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UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

Date: December 7, 2005

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FROM : Terrance R. Karels, EC *TRK*

SUBJECT : Mattress Update

In 2001, the Commission published an Advance Notice of Proposed Rulemaking (ANPR) initiating a standards development proceeding to address the risk of fire from small open flame ignition of mattresses. A Notice of Proposed Rulemaking (NPR) was published in January 2005. This memo provides updated market information in support of a possible Final Rule (FR); the tables described are at the end of the memo.

Trade Associations

The International Sleep Products Association (ISPA), of Alexandria, Virginia, represents the mattress industry. The Sleep Products Safety Council (SPSC), which is affiliated with the ISPA, sponsors research on the potential for reductions in the risk of death and injury associated with open flame ignition of mattresses. In 2005, two major US manufacturers, Serta and Sealy, withdrew their membership in the ISPA; these manufacturers remain members of the SPSC. Together, the ISPA and SPSC account for about 725 wholesalers, retailers, and manufacturers of mattresses and foundations. These members account for over 80% of total US sales of these products. In 2005, the ISPA conducted a broad-based sample survey, encompassing 62% of total

consumption of mattresses, in order to provide updated information on the extent of mattress consumption in the US; the results of this survey are included in this market update.

Another group, the National Mattress Council, of High Point, NC, was founded in 2005. This organization is involved in marketing and other statistical research associated with the mattress industry.

Market Share

According to **Furniture Today**, a trade publication, the top 4 manufacturers accounted for about 57%, by value, of total US wholesale bedding shipments in 2004. The top 15 manufacturers accounted for about 83% of the total value of shipments. The top 15 firms are shown on Table 1.

Production

According to the **Census of Manufacturers 2002**, 522 firms (organizations with one or more establishments) comprised the US mattress industry in 2002. This was down from 557 in 2001 (**Annual Survey of Manufacturers**). The majority of this decrease was accounted for in the reduction of the number of firms employing less than 20 employees.

The **US Census Bureau's** "County Business Patterns, 2003" reported that there were 571 establishments producing mattresses in 2003, down from 639 establishments in 2001, and 800 establishments in 1998. Of the establishments, 294 (or 51%) employed less than 20 workers. In 2001, 354 (55% of the total) employed less than 20 workers. Overall, the industry employed 24,500 workers in 2003, down from 25,500 in 2001, and 26,200 in 2000. The distribution of employment in the US mattress industry reported by **Census**, is shown on Table 2.

According to trade sources, the top four producers of mattresses and foundations, Serta, Sealy, Simmons, and Spring Air, operate about 50% of all US production establishments for these products. Thus, of the 639 establishments producing these products in 2001, about 320

would be accounted for by these four manufacturers. The remaining establishments are operated by smaller firms supplying products to regional markets. The South accounts for about 43% of total US production, the West accounts for about 21%, the North Central region accounts for 19%, and the Northeast accounts for 17%.

Trade sources note that there is a large (but unknown) number of mattress refinishers or renovators who use existing mattress components, apply additional padding and covers (but sometimes only putting new fabric over a discarded mattress), and sell “reconditioned” mattresses; these mattresses are not sold back to the original mattress owner. Some states require that such mattresses bear a label indicating that the mattress is reconditioned, but the practice is not required nation-wide.

Another type of mattress renovator obtains the mattress from the owner, removes all the interior padding and supports, reassembles the mattress with new materials (often high-density foam), and returns the mattress to the original owner. The prevalence of this type of mattress renovation service is unknown.

Shipments

Conventional sleep surfaces and foundations are typically sold in sets. However, more mattresses are sold annually than foundations; some mattresses are sold as replacements for existing mattresses (without the purchase of a new foundation) or are sold for use in platform beds or other beds that do not require a foundation. The ISPA estimated that, in 2004, 22.5 million conventional mattresses were shipped; this represents 55% of the total number of mattresses and foundations shipped. This is similar to that of about 22 million mattresses, or about 55% of the total number of mattresses and foundations sold in 2003.

The ISPA estimates shipments for “adult-sized conventional sleep surfaces,” based on information from its members. These estimates include innerspring, foam, and air mattresses, and foundations. (Innerspring mattresses account for 90% of all US shipments of mattresses.) The trade statistics *do not* include shipments of certain types of sleep surfaces, including futons,

crib mattresses (or juvenile mattresses), sleep sofa inserts, or hybrid water mattresses. Adult-sized “conventional” sleep surfaces reportedly account for *in excess of 80%* of total annual shipments of all sleep products, and the remainder of shipments is of these “non-conventional” sleep surfaces.

The estimated shipments of mattresses over the past 23 years are provided in Table 3. ISPA estimates of industry shipments of the “conventional” mattresses are shown. We have further estimated that the “non-conventional” sleep surfaces not included in the industry estimates totaled 10% of industry totals (the midpoint of the estimated 0-20% range for shipments not reported by ISPA). Any regulation that requires testing may impact mattresses and foundations (as sold in sets), mattresses sold separately, and, to a lesser extent, non-conventional mattress types. Thus, the staff has used the combined figures for mattresses of all types, including non-conventional mattresses, to represent the estimated number of products that may be subject to a rule.

Number in Use

To estimate the number of mattresses in use, EC has used the Directorate’s **Product Population Model**. The Model incorporates a computer algorithm that estimates the number of products remaining in use, based on the expected useful life of the product; a statistical distribution that describes the rate at which products are removed from use; and historical sales data.

The expected useful life of mattresses can vary substantially, with more expensive models generally experiencing the longest useful lives. Industry sources recommend replacement of mattresses after 10 to 12 years of use, but do not specifically estimate the average life expectancy of these products. An earlier EC market study estimated the expected useful life of mattresses at 14 years, derived from a study conducted for the CPSC, the **Product Life Feasibility and Development Study** (Battelle Columbus Laboratories, 1980). We have used a range of the expected useful life of mattresses of 10 to 14 years in order to encompass all of these prior estimates. For the statistical distribution, it is assumed that the product failure rate

over time would follow a gamma distribution, the distribution that is believed to most closely track the rate at which consumer products are removed from service.

Based on the information in Table 3, mattress shipments have increased about 3% per year in recent years. The inclusion of total annual sales of conventional and non-conventional sleep surfaces, as shown in the previous table, along with the other parameters listed above results in the estimate of the number of mattresses in use shown in Table 4.

International Trade

Historically, there has been little foreign trade in mattresses and foundations, because of the relatively high cost of shipping. Information from ISPA indicates that, in 2002, imports represented about 3% of total US shipments. By 2004, however, imports of mattresses and foundations represented about 4.8% of shipments. Exports were one-half that of imports in 2004.

Retail Trends

According to industry sources, in recent years there has been a gradual shift in the preferred sizes for mattresses toward larger sized mattresses. As shown in Table 5, in the last 5 years for which data are available, the market share of bedding in sizes larger than “full” rose from 40% in 1998 to 45% in 2002.

According to the ISPA sales statistics, the average shipment price (equivalent to the producer price) of mattresses was about \$182 in 2004, up from \$152 in 2002 and \$133 in 1999. While some of this increase may be related to inflation, it is likely that a significant share of this increase was due to the increasing share of larger mattresses in the market. The average shipment price for foundations in 2004 was \$90, up from \$86 in 2002. While there is some reluctance by industry to develop an “average” shipment price for mattress and foundation sets, it may be reasonable to assume that the average price for the set would be similar to the average of the 2 components: \$272 in 2004 ($\$182 + \90).

In a recent development, industry sources report that as much as 80% of current production of mattresses is one-sided (one sleep surface). This trend, attributed by industry to new and proposed flammability regulations and the increased competition from imports, is expected to continue. At this time, it is unclear as to the effect of this product shift on the expected useful life of mattresses but, intuitively, such a change should reduce the life of the product somewhat.

Retail Profitability

A 2004 report by the **National Home Furnishings Association** listed the gross margin retail establishments experienced for mattresses and foundations at 45%. It should be noted that these retailers are likely to carry high-end products, which would be subject to greater markups than other methods of sales. The ISPA noted that mattresses and foundations have the highest Gross Margin Return on Investment of any product in the home furnishings categories.

FR Mattresses

In 2005, some manufacturers began to produce mattresses with greater flame resistance, due in part to California's requirements under TB 603, and the CPSC staff's final draft standard. According to trade sources, Serta, with 13.9% of the total US market now produces 100% of its mattresses to comply with TB 603. The other 3 major manufacturers, with 43.4 % of the US market, currently produce 15-20% of total production to TB 603 requirements. Further, the remaining producers, with 43.6% of the US market, are required to comply with TB603 if they produce for the California market. California accounts for 11% of the US market.

Thus, at least 25% of current US mattress production already complies with standards similar to that of the CPSC staff final draft standard. (13.9% [Serta production] + 6.5% to 8.7% [other majors' reported conformance to TB 603] + 4.8 % [all others' share of CA market]).

TABLE 1**Major US Bedding Producers: Market Share**

(1) Sealy	21.3%
(2) Simmons	15.4%
(3) Serta	13.9%
(4) Spring Air	6.7%
(5) Tempur-Pedic	5.7%
(6) Select Comfort	4.7%
(7) King Koil	2.5%
(8) Therapedic	2.1%
(9) Kingsdown	1.9%
(10) Englander	1.8%
(11) IBC	1.7%
(12) Restonic	1.7%
(13) Symbol	1.4%
(14) Corsicana	1.2%
(15) Lady Americana	1.2%
Total:	83%

Source: **Furniture Today**, May 30, 2005.

TABLE 2**US Mattress Manufacturing, 2001 through 2003****Number of Establishments**

	2001	2002	2003
Number of Employees			
19 and under	346	316	294
20 to 99	170	159	204
100+	123	47	73
Total	639	607	571

Note: The category "19 and under" includes establishments with no paid employees at the time of the report, but with paid employees at some other time during the year.

Source: US Bureau of the Census, County Business Patterns of the United States.

TABLE 3
Estimated Mattress Shipments
In Thousands

	Conventional	Non-conventional	Total
1981	11,900	1,300	13,200
1982	11,300	1,300	12,600
1983	12,900	1,400	14,300
1984	13,800	1,500	15,300
1985	14,000	1,600	15,500
1986	14,900	1,700	16,600
1987	16,000	1,800	17,800
1988	16,600	1,800	18,400
1989	16,400	1,800	18,200
1990	16,200	1,800	18,000
1991	16,200	1,800	18,000
1992	16,900	1,800	18,700
1993	17,600	2,000	19,600
1994	18,300	2,000	20,300
1995	18,200	2,000	20,200
1996	18,700	2,000	20,700
1997	19,500	2,100	21,600
1998	20,200	2,200	22,400
1999	21,300	2,400	23,700
2000	21,700	2,400	24,100
2001	21,200	2,400	23,600
2002	21,500	2,400	23,900
2003	22,000	2,400	24,400
2004(f)	22,400	2,500	24,900
2005(f)	22,900	2,500	25,400

Source: IPSA, **2004 U.S. Mattress Industry** for conventional mattresses; non-conventional mattress were assumed to be 10% of the total industry production. Also includes “contract sales.”

(f) Forecasted shipments, based on ISPA projections for conventional mattresses.

Note: Numbers may not add to total, due to rounding.

TABLE 4
Estimated Number of Mattresses in Use

	If a 10-year useful life	If a 14-year useful life
1994	168.9 million	197.1 million
1995	175.9 million	208.2 million
1996	182.4 million	218.8 million
1997	189.1 million	229.4 million
1998	195.7 million	239.8 million
1999	203.0 million	250.7 million
2000	209.9 million	261.1 million
2001	215.7 million	270.3 million
2002	221.1 million	278.9 million
2003	226.5 million	287.4 million
2004(f)	231.8 million	295.7 million
2005(f)	237.0 million	303.9 million

Source: CPSC's **Product Population Model**.

(f) forecasted, based on the ISPA projection of shipments of conventional mattresses.

TABLE 5
Mattress Sales by Size

Type	Market Share			
	1998	2000	2002	2004
Twin (38x74.5 in.)	29.8%	29.6 %	29.1%	26.8%
Twin XL (38x79.5 in.)	2.1%	2.3%	2.1%	2.5%
Full (53x74.5 in.)	20.9%	20.5%	19.4%	18.0%
Full XL (53x79.5 in.)	2.0%	1.7%	1.6%	1.9%
Queen (60x79.5 in.)	31.6%	33.1%	34.2%	34.9%
King (75x79.5 in.)	6.8%	8.6%	9.3%	9.9%
California King (72x84 in.)	1.7%	1.6%	1.7%	1.6%
All Other	5.1%	2.6%	2.6%	4.4%

Source: **2002, 2004 U.S. Mattress Industry**, ISPA

Note: "all other" is composed of odd sizes, and conventional mattress replacements for use in lieu of waterbed bladders for use in waterbed frames.



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Memorandum

Date: January 10, 2006

TO Margaret L. Neily, ES
Project Manager, Mattress Flammability

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Deborah V. Aiken, Ph.D., Senior Staff Coordinator *DVA*

FROM : Soumaya M. Tohamy, Ph.D. *DVA for ST*

SUBJECT : Final Regulatory Analysis of Staff's Draft Final Standard to Address
Open-Flame Ignitions of Mattress Sets

Attached is the Final Regulatory Analysis of Staff's Draft Final Standard to Address Open-Flame Ignitions of Mattress Sets.

**Final Regulatory Analysis of
Staff's Draft Final Standard to Address
Open-Flame Ignitions of Mattress Sets***

**Soumaya M. Tohamy, Ph.D.
Directorate for Economic Analysis
U.S. Consumer Product Safety Commission**

January 10, 2006

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

Executive Summary

The U.S. Consumer Product Safety Commission received in April, 2000 a petition for rulemaking to modify the current flammability standard for mattresses to include ignition sources in addition to cigarettes. The Commission published an Advance Notice of Proposed Rulemaking (ANPR) in October, 2001, initiating a proceeding to develop a mandatory federal standard to address open-flame ignition. The Commission published a Notice of Proposed Rulemaking (NPR) in January, 2005. This *Final Regulatory Analysis*, which updates the *Preliminary Regulatory Analysis* (2004), discusses the benefits and costs associated with the staff's draft final standard and other options to address mattress fire safety.

The staff's draft final standard will apply to all mattress sets, produced domestically or imported.¹ The term mattress means a ticking (i.e., an outer layer of fabric) filled with a resilient material used alone or in combination with other products intended or promoted for sleeping upon. To comply with the staff's draft final standard, and have a "qualified" prototype, a manufacturer must test three mattress sets of the same prototype, and obtain passing results. All tested mattress sets should meet the following criteria: (1) the peak heat release rate (PHRR) does not exceed 200 kilowatts (kW) in the first 30 minutes, and (2) the total heat release does not exceed 15 megajoules (MJ) in the first 10 minutes of the test.

Manufacturers may then sell any mattress set of the qualified prototype. Manufacturers may also sell a mattress set based on a prototype that has not been tested if that subordinate prototype differs from a qualified prototype only with respect to (1) mattress/foundation size (length and width); (2) ticking, unless the ticking of the qualified prototype has characteristics designed to improve performance on the burn test; and/or (3) the manufacturer can demonstrate, based on an objectively reasonable basis, that a change in any component, material, or method of construction will not cause the prototype to exceed the test criteria specified above. If prototype pooling is conducted by the firm or establishment, one mattress set must be tested for a confirmation test by the pooling establishment or firm. Manufacturers may need to test other mattress sets periodically for quality assurance purposes.

Benefits of the staff's draft final standard represent the reduction in deaths and injuries associated with mattress fires that are expected to result from implementation of the staff's draft final standard. Using an expected mattress life of 10 years and a discount rate of 3 percent, the total lifetime benefits of complying with the staff's draft final standard are expected to range from \$45 to \$57, with a mid-point estimate of \$51, *per mattress set*. Costs of the staff's draft final standard are the increase in total resource costs (e.g., costs of material, labor, testing, and compliance efforts) that are expected to result from implementation of the staff's draft final standard. The total resource costs of the staff's draft final standard are expected to range from \$8 to \$22, with a mid-point estimate of \$15, *per mattress set*, yielding net benefits (benefits minus costs) of \$23 to \$50, with a mid-point estimate of \$36, *per mattress set*.

¹ A *mattress set* is defined as either a mattress and foundation labeled by the manufacturer for sale as a set or a mattress labeled by the manufacturer for sale without any-foundation (Section 1633.2(c)).

Aggregate lifetime benefits of the staff's draft final standard associated with a year's production of complying mattress sets are expected to range from \$1,024 to \$1,307 million, with a mid-point estimate of \$1,166 million. *Aggregate resource costs* associated with these mattress sets are expected to range from \$175 to \$511 million, with a mid-point estimate of \$343 million, yielding *aggregate* net benefits ranging from \$514 to \$1,132 million, with a mid-point estimate of \$823 million. All aggregate figures do not include mattress sets sold in California because these mattress sets are currently required to comply with California Technical Bulletin (TB) 603, which is similar to the draft final standard.

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 varied estimates resulted in positive net benefits of the staff's draft final standard. Alternatives to the staff's draft final standard were considered including varying test criteria, testing frequency, effective dates, and taking no action. The staff's draft final standard is expected to yield a positive net benefit while minimizing the impact on small manufacturers.

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Final Regulatory Analysis of Staff's Draft Final Standard to Address Open-Flame Ignitions of Mattress Sets

1. Introduction

For 1999 to 2002 there was an estimated annual average of 15,300 fires where the first item ignited was mattress/bedding (Miller, 2005).² These fires resulted in an annual average of 350 deaths, 1,750 injuries, and 295 million dollars of property loss (Miller, 2005.) The U.S. Consumer Product Safety Commission (CPSC) received in April, 2000 a petition for rulemaking to modify the current flammability standard for mattresses to include additional ignition sources. The Commission published an Advance Notice of Proposed Rulemaking (ANPR) in October, 2001, initiating a proceeding to develop a mandatory federal standard to address open-flame ignition. On January 13th, 2005, CPSC published a Notice of Proposed Rulemaking (NPR). This *Final Regulatory Analysis*, which updates the *Preliminary Regulatory Analysis* (2004), discusses the benefits and costs associated with the staff's draft final standard as well as other options to address mattress fire safety.

