MANUFACTURED HOME FIRES

John R. Hall, Jr.

July 2011

National Fire Protection Association
Fire Analysis and Research Division

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Executive Summary

During the five-year period of 2005-2009, U.S. fire departments responded to an average of 12,400 structure fires in manufactured homes per year, with annual losses of 234 civilian deaths, 453 civilian injuries and $186 million in direct property damage.
In 2009, 10,100 structure fires were reported in manufactured homes in the U.S. These fires had associated losses of 206 civilian deaths, 399 civilian injuries, and $241 million in direct property damage. The 2009 damage total was inflated by one Michigan fire coded as involving $40 million damage. It is likely that this incident was miscoded, as no such incident was identified in NFPA's large-loss fires study.

Estimates of manufactured home fires and associated civilian injuries are under-estimated in 1999 and later years.
The national estimates in this report combine the National Fire Incident Reporting System (NFIRS) and the NFPA survey, as described in Appendix A. Prior to 1999, manufactured homes were identified in 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.

Beginning in 1999 in NFIRS version 5.0, a manufactured home fire could be coded as a structure fire in a mobile or portable property (Incident Type 120-123), a non-confined structure fire (Incident Type 111-112, Property Use 410-419, Mobile Property Type 17), or a confined structure fire (Incident Type 113-118, Property Use 410-419, Mobile Property Type 17). However, if a fire is coded as a confined fire, many other details do not need to be coded and in particular, Mobile Property Type need not be reported. Therefore, one cannot separate confined manufactured home fires coded with Incident Type 113-118 from confined fires in other types of homes. Confined fires account for a large share of total structure fires and associated injuries but for almost no civilian deaths and very little direct property damage.

The estimates of manufactured home fires do not include fires coded as confined fires, because such fires cannot be identified. This means fires will be significantly under-estimated and injuries will be somewhat under-estimated, but death and property damages can be compared to pre-1999 estimates.

Civilian fire deaths and direct damage, the two loss measures least affected by estimation problems have declined by one-third to one-half since 1980. Civilian injuries, which are slightly under-estimated, have declined by slightly more than half. Fires, which are significantly under-estimated, have declined by roughly two-thirds.

Manufactured homes built after the introduction of the HUD standards have lower rates of civilian deaths per hundred reported fires than those built before the HUD standards were introduced. The 1989-1998 death rate was 54% lower for post-standard manufactured home than for pre-standard manufactured homes. There are too few fires with year of manufacture

reported among fires after 1998 to permit any more up-to-date analysis of changes in fire deaths per 100,000 units, but the general trend in manufactured home fires and deaths suggest that the principal factor in declining deaths has been the continued decline in the pre-standard share of the manufactured home inventory.

Looking at manufactured home fires by year of manufacture, the 2005-2009 average fire rate per 100,000 manufactured homes drops around the time when the HUD standards were introduced, but there is no statistical evidence that any change since then has produced enough risk reduction in enough units to produce a noticeable additional drop in the rate of fires per 100,000 units for recently manufactured units.

Manufactured homes had a 2005-2009 fire death rate per 100,000 housing units that was 30-44% higher than the rate for other one- or two-family homes, relative to occupied year-round units. The last published NFPA analysis of manufactured home fires, using 1999-2002 data and different analysis rules (intended to include confined fires), found the manufactured home fire death rate to be only 12-24% higher, but the 1999-2002 results reflected what proved to be two unusually low years for fire deaths in manufactured homes. Also, NFIRS 5.0 was not fully implemented in 1999-2002, and NFPA now advises caution in using results from these years.

In 1999, a category of confined fires was introduced for all structure fires except those that are also mobile or portable property. Fires reported as confined fires do not require detailed reporting and constitute a large share of fires in one- or two-family homes. For most confined fires, it is not possible to determine whether they were manufactured home fires. Because of limits in the new coding rules for fires in 1999 and later years, these estimates do not include fires coded as confined fires. The estimates of civilian fire deaths and property damage are not significantly affected by this omission, but the estimated number of fires is probably greatly understated, and the estimated number of civilian injuries is somewhat understated.

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. Smoke alarms are associated with a lower civilian death rate per 100 fires in post-standard manufactured homes and in all manufactured homes.

Smoke alarms reportedly are missing in half (50%) of all manufactured home fires where smoke alarm status was reported. 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.

