Designation: D204 – 02 (Reapproved 2021)

Standard Test Methods for Sewing Threads[1]

This standard is issued under the fixed designation D204; 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 can be used to evaluate sewing threads of any fiber.

1.1.1 The test methods in this standard are intended to evaluate only sewing thread taken from thread holders.

1.2 These test methods only provide for the measurement of sewing thread physical properties. These test methods do not address any other properties that may be important for the satisfactory performance of sewing threads under particular end use conditions.

1.3 These test methods can be used to measure the following properties:

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Colorfastness to Drycleaning	73 – 83
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NOTE 1—For methods covering tests on prepared seams, refer to Test Methods D1683/D1683M and D3940.

1.4 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.5 *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.*

1.6 *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]

D123 Terminology Relating to Textiles

D1422/D1422M Test Method for Twist in Single Spun Yarns by the Untwist-Retwist Method

D1423/D1423M Test Method for Twist in Yarns by Direct-Counting

D1683/D1683M Test Method for Failure in Sewn Seams of Woven Fabrics

D1776/D1776M Practice for Conditioning and Testing Textiles

D1777 Test Method for Thickness of Textile Materials

D1907/D1907M Test Method for Linear Density of Yarn (Yarn Number) by the Skein Method

D2256/D2256M Test Method for Tensile Properties of Yarns by the Single-Strand Method

D2258/D2258M Practice for Sampling Yarn for Testing

D2724 Test Method for Bond Strength of Bonded, Fused, and Laminated Apparel Fabrics

D3693 Specification for Labeled Length per Holder of Sewing Thread

D3823 Practice for Determining Ticket Numbers for Sewing Threads

D3940 Test Method for Bursting Strength (Load) and Elongation of Sewn Seams of Knit or Woven Stretch Textile Fabrics (Withdrawn 1995)[3]

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

D4849 Terminology Related to Yarns and Fibers

[1] These test methods are under the jurisdiction of ASTM Committee D13 on Textiles and are the direct responsibility of Subcommittee D13.58 on Yarns and Fibers.

Current edition approved July 1, 2021. Published July 2021. Originally published as D204 – 24 T. Last previous edition approved in 2016 as D204 – 02 (2016). DOI: 10.1520/D0204-02R21.

[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.

2.2 *AATCC Standards:*
Test Method 135 Dimensional Changes in Automatic Home Laundering of Woven and Knit Fabrics[4]
Evaluation Procedure 1, Gray Scale for Color Change[4]
Evaluation Procedure 3, Chromatic Transference Scale[4]

3. Terminology

3.1 *Definitions:*

3.1.1 Refer to Terminology D4848 for definitions of the following terms used in this standard elongation; force and loop-breaking force.

3.1.2 Refer to Terminology D4849 for definitions of the following terms used in this standard colorfastness; covered yarn, greige thread, growth, sew, sewing force, sewing thread, tex, thread holder, ticket number, and yarn number.

3.1.3 Refer to Terminology D123 for definitions of other terms used in this standard including the following; shrinkage, stitch, stitching, stitch type, and twist balance.

4. Significance and Use

4.1 *Acceptance Testing*—The test methods in Test Methods D204 for the determination of the properties of sewing thread are considered satisfactory for acceptance testing of commercial shipments of sewing thread, unless specified in the individual test method. These test methods are the best available and are used extensively in the trade.

4.1.1 If there are differences of practical significance between reported test results for two laboratories (or more) comparative test should be performed to determine if there is a statistical bias between them using competent statistical assistance. As a minimum, use the samples for such a comparative tests that are as homogeneous 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, 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 for that material must be adjusted in consideration of the known bias.

[4] Available from American Association of Textile Chemists and Colorists (AATCC), P.O. Box 12215, Research Triangle Park, NC 27709-2215, http://www.aatcc.org.

5. Sampling

5.1 *Lot Sample*—As a lot sample for acceptance testing, take at random the number of shipping units directed in an applicable material specification or other agreement between the purchaser and the supplier, such as an agreement to use Practice D2258/D2258M. Consider shipping cases or other shipping units to be the primary sampling units.

NOTE 2—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 with a meaningful producer's risk, consumer's risk, acceptable quality level, and limiting quality level.