A 1997 CPSC report (Boudreault and Smith, 1997), based on 156 mattress/bedding fires investigated by CPSC field staff between October 1994 and December 1995, concluded that bedding was the first item ignited in 67 percent of the mattress/bedding fires.³ Bedclothes (top-of-the-bed products like mattress pads, pillows, blankets, and comforters) are most likely to be ignited first and serve as a magnifier of the initial ignition. Hence, a National Institute of Standards and Technology (NIST) study (Ohlemiller *et. al.*, 2000) designed and tested the ability of gas burners to mimic the thermal impact of burning bed clothes.

Another NIST study (Ohlemiller and Gann, 2002) indicated that the potential for flashover could be reduced if the peak heat release rate (PHRR) from a bed fire in a typical room (with other contents present) remains below 1,000 kilowatts (kW). Flashover is the point in a room fire at which radiant heat from the hot smoke accumulating in the upper portions of the room ignites all flammable materials within the room. The resultant generalized burning condition leads to an abrupt transition to oxygen supply-limited combustion of the various fuel gases and a large increase in the fraction of gases turned into carbon monoxide. These hot, toxic gases leave the room and pose a very serious threat to occupants elsewhere in the building. Since the bedclothes were shown to contribute more

² These estimates are based on data obtained from the U.S. Fire Administration's (USFA) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA) annual survey of fire departments.

³ A similar study conducted by the National Association of State Fire Marshals (NASFM) in 1997 resulted in similar findings.

than 400 kW in some cases, the study suggested that a mattress contributing more than 500 kW at the same time could lead to the occurrence of flashover.⁴

California Technical Bulletin (TB) 603, which is based on the use of NIST test burners designed to mimic the local thermal insult (heat flux levels and duration) imposed by burning bedclothes, became effective in California on January 1, 2005. The California share of the market is estimated, by industry representatives, to be around 11 percent of the U.S. market. TB 603 requires all mattress/foundation sets, mattresses intended to be used without a foundation, and futons to meet the following pass/fail criteria: (1) the PHRR does not exceed 200 kW in the first 30 minutes, and (2) the total heat release does not exceed 25 megajoules (MJ) in the first 10 minutes of the test.

As of October 2005, one of the top four producers is selling mattress sets that comply with both TB 603 and the staff's draft final standard. The other three (of the top four) are producing complying mattress sets representing between 15 percent and 20 percent of their total output. This includes all mattress sets sold in California, plus other special orders, institutional mattresses and mattress sets sold in other states. Smaller manufacturers, however, may not produce mattress sets intended for sale outside California to meet TB 603 performance requirements. They are more likely to wait until a federal standard is adopted. The mattress industry and the International Sleep Products Association (ISPA) support the development of a mandatory federal standard (*Furniture Today*, May, 10, 2004). A Federal standard would eliminate the uncertainty that may result from having different flammability standards for different states.

2. The Staff's Draft Final Standard: Scope and Testing Provisions

The staff's draft final standard will apply to all mattress sets, where the term mattress set means either a mattress and foundation labeled by the manufacturer for sale as a set, or a mattress labeled by the manufacturer for sale without any-foundation (Section 1633.2(c)). The term mattress means a ticking (i.e., an outer layer of fabric) filled with a resilient material used alone or in combination with other products intended or promoted for sleeping upon. This definition includes adult mattresses, youth mattresses, crib mattresses, including portable crib mattresses, bunk bed mattresses, futons, flip chairs, water beds and air mattresses which contain upholstery material between the ticking and the mattress core, and any mattresses used in items of upholstered furniture such as convertible sofa bed mattresses. It does not include sleeping bags, mattress pads, or any top of the bed articles.

A typical innerspring mattress construction might include ticking; binding tape fabric; quilt cushioning with one or more separate layers; quilt backing fabric; thread; cushioning with one or more separate layers; flanging; spring insulator pad; spring unit; and side (border) panels. Options for meeting the standard include one or a combination of fire resistant ticking, chemically treated or otherwise fire resistant filling products, or a high-loft fire

⁴ Wallboard, carpet, and other furniture in the room will contribute to the heat release critical for flashover in a typical room.

blocking barrier (sometimes called a fiber barrier).⁵ The fire blocking barrier is placed either directly between the exterior cover fabric of the product and the first layer of cushioning materials, or beneath one or more “sacrificial” layers that can burn without reaching the heat release constraints.

While the technology exists for producing a sheet-style fire blocking barrier, sometimes called a fabric barrier, few, if any, producers are choosing it for protecting the mattress.⁶ The cost of using sheet barriers is higher than using high-loft barriers, since sheet barriers are thin and therefore could not be substituted for an existing foam or cushioning layer. There is also concern that some sheet barriers, unlike high-loft barriers, may reduce the comfort of the sleeping surface. There are already over twenty different vendors of fire resistant materials associated with the production of mattress sets, including barriers, ticking, foam, tape, and thread. These materials include chemically treated cotton, rayon, and/or polyester, melamine, modacrylic, fiberglass, aramid (Kevlar®), or some combination of them.

For each qualified prototype, three mattress sets must be tested and must pass the test requirements.⁷ To obtain a passing result, each mattress set must pass a 30 minute test, where the PHRR does not exceed 200 kW and the total heat release does not exceed 15 MJ in the first 10 minutes of the test.⁸ A failure of any of the sets would require that a modified prototype be tested and pass the test (in triplicate). Manufacturers may sell any mattress set based on a qualified prototype. Manufacturers may also sell a mattress set based on a subordinate prototype that has not been tested if that prototype differs from a qualified prototype only with respect to (1) mattress/foundation size (length and width); (2) ticking, unless the ticking of the qualified prototype has characteristics designed to improve performance on the burn test; and/or (3) the manufacturer can demonstrate, based on an objectively reasonable basis, that a change in any component, material, or method of construction will not cause the prototype to exceed the test criteria specified above.

If two or more establishments (plants within the same firm) or independent firms choose to “pool” prototypes, then each pooling plant or firm is required to test one mattress set for confirmation testing. If that set fails, then the plant or firm will need to test another mattress set after correcting its production to make sure that it is identical to the original prototype. A pooling firm can sell other mattress sets that have not been tested by the pooling firm if they are based on a subordinate prototype and differ from the confirmed prototype only with respect to (1) mattress/foundation size (length and width); (2) ticking, unless the ticking of the qualified prototype has characteristics designed to improve performance on the burn test; and/or (3) the manufacturer can demonstrate, based on an

⁵ High-loft barriers range from about half an inch to over an inch in thickness.

⁶ Some producers are using a non-skid sheet barrier at the bottom of a one-sided mattress because the mattress sits on the foundation and therefore, the appearance of the bottom does not impact the consumer. Also, because it is at the bottom of the mattress, there is no padding used, which makes it economical to use the sheet there.

⁷ The staff’s draft final standard is described in more detail in Tenney (2005).

⁸ This requirement is different from that of California TB 603. Tenney (2005) explains the technical reasons for this requirement.

objectively reasonable basis, that a change in any component, material, or method of construction will not cause the prototype to exceed the test criteria specified above.

3. Products and Industries Potentially Affected

According to the International Sleep Products Association (ISPA), the mattress producers' trade organization, the top four producers of mattresses account for almost sixty percent of total U.S. production.⁹ In total, there are 571 establishments (as of 2003) that produce mattresses in the U.S., using the U.S. Department of Commerce NAICS (North American Industry Classification System) Code 33791 for mattresses. The top four producers account for about half of the number of all these establishments (Karels, 2005). The number of establishments has been declining over time due to mergers and buy-outs. Total employment in the industry, using the NAICS Code 33791, was 24,545 workers in 2003.

The mattress manufacturing industry has three key supplying industries: spring and wire product manufacturing, broad-woven fabric mills, and foam products manufacturing. Depending on the type of fire-resistant barrier chosen by different manufacturers, the demand for foam padding or non-skid fabric for mattresses might decline if it were replaced respectively by the high-loft or sheet barrier in the construction of the mattress and foundation. This would be offset by an increase in the demand for the barrier. Fiberglass, melamine, and aramid producers may also be affected to the extent that they are used to produce fire resistant materials used in mattress production.

Manufacturers of bedclothes may also be affected by the staff's draft final standard. Sales of bedclothes may increase or decrease based on whether consumers view bedclothes as complements or substitutes for a new mattress set.¹⁰ For example, if people tend to buy all parts of a new bed (mattress, foundation, and bedclothes consisting of a comforter, pillows, and sheets) at the same time, then an increase in the quantity of mattress sets sold would cause an increase in sales of bedclothes. If, alternatively, people tend to have a fixed budget for bedding items, then an increase in the quantity of mattress sets sold would lead to a decrease in sales of bedclothes.¹¹ Also, if the decision to buy a new mattress set involves buying a mattress that is much thicker than the one currently in use, then consumers will most likely buy new sheets (and possibly matching pillowcases and other bedclothes items) to fit the new thicker mattress.

⁹ *Furniture Today* (May 30, 2005) estimates the market share of the top four producers to be 57.4 percent by value of domestic shipments in 2004. *Furniture Today* estimates the share of the top fifteen producers to be 83.2 percent.

¹⁰ Complements are goods that are generally consumed together, like DVDs and DVD players. In contrast, substitutes are goods that are generally substituted for one another, like VCRs and DVD players.

¹¹ An alternative way to analyze this is to examine what consumers would do when faced with a higher-priced mattress set. They might decide to not buy the higher-priced mattress and buy new bedclothes instead, or buy the higher-priced mattress and not buy the new bedclothes they were planning to buy.

If the cost increase is relatively small or there is no resulting increase in the price of a mattress set, then the demand for bedclothes will only be affected if consumers place a higher value on the safer mattress set and replace their current set sooner than they would have with no standard in place. An increased demand for the safer (and thicker, if the current mattress is relatively old) mattress will likely result in an increased demand for sheets that fit the newer mattresses. This effect, however, is not directly resulting from the adoption of the staff's draft final standard since the thickness of the mattress need not be increased by the presence of either type of barrier. It is the result of the increased utility some consumers may derive from the safer mattress and the consequent increase in demand for bedclothes. The increased demand for safer mattresses would most probably lead to an increase in sales and employment in the spring and wire products, broad-woven fabric, and foam products industries, as well as in the mattress and bedclothes industries.

Other producers that could potentially be affected, if the price change associated with producing compliant mattress sets is significant, are those of other substitute products, like airbeds, waterbeds, . . . etc. that contain no upholstered material and would, therefore, not be covered by the staff's draft final standard. Their sales may increase as a proportion of total bedding products.

4. Characteristics of Mattresses Used in U.S. Households

The total number of U.S. conventional mattress shipments was 22.5 million in 2004 and is estimated to be 23.0 million in 2005.¹² Table 1 shows shipments of mattresses for the years 1981 to 2005. Mattress shipments have grown at an average rate of three percent over the period. Unconventional mattresses (including futons, crib mattresses, juvenile mattresses, sleep sofa inserts, and hybrid water mattresses) are estimated to be about 10 percent of the total market (Karels, 2005). This yields an estimated total number of mattresses produced domestically of 25.6 million in 2005. The value of conventional mattress and foundation shipments in 2004, according to ISPA, was \$4.10 and \$1.68 billion, compared to \$3.26 and \$1.51 billion respectively in 2002.

The CPSC Product Population Model (PPM) can be used to estimate the number of mattresses in use in different years, based on available annual sales data and an estimate of the average product life of a mattress. Industry representatives assert that the average consumer replaces a mattress after 10 years. A CPSC market study (Homan, 1996) estimated the average expected life of a mattress to be 14 years. The PPM estimates the number of (conventional and non-conventional) mattresses in use in 2005 to be 237.0 million mattresses, using a 10-year average product life, and 303.9 million mattresses, using a 14-year average product life. These two numbers are later used to estimate the pre-standard baseline risk and the expected benefits of the staff's draft final standard.

¹² Most of the data in this section are derived from Karels (2005) and ISPA (2005a, and 2005b).

Table 1: Mattress Shipments*: 1981-2005

Year	Conventional		Unconventional	Total^
	Units (000s)	% change	Units (000s)	Units (000s)
2005(f)	22,998	2.3%	2,555	25,554
2004	22,481	2.1%	2,498	24,979
2003	22,022	2.5%	2,447	24,469
2002	21,484	1.2%	2,387	23,871
2001	21,233	-2.0%	2,359	23,592
2000	21,675	1.5%	2,408	24,083
1999	21,345	5.9%	2,372	23,717
1998	20,164	3.5%	2,240	22,404
1997	19,487	4.4%	2,165	21,652
1996	18,671	2.5%	2,075	20,745
1995	18,220	-0.4%	2,024	20,245
1994	18,297	3.7%	2,033	20,329
1993	17,642	4.5%	1,960	19,602
1992	16,888	4.5%	1,876	18,764
1991	16,163	0.0%	1,796	17,959
1990	16,160	-1.5%	1,796	17,956
1989	16,411	-1.0%	1,823	18,234
1988	16,575	3.5%	1,842	18,417
1987	16,009	7.4%	1,779	17,787
1986	14,905	6.7%	1,656	16,561
1985	13,967	1.3%	1,552	15,518
1984	13,789	6.8%	1,532	15,322
1983	12,913	14.2%	1,435	14,348
1982	11,310	-4.7%	1,257	12,566
1981	11,867		1,319	13,186
Average		2.89%		

Source: ISPA (2005) and Karels (2005).

* Total shipments are calculated assuming that unconventional shipments (including futons, crib mattresses, juvenile mattresses, sleep sofa inserts, or hybrid water mattresses) are 10 percent of the total market.

^ Numbers do not necessarily add up due to rounding.

(f) denotes forecast, as provided by ISPA (2005b).

This analysis focuses principally on queen-size mattresses because they are the most commonly used. In 2004 queen-size mattresses were used by 34.9 percent of U.S. consumers. Following the queen-size are the sizes: Twin and Twin XL (29.3 percent), Full and Full XL (19.9 percent), King and California King (11.5 percent), and all other (4.4

percent). ISPA data reflect an increasing trend of the average size of a mattress.¹³ The average manufacturing price in 2004 was \$182 for a mattress of average size and \$90 for a foundation of average size. Hence the average manufacturing price of a mattress/foundation set was about \$272 in 2004.

There are no readily available data on average retail prices for mattress/foundation sets by size. ISPA, however, reports that mattress/foundation sets selling for under \$500 represented 34.6 percent of the market in 2004, compared to 40.7 percent in 2002. Mattress/foundation sets selling for between \$500 and \$1000 represented 41.1 percent of the market in 2004, compared to 39.2 percent in 2002.

5. Mattress/Bedding Residential Fires, Deaths, Injuries, and Property Losses: 1999 to 2002

Table 2 shows the estimated average annual mattress/bedding fires and potentially addressable fires for the period 1999 to 2002 (Miller, 2005).¹⁴ Average annual mattress/bedding fires for 1999 to 2002 are 15,300. Of these, 14,300 (or 93 percent) are potentially addressable by the staff's draft final standard. Average annual mattress/bedding deaths for 1999 to 2002 are 350. Of these, 330 (or 94 percent) are potentially addressable by the staff's draft final standard. Average annual mattress/bedding injuries for 1999 to 2002 are 1,750. Of these, 1,680 (or 96 percent) are potentially addressable by the staff's draft final standard. Average annual mattress/bedding property losses for 1999 to 2002 are 295 million dollars. Of these, 281.5 million dollars (or 95 percent) are potentially addressable by the staff's draft final standard.

Expected benefits from the staff's draft final standard, measured in terms of saved lives and reduced injuries are summarized in the next section. (See Smith and Miller (2005) for a more detailed description). These benefits are then used to calculate expected first-year monetary benefits associated with a mattress/foundation set produced in 2005 and project expected lifetime benefits for the set. Expected lifetime benefits are compared to costs in Section 8.

¹³ The average size for conventional mattresses in 2005 was between the full and queen sizes, closer to the queen (ISPA, 2005a).

¹⁴ National residential fire data for the years 2003 to 2004, though available, lack mattress-specific detail and are not being used in this section. They are used in the economic analysis of benefits (Section 6), however, because the effectiveness data in Smith and Miller (2005) are provided for the five-year period 2000 to 2004.

Table 2: Estimated Residential Structure Fires and Fire Losses Involving Mattresses/Bedding, Attended by Fire Service, 1999 to 2002

Heat Source	Fires	Deaths	Injuries	Property Loss in Millions
Total Mattress/Bedding	15,300	350	1,750	\$295.0
Total Fire Losses Potentially Addressable	14,300	330	1,680	\$281.5
Smoking Material – Potentially Addressable	4,400	180	520	81.6
Smoking Material – Not Addressable	*	*	*	.1
Candles, Matches, Lighters – Potentially Addressable	4,900	60	730	\$103.5
Candles, Matches, Lighters – Not Addressable	*	*	*	\$0.8
Additional Small Open Flame – Potentially Addressable	1,900	40	160	\$37.5
Additional Small Open Flame – Not Addressable	*	*	*	\$0.8
Other In Scope Ignition – Potentially Addressable	3,100	50	270	\$59.0
Other In-Scope Ignition – Not Addressable	100	*	*	\$0.4
Out of Scope Ignition Sources – Not Addressable	800	20	60	\$11.4

Source: Miller (2005) and U.S. Consumer Product Safety Commission/EPHA. Based on data from the U.S. Fire Administration and the National Fire Protection Association

All estimates rounded to nearest 100 fires, nearest 10 deaths or injuries, and nearest tenth of a million in property loss. Detail may not add due to rounding.

* Denotes rounded fire estimates of less than 100 and death or injury estimates of less than 10.

Source.

6. Expected Benefits of the Staff's Draft Final Standard

The expected benefits of the staff's draft final standard are estimated as reductions in the baseline risk of death and injury from all mattress fires, based on a study of fire investigations from 1999-2004 by Smith and Miller (2005). Risk reductions are then calculated on a per-mattress-in-use basis based on estimates of the number of mattresses in use. The monetary value of expected benefits per mattress is derived using estimates for the value of a statistical life and the current (i.e., 2005) estimate of average cost of a mattress fire injury. To derive the monetary value of expected benefits over the life of a mattress, the expected annual benefits are discounted (using a three percent discount rate), and then

summed over the expected life of the mattress. The analysis considers mattress lives of 10 and 14 years.

