Designation: D8336 – 21

Standard Test Method for Characterizing Tack of Prepregs Using a Continuous Application-and-Peel Procedure[1]

This standard is issued under the fixed designation D8336; 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 (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers measurement of adhesion (tack) between partially cured (B-staged) composite prepreg and a substrate in a peel test, under specified conditions. The test may be conducted to measure tack between a flexible layer of prepreg and another prepreg layer bonded to a rigid substrate (Method I) or a rigid metal substrate (Method II). This test method is primarily geared towards material characterization for automated material layup but can be modified for use with other processes. It is well known that material tack is a function of multiple processing and environmental variables. Permissible composite prepreg materials include carbon, glass, and aramid fibers within a B-staged thermoset resin.

1.2 Measured tack is specified in terms of a peel force at a given specimen width.

1.3 *Units*—The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A480/A480M Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
D883 Terminology Relating to Plastics
D1781 Test Method for Climbing Drum Peel for Adhesives
D3167 Test Method for Floating Roller Peel Resistance of Adhesives
D3878 Terminology for Composite Materials
E4 Practices for Force Verification of Testing Machines
E122 Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process
E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods
E456 Terminology Relating to Quality and Statistics

3. Terminology

3.1 *Definitions*—Terminology D3878 defines terms relating to composite materials. Terminology D883 defines terms relating to plastics. Terminology E456 and Practice E177 define terms relating to statistics. In the event of a conflict between terms, Terminology D3878 shall have precedence over the other documents.

4. Summary of Test Method

4.1 A continuous application-and-peel method is employed to quantify tack at given test conditions (such as temperature) between one B-staged prepreg layer and a second B-staged prepreg layer which is bonded to a rigid substrate, or between a B-staged prepreg specimen and a rigid substrate. During a test, a prepreg specimen laid up on a substrate with or without another prepreg layer is fed through the test fixture continuously (see Fig. 1). The compaction roller presses the prepreg against the substrate (and against the peel roller) at a controllable force, bonding the prepreg to the substrate at a set application rate. Simultaneously, the prepreg is peeled from the substrate at a peel rate which is identical to the application rate. Data is collected over two phases where only the second phase is related to adhesion. The peel force is determined from the difference in the average force between the two phases. Measuring the peel force during a test gives a measure for the strength of adhesion between prepreg and substrate at the given peel rate.

[1] This test method is under the jurisdiction of ASTM Committee D30 on Composite Materials and is the direct responsibility of Subcommittee D30.03 on Constituent/Precursor Properties.

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[2] 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.

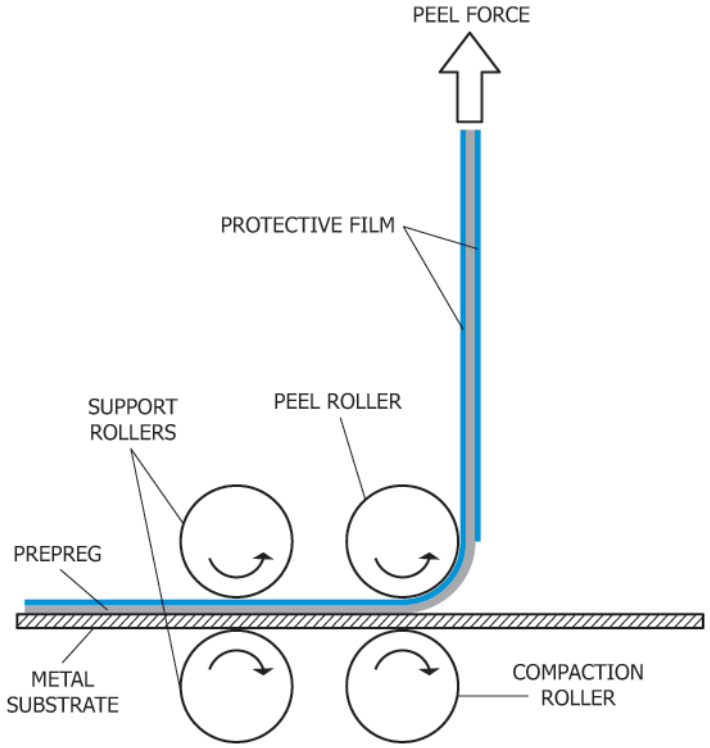

FIG. 1 Schematic of Continuous Application-and-Peel Test Method (Example: Method II)

5. Significance and Use

5.1 Characterizing tack for different prepreg materials, test parameters, surface combinations, and environmental conditions provides insight for optimizing process parameters (particularly deposition rate and deposition temperature) for industrial automated material placement processes.