5.2 *Laboratory Sample*—As a laboratory sample for acceptance testing, take at random from each shipping unit in the lot sample the number of packages or ends directed in an applicable material specification or other agreement to use Practice D2258/D2258M. Preferably, the same number of packages should be taken from each shipping unit in the lot sample. If differing numbers of packages are to be taken from shipping units in the lot sample, determine at random which shipping units are to have each number of packages drawn.

5.3 *Test Specimens*—From each package in the laboratory sample, take three specimens, unless otherwise specified. When packages contain more than one parallel wound end, select one end from which to prepare the three specimens.

6. Conditioning

6.1 For routine testing, condition the samples as directed in Practice D1776/D1776M.

6.2 When preconditioning is specified in a material specification or contract order precondition the prepared specimens for at least 3 h in an atmosphere with relative humidity between 10 % and 25 % and a temperature not exceeding 50 °C (122 °F) as directed in Practice D1776/D1776M.

6.2.1 After preconditioning, expose the specimens to moving air in the standard atmosphere for testing textiles, 21 °C ± 1 °C (70 °F ± 2 °F) and 65 % ± 2 % relative humidity, until the mass of the specimen(s) increases by no more than 0.1 % after 2 h in the standard atmosphere.

YARN NUMBER

7. Scope

7.1 This test method determines the resultant yarn number of all types of sewing threads taken from a thread holder.

8. Summary of Test Method

8.1 A measured length of conditioned thread is wound on a reel and weighed. The resultant yarn number is expressed in tex.

9. Significance and Use

9.1 This test method should be used to establish standard ticket numbers for sewing threads according to Practice D3823.

10. Apparatus

10.1 *Reel:*

10.1.1 *General*—A hand or motor-driven reel having a specified perimeter. The reel shall be fitted with a traversing

mechanism that will avoid bunching the successive wraps, and with an indicator of the length wound. A warning bell that will ring at a specified length is recommended. It is advisable that one arm be collapsible to allow for easy removal of skeins.

10.2 *Balance:*

10.2.1 For the determination of mean yarn number, a balance of suitable capacity graduated in grams with a sensitivity of 1 part in 100.

10.2.2 For ascertaining the completion of conditioning, a balance of suitable capacity graduated in grams with a sensitivity of 1 part in 1000 needed.

11. Conditioning

11.1 Use skeins wound with the given wraps as noted in Table 1 and follow the directions given in Section 6.

12. Procedure

12.1 Determine the resultant yarn number in tex as directed in Option 1 of Test Method D1907/D1907M, except that in place of Table 2 in Test Method D1907/D1907M use Table 1 of Test Methods D204.

TABLE 1 Number of Wraps for Determining Resultant Yarn Number

Resultant Yarn Number	1 m Reel Perimeter	1.5 yd Reel Perimeter
All thread finer than 250 tex	100 wraps 100 m	80 wraps 120 yd
All threads 250 tex and coarser	10 wraps 10 m	8 wraps 12 yd

TABLE 2 Number of Wraps to be Reeled in Any One Skein in Checking Length by Skein Method

Resultant Yarn Number	1 m Reel Perimeter	1.5 yd Reel Perimeter
All thread finer than 50 tex	200 wraps 200 m	200 wraps 300 yd
Threads of 50 tex up to 100 tex	100 wraps 100 m	100 wraps 150 yd
All threads 100 tex and coarser	50 wraps 50 m	50 wraps 75 yd

13. Report

13.1 State that the specimens were tested as directed in Test Methods D204. Describe the material(s) or product(s) sampled and the method of sampling used.

13.2 Report the following information:

13.2.1 Mean yarn number to three significant figures,

13.2.2 Coefficient of variation of yarn number to two significant figures,

13.2.3 Reel perimeter,

13.2.4 Length of skein, and

13.2.5 Number of specimens.

14. Precision and Bias

14.1 The precision and bias for testing yarn number are as given in Test Method D1907/D1907M.

STRENGTH AND ELONGATION

15. Scope

15.1 This test method can be used to determine single strand breaking force and elongation of sewing threads. Single strand testing includes loop strength, knot strength and elongation at sewing forces.

