UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

VOTE SHEET

DATE: NOV - 1 2004

TO: The Commission
Todd A. Stevenson, Secretary

FROM: John Gibson Mullan, General Counsel JGM
Lowell F. Martin, Assistant General Counsel for Regulatory Affairs LFM

SUBJECT: **Open Flame Flammability Standards for Mattresses, Mattress and Foundation Sets, and Bedclothes**

The attached staff briefing package recommends that the Commission issue a performance standard for the open flame flammability of mattresses and mattress and foundation sets under authority of the Flammable Fabrics Act (FFA), 15 U.S.C. §§ 1191 - 1204. The draft regulatory text for the standard prepared by the Office of the General Counsel for the Commission's consideration appears at Tab K of the staff briefing package. The draft text of the preamble that would accompany the regulatory text in a Notice of Proposed Rulemaking will be provided to the Commission under separate cover for its consideration.

The briefing package also recommends that the Commission issue an advance notice of proposed rulemaking under its FFA authority to begin the process of developing a flammability standard for the open flame ignition of bedclothes, that might include items such as sheets, blankets, mattress pads, pillows, comforters, and similar products that are used as covering on a bed. The draft ANPR appears at Tab L of the staff briefing package.

Please indicate your preferences by voting on the following alternatives:

A. <u>Mattress Flammability Standard</u>

I. Approve the regulatory text and preamble for the mattress flammability standard for publication in the Federal Register as drafted.

_____ _____ 11/1/04
Signature Date

NOTE: This document has not been reviewed or accepted by the Commission.
Initial nk Date 11/1/04

II. Approve the regulatory text and preamble for the mattress flammability standard for publication in the Federal Register with changes. (Please specify.)

_____

_____

_____

_____ _____

Signature Date

III. Do not approve the preamble and regulatory text for the mattress flammability standard.

_____ _____

Signature Date

IV. Take other action. (Please specify.)

_____

_____

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_____ _____

Signature Date

B. <u>ANPR on Bedclothes Flammability</u>

I. Approve the draft ANPR on bedclothes flammability for publication in the Federal Register as drafted.

_____ _____

Signature Date

II. Approve the draft ANPR on bedclothes flammability for publication in the Federal Register with changes. (Please specify.)

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_____ _____

Signature Date

III. Do not approve publication of the draft ANPR on bedclothes flammability.

_____ _____

Signature Date

IV. Take other action. (Please specify.)

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_____

_____

_____ _____

Signature Date

Attachment: Briefing memorandum from Margaret Neily, Project Manager, Directorate for Engineering Sciences, to the Commission, *Notice of Proposed Rulemaking for Mattress Flammability (Open Flame) and Options for Addressing Bedclothes Involvement in Mattress/Bedding Fires*, October __, 2004.

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

11/1/04

For Further Information Contact:
Margaret L. Neily, Project Manager
Directorate for Engineering Sciences
(301) 504-7530

NOTE: This document has not been reviewed or accepted by the Commission.
Initial mln Date 11/1/04

TABLE OF CONTENTS

TABS

ACKNOWLEDGEMENTS
Mattress/Bedclothes Team

Patricia Brundage, HS
Robert Franklin, EC
Michelle Gillice, CE
Jason Hartman, CE
Terry Karels, EC
Edward Krawiec, LS
Mark Levenson, EPHA
Carolyn Meiers, ESME
David Miller, EPHA
Patty Pollitzer, OGC
Linda Smith, EPHA
Allyson Tenney, ESFS
Treye Thomas, HS
Soumaya Tohamy, EC
Mary Toro, CE

EXECUTIVE SUMMARY

On October 11, 2001, the Commission published an advance notice of proposed rulemaking (ANPR), requesting public comments on a possible standard to address mattress/bedding fires initially ignited by a small open flame. Commenters generally supported the full-scale test method developed at the National Institute of Standards and Technology (NIST) and incorporated in California's standard, TB 603, published in 2004. The Commission received comments for and against the need to address the open flame ignition of bedclothes in order to reduce deaths and injuries from mattress/bedding fires.

The most recent national fire loss estimates indicate that mattresses and bedding were the first items to ignite in 19,400 residential fires attended by the fire service annually during 1995 – 1999. These mattress and bedding fires resulted in an estimated 440 civilian deaths, 2,230 civilian injuries, and $273.9 million property loss annually. Based solely on the characteristics of the fire cause, an estimated 18,500 fires causing $259.5 million in property loss annually were considered **addressable** by the staff's draft proposed standard. The estimated 440 deaths and 2,160 injuries that occurred in these fires annually are considered potentially preventable by the draft standard.

The staff evaluated in-depth investigations of fire incidents and concludes that a standard preventing 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 310-330 civilian deaths (80-86%) and 1,660-1,780 injuries (86-92%) could be potentially eliminated annually.

The staff's draft proposed standard incorporates a test method, based on the NIST test, to measure mattress fire performance and provide this level of protection. The staff's draft proposed standard has two performance criteria. The mattresses must not exceed a 200 kilowatt (kW) peak heat release rate within the 30 minutes of the test, and the total energy released must be less than 15 megajoules (MJ) for the first 10 minutes of the test. Materials are commercially available that can be used to produce comfortable, practical, and reasonably priced mattresses with significantly improved fire performance.

The extent to which various flame retardant (FR) chemicals and other alternatives for meeting the standard (e.g., inherently flame-resistant materials) will be used is uncertain. While there are some data gaps regarding many of the chemicals that could be used to meet the standard, there are FR chemicals and flame resistant materials that, based on currently available data, are not likely to pose an unacceptable risk to the environment or human health and that are widely used in other applications. Therefore, manufacturers appear to have alternatives for meeting a mattress flammability standard that will not result in unacceptable adverse impacts to the environment or human health.

Based on the preliminary regulatory analysis, the expected benefits of the staff's draft proposed mattress standard are 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. Net benefits remained positive. The regulatory analysis also considered alternatives to the draft proposed standard, and none was shown to increase net benefits. The analysis suggests that a 12 month effective date from the date when a final rule is published would be reasonable. The staff recommends publishing a notice of proposed rulemaking with a standard for the flammability (open flame) of mattresses and foundations.

Regarding bedclothes, laboratory fire tests have shown that some bedclothes burning on an improved mattress/foundation (one producing less than a 50 kW peak rate of heat release) are sufficient to cause flashover of the room. The high peak heat release rates observed from some bedclothes items with a large fuel load, such as comforters, were much higher than that allowed for a mattress/foundation in the draft proposed mattress standard. This suggests the need for limits on some bedclothes as well.

The most serious portion of the remaining mattress/bedding fire problem could be addressed by limiting the size of the fire produced by some of the largest (fuel load) bedclothes products. The total fire produced by the bed set, then, would be small enough to preserve the occupant egress time offered by preventing or delaying flashover conditions. Accordingly, the staff recommends publishing an advance notice of proposed rulemaking for a standard for bedclothes flammability.

6

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

MEMORANDUM **DATE:** NOV - 1 2004

TO : The Commission
Todd Stevenson, Secretary

Through: John Mullan, General Counsel JOM
Patricia Semple, Executive Director PS

FROM : Jacqueline Elder, Assistant Executive Director
Office of Hazard Identification and Reduction
Margaret L. Neily, Project Manager MN
Directorate for Engineering Sciences
(301-504-7530)

SUBJECT: **Notice of Proposed Rulemaking for the Flammability (Open Flame) of Mattresses and Foundations and Options for Addressing Bedclothes Involvement in Mattress/Bedding Fires**

I. INTRODUCTION

This memorandum has two parts: Mattress Rulemaking and Options for Bedclothes. The first part discusses a draft proposed standard for mattress flammability (open flame), supporting materials, and comments responding to the U.S. Consumer Product Safety Commission's (CPSC's) October 2001 advance notice of proposed rulemaking (ANPR).[1] The second part includes a discussion of issues associated with bedclothes flammability, a summary of research and existing standards, and options for addressing the hazard presented by bedclothes in mattress/bedding fires.

II. BACKGROUND

On October 11, 2001, the Commission published an ANPR, requesting public comments on a possible standard to address mattress/bedding fires initially ignited by a small open flame. (TAB A) 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 1632). An analysis of comments received during the comment period and afterwards and staff responses are provided later in this package.

[1] Superscripts designate references at the end of this memorandum.

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Initial nla Date 11/1/04

7

Commenters generally supported the test development that was being sponsored by the industry at the National Institute of Standards and Technology (NIST). The NIST full-scale test method for mattress flammability became the basis for California's standard, TB 603, which was published in 2004. CPSC staff conducted additional supporting mattress tests and evaluations at NIST in 2004 and worked with the industry to complete a precision and bias study of the test method.

The Commission received comments for and against the need to address the open flame ignition of bedclothes in order to reduce deaths and injuries from mattress/bedding fires. The California Bureau of Home Furnishings (CBHF) began developing a flammability test for bedclothes, and CPSC staff participated in their TB 604 Bedclothing Task Force.

III. DISCUSSION—MATTRESS RULEMAKING

The Commission staff has reviewed research in progress from other organizations, considered public comments and the State of California rulemaking experience, met with manufacturers and suppliers, conducted original studies, and evaluated the potential effectiveness of a standard based upon the full-scale test method developed by NIST. A draft proposed standard with technical rationale, current fire loss data, rule effectiveness evaluation, preliminary regulatory analysis, health and environmental assessments, and draft implementing rules and regulations is discussed below.

The staff has contended with numerous issues arising from the ground-breaking nature of this standard. Its development has required new scientific understanding of the nature of the hazard and new ways to measure it. The standard seeks to control the size of a mattress/bedding fire, not prevent it as do other CPSC standards. Because of this, the staff needed a sophisticated evaluation of effectiveness. The draft proposed standard also demands an unprecedented change in the supplies, products, and the manufacturing culture of a major industry.

A. Research and Standard Development (NIST and TB 603)

1. The Current Fire Hazard

Earlier research at NIST, sponsored primarily by the Sleep Products Safety Council (SPSC), produced a technical understanding of the hazard posed by the typical residential mattress/bedding fire scenario. The staff had also found existing standards to be inadequate to address the problem.[2] NIST identified ways to measure this hazard and reduce associated deaths and injuries by limiting fire size over a specified time period. A burning mattress is generally the primary energy contributor in a typical bedroom fire. Once the mattress is ignited, the fire develops rapidly, creating dangerous flashover conditions. This is the point at which the entire contents of a room are ignited simultaneously by radiant heat, making conditions in the room untenable and safe egress

impossible. More than two-thirds of all mattress fatalities are attributed to mattress fires that lead to flashover. This accounts for nearly all the fatalities that occur outside the room of origin and one half of the fatalities that occur within the room of origin.[3]

A heat release value (a measure of the size of a fire) of about 1,000 kilowatts (kW) would lead to flashover of a typical sized room. NIST tests of twin size, traditional mattress constructions (16 CFR Part 1632 compliant) without bedclothes measured peak heat release rates that exceeded 2,000 kW in less than 5 minutes. Fires produced by traditional king size mattresses were nearly double the size (peak rate of heat release) of the twin-size mattresses.[4]

2. The Standard Test Method

The objective of a standard would be to keep the size of mattress/bedding fires below 1,000 kW by reducing the heat release from the bed, specifically the mattress and foundation, and by reducing the likelihood of involving other objects in the same room. Research has been conducted by NIST for SPSC and CPSC and by CBHF and others in support of a standard test method. This work included studying burning bedclothes to design a gas burner ignition source that represents the bedclothes threat to a mattress, testing improved mattress designs as they evolved, evaluating the potential for a bed fire to ignite other items in the room, estimating the reduced fire risk from improved mattresses, using mathematical modeling to explore the fire threat throughout a home, testing bedclothes on improved mattresses, and evaluating the effects of mattress size and room size on the hazard. These studies showed that improved fire performance could be accomplished using fire barriers to protect the interior materials of the mattress. **TAB B** describes the major findings of these studies as they relate to test criteria, duration, and other options considered by the staff in preparing the draft proposed standard presented in this package.

A full-scale test was shown to be the most reliable method for measuring performance of products that contain many materials in a complex construction, such as mattresses and foundations. From their research, NIST drafted a full-scale test method for mattresses that was later incorporated in the California standard, TB 603. The staff's draft proposed standard also includes this full-scale test method, using a pair of gas burners representing burning bedclothes as the ignition source. A twin size mattress is generally used in the test to evaluate the performance of a mattress "prototype" (specified design, materials, and construction) before mattresses are produced for sale.

3. Interlaboratory Study **(TAB B)**

Conducting the test in the draft proposed standard requires a full-scale fire test facility, sophisticated instrumentation, and experienced technical staff. There are a limited number of commercial laboratories currently capable of conducting this test procedure. An inter-laboratory study was conducted with the support of the SPSC, NIST, CBHF, and other participating laboratories to explore the sensitivity, repeatability, and

reproducibility of the NIST test protocol. The study was recently completed, and a final report is expected by the end of 2004.

The sensitivities were explored by varying a range of possible test technician errors primarily associated with test set-up measurements. Repeatability was evaluated with multiple tests on two mattress designs in one laboratory. Another part of the study explored possible differences in mattress performance measures when tests were conducted in different laboratories, some with varying test room configurations (open calorimeter or test room). All of the participating laboratories conducted multiple tests of eight different mattress designs with varied critical elements: the barrier material (sheet or high-loft), type of mattress (single or double sided), and the style of mattress (tight or pillow top).

Preliminary analysis of the data does not suggest either unreasonable sensitivities or practical limitations in the test protocol. The preliminary analysis suggests that some mattress designs exhibit more consistent fire performance than other designs. The type of barrier appears to have a significant impact on the performance measured and its repeatability for all mattress designs tested. However, the lack of uniformity in other components and the manufacturing process can also contribute to variability in fire performance measures. This series of tests also appears to confirm earlier observations that mattresses constructed with current barrier technologies are able to limit the fire severity for a substantial, but not indefinite time. Most of the tested mattress designs could meet the proposed requirements if the test ends at 30 minutes. Most of the designs tested appeared to perform erratically after 30 minutes.

The preliminary analysis, supported by earlier data, suggests that significant variability exists among currently available mattress designs. Although the products appear to be moving toward consistency, the need for quality controls of components, materials, and methods of assembly is clear. Quality assurance procedures, standardized testing, and visual inspections are possible options for assuring, verifying, and controlling consistency of production. Larger manufacturers already incorporate quality assurance programs that could be expanded for this purpose. In addition several commercial laboratories are developing services designed to assist manufacturers in designing and implementing these quality assurance programs. Requirements incorporated in the staff's draft proposed standard address the need for such quality assurance programs.

Analyzing the data for sensitivity, repeatability, and reproducibility can confirm the precision of the NIST test protocol or reveal which, if any, test parameters need to be revised. Consistent differences in data trends between laboratories, such as those attributed to laboratory infrastructure, equipment, or maintenance procedures could be addressed through a laboratory accreditation program to ensure control of operations and uniformity of tests conducted. While accrediting test laboratories is not a CPSC function, the staff supports industry and commercial laboratory development of such a program.

10

B. Draft Proposed Standard, General Performance Requirements, and Technical Rationale (TAB B)

1. Scope of the Draft Proposed Standard

The draft proposed standard requires mattress and mattress/foundation prototypes (designs) to be tested with acceptable results before mattresses based on that prototype are sold or introduced into commerce. All mattresses/foundations, futons, mattresses used in other items of furniture, and multi-purpose items used for sleeping, such as flip chairs, must meet the requirements of the standard. Mattress pads and toppers are not included in this draft standard, but could be considered within the scope of a possible bedclothes regulation.

2. General Performance Requirements

The hazards presented by a burning mattress are closely associated with its peak rate of heat release and total energy released. Limiting the peak rate of heat release will ensure a less flammable mattress design. A mattress with a limited contribution to the fire will substantially increase the time available to escape and substantially reduce the current risks associated with mattress and bedding fires. The draft proposed standard has two performance criteria. The mattresses must not exceed a 200 kW peak heat release rate during the 30 minute test, and the total heat released must be less than 15 megajoules (MJ) for the first 10 minutes of the test.

The staff believes that significantly decreasing the fire contribution of the mattress and foundation set will reduce deaths and injuries from mattress and bedding ignited fires, by reducing fire severity, slowing the rate of fire growth, and substantially increasing escape time. A very low contribution from the mattress is critical during the initial stages of the fire scenario to ensure that the combined heat release rate of the mattress, foundation, and bedclothes is substantially reduced. This, in turn, would reduce the likelihood of involving other nearby objects and minimize the possibility of reaching flashover conditions. Preventing flashover under certain circumstances, minimizing the possibility of flashover, or increasing the time before flashover occurs would substantially reduce the risks associated with mattress fires.

Peak rate of heat release: Limiting the peak rate of heat release of the mattress to 200 kW (during the 30 minute test), as proposed, takes into account the contribution of bedclothes and other room contents to the fire hazard, is technically feasible, and considers many factors related to the fire scenario (such as room effects). This limit ensures a less flammable mattress design, representing a significant improvement over traditional mattress designs. The proposed limit also ensures the benefits and estimated effectiveness of the draft standard identified in the hazard analysis by the staff. This same criterion is specified in TB 603.

Early total heat release criterion: According to NIST research, untenable fire conditions could occur in a room from a fire producing 25 MJ in the first 10 minutes. This total heat

release limit in the first 10 minutes is the early performance criterion required by TB 603. Limiting the early contribution of the mattress to the fire size will have the greatest impact on reducing the risk of flashover as the mattress will have little involvement in the fire for the specified period of time. This allows for early discovery and escape from the fire in a timely manner. In the draft proposed standard, a lower early limit of 15 MJ in the first 10 minutes was chosen. This limit partially compensates for the contribution to the fire made by an uncertain combination of burning bedclothes, although it may not be as effective for cases involving larger bedclothes. This measure of the total heat release in the first 10 minutes is a simple and practical measure that ensures a substantial increase in escape time by slowing the rate of fire growth and minimizing the fire severity. **(TAB B)**

This total heat release limit is also intended to maintain the historically low fuel load contribution of non-FR mattress tickings and give manufacturers maximum flexibility to use many different mattress tickings on their products without additional prototype testing. If the ticking provides the fire barrier properties of the system, however, ticking changes must be supported by a demonstration, based on objectively reasonable criteria, that the change will not cause the prototype to exceed the test criteria. According to members of the mattress industry and researchers who have shared their test data, there are numerous technologically feasible and viable solutions for meeting this proposed 15 MJ limit.

