UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

Date: May 16, 2005

TO : Dale Ray, Project Manager, Upholstered Furniture
Directorate for Economic Analysis

THROUGH: Andrew G. Stadnik, P.E., Associate Executive Director for Laboratory Sciences
Edward W. Krawiec, P.E., Division Director, Electrical and Flammability Engineering

FROM : Linda Fansler, Division of Electrical and Flammability Engineering
Lisa L. Scott, Division of Electrical and Flammability Engineering

SUBJECT : Performance Criteria, and Standard Materials for the CPSC Staff Draft Upholstered Furniture Standard*

INTRODUCTION

This memorandum provides a discussion of the work[1,2,3,4] done by the U.S. Consumer Product Safety Commission's (CPSC) Directorate for Laboratory Sciences (LS) staff to identify standard materials and appropriate performance criteria to include as potential revisions to the staff's draft upholstered furniture standard.[5]

As part of the upholstered furniture project, LS staff conducted over 1,800 open flame and smoldering mockup tests to support the development of smoldering and small open flame test methodologies. Because upholstery fabrics have a range of fire performances, fabric and barrier classification schemes were developed by LS staff to identify combinations of materials that meet reasonable performance criteria. These mockup tests also supported an evaluation of the use of standard materials, i.e. fabrics, foams, etc. that could be used when exploring the fire performance of individual components of furniture upholstery systems.

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*This document was prepared by the CPSC staff, and has not been reviewed or approved by, and may not reflect the views of, the Commission.

[1] Memorandum to D. Ray, Project Manager, Upholstered Furniture Project, from L. Fansler and L. Scott, "Open Flame Ignition Test Methodology Development," May 2005.

[2] Memorandum to D. Ray, Project Manager, Upholstered Furniture Project, from W. Tao, "Evaluation of Test Method and Performance Criteria for Cigarette Ignition (Smoldering) Resistance of Upholstered Furniture Components," May 2005.

[3] Memorandum to D. Ray, Project Manager, Upholstered Furniture Project, from W. Tao, "Assessment of Fabric Open Flame Methodology," May 2005.

[4] Memorandum to D. Ray, Project Manager, Upholstered Furniture Project, from L. Scott, "Smoldering and Small Open Flame Ignition Performance of Upholstered Furniture Loose Fill Materials," May 2005.

[5] Draft Standard For Upholstered Furniture, R. Khanna, Engineering Sciences, revised February 19, 2001.

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STANDARD MATERIALS

The use of standard materials to evaluate individual components is desirable in order to minimize the number of tests required. Test results[1,2,3,4] suggest that standard materials could be defined to evaluate the individual components covered in the May 2005 staff's draft proposed standard.[6] Details on the fabrics, foams, fire-blocking barriers, fibrous and loose fill and loose fill containment fabrics used in this test program are found in the appendix.

Standard Cover Fabric

A standard cover fabric is a surrogate for any cover fabric and once ignited ultimately becomes the ignition source for underlying materials. Therefore, the standard cover fabric should provide a realistic challenge to any materials underneath whether used for an open flame or smoldering test. A standard fabric should also provide consistent results.

For smoldering ignitions, the data[2] suggests that Fabric 24, a cotton velvet, 10 oz/yd^2 fabric is a reasonable choice as a standard fabric because it is a smolder-enhancing fabric. Fabric 24 provides a challenge to the materials below. In addition, Fabric 24 has been used for over 10 years as the standard fabric for smoldering ignition tests by the State of California.[6]

For small open flame ignitions, Fabric 24 a cotton velvet, 10 oz/yd^2 fabric and Fabric 26, a rayon plain weave, 8 oz/yd^2 fabric, were identified as potential standard fabrics to evaluate individual furniture components.[1] Both fabrics are currently used as standard fabrics in industry and government standards.[6,7] In addition, both fabrics provided appropriate, aggressive challenges to the materials below. Fabric 26 is a slightly more aggressive fabric in that it tends to ignite more readily and burn more vigorously than Fabric 24 in tests with a small flame source. Other aggressive fabrics such as Fabric 5, a cellulosic/thermoplastic blend, may be more difficult to define as a standard fabric.

Overall, results suggest that Fabric 24 provides the needed challenge for most individual furniture components to be evaluated with a small open flame source. Figure 1 shows the results of tests with Fabric 24 and a variety of foams included in this test program. A 35 mm flame applied for 20 seconds was used in these tests to evaluate the fabric and foam combinations. For the most part, Fabric 24 performed more consistently when combined with both treated and non-treated foam than Fabric 26.

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[6] Fabric 24, 100% cotton velvet is specified in California Bureau of Home Furnishings and Thermal Insulation Technical Bulletin 117, *Requirements, Test Procedure and Apparatus for Testing the Flame Retardance of Resilient Filling Materials Used in Upholstered Furniture*, March 2000 and the revised Technical Bulletin 117, *Requirements, Test Procedure and Apparatus for testing the Flame and Smolder Resistance of Upholstered Furniture*, DRAFT February 2002.

[7] Upholstered Furniture Action Council (UFAC), *Filling/Padding Component Test Method* -1990 and *Barrier Test Method* – 1990.

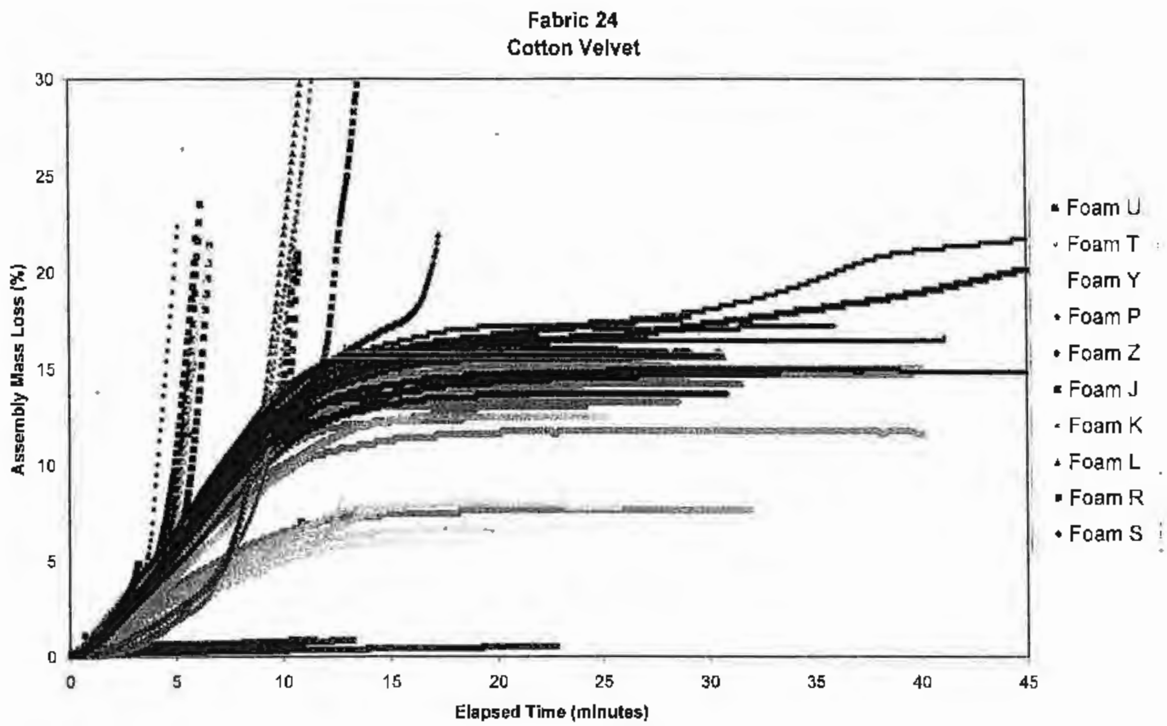

Figure 1. Assembly mass loss versus elapsed time for Fabric 24 (cotton velvet) with various foams.

In smoldering tests with just foam, Fabric 24 smoldered strongly and it is reasonable to assume that it would also challenge the performance of other materials such as barriers. In general, most of the fire-blocking barriers tested resulted in larger char lengths and greater foam mass losses as compared with the mockups tested without the barriers. These results indicate that Fabric 24 provides the needed challenge to barrier materials because it is a strong smoldering fabric.[2]

For small open flame ignitions, the use of fire-blocking barriers can provide improved fire performance of the assembled mockup.[1] Fire-blocking barriers act by preventing ignition of the filling materials and or limiting fire growth. A fairly aggressive challenge of the barrier is warranted because of the potential variety of underlying materials needing protection. In addition to tests with a 35 mm flame applied for 20 seconds, the size and duration of the flame exposure was increased to 240 mm at 70 seconds. Tests were conducted evaluating Fabric 24 and Fabric 26 for potential use as a standard cover fabric for testing of barrier materials. Results indicate there was a range of performance for materials evaluated. The data suggests that either Fabric 24 or Fabric 26 with a 70-second, flame application could be used to evaluate the fire performance of barrier materials (Figures 2 and 3). For consistency with other elements of the draft standard, LS staff recommends using Fabric 24 as the standard cover fabric to evaluate fire-blocking barrier materials.

