



UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

VOTE SHEET

Date: January 13, 2006

TO : The Commission
Todd Stevenson, Secretary

FROM : Page C. Faulk, General Counsel ^{PCF}
Patricia M. Pollitzer, Attorney ^{FMP}

SUBJECT : Final Rule for the Flammability (Open Flame) of Mattress Sets

The attached staff briefing package recommends that the Commission issue a final flammability rule for mattress sets. The draft text of the rule and a draft preamble appear at Tab G of the briefing package.

Please indicate your vote on the following options.

- I. Approve the draft regulatory text and preamble for the mattress flammability rule for publication in the *Federal Register* as drafted.

Signature

Date

- II. Approve the draft regulatory text and preamble for the mattress flammability rule for publication in the *Federal Register* with the following changes (please specify):

Signature

Date

NOTE: This document has not been reviewed or accepted by the Commission.

Initial PCF Date 1/13/06

1/13/06
RULES AND REGULATIONS
WITH PORTION OF...

III. Do not approve the draft regulatory text and preamble for the mattress flammability rule for publication in the *Federal Register*.

Signature

Date

IV. Take other action (please specify):

Signature

Date

Attachment: Briefing memorandum from Margaret Neily, Project Manager, Directorate for Engineering Sciences, to the Commission, "Final Rule for the Flammability (Open Flame) of Mattress Sets," January 13, 2006.



BRIEFING PACKAGE

FINAL RULE FOR THE FLAMMABILITY (OPEN FLAME) OF MATTRESS SETS

For Further Information Contact:
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EXECUTIVE SUMMARY

On January 13, 2005, the U.S. Consumer Product Safety Commission (CPSC) published a notice of proposed rulemaking (NPR) requesting public comments on a proposed standard for mattresses and mattress and foundation sets to address mattress/bedding fires ignited by open flame sources. These fires result in significant deaths, injuries, and property loss and are not addressed by the current standard requiring mattresses to be resistant to cigarette ignition (16 CFR Part 1632). If finalized, the new open flame mattress standard would be codified at 16 CFR Part 1633.

The CPSC staff's evaluation of in-depth investigations of fire incidents and currently marketed mattresses supports the conclusion that a standard minimizing the possibility of or delaying time to flashover from an open flame mattress fire could be effective in reducing major fire losses. The staff believes it is feasible to limit the size of mattress fires to the extent that 240 to 270 civilian deaths (69-78 percent) and 1,150-1,330 injuries (73-84 percent) presently occurring in addressable mattress/bedding fires attended by the fire service could be potentially eliminated annually.

The staff's draft final standard incorporates a test method demonstrated to measure mattress performance in order to provide this level of protection. The staff's draft standard has two performance criteria that limit fire growth. The mattress sets must not exceed a 200 kilowatts (kW) peak heat release rate within the 30 minutes of the test, and the total energy released must be no more than 15 megajoules (MJ) for the first 10 minutes of the test. Materials that can be used as fire barriers to produce comfortable, practical, and reasonably priced mattresses with significantly improved fire performance are commercially available. Since California's mattress flammability standard, TB 603, became effective January 1, 2005, mattress sets that meet the staff's draft standard have been marketed in California and nationwide.

The staff reviewed public comments on the proposed standard and conducted additional mattress tests and evaluations to address those comments. As a result, the staff made a number of changes and clarifications to definitions, test equipment, test procedures, and recordkeeping provisions. A requirement for a separate, permanent label has been added to convey critical safety information to consumers and to standardize manufacturer and importer information.

A major concern of consumers commenting on the proposed standard is the use of flame retardant (FR) chemicals in mattresses. At the time the staff conducted its preliminary qualitative assessment for the proposed standard, data on potential exposures to FR chemicals used in mattresses did not exist. Since then the staff has conducted a quantitative risk assessment to provide a more accurate estimate of the potential risk to consumers associated with exposures to these FR chemicals/chemical classes in commercially-available FR-treated barriers that may be used by mattress manufacturers to meet the draft final flammability standard. Results of the quantitative risk assessment indicate that there are a number of commercially available FR-treated barriers that can be used to meet the staff's draft final mattress flammability standard. These chemicals are

not expected to pose any appreciable risk of health effects to consumers who sleep on treated mattresses.

As indicated in the staff's earlier environmental assessment and confirmed in the updated environmental information, manufacturers appear to have a number of alternatives for meeting the staff's draft final standard that will not result in unacceptable adverse impacts to human health or the environment. 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 flame retardants if they are ever found to pose unacceptable adverse impacts to human health or the environment.

Based on the final regulatory analysis, the expected benefits of the staff's draft final standard are substantially greater than the costs. A sensitivity analysis of the cost-benefit findings showed that the results of the analysis were not altered when the underlying assumptions were varied within reasonable ranges; net benefits remained positive. The regulatory analysis also considered alternatives to the draft final standard; none was shown to increase net benefits. The analysis suggests that an effective date of the earlier of January or July that follows the date twelve months after publication of the *Federal Register* notice would be reasonable. This date would coincide with regular model/style introduction cycles and thus make it easier for all producers, especially small producers outside of California who are not already producing complying mattresses, to update their styles and produce complying mattress sets.

The staff recommends that the Commission approve issuance of a mandatory flammability standard for mattress sets, as set forth in the staff's draft final standard. The staff recommends that the effective date for the standard be set at the earlier of January 1 or July 1 following the date twelve months after publication of the *Federal Register* notice.



United States
CONSUMER PRODUCT SAFETY COMMISSION
 Washington, D.C. 20207

MEMORANDUM

DATE: January 13, 2006

TO : The Commission
 Todd Stevenson, Secretary

Through: Page Faulk, General Counsel *PF*
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FROM : Jacqueline Elder, ^{1c} Assistant Executive Director
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SUBJECT: Final Rule for the Flammability (Open Flame) of Mattress Sets

I. INTRODUCTION

This memorandum discusses the U.S. Consumer Product Safety Commission (CPSC) staff's draft final standard for mattress flammability (open flame), additional research, updated supporting materials, and responses to major public comments on the CPSC's January 13, 2005, Notice of Proposed Rulemaking (NPR).¹ The staff's recommended draft final standard and suggested effective date are included in the package for Commission consideration.

II. BACKGROUND

In 2001 the Commission began rulemaking to address mattress/bedding fires initially ignited by a small open flame. While existing standards initially appeared to address the hazard, they lack adequate test requirements, conditions, or a clear relationship to typical residential fire scenarios. A more appropriate test method was needed, and the ongoing, coordinated standards development research supported by the industry, CPSC, the National Institute of Standards and Technology (NIST), and the California Bureau of Home Furnishings (CBHF) continued. On January 1, 2005, California's Technical Bulletin (TB) 603 requirements for mattresses, based upon the jointly developed test

¹ Superscripts designate references at the end of this memorandum.

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method, became effective. On January 13, 2005, the Commission published an NPR requesting public comments on a proposed standard for mattresses and mattress and foundation sets (also based upon the NIST test method) to address mattress/bedding fires ignited by open flame sources.¹ These fires result in significant deaths, injuries, and property loss and are not addressed by the current standard requiring mattresses to be resistant to cigarette ignition (16 CFR Part 1632).

An analysis of comments received during and after the comment period and staff responses are provided later in this package. Fire safety experts, test laboratories, industry representatives, and government commenters generally supported the proposed rule. They provided a number of suggestions for improving and clarifying portions of the standard's requirements and test procedures. Consumers expressed concerns about the health effects of using flame retardant chemicals in these products. In 2005 CPSC staff conducted additional mattress tests and evaluations, in-house, at the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF), and at NIST, in order to respond to these comments.

Throughout this package, the term "proposed standard" refers to CPSC's proposed standard published in the *Federal Register* for public comment in January 2005. The "staff's draft final standard" refers to the staff's current recommendation, incorporating changes based on the public comments and additional technical evaluations.

III. UPDATED EVALUATIONS AND ANALYSES

A. Updated Incident Data and Hazard/Effectiveness Evaluation (TAB A)

1. Current National Estimates

Estimates of mattress and bedding fires attended by the fire service are based on the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS) data and the National Fire Protection Association's (NFPA's) annual survey. Several of the NFIRS data variables were used to determine whether an incident was a mattress or bedding fire, determine an incident's addressability by the draft final standard, identify intentional fires (excluded from the estimates), determine a fire's heat source type (smoking materials, small open flame, other), and break down estimates based on age and location of the victim. The methodology used for editing the data and determining addressability is described in detail in **TAB A**.

The most recent national fire loss estimates indicate that mattresses and bedding were the first items to ignite in 15,300 residential structure fires attended by the fire service annually during 1999 – 2002. These mattress and bedding fires resulted in an estimated 350 civilian deaths, 1,750 civilian injuries, and \$295.0 million in property loss annually. Based solely on the characteristics of the fire cause, an estimated 14,300 fires causing \$281.5 million in property loss annually were considered **addressable** by the draft final standard. The estimated 330 deaths and 1,680 injuries that occurred in these fires

annually are considered potentially preventable by the standard. Among the addressable casualties, smoking fires accounted for 180 deaths (55 percent) and about 520 injuries annually (31 percent). Open flame fires accounted for about 110 deaths (33 percent) and 890 injuries annually (53 percent).

