than in the pure

modes the classical tests measure, using the uneven bending moment rig that holds the mode mixity constant as the crack grows. First edition, in force since 1 October 2026. It was issued on 31 March 2026 and takes effect on 1 October 2026, as a first edition. The document is under the responsibility of the Standardization Administration of China. This page is published from the official record of the 2026 edition; the clause text of a standard this recent is not yet in circulation, and the figures, limits and tables it contains are those of the document itself, delivered in full with the English translation.

This document describes the determination of the interlaminar fracture toughness of carbon fiber reinforced composites using the double cantilever beam asymmetric bending method. Principles, instruments and equipment, test samples, conditioning and test environment, test procedures, result calculation and test report. This document applies to the determination of the interlaminar fracture toughness of carbon fiber reinforced composite unidirectional laminates under static loading, specifically the mixed interlaminar fracture toughness of type I and type II laminates. The determination of interlaminar fracture toughness of fiber-reinforced composite unidirectional laminates is based on this reference.

2 Normative references

The contents of the following documents, through normative references within the text, constitute essential provisions of this document. Dated citations are not included. For references to documents, only the version corresponding to that date applies to this document; for undated references, the latest version (including all amendments) applies. This document.

GB/T 40724 Terminology for Carbon Fibers and Their Composites

3 Terms and Definitions

The terms and definitions defined in GB/T 40724, as well as the following terms and definitions, apply to this document.

3.1 KI The magnitude of the stress field at the ideal crack tip in Type I mode.

3.2 KII The magnitude of the stress field at the ideal crack tip in Type II mode.

3.3 The ratio of the stress intensity factors of type II to type I in the mixed type I-II interlaminar fracture mode.

4.Principles The specimen consists of a cantilever end and a clamping end, with a thickness of $2H$. Bending moments (M_1 and M_2) are applied to the two arms of the cantilever end of the specimen, causing the specimen to... Delamination propagation occurs under bending loads, thereby obtaining the type I-II mixed interlaminar fracture toughness of carbon fiber reinforced composites. The principle is as follows: As shown in Figure 1, quantitative loading under the type I-II mixing ratio is achieved by adjusting the lengths of

the two loading arms (l_1 , l_2), thus obtaining different mixing ratios. Interlaminar fracture toughness.

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