The potential benefits of the staff's draft final standard consist of the reduction in deaths, injuries, and property damage that would result. Since the objective of the staff's draft final standard is to reduce the likelihood of flashover or increase the time before flashover occurs, and not to reduce fires, changes in property losses associated with the staff's draft final standard are hard to quantify.¹⁵ Property losses are expected to decline but the extent of the decline cannot be quantified (Smith and Miller, 2005). Consequently, for purposes of this analysis, no reduction in property losses is assumed. That is, all expected benefits from the staff's draft final standard are in the form of prevented deaths and injuries. It should be clear that this underestimates net benefits, since there will likely be some benefits from reduced property losses. The staff's draft final standard is expected to reduce the likelihood of flashover resulting from fires started by smoking materials or other ignition sources, as well as those started by open-flame ignition. Reductions in fires, injuries, and deaths will translate into societal benefits, as will be discussed in the benefit-cost analysis (Section 8).

Estimates of the effectiveness of the staff's draft final standard are based on a CPSC staff evaluation of in-depth investigation reports of fires (including details of the occupants' situations and actions during the fire) occurring in 1999 to 2004 in which a mattress or bedding was the first item to ignite, the fire was of the type considered addressable by the staff's draft final standard, and a civilian death or injury resulted.¹⁶ Most of the investigations also included documentation from the fire department that attended the fire. Some incident reports were initiated from death certificates with follow-up documentation from the fire department. This resulted in a total of 195 deaths and 205 injuries in the investigations to be evaluated. The distribution of mattress ignition sources was not representative of all fires involving mattresses and thus the data were weighted to match the distributions of national fire data in the National Fire Incident Reporting System (NFIRS).

Evaluations of the fire incidents by CPSC staff reviewers used the results of NIST testing (Ohlemiller, 2004; Ohlemiller and Gann, 2003; Ohlemiller and Gann, 2002), which was conducted to assess the hazard produced from burning mattresses and bedclothes. Specifically, the evaluations were based on the expectation that occupants in bed when the fire ignited but able to escape the burning bedclothes in the first 3 to 5 minutes faced a minimal hazard. Occupants in direct contact with burning bedclothes for a longer period (5 to 10 minutes) would be subject to potentially hazardous levels of heat release. If the burning bedclothes did not ignite other non-bedding items or produce flashover at this time, heat release would subside temporarily and then begin to increase as the involvement of the mattress increased.

¹⁵ The reduction in property losses may be very large or small. A large reduction would occur if reducing the likelihood of flashover restricts the damage to the room of origin and does not spread to other rooms in the residence. Conversely, the reduction in property losses would be small in some cases, if most of the damage is water damage from the use of sprinklers and is therefore not affected by the size of the fire. This reduction could also be small if fire department response time is long.

¹⁶ Smith and Miller (2005) detail the methodology for deriving the effectiveness of the staff's draft final standard.

These conditions would allow occupants 10 to 15 minutes to escape the room of origin before the situation in the room would become untenable (Tenney, 2005). Since the staff's draft final standard is expected to slow the rate of fire spread and thus increase escape time, assuming that bedclothes do not contribute enough heat to pose a hazardous condition, it was assumed that people who were outside the room of origin at the time of ignition were unlikely to die in the fire, unless they entered the room later or were incapable of exiting on their own (Smith and Miller, 2005). The analysis focused on reduction of deaths and injuries because the staff's draft final standard is designed to limit fire intensity and spread rather than prevent ignition.

Each investigation was evaluated by CPSC staff reviewers to identify the features related to the occurrence of a death or injury once the fire was ignited. These included casualty age, casualty location when the fire started (at the point of ignition, in the room of origin but not at the point of ignition, or outside the room of origin), whether the casualty was asleep, or suffered from additional conditions likely to increase the time needed to escape, whether the casualty engaged in fighting the fire, and whether a rescuer was present. All of these conditions were used to determine a range for the likelihood that each individual death or injury would have been prevented had the staff's draft final standard been in effect. Percentage reductions of deaths (injuries) within subcategories of ignition source and age group were applied to equivalent sub-categories of the national estimates based on the NFIRS and NFPA data for 1999 to 2002. The estimated reductions per category were summed and the overall percentage reductions were calculated as the percent of addressable deaths (or injuries) that would have been prevented if the likelihood of flashover were reduced in the first 30 minutes and victims had 10 to 15 minutes of escape time (Smith and Miller, 2005).

Table 3 presents the estimated effectiveness of the staff's draft final standard, based on applying the effectiveness estimates, derived from 1999 to 2004 investigations, to 1999 to 2002 NFIRS and NFPA fire data (Smith and Miller, 2005). It indicates that the staff's draft final standard is expected to reduce all addressable deaths from mattress/bedding fires by 69 to 78 percent and reduce all addressable injuries from mattress/bedding fires by 73 to 84 percent (Smith and Miller, 2005).

Table 3: Estimated Effectiveness of the Staff's Draft Final Standard

Ignition Source	Percent Reduction in Deaths	Percent Reduction in Injuries
Open-Flame Ignition	73 - 81	75 - 86
Smoking Material Ignition	67 - 76	68 - 81
Other Material Ignition	67 - 76	77 - 87
All Ignition Sources	69 - 78	73 - 84

Source: Smith and Miller (2005).

Assuming that addressable mattress/bedding fire deaths and injuries account for the same percentage of residential casualties in 2003 and 2004 as in 1999 to 2002, Smith and Miller (2005) estimate that 240 to 270 deaths and 1150 to 1330 injuries in mattress/bedding fires attended by the fire service could have been prevented annually during the period 2000 to 2004 (Smith and Miller, 2005).

Table 4 presents the estimated benefits of the staff's draft final standard, based on the estimated annual deaths and injuries that are expected to be prevented by the staff's draft final standard. The analysis will be conducted as if the standard went into effect in 2005. All dollar estimates are based on constant 2005 dollars. A discount rate of 3 percent and the average expected life of a mattress of 10 and 14 years are also assumed.

Based on the estimated number of mattresses in use for an average mattress life of 10 years (described in Section 4), the reduction in the risk of death during the first year the standard becomes effective equals 1.01 deaths per million mattresses (240 deaths divided by the estimated 237 million mattresses in use in 2005) to 1.14 per million mattresses (270 deaths / 237 million mattresses).¹⁷ The mid-point estimate of the reduction in the risk of death the first year the standard becomes effective is, therefore, 1.08. The mid-point estimate of the reduction in the risk of injury, similarly calculated, equals 5.23, with a range from 4.85 to 5.61, injuries per million mattresses for an estimated 10-year life of a mattress. The mid-point estimates of the risk reductions for an estimated 14-year average life of a mattress are 0.84 deaths, with a range from 0.79 to 0.89, and 4.08 injuries, with a range of 3.78 to 4.38, per million mattresses.

Annual risk reductions resulting from the staff's draft final are used to derive the monetary benefits from reduced deaths and injuries. The estimated reduction in the risk of death is multiplied by the value of a statistical life (and divided by a million) to derive a first-year monetary estimate for the range of benefits from lives saved per mattress. Based on the existing literature, a value of a statistical life of five million dollars is assumed (Viscusi, 1993). The estimated reduction in the risk of injury is similarly used to derive the range of first-year monetary benefits from injuries prevented.¹⁸ The benefits from preventing an injury (the cost of an injury) in 2005 are estimated to average about \$150,000, based on Zamula (2005) and Miller *et. al.* (1993). The mid-point estimate of the first-year benefits associated with preventing deaths and injuries equals \$6.17, with a range from \$5.79 to \$6.54 for an estimated mattress life of 10 years and \$4.81, with a range from \$4.52 to \$5.10, for an estimated mattress life of 14 years. (See Table 4.)

¹⁷ The estimate of the risk of death and injury is lower for 2005 (compared to the average annual risk for 2000 to 2004) because the number of deaths and injuries is divided by the estimated number of mattresses in use, which (from Table 2, based on ISPA forecast) was assumed to grow by 2.3 in 2004.

¹⁸ The estimate consists of medical costs including transport costs, productivity lost, reduced quality of life (including what is commonly referred to as "pain and suffering"), and legal and health insurance administrative costs for fire-related injuries. Data from the National Electronic Injury Surveillance System (NEISS) from 01/01/95 to 09/30/04 on medical disposition (admitted or treated and released) and NFIRS/NFPA residential fire statistics (1999 to 2002) are combined to arrive at this estimate.

Table 4: Estimated Average Benefits of the Staff's Draft Final Standard

	Mattress Life	
	10 years	14 years
DEATHS		
Annual Deaths Prevented*	<i>240 to 270</i>	<i>240 to 270</i>
First-Year # of Mattresses in Use (mill.)	237.0	303.9
First-Year Risk Reduction (per mill. mattresses)	1.08 <i>1.01 to 1.14</i>	0.84 <i>0.79 to 0.89</i>
First-Year Benefits per Mattress	\$5.38 <i>\$5.06 to \$5.70</i>	\$4.20 <i>\$3.95 to \$4.44</i>
Lifetime Benefits per Mattress	\$44.71 <i>\$39.37 to \$50.05</i>	\$45.20 <i>\$38.72 to \$51.69</i>
INJURIES		
Annual Injuries Prevented*	<i>1150 to 1330</i>	<i>1150 to 1330</i>
First-Year Risk Reduction (per mill. mattresses)	5.23 <i>4.85 to 5.61</i>	4.08 <i>3.78 to 4.38</i>
First-Year Benefits per Mattress	\$0.79 <i>\$0.73 to \$0.84</i>	\$0.61 <i>\$0.57 to \$0.66</i>
Lifetime Benefits per Mattress	\$6.54 <i>\$5.67 to \$7.41</i>	\$6.62 <i>\$5.58 to \$7.65</i>
TOTAL		
First-Year Benefits per Mattress	\$6.17 <i>\$5.79 to \$6.54</i>	\$4.81 <i>\$4.52 to \$5.10</i>
Lifetime Benefits per Mattress	\$51.25 <i>\$45.04 to \$57.46</i>	\$51.82 <i>\$44.30 to \$59.34</i>

* Smith and Miller (2005).

- Notes:
- Numbers in bold are averages. Numbers in italics refer to the whole range. Averages refer to the mid-point estimate for the range that immediately follows.
 - Risk reduction is calculated as the number of casualties prevented (2000 to 2004 annual average), multiplied by a million, divided by the estimated number of mattresses in use in the first year (2005).
 - Numbers may not add up due to rounding.
 - First-year benefits per mattress are measured in 2005 dollars. Lifetime benefits are based on the sum of the annual discounted benefits (measured in 2005 dollars, and discounted at a rate of three percent) over the expected life of the mattress.

Lifetime benefits are derived by projecting annual benefits for the life of the mattress and summing the discounted (at a rate of three percent) stream of annual benefits (measured

in constant dollars).¹⁹ The number of mattresses in use is projected to grow at a rate of zero to three percent, based on the average growth rate for the 1981 to 2004 period. Since the number of deaths and injuries are implicitly assumed to remain constant over time, a positive growth rate of mattresses in use implies a declining risk over time, Tohamy (2004a). The lower end of the ranges for estimated (10 and 14 years) lifetime benefits in Table 4 correspond to a 3 percent projected mattress growth rate and the lower end of the effectiveness ranges in Table 3. The upper end of the ranges for estimated (10 and 14 years) lifetime benefits in Table 4 correspond to a zero percent projected growth rate and the upper end of the effectiveness ranges in Table 3.

For an expected mattress life of 10 years, the resulting mid-point estimate of expected lifetime benefits of saved lives associated with the staff's draft final standard equals \$44.71, with a range of \$39.37 to \$50.05 per mattress. The corresponding mid-point estimate of benefits of prevented injuries equals \$6.54, with a range of \$5.67 to \$7.41 per mattress. Hence, for an expected mattress life of 10 years, the mid-point estimate of the expected total lifetime benefits of a compliant mattress equals \$51.25, with a range of \$45.04 to \$57.46 per mattress. For an expected mattress life of 14 years, the mid-point estimate of the total benefits equals \$51.82, with a range of \$44.30 to \$59.34 per mattress.²⁰ The sensitivity analysis section below examines how the results might change when a discount rate of seven percent is used. These estimates appear in the benefits summary in Table 6, Section 8.

7. Expected Costs of the Staff's Draft Final Standard

This section presents the expected resource costs associated with the staff's draft final standard. Resource costs are costs that reflect the use of a resource that would have been available for other uses had it not been used in conjunction with the production of mattresses compliant with the staff's draft final standard. These costs include material and labor costs; testing costs; costs to wholesalers, distributors, and retailers; costs of producers' information collection and record keeping; costs of quality control/quality assurance programs; and compliance and enforcement costs. The effect on retail prices will be discussed in Section 8.

¹⁹ This calculation assumes that the casualties of a fire will be the same for all years of the mattress life. While deaths from smoking and open-flame ignition mattress fires are decreasing, deaths from mattress fires due to other ignition sources are increasing. These two factors will likely offset each other, making this assumption not unreasonable for death casualties. Injury casualties, however, will probably decline over the lifetime of the mattress. Because reduced deaths contribute a much larger share to overall benefits, the decline in injuries is ignored in this section. The sensitivity analysis shows positive net benefits of the staff's draft final standard even if injuries were not affected and only deaths were reduced.

²⁰ The estimated life of a mattress affects the estimated benefits in two ways. First, because the estimated number of mattresses in use increases with the estimated life of the mattress, the annual risk of a fire per mattress is smaller. Consequently, the annual benefit per mattress is smaller for a longer mattress life. Second, the longer the life, the more years consumers derive benefits from the same mattress. These two offsetting effects make the net change very small, as indicated by comparing the lifetime (10 and 14 years) values per mattress, in Table 4. While the range for an expected life of 14 years is a little wider than that for an expected life of 10 years, the mid-point estimates are within a dollar from one another.

Material and Labor Costs

To comply with the staff's draft final standard, the construction of most mattress sets will include a barrier technology with improved fire performance.²¹ This barrier may be thick (high-loft) or thin (sheet). High-loft barriers replace some of the existing non-woven fiber, foam, and/or batting material, leading to a smaller increase in costs than sheet barriers, which constitute an addition to production materials (and costs). Producers, therefore, are generally using the high-loft barrier for the panel (top of the mattress) and mattress and foundation borders. If they are using sheet barriers, they limit their use to the bottom of the mattress, replacing the no-skid non-FR (fire resistant) sheet used previously.

Table 5 summarizes the resource costs of complying with the staff's draft final standard. According to several barrier producers and mattress manufacturers, the average price of a high-loft barrier that would make a mattress comply with the staff's draft final standard is around \$2.65 per linear yard, defined to have a width of 88 to 92 inches.²² Barrier costs range from \$2.00 to \$3.30, per linear yard.²³ The high-loft barrier replaces the currently-used polyester batting, which costs an average of \$ 1.15, with a range from \$0.55 to \$1.75, per linear yard. Hence, the net increase in the average cost attributed to the use of the high-loft barrier, referred to by the industry as the application cost, is \$1.50, with a range from \$0.25 to \$2.75 per linear yard, which translates to a net increase in barrier-related manufacturing costs of \$7.95, with a range from \$1.33 to \$14.58, for a queen-size mattress set.²⁴ The queen-size is used for all the cost estimates, because it is the mode size, used by 34.9 percent of consumers in 2004.²⁵

²¹ Costs of a mattress set are estimated for both a mattress and a foundation throughout the analysis. This results in a slight over estimate for costs of producing a mattress sold without an accompanying foundation.

²² This average refers to a mid-point estimate and not a statistical average.

²³ The actual lower end of this range is likely to be a bit lower because of quantity discounts offered by input suppliers to large mattress producers. These quantity discounts are offered to reward manufacturers for committing to a large daily volume and long contract durations. Moreover, the price of the sheet barrier used by manufacturers for the bottom of a one-sided mattress is lower than \$2.00 per linear yard. The range does not reflect this number because the sheet is only used in the bottom of the mattress. Hence the costs of using a combination of sheet and high-loft barriers would be slightly lower than those presented in Table 5.

²⁴ This calculation is based on the assumption that a queen-size mattress/foundation set requires 5.3 linear yards of the barrier material to be used in the two (top and bottom) panels of the mattress and the borders of both the mattress and foundation. Some producers are able to use less than 5.3 linear yards, which reduces their cost per queen mattress/foundation set.

²⁵ The median size is the full size and the average size is between the full and queen sizes. This implies that the benefit-cost analysis may underestimate net benefits, because benefits are estimated for all mattresses while cost estimates focus on queen-size mattresses.

Table 5: Estimated Average Costs of the Staff's Draft Final Standard

Barrier Cost per Linear Yard:	
(1) Price of Barrier	\$2.65 <i>\$2.00 to \$3.30</i>
(2) Price of Batting Materials Replaced by the Barrier	\$1.15 <i>\$0.55 to \$1.75</i>
(3) Barrier Application Cost Per Linear Yard* $(=(1)-(2))$	\$1.50 <i>\$0.25 to \$2.75</i>
(4) Barrier Application Cost per Mattress Set** $(=(3)*5.3)$	\$7.95 <i>\$1.33 to \$14.58</i>
FR Thread Cost per Mattress Set:	
(5) Price of FR Thread	\$0.51 <i>\$0.41 to \$0.60</i>
(6) Price of Thread Replaced by FR Thread	\$0.10
(7) Thread Application Cost $(=(5)-(6))$	\$0.41 <i>\$0.31 to \$0.50</i>
(8) Costs due to Reduced Labor Productivity per Mattress Set	\$4.40
(9) Labeling Cost	\$0.01
(10) Material and Labor Costs per Mattress Set $(=(4)+(7)+(8)+(9))$	\$12.77 <i>\$6.05 to \$19.49</i>
(11) Testing Cost per Mattress Set	\$0.82
(12) Record Keeping Cost per Mattress Set	\$0.01
(13) Quality Assurance Testing Costs per Mattress Set (7)	\$0.037
(14) Quality Assurance Labor Costs per Mattress Set (8)	\$0.038
(15) Total Quality Assurance Costs per Mattress Set $(=(13)+(14))$	\$0.075
(16) Total Production Costs per Mattress Set $(=(10)+(11)+(12)+(15))$	\$13.67 <i>\$6.95 to \$20.39</i>
(17) Costs to Wholesalers, Distributors, and Retailers per Mattress Set $(=(16)*10\%)$	\$1.37 <i>\$0.69 to \$2.04</i>
(18) CPSC Compliance and Enforcement Cost per Mattress Set	\$0.029
(19) Total Resource Cost per Mattress Set $(=(16)+(17)+(18))$	\$15.07 <i>\$7.67 to \$22.46</i>

Notes: Numbers in bold are averages. Numbers in italics refer to the whole range. Averages refer to the mid-point estimate for the range that immediately follows.

