

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION



LABORATORY TEST MANUAL

FOR

16 CFR Part 1610:

Standard for the Flammability of Clothing Textiles

October 2008

This test manual was prepared by CPSC staff and has not been reviewed or approved by, and may not necessarily represent the views of, the Commission.

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1. SCOPE

This U.S. Consumer Product Safety Commission (CPSC) staff laboratory test manual is a reference guide designed to assist with the testing procedures specified in the *Standard for the Flammability of Clothing Textiles* codified at 16 CFR Part 1610 (the Standard).

This test manual is not the complete mandatory standard, but is a tool that may be used in conjunction with the requirements specified in the Standard. The test manual is provided for guidance purposes only and is not intended to be fully inclusive of the test procedures, nor is it intended to replace or supersede any sections of the Standard. In the case of any discrepancies between this manual and the Standard, the Standard will supersede this test manual.

The test manual also identifies testing equipment used to conduct testing in accordance with the Standard. The descriptions and pictures are not meant to serve as specifications or recommendations of any brand, make, or model of instrumentation that must be used in order to comply with the Standard, but rather as examples for clarification purposes.

2. SUMMARY OF 16 CFR PART 1610

The purpose of the Standard is for the issuing of guaranties in accordance with the Flammable Fabrics Act (FFA). The Standard establishes flammability requirements that all clothing textiles, as defined in §1610.2, must meet before sale or introduction into commerce. The Standard provides a method for testing (§1610.6) and establishes three *classes* of flammability performance of textiles and textile products used for clothing (§1610.4), thereby restricting the use of any dangerously flammable clothing textiles (those designated *Class 3*). The test procedure requires that a 16 mm ($\frac{5}{8}$ in) flame impinge on a specimen mounted at a 45 degree angle for 1 second. The specimen is allowed to burn its full length or until the stop thread is broken, a distance of 127 mm (5 in). The results of several specimens are averaged and a *Class* designation is made based on the flammability performance and surface characteristics of the sample.

3. PERFORMANCE REQUIREMENTS

Samples resulting in a designation of *Class 1* or *2* meet the requirements of the Standard. A sample fails to meet the requirements of the Standard if the sample is designated as *Class 3, Rapid and intense burning*.

- For plain surface fabrics, a *Class 3* designation results from an average flame spread time of less than 3.5 seconds.
- For raised surface fabrics, a *Class 3* designation results from an average flame spread time of less than 4.0 seconds and ignition or fusing of the base fabric.

4. GENERAL EQUIPMENT LIST

Perform the test in a fume hood that has the ability to fully evacuate the combustion products caused by testing. The fume hood must have the capability of being turned off during a test. Beyond those basic facility requirements, the list below is a suggested equipment list for performing the test. Some equipment is required (indicated by an asterisk, “*”) while other equipment is recommended. Refer to *Appendix A: Description of Test Equipment* for information on test equipment. Specific equipment lists are provided at the beginning of each test section.

1. Automatic washing machine and dryer*
2. Ballast for dry cleaning*
3. Ballast for laundering*
4. Brushing device*
5. Butane, chemically pure*
6. Circulating ovens*
7. Commercial dry cleaning machine*
8. Desiccant*
9. Desiccator*
10. Dry cleaning solvent and detergent*
11. Flame measuring device
12. Flow control device (may be part of test chamber)*
13. Gloves, insulated
14. High vacuum grease to seal desiccator
15. Laundering detergent*
16. Regulator
17. Scale
18. Specimen holders and clips*
19. Specimen holding rack
20. Specimen preparation materials such as scissors, marking pens, and tape
21. Specimen template, 50 by 150 mm (2 by 6 in)
22. Stop thread, No. 50, white, mercerized 100% cotton sewing thread*
23. Test chamber (which includes chamber structure, specimen rack, specimen holder, indicator finger, ignition mechanism, timing device, draft ventilator strip, stop weight [30.0 ± 0.5 g], thread guides and door)*
24. Thermometer or thermocouple
25. Timer

5. CALIBRATION OF TEST INSTRUMENTS

Maintain all equipment used in the performance of these tests in conformance with the specifications required by 16 CFR Part 1610 and the suggested maintenance and calibration schedules. See *Appendix D: Equipment Calibration* for more information.

6. TEST OVERVIEW

Figure 1 outlines the basic steps for performing the test as described in §1610.6.

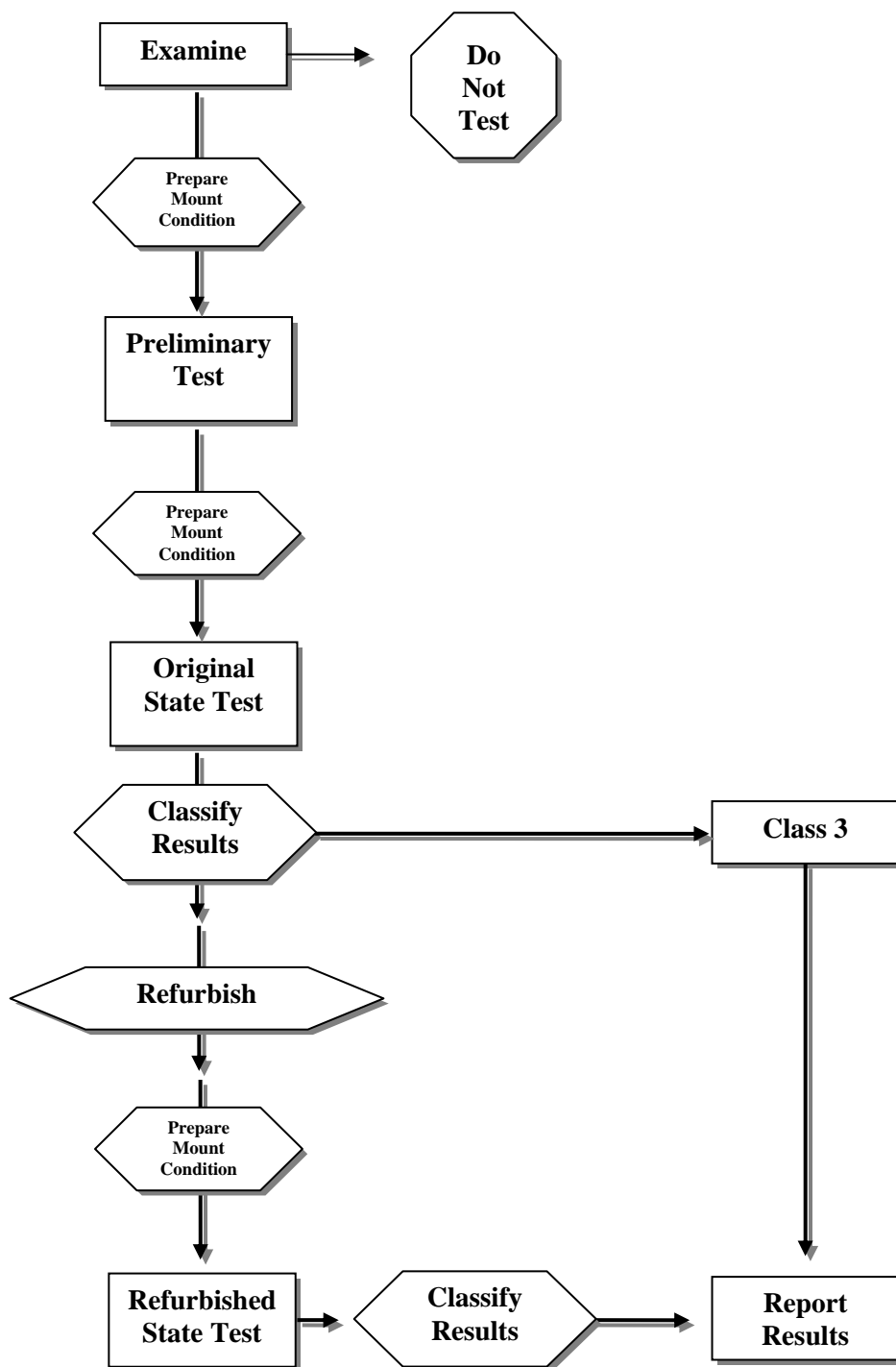


Figure 1. Test overview.

7. SAFETY

Perform all burn tests under a properly functioning fume hood. Testing personnel should have personal protective equipment available that is appropriate for the test environment and should be cleared and trained to use it. Insulated gloves should be available for removal of specimens from the oven. A method of fire suppression should be ready to use when testing specimens. Monitor all ignited specimens closely for situations that would present a danger to test personnel and/or the test facility. Monitor suppressed specimens for re-ignition and dispose of specimen remains properly.

