Tab A

Updated Estimates of Residential Fire Losses Involving Mattresses and Bedding

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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Executive Summary

On January 13, 2005, CPSC published a Notice of Proposed Rulemaking for a Standard for the Flammability (Open Flame) of Mattresses and Mattress/Foundation Sets. Fire loss data supporting the need for and evaluating effectiveness of the draft standard were contained in a CPSC staff report dated October 2004.[1]

The current report updates the estimates of fires and fire losses associated with mattresses and bedding that were contained in the October 2004 report. The methodology used for the current report repeats the methodology used for the earlier report with only minor changes to accommodate the availability of later years of fire data and a somewhat revised data collection system.

The results are as follows:

Estimated Addressable Fire Losses

- Based on national fire loss estimates for the years 1999 - 2002, ignition of mattresses and bedding resulted in an estimated 15,300 residential structure fires, 350 deaths, 1,750 injuries, and $295.0 million in property loss annually.[2] Based on the characteristics of fire cause, an estimated 14,300 fires, 330 deaths, 1,680 injuries, and $281.5 million property loss annually were considered potentially addressable (preventable) by CPSC staff's draft standard.

- Among the potentially addressable casualties, smoking fires accounted for 180 deaths (55 percent) and about 520 injuries annually (31 percent). Open flame fires accounted for about 110 deaths (33 percent) and 890 injuries annually (53 percent). The remaining casualties are from mattress/bedding fires where the heat source was not smoking materials or open flame but was considered potentially addressable.

- Children younger than age 15 accounted for an estimated 90 addressable deaths (27 percent) and 340 injuries annually (20 percent). Adults age 65 and older accounted for an estimated 80 addressable deaths (24 percent) and 180 injuries annually (11 percent).

[1] L. Smith and D. Miller, Residential Fires Involving Mattresses and Bedding, U.S. Consumer Product Safety Commission, October 2004

[2] Based on data reported in the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS) and estimates of U.S. residential structure fires and fire losses from the National Fire Protection Association.

Estimated Reduction in Fire Deaths and Injuries

- CPSC staff estimates that the draft standard may prevent 69 to 78 percent of the deaths and 73 to 84 percent of the injuries presently occurring in addressable mattress/bedding fires attended by the fire service. Applying estimated percentage reductions to the most recent available fire data (2000 – 2004[3]), we estimate potential reductions of 240 to 270 mattress/bedding fire-related deaths and 1,150 to 1,330 mattress/bedding fire-related injuries annually.

It is noted that the range of percentage reductions cited above reflects the range of probabilities of post-standard death or injury assigned to the general categories of "likely", "possible", and "unlikely", as developed by CPSC staff reviewers and described in Appendix A. They do not represent statistical confidence intervals.

[3] Though there are not NFIRS estimates available for 2003 and 2004, the totals from the NFPA Residential Fire Loss Survey are available for these years and are used to help provide estimates for these years. See Step 3 on p. 17-18 as well as Appendix E for more detail.

I. Introduction

On January 13, 2005, CPSC published a Notice of Proposed Rulemaking for a Standard for the Flammability (Open Flame) of Mattresses and Mattress/Foundation Sets. This report updates the estimates of fires and fire losses associated with mattresses and bedding that support the need for a standard. In addition, this report provides updated estimates of the effectiveness of the staff's draft standard in preventing fatalities and non-fatal injuries associated with mattress and bedding (bedclothes) fires.

The test method being recommended in the staff's draft standard is expected to reduce losses caused by smoking and other ignition sources as well as open flame sources. It is noted that the staff's draft standard will mitigate the effects of mattress fires but not prevent the fires from occurring. Therefore, evaluation of the effectiveness will be limited to reduction of deaths and injuries. While it is expected that property damage will also be reduced, it is not possible to provide an estimate of the extent of that reduction.

II. Methodology

With only minor changes, the methodology used for this update repeats the methodology used for the original estimate of effectiveness.[4] See Appendix A. Evaluation of the effectiveness of the draft standard was developed by first estimating residential fires and fire losses associated with mattresses and bedding (bedclothes) that were considered potentially addressable (preventable) by the staff's draft standard (Appendix B).[5] Since those estimates are based only on coded data, CPSC staff also reviewed CPSC and fire department investigation reports to determine the significant details involved when people died or were injured in mattress/bedding fires. From this review it was possible to identify a number of factors that adversely affected the ability of occupants to escape the fire safely, and to estimate whether the deaths and injuries that occurred could have been prevented or reduced in number under the conditions of the draft standard (Appendix C). Potential percentage reductions in casualties were then developed by subsets of victim age group and type of heat source combinations as contained in the investigation reports (Appendix D). National estimates of preventable deaths and injuries were developed by applying the potential percentage reductions of deaths and injuries within subsets of the investigations to equivalent subsets of the national estimates of addressable fire service attended deaths and injuries. The national estimates of subset reductions were summed to obtain an overall estimate of deaths and injuries that could be prevented.

This memorandum presents fire loss estimates based on product-specific data available from the National Fire Incident Reporting System (NFIRS) through 2002. NFPA estimates of aggregate residential structure fire losses (not product-specific) are

[4] L. Smith and D. Miller, Residential Fires Involving Mattresses and Bedding, U.S. Consumer Product Safety Commission, October 2004, pp 4 – 12.

[5] Estimates based on the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS) and National Fire Protection Association (NFPA) data.

available through 2004 (Appendix E). Estimates of preventable mattress/bedding fire-related deaths and injuries through 2004 were developed on the assumption that addressable deaths and injuries constituted the same proportion of all residential structure fire deaths and injuries in 2003 and 2004 as in previous years.

III. Results

A. Fire Losses Addressable by the CPSC Staff's Draft Standard

Table 1 below presents average annual estimates of residential structure fires involving ignition of mattresses and bedding for 1999 - 2002, the most recent years of fire data available that include product–level detail. There were an estimated 15,300 fires that resulted in 350 civilian deaths, 1,750 civilian injuries, and $295.0 million in direct property loss annually during this time period.

To estimate the effect that the staff's draft standard could have on mattress/bedding losses, CPSC staff identified fires, deaths, injuries, and property loss that were considered addressable, based solely on the characteristics of the fire cause. These included most mattress/bedding fires and fire losses, regardless of heat source; 14,300 fires, 330 deaths, 1,680 injuries, and $281.5 million in property loss annually.

Table 1
Estimated Residential Fires and Fire Losses Involving Mattresses/Bedding, Attended by the Fire Service, 1999 – 2002 Annual Average

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

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

The staff's draft standard is designed primarily to reduce the severity of mattress/bedding fires rather than prevent fires from occurring, although some fires also may be prevented. It is expected that property damage will be reduced as well, since the potential for flashover fires will be reduced. However, it was not possible here to estimate what the size of that effect will be. Thus, the remainder of this report will be limited to discussion of addressable deaths and injuries.

Annual estimates of addressable deaths and injuries in fires attended by the fire service, categorized by heat source and casualty age group, are presented in Tables 2 and 3 respectively. Smoking fires accounted for 180 of the addressable deaths (55 percent), and 520 of the addressable injuries (31 percent). Open flame fires accounted for about 110 addressable deaths (33 percent) and 890 addressable injuries (53 percent). Overall, children younger than age 15 accounted for an estimated 90 deaths (27 percent) and 340 injuries (20 percent) annually. Adults age 65 and older accounted for 80 deaths (24 percent) and 180 injuries (11 percent).

