CHANGE NOTICES ARE NOT
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THE STANDARD IS REVISED

FED. TEST METHOD STD. 191A
CHANGE NOTICE 5
December 28, 1989

FEDERAL TEST METHOD STANDARD

TEXTILE TEST METHODS

The following changes, which form a part of FED. TEST METHOD STD. 191A, dated July 20, 1978, are approved by the Assistant Administrator, Office of Federal Supply and Services, General Services Administration for the use of all Federal agencies.

Remove : Standard Test Method 2015.2 of January 15, 1986
Add : Revised Standard Test Method 2015.3
Remove : Standard Test Method 2016 of July 20, 1978
Remove : Standard Test Method 5100 of July 20, 1978
Add : Revised Standard Test Method 5100.1
Remove : Standard Test Method 5309 of July 20, 1978
Add : Revised Standard Test Method 5309.1
Remove : Standard Test Method 5500 of July 20, 1978
Add : Revised Standard Test Method 5500.1
Remove : Standard Test Method 5502 of July 20, 1978
Add : Revised Standard Test Method 5502.1
Remove : Standard Test Method 5556 of July 20, 1978
Add : Revised Standard Test Method 5556.1
Remove : Standard Test Method 5642 of July 20, 1978
Add : Revised Standard Test Method 5642.1
Remove : Standard Test Method 5651 of July 20, 1978
Add : Revised Standard Test Method 5651.1
Remove : Standard Test Method 5660 of July 20, 1978
Add : Revised Standard Test Method 5660.1
Remove : Standard Test Method 5671 of July 20, 1978
Add : Revised Standard Test Method 5671.1
Remove : Standard Test Method 5680 of July 20, 1978
Add : Revised Standard Test Method 5680.1
Remove : Standard Test Method 5903 of July 20, 1973
Add : Revised Standard Test Method 5903.1
Remove : Standard Test Method 6015 of July 20, 1978
Add : Revised Standard Test Method 6015.1
Remove : Standard Test Method 7560 of July 20, 1978
Add : Revised Standard Test Method 7560.1

RETAIN THIS CHANGE NOTICE AND INSERT BEFORE THE TABLE OF CONTENTS

AMSC N/A

FSC 83GP

MILITARY INTEREST:

Custodians

Army - GL
Navy - NU
Air Force - 20

Review Activities

Army - AR, EA, MD, ME, TE
Navy - AS, SH
Air Force - 11, 82, 99

CIVIL AGENCY COORDINATING ACTIVITIES:

GSA - FSS
HHS - NIH

PREPARING ACTIVITY

Army - GL

(Project 83GP-0030)

SODIUM 5-CHLORO-2- 4 CHLORO-2- 3-(3, 4 DICHLOROPHENYL)- UREIDO -PHENOXY BENZENESULFONATE CONTENT

1. SCOPE

1.1 This method is intended for determining the sodium 5-chloro-2- 4-chloro-2- 3-(3, 4-dichlorophenyl)-ureido -phenoxy benzenesulfonate content of woolen textile materials that have been treated with this compound as a mothproofing agent (see 7.1 and 7.2).

2. TEST SPECIMEN

2.1 All wool. When the material to be tested is 100-percent wool, the specimen shall weigh 500 ± 50 mg.

2.2 Polyester and wool blend. When the material to be tested is a blend of polyester and wool, the specimen shall weigh 1000 ± 100 mg.

2.3 Rayon and wool blend. When the material to be tested is a blend of rayon and wool, the specimen shall weigh 1000 ± 100 mg.

3* NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the procurement document, two specimens shall be tested from each sample unit.

4. APPARATUS AND REAGENTS

4.1 Apparatus.

4.1.1 Electric heater with variable control.

4.1.2 Heat resistant glass flask. A 250-mL round bottom single neck, alkali resistant, heat resistant glass flask.

4.1.3 250-mL trap bulb and connecting arm (see figure 2015A).

4.1.4 Graham condenser (jacket 300-mm long).

4.1.5 Funnel.

4.1.6 Flasks. Six 100-mL volumetric, low actinic red or light sensitive.

4.1.7 Flasks, volumeteric. 200 mL, 250 mL, 500 mL, 1000 mL.

4.1.8 Pipettes.

4.1.9 Weighing bottles.

4.1.10 Boiling stones.

4.1.11 Spectrophotometer. A spectrophotometer having a maximum transmission at approximately 550 nanometers.

4.1.12 Silicone stopcock lubricant.

4.1.13 Silicone antifoam.

4.1.14 Analytical balance.

4.1.15 Air oven.

4.1.16 Soxhlet extractor.

4.1.17 Standard laborratory dessicator with drying medium.

4.2 Regents. All reagents shall be prepared with distilled or deionized water.

4.2.1 3, 4 Dichloroaniline. Pure ($C_6H_3C1_2NH_2$ MW 162.02) is preferable to store in a refrigerator.

4.2.2 2.5 N potassium hydroxide. Dissolve 165g (± 3g) potassium hydroxide 85 percent into 1000-mL volumetric flask, fill to mark with water.

4.2.3 5.0 N hydrochloric acid. Dilute 570g (± 10g) HCL 35 percent into 1000-mL volumetric flask, fill to mark with water.

4.2.4 0.1 N sodium nitrite. Dissolve 6.9g (± 0.1g) $NaNo_2$ into 1000-mL volumetric flask and dilute to mark with water. This solution will stay stable for at most 2 months.

4.2.5 0.2 N sulfamic acid. Dissolve 9.7g (± 0.2g) H_2NSO_3H into 500-mL volumetric flask and fill to mark with water. This solution will stay stable for at most 2 months.

4.2.6 Acetic acid 50 percent by volume. Dilute 500-mL glacial acetic acid with 500-mL water.

4.2.7 1.0 percent N-(1-naphthyl)- ethylenediamine-dihydrochloride. Dissolve 1 g (± 0.02g) $C_{10}H_7NHCH_2.2HCL.CH3OH$ into 100-mL volumetric flask and fill to mark with water. This solution has to be stored in a dark glass bottle. Initial solution is water clear and should be renewed as soon as it changes color.

5. PROCEDURE

5.1 Preparation of standard reference solution.

5.1.1 Dichloroaniline-hydrochloride standard stock solution. On an analytical balance, weigh out 200 mg (± 0.2 mg) pure 3, 4 dichloroaniline and place in a 1000-mL volumetric flask. To that, add 2-mL 5 N hydrochloric acid and 100-mL distilled water. Dissolve by heating slowly in a water bath and fill to the mark with distilled water. The solution should be good for 2 to 4 weeks.

5.1.2 Standard reference solution. Put 25-mL of the standard stock solution into 500-mL volumetric flask and fill to mark with water. Place 5, 10, 15, 20, and 25-mL of this dilution in 100-mL light sensitive volumetric flasks and add to each of them 1-mL 5 N hydrochloric acid.

5.1.3 Diazotation, development, and spectrophotometric measuring of standard reference solution. Add 5-mL 0.1 N sodium nitrite to each of the 100-mL light sensitive volumetric flasks (see 5.1.2). Shake and let rest for at least 2 minutes. Destroy the excess nitrite by adding 5 mL 0.2 N sulfamic acid and shake vigorously (be sure to agitate until bubbling subsides because bubbles in cuvette cause erroneous readings). After at least 2 minutes, dilute the diazotizing mix with 40-mL acetic acid (50 percent), shake and add 5-mL N-(1 Naphthyl)-ethylenediamine-dihydrochloride solution (1 percent?. Add water *up* to the 100-mL mark, invert six times (shake) and let rest for 10 minutes in the dark (measuring solution). (At 20°C, the final color strength is reached after only 5 minutes; if the solution is kept in the dark the strength of the color will not change for at least 12 hours). Place in cuvette and measure absorbance of each dilution with the spectrophotometer and read its absorbance at the maximum (550 nanometers). Draw a calibration curve of these measured absorbance against mg of dichloraniline and mg mothproofing agent. A sample calibration curve is included (see chart on figure 2015B).

5.2 Weight of dry specmen. The specimen shall be placed in a weighing bottle, dried in a circulating oven at least 1 hour at a temperature of 221° to 230°F, cooled in a desiccator, and weighed. Repeat this cycle until a weight is obtained that is constant to ± 0.001 g. This is the “weight of dry specimen”.

5.3 Testing of specimens containing 100 percent wool or a blend of wool and rayon. Cut specimen into small pieces and place in a 250-mL round bottom distillation flask with a few boiling stones. Add 180 mL 2.5 N potassium hydroxide solution and three drops of antifoam. Carefully grease the joints with silicone lubricant and assemble the apparatus as shown in figure 2015C. Heat the flask content until it boils and distills about 150-mL (approximately 1 hour) . Use a 200-mL volumetric flask containing 10-mL 5 N hydrochloric acid and having a mark at 150-mL as distilling receiver. Avoid spilling any of the alkaline solution or foam into the receiver. After the distillation, take the 200-mL volumetric flask containing the distillate combined with hydrochloric acid , add distilled water at room temperature UP to the 200-A mark and mix it (=specimen stock solution). Place a 30-mL aliquot of specimen stock solution in 100-mL light sensitive flask and proceed as in 5.1.3 for diazotation.

5.4 Testing specimens of polyester/wool blends. The specimen shall be extracted with water and chloroform for 10 cycles in a Soxhlet extractor. Dry the specimen and continue with the procedure described in 5.3.

5.5 Calculations.

5.5.1 Specimens containing 100-percent wool. The percent mothproofing agent on the wool fiber shall be calculated from the absorbance measurements as follows:

$$\text{Percent mothproofing agent} = \frac{M \times 100}{W_2 \times 0.15}$$

Where: M = Amount of mothproofing agent (mg) contained in the measuring solution which equals the measured absorbance. It will be read off the Calibration Curve (see figure 2015B).

W_2 = weight of dry specimen
0.15 = Constant value when using 30-mL aliquot sample

5.5.2 Specimens containing 100-percent wool. The percent mothproofing agent on the wool fiber shall be calculated from absorbance measurements as follows:

$$\text{Percent mothproofing agent} = \frac{M \times 100 \times 1.16}{W_2 \times 0.15 \times P}$$

Where: P = Proportion of wool in sample, expressed as a decimal to the nearest 0.01.

1.06 = A constant adjusting for differences in fiber density (1.38 polyester/1.30 wool)

5.5.3 Specimens containing rayon/wool blend. The percent mothproofing agent on the wool fiber shall be calculated from absorbance measurements as follows:

$$\text{Percent mothproofing agent} = \frac{M \times 100 \times 1.16}{W_2 X\ 0.15 \times P}$$

Where: 1.16 = A constant adjusting for differences in fiber density. (1.51 rayon/1.30 wool)

6. REPORT

6.1 The percent mothproofing agent content of the sample unit shall be reported as the average of the values obtained for the specimens tested and shall be reported to the nearest 0.1 percent.

6.1.1 The individual value for each individual specimen used to calculate the average shall be reported to the nearest 0.01 percent.

7. NOTES

7.1 This method determines the content as a 100-percent active as is material.

7.2 This mothproofing formulation may be obtained under the trade name of Mitin FF High Cone. from Ciba-Geigy Corp., Dyestuffs and Chemicals Division, Swing Road, Greenboro, NC 27409 or under the name of Intracide M from Dyes and Chemicals Division, Crompton and Knowles Corp., Route 208, Fair Lawn, NJ 07410.

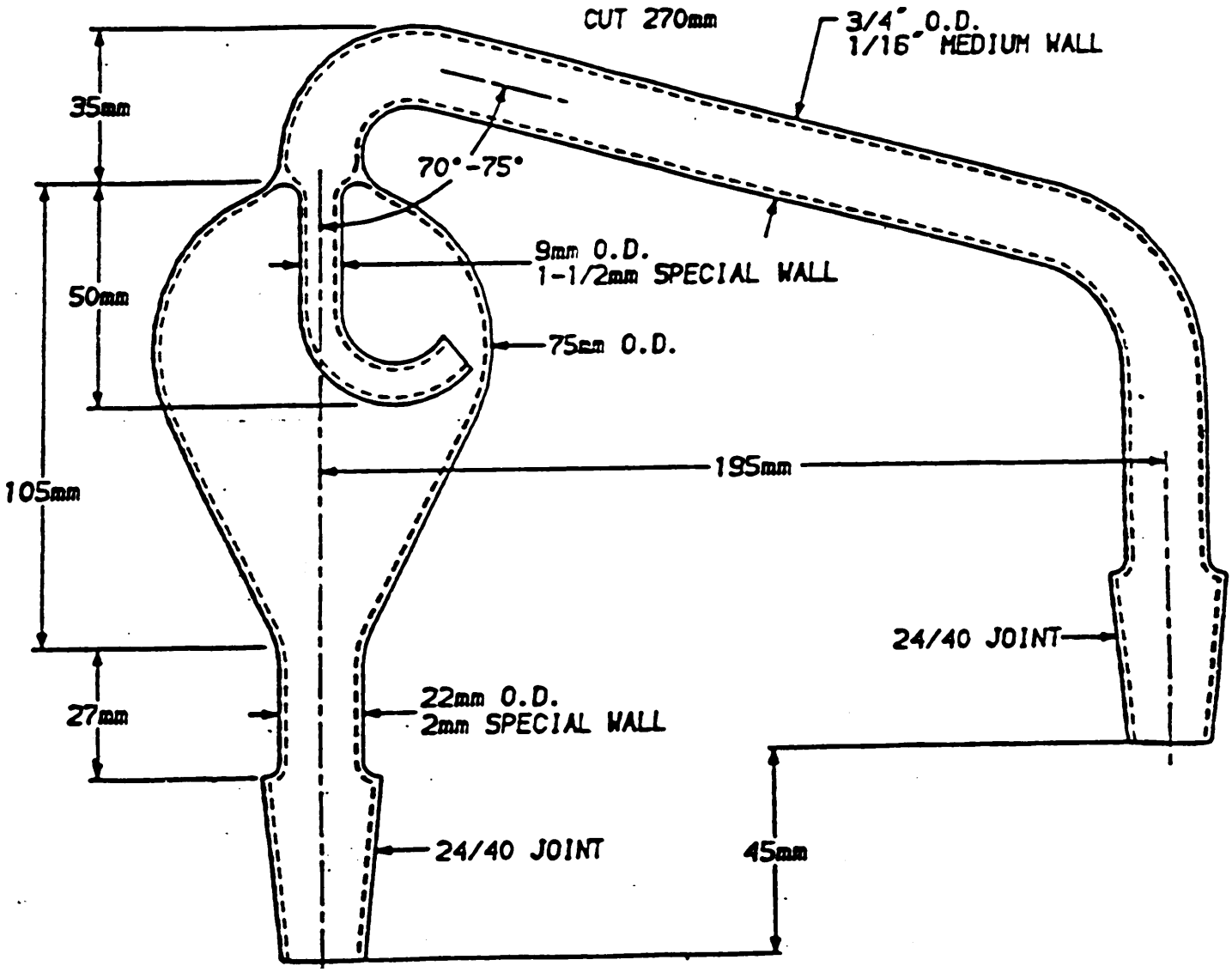

FIG. 2015A. TRAP BULB AND CONNECTING ARMS

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FIGURE 2015B.

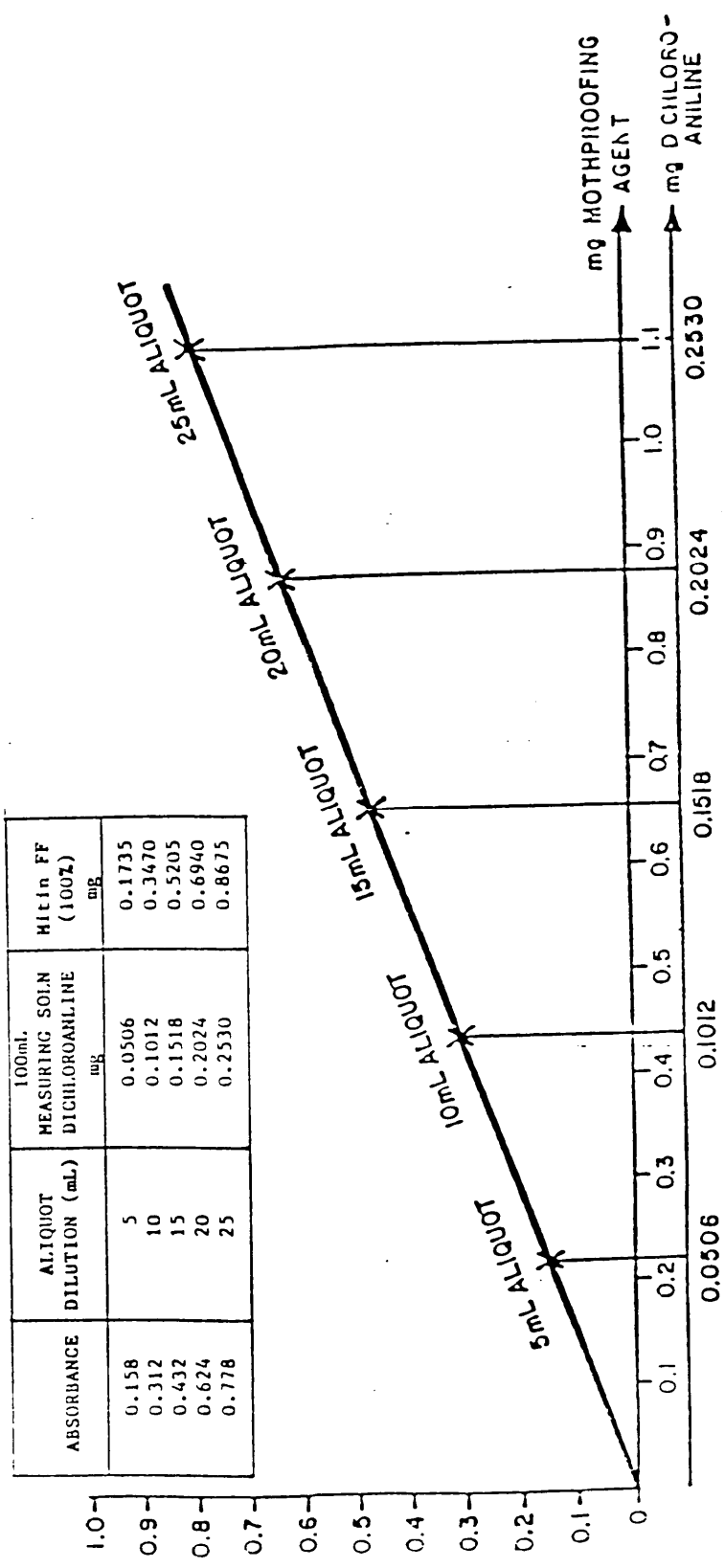
WEIGHED PORTION 202.4mg 3,4 DICHLOROANILINE INTO 1000mL, 25/1000 INTO 500mL=DILUTION

SAMPLE CALCULATION: $\frac{202.4\text{mg} \times 25\text{mL} \times (\text{mL})\text{ALIQUOT USED}}{1000\text{mL} \times 500\text{mL}} \times \frac{562.18}{162.02}$ = mg MOTHPROOFING AGENT

where; 562.18=(702.73 MW Hitin FF) X (0.8 active)

162.02=MW 3,4 DICHLOROANILINE;

ABSORBANCE	ALIQUOT DILUTION (mL)	100mL MEASURING SOLN DICHLOROANLINE mg	Hitin FF (100%) mg
0.158	5	0.0506	0.1735
0.312	10	0.1012	0.3470
0.432	15	0.1518	0.5205
0.624	20	0.2024	0.6940
0.778	25	0.2530	0.8675



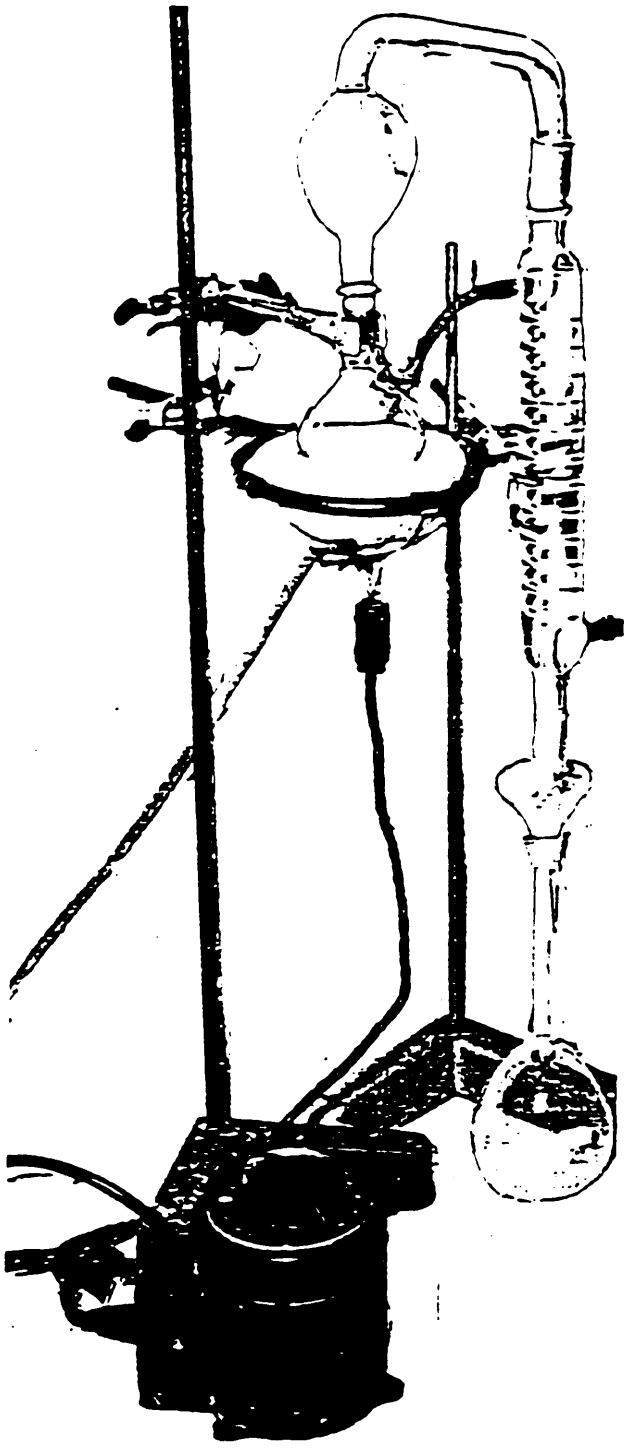


FIG 2015C DISTILLING APPARATUS

STRENGTH AND ELONGATION, BREAKING OF WOVEN CLOTH; GRAB METHOD

1. SCOPE

1.1 This method is intended for determining the breaking strength and elongation of woven, non-woven, and coated cloths.

2. TEST SPECIMEN

2.1 The specimen shall be a rectangle of cloth measuring 4 inches (102 mm) by at least 6 inches (152 mm). The long dimension shall be parallel to the direction being evaluated. No two warp specimens shall contain the same warp yarns and no two filling specimens shall contain the same filling yarns. Specimens shall not be taken nearer to the selvage than one tenth of the width of the cloth.

3* NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the procurement document, five specimens from each of the warp and filling directions shall be tested from each sample unit.

4. APPARATUS

4.1 Tension clamp. A tensioning clamp weighing 6 ounces (170 g) (see 7.3 and Figure 5100B) so designed that the weight of the clamp is evenly distributed across the complete width of the specimen.

4.2 The procedure for testing is applicable to both constant-rate-of-traverse (cRT) and constant-rate-of-extension (CRE) testers (see 7.1 and 7.2). These testers shall consist of three main parts:

a. Straining mechanism
b. Clamping mechanism
c. Load and elongation recording mechanism

4.2.1 Straining mechanism. A mechanism by which the specimen is strained by a uniform movement of the pulling clamp.

4.2.2 Clamping mechanism. The tester shall have two clamps with two jaws on each clamp. The design of the two clamps shall be such that one jaw may be an integral part of the rigid frame of the clamp and the other jaw shall be fastened to allow a slight vertical movement.

4.2.2.1 The dimensions of the back jaw in each clamp shall be 1 inch (25 mm) parallel to the application of load by l-inch (25 mm) or more perpendicular to the application of load. The dimensions of the front jaw of each clamp shall be l-inch by l-inch (25 by 25 mm). Each jaw face shall have a flat, smooth gripping surface. All edges which might cause a cutting action shall be rounded to a radius of not over 1/64-inch (0.4 mm). In cases where the specimen tends to slip when being tested, the jaws may be faced with rubber or other material to prevent slippage.

4.2.3 Load and elongation recording mechanism. The tester shall have a calibrated recording mechanism to indicate the applied load and elongation.

4.2.4 Capacity. The tester shall be of such capacity that the maximum load required to break the specimen shall not be greater than 85 percent or less than 15 percent of the rated capacity.

4.2.5 Tester efficiency. The error of the tester shall not exceed 2 percent up to and including a 50-pound (222 N) load and 1 percent over a 50-pound (222 N) load at any reading within its load range.

5. PROCEDURE

5.1 Preparation of the test specimen.

5.1.1 Woven cloth. One edge of the long dimension of the specimen shall be raveled until a continuous yarn, the length of the specimen, is obtained. Measure 1-1/2 inches (38 mm) in from this edge and draw a thin line the full length of the specimen. This must be accurately parallel to the lengthwise yarns.

5.1.2 Non-woven and coated cloths. On specimens where raveling is not practical, measure and draw a thin line 1-1/2 inches (38 mm) from the edge of the specimen. This must be, as accurately as possible, parallel to the lengthwise direction of the specimen. For coated, woven cloths, the cut edge of the long dimension of the test specimens shall be parallel to the warp yarns for warp tests and parallel to the filling yarns for filling tests.

5.2 Unless otherwise specified, the specimens shall be conditioned and tested under Standard Atmospheric Conditions in accordance with section 4 of this Standard.

5.2.1 When the wet breaking strength is required, it shall be specified in the applicable procurement document, and the method of wetting out the specimen shall be specified.

5.3 Before use, the tester shall be set at the zero point in accordance with the procedure required for the make and model tester being used, and the autographic recording mechanism shall be checked for proper operation. Insure that the recording pen has sufficient ink to avoid depletion of supply during test.

5.4 The gage length shall be 3 inches (76 mm).

5.5 Unless otherwise specified in the procurement document, the tester shall be operated at a uniform pulling speed of 12 ± 0.5 in/rein (305 ± 13 mm/min).

5.6 Each jaw face shall be in line both with respect to its mate in the same clamp and to the corresponding jaw in the other clamp.

5.7 Place the specimen between the opened jaws. Align *the* vertical outside edge of the front 1-inch by 1-inch (25 by 25 mm) top jaw with the vertical line drawn on the specimen and securely tighten the top clamp. Attach the tensioning clamp specified in 4.1 to the bottom edge of the specimen. Align the vertical outside edge of the l-inch by l-inch (25 by 25 mm) bottom jaw with the line drawn on the specimen and securely tighten the bottom clamp (see Figure 51OOA). Remove the tensioning clamp and run the test.

5.7.1 If due to the design of the bottom clamp the tensioning clamp cannot be used, appropriate means shall be taken to insure a uniform application of the 6 ounce (170 g) tension to the specimen before tightening the bottom clamp.

5.8 Observe the specimen during the test to determine if the specimen breaks in or at the edge of the jaws (jaw breaks), all yarns in the test area do not break, the specimen slips in the jaws, or the rupture of the specimen follows a random pattern. If any of the above or any other anomaly occurs which is due to faulty testing techniques and the result falls markedly below the average for the sample unit, discard the result and take another specimen. Continue this procedure until the required number of acceptable breaks have been obtained.

5.8.1 It shall be noted that certain cloths because of their inherent characteristics will not yield breaks other than jaw breaks.

5.9 When testing for elongation it shall be obtained simultaneously with the breaking strength. The elongation at the breaking point or other required load shall be expressed as the percent increase in length of the tensioned specimen held between the jaws. Elongation shall be determined from the graph of the autographic recording mechanism in accordance with the procedure required for the make and model tester being utilized.

5.9.1 That initial portion of the load-elongation curve (initial vertical traverse of the pen) which indicates elongation without load (other than the tensioning load) shall not be included in the calculation of elongation.

6. REPORT

6.1 The breaking strength of the sample unit shall be the average of the results obtained from the specimens tested in each of the warp and filling directions and shall be reported separately as follows:

Breaking strength	Reported to nearest
0-500 1bs. (0-2220 N)	1 lb. (1 N)
501 lbs. and up (2221 N and up)	5 lbs. (10 N)

6.2 The elongation of the sample unit shall be the average of the results obtained from the specimens tested in each of the warp and filling directions and shall be reported to the nearest 1 percent.

6.3 Each individual value obtained for each specimen tested shall also be reported.

7. NOTES

7.1 Unless otherwise specified in the procurement document, a constant-rate-of-load (CRL) tester will not be used.

7.2 The results obtained on a CRT tester may not be reproducible on a CRE tester and vice versa. Generally, for acceptance testing, it is not recommended to compare the results obtained on a CRT tester to those obtained on a CRE tester. In case of dispute it is recommended that a constant-time-to-break (20 ± 3 see) be used.

7.3 The tensioning clamp weighing 6 ounces (170 g) described in this method may be obtained from Custom Scientific Instruments, Inc., 13 Wing Drive? Whippany, NJ 07981.

Example. - Gage length (distance between jaws)

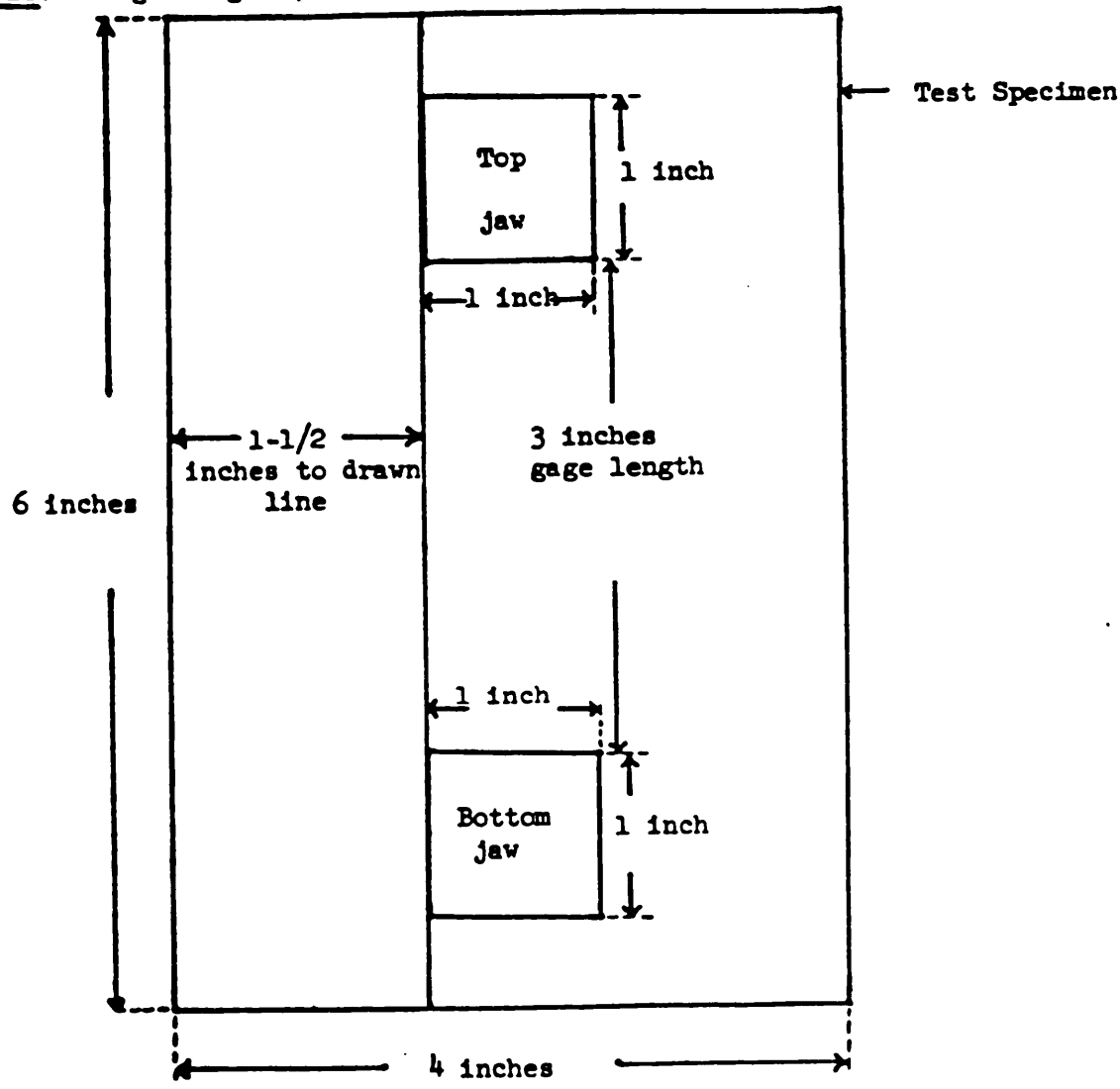


FIGURE 5100A

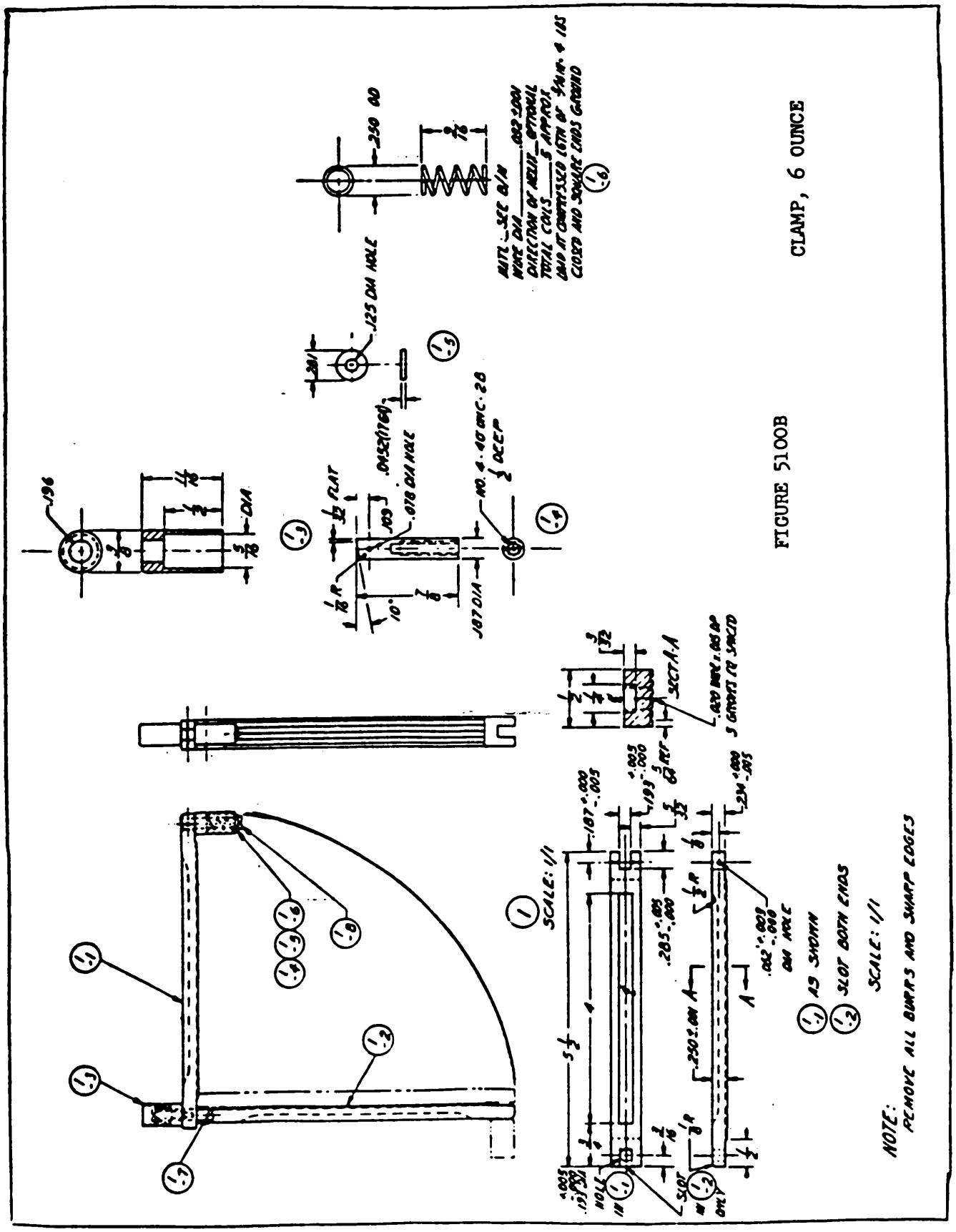


FIGURE 5100B

ABRASION RESISTANCE OF TEXTILE WEBBING

1. SCOPE

1.1 This method is intended for determining the resistance to abrasion of textile webbing.

2. TEST SPECIMEN

2.1 The specimen shall be the full width of the material being tested and shall have a minimum length of 54 inches (1372 mm).

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the procurement document, five specimens shall be tested from each sample unit.

4. APPARATUS

4.1 Webbing abrasion tester. The webbing abrasion tester (principle illustrated in Figure 5309) consists of a power driven oscillating drum. One end of each specimen is attached to the drum 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.

4.1.1 Weight “B", unless otherwise specified in the procurement document, shall be 2 pounds ± 2 ounces (0.91 kg ± 0.06 kg) for specified breaking strengths up to 1000 pounds (4450 N), 4 pounds ± 2 ounces (1.81 ± 0.06 kg) for breaking strengths of 1000 to 3000 pounds (4450 to 13350 N), and 5.2 pounds ± 2 ounces (2.4 ± 0.06 kg) for breaking strengths over 3000 pounds (13350 N).

4.1.2 Steel hexagonal rods “C” shall be 0.250 ± 0.001 inch (6.35 ± 0.03 mm) when measured across opposite flat sides and the radius of the edges shall be 0.020 ±.008 inch (0.5 ± 0.2 mm). The steel shall have a cold drawn finish and a Rockwell Hardness of B-97 to B-101 (see 6.1). The edges of the hexagonal rods shall not have any burrs, nicks, or scale.

4.1.3 Drum “D” shall have an outside diameter of 16 inches (406 mm) with a suitable means for attaching the specimen to be tested without damage to specimen.

4.1.4 The crank “E” and crank-arm “F" shall be attached to the drum in such a manner that when the specimen is attached to the drum, the specimen during the test will oscillate over the hexagonal rod the required distance during each stroke and at the required rate.

4.1.5 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 drum will form an angle of 85 ± 2 degrees “H”.

5. PROCEDURE

5.1 Unless otherwise specified in the procurement document, the specimens tested shall be conditioned and tested under standard conditions in accordance with Section 4 of this Standard.

5.2 Attach the required weight to one end of the specimen, pass the other end over the hexagonal rod and attach to the drum. The length of the specimen shall be adjusted, without altering the original length, so that the specimen will oscillate across the hexagonal rod and that each end of the abraded area will be equidistant from the ends of the specimen.

5.3 The edges of each new hexagonal rod shall be identified as 1 through 6, and only alternate edges (e.g., 1, 3, and 5) shall be used for abrading. No abrading edge shall be used more than once.

5.4 Oscillate the drum so that the specimen is given a 12 ± 1 inch (305 ± 25 mm) traverse over the rod at the rate of 60 ± 2 strokes (30 ± 1 cycles) per minute for 5000 strokes (2500 cycles). One single stroke is 12 ± 1 inches (305 ± 25 mm) in one direction Only.

5.5 The characteristics and methods for determining the degree of resistance to abrasion shall be specified in the procurement document.

5.6 Calculation of results.

5.6.1 Percent change in the characteristic being evaluated to determine resistance to abrasion shall be calculated as follows:

$$\text{Percent change in characteristic} = \frac{A - E}{A} \times 100$$

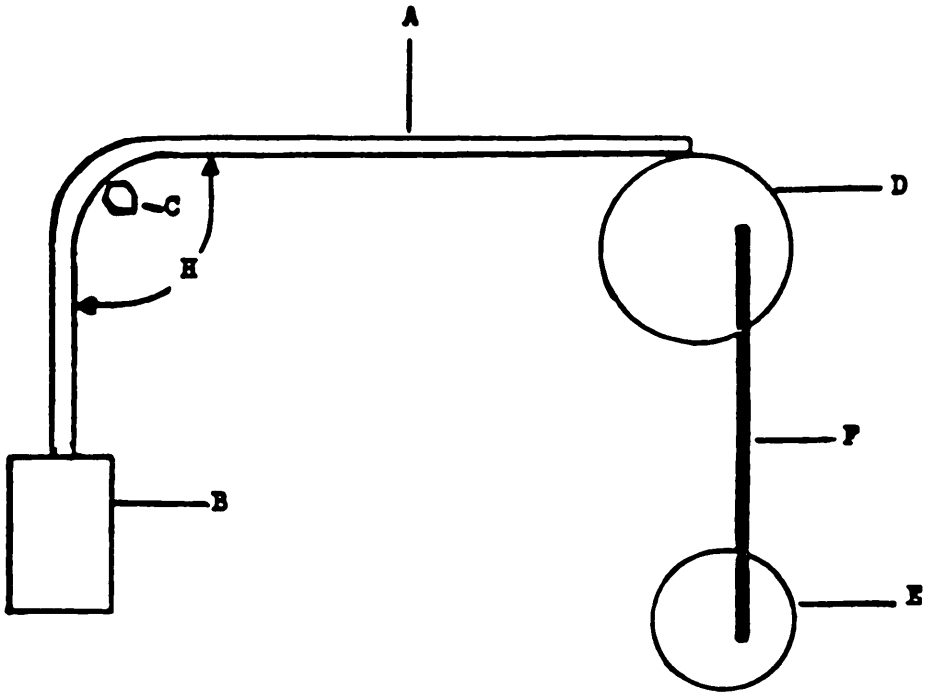
Where: A = Value before abrasion
E = Value after abrasion

6. REPORT

6.1 The resistance to abrasion shall be reported as the change in characteristics as specified in the applicable test method or procurement document.

