

TEST METHOD FOR BULK PROPERTIES
OF TEXTURED YARNS

1. SCOPE

- 1.1 This method determines crimp contraction, crimp recovery, and skein shrinkage of textured yarn. It is applicable to all yarns which develop bulk when subjected to a dry heat treatment. This method applies to all yarn up to 400 denier (45 tex).

2. DEFINITIONS

- 2.1 Linear Skein Shrinkage - the decrease in length of a sample caused by a specified treatment, expressed as a percentage of the length of the untreated sample. It is a measure of intrinsic yarn shrinkage.
- 2.2 Crimp Contraction - the difference in length of a yarn sample in the crimp state (under low tension) and in the uncrimped state (under high tension). It is expressed as a percentage of the uncrimped length. Crimp contraction is a measure of yarn's ability to shorten in length while under tensions selected to simulate loads which might be applied to the yarn during fabric finishing.
- 2.3 Crimp Recovery - the measure of a yarn's ability to recover its original crimped length after being subjected to tension.

3. SUMMARY OF METHOD

- 3.1 The specimen is wound into a skein on a reel. The skein is removed from the reel, and its length is measured under low and high tension. The skein is then placed under low tension and exposed to dry heat. After cooling, the length of the skein is again measured under low and high tension. The percent linear skein shrinkage, crimp contraction, and crimp recovery are then calculated.
- 3.2 The skeins are tested as described in 3.1 using one or more of the five suggested low tensions.

4. USES AND SIGNIFICANCE

- 4.1 This test differs from other shrinkage tests in that the yarn is treated with dry heat while under tension. The loads applied are selected to simulate those which might be applied to the yarn during fabric finishing treatments.

- 4.2 Based on previous performance of similar yarns, it may be desirable to eliminate several of the loads specified here. Where a single weight is used, the suggested value is 5 mg/den. (i.e., 0.05 cN/tex.)
- 4.3 Specimens will be exposed to a temperature of 250 degrees F (121 degrees C) for 5 minutes. (See note 6)
- 4.4 This method is generally used for polyester. When testing nylon, a wet heat method may be preferable.

5. APPARATUS AND MATERIALS

- 5.1 Reel with recommended circumference of 1.0 to 1.5 meters.
- 5.2 Rack for cooling skeins.
- 5.3 Oven with temperature maintained 250 ± 3 degrees F (121 ± 2 degrees C).
- 5.4 Assortment of light loads and a single heavy one. The selection of light loads is optional, but 2.5, 7.5, 25, and 50 grams (0.5 to 10 mg/den), (0.005 to 0.1 cN/tex) are suggested. A heavy load of 500 grams (100 mg/den), (1 cN/tex) is recommended.
- 5.6 Measuring scale consisting of a meter stick or other such scale mounted vertically. At the top, a hook is aligned with the 0 end of the scale.

6. SAMPLING, SELECTION AND NUMBER OF SPECIMENS

- 6.1 Determine the yarn size (extended) as described in ASTM D1059.
- 6.2 Reel skeins of 5000 total denier (556 tex) per sample, winding at a uniform tension of less than 0.15 grams/denier (1.5 cN/tex). Consult Appendix for determining the number of turns per skein.

7. CONDITIONING

- 7.1 Polyester - minimum of 2 hours at lab conditions. (See note 3)

8. PROCEDURE

- 8.1 Strip approximately 25 meters from each bobbin just prior to preparation of the skein (See note 1)

- 8.2 Prepare the skeins as described in Section 6.
- 8.3 Remove each skein from the reel and hang it on the measuring stand. Apply a light hand tension to prevent twisting and kinking.
- 8.4 Hang the selected light load on the skein.
- 8.5 Start the stop watch and after 15 seconds, measure the length of the skein to the nearest millimeter. Record that length as C_b at the respective load. Leave the load on the skein throughout the entire test.
- 8.6 Apply the 500 gram weight to the skein.
- 8.7 Start the stop watch and after 30 seconds, measure the length of the skein to the nearest millimeter. Record the length as L_b .
- 8.8 Remove the 500 gram weight and place the skein on the treatment rack.
- 8.9 Set the oven at 250 ± 3 degrees F (121 ± 2 degrees C) and allow the temperature to stabilize.
- 8.10 Place the rack holding the skeins into the oven for 5 minutes at equilibrium temperature of 250 degrees F (121 degrees C). (The oven is required to return to equilibrium temperature before the timing starts.) (See note 6)
- 8.11 At the end of the time period, remove the rack from the oven and allow to cool for at least 10 minutes or until lab temperature is reached.
- 8.12 Hang the skein on the measuring stand and measure its length to the nearest millimeter. Record the length as C_a .
- 8.13 Apply the 500 gram weight to the skein.
- 8.14 Start the stop watch and after 30 seconds, measure the length of the skein to the nearest millimeter. Record the length as L_a .
- 8.15 Remove the 500 gram weight.
- 8.16 Start the stop watch and after 30 seconds, measure the skein to the nearest millimeter. Record that length as C_c .