3. Other Major Technical Requirements/Specifications

Test duration: The test duration is related to, but not equivalent to, the egress time provided under typical real-world scenarios. This is because the burning initiated by the fixed burners in the test progresses more slowly over the mattress than the burning propagated by actual bedclothes. A mattress performing well for a 30 minute test, as proposed in the draft standard, is estimated to provide an adequate time for discovery of the fire and escape by occupants in the bed or otherwise in the room of origin under certain conditions. The mattress adds little to the fuel load of the burning bedclothes, providing a substantial increase in available escape time over current mattresses. **(TAB B)**

Presently, the mattress is typically the main contributor to the fire. Consequently, an improved mattress design will have the most impact on escape time. The uncertainty of the hazard, severity of the fire, and potential contribution of other items in the room significantly increase after a test time of 30 minutes. According to multiple test results from NIST, CBHF, and manufacturers, a large number of mattress designs (using a range of barrier technology) can perform well in tests with gas burners for 30 minutes. Many of the tested designs are able to meet the proposed test criteria for 30 minutes, but perform erratically after 30 minutes. The number of failures, test variability, and performance unreliability increase significantly after 30 minutes. The range of technologically feasible and viable solutions and design choices for meeting the proposed test criteria for 30 minutes is substantial. The staff considers a 30 minute test an appropriate test duration for addressing the identified hazard.

The staff also considered 60 minutes as a test duration option. The flame spread around a mattress after burner exposure can take up to 60 minutes for some mattress designs. Burning bedclothes, on the other hand, expose the entire mattress to flames faster than the localized burners. Because of this, some have suggested that the test time should be 60 minutes. The draft proposed standard does not include this option for the following reasons. Test result variability increases considerably after 30 minutes. A 60 minute test presents higher test costs and substantially limits the number of technologically feasible and viable design choices. Most importantly, the additional benefits in terms of reduced injuries and deaths from a 60 minute test are uncertain and unpredictable. **(TAB C)**

Test specimen size for prototype tests: NIST test observations show that twin size mattress designs that yield a very low heat release rate peak (less than 50 kW) with gas burners behave essentially the same as a queen or king size mattress of the same design. Mattress designs that yield a moderate heat release rate peak (greater than 100 kW, but within proposed test limits) tend to behave the same for the first 30 minutes whether twin size or king size. After ignition with the burners, the fire involving mattress materials is localized and not sensitive to mattress size. The fire slowly burns away from the area exposed to the burners and, with no further input from the burners, eventually reduces in intensity.

Based on these findings from NIST, there appears to be strong correlation between twin and king size within designs for a specified time period when exposed to gas burners. The staff's draft proposed standard, therefore, allows tests of twin size prototype samples to represent larger mattresses produced. This provision also minimizes test sample costs and makes a larger number of laboratories available for testing mattresses.

Test replicates for prototype tests: In developing the requirements of the standard, the staff has been sensitive to the high costs of conducting full-scale mattress tests. The draft proposed standard generally requires a minimum of three specimens of a prototype to be tested (each yielding passing results) before mattresses based on that prototype can be sold. (There are exceptions to the testing requirement for prototypes that closely resemble previously tested prototypes.). The numerous research studies (referenced in **TAB B**) have typically used replicates of three for mattress tests with the gas burners. As the industry has conducted research to develop options for meeting California TB 603 requirements and a possible federal standard, testing three replicate specimens has been common practice. The inter-laboratory study also used three replicates per design for the test series. Based on a preliminary analysis of the inter-laboratory study, testing three replicates appears to identify mattress set performance, relative to the proposed criteria, for an individual laboratory.

Test configurations: The draft proposed standard allows the test to be conducted either in an open calorimeter (with no enclosing walls) or a test room configuration. Room effects are a factor in mattress performance and are determined by the radiative interaction between the bed fire and the hot gas layer accumulating at the ceiling of the room. However, relevant data show that room effects do not become an issue until a fire reaches

13

about 300 to 400 kW. (See NIST research in **TAB B.**) The draft proposed standard limits the peak rate of heat release to 200 kW. Therefore, no appreciable differences in test measurements are expected among the test configurations for complying mattresses with peak heat release rates of 200 kW or less. Since a preliminary analysis of the inter-laboratory study data does not suggest any significant differences between tests based on either test configuration, either configuration is acceptable. A smaller test room configuration, not available for the inter-laboratory study but included in TB 603, was not included in the draft proposed standard because of the awkwardness of using the burners in the room and operator safety concerns.

C. Incident Data and Hazard/Effectiveness Evaluation (TAB C)

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 annual survey. Several of the NFIRS data variables were used to determine whether an incident was a mattress or bedding fire, to determine an incident's addressability by the draft proposed standard, to identify intentional fires (excluded from the estimates), to determine a fire's heat source type (smoking materials, small open flame, other), and to 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 C.**

The most recent national fire loss estimates indicate that mattresses and bedding were the first items to ignite in 19,400 residential fires attended by the fire service annually during 1995 – 1999. These mattress and bedding fires resulted in an estimated 440 civilian deaths, 2,230 civilian injuries, and $273.9 million property loss annually. Based solely on the characteristics of the fire cause, an estimated 18,500 fires causing $259.5 million in property loss annually were considered **addressable** by the staff's draft proposed standard. The estimated 440 deaths and 2,160 injuries that occurred in these fires annually are considered potentially preventable by the standard. Among the addressable casualties, smoking fires accounted for 210 deaths (48 percent) and about 640 injuries annually (30 percent). Open flame fires accounted for about 140 deaths (32 percent) and 1,050 injuries annually (49 percent).

2. Evaluation of Effectiveness of the Draft Proposed Standard

As mentioned earlier in the research discussion, current mattress fires can reach flashover conditions in less than 5 minutes. Full-scale tests at NIST demonstrated that it is feasible to manufacture mattresses that have substantially improved fire performance over those produced today. The NIST tests indicated that the presence of an improved mattress in a fire would have the effect of extending the escape time available to room occupants to 10 to 15 minutes before conditions in the room become untenable. In addition, the draft proposed standard is expected to minimize the likelihood of flashover during the first 30

minutes; thus avoiding spread of the fire to other areas of the occupancy during that period.

The test method used in the draft proposed standard is expected to reduce losses caused not only by traditional small open flame sources such as lighters, matches, and candles, but also other small open flame sources, smoking fires, and nearby heat sources. It is noted that, regardless of the initial heat source, investigation data indicated that once a fire ignited, the bedding present also ignited, which would produce a flame similar to that used in the NIST tests and draft proposed standard.

The staff evaluated the effect of the draft proposed 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. The evaluation was based on research of the technical literature and discussions with technical experts. The CPSC staff was unable to locate any time-based data on evacuation from residential occupancies. Moreover, most fire incident databases capture details only about the casualty, providing little if any information about the presence of other members of the household, unless they too were injured. Characteristics of mattress/bedding fires as they progress and factors influencing human response to these fires are discussed in **TAB B** and **TAB D**. The evaluation of effectiveness was based primarily on review of CPSC in-depth investigations conducted by CPSC field staff to provide detailed information about fires that ignited mattresses and bedding, details of the occupants' situations, and occupants' actions during the fire. Most investigations also included documentation from the fire department that attended the fire.

The in-depth investigations involved fires occurring during 1999 – 2004, and included a total of 195 deaths and 205 injuries. The distribution of mattress ignition sources in these cases is not representative of all mattress-involved fires. To adjust for this situation, both the casualties reported in the investigations and the national fire loss estimates of casualties were sub-divided into matching categories of heat source and age group combinations. The staff estimated reductions in deaths and injuries for each category by the methodology described below. The expected percentage reduction in deaths or injuries within a category of investigated casualties was applied to the national estimate for that category to estimate the number of casualties reduced. The results were then summed to estimate the overall number of deaths and injuries prevented and the overall percentage reductions. (See **TAB C** for detailed discussion.)

Staff reviewers identified criteria (listed below) that affected the ability of individual occupants to escape the fires they experienced. The methodology and rationale for applying these criteria are discussed in detail in **TAB C**. The criteria were used to estimate percentage reductions in deaths and injuries expected to occur under the much less severe fire conditions anticipated with mattresses conforming to the draft proposed standard. Evaluations of fire incidents assumed an improved fire scenario based on the results of NIST tests, mathematical modeling, and a proposed test period of 30 minutes.

15

The staff considered a number of factors that appeared to affect the likelihood of death or injury, including:

- the location of the casualty in relation to the point of fire origin,
- age of the casualty,
- whether the casualty was asleep, awake, or unable to act on his own due to extreme age (young or old) or disabilities,
- if the casualty was asleep, whether there was an indication that the person woke up (evidenced by being found not on the bed),
- if the casualty was of extreme age or disability, whether there was a potential rescuer in the household,
- presence of any other limiting conditions (less severe) that would be expected to reduce the casualty's ability to escape, e.g., drugs, alcohol, mental or physical limitations,
- whether the casualty engaged in fighting the fire.

3. Estimated Death and Injury Reductions

Overall, the staff estimates that the draft proposed standard may be expected to prevent 80 to 86 percent of the deaths and 86 to 92 percent of the injuries presently occurring in addressable mattress/bedding fires attended by the fire service. Applying these percentage reductions to the most recent available estimates of addressable mattress/bedding fire losses (1998 – 2002), an estimated 310 to 330 deaths and 1,660 to 1,780 injuries resulting from mattress and bedding fires could be prevented annually by the draft proposed standard. The ranges of percentage reductions cited above reflect the ranges of assigned probabilities attached to the general categories of "likely," "possible," and "unlikely" deaths and injuries remaining, as developed by the CPSC staff. They do not represent statistical confidence intervals. Since the potential for flashover fires is expected to be reduced, a large part of the annual property loss may also be prevented.

For children, the relatively high proportion of casualties that could be prevented is a result of the increased time that would be available for other residents to return for rescue. Currently, many people who did not exit immediately could not be rescued later. Adults at the point of ignition would benefit primarily from the increased time during which air in the room would continue to be breathable. Except in rare circumstances, everyone who was outside the room of origin when the fire ignited would survive, though some would be injured if they returned to fight the fire.

Deaths and injuries that could be prevented by a standard requiring a 60 minute test were not specifically calculated. However, the maximum additional losses that could be prevented would be 80 deaths and 280 injuries per year, the difference between the total deaths and injuries considered addressable and those expected to be reduced by a standard with a 30 minute test. The likely reductions, however, would be much lower. In view of the characteristics of those considered likely to die or be injured in conditions associated with a proposed 30 minute test, e.g., those incapable of acting on their own and with no potential rescuer in the occupancy, the chances of their rescue are unpredictable.

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

To address the hazard associated with the ignition of mattresses, the CPSC staff developed a draft performance standard to reduce mattress ignitions without creating other hazards to consumers. The CPSC staff conducted a qualitative assessment of the potential risk that might result from consumer exposure to fire retardant (FR) chemicals used in mattresses designed to meet the draft proposed mattress flammability standard.

CPSC staff assesses a product's potential chronic health effects to consumers under the Federal Hazardous Substances Act (FHSA). The FHSA is a risk-based regulation. To be considered a "hazardous substance" under the FHSA, a consumer product must satisfy a two-part definition. 15 U.S.C. §1261 (f)(1)(A). First, it must be toxic under the FHSA, or present one of the other hazards enumerated in the statute. Second, it must have the potential to cause "substantial illness or injury during or as a result of reasonably foreseeable handling or use." Therefore, exposure and risk must be considered in addition to toxicity when assessing potential hazards under the FHSA (CPSC, 1992).

The staff completed toxicity reviews on five chemicals/chemical classes that may be used to meet the draft proposed standard. These chemicals are: antimony trioxide, boric acid/zinc borate, decabromodiphenyl oxide, melamine, and vinylidene chloride. Data on potential exposures to FR chemicals does not exist. Because of the lack of exposure data, a quantitative risk assessment could not be made. Instead, staff conducted a qualitative assessment of the potential risk of health effects from exposure to FR chemicals that may be incorporated to meet the draft proposed standard based on an assessment of available toxicity data, knowledge of how FR chemicals might be used in mattresses, and staff's professional judgment.

The staff believes there are fire retarding methods (e.g., FR-treated barriers) available to mattress manufacturers that are expected to present only a negligible risk of adverse health effects in consumers. This staff opinion is based on the use of polymerized melamine compounds (resins) and vinylidene chloride in the manner described by the manufacturers of the barriers containing these compounds. Exposure data for antimony, boric acid/zinc borate, and decabromodiphenyl oxide are needed before more definitive conclusions about the potential risk of adverse health effects from these chemicals can be made.

CPSC staff will continue to obtain information on the possible techniques the manufacturers will likely use to meet the draft proposed standard, including the specific FR chemicals that will be used, and the amounts applied to specific mattress components. CPSC staff is planning migration/exposure assessment studies on treated mattress components to obtain data needed to quantify the amount of FR chemical that may be released from these mattress components. These data can then be used to more reliably estimate the potential health risks associated with the use of FR chemicals in mattresses.

E. Environmental Assessment (TAB F)

In considering the potential environmental and human health effects of the draft proposed 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 some kind of flame resistant barrier material to protect the mattress 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. It is likely that 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 or decabromodiphenyl ether).

Manufacturers will have flexibility in meeting the performance requirements of a 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 also some data gaps and uncertainties in our knowledge of some of the health and environmental impacts of many of the chemicals that could be used to meet the standard. Still, there are FR chemicals and flame resistant materials that, based on currently available data, are not expected to pose unacceptable risks to the environment and are widely used in other applications. Therefore, manufacturers appear to have 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 even 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, such as advocacy group activities and manufacturer liability concerns, which can control the use of specific flame retardants if they are found to pose hazards to the environment or human health.

F. Preliminary Regulatory Analysis and Regulatory Flexibility Analysis

The *Preliminary Regulatory Analysis,* found at **TAB G**, discusses the benefits and costs associated with the proposed standard and other options to address mattress fire safety. The *Initial Regulatory Flexibility Analysis for the Draft Proposed Standard to Address Open-Flame Ignitions of Mattresses,* also found at **TAB G**, reviews the potential economic impact on small entities, including small businesses. It describes significant alternatives to the rule that were considered to accomplish the stated objectives of the rulemaking while minimizing significant economic impact on small entities.

The benefits of the draft proposed 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 ten years and a discount rate of three percent, the total lifetime benefits of a mattress that complies with the proposed standard are expected to be around $62 to $74. Costs of the draft proposed standard are the increase in total resource costs (e.g., costs of material, labor, testing, and compliance efforts) that are expected to result from the draft

18

proposed standard. The total resource cost of the draft proposed standard is expected to be around $13 to $44 per mattress, yielding net benefits (i.e., benefits minus costs) of $18 to $62 per mattress.

Aggregate lifetime benefits associated with all mattresses produced during the first year the standard becomes effective (approximately 25.3 million mattresses) are expected to range from $1,560 million to $1,880 million. Aggregate resource costs associated with these mattresses are expected to range from $320 million to $1,110 million, yielding net benefits of about $450 million to $1,560 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 of the draft proposed standard. Alternatives to the draft proposed standard were considered, including varying the test duration, performance criteria, and production testing frequency. The staff also examined changing the effective date of the standard, relying on voluntary standards, requiring certain labeling (warning and flame retardant chemical contents), and taking no action.

The draft proposed standard is expected to minimize the impact on small businesses, while maintaining the benefits resulting from the standard. The cost of testing, record keeping, and quality control/quality assurance programs could be disproportionately higher for small businesses. While these costs are estimated to be a little over one dollar per mattress per year for average-sized establishments, they could be substantially higher for some small mattress producers. The draft proposed standard, however, allows manufacturers to "pool" or share their prototype qualification and testing, and thus these costs can be mitigated. Moreover, if manufacturers produce mattress/foundation constructions for longer than a year or use a worst-case prototype to represent other mattress constructions, these costs will be lower. It is also expected that some barrier suppliers and independent testing laboratories would be willing to do the testing and quality control/assurance programs for small producers in exchange for a small charge.

G. Compliance Requirements

Implementing regulations are included in Subpart B of the staff's draft proposed standard. Manufacturers (including importers) of mattresses are required to test and qualify mattress designs or prototypes before they are introduced into commerce. Detailed design specifications for prototypes, including materials and construction, must be documented along with the records of all prototype tests. If a manufacturer is relying on the prototype tests and qualification by another supplier or manufacturer, through a cooperative agreement known as "pooling", he must conduct a confirmatory test and retain those test records as well. Manufacturers do not need to test other prototypes differing only in specified respects from a previously tested and qualified prototype. A manufacturer must demonstrate that a change in any component, material or method of construction (other than size and non-FR tickings) will not cause a prototype to exceed the test criteria specified in the draft proposed standard.

All manufacturers must implement a quality assurance program to ensure that mattresses and mattress and foundation sets they produce are identical in all material respects to the prototype on which they are based. This includes control of incoming materials and inspection of assembled mattresses. Testing of production mattresses is encouraged as part of the quality assurance program. Permanent labeling of the mattress or mattress/foundation is required to indicate the manufacturer, location of the manufacturer, date of manufacture, style/model of the mattress/bed set, prototype identification number, and a certification that the mattress complies with this standard.