7. NOTES

7.1 To reduce variability, and in case of disagreement of results the hexagonal rods described in this method which have been cold drawn from the same die should be used and may be purchased from Narrow Fabrics Institute, Inc., 271 North Avenue, New Rochelle, NY 10801.



A. Specimen

B. Weight

C. Steel hexagonal rods

D. Drum

E. Crank

F. Crank arm

FIGURE 5309 - WEBBING ABRASION TESTER

WATER RESISTANCE OF CLOTH; DYNAMIC ABSORPTION METHOD

1. SCOPE

1.1 This method is intended for determining the amount of water absor cloth when subjected to dynamic conditions.

2. TEST SPECIMEN

2.1 The specimen shall be composed of five square pieces of the finished cloth, each 8 by 8 inches (203 by 203 mm), cut on a 45-degree bias with the loose corner yarns removed (see 7.2).

3. NUMBER CF DETERMINATIONS

3.1 Unless otherwise specified in the procurement document, two specimens (10 pieces) shall be tested from each sample unit.

4. APPARATUS

4.1 Tumble jar. A tumble jar (see figure 5500A), cylindrical in shape with approximate dimensions being 12 inches (305 mm) in height and 6 inches (152 mm) in diameter (or between opposite flat faces) with a capacity of approximately 1.6 gallons (6 L). The jar shall be of glass, corrosion-resistant metal or chemical stoneware. The jar shall be mounted in a vertical position in such a manner that it can be rotated around the horizontal axis passing through the center of the jar. Means shall be provided for rotating the jar around the axis at a speed of 55 ± 2 revolutions per minute. The jar shall be clean and thoroughly rinsed so that it is free from soap, detergent, and wetting agents (see 7.1).

4.2 Wringer. A wringer (see figure 5500B), of the household type equipped with smooth rubber squeeze rolls 2-1/8 to 2-1/2 inches (54 to 64 mm) in diameter and not less than 11 inches (279 mm) nor more than 16 inches (406 mm) in length. The rubber rolls shall have a Shore durometer hardness of 70 to 80 (A scale). The load exerted on the specimen shall be applied uniformly by means of a dead weight, attached to the top roller. The total load of the roller, means of attaching the weight and the weight itself shall be 60 pounds (27.2 kg). The rolls shall be power driven at such a speed that the specimen shall pass through the rolls at the rate of 1 inch (25 mm) per second (see 7.4).

4.3 Balance. A laboratory balance capable of weighing accurately to 0.01g.

4.4 Blotting paper. The blotting paper dimensions shall be 10 inches (254 mm) square (see 7.3). The blotting paper shall be allowed to reach moisture equilibrium under standard atmospheric conditions prior to being used in the test.

4.5 Container. Tared glass or plastic container.

5. PROCEDURE

5.1 Unless otherwise specified in the procurement document, the rotation of the jar shall be a minimum of 20 minutes.

5.2 Orignal weight of the specimen. The five pieces constituting one specimen shall be conditioned, then rolled together and weighed to the nearest 0.01 go This is the 'Weight of the original conditioned specimen" and *in* the calculation of results is designated as "O". Each individual piece of the specimens shall be marked to maintain the individual identities. Two liters of distilled water at a temperature of 80° ± 2°F (27° ± 1°C) shall be placed in the tumble jar, and the specimen shall be added, one piece at a time. Two specimens (10 pieces) may be tested at the same time providing each specimen is taken from a different sample unit. If only one specimen is tested, a specimen of similar material with respect to weight shall be run as ballast with the specimen undergoing test. The cloth in the jar during any run shall be the equivalent of two specimens.

5.3 The jar and contents shall be rotated at the rate of 55 ± 2 revolutions per minute for the time specified in the procurement document.

5.4 At the end of the required running time, one piece shall be run through the *wringer* with one edge parallel to the length of the rollers.

5.5 The same piece shall immediately be placed smoothly between two sheets of blotting paper. The piece of cloth and blotters shall be passed through the rollers of the wringer by the procedure described in 5.4. The piece of cloth shall be left between the two blotters until all five pieces of the specimen (between sheets of blotting paper) have been passed between the rollers.

5.6 Final weight of the specimen. Each of the remaining pieces shall be put through the wringer as described in 5.4 and 5.5. The five pieces shall then be removed from the blotting paper, rolled together and weighed in a tared closed container to the nearest 0.01 g. This is the "Final weight of the specimen" and in the calculation *of* results is designated as "F".

5.6.1 Care shall be taken at all times to keep evaporation of moisture from specimen to a minimum.

5.7 Calculation of result. The dynamic absorption shall be calculated as follows:

$$\text{Dynamic absorption, percent} = \frac{F-O}{O} \times 100$$

Where: O = Original weight of the specimen.

F = Final weight of the specimen.

6. REPORT

6.I The dynamic absorption of the sample unit shall be the average of the results obtained from the two specimens (1 pieces) tested and shall be reported to the nearest 0.1 percent.

6.2 Each individual value *used* to calculate the average shall also be reported.

7. NOTES

7.1 A suitable apparatus for conducting this test is available from: Atlas Electric Devices, Co., 4114 N. Ravenswood Ave., Chicago, IL 60613* The corrosion resistant metal jar is available from Mico Instrument Company, 80 Trowbridge Street, Cambridge, MA 02738, or United States Testing Co., Inc., 1415 Park Ave., Hoboken, NJ 07030.

7.2 If the material of test is subject to excessive raveling, a drop of liquid latex or rubber cement should be spread on the yarns at each corner to prevent raveling. Care should be exercised in the selection of the latex or rubber cement to insure impurities are not present which will affect results.

7.3 The blotting paper is available from:

American Association of Textile Chemists and Colorists
AATCC Technical Center
One Davis Drive
P.O. Box 12215
Research Triangle Park, NC 27709-2215

7.4 A suitable wringer is the Atlas Motorized Laboratory Wringer, available from Atlas Electric Devices, Co.,4114 N. Ravenswood Ave., Chicago, IL 60613.

DYNAMIC ABSORPTION TEST

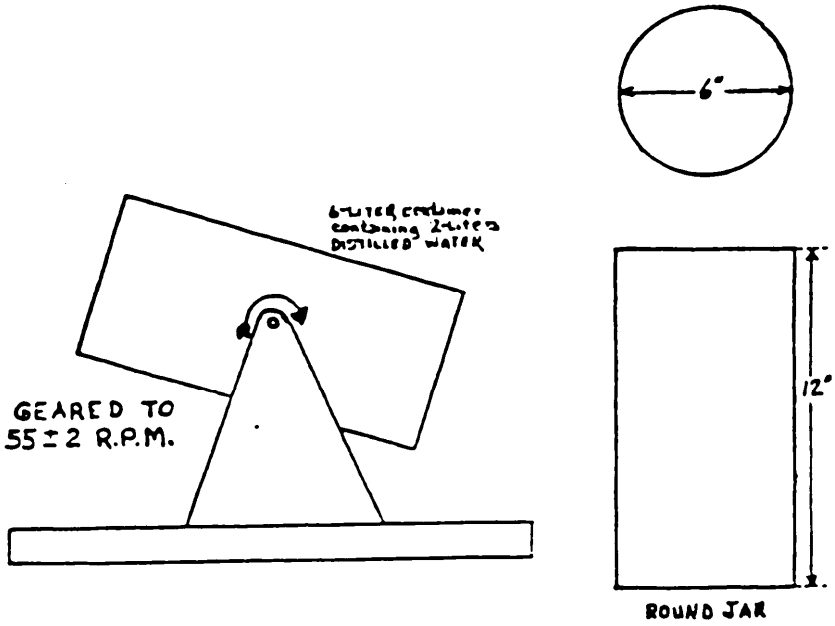


FIGURE 5500A - TUMBLE JAR

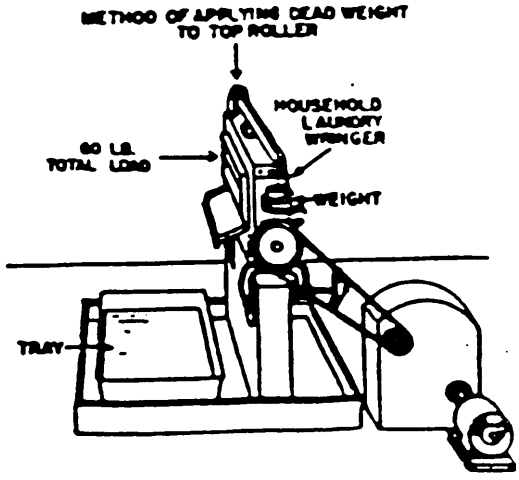


FIGURE 5500B - WRINGER

WATER RESISTANCE OF CLOTH; IMMERSION ABSORPTION METHOD

1. SCOPE

1.1 This method is intended for determining the amount of water absoroed by cloth when subjected to static conditions. This method is not as severe as Method 5500.

2. TEST SPECIMEN

2.1 The specimen shall be a square of cloth 3 inches by 3 inches (76 by 76 mm). Departure from the required specimen size shall be permitted when necessary so that specimens from appreciably heavy or light cloths will weight not less than 1 g nor more than 4 g. Changes in size shall be permitted only in multiples of 6 inches (152 mm).

2.2 Lightweight cloths. The size of the specimen for lightweight cloth shall be larger than for heavyweight cloth (6 inches by 6 inches (152 by 152 rum) for mosquito netting) and should be specified in the procurement document.

2.3 Narrow cloths. The dimensions of narrow cloth specimens shall be as follows:

Type of Material	Specimen width, inches (mm) (measured to nearest 1/8 inch (1 mm))	Length required (inches) (mm)
Narrow cloth	1/4 to 3/8 (6 to 10 mm)	24 (610 mm)
Narrow cloth	1/2 to 7/8 (13 to 22 mm)	18 (457 mm)
Narrow cloth	1 to 1-3/8 (25 to 35 mm)	12 (305 mm)
Narrow cloth	1-1/2 to 3 (38 to 76 mm)	6 (152 mm)

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the procurement document, five specimens shall be tested from each sample unit.

4. APPARATUS

4.1 Blotting paper. The standard blotting paper dimensions shall be a minimum of 4 inches by 4 inches (102 by 102 mm) (see 7.1). For lightweight cloths and narrcw cloths, the blotting paper shall be approximately 1 inch

(25 mm) greater than the length and width of the specimen. The blotting paper shall be allowed to reach moisture equilibrium under standard atmospheric conditions prior to being used in the test (see 7.2).

4.2 Wringer. The wringer (see figure 5502) shall be of a household type equipped with smooth rubber squeeze rolls 2-1/8 to 2-1/2 inches (54 to 64 mm) in diameter and not less than 11 inches (279 mm) nor more than 16 inches (406 mm) in length. The rubber rolls shall have a Shore durometer hardness of 70 to 80 (A scale). The load exerted on the specimen shall be uniformly applied by means of a dead weight, attached to the top roller. The total load of the roller, means of attaching the weight, and the weight itself shall be 60 pounds (27.2 kg). The rolls shall be power driven at such a speed that the specimen shall pass through the rolls at the rate of 1 inch (25 mm) per second.

4.3 Sinker A sinker for keeping the specimen submerged, shall consist of a rigid inverted L-shaped metal hook of noncorrosive q etal fastened to a weight. The sinker shall be sufficiently heavy to sink to the bottom of the tank when attached to the specimen. (normally a weight of 3.5 to 5.5 ounces (100 to 150 g) is adequate.) In testing narrow cloth, the horizontal end of the sinker hook shall be of sufficient length so that the portions of the specimens attached thereon may spread out to permit full contact with the water.

4.4 Tank. A tank of such size as to permit a 2-inch (51 mm) hydrostatic head of water above the top of the specimens undergoing test.

4.5 Balance. A laboratory balance capable of weighing accurately to 0.01 g.

4.6 Distilled water.

5. PROCEDURE

5.1 Unless otherwise specified in the procurement document, the time of immersion shall be 20 ± 1 minutes.

5.2 Original conditioned weight of the specimen. The specimen shall be conditioned and weighed to the nearest 0.01 g. This is the Orignal conditioned weight of the specimen" and is designated as "O". Each specimen shall be marked prior to weighing to maintain the individual identities.

5.3 When a narrow cloth is under test, the specimen shall be folded fanwise to a 6 inch (152 mm) length.

5.4 The specimen shall be attached to the sinker and immersed for the required time in a tank of distilled water at a temperature of 27° ± 1.0°C (80° ±2°F). The depth of the water shall be so regulated that, with the sinker resting on the bottom of the tank, the top of the specimen held in a vertical position shall be immersed under a 2-inch (51 mm) head of water.

5.5 At the end of the immersion period, the specimen shall be removed from the bath and sinker detached. The specimen shall be spread out and immediately placed between two blotters and passed once through the wringer at the rate of 1 inch (25 mm) per second. One edge of the specimen shall be parallel to the length of the rollers.

5.5.1 When narrow cloth is being passed through the wringer, the longitudinal direction of the material shall be perpendicular to the axis of the rolls.

5.5.2 In the case of napped cloths of all fibers and in the case of all cloth of 100 percent wool (napped or unnapped), the specimen shall be squeezed once through a wringer without blotters and then once with blotters.

5.6 Final weight of the specimen. After squeezing through the wringer, the specimens shall be weighed immediately in a tared container to the nearest 0.01 g. This is the “Final weight of the specimen” and is designated as "F”. Care shall be taken to keep evaporation of moisture from the specimen to a minimum.

5.7 Calculation of result. The immersion absorption shall be calculated as follows:

$$\text{Immersion absorption, percent} = \frac{F - O}{O} \times 100$$

Where:

F = Final weight of the specimen.

O = Original conditioned weight of the specimen.

6. REPORT

6.1 The immersion absorption of the sample unit shall be the average of the results obtained from the five specimens tested and shall be reported to the nearest 0.1 percent.

6.2 Each individual value used to calculate the average shall also be reported.

7. NOTES

7.1 The blotting paper is available from:

American Association of Textile Chemists and Colorists
AATCC Technical Center
One Davis Drive
P.O. Box 12215
Research Triangle Park, NC 27709-2215

7.2 A suitable wringer is the Atlas Motorized Laboratory Wringer, available from Atlas Electric Devices, Co., 4114 N. Ravenswood Ave., Chicago, IL 60613.

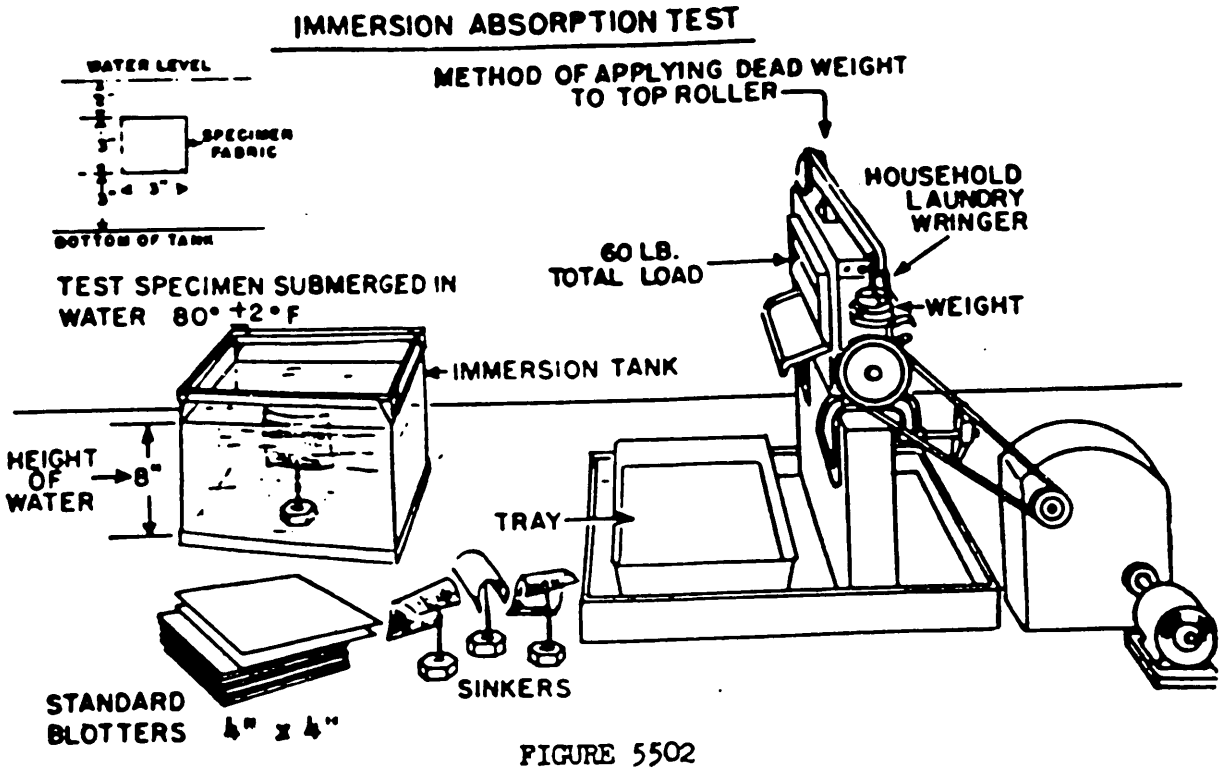


FIGURE 5502

METHOD 5556.1
December 28, 1989
SUPERSEDING METHOD 5556
July 20, 1978

MOBILE LAUNDRY EVALUATION FOR TEXTILE MATERIALS

1. SCOPE

1.1 This method is intended for use where it is desired to reproduce, by means of a laboratory procedure, changes in dimensions of woven or knitted cloth (wool, cotton, synthetics, and blends) and measure the durability or efficiency of functional finishes by two different laundering procedures which simulate field conditions. The title of the procedures, i.e., "wool" and "cotton" are so designated to allow for easy reference in procurement documents. This test method allows for two general temperature ranges of laundering and the end use application and procurement document will determine the laundering procedure to be followed in evaluating the wide range of textile materials to which it is applicable. It also allows for determining the launderability of battings and feathers.

2. TEST SPECIMEN

2.1 Specimens for determining dimensional stability. Unless otherwise specified in the procurement document, the following shall apply:

2.1.1 Woven or wrap knitted (single layer) cloths. The specimen shall be a square of cloth 22 inches by 22 inches (559 mm by 559 mm) except for wool cloth, then the specimen shall be 24 inches by 24 inches (610 mm by 610 mm).

2.1.2 Circular and tubular knit cloths. The specimen shall be 22 inches (559 mm) in length and the width of the cloth as received.

2.1.3 Cloths 22 inches (559 mm) and less in width. The specimen shall be at least 22 inches (559 mm) in length and the width of the cloth as received.

2.2 Specimens for evaluating durability and stability of functional finishes. Unless otherwise specified in the procurement document, the following shall apply:

2.2.1 Specimens for evaluating flame resistant finishes. The specimen shall be a 22-inch (559 mm) square of cloth.

2.2.2 Specimens for evaluating water resistant and other functional finishes as specified in the procurement document. The specimen shall be 1 linear yard (0.91 m) full width of the cloth.

2.3 Specimens for determining the launderability of battings. The specimen shall be 26 inches 660 mm) square of batting prepared as specified in 5.1.

2.4 Specimens for determining the launderability of feathers. The specimen shall be 1 ounce (28.4 g) of feathers prepared as specified in 5.1.

3. NUMBER OF DETERMINATIONS

3.1 Dimensional stability. Unless otherwise specified in the procurement document, three specimens from each sample unit shall be tested in each of the warp or wale and filling or course directions.

3.2 Evaluating functional finishes and determining launderability of battings and feathers. The number of cycles of laundering (see 5.2.4) and the specific evaluation criteria shall be as specified in the procurement document. When 3 launderings are specified in the procurement document for evaluating functional finishes, an additional wash cycle shall be performed without the addition of any chemicals (detergent and sour). When 5 or 10 launderings are specified, the last wash cycle shall be performed without the addition of any chemicals (detergent and sour). When 15, 20 or 25 launderings are specified, the last two wash cycles shall be performed without the addition of any chemicals (detergent and sour).

