UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
4330 EAST WEST HIGHWAY
BETHESDA, MD 20814

VOTE SHEET

Date: NOV 20 2007

TO : The Commission
Todd Stevenson, Secretary

THROUGH: Patricia Semple, Executive Director
Lowell F. Martin, Acting General Counsel
Jeffrey R. Williams, Assistant General Counsel

FROM : Patricia M. Pollitzer, Attorney

SUBJECT : Regulatory Alternatives to Address the Flammability of Upholstered Furniture

Attached is a briefing package from the staff discussing options to address the flammability of upholstered furniture. The Commission could direct the Office of General Counsel ("OGC") to prepare a notice of proposed rulemaking ("NPR") under the Flammable Fabrics Act ("FFA") based on one of the alternatives presented by the staff.

Please indicate your vote on the following options.

I. Direct OGC to prepare a draft NPR for the Commission's consideration based on the staff's 2007 draft flammability standard for upholstered furniture:

_____ _____
Signature Date

II. Direct OGC to prepare a draft NPR for the Commission's consideration based on an alternative other than the staff's 2007 draft flammability standard (please specify which alternative):

_____

_____

NOTE: This document has not been reviewed or accepted by the Commission.
Initial DK Date 11/20/07

11/29/07

_____

_____ _____
Signature Date

III. Direct OGC to prepare a draft Federal Register notice terminating the upholstered furniture rulemaking.

_____ _____
Signature Date

III. Take other action (please specify):

_____

_____

_____

_____ _____
Signature Date

U.S. CONSUMER PRODUCT SAFETY COMMISSION
STAFF BRIEFING PACKAGE ON REGULATORY ALTERNATIVES FOR UPHOLSTERED FURNITURE FLAMMABILITY*

November 2007

The U.S. Consumer Product Safety Commission (CPSC) has released a November 2007 staff briefing package, "Regulatory Alternatives for Upholstered Furniture Flammability." This package discusses options to address the risk of fire from ignitions of residential upholstered furniture. CPSC published an advance notice of proposed rulemaking (ANPR) on this matter in October 2003.

The briefing package presents a new option, developed by the staff, that focuses on smoldering ignition ("the CPSC staff's 2007 alternative draft standard") and another option, recommended by some industry groups at a July 2007 stakeholder meeting, based on existing voluntary guidelines. The package also updates the staff's analysis of prior options, including:

- a 2005 CPSC draft standard containing smoldering and open flame ignition performance requirements;
- a 2001 CPSC staff draft standard containing only open flame ignition performance requirements; and
- a 2002 draft revision of an existing California standard.

The briefing package discusses stakeholder comments and recommendations. The package also presents the latest available data on upholstered furniture-related fire losses that could be addressed by a standard, CPSC Laboratory testing and analysis, the technical rationale for the staff's 2007 alternative draft standard, and environmental and economic analyses. The Commission will consider this and other information in assessing whether to propose a rule on upholstered furniture flammability.

This briefing package is posted for public review on the Commission's web site at http://www.cpsc.gov/library/foia/foia08/brief/briefing.html. Hard copies are available from CPSC's Office of the Secretary, 4330 East-West Highway, Bethesda, MD 20814-4408, e-mail info@cpsc.gov. Inquiries about the briefing package may be directed to Mr. Dale R. Ray, Project Manager, tel. 301-504-7704 or e-mail dray@cpsc.gov. This document is in the public domain, and may be freely copied or reprinted.

*The information presented in this document was prepared by the CPSC staff; it has not been reviewed or approved by, and does not necessarily represent the views of, the Commission.

BRIEFING PACKAGE

Regulatory Alternatives for

Upholstered Furniture Flammability

For Further Information Contact:
Dale R. Ray, Project Manager
Directorate for Economic Analysis
U.S. Consumer Product Safety Commission
(301) 504-7704

November 2007

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Executive Summary

In October 2003, the U.S. Consumer Product Safety Commission (CPSC) published an advance notice of proposed rulemaking (ANPR) in the *Federal Register*, announcing the agency's intent to consider action under the Flammable Fabrics Act to address the risk of residential fires associated with ignitions of upholstered furniture. In 2006, the CPSC staff presented a draft flammability performance standard and several regulatory options, and provided supporting research updates.

Since that time, the staff has continued to conduct research and evaluate public comments and recommendations on: a) the scope and performance provisions of a possible proposed rule; and b) the use of flame retardant (FR) chemical technologies to achieve fire safety improvements. The staff met with stakeholders in July 2007 to discuss these comments and recommendations. The staff has developed an alternative draft standard option that addresses most of the stakeholder concerns while providing a significant increase in the level of fire safety to consumers.

According to the latest national fire loss data, 90% of estimated residential furniture fire deaths in 2002-2004 were caused by smoking material ignitions (mainly cigarettes). While over 85% of currently-produced upholstery coverings are considered smolder resistant, recent testing by the CPSC Laboratory confirms that furniture mockup assemblies with smolder-prone fabrics can ignite from a cigarette and sustain combustion, including transition from smoldering to flaming within about one hour. Either smoldering or flaming combustion can progress to potentially life-threatening fire conditions. Thus, the staff's 2007 alternative draft standard option contains strong smoldering ignition performance requirements for fabrics and other upholstery cover materials; complying materials would generally not progress to hazardous fire conditions from ignitions by smoldering cigarettes. These performance requirements are significantly more stringent than those of the existing voluntary guidelines. Most smolder-prone fabrics could be modified to incorporate more smolder-resistant fibers, without the use of FR treatments.

A small proportion of upholstered furniture (under 5%) is covered with fabrics that cannot be readily modified for improved smolder resistance. CPSC Laboratory testing identified fire-blocking barriers that prevent fire growth by protecting interior upholstery filling materials from cigarette-induced combustion of cover fabrics. Thus, the 2007 alternative draft also contains flammability performance requirements for barriers that manufacturers and importers may choose to use in combination with non-complying fabrics. The recent introduction of "inherently-FR fiber" barriers into the market, to meet CPSC's 2006 flammability rule for the open flame ignition of mattresses (16 C.F.R. Part 1633) provides proven technologies that can be applied without FR chemical additives. The staff's chemical risk assessment for selected FR barrier materials,

prepared for the open flame mattress rule, indicates no appreciable health risk associated with the use of those FR barriers.

Currently-produced upholstery filling materials such as polyurethane foam or polyester fiber fillings are generally resistant to smoldering ignition, unless they are covered with smolder-prone fabrics (that would largely be eliminated under the 2007 alternative draft). These interior filling materials would not be subject to any performance requirements under the alternative draft standard, and would therefore not be modified with FR additives.

Using the latest available fire loss estimates as a baseline, the CPSC staff revised its preliminary regulatory analysis to include the staff's 2007 alternative draft standard and four significant regulatory alternatives, including the staff's 2005 draft standard, the staff's 2001 draft (open flame) standard, the 2002 draft revision of the California standard (Technical Bulletin 117) and mandating the voluntary provisions of the Upholstered Furniture Action Council (UFAC) guidelines. The CPSC staff's 2007 alternative draft standard is estimated to have discounted benefits of about $419-424 million for a year's production of complying upholstered furniture, and estimated economic costs of about $32-57 million, for projected net benefits of about $367-387 million. This alternative achieves almost the same level of net benefits as previous CPSC staff draft standards, but at much lower cost. Mandating the ASTM / UFAC voluntary guidelines would have even lower costs but would likely have negligible benefits to consumers.

In another ongoing fire safety effort that may affect furniture fire losses, 22 states have enacted legislation requiring reduced ignition propensity (IP) cigarettes; five of these laws have already gone into effect. The extent of the potential risk reduction associated with reduced-IP cigarettes is not yet known. The CPSC staff has undertaken a project to evaluate the potential reduction in smoldering ignition propensity associated with reduced-IP vs. conventional cigarettes. A proposed upholstered furniture rule would likely have substantial net benefits even if reduced-IP cigarettes were effective at reducing the risk.

The CPSC staff's 2007 alternative draft standard:

- focuses on the addressable risk with simple and inexpensive smoldering performance tests for cover fabrics, the key element in determining upholstery material ignition behavior; and
- does not rely on FR chemical filling material additives or fabric treatments, and allows the use of fire-blocking barriers, like those used in mattresses, to protect interior fillings from fire growth.

If the Commission decides to propose a rule, the staff will forward a draft *Federal Register* notice containing the draft proposal and preliminary regulatory analyses for Commission consideration.

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

Date: NOV 20 2007

TO : The Commission
Todd Stevenson, Secretary

THROUGH: Lowell F. Martin, Acting General Counsel
Patricia M. Semple, Executive Director

FROM : Robert J. Howell, Acting Assistant Executive Director for
Hazard Identification & Reduction
Dale R. Ray, Project Manager,
Directorate for Economic Analysis
301-504-7704

SUBJECT : Regulatory Alternatives for Upholstered Furniture Flammability

The U.S. Consumer Product Safety Commission (CPSC) is considering regulatory options to address the risk of residential fire associated with smoldering and small open flame ignitions of residential upholstered furniture. The Commission published an advance notice of proposed rulemaking (ANPR) in the October 23, 2003 *Federal Register*. This ANPR expanded an ongoing proceeding to develop a possible flammability standard under the Flammable Fabrics Act (FFA). Pursuant to the 2003 ANPR, the CPSC staff conducted research and evaluated public comments in support of a possible proposed rule. The staff presented information to the Commission in a 2006 status update package[1] and in two supplemental technical research updates.[2,3]

The staff has continued its research and evaluation of technical issues, including those raised by stakeholders. This briefing package presents information developed by the staff on an option that addresses most stakeholder concerns and that would provide substantial fire safety benefits to consumers.

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[1]U.S. Consumer Product Safety Commission, "Status Update on Regulatory Options for Upholstered Furniture Flammability," January 2006.
[2]U.S. Consumer Product Safety Commission, "CPSC Staff Research Update on Upholstered Furniture Flammability," November 2006.
[3]U.S. Consumer Product Safety Commission, "Peer Reviewed CPSC Staff Research Reports on Upholstered Furniture Flammability," December 2006.

NOTE: This document has not been reviewed or accepted by the Commission.
Initial nh Date 11/20/07

I. Background

The CPSC staff's January 2006 briefing package presented a draft standard developed by the staff ("the 2005 CPSC staff's draft standard") and several options for Commission consideration. The 2005 staff draft contained performance requirements for upholstery materials, based on flammability tests of bench-scale furniture mockups. These tests measured mass loss over time when the mockups were exposed to smoldering cigarette and small open flame ignition sources. Since the 2006 briefing package was published, CPSC has continued to receive stakeholder comments and recommendations, chiefly regarding:

- the scope and performance provisions of a possible proposed rule (e.g., with regard to smoldering vs. open flame ignition, test methods and specifications, technical and economic feasibility, etc.); and

- the use of flame retardant (FR) chemical technologies to achieve fire safety improvements.

The staff took these stakeholder comments and recommendations into account in its most recent evaluation of possible modifications to the draft standard.

The staff's chief guiding principle has been to seek effective flammability performance requirements for upholstered furniture, taking into account the hazards associated with both smoldering and open flame ignition mechanisms, without imposing chemical-related health or environmental risks. While the staff's 2005 draft standard recognized the primary contribution of smoldering ignition to the overall risk of death and injury, and represented an effort to reduce potential exposure to FR chemicals, the staff's most recent (2006-2007) research identified another alternative more specifically focused on smoldering ignition and much less reliant on FR additives in upholstery materials.

The staff's 2007 alternative draft standard is discussed in this memorandum. Section II discusses the latest fire loss statistics. Section III discusses the principal stakeholder comments and recommendations. Section IV relates these technical issues to the staff's most recent laboratory testing. Section V presents an outline of the 2007 alternative draft standard. Section VI discusses FR chemical issues, including the staff's latest environmental review. Section VII describes the staff's most recent revised preliminary regulatory impact analysis of benefits and costs of the draft standard and significant alternatives (including the 2007 alternative draft and an industry-recommended alternative based on the voluntary Upholstered Furniture Action Council (UFAC) / ASTM International, Inc. (ASTM) smoldering ignition provisions), and the staff's initial regulatory flexibility analysis of possible impacts on small entities. Section VIII presents the staff's conclusions.

II. Fire Hazard Data Update

Ignitions of upholstered furniture continue to be a leading cause of residential fire-related deaths, injuries and property damage. The Directorate for Epidemiology's recent report of U.S. residential fire losses estimated an annual average of 7,800 non-intentional furniture fires, resulting in an estimated 540 civilian deaths, 870 injuries and about $250 million in property damage annually.[4]

The staff's fire loss estimating methodology also identifies "addressable" fire losses associated with specific consumer product categories. Addressable losses are those which could be demonstrably and directly affected by a product performance standard. The Directorate for Epidemiology's memorandum discussing the fire loss estimates and addressability appears at **Tab A**. Of the upholstered furniture fires that occurred during the 2002-2004 period, an estimated 3,500 would be addressable by a flammability standard. Estimated addressable fire losses are shown in Table 1.

Table 1
Residential Upholstered Furniture:
Estimated Average Annual Addressable Fire Losses 2002-2004*

	Smoking Materials	Small Open Flame	Total
Fires	2,500	1,100	3,500
Deaths	260	30	280
Injuries	320	170	500
Property Damage	$65 mil.	$46 mil.	$112 mil.

*All estimates within categories are rounded; thus, rows may not add to totals. Totals are based on unrounded estimates. Property loss estimates are unadjusted for inflation over time. Source: CPSC Directorate for Epidemiology, 2007.

Total annual societal costs associated with these fire losses (in 2005 dollars) are estimated at about $1.6 billion. The table shows that ignitions from smoking materials (almost always cigarettes) account for 90% of estimated deaths, 65% of estimated injuries and 59% of estimated property damage.

Reductions in the addressable fire losses represent the potential benefits to society of a furniture flammability standard or other action. The figures in the table reflect a continuing decline in upholstered furniture fire losses. The staff considered these latest estimates in developing the 2007 alternative draft standard, and in revising the preliminary regulatory analysis, as discussed in Sections V and VII.

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[4]U.S. Consumer Product Safety Commission, Directorate for Epidemiology, "2002-2004 Residential Fire Loss Estimates," July 2007. See http://www.cpsc.gov/library/foia/foia07/os/os.html.

III. Stakeholder Comments and Recommendations

The Commission received a variety of stakeholder comments and recommendations following the release of the staff's January 2006 briefing package. The staff responded to a number of these comments, regarding testing, economic and FR chemical issues in the November and December 2006 status reports. In 2007, CPSC continued to receive comments and recommendations on some of these same issues, and the staff continued to perform flammability testing and other research to update the available data and to evaluate the public comments. The staff attended a July 2007 stakeholder meeting, organized by the American Home Furnishings Alliance (AHFA), at which many stakeholder groups discussed their positions on the above issues. AHFA provided a report on this meeting to members of the Senate subcommittee on Commerce, Science and Transportation staff. A staff log of the July 2007 meeting appears at **Tab B**.

The latest round of stakeholder comments and recommendations involved two general areas: the scope and nature of a possible federal standard, including several aspects of the test methods and performance criteria of a potential standard; and concerns about the potential use of FR materials, particularly FR additives in resilient foam and other fillings.

A. Scope and Performance Test Issues

Smoldering vs. Open Flame Ignition

Several industry groups, including AHFA, the Upholstered Furniture Action Council (UFAC), the Polyurethane Foam Association (PFA), the American Fiber Manufacturers Association (AFMA), the National Cotton Council (NCC) and the National Textile Association (NTA), commented that the fire risk to the public associated with open flame ignition of upholstered furniture has become so small that regulation in that area is unnecessary. They also commented that the science of open flame ignition behavior is so complex that substantial further research would be needed to support any reasonable conclusions about the effectiveness and technical adequacy of any performance requirements. In addition, they opposed open flame requirements on the basis that compliance costs would be unreasonably high. These groups recommended that the Commission proceed with rulemaking on smoldering ignition only, and that CPSC adopt the performance tests in the ASTM / UFAC voluntary guidelines as a proposed federal rule.

Other stakeholders, including the National Association of State Fire Marshals (NASFM), the California Bureau of Home Furnishings and Thermal Insulation (BHFTI) and the American Fire Safety Council (AFSC, representing FR chemical producers), have commented that a federal rule should cover both smoldering and open flame ignition mechanisms, and that solutions are technically and economically feasible. AFSC stated its opposition to any course that would reduce the current level of safety provided by California's existing furniture regulation, Technical Bulletin (TB) 117. The

Center for the Polyurethanes Industry (CPI) of the American Chemistry Council (ACC) supported the adoption of smolder resistance requirements but favored the eventual adoption of open flame requirements as well.

Although fire losses from cigarette-ignited upholstered furniture fires have declined, large numbers of deaths and injuries remain. As noted in Section II, a substantial majority of fire losses are from cigarette-ignited fires. The staff agrees that a smoldering standard can have substantial safety benefits, but does not agree that the ASTM / UFAC performance tests as implemented in the UFAC program would adequately achieve those benefits. While UFAC has contributed to fire safety by encouraging the use of smolder resistant materials, the program allows the use of smolder-prone cover fabrics with polyurethane foam, and allows highly smolder-prone fabrics in combination with more smolder-resistant materials (e.g., polyester batting) underneath; these conforming combinations are not always adequate to prevent fire growth.

The CPSC Laboratory's recent testing confirms that smolder-prone fabrics can defeat the inherent smolder resistance of polyester batting. Further, some lower-priced furniture may use smolder-prone fabrics without smolder-resistant batting. In addition, the UFAC tests may not be adequate to characterize the smoldering behavior of all upholstery materials. For example, vertical surface char does not always reflect the extent of downward burning that typically occurs in polyurethane foam fillings. Additionally, the ASTM / UFAC draft-limiting enclosure used to hold test mockup assemblies improves repeatability but artificially restricts burning of the most smolder-prone fabrics. Overall, mandating the ASTM / UFAC tests without significant modification would have essentially no effect on currently-produced upholstered furniture, and would therefore probably have negligible safety benefits beyond those already achieved under the voluntary industry program.

Test Methods

AHFA and PFA commented on specific test method issues. They noted the variability observed by the CPSC staff in open flame test results using the standard cotton velvet cover fabric. They also questioned the need for the standard FR foam substrate, suggesting that FR foam would introduce undue variability into the smoldering tests. They opposed open flame filling material tests in the absence of an open flame fabric test, and contended that the open flame filling material requirements were too stringent for low-density foams to meet. They further commented on the need for an open flame barrier test in the CPSC staff's "smoldering only" alternative presented in the January 2006 briefing package.

The staff has identified many of these same issues in its research on furniture flammability. The staff's evaluation of these issues suggested changes to the test methods that are reflected in the staff's 2007 alternative draft standard.

The staff performed tests to ascertain the consistency of the performance of the standard cotton velvet cover fabric specified in the open flame provisions of the staff's 2005 revised draft standard. The staff concluded that the identified variability could adversely affect the repeatability and reproducibility of small open flame tests, and yield inconsistent results. To a lesser extent, inconsistencies also appeared in small open flame tests using the standard non-FR foam, and in smoldering tests using the standard FR foam. Therefore, the staff revised the qualification requirements for standard foams to ensure consistency in both open flame and smoldering tests of the 2005 draft standard.

In the 2007 alternative draft standard, the small open flame tests for filling materials are eliminated altogether, retaining standard fabrics for barrier tests only. Further, since FR foam would not be needed to comply, the staff has specified only standard non-FR foam in all tests.

In recent smoldering tests of cover fabrics, the staff evaluated several possible standard test fabric candidates for use with barriers. The staff identified the cotton velvet fabric as an appropriately challenging and consistently-performing standard fabric choice for the fire barrier smoldering test. The cotton velvet fabric does not, however, represent a "worst-case" challenge to resilient filling materials or to fire barriers. The alternative draft standard would allow the use of barriers with highly smolder-prone fabrics that could otherwise transition to flaming. Therefore, the staff concluded that barriers should be evaluated for both smoldering and open flame resistance to ensure that barriers provide adequate protection in the assembled article of furniture. Conventional polyester batting layers between highly smolder-prone fabrics and interior foam or other cushion core materials (as in UFAC-conforming furniture) would provide protection to cushion cores from smoldering but not from flaming combustion.

Several stakeholders recommended that CPSC establish a correlation between its bench scale tests and the performance of complying materials in larger or "full" scale tests that more reasonably represent the seating areas of finished articles of upholstered furniture. The staff agrees that full scale testing is a valuable source of information to help demonstrate the increased safety a standard would provide. To supplement the staff's bench scale testing and limited full scale testing performed by the California BHFTI, the staff established an Interagency Agreement (IAG) with the National Institute of Standards and Technology (NIST) to conduct larger scale mockup tests of upholstery materials. The staff plans to move forward on large scale testing programs in FY 2008.

Reduced Ignition Propensity Cigarettes

Several industry and consumer advocacy groups requested that CPSC consider the growing number of states considering or implementing legislation requiring the sale of reduced ignition propensity (reduced-IP, or "fire-safe") cigarettes. These groups noted that reduced-IP cigarettes could be the quickest, most efficient means of reducing fire risks associated with upholstered furniture and other consumer products.

State requirements for reduced-IP cigarettes may affect upholstered furniture fire losses irrespective of CPSC action. The Coalition for Fire Safe Cigarettes, an advocacy group working with state legislatures, reports that five states (plus Canada) have such requirements in effect, and that 17 more have passed legislation requiring reduced-IP cigarettes in the future. These regulations all use a test method developed by NIST and embodied in ASTM standard E 2187-02, "Standard Test Method for Measuring the Ignition Strength of Cigarettes." Complying cigarettes would likely reduce, but would not eliminate, the risk of smoldering ignition fires. The extent of the reduction is unknown.

The CPSC staff has initiated a project to review available state data and conduct laboratory tests to evaluate the reduction in smoldering ignition propensity associated with lower-IP cigarettes compared to conventional cigarettes. This project will help the staff evaluate the potential effect of reduced-IP cigarettes on furniture-related fire losses, with or without a furniture flammability standard. This issue is discussed further in Section VII.

B. FR Chemical Additive Issues

Some environmental groups have opposed any new regulations that may add to the environmental burden of FR chemicals, particularly halogenated FRs containing bromine or chlorine. Some of these groups supported the furniture industry position that CPSC should impose only smoldering ignition requirements, on the presumption that FRs would not be needed.

Furniture and filling material producers opposed significant increases in FR usage on the basis that their workers could be exposed to more FRs released from component materials. They were also concerned that state and local environmental regulations may curtail the availability of economically feasible FRs and may adversely impact the costs of recycling scrap materials. Furniture manufacturers also contended that, in view of recent adverse publicity, consumers do not want to risk exposure to potentially hazardous FRs.

Chemical producers stated that safe and effective FR solutions are available to address the furniture fire risk. They noted that non-halogenated alternatives for filling materials are currently being offered, as are "inherently FR" fiber barriers that do not present a significant likelihood of consumer exposure.

The CPSC staff notes that no standard under consideration by the agency has ever contained requirements for the use of any chemical treatments of upholstery materials. The staff's intent has always been to develop requirements that measure materials' flammability performance, rather than requirements specifying materials' physical characteristics. A benefit of this approach is that innovative technologies and consumer choices of upholstery materials are not unduly restricted. Alternatives to FR chemical additives have long been available in the form of "inherently FR" fibers and other materials.

Under the staff's 2001 draft open flame standard, most fabrics (especially synthetics) would likely be FR-treated to comply. Under the staff's 2005 revised draft, the emphasis on FR usage would be shifted to interior filling materials. While FR technologies are available for either approach to achieve fire safety without imposing significant chemical risks, the staff has sought to develop an alternative that would not rely on fabric or filling FRs to achieve compliance.

Under the 2007 alternative draft, neither fabrics nor filling materials would need to incorporate FR additives to achieve compliance. While FR-treated fabrics would remain an option, fabric suppliers would likely either: a) modify the fiber content or construction of their most smolder-prone fabrics; or b) continue to offer non-complying fabrics for use exclusively with complying barriers in the finished article of furniture. Barriers could incorporate FR treatments, but barrier producers have reported that they would likely offer inherently FR fiber materials for furniture applications, similar to those products designed to meet CPSC's open flame rule for mattresses (16 C.F.R. Part 1633).

IV. Recent CPSC Laboratory Testing

To support development of the staff's 2007 alternative draft standard and to address other technical issues raised by stakeholders, the CPSC Laboratory recently completed a test program on upholstery fabrics and fire barriers. Staff reports on this program appear at **Tab C**. The test program provided information on:

- differences in smoldering behavior among fabrics, including potential standard test fabric candidates, possessing a range of expected ignition performance characteristics; and
- the smoldering and open flame behavior of several recently-developed barriers designed to help comply with CPSC's 2006 flammability rule for open flame ignition of mattresses (16 C.F.R. Part 1633), including those constructed with "inherently FR" fibers, in which FR compounds are integral with the fiber rather than incorporated as a chemical additive.

The staff conducted tests in four phases. Phase 1 of the laboratory testing examined the smoldering behavior of five selected fabrics:

- a predominantly synthetic blend fabric with very low smoldering ignition propensity;
- a rayon fabric with low smoldering ignition propensity (and specified as a standard test fabric in the UFAC voluntary guidelines);
- a cotton plain-weave fabric with moderate smoldering ignition propensity (also specified as a UFAC standard test fabric);
- a cotton velvet fabric with moderately high smoldering ignition propensity (specified as the standard test fabric in the CPSC staff's 2005 draft standard and

the California Bureau of Home Furnishings regulation Technical Bulletin 117); and

- a cotton chenille fabric with very high smoldering ignition propensity.

The Laboratory staff tested these fabrics, using a standard test cigarette ignition source, in bench scale, in modified ASTM / UFAC seating mockups over a standard substrate of non-FR polyurethane foam pre-qualified as standard test foam with known smoldering ignition characteristics. Because prior testing in 2006 demonstrated that the ASTM / UFAC draft-limiting enclosure artificially limited combustion for the most smolder-prone fabrics, the 2007 tests were conducted in a test room with (monitored) still air without the enclosure. There were ten replicates, with randomly selected specimens of fabric and foam, for each test configuration. In 45- and 90-minute tests, the staff measured surface (horizontal and vertical) char length and mass loss of the foam substrate. The staff also observed and recorded any obvious ignitions (i.e., transition to visible flaming or burn-through of the foam).

Data and video evidence from the 100 smoldering fabric tests reinforced the staff's prior observation that smolder-prone upholstery fabrics can overcome the smolder resistance of polyurethane foam cores. This presents a risk of either excessive generation of toxic smoke or, in some cases, transition to flaming combustion of the fabric / foam combination. Transition to flaming was observed in as little as 55 minutes after exposure to the lit cigarette (the cigarette itself burns for about 25 minutes). Good performing fabrics self-extinguished before the end of the 45-minute tests.

The staff also observed that the *smoldering* mass loss results of tests with the cotton velvet fabric – the fabric that showed unacceptably excessive variability in small open flame tests – had substantially lower coefficients of variation than either of the two UFAC standard test fabrics for which high consistency was expected. While the cotton velvet did not represent the most extreme challenge to the foam substrate, this fabric did ignite and sustain combustion after the cigarette burned its length, and provided a difficult challenge to the foam substrate.

Phase 2 of the laboratory testing investigated the open flame and smoldering behavior of five interior barrier materials designed for use in mattresses, including:

- "high loft" battings that could be "drop-in" replacements for existing batting layers used in most upholstered furniture constructions; and
- some thinner, nonwoven interliners that could be used in conjunction with polyester battings and other comfort layer fillings.

The CPSC Laboratory staff tested different thicknesses of these two basic types of barriers in bench scale seating mockups; most of the barriers were evaluated with and without a standard rayon cover fabric (i.e., there was a control test set of bare barriers over foam for four of the five barriers); all mockups had a standard non-FR foam substrate. Since prior CPSC Laboratory testing indicated that the rayon test fabric did not represent the most extreme challenge to the barriers, the staff used a standard

"source #3" ignition source from the existing British Standard BS-5852 (nominal 240 mm flame height based on butane gas flow rate and source pressure, and 70 seconds exposure time) to represent a more severe challenge. To ensure high confidence in the test results, the staff tested ten replicates, with randomly selected specimens of fabric and barrier material, for each test configuration. The tests were nominally set to be terminated in 45 minutes, although results were generally evident in less time and most tests were ended before the 45 minute time limit.

Data from the 110 open flame tests of these barriers showed that some, but not all, would protect interior fillings from a burning cover fabric. Two of the five tested barriers were highly effective, essentially self-extinguishing with average assembly mass losses of about 5% and 15%. The other three did not sufficiently limit heat transfer or maintain their structural integrity, often allowing more than 20% mass loss in less than 30 minutes.

Phase 3 of the laboratory testing investigated the smoldering behavior of the two barriers that performed well in the Phase 2 open flame tests, including:

- one high-loft batting; and
- one nonwoven interliner.

In addition, the staff tested a conventional, non-FR polyester batting commonly used as a cushion wrap in currently produced furniture.

The CPSC Laboratory staff tested the barriers using the standard cigarette and foam substrate as described above for the Phase 1 tests, and the standard cotton velvet test fabric identified in Phase 1 as the candidate that best provided a substantial challenge to the barrier (averaging over 50% mass loss in the non-barrier smoldering tests) in combination with relatively low variability. As in Phase 1, the staff used bench scale, modified ASTM / UFAC seating mockups and no draft-limiting enclosure, with ten replicates for each barrier test. The staff measured substrate mass loss and char length, and observed and recorded any obvious ignitions.

Data from the barrier smoldering tests showed that the tested open flame-resistant barrier materials did not adequately protect foam fillings from smoldering cigarettes. One high-loft barrier limited average foam substrate mass loss to below 15%; the thinner, nonwoven interliner averaged about 55%. The conventional polyester batting provided good smolder resistance, averaging under 1% substrate mass loss.

In evaluating the need for a possible open flame test for barriers used with smolder-prone fabrics, the staff noted that the cotton velvet standard test fabric in the smoldering barrier test was not the most smolder-prone fabric tested; the cotton chenille fabric yielded significantly higher mass loss in the non-barrier tests, and more often transitioned to flaming combustion. A number of highly smolder-prone cover fabrics could therefore be used in furniture with complying barriers. The barrier open flame test

in the 2007 alternative draft standard provides an additional measure of protection for products using highly smolder-prone fabrics.

Phase 4 of the laboratory testing involved limited tests of the two open flame-resistant barriers identified in Phase 2 in combination with a thin layer of non-FR polyester batting. This type of configuration is being used in mattresses to meet the applicable smoldering and open flame requirements for these products. The staff performed tests on the combination barriers using the same open flame (Phase 2) and smoldering (Phase 3) methods described above. In these preliminary tests, the high-loft barrier resisted smoldering much better with the added polyester layer, going from an average substrate mass loss of about 15% to less than 1%; open flame assembly mass loss worsened somewhat (but not unacceptably), going from about 5% to about 15%. The thinner, nonwoven interliner also improved in smoldering tests, but did not perform well in open flame tests, as the added heat energy from the polyester layer overwhelmed the barrier. These limited tests suggest that manufacturers could use appropriate combinations of materials as a barrier to provide protection to interior filling materials from both smoldering and open flame ignition.

The staff used the results of the recent laboratory tests to develop the test methods chosen for the 2007 alternative draft standard. Starting in 2008, the staff plans to conduct larger scale tests, with appropriate risk measures, to confirm that upholstered furniture articles made with complying materials – especially barriers -- offer improved fire safety protection. This testing is planned to be conducted under an existing interagency agreement with NIST. The staff will also monitor the progress of a furniture flammability research program, begun in 2007 and sponsored by Underwriters Laboratories, Inc. (UL) at the National Fire Protection Research Foundation.

V. CPSC Staff's 2007 Alternative Draft Standard

The staff focused its most recent standard development effort on effectively addressing the major risk associated with upholstered furniture: the 90% of fatalities resulting from smoking material-ignited residential fires. The staff incorporated refinements to address the technical issues and stakeholder comments and recommendations discussed above. The staff considered the latest CPSC Laboratory data and technical judgment, along with economic, health and environmental factors. The Directorate for Engineering Sciences' memorandum describing the staff's technical rationale for this approach appears at **Tab D**.

The basic requirement of the staff's 2007 alternative draft standard is a simple but stringent performance test for cover fabrics and other covering materials, using a smoldering cigarette ignition source. To maintain the effectiveness of the basic performance test, the alternative draft also incorporates performance tests for interior barriers using both smoldering and open flame ignition sources. This alternative draft standard would have substantial safety benefits to the public; further, as there are no open flame requirements for fabrics or fillings and no smoldering requirements for

fillings (either of which might lead to the use of FR chemical additives), the alternative draft standard would likely have minimal potential for exposure to FR additives from complying products.

Under the staff's 2007 alternative draft standard, there would be two types of upholstered furniture:

Type 1 upholstered furniture would be finished articles made with cover fabrics or other covering materials that are smolder-resistant in accordance with the cover fabric performance test. In tests of seating mockups of fabric and standard polyurethane foam filling (SPUF), complying Type I fabrics would have to protect the interior foam: the mockup would have to self-extinguish by the end of a 45-minute test, with no obvious ignitions (i.e., transition to flaming of the mockup) and the cover fabric would be allowed to transfer only minimal heat to the interior foam (i.e., no more than 10% post-test mass loss of the SPUF substrate). Type I furniture could be constructed with any interior filling materials; no upholstery materials other than cover fabrics would have to be qualified.

Type II upholstered furniture would be finished articles made with barriers (placed between cover fabrics and any interior filling materials) that are smolder- and open flame-resistant in accordance with the two barrier performance tests. In tests of seating mockups of barriers with standard cover fabrics and SPUF, complying Type II barriers would have to protect the interior foam: the mockup could not exhibit more than 1% mass loss of the SPUF substrate at the end of a 45-minute smoldering ignition test, and no more than 20% mass loss of the total mockup assembly at the end of a 45-minute open flame test. Type II furniture could be constructed with any cover fabrics and any interior fillings; no upholstery materials other than barriers would have to be qualified. Articles of upholstered furniture with non-complying cover fabrics would be required to have Type II barriers.

For each qualified Type I cover fabric / material or Type II barrier, multiple replicate specimens would be tested to establish compliance. The staff is developing specifications for a possible test program that would provide adequate confidence in the test results without imposing an undue testing cost burden. Periodic sampling would not be required, though manufacturers and importers could choose to do so. Fabrics with the same flammability performance (e.g., different colors) could be qualified with a single set of tests and appropriate supporting data.

Thus, there are only three performance tests in the staff's 2007 alternate draft standard – one for smoldering ignition performance of cover fabrics / materials and two for barriers (one for smoldering and one for small open flame). The tests are summarized in Table 2 on the following page.

Table 2

CPSC Staff 2007 Alternative Draft Standard for Upholstered Furniture Flammability: Description of Performance Tests

Material	Test Description	Test Requirement
Type 1: Manufacturer selects smolder-resistant cover material		
Cover fabric / material (smoldering resistance)	Modified (3", no draft enclosure) ASTM/UFAC seating mockup with standard polyurethane foam substrate and standard cigarette ignition source	After 45 minutes: • No continued smoldering • No obvious flaming ignition • Maximum 10% mass loss of substrate
OR **Type 2: Manufacturer selects qualified interior barrier**		
Interior Fire Barrier (smoldering resistance)	Modified (3", no draft enclosure) ASTM/UFAC seating mockup with standard polyurethane foam substrate, standard cotton cover fabric and standard cigarette ignition source	After 45 minutes: • Maximum 1% mass loss of substrate
Interior Fire Barrier (open flame resistance)	BS 5852 seating mockup with standard non-FR polyurethane foam substrate, standard rayon cover fabric, and 240 mm / 70 sec. flame ignition source	After 45 minutes: • Maximum 20% mass loss of mockup assembly

To certify compliance for finished articles of upholstered furniture, manufacturers and importers may rely on certificates of compliance issued by material suppliers under the Flammable Fabrics Act (FFA). The FFA requires that firms conduct reasonable and representative tests sufficient to establish that production units of materials meet the applicable tests. While there are no periodic sampling requirements in the staff's 2007 alternative draft standard, manufacturers and importers of materials or furniture would be responsible for establishing appropriate test programs to assure compliance.

Each finished article of upholstered furniture would be required to carry a permanent label containing a statement certifying compliance, and identifying the method of compliance (Type I or II), the identity of the manufacturer or importer, the location and date (month and year) of manufacture, and the model and lot number of the furniture item. This information would be required to be separate from any other,

non-CPSC label. The label would help manufacturers, importers, retailers and consumers identify products and materials in the event of a recall or other corrective action.

VI. Flame Retardant Chemical Issues

In addressing the risk of fire associated with upholstered furniture, the CPSC staff has sought to improve fire safety without creating additional hazards to human health or the environment. This objective can be achieved with some FR technologies; however, as noted in Section III, many stakeholder groups have expressed concerns about potential impacts associated with the use of certain FR chemicals.

A. Filling Material FRs

CPSC received a number of recent comments opposing potential increases in the use of FRs in upholstered furniture, especially halogenated FR additives such as polybrominated diphenyl ethers (PBDEs) and brominated or chlorinated "tris" in foam filling materials. Some studies have concluded that the lower brominated compounds, especially penta-BDPO, tend to persist in the environment, including indoors, and can bioaccumulate in humans and animals. Several groups raised these concerns at the industry-sponsored July 2007 stakeholder meeting. With regard to the use of these specific compounds, the staff notes that:

- Production of the two PBDEs (penta- and octa-bromodiphenyl ether) used in polyurethane foam ceased in 2004 in the face of mounting regulation (e.g., by the Environmental Protection Agency, several states and the European Union). They were replaced with another bromine FR substitute for which health and environmental data are lacking. The remaining principal commercial PBDE, deca-bromodiphenyl ether, which is widely used in plastic products, has been used as an additive in some synthetic upholstery fabrics (e.g., in latex backcoatings in the United Kingdom to meet the U.K. furniture flammability regulations); it has not been used in (and is reportedly not suitable for) foam fillings.

- Brominated tris (which was the subject of Commission action in 1977 related to children's sleepwear) has reportedly never been used in polyurethane foam, although chlorinated tris (a likely carcinogen that could pose both cancer and non-cancer chronic health risks) continues to be used in some foams meeting the existing California regulation, Technical Bulletin (TB) 117.

FR additives would likely be used in filling materials (chiefly polyurethane foam) to comply with the staff's 2005 revised draft standard. The staff's 2006 foam FR risk assessment, however, identified significant data gaps and continuing toxicity and exposure concerns about the existing variety of foam FRs. Thus, although the staff's environmental assessment concluded that potential health and environmental impacts

would likely be insignificant, the staff recognizes and agrees with some of the concerns that have been expressed about certain FR foam additives.

Continuing uncertainty about potential health and environmental effects of FR chemical usage contributed to the staff's decision to concentrate on cover fabric smoldering performance and eliminate both smoldering and open flame provisions for filling materials from the staff's 2007 alternative draft standard. While it is possible to use FR additives to comply with the Type I cover fabric requirements, the staff considers this to be the least likely means of achieving compliance in view of the cost of FR fabric treatments (compared to fiber content and construction modifications), the aesthetic effects on certain fabrics, and the reported desire of fabric suppliers and users to avoid the use of FR additives.

B. Fire Barrier FRs

The staff's 2007 alternative draft standard would allow the use of fire barriers for the relatively small proportion of cover fabrics that is smolder prone, and would not impose fabric or filling material requirements that would likely result in the use of FR additives. Thus, the potential for FR chemical exposure would be reduced compared to earlier draft standards. In a risk assessment report prepared for the Commission's 2006 mattress rule, the staff reviewed available information on potential exposure and risk for six FR technologies that could be used in barriers. Most of these technologies use "inherently FR fibers," in which FR compounds are extruded in or otherwise integral with the barrier fiber such that migration (and potential consumer exposure) does not occur.

While not all of these technologies would likely be used in upholstered furniture barriers, the staff concluded that none of the barrier FRs would likely pose appreciable health risks to consumers. Two of the six did not satisfy the definition of "toxic" in the Federal Hazardous Substances Act (FHSA). While some barriers for upholstered furniture may be constructed somewhat differently from those for mattresses, a subset of the evaluated barrier FR technologies would probably be used, and potential exposures would be no greater than in mattresses. Thus, the same conclusion would likely apply.

C. EPA Activity

The CPSC staff has been working cooperatively with EPA's Office of Pollution Prevention and Toxics (OPPT) to develop a possible Significant New Use Rule (SNUR) for certain FR chemicals that may be used in upholstered furniture. A SNUR could be proposed roughly concurrent with any CPSC proposed rule. As with EPA's other programs, the SNUR evaluation process covers consumer, occupational and environmental risks. The SNUR could be used to obtain additional data where needed. These data could be used to establish controls on the use of FR chemicals if necessary to reduce potential risks to human health or the environment.

Under the CSPC staff's 2007 alternative draft standard, the fabric and foam FRs previously identified as possible candidates for new use in upholstered furniture would probably not be used in significant quantities. Furniture barriers incorporating FRs currently used to meet CPSC's mattress rule may not constitute a "new use" under EPA's SNUR authority. The CPSC staff continues to work cooperatively with EPA staff on the various FR chemical-related efforts, and has advised EPA staff of the nature of the CPSC staff's latest draft. The two agency staffs will evaluate whether a SNUR is reasonably necessary in light of any Commission decision or guidance.

D. Environmental Assessment

Although not required by the Commission's regulations implementing the National Environmental Policy Act of 1969 (NEPA), CPSC's Executive Director directed the staff to prepare an Environmental Assessment (EA) to determine whether an Environmental Impact Statement (EIS) is necessary or if a Finding of No Significant Impact (FONSI) is appropriate. The Directorate for Economic Analysis revised its preliminary environmental assessment, attached at **Tab E**, to include as an option the staff's 2007 alternative draft standard.

The staff previously assessed potential environmental effects associated with FR chemical usage to meet previous draft standards from 2001 and 2005. Under the staff's 2001 draft standard, about two-thirds of upholstery cover fabrics would likely use FR additive treatments. Under the staff's 2005 draft, most filling materials would contain FR additives.

The 2007 alternative draft standard, which contains no open flame fabric requirements and no smoldering or open flame filling material requirements, would lead to much lower FR usage than either the 2005 or 2001 versions. FR barriers would be used only in furniture constructed with certain highly smolder-prone cover fabrics. Many cover fabrics could simply be reengineered to comply, using neither FR treatments nor barriers.

If the Commission proposed the staff's 2007 alternative draft standard, the vast majority of upholstered furniture products could comply without using any FRs. In addition, the "inherently FR fiber" technologies likely to be used in most fire barriers would tend to be more environmentally preferable than foam filling material FRs. In view of these conditions, and in view of the available regulatory mechanisms already in place to mitigate any environmental risks that might be identified, the staff concludes that the staff's 2007 alternative draft standard would not have significant adverse impacts on human health or the environment. A memorandum from CPSC's Executive Director containing a FONSI for any of the regulatory alternatives currently under consideration is included at **Tab E.**

VII. Economic Impact Analysis

The CPSC Directorate for Economic Analysis (EC) has updated its preliminary regulatory analysis of societal benefits and costs associated with a possible standard and reasonable alternatives. This update incorporates estimates of the likely economic impacts of the staff's 2007 alternative draft standard and the UFAC approach recently recommended by some industry stakeholders. It also reflects, for other principal alternatives, estimates of potential benefits derived using the latest available data on addressable upholstered furniture-related residential fires losses. In accordance with Office of Management and Budget (OMB) guidance, the staff's analytical methodology has been peer-reviewed and posted on the Commission's web site. The updated version of the preliminary regulatory analysis and the staff's initial regulatory flexibility analysis of potential impacts on small entities, including small businesses that may be affected by a possible CPSC rule, are attached at **Tab F**.

A. Updated Preliminary Regulatory Analysis

Projected reductions in societal costs associated with the addressable fire risk constitute the potential economic benefits of a standard to the public. The staff estimates that, with current materials used in upholstered furniture production, the discounted present value of societal costs from addressable cigarette and small open flame ignitions, over the expected useful life of furniture produced in a year, is about $841 million. The staff's analysis discusses a number of different options, including possible standards focusing on smoldering ignition, open flame ignition or both.

The staff's 2007 alternative draft standard focuses on resistance to smoldering ignition of fabrics and other upholstery coverings, and provides for the use of non-complying fabrics in combination with qualified smolder- and open flame-resistant interior barriers. Based on estimates from the revised preliminary regulatory analysis, the present value of expected benefits associated with one year's production of complying upholstered furniture would range from $419-424 million.

The staff estimates that up to about 14% of the roughly 30 million sofas and chairs produced annually are constructed with cover fabrics that would have to be modified or used with interior fire barriers to comply with the 2007 alternative draft standard. Suppliers could modify the fiber content or other physical characteristics of some fabrics. Other non-complying fabrics could be used with complying barriers. FR fabric treatments are possible but the staff considers these to be the least likely method of compliance chosen by manufacturers.

Increased resource costs associated with materials, labor, distribution, testing to support guaranties, and recordkeeping are estimated to be minimal for furniture items with modified (non-FR) fabrics, and range up to about $21 per unit for furniture with barriers. For the remaining 86% of products made with complying cover materials, cost increases associated with testing and certification would be minimal. Total aggregate

costs of the staff's 2007 alternative draft standard are estimated to be about $32-57 million per year's production of complying upholstered furniture.

With estimated discounted benefits of $419-424 million over the useful life of complying upholstered furniture produced in a year and estimated annual costs of $32-57 million, projected annual net benefits to society associated with the staff's 2007 alternative draft standard would be $367-387 million per year's worth of complying furniture production.

Other Regulatory Alternatives

The staff's preliminary regulatory analysis was prepared with the staff's 2005 draft standard as its principal focus. The updated analysis of regulatory options includes not only the staff's 2007 alternative draft standard, but also the staff's 2001 draft open flame standard, the state of California's 2002 draft revision of its furniture regulation, TB-117, and an option to mandate the voluntary ASTM / UFAC guidelines. Estimated benefits and costs for each of these options are noted below and detailed in the preliminary regulatory analysis.

The CPSC staff's 2005 draft standard has smoldering requirements for fabrics and filling materials, and open flame requirements for fillings. It allows optional smoldering- and open flame-resistant barriers to be used with non-complying materials, and allows as-built composites to be tested as a further option. Most fillings would be FR-treated; most cover fabrics would not. Projected aggregate benefits would be about $597 million; estimated costs would be about $176 million, for estimated annual net benefits of $421 million.

The CPSC staff's 2001 draft standard has open flame requirements for fabrics, and allows optional open flame-resistant barriers to be used with non-complying fabrics. Most fabrics would be FR-treated; filling materials would not. Projected aggregate benefits would be about $651 million; estimated costs would be about $272 million, for estimated annual net benefits of $379 million.

The 2002 revised draft of California TB-117 has open flame requirements for fabrics (similar to those of the CPSC staff's 2001 draft small open flame standard) as well as cigarette and open flame requirements for filling materials. It does not incorporate a barrier option. Most cover fabrics would receive FR treatments. Projected aggregate benefits would be about $560 million; estimated costs would be about $370 million, for estimated annual net benefits of about $190 million.

The UFAC guidelines, embodied in the ASTM consensus standard D 1353-90, contain smoldering requirements for fabrics, fillings and other interior materials, and allow smolder-resistant barriers with non-complying fabrics. There are no open flame requirements; no FR materials would be needed. Voluntary conformance is already high. There would be almost no increase in the level of safety over that of currently-produced furniture. Estimated costs may be under $5 million; benefits are uncertain but

are likely to be very small. Potential net benefits, if any, of this alternative are also likely to be small.

Reduced Ignition Propensity Cigarettes

As pointed out in some of the public comments discussed in Section III, state requirements for reduced-IP (or "fire-safe") cigarettes may affect upholstered furniture fire losses irrespective of CPSC action. Twenty-two states have reportedly passed legislation; rules are currently in effect in five of those. Complying cigarettes would likely reduce the risk of smoldering ignition fires over time. The extent of the reduction is unknown.

The CPSC staff has recently undertaken a project to evaluate the potential reduction in smoldering ignition propensity associated with reduced-IP cigarettes compared to conventional cigarettes. Information on the effect of reduced-IP cigarettes on furniture-related fire losses is not yet available; however, even if reduced-IP cigarettes reduced the level of benefits from the staff's 2007 alternative draft standard to half the estimated level, projected net benefits would be reduced from $367-387 million to $155-177 million per year's worth of complying furniture production.

B. Initial Regulatory Flexibility Analysis

The CPSC staff updated its analysis of potential small business impacts to reflect likely effects associated with the staff's 2007 alternative draft standard. This option would have generally lower costs and other economic burdens on small firms than the staff's 2005 draft standard.

Most firms producing, importing or supplying materials for use in upholstered furniture are small. Under the CPSC staff's 2007 alternative draft standard, the cost of producing furniture could rise somewhat for most firms. In most cases, however, fabric suppliers would likely choose the lowest-cost option of reengineering their non-complying fabrics. Any such costs would generally be proportional to production volume, and would not be borne disproportionately by small firms.

Some firms that manufacture or import furniture would use fire barriers in lieu of complying cover fabrics. These would include small, low-volume producers and importers that would use barriers to maintain the large selections of decorative and other specialized fabrics and fillings that differentiate those firms in the market. The high average price of furniture made with decorator fabrics would moderate the relative cost impact of using barriers, especially to the extent that complying barriers were simply substituted for existing comfort layer materials like polyester batting cushion wraps.

The staff's 2007 alternative draft standard would allow fabric and barrier suppliers to issue guaranties of compliance for materials to furniture manufacturers. Thus, furniture manufacturers and importers would not have to test their finished

products, thereby greatly reducing testing costs that might fall disproportionately on low-volume, small firms.

VIII. Conclusions

In response to stakeholder comments regarding the need for and technical and economic feasibility of the CPSC staff's 2005 draft standard, and amid concerns about potential health and environmental issues associated with increased usage of FR chemical additives to meet a flammability standard, the staff developed another option for Commission consideration to address the upholstered furniture flammability risk. The staff's 2007 alternative draft standard achieves two basic objectives:

- It focuses on the addressable risk with simple and inexpensive smoldering performance tests for cover fabrics, the pivotal element in determining upholstery material ignition behavior; and
- It does not rely on FR chemical filling material additives or fabric treatments; manufacturers and importers who choose to use ignitable fabrics can use proven, inherently FR fiber barrier technologies, like those used in mattresses, to protect interior fillings from fire growth.

The staff's 2007 alternative draft standard would greatly reduce the risk and would have substantial estimated net benefits of $367-387 million to the public per year's worth of complying production, without posing appreciable health or environmental risks. It also addresses stakeholders' technical concerns by strengthening the primary performance tests and eliminating the less important ones. If the Commission decides to propose a rule based on this or any other alternative, the staff will forward a draft *Federal Register* notice containing the draft proposed rule and preliminary regulatory analyses for Commission consideration.