These updated fire loss estimates differ from those previously referenced in the NPR.¹ The methodology used for the current estimates repeats the methodology used for the estimates presented in the NPR briefing package² with minor changes to accommodate the availability of later years of data and a substantially revised data collection system.

2. Effectiveness of the Draft Final Standard

The staff evaluated the effect of the draft final standard on the mattress/bedding fire casualties described above. Since the standard is designed to limit fire intensity and spread rather than prevent mattress ignition, the analysis focused on the reduction of deaths and injuries, not reduction of the number of fires. While it is expected that property damage will also be reduced, it is not possible to provide an estimate of the extent of that reduction. With only minor changes, the methodology used for this update repeats the methodology used for the estimate of effectiveness developed for the proposed standard.³

3. Updated Estimates of Death and Injury Reductions

Taking into account more recent years of fire loss data and the fire performance of new mattress designs in the market (**TAB B**), the staff now estimates that the draft final standard may be expected to prevent 69 to 78 percent of the deaths and 73 to 84 percent of the injuries presently occurring in addressable mattress/bedding fires attended by the fire service. These percentage reductions were calculated using NFIRS/NFPA estimates from 1999 – 2002. Applying estimated percentage reductions to the most recent available estimates of **addressable** mattress/bedding fire losses (NFIRS/NFPA for 2000 – 2002, extrapolated to NFPA totals only for 2003 – 2004, **TAB A**), an estimated 240 to 270 deaths and 1,150 to 1,330 injuries resulting from mattress and bedding fires could be prevented annually by the draft final standard. The ranges of percentage reductions cited here reflect the ranges of assigned probabilities attached to the general categories of “likely,” “possible,” and “unlikely” used to estimate the numbers of deaths and injuries remaining, as developed by the CPSC staff and described in **TAB A**. They do not represent statistical confidence intervals.

B. Market Information (TAB C)

There were 522 mattress manufacturing firms and 607 mattress establishments in 2002, according to the Statistics of U.S. Businesses, Census Bureau data. All but the largest 12 firms had fewer than 500 employees, and more than half of mattress firms had fewer than 20 employees. (**TAB C**, Tohamy, Regulatory Flexibility Analysis) The top 4 and top 15 manufacturers accounted for about 57 percent and 83 percent of the total value of

mattress wholesale shipments in 2004, respectively. The industry estimates that 25.6 million mattresses were produced domestically in 2005. (TAB C, Karels)

More than 80 percent of total annual mattress shipments are adult-sized “conventional” sleep surfaces. The remainder consists of “non-conventional” sleep surfaces, including futons, crib/juvenile mattresses, sleep sofa inserts, and hybrid water bed mattresses. In 2004 imports represented 4.8 percent of shipments. There has been a gradual shift in consumer preference to larger mattresses (queen, king). As much as 80 percent of current production of mattresses is one-sided (one sleep surface), a trend attributed by industry to new California and proposed CPSC flammability regulations and increased competition from imports. This trend is expected to continue. At least 25 percent of the current U.S. mattress production complies with California’s TB 603, a standard similar to the staff’s draft final standard. (TAB C, Karels)

C. Mattress Performance and Test Evaluations

The staff’s draft final standard is designed to minimize or delay flashover from mattress ignition in typical fire scenarios. The technical rationale for the proposed standard² is briefly described and supplemented in TAB B to support the staff’s draft final standard. The performance criteria specified in the staff’s draft final standard are intended to effectively reduce the risks associated with mattress fires since the hazards are closely associated with peak rate of heat release and total energy. A mattress with a limited contribution to the fire, especially early in the fire, will substantially increase the available time for occupants to discover the fire and escape and, therefore, substantially reduce the current risks associated with mattress fires.

The staff’s draft final standard requires a full-scale test of mattress sets to determine their flammability, using a pair of T-shaped gas burners designed to represent burning bedclothes. The draft final standard limits the peak heat release rate to 200 kilowatts (kW) for a mattress set, not to be exceeded at any time during a 30 minute test, and limits the total heat release to 15 megajoules (MJ) for the first 10 minutes of the test.

Additional test work was conducted to explore the technical issues raised in the NPR public comments and provide technical support for the staff’s draft final standard. CPSC contracted with NIST to conduct a series of tests to evaluate the heat flux of different burner hole sizes, effects of temperature and relative humidity conditions, flammability behavior of one-sided mattresses, and the effects of flame retardant durability on the fire performance of selected flame resistant barriers.

1. Interlaboratory Study

An inter-laboratory study or precision and bias (P&B) study was conducted earlier² to explore the sensitivity, repeatability, and reproducibility of the NIST test protocol specified in the proposed standard (also the basis for California TB 603 requirements). The study, a “test of the test,” was designed to evaluate the robustness and validity of the test protocol, rather than the performance of specific mattress designs.⁴

A detailed statistical analysis of the test data suggests neither unreasonable sensitivities nor practical limitations of the NIST test protocol. The results were not affected by the varying range of parameters (primarily associated with possible test facility and operator errors) selected for the sensitivity study, suggesting that tighter controls of these factors (e.g. gas flow rate) are not necessary. The data indicate that the specified ignition source is severe enough and the test duration long enough to allow a valid/realistic evaluation of mattress set performance.

The data showed some significant differences in the test results reported by the participating laboratories, and a variety of factors possibly influenced these differences. However, the study suggests that, when the test procedures are correctly followed, it is the combined characteristics and resulting behavior of the mattress components chosen, mattress design, and consistency of the manufacturing processes that determine the test outcome. Observations from the study emphasize the importance of controlling components, materials, and methods of assembly. Quality assurance procedures, standardized testing, written records, and visual inspections are all options for assuring, verifying, and controlling consistency of production. Accordingly, these controls have been incorporated in the staff's draft final standard. Environmental conditions required for tests have also been tightened in the standard. Training for laboratory staff conducting these tests would be beneficial for developing the necessary expertise for this sophisticated performance evaluation.

2. Burner hole size (TAB B)

In 2000 NIST developed a pair of propane gas burners to consistently simulate the typical heat impact imposed on a mattress by burning bedding items. The burner designs were based on test data collected from a NIST study that characterized burning bedclothes. These burners were incorporated as the ignition source in the full-scale fire test for mattresses.

A commercial version of the NIST burner apparatus was manufactured by a commercial supplier to the mattress industry and used by various test laboratories to conduct full-scale mattress testing in accordance with TB 603 and CPSC's proposed standard. This version of the apparatus incorporated several refinements; inadvertently, the commercial version incorporated larger diameter holes in both of the burner heads (1.50 mm vs. 1.17 mm). The difference in hole size implies differing emerging gas flow velocities, distances of the gas jets reaching out from the burner, and heat fluxes between the two burners.

To determine the effects of the larger diameter burner holes on peak burner heat flux, NIST made heat flux scans on the original and commercial propane gas burners. The flux scanning apparatus used to compare the two burner holes was not available at the time the burner was developed. The goal was to measure and compare the peak flux of the burners relative to the specified peak fluxes seen in the earlier NIST study that characterized bedclothes and supported the burner development. The results of the comparison show that the burners with the larger holes do a better job of meeting the

target peak flux levels of bedclothes than do the original burners with the smaller holes (Ohlemiller/NIST, 2005), supporting continued use of the commercial version of the NIST burner apparatus rather than the original. The proposed standard specified the original NIST burner holes; the draft final standard, however, requires the burner holes used in the commercial versions.

3. Temperature and humidity effects

NIST explored the effects of laboratory relative humidity on mattress performance when tested in accordance with the proposed standard. The proposed standard requires all test samples to be conditioned in an environment with controlled temperature and relative humidity for a specific time period prior to testing. The samples are to be removed from the controlled storage conditions and tested. However, the laboratory test area conditions may be significantly different from the sample storage conditions. The test area conditions and time the sample is exposed to these conditions are likely to impact the flammability behavior and test results of mattresses.

NIST estimated the likely consequences of changes in ambient humidity and temperature on mattress flammability based on the moisture regain properties of common mattress component materials over time. The study focused on the impact of humidity on hydrophilic materials, those able to absorb water. Since water has a high heat capacity, the ability of certain materials to absorb significant amounts of moisture has the potential to significantly impact flammability behavior. The flammability behavior of hydrophobic materials, those unable to absorb water, would not be influenced by changes in humidity.

NIST concluded that relative humidity levels above about 75 percent and temperatures approaching 30°C (86°F) are likely to impact heat release rate measurements as a function of time for some mattress designs, especially those containing hydrophilic materials. NIST found that the time the sample is exposed to such conditions is a contributing factor and should be minimized, preferably to no more than 20 minutes. Based on this research, the staff added requirements to the draft final standard for test area environmental conditions and for the time allowed to begin each test once the test sample has been removed from the conditioning room. The conditioning room requirements have also been tightened to require a temperature greater than 18°C (65°F) and *less than 25°C (77°F)*.