8. SAMPLE HANDLING AND EXAMINATION

Perform an initial examination of the sample before cutting to determine that it should be subjected to testing. Factors such as fiber content, fabric weight, and previous testing experience should be used when deciding not to test a sample (see *Appendix E: Exemptions*).



If specimens of the required size cannot be prepared due to the nature of the item (i.e., hula skirts, ribbons, leis, fringe, loose feathers, wigs, etc.), do not conduct the test.

If a determination is made to test the sample, identify whether the fabric surface is a *plain* or *raised surface fabric*. See *Appendix C: Determining Fabric Surface Type* for guidance. Test the side of the fabric that will be the outer face of the garment.¹

Additionally, determine which type of test will be carried out.

- Complete Testing of Original and Refurbished States
Perform the entire test sequence, resulting in classified results.
- Original State Only
Perform only the first stage of the test sequence, usually because insufficient material is available for the full test sequence. Results are stated as *indicates Class* and the number *1* or *2* when there is insufficient material to conduct a complete test. If the test in Original State results in a *Class 3* designation, the final classification will be based on Original State test results only.

Prepare sample reporting form(s). Include the description and other information required on the form(s).

¹ Test the exposed surface of the garment only. In some cases, the inner fabric will be exposed during normal wear by a consumer. Examples include, but are not limited to, the interior fabric of a hooded sweatshirt or a zippered cardigan. See §1610.31(g) and §1610.36(e) of the Standard for further clarification.

9. SAMPLE PREPARATION

Equipment List:

- Brushing device
- Specimen holders and clips
- Specimen holding rack
- Specimen preparation materials such as scissors, marking pens, and tape
- Specimen template, 50 by 150 mm (2 by 6 in)

Procedure:

9.1 Preliminary Trials

Test preliminary specimens to determine the fastest burning area and direction of the fabric. Follow the steps outlined below to prepare, condition, and test the preliminary trial specimens. Use the results to determine how to prepare the test specimens.



If specimens of the required size cannot be prepared due to the nature of the item (i.e., hula skirts, ribbons, leis, fringe, loose feathers, wigs, etc.), do not conduct the test.

- For *plain surface fabrics*, cut one specimen from each direction (analogous to the warp/long and filling/cross directions) of the fabric and/or garment.²
- For *raised surface fabrics*, determine:
 - *The direction of the lay of the pile.*
For *raised fiber surface fabrics*, prepare the specimen so that the pile direction is parallel to the long direction of the specimen. The lay of the fabric pile can be determined in two ways:
 - Tactile and visual observation.
 - Preliminary tests to determine the direction with the fastest burn time.
 - *The presence of multiple pile heights.*
For a sample with multiple pile heights, prepare specimens from each height of pile to determine the quickest burning area of the fabric.

Follow the instructions in sections 9.2 *Test Specimens* and 9.3 *Mounting the Specimens* of this laboratory manual for preliminary trial specimen preparation. Test these specimens according to section 11. *Test Procedure* of this laboratory manual.

² For garments containing fabrics on the bias, preliminary samples may be cut on the bias.

9.2 Test Specimens

The specimens should be cut from the most flammable area and direction of the sample.³ Specimens should be cut in the warp/long direction if there is no difference in the results of the preliminary trials. See *Appendix C: Determining Fabric Surface Type* for guidance on specimen preparation.

Cut five specimens with dimensions 50 by 150 mm (2 by 6 in) with the long dimension in the direction with the fastest burn time as determined during the preliminary trials.⁴ (Fig. 2)



If there is sufficient material, cut 10 specimens to save time in case an additional 5 specimens must be tested after the initial 5 specimens are tested.



Figure 2. Cut specimens.

Identify each specimen, but do not label the specimens on any part of the test area. Labels can be used on the holders to distinguish specimens. (Fig. 3)



Figure 3. Label specimen holder.

³ The most flammable area of the garment is determined by preliminary testing or by the experience of the test operator.

⁴ Prepare specimens so that they are an extra 3.2 to 12.7 mm (0.125 to 0.5 in) in the long direction to deter *edge ignition* of the specimens during testing. See *Appendix E. Glossary of Terms*.

9.3 Mounting the Specimens

For both *plain surface* and *raised surface* specimens, place the back plate of the specimen holder on the carriage of the brushing device. The back plate should lay flush with the template on the brushing device, allowing the specimen to lay supported until it is secured in the holder. (Fig. 4)



Figure 4. Place back plate of specimen holder on brushing device carriage.

Position the specimen so that the test surface is facing up. (Fig. 5)



Double-sided tape may be helpful in securing very sheer, light-weight specimens.



Figure 5. Position specimen on back plate.

For *raised surface fabrics*, use a fingernail (or ruler edge) to determine the lay of the fabric pile before mounting the specimen. (Fig. 6)

Place the specimen so that the lay of the pile is directed away from the closed end of the holder.



Figure 6. Determine the lay of the pile.

For both *plain surface* and *raised surface fabrics*, allow 3.2 to 12.7 mm (0.125 to 0.5 in) to extend beyond the lower edges of the back plate of the specimen holder. (Fig. 7)

Positioning the specimen in this manner increases the distance between the point of impingement and the lower edge of the specimen, decreasing the likelihood of *edge ignition*. An occurrence of edge ignition requires a re-test.

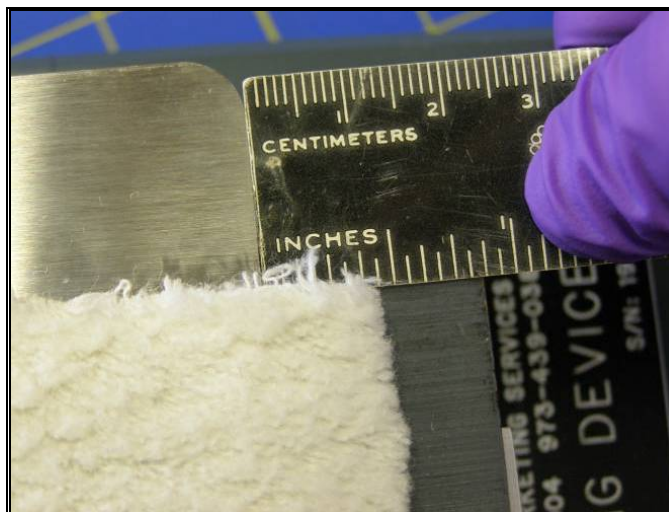


Figure 7. Allow specimen to extend beyond end of back plate.

Put the top plate of the specimen holder in place and use clips to secure the specimen. (Fig. 8)



Figure 8. Secure specimen in holder.

Tape may be used to further secure the specimen in the holder. (Fig. 9)



Figure 9. Tape may be used to further secure specimen.

For *plain surface fabrics*, place the mounted specimen horizontally in the specimen holding rack. (Fig. 10)



Specimens should not be touching!

For *raised surface fabrics*, brush each specimen following the directions in the next section.



Figure 10. Specimens in specimen holding rack.

9.4 Brushing the Specimens



Always store the brush arm for the brushing device in the vertical position so that the brush bristles do not spread out over time. Check bristles for wear before use and replace the brush when necessary.

For *raised surface fabrics* only, the specimens are brushed to raise the fabric pile. Once the specimen has been secured in the holder, push the carriage to the rear of the brushing device and lower the brush onto the specimen surface. (Fig. 11)

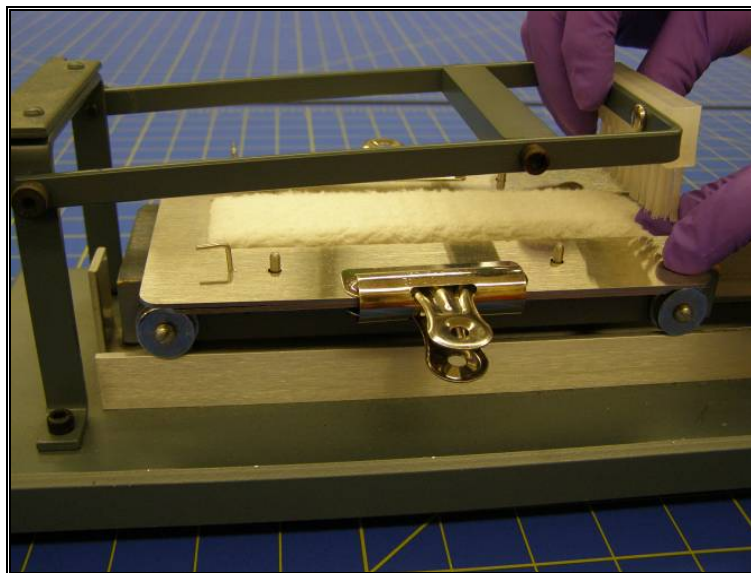


Figure 11. Lower brush onto specimen.

