

Flammability: The issue heats up

Part 2

Fire safety & the bedding industry

Fire safety officials and government regulators are often faced with the chilling and tragic reality of the results of unwanted fires. Many of these fires involve scenarios where either upholstered furniture or bedding products are the first item ignited, and many of the victims are young children. The following is a factual account of a recent fire incident in California.

Late last year a 3-year-old California boy ignited bedding while playing with a butane lighter. The resulting fire quickly spread through the family's large apartment, killing his 9-year-old sister, who was trapped in a bathroom, and injuring the child's mother, who discovered the fire.

The fire began around 8:30 p.m. while the little boy was playing in a bedroom, and his sister was taking a shower. The mother discovered the fire when her son asked her to come to the bedroom, where she found the bedclothes ablaze. She attempted to shake the bedding to extinguish the fire, only to discover that the mattress was ignited by burning bedclothes. First the mother tried to move the burning mattress, but it was too heavy for her to lift along, so she abandoned the mattress and called to her daughter taking a shower in a nearby bathroom. Unfortunately, the bathroom door was locked from the inside, and the running water in the shower apparently prevented the girl from hearing her mother's cries.

As the fire continued to grow rapidly, the mother escaped, following her 3-year-old son who had already left the apartment. Neighbors attempted to enter the burning apartment to rescue the trapped girl, but flames about seven feet above the mattress prevented them from reaching the bathroom. A neighbor and the girl's father, who had arrived on the scene, re-entered the apartment with a fire extinguisher. But flames, flashing over their heads, forced them to quickly retreat.

Firefighters found the girl burned, lifeless body in the shower. Investigators confirmed that the fire originated in the bedroom. A make-shift altar on a dresser in the bedroom included two candles and a lighter, which the child used to ignite the bedclothes. Beside the little girl's tragic loss of life, and burns sustained by the mother, the apartment building, valued at \$3 million, suffered \$2 million in damage.

Bedroom fires

This tragic fire is typical of the kinds of bedroom fires that occur all too frequently throughout north America, killing and injuring hundreds annually as well as causing extensive property damage.

Bedroom fires ignited by open flame are often complex events, potentially involving many products. These products are usually made by a variety of manufacturers. Many products in the bedroom fire become involved in the fire as secondary ignition sources and are not the initial source of ignition. But once they become involved, they contribute to a fire that often results in flashover, igniting all of the combustibles in the room of origin, and quickly spreading beyond that room to other areas of residence.

Investigation of bedroom fires shows that, most often, fires are started by a young child playing with a small open-flame, such as a match, candle or lighter. Sometimes the child is attempting to ignite a

small piece of paper, only to discover that the burning paper, or small flame, starts to burn his/her fingers. The child drops the burning paper or match etc. onto bedclothes that quickly become ignited.

Once bedclothes are ignited, not only are the mattress and foundation at risk, but also other combustibles, either in direct contact with the burning bedclothes, or in close proximity to the bed, may quickly become involved. Newspapers, magazines, throw pillows and clothing, for example, might be on top of the bed, and draperies and other furnishings may be close enough to the burning bedclothes to be ignited either by direct flame contact or by radiant heat. Soon, the combination of all of these burning products produces a rapidly developing and dangerous fire. From the point of initial ignition, the products in a bedroom can create flashover conditions in as little as 4-5 minutes.

Recent studies, including one, "Wide Awake," sponsored by the Sleep Products Safety Council (SPSC) in collaboration with the National Association of State Fire Marshals (NASFM), and another by the U.S. Consumer Product Safety Commission (CPSC), have clearly demonstrated characteristics that are commonly found in bedroom fires ignited by some type of open flame. They are:

- Bedclothes – such as sheets, blankets, pillows, mattress pads, bedspreads and/or comforters – are the first item to ignite in the majority of bedroom fires.
- Secondary involvement of other products including the mattress and/or foundation occurs.
- The fire is most often caused by a young child, playing with matches, a lighter or a candle.