Numbers may not add up due to rounding.

* To derive the lower end of the range for application cost, the upper end of the cost range for batting is subtracted from the lower end of the cost range for the barrier. The upper end of the range is derived by subtracting the lower end of the range for batting from the upper end of the range for the barrier.

Industry representatives assert that 5.3 linear yards of the barrier for a queen-size mattress set is reasonable. Manufacturers that use less barrier material will have lower costs.

In addition to the increase in material costs due to the use of a barrier, costs will increase due to the use of fire-resistant (FR) thread for tape stitching. According to several

thread producers, the average cost of FR thread is \$0.51, with a range from \$0.41 to \$0.60, per queen-size mattress set. Given that the cost of nylon (non-FR) thread is about \$0.10 per queen-size mattress set, the average application cost of FR thread (net increase in costs due to the use of FR thread) per queen-size mattress set is \$0.41, with a range from \$0.31 to \$0.50.

Costs may also increase due to slightly reduced labor productivity. Based on industry estimates of an average of two labor hours for the production of a queen-size mattress set, and a 10 percent reduction in labor productivity and an industry average hourly total compensation of \$22.00, the cost increase due to reduced labor productivity is about \$4.40. The reduced labor productivity results from the inexperience of the workers with the new production methods and should disappear when they become familiar with the products and techniques being used.

The staff's draft final standard requires producers to add a new label to both mattresses and foundations that identifies the prototype and the possible choice of foundations to be used with a specific mattress. This requirement is to ensure that consumers are buying a mattress set that was tested as a set, and would thus meet the requirements of the staff's draft final standard. This label is required to be separate from any other labels already being used and is estimated by industry representatives to result in an additional cost of \$0.01 for both the mattress and foundation. This estimate includes both the material and labor needed to add the label.

The increase in the average materials and labor costs of a mattress set is thus equal to the sum of the barrier application cost per mattress set, thread application cost, labeling cost, and costs due to reduced labor productivity. This sum equals \$12.77 (\$7.95 barrier cost + \$0.41 thread cost + \$4.40 labor cost + \$0.01 label cost).²⁶ The estimated range for the materials and labor costs is \$6.05 to \$19.49.

Costs of Prototype and Confirmation Testing

The staff's draft final standard requires each mattress set qualified prototype to be tested in triplicate for prototype qualification.²⁷ According to industry representatives, the cost of testing per twin-size mattress set is about \$500: the sum of the average cost of the materials and shipping (\$100) and the cost of the use of the lab (\$400).²⁸ Hence, the cost of

²⁶ Some producers are also using an FR mattress edge binding tape, which costs an average of \$2.52 per mattress, while a non-FR tape costs an average of \$1.68. This makes the net increase in costs, due to using FR edge binding tape, equal to \$0.84. This cost is not added to the total production costs, because it is not required for the mattress to pass the burn test.

²⁷ A prototype is defined as a specific design of mattress and corresponding foundation, or mattress only if the mattress is intended to be used without a foundation, which serves as a model for production units intended to be introduced into commerce. (See Section 1633.2(k) of the staff's draft final standard.) This definition implies that any change to the size, ticking, and/or any other component of the mattress/foundation set assembly results in a different prototype.

²⁸ The staff's draft final standard requires testing of mattress/foundation sets that are no smaller than a twin size, unless the largest size mattress/foundation set is smaller than in twin set, in which case the largest size must be tested. Given the lower cost of the twin mattresses and the availability of more

testing three mattress sets for a prototype qualification equals \$1500.²⁹ Additionally, if some mattress set prototypes do not pass the first time, then the cost will be higher, because additional tests will be done after action is taken to improve the resistance of the prototype. If 10 percent of mattress sets are retested, then the expected average cost of testing a prototype would be 10 percent higher, or \$1650. This cost is assumed to be incurred no more than once per establishment for each qualified prototype. It is expected that a qualified prototype will be used to represent a mattress set style (e.g., single-sided pillow top, double-sided pillow-top, tight-top, euro-top, . . . etc.) with all subordinate prototypes using the same style (with different sizes (lengths and widths) and different ticking materials) being based on the qualified prototype.

If companies pool their prototypes across different establishments or different companies, testing costs would be smaller as all but one of the firms/establishments producing to the specification of a pooled prototype will burn one mattress set (for the confirmation test) instead of three (for the qualified prototype test). The probability of a mattress set failing a confirmation test is smaller than one. Therefore, it is expected that the average cost of testing per mattress will be lower for firms and/or establishments that pool their results than for those that do not.

If manufacturers test every mattress set style (e.g., single-sided pillow top, double-sided pillow-top, tight-top, euro-top, . . . etc.), which is estimated, based on conversations with manufacturers, to average about 20 per manufacturer, for every establishment in a given year, then their average testing cost per mattress would approximately equal 82 cents ($\$1650 * 20 \text{ styles} * 571 \text{ establishments} / 23.0 \text{ million conventional mattresses}$) per mattress set for the first year of production.³⁰ The draft final standard would allow selling mattress sets whose (subordinate) prototypes differ from a qualified (or confirmed) prototype only with respect to size (length and width), and/or ticking material or other components that do not impact the fire performance of the prototype without testing the prototypes, to minimize testing costs to all manufacturers, especially those whose volume of output is small. Pooling testing results across establishments and/or firms will further reduce the average cost of testing per mattress set. On an annual basis, testing costs will be further reduced because qualified, confirmed, and subordinate prototypes need not be tested every year.

Cost of Information Collection and Record Keeping

In addition to prototype testing, the staff's draft final standard requires detailed documentation of all tests performed and their results including video or pictures; prototype or production identification number; date and time of test; and name and location of testing

laboratories that are equipped to test twin mattresses, it is expected that most manufacturers will only test twin size mattresses.

²⁹ As more laboratories are being built, either by mattress manufacturers to test their own production or private laboratories, this cost is expected to decline.

³⁰ Some barrier producers are offering to burn an initial number of mattresses (manufactured with their barriers) as an included service with the purchase of a barrier (and agreeing to a time commitment). This makes the costs to the producers even smaller, because some of the testing cost is born by the supplier and included in the barrier price.

facility; test room conditions; and test data for as long as the prototype is in production and for three years after its production ceases. Manufacturers are also required to keep records of a unique identification number for the qualified prototype and a list of the unique identification numbers of each prototype based on the qualified prototype and a description of the materials substituted and/or the size change. Moreover, they are required to document the name and supplier of each material used in construction of a prototype. Additionally, they are required to identify the details of the application of any fire retardant treatments and/or inherently fire resistant fibers employed relative to mattress components.

This documentation is in addition to documentation already conducted by mattress manufacturers in their efforts to meet the cigarette standard. Detailed testing documentation will be done by the test lab and is included in the estimated cost of testing. Based on CPSC Office of Compliance staff estimates, the requirements of the staff's draft final standard are expected to cost an establishment about one hour per qualified prototype. Assuming that every establishment will produce 20 different qualified prototypes, the increase in record keeping costs is about \$412.20 (1 hour * 20 qualified prototypes * \$20.61 average total compensation per hour for office and administrative support workers) per establishment per year. (Note that pooling among establishments or using a qualified, confirmed, or subordinate prototype for longer than one year will reduce this estimate.) This translates to an average cost of 1 cent per mattress set for an average establishment, with average output of 40,280 conventional mattresses.

Cost of Quality Control/Quality Assurance Programs

To ensure that all mattress sets are produced to the prototype specification across all factories and over the years for which a production line exists, mattress manufacturers will need a thorough well-documented quality control/assurance program. The top 15 mattress producers (with a market share of 83 percent) have an existing quality control program which could be modified to fit the new standard with minimal additional costs. Smaller producers, whose quality control program is less detailed or non-existent, will incur some incremental costs as a result of the staff's draft final standard. These incremental costs will be small for each manufacturer and less when measured per mattress set. (See the section on impact of the staff's draft final standard on small businesses for a description of the costs of quality control and quality assurance programs to them.)

Additionally, the standard encourages random production testing to assure manufacturers that their mattress sets continue to meet the requirements of the rule, as a possible component of the quality control/quality assurance program. Assuming that an average of 3 mattress set styles will be tested per establishment per year yields an estimated cost of production testing of about \$1500. Based on this assumption, the estimated cost of testing mattress sets for quality assurance purposes, therefore, equals 3.7 cents per mattress set (\$1500 / 40,280) for an average establishment.³¹

³¹ A thread manufacturer is marketing a barrier quality control program to mattress manufacturers that would cost less than \$5000 per establishment. This translates to an average cost of 14 cents per mattress for an average establishment, with average output per establishment equal to 40,280 mattresses per year. This program is an option for manufacturers who lack any quality

The labor needed to meet the quality assurance measures required by the staff's draft final standard is estimated by CPSC Office of Compliance staff to be 224 minutes per qualified prototype per year. Assuming that every establishment will produce 20 qualified prototypes, the increase in labor costs associated with quality assurance requirements of the staff's draft final standard is about \$1539 (224 minutes * 20 qualified prototypes * \$20.61 average total compensation per hour for office and administrative support workers) per establishment per year. (Note that pooling among establishments, which would reduce the number of qualified prototypes per establishment, or using a qualified, confirmed, or subordinate prototype for longer than one year will reduce this estimate.) This yields an average cost of 3.8 cents per mattress set for an average establishment, with average output of 40,280 mattresses per year. Hence expected total costs of quality assurance/quality control programs may average about 7.5 cents (3.7 + 3.8) per conventional mattress set per year.

Costs to Wholesalers, Distributors, and Retailers

An added cost of the staff's draft final standard is the increase in costs to wholesalers, distributors, and retailers in the form of additional storage, transportation, and inventory financing costs. Since a mattress set complying with the staff's draft final standard will not be bigger than a similar mattress set produced before the standard becomes effective, storage and transportation costs are not expected to increase. Inventory financing costs will increase by the average cost of borrowing money, applied to the wholesale price of a mattress set over the average inventory holding time period. Since most mattress producers use just-in-time production and have small inventories, this additional cost will probably not exceed 10 percent of the increase in production cost (which is the sum of material, labor, testing, record keeping, and quality assurance costs). A 10 percent mark-up is, therefore, being used to measure the cost to wholesalers, distributors, and retailers.³² This yields a resource cost to wholesalers, distributors, and retailers equal to \$1.37, with a range from \$0.69 to \$2.04, per mattress set. Retail prices may increase by more than the 10 percent mark-up. Section 8 discusses the impact of the staff's draft final standard on retail prices of mattress sets.

Costs of Compliance and Enforcement

Compliance and enforcement costs refer to the costs incurred by CPSC to ensure that manufacturers are complying with the staff's draft final standard. Based on the past staff experience with the mattress cigarette ignition standard, the estimated CPSC staff inspection time spent per location (establishment) equals 33 hours for inspection and 6 hours for sample collection. This yields a cost per inspection of about \$1722.63 (39 hours * \$44.17, the

control/assurance program. All other mattress producers would be expected to have a lower cost per establishment.

³² The remaining part of the cost-to-retail-price markup (estimated by mattress manufacturers to be about four-fold) is not a reflection of an increase in costs specific to the introduction of the staff's draft final standard. It is a mere transfer from consumers to manufacturers, wholesalers, distributors, and retailers and does not reflect any additional resource costs to society. Refer to Office of Management and Budget (1996) for a discussion of the proper treatment of transfer payments in regulatory analysis.

average wage rate for CPSC inspectors). Additionally, Compliance Officers spend an average of 20 hours per case, making their cost equal to \$1,071.20 (20 hours * \$53.56, the average hourly wage rate for Compliance Officers). This yields an average compliance and enforcement total labor cost of \$2,793.83 per inspected establishment per year.

It should be noted that the *expected* cost per establishment per year, if less than one hundred percent of establishments are inspected every year, equals the cost per inspected establishment times the probability that a given establishment will be inspected. Though the probability that a given establishment will be inspected in a given year is not known, assuming that a third of all establishments will be inspected (i.e., about 190 establishments) yields a compliance and enforcement total expected labor cost of \$931.28 ($\$2,793.83 * (1/3)$) per establishment per year.

In addition to labor costs, CPSC will incur testing costs. It should be noted that the decision to collect samples after an inspection visit is made at the discretion of the investigator and, therefore an accurate assumption about the number of samples collected and sent for a burn test cannot be made. If, based on inspection, samples from 10 percent of all inspected establishments were to be collected and sent to a lab for a burn test, and if samples representing 5 (qualified, confirmed, or subordinate) prototypes are taken from each of these establishments, then the total cost of CPSC testing will be \$142,750 (5 prototypes * \$1,500 (the cost of testing 3 mattress sets for each prototype) * 19 (10 percent of inspected establishments, equal to a third of 571)). These assumptions about frequency of testing yield an expected cost of testing per establishment of \$250 ($\$142,750 / 571$).

Therefore the expected total CPSC wage and testing costs associated with the staff's draft final standard per establishment per year equal \$1,181.28 ($\$931.28 + \250.00). With an average production of 40,280 mattresses per establishment (23 million mattresses divided by 571 establishments), the average CPSC wage and testing costs equal 2.9 cents per mattress set ($\$1,181.28 / 40,280$). These costs are expected to decrease over time as manufacturers learn the requirements of the staff's draft final standard and become more likely to comply with these requirements.

Total Resource Costs

Expected total resource costs (including material costs, labor costs, costs of prototype and confirmation testing, paperwork collection and record keeping costs, costs of quality control/quality assurance programs, production testing costs, costs to wholesalers, distributors, and retailers, and costs of compliance and enforcement) are estimated to be \$15.07, with a range from \$7.67 to \$22.46, per mattress set. The section on the impact of the staff's draft final standard on small businesses and other small entities discusses how costs of testing and quality control/quality assurance programs may differ for small businesses and strategies that small manufacturers might adopt to reduce these costs.

Projected Future Costs

It is possible that costs associated with the standard will decline over time. A supplier of fire resistant barriers predicts that the price of the barriers will decline in the next two years, due to decreased uncertainty and increased competition. (They have already dropped significantly since TB603 was proposed.) The increase in labor costs due to decreased productivity is expected to be temporary and be reduced when workers get more training and/or the older machines get replaced with newer machines that are more capable of handling the FR thread and material used in fire resistant barriers. Moreover, as noted above, prototype testing costs are expected to decline after the first year of the standard.

The staff's draft final standard references an effective date of the earlier of January or July following twelve months following publication of a final rule. The costs reported here are based on the assumption that supplier companies will be able to maintain existing capacity. If federal standards for bedclothes and upholstered furniture were mandated at the same time and input producers were not given enough time to increase their capacity, input prices would rise in the short-run because of increased demand for the FR material used by all three industries.

Unquantifiable Costs

A mattress manufacturer indicated that in response to an open-flame mattress standard, the number of models/styles produced may be cut by half. If this response is typical, then there may be a reduction in consumers' utility, because of the reduction in mattress types that they would have to choose from. Others indicate that there will be an aversion to producing double-sided mattresses, because it would be harder for them to pass the burn test. Double-sided mattresses possibly have a longer expected life than single-sided ones. To the extent that consumers prefer double-sided mattresses to single-sided mattresses, the shift away from producing double-sided mattresses imposes a non-monetary cost. Though unquantifiable, this reduction in choices of styles and designs is an added cost to consumers of the staff's draft final standard.

8. Benefits and Costs of the Staff's Draft Final Standard

This section compares benefits and costs of the staff's draft final standard, presents a sensitivity analysis, and highlights the impact of the staff's draft final standard on retail prices, small businesses, children, and the environment. The sensitivity analysis examines the effect of changing some of the assumptions used earlier. The analysis shows that net benefits continue to be positive under a reasonable range of assumptions about the death and injury effectiveness of the staff's draft final standard, the reduction in injuries resulting from the staff's draft final standard, the value of a statistical life estimate, the discount rate, or the expected mattress life.

The top half of Table 6 shows benefits, costs and net benefits *per mattress set* associated with the staff's draft final standard, using different assumptions about the expected average life of a mattress and the discount rate. Using an expected mattress life of 10 years and a discount rate of 3 percent, the mid-point estimates for total benefits, costs, and net benefits equal \$51.25, \$15.07, and \$36.18 respectively per mattress set. The ranges for these estimates are \$45.04 to \$57.46, \$7.67 to \$22.46, and \$22.58 to \$49.78 respectively per mattress set. The lower end of the range for net benefits is derived by subtracting the upper end of the range for costs from the lower end of the range for total benefits. The upper end of the range for net benefits is derived by subtracting the lower end of the range for costs from the upper end of the range for total benefits. The whole range for net benefits is positive, which means that the expected benefits of the staff's draft final standard will always exceed the expected costs. The sensitivity analysis, which allows the discount rate and the expected product life to vary, shows that net benefits remain positive when varying assumptions are made.

The bottom half of Table 6 also shows that the expected aggregate lifetime benefits associated with one year's production of mattresses. Assuming that all mattress sets in California would have complied with a standard that is very similar to the staff's draft final standard, aggregate costs, benefits, and net benefits are derived by applying the per unit cost and benefit of the staff's draft final standard to 89 percent of the estimated U.S. market for mattresses (equal to 25.6 million units). The sensitivity analysis section below shows aggregate costs, benefits, and net benefits of the draft final standard assuming that current production shares would continue into the future without the anticipation of a federal standard.

Using a discount rate of three percent and an expected 10-year mattress life, aggregate benefits of the staff's draft final standard are expected to be \$1,024 to \$1,307 million (\$45.04 to \$57.46 per mattress times 89 percent times 25.6 million mattresses). The mid-point estimate for aggregate benefits is \$1,166 million. The corresponding expected aggregate resource costs of the staff's draft final standard are \$175 to \$511 million (\$7.67 to \$22.46 times 89 percent times 25.6 million). The mid-point estimate for aggregate costs is \$343 million. The resulting aggregate net benefits equal \$514 to \$1,132 million (\$22.58 to \$49.78 times 89 percent times 25.6 million). The mid-point estimate for aggregate net benefits is \$823 million. For a mattress life of 14 years (and a 3 percent discount rate), the mid-point estimates for aggregate lifetime benefits, costs, and net benefits of the staff's draft final standard associated with one year of production are \$1,179, \$343, and \$836 million respectively. The expected benefits of the staff's draft final standard will accrue for a long

period of time and discounted net benefits will, therefore, be much greater than net benefits associated with only the mattress production in the first year the standard becomes effective.