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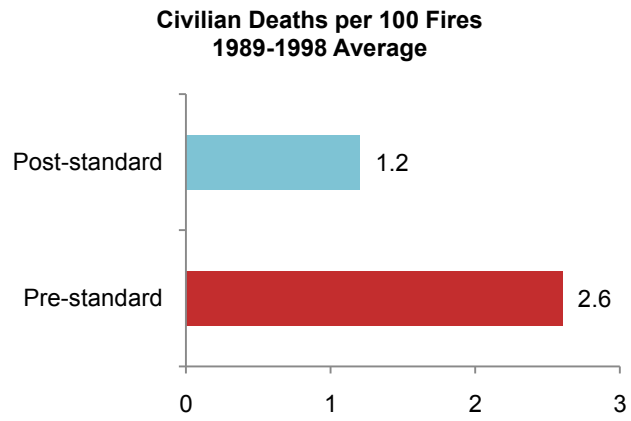
Manufactured Home Fires

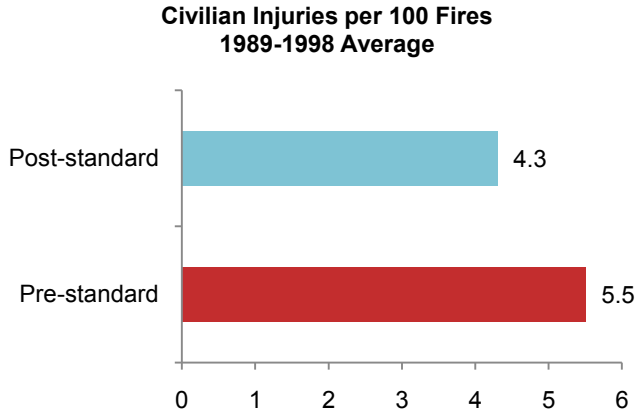
In 2005-2009, 12,400 structure fires per year were reported in manufactured homes, with associated losses of:

- 234 civilian deaths,
- 453 civilian injuries, and
- $186 million in direct damage per year.

Because of changes in the way fires are reported since 1999, the manufactured home share of certain minor fires cannot be identified, which means estimated fires are significantly under-estimated and associated injuries are somewhat under-estimated. Estimates of associated deaths and direct property damage are essentially unaffected. Also, only 2% of manufactured home fires reported in 1999 or later report year of manufacture. Therefore, some analyses cannot use statistics later than 1998 and others must use percentages and related indexes other than actual numbers

Compared to pre-HUD-standard manufactured homes (built before 1976), post-standard homes had a 54% lower rates of civilian deaths per 100 fires and a 22% lower rate of civilian injuries per 100 fires.





Manufactured homes have a 30-44% higher fire death rate per 100,000 occupied housing units than other one- or two-family homes.

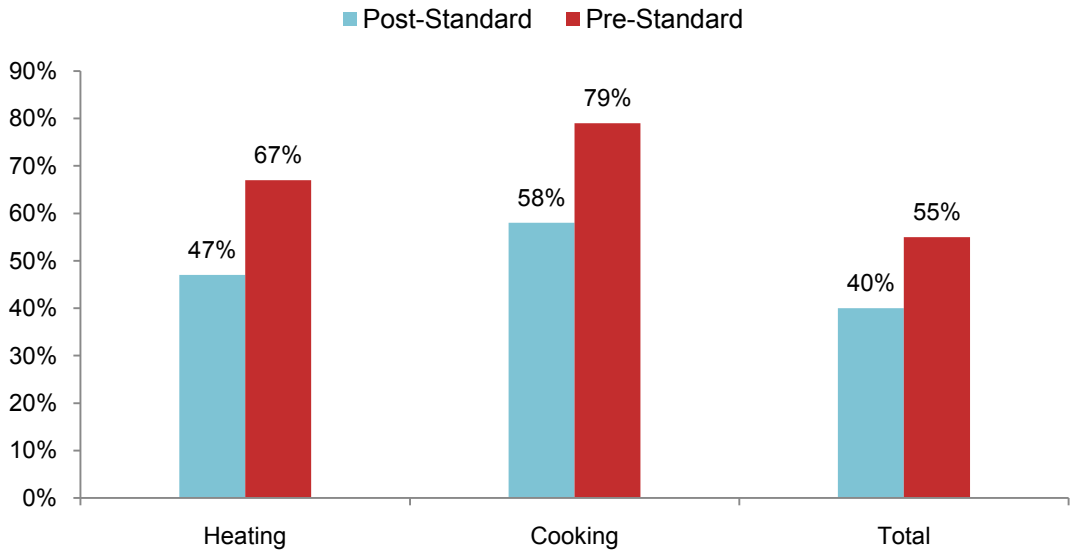
If all pre-standard manufactured homes were removed from the inventory of occupied units, it is estimated that the manufactured home fire death rate would still be 13-25% higher than the rate in other one- or two-family homes.