Table 2
Estimated Addressable Mattress/Bedding Deaths
By Heat Source and Age Group 1999 – 2002 Annual Average,
Fire Service Attended

Heat Source	Age Group (years)				
	Total	Less than 5	5-14	15-64	65+
Total	330	70	20	160	80
Smoking	180	10	**	120	50
Open Flame	110	40	20	30	20
Other	50	10	**	20	10

Detail may not add due to rounding.
Source: U.S. Consumer Product Safety Commission/EPHA. Based on data from the U.S. Fire Administration and the National Fire Protection Association

Table 3
Estimated Addressable Mattress/Bedding Injuries
By Heat Source and Age Group 1999 – 2002 Annual Average,
Fire Service Attended

Heat Source	Age Group (years)				
	Total	Less than 5	5-14	15-64	65+
Total	1,680	150	190	1,160	180
Smoking	520	20	20	390	90
Open Flame	890	110	150	580	50
Other	270	20	30	180	40

Detail may not add due to rounding.
Source: U.S. Consumer Product Safety Commission/EPHA. Based on data from the U.S. Fire Administration and the National Fire Protection Association

B. Casualties That Could be Prevented by the CPSC Staff's Draft Standard

CPSC staff developed a Post-Standard Casualty Category guideline (Appendix C) to assess the likelihood that each individual who died or was injured in an investigated fire (1999 – 2004) would still die or be injured if the mattress met the staff's draft standard that requires a testing time of 30 minutes. Percentage reductions were calculated by sub-categories, using the pre-standard deaths and injuries reported in the investigations and the anticipated post-standard deaths and injuries that would remain (Appendix D). When adequate data were available, these percentages were then applied to the national estimates of addressable deaths and injuries in the equivalent sub-categories, and summed, to arrive at overall estimates of the number and percentages of deaths and injuries that could be prevented annually for 1999 – 2002.

1) 1999 – 2002 Estimated Casualties That Could Have Been Prevented

Applying the anticipated percentage reductions in post-standard casualties (Tables D-3 and D-4) to estimates of pre-standard addressable casualties (Tables 2 and 3), CPSC staff estimates that 230 to 260 mattress/bedding deaths annually (69 to 78 percent overall reduction) could have been prevented during 1999 - 2002 (Table 4). By age group, the estimated reduction among children younger than age 5 was 50 to 60 deaths annually (77 – 87 percent), among ages 5 to 14 the reduction was 20 deaths annually (83 to 92 percent), among ages 15 – 64 the reduction was 110 to 130 deaths annually (68 to 77 percent), and among adults age 65 and older the reduction was 50 to 60 deaths annually (62 to 70 percent). By heat source, the estimated reductions were 120 to 140 deaths annually for smoking-ignited fires, 80 to 90 deaths for open flame-ignited fires, and 30 to 40 deaths for other addressable fires.

Mattress/bedding fire related injuries that could have been prevented during this period (Table 5) were estimated to be 1,230 to 1,420 annually (73 to 84 percent overall reduction). By age group, the estimated reduction among children younger than age 5 was 90 to 110 injuries annually (59 to 73 percent), among children ages 5 to 14 the reduction was 150 to 170 injuries annually (80 to 89 percent), among those ages 15 to 64 the reduction was 880 to 1,000 injuries annually (76 to 86 percent), and among adults ages 65 and older the reduction was 110 to 140 injuries annually (62 to 76 percent). By heat source, an estimated 350 to 420 injuries that occurred in smoking ignited mattress/bedding fires could be prevented, along with 670 to 760 injuries in open flame-ignited fires, and 210 to 230 injuries in other addressable fires.

Table 4
Estimated Mattress/Bedding Fire Deaths Preventable by the Draft Standard, By Heat Source and Age Group, Fire Service Attended, 1999 - 2002 Annual Average

Heat Source	Total	Age Group (years)			
		Less Than 5	5 to 14	15 to 64	65+
All Heat Sources					
1999 - 2002 Estimate	**330**	**70**	**20**	**160**	**80**
Percent to be Prevented	**69 - 78**	**77 - 87**	**83 - 92**	**68 - 77**	**62 – 70**
Number Prevented	**230 – 260**	**50 – 60**	**20**	**110 – 130**	**50 – 60**
Smoking					
1999 - 2002 Estimate	180	10	**	120	50
Percent to be Prevented	67 – 76	80 – 90	80 – 90	68 – 76	63 – 72
Number Prevented	120 -140	10	**	80-90	30-40
Open Flame					
1999 - 2002 Estimate	110	40	20	30	20
Percent to be Prevented	73 – 81	77 – 87	83 – 92	72 – 81	56 – 64
Number Prevented	80 – 90	30-40	10 – 20	20	10
Other					
1999 - 2002 Estimate	50	10	**	20	10
Percent to be Prevented	67 – 76	76 – 86	84 – 92	63 – 72	66 – 75
Number Prevented	30	10	**	10 - 20	10

** Estimate is less than 5.

Detail may not compute due to rounding of estimates presented. All calculations based on unrounded data.

Source: U.S. Consumer Product Safety Commission/EPHA

Table 5
Estimated Mattress/Bedding Fire Injuries Preventable by the Draft Standard, By Heat Source and Age Group, Fire Service Attended, 1999-2002 Annual Average,

Heat Source	Total	Age Group (Years)			
		Less Than 5	5 to 14	15 to 64	65+
All Heat Sources					
1999-2002 Estimate	**1,680**	**150**	**190**	**1,160**	**180**
Percent Prevented[6]	**73 – 84**	**59 – 73**	**80 – 89**	**76 – 86**	**62 – 76**
Number Prevented[6]	**1,230 – 1,420**	**90 – 110**	**150 – 170**	**880 – 1,000**	**110 - 140**
Smoking					
1999 - 2002 Estimate	520	20	20	390	90
Percent to be Prevented[6]	68 – 81	67 – 83	78 – 89	69 – 81	61 – 76
Number Prevented[6]	350 – 420	20	10 – 20	270 – 320	50 – 70
Open Flame					
1999 - 2002 Estimate	890	110	150	580	50
Percent to be Prevented[6]	75 – 86	59 – 72	78 – 89	79 – 89	55 – 68
Number Prevented[6]	670 – 760	70 – 80	120 – 130	460 – 520	30
Other					
1999 - 2002 Estimate	270	20	30	180	40
Percent to be Prevented[6]	77 – 87	47 – 64	82 – 91	80 – 89	73 – 84
Number Prevented[6]	210 – 230	10	20	150 – 170	30

Detail may not compute due to rounding of estimates presented. All calculations based on unrounded data.
Source: U.S. Consumer Product Safety Commission/EPHA

2) 2000 - 2004 Estimated Casualties That Could Have Been Prevented

National estimates of fire cause and casualty detail are available only through NFIRS, for which the most recent year available is 2002. However, the NFPA estimates to which NFIRS data are applied are available through 2004 (Appendix E). If we assume that addressable mattress/bedding fire deaths and injuries account for the same percentage of residential casualties in 2003 and 2004 as in 1999 - 2002 (11.03 percent of all residential fire deaths and 10.46 percent of all residential fire injuries), we are able to estimate more recent mattress/bedding fire losses that could have been prevented. Applying the estimated overall percentage reductions presented above to the more recent NFPA estimates, we estimate that 240 to 270 deaths and 1,150 to 1,330 injuries in mattress/bedding fires attended by the fire service could have been prevented annually during the time period 2000 - 2004 (Table 6).

[6] These estimates account for injuries prevented by the standard based on the pre-standard injuries but also for injuries that occur as a result of deaths prevented. See Step 4 on p. 18 - 19 for more details.

Table 6
Estimated Residential Mattress/Bedding
Fire Deaths and Injuries Preventable by the Draft Standard,
Fire Service Attended, 2000 -2004 Annual Average

	Annual Deaths	Annual Injuries
Estimated Addressable Mattress/Bedding Casualties [1]	350	1,580
Range of Percentages Prevented [2]	69 – 78	73 – 84
Range of Estimated Casualties Prevented	240 – 270	1,150 – 1,330

[1] Assumes addressable deaths = 11.03 % and addressable injuries = 10.46 % of all residential structure fire casualties, based on NFIRS and NFPA, 1999 - 2002
[2] Appendix D
Detail may not compute due to rounding of estimates presented. All calculations based on unrounded data.
Source: U.S. Consumer Product Safety Commission/EPHA

Discussion

Beginning with the 1999 data file, major changes were made to the NFIRS, the data system that identifies fire cause. Since the revised system is not strictly comparable with the pre -1999 data system, the updated estimates provided here are limited to fires that occurred in 1999 and later. Differences in the two sets of estimates should not be considered an indicator of a trend over time.

Mattress foundations, e.g., box springs, generally are considered to be included in the same fire reporting code as mattresses and pillows since there is no separate code for foundations. Estimates include ignition of mattresses and bedding combined due to the nature of the reporting system and the difficulty faced by the fire service in determining which item ignited first, particularly in the absence of background information about the incident.

Conclusion

Based on the most recent available data, an estimated 240 to 270 deaths and 1,150 to 1,330 injuries resulting from residential mattress/bedding fires could have been prevented annually during 2000 - 2004 as a result of the CPSC staff's draft standard for mattresses and foundations.