Table 6: Summary of Expected Benefits and Costs of the Staff's Draft Final Standard, Measured in 2005 \$US

	Total Benefits	Costs	Net benefits
PER MATTRESS SET			
Average Life of 10 Years			
3 percent discount rate	\$51.25 <i>\$45.04 to \$57.46</i>	\$15.07 <i>\$7.67 to \$22.46</i>	\$36.18 <i>\$22.58 to \$49.78</i>
7 percent discount rate	\$44.01 <i>\$38.88 to \$49.15</i>	\$15.07 <i>\$7.67 to \$22.46</i>	\$28.95 <i>\$16.42 to \$41.47</i>
Average Life of 14 Years			
3 percent discount rate	\$51.82 <i>\$44.30 to \$59.34</i>	\$15.07 <i>\$7.67 to \$22.46</i>	\$36.75 <i>\$21.84 to \$51.66</i>
7 percent discount rate	\$41.99 <i>\$36.26 to \$47.72</i>	\$15.07 <i>\$7.67 to \$22.46</i>	\$26.93 <i>\$13.80 to \$40.05</i>
AGGREGATE			
(MILLION \$*)			
Average Life of 10 Years			
3 percent discount rate	1,166 <i>1,024 to 1,307</i>	343 <i>175 to 511</i>	823 <i>514 to 1132</i>
7 percent discount rate	1,001 <i>884 to 1,118</i>	343 <i>175 to 511</i>	658 <i>373 to 943</i>
Average Life of 14 Years			
3 percent discount rate	1,179 <i>1,008 to 1,350</i>	343 <i>175 to 511</i>	836 <i>497 to 1175</i>
7 percent discount rate	955 <i>825 to 1085</i>	343 <i>175 to 511</i>	612 <i>314 to 911</i>

Notes: Aggregate estimates are based on estimated sales of both conventional and non-conventional mattresses outside of California, estimated to be about 89 percent of total sales in 2005 (equal to 25.6 million mattresses). This reflects the implicit assumption that per mattress costs are equal for conventional and non-conventional mattresses.
Numbers may not add up due to rounding.

Sensitivity Analysis

The previous analysis compares benefits and costs of the staff's draft final standard using expected mattress lives of 10 and 14 years, a discount rate of 3 percent, an expected effectiveness rate of the staff's draft final standard of 69 to 78 percent of deaths and 73 to 84 percent of injuries, an estimated value of a statistical life of 5 million dollars, and an

estimated cost of injury of \$150,000. It also assumes that all only mattresses sold in California would have to, and therefore will, comply with TB 603, if producers are not anticipating a federal standard to be issued in the near future. This section examines the effect of changing any of these assumptions on the expected net benefits of the staff's draft final standard.

Comparing expected per-mattress set benefits and costs of the staff's draft final standard (as indicated in Table 6), it is clear that net benefits are expected to be positive (i.e., expected total benefits exceed expected costs) for an average mattress life of 10 or 14 years. Though increasing the expected mattress life from 10 to 14 years, while using the 3 percent discount rate, expands the positive range of net benefits per mattress set, it does not affect the conclusion regarding net benefits. A further increase of the expected life of a mattress similarly would not affect the estimate of net benefits. For example, using the Product Population Model estimate of the number of mattresses in use based on an expected mattress life of 18 years (equal to 354.2 million mattresses) yields net benefits of \$21.76 to \$54.31, with a mid-point estimate of \$38.04, per mattress set using a discount rate of 3 percent.

Net benefits per mattress set are also positive using discount rates of either 3 or 7 percent. Using a 3 percent discount rate, the mid-point estimate of net benefits per mattress set equals \$36.18 for an average life of 10 years and \$36.75 for an average life of 14 years. Using a 7 percent discount rate, the mid-point estimate of net benefits per mattress set equals \$28.95 for an average life of 10 years and \$26.93 for an average life of 14 years. Assuming a larger discount rate reduces net benefits, because future benefits reaped over the life of the mattress set contribute less to total discounted benefits.

Net benefits in Table 6 are based on an estimated value of a statistical life equal to \$5 million. Changing the estimate used for the value of a statistical life does not have a major impact on the results. For example, if \$3 million, the lower bound estimate in Viscusi (1993), is used as an estimate of the value of a statistical life, the mid-point estimate of net benefits becomes \$18.30 per mattress set (using a 3 percent discount rate and an estimated mattress life of 10 years).³³ Alternatively, a \$7 million estimate, the higher bound estimate in Viscusi (1993), yields a mid-point estimate of net benefits equal to \$54.06 per mattress set (using a 3 percent discount rate and an estimated mattress life of 10 years).

Changing the estimate used for the cost of injury will have minimal impact on the results, because the share of benefits from reduced injuries is only 13 percent of total benefits. Hence, even if there were no reduction in injuries from the staff's draft final standard, the mid-point estimate of net benefits would be \$29.64, with a range of \$16.91 to \$42.37 per mattress set (using a mattress life of 10 years and a 3 percent discount rate).

The analysis assumes that the effectiveness of the staff's draft final standard ranges from 69 to 78 percent for deaths and 73 to 84 percent for injuries. Even with a lower effectiveness rate, net benefits will remain positive. For example, assuming an effectiveness rate of 50 percent for deaths and injuries yields net benefits of \$9.32 to \$28.24 per mattress

³³ The range for net benefits was derived by subtracting the upper end of the cost range from the lower end of the benefits range to get the lower end of the range for net benefits and subtracting the lower end of the cost range from the higher end of the benefits range to get the higher end of the range for net benefits. Because of this method, both ends of the range for net benefits are a very unlikely occurrence.

set, with a mid-point estimate of \$18.78, and aggregate net benefits of \$212 to \$642 million, with a mid-point estimate of \$427 million, from all mattress sets produced the first year the staff's draft final standard is mandated and sold outside California (using a mattress life of 10 years, a 3 percent discount rate, and the same effectiveness for injuries as used in the baseline analysis). Also, assuming a smaller number of deaths and injuries before the staff's draft final standard is mandated (a smaller baseline risk) would still result in positive net benefits. A 50 percent reduction in baseline death and injury risks yields net benefits of \$0.09 to \$20.16 per mattress set, with a mid-point estimate of \$10.12, and aggregate net benefits of \$2 to \$515 million, with a mid-point estimate of \$259 million, from all mattress sets produced the first year the mattress standard is mandated (using a mattress life of 10 years, a 3 percent discount rate, and the estimated effectiveness measures used in the baseline analysis).

The estimates of aggregate benefits, costs, and net benefits (presented in Table 6) are based on the assumption that compliance before the promulgation of the staff's draft final standard was limited to California, which represents a market share of 11 percent. If, instead, we assume that current (October 2005) production shares would continue in the absence of the staff's draft final standard, the expected aggregate benefits, costs, and net benefits associated with the staff's draft final standard will decline. Assuming that the top four producers continue to produce the same percent of TB 603-complying mattress sets that they are now (one producing complying mattress sets nationwide, the other three producing 15 percent to 20 percent complying mattress sets), while all others produce complying mattress sets only in California, then the ranges for the mid-point estimates for aggregate benefits, costs, and net benefits are \$952 million to \$981 million, \$280 million to \$288 million, and \$672 million to \$692 million respectively.³⁴ These aggregate benefits are associated with one year's worth of mattress output. Summing all benefits over all mattress output over the time period during which the staff's draft final standard remains effective would result in much more positive benefits than indicated here.

Impact on Retail Prices

One of the top four mattress manufacturers in the industry has re-merchandised its product lines to lower the costs of other materials so that total costs (and prices) are the same as they were before the production of mattress sets that comply with TB603. Other manufacturers have indicated that they will have to increase their price which, according to some manufacturers and based on reported traditional industry mark-ups, might translate to an increase in the retail price to consumers that could reach approximately four-fold the increase in manufacturers' costs. Hence the average increase in the price at which mattress manufacturers are willing to sell their products (supply price) will be anywhere between the price of a similar mattress set without FR material and that price plus four times the increase

³⁴ These ranges are based on the estimated market share of complying mattresses produced by the one producer selling complying mattresses nationwide (13.9 percent), the estimated market share of the remaining three of the top four producers who are selling some complying outside California (43.4 percent), and the estimated market share of all remaining producers (42.7 percent). With these three groups producing complying mattresses representing all output, 15 to 20 percent of output, and 11 percent of output (for California) respectively, the resulting U.S. market share of complying mattresses is 25.1 to 27.3 percent. (Estimated market shares are derived from Furniture/Today, May 30, 2005.)

in the costs of production. Given the presence of at least one company that did not increase the price, it is unlikely that the new average price will be close to the higher end of the range because of competition for market share among manufacturers.

The market (equilibrium) price is determined by the intersection of consumers' willingness to buy and producers' willingness to sell the product at different prices. The value the equilibrium price will take (relative to the price before the introduction of fire resistant mattress sets) will be affected by the change in the demand and supply curves for fire resistant mattress sets and their relative elasticities. Assuming that the demand curve is unaffected, the equilibrium price will reflect the price elasticity of demand (i.e., the sensitivity of the change in the quantity demanded to the change in price) as well as the shift in supply. In the short-run, consumers have a relatively elastic demand curve, because they can usually postpone the purchase of a durable good, and therefore the increase in the equilibrium price is expected to be much lower than the increase in the supply price (what producers would want to sell the same number of mattress sets for). Because of the relatively high elasticity of demand, sales are likely to decrease in the short-run. In the long-run, the demand curve is less elastic, and therefore the equilibrium price and quantity (sales) will be higher than the short-run price and quantity.

Given the availability of mattresses whose retail prices will not increase and the competitive nature of the industry, it is possible that, on average, prices will rise by about twice the costs associated with the standard (i.e., retail price mark-up will average about twice the increase in production costs).³⁵ Under this assumption, consumers would pay an additional mark-up of 10 percent (the cost to wholesalers, distributors, and retailers) to 100 percent of total production costs, applied to the total production cost per mattress set. Hence the range for the price increase is \$7.64 ($\6.95×1.1) to $40.78(20.39 \times 2)$, with a mid-point estimate of \$24.21, per mattress set (compared to the price they would have paid for a current mattress set that does not comply with the staff's draft final standard). Assuming that the demand curve for mattress sets is unaffected by the staff's draft final standard, some consumers will choose not to purchase (or at least delay the purchase of) a new mattress set. These consumers who delay or choose not to purchase a new set will not be getting the value (or benefits) that they would have gained from purchasing a new set. This loss, though difficult to quantify, is sometimes measured as a loss in consumer surplus (McCloskey, 1982).

It is unlikely, however, that the post-standard demand curve for mattress sets will be the same as the current demand. Market observations indicate consumer and retail enthusiasm about the fire resistant mattress sets already available for sale, produced by Serta and Carolina Mattress Guild (*Furniture Today*, April 26th, 2004.) If this enthusiasm generally reflects consumers' preferences, then the demand for mattress sets may increase. This would tend to offset any reduction in mattress set sales and possible losses in consumer surplus.

³⁵ These cost figures include labor and material costs; testing costs; record-keeping costs; and quality assurance program costs. They do not include the costs to wholesalers, distributors, and retailers or compliance costs because they are not incurred by the manufacturers.

Impact on Small Businesses and Other Small Entities

The increase in material and labor costs to meet the staff's draft final standard is not likely to be dependent on a firm's size and will therefore not disproportionately affect small businesses.³⁶ The cost imposed disproportionately (per unit produced) on small businesses will be the cost of testing, information collection and record keeping and quality control/quality assurance programs. While these costs are estimated to be a little less than a dollar per mattress set per year for average-sized establishments, they could be substantially higher for some small mattress manufacturers.

The staff's draft final standard allows two or more establishments (plants within the same firm) or independent firms to "pool" prototypes. This reduces the cost of testing because only one of the pooling firms is required to test three sets (for a qualified prototype) with all remaining firms testing one set (for a confirmation test). The staff's draft final standard would also allow selling mattress sets based on subordinate prototypes and differing from a qualified prototype only with respect to size (length and width), and/or ticking material or other components that do not impact the fire performance of the prototype without testing the prototypes, to minimize testing costs to all manufacturers, especially those whose volume of output is small. Moreover, costs could be reduced if a qualified, confirmed, or subordinate prototype is used to produce mattress set styles for longer than a year. Furthermore, firms with more than one establishment (or different firms) may be able to reduce costs by pooling their quality control programs over all establishments.

Use of prototype pooling across establishments and firms would ameliorate the impact of the staff's draft final standard on small businesses. By getting together across different states and regions, small manufacturers who do not share a common market (and therefore do not compete with each other) can resemble a large producer in their testing and quality control/quality assurance efforts and therefore reduce their costs per mattress set. It is also expected that some barrier suppliers would be willing to do the testing and quality control/assurance programs for small manufacturers in exchange for a small charge, which will be similar to the average cost per mattress set for large businesses, because the volume of output will be large.

To reduce the impact of the staff's draft final standard on small businesses, staff eliminated the requirement of keeping physical samples. This reduced the average record keeping cost per establishment (assuming that they produce 20 different prototypes) from \$767 to \$412.

Impact on the Environment

The extraction, processing, refinement, and conversion of raw materials to meet the staff's draft final standard involve energy consumption, labor, and the use of potentially toxic chemicals. Most manufacturing has some impact on the environment, and manufacturing fire resistant mattress sets is no exception. Because the staff's draft final standard is a performance standard and does not limit manufacturers' choice of fire resistant inputs to use

³⁶ The *Final Regulatory Flexibility Analysis* (2005) details the expected impact of the staff's draft final standard, and other alternatives on small businesses.

in the production of mattress sets, however, there are several economically viable options to meet the standard that do not impose health risks to consumers or significantly affect the environment.³⁷ Thomas and Brundage (2005) details the CPSC staff studies on selected fire retardant materials to assess their potential risk to consumers.

Impact on Children

Deaths and injuries among children constitute a substantial proportion of mattress-related fire losses, and of the potential benefits of the staff's draft final standard. Boudreault and Smith (1997) report, based on a field investigation study in 1995 to learn more about cigarette-ignited fires and open-flame fires, that 70 percent of open-flame fires involved child play and that child play was involved in 83 percent of the 150 deaths of children less than five years of age. A National Association of State Fire Marshals 1997 study also indicated that 66 percent of the small open-flame ignitions were reportedly started by children under the age of 15 (21 percent by children under 5).

For virtually all of the fires started by children less than 15 years of age, the ignition was not witnessed by an adult (Boudreault and Smith, 1997). Reducing the likelihood of flashover in the first 30 minutes of the fire may therefore benefit children disproportionately, as it allows enough time for adults to detect the fire and save young children in close proximity to the fire. Also children between 5 and 9 who sometimes do not cooperate with adults and run away from adults to other parts of the occupancy will have enough time to be found and rescued by an adult.

Smith and Miller (2005) show that, based on national fire estimates for the years 1999 to 2002, the staff's draft final standard would reduce deaths and injuries to children ages 5 and younger by 77 to 87 percent and 59 to 73 percent respectively. Deaths and injuries to children ages 5 to 14 were estimated to be reduced by 83 to 92 percent and 80 to 89 percent respectively. This represents a total of 70 deaths of children less than 15 years of age per year for the 1999 to 2002 period. It also represents 240 to 280 injuries to children less than 15 years of age for the same period.

9. Alternatives to the Staff's Draft Final Standard

Alternative Maximum Peak Heat Release Rate (PHRR) and Test Duration

The initial California TB 603 proposal required the duration of the test to be 60 minutes with a maximum PHRR of 150kW. Following industry opposition to this proposal, the California Bureau of Home Furnishings and Thermal Insulation changed the criterion to a maximum of 200 kW PHRR in the first 30 minutes, the requirement for both the CPSC staff's draft federal final standard and the current TB 603.

³⁷ For a detailed analysis of environmental impact of the staff's draft final standard, see Franklin (2005).

Increasing the duration of the test and reducing the PHRR would, according to several input suppliers, increase the production costs to manufacturers of a queen mattress set by \$15.42 to \$46.88, with a mid-point estimate of \$31.15, compared to non-complying products (i.e., those not conforming to the staff's draft final standard.) Adding the costs to wholesalers, distributors, and retailers, and CPSC compliance efforts, yields a total resource cost of the stricter standard (150 kW and 60 minutes) of \$17.00 to \$51.61, with a mid-point estimate of \$34.30. (The resource cost is the sum of the production cost, cost to wholesalers, distributors, and retailers, and CPSC compliance cost). This represents a marginal increase in resource costs averaging \$19.24 over the mid-point estimate of the costs associated with the staff's draft final standard.

Potential benefits of the stricter standard could be higher than the staff's draft final standard, but the extent is uncertain. Given an effectiveness rate of the staff's draft final standard of 69 to 78 percent for death and 73 to 84 percent of injuries, the additional benefits of stricter test requirements are limited. Using the mid-point estimate of these effectiveness ranges (73.5 percent for deaths and 78.5 percent for injuries) and assuming that the stricter standard eliminates 50 percent of the remaining addressable deaths and injuries (i.e., it saves 46 additional lives and prevents 167 additional injuries), then an additional benefit of about \$8.34 per mattress set is expected. This additional benefit may be lower than the expected associated costs of \$19.24 and thus reduce net benefits.³⁸ Moreover, a small increase in net benefits may not justify the large increase in retail price that would result from a stricter standard.

Such increase in costs would likely result in consumers facing higher mattress prices. Based on traditional industry mark-ups, the new price may reflect a two- to four-fold increase over the increase in production costs, depending on the relative elasticity of demand and supply for mattress sets. This yields a total increase in the average price of a queen mattress set of \$30.84 (2 times the lower end of the range for the increase in production costs, equal to \$15.42) to \$187.52 (4 times the upper end of the range for the increase in production costs, equal to \$46.88), with a mid-point estimate of \$109.18. A bedding official estimated that the price increase resulting from the stricter standard may reduce sales by 25 percent or more (Furniture/Today, July 21, 2004).