4. Updated estimates of the standard's effectiveness (TAB B)

The staff's original effectiveness estimates were based upon full-scale tests of experimental mattress designs incorporating strong, but not necessarily cost-effective barrier systems. These mattress tests were conducted with burning bedclothes so that the fires produced could be used to estimate changes in deaths and injuries expected to result from the standard.² In the past few years, mattress designs and materials have evolved with manufacturers now producing mattresses to meet California TB 603. New fire barrier products have been introduced, mattress designs have been more closely

engineered to achieve the required performance, and single-sided mattresses have become an increasingly larger and more significant portion of the residential market.

For studying these new mattresses, the staff chose a single-sided mattress design made with an increasingly popular barrier technology, considered to be representative of those now entering the market. In burner tests of these mattresses, a small split developed in the crevice of the pillowtop section, but the mattresses met the performance criteria of the proposed standard. While they cannot reproduce all of the effects in the same amount of time, the test burners, as specified in the draft final standard, are designed to be a reasonable representation of a set of burning bedclothes.² Actual burning bedclothes could allow splits to occur more quickly, increasing the chance that flames could enter the mattress. Nevertheless, these complying mattresses represent a significant improvement in performance compared to traditional mattress designs and will substantially increase the available time for occupants to discover the fire and escape.

To evaluate the performance of single sided mattresses, NIST examined this single-sided mattress design using an actual set of burning bedclothes. The mattress design was tested in three foundation conditions: (1) aligned on top of its intended foundation (baseline tests), (2) on top of a misaligned foundation, and (3) on top of a completely unprotected foundation made of traditional materials. Tests of these mattresses conducted with bedclothes resulted in fires in all three conditions involving both the mattresses and foundations. Although, this made observations that could be attributed specifically to the one-sided design in these conditions nearly impossible, it suggests that the use of a single-sided mattress on an unprotected foundation could pose an increased hazard. The label required in the staff's draft final standard will help to inform consumers that the correct foundation is needed to ensure the safety provided by the standard.

These tests also showed that, when mattresses are closely designed to the performance requirements, as is expected as the industry develops their new products, flashover conditions could occur earlier than previously measured with experimental and initially over-engineered designs. The staff accounted for this observed behavior by reducing the effectiveness estimates for the staff's draft final standard, adjusting for the effect on some occupants, especially those with limiting conditions outside the room of origin. **(TAB A)** The draft final standard's limit on the early contribution of the mattress to the fire will help to maintain tenable conditions early in the fire and allow for timely discovery and escape from growing fire conditions.

5. Flammability performance (durability) of selected flame retardant barriers (TAB B)

The need for materials that are flame resistant and exhibit improved flammability performance to meet the proposed standard has spurred improvements in manufacturing, innovations in technologies, and the development of new products. Some components and barrier materials, being used by major mattress manufacturers to meet California's TB 603 standard, incorporate water soluble fire retardants. Concerns have been raised by commenters regarding the ability of these FR chemicals to remain effective after

exposure to water, urine, or other liquids. The staff conducted additional research on this issue.

The CPSC staff developed a conditioning protocol with exposure cycles representing a bed-wetting scenario, anticipated to be a likely and compromising water exposure to a mattress. A description of the procedures used for wetting and drying and results of the staff's FR chemical content analysis of the two test mattress designs is provided in **TAB B** (Cobb). NIST examined the fire performance of two mattress designs that incorporated barrier materials/systems utilizing different inorganic compounds that are both somewhat water soluble. The inorganic compounds include boric acid/borax combinations and ammonium polyphosphate. Both designs were tested in accordance with the proposed standard before and after 10 repeated cycles of localized wetting and drying.

In this limited evaluation, the effects of repeated wetting and drying cycles did not change the flammability performance of the mattress sets. Both designs showed localized, persistent smoldering in the exposed areas. For the design containing a borate treated system, despite the smoldering, the repeated wetting exposures had no significant consequences on overall fire growth. No open flaming was observed in tests of the borate treated mattress design within the 30 minute test time.

The design using an ammonium polyphosphate treated system also showed no significant consequences from the repeated wetting cycles in NIST tests. The smoldering, however, was more pronounced and transitioned into flaming in two cases. The limited testing of this design suggests that this behavior could allow the interior of the mattress to become involved earlier. A producer of ammonium polyphosphate barrier products also conducted flammability tests of a different mattress design, using a different protocol and exposure to synthetic urine. Their mattress sets met the performance criteria of the proposed standard both before and after wetting cycles. (**TAB B**)

All of the samples tested by NIST passed the early total heat release requirements of the proposed standard. The exposure to water was localized; and, even if the exposed area has decreased fire resistance, the tests suggest that the remainder of the mattress should retain its improved flammability performance, especially the performance expected early in the fire. Since localized wetting is anticipated to be the most likely, and perhaps most severe, exposure of a mattress to deeply penetrating water in actual use, currently available data do not suggest it is necessary to modify the requirements to include a test for durability in the staff's draft final standard.

6. Test procedure issues involving various mattress products

The CPSC staff conducted tests of a variety of mattress products, including futons, crib mattresses, foam-core mattresses, flip chairs, sofa bed mattresses, bunk bed mattresses, and air mattresses, to support refinements in the proposed test procedure. These tests identified the need for eliminating air gaps between some test specimens and the frame support. This issue has been addressed in the test procedure of the staff's draft final standard. Because mattress geometries vary widely, the function of the platen, which is

to ensure the alignment of the mattress and foundation, needed to be clarified in the draft final standard. Sizing and construction of the support frame and positioning of the side burner have also been clarified to accommodate such mattress products. (TAB B, Porter)

D. Potential Health Issues Associated with Flame Retardant Use (TAB D)

In the 2004 NPR briefing package, the staff reported on its preliminary qualitative assessment of the potential risk of health effects from exposure to flame retardant chemicals that may be incorporated in mattresses to meet the proposed standard. Five flame retardant (FR) chemicals/chemical classes (i.e., antimony trioxide, boric acid/zinc borate, decabromodiphenyl oxide, melamine, and vinylidene chloride) were reviewed.² At the time, data on potential exposures to FR chemicals used in mattresses did not exist. Since that time, the staff has conducted a quantitative risk assessment to provide a more accurate estimate of the potential risk to consumers associated with exposures to these FR chemicals/chemical classes in commercially-available FR-treated barriers that may be used by mattress manufacturers to meet the proposed flammability standard.

To quantify the amount of FR chemical(s) that may be released from the barriers, the staff conducted migration/exposure assessment studies on selected FR-treated mattress barriers. These barriers were treated with a variety of FR chemicals including: antimony trioxide (AT), boric acid, decabromodiphenyl oxide (DBDPO), melamine, ammonium polyphosphate, and vinylidene chloride. The exposure studies were conducted in three sequential phases to estimate exposures from dermal absorption, ingestion, and inhalation. The staff measured the total amount of FR chemical present in the barrier and the potential migration of the FR chemical(s) in the barrier to a surrogate material for skin, to estimate dermal absorption. Tests were also done to determine the amount of FR chemical that may be ingested. Finally, the airborne particle-bound release of the FR chemical(s) from the barrier during tests simulating normal use over 10 years was used to estimate potential inhalation exposures. The staff also conducted limited aging studies to assess the effects of environmental factors, such as heat and humidity, on the release of airborne particle-bound FR chemicals.

The staff quantitatively assessed all applicable routes of exposure (i.e., dermal, oral, and inhalation) for the FR chemicals for which migration/exposure data were available and determined the potential risk associated with exposure to these FR chemicals. The analysis included estimates of average exposure, as well as the reasonable upper bound exposures. Staff evaluated potential exposure through all three routes combined, as well as individually. The staff's studies and analyses applied conservative assumptions in areas of scientific uncertainty, that is, assumptions that tend to overestimate exposure and risk. The results of these quantitative measurements and associated test procedures and the methodology for estimating exposure and calculating risk are described in **TAB D** (Thomas and Brundage). The risk assessment report was peer reviewed by outside scientists, and staff responses to the peer reviewer's comments are also in **TAB D** (Thomas and Brundage).

Based on this risk assessment, the staff concludes that AT, boric acid, and DBDPO would not present any appreciable risk of health effects to consumers who sleep on treated mattresses. The estimated hazard index values for these compounds are all less than one under all exposure conditions. In addition, detectable concentrations of vinylidene chloride were not found in the staff's initial extreme extraction studies; thus, it is considered unlikely that significant quantities of this compound will be released from mattress barriers. Since melamine and ammonium polyphosphate do not satisfy the FHSA definition of "toxic", these compounds are also not expected to present any appreciable risk of health effects to consumers and, therefore, were not tested extensively.

The results of this exposure and risk assessment of the selected FR treatments suggest that there are a number of commercially available FR-treated barriers that can be used to meet the staff's draft final standard that are not expected to pose any appreciable risk of health effects to consumers who sleep on treated mattresses.

E. Environmental Update (TAB C)

In considering the potential environmental and human health effects of the staff's draft final mattress flammability standard, Commission staff looked at the currently available technology for manufacturers to meet the standard's performance criteria, as well as the expected life cycle of a mattress and foundation (bed set). It is expected that most manufacturers will use flame resistant barrier materials to protect interior components with the greatest combustible fuel load from exposure to an open flame. Flame resistant barriers for mattresses may take several forms, including ticking fabrics, woven and non-woven interlinings, and battings. These barriers will be made with an inherently flame resistant fiber (e.g., para-aramid or fiberglass) or by treatment with flame retardant chemicals (e.g., boric acid, ammonium polyphosphate, or decabromodiphenyl ether).