Appendix A

Methodology

A. Current National Estimates

1. Fire Losses Attended by the Fire Service

Annual estimates of national fires and fire losses in which a mattress or bedding ignited first were based on data from the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA) annual survey of fire departments. The NFPA survey is a stratified random sample of fire departments that produces national estimates of total residential structure fires and fire losses. It does not, however, provide data on product involvement.

The NFIRS is a data system to which participating fire departments across the country voluntarily report data on the fires they attend, providing details of product involvement. Since the NFIRS is not a probability sample, NFIRS data were weighted to the NFPA national estimates to produce product-specific estimates. In recent years, approximately one-third to one-half of U.S. fire departments participated in NFIRS.[7] A general description of the estimation procedure is described in Hall and Harwood. [8] National estimates in this report reflect residential structure fires and fire losses, excluding intentional fires and fire losses and fire fighter casualties.

NFIRS Coding System Revision:

The NFIRS coding system recently underwent a major revision. Fire data reflecting this revision (version 5.0) were first released by the U.S. Fire Administration in the 1999 NFIRS data file. Data reported from departments still using the older 4.1 version were converted to the new version to the extent possible and represent a decreasing part of the file over time. Many of the reporting variables and reporting procedures changed during this revision, with the result that data from the two systems are no longer directly comparable. Estimates presented here are limited to data from the most recent version of NFIRS. Annual estimates were produced for single years, averaged, and rounded to produce four-year averages (1999 – 2002).

Editing and Addressability:

Several NFIRS variables were used to determine whether an incident was a mattress or bedding fire, determine an incident's addressability by the draft standard, identify intentional fires (excluded from the estimates), determine a fire's heat source

[7] For additional detail on NFIRS, see "Fire Loss in the United States, 1992 – 2001, Thirteenth Edition," Department of Homeland Security, Federal Emergency Management Agency, U.S. Fire Administration, National Fire Data Center.

[8] John R. Hall, Jr. and Beatrice Harwood, " The National Estimates Approach to U.S. Fire Statistics," Fire Technology, May 1989, Volume 25, Number 2, pp 99 – 113.

type (smoking materials, small open flame, other), and break down estimates based on victim age. The NFIRS variable "Item First Ignited" was used to identify mattress and bedding fires. The codes counted as mattress or bedding for both of these variables were '31 – mattress, pillow' and '32 – bedding, blanket, sheet, comforter'.

Since several variables are used in NFIRS to capture the characteristics of each fire, it was possible that the coded values could be inconsistent in producing an accurate picture of the situation. When they were inconsistent, it was felt that the cause was usually miscoding of one of the variables. Nevertheless, when this occurred, to be conservative, CPSC staff assumed for this analysis that it was always the mattress/bedding variable that could not be relied upon. Any such incidents were edited out and not counted as mattress or bedding fires. Thus, an incident citing the "Area of Origin" code "escalator" would not be counted as a mattress fire. Appendix Tables B-1 and B2.1 – B2.3 include the list of codes edited out and the codes considered as mattress/bedding incidents, both addressable and not addressable. The term "addressable" refers to incidents expected to be affected by the draft mattress standard, based solely on the characteristics of fire cause.

Estimates of fires attended by the fire service combined the mattress and bedding codes since it was uncertain whether the fire service routinely could distinguish which ignited first. However, NFIRS captures only the item first ignited. Thus, if a fire coded as igniting bedding did not also involve a mattress (a non-addressable situation), it could not be conclusively identified from the NFIRS data alone.

Staff review of the NFIRS data to explore this issue identified the laundry room as the only location in which there were a disproportionate number of bedding ignitions compared to mattress ignitions as the first item ignited. Slightly over half of these bedding fires involved clothes dryers, suggesting that the bedding was separated from the mattress. Bedding fires in laundry rooms overall involved about 1.5 % of all mattress and bedding fires. Review of the casualty data, however, indicated that no deaths and less than one percent of the mattress and bedding injuries were associated with bedding ignitions involving clothes dryers. Therefore, it is concluded that the addressable mattress and bedding fire estimates could include a small proportion of non-mattress fires but a negligible number of non-mattress injuries and no non-mattress deaths were included within the estimates of addressable deaths and injuries.

In general, the staff's draft standard is expected to address not only fires caused by traditional small open flame sources such as lighters, matches, and candles, but also other small open flame sources, smoking material fires (in conjunction with FR 1632), and ignition sources such as fires caused by proximity to a heat source. The variables used to determine whether a mattress or bedding fire was addressable were "Factors Contributing to Ignition", "Equipment Involved in Ignition", and "Heat Source". It is noted that regardless of initial heat source, investigation data indicated that once a fire ignited, the bedding present also ignited.

There were some ignition factors that made an incident not addressable only when the "Form of Heat of Ignition" was smoking materials, a candle, a match, or a lighter. These included 'cutting, welding too close to', 'equipment overloaded', and 'backfire,' which could not be possible malfunctions for these products. There were some "Equipment Involved with Ignition" codes that caused any mattress or bedding fire to be not addressable. Some of the Equipment codes that made a fire not addressable were conveyors, printing presses, soldering equipment, and garbage disposer. Some "Heat Source" codes made an incident not addressable. These included munitions, model and amateur rockets, lightning, and others.

A vast majority of reported incidents coded as a mattress or bedding fire in the NFIRS data base were counted as such – few were edited out. Similarly, a vast majority of mattress and bedding fire incidents were deemed addressable by the staff's draft standard.

In NFIRS 5.0, all causes of arcing fall under one heat source code, which was considered 'Additional Small Open Flame' for this analysis. In NFIRS 4.1, there were several codes that captured specific causes of arcing but only one was considered 'Additional Small Open Flame' while the others were considered 'Other In-Scope Ignition.' This change accounts for the higher estimate of fires for 'Additional Small Open Flame' in this report compared to the October 2004 report.

Also, if an incident involved playing by a child younger than age 10, that incident was always considered to be unintentional.

Allocation of Unknowns

It was possible to have "unknown" values for each of the NFIRS variables used for this analysis. A technique known as raking was used to allocate the unknown values for each of the variables used for this analysis. Raking involves an iterative mathematical procedure to adjust a cross-tabulation of the data so that the resulting table, without unknowns, maintains the same proportional relationship as the original cross-tabulation. Battaglia, Hoaglin, and Izrael describe the raking algorithm and provide the statistical software (SAS version 6.12; SAS Institute, Inc., Cary, NC).[9]

The raking procedure used for 1999 – 2002 NFIRS was simpler than in previous years because of the revisions to the NFIRS coding system. The new NFIRS coding system has no partial unknowns. Therefore there is only one stage of raking, wherein the unknowns for each variable are allocated. As with the previous estimates for years 1995 – 1998, editing and elimination of intentional fires occurred after raking for these 1999 - 2002 estimates.

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

B. CPSC Investigation Reports

In-depth investigations were conducted by CPSC field staff to provide detailed information about the fires that ignited mattresses and bedding. Most such investigations also included documentation from the fire department that attended the fire. Nearly half of the investigated deaths were identified from death certificates with follow-up reports from the fire department. Investigations used for this report were limited to fires in which a mattress or bedding was reported as the first item to ignite, the fire was of the type considered addressable by the draft standard, and a civilian death or injury resulted. These incidents were further limited to those that occurred during 1999-2004 and were entered into a CPSC data base by June 30, 2004. A total of 195 deaths and 205 injuries that occurred in fires attended by the fire service were included. See Appendix Tables D-1 (deaths) and D-2 (injuries). In addition to investigation reports initiated from death certificates, incidents were selected for investigation based on a variety of CPSC staff interests during this time period. This included fires initially reporting involvement of mattresses or bedding, fires ignited by candles or lighters, and a variety of other fire ignition sources. Most fires involved the ignition of both bedding and mattresses but no incidents that involved solely bedding were included among the investigations used to evaluate mattress standard effectiveness. As a result of the investigation assignment process, the distribution of mattress ignition sources is not representative of all mattress-involved fires. To accommodate this situation, results within subsets of the investigation data (by heat source and victim age group combinations), deaths and injuries separately, were applied to matching subsets of the NFIRS-based national estimates.

