Designation: D 6770 – 02ε1

Standard Test Method for Abrasion Resistance of Textile Webbing (Hex Bar Method)[1]

This standard is issued under the fixed designation D 6770; 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.

ε[1] NOTE—Figure 1 was corrected editorially in May 2002.

1. Scope

1.1 This test method covers the determination of abrasion resistance of textile webbing using a hex bar abrasion tester.

1.1.1 The resistance is expressed as a percentage of retained break strength.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as the standard. Within the text, the inch-pound units are shown in parentheses. 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 nonconformance with this test method.

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.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 123 Terminology Relating to Textiles[2]

D 1776 Practice for Conditioning and Testing Textiles[2]

2.2 *Other Standard:*

Federal Standard 191, Method 4108 "Strength and Elongation, Breaking; Textile Webbing, Tape and Braided Items"[3]

3. Terminology

3.1 *Definitions:*

3.1.1 *abrasion*, *n*—the wearing away of any part of a material by rubbing against another surface.

3.1.2 *abrasion cycle*, *n*—one or more movements of an abradant across a material surface, or the material surface across the abradant, that permits a return to its starting position.

3.1.2.1 *Discussion*—The abrasion cycle is dependent on the programmed motions of the abrasion machine and the test standard used. It may consist of one back-and-forth unidirectional movement or one circular movement, or a combination of both. For the hex bar abrasion method a cycle is comprised of two strokes.

3.1.3 *breaking force*, *n*—the maximum force applied to a material carried to rupture. (Compare *breaking point*, *breaking strength*.)

3.1.4 *standard atmosphere for preconditioning textiles*, *n*—a set of controlled conditions having a temperature not over 50°C (122°F), with respective tolerance of ±1°C (2°F), and a relative humidity of 5 to 25 ± 2 % for the selected humidity, so that drying can be achieved prior to conditioning in the standard atmosphere for testing textiles.

3.1.5 *standard atmosphere for testing textiles*, *n*—laboratory conditions for testing fibers, yarns, and fabrics in which air temperature and relative humidity are maintained at specific levels with established tolerances.

3.1.5.1 *Discussion*—Textile materials are used in a number of specific end-use applications that frequently require different testing temperatures and relative humidities. Specific conditioning and testing of textiles for end-product requirements can be carried out as defined in Practice D 1776.

3.1.6 *stroke*, *n—in hex bar abrasion testing*, one-half of an abrasion cycle that consists of one forward or one backward motion.

3.1.7 *webbing*, *n—in textiles*, a stout narrow fabric with a mass per unit area of at least 0.5 kg/m^2 (0.1 lb/ft^2) for each 25.4 mm (1 in.) of width. (Compare *narrow fabric*, *ribbon*, and *tape*.)

[1] This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.60 on Fabrics, Specific.
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[2] *Annual Book of ASTM Standards*, Vol 07.01.

[3] Available from Superintendent of Documents, Government Printing Office, Washington, DC 20402.

3.2 For definitions of other textile terms used in this test method, refer to Terminology D 123.

4. Summary of Test Method

4.1 Abrasion resistance is measured by subjecting the specimen to unidirectional reciprocal rubbing over a specific bar under specified conditions of tension, stroke length and time. Resistance to abrasion is evaluated by determining the percent retention of breaking force of an abraded specimen compared to an unabraded specimen.

5. Significance and Use

5.1 The measurement of the resistance to abrasion of textile webbing is very complex. The resistance to abrasion is affected by many factors that include the inherent mechanical properties of the fibers; the dimensions of the fibers; the structure of the yarns; the construction of the webbing; the type, kind, and amount of treatment added to the fibers, yarns, or webbing; the nature of the abradant; the variable action of the abradant over the specimen area abraded; the tension on the specimen; the pressure between the specimen and the abradant; and the dimensional changes in the specimen.