9. CALCULATION OF RESULTS

- 9.1 Calculate the linear skein shrinkage, LSS, to the first decimal place, for each skein using the following formula:

$$\text{Linear Skein Shrinkage, \%LSS} = \frac{(L_b - L_a) \times 100}{L_b}$$

- 9.2 Calculate the crimp contraction, to the first decimal place, before (CCB) and after (CCA) dry heat for each skein using the following formulas:

$$\text{Crimp Contraction, \%CCB} = \frac{(L_b - C_b) \times 100}{L_b}$$

$$\text{Crimp Contraction, \%CCA} = \frac{(L_a - C_a) \times 100}{L_a}$$

- 9.3 Calculate the crimp recovery, to the first decimal place, after dry heat using the following formula:

$$\text{Crimp Recovery, \%CR} = \frac{L_a - C_c}{L_a - C_a} \times 100$$

10. REPORT

- 10.1 Report the linear skein shrinkage, the crimp contraction before and after dry heat, and the crimp recovery to the first decimal place for each skein, indicating the load used.
- 10.2 The load used should be written as a subscript. [Examples: CCB₅ for mg/den (0.05 cN/tex); CCB_{0.5} for 0.5 mg/den (0.01 cN/tex).]

NOTES

1. Stripping is necessary to remove surface yarn that may have been altered by relaxation. It should be done within 15 minutes before preparing the test skeins.
2. When hanging weights, use care not to let the weight drop, bounce, or otherwise stretch the yarn beyond its loading tension.

3. Time lapse (lag) between processing and testing significantly affects the results of this test, especially during the first 72 hours. Therefore, lag time should be kept constant for samples being compared. This stress relief period normally levels out beyond seven (7) days; therefore, samples tested later than this period do not show significant differences and can be compared directly.
4. This procedure is intended to provide relative comparisons between test specimens. The results should be used only on a comparative basis.
5. The results should not be used to speculate on the performance of fabrics prepared from the test yarns except in narrow, well-defined comparisons of the same products.
6. Some labs are using 5 minutes while others are using 10 minutes. Interlab tests will be conducted to determine stated time.

APPENDIX ITURNS FOR 5000 DENIER SKEIN

EXTENDED DENIER	NUMBER OF TURNS	EXTENDED DENIER	NUMBER OF TURNS
58.8 - 60.2	42	107.0 - 111.0	23
60.3 - 61.7	41	112.0 - 116.0	22
61.8 - 63.3	40	117.0 - 122.0	21
63.4 - 64.8	39	123.0 - 128.0	20
64.9 - 66.7	38	129.0 - 135.0	19
66.8 - 68.5	37	136.0 - 143.0	18
68.6 - 70.4	36	144.0 - 151.0	17
70.5 - 72.4	35	152.0 - 161.0	16
72.5 - 74.6	34	162.0 - 172.0	15
74.7 - 76.8	33	173.0 - 185.0	14
76.9 - 79.3	32	186.0 - 200.0	13
79.4 - 81.9	31	201.0 - 217.0	12
82.0 - 84.6	30	218.0 - 238.0	11
84.7 - 87.7	29	239.0 - 263.0	10
87.8 - 90.8	28	264.0 - 294.0	9
90.9 - 94.3	27	295.0 - 333.0	8
94.4 - 98.0	26	334.0 - 385.0	7
98.1 - 101.0	25	386.0 - 400.0	6
102.0 - 106.0	24		

For other denier - No. of Turns = 2500

Denier

For the tex system - No. of Turns = 278