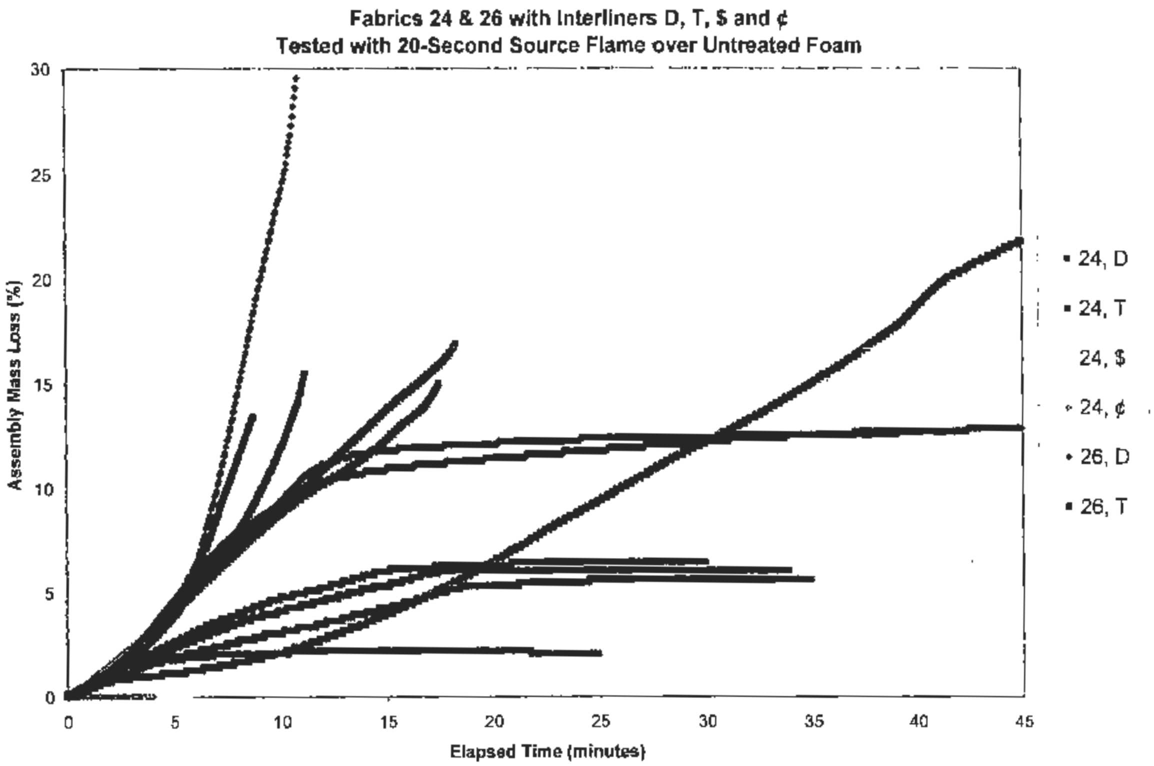

Figure 2. Twenty-second flame application tests with Fabric 24 (cotton velvet) and Fabric 26 (rayon) and various fire-blocking barriers, (Interliners D, T, $ and ¢).

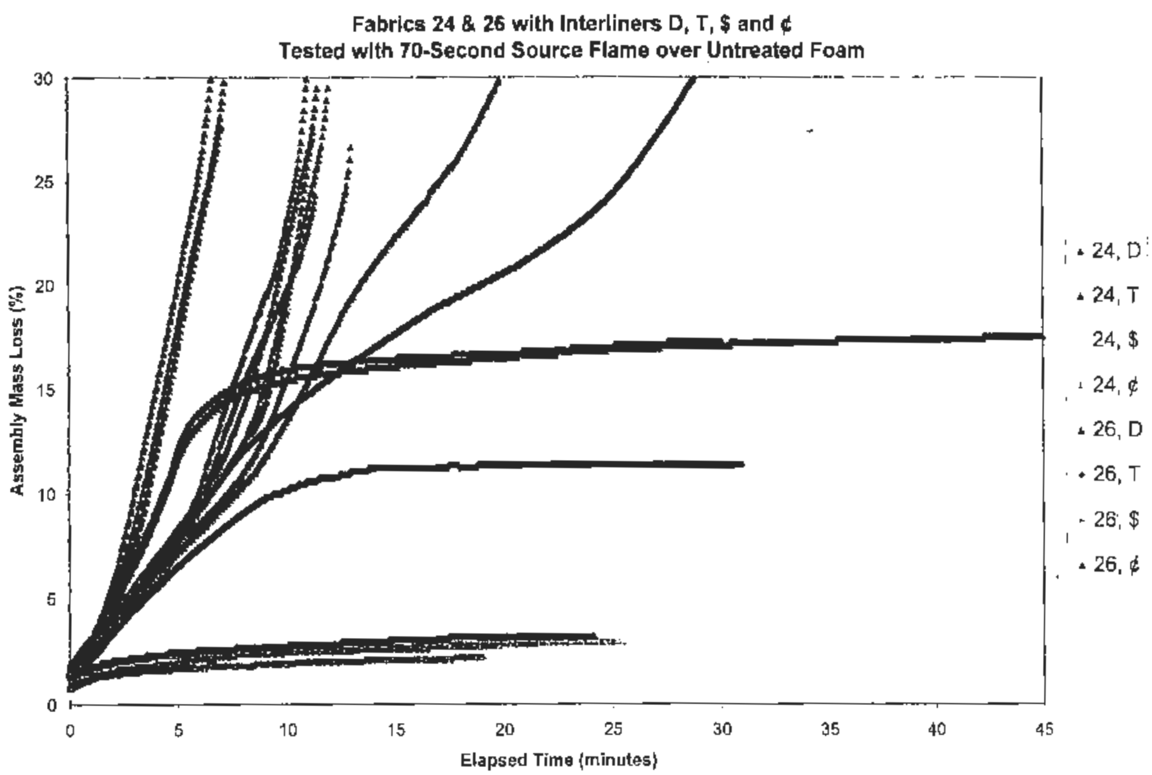

Figure 3. Seventy-second flame application tests with Fabric 24 (cotton velvet) and Fabric 26 (rayon) and various fire-blocking barriers, (Interliners D, T, $ and ¢).

For smoldering and open flame ignitions, the data indicate that Fibrous Fill and other Interior Materials are adequately challenged with Fabric 24. Loose fill and Loose fill Interior Fabrics are also adequately challenged with Fabric 24 for smoldering and open flame evaluations.[1,2,4]

Specifications for Cotton Velvet Standard Cover Fabric

Content: pile = cotton
ground = cotton
filling = cotton
width: 54 inches
weight: 10.0 oz/yd^2
backcoating: none
color: beige
flammability performance: (*To be determined*).
no chemical treatments

Standard Foam

When evaluating cover fabrics or other materials, the use of a standard resilient material is desirable. For smoldering ignitions, the data[2] suggest that the small amount of flame retardant chemical treatments found in several treated foams actually reduced resistance to smoldering behavior. The amount and kinds of chemicals[8] identified in some of the treated foams used in this test program are as follows:

- Foam T treated with approximately 2 percent melamine and 6 to 9 percent tris (1,3-dichloro-2-propyl) phosphate (TDCP),
- Foam S treated with approximately 7 percent TDCP,
- Foam Z treated with approximately 2 to 3 percent melamine and 5.5 to 6 percent Fire Master 550™[9],
- Foam R treated with approximately 3 percent Fire Master 550™ and 3 percent Polybrominated Diphenyl Ether, (PBDE).

Overall, foam treated with about a total of 10 percent by weight of flame-retardant chemicals appears to provide a good standard substrate for the evaluation of fabric, filling, and fire barrier materials with respect to smoldering ignition because it presents a greater challenge than untreated foam. Figure 4 shows that mockups tested with chemically treated foam (Foams T, S, Z, and R), containing the amounts and kinds of chemicals listed above, had greater foam mass loss than the same mockups tested with either untreated foam (Foams U, J, K, L and N) or the more heavily treated foam (Foams Y and P).

[8] Memorandum to D. Ray, LSE, from D.Cobb and S.Chen, "Analysis of FR Chemicals Added to Foams, Fabric, Batting, Loose Fill, and Barriers," May 2005, CPSC.
[9] The material safety data sheet for FM550™ indicates it contains a mixture of halogenated aryl esters and aromatic phosphates such as triphenyl phosphate.

