

HOME FIRES THAT BEGAN WITH UPHOLSTERED FURNITURE

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Abstract

Based on data from the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA's) annual fire department experience survey, NFPA estimates that during 2002-2005, upholstered furniture was the item first ignited in an average of 7,630 reported home structure fires per year. (Homes include one- and two-family dwellings, apartments or other multiple family dwellings, and manufactured housing.) These fires caused an estimated annual average of 600 civilian deaths, 920 civilian injuries and \$309 million in direct property damage. Upholstered furniture is the leading item first ignited in home fire deaths. Although upholstered furniture fires started by smoking materials have fallen sharply since 1980, smoking materials remain the leading cause of these fires and associated losses.

Keywords: upholstered furniture; small open flame; fires; home fires, fire causes, fire statistics; smoking materials, smoke alarms.

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The National Fire Protection Association thanks all the fire departments and state fire authorities who participate in the National Fire Incident Reporting System (NFIRS) and the annual NFPA fire experience survey. These firefighters are the original sources of the detailed data that make this analysis possible. Their contributions allow us to estimate the size of the fire problem.

We are also grateful to the U.S. Fire Administration for its work in developing, coordinating, and maintaining NFIRS.

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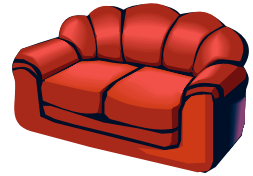
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Home Fires that Began with Upholstered Furniture

In 2002-2005, U.S. fire departments responded to an average of 7,630 home structure fires per year in which upholstered furniture was the first item ignited. These fires caused an annual average of 600 civilian fire deaths, 920 civilian fire injuries, and \$309 million in direct property damage.

On average, one of every 13 upholstered furniture fires resulted in death.

Overall, fires beginning with upholstered furniture accounted for 2% of reported home fires but 21% of home fire deaths.

Major Causes of Upholstered Furniture Fires

Smoking materials remain the leading cause of upholstered furniture fires and losses.

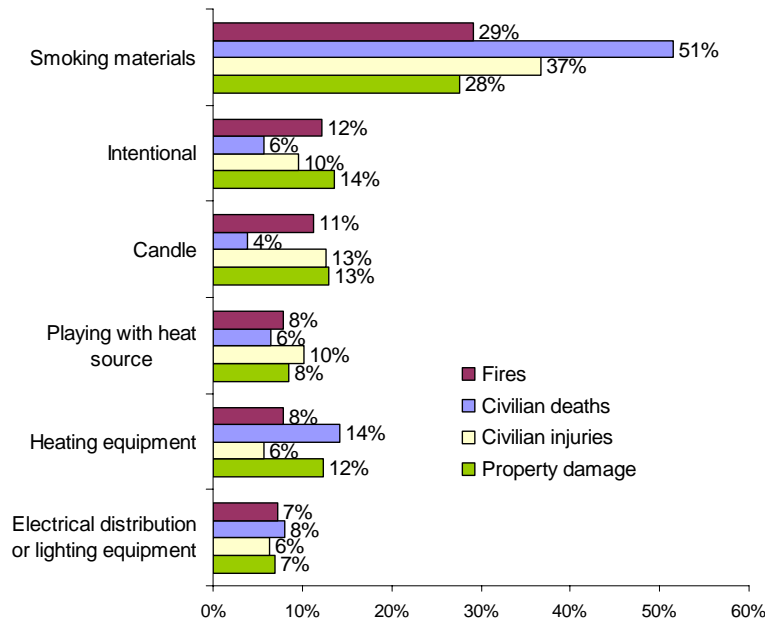
- One of every seven upholstered furniture fires started by smoking materials resulted in death.

Together, candles, matches and lighters were involved in 22% of the fires and 12% of the deaths.

- On average, one of every 23 such fires resulted in death.

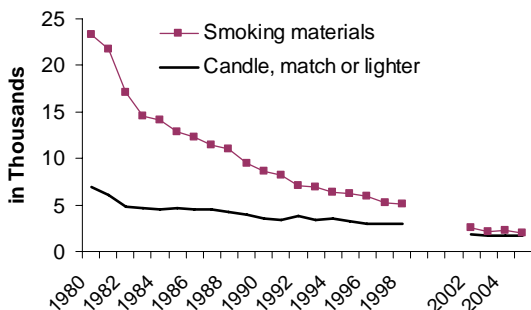
Portable and fixed space heaters were involved in 6% of the upholstered furniture fires and 12% of the associated deaths.

Electrical failures or malfunctions were factors in 14% of the home upholstered furniture fires and deaths. These failures were in all types of electrical appliances, not just electrical distribution or lighting equipment.

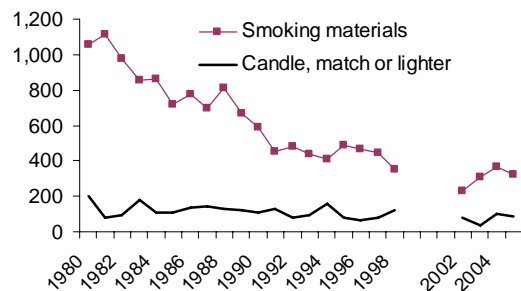


Upholstered furniture fires started by smoking materials and associated deaths fell sharply since 1980. The decline in upholstered furniture fires started by candles, matches or lighters was not as sharp. No clear trend was seen for upholstered furniture deaths from candles, matches and lighters.

Home Upholstered Furniture Fires Started by Smoking Materials vs. Candles, Matches and Lighters, by Year



Civilian Deaths from Home Upholstered Furniture Fires Started by Smoking Materials vs. Candles, Matches and Lighters, by Year



Executive Summary

During 2002-2005, upholstered furniture was the item first ignited in an average of 7,630 reported home structure fires per year. These fires caused an estimated annual average of 600 civilian deaths, 920 civilian injuries and \$309 million in direct property damage. Overall, fires beginning with upholstered furniture accounted for 2% of reported home fires but 21% of home fire deaths.

Upholstered furniture fires in the home environment have decreased sharply, with a very large decrease seen in fires started by smoking materials. However, upholstered furniture remains the leading item first ignited in home fire deaths. Smoking materials remain the leading heat source. Voluntary standards have played a role in reducing these fires and deaths, but mandatory standards have been proposed to reduce them further. In the early 1980s, more than three times as many upholstered furniture fires were started by smoking materials as by candles, matches or lighters. That gap narrowed considerably over time. Upholstered furniture fires from candles, matches and lighters have also declined, but not as sharply. Deaths from these small flame ignitions show no clear pattern, but are much less frequent than deaths from upholstered furniture fires started by smoking materials.

The term “upholstered furniture” is not further defined in the National Fire Incident Reporting System (NFIRS), the source of detailed data about these fires. The CPSC uses a narrower definition in its proposed flammability standard. Furniture that is intended for outdoor use would not be covered under that standard. In 2002-2005, an average of 1,690 fires per year on home properties were either coded

- a) with incident types identifying the fire as outside or unclassified, or
- b) as structure fires that began in outside or open spaces such as balconies, patios or by exterior walls.

Assessing the probable impact of standards is challenging. Upholstered furniture is a durable product. New furniture is likely to meet current standards. Over time, things get spilled on the furniture, the fabric may wear out, and the furniture may pass to a different household. It is important to remember that these statistics are based on all upholstered furniture ranging from very old and heavily used to newly purchased and never used.

Changes in the environment also complicate the issue. Homes are much more likely to have smoke alarms today than they were in 1980. This means that more fires may be discovered before fire department assistance is required. The CPSC required lighters to be child-resistant beginning in 1994, resulting in a drop in fires started by children playing. The increase in candle sales in the 1990s was accompanied by an increase in candle fires. New materials enter the marketplace. “Fire-safe” cigarettes that extinguish in minutes when not inhaled are required in increasingly more states.

While playing with fire dominates the candle, match or lighter scenarios for small open flames, a candle flame is likely to impinge on the furniture differently than a match or lighter held by a child. Intentional fires are often excluded from the discussion, but the

large number of intentional fires that had playing with heat source as a contributing factor suggest that these fires may be intentionally set by children, not determined arsonists.

Many upholstered furniture fires were not started by smoking materials or open flames. For example, 15% of the upholstered furniture fires and 22% of the associated deaths involved either heating equipment or electrical distribution or lighting equipment. Equipment such as heaters or cords may be under or adjacent to the furniture. Scenarios with convective or radiant heat transfer should be included in the discussions.

Home Fires Beginning with Upholstered Furniture

Overview

On average, 7,630 home structure fires began with upholstered furniture each year. During the four-year period of 2002-2005, upholstered furniture was the item first ignited in an estimated average of 7,630 reported home structure fires per year. These fires caused an annual average of 600 civilian deaths, 920 civilian fire injuries, and \$309 million in direct property damage.

Homes include one- and two-family dwellings, manufactured housing, apartments, tenements, flats, townhouses and row houses, regardless of ownership. The term “civilian” is used to describe anyone who is not a member of the fire service.

Upholstered furniture has been the leading item first ignited in home fire deaths for years. On average, one of every 13 upholstered furniture fires resulted in death.

Statistics are derived from NFIRS and NFPA’s annual fire department survey.

The national estimates in this analysis are projections based on fire department assessments of cause, circumstances, and occupancy. These estimates are derived from the U.S. Fire Administration’s (USFA’s) National Fire Incident Reporting System (NFIRS) and NFPA’s annual fire department survey. Upholstered furniture was identified by item first ignited code 21, which captures upholstered sofas, chairs and vehicle seats.¹ In the Consumer Product Safety Commission’s 2008 notice of proposed rulemaking on residential furniture flammability, a narrower definition is used that includes only furniture intended for indoor use that is constructed with a contiguous upholstered seat and back or arms.²

Only fires reported to public fire departments are included in the statistics in this analysis. Only details from Version 5.0 of NFIRS were used in the 2002-2005 estimates in this analysis. Data originally collected in earlier versions were used only in the trend tables for 1980-1998. The total number of home upholstered furniture structure fires was taken from NFPA’s report, *Home Structure Fires*.³ This estimate includes a proportional share of fires in which the item first ignited was unknown or not reported. Percentages calculated from the details in NFIRS 5.0 were applied to the projections of home fires and losses derived from NFPA’s survey. In the analysis that follows, fires and losses with missing or unknown data were allocated proportionally among fires with known data.

¹ U.S. Fire Administration National Fire Data Center. National Fire Incident Reporting System 5.0, Complete Reference Guide, January 2006.

² U.S. Consumer Product Safety Commission. “16 CFR Part 1634: Standard for the Flammability of Residential Upholstered Furniture: Notice of Proposed Rulemaking,” *Federal Register*, March 4, 2008, p. 11703.

³ Marty Ahrens. *Home Structure Fires*. Quincy, MA: National Fire Protection Association, September 2007.

NFIRS 5.0 includes six categories of confined structure fires, identified by incident type. For cooking fires confined to the cooking vessel, confined chimney or flue fires, confined incinerator fires, confined fuel burner or boiler fires or delayed ignitions, confined commercial compactor fires, and trash or rubbish fires in a structure with no flame damage to the structure or contents, little more than basic dispatch data and property use is required by the NFIRS 5.0 system. These confined fires were excluded from the analysis of upholstered furniture fires. Appendix A describes the methodology used. Tables supporting the text are provided at the end of this analysis.

21% of home structure fire deaths resulted from fires that began with upholstered furniture.

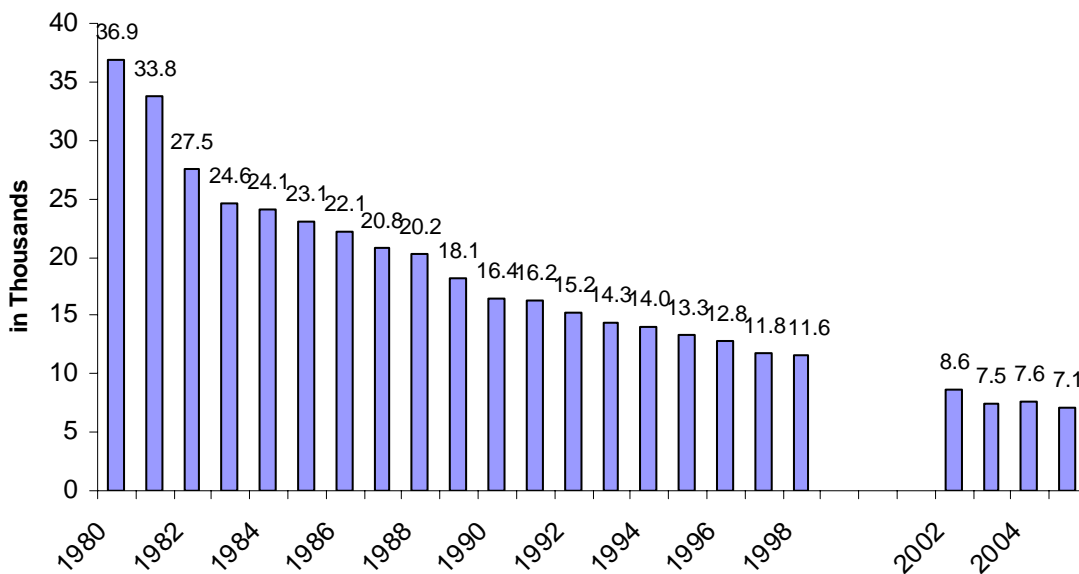
During 2002-2005, U.S. fire departments responded to an estimated average of 377,100 home structure fires per year. These incidents caused an average of 2,870 civilian deaths, 13,360 civilian fire injuries, and \$5.9 billion in direct property loss per year. The 7,630 fires that began with upholstered furniture accounted for an average of 2% of the reported home structure fires, 21% of the home civilian structure fire deaths, 7% of the civilian structure fire injuries, and 5% of the structure fire direct property loss per year.

Since 1980, these structure fires fell 81%.

As shown in Table 1 and Figure 1, home structure fires beginning with upholstered furniture fell 81% from a high of 36,900 in 1980 to 7,100 in 2005, the lowest point in the 26 years of data. From 2004 to 2005, these fires fell 3%. Details collected in NFIRS 5.0 were used to derive the estimates from 1999 on. Due to the small portion of fires originally collected in NFIRS 5.0 during 1999-2001, estimates for these years are omitted from the trend graphs.

Total home structure fires fell 48% from 1980 to 2005. From 2004 to 2005, total home structure fires fell 4%.

Figure 1. Home Structure Fires that Began with Upholstered Furniture, by Year

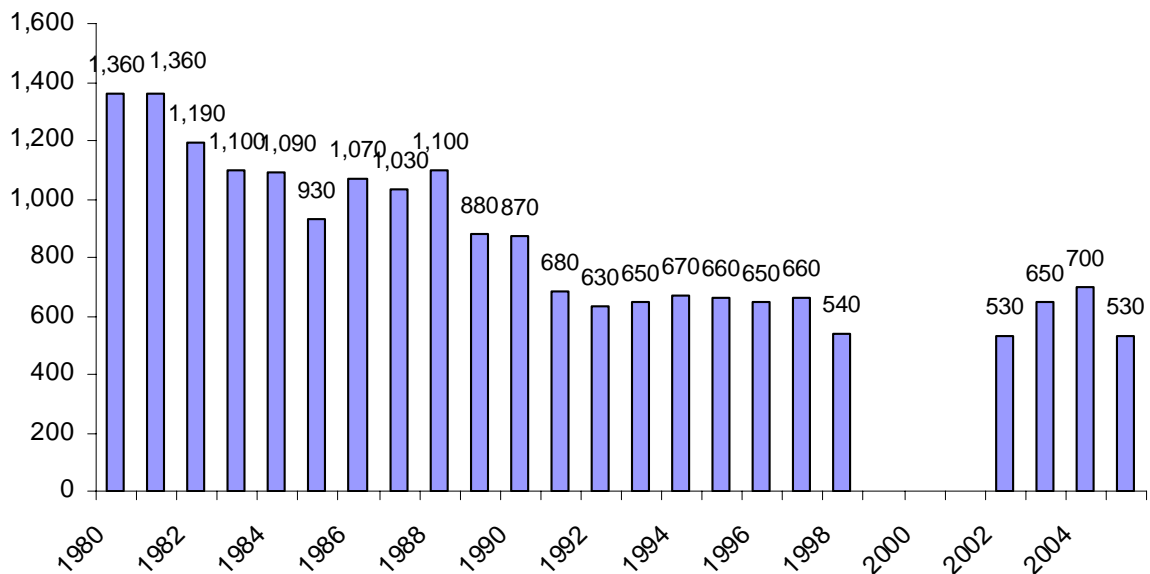


Source: NFIRS and NFPA survey.

Upholstered furniture fire deaths declined sharply in the 1980s, then hit a plateau. Deaths resulting from home structure fires beginning with upholstered furniture were at their highest in 1980 and 1981, with an estimated 1,360 such deaths both years. Figure 2 shows that deaths hit a plateau in the 1990s at roughly half the 1981 and 1982 highs. The 2002-2005 average is only 4% lower than the 1995-1998 average and 56% below the peak. The 530 deaths reported in 2005 is 61% lower than the highs in 1980 and 1981, and 23% lower than the 14-year peak of 700 reported in 2004.

The average number of civilian fire deaths from all home structure fires fell 42% from 1980 to 2005 and 5% from 2004 to 2005.

Figure 2. Civilian Fire Deaths Resulting from Home Structure Fires that Began with Upholstered Furniture, by Year



Source: NFIRS and NFPA survey.

Vast majority of upholstered furniture fires began with fabric.

Table 2 shows that fabric, fiber or finished goods made of cotton, blends, rayon or wool was the type of material first ignited in roughly three-quarters of these fires and associated losses. In 14% of the fires and 12% of the deaths, an unclassified fabric, textile or fur was first ignited.

56% of upholstered furniture deaths resulted from fires in the living room, family room or den.

Table 3 shows that 39% of the home structure fires that began with upholstered furniture started in the living room, family room, or den. These fires caused 56% of the associated civilian deaths, 48% of the civilian injuries, and 41% of the direct property damage. Roughly one-quarter of the fires and associated losses began in an unclassified function area. The 15% that started in a bedroom caused 8% of the deaths.

