

## **MANUFACTURED HOME FIRES**

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## Executive Summary

In 2002, an estimated 17,200 structure fires in manufactured homes were reported in the U.S., with associated losses of 210 civilian deaths, 510 civilian injuries, and \$134 million in direct property damage.

Fires and associated losses have declined by one-third to one-half since 1980 if direct property damage is adjusted for inflation. The rate of decline has been comparable to that for other types of homes (i.e., dwellings, duplexes, apartments).

Manufactured homes built after the introduction of the HUD standards have lower rates of civilian deaths per reported fire than those built before the HUD standards were introduced. The death rate was 54% lower in 1994-1998. From 1999 on, the reporting of unit age has become so rare that statistics are not reliable.

Manufactured homes have a higher rate of civilian deaths per hundred reported fires than do other dwellings, but as of 1999-2002, they have nearly the same risk of fire death relative to the number of occupied units.

Post-standard manufactured homes are more likely to have fires confined to room of origin, and this correlates with provisions of the standards that are designed to achieve such confinement. Sections 3280.203 – 3280.206 of the HUD standards provide requirements that are intended to slow or limit the spread of a fire by such means as:

- flame spread requirements for interior finish materials on
  - exposed walls,
  - columns,
  - partitions, and
  - ceilings;
- more targeted flame spread requirements for
  - wall and floor coverings near central heating units or water heaters,
  - interior finishes exposed to cooking ranges,
  - kitchen cabinet surfaces, and
  - plastic bathroom fixtures; and
- firestopping requirements.

The percentage of fires confined to room of origin was 15 percentage points higher for post-standard manufactured homes, compared to pre-standard manufactured homes, in 1994-1998 and 9 percentage points higher in 1999-2002 (excluding confined fires).

Smoke alarms are associated with a substantially lower civilian death rate per 100 fires in post-standard manufactured homes and, less consistently, in pre-standard manufactured homes.

Smoke alarms reportedly are missing in a large share of all post-standard manufactured home fires where smoke alarm status was reported (45% in 1999-2002). Because all post-standard manufactured homes are required to be sold with smoke alarms installed, this implies a disturbingly high rate of smoke alarm removal by occupants.

## Table of Contents

	<b>Page</b>
Executive Summary	i
Table of Contents	iii
List of Tables and Figures	iv
Manufactured Home Fire Problem	1
Effects of HUD Standards	5
Appendix A: How National Estimates Are Calculated	31

## List of Tables and Figures

	<b>Page</b>
Table 1. Overview of Manufactured Home Fires	3
Table 2. Civilian Deaths and Injuries per 100 Fires in Pre-Standard vs. Post-Standard Manufactured Homes	10
Table 3. U.S. Manufactured Home Fire Rates by Age of Unit	11
Table 4. U.S. Manufactured Homes vs. Other Dwellings	12
Table 5. Loss per Fire, by Extent of Flame Damage	14
Figure 1. Percent of Fires Confined to Room of Origin, by Cause	16
Table 6. Pre-Standard and Post-Standard Manufactured Home Fires	18
Table 7. Pre-Standard and Post-Standard Manufactured Home Civilian Fire Deaths	20
Table 8. Pre-Standard and Post-Standard Manufactured Home Civilian Fire Injuries, by Cause	22
Table 9. Pre-Standard and Post-Standard Manufactured Home Direct Property Damage	24
Table 10. Manufactured Home Fires, by Cause and Year	26
Figure 2. Civilian Death Rates per Hundred Fires, With and Without Smoke Alarms	30

## Manufactured Home Fire Problem

### **In 2002, 17,200 structure fires were reported in manufactured homes in the U.S.**

These fires had associated losses of 210 civilian deaths, 510 civilian injuries, and \$134 million in direct property damage. Of the 17,200 fires, 3,900 fires were confined fires (e.g., confined to a chimney, oven, or pan on a stove). Fires and associated losses have declined by one-third to one-half since 1980 if direct property damage is adjusted for inflation. The rate of decline has been comparable to that for other types of homes (i.e., dwellings, duplexes, and apartments). (See Table 1A.)

Manufactured home fires in the U.S. are about 20 times the corresponding number of fires in Canada. The population ratio is roughly 9-to-1, which would suggest a higher fire rate in the U.S. However, the ratio of housing units of the manufactured-home type is more than 40-to-1 (7,219,000 vs. 157,560), based on the U.S. census figure for 2001 occupied housing units in “mobile home or trailer” and the Canadian census figure for 2001 dwelling units in “moveable dwellings.”\* This implies that the U.S. manufactured home fire incident rate, relative to usage, is considerably lower than the Canadian rate. This is even more true for civilian fire deaths. (See Table 1B.)

### **A manufactured home is not a motor home or trailer, and although it is often called a “mobile home,” it is not that either.**

A manufactured home is a structure built on a chassis and designed to be towed by a vehicle to a permanent or semi-permanent site, where it will be used as a single-family residence. (Similar structures can be used for other purposes, such as temporary offices, but such uses are excluded from the definitions and statistics here.) Prior to 1999, manufactured homes were identified in the National Fire Incident Reporting System (NFIRS) as Mobile Property Type 17, used to identify mobile buildings; Specific Fixed Property Use 410-419, one- or two-family dwellings; and Type of Situation Found 11, used to identify structure fires. Manufactured homes in transit would be coded as Type of Situation Found 13 (vehicle fire) and should not be included.

Manufactured homes are no longer called “mobile homes” by the industry to avoid confusion with motor homes or travel or camping trailers, which are designed for routine relocation from place to place. These properties have their own codes in the national fire incident data bases. Manufactured homes also should not be confused with modular or prefabricated homes, where major components of a home are manufactured as units off-site, then assembled on-site, where they are subject to the regulations of the local authority.

In 1976, the U.S. Department of Housing and Urban Development (HUD) took jurisdiction over fire safety standards for the manufacture of manufactured homes. Therefore, pre-1976 and post-1976 manufactured homes are referred to as pre-standard and post-standard manufactured homes, respectively.

Most of the requirements of the HUD standards were part of NFPA’s voluntary consensus standard for manufactured homes (NFPA 501B) prior to 1976. For this reason and the fact

\*Statistics Canada website, accessed March 19, 2003; *Statistical Abstract of the United States 2002*, Table 936.

that some of these features (e.g., smoke alarms) are not difficult to retrofit, it cannot be assumed that all pre-1976 manufactured homes lack the features specified in the HUD standards.

Beginning in 1999, NFIRS Version 5.0 changed the relevant codes. The new Incident Type codes potentially relevant to manufactured homes and their treatment in this report are as follows:

<b>Incident Type</b>	<b>How It Is Treated</b>
121 – Mobile home used as fixed residence	Included if Property Use = 410-419. In 1999-2002, 95.4% of Incident Type 121 fires were coded as Property Use 410-419.
120 – Unclassified mobile property used as a fixed property	Included if Property Use = 410-419. In 1999-2002, 41.1% of Incident Type 120 fires were coded as Property Use 410-419.
122 – Motor home, camper, or recreational vehicle used as a structure.	Excluded because they are a different type of property. In 1999-2002, 46.9% of Incident Type 122 fires were coded as Property Use 410-419.
123 – Portable building used at a fixed location, typically for commercial or educational purposes.	Excluded. In 1999-2002, 4.7% of Incident Type 123 fires were coded as Property Use 410-419.
113-118 – New codes for confined fires in structures.	Included proportionally, based on the ratio between fires coded Incident Type 120-121 to fires coded Incident Type 110-112 within fires coded as Property Use 410-419. Manufactured home fires with these codes cannot be directly separated from the fires in other dwellings.

**Table 1. Overview of Manufactured Home Fires  
Structure Fires Reported to Fire Departments**

**A. U.S., 1980-2002**

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)	
				Current Dollars	In 2002 Dollars
1980	29,700	410	860	\$135	\$295
1981	27,100	530	850	\$142	\$280
1982	28,300	460	1,020	\$145	\$270
1983	26,300	480	870	\$167	\$301
1984	26,000	380	820	\$193*	\$334*
1985	25,800	550	860	\$174	\$291
1986	25,400	410	840	\$169	\$278
1987	22,900	450	800	\$140	\$221
1988	23,600	510	960	\$157	\$238
1989	20,200	430	920	\$140	\$203
1990	19,100	380	750	\$170	\$235
1991	19,800	370	920	\$190	\$251
1992	19,300	380	850	\$157	\$201
1993	20,100	400	920	\$201	\$250
1994	19,200	350	870	\$148	\$179
1995	18,200	430	860	\$154	\$182
1996	17,900	440	800	\$173	\$199
1997	17,500	320	650	\$158	\$177
1998	15,500	190	640	\$144	\$159
1999	13,600 (13,300)	200 (200)	560 (560)	\$125 (\$124)	\$135
2000	12,900 (12,100)	270 (270)	510 (510)	\$128 (\$128)	\$134
2001	14,600 (12,200)	270 (270)	630 (600)	\$119 (\$118)	\$120
2002	17,200 (13,300)	210 (210)	550 (510)	\$135 (\$134)	\$135

\*This reflects the effect of one National Fire Incident Reporting System (NFIRS) fire reported to have a loss of \$10 million, which therefore added \$24.2 million to the national estimates total in current dollars.