C. Estimation of Death and Injury Reduction[10]

Step 1) Review investigation reports to assess likelihood of post-standard death or injury

Evaluation of whether a particular death or injury would be prevented by the staff's draft standard was based on detail cited in the investigation report. For most of the incidents used for this report the mattress/bedding was ignited by small open flame sources such as lighters or candles, or by other equipment-related fires which were of interest to CPSC staff during this period. Relatively few smoking-related incidents were included compared to the proportion of smoking incidents contained in the national fire data.

Evaluations of the fire incidents by CPSC staff reviewers assumed the following scenarios which were based on the results of National Institute of Standards and Technology (NIST) testing conducted to assess the hazard produced from the burning mattress and bedclothes.

- Occupants in bed when the fire ignited but able to escape the burning bedclothes in the first 3 to 5 minutes were expected to be subjected to a minimal hazard.

[10] Note: The investigation reports used were not changed from the October 2004 EPHA report.

- Occupants in direct contact with burning bedclothes for a longer period would be subjected to potentially hazardous levels of heat release that would peak at about 5 to 10 minutes after ignition.

- If the burning bedclothes did not ignite other non-bedding items in the room or produce flashover in this time period, heat release would subside temporarily and then begin to increase again as the involvement of the mattress increased.

- Assuming the conditions above, occupants would have a total of about 10 to 15 minutes to escape the room of origin before the situation in that room became untenable.

- Assuming that the mattress design was capable of withstanding the threat from the bedclothes and that the bedclothes did not contribute enough heat to pose a hazardous condition, the draft mattress standard was expected to minimize the likelihood of flashover during the first 30 minutes. As a result, occupants in other rooms would not be confronted by the intense heat and smoke experienced by those in the room of origin during this period.

Thus, it was expected that people who were outside the room of origin at the time of ignition would be unlikely to die in the fire, unless they entered the room of origin during the fire or were incapable of exiting the occupancy on their own, e.g., those who could not move on their own.

Each investigation was evaluated by three CPSC staff reviewers[11] to identify the features related to the occurrence of a death or injury. In order to categorize individual incidents, a set of criteria was developed to standardize decision-making. These criteria captured a variety of factors that appeared to affect the likelihood of death or injury, taking into account the characteristics of the fire, the fire source, the characteristics and behavior of the casualty, and the other members of the household who were present (Appendix C, Tables C-1 and C-2). The primary criteria considered were the following:

- the location of the casualty in relation to the point of fire origin,
- the age of the casualty,
- whether the casualty was asleep, awake, or unable to act on his own due to extreme age (young or old) or disabilities,
- if the casualty was asleep, whether there was an indication that the person woke up (evidenced by being found not on the bed),
- if the casualty was of extreme age or disability, whether there was a potential rescuer in the household,

[11] CPSC staff reviewers were Linda Smith, Directorate for Epidemiology, Allyson Tenney, Directorate for Engineering Sciences, and Carolyn Meiers, Directorate for Engineering Sciences.

- presence of any other limiting conditions (less severe) that would be expected to reduce the casualty's ability to escape, e.g., drugs, alcohol, mental or physical limitations,
- whether the casualty engaged in fighting the fire.

The presence of a rescuer was considered critical for children ages 2 and younger since they do not have adequate cognitive or motor abilities to extract themselves from the fire area. The ability of children ages 3 to 4 to leave the fire area on their own was considered uncertain even though they have better cognitive development and are more independent. While children ages 5 to 9 should mostly have been able to escape on their own, several reports stated that children of this age group ran into other rooms or broke away from exiting family members. Rescuers were considered critical for those aged 85 and older primarily because of the greater likelihood that they could have moderately severe physical limitations or perhaps reduced cognitive abilities.

Each set of conditions was assigned to one of five categories capturing expected likelihoods of death or injury if the fire had involved a mattress that met the staff's draft standard; that a death (or injury) would still occur, would likely occur, would possibly occur, would be unlikely to occur, or would not occur. A range of probabilities was then assigned to each category to reflect those terms (See table below). For example, for each pre-standard death in the Possible (P) category, there would be between .45 to .55 deaths expected to occur if the involved mattress met the draft standard.

Post-Standard Casualty Category	Probability of Post-Standard Occurrence
Y Death (or injury) would still occur	1
L Deaths (or injury) was considered likely to still occur.	.75 - .85
P Deaths (or injury) was considered possible to still occur.	.45 - .55
U Deaths (or injury) was considered unlikely to still occur.	.1 - .2
N No death (or injury) would occur	0

To estimate the higher number of expected deaths or injuries remaining, the higher probabilities in each category were applied. Conversely, the lower probabilities in each category were applied to calculate the lower number of expected deaths or injuries remaining. In the hypothetical example below, 5 deaths were present initially with one death occurring in each of the likelihood categories. For this subset, the expected number of deaths that would remain after the standard would range from 2.3 to 2.6.

Hypothetical Example
Children Younger Than Age 5 Dying in Open Flame Fires

Observation	Likelihood Category	Probability Range	Lower Probability of Still Occurring	Upper Probability of Still Occurring
1	Y	1	1	1
2	L	.75 - .85	.75	.85
3	P	.45 - .55	.45	.55
4	U	.1 - .2	.1	.2
5	N	0	0	0
Total: 5			**2.3**	**2.6**

The same categories and probability values were applied to both deaths and injuries. Unless a death was considered certain, the casualty also was assigned a likelihood category for injury. This took into account the possibility that if a person did not die he could still be injured. Whenever someone was injured trying to extinguish the fire, it was assumed that he/she would try to extinguish the fire under the new conditions as well. These persons were assigned to the "unlikely injury" category. The injury categories do not reflect estimates of the severity of remaining injuries. When location of the casualty was not specified, the arithmetic mean of the worst and best possibilities given the individual's circumstances was used to estimate the probability of death or injury.

Step 2) Estimate proportion of casualties prevented, by sub-category

Using unweighted investigation data, tables were constructed to estimate casualties prevented within each sub-category of interest (Appendix Tables D-3 for deaths and D-4 for injuries). The proportion of deaths (or injuries) prevented by sub-category was estimated as follows:

$$P = (n^b - n^a)/n^b$$

where P= the estimated proportion of deaths (injuries) in the sub-category that would be prevented, n^b = number of deaths (or injuries) in the sub-category in the investigation database, and n^a= estimated deaths (or injuries) in the sub-category that would remain post-standard. In the hypothetical example above, the expected reduction for this hypothetical set would be calculated as

$P = (5 - 2.3)/5 = .54$, the greatest reduction, or
$P = (5-2.6)/5 = .48$, the least reduction.

Step 3) Estimate number of casualties prevented

Percentage reductions of deaths (injuries) within sub-categories of heat 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. In the hypothetical example above, setting the national estimate for this subset at a hypothetical 50 deaths, the estimate of deaths prevented among children younger than age 5 from open flame fires would be:

50 * .54 = 27 deaths, the greatest reduction, or
50 * .48 = 24 deaths, the least reduction.

Estimated reductions were summed for all subcategories to arrive at an overall estimate of deaths and injuries prevented. This was done in two steps, where all categories were set at the greatest reduction and where all categories were set at the least reduction.

Although NFIRS-level detail is not available at this time for post-2002 years, NFPA estimates of overall residential structure fires and fire losses are available through 2004 (Appendix E). NFPA estimates indicate that residential fires and deaths did not continue to decline during 2003 and 2004. To take the most recent data into account, preliminary estimates of losses expected and prevented for the most recent 5-year period (2000-2004) were prepared. This estimation process required the following assumptions:

1) Mattress/bedding fires and fire losses, total and addressable, as a proportion of all residential structure fires, were the same during the most recent five years, 2000-2004, as during the earlier period when specific data were available, 1999 – 2002.

2) Heat source and age group distributions involved in mattress/bedding fires have not changed from the earlier period to the later period.

Some conditions external to mattresses could reduce both smoking and open flame fires in years subsequent to 2002. Smoking rates have continued to decrease over the years.[12] The CPSC child–resistant multi-purpose lighter standard took effect in December 2000 but its effect on fires may not be fully in place by 2002. If these factors have caused mattress/bedding casualties to decrease faster than other kinds of residential casualties, the estimates of addressable casualties presented here may be somewhat higher than estimates that may be developed later when more specific data are available. On the other hand if the proportion of residential structure fire losses that are associated with mattresses and bedding has increased subsequent to 2002, then the estimates may be lower than future estimates.

