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# Standard Guide for Reporting Test Methods and Results on High Modulus Fibers[1]

This standard is issued under the fixed designation D 3544; 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 Department of Defense.*

## 1. Scope

1.1 Committee D-30, having conducted several interlaboratory tests of high modulus fibers, believes that many types of equipment and techniques will yield consistent data characterizing the tensile strength and modulus of high modulus fibers. The most important consideration is the complete description of the test methods.

1.2 This guide consists of the following three parts:

1.2.1 Part A—*Description of Equipment and Techniques*—This section describes the equipment and the techniques used for each series of tests. The section is complete and universal, and should be reviewed by the engineer or scientist responsible for the overall test program.

1.2.2 Part B—*Description of Test Specimens*—This section describes each type of fiber tested in a particular series, and can be prepared by the test technician.

1.2.3 Part C—*Report of Tension Test Results*—This section summarizes the results of each test series. The format simplifies the reporting of essential data. Additional information may be required to report the results of tests on specific fiber types.

1.3 *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. Significance and Use

2.1 The purpose of this guide is to be a research tool (*1*) to aid in the analysis and correlation of test results obtained from the use of various types of tension testing equipment by different investigators and (*2*) to identify the important details that must be made in testing to make the results easily understood and comparable with the results of other investigators.

NOTE 1—The ASTM practice of providing units of measure in the International System of Units (SI) has been used. The SI unit for pressure or stress is pascal (Pa = $N/m^2$ ) or megapascal (MPa = $MN/m^2$). The following equivalents may be helpful:

1 lbf = 4.448 N
1 psi = 6895 Pa = 6.895 kPa
1000 psi = 6.895 MPa

[1] This guide is under the jurisdiction of ASTM Committee D-30 on High Modulus Fibers and Their Compositesand is the direct responsibility of Subcommittee D30.03 on Constituent/Precursor Properties.

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## PART A—DESCRIPTION OF EQUIPMENT AND TECHNIQUES
## DESCRIPTION OF TENSION TEST MACHINE

Date_____

Manufacturer, Model, and Modifications

*Orientation of Test Specimen:*
- Horizontal ☐
- Vertical ☐
- Other—Describe

*Method and Rate of Strain or Load Application:*
- Discontinuous ☐
- Continuous ☐
- Constant Rate of Traverse ☐
- Constant Rate of Elongation ☐
- Constant Rate of Load ☐
- Other—Describe

Time to Failure _____ s

*Description of Load-Measuring System:*
Capacity _____ N (_____ lbf), max

Deflection of Sensing Element at Load _____ mm (_____ in.), max
Load Range _____ N (_____lbf)
Type of Measuring Element

Resolution and Estimate of Error

*Description of Elongation Measuring System:*
Jaw Separation ☐
Extensometer on Sample ☐
Optical ☐
Continuous Tracking ☐
Discontinuous or Manual Tracking ☐
Other—Describe

Resolution and Estimate of Error

Method Used to Determine System Compliance

Compliance Correction Value _____ mm/N (_____ in./lbf)

*Load Calibration Procedure:*

Estimate of Error

*Elongation Calibration Procedure:*

Estimate of Error

*Linearity of Recording Unit*(*indicate maximum departure from linear response*)*:*
Load Indication _____ %
Elongation Indication _____ %

Response Time of Recording Unit _____ s full scale



## MEASUREMENT OF CROSS-SECTIONAL AREA

*Method of Measurement:*
Micrometer ☐
Microscopical—Longitudinal View ☐
Microscopical—Transverse View ☐
Calculated from Linear Density ☐
Other—Describe



Time When Measurement Was Made:
Before Test on Each Specimen ☐
After Test on Each Specimen ☐
On Group of Specimens—Average ☐
Location of Measurements Along Length—at fracture ☐ in gage length ☐ other _____:

Number of Measurements Made on Each Fiber or Strand _____
Estimate of Error in Cross-Sectional Area _____ %

## MEASUREMENT OF SPECIMEN GAGE LENGTH

*Distance Between Fiber or Strand Mounts:*
Method of Measurement
Resolution and Estimate of Error
*Length of Fiber or Strand over Which Elongation Was Measured:*
General Description
Resolution and Estimate of Error

Location and Type of Gage Marks

## METHOD OF GRIPPING AND ALIGNING FIBER OR STRAND

*Fiber or Strand Mounting Technique:*
Clamped Directly in Jaw☐
Bonded to a Tab ☐ Bonded Between Tabs ☐
Tab Geometry length____mm (____in.) width____mm (____in.) thickness____mm (____in.)
Type of Adhesive

Other—Describe

Jaw Type:
Flat Faces—Exerting Transverse Pressure ☐

Wedge Type ☐
Pin-Vise Type ☐
Other—Describe

Jaw Face Lining:
Face Material _____ Frequency of Replacement _____
Surface Geometry flat ☐ _____ serrated ☐ _____ other ☐ _____
Thickness _____ mm (_____ in.)
Hardness, Durometer, etc. _____

Clamping Pressure: Manual ☐, Hydraulic ☐, Pneumatic ☐
Magnitude _____ MPa (_____ psi)
Method of Measurement

Sample Pre-Tension—During Mounting☐ , During Strand Cure ☐ Preload in Machine☐
Magnitude _____ MPa (_____ psi)
Method of Measurement

Rotational Freedom of Jaws: Top ☐ Bottom ☐ Both ☐
Rigid ☐
Pivot ☐
Swivel, Universal ☐
Other—Describe

Describe Method of Fiber Alignment[A]*

Estimate of Fiber Misalignment with Machine Axis and Method of Measurement_____

[A] * Detail if special considerations or techniques are necessary.

## ENVIRONMENTAL CONDITIONS—METHOD OF CONTROL AND NOMINAL VALUES

Specimen Conditioning Environment:
Temperature_____ _____°C (_____°F)
Relative Humidity_____ _____%
Atmosphere Composition_____ air ☐, other_____
Atmosphere Pressure_____ Ambient ☐, other_____
Duration of Time at These Conditions_____ h

Specimen Test Environment:
Temperature_____ _____°C (_____°F)
Relative Humidity_____ _____%
Atmosphere Composition_____ air, ☐
other_____
Atmosphere Pressure_____ Ambient, ☐
other_____
Duration of Time to Reach Conditions _____ min
Duration of Time at Test Conditions _____ min

Portion of Fiber or Strand Exposed to Test Conditions:
Fiber and Grips ☐
Short Portion of Fiber ☐
Exposed Length _____ mm (_____ in.)
Location of Exposed Length

## MEASUREMENT OF MODULUS OF ELASTICITY

Static—Tension Test ☐
Calculated as Initial Modulus ☐
Calculated as Secant Modulus ☐
Calculated as Tangent Modulus ☐
Other Method—Describe

Dynamic—Sonic Test ☐
Standing Wave Technique
Manufacturer, Model, and Modifications
Tension on Fiber _____ N (_____ lbf) or Stress _____ MPa (_____ psi)
Method of Tension Measurement
Resolution and Estimate of Error
Sample Length _____ mm (_____ in.)
Method of Length Measurement
Resolution and Estimate of Error
Frequency _____ Hz
Method of Frequency Measurement