In 1989-1998, post-standard manufactured homes with smoke alarms had a 31% lower death rate per 100 fires than post-standard manufactured homes with no smoke alarms.

According to the *American Housing Survey*, in 2009, occupied manufactured homes were less likely (91.6% vs. 93.3%) than all occupied housing units including multi-family to have working smoke alarms. In the U.S. Consumer Product Safety Commission's 2004-2005 study of unreported fires, manufactured homes with unreported fires were less likely (90% vs. 97-98%) to have smoke alarms than either detached single-family homes, townhouses or row homes, or multi-family housing.

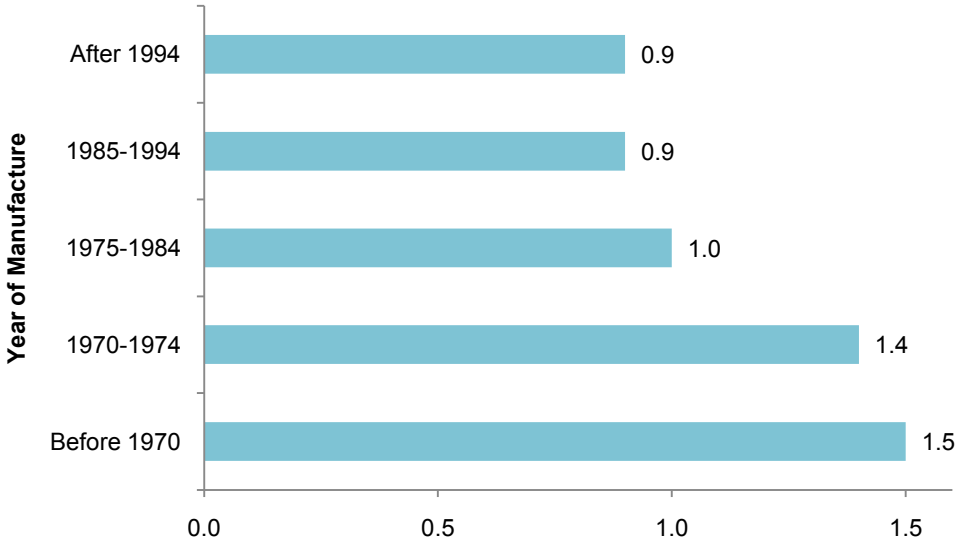
Post-standard manufactured home fires are more likely to have flame damage confined to room of origin, especially if the fires are started by heating or cooking equipment.

Percent of 1989-1998 Fires with Flame Damage Confined to Room of Origin



Fires per 1,000 occupied manufactured homes dropped sharply when the HUD standards were introduced but have not declined since then. (Risk index equals percent of fires divided by percent of occupied manufactured homes.)

Risk Index of 2005-2009 Fires per 1,000 Manufactured Homes



NFPA's Fire Safety Resources

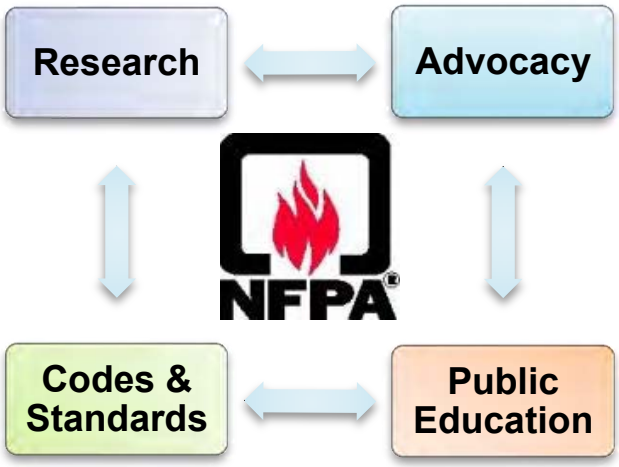
NFPA´s wealth of fire-related research includes investigations of technically significant fire incidents, fire data analysis, and the Charles S. Morgan Technical Library, one of the most comprehensive fire literature collections in the world. In addition, NFPA´s Fire Protection Research Foundation is a source of independent fire test data. Find out more at:

www.nfpa.org/research

Properly installed and maintained smoke alarms are necessary to provide a warning of any fire to all occupants. You can find out more information about smoke alarms here: NFPA Smoke Alarm Information

Home fire sprinkler systems provide even greater protection. These systems respond quickly to reduce the heat, flames, and smoke from a fire until help arrives. More information about home fire sprinklers may be found at www.firesprinklerinitiative.org

Simply put, smoke alarms and fire sprinklers save lives.