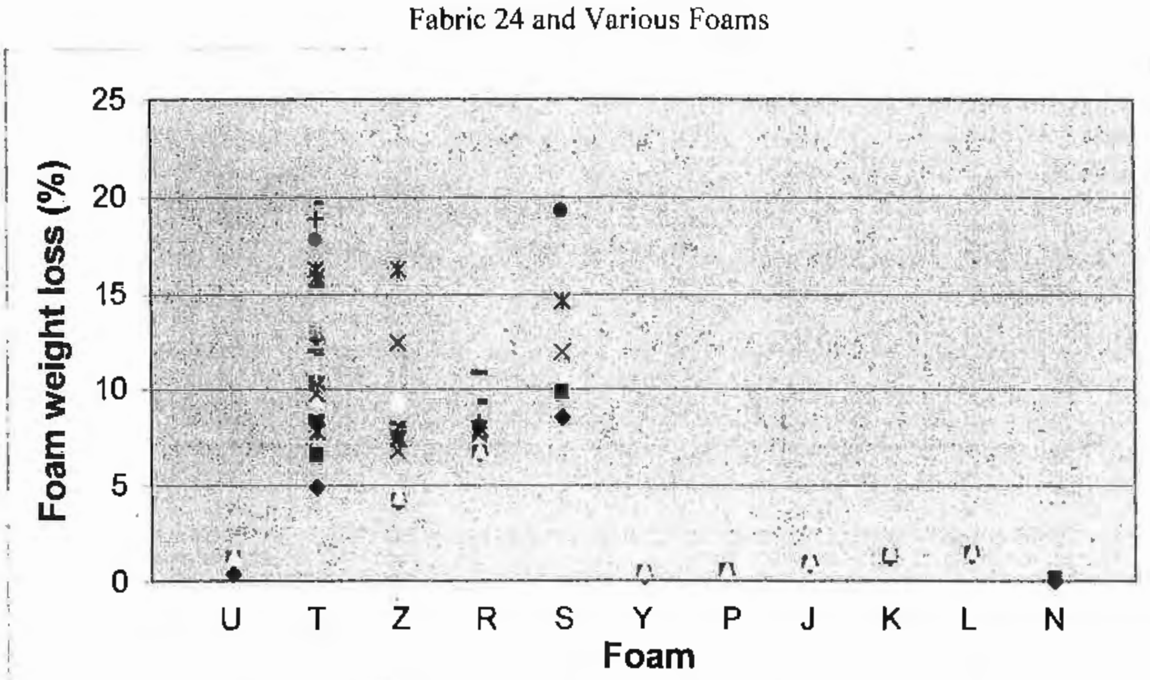

Figure 4. Foam mass loss for mockups constructed with Fabric 24 (cotton velvet) and various foams.

Two types of foams were evaluated for their use as standard foam as part of the small open flame ignition tests.[1] The first, an untreated foam, Foam U, is a feasible choice to evaluate those materials intended to offer the highest level of protection to materials below. This includes those cover fabrics that do not ignite and fire-blocking barriers. The added level of fire performance from treated foam is not necessary if highly resistant fabrics and fire-blocking barriers are in place to provide protection to the materials below. Although marketed as non-chemically treated foam, when analyzed,[8] Foam U was found to contain on average 1.2 percent of melamine, a known flame retardant chemical. Tests done with Foams J, K, and L, which have no flame retardant chemicals detected, performed similarly (Figure 5).

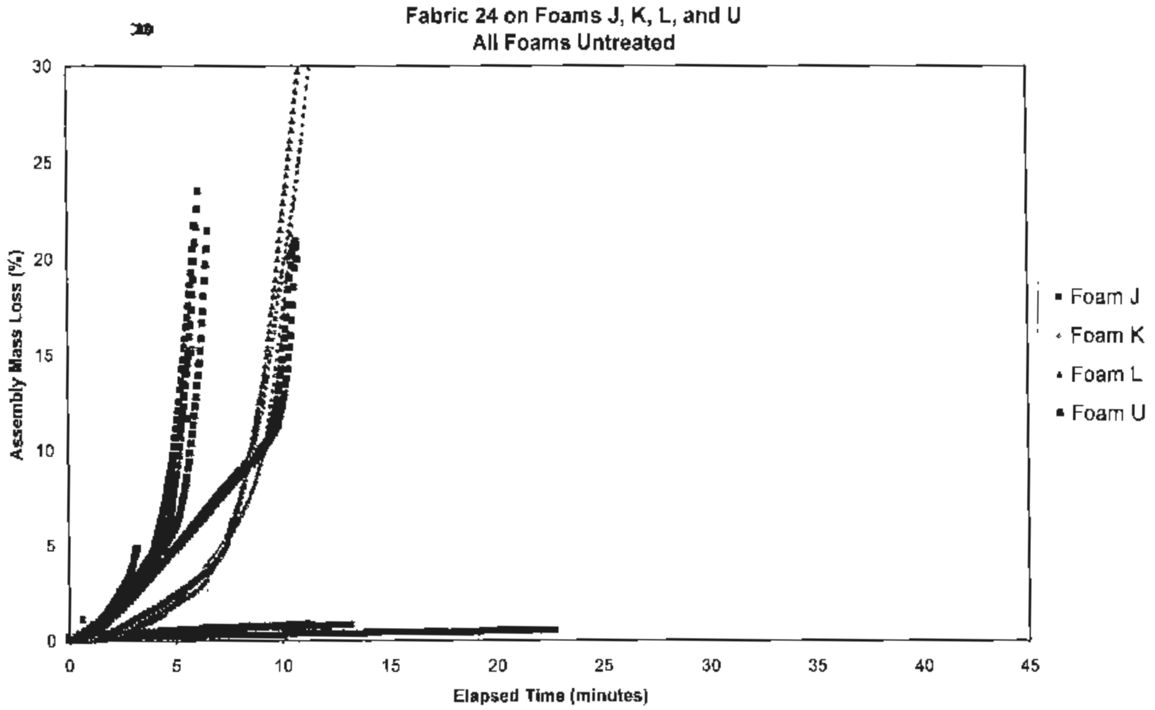

Figure 5. Assembly mass loss versus elapsed time for Fabric 24 (cotton velvet) and untreated foam.

The other types of foam used for small open flame ignition evaluations contained flame retardant chemicals. The same foams that provided challenge in smoldering ignition tests are also reasonable choices for standard foams to evaluate those cover fabrics that ignite and continue to burn, Fibrous Fill and other Interior Materials. To specify a standard test foam, CPSC staff considered chemical specifications but felt that the types and uses for flame resistant chemicals will change over time. CPSC staff believes that what is important is the fire performance behavior of the standard foam under both smoldering and open flame conditions.

Time to ignition of the foam itself is a measure of acceptable foam performance. Results[1] indicate that two of the treated foams with characteristics desirable for a standard test foam did not ignite at 20 seconds but did ignite when the small flame source was applied for 30 seconds on the bare foam. This is a performance parameter in the California Bureau of Home Furnishings February 2002 draft revision of Technical Bulletin 117.

Two other measures to determine improved foam performance for a standard foam are foam mass loss for smoldering ignition and assembly mass loss for small open flame ignition. For smoldering ignition, a treated foam mass loss between 10 and 15 percent at 30 minutes provides suitable performance for a standard test foam evaluated with Fabric 24 cotton velvet. Foam performance for small open flame ignition using Fabric 24 was established using assembly mass loss over time data. Figure 6 shows a range of fire performance for treated foams. In general two foams, Foam Z and Foam R fall into the performance band. The performance band is narrow in the early stages of the test but at 20 minutes widens to accept a range of assembly mass loss of 12 to 20 percent (Figure 6).