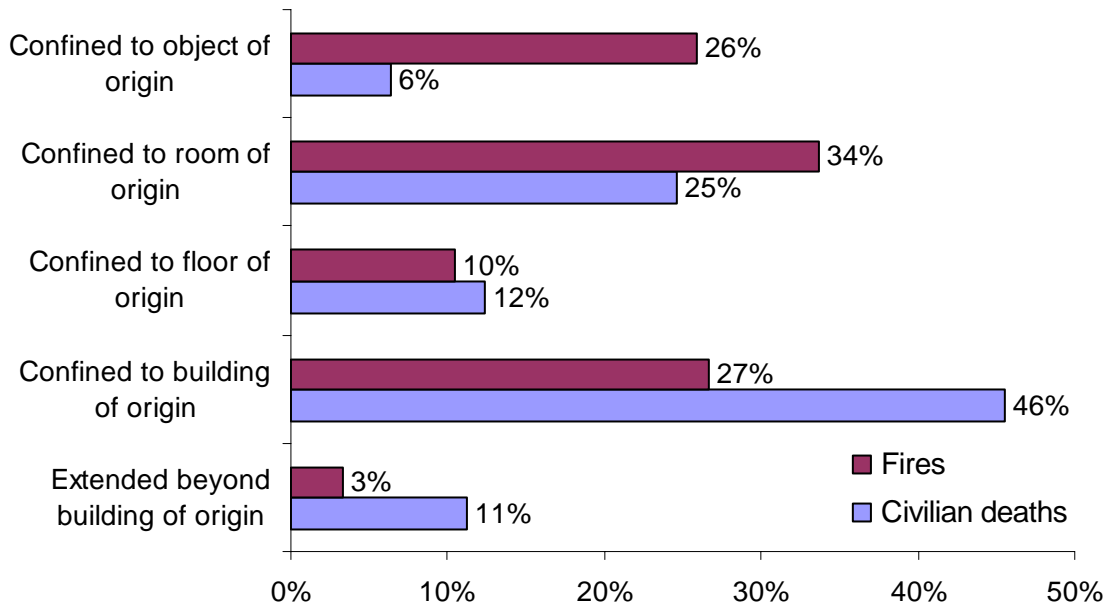
On average, 1,690 upholstered furniture per year were outside or unclassified fires or began in outside structural areas.

In 2002-2005, an annual average of 1,360 fires on home properties began with upholstered furniture and had incident types identifying the fire as outside or unclassified. In addition, an average of 330 home structure fires per year began in outside or open spaces. Table 3 shows that an annual average of 160 (2%) began on exterior balconies or unenclosed porches; 60 (1%) began on a courtyard, terrace or patio; another 60 began at an exterior wall; and 50 (1%) started in an unclassified outside area. Combined, these 1,690 fires caused an average of seven civilian deaths, 31 civilian injuries, and \$16 million in direct property damage per year. A few of the incidents described in Appendix B reference upholstered furniture on the porch. Such furniture may have been purchased specifically for porch use or old furniture may have been relegated there.

Flame damage was limited to the room of origin in almost one-third of home upholstered furniture fire deaths.

Figure 3 and Table 4 show that that the 60% of home upholstered furniture fires with flame damage confined to the object or room of origin resulted in 31% of the associated civilian deaths.

**Figure 3. Home Structure Fires that Began with Upholstered Furniture
By Extent of Flame Damage: 2002-2005**



Source: NFIRS and NFPA survey.

Upholstered furniture ranked second in item contributing most to flame spread for fire deaths.

NFIRS 5.0 collects information about the item contributing most to flame spread. However, if no flame spread occurred, if the item contributing most to flame spread is the same as the item first ignited, or if the item contributing most to flame spread is unknown, a box may be checked and the section skipped. In some cases, data were entered even when not required. Because of these limitations, national estimates were

not calculated. Based on the known data entered in this field, upholstered furniture was the item contributing most to flame spread in 5% of the non-confined home structure fires, 16% of the associated civilian deaths, 9% of the civilian injuries, and 5% of the direct property damage. Upholstered furniture ranked fifth in item contributing most to flame spread for fires and direct property damage, second in civilian deaths and third in civilian injuries. (Structural member or framing ranked first across all loss measures.)

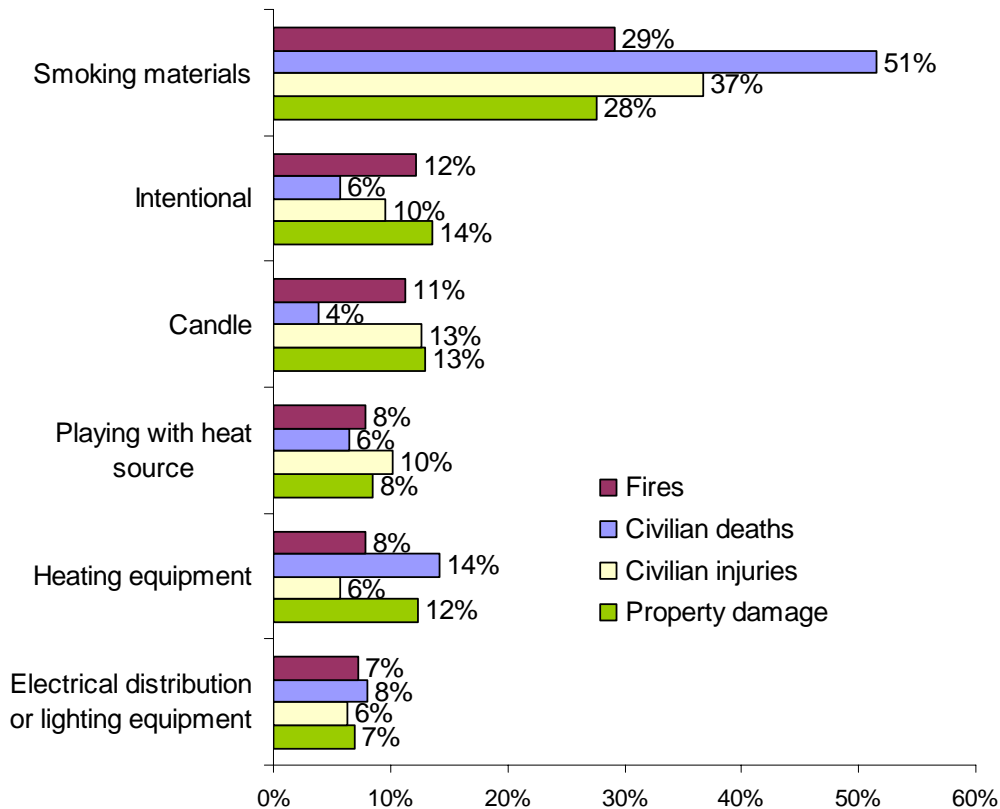
When the item first ignited was upholstered furniture, the item contributing most to flame spread was also upholstered furniture in 71% of the fires, 62% of the deaths, 70% of the injuries, and 56% of the direct property damage.

When the item contributing most to flame spread was upholstered furniture, the item first ignited was upholstered furniture in 66% of the fires and injuries, 75% of the deaths, and 59% of the direct property damage.

Smoking materials are the leading cause of upholstered furniture fires and associated losses.

Smoking materials were the heat source in an average of 2,220, or 29%, of the home structure fires that began with upholstered furniture per year. These fires resulted in an annual average of 310 (51%) civilian deaths, 340 (37%) of the civilian injuries, and \$85 million (28%) in direct property damage.

Figure 4. Major Causes of Home Structure Fires that Began with Upholstered Furniture: 2002-2005



Source: NFIRS 5.0 and NFPA survey.

Figure 4 shows the leading causes of fires in these properties with data summarized from several NFIRS fields. In some cases, the equipment involved in ignition is most relevant; heat source, the field “cause” (as opposed to this summary of “major causes” from multiple fields) and factor contributing to ignition also provide relevant information. The causal factors shown in this graph are not mutually exclusive when they have been pulled from different fields.

More detailed information on details from the cause of ignition field may be found in Table 5, factor contributing to ignition in Table 6, more information on heat source is shown in Table 7, and additional information on equipment involved in ignition is found in Table 8. More detailed information on the definitions and methodology used to create this graph is found in Appendix C.

Appendix B includes a collection of previously published incident descriptions grouped by scenario. Examples are included of fires started by smoking materials, open flames, heating equipment, electrical distribution or lighting equipment, and other causes. In most of these cases, upholstered furniture was the item first ignited. In others, the fire spread to upholstered furniture. These incidents are included to show what *can* happen, not what is typical. The incidents that are included are more likely to be serious than the typical fire. However, narratives can provide more detailed information about how different heat sources actually ignite the furniture.

Twelve percent of the home upholstered fires were intentionally set.

On average, 930 (12%) of the home upholstered furniture fires were intentionally set per year. These incidents caused an average of 30 (6%) of the associated civilian deaths, 90 (10%) of the civilian injuries, and \$42 million (14%) in direct property damage.

Candles started 11% of these fires.

Candles were the heat source in an average of 860 (11%) home upholstered furniture fires per year, resulting in an average of 20 (4%) civilian deaths, 120 (13%) of the civilian injuries, and \$40 million (13%) in direct property damage per year.

Someone playing with fire started 8% of the home upholstered furniture fires.

Six hundred (8%) home upholstered furniture fires per year, on average, were caused by someone, typically a child, playing with fire or other heat source. These fires caused an average of 40 (6%) civilian deaths, 90 (10%) civilian injuries, and \$26 million (8%) in direct property damage per year. As mentioned earlier, factors from different fields overlap. Roughly one-third of the upholstered furniture fires started by playing were intentionally set. The share was comparable for the associated losses.

Portable or fixed space heaters were involved in 12% of the home upholstered furniture fire deaths.

Heating equipment, including unclassified heating and ventilation equipment, was involved in an estimated average of 600 (8%) home upholstered furniture fires per year. These fires caused an average of 80 (14%) civilian deaths, 50 (6%) civilian injuries, and \$38 million (12%) in direct property damage. Portable and fixed space heaters, including

wood stoves, were involved in an annual average of 440 (6%) upholstered furniture fires. These fires caused 70 (12%) of the associated deaths.

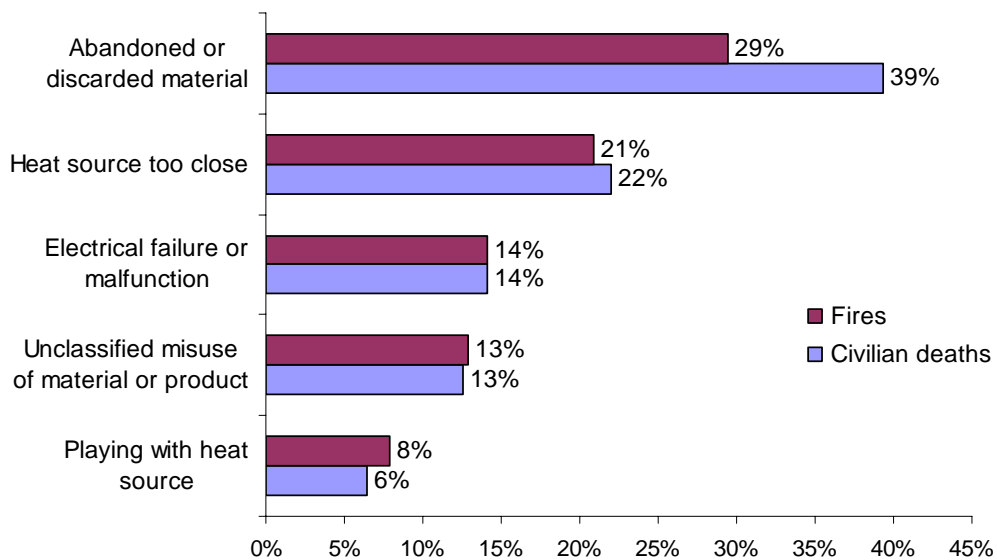
Electrical distribution or lighting equipment was involved in 7% of the home upholstered furniture fires.

Electrical distribution or lighting equipment was involved in an annual average of 560 (7%) reported home fires that began with upholstered furniture. These fires caused an average of 50 (8%) civilian deaths, 60 (6%) civilian injuries, and \$22 million (7%) in direct property damage. Cords and plugs accounted were involved in an average of 200 of these fires and 30 of the associated deaths per year. Lamps and other lighting equipment were also involved in an average of 200 fires per year, but only 10 deaths year. Wiring, switches or outlets were involved in an average of 120 of these fires and 10 associated deaths a year.

Abandoned or discarded material is the leading factor contributing to ignition.

The field “factor contributing to ignition” explains how the heat source interacted with the fuel source to start a fire. Figure 5 and Table 6 show that the leading factor for home upholstered furniture fires was abandoned or discarded material. This factor is often used to describe discarded cigarettes. Upholstered furniture was too close to a heat source such as a candle or heater in roughly one-fifth of the fires and deaths. Electrical failures or malfunctions from all types of equipment powered by electricity, not just electrical distribution or lighting equipment, were factors in 14% of home structure fires that began with upholstered furniture per year as well as 14% of the associated civilian deaths.

Figure 5. Home Structure Fires that Began with Upholstered Furniture By Leading Factor Contributing to Ignition: 2002-2005



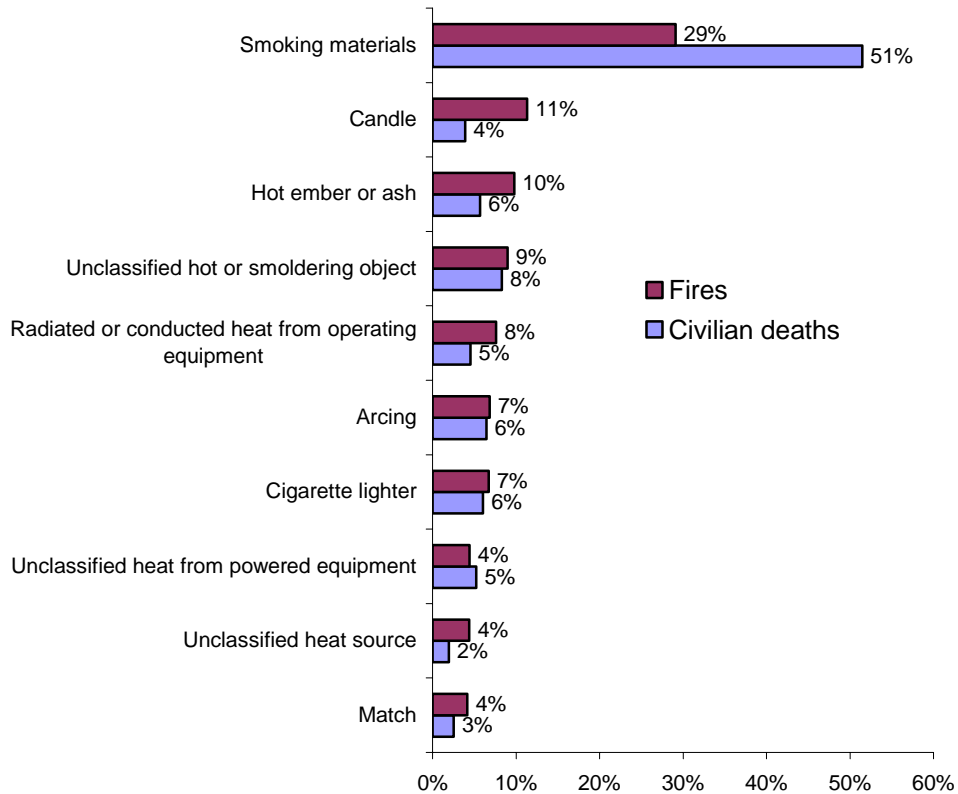
Source: NFIRS 5.0 and NFPA survey.

A wide variety of heat sources started these fires.

Figure 6 and Table 7 show that a wide variety of heat sources are involved in home upholstered furniture fires. As mentioned previously, smoking materials were the leading heat source in upholstered furniture fires and all associated loss measures. Candles

started 11% of the incidents. Hot embers or ashes started 10% of the fires; these resulted in 6% of the associated deaths. The source of embers or ashes is not specified. Nine percent of the fires were started by unclassified hot or smoldering objects. Together, candles, matches and lighters were involved in 22% of the fires and 12% of the deaths.

Figure 6. Home Structure Fires that Began with Upholstered Furniture By Leading Heat Sources: 2002-2005



Source: NFIRS 5.0 and NFPA survey.

Fires Started by Smoking Materials vs. Candles, Matches or Lighters

Existing and proposed flammability requirements for upholstered furniture focus on fires started by either smoking materials or small open flames. This part of the analysis focuses on the circumstances of the two categories. Because the numbers are smaller than in the category as a whole, casualties are rounded to the nearest one. Because their share of the problem differs, the estimated annual average number of fires or deaths (including projections and allocation of unknown data and projections) is shown in the non-trend graph legends.

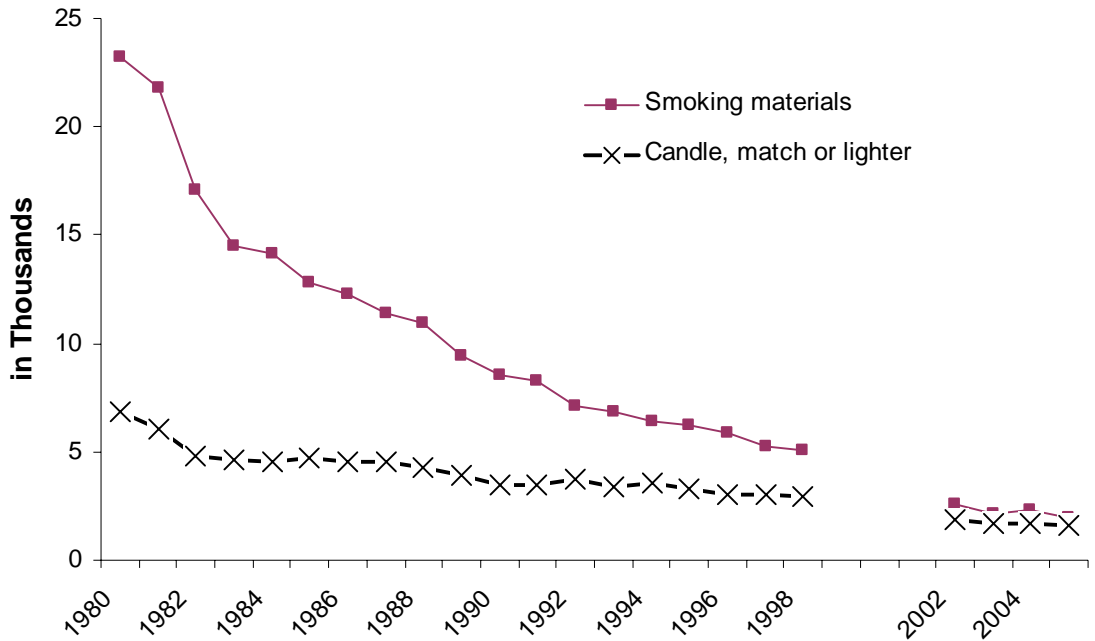
The 2,220 home upholstered furniture fires started by smoking materials resulted in an annual average of 309 deaths. On average, one of every seven such fires resulted in death.

