Designation: D6588/D6588M – 10a

Standard Test Method for Fatigue of Tire Cords (Disc Fatigue Test)[1]

This standard is issued under the fixed designation D6588/D6588M; 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 covers the determination of fatigue of tire cords in rubber due to compression or extension, or both, using a disc fatigue tester. The fatigue is measured as a loss in strength.

1.2 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.

1.3 *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 to 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
D885 Test Methods for Tire Cords, Tire Cord Fabrics, and Industrial Filament Yarns Made from Manufactured Organic-Base Fibers
D1776 Practice for Conditioning and Testing Textiles
D6477 Terminology Relating to Tire Cord, Bead Wire, Hose Reinforcing Wire, and Fabrics
D7269 Test Methods for Tensile Testing of Aramid Yarns

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms relating to tire cord and fabrics, see Terminology D6477.

3.1.2 For definitions of other terms related to textiles, see Terminology D123.

4. Summary of Test Method

4.1 disc fatigue is a measure of the strength loss of a tire cord, which is subjected to repeated stresses. The stresses are accomplished by subjecting the tire cords, after being cured in rubber, to repeated cycles of compression and extension.

4.2 The specimen of interest is the cord after it has been stressed and later removed from the rubber in which it was imbedded. Cord specimens are placed between strips of rubber compound and molded into blocks. The specimen block is then mounted between two rotating discs that are positioned in such a way that the specimen will undergo compression or extension, or both, as the discs rotate. After a specified number of cycles, the cords are removed from the blocks and their breaking force measured on a tensile testing machine. The fatigue, based on the unfatigued specimen strength, is expressed as a percent strength loss in fatigued specimens.

5. Significance and Use

5.1 This test method is not recommended for acceptance testing of commercial shipments in the absence of reliable information on between-laboratory precision.

5.1.1 If there are differences of practical significance between the reported test results for two laboratories (or more), a comparative test 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 a material from which the disparate test results were obtained, and that are randomly assigned in equal numbers to each laboratory for testing. Other fabrics 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.

[1] This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.19 on Industrial Fibers and Metallic Reinforcements

Current edition approved June 1, 2010. Published August 2010. Originally approved in 2000. Last previous edition approved in 2002 as D6588–02. DOI: 10.1520/D6588_D6588M-10A.

[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.

6. Apparatus, Materials, and Reagents

6.1 *Disc Fatigue Tester* (see schematic drawing in Fig. 1), with capacity for 12 specimens. For actual dimensions, see patent US 2595069. Testers with different capacity are acceptable.

6.2 *Displacement Transducer*, with digital readout or dial gage for setting distance between disc fatigue flanges to the nearest 0.01 mm [0.004 in.].

6.3 *Mold*, top and bottom sections with cavities in each for 12 or 24 specimens with the dimensions of 10.8 by 12.7 by 76.2 mm [7⁄16 by ½ by 3 in.]. (See schematic drawing in Fig. 2). All dimensions given require an accuracy of 0.1 mm [0.04 in.]. The top of the mold may be coated with TFE-fluorocarbon to release the specimens easily. Molds with other numbers of cavities may be used.

6.4 *Weights*, having a mass of 50 ± 5 g or 100 ± 10 g, or both, for tensioning yarns or cords while building specimen blocks.

6.5 *Curing press*, capable of maintaining a minimum pressure of 3.5 MPa [500 psi] over the total area of the mold surface, and capable of a platen temperature control within ±3°C [±5°F] of the temperature specified for curing the rubber compound.

6.6 *Guillotine, Hand-operated*, capable of slicing the sample blocks (see 11.2.2).

6.7 *Tensile Testing Machine*, CRE type, in accordance with Specification D76.

6.8 *Clamps*, air-actuated, flat, rubber-faced or bollard-type.

6.9 *Rubber Compound*, with a thickness of 6.0 ± 0.3 mm [0.24 ± 0.01 in.], rolled up in polyethylene liner and free from moisture and contamination.

NOTE 1—The rubber type used, especially rubber modulus, will affect the results.

6.10 *Gloves*, neoprene or other solvent-resistant rubber.

6.11 *Solvent*, 1.1.2.2 tetrachloroethylene, $CHCl_2$ $CHCl_2$ or 1.1.1 trichloroethane CCl_3CH_3) for removing cords from rubber.

6.12 *Tachometer or Stroboscope*.

6.13 *Screwdriver*, or other tightening device.

7. Hazards

7.1 The manufacturer's material data sheets (MSDSs) shall be used to obtain information on handling, storage, use, and disposal of chemicals used in this test method.

8. Sampling and Test Specimens

8.1 *Primary Sampling Unit*—Consider one roll of dipped tire cord fabric or a cord package as the primary sampling unit.

8.2 *Laboratory Sampling Unit*—As a laboratory sampling unit, from each primary sampling unit prepare tabby samples by taking 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.