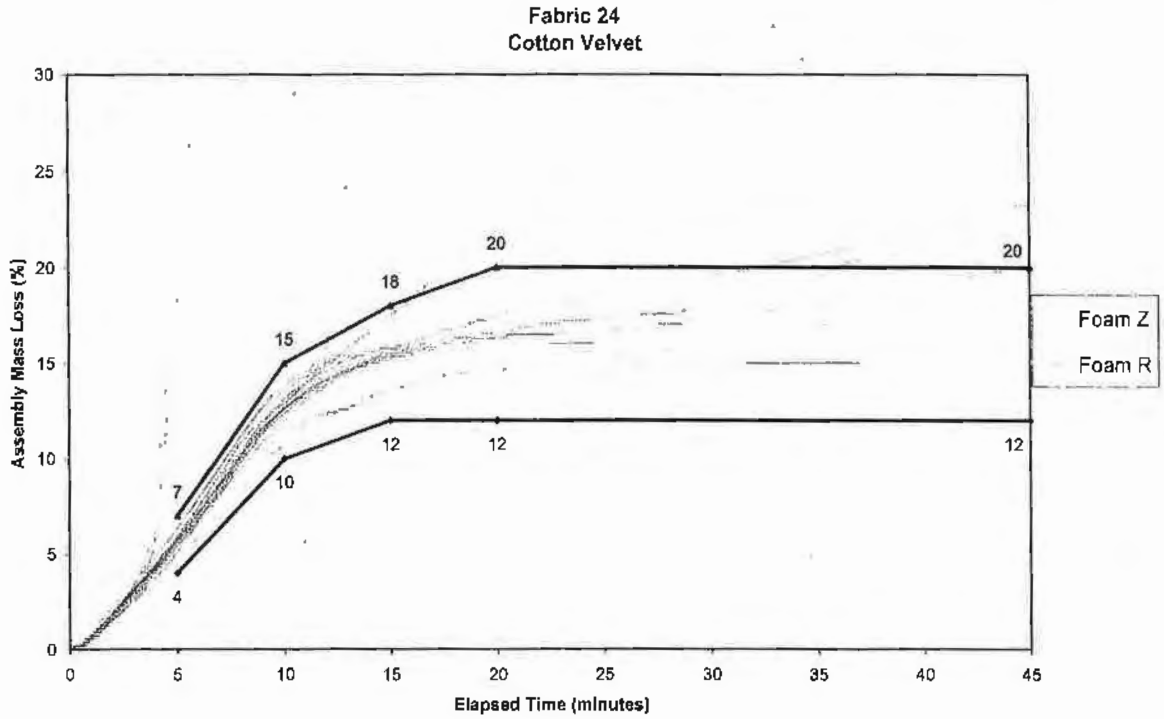

Figure 6. Assembly mass loss versus elapsed time for Fabric 24 (cotton velvet) and flame retardant chemically treated foam.

Specifications for Standard Foams

Untreated:
Polyether polyurethane foam.
Not treated with any flame retardant chemicals.
Density 1.8 lb/ft^3, 25 to 30 ILD, and air permeability greater than 4 ft^3/min.

Treated:
Polyether polyurethane foam.
Density 1.4 lb/ft^3, 25 to 30 ILD, and air permeability greater than 4 ft^3/min.
Treated with flame retardant chemicals to achieve small open flame and smoldering combustion performances outlined below.

Open Flame Performance Requirements:

1. In tests of three specimens of bare foam, ignition must occur when the small open flame (35 mm) source is applied for 30 seconds resulting in an assembly mass loss greater than 4 percent in 1 minute but must not ignite when the small flame source is applied for 20 seconds and must not produce an assembly mass loss greater than 0.5 percent.

2. When tested with standard fabric, (Fabric 24, 100% cotton velvet in the test program), and the small open flame source (35 mm) applied for 20 seconds, the assembly mass loss over time must fall into the performance band (Figure 7) for 5 out of 6 trials.

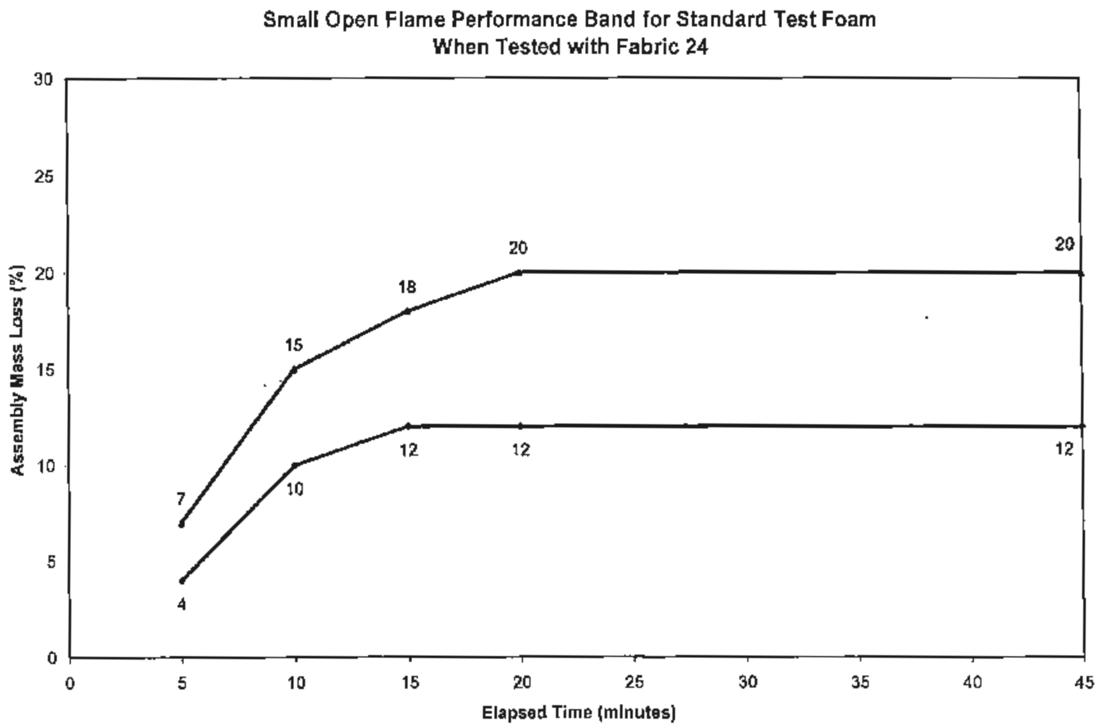

Figure 7. Assembly mass loss versus elapsed time for Standard Flame Retardant Polyurethane Foam.

Smoldering Performance Requirements:

1. Each of 12 trials with a standard fabric (Fabric 24, 100% cotton velvet in the test program), must produce a foam mass loss of between 8 and 20 percent and an average of all trials of between 10 and 15 percent.

Standard Loose Fill

In some furniture constructions, loose fill is contained in a fabric or other material, i.e. the loose fill is 'bagged'. Test results[4] showed that the containment materials are aggressively challenged using polyester fiberfill as a standard filling material. In small flame tests, polyester fiberfill ignites readily and burns rapidly.

Specifications for Standard Loose Fill

White, 100% untreated polyester fibers

PERFORMANCE CRITERIA FOR UPHOLSTERY COMPONENTS

OPEN FLAME

The May 2005 CPSC staff proposed draft standard[10] emphasizes two possible approaches to reducing the hazards of open flame ignition of upholstered furniture, preventing the foam from

[10] Draft Standard For The Flammability of Upholstered Furniture And Upholstered Furniture Materials, May 2005, CPSC's website: http://www.cpsc.gov.

igniting and/or slowing down foam ignition. Since the resilient foam provides the largest fuel load in most upholstery systems, the staff believes that preventing ignition of the foam or at least reducing the rate of combustion of the foam can generally provide the greatest reduction of the hazard. Once ignited, foam is unlikely to self-extinguish until all combustibles are consumed. There are several ways to prevent foam from igniting and/or slowing down the combustion process. One is to treat the foam with flame retardant chemicals. Another way is to protect the foam using a flame resistant barrier. The barrier can be the cover fabric itself or an interliner material designed to prevent the transfer of heat and/or flames to underlying materials.

Both of these means were evaluated as part of the current study.[1,3] Foams with higher levels of flame retardant chemicals were able to resist ignition and/or slow down the combustion process when tested with many cover fabrics. However, treated foam was not able to resist ignition when combined with some cover fabrics that burned rather aggressively. When fire-blocking barriers were included in the mockup construction, some barriers even prevented ignition of non-flame retardant treated foam with the most aggressively burning cover fabrics. Several types of cover fabrics provided protection equivalent to a separate barrier in that they also prevented ignition of the foam.[1]

Performance Criteria for Upholstery Cover Fabrics

A range of cover fabrics were tested over several types of resilient foam. The mockup assemblies were tested by exposure to a small open flame applied for 20 seconds.[11] The flammability of the assemblies was characterized by their mass loss versus time during active combustion up to 45 minutes from ignition.[1] Some examples of the data are shown in Figures 8-10.

LS staff observed differences in the flammability performance of cover fabrics that led to the use of a fabric classification system for open flame performance. Results indicate that the small open flame mockup protocol is able to discriminate between the burning characteristics of upholstery cover fabrics. A 10-second exposure of the flame source identifies those upholstery cover fabrics included in this study that ignite and burn rapidly causing ignition of the filling materials below.[3]

In an effort to characterize the fabric performance, i.e., the fabric's ability to provide protection to the filling materials below, LS staff identified classes of upholstery cover fabrics with similar flammability performances. Fabrics fell into one of three broad categories; (1) fabrics that either did not ignite or did not ignite readily – Class A; (2) fabrics that ignited but did not burn aggressively – Class B; and (3) fabrics that ignited and burned aggressively causing rapid ignition of even highly flame retardant treated foam – Class C. Potential performance criteria for each type of fabric are outlined below.