List of Attachments

Tab A CPSC Directorate for Epidemiology memorandum, D. Miller, Upholstered Furniture Addressable Fire Loss Estimates for 2002-2004, November 16, 2007

Tab B CPSC Meeting Log, D. Ray, Upholstered Furniture Stakeholders meeting, July 25, 2007

Tab C CPSC Directorate for Laboratory Sciences memorandum, A. Bernatz, L. Fansler & L. Scott, Test Program for Upholstery Fabrics and Fire Barriers, November 8, 2007

CPSC Directorate for Epidemiology memorandum, D. Miller, Analysis of Laboratory Test Data for Upholstered Furniture, November 16, 2007

Tab D CPSC Directorate for Engineering Sciences memorandum, R. Khanna & S. Mehta, Technical Rationale Report for the Draft Standard for the Flammability of Upholstered Furniture, November 2007

Tab E CPSC Directorate for Economic Analysis report, R. Franklin, Environmental Assessment of a Draft Proposed Flammability Standard for Residential Upholstered Furniture, November 2007

CPSC Office of the Executive Director memorandum, P. Semple, Finding of No Significant Impact From Implementation of a Proposed Flammability Standard for Residential Upholstered Furniture, November 19, 2007

Tab F CPSC Directorate for Economic Analysis report, C. Smith, Preliminary Regulatory Analysis of a Draft Proposed Flammability Rule to Address Ignitions of Upholstered Furniture, November 2007

CPSC Directorate for Economic Analysis memorandum, W. Zamula, Costs for Non-Fatal, Addressable Residential Civilian Injuries Associated with Upholstered Furniture Fires, September 6, 2007

CPSC Directorate for Economic Analysis report, C. Smith, Proposed Rulemaking on Upholstered Furniture Flammability: Initial Regulatory Flexibility Analysis, November 2007

CPSC Upholstered Furniture Project Team

Patricia Adair, Directorate for Engineering Sciences
Michael Babich, PhD., Directorate for Health Sciences
Andrew Bernatz, Directorate for Laboratory Sciences
Sarah Brown, Directorate for Engineering Sciences
David Cobb, Directorate for Laboratory Sciences
Patty Davis, Office of Public Affairs
Frank Dunmore, PhD., Directorate for Laboratory Sciences
Linda Fansler, Directorate for Laboratory Sciences
Robert Franklin, Directorate for Economic Analysis
Rohit Khanna, Directorate for Engineering Sciences
Shivani Mehta, Directorate for Engineering Sciences
David Miller, Directorate for Epidemiology
John Murphy, Directorate for Engineering Sciences
Lisa Scott, Directorate for Laboratory Sciences
Charles Smith, Directorate for Economic Analysis
Mary Toro, Office of Compliance
William Zamula, Directorate for Economic Analysis

For further information, contact Dale Ray, Project Manager,
Directorate for Economic Analysis
Phone: 301-504-7704
E-mail: dray@cpsc.gov

Tab A

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

Date: November 16, 2007

TO: Dale Ray
Directorate for Economic Analysis

THROUGH : Russell Roegner, Ph.D.
Associate Executive Director
Directorate for Epidemiology

Kathleen Stralka
Division Director
Division of Hazard Analysis

FROM: David Miller
Division of Hazard Analysis

SUBJECT: 2002 - 2004 Fire Loss Estimates for Upholstered Furniture

This memorandum provides the 2002 - 2004 estimates of fires and fire losses from residential structure fires where upholstered furniture was the item first ignited. It also provides the estimates of addressable[1] upholstered furniture fires and associated losses.

Based on data from the National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA) Annual Survey of Fire Losses, CPSC staff produces estimates of fires and fire losses associated with specific consumer products. These estimates are for fire department-attended fires only. Also, they exclude fires and losses from intentionally set fires and include only civilian casualties.

Table 1. Fires and Losses from Fires where Upholstered Furniture was the Item First Ignited

Year	Fires	Deaths	Injuries	Property Loss (in $Millions)
2002	8,600	460	940	251
2003	7,500	560	890	247
2004	7,200	610	800	250
2002 – 2004 Average	7,800	540	870	250

Note: Fires are rounded to the nearest hundred, deaths and injuries to the nearest ten, and property loss to the nearest hundred thousand dollars.

[1] Based on the heat source as well as other factors, some fires are deemed addressable by a CPSC fire safety standard and some are not. See Appendix for details.

Addressable Upholstered Furniture Fires and Losses

Tables 2 - 5 show estimates of **addressable** fires and fire losses for fires where upholstered furniture was the item first ignited in the fire. The estimates are limited to fire department-attended, non-arson residential structure fires and to civilian casualties. The estimates are broken down between whether the heat source was a small open flame or smoking materials. Upholstered furniture fires with other heat sources are deemed not addressable.

Table 2. Estimates of Addressable Fires where Upholstered Furniture was the Item First Ignited

Year	Smoking Materials	Small Open Flame	Total
2002	2,800	1,200	4,000
2003	2,400	1,100	3,400
2004	2,200	1,000	3,200
2002 – 2004 Average	2,500	1,100	3,500

Note: Fires are rounded to the nearest hundred, deaths and injuries to the nearest ten, and property loss to the nearest hundred thousand dollars. Detail may not add to total due to rounding.

Table 3. Estimates of Addressable Fire Deaths where Upholstered Furniture was the Item First Ignited

Year	Smoking Materials	Small Open Flame	Total
2002	190	40	240
2003	290	20	310
2004	290	20	310
2002 – 2004 Average	260	30	280

Note: Fires are rounded to the nearest hundred, deaths and injuries to the nearest ten, and property loss to the nearest hundred thousand dollars. Detail may not add to total due to rounding.

Table 4. Estimates of Addressable Fire Injuries where Upholstered Furniture was the Item First Ignited

Year	Smoking Materials	Small Open Flame	Total
2002	330	220	550
2003	340	170	510
2004	290	140	430
2002 – 2004 Average	320	170	500

Note: Fires are rounded to the nearest hundred, deaths and injuries to the nearest ten, and property loss to the nearest hundred thousand dollars. Detail may not add to total due to rounding.

Table 5. Estimates of Addressable Fire Property Loss (in Millions) where Upholstered Furniture was the Item First Ignited

Year	Smoking Materials	Small Open Flame	Total
2002	62	58	121
2003	62	39	101
2004	72	41	113
2002 – 2004 Average	65	46	112

Note: Fires are rounded to the nearest hundred, deaths and injuries to the nearest ten, and property loss to the nearest hundred thousand dollars. Detail may not add to total due to rounding.

Appendix: Estimation Methodology and Addressability

Methodology:

The estimates are obtained following the general procedure of the National Estimates Approach[2]. This means using NFIRS to estimate the proportion of residential structure fires and fire losses that have upholstered furniture as the *item first ignited*, then multiplying this proportion by residential structure fire and fire loss totals (across all products) obtained from the annual NFPA survey of fire losses.

To estimate the proportion of fires and fire losses involving upholstered furniture, an imputation method known as *raking* was performed. It is necessary to impute because some of the NFIRS data is incomplete (e.g., the *item first ignited* is sometimes left blank or coded as 'unknown'). The raking procedure is performed by a SAS macro[3]. Raking maintains the marginal distributions for the known data while imputing the unknown data for all the variables involved.

The SAS macro that does the raking for the upholstered furniture estimates involves three NFIRS variables: (1) *cause of ignition*; (2) *item first ignited*; and (3) *heat source*. The raking imputes the unknown data for these variables. The *cause of ignition* variable has codes for intentional and unintentional fires. It is included because intentional fires and their losses are excluded from the estimates (with the exception of child play). The *item first ignited* variable is the NFIRS variable that has 'Upholstered furniture' as one of the codes. For the raking procedure this variable is broken down to 'Upholstered furniture', 'Not upholstered furniture', and 'unknown'. The raking imputes the unknown data. The *heat source* variable indicates what provided the source of heat for the fire. For this procedure it is broken up into 'smoking materials', 'small open flame'[4], 'other heat source', and 'unknown'. Only 'smoking materials' and 'small open flame' are addressable by the draft standard.

The raking procedure is performed separately for the different losses (fires, deaths, injuries, and property loss). After the raking is performed, there are NFIRS estimates for each loss (with intentional fires and their losses excluded) broken down by 'smoking materials' and 'small open flame'. Then the estimates are weighted up by the totals from the NFPA survey for each particular loss to obtain national estimates.

Addressability and Scope:

It is not expected that all of the fire losses associated with upholstered furniture would be eliminated under a possible CPSC standard. A standard could address only fires from small open flame and smoldering ignitions of upholstered furniture. Ignitions from other sources such as electric appliances or space heaters would not be addressable.

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[2] J. Hall, B. Harwood, "The National Estimates Approach to U.S. Fire Statistics", *Fire Technology*, May 1989.

[3] M. Battaglia, D. Hoaglin and D. Izrael, "A SAS Macro for Balancing a Weighted Sample", SAS Users Group International (SUGI) 25th Annual Conference, April 9-12, 2000, Paper #258-25.

[4] 'Small open flame' consists of candles, matches, and cigarette lighters.

Before the raking is performed, some NFIRS variables are used to eliminate some cases for being out-of-scope for the analysis. The logic is that the inconsistency implies a coding error and to be conservative, the case will not count as upholstered furniture in case the coding of 'upholstered furniture' as the *item first ignited* was the coding error. These variables are *equipment involved in ignition, factors contributing to ignition, area of fire origin,* and *type of material first ignited.* An example of an out-of-scope case is one where the *item first ignited* is upholstered furniture but the *type of material first ignited* is coded as 'Food, starch'. The more variables involved in the raking algorithm, the more difficult it is for the algorithm to perform reasonably. For this reason, the raking was limited to the three variables (*cause of ignition, item first ignited,* and *heat source*). The other four variables involved (*equipment involved in ignition, factors contributing to ignition, area of fire origin,* and *type of material first ignited*) are used to eliminate inconsistent coding. Since it is not necessarily inconsistent to have 'upholstered furniture' as the *item first ignited* and have one or more of these variables as 'Undetermined', these cases are left as in-scope. Tables A1 and A2 list these NFIRS variables along with the breakdown showing which codes are in-scope vs. out-of-scope:

Table A1: Equipment Involved in Ignition Codes.

Description	**Code**	**Scope**
Heating, Ventilating & Systems Air Conditioning	100 – 152	Out
Electrical Distribution, Lighting & Power Transfer	200 – 263	Out
Shop Tools & Industrial Equipment	300 – 377	Out
Commercial & Medical Equipment	400 – 451	Out
Garden Tools & Agricultural Equipment	500 – 538	Out
Kitchen & Cooking Equipment	600 – 656	Out
Electronic and Other Electrical Equipment	700 – 757	Out
Personal & Household Equipment	800 – 897*	Out
Other equipment involved in ignition	000	Out
Equipment involved in ignition undetermined	UUU	In[5]
Other	All other codes	In

*Excludes 872 "Charcoal lighter" and 873 "Cigarette lighter, pipe lighter".

[5] As with *Factors Contributing to Ignition*, *Type of Material First Ignited*, and *Area of Origin*, it is not considered inconsistent for the *Equipment Involved in Ignition* to be 'Undetermined' in an upholstered furniture fire. Since these variables are not involved in the raking algorithm, the 'undetermined' values are in-scope.

Table A2: Factors Contributing to Ignition Codes.

Description	Code	Scope
Cutting, welding too close to combustible	13	Out
Flammable liquid or gas spilled	14	Out
Improper fueling technique	15	Out
Flammable liquid used to kindle fire	16	Out
Washing part, painting with flammable liquid	17	Out
Improper container or storage	18	Out
Mechanical Failure, Malfunction	20 – 27	Out
Electrical Failure, Malfunction	30 – 37	Out
Equipment overloaded	54	Out
Undetermined factor contributing to ignition	UU	In
Other	All other codes	In

Table A3: Type of Material First Ignited Codes.

Description	Code	Scope
Flammable Gas	10 – 19	Out
Flammable, Combustible Liquid	20 – 29	Out
Volatile Solid, Chemical	30 – 39*	Out
Cork	52	Out
Hay, straw	54	Out
Coal, coke, briquettes, peat	56	Out
Food, starch	57	Out
Tobacco	58†	Out
Wood Paper	60 – 69	Out
Wig	75	Out
Human hair	76	Out
Material Compounded with Oil	80 – 89	Out
Multiple types of material first ignited	99	Out
Undetermined type of material	UU	In
Other	All other codes	In

*Excludes code 33 "Polish, paraffin, wax" when *Heat Source* is 66 "Candle, taper".

† Excludes code 58 "Tobacco" when *Heat Source* is 61 "Cigarette" or 62 "Pipe or cigar".

Table A4: Area of Origin Codes.

Description	**Code**	**Scope**
Escalator	4	Out
Dumbwaiter or elevator shaft	51	Out
Conduit, pipe, utility, or ventilation shaft	52	Out
Light shaft	53	Out
Chute; laundry or mail, excluding trash chutes	54	Out
Duct: hvac, cable, exhaust, heating, or AC	55	Out
Chimney	57	Out
Conveyor	58	Out
Wall surface	75	Out
Wall surface: exterior	76	Out
Awning	78	Out
Transportation, Vehicle Area	80 – 89	Out
Undetermined area of origin	UU	In
Other	All other codes	In

Tab B

U.S. Consumer Product Safety Commission
LOG OF MEETING

Subject: Upholstered Furniture Flammability Stakeholder Meeting (sponsored by the American Home Furnishings Alliance)

Date of Meeting: July 25, 2007

Log Entry Source: Dale R. Ray, Project Mgr., EC, (301) 504-7704

Date of Log Entry: August 21, 2007

Meeting Location: Sheraton Crystal City Hotel, Arlington, VA

CPSC Attendees: Dale Ray, Project Manager, Directorate for Economic Analysis
Patty Adair, Directorate for Engineering Sciences

Non-CPSC Attendees:

Brad Sperber & Beth Fascetelli, Keystone Group (facilitators)
David Ryan, Craftex / National Textiles Ass'n.
Richard Taffet, Decorative Fabrics Ass'n.
Steve Dehaan, National Home Furnishings Ass'n. (retailers)
Lynn Knudtson, Future Foam / Polyurethane Foam Ass'n.
Bob Barker, American Fiber Mfrs. Ass'n.
Joe Ziolkowski, Upholstered Furniture Action Council
Andy Counts, American Home Furnishings Alliance
Phil Wakelyn, National Cotton Council
Tom Long, Exponent Failure Analysis Assoc. (fire consultant)
Tom Chapin, Underwriters Laboratories
Mark Buczek, Supresta / American Fire Safety Council / Alliance for the Polyurethanes Industry / American Chemistry Council
Peter Brigham, American Burn Ass'n.
Pat Morrison, International Association of Fire Fighters

+ Teleconferenced participants:
Bob Luedeka, Polyurethane Foam Ass'n.
Andrew McGuire, Trauma Foundation
Arlene Blum, U. of CA – Berkeley (Health / environmental consultant)
Russell Long, Friends of the Earth

+ Observers:
Russ Batson, AHFA
Joe Gerard, UFAC consultant
Mary Martha McNamara, attorney (UFAC)
Hugh Talley, HTI (UFAC consultant)
Wogan Badcock, retailer

Claire Kammer, Bob Backstrom & John Bender, UL
Alan Ball & Becky Frazier, Sateri (fiber importer)
Kevin Curtin, attorney (Coalition for Home Fire Safety)

Summary of Meeting:

This meeting was organized by AHFA following their discussions with Senate staff on possible stakeholder recommendations to CPSC regarding upholstered furniture flammability rulemaking. Mr. Sperber opened the meeting and talked about AHFA's goal of assembling a consensus position to be embodied in a letter to the Senate subcommittee staff. Mr. Ray and Ms. Adair attended as observers and provided comments on various technical issues. Following a brief, general background statement from Mr. Ray, the participants each presented a brief summary of the positions of their respective organizations.

The AHFA, PFA, AFMA, NCC and NTA industry participants favored a recommendation, articulated by Mr. Ziolkowski and Mr. Counts, that CPSC propose a rule that would address the smolder resistance of upholstered furniture and that would pre-empt potentially conflicting state regulations. The AHFA representatives' recommended approach for such a rule would be to implement the existing UFAC voluntary guidelines, in accordance with existing ASTM 1353 smoldering ignition test methods referenced in the UFAC guidelines. Citing the technical complexity of open flame ignition testing, they also suggested that the group recommend that further research be conducted on open flame resistance for future consideration. Mr. Ray noted that these recommendations were consistent with AHFA's prior written comments to CPSC.

Mr. Long and some other participants voiced concerns about the potential use of flame retardant (FR) chemical additives that might be used to meet any open flame requirements in a standard; some participants specifically opposed any recommendation that could lead to any increase in FR use in upholstered furniture. They stated their general support for the AHFA recommendations based on the presumption that the use of FR additives would not be encouraged. In the discussion on this issue, Mr. Barker noted the availability of fire blocking barriers (similar to those used to comply with CPSC's new mattress rule) that are made with inherently-FR fibers and that would not present a risk of FR chemical exposure to consumers.

Mr. Buczek stated his opposition to 'any course that would reduce the current level of safety,' referring to the likelihood that the open flame requirements of existing California regulations would be pre-empted by a CPSC smolder-resistance rule. He indicated that neither AFSC nor API would concur with AHFA's recommendation. Mr. Ray noted that these views, like those of the AHFA supporters, reflected existing comments on the record.

Mr. Brigham suggested that the group recommend that CPSC consider the role of lower ignition propensity cigarettes now coming into use in many states; some discussion followed. Mr. Ray noted that the CPSC staff was undertaking a study to characterize the differences in ignition strength among newer, low-IP cigarettes and traditional cigarettes, and that the staff would consider the results of this study in its regulatory development work.

Mr. Sperber was charged with preparing a summary of the meeting and a description of the 'majority consensus' essentially recommending that CPSC a) issue a smolder resistance rule based on the ASTM / UFAC voluntary scheme, and b) defer action on open flame resistance pending further research. Mr. Sperber agreed to circulate a draft report to participants (and to CPSC staff) for review within about a week. He indicated that AHFA might then prepare a letter to the Senate subcommittee describing the 'majority consensus' recommendation to CPSC.

Tab C

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

Date: November 8, 2007

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 Engineering

FROM : Andrew J. Bernatz, Division of Electrical Engineering
Linda Fansler, Division of Electrical Engineering
Lisa L. Scott, Division of Electrical Engineering

SUBJECT : Test Program on Upholstery Fabrics and Fire Barriers

During September, October and November 2007, Laboratory Sciences staff conducted smoldering and small open flame tests in support of the U.S. Consumer Product Safety Commission (CPSC) staff's 2007 alternative draft standard. This testing included an evaluation of several possible standard test fabric candidates for smoldering evaluation, and an evaluation of fire barriers for smoldering and open flame performance.

The testing consisted of four phases. In Phase 1, five cover fabrics were evaluated as potential standard test fabric candidates for smoldering tests. The fabrics included in Phase 1 were:

- Fabric 5 – 56% rayon, 34% polyester, 10% cotton, 10 oz/yd^2,
- Fabric 7 – 92% cotton, 8% rayon, 20 oz/yd^2,
- Fabric 24 – 100% cotton, 10 oz/yd^2,
- Fabric 25 – 100% cotton, 9.0 oz/yd^2, and
- Fabric 26 – 100% rayon, 8.0 oz/yd^2.

In addition, test time duration was also evaluated in Phase 1. Smoldering tests in Phase 1 were conducted at either 45 or 90 minutes. Tests were conducted using the test procedure in the staff's 2005 draft standard with one modification; the draft enclosure was eliminated in this test series. All smoldering tests were also conducted with untreated foam.

Results of Phase 1 show that tests with Fabric 7 resulted in the highest foam mass loss. This was true for both the 45 and 90 minute test durations. The average foam mass loss for tests with Fabric 7 was 94% at 90 minutes and 64% at 45 minutes. Fabric 24 had the next highest average foam mass losses of 88% at 90 minutes and 48% at 45 minutes.

A total of five mockups transitioned from smoldering to flaming ignition.

- Fabric 7 at 55 minutes.
- Fabric 7 at 60 minutes.
- Fabric 7 at 61 minutes.
- Fabric 24 at 66 minutes.
- Fabric 26 at 79 minutes.

In Phase 2, small open flame tests were conducted following the procedure in the staff's 2005 draft standard, using untreated foam, five fire barriers and either Fabric 26 or no cover fabric. A 240 mm butane flame applied for 70 seconds (Source 3 flame) was used as an ignition source. Although a 45-minute test duration was specified, a test was stopped before 45 minutes if: (1) the mockup assembly self-extinguished, or (2) foam ignition occurred and the mockup had at least 50% assembly mass loss. The five fire barriers evaluated with the Source 3 flame were:

- Barrier AA – ¼ inch loft batt,
- Barrier BB – 1 inch loft batt,
- Barrier DD – ¼ inch loft batt,
- Barrier EE – nonwoven sheet, and
- Barrier FF – nonwoven sheet.

Results of Phase 2[1] show fire barrier materials evaluated without a cover fabric did not result in any foam ignitions. However when evaluated with a cover fabric (Fabric 26), only Barrier BB and Barrier FF provided protection to the foam filling below.

In Phase 2A, two fire barriers (Barrier BB and Barrier FF), resisting ignition with the Source 3 flame were further evaluated using Fabric 5 (a readily ignitable, fast burning cover fabric) and a 35 mm butane flame applied for 20 seconds (Source 1 flame). Although a 45-minute test duration was specified, a test was stopped before 45 minutes if: (1) the mockup assembly self-extinguished, or (2) foam ignition occurred and the mockup had at least a 50% assembly mass loss.

Results for Phase 2A show that Fabric 5 and a Source 1 ignition flame is more of a challenge to the underlying materials than when Fabric 26 and a Source 3 ignition flame is used. Foam ignition occurred when Barrier BB was combined with Fabric 5 and a Source 1 ignition flame in 80% of the tests, while foam ignition occurred about 30% of the time with Barrier FF.

In Phase 3, smoldering tests were conducted evaluating the following materials:

- Barrier BB,
- Barrier FF,
- Polyester batting, (approximately 1 inch thick), and
- No barrier.

[1] Some of these tests were conducted as part of Phase 2A due to supply issues. This occurred for one-half of the tests with Barrier BB and all of the tests with Barrier FF.

Fabric 24 was selected for use as the cover fabric for Phase 3 testing by the Directorate for Epidemiology based on an analysis of Phase 1 data. The tests were conducted over untreated foam following the staff's 2005 draft standard without the draft enclosure. A 45-minute test duration was used.

Phase 3 results show that fire barrier materials that generally perform well in small open flame test conditions by providing protection to the foam filling material do not necessarily provide the same protection in smoldering test conditions. This observation is consistent with prior CPSC laboratory test results of barrier materials. Mockups containing the two fire barriers smoldered but did not transition from smoldering to flaming ignition. Foam mass loss averages were 13% for Barrier BB and 57% for Barrier FF. The average foam mass loss for mockups made with Fabric 24 and no barrier was 50%. As expected, mockups with polyester batting resulted in foam mass losses of less than 1%.

In Phase 4, limited smoldering and small open flame tests were conducted to test the theory that a thin layer of polyester batting may improve the smoldering performance of Barrier BB and Barrier FF while not adversely affecting the small open flame performance of those barriers. An approximately ¼ inch thick polyester batting was placed between the fire barrier and the cover fabric for these tests.

For smoldering ignition evaluations, the tests were conducted following the staff's 2005 draft standard without the draft enclosure and using untreated foam. A 45-minute test duration was used. The following combinations were evaluated for smoldering ignition.

- Fabric 24 / ¼ inch Polyester Batting / Untreated Foam.
- Fabric 24 / ¼ inch Polyester Batting / Barrier BB / Untreated Foam.
- Fabric 24 / ¼ inch Polyester Batting / Barrier FF / Untreated Foam.

The thin layer of polyester batting markedly improved the smoldering performance of Barrier BB and Barrier FF. The foam mass loss averages were within the measurement uncertainty for mockups built with either barrier.

A source 3 ignition flame was used for the small open flame tests in Phase 4. The following combinations were evaluated.

- Fabric 26 / ¼ inch Polyester Batting / Barrier BB / Untreated Foam.
- Fabric 26 / ¼ inch Polyester Batting / Barrier FF / Untreated Foam.
- Fabric 24 / ¼ inch Polyester Batting / Barrier FF / Untreated Foam.

Of the two fire barriers evaluated with a thin layer of polyester batting, only Barrier BB provided protection to the filling material. Foam ignition occurred in the mockups containing Barrier FF, while the average assembly mass loss for mockups with Barrier BB was 14%. Although including the layer of thin polyester batting increased the assembly mass loss for those tests with Barrier BB as compared to the typical mass loss without the polyester layer (5% assembly mass

loss), foam ignition did not occur. This limited testing indicates a potential option for compliance with the staff's 2007 draft standard.

Laboratory staff followed an experimental design provided by the Directorate for Epidemiology in conducting these tests. The data for Phases 1, 2, 2A, 3, and 4 follow.

Phase 1. Smoldering Tests

Test #	Fabric	Duration	Date	% loss	Horiz Char	Vert Char	Smoldering?	Comments
13	5	45	9/17	0.5	0.125	0.5625	N	cool, no smoldering
31	5	45	9/17	0.4	0.1875	0.4375	N	cool, no smoldering
32	5	45	9/17	0.4	0.25	0.375	N	cool, no smoldering
40	5	45	9/18	0.4	0.25	0.4375	N	cool, no smoldering
43	5	45	9/18	0.4	0.25	0.5	N	cool, no smoldering
60	5	45	9/19	1.9	0.5	0.5	N	cool, no smoldering
65	5	45	9/19	0.3	0.125	0.5	N	cool, no smoldering
66	5	45	9/19	0.4	0.375	0.5	N	cool, no smoldering
85	5	45	9/20	0.4	0.25	0.5	N	cool, no smoldering
88	5	45	9/20	1.0	0.3125	0.5	N	cool, no smoldering
34	7	45	9/18	66	3	3	Y	fabric glowing
35	7	45	9/18	59	3	3	Y	fabric glowing
45	7	45	9/18	68	3	3	Y	fabric glowing
46	7	45	9/18	69	3	3	Y	fabric glowing
58	7	45	9/19	72	3	3	Y	fabric glowing
62	7	45	9/19	62	3	3	Y	fabric glowing
83	7	45	9/20	67	3	3	Y	fabric glowing
96	7	45	9/21	56	3	2.6875	Y	fabric glowing
99	7	45	9/21	50	3	2.625	Y	fabric glowing
100	7	45	9/21	66	3	3	Y	fabric glowing
11	24	45	9/17	43	2.9375	2.8125	Y	smoldering
30	24	45	9/17	58	3	3	Y	smoldering
37	24	45	9/18	44	2.9375	2.8125	Y	smoldering
38	24	45	9/18	48	3	3	Y	smoldering
39	24	45	9/18	56	3	3	Y	smoldering
41	24	45	9/18	52	3	3	Y	smoldering
59	24	45	9/19	42	2.9375	3	Y	smoldering
63	24	45	9/19	50	3	3	Y	smoldering
86	24	45	9/20	42	3	3	Y	smoldering
97	24	45	9/21	44	2.9375	2.9375	Y	smoldering
12	25	45	9/17	1.4	0.75	1.625	Y	fabric glowing
16	25	45	9/17	1.6	1	1.75	Y	1 relight, fabric glowing
33	25	45	9/18	8.2	1.9375	2.25	Y	fabric glowing
42	25	45	9/18	2.0	0.125	2.125	N	cool, no smoldering
47	25	45	9/18	1.2	0.625	0.75	N	cool, no smoldering
61	25	45	9/19	1.2	0.875	1.4375	Y	fabric glowing
64	25	45	9/19	1.9	1	1.75	Y	fabric glowing
82	25	45	9/20	1.2	0.8125	1.25	Y	fabric glowing
84	25	45	9/20	0.9	0.625	0.9375	N	cool, no smoldering
89	25	45	9/21	1.0	0.75	1	N	cool, no smoldering
14	26	45	9/17	0.9	0.625	1.0625	N	cool, no smoldering
15	26	45	9/17	8.6	2.25	2.25	N	no smoldering at end
17	26	45	9/17	0.9	0.75	0.75	N	cool, no smoldering
18	26	45	9/17	1.7	0.5625	0.75	N	cool, no smoldering
19	26	45	9/17	1.9	0.625	1	N	cool, no smoldering

36	26	45	9/18	1.2	0.75	1.125	N	cool, no smoldering
44	26	45	9/18	1.1	0.625	0.75	N	cool, no smoldering
87	26	45	9/20	1.3	0.75	1.6875	Y	fabric glowing
90	26	45	9/21	1.6	0.9375	1.75	N	cool, no smoldering
98	26	45	9/21	14	2.125	2.625	Y	smoldering
22	5	90	9/18	0.5	0.25	0.5625	N	cool, no smoldering
29	5	90	9/18	0.5	0.25	0.5	N	cool, no smoldering
53	5	90	9/19	0.5	0.3125	0.375	N	cool, no smoldering
55	5	90	9/19	0.5	0.3125	0.375	N	cool, no smoldering
56	5	90	9/19	0.8	0.3125	0.4375	N	cool, no smoldering
57	5	90	9/19	0.4	0.25	0.375	N	cool, no smoldering
71	5	90	9/20	0.3	0.1875	0.375	N	cool, no smoldering
73	5	90	9/20	0.3	0.3125	0.5	N	cool, no smoldering
76	5	90	9/20	0.5	0.4375	0.4375	N	cool, no smoldering
95	5	90	9/21	0.3	0.25	0.4375	N	cool, no smoldering
6	7	90	9/17	100	N/A	N/A		flaming ignition 55 min.
9	7	90	9/17	90	3	3	Y	intense smoldering
21	7	90	9/17	97	3	3	Y	intense smoldering
23	7	90	9/18	100	N/A	N/A		flaming ignition 61 min
49	7	90	9/19	88	3	3	Y	fabric glowing
67	7	90	9/20	90	3	3	Y	fabric glowing
77	7	90	9/20	100	N/A	N/A		flaming ignition 1 hour
78	7	90	9/20	90	3	3	Y	fabric glowing
81	7	90	9/21	94	3	3	Y	fabric glowing
94	7	90	9/21	91	3	3	Y	fabric glowing
2	24	90	9/17	85	3	3	Y	intense smoldering
4	24	90	9/17	83	3	3	Y	intense smoldering
5	24	90	9/17	86	3	3	Y	intense smoldering
8	24	90	9/17	100	N/A	N/A		flaming ignition 66 min
20	24	90	9/17	91	3	3	Y	intense smoldering
28	24	90	9/18	100	N/A	N/A		consumed, no flaming ignition
72	24	90	9/20	84	3	3	N	cool, no smoldering
74	24	90	9/20	81	3	3	N	cool, no smoldering
79	24	90	9/20	85	3	3	Y	fabric glowing
93	24	90	9/21	83	3	3	Y	fabric glowing
3	25	90	9/17	1.7	0.9375	1.5	Y	fabric glowing
10	25	90	9/17	2.5	0.875	2.0625	Y	fabric glowing
50	25	90	9/19	1.6	1.0625	2.25	N	cool, no smoldering
51	25	90	9/19	1.7	1.75	1.75	Y	fabric glowing
52	25	90	9/19	0.7	0.625	1	N	cool, no smoldering
54	25	90	9/19	90	3	3	Y	fabric glowing
75	25	90	9/20	93	3	3	Y	fabric glowing
80	25	90	9/20	76	3	3	Y	fabric glowing
91	25	90	9/21	1.0	0.625	0.75	N	cool, no smoldering
92	25	90	9/21	0.9	0.75	0.75	N	cool, no smoldering
1	26	90	9/17	89	3	3	Y	intense smoldering
7	26	90	9/17	1.0	0.5	1	N	no smoldering at end
24	26	90	9/18	91	3	3	Y	1 relight, fabric glowing

25	26	90	9/18	0.6	0.75	0.75	N	cool, no smoldering
26	26	90	9/18	1.3	0.5	0.875	N	cool, no smoldering
27	26	90	9/18	100	N/A	N/A		flaming ignition 79 min
48	26	90	9/19	1.0	0.75	1.8125	N	cool, no smoldering
68	26	90	9/20	1.1	0.75	1.25	N	cool, no smoldering
69	26	90	9/20	0.8	0.5	1	N	cool, no smoldering
70	26	90	9/20	1.1	0.875	1.25	N	cool, no smoldering

Phase 2. Small Open Flame Tests

Test #	Barrier ID	Cover Fabric	Date	4% loss	10 % loss	20 % loss	Foam Ign. ?	Final % loss
7	AA	Bare	9/24	....	....	....	No	0.4
14	AA	Bare	9/25	....	....	....	No	0.4
34	AA	Bare	9/28	....	....	....	No	0
42	AA	Bare	10/1	....	....	....	No	0.3
43	AA	Bare	10/1	....	....	....	No	0.3
45	AA	Bare	10/1	....	....	....	No	0.3
52	AA	Bare	10/2	....	....	....	No	0.3
59	AA	Bare	10/3	....	....	....	No	0.4
61	AA	Bare	10/3	....	....	....	No	0.5
68	AA	Bare	10/4	....	....	....	No	0.5
2	AA	26	9/24	3:30	6:16	10:34	10:34	53
19	AA	26	9/26	4:54	7:42	11:09	10:15	53
33	AA	26	9/28	4:24	7:50	11:53	11:05	50
41	AA	26	10/1	4:34	7:13	10:46	10:46	59
46	AA	26	10/1	4:17	6:56	10:42	9:58	54
48	AA	26	10/2	6:21	9:11	13:20	12:42	60
63	AA	26	10/3	4:06	6:48	10:17	10:10	53
70	AA	26	10/4	4:52	6:49	10:19	9:10	52
76	AA	26	10/5	....	....	....	No	1.2
80	AA	26	10/5	4:11	6:59	11:38	11:50	52
9	BB	Bare	9/24	....	....	....	No	0.2
11	BB	Bare						
15	BB	Bare	9/25	....	....	....	No	0.2
18	BB	Bare						
36	BB	Bare						
47	BB	Bare	10/1	....	....	....	No	0.3
53	BB	Bare	10/2	....	....	....	No	0.3
57	BB	Bare						
65	BB	Bare						
69	BB	Bare	10/4	....	....	....	No	0.3
8	BB	26						
13	BB	26	9/25	....	....	....	No	2.7
17	BB	26	9/26	....	....	....	No	3.2
22	BB	26						
40	BB	26	10/1	13:05	....	....	No	4.2
44	BB	26						
50	BB	26						
58	BB	26	10/3	....	....	....	No	3.3
60	BB	26	10/3	....	....	....	No	4
66	BB	26						
4	DD	Bare	9/24	....	....	....	No	0.4
6	DD	Bare	9/24	....	....	....	No	0.2
23	DD	Bare	9/26	....	....	....	No	0.2
30	DD	Bare	9/27	....	....	....	No	0.6
32	DD	Bare	9/27	....	....	....	No	0.2

38	DD	Bare	10/1	....	....	....	No	0.2
56	DD	Bare	10/2	....	....	....	No	0.2
74	DD	Bare	10/4	....	....	....	No	0.4
77	DD	Bare	10/5	....	....	....	No	0.2
79	DD	Bare	10/5	....	....	....	No	0.4
3	DD	26	9/24	2:56	5:36	8:49	10:08	63
16	DD	26	9/26	3:23	8:23	12:29	15:18	74
24	DD	26	9/26	2:31	5:46	8:56	10:58	59
26	DD	26	9/27	3:26	7:02	10:27	12:40	54
28	DD	26	9/27	3:37	6:55	10:12	11:51	55
29	DD	26	9/27	3:04	6:19	9:30	11:49	56
31	DD	26	9/27	3:12	5:42	8:45	10:41	59
62	DD	26	10/3	3:25	6:22	9:48	12:16	57
67	DD	26	10/4	3:26	6:20	9:38	11:30	58
73	DD	26	10/4	3:26	6:29	10:08	13:08	54
1	EE	Bare	9/24	....	....	....	No	0.4
20	EE	Bare	9/26	....	....	....	No	0.6
21	EE	Bare	9/26	....	....	....	No	0.6
25	EE	Bare	9/26	....	....	....	No	0.4
27	EE	Bare	9/27	....	....	....	No	0.4
39	EE	Bare	10/1	....	....	....	No	0.6
49	EE	Bare	10/2	....	....	....	No	0.2
64	EE	Bare	10/4	....	....	....	No	0.4
72	EE	Bare	10/4	....	....	....	No	0.6
75	EE	Bare	10/5	....	....	....	No	0.5
5	EE	26	9/24	2:30	4:48	8:05	8:35	57
10	EE	26	9/24	2:22	4:38	9:22	9:34	63
12	EE	26	9/25	2:34	4:46	8:09	11:21	57
35	EE	26	9/28	3:00	5:24	9:30	12:49	54
37	EE	26	9/28	3:03	5:23	11:57	14:56	58
51	EE	26	10/2	2:53	5:20	10:09	12:36	53
54	EE	26	10/2	2:56	5:24	11:53	11:53	54
55	EE	26	10/2	3:13	5:34	9:47	11:40	58
71	EE	26	10/4	2:57	5:30	9:52	15:16	54
78	EE	26	10/5	2:44	5:05	9:30	11:15	52

Grayed out cells represent tests that were not conducted due to supply issues. These tests were incorporated into test series 2A when supplies became available.

Phase 2A. Small Open Flame Tests

Test	Barrier ID	Cover Fabric	Flame Source	Date	4%	10%	20%	Foam Ign.?	Final % Loss
3	BB	5	1	10/15	4:37	8:19	12:59	22:52	56
6	BB	5	1	10/15	5:50	10:21	13:58	24:54	56
10	BB	5	1	10/16	4:53	9:26	13:31	19:08	53
16	BB	5	1	10/17	4:39	9:24	13:36	22:26	54
19	BB	5	1	10/17	4:51	....	....	No	9.6
23	BB	5	1	10/18	5:05	8:29	13:02	18:49	57
25	BB	5	1	10/18	4:42	8:22	12:33	20:07	55
28	BB	5	1	10/19	4:31	9:18	13:50	28:50	54
30	BB	5	1	10/19	4:45	10:27	16:33	32:30	60
40	BB	5	1	10/24	5:18	12:10	17:15	26:05	51
5	BB	26	3	10/15	....	....	....	No	3.7
9	BB	26	3	10/16	23:29	....	....	No	4.4
12	BB	26	3	10/16	10:18	....	....	No	4.7
14	BB	26	3	10/17	4:34	15:19	23:10	26:55	53
39	BB	26	3	10/24	....	....	....	No	3.7
2	BB	Bare	3	10/15	....	....	....	No	0.2
17	BB	Bare	3	10/17	....	....	....	No	0.2
21	BB	Bare	3	10/17	....	....	....	No	0.2
33	BB	Bare	3	10/23	....	....	....	No	0.2
37	BB	Bare	3	10/23	....	....	....	No	0.2
1	FF	5	1	10/15	4:49	8:40	13:10	No	42
7	FF	5	1	10/16	4:51	8:00	11:27	13:18	53
11	FF	5	1	10/16	6:09	9:11	21:29	No	34
13	FF	5	1	10/16	8:46	....	....	No	4.4
18	FF	5	1	10/17	17:06	....	....	No	4.1
22	FF	5	1	10/18	8:42	....	....	No	7.4
32	FF	5	1	10/19	5:34	11:15	....	No	13
34	FF	5	1	10/23	....	....	....	No	1.7
36	FF	5	1	10/23	5:43	8:54	13:30	14:35	50
38	FF	5	1	10/24	5:40	10:00	14:05	15:44	50
4	FF	26	3	10/15	....	....	....	No	3.4
8	FF	26	3	10/16	6:04	....	....	No	4.6
15	FF	26	3	10/17	16:42	....	....	No	4.4
20	FF	26	3	10/17	23:16	....	....	No	4.0
24	FF	26	3	10/18	....	....	....	No	3.9
26	FF	26	3	10/18	....	....	....	No	3.8
27	FF	26	3	10/18	....	....	....	No	1.5
29	FF	26	3	10/19	....	....	....	No	3.1
31	FF	26	3	10/19	....	....	....	No	2.1
35	FF	26	3	10/23	....	....	....	No	3.0

Phase 3. Smoldering Tests

Test #	Barrier ID	Cover Fabric	Date	% loss	Horiz Char	Vert Char	Smoldering?	Comments
4	///////	24	10/25	45	2.9375	3	Y	fabric glowing
5	///////	24	10/25	50	2.875	3	Y	fabric glowing
11	///////	24	10/25	48	3	3	Y	fabric glowing
13	///////	24	10/26	54	3	3	Y	fabric glowing
20	///////	24	10/26	52	3	3	Y	fabric glowing
21	///////	24	10/26	46	2.9375	3	Y	fabric glowing
28	///////	24	10/26	43	2.9375	3	Y	smoldering
29	///////	24	10/26	52	3	3	Y	smoldering
36	///////	24	10/29	56	3	3	Y	fabric glowing
38	///////	24	10/29	55	3	3	Y	fabric glowing
3	BB	24	10/25	11	1.25	2.875	Y	smoldering
7	BB	24	10/25	10	1	2.8125	Y	smoldering
12	BB	24	10/25	16	1.5625	3	Y	smoldering
14	BB	24	10/26	8.9	1.125	2.875	Y	smoldering
17	BB	24	10/26	8.1	1.375	2.625	Y	smoldering
24	BB	24	10/26	18	2	3	Y	smoldering
26	BB	24	10/26	15	1	3	Y	smoldering
31	BB	24	10/26	7.7	1.25	2.75	Y	smoldering
34	BB	24	10/29	22	1.625	3	Y	smoldering
37	BB	24	10/29	13	1	3	Y	smoldering
2	FF	24	10/25	46	2.875	2.875	Y	smoldering
8	FF	24	10/25	55	2.9375	3	Y	fabric glowing
10	FF	24	10/25	52	2.9375	3	Y	fabric glowing
15	FF	24	10/26	58	3	3	Y	fabric glowing
18	FF	24	10/26	63	3	3	Y	smoldering
23	FF	24	10/26	65	3	3	Y	fabric glowing
25	FF	24	10/26	52	2.9375	3	Y	smoldering
30	FF	24	10/26	59	3	3	Y	fabric glowing
35	FF	24	10/29	59	3	3	Y	fabric glowing
40	FF	24	10/29	60	3	3	Y	smoldering
1	P	24	10/25	0.2	0	0	N	cool, no smoldering
6	P	24	10/25	0.2	0	0	N	cool, no smoldering
9	P	24	10/25	0.2	0	0	N	cool, no smoldering
16	P	24	10/26	0.3	0	0	N	cool, no smoldering
19	P	24	10/26	0.2	0	0	N	cool, no smoldering
22	P	24	10/26	0.2	0	0	N	cool, no smoldering
27	P	24	10/26	0.2	0	0	N	cool, no smoldering
32	P	24	10/26	0.1	0	0	N	cool, no smoldering
33	P	24	10/26	0.2	0	0	N	cool, no smoldering
39	P	24	10/29	0.2	0	0	N	cool, no smoldering

Phase 4. Smoldering Tests

Test #	Fabric	Barrier	Date	% loss	Horiz Char	Vert Char	Smoldering?	Comments
1	24	Thin Poly	11/5	0.3	0.3125	0.625	N	cool, no smoldering
6	24	Thin Poly	11/5	0.3	0.1875	0.4375	N	cool, no smoldering
9	24	Thin Poly	11/5	0.3	0.25	0.25	N	cool, no smoldering
2	24	Thin Poly and BB	11/5	0.2	0	0	N	cool, no smoldering
5	24	Thin Poly and BB	11/5	0.2	0	0	N	cool, no smoldering
8	24	Thin Poly and BB	11/5	0.2	0	0	N	cool, no smoldering
3	24	Thin Poly and FF	11/5	0.5	0.25	0.9375	N	cool, no smoldering
4	24	Thin Poly and FF	11/5	0.3	0.0625	0.5625	N	cool, no smoldering
7	24	Thin Poly and FF	11/5	0.3	0.1875	0.75	N	cool, no smoldering

Phase 4. Small Open Flame Tests

Test #	Fabric	Barrier	Date	4% loss	10 % loss	20 % loss	Foam Ign.	Final % loss
1	24	Thin Poly and FF	11/5	2:11	4:35	7:21	7:05	52
2	26	Thin Poly and FF	11/5	1:39	3:45	6:03	6:52	53
3	26	Thin Poly and BB	11/5	2:58	9:40	...	No	16
4	24	Thin Poly and FF	11/6	2:50	6:27	10:03	9:48	55
5	26	Thin Poly and FF	11/6	1:15	3:30	6:21	10:14	60
6	26	Thin Poly and BB	11/6	2:37	8:07	...	No	14
7	24	Thin Poly and FF	11/6	1:45	3:58	6:33	5:53	52
8	26	Thin Poly and FF	11/8	1:22	3:45	6:12	8:28	56
9	26	Thin Poly and BB	11/8	2:24	9:04	10:26	No	11

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

		Date:	November 16, 2007
TO:	Dale Ray Directorate for Economic Analysis		
THROUGH :	Russell Roegner, Ph.D. Associate Executive Director Directorate for Epidemiology Kathleen Stralka Division Director Division of Hazard Analysis		
FROM:	David Miller Division of Hazard Analysis		
SUBJECT:	Analysis of Laboratory Test Data for Upholstered Furniture		

Purpose:

CPSC Lab staff conducted a series of smoldering testing without barriers and both smoldering and small open flame testing with barriers. The pilot tests were conducted for several reasons. One was to characterize upholstery fabric smoldering performance. Another was to identify a possible standard cover fabric to evaluate foams for smoldering. A third was to identify barriers that might sufficiently improve flammability performance of upholstered furniture with cover fabrics that do not perform well without a barrier.

CPSC Lab staff conducted smoldering tests of upholstered furniture mockups using SPUF (Standard Polyurethane Foam) and five different cover fabrics. Each cover fabric was tested ten times at a 45 minute duration and ten times at a 90 minute duration. Overall there were 100 different smoldering tests (five cover fabrics * two test durations * ten replicates each). For each test three outcomes were measured. These outcomes were the percentage mass loss of the foam, the vertical char length of the foam (in inches) and the horizontal char length of the foam (in inches). The purpose of these tests was to evaluate different cover fabrics, test durations, and measures (mass loss and char length) as candidates for a possible standard cover fabric test.

A good candidate for a standard cover fabric would be a fabric that smolders enough to provide a challenge to the foam but that doesn't smolder so much that there is no reasonable test criterion for the foam. Also, a good candidate will smolder consistently – the variance of the measurements (whether it's mass loss or char length) will be relatively low. If the variance is high, then the fabric is not a good candidate (at least for that particular duration and measure) because then for a foam to pass a test consistently it would have to pass by a large margin on average. That is, a fabric that is highly variable with respect to outcome measures would impose a higher performance level on the foam.

The next group of tests was small open flame tests involving barriers. Some of these tests involved cover fabrics and others were just the barrier over bare foam. Rayon (Fabric 26) was used because it is very challenging in a small open flame scenario. For some tests a larger flame source was used and so a better performing fabric (synthetic blend, fabric 5) was used in combination. The purpose of these tests was to evaluate the effectiveness of individual barriers in an open flame scenario. Five different barriers were used in the testing.

The third group of tests was smoldering barrier tests. The purpose of these tests was to evaluate the two barriers (BB and FF) that performed the best on the small open flame barrier tests in a smoldering scenario. There were ten tests each of these two barriers over SPUF foam with a cotton-velvet cover fabric. For comparison there were also ten tests each of cotton-velvet over polyester batting and cotton-velvet with no barrier. Each test was 45 minutes in duration.

See Appendix for the results of all three groups of tests.

Findings:

Smoldering Non-barrier Testing:

- As shown by the overall analysis of variance F-tests (p-value < 0.0001), there is strong evidence that there are differences in smoldering behavior resulting from the different fabrics in these tests. This is true at both durations (45 minutes and 90 minutes) and for all three measures (%mass loss, horizontal char length, and vertical char length). All tests used a fabric over the same SPUF foam and the results showed large significant differences in smoldering behavior that must be attributed to the differences in the fabrics.

- Fabric 5 ('Blue shell' synthetic blend) smolders very little. Both at 45 and 90 minutes the sample mean for the percent mass loss was well below 1%. In fact, the average mass loss for 90 minutes was even lower than it was for 45 minutes. The smoldering doesn't continue very long after the cigarette stops burning. Because this fabric smolders so little, it may not pose an adequate smoldering challenge to materials beneath it. As a standard cover fabric, it may not provide a sufficient challenge to interior upholstery materials.

- Fabric 7 (predominantly cotton chenille) smolders greatly and overwhelms the SPUF foam used in the test. The horizontal char is all the way through the foam (3 inches) in all of the 45-minute and 90-minute tests. The vertical char is all the way through in all of the 90-minute tests and eight of the ten 45-minute tests. This fabric had an average of 63.54% mass loss in the 45-minute tests and 94.10% mass loss with the 90-minute tests. Three of the ten 90-minute tests resulted in flaming ignitions which were counted as 100% mass loss. Since this fabric smolders so much and overwhelms the standard foam, it may also not discriminate well as a standard test fabric among interior upholstery materials.

- Fabric 24 (Cotton velvet) smoldered nearly as much in the testing as Fabric 7. The horizontal char was all the way through the foam (3 inches) in six of the 45-minute and all ten of the 90-minute tests. For the vertical char, it burned through in seven of the 45-minute tests and all of the 90-minute tests. The average mass loss for the ten 45-minute tests was 47.93%. For the 90-minute tests the average was 87.83% including one test where the mockup caught fire which was counted as 100% mass loss. There was another test where the mockup didn't catch fire but there was 100% mass loss. Though it does not smolder as much as the chenille, this is a challenging standard cover fabric for a foam smoldering test.

- Fabric 25 ('Blue Stripe' cotton) generally didn't smolder very much but did on a few occasions. The distributions of the mass loss and the char length at both durations were heavy in the tails. At 45-minutes the mean mass loss was 2.04%. Nine of the ten tests showed a mass loss below the mean and there was one test with a mass loss of 8.18%. At 90-minutes there were three observations with high mass loss (76.24%, 90.31%, 92.64%) and the other seven were 2.48% or lower. This fabric appears to smolder in a bimodal way. It either doesn't smolder much at all or it smolders greatly. This large variability in its smoldering behavior would make it a poor candidate for a smoldering standard cover fabric. It would provide an inconsistent test for foams.

- Fabric 26 (Rayon) performed very similar to Fabric 25 in the smoldering tests. The distributions of the measurements were heavy in the tails for both 45-minute and 90-minute tests for all three outcomes. The sample mean mass loss for the 45-minute tests was 3.30% but eight of the ten tests had a mass loss of 1.87% or lower. The other two had mass losses of 8.58% and 13.76% respectively. At 90 minutes the same pattern emerges. Seven of the ten tests had mass losses of 1.34% or lower. The other three tests showed mass losses of 88.89%, 90.55%, and 100% (flaming ignition). As with Fabric 25, the mockups either do not smolder or they smolder greatly. At 90 minutes, the ones that smolder a lot have extremely high mass losses. The distribution of the measurements seems to be bimodal. This fabric would probably not provide a consistent smoldering test for the foams.

Small Open Flame Barrier Testing:

- The tests with the barriers over bare foam with no cover fabric show that the barriers performed very well in this situation with no cover fabric. Not only did none of these 40 tests reach 20% mass loss[1], none of them even reached 4% mass loss.