In 2002-2005, candles, matches and lighters started an estimated average 1,690 home upholstered furniture fires annually, resulting in an average of 75 deaths per year. On average, one of every 23 such fires resulted in death.

Twelve times as many upholstered furniture fires were started by smoking materials in 1980 as in 2005.

Figure 7 and Table 9 show that home upholstered furniture fires started by smoking materials fell 92% from a high of 23,300 in 1980 to a low of 2,000 in 2005. Figure 8 and Table 10 show that home upholstered furniture fires started by candles, matches or lighters fell 76% from a high of 6,900 in 1980 to a low of 1,600 in 2005. In the early 1980s, more than three times as many upholstered furniture fires were started by smoking materials as by candles, matches or lighters. That gap narrowed considerably over time.

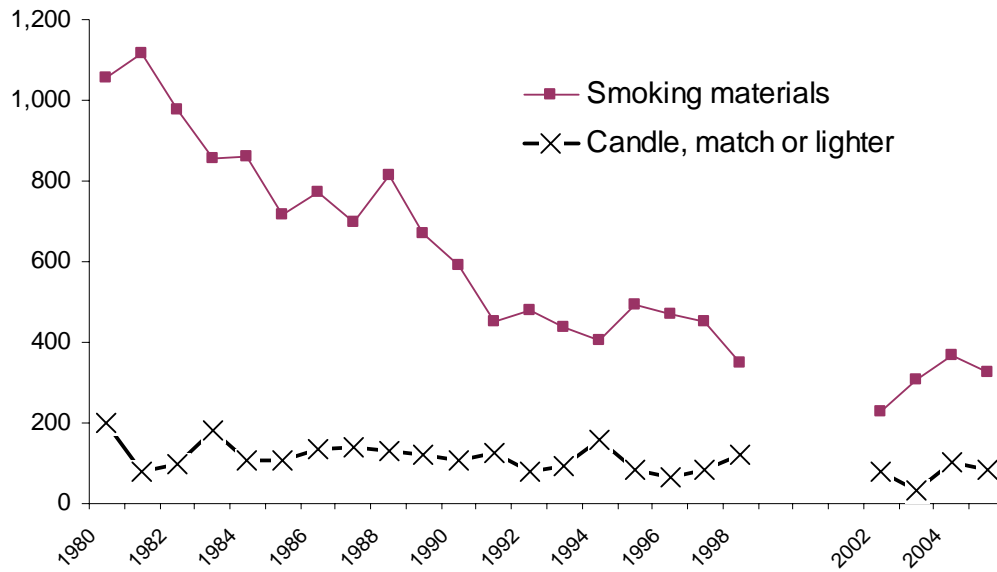
Figure 7. Home Upholstered Furniture Fires Started by Smoking Materials and Candles, Matches and Lighters, by Year: 1980-2005



Source: NFIRS and NFPA survey.

Figure 8 shows that the 330 deaths resulting from home upholstered furniture fires started by smoking materials in 2005 was 69% lower than the 1,060 such deaths in 1980. No clear pattern is seen for deaths resulting from upholstered furniture fires started by candles, matches or lighters. However, the number of these deaths is much lower than the number from smoking materials.

Figure 8. Civilian Deaths Resulting from Home Upholstered Furniture Fires Started by Smoking Materials and Candles, Matches and Lighters, by Year: 1980-2005

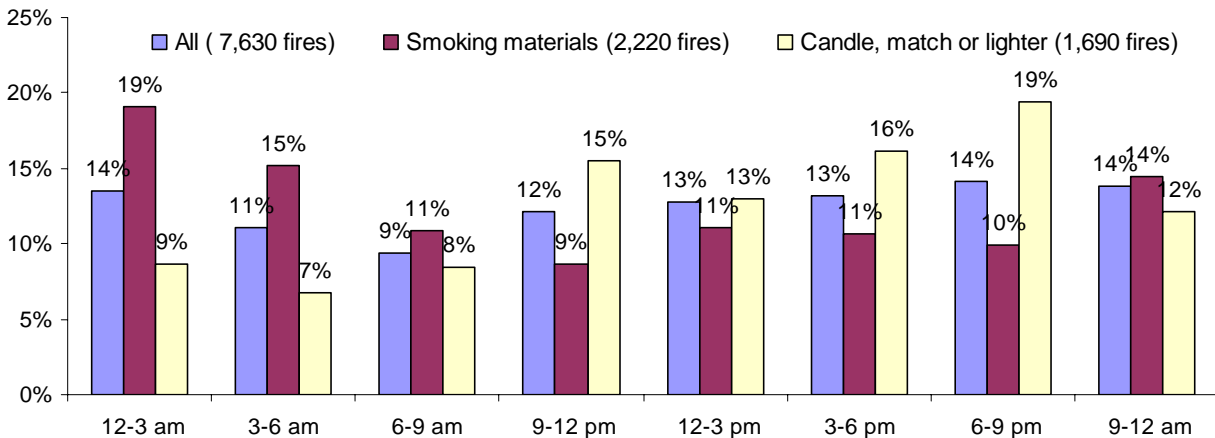


Source: NFIRS and NFPA survey.

Time patterns differ by heat source.

Figure 9 shows that upholstered furniture fires started by smoking materials were more common late at night and in the early morning, while fires started by candles, matches or lighters were less common during those hours.

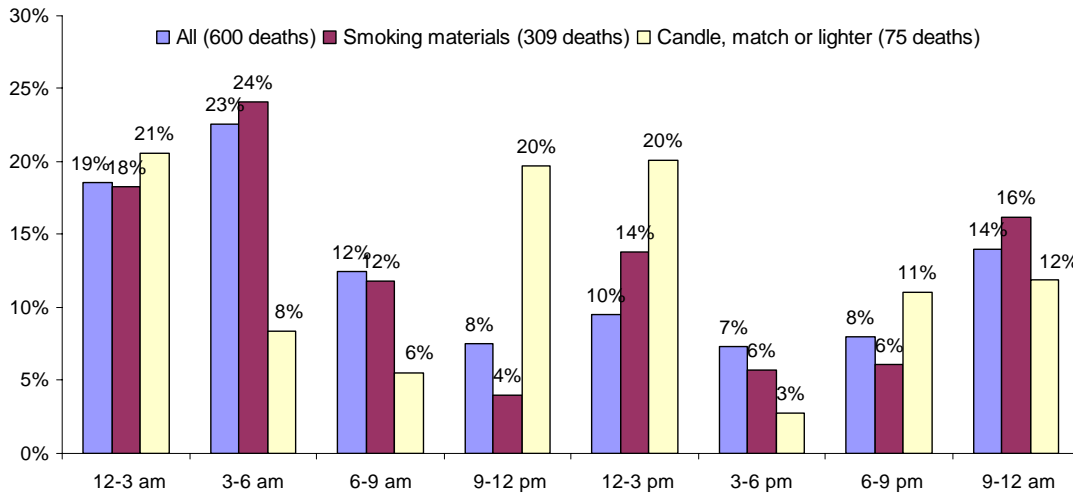
Figure 9. Home Upholstered Furniture Fires by Time of Alarm and Smoking Materials vs. Candles, Matches and Lighters: 2002-2005



Source: NFIRS 5.0 and NFPA survey.

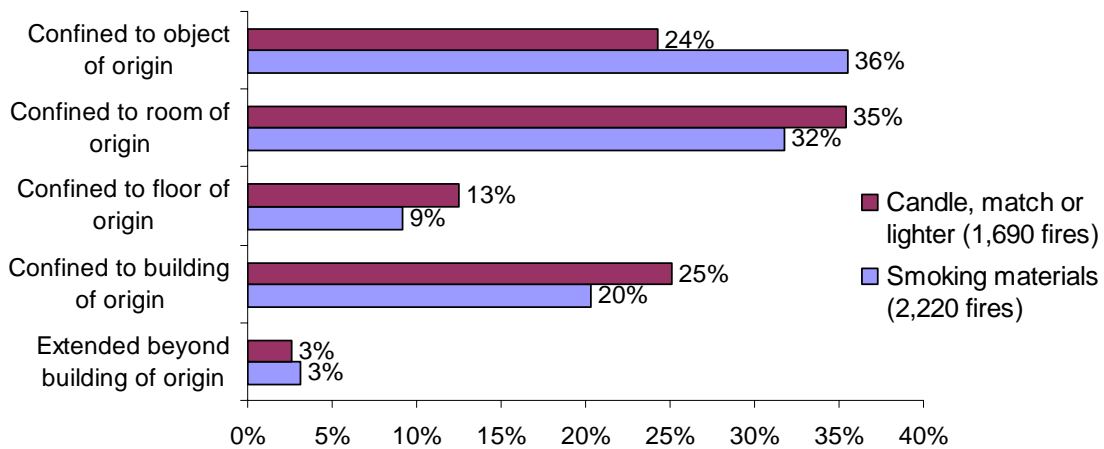
A similar pattern is seen for deaths resulting from these fires. Deaths from fires started by smoking materials peak in the early morning hours, while deaths from upholstered furniture fires started by candles, matches and lighters peak between 9:00 am and 3:00 p.m.

Figure 10. Home Upholstered Furniture Fire Deaths by Time of Alarm and Smoking Materials vs. Candles, Matches and Lighters: 2002-2005



Source: NFIRS 5.0 and NFPA survey.

Figure 11. Home Upholstered Furniture Fire Deaths by Extent of Flame Damage and Smoking Materials vs. Candles, Matches and Lighters: 2002-2005



Source: NFIRS 5.0 and NFPA survey.

More than one-third of smoking material deaths from upholstered furniture fires resulted from fires with flame damage limited to the room of origin.

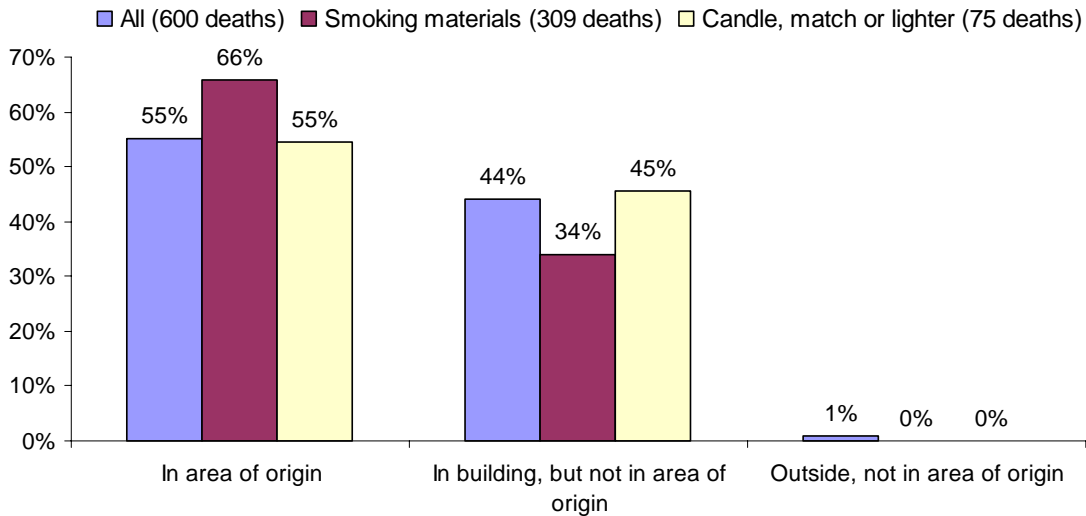
Tables 11 and 12 show that there is relatively little difference in extent of flame damage in fires started by the two different categories of heat source. However, Figure 11 shows that flame damage was confined to the object or room of origin in 37% of the deaths from upholstered furniture fires started by smoking materials compared to only 11% of the deaths resulting from fires started by candles, matches or lighters.

A wider variety of factors contributing to ignition is seen for fires started by candles, matches or lighters.

Table 13 shows that abandoned or discarded materials or products were contributing factors in almost two-thirds of the home upholstered furniture fires started by smoking materials. Table 14 shows that playing with heat source was a factor in one-third of the upholstered furniture fires started by candles, matches and lighters, and 57% of the associated deaths. A heat source too close to the furniture was a factor in 31% of these fires and 21% of the associated deaths.

Only 2% of the upholstered fires started by smoking materials were intentionally set. These fires caused 1% of the associated deaths. In contrast, 24% of the upholstered material fires started by candles, matches or lighters were intentionally set. These incidents caused 27% of the associated fatalities. However, playing with heat source was a contributing factor in three-quarters of these intentional fires and two-thirds of the associated deaths.

Figure 12. Home Upholstered Furniture Fire Deaths by Victim’s Location at Time of Fatal Injury and Smoking Materials vs. Candles, Matches and Lighters: 2002-2005



Source: NFIRS 5.0 and NFPA survey.

Victims of upholstered furniture fires started by smoking materials were more likely to have been in the room of origin.

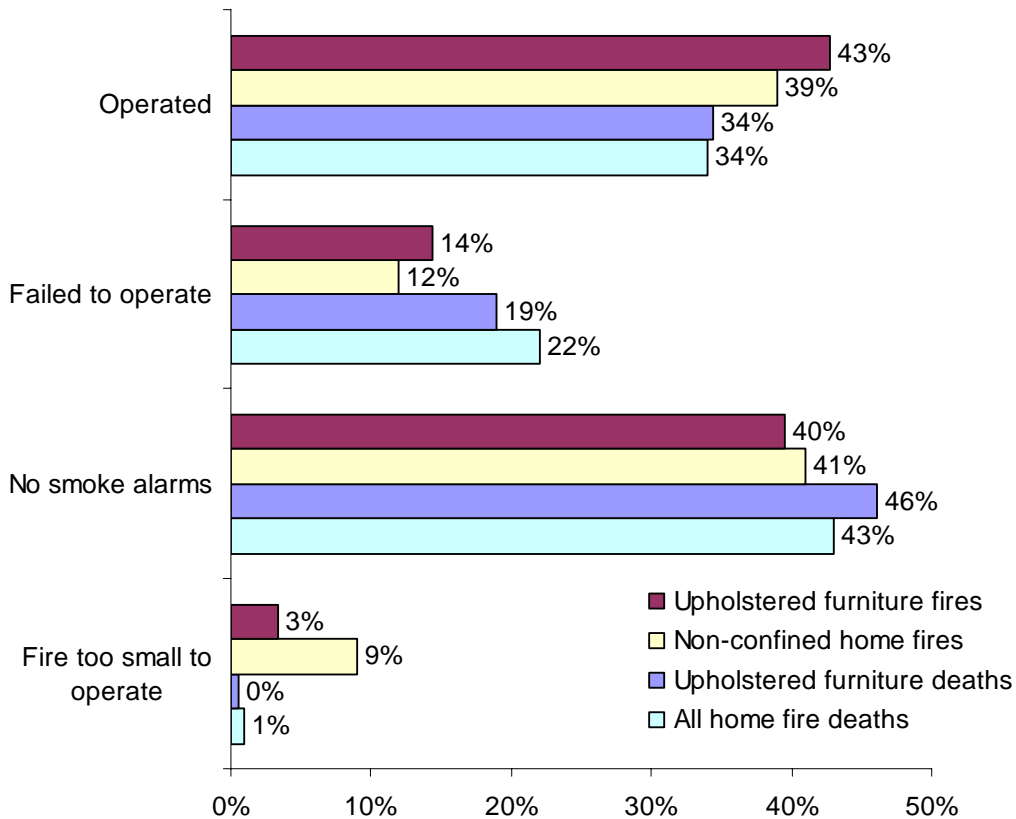
Figure 12 shows that 66% of the fatalities in upholstered furniture fires started by smoking materials were in the area of origin when fatally injured compared to only 55% of the victims of fires started by candles, matches or lighters.

Smoke Alarms and Home Upholstered Furniture Fires

Little difference is seen between smoke alarm status in upholstered furniture fires vs. home fires overall.

Figure 13 and Table 15 shows that smoke alarms were present and operated in 43% of the home upholstered furniture fires and 34% of the associated deaths. They failed to operate in 14% of the fires and 19% of the deaths. In overall home fires, excluding the confined fires discussed on p. 1, smoke alarms were present and operated in 39% of the fires and 34% of the deaths. They were present but failed to operate in 12% of the non-confined home fires and 22% of the deaths.⁴

Figure 13. Smoke Alarm Status in Home Upholstered Furniture Fires and All Non-Confined Home Fires: 2002-2005

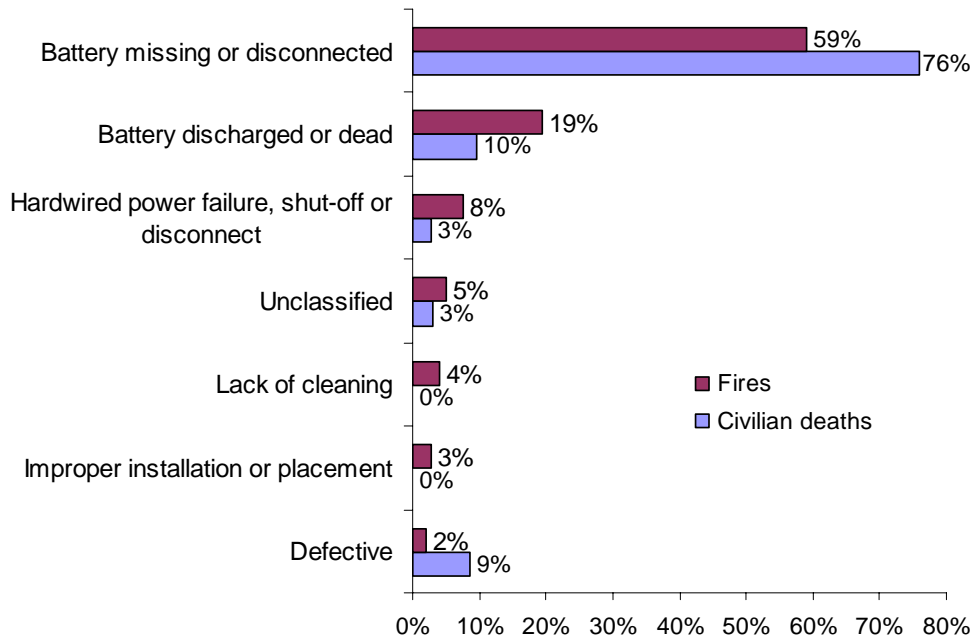


Source: NFIRS 5.0 and NFPA survey.