Class A fabrics offer the most resistance to ignition from the small flame source. For example, wool (Fabric 31), leather (Fabric 32), vinyl (Fabric 34) and a heavy weight (12.3 oz/yd^2) nylon fabric reported by the manufacturer to be 'lightly flame-retardant back coated'[12] did not ignite when exposed to the small open flame for 20 seconds as shown in Figure 8. Previous experience

[11] Details on the fabrics, foams, fire-blocking barriers, fibrous and loose fill and loose fill containment fabrics used in this test program are found in the appendix.

[12] Telephone conversation between W. Tao, CPSC and D. Petty, Quaker Fabrics, April 6, 2005.

has shown[13] that other types of cover fabrics that do not ignite when exposed to the small open flame for 20 seconds are treated with flame-retardant chemicals, (either topically or back coated). Class A fabrics limit the assembly mass loss to less than or equal to 10 percent at 45 minutes when tested over untreated foam. Because the protection provided by Class A fabrics is considerable, Class A fabrics are highly resistant to small open flame ignition in combination with any underlying materials (Figure 8).

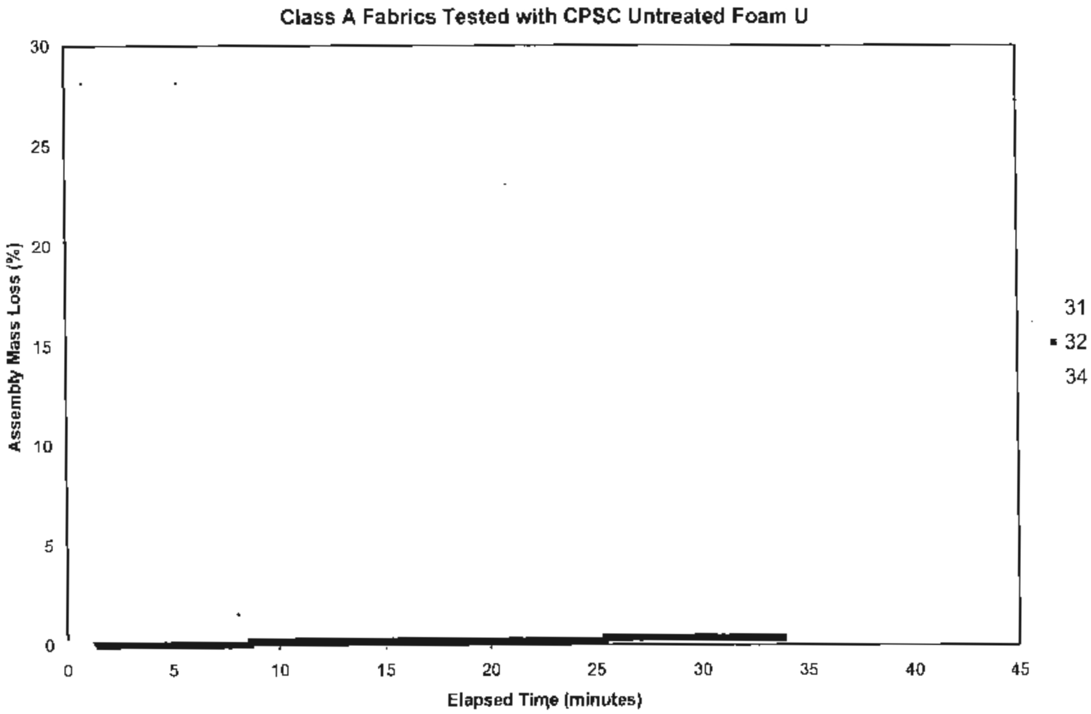

Figure 8. Assembly mass loss versus elapsed time for Class A fabrics on CPSC Standard Untreated Foam. Fabric 31 is 100% wool, Fabric 32 is 100% leather and Fabric No. 34 is 100% vinyl.

Data suggests a second group of cover fabrics that ignite when exposed to the small open flame for 20 seconds but burn slowly over a period of time. Although the foam may become involved in the ignition process, the progression of the fire is slow. In this study, fabrics that behaved in this manner were typically medium weight cotton fabrics (9.0 to 11.5 oz/yd^2 range). LS staff categorized this group of slow burning fabrics as Class B fabrics.

Figures 9a and 9b are examples of Class B fabrics combined with barriers or treated foam and interliners. LS staff identified barriers that when combined with Class B fabrics offer resistance to ignition, as Class B barriers. LS staff also identified treated foam and interliner materials resisting ignition from the small open flame source as complying layers. These combinations resist ignition from the small open flame ignition source. Figure 9a shows Fabric 6, a Class B fabric without a barrier, igniting and reaching 20 percent assembly mass loss before the termination of the test. However, when Fabric 6 is combined with Class B barriers, (Barrier D and Barrier T) the fire performance is enhanced, (the progression of the fire is slowed).

[13]Regulatory Options Briefing Package on Upholstered Furniture Flammability, October 1997, CPSC.

Figure 9b shows Fabric 24, a Class B fabric with and without complying layers. Fabric 24 on untreated foam ignites and reaches an assembly mass loss greater than 20 percent in approximately 10 minutes. However, the assembly mass loss is limited to less than 20 percent in 45 minutes when complying materials are used.

The flammability performance of those fabrics that ignite and burn slowly (Class B fabrics) is enhanced when they are combined with other components that also offer resistance to the small open flame ignition source. The performance of Class B fabrics is improved when treated foam/filling materials and/or fire-blocking barriers are introduced. Class B fabrics can limit the assembly mass loss to less than or equal to 20 percent at 45 minutes when tested over a treated foam and/or combined with a fire-blocking barrier.

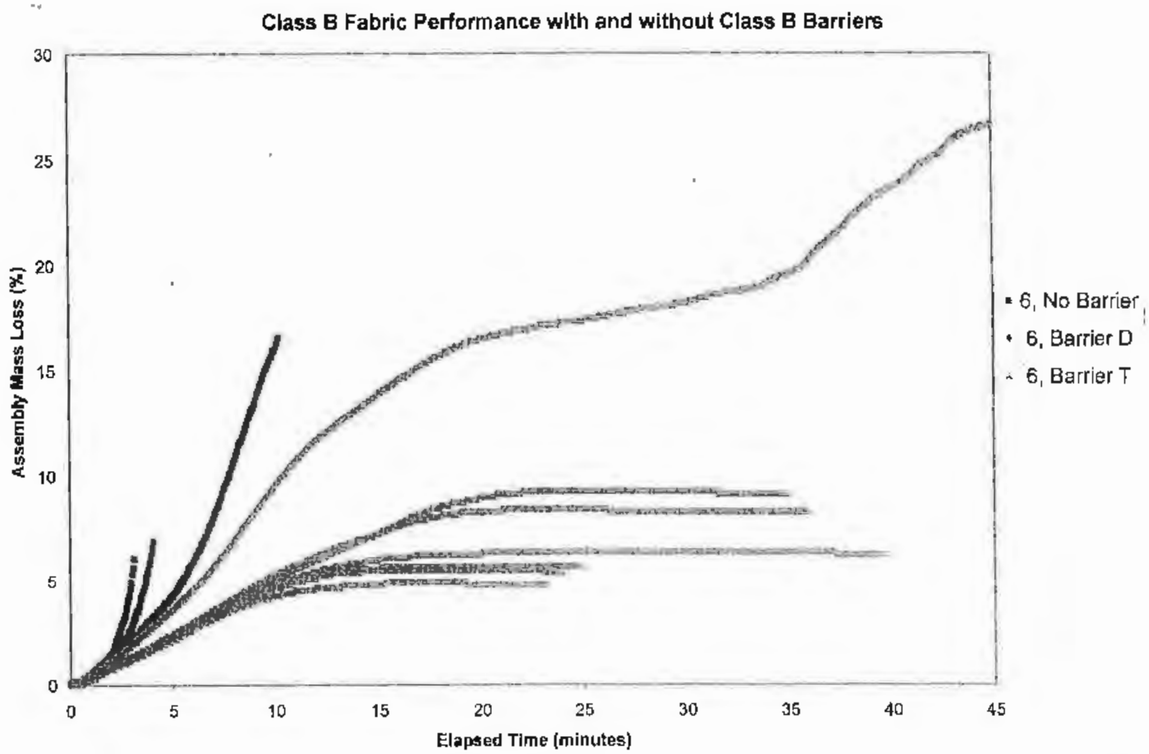

Figure 9a. Assembly mass loss versus elapsed time for Fabric 6, (cotton twill) with and without Class B barriers.