- The tests with cover fabric 26 (rayon) were more difficult for the barriers generally. Of the 50 tests, 20% mass loss was reached in 30 (60%) of these tests. It was reached in 29 of the 30 tests involving barriers AA, DD, and EE; however, this unacceptable level of mass loss was reached in only one of the ten tests involving barrier BB and none of the ten tests involving barrier FF.

[1] 20% mass loss is of particular interest because bench scale smoldering ignition tests have indicated that in mockups with less than 20% mass loss in 45 minutes, the filling materials do not ignite.

- Because barriers BB and FF were the better performers with the rayon cover fabric, they were challenged with a source 1 flame applied to Fabric 5 over the barriers. This was to give a stronger challenge to these barriers. Although Fabric 5 doesn't smolder much, it is a poor performer in a small open flame scenario. Nine of the ten tests with barrier BB and five of the ten with barrier FF allowed the foam substrate to reach 20% mass loss. Of the five barriers tested, only BB and FF appear to be possible candidates to be effective barriers in a small open flame scenario with a challenging small open flame cover fabric such as rayon.

Smoldering Barrier Testing:

- The polyester batting outperformed the two barriers in these tests. After 45 minutes all of the tests involving barriers BB and FF (as well as the no-barrier tests) were still smoldering. None of the ten tests with the polyester batting were still smoldering. These hardly smoldered at all showing an average mass loss of 0.19% and no foam char whatsoever.

- Barrier BB was more effective at preventing mass loss than barrier FF. The average mass loss for barrier BB was 12.98% whereas it was 56.82% for barrier FF. These were found to be significantly different using a Tukey multiple comparison test. Barrier BB did have five burn-throughs on the vertical char.

- The overall F-test for differences in mass loss between the three barriers was highly significant with a p-value < 0.0001. This indicates differences in the barriers' ability to prevent mass loss. The same was true for horizontal char and vertical char - the overall F-tests showed differences between barriers with a p-value < 0.0001. The multiple comparison tests for all three measures showed significant differences between all three barriers. Barrier BB is significantly different than barrier FF and polyester, barrier FF is significantly different than barrier BB and polyester, and polyester is significantly different than the two barriers.

  When the tests with no barrier are included, the overall F-test is still significant for all three measures. The multiple comparison tests show no significant differences between barrier FF and 'no barrier' but significant differences with all other comparisons.

Conclusions:

- Smolder prone fabrics such as Fabric 7 and Fabric 24 will continue to smolder and occasionally transition to flaming combustion.

- Of the five candidates for standard cover fabrics evaluated in the smoldering non-barrier tests, none appeared to be good candidates for a standard cover fabric to test foams. Fabric 7 and Fabric 24 smoldered a lot, Fabric 5 smoldered very little, and Fabrics 25 and 26 smoldered inconsistently.

- Of the five barriers examined in the small open flame barrier testing, only barriers BB and FF appear to be possibly effective at preventing a lot of foam mass loss when there is a challenging cover fabric.

- When barriers BB and FF were evaluated with a cigarette test and a cotton-velvet cover fabric, they didn't perform particularly well (especially barrier FF). Polyester batting, which was ineffective in a small open flame scenario, appears to be greatly effective at preventing smoldering.

Appendix

Results:

Smoldering Non-barrier Testing:

The five cover fabrics used in the tests were:

Fabric 5 – 'Blue Shell' synthetic blend
Fabric 7 – Predominantly Cotton Chenille
Fabric 24 – Cotton Velvet
Fabric 25 – 'Blue Stripe' cotton
Fabric 26 – Rayon

For each fabric, there were 10 tests at 45 minutes and 10 at 90 minutes. For each test the %mass loss as well as the vertical char and horizontal char were measured. There are six tables below – one for each combination of duration and outcome measure. Each table gives the arithmetic sample mean, sample standard deviation, number of 100% mass loss tests or burn through tests, and the coefficient of variation for the ten tests for each of the five fabrics. A burn through test is where the char goes all the way through the foam. The foam is 3 inches x 3 inches so the char length is counted as 3 for the burn through tests.

45 minutes, %Mass Loss

Fabric	x-bar	sd	#100% mass loss	cv	Observations (% mass loss)
5	0.62	0.49	0	79%	0.33, 0.39, 0.40, 0.41, 0.42, 0.42, 0.44, 0.46, 1.05, 1.88
7	63.54	6.89	0	11%	49.60, 55.91, 58.99, 62.36, 66.03, 66.18, 66.94, 67.93, 69.18, 72.28
24	47.93	6.06	0	13%	41.80, 42.17, 43.08, 43.51, 43.68, 48.14, 50.16, 52.31, 56.18, 58.27
25	2.04	2.19	0	107%	0.88, 0.95, 1.17, 1.18, 1.19, 1.39, 1.61, 1.88, 1.98, 8.18
26	3.30	4.34	0	132%	0.87, 0.94, 1.06, 1.23, 1.32, 1.64, 1.69, 1.87, 8.58, 13.76

90 minutes, %Mass Loss

Fabric	x-bar	sd	#100% mass loss	cv	Observations (% mass loss)
5	0.44	0.15	0	33%	0.26, 0.27, 0.32, 0.39, 0.45, 0.46, 0.48, 0.50, 0.51, 0.76
7	94.10	4.65	3	5%	88.49, 90.31, 90.33, 90.41, 91.17, 93.39, 96.86, 100, 100, 100
24	87.83	7.01	2	8%	80.59, 82.64, 83.18, 84.33, 84.77, 85.15, 86.19, 91.47, 100, 100
25	26.93	41.25	0	153%	0.72, 0.88, 0.95, 1.63, 1.72, 1.74, 2.48, 76.24, 90.31, 92.64
26	28.64	44.60	1	156%	0.62, 0.76, 1.00, 1.01, 1.12, 1.14, 1.34, 88.89, 90.55, 100

45 minutes, Horizontal Char (in inches)

Fabric	x-bar	sd	#burn throughs	cv	Observations (horizontal char)
5	0.26	0.11	0	43%	0.125, 0.125, 0.1875, 0.25, 0.25, 0.25, 0.25, 0.3125, 0.375, 0.5
7	3.00	0	10	0%	3, 3, 3, 3, 3, 3, 3, 3, 3, 3
24	2.98	0.03	6	1%	2.9375, 2.9375, 2.9375, 2.9375, 3, 3, 3, 3, 3, 3
25	0.85	0.46	0	54%	0.125, 0.625, 0.625, 0.75, 0.75, 0.8125, 0.875, 1.0, 1.0
26	1.00	0.64	0	64%	0.5625, 0.625, 0.625, 0.625, 0.75, 0.75, 0.75, 0.9375, 2.125, 2.25

90 minutes, Horizontal Char (in inches)

Fabric	x-bar	sd	#burn throughs	cv	Observations (horizontal char)
5	0.29	0.07	0	23%	0.1875, 0.25, 0.25, 0.25, 0.25, 0.3125, 0.3125, 0.3125, 0.3125, 0.4375
7	3.00	0.00	10	0%	3, 3, 3, 3, 3, 3, 3, 3, 3, 3
24	3.00	0.00	10	0%	3, 3, 3, 3, 3, 3, 3, 3, 3, 3
25	1.56	1.04	3	67%	0.625, 0.625, 0.75, 0.875, 0.9375, 1.0625, 1.75, 3, 3, 3
26	1.36	1.14	3	83%	0.5, 0.5, 0.5, 0.75, 0.75, 0.75, 0.875, 3, 3, 3

45 minutes, Vertical Char (in inches)

Fabric	x-bar	sd	#burn throughs	cv	Observations (vertical char)
5	0.48	.05	0	11%	0.375, 0.4375, 0.4375, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5625
7	2.93	.15	8	5%	2.625, 2.6875, 3, 3, 3, 3, 3, 3, 3, 3
24	2.96	.08	7	3%	2.8125, 2.8125, 2.9375, 3, 3, 3, 3, 3, 3, 3
25	1.49	.50	0	34%	0.75, 0.9375, 1.0, 1.25, 1.4375, 1.625, 1.75, 1.75, 2.125, 2.25
26	1.38	.67	0	49%	0.75, 0.75, 0.75, 1.0, 1.0625, 1.125, 1.6875, 1.75, 2.25, 2.625

90minutes, Vertical Char (in inches)

Fabric	x-bar	sd	#burn throughs	cv	Observations (vertical char)
5	0.44	0.07	0	15%	0.375, 0.375, 0.375, 0.375, 0.4375, 0.4375, 0.4375, 0.5, 0.5, 0.5625
7	3.00	0.00	10	0%	3, 3, 3, 3, 3, 3, 3, 3, 3, 3
24	3.00	0.00	10	0%	3, 3, 3, 3, 3, 3, 3, 3, 3, 3
25	1.91	0.91	3	48%	0.75, 0.75, 1.0, 1.5, 1.75, 2.0625, 2.25, 3, 3, 3
26	1.69	0.95	3	56%	0.75, 0.875, 1.0, 1.0, 1.25, 1.25, 1.8125, 3, 3, 3

For each of the six combinations of duration and measurement, the data showed significant differences among fabrics. The overall analysis of variance F-test which compares the differences in outcome measures within fabrics to the differences between fabrics was significant with a p-value less than 0.0001 for each of the six sets of data (five fabrics with 10 replicates each). So at each of 45 and 90 minutes, and for the three outcome measures (%mass loss, horizontal char length, and vertical char length) there were significant differences between fabrics. Tukey multiple comparison tests were performed for each of the six sets of data. For the 45-minute/%mass loss data set, these tests showed significant differences between Fabric 7 and all other fabrics as well as significant differences between Fabric 24 and all other fabrics.

For many of the fabric-duration-outcome measure combinations, the data does not appear to be normally distributed. Anderson-Darling tests for normality were done on each of the five fabrics for each of the six sets of data (two durations and three measurements). Only seven of the tests had p-values above 0.05. In the cases where the data doesn't appear normal, transformations were performed in an attempt to normalize the data. This met with varying degrees of success. In the end, since none of the fabrics appeared to be good standard cover fabrics (based on either smoldering too much, too little, or too inconsistently) it wasn't necessary to use any of the transformed data. If one of the fabric-duration-measure combinations was a good candidate but the data didn't appear to be normal, it would make sense to transform the data or maybe even do more testing to learn more about the distribution.

Small Open Flame Barrier Testing:

There were five different barriers tested. They were tested over bare foam with no cover fabric as well as with a cover fabric. In general, the barriers had no difficulty when there was no cover fabric but most barriers struggled to prevent a large mass loss when there was a cover fabric. The table below documents how often the tests reached a twenty percent mass loss of the foam substrate. The average time to 20% mass loss is given in the last column. This average is taken only for the tests that reached 20% mass loss. When looking at the average it is important to also keep in mind how many of the ten tests reached 20% mass loss to get an idea of how that particular barrier-fabric combination performed. The five barriers were:

Barrier AA
Barrier BB
Barrier DD
Barrier EE
Barrier FF

Barrier	Cover Fabric	Flame [2]Source	#Reps	#that reached 20% mass loss	Avg time to 20% mass loss
AA	Bare	3	10	0	-
AA	Fabric 26	3	10	9	11 minutes and 5 seconds
BB	Bare	3	10	0	-
BB	Fabric 26	3	10	1	23 minutes and 10 seconds
BB	Fabric 5	1	10	9	14 minutes and 9 seconds
DD	Bare	3	10	0	-
DD	Fabric 26	3	10	10	9 minutes and 52 seconds
EE	Bare	3	10	0	-
EE	Fabric 26	3	10	10	9 minutes and 49 seconds
FF	Fabric 5	1	10	5	14 minutes and 44 seconds
FF	Fabric 26	3	10	0	-

Smoldering Barrier Testing:

There were forty smoldering barrier tests performed and the percentage mass loss and char length measures (in inches) were recorded for each one. All used a cotton-velvet cover fabric (Fabric 24) and SPUF foam. Ten tests were performed with each of barrier BB, barrier FF, polyester batting, and no barrier. The outcome measures are percent mass loss, horizontal char of the foam substrate in inches, and vertical char of the foam substrate in inches. The tests were 45 minutes long. After the 45 minutes it was noted whether or not the mockup was smoldering or had stopped smoldering. Below are the results.

Barrier	x-bar %mass loss	sd %mass loss	x-bar h-char	sd h_char	x-bar v-char	sd v-char	# still smoldering after 45 minutes
None	50.15	4.39	2.97[3]	0.04	3[4]	0	10
BB	12.98	4.73	1.32	0.33	2.89[5]	0.13	10
FF	56.82	5.69	2.97[6]	0.04	2.99[7]	0.40	10
polyester	0.19	0.56	0	0	0	0	0

[2] Source 1 is a smaller flame than Source 3. It was thought that with Fabric 5, which is very prone to flaming, a smaller flame source would be necessary.
[3] Includes six that burned all the way through (3 inches).
[4] All ten burned through.
[5] Five burned through.
[6] Six burned through.
[7] Nine burned through.

Tab D

Technical Rationale Report for the 2007 Alternative Draft Standard for the Flammability of Upholstered Furniture

November 2007

Rohit Khanna and Shivani Mehta
Division of Combustion and Fire Sciences
Directorate for Engineering Sciences
U.S. Consumer Product Safety Commission
Washington, DC 20207

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1.0 Introduction

In October 2003, the U.S. Consumer Product Safety Commission (CPSC) published an advance notice of proposed rulemaking (ANPR) in the Federal Register, initiating the development of a possible proposed flammability standard addressing the risk of death and injury resulting from ignitions of upholstered furniture. This ANPR expanded an existing regulatory proceeding initiated under a previous ANPR published by the Commission in 1994. The CPSC staff's 2007 Alternative Draft Standard ("2007 alternative draft standard") is a regulatory option that takes into consideration a number of technical recommendations submitted by stakeholders in response to the 2003 ANPR and subsequent public meetings.

This report contains the basis for the technical requirements in the 2007 alternative draft standard. This approach addresses the fire hazard posed by furniture with an emphasis on the reduction of smoldering upholstery cover materials. The 2007 alternative draft standard allows for a manufacturer to select from one of two approaches to establish compliance with the flammability requirements.

The flammability tests incorporate bench scale test methods using mockups that represent the seating area configuration of furniture to evaluate upholstery cover materials and fire-barriers. Each material to be evaluated is assembled in a mockup in conjunction with standard test materials. A standardized ignition source is placed in the intersection of the vertical and horizontal surfaces, i.e., the crevice location of the mockup. Observations and measurements of mass loss are recorded during or at the conclusion of the specified test duration. The acceptable performance of upholstery materials is demonstrated by the resulting mass loss being below specified limits and the extinguishment of smoldering.

2.0 Objective

The objective of the 2007 alternative draft standard is to reduce the likelihood of deaths and injuries from upholstered furniture fires that predominantly result from careless smoking. In upholstered furniture fires, the primary fuel load is filling material, e.g., polyurethane foam, polyester fiber, and loose fillings, in the interior of a furniture item. The 2007 alternative draft standard requires upholstery cover materials or fire-barriers to protect this interior fuel load from ignition.

3.0 Upholstered Furniture Fire Hazard Data

Of the products within the CPSC's jurisdiction, ignitions of upholstered furniture are a leading cause of residential fire-related deaths, injuries and property damage. Some of the reported residential upholstered furniture fires involved ignition sources such as large open flames or electrical sparks/arcs. These fires are not considered addressable by the 2007 alternative standard. About 45% of estimated fires that occurred during the 2002 through 2004 period are potentially addressable by the 2007 alternative draft standard[1]. Estimated addressable fire losses are shown in Table 1.

Table 1
Residential Upholstered Furniture:
Estimated Average Annual Addressable Fire Losses 2002-2004

	Smoking Materials	Small Open Flame	Total
Fires	2,500	1,100	3,500
Deaths	260	30	280
Injuries	320	170	500
Property Damage	$65 million	$46 million	$112 million

*All estimates within categories are rounded; totals are based on non- rounded estimates; property loss estimates are unadjusted. Source: CPSC Directorate for Epidemiology, 2007

Ignitions from smoking materials (primarily cigarettes) account for about 90% of estimated deaths, 65% of estimated injuries and 59% of estimated property damage. Analysis of the most recent available residential fire loss estimates supports the focus of the 2007 alternative draft standard on improving the smoldering ignition resistance of upholstered furniture.

4.0 Development of the 2007 Alternative Draft Standard

The 2007 alternative draft standard development focused on improving the methodologies that would address cigarette ignited fires, which caused an estimated 90% of the fatalities from 2002 through 2004. A significant difference in approach of the 2007 alternative draft standard from the previous version (2005 draft standard[2]) is the exclusion of open flame requirements for upholstery filling materials. The decision to exclude open flame requirements for fillings is based on the relatively low potential reduction in addressable open flame fire deaths (10% of total) and on the staff's desire to minimize the use of flame retardant (FR) chemicals additives in interior filling materials. There is a lack of toxicity data and empirical exposure data; particularly related to inhalation of some vapor phase FR chemicals[3].

During development of the 2007 alternative draft standard, CPSC staff analyzed recent available hazard data, held discussions with interested stakeholders and conducted additional laboratory testing to evaluate the technical feasibility of this. Interested stakeholders provided data and suggestions that the staff considered in developing the requirements and test procedures of the 2007 alternative draft standard.

4.1 Bench-Scale Test Methods

The application of bench scale test methods has been used in consensus voluntary standards and government regulations to evaluate upholstered flammability hazards by the U.S. and international communities. Bench scale tests evaluate the response of materials to an ignition source under controlled laboratory conditions, but due to smaller scale and simplified geometry, do not fully characterize finished products under real-world fire conditions. The materials used and the geometry of mockups are significant factors in the extent to which the data obtained from bench scale tests reflect the performance of finished products. To bridge the gap between bench scale test results and real-world flammability performance, validation testing is needed. Validation testing should consist of a test program comparing material bench scale test data to large or full scale performance. In Fiscal Year 2008, the CPSC staff plans to begin large scale validation testing in support of a possible proposed standard.

Each upholstery cover material or interior fire barrier material subject to the 2007 alternative draft standard is tested as part of a composite assembly, where the material's flammability performance is evaluated in conjunction with standard test materials. Figure 1 and Figure 2 show the mockup assemblies for smoldering and open flame ignition tests.

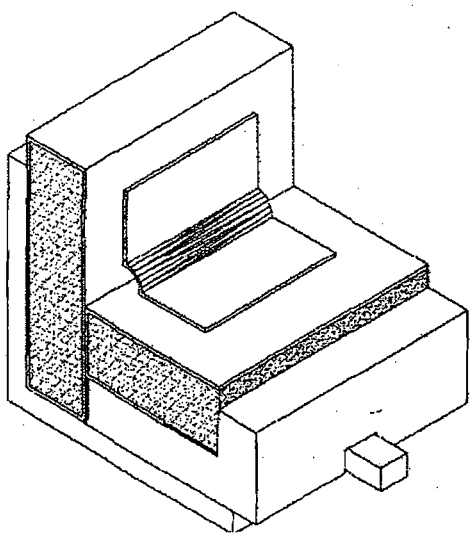

Figure 1. Smoldering Resistance Mockup

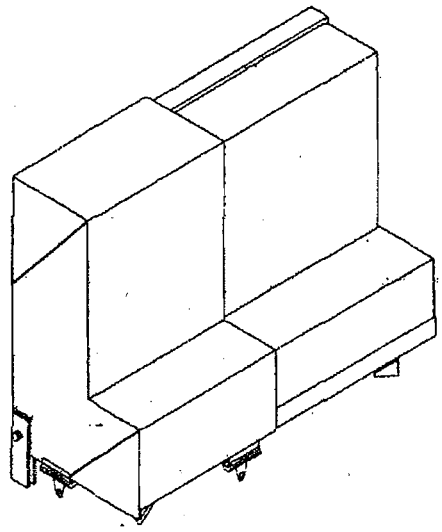

Figure 2. Open Flame Resistance Mockup

4.2 Furniture Classification: Type I and II

In the 2007 alternative draft standard, upholstered furniture materials are subject to applicable bench scale smoldering and open flame test requirements based on the classification chosen by the manufacturer: Type I or Type II.

Type I furniture is defined in the 2007 alternative draft standard as furniture that is assembled with a cover material that is smolder resistant according to a bench scale performance test conducted with a standard foam substrate. In fires involving ignition by cigarettes, upholstery cover materials are typically the first item ignited. By providing stringent performance requirements for the upholstery cover materials with respect to smoldering ignition, the 2007 alternative draft standard aims to substantially reduce the likelihood that smoldering ignitions will progress to involve underlying filling materials. There are no specific performance requirements for filling materials in Type I furniture.

In the case that some cover materials cannot meet the specified performance requirements, manufacturers can classify such furniture as Type II by using an interior fire barrier to provide protection for filling materials. Type II furniture is defined in the 2007 alternative draft standard as furniture that is produced with an interior fire barrier. Interior fire barriers must comply with the applicable smoldering and open flame bench scale test methods. There are no additional requirements for cover or filling materials in Type II furniture. This type of furniture is included in the standard to provide flexibility to manufacturers and to increase consumer choice. The staff expects that Type II upholstered furniture would mainly be relatively low-volume, higher-priced articles using decorative fabrics that may be more smolder-prone.

4.3 Performance Measures

Existing upholstered furniture flammability standards use various parameters to establish acceptable performance to assess fire hazards posed by the materials. These parameters include allowable duration of combustion (extinguishment), flame spread, char length, total mass loss, or heat release rates experienced during or at the end of the test. The 2007 alternative draft standard's performance measures include extinguishment, substrate mass loss, composite assembly mass loss, and observations of ignition such as mockup transition to flaming.

Mass Loss Application in Smoldering Tests

As discussed in a previous briefing package [2], the rationale for designating mass loss as opposed to char length measurement to assess the smoldering ignition performance of materials was based on observations during bench scale testing. It is important to note that mass loss in smoldering tests does not apply to material being evaluated (cover materials or interior fire barriers), but to the standard foam substrate. Bench scale tests show that smoldering can progress in any direction from the ignition source, including downward and/or into the interior materials. Since smoldering is a 3-dimensional phenomenon, a 1-dimensional char length measurement is not a sufficient parameter to determine smoldering behavior. The amount of mass loss of the substrate provides a good indication of the smolder propensity of a cover material in Type I furniture and a good indication of an interior fire barrier's ability to protect filling materials in Type II furniture. The smoldering tests in the 2007 alternative draft standard employ the same mass loss measurement techniques as in the 2005 Staff Draft Standard[2].

Mass Loss Application in Open Flame Tests

To assess the fire hazard of upholstered furniture, it is important to evaluate the progress of combustion into the interior materials. As discussed in the previous briefing package, mass loss (opposed to flame spread) is a better indicator of the flammability performance since it provides information on the involvement of interior materials[2]. The open flame test in the 2007 alternative draft standard employs the same mass loss measurement techniques as the 2005 Staff Draft Standard.

4.4 Standard Materials

The performance tests specified in the 2007 alternative draft standard require the use of standard materials to ensure that the evaluation accounts for the interaction of upholstery materials in the finished article of furniture. The performance tests require five standard materials: one foam substrate, two types of cover fabrics, sheeting material and a smoldering ignition source.

Standard Polyurethane Foam (SPUF) Substrate

The Standard Polyurethane Foam (SPUF) substrate represents foam cushioning used in furniture. A SPUF substrate is used in the performance tests for both Type I and Type II furniture.

The specifications of the SPUF substrate are as follows:

(1) Density: 1.8 ± 0.1 lb/ft^3
(2) Indentation Load Deflection (ILD) (%): 25 to 30
(3) Air Permeability: Greater than 4.0ft^3/min
(4) No flame-retardant chemical treatment as determined by post production chemical analysis

To ensure repeatability of the SPUF substrate's combustion behavior, there are additional smoldering and open flame test performance requirements specified in the 2007 alternative draft standard to qualify the standard foam.

Standard Cover Fabrics

Standard cover fabrics are used for evaluation of the flammability performance of interior fire barriers. The standard cover fabric represents the outermost layer of upholstered furniture constructions, which is typically the first material to be exposed to an ignition source. Once the cover fabric ignites, it acts as the ignition source for the components below it, i.e., interior fire barriers and fillings.

The 2007 alternative draft standard requires that fire barrier mockups incorporate standard cover fabrics, both for smoldering and open flame tests. A cotton velvet fabric was chosen as the standard cover fabric for the smolder resistance tests as a result of evaluations conducted by CPSC staff in 2007.[4,5] The general requirements for the fabric are as follows:

(1) Cotton Velvet
(2) Weight/linear yard: nominally 10.0 oz/yd^2

In addition to the above requirements, the standard cotton velvet fabric must be tested over the SPUF substrate to demonstrate flammability characteristics as described in the 2007 alternative draft standard. While recent research has demonstrated that the cotton velvet is not a consistent performer as an open flame source, it is a reasonable smoldering ignition source due to its relatively high smolder propensity and low observed coefficient of variation in smoldering testing[5]. This fabric provides an appropriate smolder challenge to the fire barrier material with reasonable consistency.

A rayon fabric was chosen as the standard fabric for the open flame tests. The rayon cover fabric is a plain weave fabric that provides a repeatable and appropriate open flame ignition source on the interior fire barriers.[4,5] The rayon fabric is specified as a standard test material in the UFAC test method for interior barriers. The general requirements for the standard rayon cover fabric are as follows:

(1)100% bright regular rayon, scoured, 20/2, ring spun, basket weave construction,
(2) 271 ± 12 g/m^2 (8.0 ± 0.5 oz/yd^2)

In addition to the above requirements, the rayon fabric must be tested over the SPUF substrate to demonstrate flammability characteristics as described in the 2007 alternative draft standard to ensure consistency.

Standard Sheeting Material

Sheeting material is used to cover the standard test cigarettes after they are lit and placed in the crevice location of mockups. The cotton sheeting induces smoldering and reduces the likelihood of self-extinguishment of the standard test cigarettes. Covering the test cigarette makes ignition of the cover material more likely to occur. The general specifications for the sheeting material are as follows:

(1) Fiber content: 100% cotton
(2) Color: white
(3) Construction: plain weave, 19-33 threads per square centimeter (120-210 threads per square inch)
(4) Weight: 125± 28 g/m^2 (3.7 ± 0.8 oz/yd^2)

Prior to testing, the cotton sheeting is laundered according a procedure specified in the 2007 alternative draft standard to remove any finishing on the fabric that may influence test results.

Standard Smoldering Ignition Source

Test data evaluating temperatures developed by burning cigarettes show that king-size non-filter tipped cigarettes produce higher smoldering temperatures than their filter tip counterparts. Based on the results of this study, the non-filter tip cigarette was selected as the standard ignition source for 16 CFR Part 1632 - Standard for the Flammability of Mattresses and Mattress Pads. This ignition source is also accepted as an appropriate standard smoldering ignition source as specified in UFAC and ASTM voluntary standards.

The ignition source for all tests shall be:
(1) Cigarettes without filter tips made from natural tobacco
(2) 85 ± 2 mm (3.3 ± 0.1 in) long
(3) Packing density of 0.27 ± 0.02g/cm^3 (0.16 ± 0.01 oz/in^3)
(4) Total weight of 1.1 ± 0.1 g (0.039 ± 0.004 oz).

5.0 Type I – Upholstery Cover Fabrics

Complying Type I furniture must use upholstery cover materials that pass a smoldering ignition resistance test. The smoldering test method uses a bench-scale mockup approach and is based on the ASTM International (ASTM)/Upholstered Furniture Action Council (UFAC) voluntary method.[6] The mockups are constructed with the sample of material to be evaluated in conjunction with standard polyurethane foam to represent the seating area configuration of furniture. A standard cigarette ignition source is lit, placed in the crevice location formed by the intersection of vertical and horizontal panels of each test assembly, and covered with cotton sheeting material. Test observations and measurements are recorded during the 45-minute test duration. In order for a cover fabric to pass the test, at the end of the 45-minute test duration, the following requirements must be met:

(1) No transition to flaming occurs during the 45-minute test duration.

(2) No smoldering of the mockup is observed at the end of the 45-minute test duration.
(3) The mass loss of the standard polyurethane foam substrate must not exceed 10%.

5.1 Acceptance Criteria Discussion

Time Limit

A comprehensive bench scale test program conducted in previous years indicated the importance of a time limit on the smoldering tests. The 2005 staff draft standard limited the test duration to 30 minutes.[2] Additional data and experience gained from testing indicate that the 30 minute limit is not adequate to observe smoldering behavior of upholstery materials.[4, 5] The standard cigarette takes an average of 25 minutes to burn to completion. Incident and anecdotal information indicates that fires resulting from dropped cigarettes begin after a considerable amount of time has passed. However, the open-ended nature of the UFAC test procedure is not considered practical by CPSC staff as it can lead to excessive variability in test results. The 2007 alternative draft standard limits the test duration to 45 minutes to provide more time for the smoldering cigarette ignition source to consume itself and to observe resulting smoldering behavior. The staff considered longer times (e.g. 90 minutes), but observed that mockups smoldering after 45 minutes were likely to continue to smoldering for extended periods and may transition to flaming combustion.

Extinguishment Requirement

The 2007 alternative draft standard includes a requirement that the cover fabric fully extinguish by the end of the 45-minute test, with no observable smoldering of the mockup assembly. This variation from prior versions of the test requirements becomes essential to protect upholstered furniture fillings from exposure to an ignition source. CPSC staff testing has shown that smolder-prone cover fabrics may continue to smolder slowly then progressively transition to flaming even after the originating ignition source, i.e., a cigarette, has extinguished.[4] Therefore, the requirement for smoldering to end assures that the cover fabric has extinguished and that fillings will be adequately protected from being ignited. Since furniture filling materials are not subject to flammability performance requirements, the requirement for upholstery cover materials to extinguish at the end of the test will result in the use of more smolder ignition resistant furniture and substantially reduce furniture fires.

10% Mass Loss Limit

In addition to the extinguishment requirement, substrate mass loss is also evaluated to ensure smoldering from upholstery fabrics does not penetrate to interior materials. Not withstanding cover material self-extinguishment, the 10% maximum allowable post-test mass loss limit was developed based on bench scale smoldering ignition tests using a wide range of upholstery materials and procedures similar to the UFAC standard. The data suggested that a 10% mass loss performance metric would be acceptable to determine whether or not smoldering has progressed to the interior of the mockup.[2]

5.2 Apparatus and Materials

The 2005 Staff Draft Standard included a draft enclosure as one specified in the UFAC test method. The draft enclosure was included in the test method to limit extreme changes in surface ventilation rates. Tests conducted by the CPSC staff indicate that the draft enclosure limits the available oxygen for the test mockups to burn, which artificially lessens the severity of the test for smolder prone materials.[7] The presence of the draft enclosure has little impact on test results with fabrics that have a low propensity to smolder; whereas in high smolder prone fabrics, the presence of the draft enclosure plays a more significant role in performance. High smolder propensity fabrics can consume the available oxygen quickly and self-extinguish before the end of the test duration. The 2007 alternative draft standard eliminates the use of the draft enclosure in smoldering ignition testing and specifies testing be conducted in a controlled test room environment to limit draft effects.

The 2007 alternative draft standard described here requires the same specimen holders, ignition source, sheeting material and conditioning requirements, as the 2005 Staff Draft Standard.[2]

5.3 Performance Test

Scope

This test method is intended to measure the cigarette ignition resistance of upholstery cover materials used in upholstered furniture and to evaluate the likelihood of smolder transfer to underlying materials. Upholstery cover materials that do not meet the requirements of this test can only be used in furniture with complying interior fire barrier materials, as described below in 6.0 Type II Interior Fire Barriers.

Summary of Test Method

Vertical and horizontal panels of a standard polyurethane foam (SPUF) substrate are covered, using the upholstery cover fabric to be tested as seen in Figure 3. These panels are placed in specimen holders, and a lit cigarette is placed in each crevice formed by the intersection of vertical and horizontal panels of each test assembly. Each cigarette is covered with a piece of standard cotton sheeting fabric. The cigarettes are allowed to burn their entire length. Test measurements and observations are recorded during the 45-minute test duration. The sample must not exceed the mass loss limit, transition to open flaming or present any signs of smoldering.

This test method is based on the ASTM /UFAC cigarette ignition resistance of components of upholstered furniture standards.[6] The significant differences include an extinguishing requirement at the end of the test, test duration of 45 minutes, and the use of mass loss as a performance measure as opposed to vertical char length.

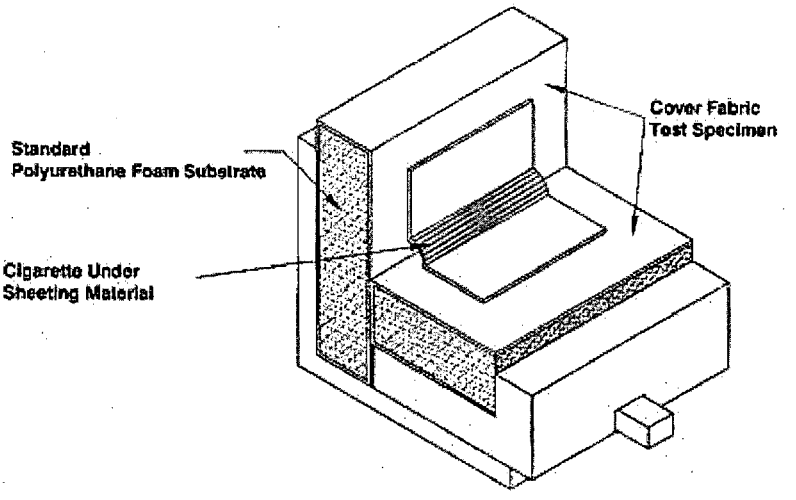

Figure 3. Mockup Assembly for Upholstery Cover Fabric Smoldering Ignition Resistance Test.

6.0 Type II Interior Fire Barriers

Interior fire barriers must pass a smoldering resistance and an open flame resistance test for the upholstered furniture to comply as Type II furniture. Although the 2007 alternative draft standard aims to address fires caused by smoldering ignition sources, an open flame evaluation is included in the interior fire barrier requirements in case the cover fabric transitions to flaming after being exposed to a smoldering ignition source such as a cigarette. Since the reactions of the interior fire barrier to a smoldering ignition source and to an open flame source may differ, the resistance tests have different acceptance criteria. Materials that comply with the smoldering and open flame requirements of the 2007 alternative draft standard limit the transfer of combustion to underlying materials. These test requirements provide manufacturers greater flexibility in production of complying upholstered furniture.

The smoldering ignition resistance test method uses the same bench scale mockup approach as for the cover fabric performance tests. The mockups are constructed with a sample of the interior fire barrier between a standard cotton velvet cover fabric and a standard polyurethane foam substrate to represent the seating area configuration of furniture. A standard cigarette ignition source is lit, placed in the crevice location formed by the intersection of vertical and horizontal panels of each test assembly, and covered with cotton sheeting material. Test observations and measurements are recorded during the 45-minute test duration. In order for an interior fire barrier to pass the test, at the end of the 45-minute test duration, no more than 1% mass loss of the foam substrate is allowed. The 1% maximum allowable mass loss provision for interior fire barriers requires that that barriers maintain their structural integrity for the duration of the test; this substantially reduces the likelihood of smolder-prone fabrics igniting the underlying filling materials.

The open flame resistance test method uses a bench scale mockup and is based on the British Standard (BS 5852) test method. The mockups are constructed with a sample of the interior fire barrier between a standard rayon fabric and a standard polyurethane

foam substrate to represent the seating area configuration of furniture. A 240 mm, butane flame is applied to the center of the crevice of the mockup for 70 seconds. Test observations and measurements are recorded during the 45-minute test duration. In order for an interior fire barrier to pass the test, the mass loss of the entire mockup must not exceed 20% at the end of the 45-minute test duration.

6.1 Type II Smolder Acceptance Criteria Discussion

1% Mass Loss

Since Type II furniture allows for any type of cover material to be used it is paramount that the barrier be able to protect the fillings as the cigarette transfer smoldering from the cover material into interior materials. The 1% maximum allowable mass loss requirement is intended to require interior fire barriers to protect filling materials from smoldering ignition by allowing minimal smolder progression into the substrate.

6.2 Type II Open Flame Acceptance Criteria Discussion

20% Mass Loss & Time Limit

The 20% maximum allowable mass loss limit was developed based on bench scale open flame ignition tests over a wide range of upholstery materials. These tests indicated that mockups with less than 20% mass loss in a 45-minute test duration, exhibit a reasonable delay in fire growth.[2]

6.3 Apparatus and Materials

Smolder Resistance Tests

The 2005 Staff Draft Standard required a draft enclosure when evaluating the smolder resistance performance of interior fire barriers. As is the case in the tests for Type I cover fabrics, Type II interior fire barriers are tested without the draft enclosure in the 2007 alternative draft standard. The specimen holders, ignition source, sheeting materials and conditioning, for the smolder resistance tests are the same as the 2005 Staff draft standard.

Open Flame Resistance Tests

Open flame resistance tests are required to be conducted in a test room with a volume that is greater than $20m^3$ to ensure sufficient oxygen for testing. This requirement is the same as in the 2005 CPSC Staff Draft Standard. The specimen holder for the open flame resistance test is a metal frame as described in the 2005 CPSC Staff Draft Standard.

The ignition source for the interior fire barrier open flame resistance test is a 240 mm (nominal) butane flame that is applied to the center of the crevice for 70 seconds. This ignition source is specified in the British Standard, BS 5852, as Source 3. The flame size and duration are needed to evaluate the interior fire-barrier's ability to prevent the spread of fire to underlying materials. Since interior fire-barriers would be located between potentially flammable cover fabrics and filling materials, it is critical that interior fire barriers be capable of withstanding the heat exposure presented by an ignited cover fabric.

6.4 Interior Fire Barrier Smolder Resistance Performance Test

Scope

This test method is intended to measure the smolder ignition resistance of interior fire-barrier materials used in upholstered furniture. This test method applies to fire-resistant interior fabrics, battings, or other materials to be qualified as fire barriers. Smoldering requirements for interior fire barrier materials are included in the 2007 alternative draft standard as an alternate means of achieving ignition resistance. Preliminary CPSC Laboratory testing indicate that combinations of commercially available materials can be placed between upholstery cover and filling materials to prevent the transfer of smoldering to underlying materials, therefore reducing the need for complying upholstery cover fabrics and FR filling materials. In addition to complying with this test, interior fire barrier materials must also comply with open flame test requirements described in Section 6.5 to be qualified as approved fire barriers.

Summary of Test Method

Vertical and horizontal panels of the interior fire barrier material to be tested are placed between a standard foam substrate and a standard cover fabric as seen in Figure 4. The panels are placed in specimen holders and a lit cigarette is placed in the crevice formed by the intersection of the vertical and horizontal panels in each test assembly. Each cigarette is covered with a piece of standard cotton sheeting fabric. The cigarettes are allowed to burn their full length. Test measurements and observations are recorded during the 45-minute test duration. The interior fire barrier must not allow more than 1% mass loss of the foam substrate at the end of the test duration.

This test method is based on the barrier material test included in the ASTM/UFAC voluntary standards. The significant differences in the 2007 alternative draft standard and the ASTM/UFAC test methods are the test duration of 45 minutes, and the use of mass loss as the performance measure as opposed to vertical char length.

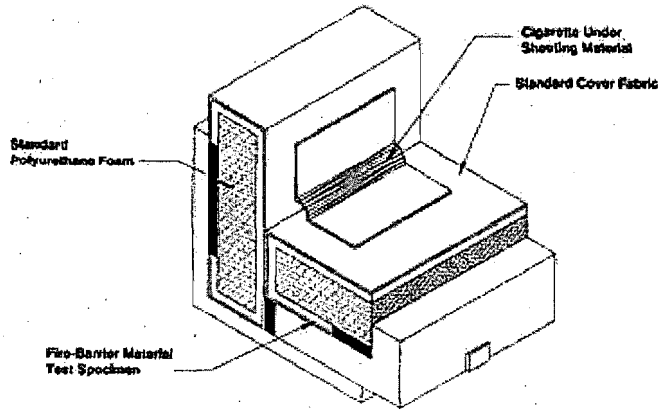

Figure 4. Mockup Assembly of Interior Fire Barrier Material Smoldering Ignition Resistance Test.

6.5 Interior Fire Barrier Open Flame Resistance Performance Tests

Scope

This test procedure is intended to measure the open flame ignition resistance of interior fire barrier materials used in upholstered furniture construction. This test applies to interior fabrics, or other suitable materials, to qualify them as approved interior fire barriers. These test requirements provide manufacturers greater flexibility in production of complying upholstered furniture. In addition to complying with this test, interior fire barriers must also comply with the barrier smoldering test requirements described in Section 6.4 to be qualified as approved interior fire barriers.

Summary of Test Method

The interior fire barrier material to be tested is placed between a standard rayon cover fabric and standard polyurethane foam substrate and assembled on a metal test frame (see Figure 5). A 240mm butane flame ignition source is applied to the crevice formed by the intersection of the seat/back surfaces of the mockup for 70 seconds. Test measurements and observations are recorded during the 45-minute test duration. The mockup assembly must not exceed a 20% mass loss limit.

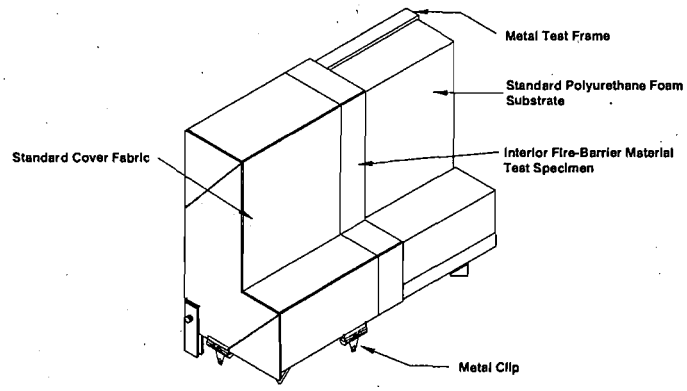

Figure 5. Mockup Assembly of Interior Fire Barrier Material Open Flame Ignition Resistance Test.

7.0 CPSC Staff's 2007 Alternative Draft Standard and the UFAC Method

Although portions of the UFAC method are used in the 2007 alternative draft standard, the staff concludes that the UFAC method alone does not adequately address the residential smoldering fire risk. The performance metric of char length in the UFAC method does not adequately identify the burning behavior within the mockup. The draft enclosure used in the UFAC method was intended to minimize air disturbances but also acts to limit oxygen to highly smolder-prone materials, which can result in smoldering prone materials meeting test requirements. While smoldering fires can take a significant amount of time to develop, a time limit must be imposed on the test duration for practical comparison of data among upholstery materials. Lastly, the UFAC method does not address open flame ignition of interior barriers; the criteria allow highly smolder-prone materials to overwhelm interior barriers by not adequately testing the barriers with open flame ignition sources. The interior fire barrier is not directly exposed to the smoldering

ignition source, i.e. a cigarette; instead it is directly exposed to the cover fabric. If the cover fabric transitions to flaming as a result of being exposed to a smoldering ignition source, the interior barrier will be exposed to an open flame.

8.0 Conclusions

This report serves as a technical rationale document to support the CPSC Staff's 2007 Alternative Draft Standard. The goal of the standard is to significantly reduce the number of deaths, injuries, and property loss caused by upholstered furniture fires. The 2007 alternative draft standard developed by staff is a technically feasible flammability standard that would substantially improve the smoldering ignition resistance of upholstered furniture.

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1 Memorandum to D. Ray, Project Manager, Upholstered Furniture Project, from D. Miller, "Upholstered Furniture Addressable Fire Loss Estimates for 2002-2004".
2 U.S. Consumer Product Safety Commission, "Status Update on Regulatory Options for Upholstered Furniture Flammability," January 2006.
3 CPSC Directorate for Health Sciences Report, "CPSC Staff Preliminary Risk Assessment of Flame Retardant (FR Chemicals in Upholstered Furniture Foam", December 2006.
4 CPSC Directorate for Laboratory Sciences Memorandum, A. Bernatz, L. Fansler, and L. Scott, "Test Program for Upholstery Fabrics and Fire Barriers", November 2007.
5 CPSC Directorate for Epidemiology Memorandum, D. Miller "Analysis of Laboratory Test Data for Upholstered Furniture", November 2007.
6 ASTM E 1353 Cigarette Ignition Resistance of Components of Upholstered Furniture and Upholstered Furniture Action Council Test Methods
7 CPSC Directorate for Laboratory Sciences Memorandum, W. Tao, "Upholstered Furniture-Evaluation of the Draft-Limiting Enclosure Specified in the Smoldering Ignition Test Method", October 2006.

Tab E

Environmental Assessment of Regulatory Alternatives for Addressing Upholstered Furniture Flammability

Robert Franklin
Directorate for Economic Analysis
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Introduction

This report discusses the potential environmental effects of several regulatory alternatives for addressing the flammability of residential upholstered furniture. The regulatory alternatives have been developed by the staff of the Consumer Product Safety Commission (CPSC) over several years and are intended to reduce deaths, injuries, and property damage from fires originating in residential upholstered furniture (RUF). Each of the alternatives considered would establish performance standards that upholstered furniture components would have to meet. Generally, CPSC rules establishing performance requirements are considered to "have little or no potential impact for affecting the human environment" and environmental assessments are not usually prepared for these rules (see 16 CFR § 1021.5 (c)(1)). However, depending upon the specific regulatory alternative selected, some manufacturers may have to change some materials that they use in RUF. In order to meet the requirements some manufacturers could opt to use flame retardant (FR) chemicals. Because some flame retardant chemicals have been identified as having the potential for adverse effects on the environment, a more thorough consideration of the potential environmental impacts is warranted.

This analysis concludes that since all of the regulatory alternatives are performance standards, manufacturers will have several options for meeting the requirements under all of the alternatives. Even for those alternatives that could require a greater quantity of FR chemicals, although there are still some unsettled questions, there appear to be several promising methods that manufacturers could use without posing an unacceptable health risk to consumers or significantly affecting the environment. Moreover, even if a chemical used by some furniture or component manufacturers is later shown to pose an unacceptable risk to human health or the environment, there are various regulatory and other mechanisms that could be used to remove the chemical from applications where it poses a risk.

Purpose

The purpose of the regulatory alternatives is to reduce deaths and injuries due to fires that originate in upholstered furniture. Fires originating in upholstered furniture are responsible for an estimated 280 deaths and 500 injuries annually that could be addressed by a standard. These are often caused by lit cigarettes falling onto the furniture and smoldering until a fire starts or by small open flames, such as a candle toppling over or from children playing with matches or lighters. Fires resulting from smoking materials (almost always cigarettes) account for 90% of the deaths and 65% of the injuries.

Regulatory Alternatives

Specifically, this assessment is considering the potential environmental effects of 5 regulatory alternatives that are presented in a CPSC staff briefing package to the Commission. A brief description of each of these alternatives is given below.

CPSC staff's 2007 alternative standard. The CPSC staff's 2007 alternative standard focuses on smoldering ignition resistance. It would require upholstered furniture cover fabrics to pass a smoldering ignition resistance test. Manufacturers would have the option of using fire blocking barriers between the cover fabrics and filling materials in lieu of using qualified cover fabrics. The fire blocking barriers would have to pass both a smoldering ignition resistance test and an open-flame ignition resistance test.

CPSC staff's 2005 draft standard. The CPSC staff's 2005 draft standard contains a smoldering ignition resistance standard for all upholstered furniture cover fabrics. It also includes both smoldering ignition resistance tests and open flame ignition tests for the filling materials, such as polyurethane foam and fibrous batting or loose fill. Manufacturers would have the option of using fire blocking barriers between the cover fabrics and filling materials in lieu of using qualified cover fabrics or filling materials. The fire blocking barriers would have to pass both a smoldering ignition resistance test and an open-flame ignition resistance test.

CPSC staff's 2001 draft standard. The CPSC staff's 2001 draft standard contains open flame ignition resistance tests for upholstered furniture cover fabrics. There are no tests for filling materials.

2002 revised draft of California TB-117. The 2002 revised draft of a California Technical Bulletin 117 (or "TB-117") contains open flame ignition resistance requirements for cover fabrics and both open flame and smoldering ignition resistance requirements for filling materials.

Mandating the UFAC guidelines. The Upholstered Furniture Action Council (UFAC) developed voluntary guidelines for flammability resistance to which an estimated 90% of all residential upholstered furniture are thought to be in conformance with. The UFAC guidelines contain cigarette smoldering ignition resistance tests for cover fabrics. Additionally, there are some construction criteria for welt cords, decking substrates, filling materials, and interior fabrics.

Potential for Affecting the Environment

If the draft standard has any adverse environmental impact it will likely result from the use of FR chemicals to meet the requirements. FR chemicals are not a specific class of chemicals, but include many different types of chemicals. Chemicals that can have flame retardant properties include some chemicals that are boron, phosphorous, nitrogen, bromine, and chlorine-based. Antimony trioxide is often used with some other FR chemicals as a synergist.

Life Cycle of Residential Upholstered Furniture

In considering the environmental impact of a standard, one must consider the impact at each stage of the life cycle of the product. In the case of FR chemicals and barriers used in RUF, this will involve the extraction and refinement of raw materials and the use of these materials to

manufacture the FR chemicals or materials. These materials must then be incorporated into the furniture components, such as the filling materials, cover fabrics, and barriers. These processes involve the use of labor, energy, and other chemicals. During these processes workers may be exposed to some of the chemicals and environmental releases may occur, depending upon the processes and the controls used.

The components must be shipped to the furniture manufacturers where they are assembled into finished pieces of upholstered furniture. Workers at the furniture manufacturing facilities could be exposed to chemicals used to meet the draft standard. The exposures could be dermal (e.g., from handling FR-treated fabric or foam) or inhalation (e.g., from inhaling small pieces of fibers or dust or off-gassing from the furniture components). Scrap and waste material will be generated which will have to be either recycled or disposed of through incineration or at a landfill.

The consumers could be exposed to chemicals used to meet the draft standard. The exposure could be through dermal contact with the furniture, mouthing of the furniture by small children, or though the inhalation of dust or emissions from the furniture. Because an old piece of furniture will likely be replaced by another piece, consumers will effectively be exposed to upholstered furniture that meet the draft standard throughout their lives.

Ultimately each piece of upholstered furniture will be disposed of, most likely in a landfill or by incineration. The potential for adverse environmental impacts from disposal can vary depending on the method used to meet the draft standard. For example, some flame retardant chemicals could dissolve in water and migrate with the water. Others might be more tightly bound to soil particles and stay in the landfill. Some FR chemicals are persistent in the environment and may bioaccumulate, which could eventually pose toxicity problems. However, other FR chemicals are likely to breakdown in the environment and have a low potential for bioaccumulation.