4. APPARATUS AND REAGENTS

4.1 Apparatus.

4.1.1 Wash wheel (see 7.1). A cylindrical wash wheel of the reversing type shall be used. The wheel (cage) shall be 20 to 24 inches (508 to 610 mm) inside diameter and 20 to 24 inches (508 to 610 mm) inside length. There shall be three fins each approximately 3 inches (76 mm) wide extending the full length of the inside of the wheel. One fin shall be located every 120 degrees around the inside diameter of the wheel. The wash wheel shall rotate at a speed of 30 ± 4 revolutions per minute making 5 to 10 revolutions before reversing. The water inlets shall be large enough to permit filling the wheel to an 8-inch (203 mm) level in less than 2 minutes, and the outlet shall be large enough to permit discharge of this same amount of water in less than 2 minutes. The wash wheel shall be equipped with a pipe for injecting live steam that shall be capable of raising the temperature of water at an 8-inch (203 mm) level from 100° to 140°F (38° to 60°C) in less than 2 minutes.

4.1.1.1 The wash wheel shall be equipped with a thermometer or other equivalent equipment for determining the temperature of the water during the washing and rinsing procedures, and with an outside water gage that will indicate the level of the water in the wheel.

4.1.2 Preheatingtank or other device. A preheating device to supply water in quantity within ± 4°F (± 2°C).

4.1.3 Extractor (see 7.2). A centrifugal extractor of the laundry type with a perforated basket, approximately 11 inches (279 mm) deep by 17 inches (432 mm) in diameter with an operating speed of approximately 1500 revolutions per minute.

4.1.4 Drier (see 7.1). A drier of the rotary, tumble type having a cylindrical basket approximately 36 inches (914 mm) in diameter and 24 inches (610 mm) in length and rotating at 35 ± 2 revolutions per minute. The drier shall be capable of maintaining the stack temperature specified in 5.2.2 and 5.2.3. The stack temperature shall be measured 20 ± 2 inches (508 ± 51 mm) from the exhaust opening of the drier.

4.1.5 Pressing equipment. Any flat-bed press capable of pressing a specimen 24 inches 610 mm) square or a hand iron weighing approximately 3.5 pounds (1.5 kg) may be used as an alternative. The flat-bed press or iron shall be equipped with a temperature control to maintain the temperature between 248° to 305°F (120° to 152°C) (see 7.2).

4.1.6 Measuring scale. Yardstick, meterstick, metal tape, or other suitable measuring device graduated in increments of 1/16 inch (1 mm) . The following may be used: An 18-inch ruler or tape, graduated to give percent change read to the nearest 0.1 percent. (Based on an original 18-inch marking).

4.1.7 Balance. Balance or scale capable of weighing the specimen to an accuracy of ± 0.5 g.

4.2 Reagents.

4.2.1 Synthetic detergent. Synthetic detergent meeting the requirements of MIL-D-43362, Detergent, Laundry (Anionic: A Standard for Testing) (see 7.3).

4.2.2 Sour. Sour conforming to the requirements of P-S-683, Sour, Laundry (Fluoridated) Type I.

4.2.3 Water of not over 50 parts per million hardness.

5. PROCEDURE

5.1 Preparation of specimen. Prior to initial markings for determining dimensional stability and prior to determining the change after laundering, the cloth shall be brought to equilibrium under standard atmospheric conditions as defined in Section 4 of this Standard. When evaluating woolen cloth, the edge shall be slit by diagonal cuts at intervals of about 6 inches (152 mm).

5.1.1 Preparation of specimen for dimensional stability.

5.1.1.1 Woven or warp knitted (single layer) cloth. The three specimens shall be selected from the cloth (sample unit) as follows: One specimen from each side of the cloth to within 3 inches (76 mm) of the selvage and one specimen from the center of the cloth. No two specimens shall contain the same filling yarns or courses. The specimens shall be laid without tension on a flat surface, care being taken that the cloth is free from wrinkle: on.

creases. Three distances, each a minimum of 18 inches (457 mm) shall be measured and marked off parallel to each of the warp and filling or wale and course directions of the specimen. The distance shall be a minimum of 6 inches (152 mm) apart with 1 inch (25 mm) from any edge of the specimen. The distance may be marked with indelible ink and a fine pointed pen, or by sewing fine threads into the cloth, or by a stamping machine (see 7.5). The measured distance shall be parallel to the respective yarns.

5.1.1.2 Circular and tubular knit cloths. Three distances, each a minimum of 18 inches (457 mm) shall be measured and marked off parallel to the wale directions of the specimen. The distances shall be a minimum of 6 inches (152 mm) apart.

5.1.1.3 Cloths 22 inches (559 mm) and less in width. Three distances, each a minimum of 18 inches (457 mm) , shall be measured and marked off parallel to the warp or wale direction. Three width measurements shall be made and marked off along the full width of the cloth parallel to the filling or course direction. The distances shall be a minimum of 6 inches (152 mm) apart.

5.1.2 Preparation of specimen for laundering of batting. The 26-inch (660 mm) square of batting shall be sewn between two pieces of cotton balloon cloth conforming to MIL-C-332, type I, class 2. The bonded batting shall be placed between the two pieces of balloon cloth with the warp direction of the cloth coinciding with the length direction of the batting. The assembly shall be completely stitched on all four sides approximately 1 inch (25 mm) in from the outer edges. In addition, the assembly shall be stitched at 6-inch (152 mm) intervals in the warp direction yielding four channels in the test specimen.

5.1.3 Preparation of specimen for laundering of feathers. The one ounce (28.4 g) specimen of feathers shall be sewn in a 17-by 6-inch (432 by 152 mm) cotton balloon cloth bag conforming to MIL-C-332, type I, class 2. Care shall be taken in constructing the bag to insure that seams are tight and strong to prevent loss of feather material.

5.2 The procedure to be followed, i.e., cotton or wool, shall be specified in the end item specification or procurement document.

5.2.1 Standard loads. Unless otherwise specified in the procurement document, the following standard loads shall be comprised of the specimen under test and clean ballast. Ballast shall be of comparable size, weight, type, and functionally finished in the same manner as the test specimen(s).

5.2.1.1 Cotton laundering procedure. A total weight of 20 pounds (9.1 kg) consisting of specimen and ballast.

5.2.1 .1.1 Cotton laundering procedure when evaluating flame resistant finishes. A total weight of 20 pounds (9.1 kg) consisting of sufficient 22 inch (457 mm) squares of specimen and 22-inch (457 mm) squares of ballast.

5.2.1.2 Wool laundering procedure. A total weight of 20 pounds (9.1 kg) consisting of specimen and ballast.

5.2.2 Cotton laundering procedure. Water of not over 50 parts per million hardness at the required temperature ± 4°F (± 2°C) shall be introduced into the wash wheel to the designated level. The specimens and ballast shall then be placed in the wash wheel. The schedule of table I shall be followed. At the end of each time interval, the machine shall be stopped, drained without removing the load and refilled to the proper level before starting again. After laundering, the standard load shall be extracted in two equivalent portions, a minimum of 3 minutes each. The specimens and ballast shall be separated, opened to full width and placed in a drier pre-heated at a stack temperature of 140°F to 180°F (60° to 82°C), and dried together at this temperature for 45 to 60 minutes. Temperature recovery time at beginning of cycle may *vary* depending on drier and fabric type.

TABLE 1. Cotton laundering schedule (see 7.4)

Operation	Composition	Water level inches (mm)	Temperature °F (°c)	Time (minutes of wheel in motion)
1. Suds	Synthetic detergent (10 g)	6 (152 mm)	100 (38)	5
2. Suds	Synthetic detergent (6 g)	4 (102 mm)	140 (60)	5
3. Rinse		8 (203 mm)	140 (60)	3
4. Rinse		8 (203 mm)	120 (49)	3
5. Rinse	Sour (24 g)	8 (203 mm)	100 (38)	3
6. Rinse		8 (203 mm)	100 (38)	3
				22

5.2.3 Wool laundering procedure. Water of not, over 50 parts per million hardness at the required temperature ± 4°F (± 2°c) shall be introduced into the wash wheel to the designated level. The specimen and ballast shall then be placed in the wash wheel. The schedule of table II shall be followed. At the end of each operation, the machine shall be stopped, drained without removing the load, and refilled to the required level before starting again. After laundering, the standard load shall be extracted in two equivalent portions for 5 minutes each. The specimens shall be separated, opened to full width and placed in a drier pre-heated at a stack temperature of 140°F to 180°F (60° to 82°c), and dried together at this temperature for 30 to 45 minutes. Temperature recovery time at beginning of cycle may vary depending on drier and fabric type.

TABLE II. Wool laundering schedule (see 7.4)

Operation	Composition	Water level inches (mm)	Temperature °F (°C)	Time (minutes of wheel in motion)
1. Suds	Synthetic detergent (10 g)	7 (178 mm)	100 (38)	5
2. Suds	Synthetic detergent (6g)	7 (178 mm)	100 (38)	5
3. Rinse		8 (203 mm)	100 (38)	3
4. Rinse		8 (203 mm)	100 (38)	3
5. Finse	Sour (24 g)	8 (203 mm)	100 (38)	4
				20

5.2.4 Laundering cycles. When the requirement in the end item specification or procurement document requires more than one laundering, the complete cycle of washing, extraction, and drying shall be performed the number of times specified. Pressing need only be performed once.

5.3 Pressing.

5.3.1 Pressing of cloths for dimensional stability. The dry specimen shall be allowed to cool a minimum of 5 minutes and shall then be sufficiently moistened with water to allow good pressing. This wetting of the specimen shall be accomplished by a spray nozzle set for fine mist. The specimen shall be permitted to remain in this condition for 5 minutes, smoothed to remove wrinkles but not distorted, and then pressed either with a flat-bed press or hand-iron. The head of the press or the hand-iron shall be set at a temperature of 2480 to 3020F (1200 to 1500c).

5.3.2 When a hand-iron is used, the iron shall not be slid back and forth on the specimen, but simply pressed down upon it in a manner simulating the action of a flat-bed press.

5.3.3 Unless otherwise specified in the procurement document, knitted cloths, battings and feathers shall not be moistened or pressed. Fabrics tested for durability or stability of functional finishes (i.e. water repellency , flame retardancy, etc.) shall not be moistened or pressed.

5.4 Evaluation.

5.4.1 Evaluation of cloth for dimensional stability. The specimen shall be laid out without tension on a flat surface in the standard atmosphere until moisture equilibrium is reached. Care shall be taken that the specimen is

smooth and free from wrinkles or creases. The previously measured distance marked on the specimen shall again be measured in both the warp or wale and filling or course direction.

5.4.2 Evaluation of functional finishes, battings, and feathers. The criteria employed in evaluating functional finishes shall be as specified in the applicable end item specification or procurement document.

5.5 Calculation of results. The dimensional stability of the specimen shall be calculated as follows:

$$\text{Shrinkage, percent} = \frac{A - B}{A} \times 100$$

Where: A = average of initial measurements (3 specimens)

B = average of measurements after laundering (3 specimens).

6. REPORT

6.1 Dimensional stability.

6.1.1 The shrinkage of the sample unit in the warp or wale direction and in the filling or course direction shall be the average of the specimens tested from each direction, respectively, and shall be reported separately to the nearest 0.1 percent.

6.1.1.1 A final measurement smaller than the original measurement results in a negative dimensional change which is shrinkage. A final measurement larger than the original measurements results in a positive dimensional change which is growth or elongation.

6.2 Curability or stability of functional finishes.

6.2.1 Reporting the results in the evaluation of functional finishes shall be as specified in the applicable end item specification or procurement document.

6.3 Launderability of battings and feathers. The reporting of results in the evaluation of launderability of battings and feathers shall be as specified in the applicable end item specification or procurement document.

6.4 Each individual value used to calculate the average shall also be reported.

7. NOTES

7.1 The wash wheel and drier as described may be obtained from Ewing Division of Powercom, P.O. Box 454, Troy, NY 12181.

7.2 The pressing equipment and extractor may be obtained from Ewing Division of Powercom, P.O. Box 454, Troy, NY 12181; American Laundry Machinery Company 5050 Section Avenue, Cincinnati, OH 45212 and Troy Laundry Machinery, East Moline, IL 61244.

7.3 Synthetic Laundering Detergent (Igepon T-77) may be obtained from GAF Corporation, Chemicals Division, P.O. Box 700, Linden, NJ 07036.

7.4 The water levels shown in the tables are based on a wash wheel with 24 inch (610 mm) inside diameter and 24 inch (610 mm) inside length. Table III shows the volumes of liquids corresponding to these water levels:

TABLE III

Water level in the wash wheel		Volume	
Inches	(mm)	Gallons	(L)
4	(102)	9.3	(35)
6	(152)	14.3	(54)
7	(178)	17.5	(66)
8	(203)	20.5	(77.6)
10	(254)	26.2	(99)

7.5 Ruler, stamping device and ink. The measuring ruler, stamping device and indelible ink may be obtained from the Sanforized Co., 433 River Street, Troy, NY 12180.

COLORFASTNESS OF TEXTILE MATERIALS TO DRY HEAT

1. S COPE

1.1 This method is intended for determining the colorfastness of textile materials to dry heat, including sublimation

2. TEST SPECIMEN

2.1 Standard sample. Unless otherwise specified in the procurement document, when a standard sample has been established, the required specimens from the sample unit of the material to be tested and one specimen from the standard sample shall be as follows:

2.1.1 Cloth. A rectangle of cloth 2 inches by 4 inches (51 mm by 102 mm).

2.1.2 Yarn and thread. Not less than 1 g and not more than 3 g of yarn so held together as to form a unit for testing.

2.1.3 Tapes, braids and narrow fabrics. A rectangle of the specimen 2 inches by 4 inches (51 mm by 102 mm). When the full width of the specimen is not 2 inches (51 mm), several lengths of the material shall be placed adjacent and parallel.

2.2 No standard sample. Unless otherwise specified in the procurement document, when a standard sample has not been established, the required specimens from the sample unit of the material to be tested shall be as specified in 2.1.1, 2.1.2 or 2.1.3. One additional specimen shall be taken from each sample unit of material to be tested and shall be retained, untested, for comparison. All specimens shall be taken from adjacent areas of the sample unit.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the procurement document, one specimen shall be tested from each sample unit.

4. APPARATUS

4.1 Heating arrangement providing even heat transfer by close contact to both sides of the specimen. This device shall be capable of maintaining selected temperatures within a tolerance of ± 6°F (± 3°C) in the range of 3000 through 426°F (149° through 219°C) and of maintaining sufficient pressure on the composite specimen to assure intimate contact between the test specimen and the heating medium (see 7.1).

4.2 Color transfer cloth. Two pieces of Multifiber Test Fabric No. 10 measuring 2 inches by 4 inches (51 mm by 102 mm) and consisting of acetate, cotton, nylon 66, polyester (polyethylene terephthalate), acrylic, and Wool shall be used (see 7.2).

4.3 Time indicator. Stop watch or other timing device which will indicate the time in seconds.

4.4 Gray Scale for Staining (see 7.3). Or AATCC Chromatic Transference Scale.

5. PROCEDURE

5.1 Standard sample. When a standard sample has been established a specimen from the standard shall be subjected to the same conditions of testing as the specimen of the material being tested.

5.2 No standard sample. When a standard sample has not been established) one specimen from each sample unit to be tested shall be retained, untested, for comparison.

5.3 Preparation of specimen. Place the specimen between the two pieces of the Multifiber Test Fabric No. 10, so that the specimen will be in contact with all the bands of the test cloth, to form a composite specimen.

5.4 Unless otherwise specified in the procurement document, place the composite specimen in the heating device for 30 seconds at the specified temperature.

5.4.1 One or more of the following temperatures shall be used to perform the test. The applicable procurement document shall specify the proper temperature or temperatures for that material.

1. 300° ± 6°F (149° ± 3°c)
2. 325° ± 6°F (163° ± 3°C)
3. 351° ± 6°F (177° ± 3°C)
4. 376° ± 6°F (191° ± 3°C)
5. 401° ± 6°F (205° ± 3°C)
6. 426° ± 6°F (219° ± 3°C)

5.5 Remove the composite specimen from the heating device and separate components for evaluation.

5.6 Evaluation.

5.6.1 The color change of the test specimen and the staining of the color transfer cloth shall be evaluated separately to determine the colorfastness to dry heat.

5.6.2 Color change.

5.6.2.1 Standard sample. The color change exhibited by the tested specimen when compared to the untested specimen retained shall be evaluated against the color change exhibited by the tested standard when compared to the untested standard retained.

Pass: Color change equal to or less than that of the standard sample.
Fail: Color change greater than that of the standard sample.

5.6.2.2 No standard sample. When a standard sample has not been established, the test specimen shall be compared to the untested specimen retained for comparison and shall be rated as follows:

Excellent: No preceptible change in color.
Good : Perceptible but not an appreciable change in color.
Fair: Appreciable but not an objectionable change in color.
Poor: Objectionable change in color.

Appreciable change in color means a change that is immediately noticeable in comparing the test specimen with the original sample for comparison. If closer inspection or a change of angle of light is required to make apparent a slight change of color, the change is not considered appreciable.

5.6.3 Color transfer.

5.6.3.1 Standard sample. When a standard sample has been established, the color transfer cloth from the specimen shall be compared with the color transfer cloth from the standard sample and rated as follows:

Pass: Staining equal to or less than that of the standard sample.
Fail: Staining greater than that of the standard sample.

5.6.3.2 When a standard sample has not been established the test color transfer cloth shall be compared with the Gray Scale for Staining or AATCC Chromatic Transference Scale and rated as follows:

Excellent: Staining rated numerically greater than 4.5.
Good : Staining rated equal to or greater than 3.5.
Fair: Staining rated equal to or greater than 2.5.
Poor: Staining rated equal to or less than 2.5.

6. REPORT

6.1 Standard sample.

6.1.1. Colorfastness (color change) to dry heat shall be reported as “pass” or "fail" specimen is compared to the standard sample.

6.1.2 Colorfastness (staining) to dry heat shall be reported as “pass” or “fail” when the color transfer cloth from the test specimen is compared with the color transfer cloth from the standard sample.

6.1.3 When failure is reported, the severest departure (i.e. the actual rating “fair” or “poor”), of the change of the test specimen or staining of specific fibers of the color transfer cloth, shall be distinguished and reported.

6.2 No standard sample.

6.2.1 Colorfastness (color change) to dry heat shall be reported as “pass” or “fail” when the test specimen is compared with the untested specimen and rated in accordance with the adjective ratings of 5.6.2.2.

6.2.2 Colorfastness (staining) to dry heat shall be reported as “pass” or “fail” when the color transfer cloth is rated in accordance with the adjective ratings of 5.6.3.2.

6.2.3 When failure is reported, the severest departure (i.e. the actual rating , “fair” or “poor”), of the change of test specimen or staining of specific fibers of the color transfer cloth, shall be distinguished and reported.

7. NOTES

7.1 The apparatus described (Scorch Tester) may be obtained from the Atlas Electric Devices Co., 4114 N. Ravenswood Avenue, Chicago, IL 60613.

7.2 The Multifiber Test Fabric No. 10 (color transfer cloth) may be obtained from Testfabrics, Inc., P.O. Drawer O, Middlesex, NJ 08846.

7.3 Gray Scale for Staining and AATCC Chromatic Transference Scale may be obtained from the American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.

METHOD 5651.1
December 28, 1989
SUPERSEDING METHOD 5651
July 20, 1978

COLORFASTNESS OF TEXTILE MATERIALS TO CROCKINC

1. SCOPE

1.1 This method is intended for determining the resistance of woven or knitted cloth to crocking. Crocking in this case refers to the transfer of coloring matter from one cloth to another cloth with which it may come in contact. This method is applicable to cloth of all fibers whether dyed, printed, impregnated, or otherwise colored. The method is particularly applicable to cloth of solid color, although variegated cloth may be tested if the colored area is of sufficient size. The method also includes provisions for testing the crocking of white or light functionally finished cloths against dark colored cloth when required by the cloth specification. Wet and dry crocking may be determined by this method. Unless otherwise specified in the procurement document, both wet and dry crocking are considered in rating the resistance to crocking as determined by this method.

2. TEST SPECIMEN

2.1 Standard sample. Unless otherwise specified in the procurement document, when a standard sample has been established, the required specimens from the sample unit of the material to be tested and one specimen from the standard sample shall be as follows:

2.1.1 Cloth. Unless otherwise specified. the specimen shall be a rectangle of cloth 8 inches by 4 inches (203 mm by 102 mm). The long dimension shall be parallel to the warp.

2.1.2 Tapes and laces. For narrow tapes and laces, the specimen shall be held in the test position by any suitable means. For example, lace may be attached firmly to a piece of white cotton cloth. When the individual item is too narrow for the size of the crocking finger, specimens of the material shall be laid adjacent and closely packed so that the full crocking area of the finger is covered.

