STANDARD TEST METHODS

COATED FABRICS AND FILM

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Compiled and Issued by:

CFFA COATED FABRICS & FILM ASSOCIATION, INC.

1300 Sumner Avenue
Cleveland, OH 44115-2851
Phone: 216-241-7333
Email: cffa@coatedfabricsandfilm.com
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America's leading manufacturers and consumers use products from Coated Fabrics and Film members for a myriad of uses.

AIRCRAFT	Seat backs, upholstery, wall panels, and compartments.
ATHLETICS & SPORTING GOODS	Bowling bags, exercise mats, golf bags, gym and workout bags, and tennis bags.
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GRAPHIC ARTS & CASE COVERINGS	Bookbinding cover stock, checkbooks, coin purses, etc., handbags and accessories, luggage, and briefcases.
HEALTHCARE FURNISHINGS	Waiting room and lobby seating, tables, carts, storage, and furniture.
HOME & CONTRACT FURNISHINGS	Ceiling tile facings, commercial seating, folding doors, laminating films for wood, metal and wallboard, matting, residential upholstery, window shades, and blinds.
MARINE	Convertible topping, decking, upholstery, and bolsters.
MISCELLANEOUS	Children safety seats, industrial tapes, juvenile furniture, mattress covers, strip doors, tank lining, and toys.

FOREWORD

This, the 14th Edition of the Standard Test Methods (STM) Pamphlet, has been prepared by the Technical Committee of the Coated Fabrics & Film Association. These test methods are used by the industry and its customers to determine the physical properties of coated fabrics and films, to facilitate quality control and to ensure customer satisfaction.

Section I covers test procedures for coated fabrics; Section II covers test procedures for coated films. These tests include adhesion of coating, weight, resistance to cold, blocking, aging, abrasion resistance, hydrolytic stability, volatility, tensile, tearing strength, and many more. The purpose of each test is explained in non-technical terms, and the tests are referenced to comparable standard test methods of the American Society for Testing and Materials, Federal Test Methods, Specifications, and the American Association of Textile Chemists and Colorists.

Section III includes terminology and customs in the industry. Also in this section are suggestions on how to remove common stains, and the chronological history of fabric coating, and information about the Coated Fabrics & Film Association.

Every effort has been made to ensure the accuracy of the information in this pamphlet and the avoidance of excessive risks in the tests. However, the Association and those responsible for the preparation of Association publications make no representation or warranty, or assume or accept any responsibility or liability, with respect thereto.

In test methods where a specific material, apparatus, and/or supplier is listed, please note that such a listing is for the convenience of users of the Standard Test Methods. Any equipment from any supplier which produces comparable results under the testing procedure is acceptable.

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Note: *Test methods are listed alphabetically. Single- and double-digit numbers used to reference the test methods contained herein have not been changed from the previous editions. Three-digit numbers indicate test methods added to the Seventh and later Editions.*

SECTION I – TESTS FOR COATED FABRICS

Standard Conditions of Test

Reference: ASTM D751-19- Standard Test Methods for Coated Fabrics

Physical tests may be made under prevailing atmospheric conditions except in the settlement of disputes. Unless otherwise specified, tests shall then be made upon material in standard conditions, i.e., the condition reached when the material is in moisture equilibrium with an atmosphere having a relative humidity of 65% and temperature of 70°F (21°C). A tolerance of +/- 2% is permitted in relative humidity and +/- 2°F (1°C) in temperature. Material shall be considered to be in equilibrium when it shows no progressive change in weight after free exposure to moving air.

Because of the labor involved in determining whether equilibrium has been reached, it is customary to condition the material for a minimum period of 15 hours at the temperature and relative humidity previously mentioned.

Note: *These conditions are standard and will be used unless the test method requires special environmental conditioning*.

(Rev. 4/20)

CFFA-1: Abrasion Resistance

a. Wyzenbeek Method

Purpose: To determine the abrasion resistance of coated fabrics under service conditions

Reference: ASTM D4157 – Standard Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)

Apparatus: Oscillatory Cylinder Type*

To determine abrasion resistance of coated fabrics, one specimen of each sample approximately 2 x 8 inches (5 x 20 cm) in size shall be cut with the long dimension parallel to the machine direction and tested for resistance to abrasion, using the Wyzenbeek abrasion wear tester, operating under the following conditions:

Pressure on Specimen	2 lbs.**
Tension on Specimen (with scale bar in horizontal position)	6 lbs.**
Abradants	#10 Cotton Duck (certified to meet the requirements of ASTM D4157)*** #220 Grit Silicon Carbide Sheet, Stainless Steel Screen (Surface Screen 50 x 70 Mesh, Support Screen 14-18 Mesh) or Abradants as specified
Speed, Double Rubs/Hour	5000
Temperature of Room	70□ - 90□F (21□ - 32□C)

On stretchable fabrics such as knit, masking tape shall be used to reinforce backing to prevent elongation.

*Available from Schap Specialty Machine, Inc., 17309 Taft Street, Spring Lake, MI 49456, www.schapmachine.com or www.wyzenbeek.com.
**CFFA TM 1 cites settings of 2 lbf pressure, and 6 lbf tension. More common settings of 3 lbf and 4 lbf respectively are acceptable as there is little statistical difference in the test results.
***Available from Testfabrics, P. O. Box 26, 415 Delaware Avenue, West Pittston, PA 18643, www.testfabrics.com.

(Rev. 8/25)

b. Taber Abraser Method

Purpose: To determine the abrasion resistance of coated fabrics and films using a rotary platform double head tester

Reference: ASTM D3389– Standard Test Method for Coated Fabrics Abrasion Resistance (Rotary Platform Abrader)

Apparatus: Rotary Platform Double Head Abraser*

To determine the abrasion resistance of a coated fabric or film, one specimen of each sample shall be cut in a 4-1/8" circle and mounted on a S-16 Specimen Plate*. This specimen plate shall then be mounted on the Taber platform. Abrasion resistance is tested by the Taber platform turning on a vertical axis, against the sliding rotation of two rubber-base abrading wheels. Various hardness abrasive wheels, test weights, and test cycles can be used in the Taber test. These are specified depending on the type of material being tested and the expected service requirements of the finished coated fabrics or film.

After exposing the specimen to the required number of test cycles using the specified abrasive wheel and weight, the sample should be examined for signs of visual wear or loss of embossing detail.

*Available from Taber Industries, 455 Bryant Street, North Tonawanda, NY 14120, www.taberindustries.com.

(Rev. 8/25)

CFFA-101: Accelerated Exposure to Disinfectants

Note: As of December 2023, CFFA-101 is a new test method that supersedes CFFA-100, which has been removed from the current edition of the Standard Test Methods.

Purpose: To determine surface changes for color, gloss, and surface deterioration including cracking or peeling as a result of exposure to disinfectants.

Reference: AATCC TM 8, Modified

Apparatus:
Crockmeter
AATCC TM 8 approved cotton squares, 2" x 2"
Light Booth (Daylight Illuminant)
Gray Scale
Disinfectant Cleaners:
- Clorox Healthcare Hydrogen Peroxide Disinfectant Wipes
- Clorox Healthcare Bleach Germicidal Wipes
- Virex II 256, diluted to specific concentration (one part to 256 parts water)
  - Saturate AATCC TM 8 2"x 2" cotton squares with the Virex solution

Test Specimens: Cut into 3" x 6" squares (Keep one untested specimen as a control)
Distilled water

Procedure:
1. Mount a test specimen on to Crockmeter.
2. Mount disinfectant saturated fabric onto the test finger (finger applies a 900 gm load).
3. Immediately rub the specimen for 10 cycles.
4. Remove the specimen and allow it to dry overnight.
5. Repeat steps 1 through 4 for a total of five applications over five days.

Evaluation: 1. Clean the specimens with distilled water using TM 8 cotton squares. Allow to dry thoroughly.
2. In the Light Booth, compare specimens visually for:
- Color Change
- Gloss Change

3. Using a pick glass (5x magnification) look for:
- cracking or peeling of the coating.

4. Take Gray Scale readings, comparing to the untested sample.

Grading: Test specimens should be compared visually to the control sample for differences in general appearance.
Minor color or gloss variations are acceptable.
Cracking and/or peeling are not acceptable.

	RATING	PROPERTY	MINIMUM
5	No change	Color Change	4
4	Slight change	Gloss Change	4
3	Moderate change	Cracking/Peeling	5
2	Objectionable change		
1	Severe change		

(Rev. 8/24)

CFFA-2: Accelerated Light Aging and Outdoor Weathering

Plastic materials that are used for both interior and exterior applications are subject to attack typically by ultraviolet light, oxygen and water. No single light exposure apparatus can exactly simulate natural exposure, as climatic conditions will vary with respect to geography and topography.

Listed are commonly used methods with the coated fabrics and film industries. They have been found to be useful tools in predicting the behavior of plastics under exposure conditions, only after a history of their use has been established.

After exposure, the specimens are examined for any signs of stiffness, tack, crazing, color change, or any other deviation. Acceptable degree of change in color can be an agreed upon visual variation or measured by an agreed upon spectrophotometer, values expressed in Delta E units, in CIELAB, or CMC systems.

a. Accelerated Lightfastness (Fadeometer or Weatherometer), Xenon Arc, Indoor

References: AATCC Test Method 16.3 – Colorfastness to Light: Xenon-Arc – Option 3

ASTM G155 – Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials

Apparatus: Xenon Arc Weathering Test Chamber*

Using the apparatus specified, two specimens from each sample are exposed under the following conditions:

AATCC Test Method 16.3 – Option 3:
- Test Cycle: Continuous light with no water spray;
- Black Panel Temperature: 63 ± 1 °C;
- Chamber Air Temperature: 43 ± 1 °C;
- Relative Humidity: 30 ± 5%;

- Irradiance Setpoint: 1.1 W/m²/nm at 420 nm;
- Filters: Daylight filtered through window glass filters.

Follow all relevant instrument performance, operation, maintenance, and operation guidelines specified in ASTM G151 and ASTM G155. Utilize water for humidity as specified in ASTM G151.

b. Accelerated Weathering (Weatherometer), Xenon Arc, Outdoor

References: ASTM G155 – Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials – Table X3.1, Cycle 1

Apparatus: Xenon Arc Weathering Test Chamber*

Using the apparatus specified, two specimens from each sample are exposed under the following conditions:

ASTM G155 – Standard Practice for Operating Xenon Arc Light, Apparatus for Exposure of Nonmetallic Materials – Table X3.1, Cycle 1:

- Test Cycle 1: 102 minutes of light followed by 18 minutes of light and deionized water spray;
- Black Panel Temperature: 63 ± 3 °C;
- Chamber Air Temperature: 43 ± 3°C;
- Relative Humidity: 50 ± 10%;
- Irradiance Setpoint: 0.35 W/m²/nm at 340 nm;
- Filters: Daylight filters.