5.2 Results obtained through employing the continuous application-and-peel method, as described in studies (**1-3**),[3] reflect the effects of adhesion forming between prepreg layers or between prepreg and metal substrate, and loss of cohesion within the resin in the prepreg, upon tack. This test method allows the adhesive properties of B-staged resin to be explored in a manner relevant for dynamic material deposition processes, where timescales for bonding of prepreg to the substrate or previously placed prepreg layers are short prior to curing. In contrast, Test Methods D3167 and D1781 determine the peel resistance of adhesive bonds for adhesion measurement and process control of laminated or bonded adherends.

5.3 The test method is suitable to quantify tack of prepregs for acceptance and process control and can be extended to determine resin shelf life or to adjust process parameters to resin out-time. Direct comparison of different resins/prepreg or processes can only be made when specimen preparation and test conditions are identical.

6. Interferences

6.1 *Material Test Face*—The manufacturing of prepregs may cause differences in resin content and resin distribution between the two sides or faces of the prepreg, which may have an effect on tack. Hence, tack tests must be carried out consistently on the same prepreg face to minimize interference due to the possible difference in material properties on the prepreg surfaces. It is recommended that the specimen layup assembly should represent the layup relevant to the intended use of the prepreg.

6.2 *Material Out-Time*—Prepreg out-time from frozen storage can change the characteristics of the material. Follow the guidelines provided by the material manufacturer for material storage and out-life. The operator must record and report changes to material out-time where applicable, in line with 13.1.

6.3 *Rigid Substrate Test Surface*—For tests following Method II, contaminants on the metal substrate surfaces can affect prepreg tack. Ensure that the surfaces are clean and dry as specified in 11.3, prior to application of the prepreg.

6.4 *Environmental Control and Measurement*—Variation in test temperature will affect tack; the recommendations for temperature control in the environmental chamber are specified in 7.1.11. Relative humidity has also been shown to affect prepreg tack (**2**). Unless specific conditioning of the prepreg is required (see Section 10), the relative humidity during the test shall be recorded as specified in 11.4.4 for each test temperature.

7. Apparatus

7.1 The test fixture (Fig. 2) holds two pairs of stiff rollers, arranged horizontally. One pair of rollers supports the specimen during a test. In the second pair, the top roller (peel roller) is fixed in position, while springs apply a vertical force on the

[3] The boldface numbers in parentheses refer to the list of references at the end of this standard.

