Designation: D 3916 – 94

An American National Standard

Standard Test Method for Tensile Properties of Pultruded Glass-Fiber-Reinforced Plastic Rod[1]

This standard is issued under the fixed designation D 3916; 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 describes a procedure for determining the tensile properties of pultruded, glass-fiber-reinforced thermosetting plastic rod of diameters ranging from 3.2 mm (⅛ in.) to 25.4 mm (1 in.). Little test specimen preparation is required; however, reusable aluminum tab grip adapters (Fig. 1) of appropriate size are required to prevent premature failure of the specimens at the grips.

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

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.* Specific hazards statements are given in Note 3 and Note 4.

NOTE 1—There is no known ISO equivalent to this test method.

2. Referenced Documents

2.1 *ASTM Standards:*

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing[2]

D 638 Test Method for Tensile Properties of Plastics[2]

E 4 Practices for Force Verification of Testing Machines[3]

E 83 Practice for Verification and Classification of Extensometers[3]

3. Significance and Use

3.1 The high axial-tensile strength and the low transverse-compressive strength of pultruded rod combine to present some unique problems in determining the tensile strength of this material with conventional test grips. The high transverse-compressive forces generated in the conventional method of gripping tend to crush the rod, thereby causing premature failure. In this test method, aluminum-alloy tabs contoured to the shape of the rod reduce the compressive forces imparted to the rod, thus overcoming the deleterious influence of conventional test grips.

3.2 Tensile properties are influenced by specimen preparation, strain rate, thermal history, and the environmental conditions at the time of testing. Consequently, where precise comparative results are desired, these factors must be carefully controlled.

3.3 Tensile properties provide useful data for many engineering design purposes. However, due to the high sensitivity of these properties to strain rate, temperature, and other environmental conditions, data obtained by this test method should not, by themselves, be considered for applications involving load-time scales or environmental conditions that differ widely from the test conditions. In cases where such dissimilarities are apparent, the sensitivities to strain rate, including impact and creep, as well as to environment, should be determined over a wide range of conditions as dictated by the anticipated service requirements.

4. Apparatus

4.1 *Water-Cooled Diamond or Tungsten-Carbide Saw*, for cutting rod to size.

4.2 *Micrometer*, reading to at least 0.025 ± 0.000 mm (0.001 ± 0.000 in.), for measuring the width and thickness of the test specimens. The thickness of nonrigid plastics should be measured with a dial micrometer that exerts a pressure of 25 ± kPa (3.6 ± 0.7 psi) on the specimen and measures the thickness to within 0.025 mm (0.001 in.). The anvil of the micrometer shall be at least 30 mm (1.4 in.) in diameter and parallel to the face of the contact foot.

4.3 *Universal Testing Machine*, verified in accordance with Practices E 4, having a capacity of at least 530 kN (120 000 lbf) to permit the testing of 25.4 mm (1 in.) diameter rod. Smaller-diameter rod may be tested on lower-capacity equipment, commensurate with the anticipated tensile strength of such rod.

4.4 *Extensometer*—A suitable instrument for determining the distance between two designated points located within the gage length of the test specimen as the specimen is stretched. It is desirable, but not essential, that this instrument automatically record this distance (or any change in it) as a function of the load on the test specimen or of the elapsed time from the start of the test, or both. If only the latter is obtained, load-time data must also be taken. This instrument shall be essentially