Some FR Chemicals Have Caused Health or Environmental Concerns

FR chemicals vary in their properties including the health risks associated with the chemicals and their environmental fate. Some chemicals that have been used for their fire resistant properties have been determined to have unacceptable adverse impacts on health and the environment in some applications. For example, many years ago, some children's sleepwear manufacturers treated their product with a chemical called tris (2,3,-dibromopropyl) phosphate ("TRIS" or "TDBP") in order to meet a flammability standard. The CPSC later determined that TDBP posed a cancer risk and acted to ban the sale of children's clothing treated with the chemical in 1977.[1] A group of bromine-based FR chemicals called "polybrominated biphenyls" were used as flame retardants until questions regarding their safety were raised in the 1970s and manufacturers voluntarily ended their production. Another class of bromine-based flame retardants was developed to replace them: polybrominated diphenyl oxides ("PBDO," also

[1] The ban of TDBP or TRIS was blocked by the courts on procedural grounds. However, the Commission's authority to ban TRIS was not at issue. Children's sleepwear manufacturers stopped using TRIS voluntarily.

referred to as polybrominated diphenyl ethers or "PBDEs") (ATSDR, 2002). However, some PBDOs have been found to be persistent and bioaccumulative (Birnbaum and Staskal, 2004). The only U.S. manufacturer of pentabromodiphenyl oxide ("pentaBDO") and octabromodiphenyl oxide ("octaBDO"), the PBDOs that were the subject of the most controversy, ceased production of these two chemicals in 2004 (EPA, 2003). The European Union and the States of California, Hawaii, and Maine have recently enacted bans on the use of pentaBDO and octaBDO that will be taking effect over the next couple of years.[2]

Other FR Chemicals Are Widely Used

While some fire resistant chemicals and materials have been found to be hazardous and are no longer used, other FR chemicals continue to be widely used. In the US, the consumption of flame retardant chemicals is estimated to be over 1 billion pounds annually and is increasing at a rate of about 5 percent annually.[3] This includes various bromine, antimony, chlorine, phosphorous, nitrogen, and boron-based FR chemicals. Additionally, there are some fibers where the FR chemical is incorporated into the polymer of the fiber itself or that are inherently fire resistant. These include some modacrylic and melamine fibers.

Flame resistant technology is advancing as manufacturers seek more effective and less expensive methods for meeting various flammability standards as well as to address health or environmental concerns. The same manufacturer that stopped producing pentaBDO is manufacturing a chemical that can be used as a replacement for it. A preliminary assessment by the U.S. Environmental Protection Agency (EPA) indicates that the new chemical is not persistent, bioaccumulative, or toxic to aquatic organisms (EPA, 2003). A second manufacturer has also introduced an alternative chemical for pentaBDO. In both the cases, the substitute chemicals are bromine and phosphorous-based.

FR chemicals and other materials are already widely used in other goods to which consumers are exposed, including some residential upholstered furniture. Residential upholstered furniture sold in Great Britain must meet the requirements of a flammability standard (referred to as BS 5852") that includes ignition resistance requirements for both cover fabrics and filling materials. Filling materials used in upholstered furniture that is sold in the State of California must meet ignition resistance requirements that are similar to those in some of the regulatory alternatives.[4] Beginning in July, 2007, mattresses manufactured for sale in the U.S. must also meet strict flammability standards (16 CFR 1632 - 1633). Cover fabrics and filling materials used in applications such as airline seating and some commercial and institutional furniture

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[2] The ban in Maine took effect on 1 January 2006. The bans in California and Hawaii will take effect on 1 January 2008.

[3] Business Communications Company estimated that U.S. consumption of FR chemicals would reach 969 million pounds in 2003 and was growing at a rate of 5 percent annually (Flame Retardant Chemicals, Report C-004Z, Business Communications Company, Inc., Norwalk, CT, Richard Hilton, Project Analyst, October 1998). The European Flame Retardants Association, citing SRI Consulting, estimated U.S. consumption of FR chemicals to be 1,086 million pounds in 2001 (http://www.cefic-efra.org [Information accessed on 7 November 2007. The data were provided in metric tons and converted to pounds using the conversion calculator at www.onlineconversion.com.).

[4] The standard is the State of California Home Furnishings Bureau Technical Bulletin Number 117 ("CA TB 117").

frequently must meet ignition resistance standards. FR chemicals are also widely used in the plastics in television and computer monitor casings, electrical wiring insulation, and in textile products such as sleepwear, protective clothing, draperies, and carpets.

Some Controls to Chemical Exposure May Already Exist

Because the same or similar FR chemicals that will be used to meet a RUF flammability standard are already being used, the exposures and releases similar to the ones that could be attributable to such a standard are potentially occurring now. Controls or procedures that limit worker exposure or environmental releases in those other applications (e.g., ventilation requirements, filters, or protective clothing) are probably applicable to RUF manufacturing as well.

Some chemicals other than FR chemicals that are used in the upholstered furniture industry can also be toxic or have adverse environmental effects if they are handled improperly. Such chemicals are used in various dyes, cleaning solutions, and the manufacture and processing of the various natural and synthetic furniture components. Therefore, furniture and furniture component manufacturers may already have to meet regulatory requirements concerning safe handling and disposal of chemicals. Some of these controls may be applicable to any FR chemicals and materials used.

The hazard communication standard, established by the U.S. Occupational Safety and Health Administration, requires each manufacturer or importer of chemical substances to evaluate the chemicals for health hazards and prepare material safety data sheets ("MSDS") for each chemical substance. The MSDS describes the hazards associated with the chemical and the procedures necessary for its safe handling, including when it is accidentally spilled or released. The MSDS must be provided to all users of the chemical. Any employer using these chemicals must maintain a copy of the MSDS for all hazardous chemicals used in their workplace and train their workers in the safe handling of the hazardous chemicals. The hazard communication standard applies to all chemicals, including flame retardant chemicals.

The Federal Hazardous Substances Act (FHSA),[5] which is administered by the CPSC, requires manufacturers to label any consumer product that contains a substance that is toxic and could cause injury or illness to consumers through normal or reasonably foreseeable use. The label must describe the hazard and the steps that the consumer must take to avoid the hazard. This would apply to residential furniture if it contained a substance that could present a hazard to consumers through reasonable foreseeable use of the furniture.

It should also be noted that products containing FR chemicals are already used by consumers and products containing FR chemicals are being disposed of in landfills and incinerated. Therefore, for the most part, a flammability standard for RUF would not cause new environmental impacts, but it might intensify impacts that are already occurring. Controls applicable to the disposal of these other products would probably be applicable to furniture as well.

[5] Codified at 15 U.S.C. §1261-1278.

Methods that May Be Used To Meet the Regulatory Alternatives

Each of the regulatory alternatives would establish performance standards and would not prescribe the methods or treatments that manufacturers must use to meet the requirements. However, CPSC staff believes that under each of the alternatives some cover fabrics, polyurethane foam, and other filling materials would be modified using FR chemical treatments or fire-blocking barriers to meet the requirements. Some of the methods that are now available for producing flame and smoldering resistant fabrics, polyurethane foam, and barriers and interliners are discussed below. However, the specific methods that will be used by individual manufacturers are not known. Moreover, research into flame retardant technology is continuing and new FR chemicals and barrier materials are being developed. Therefore, the strategies used by manufacturers to meet a flammability standard could change as their knowledge and experience increases.

Filling Materials

Polyurethane Foam: Polyurethane foam is one of the most common filling materials used in upholstered furniture; about 350 million pounds of it are used annually. Two regulatory alternatives (the CPSC staff's 2005 draft standard and the 2002 revised draft of TB-117) include smoldering open flame ignition resistance tests. It is believed that about 25 percent of the foam now used in upholstered furniture already complies with California TB 117 (Smith,2007). Assuming that polyurethane foam that complies with TB 117 will also comply with the 2005 draft standard, this suggests that about 75 percent of the polyurethane foam now used in furniture will require some modification (or the use of a FR barrier) if either of these alternatives is adopted.

As noted earlier, pentaBDO was widely used as a flame retardant in polyurethane foam but was found to be persistent in the environment and bioaccumulative. It has since been banned by the European Union and the States of California, Hawaii, and Maine. These bans will be taking effect over the next few years.[6] The only domestic manufacturer of pentaBDO stopped producing it in 2004, effectively ending its use (EPA, 2003). Therefore, pentaBDO will not be used to meet an upholstered furniture flammability standard.

Chemical manufacturers have developed alternative FR treatments for polyurethane foam. The EPA has preliminarily concluded that at least one of these chemicals is not persistent, bioaccumulative, or toxic, based on several tests it required on the chemical (EPA, 2003). Alternatives for PBDEs in polyurethane foam include bromine, chlorine, phosphorous, and nitrogen compounds. Through its "Design for the Environment" program, the EPA is working with manufacturers and other stakeholders to coordinate the testing and assessment of FR chemicals intended for use in polyurethane foams to identify the chemicals that are likely to have

[6] The ban in Maine took effect on 1 January 2006. The bans in California and Hawaii will take effect on 1 January 2008.

a low potential for persistence and bioaccumulation in the environment, have low toxicity, are likely to result in low exposure, and whose breakdown products also have low potential for persistence and bioaccumulation and have low toxicity.

The first report of the furniture flame retardancy partnership of the Design for the Environment Program was released in September 2005. It includes a qualitative assessment of the health and environmental concerns for 14 substances that could be used as substitutes for PBDO polyurethane foam. Future plans of this EPA-sponsored partnership include developing additional toxicological data based on the needs determined in the initial assessment. It plans to focus more effort on those substances that become the most widely used flame retardants in polyurethane foam. [7]

CPSC staff conducted a risk assessment of one of the FR products developed as a replacement for pentaBDO in polyurethane foam. The chemical is actually a blend of two aromatic phosphates and two halogenated aryl esters. The staff lacked sufficient toxicity information for the specific chemicals used in the blend and had to use surrogate toxicity data based on toxicity data for similar chemicals in the same chemical class in its analysis. Using the surrogate toxicity data and estimates of what the average daily dose from oral, dermal, inhalation, and ingestion exposures that would result from its use in RUF, the staff concluded that this FR product probably would not pose a hazard to consumers if used in RUF. Toxicity data on the specific chemicals used in the product is required before a more definite conclusion can be made (Babich, et. al., 2006).

Another FR chemical that had been suggested as having applications in polyurethane foam is tris (1,3-dichloropropyl-2) phosphate ("TDCP"). According to a risk assessment performed by the CPSC staff, TDCP could present health hazards to consumers, both cancer and non-cancer, if used in upholstered furniture foam. TDCP is structurally similar to TDBP, which was used as a flame retardant in some children's sleepwear until it was determined that it could cause cancer (Babich, et.al., 2006).

Other Filling Materials: Other common filling materials include polyester and cotton batting. Most cotton batting used in furniture is already treated with boric acid and is expected to meet the requirements of the CPSC staff's 2005 standard and the 2002 revised draft of California TB-117. Polyester batting would require modification to meet these standards. Modifications could include incorporating inherently FR fibers into the batting, the use of FR chemicals, or the use of a fire-blocking barrier.

Loose filling materials, such as polyester fiberfill, shredded foam, feathers, and polystyrene beads, would also be subject to smoldering and small open-flame ignition resistance tests under CPSC staff's 2005 standard and the 2002 revised draft of California TB-117. Polyester fiberfill and other loose filling materials may need modification to meet these standards. Additionally, polyester fiberfill is frequently coated with a silicone "slickening" agent

[7] The first report of the Furniture Flame Retardancy Partnership (of the Design for the Environment Program) was published in September 2005. (United States Environmental Protection Agency, Furniture Flame Retardancy Partnership: Environmental Profiles of Chemcial Flame-Retardant Alternatives for Low-Density Polyurethane Foam, September 2005. http://www.epa.gov/dfe/projects/flameret/index.htm).

to facilitate blowing it into pre-sewn cushions. The silicone agent acts as an accelerant and increases its propensity for ignition. (Smith 2007) Options for meeting the requirement include using a different, non-flammable slickening agent, a different mix of fibers, or encasing the fibers in an FR interliner barrier.

Upholstery Cover Fabrics

All of the regulatory options include either a smoldering ignition resistance test, an open flame ignition resistance test, or both, for cover fabrics. The CPSC staff believes that most thermoplastic (e.g., polyester, nylon, acrylic, and polypropylene), wool, leather, and vinyl-coated upholstery cover fabrics will be able to meet smoldering ignition resistance requirements in the alternatives without any modifications. Based on tests conducted by the CPSC laboratory, the fabrics that are expected to fail the smoldering ignition resistance test are the heavier weight fabrics composed primarily of cellulosic fibers (e.g., cotton, rayon, and linen). CPSC staff believes that these fabrics accounted for up to 14.2% of the cover fabrics used in RUF (Smith 2007). Based on estimates of total upholstery fabric consumption for RUF, up to 65 million linear yards of the upholstery cover fabric used annually would not pass the smoldering ignition resistance test.[8]

The tests for open-flame ignition resistance are more severe. Leather, wool, and vinyl coated fabrics tend to be inherently flame resistant and would probably pass these tests. However, all other fabrics would probably require some modification, such as treatment with FR chemicals to pass an open flame ignition resistance test. If a regulatory alternative with an open flame test for cover fabrics is adopted, up to 300 million linear yards of cover fabric could require modification with FR chemicals.[9]

FR chemical treatment of all the fabric that would fail an open flame ignition resistance test could require between 17 and 62 million pounds of FR chemicals, assuming that the typical FR chemical application rates used to meet a British open-flame fabric test are used.[10] If an alternative with a smoldering ignition resistance test is adopted fewer FR chemicals would be required. Moreover, instead of using FR chemicals, some furniture manufacturers may move away from using fabrics with a high propensity for smoldering ignition because there are a wide variety of fabrics available that will likely pass the smoldering ignition resistance test without FR chemical treatment. CPSC staff also expect that some furniture manufacturers may opt to use FR barriers instead of modifying the cover fabrics.

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[8]Based on estimates that about 4.3 million units of upholstered furniture use these severely or moderately cigarette smoldering ignition prone fabrics and each unit requires up to 15 linear yards (Smith (2007)).

[9] Based on estimates that about 20 million units of upholstered furniture would be affected by an open flame test and up to 15 linear yards of cover fabric are used for each unit (Smith, 2007).

[10] FR chemical application rates are from National Academy of Sciences, Toxicological Risks of Selected Flame-Retardant Chemicals, National Academy Press, Washington, DC (2000). The application rates are chemical specific and range from 2 to 7.5 mg/cm^2 or .055 to 0.207 pounds per linear yard. These application rates are the typical rates required to meet the British open flame standard. It is not known how applicable they are to a "smoldering resistance" test.

Several activities have been undertaken by CPSC staff and others to learn more about the potential health and environmental risks associated with the flame retardant chemicals. These include risk assessments of selected FR chemicals and laboratory analysis of the migration of selected FR chemicals from upholstery fabric treated with the chemicals. The National Academy of Sciences (NAS) evaluated the toxicological risk to consumers of using 16 FR chemicals in RUF (NAS, 2000). The chemicals or chemical classes evaluated were those that the Flame Retardant Chemicals Association identified as potential candidates for use in meeting an open-flame ignition resistance standard for upholstered furniture cover fabrics. The NAS used high (or conservative) exposure assumptions in its assessments. High exposure assumptions would tend to lead to over-estimates of the risks. Of the 16 chemicals or chemical classes assessed by the NAS, it concluded that 8 could be used in RUF with minimal risks to consumers, but that more information was needed on the other eight. The NAS conclusions by chemical are summarized in the Table below.

CPSC staff conducted its own risk assessment on eight of the chemicals (Babich and Thomas, 2001). It concluded that four of the chemicals would pose minimal risk to consumers if used in RUF, but more information was needed to properly assess the other four. For six of the chemicals evaluated by both the NAS and the CPSC, the CPSC staff conclusions were similar to those of the NAS. In the case of tetrakis (hydroxymethyl) phosphonium salts, the CPSC staff concluded that more information concerning the exact identity of phosphorous compounds found to be migrating from fabric treated with the chemical was needed before the risks could be properly assessed. In the case of organic phosphonates, the NAS and the CPSC staff based their respective conclusions on two different chemicals in the class. The CPSC conclusions are also summarized in the Table below.

FR Chemicals That Could Be Used in Upholstery Fabrics

Chemical	Found to Pose Low Consumer Risks by NAS	Found to Pose Low Consumer Risks by CPSC Staff
Antimony Trioxide (AT)	MDN	MDN
Decabromodiphenyl oxide (DBDPO)	Yes	Yes
Hexabromocyclododecane (HBCD)	Yes	Yes
Tris(chloropropyl)phosphate (TCPP)	MDN	--
Tris(1,3-dichloro-2-propyl) phosphate (TDCPP)	MDN	MDN
Phosphonic acid (PA)	Yes	Yes
Tetrakis(hydroxymethyl) phosphonium salts (THPC)	Yes	MDN
Organic Phosphonates Dimethyl hydrogen phosphite Cyclic phonate esters (CPE)	 MDN --	 -- Yes
Aromatic Phosphates Tricresyl Phosphate (TCP) 2-ethylhexyl diphenyl phosphate (EHDP)	 MDN --	 -- MDN*
Chlorinated paraffins (CP)	MDN	--
Molybdates	MDN	--
Antimonates	MDN	--
Zinc Borate	Yes	--
Alumina trihydrate	Yes	--
Magnesium hydroxide	Yes	--
Ammonium polyphosphate (APP)	Yes	--

MDN: More data needed.
-- : Not assessed.
* CPSC staff concluded that EHDP probably would *not* present a hazard to consumers unless the fabric were exposed to non-aqueous cleaners, such as dry cleaning fluid.

If the CPSC adopts a rule that could be expected to cause manufacturers to use FR chemicals in RUF cover fabrics, the U.S. Environmental Protection Agency (EPA) could issue a significant new use rule (SNUR) that would cover the use of specific FR chemicals in residential upholstered furniture cover fabrics. SNURs are provided for by Section 5(a)(2) of the Toxic Substances Control Act (TSCA). The SNUR would require anyone intending to manufacture,

import, or process FR chemicals for use in RUF to notify the EPA at least 90 days beforehand. This notice period is intended to give the EPA an opportunity to review the existing data on the chemical and evaluate its use in RUF. If necessary, the EPA can order additional testing on the chemicals and place restrictions on the use of the chemical in order to prevent unacceptable risks to health or the environment. The EPA may exclude some chemicals from a SNUR if it judges that there is already sufficient evidence that the chemicals would not pose a risk to human health or the environment if used in upholstered furniture. It should be noted that the EPA would consider the potential environmental impacts at every stage of the life cycle, including occupational and consumer exposures, environmental releases during the manufacture and use of the furniture, and the ultimate disposal of the furniture. In their analyses, both the CPSC staff and the NAS only considered the potential impacts on consumers using upholstered furniture.

Flame Resistant Barriers and Interliners

In three of the regulatory alternatives, furniture manufacturers would have the option of using flame resistant barriers or interliners that pass the appropriate tests described in the draft standard, in lieu of using complying fabric or filling materials. CPSC staff expects that this option would be more likely to be used by manufacturers that serve the upper-end of the retail furniture market (Smith, 2007). Research and development of fire-resistant barriers that can be used in residential furniture is advancing. Much of this research was spurred by new flammability standards for mattresses.[11] Materials used to construct barriers to meet the mattress flammability standards might be used to construct FR barriers or interliners for upholstered furniture.[12] Some of the materials that can be used to construct FR barriers and interliners are discussed below.

Modacrylic fibers are composed of acrylonitrile and vinylidine chloride. Antimony trioxide is usually added to the polymer to enhance the FR properties of the fiber. Tests conducted by the CPSC staff for the migration of antimony trioxide and vinylidine chloride from an FR barrier material designed for mattresses confirmed the migration of these chemicals was low when the chemicals are incorporated in the polymer itself (Thomas and Brundage, 2004). Modacrylic fibers have been used since the 1940s in applications such as children's sleepwear, synthetic fleece, and fake fur and hair.

Melamine fibers are produced from the same type of resin often used for laminates for countertops and in some plastic cooking utensils. It is also used in some protective apparel. CPSC staff believe that the toxicity potential of melamine is low. Moreover, when incorporated into polymer fibers, the potential for consumer exposure is also low (Thomas and Brundage, 2004).

[11] A national standard for flame resistant mattresses became effective in July 2007.

[12] There are differences between the mattress flammability standard and those in the regulatory alternatives for addressing upholstered furniture flammability. Therefore, a barrier designed for upholstered furniture is likely to be constructed differently than a barrier designed for mattresses, even though some of the same FR materials or chemicals may be used.

FR viscose is a fiber produced from wood pulp to which sodium silicate and other materials are added. Viscose fibers (e.g., rayon) are widely used. Sodium silicate is also a very widely used chemical. For example, some household cleaning products and detergents contain sodium silicate. One manufacturer of FR viscose asserts that the product is biodegradable and produces low toxic smoke emissions in a fire (Perry, 2004).

Decabromodiphenyl oxide ("decaDBO) is an FR chemical that could be used in FR barriers. Typically, it is applied to a fabric in a polymer back coating. Antimony trioxide is often used with decaDBO as a synergist. Testing, by CPSC staff, of an FR barrier designed for mattresses that contained decaDBO and antimony trioxide found that the release of decaDBO and antimony trioxide from the barrier was low and not expected to present a health risk to consumers (Thomas and Brundage, 2004).

DecaDBO is generally considered to be less toxic and less well absorbed than are other PBDOs, such as pentaDBO. DecaDBO is not thought to be bioaccumulative although it is persistent. There is also some concern that decaDBO may debrominate or break down into the lower and more toxic forms of PBDOs, such as pentaDBO. This debromination might result from chemical or physical processes in the environment or by metabolic processes when taken up by some animals, such as fish. A recent animal study suggests that decaDBO could be a developmental neurotoxicant. Whether the debromination of decaDBO or the possibility that it is a developmental neurotoxicant are significant problems can not be determined with the available data. Studies on these issues by the EPA and the European Union are continuing (Babich, 2004).

Boric acid-treated cotton fabric or batting can be used in FR barriers. CPSC staff tested one such barrier designed for use in mattresses and found that consumers were unlikely to be exposed to a sufficient amount of boric acid to present an unacceptable risk of adverse health effects (Thomas and Brundage, 2004). As noted earlier, boric acid-treated cotton batting is already used in some residential upholstered furniture, mattresses, and futons.

Regulatory and Other Protections

Even if some manufacturers use a chemical that is later determined to pose an unacceptable risk to health or the environment, there are established regulatory mechanisms that can limit or remove the hazard. These include using current laws and regulations that are administered by agencies such as the EPA, the CPSC, and others. Other agencies, such as some under the Department of Health and Human Services, do not regulate the use of chemicals but conduct related research on the toxicity of selected chemicals.

There is precedent for using such mechanisms with regards to health concerns caused by flame retardant chemicals. For example, in 1977 the CPSC determined that tris (2,3,-dibromopropyl) phosphate, which was used by some manufacturers to meet a children's sleepwear flammability standard, posed a cancer risk. To eliminate this risk, the Commission acted to ban the sale of children's clothing treated with the chemical.[13] However, the

[13] The ban of TRIS was blocked by the courts on procedural grounds. However, the Commission's authority to ban TRIS was not at issue. Children's sleepwear manufacturers stopped using TRIS voluntarily.

Commission did not alter the flammability standards for children's sleepwear; it only acted to remove one option for meeting the standard.

The U.S. Environmental Protection Agency has comprehensive powers to regulate the use of toxic chemicals under the Toxic Substances Control Act (TSCA).[14] As discussed earlier, the EPA is developing a significant new use rule (SNUR), under Section 5(a)(2) of TSCA, which could cover FR chemicals that are candidates for use in residential upholstered furniture cover fabrics.

The EPA's New Chemical Program, which is also mandated by Section 5 of TSCA, requires any one seeking to manufacture or import a new chemical to notify the EPA at least 90 days in advance. This allows the EPA the opportunity to determine whether there is enough information to determine whether the chemical may have significant adverse impacts. And if it is determined that the chemical could have significant adverse impacts or if there is not sufficient information to make this determination, the EPA can establish controls on the use of the chemical.

Other EPA activities involve researching and monitoring the use of certain chemicals, including some FR chemicals. These include some voluntary programs, in cooperation with chemical manufacturers, such as the "Voluntary Children's Chemical Evaluation Program" and the "High Production Volume Challenge Program."[15] If information is developed during these activities suggesting that a flame retardant could be toxic or have adverse environmental effects, the EPA could impose controls on the use of the chemical to ensure human or environmental safety. As discussed earlier, through its "Design for the Environment" program, EPA is helping to coordinate the testing of FR chemicals that may be used to replace PBDOs in polyurethane foam in order to identify alternatives that are expected to have low impacts on health and the environment.

If the use of a particular FR chemical or material in RUF could pose a hazard to consumers, the CPSC has authorities under the Consumer Product Safety Act (CPSA)[16] and the FHSA that can be used to prohibit the use of the substance in applications that could cause health hazards. For example, the CPSC could ban the use of furniture components treated with a particular chemical, if its use in that application could expose consumers to health hazards.

The National Toxicology Program (NTP) of the Department of Health and Human Services ("HHS") coordinates the toxicological review and testing of chemicals for agencies under the HHS. Federal and state agencies, academics, advocacy groups, industry representatives, and private citizens may nominate substances for testing under the NTP. The NTP chooses substances for further testing and evaluation based upon factors such as the extent of human exposure and the degree of suspicion of toxicity and the extent of any toxicological data gaps. Agencies such as the EPA and CPSC may nominate chemicals for testing and use the results of NTP testing to regulate a substance if the results indicate that it could be hazardous.

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[14] 15 U.S.C. s/s 2601 et. seq (1976).

[15] See the Federal Register, Vol. 65, No. 248, pp. 81686-81718, (26 December 2000).

[16] Codified at 15 U.S.C. §2051-2084.

The NTP has examined or is evaluating some flame retardant chemicals, including several PBDOs. The NTP is now planning tests on two FR chemicals nominated by the CPSC. These are antimony trioxide and tris (chloropropyl) phosphate.

Several advocacy groups have researched and monitored flame retardants and other chemicals for human and environmental toxicity. These parties often publicize their findings and advocate for regulations when they find potential problems.[17] Manufacturers also have incentives to investigate the potential toxicity of their products, both to avoid liability for damage caused by their products and to ensure that they have other marketable products should some be removed from the market. As previously noted, some manufacturers have voluntary stopped the manufacture of flame retardants when questions have been raised about their toxicity or environmental effects. Chemical manufacturers are actively developing alternative chemicals and are cooperating with the EPA to ensure that the substitutes do not pose unacceptable risks to health or the environment (EPA, 2003).

In a plausible "worst case" scenario, a particular chemical or material that is used by some manufacturers to meet a flammability standard could be determined to pose an unacceptable health or environmental risk. For example, new evidence might show that the potential consumer exposure to a chemical or material could raise the risk of developing a particular type of cancer above some threshold of concern (e.g., one in a million) or could exceed the level that toxicologists consider to be an acceptable daily intake to avoid other chronic diseases or injuries. Or, new evidence could show that a particular FR chemical used to meet the standard bioaccumulates, that is that there are increasing concentrations of the chemical in living organisms.

If a chemical or material used to meet the draft standard is determined to present an unacceptable risk, there are regulatory mechanisms that can be used to limit the specific risk. For example, the EPA, the Occupational Safety and Health Administration (OSHA), or the CPSC could establish controls or bans on the use of the specific chemical or material as appropriate. Such mechanisms have been used when other chemicals used in consumer products have been found to have unacceptable risks. For example, as discussed previously, a flame retardant used in children's sleepwear (tris (2,3,-dibromopropyl) phosphate was found to pose an unacceptable risk of cancer. As noted earlier, pentaBDO, which was formerly used as an FR chemical in polyurethane foam, has been found to bioaccumulate. In both cases, regulatory authorities, here and abroad, undertook investigations of the risks, and in some instances took steps towards regulating the use of the chemical. And in both cases, manufacturers took steps to stop using the chemicals before final bans or regulations went into effect.[18] Moreover, in both cases, substitutes have been developed. It should also be noted that both of the chemicals cited above were in use prior to the establishment of the EPA, CPSC, and OSHA in the 1970s.

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[17] For example, the Environmental Working Group has recently published several reports on PBDE flame retardants: Tainted Catch (2003), Mothers Milk (2003), and In the Dust (2004). These are available at http://www.ewg.org.

[18] Sleepwear manufacturers stopped using tris in children's sleepwear even though a CPSC ban was not finalized. The manufacturers of CCA voluntarily requested that the EPA to cancel their registrations of CCA, effectively banning the product. Finally, the only US manufacturer of pentaDBO has announced that it is voluntarily phasing out its production.

In summary, several regulatory agencies, advocacy groups, and industry participants have mandates or interests in monitoring the use of chemicals that may be toxic or have adverse impacts on the environment. Taken together, these regulatory agencies, advocacy groups and industry participants provide mechanisms for banning or establishing other controls on the use of substances that are determined to pose unacceptable risks to human health or the environment.

Discussion of the Regulatory Alternatives

The CPSC staff have examined several alternatives to the draft standard. With the exception of a "no action" or "labeling only" alternative, all of the alternatives considered would require the use of some FR chemicals or barriers. However the specific chemicals used and the volume of chemicals used would vary among the alternatives. Each of the alternatives is discussed below.

***CPSC staff's 2007 alternative standard*:** The CPSC staff's 2007 draft alternative standard focuses on smoldering ignition resistance, such as those started by a dropped cigarette. As noted earlier, smoking materials are responsible for 90% of all deaths and 65% of all injuries in fires originating in RUF. This alternative contains a smoldering ignition resistance test for cover fabrics. It has no tests for filling materials. Manufacturers would have the option of using a fire-blocking barrier in lieu of qualified cover fabrics.

CPSC staff believes that most cover fabrics would pass the qualifying test in this alternative without modification, but that about 14.2% of the cover fabrics would require some modification to pass (Smith, 2007). It is likely that some manufacturers would shift to using more fabrics that can pass the qualifying tests without the use of FR chemicals. In some other cases, manufacturers might be able to alter the fiber content of some fabrics so that they can pass the test without the use of FR chemicals. Fire-blocking barriers may be used by some manufacturers. No modification would be needed to any filling materials since there are no tests for filling materials in this standard.

If FR chemicals are used, the ones that are currently thought to be most likely to be used to treat the smoldering ignition prone cover fabrics are phosphonic acid and tetrakis hydroxymethyl phosponium salts (THPC). Both the assessment by the NAS and the CPSC staff suggested that phosphonic acid would probably pose a low level of risk if used in upholstery cover fabrics. The NAS also concluded that THPC would pose a low level of risk. However, the CPSC staff concluded that more information was needed concerning some phosphorous compounds found in extracts from THPC-treated fabrics before the risks could be assessed. However, it was noted that the amount of the phosphorous compounds extracted declined rapidly with subsequent extractions. This suggests that a "wash" or "rinse" procedure added to the treatment process could reduce consumer exposure to the compounds (Babich and Thomas, 2001).

The CPSC staff's 2005 draft standard: The 2005 draft standard provides manufacturers with two options for meeting the requirements. One option is to use filling materials and cover fabrics that pass the tests prescribed in the draft standard. Filling materials, such as polyurethane foam, cotton batting, polyester fiberfill, down feathers, and polystyrene beads, must pass a smoldering ignition resistance test and an open flame ignition resistance test. Cover fabrics must pass a smoldering ignition resistance test. The other option is to use a flame-resistant barrier or interliner that has passed the appropriate tests described in the draft standard in lieu of using complying cover fabrics or filling materials. The cover fabric may serve as an FR barrier if it passes the cover barrier ignition resistance tests described in the draft standard.

The smoldering ignition resistance test in the 2005 draft standard is not as severe a test as in the 2007 draft standard. The cover fabric on only 9.6% of the furniture items would need modification to pass this test. The modifications could include substituting other cover fabrics that would pass the tests without modification, changing the fiber content so that the fabric could pass the test, or the use of FR chemicals. A fire-blocking barrier could be used in lieu of any of these modifications.

Many filling materials such as polyurethane foam, fibrous batting or loose fill, and polystyrene beads will require some modification in order to comply with the standard. The modifications could involve incorporating FR chemicals into the component or using a complying FR barrier or interliner.

In summary, the 2005 draft standard might result in fewer FR chemicals being used treat cover fabrics than the 2007 draft standard. However, the 2005 draft standard would result in some FR chemicals being used to treat filling materials, which would not be needed under the 2007 draft standard.

The CPSC staff's 2001 draft standard: In 2001, the CPSC staff developed a draft flammability standard that called for a small open-flame testing of upholstery cover fabrics. The 2001 draft standard called for cover fabrics to be exposed to a small open flame for 20 seconds. To pass, all combustion would have to cease within 2 minutes after the flame was removed from the fabric. The 2001 draft did not include any test for filling materials. It did include a fire blocking barrier option

Promulgating the 2001 draft standard would result in a different mix of FR chemicals being used than the 2005 draft standard, but it is uncertain if the total amount of FR chemicals used would be different. The cover fabrics on about 20 million furniture items would require FR chemical treatment to pass this the test in the 2001 draft standard, including furniture covered with most thermoplastic and cellulosic fabrics. Therefore, this standard could result 17 to 62 million pounds of FR chemicals being used to treat upholstery cover fabric.[19] The 2005 draft standard would result in substantially less FR chemicals being used to treate cover fabrics. However, the 2005 draft standard also includes requirements for filling materials, which could require a substantial amount of FR chemicals.

[19] Assuming that 15 linear yards of cover fabrics are used in each item and the FR chemical application rate is between.055 and 0.207 pounds per linear yard.

2002 revised draft of California TB-117: The 2002 revised draft of TB-117 includes an open flame ignition resistance test for cover fabrics and both open flame and smoldering ignition resistance tests for filling materials. The cover fabric test is considered to be not quite as severe as the test in the CPSC staff's 2001 draft standard, but it is still thought that the cover fabric on almost as many furniture items would have to be FR chemically treated to pass this test. The tests for filling materials are similar to the tests in the CPSC staff's 2005 draft standard. However, there is no fire-blocking barrier option in the 2002 revised draft of TB-117. Therefore, virtually all of the filling materials would require FR chemical treatment to comply with this alternative. As a result, adopting this alternative probably would increase the use of FR chemicals by a greater extent than any of the other regulatory options.

Mandating the UFAC guidelines: The UFAC program classifies upholstery cover fabrics based upon their propensity for cigarette or smolering ignition and establishes construction criteria for furniture based upon class of cover fabric used. For example, furniture that uses an smoldering ignition prone cover fabric and polyurethane foam in the seat cushions must have a smolder resistant barrier between the cover fabric and the foam.

It is unlikely that mandating the UFAC guidelines would result in any increase in the use of FR chemicals. As noted in the discussion above, most cover fabrics would pass a smoldering ignition resistance test. Moreover, the UFAC guidelines do not prohibit the use of cover fabrics that are prone to smoldering ignitions; the UFAC guidelines only specify construction criteria for the furniture on which they are used. About 90% of the furniture on the market is thought to be in compliance with the UFAC guidelines (Smith, 2007)

"No Action" or Adoption of Only a Labeling Rule: The Commission could opt not to promulgate a standard or adopt a rule requiring only label warning of the flammability danger of upholstered furniture. Neither of these options would likely reduce the number of fires originating in upholstered furniture. However, taking no action or not promulgating a standard would not increase the volume of FR chemicals that are used to treat RUF components. However, some use would still occur to meet other standards, such as the State of California standard (CA TB 117).

Additionally, not promulgating a standard would not reduce the environmental damage that can result from residential fires. In addition to the immediate death and injuries, the burning of the various materials that are be found in houses (e.g., building materials, furniture, polyvinyl chloride, electrical and electronic equipment, and so on) can create toxic compounds that are released into the environment. These can include dioxins, hydrogen cyanide, and polycyclic aromatic hydrocarbons.[20] Water used for fighting fires is contaminated with the various pollutants that are created in house fires. This water may carry these pollutants into the streams,

[20] Petra Andersson and Margaret Simonson, "Fire safety of upholstered furniture, A Life-Cycle Assessment – Summary Report," SP Swedish National Testing and Research Institute. This a summary of SP Report 2003:22, prepared for the European Flame Retardants Association and IKEA.

rivers, and ground water. Such pollution could be reduced if fewer fires occur. To the extent that ignition resistance standards for RUF would reduce the number or severity of residential fires, these adverse environmental impacts would be reduced. Furthermore, the fire itself and the creation of toxic compounds may have substantial adverse effects on the health and safety of firefighters.

Summary and Conclusion

Manufacturers would have flexibility in meeting the performance requirements in any of the regulatory alternatives examined in this assessment. Thus the extent to which each of the various FR chemicals and other alternatives for meeting the requirements (e.g., using FR barriers or substituting less ignition prone materials) will be used is uncertain. Although some data gaps and uncertainties in our knowledge of some of the health and environmental impacts exist, there are FR chemicals and flame resistant materials that, based on currently available data, are not expected to pose unacceptable risks to the environment and that are widely used in other applications. Therefore, manufacturers probably have alternatives for meeting an upholstered furniture flammability standard that will not result in unacceptable adverse impacts to the environment or human health. Moreover, government agencies, advocacy organizations, academics, and chemical manufacturers are monitoring and conducting research on the environmental and health impacts of different FR chemicals and other materials. There are regulatory and other mechanisms that can be used to control the use of specific FR chemicals if they are found to pose hazards to the environment or health.

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APPENDIX

Sources Consulted

This assessment is largely the result of the analyses of CPSC staff experts. These experts include PhD chemists, toxicologists, and pharmacologists. CPSC staff have conducted numerous assessments of FR chemicals and materials since work began on this project in the mid 1990s. This work has included chemical migration testing of some FR materials by the CPSC Directorate for Laboratory Sciences. Some of this work is referenced in this environmental assessment.

CPSC staff have worked and consulted with staff at the U.S. Environmental Protection Agency in developing a SNUR for FR chemicals that would be used in upholstery cover fabrics.

On May 5 – 6, 1998, the Consumer Product Safety Commission held a public hearing on health and environmental concerns about the use of FR chemicals in residential upholstered furniture. Among those testifying or submitting comments were officials and representatives from the U.S. Environmental Protection Agency, The Occupational Safety and Health Agency, flame retardant chemical manufacturers, fabric and furniture manufacturers, and professional firefighters.

United States
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

November 19, 2007

TO: The Commission
Todd A. Stevenson, Secretary

THRU: Lowell F. Martin, Acting General Counsel

FROM: Patricia Semple, Executive Director

SUBJECT: Finding of No Significant Impact From Implementation of the Proposed Flammability Standard for Residential Upholstered Furniture

The National Environmental Policy Act (NEPA), 42 U.S.C. § 4321 *et seq.* (1994), requires Federal agencies to prepare an Environmental Impact Statement (EIS) for major Federal actions significantly affecting the quality of the human environment. In accordance with the Commission's regulations on environmental review at 16 C.F.R. part 1021, I previously directed the Commission staff, by memorandum dated October 26, 2004, to prepare an Environmental Assessment (EA) for the draft proposed flammability standard for residential upholstered furniture (RUF standard). I have now determined, based on the reasons summarized below and the analysis provided in the attached EA, that there will be no significant impacts on the quality of the human environment as a result of implementing any of the alternatives discussed in the EA as a RUF standard.

A proposed RUF standard would address the hazards posed by residential upholstered furniture fires and sets forth a performance standard to reduce the associated deaths and injuries caused by such fires. To comply with the proposed standard, some furniture manufacturers may change the materials used in their upholstered furniture or incorporate flame retardant (FR) fire-blocking barriers. FR fabrics and interior filling materials would not be required. There appears to be a number of promising barrier technologies that manufacturers could use to meet a proposed standard that are not likely to have any significant adverse impact on human health or the environment.

The Commission staff will continue working with the U.S. Environmental Protection Agency (EPA) to evaluate potential FR chemicals risks on human health or the environment. Because the EPA has primary responsibility for regulating chemical risks, it has implemented several programs to assess potential consumer, occupational and environmental risks related to FR chemicals. The Commission staff actively participates in these programs. For example, the Commission staff has been working with EPA to develop a possible significant new use rule (SNUR) under the Toxic Substances Control Act, 15 U.S.C. § 2601 *et seq.* (1994), for certain FR chemicals that may be used in upholstered furniture. This rule would require that chemical producers provide advance notice to EPA of their intent to sell the chemicals for use in upholstered furniture and provide data on the chemicals, which would then be reviewed by the EPA. The Commission staff will continue to work with EPA, other regulatory agencies, advocacy groups and industry participants, to identify and mitigate any potential adverse environmental impacts.

Based on the analysis documented in the EA, I find, in accordance with 16 C.F.R. §§ 1021.5(d) and 1021.13, that the proposed action is not a major Federal action significantly affecting the quality of the human environment that requires preparation of an EIS.

Attachment: *Environmental Assessment of a Draft Proposed Flammability Standard for Residential Upholstered Furniture*, Robert Franklin, Directorate for Economic Analysis, November 17, 2004.

Tab F

Preliminary Regulatory Analysis of a Draft Proposed Flammability Rule to Address Ignitions of Upholstered Furniture*

Charles L. Smith
Directorate for Economic Analysis
U.S. Consumer Product Safety Commission

November 2007

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

EXECUTIVE SUMMARY

In an Advance Notice of Proposed Rulemaking (published in the October 23, 2003, *Federal Register*), the U.S. Consumer Product Safety Commission (CPSC) announced its preliminary determination that ignitions of upholstered furniture by small open flames and cigarettes might constitute an unreasonable risk to the public. In December 2006, the Directorate for Economic Analysis of the CPSC prepared a preliminary regulatory analysis which analyzed the possible costs and benefits of regulatory alternatives, including a standard drafted by the CPSC staff in 2005 that addressed small open flame and cigarette ignition. This analysis updates the December 2006 *Preliminary Regulatory Analysis*, and evaluates two new alternatives that were not previously considered: a draft standard developed by the CPSC staff that focuses on smoldering ignition (referred to as "CPSC Staff's 2007 Alternative Draft Standard" in the November 2007 briefing package cover memo) and an alternative that would incorporate the provisions of the UFAC voluntary program in a mandatory standard.

The analysis has also been revised to consider updated fire loss data from 2002 through 2004. During that time period, there were an average of about 280 addressable deaths, 500 addressable injuries, and $112 million in addressable property losses annually from fires started by either smoldering ignition sources (such as cigarettes) or small open flame ignition sources (*e.g.*, lighters, matches, and candles) in which upholstered furniture was the first item ignited. About 90 percent of these deaths, 65 percent of the injuries, and 59 percent of the property damage resulted from fires started from cigarette ignition. The estimated remaining addressable fires during 2002-2004 were started from small open flames. CPSC laboratory test data show that furniture covered with predominantly cellulosic fabrics (*e.g.*, cotton and rayon) is much more likely to be involved in cigarette ignited fires than items covered with thermoplastic fabrics (*e.g.*, polyester, polyolefin, and nylon); consequently, the estimated societal losses per item of furniture are much greater for items with cellulosic fabrics. Factors such as fiber content, density, and weave have been shown to make some cellulosic fabrics more likely to ignite from cigarettes than others.

The staff's 2005 draft standard specifies tests to determine the ignition resistance of upholstery fabrics, barrier materials, and filling materials. As described in the current *Regulatory Analysis*, the aggregate benefits of the staff's 2005 draft standard (*i.e.*, the reduction in the societal costs associated with complying furniture), based on the annual sales of a little over 30 million furniture items, are expected to be about $597 million, if a 3 percent discount rate is used, and about $447 million, if future benefits are discounted at 7 percent. Total aggregate costs of the 2005 draft standard for each year's production are estimated to range from about $167 million to $184 million, with a midpoint of about $176 million. Estimated benefits and costs per unit would vary greatly depending on cover materials. Most units would incur costs related to FR-treatment of filling materials, and an estimated 10 percent of units covered with more ignition-prone fabrics would require modifications (FR-fabric treatment or FR barriers) that would lead to higher costs

of compliance. Projected annual net benefits to society from the staff's 2005 draft standard total $421.5 million, if a 3 percent discount rate is used, and about $271 million if a 7 percent discount rate is used. A sensitivity analysis of several factors (value of life, injury costs, effectiveness, and costs) shows that alternative assumptions still yield substantially positive net benefits.

The alternative standard drafted by the CPSC staff in 2007 (discussed in Section 8.1.) that focuses on the smoldering ignition hazard is expected to require modifications to about 14 percent of furniture items covered with cellulosic fabrics that are likely to fail the draft's smoldering ignition test for cover fabrics. The cost impacts of these modifications would range from the less expensive alternative of substituting upholstery fabrics that pass the smoldering requirements for those that do not, to more costly measures of FR-treatment of fabrics and the use of barrier materials that pass additional open flame and smoldering ignition requirements. Estimated benefits resulting from the 2007 staff draft standard that focuses on smoldering range from about $419 million to $424 million. Depending on the extent to which fabrics are FR-treated to comply with the alternative, estimated costs of compliance may range from about $32 million to $57 million annually. The estimated net benefits of the draft standard that focuses on smoldering ignition would be in the range of $367 million to $387 million.

The other new alternative addressed in this analysis is a mandatory standard based on the UFAC voluntary program (discussed in Section 8.3.). Such a mandatory standard would be expected to result in minimal costs of compliance, since 90 percent or more of units currently produced may be in compliance with the voluntary program, and product changes necessary to bring remaining production into compliance should not involve substantial cost increases per unit. The ignition resistance of most furniture items would not be significantly improved under an alternative that mandates compliance with the UFAC program, and the expected net benefits would be far lower than other alternative performance standards discussed in the analysis.

In addition to discussing the 2007 staff draft that focuses on smoldering and a mandatory standard based on the UFAC program, the current *Preliminary Regulatory Analysis* also evaluates an alternative that primarily addresses open flame ignited fires (the 2001 CPSC staff draft standard) and adoption of revised requirements drafted by California. These alternatives could also result in substantial net benefits to society: $190 million for a standard based on the revised draft California Technical Bulletin 117 and $379 million for the 2001 CPSC staff draft open flame standard. In addition to alternatives based on performance standards, the *Preliminary Regulatory Analysis* also discusses a regulatory alternative requiring product labeling that warns consumers about the flammability hazards; alternative effective dates; and the alternative of taking no regulatory action by the CPSC.

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Appendix A

1. INTRODUCTION

In 1993 the U.S. Consumer Product Safety Commission (CPSC) docketed a petition from the National Association of State Fire Marshals (NASFM) to initiate a rulemaking proceeding to address hazards associated with upholstered furniture fires started by small open flame ignition sources, cigarettes, and larger open-flame sources. To address hazards associated with small open-flame ignitions, NASFM sought the adoption of California's Bureau of Home Furnishings Technical Bulletin 117 as mandatory requirements for upholstered furniture sold for consumer use in the United States. Technical Bulletin 117 requires testing of the fabric and filling material components used to make furniture to increase their resistance to ignition from small open-flame and smoldering sources. NASFM's petition also sought the adoption of the California Bureau of Home Furnishings Technical Bulletin 116, and some aspects of Technical Bulletin 117, to address hazards associated with ignitions of furniture by cigarettes and other smoking materials. NASFM also asked the Commission to adopt Technical Bulletin 133, which addresses large open-flame ignition performance of furniture used in specified occupancies.

The part of NASFM's petition seeking mandatory regulation to address ignition of furniture by large open flame sources was denied by the Commission on May 12, 1994. The Commission determined that ignitions of upholstered furniture by small open flames might constitute an unreasonable risk to the public and granted that part of the petition (while reserving judgment on the technical merits of the California standard). An Advance Notice of Proposed Rulemaking (ANPR) was published in the *Federal Register* on June 15, 1994. Action on that part of the petition asking the Commission to regulate cigarette ignition hazards was initially delayed pending CPSC staff review of the effectiveness of the voluntary activities of the furniture industry.

In an ANPR published in the October 23, 2003, *Federal Register*, the CPSC announced its determination that ignitions of upholstered furniture by cigarettes, in addition to ignitions by small open flames, might constitute an unreasonable risk to the public, even with the presence of the voluntary industry program. The CPSC staff evaluated test requirements proposed by affected industry stakeholders, and drafted a standard that addresses both upholstered furniture ignition by cigarettes and small open flames. The provisions of this draft standard are discussed in Section 2.

This *Preliminary Regulatory Analysis* discusses the impacts of provisions specified in the CPSC staff's 2005 draft standard for addressing the cigarette and small open-flame ignition hazards presented by residential upholstered furniture. It provides information on the products and industries that are likely to be affected by actions taken to reduce upholstered furniture fires. The *Analysis* also discusses potential costs and benefits associated with requirements of that draft standard and selected alternatives. This analysis also discusses potential effects on small firms and other market impacts.

2. THE 2005 DRAFT STANDARD: SCOPE AND PROVISIONS

In 2005 the staff of the CPSC developed a draft standard that specifies tests to determine the ability of upholstered furniture to resist ignition when subjected to a burning cigarette or small open-flame source (*e.g.*, match, cigarette lighter, or candle).[1] This draft standard contains flammability performance requirements for cover fabrics and filling materials used in most residential upholstered furniture that set mass loss limits intended to prevent or slow burning behavior of materials subject to the standard. The CPSC staff's draft standard applies to finished or ready-to-assemble articles of upholstered furniture (such as upholstered sofas, loveseats, sofa beds, rockers, recliners, and other chairs) that are:

a. primarily intended for indoor use in residences;
b. constructed with an upholstered seating area, comprised of a contiguous upholstered seat and back and/or arm(s); and,
c. manufactured or imported after the effective date.

The staff's 2005 draft standard offers manufacturers alternative methods to produce complying furniture. Furniture items can comply with the staff's draft standard by being made with filling materials that pass specified tests of ignition resistance and upholstery cover materials that pass the cover material cigarette ignition test (designated as "Type III upholstered furniture" in the staff's draft standard). In lieu of using complying loose filling materials, manufacturers may encase such materials with fabrics that pass optional loose filling interliner fabric ignition tests of the staff's draft standard. Alternatively, manufacturers may comply with the staff's draft standard by using a barrier material under the upholstery fabric that passes the staff's draft standard's applicable barrier tests ("Type I upholstered furniture"). This option allows manufacturers to use noncomplying upholstery fabrics and filling materials. The staff's draft standard also specifies optional performance requirements for cover materials that qualify them as barriers, which would allow the use of noncomplying filling materials ("Type II upholstered furniture"). Finally, the staff's draft standard allows manufacturers the option of qualifying combinations of upholstery materials for use in production furniture based on the results of end-product smoldering and open flame ignition resistance testing ("Type IV upholstered furniture").

[1] CPSC Staff, "Standard for Flammability of Upholstered Furniture and Upholstered Furniture Materials," May 12, 2005. (Note: Until accepted by a vote of the Commission for proposal as a mandatory standard, this is the "CPSC staff's draft standard.")

3. PRODUCTS AND INDUSTRIES POTENTIALLY AFFECTED BY CPSC REGULATORY ACTION ON UPHOLSTERED FURNITURE

3.1. Upholstered Furniture

3.1.1. Household Upholstered Furniture Manufacturing

The largest class of furniture products that would be affected is upholstered furniture on wood frames and dual purpose sleep furniture such as sofa beds, commonly bought for use in living rooms and family rooms. Other types of affected products include upholstered metal, reed, and rattan furniture.

Products referred to as "Household Upholstered Furniture" by the Census Bureau are classified in code 337121 of the North American Industrial Classification System (NAICS). This classification includes production of upholstered furniture on frames made of wood, metal, or other materials, as well as dual-purpose sleep furniture, such as convertible sofa beds. The 2002 *Economic Census* reports that 1,686 U.S. companies (with 1,946 establishments) manufactured upholstered household furniture or dual-purpose sleep furniture as their primary product.[2] Many other firms may also produce upholstered furniture as secondary products.