Note: All fires are 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 estimated to the nearest hundred, deaths and injuries to the nearest ten, and direct property damage to the nearest million dollars. Inflation adjustment to 2002 dollars is done using the consumer price index.

Statistics shown in parentheses are without allocation of confined fires. "Confined fires" refer to fires confined to chimneys, cooking equipment (e.g., ovens, pots, pans on stoves), furnaces, or trash containers. Such fires do not have to be coded for most details, including manufactured home vs. other dwelling. Confined fires in manufactured homes are estimated based on the manufactured home share of all other fires in one- and two-family dwellings.

Source: NFIRS and NFPA survey.

**Table 1. Overview of Manufactured Home Fires  
Structure Fires Reported to Fire Departments (Continued)**

**B. Canada, 1990-1999**

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)		
				In Canadian Dollars	In U.S. Dollars	In 2002 U.S. Dollars
1990	1,200	30	60	\$19	\$17	\$23
1991	1,100	30	50	\$17	\$15	\$19
1992	1,000	30	80	\$18	\$15	\$20
1993	800	20	30	\$13	\$10	\$13
1994	700	10	30	\$12	\$9	\$11
1995	900	20	50	\$18	\$13	\$15
1996	1,000	30	70	\$24	\$18	\$21
1997	600	20	40	\$15	\$11	\$12
1998	700	10	40	\$14	\$10	\$11
1999	700	20	60	\$13	\$9	\$10

Note: Deaths and injuries include firefighter casualties, which are not included in U.S. figures. Category includes “trailers,” which are excluded from U.S. figures. Fires are estimated to the nearest hundred, deaths and injuries to the nearest ten, and direct property damage to the nearest million dollars.

Source: Annual reports of the Canadian Fire Commissioners.

## Effects of HUD Standards

**In recent years, manufactured homes built after the introduction of the HUD standards have shown slightly lower rates of civilian deaths per reported fire (excluding confined fires).**

The 1989-1998 fire death rate per 100 fires in post-standard manufactured homes was 54% lower than the rate for pre-standard manufactured homes. (See Table 2.)

It appears NFIRS reporting of the year of manufacture is being effectively phased out with the change-over to Version 5.0. Therefore, it is becoming more and more difficult to measure with confidence the differences between pre- and post-standard fire death rates, and the only reliable statistics that distinguish by year of manufacture for years after 1998 are percents calculated within the pre- and post-standard unit categories.

**Current data provide little evidence of heightened fire risk in older manufactured homes, apart from the effects of the HUD Standards.**

Table 3A compares 1999-2002 reported fires by year of unit manufacture to number of units in the manufactured home inventory, from U.S. Census Bureau surveys conducted in odd-numbered years. Because such a small fraction of fires have unit age reported since the advent of NFIRS Version 5.0, only percentages are shown and risk is shown as a relative index. There is little or no significant variation in this index by age, including little difference between pre- and post-standard units.

**Manufactured homes have a higher death rate per hundred fires in occupied buildings than other dwellings, but, as of 1999-2002, roughly the same risk of fire deaths relative to number of occupied units.**

Table 4 provides a comparison of fire experience rates for manufactured homes and other dwellings, relative to occupied year-round units (Table 4A) and relative to all units excluding vacant year-round units (Table 4B). The latter group includes seasonal units, which constitute a larger share of total units for manufactured homes than for other dwellings. Buildings that were vacant, under construction or under demolition were excluded, while buildings that were idle or under major renovation were treated as occupied and included. The figures on numbers of manufactured homes include trailers, and the ranges for one- and two-family dwellings other than manufactured homes include (high end of range) and exclude (low end of range) housing units in two- to four-family buildings, because two-family dwellings are not shown separately. Confined fires are included through a proportional allocation between manufactured homes and other dwellings, based on their respective shares of non-confined fires.

Manufactured homes had a fire incidence rate per 100,000 housing units 38-44% lower than the rate for other dwellings relative to occupied year-round units and 42-48% lower relative to total units, excluding vacant year-round units. Manufactured homes had a fire death rate per 100,000 housing units that was 12-24% higher relative to occupied year-round units but only 5-17% higher relative to total units excluding vacant year-round units. Tables 4A and 4B shows that the rate of fire deaths per 100 fires is roughly twice as high in manufactured homes as in other one- and two-family dwellings. That difference was almost completely

offset by the difference in fire rates relative to usage. Fire injury rates per 100,000 housing units are lower in manufactured homes, because their 3% higher likelihood of injury if fire occurs is more than offset by their lower fire rate per 100,000 housing units.

**Manufactured homes tend to be smaller, which could support more rapid fire growth to flashover.**

In 2001, the median size for occupied manufactured homes was 1,108 square feet, compared to 1,736 square feet for all occupied housing units.\* The median manufactured home had nearly two-thirds the space of the median home but almost the same (89% of the) number of rooms (5.0 vs. 5.6).\* This means the median room sizes were smaller in manufactured homes, which can mean that flashover can occur more rapidly in manufactured homes than in other housing units. The HUD standards affect some of the paths for rapid fire growth through restrictions on the type of interior finishes, but early involvement of some major fuel items, such as upholstered furniture or mattresses and bedding, can support fire growth to flashover even without involvement of the room interior finishes.

**Occupants of manufactured homes tend to be poorer.**

In 2001, for example, the median household income in occupied manufactured homes was \$26,100. This compared to \$38,400 for all occupied housing units.\* The percentage of households falling below the poverty line was 19% for occupied manufactured homes compared to 14% for all occupied housing units.\* Studies of homes in general have shown that poverty is associated with higher fire and fire death rates and is a stronger predictor than age of housing.\*\*

**Post-standard manufactured homes are more likely to have fires confined to room of origin.**

This correlates with provisions of the standards that are designed to achieve such confinement. Sections 3280.203 - 3280.206 of the HUD standards provide requirements that are intended to slow or limit the spread of a fire by such means as flame spread rating requirements for interior finish materials on exposed walls, columns, partitions, and ceilings; more targeted flame spread requirements for wall and floor coverings near central heating units or water heaters, interior finishes exposed to cooking ranges, kitchen cabinet surfaces, and plastic bathroom fixtures; and firestopping requirements. Table 5 shows these requirements are associated with a measurable difference in the percentage of fires confined to the room of origin.

The percentage of fires confined to room of origin was 15 percentage points higher for post-standard manufactured homes, compared to pre-standard manufactured homes, in 1989-1998 and 9 percentage points higher in 1999-2002. (This difference could also be partly attributed to any major changes in room linings not mandated by the standards but introduced at the

\**American Housing Survey for the United States: 2001*, U.S. Census Bureau website, Tables 2-3, 2-13, and 2-20.

\*\*See, for example, John R. Hall, Jr., *U.S. Fire Death Patterns by State*, Quincy, MA: NFPA Fire Analysis and Research Division, August 2004; John R. Hall, Jr., and Michael Karter, "Fire Rates Versus Community Characteristics," Supplemental Technical Report and Working Paper, prepared for the National Science Foundation, Washington: Urban Institute, April 1976.

same time. Some industry sources have indicated that the use of gypsum wallboard, for example, increased more than the standards required. Also, fires coded as confined fires are excluded from the 1999-2002 calculation.)

Table 5 also shows that this smaller fire size translates into reduced loss, because the average direct property damage per fire increases substantially as fire size increases. However, the overall average loss per fire in post-standard manufactured homes is higher than in pre-standard manufactured homes, because the reduced size of fires in post-standard manufactured homes is more than offset by a higher average loss per fire in fires of any particular size.

