

Application News

Tensile Fracture Evaluation of CFRP Using Wedge Grips for Positioning FRP

Motofumi Kimura and Takashi Murakami

User Benefits

- ◆ Randomly oriented thermoplastic CFRP samples can be tested with the standard catalog wedge grip product for positioning FRP instead of grips specifically for randomly oriented thermoplastic CFRP.

Introduction

In recent years, there has been a shift from metallic materials to lighter alternatives for materials that require mechanical reliability. The main reason for this is that by reducing the weight of products, the amount of carbon dioxide emissions associated with product transportation can be reduced. CFRP and other fiber-reinforced composites are expected to be applied to all kinds of products, including automobiles, because of their outstanding strength and lightness.

This article presents a case in which tensile fracture evaluation of randomly oriented thermoplastic CFRP was carried out using wedge grips for positioning FRP, which was launched as an accessory for the precision universal testing machine Autograph.

Randomly Oriented Thermoplastic CFRP

Randomly oriented thermoplastic CFRP is a carbon fiber reinforced composite material that can be compressed and molded in a short period of time (Fig. 1). In addition to its high strength characteristics in tension, compression, and in-plane shear modes, it is possible to produce structural members in one process. To date, various property evaluation methods have been developed to realize high-precision numerical simulation¹⁻²⁾, impact axial crush evaluation of crush tubes, etc.³⁾, and development and demonstration tests have been carried out with the aim of practical application to mass-produced vehicles.

For the randomly oriented thermoplastic CFRP used in this article, a UD tape of 6 to 8 mm width based on thermoplastic epoxy was cut into 6.5 mm, 13.0 mm and 26 mm pieces and pressed to form a material plate of 3 mm thickness. The surface of the specimen was judged to be shiny and difficult to see the fracture condition due to the reflection of light, so a matte white paint was sprayed on the surface to enable tensile fracture to be evaluated.

The specimens were cut into 250 mm long and 25 mm wide pieces based on ISO527-4(2021) "Test conditions for isotropic and orthotropic fiber-reinforced plastic composites." During the tensile tests, a #600 sand cloth was inserted between the gripped part of the specimens and the gripping teeth of the grips, using a virtual tab.

Testing Equipment

For this evaluation, the Shimadzu Autograph AGX-V precision universal testing machine (Fig. 2) was used with wedge grips for FRP (PN: S336-02549-01) (Fig. 3).

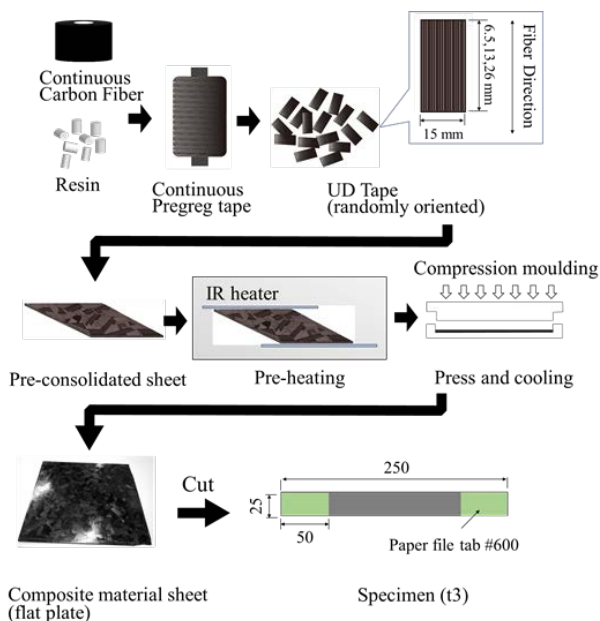


Fig. 1 Molding Process and Specimen Geometry of Randomly Oriented Thermoplastic CFRP



Fig. 2 Shimadzu Autograph AGX™-V Precision Universal Testing Machine



Fig. 3 Wedge Grips for FRP

■ Test Conditions and Results

Table 1 shows the test conditions. The number of specimens used for tensile fracture evaluation was set with n=5 in mind, so six specimens were evaluated, including one specimen.

Figs. 4, 5, and 6 show photos of the UD tape after fracture after tensile testing for three different lengths of UD tape. The part sprayed with white paint is the gauge section. It can be seen that all the specimens were fractured in the gauge section, and that good tensile fracture tests were carried out without failure at the chucks.

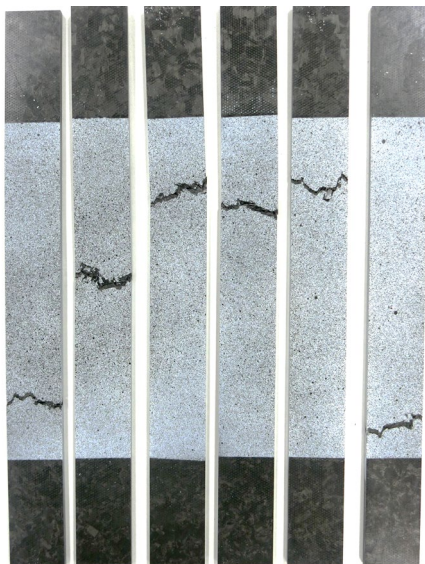


Fig. 4 Failure State (UD Tape Length 6.5 mm)

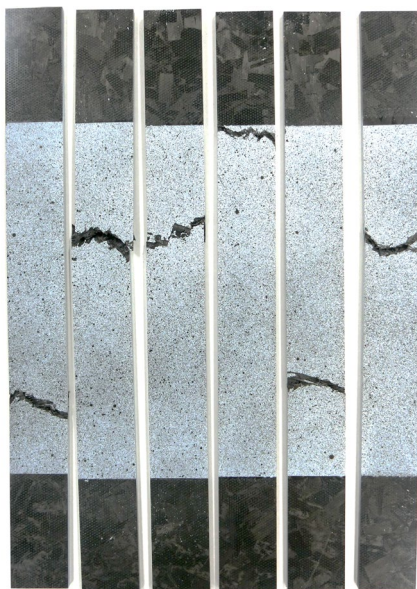


Fig. 5 Failure State (UD Tape Length 13 mm)



Fig. 6 Failure State (UD Tape Length 26 mm)

Table 1 Test Conditions

Testing Equipment:	AGX-50kNVD (fixed joint)
Grips:	Wedge grips for FRP (S336-02549-01)
Grip Face:	Standard accessory teeth (trapezoidal and ground teeth for composite materials)
Virtual Tab:	#600 sand cloth
Tests Speed:	1 mm/min
Distance between Grips:	150 mm
Software:	TRAPEZIUM X-V (single)

*The wedge grips for FRP positioning has a capacity up to 100 kN. Conversion fittings are required for use with a 50 kN capacity testing machine.

■ Conclusion

By using the Shimadzu Precision Universal Testing Machine Autograph and wedge grips for FRP, it was possible to perform tensile tests on randomly oriented thermoplastic CFRP with fracture occurring in the gauge section, without failure at the chucks.

The results presented here were obtained as part of the International Standardization of Basic Properties of Carbon Fiber Reinforced Thermoplastics, a project commissioned by METI. We would like to express our gratitude to everyone involved.

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