



Designation: D1578 – 93 (Reapproved 2022)

Standard Test Method for Breaking Strength of Yarn in Skein Form¹

This standard is issued under the fixed designation D1578; 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 This test method covers the determination of the breaking strength of yarn in skein form. The observed breaking strength is expressed in units of force, and equations are provided to convert breaking strength to skein breaking tenacity and to skein break factor.

NOTE 1—For the determination of the breaking strength and elongation of yarn by the single strand method, refer to Test Method [D2256](#).

1.2 This test method is applicable to spun yarns, either single or plied, composed of any fiber or blend of fibers, but is not suitable for yarns which stretch more than 5 % when the tension is increased from 2.5 to 7.5 mN/tex or 0.03 to 0.08 gf/denier.

1.3 This test method provides three options based on the perimeter of the reel, the number of wraps in the skein, and the machine speed or time-to-break.

1.3.1 *Option 1*—Eighty, forty, or twenty turns on a 1.50 m or 1.5-yd reel, broken at 300 mm/min or 12 in./min.

1.3.2 *Option 2*—Fifty turns on a 1.00 m or 1-yd reel, broken at 300 mm/min or 12 in./min.

1.3.3 *Option 3*—Fifty turns on a 1 m reel, broken in 20 s.

NOTE 2—Option 1 is in general use in the United States, Option 2 is used for woolen yarns, and Option 3 has been proposed in the International Standards Organization (ISO) for international use.

NOTE 3—Metric reels are available with 1 and 1.125 m circumferences. Data from the two reels will be about 1 % different (see [5.6](#)). ISO uses a 1 m circumference reel.

1.4 This test method is frequently combined with the determination of linear density carried out on the same skeins. Special precautions for reeling such skeins are noted.

1.5 Where appropriate, this test method states all requirements in SI units. The traditional units are inch-pound and are exact values.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

1.7 *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](#) Practice for Conditioning and Testing Textiles

[D1907](#) Test Method for Linear Density of Yarn (Yarn Number) by the Skein Method

[D2256](#) Test Method for Tensile Properties of Yarns by the Single-Strand Method

[D2258](#) Practice for Sampling Yarn for Testing

[D2904](#) Practice for Interlaboratory Testing of a Textile Test Method that Produces Normally Distributed Data (Withdrawn 2008)³

[D4849](#) Terminology Related to Yarns and Fibers

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of textile terms used in this test method: breaking force, force, skein break factor, skein, skein breaking tenacity, skein strength, strength, refer to Terminology [D4849](#).

3.1.2 For definitions of other textile terms used in this test method, refer to Terminology [D123](#).

¹ This test method is under the jurisdiction of ASTM Committee [D13](#) on Textiles and is the direct responsibility of Subcommittee [D13.58](#) on Yarns and Fibers.

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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.

4. Summary of Test Method

4.1 A skein of yarn, prepared by winding the prescribed number of turns on a reel, is broken on a tensile testing machine.

NOTE 4—If the yarn number is also required for the determination of skein breaking tenacity or break factor, the broken skein may be weighed and the yarn number calculated as directed in Test Method **D1907**.

5. Significance and Use

5.1 Test Method D1578 for testing any spun yarn for breaking strength is considered satisfactory for acceptance testing of commercial shipments since the method has been used extensively in the trade.

5.1.1 In case of a dispute arising from differences in reported test results when using Test Method D1578 for acceptance testing of commercial shipments, the purchaser and the supplier should conduct comparative tests to determine if there is a statistical bias between their laboratories. Competent statistical assistance is recommended for the investigation of bias. As a minimum, the two parties should take a group of test specimens which are as homogeneous as possible and which are from a lot of material of the type in question. The test specimens should then be randomly assigned in equal numbers to each laboratory for testing. The average results from the two laboratories should be compared using Student's *t*-test for unpaired data and an acceptable probability level chosen by the two parties before testing is begun. If a bias is found, either its cause must be found and corrected or the purchaser and the supplier must agree to interpret future test results in the light of the known bias.