One way fires of similar size can result in higher average losses is if the value per square foot is higher, in contents, furnishings and structure. Age of home tends to be correlated with income for housing units generally, and this relationship probably extends to manufactured homes. For example, in 2001 median annual income of families and primary individuals in occupied housing units of all types was \$55,800 for units built in or after 2000, \$47,300 to \$52,700 for units built between 1985 and 1999, \$38,200 to \$40,300 for units built between 1975 and 1984, \$35,000 to \$37,400 for units built between 1950 and 1974, and \$31,500 to \$33,300 for units built before 1950. If possessions are worth more, then one can have a higher dollar loss in a fire of the same size or severity. For the fraction of fires that damage the manufactured home itself, post-standard manufactured homes also are worth more than pre-standard manufactured homes, allowing for depreciation.

**The HUD standards are particularly effective in producing fewer, smaller heating and cooking fires.**

Because heating and cooking equipment are singled out for special attention in the HUD standards - in the form of the flame spread ratings for surfaces near central heating units, water heaters, and cooking ranges - one might expect that heating and cooking fires would tend to be larger in pre-standard homes. In fact, such fires might even be reported less often in post-standard homes if some of them were slowed in their growth sufficiently that the occupants could control the fires while they were still small and so not need to report them to fire departments.

Figures 1A and 1B examines the percentage of fires confined to room of origin for each of five cause groups - cooking, heating, other known causes, all known causes, and all fires.

If certain flame spread requirements are applicable only to the surfaces near a particular hazard, and if use of those requirements leads to smaller fires for fire causes associated with that hazard, then the measure of smaller fire size would be the difference between post-standard and pre-standard manufactured homes in the proportion of fires confined to room of origin. In 1989-1998, this difference was 15 percentage points for all fires and for fires with known cause, and 12 percentage points for fires with known causes other than heating and cooking, which is the best baseline for comparison. In 1999-2002 (excluding fires coded as confined fires, which cannot be identified as manufactured home vs. other dwelling), the differences were 9 percentage points for all fires, 7 percentage points for fires with known cause, and 5 percentage points for fires with known cause other than heating or cooking.

Based on this approach, the flame spread requirements for surfaces near heating and cooking equipment appear to be associated with greater success in keeping fires small. The 20 and 21 percentage-point differences, respectively, for these cause classes of fires in 1989-1998 are much larger than the 12 percentage-point difference for fires with other known cause. The 17 and 13 percentage-point differences, respectively, in 1999-2002 are also much larger than the 7 percentage point difference for fires with other known cause.

There are other possible explanations. One is that there could be major differences in the design of heating and cooking equipment in pre- vs. post-standard units, but no such differences have been identified. Another is that the standards did not introduce the requirements but made a major difference in enforcing compliance with them, but this explanation is really a different way of crediting the changes to the requirements.

Tables 6-9 show that post-standard manufactured homes also show a greatly reduced share of heating fires. Nothing in the standards can prevent heating fires outright, but the low-flame-spread requirements around heating equipment could keep fires so small that they would go unreported to fire departments, because of early control of fire by occupants.

If post-standard manufactured homes have lower shares of fires due to certain causes, then one might also expect that the cause profile of *all* manufactured homes combined would show a steady shift over time. Table 10 shows this is true for heating fires, which have dropped from a typical one-fourth share of all manufactured home fires to a one-sixth to one-fifth share.

**Smoke alarms mean a lower death rate per 100 fires in post-standard manufactured homes and, less consistently, in pre-standard manufactured homes.**

Section 3280.208 of the HUD standards requires that at least one smoke alarm be provided in the living area, as well as each room designed for sleeping. In dwellings of all types, including manufactured homes, smoke alarms reduce the death rate per 100 fires by 40-50%.\* Figure 2 shows a similar pattern exists for manufactured homes.

In 1994-1998, in post-standard manufactured homes the civilian death rate per 100 fires was 0.9 if smoke alarms were present, 31% less than the 1.3 rate if smoke alarms were not present. In pre-standard manufactured homes, the civilian death rate per 100 fires was 2.4 with smoke alarms in 1994-1998, roughly the same as the 2.3 rate if there were no smoke alarms. Because so few fires in 1999 or later show the year of manufacture of the unit, none of the 1999-2002 statistics are meaningful.

**Smoke alarms are absent in a large share of post-standard manufactured home fires.**

In 1999-2002, 45% of post-standard manufactured home fires were reported as no smoke alarms present, a higher percentage than in 1997 and 1998. (This estimate is based solely on fires reported in NFIRS Version 5.0, because conversion rules for earlier coding improperly converted cases of (a) smoke alarm presence undetermined and (b) smoke alarm present outside room of fire origin and did not activate to (c) no alarm present, and improperly

\*Marty Ahrens, *U.S. Experience With Smoke Alarms*, Quincy, MA: NFPA Fire Analysis & Research Division, November 2004.

converted cases of (d) unclassified smoke-alarm presence to (e) smoke alarm present. The question in version 5.0 asks whether smoke alarms were present “in the fire area.” Previous versions of NFIRS asked about smoke alarm performance and distinguished whether the smoke alarm cited was in or not in the room or area of fire origin.

Not until 1986 did the percentage of post-standard manufactured home fires reported as having no smoke alarms present fall below 50%. This large gap between what the standards require and what is being reported from the field is troubling.

**Table 2. Civilian Deaths and Injuries per 100 Fires  
in Pre-Standard vs. Post-Standard Manufactured Homes  
1989-1998 Annual Average Structure Fires Reported to U.S. Fire Departments**

<b>Year of Manufacture</b>	<b>Civilian Deaths per 100 Fires</b>	<b>Civilian Injuries per 100 Fires</b>
Pre-standard (Pre-1976)	2.6	5.5
Transitional year (1976)	1.1	5.5
Post-standard (Post-1976)	1.2	4.3
Total	2.0	4.4

Note: These are 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 estimated to the nearest hundred, and civilian deaths and injuries are estimated to the nearest ten. Total row includes fires with unknown year of manufacture, which account for nearly three-fourths of reported manufactured home fires.

Source: NFIRS and NFPA survey.

**Table 3. U.S. Manufactured Home Fire Rates,  
by Age of Unit, 1999-2002 (Excluding Confined Fires)**

<b>Year of Manufacture</b>	<b>Percent of Fires</b>	<b>Percent of Occupied Manufactured Homes</b>	<b>Risk Index</b>
1995-2002	20%	23%	0.9
1985-1994	22%	23%	1.0
1975-1984	29%	26%	1.1
1970-1974	17%	16%	1.1
Before 1970	11%	12%	0.9
Total	100%	100%	1.0

Note: These are fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Confined fires are not included because they are not coded to distinguish manufactured homes from other dwellings, let alone to distinguish by year of manufacture. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Sums may not equal totals because of rounding error.

Percent of occupied manufactured homes in 1999-2002 is calculated as a weighted average of available percentages in 1999 and 2001, with 2001 weighted three times to one for 1999. This calculation therefore assumes that the number of manufactured homes in 2001 is a good estimate of the average number is 2000-2002. This will be roughly true if the annual change in the number of new units introduced is steady, except for the newest units, where this approach will slightly underestimate the size of the inventory and so slightly overestimate the fire rate per thousand units for the range with the most current year. Risk index is ratio of percent of fires to percent of occupied manufactured homes.

Sources: NFIRS and NFPA Survey; *American Housing Survey for the United States in, 1999, 2001*, U.S. Census Bureau website, Table 2-1.

**Table 4. U.S. Manufactured Homes vs. Other Dwellings  
Fire Experience Rates (Excluding Fires in Buildings That Are Vacant  
or Under Construction or Demolition), 1999-2002**

**A. Occupied Year-Round Housing Units**

<b>Measure</b>	<b>Manufactured Homes</b>	<b>Other One- and Two-Family Dwellings</b>
Fires (1999-2002 annual average)	14,000	260,500
Civilian deaths (1999-2002 annual average)	240	2,190
Civilian injuries (1999-2002 annual average)	550	9,970
Number of housing units (weighted average of 1999 and 2001, in millions)	7.1*	73.7 – 82.0**
Civilian deaths per 100 fires	1.7	0.8
Civilian injuries per 100 fires	3.9	3.8
Fires per 1,000 housing units	2.0	3.2 – 3.5
Civilian deaths per 100,000 housing units	3.3	2.7 – 3.0
Civilian injuries per 100,000 housing units	7.7	12.2 – 13.5

\*This is an upper bound because the definition includes "trailers," which probably is not limited to the trailer coaches or other manufactured housing referred to by terms including the word "trailer."