NFPA also develops, publishes, and disseminates more than 300 consensus codes and standards intended to minimize the possibility and effects of fire and other risks. Among these are:

NFPA 501: Standard on Manufactured Housing

NFPA 501A: Standard for Fire Safety Criteria for Manufactured Home Installations, Sites, and Communities

For consumers: NFPA has consumer safety information regarding causes, escape planning, fire & safety equipment, and many other topics.

For Kids: Sparky.org has important information for kids delivered via fun games, activities, and cartoons.

For public educators: Resources on fire safety education programs, educational messaging, grants & awards, and many other topics.

Chapter 1. Manufactured Home Fire Problem

During the five year period of 2005-2009, U.S. fire departments responded to an average of 12,400 structure fires in manufactured homes per year, with annual losses of 234 civilian deaths, 453 civilian injuries and $186 million in direct property damage.
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Beginning in 1999 in NFIRS version 5.0, a manufactured home fire could be coded as a structure fire in a mobile or portable property (Incident Type 120-123), a non-confined structure fire (Incident Type 111-112, Property Use 410-419, Mobile Property Type 17), or a confined structure fire (Incident Type 113-118, Property Use 410-419, Mobile Property Type 17). However, if a fire is coded as a confined fire, many other details do not need to be coded, and in particular, Mobile Property Type need not be reported. Therefore, one cannot separate confined manufactured home fires coded with Incident Type 113-118 from confined fires in other types of homes. Confined fires account for a large share of total structure fires and associated injuries but for almost no civilian deaths and very little direct property damage.

The estimates of manufactured home fires do not include fires coded as confined fires, because such fires cannot be identified. This means fires will be significantly under-estimated, injuries will be somewhat under-estimated, but deaths and property damages can be compared to pre-1999 estimates.

Civilian fire deaths and inflation-adjusted direct property damage, the two loss measures least affected by estimation problems declined by one-third to one-half from the early 1980s to the late 2000s if direct property damage is adjusted for inflation. Civilian injuries, which are slightly under-estimated, declined by slightly more than half. Fires, which are significantly under-estimated, declined by roughly two-thirds. (See Table 1-1.)

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.)

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.

Fires coded as Incident Type 120-123, structure fire in mobile or portable property, are treated as follows in this report:

Incident Type	How It Is Treated
121 – Mobile home used as fixed residence	Included.
120 – Unclassified mobile property used as a fixed property	Included if Property Use = 400-429, suggesting fixed residence is most likely property use.
122 – Motor home, camper, or recreational vehicle used as a structure.	Excluded because they are a different type of property.
123 – Portable building used at a fixed location, typically for commercial or educational purposes.	Excluded.

How many fires are missing from the estimates?
Table 1-A shows the base estimated annual average of 2005-2009 manufactured home fires and associated losses, along with estimates of other fires that might be relevant but are not included in the base estimate.

Table 1-A. Sensitivity Analysis of Estimates of Potential Components of 2005-2009 Manufactured Home Fire Problem, Annual Averages

	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)
Base estimate [Incident Type 121; and Incident Type 120 with Property Use 400-429]	12,400	234	453	$186
Estimated confined fires [Incident Type 113-118, Property Use 410-419; manufactured home percentage share of confined fires estimated as Base Estimate of manufactured home fires divided by estimated fires with Incident Type 111-112 or 120-123 and Property Use 400-429]	6,200	0	52	$1
Fires coded as Incident Type 111-112, Property Use 400-429, and Mobile Property Type 17 [analogous to coding used for manufactured Home fires pre-1999]	200	3	19	$5
Fires coded as Incident Type 122, Property Use 400-429 [motor home or recreational vehicle]	800	20	25	$7
Fires coded as Incident Type 123, Property Use 400-429 [portable building at fixed location]	200	0	3	$1