2.2 No standard sample. Unless otherwise specified in the procurement document, when a standard sample has not been established, the required specimen from the sample unit of the material to be tested shall be as specified in 2.1.1 and 2.1.2. One additional specimen shall be taken from each sample unit of material to be tested and retained, untested, for comparison. All specimens shall be taken from adjacent areas of the sample unit.

3. NJUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the procurement document, one specimen shall be tested from each sample unit.

4. APPARATUS AND METHOD CITED

4.1 Crockmeter. A crockmeter consisting of a wooden base or equivalent, upon which a sliding arm operated by a crank shall be fixed in such a manner as to slide back and forth in a straight line with a stroke of 4 inches (102 mm). The arm shall have a flat-ended cylindrical finger, 5/8 inch (16 mm) in diameter, which shall exert a total force of 2 pounds (9 N) on the cloth clamped to the base (see 7.1).

4.2 Color transfer cloth.

4.2.1 White. Unless otherwise specified in the procurement document the color transfer cloth shall be a bleached, desized, 80 by 84 (32 by 33 yards/cm) combed yarn cotton lawn cloth, and cut into 2-inch (51 mm) squares. The cloth shall contain no bluing or optical bleach (see 7.4).

4.2.2 Blue. When specified, the color transfer cloth shall be vat dyed, 80 by 84 (3? by 33 yarns/cm) combed yarn cotton lawn cloth, Blue 186, and cut into 2-inch (51 mm) squares (see 7.5).

4.3 Evaluation scales.

4.3.1 Unless otherwise specified in the procurement document, any of the following evaluation scales may be used.

4.3.1.1 Munsell Neutral Value Scale. Munsell Neutral Value Scale (1 to 9), for use in evaluating fire, weather, and water resistant cloths or similarly impregnated cloth (see 7.3).

4.3.1.2 Munsell Color Chips. Munsell Color Chips of hues red, yellow, green, blue and purple, in values 6 to 9 with 2 steps of chroma, may be used in conjunction with the A.A.T.C.C. Chromatic Transference Scale for evaluating colored textiles (see 7.3).

4.3.1.3 A.A.T.C.C. Chromatic Transference Scale. The Chromatic Transference Scale may be used for evaluating colored textiles. For critical evaluations, ratings must be based on the geometric Gray Scale for evaluating stainings (see 7.6).

4.4 Wringer. A household type wringer equipped with smooth rubber squeeze rolls 2-1/8 to 2-1/2 inches (54 mm to 64 mm) in diameter and not less than 11 inches (279 mm) or more than 16 inches (406 mm) long. The rubber rolls shall have a Shore durometer hardness of 70 to 80 (A scale). The load exerted on the specimen shall be applied uniformly by means of a dead weight attached to the top roller. The total load of the roller, means of attaching the weight, and the weight itself shall be 60 pounds (27 kg). The rolls shall be power driven at such a speed that the specimen shall pass through the rolls at the rate of 1 inch (25 mm) per second.

4.5 The color transfer cloth shall be mounted with the weave parallel to the direction of rubbing and placed over the flat end cf the cylindrical finger which projects downward from the weighted sliding arm. A spiral wire clip or other similar device shall be used to hold the crock cloth tightly over the end of the finger. The clip should be positioned with the loops upward.

4.6 Distilled water. Distilled water for wetting the crock cloth for wet crocking.

4.7 Blotting paper. The blotting paper dimensions shall be 4 inches by 8 inches (102 mm by 203 mm) (see 7.2).

4.8 Method cited. Method 9010, Shade Matching of Textile Materials; Visual Method .

5. PROCEDURE

5.1 Standard sample. When a standard sample has been established for colorfastness to crocking, Method A shall be used for evaluating the resistance to crocking (see 5.5).

5.1.1 No standard sample. When a standard sample has not been established, Method B shall be used for evaluating the resistance to crocking.

5.2 When a standard or comparison sample has been established, a specimen from the standard or comparison sample shall be tested under the same conditions as the specimen undergoing the test.

5.3 Unless otherwise specified in the procurement document, the face of the cloth shall be against the finger of the crockmeter.

5.4 Dry crocking.

5.4.1 The specimen and the "dry" crock cloth shall be brought to moisture equilibrium under standard conditions, in accordance with Section 4 of this standard.

5.4.2 The specimen shall be placed on the abrasive cloth-covered base of the crockmeter so that the finger contacts the specimen about 1 inch (25 mm) from the 8-inch (203 mm) warp edge of the specimen.

5.4.3 The finger with the cloth attached shall be placed on the surface of the specimen and moved back and forth on the specimen at the approximate rate of 1 cycle per second. Ten cycles (20 strokes) shall constitute the test.

5.5 Wet crocking.

5.5.1 The test shall be repeated on an area adjacent to the previous test using a new crock cloth "wet" with distilled water. For wetting, the dry crock cloth shall first be placed between two blotters. The blotters and crock cloth shall then be saturated and passed through the wringer to remove excess water. The moisture pickup shall be 65 ± 5 percent based on the conditioned weight of the crock cloth. The crock test shall be performed immediately after wringing.

5.6 Evaluation. staining of the dry and wet crock cloths shall be considered in rating the resistance to crocking. Evaluation shall be conducted in accordance with Method 9010. During evaluation, the crock cloth of the test specimen (dried in atmospheric conditions in the case of the wet test) should be backed by three layers of the crock cloth.

5.6.1 Method A, standard sample. The "crock" obtained from the test specimen shall be compared with the "crock" obtained in testing the specimen from the standard sample and rated as follows:

Pass: Equal or superior to the standard sample in resistance to crocking.
Fail : Inferior to the standard sample in resistance to crocking.

5.6.2 Method B, no standard sample. The coloration transferred to the test crock cloth as a result of contact with the test specimen shall be compared with the Munsell Neutral Value Scale, Munsell Color Chips or the A.A.T.C.C. Chromatic Transference Scale, or the Gray Scale for Staining as required and unless otherwise specified (see 6.2 and 6.4) evaluated as follows:

5.6.2.1 When white crock cloth is required.

Excellent: No perceptible staining of the white crock cloth.
Good : Slight staining of the white crock cloth. Not to be numerically lower than Munsell Value 8.5 or lower than the AATCC Chromatic Transference Scale of 3.5.
Fair: Appreciable, but not objectionable, staining of the white crock cloth. Not to be numerically lower than Munsell Value 6.5 or lower than the AATCC Chromatic Transference Scale of 1.5.
Poor: Objectionable staining of white crock cloth, numerically lower than Munsell Value 6.5 or lower than the AATCC Chromatic Transference Scale of 1.5.

5.6.2.2 When blue crock cloth is required.

Excellent: No perceptible staining of the blue crock cloth.
Good : Slight staining of the blue crock cloth. Not to be numerically higher than Munsell Value 4.5.
Fair: Appreciable, but not objectionable, staining of the blue crock cloth. Not to be numerically higher than Munsell Value 6.5.
Poor: Objectionable staining of the blue crock cloth.

"Appreciable change in color" means a change which is immediately noticeable in comparing the tested specimen with the original comparison specimen. If closer inspection or a change of angle of light is required to make apparent a slight change in color, the change is not considered appreciable.

6. REPORT

6.1 Standard sample. When a standard sample has been established, the resistance to crocking shall be reported as "pass" or "fail".

6.2 No standard sample. When a standard sample has not been established, the resistance to crocking shall be reported as "pass" or "fail", unless otherwise specified in the procurement document. When failure is reported, the numeric rating and the adjective rating, "good", "fair", or "poor", shall also be reported.

Pass: Equal or higher than the numeric value required by the procurement document.
Fail : Less than the numeric value required by the procurement document.

6.3 When specified in the procurement document, the resistance to crocking shall be reported to the value nearest to one of the Munsell Values (4.3. 1.1 , 4.3.1.2, 4.3.1.3), or to the nearest AATCC Chromatic Transference Scale Rating.

6.4 The dry and wet crocking resistance of each sample unit shall be reported separately.

6.5 The scale used for evaluation shall be reported.

7. NOTES

7.1 The crockmeter may be purchased from the Executive Secretary, A.A.T.C.C. National Headquarters, P.O. Box 12215, Research Triangle Park, NC 2770°, and Atlas Electric Devices Co., 4114 North Ravenswood Ave., Chicago, IL 60613.

7.2 The blotting paper may be purchased from AATCC National Headquarters, P.O. Box 12215, Research Triangle Park, NC 27709.

7.3 The Munsell Neutral Value Scale and the Munsell Color Chips may be purchased from the Munsell Color Co., 2441 North Calvert St., Baltimore, MD 212I8.

7.4 The white crock cloth which meets the requirements of this method may be purchased from TestFabrics, Inc., P.O. Drawer 0, 200 Blackford Ave., Middlesex, NJ 08846.

7.5 The blue crock cloth may ne obtained from the Defense Personnel Support Center, 2800 South 20th Street, Philadelphia, PA 19191.

7.6 The Chromatic Transfererce Scale and the Gray Scale for staining may be purchased from A.A.T.C.C. National Headquarters, P.O. Box 12215, Research Triangle Park, NC 27759.

COLORFASTNESS TO LIGHT OF TEXTILE MATERIALS;

ACCELERATED METHOD: ENCLOSED CARBON ARC

1. SCOPE

1.1 This method is intended for determining the colorfastness of textile materials to light in a carbon-arc fading apparatus.

2. TEST SPECIMEN

2.1 No standard sample available. Unless otherwise specified in the procurement document when a standard sample has not been established, one specimen from each sample unit of the material to be tested shall be selected as in 2.1.

2.2 Standard sample available. Unless otherwise specified in the procurement document, when a standard sample has been established and the amount of exposure has been specified, one specimen from each sample unit of the material to be tested, and one specimen from the standard sample shall be as specified in 2.2.1 through 2.2.3.

2.2.1 When a standard sample has been established and amount of exposure has not been specified, one specimen from each sample unit and one specimen from the standard sample shall be taken for testing.

2.3 The specimens for testing shall be as follows:

2.3.1 cloth. A rectangle of cloth measuring 2-1/2 inches by 3 inches (64 mm by 76 mm) with the long dimension parallel to the warp direction.

2.3.2 Textile fibers. Fibers will be made into pads forming a rectangle measuring 2-1/2 inches by 3 inches (64 mm by 76 mm).

2.3.2 Yarns, threads, luight cordage, tapes and webbing. Yarns , threads, light cordage, tapes and webbing shall be wound on white cards forming a rectangle 2-1/2 inches by 3 inches (64 mm by 76 mm) with the long dimension lengthwise of the materials being tested.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the procurement document, one specimen shall be tested from each sample unit.

4. APPARATUS AND METHOD CITED

4.1 Apparatus.

4.1.1 Carbon-arc lamp fading apparatus (see 7.2). The carbon-arc lamp fading apparatus shall conform to the following:

4.1.1.1 Vertical carbon-arc assembly mounted at the center of a vertical cylindrical specimen rack.

4.1.1.2 The electrodes shall be carbon, one solid, 1/2 inch (13 mm) diameter and one cored, 1/2 inch (13 mm) diameter, placed in the machine in the manner described in the operating instructions.

4.1.1.3 The arc shall be operated at 15 to 17 amperes 60-cycle alternating current with an arc voltage of 135 to 145 volts and a line voltage of 208 to 250 volts.

4.1.2 Clear glass globe of No. 9200 Pyrex, or equal, for enclosing the arc.

4.1.3 Cylindrical specimen rack designed such that the specimen is positioned at a radial distance of 10 inches (254 mm) from the center of the arc with no part over 5 inches (127 mm) above or below the arc.

4.1.3.1 The specimen rack shall revolve at 1 revolution per minute about the arc.

4.1.4. The black panel thermometer unit shall consist of a 20-gage stainless steel panel, 2-3/4 by 5-7/8 inches (70 to 150 mm) to which is fastened a stainless steel bimetallic dial-type thermometer. The face of the panel with the thermometer shall be the same distance from the arc as the surface of the specimen. The black panel thermometer shall be periodically cleaned to keep the face free of foreign matter and in good condition.

4.1.5 Chamber temperature shall be controlled by regulating the temperature of a constant volume of air flowing across the specimens. An atomizing unit shall control the addition of moisture to the air prior to its entry into the test chamber in such manner that the relative humidity within the test chamber shall be controlled in the range of 30 percent to 50 percent. Black panel temperature shall be maintained at 145° ± 6°F (63° ± 3°C).

4.1.6 Abridged spectrophotometers or spectrophotometers with suitable geometry for reflectance measurements may be used. The standard aperture size used in the color measuring device shall be 1.0 to 1.25 inches in diamater. Such instruments require tristimulus integrators or direct readout for computer calculation of the calorimetric data. Suitable instrumentation would include the Diane-Hardy, Diane-Match-Scan II, Hunterlab UltraScan Spectrocolorimeter, ACS Spectro-Sensor, or the Macbeth MS-2000.

4.2 Determination of standard fading. The standard Blue Wool shall be obtained from the AATCC. One specimen of the AATCC Blue Wool Lightfastness Standard is required. Cut a rectangular specimen 2-1/2 inches by 3 inches, unless otherwise specified in the applicable military specification or procurement document, with the larger dimension in the warp direction.

4.3 Method cited.

Method 9010, Shade Matching of Textile Materials; Visual Method.

5. PROCEDURE

5.1 Preparation of specimen.

5.1.1 For specimens containing other than wool fiber. The specimens shall be conditioned a minimum of 4 hours at standard conditions in accordance with Section 4 of this Standard prior to being exposed in the machine.

5.1.2 For wool specimens and specimens containing blends of wool fiber. The specimens (test specimen and specimen of standard sample when applicable) shall be prepared as follows prior to exposure: The specimen shall be laid flat, without folding, in a sink or similar apparatus, and water at a temperature of 75° to 86°F (24° to 30°C) applied in a fine spray against it until it is thoroughly wet. No wetting agent shall be used. The specimen shall be turned over and the reverse side sprayed until it is saturated. The specimen shall then be extracted and then spread out without distortion on a drying tray to remove wrinkles and permitted to air dry. The drying time may be decreased by placing the specimen on the tray in moving air from a fan or it may be placed in a drying oven at a temperature not to exceed 180°F (82°C). Pressing of the specimens is prohibited. After drying the specimen shall be conditioned for a minimum of 4 hours under standard conditions prior to being mounted in the apparatus.

5.1.3 Mount specimen in specimen holder using no backing material of any kind, taking care to insure that the front and back covers make good contact with the specimen. The specimen holder cover and back clip should be fastened reasonably tight to yield a sharp line of demarcation between exposed and unexposed areas, but should not compress the specimens unnecessarily. Specimens shall be mounted for testing as follows:

5.1.3.1 No standard sample. When no standard sample is available, one holder containing the test specimen and one holder containing the Blue Wool shall be prepared. All available spaces on the specimen rack shall be filled.

5.1.3.2 Standard sample. When a standard sample is available for comparison purposes and the number of standard hours of exposure is specified one holder containing the test specimen, one holder containing the standard sample, and one holder containing Blue Wool shall be prepared. When several

specimens of the same material and shade are being exposed at the same time and for the same exposure time, one specimen of the standard and one Blue Wool shall suffice for all specimens. All available spaces on the specimen rack shall be filled.

5.1.3.3 When a standard sample is available for comparison purposes and the number of standard hours is not specified; one holder containing test specimens, one holder containing standard sample, and one holder containing the Blue Wool shall be prepared. Remaining holders shall be prepared with other test specimens or filler materials to insure that all specimen holders are filled.

5.2 Prepartion of appartus prior to installing specimens.

5.2.1 Install a new trim of carbons in accordance with operating instructions.

5.2.2 The globe inclosing the carbon-arc shall be cleaned after every 24 hours of operating time. Prior to installation, the globe shall be checked for cracks, chips or discoloration. The globe shall be discarded after 2000 hours of operation or when discoloration, cracking, or chipping develops.

5.2.3 Clean or replace wet bulb wick and air filter, in accordance with manufacturer's operating instructions.

5.3 Installation of specimen holders in machine. Place the filled specimen holders in the specimen rack with the holders supported both top and bottom in proper vertical alignment. A small displacement of the specimen toward or away from the lamp may lead to too much or too little fading. Insure that the rack is completely filled with specimen holders. When utilizing a standard sample, place the standard and the test specimen adjacent to one another on the rack.

5.4 Close the chamber door and set the timer for 20 clock hours or for that number of clock hours which are known to be equivalent to the specified AATCC fading units, and start the machine. Check controls to insure that the machine is funetioning properly.

5.5 Length of exposure.

5.5.1 No standard sample. Unless otherwise specified in the procurement document, when a standard sample has not been established or is not available for comparison, the test specimen shall be exposed for 40 AATCC fading units. At the end of each 20-hour exposure period, a new piece of L-4 Blue Wool shall be placed in the machine. The exposed L-4 Blue Wool shall be retained and evaluated in accordance with instructions contained in 5.6.

5.5.2 Standard sample available. When a standard sample has been established and is available for comparison purposes and the number of standard fading hours of exposure is not specified, one test specimen from the material undergoing test, one specimen from the standard sample, and one specimen of the L-4 Blue Wool shall be exposed. At the end of the specified number of hours of exposure, the specimens shall be removed from the fading apparatus and the test specimens and specimen of the standard sample compared with the unexposed specimen for an appreciable change in color as described in 5.7.2.

5.5.3 The L-4 Blue Wool shall be replaced with another unexposed L-4 Blue Wool (the exposed L-4 Blue Wool being retained) and all the specimens replaced in the machine. This procedure shall be repeated every 20 AATCC fading hours of exposure.

5.5.4 When an appreciable change in color is evident in either sample being evaluated or the standard sample, the specimens shall be again placed in the fading apparatus. Exposure shall be continued for an additional number of hours equal to the number of hours at which the “appreciable change in color” was apparent, and the test is terminated at the end of that period.

5.5.5 Specimens which do not show an “appreciable change in color” until 80 or more standard fading units of exposure shall be returned to the fading apparatus for a total exposure period not exceeding 140 standard fading units, at which time the test shall be terminated.

5.5.6 At the end of the total exposure period, the test specimen and the specimen of the standard sample shall be removed from the apparatus and placed in the dark at room temperature for a minimum of 4 hours before evaluation.

5.6 Evaluation of Blue wool.

5.6.1 The exposed specimen of Blue Wool after removal from the apparatus shall be placed in the dark at room temperature for a minimum of 4 hours.

5.6.2 Calibrate the spectrophotometer according to manufacturer’s recommendations. Calorimetric Data will be obtained using CIE illuminant D65 and the 10 Degrees 1964 Supplementary standard observer. Spectral reflectance data shall be relative to a Barium Sulfate standard, the preferred white reference standard. Other white reference standards may be used, providing they are calibrated to an absolute white, e.g. Halon, Magnesium or Vitrolite Tiles (see 7.4).

5.6.3 Place specimen against the sample port of the instrument so that a smooth , taut surface is prepared for measurement. Areas of the specimen to be measured should be free of fabric irregularities and soiled areas. Back the specimen with one layer of unexposed Blue Wool lightfastness standard. Take one measurement with the specimen aligned in the warp direction, rotate the specimen 90 degrees, and take the second measurement and calculate the

average . Inspect two measurements per area for reasonable agreement. If in doubt about the results, repeat the measurements. A fresh piece of Blue Wool lightfastness standard and not the unexposed area of the fade test specimen, should be used for the unexposed area measurement. Next, measure the exposed area of the fade test specimen, insuring no overlap of unexposed area is included. Compute the color difference (ΔE)* in CIELAB* units of color difference (see 7.5).

5.6.3.1 Any fading lamp may change its rate of fading from day to day. Therefore, AATCC Standard L-4 Blue Wool shall be used as a control in all testing, that is, the L-4 Blue Wool shall be exposed at the same time as the test specimens.

5.6.4 The fading units recorded for each of exposure shall be totaled. This figure is the total number of standard fading units to which the material has been exposed.

5.6.5 Calculation for L-4 Blue Wool

$$\text{AATCC Fading units} = \frac{(\Delta E^*) \times (20 \text{ hours}}{1.7}$$

Note: 16 to 22 AATCC fading units are acceptable as 20 fading hours. 20 = number of clock hours L-4 Blue Wool lightfastness standard is exposed. 1.7 = CIELAB* units of color difference. The amount of fade shown by L-4 Blue Wool lightfastness standard at 20 AATCC fading units of exposure is equivalent to 1.7 CIELAB* units and is equivalent to just appreciable fading or a visual comparison of step 4 on the AATCC Grey Scale for Color Change.

5.7 Specimen color change when standard sample is available.

5.7.1 When a standard sample is available and the number of hours of exposure has not been established, the test specimen and the specimen of the standard sample which have been exposed for the total exposure, shall be compared and the test specimen rated as follows:

Pass: Color change equal to or less than that of the standard sample.
Fail : Color change greater than that of the standard sample.