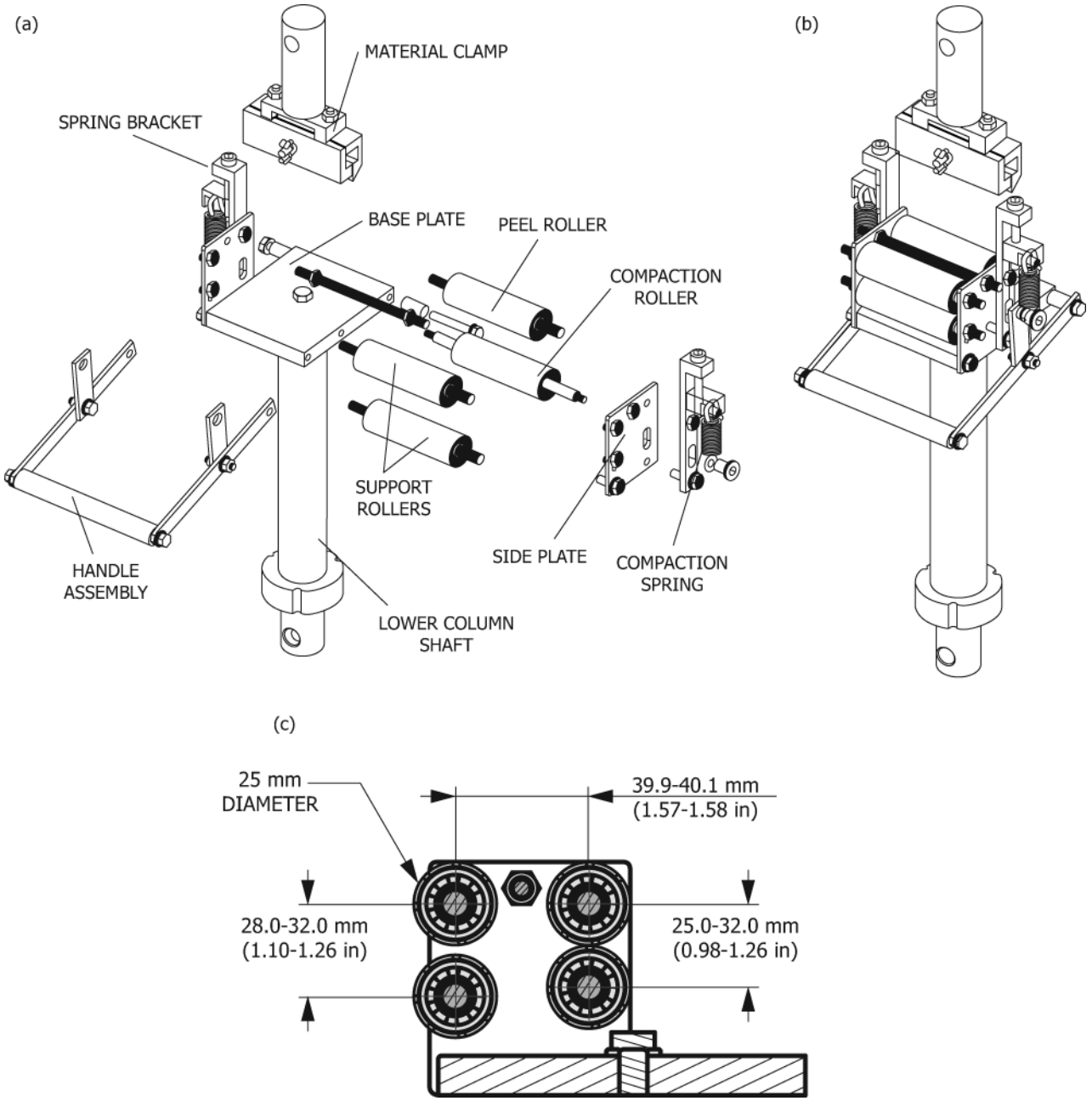

FIG. 2 Tack Testing Fixture: (a) Exploded View of Assembly, (b) Fully Assembled, and (c) Initial Rollers Positions Prior to a Test Whereby the Vertical Distance Indicates the Travel Range Between the Two Rollers to Accommodate Various Thicknesses of Prepreg and Substrate

bottom roller (compaction roller), allowing it to press the prepreg onto the substrate. All components of the fixture shall be of sufficient stiffness not to deform during a test. The fixture is mounted on the base of a test machine.

7.1.1 The base plate shall be wide enough to accommodate the rollers.

7.1.2 The side plates shall be attached to the base plate. The side plates shall have holes for the peel roller axle and the top support roller axle, slots (vertical) for the compaction roller axle, as well as slots for the bottom support roller axle (which can be adjusted to ensure sufficient clearance between the support rollers to accommodate specimens of different thickness).

7.1.3 The lower column shaft shall fit the base of the testing machine. Its dimensions shall position the peel roller directly below the moving cross-head (Fig. 2(b)) to allow the prepreg to be peeled from the substrate at an angle of 90°. Positioning is critical to ensure clearance between all parts of the set-up during a test. For tests conducted in non-ambient environments, the lower column shaft shall position the fixture in the center of the environmental chamber.

7.1.4 The peel roller shall be in a fixed position as determined by holes in the side plates. The roller surface shall be stiff and not deform when a compaction load is applied. Rotary bearings shall be used to minimize frictional losses in the roller. The recommended roller width is 80 mm (3.15 in.), and