Manufacturers will have flexibility in meeting the performance requirements of the standard; thus the extent to which each of the various FR chemicals and other alternatives for meeting the standard (e.g., inherently flame-resistant materials) will be used is uncertain. There are some data gaps and uncertainties in our knowledge of some of the health and environmental impacts of some of the chemicals that could be used to meet the standard. However, there are FR chemicals and flame resistant materials that, based on CPSC staff testing and other available data, are not expected to pose unacceptable risks to the environment and are widely used in other applications. These are already in use to meet California TB 603 and include melamine, vinylidene chloride, decabromodiphenyl ether, antimony trioxide, boric acid, and ammonium polyphosphate. Therefore, manufacturers have an increasing number of alternatives for meeting the draft final standard that are not expected to result in unacceptable adverse impacts to the environment or human health.

F. Final Regulatory Analysis and Regulatory Flexibility Analysis

The *Final Regulatory Analysis of Staff's Draft Final Standard to Address Open-Flame Ignitions of Mattress Sets*, found at **TAB C**, discusses the benefits and costs associated with the staff's draft final standard and other options to address mattress fire safety. The *Final Regulatory Flexibility Analysis for Staff's Draft Final Standard to Address Open-Flame Ignitions of Mattress Sets*, also found at **TAB C**, reviews the potential economic impact on small entities, including small businesses. It describes significant alternatives to the draft final rule that were considered to accomplish the stated objectives of the rulemaking while minimizing significant economic impact on small entities.

The summary of costs and benefits of the staff's draft final standard is presented here in terms of mid-point estimates. The ranges for all estimates are provided in **Tab C**. The benefits of the staff's draft final standard represent the reduction in the societal costs of deaths and injuries that are expected to be prevented by it. Using an expected mattress life of 10 years and a discount rate of 3 percent, the total lifetime benefits are about \$51 per mattress set. The costs, which represent the increase in total resource costs (e.g., costs of material, labor, testing, and compliance efforts) that are expected to result, are estimated to be about \$15 per mattress set. This yields an estimate of net benefits (i.e., benefits minus costs) of \$36 per mattress set.

The estimate of aggregate lifetime benefits associated with all mattresses produced during the first year the standard becomes effective is about \$1,166 million. The estimate of aggregate resource costs associated with these mattresses is \$343 million, resulting in aggregate net benefits of \$823 million.

The assumptions about the expected mattress life, discount rate, effectiveness in preventing deaths and injuries, and value of life estimates were varied in a sensitivity analysis. Reasonable ranges for all these estimates continued to result in positive net benefits. Alternatives to the draft final standard were also considered, including varying the test duration, performance criteria, testing frequency, effective date of the standard, and taking no action. None of these alternatives would be expected to increase net benefits relative to the staff's draft final standard.

While maintaining the benefits resulting from the standard, the draft final standard is expected to minimize the impact on small businesses. Material and labor cost increases are expected to be borne equally by all firms, regardless of size. The cost of testing, recordkeeping, and quality control/quality assurance programs could be disproportionately higher for small businesses. The draft standard, however, allows manufacturers to "pool" or share their prototype qualification and testing, and thus these costs can be mitigated. The draft final standard also allows selling subordinate prototypes of mattress sets without testing. Subordinate prototypes are based on qualified prototypes and differ from them only with respect to size and/or components (including tickings) that do not impact the fire performance of the prototype. This should also help reduce costs to all manufacturers, especially those whose output volume is small.

IV. RESPONSES TO PUBLIC COMMENTS AND RELATED CHANGES TO THE PROPOSED STANDARD

A. Public Comments on the NPR and Staff Responses

The Commission's NPR for a mandatory open-flame standard for mattresses was published in the *Federal Register* on January 13, 2005. During the comment period, the CPSC received in excess of 540 written comments from consumers, businesses, associations and interested parties representing various segments of the mattress industry and individual consumers. A list of these comments is in **TAB E**. Comments were also presented by interested parties at the Mattress NPR public hearing on March 3, 2005. Since then a number of additional substantive comments have been submitted, dealing with issues raised during the formal comment period.

Those commenters who generally supported the proposed rule provided comments regarding definitions, testing procedures, recordkeeping requirements, importer/renovator responsibilities, and other related issues. Those opposed to the standard expressed concerns about the health effects of flame retardant chemicals needed to help mattress sets comply with the performance requirements.

Major issues and staff responses are summarized here and discussed in more detail in respective tabs. Minor comments and those previously addressed in the NPR are also included in those tabs. In response to a number of the major comments, changes have been incorporated in the staff's draft final rule and are discussed in the next section.

1. Scope and Definitions of the Proposed Standard (TAB F)

a. One commenter noted inconsistency in use of the terms "mattress" and "mattress set," which could lead to confusion. The commenter suggests using and defining "mattress set" to refer to mattresses to be tested both with and without a foundation.

CPSC staff agrees and has defined "mattress set" to include mattresses intended to be sold alone and mattresses intended to be sold with a foundation, depending upon the manufacturer's intentions, to resolve the problem of inconsistency, as well as reduce wordiness. The revised definition also makes clear that foundations need not meet the test requirements by themselves. The term is used throughout the draft final standard.

b. Two commenters stated that the distinction between prototypes that need to be tested and those that do not is unclear. They suggest using a different term, such as "Model," for prototypes that do not need to be tested.

CPSC staff agrees that using a different term to refer to prototypes that are not required to be tested would prevent confusion. "Subordinate prototype," defined at § 1633.2(p), is used for an untested prototype based on either a qualified or confirmed prototype.

c. One commenter recommended that the term “prototype developer” be defined to permit third parties, such as component suppliers, to design and test prototypes that can be used by mattress manufacturers.

The draft final standard does not prohibit entities other than mattress manufacturers from designing and testing mattresses for pooling purposes. A definition for prototype developer has been added to the standard to describe a third party providing this service to the industry. If such an entity designs a prototype for a mattress manufacturer, the manufacturer would still be responsible for causing confirmation testing of and maintaining all records required for that prototype, including those documenting the prototype qualification.

d. Commenters questioned the applicability of the proposed standard to mattresses used in recreational vehicles and the lodging industry. (TAB C)

The proposed standard applies to essentially the same mattresses as are currently regulated under 16 CFR Part 1632, Standard for the Flammability of Mattresses and Mattress Pads (cigarette ignition resistance). Mattresses are “products” under the Flammable Fabrics Act. However, **motorized** RVs that are subject to the National Highway Traffic Safety Administration’s FMVSS No. 302 would not be subject to the Commission’s mattress standard.

Over the years, the Commission’s staff and Office of General Counsel have issued interpretations of whether certain products would be considered “mattresses” and therefore subject to the 16 CFR Part 1632 mattress standard. The reasoning in these interpretations also applies to the new mattress standard. For example, in Advisory Opinion 97, the Commission’s General Counsel stated that the flammability standards issued under the FFA (including Part 1632) are applicable to mattresses, carpets and rugs when installed in travel trailers, 5th wheelers and slide-in campers. A 1973 letter from the Office of Compliance stated the staff’s view that travel trailer cushions that have dual purposes as mattresses and seat cushions would not be considered mattresses, but cushions designed basically for “sleeping upon” would be considered mattresses and be regulated under the mattress flammability standard (letter from Edward B. Finch, Acting Director, Compliance to Ray Stutsman, dated June 6, 1973).

Mattresses used in the lodging industry are subject to 16 CFR Part 1632. Commenters have not presented any reasons why these mattresses should be treated differently under the proposed standard, designated 16 CFR Part 1633, addressing open flame ignition. In the absence of such information, the Commission believes it is appropriate to continue to include mattresses used in the lodging industry.

2. Technical Requirements/Specifications (TAB B)

a. Several commenters recommended changing the specified burner hole size to the #53 drill size (1.50 mm) used on production burners.

As discussed in the previous section of this package under **Mattress Performance and Test Evaluations**, NIST recently evaluated peak heat fluxes from two versions of gas burner designs, the original burners and the commercial burners with larger holes. The study showed that the burners with the larger holes do a better job of meeting the target peak flux levels of bedclothes than do the original burners with the smaller holes. Accordingly, the staff revised the proposed standard to specify a nominal burner hole size of 1.50 mm, which corresponds to Grade 10 machining practice with a well formed #53 drill bit. This maintains the integrity of all supporting research for the draft final standard and manufacturer testing to date, providing additional support for requiring the use of the commercial version of the NIST burners.

b. Several commenters recommended tightening sample conditioning and test area conditioning requirements. They suggested limiting the time between removal of the sample from conditioning and the start of the test.

CPSC staff agrees that exposure of a mattress sample to varying fire test room environmental conditions could likely have an impact on test results. Some laboratories have observed seasonal variations in test performance. It is reasonable, therefore, to require that testing of a specific conditioned sample should begin within a certain amount of time after removal from the conditioning room.