5.7.1.2 When a standard sample is available and the number of hours of exposure has been established, the test specimen and the specimen of the standard sample shall be compared and the test specimen rated as follows:

Pass: Color change equal to or less than that of the standard sample.
Fail: Color change greater than that of the standard sample.

5.7.2 Specimen color change evaluation when no standard sample is available. When a standard sample has not been established, the exposed test specimen shall be compared with the unexposed specimen from the sample unit and rated as follows:

Excellent: No perceptible change in color.
Good : Perceptible, but not appreciable change in color.
Fair: Appreciable, but not objectionable change in color.
Poor: Objectionable change in color.

"Appreciable change in color" means a change that is immediately noticeable in comparing the test specimen with the original unexposed specimen. If closer inspection or a change of angle of light is required to make apparent a slight change in color, the change is not considered appreciable.

6. REPORT

6.1 Standard sample. When a standard sample has been established, colorfastness to light shall be reported as "pass" or "fail". When failure is reported, the severest departure (i.e. the actual rating, "fair" or "poor"), of the change of the test specimen, shall be reported,

6.2 No. standard sample. When no standard sample has been established, colorfastness to light shall be reported as "pass" or "fail". When failure is reported, the severest departure (i.e. the actual rating, "fair" or "poor"), of the change of the test specimen, shall be reported.

7. NOTES

7.1 AATCC Standard Blue Wool and AATCC Gray Scale for Color Change are available from AATCC.

7.2 An apparatus of the type described in this method may be obtained from the Atlas Electric Devices Co., 4114 N. Ravenswood Avenue, Chicago, IL 60613.

7.3 With wool-like materials in particular, the finish of the unexposed area may be altered during the exposure period due to pressure of the holding plates in the specimen holders on the fabric. Also, there is the possibility of changes due to thermal effects. When such situations are noted, two courses of action are possible. One is to evaluate the exposed area against a retained but sponged portion of the fabric. The other is to re-sponge the exposed specimen and evaluate after the specimen has dried and has been conditioned . Where calorimetric methods of measurement are used in evaluation, the exposed specimen shall, in every case, be compared to the retained sponged original specimen.

7.4 White standard. Barium sulfate of suitable quality for use as a white reference standard is available from the Eastman Kodak Company, Rochester, NY 14650. The same source has available magnesium reagent (ribbon) and Halon. Suitable titles can be obtained from the National Institute of Standards and Technology or the instrument manufacturer.

7.5 Computation of CIELAB* units of color difference can be achieved by following the method outlined in Robertson, A.R., "The CIE 1976 Color Difference Formula", Color Research and Application, Vol. 2, 1977, p. 7.

METHOD 5671.1
December 28, 1989
SUPERSEDING METHOD 5671
July 20, 1978

COLORFASTNESS OF TEXTILE MATERIALS TO WEATHER;

ACCELERATED WEATHERING METHOD: OPEN FLAME CARBON ARC

1. SCOPE

1.1 This method is intended for determining the colorfastness of textile materials when subjected to accelerated weathering conditions.

2. TEST SPECIMENS

2.1 Standard sample available. Unless otherwise specified in the procurement document, when a standard sample has been established and the length of time of exposure has been specified, one specimen from each sample unit of the material to be tested and one specimen from the standard sample shall be prepared as specified in 2.3.1 through 2.3.3.

2.1.1 When a standard sample has been established and the length of time of exposure has not been specified, three specimens from each sample unit and three specimens from the standard sample shall be taken for testing. The three specimens shall be cut from adjacent material in the sample unit.

2.2 No standard sample available. Unless otherwise specified in the procurement document, when a standard sample has not been established, one specimen from the sample unit of the material to be tested shall be as specified in 2.3.1 through 2.3.3. One additional specimen shall be taken from the sample unit of the material to be tested and shall be retained unexposed for comparison. Both specimens shall be cut from adjacent areas of the sample unit.

2.3 The specimens for testing shall be as follows:

2.3.1 Cloth. The specimen shall measure 2-1/2 inches by 10 inches (64 mm by 254 mm) with the long dimension parallel to either the warp or filling.

2.3.2 Yarn, thread, light cordage. The specimen shall be of sufficient length so that it may be close-wound on a plastic or wood panel to form a rectangle 2-1/2 inches by 10 inches (64 mm by 254 mm).

2.3.3 Narrow fabrics (tape, webbing, braid). The specimen shall be of sufficient length so that it may be close-wound on a plastic or wood panel to form a rectangle 2-1/2 inches by 10 inches (64 mm by 254 mm) except when the width of the sample unit is greater than 2-1/2 inches (64 mm). When the width of the sample unit is greater than 2-1/2 inches (64 mm) the specimen will be cut so that the longest dimension will be parallel to the length of the sample unit and an equal distance from the sides of the sample unit.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the procurement document, one determination shall be made on each sample unit.

4. APPARATUS AND METHODS CITED

4.1 Apparatus.

4.1.1 The apparatus shall be as described for Method 5804.

4.2 Methods cited.

Method 5804, Weathering Resistance of Cloth; Accelerated Weathering Method .
Method 9010, Shade Matching of Textile Materials; Visual Method.

5. PROCEDURE

5.1 All temperatures, water pressures and other conditions required for testing colorfastness to weathering shall be as described in Method 5804.

5.2 Stanndard sample. When a standard sample has been established and the number of hours of exposure is specified, one holder containing a specimen of the material being tested, and one holder containing a specimen of the standard sample shall be prepared.

5.3 No standard sample. When a standard sample has not been established, one holder containing one specimen of the material to be tested shall be prepared, and the remaining specimens shall be retained unexposed, for comparison purposes.

5.4 When several specimens of the same material are being exposed at the same time and under the same conditions, one specimen of the standard sample shall suffice for comparison with all test specimens (see 5.2).

5.5 When all specimens are placed in the test chamber and there are unfilled spaces, they shall be filled with specimen holders containing either filler material or other test specimens.

5.6 Length of exposure.

5.6.1 No standard sample. Unless otherwise specified in the procurement document, when a standard sample has not been established, the test specimen shall be exposed for 40 hours.

5.6.2 Standard sample. When a standard sample has been established and the number of hours of exposure is specified, the test specimen and the specimen from the standard sample shall be exposed for the specified number of hours of exposure.

5.6.2.1 When a standard sample has been established and the number of hours of exposure is not specified, two test specimens from the material undergoing test and two specimens from the standard sample shall be exposed. At the end of 20 hours of exposure, the specimens shall be removed from the test chamber. The test specimens and specimens of this standard sample shall be compared with the unexposed specimens for an "appreciable change in color" as described in 5.7.2.3.

5.6.2.1.1 If an "appreciable" change is not evident, all the specimens shall be exposed for an additional 20 hours and the color change evaluated. Repeat this procedure until an appreciable change in color occurs.

5.6.2. 1.2 When an "appreciable change in color" is evident in either test specimen when compared with a specimen of the standard sample, the length of time of exposure shall be recorded and the two specimens (one test specimen showing the "appreciable change in color" and the one specimen of the standard sample) shall be placed in the dark at room temperature for a minimum of 4 hours before evaluation.

5.6.2. 1.3 The remaining test specimen and specimen of the standard sample shall again be placed in the test chamber and the exposure continued for an additional number of hours of exposure equal to the number of hours at which the "appreciable change in color" was apparent and the test terminated at the end of that period.

5.6.2.1.4 Specimens which do not show an "appreciable change in color" until 80 hours *or* more of exposure shall be returned to the test chamber for a total exposure period not exceeding 140 hours of exposure, at which time the test shall be terminated.

5.6.3 At the end of a period of exposure, when the specimens are removed from the test chamber, the specimens will be dried by any convenient method at a temperature not exceeding 176° ± 4°F (80° ± 2°C) and placed in the dark for a minimum of 4 hours before evaluation.

5.7 Evaluation.

5.7.1 The evaluation tests shall be made only on that part of the specimen which was fully exposed and not protected by the frame or damaged when secured to the rack.

5.7.2 The evaluation of the test specimen with the standard or comparison sample shall be in conformance with Method 9010.

5.7.2.1 Standard sample. When a standard sample has been established and the number of hours of exposure has been established, the test specimen and the specimen of the standard sample shall be compared and the test specimen rated as follows:

Pass: Color change equal to or less than that of the standard sample.
Fail: Color change greater than that of the standard sample.

5.7.2.2 When a standard sample has been established and the number of hours of exposure has not been established, the test specimen and the specimen of the standard sample which have been exposed for the total exposure shall be compared and the test specimen rated as follows:

Pass: Color change equal to or less than that of the standard sample.
Fail: Color change greater than that of the standard sample.

In the event that the standard sample and the test specimen reverse their relative rating from the first appreciable change in color to the end of the exposure cycle, the results at the end of the total exposure cycle shall nevertheless constitute the basis for the rating.

5.7.2.3 No standard sample. When a standard sample has not been established, the exposed test specimen shall be compared with the unexposed specimen from the sample unit and rated as follows:

Excellent: No perceptible change in color.
Good : Perceptible, but not appreciable change in color.
Fair: Appreciable, but not objectionable change in color.
Poor: Objectionable change in color.

“Appreciable change in color” means a change that is immediately noticeable when comparing the tested specimen with the original specimen. If closer inspection or a change of angle of light is required to make apparent a slight change in color, the change is not considered appreciable.

6. REPORT

6.1 Standard sample. When a standard sample has been established, colorfastness to weather shall be reported as “pass” or "fail". When failure is reported, the severest departure (i.e. the actual rating, “fair” or “poor”), of the change of the test specimen, shall be distinguished and reported. When specimens are tested as in 5.6.2.1 and evaluated as in 5.7.2.2 they shall be reported as one determination.

6.2 No standard sample. When a standard sample has not been established, colorfastness to weather shall be reported as “pass” or “fail”. When failure is reported, the severest departure (i.e. the actual rating, “fair” or “poor”), of the change of the test specimen, shall be distinguished and reported.

7. NOTES

7.1 An apparatus of the type described in this method may be obtained from the Atlas Electric Devices Co, 4114 North Ravenswood Avenue, Chicago, IL 61613.

7.2 For colorfastness evaluation, the apparatus shall be operated with the filter inclosing the arc unless otherwise specified in the procurement document.

METHOD 5680.1
December 28, 1989
SUPERSEDING METHOD 5680
July 20, 1978

COLORFASTNESS OF TEXTILE MATERIALS TO PERSPIRATION

PERSPIROMETER METHOD

1. SCOPE

1.1 This method is intended for determining the colorfastness of textile materials to perspiration. It is applicable to dyed, printed or otherwise colored textiles of all kinds.

2. TEST SPECIMEN

2.1 Standard sample. Unless otherwise specified in the procurement document, when a standard sample has been established, the required specimens from each sample unit of the material to be tested and two specimens from the standard sample shall be as follows:

2.1.1 Cloth. A square of cloth 2-1/4 inches (57 mm).

2.1.2 Fibers, yarn, thread, light cordage, tape, webbing, and braid. Sufficient lengths of the applicable specimen shall be arranged to form a square 2-1/4 by 2-1/4 inches (57 mm by 57 mm).

2.2 No standard sample. Unless otherwise specified in the procurement document, when a standard sample has not been established, the required specimen from the sample unit of the material to be tested shall be as specified in 2.1.1 and 2.1.2. One additional specimen shall be taken from each sample unit of material to be tested and retained, untested, for comparison. All specimens shall be taken from adjacent areas of the sample unit.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the procurement document, one specimen from each sample unit shall be tested in each of the two perspiration solutions.

4. APPARATUS, REAGENTS AND METHOD CITED

4.1 Apparatus.

4.1.1 Perspirometer or equivalent apparatus.

4.1.1.1 The Perspirometer is a testing device capable of maintaining uniform pressure on the test specimen located between two plastic plates (4-1/2 inches by 2-1/2 inches by 1/8 inches) (114 mm by 64 mm by 3 mm).

4.1.1.2 Two Perspirometer models are permissible.

4.1 .1.2.1 The pressure is obtained in one model by added weights, with plates being stacked vertically, until the pressure is adjusted. When the required pressure is reached, the pressure plate is locked, the weights removed, and the units placed in the oven so that the plates and specimens are vertical.

4.1 .1.2.2 The pressure in the second model is obtained by means of adjusting screws, the moveable plate being made to exert increasing pressure against the test specimens until the required force is reached as indicated on the scale. The specimen unit is locked at this point, removed from the section applying the pressure, and placed in the oven so that the plates and specimens are vertical.

4.1.2 Wringer. The wringer shall be of the household type equipped with smooth rubber rolls 2-1/8 to 2-1/2 inches (54 mm to 64 mm) in diameter and not less than 11 inches (279 mm) or more than 16 inches (406 mm) in length. The rubber rolls shall have a Shore Durometer Hardness of 70 to 80 (A scale). The load exerted on the specimen and the multifiber test fabric combined shall be applied uniformly by means of an adjustable weight attached to the top roll. The total load of the roll, means of attaching the weight, and the weight itself shall be such that the specimen and the multifiber test fabric together will retain 100 plus or minus 5 percent perspiration solution. Certain fabrics may not be able to retain 100 percent pick-up after passing through a wringer even when the minimum pressure is applied. In such cases, the maximum percent perspiration solution pick-up obtained shall be used for the test and recorded along with the test results. In order to obtain true and consistent results, all specimens of the same type fabric in a test series shall have equivalent solution pick up with a ± 5 percent, as the degree of staining increases with the amount of retained perspiration solution (see 7.3).

4.1.3 Oven. A circulating air oven capable of maintaining the required temperature at ± 2°F (± 1°C).

4.1.4 Color transfer cloth. A test cloth with a 6-fiber repeat made up of equal bars of acetate, cotton, nylon 66, polyester (polyethylene terephthalate) acrylic and wool. Each 6-fiber repeat shall measure approximately 2 inches (51 mm) and shall be separated by a waste filling stripe (see 7.2).

4.1.5 White thread.

4.2 Reagents. (See 7.4)

4.2.1 Acid solution. - 10 g sodium chloride
1 g lactic acid U.S.P., 85 percent
0.25 g histidine monohydrochloride.
1 g disodium orthophosphate, anhydrous.

Dissolve with distilled water and make up to 1 liter. The pH of this solution should be 4.3 plus or minus 0.2 as established by use of an accurate pH meter. Should the pH of the prepared acid solution be outside the range of 4.1 to 4.5 discard the solution and prepare a new one making sure that all ingredients are weighed precisely.

4.2.2 Alkaline solution - 10 g sodium chloride.
0.25 g histidine monohydrochloride.
1.0 g disodium orthophosphate, anhydrous.

Dissolve in distilled water and make up to 1 liter. Using an accurate pH meter adjust the PH to 8.0 plus or minus 0.2 with ammonium carbonate, U.S.P.

4.2.3 The solution shall not be used if cloudy or older than three days.

4.3 Method cited.

Method 9010, Shade Matching of Textile Materials; Visual Method.

5. PROCEDURE

5.1 Preparation of specimen.

5.1.1 One 6-fiber repeat of the color transfer cloth shall be sewn with white thread or otherwise firmly attached to each specimen of the material to be tested and to each specimen of the standard sample.

5.2 The testing of two specimens (i.e., one in the acid solution and one in the alkaline solution) shall be considered one determination.

5.2.1 Standard sample. When a standard sample has been established, two specimens of the standard sample shall be tested at the same time and under the same conditions as the specimens undergoing test.

5.2.2 No standard sample. When a standard sample has not been established the required specimens of the material undergoing test shall be tested, and one specimen shall be retained without testing for comparison.

5.3 One test assembly per beaker (see 5.2) shall be immersed in the acid solution for 30 minutes with occasional stirring. One test assembly per beaker shall be immersed in the alkaline solution for 30 minutes with occasional stirring. Care shall be exercised to insure that the assemblies are adequately wetted by the solutions.

5.3.1 To insure that the test assembly treated with the acid solution has a pH of 4.3 ± 0.2 and that the assembly treated with the alkaline solution has a pH of 8.0 ± 0.2, the assemblies shall be rinsed three times with the appropriate test solution, the rinse solution being discarded each time.

5.4 The test assemblies, when removed from the solutions, shall be passed flat through the wringer to remove excess liquid, retaining the equivalent of 100 ± 5 percent pickup by the assembly.

5.4.1 One test assembly shall be positioned in the center between each plastic plate and inserted in the Perspirometer in such a way that the stripes of the multifiber test fabric shall be in a vertical position when placed in the oven. The Perspirometer shall be adjusted to produce a pressure of 10 pounds (4.536 kg) on the test assemblies. All twenty one plates shall be used regardless of the number of test specimens.

5.4.2 The loaded test plate units shall be placed in the oven for a minimum of 6 hours, the temperature of the oven maintained at 100° ± 2°F (38° ± 1°C). For convenience, the test may be run overnight for as much as 16 hours. Tests have shown that no appreciable or additional change in shade or staining occurs after the 6-hour period.

5.4.3 The test assemblies shall be removed from the test plates. If the assemblies are not completely dry at this time, they may be dried by any convenient means at a temperature not to exceed 140°F (60°C).

5.5 Evaluation.

5.5.1 Evaluation shall be conducted in accordance with Method 9010.

5.5.2 The color change of the test specimen and the staining of the color transfer cloth shall be evaluated to determine the colorfastness to perspiration.

5.5.3 The color change exhibited by the tested specimen when compared to the untested specimen retained shall be evaluated against the color change exhibited by the tested standard when compared to the untested standard retained . Unless otherwise specified, the staining of the color transfer of the specimen shall be evaluated against the staining of the color transfer cloth of the standard.

5.5.3.1 Specimen

Pass: Color change less than that of the standard sample.

Fail: Color change greater than that of the standard sample.

5.5.3.2 Color transfer cloth.

Pass: Staining equal to or less than that attached to the standard sample.

Fail : Staining greater than that attached to the standard sample.

5.5.4 No standard sample. When a standard sample has not been established, evaluation of the test specimen and its attached color transfer cloth shall be rated as follows:

5.5.4.1 Test specimen when compared to the specimen retained untested for comparison and color transfer cloth evaluated according to the degree of staining shall be rated as:

Excellent: No perceptible color change and staining.

Good : Perceptible but not an appreciable change in color and staining.

Fair: Appreciable but not an objectionable change in color and staining.

Poor: Objectionable change in color and staining.

"Appreciable change in color" means change that is immediately noticeable when comparing the tested specimen with the original sample. If closer inspection or a change of angle of light is required to make apparent a slight change of color, the change is not considered appreciable."

6. REPORT

6.1 Standard sample. Colorfastness to perspiration shall be reported as "pass" or "fail" when compared with the standard sample. If either the test specimen or the transfer cloth of the test specimen shows failure when compared to comparable material of the standard sample, the specimen shall be reported as failing. When failure is reported, the nature of the failure shall also be reported.

6.2 No standard sample. Colorfastness to perspiration shall be reported as "pass" or "fail" when the test specimen and color transfer cloth are evaluated and rated in accordance with the adjective ratings of 5.5.4. Failure of either the test specimen or the color transfer cloth to meet the adjective rating specified in the applicable procurement document shall be reported. When failure is reported, the severest departure (i.e. the actual rating, "fair" or "poor") , of the change of test specimen or staining of specific fibers of the color transfer cloth, shall be distinguished and reported.

7. NOTES

7.1 Equipment suitable for conducting this test may be purchased from: The Orange Machine and Manufacturing Company, 1503 Bay Avenue, Point Pleasant, N.J 08742 and Atlas Electric Devices Company, 4114 No. Ravenswood Avenue, Chicago, IL 60613.

7.2 Multifiber test cloths (color transfer cloth) may be obtained from Test Fabrics, Inc., P.O. Drawer O, 200 Blackford Ave., Middlesex, NJ 08846.

7.3 A suitable wringer is the Atlas Motorized Laboratory Wringer, available from Atlas Electric Devices, Co., 4114 N. Ravenswood Ave., Chicago, IL 60613.

7.4 Histidine monohydrochloride can be purchased from Eastman Kodak Co., Laboratory and Research Products Division, Rochester, NY 14650.

FLAME RESISTANCE OF CLOTH; VERTICAL

1. SCOPE

1.1 This method is intended for use in determining the resistance of cloth to flame and glow propagation and tendency to char. It is designated primarily for flame resistant fabrics, but may be utilized in other applications as specified in applicable procurement documents. In addition to the vertical position of the sample and flame exposure conditions common to tests *of* this type, the method defines gas, burner, cabinet, temperature and humidity test conditions.

2. TEST SPECIMEN

2.1 The specimen shall be a rectangle of cloth 3 inches (76 mm) by 12 inches (305 mm) with the long dimension parallel to either the warp or filling direction of the cloth. No two warp specimens shall contain the same warp yarns, and no two filling specimens shall contain the same filling yarns.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the procurement document, five specimens from each of the warp and filling directions shall be tested from each sample unit.