\*\*The lower and higher figures in this range reflect the exclusion and inclusion of housing units in buildings housing 2-4 housing units. Buildings having just two housing units, which correspond to the fire statistics on one- and two-family dwellings, cannot be isolated.

Note: These are 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 estimated to the nearest hundred, and civilian deaths and injuries are estimated to the nearest ten. Property damage has not been adjusted for inflation. Totals may not equal sums because of rounding.

Sources: NFIRS and NFPA Survey; *Statistical Abstract of the United States*, Washington: U.S. Bureau of the Census, 2001 and 2003, Tables 952 and 959, respectively.

**Table 4. U.S. Manufactured Homes and Other Dwellings  
Fire Experience Rates (Excluding Fires in Buildings That Are Vacant  
or Under Construction or Demolition) (Continued)**

**B. Seasonal and Occupied Year-Round Housing Units**

<b>Measure</b>	<b>Manufactured Homes</b>	<b>Other One- and Two-Family Dwellings</b>
Fires (1999-2002 annual average)	14,000	260,500
Civilian deaths (1999-2002)	240	2,190
Civilian injuries (1999-2002)	550	9,970
Number of housing units (weighted average of 1999 and 2001, in millions)	7.7*	75.7 – 84.1**
Civilian deaths per 100 fires	1.7	0.8
Civilian injuries per 100 fires	3.9	3.8
Fires per 1,000 housing units	1.8	3.1 – 3.4
Civilian deaths per 100,000 housing units	3.0	2.6 – 2.9
Civilian injuries per 100,000 housing units	7.1	11.8 – 13.2

\*This is an upper bound because the definition includes "trailers," which probably is not limited to the trailer coaches or other manufactured housing referred to by terms including the word "trailer."

\*\*The lower and higher figures in this range reflect the exclusion and inclusion of housing units in buildings housing 2-4 housing units. Buildings having just two housing units, which correspond to the fire statistics on one- and two-family dwellings, cannot be isolated.

Note: These are 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 estimated to the nearest hundred, and civilian deaths and injuries are estimated to the nearest ten. Property damage has not been adjusted for inflation. Totals may not equal sums because of rounding.

Sources: NFIRS and NFPA Survey; *Statistical Abstract of the United States*, Washington: U.S. Bureau of the Census, 2001 and 2003, Tables 952 and 959, respectively.

**Table 5. Loss per Fire, by Extent of Flame Damage  
Pre-Standard vs. Post-Standard Manufactured Homes  
Structure Fires Reported to U.S. Fire Departments**

**A. 1989-1998 Annual Average**

Extent of Flame Damage	Pre-Standard (Pre-1976)		Post-Standard (Post-1976)	
	Fires	Loss per Fire (in Thousands)	Fires	Loss per Fire (in Thousands)
Confined to room of origin	1,000 (40%)	\$2.9	1,200 (55%)	\$5.8
Confined to building of origin but extended beyond room of origin	1,300 (51%)	\$12.4	900 (40%)	\$20.3
Extended beyond building of origin	200 (9%)	\$13.4	100 (5%)	\$20.4
All fires with known extent of flame damage	2,700 (100%)	\$8.5	2,300 (100%)	\$12.4

Note: These are 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 estimated to the nearest hundred, civilian deaths and injuries are estimated to the nearest ten, and direct property damage is estimated to the nearest million dollars. Property damage has not been adjusted for inflation. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey.

**Table 5. Loss per Fire, by Extent of Flame Damage  
Pre-Standard vs. Post-Standard Manufactured Homes  
Structure Fires Reported to U.S. Fire Departments (Continued)**

**B. 1999-2002 (Excluding Confined Fires)**

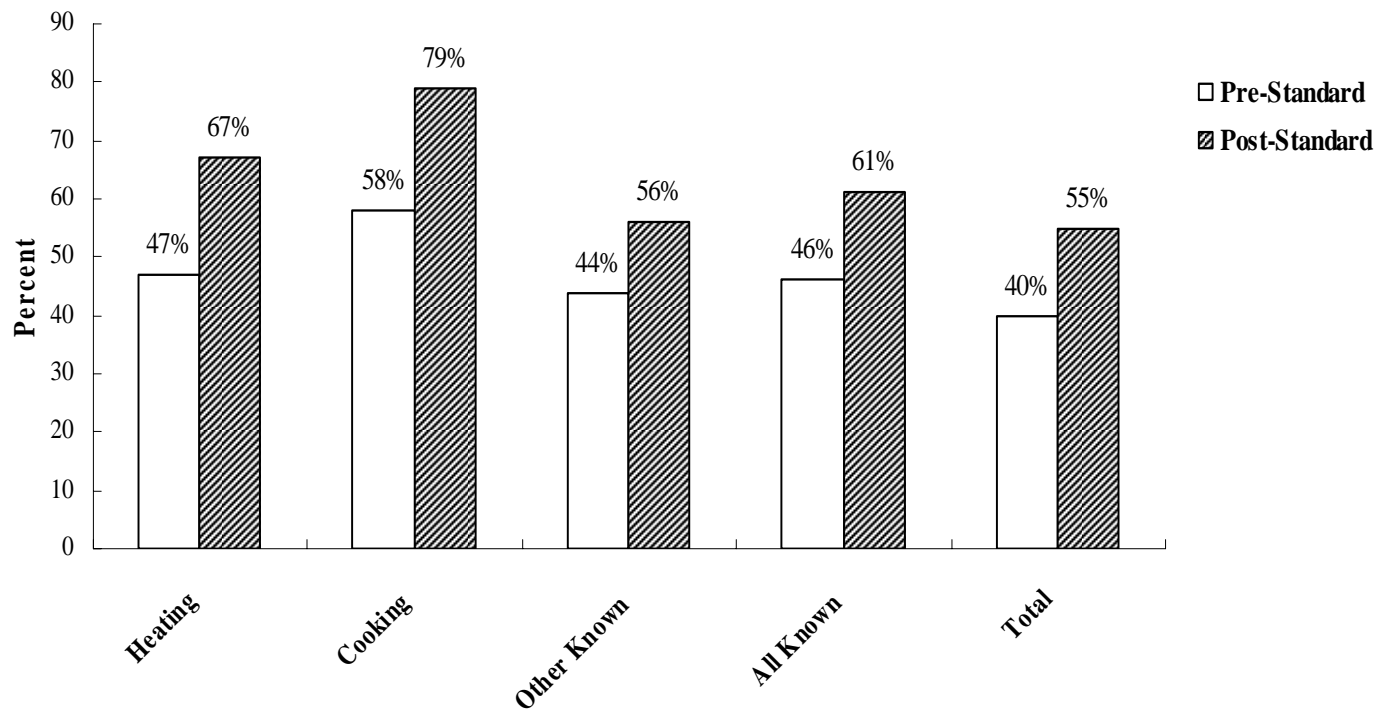
Extent of Flame Damage	Pre-Standard (Pre-1976)		Post-Standard (Post-1976)	
	Fires	Loss per Fire (in Thousands)	Fires	Loss per Fire (in Thousands)
Confined to room of origin	38%	\$5.9	47%	\$10.0
Confined to building of origin but extended beyond room of origin	49%	\$16.9	40%	\$38.4
Extended beyond building of origin	13%	\$21.1	13%	\$45.2
All fires with known extent of flame damage	100%	\$13.2	100%	\$26.0

Note: These are 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. Totals may not equal sums because of rounding.

One way fires of similar size can result in higher average losses is if the value per square foot is higher, in contents, furnishings and structure. Age of home tends to be correlated with income for housing units generally, and this relationship probably extends to manufactured homes. If possessions are worth more, then one can have a higher dollar loss in a fire of the same size or severity. For the fraction of fires that damage the manufactured home itself, post-standard manufactured home itself, post-standard manufactured homes also are worth more than pre-standard manufactured homes, allowing for depreciation.

Source: NFIRS and NFPA survey.