15.2 *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.*

16. Summary of Test Method

16.1 Single strand yarn specimens are broken on a tensile testing machine at a predetermined elongation rate and the tensile properties are determined.

16.2 The test method offers the following three physical configurations of the specimen:

16.2.1 straight,

16.2.2 looped,

16.2.3 knotted.

17. Significance and Use

17.1 There are several properties of sewing thread that are significant with regards to sewing and seam performance, including: straight breaking strength, loop breaking strength, loop elongation, elongation at sewing force, and knot strength.

17.1.1 *Straight Strength*—The straight breaking strength of a thread can be used to calculate the loop breaking strength once a regression equation has been determined because the loop properties are strongly dependent on the straight strength.

17.1.2 *Loop Strength*—The loop breaking strength is a measure of the thread's ability to contribute to seam performance. Loop breaking strength of a thread bears a direct relationship to stitch breaking strength and hence to seam breaking strength.

17.1.3 *Loop Elongation*—The loop elongation of the thread is one important factor contributing to elongation of a seam, along with the stitch and seam type, the number of stitches per inch, and the nature of the material stitched.

17.1.4 *Elongation at Sewing Force*—The elongation at sewing force of a thread influences its behavior during the stitching cycle on a sewing machine.

17.1.5 *Knot Strength*—The reduction in breaking force due to the presence of a knot is considered a measure of the brittleness of the thread.

18. Conditioning

18.1 Condition the specimens as directed in Section 6 of these Test Methods D204.

19. Procedure

19.1 *Straight Strength and Elongation:*

19.1.1 *Conditioned Threads*—Select conditioned specimens and determine breaking force and elongation as directed in Option A1 of Test Method D2256/D2256M except that a 250 mm ± 3 mm (10.0 in. ± 0.1 in.) or 500 mm ± 5 mm (20.0 in. ± 0.2 in.) gage length and a constant-rate-of-extension (CRE) type tensile testing machine having a jaw separation rate of 300 mm/min ± 10 mm/min (12.0 in./min ± 0.5 in./min) shall be used. Disregard the 20 s to break requirement.

19.1.2 *Wet Threads*—Select conditioned specimens and determine the breaking force and elongation as directed in Option A2 of Test Method D2256/D2256M except that a CRE type testing machine having a jaw separation rate of 300 mm/min ± 10 mm/min (12.0 in./min ± 0.5 in./min) shall be used. Disregard the 20 s to break requirement.

19.2 *Loop Strength*—Select conditioned specimens and determine the loop breaking force as directed in Option C1 of Test Method D2256/D2256M. Disregard the 20 s to break.

19.3 *Knot Strength*—Select conditioned specimens and determine the knot breaking force as directed in Option B1 of Test Method D2256/D2256M. Disregard the 20 s to break.

19.4 *Elongation at Sewing Forces*—Test the specimens as directed for conditioned thread in 19.1.1. Read the elongation from the force elongation chart or display at the force specified for the needle thread of the seam to be sewn.

19.4.1 If the force on the needle thread is not known, a guideline for sewing elongation can be obtained by reading the force-extension chart, or display at a force of 227 g (½ lb) for thread used for seams in light-weight fabrics in the 0.135 g/m to 270 g/m, or (4 oz/yd to 8 oz/yd) range and at a force of 340 g (¾ lb) for thread used for seams in heavy fabrics 270 g/m to 0.520 g/m (8 oz/yd to 15 oz/yd).

20. Report

20.1 State that the specimens were tested as directed in Test Methods D204. Describe the material(s) or product(s) sampled and the method of sampling used.

20.2 Report the following information:

20.2.1 Options if other than A1,

20.2.2 Testing machine type if other than CRE,

20.2.3 Gage length tested,

20.2.4 Number of specimens tested,

20.2.5 The average of the breaking forces for a sample is the sample breaking strength.

20.2.6 Average and coefficient of variation of percent elongation at break or at specified force as determined for single-strand, knot and loop configurations, and

20.2.7 Average elongation at sewing forces, loop elongation, either or both, if determined.

21. Precision and Bias

21.1 The precision and bias for testing strength and elongation are given in Test Method D2256/D2256M.

TWIST

22. Scope

22.1 This test method determines the amount and direction of twist at the completion of any stage of twisting in single (spun or filament), plied, or cabled thread. The procedures are designed primarily for thread on holders.