The CPSC staff is preparing for possible compliance testing needs by developing full-scale test capabilities at other federal government laboratories. In July 2004, the CPSC established a Memorandum of Understanding with the Bureau of Alcohol, Tobacco, Firearms, and Explosives' (ATF) Laboratory, part of which includes an effort to develop and qualify the ATF Fire Testing Laboratory to conduct full-scale mattress testing. In late 2004, CPSC staff, working with ATF, expects to complete a series of tests to calibrate and qualify the calorimetry test hoods at the ATF's test facility in Ammendale, Maryland. The staff will then be able to conduct any additional regulatory and compliance methodology development testing that may be needed for mattresses and bedding. In 2005, CPSC staff will develop a similar agreement with NIST so that a back-up test facility will be available should ATF program work adversely affect the timeliness of CPSC compliance tests. For the future, the CPSC staff is working to develop its own full scale calorimetry test facility as part of the CPSC Laboratory Modernization Plan.

IV. DISCUSSION—OPTIONS FOR BEDCLOTHES

When the Commission began rulemaking in 2001 for a standard to address open flame ignition of mattress/bedding fires, the emphasis was primarily on the performance of the mattress which is typically ignited by burning bedclothes. Commenters on the mattress ANPR raised the issue of a separate standard for bedclothes. The discussion below summarizes available incident data, research defining the role of bedclothes in mattress/bedding fires, market information on the bedclothes industry, existing standards, relevant state regulatory activities, and options for addressing associated fire losses.

Mattresses and bedding are often involved in the same fires, most often ignited by traditional small open flame sources such as candles, matches, and lighters. Other small ignition sources include heat escaping from fueled equipment, short circuit arcs, and heat from overloaded equipment. Typically, the small open flame source ignites the bedclothes, which in turn ignite the mattress. The bedclothes contribute to the magnitude of the fire by creating a large open-flame source that can ignite the mattress and lead to dangerous flashover conditions. Much of what we now know about the role of bedclothes in mattress/bedding fires comes from recent laboratory research where the burning behavior of mattresses and bedclothes can be studied together and separately. Even with a substantially improved mattress, certain bedclothes combinations have produced near flashover conditions in these laboratory tests. **(TAB B and I)**

20

A. Incident Data (TAB H)

The earlier section on mattress/bedding fire incident data describes the most recent estimates of national fire losses associated with these products. Based on these data alone, it is very difficult to determine whether the first item ignited was a mattress or an item of bedclothing. A staff review of CPSC databases and 241 in-depth investigations is given in **TAB H**. Among the in-depth investigations reviewed (which include more details of the incident scenarios), it appears that non-electric bedclothes items were the first items to ignite in about 80 percent of mattress/bedding fires.

Ignition sources included cigarette lighters (primarily children playing), candles, smoking materials, and other nearby heat sources. It is difficult to draw conclusions about the relative propensity of specific types of bedding items to ignite because there is little information about the prevalence of bedding items in use generally and about the bedding items present for most of the investigated fires. The data reviewed indicated that bedding was a major contributor to ignition in fires that ignited mattresses. The data also indicated that once a fire was ignited, most bedding items that were present ignited at some point in the ensuing fire.

B. Research on Bedclothes Involvement in Fires (TAB I)

Several research projects were conducted to gain a more thorough understanding of the hazards and scenarios associated with open flame-ignited mattress and bedding fires. References for these study reports are given in **TAB I**. Although much of the research focused on mattresses and foundations, the significant contribution of bedclothes to the hazard often necessitated the inclusion of bedclothes in tests.

The SPSC sponsored several phases of research at NIST that focused on the flammability of mattresses exposed to burning bedding. These early tests measured peak heat release rates of typical bedclothes combinations (sheets, mattress pads, blankets, pillows, and comforters) burned on an inert mattress. The 12 combinations all produced peak heat release rates less than 200 kW. Combinations without comforters typically produced less than 100 kW. This work formed the basis for the full-scale test method that measures the performance of mattresses involved in typical residential fire scenarios.

The CBHF later tested a heavier twin size comforter that produced a 400 kW peak heat release rate. SPSC then expanded its research at NIST by adding tests of filled bedclothes (e.g., comforters, pillows, and mattress pads) made with new fabrics and filling materials with fire-blocking properties to assess the effect of material changes on flammability behavior. Prior research suggested that as the performance of the mattress improves, the heat release rate of a complete bedding system might approach that of the bedclothes *alone*. Since the peak rate of heat release for some bedclothes combinations alone can be a significant threat, further reduction of the mattress/bedding fire hazard could depend on lessening the contribution from the bedclothes. This could also slow the rate of burning of the overall bed system, since the fire performance of the mattress and

21

foundation depends on the extent and duration of the ignition source, which is typically the bedclothes.

The NIST report on the bedclothes study was published in February 2003. According to NIST, for a mattress standard to be most effective, the performance of the entire bedding ensemble must be taken into consideration. The study showed that the bedclothes and the mattress/foundation function as a system and that improved mattress pads, pillows, and comforters resulted in major improvements in the performance of the system. This was indicated by a lower peak heat release rate or a longer time to peak. The study also showed that improved mattress designs with reduced peak heat release rates have less potential involvement or synergism with bedclothes. In the tests, an early peak rate of heat release was caused by the flammability behavior of the bedclothes, and the bedclothes had burned away before the late peak heat release rate occurred from the mattress. Both NIST and CBHF tests (in support of California regulation) showed that bedclothes constructed with improved filling materials performed better than those with conventional fillings.

A related research project conducted for CPSC by NIST in 2003 reinforced one of the conclusions of the bedclothes study. Although the project was focused on mattress flammability, a portion of the tests were conducted using conventional bedclothes instead of the burners that simulate burning bedclothes. These tests showed that, as mattress designs are improved, two separate peak heat release rates are observed. The first observed peak appears to be dominated by the bedclothes, while the second is dominated by the mattress and foundation. Good mattress designs tended to have a peak heat release rate appreciably later in the test and comparable to or less than the peak dominated by the bedclothes.

The available NIST data shows that bedclothes tend to burn in a similar pattern, despite the range of observed heat release rate peaks among bedclothes combinations. After ignition, the first few minutes are generally characterized by slow burning and very low heat release. Typically the bedclothes peak occurs between 5 and 10 minutes after ignition. The fire intensity recedes as the fuel from the bedclothes is consumed, usually a few minutes after the peak.

A more recent study on mattress flammability conducted by NIST in 2004 for CPSC, included a series of tests using the same bedclothes combination on twin, queen, and king size mattresses. The tests were conducted in a room environment to evaluate any resulting room effects, which generally begin to appear at heat release rates of about 300 to 400 kW. The early heat release rate peaks, driven primarily by burning bedclothes, were shown to triple from twin size to king size. Larger size bedclothes combinations on good performing mattress designs (less than 50 kW when tested with burners and no bedclothes) showed heat release rate peaks up to 800 kW, occurring 7-8 minutes after ignition. On mattress designs that yield a moderate heat release rate peak with burners, the bedclothes resulted in more serious fires.

22

The study shows that a combination of some bedclothes and a mattress/foundation producing less than a 50 kW peak rate of heat release is sufficient to cause flashover of the room. These findings were incorporated into the effectiveness estimation of the draft proposed mattress standard. The high peak heat release rates observed from some larger bedclothes items, much higher than that allowed for a mattress/foundation in the draft proposed mattress standard, suggests the need for limits on some bedclothes as well.

C. California Regulatory Activity (TAB I)

The California state legislature passed Assembly Bill 603 (AB 603) mandating that the CBHF issue a standard for mattresses/bedding flammability by January 2004. The CBHF is also required by this legislation to mandate an open flame standard for bedclothes if bedclothes are found to contribute to mattress fires. Based upon the research by NIST and their laboratory, CBHF determined that regulation of filled bedding is appropriate. In cooperation with a group of industry representatives called the TB 604 Bedclothing Task Force, CBHF conducted additional tests of bedclothes (comforters, mattress pads and pillows) to obtain flammability data for their rulemaking process. CBHF is attempting to develop a small-scale test that will predict the flammability behavior of filled bedclothes.

CBHF prepared a draft standard that was discussed in the Task Force in 2003; it was withdrawn because of technical problems with the test method. California has been working directly with individual manufacturers to prepare another approach. CBHF issued a new draft of the TB 604 standard on October 1, 2004, and scheduled a Task Force meeting for November 16, 2004, to discuss it. Based upon comments from the meeting, CBHF expects to open formal rulemaking at the end of the year and hold hearings in January or February 2005.

D. Existing Standards (TAB I)

Currently, there are no mandatory flammability requirements for residential bedclothes or bedding items in the United States. A limited number of voluntary standards apply to bedding items. ASTM D4151-92(2001) measures ease of ignition and surface flame spread of blankets. Underwriters Laboratories (UL) has a standard for electric blankets. ISO 12952—*Textiles—Burning behaviour of bedding items, Parts 1-4*, specifies a general test method for assessing the ignitability of bedding items. The test method allows observation of progressive smoldering and/or flaming when a bedding specimen is exposed to a small propane burner. None of these tests appears adequate to measure or address the specific hazard posed by a bedclothes item or its contribution to a residential mattress/bedding fire.

E. Market Information—Bedclothes

Textile bedding products include sheets, blankets, mattress pads, pillows, comforters, and similar products. Those that contain fibrous or other materials are called "filled" bedding. They are more likely than unfilled products (sheets and blankets) to contribute

significantly to a mattress/bedding fire because of their mass or fuel load. **TAB J** presents preliminary product and market information for these products, including the results of a 2003 survey conducted by the American Textile Manufacturers Institute (ATMI) on the U.S. market for filled textile bedding products.

While the U.S. firms surveyed by ATMI reportedly account for 80 percent of the U.S. market of filled bedclothes, "outsourcing" has become increasingly common with these products. A sizeable portion of filled bedding is produced outside the U.S. According to U.S. Department of Commerce 2002 import statistics, perhaps 90 percent of all quilts and comforters and perhaps 20 percent of bed pillows are imported.

According to the ATMI survey, the most common filling material for bedclothes is conventional polyester (non flame-resistant). While improved filling materials that could replace polyester are being developed for the mattress industry and may also have applications in filled bedclothes, cost increases will depend upon the fire performance requirements established by an applicable standard. Other approaches to improving the fire performance of filled bedclothes include the use of barrier fabrics or flame resistant outer fabrics. Costs and other economic effects of using these materials would also be developed in the context of a specific performance standard.

All-foam mattress pads, including "egg crate" and memory foam types, are constructed of the same types of foam used in mattresses and filled bedding products and could also contribute significantly to mattress/bedding fires. Industry estimates suggest that approximately 7 to 8 million units of these products are sold each year. Methods and costs of improving the fire performance of these products would also be developed in the context of a specific performance standard.

F. Discussion of Bedclothes Flammability

The flammability hazard from open flame ignition of bedclothes depends on the likelihood of ignition, burning intensity, potential to ignite nearby combustibles, and possibility of reaching conditions to cause flashover. These are the same hazard parameters of concern when a mattress is ignited by an open flame. Recent flammability research programs have provided an improved understanding of residential mattress and bedclothes fire scenarios and supporting data on mattress and bedclothes flammability behavior. The data clearly show that a relationship exists between the mattress and bedclothes in a fire and that they interact as a system.

Limited data on the flammability of bedclothes tested alone suggest that filled bedding items contribute to the fire hazard and have the potential to be modified to improve performance. Tests show that as the performance of the mattress improves, the contribution of the bedclothes to the fire hazard becomes more obvious and separate from the contribution of the mattress. Peak heat release rates as high as 800 kW were observed from some larger bedclothes items. This is much higher than the 200 kW allowed for a mattress/foundation in the staff's draft proposed mattress standard.

The extent to which bedclothes can be modified in a technologically practicable and economically feasible manner is unclear at this time. However, as more research is conducted on bedclothes flammability, an increasing emphasis is being placed on the need for reducing the contribution of filled bedding items (mattress pads, pillows, and comforters) to reduce the risk of creating flashover conditions from a mattress/bedding fire.

V. MATTRESS ANPR COMMENTS AND ANALYSIS

The Commission's ANPR to develop a mandatory open-flame standard for mattresses was published in the *Federal Register* on October 11, 2001. During the comment period, the CPSC received a total of sixteen written comments from businesses, associations and interested parties representing various segments of the mattress and bedding industries. Since then a number of additional substantive comments have been submitted, dealing with issues specific to the evolving standard being considered by the staff. These comments (listed in **TAB A**) and the staff's responses are discussed below.

A. Mattress Comments

1. *Commenters agree that the hazards associated with mattress fires appear to be clearly identified. All of the commenters support the need for an open flame standard for mattresses and initiation of federal rulemaking.*

CPSC staff agrees that mattress and bedding fires continue to be one of the major contributors to residential fire deaths and civilian injuries among products within CPSC's jurisdiction. The most recent national fire loss estimates indicate that mattresses and bedding were the first items to ignite in 19,400 residential fires attended by the fire service annually during 1995 – 1999. These fires resulted in an estimated 440 civilian deaths, 2,230 civilian injuries, and $273.9 million property loss annually. In these fires, the bedclothes are most frequently ignited by a small open flame source. The burning bedding then creates a large open-flame source igniting the mattress and creating dangerous flashover conditions, the point when the entire room and its contents are ignited simultaneously by radiant heat.

The draft proposed standard is designed to address the identified hazard of flashover resulting from open flame ignition of mattresses, usually from burning bedclothes. Under the draft proposed standard, mattresses and mattress/foundation sets are exposed to gas burners, simulating burning bedclothes. Mattresses are required to meet two performance criteria that minimize the possibility of or delay flashover for a period of time. Mattresses must not exceed 200 kW peak heat release rate during the 30 minute test, and the total heat released must be less than 15 MJ for the first 10 minutes of the test.

2. *Most commenters endorsed the direction of the mattress flammability test development research underway at the National Institute of Standards and Technology and encouraged the CPSC to issue a technologically practicable, reasonable standard. More*

recent commenters suggest California Technical Bulletin 603 be adopted as the federal standard.

CPSC staff agrees with the technical approach suggested by the NIST research. A majority of the commenters agreed that preventing flashover from mattress fires would appropriately address the risk and that a full scale test with an ignition source comparable to burning bedclothes could achieve that objective. They strongly supported the NIST approach and discouraged the adoption of any existing standards.

Before California's adoption of TB 603, one commenter suggested using a modification of the small-scale British test, BS 5852, for smoldering and flaming ignition of upholstered furniture seating composites. However, a full-scale rather than small-scale test is generally considered the most reliable method for measuring performance of a product that contains many materials in a complex construction, such as a mattress. NIST research confirmed that a full-scale test of the mattress was needed to measure its performance when exposed to burning bedclothes or the representative set of gas burners. Their comprehensive, scientifically based research program was designed to address the open-flame ignition of mattresses and bedclothes under controlled conditions closely resembling those of real-life fire scenarios. The program focused on understanding the dynamics of fires involving mattress and bedclothing assemblies and on developing an appropriate and technologically practicable methodology to effectively measure the hazard.

NIST subsequently prepared a test method which the State of California incorporated into Technical Bulletin (TB) 603, "Requirements and Test Procedure for Resistance of a Mattress/Box Spring Set to a Large Open-Flame" in 2004. The staff's draft proposed standard is also based on the test method developed by NIST. Research on mattress and bedclothes fires conducted by NIST for CPSC and the industry provides the basis for the test criteria specified in the draft proposed standard. Manufacturers and suppliers have demonstrated that mattress designs complying with these performance criteria and suitable for the residential market can be produced.

3. One commenter requested the exclusion of certain product categories, such as mattresses used for therapeutic reasons and in healthcare environments, from an open flame standard.

The staff's draft proposed standard includes all mattresses, including those used in or as part of upholstered furniture items. "One-of-a-kind" mattresses and foundations are defined as physician prescribed mattresses to be used in connection with the treatment or management of a named individual's physical illness or injury. These products may be exempted from testing under the draft proposed standard in accordance with the rules established by the Commission. The draft proposed standard requires them to be permanently labeled with a warning statement indicating that the mattress and foundation have not been tested under the standard and may be subject to a large fire if exposed to an open flame.

4. In October 2003 the California Bureau of Home Furnishings (CBHF) urged the Commission to adopt their new standard, California Technical Bulletin 603 (TB 603). Subsequently, a number of commenters expressed written support for adopting the TB 603 test methodology and performance criteria.

CBHF claimed that harmonization of California and federal standards would avoid a number of potential problems. They noted potential problems such as possible federal preemption and negative impacts on interstate commerce. Since TB 603 is a newly developed methodology, CBHF suggested that an inter-laboratory study be conducted before a potential adoption of TB 603 by CPSC. They noted that data obtained from an inter-laboratory study would verify the credibility of the test method.

An inter-laboratory study was conducted with the support of SPSC, NIST, CBHF, and other participating laboratories to collect additional data and confirm the test protocol developed by NIST. A number of laboratories participated in the study to evaluate sensitivity, repeatability, and reproducibility of the test protocol. While the final report is not yet available, preliminary analysis of the data does not suggest either unreasonable sensitivities or practical limitations in the test protocol.

The CPSC staff's draft proposed standard is similar to California's TB 603. The draft proposed standard and TB 603 use the same test method and limit the peak rate of heat release of a mattress or mattress/foundation to 200 kW during the 30 minute test. TB 603 also limits the size of the fire produced in the first 10 minutes of the test to 25 MJ. According to NIST research, untenable fire conditions could occur in a room from a fire of this size. Unlike TB 603, the staff's draft proposed standard requires that the mattress itself contribute no more than 15 MJ to the early fire scenario. This ensures that the mattress will have little involvement in the fire for the specified period of time. This lower limit partially compensates for the contribution of an uncertain combination of burning bedclothes on the bed, helping to preserve tenable conditions for egress.

5. Two commenters recognize the sophistication and complexity of the test method used in California TB 603 and potentially in a federal standard. They suggest that CPSC explore laboratory accreditation programs to ensure test labs are properly qualified to conduct this complex test.

