Designation: D2343 – 09

Standard Test Method for Tensile Properties of Glass Fiber Strands, Yarns, and Rovings Used in Reinforced Plastics[1]

This standard is issued under the fixed designation D2343; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This test method covers the determination of the comparative tensile properties of glass fiber strands, yarns, and rovings in the form of impregnated rod test specimens when tested under defined conditions of pretreatment, temperature, humidity, and tension testing machine speed. This test method is applicable to continuous filament, glass fiber materials that have been coated with a resin compatible sizing. This method is intended for use in quality control and R & D, and should not be used to develop composites design data.

NOTE 1—This method is technically equivalent to the short method described in ISO 9163.

NOTE 2—Prime consideration should be given to the use of a polymeric binder that produces specimens that yield the highest consistent values for the glass fiber material under test. Tensile properties may vary with specimen preparation, resin impregnation system, and speed and environment of testing. Consequently, where precise comparative results are desired, these factors must be carefully controlled.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

NOTE 3—Prime consideration should be given to the use of a polymeric binder that produces specimens that yield the highest consistent values for the glass fiber material under test. Tensile properties may vary with specimen preparation, resin impregnation system, and speed and environment of testing. Consequently, where precise comparative results are desired, these factors must be carefully controlled.

1.3 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D618 Practice for Conditioning Plastics for Testing

D883 Terminology Relating to Plastics

D3039/D3039M Test Method for Tensile Properties of Polymer Matrix Composite Materials

D5083 Test Method for Tensile Properties of Reinforced Thermosetting Plastics Using Straight-Sided Specimens

E4 Practices for Force Verification of Testing Machines

E6 Terminology Relating to Methods of Mechanical Testing

2.2 *ISO Standard:*

ISO 9163 Textile Glass—Rovings—Manufacture of Test Specimens and Determination of Tensile Strength of Impregnated Rovings

3. Terminology

3.1 *Definitions:*

3.1.1 Definitions of terms and symbols relating to this test method appear in Terminologies E6 and D883.

4. Summary of Test Method

4.1 This test method consists of impregnating glass fiber strands, yarns, or rovings with a suitable polymeric binder material and loading the resulting test specimens to failure in a tension testing machine having a constant-rate-of crosshead movement. The cross sectional area is determined from skeins of glass fiber taken before and after each set of test specimens. After impregnation and curing, the specimens shall either be tabbed using glass fiber mat or cardboard and tested with standard grips; or the ends shall be sanded with 240 grit sandpaper or fine emery cloth and tested using rubber faced grips.

[1] This test method is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.18 on Reinforced Thermosetting Plastics.

Current edition approved Sept. 1, 2009. Published September 2009. Originally approved in 1965. Last previous edition approved in 2008 as D2343 - 08. DOI: 10.1520/D2343-09.

[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.

***A Summary of Changes section appears at the end of this standard**

5. Significance and Use

5.1 Tensile properties determined by this test method are of value for identifying and characterizing materials for control and specification purposes as well as for providing data for research and development studies.

5.2 This test method is intended for use in testing resin-compatible sized glass fiber materials that have been designed specifically for use with certain generic types of plastics. The use of a resin impregnant that is compatible with the reinforcement material under test produces results that are most representative of the actual strength that is available in the material when used as intended in an end item. Premature reinforcement failure may occur if the elongation of the resin system is less than that of the reinforcement being tested. This requirement may restrict the use of certain resin systems in this procedure. Misleading results may be obtained when glass fiber materials are tested without complete resin impregnation of the fiber or when a non-compatible resin is used for impregnation.

5.3 This test method is useful for testing pretreated specimens for which comparative results are desired. Values obtained by this test method may be affected by gage length, gripping system, testing speed, and the resin impregnation ratio of the specimen.

6. Apparatus

6.1 *Impregnation Apparatus*—An example of an acceptable impregnation apparatus for strands is shown in Fig. 1. Minor modifications to the apparatus are acceptable providing consistent samples are produced. The apparatus shall consist essentially of the following:

6.1.1 *Free Wheeling Spindle (Optional)*—A freely turning spindle with a horizontal axis for holding the yarn spool or roving ball. A spindle allows fiber to be pulled from a yarn bobbin or the outside of a roving package. Alternatively, the fiber may be drawn from the package without the spindle as in the case of pulling from the interior of a roving package or forming cake.

6.1.2 *Tension Regulating System* capable of maintaining the roving or yarn under tension between 0.2 Newtons and 20 Newtons.