Follow all relevant instrumental performance, operation, maintenance, and operation guidelines specified in ASTM G151 and ASTM G155. Utilize water for humidity and spraying as specified in ASTM G151.

c. Fluorescent UV/Condensation Accelerated Weathering QUV, Outdoor

References: ASTM D4329 – Standard Practice for Fluorescent UV Exposure of Plastics, Cycle A

ASTM G154 – Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

Apparatus: Fluorescent UV/Condensation Device equipped with irradiance monitoring and Control*

Using the apparatus specified, two specimens from each sample are exposed under the following conditions:

ASTM D4329 – Standard Practice for Fluorescent UV Exposure of Plastics, Cycle A:

- Test Cycle A: 8 Hours of UV / 4 Hours Condensing Humidity
- Black Panel Temperature: UV Cycle – 60 ± 3°C, Condensation Cycle – 50 ± 3 °C;
- Lamp Type: UVA-340 with a peak emission of 340 nm;
- Irradiance: 0.89 W/m²/nm at 340 nm.

Follow all relevant instrument performance, operation, maintenance, and operation guidelines specified in ASTM G151 and ASTM G154. Utilize water for condensation as specified in ASTM G151 and ASTM G154.

d. Fluorescent UV Accelerated Light Aging QUV, Dry Cycle, Indoor

References: ASTM D4329 – Standard Practice for Fluorescent UV Exposure of Plastics, Dry heat only.

ASTM G154 – Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

Apparatus: Fluorescent UV/Condensation Device equipped with irradiance monitoring and Control*

Using the apparatus specified, two specimens from each sample are exposed under the following conditions:

ASTM D4329 – Standard Practice for Fluorescent UV Exposure of Plastics, Cycle A:

- Test Cycle A: UV Exposure, no condensing humidity
- Black Panel Temperature: UV Cycle – 60 ± 3°C,
- Lamp Type: UVA-340 with a peak emission of 340 nm;
- Irradiance: 0.89 W/m²/nm at 340 nm.

Follow all relevant instrument performance, operation, maintenance, and operation guidelines specified in ASTM G151 and ASTM G154.

Evaluation: Evaluation Rating for all three test methods a, b, c:
5–No Change
4–Slight Change
3–Moderate Change
2–Significant Change
1–Severe Change

Note: Test methods for the Carbon Arc Fadometer and Weatherometer, devices developed in the 19th century, have been removed from the current edition of the Standard Test Methods.

*Suppliers of these types of apparatus include

Atlas Electric Devices Co., 4114 North Ravenswood Ave., Chicago, IL 60613.
The Q-Panel Company, 26200 First Street, Cleveland, OH 44145.

(Rev. 7/20)

CFFA-3: Adhesion of Coating to Fabric

Purpose: To determine the force or pull necessary to separate chemical coating from its fabric backing.

Reference: ASTM D751 – Standard Test Methods for Coated Fabrics

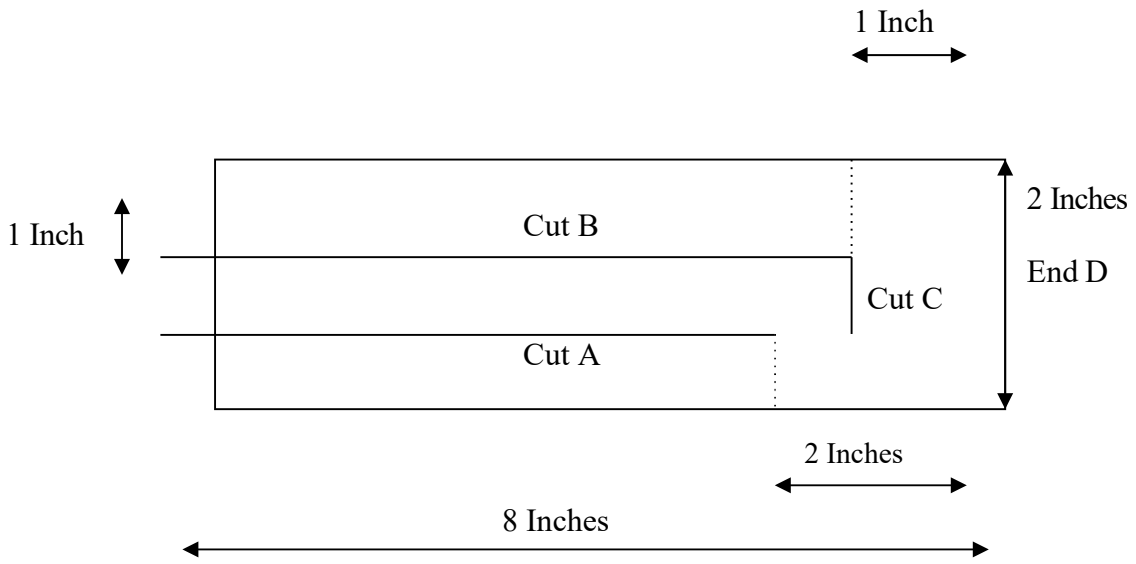
Apparatus: Testing machine consisting of straining mechanism, holding clamps, and load recording mechanism (Universal Tester).

Specimens 2 inches (5 cm) in width and 8 inches (20 cm) in length shall be cut from the coated fabric. Two sets of two specimens each will be required, one set for adhesion in the machine direction having the longer dimension parallel to the machine direction of the fabric, and the other set for adhesion in the cross machine direction having the longer dimension parallel to the cross machine direction of the fabric. The specimens shall be prepared for test as follows:

a. When the strength of the coating film exceeds the adhesive bond to the fabric, as with thick films, the specimen shall be prepared for test by carefully cutting the coating through to the fabric on two parallel cuts

A and B, 1 inch (2.5 cm) apart running lengthwise of the specimen with one cut 1 inch (2.5 cm) longer than the other as shown in the drawing.

The ends of cuts A and B shall be joined together with a diagonal cut C which shall also be carefully cut through the coating to the fabric. The edge of a knife shall be worked under the strip separated from the backing for a distance of 2 inches (5 cm) from that point.



b. With thin films or in cases where the coating is not sufficiently strong to be stripped from the fabric as described in Paragraph (a), two specimens of the coated fabric shall be cemented together face to face with an adhesive suitable for adhering the type of coating being evaluated. Care should be taken not to alter the coating/fabric adhesion. The cuts shown in the above drawing shall then be made from one side being careful to penetrate only through one layer of fabric and not to injure the other fabric layer. The fabric from one side shall then be stripped down for a distance of 2 inches (5 cm). This will allow the backing fabric to be inserted in one jaw of the machine. The force required to separate the coating and the backing fabric can then be measured.

Note: *In case the fabric is too weak to be tested in a 1 inch (2.5 cm) width, the specimen may be cut 3 inches (7.5 cm) in width and the strip for evaluation cut 2 inches (5 cm) in width. The results shall then be recorded as pounds pull per 2 inch (5 cm) strip.*

Clamp the separated portion of the 1 inch (2.5 cm) strip in the moveable jaw of the testing machine and end D (the end of the specimen opposite the cut strip) in the fixed jaw so that the movement of the moveable jaw will separate the coating from the backing. The rate of travel of the moveable jaw shall be either 2 inches (5 cm) per min. or 12 inches (30 cm) per min., as specified. The distance of the separation of the coating or plies shall be a minimum of 3 inches (7.5 cm).

The report shall include the following:

1. Type of testing machine and the rate of travel of the moveable jaw, and
2. The average test value for at least two specimens cut in the longitudinal direction and two specimens cut in the transverse direction. The averages of the five high peaks shall be used to determine the pull in pounds for reporting the adhesion of the coating or plies.

Drawing must be altered to include 'D', the end of the sample opposite from the cut segment.

(Rev. 4/20)

CFFA-300: Bacterial Resistance

Purpose: To determine the degree of bacteriostatic activity of coated fabrics and films.

Reference: *AATCC TM147

Principle: Specimens of the test material are placed in contact with the AATCC Bacteriostastis agar** which has been streaked with:

Staphylococcus aureus	American Type Culture Collection No. 6538***
Klebsiella pneumoniae	American Type Culture Collection No. 4352***
Salmonella choleraesuis	American Type Culture Collection No. 10708***
Pseudomonas aeruginosa	American Type Culture Collection No. 13388***

After incubation at 99°F (37°C) for 18 to 24 hours, the incubated plates are examined for interruption of growth along the streaks of inoculum beneath the fabric and for a clear zone of inhibition beyond the specimen edge. Reports of results will include an observation of zones of inhibition and growth under the specimen if present. The customer (or supplier) will establish the final criteria for a pass or fail judgment based on observations of the results.

*Available from American Association of Textile Chemists and Colorists, P. O. Box 12215, Research Triangle

Park, NC 27709, 919-549-8141.
**Available from Difco Laboratories, 920 Henry Street, Detroit, MI 48201.
***Available from American Type Culture Collection, P. O. Box 1549, 10801 University Boulevard, Manassas, VA 20110-2209, 703-365-2700.

(Rev. 8/25)

CFFA-4: Blocking

Purpose: To determine the development of surface tack at an elevated temperature

Apparatus: Forced Air Laboratory Oven

Two specimens 2 x 2 inches (5 x 5 cm) shall be placed face to face between two glass plates 2-1/2 x 2-1/2 inches (6.4 x 6.4 cm), weighted with a one pound (454 gms) weight and exposed to 180° +/- 2°F (82° +/- 1°C) for a period of thirty minutes. Specimens shall be removed from the oven, taken from between the glass plates, and allowed to condition (at room temperature) for at least fifteen minutes before making observations.

Evaluation: Specimen shall be rated according to the following scale:

1–No blocking;	No adhesion.
2–No blocking;	Slight adhesion.
3–Slight blocking;	Coating must be peeled to be separated.
4–Blocking;	Coating cannot be separated intact.

Where specified, both sides of double coated material shall be tested.

(Rev. 4/20)

CFFA-6: Cold Crack Resistance

Purpose: To determine the temperature at which cracks may appear if coated fabrics are left in the cold and then folded sharply

Apparatus: Low Temperature Apparatus

a. Roller Method

Four 2 x 6 inch (5 x 15 cm) specimens are cut, two in the machine direction and two in the cross machine direction, one set each to be tested on both sides.

The two narrow ends of each specimen are brought together and stapled to a card so as to form a smooth loop at the unstapled end. The specimens shall be exposed for 2 hours at the specified temperature.

A 5 pound (2.2 Kg.) roller shall be used on light materials (up to 15 oz/yd^2 or 500 g./m^2) and a 10 pound (4.5 Kg.) roller on heavier materials. The roller shall be rolled lengthwise from the stapled end toward the loop, with no pressure exerted other than the weight of the roller on the specimen. The specimen shall be evaluated in one of two ways:

1. Serious cracking will be visible to the naked eye.
2. Fine cracking may be detected by examination under a magnifying glass.

Note: *Cracks caused by obvious defects in the coated fabric are to be discarded and the test re-run.*

b. Mandrel Method

Four specimens, 2 x 8 inches (5 x 20 cm), are cut, two in the machine direction and two in the cross machine direction, one set each to be tested on both sides. A ½ inch (12 mm) diameter mandrel shall be conditioned at the specified temperature for a minimum of 30 minutes before testing. After conditioning and without removal from the test conditions, the specimen shall be bent quickly 180 degrees around the mandrel and the specimen shall meet at not more than 1/4 inch (6 mm) behind the mandrel. The specimen is then evaluated visually for cracks.