Based on NIST's evaluation of the effects of laboratory humidity on fire test performance, the staff revised the proposed standard to require that testing must begin within 20 minutes after removal from the conditioning room. The sample conditioning requirements in §1633.7(b) have been revised to specify an upper limit on the temperature. The temperature range must be greater than 18°C (65°F) and less than 25°C (77°F). The test area conditions must now be maintained at a temperature greater than 15°C (59°F) and less than 27°C (80.6°F) and a relative humidity less than 75 percent. These specifications will minimize environmental influences on test results.

c. Several commenters requested the use of slightly modified test equipment. For example, one commenter requested to use a modified technique to obtain the required burner offset from the specimen instead of the stand-off foot. Another comment pertained to using an alternate method of measuring the burner gas flow, rather than using a rotameter type of flowmeter.

To address issues that would not be expected to influence the test, the draft final standard includes a provision for the use of alternate apparatus in §1633.7(k): Mattress sets may be tested using test apparatus that differs from that described in this section if the manufacturer obtains and provides to the Commission data demonstrating that tests using the alternate apparatus for the procedures specified in this section yield failing results as often as, or more often than, tests using the apparatus specified in the standard. The manufacturer must provide the supporting data to the Office of Compliance, and staff will then review the data and determine whether the alternate apparatus may be used.

3. Exposure to Flame Retardant Chemicals (TAB D)

a. Numerous commenters stated that they were concerned about the possible toxicity of flame retardant (FR) chemicals in general. Other commenters, including manufacturers of mattresses or mattress components, stated that there are FR chemicals that can be used without presenting a hazard to consumers, workers, or the environment.

In the view of the CPSC staff, there are inherently flame resistant materials and FR chemicals available that can be used to meet the proposed mattress standard and that are not expected to pose any appreciable risks to consumers, workers, or the environment. The CPSC and Environmental Protection Agency (EPA) staffs are continuing to evaluate the potential hazards of FR treatments to ensure that they do not pose any appreciable risks to consumers, workers, or the environment.

Mattress manufacturers would be free to choose the means of complying with the CPSC staff's draft flammability standard. Options available to manufacturers include the use of inherently flame resistant materials, FR barriers, and FR chemicals. To meet the draft standard, FR chemicals would most likely be applied to components inside the mattress, such as batting or barriers. However, FR chemicals might be applied to mattress ticking (cover fabric) in some cases. The potential risk presented by any chemical, including FR chemicals, depends on both toxicity and exposure. To the extent that FR chemical treatments remain bound to or within the mattress, exposure and its attendant risk would be minimized.

In addressing the hazards associated with mattress fires, the CPSC staff is working to develop a performance standard without creating additional health hazards to consumers or the environment. The CPSC staff has considered the potential chronic health risks associated with FR chemicals that may be used in mattresses to comply with the proposed standard (Thomas and Brundage 2004²) and continues to study the potential exposures to FR chemicals that may occur over the lifetime of a mattress (TAB H, Cobb 2005; TAB D, Thomas and Brundage 2005). The staff concludes that there are inherently flame resistant materials, FR barriers, and FR chemical treatments that can be used without posing any appreciable risks of health effects to consumers (Thomas and Brundage 2004, 2005).

The CPSC staff is also working with the EPA to ensure that the use of FR chemicals does not endanger consumers, workers, or the environment. EPA has broad statutory authority over chemical substances that address potential risks to consumers, workers, and the environment. EPA has several programs such as the Design for the Environment (DfE), High Production Volume (HPV) Chemical Challenge, and Voluntary Children's Chemical Exposure Program (VCCEP) to evaluate the potential hazards of flame retardants and other chemicals to consumers, workers, and the environment. In addition, the CPSC staff is cooperating with EPA in developing a significant new use rule (SNUR) for FR chemicals that could be used to comply with CPSC or state flammability requirements for upholstered furniture. EPA's programs and statutory authority can be

used to obtain additional toxicity or exposure data where needed, and complement the activities of the CPSC staff and the statutory authority of the Commission.

b. Some individuals commented that the “precautionary principle” should be applied to FR chemicals, that is, they should not be used until proven safe.

All of the statutes that provide regulatory authority to the CPSC explicitly require risk-based decision making, thus precluding application of the “precautionary principle.”

c. A number of commenters were specifically concerned about the toxicity of boric acid, which is used to treat cotton batting. Some of these commenters also cited the use of boric acid as an insecticide as proof of its toxicity.

Other commenters, including manufacturers of mattresses, mattress components, and chemicals, noted that boric acid has been used in mattresses for many years and that their employees have not suffered any ill effects. They noted that the EPA also recently increased its reference dose (RfD) for boric acid. (This means that a greater daily exposure to boric acid is considered acceptable by EPA.)

Since the publication of the Notice of Proposed Rulemaking (NPR), the CPSC staff has performed studies to estimate the potential for exposure (TAB H, Cobb 2005) as well as the potential health risk (Thomas and Brundage 2005) associated with the use of boric acid as a flame retardant for mattresses. The staff’s studies and analysis applied conservative assumptions in areas of scientific uncertainty, that is, assumptions that may overestimate, rather than underestimate, exposure and risk. The staff concluded that the estimated exposure to boric acid was substantially below the ADI (Thomas and Brundage 2005). Thus, boric acid is not expected to pose any appreciable risk of health effects to consumers who sleep on treated mattresses. Some manufacturers have stated that they are also developing exposure data. (TAB D)

d. One commenter specifically mentioned fiberglass as a potentially hazardous FR treatment due to inhalation of glass fibers.

The type of fiberglass used in textiles and FR barriers (continuous filament) is not considered hazardous. Fiberglass textiles are made from “continuous filament,” which contains longer, larger diameter fibers that are too large to be inhaled. Fiberglass textiles are not considered hazardous to consumers or workers (IARC 1988, 2002; Shannon et al. 1990).

e. Some commenters argued that the risk of dying in a fire is lower than the risk of adverse health effects from exposure to FR chemicals.

The CPSC staff disagrees with the claim of some commenters that the risk of dying in a fire is lower than the risk of adverse health effects from exposure to FR chemicals. Commenters did not provide supporting data to substantiate this claim.

There are approximately 15,300 fires per year in the U.S. in which mattresses or bedding were the first item ignited, resulting in about 1,750 injuries and 350 deaths per year (TAB A, Smith and Miller 2005). Thus, the risk of injury or death in a fire involving mattresses or bedding is substantial. The results of the CPSC staff's exposure and risk assessment suggest that there are a number of commercially available FR-treated barriers that can be used to meet the staff's draft mattress flammability standard that will not pose any appreciable risks of health effects to consumers who sleep on treated mattresses (Thomas and Brundage 2004, 2005). (TAB D)

f. Numerous commenters stated that they have multiple chemical sensitivity (MCS), allergies, or other health conditions that could be exacerbated by exposure to FR chemicals. Some commenters disagreed with statements that boric acid could contribute to allergies or MCS, noting that boric acid and other forms of boron have been used safely in consumer products for many years.

The CPSC staff concludes that there is no evidence to suggest that FR chemicals would contribute to the causation or exacerbation of allergies, asthma, or multiple chemical sensitivity (MCS). For the most part, the materials and FR chemicals that will be used to comply with the proposed flammability standard do not share the characteristics of the types of exposures associated with the conditions noted by the commenters.

MCS is a "condition in which a person reports sensitivity or intolerance (as distinct from 'allergic') to a number of chemicals and other irritants at very low concentrations" (EPA 2005). The chemicals include both recognized pollutants—for example, formaldehyde, volatile organic compounds (VOC's), and environmental tobacco smoke—as well as agents generally considered to be innocuous, such as fragrances. Health professionals and biomedical scientists differ in their views regarding the underlying causes and physiological processes of this condition. Non-allergic asthma and rhinitis are generally associated with exposure to respiratory irritants such as combustion products, environmental tobacco smoke (ETS), dusts, and solvents, while allergic asthma and rhinitis symptoms are most often associated with exposures to airborne biological substances, such as animal dander, insect wastes, molds, and pollen. The FR materials or chemicals under consideration are generally non-volatile, are not associated with fragrances or odors, and are not derived from biological materials.

Furthermore, the potential risks presented by FR chemicals depend on both toxicity and exposure. In most cases, FR chemicals would be applied to components inside the mattress, such as batting or barriers. To the extent that FR chemical treatments remain bound to or within the mattress, exposure and its attendant risk would be minimized.

g. Some commenters claimed that FR chemicals may cause sudden infant death syndrome (SIDS).

The CPSC staff disagrees with the claim that antimony compounds or any other FR chemicals may cause sudden infant death syndrome. The CPSC staff previously addressed this issue in detail.⁵ Following a four year study in the United Kingdom and

reviews by a number of expert panels in the UK and the U.S., the expert panels concluded that there is no credible evidence that antimony compounds or any other FR chemical contribute to SIDS. The CPSC staff concurs with the findings of the expert panels.

h. Some commenters were specifically concerned about the toxicity of polybrominated diphenyl ethers (PBDE's), including decabromodiphenyl oxide (DBDPO).