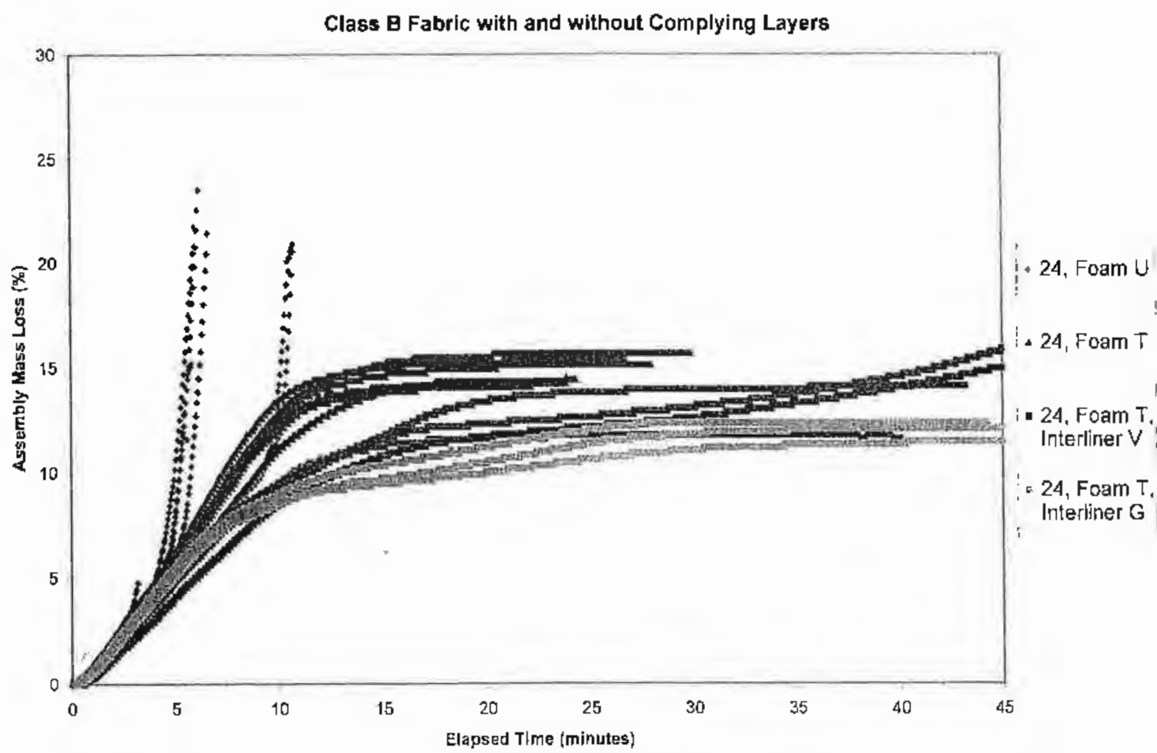

Figure 9b. Assembly mass loss versus elapsed time for Fabric 24 (cotton velvet) with and without complying layers.

LS staff identified those fabrics that ignite and burn aggressively causing rapid ignition of the treated foam as Class C fabrics. The Class C fabrics in this study tended to shrink, melt and split open. The rate of flame spread is very rapid and the assembly mass loss typically reaches 20 percent in 5 minutes or less even with flame exposures as low as 5 to 10 seconds.[3]

Figure 10a shows the rapid ignition of two rapidly igniting fabrics. Both fabrics, Fabric 5 and Fabric 26 when tested over untreated foam ignited and burned aggressively reaching an assembly mass loss greater than 20 percent in less than 5 minutes. Figure 10a also shows an example where a high performance fire-blocking barrier could permit the use of a Class C fabric over untreated upholstery components. This was demonstrated by insertion of a commercially available, inherently flame resistant fabric between various Class C fabrics and untreated components. The use of the flame resistant fabric as a barrier resulted in assembly mass losses typical of non-igniting, Class A fabrics.

Figure 10b is an example of a highly treated foam being overpowered by the aggressive nature of Fabric 5, a Class C fabric. Although Foam P was able to slow the rapid ignition, an assembly mass loss greater than 20 percent was reached in 10 minutes vs. less than 5 minutes with untreated foam.

Class C fabrics in some cases can even overwhelm the ignition resistance of highly treated foam. Class C fabrics offer little or no resistance to ignition and do not provide any protection to the filing materials below. If an open flame fabric classification were to be included in the draft standard, Class C fabrics would need to be combined with complying Class C barriers as defined below or qualified in combination with specific materials and components that will be used in the furniture assembly.

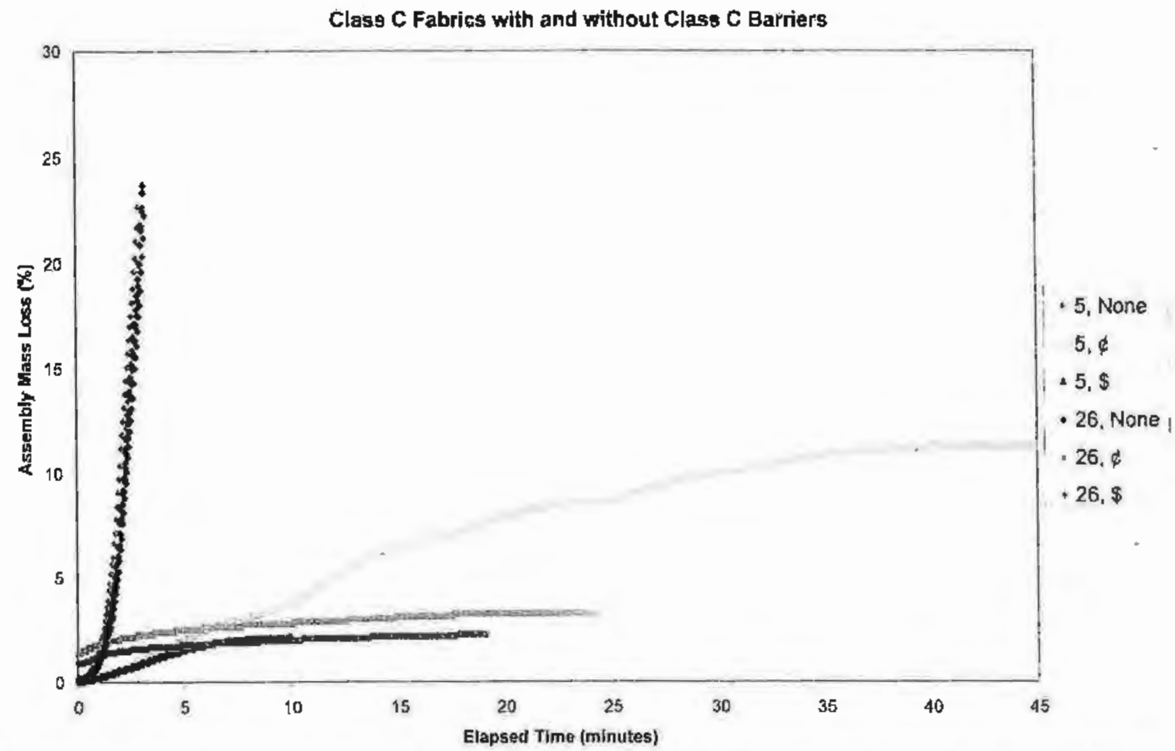

Figure 10a. Assembly mass loss versus elapsed time for Class C fabrics, Fabric 5 (cellulosic/thermoplastic blend) and Fabric 26 (rayon plain weave) with and without Class C barriers.