Industry response

Many years ago, the mattress industry, working with government regulators, successfully addressed issues related to ignitability of mattresses and mattress pads by cigarettes. U.S. mattress manufacturers have made cigarette-resistant mattresses in the United States since 1974. The mattress cigarette standard, 16 CFR 1632, is currently enforced by the federal CPSC.

But the problem of mattress flammability has not gone away. More than 25 years after the implementation of the federal cigarette standard, the specter of combustibility again faces the bedding industry. In September 2000, *BEDtimes* (p. 53-60) published an article, "Flammability – the issue heats up," that outlined recent activities of the International Sleep Products Association (ISPA) and the SPSC, as well as the participation of federal and state agencies, in addressing the problem of bedroom fires caused by open flame ignition. These actions have resulted from an evaluation of recent fire statistics that show a significant decline in bedroom fires caused by cigarette ignition, but an increase in the percentage of bedroom fires caused by ignition of bedding by various types of open flame.

CPSC estimates that in 1998 mattress and bedding fires were second only to upholstered furniture in the number of fire-related deaths, and were the first products to ignite in about 18,000 residential fires. These bedroom fires caused an estimated 390 deaths and 2,160 emergency room injuries. CPSC fire statistics also show that from 1994 to 1998, over three-quarters of the deaths relating to mattress and bedding fires ignited from sources such as matches, lighters and candles were to children under that age of 15. The majority of these fires begin when a small open flame ignited the bedclothes and then the fire grows into a much larger fire, eventually involving the bed set.

The *BEDtimes* article highlighted mattress fire research sponsored by SPSC at the National Institute of Standards and Technology (NIST), and also summarized the interests and activities of the CPSC in this

topic. The current article is a follow-up article, and is intended to provide an update on relevant mattress flammability activities over the past year at NIST, CPSC and in the State of California.

The Consumer Product Safety Commission (CPSC)

The CPSC, pursuant to the provisions of the Federal Flammable Fabrics Act (FFA), is authorized to establish flammability standards for furnishings, including mattresses. In February 1998, the Commission held a Mattress Flammability Round Table. This meeting put the bedding industry on notice of the CPSC's intent to look at issues related to the open flame ignition of mattresses and bedroom fires. For the past two years, staff of the CPSC have monitored the fire research sponsored by SPSC at NIST.

In early September 2001, CPSC staff published a briefing package related to the flammability of mattresses, specifically, resistance of bedding to ignition by open flame: "Briefing Package – Options to Address Open Flame Ignition of Mattresses/Bedding and Petitions From the Children's Coalition for Fire-Safe Mattresses."

CPSC staff recommended to the CPSC commissioners that the Commission publish an Advanced Notice of Proposed Rulemaking (ANPR). CPSC staff formally presented the briefing package to the Commissioners in a public meeting in late September 2001. On Oct. 2, 2001, the CPSC Commissioners voted unanimously (3-0) to issue the ANPR. The ANPR was formally published in Federal Register on Oct. 11, 2001.

In voting to approve the ANPR each of the Commissioners provided a statement in support of the issuance of the ANPR. Mary Sheila Gall in her statement indicated:

"This rulemaking represents a model for government and industry cooperation. The Commission staff has conducted field investigations that showed that most small open-flame ignition incidents involve bedding materials first, followed by ignition of the mattress. Industry's Sleep Products Safety Council sponsored research at the National Institute of Standards and Technology that provided the technical basis for testing methods and performance requirements. This work has resulted in the first step being taken toward a realistic standard that prevents a mattress fire resulting in a flashover and the associated ignition of all flammable surfaces in the immediate area."

Included in the comments of Commissioner Thomas Moore was the following:

"Our data indicate that, among all products within the Commission's jurisdiction, mattress and bedding fires are a leading cause of injury, and in recent years, were second only to upholstered furniture in the number of deaths. We know that mattresses present a unique and complicated problem because of the involvement of bedding materials in the source of ignition. Any performance standard that simply deters ignition of the mattress without consideration of the effect of the potential ignition source in the bedding materials couldn't possibly be effective or reasonable.