The larger increase in prices (compared to the less strict test) and the resulting reduction in sales could drive some of the smaller producers out of business. (The stricter standard is more likely to require replacing some existing machines to accommodate the denser barrier material, which would be disproportionately more costly for smaller firms whose machinery is older and less sophisticated.) Since mattress sets are durable goods, one would expect a larger drop in sales in the short-run than in the long-run, as consumers choose to keep their old mattress sets longer than before. This would make the reduction in sales more pronounced in the short-run, increasing the likelihood that some firms may exit the

³⁸ These cost estimates (and the resulting marginal increase) should be viewed as approximate since no extensive tests of the barriers have been conducted for 60 minutes, as most manufacturers are focused on meeting the California requirements, which are less strict. Input suppliers generally do not assemble and test large numbers of mattresses, and may therefore underestimate reduced labor productivity and/or reduced output per machine (compared to a maximum PHRR of 200kW for a 30-minute test) due to handling the thicker denser barrier. A number of mattress producers estimate that to meet the stricter standard, manufacturing costs would increase \$50 to \$70 for a queen-sized set (Furniture/Today, July 21, 2004).

market. Moreover, if a large number of consumers choose to extend the life of their mattress sets for a longer time period, it will take longer to achieve the benefits expected to be associated with the safer mattress sets.

Alternative Total Heat Released in the First Part of the Test

TB 603 requires the total heat released during the first 10 minutes of the test to not exceed 25 MJ. The stricter criterion of the staff's draft final standard (15 MJ in the first 10 minutes) reduces the expected size of the initial fire and hence allows consumers a greater chance to escape the fire and get out of the room. The effectiveness rates presented in the analysis are based on the stricter criterion. Using the TB 603 criterion (25 MJ in the first 10 minutes) would likely reduce estimated benefits (the estimated reductions in deaths and injuries), without having any significant effect on costs. According to several producers, mattress sets that use existing barrier technology release total heat that is far below the 25 MJ requirement of TB 603. Therefore, using the TB 603 criterion for the total heat released would not change costs but could potentially reduce the benefits and, hence, the net benefits of the staff's draft final standard.

Moreover, because of the small fuel load of ticking materials currently being used, the lower total heat release requirement allows the production of mattress sets based on a prototype that has not been tested as long as it differs from a qualified prototype only with respect to ticking and the ticking material is not part of the fire resistance solution. Requiring a test for every prototype with a different ticking was rejected by the staff because of the magnitude of the burden it would impose on small producers who do not produce large numbers of any one prototype and who would have been adversely affected by these requirements.

Alternative Testing Requirements

The staff's draft final standard requires prototype testing (of three mattress sets) before a manufacturer starts production of a given mattress set design and a confirmatory test of one mattress set if more than one establishment or firm are pooling their results. (Manufacturers may sell a mattress set based on a subordinate prototype that has not been tested if that prototype differs from a qualified or confirmed prototype only with respect to (1) mattress/foundation size (length and width); (2) ticking, unless the ticking of the qualified prototype has characteristics designed to improve performance on the burn test; and/or (3) the manufacturer can demonstrate, based on an objectively reasonable basis, that a change in any component, material, or method of construction will not cause the prototype to exceed the test criteria specified above.) Though production testing (i.e., random burning of mattress sets to ensure that all production units meet the standard) is encouraged by the staff's draft final standard, as a possible component of the quality assurance program, no specified frequency is set by the staff's draft final standard. The individual manufacturer's decision on the frequency of production testing will clearly depend on the efficacy of its quality assurance/control efforts.

As an alternative, the CPSC staff's draft final federal standard could, like TB 603, not specify any testing requirements. The absence of testing requirements might, however, reduce manufacturers' incentive to comply. Alternatively, the standard could require production testing with a specified frequency. This specification, however, could result in unnecessary costs if they are not justified given the quality control measures generally undertaken by manufacturers in the absence of the staff's draft final standard. Requiring more tests per establishment, prototype, or enterprise will increase the estimated costs per mattress set and could reduce net benefits.

Alternative Effective Date

The effective date in the staff's draft final standard is the earlier of January or July after the date twelve months from the date of publication of the final rule in the *Federal Register*. Given the length of time needed to ensure the availability of inputs for the production of barrier materials, availability of barriers for mattress producers, and a sufficient volume of inventories at retailers' showrooms, an earlier effective date may result in higher input costs to manufacturers. More importantly, it is expected that smaller manufacturers will be disproportionately affected, as they are more likely to wait to invest in development efforts until the technology is developed by larger firms, or until the staff's draft final standard becomes effective. Staff chose the January and July date to coincide with the cycle for introduction of new mattress models, as suggested by the public comments.

A later effective date (longer than 18 months) could reduce expected net benefits as more fires, deaths, and injuries associated with mattresses would occur between the date of publication in the *Federal Register* and the date the standard becomes effective. Staff is unaware of evidence that small manufacturers would benefit from extending the effective date further into the future. The staff requested comments from small businesses on the expected economic impact of the effective date (Tohamy, 2004b) and received one comment from a small business owner indicating that his firm would need more than twelve months to meet the standard.³⁹ If the staff's draft final standard becomes a final rule, it would be 12 to 18 months after publication of the *Federal Register* notice (the earlier of January or July that follows twelve months after publication of the *Federal Register* notice). Staff believes this provides enough time for the commenter to transition to producing compliant mattress sets.

Taking No Action or Relying on a Voluntary Standard

If the Commission chooses to take no action, only 11 percent of all mattress sets produced in the United States would have to comply with a standard that is very similar to the staff's draft final standard (California's TB 603). It is uncertain whether there will be any incentive for producers outside California to incur additional costs to produce mattress sets that would comply with California's TB 603. Consequently, how much, if any, of the remaining 89 percent of production would comply is uncertain. One of the largest four producers is currently producing mattress sets that comply with the staff's draft final standard. The other three top producers produced complying mattress sets that accounted for

³⁹ Six other commenters urged the commission to move expeditiously with the proposed rule.

around 15 to 20 percent of total production in October, 2005. It is not clear, however, that any of these producers would continue to sell complying mattress sets outside California if they are not anticipating a future promulgation of a federal standard. Moreover, the absence of a federal standard may lead other states to develop their own standard, which would result in unnecessary burden (in terms of higher production costs) on manufacturers selling mattress sets in different states with different flammability requirements. Hence, expected aggregate net benefits associated with the staff's draft final standard are higher than the net benefits that result from taking no action and only relying on the California standard.

No effort has been undertaken to develop a voluntary standard. Furthermore, industry representatives support a mandatory standard to level the playing field among domestic producers (large and small) and importers. If a voluntary standard were developed, the economic burden would fall primarily on the larger companies that meet the voluntary standard, their market shares could be reduced significantly and benefits to consumers (in terms of reduced deaths and injuries) would likely decline accordingly.

Labeling Requirements Instead of Performance Standard

The Commission could require labeling on mattresses to warn consumers in lieu of a standard. Requiring warning labels is not considered an effective option for reducing the risk of fires. Since mattress labels are usually covered by bedclothes and may not be seen by the mattress users, mandating warning labels on mattress sets is unlikely to be an effective alternative to a performance standard. Moreover, fires started by children who cannot read or do not change the bed sheets will not be reduced by a labeling requirement. Hence, while labeling costs are probably negligible, labels alone are unlikely to reduce mattress fires significantly.

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UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

Date: January 10, 2006

TO : Margaret L Neily, ES
Project Manager, Mattress Flammability

THROUGH: Gregory Rodgers, Ph.D., AED, EC *GR*
Deborah V. Aiken, Ph.D, Senior Staff Coordinator *DVA*

FROM : Soumaya M. Tohamy, Ph.D. *DVA for ST*

SUBJECT : Final Regulatory Flexibility Analysis for Staff's Draft Final Standard to Address Open-Flame Ignitions of Mattress Sets.

Attached is the Final Regulatory Flexibility Analysis for Staff's Draft Final Standard to Address Open-Flame Ignitions of Mattress Sets.

**Final Regulatory Flexibility Analysis for
Staff's Draft Final Standard to Address
Open-Flame Ignitions of Mattress Sets***

**Soumaya M. Tohamy, Ph.D.
Directorate for Economic Analysis
U.S. Consumer Product Safety Commission**

January 10, 2006

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

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Final Regulatory Flexibility Analysis for Staff's Draft Final Standard to Address Open-Flame Ignitions of Mattress Sets

1. Introduction

For 1999 to 2002 there was an estimated annual average of 15,300 fires where the first item ignited was mattress/bedding (Miller, 2005). These fires resulted in an annual average of 350 deaths, 1,750 injuries, and 295 million dollars of property loss (Miller, 2005). The U.S. Consumer Product Safety Commission received in April 2000 a petition for rulemaking to modify the current flammability standard for mattresses to include additional ignition sources. The Commission published an Advance Notice of Proposed Rulemaking (ANPR) in October 2001, initiating a proceeding to develop a mandatory federal standard to address open-flame ignition. The Commission published a Notice of Proposed Rulemaking (NPR) in January 2005. As indicated in the final regulatory analysis (Tohamy, 2005), the staff's draft final standard addresses open-flame mattress fires that are ignited by a small open flame, smoking materials, or other ignition sources. Some of these ignitions may have started the bedclothes on fire before igniting the mattress. The staff's draft final standard would apply to mattress sets and futons produced domestically and imported.¹

The Regulatory Flexibility Act (RFA) requires that rules proposed by the Commission be reviewed for their potential economic impact on small entities, including small businesses. Section 603 of the RFA calls for the Commission to prepare and make available for public comment an initial regulatory flexibility analysis describing the impact of the proposed rule on small entities and identifying impact-reducing alternatives. The Commission published the initial regulatory flexibility analysis in January 2005. The RFA further requires an agency promulgating a final rule to publish a final regulatory flexibility analysis. The final regulatory flexibility analysis is required to contain:

- a) a succinct statement of the need for and objectives of the rule,
- b) a summary of the significant issues raised by the public comments in response to the initial regulatory analysis, a summary of the assessment of the agency of such issues, and a statement of any changes made in the proposed rule as a result of such comments.
- c) a description of and an estimate of the number of small entities to which the rule will apply,
- d) a description of the projected reporting, recordkeeping and other compliance requirements of the proposed rule, including an estimate of the classes of small

¹ A *mattress set* is defined as either a mattress and foundation labeled by the manufacturer for sale as a set, or a mattress labeled by the manufacturer for sale without any-foundation (Section 1633.2(c)).

entities subject to the requirements and the type of professional skills necessary for the preparation of reports or records, and

- e) a description of the steps the agency has taken to minimize the significant economic impact on small entities consistent with the stated objectives of applicable statutes, including a statement of the factual, policy, and legal reasons for selecting the alternative adopted in the final rule and why each one of the other significant alternatives to the rule considered by the agency which affect the impact on small entities was rejected.

The Commission routinely considers potential effects on competition and small businesses as part of the agency's overall evaluation of potential economic effects of rulemaking actions. A summary of these effects is included in the final regulatory analysis (Tohamy, 2005) required for the staff's draft final standard under Section 4(j) of the FFA (Flammable Fabrics Act). Since most of the affected firms are considered to be small companies, the Commission is issuing a separate final regulatory flexibility analysis of the staff's draft final standard to analyze the potential economic effects of the staff's draft final standard on such firms.

2. The Need for and Objective of the Rule:

The staff's draft final standard addresses the risk of death and injury from residential mattress fires that are started by small open flames, smoking materials, or other ignition sources. As indicated earlier, for 1999 to 2002 there was an estimated annual average of 15,300 fires where the first item ignited was mattress/bedding (Miller, 2005). These fires resulted in an annual average of 350 deaths, 1,750 injuries, and 295 million dollars of property loss (Miller, 2005) By reducing the likelihood of flashover in the first 30 minutes of the fire, the staff's draft final standard will slow the rate of fire spread and thus reduce the risk of injury and death (Smith and Miller, 2005). Because fires will not be eliminated, any reduction in property damage that might result from the staff's draft final standard cannot be quantified.

The Commission is required to consider whether appropriate voluntary standards could adequately address the problem rather than imposing a mandatory rule. No voluntary standard, however, was submitted to the Commission for consideration in response to the ANPR or the NPR, and the Commission staff is unaware of any voluntary standard that addresses the problem. Deferring to a voluntary standard, therefore, does not represent an alternative to the staff's draft mandatory standard.

The purpose of the staff's draft final standard is to reduce the risk of death and injury from mattress fires that are not addressed by the existing mattress flammability standard (16 CFR Part 1632) that are ignited by small open flames, smoking materials, and other ignition sources. It is expected that the staff's draft final standard will substantially reduce the incidence and cost to society of these fires. The standard is being issued under the authority of the FFA (Flammable Fabrics Act). Section 4(j) of the FFA requires the agency to describe the potential benefits and costs of the staff's draft final standard. The final regulatory analysis (Tohamy, 2005) provides this description.

3. Issues Relating to Small Businesses Raised by the Public Comments on NPR:

a. Effective Date:

A commenter (the International Sleep Products Association, representing the U.S. mattress industry) suggested that the effective date coincide with regular model changes (January and July) and recommended allowing retailers one year to sell pre-standard inventories. In response to this comment, the staff's draft final standard now provides an effective date of the earlier of January or July that follows the date twelve months after publication of the *Federal Register* notice. This date would coincide with the industry's regular model/style change cycle and thus make it easier for all producers, especially small producers outside of California who are not producing complying mattress sets, to update their styles and produce complying mattress sets.

Six commenters urged the Commission to move forward expeditiously with the regulation. They suggested a fast track to implementation, an immediate effective date, and acceleration of nationwide implementation. One of the six suggested no more than six months after publication of the Federal Register notice. Only one commenter (a small producer) suggested that his company will need more than twelve months to comply when and if the new "legislation" is passed. If the staff's draft final standard is issued as a final rule, it would be 12 to 18 months after publication of the *Federal Register* notice (the earlier of January or July that follows the date twelve months after publication of the *Federal Register* notice). Staff believes this provides enough time for manufacturers to transition to producing and selling compliant mattress sets.

All producers who sell mattress sets in California already have developed the production technology and conducted the testing required for California's TB 603, which is very similar to the staff's draft final standard. One of the top three producers is already selling mattress sets complying with TB 603 nationwide. The other three producers are selling 15 percent to 20 percent complying mattress sets nationwide. Smaller companies not based in California may be behind in their design, production, and testing efforts. Staff believes, however, that the recommended effective date provides enough time for manufacturers to transition to producing and selling compliant mattress sets.

b. Expected Costs of Meeting the Staff's Draft Final Standard:

A commenter expressed concern about the increased cost [due to use of a fire resistant (FR) barrier]. The final regulatory analysis estimated net costs of the barrier (the cost of the barrier minus the cost of the material it replaces), also referred to by the industry as the application cost, to range from \$1.33 to \$14.58, with a mid-point estimate of \$7.95, per (queen) mattress set. Adding all other resource costs (including reduced productivity, cost of testing, record keeping, quality assurance costs and compliance costs) results in costs ranging from \$7.67 to \$22.46, with a mid-point estimate of \$15.07, per (queen) mattress set. These

cost estimates are expected to drop as a result of technological developments and increased competition among barrier producers.

A commenter suggested that the cost of the barrier (without subtracting the cost of the material it replaces) is \$12 to \$20 for a queen mattress set. Another commenter supported this statement by indicating that there are barriers with a cost of under \$20 for a queen set (again, not subtracting the cost of the material it replaces). Industry representatives now assert that the cost of the barrier ranges from \$10.60 (\$2.00 times 5.3 linear yards) to \$17.49 (\$3.30 times 5.3 linear yards). This estimate is lower for producers that use less than 5.3 linear yards. Subtracting the cost of the polyester that would be replaced by the barriers leads to a net increase in costs of \$1.33 to \$14.58, with a mid-point estimate of \$7.95, per (queen) mattress set. Again, this estimate is lower for producers that use less than 5.3 linear yards. The final regulatory analysis shows that adding all other resource cost results in total resource costs not exceeding \$23.00 per (queen) mattress set.

c. Impact on Small Businesses:

Six commenters addressed the impact on small businesses. Three are small producers of residential mattress sets, two are FR barrier producers, and one is a producer of mattresses used in Recreational Vehicles (RVs). The small producers expressed concern over the burden of testing costs and the feasibility of producing complying mattress sets in twelve months. A small producer projects the cost of prototype testing to be \$4750 or 5.32 percent of sales. He suggested that producers under a certain dollar volume be permitted to continue testing under 16 CFR 1632. Another indicated knowledge of one plant where it costs 1.4 hours to produce a mattress set that complies with TB 603 requirements, compared to 0.7 hours to produce one that does not.

Testing, record keeping, and quality control/quality assurance requirements may have a disproportionate impact on small manufacturers because they are generally required per firm or per prototype and therefore would constitute a larger percent of total revenues, sales, and value added for the smaller firms. To minimize the adverse impact on small manufacturers, the draft final standard provides for prototype pooling among different establishments within the same firm and among different firms. Prototype pooling is defined as a cooperative arrangement whereby one or more manufacturers build mattresses based on a qualified prototype produced by another manufacturer or prototype developer.

The draft final standard would also allow selling mattress sets whose (subordinate) prototypes differ from a qualified (or confirmed) prototype only with respect to size (length and width), and/or ticking material or other components that do not impact the fire performance of the prototype without testing the prototypes, to minimize testing costs to all manufacturers, especially those whose volume of output is small. Moreover, if a particular qualified, confirmed, or subordinate prototype was used to produce mattress sets for more than one year, then the testing cost would be reduced.

The suggestion that producers under a certain dollar volume be permitted to continue testing under 16 CFR 1632 is not feasible because it would not protect consumers from the risk of fires, deaths, and injuries associated with open flame ignitions. It would also give small producers an unfair advantage over medium-sized producers.

The increase in time needed to produce a mattress set is expected to decline as workers get more experienced in producing the new models. Staff currently estimates the additional time (and wages) to average 10 percent, with the expectation that it will decline over time.

The two barrier producers who commented on the Notice of Proposed Rulemaking (NPR) asserted that the costs of meeting the proposed standard are low, with one stating that there is “zero economic impact on small business due to the wide breadth and variety of FR barrier products being offered to the market.” A barrier producer suggested only testing one mattress set if the peak heat release rate (PHRR) does not exceed 50 megajoules (MJ) in the first 30 minutes. This suggestion would reduce the cost of testing to all producers. It might not, however, provide an adequate measure of compliance with the standard, according to CPSC Engineering Sciences Directorate staff.

