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Standard Test Method for Preparation and Tension Testing of Filament-Wound Pressure Vessels¹

This standard is issued under the fixed designation D 2585; 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.

^{e1} NOTE—Editorial changes were made throughout and Sections 10 and 11 were added in April 1990.

1. Scope

1.1 This test method covers the determination of the apparent tensile parameters of filament-wound pressure vessels. The tensile parameters are predicted on defined conditions of geometry, fabrication, and test. This test method also describes the details necessary to wind either inplane or helical winding patterns. The two general procedures used in preparing the specimens are:

Procedure A, winding on a washout-type mandrel, and

Procedure B, winding on a rubber-lined steel mandrel.

1.2 Both procedures have been used successfully for design data generation and quality control by various agencies.

1.3 The values stated in inch-pound units are to be regarded as the standard. The values in parentheses are for information only.

1.4 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems 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.*

2. Referenced Documents

2.1 ASTM Standards:

D 618 Methods of Conditioning Plastics and Electrical Insulating Materials for Testing²

D 2290 Test Method for Apparent Tensile Strength of Ring or Tubular Plastics and Reinforced Plastics by Split Disk Method³

D 2344 Test Method for Apparent Interlaminar Shear Strength of Parallel Fiber Composites by Short-Beam Method³

E 4 Practice for Load Verification of Testing Machines⁴

3. Summary of Test Method

3.1 *Procedure A*—The test specimen is wound on a washout-type mandrel. An elastomeric liner (see Appendix

X1) is installed and the vessel is hydrotested. The test simulates performance requirements of the end product.

3.2 *Procedure B*—The test specimen is wound over a steel mandrel lined with an elastomeric liner. The entire assembly is then hydrotested.

3.3 The calculations necessary to determine the tensile parameters of the composite and fiber are based on netting analyses. The elastic modulus of the composite can be obtained by taking strain measurements.

4. Significance and Use

4.1 A small pressure vessel used to determine tensile strength and modulus will provide reasonably accurate information concerning the apparent properties of a reinforced matrix if conditions approximate those under which the tests are conducted and if data are interpreted correctly.

4.2 This tension test provides a standard method of obtaining data for design research and development, quality control, and acceptance rejection specifications. The test is valid only if the load-time scale described herein is followed.

4.3 An internal diameter of 146 mm (5.75 in.) is recommended to provide a pressure vessel test in the diameter range of those presently used by industry. In addition, the specimen will have prime value in providing a master specimen from which other specimens can be cut and tested by other ASTM methods, such as Test Method D 2344 and Test Method D 2290.

5. Apparatus

5.1 Pressure Vessel Fabrication Equipment:

5.1.1 *Winding Machine*—The machine shall be capable of duplicating either a helical or an inplane winding pattern and be capable of winding circumferentially as required for the vessel shown in Fig. 1.

NOTE 1—A special machine is not required; however, a machine that can perform circumferential windings is necessary unless adequate lathe facilities are available within the immediate winding area.

5.1.2 Mandrels:

5.1.2.1 *Washout-Type Mandrel (Procedure A)*—A typical and satisfactory mandrel fabrication technique is appended (see Appendix X1). Any soluble mandrel will meet this requirement.

NOTE 2—A release agent (polyfluorocarbon tape or equivalent) is placed on the mandrel prior to winding. The thickness of the release agent can be adjusted to compensate for the contraction of the pressure vessel after mandrel removal; this brings the vessel inside diameter to the

¹ This test method is under the jurisdiction of ASTM Committee D-30 on High Modulus Fibers and Their Composites and is the direct responsibility of Subcommittee D30.04 on High-Performance Fibers and Composites.

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² Annual Book of ASTM Standards, Vol. 08.01.

³ Annual Book of ASTM Standards, Vol. 15.03.

⁴ Annual Book of ASTM Standards, Vol. 03.01.