4. APPARATUS

4.1 Cabinet. A cabinet and accessories, fabricated in accordance with the requirements specified in figures 5903A, B, and C. Galvanized sheet metal or other suitable metal shall be used. The entire inside back wall of the cabinet shall be painted black to facilitate the viewing of the test specimen and pilot flame (see 7.1.2).

4.2 Burner. The burner shall be equipped with a needle valve to adjust the flame height, a barrel having a 3/8 inch (10 mm) inside diameter and a pilot light.

4.2.1 The burner may be constructed by combining a 3/8 inch (10 mm) inside diameter barrel 3 ± 1/4 inches (76 ± 6 mm) long with a base from an adjustable valve burner. A tirrill burner is recommended but a bunsen burner modified to conform to this test method will also suffice.

4.2.2 The pilot light tube shall have an inside diameter of approximately 1/16 inch (2 mm) and shall be spaced 1/8 inch (3 mm) away from the burner edge.

4.2.3 The necessary gas connections and the applicable plumbing shall be as specified in Figure 5903D except that a solenoid valve may be used in lieu of the stopcock valve to which the burner is attached. The solenoid valve shall be capable of being fully opened or fully closed in 0.1 second and activated by an adjustable timer.

4.2.4 On the side of the barrel of the burner, opposite the pilot light there shall be a metal rod of approximately 1/8 inch (3 mm) diameter spaced approximately 1/2 inch (13 mm) from the barrel and extending above the burner. The rod shall have two prongs (approximately 5/16 inch (8 mm)) marking the distances of 3/4 inch (19 mm) and 1-1/2 inches (38 mm) above the top of the burner.

4.2.5 The burner shall be movable when placed in the cabinet and capable of adjustment so that the center of the barrel of the burner is directly below the center of the specimen when performing the test.

4.3 Gas regulator valve system. A control valve system with a delivery rate designed to furnish gas to the burner under a pressure of 2-1/2 ± 1/4 pounds per square inch (17.2 kPa ± 1.7 kPa) at the burner inlet. The manufacturer's recommended delivery rate for the valve system shall include the required pressure (see 7.1.1).

4.4 Gas mixture. Methane 99% pure (see 7.1.1).

4.5 Metal hooks and weights. Metal hooks and weights to produce a series of total loads to determine length of char. The metal hooks shall consist of No. 19 gage steel wire or equivalent and shall be made from 3-inch (76 mm) lengths of the wire and bent 1/2 inch (13 mm) from one end to a 45-degree hook .

4.6 Stop watch. Stop watch or other device to measure the burning time to 0.2 second.

4.7 Measuring scale. Measuring scale graduated in increments of 1/8 inch (3 mm) to measure the length of char.

4.8 Specimen holder clamps. Spring steel clamps capable of holding the specimen firmly in its holder while subjected to the flame test.

5. PROCEDURE

5.1 The material undergoing test shall be evaluated for the characteristics specified in the applicable procurement document, i.e. after-flame time) after-glow time and char length on each specimen.

5.2 All specimens to be tested shall be at moisture equilibrium under standard atmospheric conditions in accordance with Section 4 of this standard. Each specimen to be tested shall be exposed to the test flame within 2 q inutes after removal from the standard atmosphere.

5.3 The test cabinet can be set up in a laboratory hood. Precautions shall be taken to minimize the draft through the laboratory hood while testing. Open doors or windows are examples of unnecessary causes of drafts and shall be avoided. A ventilation smoke tube kit may be obtained to check for the presence of drafts (see 7.1.3).

5.4 Adjust gas pressure to 2.5 ± 0.25 pounds per square inch (see 4.3). Ignite and adjust the pilot flame approximately 1/8 inch (3 mm) in height when measured from its lowest point to the tip so that it does not alter shape of the test flame during the 12 seconds ignition time. The burner flame shall be adjusted by means of the needle valve in the base of the burner to give a flame height of 1-1/2 inches (38 mm) with the solenoid fully open and the air supply to the burner shut off or taped so as not to allow air to enter. The 1-1/2 inch (38 mm) flame height is obtained by adjusting the needle valve so that the uppermost portion (tip) of the flame is level with the top of the metal prong. (It is important that the flame height be adjusted with the tip of the flame level with the tip of the metal prong. This may be more easily accomplished with nearby lights turned off.)

5.5 Adjust the timer to 12 seconds. This can be accomplished by timing the period between the opening and closing of the solenoid with an accurate laboratory timer or stopwatch.

5.6 The specimen shall be clamped in its holder in such a manner that the entire length of the specimen is exposed. Insert the holder containing a specimen into the test cabinet (with the laboratory hood ventilation off) and position the burner so that the middle of the lower edge of the specimen is centered 3/4 inch (19 mm) above the burner and level with the bottom metal prong. Open the solenoid by starting the timer thereby creating the test flame. At the end of the 12-second period, afterflame and afterglow shall be determined (see 5.7 and 5.8). Remove the specimen. If appropriate, turn on the laboratory hood fan (if available) until all smoke and fumes are removed, then shut off the fan and proceed with testing of additional specimens.

5.7 The afterflame time shall be the time the specimen continues to flame after the 12 second period (as indicated by the closing of the solenoid). Timing of afterflame shall be accomplished by means of a timer, stop watch or any timing device capable of recording to 0.2 second.

5.8 The afterglow time shall be the time the specimen continues to glow after it has ceased to flame (as a result of the 12 seconds flame impingement and afterflame). Timing of afterglow shall be accomplished by means of a timer, stop watch, or any timing device capable of recording to 0.2 seconds. The glow shall not be extinguished even when the afterglow time is not being evaluated because of the glow’s effect on char length.

5.9 After each specimen is removed, the test cabinet shall be cleared of fumes and smoke prior to testing the next specimen.

5.10 After removing the specimen from the cabinet the specimen shall be allowed to cool and the char length measured. The char length shall be the distance from the end of the specimen which was exposed to the flame to the top of the lengthwise tear made through the center of the charred area. The specimen shall be folded lengthwise and creased by hand along a line through the highest peak of the charred area. The hook shall be pierced into the specimen (or inserted into a hole, 1/4 inch (6 mm) diamter or less) at one side of the charred area 1/4 inch (6 mm) in from the lower end. A weight of sufficient size (such that the weight and hook together shall equal the total tearing load required in 5.1.1) shall be attached to the hook.

5.11 A tearing force shall be applied gently to the specimen by grasping the corner on the cloth at the opposite edge of the char from the load and raising the specimen and weight clear of the supporting surface. The specimen shall be raised *in* one smooth continuous motion, and shall not be jerked or pulled forcefully upward. The end of the tear shall be marked on the edge of the specimen and the char length measurement made along the undamaged edge.

5.11.1 Loads for determining char length. The specific load applicable to the weight of the test cloth shall be as follows:

Specified weight per square yard of cloth before any fire retardent treatment or coating		The tearing weight for determining the charred length	
Ounces per square yard	g/m^2	Pounds	kg
2.0 to 6.0	68 to 203	0.25	0.1
Over 6.0 to 15.0	Over 203 to 508	0.5	0.2
Over 15.0 to 23.0	Over 508 to 780	0.75	0.3
Over 23.0	Over 780	1.0	0.45

6. REPORT

6.1 The afterflame time, afterglow time and char length of the sample unit shall be the average of the results obtained from the individual specimens tested in each of the warp and filling directions. The averages for the warp and filling shall be reported separately. All values obtained from the individual warp and filling specimens shall be recorded in addition to the averages.

6.2 The averages of the afterflame time and afterglow time shall be reported to the nearest 0.5 second and the char length to the nearest 1/8 inch (3 mm).

7. NOTES

7.1 Suggested sources of materials and equipment.

7.1.1 Gas mixture (4.4) and regulator valve system (4.3) are available from:

(a) Matheson Gas Products
P.O. Box 85
East Rutherford, NJ 07073

(b) Air Products and Chemicals, Inc.
P.O. Box 538
Allentown, PA 18105

7.1.2 Test cabinet (4.1) is available from:

(a) U.S. Testing Company
1941 Park Avenue
Hoboken, NJ 07030

(b) The Govmark Organization, Inc.
P.O. Box 807
Bellmore, NY 11710

(c) Custom Scientific Instruments, Inc.
13 Wing Drive
Cedar Knolls, NJ 07927

7.1.3 Ventilation Smoke Tube Kit (5.3) is available from:

Mine Safety Appliances Co.
Pittsburgh, PA 15230

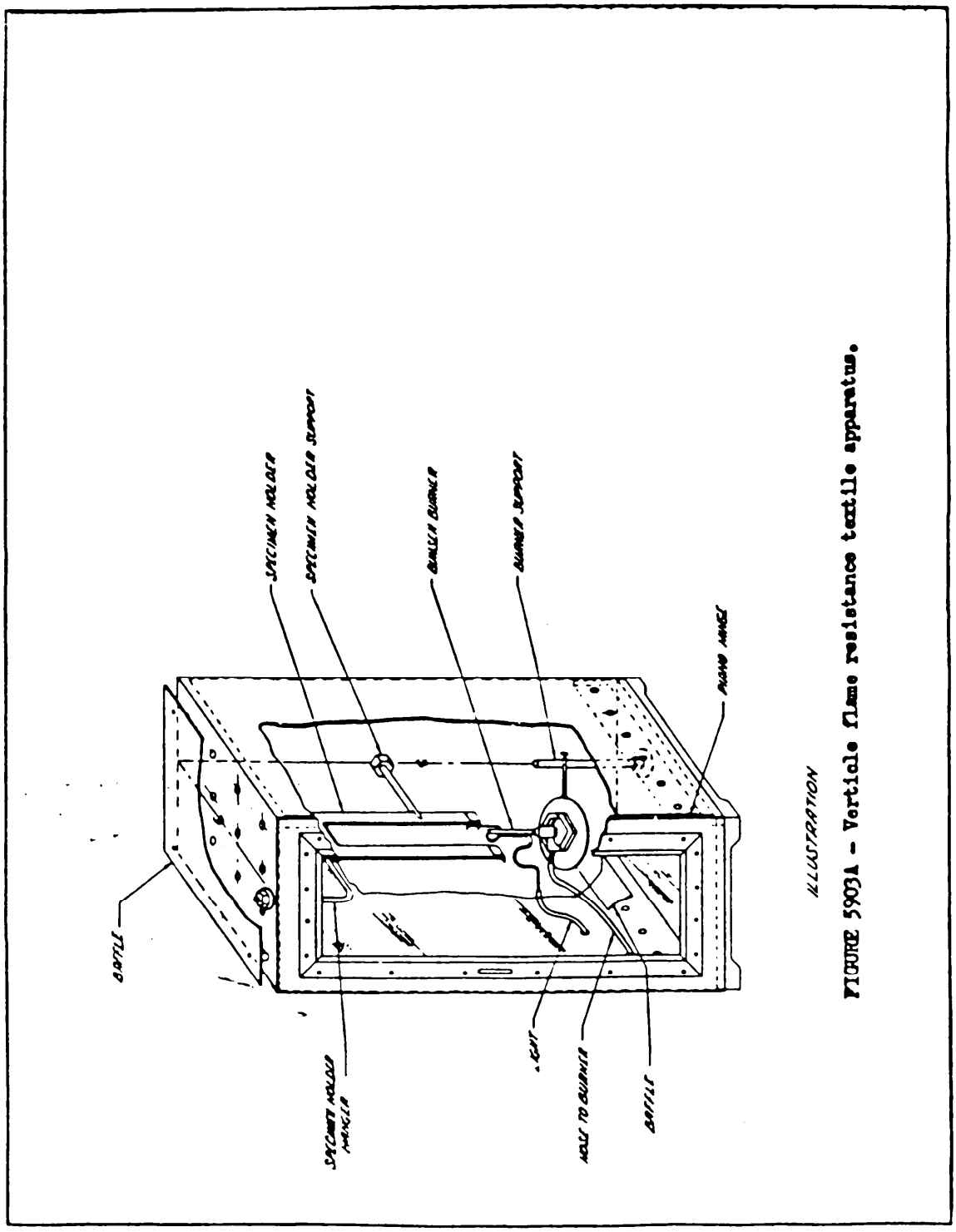


FIGURE 5903A - Vertical flame resistance textile apparatus.

ILLUSTRATION

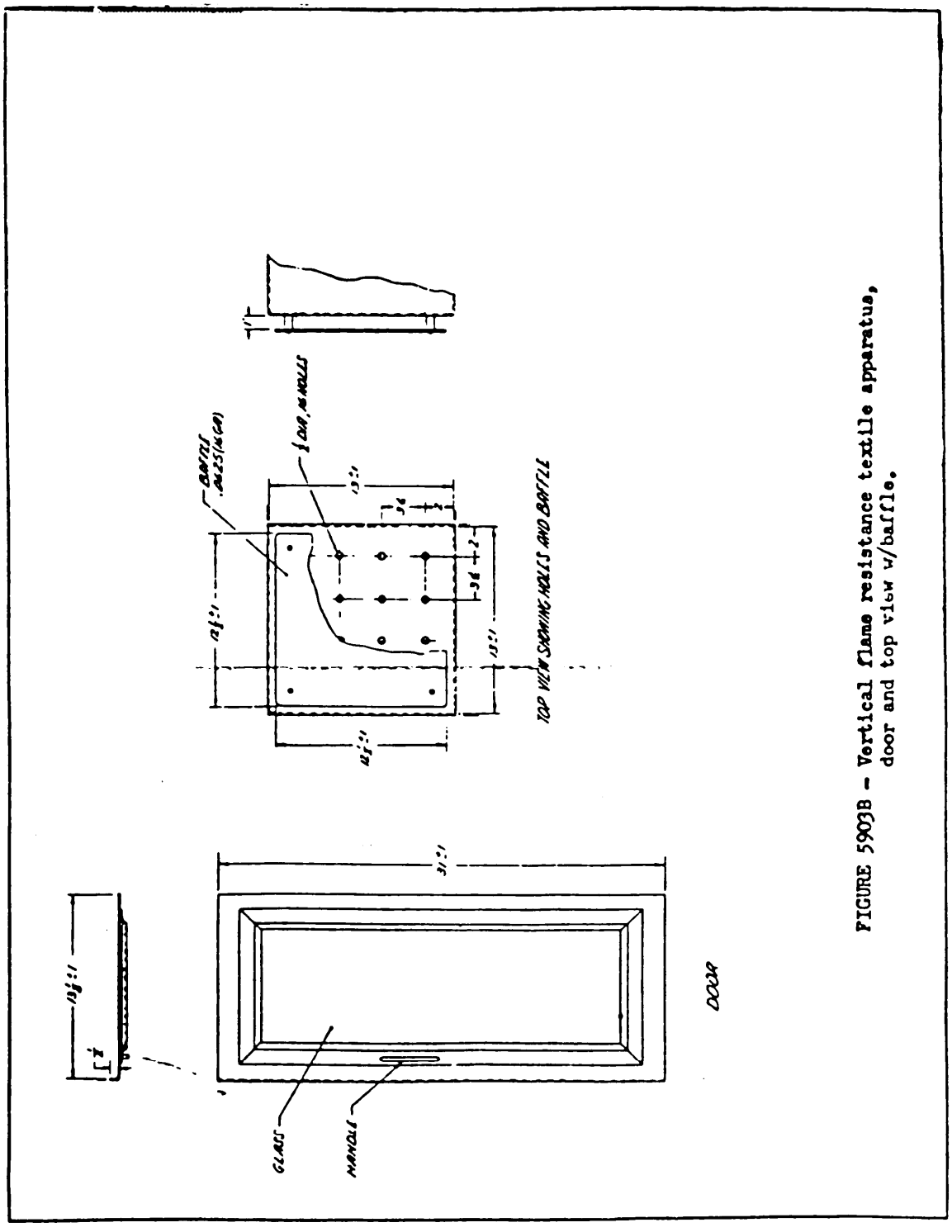


FIGURE 5903B - Vertical flame resistance textile apparatus, door and top view w/baffle.

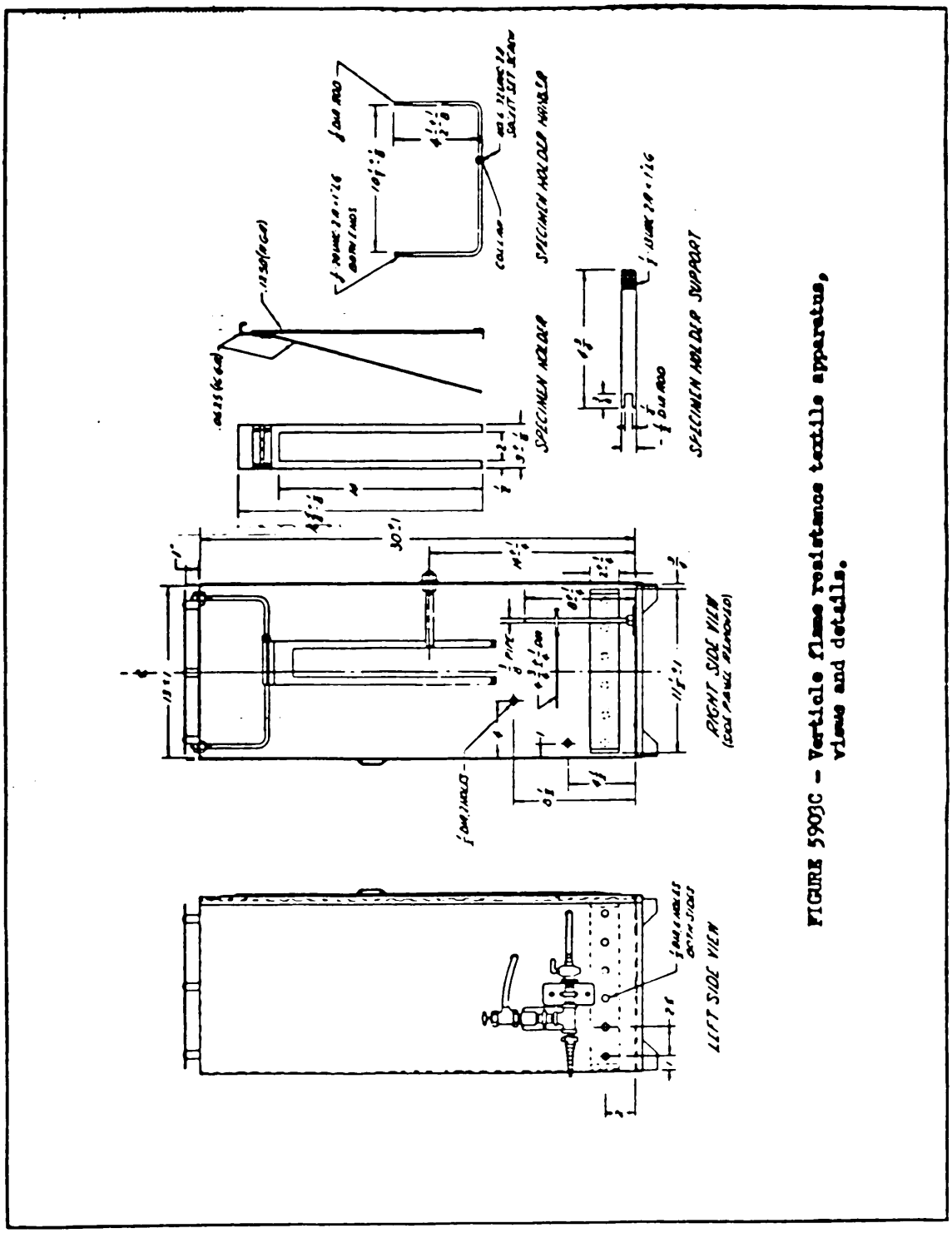


FIGURE 5903C - Vertical flame resistance textile apparatus, views and details.