8.2.1 *Preparation of Tabby Samples*—The handling of the samples must be done with care. The person obtaining the sample should wear clean gloves. Cut the warp cords of the dipped fabric along the centerline 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. Discard any specimen subjected to any bend with a diameter less than ten times the yarn/cord thickness (or diameter). The board with the

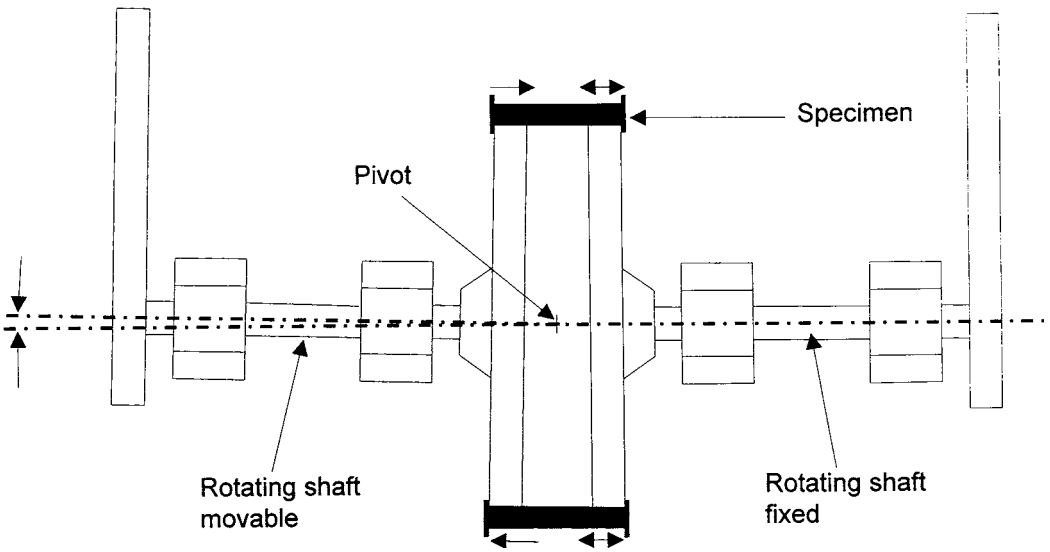

FIG. 1 Schematic Top View of the Disc Fatigue Tester with Two Specimens

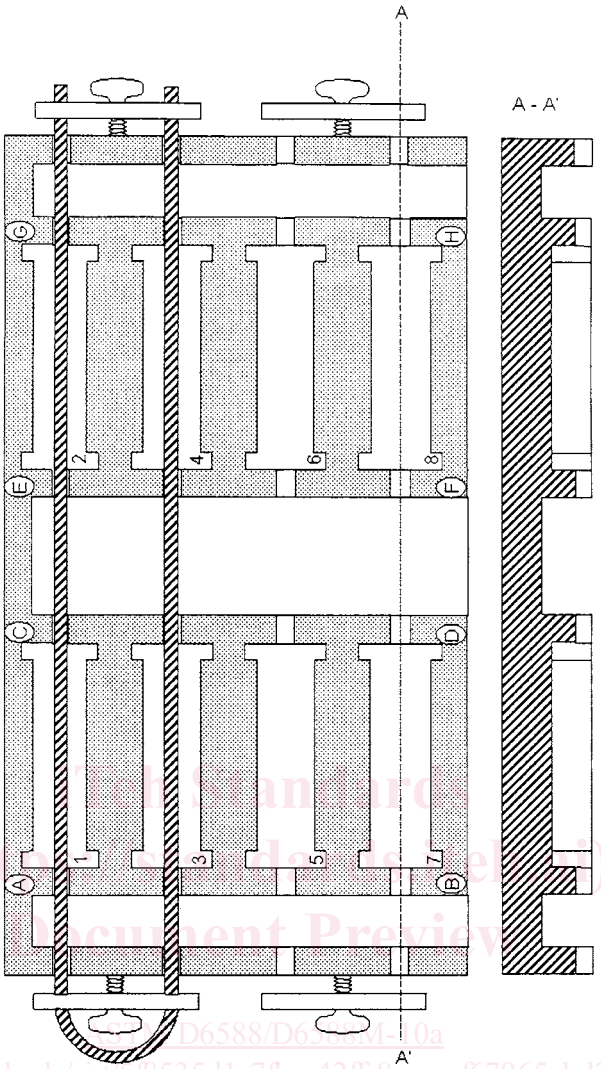

FIG. 2 Schematic View of the Mold

sample may be folded lengthwise and parallel with the warp for convenience. Place the board with the fabric sample in a black polyethylene bag, or wrap it with several layers of black polyethylene film to protect the sample from ultraviolet (UV) and ozone.

8.3 *Test Specimens*:

8.3.1 *Specimens Yarns or Cord*—From the laboratory sample, take the number of specimens needed for each block, multiplied by the number of blocks that have to be built as shown in Table 1. For Nylon, Polyester, and Rayon, take a duplicate number of specimens for unfatigued control testing. For Aramids, the unfatigued control testing is done on the laboratory sample.

8.3.2 *Number of Blocks for Fatigue and Control Testing*—Prepare the number of blocks to be fatigue tested as shown in Table 1. For Nylon, Polyester, and Rayon, take a duplicated number of blocks for unfatigued control testing. For Aramids, the unfatigued control testing is done on the laboratory sample.

8.3.3 Label both yarn/cord specimens and block specimens to maintain specimen identity.

TABLE 1 Number of Specimens (Cords) per Block

Material	Nominal Linear Density, Dtex	Number of Specimens (Cords) per Block	Number of Blocks
Nylon	≤2200	5	3
	>2200	3	3
Polyester	≤2200	5	3
	>2200	3	3
Rayon	all	1	6
Aramid	all	1	6
Twisted yarn of any material	all	1	6

8.4 *Building Test Specimen Blocks*—Prepare test specimen blocks in accordance with the directions in 8.4.1 through 8.4.5

8.4.1 Cut a piece of rubber stock large enough to cut two strips of 6.0 ± 0.3 mm [0.24 ± 0.01 in.] for each cavity in the mold. Cut sufficient number of strips of the rubber stock. Remove polyethylene backing from one side of rubber strips just prior to using. Place a strip in each of the cavities of the two halves of the mold with the polyethylene side up. Press the