That is why our staff has been and is presently involved in a methodical, scientific and cooperative approach to finding the best way to address this problem. Commission and industry sponsored research and test development efforts, designed to measure and define clearly the fire risk involved in residential mattress fire scenarios, are underway at NIST. This research has already provided useful data regarding the behavior of real life mattress fires and burning bedding situations. There are some

preliminary indications that suggest that limiting fire intensity and preventing flashover could significantly reduce the number of victims of these fires by providing more time to escape.”

The advanced notice of proposed rulemaking (ANPR)

Publishing the ANPR is the first step in the CPSC’s three step rule-making process to establish a mandatory federal standard for open-flame fire performance of residential bed sets. The second step is to publish a proposed standard and test method, usually within 12 months of the ANPR, but this timeframe may be extended. Lastly, a final test method and standard is published, again in the Federal Register. The federal standard becomes effective on a date specified in the Federal Register notice. It is important to note that the CPSC is required to solicit, and respond to, public comment between each step in this rule-making process.

The CPSC is not only monitoring the NIST bedding flammability research outlined above. The Commission has also funded independent research at NIST to investigate the possibility of developing a mattress flammability screening test. This work will attempt to provide the Commission, testing small mattress composites, with a tool to determine if retail bed sets are likely to comply with the published flammability standard. It is anticipated that the SPSC-sponsored work at NIST, and the activities of the CPSC, may result in a proposed national bedding standard requiring testing of either a complete bed set or a medium-scale bedding composite. The CPSC recognizes the difficulty of enforcing such a standard, because of the agency’s current inability to perform large fire tests. The development of a flammability screening test may assist the CPSC in future enforcement and compliance activities, as well as provide the bedding industry with an additional product development testing tool.

California

For more than 30 years, the state of California has been in the forefront of developing flammability standards for furnishings. In 1970, the California legislature enacted law requiring all mattresses sold in the state to be flame retardant. This was followed in 1972 by subsequent legislation addressing the flammability of upholstered furniture. In each instance, the California Bureau of Home Furnishings (CBHF) was assigned the responsibility of establishing the test methods and standards that define the acceptable level of fire performance for these furnishings when sold in California.

Over the years, the CBHF has published fire performance tests such as Technical Bulletins 116 and 117 for residential furniture, Technical Bulletin 133, for contract or public building furniture, Technical Bulletin 106 for residential mattresses, Technical Bulletin 121 for prison mattresses and Technical Bulletin 121 for prison mattresses and Technical Bulletin 129 for mattresses intended for certain public buildings. In addition, several of the Bureau’s fire tests have received national recognition after adoption by the American Society for Testing and Materials (ASTM) and the National Fire Protection Association (NFPA).

Recent legislative and regulatory activities in California reveal that flammability concerns for furnishings still occupy a prominent and important role in the state. In the fall of 1999, the Bureau announced a major revision of Technical Bulletin 117, California’s mandatory requirement for residential furniture, enforced since 1975. Following the most recent session of the California legislature, on Aug. 10, 2001, Governor Gray Davis (D) signed into law Assembly Bill 603, legislation that will significantly impact the U.S. bedding industry.

California Assembly Bill 603 (AB 603)

AB 603 was introduced by Assemblyman John Dutra (D) and was supported by a variety of consumer groups, including the Children's Coalition for the Fire Safety of Mattresses, based on Sacramento, Calif. Whitney Davis, a lawyer who is the founder of the Children's Coalition for the Fire Safety of Mattresses, was very active in supporting the legislation and in providing technical guidance to the author of the bill. Some of the activities of the Coalition at the federal level were discussed in the September 2000 BEDtimes article.