The *Economic Census* reports that the value of shipments of upholstered household furniture by U.S. firms in 2002 was $10.3 billion. The *Annual Survey of Manufactures* reported value of product shipments of $10.0 billion in 2003 and $9.55 billion in 2004.[3] The value of product shipments for 2005 was reported by the Census Bureau to have totaled $9.9 billion.

Although there are a large number of upholstered furniture manufacturers, the top four companies accounted for nearly 35 percent of the total value of household upholstered furniture shipments in 2002 (the latest year for which industry concentration ratio data are available); the 50 largest companies accounted for about 67 percent.[4] Reports from the trade press indicate that the industry has become more concentrated in the last ten years. Several firms have ceased operations; others have merged with larger companies through buyouts. The consolidation included Furniture Brands International's acquisition of HDM Furniture Industries (which included Henredon and Drexel Heritage) in 2001, and La-Z-Boy's acquisition of Ladd in January 2000 and Bauhaus and Alexvale in 1999. La-Z-Boy is the number one upholstered furniture manufacturer (by dollar volume), and Ladd, Bauhaus, and Alexvale all

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[2] U.S Census Bureau, U.S. Department of Commerce, 2002 Economic Census, report EC02-311-337121, "Upholstered Household Furniture Manufacturing: 2002," September 2004.
[3] U.S Census Bureau, U.S. Department of Commerce, *Value of Product Shipments: 2005, Annual Survey of Manufactures*, November 2006.
[4] U.S Census Bureau, U.S. Department of Commerce, 2002 Economic Census, report EC02-31SR-1, "Concentration Ratios: 2002," May 2006.

previously ranked in the top 30. Furniture Brands International is the second-leading domestic manufacturer of upholstered furniture, and companies it acquired were previously part of number four-ranked LifeStyle Furnishings, International, Ltd.

The industry also includes many small companies/establishments. The 2002 *Economic Census* reports that only 29 percent of upholstered furniture establishments (564 of 1,946) had 20 or more employees, and only 10 percent (200 establishments) had 100 or more. By some measures, such as the U.S. Small Business Administration's (SBA's) definition for qualification for small business loans, a furniture manufacturing company is considered to be "small" if it has fewer than 500 employees (at all of its establishments). This definition encompassed more than 97 percent of firms in the industry in 2002.[5]

3.1.2. Household Upholstered Furniture Foreign Trade

Exports of upholstered furniture had a value of about $285 million in 2005, or almost 3 percent of the total value of shipments.[6] The value of imports of products categorized by the Census Bureau as NAICS 337121 was $2,792 million in 2005.[7] Therefore, there were net imports of about $2.5 billion. With estimated domestic shipments of $9.9 billion, these net imports resulted in total apparent consumption of upholstered furniture in 2005 (domestic shipments plus imports, minus the value of exports) of about $12.4 billion.

Imports have grown in recent years, accounting for about 22 percent of the value of total apparent consumption of residential upholstered furniture in 2005. By way of comparison, about 10 percent of the value of apparent consumption of upholstered household furniture in 1999 was imported. The leading country of origin is China, which accounted for about 52 percent of the value of imports in 2005 and nearly 63 percent of the value of imports in 2006. Mexico accounted for about 11 percent of imports in 2006; Italy about 8 percent, and; Canada about 5 percent. These four countries accounted for 86 percent of the total value of imported upholstered furniture in 2006.

The importance of China as a source for imports has grown significantly in recent years. China supplanted Italy as the leading country of origin in 2003, and by 2006 the value of imports from China was almost 6 times that of the second-ranked country of origin, Mexico. Italy had been the number one source for upholstered furniture imports for many years. The majority of units from both China and Italy in 2004 reportedly were upholstered in leather.[8] Although much of the gain in China's market share has been at the expense of Italian imports, some of the furniture imported

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[5] Based on 2002 firm size data compiled by the United States Small Business Administration's Office of Advocacy which is available online at http://www.sba.gov/advo/research/data.html.
[6] U.S. Department of Commerce data.
[7] U.S. Department of Commerce and U.S. International Trade Commission data (c.i.f. cost basis).
[8] Industry analyst, Jerry Epperson, reported in *Furniture|Today*, December 12, 2005. P. 66.

from China is from plants that have been established by several major Italian firms. China has been the leading source of wood (non-upholstered) furniture imports and its growth as a source of upholstered furniture is expected to continue.

3.1.3. Other Upholstered Furniture

In addition to affecting manufacturers of residential upholstered furniture typically found in living room and family rooms, the staff's draft proposed standard also includes dining room and kitchen chairs within its scope if they are made with contiguously upholstered seats and backs. Similarly upholstered desk chairs purchased for household use are also covered by the standard. Dining chairs are generally products of firms classified in the wood household furniture industry, NAICS 337122. The *Economic Census* reports that 4.8 million wood dining room chairs were shipped in 1997, with a value of shipments totaling about $526 million. In 2002, shipments fell to 2.9 million chairs, with a value of about $446 million. The decline in domestic shipments is attributable to significant increases in imports of wood furniture from China and other countries.

Census data are not reported separately for upholstered and non-upholstered dining chairs. In 1994, Heiden Associates surveyed participants in the voluntary industry program to improve the cigarette ignition resistance of furniture that was developed by the Upholstered Furniture Action Council (UFAC). Among the firms surveyed were manufacturers of upholstered dining room and kitchen seating. Heiden Associates estimated that the total value of shipments of such furniture that complied with the UFAC Program (and, therefore, had upholstered seats) was about $250 million for 1993.[9] Based on the value of 1992 shipments ($580 million), perhaps 3 to 4 million upholstered dining chairs were shipped by these UFAC participants. Perhaps the great majority of these items did not have upholstered backs, or they had upholstered backs that were not contiguous with upholstered seats. Other firms that are not participants in the UFAC Program also manufacture upholstered dining furniture. Given the limitations of the market data, the number of dining chairs produced annually that fall within the scope of the staff's draft proposed standard cannot be estimated with much precision, although the total number of units is thought to be relatively small.

3.2. Marketers of Upholstered Furniture

Annual domestic retail sales of all types of living room and family room upholstered furniture total about 30 to 33 million units with a value of over $20 billion. Furniture manufacturers, especially smaller firms, commonly market their products through independent sales representatives who provide information on the market, and get and service new retail accounts for manufacturers. Recently, some manufacturers

[9] Heiden Associates, Inc., "Report on Survey of UFAC Members re: Compliance with Upholstered Furniture Cigarette Ignition Flammability Standard," December 15, 1994.

have reduced their reliance on independent representatives by employing their own salespeople.

Besides purchasing from manufacturers through independent sales representatives or the manufacturers' own sales staff, retailers may purchase furniture from wholesale furniture distributors. These wholesalers purchase from perhaps 25 to 30 manufacturers of different types and styles of furniture. The sales staffs of the wholesalers then call on retailers within their areas. Dealing through local wholesalers that stock an assortment of furniture, and that also offer competitive prices, credit, and other services, is advantageous to many retailers, particularly smaller firms.[10]

According to the 2002 *Census of Retail Trade*, 19,403 retail establishments carried upholstered furniture as a product line.[11] Retail prices of upholstered furniture fall into a very broad range, depending on materials and manufacturing techniques used. Larger retailers are more likely to purchase directly from furniture manufacturers, and smaller firms are more likely to purchase through wholesale distributors. Increasingly in recent years, retailers have reportedly devoted more floor space to private labeled furniture imported directly from foreign manufacturers. In response, several of the larger domestic furniture manufacturers have opened or expanded their own retail outlets.

3.3. Upholstery Fabric / Materials

A review of trade publications indicates that approximately 100 to 200 manufacturers derive a significant share of their revenues from fabric for residential upholstered furniture.[12] This number includes textile mills that produce finished upholstery fabric and textile finishers that purchase unfinished goods and perform additional processes, such as printing and dyeing. Like the upholstered furniture manufacturing industry, the 1990's saw consolidation of firms specializing in upholstery fabric production, with larger firms buying out competitors or divisions of competitors. However, in just the last few years the U.S. industry has been shaken by the decreased demand for domestically-produced fabric as a result of increased competition from imported upholstery fabric, the increased popularity of leather upholstery, and the dramatic increase in consumption of upholstered furniture imported from China. Culp, Inc., one of the largest marketers of upholstery fabrics in the U.S., reported that the trend to greater foreign competition and the entry of more converters of upholstery fabric (companies which purchase and resell fabrics) has

[10] Handbook of Furniture Manufacturing & Marketing, Volume 9, Wholesaling, AKTRIN Research Institute and High Point University, May 1994.
[11] U.S Census Bureau, U.S. Department of Commerce, 2002 Economic Census, report EC02-441-09 "Furniture Stores: 2002," August 2004.
[12] Including the Directory of Manufacturers published by the former industry association, the American Textile Manufacturers Institute (ATMI)

resulted in greater fragmentation of the upholstery fabric industry in recent years, with lower barriers to entry, and an increase in competition based on price.[13]

Interior fabric revenues of the top 10 firms totaled more than $1.9 billion in 2002, based on a survey done by *Furniture | Today*.[14] These revenues included sales of fabrics other than those used in residential upholstery. A similar survey conducted by *Furniture | Today* found that the top ten upholstery fabric mills had combined revenues from interior fabric shipments of $2.4 billion.[15] In addition to declining sales for the leading U.S. upholstery fabric manufacturers, the difficult state of the industry is evidenced by recent bankruptcies of firms that were once industry leaders, such as Joan Fabrics (previously the number one upholstery manufacturer) and Quaker Fabric (previously the number three firm). Both of these firms have ceased operations and their production facilities have been liquidated in 2007.

3.3.1. Textile Mills

Textile mills that make upholstery fabrics as their primary products are included in the North American Industry Classification System (NAICS) code 313210. Of 663 firms in NAICS 313210 in 2002, only 63 (about 10 percent) had 500 or more employees. About 65 percent of the firms had fewer than 20 employees.[16] The SBA considers firms with fewer than 1,000 employees to be small businesses for the purposes of programs administered by that agency. Although these data are indicative of the sizes of firms involved in the production of furniture upholstery fabrics, NAICS 313210 encompasses many firms that produce fabrics other than furniture upholstery. Nevertheless, it is likely that nearly all manufacturers of upholstery fabrics could be considered small businesses under SBA guidelines.

3.3.2. Fabric Finishers

Fabric finishers also tend to be small. Finishers are firms that receive unfinished fabrics ("greige goods" or "gray goods") and perform additional manufacturing processes (*e.g.* printing, dyeing, backcoating, needle-punching, and stain-guarding). Fabrics may be purchased by the finishers, or finished under contract to other firms that supply the fabrics. Fabric finishers are classified in NAICS code 313311. Of 1,016 broadwoven fabric finishing firms in NAICS 313311 in 2002, only 30 (3 percent) had 500 or more employees.[17] Only a few firms currently apply FR treatments to upholstery fabrics.

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[13] Culp, Inc. Annual Company report for the fiscal year ended April 29, 2007.
[14] "U.S. fabric producers still standing despite import wave." Furniture/Today, Cahners Publishing, Greensboro, NC, June 2, 2003.
[15] "Mastercraft buy puts Joan at top." Furniture/Today, Cahners Publishing, Greensboro, NC, June 1, 1998.
[16] Based on 2002 firm size data compiled by the United States Small Business Administration's Office of Advocacy which is available online at http://www.sba.gov/advo/research/data.html.
[17] *IBID.*

3.3.3. Upholstery Fabric Consumption by the Furniture Industry

The U.S. Census Bureau reported that U.S. upholstery fabric production in 2004 was 284 million square yards (which is the equivalent of 189 million linear yards).[18] This production was 43 percent lower than 2002's reported production of 499 million square yards (332 million linear yards) of upholstery fabric.[19] The number of looms in operation for the production of these fabrics totaled 2,610 at the end of 2004, down 20 percent from 3,098 looms at the end of 2002. The major end-use markets for upholstery production are in upholstered furniture and automobile manufacturing. Upholstery fabrics are also used in the manufacture of window treatments and other home textiles. Based on a survey of upholstered furniture manufacturers by Ciprus, Ltd., about 233 million linear yards of upholstery fabric were consumed in the production of household furniture in 2001.[20] This total does not include leather and vinyl upholstery, which are estimated to have comprised about 30 percent of all furniture upholstery materials used in 2001. Therefore, total upholstery use for the domestic manufacture of residential upholstered furniture was about 333 million linear yards. Estimates of total annual upholstery fabric consumption based on average requirements for chairs and sofas/loveseats are 225 million linear yards.[21]

The U.S. Census Bureau's Economic Census report, *Upholstered Household Furniture Manufacturing: 2002*, included information on the costs of upholstery fabrics and other materials used in the production of upholstered household furniture in that year. The report placed the delivered cost of woven cotton upholstery fabrics (excluding ticking) at $312 million and the delivered cost of other woven upholstery fabrics, such as those made of rayon, nylon, and polyester (excluding ticking) at $802 million.[22] The combined total delivered cost of upholstery fabric of $1,114 million was about 22 percent of the total delivered cost of all materials used in upholstered furniture manufacturing in 2002 (which was, according to the Census Bureau, $5,107 million). Other upholstery cover materials include leather, which is not reported as a separate material category by the Bureau of the Census, and coated and laminated fabrics, which had a delivered cost of about $185 million in 2002. In its 2007 Annual Report, La-Z-Boy, the largest manufacturer of upholstered furniture in the U.S., reported that purchased cover materials (primarily fabric and leather) accounted for about 28 percent of the total cost of raw materials for its upholstery group.[23]

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[18] U.S. Census Bureau. *Current Industrial Reports, Broadwoven Fabrics (Gray): 2004.* MQ313T(04)-5. June 2005.
[19] U.S. Census Bureau. *Current Industrial Reports, Broadwoven Fabrics (Gray): 2002.* MQ313T(02)-5. June 2003.
[20] Ciprus Limited, LLC. *The North American Market for Contract & Residential Upholstery Fabric*, 2001.
[21] According to industry sources, an average of approximately 7 linear yards of fabric is needed to upholster chairs and 11 to 15 yards are needed for sofas. Based on about 31.5 million annual unit shipments (of which perhaps about 53 percent are sofas, sofabeds, and loveseats and about 47 percent are other chairs) estimated annual upholstery material requirements are about 321 million linear yards (about 217 million yards for sofas, sofabeds & loveseats plus 104 million yards for chairs). About 70 percent of total yardage (about 225 million yards) would be fabrics that might require FR treatment.
[22] U.S. Census Bureau, *2002 Economic Census, Upholstered Household Furniture Manufacturing: 2002*, EC02-311-313311. September 2004.
[23] La-Z-Boy, Inc. *Annual Report for the Fiscal Year Ended April 28, 2007* (Form 10-K.) Page 5.

3.3.4. Upholstery Fabric Foreign Trade

Until recent years, relatively little upholstery fabric was imported. A report by Keyser Ciprus, Ltd., estimated that 8 million linear yards of residential upholstery fabric were imported in 1997. That accounted for approximately 2 percent of total consumption of upholstery fabric for residential furniture production in that year.[24] However, as noted above, foreign upholstery fabric production facilities (located primarily in China) have expanded operations and imports of upholstery fabrics have grown substantially.

Much of the foreign production is from facilities that are owned or operated in partnership with U.S. textile firms. For example, Culp, Inc., reported that almost 60 percent of their sales of upholstery fabrics in their fiscal year ended April 29, 2007, consisted of fabrics produced in plants outside the U.S., compared to 17 percent of sales just two years before.[25] Culp owns and operates four upholstery plants in Shanghai, China, and markets other fabrics from third party sources which are also located in China. The firm only has one remaining upholstery fabric plant in the U.S., down from fourteen in 2000.[26] Culp's experience in shifting production to foreign plants was also been reported by other U.S. upholstery fabric manufacturers. In January 2007 Richloom Fabrics Group shifted production of its Berkshire Weaving upholstery line from its South Carolina plant to a facility in Shanghai.[27] Quaker Fabric Corporation also entered into business agreements in recent years with Asian firms to produce fabrics it designs. Quaker estimated that, industry-wide, about 42 percent of total domestic upholstery fabric sales (excluding automotive fabrics) were imported in 2004, versus only 11 percent in 2002. The company's management believed it was likely that the trend continued, and it estimated that about 60 percent of furniture upholstery fabric sales were imported by the end of 2006.[28] As noted above, Quaker Fabric, which had long been a major U.S. producer of upholstery fabric, could not successfully adjust its operations to meet the recent market shifts, and the firm was forced to liquidate its operations in 2007.

At least until recent years, exports of upholstery fabric were significant for many U.S. manufacturers. In the late 1990's as much as 20 percent of the upholstery fabric production by U.S. manufacturers in recent years may have been exported. As noted above, more upholstery fabric is being imported from China and other foreign sources in more recent years, and some major U.S. fabric manufacturers have established production facilities in China, or have established business relationships with Chinese firms to produce fabrics to their specifications and designs. These market changes could be expected to reduce exports by domestic firms from previous levels.

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[24] Keyser Ciprus Limited, *op. cit.*, p. 40.
[25] Culp, Inc. Annual Company report for the fiscal year ended April 29, 2007. (Reportedly includes fabrics produced at Culp's Shanghai manufacturing plant and production sourced from other Asian firms.)
[26] Culp, Inc. Annual Company report for the fiscal year ended April 23, 2000.
[27] Andrews, Susan M. "Richloom moves production to China." *Furniture\|Today*, December 18, 2006.
[28] Quaker Fabric Corp. *Annual Report for the Fiscal Year Ended December 30, 2006* (Form 10-K.)

There is a growing practice, especially for leather, to purchase fully cut and sewn parts from areas outside of the United States including but not limited to: Argentina, Brazil, China, Italy, Thailand and Uruguay. This trend should continue given the lower labor costs in some of these areas and other existing economic conditions. La-Z-Boy reports that importing cut and sewn leather parts results in savings of 10 to 20 percent compared to domestic purchases and fabrication of these parts. [29] Cut and sewn "kits" reportedly are manufactured to the specifications of furniture manufacturers at facilities maintained by foreign fabric producers. Culp reports that it rapidly expanded its cut and sew operations in its Shanghai plants.[30]

3.3.5. Characteristics of Upholstery Fabrics

CPSC-sponsored surveys of furniture manufacturers in 1981, 1984, and 1995, and commercial surveys in 1997, 2001, and 2006[31] provided information on two characteristics of fabrics: *fabric type* and principal *fiber (or material) type*. *Fabric Type* refers to commonly-accepted descriptions of the ways in which fabrics are manufactured or of their distinctive characteristics. For the period covered by these surveys, manufacturers increased their use of jacquards and dobbies, and decreased their use of velvets.[32] Usage of cotton prints and flocks fluctuated within fairly narrow ranges during the period, according to the surveys.

Fiber (or material) Type refers to the fibers or materials used in the manufacture of the fabrics or upholstery. Most upholstery fabric fibers are classified as *cellulosic* (*e.g.* cotton and rayon) or *thermoplastic* (*e.g.*, polyester, polyolefin, and nylon); other materials used to make upholstery include vinyl (which is coated on a base fabric), wool, and leather. Based on the 2006 Ciprus Limited survey, cellulosic fabrics currently account for about 25 percent of upholstered furniture upholstery covering materials; thermoplastic fabrics account for 45 percent; leather, wool and vinyl-coated fabrics account for about 30 percent.

Review of the data on material types from the surveys conducted since 1981 indicates that the most notable changes over the years have been the increase in use of leather at the expense of both cellulosic and thermoplastic fibers. The Ciprus survey in 2001 found that about 30 percent of furniture covering materials used in that year was leather, significantly greater than found in the earlier surveys.[33] Fabrics made from predominantly cellulosic fibers include heavier-weight fabrics (such as cellulosic jacquards and velvets) and lighter-weight fabrics (mainly cotton prints). Analysis of

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[29] La-Z-Boy. *op. cit.*, p. 4.
[30] Culp, Inc. Annual Company report for the fiscal year ended April 29, 2007.
[31] Keyser-Ciprus, Ltd. survey (1997) and Ciprus Limited, LLC, surveys (2001 and 2006).
[32] "Jacquards" and "dobbies" refer to the types of looms and weaves used to produce fabrics. Brocades, damasks, velvets, tapestry weaves, and matelasses are often jacquard-woven. Dobbie looms enable weaving of small, geometric figures as a regular pattern. Dobby looms produce patterns that are beyond the range of simple looms, but are somewhat limited compared to a jacquard loom, which has a wider range of pattern capabilities.
[33] Ciprus Limited. *op. cit.*

survey data since 1981 indicates that heavier cellulosic fabrics have usually comprised about 15 to 20 percent of all upholstery covering yardage.

3.3.6. Upholstered Furniture Cushioning Materials

The staff's 2005 draft standard also requires furniture manufacturers to use cushioning materials that comply with specific smoldering and open flame flammability performance requirements. As with upholstery fabric manufacturers, many manufacturers of urethane foam cushioning, polyester fiber, and cotton fiber cushioning materials would be expected to provide guaranties under the Flammable Fabrics Acts (FFA) to the furniture manufacturers that use their products. Many of these firms already test their products to market them as complying with voluntary flammability standards, and mandatory standards in effect in California and some other jurisdictions.

Based on surveys of furniture manufacturers, resilient urethane foam cushioning material is used in nearly all seat cushions, and is also a common cushioning material for furniture arms and backs. The American Furniture Manufacturers Association (AFMA) reported that an estimated 350 million pounds of urethane foam were used in furniture production in 2002.[34] Based on information provided by officials of major urethane foam manufacturers contacted by the Directorate for Economic Analysis, approximately 20 U.S. firms manufacture flexible urethane foam for use in upholstered furniture. These firms operate perhaps 80 to 90 plants. Based on *Census of Business* data for manufacturers of urethane foam, nearly all of these establishments would be considered small businesses.[35] Although about 20 firms reportedly manufacture flexible urethane foam for furniture, the top four were said to account for perhaps 60 to 65 percent of foam cushioning used by the upholstered furniture industry. These and other firms fabricate cushions that are marketed to the upholstered furniture industry. One major trade publication for the furniture industry lists 59 sources of urethane foam cushioning for furniture.[36] Presumably this is an extensive list of major suppliers to the industry.

The CPSC staff's 2005 draft standard also applies to manufacturers and suppliers of fibrous filling materials, such as polyester and cotton batting, and loose polyester fiberfill. A major trade publication lists about 40 suppliers of these materials to the furniture industry. Many suppliers of cotton batting also provide polyester batting and fiberfill. Some also are listed as suppliers of urethane foam cushioning. According to

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[34] Bill Perdue, Director of Environmental and Technical Affairs, AFMA. Presentation at the Brominated Flame Retardants and Foam Furniture Conference and Roundtable. April 29 & 30, 2003. Note: the association has since changed its name to the American Home Furnishings Alliance (AHFA).

[35] U.S. Census Bureau, 2002 Economic Census, *Urethane and Other Foam Product (Except Polystyrene) Manufacturing: 2002*, EC02-311-326150. September 2004. (Fewer than 1 percent of the total of all establishments in the category (623) had more than 500 employees.)

[36] *Upholstery Design & Management* (udm), May 2004, p.39.

the *Census of Business*, 57 establishments produced "Paddings and upholstery filling, batting, and wadding" in 2002, with a value of shipments of $490 million.[37] According to the Census report for upholstered furniture, the delivered cost of these materials for the production of furniture was about $254 million. Census data indicate that nearly all suppliers of fibrous filling materials to the furniture industry are small businesses according to SBA guidelines (*i.e.*, with fewer than 500 employees).

4. CHARACTERISTICS OF FURNITURE IN U.S. HOUSEHOLDS

4.1. Numbers of Units in Use

The number of furniture units in use is estimated with the CPSC Product Population Model, based on available annual sales data and industry estimates of the average product life of furniture.[38] Estimates are for sofas, loveseats, armchairs, recliners, convertible sofas and other upholstered furniture commonly found in residential living rooms, family rooms, and guest rooms.

Sales are defined as shipments from U.S. manufacturers plus net imports. Annual shipment data are available from the *Economic Census* published every five years (*i.e.*, 2002, 1997, 1992, ...) by the Bureau of the Census. For upholstered wood furniture and dual-purpose sleep furniture, the *Economic Census* usually provides information on unit shipments, by type (such as sofas, sleep sofas, rockers, recliners, and other chairs). For product categories for which unit shipment data were not available, we estimated unit shipments by assigning average per unit values to the *Census* data on value of shipments. Finally, estimates of net imports were added to shipments to estimate the total number of upholstered units sold to U.S. households. For the years in which *Economic Census* data are not available, shipment estimates were based on furniture shipment values published by the Department of Commerce in the *Annual Survey of Manufactures*.[39]

The CPSC's Product Population Model uses sales data and information on the average product life to estimate the numbers of items remaining in use in the years following their purchase by consumers. The estimated average useful life of upholstered furniture reportedly ranges from 15 to 17 years.[40] Based on the assumption that the expected life of a piece of upholstered furniture is 16 years, the average number of upholstered items in household use during 2002-2004 was about 447 million pieces.

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[37] U.S. Census Bureau, 2002 Economic Census, *All Other Miscellaneous Textile Product Mills: 2002*, EC02-311-314999. August 2004.

[38] M.L. Lahr and B.B. Gordon, *Final Report on Product Life Model Feasibility and Development Study*, Battelle Columbus Laboratories, July 14, 1980.

[39] Estimated shipments before 1967 were based on the Federal Reserve's annual furniture production index.

[40] Based on discussions between industry officials and Department of Commerce personnel.

4.2. Upholstery Covering Materials on Furniture in Household Use

Surveys of furniture manufacturers in the last several years show the shift towards thermoplastic fabrics peaked during the period of the mid-1980's to the mid-1990's. Information provided to the CPSC by the Upholstered Furniture Action Council (UFAC) showed that a significant shift to greater use of thermoplastic fabrics began in the 1950's, and became more pronounced in the 1970's.[41] These data on usage of different types of fabrics over the years can be used to characterize upholstery fabrics found on furniture in U.S. households. An estimated 31.2 percent of furniture in use in U.S. households during the period 2002-2004 was covered with fabrics predominantly made with cellulosic fabrics; an estimated 50.2 percent were covered with predominantly thermoplastic fabrics, and 18.6 percent were covered with other materials (mainly leather, wool, and vinyl-coated fabrics).

5. EXPECTED BENEFITS OF THE 2005 DRAFT STANDARD

The expected benefits of the CPSC staff's draft proposed standard are estimated as the reduction in the societal costs associated with upholstered furniture fires that would be prevented by the standard. We estimate the benefits in several steps. First, the average annual societal costs of upholstered furniture fires are estimated, based on estimates of the aggregate annual costs of fire-related deaths, injuries, and property damage. These costs are differentiated by ignition source (*i.e.*, cigarette *vs.* open flame ignition) and by fabric covering type (since different fabrics exhibit different ignition propensities). Societal costs are also estimated on a "per product in use" basis, based on estimates of the numbers of furniture items in use.

Second, since each furniture item is expected to remain in use for an average of 15 to 17 years, the present value of the product's estimated lifetime fire costs is estimated by summing the discounted annual costs over the item's expected useful life. The estimated annual societal costs that are expected to accrue over the furniture item's useful life are discounted at an annual rate of 3 percent. This rate is consistent with recommendations in the economic literature for discounting the costs and consequences of health programs.[42] Societal costs have also been estimated using a 7 percent discount rate, as recommended by the Office of Management and Budget (in addition to 3 percent) in its guidance to Federal agencies on the use of discounting in regulatory analysis (Circular A-4).

[41] Report to the CPSC on the UFAC Voluntary Program, Upholstered Furniture Action Council, March 21, 1978.
[42] For example: Viscusi, W.K., "Discounting Health Effects for Medical Decisions," in *Valuing Health Care: Costs, Benefits, and Effectiveness of Pharmaceuticals and Medical Technologies*, ed. F.A. Sloan, 123-24. New York: Cambridge University Press. 1995. Also, Gold, Marthe R., *et. al.*, *Cost-Effectiveness in Health and Medicine.* New York: Oxford University Press. 1996.

Third, the expected effectiveness of the staff's draft proposed standard (*i.e.*, the percentage reduction in fire losses) is estimated for each ignition source and upholstery cover type. As discussed below, effectiveness of the standard at reducing societal costs is based on judgments regarding improvements attributed to fabric treatments and effectiveness of barrier materials, and the contribution made by improved ignition performance of filling materials that comply with the smoldering and open flame material tests.

We begin the analysis in Section 5.1. by evaluating the societal costs of cigarette fires and the expected benefits associated with preventing these fires. This is followed in Section 5.2. with an evaluation of the societal costs and likely benefits associated with the prevention of open-flame ignited fires.

5.1. Expected Benefits from Reducing Cigarette Fire Losses

5.1.1. Societal Costs of Furniture Fires Started by Cigarettes

The purpose of this section is to estimate the societal costs of cigarette-related upholstered furniture fires to use as the basis for estimating the cigarette benefits. In the next section (5.1.2.), benefits are estimated as avoided societal costs. These costs are based on fire losses (deaths, injuries and property loss) estimated by the CPSC Directorate for Epidemiology, which relies on fire loss data acquired from the National Fire Protection (NFPA) annual survey of fire departments and the U.S. Fire Administration (USFA) National Fire Incident Reporting System (NFIRS). The most recent fire data available to make such estimates was for the 2002-2004 time period. Societal cost estimates are also differentiated by fabric cover types, which (as described below) exhibit different cigarette ignition propensities.

According to the CPSC's Directorate for Epidemiology, there was an average of 260 addressable civilian deaths and 320 nonfatal civilian injuries annually from fires started by cigarettes during the 2002-2004 time frame.[43] There was also an average of about $73 million annually (in 2005 dollars) in property losses from cigarette-ignited fires.[44] By combining the costs associated with deaths, injuries, and property damage total societal costs can be estimated.

For analytic purposes staff assigns a value of $5 million as the value of a statistical life for the calculation of societal costs. The $5 million estimate is consistent with the general range of the value of a statistical life published in the literature, which

[43] Miller, David. "2002 – 2004 Fire Loss Estimates for Upholstered Furniture." Directorate for Epidemiology, U.S. Consumer Product Safety Commission, August 3, 2007 (Draft). The Directorate for Epidemiolgy based its estimates on a methodology that was refined to address concerns raised by the General Accounting Office (GAO) in a 1999 report, "Consumer Product Safety Commission: Additional Steps Needed to Assess Fire Hazards of Upholstered Furniture."

[44] Estimated average property losses of about $65 million for 2002-2004 (Miller, *op. cit.*) are expressed in 2004 dollars ($70 million) based on changes in the Producer Price Index for construction materials.

generally falls in the $3 million to $7 million range.[45] Multiplying the annual estimate of about 260 deaths by the value of a statistical life of $5 million yields annual fatality costs of $1.3 billion.

Nonfatal injuries were assigned an average cost of $146,740 each. The basis for this estimate was the analysis of burn injury costs reported in the August 1993 report "Societal Costs of Cigarette Fires," part of the research sponsored by the CPSC under the Fire Safe Cigarette Act of 1990. [46,47] The $146,740 figure represents a weighted average of injury costs (including pain and suffering) for both hospitalized injuries and injuries treated and released. The estimate of 320 injuries annually results in societal costs of about $47 million.

As noted above, the staff's 2005 draft standard would also address about $70 million annually in property losses from fires started by cigarettes, based on estimates for the 2002-2004 period. Consequently, the total annual costs of cigarette-ignited fires addressed by the draft standard amounted to an annual average of about $1,420 million ($1,300 million + $47 million + $73 million) during the 2002-2004 time period.

Information on the number of furniture items (*i.e.*, separate pieces of furniture) in use provides a basis for estimating the costs of cigarette ignition fires on a per unit basis. As noted in Section 4.1, the average estimated number of items of residential living room and family room upholstered furniture in use during the 2002-2004 time period was about 447 million units, based on an expected useful product life of 15-17 years. Given the annual societal costs and the number of furniture units in use, the annual societal cost per unit of furniture in use, resulting from cigarette ignition, amounted to about $3.18 ($1,420 million / 447 million units of furniture). This per unit societal cost estimate represents an average across all furniture items in use. However, because different fabric coverings for furniture exhibit different ignition propensities, we can develop more precise estimates of per unit societal costs by accounting for the fabric cover.

Ignition testing of chairs by CPSC staff and others over the years has shown that the cigarette ignition hazard of furniture mainly involves chairs covered with fabrics that are predominantly woven from cellulosic fibers, *i.e.*, cotton and rayon. Chair testing done by the CPSC staff and California's Bureau of Home Furnishings has shown that chairs covered with predominantly thermoplastic fabrics (*e.g.*, polyester, polypropylene, and nylon) are much less likely to ignite from cigarettes. Chairs covered with some materials, such as leather, vinyl-coated fabrics, and wool fabrics are

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[45] Viscusi, W. Kip, "The Value of Risks to Life and Health," Journal of Economic Literature, Vol. XXXI, December 1993, pp. 1912-1946.

[46] Zamula, William W., "Costs for Non-Fatal, Addressable Residential Civilian Injuries Associated with Upholstered Furniture Fires." (Memorandum to Gregory B. Rodgers, AED, EC) Directorate for Economic Analysis, U.S. Consumer Product Safety Commission. September xx, 2007. (Costs are estimated in 2005 dollars.)

[47] Miller, Ted R., *et. al.*, "Societal Costs of Cigarettes Fires," prepared for the U.S. Consumer Product Safety Commission under the Cigarette Safety Act of 1984, August 1993.

resistant to ignition from cigarettes. Given the disparity of ignition propensities, some types of furniture would be expected to result in greater societal costs from fires. Information relevant to the determination of average ignitability and estimation of societal costs for furniture covered with different types of materials is discussed below.

The results of the analysis described in this section (including estimates of market shares by fabric covering, estimates of ignition propensities and risk by fabric type, and estimates of annual societal costs) are summarized in Table 1.

Estimated Market Shares, by Type of Upholstery Covering

Estimates of the types of upholstery on furniture pieces found in households during 2002-2004 were derived from historical data from surveys in various years, estimates of annual sales of upholstered furniture, and calculations of the survival of furniture in years after purchase (using the CPSC's Product Population Model). Based on these sources, the Directorate for Economic Analysis estimates that 50.2 percent of the 447 million upholstered furniture items that were in use during 2002-2004 were covered with thermoplastic fabrics, 31.2 percent were covered with cellulosic fabrics, and 18.6 percent were covered with leather, vinyl-coated fabrics, or wool fabrics. These market shares are shown in Table 1, column 1.

Note that the market shares in the first three rows sum to the 31.2 percent of the furniture in use covered with cellulosic fabrics. However, because extensive testing data show that some cellulosic fabrics are more likely to ignite than others, this analysis also separates cellulosic fabrics into three categories according to their ignition propensities. The next several paragraphs describe this sub-categorization of cellulosic fabric coverings.

Testing by the CPSC laboratory using the draft *Upholstery Fabric Smoldering Ignition Test* [48] indicates that upholstery cover materials which are most likely to fail the test are fabrics woven entirely of cellulosic fibers that are heavier than eight ounces per square yard. These fabrics are assumed to include all fabrics that would be classified as Class II fabrics under the UFAC Program as well as predominantly cellulosic fabrics that would be classified as Class I fabrics under the UFAC Program and Class D fabrics according to the draft furniture flammability standard fabric test method developed by the National Bureau of Standards (NBS, now the National Institute of Standards and Technology) in the 1970's. Estimation of the percentage of fabrics that would fail the fabric test of the CPSC staff's 2005 draft standard, and assessment of the societal costs presented by different types of upholstery cover materials are, therefore, based on fabric and chair test data accumulated over the years.

[48] The *Upholstery Fabric Smoldering Ignition Test* is cigarette ignition testing of fabrics over a standard flame-retardant polyurethane foam substrate.

Classification of cellulosic fabrics according to the test developed by UFAC (which classifies fabrics according to char length on the vertical surface when tested over standard non-FR polyurethane foam) and the test developed by NBS (which classifies fabrics according to char length when tested over a glass fiberboard substrate) have been used to categorize the ignition performance of cellulosic fabrics in this analysis. CPSC laboratory analyses since 1980 found that about 82 percent of cellulosic fabrics tested were Class I fabrics according to the fabric classification test of the UFAC Program (*i.e.*, having a vertical char length of less than 1.75 inches), and 18 percent of cellulosic fabrics were UFAC Class II fabrics (*i.e.*, having a vertical char length of 1.75 inches or greater). Assuming the tested fabrics were representative of cellulosic fabrics, 25.6 percent of all fabrics on furniture in use during 2002-2004 were UFAC Class I (31.2% that were covered with cellulosic fabrics x 82%) and 5.6 percent were UFAC Class II (31.2% x 18%).

Laboratory testing shows that the *Upholstery Fabric Smoldering Ignition Test* of the staff's 2005 draft standard is slightly more severe than the UFAC Fabric Classification Test.[49] Therefore, for the purposes of this analysis, UFAC Class II fabrics are assumed to fail the draft fabric test without changes that would improve their ignition resistance. Limited testing also indicates that some portion of UFAC Class I fabrics will fail the fabric test of the staff's draft standard. Twenty-five percent of the Class I fabrics tested by the CPSC staff in 1980 and 1984 were found to be generally more ignition-prone Class D fabrics according to the NBS fabric classification test (*i.e.*, sustaining chars of greater than 3 inches when tested over glass fiberboard). If we assume that such fabrics would fail the 2005 draft standard's fabric test, an estimated 12 percent of fabrics found on furniture in 2002-2004 would have failed the test (5.6 percent which were UFAC Class II, plus 25 percent of the 25.6 percent of other cellulosic fabrics which were UFAC Class I. (Designated as "Severely Ignition-Prone Cellulosics" in Table 1.)

Fabrics assumed to pass the staff's 2005 draft standard include more moderately ignition-prone fabrics that are Class I according to the UFAC Fabric Classification test and Class C according to the NBS fabric test (*i.e.*, sustaining chars of 1.5 - 3 inches when tested over glass fiberboard), and more ignition-resistant Class B cellulosic fabrics according to the NBS fabric test (which sustain char lengths of less than 1.5 inches when tested over glass fiberboard). The Class C fabrics accounted for an estimated 5.8 percent of fabrics found on furniture in 2002-2004 (22.5 percent of UFAC Class I cellulosic fabrics according to CPSC staff testing). These fabrics are designated as "Moderately Ignition-Prone Cellulosics" in Table 1. More ignition-resistant NBS Class B fabrics are estimated to have comprised 52.5 percent of UFAC Class I cellulosic fabrics, or 13.4 percent of all fabrics and covering materials found on upholstered items in 2002-2004. These fabrics are designated as "Less Ignition-Prone Cellulosics" in Table 1.

[49] Tao, Weiying, Ph.D. "Evaluation of Test Method and Performance Criteria for Cigarette Ignition (Smoldering) Resistance of Upholstered Furniture Materials." Division of Electrical and Flammability Engineering, Directorate for Laboratory Sciences, U.S. Consumer Product Safety Commission. May 2005.

Estimated Ignition Propensities

Estimated ignition propensities for furniture covered with cellulosic fabrics are based on chair testing that was done in 1984 and 1994. Evaluating chair test results according to UFAC and NBS fabric classifications, 58.3 percent of test cigarettes were estimated to lead to ignitions for chairs covered with UFAC Class II fabrics. The estimated ignition propensity for test cigarettes on chairs covered with UFAC Class I, NBS Class D fabrics was 46.6 percent. Combining these two severely-ignition-prone fabric classes yields an average estimated ignition propensity of 52.1 percent (weighted by their 2002-2004 market shares). Cigarettes placed on furniture covered with moderately ignition-prone fabrics had an estimated 32.2 percent likelihood of resulting in ignition.[50] About 10.5 percent of test cigarettes were estimated to lead to ignitions for chairs covered with less ignition-prone cellulosic fabrics.[51] (See column 2 of Table 1.)

Because of less concern with the ignition propensity of thermoplastic fabrics, ignition testing data for such materials are more limited. Expanding chair test data to include tests conducted in 1980 led to an estimate that 1.5 percent of test cigarettes would result in ignition for furniture covered with thermoplastic fabrics. Additionally, based on limited laboratory ignition testing data, materials such as leather, wool fabrics, and vinyl-coated fabrics are assumed to be highly resistant to ignition from cigarettes.

Weighted Ignition Propensities

The calculation of weighted ignition propensities of furniture covered with different types of fabrics is the product of the estimated market share of furniture in use in 2002-2004 for each type of fabric and its estimated ignition propensity. The estimated weighted ignition propensity was .063 for items covered with severely ignition-prone cellulosic fabrics (*i.e.*, 12.0% share of the market x 52.1% ignition propensity); .019 for items covered with moderately ignition-prone cellulosic fabrics (5.8% x 32.2%); .014 for items covered with less ignition-prone cellulosic fabrics (13.4% x 10.5%); and .008 for items covered with thermoplastic fabrics (50.2% x 1.5%). (See column 3 of Table 1.)

Percent of Total Risk, by Fabric Type

The percent of total risk presented by furniture covered with different fabric types was derived by dividing estimated weighted ignition propensities by the sum of all weighted ignition propensities (which was about .103 for furniture in use in 2002-2004). Thus, as shown in the table, the more severely ignition-prone cellulosic fabrics[52] were estimated to account for 60.9 percent of the total risk (.063/.103); moderately ignition-prone cellulosic fabrics[53] accounted for an estimated 18.0 percent of the risk

[50] UFAC Class I, NBS Class C cellulosic fabrics.
[51] NBS Class B cellulosic fabrics.
[52] UFAC Class II and UFAC Class I/NBS Class D fabrics.
[53] NBS Class C cellulosic fabrics.

(.019/.103); less ignition-prone cellulosic fabrics accounted for about 13.7 percent of the risk (.014/.103); and thermoplastic fabrics accounted for about 7.3 percent of the risk (.008/.103). (See column 4 of Table 1.[54])

Average Annual Societal Costs of Cigarette Ignition, by Fabric Type and Ignition Propensity

The average annual societal costs associated with cigarette ignitions of each fabric type were estimated by dividing the product of estimated percent of total risk (above) and the total estimated average annual societal costs associated with cigarette ignition of furniture ($1,420 million) by the estimated number of units in use during 2002-2004 with each fabric type (447 million units in use x estimated market share). The average annual societal costs were estimated to be $16.08 for items covered with severely ignition-prone cellulosic fabrics (60.9% x $1,420 million /447 million x 12.0%); $9.94 for items covered with moderately ignition-prone cellulosic fabrics (18.0% x $1,420 million /447 million x 5.8%); $3.24 for items covered with less ignition-prone cellulosic fabrics (13.4% x $1,420 million /447 million x 13.7%); and $.46 for items covered with thermoplastic fabrics (7.3% x $1,420 million /447 million x 50.2%). (See column 5 of the Table 1.)

Lifetime Societal Costs of Cigarette Ignition, by Fabric Type

The estimated lifetime societal costs per unit of furniture were calculated as the present value of the estimated annual societal costs over the expected product life of the item of furniture. The annual expected societal costs of cigarette ignition were assumed to apply each year that an item of furniture remains in household use. The CPSC's Product Population Model was used to calculate the likelihood that furniture items would remain in use in years after purchase. Annual societal costs per unit were multiplied by estimated probability of survival in subsequent years. The estimated stream of future expected societal costs were discounted to their present values, using a discount rate of 3 percent.

Adjustments for Changes in Smoking Behavior and Other Factors

Available data suggest that other factors (in addition to changes in fabrics) have contributed to a decline in fires resulting from cigarette ignition of upholstered furniture over time. These factors include changes in smoking-related behavior of individuals, increased presence of smoke alarms, and changes in furniture filling materials. The present value estimates were further adjusted to account for an expected future decline in smoking-related fire incidents. This was done by forecasting future fire deaths by year, based on trends in deaths from cigarette ignitions of upholstered

[54] Percent of total risk for each fabric type was calculated from estimates of market share and ignition propensity that were not rounded.

furniture during 1980-2004, and reducing the expected societal costs of cigarette ignited fires by the projected percentage reduction. This analysis found that expected lifetime societal costs, discounted to their present value using a 3 percent discount rate, should be reduced by approximately 28 percent. Thus, expected lifetime societal costs per unit of $195.31 for items covered with severely ignition-prone cellulosic fabrics were reduced to $140.04 after incorporating the trend data. Similar calculations led to estimates of lifetime societal costs of $86.60 for items covered with moderately ignition-prone cellulosic fabrics; $28.24 for items covered with less ignition-prone cellulosic fabrics; and $4.06 for items covered with thermoplastic fabrics. (See column 6 in Table 1.)

5.1.2. Expected Benefits

The purpose of this section is to estimate the expected benefits of preventing cigarette ignition fires (i.e., the reduction in societal costs that will result), based on the societal cost estimates derived in Table 1.

The analysis described in Section 5.1.1. estimated the per unit hazard costs associated with the upholstery materials of different ignition propensities, based on the furniture in use during 2002-2004, the most recent time period for which fire data is available. However, as discussed in Section 4, the types of upholstery materials used in the production of furniture has changed over the years. Since a standard would address risks associated with current production, projection of benefits requires estimating the societal costs associated with materials now being used to manufacture furniture. This is accomplished by estimating the percentage of furniture items currently made with covering materials of differing ignition propensities.

Table 1.

Estimated Societal Costs of Cigarette Ignition of Upholstered Furniture, by Ignition Propensity of Cover Materials, for Furniture in Use During 2002-2004 *(in 2005 dollars)*

Type of Upholstery Cover Material	(1) % of Furniture in Use, 2002-2004	(2) Ignition Propensity	(3) Weighted Ignition Propensity (1) x (2)	(4) % of Overall Risk [4]	(5) Annual Societal Costs per Unit	(6) Lifetime Societal Costs per Unit, Adjusted [5]
Severely Cigarette-Ignition-Prone Cellulosics [1]	12.0%	.521	.063	60.9%	$16.08	$140.04
Moderately Cigarette-Ignition-Prone Cellulosics [2]	5.8%	.322	.019	18.0%	$9.94	$86.60
Lower Cigarette-Ignition-Prone Cellulosics [3]	13.4%	.105	.014	13.7%	$3.24	$28.24
Thermoplastics	50.2%	.015	.008	7.3%	$0.47	$4.06
Leather, wool, vinyl-coated	18.6%	See note [6]	See note [6]	See note [6]	See note [6]	See note [6]

[1] UFAC Class II (5.6% of fabrics) and Cellulosic UFAC Class I/NBS Class D Fabrics (6.4% of fabrics).

[2] UFAC Class I/NBS Class C Cellulosic Fabrics.

[3] Predominantly Cellulosic Class B Fabrics according to the NBS draft standard.

[4] The Percent of Overall Risk for each type of upholstery cover material (column 4) is calculated by dividing weighted ignition propensity (column 3) by the summation of the weighted ignition propensities (0.103).

[5] Based on a 3% discount rate.

[6] Based on limited laboratory testing data, leather, wool, and vinyl-coated fabrics are assumed to be highly resistant to ignition from cigarettes. Therefore, ignition propensity of these materials is small, but unknown, as are the annual and lifetime societal costs per unit covered with these materials.

A 2006 survey of furniture manufacturers by Ciprus Limited provides information on consumption of cellulosic, thermoplastic, and leather covering materials in the production of furniture.[55] Using CPSC staff test data discussed above, the percentages of current production (as indicated by the Ciprus data) made with materials ranging from severely ignition-prone cellulosic fabrics to ignition resistant materials such as leather were estimated. These estimates are shown in column 1 of Table 2 below. The estimated percentage of upholstered items now made with severely ignition-prone cellulosic fabrics has fallen to 9.6 percent of annual production, from 12.0 percent estimated for furniture in use during 2002-2004. This is a 20 percent decrease in the relative use of the most ignition-prone class of fabrics. The use of other ignition-prone fabrics has also declined, in relative terms, while the use of generally ignition-resistant materials such as leather (estimated to be about 30 percent of current production) is 62 percent greater than found in household use in 2002-2004.

Column 2 of Table 2 shows the expected number of furniture units produced annually, by type of covering material, based on the market shares of the various fabric coverings (column 1) and an estimated 30.5 million furniture units produced. Column 3 provides the estimates of per unit lifetime societal costs derived in Table 1.

Based on current estimates of the types and quantity of furniture produced, the estimated total present value of the expected societal costs from cigarette fires is $681 million for furniture produced in a year, in the absence of a standard. (See column 4 of Table 2.) Total estimated societal costs involving furniture covered with severely ignition-prone cellulosic fabrics account for $411 million, or about 60 percent of the total. In contrast, thermoplastic fabrics, which are used to cover about 45 percent of all upholstered furniture produced, account for an estimated $55.5 million in societal costs, or only about 8 percent of the total.

Estimated Effectiveness of the Staff's 2005 Draft Standard

A comparison of the ignition performance of upholstered chairs made with current fabrics and filling materials with that of chairs made in compliance with the staff's draft standard would provide data to assess the likely reduction in ignition propensity that would result from the draft standard. In the absence of such data, we can estimate the benefits of the standard by making reasonable judgments about improvements in ignition performance that would result from the use of complying materials.

We assume that furniture currently manufactured with severely ignition-prone cellulosic fabrics would realize a reduction in societal costs per unit under the staff's draft standard to the equivalent of that now estimated for furniture covered by less ignition-prone cellulosic fabrics. This reduction would be attributable to improved

[55] Ciprus Limited, *op. cit.*

ignition performance of FR-treated fabrics and improved ignition performance of filling materials, or from the use of qualifying barriers. The reduction in lifetime societal costs per unit from $140.04 to $28.24 amounts to a hazard reduction of 79.8 percent (shown in column 5 of Table 2). We likewise assume that pre-standard societal costs estimated for moderately ignition-prone cellulosic fabrics also would fall to the estimated hazard costs associated with furniture covered with less ignition-prone fabrics. The estimated reduction from estimated lifetime societal costs of $86.60 to $28.24 would be a 67.4 percent reduction in the hazard presented (also shown in column 5). For the purposes of this analysis, we estimate that upholstered furniture items covered with less ignition-prone cellulosic fabrics and thermoplastic fabrics would also realize a 67.4 percent reduction in their expected societal costs. The reduction in the hazard is expected to result from smoldering ignition requirements for filling materials when tested with a standard cover fabric. The staff's 2005 draft standard requires that materials that are tested shall not have less than 90 percent non-smolder residue of the substrate or filling material at 30 minutes when tested in accordance with the appropriate test method. Materials that comply with the smoldering tests should present a much lower likelihood that smoldering ignitions would progress to hazardous conditions.

The estimated benefits per unit were calculated for each fabric class. (See column 6 of Table 2.) Per unit benefits of the staff's draft standard range from $2.74 for furniture covered with relatively ignition-resistant thermoplastic fabrics to an estimated $111.80 per unit for items currently covered by severely ignition-prone cellulosic fabrics. The benefits, from ignition resistant materials such as leather, wool, and vinyl-coated fabrics are unknown, but are expected to be small.

The total estimated benefits of the staff's 2005 draft standard are calculated by multiplying estimated per unit benefits (shown in column 6) by the estimated annual units produced with each class of covering material (column 2). Based on these calculations, estimated benefits of the standard, in the form of expected lifetime reduction in societal costs associated with production of furniture in one year, discounted to their present value using a discount rate of 3 percent, total $510.1 million. About 64 percent of total estimated benefits are associated with the approximately 10 percent of furniture currently made with severely ignition-prone cellulosic fabrics.

