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# Standard Test Methods for Tire Cords, Tire Cord Fabrics, and Industrial Filament Yarns Made from Manufactured Organic-Base Fibers[1]

This standard is issued under the fixed designation D885/D885M; 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 These test methods cover the testing of industrial filament yarns made wholly of manufactured organic-base fibers, cords twisted from such yarns, fabrics woven from such cords, and products that are made specifically for use in the manufacture of pneumatic tires. They may be applied to similar yarns and cords used for reinforcing other rubber goods and for other industrial applications. The test methods apply to nylon, polyester, and rayon yarns and tire cords twisted from such yarns and to fabrics made from such cords. The yarn or cord may be wound on cones, tubes, bobbins, spools, or beams; may be woven into fabric; or may be in some other form. The methods include testing procedure only and include no specifications or tolerances.

1.2 No procedure is included for the determination of fatigue resistance of cord, but several commonly used procedures for the measurement of fatigue resistance of cords in rubber were published in the appendix of these test methods in the *1967 Annual Book of ASTM Standards*, Part 24, and in earlier issues of Test Methods D885.

1.3 The sections on "Growth of Conditioned Yarns and Cords," "Properties of Yarns and Cords at Elevated Temperature," and "Properties of Wet Yarns and Cords" have been moved to Appendix X1 – Appendix X3 as non-mandatory informational items because of their very limited use by the industry and because precision and bias statements are not included.

1.4 This standard includes the following sections:



1.5 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

[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.

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1.6 *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]

D76 Specification for Tensile Testing Machines for Textiles
D123 Terminology Relating to Textiles
D276 Test Methods for Identification of Fibers in Textiles
D1423 Test Method for Twist in Yarns by Direct-Counting
D1776 Practice for Conditioning and Testing Textiles
D1777 Test Method for Thickness of Textile Materials
D1907 Test Method for Linear Density of Yarn (Yarn Number) by the Skein Method
D1909 Standard Tables of Commercial Moisture Regains and Commercial Allowances for Textile Fibers
D2257 Test Method for Extractable Matter in Textiles
D2258 Practice for Sampling Yarn for Testing
D2462 Test Method for Moisture in Wool by Distillation With Toluene
D2494 Test Method for Commercial Mass of a Shipment of Yarn or Manufactured Staple Fiber or Tow
D2654 Test Method for Moisture in Textiles (Withdrawn 1998)[3]
D3774 Test Method for Width of Textile Fabric
D3775 Test Method for Warp (End) and Filling (Pick) Count of Woven Fabrics
D3776 Test Methods for Mass Per Unit Area (Weight) of Fabric
D4393 Test Method for Strap Peel Adhesion of Reinforcing Cords or Fabrics to Rubber Compounds
D4776 Test Method for Adhesion of Tire Cords and Other Reinforcing Cords to Rubber Compounds by H-Test Procedure
D4848 Terminology Related to Force, Deformation and Related Properties of Textiles
D6477 Terminology Relating to Tire Cord, Bead Wire, Hose Reinforcing Wire, and Fabrics

## 3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms relating to tire cord, bead wire, hose wire, and tire cord fabrics, refer to Terminology D6477.

3.1.1.1 The following terms are relevant to this standard: cord, cord twist, dip, dip pickup, in a textile cord or fabric, industrial yarn, moisture equilibrium for testing, for industrial yarns and tire cords, pneumatic tire, single twist, standard atmosphere for testing textiles, tabby sample, tire, and tire cord fabric.

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

3.1.2.1 The following terms are relevant to this standard: breaking force, breaking strength, breaking tenacity. breaking toughness, chord modulus, in a stress-strain curve, elongation, force at specified elongation (FASE), initial modulus, tensile strength, and work-to-break.

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

3.1.3.1 The following terms are relevant to this standard: fabric and growth.

## 4. Summary of Test Methods, General

4.1 A summary of the directions prescribed for the determination of specific properties is stated in the appropriate sections of specific test methods.

## 5. Significance and Use, General

5.1 The procedures in these test methods should be used with caution for acceptance of commercial shipments owing to the absence of factual information on the between-laboratory precision of many of the test procedures included in these test methods. It is recommended that any program of acceptance testing be preceded by an interlaboratory check in the laboratory of the purchaser and the laboratory of the supplier on replicate specimens of the materials to be tested for each property (or properties) to be evaluated.

5.1.1 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.

5.2 The significance and use of particular properties are discussed in the appropriate sections of specific test methods.

## 6. Sampling

6.1 *Yarn:*

6.1.1 *Packages*—For acceptance testing, sample each lot as directed in Practice D2258. Place each laboratory sampling unit in a moisture-proof polyethylene bag or other moisture-proof container to protect the samples from atmospheric changes until ready to condition the samples in the atmosphere for testing industrial yarns and tire cords. Take the number of specimens for testing specified for the specific property measurement to be made.