(Rev. 8/25)

CFFA-7: Crocking Resistance

Purpose: To determine the resistance to transfer of color from chemical coating to another surfaceby rubbing action

Reference: AATCC TM 8

Apparatus: Crockmeter*

a. Dry

The specimen to be tested shall be rubbed with an unstarched, 96 x 100 (80 x 80) cotton print cloth with a Crockmeter or similar device. The essential features are that the white cloth be firmly held over the flat end of a cylindrical "finger" 5/8 inch (1.5 cm) in diameter which presses with a weight of 32 ounces/force upon the coated surface to be tested. The finger shall be moved across the specimen twenty times at the approximate rate of 1/2 second per stroke, four inches (10 cm) long. The test is made with dry cloth and test piece.

b. Wet

The wet crocking test is conducted in the same manner as dry crocking except the crock cloth is saturated with distilled or deionized water and squeezed or wrung to remove excess water to a moisture pickup of 65 +/- 5% based on the weight of dry crock cloth. The crocking test shall be performed immediately thereafter.

Evaluation: Using a sample of the original material compared with the material tested when white crock cloth is required.

4–Excellent:	No perceptible staining of the white crock cloth.
3–Good:	Slight staining of the white crock cloth.
2–Fair:	Appreciable, but not objectionable, staining of the white crock cloth.
1–Poor:	Objectionable staining of white crock.

*Available from SDL Atlas LLC, 1813A Associates Lane, Charlotte, NC 28217, 704-329-0911, Fax: 704-329-0914, www.sdlatlas.com.

(Rev. 4/20)

CFFA-70: Denim Stain Resistance

Purpose: To determine the resistance to transfer of color from denim fabric to a coated fabric by rubbing action.

Reference: General Motors Test Procedure GMW15377 (modified)

Apparatus: Martindale Tester

Staining Material: Indigo Sulfur Black Denim, EMPA article 128/1
(Empa Test Materialen, AG, Moeven Strasse 12, CH 915 St. Gallen, Switzerland.)

A minimum of three specimens shall be tested.

The 150 mm diameter test specimens are mounted over a 140 mm diameter felt on the test platform on the Martindale device.

The 38 mm Denim patch that applies the stain is mounted over a 38 mm foam on a specimen holder of the Martindale typically used for abrasion testing. An additional weight of 595 +/- 7 grams is added to this holder assembly to produce a pressure of approximately 12KPA (1.45 lbs.).

Using the Lissajous rubbing motion, the Martindale device is run for 1,000 cycles.

Remove the specimens from the tester. Stain should be approximately in the shape of a square.

Clean with Dawn liquid detergent (or equivalent) using a white cotton cloth 150 mm (6 inches) square to gently rub the stain.

Visually examine the cleaned specimens, comparing them to an unstained specimen.

Evaluation:

10–No Change:	Visible at any viewing angle
8–Slight Change:	Visible at any viewing angle
6–Moderate Change:	Visible at any viewing angle
4–Significant Change:	Objectionable amount of staining visible
2–Severe Change:	Intense Staining

(Rev. 8/25)

CFFA-700: Dimensions of Coated Fabric

Purpose: To determine the dimensions of a coated fabric

Reference: ASTM D751 – Standard Test Methods for Coated Fabrics

a. Width

Measure the width of the coated fabric laid out smooth on a horizontal surface without tension in either direction. Report the average of at least five different measurements uniformly distributed along the full length of the roll or piece as the average width. Also report the minimum width.

b. Length

Lay the coated fabric out smooth, without tension, on a horizontal surface and measure the length parallel to the selvage; or, measure successive portions, each at least 5 yards (4.5 m) in length, under the same conditions.

c. Thickness

Apparatus: The gauge used for the measurement of thickness shall be of the deadweight type

equipped with a dial graduated to read directly to 0.001 in. (0.025 mm). The presser foot shall be circular with a diameter of 0.375 +/- 0.001 inches (9.52 +/- 0.03 mm). The presser foot and moving parts connected therewith shall be weighted so as to apply a total force of 6 +/- 0.1 oz. (1.7 +/- 0.1 N) equivalent to a pressure of 23.5 +/- 0.5 kPa (3.4 psi) to the specimen. The presser foot and anvil surfaces shall be plane to within 0.0001 inches (0.0025 mm) and parallel to each other within 0.0001 inches (0.0025 mm). The gauge shall be calibrated for the actual load exerted by the presser foot by means of any device so arranged as to measure the total vertical force exerted by the presser foot at the several gauge readings or presser foot levels selected for calibration. The presser foot shall be brought to each calibration level from a higher one.

Place the coated fabric upon the anvil of the gauge smooth, but without tension. Lower the presser foot upon the material gradually (without impact), allow it to rest upon it 10 seconds, and then observe the reading of the dial. Make similar measurements at no less than five different places uniformly distributed over the surface of the coated fabrics exclusive of the area adjacent to either selvage and within one tenth the width of the fabric or within 100 inches (2.5 m) of either end of a roll of piece. Report the average of the five or more measurements as the average thickness.

d. Mass

Method Applicable to a Piece, Cut, or Roll – Weigh the full piece, cut, or roll on a calibrated scale accurate to 0.25%, measure the length and width of the coated fabric, and calculate the mass, reporting it in ounces per square yard (grams per square meter) to the nearest 0.1 oz. (2 g).

Method Applicable to a Sample – Cut a specimen having an area of at least 20 $in.^2$ (129 cm^2), or a number of specimens not less than 2 in. (50 mm) square and having a total area of at least 20 $in.^2$ (129 cm^2) from the coated fabric, weigh on a calibrated scale accurate to 0.25%, and calculate the mass, reporting it in ounces per square yard (grams per square meter). Unless the specimen is the full width of the fabric, take no specimen nearer the selvage than one-tenth the width of the fabric.

Note: *This test method is intended for use when a small sample of coated fabric is sent to the laboratory for testing. The result is considered to be applicable to the sample, but not to the piece or lot of goods from which the sample was taken, unless the number of samples and method of sampling are specified and agreed upon by those concerned. If this is done, each sample should be tested and the results averaged. Report the average mass in ounces per square yard (grams per square meter).*

(Rev. 8/25)

CFFA-8: Dry Cleanability

Purpose: To determine the resistance of coated fabrics to dry cleaning

Reference: International Fabricare Institute, 14700 Sweitzer Lane, Laurel, MD 20707, 301-622-1900.

History: In the past, CFFA recommended laboratory testing of coated fabrics for resistance to dry cleaning. Because there have been many changes in the typical dry cleaning process in recent years, it is now recommended that the dry cleanability of a product be tested outside at the International Fabricare Institute.

Principle: Actual samples of the coated fabric are dry cleaned in perchloroethylene and then tumbled dry at 140°F (60ºC). The criteria for a pass is to retain an acceptable hand or ability to pass a specified cold crack specification after either three (3) five minute or ten-minute dry cleaning cycles.

(Rev. 8/25)

CFFA-9: Flame Resistance

There are several flame-retardant and smoke density test methods for specific applications of coated fabrics and films. Please determine the required test(s) for your intended use.

For many contract upholstery, healthcare, and select marine applications, commonly specified flammability standards evaluate resistance to ignition from a smoldering cigarette. These include:

- California TB 117-2013, Section E
- NFPA 260
- UFAC Class 1

These tests are designed to simulate ignition from a smoldering cigarette, which represents a common real-world ignition source.

Certain applications, particularly those involving higher-risk environments or regulated transportation settings, may require more stringent flame-retardant performance. Examples include:

- **ASTM E1537**
  Used for upholstered furniture in high-risk environments such as prisons and nursing homes.

- **FMVSS 302**
  A standard for automotive applications that measures the burn rate of a horizontal specimen exposed to a Bunsen burner flame.

- **FAR 25.853, Appendix F, Part 1(a)(1)**
  Specifies flammability and smoke density requirements for coated fabrics used in aircraft cabin interiors.

- **IMO FTP Code 2010 (MSC.307(88)), Part 8, Sections 3.1 and 3.2**
  Required for coated fabrics used on cruise ships and other marine vessels:
  - Annex 1, Section 3.1: Smoldering cigarette test
  - Annex 1, Section 3.2: Butane flame test

- **49 CFR 238.103, Appendix B**
  Defines flammability and smoke density test methods for coated fabrics used in passenger train interiors.

Note: This listing is for informational purposes only.

(Rev.7/26)

CFFA-10: Flex Resistance

Purpose: To determine resistance of a coated fabric to repeated flexing under specific conditions

Reference: ASTM D2097 – Standard Test Method for Flex Testing of Finish on Upholstery Leather

Apparatus: Flex-O-Test* (formerly known as the Newark Flex Tester)

The minimum distance between the pistons shall be 15 times the thickness of the specimen.

Two specimens, 3 x 4-1/2 inches (7.5 x 11 cm) are required for each test, one for the machine direction, the other for the cross machine direction test. The Flex Tester shall be turned by hand until the pistons reach top dead center. One 4-1/2 inch (11 cm) end of the specimen shall be clamped, coated side out, into the stationary grip. The other 4-1/2 inch (11 cm) end shall be clamped into the movable grip. The machine shall be run 500 cycles per minute for a specific time. The specimens shall be removed and examined visually for evidence of cracking, whitening, crazing, or separation of coating from fabric backing.

Evaluation: Specimen must meet all four criteria.

No Cracking
No Whitening
No Crazing*
No Fabric Delamination

*Available from Aim Tool & Die, 14324 172nd St., Grand Haven, MI 49417, (616) 842-1503, Fax (616) 842-8232.

(Rev.4/20)

CFFA-11: Hydrolytic Stability – Vinyl

Purpose: To determine the resistance of a coated fabric to exposure to a wet environment

Reference: ASTM D1239 – Standard Test Method of Test for Resistance of Plastic Films to Extraction by Chemicals

Apparatus: Forced Air Laboratory Oven.

Four specimens, 3-1/2 x 4-1/2 inches (9 x 11 cm), two with the long dimension in the machine direction, the other two with the long dimension in the cross machine direction shall be cut from the specimen to be tested. Two of these specimens, one in each direction, shall be exposed to distilled water 158°F (70°C) for 14 days in accordance with ASTM D 1239. All four specimens shall then be subjected to the flexing test in accordance with CFFA-10.

All four specimens shall be examined for cracks, peeling and delamination of the coating. The difference between the control and material subjected to water shall indicate the degree of hydrolysis.

(Rev. 6/17)

CFFA-110: Hydrolytic Stability – Polyurethane

Purpose: To determine the resistance of a urethane coated fabric to hydrolysis when subjected to a combination of an elevated temperature and high humidity.

Reference: ASTM D3690, Section 6.11 – Standard Performance Specification for Vinyl Coated and Urethane Coated Upholstery Fabrics, Indoor (Sometimes referred to as 'The Jungle Test')

Apparatus: Environmental Chamber, capable of maintaining the required temperature within +/- 2ºF (+/- 1ºC), and the relative humidity within +/- 5%.

Universal Tensile Tester
Wyzenbeek Abrader
Flex-O-Test (Newark Flex Tester)

A sample with minimum dimensions of 12 inches in the Machine Direction (MD) of the coated fabric, and 20 inches in the Cross Direction (CD) is required, sample to be taken at least six inches away from a machine direction edge and a yard from an end, if possible.