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

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)	
				Current Dollars	In 2009 Dollars
1980	29,800	413	863	$136	$353
1981	27,200	536	849	$142	$335
1982	28,400	460	1,020	$146	$324
1983	26,400	480	868	$167	$361
1984	26,100	382	815	$194	$399
1985	25,900	545	864	$175	$348
1986	25,500	409	837	$170	$332
1987	23,000	450	800	$140	$265
1988	23,700	507	959	$157	$285
1989	20,400	432	925	$140	$243
1990	19,200	380	750	$171	$281
1991	19,900	367	925	$191*	$301*
1992	19,400	391	856	$158	$242
1993	20,300	402	924	$202	$300
1994	19,400	347	876	$149	$215
1995	18,400	437	867	$156	$220
1996	18,100	450	814	$175	$239
1997	17,600	322	654	$159	$213
1998	15,700	200	653	$145	$191
Pre-NFIRS 5.0					
NFIRS 5.0					
1999	14,400	214	1,519	$130	$167
2000	17,100	336	777	$190	$237
2001	16,900	314	788	$183	$221
2002	16,400	216	546	$167	$199
2003	14,000	299	534	$168	$196
2004	14,500	291	527	$168	$191
2005	12,700	264	502	$165	$182
2006	13,300	205	498	$175	$187
2007	13,100	245	448	$155	$160
2008	12,700	250	420	$195	$194
2009	10,100	206	399	$241*	$241*

* All 1991 home property damage figures are inflated by estimation problems related to the handling of the Oakland fire storm. The 2009 total may be inflated by one fire apparently miscoded as $40 million.

Note: These are national estimates of 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 expressed to the nearest one, and property damage is rounded to the nearest million dollars. *Because of low participation in NFIRS Version 5.0 during 1999-2001, estimates for those years are highly uncertain and must be used with caution.* Inflation adjustment to 2009 dollars is done using the consumer price index.

From 1999 on, manufactured home fires are identified as Incident Type 121 with any Property Use or Incident Type 120 with Property Use 400-429. Manufactured home fires coded as Incident Type 110-118 with Mobile Property Type 17 are not included because nearly all fires with Incident Type 113-118 (confined fires) have Mobile Property Type blank, making it impossible to estimate relevant fires of this type. For this reason, fires coded as confined fires are excluded from comparisons of manufactured home fires to fires in other one- or two-family dwellings.
Source: NFIRS and NFPA survey.

Chapter 2. How Safe Are Manufactured Homes?

Effects of HUD Standards

In 1976, the U.S. Department of Housing and Urban Development (HUD) took jurisdiction over construction standards for 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 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.

In 1989-1998, post-HUD-standard manufactured homes had lower rates of civilian deaths per 100 fires (by 54%) and civilian injuries per 100 fires (by 22%).

Because only 2% of manufactured home fires are now reported with year of manufacture, and because current analyses will tend to under-estimate the number of fires and injuries but not the number of deaths, the best statistical evidence of the overall effect of the HUD standards must be taken from pre-1999 statistics. (see Table 2-A.)

Table 2-A. 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

Year of Manufacture	Civilian Deaths per 100 Fires	Civilian Injuries per 100 Fires
Pre-standard (Pre-1976)	2.6	5.5
Post-standard (Post-1976)	1.2	4.3
All manufactured homes	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. Last row includes fires with unknown year of manufacture, which accounted for nearly three-fourths of reported manufactured home fires in 1989-1998.

Source: NFIRS and NFPA survey.

According to the latest data that permitted the comparison (1998 or earlier), post-standard manufactured homes are more likely than pre-standard manufactured homes 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 2-1 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.

Table 2-1 shows that smaller fires have much lower average property damage per fires, and so a lower share of fires spreading beyond room of origin will mean a lower overall average loss per fire, all other things being equal. However, the overall average loss per fire in post-standard manufactured homes is higher than in pre-standard manufactured homes, despite the fact that post-standard units have a smaller share of large fires. The reason is that the average loss per fire for any particular size of fire is higher for post-standard units than for pre-standard units, and these difference are large enough to more than offset the reduced fraction of fires having the larger sizes.

One way you can have higher average losses per fire for the same fire size (in area) is if the value per square foot is higher, in contents, furnishings and structure. Post-standard units are newer housing, which probably means, on average, wealthier occupants and more average value per square foot.