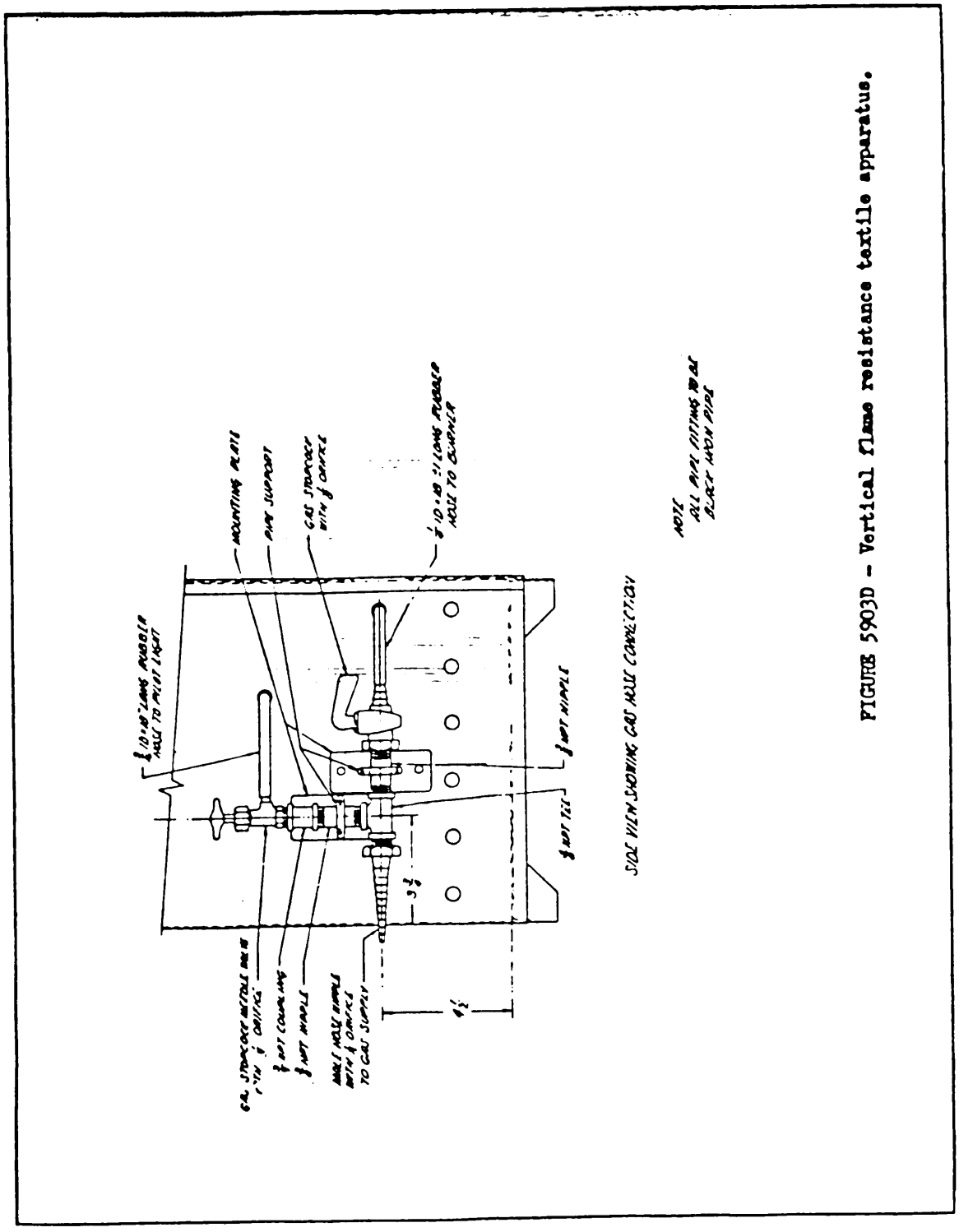


FIGURE 5903D - Vertical flame resistance textile apparatus.

STRENGTH AND ELONGATION, BREAKING OF CORDAGE;

SPLICED SPECIMEN METHOD

1. SCOPE

1.1 This method is intended for determining the breaking strength and elongation of spliceable cordage.

2. TEST SPECTMEN

2.1 The specimen shall be a single length of the cordage, and shall have an eye splice at each end. The inside length of each eye shall be not less than 7 inches (178 mm) or more than 24 inches (610 mm) with the eye closed. The distance of clear rope between the outer ends of the splices shall *not* be less than 3 feet (914 mm).

2.1.1 Eye splice on three-strand twisted cordage (Natural fiber). Eye splices on natural fiber twisted three-strand cordage shall be accomplished with a minimum of three full tucks. Tapered splices are permitted (see Figure 6015A).

2.1.2 Eye splice on three-strand twisted cordage (Synthetic fiber). Eye splices on synthetic fiber twisted three-strand cordage shall be accomplished with a minimum of four full tucks. Tapered splices are permitted (see Figure 6015A).

2.1.3 Eye splice on plaited cordage (Synthetic fiber). Eye splices on synthetic fiber plastic cordage shall be accomplished with a minimum of two double folds and two singles (see Figure 6015B).

2.1.4 Eye splice on hollow braided cordage. Eye splices on hollow braided cordage shall be accomplished with a tapered buried eye splice. The taper shall consist of cutting out every fifth pick in right and left strands for 16, 24, and 32-strand round braids and alternately fourth and fith picks for 20-strand braid (see Figure 6015c).

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the procurement document, the number of determinations shall be as follows:

Rope with a circumference up to and including 5 inches (127 mm): Three specimens shall be tested from each sample unit.

Rope with a circumference over 5 inches (127 mm):
Two specimens shall be tested from each sample unit.

4. APPARATUS

4.1 Testing machine. The testing machine shall consist of three main parts:

(a) Straining mechanism.
(b) Means for holding the specimen.
(c) Load indicating mechanism.

4.1.1 Straining mechanism. The straining mechanism shall be such that the movement of the pulling clamp shall be uniform at a rate of 6 ± 1 inches (152 ± 25 mm) per minute under no load. The distance between the clamps is arbitrary.

4.1.2 Specimen holders. The means for holding the specimen during testing shall consist of round metal pins or posts. The pins or posts shall be of sufficient size and held in any manner that will assure breaking of the specimen in the free length end of one eye splice to the end of the other eye splice.

4.1.3 Load indicating mechanism. The load indicating mechanism shall be a calibrated dial, scale or chart for indicating the applied load. Unless otherwise specified for load determination, the mechanism shall be adjusted or set so that the maximum load required to break the specimen will remain on the dial, scale or chart after the specimen is ruptured.

4.1.4 The test machine shall be of such capacity that the maximum load required to break the specimens shall not be greater than 85 percent or less than 15 percent of the rated capacity.

4.1.5 Measuring scale. Yardstick, meterstick, or metal tape graduated in increments of 1/8 inch (1 mm), for use in applying gage marks to the specimen, and for measuring between the marks to determine elongation.

5. PROCEDURE

5.1 Preparation of specimen. Unless otherwise specified in the procurement document, the specimen shall be conditioned and tested under Standard Atmospheric Conditions in accordance with Section 4 of this Standard.

5.1.1 When elongation of the specimen is to be determined, a load equal to 1 percent of the specified minimum breaking strength shall be applied to the specimen. While under tension, two fine gage marks shall be spaced 30 inches (762 mm) apart on the specimen in such a manner that neither mark will be closer than 3 inches (’76 mm) to the inner end of either splice.

5.1.2 If soaking of the splice is required (this requirement applies to specimens of cordage made from jute, sisal, manila, henequen and other hard fiber ropes), the eyes and splices up to the inner ends of the splices shall be immersed in water for a minimum of 15 minutes. Gage marks if required for determining elongation shall be placed on the specimens before soaking.

5.2 Elongation. Elongation shall be determined during the determination of the breaking strength of the specimen. It shall be measured when the load applied during the test is 75 percent of the specified minimum breaking strength of the specimen being tested.

5.2.1 When the specimen is pulled to 75 percent of the specified minimum breaking strength, the machine may be stopped and the distance "E" between the gage marks on the specimen measured and recorded. The distance between the marks shall be measured to the nearest 1/8 inch (1 mm).

5.3 Breaking strength. If the machine has been stopped for determination of elongation after the distance between the marks has been measured the machine shall be restarted and the load increased until the specimen breaks.

5.3.1 If the splices are noticed to be slipping and the individual measurement falls markedly below the apparent average, such a measurement shall be disregarded and another specimen shall be tested from the same sample unit. If a failure occurs within the body of the eye splice, the test shall be discarded and another specimen shall be tested from the same sample unit.

5.4 Calculations. The elongation shall be calculated as follows:

$$\text{Elongation, percent} = \frac{E - O}{O} \times 100$$

Where: E = The distance in inches (mm) between gage marks at 75 percent of the specified minimum breaking strength.
O = The distance in inches (mm) between the gage marks at 1 percent of the specified minimum breaking strength (see 5.1.1).

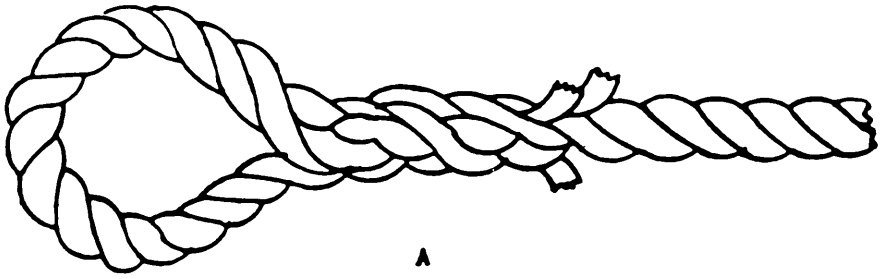
6. REPORT

6.1 Breaking strength. The breaking strength of the sample unit shall be the average of the specimens tested and shall be reported as follows:

Cordage breaking strength	Reported to nearest
0 to 150 lbs (0 to 670 N)	1 lb (1 N)
151 to 2000 lbs (671 to 8900 N)	5 lbs (10 N)
2001 to 50,000 lbs (8901 to 222, 500 N)	10 lbs (100 N)
50,000 lbs and up (222,501 and up)	100 lbs (1000 N)

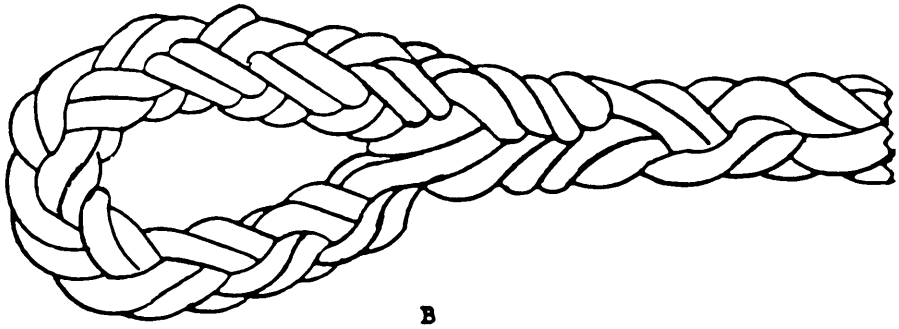
6.2 Elongation. The elongation of the sample unit shall be the average of the specimens tested and shall be reported to the nearest 0.5 percent.

6.3 Each individual value used to calculate the average shall also be reported.



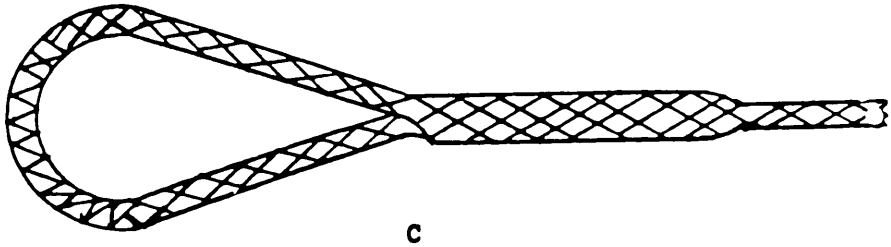
A

EYE SPLICE ON 3-STRAND TWISTED CORDAGE



B

EYE SPLICE ON PLAITED CORDAGE



C

EYE SPLICE ON BRAIDED CORDAGE

FIGURE 6015

SHRINKAGE IN LAUNDERING OF SHRINK-RESISTANT WOOL SOCKS

1. SCOPE

1.1 This method is intended for determining shrinkage during the relaxation process and the laundering of wool socks which have been given a shrink-resistant treatment. Shrinkage in laundering is the change in measured distances due to laundering.

2. TEST SPECIMEN

2.1 The specimen shall be one sock.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the procurement document, eight specimens shall be tested from each sample unit.

4. APPARATUS, REAGENT AND METHOD CITED

4.1 Apparatus. (See figure 7560)

4.1.1 Sock measuring machine. The apparatus consists of a metal foot form over which the sock is drawn, so constructed that the toe section slides freely out of the heel section. This form shall be fixed in front of an upright arm bearing a scale graduated in divisions of 0.1 inch (1 mm) and shall have a freely rotating pulley at the top. A pivoting clamp shall be mounted at an angle so that it will hold the heel of the sock in a predetermined position. An indicator consisting of a pointer pin which is inserted through the toe of the sock and the hole in the toe piece of the form shall be provided. This indicator shall be attached by means of a cord which passes over a pulley on the upright to a weight formed of two sections, the smaller of which screws into a threaded opening in the base of the larger. When the short toe section is used, the small section of the weight shall be removed to compensate for the difference in weight of the toe sections. The pointed end of the pointer pin indicates the length of the sock under tension of 5 pounds (2.3 kg) by its position against the graduated scale on the instrument upright.

4.1.2 Wash wheel. A wash wheel as described in Method 5550.

4.1.3 Extractor. The extracting equipment shall be as described in Method 5550.

4.1.4 Preheating tanks. A preheating tank or other device capable *of* supplying water in quantity and temperature as required in 5.2.

4.1.5 Water. A source of water which will furnish water containing not more than 50 parts per million of hardness.

4.1.6 Oven. Circulating air oven

4.2 Reagents.

4.2.1 Detergent. Soap meeting the requirements of type T, class 1 of P-S-1792, Soap, Laundry (Neutral and Built).

4.2.2 Sodium carbonate. Sodium carbonate meeting the requirements of types I or IT of O-S-571, Sodium Carbonate, Anhydrous, Technical.

4.3 Method cited.

Method 5550, Shrinkage in Laundering; Cotton, Linen and Blended Cotton and Linen Cloth

5. PROCEDURE

5.1 Measurement of specimen. The specimen shall be placed over the metal foot form and the heel gore aligned with the pivoting clamp which has been brought to the position governed by the limit stop, and the clamp tightened. The toe gore shall be aligned with the center of the toe form and drawn smoothly through the sock and small hole in the top of the toe section, and the pull of the 5-pound (2.3 kg) weight shall be transferred to the sock in about 3 seconds. When socks are too short to go over the large toe form, the short toe form shall be used, in which case the lower separable portion of the weight shall be removed to compensate for the difference in weight of the form. The sock size under a load tension of 5 pounds (2.3 kg) for 1 minute shall be read directly from the scale and is the “foot-length” when evaluating the relaxation and foot shrinkage.

5.2 Determination of relaxation shrinkage. After the specimen has been measured according to 5.1, it shall be relaxed by soaking without agitation, in 20 to 30 times its weight of water containing 0.05 Percent of neutral soap at a temperature of 81° ± 2°F (27° ± 1°C). The soaking process shall be continued for 2 hours at a temperature of 81° ± 2°F (27° ± 1°C). After this, the sock shall be extracted by means of the centrifuge for approximately 5 minutes, arranged evenly without wrinkles or tension on the drying tray, and allowed to dry at room temperature or in a circulating air oven at a temperature of 221°F to 230°F. Care shall be taken so as not to over-dry the sock . The sock shall then be brought to standard condition described in Section 4 of this Standard and measured as outlined in 5.1.

5.3 Determination of shrinkage after laundering. After determining the relaxation shrinkage, the socks shall be washed as follows:

Water at 140° ± 2°F (60° ± 1°C) shall be added to the machine until it reaches a level of 2 inches (51 mm) above the bottom of the cylinder. To this water a calculated amount of sodium carbonate shall be added to obtain a 0.2 percent solution and a minimum amount of neutral soap added to produce a low-level suds. This condition is considered to have been reached when the suds come halfway up the cylinder on rotating the cylinder (cage) away from the operator. The specimen or specimens shall be added to the wash wheel with sufficient shrink resistant and nonfelted wool or wool not previously laundered for more than 6 hours, to make up a dry load of 5 pounds (2.3 kg) and the machine set in motion. Socks which contain 80 percent or less of wool shall be laundered for a period of 2 hours. Socks with more than 80 percent wool shall be laundered for 1 hour. The temperature of the washing solution shall be maintained at 140° ± 2°F (60° ± 1°C). At the end of the washing period, the machine shall be drained and the socks subjected to two 5-minute rinses with water at a temperature of 120° ± 2°F (49° ± 1°C). The rinse water depth shall be 10 inches (254 mm) as measured from the bottom of the cylinder. After the second rinse the socks shall be extracted for 5 minutes, arranged evenly without wrinkles or tension on the drying tray, and dried as described in 5.2. The socks shall then be brought to standard condition as described in Section 4 of this Standard, and measured as described in 5.1.

5.4 Calculation of results.

5.4.1 Shrinkage shall be calculated as follows:

$$\text{Relaxation shrinkage, percent} = \frac{\text{Initial measurement} - \text{Measurement after relaxation}}{\text{Initial measurement}} \times 100$$

$$\text{Felting shrinkage, percent} = \frac{\text{Measurement after relaxation} - \text{Measurement after laundering}}{\text{Measurement after relaxation}} \times 100$$

$$\text{Total shrinkage, percent} = \frac{\text{Initial measurement} - \text{Measurement after laundering}}{\text{Initial measurement}} \times 100$$

6. REPORT

6.1 The relaxation, felting, and total shinkage of the sample unit shall be the average of the results obtained from the specimens tested and shall be reported separately to the nearest 0.1 percent.

6.2 Each individual value used to calculate the average shall also be reported.

SOCK MEASURING DEVICE

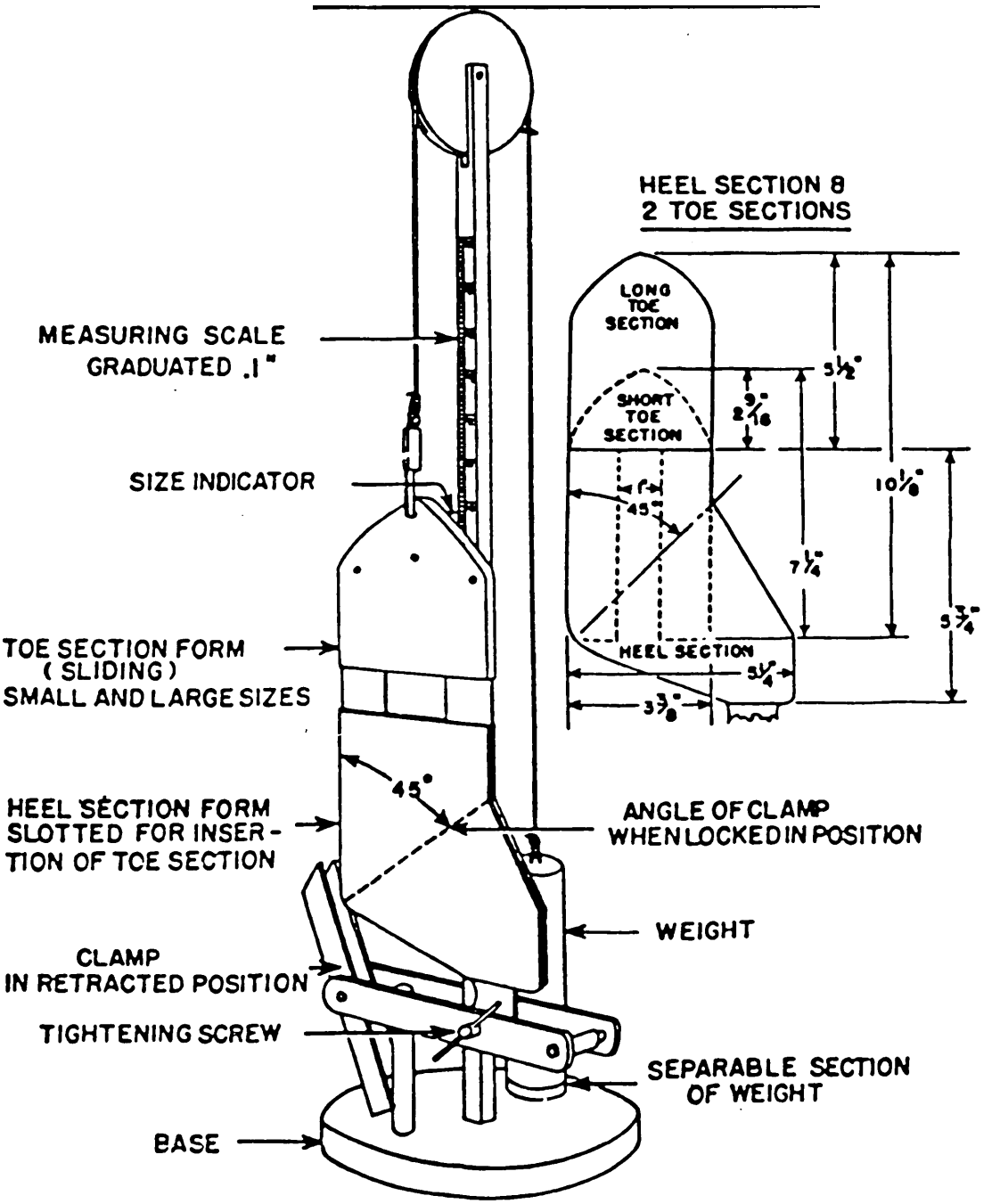


FIGURE 7560