Step 4) Estimate number of injuries that would occur as a result of deaths prevented

Some of the deaths that will be prevented by the standard could result in injuries instead of deaths. The likelihoods used to produce estimates for these injuries are in the last column of Table C-1. These likelihoods were used in combination with the death investigations to produce proportions of pre-standard deaths that would be non-fatal injuries after the standard. These estimated proportions were by age of victim and heat source. Applying these proportions to the NFIRS/NFPA estimates for deaths resulted in estimates of injuries that would occur after the standard to people who would've

[12] The percentage of people over 18 who are cigarette smokers has declined from 25.3 percent in 1990 to 22.7 percent in 2001. *Health, United States, 2003*, National Health Interview Survey, National Center for Health Statistics.

otherwise died before the standard. These injuries were added to the injuries remaining after accounting for the injuries prevented estimates that come from the injury investigations. An example of how this works follows:
Example:

Injuries prevented for mattress/bedding fires where the heat source is 'Smoking' and the victim's age is 5 – 14.

The post-standard likelihoods of injuries in Table C-2 are applied to the dataset of 205 injury investigations to produce a range of percent prevented for this category:

This range is 80% - 90%. This says that an estimated 80% - 90% of the injuries to victims age 5 – 14 that occurred before the standard in mattress fires where the heat source was smoking materials would not occur after the standard with compliant mattresses.

The range is applied to the NFIRS/NFPA 1999 – 2002 average annual estimate of mattress fire injuries where the heat source was smoking materials and the victim was between 5 and 14 years old. That estimate is 18.39. Multiplying by the 80% - 90% gives the estimate that 14.71 – 16.55 of these injuries would be prevented and only 1.84 – 3.68 injuries would remain.

At this point, the estimate of injuries prevented is not complete because the injuries that result from deaths prevented have not been accounted for. These injuries are injuries that were deaths before the standard but some of the people whose deaths would be prevented by the compliant mattresses would be injured instead. To estimate these, the likelihoods in the last column of Table C-1 (Post-standard likelihood of injury) were applied to the dataset of 195 death investigations to get a range. The estimated range here is 10% - 20%. This means that 10% - 20% of the pre-standard deaths where the heat source is 'Smoking' and the victim is between 5 and 14 will be injuries after the standard with compliant mattresses. Applying this range to the NFIRS/NFPA 1999 – 2002 average annual estimate of deaths for this subcategory (1.79) gives a range of 0.18 - 0.36 injuries that would occur as a result of deaths prevented.

Adding these injuries to the remaining injuries of 1.84 – 3.68 gives a sum of 2.02 – 4.04 remaining injuries. The annual estimate of injuries for 1999 - 2002 was 18.39 so the estimated number prevented is 14.35 – 16.37. And the net percentage prevented is 78% - 89%.

Appendix B
NFIRS Version 5.0 Codes Used to Identify Mattress and Bedding Fires

Table B-1
Standard Codes Used in Mattress and Bedding Fire Loss Estimates, Without Regard to Addressability

Heat Source	NFIRS Version 5.0 Codes
Smoking Materials	Cigarette (61) Pipe or cigar (62) Heat from undetermined smoking material (63)
Traditional Small Open Flame Sources	Match (64) Cigarette lighter (65) Candle (66)
Additional Small Open Flame Sources	Spark, ember or flame from operating equipment (11) Arcing (13) Hot ember or ash (43) Fireworks (54)
Other In-scope Heat Sources	Heat from powered equipment, other (10) Radiated, conducted heat from operating equipment (12) Hot or smoldering object, other (40) Heat, spark from friction (41) Molten, hot material (42) Model and amateur rockets (55) Heat from other open flame or smoking materials (60) Backfire from internal combustion engine (68) Chemical, natural heat source, other (70) Sunlight (71) Chemical reaction (72) Other static discharge (74)
Out-of-Scope Heat Sources	Heat source, other (00) Explosive, fireworks, other (50) Munitions (51) Blasting agent (53) Incendiary device (56) Lightning (73) Heat spread from another fire, other (80) Heat from direct flame, convection currents (81) Radiated heat from another fire (82) Flying brand, ember, spark (83) Conducted heat from another fire (84) Multiple heat sources including multiple ignitions (97)
Unknown Heat Sources	'UU', blank
Form of Material First Ignited	
Mattress, Bedding	31 – Mattress, pillow 32 – Bedding; blanket, sheet, comforter
Not Mattress, Bedding	All codes except 31, 32, 'UU', and blank
Unknown Form of Material First Ignited	'UU', blank

Table B-2.1
Mattress and Bedding Fire Edits to Define Addressability When Heat Source = Traditional Small Open Flame (Candles, Matches, Lighters) or Smoking Material

Variable	Mattress/Bedding - Addressable (In-scope)	Mattress/Bedding – Not Addressable (Out-of-Scope)	Not Mattress/Bedding
Type of Material First Ignited	Other type of material ignited (00) Plastic (41) Natural product, other (50) Rubber, excluding synthetic rubbers (51) Leather (53) Grain, natural fiber, (preprocess) (55) Fabric, textile, fur, other (70) Fabric, fiber, cotton, blends, rayon, wool (71) Fur, silk, other fabric (74) Plastic coated fabric (77)		Flammable Gas (10 – 15) Flammable, Combustible Liquid (20 – 27) Volatile Solid or Chemical (30 – 38) Cork (52) Hay, straw (54) Coal, coke, briquettes, peat (56) Food, starch, excluding fat and grease (57) Tobacco (58) Wood or Paper - Processed (60 – 68) Wig (75) Human hair (76) Material compounded with oil, other (80) Linoleum (81) Oilcloth (82) Asphalt treated material (86) Multiple types of material first ignited (99)
Area of Origin	Area of origin, other (00) Corridor, mall (01) Exterior stairway, ramp, or fire escape (02) Interior stairway or ramp (03) Entrance way, lobby (05) Egress/exit, other (09) Assembly, Sales Areas (Groups or People) (10 – 17) Function Area (20 – 28) Technical Processing Areas (30 – 38) Storage area, other (40) Storage room, area, tank, or bin (41) Closet (42) Storage: supplies or tools; dead storage (43) Records storage room, storage vault (44) Shipping/receiving area; loading area, dock or bay (45) Vehicle storage area; garage, carport (47) Service facilities, other (50) Display window (56) Service, Equipment Areas (60 – 67) Structural area, other (70) Substructure area or space, crawl space (71) Exterior balcony, unenclosed porch (72) Ceiling & floor assembly, crawl		Escalator, exterior, interior (04) Chute/container – trash, rubbish, waste (46) Dumbwaiter or elevator shaft (51) Conduit, pipe, utility, or ventilation shaft (52) Light shaft (53) Chute; laundry or mail, excluding trash chutes (54) Duct: hvac, cable, exhaust, heating or AC (55) Conveyor (58) Awning (78) Transportation, Vehicle Area (80 – 86)

	space between stories (73) Attic: vacant, crawl space above top story, cupola (74) Wall assembly (75) Wall surface: exterior (76) Roof surface: exterior (77) Other Area of Origin (90 – 98)		
Factors Contrib. to Ignition	Factor contributing to ignition, other (00) No factor contributing to ignition (NN) Misuse of material or product, other (10) Abandoned or discarded materials or products (11) Heat source too close to combustibles (12) Improper container or storage (18) Playing with heat source (19) Mechanical failure, malfunction, other (20) Automatic Control Failure (21) Manual control failure (22) Leak or break (23) Worn out (25) Improper fuel used (27) Water caused short-circuit arc (31) Short circuit arc from mechanical damage (32) Short circuit arc from defective, worn insulation (33) Arc from faulty contact, broken conductor (35) Arc, spark from operating equipment (36) Fluorescent light ballast (37) Installation Deficiency (40 – 44) Operational deficiency, other (50) Collision, knock down, run over, turn over (51) Accidentally turned on, not turned off (52) Equipment unattended (53) Failure to clean (55) Improper startup (56) Equipment used for not intended purpose (57) Equipment not being operated properly (58) Animal (66) Fire spread or control, other (70) Outside/open fire for debris or waste disposal (73) Outside/open fire for warming or cooking (74) Agriculture or land management (75)	Cutting, welding too close to combustible (13) Flammable liquid or gas spilled (14) Improper fueling technique (15) Flammable liquid used to kindle fire (16) Washing part, painting with flammable liquid (17) Backfire (26) Electrical failure, malfunction, other (30) Unspecified short-circuit arc (34) Equipment overloaded (54) Natural condition, other (60) High wind (61) Storm (62) High water including floods (63) Earthquake (64) Volcanic action (65) Exposure fire (71) Rekindle (72)	