Table 2-1 showed that in 1989-1998, reported manufactured home fires had flame damage confined to room of origin for 40% of pre-HUD-standard units and 55% of post-standard units. The percentage for all manufactured homes, including the three-fourths of reported fires with year of manufacture unreported, was 50%. For the same years, the percentage of fires with flame damage confined to room of origin was 71% for other one- or two-family homes.

Using 2005-2009 data, where identifiable manufactured home fires probably miss many, if not most, confined fires, the percentage of manufactured home fires with flame damage confined to room of origin was 46%. The percentages for other one- or two-family homes were 72% with confined fires included, essentially the same as in 1989-1998, and 53% for non-confined fires only, somewhat better than the manufactured home percentage.

These statistics do not provide a sufficiently clear trend or comparison to stand out against the many changes in coding and identifiability of different types of fires. It is reasonable to assume that the value of the HUD standards in confining more fires to room of origin is still in place, as shown using 1989-1998 data in Table 2-1, but no other patterns are apparent.

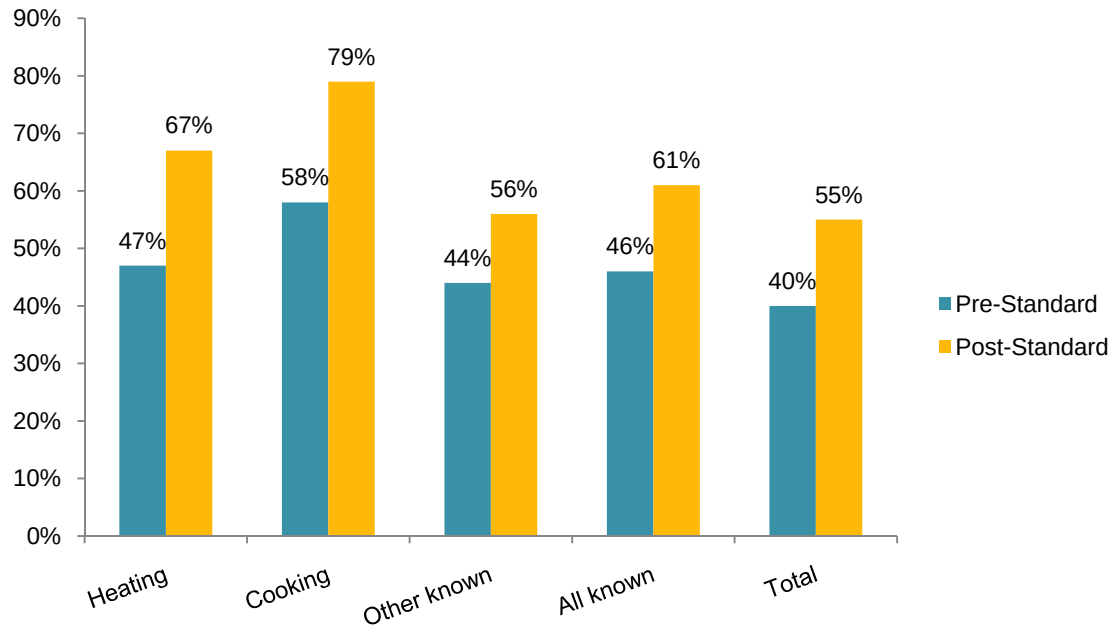
The HUD standards are particularly effective in confining heating and cooking fires to the room of origin.

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. (The “heating equipment” category also includes fixed and portable space

heaters, fireplaces, chimneys, and flues. The "cooking equipment" category also includes separate ovens, microwave ovens, toasters, and a number of other types of portable cooking or warming equipment.) These special provisions should mean that heating and cooking fires would tend to be smaller in post-standard homes.

Figure 2-1 shows that the HUD standards are associated with even more success in confining heating and cooking fires to room of origin than has already been shown for fires of all causes.

Figure 2-1. Percent of Fires With Flame Damage Confined to Room of Origin by Cause, 1989-1998
U.S. Pre- vs. Post-Standard Manufactured Homes



Note: Each percent is based on a ten-year total of estimated fires, and all percentages are based on reported fires that number more than a thousand before projection from the NFIRS sample. "Total" percents are less than "all known" percents because percents are much lower for fires with unknown cause.

Source: NFIRS and NFPA survey.

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.

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.