The interlaboratory study may identify laboratory practices, equipment, and other related factors that must be controlled to ensure consistent and accurate test results. The report and findings of the study will be available to the public; and appropriate guidance can be provided to interested laboratories. While accrediting test laboratories is not a CPSC function, the staff supports industry and commercial laboratory development of such a program.

6. A commenter expressed concerns about environmental impact and consumer sensitivity to flame retardants that may be used in mattresses, whether topically applied or integrated into fibers. The commenter recommends requiring a label that discloses the

use of flame retardants in the mattress and provides a source of more specific information.

Mattress fire performance can be improved by incorporating fire retardant chemicals into component materials or by using materials that are inherently fire resistant. Flame retardant chemicals are already widely used in other applications. More than one billion pounds of different flame retardant chemicals are currently used annually in the United States, including applications in many consumer products. There are also flame resistant (FR) materials that may be used for mattress barriers that have other consumer product applications. For example, melamine resins, which can be used in FR barriers, are also used in many laminated counter tops.

The CPSC staff believes that there are available options for meeting the standard without posing an unacceptable health risk to consumers or significantly affecting the environment. Moreover, even if a method used by some manufacturers to meet the standard did turn out to pose an unacceptable risk, there are regulatory and other mechanisms that can be used to control that particular method.

The commenter suggested labeling of chemically treated components as a possible requirement of the standard, to inform consumers of the materials used. The staff's draft proposed standard requires manufacturers to maintain records specifying details of all materials, including flame retardant treatments applied and inherently flame resistant materials, used in each mattress design (prototype) and a record of all mattresses based on a given prototype. This will allow identification of relevant mattresses and mattress/foundation sets if an unacceptable risk is identified.

7. Another commenter recommended test provisions in the standard that address the long term durability of the flame retardant chemicals used in mattresses to ensure they continue to meet the fire performance requirements.

It is expected that most manufacturers will use some kind of flame resistant barrier material to protect the mattress 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. It is likely that these barriers will be made with an inherently flame resistant fiber (e.g., para-aramid or fiberglass) or by treatment with flame retardant chemicals, many of which are incorporated within the fiber, foam, or other material. At this point in the development of technologies that may be used to meet TB 603 or the staff's draft proposed standard, the staff has seen no evidence that suggests that changes in these materials over time will occur or affect fire performance.

8. One commenter expressed concerns about the potentially severe economic impact of a federal regulation, similar to TB 603, on small businesses.

The staff acknowledges that the cost of testing, record keeping, and quality control/quality assurance programs could be disproportionately higher for small

businesses. While these costs are estimated to be a little over one dollar per mattress per year for average-sized establishments, they could be substantially higher for some small mattress producers. The draft proposed standard, however, allows manufacturers to pool their prototype qualification and testing, and thus these costs can be mitigated. Moreover, if manufacturers produce mattress/foundation constructions for longer than a year or use a worst-case prototype to represent other mattress constructions, these costs will be lower. It is also expected that some barrier suppliers or independent laboratories would be willing to do the testing and quality control/assurance programs for small producers in exchange for a small charge. Therefore, the draft proposed standard is expected to minimize the impact on small businesses, while maintaining the benefits resulting from the standard.

The staff recommends that the *Federal Register* notice requests comments from small businesses on the expected economic impact of the requirements of the proposed standard and the proposed effective date of 12 months after publication of the final rule in the *Federal Register.*

9. One commenter reported that some juvenile or crib mattresses, while meeting the 200 kW peak rate of heat release requirement, produce large amounts of flaming droplets that have the potential for spreading flames beyond the mattress. TB 603 does not address these flaming droplets.

The objective of the staff's draft proposed standard is to reduce the size of mattress/bedding fires and, thereby reduce the likelihood of or delay the development of flashover conditions in the room. Based on research conducted by NIST, performance criteria were developed to limit the size of the mattress fire and reduce the likelihood of it involving other objects in the room. The staff believes that, while the draft proposed standard may be less effective in isolated circumstances, the objective of the standard can be met with the performance criteria specified: maximum 200 kW peak heat release rate during the 30-minute test and maximum 15 MJ total heat release in the first 10 minutes of the test. Laboratory tests of currently marketed crib mattresses of which the staff is aware show unacceptable performance in one or both of these fire performance measures. Like full-size mattresses, these crib mattresses would also need to be improved to meet the requirements of the draft proposed standard.

10. One commenter suggested that a 60-minute test duration is needed in the standard to allow for fire and rescue workers to respond and help occupants escape.

The commenter notes that the longer test time will allow emergency responders to assist vulnerable citizens to escape fires involving mattresses and bedding. They report that response times can vary widely among local circumstances, from approximately 16 minutes to an hour or more.

To estimate the draft proposed standard's potential effectiveness, the staff reviewed in-depth investigations that provided detailed information about fires that ignited mattresses and bedding, details of the occupants' situation, and occupants' actions during the fire.

Most investigations also included documentation from the fire department that attended the fire. The in-depth investigations involved fires occurring during 1999 – 2004, and included a total of 195 deaths and 205 injuries. In some of these cases, even with traditional mattresses and bedding, other members of the household present at the time of the fire and emergency responders arriving within as little as 5 minutes were able to rescue victims.

With improved mattresses, those complying with the 30-minute test specified in the staff's draft proposed standard, the fire growth is slowed considerably and flashover conditions are delayed, making successful rescue efforts of family members and emergency responders more likely. The staff estimates that 310 to 330 deaths and 1,660 to 1,780 injuries resulting from mattress and bedding fires could be prevented annually by the draft proposed standard. A maximum additional 80 deaths and 280 injuries, considered addressable by the draft standard, might be further reduced with a 60-minute test. However, actual reductions would likely be much lower because of the uncertainties of another household member being present or timely emergency response rescue.

Based on the preliminary regulatory analysis, the expected benefits of the staff's draft proposed standard, incorporating a 30-minute test, are greater than the costs. The regulatory analysis also considered alternatives to the draft proposed standard, including a 60-minute test; neither this nor any other alternative was shown to increase net benefits.

11. A few commenters expressed the need to maintain protection from the threat of cigarette ignitions while considering an open flame standard.

The standard that addresses cigarette ignition resistance, the *Standard for the Flammability of Mattresses and Mattress Pads*, codified as 16 CFR Part 1632, remains in effect unless it is modified or revoked by the Commission in a separate rulemaking proceeding. During such a rulemaking, the need for maintaining both an open flame standard and the standard for cigarette ignition resistance would be thoroughly evaluated.

B. Bedclothes Comments

Most of the commenters refer to the impact of burning bedclothes on mattress/bedding fires and express opinions on the potential scope of an open flame mattress standard. Some commenters urge the Commission to limit the scope of a standard to mattresses while opposing commenters recommend that either the scope be expanded to incorporate bedclothes or bedclothes should have ignition standards of their own.

Commenters in support of regulating bedclothes believe that studying the impact of burning bedclothes is appropriate and would assist in the development of better performing, safer products. They note that bedclothes contribute to the intensity and spread of the original ignition source often involved in mattress fires. Therefore, burning bedclothes become a significant ignition source to the mattress and impact the burning characteristics of the mattress and foundation. They further note that bedclothes alone have been shown to generate a fire large enough to pose a hazard and can alone be the

cause of ignition to nearby items. According to these commenters, improving the flammability of certain bedding items, such as filled items, is economically feasible. One commenter claims that mattress fires cannot be adequately addressed without also considering the flammability of bedclothes.

In support of limiting the scope to mattresses and not regulating bedclothes, some commenters identify bedding items as an uncontrolled variable. They claim that there is no way to predict the type of bedclothes that may be involved in an incident at any given time; the number and type of items used by consumers is indefinable and consumers select items based on season, fashion, and climate. In addition, according to these commenters, there is no objective method to determine if consumers would use regulated bedclothes; there is little data to suggest that regulating some selected items will have an impact on the hazard; and flammability performance should not be based on what consumers may or may not use as bedclothes. These commenters also state that most U.S. textile manufacturers already voluntarily test for small open flame ignition of bedclothes using ASTM voluntary test methods. They assert that the additional burden and expense of any regulation on bedclothes would be substantial and could not be justified.

CPSC staff notes that bedclothes substantially contribute to the complexity and magnitude of the mattress fire hazard. In laboratory tests peak heat release rates as high as 800 kW were observed from some larger bedclothes items. This presents a clear risk of flashover; and this heat release rate is much higher than that allowed for a mattress/foundation in the draft proposed standard. The extent to which bedclothes can be modified in a manner that is technologically practicable and economically feasible is unclear at this time. However, reducing the contribution of certain high fuel load bedding items to a mattress/bedding fire is desirable. The staff recommends issuing an ANPR for a bedclothes flammability standard. The staff believes that such a standard would increase the likelihood that mattress/bedding fire losses are effectively reduced.

VI. CONCLUSIONS

The staff evaluation of in-depth investigations of fire incidents supports the conclusion that a standard preventing 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 310-330 civilian deaths (80-86%) and 1,660-1,780 injuries (86-92%) could be potentially eliminated annually.

The standard drafted by the staff incorporates a test method demonstrated to measure mattress performance in order to provide this level of protection. The staff's draft proposed standard has two performance criteria. The mattresses must not exceed a 200 kW peak heat release rate within the 30 minutes of the test, and the total energy released must be less than 15 MJ for the first 10 minutes of the test. Materials are commercially available that can be used to produce comfortable, practical, and reasonably priced mattresses with significantly improved fire performance.

The extent to which various FR chemicals and other alternatives for meeting the standard (e.g., inherently flame-resistant materials) will be used is uncertain. While there are some data gaps regarding many of the chemicals that could be used to meet the standard, there are FR chemicals and flame resistant materials that, based on currently available data, are not likely to pose an unacceptable risk to the environment and that are widely used in other applications. Therefore, manufacturers appear to have 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 even 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 found to pose hazards to the environment or health.

Based on the preliminary regulatory analysis, the expected benefits of the staff's draft proposed standard are 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; net benefits remain positive. The regulatory analysis also considered alternatives to the draft proposed standard; none was shown to increase net benefits. The analysis suggests that a 12 month effective date from the date when a final rule is published would be reasonable.

The most serious portion of the remaining mattress/bedding fire problem could be addressed by limiting the size of the fire produced by some of the largest (fuel load) bedclothes products. Certainly, any one bedclothes item should not produce a fire exceeding that allowed of the mattress (200 kW). The total fire produced by the bed set, then, would be small enough to preserve the occupant egress time offered by preventing or delaying flashover conditions.

VII. OPTIONS

Mattresses

1. Issue an NPR for a mandatory flammability standard if the Commission finds that such a standard is needed to address an unreasonable risk of casualties from ignition of mattresses.

2. Issue an NPR for mandatory requirements for labeling of mattresses, in addition to, or as an alternative to, the requirements of a mandatory flammability standard. (See Preliminary Regulatory Analysis, **TAB G**)

3. Terminate the proceeding for development of a flammability standard if a voluntary standard would adequately address the risk of fire and substantial compliance with such a standard is likely to result. (See 2001 Briefing Package[2])

Bedclothes

1. Issue an ANPR to address the open flame ignition of bedclothing.

2. Consider relying on a voluntary standard to address the hazard.

3. Determine that possible rulemaking for bedclothes flammability is unnecessary.

VIII. RECOMMENDATIONS

The staff recommends that the Commission publish the draft regulatory text of the mattress open flame standard **(TAB K)** for a 75-day period of public comment. The staff also recommends publishing an ANPR for a standard to address the open flame ignition of certain bedclothes. **(TAB L)**

33

IX. REFERENCES

1. *Federal Register* notice, "16 CFR Part 1633, Standard To Address Open Flame Ignition of Mattresses/Bedding; Advance Notice of Proposed Rulemaking," published by the Consumer Product Safety Commission; October 11, 2001 (66 FR 51886).

2. "Briefing Package Options to Address Open Flame Ignition of Mattresses/Bedding and Petitions from the Children' Coalition for Fire-Safe Mattresses," CPSC, August 16, 2001.

3. Thomas J. Ohlemiller and Richard G. Gann, *NIST Technical Note 1446*, "Estimating Reduced Fire Risk Resulting from an Improved Mattress Flammability Standard," NIST, August 2002

4. Thomas J. Ohlemiller, et. al., *NIST Technical Note 1446, NISTIR 7006*, and subsequent full-scale tests conducted for CPSC in 2004.

Tab A

The Petitioner's Conclusion

The petitioner maintains that its proposed amendment of appendix K to 10 CFR part 50 would modernize the regulation by endorsing a contemporary consensus standard that incorporates results from recent data measurements and summation calculations.

The petitioner further argues that the proposed amendment is consistent with NRC's Strategic Performance Goals. The NRC's strategic performance goals are: (1) To maintain safety, protection of the environment, and the common defense and security; (2) to increase public confidence; (3) to make NRC activities and decisions more effective, efficient, and realistic; and (4) to reduce unnecessary regulatory burden on stakeholders.

The petitioner claims that its amendment would enhance nuclear safety by basing decay heat curves and uncertainties on up-to-date data measurements for specific fuel isotopes, allowing more accurate decisions involving relative risk. According to the petitioner, the amendment would also increase public confidence because the bases and data relied upon in the latest ANS consensus standard are technically accurate and reproducible. The petitioner maintains that adopting its proposal would provide the NRC with sound and realistic technical bases for make accurate decisions about decay heat power. Better decision-making, says the petitioner, would allow the NRC staff to more effectively allocate resources to other safety significant issues. Finally, the petitioner claims that its proposed amendment would reduce unnecessary technical burden on licensees, allowing them, in turn, to expend their resources on other issues.

The petitioner states that, because the amendment would merely codify the latest consensus standard on decay heat, a direct final rule would be the most appropriate and cost-effective means of implementation.

Dated at Rockville, Maryland, this 4th day of October, 2001.

For the Nuclear Regulatory Commission.

Annette L. Vietti-Cook,

Secretary of the Commission.

[FR Doc. 01–25565 Filed 10–10–01; 8:45 am]

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CONSUMER PRODUCT SAFETY COMMISSION

16 CFR Part 1633

Standard To Address Open Flame Ignition of Mattresses/Bedding; Advance Notice of Proposed Rulemaking

AGENCY: Consumer Product Safety Commission.

ACTION: Advance Notice of Proposed Rulemaking (ANPR).

SUMMARY: The Commission is considering issuing a flammability standard that would address open flame ignition of mattresses/ bedding. The Commission currently has a flammability standard that addresses ignition of mattresses by cigarettes. However, mattress/bedding fires ignited by small open flames are a significant problem not addressed by the existing standard. In 1995, the Commission staff began a project on mattress fires, and the information obtained from that research is reflected in the ANPR. This ANPR also addresses two subsequently-filed petitions from the Children's Coalition for Fire-Safe Mattresses ("CCFSM") requesting that the Commission issue an open flame standard similar to the full-scale test set forth in California Technical Bulletin 129 or an open flame standard similar to the component test set forth in British Standard 5852. The Commission invites comments concerning the risk of injury identified in this notice, the regulatory alternatives being considered, and other possible alternatives. The Commission also invites submission of any existing standard or statement of intention to modify or develop a voluntary standard to address the flammability risk of mattress/bedding fires ignited by small open flames.

DATES: Comments and submissions must be received by December 10, 2001.

ADDRESSES: Comments should be mailed, preferably in five copies, to the Office of the Secretary, Consumer Product Safety Commission, Washington, DC 20207–0001, or delivered to the Office of the Secretary, Consumer Product Safety Commission, Room 502, 4330 East-West Highway, Bethesda, Maryland; telephone (301) 504–0800. Comments also may be filed by telefacsimile to (301)504–0127 or by email to cpsc-os@cpsc.gov. Comments should be captioned "Mattress ANPR."

FOR FURTHER INFORMATION CONTACT: Margaret Neily, Directorate for Engineering Sciences, Consumer Product Safety Commission, Washington, DC 20207; telephone (301) 504–0508, extension 1293.

SUPPLEMENTARY INFORMATION

A. Background

The Commission currently has a flammability standard for mattresses that addresses ignition by cigarettes. 16 CFR part 1632. Smoldering ignition of mattresses/bedding (usually caused by cigarettes) has declined since the standard took effect in 1973. However, the open flame ignition of mattresses/ bedding continues to cause a significant number of deaths and injuries, especially to children. The most common open flame sources are lighters, candles and matches. The Commission staff has been evaluating data concerning such fires for several years to determine how best to address open flame ignition of mattresses/ bedding.

In 1995, CPSC conducted a field investigation study to learn more about cigarette-ignited fires and open flame fires. The report, issued in 1997, showed that about 70% of the open flame fires involved child play and that 68% of the open flame deaths were to children playing with lighters, matches, or other open flame sources. The mattress was ignited directly by open flame in about 24% of the cases. However, bedding was the first item to ignite in about 60% of the cases. In the latter scenario, the fire had already developed to a considerable size before the mattress became involved. A similar study conducted by the National Association of State Fire Marshals ("NASFM") in 1997 confirmed these findings.

A CPSC Chairman's Roundtable, conducted in February 1998, was intended to develop approaches to address these fires and fire deaths. The Roundtable concluded that technical studies were needed and that a public education effort should be considered. The industry's Sleep Products Safety Council ("SPSC"), an affiliate of the International Sleep Products Association ("ISPA"), sponsored a research program at the National Institute of Standards and Technology ("NIST") to provide the technological basis for future performance requirements that could be included in a standard for mattresses and/or bedclothes. The mattress industry also began developing an expanded public education program in cooperation with other interested organizations.

On March 28, 2000, Whitney Davis, director of the Children's Coalition for Fire-Safe Mattresses ("CCFSM") submitted four petitions to the Commission concerning mattress

flammability. The petitions proposed four options: (1) An open flame standard similar to the full-scale test set forth in California Technical Bulletin 129; (2) an open flame standard similar to the component test set forth in British Standard 5852; (3) a warning label for mattresses warning of polyurethane foam fire hazards, and (4) a permanent, fire-proof mattress identification tag. The petitions are discussed in greater detail in section G.

