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PEOPLE'S REPUBLIC OF CHINA**

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**Test method for mixed mode I-III interlaminar fracture
toughness of fiber-reinforced plastic composites**

纤维增强塑料复合材料I型-III型混合层间断裂韧性的测定

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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.

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Fiber-reinforced plastic composites Type I-III Determination of mixed interlaminar fracture toughness

1 Scope

This document describes the principle, specimens, testing equipment, and testing procedures for determining the interlaminar fracture toughness of fiber-reinforced plastic composites of types I-III hybrids.

Test conditions, test procedures, result calculation, and test report.

This document applies to Type I-III mixed-layer discontinuity fiber-reinforced plastic composite laminates prepared by prepreg autoclave molding process.

For the determination of crack toughness, the same procedure shall be followed for fiber-reinforced composite laminate specimens prepared by other molding processes.

2 Normative references

GB/T 1446

GB/T 3961

GB/T 28889

GB/T 28891

GB/T 38537

GB/T 41762.1

GB/T 46221

3 Terms and Definitions

The terms and definitions defined in GB/T 3961, GB/T 28891 and GB/T 46221, as well as the following terms and definitions, apply to this document.

3.1 Type I-III mixed mode

The crack initiation and tearing patterns caused by loads applied simultaneously vertically and parallel to the layers of the specimen.

Note. Abbreviated as "hybrid mode".

3.2 GC

Critical value of total strain energy release rate during crack initiation and propagation under the mixed mode of type I-III (3.1).

Note 1. The total strain energy release rate in the hybrid mode is the sum of the strain energy release rates of type I and type III strain energy release rates at crack initiation and propagation.

Note 2. The unit is joules per square meter (J/m²).

4 Principles

By introducing circumferential pre-cracks through inserts, symmetrical and balanced composite laminate specimens with edge circumferential cracks were formed (as shown in Figure 1).

(See diagram). A combined tensile-torsion testing machine was used to clamp the specimen-fixture assembly. A type III delamination load was introduced through torsional loading, followed by tensile loading.

By introducing a type I delamination load, the mixed interlaminar fracture toughness of the composite material (type I-III) was determined.

5.1 Sample shape and size

The schematic diagram of the specimen is shown in Figure 1. The specimen is a square (or circular) composite laminate of uniform thickness, and the side length (or diameter) a of the specimen is...

(120 ± 0.5) mm, the sample thickness should not exceed 10 mm for 2h. An insert prefabricated portion is introduced outside the circular central bonding area on the middle surface of the sample.

The central bonding area of the layer has a radius r of (25 ± 1) mm, and the thickness of the embedding should not exceed 10 μ m. The sample coordinate system is shown in Figure 2.

a) Front view of a square specimen b) Front view of a circular specimen

c) Top view of a square specimen d) Top view of a circular specimen Index number explanation. 1 --- Embedded object; 2 --- Central bonding area;

a --- Sample side length or diameter;

r --- Radius of the central bonding area of the sample; $2h$ --- Sample thickness.

Figure 1 Schematic diagram of the sample