6.1.3 *Impregnation Tank,* as illustrated in Fig. 2, consisting of a container and a static spreader bar assembly. The tank must have the capability of maintaining the required resin temperature within ±5°C. This may be accomplished by use of a double walled vat, with heating fluid circulating between the walls, or by use of an external heating plate.

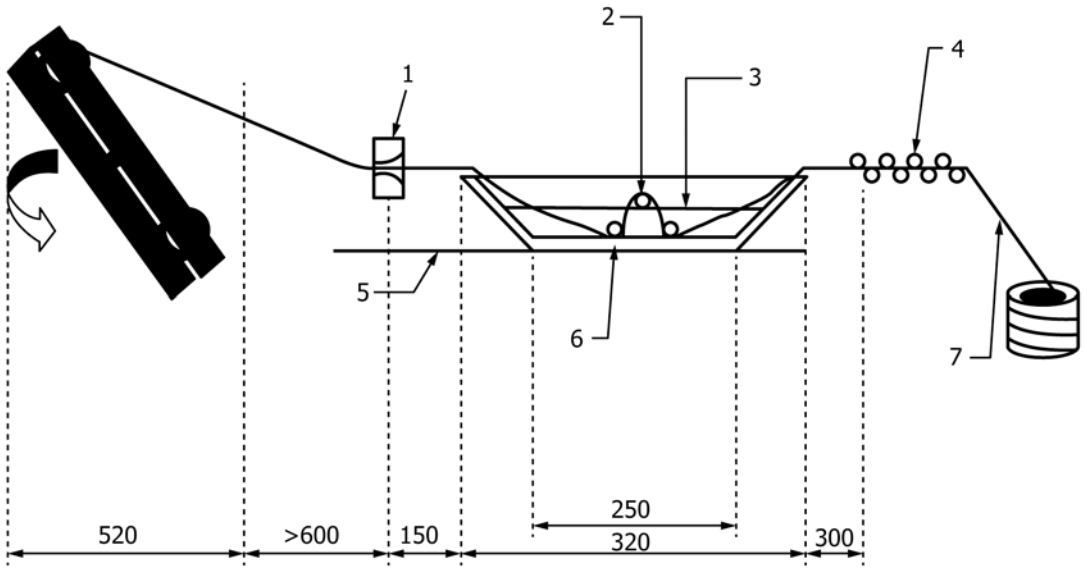
6.1.4 *Die,* as illustrated in Fig. 3, made of stainless steel which gives a defined circular cross-section to the impregnated roving.

6.1.5 *Winding Device and Frame*—for collecting the impregnated roving which insures that the fibers are kept under constant tension and places the strands onto the fixture in a manner which allows separate specimens to be fabricated.

6.2 *Template for Tabbing (Optional)*—A template, as shown in Fig. 4, shall be used to provide proper positioning of end tabs.

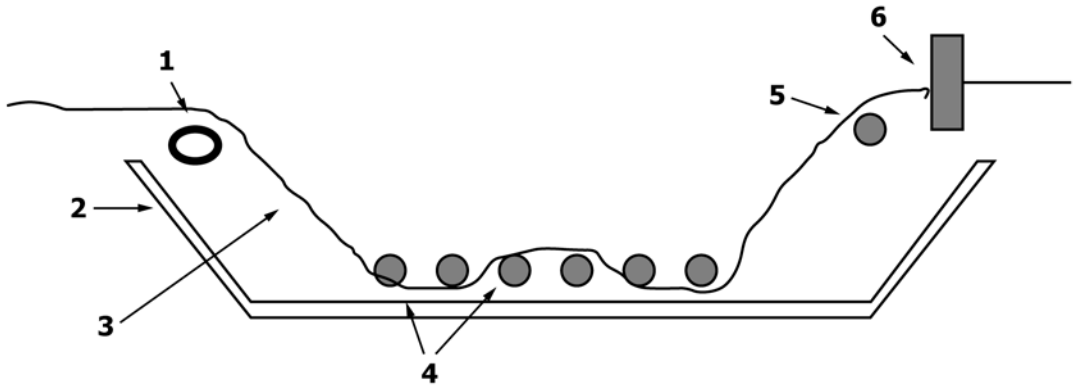
6.3 *Tension Testing Machine*—A testing machine having a constant-rate-of-crosshead movement and comprising essentially the following shall be available:

6.3.1 *Stationary Member,* with one grip.