23. Summary of Test Method

23.1 The turns of twist in a known length of thread are counted as they are being removed by rotating one end of the specimen while the other end remains fixed until the elements of the yarn being tested are parallel and free from twist. Twist is reported as the number of turns required to untwist the thread, per unit length.

24. Significance and Use

24.1 Twist is an important factor for determining the ability of a sewing thread to withstand sewing forces and provide strength to the seam.

25. Procedure

25.1 Determine the amount of twist in the component elements of a plied, or cabled thread made on the Linen, or Worsted Spinning System as directed in Test Method D1423/D1423M, except take the conditioned specimen directly from the side of the thread holder for testing.

25.2 Determine the amount of ply twist in a plied, or the component elements of a cabled thread made on the Cotton Spinning System as directed in Test Method D1423/D1423M, except take the conditioned specimen directly from the side of the thread holder for testing. Determine the singles twist as directed in Test Method D1422/D1422M.

26. Report

26.1 State that the specimens were tested as directed in Test Methods D204. Describe the material or produce sampled and the method of sampling used.

26.2 Report the following information:

26.2.1 Average single, plied, and cabled thread twist in turns per metre to the nearest whole number of turns per inch to one decimal.

26.2.2 Standard deviation and coefficient of variation, if calculated,

26.2.3 Direction of each twist, S or Z.

26.2.4 Length of test specimens, in millimetres or inches.

26.2.5 Tension used, if different from that specified in Test Methods D1422/D1422M or D1423/D1423M.

27. Precision and Bias

27.1 The precision and bias for twist testing are given in Test Methods D1422/D1422M and D1423/D1423M, as applicable.

TWIST BALANCE

28. Scope

28.1 This test method determines the tendency of thread to twist on itself when held in loop form.

31.2 Count the number of complete revolutions made by the thread as an indication of twist balance.

TABLE 3 Components of Variance as Standard Deviations, Units as Indicated

Names of Properties	Single-Operator Component	Within-Laboratory Component	Between Laboratory Component
Twist balance, turns	0.0100	0.0100	0.200
Length, m	1.69	0.000	1.67
Diameter, mm	0.025	0.025	0.025
Shrinkage, wet or dry percentage points	0.310	0.310	0.340

TABLE 4 Critical Difference,[A] Units as Indicated, for the Conditions noted

Name of Properties	Number Observations in Each Average	Single-Operator Precision	Within Laboratory Precision	Between Laboratory Precision
Twist balance, turns	1	0.0232	0.0329	0.466
	3	0.0134	0.0268	0.466
	5	0.0104	0.0254	0.466
	10	0.00735	0.0244	0.466
Length, m	1	3.93	3.93	5.53
	3	2.27	2.27	4.50
	5	1.76	1.76	4.26
	10	1.24	1.24	4.08
Diameter, mm	1	0.058	0.082	0.100
	3	0.034	0.067	0.089
	5	0.026	0.064	0.086
	10	0.018	0.061	0.084
Shrinkage, wet or dry percentage points	1	0.721	1.02	1.29
	3	0.416	0.833	1.15
	5	0.322	0.790	1.12
	10	0.228	0.756	1.09

[A] The critical differences were calculated using t = 1.645, which is based on infinite degrees of freedom.

29. Summary of Test Method

29.1 The thread is held in loop form and its tendency to twist is noted.

30. Significance and Use

30.1 This test method is important in predicting the kinking and snarling tendency of thread during actual sewing operation.

31. Procedure

31.1 Withdraw approximately 1 m (1 yd) of conditioned thread from the holder in the same manner as that in which the thread is delivered to the sewing machine. Cut the thread and form the segment in a loop with the free ends approximately 100 mm (4 in.) apart. Suspend the loop in a draft-free environment and let the thread twist on itself until it comes to rest.

NOTE 3—A twist tester may be used to determine the number of revolutions.