Pull the carriage under the brush at a uniform rate toward the front of the brushing device in the opposite direction of the fabric pile. Hold the lower edge of the specimen so that the bristles raise the surface fibers without distorting the specimen. (Fig. 12)

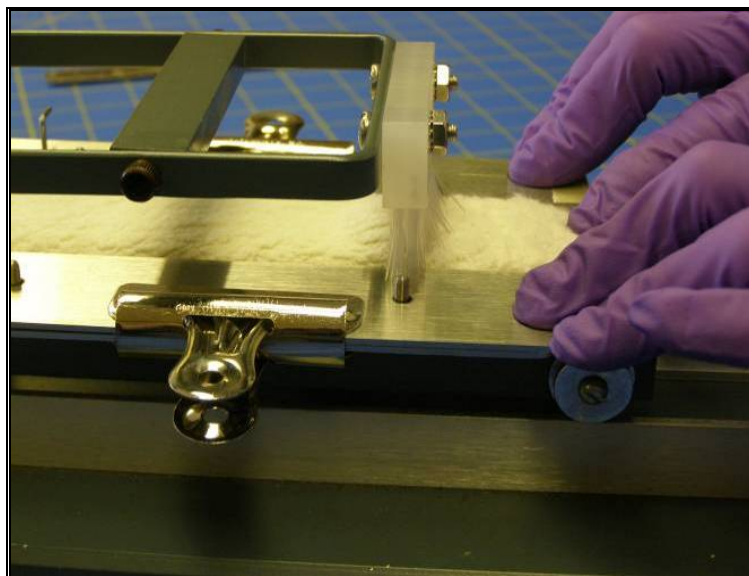


Figure 12. Draw specimen under brush.

Place the brushed mounted specimen horizontally in the specimen holding rack. (Fig. 13)



Figure 13. Place brushed specimen in specimen holding rack.



Be sure that specimens are not touching.

10. SAMPLE CONDITIONING

Equipment List:

- Circulating ovens
- Desiccant
- Desiccator
- Gloves, insulated
- High vacuum grease
- Specimen holding rack
- Timer

Procedure:

Pre-heat the circulating oven until it reaches the temperature requirement in §1610.5(b)(1), shown in Table 1.

Table 1. Conditioning Requirements

Oven Temperature	Duration
$105 \pm 3\text{ }^{\circ}\text{C}$ ($221 \pm 5\text{ }^{\circ}\text{F}$)	30 ± 2 minutes



Before starting the conditioning process, check the state of the desiccant in the desiccators. If necessary, refresh the desiccant following the manufacturer's instructions. Check the seal between the desiccator and lid. If necessary, apply high vacuum grease.

Place the specimen holding rack in the oven in such a way as to allow air flow around the specimens. Do not allow specimens to touch. (Fig. 14)

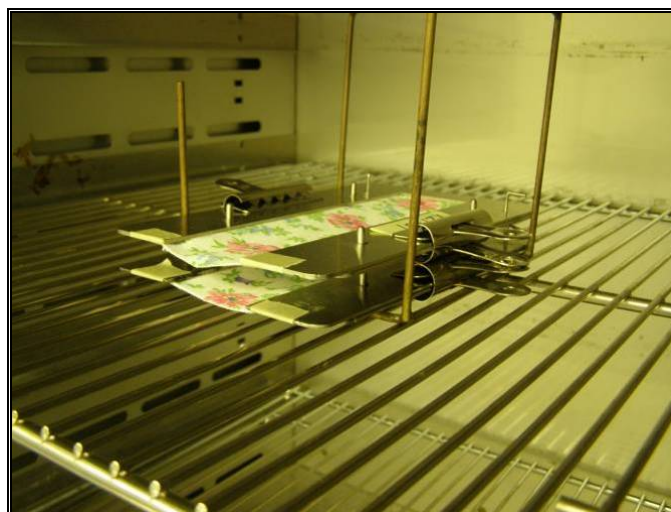


Figure 14. Place specimens in oven.

Close the oven door and allow the temperature to return to $105 \pm 3^{\circ}\text{C}$ ($221 \pm 5^{\circ}\text{F}$). Once the temperature has stabilized, start the timer for 30 minutes. (Fig. 15)



Figure 15. Set timer.

After 30 minutes, remove the specimen holding rack from the oven using insulated gloves. (Fig. 16)



Figure 16. Remove specimens from oven.

Place the specimen holding rack in a desiccator to cool. (Fig. 17)



Figure 17. Place specimens in desiccator.

11. TEST PROCEDURE

Equipment List:

- Butane, chemically pure
- Flame measuring device
- Flow control device (may be part of test chamber)
- Regulator
- Stop thread, No. 50, white, mercerized 100% cotton sewing thread
- Test chamber (which includes chamber structure, specimen rack, specimen holder, indicator finger, ignition mechanism, timing device, draft ventilator strip, stop weight [30.0 ± 0.5 g], thread guides and door)

Procedure:

1. Before testing, ensure that the flame impingement timer is set to 1.0 s.

Turn on gas supply to the test chamber and allow air to be displaced from the supply line. Use the flow control device to set the flow of butane to the igniter. Once gas is supplied to the igniter, light the igniter. (Fig. 18)



Figure 18. Light igniter.

2. Once the flow has stabilized (approximately 5 minutes), adjust the flame length so that the test flame is 16 mm ($\frac{5}{8}$ in). (Fig. 19) The fume hood should be turned off before testing begins.

Periodically check (and adjust, if necessary) the test flame length during testing. Use the regulator on the gas tank to modify the flame length.

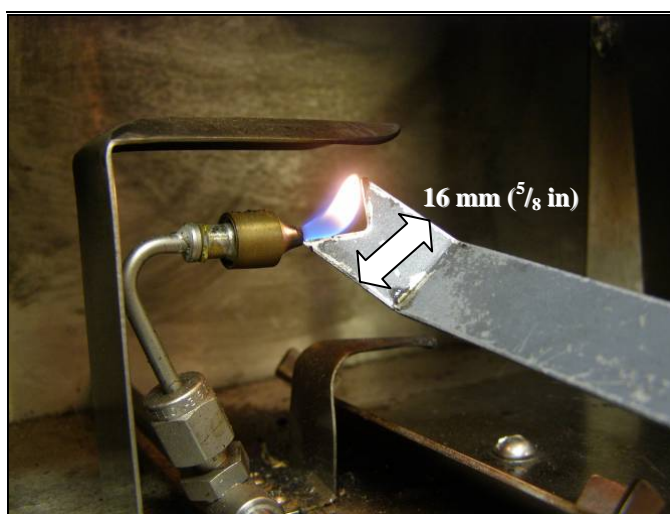


Figure 19. Check flame length.

3. Remove a mounted specimen from the desiccator. (*Fig. 20*)



Replace the desiccator lid between tests.

Begin the test within 45 seconds of removing the mounted specimen from the desiccator.

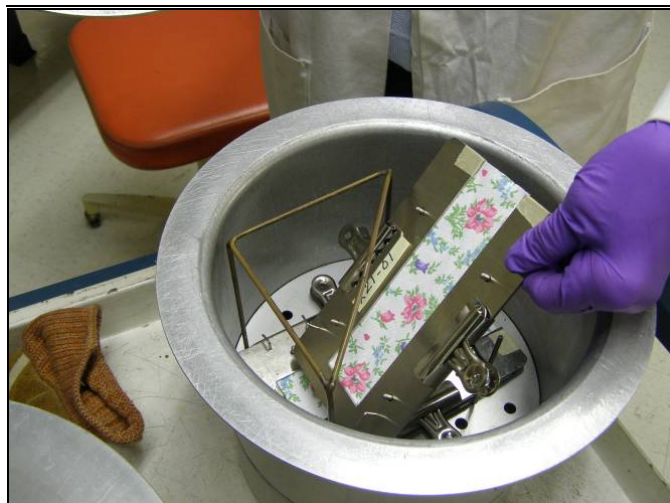


Figure 20. Remove specimen from desiccator.

4. Place the mounted specimen on the specimen rack in the test chamber. (*Fig. 21*)



Figure 21. Place specimen on rack.

5. Adjust the specimen rack so that the indicator finger just touches the surface of the specimen. (*Fig. 22*)



Figure 22. Adjust specimen rack.