⁴ Marty Ahrens. *U.S. Experience with Smoke Alarms and Other Fire Detection Equipment*, Quincy, MA: National Fire Protection Association, April 2007, p. 24.

Figure 14 shows that when smoke alarms were present but failed to operate in home upholstered furniture fires, smoke alarm batteries were missing or disconnected in 59% of the fires and 76% of the deaths. In all types of home fires, missing or disconnected batteries accounted for 54% of the failures in fires and 75% in deaths.

Figure 14. Reason for Failure when Smoke Alarms Did Not Operate in Home Upholstered Furniture Fires: 2002-2005



Source: NFIRS 5.0 and NFPA survey.

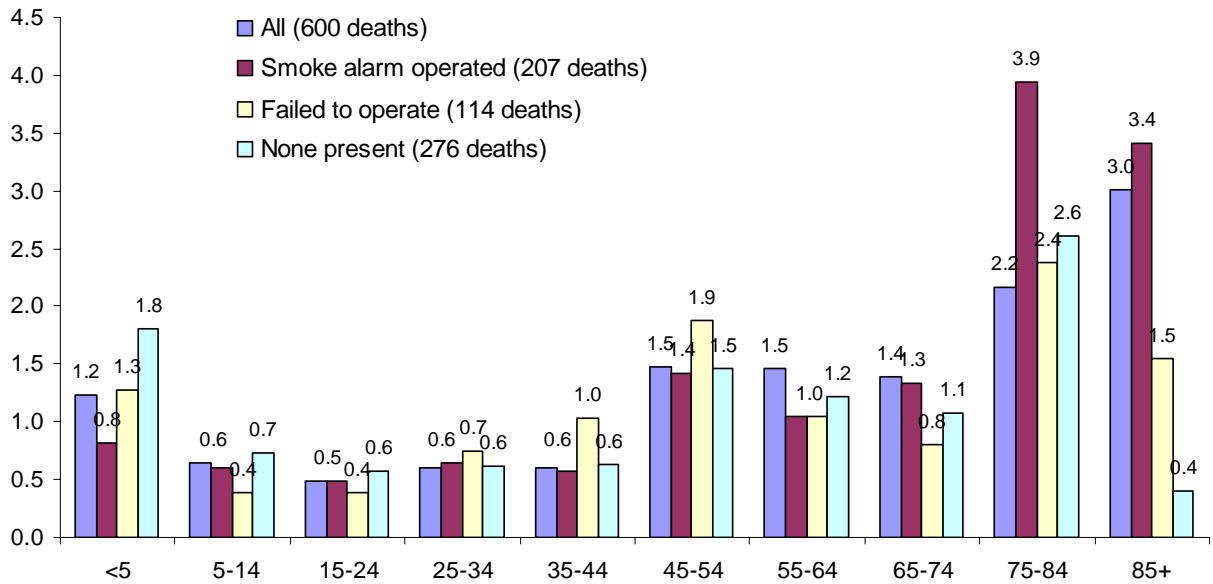
Older adults appear to receive less benefit from the operating smoke alarms in upholstered furniture fires.

Figure 15 shows that adults 75 and older face the highest relative risk of death from upholstered furniture fires. Relative risk compares the risk of one group to the risk of the total population. Relative risk of fire death is calculated by dividing the percentage of the population in each age group by the percentages of fire deaths in each group. A relative risk of one means the percentage of deaths for that age group is equal to the percentage of people in that age group in the general population.

Figure 15 and Tables 16-18 also show that compared to other age groups, older adults faced a much higher risk of dying in a home upholstered furniture fire with a working smoke alarm. Bruck and Thomas found that adults over 75 were at increased risk of sleeping through high-pitched signal currently used by most smoke alarms. They speculate that this is due to the loss of ability to hear high-pitched sounds that often accompanies aging.⁵

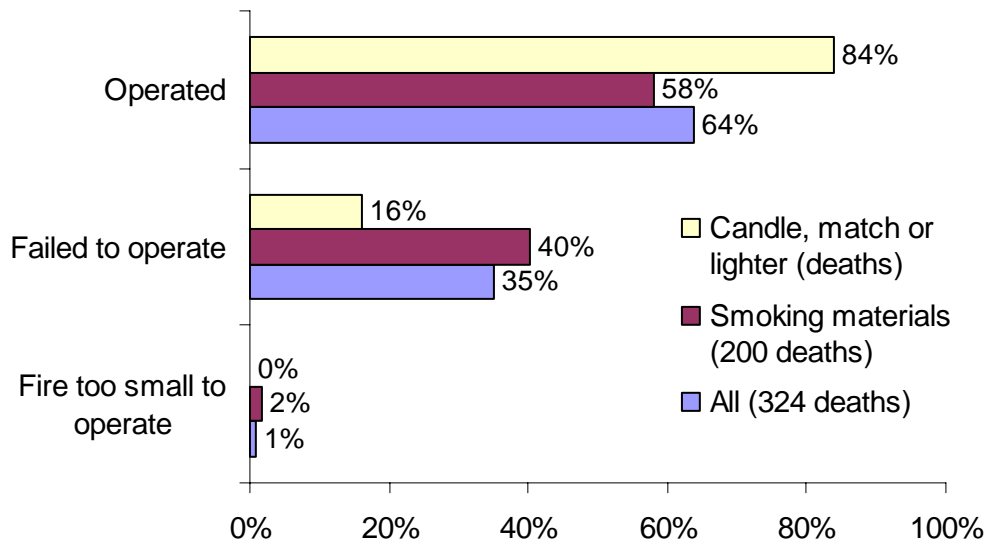
⁵ Dorothy Bruck and Ian Thomas. “Comparison of the Effectiveness of Different Fire Notification Signals in Sleeping Older Adults.” *Fire Technology*, 44, 15-38, 2008, DOI: 10.1007/s10694-007-0017-5.

Figure 15. Relative Risk of Death by Age Group and Smoke Alarm Status in Home Upholstered Furniture Fires: 2002-2005



Source: NFIRS 5.0 and NFPA survey.

Figure 16. Home Upholstered Furniture Fire Deaths from Fires with Smoke Alarms Present by Smoke Alarm Operation and Smoking Materials vs. Candles, Matches and Lighters: 2002-2005



Source: NFIRS 5.0 and NFPA survey.

Working smoke alarms were less common in deaths from upholstered furniture fires started by smoking materials.

Tables 19 and 20 show that smoke alarms operated in half of the home upholstered furniture fires started by candles, matches or lighters and 46% started by smoking materials. Smoke alarms were present, but failed to operate in 17% of the fires started by smoking materials compared to 14% started by candles, matches or lighters. None were present in one-third of both types of fires.

Figure 16 shows a bigger discrepancy in terms of fire deaths and smoke alarm operation. When smoke alarms were present, they operated in 84% of the deaths resulting from home upholstered furniture fires started by candles, matches or lighters, but only 58% of the deaths from fires started by smoking materials.

Follow-up after a New Zealand smoke alarm installation program discovered that working smoke alarms were more likely to be found in homes without smokers or pre-school children compared to homes with smokers or pre-school children.⁶ Follow-up in a U.K. smoke alarm installation study also found that working smoke alarms were less likely in households with smokers.⁷ The Consumer Product Safety Commission's (CPSC's) National Smoke Detector Project found that unwanted activations caused the largest share of disabled smoke alarms.⁸

In their tests of nuisance alarm sources and smoke alarm performance, researchers at the National Institute of Standards and Technology (NIST) conducted two tests in which two smokers seated in a manufactured home's kitchen area smoked one cigarette each over a period of about four minutes. No alarm thresholds were reached in the first test, but in the second, two thresholds were reached in the ionization alarm closest to the smokers. They also noted that: "The mass concentrations during both tests appear to be approaching threshold levels for photoelectric alarms, suggesting repeated smoking, or more smokers, could produce threshold level values."⁹

⁶ Mavis Duncanson, Katherine Lawrence, Jean Simpson and Alistair Woodward, *Follow-up Survey of Auahi Whakatupato Smoke Alarm Installation Project in the Eastern Bay of Plenty*, New Zealand Fire Service Commission Research Report Number Seven, University of Otago, August 2000, from http://www.fire.org.nz/research/reports/reports/report_7.htm.

⁷ Diane Rowland, Caroub GiGuisseppi, Ian Roberts, Katherine Curtis, Helen Roberts, Laura Ginnelly, Mark, Sculpher, and Angela Wade. "Prevalence of Working Smoke Alarms in Local Authority Inner City Housing: Randomised Controlled Trial," *BMJ* 2002; 325:998-1001, online at <http://www.bmj.com/cgi/reprint/325/7371/998>.

⁸ Charles L. Smith, *Smoke Detector Operability Survey – Report on Findings*, Bethesda, MD: U.S. Consumer Product Safety Commission, November 1993, p. 12.

⁹ Richard W. Bukowski, Richard D. Peacock, Jason D. Averill, Thomas G. Cleary, Neslon P. Bryner, William D. Walton, Paul A. Reneke, and Erica D. Kuligowski, NIST Technical Note 1455, *Performance of Home Smoke Alarms: Analysis of the Response of Several Available Technologies in Residential Fire Settings*, Washington, DC: U.S. Department of Commerce, National Institute of Standards and Technology, revised February 2008, p. 194, available at <http://smokealarm.nist.gov/HSAT.pdf>.

Additional Information

Vytenis Babrauskas' chapter "Upholstered Furniture and Mattresses" in 20th edition of NFPA's *Fire Protection Handbook* provides information on materials used in upholstered furniture, flammability standards, smoldering vs. flaming heat sources, and testing.

NFPA has two standards related to flammability testing of upholstered furniture:

NFPA 260, *Standard Methods of Tests and Classification System for Cigarette Ignition Resistance of Components of Upholstered Furniture*, and

NFPA 261, *Standard Method of Test for Determining Resistance of Mock-Up Upholstered Furniture Material Assemblies to Ignition by Smoldering Cigarettes*.

Safety Tips

- If you smoke, choose "fire-safe" cigarettes that will self-extinguish if they are not inhaled for a few minutes. If you smoke, smoke outside. Be careful when smoking around upholstered furniture. Use large, deep, sturdy ashtrays and do not rest them on a sofa or chair. When lighting cigars, pipes, or cigarettes, make sure sparks from matches do not land on the couch or chair. In addition, whenever there has been smoking in a room, check under cushions and in cracks for discarded butts before going to bed or leaving the home. Do not smoke when drowsy, intoxicated or medicated. Never smoke where medical oxygen is used.
- Cigarette ignition-resistant upholstered furniture is more common now, but be aware of potential higher fire risk when purchasing antique or used furniture from the mid-1960s or before.
- Keep heaters and upholstered furniture at least three feet (1 meter) away from each other. See the manufacturer's instructions for how to operate and install the appliance safely.
- Do not place furniture near a fireplace or wood stove. Leave adequate space for ventilation. The furniture should be at least three feet (1 meter) away from a heat source.
- Eight percent of upholstered furniture fires were begun by someone, usually a child, playing with fire. Children should not be left unsupervised – particularly young children, sometimes as young as two, who play with fire but do not understand the consequences of it. Keep matches and lighters up high, out of the reach of children, preferably in a locked cabinet. Encourage children to tell an adult when they find matches and lighters.
- Extinguish all candles when leaving the room or going to sleep. Make sure candles are placed on a stable piece of furniture in sturdy holders that won't tip over.

Table 1. Home Structure Fires that Began with Upholstered Furniture, by Year 1980-2005

Reporting Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)	Adjusted Loss in Millions of 2005 Dollars
1980	36,900	1,360	2,970	\$220	\$521
1981	33,800	1,360	2,630	\$218	\$468
1982	27,500	1,190	2,530	\$272	\$550
1983	24,600	1,100	2,700	\$200	\$392
1984	24,100	1,090	2,310	\$217	\$407
1985	23,100	930	2,330	\$225	\$408
1986	22,100	1,070	2,200	\$234	\$417
1987	20,800	1,030	2,150	\$196	\$337
1988	20,200	1,100	2,290	\$223	\$369
1989	18,100	880	2,120	\$229	\$361
1990	16,400	870	2,050	\$257	\$384
1991	16,200	680	2,050	\$290	\$416
1992	15,200	630	1,660	\$188	\$262
1993	14,300	650	1,960	\$231	\$312
1994	14,000	670	1,710	\$234	\$308
1995	13,300	660	1,680	\$239	\$307
1996	12,800	650	1,610	\$249	\$311
1997	11,800	660	1,440	\$213	\$259
1998	11,600	540	1,430	\$225	\$269
1999*	8,100	490	870	\$255	\$298
2000	9,000	580	1,390	\$363	\$412
2001	9,500	620	1,080	\$313	\$346
2002	8,600	530	970	\$284	\$308
2003	7,500	650	960	\$294	\$313
2004	7,600	700	820	\$290	\$301
2005	7,100	530	930	\$365	\$365

* Estimates for 1999-2005 are based on data collected originally in NFIRS 5.0 only. Due to the smaller share of NFIRS data collected in 1999-2001, statistics for these years should be viewed with caution.

Note: These are national estimates of *non-confined* structure fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, civilian deaths and injuries are rounded to the nearest ten, and direct property damage is rounded to the nearest million dollars. These statistics include a proportional share of fires in which the item first ignited was undetermined or not reported.

Sources: NFIRS and NFPA survey. Inflation adjustments were based on Table No. 697, "Purchasing Power of the Dollar: 1950 to 2006," U.S. Census Bureau's *Statistical Abstract of the United States: 2008*, 127th Edition, 2007.

**Table 2. Home Structure Fires that Began with Upholstered Furniture
by Type of Material First Ignited
2002-2005 Annual Averages**

Type of Material	Fires		Civilian		Civilian		Direct	
			Deaths	Injuries	Property Damage (in Millions)			
Fabric, fiber, or finished goods made of cotton, blends, rayon or wool	5,550	(73%)	450	(76%)	710	(78%)	\$225	(73%)
Unclassified fabric, textile or fur	1,070	(14%)	70	(12%)	100	(11%)	\$46	(15%)
Multiple types of material	210	(3%)	20	(3%)	30	(4%)	\$9	(3%)
Plastic	170	(2%)	10	(1%)	20	(2%)	\$5	(1%)
Unclassified type of material	140	(2%)	10	(1%)	10	(1%)	\$4	(1%)
Plastic-coated fabric	100	(1%)	0	(0%)	10	(1%)	\$4	(1%)
Sawn wood, including finished lumber	70	(1%)	20	(3%)	10	(1%)	\$3	(1%)
Unclassified processed wood or paper	40	(1%)	0	(0%)	0	(0%)	\$1	(0%)
Unclassified natural product	40	(1%)	0	(0%)	0	(0%)	\$2	(1%)
Other known type	230	(3%)	20	(3%)	20	(2%)	\$10	(3%)
Total	7,630	(100%)	600	(100%)	920	(100%)	\$309	(100%)

Note: These are national estimates of *non-confined* fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires, civilian deaths and injuries are rounded to the nearest ten and direct property damage is rounded to the nearest million dollars. Property damage has not been adjusted for inflation. These statistics include a proportional share of fires in which the item first ignited was undetermined or not reported. Fires in which the type of material first ignited was unknown or not reported were allocated proportionally among fires with known type of material first ignited. Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.

**Table 3. Home Structure Fires that Began with Upholstered Furniture
by Area of Origin
2002-2005 Annual Averages**

Area of Origin	Fires		Civilian		Civilian		Direct	
			Deaths	Injuries	Property Damage	(in Millions)		
Living room, family room or den	2,990	(39%)	340	(56%)	440	(48%)	\$127	(41%)
Unclassified function area	1,700	(22%)	150	(25%)	220	(24%)	\$73	(24%)
Bedroom	1,110	(15%)	50	(8%)	120	(13%)	\$33	(11%)
Unclassified structural area	240	(3%)	10	(2%)	20	(2%)	\$9	(3%)
Unclassified area of origin	180	(2%)	20	(3%)	10	(1%)	\$6	(2%)
Garage or vehicle storage area*	160	(2%)	0	(0%)	10	(1%)	\$5	(2%)
Exterior balcony, unenclosed porch	160	(2%)	0	(0%)	20	(2%)	\$9	(3%)
Crawl space or substructure space	120	(2%)	0	(1%)	10	(1%)	\$6	(2%)
Kitchen or cooking area	120	(2%)	10	(2%)	10	(1%)	\$3	(1%)
Lobby or entrance way	70	(1%)	0	(0%)	10	(1%)	\$2	(1%)
Wall assembly or concealed space	70	(1%)	0	(0%)	0	(0%)	\$3	(1%)
Ceiling/floor assembly or concealed space	70	(1%)	0	(0%)	0	(0%)	\$2	(1%)
Courtyard, terrace or patio	60	(1%)	10	(1%)	0	(0%)	\$4	(1%)
Exterior wall surface	60	(1%)	0	(0%)	0	(0%)	\$1	(0%)
Multiple areas of origin	50	(1%)	0	(0%)	0	(0%)	\$7	(2%)
Unclassified outside area	50	(1%)	0	(0%)	0	(0%)	\$1	(0%)
Unclassified means of egress	40	(1%)	0	(0%)	10	(1%)	\$1	(0%)
Unclassified storage area	40	(1%)	0	(0%)	0	(0%)	\$1	(0%)
Other known area	350	(5%)	0	(1%)	30	(3%)	\$15	(5%)
Total	7,630	(100%)	600	(100%)	920	(100%)	\$309	(100%)

* Does not include dwelling garages coded as a separate property.

Note: These are national estimates of *non-confined* fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires, civilian deaths and injuries are rounded to the nearest ten and direct property damage is rounded to the nearest million dollars. Property damage has not been adjusted for inflation. These statistics include a proportional share of fires in which the item first ignited was undetermined or not reported. Fires in which the area of origin was unknown or not reported are allocated proportionally among fires with known area of origin. Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.