32. Report

32.1 State that the specimens were tested as directed in Test Methods D204. Describe the material(s) or product(s) sampled and the method of sampling used.

32.2 Report the number of complete revolutions specimen and the average of all specimens.

33. Precision and Bias

33.1 *Precision*—For the components of variance in Table 3, two averages of observed values should be considered significantly different at the 90 % probability level if the difference equals or exceeds the critical differences tabulated in Table 4.

33.2 *Bias*—This procedure for measuring twist balance has no known bias because the value of the twist properties can be defined only in terms of a test method.

LENGTH PER THREAD HOLDER

34. Scope

34.1 This test method determines sewing thread lengths wound on a thread holder.

35. Summary of Test Method

35.1 The length of sewing thread on a thread holder is measured by winding the thread from the thread holder onto a reel of known perimeter into skeins of specified wraps (see Table 2) and any residual part skeins and counted wraps. The total length is the sum of the full skeins and length of any part skein.

36. Significance and Use

36.1 This test method is used to establish the length per thread holder when thread is being sold on a length basis.

37. Apparatus

37.1 *Reel:*

37.1.1 *General*—A hand or motor-driven reel having a specified perimeter. The reel shall be fitted with a traversing mechanism that will avoid bunching the successive wraps, and with an indicator of the length wound. A warning bell that will ring at a specified length is recommended. It is advisable that one arm be collapsible to allow for easy removal of skeins.

38. Sampling

38.1 Sample as directed in Specification D3693.

39. Procedure

39.1 Determine the tension for reeling as directed in Test Method D1907/D1907M. The thread need not be measured for length per thread holder in the standard atmosphere for testing textiles.

39.2 Remove the thread from the holder by reeling skeins having the length specified in Table 2. Determine the length of the final part skein in metres (yards) by counting the number of complete revolutions of the reel and by measuring the length of the last partial wrap to the nearest 0.1 m (4 in.).

40. Calculation

40.1 Calculate the total length of each thread holder to the nearest 1 m (1 yd) for holders with nominal length in excess of 100 m (150 yd) and to the nearest 0.1 m (4 in.) for holders with nominal length of 100 m (150 yd) or less, using Eq 1:

$$\text{Length of thread holder, m} = A \pm B \pm C \quad (1)$$

where:

A = number of whole skeins times length per skein,
B = number of complete wraps in last partial skein times metres per wrap and,
C = length of last partial wrap on the reel, m (yd).

40.2 Calculate the average length per holder of sewing thread for the lot sample.

41. Report

41.1 State that the specimens were tested as directed in Test Methods D204. Describe the material(s), or product(s) sampled and the method of sampling used.

41.2 Report the individual lengths per holder, and the average length based on the lengths on all the holders tested.

42. Precision and Bias

42.1 *Precision*—For the components of variance in Table 3, two averages of observed values should be considered significantly different in the 90 % probability level if the difference equals or exceeds the critical differences tabulated in Table 4.

42.2 *Bias*—This procedure for measuring length per thread holder has no known bias because the value of the length properties can be defined only in terms of a test method.

DIAMETER

43. Scope

43.1 This test method determines thread diameter either by a thickness gage (preferred procedure) or by optical measurements.

44. Summary of Test Method

44.1 Segments of thread are placed on the stage of a thickness gage and the diameter is the thickness read from the gage. Optionally, segments of thread are placed on a rotatable microscope stage and their diameters are measured using a calibrated eyepiece.

45. Significance and Use

45.1 A knowledge of thread diameter is important because diameter can affect sewing performance and seam appearance. Sewing performance can be affected because the thread is required to pass through restrictions such as the needle eye and tension disks. Seam appearance can be adversely affected when the diameter of the thread is large enough to displace fabric yarn and result in a puckered seam.

45.1.1 Thread diameter is also a consideration when selecting sewing threads for embroidery, contrast stitching, or other decorative applications since cover is important with such threads.

45.2 *Acceptance Testing*—The optical procedure for testing sewing threads for diameter is not recommended for acceptance testing of commercial shipments since the optical procedure suffers from difficulty in determining the exact boundaries of threads having protruding fibers on the surface.