The essential features of California AB 603 are:

- Every residential mattress sold in California after Jan. 1, 2004, must be manufactured to resist open-flame ignition.
- The bill assigns responsibility for defining the specific fire test to the California Bureau of Home Furnishings and Thermal Insulation (CBHF).
- However, the bill indicates that the fire test must be at least equivalent to California's public building standard, Technical Bulletin 129, or must be identical to the test proposed by the CPSC and based upon the research currently underway at NIST.
- Should a federal standard become effective on or before Jan. 1, 2004, the federal CPSC standard would prevail in California and preempt the California regulations. In the absence of a federal standard, the California standard would become effective in California on Jan. 1, 2004.
- The CBHF is also authorized to investigate the flammability of, and set flammability standards for, certain bedclothes, such as those containing concealed filling materials, if the Bureau considers these products to be a factor in contributing to bedroom fires.

It is important to recognize that in California the CBHF operates under a legislative mandate to have a mattress flammability standard in place by Jan. 1, 2004. At the federal level, certain flexibility exists in the rule-making process with respect to a timeline, however, no latitude or discretion is permitting in the California regulatory scheme relative to the effective date for the standard. To assist in coordinating the efforts of both California and federal authorities, and to ensure that all the relevant parties are fully informed of the CBHF to participate in activities related to the ongoing SPSC-sponsored research at NIST.

NIST research

In 1999, SPSC funded research at NIST to look carefully at the fire properties of common bedding systems. The purpose of this work was to investigate the interaction of bed sets and bed clothing under open-flame fire conditions, and to provide test data to guide the development of a realistic test method for residential bed sets, based upon the best possible science. The first phase of the NIST research was completed in 2000. The following briefly summarizes Phase 1 of the NIST research.

NIST Phase 1 research

Phase 1 of the NIST mattress research has been completed. The following tasks were accomplished:

- (a) Evaluation of the fire properties of 12 typical combinations of bedclothes.
- (b) Development of gas burnings that mimic the fire performance of burning bedclothes.
- (c) Full-scale fire testing of several mattresses, of both conventional and fire-improved constructions, using both conventional bedclothes components and the gas burners developed by NIST as ignition devices. The purpose of this part of the research was to compare the test results of mattresses tested by both ignition sources, burners and bedding, to ensure comparable test results between the two ignition sources.

A detailed technical report of the Phase 1 research was published by NIST in June 2000, entitled: NISTIR 6497 Flammability Assessment Methodology for Mattresses by T.J. Ohlemiller, J.R. Shields, R. McLane and R.C. Gann. (A free copy of the report is available from NIST, phone 301-975-6478, or e-mail a request to inquiries@nist.gov or fax 301-926-1930.)

The results of the Phase 1 research have been shared with members of the mattress industry, the SPSC Combustibility Committee, the Consumer Product Safety Commission, the California Bureau of Home Furnishings and various other interested parties and trade groups. Following a review of the results of the Phase 1 NIST mattress research, the SPSC sponsored, with the concurrence of the CPSC, a second phase of research.

NIST Phase 2 research

The second phase of the NIST mattress research is currently underway, and will address the following issues:

- (a) An evaluation of reduced-scale mattresses (mini-matts) to determine the predictability or reduced-scale mattress fire test results to full-scale fire performance. The fire test work on this part of the research has been completed, although analysis of the test data is still proceeding. If the results of this part of the research are satisfactory, mattress manufacturers may be able to conduct product development fire tests using reduced scale bed set constructions. This will reduce the number of full-scale fire tests that may be needed once a standard has been developed.
- (b) Testing of king-size mattresses to determine the fire conditions and fuel loads anticipated when large bedding systems are ignited and burn. The fire test work on this part of the research has also been completed. Analysis of the test data is underway. Data from this part of the study will be incorporated in the Hazard Analysis described below.
- (c) Development of a Hazard Analysis for bedroom fires. This portion of the research is currently underway, and will attempt to answer questions such as:

“Recognizing that bedclothes burns, and may produce a fire of 200 kW of peak rate of heat release, or greater, what is an acceptable level of bed sets fire behavior?”

“How low must the heat release rate from a bed set be, to substantially lower the rate of fire casualties and property loss from bedding fires?”