As noted previously, OMB guidance to Federal agencies on the use of discounting in regulatory analysis recommends that future benefits (and costs) of federal regulations be presented using discount rates of 3 percent and 7 percent. Projected benefits from reductions in smoldering ignitions have an estimated present value of $365 million if future benefits are discounted at a 7% discount rate. Table 2a in Appendix A presents estimated benefits from reduction in smoldering ignition fires based on the higher rate.

Table 2.

Cigarette Ignition Societal Costs and Estimated Benefits from the Staff's 2005 Draft Standard for Furniture Produced in a Year

(in 2005 dollars)

Type of Upholstery Cover Material	(1) % of Annual Production	(2) Annual Units Produced	(3) Lifetime Societal Costs per Unit, Adjusted[1] (Table 1)	(4) Total Estimated Societal Costs[2] (million $) (2) x (3)	(5) Estimated Hazard Reduction	(6) Estimated Benefits per Unit (3) x (5)	(7) Total Estimated Benefits (million $) (2) x (6)
Severely Cigarette-Ignition-Prone Cellulosics	9.6%	2,934,901	$140.04	$411.0	79.8%	$111.80	$328.1
Moderately Cigarette-Ignition-Prone Cellulosics	4.6%	1,406,465	$86.60	$121.8	67.4%	$58.36	$82.1
Lower Cigarette-Ignition-Prone Cellulosics	10.8%	3,281,752	$28.24	$92.7	67.4%	$19.03	$62.5
Thermoplastics	44.8%	13,653,682	$4.06	$55.5	67.4%	$2.74	$37.4
Leather, wool, vinyl-coated	30.2%	9,223,200	**See note [3]**	**See note [3]**	**See note [3]**	**See note [3]**	**See note [3]**
All Covering Materials	100.0%	30,500,000	$22.33	$681.0	--	$20.40	$510.1

[1] Based on a 3% discount rate; see Table 2a in Appendix A for calculations based on a 7% discount rate.

[2] Based on estimated annual production of 30.5 million pieces of upholstered furniture for household consumption.

[3] Based on limited testing data, leather, wool, and vinyl-coated fabrics are assumed to be highly resistant to ignition from cigarettes. Therefore, the societal costs (and, hence, the potential benefits) associated with these covering materials are small but unknown.

5.2. Expected Benefits from Reducing Small Open Flame Fire Losses

5.2.1. Societal Costs of Small Open-Flame Fires

In addition to cigarette losses, the Directorate for Epidemiology estimated open-flame ignitions for the years 2002-2004.[56] During this time period, there were an average of 30 deaths and 170 nonfatal injuries annually from fires started by small open flames. There was also an average of about $50 million annually in property losses from small open flame-ignited fires during this time frame.[57]

Assuming a value of statistical life of $5 million,[58] the societal costs associated with the 30 deaths annually amounted to about $150 million. The 170 nonfatal injuries were assigned an average cost of $146,740 each,[59] resulting in societal costs of about $25 million. Adding in the $50 million annually in property losses from fires started from small open-flame ignition, the total annual costs of open-flame ignited fires addressed by the staff's 2005 draft standard amount to about $225 million ($150 million + $25 million + $50 million).

As in Table 1, these annual estimates of the open-flame losses are used to develop estimates of the lifetime societal costs of open-flame hazards per unit of furniture in use during 2002-2004, for each of the five fabric categories. The results are presented in Table 3.

Column 1 of Table 3 shows the proportions of furniture in each fabric material category, and is identical to the corresponding column in Table 1. Column 2 describes open-flame ignition propensities, based on small open flame ignition testing by the CPSC laboratory in 1996. In that testing, cellulosic and thermoplastic fabrics had nearly the same ignition propensity when subjected to a small flame for 20 seconds. Ignitions in 20 seconds or less were observed for 27 of 29 predominantly cellulosic fabrics (about 93 percent) and 17 of 18 predominantly thermoplastic fabrics (about 94 percent).[60]

Based on these ignition propensities and the estimated percentages of furniture in use comprised by upholstered items with cellulosic and thermoplastic fabrics, furniture covered with thermoplastic fabrics accounted for an estimated 62 percent of the overall risk of small open flame ignitions during 2002-2004; items covered with cellulosic fabrics accounted for an estimated 38 percent of the risk. While Table 3 separates cellulosic fabrics according to differences in their cigarette ignition

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[56] Miller, David. *op.cit.*

[57] Estimated average property losses for 2002-2004 are expressed in 2005 dollars, based on changes in the Producer Price Index for construction materials.

[58] Viscusi, W. Kip, *op. cit.*

[59] Zamula, William W., *op. cit.* Injury costs are expressed in 2005 dollars.

[60] Based on testing data presented in Directorate for Laboratory Sciences memoranda dated October 3, 1996, through September 19, 1997, Tab D, "Upholstered Furniture Flammability: Regulatory Options for Small Open Flame & Smoking Material Ignited Fires," October 24, 1997.

propensities, for this analysis all cellulosic fabrics are assumed to have the same small open flame ignition propensity. The estimated percent of overall risk for each type of cellulosic fabric is, therefore, determined by market share. As with the risk of ignition by cigarettes, furniture covered by leather, wool, and vinyl-coated fabrics is assumed to be resistant to ignition from a 20-second exposure to a small open flame.

Following the same methodology described in Table 1, the average annual societal costs associated with small open flame ignitions of each fabric type were estimated by dividing the products of estimated percent of total risk and the total estimated average annual societal costs associated with small open flame ignition of furniture ($225 million) by the estimated number of units in use during 2002-2004 with each fabric type (447 million units in use x estimated market share). This approach resulted in estimated average annual societal costs of about $.62 for items covered with thermoplastic fabrics (62% x $225 million/447 million x 50.2%) and about $.61 for items covered with predominantly cellulosic fabrics (38% x $225 million/447 million x 31.2%). (See column 5 of Table 3.)

Finally, the lifetime societal costs (per unit of furniture) were estimated as the present value of the annual per unit societal costs over the expected product life of a furniture item. This present value estimate (shown in column 6), discounted at a rate of 3 percent, is about $7.55 for items covered with predominantly thermoplastic fabrics and $7.44 for items covered with predominantly cellulosic fabrics.

5.2.2. Expected Benefits

The estimated benefits associated with the prevention of open-flame fires are described in Table 4. The methodology is similar to that described for Table 2. Column 1 shows the current market shares, by fabric type, and Column 2 shows annual sales based on annual furniture shipments of 30.5 million units. Column 3 provides the estimates of per unit lifetime societal costs derived in Table 3, and Column 4 provides estimates of the aggregate societal costs of fires associated with open-flame ignition.

For the purposes of this analysis, it is assumed that 60 percent of furniture currently manufactured with severely cigarette ignition-prone cellulosic fabrics (accounting for 5.8 percent of all furniture items) would be made with fabrics treated with FR chemicals to enable them to pass the upholstery cover fabric smoldering ignition resistance test (but not the upholstery fabric fire barrier open flame ignition resistance test).[61] In 2001 the CPSC staff estimated that FR treatment of fabrics to

[61] The Decorative Fabrics Association (DFA), in a comment submitted to the CPSC on August 31, 2000, estimated that its member firms accounted for 1 to 1.5 percent of upholstery fabric production. The DFA stated that member firms, as well as designers and furniture manufacturers that use their fabrics, would prefer the use of barrier materials to FR treatment of fabrics. Although the use of barriers is more costly, we assume that some non-DFA firms and furniture manufacturers that use their fabrics would also prefer the use of barriers, bringing the use of barriers up to about 4% of total cover fabric yardage (up to 4 times the yardage reportedly produced by DFA members). This would account for 40% of the "severely cigarette ignition-prone" fabric category. We therefore assume that the remaining 60% of severely cigarette ignition-prone cellulosic fabrics would be treated with FR chemicals.

Table 3.

Estimated Societal Costs from Small Open Flame Ignition of Upholstered Furniture for Furniture in Use During 2002-2004

(in 2005 dollars)

Type of Upholstery Cover Material	(1) % of Furniture in Use, 2002-2004	(2) Ignition Propensity	(3) Weighted Ignition Propensity (1) x (2)	(4) % of Overall Risk [1]	(5) Annual Societal Costs per Unit	(6) Lifetime Societal Costs per Unit [2]
Severely Cigarette-Ignition-Prone Cellulosics	12.0%	.93	.112	14.6%	$.61	$7.44
Moderately Cigarette-Ignition-Prone Cellulosics	5.8%	.93	.054	7.0%	$.61	$7.44
Lower Cigarette-Ignition-Prone Cellulosics	13.4%	.93	.125	16.4%	$.61	$7.44
Thermoplastics	50.2%	.94	.474	62.0%	$.62	$7.55
Leather, wool, vinyl-coated	18.6%	See note [3]	See note [3]	See note [3]	See note [3]	See note [3]

[1] The Percent of Overall Risk for each type of upholstery cover material (column 4) is calculated by dividing weighted ignition propensity (column 3) by the summation of the weighted ignition propensities (0.765).

[2] Based on a 3% discount rate.

[3] Based on limited laboratory testing data, leather, wool, and vinyl-coated fabrics are assumed to be highly resistant to ignition from small open flames. Therefore, ignition propensity of these materials is small, but unknown, as are the annual and lifetime societal costs per unit covered with these materials.

achieve compliance with a draft small open flame standard might result in an 88 percent reduction in small open flame fire losses.[62] Since FR fabric treatments under the 2005 standard drafted by the CPSC staff would specifically address cigarette ignition performance of fabrics, their effectiveness at reducing the small open flame fire hazard probably would be lower. However, we note that a major intent of the staff's 2005 draft standard is limiting the burning rate of many filling materials so that fire growth would be slow enough to delay the onset of untenable fire conditions. To this end, the staff's 2005 draft standard incorporates requirements limiting the mass loss of interior filling materials over time. The ignition performance of these filling materials, which were not addressed by the small open flame standard drafted by the CPSC staff in 2001, should allow additional escape time for occupants of the residence, thereby reducing deaths and injuries. Therefore, improved ignition performance of filling materials under the staff's 2005 draft standard should largely offset any reductions in effectiveness of FR fabric treatments vis-à-vis FR treatments intended to pass the 20-second small open flame fabric test of the 2001 CPSC staff draft standard. Consequently, the hazard reduction for furniture with FR-treated fabrics and complying interior filling materials may be about 80 percent. We also assume that 40 percent of furniture currently manufactured with severely cigarette ignition-prone cellulosic fabrics (accounting for 3.8 percent of all furniture items) would be used with barrier materials. Barriers would reduce the societal costs of small open flame ignitions by about 90 percent, based on previous estimates of the benefits of barriers used under the draft standard for small open flame ignition of furniture.[63] The average small open flame hazard reduction for severely cigarette ignition-prone cellulosic fabrics would, therefore, be about 84 percent (80% reduction x 60%) + (90% reduction x 40%).

Additionally, finished items made with untreated fabrics and complying filling materials could realize a reduction in societal costs associated with small open flame ignitions of about 50 percent.[64] This reduction would be attributable to improved ignition performance of filling materials, which, as noted above, is expected to slow the rate of fire growth and reduce the open flame ignition hazard.

The estimated benefits per unit were calculated in Table 4 as the product of lifetime per unit societal costs (column 3) and the expected hazard reduction (column 5), for each class of covering material. The resulting per unit benefits range from $3.72 for furniture covered with less-to-moderately cigarette ignition-prone cellulosic fabrics, to $6.25 for items currently covered by severely cigarette ignition-prone cellulosic fabrics. These estimated benefits per unit are shown in column 6 of Table 4. The benefits, if any, involving inherently ignition-resistant materials such as leather, wool, and vinyl-coated fabrics are small but unknown.

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[62] Smith, Charles, Directorate for Economic Analysis, CPSC, *Economic Analysis of Regulatory Options to Address Small Open Flame Ignitions of Upholstered Furniture*, October 2001.

[63] *IBID.*

[64] Preliminary estimates of effectiveness are based on discussions with Directorate for Engineering Sciences staff, and may be refined following the analysis of composite flammability testing data gained from a testing program that is being planned.

Table 4.

Small Open Flame Ignition Societal Costs and Estimated Benefits from the Staff's 2005 Draft Standard for Furniture Produced in a Year *(in 2005 dollars)*

Material	(1) % of Annual Production	(2) Annual Units Produced	(3) Lifetime Societal Costs per Unit[1] (Table 3)	(4) Total Estimated Societal Costs[2] (million $) (2) x (3)	(5) Estimated Hazard Reduction	(6) Estimated Benefits per Unit (3) x (5)	(7) Total Estimated Benefits (million $) (2) x (6)
Severely Cigarette-Ignition-Prone Cellulosics	9.6%	2,934,901	$7.44	$21.8	84%	$6.25	$18.3
Moderately Cigarette-Ignition-Prone Cellulosics	4.6%	1,406,465	$7.44	$10.5	50%	$3.72	$5.2
Lower Cigarette-Ignition-Prone Cellulosics	10.8%	3,281,752	$7.44	$24.4	50%	$3.72	$12.2
Thermoplastics	44.8%	13,653,682	$7.55	$103.0	50%	$3.77	$51.5
Leather, wool, vinyl-coated	30.2%	9,223,200	**See note [3]**	**See note [3]**	**See note [3]**	**See note [3]**	**See note [3]**
All Covering Materials	100.0%	30,500,000	$5.24	$159.8	--	$2.86	$87.3

[1] Based on a 3% discount rate; see Table 4a in Appendix A for calculations based on a 7% discount rate.

[2] Based on estimated annual production of 30.5 million pieces of upholstered furniture for U.S. household consumption.

[3] Based on limited testing data, leather, wool, and vinyl-coated fabrics are assumed to be highly resistant to ignition from small open flames. Therefore, the societal costs (and, hence, the potential benefits) associated with these covering materials are small but unknown.

The aggregate estimated benefits are calculated in column 7 as the product of the estimated per unit benefits (column 6) and the annual number of units produced (column 2). Based on these calculations, estimated benefits of the staff's 2005 draft standard, in the form of expected lifetime reduction in societal costs of fires started by small open flames associated with production of furniture in one year, discounted at an annual rate of 3 percent, will total $87.3 million.

In accordance with OMB guidance that future benefits (and costs) of federal regulations be presented using discount rates of 3 percent and 7 percent, open flame benefits of the draft standard have also been estimated to have a present value of $62.5 million if future benefits are discounted at a 7 percent discount rate. Table 4a in Appendix A presents estimated benefits from reduction in small open flame ignition fires based on the higher discount rate.

6. EXPECTED COSTS OF THE 2005 DRAFT STANDARD

This section of the analysis presents information about the expected resource costs associated with the staff's 2005 draft standard. These costs include manufacturing costs incurred for materials, labor, testing, and recordkeeping, and distribution costs to wholesalers, distributors, and retailers. The estimates are expressed in 2005 dollars (as were estimated benefits). Cost estimates are limited to upholstered household furniture that may commonly be found in living rooms and family rooms. A relatively small number of other types of chairs that fall within the scope of the standard, such as a small percentage of dining chairs and desk chairs purchased by consumers, are excluded from this analysis.[65] Cost estimates are summarized in Table 5.

6.1. Costs Related to Upholstery Fabrics and Barrier Materials

6.1.1. Upholstery Fabric FR Treatments

Fabrics failing the fabric test of the draft standard could be treated with FR chemicals or be reformulated with fibers that enable passing results. Manufacturers would also be able to continue using fabrics without modifications if they use an acceptable barrier material (*i.e.*, one that passes the draft Barrier Test) between the fabric and filling materials. For purposes of this analysis, the highly cigarette ignition-prone fabrics, estimated to account for 9.6 percent of total upholstery cover materials, are assumed to require the use of FR treatments or barriers if their use is to continue under the staff's 2005 draft standard.

[65] Those other items probably would incur relatively minor increases in costs because of the types of materials used, and smaller material requirements per unit of furniture.

Table 5.
Estimated Increase in Manufacturing Costs Under the 2005 Draft Standard
(2005 Dollars)

Upholstery Covering Materials	Manufacturing Cost Increases per Unit, by Material Affected				(5) Compliance Verification Costs per Unit	(6) Distribution Costs per Unit	(7) Range of Total Costs Per Unit	(8) Annual Units Produced	(9) Aggregate Costs (million $)
	(1) FR Fabric	(2) Barriers	(3) Urethane	(4) Fibrous Filling			(Average)	(% of Total)	(midpoint)
Severely Cigarette-Ignition-Prone Fabrics	$6.61 to $11.28 (60% of type)	$15.90 to $22.05 (40% of type)	$2.05 (See Note)	$1.46 (See Note)	$0.20	$1.40 - $1.93	$15.44 to $21.23 ($18.33)	2,934,901 (9.6%)	$45.3 - $62.3 ($53.8)
Moderately Cigarette-Ignition-Prone Cellulosic Fabrics	n/a	n/a	$3.41	$2.44	$0.20	$0.60	$6.65	1,406,465 (4.6%)	$9.4
Lower Cigarette-Ignition-Prone Cellulosic Fabrics	n/a	n/a	$3.41	$2.44	$0.20	$0.60	$6.65	3,281,752 (10.8%)	$21.8
Thermoplastic Fabrics	n/a	n/a	$3.41	$2.44	$0.20	$0.60	$6.65	13,653,682 (44.8%)	$90.8
Ignition Resistant Materials	n/a	n/a	See Note					9,223,200 (30.2%)	See Note
								30,500,000	$167.3-$184.3 ($175.8)

Note: Estimates of per unit urethane foam and polyester filling costs are based on the assumption that changes would not be necessary if barriers are used. Further, we assume that "Ignition Resistant Materials" will be qualified as barriers by the optional cover material barrier tests, thereby eliminating the requirements to use complying cushioning materials.

Based on fabrics that have been tested by the CPSC laboratory, many of the fabrics that would fail the fabric test of the staff's 2005 draft standard are heavier weight (over eight ounces per square yard) fabrics that are made entirely of cellulosic fibers, such as cotton or rayon. Many of these fabrics could be treated with FR chemicals to enable them to pass the fabric test. Typically, fully upholstered chairs require about 7 linear yards of fabric, and sofas require 11 to 15 yards, depending on factors such as the need to match patterns (which results in more fabric waste in pattern cutting). The average increase in fabric costs could range from $.62 to $1.05 per linear yard for manufacturers, based on previous estimates for FR backcoating to achieve resistance to ignition from small open flames.[66] Also, although the staff's draft standard does not specify frequency of testing to assure compliance of treated fabrics with the fabric test, we assume that testing will be done to provide guaranties to furniture manufacturers. Based on our earlier evaluation of testing costs, this testing could increase fabric costs an additional $.03 to $.06 per linear yard of fabric, on average. Therefore, total average manufacturing cost increases for furniture made with FR-treated upholstery fabrics under the staff's draft standard could range from $4.55 to $7.77 for chairs and $8.45 to $14.43 for sofas and loveseats.[67] Considering estimates of unit shipments of chairs and sofas (based on an analysis of Department of Commerce *Economic Census* data), the average manufacturing cost increase per item of furniture resulting from FR treatments of fabric is estimated to range from $6.61 to $11.28.[68] (See column 1 of Table 5.)

6.1.2. Barrier Materials

Some furniture manufacturers may choose to offer fabrics that do not pass the fabric classification test by using an acceptable barrier material under the cover fabric. Based on barriers used in the UK to comply with the barrier test of that country's furniture flammability standard, the cost to manufacturers could range from $2.00 to $2.47 per linear yard (reportedly 54 to 59 inches in width) for standard FR barriers, and about $2.67 to $2.94 per linear yard for down-proof barriers (*i.e.* having yarns and weaves suitable for encasing down).[69] As with FR-treated cover fabrics, testing would be done to assure compliance with the barrier test of the draft standard. However, given expected large production runs of barriers and the greater degree of uniformity of barrier materials compared to cover fabrics, additional testing costs to furniture manufacturers could be about $.01 per yard of barrier fabric.

The decision to use barriers as a means to comply with the standard is more likely to be taken by firms that serve the upper-end furniture market. These furniture

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[66] Smith, Charles. Directorate for Economic Analysis, CPSC, *Economic Analysis of Regulatory Options to Address Small Open Flame Ignitions of Upholstered Fumiture*, October 2001. Note: Bureau of Labor Statistics reports virtually no change in Producer Price Index for job or commission finishing of cotton broadwoven fabrics from 2001-2005. Therefore, previous estimates are used in this analysis.

[67] Assuming average fabric yardage for sofas and loveseats is 13 linear yards.

[68] We estimate that in 1997, upholstered living room and family rooms furniture purchased for consumer use was comprised of about 15.6 million sofas, sofabeds, and loveseats (52.7%), and 14.0 million chairs (47.3%). Therefore: ($4.55 x 47.3%) + ($8.45 x 52.7%) = $6.61; and ($7.77 x 47.3%) + ($14.43 x 52.7%) = $11.28.

[69] Smith, Charles. *op. cit.*

items are more likely to be manufactured with interior fabrics between the cushioning materials and the upholstery covers. In a 1995 survey of furniture manufacturers, the CPSC found that about one-third of the seat, arm and back cushions were made with interior fabrics. Interior fabrics were used in an average of about 50 percent of cushions made by smaller firms, which are more likely to serve the upper-end market. To the extent that manufacturers already enclose filling materials in interliner fabrics, the FR barriers could be replacing untreated materials.

Cushions are usually purchased from fabricators that make them to the specifications of the furniture manufacturers. For seat cushions, the barrier alternative would result in a change in the interior fabric used by the cushion fabricators. For such items, barrier costs would be offset by the costs of the untreated materials, about $.30 per yard for standard interliner fabrics and $.80 per yard for down-proof interliner fabrics. Net increases in material costs, including costs for testing, would be about $1.71 to $2.18 per yard for standard fabrics and $1.88 to $2.15 per yard for down-proof fabrics. Cushions typically have sides that are about 24 inches long, and they are about 5 inches thick. Therefore, about one linear yard of 54-inch wide interior fabric would be used per seat cushion, and the cost increases per linear yard of material would also hold true for cost increases per cushion.

Barrier materials required for other parts of the seating areas of furniture items might require about two yards of material per chair and four yards per sofa. These areas may be less likely to have interliner fabrics currently than is the case with seat cushions. Therefore, increased material costs probably would be $2.01 to $2.48 per linear yard for standard FR barriers. These materials would increase material costs by about $4.02 to $4.96 for chairs and $8.04 to $9.92 for sofas. Adding the approximately $1.71 to $2.18 per cushion material cost increases from substituting the use of FR barriers for standard interliner materials, total increased material costs might be about $5.73 to $7.14 for chairs and $13.17 to $16.46 for sofas.

In addition to increased material costs, manufacturers would also be faced with additional costs related to labor needed to include FR barriers on parts of the upholstered items that are not currently made with interliner fabrics. The additional labor required might average about 15 to 20 minutes per item.[70] Hourly labor costs, including benefits, are estimated to range from about $25 to $30.[71] Therefore, labor costs for the additional upholstery work could be about $6.25 to $10.00. Total increases in manufacturing costs (material and labor) are estimated to range from $11.98 to $17.14 for chairs and $19.42 to $26.46 for sofas and loveseats. The average increase in

[70] Based on a telephone conversation between John Bray, Vanguard Furniture, and Charles Smith, Directorate for Economic Analysis, CPSC, on February 23, 2001.

[71] Although the Bureau of Labor Statistics National Compensation Survey reports that average upholsterer wages for the Hickory-Morganton-Lenoir, NC area were $17.03 per hour in 2005, we assume that wages and other labor costs are typically higher ($25-$30) for upholsterers that work for manufacturers using expensive decorative fabrics (which are more likely to be used with barrier materials). This assumption is supported by labor cost information provided by John Bray, Vanguard Furniture, *op. cit.*

manufacturing costs per item of upholstered furniture that would be made with FR barriers is estimated to range from $15.90 to $22.05.[72] (See column 2 of Table 5.)

6.1.3. Aggregate Costs of FR Fabric Treatments and Barriers

As noted above, highly cigarette ignition-prone fabrics, estimated to comprise 10.3 percent of total upholstery cover materials, are assumed to require the use of FR treatments or barriers if their use is to continue under the draft standard. The use of barriers is more economically feasible with more expensive fabrics, such as those produced by members of the Decorative Fabrics Association (DFA). The DFA estimates that fabrics marketed by its members comprise perhaps 1.5 percent of total upholstery fabric yardage used to make furniture.[73] If 40 percent of highly cigarette ignition-prone fabrics (3.8% of all upholstery cover materials, *i.e.*, more than just the 1.5 percent of fabric yardage reportedly marketed by DFA members) are assumed to be used with acceptable barrier materials under a standard, about 1.1 million furniture pieces annually might be made with barriers under a standard. The aggregate manufacturing cost increase related to use of complying barrier fabrics under these assumptions would range from about $18.7 million to $25.9 million.[74] If 60 percent of highly cigarette ignition-prone fabric yardage (covering 5.8% of all furniture items) is assumed to be treated with FR chemicals, the estimated aggregate increase in manufacturing costs from FR treatment of fabrics would range from $11.6 million to $19.9 million annually.[75] The combined aggregate costs of fabric treatments and barriers would total $30.3 million to $45.7 million annually.

It should be noted that this analysis assumes that all furniture made with fabrics that fail the fabric test of the draft standard will continue to use those fabrics through the use of FR treatments or barrier materials. An alternative available to manufacturers will be reformulation of fabrics, such as through use of thermoplastic fibers or changes to other fabric characteristics. Also, some fabrics that do not pass the draft test could be discontinued. Change in manufacturing costs if these alternatives are chosen should be negligible. However, our cost estimates are based on compliance through either FR treatments of fabrics or the use of barrier materials. Therefore, aggregate estimated costs of FR fabric treatments and use of complying barrier materials may be overstated.

6.2. Costs Related to Urethane Foam Cushioning

The staff's 2005 draft standard includes smoldering and small open flame tests for resilient foam filling materials used in the manufacture of furniture. All future items will need to comply with these tests unless they use acceptable barrier materials. Based

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[72] We estimate that in 1997, upholstered living room and family rooms furniture purchased for consumer use was comprised of about 15.6 million sofas, sofabeds, and loveseats (52.7%), and 14.0 million chairs (47.3%). Therefore: ($11.98 x 47.3%) + ($19.42 x 52.7%) = $15.90; and ($17.14 x 47.3%) + ($26.46 x 52.7%) = $22.05.

[73] Information provided to the staff at a June 29, 2000, public meeting.

[74] (30.5 million units x 3.8% x $15.90) = $18.7 million; (30.5 million units x 3.8% x $22.05) = $25.9 million.

[75] (30.5 million units x 5.8% x $6.61) = $11.6 million; (30.5 million units x 5.8% x $11.28) = $19.9 million.

on current industry practice, the material that will be affected by this test is flexible polyurethane foam cushioning. Based on surveys of furniture manufacturers, this material is used in nearly all seat cushions, and is also a common cushioning material for furniture arms and backs. As noted in Section 3, the American Furniture Manufacturers Association (AFMA) reported that an estimated 350 million pounds of polyurethane foam were used in furniture production in 2002.[76] Compliance with the staff's 2005 draft standard will require reformulation of much of the polyurethane foam used in furniture production. However, furniture items made with acceptable barrier materials, or cover materials that qualify as barriers (*e.g.*, most leather, and wool and vinyl fabrics) could be made with standard urethane foam.

Under the staff's 2005 draft standard, the principal means of compliance for polyurethane foam will be the use of combustion modifying additives such as halogenated compounds in conjunction with organic phosphorus compounds. Some formulators might also use other combustion modifiers in their formulations, such as melamine. The polyurethane foam industry has experience with the use of combustion modifiers because of flammability standards that have been imposed by the state of California which include ignition testing requirements applicable to polyurethane foam.

As shown below, the impact of the 2005 draft standard on urethane foam manufacturing will vary depending on densities of foam that are used. The addition of FR chemicals to lower density foams (*e.g.*, 1.0 pounds per cubic foot, or "pcf") necessary to pass the CPSC staff's 2005 draft standard may involve greater incremental costs per board foot than higher density foams. The incremental costs of FR chemicals reportedly continue to decline as foam density increases. Also, since the lower density foams might not have acceptable physical properties with added FR chemical loadings needed to pass the CPSC staff's draft tests, more costly higher density foams might be necessary for certain applications. This would also contribute to greater incremental costs of compliance for lower density foams.

6.2.1. Seat Cushions

The staff's 2005 draft standard incorporates testing requirements for flexible polyurethane foam that are similar to those of the proposed draft (2002) revision to California's Technical Bulletin (TB) 117, the standard for upholstered furniture sold in that state.[77] Some flexible urethane foam manufacturers have reported that higher density foams (1.4 pcf and greater) that meet the current requirements of TB 117 will also meet the revised draft California requirements without modification. Results of limited testing by the CPSC's Directorate for Laboratory Sciences indicate that urethane

[76] Bill Perdue, Director of Environmental and Technical Affairs, AFMA. Presentation at the Brominated Flame Retardants and Foam Furniture Conference and Roundtable. April 29 & 30, 2003. The association has since changed its name to the American Home Furnishings Alliance (AHFA).

[77] Although both draft tests for flexible foam subject foams in a test structure to an open flame, the test drafted by the CPSC staff specifies that the foam is to be covered by a standard fabric. Also, the CPSC staff and California draft open flame tests specify different mass-loss by time criteria in determining compliance.

foams with densities of 1.4 pcf and greater that comply with the revised draft TB 117 can also pass the applicable tests drafted by the CPSC staff.

Higher density foam is commonly used in seat cushions. Although some low-cost furniture reportedly uses lower-density foam for this purpose, foams having densities below 1.2 pcf generally do not provide a support factor considered to be better-suited for load-bearing applications such as furniture seat cushions.[78] According to information provided by knowledgeable persons in the furniture and foam industries, about 25 percent of the polyurethane foam used in the production of furniture might now comply with the current version of TB 117. Thus, somewhat more than 75 percent of the flexible foam now used in seat cushions could require modifications to comply with the standard drafted by the CPSC staff in 2005.

The Polyurethane Foam Association (PFA) provided proprietary pricing information for urethane foams of various densities and flammability performance to the staff of the CPSC on August 31, 2005.[79] Pricing data was provided for bulk foam purchases, and did not account for additional cushion fabrication costs typically incurred by furniture manufacturers. Pricing data are assumed to incorporate associated costs related to testing to verify compliance with the California standard. The Directorate for Economic Analysis estimated increased urethane foam cushion costs as charged by cushion fabricators, based on correspondence with a major foam manufacturer.[80]

The increased costs of producing foam that complies with flammability standards are inversely related to the density of the foam to be treated. Based on the pricing information provided by the PFA, complying seat cushions made with lower density foams (*e.g.*, 1.0 pcf) might incur cost increases averaging $1.78 per cushion.[81] This estimated increase assumes that lower density foam, in addition to being FR-treated, would be increased in density to 1.4 pcf.[82] Complying cushions made with 1.4 pcf density foam may cost furniture manufacturers about $.41 more per cushion. Seat cushions made with 1.8 pcf and denser foams would cost an estimated $.21 more per seat cushion. Implicit in these cost estimates is the inclusion of testing costs in the price difference of complying foam.

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[78] *In Touch: Information on Polyurethane Foam*, Polyurethane Foam Association. Volume I, Number 2, May 1991.

[79] James T. McIntyre, counsel for the PFA, letter to Dale Ray, Upholstered Furniture Project Manager, CPSC, August 31, 2005. (Attachment with proprietary business information on foam costs.)

[80] According to Bobby Bush, Vice President, Hickory Springs (in an e-mail correspondence with Charles Smith, Directorate for Economic Analysis, CPSC, September 8, 2005), a reasonable approximation of the value of the urethane component of seat cushions purchased from cushion fabricators is 150% of the board foot price of the foam as produced in "bun" form.

[81] Based on an average of 20 board feet per cushion that is 24 inches square and 5 inches deep. Estimates are based on estimated fabricated cushion costs, and on the assumption that 25% of lower density foam complies with TB117.

[82] However, it is possible that lower density foams could be produced in compliance with the draft standard, based on information provided by foam manufacturers. The development of lower density foams that comply with the draft standard would moderate the costs faced by furniture manufacturers.

An estimated 43 million seat cushions produced annually would be subject to the CPSC staff's 2005 draft standard's testing provisions for resilient foam.[83] If we assume that about 5 percent of these seat cushions, or 2.2 million annually, are made with low density (about 1.0 pcf) foam, increased annual foam costs for these cushions would be $3.9 million (2.2 million cushions x $1.78). About 10.1 million seat cushions (out of 43 million subject to testing requirements) would not require modifications under the standard, since they already comply with TB 117 (and are also assumed to comply with the CPSC staff's 2005 draft standard) and are made with foams of 1.4 pcf density and higher.[84] The average cost impact on the remaining estimated 30.7 million seat cushions will vary according to the density of foam used. As discussed above, for the remaining seat cushions made with foams that are 1.4 pcf are estimated to incur costs of about $.41 each; cushions made with foams that are 1.8 pcf and greater may incur increased costs of about $.21 each. If about 65 percent of all seat cushions that would be subject to the draft testing provisions are made with 1.8 pcf and greater density foam and 30 percent are 1.4 pcf, aggregate annual costs to bring the estimated 30.7 million seat cushions into compliance would be about $8.3 million.[85] Therefore, total annual increased seat cushion costs would be about $12.1 million for all densities of urethane foam. For the estimated 20.1 million units affected annually, average costs per unit would be about $.60 per item of furniture.

6.2.2. Other Urethane Foam Cushioning

About 152 million pounds of polyurethane foam are estimated to be used annually for furniture backs, arms and other locations.[86] This material is used in 25 percent to 30 percent of the arms, and in about 80 percent of the back cushions according to the most recent survey of manufacturers.[87] Since an estimated 34 percent of furniture units would be made with complying barrier materials, about 100 million pounds of this urethane would be affected by the 2005 draft tests for resilient filling materials.

Based on available information on densities of foam used by the furniture industry and our calculations of foam use for seat cushions, the average density of

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[83] The total estimated number of seat cushions for annual furniture sales of 30.5 million units is 65 million. In addition to the estimated 43 million seat cushions that would be subject to the draft standard's testing provisions, urethane foam in an estimated 22 million other seat cushions would be used with acceptable barrier materials, and, therefore, would not be required to pass the tests for resilient filling materials.

[84] 43 million cushions x 25% (TB117 foam market share) x 95% (which are assumed to be foam of 1.4 pcf and greater) = 10.1 million cushions.

[85] These assumptions lead to an estimated 9.9 million seat cushions with 1.4 pcf foam and 21.4 million cushions with 1.8 pcf and denser foam that would require FR modifications averaging $.41 and $.21 per cushion, respectively.

[86] This is based on an estimated total of 67 million urethane seat cushions on 30.5 million pieces of furniture produced annually (including cushions made with barrier materials). If 65% of cushions are made with 1.8 pcf and denser foam having an average density of 2.0; 35% of cushions are made with 1.4 pcf foam; and 5% of cushions are made with 1.0 pcf foam, total estimated foam consumption for seat cushions is 198 million pounds annually, out of total annual urethane use of 350 million pounds. This leaves an estimated residual of 152 million pounds of urethane foam consumed annually for furniture applications other than seat cushions.

[87] Smith, Charles. Directorate for Economic Analysis, CPSC, "Results of Surveys of Manufacturers of Upholstered Furniture," September 1996.

foams used in non-seat cushion applications is a little over 1.2 pcf. This yields an estimate of 972 million board feet annually that would be subject to the draft tests.[88] The estimated proportion of urethane use in these other applications that is 1.0 pcf foam is 62 percent.[89] Foams of about 1.4 pcf density account for almost 21 percent of board feet used in these applications, and 1.8 pcf and denser foams account for 17 percent.[90] Information provided by the industry indicates that 1.0 pcf density foam could incur cost increases of about $.09 per board foot under the CPSC staff's 2005 draft standard, assuming FR-treated foam with a density of 1.4 pcf would be required.[91] Foams with density of 1.4 pcf used in these other applications could incur cost increases on the order of $.02 per board foot, unless the foams previously complied with TB 117. Based on current compliance with TB 117 by about 25 percent of the urethane foam used in furniture production, the average increase for 1.4 pcf density foam could be about $.015 per board foot ($.02 x .75). Foams with densities of 1.8 pcf and greater would incur estimated cost increases of about $.01 per board foot; average costs would be about 25 percent lower because of compliance with TB 117. The weighted estimated aggregate cost increase of urethane foam used in applications other than seat cushions is about $56 million annually.[92] For the estimated 20.1 million furniture units made without acceptable barrier materials or barrier fabrics, this would average about $2.81 per item of furniture.

6.2.3. Summary of Costs Associated with Polyurethane Foam Cushioning

The overall estimated increase in polyurethane foam costs, including seat cushions and cushioning in other parts of furniture, totals about $3.41 per unit of furniture affected by the 2005 draft standard's testing provisions for resilient filling materials. (See column 3 of Table 5.) Since cushioning materials used with complying barrier materials (including cover materials that qualify as barriers under the optional cover material barrier test of the draft standard) do not have to comply with material tests, aggregate costs may total about $67 million.[93]

6.3. Costs Related to Fibrous Filling Materials

Like the UK standard for upholstered furniture flammability, BS 5852, the staff's 2005 draft standard incorporates testing requirements for fibrous filling materials (*i.e.*, filling materials made from natural or synthetic fibers in the form of loose fill or as fibrous batting). However, the draft tests developed by the CPSC staff incorporate a standard test fabric that probably results in a more stringent test of the filling material.

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[88] 100 million lbs./1.235 pcf = 81 million cubic feet. 81 million cubic ft. x 12 board ft./ cubic ft. = 972 million board ft.
[89] Calculated as a residual for non-seat cushion uses if 35% of total urethane foam use is 1.0 pcf foam.
[90] Calculated as residuals if 25% of all foam use is 1.4 pcf and 35% is 1.8 pcf and greater.
[91] Cost estimates are based on pricing information submitted to the CPSC staff by PFA on August 31, 2005, increased by a factor of 150% to account for costs of fabrication.
[92] (972 million board feet X 62% X $.089 cost difference) + (972 million board feet X 21% X $.015 cost difference) + (972 million board feet X 17% X $.008 cost difference) = $58 million
[93] Based on about 20 million units produced annually without either qualifying barriers or qualifying barrier fabrics.

Officials with the furniture industry and materials suppliers and the director of the major testing firm in the UK maintain that, in order to pass BS 5852, modifications are necessary for polyester fiberfill that has been coated with a slickening agent such as silicone to facilitate blowing the material into pre-sewn loose back cushions. However, non-slickened polyester and FR cotton batting reportedly can pass the non-foam resilient filling material test of BS 5852.

6.3.1. Costs for Loose Fill

Alternative fiberfill formulations that comply with the BS 5852 test are commercially available which would facilitate blowing the loose material into back cushions. At least one material supplier to the UK furniture trade, Wellman Fiber, has developed a lubricant that enables loose fiberfill to be blown into cushions, but still yields a product that can pass the performance test of the UK standard. The complying fiberfill reportedly costs about $.10 more per pound than siliconized fiberfill.[94] However, information indicating that this material would pass the CPSC staff's 2005 draft fibrous filling test is currently not available. Materials that are blends of siliconized polyester and FR fibers reportedly are available at costs that are $1.00 or more per pound greater than the cost of slickened polyester.[95] Since these products are not widely used by the furniture industry, it may be reasonable to assume that initial per unit costs would be lower in the future. Given the range of costs of products that might comply with the draft CPSC staff's test, for purposes of this analysis the resulting increase in material costs for fiberfill is assumed to be about $.75 per pound. If a back cushion contains about 3 pounds of fiberfill, the increased material cost to the furniture manufacturer could total $2.25 per chair and $6.75 or more per sofa (assuming three seat cushions per sofa). The average cost per upholstered item could be about $4.88 based on the proportions of chairs and sofas in annual production. If about 50 percent of furniture backs are made with blown slickened polyester fiber, the average per unit cost increase associated with polyester fiberfill would be about $2.44 per item of furniture.[96] (See column 4 of Table 5.) Aggregate increases in manufacturing costs could be about $49 million annually.[97]

The staff's draft standard contains provisions that permit manufacturers to use complying barrier interliner materials to encase noncomplying filling materials such as siliconized polyester fiber. Based on information on barrier costs presented in section

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[94] Joe McFayden, Wellman Fiber, in a telephone conversation with Charles Smith, Directorate for Economic Analysis, CPSC. August 30, 2004.

[95] Bobby Bush, Vice President, Hickory Springs, in a telephone conversation with Charles Smith, Directorate for Economic Analysis, CPSC. May 13, 2004.

[96] The staff's draft standard allows furniture manufacturers the option of encasing non-complying polyester in fabric that complies with the loose filling material interliner fabric smoldering and open flame ignition tests. Based on estimated costs of the use of barrier materials in seat cushions, discussed in Section 6.1.2., the costs to manufacturers to use FR interliner fabrics might be about the same as the costs of complying polyester-based loose filling materials.

[97] Based on about 20.1 million units produced annually without either qualifying barriers or qualifying barrier fabrics.

6.1.2., the per-unit manufacturing costs of this alternative means of compliance could be similar to those estimated for FR modifications to loose polyester fiber.

6.3.2. Costs for Fibrous Batting

The Directorate for Economic Analysis assumes that non-siliconized polyester fiber could be used to produce complying batting materials with minimal or no increase in material costs to the furniture industry. Also, the Directorate assumes that cotton batting currently used in the manufacture of furniture, which is treated with boric acid for flame retardance, would comply with the staff's draft proposed standard without significant increases in costs for the material. If the material, as a result of the standard, becomes lower in cost in relation to other materials for some applications, its use by the furniture industry could increase.

6.4. Costs Related to Compliance Verification

Costs related to compliance verification will result from requirements placed on furniture manufacturers to maintain records and to apply a permanent label to the items.[98] Other resource costs of compliance verification include the costs of compliance and enforcement activities undertaken by CPSC staff. These costs, addressed below, may total about $6 million annually. Average costs could be as much as $.20 per item of furniture. (See column 5 of Table 5.) The components of these compliance verification costs are discussed below.

6.4.1. Costs to Industry Related to Recordkeeping

Subpart B, Section 1634.22, of the staff's 2005 draft standard specifies test and manufacturing records that must be prepared by furniture manufacturers, and maintained for a period of three years after items are produced. These records shall include sufficient information to identify products and related information that provides an objectively reasonable basis for certification of compliance with the rule (e.g., guaranties for each upholstered furniture material provided by suppliers, or records of reasonable and representative tests demonstrating compliance). For each certification family (all the items of upholstered furniture of a specific "Type" that rely on the same basis for certification, such as guaranties or reasonable and representative tests), manufacturers shall maintain records sufficient to identify all articles of upholstered furniture comprising the certification family; identify the supplier of each upholstered furniture material used in the upholstered furniture comprising the certification family; and identify each retailer and other non-consumer customer to whom sales of upholstered furniture from the certification family have been made.

[98] Costs related to production testing are incorporated in the estimated material costs of the draft standard.

Incremental costs related to recordkeeping would depend, in part, on the extent to which furniture manufacturers currently maintain records identifying upholstery fabrics and filling materials with finished items. Small firms with limited product lines may require additional labor of less than one man-month a year to maintain the records. Large firms with broad product lines may require the equivalent of an additional full-time employee. Depending on media used to store records, additional office space may also be required. While the recordkeeping costs are uncertain, if average annual costs would be about $2,000 per firm, aggregate annual costs may be about $3.4 million. Average increased costs to manufacturers would be about $.11 per item.

6.4.2. Labeling Costs

Section 1634.24 of Subpart B of the staff's 2005 draft standard specifies labeling requirements for furniture subject to the standard. The rule would require a permanent, conspicuous, and legible label on all items. The staff's draft standard provides that labels must contain the manufacturer or importer name and location; month and year of manufacture; model identification; and type identification indicating the means of compliance (*i.e.*, "Type I," "Type II," "Type III," "Type IIIB," "Type IV"). This information must be separate from other label information. The label would help retailers and consumers identify products and materials, *e.g.*, in the event of a recall or other corrective action. The costs of labeling could be a few cents per item, based on reported labeling costs under the UFAC Voluntary Action Program and estimates provided by a manufacturer of labels.

6.4.3. Costs to the CPSC Related to Compliance and Enforcement

Compliance and enforcement costs refer to the costs incurred by CPSC to ensure that manufacturers are complying with the staff's draft proposed standard. Based on past experience, the estimated CPSC staff time per establishment visit may amount to about 39 hours for inspectors and 20 hours for compliance officers. Given average staff resource costs of about $43 per hour for inspectors and $52 per hour for compliance officers, the staff resource costs per plant visit would average about $2,717 (39 hours x $43 + 20 hours x $52).

While no formal compliance and enforcement plans have been developed, discussions with the CPSC Office of Compliance suggest that as many as 250 establishments might be inspected annually under an upholstered furniture standard. This would result in total annual staff resource costs of about $679,250 ($2,717 x 250 inspections). In addition to staff resource costs, staff will incur the costs of collecting and testing samples from establishments that do not have sufficient records to demonstrate compliance with the standard. These costs are not known. However, if overall sample collection and testing costs would approximately equal staff resource costs, total compliance and enforcement cost might amount to as much as $1,358,500 annually. It seems unlikely that these costs could be sustained by the CPSC on an

annual basis over the long term. Nevertheless, such compliance and enforcement costs would amount to an average of about $.04 per furniture unit produced annually ($1,358,500 / 30.5 million units of furniture).

6.5. Distribution Costs

An additional cost of the staff's 2005 draft standard could be increases in costs to wholesalers, distributors, and retailers in the form of added storage, transportation, and inventory financing costs. Since furniture items that would be produced under the standard are not likely to be larger or heavier than pre-standard items, added storage and transportation costs are likely to be negligible. However, inventory financing costs will increase by the average cost of borrowing money, applied to the increase in the wholesale price of a furniture item over the average inventory holding time period. Since most furniture producers use just-in-time production and have small inventories of finished items, this additional cost will probably not exceed 10 percent of the increase in manufacturing costs. A 10 percent markup, therefore, is being used to measure these distribution costs. This yields a resource cost to the firms in the distribution chain averaging about $1.40 to $1.93 per furniture item made with FR-treated fabrics or barriers, and about $.60 per unit for other furniture items. (See column 6 of Table 5.) Aggregate costs associated with estimated increased inventory financing costs range from $15.4 million to $17.0 million annually. As discussed in Section 7, the staff's draft proposed standard may lead to increases in retail prices of furniture greater than the 10 percent markup. The possible increase in retail outlays by consumers is addressed in greater detail in that section.

6.6. Summary of Expected Costs

Table 5 summarizes the results of the cost analyses. It illustrates the differing costs estimated to be incurred under the 2005 draft standard by furniture items covered with the different classifications of upholstery materials previously discussed in the societal costs and benefits section of this analysis. The estimated 9.6 percent of furniture items covered by severely cigarette-ignition-prone cellulosics would incur greater total and per unit costs under the draft standard. We assume these fabrics would fail the upholstery cover fabric smoldering ignition resistance test of the 2005 draft standard. Therefore, their continued use in furniture production would require FR treatments that allow them to pass the fabric test, or the use of barrier materials that pass the barrier test of the draft standard. The estimated total costs of compliance range from about $13.93 to $19.06 per unit of furniture made with complying filling materials and fabric treated with FR chemicals to pass the smolder ignition resistance test.[99] For items made with complying barrier materials (allowing the use of non-complying fabric and filling materials) estimated total costs of compliance range from about $17.71 to $24.48 per

[99] Based on estimated fabric treatment costs of $6.61 to $11.28 per unit; urethane costs of $3.41 per unit; costs of $2.44 for fibrous filling; $.20 for compliance verification costs; and $1.27 to $1.73 for distribution costs (10%).

unit.[100] Assuming 60 percent of severely cigarette-ignition-prone cellulosics would be made with FR-treated fabrics and complying filling materials and 40 percent would be made with barriers, the weighted range of estimated costs is $15.44 to $21.23. Total estimated aggregate costs for furniture covered with these fabrics range from $45.3 million to $62.3 million, or about 31 percent of aggregate costs estimated for all furniture items. (See column 9 of Table 5) As noted above, since changes in fiber contents of fabrics or dropping fabrics from selections offered by manufacturers will be an option available to manufacturers, the aggregate manufacturing costs related to FR treatments and barriers could be lower.

Furniture items covered with other types of upholstery materials, ranging from moderately cigarette-ignition-prone cellulosics to ignition-resistant leather, wool, and vinyl-coated fabrics, should not require FR-treated fabrics or barriers. However, all would require filling materials that comply with other material tests of the 2005 draft standard, unless the cover material is also qualified as a barrier. We assume that cover materials such as leather, wool, and vinyl-coated fabrics would pass the optional cover material barrier test. Therefore, items covered with these materials would not incur significant costs for cushioning materials under the draft standard. We assume that all items that are made with complying cushioning materials would incur similar per unit cost increases, with total increases varying according to current estimated market shares and annual units produced (shown in column 8 of Table 5).

Based on the estimated increases in manufacturing costs associated with changes in fabrics and filling materials, aggregate increases in manufacturing costs, costs of recordkeeping, and distribution costs under the draft standard are estimated to range from $167.3 million to $184.3 million annually. The midpoints of the estimated ranges of costs total $175.8 million.

7. COMPARISON OF COSTS AND BENEFITS

7.1. Benefits and Costs of the Staff's 2005 Draft Standard

The expected benefits of the staff's 2005 draft standard, which will vary depending on the cigarette ignition propensity of the upholstery cover material used, were discussed in Section 5 (and shown in Tables 2 and 4) and are summarized in Table 6 on the following page. Table 6 shows the estimated benefits (per unit of furniture) in columns 1, 2, and 3. For example, the benefits associated with bringing furniture pieces now covered with severely cigarette ignition-prone cellulosic fabrics into compliance are estimated to total $118.05 per unit (comprised of $111.80 from reduced losses from furniture fires started by cigarettes and $6.25 from reduced losses from fires started by

[100] Based on estimated barrier cost of $15.90 to $22.05; $.20 for compliance verification costs; and $1.61 to $2.23 for distribution costs (10%).

Table 6.

Estimated Costs and Benefits of the 2005 Draft Standard*

(Per Unit and Aggregate for Production in One Year, in 2005 Dollars)

Type of Upholstery Cover	Projected Benefits Per Unit, by Source of Ignition			(4) Costs Per Unit	(5) Net Benefits per Unit	(6) Annual Units Produced (% of Total)	(7) Total Net Benefits (million $)	(8) Cumulative Net Benefits (million $)
	(1) Cigarettes	(2) S.O.F.	(3) Total Benefits					
Severely Cigarette Ignition-Prone Fabrics	$111.80	$6.25	$118.05	$18.33	$99.72	2,934,901 (9.6%)	$292.7	$292.7
Moderately Cigarette Ignition-Prone Cellulosic Fabrics	$58.36	$3.72	$62.08	$6.65	$55.43	1,406,465 (4.6%)	$78.0	$370.6
Lower Cigarette Ignition-Prone Cellulosic Fabrics	$19.03	$3.72	$22.75	$6.65	$16.10	3,281,752 (10.8%)	$52.8	$423.5
Thermoplastic Fabrics	$2.74	$3.77	$6.51	$6.65	($0.14)	13,653,682 (44.8%)	($1.9)	$421.5
Ignition Resistant Materials	See note					9,223,200 (30.2%)	See note	

Note: Based on limited ignition testing data, societal costs, and, hence, any potential benefits associated with ignition resistant materials such as leather, wool, and vinyl-coated fabrics are assumed to be small, but are unknown. Assuming these materials pass the optional cover material barrier tests, compliance costs for such furniture items would also be minimal.