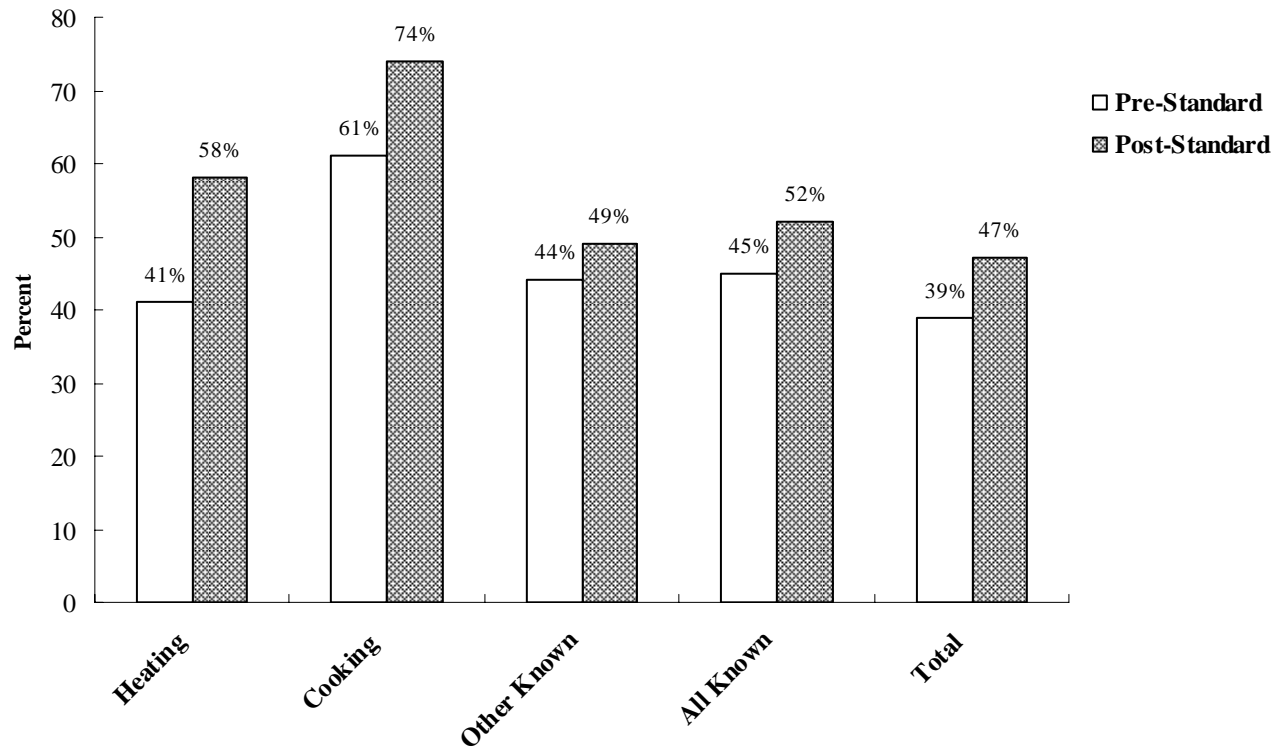
**Figure 1A. Percent of Fires Confined to Room of Origin  
by Cause, 1989-1998  
U.S. Pre- vs. Post-Standard Manufactured Homes**



Source: NFIRS and NFPA survey.

Note: Each percent is based on a ten-year total of estimated fires, and no percentage is based on an estimated ten-year total of less than 2,300 fires.

**Figure 1B. Percent of Fires Confined to Room of Origin  
by Cause, 1999-2002  
U.S. Pre- vs. Post-Standard Manufactured Homes**



Source: NFIRS and NFPA survey.

Note: Each percent is based on a ten-year total of estimated fires, excluding confined fires, and no percentage is based on an estimated ten-year total of less than 175 fires.

**Table 6. Pre-Standard and Post-Standard  
Manufactured Home Fires, by Cause  
Structure Fires Reported to U.S. Fire Departments**

**A. 1989-1998 Annual Average**

Cause	Pre-Standard		Post-Standard	
	(Pre-1976)		(Post-1976)	
Electrical distribution	500	(20%)	400	(17%)
Heating	500	(19%)	300	(13%)
Intentional	300	(11%)	300	(13%)
Cooking	300	(11%)	300	(14%)
Other equipment	200	(9%)	200	(8%)
Appliances, tools, or air conditioning	200	(8%)	300	(11%)
Smoking material (i.e., lighted tobacco product)	100	(5%)	100	(6%)
Child playing	100	(5%)	100	(5%)
Open flame	100	(5%)	100	(4%)
Exposure (to other hostile fire)	100	(4%)	100	(5%)
Other heat source	0	(1%)	0	(2%)
Natural causes	0	(1%)	0	(2%)
<b>Total</b>	<b>2,700</b>	<b>(100%)</b>	<b>2,300</b>	<b>(100%)</b>

Note: These are 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 estimated to the nearest hundred. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey.

**Table 6. Pre-Standard and Post-Standard  
Manufactured Home Fires, by Cause  
Structure Fires Reported to U.S. Fire Departments (Continued)**

**B. 1999-2002**

Cause	Pre-Standard (Pre-1976)	Post-Standard (Post-1976)
Electrical distribution	17%	10%
Heating	16%	8%
Intentional	13%	10%
Exposure (to other hostile fire)	10%	16%
Other equipment	9%	21%
Cooking	9%	9%
Open flame, candle, or torch	7%	7%
Appliance, tool, or air conditioning	7%	5%
Smoking material (i.e., lighted tobacco product)	4%	5%
Child playing	4%	4%
Other heat source	3%	4%
Natural causes	1%	1%
Total	100%	100%

Note: These are percents of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Only percents are shown because so few fires have unit age coded after 1998. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Totals may not equal sums because of rounding.

Changes in coding and analysis rules produced some shifts in shares by major cause, beginning in 1999 and growing thereafter. Major changes include: (1) movement of unknown-equipment fires from “other equipment” to “unknown,” where they are then statistically allocated; and (2) movement of playing fires where firestarter age is not recorded from “child playing” to the category for the heat source, primarily “open flame.”

Source: NFIRS and NFPA survey.

**Table 7. Pre-Standard and Post-Standard  
Manufactured Home Civilian Fire Deaths, by Cause  
Structure Fires Reported to U.S. Fire Departments**

**A. 1989-1998 Annual Average**

Cause	Pre-Standard (Pre-1976)		Post-Standard (Post-1976)	
	Count	Percentage	Count	Percentage
Heating	10	(19%)	0	(8%)
Smoking material (i.e., lighted tobacco product)	10	(17%)	0	(17%)
Cooking	10	(15%)	0	(12%)
Electrical distribution	10	(14%)	0	(5%)
Child playing	10	(11%)	10	(24%)
Other equipment	10	(10%)	0	(2%)
Intentional	10	(9%)	0	(13%)
Appliances, tools, or air conditioning	0	(2%)	0	(2%)
Other heat source	0	(2%)	0	(8%)
Open flame	0	(1%)	0	(9%)
Exposure (to other hostile fire)	0	(1%)	0	(0%)
Natural causes	0	(0%)	0	(0%)
<b>Total</b>	<b>70</b>	<b>(100%)</b>	<b>30</b>	<b>(100%)</b>

Note: These are 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 are estimated to the nearest ten. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey.

**Table 7. Pre-Standard and Post-Standard  
Manufactured Home Civilian Fire Deaths, by Cause  
Structure Fires Reported to U.S. Fire Departments (Continued)**

**B. 1999-2002**

Cause	Pre-Standard (Pre-1976)	Post-Standard (Post-1976)
Child playing	18%	0%
Smoking material (i.e., lighted tobacco product)	18%	10%
Heating	17%	30%
Other equipment	11%	17%
Intentional	9%	31%
Cooking	9%	5%
Appliance, tool, or air conditioning	9%	0%
Other heat source	9%	0%
Electrical distribution	0%	5%
Open flame, candle, or torch	0%	4%
Exposure (to other hostile fire)	0%	0%
Natural causes	0%	0%
<b>Total</b>	<b>100%</b>	<b>100%</b>

Note: These are percents of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Only percents are shown because so few fires have unit age coded after 1998. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Totals may not equal sums because of rounding.

Changes in coding and analysis rules produced some shifts in shares by major cause, beginning in 1999 and growing thereafter. Major changes include: (1) movement of unknown-equipment fires from “other equipment” to “unknown,” where they are then statistically allocated; and (2) movement of playing fires where firestarter age is not recorded from “child playing” to the category for the heat source, primarily “open flame.”

Source: NFIRS and NFPA survey.