The Commission is considering a flammability standard that would address mattress fires ignited by small open flames. To be effective the standard must reflect the actual use of mattresses. Mattresses generally are not used alone, but are covered by bedding or bedclothes, such as sheets, blankets and comforters. The presence of these materials significantly affects the character of the fire. In some incidents the small open flame may ignite the mattress directly. But it is more common that the smaller flame source initially ignites the bedding, and these materials serve as a larger ignition source for the mattress. Thus, an effective standard must consider the interplay between the mattress and the bedding.

B. The Product

According to the International Sleep Products Association ("ISPA"), 1999 sales of mattresses were an estimated $2.8 billion. ISPA represents about 725 wholesalers, retailers, and manufacturers of conventional mattresses and foundations, accounting for over 80% of total U.S. sales of these products.

The expected useful life of mattresses is about 14 years. Based on estimates from ISPA and previous staff studies, the Commission's Product Population Model estimates about 240 million mattresses may have been in use in residential, commercial, and institutional applications at the end of 1999.

The top four producers operate about one-half of the 800 production facilities in the U.S. and account for over 50% of the total U.S. production of mattresses. The remainder of the production facilities are operated by smaller manufacturers that tend to be family-owned firms supplying mattresses and foundations to a regional market. While renovated mattresses account for as much as 25% of those in use in some parts of the country, the total extent of such renovated mattress use is unknown. Mattresses produced for institutional and commercial use are available to consumers by special order.

C. Risk of Injury

In 1998, mattress or bedding items were first to ignite in about 18,100 residential fires that resulted in 390 deaths, 2,160 injuries, and $208.3 million in property damage. Over the five-year period from 1994 through 1998, children under age 15 represented over 75% of the deaths in fires ignited by candles, matches, and lighters, and incurred over one third of the injuries from these fires. The most common ignition sources for the incidents involving deaths of these children were candles, matches and lighters. Among victims 15 years of age and older, smoking materials were the most common ignition sources causing death. In 1998, smoking materials accounted for 5,300 fires, 230 deaths, 660 injuries, and $61.3 million in property damage.

Since mattress fires often involve the ignition source of burning bedding, initially ignited by a smaller source, a standard incorporating an ignition source representing burning bedding could address deaths and injuries from fires caused by smoking materials, traditional small open flame sources, as well as other heat sources. Because few materials can resist such a large ignition source, the typical approach of preventing ignition of a mattress through a product performance standard is not reasonable. However, limiting the fire intensity and preventing flashover in mattress/bedding fires could result in a reduction in the number of casualties due to such fires. Flashover occurs when a fire becomes so intense that all exposed surfaces ignite nearly simultaneously, and quickly spreads through the structure. While victims intimate with the ignition may still be at risk due to their direct contact with the burning mattresses and bedclothes, preventing flashover may reduce the number of casualties to a portion of the other victims inside as well as those located outside the room of fire origin.

D. Statutory Provisions

Section 4 of the Flammable Fabrics Act ("FFA") authorizes the Commission to initiate proceedings for a flammability standard when it finds that such a standard is "needed to protect the public against unreasonable risk of the occurrence of fire leading to death or personal injury, or significant property damage." 15 U.S.C. 1193(a). That section also sets forth the process by which the Commission can issue a flammability standard. The Commission first must issue an advance notice of proposed rulemaking ("ANPR") which: (1) Identifies the fabric or product and the nature of the risk associated with the fabric or product; (2) summarizes the regulatory alternatives under consideration; (3) provides information about existing relevant standards and reasons why the Commission does not preliminarily believe that these standards are adequate; (4) invites interested persons to submit comments concerning the identified risk of injury, regulatory alternatives being considered, and other possible alternatives; (5) invites submission of an existing standard or portion of a standard as a proposed regulation; and (6) invites submission of a statement of intention to modify or develop a voluntary standard to address the risk of injury. 15 U.S.C. 1193(g).

If, after reviewing comments and submissions responding to the ANPR, the Commission determines to continue the rulemaking proceeding, it will issue a notice of proposed rulemaking. This notice must contain the text of the proposed rule along with alternatives the Commission has considered and a preliminary regulatory analysis. 15 U.S.C. 1193(i). Before issuing a final rule, the Commission must prepare a final regulatory analysis, and it must make certain findings concerning any relevant voluntary standard, the relationship of costs and benefits of the rule, and the burden imposed by the regulation. *Id.* 1193(j). The Commission also must provide an opportunity for interested persons to make an oral presentation before the Commission issues a final rule. *Id.* 1193(d).

E. Existing Open Flame Standards

The staff has reviewed 13 existing tests or standards relevant to open flame hazards associated with mattresses/bedding. State and local government tests and standards include Technical Bulletin ("TB") 129, TB 121, and TB 117 from California, the Michigan Roll-up Test, and Boston Fire Department ("BFD") 1X–11 from Boston. The staff reviewed other standards from the American Society for Testing and Materials standards (ASTM E–1474 and ASTM E–1590), Underwriters Laboratories (UL 1895 and UL 2060), the National Fire Protection Association (NFPA 264A and NFPA 267) and the United Kingdom (British Standard ("BS") 6807 and BS 5852).

Several of these standards specify tests which are duplicates or modifications of each other. To simplify the discussion of these existing standards, tests are grouped in two broad categories: Full-scale fire tests of mattresses (sometimes including bedding items) and small-scale component tests of mattress materials.

Important aspects of the standards are briefly summarized below.

Full-scale Tests: A full-scale test is generally considered the most reliable in measuring product performance, especially when the product contains multiple materials in a complex construction such as a mattress or mattress/bedding combination. Nine of the tests reviewed are full-scale burn tests of mattresses that can produce large fires. There are only about twelve laboratories in the United States that have test facilities capable of safely conducting these tests and properly controlling emissions produced. These tests are costly, ranging from $2,000–5,000 per test; and CPSC does not have this type of facility.

TB 129, TB 121, BFD IX–11, ASTM E–1590, NFPA 267, UL 1895, and UL 2060 use gas burners simulating a newspaper fire in a wastebasket, newsprint in a metal container, or burning bedding as the ignition source. The mattress is sometimes tested in combination with a foundation and bedding. Bedclothes are generally optional and unspecified (chosen by the tester). The ignition sources are applied to the side or underneath the mattress. The acceptance criteria, when specified, are intended to minimize the size/intensity of the fire and related hazards rather than prevent ignition. The standards limit the peak rate of heat release and/or total heat release, maximum temperature above the mattress, carbon monoxide concentration, and mass loss.

BS 6807, a voluntary British standard, provides multiple ignition source options for a full-scale test of a mattress or mattress/foundation combination. The top or underside of the mattress is exposed, depending on the specific ignition source. Ignition/non ignition is determined from the exposure to a cigarette, butane flame, wood crib, or bedclothes chosen by the tester.

The Michigan Roll-up Test was designed to test jail pads that had been rolled up and intentionally ignited by inmates. The pad or mattress is rolled and tied, stuffed with newsprint, leaned against a bed frame, and ignited. No test criteria are specified.

Small-scale tests: The staff reviewed four smaller scale standards, all of which are used for evaluating mattress components rather than the full mattress. One serious drawback of component tests is their inability to accurately predict the real life performance of the full product, a complex combination of mattress, foundation and bedclothes.

TB 117 is mandatory in California for polyurethane foam used in mattresses. The test requires the average flame spread time of 5 inch specimens to be 10 seconds or more.

ASTM E–1474 and NFPA 264A measure the heat release rate of a small specimen of a mattress component material exposed to 35 kilowatts per square meter (kW/m^2) from the burner of a Cone Calorimeter.

BS 5852 is a British standard, mandatory for mattress filling materials (typically foam) used in single-filling mattresses. A horizontal/vertical crevice of foam covered with a standard flame-resistant (FR) polyester fabric is exposed to an ignition source. Options include a cigarette, butane flames, and wood cribs of varying sizes with increasing thermal outputs. Maximum smoldering/flaming time and mass loss are specified.

Several of these standards, small and large scale, may ultimately offer the best choices for a test method, test conditions, magnitude and nature of the ignition source, technical rationale, acceptance criteria, and so forth. However, more data are necessary to determine the most appropriate test. As a group, these standards lack clear links to the specific hazard of ignition from burning bedding materials typical of residential fire incidents, which is especially important for establishing effective acceptance criteria. A better understanding of the fire scenario, the magnitude of the hazard to be addressed, the contribution of burning bedding, and the effectiveness of product changes is needed. With this information, preparation of a reasonable, effective performance standard to reduce deaths and injuries is possible; and mattress materials and constructions suitable for the residential mattress market can be developed.

F. Technical Research and Test Development

From the CPSC and ISPA/NASFM studies of mattress fire incidents and the roundtable discussions, it became clear that a better understanding of the problem, desired performance objectives, and technical means to meet the objectives were needed. As discussed above, existing standards and tests were inadequate and new technical research was needed to support and develop an effective test method and standard. In 1998, in consultation with CPSC staff, SPSC began sponsoring the necessary research at NIST to define and measure the hazard from open flame ignition of mattresses from burning bedding. The first phase of the research was completed in June 2000, and work on Phase 2 has begun and is scheduled for completion later in 2001. CPSC is sponsoring NIST to develop a complementary, smaller scale test method to address practical issues of enforcement and product development. The small-scale test method development will continue into 2002. These programs are summarized below.

1. Phase One

The Flammability Assessment Methodology for Mattresses-Phase 1, involved four main objectives: (1) Initial evaluation of bedding products, (2) characterization of heat impact on a mattress, (3) design of gas burners, and (4) tests of mattresses/bedclothes with burners.

Because the bedclothes are most likely to be the item first ignited and serve as a magnifier for the original, small open flame source, NIST characterized the fire behavior of bedclothes typically used in residential settings. Tests of twelve combinations of bedclothes (sheets, pillows, comforters, and blankets) produced peak heat release rates that ranged from 50 kW to about 200 kW; all substantially higher than a match or lighter. Peak heat release rate is basically a measure of the intensity of the fire produced by these items.

NIST measured the heat impact imposed on the surface of a mattress by six bedding combinations covering a range of performance, from moderate to most intense ignition threat. Measurements of heat flux, duration and affected location were taken. Distinctly different burning conditions existed on the top and side of the mattress, the top being more severe.

NIST then designed two gas burners to consistently simulate the typical heat impact imposed on a mattress top and side by burning bedding products. This is necessary for providing controlled and reproducible test results. The heat flux of the top surface burner is 65 kW/m^2 with a duration time of either 45 seconds or 70 seconds. The heat flux of the side surface burner is 50 kW/m^2 with a duration time of either 25 seconds or 50 seconds. These measurements were used to establish appropriate burner intensities and exposure times when applied to the mattress.

The burners were tested on five different types of mattresses to ensure their ability to produce results that correlated with actual tests of burning bedding. One mattress represented current residential technology. The other four mattresses were constructed with different types of potentially fire resisting components, including barrier fabrics, modified fibers, and treated foams. Correlation was good except for one mattress construction that exhibited internal over-pressurization with the

ignited bedding. Internal over-pressurization occurs when a flammable gas mixture builds up within the mattress causing rupturing of the mattress seams and allowing fire to penetrate the interior. Mattresses with this behavior should be avoided or designed to resist rupturing during a fire.

The research conducted during Phase 1 provided extremely useful information regarding fires involving mattresses and the interaction with bedclothes. Burning bedclothes by themselves were shown to produce large fires, reaching heat release rates up to 200 kW. A 200 kW fire is a much larger fire than a match, candle or lighter ignition source but not large enough to create flashover conditions. Mattresses without bedclothes, however, were shown to produce fires large enough to cause room flashover, adding to the complexity of the hazard. The gas burners appear to successfully simulate most burning bedding conditions and show how mattress materials and construction techniques can improve mattress fire behavior.

2. Phase Two

Phase 2 of the NIST/SPSC research will determine the ability of small-scale mattresses to predict burning behavior of twin size and larger bedding systems. Phase 2 will also provide an analytical basis for estimating the performance characteristics of the mattress needed to address and reduce the hazard.

Most available fire test data relate to twin size mattresses. To understand the effects of mattress size, it will be necessary to obtain data on larger size mattresses. The research will evaluate the effects of scale from king size to a 2′ × 2′ mini-mattress, a size commonly used by manufacturers as a selling tool. If the heat release rate behavior or other measure (*e.g.* weight or mass loss) seen in smaller mattresses correlates with that of larger size mattresses, the feasibility of conducting safe, convenient mattress tests and producing fire safe products increases. Additional tests will evaluate how the lateral dimensions of mattresses affect fire intensity and how different size mattresses affect a specified room environment.

Several factors will be considered in order to estimate the peak rate of heat release from a mattress that would substantially reduce the fire hazard. These include: (1) The effect of bed size and room size on fire size, (2) the proximity of other furnishings around the bed fire and the ignition threat of surrounding objects, and (3) the location of persons with respect to the location of fire origin. Three tiers of hazard for victims of mattress/bedding fires have been identified using National Fire Incident Reporting System (NFIRS) data: (1) Outside the room of origin, (2) within the room of origin but not in contact with mattress fire and, (3) direct contact with mattress fire. Through analysis of the various tests, NIST will explore the relationship between fire size and the number of fatalities and determine what reduction in bed fire intensity will significantly reduce fatalities based on the three hazard tiers.

Phase 2 has been expanded to include tests of bedclothes (quilts, comforters, pillows) constructed with a variety of flame-resistant filling and cover materials to assess the effect of material changes on the flammability behavior.

3. Small-scale Screening Test

To be conducted concurrently with Phase 2, CPSC (with funding support from the U.S. Fire Administration) has contracted with NIST to develop a bench scale screening test to be used as a surrogate for full-scale tests of mattresses exposed to burning bedding or equivalent gas burners. Although the most reliable measures of mattress performance are full-scale tests, they are expensive and require specialized facilities. A bench scale test could be used by CPSC for compliance screening and by manufacturers for screening designs/materials. A similar concept is used in the mattress standard (16 CFR part 1632) for substitution of tickings and materials used at the tape edge. Test specimens will be from actual production mattresses. Based on the performance of a variety of materials, designs, and constructions, the test will be designed to be more stringent than the full-scale test to avoid problems (such as approving a mattress construction that fails the full-scale test and must be recalled later).

G. The Petitions

CCFSM's petitions (Petitions FP 00–1, FP 00–2, FP 00–3, and FP 00–4) proposed four options to address open flame ignition of mattresses: (1) An open flame standard similar to the full-scale test set forth in California Technical Bulletin 129; (2) an open flame standard similar to the component test set forth in British Standard 5852; (3) a label warning of polyurethane foam hazards and (4) a permanent, fire-proof mattress identification tag. The petitioner also requested that the Commission impose fines and take other actions to enforce the existing mattress flammability standard against renovated mattresses. This request was not docketed as a petition because it concerned action that cannot be taken through rulemaking.

The petitioner noted that the existing mattress flammability standard addresses deaths and injuries associated with cigarette ignition of mattresses, not small open flame ignition. The petitioner observed that the greater amount of polyurethane foam used in today's mattresses provides increased fuel for mattress fires. He argued there is a significant need for a standard that would address open flame ignition of mattresses.

In one petition (FP 00–1) the petitioner requested that the Commission issue a standard based on a full-scale test like that in California TB 129, discussed above. In another petition (FP 00–2) the petitioner requested that the Commission issue a standard based on a component test like that in BS 5852, discussed above. The Commission has determined to grant both of these petitions requesting standards. The Commission also voted to deny the remaining two petitions. A label warning of the flammability of polyurethane foam may not accurately reflect the flammability of a finished mattress, particularly as it may actually be used with bedding. As for the requested fire-proof identification tag, although it might help identify a mattress after a fire, it would not affect a mattress's flammability performance.

The Commission will consider both full-scale and component tests in the course of rulemaking to determine the most effective standard to address mattress fires ignited by small open flames. As explained above, the Commission staff is involved in extensive research that is examining the characteristics of mattress/bedding fires and evaluating all relevant tests that could form the basis for a standard.

H. Response to Comments on the Petitions

On June 12, 2000, the Commission published a request in the **Federal Register** for public comments on these petitions. 65 FR 36890. Nine comments were submitted by a fire safety expert and various industry associations. Most of these comments were on the general issue of open flame ignition of mattresses rather than the specific petition recommendations. The major issues raised by the comments and responses to them are discussed below.

1. General Comments

Comment: Some commenters were concerned that standard tests recommended by the petitions do not reflect real hazards typical of residential mattress fire scenarios. Some stated that

NIST's work examining mattresses and bedclothes is a preferable basis for a standard.

CPSC Response: Real-life residential bedding fires involve a complex system of materials, typically a mattress and foundation with a collection of bedclothes which may include any number of sheets, blankets, comforters, pillows, quilts and decorative items. The bedclothes add to the complexity of the hazard. Often, the mattress is essentially exposed to burning bedding, a much larger ignition source than the flame from a match, candle or lighter that may have been the original source of ignition. Two of the petitions request test methods to address the hazard of residential mattress fires (FP00–1 and FP00–2). The ability of the requested test methods to address real-life residential mattress fires is unclear at this time. An appropriate test method should effectively address the hazard as it exists in real-life fire scenarios, representing all materials present, the typical ignition source, and the point of ignition.

The current study being conducted by NIST is a scientifically based research program designed to address the open flame ignition of mattresses and bedclothes under conditions that closely resemble real-life residential fire scenarios. The study is focused on understanding the dynamics of fires involving mattresses and bedclothes assemblies and on developing appropriate and technologically practicable methodology that can effectively address the hazard.

Comment: Some commenters stated that any new regulation should not compromise cigarette resistance. Commenters stated that any new regulation should provide a standard with a simple test that can be widely used. It should have the attributes of a good standard.

