



Designation: D8054/D8054M – 22

Standard Test Methods for Tensile Testing of Para-Aramid Flat Yarns¹

This standard is issued under the fixed designation D8054/D8054M; 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 These test methods cover the tensile testing of para-aramid flat yarns. The methods include testing procedure only and include no specifications or tolerances.

1.2 This standard includes the following test methods:

	Section
Linear Density	10
Force at Specified Elongation (FASE)	11
Modulus	11

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

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

D76 Specification for Tensile Testing Machines for Textiles
D123 Terminology Relating to Textiles
D1776/D1776M Practice for Conditioning and Testing Textiles
D1907/D1907M Test Method for Linear Density of Yarn (Yarn Number) by the Skein Method

¹ These test methods are under the jurisdiction of ASTM Committee D13 on Textiles and are the direct responsibility of Subcommittee D13.19 on Industrial Fibers and Metallic Reinforcements.

Current edition approved Nov. 1, 2022. Published November 2022. DOI: 10.1520/D8054_D8054M-22.

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.

D2258 Practice for Sampling Yarn for Testing

D3800 Test Method for Density of High-Modulus Fibers

D4848 Terminology Related to Force, Deformation and Related Properties of Textiles

D6477 Terminology Relating to Tire Cord, Bead Wire, Hose Reinforcing Wire, and Fabrics

D6587 Test Method for Yarn Number Using Automatic Tester

D7269 Test Methods for Tensile Testing of Aramid Yarns

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

3. Terminology

3.1 The following terms are relevant to this standard: elongation, flat yarn, force at specified elongation (FASE), force-elongation curve, modulus.

3.2 For definitions of terms related to industrial fibers and metallic reinforcements, see Terminology D6477.

3.3 For definitions of terms related to force and deformation in textiles, refer to Terminology D4848.

3.4 For definitions of other terms related to textiles, refer to Terminology D123.

4. Summary of Test Methods

4.1 Using various test methods and protocols identified in the procedures, this standard determines the tensile strength, force at specified elongation (FASE), linear density and modulus of para-aramid flat yarns.

5. Significance and Use

5.1 For application areas such as optical fiber and cable reinforcements, aramid is usually used in a linear – not twisted – form. For designing constructions like this, it is essential to use data based on a specimen without twist applied.

5.1.1 The modulus and FASE of twisted yarns demonstrate reduced values when compared to p-aramid flat yarns.

5.1.2 Use Test Method D7269 for testing of twisted p-aramid yarns.

5.2 The levels of tensile properties obtained when testing aramid yarns are dependent on the age and history of the

specimen and on the specific conditions used during the test. Among these conditions are rate of stretching, type of clamps, gauge length of specimen, temperature and humidity of the atmosphere, rate of airflow across the specimen, and temperature and moisture content of the specimen. Testing conditions accordingly are specified precisely to obtain reproducible test results on a specific sample.

5.3 FASE (Force At Specified Elongation) describes the absolute resistance of the p-aramid flat yarn to an imposed elongation.

5.4 Modulus is a measure of resistance of yarn or cord to extension as a force is applied. It is useful for estimating the response of a textile reinforced structure to the application of varying forces and rates of stretching. Although modulus may be determined at any specified force, initial modulus is the value most commonly used.

5.5 Shape, size, and internal construction of the end-product can have appreciable effect on product performance. It is not possible, therefore, to evaluate the performance of end product in terms of the reinforcing material alone.

5.6 If there are differences of practical significance between reported test results for two laboratories (or more), comparative tests should be performed to determine if there is a statistical bias between them, using competent statistical assistance. As a minimum, test samples should be used that are as homogeneous as possible, that are drawn from the material from which the disparate test results were obtained, and that are randomly assigned in equal numbers to each laboratory for testing. Other materials with established test values may be used for this purpose. The test results from the two laboratories should be compared using a statistical test for unpaired data, at a probability level chosen prior to the testing series. If a bias is found, either its cause must be found and corrected, or future test results must be adjusted in consideration of the known bias.

6. Apparatus

6.1 *Tensile Testing Machine*—A single-strand tensile testing machine of the constant rate of extension (CRE) type. The tensile testing equipment can be either manually operated or can be an automated device. The specifications and methods of calibration and verification of these machines shall conform to Specification . The tester shall be equipped with an electronic data acquisition and data evaluation system.

6.2 Bollard type clamps, in which the specimen is gripped between plane-faced jaws and then makes a partial turn (wrap angle) around a curved extension (or other type of snubbing device) of one jaw face before passing to the other similar clamp (see [Appendix X1](#); [Fig. X1.1](#)). Clamps with a minimum wrap angle of 180° are required for yarns with a linear density up to 3500 decitex [3000 denier]. For linear densities above 3500 decitex [3000 denier], clamps with a minimum wrap angle of 270° are recommended to prevent slippage. See [Note 1](#).

6.3 Clamps shall grip the test specimen without spurious slippage or damage to the test specimen which can result in jaw

breaks. The clamps shall maintain constant gripping conditions during the test by means of pneumatic or hydraulic clamps. The surface of the jaws in contact with the specimen shall be of a material and configuration that minimizes slippage or specimen failure, or both, in the clamping zone.

6.4 *Gauge Length*—The gauge length shall be the total length of yarn measured between the clamping point A of the first clamp and the point B of the second clamp in the starting position (see [Appendix X1](#); [Fig. X1.1](#)).

NOTE 1—The selected testing equipment (tester, clamp, gauge length) is known to have an influence on the properties measured. A method for eliminating the influences introduced by the selected testing equipment is given in Test Methods [D7269](#), Appendix X1.

7. Sampling

7.1 *Yarn*—For acceptance testing, sample each lot as directed in Practice [D2258](#). Take the number of specimens for testing specified for the specific property measurement to be made.

7.1.1 *Number of Samples and Specimens*—The recommended number of specimens is included in the appropriate sections of specific test methods covered in this standard. Where such is not specified, the number of specimens is as agreed upon between buyer and supplier. Take samples at random from each of a number of cones, tubes, bobbins, or spools within a lot to be as representative as possible within practical limitations. Make only one observation on an individual package for each physical property determination. Take the number of samples, therefore, that will be sufficient to cover the total number of specimens required for the determination of all physical properties of the yarn.

7.1.2 *Preparation of Samples*—Remove and discard a minimum of 25 m [27 yd] from the outside of the package before taking the sample or any specimens. Use care in handling the sample. Special care should be used to prevent over handling and disruption of the filament alignment in the yarn bundle. Discard any sample subjected to any change of twist, kinking, or making any bend with a diameter less than 10 times the yarn thickness (or diameter).

8. Conditioning

8.1 Without pre-drying, bring the bobbin with yarn to equilibrium in the atmosphere for testing as directed in Practice [D1776/D1776M](#) for aramid.

9. Sample Preparation

9.1 *Sample Preparation*—Take test specimens directly from the original package. Rewound and skein specimen will likely result in lower values. Remove the surface layer and discard.

9.2 *Specimen Preparation*—Mount the sample onto a frame using the “Rolling take off” method. Examples of suitable frames are shown in [Fig. 1](#). Take off test specimen tangentially from the bobbin directly without touching any of the measured part of the yarn and without applying any twist.

9.3 Holding the yarn firmly at the free end and using the “rolling take off” method, remove about 1 m for the specimen. Do not use yarn within 50 mm of either end of the sample ball. Do not let test specimen sag or loop.