**Table 8. Pre-Standard and Post-Standard  
Manufactured Home Civilian Fire Injuries, by Cause  
Structure Fires Reported to U.S. Fire Departments**

**A. 1989-1998 Annual Average**

Cause	Pre-Standard		Post-Standard	
	(Pre-1976)		(Post-1976)	
Heating	30	(17%)	10	(11%)
Cooking	20	(16%)	20	(25%)
Child playing	20	(13%)	20	(17%)
Electrical distribution	20	(13%)	10	(8%)
Appliances, tools, or air conditioning	10	(10%)	10	(12%)
Smoking material (i.e., lighted tobacco product)	10	(9%)	0	(5%)
Other equipment	10	(8%)	10	(7%)
Intentional	10	(7%)	0	(5%)
Other heat source	0	(3%)	10	(6%)
Open flame	0	(3%)	0	(2%)
Natural causes	0	(1%)	0	(1%)
Exposure (to other hostile fire)	0	(1%)	0	(0%)
<b>Total</b>	<b>150</b>	<b>(100%)</b>	<b>100</b>	<b>(100%)</b>

Note: These are 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 injuries are estimated to the nearest ten. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey.

**Table 8. Pre-Standard and Post-Standard  
Manufactured Home Civilian Fire Injuries, by Cause  
Structure Fires Reported to U.S. Fire Departments (Continued)**

**B. 1999-2002**

Cause	Pre-Standard (Pre-1976)	Post-Standard (Post-1976)
Intentional	30%	8%
Heating	17%	6%
Child playing	13%	15%
Electrical distribution	12%	12%
Smoking material (i.e., lighted tobacco product)	10%	7%
Cooking	7%	14%
Open flame, candle, or torch	4%	12%
Other equipment	4%	23%
Other heat source	2%	0%
Exposure (to other hostile fire)	0%	3%
Appliance, tool, or air conditioning	0%	1%
Natural causes	0%	0%
Total	100%	100%

Note: These are percents of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Only percents are shown because so few fires have unit age coded after 1998. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Totals may not equal sums because of rounding.

Changes in coding and analysis rules produced some shifts in shares by major cause, beginning in 1999 and growing thereafter. Major changes include: (1) movement of unknown-equipment fires from “other equipment” to “unknown,” where they are then statistically allocated; and (2) movement of playing fires where firestarter age is not recorded from “child playing” to the category for the heat source, primarily “open flame.”

Source: NFIRS and NFPA survey.

**Table 9. Pre-Standard and Post-Standard  
Manufactured Home Direct Property Damage (in Millions) From Fires, by Cause  
Structure Fires Reported to U.S. Fire Departments**

**A. 1989-1998 Annual Average**

<b>Cause</b>	<b>Pre-Standard (Pre-1976)</b>		<b>Post-Standard (Post-1976)</b>	
Electrical distribution	\$5	(22%)	\$6	(23%)
Heating	\$4	(19%)	\$3	(11%)
Intentional	\$2	(11%)	\$5	(16%)
Appliance, tool, or air conditioning	\$2	(10%)	\$3	(9%)
Cooking	\$2	(9%)	\$2	(8%)
Other equipment	\$2	(9%)	\$3	(11%)
Smoking material (i.e., lighted tobacco product)	\$2	(7%)	\$2	(7%)
Child playing	\$1	(5%)	\$1	(5%)
Open flame	\$1	(3%)	\$1	(3%)
Exposure (to other hostile fire)	\$1	(2%)	\$1	(3%)
Other heat source	\$0	(1%)	\$1	(2%)
Natural causes	\$0	(1%)	\$1	(2%)
<b>Total</b>	<b>\$23</b>	<b>(100%)</b>	<b>\$29</b>	<b>(100%)</b>

Note: These are 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. Direct property damage is estimated to the nearest million dollars. Property damage has not been adjusted for inflation. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey.

**Table 9. Pre-Standard and Post-Standard  
Manufactured Home Direct Property Damage (in Millions) From Fires, by Cause  
Structure Fires Reported to U.S. Fire Departments (Continued)**

**B. 1999-2002**

Cause	Pre-Standard (Pre-1976)	Post-Standard (Post-1976)
Heating	21%	7%
Other equipment	21%	37%
Electrical distribution	15%	9%
Intentional	8%	8%
Smoking materials (i.e., lighted tobacco products)	6%	6%
Exposure (to other hostile fire)	6%	6%
Appliance, tool, or air conditioning	6%	4%
Cooking	5%	3%
Child playing	4%	4%
Other heat source	3%	5%
Open flame, candle, or torch	3%	8%
Natural causes	1%	3%
Total	100%	100%

Note: These are fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Only percents are shown because so few fires have unit age coded after 1998. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Totals may not equal sums because of rounding.

Changes in coding and analysis rules produced some shifts in shares by major cause, beginning in 1999 and growing thereafter. Major changes include: (1) movement of unknown-equipment fires from “other equipment” to “unknown,” where they are then statistically allocated; and (2) movement of playing fires where firestarter age is not recorded from “child playing” to the category for the heat source, primarily “open flame.”

Source: NFIRS and NFPA survey.

**Table 10. Manufactured Home Fires, by Cause and Year  
Structure Fires Reported to U.S. Fire Departments**

<b>Cause</b>	<b>1980</b>		<b>1981</b>		<b>1982</b>		<b>1983</b>		<b>1984</b>		<b>1985</b>	
Cooking	3,600	(12%)	3,400	(12%)	4,000	(14%)	3,400	(13%)	3,500	(13%)	3,300	(13%)
Heating	7,300	(25%)	6,200	(23%)	6,700	(24%)	6,400	(24%)	5,600	(22%)	6,100	(24%)
Intentional	3,100	(10%)	2,800	(10%)	2,900	(10%)	2,700	(10%)	2,600	(10%)	2,800	(11%)
Open flame, candle, or torch	1,200	(4%)	1,200	(4%)	1,200	(4%)	1,200	(5%)	1,100	(4%)	1,200	(5%)
Other heat source	400	(1%)	300	(1%)	400	(1%)	500	(2%)	400	(2%)	400	(1%)
Electrical distribution	5,400	(18%)	4,800	(18%)	4,800	(17%)	4,600	(17%)	4,700	(18%)	4,300	(17%)
Appliance, tool or air conditioning	2,800	(9%)	2,400	(9%)	2,600	(9%)	2,400	(9%)	2,600	(10%)	2,600	(10%)
Exposure	1,200	(4%)	1,200	(5%)	1,200	(4%)	900	(3%)	1,100	(4%)	1,100	(4%)
Smoking material	2,000	(7%)	2,100	(8%)	1,800	(6%)	1,700	(6%)	1,500	(6%)	1,400	(5%)
Child playing	1,000	(3%)	1,000	(4%)	1,100	(4%)	1,000	(4%)	1,000	(4%)	900	(4%)
Other equipment	1,400	(5%)	1,300	(5%)	1,400	(5%)	1,300	(5%)	1,600	(6%)	1,300	(5%)
Natural causes	500	(2%)	300	(1%)	400	(1%)	300	(1%)	300	(1%)	300	(1%)
<b>Total</b>	<b>29,700</b>	<b>(100%)</b>	<b>27,100</b>	<b>(100%)</b>	<b>28,300</b>	<b>(100%)</b>	<b>26,300</b>	<b>(100%)</b>	<b>26,000</b>	<b>(100%)</b>	<b>25,800</b>	<b>(100%)</b>

Note: These are 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 estimated to the nearest hundred. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey.

**Table 10. Manufactured Home Fires, by Cause and Year  
Structure Fires Reported to U.S. Fire Departments (Continued)**

<b>Cause</b>	<b>1986</b>		<b>1987</b>		<b>1988</b>		<b>1989</b>		<b>1990</b>		<b>1991</b>	
Cooking	3,200	(13%)	3,200	(14%)	2,800	(12%)	2,500	(12%)	2,600	(14%)	2,700	(14%)
Heating	5,100	(20%)	4,300	(19%)	4,300	(18%)	4,000	(20%)	3,200	(17%)	3,400	(17%)
Intentional	3,300	(13%)	2,800	(12%)	2,800	(12%)	2,400	(12%)	2,400	(13%)	2,700	(14%)
Open flame, candle, or torch	1,100	(4%)	1,000	(4%)	1,100	(5%)	1,100	(6%)	900	(5%)	900	(4%)
Other heat source	400	(2%)	400	(2%)	300	(1%)	300	(1%)	300	(1%)	300	(1%)
Electrical distribution	4,500	(18%)	3,800	(16%)	4,100	(18%)	3,200	(16%)	3,300	(17%)	3,500	(18%)
Appliance, tool or air conditioning	2,400	(10%)	2,200	(9%)	2,500	(11%)	2,100	(10%)	1,900	(10%)	1,800	(9%)
Exposure	1,100	(4%)	1,100	(5%)	1,500	(6%)	900	(5%)	900	(5%)	800	(4%)
Smoking material	1,500	(6%)	1,300	(6%)	1,400	(6%)	1,100	(5%)	1,100	(6%)	1,000	(5%)
Child playing	1,000	(4%)	900	(4%)	900	(4%)	800	(4%)	800	(4%)	800	(4%)
Other equipment	1,500	(6%)	1,700	(7%)	1,600	(7%)	1,500	(7%)	1,400	(7%)	1,500	(8%)
Natural causes	300	(1%)	300	(1%)	300	(1%)	300	(1%)	300	(1%)	300	(1%)
<b>Total</b>	<b>25,400</b>	<b>(100%)</b>	<b>22,900</b>	<b>(100%)</b>	<b>23,600</b>	<b>(100%)</b>	<b>20,200</b>	<b>(100%)</b>	<b>19,100</b>	<b>(100%)</b>	<b>19,800</b>	<b>(100%)</b>

Note: These are 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 estimated to the nearest hundred. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey.