“Is it possible to provide a semi-quantitative basis for estimating a reduction in bed fire hazards as a function of the reduction in the peak heat release rate from bed sets.?”

It is anticipated that the data developed from the Hazard Analysis will assist regulators in making scientifically based choices of acceptable fire performance for future open-flame fire test methods for residential bed sets. For example, if the size of a fire from a bed set (measured in heat release rate – HRR) is reduced by a factor of 50 percent, it is anticipated that the hazard analysis will enable a regulator to determine the society benefit, in terms of a reduction in deaths, injuries and property loss, that would be gained from a lower HRR.

It is important to recognize that products do not necessarily need to be non-burning to demonstrate a benefit to society. Most current bedroom fires develop very rapidly, giving very limited opportunity for escape, unless a resident is alerted to a fire shortly after it commences. If standards require that products, such as bed sets, burn more slowly and with a reduced rate of heat release, there may be significant societal benefits related to increased time for escape, and extra time for detection, notification and suppression of the fire, as well as prevention of flashover. It is expected that the Phase II Hazard Analysis of bedroom fires will provide the framework for making scientifically based decisions related to a reduced ignition threat and improved fire performance of bedding products.

Bedclothes flammability

Phase 1 of the NIST research clearly demonstrated that conventional bed clothing, such as sheets, pillows, comforters, blankets and mattress pads etc. can produce a large fire, irrespective of the contribution of the bed set. The size and type of fire from burning bedclothes may depend upon many factors, including the quantity of mass of bedclothes, the generic type of bedclothes burning, the physical configuration of the bedclothes on the bed, and the kind of ignition source to which they are subjected.

Although bedclothes themselves produce smaller fires than do most mattresses, the NIST Phase 1 fire test data showed that heat from burning bedclothes is an order of magnitude greater than the match, candle or lighter that may have been used to initially start the bedroom fire. It is clearly evident that burning bedclothes create a significant thermal challenge to virtually every residential mattress currently sold in the United States. Also, burning bedclothes clearly have the potential to ignite other common combustibles in a bedroom such as drapes, curtains, furniture, throw pillows, toys etc. and thus cause secondary fires. These burning secondary products, in turn add fuel to the developing bedroom fire.

There are several ignition approaches that one might use to evaluate the open flame resistance of residential bed sets. One approach is to design bed sets that themselves resist ignition from the types of open flame ignition sources commonly associated with bedroom fires, namely, matches, candles and lighters. However mattress industry and CPSC studies, combined with the NIST research, clearly show that such an approach does not address the real-life ignition scenario of fires involving bed sets – an ensemble of burning bedclothes.

It is clear that the large fires that often occur in residential bedrooms are usually caused by the combination of the burning bedclothes and bed set. Bed sets represent a relatively large fuel load in a typical bedroom, while bedclothes represent a smaller, but not unsubstantial, fuel package.

Bedclothes flammability research

Historically, a significant quantity of research has been conducted on the fire performance of mattresses, and in methods of improving their fire performance. Numerous published studies over the past 25-30 years have documented the fire properties of a whole range of mattress constructions intended both for residential and contract/public occupancy applications. Today, specially designed mattresses, for a variety of public buildings, are routinely manufactured to comply with full-scale fire tests such as California Technical Bulletins 121 and 129, NFPA 267, ASTM E 1590, the Boston Mattress Fire Test, and several test methods developed by Underwriter Laboratories (UL).

However, over this same time period little, if any, research has been conducted on the fire properties of the bedclothes commonly used along with the mattress and foundation. Great effort has been focused on the flammability of the bed set, but little energy has been expended on investigating, and possibly improving, the fire properties of the bed covering items.

Phase 1 of the NIST research demonstrated that the most significant thermal impact seen by a mattress in a fire appears to be related to the combustion of bedclothes with concealed filling materials. This includes products such as mattress pads, pillows and comforters. The apparent mechanism of the thermal insult on the mattress surface is created when burning thermoplastic fibers, such as polyester, melt and form a molten burning plastic mass on the mattress surface. The burning of this molten mass is often intense and prolonged.