**Table 4. Home Structure Fires that Began with Upholstered Furniture
By Extent of Flame Damage
2002-2005 Annual Averages**

Extent of Flame Damage	Fires		Civilian		Civilian		Direct	
			Deaths	Injuries	Injuries	Property Damage (in Millions)		
Confined to object of origin	1,970	(26%)	40	(6%)	150	(16%)	\$23	(7%)
Confined to room of origin	2,570	(34%)	150	(25%)	280	(30%)	\$58	(19%)
Confined to floor of origin	790	(10%)	70	(12%)	120	(13%)	\$40	(13%)
Confined to building of origin	2,040	(27%)	270	(46%)	310	(34%)	\$154	(50%)
Extended beyond building of origin	260	(3%)	70	(11%)	50	(6%)	\$33	(11%)
Total	7,630	(100%)	600	(100%)	920	(100%)	\$309	(100%)

Source: NFIRS 5.0 and NFPA survey.

**Table 5. Home Structure Fires that Began with Upholstered Furniture, by Cause
2002-2005 Annual Averages**

Cause	Fires		Civilian		Civilian		Direct	
			Deaths	Injuries	Injuries	Property Damage (in Millions)		
Unintentional	5,780	(76%)	520	(87%)	760	(83%)	\$233	(75%)
Intentional	930	(12%)	30	(6%)	90	(10%)	\$42	(14%)
Failure of equipment or heat source	660	(9%)	30	(5%)	60	(7%)	\$27	(9%)
Unclassified	230	(3%)	10	(1%)	10	(1%)	\$5	(2%)
Act of nature	40	(0%)	0	(1%)	0	(0%)	\$2	(1%)
Total	7,630	(100%)	600	(100%)	920	(100%)	\$309	(100%)

Note: These are national estimates of *non-confined* fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires, civilian deaths and injuries are rounded to the nearest ten and direct property damage is rounded to the nearest million dollars. Property damage has not been adjusted for inflation. These statistics include a proportional share of fires in which the item first ignited was undetermined or not reported. Fires in which the extent of flame damage or cause was undetermined, under investigation or not reported were allocated proportionally among fires with known extent of flame damage or cause. Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.

**Table 6. Home Structure Fires that Began with Upholstered Furniture
by Factor Contributing to Ignition
2002-2005 Annual Averages**

Factor Contributing	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Abandoned or discarded material	2,250	(29%)	240	(39%)	310	(33%)	\$88	(29%)
Heat source too close	1,600	(21%)	130	(22%)	190	(20%)	\$71	(23%)
Electrical failure or malfunction	1,080	(14%)	80	(14%)	80	(9%)	\$48	(15%)
Unclassified misuse of material or product	980	(13%)	80	(13%)	140	(16%)	\$36	(12%)
Playing with heat source	600	(8%)	40	(6%)	90	(10%)	\$26	(8%)
Unclassified factor	570	(7%)	40	(7%)	80	(9%)	\$20	(7%)
Equipment unattended	150	(2%)	0	(0%)	10	(1%)	\$7	(2%)
Collision, knock down, or turn over	90	(1%)	0	(0%)	10	(1%)	\$4	(1%)
Unclassified mechanical failure or malfunction	80	(1%)	0	(0%)	0	(0%)	\$2	(1%)
Exposure fire	60	(1%)	0	(1%)	10	(1%)	\$2	(1%)
Unclassified operational deficiency	50	(1%)	0	(0%)	10	(1%)	\$3	(1%)
Equipment overloaded	50	(1%)	10	(1%)	20	(2%)	\$2	(1%)
Accidentally turned on or not turned off	50	(1%)	10	(1%)	10	(1%)	\$2	(1%)
Rekindle	50	(1%)	0	(0%)	0	(0%)	\$0	(0%)
Fire spread or control, other	50	(1%)	0	(0%)	10	(1%)	\$4	(1%)
Flammable liquid used to kindle fire	40	(1%)	0	(0%)	0	(0%)	\$2	(1%)
Animal	40	(1%)	0	(0%)	0	(0%)	\$3	(1%)
Other known factor	280	(4%)	10	(1%)	30	(3%)	\$15	(5%)
Total entries*	8,080	(106%)	630	(106%)	1,000	(109%)	\$335	(108%)
Total fires	7,630	(100%)	600	(100%)	920	(100%)	\$309	(100%)

*Multiple entries are allowed, resulting in more factor entries than fires.

Note: These are national estimates of *non-confined* fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires, civilian deaths and injuries are rounded to the nearest ten and direct property damage is rounded to the nearest million dollars. Property damage has not been adjusted for inflation. These statistics include a proportional share of fires in which the item first ignited was undetermined or not reported. Fires in which the factor contributing to ignition was undetermined, coded as “none,” or not reported were allocated proportionally among fires with known factor contributing to ignition. Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.

**Table 7. Home Structure Fires that Began with Upholstered Furniture
by Heat Source
2002-2005 Annual Averages**

Heat Source	Fires		Civilian		Civilian		Direct	
			Deaths	Injuries	Injuries	Property Damage (in Millions)		
Smoking materials	2,220	(29%)	310	(51%)	340	(37%)	\$85	(28%)
Candle	860	(11%)	20	(4%)	120	(13%)	\$40	(13%)
Hot ember or ash	750	(10%)	30	(6%)	90	(10%)	\$22	(7%)
Unclassified hot or smoldering object	680	(9%)	50	(8%)	60	(7%)	\$26	(9%)
Radiated, conducted heat from operating equipment	580	(8%)	30	(5%)	60	(6%)	\$24	(8%)
Arcing	520	(7%)	40	(6%)	40	(5%)	\$24	(8%)
Cigarette lighter	510	(7%)	40	(6%)	90	(10%)	\$26	(8%)
Unclassified heat from powered equipment	340	(4%)	30	(5%)	20	(2%)	\$15	(5%)
Unclassified heat source	330	(4%)	10	(2%)	20	(2%)	\$12	(4%)
Match	320	(4%)	20	(3%)	40	(4%)	\$13	(4%)
Spark, ember or flame from operating equipment	130	(2%)	20	(3%)	10	(1%)	\$5	(2%)
Multiple heat sources including multiple ignitions	70	(1%)	0	(0%)	10	(1%)	\$4	(1%)
Flame or torch used for lighting	60	(1%)	0	(0%)	10	(1%)	\$3	(1%)
Molten or hot material	40	(1%)	0	(0%)	0	(0%)	\$1	(0%)
Incendiary device	40	(1%)	0	(1%)	0	(0%)	\$2	(1%)
Fireworks	40	(1%)	0	(0%)	0	(0%)	\$1	(0%)
Other known heat source	120	(2%)	0	(0%)	10	(1%)	\$4	(1%)
Total	7,630	(100%)	600	(100%)	920	(100%)	\$309	(100%)

Note: These are national estimates of *non-confined* fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires, civilian deaths and injuries are rounded to the nearest ten and direct property damage is rounded to the nearest million dollars. Property damage has not been adjusted for inflation. These statistics include a proportional share of fires in which the item first ignited was undetermined or not reported. Fires in which the heat source was undetermined or not reported were allocated proportionally among fires with known heat source. Sums may not equal due to rounding errors. The estimates of matches, lighters, smoking materials and candles include a proportional share of fires in which the heat source was heat from an unclassified open flame or smoking material. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.

**Table 8. Home Structure Fires that Began with Upholstered Furniture
by Equipment Involved in Ignition
2002-2005 Annual Averages**

Equipment Involved	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
No equipment involved	5,870	(77%)	440	(74%)	720	(78%)	\$224	(72%)
Fixed or portable space heater	440	(6%)	70	(12%)	40	(4%)	\$28	(9%)
Lamp or lighting	200	(3%)	10	(1%)	30	(3%)	\$7	(2%)
Cord or plug	200	(3%)	30	(5%)	20	(2%)	\$8	(3%)
Wiring, switch or outlet	120	(2%)	10	(1%)	10	(1%)	\$5	(2%)
Air conditioner	80	(1%)	0	(0%)	10	(1%)	\$1	(0%)
Unclassified heating, ventilation or air conditioning	80	(1%)	10	(2%)	10	(1%)	\$5	(2%)
Cigarette or pipe lighter	70	(1%)	10	(2%)	40	(4%)	\$6	(2%)
Office, electronic or entertainment equipment	70	(1%)	10	(1%)	10	(1%)	\$3	(1%)
Unclassified personal or household equipment	60	(1%)	10	(1%)	10	(1%)	\$2	(1%)
Unclassified equipment involved in ignition	50	(1%)	0	(0%)	10	(1%)	\$1	(0%)
Heating pad	40	(1%)	0	(0%)	0	(0%)	\$2	(1%)
Fan	40	(0%)	0	(0%)	0	(0%)	\$2	(0%)
Other known equipment	320	(4%)	10	(1%)	40	(4%)	\$14	(4%)
Total	7,630	(100%)	600	(100%)	920	(100%)	\$309	(100%)

Note: These are national estimates of *non-confined* fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires, civilian deaths and injuries are rounded to the nearest ten and direct property damage is rounded to the nearest million dollars. Property damage has not been adjusted for inflation. These statistics include a proportional share of fires in which the item first ignited was undetermined or not reported. Fires in which the equipment involved in ignition was undetermined or not reported were allocated proportionally among fires with known equipment involved in ignition. Fires in which the equipment involved in ignition was entered as none but the heat source indicated equipment involvement or the heat source was unknown were also treated as unknown and allocated proportionally among fires with known equipment involved. Sums may not equal due to rounding errors. The estimates of matches, lighters, smoking materials and candles include a proportional share of fires in which the heat source was heat from an unclassified open flame or smoking material. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.

**Table 9. Home Upholstered Furniture Fires Started by Smoking Materials
by Year: 1980-2005**

Reporting Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)	Adjusted Loss in Millions of 2005 Dollars
1980	23,300	1,060	2,050	\$127	\$300
1981	21,800	1,120	1,890	\$136	\$292
1982	17,100	980	1,710	\$187	\$378
1983	14,500	850	1,800	\$110	\$216
1984	14,100	860	1,480	\$124	\$233
1985	12,800	720	1,470	\$122	\$220
1986	12,300	770	1,320	\$120	\$213
1987	11,400	700	1,370	\$100	\$172
1988	11,000	810	1,420	\$114	\$188
1989	9,400	670	1,170	\$112	\$177
1990	8,500	590	1,220	\$141	\$211
1991	8,200	450	1,140	\$131	\$187
1992	7,100	480	850	\$74	\$102
1993	6,900	440	1,060	\$107	\$145
1994	6,400	410	920	\$103	\$136
1995	6,200	490	860	\$109	\$140
1996	5,900	470	920	\$95	\$119
1997	5,300	450	740	\$90	\$110
1998	5,100	350	750	\$89	\$107
1999*	3,100	360	190	\$113	\$132
2000	3,100	330	500	\$123	\$139
2001	3,100	390	470	\$122	\$135
2002	2,600	230	280	\$70	\$76
2003	2,200	310	390	\$77	\$82
2004	2,300	370	310	\$79	\$82
2005	2,000	330	360	\$112	\$112

* Estimates for 1999-2005 are based on data collected originally in NFIRS 5.0 only. Due to the smaller share of NFIRS data collected in 1999-2001, statistics for these years should be viewed with caution.

Note: These are national estimates of *non-confined* structure fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, civilian deaths and injuries are rounded to the nearest ten, and direct property damage is rounded to the nearest million dollars. These statistics include proportional shares of fires in which the item first ignited or heat source was undetermined or not reported. The 1999-2005, estimates also include proportional shares of fires in which the heat source was an unclassified open flame or smoking material.

Sources: NFIRS and NFPA survey. Inflation adjustments were based on Table No. 697, "Purchasing Power of the Dollar: 1950 to 2006," U.S. Census Bureau's *Statistical Abstract of the United States: 2008*, 127th Edition, 2007.

**Table 10. Home Upholstered Furniture Fires
Started by Candles, Matches or Lighters, by Year: 1980-2005**

Reporting Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)	Adjusted Loss in Millions of 2005 Dollars
1980	6,900	200	570	\$36	\$86
1981	6,000	80	460	\$35	\$76
1982	4,800	100	430	\$29	\$59
1983	4,700	180	500	\$36	\$71
1984	4,600	110	480	\$39	\$73
1985	4,700	110	450	\$44	\$79
1986	4,500	130	500	\$47	\$84
1987	4,500	140	450	\$45	\$77
1988	4,300	130	430	\$43	\$72
1989	3,900	120	480	\$46	\$73
1990	3,500	110	520	\$48	\$73
1991	3,400	130	560	\$63	\$90
1992	3,800	80	480	\$43	\$60
1993	3,400	90	470	\$53	\$71
1994	3,600	160	510	\$64	\$84
1995	3,300	80	460	\$59	\$76
1996	3,000	70	390	\$58	\$72
1997	3,000	80	520	\$63	\$77
1998	3,000	120	390	\$59	\$71
1999*	2,400	0	620	\$80	\$93
2000	1,900	40	470	\$89	\$101
2001	2,100	90	280	\$77	\$85
2002	1,900	80	330	\$73	\$79
2003	1,700	30	220	\$71	\$76
2004	1,700	100	210	\$76	\$78
2005	1,600	80	240	\$95	\$95

* Estimates for 1999-2005 are based on data collected originally in NFIRS 5.0 only. Due to the smaller share of NFIRS data collected in 1999-2001, statistics for these years should be viewed with caution.

Note: These are national estimates of *non-confined* structure fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, civilian deaths and injuries are rounded to the nearest ten, and direct property damage is rounded to the nearest million dollars. These statistics include proportional shares of fires in which the item first ignited or heat source was undetermined or not reported. These statistics include a proportional share of fires in which the heat source or form of heat ignition was undetermined or not reported, as well as proportional shares of fires 1980-1998 in which the form of heat of ignition was an unclassified or unknown-type open flame or spark, and in 1999-2005, in which the heat source was an unclassified open flame or smoking material.

Sources: NFIRS and NFPA survey. Inflation adjustments were based on Table No. 697, "Purchasing Power of the Dollar: 1950 to 2006," *U.S. Census Bureau's Statistical Abstract of the United States: 2008*, 127th Edition, 2007.

**Table 11. Home Upholstered Furniture Fires Started by Smoking Materials
By Extent of Flame Damage
2002-2005 Annual Averages**

Extent of Flame Damage	Fires		Civilian		Civilian		Direct	
			Deaths	Injuries	Injuries	Property Damage (in Millions)		
Confined to object of origin	790	(36%)	37	(12%)	78	(23%)	\$6	(7%)
Confined to room of origin	710	(32%)	77	(25%)	106	(31%)	\$19	(22%)
Confined to floor of origin	200	(9%)	46	(15%)	35	(10%)	\$13	(15%)
Confined to building of origin	450	(20%)	130	(42%)	94	(28%)	\$41	(48%)
Extended beyond building of origin	70	(3%)	19	(6%)	24	(7%)	\$7	(8%)
Total	2,220	(100%)	309	(100%)	337	(100%)	\$85	(100%)

Source: NFIRS 5.0 and NFPA survey.

**Table 12. Home Upholstered Furniture Fires
Started by Candles, Matches or Lighters by Extent of Flame Damage
2002-2005 Annual Averages**

Extent of Flame Damage	Fires		Civilian		Civilian		Direct	
			Deaths	Injuries	Injuries	Property Damage (in Millions)		
Confined to object of origin	410	(24%)	0	(0%)	32	(13%)	\$6	(8%)
Confined to room of origin	600	(35%)	8	(11%)	59	(24%)	\$14	(17%)
Confined to floor of origin	210	(13%)	22	(29%)	33	(13%)	\$13	(17%)
Confined to building of origin	430	(25%)	42	(57%)	112	(45%)	\$42	(53%)
Extended beyond building of origin	40	(3%)	2	(3%)	13	(5%)	\$4	(5%)
Total	1,690	(100%)	75	(100%)	248	(100%)	\$79	(100%)

Note: These are national estimates of *non-confined* fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries are rounded to the nearest one, and direct property damage is rounded to the nearest million dollars. Property damage has not been adjusted for inflation. These statistics include a proportional share of fires in which the item first ignited was undetermined or not reported. They also include a proportional share of fires in which the heat source or form of heat ignition was undetermined or not reported and in which the heat source was an unclassified open flame or smoking material. Fires in which the extent of flame damage was undetermined or not reported were allocated proportionally among fires with known extent of flame damage. Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.

**Table 13. Home Upholstered Furniture Fires Started by Smoking Materials
by Factor Contributing to Ignition
2002-2005**

Factor Contributing	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage	
Abandoned or discarded materials or products	1,420	(64%)	212	(69%)	205	(61%)	\$58	(68%)
Unclassified misuse of material or product	430	(20%)	30	(10%)	74	(22%)	\$14	(17%)
Heat source too close to combustibles	230	(10%)	48	(15%)	34	(10%)	\$10	(12%)
Unclassified factor contributed to ignition	140	(6%)	23	(7%)	28	(8%)	\$6	(7%)
Playing with heat source	20	(1%)	0	(0%)	0	(0%)	\$0	(0%)
Unclassified operational deficiency	10	(1%)	0	(0%)	1	(0%)	\$0	(0%)
Other known factor	50	(2%)	7	(2%)	12	(3%)	\$2	(2%)
Total entries*	2,310	(104%)	319	(103%)	354	(105%)	\$90	(106%)
Total*	2,220	(100%)	309	(100%)	337	(100%)	\$85	(100%)

*Multiple entries are allowed, resulting in more factor entries than fires.

Note: These are national estimates of *non-confined* fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries are rounded to the nearest one, and direct property damage is rounded to the nearest million dollars. Property damage has not been adjusted for inflation. These statistics include a proportional share of fires in which the item first ignited was undetermined or not reported. They also include a proportional share of fires in which the heat source or form of heat ignition was undetermined or not reported and in which the heat source was an unclassified open flame or smoking material. Fires in which the factor contributing to ignition was undetermined, coded as "none," or not reported were allocated proportionally among fires with known factor contributing to ignition. Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.