6. Pull the stop thread through the guides of the specimen holder and test chamber. (*Fig. 23*)

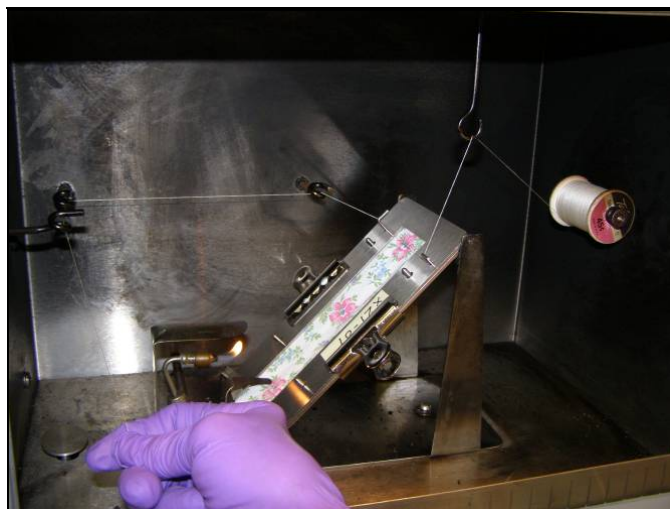


Figure 23. Pull stop thread through guides.

7. Attach the stop weight to the thread just below the stop weight thread guide. (*Fig. 24*)

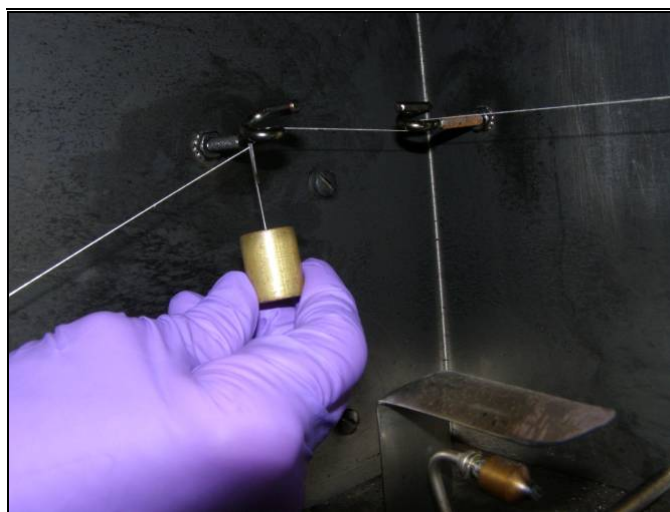


Figure 24. Attach stop weight.

8. Set the timing device to zero. (*Fig. 25*)

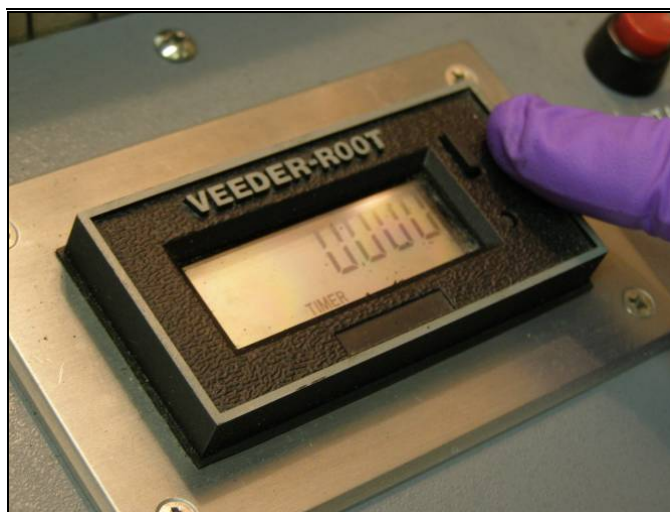


Figure 25. Set timer to zero.

9. Close the door of the test chamber.



Begin the test within 45 seconds of removing the mounted specimen from the desiccator.

10. Activate the trigger device so that the flame impinges on the specimen for 1.0 s. The timing device starts automatically. (Fig. 26)



Figure 26. Activate trigger device.

11. At the end of the test, there will be either:
- **A burn time** – occurs when the specimen ignites and the flame travels up the specimen, breaking the stop thread. When the stop thread breaks, the stop weight falls and stops the timing device.
 - **No burn time** – occurs when the specimen:
 - 1) Does not ignite.
 - 2) Ignites, but self-extinguishes before reaching the stop thread.
 - 3) Ignites, but the flame travels under the stop thread without breaking it.

The occurrence of *surface flash* should be noted for *raised surface* specimens.



Allow *raised surface* specimens to continue burning after the timer has stopped to determine:

1. If the base fabric will ignite/fuse; and if so,
2. Where the base fabric starts burning as a result of the surface flash.

12. Record the burn time from the timing device as well as any visual observations using the prescribed test result codes (refer to section *13. Test Result Codes and Sequence* of this laboratory manual). If there is no burn time, record any visual observations using the test codes.
13. At the end of each test, turn on the fume hood to exhaust any fumes or smoke produced during the test. The fume hood should be turned off once the effluent has been cleared.
14. Before testing the next specimen, check that the fume hood has been turned off and reset the timing device to zero.
15. Test five specimens. Determine the average burn time. For *raised surface fabrics*, determine the type of burn using the test result codes. Use the appropriate Test Sequence flow chart in section *13. Test Result Codes and Sequence* of this laboratory manual to determine the next step in testing.

12. REFURBISHMENT

Equipment List:

- Automatic washing machine and dryer
- Ballast for dry cleaning (80% wool and 20% cotton fabrics)
- Ballast for laundering
- Commercial dry cleaning machine
- Dry cleaning solvent and detergent
- Laundering detergent
- Scale
- Thermometer or thermocouple

Procedure:

If testing of a sample results in a preliminary classification of *Class 1* or *2* in the Original State test, refurbish the sample. Dry clean all samples before laundering. Refurbish a sufficient amount of the fabric (i.e., the remaining portion of the sample) tested in the Original State. Label the sample using an indelible marker.

12.1 Dry cleaning

Use ballast composed of 80% wool and 20% cotton fabrics. The requirements for the dry cleaning procedure are shown in Table 2 and §1610.6(b)(1)(i) of the Standard.

Table 2. Requirements for Dry Cleaning

Solvent	Perchloroethylene, Commercial Grade
Detergent Class	Cationic
Cleaning Time	10-15 minutes
Extraction Time	3 minutes
Drying Temperature	60-66 °C (140-150 °F)
Drying Time	18-20 minutes
Cool Down/Deodorization Time	5 minutes
Load	80% of machine capacity

12.2 Laundering

Once the dry cleaning process is complete, perform one laundering of the sample following the American Association of Textile Chemists and Colorists (AATCC) Test Method 124-2006, *Appearance of Fabrics after Repeated Home Laundering*. The procedure can be described as option (1)(IV)(A)(iii) from Table II of that test method. See Table 3 and §1610.6(b)(1)(ii) of the Standard.

Table 3. Washing and Drying Conditions

Washing Cycle	(1) Normal/Cotton Sturdy
Wash Temperature	(IV) 49 ± 3 °C (120 ± 5 °F)
Rinse Temperature	< 29 °C (85 °F)
Drying Procedure	(A) Tumble, (iii) Permanent Press

The technical requirements for the laundering procedure are shown in Table 4.

Table 4. Technical Requirements for Laundering

Washing Machine Conditions	Water Level	18 ± 1 gal
	Agitator Speed	179 ± 2 spm
	Washing Time	12 min
	Spin Speed	645 ± 15 rpm
	Final Spin Cycle	6 min
	Wash Load	3.1 to 3.6 kg (7 to 8 lb)
Detergent	AATCC 1993 Std Reference Detergent	Powder
	Amount	66.0 ± 0.1 g
Dryer Conditions	Exhaust Temperature	66 ± 5 °C (150 ± 10 °F)
	Cool Down Time	10 min



Check the indelible markings to be sure that they have not been removed. If they are faint, re-label the specimen with the sample identification information.

Weigh the sample and add cotton fabric as ballast to make a wash load of 3.1 to 3.6 kg (7.0 to 8.0 lb).

Fill the wash tub. Use a temperature measuring device such as a thermometer or thermocouple to check the water temperature as the wash tub fills. (Fig. 27)



Figure 27. Check water temperature.



If the water temperature is outside of the stated range as the wash tub fills, empty the wash tub using the spin cycle and refill. Do not add the detergent, sample, and ballast until the water temperature is in the stated range.