Equipment Involved in Ignition	Other equipment (000) No equipment (NNN) Charcoal/utility lighter (872) Cigarette/pipe lighter (873)	All other codes	

Table B-2.2
Mattress and Bedding Fire Edits to Define Addressability When Heat Source = Additional Small Open Flame Sources and Other In-Scope Heat Sources

Variable	Mattress/Bedding - Addressable (In-scope)	Mattress/Bedding – Not Addressable (Out-of-Scope)	Not Mattress/Bedding
Type of Material First Ignited	Other type of material ignited (00) Plastic (41) Natural product, other (50) Rubber, excluding synthetic rubbers (51) Leather (53) Grain, natural fiber, (preprocess) (55) Fabric, textile, fur, other (70) Fabric, fiber, cotton, blends, rayon, wool (71) Fur, silk, other fabric (74) Plastic coated fabric (77)		Flammable Gas (10 – 15) Flammable, Combustible Liquid (20 – 27) Volatile Solid or Chemical (30 – 38) Cork (52) Hay, straw (54) Coal, coke, briquettes, peat (56) Food, starch, excluding fat and grease (57) Tobacco (58) Wood or Paper - Processed (60 – 68) Wig (75) Human hair (76) Material compounded with oil, other (80) Linoleum (81) Oilcloth (82) Asphalt treated material (86) Multiple types of material first ignited (99)
Area of Origin	Area of origin, other (00) Corridor, mall (01) Exterior stairway, ramp, or fire escape (02) Interior stairway or ramp (03) Entrance way, lobby (05) Egress/exit, other (09) Assembly, Sales Areas (Groups or People) (10 – 17) Function Area (20 – 28) Technical Processing Areas (30 – 38) Storage area, other (40) Storage room, area, tank, or bin (41) Closet (42) Storage: supplies or tools; dead storage (43) Records storage room, storage vault (44) Shipping/receiving area; loading area, dock or bay (45) Vehicle storage area; garage, carport (47) Service facilities, other (50) Display window (56)		Escalator, exterior, interior (04) Chute/container – trash, rubbish, waste (46) Dumbwaiter or elevator shaft (51) Conduit, pipe, utility, or ventilation shaft (52) Light shaft (53) Chute; laundry or mail, excluding trash chutes (54) Duct: hvac, cable, exhaust, heating or AC (55) Conveyor (58) Awning (78) Transportation, Vehicle Area (80 – 86)

	Service, Equipment Areas (60 – 67) Structural area, other (70) Substructure area or space, crawl space (71) Exterior balcony, unenclosed porch (72) Ceiling & floor assembly, crawl space between stories (73) Attic: vacant, crawl space above top story, cupola (74) Wall assembly (75) Wall surface: exterior (76) Roof surface: exterior (77) Other Area of Origin (90 – 98)		
Factors Contributing to Ignition	Factor contributing to ignition, other (00) No factor contributing to ignition (NN) Misuse of material or product, other (10) Abandoned or discarded materials or products (11) Heat source too close to combustibles (12) Cutting, welding too close to combustible (13) Improper container or storage (18) Playing with heat source (19) Mechanical failure, malfunction, other (20) Automatic Control Failure (21) Manual control failure (22) Leak or break (23) Worn out (25) Backfire (26) Improper fuel used (27) Electrical failure, malfunction, other (30) Water caused short-circuit arc (31) Short circuit arc from mechanical damage (32) Short circuit arc from defective, worn insulation (33) Unspecified short-circuit arc (34) Arc from faulty contact, broken conductor (35) Arc, spark from operating equipment (36) Fluorescent light ballast (37) Installation Deficiency (40 – 44) Operational deficiency, other	Flammable liquid or gas spilled (14) Improper fueling technique (15) Flammable liquid used to kindle fire (16) Washing part, painting with flammable liquid (17) Natural condition, other (60) High wind (61) Storm (62) High water including floods (63) Earthquake (64) Volcanic action (65) Exposure fire (71) Rekindle (72)	

	50) Collision, knock down, run over, turn over (51) Accidentally turned on, not turned off (52) Equipment unattended (53) Equipment overloaded (54) Failure to clean (55) Improper startup (56) Equipment used for not intended purpose (57) Equipment not being operated properly (58) Animal (66) Fire spread or control, other (70) Outside/open fire for debris or waste disposal (73) Outside/open fire for warming or cooking (74) Agriculture or land management (75)		
Equipment Involved in Ignition	Other equipment (000) No equipment (NNN) HVAC (100 – 152) Electric Distribution, Lighting, & Power Transfer (200 – 263) (except for 228 – Battery charger) Power tools, other (310) Power saw (311) Power lathe (312) Power shaper, router, jointer, planer (313) Power cutting tool (314) Power drill, screwdriver (315) Power sander, grinder, buffer, polisher (316) Power hammer, including jackhammers (317) Power nail gun, stud driver, stapler (318) Paint dipper (321) Paint flow coating machine (322) Paint mixing machine (323) Paint sprayer (324) Welding torch (331) Cutting torch (332) Hydraulic equipment, other (340) Air compressor (341) Gas compressor (342) Atomizing equipment (343) Pump (344) Wet/dry vacuum (shop vacuum)	Battery charger, rectifier (228) Shop or industrial equipment, other (300) Painting tools, other (320) Coating machine, including asphalt saturating (325) Burners (333) Soldering equipment (334) Atomizing equipment (343) Hoist, lift (346) Heat treating equipment (351) Incinerator (352) Industrial furnace, kiln (353) Tarpot, tar kettle (354) Casting, molding, forging equipment (355) Distilling equipment (356) Digester, reactor (357) Extractor, waste recovery machine (358) Conveyor (361) Power transfer equipment: ropes, cables, blocks (362) Power take-off (363) Powered valves (364) Bearing or brake (365) Printing press (376) Car washing equipment (377) Studio type TV camera (424) Studio type sound recording/modulating equipment (425) Radar equipment (426) Amusement ride equipment (431)	

	(345) Powered jacking equipment (347) Drilling machinery or equipment (348) Picking, carding, weaving machine (371) Testing equipment (372) Gas regulator (373) Motor – separate (374) Internal combustion engine (non-vehicular) (375) Commercial or medical equipment, other (400) Dental, medical, or other powered bed or chair (411) Dental equipment, other (412) Dialysis equipment (413) Medical imaging equipment (414) Medical monitoring equipment (415) Oxygen administration equipment (416) Radiological equipment, X-ray, radiation therapy (417) Sterilizer: medical (418) Therapeutic equipment (419) Transmitter (421) Telephone switching gear, including PBX (422) TV monitor array (423) Vending machine (443) Kitchen & Cooking Equipment (600 – 656) (except for 653 – Garbage disposer) Electronic and Other Electrical Equipment (700 – 757) (except for 723 – Cash register and 727 – Postage, shipping meter equipment) Personal & Household Equipment (800 – 897) (except for 861 – Automatic door opener, 872 – Charcoal Lighter, and 873 – Cigarette lighter, pipe lighter	Ski lift (432) Elevator or lift (433) Escalator (434) Microfilm, microfiche viewing equipment (441) Photo processing equipment (442) Vending machine (443) Non video arcade game (444) Water fountain, water cooler (445) Telescope (446)	

Table B-2.3
Mattress and Bedding Fire Edits to Define Addressability When Heat Source = Out-of-Scope Heat Sources