Smaller fires could actually lead to fewer reported fires, if the smaller sizes allowed occupants to control more fires without needing to call the fire department. This appears to be true for heating equipment fires. Post-HUD-standard manufactured homes have *fewer* heating equipment fires per 1,000 housing units than pre-standard units, in that heating equipment has a smaller share of what was already shown to be a lower overall rate of fires per 1,000 housing units. Tables 2-2 to 2-5 show 1989-1998 major causes for pre-standard and post-standard manufactured home fires and associated losses. On every loss measure, the heating equipment share is considerably larger for pre-standard units, as compared to post-standard units. The differences are 6 percentage points for fires (19% vs. 13%), 11 percentage points for civilian deaths (19% vs. 8%), 6 percentage points for civilian injuries (17% vs. 11%), and 8 percentage points for direct property damage (19% vs. 11%).

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. This means smoke alarms have been required in all new manufactured homes since 1976, years before the last states required smoke alarms in other one- or two-family homes. However, available national statistics suggest that a lower percentage of manufactured homes have smoke alarms. The 2009 *American Housing Survey* found 91.6% of occupied manufactured homes reported having working smoke alarms, compared to 93.3% of all occupied housing units (including multi-family).[1] Also, the 2004-2005 Consumer Product Safety Commission study of unreported fires found that only 91% of manufactured homes with unreported fires had smoke alarms, compared to 97-98% of either detached single family homes, townhouses or row house, or multi-family housing with unreported fires.[2]

In 1989-1998, 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 1989-1998, roughly the same as the 2.3 rate if there were no smoke alarms. The apparent absence of a smoke alarm effect in pre-standard manufactured homes is at least partly due to the fact that smoke alarms were less likely to operate, when present in a fire large enough to activate them, in pre-standard manufactured homes (62%) than in post-standard manufactured homes (70%).

It should be clear that it is important to install smoke alarms and to make sure they are working. Both steps – acquisition and regular maintenance, primarily testing and battery replacement – save lives. Since 1976, every manufactured home sold should have included

[1] *American Housing Survey*, Washington: U.S. Bureau of the Census, 2009, Table 2-4.
[2] Michael A. Greene and Craig Andres, *2004-2005 National Sample Survey of Unreported Residential Fires*, U.S. Consumer Product Safety Commission, July 2009.

installed, hard-wired smoke alarms. Just over 20% of 2009 occupied manufactured homes were constructed before 1976, and those units accounted for roughly 30% of 2005-2009 manufactured home fires. (See Table 2-6.) However, half of manufactured home fires are consistently reported as no smoke alarm present, which suggests a high rate of disabling and removal of smoke alarms. In the manufactured home fires where smoke alarms were present and the fire was large enough to activate an operational smoke alarm, smoke alarms operated 78% of the time.

Changes Since the HUD Standards Were First Introduced

Except for a drop in the rate of fires per 1,000 manufactured homes when the HUD standards were introduced, there is no evidence that older manufactured homes have higher rates of fires per thousand manufactured homes than newer manufactured homes.

Table 2-6 compares 2005-2009 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 only 2% of manufactured home fires have unit age reported since the advent of NFIRS Version 5.0 in 1999, only percentages are shown and risk is shown as a relative index. There is little or no significant variation in this index by age, except for the break between 1974 and 1975, which presumably reflects the effects of the HUD standards, introduced during 1976.

The same statistics that show no age-of-unit effect on fire rates, apart from the introduction of the HUD standards, also show no continued improvements that might be attributable to refinements in the HUD standards. The risk indexes in Table 2.6 are roughly the same for 1975-1984, 1985-1994, and 1995 to present. (If the period 2000 to present is considered separately, there is still no decline in the risk index.)

Within the limits of the available data, it appears as if the decline in fire risk in manufactured homes is nearly all explainable in terms of the continued reduction in number and share of occupied manufactured homes built before the 1976 HUD standards became effective or in terms of the impact of changes that are not installed and affect all housing units, not just manufactured homes (e.g. child-resistant lighter, cigarette-resistant mattresses and upholstered furniture). Any other changes have had little or no measurable effect, either because they still affect only a small part of the manufactured home inventory or because their potential impact on risk is slight.

Manufactured Homes vs. Other Homes

Manufactured homes have a 30-44% higher death rate per 100,000 occupied housing units than other one- or two-family homes.

Table 2-7 provides a comparison of 2005-2009 fire experience rates for manufactured homes and other one- or two-family homes, relative to occupied year-round units. 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 may include some trailers. There is a range for one- or two-

family homes other than manufactured homes. The high end of this range includes and the low end excludes housing units in two- to four-family buildings, because two-family dwellings are not shown separately and so one must either include or exclude all two- to four-family dwellings.