Weigh 66.0 ± 0.1 g of detergent (AATCC 1993 Standard Reference Detergent, powdered).
(Fig. 28)



Remember to tare the scale for the weighing container!



Figure 28. Weigh detergent.

Add the detergent to the wash tub as it fills. Allow detergent to dissolve before adding the sample and ballast. Add the sample and ballast before the machine agitation begins.

Wash the sample and ballast according to the conditions and settings in Tables 3 and 4.

Once the washing process is complete, place the sample and ballast in the dryer and dry according to the conditions and settings in Tables 3 and 4.



Washing and drying should be performed the same day.

Once the refurbishment process is completed, repeat the entire test procedure (including preliminary tests) with the refurbished specimens.

13. TEST CODES AND SEQUENCE

13.1 Test Result Codes

Use the test results (time in seconds) and test observations to determine the test result code from the tables below. Use the appropriate test result code for each specimen in the test report.

For *plain surface fabrics*, choose between the three codes listed in Table 5. Note that no time is reported for codes *DNI* or *IBE*.

Table 5. Test Result Codes: Plain Surface Fabrics

DNI	Did not ignite (no time)
IBE	Ignited, but extinguished (no time)
__ sec	Actual burn time measured and recorded by the timing device in 0.0 seconds

For *raised surface fabrics*, choose between the eight codes listed in Table 6. Note that no time is reported for codes *SF uc*, *SF pw*, or *SF poi*.

Table 6. Test Result Codes: Raised Surface Fabrics

SF uc	Surface flash, under stop thread, but does not break thread (no time).
SF pw	Surface flash, part way; does not break thread (no time).
SF poi	Surface flash, at point of impingement only (no time); equivalent to <i>DNI</i> for <i>plain surface fabrics</i> .
__ sec	Actual burn time (sec) measured and recorded by the timing device.
__ SF	Time (sec), surface flash only; no damage to the base fabric.
__SFBB	Time (sec), surface flash base burn starting at places other than the point of impingement as a result of surface flash.
__SFBBpoi	Time (sec), surface flash base burn starting at the point of impingement. This result does not qualify as a base burn under the current interpretation of 16 CFR Part 1610.
__SFBBpoi*	Time (sec), surface flash base burn possibly starting at the point of impingement; the asterisk is accompanied by the following statement: <i>Unable to make absolute determination as to source of base burns</i> . This statement is added to the result of any specimen if there is a question as to the origin of the base burn. This result does not qualify as a base burn under the current interpretation of 16 CFR Part 1610.

The flowcharts in Figures 29-32 provide guidance on the correct test sequence based on the fabric type and state.

13.2 Plain Surface Fabrics

Test Sequence for Plain Surface Textile Fabrics In Original State §1610.7(b)(1), Step 1.

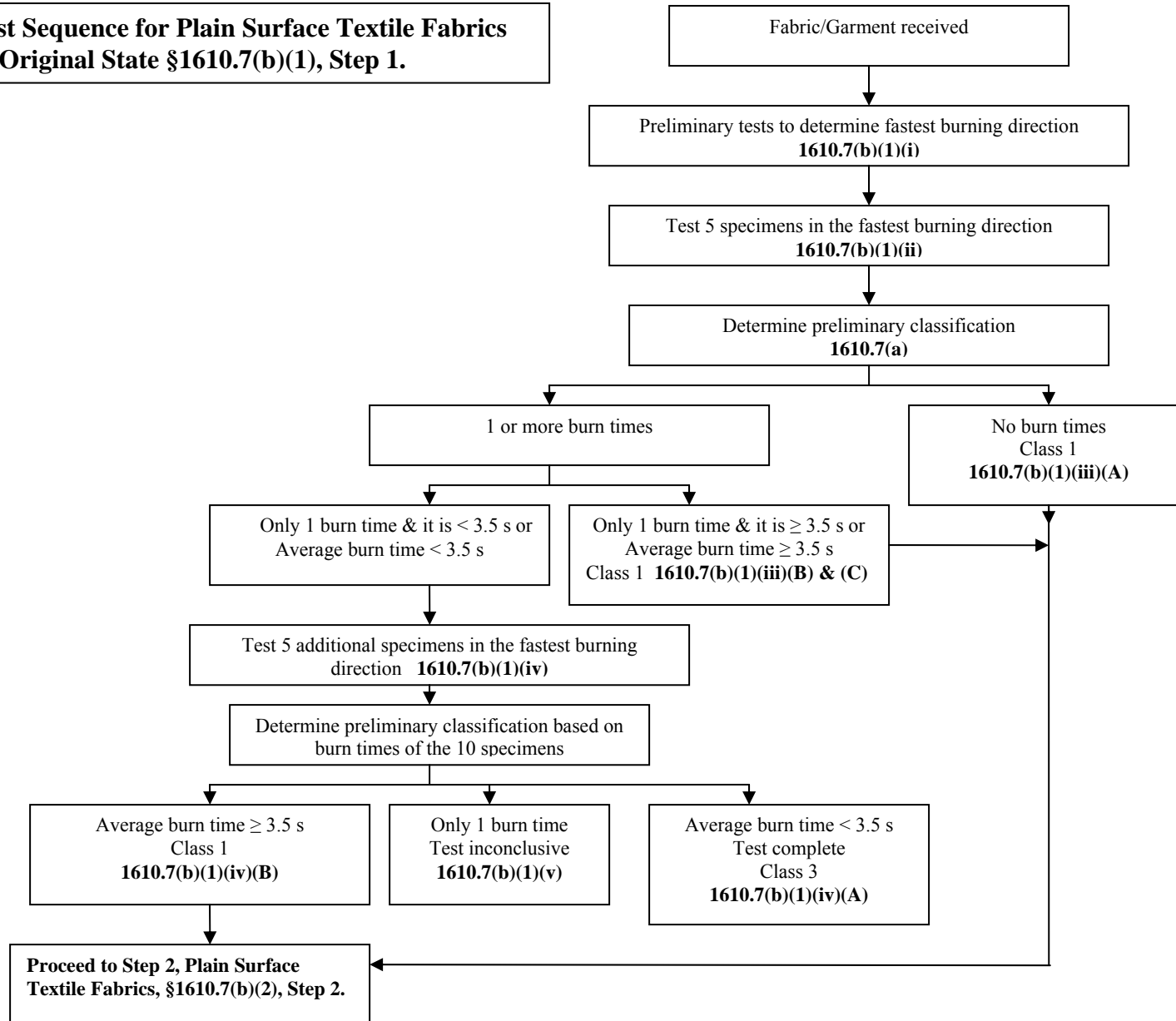


Figure 29. Test sequence for plain surface, Original State, with preliminary classifications.