Cut a second sample of the same dimensions to be used as an unexposed control.

Before testing, condition the sample for 24 hours at 70° +/- 2°F (21° +/- 1.1°C).

Expose the sample (from which test specimens will be taken) to a temperature of 158° +/- 2°F (70° +/- 1.1°C) and 95° +/- 5% relative humidity.

Exposure time: Contract Grade – 15 days
Healthcare Grade – 10 Weeks

After conditioning for two hours, cut specimens for testing as follows:

Adhesion:	Two specimens, 2" x 8", Machine Direction Two specimens, 2" x 8", Cross Direction
Abrasion:	Two specimens, 2-7/8 x 9-5/8", Machine Direction Each trimmed with 'Wings' to fit the Wyzenbeek Abrader
Flex Resistance:	One specimen, 3" x 4-½", Machine Direction One specimen, 3" x 4-½", Cross Direction

Prepare similar sets of specimens from the Control sample.

Evaluation: Requirements to pass.

1. Adhesion: Measure adhesion in accordance with CFFA-3. Average the two specimens from each group. Calculate % Loss of Adhesion in both MD and CD,

$$L = 100 \frac{(O - H)}{O}$$

L = % Loss of Adhesion
O = Original Adhesion
H = Adhesion after Exposure in Hydrolytic Chamber

Minimum Standard: 'Maintains 75% of original strength'.

2. Abrasion Resistance: Minimum Standard: No cracking or delamination at 25,000 double rubs.

*Substitute Wyzenbeek Method ASTM D4157-13 (CFFA Method 1a), using 2 lb head pressure and 6 lb tension and bleached cotton duck as the abradent.

3. Flex Resistance: Measure flex in accordance with CFFA-10. Test both exposed and control specimens, MD and CD. Minimum Standard: No breaks in coating at 15,000 cycles.

(Rev. 1/21)

CFFA-12: Lacquer or Varnish Lifting

Purpose: To determine the ability of coated fabrics to remain in contact with a lacquered or varnished surface without damaging either material.

Reference: ASTM D2199 – Standard Test Method for Measurement of Plasticizer Migration from Vinyl Fabrics to Lacquers

Apparatus:

1. Draw down blade capable of giving a 1-4 mil dry thickness coating, 2 inches (5 cm) wide.

2. Plate glass panels, 3 x 3 inches (8 x 8 cm) or greater, double strength.

3. Window glass, 2 x 2 inches (5 x 5 cm), double strength.

4. Weights, 1 lb. flat bottom (providing a pressure of .25 psi on the 2 x 2 inch (5 x 5 cm) glass plate).

5. Forced convection oven, thermostatically controlled to +/- 4ºF (+/- 2□C).

6. Roller of sufficient weight to ensure intimate contact of the vinyl and coating.

7. Aluminum foil.

Draw down a 2.5 x 2 inch (6.3 x 5 cm) or longer 1-4 mil dry thickness of the agreed upon coating on a 3 x 3 inch (8 x 8 cm) or larger plate glass panel and dry according to the manufacturer's instructions.

Place a 3 x 2 inch (8 x 5 cm) section of coated fabric perpendicular to the length of the coating on the panel and roll with a roller to ensure intimate contact of the coated side of the fabric with the coating on a 2 x 2 inch (5 x 5 cm) section. Place a smooth 2 x 2 inch (5 x 5 cm) foil over this section, followed by a 2 x 2 inch (5 x 5 cm) glass plate. Place a 1 lb. weight on top.

Put the assembly into a forced convection oven preheated to 120ºF (50□C) and examine the interface between the coating and the coated fabric at 24, 72, and 168 hours.

Report any resistance to removal. Examine the surfaces and report any liquid buildup, surface change, or softening.

Evaluation: Use a scale of:

No Change
Faint Imprint
Severe Imprint
Marring

*Available from DuPont Industries, Paint Division, Wilmington, DE 19810-2542.

(Rev. 8/25)

CFFA-120: Mildew Resistance

Purpose: To determine degree of fungal growth on coated side only of coated fabric, samples are placed on (non-nutrient) mineral salts agar and inoculated with a mixed fungal spore suspension of:

Aspergillus brasiliensis	American Type Culture Collection No. 9642*
Penicillium funiculosum	American Type Culture Collection No. 11797*
Chaetomium globosum	American Type Culture Collection No. 6205*
Aureobasidium pullulans	American Type Culture Collection No. 15233*
Trichoderma virens	American Type Culture Collection No. 9645*

Reference: ASTM G21 – Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

After a minimum of 28 days incubation at 82°F (28°C), antifungal activity is evaluated by visually rating the degree of fungal growth on the samples.

Note: *There is no standard sample size. However, a 1" (25 mm) square is a typical size used.*

Evaluation: Surface growth is rated by the degree of coverage on the following scale:

(NG) No Growth:	0
(TG) Trace of Growth (less than 10% coverage):	1
(LG) Light Growth (10 to 30% coverage):	2
(MG) Moderate Growth (30 to 60% coverage):	3
(HG) Heavy Growth (60% to full coverage):	4

*Available from American Type Culture Collection, 10801 University Boulevard, Manassas, VA 20110-2209.

(Rev. 8/25)

CFFA-121: Pink Stain

Purpose: To evaluate the antimicrobial performance in or on a polymeric film against staining by Streptomyce species (A pink stain organism).

Reference: ASTM E-1428-15a, Standard Test Method for Evaluating the Performance of Antimicrobials in or on Polymeric Solids against Staining by Streptomyce species (A Pink Stain Organism)

Apparatus: Pre-sterilized disposable plastic Petri Dishes, 100 mm Diameter (from any lab supply house).
Cotton Swabs.
Incubator capable of maintaining 29º +/- 1°C (84.2° +/- 1.8°F).

Reagents: Yeast Malt Extract (ISP Medium 2), Bacto-Yeast Malt Extract, Stock No. 0770-01*.
Inoculum Streptomyces species- ATCC25607** (deposited as Streptoverticillium reticulum)

Maintain stock cultures on yeast malt extract agar. The stock may be kept for no more than 12 months at approximately 3° to 9°C. Subcultures, incubated at 29º +/- 1°C for 7 to 14 days shall be used for inoculation.

Cut duplicate 0.75 in. diameter discs from each sample to be tested. If the samples are of different construction on each side, two specimens of each, two face up and two, face down, shall be tested. Heavily soiled test samples should be rinsed vigorously in water z9If available, a test specimen with no biocide should be included as a positive stain control, and a sample known to inhibit staining should also be included as a negative stain control).

Inoculation: Pour sufficient yeast malt extract agar into Petri dishes to provide a solidified agar layer 5 to 8 mm deep. Moisten the agar surface by streaking with a cotton swab dipped in sterile water. Add 3 ml sterile saline to the stock culture plate and use the pre-moistened swab to harvest the Streptomyces cells. Streak the cell- laden swab by streaking in a manner that will ensure total coverage by the organism. Using forceps, place the test specimens, two to a plate, on the agar surface assuring good contact.

Incubation: Cover the inoculated test plates containing the specimens and incubate at 29° +/- 1°C for 14 days. Covered Petrie dishes containing yeast malt extract are considered to have the desired humidity.

The degree of staining is determined by the area of surface stained, rather than intensity of color. Any discoloration that is not pink should be disregarded. (Exception: pigmented samples that show a color change associated with pink, e.g.: blue film changing to purple.)

Evaluation:	Degree of Stain Rating:
No Stain:	0
Trace of Stain (less than 10% coverage):	1
Slight Stain (10 to 30% coverage):	2
Moderate Stain (30 to 50% coverage):	3
Heavy Stain (50% to complete coverage):	4

Zone of Inhibition: Yes/No (Reports existence of an area of no organism growth adjacent to the specimen.)

*Available from Difco Labs, P.O. Box 1058A, Detroit, MI 28232.
**American Type Culture Collection, 10801 University Blvd, Manassas, VA 20110.

(Rev. 5/17)

CFFA-14: Seam Strength

Purpose: To simulate resistance to seam tearing

Reference: ASTM D751 – Standard Test Methods for Coated Fabrics – Section 50-54 – Tack-Tear Resistance, modified as follows:

Apparatus: (a) Tack-Tear Tester per ASTM D 751 but using needles of 0.048 diameter, 5/8 inch (1.5 cm) length, with 3/16 inch (0.47 cm) taper* instead of phonograph needles.
(b) Testing machine consisting of straining mechanism, holding clamps and load recording mechanism. Machine speed shall be set at 12 inches/minute.

Two sets of five specimens, each 2 inches (5 cm) in width and 6 inches (15 cm) in length shall be used. One set is used for machine direction tack-tear strength having the longer dimension parallel to the cross machine direction. The other set is used for cross machine direction tack-tear strength having the longer dimension parallel to the machine direction. The specimens shall be mounted in the testing machine so that the distance from the top of the lower clamp to the bottom of the needles shall be 3 inches (7.5 cm). If the machine is the pendulum type, disengage the pawls on the pendulum from the ratchet. The maximum load necessary to tear the fabric shall be recorded. The seam strength of the specimen shall be reported as the average of all individual results in lb. force/1 in. +/- 0.1 lb force/1 in., (N/25mm +/- 0.4N/25mm).

*Available from Robert A. Main & Sons, Inc., Wyckoff, NJ 07481, (201-447-3700). (Only supplied in English units).

(Rev. 4/20)

CFFA-140: Shrinkage

Purpose: To determine the ability of coated fabrics to resist shrinkage

Reference: ASTM D751 – Standard Test Methods for Coated Fabrics

Three specimens 10 x 10 inch (250 x 250 mm) shall be accurately measured in each direction to the nearest 1/32 in. (0.5 mm). The specimens shall be soaked for 30 minutes in distilled water at room temperature, removed and dried at 200□F (87□C) for 30 minutes. The specimens shall then be conditioned at the standard
conditions as provided in ASTM Specification D751 for a minimum of 8 hours prior to re-measuring. The percent shrinkage in each direction shall be calculated using the following formula:

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

Where: A = Length before test.
B = Length after test.

(Rev. 8/25)

CFFA-141: Stain Resistance

Purpose: To determine the resistance of the surface of coated fabrics to staining by common household chemicals and/or different staining compounds

Reference: ASTM D1308 – Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes

Apparatus: Template with an opening of 7 x 0.2 x 0.3 inches (17.5 x 0.5 x 0.75 cm). See diagram.

Reagents: Use and by agreement between the buyer and the seller (including brand, type and concentration).

Cut a piece of the coated material to be tested, about 8.5 x 11 inch. Using the Template, apply stain materials through the opening, in a continuous line across the width. It could be necessary to use a cotton swab to apply the stain materials and distribute along the opening. When cleaning, to eliminate cross contamination, a space between stains is recommended. Follow specific sample preparations under the CFFA Standard Test Conditions for 2 and 24 hours. Allow staining agents to set at Atmospheric Conditions. Remove the excess of the staining material. Clean the stains using a dry, clean cotton swab or whatever material or article was agreed upon by the buyer and seller, to treat all the samples to be tested under the same conditions. Upon agreement of the material to use for cleaning and the cleaning agents, try to clean for ten (10) cycles, or as agreed to by buyer and seller. Each stain to be consistent. Use one cotton swab per cleaner to avoid contamination.