5.2 The resistance of textile webbing to abrasion as measured by this test method does not include all the factors which account for wear performance or durability in actual use. While the abrasion resistance stated in terms of the number of cycles and durability (defined as the ability to withstand deterioration or wearing out in use, including the effects of abrasion) are frequently related, the relationship varies with different end uses. Different factors may be necessary in any calculation of predicted durability from specific abrasion data.

5.3 Laboratory tests may be reliable as an indication of relative end use in cases where the difference in abrasion resistance of various materials is large, but they should not be relied upon where differences in laboratory test findings are small. In general, the results should not be relied upon for prediction of performance during actual wear life for specific end uses unless there are data showing the specific relationship between laboratory abrasion tests and actual wear in the intended end use.

5.4 While there has not been extensive interlaboratory testing prior to development of this standard, there has been some quality control testing by manufacturers. An intralaboratory test was conducted to initiate this test method, using a single product. This data will be used to determine a preliminary statement on precision and bias. Subsequent to approval of this standard, a formalized interlaboratory procedure will be initiated under the direction of a professional statistician and will produce a research report. Samples used in this controlled test will be representative of end use applications.

5.5 These general observations apply to most webbings that are used in automotive, aerospace, industrial, and military applications.

5.6 This test method can be used for acceptance testing of commercial shipments but comparisons should be made with caution because estimates of between-laboratory precision are incomplete.

5.7 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, use samples for such comparative tests that are as homogenous as possible, drawn from the same lot of material as the samples that resulted in disparate results during initial testing, and randomly assigned in equal numbers to each laboratory. The test results from the laboratories involved should be compared using a statistical test for unpaired data, as a probability level chosen prior to the testing series. If 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 *Webbing Abrasion Tester*—The webbing abrasion tester consists of a suitable mechanism that will provide a reciprocating motion of the webbing over a standardized hex bar. One end of each specimen is attached to the mechanism and the other end passing over a hexagonal steel rod is attached to a weight. The hexagonal rod is so fixed as to subject the webbing specimen to abrasion on two adjacent edges as the drum moves the specimen across the rod. One example of such a mechanism is a reciprocating drum as illustrated in Fig. 1.

6.1.1 Mass "B" shall be 900 ± 60 g (2 lb ± 2 oz) for webbing with breaking strengths up to 4500 N (1000 lb), 1800 ± 60 g (4 lb ± 2 oz) for breaking strengths of 4500 to 13 500 N (1000 to 3000 lb) and 2400 ± 60 g (5.2 ± 2 lb) for breaking strengths over 13 500 N (3000 lb).

6.1.2 Steel hexagonal rods "C" shall be 6.35 ± 0.03 mm (0.250 ± 0.001 in.) when measured across opposite flat sides and the radius shall be 0.5 ± 0.2 mm (0.020 ± 0.008 in.). The steel shall have a cold drawn finish and a Rockwell Hardness of B-91 to B-101. The edges of the hexagonal rods shall not have any burrs, nicks or scale.

6.1.3 The mechanism "D" shall have a nominal outside diameter of 400 mm (16 in.) or be some mechanism able to produce a reciprocating motion of at least 300 mm (12 in.) over the hex rod with a suitable means for attaching the specimen to be tested without damage to the specimen.

6.1.4 The crank-arm "F" shall be attached to the mechanism "D" and to the driver disk "E" in such a manner that when the specimen is attached to the mechanism, the specimen during the test will oscillate over the hexagonal rod the required distance during each stroke and at the required rate (see 10.4).

6.1.5 The hexagonal rod shall be so placed that specimen "A" with the weight attached to one end and the other end passing over the hexagonal rod and attached to the drive mechanism will form an angle of 85 ± 2° "H".

6.2 *Tensile Testing Machine*, CRE-Type equipped with split-drum webbing clamps as described in Federal Test Method 191b, Method 4108.

7. Sampling and Test Specimens

7.1 *Lot Sample*—Take a lot sample as directed in the applicable material specification. In absence of such a specification randomly select five rolls or pieces to constitute the lot sample.