Pentabromodiphenyl oxide, which was used to treat flexible polyurethane foam, is no longer manufactured. The CPSC staff concluded that decabromodiphenyl oxide used in barriers for mattresses is not likely to present a hazard to consumers (**TAB D**). The European Chemicals Bureau concluded that there is no reason to ban DBDPO. The U.S. EPA and the European Chemicals Bureau continue to review the potential environmental effects of DBDPO.

Polybrominated diphenyl ethers (PBDE's) are a family of FR chemicals that have been used in some components of upholstered furniture and mattresses, as well as other products. Octabromodiphenyl ether (octa-BDE) was a relatively minor product that was never used in mattresses or upholstered furniture. Pentabromodiphenyl ether (penta-BDE) is no longer in use. It was one of the primary FR treatments for flexible polyurethane foam (PUF), which is used in mattresses, upholstered furniture, and other applications. However, most non-California residential mattresses and upholstered furniture do not require FR-treated PUF to pass current flammability requirements.

The European Union (E.U.) and some states have banned the use of pentabromodiphenyl ether (penta-BDE) and octabromodiphenyl ether (octa-BDE). Penta-BDE and octa-BDE are no longer manufactured in the U.S. or Europe. The only manufacturer of penta- and octa-BDE voluntarily ceased production. Recently, the U.S. EPA issued a significant new use rule (SNUR), which would require any manufacturer or importer to notify EPA if they plan to produce or import either product. Thus, penta- and octa-BDE are no longer relevant to any rulemaking activities on mattresses and bedding. The banning and withdrawal of penta- and octa-BDE were primarily due to concerns about their persistence and accumulation in the environment, animals, and in human tissue. The E.U. concluded that the risk to consumers from direct exposure to penta-BDE in upholstery foam is negligible. Other FR chemicals can be used to treat PUF. The U.S. EPA, through its Design for the Environment program (DfE), in which CPSC staff are participating, is working to ensure that penta-BDE substitutes do not present a hazard to consumers, workers, or the environment. However, FR-treated PUF is not necessarily needed to comply with the proposed flammability standard.

Decabromodiphenyl oxide (DBDPO), also referred to as decabromodiphenyl ether (deca-BDE), is primarily used in housings for televisions and other electronic equipment. DBDPO is less toxic and less bioaccumulative than penta- and octa-BDE. DBDPO is generally found less frequently and at lower levels than penta- and octa-BDE in the environment, animals, and human tissue. However, not all researchers routinely test for DBDPO along with other PBDE's. The E.U. has assessed the potential environmental

effects of DBDPO, and the U.S. EPA is reviewing DBDPO under its VCCEP program. Thus far, neither the U.S. EPA nor the E.U. has taken any steps to ban the use of DBDPO. EPA, the E.U., and the CPSC staff continue to monitor new information relating to DBDPO and, if necessary, to make appropriate changes to their risk assessments.

DBDPO can be applied to barrier materials for use in mattresses and upholstered furniture. DBDPO may also be applied in the form of a polymeric back-coating to upholstered furniture cover fabrics. However, it will not necessarily be one of the primary means of FR-treating mattresses, as suggested by some commenters.

The CPSC staff has considered the potential risks to consumers from the use of DBDPO in mattresses. Although there is some uncertainty in the staff's analysis, the estimated exposure to DBDPO was several orders of magnitude below the ADI level. Therefore, the staff concludes that DBDPO in mattresses is not expected to pose any appreciable risk of health effects to consumers.

i. Some individuals commented that there is no guidance for manufacturers to consider toxicity and exposure when selecting FR chemicals.

Under the Federal Hazardous Substances Act (FHSA), manufacturers are responsible for ensuring that their products either do not present a hazard to consumers or, if they are hazardous, that they are properly labeled according to the requirements of the FHSA. In 1992, the Commission issued chronic hazard guidelines to assist manufacturers in complying with the FHSA (CPSC 1992). The guidelines address carcinogenicity, neurotoxicity, reproductive and developmental toxicity, exposure, bioavailability, and risk assessment.

j. One manufacturer commented that the CPSC staff should use realistic exposure scenarios, rather than overly conservative ones.

In assessing chronic health hazards, the goal of the CPSC staff is to determine whether "reasonably foreseeable handling and use" of a product or substance may be hazardous to consumers. Therefore, the staff generally attempts to make best estimates of exposure under realistic conditions. However, in the absence of adequate data, the staff applies "conservative" assumptions, that is, assumptions that might overestimate, rather than underestimate risk.

The CPSC chronic hazard guidelines describe various approaches to exposure assessment. Direct measures of exposure such as field studies are generally preferred over laboratory studies and mathematical modeling. However, field studies are not always practical for technical or economic reasons. Thus, the staff frequently relies on a combination of laboratory data and mathematical models.

The CPSC staff developed laboratory methods and exposure scenarios to assess the potential exposure to FR chemicals in mattresses. These methods are conservative in that they may overestimate, rather than underestimate, the potential risk.

4. Durability of Flame Retardant Chemicals—Fire Performance (TAB B)

Several commenters recommended requiring performance tests to assure the durability of flame retardant chemicals and barrier performance after exposure to moisture. Some provided test data to support their concerns. Other commenters provided data from tests of used mattresses taken out of service, indicating they still met applicable standards.

Data provided by commenters were either irrelevant (tests using smoldering cigarettes) or based upon severe exposure of barrier materials, apart from the mattress, before testing. New test data, supplied by manufacturers of barrier products and obtained through a limited evaluation of effects of moisture on flammability behavior by CPSC and NIST, do not support requiring specific durability tests for barrier components. The two mattress designs evaluated by CPSC staff and NIST incorporated barrier materials/systems utilizing different inorganic compounds that are water soluble. NIST fire tests were conducted after the mattress sets were exposed to 10 localized, wetting and drying cycles. The effects of the realistic wetting exposures did not change the overall flammability performance of the mattress sets. In addition, even if exposed areas have decreased fire resistance, the tests suggest that the remainder of the mattress should retain its improved flammability performance, especially the performance expected early in the fire. Since localized wetting, as in bedwetting, is anticipated to be the most likely exposure of a mattress to water in real-world applications, it appears unnecessary to add durability test requirements to the draft final standard to account for mattress designs that incorporate barrier systems that use water-soluble flame retardants.

5. Effective Date (TAB C)

Commenters suggested a variety of effective dates for the final rule ranging from immediate implementation to coinciding with regular model changes (January and July) and 18 months from final publication.

The staff's draft final standard recommends an effective date of the earlier of January or July that follows the date twelve months after publication of the *Federal Register* notice. This suggested date would coincide with regular model/style changes and thus make it easier for all producers, especially small producers outside of California who are not producing complying mattress sets, to update their styles and produce complying mattress sets.

All national producers that sell mattresses in California already have developed the production technology and conducted the testing required to meet California TB 603, which is very similar to the staff's draft final standard. One of them is already selling mattresses complying with performance requirements of the draft final standard nationwide. Three of the top four producers are selling complying mattress sets

representing between 15 to 20 percent of their total output. Smaller companies not based in California may be behind in their design, production, and testing efforts. However, the staff believes that an effective date of one year plus time to the next model introductions provides enough time for all manufacturers to transition to producing and selling compliant mattresses.

6. Labeling

a. One commenter urged the Commission to require the labels of imported mattresses to bear the foreign manufacturer's name and full address, including country, as well as the importer's name and full address.

CPSC staff agrees that such information should be present on the mattress set label and §1633.12 (a) of the draft final standard reflects this. **(TAB F)**

b. One commenter referred to the Textile Fiber Products Identification Act, which is administered by the Federal Trade Commission (FTC) and requires, among other things, that mattresses made with "reused stuffing" be labeled so. The Commenter suggested that CPSC coordinate with FTC to allow the disclosure to appear on the label with the other information required by the standard.

Labeling of mattresses is governed by several organizations, including CPSC, FTC, and individual states. The staff's draft final standard requires the information specified in §1633.12 to be displayed on a permanent, dedicated label in a prescribed format. Therefore, no other information apart from that required by the draft final standard may appear on this label. This helps to ensure prominence of consumer safety information and to prevent potential confusion with other labeling requirements. **(TAB F)**

c. One commenter proposed requiring renovated mattresses to bear a yellow label that would distinguish them from new mattresses, which traditionally bear white labels. In addition, the commenter recommended that labels for renovated mattresses be required to contain a statement indicating that compliance with the standard does not imply that the renovated mattress is sanitary or hygienic.

The draft final standard seeks to reduce injuries and deaths due to fires. It is not intended to address the sanitary condition of mattresses. **(TAB F)**

d. One commenter expressed concern that requiring a dedicated label might detract from an industry safety hangtag program, conflict with the state law labeling program, and negatively affect the aesthetics of the finished product. The commenter suggested allowing manufacturers to display the required information on the safety hangtag.

CPSC staff revised the labeling provision in the proposed standard to 1) include intended usage information for the safety of the consumer, 2) require all information specified in § 1633.12 to appear on a dedicated label, and 3) permit the display of the consumer usage information in any other language on the reverse (blank) side of the label. Consumers

must be able to identify the correct foundation, if any, to use with the mattress they purchase. With this intended usage information, consumers will be able to ascertain that the mattress they purchase meets the requirements of the standard when used alone, with one or more **specific** foundations, or both.