4. Firms Subject to the Staff’s Draft Final Standard

The staff’s draft final standard covers producers and importers of mattresses. There were 522 mattress firms and 607 mattress establishments in 2002, according to the Statistics of U.S. Businesses, Census Bureau data.² (According to the Economic Census data, the number of mattress establishments was 571 for 2003.) All but the largest twelve firms had less than 500 employees.³ The U.S. Small Business Administration’s Office of Advocacy defines a small business as one that is independently owned and operated and not dominant in its fields. A definition for the mattress manufacturing industry that is used by the Small Business Administration and is less subject to interpretation is a firm with fewer than 500 employees.⁴ The latter definition classifies 97.7 percent $((522 - 12) / 522)$ of all mattress firms as small businesses. Table 1 shows the distribution of mattress firms by enterprise employment size.

² 2003 Economic Census data, which divide establishments by employment size of the establishment and not the firm or enterprise, show that all mattress establishments had less than 500 employees in 2002.

³ The Census uses North American Industry Classification Code (NAICS) 33791 for this measure. The firm is a business organization consisting of one or more domestic establishments in the same state and industry that were specified under common ownership or control. The firm and establishment are the same for single-establishment firms. For each multi-establishment firm, establishments in the same industry within a state are counted as one firm. The firm and enterprise are the same for national data collection purposes. The firm employment and annual payroll are summed from the associated establishments.

⁴ *Small Business Size Standards matched to North American Industry Classification System*. United States Small Business Administration. 2004. (<http://www.sba.gov/size/sizetable2002.html>.)

Table 1: Number of U.S. Mattress Establishments by Enterprise Employment Size, 2002*

	Total	Employment Size of the Enterprise [^]								
		0**	1 to 4	5 to 9	10 to 19	<20	20 to 99	100 to 499	<500	500+
Firms^{^^}	522	17	117	87	95	316	159	35	510	12
Percent of Total	100%	3.26%	22.41%	16.67%	18.20%	60.54%	30.46%	6.70%	97.70%	2.30%
Employment	24,138	0	286	588	1,315	2,189	7,298	5,675	15,162	8,976
Annual Payroll (\$1000)	762,839	1,268	6,184	11,436	29,309	48,197	206,599	182,527	437,323	325,516
Average Employment per Firm	46.2		2.1	6.8	13.8	6.9	45.9	162.1	29.7	748.0
Average Annual Wage	31,603		21,622	19,449	22,288	22,018	28,309	32,163	28,843	36,265

Source: 2002 County Business Patterns and 2002 Economic Census.

* North American Industry Classification System (NAICS) Code 33791 is used for the definition of the mattress industry.

[^] An enterprise is a business organization consisting of one or more domestic establishments under common ownership or control. Employment size, employment, and annual payroll are determined only for the entire enterprise.

** This group includes firms for which no associated establishment reported paid employees in the mid-March pay period but paid employees at some time during the year.

^{^^} A firm is a business organization consisting of one or more domestic establishments in the same state and industry that were specified under common ownership or control. A firm is the same as an enterprise in this table because it represents only national data.

Table 1 shows that average employment per firm for the whole industry is 46.2 employees. Average employment for the 1 to 4 employees per enterprise group, which represents 22.41 percent of all firms, is 2.1 employees. Average employment for the less than 20 employees per enterprise group, which represents 60.54 percent of all firms, is 6.9 employees. Hence more than half of mattress firms have less than 20 employees.

5. Reporting, Recordkeeping and other Compliance Requirements of the Staff's Draft Final Standard and Possible Impacts on Small Businesses

The staff's draft final standard will apply to all mattress sets, where a mattress set means either a mattress and foundation labeled by the manufacturer for sale as a set, or a mattress labeled by the manufacturer for sale without any foundation (Section 1633.2(c)). A mattress includes a ticking (i.e., an outer layer of fabric) filled with a resilient material used alone or in combination with other products intended or promoted for sleeping upon. This definition includes adult mattresses, youth mattresses, crib mattresses, including portable crib mattresses, bunk bed mattresses, futons, flip chairs, water beds and air mattresses which contain upholstery material between the ticking and the mattress core, and any mattresses used in items of upholstered furniture such as convertible sofa bed mattresses. It does not include sleeping bags, mattress pads, or any top of the bed articles. Options for meeting the standard include one or a combination of fire resistant ticking, chemically treated or otherwise fire resistant filling products, or a fire blocking barrier (either a sheet style barrier or a high-loft barrier, sometimes called a fiber barrier).

The staff's draft final standard is a performance standard, not a design standard, and hence allows producers to choose their own technology to meet the mattress set test requirements. All mattress sets subject to the staff's draft final standard must be tested in prototype and meet the specified performance requirements before production.⁵ For each prototype, three mattress sets must be tested.⁶ A qualified prototype is one that has been tested in triplicate and meets the performance requirements for all three mattress sets. A failure of any of the sets would require that a modified prototype be tested and pass the test (in triplicate). Each mattress set must pass a burn test where the peak heat release rate (PHRR) does not exceed 200 kilowatt (kW) for the full 30 minutes and the total heat release does not exceed 15 megajoules (MJ) in the first 10 minutes of the test. A manufacturer may sell mattress sets produced according to a prototype that has not been tested if that prototype differs from a qualified prototype only with respect to (1) mattress/foundation size (length and width); (2) ticking, unless the ticking of the qualified prototype has characteristics designed to improve performance on the burn test; and/or (3) the manufacturer can demonstrate, based on an objectively reasonable basis, that a change in any component,

⁵ The rationale for the staff's draft final standard and its testing requirements, and a description of set-up and heat contribution of test burners are provided in detail in Tenney (2005).

⁶ A prototype is defined as a specific design of mattress set that serves as a model for production units intended to be introduced into commerce (Section 1633.2 (m) of the staff's draft final standard). This definition implies that any change to the size, ticking, and/or any other component of the mattress set assembly results in a different prototype.

material, or method of construction will not cause the prototype to exceed the test criteria specified above.

Manufacturers are required to keep records of all tests performed and their results including video or pictures; prototype or production identification number; date and time of test; and name and location of testing facility; test room conditions; and test data for as long as the prototype is in production and for three years after its production ceases. They are also required to keep records of a unique identification number for the qualified prototype and a list of the unique identification numbers of each prototype based on the qualified prototype and a description of the materials substituted and/or the size change. Moreover, they are required to document the name and supplier of each material used in construction of a prototype. Additionally, they are required to identify the details of the application of any fire retardant treatments and/or inherently fire resistant fibers employed relative to mattress components. Finally, they are required to have an adequate quality assurance program in place.

The increase in the average materials and labor costs of a mattress set that meets the staff's draft final standard (estimated in the regulatory analysis (Tohamy, 2005) to be \$12.77, with a range of \$6.05 to \$19.49 per mattress set) is not likely to be dependent on a firm's size and will therefore not disproportionately affect small businesses. Larger firms are bearing all the capital investment costs of research and development, sharing some of these costs with input suppliers. Most smaller firms will simply buy from the suppliers a barrier solution, which has been tested extensively and is known to meet the standard. The price these smaller firms pay to cover the development and testing costs are borne by the supplier but will not have a disproportionate adverse impact on the small firms, because the price is not measured relative to their small output, but relative to the supplier's output. Other smaller firms may combine their development efforts to be able to benefit from dividing the costs over a larger number of firms. Finally, small mattress producers that do not assemble the mattress panels (the quilted assembly, including ticking, batting material, and barrier, used to cover the contents of the mattress construction), but buy them from a panel supplier are effectively combining all their output in a "pooling" arrangement. This is because the panel supplier will be responsible for including a barrier in the panel assembly and will pass that cost on to the mattress producers, again not disproportionately impacting the small producers who buy the already assembled panels.

The costs more likely to be imposed disproportionately (per unit produced) on small businesses will be the costs of testing, information collection and record keeping, and quality control/quality assurance programs. While the regulatory analysis estimates these costs (including the cost of compensating office and administrative support workers for record-keeping and quality control/quality assurance requirements) to be less than one dollar per mattress set per year for average-sized establishments, they could be substantially higher for some small mattress producers (Tohamy, 2005a). To reduce the impact on small businesses, staff eliminated the requirement of keeping physical samples, included in the proposed standard. This reduced the average record keeping cost per establishment (assuming that they produce 20 different prototypes) from \$767 to \$412.

6. Steps Taken to Minimize the Economic Impact of the Staff's Draft Final Standard on Small Entities:

The staff's draft final standard allows two or more establishments (plants within the same firm) or independent firms to "pool" prototypes. This reduces the cost of testing because only one of the pooling firms is required to test three sets (for a qualified prototype) with all remaining firms testing one set (for a confirmation test). The staff's draft final standard would also allow selling mattress sets based on subordinate prototypes and differing from a qualified prototype only with respect to size (length and width), and/or ticking material or other components that do not impact the fire performance of the prototype without testing the prototypes, to minimize testing costs to all manufacturers, especially those whose volume of output is small. Moreover, costs could be reduced if a qualified, confirmed, or subordinate prototype is used to produce mattress set styles for longer than a year. Furthermore, firms with more than one establishment (or different firms) may be able to reduce costs by pooling their quality control programs over all establishments.

Use of prototype pooling across establishments and firms is allowed by the staff's draft final standard to ameliorate its impact on small businesses. By getting together across different states and regions, small manufacturers who do not share a common market (and therefore do not compete with each other) can resemble a large manufacturer in their testing and quality control/quality assurance efforts and therefore reduce their costs per mattress set. It is also expected that some barrier suppliers would be willing to do the testing and quality control/assurance programs for small manufacturers in exchange for a small charge, which will be similar to the average cost per mattress set for large businesses, because the volume of output will be large. Compared to all other alternatives considered by the staff, and listed below, the staff's draft final standard minimizes the impact on small businesses.

In response to a comment from the mattress producers' association, ISPA, the staff's draft final standard now provides an effective date of the earlier of January or July that follows the date twelve months after publication of the *Federal Register* notice. This date would coincide with the industry's regular model/style change cycle and thus make it easier for all producers, especially small producers outside of California who are not producing complying mattress sets, to update their styles and produce complying mattress sets.

Finally, to reduce the impact of the staff's draft final standard on small businesses, staff eliminated the requirement of keeping physical samples. This reduced the average record keeping cost per establishment (assuming that they produce 20 different prototypes) from \$767 to \$412.

7. Alternatives to the Staff's Draft Final Standard

a. Alternative Maximum Peak Heat Release Rate (PHRR) and Test Duration

The initial California TB 603 proposal required the duration of the test to be 60 minutes with a maximum peak heat release rate (PHRR) of 150 kW. Following industry opposition to this proposal, the California Bureau of Home Furnishings and Thermal

Insulation changed the criterion to a maximum of 200 kW PHRR in the first 30 minutes, the requirement for both the CPSC staff's draft final federal standard and the current TB 603.

As described in the regulatory analysis (Tohamy, 2005), increasing the duration of the test and reducing the PHRR would, according to several input suppliers, increase the production costs to manufacturers of a queen mattress set by \$15.42 to \$46.88, with a mid-point estimate of \$31.15, compared to non-complying products (i.e., those not conforming to the staff's draft final standard.) Adding the costs to wholesalers, distributors, and retailers, and of CPSC compliance efforts, yields a total resource cost of the stricter standard (150 kW and 60 minutes) of \$17.00 to \$51.61, with a mid-point estimate of \$34.30. (The resource cost is the sum of the production cost, cost to wholesalers, distributors, and retailers, and CPSC compliance cost). This represents a marginal increase in average resource costs of \$19.24 over the mid-point estimate of the costs associated with the staff's draft final standard.⁷

Potential benefits of the stricter standard could be higher than the staff's draft final standard, but the extent is uncertain. Given an effectiveness rate of the staff's draft final standard of 69 to 78 percent for death and 73 to 84 percent of injuries, the additional benefits of stricter test requirements are limited. Using the mid-point estimate of these effectiveness ranges (73.5 percent for deaths and 78.5 percent for injuries) and assuming that the stricter standard eliminates 50 percent of the remaining addressable deaths and injuries (i.e., it saves 46 additional lives and prevents 167 additional injuries), then an additional benefit of about \$8.34 per mattress set is expected. This additional benefit may be lower than the expected associated costs of \$19.24 and thus reduce net benefits.⁸ Moreover, a small increase in net benefits may not justify the large increase in retail price that would result from a stricter standard.

Such increase in costs would likely result in consumers facing higher mattress set prices. Based on traditional industry mark-ups, the new price may reflect a two- to four-fold increase over the increase in production costs, depending on the relative elasticity of demand and supply for mattress sets. This yields a total increase in the average price of a queen mattress set of \$30.84 (2 times the lower end of the range for the increase in production costs, equal to \$15.42) to \$187.52 (4 times the upper end of the range for the increase in production costs, equal to \$46.88), with a mid-point estimate of \$109.18. A bedding official estimated

⁷ These cost estimates (and the resulting marginal increase) should be viewed as approximate since no extensive tests of the barriers have been conducted for 60 minutes, as most manufacturers are focused on meeting the California requirements, which are less strict. Input suppliers generally do not assemble and test large numbers of mattresses, and may therefore underestimate reduced labor productivity and/or reduced output per machine (compared to a maximum PHRR of 200kW for a 30-minute test) due to handling the thicker denser barrier. A number of mattress producers estimate that to meet the stricter standard, manufacturing costs would increase \$50 to \$70 for a queen-sized set (Furniture/Today, July 21, 2004).

⁸ These cost estimates (and the resulting marginal increase) should be viewed as approximate since no extensive tests of the barriers have been conducted for 60 minutes, as most manufacturers are focused on meeting the California requirements, which are less strict. Input suppliers generally do not assemble and test large numbers of mattresses, and may therefore underestimate reduced labor productivity and/or reduced output per machine (compared to a maximum PHRR of 200kW for a 30-minute test) due to handling the thicker denser barrier. A number of mattress producers estimate that to meet the stricter standard, manufacturing costs would increase \$50 to \$70 for a queen-sized set (Furniture/Today, July 21, 2004).

that the price increase resulting from the stricter standard may reduce sales by 25 percent or more (Furniture/Today, July 21, 2004).

The larger increase in prices (compared to the less strict test) and the resulting reduction in sales could drive some of the smaller producers out of business. (The stricter standard is more likely to require replacing some existing machines to accommodate the denser barrier material, which would be disproportionately more costly for smaller firms whose machinery is older and less sophisticated.) Since mattress sets are durable goods, one would expect a larger drop in sales in the short-run than in the long-run, as consumers choose to keep their old mattress sets longer than before. This would make the reduction in sales more pronounced in the short-run, increasing the likelihood that some firms may exit the market. Moreover, if a large number of consumers choose to extend the life of their mattress sets for a longer time period, it will take longer to achieve the benefits expected to be associated with the safer mattress sets.

b. Alternative Total Heat Released in the First Part of the Test

TB 603 requires the total heat released during the first 10 minutes of the test to not exceed 25 MJ. The stricter criterion of the staff's draft final standard (15 MJ in the first 10 minutes) reduces the expected size of the initial fire and hence allows consumers a greater chance to escape the fire and get out of the room, even if the room never reaches flashover. The effectiveness rates presented in the analysis are based on the stricter criterion. Using the TB 603 criterion (25 MJ in the first 10 minutes) would likely reduce estimated benefits (the estimated reductions in deaths and injuries), without having any significant effect on costs. According to several producers, mattress sets that use existing barrier technology release total heat that is far below the 25 MJ requirement of TB 603. Therefore, using the TB 603 criterion for the total heat released would not change costs but could potentially reduce the benefits and, hence, the net benefits of the staff's draft final standard.

Moreover, because of the small fuel load of ticking materials currently being used, the lower total heat release requirement allows the production of mattress sets based on a prototype that has not been tested as long as it differs from a qualified prototype only with respect to ticking and the ticking material is not part of the fire resistance solution. Requiring a test for every prototype with a different ticking was rejected by the staff because of the magnitude of the burden it would impose on small producers who do not produce large numbers of any one prototype and who would have been adversely affected by these requirements.

c. Alternative Testing Requirements

The staff's draft final standard requires prototype testing (of three mattress sets) before a manufacturer starts production of a given mattress set design and a confirmatory test of one mattress set if more than one establishment or firm are pooling their results. (Manufacturers may sell a mattress set based on a subordinate prototype that has not been tested if that prototype differs from a qualified prototype only with respect to (1) mattress/foundation size (length and width); (2) ticking, unless the ticking of the qualified

prototype has characteristics designed to improve performance on the burn test; and/or (3) the manufacturer can demonstrate, based on an objectively reasonable basis, that a change in any component, material, or method of construction will not cause the prototype to exceed the test criteria specified above.) Though production testing (i.e., burning mattress sets to ensure that all production units meet the standard) is encouraged by the staff's draft final standard, as a possible component of the quality assurance program, it is not required. The individual manufacturer's decision on the frequency of production testing will clearly depend on the efficacy of his/her quality assurance/control efforts.

As an alternative, the CPSC staff's draft final federal standard could, like TB 603, not specify any testing requirements. The absence of testing requirements might, however, reduce manufacturers' incentive to comply. Alternatively, the standard could require production testing with a specified frequency. This specification, however, could result in unnecessary costs if they are not justified given the quality control measures generally undertaken by producers in the absence of the staff's draft final standard. Requiring more tests per establishment, prototype, or enterprise will increase the estimated costs per mattress set and could reduce net benefits.

d. Alternative Effective Date

The effective date included in the staff's draft final standard is the earlier of January or July after the date twelve months from the date of publication of the final rule in the *Federal Register*. Given the length of time needed to ensure the availability of inputs for the production of barrier materials, availability of barriers for mattress producers, and a sufficient volume of inventories at retailers' showrooms, an earlier effective date may result in higher input costs to producers. More importantly, it is expected that smaller producers will be disproportionately affected, as they are more likely to wait to invest in development efforts until the technology is developed by larger firms, or until the staff's draft final standard becomes effective. Staff chose the January and July date to coincide with the introduction of new mattress models, as suggested by the public comments. A later effective date (longer than eighteen months) could reduce expected net benefits as more fires, deaths, and injuries associated with mattresses would occur between the date of publication of a final rule in the *Federal Register* and the date the standard becomes effective.

Staff is unaware of evidence that small manufacturers would benefit from extending the effective date further into the future. The staff requested comments from small businesses on the expected economic impact of the effective date and received one comment from a small business owner indicating that his firm would need more than twelve months to meet the staff's draft final standard Tohamy, 2004b.⁹ If the staff's draft final standard becomes a final rule, it would be 12 to 18 months after publication of the *Federal Register* notice (the earlier of January or July that follows twelve months after publication of the *Federal Register* notice). Staff believes this provides enough time for manufacturers to transition to producing and selling compliant mattress sets.