**Table 14. Home Upholstered Furniture Fires
Started by Candles, Matches or Lighters, by Factor Contributing to Ignition
2002-2005**

Factor Contributing	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage	
Playing with heat source	570	(33%)	43	(57%)	92	(37%)	\$29	(37%)
Heat source too close to combustibles	530	(31%)	15	(21%)	60	(24%)	\$19	(24%)
Unclassified misuse of material or product	210	(12%)	6	(8%)	39	(16%)	\$12	(16%)
Abandoned or discarded materials or products	180	(10%)	4	(5%)	35	(14%)	\$10	(12%)
Unclassified factor contributed to ignition	120	(7%)	10	(13%)	34	(14%)	\$5	(6%)
Equipment unattended	40	(3%)	0	(0%)	3	(1%)	\$2	(2%)
Collision, knock down, or turn over	40	(3%)	0	(0%)	5	(2%)	\$3	(3%)
Animal	30	(2%)	0	(0%)	2	(1%)	\$2	(3%)
Fire spread or control, other	10	(1%)	0	(0%)	0	(0%)	\$1	(1%)
Flammable liquid or gas spilled	10	(1%)	0	(0%)	3	(1%)	\$0	(0%)
Improper container or storage	10	(1%)	0	(0%)	0	(0%)	\$0	(0%)
Flammable liquid used to kindle fire	10	(1%)	0	(0%)	1	(1%)	\$0	(0%)
Other known factor	40	(3%)	0	(0%)	8	(3%)	\$1	(1%)
Total entries*	1,800	(106%)	78	(104%)	282	(114%)	\$84	(106%)
Total	1,690	(100%)	75	(100%)	248	(100%)	\$79	(100%)

*Multiple entries are allowed, resulting in more factor entries than fires.

Note: These are national estimates of *non-confined* fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries are rounded to the nearest one, and direct property damage is rounded to the nearest million dollars. Property damage has not been adjusted for inflation. These statistics include a proportional share of fires in which the item first ignited was undetermined or not reported. They also include a proportional share of fires in which the heat source or form of heat ignition was undetermined or not reported and in which the heat source was an unclassified open flame or smoking material. Fires in which the factor contributing to ignition was undetermined, coded as “none,” or not reported were allocated proportionally among fires with known factor contributing to ignition. Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.

**Table 15. Home Structure Fires that Began with Upholstered Furniture,
by Smoke Alarm Status
2002-2005 Annual Averages**

Smoke Alarm Status	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Smoke alarms present	4,610	(60%)	320	(54%)	650	(71%)	\$211	(68%)
<i>Operated</i>	3,270	(43%)	210	(34%)	450	(49%)	\$168	(54%)
<i>Failed to operate</i>	1,090	(14%)	110	(19%)	180	(20%)	\$41	(13%)
<i>Fire too small to operate</i>	250	(3%)	0	(0%)	10	(2%)	\$1	(0%)
No smoke alarms	3,020	(40%)	280	(46%)	270	(29%)	\$98	(32%)
Total	7,630	(100%)	600	(100%)	920	(100%)	\$309	(100%)

Note: These are national estimates of *non-confined* fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires, civilian deaths and civilian injuries are rounded to the nearest ten and direct property damage is rounded to the nearest million dollars. Property damage has not been adjusted for inflation. All types of detection equipment are grouped together as “smoke alarms.” These statistics include a proportional share of fires in which the item first ignited was undetermined or not reported. Fires in which detection equipment presence or operation was undetermined or not reported were allocated proportionally among fires with known presence or operation. Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.

**Table 16. Victims of Home Upholstered Furniture Fires
with Operating Smoke Alarms, by Age Group
2002-2005 Annual Averages**

Age Group	Civilian Deaths	Relative Death Risk	Civilian Injuries	Relative Injury Risk	Population (in Millions)
0-4	12 (6%)	0.8	13 (3%)	0.4	19.9 (7%)
5-14	17 (8%)	0.6	22 (5%)	0.3	40.8 (14%)
15-24	14 (7%)	0.5	69 (15%)	1.1	41.4 (14%)
25-34	18 (9%)	0.6	71 (16%)	1.2	39.9 (14%)
35-44	18 (9%)	0.6	82 (18%)	1.2	44.3 (15%)
45-54	41 (20%)	1.4	73 (16%)	1.1	41.2 (14%)
55-64	21 (10%)	1.0	46 (10%)	1.0	28.5 (10%)
65-74	17 (8%)	1.3	32 (7%)	1.1	18.4 (6%)
75-84	36 (17%)	3.9	30 (7%)	1.5	12.9 (4%)
85 and older	12 (6%)	3.4	13 (3%)	1.8	4.8 (2%)
Total	207 (100%)	1.0	451 (100%)	1.0	292.3 (100%)

Note: These are national estimates of victims of *non-confined* fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Civilian deaths and injuries are rounded to the nearest one. All types of detection equipment are grouped together as “smoke alarms.” These statistics include a proportional share of fires in which the item first ignited, detection presence or detection operation was undetermined or not reported. Victims with unknown or unreported age were allocated proportionally among victims of known age. Relative risk was calculated by dividing the percent of casualties in each group by the percent of population in each age group. Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Sources: NFIRS 5.0 and NFPA survey. Population estimates were based on Table No. 7, “Resident Population by Age and Sex: 1950 to 2006,” U.S. Census Bureau’s *Statistical Abstract of the United States: 2008*, 127th Edition, 2007.

**Table 17. Victims of Home Upholstered Furniture Fires
with Smoke Alarms that Did Not Operate, by Age Group
2002-2005 Annual Averages**

Age Group	Civilian Deaths		Relative Death Risk	Civilian Injuries		Relative Injury Risk	Population (in Millions)	
0-4	10	(9%)	1.3	21	(12%)	1.7	19.9	(7%)
5-14	6	(5%)	0.4	3	(1%)	0.1	40.8	(14%)
15-24	6	(5%)	0.4	36	(20%)	1.4	41.4	(14%)
25-34	12	(10%)	0.7	35	(19%)	1.4	39.9	(14%)
35-44	18	(16%)	1.0	34	(19%)	1.2	44.3	(15%)
45-54	30	(26%)	1.9	21	(12%)	0.8	41.2	(14%)
55-64	12	(10%)	1.0	19	(11%)	1.1	28.5	(10%)
65-74	6	(5%)	0.8	6	(3%)	0.5	18.4	(6%)
75-84	12	(11%)	2.4	5	(3%)	0.6	12.9	(4%)
85 and older	3	(3%)	1.5	1	(1%)	0.4	4.8	(2%)
Total	114	(100%)	1.0	182	(100%)	1.0	292.3	(100%)

Note: These are national estimates of victims of *non-confined* fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Civilian deaths and injuries are rounded to the nearest one. All types of detection equipment are grouped together as “smoke alarms.” These statistics include a proportional share of fires in which the item first ignited, detection presence or detection operation was undetermined or not reported. Victims with unknown or unreported age were allocated proportionally among victims of known age. Relative risk was calculated by dividing the percent of casualties in each group by the percent of population in each age group. Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Sources: NFIRS 5.0 and NFPA survey. Population estimates were based on Table No. 7, “Resident Population by Age and Sex: 1950 to 2006,” U.S. Census Bureau’s *Statistical Abstract of the United States: 2008*, 127th Edition, 2007.

**Table 18. Victims of Home Upholstered Furniture Fires
with No Smoke Alarms Present, by Age Group
2002-2005 Annual Averages**

Age Group	Civilian Deaths	Relative Death Risk	Civilian Injuries	Relative Injury Risk	Population (in Millions)
0-4	34 (12%)	1.8	24 (9%)	1.3	19.9 (7%)
5-14	28 (10%)	0.7	14 (5%)	0.4	40.8 (14%)
15-24	22 (8%)	0.6	47 (17%)	1.2	41.4 (14%)
25-34	23 (8%)	0.6	45 (17%)	1.2	39.9 (14%)
35-44	26 (10%)	0.6	42 (16%)	1.0	44.3 (15%)
45-54	57 (21%)	1.5	55 (20%)	1.4	41.2 (14%)
55-64	33 (12%)	1.2	15 (5%)	0.6	28.5 (10%)
65-74	19 (7%)	1.1	15 (6%)	0.9	18.4 (6%)
75-84	32 (12%)	2.6	12 (4%)	1.0	12.9 (4%)
85 and older	2 (1%)	0.4	2 (1%)	0.5	4.8 (2%)
Total	276 (100%)	1.0	271 (100%)	1.0	292.3 (100%)

Note: These are national estimates of victims of *non-confined* fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Civilian deaths and injuries are rounded to the nearest one. All types of detection equipment are grouped together as “smoke alarms.” These statistics include a proportional share of fires in which the item first ignited or detection presence was undetermined or not reported. Victims with unknown or unreported age were allocated proportionally among victims of known age. Relative risk was calculated by dividing the percent of casualties in each group by the percent of population in each age group. Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Sources: NFIRS 5.0 and NFPA survey. Population estimates were based on Table No. 7, “Resident Population by Age and Sex: 1950 to 2006,” U.S. Census Bureau’s *Statistical Abstract of the United States: 2008*, 127th Edition, 2007.

**Table 19. Home Upholstered Furniture Fires Started by Smoking Materials
By Smoke Alarm Status: 2002-2005 Annual Averages**

Smoke Alarm Status	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Smoke alarms present	1,490	(67%)	200	(65%)	251	(75%)	\$61	(72%)
<i>Operated</i>	1,020	(46%)	116	(38%)	177	(53%)	\$46	(54%)
<i>Failed to operate</i>	380	(17%)	80	(26%)	66	(20%)	\$15	(17%)
<i>Fire too small to operate</i>	100	(4%)	4	(1%)	8	(2%)	\$0	(0%)
No smoke alarms	730	(33%)	109	(35%)	86	(25%)	\$24	(28%)
Total	2,220	(100%)	309	(100%)	337	(100%)	\$85	(100%)

Source: NFIRS 5.0 and NFPA survey.

**Table 20. Home Upholstered Furniture Fires
Started by Candles, Matches or Lighters, by Smoke Alarm Status
2002-2005 Annual Averages**

Smoke Alarm Status	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Smoke alarms present	1,140	(67%)	41	(55%)	193	(78%)	\$59	(75%)
<i>Operated</i>	840	(50%)	35	(47%)	144	(58%)	\$48	(61%)
<i>Failed to operate</i>	230	(14%)	7	(9%)	47	(19%)	\$11	(14%)
<i>Fire too small to operate</i>	60	(3%)	0	(0%)	2	(1%)	\$0	(0%)
No smoke alarms	560	(33%)	33	(45%)	55	(22%)	\$20	(25%)
Total	1,690	(100%)	75	(100%)	248	(100%)	\$79	(100%)

Note: These are national estimates of *non-confined* fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries are rounded to the nearest one, and direct property damage is rounded to the nearest million dollars. Property damage has not been adjusted for inflation. All types of detection equipment are grouped together as “smoke alarms.” These statistics include a proportional share of fires in which the item first ignited was undetermined or not reported. They also include a proportional share of fires in which the heat source or form of heat ignition was undetermined or not reported and in which the heat source was an unclassified open flame or smoking material. Fires in which detection equipment presence or operation was undetermined or not reported were allocated proportionally among fires with known presence or operation. Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.

Appendix A. How National Estimates Statistics Are Calculated

The statistics in this analysis are estimates derived from the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA's) annual survey of U.S. fire departments. NFIRS is a voluntary system by which participating fire departments report detailed factors about the fires to which they respond. Roughly two-thirds of U.S. fire departments participate, although not all of these departments provide data every year.

NFIRS provides the most detailed incident information of any national database not limited to large fires. NFIRS is the only database capable of addressing national patterns for fires of all sizes by specific property use and specific fire cause. NFIRS also captures information on the extent of flame spread, and automatic detection and suppression equipment. For more information about NFIRS visit <http://www.nfirs.fema.gov/>. Copies of the paper forms may be downloaded from <http://www.nfirs.fema.gov/download/nfirspaperforms2007.pdf>.

Each year, NFPA conducts an annual survey of fire departments which enables us to capture a summary of fire department experience on a larger scale. Surveys are sent to all municipal departments protecting populations of 50,000 or more and a random sample, stratified by **community size**, of the smaller departments. Typically, a total of roughly 3,000 surveys are returned, representing about one of every ten U.S. municipal fire departments and about one third of the U.S. population.

The survey is stratified by size of population protected to reduce the uncertainty of the final estimate. Small rural communities have fewer people protected per department and are less likely to respond to the survey. A larger number must be surveyed to obtain an adequate sample of those departments. (NFPA also makes follow-up calls to a sample of the smaller fire departments that do not respond, to confirm that those that did respond are truly representative of fire departments their size.) On the other hand, large city departments are so few in number and protect such a large proportion of the total U.S. population that it makes sense to survey all of them. Most respond, resulting in excellent precision for their part of the final estimate.

The survey includes the following information: (1) the total number of fire incidents, civilian deaths, and civilian injuries, and the total estimated property damage (in dollars), for each of the major property use classes defined in NFIRS; (2) the number of on-duty firefighter injuries, by type of duty and nature of illness; and (3) information on the type of community protected (e.g., county

versus township versus city) and the size of the population protected, which is used in the statistical formula for projecting national totals from sample results. The results of the survey are published in the annual report *Fire Loss in the United States*. To download a free copy of the report, visit <http://www.nfpa.org/assets/files/PDF/OS.fireloss.pdf>.

Projecting NFIRS to National Estimates

As noted, NFIRS is a voluntary system. Different states and jurisdictions have different reporting requirements and practices. Participation rates in NFIRS are not necessarily uniform across regions and community sizes, both factors correlated with frequency and severity of fires. This means NFIRS may be susceptible to systematic biases. No one at present can quantify the size of these deviations from the ideal, representative sample, so no one can say with confidence that they are or are not serious problems. But there is enough reason for concern so that a second database - the NFPA survey - is needed to project NFIRS to national estimates and to project different parts of NFIRS separately. This multiple calibration approach makes use of the annual NFPA survey where its statistical design advantages are strongest.

Scaling ratios are obtained by comparing NFPA's projected totals of residential structure fires, non-residential structure fires, vehicle fires, and outside and other fires, and associated civilian deaths, civilian injuries, and direct property damage with comparable totals in NFIRS. Estimates of specific fire problems and circumstances are obtained by multiplying the NFIRS data by the scaling ratios.

Analysts at the NFPA, the USFA and the Consumer Product Safety Commission have developed the specific analytical rules used for this procedure. "The National Estimates Approach to U.S. Fire Statistics," by John R. Hall, Jr. and Beatrice Harwood, provides a more detailed explanation of national estimates. A copy of the article is available online at <http://www.nfpa.org/osds> or through NFPA's One-Stop Data Shop.

Version 5.0 of NFIRS, first introduced in 1999, used a different coding structure for many data elements, added some property use codes, and dropped others.

Figure 1.

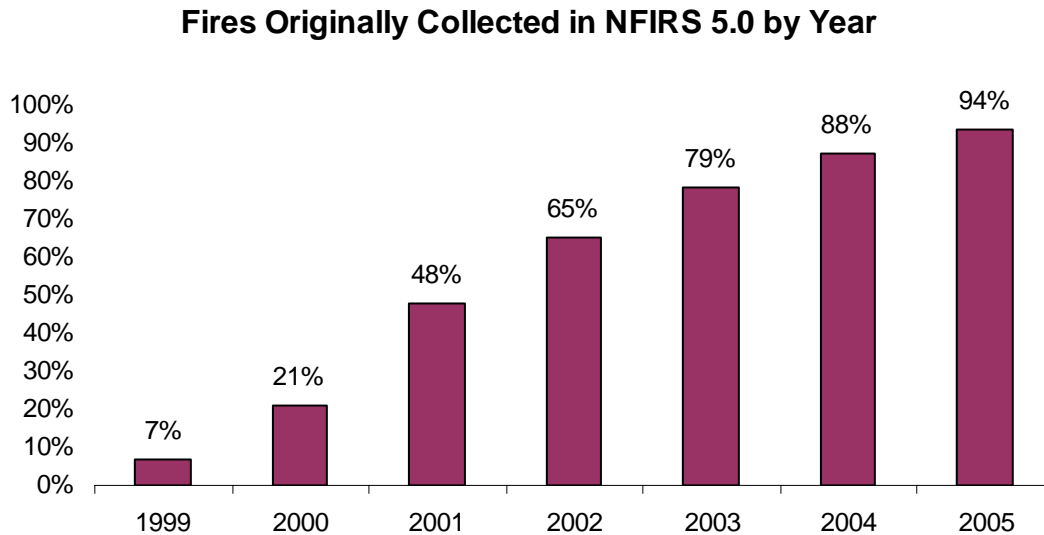


Figure 1 shows the percentage of fires originally collected in the NFIRS 5.0 system. Each year's release version of NFIRS data also includes data collected in older versions of NFIRS that were converted to NFIRS 5.0 codes.

For 2002 data on, analyses are based on scaling ratios using only data originally collected in NFIRS 5.0:

$$\frac{\text{NFPA survey projections}}{\text{NFIRS totals (Version 5.0)}}$$

For 1999 to 2001, the same rules may be applied, but estimates for these years in this form will be less reliable due to the smaller amount of data originally collected in NFIRS 5.0; they should be viewed with extreme caution.

A second option is to omit year estimates for 1999-2001 from year tables.

NFIRS 5.0 has six categories of confined structure fires, including:

- cooking fires confined to the cooking vessel,
- confined chimney or flue fires,
- confined incinerator fire,
- confined fuel burner or boiler fire or delayed ignition,
- confined commercial compactor fire, and
- trash or rubbish fires in a structure with no flame damage to the structure or its contents.

Although causal and other detailed information is typically not required for these incidents, it is provided in some cases. In order for that limited detail to be used to characterize the confined fires, they must be analyzed separately from non-confined fires.

Otherwise, the patterns in a factor for the more numerous non-confined fires with factor known will dominate the allocation of the unknown factor fires for both non-confined and confined fires. If the pattern is different for confined fires, which is often the case, that fact will be lost unless analysis is done separately.

For most fields other than Property Use, NFPA allocates unknown data proportionally among known data. This approach assumes that if the missing data were known, it would be distributed in the same manner as the known data. NFPA makes additional adjustments to several fields.

For Factor Contributing to Ignition, the code “none” is treated as an unknown and allocated proportionally. For Human Factor Contributing to Ignition, NFPA enters a code for “not reported” when no factors are recorded. “Not reported” is treated as an unknown, but the code “none” is treated as a known code and not allocated. Multiple entries are allowed in both of these fields. Percentages are calculated on the total number of fires, not entries, resulting in sums greater than 100%. Groupings for this field show all category headings and specific factors if they account for a rounded value of at least 1%.

Type of Material First Ignited (TMI). This field is required only if the Item First Ignited falls within the code range of 00-69. NFPA has created a new code “not required” for this field that is applied when Item First Ignited is in code 70-99 (organic materials, including cooking materials and vegetation, and general materials, such as electrical wire, cable insulation, transformers, tires, books, newspaper, dust, rubbish, etc..) and TMI is blank. The ratio for allocation of unknown data is:

$$\frac{\text{(All fires – TMI Not required)}}{\text{(All fires – TMI Not Required – Undetermined – Blank)}}$$

Heat Source. In NFIRS 5.0, one grouping of codes encompasses various types of open flames and smoking materials. In the past, these had been two separate groupings. A new code was added to NFIRS 5.0, which is code 60: “Heat from open flame or smoking material, other.” NFPA treats this code as a partial unknown and allocates it proportionally across the codes in the 61-69 range, shown below.