6.1.2 *Beams*—For acceptance testing, sample by winding yarns on a tube or spool by means of a winder using a tension of 5 ± 1 mN/tex [0.05 ± 0.01 gf/den]. Take the yarn from the

[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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

outside beam layers unless there is a question or disagreement regarding the shipment; in this case, take the sample only after removing yarn from the beam to a radial depth of 6 mm [¼ in.] or more to minimize the effects of handling and atmospheric changes that may have occurred during shipment or storage. Place each laboratory sampling unit in a moisture-proof polyethylene bag or other moisture-proof container to protect the samples from atmospheric changes until ready to condition the samples in the atmosphere for testing industrial yarns and tire cords. Take the number of specimens for testing specified for the specific property measurement to be made.

6.2 *Cord:*

6.2.1 *Number of Samples and Specimens*—The size of an acceptance sampling lot of tire cord shall be not more than one truck or rail car load or as determined by agreement between the purchaser and the 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 tire cord. 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.

6.2.2 *Preparation of Samples*—Remove and discard a minimum of 25 m [25 yd] from the outside of the package before taking the sample or any specimens. If specimens are not taken directly from the original package, preferably wind the sample on a tube or spool by means of a winder using a tension of 5 ± 1 mN/tex [0.05 ± 0.01 gf/den]. If the sample is collected as a loosely wound package, or in the form of a skein, some shrinkage invariably will occur, in which case, report that the observed results were determined on a relaxed sample. Use care in handling the sample. Discard any sample subjected to any change of twist, kinking, or making any bend with a diameter less than 10 times the yarn/cord thickness (or diameter). Place the sample in a moisture-proof polyethylene bag or other moisture-proof container to protect it from atmospheric changes until ready to condition the sample in the test atmosphere for industrial yarns and tire cords.

6.3 *Tire Cord Fabric:*

6.3.1 *Number of Samples and Specimens*—The size of an acceptance sampling lot of tire cord fabric shall be one loom creel of cord. Take a sample from at least one roll of fabric per lot. From each roll of tire cord fabric, take the number of specimens as specified in the test method for each property to be measured.

6.3.2 *Size of Sample*—Take a sample equal to the length of cord between the regular tabby woven at the end of the roll and a special tabby woven a short distance from the end when the roll of fabric is manufactured. For rolls that do not have a special woven tabby, improvise a tabby by the use of gummed tape or strips of cemented fabric applied across a section of the cord fabric to give a tabby sample length at least 0.5-m [18-in.] long and at least one tenth of the roll width wide.

6.3.3 *Preparation of Samples*—Cut the warp cords of the fabric along the center line of the special tabby for a distance equal to the width of the sample. If this distance is less than the full width of the fabric, cut the filling yarns of the sample and of the special and regular tabbies in the direction parallel with the warp cords. The resulting section of cord fabric is the tabby sample. Attach the tabby sample to a piece of cardboard or fiberboard, the length of which shall be equal to at least the length of the cord warp between tabbies. Fold the tabby portions of the sample over each end of the board, and secure the sample to the board with pressure-sensitive tape or staples. Use care to avoid contact of tape or staples with the area to be tested. Handle the sample carefully, and hold it under sufficient tension in the warp direction to prevent the cords from kinking. Discard any specimen subjected to change of twist, kinking, or making any bend with a diameter less than 10 times the yarn/cord thickness (or diameter). The board with the sample may be folded lengthwise and parallel with the warp for convenience. Place the board with the fabric sample in a polyethylene bag, or wrap it with several layers of polyethylene film, to protect the sample from changes in atmospheric moisture content until ready to condition the sample in the atmosphere for testing industrial yarns and tire cords. Use care during subsequent handling of the sample to prevent any change in the cord twist and to avoid kinking the cords.

6.4 *Cord from Cured Tires:*

6.4.1 *Number of Samples and Specimens*—For each test, test ten cords from each location or ply of each tire.

6.4.2 *Preparation of Samples*—Obtain a tire section comprising approximately one sixth of the whole tire. Smaller sections may be used, particularly for carcass cord samples of radial tires. If it is suspected that cords may be damaged in pulling them from the tire, immerse the section in a solvent[4] for 1 to 3 days to swell and soften the rubber. For convenience, turn the section inside out, if possible; clamp one of the beads in a vise. Mark a line along the inside of the section approximating the cord path of the first ply. Make a shallow cut down to the first ply along this line. Make an incision adjoining and perpendicular to this first cut at sufficient depth to sever several first-ply cords. Carefully cut and pull these cords from the tire from bead to bead following the cord path. Discard these initial cords. After initial cords are removed, remove bands of cords for testing by cutting near the bead through Ply 1 cords adjacent to the trough formed in initial cord removal. Carefully pull several cord bands approximately 2 cm [¾ in.] in width from the tire. Identify band fully, including tire number and ply number. Remove the remainder of Ply 1 to uncover Ply 2. Proceed with Ply 2 or additional plies as directed for Ply 1. If the cords to be removed are from a tire having only one ply of reinforcement in the area to be sampled, for example, carcass ply of many radial tires reinforced with glass, or steel, it is preferable to remove cords for testing one at a time from the tire section itself. It is preferred that cord be removed in such a manner that it is not subjected to narrow-radius bending, such as a 3.14 rad [180°] bend back upon itself.

[4] Heptane, 1,1,1-trichloroethane, cyclohexane, and a mixture of 50/50 Freon 113 and Stoddard Solvent have been used for this purpose.