**Table 10. Manufactured Home Fires, by Cause and Year  
Structure Fires Reported to U.S. Fire Departments (Continued)**

<b>Cause</b>	<b>1992</b>		<b>1993</b>		<b>1994</b>		<b>1995</b>		<b>1996</b>		<b>1997</b>	
Heating	2,800	(14%)	2,900	(15%)	2,600	(14%)	2,600	(14%)	2,400	(14%)	2,500	(14%)
Heating	3,200	(17%)	3,400	(17%)	3,100	(16%)	2,900	(16%)	2,800	(16%)	2,700	(15%)
Intentional	2,600	(13%)	2,600	(13%)	2,400	(13%)	2,500	(14%)	2,500	(14%)	2,400	(14%)
Open flame, candle, or torch	900	(4%)	800	(4%)	900	(5%)	900	(5%)	900	(5%)	900	(5%)
Other heat source	300	(2%)	400	(2%)	400	(2%)	400	(2%)	300	(2%)	500	(3%)
Electrical distribution	3,100	(16%)	3,300	(16%)	3,000	(16%)	3,100	(17%)	2,900	(16%)	3,000	(17%)
Appliance, tool or air conditioning	1,800	(9%)	2,000	(10%)	1,800	(10%)	1,700	(9%)	1,500	(8%)	1,600	(9%)
Exposure	900	(5%)	1,000	(5%)	1,000	(5%)	800	(5%)	1,100	(6%)	700	(4%)
Smoking material	1,000	(5%)	900	(5%)	900	(5%)	900	(5%)	900	(5%)	700	(4%)
Child playing	1,000	(5%)	1,000	(5%)	1,100	(6%)	800	(4%)	800	(4%)	800	(4%)
Other equipment	1,500	(8%)	1,500	(7%)	1,600	(8%)	1,400	(8%)	1,600	(9%)	1,400	(8%)
Natural causes	300	(1%)	300	(1%)	300	(2%)	200	(1%)	200	(1%)	300	(2%)
<b>Total</b>	<b>19,300</b>	<b>(100%)</b>	<b>20,100</b>	<b>(100%)</b>	<b>19,200</b>	<b>(100%)</b>	<b>18,200</b>	<b>(100%)</b>	<b>17,900</b>	<b>(100%)</b>	<b>17,500</b>	<b>(100%)</b>

Note: These are 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 estimated to the nearest hundred. Totals may not equal sums because of rounding.

Source: National estimates based on NFIRS and NFPA survey.

**Table 10. Manufactured Home Fires, by Cause and Year  
Structure Fires Reported to U.S. Fire Departments (Continued)**

<b>Cause</b>	<b>1998</b>		<b>1999*</b>		<b>2000*</b>		<b>2001*</b>		<b>2002*</b>	
Cooking	2,300	(15%)	2,100	(16%)	2,100	(16%)	2,700	(19%)	3,200	(19%)
Heating	2,000	(13%)	2,300	(17%)	2,100	(17%)	2,500	(17%)	3,100	(18%)
Intentional	2,300	(15%)	1,800	(13%)	1,700	(13%)	1,700	(12%)	2,300	(13%)
Open flame, candle, or torch	700	(5%)	1,000	(8%)	1,000	(8%)	1,400	(10%)	1,800	(10%)
Other heat source	500	(3%)	400	(3%)	500	(4%)	1,000	(7%)	1,400	(8%)
Electrical distribution	2,600	(17%)	2,400	(18%)	1,800	(14%)	1,500	(10%)	1,300	(8%)
Appliance, tool or air conditioning	1,300	(9%)	1,300	(10%)	1,200	(9%)	1,100	(8%)	1,200	(7%)
Exposure	900	(6%)	700	(5%)	900	(7%)	900	(6%)	1,000	(6%)
Smoking material	700	(4%)	700	(5%)	700	(5%)	800	(5%)	800	(5%)
Child playing	700	(4%)	500	(4%)	600	(4%)	600	(4%)	600	(4%)
Other equipment	1,300	(8%)	200	(1%)	200	(2%)	300	(2%)	300	(2%)
Natural causes	300	(2%)	100	(1%)	100	(1%)	200	(1%)	200	(1%)
<b>Total</b>	<b>15,500</b>	<b>(100%)</b>	<b>13,600</b>	<b>(100%)</b>	<b>12,900</b>	<b>(100%)</b>	<b>14,600</b>	<b>(100%)</b>	<b>17,200</b>	<b>(100%)</b>

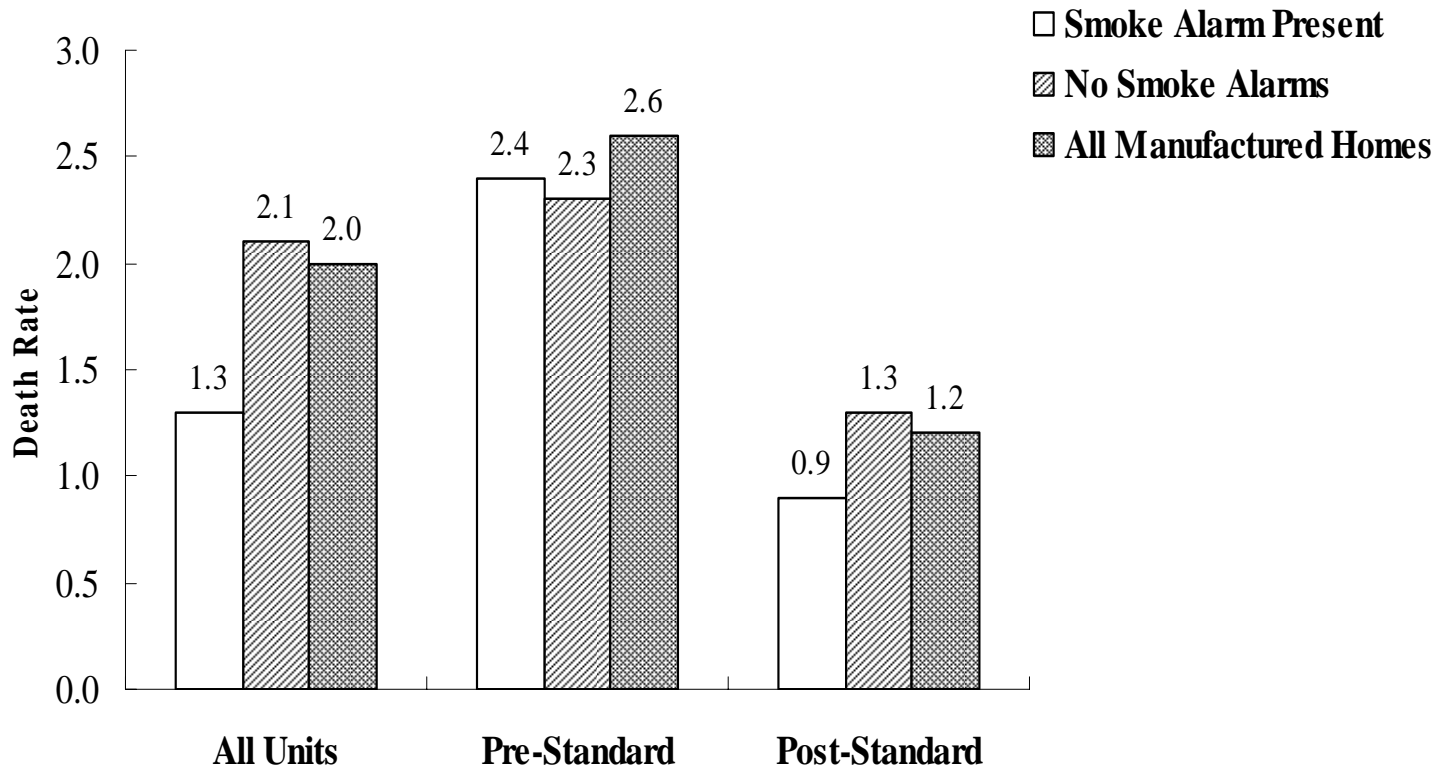
\*Totals include confined fires, which account for the growth in cooking share in recent years.