Requiring the specified information to appear on a dedicated label has the benefit of 1) ensuring that such information is not detracted from or minimized, 2) avoiding potential conflict or confusion with state labeling requirements, 3) guaranteeing that the intended usage information is highlighted and presented in a consistent manner, and 4) allowing manufacturers the option of providing the intended usage information in any other language on the back of the label. CPSC staff designed the required label to be as small as possible without compromising the clarity and effectiveness of the specified information.

e. Several commenters recommended including in the standard a requirement that mattresses be provided with a label listing FR chemicals used or a statement warning of health risks.

The staff has found that numerous FR materials are available that will enable mattresses to meet the draft standard without posing any appreciable risks of health effects to consumers. Moreover, the FHSA would require a hazard warning label if a mattress were a “hazardous substance”, as that term is defined in the Act. The potential health hazard associated with any chemical depends on both toxicity and exposure. A label stating the names of any FR chemicals used in the mattress would not likely provide useful information to the consumer because the mere presence of an FR chemical is not an indication that the mattress containing that chemical poses any health risk. **(TAB D)**

7. Preemption

Issues associated with preemption that were raised by commenters are addressed in separate (restricted) memoranda to the Commission from the Office of the General Counsel.

8. Domestic Manufacturer/Renovator vs. Importer Responsibilities (TAB F)

a. Two commenters suggested making importer testing/recordkeeping responsibilities explicit. They proposed including language specifying that testing needs to be conducted (either qualification or confirmation) and records maintained for each foreign manufacturer if the importer is importing from more than one manufacturer.

The requirements under the draft final standard are to be the same for domestic manufacturers/renovators and importers: each is responsible for maintaining the appropriate qualification and confirmation test records for mattress sets they produce and/or import. These requirements have been clarified in the staff’s draft final standard. **(TAB F)**

b. One commenter expressed concern that foreign manufacturers may circumvent testing requirements by drop-shipping directly to consumers. The commenter recommended adding a definition of “importer” that identifies domestic agents involved with selling or marketing the product to be drop-shipped as the responsible party.

The CPSC staff does not believe that adding a definition of importer will suitably address the issue. Section 3 (a) of the Flammable Fabrics Act already prohibits “[t]he manufacture for sale, or the offering for sale, in commerce, or the importation into the United States, or the introduction, delivery for introduction, transportation or causing to be transported in commerce or for the purpose of sale or delivery after sale in commerce...” of any product violating a standard issued under its authority. This means that any party – including importers and other agents initially introducing goods regulated under the FFA into commerce – engaged in the foregoing actions with respect to non-complying products would be liable under the Act.

In response to the commenter’s concern, the CPSC staff revised the proposed standard to require each manufacturer to maintain a copy of the records demonstrating compliance at a U.S. location. Additionally, this location would be required to appear on the mattress label. Section 1633.11 (e) of the draft final standard reflects this revision.

9. Quality Assurance Requirements (TAB F)

One commenter suggested limiting the scope of the components and materials required to be controlled for quality assurance to only those that are critical to the flammability performance of the finished product.

CPSC staff believes that it is premature to limit the scope of the quality control on incoming components and materials. The staff could revisit this issue once significant experience with the standard is gained and the industry and the CPSC staff have more confidence in the contributions of various components to the full-scale fire performance of mattress sets.

10. Recordkeeping and Sample Retention (TAB F)

a. One commenter recommended that the test and manufacturing records require the “name and full address” of the testing laboratory, as opposed to just the “location.” The same commenter likewise suggested substituting “full address” for “location” for both the manufacturer of the qualified prototype in the pooling confirmation test records and the suppliers in the prototype records.

CPSC staff agrees that the name and complete address of the testing laboratory, as well as the complete addresses of the qualified prototype manufacturer and each material and component supplier, should appear in the respective records. This will provide more complete and accurate information for compliance purposes. Section §1633.11 of the draft final standard reflects the appropriate changes.

b. One commenter urged the Commission to limit the records required under §1633.11 (d)(5) of the standard to only those relating to the testing and evaluations of components, materials, and assembly methods critical to flammability performance of the qualified prototype.

Since it is too early to know exactly what components, materials, and assembly methods will influence the flammability performance of a mattress, CPSC staff does not believe it is appropriate to limit the types of records required under §1633.11 (d)(5) at this time. Moreover, these records will likely be used by manufacturers to demonstrate that a change in component, material, and/or assembly method will not degrade the flammability performance of a prototype, thus allowing the manufacturer to forgo testing and qualifying a new prototype. To that end, it is in the interest of the manufacturer to maintain a broader scope of such records.

c. Two commenters remarked that the requirement to keep physical samples of all materials used in each prototype is overly burdensome and impractical. The large numbers of samples would require significant storage space while the objective could be accomplished through test and quality certificates and other documentation already required in the quality assurance records.

The requirement to maintain physical samples of prototype materials and components was included in the proposed standard as an added measure for manufacturers to verify that production mattresses match their representative prototype. Given that the prototype recordkeeping requirements already call for manufacturers to provide a detailed description of and specifications for each material and component used in every prototype, and given that this information may be used to reliably verify material and component consistency, the requirement to keep physical samples has been eliminated in the staff's draft final standard.

11. Consider Revoking Existing Cigarette Standard for Mattresses, 16 CFR Part 1632

Some commenters recommend revoking the existing standard for cigarette ignition of mattresses and mattress pads. Others recommend careful review of risks, incident data, and benefits of the current standard before revocation is considered.

On June 23, 2005, the Commission published an advance notice of proposed rulemaking for the possible revocation or amendment of the Standard for the Flammability of Mattresses and Mattress Pads (Cigarette Ignition).⁶ The rulemaking will allow for a full evaluation of options to reduce unnecessary burdens while maintaining the safety afforded by this standard.

12. Costs Associated with the Standard (TAB C)

Commenters expressed concerns about the increased costs of barrier materials needed to produce complying mattresses and increased costs to consumers.

Staff estimates of barrier and other resource costs for mattress producers are lower in the final regulatory analysis than those in the initial regulatory analysis and are expected to drop further as a result of technological developments and increased competition among barrier producers. Total costs are not expected to exceed \$23.00 per mattress set.

The expected price increase for consumers was initially estimated to range from \$23.00 to slightly less than \$80.00. However, the final regulatory analysis updated the costs, which have declined because of technological advances and market competition. This means that the consumer price will increase by a mid-point estimate of \$24.21 per mattress.

One national producer currently complies with the staff's draft final standard without increasing the price of its mattress/foundation sets. Staff expects competition for market share among producers to drive the price closer to the one charged by this national producer, which makes any likely increase even lower than that suggested by the \$24.21 above.

13. Bedclothes Rulemaking

Some commenters expressed support for an additional rulemaking for bedclothes because of the significant role those products play in mattress/bedding fire losses. Other commenters shared concerns about the potential use of FR chemicals in bedclothes.

On January 13, 2005, the Commission published an advance notice of proposed rulemaking for a standard to address open flame ignition of bedclothes.⁷ Recent research has shown that bedclothes are a significant ignition source for mattress fires and can also generate a fire large enough to pose a hazard on their own. Laboratory tests also showed that fire performance of these products could be improved. The environmental and health implications of compliance strategies, including FR chemicals, will be evaluated in the course of that rulemaking.

14. Miscellaneous Comments

Additional public comments are addressed in the earlier 2004 NPR briefing package² and *Federal Register* notice¹ or the tabs of this package. Comments on mattress life, an exemption for small producers, recreational vehicle and lodging mattresses, allowing choice for non-smokers, and protecting smokers are covered in **TAB C**. **TAB D** discusses potential health effects associated with use of FR chemicals. Comments on production lot definitions (also for importers), definition of foundation, quality assurance options, and unnecessary maintenance of records of other tests are addressed in **TAB F**.

TAB B discusses the issues of test room alternatives, draft protection with screens, equipment protection with copper tubing, burner placement for mattresses with seamless edges, a closed or solid test frame alternative, reduced test replicates, performance criteria alternatives, burner application duration alternative, separate requirements for

foam components, need for ensuring the use of quality assurance programs, and the impact of smoke alarm response to fires involving complying mattresses.

A number of comments were previously addressed in the 2004 NPR Briefing Package², including the labeling of FR chemicals used, requirement for use of an accredited laboratory or third party certification, test replicates required, performance criteria, separate requirements for foam components, and the need for quality assurance programs.

B. Changes in the Proposed Standard

The following changes in response to public comments on the proposed standard have been incorporated in the staff's draft final rule in **TAB G**.

1. Definitions (TABS B and F)

a. Mattress set

The term "mattress set" has been added to include mattresses to be sold alone and mattresses to be sold with a foundation, depending upon the manufacturer's intentions. That term is now used throughout the draft final standard.

b. Subordinate prototype

The term "subordinate prototype" was added to refer to a prototype that is not required to be tested and is defined at §1633.2(p).

c. Confirmed prototype

A "confirmed prototype" definition was added to describe a prototype that is based on a qualified prototype in a pooling arrangement.

d. Edge

"Edge seam" was redefined as "edge" to accommodate mattress or foundation constructions that do not have a seam, as in a continental border.

e. Prototype developer

"Prototype developer" was added to describe a third party that designs mattress prototypes for use by a manufacturer, but does not produce mattress sets for sale. The prototype developer does not necessarily conduct tests to qualify the mattress prototype. A barrier supplier, for example, could be a prototype developer.

f. Renovator

The definition for "manufacturer" now includes renovators.

g. Prototype pooling

The term "prototype pooling" was clarified to explain the responsibilities of the involved parties.