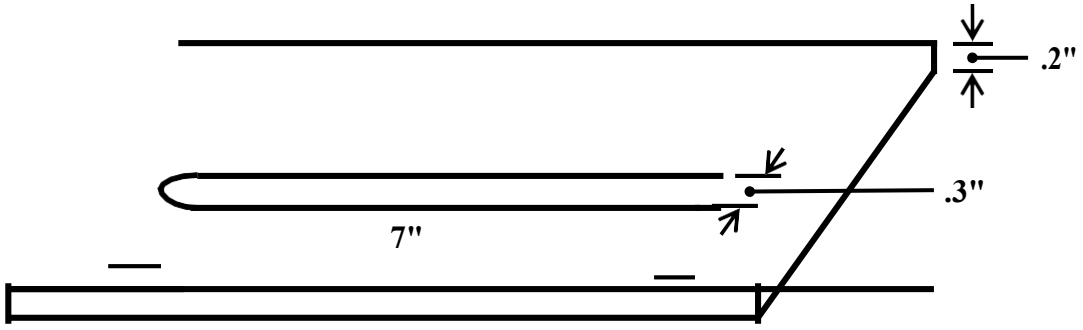
Evaluation: The ratings for stain resistance are based on the following scale:

4–Excellent Cleanability, no stain mark in the material.
3–Good Cleanability, slight stain.
2–Poor Cleanability, stain is almost intact.
1–Non-Cleanable, no stain removed.

Report:

Applications and/or coating use. Stain reagents.
Cleaning reagents.
Procedure used.
Evaluation (rating for cleaning the stains).

Template Diagram:



(Rev. 4/20)

CFFA-142: Stain Resistance in Healthcare Environments

Purpose: To determine the resistance of the surface of coated fabrics used in healthcare to staining by transferable stains, including body fluids. Serves as a qualification test for healthcare applications.

Reference: ASTM 1308, Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes

Apparatus: Medicine dropper; cleaning/disinfecting agents, soft clean white cotton cloth/cotton patches.

Transferable Stain Types:
Synthetic Body Fluids:
Stomach Acid – Carolina Biological Supply Company: Gastric Juice, Artificial, Laboratory Grade
Human Sweat – Pickering AATCC TM15 Sweat pH 4.3
Urine – Carolina Biological Supply Company: Simulated Urine, Normal

Inks:
Viscot Mini Surgical Fine Tip Marker
Ballpoint pen- Bic Round Stic – Blue

Transferable Stains:
Revlon Super Lustrous Lipstick- Love That Red
Johnson's Baby Oil
Jergens Daily Moisture Dry Skin Moisturizer
Cutex Quick and Gentle Polish Remover, Non-Acetone
Coppertone Complete 50 (Replaces Coppertone Ultraguard Broad-Spectrum Sunscreen Continuous Spray SPF 50 (Oxybenzone 5%, Avobenzone 3%, Octocrylene 4%, Homosalate10%, Octisalate 5%) due to discontinuation of SPF's containing Oxybenzone).

Shea Moisture Jamaican black castor oil strengthen restore leave in conditioner

NOTE: Sample preparation, application and cleaning procedure should be done for each stain type noted above. Conduct the test at ambient temperature and humidity.

Sample Preparation:
Cut a coated fabric sample large enough for the application of two stain samples of one of the stain types noted above. Allow enough space between to be cleaned at one hour and 24 hours. Do this for each of the stain types.

Application:
For liquid stains, using a medicine dropper, place five drops of each stain type on the coated fabric sample to be tested. For stain types that cannot be applied with a medicine dropper, such as pens, lipstick or applicators, apply by drawing a straight line approximately four inches long on the coated fabric sample using light pressure.

Apply the stain, as noted above, to three areas of the coated fabric sample, cleaning one area after one hour and the second after 24 hours. The third area should not be cleaned; only for comparison (before testing and after testing).

Cleaning Procedure:
Follow Manufacturer's Cleaning Instructions: Apply the cleaning agent using a clean soft white cotton cloth or patch.
1. Clean with a household cleaner such as Formula 409 or equivalent
2. If stains remain, use 91% isopropyl alcohol.

Evaluation:
After following the cleaning procedure for the stain for each time period, evaluate and report results.

Rating:
4–No Stain
3–Slight Stain
2–Visible Stain
1–Heavy Stain

(Rev. 6/25)

CFFA-15: Stretch and Set

Purpose: To determine the stretch resistance and recovery of coated fabrics

Reference: Society of Automotive Engineers Method J855-2009

Apparatus: Clamps and Weights as specified

Test specimens 3 x 9 inches (7.6 x 22.9 cm) shall be cut in both the machine and cross machine directions. No specimen is taken closer to either selvage than 1/10 of the width. For machine direction stretch, the long dimension of the specimen shall be parallel to the machine direction; for the cross machine direction, the long dimension shall be parallel to the cross machine direction. Mark two sharp clear lines 3 inches (76 mm) apart across the center portion of the sample.

The specimen shall be held by two pairs of jaws, so that the long dimension of the specimen is parallel to the direction of the application of the load. The jaws shall be placed 1 inch (2.5 cm) from the end of the specimen and perpendicular to the long direction. Both faces of each pair of jaws must be a minimum of 3 inches (7.6 cm) wide. The specimen is suspended vertically with the load for a period of five minutes. At the end of this period, and while the specimen is still under tension, the increased length of the marked section shall be measured. The percent stretch shall be calculated in the following manner:

$$\% \text{ Stretch} = \frac{L_2 - L_1}{L_1} \times 100$$

L_1 = Original Length between Benchmarks.
L_2 = Measured Length after the weight is applied for five minutes. L_3 = Measured Length after 5-minute recovery period.

The weight shall be removed and the specimen placed in a horizontal position. The distance between the Benchmarks shall again be measured after the specimen has remained in this position for five minutes. The percent set shall be calculated in the following manner:

$$\% \text{ Set} = \frac{L_3 - L_1}{L_1} \times 100$$

A total load of 27 pounds (12.2 Kg) which includes the weight of the lower jaw shall be applied to the specimen.

Note: *If the stretch produced by the 27 pound (12.2 Kg) weight exceeds the elastic limit of the test specimen, the test shall be repeated with a 10 pound (4.5 Kg) weight.*

(Rev. 8/25)

CFFA-16: Tearing Strength

Purpose: To determine the resistance to further tearing after the material has been cut

a. Elmendorf Method

Reference: ASTM D1424 – Standard Test Method for Tearing Strength of Fabrics by Falling-Pendulum Type (Elmendorf-Type) Apparatus

Apparatus: Elmendorf Tester

The tearing strength of a coated fabric may be determined by the falling pendulum method. The average force required to propagate tearing from a pre-cut specimen is measured using a precisely calibrated pendulum device known as the Elmendorf Tester. Acting by gravity, the pendulum swings through an arc, tearing the specimen from a pre-cut slit. The specimen is held on one side of the slit by the pendulum and on the other side by a stationary member. The loss in energy of the pendulum is indicated by a pointer reading on a scale and is a function of the force required to tear the specimen.

Specimens should be taken so as to obtain two sets of five test specimens, 4 inches (10 cm) wide and 2.5 inches (6.3 cm) long. One set shall have the long dimension parallel to the machine direction and the other set shall have the long dimension parallel to the cross-machine direction. Either before or after mounting in the test apparatus a slit of 0.8 inches (2.0 cm) long is made at the center line of the wide edge and in the direction of the specimen length. This leaves 1.7 inches (4.3 cm) of tearing length between the end of the slit and the opposite edge of the specimen.

The test apparatus shall be checked for friction loss and calibrated as described in the referenced ASTM method.

With the pendulum in its raised position, the specimen is placed midway in the clamps so that its upper edge is parallel to the top of the clamps and the initial slit is at right angles to the top of the clamps. When the specimen is torn, the reading shall be between 20 and 80 percent of full scale reading. If over 90%, auxiliary weights shall be employed to double or quadruple the capacity of the machine. The isolated very high or very low result, when a consistent average has been obtained without the abnormal reading, shall be

discarded and a duplicate specimen tested. If the tear deviates more than 3/8 inches (10 mm) from the line of the initial slit, the specimen should also be rejected and a duplicate specimen tested.

Results shall be calculated as follows:

Grams to tear specimen: Directly or by calculating from scale reading. If auxiliary weights are needed, the appropriate multiplier must be used. The average, maximum and minimum results for both the machine and cross machine directions shall be reported.

b. Tongue Method

Reference: ASTM D2261-e1 – Standard Test Method for Tearing Strength of Fabrics by the Tongue Tear (Single Rip or Single Tear) Procedure (Constant-Rate-of-Extension Tensile Testing Machine)

Apparatus: Testing machine consisting of straining mechanism, holding clamps and load recording mechanism (Universal Tester).

The tearing strength may be determined by the tongue method. The width of the jaws of the apparatus shall be 2 inches (5 cm) or more. The rate of separation of the jaws shall be 12 +/- 0.5 inches (30 +/- 1 cm) per minute. Testing speed can range from 2 +/- .1 inches per minute to as high as 12 +/- 0.5 inches per minute.

Specimens 8 inches (20.0 cm) long by 3 inches (7.5 cm) wide are taken for the test. Two sets of five specimens each are required, one set having the longer dimension parallel to the machine direction, and the other set having the longer dimension parallel to the cross-machine direction. A longitudinal cut 3 inches (7.5 cm) in length shall be made lengthwise of the specimen starting in the center of one of the short edges.

The specimen shall be placed squarely in the machine with one of the tongues in each clamp. The load necessary to continue the tear after it has been started fluctuates and is recorded by means of a suitable autographic recording device on the testing machine.

The tearing strength of the specimen shall be the average of the five highest peak loads of resistance registered after .25 inches (6 mm) of separation of the tear.

Machine capacity should be chosen so that neither the lower 15% nor the upper 15% of the dial reading is used.

c. Trapezoid Method

Reference: ASTM D751 – Standard Test Method for Coated Fabrics, Trapezoidal (Preferred Method for Non-Woven Coated Fabrics)

Apparatus: Testing machine consisting of straining mechanism, holding clamps and load recording mechanism.

The tearing strength also may be determined by the trapezoid method. The width of the jaws of the apparatus shall be 3 inches (7.5 cm) or more. The rate of separation of the jaws shall have a speed up to 12 inches (30 cm) per minute. Distance between clamps at the start of the test shall measure 1 inch.

Rectangular specimens 6 inches (15 cm) long by 3 inches (7.5 cm) wide are taken for the test. Two sets of five specimens each are required, one set having the longer dimension parallel to the machine direction, and the other set having the longer dimension parallel to the cross-machine direction.

An isosceles trapezoid having an altitude of 3 inches (7.5 cm) and a base of 4 inches (10 cm) in length. A cut approximately 3/8 inches (1 cm) in length (5/8 inches (1.5 cm) for knit back construction) shall then be made in the center of and perpendicular to a 4 inch (10 cm) edge.

The specimen shall be clamped in the machine along the non-parallel sides of the trapezoid so that these sides lie along the lower edge of the upper clamp and the upper edge of the lower clamp with the cut half-way between the clamps. The short trapezoid base shall be held taut and the long trapezoid base shall lie in the folds.

