



Designation: D5573 – 99 (Reapproved 2012)

# Standard Practice for Classifying Failure Modes in Fiber-Reinforced-Plastic (FRP) Joints<sup>1</sup>

This standard is issued under the fixed designation D5573; 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 reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This practice covers the method of classifying, identifying, and characterizing the failure modes in adhesively bonded fiber-reinforced-plastic (FRP) joints. The FRP used in developing this practice consists of glass fibers in a thermoset-polyester-resin matrix, commonly referred to as sheet-molding compound, or SMC.

1.2 One objective of this practice is to present comprehensive definitions of possible failure modes to serve as a guide for contracts, drawings, product specifications, and product performance.

NOTE 1—Figures 2 through 11 referred to in the practice are contained in the ASTM adjunct, Color Photographs of Failure Modes.<sup>2</sup>

Fig. 2—Side-by Side Comparison of Failure Modes

Fig. 3—Adhesive Failure

Fig. 4—Cohesive Failure

Fig. 5—Thin-Layer Cohesive Failure

Fig. 6—Fiber-Tear Failure

Fig. 7—Light-Fiber-Tear Failure

Fig. 8—Stock-Break Failure

Fig. 9—Mixed Failure—40 % Fiber-Tear Failure, 60 % Light-Fiber-Tear Failure

Fig. 10—Mixed Failure—32 % Adhesive Failure, 68 % Fiber-Tear Failure

Fig. 11—Mixed Failure—20 % Adhesive Failure, 60 % Light-Fiber-Tear Failure, 20 % Fiber-Tear Failure

NOTE 2—This practice may be used to describe the failure modes generated from testing, using procedures such as Test Methods D3163, D3164, D3165, D3807, D5041, D5868, and SAE J1525.

1.3 The values stated in SI units are to be regarded as the standard.

1.4 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee D14 on Adhesives and is the direct responsibility of Subcommittee D14.40 on Adhesives for Plastics.

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<sup>2</sup> Available from ASTM International Headquarters. Order Adjunct No. ADJD5573. Original adjunct produced in 1993.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>3</sup>

D907 Terminology of Adhesives

D3163 Test Method for Determining Strength of Adhesively Bonded Rigid Plastic Lap-Shear Joints in Shear by Tension Loading

D3164 Test Method for Strength Properties of Adhesively Bonded Plastic Lap-Shear Sandwich Joints in Shear by Tension Loading

D3165 Test Method for Strength Properties of Adhesives in Shear by Tension Loading of Single-Lap-Joint Laminated Assemblies

D3807 Test Method for Strength Properties of Adhesives in Cleavage Peel by Tension Loading (Engineering Plastics-to-Engineering Plastics)

D5041 Test Method for Fracture Strength in Cleavage of Adhesives in Bonded Joints

D5868 Test Method for Lap Shear Adhesion for Fiber Reinforced Plastic (FRP) Bonding

### 2.2 SAE Standard:

SAE J1525 SAE Recommended Practice—Lap Shear Test for Automotive-Type Adhesives for Fiber Reinforced Plastic (FRP) Bonding<sup>4</sup>

### 2.3 ASTM Adjuncts:

Color Photographs of Failure Modes<sup>2</sup>

## 3. Terminology

### 3.1 Definitions:

3.1.1 Definitions may not appear outside of this practice unless the following delimiting phrase is included: “relating to testing FRP bonded joints and ASTM Practice D5573.”

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *failure-mode classification, n*—relating to testing FRP bonded joints, a classification that includes the seven classes of failure modes identified here: (1) adhesive failure, (2) cohesive failure, (3) thin-layer cohesive failure, (4) fiber-tear failure, (5)

<sup>3</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard’s Document Summary page on the ASTM website.

<sup>4</sup> Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, http://aerospace.sae.org.