1 Die
2 Tensioning Bars
3 Resin Level
4 Tensioning Device
5 Moving Support
6 Impregnation Vat (temperature regulated)
7 Glass Input

FIG. 1 Typical Impregnation Equipment Configuration



1 Entrance Guide Eye
2 Impregnating Vat
3 Glass Roving or Yarn
4 Breaker Bars
5 Exit Tensioning Bar
6 Die

FIG. 2 Impregnation Tank

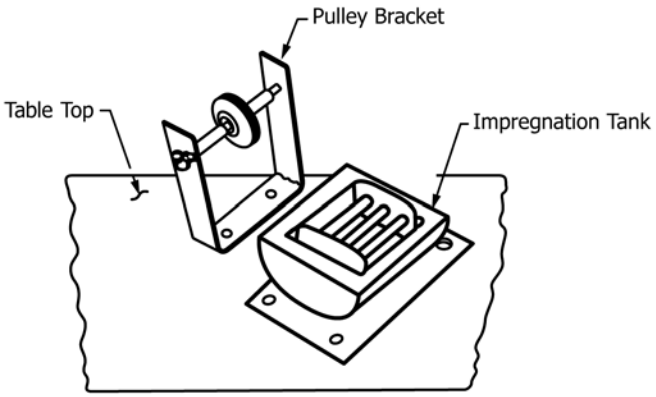


FIG. 3 Guide Pulley and Impregnation Tank

6.3.2 *Movable Member,* with a second grip.

6.3.3 *Grips*—Grips for holding the test specimen between the fixed and the movable member shall be of the self-aligning type (that is, they shall be attached to the fixed and movable members in such a manner that they will move freely into alignment as soon as any load is applied). The long axis of the test specimens will then coincide with the direction of the applied pull through the center line of the grip assembly.

NOTE 4—Air-actuated grips have been found advantageous and are recommended for use in this test method.

NOTE 5—Rubber with a Shore A hardness of 91 has been found to work well as a grip surface.

NOTE 6—Recommended starting gripping pressures are 80 bars for specimens with no tabs, 60 bars for specimens with cardboard tabs, and 40 bars for composite tabs. These may be adjusted as necessary to prevent slippage providing damage to the specimen due to crushing is prevented.

6.3.4 *Jaws*—A set of removable jaws to match the required grips shall be used for clamping the test specimens. One of the faces of the jaws shall be adjustable to compensate for thickness of the specimen ends, so that the tension force is aligned with the center of the jaw. Rubber-faced jaws, with a gripping length of at least 50 mm, shall be used for gripping specimens unless tabs are used. The jaws shall be wider than the test specimen and shall have a gripping length of at least 50 mm. Their faces shall be plane and parallel and shall ensure uniform pressure over the whole width of the test specimen to assure the specimen is held without slippage. If slippage of the test specimens is observed, 240 grit sandpaper strips shall be used to improve gripping. The sandpaper should be replaced when it has lost its grittiness, or after every 30 to 50 breaks. Alternatively, tabbing shall be used.

6.3.5 *Drive Mechanism*—A drive mechanism capable of imparting a uniform controllable speed to the movable member of the apparatus.

6.3.6 *Load Indicator*—A suitable load-indicating mechanism capable of showing the total tensile load carried by the test specimen when held by the grips shall be used. This mechanism shall be essentially free of inertial lag at the specified rate of testing and shall indicate the load with an accuracy of at least ±1 % of the indicated load value. The accuracy of the testing machine shall be verifiable in accordance with Practices E4.

6.3.7 *Deflection-Measuring Device and Recorder*—A suitable instrument for measuring deflection (extensometer) and a suitable mechanism for recording this deflection shall be provided. It is desirable that this instrument and recorder automatically record this deflection as a function of the load on the test specimen. An extensometer gauge length of 50 mm is recommended.

6.4 *Balance, Analytical.*

7. Test Specimens

7.1 Test specimens shall consist of straight lengths of impregnated glass fiber strands, yarns, or roving. The lengths shall be at least 250 mm.

7.2 *Effective Gage Length*—The distance between the tabs or the distance between the rubber faced jaws shall be 150 mm.

7.3 *Number of Specimens*—At least five tension test specimens shall be tested for each ball or spool of glass fiber material for each property tested.

7.4 *Glass Content*—The glass content of the impregnated glass samples shall be 70 ± 5 % unless otherwise specified.