CPSC Response: The Commission agrees that any new regulation regarding mattress flammability should be closely assessed for possible impacts on the benefits of the existing regulation. While full-scale mattress tests may provide the most definitive measures of mattress fire behavior, they are costly, dangerous, and cannot be widely conducted. A valid bench or small-scale test that is practical and cost effective is a necessary component of a performance standard when many tests are needed. A simple bench scale test would enable manufacturers to conduct some of their own testing, allowing them to proceed more easily with product and design innovation an address safety concerns regarding their facilities and employees. A bench scale test that uses products obtained at retail would also be useful for regulatory and compliance purposes. The Commission agrees that any new standard would need to be representative of the real-life fire hazard, and the methodology should be reasonable, technologically practicable and based on sound comprehensive research.

2. Petition FP 00–1 Suggesting California TB 129

Comment: One commenter noted that TB 129 provides a direct measure of the danger posed by the mattress tested and is excellent for assessing product performance. Another commenter, however, observed that the type of ignition source and point of ignition used in the test are not appropriate for residences. Two commenters noted that TB 129 tests are expensive and can only be conducted by a fire test laboratory with large-scale heat release measurement capabilities.

CPSC Response: TB 129 was developed to address hazards associated with ignition of mattresses in public institions. It is not clear that TB 129 provides a test method that is a true and direct measure of the danger posed by a typical residential mattress fire. The CPSC staff has concerns about the lack of bedclothes and mattress foundations in the test, the intensity of the specified ignition source, and the required side ignition point. It is also true that full-scale open flame mattress tests, like TB 129, require specialized fire test facilities and are dangerous and costly to conduct.

3. Petition FP 00–2 Suggesting BS 5852

Comment: One commenter stated that British Standard 5852 has been effective in significantly reducing deaths and injuries from upholstery fires.

CPSC Response: Limited data are available for assessing the effectiveness of BS 5852 in reducing deaths and injuries, particularly for assessing losses from mattress fires. The UK Department of Trade and Technology's report evaluting benefits of the 1988 regulations states that the data on mattresses is less clear than the data for upholstered furniture. Mattress regulations require the filling materials to meet the regulations for polyurethane foams, but do not specify fire resistant requirements for mattress fabric coverings or tickings. Moreover, the report did not consider variables such as a decrease in smoking, increase in consumer awareness, increased use of smoke alarms, and increase in use of FR products.

Comment: One commenter reported on full-scale tests of UK mattresses which, mostly ignited by a match, show reduced fire intensity. It is not necessary to ensure resistance to burning bedding because the British experience using complying foams has been good and complying foams do not cause big fires with larger ignition sources.

CPSC response: Full-scale tests of British mattresses composed of treated foam components may exhibit a resistance to small open flames, such as matches, lighters and candles when compared to mattresses composed of untreated foam. Recent tests, however, show that British mattresses are clearly inadequate when presented with the intense flames and higher heat fluxes typically caused by burning bedding. Several full-scale tests of British mattresses were included in the mattress flammability study conducted at the NIST. While the British mattresses may take several minutes to reach their peak rate of heat release, the peak rate of heat release observed for the mattresses alone (without bed clothing) was significantly above the level necessary to cause flashover. Testing of mattresses complying with British regulations with bed clothing resulted in an even higher peak rate of heat release, clearly showing that bedding continues to be a major contributor to the fire hazard causing serious flaming of the foam.

Comment: Commenters indicated that BS 5852 is easy to run and relatively inexpensive. However, it is a composite test, does not assess heat release and does not account for bed clothing in the residential fire scenario.

CPSC response: The Commission agrees that BS 5852 is a relatively inexpensive and easy to run test method, but at the same time, is concerned that the test does not measure heat release rates or account for the more severe ignition source from burning bedding.

Comment: One commenter suggested that a simple test, like BS 5852, that can be used very widely is the most appropriate for a national regulation.

CPSC Response: The Commission agrees that an easy-to-run test is appropriate. It is unclear, however, if the most appropriate test is BS 5852.

4. Petition FP 00–3, Mattress Combustability Warning Labels

Comment: One commenter noted that Sleep Product Safety Council product labels have been used on finished mattresses since 1989. The commenter stated that the petition suggests a label that is extreme and does not represent the performance of the finished product in a real life fire situation.

CPSC Response: The Commission agrees that the label recommended by the petition does not represent the hazard presented by the finished product in a real life fire situation. Polyurethane foam is just one of many components used to construct a mattress. Since it is unclear what relation the fire behavior of an individual component has to the likely fire performance of a completed product, the Commission agrees that the suggested warning is not appropriate for the final mattress product.

5. Petition FP 00–4, Fire-proof Mattress Identification Tags

Comment: One commenter argues that an ID tag would have no impact on the propensity of a mattress to ignite or the intensity of the resulting fire.

CPSC response: Petition FP 00–4 requests that all mattresses have an identification tag designed to survive a fire permanently attached to the innerspring unit. The Commission agrees that such a tag is unlikely to have any impact on reducing mattress fires or the propensity of a mattress to ignite when exposed to an open flame. Such a tag is not visible to consumers to influence their behavior, and the tag has no influence on the mattress's ability to resist ignition or its performance once ignited. An ID tag could be desirable for identifying mattresses involved in fires to improve the utility of collected fire data and support further regulatory actions. However, the tag cannot be justified in terms of directly reducing death or injury from fires.

I. Invitations to Comment

In accordance with section 4(g) of the FFA, the Commission invites comments on this notice. Specifically, the Commission invites the following types of comments.

1. Comments concerning the risk of injury identified in this notice, the regulatory alternatives discussed above, and other alternatives to address the risk of injury;

2. An existing standard or portion of a standard as a proposed rule;

3. A statement of intention to modify or develop a voluntary standard to address the risk of injury identified in the notice along with a description of a plan to modify or develop the standard.

In addition, the Commission is interested in obtaining further information about the following issues.

1. Materials that could improve mattress performance in open flame tests.

2. Any adverse consequences that an open flame standard might have on cigarette ignition of mattresses/bedding.

3. The appropriate scope of the standard, that is, particular items that should be included or excluded.

Dated: October 4, 2001.

Todd Stevenson,

Consumer Product Safety Commission.

List of Relevant Documents

1. Briefing memorandum from Margaret Neily, Project Manager, Directorate for Engineering Sciences, to the Commission, "Options to Address Open Flame Ignition of Mattress/Bedding and Petitions from the Children's Coalition for Fire Safe Mattresses," August 16, 2001.

2. Memorandum from Signe Hiser, EPHA, to Margaret Neily, Engineering Sciences, Residential Fires in Mattresses and Bedding 1980 "1998," June 11, 2001.

3. Memorandum from Terrance R. Karels, EC, to Margaret L. Neily, ES, "Mattress Petitions," June 15, 2001.

4. Memorandum from Allyson Tenney, ES, to Margaret Neily, Project Manager, "Current Research Program to Evaluate Open flame Mattress Flammability," April 25, 2001.

5. Memorandum from Allyson Tenney, ES, to Margaret Neily, Project Manager, "Response to Comments Received on Petitions FP 00–1 through FP 00–4, Requesting Standards, Labeling and Identification Tags for Mattresses," April 25, 2001.

6. Memorandum from Carolyn Meiers, ESHF, to Margaret Neily, Project Manager, "Petition to Provide Rulemaking Regarding Mattress Combustibility Warning Labels," March 16, 2001.

[FR Doc. 01–25442 Filed 10–10–01; 8:45 am]

BILLING CODE 6355–01–P

DEPARTMENT OF THE INTERIOR

Office of Surface Mining Reclamation and Enforcement

30 CFR Part 950

[WY–029–FOR]

Wyoming Regulatory Program

AGENCY: Office of Surface Mining Reclamation and Enforcement, Interior.

ACTION: Proposed rule; public comment period and opportunity for public hearing on proposed amendment.

SUMMARY: The Office of Surface Mining Reclamation and Enforcement (OSM) is announcing receipt of a proposed amendment to the Wyoming regulatory program (hereinafter, the "Wyoming program") under the Surface Mining Control and Reclamation Act of 1977 (SMCRA). Wyoming proposes revisions to rules about surface water hydrology, coal mine waste impoundments, alluvial valley floors, and Threatened and Endangered Plant Species. Wyoming intends to revise its program to be consistent with the corresponding Federal regulations, and improve operational efficiency.

DATES: We will accept written comments on this amendment until 4:00 p.m., m.d.t. November 13, 2001. If requested, we will hold a public hearing on the amendment on November 8, 2001. We will accept requests to speak until 4:00 p.m., m.d.t. on October 26, 2001.

ADDRESSES: You should mail or hand deliver written comments and requests to speak at the hearing to Guy Padgett at the address listed below.

You may review copies of the Wyoming program, this amendment, a listing of any scheduled public hearings, and all written comments received in response to this document at the addresses listed below during normal business hours, Monday through Friday, excluding holidays. You may receive one free copy of the amendment by contacting OSM's Casper Field Office.

Guy Padgett, Director
Casper Field Office
Office of Surface Mining Reclamation and Enforcement
100 East "B" Street, Room 2128
Casper, WY 82601–1918

Dennis Hemmer, Director
Department of Environmental Quality
Herschler Building
122 West 25th Street
Cheyenne, WY 82002
Telephone: 307/777–7682

FOR FURTHER INFORMATION CONTACT: Guy Padgett, Telephone: 307/261–6550. Internet: Gpadgett@OSMRE.GOV.

SUPPLEMENTARY INFORMATION:

I. Background on the Wyoming Program.
II. Description of the Proposed Amendment.
III. Public Comment Procedures.
IV. Procedural Determinations.

I. Background on the Wyoming Program

Section 503(a) of the Surface Mining and Reclamation Act (the Act) permits a State to assume primacy for the regulation of surface coal mining and reclamation operations on non-Federal and non-Indian lands within its borders by demonstrating that its program includes, among other things, "a State law which provides for the regulation of surface coal mining and reclamation operations in accordance with the requirements of the Act * * *" and "rules and regulations issued by the Secretary" pursuant to the Act. 30 U.S.C. 1253(a)(1) and (7). On the basis of these criteria, the Secretary of the Interior conditionally approved the Wyoming program on November 26, 1980. You can find background information on the Wyoming program,

6 book 12/13/01

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

MEMORANDUM

DATE: 12/13/01

TO : ES

Through: Todd A. Stevenson, Secretary, OS

FROM : Martha A. Kosh, OS

SUBJECT: Standard to Address Open Flame Ignition of Mattresses/Bedding; ANPR

ATTACHED ARE COMMENTS ON THE CF 02-1

COMMENT	DATE	SIGNED BY	AFFILIATION
CF 02-1	10/16/01	Anthony Padilla	1708 Melrose Ave E. #502 Seattle, WA 98122
CF 02-2	12/07/01	John Biechman Vice President Government Affairs	National Fire Protection Association 1110 N Glebe Road Suite 210 Arlington, VA 22201
CF 02-3	12/07/01	Jeff Simmons Dept. Manager	SGS US Testing Co., Inc jeffrey simmons@sgs.com
CF 02-4	12/07/01	James McIntyre Counsel to Polyurethane Foam Association	McIntyre Law Firm, PLLC Madison Office Building Suite 1101 1155 15th St, NW Washington, DC 20005
CF 02-5	12/10/01	Joseph G. Manta Counsel for Hill-Rom Company, Inc	Klett Rooney Lieber & Schorling Two Logan Square, 12th Floor Philadelphia, PA 19103
CF 02-6	12/10/01	Harrison Murphy President	Ventex, Inc. P.O. Box 1038 Great Falls, VA 22066

Standard to Address Open Flame Ignition of Mattresses/Bedding; ANPR

CF 02-7	12/10/01	Wendy M. Yoviene General Counsel for Decorative Fabric Assoc. Coalition of Converters of Decorative Fabrics & Calico Corners	Thelen Reid & Priest LLP, Market Square, Suite 800 701 Pennyslanvia Ave NW Washington, DC 20004
CF 02-8	12/10/01	Phillip Wakelyn Ph.D., Senior Scientist, Environmental Safety & Health	National Cotton Council of America 1521 New Hampshire Ave, NW Washington, DC 20036
CF 02-9	12/10/01	Patty Adair Asst. Director Textile Products & Standards	American Textile Manufacturers Institute 1130 Connecticut Ave NW Suite 1200 Washington, DC 20036
CF 02-10	12/10/01	Dr. M. Hirschler	GBH International 2 Friar's Lane Mill Valley, CA 94941
CF 02-11	12/10/01	NASFM	National Association of State Fire Marshals 1319 F Street, NW Suite 301 Washington, DC 20004
CF 02-12	12/10/01	Frederick Locker Counsel for the Juvenile Product Manufactuers Association	Locker Greenbert & Brainin, P.C. 420 Fifth Avenue New York, NY 10018
CF 02-13	12/10/01	Fran Lichtenberg Exec. Director	Alliance for the Polyurethanes Industry 1300 Wilson Boulevard Suite 800 Arlington, VA 22209
CF 02-14	12/10/01	Carl Ogburn Vice President	Chestnut Ridge Foam Inc crfoam@westol.com
CF 02-15	12/10/01	Patricia Martin Exec. Director	Sleep Products Safety Council 501 Wythe Street Alexandria, VA 22314

Standard to Address Open Flame Ignition of Mattresses/Bedding; ANPR

CF 02-16	12/10/01	Park B. Smith President	Home Fashion Products Association 355 Lexington Ave New York, NY 10017

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

MEMORANDUM

DATE: September 27, 2004

TO : ES

Through: Todd A. Stevenson, Secretary, OS

FROM : Martha A. Kosh, OS

SUBJECT: Standard to Address Open Flame Ignition of Mattresses/Bedding ANPR **(Revised)**

ATTACHED ARE COMMENTS ON THE CF 04-2

COMMENT	DATE	SIGNED BY	AFFILIATION
CF04-2-1	10/06/03	Lynn Morris Chief	Bureau of Home Furnishings & Thermal Insulation 3485 Orange Grove Ave North Highlands, CA 95660
CF04-2-2	10/27/03	J Thomas Chapin General Manager Fire & Construction SBU	Underwriters Lab., Inc. 333 Pfingsten Road Northbrook, IL 6062-2096
CF04-2-3	06/11/04	Blair Schrader President	E.J. Schrader Mattress Company 6601 Norton Avenue West Palm Beach, FL 33405
CF04-2-4	07/12/04	AFMA & Others	American Furniture Manufacturers Assoc. 1120 Connecticut Ave, NW Suite 800 Washington, DC 20036
CF04-2-5	03/18/04	Andrew Herz	The Law Offices of Andy Herz At Fort Mgmt 40 Wall St, Suite 31b New York, NY 10005
CF04-2-6	08/24/04	William Degnan Chair Consumer Product Fire Safety Task Force	National Association of State Fire Marshals 1319 F St, NW, Suite 301 Washington, DC 20004

Tab B

U.S. CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, D.C. 20207

Memorandum

October 29, 2004

TO: Margaret Neily, Project Manager for Mattresses & Bedding
Directorate for Engineering Sciences

THROUGH: Hugh McLaurin, Associate Executive Director
Directorate for Engineering Sciences

FROM: Allyson Tenney, M.S., Textile Technologist
Directorate for Engineering Sciences

SUBJECT: Background and Technical Rationale for Draft Proposed Standard for Open-Flame Mattress Flammability

Introduction

Mattress and bedding fires continue to be among the major contributors to residential fire deaths and civilian injuries among products within the jurisdiction of the U.S. Consumer Product Safety Commission (CPSC). Based on national fire estimates for the five-year period between 1995-1999, ignition of mattresses and bedding resulted in an estimated 19,400 residential fires, 440 deaths, 2,230 injuries, and $273.9 million in property loss annually. Of these, an estimated 18,500 fires, 440 deaths, 2,160 injuries, and $259.5 million property loss are considered addressable by an open-flame standard for mattresses (Smith and Miller, 2004). This memorandum provides a summary of comments received on the advance notice of proposed rulemaking (ANPR) to address open-flame ignition of mattresses, research conducted to develop a test method, the basis for evaluating potential effectiveness of the draft proposed standard, and supporting technical rationale for the draft proposed standard.

Advance Notice of Proposed Rulemaking

Advance notice of proposed rulemaking The Commission voted in October 2001 to issue an advance notice of proposed rulemaking (ANPR) to develop a mandatory open-flame standard for mattresses. The ANPR was published in the *Federal Register* on October 11, 2001 (6FR51886) and invited comments concerning the risk of injury associated with the regulatory alternatives being considered, and other possible options.

ANPR comments During the comment period, from October 11, 2001 through December 11, 2001 the CPSC received written comments from businesses, associations and interested parties representing various segments of the mattress and bedding industries. A total of twenty-two comments was received; six comments were received after the comment period closed. Almost all of the comments agreed that the hazards associated with mattress fires appear to be clearly identified. Nearly all of the commenters support the need for an open-flame standard for mattresses and initiation of federal rulemaking.

Technical approach A majority of the commenters agrees that preventing flashover from mattress fires would appropriately address the risk. Aside from one commenter who suggests adopting one of the existing mattress standards, Boston BFD IX-11[1], all of the commenters indicate strong support for the development of a standard based on research programs underway at the National Institute of Standards and Technology (NIST) and discourage the adoption of any existing standards. The comments endorse the direction of the NIST research and encourage the CPSC to issue a technologically feasible and practicable standard. Many comments consider the most effective methodology to be a full-scale test with an ignition source comparable to burning bedclothes.

Bedclothes regulation Most of the comments refer to the impact of burning bedclothes and express opinions on the potential scope of an open-flame mattress standard. The combustibility and effects of burning bedclothes are a concern of many commenters. Some comments urge the Commission to limit the scope of a standard to mattresses, while opposing comments recommend either the scope be expanded to incorporate bedclothes or bedclothes should have combustion standards of their own.