61. Cigarette,
62. Pipe or cigar,
63. Heat from undetermined smoking material,
64. Match,
65. Lighter: cigarette lighter, cigar lighter,
66. Candle,
67. Warning or road flare, fusee,
68. Backfire from internal combustion engine. Excludes flames and sparks from an exhaust system, (11)
69. Flame/torch used for lighting. Includes gas light and gas-/liquid-fueled lantern.

In addition to the conventional allocation of missing and undetermined fires, NFPA multiplies fires with codes in the 61-69 range by

$$\frac{\text{All fires in range 60-69}}{\text{All fires in range 61-69}}$$

The downside of this approach is that heat sources that are truly a different type of open flame or smoking material are erroneously assigned to other categories. The grouping “smoking materials” includes codes 61-63 (cigarettes, pipes or cigars, and heat from undetermined smoking material, with a proportional share of the code 60s and true unknown data.

Equipment Involved in Ignition (EII). NFIRS 5.0 originally defined EII as the piece of equipment that provided the principal heat source to cause ignition if the equipment malfunctioned or was used improperly. In 2006, the definition was modified to “the piece of equipment that provided the principal heat source to cause ignition.” However, the 2006 data is not yet available and a large portion of the fires coded as no equipment involved (NNN) have heat sources in the operating equipment category. To compensate, NFPA treats fires in which EII = NNN and heat source is not in the range of 40-99 as an additional unknown.

To allocate unknown data for EII, the known data is multiplied by

$$\frac{\text{All fires}}{\text{All fires} - \text{blank} - \text{undetermined} - [\text{fires in which EII} = \text{NNN and heat source} <> 40-99]}$$

Additional allocations may be used in specific analyses. For example, NFPA’s report about home heating fires treats Equipment Involved in Ignition Code 120, fireplace, chimney, other” as a partial unknown (like Heat Source 60) and allocates it over its related decade of 121-127, which includes codes for fireplaces (121-122) and chimneys (126-127) but also includes codes for fireplace insert or stove, heating stove, and chimney or vent connector. More general analyses of specific occupancies may not perform as many allocations of partial allocations. Notes at the end of each table describe what was allocated.

Rounding and percentages. The data shown are estimates and generally rounded. An entry of zero may be a true zero or it may mean that the value rounds to zero. Percentages are calculated from unrounded values. It is quite possible to have a percentage entry of up to 100%, even if the rounded number entry is zero. Values that appear identical may be associated with different percentages, and identical percentages may be associated with slightly different values.

Appendix B.

Previously Published Upholstered Furniture Fire Incidents

Published incidents provide information about what can happen, not what is typical.

Articles from NFPA publications about specific incidents illustrate some of the ways in which upholstered fire catches fire or is involved in fire. These incidents were taken from the "Firewatch" columns and annual studies of catastrophic fires in *NFPA Journal*. These incidents tend to be more serious than the typical fire.

Smoking Materials

Cigar Ignites Upholstered Chair in Fatal Fire, Maryland

An 80-year-old man whose upholstered chair ignited shortly after he lit a cigar suffered burns that led to his death nearly a month later.

The fire occurred in an 11-story, fire-resistive apartment building measuring 100 feet (30 meters) by 100 feet (30 meters). The structure, which had concrete floors and walls and a masonry exterior, was protected by a wet-pipe sprinkler system and a smoke detection system.

The victim said he lit a cigar while sitting in the chair in his eighth-floor apartment, and the next thing he saw was a flash. When the fire spread from the chair to the victim's shirt, he took off the burning shirt and dropped it to the floor, allowing the fire spread to the carpet. Although burned, he managed to go to a neighbor's apartment for help.

Responding firefighters, who received the 911 call at 4:19 p.m., found that a sprinkler had already extinguished the fire by the time they arrived. Investigators determined that dropped or discarded smoking materials ignited the inside of the chair.

The victim suffered second- and third-degree burns to his upper torso, face, and head. He lived for almost a month before succumbing to his injuries. The apartment, valued at \$200,000, sustained a \$30,000 loss; its contents, valued at \$30,000, sustained damages of \$10,000

Kenneth J. Tremblay, 2006, "Firewatch," *NFPA Journal*, May/June, 38.

Carelessly Discarded Cigarette Leads to Fatal Fire, Nebraska

A cigarette carelessly discarded in an overstuffed chair started a fire that killed a 46-year-old woman in her apartment.

The two-story, four-unit apartment building, which was 60 feet (18 meters) long and 30 feet (9 meters) wide, had brick exterior walls. There were smoke alarms in each unit, but they weren't part of a monitored fire-detection system. There were no sprinklers.

At 10:12 p.m., firefighters received a call from a neighbor who thought she heard a smoke detector sounding. Fire crews arrived minutes later and were directed to a smoke-filled, second-floor unit, where they found the unconscious woman. Paramedics transported her to the local hospital.

The fire was confined to the living room chair, although smoke damaged other parts of the apartment. Investigators found cigarette butts, empty cigarette packages, and burn marks throughout the apartment and determined that the victim had dropped a cigarette, which ignited the chair. The woman, who died of smoke inhalation, had a chronic illness that may have prevented her from escaping.

Although the unit of origin suffered heavy smoke damage, the rest of the building had only moderate smoke and heat damage. Losses to the building, valued at \$160,000, were estimated at \$5,000. Its contents, valued at \$10,000, sustained a \$5,000 loss.

Kenneth J. Tremblay, 2002, "Firewatch," *NFPA Journal*, November/December 18.

Cigarette Started Catastrophic Upholstered Furniture Fire, Michigan

In May 1999, a Michigan fire department was alerted at 4:45 a.m. to a fire in a two-story, single-family dwelling of unprotected wood-frame construction. Six people died in this fire.

A discarded cigarette ignited a couch in an enclosed porch that was used as a family room. The occupants thought they'd extinguished the fire, but it continued to smolder, burst into flames, and spread throughout the house.

The house had smoke alarms that worked on all levels. There was no alarm in the room of fire origin, though it wasn't required. Two of the victims were disabled and three others, who were visitors, were asleep and intoxicated.

Excerpted and adapted from Robert S. McCarthy, 2000, "1999 Catastrophic Fires," *NFPA Journal*, September/October, 56.

Open Flame or Intentional

Candles Ignite Deadly Fire, New Jersey

Several candles used for illumination and located throughout the home are believed to have started a deadly fire that killed a woman and two children. The utility company disconnected electrical power to the home earlier in the afternoon due to non-payment. The homeowner stated they were using candles about the house, but that all were extinguished before they retired for the evening. The single-family, one-story home did not have smoke alarms or sprinklers.

A dog woke an occupant who opened her bedroom door and found smoke and heat within the home. She called her daughter who responded and then exited the home using a rear door. The daughter called back to her mother that she couldn't make it out, as the mother tried to re-enter the home.

The fire department received the alarm at 2:11 a.m. and responded within nine minutes to find the home well involved, especially the living area. After the fire was controlled they found a 9-year old boy in one bedroom, a 28-year old female, and a 2-year old boy together in another bedroom.

Investigators believe that a candle on a wall-mounted holder fell and ignited a couch. Fire traveled horizontally throughout the house and trapped three of the occupants who succumbed of smoke inhalation. Three firefighters also received injuries during suppression. The estimated losses and the home's value were not reported.

Kenneth J. Tremblay, 2007, "Firewatch," *NFPA Journal*, July/August 27-28.

Child Ignites Fire in Apartment that Kills Four People, Georgia

Four people died in a fire that started when a child playing with a lighter ignited a sofa. The first-floor apartment fire quickly involved the entire unit when the fire department arrived. Firefighters entered a bedroom, performed a search, and quickly left when the fire got worse.

The two-story apartment building measured 30 feet (9 meters) by 60 feet (18 meters) and contained four units. It was a wooden-frame building with a brick veneer and a wooden-decked roof covered by asphalt shingles. Investigators were unable to locate any smoke detection equipment. There were no sprinklers.

The fire was detected by an occupant who called 911 at 7:56 p.m. Firefighters arrived five minutes later and found fire coming from windows and doors at the front and rear of the building. Witnesses reported several people trapped, as the first arriving crew entered a front bedroom window to do a quick search. Two 1-3/4-inch hose lines were advanced into the front door to extinguish the fire.

During the overhaul, firefighters found the bodies of two boys, 8 and 5, and a 9-year-old girl. Details of an adult who also died at the scene are unavailable. There were no firefighter injuries.

Kenneth J. Tremblay, 2007, "Firewatch," *NFPA Journal*, May/June 34.

Candle Fire in Basement Apartment Kills Man, Nebraska

A candle left burning on the floor in a rented basement room that had no smoke alarm started a fire that eventually burned itself out, but not before fatally injuring the room's occupant.

The fire occurred in a single-story, wood framed house with two living units on the first floor. Each unit also had a bedroom in the basement that was rented out to a single occupant. The only smoke alarm in the unsprinklered house, which measured 50 feet (15.2 meters) by 20 feet (6 meters), was in the first-floor hallway near sleeping areas. One of the basement renters smelled smoke and alerted the other occupants before calling the fire department at 6:08 a.m. He did not know whether the other basement renter, a 28-year-old man, was home at the time but told first responders he might be.

Fire crews arriving six minutes later found light smoke coming from the building but could see no fire. When they searched the lower level, they found that the blaze in the victim's room had nearly extinguished itself. Searching further, they found the man leaning against a clothes dryer in his room, overcome by smoke.

Investigators determined that the candle ignited a sofa and that the fire spread to a table and other combustibles, producing heavy smoke. The coroner's report stated that the victim died of severe carbon monoxide poisoning and had levels of an illegal substance and alcohol in his blood at the time of his death. All the house's other occupants, who were sleeping at the time, escaped unharmed.

Damage to the \$200,000 structure was approximately \$6,000.

Kenneth J. Tremblay, 2006, "Firewatch," *NFPA Journal*, January/February, 18.

Child-Playing Fire Kills Two Family Members, New York

A 6-year-old playing with fire ignited a couch, and the resulting blaze trapped his mother and two younger siblings in their apartment. Although the fire was primarily confined to the foam-filled sofa, it created enough smoke to block their exit. The child who started the fire got out of the apartment unharmed.

The fire occurred in a seven-story, 80-unit apartment building of fire resistive construction that measured 250 feet by 150 feet (76 by 46 meters). The building had a hardwired fire detection system that provided only a local alarm.

A call to 911 at 6:44 p.m. alerted the fire department, and firefighters were advancing hose lines to the unit of origin on the sixth floor within a few minutes of their arrival. They quickly controlled the fire and rescued the 41-year-old mother and her 3- and 5-year-old children within 8 to 10 minutes of dispatch or an estimated 16 to 18 minutes after ignition. Firefighters were able to revive the mother, but the two children died of smoke inhalation.

The fire began when the 6-year-old ignited some toilet paper while playing with the kitchen stove and carried it into the living room. When his mother entered the apartment from the rear, the boy hid the burning paper, either under a sofa cushion or under the sofa. The flames ignited the couch. The boy ran from the apartment, as his mother went to try to rescue her two younger children, who were trapped in a back room.

Damage to the building, valued at \$2.5 million, was estimated at \$10,000. Damage to its contents came to \$2,000. Two firefighters were injured fighting the fire. One suffered a knee injury and the other a back injury.

Kenneth J. Tremblay, 2000, "Firewatch," *NFPA Journal*, September/October 22-23.

Heating Equipment

Heater Starts Fatal Fire, Ohio

A six-year-old boy died of smoke inhalation in a fire that began when a heater ignited a couch on the screened porch of his single-family, wood-frame home. The two-story house, which had an asphalt roof, was 50 feet (15 meters) long and 30 feet (9 meters) wide. It had no smoke alarms.

The residents awoke at some point during the fire and tried to extinguish the flames using water from the kitchen before someone finally called 911 at 3:25 a.m. Firefighters arrived to find the room of origin totally involved in flames.

The location of the boy was not reported. The house, valued at \$65,000, and its contents, valued at \$10,000, were nearly destroyed.

Kenneth J. Tremblay, 2006, "Firewatch," *NFPA Journal*, November/December, 21.

Portable Heater Fire Kills Occupant, New York

A 65-year-old man died when a portable electric heater placed too close to the recliner in which he was sleeping ignited the chair or his blanket.

The two-story, wood-frame single family home, which was 36 feet (11 meters) long and 25 feet high (8 meters), had no smoke alarms or sprinklers.

At 4 a.m. a passerby called 911 after seeing flames 4 feet (1.2 meters) long coming from the windows of the house.

At some point during the fire, the victim tried to escape. He was found on the floor behind a door where he had succumbed to smoke inhalation and burns.

The house, valued at \$9,000, and its contents, valued at \$20,000, were destroyed.

Kenneth J. Tremblay, 2007, "Firewatch," *NFPA Journal*, January/February, 20.

Furniture on Floor Furnace Ignites Fatal Fire, California

A 29-year-old man died and a woman was injured in an early-morning fire that began after a sofa placed over a floor furnace in the man's single-family home ignited and burned undetected. The one-story, wood-frame house, which measured 36 feet (11 meters) by 40 feet (12 meters), had no smoke alarms or sprinklers.

Firefighters responding to the 3:34 a.m. 911 call found the woman outside the burning house from which she had escaped by crawling through a bedroom window, sustaining numerous lacerations. Fire crews who entered the house in search of the other occupant found him in the bathtub, dead of smoke inhalation. Apparently, he had become aware of the fire but went to look for his cat rather than escape. The cat was found dead in one of the bedrooms.

Investigators found that the furnace's thermostat had been turned up and determined that the heat had caused the sofa to ignite. The fire burned in a V-pattern from the living room to other areas of the home and down to a crawl space below.

Damage to the house, valued at \$700,000, was estimated at \$200,000. Its contents, valued at \$400,000, were destroyed.

Kenneth J. Tremblay, 2006, "Firewatch," *NFPA Journal*, September/ October, 32.

Smoke Alarm Alerts Occupant, Rhode Island

Smoke from a fast-moving fire in the living room of an apartment in a three-family house activated a smoke alarm, alerting the structure's occupant.

The three-story, wood-frame dwelling measured 30 feet (9 meters) by 26 feet (8 meters). Battery-operated smoke alarms had been installed in the apartment of origin, but there were no fire sprinklers.

The fire began around 10 a.m. when radiant heat from a portable electric space heater on a living room coffee table ignited the fabric of two couches. A smoke alarm alerted the occupant, who tried to control the fire with a portable fire extinguisher until smoke forced him from the room. The fire caused the apartment's windows to fail, and the exterior wood siding ignited before the fire department arrived.

Fire companies used master streams to knock down the heavy fire, then completed extinguishment using several hose lines on each floor. The \$200,000 building and its contents, valued at \$40,000, were destroyed. There were no injuries.

Kenneth J. Tremblay, 2004, "Firewatch," *NFPA Journal*, January/February 15.

Kerosene Heater ignited Upholstered Chair in Catastrophic Fire, North Carolina

In April 1999, a North Carolina fire department was notified at 11:55 a.m. of a fire in a single-family manufactured home of unprotected wood-frame construction. Five people died in this fire, including one child under age six.

An unvented kerosene heater ignited an upholstered chair in the living room, and the resulting fire spread throughout the home. There were no smoke alarms to warn the victims, who were all asleep when the fire broke out.

Excerpted and adapted from Robert S. McCarthy, 2000, "1999 Catastrophic Fires," *NFPA Journal*, September/October, 58.

Electrical Distribution or Lighting Equipment

Extension Cord Involved in Sofa Ignition Catastrophic Fire, North Carolina

In March 2006, a North Carolina fire department was notified at 4:00 a.m. of a fire in a 1½-story, single-family home of unprotected ordinary construction. Five people died in this fire, including one child under age six.

The fire originated in the living room. A couch was positioned against an extension cord plug. Pressure from the arm support flattened the plug causing a short circuit in the wiring. The short circuit ignited the couch. Fire burned into the fabric and foam cushion, producing heavy black smoke. Four of the victims were located in a first-story bedroom with doors closed. The fifth victim was found near the doorway. He had attempted to extinguish the fire with water from a sink.

There was a delay in reporting the fire, and one occupant attempted to extinguish the fire rather than evacuate. The remains of a smoke alarm was found, with battery installed, but it is undetermined if it activated.

Excerpted and adapted from Stephen G. Badger, 2007, "U.S. Multiple-Death Fires for 2006," *NFPA Journal*, September/October, 58.

Damaged Extension Cord Started Catastrophic Fire, Pennsylvania

In March 2006, a Pennsylvania fire department was notified at 2:30 a.m. of a fire in a two-story, single-family row house of unprotected ordinary construction. Five people died in this fire, including two children under age six. No smoke alarms or sprinklers were present.

An extension cord to a space heater was under a chair and was damaged by the weight of the chair. The damaged overloaded cord ignited the chair. The fire spread to a nearby

sofa then vented out the first-story front room. The fire also extended up an open stairway to the second-story hallway.

A heavy security screen and security storm door hindered escape of the victims and delayed the firefighters in their fire attack and rescue. The only exit was a front door. One victim had jumped and was found outside, while another was located on the first-story, and the other three were in a second-story bedroom.

Excerpted and adapted from Stephen G. Badger, 2007, "U.S. Multiple-Death Fires for 2006," *NFPA Journal*, September/October, 58 (adapted).

Overheated Power Strip Ignited Couch in Catastrophic Fire, Michigan

In July 2003, a Michigan fire department was notified at 10:00 p.m. of a fire in a two-story single-family dwelling of unprotected ordinary construction. The fire killed six people, including four children under the age of six. No smoke alarms or sprinklers were present.

A power strip for a window air-conditioning unit was pinned between a wall and couch. It overheated and ignited the couch, window treatments, and penetrated the joist space. The victims were in bed in second-story bedrooms and had no warning of the fire.

Excerpted and adapted from Stephen G. Badger, 2004, "Catastrophic Multi-Death Fires of 2003," *NFPA Journal*, September/October, 68-69.

Other or Undetermined Sources of Upholstered Furniture Ignition or Fire Spread to Upholstered Furniture

Sprinklers Douse High-Rise Fire, Minnesota

Two sprinklers activated and extinguished a fire in an apartment in a 20-story apartment building. At the time of the fire, the occupant of the second-floor apartment was not at home.