**Test Sequence for Plain Surface Textile Fabrics
After Refurbishing §1610.7(b)(2), Step 2**

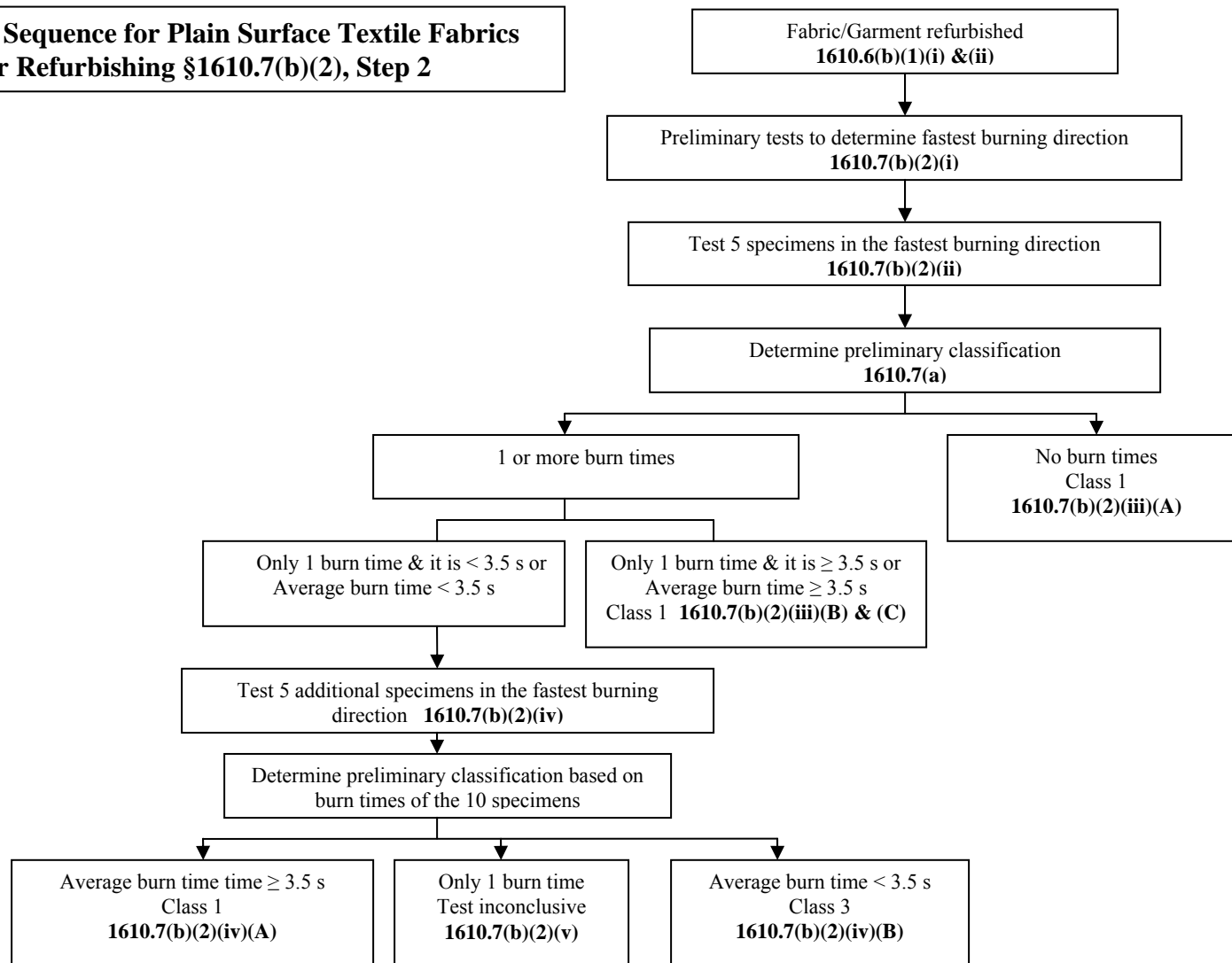


Figure 30. Test sequence for plain surface, Refurbished State, with preliminary classifications.

13.3 Raised Surface Fabrics

Test Sequence for Raised Fiber Surface Textile Fabrics in Original State §1610.7(b)(3), Step 1

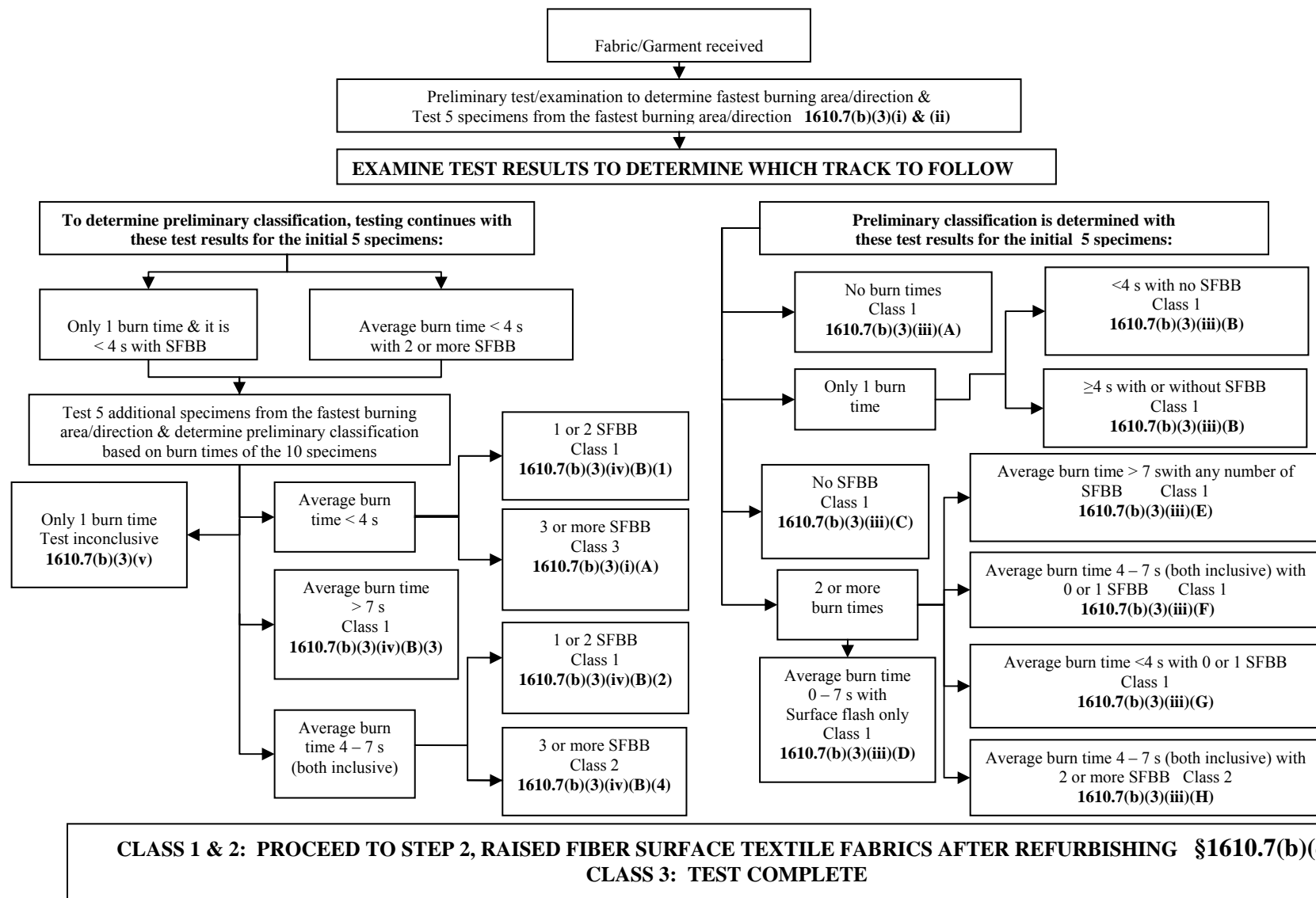


Figure 31. Test sequence for raised surface, Original State, with preliminary classifications.

Test Sequence for Raised Fiber Surface Textile Fabrics After Refurbishing §1610.7(b)(4), Step 2