Other comments A related comment regarding scope requests the exclusion of certain product categories such as mattresses used for therapeutic reasons and in healthcare environments from an open-flame standard. Another commenter specifically asks whether crib mattresses will be included. A few comments express the need to maintain protection from the threat from cigarette ignitions while considering an open-flame standard. One small manufacturer expressed concerns about the economic impact that a standard could have on small businesses.

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[1] Boston BFD-IX-11 is discussed in a separate memorandum, *Review of existing open-flame mattress flammability standards*, (Tenney, 2001), which was part of the supporting package for the ANPR for mattresses.

California regulations Two comments refer to recent flammability regulations issued by the State of California. The California Bureau of Home Furnishings (CBHF) submitted written comments in October 2003 urging the Commission to adopt California Technical Bulletin 603 (TB 603). More recently, a number of industry stakeholders jointly expressed written support for adopting TB 603 methodology and criteria.

The California state legislature passed Assembly Bill 603 (AB 603) mandating that the CBHF issue a standard for mattresses/bedding flammability by January 2004. CBHF issued a standard for mattresses, TB 603, with an effective date of January 1, 2005. TB 603 methodology is based on the test method developed by NIST, discussed in detail later in this memorandum. Final TB 603 test criteria limit the peak heat release rate of the mattress set to 200 kilowatts (kW), not to be exceeded at any time during the 30 minute test, and limit total heat release to 25 megajoules (MJ) within the first 10 minutes of the test.[2]

CBHF claims that harmonization of California and Federal standards will avoid a number of potential problems, including the possibility of federal preemption and negative impacts on interstate commerce. Since TB 603 is a newly developed methodology, CBHF suggested an inter-laboratory study be conducted before a potential adoption of TB 603 by CPSC. Data obtained from an inter-laboratory study would verify the credibility of the test method. CBHF also suggested CPSC explore laboratory accreditation programs to ensure test labs are properly qualified to conduct this complex test. This concept was also supported in a separate comment from Underwriters Laboratories (UL).

Mattress Flammability Research

An open-flame mattress standard and test method must effectively address the specific hazards under conditions that closely resemble an actual fire scenario. Mattress and bedding fires pose a unique and complex fire hazard. A typical bed consists of several components including the mattress, foundation, and a collection of bedclothes (mattress pad, sheets, pillows, blankets, quilts and comforters). Typically, burning bedclothes create a large open-flame source igniting the mattress and creating dangerous flashover conditions, the point at which the entire contents of a room are ignited simultaneously by radiant heat. The room conditions are untenable, preventing escape from the fire. A heat release rate of about 1000kW (1.0MW) is generally considered capable of causing flashover of a typical room. About two-thirds of all mattress fatalities are attributed to mattress fires that lead to flashover. This accounts for nearly all the fatalities that occur outside the room of fire origin and about half of the fatalities that occur within the room of origin (Ohlemiller, 2002; Hiser, 2001).

A burning mattress is generally the primary energy contributor in a typical bedroom fire. Once the mattress is ignited, the fire develops rapidly. Tests on traditional twin size mattress constructions (16CFR1632 compliant) without bedclothes

[2] In fire testing, the fire size is expressed as the heat release rate (HRR) in kilowatts (kW). Joule is a unit of heat; one Watt is equal to one Joule per second (1W= 1J/s).

measured peak heat release rates that exceeded 2000kW (2.0MW) in less than 300 seconds (5 minutes). Peak heat release rates of king size mattresses approached a factor of two times greater than tests of twin size mattresses (Ohlemiller, 2002). Several research projects were initiated to gain a more thorough understanding of the hazards and scenarios associated with fires.

Industry support The mattress industry supports a mandatory open-flame mattress standard. The Sleep Products Safety Council (SPSC) sponsored several phases of research at NIST to gain an understanding of the complex fire scenario involving mattresses and develop an effective test method to evaluate mattress performance when exposed to an open-flame ignition source. The first phase of the research program, known as Flammability Assessment Methodology for Mattresses, involved four main objectives. The objectives focused on evaluating the fire behavior of various combinations of bedclothes, characterizing the heat impact imposed on a mattress by bedclothes, developing burners to simulate typical heat impact imposed on a mattress by bedclothes, and testing the burners on different mattress designs to ensure their consistency. NIST's findings, published in NISTIR 6497, *Flammability Assessment Methodology for Mattresses*, established the basis for an appropriate test method and the next phase of the research program (Ohlemiller, 2000).

Hazard analysis The next research phase focused on analyzing the hazard by estimating the peak rate of heat release from a mattress that would substantially reduce the fire hazard by preventing flashover under certain conditions. Measuring the ability of a burning mattress to involve nearby items was a major objective of this analysis. Part of this phase also included a limited assessment of bedclothes and their contribution to mattress fire hazards. The findings are detailed in NIST Technical Note 1446, *Estimating Reduced Fire Risk Resulting from an Improved Mattress Flammability Standard* (Ohlemiller, 2002).

This study was based on flammability properties of improved mattress designs while the flammability properties of bedclothes remained unchanged. The mattress fire hazard was differentiated as having three aspects: the bed fire, meaning the mattress along with bedclothes; the potential to ignite and involve other objects in the same room; and the heat and toxic gas threat from the bed fire.

Tests with bedclothes NIST conducted tests on twin and king size mattresses with corresponding size bedclothes. Since bedclothes were shown to contribute 400kW in some cases with king-size (later studies, discussed in this memorandum, showed similar contributions with some twin-size bedclothes), the study suggests that a mattress contributing more than 500kW at the same time could lead to flashover. At these heat release levels, the potential to ignite other objects in the room would increase and could result in flashover. According to NIST, even a total bed fire of 500kW poses a substantial risk of ignition of other objects in the room, with an attendant threat of reaching flashover (Ohlemiller, 2004).

NIST estimates of critical heat release rates were based on relationships between heat release and estimated hazard. A critical heat release rate for an ordinary sized room is estimated to be about 1000kW (1.0MW). This estimate is based on a collective contribution from any items possibly involved. Staying below this value could be accomplished by reducing the heat release from the bed and by reducing the likelihood of involving other objects in the same room (Ohlemiller, 2000; Ohlemiller, 2002).

Ignition of secondary objects Part of the NIST study assessed the potential of a bed fire to ignite other objects in the same room. The involvement of other objects occurs by either direct flame impingement or by fire generated radiation. NIST characterized radiative ignition in terms of a maximum piloted ignition reach[3] from the bed fire, as a fraction of room area. This value depends on the properties of the object being ignited, size of the room, and the radiant energy generated by the bed fire (size of the fire). Although the location of objects in a bedroom is highly variable, their potential involvement is significantly influenced by their shape and properties relating to ease of ignition. The likelihood of potential ignition is higher for more susceptible items, such as upholstered furniture, another bed, or drapes, and in general, for items closer to the bed. NIST concluded that a further reduction in the heat release rate from the bed could be expected to reduce the radius for potential ignition of other objects and therefore reduce their contribution to the overall heat release rate (Ohlemiller, 2002).

Fire modeling Fire modeling, using test data as input, was used to explore the threat throughout a home from heat and toxic gases from bed fires. Fire modeling is an analytical tool that uses mathematical calculations to predict actual fire behavior. CFAST modeling, the Consolidated Model of Fire Growth and Smoke Transport, is a zone or finite element fire model in which each room is divided into zones assumed to be internally uniform. It is based on solving a set of equations that predict changes in enthalpy (heat absorbed at constant pressure) and mass over time. CFAST is a useful analytical tool for exploring theories and providing insight to a predicted fire scenario.

NIST used CFAST to corroborate test data by exploring the predicted levels of heat and toxic gases for the room of origin and areas outside the room of origin. CFAST showed that bed fires present a substantial threat from heat exposure in the room of origin as well as other rooms. It suggested that increasing the bed size would increase the amount of generated smoke and toxic gases. However, the size of the bed had little effect on time to reach untenable conditions, conditions threatening life safety and preventing escape from the fire. CFAST suggested untenable fire conditions would occur, with little difference between a small or large room, at 10 minutes and 25MJ. NIST suggested that minimizing the contribution from the mattress, although bedclothes and other room contents continue to contribute to the fire threat, showed substantial

[3] Maximum piloted ignition reach characterizes a remote, radiative ignition of additional items from a burning object, in this case a burning mattress. The reach depends on the nature of the item being ignited and the energy generated by the burning mattress (Ohlemiller, 2002). A complete discussion is available in NIST Technical Note 1446.

decrease in the projected levels of heat and toxic gases, therefore decreasing the life safety threats from the hazard (Ohlemiller, 2002).

CPSC/NIST research With funding from the United States Fire Administration (USFA), CPSC staff contracted with NIST to expand upon earlier studies and conduct separate studies involving several series of tests. One series evaluated improved mattress designs and further supported the correlation between full-scale mattress tests with the NIST gas burners and actual bedclothes. Results from the study, reported in NISTIR 7006, *Flammability Test of Full-Scale Mattresses: Gas Burners versus Burning Bedclothes*, found that the gas burners adequately predict the behavior of mattresses from burning bedclothes. Mattress designs showing good performance when tested with burners exhibited significantly improved performance when tested with burning bedclothes. The time to the peak rate of heat release was found to be longer with burners than with burning bedclothes. Burning bedclothes have a progressive burn pattern, are a highly variable ignition source, and typically ignite a larger area of a mattress compared to the gas burners. Since, when compared to the burners, the fire spread can be greater within a specified time with bedclothes, certain weaknesses can be identified at a faster rate (Ohlemiller, 2004). Even considering these observations, the standard burners were found to be a reliable and reasonable representation of burning bedclothes for measuring mattress performance.

This study also reinforced observations from previous NIST research on the interaction between the mattress and bedclothes. Tests on improved mattress designs with burning bedclothes as the ignition source tended to exhibit a bed fire with two well-separated heat release rate peaks, illustrated in Figure 1. The first peak is predominately from the burning bedclothes while the second is predominately the mattress and foundation. NIST found the second peak to be comparable or lower than the first peak and to occur appreciably later in tests of good performing mattress designs (Ohlemiller, 2003; Ohlemiller 2004).

Mattress size and room interaction In a separate study, CPSC contracted with NIST to study the effects of mattress size and room interaction. The series evaluated the flammability behavior of a range of mattress sizes and constructions. The study used mattress designs with various levels of expected performance to evaluate behavior after exposure to both burning bedclothes and standard burners in a room environment, rather than an open laboratory. Under fairly severe circumstances (half-open door and burning bedclothes), enhanced room effects (heat release rate enhancement) are likely. Room effects result from confinement of a fire by the room boundaries. As a fire develops in a closed space or room, hot gases and smoke collect at the ceiling. The radiation from the collecting heat can significantly enhance the development of the fire. Room effects generally start to happen at heat release rates of about 300kW to 400kW (Ohlemiller, 2004). This series of tests also explored how well tests of twin size mattresses could represent the flammability behavior of mattresses larger than twin size.

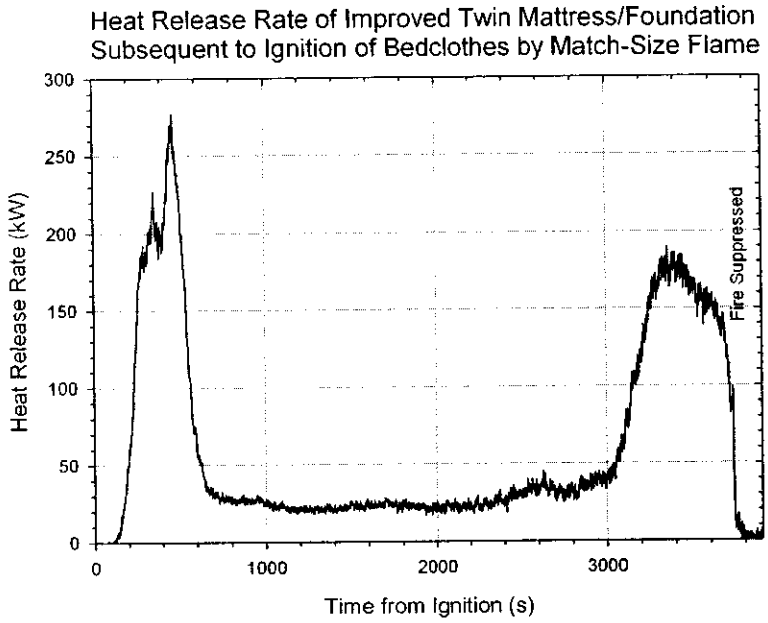

Figure 1. Time from ignition (s) and Heat release rate (kW) (Ohlemiller, 2004; NIST)

NIST's observations showed twin size mattress designs that yield a very low heat release rate peak (less than 50kW) with gas burners behave essentially the same as when the burners are applied to a queen or king size mattress of same design. Mattress designs that yield a moderate heat release rate peak (greater than 100kW, but within proposed test limits) tend to behave the same for the first 30 minutes in twin size and king size (Ohlemiller, 2004)[4]. Based on NIST's findings, there appears to be strong correlation between twin and king size within designs for a specified time period when exposed to gas burners. After ignition with the burners, the fire is localized and not sensitive to mattress size. The fire burns away from the area exposed to the burner and eventually reduces in intensity (Ohlemiller, 2004). The involvement of split foundations, such as the two foundation units used with king size mattresses, was not explored during this test series. It is not clear if their involvement would yield similar findings for time periods beyond 30 minutes or if they would become involved early in the fire.

The same mattress designs and sizes were also evaluated with burning bedclothes. NIST found mattress size to have an apparent effect during these tests, due to the size and fuel load of the bedclothes. Tests on mattress designs that yielded a very low heat release rate peak (less than 50KW) with burners, showed an early heat

[4] Mattress designs that yield a moderate heat release rate peak were not tested in queen size. However, tests on queen size would not be expected to yield greater heat release rates than those same designs tested in king size, which are larger, have split foundations, and have greater fuel loads. This is supported by the results from the mattress design that was tested in twin, queen, and king size in the same test series.

release rate peak (driven by burning bedclothes) that tripled from twin size to king size with burning bedclothes. The tests of larger size bedclothes combinations on mattress designs that yield a very low heat release rate peak (less than 50kW) showed heat release rate peaks from the bedclothes ranging from 500kW to 800kW, occurring about seven to eight minutes after ignition. On mattress designs that yield a moderate heat release rate peak (greater than 100kW, but within proposed test limits) with burners, the bedclothes resulted in more serious fires, especially with king size where the intensity of the burning bedclothes overwhelmed the barrier design. The more intense, room-enhanced burning of the bedclothes on a king size mattress may defeat some barrier designs. This implies that some mattress designs that pass the proposed draft standard in twin size may be defeated by bedclothes in real fires in king size. Room feedback to the burning bedclothes with larger size mattresses appears to result in a substantially more severe thermal insult to the mattress (Ohlemiller, 2004). This situation may be substantially improved if the combustion characteristics potential of bedclothes is reduced.

Room feedback depends on a radiative interaction between the bed fire and the hot gas layer accumulating in the upper part of the room. The observed room effects from the NIST tests, especially with larger than twin size mattresses, increase the uncertainty of burning behavior in an actual fire scenario. NIST concluded that the benefit from improved mattresses in large sizes is less certain than the benefit from improved twin size mattresses based on the high heat release rates of the burning bedclothes and potential room interaction (Ohlemiller, 2004).

Inter-laboratory study An inter-laboratory study was conducted to explore the sensitivity, repeatability, and reproducibility of the NIST test protocol (the basis for California TB 603 requirements). The sensitivities were explored by varying a range of possible test technician errors primarily associated with test set-up measurements. The selected factors could reasonably be expected to occur with some frequency when commercial laboratories are conducting routine testing. Repeatability was evaluated with multiple tests of the same mattress designs at a single laboratory. Another part of the study was designed to explore possible differences in performance when tests were conducted in different laboratories with different test room configurations (open calorimeter or test room). All of the participating laboratories conducted multiple tests of eight different mattress designs that had been constructed so as to minimize possible variations in manufacturing. This test series used eight mattress designs that varied critical elements (barrier [sheet or high-loft], type of mattress [single or double sided], and the style of mattress [tight or pillow top]). Analyzing the data for sensitivity, repeatability, and reproducibility can confirm the precision of the NIST test protocol or reveal which, if any, test parameters need to be revised. The study was recently completed and a final report is expected by the end of 2004.

Preliminary analysis of the data does not suggest either unreasonable sensitivities or practical limitations in the NIST test protocol. If the final report suggests consistent differences in data trends among laboratories, which could imply that laboratory infrastructure, equipment, and maintenance procedures affect the fire performance of mattresses, options for addressing specific differences could be

considered. Laboratory accreditation programs to ensure uniformity of tests conducted at different laboratories and control the operations of commercial laboratories could be a desirable consideration for addressing such issues.

The preliminary analysis also suggests that some mattress designs exhibit more consistent fire performance than other designs. The type of barrier appears to have a significant impact on the performance and repeatability of performance of all of the tested mattress designs. Consistency of the quality of other components and the manufacturing process can also contribute to variability in performance. This series of tests also appears to confirm earlier observations that mattresses constructed with current barrier technology are able to limit the fire severity for a substantial but not undefined time. Most of the tested mattress designs could meet the proposed requirements when required to meet a 30 minute test. Most of the designs tested appear to perform erratically after 30 minutes.

Variability in the fire performance of mattresses The preliminary analysis, supported by earlier data, suggests that significant variability exists among currently available mattress designs. Although the products appear to be moving toward consistency, the need for controls of components, materials, and methods of assembly is clear. Quality assurance procedures, standardized testing, and visual inspections are possible options for assuring, verifying, and controlling consistency of production. Some larger manufacturers already manage their own quality assurance programs that can be expanded for this purpose. In addition, several commercial laboratories are developing services to assist manufacturers in designing and implementing these programs.