46. Apparatus

46.1 *Thickness Gage Procedure:*

46.1.1 *Thickness gage,* as described in Test Method D1777, with a presser foot diameter of 9.52 mm ± 0.02 mm (0.375 in. ± 0.001 in.). The presser foot and moving parts connected therewith shall be weighted to apply a total force of 1.67 ± 0.03 N (6 ± 0.1 oz) equivalent to a pressure of 23.4 kPa (3.5 psi).

46.2 *Optical Procedure:*

46.2.1 *Microscope,* having a stage that can be rotated to bring the thread parallel to the movable cross hair in the eyepiece, a magnification to allow the thread to cover approximately one quarter of the field of view, and either a micrometer eyepiece with a scale, or a filar micrometer eyepiece.

46.2.2 *Mounting Plate,* with clips or other means suitable for holding thread at a constant tension sufficient to remove slack without stretching the specimen while it is measured on the microscope stage.

47. Procedure

47.1 *Thickness Gage:*

47.1.1 Draw the thread from the side of the holder, taking care not to disturb the twist. Place four strands of the thread side by side on the anvil and approximately mid-way between the sides of the presser foot of the thickness gage.

47.1.2 Read the thickness from the gage indicator to the nearest 0.02 mm (0.001 in.) and record this as the diameter of the thread.

47.1.3 Remove at least 300 mm (12 in.) of thread from the holder.

47.1.4 Repeat 47.1.1 – 47.1.3 to obtain a total of ten readings.

47.2 *Optical:*

47.2.1 Draw the thread from the side of the holder, taking care not to disturb the twist. Mount the thread on the movable stage of the microscope using the mounting plate. Take care that no change in twist occurs and that the tension applied is sufficient to remove slack without appreciably stretching the thread. Rotate the stage until the thread is parallel to the movable cross hair.

47.2.2 Determine the diameter of the thread to the nearest 0.02 mm (0.001 in.) as the difference in the micrometer settings when the cross hair is moved from one edge of the thread to the other.

47.2.3 Repeat 47.2.1 and 47.2.2 for a total of 20 measurements on segments of thread separated by at least 300 mm (12 in.).

48. Calculation

48.1 Calculate the average of the ten thickness gage values recorded in 47.1 or 20 optically measured values recorded in 47.2 for each thread holder to the nearest 0.02 mm (0.001 in.).

48.2 Calculate the average for the lot to the nearest 0.02 mm (0.001 in.).

49. Report

49.1 State that the specimens were tested as directed in Test Methods D204. Describe the material(s) or product(s) sampled and the method of sampling used.

49.2 Report the following information:

49.2.1 The procedure used,

49.2.2 The average diameter of the sewing thread on each thread holder, and

49.2.3 The average diameter of the sewing thread in the lot.

50. Precision and Bias

50.1 *Precision*—For the components of variance in Table 3, two averages of observed values should be considered significantly different at the 90 % probability level if the difference equals or exceeds the critical differences tabulated in Table 4.

50.2 *Bias*—This procedure for measuring diameter has no known bias because the value of the diameter properties can be defined only in terms of a test method.

SHRINKAGE, SINGLE STRAND

51. Scope

51.1 This test method determines single strand thread shrinkage due to exposure to boiling water or dry heat.

52. Summary of Test Method

52.1 A conditioned single strand of thread is tied in a loop and measured under a prescribed tensioning force before and after exposure to boiling water or dry heat. The change in length is expressed as a percentage of the length before exposure.

53. Significance and Use

53.1 Shrinkage in sewing thread is of interest because it can cause puckering along seams, adversely affecting seam appearance.

53.1.1 A knowledge of the shrinkage in sewing thread by itself is not a sound basis for predicting the effect the thread shrinkage will have on seam shrinkage. Any combination of the following can alter the effects of sewing thread shrinkage on the seam: the construction and mass of the seamed fabric, the nature of the seam assembly, or the tensions on the sewing thread during the sewing operation.

54. Apparatus

54.1 *Vertical Stand with Hook*—A stand to which is affixed a measuring scale with the hook located at the top of the measuring scale so that the top of a loop of thread when hung on the hook will coincide with the zero index of the measuring scale.

54.2 *Measuring Scale,* graduated in increments of 1 mm.