During Phase 2 of the NIST research, the SPSC will sponsor research into potential methods of improving the fire performance of bedclothes containing concealed filling materials. There is no intent in this research to address the fire properties of bedclothes such as sheets and blankets, since modification of these products might require that somewhat controversial application of flame retardant chemicals to bedding products that are in direct contact with human skin.

The proposed NIST research will focus on several potential methods of improving the flammability of filled bedclothes:

1. The effect of changing the filling, by using filling materials of improved fire performance.
2. Protecting the existing filling materials by use of a fire barrier or blocker. Fire barriers have been widely used for many years in furniture and mattresses designed to pass full-scale fire tests.

Results of this bedclothes research may provide regulators with additional information as they make decisions about the hazard of bedroom fires, and may become an important part of the overall hazard analysis of bedroom fires.

The Sleep Products Safety Council (SPSC)

All of the industry mattress flammability research at NIST has been sponsored and funded by the SPSC. It was established in 1986 to provide consumer safety information, support research and promote activities aimed at reducing hazards associated with sleep products. The SPSC is primarily funded by the sale of the "SPSC Safety Hangtag" that is attached to millions of mattresses sold in the United States and Canada each year. (To order, phone 703-683-8371 and ask for Jane Oseth. They are available in English/Spanish and French/Spanish versions.) By attaching the tag to their mattresses, manufacturers certify that their products conform to the existing Federal Mattress Flammability Standard, helping to reduce the incidence of mattress fires caused by smoldering cigarettes. The hangtag, which can be purchased from the SPSC office, also warns consumers of

the potential fire and safety hazards that may result from the improper use of sleep products. It is probable that the SPSC Hangtag will become an even more important part of the industry's overall safety program as the test methods and standards for open-flame ignition resistance of residential mattresses are developed.

The SPSC sponsors cutting-edge research that has made an important contribution to fire and sleep safety. Examples of that research include the open-flame ignition research currently underway at NIST, the development of California Technical Bulletin 129, in the early 1990s, in cooperation with the California Bureau of Home Furnishings, and research into effects of indoor air quality from bed sets.

SPSC also provides both industry and consumer education. Regular industry educational safety conferences are sponsored by SPSC, featuring workshops on the latest trends and technology, as well as updates from regulators. A SPSC Combustibility Database offers up-to-date information on regulations, tests, policies, statutes and codes for all 50 states and six major metropolitan users of the SPSC safety hangtag (For information, contact Jane Oseth at 703-683-8371).

Consumer information is provided by the newly constructed SPSC Web site at www.safesleep.org, and by involvement in programs such as Sleep Safety Month and Operation Sleep Safe. The SPSC also issues press releases and other media materials to provide consumer information on maintaining a fire-safe residence. Partnerships with other related organizations such as Operation Life Safety, the National Association of State Fire Marshals, the California Bureau of Home Furnishings, the Association of Bedding and Furniture Law Officials and the CPSC are also an important ingredient of the SPSC's program.

In the critical days ahead for the U.S. bedding industry, it is vitally important that you fully support the activities of the SPSC by the regular purchase of Safety Hang-Tags. The flammability initiatives of the next 24-36 months could very well shape the future of the U.S. bedding industry for many years to come. Your continuing support of the SPSC, by regularly purchasing and using hangtags, may be vital in helping to shape that future. Support of the SPSC and its many and varied programs, is in fact, support for the future of the bedding industry.

Conclusion

All indications are that there will be some type of an open-flame fire test for residential bed sets within the next 2-3 years. It also appears that the test standard, when finally developed and proposed by the CPSC and/or the state of California, will be a mandatory rather than a voluntary requirement. The details of the test requirement are still uncertain, however it is anticipated that the SPSC sponsored research at NIST will form the basis for the standard. In addition to bed sets, both the NIST research and the State of California will also address issues related to the fire performance of bedclothes.