The load necessary to continue the tear after it has been started fluctuates and is recorded by means of a suitable autographic recording device on the testing machine. Tearing strength of each individual test shall be the average of the five highest peaks. The average of the results of the five individual tests on the machine direction shall be reported as the machine tear strength of the specimen, and the average of the five individual tests in the cross machine direction shall be reported as the cross machine tear strength of the specimen.

Machine capacity should be chosen so that neither the lower 15% nor the upper 15% of the dial reading is used.

(Rev. 4/20)

CFFA-17: Tensile Strength and Elongation (Also Referred to as Breaking Strength)

Grab Test Method

Purpose: To determine the pulling force required to rupture coated fabrics

Reference: ASTM D751 – Standard Test Methods for Coated Fabrics

Apparatus: Testing machine consisting of straining mechanism, holding clamps and load recording mechanism (Universal Tester).

Specimens 4 inches (10 cm) wide and not less than 6 inches (15 cm) long are taken for the test. Two sets of five specimens each are required, one set for the machine direction tensile strength having the long dimension parallel to the machine direction, and the other set for cross-machine direction tensile strength having the long dimension parallel to the cross machine.

Unless otherwise specified, no specimen is taken nearer the selvage than $1/10^{th}$ the width of the material.

The distance between the two pairs of jaws on the apparatus is 3 inches (7.5 cm) at the start of the test. The rate of separation of the jaws shall be 12 +/- 0.5 inches (30 +/- 1 cm) per minute. The jaws have smooth flat faces with edges slightly rounded to prevent cutting. The face of one jaw of each pair measures 1 x 1 inch (2.5 x 2.5 cm); that of the other jaw of each pair measures 1 x 2 or more inches (2.5. x 5 or more cm), the long dimension being perpendicular to the application of the load.

The specimen is placed symmetrically in the jaws of the machine with the long dimension parallel to and the short dimension at right angle to the direction of application of the load. If woven backings apply, care should be taken to grip the same yarns in the fabric backing by both pairs of jaws.

Tensile specimen at break is the numerical average of the results obtained by breaking five specimens separately and is expressed as force/unit width (e.g., lbs/in.).

If a specimen slips in the clamps, breaks in the clamps, breaks at the edge of the clamps, or for any reason attributable to faulty operation causes the results of a single specimen to fall markedly below the average for the set, the result is discarded, another specimen taken and the result of the break included in the average. No two specimens for machine direction breakage shall contain the same yarns, or for the cross machine breaking strength. Machine capacity should be chosen so that neither the lower 15% nor the upper 15% of the dial reading is used.

Elongation at break (Ultimate Elongation) shall be calculated as follows:

$$\% \text{ Elongation at Break} = \frac{X_1 - X_0}{X_o} \times 100$$

Where X_0 = Distance between jaws at start of test
X_1 = Distance between jaws at moment of rupture

(Rev. 8/25)

CFFA-18: Volatility

Activated Carbon Method

Purpose: To determine the rate at which materials volatilize from a coated fabric at a given temperature.

Reference: ASTM D1203– Standard Test Methods for Volatile Loss From Plastics Using Activated Carbon Methods

Apparatus: Forced air laboratory oven or a bath capable of maintaining the temperature to within +/- 2ºF (+/- 1ºC) between temperatures of 122º - 194º (50º - 90ºC), analytical balance capable of measuring weight to nearest 0.001 g, 1 pint (500 cm^3) containers, 6/14 mesh activated carbon and a micrometer capable of measuring to the nearest 0.0001 in. (0.0025 mm).

Specimens shall be conditioned at the standard laboratory atmosphere of 73º +/- 2ºF (23ºC +/- 1ºC) and 50% (+/- 5%) relative humidity a minimum of five hours at the start and end of the test.

A minimum of two specimens and a maximum of three specimens 50 +/-1mm in diameter shall be weighed from each sample. Record this weight as W_o. The thickness of the specimen shall be recorded (the standard thickness is 0.25 +/- 0.025 mm). Volatility measurements should not be compared directly if thickness measurements vary more than 10% from a nominal thickness. 120 cm^3 of activated carbon is placed in the bottom of the container. A specimen is placed on top of the activated carbon and covered with 120 cm^3 of carbon. Each successive specimen is placed on top of the first and also covered with 120 cm^3 of carbon.

The lid shall be placed on the container, in such a way that the container is vented. Ensure the carbon is not packed down by pressure other than under its own weight and the weight of the samples. The container shall be placed upright in the heating unit at 158°F (70°C) for 24 hours. The container shall be removed and allowed to cool for 15 minutes. Open the container, remove the specimens to brush off excess carbon, and recondition as specified above. After reconditioning, reweigh the specimens. Record this weight as W_1.

The loss of weight is then calculated and the specimens compared with the original specimen. The loss of weight shall not exceed an amount agreed upon by the principals.

Calculate as follows:

$$\% \text{ Weight loss} = \frac{W_o - W_1}{W_o} \times 100$$

Where W_o = Initial weight of test specimen
W_1 = Final weight of test specimen

(Rev. 8/25)

CFFA-19: Water Vapor Transmission

Purpose: Determination of Water Vapor Transmission (WVT) of Materials

Reference: ASTM E96/E96M – Standard Test Methods for Water Vapor Transmission of Materials

Apparatus: Test Dish – Any container non-corroding and impermeable to water or water vapor.

Test Chamber – A humidity and temperature controlled room or cabinet where test dishes are placed.

Balance and Weights – Sensitive to changes smaller than 1% of the total weight change during the test.

Materials: Desiccant or distilled water, depending on the method. Desiccant can be anhydrous CaCI2 or Silica gel.

Sealant – three are recommended:

1. asphalt 180-200ºF (82-93ºC) softening point),
2. beeswax/rosin mixture (50/50) or
3. microcrystalline wax/refined paraffin wax mixture (60/40).

Procedure: Either of two procedures may be employed. 1) The Desiccant Method or 2) the Water Method.

Desiccant Method – Desiccant is added to the test dish, the sample is sealed to the test dish and placed in the test chamber. The weight gained by the desiccant over time is used to calculate the permeability of the sample.

Water Method – Water is added to the test dish, the sample is sealed to the test dish and placed in the test chamber. The weight lost through the sample over time is used to calculate the permeability of the sample.

Temperature and humidity should be chosen to closely approximate the end use conditions. The Water Method is better suited when temperature can be controlled but humidity control is not easily achieved. Useful standard test conditions are described below.

Water (Procedure B) and Desiccant (Procedure A) Methods at 73.4ºF (23ºC). Inverted Water Method at 73.4ºF (23ºC) (Procedure BW). Water and Desiccant Methods at 90ºF (32.2ºC) (Procedures C & D). Desiccant Method at 100ºF (37.8ºC) (Procedure E).

Test Conditions

Procedure*	Temperature	Relative Humidity on the Two Sides of Sheet	
		In Dish, Percent	Outside Dish, Percent
A	73.4°F (23.0°C)	0	50
B	73.4°F (23.0°C)	100	50
BW	73.4°F (23.0°C)	100	50
C	90°F (32.2°C)	0	50
D	90°F (32.2°C)	100	50
E	100°F (37.8°C)	0	90

*Procedures A, C and E are Desiccant Methods; Procedures B, BW and D are water methods.

(Rev. 6/17)

CFFA-20: Weight of Coating and Fabric

Purpose: To determine the average weight of chemical coating and fabric separately

Reference: ASTM D751 – Standard Test Methods for Coated Fabrics

Apparatus: Laboratory Scales

The weight of the coated fabric shall be determined under Standard Conditions of Test (see page 6), by taking the average weight of five specimens taken from across the width of the fabric in a line at right angles to the selvage. No specimen is taken closer to either selvage than 1/10 of the width.

Specimens are to be not less than 4 square inches (6 cm^2) in area.

The weight of the chemical coating shall be determined by removing the coating with suitable solvents, drying the cloth, and deducting the weight of the cloth from the weight of the finished material.

To ensure removal of all solvent, the fabric shall be dried by heating in an oven for sufficient time. Care should be taken to select time, temperature and solvent to ensure that there is no deterioration of fabric.

To determine weight of fabric itself after the determinations for weight of coating have been made, the sample fabric must be brought to standard humidity conditions.

(Rev. 8/25)

SECTION II – TESTS FOR FILMS

CFFA-200: Abrasion Resistance

a. Wyzenbeek Method

Reference: ASTM D4157 – Standard Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)*, CFFA Method 1a

b. Taber Abraser Method

Reference: ASTM D3389 – Standard Test Method for Coated Fabrics Abrasion Resistance (Rotary Platform Abrader)**, CFFA Method 1b

*Available from Schap Specialty Machine, Inc., 17309 Taft Street, Spring Lake, MI 49456, 616-846-6530, Fax: 616-846-6675, www.schapmachine.com or www.wyzenbeek.com.

**Available from Taber Industries, 455 Bryant Street, North Tonawanda, NY 14120, www.taberindustries.com.

(Rev. 4/20)

CFFA-201: Blocking - Film

The blocking of plastic film may be determined by the Elevated Temperature Method described in CFFA Standard Test Method 4, except the cooling period should be at least one hour after removal from the oven.

(Rev. 4/10)

CFFA-21: Density

Displacement Method

Purpose: To determine the density of films by displacement of water and determination of change in weight

Reference: ASTM D792 – Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

Apparatus: Analytical Balance capable of reading to 5 decimal places, sample holder, breaker, thermometer, beaker stand (if necessary).

Density may be determined using an analytical balance equipped with a stationary support for the immersion vessel above the balance pan and a corrosion-resistant sample holder for suspending the specimen into a beaker or other wide mouth vessel containing distilled, air-free water. (See balance manufacturer for a density kit.) Test must be conducted in the standard laboratory atmosphere of 73º +/- 2ºF (23º +/- 1ºC) and 50% +/- 5% relative humidity.

The test specimen shall be a single piece of material weighing at least 0.5 grams and its surfaces and edges shall be made smooth and free from foreign matter. The specimen is weighed in air to the nearest 0.1 mg. A sample holder, sufficiently long to reach from the hook above the pan to the support for the immersion vessel, is attached to the balance. The test specimen is then attached to the wire so that it is suspended about 1 inch (2.5 cm) above the vessel support. If the specimen might float (less dense than water), add a weight to the wire to help hold the specimen down in the water. Then the immersion vessel is mounted on the support, and the suspended specimen is immersed into the water at a temperature of 73 +/- 2°F (23ºC) taking care to prevent the sample from touching the vessel and to remove any air bubbles adhering to the specimen. The apparent weight of the specimen is determined to 0.1 mg. Remove the specimen and weigh the wire in water immersed to the same depth as it was when weighing the specimen in the water. If a weight was used to hold down the specimen, be sure to include the weight as part of
the wire.

The density shall be calculated as follows:

$$D_{23} = \frac{0.997a}{a+w-b}$$

Where:

D_{23} = Density at 23ºC (g/cm^3)
a = Weight of specimen in air without wire.
b = Apparent weight of specimen completely immersed and wire partially immersed. w = Apparent weight of partially immersed holder.