* Present value estimates of future benefits are based on a 3 percent discount rate; see Table 6a in Appendix A for calculations based on a 7 percent discount rate.

small open flames). The projected benefits resulting from modifications to furniture covered with other types of covering materials range from $62.08 per unit for items covered by moderately cigarette ignition-prone cellulosic fabrics to $6.51 for items covered with predominantly thermoplastic fabrics. The benefits for items covered with cigarette and open flame-ignition resistant materials such as leather have not been projected, but they are assumed to be small.

Table 6 also shows (in column 4) the midpoints of the ranges of estimated per unit costs of compliance with the 2005 draft standard, which were derived in Section 6 (and shown in column 7 of Table 5). For example, items covered by severely cigarette ignition prone cellulosic fabrics were estimated to incur costs ranging from $15.44 to $21.23, with a midpoint in the estimated range of $18.33 per unit. Furniture items covered with most other materials were estimated to incur average total costs of $6.65. Furniture items covered with ignition resistant materials, such as leather, probably will incur small average total costs; however, information that would enable us to estimate these minor costs is not available at this time.

Table 6 also shows aggregate and cumulative net benefits associated with the staff's 2005 draft standard. The total net benefits shown in column 7 are the product of per unit net benefits and number of units produced annually by type of cover material. For example, the total net benefits from furniture covered with moderately cigarette ignition-prone cellulosic fabrics amounts to $78 million, given by the product of 1.4 million units produced and per unit net benefits of $55.43. The cumulative net benefits (shown in column 8 of Table 6) are calculated by the vertical summation of the "Total Net Benefits" column. Total net benefits of the staff's draft standard are estimated to be $421.5 million.

As noted in Table 6 and in previous sections of this analysis on benefits, expected benefits accruing in future years have been discounted to their present value using a 3 percent discount rate to reflect society's time preference. In accordance with OMB guidelines on benefits calculations, calculations have also been made using a 7 percent discount rate. Using this higher rate, total net benefits of the draft standard are estimated to be about $271 million over the life of upholstered furniture produced in a year.[101] This calculation is shown in Table 6a in Appendix A. Analyses using both discount rates assume that manufacturers would use FR treatments in a manner that poses no additional risk of injury or adverse health effects to consumers.

7.2. Sensitivity Analysis

The previous analysis compares benefits and costs of the staff's 2005 draft standard using discount rates of 3 percent and 7 percent to express expected benefits accruing in the future in their present value, an estimated value of a statistical life of $5

[101] Aggregate benefits of $446.8 million minus aggregate costs of $175.8 million (midpoint of range).

million, and an estimated average cost of injury of $146,740. Net benefits were also estimated based on estimated increases in costs of producing and marketing furniture that complies with the 2005 draft standard. In addition to these factors, the estimation of benefits was based on assumptions regarding the effectiveness of the standard at reducing losses from cigarette and small open flame ignitions. This section examines the effect of changing any of these assumptions on the expected net benefits that would result from compliance with the draft standard. In all cases, the estimated net benefits of the draft proposed standard remain positive.

Discount rates of 3 percent and 7 percent were used to express expected benefits accruing in the future in their present value. Using a 3 percent rate, total estimated benefits of the standard are $597.4 million, the midpoint of the range of estimated total costs is $175.8 million, and total net benefits are $421.5 million. Using a 7 percent discount rate, the present value of benefits would total about $446.8 million, and total net benefits would be $271 million.

Estimated benefits of the staff's 2005 draft standard were based on a value of a statistical life of $5 million. If benefits are calculated based on a lower bound of $3 million as the value for a statistical life,[102] total estimated benefits of the standard would be about $387 million using a 3 percent discount rate and about $290 million using a 7 percent discount rate. Total net benefits would be about $211 million using a 3 percent discount rate and $114 million using a 7 percent discount rate. Alternatively, if a value of $7 million is assigned to a statistical life, total estimated benefits would increase to about $808 million (3% rate) and $604 million (7% rate); and total net benefits would increase to about $632 million (3% rate) and $428 million (7% rate).

Estimated benefits of the staff's 2005 draft standard are based on an average societal cost of $146,740 per injury. Changing the estimate used for the cost of injury will have minimal impact on the results, because the share of benefits from reduced injuries is only 4.4 percent of total benefits. Hence, even if there were no reduction in injuries from the draft proposed standard, the total estimated benefits would be about $571 million and total net benefits would be $395 million using a 3 percent discount rate. Using a 7 percent discount rate, estimated benefits would be about $427 million and net benefits would be about $251 million.

Section 6 addresses the expected costs of the 2005 draft standard. Estimates of costs are based on judgments regarding changes to materials that will be required to meet performance tests of the draft proposed standard, the costs of those changes per unit, and the number of affected furniture items produced annually. Based on the midpoints of ranges of estimated cost impacts of material changes, aggregate costs of the standard were estimated to be $175.8 million for annual production of upholstered household furniture. With these costs, total estimated net benefits of the 2005 draft standard are $421.5 million using a 3 percent discount rate and $271 million using a 7

[102] Viscusi, W. Kip. *op. cit.*

percent discount rate. Even if we assume that the costs of the standard are twice those estimated in Section 6 (*i.e.*, $351.6 million) the standard would still have estimated net benefits totaling about $246 million from annual production of upholstered furniture if future benefits are discounted at 3 percent, and about $95 million if a 7 percent discount rate is used.

Estimated benefits of the staff's draft standard were based on assumptions regarding the effectiveness at reducing societal costs of cigarette and small open flame ignitions of furniture. However, if we assume that the standard will have one-half the effectiveness that our estimated benefits are based upon, aggregate benefits would still be about $299 million, and net benefits would be about $123 million, using a 3 percent discount rate. Using a 7 percent discount rate, estimated benefits would be about $223 million, and net benefits would be about $48 million.

7.3. Impact of the Staff's 2005 Draft Standard on Retail Prices

The estimated costs of the staff's 2005 draft standard include the increased costs of materials, labor, and distribution directly attributable to the rule. It is likely that manufacturers will pass on at least some of the costs of complying with the standard to the consumer, in the form of higher retail prices. The actual increase in retail prices will depend on the price elasticity of demand for furniture products (i.e. the responsiveness of quantity demanded to the change in price). If demand is highly price elastic, then manufacturers will experience a relatively large decrease in sales of upholstered furniture products in response to a price increase, and their ability to pass on increased regulatory costs to the consumer is limited. If demand is price inelastic, consumers respond less intensely to price increases, enabling producers to successfully pass through cost increases.

Regarding the market for upholstered furniture, it is anticipated that demand is relatively price elastic in the short run, because consumers can usually postpone the purchase of a durable good. Increases in retail prices are thus likely to be limited. In the long run, demand is less elastic and any attempt to pass through increased costs is more likely to succeed. Consequently, increases in retail prices are more likely to be observed.

In the absence of information on the price elasticity of demand for upholstered furniture products, it is possible to make use of traditional industry markup rates to provide an upper bound estimate for retail price increases. Such estimates may be viewed as upper bound estimates because they do not reflect the price elasticity of demand. Moreover, traditional markups do not factor in the role of competition, which can also influence attempts to increase prices. Rather, the markup simply reflects the price that producers will want to charge based on historical accounting costs. As noted above, an increase in price will result in a reduction in sales and in the case of highly elastic demand, revenues will decline as well, which will tend to moderate attempts to increase retail prices.

According to industry sources, higher production costs for materials and labor could result in retail prices that are higher by a factor of 2.5, or 150 percent. Based on this markup, the average retail price impact of the draft proposed standard on furniture items made with FR treated fabrics could be $37.49 (for about 6 percent of all items), and the average retail price impact for furniture produced with barrier materials could be $47.94 (for about 4 percent of furniture items). The average retail price impact for furniture that will require complying cushioning materials, but not FR fabric treatments or barriers under fabrics (perhaps 60 percent of units), could be $15.13 per unit. Any increases in retail prices of furniture covered with ignition-resistant materials that pass the optional cover material barrier test (perhaps 30 percent of units) should be minor -- associated with minor testing and compliance verification costs for this furniture. The average increase in retail prices for all upholstered furniture is estimated to be about $13.29 per item, based on the traditional industry markup rates.

8. ALTERNATIVES TO THE STAFF'S 2005 DRAFT STANDARD

This section evaluates a number of possible alternatives to the staff's 2005 draft standard, including an alternative that primarily addresses open flame ignited fires; adoption of an industry proposal as a mandatory rule; adding a small open flame ignition resistance test for cover fabrics; adopting only provisions of the draft standard relating to smoldering ignition resistance; adopting requirements without open flame provisions for loose fill; requiring product labeling that warns consumers about the flammability hazards; alternative effective dates; and the alternative of taking no regulatory action by the CPSC. This discussion is limited to comparisons of benefits calculated using a 3 percent rate to discount estimated benefits accruing in future years.

8.1. An Alternative that Focuses on Smoldering Ignition

In 2007 the staff drafted an alternative standard after considering substantial public comment on the upholstered furniture rulemaking proceeding. Under this alternative, upholstered furniture covering materials would have to comply with cigarette ignition performance tests. Manufacturers would have the option of using fire blocking barriers which pass tests of smoldering and open flame ignition resistance instead of using complying fabrics.

8.1.1. Costs

The costs of a standard based on the smoldering requirements would mainly be those related to modification of fabrics and use of acceptable barrier materials. Estimated costs associated with bringing the estimated 9.6 percent of furniture items covered with "severely cigarette-ignition-prone cellulosics" into compliance have a

range of $30.3 million to $45.7 million, with a midpoint of $38.0 million.[103] This estimate assumes per unit costs of barriers and FR treatment would be the same as estimated for the 2005 CPSC staff draft standard. In addition to these costs, the smoldering test for upholstery fabric in this alternative standard is more stringent than that included in the 2005 staff draft standard. Therefore, the alternative may also require fabric modifications or barriers to furniture constructed with the estimated 4.6 percent of fabric yardage currently used that is classified as "moderately cigarette-ignition-prone cellulosics." If we assume that these fabrics would all be FR-treated (rather than being brought into compliance through the more costly use of barriers), manufacturing costs would increase by an estimated $9.3 million to $15.9 million, with a midpoint of $12.6 million. The total costs associated with FR-treatment of fabrics, the use of barriers, or other modifications would, therefore, range from about $40 million to $62 million, with a midpoint of about $51 million. The only other costs would be those related to compliance verification and distribution, which might total about $6 million.[104] Therefore, the total estimated costs of the 2007 alternative that focuses on smoldering ignition could be about $57 million.

It should be noted that these cost estimates could be considered to be the upper bound of costs of the smoldering alternative, since manufacturers would have the less expensive alternative of substituting upholstery fabrics that pass the smoldering requirements for those that do not, without the application of FR chemicals or the use of barrier materials. If choosing these options were to reduce reliance on FR-treatments of fabric by 80 percent from that assumed in the above analysis, FR-treatment costs under the 2007 alternative could total about $6 million annually. Under this assumption, an estimated 2.1 percent of furniture items would be made with FR-treated fabrics; 3.8 percent would be made with barrier materials, and; 8.3 percent would be units in which fabrics were reformulated with more ignition-resistant fibers or otherwise switched fabrics/covers that comply without treatments or barriers. In this scenario, aggregate costs of FR-treatment of fabrics, the use of barriers, and associated costs of compliance verification and distribution would be about $32 million.

8.1.2. Benefits

Without the open flame filling materials tests of the 2005 staff draft standard, benefits of the smoldering alternative would be limited to furniture items brought into compliance by the use of barrier materials or modifications to fabrics that would fail the smoldering test (including changes in fibers, discontinuing the use of certain fabrics and possible FR-treatments).

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[103] Estimated FR-treatment costs for 60% of severely ignition-prone fabrics range from about $11.6 million to $19.9 million; estimated costs for barriers under the remaining 40% of these fabrics ranges from about $30.3 million to $45.7 million.

[104] About $5.3 million of these costs are for the 4.3 million units made with FR treated fabrics or barriers and $.9 million are for furniture covered with other fabrics and materials.

The expected benefits associated with the use of barrier materials for furniture covered with severely ignition-prone cellulosic fabrics will be the same as under the 2005 staff draft standard, since filling materials would not have to comply with smoldering or open flame tests under either regulatory alternative. Consequently, the expected lifetime benefits should amount to about $139.1 million.[105]

Benefits will also be derived from furniture items covered with fabrics that are FR-treated to comply with the fabric test of the draft smoldering standard. Unlike the 2005 staff draft, the smoldering alternative would not result in more ignition-resistant filling materials that would contribute to the overall ignition resistance of furniture items. However, the more stringent smoldering test for fabrics in the 2007 smoldering alternative could be expected to result in reductions in cigarette-ignition hazards similar to those estimated for the 2005 staff draft standard. Based on the results shown in Table 2, cigarette ignition benefits might amount to about $111.80 per unit of furniture previously covered with "severely ignition-prone cellulosics" and $58.36 per unit previously covered with "moderately ignition-prone cellulosics." Estimated aggregate cigarette-ignition benefits for FR-treated fabrics would total about $279 million.[106]

Instead of treating fabrics with FR chemicals, the industry could drop fabrics from use that do not comply with the smoldering test or reformulate fabrics to include fibers that impart resistance to cigarette ignition. Either alternative could be expected to result in cigarette ignition benefits similar to those estimated for FR-treatment of fabrics; the associated benefits would properly be ascribed to the alternative that focuses on smoldering ignition.

Without the 2005 staff draft standard's contribution of filling materials that comply with open flame tests, furniture made with re-engineered (non-FR) fabrics under the 2007 staff alternative would not be expected to provide any open flame benefits. FR-treated fabrics would also yield smaller reductions in the hazard associated with small open flame ignitions than under the 2005 staff's draft standard. If we assume that FR treatments designed to pass the smoldering test for fabrics lead to a 25 percent reduction in the open flame hazard (rather than 50 percent assumed for the 2005 staff draft standard), per unit open flame ignition benefits would be about $1.86, and aggregate open flame benefits would total about $6 million. If the use of FR-treatments of fabrics is 80 percent lower than assumed, aggregate open flame benefits would be about $1.2 million.

Based on the assumptions described above, total estimated benefits resulting from the 2007 alternative that focuses on smoldering would range from about $419 million to $424 million.

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[105] For the estimated 1.17 million units that will be made with barrier materials under severely ignition prone fabrics, cigarette ignition benefits are assumed to be $111.80 per unit ($131.2 million aggregate benefits) and open flame ignition hazard reduction is assumed to be 90% ($6.70 per unit benefits - - $7.9 million aggregate benefits).

[106] Based on about 3.2 million units that would be made with FR-treated fabrics.

8.1.3. Summary

Depending on the extent to which fabrics are FR-treated to comply with the 2007 alternative, estimated costs of compliance may range from about $32 million to $57 million annually. Based on estimated aggregate benefits of $419 million to $424 million, net benefits would be in the range of $367 million to $387 million. This range is $34 million to $54 million lower than net benefits estimated for the 2005 staff draft standard ($421.5 million).

8.2. Adoption of the Draft Small Open Flame Ignition Standard

As an alternative to the staff's proposed draft standard, the Commission could adopt the standard drafted by CPSC staff in 2001 that focused on small open flame ignition of upholstered furniture. That draft standard was the subject of a staff briefing package submitted to the Commission in October 2001. Compliance with the draft small open flame standard would require the use of upholstery cover materials that do not sustain combustion following exposure to a small flame for 20 seconds, or, alternatively, the use of materials that would pass a barrier test. The staff estimated that most fabrics would fail the 20-second flame test unless they would be treated with FR chemicals. Although the FR treatments under that standard specifically addressed small open flame ignition hazards, CPSC testing data also showed substantial improvement in cigarette ignition resistance. In fact, most of the estimated benefits of the small open flame standard were projected to result from reductions in societal losses from cigarette ignitions.

Based on estimated costs of compliance and estimated reductions in both small open flame and cigarette ignition hazards, adoption of the 2001 draft small open flame standard would result in estimated aggregate benefits totaling $651 million and aggregate costs of about $272 million from annual production of about 30.5 million pieces of upholstered furniture.[107] Therefore, estimated aggregate net benefits of the small open flame standard would be $379 million. This compares with estimated net benefits of $421.5 million for the 2005 staff draft standard. [108]

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[107] Smith, Charles, *op. cit.* Based on "Best Estimates" of reductions in ignition propensity and midpoints of estimated increases in manufacturing costs; as with the current analysis, distribution costs are estimated to be an additional 10 percent. The best estimate for cigarette ignition reduction involving cellulosic fabrics is 75%, based on 2003 estimates made by Mark Levenson, EPHA, CPSC.

[108] The higher net benefits of the staff's current draft standard may also be underestimated. The difference does not take into account the likely heavier (and hence more costly) loadings of FR chemicals that would be needed to meet the 20-second open flame test of the alternative open flame standard. (For purposes of comparison, the FR treatment costs between these two alternatives were assumed to be the same.) Nor does it take into account the likelihood that, under the 2005 staff draft, some manufacturers are likely to choose a lower cost option of simply substituting a complying fabric or modifying the fiber content of the fabric slightly to comply with the smoldering test, rather than treat fabrics with FR chemicals or barriers. This is less likely under the alternative open flame standard because almost all fabrics would have to be treated to meet the 20-second open flame test.

While the estimated net benefits of the CPSC staff's 2005 draft proposed standard are relatively close to those estimated for the alternative small open flame standard, the costs associated with the 2005 draft standard are substantially less. In fact, the estimated costs of that draft standard (about $176 million) are about 35 percent lower than the costs of the alternative draft small open flame standard ($272 million). The difference is related, in large part, to the reduced level of treatment of upholstery fabric with FR chemicals. Unlike the 2005 staff draft standard, which would result in the treatment of roughly 6 percent or less of upholstery fabric coverings, nearly 66 percent of the upholstery covers would likely receive FR treatments to pass the 20-second open flame test of the CPSC staff's 2001 draft standard.

It should also be noted that retail price impacts of the staff's 2005 draft standard, reflecting the lower underlying costs, would also be substantially lower than under the alternative small open flame standard. Increases in the retail price of furniture may have some negative impact on sales. Higher prices may lead some consumers to delay the purchase of new furniture or lead them to buy it less frequently, and could potentially result in secondary impacts on the sales of furniture components and industry employment; such effects are likely to be more pronounced in the short run. While the impact of these price increases cannot be predicted with any certainty, the higher costs of the alternative open flame standard would likely have more pronounced effects. Additionally, while the retail price impact of the staff's 2005 draft standard will fall most heavily on more expensive furniture items (*i.e.*, those with the more expensive cellulosic fabrics), the alternative open flame standard would fall disproportionately on the more inexpensive furniture with thermoplastic fabrics, the fabrics less prone to cigarette ignition.

Finally, while the volume of FR chemicals used under the two alternative standards may be similar, the usage patterns would be different. The alternative open flame standard could have resulted in about 50 million pounds of FR chemicals being used annually to treat upholstery cover fabric. Under the 2005 draft standard, however, an estimated 1 to 8 million pounds of FR chemicals would be used to treat cover fabric; the remainder would be used to treat filling materials.[109] This change in resulting FR chemical use addresses some industry concerns that the use of FR treated-fabrics could reduce the aesthetic quality of upholstery fabrics. It will also reduce the potential for human exposure to FR-treated cover fabrics.

8.3. Adoption of the UFAC Voluntary Program as a Mandatory Standard

As an alternative to the staff's proposed draft standard, the Commission could adopt the provisions of the UFAC Voluntary Action Program as a mandatory standard. The Upholstered Furniture Action Council, or UFAC, was formed by major furniture

[109] Franklin, Robert. *Preliminary Environmental Assessment of a Draft Proposed Flammability Standard for Residential Upholstered Furniture.* November 2004.

industry associations in 1974, largely as a response to prospective CPSC actions on upholstered furniture. The UFAC Voluntary Action Program was developed in the late 1970's and amended as "Phase 2" in 1983. Tests for decorative trim were added to the program in 1993. The program requires classification of upholstery cover fabrics into either "Class I" or "Class II," based on a cigarette ignition performance test. All conforming furniture must comply with specified construction criteria for welt cords, decking substrates, filling materials, and interior fabrics; and more cigarette ignition-prone Class II fabrics used with polyurethane foam seat cushions must have a barrier material between the fabric and foam that passes a barrier performance test. Conforming furniture is to be labeled with a UFAC tag.

The last market evaluation of conformance that the CPSC staff conducted occurred in 1996. At that time, based on ignition testing of chairs purchased by the CPSC, the staff estimated that about 90 percent of upholstered furniture may have been produced in conformance with the UFAC program (including a majority of units produced by firms that did not participate in the UFAC program). Although the UFAC program is designed to prevent the use of furniture components that may be more likely to lead to cigarette ignition of the finished items, the program is not designed to predict the ignition performance of all UFAC furniture. CPSC testing found that some chairs that conformed to the UFAC program ignited from cigarettes, and some nonconforming chairs resisted ignition. The findings illustrated that cigarette-ignition resistance of upholstered furniture is more dependent on the fabrics and filling materials used, rather than on conformance with all aspects of the UFAC Program.[110]

Costs of mandating the requirements of the UFAC program would likely be minimal. Perhaps the major program element associated with costs is the requirement for a smolder-resistant barrier to be used under Class II fabrics when the seat cushion core is standard urethane foam. The primary barrier material for this purpose under the UFAC program is polyester fiberfill cushion wrap. Based on analysis of market data, fewer than 5 percent of upholstered furniture items are currently produced with Class II fabrics. The great majority of the seat cushions on these items already are made with polyester wraps, and, therefore, are conforming to the UFAC program. Incremental costs of using polyester wraps on all seat cushions covered with Class II fabrics could total less than $500,000.[111] Non-UFAC establishments surveyed in 1995 were found to be less likely than UFAC program participants to use heat-conducting welt cords in seat cushions. Welt cord that conforms to the UFAC program reportedly costs furniture manufacturers less than one cent more per yard, compared to comparable welt cord that does not conform to the UFAC program.[112] Incremental

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[110] Charles Smith, Directorate for Economic Analysis, CPSC, and Linda Fansler, Directorate for Laboratory Sciences, *Cigarette Ignition Propensity of Upholstered Furniture*, November 1996.

[111] Based on the assumption that 5% of seat cushions with Class II fabrics (perhaps 150,000 cushions) would require polyester wraps.

[112] Bill Dotson, General Manager of welt cord manufacturer, Petco-Sackner, reported during an October 17, 2007, telephone conversation with Charles Smith, Directorate for Economic Analysis, that UFAC welt cord is sold to furniture manufacturers for $32 per 1,000 yard reel, versus $25 per 1,000 yards for similar non-UFAC welt cord.

costs could be less than $.04 per seat cushion and $.07 or less per chair and $.15 or less per sofa, for items made with welt cord. Given what is believed to the current high conformance rate, and the absence of welt cord in a substantial portion of upholstered furniture styles, incremental costs to substitute UFAC-compliant welt cord might total less than $200,000.[113] Other costs associated changes in construction materials associated with the adoption of the UFAC program as a mandatory rule should be very minor. Incremental costs related to compliance enforcement should be lower than the $.20 per unit estimated for the 2005 staff draft standard, since materials are already subject to verification testing to qualify as acceptable materials under the UFAC program and manufacturers already incur labeling costs under the UFAC program. However, it is possible that somewhat higher recordkeeping costs could be one of the major cost elements of mandating the UFAC program, given the minor costs related to materials. Total costs of compliance for adoption of the UFAC program as a mandatory standard could be under $5 million.

Benefits that would result from mandating compliance with the UFAC program would also be much smaller than estimated for alternative performance standards discussed in this analysis. Most furniture covered with fabrics that would benefit most from a barrier of polyester fiberfill over urethane foam already are manufactured in that way. The cigarette-ignition resistance of nearly all upholstered items would not be significantly improved under this alternative. Although only a minimal reduction in the overall smoldering hazard (less than 1 percent) could result in positive net benefits, the expected net benefits of adoption of the UFAC program as a mandatory standard would be minimal, and substantially below any other alternative performance standards discussed in this analysis.

8.4. Adoption of the Revised Draft Provisions of California Technical Bulletin 117 as a Mandatory Furniture Standard

8.4.1. Description of the California Revised Draft Technical Bulletin 117 and the Expected Means of Compliance

In February 2002, California's Bureau of Home Furnishings published draft revisions to the state's Technical Bulletin (TB117) that contains mandatory requirements for materials used in the manufacture of upholstered furniture sold in the state. As is the case with the CPSC staff's draft standard, the revised California draft standard specifies open flame and smoldering ignition tests for filling materials (including urethane foam and loose filling materials). However, unlike the staff's 2005 draft, the filling materials requirements apply to all furniture items, including those covered in ignition resistant fabrics such as leather, wool and vinyl.

[113] If current UFAC conformance is about 90% and about 55% of units are made with welt cord (based on 1995 survey of manufacturers), average incremental welt cord costs of about $.11 per item would be applied to approximately 1.7 million units annually, with aggregate costs of about $185 million.

In addition, the revised draft TB117 specifies a small open flame test for upholstery fabrics. The open flame test requires the 20 second application of a small open-flame to the crevice of a seat/back mock-up assembly of fabric over a standard flame-retardant polyurethane foam pad. The specimen fails if (1) weight loss exceeds 4 percent in the first 10 minutes, or (2) the specimen burns progressively before 10 minutes.

In the view of the Directorate for Engineering Sciences (ES), the open flame fabric test is less stringent than the open flame test for fabrics that was part of the CPSC staff's 2001 draft standard.[114] Nevertheless, ES believes that the great majority of fabrics currently used by the furniture industry would require modification in order to comply with the draft TB 117 test. This judgment is shared by the California Bureau of Home furnishings personnel, based on their testing experience.[115]

Based on testing by California's Bureau of Home Furnishings and the CPSC laboratory, it is reasonable to assume that the majority of cover materials are likely to fail the revised draft TB117 open flame test, with the exception of ignition resistant cover materials (such as leather, wool, and vinyl-coated coverings) and some of the heavier-weight cellulosic fabrics. Consequently, for purposes of evaluating the costs and benefits of this alternative, we assume that two-thirds of the approximately 10 percent of cover materials that are severely ignition prone cellulosic fabrics (which cover about 2 million units of furniture annually, or about 6 percent of all fabric coverings) would pass the draft TB117 open flame fabric test. The remaining severely ignition prone cellulosic fabrics (covering about 1 million furniture items) will be assumed to fail the test and therefore require FR treatment. An additional assumption is that all of the moderate- and lower-ignition prone cellulosics and thermoplastic cover materials (covering about 18 million furniture items annually, or about 60 percent of all furniture items produced) would fail the open flame fabric test and have to be treated. Thus, a total of about 19 million units of furniture would be covered in fabrics that would have to be treated in order to comply with the revised draft TB117.

8.4.2. Estimated Costs of the Revised Draft TB117

The primary costs of the revised draft TB117 would be the costs of treating the filling materials (*e.g.*, urethane foam and loose fill) and the cover fabrics that fail the open flame test. The per-unit costs of treating urethane foam and the loose fill could be similar to those estimated for the standard drafted by the CPSC staff. Consequently, the filling materials costs per item of furniture might amount to about $5.85 per unit (see, *e.g.*, cost estimates from Table 5). Since the TB117 filling materials requirements would apply to all furniture items produced (including items using ignition resistant cover

[114] The 2001 CPSC draft standard required that there be no continuing combustion 15 minutes after a 20-second small flame application to a composite consisting of the fabric to be tested and non-FR urethane foam.
[115] Said Nurbakhsh, Ph.D., California Bureau of Home Furnishings, in a November 14, 2005, e-mail to Charles Smith, Directorate for Economic Analysis, CPSC.

fabrics), the total filling materials costs would amount to about $178 million ($5.85 per unit x 30.5 million units). It is possible that additional costs would be required to treat fibrous filling materials under the revised draft TB117, since the open flame test for that material could be more stringent than that drafted by the CPSC staff.

Based on the assumptions described above, approximately 19 million units of furniture would be covered in fabrics that fail the open flame fabric test and would therefore have to be treated. The estimated costs of FR treatments based on the 2001 CPSC staff draft open flame standard ranged from about $6.61 to $11.28 per average unit of furniture, with a midpoint of about $8.95 per item. If we assume that the incremental costs of FR-treated fabrics under TB117 amount to about 75 to 100 percent of the costs estimated for the 2001 draft open flame standard, the midpoint of the resulting range of costs would be about $7.83 per item of furniture. Therefore, the aggregate costs of the FR treatment of fabrics might amount to about $151 million ($7.83 per item x 19.3 million items).

In summary, the costs of treating the filling materials and fabrics under TB117 could amount to about $330 million annually or more ($178 million for filling materials and $151 million for fabrics). The associated compliance and distribution costs could bring the total up to about $370 million annually. This would be more than double the estimated costs of the CPSC staff's 2005 draft standard, estimated at about $176 million.

8.4.3. Estimated Benefits of the Revised Draft TB117

The likely benefits that would result from adoption of the revised draft of TB117 as a mandatory standard vary by cover material type. First consider the furniture covered by severely cigarette ignition-prone cellulosic fabrics (2.9 million units). Based on the assumptions described above, about 1 million of these furniture items will fail the open flame fabric test of the revised draft TB117 and have to be treated. Since these furniture items will have fabric treatments as well as complying filling materials, it may be reasonable to assume that the benefits under the revised draft TB117 would be comparable to those of the CPSC staff's 2005 draft standard (which will also have treated filling materials), about $118 per unit (see Table 6). Thus, the benefits from these items would amount to about $115 million ($118.05 per item x 978,300 items). Additionally, for the remaining 2.0 million units covered with severely cigarette ignition prone fabrics that are not treated, the benefits would probably be no more than about half of the benefits associated with the treated units, or about $59 per unit. Thus, the benefits associated with these 2.0 million units with untreated fabrics might amount to about $115 million ($59.03 per unit x 1,956,600 units). Therefore, the total estimated benefits resulting from annual production of complying furniture upholstered with severely cigarette ignition prone cellulosic fabrics would be about $231 million.

About 18.3 million units of furniture covered in moderately- and lower-ignition prone cellulosic fabrics and thermoplastic fabrics will also likely fail the open flame

fabric test of the revised draft TB117 and have to be treated. Under the staff's 2005 draft proposed standard, these furniture items would have treated filling materials, but not treated fabric coverings. For purposes of this analysis, we will assume that the benefits associated with the filling materials tests of the revised draft TB117 are similar to those of the CPSC staff's draft proposed standard. Consequently, the estimated benefits associated with the revised draft TB117 would be greater because the cover fabrics would also be treated. In other words, unlike the 2005 CPSC staff's draft proposed standard, the benefits of treated filling materials would be augmented by the use of FR-treated fabrics under the revised draft TB117. Since the estimated benefits for these furniture items under the staff's 2005 proposed draft standard amount to about $251 million (based on the results shown in Table 6), the gross benefits associated with the revised draft TB117 would be greater than $251 million. If we assume that the fabric treatments would reduce the remaining societal costs by about 50 percent, then the gross benefits for these 18.3 million units might amount to about $329 million ($251 million + 0.5 x ($408 million - $251 million).[116]

Based on this analysis, the total benefits associated with the revised draft TB117 might amount to about $560 million ($231 million from furniture covered with severely ignition prone fabrics and $329 million from furniture covered with other fabrics). These estimated benefits are slightly less than those associated with the CPSC staff's 2005 draft standard (about $597 million).

8.4.4. Summary

In summary, the estimated annual costs associated with the revised draft TB117 may amount to about $370 million, and the estimated benefits may amount to about $560 million. Therefore, the estimated net benefits of this regulatory alternative are about $190 million. This compares to about $422 million in net benefits estimated to result from the CPSC staff's draft standard.

8.5. Adoption of a Labeling Rule

A rule requiring hazard information to be presented on labels could be adopted by the Commission in addition to, or in lieu of, a standard. The costs of labeling would be just a few cents per item (based on reported labeling costs under the UFAC Voluntary Action Program and estimates provided by a label manufacturer). However, the impacts of such labeling on product safety are likely to be minimal. Labeling that warns of cigarette ignition hazards is unlikely to be effective, because labels are unlikely to be seen by consumers when the upholstered item is in use, and because there already is general public awareness of these hazards. Additionally, a warning label would not be likely to prevent fires started by children playing with lighters and matches, who are unlikely to read the statements provided.

[116] Based on estimates from tables 2, 4, and 6.

8.6. Effective Date

Section 4 of the Flammable Fabrics Act states that standards or regulations shall become effective 12 months from the date of promulgation, unless the Commission finds that a different effective date is in the public interest. Because of the need for FR treatment of some fabrics used in the manufacture of furniture and the fact that furniture manufacturers carry stocks of fabrics, a longer period before the rule becomes effective, such as 18 months, could provide some firms additional time to use inventories of fabrics that would not pass the staff's draft standard's fabric test without FR treatment. However, given the small percentage of fabrics that will need to be treated (under 10 percent), it seems unlikely that limiting the effective date to 12 months will substantially burden firms.

Additionally, several options might be available to furniture manufacturers that have fabric that does not comply with a regulatory alternative adopted by the CPSC as the effective date for the action approaches. They might send the remaining fabric yardage to contract finishers for backcoating with FR chemicals. They could use FR barrier materials beneath the untreated fabric, as allowed by that alternative method of compliance with the staff's draft standard. Also, they might sell the fabric to jobbers who would market it to furniture manufacturers that use FR barriers with untreated upholstery fabrics and for other end-uses that are not within the scope of the regulation. In view of the relatively small percentage of fabrics estimated to require FR treatments or other modifications, and other options available to furniture manufacturers, an effective date longer than 12 months from the date of promulgation might not be in the public interest.

Compliance with the staff's 2005 draft standard would also require manufacturers and suppliers of urethane foam, polyester fiberfill, cotton batting, and other materials to provide materials that meet the relevant smoldering and open flame material tests so that they would be available for use by furniture manufacturers within 12 months of the date of promulgation of the rule. Current processes and capacities used by the manufacturers of urethane foam and cotton batting to meet mandatory flammability requirements of California and other jurisdictions, and voluntary standards such as the UFAC program, are expected to be adequate to produce sufficient quantities of urethane foam and cotton batting for use by the furniture industry under the staff's draft standard. Additionally, we assume that suppliers of polyester cushioning materials and furniture manufacturers will be able to develop products and processes that will enable the use of polyester-based cushioning materials within that period.

8.7. No Action

The Commission could determine that no rule is reasonably necessary to reduce the risk of fires associated with cigarette and small open-flame ignitions of upholstered furniture. Under this alternative, future societal losses would be determined by factors that affect the likelihood that ignition sources come in contact with upholstery and the ignition resistance of upholstery materials used by furniture manufacturers. For example, the apparently increasing use of ignition-resistant upholstery materials, such as leather, could reduce fires over time. Also, the state of California might adopt the draft revisions to its mandatory standard for upholstered furniture. Those revisions could result in reduced fire losses in that state, which accounts for perhaps 15 percent of the furniture market. Some furniture manufacturers might use materials that comply with some or all provisions of the California revised standard for all of their furniture production, which could reduce fire losses in other areas. Additionally, other political jurisdictions could impose requirements that would reduce future losses from furniture fires.

Factors other than furniture materials will also determine fire losses in the future. Some of these will tend to increase future losses (such as projected annual increases of about 1 percent in population and households) and others might decrease future losses (such as continued reductions in rates of smoking and alcohol consumption, increasing smoke alarm operability, information and education efforts, and installation of sprinkler systems in new construction).

Particularly noteworthy is the expected growth in the availability of cigarettes that reduce the probability of igniting upholstered furniture. Effective on June 28, 2004, the State of New York required all cigarettes sold in the state to self-extinguish if they are left unattended. Such cigarettes are expected to reduce greatly, but not eliminate, residential fires started by cigarettes. Similar legislation became effective in Vermont in 2006 and California, Oregon, and New Hampshire in 2007, and has been signed into law in 17 other states, with effective dates ranging from January 1, 2008, to January 1, 2010. Legislation has also been introduced in nine other states. By 2010, more than half of the U.S. population will be living in states with mandatory laws addressing the ignition propensity of cigarettes.[117] In addition to state actions, R.J. Reynolds Tobacco Company, the second-largest cigarette manufacturer with about one-third of the U.S. market, recently announced its intention to only market reduced ignition propensity cigarettes in the U.S. by the end of 2009.[118] This policy, combined with the increased imposition of state requirements, could spur other cigarette manufacturers to make similar business decisions.

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[117] Coalition for Fire-Safe Cigarettes, Legislative Updates. www.firesafecigarettes.org (referenced on September 19, 2007)

[118] Payne, Tommy J., Executive Vice President – Public Affairs, Reynolds American Inc., in a letter to James M. Shannon, National Fire Protection Association, October 25, 2007.

If the Commission does not adopt a mandatory rule to address furniture flammability from both smoldering and open flame ignition sources it is possible that a voluntary standard (perhaps through modifications to the existing UFAC Voluntary Action Program) could be developed based on the CPSC staff's 2005 draft standard or other alternatives, to address these hazards. However, no such voluntary program is currently underway. Moreover, the effort begun in 1996 through ASTM to establish a voluntary standard is currently inactive. Furthermore, comments submitted in response to the October 23, 2003, ANPR representing all segments of the affected industries supported mandatory federal regulation to address upholstered furniture flammability.

Thus, while furniture fires might decline with no CPSC action, there is no reason to believe that the decline would approach the proportion of fire losses that could be prevented with the staff's draft proposed standard, or some of the other performance standard alternatives described in this analysis.

Appendix A.

This appendix presents alternative estimates of the present values of benefits and net benefits shown in Tables 2, 4, and 6 of the Preliminary Regulatory Analysis. Tables 2a, 4a, and 6a present estimates based on application of a 7 percent annual discount rate for benefits accruing in future years.

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Table 2a.

Cigarette Ignition Societal Costs and Estimated Benefits from the Staff's 2005 Draft Standard for Furniture Produced in a Year

(in 2005 dollars)

Type of Upholstery Cover Material	(1) % of Annual Production	(2) Annual Units Produced	(3) Lifetime Societal Costs per Unit, Adjusted[1] (Table 1)	(4) Total Estimated Societal Costs[2] (million $) (2) x (3)	(5) Estimated Hazard Reduction	(6) Estimated Benefits per Unit (3) x (5)	(7) Total Estimated Benefits (million $) (2) x (6)
Severely Ignition-Prone Cellulosics	9.6%	2,934,901	$105.51	$309.7	79.8%	$84.24	$247.2
Moderately-Ignition-Prone Cellulosics	4.6%	1,406,465	$65.25	$91.8	67.4%	$43.97	$61.8
Lower Ignition-Prone Cellulosics	10.8%	3,281,752	$21.28	$69.8	67.4%	$14.34	$47.1
Thermoplastics	44.8%	13,653,682	$3.06	$41.8	67.4%	$2.06	$28.2
Leather, wool, vinyl-coated	30.2%	9,223,200	**See note [3]**	**See note [3]**	**See note [3]**	**See note [3]**	**See note [3]**
All Covering Materials	100.0%	30,500,000	$22.33	$513.1	--	$12.60	$384.3

[1] Based on a 7% discount rate; see Table 2 in the body of the *Preliminary Regulatory Analysis* for calculations based on a 3% discount rate.

[2] Based on estimated annual production of 30.5 million pieces of upholstered furniture for household consumption.

[3] Based on limited testing data, leather, wool, and vinyl-coated fabrics are assumed to be highly resistant to ignition from cigarettes. Therefore, the societal costs (and, hence, the potential benefits) associated with these covering materials are small but unknown.

Table 4a.

Small Open Flame Ignition Societal Costs and Estimated Benefits from the Staff's 2005 Draft Standard for Furniture Produced in a Year *(in 2005 dollars)*

Material	(1) % of Annual Production	(2) Annual Units Produced	(3) Lifetime Societal Costs per Unit[1] (Table 3)	(4) Total Estimated Societal Costs[2] (million $) (2) x (3)	(5) Estimated Hazard Reduction	(6) Estimated Benefits per Unit (3) x (5)	(7) Total Estimated Benefits (million $) (2) x (6)
Severely Cigarette Ignition-Prone Cellulosics	9.6%	2,934,901	$5.32	$15.6	84%	$4.47	$13.1
Moderately Cigarette Ignition-Prone Cellulosics	4.6%	1,406,465	$5.32	$7.5	50%	$2.66	$3.7
Less Cigarette Ignition-Prone Cellulosics	10.8%	3,281,752	$5.32	$17.5	50%	$2.66	$8.7
Thermoplastics	44.8%	13,653,682	$5.40	$73.7	50%	$2.70	$36.9
Leather, wool, vinyl-coated	30.2%	9,223,200	**See note [3]**	**See note [3]**	**See note [3]**	**See note [3]**	**See note [3]**
All Covering Materials	100.0%	30,500,000	$3.75	$114.3	--	$2.05	$62.5

[1] Based on a 7% discount rate; see Table 4 the body of the *Preliminary Regulatory Analysis* for calculations based on a 3% discount rate.

[2] Based on estimated annual production of 30.5 million pieces of upholstered furniture for U.S. household consumption.

[3] Based on limited testing data, leather, wool, and vinyl-coated fabrics are assumed to be highly resistant to ignition from small open flames. Therefore, the societal costs (and, hence, the potential benefits) associated with these covering materials are small but unknown.

Table 6a. Estimated Costs and Benefits of the 2005 Draft Standard*

(Per Unit and Aggregate for Production in One Year, in 2005 Dollars)

Type of Upholstery Cover	Projected Benefits Per Unit, by Source of Ignition			(4) Costs Per Unit	(5) Net Benefits per Unit	(6) Annual Units Produced (% of Total)	(7) Total Net Benefits (million $)	(8) Cumulative Net Benefits (million $)
	(1) Cigarettes	(2) S.O.F.	(3) Total Benefits					
Severely Cigarette Ignition-Prone Fabrics	$84.24	$4.47	$88.71	$18.33	$70.38	2,934,901 (9.6%)	$206.56	$206.56
Moderately Cigarette Ignition-Prone Cellulosic Fabrics	$43.97	$2.66	$46.64	$6.65	$39.98	1,406,465 (4.6%)	$56.23	$262.80
Lower Cigarette Ignition-Prone Cellulosic Fabrics	$14.34	$2.66	$17.00	$6.65	$10.35	3,281,752 (10.8%)	$33.96	$296.76
Thermoplastic Fabrics	$2.06	$2.70	$4.76	$6.65	($1.89)	13,653,682 (44.8%)	($25.79)	$270.97
Ignition Resistant Materials	See note					9,223,200 (30.2%)	See note	

Note: Based on limited ignition testing data, societal costs, and, hence, any potential benefits associated with ignition resistant materials such as leather, wool, and vinyl-coated fabrics are assumed to be small, but are unknown. Assuming these materials pass the optional cover material barrier tests, compliance costs for such furniture items would also be minimal.

* Present value estimates of future benefits are based on a 3 percent discount rate; see Table 6 for calculations based on a 3 percent discount rate.

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

Date: November 16, 2007

TO : Gregory B. Rodgers, Ph.D., AED, EC GBR

THROUGH: Deborah V. Aiken, Ph.D., Senior Staff Coordinator, EC

FROM : William W. Zamula, EC WZ

SUBJECT : Costs for Non-Fatal, Addressable Residential Civilian Injuries Associated with Upholstered Furniture Fires

The purpose of this memorandum is to document the procedure for estimating the annual costs of non-fatal residential fire injuries that could potentially be prevented by an upholstered furniture flammability standard.

The Congress directed the Commission in Section 2(b2) of the Fire Safe Cigarette Act of 1990 to "develop information on the societal costs of injuries of cigarette-ignited fires." The estimates for the costs of injuries in this memorandum are based primarily on a report, *Societal Costs of Cigarette Fires*, T. Miller, et al, NPSRI, 1993, in response to this directive. The injury costs developed in that report for cigarette-related fires are appropriate for upholstered furniture, because the costs are tailored to thermal burns (NPSRI terms them "flame burns,") and fire-related anoxia injuries and because a high proportion (65 percent, D. Miller, 2007) of upholstered furniture fire injuries involve ignition by cigarettes or other smoking materials. To apply the NPSRI cost estimates, we need estimates of the number of injuries in each of the categories he uses. NPSRI's injury categories are the NFIRS/NFPA categories modified to provide additional detail on the level of treatment received by the fire injury victim at the hospital. To obtain estimates for these categories, we will use the most recent NFIRS/NFPA fire injury data; break the injuries down first by diagnosis, then by whether the victim was taken to a medical facility. Finally, we will use NEISS data to further break down those injuries taken to a medical facility into either hospital-admitted injuries or treated and released injuries.

First, we start with three years worth of NFIRS/NFPA (2002-2004) data [draft memorandum from David Miller to William Zamula, August 31, 2007] to estimate the annual number of residential fire injuries associated with upholstered furniture. Rather than use the rounded estimates provided in this memorandum, we use the underlying estimates on which this memo is based to avoid compounding the rounding. Table 1 shows the average annual estimate by diagnosis for addressable, upholstered furniture fire injuries based on NFIRS/NFPA data for 2002-2004.

Table 1 – Diagnoses for Addressable Upholstered Furniture Fire Injuries Based on NFIRS/NFPA Data from 2002-2004

Diagnosis	Anoxia Only (Asphyxia & Smoke)	Burns and Anoxia	Burns Only	Other	Total
Number of Injuries (%)	234.08 (47.2%)	126.85 (25.6%)	81.56 (16.5%)	53.16 (10.7%)	495.64 (100%)

The NFIRS/NFPA data also provide information on whether the victim was transported to the hospital or not. Table 2 shows the same reports of fire injuries broken down by whether or not the victim was transported to a medical facility; we use the percentages in Table 2 to allocate injuries for each diagnosis.

Table 2 - Fire Department Assigned Dispositions for Addressable Upholstered Furniture Fire Injuries Based on NFIRS/NFPA Data from 2002-2004

Disposition Assigned By Fire Department / Diagnoses	Not taken to a Medical Facility (Not transported, other treatment)	Taken to a Medical Facility (Transported)	Total
Burns, Burns and Anoxia	92.86 (44.6%)	115.54 (55.4%)	208.41 (100%)
Anoxia Only	107.84 (46.1%)	126.24 (53.9%)	234.08 (100%)
Other	23.57 (44.3%0	29.59 (55.7%)	53.16 (100%)
Total	224.27 (45.2%)	271.37 (54.8%)	495.64 (100%)

In the NFIRS/NFPA data the fire department assigned disposition does not identify what level of treatment was required for the upholstered furniture injury victim at the hospital. However, the hospital-based estimates from the NEISS system can be used to project disposition information (whether the fire injury victim was treated and released or admitted to the hospital). Approximately ten years of NEISS data (from 01/01/95 to 9/30/04) on potentially addressable upholstered furniture injuries were used. The NEISS cases are selected from burn and anoxia cases associated with the upholstered furniture injury codes (679-680, 4019-4020, 4052, and 4053 have cases) that have been positively identified as residential fire cases in the NEISS records. These cases, when used with the NEISS weights, provide us with a ratio of admitted injuries to treated and released injuries, as shown in Table 3.

Table 3 - Hospital Dispositions for Addressable, Fire Department Attended, NEISS Injuries from 01/01/1995 to 09/30/04

Diagnosis\Disposition	% Admitted to Hospital (Hospitalized)	% Treated and Released (ER only)
Burns, Burns and Anoxia	36.1	63.9
Anoxia Only	15.6	84.4

Table 4 shows the various combinations of injury diagnoses and dispositions with their associated costs, using the injury information from the previous three tables. The injuries consist of the three-year averages of upholstered furniture injuries derived from the 2002-2004 NFIRS/NFPA data. The burn and anoxia injuries are first broken down by whether or not the victims were transported to a medical facility according to the proportions of the three-year averages in Table 2 above. Table 2 shows that 53.9 percent of the 234.08 (126.24) anoxia/asphyxia injuries reported in Table 1 are distributed into the "taken to the hospital" or "transported" category. The 126.24 injuries "taken to the hospital" are then allocated into hospital admitted (19.7) or treated and released (106.5) in Table 4, Column 1 according to their proportions in the potentially addressable injuries from the NEISS in Table 3 above. Injuries that are listed as treated and transferred or held for observation in the injury record are considered to be hospital admitted. Figure 1 at the end of the memorandum shows the process for deriving all the injury estimates in Table 4.

It should be noted that "other injuries" are treated differently than the burn and anoxia injuries. "Other injuries" is a catch-all term for the fractures, cuts, and other injuries that occur when people attempt to escape a fire. There are relatively few of these injuries, so rather than use an allocation process based on the more severe burn and anoxia injuries, which might cause us to overstate the severity of "other injuries," we use the proportions from the 1993 NPSRI study for cigarette fire ignitions. For this "other injury" category, NPSRI only has two categories: hospital admitted and other treatment.

Table 4 also shows the four cost components included in the estimates: medical costs, productivity losses, pain and suffering, and administrative/legal costs. Theses cost estimates are derived from the 1993 NPSRI study, and updated to 2005 price levels using the indices in the Commission's Injury Cost Model (T. Miller 2000): the employment cost index for productivity, pain and suffering, and legal/administrative; and medical costs per capita for the medical cost component.

The annual injury costs associated with the civilian injuries that could potentially be addressed by a flammability standard for upholstered furniture amount to $72.7 million in 2005 dollars. Since these were an estimated average of 495.64 injuries per year, the average injury cost, in 2005 dollars, amounts to about $146,740. This estimate may be low, because it does not include the societal costs associated with the upholstered furniture related residential fire injuries that are captured by the NEISS system but are not captured in the NFIRS/NFPA estimates. An example of such an injury is a burn injury victim who seeks medical attention at a hospital but does not call the fire department.