Fire Hazard

While the collective research efforts provided support for the development of a test method, they also provided a more thorough understanding of mattress fire scenarios. The sequence of events and predicted conditions must be considered in order to assess the effectiveness of a proposed standard. Early in the fire, the hazard is contained to the room. The fire forces relatively small amounts of dilute smoke from the room. As the room fire grows, the layer of accumulating hot gases and smoke thickens downward from the ceiling. Eventually, the layer can descend from the ceiling to reach the floor level. Fire modeling and available fire test data show that the interface descends to about five feet for relatively small fires (with heat release rates of approximately 300kW). For fires exceeding 600kW, the interface descends to less than three feet. Heat release rates exceeding 500kW are generally considered to pose a serious threat as a dangerous pre-flashover situation is approaching, and the threat of igniting nearby items is high. The threat of incapacitation to occupants in the room of origin is also likely.

Flashover phase Flashover is the point at which the entire contents of a room are in flames. At the point of flashover, radiant heat from the hot gases and smoke accumulating in the upper portions of the room ignite all flammable materials in the room. As the layer of hot gases and smoke at the ceiling thickens, the heat release rate

of the burning bed and the temperature in the room increase. At flashover, room temperatures typically exceed 600-800°C (approximately 1100-1470°F). The high heat release rates and room temperatures lead to the rapid production of carbon monoxide and depletion of oxygen in the room environment. Flaming combustion of unburned volatiles outside of the room of origin begins. Heat, hot toxic gases, and smoke being pushed from the room of origin pose a serious threat to those outside the room in which the fire originated.

Flashover occurs when the heat release rate reaches a critical value. The critical heat release value depends on several factors, predominately room size and ventilation. Ability for a person to escape a fire depends on fire growth and intensity, smoke density, and threat from heat and toxic gases. The rapid and intense burning of mattresses in typical fire scenarios provides insufficient time for escape from the fire source, room of origin, and other rooms under certain conditions. Discovery and escape from the fire must take place before the fire grows to the critical heat release rate for the specific room.

Bedclothes contribution Bedclothes substantially contribute to the complexity and magnitude of the mattress fire hazard. While some incidents report the mattress as the first item to ignite, bedclothes are reported as the first item ignited in a majority of the cases (Smith, 2004; Hiser, 2001). The bedclothes magnify the ignition source seen by the mattress as well as contribute to the overall heat release rates. Collective research conducted by NIST and CBHF has clearly shown that bedclothes can substantially contribute to the hazard. Initial NIST work found combinations of typical twin-size bedclothes to contribute about 200kW to the fire (Ohlemiller, 2002). Later research shows the contribution can be even greater, averaging values greater than 400kW in some cases (Ohlemiller, 2004). The combination of some bedclothes and a well performing mattress and foundation are sufficient to cause flashover of the room. The effects of bedclothes are discussed further in a separate memorandum (Tenney, 2004).

Despite the range of observed heat release rate peaks among bedclothes combinations, bedclothes tend to burn in a similar pattern. After ignition, the first few minutes are generally characterized by slow burning and very low heat release. Typically the peak occurs between five and ten minutes after ignition. The fire intensity recedes as the fuel from the bedclothes is consumed, usually a few minutes after the peak (Ohlemiller, 2003; Ohlemiller, 2004).

Risk reduction Significantly decreasing the fire contribution of the mattress and foundation set will reduce deaths and injuries from mattress and bedding ignited fires, by reducing fire severity, slowing the rate of fire growth, and substantially increasing escape time. A very low contribution from the mattress is critical during the initial stages of the fire to ensure that the combined heat release rate of the mattress, foundation, and bedclothes is substantially reduced. This will reduce the likelihood of involving other nearby objects and minimize the possibility of reaching flashover conditions. Preventing flashover under certain circumstances, minimizing the possibility

of flashover, or increasing the time before flashover occurs could substantially reduce the risks associated with mattress fires.

Early fire contribution Limiting the early contribution to the fire size by the mattress will have the greatest impact on reducing the risk as the mattress will have little involvement in the fire for a specified period of time. An early limit partially compensates for uncertainty of burning bedclothes, although this is not as effective for cases involving large beds. As mattress designs improve, the fire tends to exhibit two well-separated peaks, the first dominated by bedclothes and the second dominated by the mattress. Twin mattress designs that yield very low heat release rates early in the test were found to produce a second peak comparable to the first peak.

Draft Proposed Test Method

A reasonable standard needs to effectively address the specific hazards under conditions that closely resemble actual fire scenarios. A suitable test method must be technically feasible, practicable, and cost effective while accounting for typical residential mattress and foundation constructions. The ignition source and point of ignition must reasonably reproduce the danger posed in typical mattress fire scenarios.

Staff considered a number of existing standards to address the hazard and reduce the number of deaths and injuries from mattress and bedding fires (Tenney, 2002). Staff concluded that although some of the methodologies may have useful elements, the specific hazard involving residential mattresses would not be adequately addressed by any of the existing standards.

The basis for the staff's draft proposed standard and test criteria is the research conducted by NIST for the industry and CPSC on mattress fires. The comprehensive, scientifically based research program conducted by NIST was designed to address the open-flame ignition of mattresses and bedclothes under controlled conditions closely resembling those of actual fire scenarios. The program focused on understanding the dynamics of fires involving mattress and bedclothing assemblies and on developing an appropriate and technologically practicable methodology to effectively address the hazard.

Draft Proposed Test Method NIST developed a full-scale test method. Based on the test method, the draft proposed standard, *The Standard for the Flammability (open-flame) of Mattresses and Foundations,* was developed by CPSC staff and will be referred to as the "Draft Proposed Standard" in this memorandum. The Draft Proposed Standard establishes flammability requirements that all mattresses and mattress and foundation sets must meet before sale or introduction into commerce. The Draft Proposed Standard requires full-scale testing using a pair of propane burners designed to represent burning bedclothes to determine the flammability of mattresses and mattress and foundation sets.

Test methodology The Draft Proposed Standard includes a full-scale test method using a pair of gas burners as the ignition source. A full-scale test is generally considered the most reliable method for measuring performance of a product that contains many materials in a complex construction, such as a mattress. The fire performance of individual mattress or foundation components does not necessarily reveal the likely fire performance of the complete mattress or foundation.

Ignition source The complete mattress and foundation set is exposed to a pair of T-shaped gas burners. The burners impose a specified local heat flux simultaneously to the top and side of the mattress and foundation set for a specified duration. The heat flux and burner duration were derived from data obtained from burning a wide range of bedding items. NIST test results using the burners have been shown to correlate with results obtained with burning bedclothes (Ohlemiller, 2000; Ohlemiller, 2003).

The burners are designed to represent the local heat flux imposed on a mattress by burning bedclothes. The burners test an area, assumed to be representative of the entire assembly, for resistance to flame penetration. The burners impose a maximum thermal load which is comparable in severity to that of burning bedclothes to a representative section of the mattress.

Burning bedclothes have a progressive burn pattern that typically ignites a larger area of the specimen than the stationary burners within a specified time. However, NIST tests showed that bedclothes are a highly variable ignition source, even under controlled conditions (Ohlemiller, 2000). Their variability makes them inappropriate to use as a standard ignition source in a mattress performance test.

Although the stationary burners do not emulate the moving fire of burning bedclothes, the burners are representative of local heat fluxes imposed by burning bedclothes. Making the burners stationary provides an ignition source that is repeatable, technically practicable, and a reproducible tool for regulating the flammability of mattresses. The staff considers the burners to be an adequate ignition source that is representative of typical ignition sources involved in mattress fire incidents, and to produce a true and direct measure of the associated hazards of burning bedclothes.

Test configuration The Draft Proposed Standard allows the test to be conducted in either an open calorimeter or test room configuration. The staff finds either configuration acceptable. Room effects are a factor in mattress performance and are determined by the radiative interaction between the bed fire and the hot gas layer accumulating at the ceiling of the room. Data show that room effects do not become an issue until a fire reaches about 300 to 400 kW (Ohlemiller, 2004). The Draft Proposed Standard limits the peak rate of heat release to 200kW, a value below those shown to be sensitive to room effects. There are no appreciable differences in test measurements expected among the test configurations for peak heat release rate values of 200kW or less. Preliminary analysis of the inter-laboratory study data does not suggest any significant differences between tests based on either test configuration.

CPSC staff acknowledges that the open calorimeter configuration is more conducive to close visual observations of the test progression and subtle failure mechanisms than the test room configuration. A third test configuration, a smaller test room, is included in California TB 603. This configuration was not utilized for the inter-laboratory study and is not included in the Draft Proposed Standard because of the awkwardness of using the burners in the room and operator safety concerns.

Draft Proposed Test Criteria

After considering a number of test criteria options, the staff recommends limiting the peak heat release rate to 200kW for a mattress and foundation set, not to be exceeded at any time during a 30 minute test, and limiting the total heat release to 15MJ for the first 10 minutes of the test to meet the Draft Proposed Standard and test method. The Draft Proposed Test Criteria are intended to effectively and feasibly reduce the risks associated with mattress fires.

Performance criteria The hazards presented by a burning mattress are closely associated with its peak rate of heat release and total energy. Limiting the peak rate of heat release will ensure a less flammable mattress design. A mattress with a limited contribution to the fire, especially early in the fire, will substantially increase the available time to discover the fire and escape, and, therefore, substantially reduce the current risks associated with mattress fires.

Peak rate of heat release Limiting the peak rate of heat release of the mattress to 200kW (during the 30 minute test), as proposed, ensures a less flammable design. It represents a significant improvement in performance compared to traditional mattress designs. Tests on traditional twin size mattress designs (16CFR1632 compliant) without bedclothes measured peak heat release rates that exceeded 2000kW in less than 5 minutes.

As discussed previously in this memorandum, the mattress is typically the main contributor to the fire. These fires typically include simultaneous burning of bedclothes. The rapid and intense burning of the mattress, along with burning bedclothes, is likely to quickly ignite and involve other objects in the room. These fires tend to grow rapidly, reach untenable room conditions (threatening life safety and preventing escape from the fire), and exceed flashover conditions within a few minutes. This typical fire scenario provides insufficient time for escape from the fire source, room of origin, and other rooms under certain conditions. Discovery and escape from the fire must take place before the fire grows to the critical heat release rate for the specific room.

Consequently, an improved mattress design will have the most impact on available escape time. The proposed peak rate of heat release limit accounts for the contribution of bedclothes and other room contents to the fire hazard and ensures that the mattress does not cause flashover on its own. Bedclothes tend to burn in a similar pattern. After ignition, the first few minutes are generally characterized by slow burning and very low heat release. Typically the peak occurs between five and 10 minutes after

ignition. The fire intensity recedes as the fuel from the bedclothes is consumed, usually a few minutes after the peak (Ohlemiller, 2003; Ohlemiller, 2004). Limiting the peak rate of heat release, as proposed, accounts for the contribution of bedclothes and other contents to the fire hazard, is technically feasible, and considers many factors related to the fire scenario (such as room effects). The proposed limit also ensures the benefits and estimated effectiveness identified in the hazard analysis by CPSC staff (Smith & Miller, 2004).

CPSC staff also considered limiting the peak rate of heat release to either 150kW or 50kW. Any additional benefits from limiting the heat release rate to 150kW are unclear and unsubstantiated. Although limiting the peak rate of heat release to 50kW would represent a mattress design that would have little contribution to the fire, such a limit would substantially reduce the number of viable design choices. Additionally, available data suggests that reducing the total energy during early stages of the fire results in the greatest increase in escape potential while still permitting a range of technically feasible, practicable, and cost effective mattress design options.

Early limit of total heat release Much of the estimated effectiveness emphasizes the need for early discovery and escape from the fire without delay. Limiting the early contribution of the mattress will have the greatest impact on reducing the risk as the mattress will have little involvement in the fire for the specified period of time. The proposed early limit of 15 MJ for the first 10 minutes of the test partially compensates for burning bedclothes and ticking by preventing early involvement of the mattress as the bedclothes burn. The early limit also compensates for other items that might be involved early in a fire. The total heat release limit for the first 10 minutes of the test is a practical and simple measure that provides a substantial increase in escape time by slowing the rate of fire growth and severity.

Allowing a total heat release rate of 25MJ during the first 10 minutes of the test, as in TB 603, was also considered. NIST research, supported by fire modeling and early fire research, suggests untenable fire conditions occur at 10 minutes and 25MJ. This represents a total contribution from all possible items involved in the fire. It suggests that any single item must be lower than 25MJ. Available data suggests that minimizing the contribution from the mattress, although bedclothes and other room contents continue to contribute to the fire threat, showed substantial decrease in the projected levels of heat and toxic gases, therefore decreasing the life safety threats from the hazard (Ohlemiller, 2002).

CPSC staff proposes limiting the peak heat release rate to 200kW for a mattress and foundation set, not to be exceeded at any time during the 30 minute test, and limiting the total heat release to 15MJ for the first 10 minutes of the test. While ensuring estimated effectiveness, the feasibility and achievability of reducing the overall and early contribution of the mattress are well supported by test data. According to the mattress

industry[5] and available test data, there are numerous technologically feasible and viable solutions for meeting the proposed limits on heat release and total energy, thereby limiting the early contribution of the mattress.

Test duration The test duration is related to, but not equivalent to, the estimated time required to permit discovery of the fire and allow escape under typical fire scenarios. A 30 minute test, as proposed, is based on an analysis of the hazard and the technological feasibility of producing complying mattresses. It is intended to provide a substantial increase in time for an occupant to discover and escape the fire. Under certain conditions[6], staying below the proposed 200kW limit for a 30 minute test is estimated to provide an adequate time for fire discovery and escape by occupants in the bed or otherwise in the room of fire origin. Much of the effectiveness is based on a timely escape from the hazardous conditions.

The uncertainty of the hazard, severity of the fire, potential contribution of other items in the room, and development of untenable room conditions significantly increase after 30 minutes. According to multiple test results, a large number of mattress designs (using a range of barrier technology) can perform well in tests with gas burners for 30 minutes. Many of the tested designs are able to meet the proposed test criteria for 30 minutes, but perform erratically after 30 minutes. The number of failures, test variability, and performance unreliability increase significantly after 30 minutes. The range of technologically feasible and viable solutions and design choices for meeting the draft proposed test criteria of 30 minutes are substantial. The costs are also lower for a 30 minute test. Further discussion of the costs and related economic analysis is provided in a separate memorandum (Tohamy, Directorate of Economic Analysis, 2004).

The staff considered 60 minutes as a test duration option. Although burning bedclothes expose the mattress to flames faster than the localized burners and the flame spread can take up to 60 minutes for some mattress designs, staff believes that a 60 minute test is not the most appropriate option. With a 60 minute duration, test variability increases; it presents higher test costs and substantially limits the number of technologically feasible and viable design choices. Most importantly, any additional benefits from a 60 minute test are unclear and unsubstantiated by currently available data (Smith & Miller, 2004). The staff considers a 30 minute test an appropriate test duration for addressing the identified hazard.

Test replicates The Draft Proposed Standard requires a minimum of three specimens to be tested (each yielding passing results) for each prototype design. The numerous research studies (many referenced in this memorandum) have typically used replicates of three for testing with the developed gas burners. Three replicates per design have

[5] CPSC staff met with individual mattress manufacturers to discuss their specific testing experiences and available test data. Staff met with representatives from Restonic Mattress Corporation, Sealy, Inc., Serta, Inc., Simmons Company, and The Spring Air Company.

[6] The assumed conditions are that the bedclothes do not contribute to the mattress fire to the extent that the combined fire rapidly poses a hazardous condition, preventing escape, or threatens ignition of other objects in the room, accelerating further fire growth. It is further assumed that occupants of the room are capable of reacting to a fire in a timely manner.

also been the general practice of the industry as they research and develop options for meeting California TB 603 requirements and a possible federal standard. The inter-laboratory study also used three replicates per design for the test series. Based on a preliminary analysis of the inter-laboratory study, three replicates appear to identify mattress set performance, relative to the proposed criteria, for an individual laboratory. CPSC staff therefore proposes testing three replicates of each prototype design as required in the Draft Proposed Standard in order to obtain a meaningful measure of mattress fire performance.

Ticking substitution With one exception, the Draft Proposed Standard's definition of "prototype" excludes differences in ticking, allowing the substitution of ticking materials without additional prototype qualification[7]. Ticking materials have historically been reasonably homogeneous in textile construction, fabric weight, and fuel load despite differences in color, patterns, and prints. The range of ticking materials is somewhat limited by CPSC's mandatory requirements for mattresses codified as 16CFR1632—*Standard for the Flammability of Mattresses and Mattress Pads*, requiring resistance of ignition from a lighted cigarette.

Test data suggests that ticking impacts the persistence and intensity of the crevice flame (the space at the bottom, outer edge, of a mattress as it rests on a foundation), although the resulting crevice flame behavior typically influences fire performance later in the test. Since CPSC staff anticipates that the industry will continue using traditionally homogeneous ticking materials and prototyped units will meet the proposed limit of 15MJ for the first 10 minutes of the test, CPSC staff supports the ticking exemption. Traditional ticking materials do not appear to have a substantial impact on available escape time based on the requirements set forth in the Draft Proposed Standard. An explanation of the economic basis for exempting ticking from the definition of prototype in the Draft Proposed Standard is provided in a separate memorandum (Tohamy, Directorate of Economic Analysis, 2004).

Conclusion

Significantly decreasing the fire contribution of bed sets will reduce deaths and injuries from the hazards associated with mattress fires by slowing the rate of fire growth and severity. This provides a substantial increase in escape time. The technically feasible requirements set forth in the Draft Proposed Standard effectively increase the time before flashover occurs or minimize the possibility of flashover.

[7] If the ticking itself provides the fire performance properties to meet the requirements in the Proposed Draft Standard, ticking changes cannot be made during production without a new prototype qualification or showing to the satisfaction of the Commission staff, through tests and/or technical evaluation, that a change would not negatively influence the specified fire performance test criteria.

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