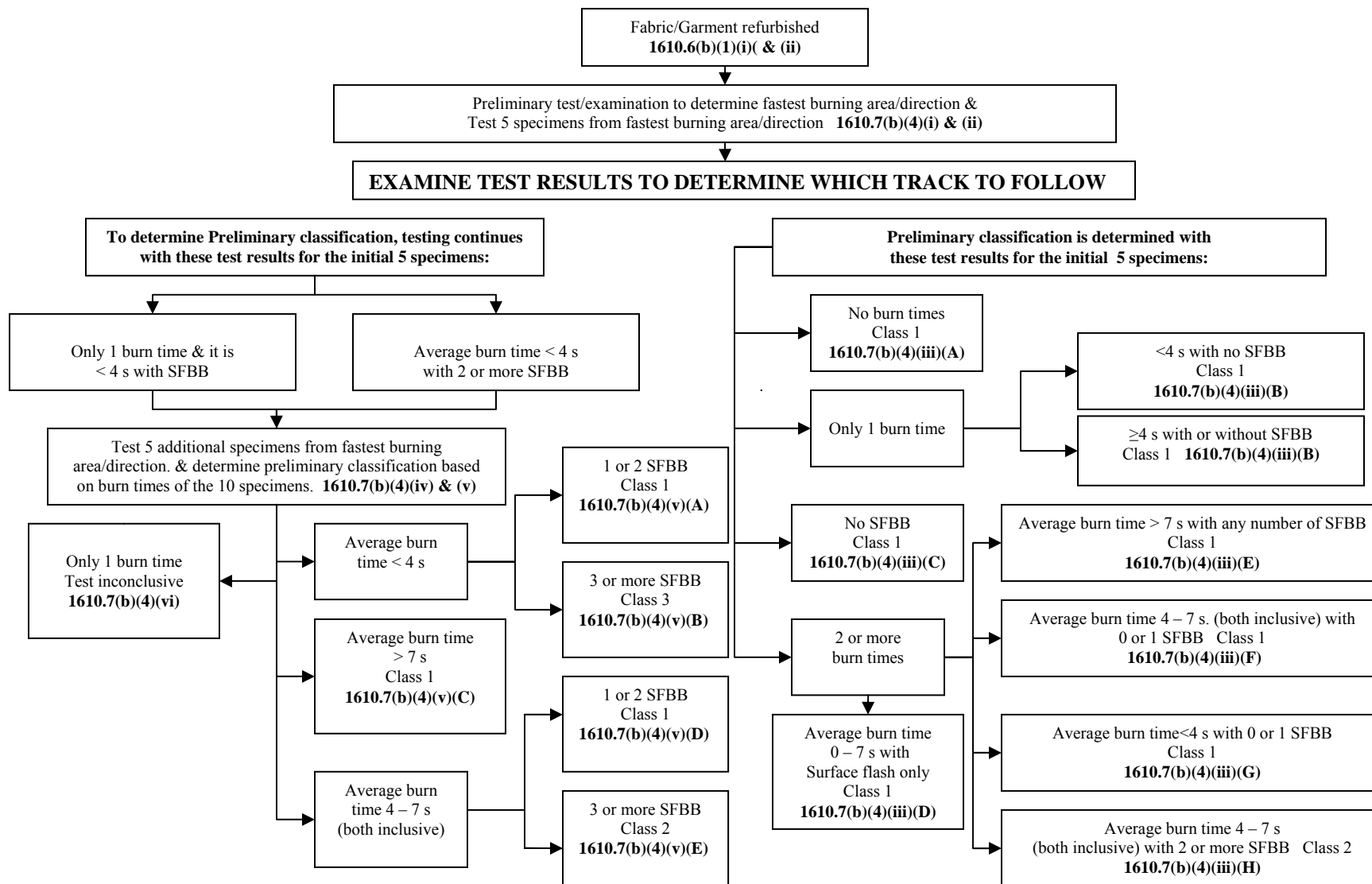


Figure 32. Test sequence for raised surface, Refurbished State, with preliminary classifications.

14. SAMPLE CLASSIFICATION

14.1 Summary of Classifications

Table 7. Sample Classifications

Classification	Plain Surface	Raised Fiber Surface⁵
Class 1	Average burn time ≥ 3.5 s	Average burn time > 7.0 s OR Average burn time is 0-7 s with no base burns (SFBB)
Class 2	N/A	Average burn time is 4-7 s with base burn (SFBB)
Class 3	Average burn time < 3.5 s	Average burn time < 4.0 s with base burn (SFBB)

14.2 Preliminary Classification

A preliminary classification is made after each stage of testing. For samples tested in Original State Only or that result in a *Class 3* designation in Original State, the preliminary classification serves as the final classification. See section 13. *Test Codes and Sequences* of this laboratory manual for guidance on classifications.

14.3 Final Classification

The final classification is the preliminary classification before or after refurbishing, whichever is the most severe flammability classification. See section 13. *Test Codes and Sequences* of this laboratory manual for guidance on classifications.

15. TEST REPORT AND CERTIFICATION

Generate a test report for each set of tests performed on each sample. Include any preliminary trial results and classifications with the final test results. Certification of the test report should be completed by personnel with an understanding of the test, provided that they did not perform the tests to be certified.

⁵ This table is not all-inclusive for raised fiber surface fabric classification. See section 13. *Test Codes and Sequences* for more information.

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Appendix A: Description of Test Equipment

Automatic washing machine and dryer: The second stage of refurbishment requires the use of an automatic washing machine and tumble dryer. The specifications for this equipment are found in §1610.6(b)(1)(ii) of the Standard and in section 12. *Refurbishment*, Tables 2, 3, and 4 of this laboratory manual.

Ballast for dry cleaning: If the sample alone does not generate a load that is 80% of the machine's capacity, use ballast consisting of a combination of 100% wool fabric and 100% cotton fabric or garments to make up the difference. The ballast should consist of 80% wool and 20% cotton fabric pieces that are clean, white or light-colored.

Ballast for laundering: To make up an 8 lb sample for laundering, cotton material is used as ballast. Cotton material that is different from the ballast used for dry cleaning may be used.

Brushing device: The brushing device serves two functions: (1) to support the specimen during the mounting procedure and (2) to raise the pile of raised fiber surface specimens. The brushing device is composed of a stable base that provides a track for a carriage. The carriage is used to support the specimen during mounting with a metal plate located on the center of the top surface. The carriage moves on parallel tracks to pull the specimen under the brush (for raised fiber surface specimens). The brush, two rows of stiff, off-set nylon tufts, is secured to the base with a hinged attachment so that it can be stowed in the vertical position when not in use and then lowered to brush a specimen. The brush exerts a pressure of 150 gf (0.33 lbf) in the horizontal position.



Do not store the brushing device with the brush in the horizontal position as it may cause the bristles to splay. Specifications for the brushing device may be found in §1610.5(b)(10) and Figures 7-9 of the Standard.

Butane, chemically pure: Chemically pure (CP) butane is specified by the Standard. CP butane is considered to be a minimum of 99.0% butane.

Circulating ovens: Circulating ovens are used to condition test specimens. The Standard specifies the use of forced circulation drying ovens capable of maintaining 105 ± 3 °C (221 ± 5 °F) for 30 ± 2 minutes.

Commercial dry cleaning machine: The first stage of refurbishment specifies the use of a commercial dry cleaning apparatus. The specifications for this equipment are found in §1610.6(b)(1)(i) and section 12. *Refurbishment*, Table 2 of this laboratory manual.

Desiccant: The Standard specifies the use of anhydrous silica gel desiccant. Check the desiccant before a test series to determine if it needs to be refreshed. Follow the manufacturer's instructions to refresh the desiccant.

Dry cleaning solvent and detergent: The Standard specifies the use of commercial grade perchloroethylene solvent and cationic class dry cleaning detergent.

Flame measuring device: A device may be purchased or fashioned to quickly and accurately check the test flame length of 16 mm ($\frac{5}{8}$ in). This device should be fashioned from non-flammable material. The flame length typically is controlled by the regulator on the gas tank.

Flow control device: A flow control device is usually part of the test chamber. Many commercially available test chambers use a manometer to determine the flow of fuel to the ignition mechanism; however, another type of flow control device such as a rotameter or mass flow controller may be used.

Indicator finger: When positioned correctly, the specimen rack should hold the mounted specimen so that the indicator finger just touches the surface of the specimen. The indicator finger ensures that the igniter tip will impinge properly on the specimen surface. The indicator finger is described in §1610.5(a)(1)(iv) and Figures 1, 2, and 4 of the Standard.

Laundering detergent: AATCC 1993 Standard Reference Detergent (powdered) is specified by the Standard. This detergent can be obtained from the American Association of Textile Chemists and Colorists (AATCC)⁶.

Specimen holders: The specimen holder secures the specimen for handling and presentation to the ignition source. The specimen holder consists of two U-shaped metal plates, 2 mm (0.06 in) thick. A specimen is mounted between the plates with the three layers secured with clips on each side of the U. The specimen holders are described in §1610.5(a)(1)(iii) and Figures 1 and 3 of the Standard.

Specimen holding rack: For ease of specimen handling, a specimen holding rack may be used. This device allows the stacking of mounted specimens for placement in the ventilated oven and desiccator.

Specimen rack: The specimen rack supports the mounted specimen at a 45 degree angle in the test chamber. The specimen rack can be adjusted so that the indicator finger just touches the surface of the specimen, allowing for proper impingement of the igniter tip to the surface of the specimen. The specimen rack is described in §1610.5(a)(1)(ii) and Figures 1 and 3 of the Standard.

Stop thread: The Standard specifies that the stop thread be a spool of No. 50, white, mercerized, 100% cotton sewing thread. The stop thread is described in §1610.5(a)(2)(ii).

Stop weight: The stop weight (30.0 ± 0.5 g) is attached to the stop thread. When the flame breaks the thread, the stop weight drops, actuating the stop motion for the timing device. The stop weight is described in §1610.5(a)(1)(vii).

Test chamber: The test chamber used to conduct testing according to the Standard is described in §1610.5(a)(1) and Figures 1-6 of the Standard. It is important to recognize that while some flexibility is allowed in the construction and design of the test chamber, the Standard specifies several criteria that must be met.

⁶ American Association of Textile Chemists and Colorists (AATCC), PO Box 12215, Research Triangle Park, NC 27709 (www.aatcc.org)

Appendix B: Determining Fabric Surface Type

A **plain surface textile fabric** is defined by the Standard as any textile fabric which does not have an intentionally raised fiber or yarn surface, such as a pile, nap, or tuft, but shall include those fabrics that have fancy woven, knitted or flock-printed surfaces (§1610.2(k)).