Table 4 – Injury Cost Components by Diagnosis and Disposition for Addressable Upholstered Furniture Fire Injuries

	Number of Injuries	Medical Costs (2005$)	Productivity Costs (2005$)	Pain & Suffering Costs (2005$)	Admin. & Legal Cost (2005$)	Average Injury Costs (2005$)	Total Injury Costs (2005$)
Diagnosis/ Disposition							
Anoxia, Total	234.08						
Anoxia, Treated and Released	106.55	1,347	4,680	115,601		21,628	2,304,474
Anoxia, Admitted	19.69	9,620	24,962	171,611	4,680	210,873	4,152,087
Anoxia, Not Transported	107.84	192	624	2,340		3,157	340,407
Burns, Total	208.41						
Burns Admitted	41.71	98,124	67,084	1,224,679	29,642	1,419,529	59,208,542
Burns, Treated and Released	73.83	1,347	4,680	17,161	234	23,422	1,729,262
Burns, Not Transported	92.86	192	624	2,340		3,157	293,121
Other Injuries, Total	53.16						
Other Inj., Admitted	8.51	26,936	45,243	366,624	9,361	448,163	3,813,867
Other Inj., Other treatment	44.7	1,154	1,560	17,161		19,876	888,439
Grand Total Injuries	495.64					Grand Total Costs	72,730,200

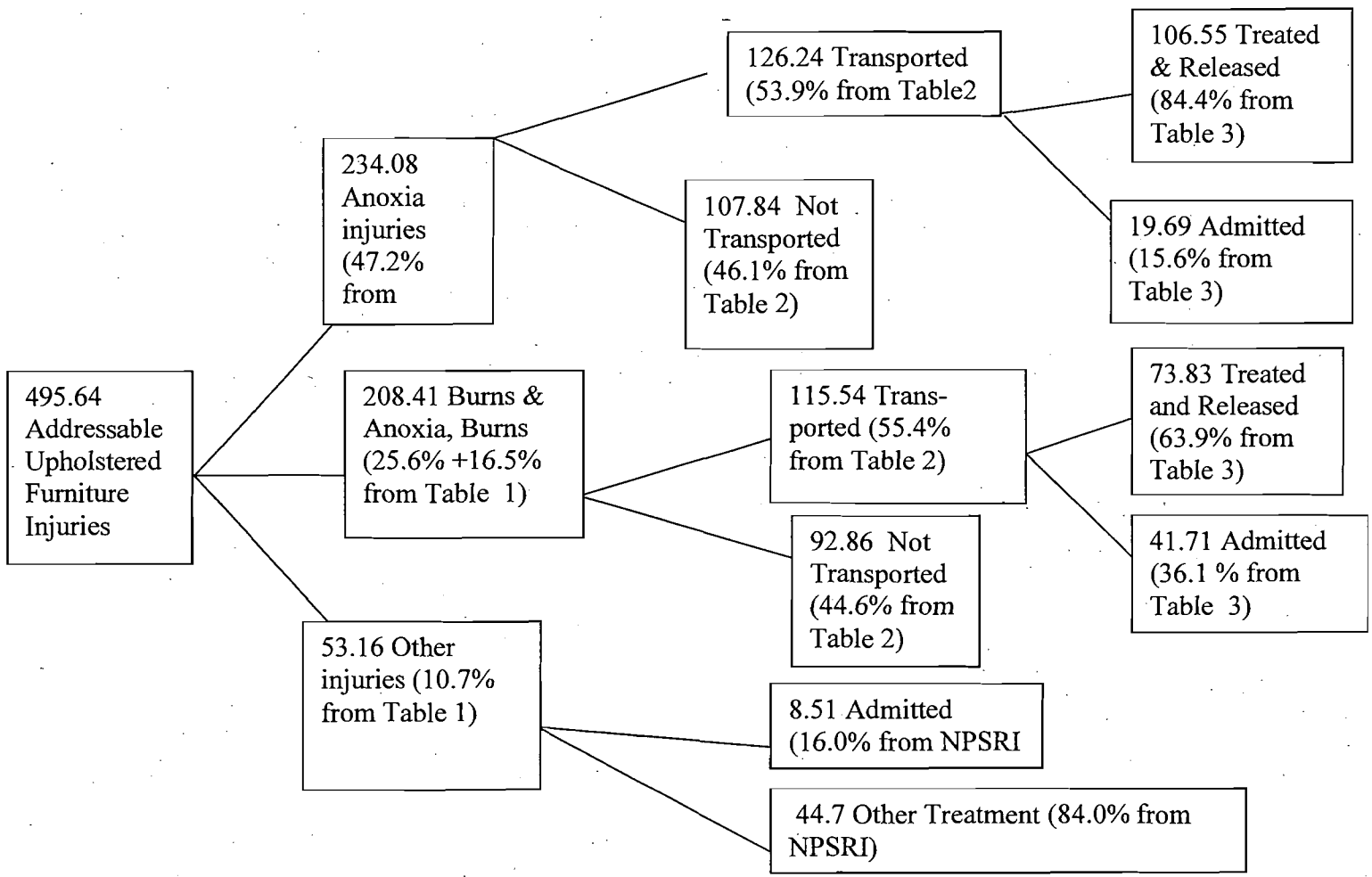
References

Miller, D. Memorandum to William Zamula. 2002-2004 Addressable Fire Injury Estimates for Upholstered Furniture. Consumer Product Safety Commission, August 31, 2007.

Miller T, et al. The Consumer Product Safety Commission's Revised Injury Cost Model. National Public Services Research Institute, Calverton, MD, December 2000.

Miller T, et al. Societal Costs of Cigarette Fires. National Public Services Research Institute, Landover, MD, August 1993.

Figure 1 - Schematic for Deriving the Injury Estimates for Table 4



Draft Standard on Upholstered Furniture Flammability

Initial Regulatory Flexibility Analysis

Charles L. Smith
Directorate for Economic Analysis
U.S. Consumer Product Safety Commission
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1. Introduction

The U.S. Consumer Product Safety Commission (CPSC) is considering regulation to address ignitions of residential upholstered furniture. The Commission published an Advance Notice of Proposed Rulemaking (ANPR) initiating a regulatory proceeding on June 15, 1994, addressing the risk of small open flame ignitions of upholstered furniture. On October 23, 2003, the Commission issued an ANPR which reflected the Commission's decision to expand its proceeding to explicitly address the risk of cigarettes ignitions as well. If a standard is proposed by the Commission to address these hazards, the rule would be under the principal authority of the Flammable Fabrics Act (FFA), and would apply to upholstered furniture sold in the U.S.

The Regulatory Flexibility Act (RFA) requires that rules proposed by the Commission be reviewed for the potential economic impact on small entities, including small businesses. Section 603 of the RFA requires the Commission to prepare and make available for public comment an Initial Regulatory Flexibility Analysis describing the impact of the proposed rule on small entities and identifying impact-reducing alternatives. The Initial Regulatory Flexibility Analysis is to contain:

1) a description of the reasons why the action is being considered;

2) a succinct statement of the objectives of, and legal basis for, the proposed rule;

3) a description of and, where feasible, an estimate of the number of small entities to which the proposed rule will apply;

4) a description of the projected reporting, recordkeeping, and other compliance requirements of the proposed rule, including an estimate of the classes of small entities which will be subject to the requirement and the types of professional skills necessary for the preparation of the report or record; and

5) an identification, to the extent possible, of all relevant Federal rules which may duplicate, overlap, or conflict with the proposed rule.

In addition, the Initial Regulatory Flexibility Analysis must contain a description of any significant alternatives to the proposed rule that would minimize any significant economic impact of the proposed rule on small entities. Suggested alternatives for discussion include: different compliance or reporting requirements for small entities; classification, consolidation, or simplification of compliance or reporting requirements for small entities; the use of performance rather than design standards; and partial or total exemptions from coverage for small entities. A draft standard that would address ignitions of residential upholstered furniture has been prepared by the CPSC staff. Although the Commission has not approved the draft standard, this analysis presents information on likely impacts of the standard, and alternatives available for consideration by the Commission.

2. Reasons the Commission is Considering Action

Upholstered furniture fires started by smoldering ignition sources (principally cigarettes) and small open flame ignition sources (such as lighters, matches, and candles) are a leading cause of death, injury, and property damage in the U.S. The most recent fire loss data are from 2002 through 2004. During that time period, there were an average of about 280 deaths, 500 injuries, and $112 million in property losses annually from fires started by either smoldering ignition sources (such as cigarettes) or small open flame ignition sources (*e.g.*, lighters, matches, and candles) in which upholstered furniture was the first item ignited, and which could be addressable by a mandatory flammability standard. About 93 percent of these deaths, 64 percent of the injuries, and 58 percent of the property damage resulted from fires started from cigarette ignition. The remainder started from small open flames (*e.g.*, lighters, matches, candles). Based on these data, the Directorate for Economic Analysis estimates that the societal costs from cigarette and small open flame ignitions expected over the useful lives of furniture produced in one year, based on materials currently used to manufacture furniture, total about $841 million.[1]

3. Objectives of, and Legal Basis for, a Rule Based on the Draft Standard

In 1993 the National Association of State Fire Marshals (NASFM) petitioned the CPSC to initiate a proceeding to regulate hazards associated with upholstered furniture fires started by small open flame ignition sources, cigarettes, and larger open flame sources. NASFM suggested adopting the State of California's existing flammability regulations (known as Technical Bulletins). The Commission determined that ignitions of upholstered furniture by small open flames might constitute an unreasonable risk to the public and granted that part of the petition (while reserving judgment on the technical merits of the California regulations). In 1994 the Commission commenced a regulatory proceeding under the Flammable Fabrics Act (FFA) to address the risk of fire from small open flame sources. By an ANPR issued on October 23, 2003, the Commission expanded the regulatory proceeding to address cigarette ignitions of upholstered furniture.

In 2005, the CPSC staff developed a draft standard intended to reduce the risk of deaths, injuries and property loss from upholstered furniture fires started by cigarettes and small open flames. If adopted by the Commission, the rule would be expected to substantially reduce these fire losses. The rule would be proposed under Section 4 of the FFA. This section requires the agency to consider economic effects of proposed

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[1] Smith, Charles L. "Preliminary Regulatory Analysis of a Draft Proposed Rule to Address Cigarette and Small Open Flame Ignitions of Upholstered Furniture." Directorate for Economic Analysis, U.S. Consumer Product Safety Commission. October 2007.

safety regulations on industry and consumers, and alternatives to the proposed regulation that might reduce its burden.

4. Requirements of the 2005 Draft Standard

The staff's 2005 draft standard specifies tests to determine the ability of upholstered furniture to resist ignition when subjected to a burning cigarette or small open-flame source (*e.g.*, match, cigarette lighter, or candle). As drafted, the standard would apply to "moveable products that are primarily intended for seating use, and that contain a textile or other soft cover materials and cushions or other soft interior filling materials." The 2005 draft standard applies to finished or ready-to-assemble articles of upholstered furniture (such as upholstered sofas, loveseats, sofa beds, rockers, recliners, and other chairs) that are:

primarily intended for indoor use in residences;

constructed with an upholstered seating area, comprised of a contiguous upholstered seat and back, or seat and side; and,

manufactured or imported after the effective date of the standard.

The 2005 draft standard limits the fire hazard by means of a series of performance tests for the major upholstery materials in furniture constructions that contribute significantly to fire behavior. The upholstery materials involved in the performance tests include:

Cover fabrics/materials, the outermost layer of upholstery;

Resilient foam filling materials, such as polyurethane or latex cushion cores;

Fibrous filling materials, such as cushion wraps made of polyester fiberfill or cotton batting; and

Loose filling materials, such as blown polyester fiber, shredded foam, down, etc.

The 2005 draft standard offers manufacturers alternative methods to produce complying furniture. Furniture items can comply by being made with filling materials that pass specified tests for smoldering ignition resistance and small open flame ignition resistance and upholstery cover materials that pass the cover material cigarette ignition test (such furniture is designated as "Type III upholstered furniture" in the 2005 draft standard). In lieu of using complying loose filling materials, manufacturers may encase

such materials with fabrics that pass loose filling interliner fabric ignition tests of the draft standard.

Alternatively, manufacturers may comply with the 2005 draft standard by using a barrier material under the upholstery fabric that passes the draft standard's applicable barrier tests ("Type I upholstered furniture"). This option allows manufacturers to use noncomplying upholstery fabrics and filling materials. The draft standard also specifies optional performance requirements for cover materials that qualify them as barriers, which would also allow the use of noncomplying filling materials ("Type II upholstered furniture"). Finally, the draft standard allows manufacturers the option of qualifying combinations of upholstery materials for use in production furniture based on the results of end-product smoldering and open flame ignition resistance testing ("Type IV upholstered furniture").

Each material test is conducted using a seating mockup of fabric and filling. For each of the materials evaluated in the draft standard, the goal is to limit the mass loss from combustion (smoldering, melting, or flaming) of the mockup's interior filling materials. Pass / fail criteria are based on maximum acceptable mass loss percentages over the specified duration of the test. Complying materials are more difficult to ignite and burn more slowly if ignited; thus, each material contributes to preventing or greatly delaying full involvement of the article of furniture in a fire.

While the various complying materials in upholstered furniture may have to pass as many as seven individual performance tests, the draft standard employs two basic sets of similar tests - one set for smoldering ignition performance and another set for small open flame ignition performance. Fire barriers need only pass two barrier tests - one for smoldering and one for open flame.

In addition to flammability performance requirements, the staff's 2005 draft standard contains provisions relating to certification and recordkeeping, testing to support guaranties issued by material suppliers, and labeling of finished articles of upholstered furniture. These quality assurance and quality control-related requirements are intended to help manufacturers, importers and suppliers ensure that their products comply, and to help the CPSC staff to enforce the draft performance standard. These provisions are contained in Subpart B of the draft standard.

Certification & Recordkeeping

Manufacturers and importers would certify that their finished articles of upholstered furniture comply with the draft standard. Manufacturers and importers would be required to retain records demonstrating compliance, including test records or other information to support guaranties from material suppliers, as well as model or

stock keeping unit identification. These records must be retained for as long as the finished article or material is produced or imported, and for three years thereafter.

Testing to Support Guaranties

To certify compliance for finished articles of upholstered furniture, manufacturers and importers may rely on guaranties of compliance issued by material suppliers under the Flammable Fabric Act. These guaranties must be supported by reasonable and representative tests sufficient to establish that production units of materials meet the applicable tests. There are no specific sampling or production testing requirements in the draft standard.

Labeling

The staff's 2005 draft standard provides that finished articles of upholstered furniture must carry a permanent label containing the manufacturer or importer name and location; month and year of manufacture; model identification; and type identification indicating the means of compliance (*i.e.*, "Type I," "Type II," "Type III," "Type IIIB," "Type IV"). This information must be separate from other label information. The label would help retailers and consumers identify products and materials, *e.g.*, in the event of a recall or other corrective action.

In summary, all manufacturers and importers of upholstered furniture would be subject to the draft standard if it is adopted as a rule by the Commission. However, it is likely that the great majority of testing would be done by or for fabric and filling material suppliers. These results would then be used to support guaranties of compliance that will be provided to furniture manufacturers. Records would be prepared by those conducting tests (fabric and filling material manufacturer personnel or outside testing facilities); copies of reports and records would be maintained by upholstered furniture manufacturers and furniture importers. No special skills that are not already available to manufacturers and importers would be required to establish or verify compliance with the draft proposed rule.

5. Firms Subject to the 2005 Draft Standard and Possible Impacts

Firms Subject to the 2005 Draft Standard

As drafted, the standard would apply to manufacturers and importers of upholstered furniture intended for sale to consumers. Manufacturers of household upholstered furniture are classified in code 337121 of the North American Industrial Classification System (NAICS). According to the Census Bureau's 2002 *Economic Census*, 1,686 U.S. companies (with 1,946 establishments) manufactured upholstered

household furniture or dual-purpose sleep furniture as their primary product.[2] Many other firms may also produce upholstered furniture as secondary products, and a large number of firms, including major retailers, import upholstered furniture subject to the draft proposed regulation.

The top four upholstered furniture manufacturers accounted for nearly 35 percent of the total value of upholstered furniture shipments in 2002 (the most recent year for such information), and the 50 largest companies accounted for 67 percent.[3] Reports from the trade press indicate that the industry has become more concentrated in the last ten years: several firms have ceased operations; others have merged with larger companies through buyouts. However, the industry also includes many small companies/establishments. The 2002 *Economic Census* reports that only 29 percent of upholstered furniture establishments (564 of 1,946) had 20 or more employees, and only 10 percent (200 establishments) had 100 or more.[4] By some measures, such as the U.S. Small Business Administration's (SBA's) definition for qualification for small business loans, a furniture manufacturing company is considered to be "small" if it has fewer than 500 employees (at all of its establishments). This definition encompassed more than 97 percent of firms in the industry in 2002.[5]

A standard would also affect manufacturers and finishers of upholstery fabrics used in the production of furniture. Although their products are not directly regulated by the draft proposed standard, it is expected that they will provide guaranties to furniture manufacturers regarding fabric ignition resistance. It is expected that nearly 10 percent of upholstery cover fabric yardage will require changes in production, such as the incorporation of flame retardant (FR) chemicals or changes in fibers, in order to pass the fabric test of the draft proposed standard. As noted above, noncomplying fabrics could still be used with complying barrier materials.

Textile mills that make upholstery fabrics as their primary product are included in the NAICS code 313210. Of 663 firms in NAICS 313210 in 2002, only 63 (about 10 percent) had more than 500 employees. About 65 percent of the firms had fewer than 20 employees.[6] The SBA considers fabric manufacturing firms with fewer than 1,000 employees to be small businesses for the purposes of programs administered by the agency. Although these data are indicative of the sizes of firms involved in the

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[2] U.S Census Bureau, U.S. Department of Commerce, 2002 Economic Census, *Upholstered Household Furniture Manufacturing: 2002*, EC02-311-337121. September 2004.

[3] U.S Census Bureau, U.S. Department of Commerce, 2002 Economic Census, report EC02-31SR-1, *Concentration Ratios: 2002*. May 2006.

[4] U.S Census Bureau, U.S. Department of Commerce, 2002 Economic Census, Upholstered Household Furniture Manufacturing: 2002, EC02-311-337121. September 2004.

[5] Based on 2002 firm size data compiled by the United States Small Business Administration's Office of Advocacy which is available online at http://www.sba.gov/advo/research/data.html.

[6] *Ibid.*

production of furniture upholstery fabrics, NAICS 313210 encompasses many firms that produce fabrics for end-uses other than furniture upholstery. Nevertheless, it is likely that the great majority of manufacturers of upholstery fabrics could be considered small businesses under SBA guidelines.

Fabric finishers also tend to be small. Finishers are firms that receive unfinished fabrics ("greige goods") and perform additional manufacturing operations (*e.g.*, printing, dyeing, backcoating, and stain-guarding). Fabrics may be purchased by the finishers, or finished under contract to other firms that supply the fabrics. Fabric finishers are classified in NAICS code 313311. Of 1,016 broadwoven fabric finishing firms in 2002, only 30 (3 percent) had more than 500 employees.[7] As is the case with manufacturers of broadwoven fabrics, fabric finishing firms with fewer than 1,000 employees are considered to be small businesses under SBA guidelines. Thus, it is likely that nearly all fabric finishing firms that would be affected by the 2005 draft standard would be small businesses. However, we note that only a few of the firms that are classified in NAICS code 313311 currently apply FR treatments to upholstery fabrics.

The 2005 draft standard also requires furniture manufacturers to use cushioning materials that comply with specific smoldering and open flame flammability performance requirements, unless materials complying with alternative barrier material tests are used. As with upholstery fabric manufacturers, we expect manufacturers of urethane foam cushioning, polyester fiber, and cotton fiber cushioning materials to provide guaranties under the FFA to the furniture manufacturers that use their products. Many of these firms already test their products to market them as complying with voluntary flammability standards, and mandatory standards in effect in California and some other jurisdictions.

Based on information provided by officials of urethane foam manufacturers contacted by the Directorate for Economic Analysis, about 20 U.S. firms manufacture flexible urethane foam for use in upholstered furniture. These firms operate perhaps 80 to 90 plants. According to *2002 Economic Census* data for all manufacturers of urethane foam (NAICS 32615), including those manufacturing foam for uses other than furniture, most of these firms probably are small businesses under SBA guidelines.[8] Although about 20 firms reportedly manufacture flexible urethane foam for furniture, the top four were said to account for perhaps 60 to 65 percent of foam cushioning used by the upholstered furniture industry. These and other firms fabricate cushions that are

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[7] *Ibid.*

[8] *Ibid.* About 8 percent of all firms that manufactured urethane and other foam products (33 of 409 firms) in 2002 would be classified as small businesses (fewer than 500 employees at all establishments owned by the company).

marketed to the upholstered furniture industry. One major trade publication for the furniture industry listed 59 sources of urethane foam cushioning or furniture.[9]

The 2005 draft standard also applies to manufacturers and suppliers of fibrous filling materials, such as polyester and cotton batting, and loose polyester fiberfill. A major trade publication lists about 40 suppliers of these materials to the furniture industry. Many suppliers of cotton batting also provide polyester batting and fiberfill. Some also are listed as suppliers of urethane foam cushioning. According to the *2002 Economic Census*, 57 establishments produced "Paddings and upholstery filling, batting, and wadding" in 2002, with a value of shipments of $490 million.[10] According to the Census report for upholstered furniture, the delivered cost of these materials for the production of furniture was about $254 million. Census data indicate that nearly all suppliers of fibrous filling materials to the furniture industry are small businesses according to SBA guidelines (*i.e.*, with fewer than 500 employees).[11]

Possible Impacts of the 2005 Draft Standard on Small Businesses

The usual means of compliance with the 2005 draft standard will be the use of fabrics that do not need additional FR treatments (or barriers) combined with filling materials that either pass the applicable materials tests of the standard without modifications, or pass through incorporation of FR chemicals. Sixty percent or more of all upholstered furniture items made under the draft standard would be made with such materials. For these items estimated average increased costs of materials, labor and distribution total about $6.65 per unit.[12] For those units that comply as a result of FR treatment of fabrics or the use of barriers, estimated costs are higher, but are only estimated to involve less than 10 percent of total production. The increased resource costs associated with furniture using treated FR fabrics (*i.e.*, the costs associated with materials, labor, and distribution) are expected to average about $16.50 per item of furniture, including costs of complying cushioning materials; the increased costs associated with the use of barriers may amount to about $21 per unit. For the estimated 30 percent of furniture produced with ignition resistant cover materials that would likely qualify as barriers under the draft standard, only minor costs per unit would result from the standard.

The cost impacts faced by firms using treated materials, including smaller manufacturers, would be proportionate to the amounts of treated cushioning materials

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[9] *Upholstery Design & Management (udm)*, May 2004, p.39. (Note: publication ceased in 2005)

[10] U.S. Census Bureau, 2002 Economic Census, *All Other Miscellaneous Textile Product Mills: 2002*, EC02-311-314999. August 2004.

[11] SBA Office of Advocacy, *op. cit.* (2,178 of 2,226 firms in NAICS 314999, or 98%, had fewer than 500 employees in 2002.)

[12] Cost estimates are weighted based on shipment data of larger items such as sofas and sofabeds (with higher costs) and smaller items such as chairs (with lower costs).

used, and yardage of treated upholstery fabrics or barrier materials used. Therefore, the costs of these methods of compliance are not expected to be borne disproportionately by smaller manufacturers of furniture. Small businesses that manufacture relatively inexpensive furniture that will require only treated cushioning materials should face only modest increases in costs of materials and labor, estimated to average $6.65 per unit.[13] In addition, they should be able to pass at least some of these increased costs on to residential consumers. For these reasons, it seems unlikely that the rule would have a significant impact on these small furniture manufacturers.

Many of the fabrics used by small furniture manufacturers that would fail the fabric test of the 2005 draft standard are likely to be relatively expensive decorative fabrics. The draft standard's option of using FR barrier materials would be a likely means of compliance for furniture made with such fabrics, and this option was requested by the segment of the industry using the more expensive decorative fabrics when the CPSC staff was drafting an open flame standard in 2001. Other fabrics used by these small furniture manufacturers could be brought into compliance with FR treatments at somewhat lower per unit costs, if their aesthetic qualities would not be significantly degraded by the processes. These alternative means of compliance would allow decorative fabrics to remain available to the upholstered furniture industry and the consuming public. Since the prices of fabrics that would be treated or used with barriers, and the furniture made with them, are likely to be considerably higher than average, the relative increases in per unit costs would be moderated for the small furniture manufacturers that use them. Additionally, discussions with upholstered furniture manufacturers producing the more expensive furniture using decorative fabrics suggest that the barrier option will substantially address their concerns with likely adverse aesthetic effects of FR treatments for many of these fabrics.

The estimated per unit costs of the 2005 draft standard discussed above include relatively modest costs for recordkeeping (averaging about $.11 per item of furniture). The draft standard would require furniture manufacturers to maintain records for a period of three years after items are produced. The records will include identification and description of the furniture items and materials used in their manufacture, contact information for material suppliers, and results of relevant material tests. Smaller firms with limited product lines are expected to bear lower costs than larger firms with broad product lines. In summary, the recordkeeping requirements of the draft proposed rule place a substantial burden on small businesses.

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[13] Smith, *op. cit.* Note that the $6.65 per unit includes cost increases for cushioning materials associated with the 2005 draft standard. Thus, the analysis implicitly assumes that firms that manufacture cushioning materials fully pass on regulatory costs to furniture manufacturers. To the extent that they only partially pass through regulatory costs (*i.e.*, to the extent that cushioning and furniture manufacturers "share" the regulatory burden), the $6.65 per unit cost increase incurred by furniture manufacturers represents an overestimate. Under a scenario of regulatory cost sharing, the impact of the draft standard on small furniture manufacturers will be even less significant.

The 2005 draft standard was also designed to minimize testing costs that would be imposed on small furniture manufacturers. Since they may rely on guaranties provided by material suppliers, the draft rule does not require firms to test composites of their fabrics and cushioning materials. Such testing would significantly increase costs of the draft standard, and would likely disproportionately affect small manufacturers of upholstered furniture. Further, the 2005 draft standard does not include a requirement for a small open flame test of cover fabrics. An open flame test requirement similar to the 2001 CPSC staff draft furniture flammability standard would have added substantially to costs faced by small furniture manufacturers.

Many of the fabrics that would fail the fabric test of the 2005 draft standard are likely to be more expensive decorative fabrics. Based on information provided by the Decorative Fabrics Association, its members are generally among the smaller establishments that will be affected by the draft standard. Partially in response to comments received from this segment of the industry, the CPSC staff included the provision for use of acceptable barrier materials as an alternative means of compliance. This alternative was sought by the industry because of concerns that aesthetic qualities of many decorative fabrics would be adversely affected by FR treatments. This alternative allows all upholstery fabrics manufactured by small textile firms to be used under the draft standard, and is expected to substantially mitigate the impact of the draft standard on their businesses.

The estimated costs per unit discussed above that would be incurred by small furniture manufacturers include increased costs for cushioning materials, such as flexible urethane foam, polyester fiberfill, and cotton batting. The Directorate for Economic Analysis estimates that increased urethane foam costs would be similar to those reported by industry contacts for foam that complies with the revised draft California Technical Bulletin 117. Estimated polyester filling cost increases are based on a wide range of possible cost impacts for this material. Cotton batting currently marketed to the furniture industry is not expected to incur significant cost increases under the draft proposed standard. These estimated costs are discussed in detail in the *Preliminary Regulatory Analysis of a Draft Proposed Rule to Address Cigarette and Small Open Flame Ignitions of Upholstered Furniture.*[14] The Directorate for Economic Analysis believes that processes and materials will be readily available to small businesses that manufacture cushioning materials for the furniture industry. Consequently, since at least some of the cost increases are likely to be passed on to the furniture manufacturers that purchase the materials, a rule based on the draft standard would probably not have a significant impact on a substantial number of small businesses that manufacture cushioning materials subject to the rule.

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[14] Smith, *op. cit.*

Under the 2005 draft standard, manufacturers of fabrics and cushioning materials are required to conduct reasonable and representative tests to support initial guaranties of compliance for their materials. However, the costs associated with these requirements are expected to be minimal since many of these costs are now incurred for products marketed for use as complying with voluntary standards or mandatory standards enforced by California and other jurisdictions. Manufacturers of upholstery fabrics already classify their fabrics using the UFAC fabric classification test, which is similar to the fabric test of the draft proposed standard. Also, manufacturers of urethane foam, polyester fiberfill, and cotton batting that supply materials for use in furniture intended for sale in California now assure furniture manufacturers that their products comply with that state's Technical Bulletin 117 material tests. Additionally, suppliers of cotton batting to the furniture industry certify that their products comply with the relevant material test of the UFAC voluntary program. Cotton batting manufacturers that are members of the National Cotton Batting Institute (NCBI) have their products tested and certified by Underwriters Laboratories as a fire retardant filling that meets safety standards.

Thus, small manufacturers of fabrics and filling materials should only face minor incremental costs for testing under the draft standard, compared to current industry practices. Furthermore, small manufacturers should be able to pass at least some of the additional costs of testing to furniture producers and jobbers that purchase their products. This information suggests that the testing necessary to provide guaranties of compliance by small manufacturers of fabrics and filling materials will not result in a substantial impact on such firms.

6. Other Federal Rules

No Federal rules are known to exist which may duplicate, overlap, or conflict with a rule that would reflect the staff's draft standard.

7. Alternatives to the Staff's 2005 Draft Standard

The staff has provided an analysis of three alternative standards available for consideration by the Commission: a 2007 CPSC staff alternative draft standard with requirements that focus on smoldering ignition; the staff's 2001 draft small open flame standard; a standard based mandating the provisions of the UFAC voluntary program; and a standard based on the 2002 revised draft California furniture regulation (TB117). Other regulatory options are available that might lessen the potential burden on industry, including small firms. These regulatory alternatives include extending the effective date beyond 12 months after promulgation, and adoption of warning label requirements. Another alternative for consideration is the reliance on a voluntary standard or taking no action.

7.1. An Alternative that Focuses on Smoldering Ignition

In 2007 the CPSC staff drafted an alternative standard after considering substantial public comment on the upholstered furniture rulemaking proceeding. Under this alternative, upholstered furniture covering materials would have to comply with cigarette ignition performance tests. Manufacturers would have the option of using fire blocking barriers which pass tests of smoldering and open flame ignition resistance instead of using complying fabrics.

The costs of a standard based on the smoldering requirements would mainly be those related to: a) re-engineering of fabrics for improved smoldering performance or, less probably, FR fabric treatments; and b) the use of acceptable barrier materials. Estimated costs associated with bringing the estimated 9.6 percent of furniture items covered with "severely cigarette-ignition-prone cellulosics" into compliance have a range of $30.3 million to $45.7 million, with a midpoint of $38.0 million.[15] This estimate assumes per unit costs of barriers and FR treatment would be the same as estimated for the 2005 CPSC staff draft standard. In addition to these costs, the smoldering test for upholstery fabric in this alternative standard is more stringent than that included in the 2005 staff draft standard. Therefore, the alternative may also require fabric modifications or barriers for furniture constructed with the estimated 4.6 percent of fabric yardage currently used that is classified as "moderately cigarette-ignition-prone cellulosics." If we assume that these fabrics would be FR-treated (rather than being brought into compliance through the more costly use of barriers), manufacturing costs would increase by an estimated $9.3 million to $15.9 million, with a midpoint of $12.6 million.. The total costs associated with re-engineering, potential FR-treatment of fabrics and the use of barriers would, therefore, range from about $40 million to $62 million, with a midpoint of about $51 million. The only other costs would be those related to compliance verification and distribution, which might total about $6 million.[16] Therefore, the total estimated costs of the alternative that focuses on smoldering ignition could be about $57 million.

It should be noted that the estimated costs of the smoldering alternative could be lower than estimated above, since manufacturers would always have the alternative of substituting upholstery fabric that passes the smoldering requirements for those that do not, without the application of FR chemicals or the use of barrier materials. If choosing these options were to reduce reliance on FR-treatments of fabric by 80 percent from that assumed in the above analysis, FR-treatment costs under the 2007 alternative could total

[15] Estimated FR-treatment costs for 60% of severely ignition-prone fabrics range from about $11.6 million to $19.9 million; estimated costs for barriers under the remaining 40% of these fabrics ranges from about $30.3 million to $45.7 million.

[16] About $5.3 million of these costs are for the 4.3 million units made with FR treated fabrics or barriers and $.9 million are for furniture covered with other fabrics and materials.

about $6 million annually. Under this assumption, aggregate costs of FR-treatment of fabrics, the use of barriers, and associated costs of compliance verification and distribution would be about $32 million.

Without the open flame filling materials tests of the 2005 staff draft standard, benefits of the smoldering alternative would be limited to furniture items which are brought into compliance by the use of barrier materials or modifications to fabrics that would fail the smoldering test (including changes in fibers, discontinuing use of fabrics for furniture production or FR treatments). The expected benefits associated with the use of barrier materials for furniture covered with severely ignition-prone cellulosic fabrics will be the same as under the 2005 staff draft standard, since filling materials would not have to comply with smoldering or open flame tests under either regulatory alternative. Benefits will also be derived from furniture items covered with fabrics that are modified to comply with the fabric test of the draft smoldering standard. Unlike the 2005 staff draft, the smoldering alternative would not result in more ignition-resistant filling materials that would contribute to the overall ignition resistance of furniture items. However, the more stringent smoldering test for fabrics in the 2007 smoldering alternative could be expected to result in reductions in cigarette-ignition hazards similar to those estimated for the 2005 staff draft standard. On the other hand, the absence of performance tests for filling materials is estimated to result in lower open flame benefits than the 2005 staff draft standard for modified fabrics, and no open flame benefits for furniture covered with fabrics that are not modified or used over barrier materials. Depending on the extent to which non-complying fabrics are re-engineered with different fibers, FR-treated or dropped from product lines, total estimated benefits resulting from the 2007 alternative that focuses on smoldering would range from about $419 million to $424 million.

In summary, estimated costs of compliance with the 2007 alternative that focuses on smoldering may range from about $32 million to $57 million annually. These costs are well below the estimated costs of the 2005 staff draft standard (about $176 million annually), and should, therefore, result in a lower impact on furniture manufacturers, including small businesses. It is possible that the more stringent fabric test could present greater impacts for some small upholstery fabric manufacturers. The absence of requirements for filling materials should reduce the burden on small businesses that market those products to the furniture industry. Based on estimated aggregate benefits of $419 million to $424 million, net benefits would be in the range of $367 million to $387 million. This range is $34 million to $54 million lower than net benefits estimated for the 2005 staff draft standard ($421.5 million).

7.2. Adoption of the 2001 Draft Small Open Flame Ignition Standard

As an alternative to the proposed draft standard, the Commission could adopt the standard drafted by the CPSC staff in 2001 that focused on small open flame

ignition of upholstered furniture. That draft standard was the subject of a staff briefing package submitted to the Commission in October 2001. Compliance with the small open flame standard would require the use of upholstery cover materials that do not sustain combustion (over standard urethane foam) following exposure to a small flame for 20 seconds, or, alternatively, the use of materials that would pass a barrier test. Although the FR treatments under that standard would specifically address small open flame ignition hazards, CPSC testing data also showed substantial improvement in cigarette ignition resistance of treated fabrics. In fact, most of the estimated benefits of the small open flame standard were projected to result from reductions in societal losses from cigarette ignitions.

Based on current market data, the 2001 draft small open flame standard probably would require FR treatments for about 70 percent of all upholstery cover materials, or the use of acceptable barrier materials, compared with less than 10 percent of cover materials requiring such modifications under the staff's current draft proposed standard. Although the estimated net benefits of the 2001 draft small open flame standard are substantial, they are somewhat lower than total net benefits estimated for the staff's current draft standard. Moreover, the estimated costs of the alternative small open flame standard ($272 million) are about 55 percent higher than the staff's current draft proposal (about $176 million). The higher estimated costs of compliance of the draft small open flame standard would place greater burdens on all manufacturers, including smaller firms.

Unlike the staff's current draft proposal, the small open flame draft standard would require substantial production testing, which could disproportionately affect small upholstered furniture manufacturers with smaller production runs. Additionally, since up to 70 percent of upholstery fabric yardage could require FR treatments under the small open flame standard, there would be greater competition for the available fabric backcoating capacity. Smaller furniture and fabric producers, with smaller lots of fabrics to be treated, reportedly would be faced with difficulties in competing with larger firms for timely access to fabric finishing services for necessary FR treatments.

The higher manufacturing costs associated with the small open flame standard could also result in substantially higher average retail price increases for consumers than would result from the staff's current draft proposal. The greater increases in retail prices that might result from the small open flame standard could lead some consumers to delay the purchase of new furniture or lead them to buy less frequently, and could potentially result in secondary impacts on the sales of furniture components and industry employment. Such effects are likely to be more pronounced in the short run. While the impact of these price increases cannot be predicted with any certainty, the higher costs of the small open flame standard would likely have more pronounced effects.

In summary, the 2001 draft small open flame standard probably would have a more substantial and more disproportionate impact on small businesses than the staff's 2005 draft standard.

7.3. Adoption of the UFAC Voluntary Action Program as a Mandatory Standard

As an alternative to the staff's 2005 draft standard, the Commission could adopt the provisions of the UFAC Voluntary Action Program as a mandatory standard. The Upholstered Furniture Action Council, or UFAC, was formed by major furniture industry associations in 1974, largely as a response to prospective CPSC actions on upholstered furniture. The UFAC Voluntary Action Program was developed in the late 1970's and amended as "Phase 2" in 1983. Tests for decorative trim were added to the program in 1993. The program requires classification of upholstery cover fabrics into either "Class I" or "Class II," based on a cigarette ignition performance test. All conforming furniture must comply with specified construction criteria for welt cords, decking substrates, filling materials, and interior fabrics; and more cigarette ignition-prone Class II fabrics used with polyurethane foam seat cushions must have a barrier material between the fabric and foam that passes a barrier performance test. Conforming furniture is to be labeled with a UFAC tag.

The last market evaluation of conformance that the CPSC staff conducted occurred in 1996. At that time, based on ignition testing of chairs purchased by the CPSC, the staff estimated that about 90 percent of upholstered furniture may have been produced in conformance with the UFAC program (including a majority of units produced by firms that did not participate in the UFAC program). Although the UFAC program is designed to prevent the use of furniture components that may be more likely to lead to cigarette ignition of the finished items, the program is not designed to predict the ignition performance of all UFAC furniture. CPSC testing found that some chairs that conformed to the UFAC program ignited from cigarettes, and some nonconforming chairs resisted ignition. The findings illustrated that cigarette-ignition resistance of upholstered furniture is more dependent on the fabrics and filling materials used, rather than on conformance with all aspects of the UFAC Program.[17]

Costs of mandating the requirements of the UFAC program would likely be minimal. Perhaps the major program element associated with costs is the requirement for a smolder-resistant barrier to be used under Class II fabrics when the seat cushion core is standard urethane foam. The primary barrier material for this purpose under the UFAC program is polyester fiberfill cushion wrap. Based on analysis of market data, fewer than 5 percent of upholstered furniture items are currently produced with Class II fabrics. The great majority of the seat cushions on these items already are made

[17] Charles Smith, Directorate for Economic Analysis, CPSC, and Linda Fansler, Directorate for Laboratory Sciences, *Cigarette Ignition Propensity of Upholstered Furniture*, November 1996.

with polyester wraps, and, therefore, are conforming to the UFAC program. Incremental costs of using polyester wraps on all seat cushions covered with Class II fabrics could total less than $500,000.[18] Non-UFAC establishments surveyed in 1995 were found to be less likely than UFAC program participants to use heat-conducting welt cords in seat cushions. Welt cord that conforms to the UFAC program reportedly costs furniture manufacturers less than one cent more per yard, compared to comparable welt cord that does not conform to the UFAC program.[19] Incremental costs could be less than $.04 per seat cushion and $.07 or less per chair and $.15 or less per sofa, for items made with welt cord. Given what is believed to the current high conformance rate, and the absence of welt cord in a substantial portion of upholstered furniture styles, incremental costs to substitute UFAC-compliant welt cord might total less than $200,000.[20] Other costs associated changes in construction materials associated with the adoption of the UFAC program as a mandatory rule should be very minor. Incremental costs related to compliance enforcement should be lower than the $.20 per unit estimated for the 2005 staff draft standard, since materials are already subject to verification testing to qualify as acceptable materials under the UFAC program and manufacturers already incur labeling costs under the UFAC program. However, it is possible that somewhat higher recordkeeping costs could be one of the major cost elements of mandating the UFAC program, given the minor costs related to materials. Total costs of compliance for adoption of the UFAC program as a mandatory standard could be under $5 million.

Benefits that would result from mandating compliance with the UFAC program would also be much smaller than the benefits estimated for alternative performance standards discussed in this analysis. Most articles of furniture covered with smolder-prone fabrics and urethane foam are already manufactured with a barrier of polyester fiberfill. The cigarette-ignition resistance of nearly all upholstered items would not be significantly improved under this alternative. Although only a minimal reduction in the overall smoldering hazard (less than 1 percent) could result in positive net benefits, the expected net benefits of adoption of the UFAC program as a mandatory standard would be minimal, and substantially below any other alternative performance standards discussed in this analysis.

In summary, a mandatory standard based on the UFAC voluntary program would have a minimal impact on small businesses; much smaller than the staff's 2005

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[18] Based on the assumption that 5% of seat cushions with Class II fabrics (perhaps 150,000 cushions) would require polyester wraps.

[19] Bill Dotson, General Manager of welt cord manufacturer, Petco-Sackner, reported during an October 17, 2007, telephone conversation with Charles Smith, Directorate for Economic Analysis, that UFAC welt cord is sold to furniture manufacturers for $32 per 1,000 yard reel, versus $25 per 1,000 yards for similar non-UFAC welt cord.

[20] If current UFAC conformance is about 90% and about 55% of units are made with welt cord (based on 1995 survey of manufacturers), average incremental welt cord costs of about $.11 per item would be applied to approximately 1.7 million units annually, with aggregate costs of about $185 million.

draft standard. However, this regulatory alternative would not be expected to lead to a significant reduction in smoldering or open flame ignition hazards of upholstered furniture.

7.4. A Standard Based on the 2002 Proposed Draft Revisions to the California Furniture Regulation (TB117)

In February 2002, California's Bureau of Home Furnishings published draft revisions to the state's Technical Bulletin (TB117) that contains mandatory requirements for materials used in the manufacture of upholstered furniture sold in the state. As is the case with the CPSC staff's draft standard, the revised California draft standard specifies open flame and smoldering ignition tests for filling materials (including urethane foam and loose filling materials). However, unlike the staff's draft, the filling materials requirements apply to all furniture items, including those covered in ignition-resistant fabrics such as leather, wool and vinyl.

In addition tests for filling materials, the revised draft TB117 specifies a small open flame test for upholstery fabrics. The open flame test requires the 20 second application of a small open-flame to the crevice of a seat/back mock-up assembly of fabric over a standard flame-retardant polyurethane foam pad. The specimen fails if (1) weight loss exceeds 4 percent in the first 10 minutes, or (2) the specimen burns progressively before 10 minutes. The great majority of fabrics currently used by the furniture industry probably would require modification in order to comply with the draft TB 117 test. For purposes of evaluating the costs and benefits of this alternative, the Directorate for Economic Analysis assumes that about 62 percent of all furniture items produced would be covered in fabrics that would have to be treated in order to pass the fabric test specified in the revised draft TB177. Non-complying fabrics are assumed to include one-third of the severely ignition-prone cellulosic fabrics (covering about 1 million furniture items) in addition to all of the moderate- and lower-ignition prone cellulosics and thermoplastic cover materials (covering about 18 million furniture items annually) would fail the open flame fabric test and have to be treated. Thus, a total of about 19 million units of furniture would be covered in fabrics that would have to be treated in order to comply with the revised draft TB117. The midpoint of the estimated range of fabric treatment costs is about $7.83 per item of furniture. Therefore, the aggregate costs of the FR treatment of fabrics might amount to about $151 million ($7.83 per item x 19.3 million items).

The per-unit costs of treating urethane foam and loose filling materials could be similar to those estimated for the standard drafted by the CPSC staff. Consequently, the filling materials costs per item of furniture might amount to about $5.85 per unit. Since the filling materials requirements of the revised draft TB117 would apply to all furniture items produced (including items using ignition resistant cover fabrics, the total filling materials costs would amount to about $178 million ($5.85 per unit x 30.5

million units). It is also possible that additional costs would be required to treat fibrous filling materials under the revised draft TB117, since the open flame test for that material could be more stringent than that drafted by the CPSC staff.

The combined costs of treating the filling materials and fabrics under the revised draft TB117 could amount to about $330 million annually or more ($178 million or more for filling materials and $151 million for fabrics). The associated compliance and distribution costs could bring the total up to about $370 million annually. This would be more than double the estimated costs of the CPSC staff's 2005 draft standard, estimated at about $176 million. The higher estimated costs of compliance of a standard based on the revised draft TB117 regulation would place greater burdens on all manufacturers, including smaller firms.

Additionally, since about 60 percent of upholstery fabric yardage could require FR treatments in order to comply with the open flame fabric test of the revised draft TB117, there would be greater competition for the available fabric backcoating capacity. As was reported to be likely with the 2001 CPSC draft open flame standard, smaller furniture and fabric producers, with smaller lots of fabrics to be treated, could be faced with difficulties in competing with larger firms for timely access to fabric finishing services for necessary FR treatments.

The higher estimated manufacturing costs associated with the revised draft TB117 could also result in substantially higher average retail price increases for consumers than would result from the staff's current draft proposal. The greater increases in retail prices that might result from a standard based on the revised draft TB117 could lead some consumers to delay the purchase of new furniture or lead them to buy less frequently, and could potentially result in secondary impacts on the sales of furniture components and industry employment. Such effects are likely to be more pronounced in the short run. While the impact of these price increases cannot be predicted with any certainty, the higher costs of a standard based on the revised draft California furniture regulation would likely have more pronounced effects.

In summary, a standard based on the revised draft California furniture flammability regulation, TB117, probably would have a more substantial and more disproportionate impact on small businesses than the CPSC staff's 2005 draft standard. The Directorate for Economic Analysis estimates that the greater burden would not result in higher benefits than the CPSC draft standard, and estimated net benefits from one year's production of upholstered furniture under the regulatory alternative are more than $200 million lower than the net benefits estimated to result from the CPSC staff's 2005 draft standard.

7.5. Alternative Effective Date

Section 4 of the Flammable Fabrics Act states that standards or regulations shall become effective twelve months from the date of promulgation, unless the Commission finds that a different effective date is in the public interest. Because of the need for FR treatment of some fabrics used in the manufacture of furniture and the fact that furniture manufacturers carry stocks of fabrics, a longer period before the rule becomes effective, such as 18 months, could provide some firms (including smaller firms) additional time to use inventories of fabrics that would not pass the draft standard's fabric test without FR treatment. However, given the small percentage of fabrics that will need to be treated (under 10 percent), it seems unlikely that setting an effective date of 12 months from the date of promulgation will substantially burden firms.

Additionally, several options might be available to furniture manufacturers (including smaller firms) that have fabric that does not comply with a regulatory alternative adopted by the CPSC as the effective date for the action approaches. They might send the remaining fabric yardage to contract finishers for backcoating with FR chemicals. They could use FR barrier materials beneath the untreated fabric, as allowed by that alternative method of compliance with the standard. Also, they might sell the fabric to jobbers who would market it to furniture manufacturers that use FR barriers with untreated upholstery fabrics and for other end-uses that are not within the scope of the regulation.

Compliance with the staff's 2005 draft proposed standard would also require manufacturers and suppliers of urethane foam, polyester fiberfill, cotton batting, and other materials to provide materials that meet the relevant smoldering and open flame material tests so that they would be available for use by furniture manufacturers within 12 months of the date of promulgation of the rule. Current processes and capacities used by the manufacturers of urethane foam and cotton batting to meet mandatory flammability requirements of California and other jurisdictions, and voluntary standards such as the UFAC program, are expected to be adequate to produce sufficient quantities of urethane foam and cotton batting for use by the furniture industry under the proposed rule. Additionally, it seems likely that suppliers of polyester cushioning materials and furniture manufacturers will be able to develop products and processes that will enable the use of polyester-based cushioning materials within that period.[21]

In summary, smaller businesses are not expected to face significant impacts attributable to an effective date of 12 months after the date of promulgation.

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[21] Options that should be available to manufacturers include blending FR fibers with polyester, using alternative fiber treatments, and using fire resistant interliner materials to encase loose filling materials.

7.6. Adoption of a Labeling Rule

The Commission could also require hazard information to be presented on labels in addition to, or in lieu of, a standard. The costs of labeling would be just a few cents per item (based on reported labeling costs under the UFAC Voluntary Action Program and estimates provided by a manufacturer), and thus, should not present significant costs to small furniture manufacturers. However, the impacts of such labeling on product safety are likely to be minimal. Labeling that warns of cigarette ignition hazards probably would not be effective, because labels are unlikely to be seen by consumers when the upholstered item is in use, and because there already is public awareness of these hazards. Additionally, a warning label would not be likely to prevent fires started by children playing with lighters and matches, who are unlikely to read, or be affected by, the statements provided.

7.7. Relying on a Voluntary Standard

If the Commission does not adopt a mandatory rule to address furniture flammability from both smoldering and open flame ignition sources it is possible that a voluntary standard (perhaps through modifications to the existing UFAC Voluntary Action Program) could be developed based on the CPSC staff's 2005 draft standard or one of the other alternatives to address these hazards. There is no such voluntary effort currently underway. Moreover, the effort begun in 1996 through ASTM to establish a voluntary standard is currently inactive. Furthermore, comments submitted in response to the October 23, 2003, ANPR representing all segments of the affected industries supported mandatory federal regulation to address upholstered furniture flammability.

7.8. Taking No Action

The Commission could determine that no rule is reasonably necessary to reduce the risk of fires associated with cigarette and small open-flame ignitions of upholstered furniture. Under this alternative, future societal losses would be determined by factors that affect the likelihood that ignition sources come in contact with upholstery and the ignition resistance of upholstery materials used by furniture manufacturers. For example, the apparently increasing use of ignition-resistant upholstery materials, such as leather, could reduce fires over time. Also, the state of California might adopt the draft revisions to its mandatory standard for upholstered furniture. Those revisions could result in reduced fire losses in that state, which accounts for perhaps 15 percent of the furniture market. Some furniture manufacturers might use materials that comply with some or all provisions of the California revised standard for all of their furniture production, which could reduce fire losses in other areas. Additionally, other political jurisdictions could impose requirements that would reduce future losses from furniture fires.

Factors other than furniture materials will also determine fire losses in the future. Some of these will tend to increase future losses (such as projected annual increases of about 1 percent in population and households) and others might decrease future losses (such as continued reductions in rates of smoking and alcohol consumption, increasing smoke alarm operability, information and education efforts, and installation of sprinkler systems in new construction).

Particularly noteworthy is the expected growth in the availability of cigarettes that reduce the probability of igniting upholstered furniture. Effective on June 28, 2004, the State of New York required all cigarettes sold in the state to self-extinguish if they are left unattended. Such cigarettes are expected to reduce greatly, but not eliminate, residential fires started by cigarettes. Similar legislation became effective in Vermont in 2006 and California and Oregon in 2007, and has been signed into law in 18 other states, with effective dates ranging from October 1, 2007, to January 1, 2010. Legislation has also been introduced in nine other states. By 2010, more than half of the U.S. population will be living in states with mandatory laws addressing the ignition propensity of cigarettes.[22]

As noted in Section 7.7, if the Commission does not adopt a mandatory rule to address furniture flammability from both smoldering and open flame ignition sources it is possible that a voluntary standard (perhaps through modifications to the existing UFAC Voluntary Action Program) could be developed based on the CPSC staff's 2005 draft standard or based on some other alternative. However, no such voluntary effort is currently underway. Moreover, the effort begun in 1996 through ASTM to establish a voluntary standard is currently inactive. Furthermore, comments submitted in response to the October 23, 2003, ANPR representing all segments of the affected industries supported mandatory federal regulation to address upholstered furniture flammability.

Thus, while furniture fires might decline with no CPSC action, there is no reason to believe that the decline would approach the proportion of fire losses that could be prevented with the staff's 2005 draft standard or any of the other performance standard alternatives described in this analysis.

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[22] Coalition for Fire-Safe Cigarettes, Legislative Updates. www.firesafecigarettes.org (referenced on September 19, 2007)