⁹ Six other commenters urged the commission to move expeditiously with the proposed rule.

e. Taking No Action or Relying on a Voluntary Standard

If the Commission chooses to take no action, only 11 percent of all mattress sets sold in the United States would have to comply with a standard that is very similar to the staff's draft final standard (California's TB 603). It is uncertain whether there will be any incentive for producers selling outside California to incur additional costs to produce mattress sets that would comply with California's TB 603. Consequently, how much, if any, of the remaining 89 percent of production would comply is uncertain. One of the four largest producers is currently producing mattress sets that comply with the staff's draft final standard. The other three top producers were producing complying mattress sets that accounted for around 15 to 20 percent of total production in October, 2005. It is not clear, however, that any of these producers would continue to sell complying mattress sets outside California if they are not anticipating a future promulgation of a federal standard. Moreover, the absence of a federal standard may lead other states to develop their own standard, which would result in an unnecessary burden (in terms of higher production costs) on manufacturers selling mattress sets in different states with different flammability requirements. Hence, expected aggregate net benefits associated with the staff's draft final standard are higher than the net benefits that result from taking no action.

No effort has been undertaken to develop a voluntary standard. Furthermore, industry representatives support a mandatory standard to level the playing field among domestic producers (large and small) and importers. If a voluntary standard were developed, the economic burden would fall primarily on the larger companies that meet the voluntary standard, their market shares could be reduced significantly and benefits to consumers (in terms of reduced deaths and injuries) would likely decline accordingly.

f. Labeling Requirements

The Commission could require labeling on mattress sets to warn consumers in lieu of a performance standard. Labeling is not considered an effective option for reducing the risk of fires. Since mattress labels are usually covered by bedclothes and may not be seen by the mattress users, labeling mattress sets is likely to be ineffective. Moreover, fires started by children who cannot read or do not change the bed sheets will not be reduced by a labeling requirement. Hence, while labeling costs are probably negligible, labels are unlikely to reduce mattress fires.

Labeling of chemically treated components has been suggested as a possible requirement, to inform consumers of the materials used. The costs of such labeling would be negligible, since existing mattresses have labels and producers could probably add a description of the chemical treatment (if any) to the existing label. Labeling of chemically treated components might provide small unquantifiable benefits to consumers. A label stating that mattress components were chemically treated, however, would not necessarily provide the consumer any guidance about whether the mattress presented a health risk or not. Information on the use of chemically treated components may be proprietary and is, therefore, not required on the mattress label by the staff's draft final standard. The staff's draft final standard, however, requires this information under its record keeping requirements.

The staff's draft final standard requires labeling of mattresses and foundations that are tested together (with the model number) to ensure that consumers realize that for their mattress to comply with the staff's draft final standard, and reduce the risk of death and injury, the mattress needs to be used with the foundation specified in the label.

8. Summary and Conclusions

The staff's draft final standard to address open-flame ignition of mattress sets will affect all mattress manufacturers. Almost all of these firms would be considered small businesses, using the Small Business Administration definition. Material and labor costs for all firms are expected to initially increase on average by \$6.05 to \$19.49, with a mid-point estimate of \$12.77, per mattress set produced (Tohamy, 2005a). These cost increases are expected to be borne equally by all firms and hence do not have a disproportionate adverse impact on the smaller mattress producers. These costs are expected to decline in the future due to improved technology of producing fire resistant materials and increased competition among suppliers of inputs used by the mattress industry.

Testing, record keeping, and quality control/quality assurance requirements may have a disproportionate impact on small manufacturers because they are generally required per firm or per prototype and therefore would constitute a larger percent of total revenues, sales, and value added for the smaller firms. To minimize the adverse impact on small manufacturers, the staff's draft final standard provides for prototype pooling among different establishments within the same firm and among different firms. The staff's draft final standard would also allow selling mattress sets based on subordinate prototypes and differing from a qualified prototype only with respect to size (length and width), and/or ticking material or other components that do not impact the fire performance of the prototype without testing the prototypes, to minimize testing costs to all manufacturers, especially those whose volume of output is small.

Compared to other effective alternatives considered, the staff's draft final standard minimizes the impact on small businesses. The only alternatives that might have a lower adverse impact on small business are labeling or doing nothing. Either alternative is ineffective in reducing the fires, deaths, and injuries associated with mattresses and is, therefore, not recommended.

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UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

Date: 14 December 2005

TO : Margaret Neily
Project Manager for Mattress Flammability
Directorate for Engineering Sciences

THROUGH: Gregory B. Rodgers, Ph.D. *GBR*
Associate Executive Director
Directorate for Economic Analysis

FROM : Robert Franklin *RF*
Economist
Directorate for Economic Analysis

SUBJECT : Updated Environmental Information

This memorandum provides an update on the environmental issues associated with the proposed mattress flammability standard. Prior to the Commission proposing the mattress flammability standard, the staff prepared an environmental assessment of the standard (dated 27 October 2004). Based on the environmental assessment, the Executive Director found that the mattress standard would not have a significant impact on the environment.¹ None of the new information available to the staff contradicts this finding.

Since the environmental assessment was completed, the Directorate for Health Sciences has completed a quantitative risk assessment of several chemicals used in fire-resistant barriers for mattresses. This assessment was based on the chemical migration from several commercially available barriers tested by the Directorate for Laboratory Sciences. The chemicals that were analyzed were boric acid, melamine, decabromodiphenyl oxide, antimony trioxide, and vinylidene chloride.²

With regards to boric acid, decabromodiphenyl oxide, and antimony trioxide, Health Sciences determined that consumers would not be exposed to a sufficient amount of the chemical from the barriers tested to present a health hazard. The migration of vinylidene chloride from the barrier samples containing it was below the detectable limits. Therefore, it probably will not present a hazard to consumers. Health Sciences does not consider melamine to be toxic as defined by the Federal Hazardous Substances Act.

¹ CPSC Memorandum from Patricia Semple, Executive Director, to the Commission, "Finding of No Significant Impact from Implementation of the Proposed Open-Flame Ignition Resistance Standard for Mattresses and Mattress/Foundation Sets." 19 November 2004.

² CPSC Memorandum from Treye Thomas and Patricia Brundage to Margaret Neily, "Quantitative Assessment of Potential Health Effects From the Use of Fire Retardant (FR) Chemicals in Mattresses," November 2005.

Many public comments were received in response to the notice of proposed rulemaking expressing concerns about the potential for “roach poison” (boric acid) being used in mattresses. However, as noted above, the Directorate for Health Sciences has concluded that the amount of boric acid to which consumers would be exposed from a commercially available mattress barrier would not present a hazard.



UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

Date: January 10, 2006

TO Margaret L. Neily, ES
Project Manager, Mattress Flammability

THROUGH: Gregory Rodgers, Ph.D., AED, EC *GBR*
Deborah V. Aiken, Ph.D., Senior Staff Coordinator *DVA*

FROM : Soumaya M. Tohamy, Ph.D. *DVA An ST*

SUBJECT : Staff Response to Economic Comments on NPR Standard for the
Flammability (Open Flame) of Mattress Sets

Attached are the responses to economic comments regarding the preliminary regulatory analysis and the regulatory flexibility analysis for the Standard for the Flammability (Open Flame) of Mattress Sets.

Responses to NPR for Open Flame Mattress Standard 12/09/05

1. **Effective Date:** A commenter (the International Sleep Products Association, which represented the majority of the U.S. mattress industry) suggested that the effective date coincide with regular model changes (January and July) and recommended allowing retailers one year to sell pre-standard inventories. Six commenters urged the Commission to move forward expeditiously with the regulation. They suggested a fast track to implementation, an immediate effective date, and acceleration of nationwide implementation. One of the six suggested an effective date no more than six months after publication of the *Federal Register* notice. One commenter (a small producer) suggested that his company will need more than twelve months to comply when and if the new “legislation” is passed.

Staff Response: The staff’s draft final standard provides an effective date of the earlier of January or July that follows the date twelve months after publication of the *Federal Register* notice. This date would coincide with regular model/style changes and thus make it easier for all producers, especially small producers outside of California who are not producing complying mattress sets, to update their styles and produce complying mattress sets.¹

All national producers who sell mattress sets in California already have developed the production technology and conducted the testing required to meet California’s mattress standard, which is very similar to the staff’s draft final standard. One of them is already selling mattress sets complying with the California standard nationwide. Three of the top four producers are selling 15 to 20 percent complying mattress sets nationwide. Smaller companies not based in California may be behind in their design, production, and testing efforts.

If the staff’s draft final standard becomes a final rule, it would be 12 to 18 months after publication of the *Federal Register* notice (the earlier of January or July that follows twelve months after publication of the *Federal Register* notice). Staff believes this provides enough time for manufacturers to transition to producing and selling compliant mattress sets.

2. **Expected Costs of Meeting the Standard:** A commenter expressed concern about the increased cost [due to use of the barrier].

Staff Response: The CPSC staff’s final regulatory analysis (Tohamy, 2005a) estimated net costs of the barrier (the cost of the barrier minus the cost of the material it replaces), also referred to by the industry as the application cost, to range from \$1.33 to \$14.58, with a mid-point estimate of \$7.95, per (queen) mattress set. Adding all other resource costs (including reduced productivity, labeling cost, cost of testing, record keeping, quality assurance costs and compliance costs) results in costs ranging from \$7.67 to \$22.46, with a mid-point estimate of \$15.07, per (queen) mattress set. These cost estimates are lower than those in the initial regulatory analysis

¹ A *mattress set* is defined as either a mattress and foundation labeled by the manufacturer for sale as a set, or a mattress labeled by the manufacturer for sale without any-foundation (Section 1633.2(c)).

(Tohamy, 2004a), estimated to range from \$13 to \$44 per mattress set, and are expected to drop further as a result of technological developments and increased competition among barrier producers.

Industry representatives assert that the current (as of October 2005) cost of a barrier ranges from \$10.60 (\$2.00 times 5.3 linear yards) to \$17.49 (\$3.30 times 5.3 linear yards). This estimate is lower for producers that use less than 5.3 linear yards. Subtracting the cost of the polyester that would be replaced by the barriers leads to a net increase in costs of \$1.33 to \$14.58, with a mid-point estimate of \$7.95, per (queen) mattress set. Again, this estimate is lower for producers that use less than 5.3 linear yards. Adding all other resource cost results in total resource costs not exceeding \$23.00 per mattress set.

3. Price Increase: Three commenters expressed concern about the price increase of mattress sets. Two of them suggested the standard will increase prices by \$100.

Staff Response: The CPSC staff's preliminary regulatory analysis (Tohamy, 2004a) stated that:

[g]iven the availability of mattresses whose retail prices will not increase and the competitive nature of the industry, it is possible that, on average, prices will rise by about twice the costs associated with the standard (i.e., retail price mark-up will average about twice the increase in manufacturing costs). Under this assumption, consumers would pay an additional \$22.91 ($\$11.46 * 2$) to \$79.69 ($\$39.85 * 2$) per mattress set (compared to the price they would have paid for a current mattress set that does not comply with the draft proposed standard).²

According to the preliminary regulatory analysis, the expected price increase would not be \$100 per mattress set. It would range from \$23.00 to slightly less than \$80.00.

Moreover, the final regulatory analysis updated the costs, which have declined because of technological advances and market competition. (See response to comment 2 above.) This means that the price will increase by \$7.64 (the lower end the range for total production costs, equal to \$6.95, times a retail markup of 1.1) to \$40.78 (the upper end of the range for total production costs, equal to \$20.39, times retail markup of 2). The mid point-estimate for this range equals \$24.21.

Additionally, a national producer complied with the California standard, which is very similar to the staff's final standard, without increasing the price of its mattress sets. Staff expects competition for market share among producers to drive the price closer to the one charged by this national producer, which makes the increase even lower than that suggested by the \$24.21 above.

² These cost figures include labor and material costs; testing costs; record-keeping costs; and quality assurance program costs. They do not include the costs to wholesalers, distributors, and retailers or compliance costs because they are not incurred by the manufacturers.

4. Mattress Life: One commenter suggested that the regulatory analysis use an expected mattress life of five to seven years instead of ten to fourteen years, because it is more reasonable.

Staff Response: The International Sleep Products Association, representing the U.S. mattress industry, indicates that ten years is the manufacturer recommended time to keep a mattress. Clearly, consumers keep them for longer: Commenters suggested that some consumers use the same mattress for up to 40 years. Therefore, a range for the expected average mattress life of ten to fourteen years is reasonable.

5. Impact on Small Businesses: Six commenters addressed the impact on small businesses. Three are small producers of residential mattresses, two are FR barrier producers, and one is a producer of mattresses used in Recreational Vehicles (RVs).

a. Small producers: The small producers expressed concern over the burden of testing costs and the feasibility of producing complying mattress sets in twelve months. One small producer projects the cost of prototype testing to be \$4750 or 5.32% of sales. He suggested that producers under a certain dollar volume be permitted to continue testing under 16 CFR 1632. Another indicated knowledge of one plant where it costs 1.4 hours to produce a mattress set that complies with TB 603 requirements, compared to 0.7 hours to produce one that does not.

Staff Response: Testing, record keeping, and quality control/quality assurance requirements may have a disproportionate impact on small manufacturers because they are generally required per firm or per prototype and therefore would constitute a larger percent of total revenues, sales, and value added for the smaller firms. To minimize the adverse impact on small manufacturers, the draft final standard provides for prototype pooling among different establishments within the same firm and among different firms. Prototype pooling is defined as a cooperative arrangement whereby one or more manufacturers build mattresses based on a qualified prototype produced by another manufacturer or prototype developer.

The draft final standard would also allow selling mattress sets whose (subordinate) prototypes differ from a qualified (or confirmed) prototype only with respect to size (length and width), and/or ticking material or other components that do not impact the fire performance of the prototype without testing the prototypes, to minimize testing costs to all manufacturers, especially those whose volume of output is small. Moreover, if a particular qualified, confirmed, or subordinate prototype was used to produce mattress sets for more than one year, then the testing cost would be reduced.

The suggestion that producers under a certain dollar volume be permitted to continue testing only under 16 CFR 1632 is not feasible because it would not protect consumers from the risk of fires, deaths, and injuries associated with open flame ignitions. It would also give small producers an unfair advantage over medium-sized producers.

The increase in time needed to produce a mattress set is expected to decline as workers get more experienced in producing the new designs. Staff estimates the additional time (and wages) to average ten percent.

b. Barrier producers: The barrier producers asserted that the costs of meeting the standard are low, with one stating that there is “zero economic impact on small business due to the wide breadth and variety of FR barrier products being offered to the market.” A barrier producer suggested only testing one set if the peak heat release rate (PHRR) does not exceed 50 MJ in the first 30 minutes.

Staff Response:³ The suggestion to stop after testing one mattress set if the PHRR does not exceed 50 MJ in the first 30 minutes would reduce the cost of testing to all producers. It will not necessarily identify variability in the product design and construction. Testing three replicates of each tested design is needed to provide a meaningful measure of compliance with the standard.

c. Mattress Sets used in recreational vehicles (RVs) and the lodging industry: The RV producer questioned the need to test mattresses used in RVs stating: “given the numerous different fixtures they produce and/or install these small businesses could end up having to conduct many more tests.” The lodging industry recommended limiting the standard to mattress sets for non-commercial residences.

Staff Response:⁴ The Commission intends for this standard to apply to essentially the same mattresses as are currently regulated under Part 1632. Mattresses are “products” under the Flammable Fabrics Act. A “product” is defined as “any article of wearing apparel or interior furnishing.” The term “interior furnishing is defined as “any type of furnishing made in whole or in part of fabric or related material and intended for use or which may reasonably be expected to be used, in homes, offices, or other places of assembly or accommodation.”

We note that motorized recreational vehicles are subject to the Federal Motor Vehicle Safety Standards (“FMVSS”) promulgated by the National Highway Traffic Safety Administration (“NHTSA”) including standard No. 302; Flammability of Interior Materials. 49 CFR § 571.302. Motorized RVs that are subject to FMVSS No. 302 would not be subject to the Commission’s mattress standard.

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

As for mattresses used in the lodging industry, these mattresses are subject to the 1632 mattress standard. Commenters have not presented any reasons why these mattresses should be treated

³ This response was provided by Allyson Tenney in CPSC ES Directorate.

⁴ This response was provided by Patty Pollitzer in CPSC Office of General Council.

differently under the new 1633 regulation. In the absence of such information, the Commission believes it is appropriate to continue to include mattresses used in the lodging industry as subject to Commission mattress flammability rules.

6. Choice: Thirty-eight commenters suggested making the purchase of fire-resistant (FR) mattress sets or mattress sets treated with FR chemicals optional. Eighteen additional commenters wanted to have an option available to non-smokers to not use FR mattress sets.

Staff Response: There is a wide array of solutions available on the market that allow a mattress set to meet the staff's draft final standard. These include natural materials, inherently FR materials and chemically treated materials. The staff's draft final standard is a performance standard and does not limit manufacturer's choice of materials to meet the standard.

The staff's draft final standard allows an exemption for one-of-a-kind mattress sets if they are manufactured to fulfill a physician's written prescription or manufactured in accordance with comparable medical therapeutic specifications. This allows consumers the option to buy a non-complying mattress set.

Eliminating the requirement of a physician's written prescription would make it easier for consumers who do not want to buy a complying mattress set and might therefore lead to some unquantifiable benefits to those consumers. It would, however, reduce the number of complying mattress sets available for sale and subject consumers to the risks of death and injury that the standard addresses.

7. Protecting smokers: Twenty-three commenters suggested that the proposed standard is only beneficial to smokers. They, therefore, suggested producing FR mattress sets for smokers, who smoke in bed, but not the rest of the population.

Staff Response: The staff's draft final standard open flame mattress standard is not intended to address only fires resulting from smoking material ignitions. The staff's draft final standard is expected to protect the broader population because it addresses fires due to open-flame, smoking material, and other sources of ignitions. Smith and Miller (2005) show that the estimated average (1999 to 2002) annual fires caused by smoking material ignitions that would have been considered addressable by the staff's draft final standard were 4,400 compared to a total number of fires (e.g. caused by candles, candles, matches, lighters, spark from operating equipment or switch, and heat from gas-fueled equipment, oil-fueled equipment, or electric equipment arcing) of 15,300. This represents only 29 percent of average annual fires. Deaths, injuries, and property damage from smoking related fires represent 51 percent, 30 percent, and 28 percent respectively.

References

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