Note: This test method calls for a 0.5 gram specimen and an extremely precise (and expensive) analytical balance capable of reading to one hundredth of a milligram. The ASTM Standard allows for specimens 1 gram or greater, and the only requirement is that the balance "shall provide the precision that all materials tested have three significant figures on density".

(Rev. 8/25)

CFFA-210: Determination of Calcium Carbonate Content

Purpose: To determine the percentage of Calcium Carbonate in Flexible PVC as a percentage of the sample composition.

Reference: N/A

Apparatus: Inductively Coupled Plasma (ICP) Spectroscopy / Scanning Electron Microscopy (SEM) with Energy Dispersive X-Ray Spectroscopy (EDS)
Sample: 10-20 grams of unprinted film

Procedure: Examination of the sample using ICP and SEM with EDS for characterization
Report percent of Calcium Carbonate in the sample as a percent of the total compound measuring to the nearest 0.1%

Evaluation: Report percent of Calcium Carbonate in the sample as a percent of the total compound measuring to the nearest 0.1%

CFFA-22: Dimensional Changes at Elevated Temperatures

Purpose: To determine the linear shrinkage or expansion of films when exposed to heat

Reference: ASTM D1204 – Standard Test Method for Linear Dimensional Changes of Non-Rigid Thermoplastic Sheeting or Film at Elevated Temperatures

Apparatus: Forced Air Laboratory Oven

Two specimens, 10 x 10 inches (25 x 25 cm) shall be cut by means of a template, one from either of the two machine direction edges and one from the center of the sheet.

Each specimen shall be placed on heavy paper, previously dusted with finely ground talc to prevent sticking or interference with shrinkage. Each specimen shall be covered with a second piece of dusted paper. The paper/plastic sandwiches shall then be placed in an air circulating oven operating at 212°F (100°C), for 30 minutes. The specimen shall be removed from the oven, cooled for 1 hour, and the change in dimension (shrinkage or expansion) of the cut area calculated by the following formula:

$$\% \text{ Dimensional Change} = \frac{L_o - L_1 \times 100}{L_o}$$

Where:

L_o = Original length (or width) of marked area, to the nearest 0.01 inch.

L_1 = Final length (or width) of marked area, to the nearest 0.01 inch, after exposure to test conditions.

The dimensional change in length (or width) is the average of the values calculated for each of the two specimens. A negative value denotes shrinkage, and a positive value indicates expansion.

(Rev. 8/25)

CFFA-220: Dimensions of Film

Reference: ASTM D751 - Standard Test Methods for Coated Fabrics
ASTM D792 – Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

Width: Use CFFA 700, Section a.

Length: Use CFFA 700, Section b.

Thickness:

Method 1: Use CFFA 700c. for smooth or shallow textured films.
Method 2: Use ASTM D792 Displacement Method for embossed films (in case of dispute, the Displacement Method prevails.)

Procedure for Method 2:

Determine Density (D_{23}) using CFFA 21. Calculate gauge (thickness) as follows:

$$\text{Gauge (mm)} = \frac{10 \times (W - A)}{D_{23}}$$

Where:

W = Sample weight in grams
A = Area of the specimen in cm^2
D_{23} = Density at 23°C (73°F)

(Rev. 4/20)

CFFA-221: Lay-flat

Purpose: This procedure provides a standard method of determining PVC roll contour characteristics.

A roll of PVC film should be of uniform contour across its width. The roll surface should be flat without bumps or valleys that may be caused by an uneven thickness profile or other winding problems such as entrapped air or varying tensions. A condition of non-uniform contour can be readily determined by measuring roll circumference at several points across the roll.

Apparatus: Steel tape measure that converts circumference into diameter measurements, graduated to 1/16".

Measure roll circumference to the nearest 1/16" on at least 3 points on the roll. These should be the End, Middle, and End. Mark where the measurements have been taken. Calculate percent difference between readings.

Suspend the roll for 60 minutes on a mandrel and repeat measurements at same locations if material falls outside of specifications.

Calculate percent difference.

CFFA-23: Low Temperature Impact Resistance

Purpose: To determine the temperature at which plastic films will

crack if folded sharply **Reference:** ASTM D1790 - Brittleness

Temperature of Plastic Film by Impact **Apparatus:** SPI Impact Tester.*,

Low Temperature Chamber

Five 2 x 5 inch (5 x 12.5 cm) specimens are cut in both the machine and cross-machine directions of the film. The two ends of the short dimension of each sample are brought together with the finished side out and stapled to a 2 x 5 inch (5 x 12.5 cm) card so as to form a smooth loop at the unstapled end. The 2 inch (5 cm) end of the card is matched with the ends of the specimen, and the staple attaching card and specimen applied 1 inch (2.5 cm) from the ends of the specimen.

For testing at low temperatures the apparatus is placed in an insulated enclosure with the specified test temperature maintained at +/- 2°F (+/- 1°C) for one hour prior to testing. The specimens shall be similarly conditioned for at least 10 minutes. As the specimens are put in the test chamber, a 0.5 inch (1.25 cm) diameter metal bar cooled to
the test temperature is placed through the loop of the specimen to maintain the loop dimensions. It is removed prior to testing.

The specimen is placed on the anvil with the staple in the slot and the loop pointed away from the arm. The arm is raised to a vertical position and then allowed to drop of its own weight onto the specimen. The tested specimens are examined for breaks.

80% of the specimens must pass the impact test at the specified temperature.

*Available from U.S. Testing Company, Inc., 291 Fairfield Avenue, Fairfield, NJ 07004, 973-575-5252.

(Rev. 4/20)

CFFA-240: PVC Roll Contour and Racetracking

Purpose: This procedure provides a standard method for determining PVC rolled film contour and racetracking. After PVC film is cut from a roll, the cut sheet should maintain the same contour as when it was wound on the core. Some film, because of the manner in which it was wound on a core, will deviate from its original contour, causing the film to "racetrack" or not unwind in a straight line. This can result in sheets being so far out of dimension tolerance that fabrication of end products is difficult or impossible. Racetracking can also be due to edge to edge gauge variation in the film.

Apparatus: 1) Large, flat and clean surface.
2) A piece of string or straight edge at least 35 feet in length.

Place the roll on a clean flat surface. Kraft paper may be rolled out first to provide a clean surface.

Roll out film to a length of 30 feet or as required by the product specification. The roll should be unwound carefully and uniformly so as not to affect the natural layflat or tendency to roll curved or flat. Two people are recommended to perform this roll out satisfactorily.

Hold an appropriate length of string taut along the edge of the unwound film or align the material to a straight edge. The string or straight edge should touch the edge of the film at a point where it just comes away from the roll (on the floor) and at the end of the unwound section.

Measure, to the nearest 1/16", the gap between the string and the largest deviation in the edge of the film.

CFFA-241: Snap Back Testing for Pool Liner Films

Purpose: To determine PVC rolled film snapback.

Apparatus: A large, flat, smooth surface and a steel tape measure graduated to the nearest 1/16".

When a pool liner film is calendered, printed or just re-wound, it can be stretched. This stretch can then be temporarily locked into the film when it is wound into a roll. When the film is then removed from the roll and allowed to relax, it wants to return to its normal length. This phenomenon is called snap back. Snap back, however, can last anywhere from 24 hours to 72 hours to completely relax. There are several factors that control the rate at which it relaxes, but temperature is one of the major factors. Therefore, if snap back is being measured in a colder temperature it may take much longer to relax than if it is warmer.

Using the apparatus, specimens are exposed using the following conditions:

1. Remove two (2) outer wraps from the roll to be measured and discard.
2. Cut a twelve (12) foot sample from the roll to be measured.
3. Fan fold the cut sample and immediately place it on the smooth flat table so that it can be laid flat.
4. Place two (2) marks 100" apart on one edge of the film.
5. The maximum amount of time that shall elapse from the time the sample is removed from the roll until the 100" marks are placed on the sheet (steps 2, 3, & 4) is three (3) minutes. If more time has elapsed the sampling process must begin again.
6. After 24 hours, measure the distance between the two marks on the sheet.
7. Calculate the percent (%) snapback = 100-(distance in step 5).

CFFA-25: Soapy Water Extraction

Purpose: To determine the weight loss of films after extended contact with soapy water

Reference: ASTM D1239 – Standard Test Method for Resistance of Plastic Films to Extraction by Chemicals

Apparatus: Forced Air Laboratory Oven

The test specimens shall be in the form of squares 2 inches (5 cm) on each side. At least three specimens shall be tested. The test solution is a 1% concentration of pure white soap flakes in distilled water.

The test procedure consists of the following steps:

1. The test specimens shall be preconditioned for 40 hours at 73.4ºF +/- 3.6ºF (23º +/- 2ºC) and 50 +/- 5% relative humidity, then removed from the oven, cooled to room temperature in a desiccator, and weighed.

2. Each test specimen shall be separately immersed in one pint (400 ml.) of soap solution, freely suspended in a vertical position in its own container.

3. The container shall be covered and placed in the oven at 104°F (40°C) for 24 hours.

4. The test specimen shall be removed from the soap solution, rinsed in clear water, wiped dry, and conditioned and weighed as in step 1.

The percentage weight loss = $\frac{W_o - W_1}{W_o} \times 100$

Where:

W_o = Original specimen weight.
W_1 = Specimen weight after extraction.

All weighing shall be made to 4 decimal points.

Note: *Some pool liner manufacturers report only Water Extraction. The test method is the same with the exception that distilled or deionized water without soap is used as the extracting medium.*

(Rev. 8/25)

CFFA-26: Tearing Strength

Purpose: To determine the force required to initiate and propagate tearing in plastic films or sheeting

a. Graves Method

Reference: ASTM D1004 - Initial Tear Resistance of Plastic Film and Sheeting
Apparatus: Testing machine consisting of a power driven machine of either of the two following types shall be used:

Static Weighing - Constant Rate of Grip
Separation Type Pendulum Weighing -
Constant Rate of Powered Grip Motion Type

The tearing strength may be determined on any suitable testing machine of the constant rate of jaw separation type. Suitable steel grips shall be used and the rate of travel of the grip shall be 2 inches (5 cm) per minute. Knurled grips, grips faced with abrasive paper or those of the eccentric type shall be used when flat smooth steel grips give rise to slippage or failure at the edge of the grip jaws.

The test specimen shall be uniform in thickness and cut with a (Graves) die, dimensions of which are described in ASTM D 1004-13. Thickness of the specimen

shall be measured with a micrometer accurate to 0.0001 inches (0.0025 mm).

Five specimens shall be cut in both the machine and cross machine directions of the sheet. The test specimen shall be clamped in the jaws of the testing machine, care being taken that the jaws grip the specimen evenly and that the longitudinal axis is in line with the direction of the application of the load.

The tear resistance shall be calculated by dividing the maximum load registered by the thickness, and shall be expressed as weight/thickness (e.g. lbs/in. or gms/cm).

The average resistance to tearing shall be calculated using all five specimens tested in each principal direction of orientation.

b. Elmendorf Method

Reference: ASTM D1922 – Propagation Tear Resistance of Plastic Film and Thin Sheeting by Pendulum Method

The tearing strength of a plastic film may be determined by the falling pendulum method described in CFFA Standard Test Method 16.