5.2 This test method is not suitable for yarns that stretch more than 5 % when the force is increased from 2.5 to 7.5 mN/tex or 0.03 to 0.08 gf/denier, because (a) they require special precautions as to tension in reeling, and (b) users of such yarns are more interested in their elastic behavior at low forces than in their ultimate breaking strength.

5.3 For Option 1, it is advisable to use a tensile testing machine of the proper capacity to break skeins with 80 turns. If it is necessary to break skeins having only 40 or 20 turns, convert the observed results to an 80-turn basis by multiplying by factors of 2 or 4, respectively. (The available literature does not show that any significant error is introduced by the use of these factors.)

5.4 The circumference of the skeins used to determine the breaking load is not critical, and as a consequence, close control of the tension at which the skeins are wound is not necessary. If, however, the same skeins are to be used to determine yarn number for any purpose, the skeins must be reeled under controlled tension on a reel meeting the requirements given in Test Method **D1907**.

5.5 For some purposes it may be advisable to convert the skein breaking strength observed for yarn of one number to the estimated skein breaking strength of a different yarn number. Factors for making such a conversion for cotton yarns are given in **11.2**. No corresponding factors have been developed for yarns spun from other fibers.

5.6 The results obtained from different options are not fully comparable because the breaking force per wrap increases slightly as the perimeter of the skein is reduced. The skein breaking tenacity observed for 1 m skeins may be as much as 4 % higher, and from 1-yd skeins 5 % higher, than that observed for 1.5-yd skeins. These relationships may vary with the type of yarn or with yarn unevenness and should not be used as conversion factors. With a reasonable number of specimens, this method provides a useful index that combines the effects of unevenness and single strand strength.

5.7 This method is rarely, if ever, used for filament yarns because their uniformity makes it possible to obtain reliable results economically by the single-strand method.

6. Apparatus

6.1 *Reel*—A hand or motor-driven reel having a perimeter of 1.50 m or 1.5 yd for Option 1, 1.0 m or 1 yd for Option 2 (see **Note 3**), or 1 m for Option 3. The reel shall be fitted with a traversing mechanism that will minimize bunching the yarn on the reel and with an indicator of the length wound. A warning bell or an automatic cutoff that will operate at a specified number of turns is advisable. It is also recommended that the reel have a collapsible arm for relaxing the tension on the skeins to facilitate their removal from the reel. If yarn number is to be determined from the same skeins, refer to Test Method **D1907** for additional reel specifications.

6.2 *Package Holders*—Vertical spindles for bobbins or cones if not provided as an integral part of the reel, shafts on which tubes or flanged spools can turn freely.

6.3 *Tensile Testing Machine*—A constant-rate-of-traverse (CRT type) or constant-rate-of-extension (CRE type) tensile testing machine of suitable capacity as prescribed in Specification **D76**, capable of operating the moving clamp (spool) at a uniform speed of 300 ± 10 mm/min or 12 ± 0.5 in./min (for Options 1 and 2) or capable of operating at a rate that will break the skein broken in an average time of 20 ± 3 s from the start of application of tension to the skein (for Option 3). The machine shall be equipped with spools not less than 25 mm or 1 in. nor more than 30 mm or 1.25 in. in both diameter and length, and supported with at least one spool free to turn on its axis. The distance between the spools shall be sufficient to permit placing the skeins on the spools in a wide, flat band.

6.4 *Skein Holder or Rack*, having parallel pegs or bars placed a sufficient distance apart to hold the skeins extended to nearly their full length without either stretching, kinking, or entangling the yarn.

7. Sampling

7.1 *Lot Sample*—Take a lot sample as directed in an applicable specification, or as agreed upon between the purchaser and the supplier. In the absence of an applicable specification or agreement, take a lot sample as directed in Practice **D2258**.

NOTE 5—An adequate specification or other agreement between the purchaser and the supplier requires taking into account variability between shipping units, between packages or ends within a shipping unit, and between specimens from a single package so as to provide a sampling plan