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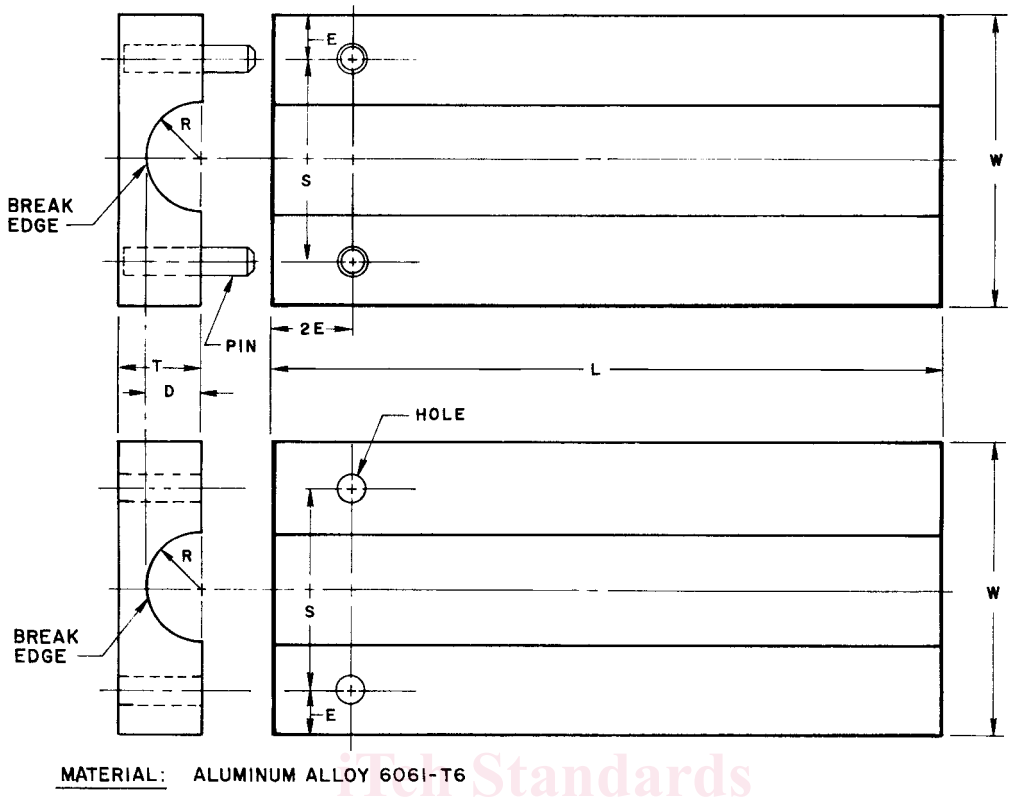
[2] *Annual Book of ASTM Standards*, Vol 08.01.

[3] *Annual Book of ASTM Standards*, Vol 03.01.



NOTE 1—Sandblast Clamp Face with 100-mesh Carbide at 100 psi.

FIG. 1 General Schematic of Tab Grip Adapters

free of inertia lag at the specified speed of testing and shall be accurate to ±1 % of strain or better.

NOTE 2—Reference is made to Practice E 83.

4.5 *One Pair of 6061 – T6 Aluminum-Alloy Tab Grip Adapters*, as described in Fig. 1 and Table 1, to fit in split wedge-type action jaws of the testing machine.

4.6 *Solvent*, such as methylene chloride, for cleaning the gripping surfaces of the aluminum-alloy tab grip adapters to remove any mold release, oil, or other foreign material that might act as a lubricant. The improper use of solvents can present hazardous conditions. Use of proper equipment, ventilation, and training of personnel in proper techniques should be practiced to minimize hazards associated with the use of any volatile solvent.

5. Test Specimens

5.1 At least five specimens shall be cut from the rod sample of interest. Specimen length shall be as great as possible, commensurate with the physical limitations of the testing machine.

NOTE 3—**Caution:** When fabricating composite specimens by machining operations, a fine dust consisting of particles of fibers or the matrix material, or both, may be formed. These fine dusts can be a health or safety hazard, or both. Adequate protection should be afforded operating personnel and equipment. This may require adequate ventilation or dust collecting facilities, or both, at a minimum.

6. Conditioning

6.1 Standard conditioning shall be in accordance with Procedure A of Practice D 618.

6.2 Tests at other than standard laboratory atmospheric conditions should be described, including time (hours), temperature, and test environment, such as watersoak, etc. Tests should be made as near to these conditions as possible.

7. Number of Test Specimens

7.1 At least five specimens shall be tested for each sample. When specimens are preconditioned (for example, water-boiled or oven-aged) prior to test, five specimens per sample shall be tested for each condition employed.

8. Procedure

8.1 Measure and record the diameter of the rod specimen at several points along its length with a micrometer, noting both the minimum and average values of these measurements.

8.2 Wipe the ends of the specimen and the gripping surfaces of the aluminum tabs with a cloth saturated with a suitable solvent to remove any foreign material that might act as a lubricant.

8.3 Assemble the aluminum tabs to the ends of the specimen, allowing 10 to 20 mm (0.4 to 0.8 in.) of the specimen to extend beyond the tabs at each end, and mount this assembly in the grips of the testing machine, taking care to align the long axis of the specimen with that of the grips of the machine.

8.4 If values of the modulus of elasticity are being determined, proceed as follows:

8.4.1 Attach the extensometer.

8.4.2 Start the machine and operate it at a nominal crosshead speed of 5 mm (0.20 in.)/min.