(Rev. 4/20)

CFFA-27: Tensile Properties of Thin Plastic Sheeting

Purpose: To determine the Tensile Strength, Ultimate Elongation and 100% Modulus of thin plastic sheeting and film.

Reference: ASTM D882 - Tensile Properties of Thin Plastic Sheeting

Apparatus: Any suitable universal testing machine of the constant rate-of-crosshead-movement type. Grips should be designed to eliminate slippage or tearing. Rate of separation of grips shall be 20 in/min. (500 mm/min.).

Shall consist of strips of uniform width and thickness, measured to an accuracy of 0.0100 inches (0.25 mm) and 0.0001 inches (0.0025 mm), respectively. Test specimens should be conditioned at least 24 hours at 73°+/- 2□F (23□+/- 1°C) and 50° +/- 5% relative humidity. Ratio of width/thickness shall be at least 8/1, and width should be between 0.20 inches (5.0 mm) and 1.0 inch (25.4 mm). Length of samples shall be at least 2 inches (50 mm) between grips. Cutting should be done in such a manner as to avoid edge imperfections. Using a sharp, well maintained die will ensure uniform cuts and reduce edge imperfections. ASTM Type IV or C dies are commonly used. Five specimens in both the machine direction and cross direction shall be tested and the average value of each direction reported.

Clamp the specimen in the jaws of the machine, with care being taken that the jaws grip the specimen evenly with no slack and that the longitudinal axis is in line with the direction of load application. Start the machine.

For 100% Modulus measure the force at 100% elongation.

For Tensile and Ultimate Elongation, measure the force and the distance between grips at break.

Tensile Strength at Break: Calculated by dividing the load at break by the original minimum cross-sectional area of the specimen and expressed in pounds - force per square inch (or Newtons per meter).

Elongation at Break (Ultimate Elongation):

Calculated as follows: Percent Elongation = $\frac{(L_1 - L_0)}{L_0} \times 100$

Where: L_1 = Distance between grips at rupture. L_0 = Original distance between grips

100% Modulus: Calculated by dividing the load at 100% elongation by the original minimum cross sectional area of the specimen and expressed in pounds-force per square inch (or Newtons per meter).

Note: *When gauge marks or extensometers are used to define a specific test section, only this length shall be used in the calculation.*

(Rev. 4/20)

CFFA-270: Volatility

Reference: ASTM D1203 – Standard Test Methods for Volatile Loss From Plastics Using Activated Carbon Methods

The volatility of a plastic film may be determined by the Activated Carbon Volatility Method as described in CFFA Standard Test Method 18.

(Rev. 4/20)

SECTION III

Terminology and Customs in the Industry

Length

Coated fabrics are usually sold by the linear yard.

Films are usually sold by the pound, square yard, or linear yard for light gauge material (under 6 mils), and by the square yard in heavier gauges (6 mils and over).

Number of Pieces

(a) The maximum number of pieces (cuts).

The maximum number of separate pieces ordinarily acceptable in a roll of coated fabrics:

1 - 15 yard roll - 1 piece

16 - 30 yard roll - 2 pieces
31 - 60 yard roll - 3 pieces
61 - 90 yard roll - 4 pieces
91 - 115 yard roll - 5 pieces
116 - 125 yard roll - 6 pieces

(b) The minimum length of pieces.

The minimum length of a single piece in any roll of coated fabrics is not ordinarily less than three linear yards.

Width

There is no minus width tolerance. The width specified is the minimum guaranteed width of the material between edges. Width may be expressed as 52/53 which means minimum is 52 inches.

Finished Weight

(a) Coated Fabrics.

Tolerance on weight specifications are typically plus or minus 10%.

(b) Coated Films.

Film is customarily sold by thickness in measurements of thousandths (.001) of an inch. The thickness of smooth film is determined by measuring with a standard type paper micrometer.

A reasonable plus or minus tolerance from the weight/thickness specification is generally acceptable. Tolerance on weight/thickness is customarily plus or minus 10%.

On deeply embossed or texture grained film, the weight per square yard is used as an indication of thickness. The average thickness can be determined by the weight method which determines the specific gravity of the material. (Reference ASTM D 792).

Allowances

The maximum number of allowances for imperfections in one 60-yard roll is customarily four. If there is more than one piece in a 60-yard roll, then the number of pieces plus the number of allowances in the 60 yards of material generally should not exceed six. For rolls of greater or lesser length, allowance for imperfections is increased or decreased proportionately.

(a) Flags are inserted or attached to the edge of the goods, or marks satisfactory to the customer made on the edge, to indicate the imperfections for which allowances have been made.

(b) Each flag or mark indicates allowance of a minimum of 1/8th of a yard for noticeable defect, and as much more allowance as may be necessary, depending upon the extent of the defect. There should be no less than five yards between defect flags or markers.

Packaging

Material ordinarily is rolled on cardboard tubes of adequate strength and circumference and wrapped in paper or plastic stretch wrapping of adequate weight and strength with roll ends properly secured---material may be packed in cartons. Large diameter rolls of film products are usually placed in suspended packaging.

In packaging instructions, a notation should be included as to special handling requirements for urethane coated fabrics.

Cleaning and Care Suggestions

Coated fabrics and film are made to withstand scuffing, cracking, peeling, hard use, and soiling. Manufacturer's cleaning instructions should be consulted. In general, most household soil can be easily cleaned with warm soapy water and several clear water rinses. Moderate scrubbing with a medium bristle brush will help to loosen the soiling agent from the depressions of embossed surfaces. Certain commercially available products clean routine household spills from vinyl very effectively. Check label on product to see if recommended. Full strength rubbing alcohol or bleach diluted with water may be tried if the above suggestions do not work. Certain household cleaners could cause damage or discoloration of the vinyl product and should be avoided.

Certain stains may become set if they are not removed immediately. Several stains and suggestions for removal (subject to manufacturer's instructions for stain removal) are discussed below.

BALLPOINT INK --- Ink spots usually stain plastic products permanently, but much of the stain may be removed by immediate wiping with rubbing alcohol.

OIL BASE PAINT --- Turpentine will remove fresh paint. Dried paint must be sparingly moistened with a semi- solid stripper so that the softened paint can be gently scraped away. CAUTION---paint stripper will probably remove the printed patterns on plastic surfaces.

LATEX PAINT --- Fresh paint can be wiped off with a damp cloth. Follow the instructions for dried oil paint if the latex has dried.

SURFACE MILDEW --- Wash with a bleach solution of one tablespoon of bleach to a quart of water, then rinse several times with clear water.

TAR, ASPHALT --- Remove immediately. Lengthy contact will cause a permanent stain. Using a cloth dampened with kerosene or mineral spirits, rub gently from outside edge of stain to center. This will prevent stain from spreading. Rinse with soap and water.

CHEWING GUM, CAR GREASE, SHOE POLISH --- Scrape off as much as possible (chewing gum will come of more easily if rubbed with ice cube) and go over lightly with mineral spirits

to remove remainder. No time should be lost in removing shoe polish as it contains dye which can cause permanent staining. Rinse thoroughly.

Note: *Powdered abrasives, steel wool, and industrial strength cleaners are not recommended. They will cause dulling of glossy surfaces. Dry cleaning fluids and lacquer solvents are not recommended because they will attack most coated fabrics and film, remove the printed patterns, and/or disturb the surface.*

Wax should only be used on coated fabrics and film if the manufacturer recommends its use. Many waxes contain dyes, and dyes will stain.

Follow manufacturer's instructions regarding washing, tumble drying, ironing, or dry cleaning.

History of Coated Fabrics

Early History:
From the Egyptian's resin-treated flax used to wrap and preserve the dead, to the Pre-Colombian Aztecs who coated fabrics with latex for water repellency, to oil cloths of the 18th century, to rubber coatings (Mackintosh) and Pyroxylin in the 19th century, coated fabrics have continued to evolve.

Early twentieth century, Pyroxylin, aka Cellulose Nitrate or Gun Cotton, was used to coat airplane cloth and is still used to a limited degree in bookbinding.

Modern Coated Fabrics:

1838 Vinyl Chloride first synthesized in France by Regnault.
1872 Accidentally polymerized by Bauman in Germany. Just a lab curiosity at the time.
1914 Dr. Fritz Klatte receives a German patent for the polymerization of Polyvinyl Chloride (the method was not commercially feasible, the polymer was unworkable, and no potential markets were identified. Rights were transferred to Wacker Chemie but were allowed to expire in 1926. In 1935, Wacker would obtain a patent for suspension PVC, with continuous production starting in 1940.).
1926 Dr. Waldo Semon of the B. F. Goodrich Company, discovers that PVC can be readily processed with the addition of solvents and plasticizers. To demonstrate to management the potential of flexible vinyl, Dr. Semon applies a thin coating of plasticized vinyl to fabric from his wife's sewing basket, making the first vinyl coated fabric.
1927 Carbon & Carbide (later Union Carbide) manufactures the first commercial PVC resin.
1933 Dr. Semon receives a patent for plasticized PVC. B. F. Goodrich introduces Koroseal, the first commercial vinyl film.
1937 Prof. Dr. Otto Bayer of Farbenfabriken Bayer discovers basic polyurethane chemistry. WW II Lack of access to conventional raw materials on both sides stimulates the rapid development of alternate materials from available resources. Vinyls and urethanes meet many of these needs.
1950s Pete Roggi of the U.S. Rubber Co. receives a patent for expanded vinyl using Celogen AZ (Azodicarbonamide), the preferred blowing agent for coated fabrics to this day. S.D Warren Co. and the Plastic Film Company develop the transfer coating method using release paper, the preferred process for producing expanded vinyl coated fabrics.
1960s Bayer introduces urethane coated fabrics for upholstery. Coated fabrics find applications in many forms in many industries.
1990s Calendering, extrusion and plastisol coating technology advances rapidly. Each create coated fabrics with critical performance features, meeting demands in specific markets for resistance to UV radiation, fire

and smoke generation, mold and mildew, fungal growth, pathogens, and common stains. For the furniture industry, a proliferation of innovative color options and finishing techniques open a new world for creative design.

The new millennium:

Silicones, Thermoplastic Elastomers, Thermoplastic Urethanes and other polymers enter the coated fabric marketplace.

The Coated Fabrics & Film Association (CFFA)

Keeping abreast of product change and development, the industry trade organization has changed its name five times since it was first formed in September 1927, as The Association of Pyroxylin Coated Manufacturers. Pyroxylin (Cellulose Nitrate or 'Gun Cotton') obviously was then the predominant product. Subsequent changes and reason for change:

Name Change	**Date Adopted**
Institute of Leather Cloth and Lacquered Fabric Manufacturers (to identify with product appearance)	June 1932
Pyroxylin and Resin Coaters Institute (to include vinyl resin coating)	December 1943
Plastic Coatings and Film Association (to include film and sheeting)	March 1948
Vinyl Fabrics Institute (to recognize the growth and predominance of vinyl)	September 1955
Chemical Fabrics and Film Association (to recognize the diversity of materials and provide a more permanent name for a developing industry)	January 1972
Chemical Fabrics & Film Association, Inc. (to recognize the incorporation of the Association)	December 1980
Coated Fabrics & Film Association, Inc. (to recognize industry usage and materials within the Association’s scope)	August 2025