Each floor of the 149-unit building covered about 15,000 square feet (4,572 square meters) and was protected by a sprinkler system and fire detection system.

Firefighters received the alarm at 5:54 a.m. and responded to the apartment to find that the fire had already been extinguished. A small burned area in the living room contained the melted remains of a portable box-type fan and an upholstered swivel chair.

The apartment's occupant told investigators that the fan had been operating normally when he left the apartment about five hours earlier. The investigator determined that it malfunctioned and tipped over, igniting the carpeting and chair.

Losses were estimated at \$10,000. There were no injuries.

Kenneth J. Tremblay, 2006, Firewatch, *NFPA Journal*, July/August, 27.

Smoke Detectors Save Occupants From Fast-Moving Fire, Pennsylvania

Seven people owe their lives to an automatic fire detection system installed in a single-family home used for student housing. An intentionally set fire on the first floor quickly traveled up the stairs to the second and third floors, blocking the primary exit for the occupants. Four occupants on the second floor had no choice but to fall from second floor windows to escape. Two third-floor occupants were trapped and suffered smoke inhalation injuries.

The three-story wooden-frame dwelling measured 55 feet (16 meters) by 16 feet (4 meters) and had an asphalt-shingle roof. An automatic smoke detection system provided coverage in the bedrooms and common hallways. There were no sprinklers.

An occupant used an open flame device to ignite a blanket resting on top of an upholstered couch. The fire spread to the couch and throughout the living room before advancing vertically to upper floors. Two occupants of the second floor suffered trauma; two others from the same floor had smoke inhalation. The first-floor occupant also suffered smoke inhalation. The building, valued at \$100,000, was a total loss.

Kenneth J. Tremblay, 2007, "Firewatch," *NFPA Journal*, May/June 32-33.

Porch Fire Spreads into House, Massachusetts

Smoking materials dropped on a couch on the porch of a single-family house started a fire that spread into the home, trapping and killing an 89-year-old man. A passerby rescued three other occupants, and firefighters responding to a 911 call from the house saved a fourth.

The two-story, wood-frame house, which was 34 feet (10.4 meters) long and 24 feet (7.3 meters) wide, was unsprinklered. Smoke alarms had been installed in the basement and on the second floor, but their operation during the fire was not reported.

Investigators determined that the carelessly disposed of smoking materials ignited a couch on the porch. The fire then spread to other furnishings, aerosol cans, and a 20-pound (9-kilogram) propane cylinder, the contents of which contributed to the fire spread into the house.

The house, valued at \$125,000, sustained structural losses of \$80,000, and damage to its contents, valued at \$80,000, came to \$40,000.

The man firefighters rescued died of burns and smoke injuries about two months after the fire. The passerby who rescued the three occupants suffered smoke inhalation and burns, as did two firefighters.

Kenneth J. Tremblay, 2006, "Firewatch," *NFPA Journal*, January/February, 18.

Intentional Porch Fire Spreads through Window to Ignite an Upholstered Couch in Catastrophic Fire, Pennsylvania

In November 2003, a Pennsylvania fire department was notified at 3:42 a.m. of a fire in a two-story single-family dwelling of unprotected ordinary construction. The fire killed five people, including one child under six. Two smoke alarms were present, but one had a dead battery and the other had no battery.

This fire was set on a porch at the front door and extended to the porch roof and into the house via a front window where it ignited a foam-padded sofa. Smoke and flames extended via the stairway to the second story. Four victims were found on the second story.

Excerpted and adapted from Stephen G. Badger, 2004, "Catastrophic Multi-Death Fires of 2003," *NFPA Journal*, September/October, 70.

Fireworks inside a Residence Ignite Deadly Fire, Missouri

A 6-year old boy and a 40-year old male died when fireworks ignited the interior of their home. Investigators believe hot embers from fireworks ignited an upholstered sofa and quickly spread, trapping the occupants. Firefighters fought through the fire and heavy smoke coming from the front door and quickly found one victim and later a second, but both had succumbed to smoke inhalation and burn injuries.

The single-family home was constructed of wood framing with a wooden roof and asphalt shingles. The 1,200-square-foot (111-square-meter) home lacked smoke alarms and sprinklers.

The fire department received a call from a passerby at 11:50 p.m. and arrived five minutes later to find police on scene reporting a person possibly trapped. As flames came out the front door and window, firefighters advanced a hose line into the front door knocking down the heavy fire as they went.

Within 10 feet (3 meters) of the door, the first victim was found and removed to the front lawn. Firefighters suppressed the fire and continued the primary search. A second victim was found in the kitchen and removed. The fire was contained to the first floor and the dwelling ventilated as the investigation began. Damages to the home were not reported.

Kenneth J. Tremblay, 2007, Firewatch, *NFPA Journal*, September/October 26.

Four Die in House Fire, West Virginia

A family of four died in an early-morning fire that spread from the first-floor living room to the upper floors. By the time firefighters arrived, the house was engulfed in flames, and the fire was threatening the houses on either side.

The single-family, wood-framed home was two stories high with wood siding and a metal roof. It was 30 feet (9 meters) wide. No smoke detection equipment was found, and there were no fire sprinklers.

A passerby discovered the fire, and woke the neighbors, and tried to get the occupants out of the house. The fire department received the 911 call at 3:08 a.m. Arriving firefighters established a water supply and used two 1 ¾-inch hose lines to protect the exposures. A second engine company also established a water supply and advanced additional hose lines to back up the first responders. They tried to enter the house, but heavy fire drove them out, and the incident commander ordered a defensive approach.

Investigators determined that the fire began in the living room couch, but they couldn't determine what started it.

A man and a woman, both 44, and two boys, ages 14 and 11, succumbed to smoke inhalation. The house, valued at \$40,000 and its contents, valued at \$15,000 were destroyed.

Kenneth J. Tremblay, 2004, "Firewatch," *NFPA Journal*, March/April 19.

No Injuries in Early Morning Apartment Fire, Michigan

Seventy-five residents of an apartment building for older adults were evacuated safely even though smoke and flames spread to two floors and the attic during an early morning fire. Firefighters and sprinklers were able to limit fire spread to one interior fire division.

The L-shaped, 72-unit apartment building contained 24 units per floor, and the two wings were connected by a central common area. Each wing had a center corridor nearly 142 feet (43 meters) long by 58 feet (18 meters) wide. The common areas, which measured 94 feet by 58 feet (29 meters by 18 meters), included a day room, a lobby, a mechanical room, and storage rooms. The apartments and common area had hard-wired smoke detectors monitored by a central station alarm company. Standpipes and a partial wet-pipe sprinkler system protected the hallways and common areas.

At 1:56 a.m., the fire department received a 911 call reporting smoke on the second floor. Arriving three minutes later, firefighters noted smoke coming from the roof and second floor and, with the help of police officers, began evacuating the building and rescuing occupants from balconies.

The first five responding firefighters were joined by roughly 270 other emergency workers. They provided numerous ambulances and dry school buses that transported the residents from a temporary staging area in a nearby parking lot to the hospital, where the cafeteria was used as a temporary processing center. Five residents were treated for smoke inhalation.

The blaze began in an unoccupied second-floor apartment, where an unknown heat source ignited an upholstered chair. The fire spread to nearby curtains and out the open patio door, allowing the flames to spread up the building's wall to a third-floor apartment and the attic.

Using numerous resources, including a fire partition in the attic and a pre-incident plan, firefighters stopped the blaze from spreading into the common area and the building's other wing. The activation of 20 sprinklers also helped prevent the fire from spreading and protected the hallways for evacuation.

The \$1.6 million building suffered \$850,000 in damage. Contents, valued at \$1.5 million, sustained a \$750,000 loss. No firefighters were injured.

Kenneth J. Tremblay, 2001, Firewatch, *NFPA Journal*, July/August 24.

Smoke Detectors Save Occupants From Fast-Moving Fire, Pennsylvania

Seven people owe their lives to an automatic fire detection system installed in a single-family home used for student housing. An intentionally set fire on the first floor quickly traveled up the stairs to the second and third floors, blocking the primary exit for the occupants. Four occupants on the second floor had no choice but to fall from second floor windows to escape. Two third-floor occupants were trapped and suffered smoke inhalation injuries.

The three-story wooden-frame dwelling measured 55 feet (16 meters) by 16 feet (4 meters) and had an asphalt-shingle roof. An automatic smoke detection system provided coverage in the bedrooms and common hallways. There were no sprinklers.

An occupant used an open flame device to ignite a blanket resting on top of an upholstered couch. The fire spread to the couch and throughout the living room before advancing vertically to upper floors. Two occupants of the second floor suffered trauma; two others from the same floor had smoke inhalation. The first-floor occupant also suffered smoke inhalation. The building, valued at \$100,000, was a total loss.

Kenneth J. Tremblay, 2007, Firewatch, *NFPA Journal*, May/June 32-33.

Sprinklers Extinguish Fire in Home Oxygen Unit, Arizona

Careless disposal of smoking materials contributed to the smoke-inhalation death of a woman in her single-family home, despite the activation of two sprinklers that extinguished the flames.

The single-story, wood-frame house, which measured 50 feet (15 meters) by 40 feet (12 meters), had a stucco exterior and a tile roof. The home had a wet-pipe residential sprinkler system and a local smoke alarm, but neither system was monitored, and the smoke alarm may not have activated during the fire.

Investigators believe that smoking materials carelessly disposed of in a wastebasket ignited paper. When the occupant discovered the fire, she moved the wastebasket to the sink to extinguish it, but not before the fire burned through plastic oxygen tubing running under the basket. Flames spread along the oxygen-enriched tubing, igniting an upholstered stool and the oxygen generator in the first-floor living room. The fire was finally extinguished by two sprinklers, which operated above each burning item.

Water flowing from under the garage alerted a neighbor, who called the fire department at 9:30 a.m. Responding firefighters discovered the woman in the bathroom, where she had succumbed to smoke inhalation.

The house and its contents, valued at \$200,000, suffered an estimated loss of \$40,000

Kenneth J. Tremblay, 2004, "Firewatch," *NFPA Journal*, November/December, 17.

Appendix C. Methodology and Definitions Used in “Leading Cause” Tables

The cause table reflects relevant causal factors that accounted for at least 2% of the fires in a given occupancy. Only those causes that seemed to describe a scenario are included. Because the causal factors are taken from different fields, some double counting is possible. Percentages are calculated against the total number of structure fires, including both confined and non-confined fires. Bear in mind that every fire has at least three “causes” in the sense that it could have been prevented by changing behavior, heat source, or ignitability of first fuel, the last an aspect not reflected in any of the major cause categories. For example, several of the cause categories in this system refer to types of equipment (cooking, heating, electrical distribution and lighting, clothes dryers and washers, torches). However, the problem may be not with the equipment but with the way it is used. The details in national estimates are derived from the U.S. Fire Administration’s National Fire Incident Reporting System (NFIRS). This methodology is based on the coding system used in Version 5.0 of NFIRS. The *NFIRS 5.0 Reference Guide*, containing all of the codes, can be downloaded from <http://www.nfirs.fema.gov/documentation/reference/>.

Cooking equipment and heating equipment are calculated by summing fires identified by equipment involved in ignition and relevant confined fires. Confined fires will be shown if they account for at least 1% of the incidents. **Confined cooking fires** (cooking fires involving the contents of a cooking vessel without fire extension beyond the vessel) are identified by NFIRS incident type 113;

Confined heating equipment fires include **confined chimney or flue fires** (incident type 114) and **confined fuel burner or boiler** fires (incident type 116). The latter includes delayed ignitions and incidents where flames caused no damage outside the fire box. The two types of confined heating fires may be combined or listed separately, depending on the numbers involved.

Contained trash or rubbish fires with no flame damage to structure or its contents are identified by incident type 118. No cause can be ascertained for these incidents, but they account for a substantial share of the incidents in some occupancies. When appropriate, these fires are generally shown at the bottom of a cause table.

Confined or contained fires (incident type 113-118) are excluded from the remaining estimates. Unknown data is allocated proportionally among non-confined fires.

Intentional fires are identified by fires with a “1” (intentional) in the field “cause.” The estimate includes a proportional share of fires in which the cause was undetermined after investigation, under investigation, or not reported. All fires with intentional causes are included in this category regardless of the age of the person involved. Earlier versions of NFIRS included codes for incendiary and suspicious; both convert to intentional. Intentional fires were deliberately set; they may or may not be incendiary in a legal sense. No age restriction is applied.

Fires caused by **playing with heat source** (typically matches or lighters) are identified by code 19 in the field “factor contributing to ignition.” Because of conversion issues, only data originally collected in Version 5.0 of NFIRS is used in the initial calculation. It appears that “none” is often being used in place of “unknown.” Fires in which the factor contribution to ignition was undetermined (UU), entered as none (NN) or left blank are considered unknown and allocated proportionally. Because factor contributing to ignition is not required for intentional fires, the share unknown, by these definitions, is somewhat larger than it should be. After the Version 5.0 only data has been run for non-confined fires and the unknown data allocated, percentages are calculated for each code of Version 5.0 non-confined fires. Total non-confined structure fires (all versions) are multiplied by these percentages to obtain national estimates. The final percentage of fires is calculated by dividing these estimates by the total number of confined and non-confined fires from all versions.

The heat source field is used to identify fires started by: **smoking materials** (cigarette, code 61; pipe or cigar, code 62; and heat from undetermined smoking material, code 63); **candles** (code 66), **lightning** (code 73); and **spontaneous combustion or chemical reaction** (code 72). Fires started by heat from unclassified open flame or smoking materials (code 60) are allocated proportionally among the “other open flame or smoking material” codes (codes 61-69) in an allocation of partial unknown data. This includes smoking materials and candles. This approach results in any true unclassified smoking or open flame heat sources such as incense being inappropriately allocated. However, in many fires, this code was used as an unknown.

The equipment involved in ignition field is used to find several cause categories. This category includes equipment that functioned properly and equipment that malfunctioned.

Identified cooking equipment refers to equipment used to cook, heat or warm food (codes 600, 620-649 and 654). Fire in which ranges, ovens or microwave ovens, food warming appliances, fixed or portable cooking appliances, deep fat fryers, open fired charcoal or gas grills, grease hoods or ducts, or other cooking appliances) were involved in the ignition are said to be caused by cooking equipment. Food preparation devices that do not involve heating, such as can openers or food processors, are not included here. Unclassified kitchen and cooking equipment (code 600) is included here because a larger share of the whole category involved cooking rather than kitchen equipment.

Identified heating equipment (codes 100 and 120-199) includes central heat, portable and fixed heaters (including wood stoves), fireplaces, chimneys, hot water heaters, and heat transfer equipment such as hot air ducts or hot water pipes. Heat pumps are not included. Unclassified heating, ventilation and air condition equipment (code 100) is included here because a larger share of the whole category involved heating rather than air conditioning or ventilation equipment.

Electrical distribution and lighting equipment (codes 200-299) include: fixed wiring; transformers; associated overcurrent or disconnect equipment such as fuses or circuit breakers; meters; meter boxes; power switch gear; switches,

receptacles and outlets; light fixtures, lamps, bulbs or lighting; signs; cords and plugs; generators, transformers, inverters, batteries and battery charges.

Torch, burner or soldering iron (codes 331-334) includes welding torches, cutting torches, Bunsen burners, plumber furnaces, blowtorches, and soldering equipment.

Clothes dryer or washer (codes 811, 813 and 814) includes clothes dryers alone, washer and dryer combinations within one frame, and washing machines for clothes.

Electronic, office or entertainment equipment (codes 700-799) includes: computers and related equipment; calculators and adding machines; telephones or answering machines; copiers; fax machines; paper shredders; typewriters; postage meters; other office equipment; musical instruments; stereo systems and/or components; televisions and cable TV converter boxes; cameras, excluding professional television studio cameras, video equipment and other electronic equipment. Older versions of NFIRS had a code for electronic equipment that included radar, X-rays, computers, telephones, and transmitter equipment. Because this code was so broad, it unfortunately converts to equipment involved undetermined.

Shop tools and industrial equipment excluding torches, burners or soldering irons (codes 300-330, 335-399) includes power tools; painting equipment; compressors; atomizing equipment; pumps; wet/dry vacuums; hoists, lifts or cranes; powered jacking equipment; water or gas drilling equipment; unclassified hydraulic equipment; heat-treating equipment; incinerators, industrial furnaces, ovens or kilns; pumps; compressors; internal combustion engines; conveyors; printing presses; casting, molding; or forging equipment; heat treating equipment; tar kettles; working or shaping machines; coating machines; chemical process equipment; waste recovery equipment; power transfer equipment; power takeoff; powered valves; bearings or brakes; picking, carding or weaving machines; testing equipment; gas regulators; separate motors; non-vehicular internal combustion engines; and unclassified shop tools and industrial equipment.

Medical equipment (codes 410-419) includes: dental, medical or other powered bed, chair or wheelchair; dental equipment; dialysis equipment; medical monitoring and imaging equipment; oxygen administration equipment; radiological equipment; medical sterilizers, therapeutic equipment and unclassified medical equipment.

Mobile property (vehicle) describes fires in which some type of mobile property was involved in ignition, regardless of whether the mobile property itself burned. Mobile property includes: highway-type vehicles such as cars, trucks, recreational vehicles, and motorcycles; trains, trolleys and subways; boats and ships; aircraft; industrial, agricultural and construction vehicles; and riding lawn mowers, snow removal vehicles and tractors. Because of conversion issues, only data originally collected in Version 5.0 of NFIRS is used in the initial calculation. The data was obtained by first running Version 5.0 non

confined fires only to identify vehicles that were involved in ignition whether or not they burned themselves (mobile property involved codes 2 and 3). After the unknown data was allocated, percentages are calculated for each code of Version 5.0 non-confined fires. Total non-confined structure fires (all versions) are multiplied by these percentages to obtain national estimates. The final percentage of fires is calculated by dividing these estimates by the total number of confined and non-confined fires from all versions.

Exposures are fires that are caused by the spread of or from another fire. These include fires in which the exposure number is greater than 0; the factor contributing to ignition is property too close (code 71); or heat source is heat spreading from another fire via direct flame or convection current (code 80-89). Because exposures are identified by the older hierarchical sort, all non-confined fires with exposure number greater than zero are counted as exposures, but those identified by heat source and factor contributing to ignition include only fires that were not grouped in other categories such as cooking or heating equipment.