Note: These are 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 estimated to the nearest hundred. Totals may not equal sums because of rounding.

Changes in coding and analysis rules produced some shifts in shares by major cause, beginning in 1999 and growing thereafter. Major changes include: (1) movement of unknown-equipment fires from “other equipment” to “unknown,” where they are then statistically allocated; and (2) movement of playing fires where firestarter age is not recorded from “child playing” to the category for the heat source, primarily “open flame.”

Source: NFIRS and NFPA survey.

**Figure 2. Civilian Death Rate per Hundred Fires  
With and Without Smoke Alarms  
U.S. Pre- vs. Post-Standard Manufactured Homes, 1989-1998**



Source: NFIRS and NFPA survey.

## **Appendix A: How National Estimates Statistics Are Calculated**

Estimates are made using the National Fire Incident Reporting System (NFIRS) of the Federal Emergency Management Agency's (FEMA's) United States Fire Administration (USFA), supplemented by the annual stratified random-sample survey of fire experience conducted by the National Fire Protection Association (NFPA), which is used for calibration.

### **Data Bases Used**

NFIRS provides annual computerized data bases of fire incidents, with data classified according to a standard format based on the NFPA 901 Standard. Roughly three-fourths of all states have NFIRS coordinators, who receive fire incident data from participating fire departments and combine the data into a state data base. These data are then transmitted to FEMA/USFA. Participation by the states, and by local fire departments within participating states, is voluntary. NFIRS captures roughly one-third to one-half of all U.S. fires each year. More than one-third of all U.S. fire departments are listed as participants in NFIRS, although not all of these departments provide data every year.

The strength of NFIRS is that it provides the most detailed incident information of any national data base not limited to large fires. NFIRS is the only data base capable of addressing national patterns for fires of all sizes by specific property use and specific fire cause. (The NFPA survey separates fewer than 20 of property use categories defined by NFIRS and solicits no cause-related information except for intentional fires.) NFIRS also captures information on the avenues and extent of flame spread and smoke spread and on the performance of detectors and sprinklers.

The NFPA survey is based on a stratified random sample of roughly 3,000 U.S. fire departments (or just over one of every ten fire departments in the country). 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 by the NFPA 901 Standard; (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 NFPA survey begins with the NFPA Fire Service Inventory, a computerized file of about 30,000 U.S. fire departments, which is the most complete and thoroughly validated such listing in existence. The survey is stratified by size of population protected to reduce the uncertainty of the final estimate. Small rural communities protect fewer people per department and are less likely to respond to the survey, so a large 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.

### **Projecting NFIRS to National Estimates**

To project NFIRS results to national estimates, one needs at least an estimate of the NFIRS fires as a fraction of the total so that the fraction can be inverted and used as a multiplier or scaling ratio to generate national estimates from NFIRS data. But NFIRS is a sample from a universe whose size cannot be inferred from NFIRS alone. Also, participation rates in NFIRS are not necessarily uniform across regions and sizes of community, both of which are 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 data base - 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.

There are separate projection formulas for four major property classes (residential structures, non-residential structures, vehicles, and other) and for each measure of fire severity (fire incidents, civilian deaths, and civilian injuries, and direct property damage).

For example, the scaling ratio for 2002 civilian deaths in residential structures is equal to the total number of 2002 civilian deaths in residential structure fires reported to fire departments, according to the NFPA survey (2,695), divided by the total number of 2002 civilian deaths in residential structure fires reported to NFIRS (1,029). Therefore, the scaling ratio is  $2,695/1,029 = 2.62$ .

The scaling ratios for civilian deaths and injuries and direct property damage are often significantly different from those for fire incidents. Except for fire service injuries, average severity per fire is generally higher for NFIRS than for the NFPA survey. Use of different scaling ratios for each measure of severity is equivalent to assuming that these differences are due either to NFIRS under-reporting of small fires, resulting in a higher-than-actual loss-per-fire ratio, or possible biases in the NFIRS sample representation by region or size of community, resulting in severity-per-fire ratios characteristic only of the oversampled regions or community sizes.

Note that this approach also means that the NFPA survey results for detailed property-use classes (e.g., fires in storage structures) may not match the national estimates of the same value.

### **Calculating National Estimates of Particular Types of Fires**

Most analyses of interest involve the calculation of the estimated number of fires not only within a particular occupancy but also of a particular type. The types that are mostly frequently of interest are those defined by some ignition-cause characteristic. The

six cause-related characteristics most commonly used to describe fires are: form of the heat that caused the ignition, equipment involved in ignition, form or type of material first ignited, the ignition factor that brought heat source and ignited material together, and area of origin. Other characteristics of interest are victim characteristics, such as ages of persons killed or injured in fire.

For any characteristic of interest in NFIRS, some reported fires have that characteristic unknown or not reported. If the unknowns are not taken into account, then the propensity to report or not report a characteristic may influence the results far more than the actual patterns on that characteristic. For example, suppose the number of fires remained the same for several consecutive years, but the percentage of fires with cause unreported steadily declined over those years. If the unknown-cause fires were ignored, it would appear as if fires due to every specific cause increased over time while total fires remained unchanged. This, of course, does not make sense.

Consequently, most national estimates analyses allocate unknowns. This is done by using scaling ratios defined by NFPA survey estimates of totals divided by only those NFIRS fires for which the dimension in question was known and reported. This approach is equivalent to assuming that the fires with unreported characteristics, if known, would show the same proportions as the fires with known characteristics. For example, it assumes that the fires with unknown ignition factor contain the same relative shares of child-playing fires, incendiary-cause fires, short circuit fires, and so forth, as are found in the fires where ignition factor was reported.

## **Rounding Errors**

The possibility of rounding errors exists in all our calculations. One of the notes on each table indicates the extent of rounding for that table, e.g., deaths rounded to the nearest one, fires rounded to the nearest hundred, property damage rounded to the nearest hundred thousand dollars. In rounding to the nearest one, functional values of 0.5 or more are rounded up and functional values less than 0.5 are rounded down. For example, 2.5 would round to 3, and 3.4 would round to 3. In rounding to the nearest one, a stated estimate of 1 could be any number from 0.5 to 1.49, a roughly threefold range.

The impact of rounding is greatest when the stated number is small relative to the degree of rounding. As noted, rounding to the nearest one means that stated values of 1 may vary by a factor of three. Similarly, the cumulative impact of rounding error - the potential gap between the estimated total and the sum of the estimated values as rounded - is greatest when there are a large number of values and the total is small relative to the extent of rounding.

Suppose a table presented 5-year averages of estimated deaths by item first ignited, all rounded to the nearest one. Suppose there were a total of 30 deaths in the 5 years, so the total average would be  $30/5 = 6$ .

In case 1, suppose 10 of the possible items first ignited each accounted for 3 deaths in 5 years. Then there would be 10 entries of  $3/5 = 0.6$ , rounded to 1, and the sum would be 10, compared to the true total of 6.

In case 2, suppose 15 of the possible items first ignited each accounted for 2 deaths in 5 years. Then there would be 15 entries of  $2/5 = 0.4$ , rounded to 0, and the sum would be 0, compared to the true total of 6.

Here is another example: Suppose there were an estimate of 7 deaths total in 1992 through 1996. The 5-year average would be 1.4, which would round to 1, the number we would show as the total. Each death would represent a 5-year average of 0.2.

If those 7 deaths split as 4 deaths in one category (e.g., smoking) and 3 deaths in a second category (e.g., heating), then we would show  $4 \times 0.2 = 0.8$  deaths per year for smoking and  $3 \times 0.2 = 0.6$  deaths per year for heating. Both would round to 1, there would be two entries of 1, and the sum would be 2, higher than the actual rounded total.

If those 7 deaths split as 1 death in each of 7 categories (quite possible since there are 12 major cause categories), then we would show 0.2 in each category, always rounding to 0, and the sum would be 0, lower than the actual rounded total. The more categories there are, the farther apart the sum and total can -- and often do -- get.

Note that percentages are calculated from unrounded values, and so it is quite possible to have a percentage entry of up to 100%, even if the rounded number entry is zero.