The future of bedroom flammability standards has become clearer with each passing month. Since the previous BEDtimes report in September 2000, California has passed AB 603; the CPSC has published an Advanced Notice of Proposed Rule-Making; and Phase II of the NIST research will be completed in 2002.

There will be a new mattress flammability standard addressing the flammability of residential bed sets. The time to start preparing is now! So what should you do?

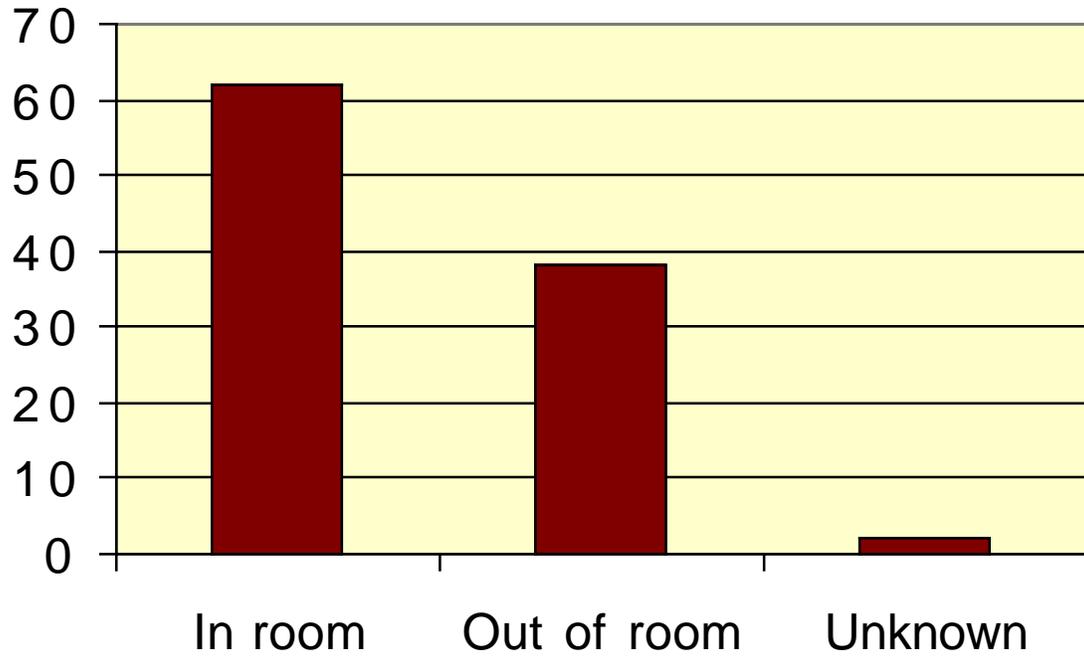
- Talk with suppliers about the availability of potential solutions.
- Find out about the new and improved materials that are available. Some materials may require bed sets to be made a little differently than is the custom.
- Attend SPSC and ISPA-sponsored seminars and conferences related to fire safety to obtain the latest and most current information from the researchers and the experts.
- Buy SPSC hangtags, put one on every mattress that you sell, and help support the industry safety research.
- Read all the mattress flammability information that you can obtain – the SPSC has flammability documents and publications that will help educate.

What should you avoid doing?

- Doing nothing.
- Do not delay or procrastinate in looking for potential solutions to the open-flame ignition challenge.
- Make sure that your products are not “fanning the flames” when the new flammability standard takes effect.

The new open-flame fire test will apply to every newly manufactured bed set and futon sold in the United States. The next 24-36 months promises to be challenging for the bedding industry. Change is often disruptive and threatening, particularly when things can change quickly. However, BEDtimes and other industry publications will attempt to keep you fully informed of the most recent activities related to this subject. We cannot overemphasize the importance of every bedding manufacturer, supplier and retailer keeping up-to-date with the latest developments on this critically important safety issue. Significant new challenges will face the bedding industry over the coming months – make sure that you are starting to prepare now!

Bedroom Fires (1994-1998) Location of Victims – percent



**Home fires where mattress or bedding
ignite first (1994-1998)
Location of victims – percent**