2. Technical Requirements/Specifications (TAB B)

a. Tightened conditioning requirements, test area conditions, and time limit to test
Specifications for conditioning have been tightened to require a conditioning temperature greater than 18°C (65°F) and *less than 25°C (77°F)* and a relative humidity less than 55 percent. Test area conditions have been added and require a temperature greater than 15°C (59°F) and less than 27°C (80.6°F) and at a relative humidity less than 75 percent. Initiation of flammability testing must begin within 20 minutes after removal of the mattress sample from the conditioning room.

b. Bed frame

Specifications for the bed frame supporting the test specimen have been clarified to address dimensions for specimens other than twin-size, frame height to accommodate the side burner in tests of thin mattresses without foundations, and support for more flexible mattress products.

c. Burner hole size

The specification for the gas burner hole size has been changed, providing a more accurate representation of burning bedclothes in the test. This will also match the holes of commercially produced burners in use by all known laboratories, private and government, currently doing these tests.

d. Use of alternate apparatus

A provision has been added to the draft final standard at §1633.7(k) that allows the use of alternate test apparatus with the approval of the Office of Compliance.

e. Additional clarifications

Other minor changes in the test procedure, equipment and set up, noted in **TAB B**, include clarifications of gas specifications, draft control, and burner orientation.

f. Reliance on tests conducted before the effective date (TAB F)

The staff has clarified §1633.4(d)(2) regarding conditions under which a manufacturer may rely upon tests conducted before the effective date of the standard. Certain records are required for pooling and support of subordinate prototypes.

3. Effective Date (TAB C)

The staff's draft final standard recommends an effective date of the earlier of January 1 or July 1 following the date twelve months after publication of the *Federal Register* notice. This suggested date would coincide with regular model/style changes and thus make it easier for all producers, especially small producers outside of California who are not yet producing complying mattresses, to update their styles and produce or import complying mattresses.

4. Labeling (TAB F)

Changes in the labeling requirements of the proposed standard were made for two reasons: to provide more complete and accurate information regarding the manufacturer/importer and to convey critical safety information to consumers that was not included in the proposed standard. Consumers must be able to identify the correct foundation, if any, to use with the mattress they purchase. With this intended usage information, consumers will be able to ascertain that the mattress they purchase meets the requirements of the standard when used alone, with one or more **specific** foundations, or both.

Due to the nature and increased quantity of the required information, and to ensure that such information is in no way detracted from or minimized, the staff recommends requiring that it appear on a separate and distinct label. A dedicated label has the added benefit of preventing potential confusion with state labeling requirements. Likewise, the prescribed format is included to guarantee that the intended usage information is highlighted and that all required information is presented in a consistent manner. The label information may be reproduced in any other language and printed on the reverse side of the label.

5. Importer/Renovator Responsibilities (TAB F)

The requirements in the proposed standard for testing and recordkeeping have been clarified so it is clear that they are the same for importers, domestic manufacturers, and renovators. The draft final standard was also revised to require that all records be maintained in the United States, regardless of the location (domestic or foreign) of manufacture.

6. Recordkeeping Requirements (TAB F)

The staff has made several changes in recordkeeping requirements. Manufacturers are no longer required to maintain physical samples. The staff also clarified requirements for the inclusion in records of complete physical addresses of suppliers, manufacturing facilities (foreign and domestic), and test laboratories. All required records must be maintained in the United States, regardless of the location of mattress manufacture.

V. CONCLUSIONS

The staff's evaluation of in-depth investigations of fire incidents and currently marketed mattresses supports the conclusion that a standard **minimizing the possibility of or delaying time to flashover** from an open flame mattress fire could be effective in reducing major fire losses. The staff believes it is feasible to limit the size of mattress fires to the extent that 240 to 270 civilian deaths (69-78 percent) and 1,150-1,330 injuries (73-84 percent) presently occurring in addressable mattress/bedding fires attended by the fire service could be potentially eliminated annually.

The staff's draft final standard incorporates a test method demonstrated to measure mattress performance in order to provide this level of protection. The staff's draft standard has two performance criteria that limit fire growth. The mattress sets must not exceed a 200 kW peak heat release rate within the 30 minutes of the test, and the total energy released must be no more than 15 MJ for the first 10 minutes of the test. Materials that can be used as fire barriers to produce comfortable, practical, and reasonably priced mattresses with significantly improved fire performance are commercially available. Since California's TB 603 standard became effective in 2005, mattress sets that meet the staff's draft standard have been marketed in California and nationwide.

The staff reviewed public comments on the proposed standard and conducted additional mattress tests and evaluations to address those comments. As a result, the staff made a number of changes and clarifications to definitions, test equipment, test procedures, and recordkeeping provisions. A requirement for a separate, permanent label has been added to convey critical safety information to consumers and to standardize manufacturer and importer information.

A number of consumers commenting on the proposed standard raised the issue of potential use of FR chemicals. At the time the staff conducted its preliminary qualitative assessment for the proposed standard, quantitative data on potential exposures to FR chemicals as used in mattresses did not exist. Since then the staff has conducted a quantitative risk assessment to provide a more accurate estimate of the potential risk to consumers associated with exposures to these FR chemicals/chemical classes in commercially-available FR-treated barriers that may be used by mattress manufacturers to meet the draft final flammability standard. Results of the quantitative risk assessment indicate that there are a number of commercially available FR-treated barriers that can be used to meet the staff's draft final mattress flammability standard. These chemicals are not expected to pose any appreciable risk of health effects to consumers who sleep on treated mattresses.

As indicated in the staff's earlier environmental assessment² and confirmed in the updated environmental information, manufacturers appear to have a number of alternatives for meeting a mattress 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 flame retardants if they are ever found to pose hazards to the environment or health.

Based on the final regulatory analysis, the expected benefits of the staff's draft final standard are substantially greater than the costs. A sensitivity analysis of the cost-benefit findings showed that the results of the analysis were not altered when the underlying assumptions were varied within reasonable ranges; net benefits remain positive. The regulatory analysis also considered alternatives to the draft final standard; none was

shown to increase net benefits. The analysis suggests that an effective date of the earlier of January 1 or July 1 following the date twelve months after publication of the *Federal Register* notice would be reasonable. This date would coincide with regular model/style changes and thus make it easier for all producers, especially small producers outside of California who are not already producing complying mattresses, to update their styles and produce complying mattress sets.

VI. OPTIONS

1. Issue a final mandatory flammability standard if the Commission finds that such a standard is needed to address an unreasonable risk of deaths and injuries from open flame ignition of mattress sets.
2. Terminate the proceeding for development of an open flame flammability standard if the Commission finds that a mandatory standard is not necessary to address an unreasonable risk of deaths and injuries from open flame ignition of mattress sets.

VII. RECOMMENDATION

The staff recommends that the Commission approve issuance of a mandatory flammability standard for mattress sets, as set forth in the staff's draft final standard at **TAB G**. The staff recommends that the effective date for the standard be set at the earlier of January 1 or July 1 following the date twelve months after publication of the *Federal Register* notice.

VIII. REFERENCES

1. *Federal Register* notice, “16 CFR Part 1633, Standard for Flammability (Open Flame) of Mattresses and Mattress/Foundation Sets; Notice of Proposed Rulemaking,” published by the Consumer Product Safety Commission; January 13, 2005 (70 FR 2470).
2. Briefing Package “Notice of Proposed Rulemaking for the Flammability (Open Flame) of Mattresses and Foundations and Options for Addressing Bedclothes Involvement in Mattress/Bedding Fires,” CPSC, November 1, 2004.
3. L. Smith and D. Miller, “Updated Estimates of Residential Fire Losses Involving Mattresses and Bedding,” U.S. Consumer Product Safety Commission, October 2004.
4. G. Damant and the Sleep Products Safety Council, “Developing an Open-Flame Ignition Standard for Mattresses and Bed Sets,” Sleep Products Safety Council, December 2005.
5. Memorandum from P. Bittner, Toxicologist, and M. Babich, Chemist, to Thomas Murr, Acting Executive Director, “Health Sciences Response to Public Hearing Comments on Upholstered Furniture,” CPSC, April 18, 2001.
6. *Federal Register* notice, “16 CFR 1632. Advance Notice of Proposed Rulemaking; Possible Revocation or Amendment of Standard for the Flammability of Mattresses and Mattress Pads (Cigarette Ignition),” published by the CPSC, June 23, 2005 (70 FR 36357).
7. *Federal Register* notice, “16 CFR Part 1634. Standard To Address Open Flame Ignition of Bedclothes; Advance Notice of Proposed Rulemaking,” published by the CPSC, January 13, 2005 (70 FR 2514).