A **raised surface textile fabric** is defined by the Standard as any textile fabric with an intentionally raised fiber or yarn surface, such as a pile, including flocked pile, nap, or tufting (§1610.2(l)).

Some fabrics require special attention to preparation based on their construction. The examples below are not meant to be fully inclusive of all fabrics requiring special handling.

- Flocked Fabrics: Treat flocked fabrics as *raised surface* textiles unless they are flock printed. Flock printed fabrics are usually patterned and the flocking does not cover the entire fabric surface.
- Cut Velvet Fabrics: Treat cut velvet fabrics with a patterned construction as a *raised surface fabric*. Velvet fabrics are made by weaving a pile yarn into a base fabric. The base fabric is visible in a cut velvet fabric.
- Metallic Thread Fabrics: Treat fabrics containing metallic threads as *plain surface fabrics* if the base fabric is smooth. Cut specimens so that metallic threads are parallel to the long dimension of the specimen and so that the test flame impinges directly on the metallic threads during ignition of the specimen.
- Embroidery: Use two sets of preliminary specimens to determine the most flammable direction and area of the fabric, the base fabric or the embroidery. Cut specimens so that the test flame impinges on the desired area during ignition of the specimen. Test the most flammable direction of the most flammable area as a *plain surface fabric*.
- Burn-out Patterns: Treat burn-out patterned fabric as a plain surface fabric as long as it is a flat, woven construction.
- Narrow Fabrics and Loose Fibrous Materials: Do not test samples that cannot yield specimens at least 50 by 150 mm (2 by 6 in). There is no provision for testing loose, fibrous materials that do not yield a consistent, self-supporting specimen with dimensions 50 by 150 mm (2 by 6 in). Examples of such materials may include hula skirts, leis, fringe, loose feathers or boas, wigs, hairpieces, etc.
- For information on how to address some product types, see §1610.36 *Application of Act to particular types of products*. This section provides guidance on such products as handkerchiefs, veils and hats, and footwear.

Appendix C: Calibration Procedures for Test Equipment

All equipment associated with this test procedure should be calibrated and maintained according to the manufacturer's instructions. It is recommended that a calibration log be maintained for all equipment.

Calibration of Test Chamber

Two components of the test chamber apparatus performance should be checked and, if necessary, calibrated on at least an annual basis:

- The igniter tip alignment
- The impingement time

Suggested calibration protocols for these components are outlined below.

Igniter tip alignment: The tip of the igniter should just touch the surface of the specimen. Use a calibration plate to check and, if necessary, adjust the point at which the igniter impinges on the specimen. The plate should have a marked location that is 5.0 inches from the position of the stop thread. (*Fig. 33*) Mount the plate in a specimen holder and place it on the specimen rack following the same protocol used for a test specimen. Use the indicator finger to position the mounted calibration plate. Allow the igniter to impinge on the calibration plate. If the igniter does not impinge at the correct location, follow the instructions for adjusting the test chamber components and repeat the burner impingement check until the impingement point is correct.

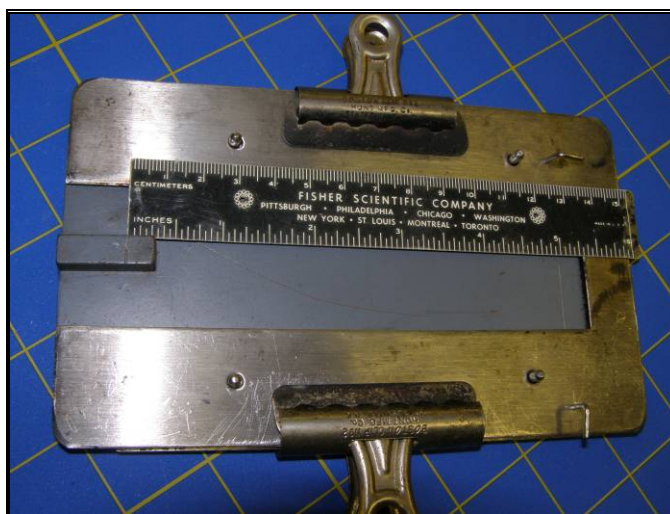


Figure 33. Example calibration plate for igniter tip alignment.

Impingement time: The igniter should impinge on the specimen for 1.0 s. Check the time of impingement using a calibration plate with a metal pad at the location of the igniter impingement. (*Fig. 34*) Connect a lead from a timer to the metal plate. A second lead should be connected to the test cabinet through a low voltage power supply. The burner tip should make contact with the metal plate, generating an electrical pulse. The duration of the pulse is measured by the timer. If the pulse duration is not 1.0 s when the test chamber timer is set at 1.0 s, follow the instructions for adjusting the test chamber timer and repeat the impingement time check until it is correct.



Figure 34. Example calibration plate for timer.

Appendix D: Exemptions and Exceptions

Based on years of test experience, CPSC staff has identified several cases where samples can be *exempted* from testing. Refer to §1610.1(d) of the Standard for specific exemptions.

- *Plain surface fabrics* weighing 88.2 g/m² (2.6 oz/yd²) or greater.
- *Plain or raised surface fabrics* regardless of fabric weight made entirely from or combinations of the following generic fiber types:
 - acrylic,
 - modacrylic,
 - nylon,
 - olefin,
 - polyester, or
 - wool.

There are several product categories that are *exceptions* to the Standard. Refer to §1610.1(c) of the Standard for specific exceptions.

- 1) Interlinings: Fabrics sold for the purpose of covered or unexposed interlinings are exempt from testing. Interlinings are located between an outer shell and an inner lining in a garment and are not exposed in normal wear of the garment.
- 2) Hats, gloves, and footwear: Hat, glove, and footwear fabrics are exempt from testing in most cases. Some examples where these items would not be exceptions are:
 - a. Gloves longer than 14 inches and/or attached to a garment,
 - b. Hats that provide a covering for the neck, face, or shoulders when worn by an individual,⁷ and
 - c. Footwear that consists of hosiery in whole or part or forms an integral part of another garment.

⁷ Veils and hats: Veils and hats with veils or millinery that do not extend more than 9 inches from the crown or 2 inches beyond the hat brim are an exception to the Standard.

Appendix E: Glossary of Terms

Base burn: Also known as *base fabric ignition* or *fusing*, a base burn indicates the point at which the ground or base fabric of a raised fiber surface fabric burns, providing a self-sustaining flame. When used to establish a *Class 3* fabric, base burns must result from surface flash at points other than the point of impingement. Base burns can be identified by a change in fabric opacity, scorching visible on the reverse side of the specimen, or the formation of a hole.

Classification: Based on fabric surface type and flammability performance as measured according to the Standard, samples are assigned a *classification* of *Class 1*, *2*, or *3*. See sections *13. Test Codes and Sequence* and *14. Sample Classification* of this laboratory manual.

Edge ignition: Edge ignition occurs when the flame travels to the bottom edge of the specimen and proceeds to burn up the reverse side of the specimen. An occurrence of edge ignition necessitates a re-test.

Original state: *Original state* indicates a garment is in a “new” state (as a consumer would receive the item). Specimens resulting in a classification of *Class 3* in Original State are given a final classification of *Class 3* without testing in the refurbished state.

Plain surface textile fabric: A *plain surface textile fabric* is defined by the Standard as any textile fabric which does not have an intentionally raised fiber or yarn surface, such as a pile, nap, or tuft, but shall include those fabrics that have fancy woven, knitted or flock-printed surfaces (§1610.2(k)). See *Appendix C: Determining Fabric Surface Type*.

Point of impingement (POI): The point at which the igniter contacts the specimen is known as the point of impingement. Note that base burns occurring at the point of impingement are not used in establishing a raised fiber surface sample as a *Class 3* fabric.

Raised surface textile fabric: A *raised surface textile fabric* is defined by the Standard as any textile fabric with an intentionally raised fiber or yarn surface, such as a pile, including flocked pile, nap, or tufting (§1610.2(l)). See *Appendix C: Determining Fabric Surface Type*.

Refurbished state: A specimen in the *refurbished state* has been dry cleaned and laundered according to the Standard. Samples resulting in a preliminary classification of *Class 1* or *2* in Original State are refurbished and tested again before a final classification is reported. See section 8. *Sample Handling and Examination* of this laboratory manual.

Sample: The term *sample* is used to describe a lot of fabric or garments.

Specimen: The term *specimen* is used to describe a piece of fabric that is 50 by 150 mm (2 by 6 in) taken from a sample. A specimen will yield a test observation.

Surface flash: A *surface flash* is a rapid burning of a specimen’s pile that may or may not result in the base fabric igniting or fusing.