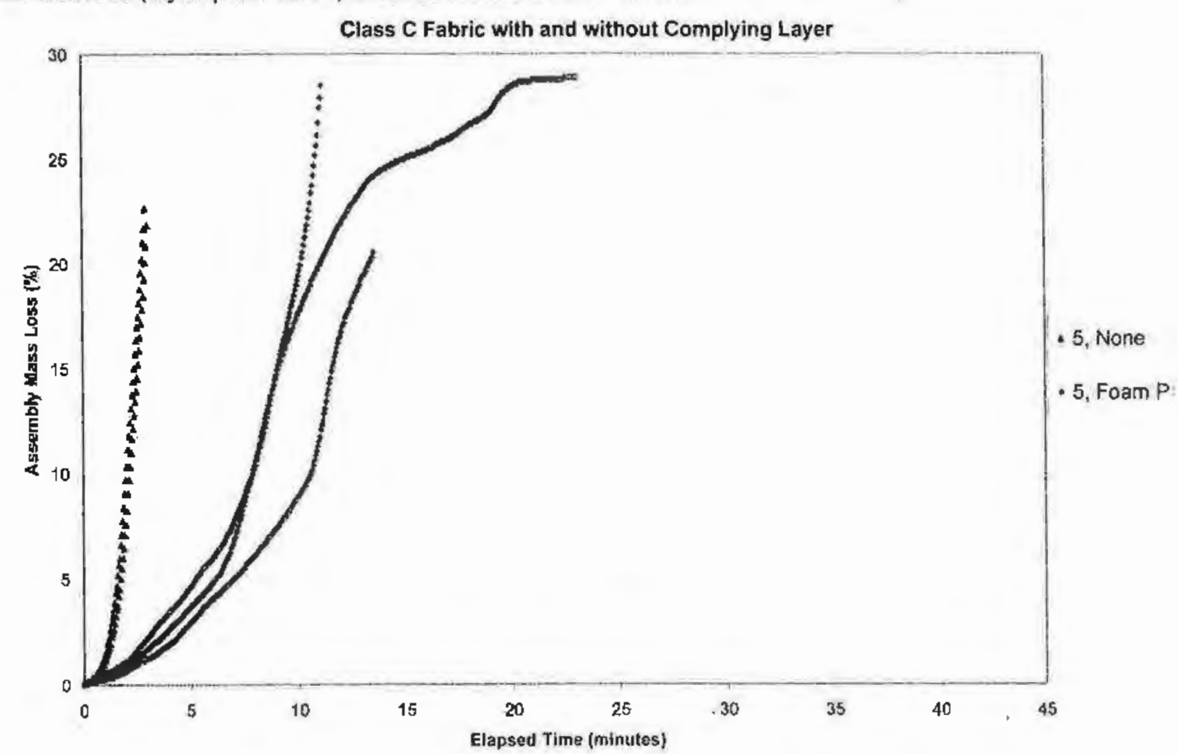

Figure 10b. Assembly mass loss versus elapsed time for Class C fabric, Fabric 5 (cellulosic/thermoplastic blend) with a complying layer.

Figure 11 is a plot of the fabrics tested under the open flame test program using untreated foam and modestly flame resistant foam. Figure 11 shows how they fit into the fabric classification scheme.

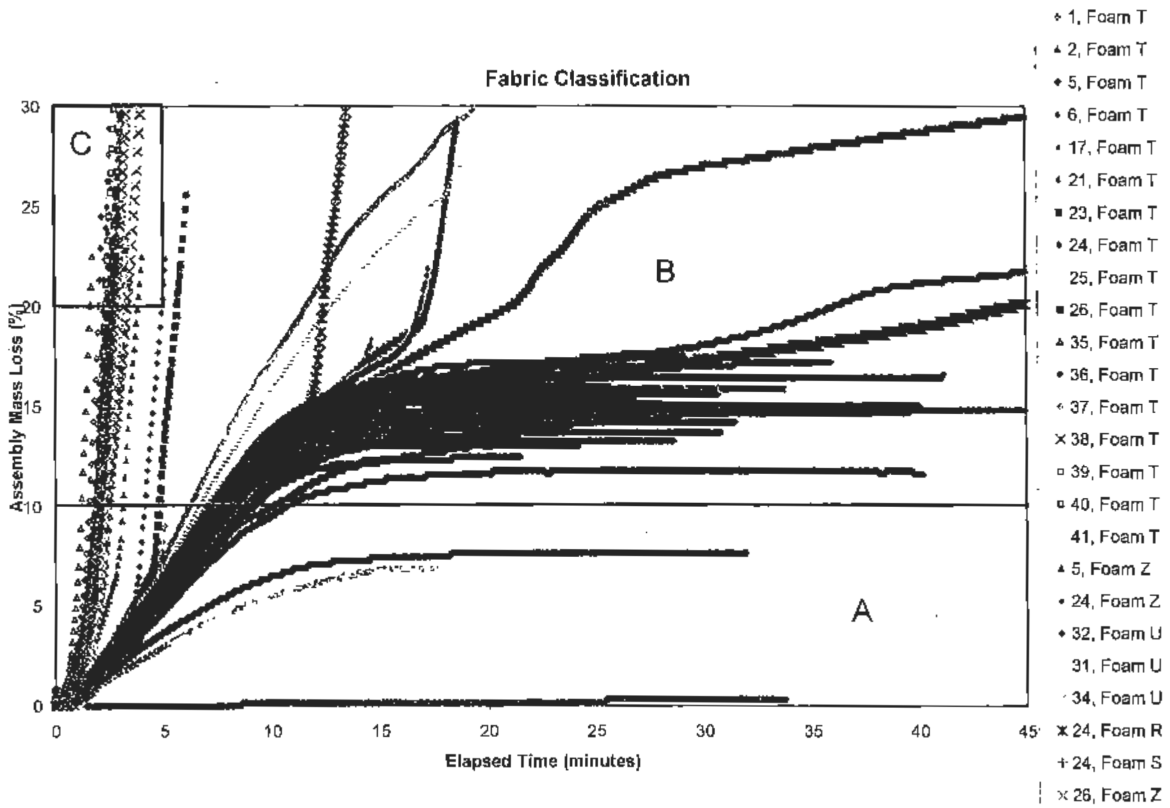

Figure 11. Assembly mass loss versus elapsed time for all cover fabrics evaluated with various foams.

Performance Criteria for Fire-Blocking Barriers

Because other components may also contribute to reducing the likelihood of ignition and/or limit fire growth, the necessary level of fire performance for a barrier is dependent on the other materials. For example, an upholstery fabric that is slow to ignite may not need a fire barrier with the same performance level as an upholstery fabric that ignites readily and burns rapidly. LS staff also identified two possible performance levels for fire-blocking barrier materials if additional flexibility is desirable and if an upholstery fabric flammability test were to be considered. The size and duration of the ignition source was used to discriminate between two levels of barrier fire performance using a single standard cover fabric.

Barriers intended for use with Class C upholstery fabrics would need to sustain a greater heat and energy impact than that generated from burning Class B fabrics and therefore a higher performance level would be considered. Barriers intended for use with Class C cover fabrics were evaluated with an equally aggressively burning standard cover fabric and ignition source. Fabric 24 (a cotton velvet, 10 oz/yd^2, Class B fabric) when combined with a 240 mm ignition flame applied for 70 seconds mimics the fire performance of aggressively burning Class C cover fabrics included in this study. Barriers intended for use with Class C cover fabrics (identified as Class C barriers) were evaluated with Fabric 24 over untreated foam, using the 70-second flame source. Under these conditions, Class C barriers limited the assembly mass loss to less than or equal to 20 percent in less than or equal to 45 minutes. Barriers meeting this criterion provided adequate protection to untreated filling materials below Class C fabrics (Figure 10a).

Barriers intended for use with less aggressively burning upholstery fabrics, i.e., Class B fabrics, do not have to provide the same degree of fire-blocking performance as required of Class C barriers. Class B barriers were evaluated with Fabric 24 over untreated foam using the 20-second, 35 mm flame source. Class B barriers evaluated with these standard materials that limit the assembly mass loss to less than or equal to 20 percent in less than or equal to 45 minutes provided adequate protection to the filling materials below Class B cover fabrics (Figure 9a).

Component Performance Requirements

Results of the tests of various component materials (interliners, fibrous fillings, etc.) were reviewed and LS staff determined that when combined with Class B cover fabrics, an improved fire performance was observed.[1,3] If a barrier was not used with Class B fabrics, to achieve an improvement in fire performance the other component materials must comply with the criteria outlined below.

- Fibrous Fill materials tested with Fabric 24 and treated foam must limit the assembly mass loss to 20 percent or less during a 45-minute maximum test duration (Figure 9b).

- Loose Fill materials tested with Fabric 24 must limit the assembly mass loss to 20 percent or less during a 45-minute test duration (Figure 12).

- Loose fill containment fabrics and other interior materials need to provide protection to the filling materials beneath containment fabrics and when tested with Fabric 24 and a standard loose fill material must limit the mass loss to 20 percent or less during a 45-minute test duration (Figure 12).