Variable	Mattress/Bedding - Addressable (In-scope)	Mattress/Bedding – Not Addressable (Out-of-Scope)	Not Mattress/Bedding
Type of Material First Ignited		Other type of material ignited (00) Plastic (41) Natural product, other (50) Rubber, excluding synthetic rubbers (51) Leather (53) Grain, natural fiber, (preprocess) (55) Fabric, textile, fur, other (70) Fabric, fiber, cotton, blends, rayon, wool (71) Fur, silk, other fabric (74) Plastic coated fabric (77)	Flammable Gas (10 – 15) Flammable, Combustible Liquid (20 – 27) Volatile Solid or Chemical (30 – 38) Cork (52) Hay, straw (54) Coal, coke, briquettes, peat (56) Food, starch, excluding fat and grease (57) Tobacco (58) Wood or Paper - Processed (60 – 68) Wig (75) Human hair (76) Material compounded with oil, other (80) Linoleum (81) Oilcloth (82) Asphalt treated material (86) Multiple types of material first ignited (99)
Area of Origin		Area of origin, other (00) Corridor, mall (01) Exterior stairway, ramp, or fire escape (02) Interior stairway or ramp (03) Entrance way, lobby (05) Egress/exit, other (09) Assembly, Sales Areas (Groups or People) (10 – 17) Function Area (20 – 28) Technical Processing Areas (30 – 38) Storage area, other (40) Storage room, area, tank, or bin (41) Closet (42) Storage: supplies or tools; dead storage (43) Records storage room, storage vault (44) Shipping/receiving area; loading area, dock or bay (45) Vehicle storage area; garage, carport (47) Service facilities, other (50)	Escalator, exterior, interior (04) Chute/container – trash, rubbish, waste (46) Dumbwaiter or elevator shaft (51) Conduit, pipe, utility, or ventilation shaft (52) Light shaft (53) Chute; laundry or mail, excluding trash chutes (54) Duct: hvac, cable, exhaust, heating or AC (55) Conveyor (58) Awning (78) Transportation, Vehicle Area (80 – 86)

		Display window (56) Service, Equipment Areas (60 – 67) Structural area, other (70) Substructure area or space, crawl space (71) Exterior balcony, unenclosed porch (72) Ceiling & floor assembly, crawl space between stories (73) Attic: vacant, crawl space above top story, cupola (74) Wall assembly (75) Wall surface: exterior (76) Roof surface: exterior (77) Other Area of Origin (90 – 98)	
Factors Contributing to Ignition		All codes	
Equipment Involved in Ignition		All codes	

Appendix C
Post-Standard Casualty Category

Table C-1
Current Deaths

Situation at Time of Fire	Post-Standard Likelihood of Death	Post-Standard Likelihood of Injury
Intimate with Ignition		
Unable to Act (takes precedence)		
Restrained or Severe Physical Disablement (incapable of exiting alone)		
No rescuer available	L	U
Rescuer available	U	L
Ages 0-2		
No rescuer available	L	U
Rescuer available	U	P
Ages 3-4		
No rescuer available	P	P
Rescuer available	U	P
Asleep		
No indication of movement (found in bed) , any age	Y	
Indication of movement (found partially or fully off the bed)		
≥ Age 85 (assumes burned by bedclothes)	P	P
Ages <5 Same as above categories		
Ages 5-9		
No rescuer available	P	U
Rescuer available	U	U
Other Ages		
With Limiting Conditions (inc drugs, alcohol, mental incapacitation)	P	P
Without Limiting Conditions	U	U
Not Asleep		
Ages < 5 Same as above		
≥ Age 85		
With Limiting Conditions	U	P
Without Limiting Conditions	U	P
Ages 5-9		
No rescuer available	U	U
Rescuer available	U	U
Other Ages		
With Limiting Conditions	U	P
Without Limiting conditions	N	U

Legend: Likelihood of a Casualty Occurring
Y= Death Certain (1)
L= Likely (.75 - .85)
P=Possible (.45 - .55)
U=Unlikely (.1 - .2)
N=None (0)

Table C-1 (continued)
Current Deaths

Situation at Time of Fire	Post-Standard Likelihood of Death	Post-Standard Likelihood of Injury
In Room of Origin , Not Intimate with Ignition		
Unable to Act (takes precedence)		
Restrained or Severe Physical Disablement		
No rescuer available	L	U
Rescuer available	U	P
Ages 0-2		
No rescuer available	L	U
Rescuer available	U	P
Ages 3-4		
No rescuer available	U	U
Rescuer available	U	U
Asleep		
No indication of movement, any age	P	P
Indication of movement (partially or fully off the bed)		
≥ Age 85	U	U
Ages <5 Same as above		
Ages 5-9		
No rescuer available	U	U
Rescuer available	N	U
Other Ages		
With Limiting Conditions (inc drugs, alcohol, mental incapacity)	U	U
Without Limiting Conditions	N	U
Not Asleep		
Ages < 5. Same as above		
≥ Age 85		
With Limiting Conditions	U	L
Without Limiting Conditions	N	U
Ages 5-9		
No rescuer available	U	U
Rescuer available	N	N
Other Ages		
With Limiting Conditions	U	U
Without Limiting Conditions	N	N
Not in Room of Origin		
Physically Restrained, Severe Physical Disablement,		
Including ≤ age 2 with no rescuer	U	U
Other		
Not Entered Room	U	U
Entered Room of Origin Before Extinguishment	U	U
Fighting Fire, Regardless of Initial Location, Condition	U	U

Legend: Likelihood of a Casualty Occurring
Y= Death Certain (1)
L= Likely (.75 - .85)
P=Possible (.45 - .55)
U=Unlikely (.1 - .2)
N=None (0)
Source: U.S. Consumer Product Safety Commission

Table C-2
Current Injuries

Situation at Time of Fire	Likelihood of Post-Standard Injury
Intimate with Ignition	
Unable to Act (takes precedence)	
Restrained or Severe Physical Disablement (incapable of exiting alone)	
No rescuer available	Y
Rescuer available	P
Ages 0-2	
No rescuer available	Y
Rescuer available	P
Ages 3-4	
No rescuer available	P
Rescuer available	U
Asleep	
Indication of movement (found partially or fully off the bed)	
≥ Age 85 (assumes burned by bedclothes)	P
Ages <5 Same as above categories	
Ages 5-9	
No rescuer available	U
Rescuer available	U
Other Ages	
With Limiting Conditions (inc drugs, alcohol, mental incapacitation)	P
Without Limiting Conditions	U
Not Asleep	
Ages < 5 Same as above	
≥ Age 85	
With Limiting Conditions	P
Without Limiting Conditions	U
Ages 5-9	
No rescuer available	U
Rescuer available	U
Other Ages	
With Limiting Conditions	P
Without Limiting conditions	U

Legend: Likelihood of a Casualty Occurring
Y= Injury Certain (1)
L= Likely (.75 - .85)
P=Possible (.45 - .55)
U=Unlikely (.1 - .2)
N=None (0)

Source: U.S. Consumer Product Safety Commission

Table C-2(continued)
Current Injuries

Situation at Time of Fire	Likelihood of Post-Standard Injury
In Room of Origin, Not Intimate with Ignition	
Unable to Act (takes precedence)	
Restrained or Severe Physical Disablement	
No rescuer available	L
Rescuer available	U
Ages 0-2	
No rescuer available	L
Rescuer available	U
Ages 3-4	
No rescuer available	P
Rescuer available	U
Asleep	
≥ Age 85	U
Ages <5 Same as above	
Ages 5-9	
No rescuer available	U
Rescuer available	U
Other Ages	
With Limiting Conditions (inc drugs, alcohol, mental incapacity)	U
Without Limiting Conditions	N
Not Asleep	
Ages < 5. Same as above	
≥ Age 85	
With Limiting Conditions	U
Without Limiting Conditions	N
Ages 5-9	
No rescuer available	U
Rescuer available	N
Other Ages	
With Limiting Conditions	N
Without Limiting Conditions	N
Not in Room of Origin	
Physically Restrained, Severe Physical Disablement,	
Including ≤ age 2 with no rescuer	U
Other	
Not Entered Room	U
Entered Room of Origin Before Extinguishment	U
Fighting Fire, Regardless of Initial Location, Condition	U

Legend: Likelihood of a Casualty Occurring
Y= Injury Certain (1)
L= Likely (.75 - .85)
P=Possible (.45 - .55)
U=Unlikely (.1 - .2)
N=None (0)
Source: U.S. Consumer Product Safety Commission

Appendix D
Investigated Deaths and Injuries, 1/99 to 6/04

Table D-1
Addressable Mattress/Bedding Fire Deaths, By Age Group and Ignition Type
n=195

Age Group & Victim Location	Total	Ignition Type		
		Smoking	Open Flame	Other
Total	195	60	86	49
LT Age 5	65	2	44	19
Intimate with Ignition	31	0	26	5
In Room of Origin-Not Intimate	10	0	5	5
Outside Room of Origin	24	2	13	9
Location Unknown	0	0	0	0
Ages 5 to 14	31	4	18	9
Intimate with Ignition	9	0	6	3
In Room of Origin-Not Intimate	5	0	2	3
Outside Room of Origin	17	4	10	3
Location Unknown	0	0	0	0
Ages 15 to 64*	58	32	17	9
Intimate with Ignition	38	23	8	7
In Room of Origin-Not Intimate	2	0	2	0
Outside Room of Origin	15	6	7	2
Location Unknown	3	3	0	0
Ages 65+	41	22	7	12
Intimate with Ignition	27	17	4	6
In Room of Origin-Not Intimate	2	0	1	1
Outside Room of Origin	12	5	2	5
Location Unknown	0	0	0	0

*Includes 1 adult of unknown age

Note: Includes only deaths in fires attended by the fire service.

Source: U.S. Consumer Product Safety Commission, Investigation reports, 1/99 – 6/04

Table D-2

Addressable Mattress/Bedding Fire Injuries, By Age Group and Ignition Type

n=205

Age Group & Victim Location	Total	Ignition Type		
		Smoking	Open Flame	Other
Total	205	27	132	46
Child, Age Unknown	3	0	0	3
Intimate with Ignition	0	0	0	0
In Room of Origin-Not Intimate	0	0	0	0
Outside Room of Origin	3	0	0	3
Location Unknown	0	0	0	0
LT Age 5	39	2	33	4
Intimate with Ignition	17	0	16	1
In Room of Origin-Not Intimate	10	1	7	2
Outside Room of Origin	9	1	8	0
Location Unknown	3	0	2	1
Ages 5 to 14	24	2	15	7
Intimate with Ignition	12	0	9	3
In Room of Origin-Not Intimate	4	0	2	2
Outside Room of Origin	7	2	3	2
Location Unknown	1	0	1	0
Ages 15 to 64	86	14	49	23
Intimate with Ignition	32	5	16	11
In Room of Origin-Not Intimate	5	1	0	4
Outside Room of Origin	45	7	30	8
Location Unknown	4	1	3	0
Ages 65+	13	5	3	5
Intimate with Ignition	6	1	2	3
In Room of Origin-Not Intimate	4	2	0	2
Outside Room of Origin	2	1	1	0
Location Unknown	1	1	0	0
Adult, Age Unknown	40	4	32	4
Intimate with Ignition	5	0	4	1
In Room of Origin-Not Intimate	2	0	2	0
Outside Room of Origin	32	3	26	3
Location Unknown	1	1	0	0

Note: Includes only injuries in fires attended by the fire service.

U.S. Consumer Product Safety Commission, Investigation Reports, 1/99 – 6/04

Table D-3

Estimated Reduction Due to Draft Standard Addressable Mattress/Bedding Fire Deaths

n=195

Age Group & Victim Location	Total	Ignition Type		
		Smoking	Open Flame	Other
Total	69% - 78%	67% - 76%	73% - 81%	67% - 76%
LT Age 5	77% - 87%	80% - 90%	77% - 87%	76% - 86%
At Point of Ignition	77% - 87%	**	76% - 86%	80% - 90%*
In Room of Origin-Not at Point of Ignition	79% - 89%	**	79% - 88%*	80% - 90%*
Outside Room of Origin	76% - 86%	80% - 90%*	77% - 87%	72% - 82%*
Location Unknown	**	**	**	**
Ages 5 to 14	83% - 92%	80% - 90%	83% - 92%	84% - 92%
At Point of Ignition	82% - 91%	**	83% - 92%*	80% - 90%*
In Room of Origin-Not at Point of Ignition	96% - 98%*	**	100%*	93% - 97%*
Outside Room of Origin	80% - 90%	80% - 90*	80% - 90%	80% - 90%*
Location Unknown	**	**	**	**
Ages 15 to 64*	68% - 77%	68% - 76%	72% - 81%	63% - 72%
At Point of Ignition	62% - 70%	63% - 71%	61% - 70%*	59% - 67%*
In Room of Origin-Not at Point of Ignition	90% - 95%*	**	90% – 95%*	**
Outside Room of Origin	80% - 90%	80% - 90%*	80% - 90%*	80% - 90*
Location Unknown	80% - 90%*	80% - 90%*	**	**
Ages 65+	62% - 70%	63% - 72%	56% - 64%	66% - 75%
At Point of Ignition	54% - 62%	60% - 69%	34% - 41%*	49% - 58%*
In Room of Origin-Not at Point of Ignition	100%*	**	100%*	100%*
Outside Room of Origin	77% - 87%	73% - 83%*	80% - 90%*	80% - 90%*
Location Unknown	**	**	**	**

* Fewer than 10 investigations

** No incidents among investigations

Source: U.S. Consumer Product Safety Commission, Investigation Reports, 1/99 – 6/04

Table D-4

Estimated Reduction Due to Draft Standard Addressable Mattress/Bedding Fire Injuries[13]

n=205

Age Group & Victim Location	Total	Ignition Type		
		Smoking	Open Flame	Other
Total	79% - 89%	78% - 88%	79% - 88%	82% - 91%
LT Age 5	75% - 85%	80% - 90%	75% - 84%	70% - 80%*
At Point of Ignition	69% - 79%	**	71% - 80%	45% - 55%*
In Room of Origin-Not at Point of Ignition	82% - 91%	80% - 90%*	83% - 91%*	80% - 90%*
Outside Room of Origin	80% - 90%	80% - 90%*	80% - 90%*	**
Location Unknown	63% - 73%*	**	63% - 73%*	63% - 73%*
Ages 5 to 14	81% - 90%	80% - 90%*	82% - 90%	82% - 91%
At Point of Ignition	80% - 90%	**	80% - 90%*	80% - 90%*
In Room of Origin-Not at Point of Ignition	95% - 98%*	**	100%*	90% - 95%*
Outside Room of Origin	80% - 90%*	80% - 90%*	80% - 90%*	80% - 90%*
Location Unknown	63% - 73%*	**	63% - 73%*	**
Ages 15 to 64	79% - 89%	77% - 87%	80% - 90%	83% - 91%
At Point of Ignition	77% - 87%	66% - 76%*	78% - 88%	80% - 90%
In Room of Origin-Not at Point of Ignition	97% - 99%*	100%*	90% - 95%*	100%*
Outside Room of Origin	80% - 90%	80% - 90%	80% - 90%	80% - 90%
Location Unknown	80% - 90%*	80% - 90%*	80% - 90%*	**
Ages 65+	78% - 87%	80% - 90%*	68% - 78%*	84% - 92%*
At Point of Ignition	74% - 84%*	80% - 90%*	63% - 73%*	80% - 90%*
In Room of Origin-Not at Point of Ignition	85% - 93%*	80% - 90%*	**	90% - 95%*
Outside Room of Origin	80% - 90%*	80% - 90% *	80% - 90% *	**
Location Unknown	80% - 90%*	80% - 90%*	**	**

Note: Adults and children of unknown ages were allocated proportionally to the adult or child categories.

* Fewer than 10 investigations

** No investigation injuries in this category

Source: U.S. Consumer Product Safety Commission, Investigation Reports, 1/99 – 6/04

[13] This table refers to the injuries prevented based on the injury investigations only and does not provide the net injuries prevented that accounts for the injuries that result from deaths prevented. This is the reason that the percentage ranges here will not necessarily match those in Table 5 on p. 9.

Appendix E

Table E-1

Estimated Residential Structure Fires and Fire Losses, 1993 – 2004

Year	Fires	Deaths	Injuries	Property Loss (millions)
1993	470,000	3,825	22,600	$4,843
1994	451,000	3,465	20,025	$4,317
1995	425,000	3,695	19,125	$4,363
1996	428,000	4,080	19,300	$4,962
1997	406,500	3,390	17,775	$4,585
1998	381,500	3,250	17,175	$4,391
1999	383,000	2,920	16,425	$5,092
2000	379,500	3,445	17,400	$5,674
2001	396,500	3,140	15,575	$5,643
2002	401,000	2,695	14,050	$6,055
2003	402,000	3,165	14,075	$6,074
2004	410,500	3,225	14,175	$5,948

Source: National Fire Protection Association annual sample survey. See methodology in *NFPA Journal*, November/December 2004, pp 66 - 71.