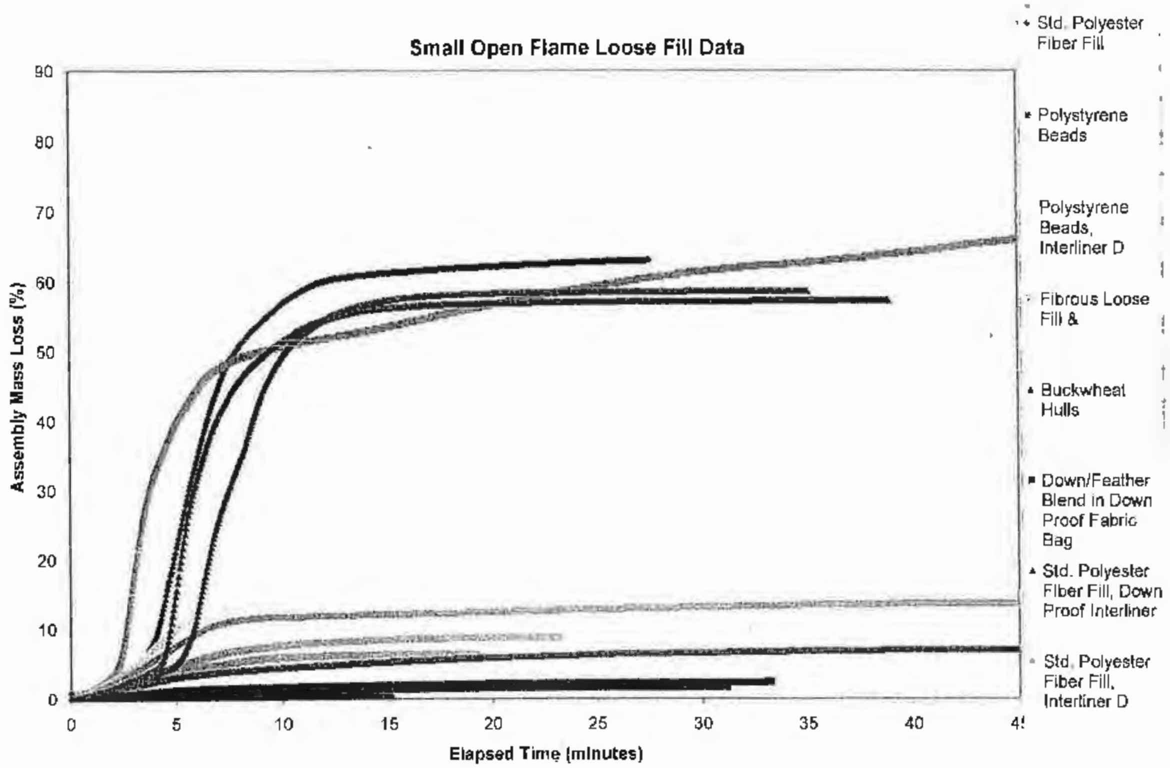

Figure 12. Assembly mass loss versus elapsed time for loose fill and loose fill containment materials.

SMOLDERING (CIGARETTE) IGNITION

The staff's May 2005 draft proposed standard attempts to reduce the risks associated with exposure to a smoldering cigarette by preventing or limiting the propagation of the smoldering combustion to the furniture upholstery system. The smoldering combustion performances of several combinations of fabric, foam, barrier, batting and loose fill layers were evaluated as part of the test program. The data suggests that foam treated with a relatively low concentration of flame retardant chemicals actually increases the damage to cover fabrics from a smoldering cigarette relative to untreated foam. The data suggests that acceptable performance can be defined as limiting the mass loss of the foam to 10 percent or less when tested in a 3-inch thick mockup configuration using a low concentration flame retardant chemically treated foam during a 30-minute test duration.[2]

APPENDIX – Materials Used in this Test Program

Table 1. Fabrics

CPSC Fabric No.	Fiber Content	Weight oz/yd^2
1	60% acetate/40% cotton	3.5
2	100% cotton, print	6.0
3	57% acrylic/31% polyester/12% olefin	8.0
4	100% cotton, corduroy	9.0
5	56% rayon/34% polyester/10% cotton	10.0
6	100% cotton, twill	11.5
7	92% cotton/8% rayon, chenille	20.0
8	90% cotton/10% rayon chenille, FR* backcoated	24.0
9	100% cotton twill, FR backcoated	14.0
10	50% cotton/50% polyester, ½** FR backcoated	9.0
11	100% cotton, FR treated	7.5
12	57% cotton/36% polyester/7% rayon, FR backcoated	12.0
13	88% cotton/12% nylon, sateen, FR treated	10.0
14	100% wool	11.0
15	100% silk	3.7
16	100% polyester, BS 5852 test fabric***	6.5
17	100% nylon, FR backcoated	12.3
18	50% rayon/50% nylon, FR backcoated	14.5
19	100% cotton	10.0
20	54% acrylic/24% polyester/22% olefin	8.2
21	100% olefin	18.7
22	100% olefin	5.7
23	100% cotton, twill	9.5
24	100% cotton, velvet, TB117 (draft 2002) test fabric+	10.0
25	100% cotton, UFAC test fabric++	9.0
26	100% rayon, UFAC test fabric++	8.0
27	100% cotton	7.5
28	56% rayon/34% polyester/10% cotton	9.7
29	41% olefin/33% acrylic/26% polyester	7.9
30	52% rayon/48% polyester	9.4
31	100% wool	12.5
32	Leather 1	7.3
33	Leather 2	12.0
34	Vinyl	21.5
35	100% olefin	10.0
36	100% olefin	10.0
37	100% polypropylene	11.5
38	56% cotton/44% polyester	10.0
39	58% polyester/42% cotton	8.3
40	67% cotton/33% polyester	11.0
41	60% rayon/40% polyester	13.8

*FR = flame resistant backcoating applied

**1/2 FR = reduced amount of flame resistant backcoating applied, approximately half of what is commonly applied to meet BS5852 requirements, as reported by the manufacturer.

***BS5852 test fabric = BS5852:1990, Methods of Test for Assessment of the Ignitability of Upholstered Seating by Smouldering and Flaming Ignition Sources, British Standards Institution, London.

+TB117 (draft 2002) test fabric = Technical Bulletin 117, Requirements, Test Procedure and Apparatus for testing the Flame and Smolder Resistance of Upholstered Furniture, State of California, Department of Consumer Affairs, Bureau of Home Furnishings and Thermal Insulation, February 2002, DRAFT.

++ UFAC test fabric = Upholstered Furniture Action Council (UFAC), Filling/Padding Component Test Method – 1990 and Barrier Test Method – 1990.

Table 2. Foams

CPSC Foam ID	Type	Melamine %		TDCP*%	
		Manufacturer Claim	CPSC Staff Analysis	Manufacturer Claim	CPSC Staff Analysis
U	polyurethane untreated	0	Avg. = 1.2 Range = 1.1-1.5	0	0
T	polyurethane treated	2	Avg.= 2.2 Range = 1.2-4.2	6	Avg.= 8.2 Range = 6.6-9.2
Y	polyurethane treated	12	Avg. = 11.1 Range =10.3-12.4	3	Avg. = 3.5 Range = 3.1-4.6
P	polyurethane treated	30	Avg. = 28.4 Range = 23.2-34.1	3	Avg. = 2.9 Range = 2.6-3.4
S	polyurethane treated	0	0	7.8	Avg. = 6.6 Range = 6.3-6.9
		Melamine %		**FM-550**%**	
Z	polyurethane treated	3.63	Avg. = 2.8 Range = 2.2-3.3	6.96	Avg. = 6.0 Range = 5.5-6.2
		PBDE* %**		**FM-550%**	
R	polyurethane treated	N/A	Avg. = 3.0 Range = 2.9 -3.2	4.1	Avg. = 3.3 Range = 3.1- .5
		Chemical Content			
J	visco-elastic	no chemical treatment claimed or detected			
K	visco-elastic	no chemical treatment claimed or detected			
L	visco-elastic	no chemical treatment claimed or detected			
N	polyester	no chemical treatment claimed or detected			

*TDCP = tris (1,3-dichloro-2-propyl) phosphate.

**FM-550 is a flame retardant chemical containing a mixture of halogenated aryl esters and aromatic phosphates.

*** PBDE = polybrominated diphenyl ethers.

Table 3. Interliners (Includes Fibrous Filling Materials and Fire-Blocking Barriers)

CPSC Interliner ID	Description	Density oz/yd^2
P	UFAC std garneted polyester batting	18.0
S	nonwoven, loft barrier	4.3
M	nonwoven, loft barrier	7.8
V	nonwoven, loft barrier	5.3
L	nonwoven, loft barrier	6.6
O	nonwoven, sheet barrier	4.2
D	nonwoven, sheet barrier	3.0
T	nonwoven, sheet barrier	3.5
C	organic cotton batting	3.2
G	nonwoven, loft barrier	5.5
W	nonwoven, loft barrier	4.3
K	nonwoven, barrier	N/A*
$	woven, ceramic barrier	18.3
¢	woven, ceramic barrier	10.0

* N/A = not available.

Table 4. Loose Fill and Loose Fill Containment Fabrics

CPSC Loose Fill ID	Description
A	100% polyester fibers
B	100% polyester fibers
C	100% polyester fibers, slickened
D	down/feather blend
E	polystyrene crumbled
F	shredded foam
H	polystyrene beads
V	100% polyester fibers, slickened
W	buckwheat hulls
&	FR* rayon/modacrylic blend
CPSC Containment Fabric ID	**Description**
R	100% cotton, down proof ticking fabric
Interliner D	nonwoven, sheet barrier

*FR = flame resistant.