The last published NFPA analysis of manufactured home fires, using 1999-2002 data and different analysis rules (intended to include confined fires), found the manufactured home fire death rate to be only 12-24% higher, but the 1999-2002 results reflected what proved to be two unusually low years for fire deaths in manufactured homes. Also, NFIRS 5.0 was not fully implemented in 1999-2002, and NFPA now advises caution in using results from these years.

As in previous analyses, manufactured homes show a lower rate of fires per 1,000 occupied housing units, partially offsetting a higher rate of deaths per 100 fires. Manufactured homes have a lower rate of civilian fire injuries per 100,000 occupied housing units than other one- or two-family homes, because manufactured homes have not only a lower fire rate per 1,000 housing units but also a lower injury rate per 100 fires.

If all pre-HUD-standard manufactured homes were removed from the inventory, the fire death rate per 100,000 occupied manufactured homes would still be estimated at 2.9, or 13-25% higher than the rate for other one- or two-family homes.
The 2.9 estimate is based on compounding the roughly one-third lower fire rate per 1,000 occupied units indicated in Table 2-6 for post-standard units over pre-standard units with the roughly one-half lower death rate per 100 fires shown in Table 2-A, and applying these to the roughly one-fifth of the inventory that is still of pre-standard age.

In other words, the gap between fire death rate per 100,000 housing units in manufactured homes and the rate in other one- or two-family homes is not projected to disappear even when all pre-standard units leave the manufactured home inventory.

Manufactured homes tend to be smaller, which could support more rapid fire growth to flashover.
In 2007, the median size for occupied manufactured homes was 1,162 square feet, compared to 1,807 square feet for all occupied housing units.[3] The median manufactured home had nearly two-thirds the space of the median home but almost 90% of the average number of rooms (5.1 vs. 5.7). 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.

[3] *American Housing Survey for the United States*: 2007, U.S. Census Bureau website, Tables 2-3, 2-9, and 2-12.

Occupants of manufactured homes are more likely to have risk factors for fire than households in general.
In 2007, for example, the percentage of households falling below the poverty line was 21% for occupied manufactured homes compared to 13% for all occupied housing units.[4] Also 26% of households occupying manufactured homes included at least one person aged 65 or older, compared to 23% of households in general. In 29% of occupied manufactured homes, the householder did not have a high school diploma, compared to 15% of all households combined.

In 2005-2009 manufactured home fires, the heating equipment share is higher and the cooking equipment share is lower than for non-confined fires in other one- or two-family homes.
Tables 2-8 to 2-11 show 2005-2009 leading causes, using a slightly different set of cause categories, for manufactured home and non-confined structure fires in other one- or two-family homes. Heating and cooking equipment are by far the top two major causes for fires, but their relative importance is slightly different. The manufactured home heating equipment share (19%) is now higher than the heating equipment share for other one- or two-family homes (14%). Note that the heating equipment shares and especially the cooking equipment shares are much higher for one- or two-family homes when confined fires are included. The same might be true for manufactured homes if it were possible to identify confined fires in manufactured homes.

The share for electrical distribution or lighting equipment had been higher for manufactured homes than for other one- or two-family homes in the 1980s and 1990s but is now the same. There are stresses on the electrical system of a manufactured home during transport that could have explained their higher share of manufactured home fires, but there is no sign of such a difference now.

The case for fire sprinklers is as strong for manufactured homes as it is for other one- or two-family homes.
Manufactured homes have a higher fire death rate per 100,000 occupied housing units than other one- or two-family homes, and the statistical evidence indicates that there are no factors, trends, or strategies already in place that will eliminate this gap. Therefore, the case for sprinklers as a proven strategy for additional risk reduction is at least as strong for manufactured homes as for other homes, and model codes have already concluded that the case for sprinklers in other homes is strong enough that they have required that sprinklers be installed in all new homes.

[4] *American Housing Survey for the United States*: 2007, U.S. Census Bureau website, Tables 2-3, 2-9, and 2-12.

Table 2-1. 1989-1998 Loss per Fire, by Extent of Flame Damage
Pre-Standard vs. Post-Standard Manufactured Homes
Structure Fires Reported to U.S. Fire Departments

Extent of Flame Damage	Pre-Standard (Pre-1976) Fires		Pre-Standard (Pre-1976) Loss per Fire (in Thousands)	Post-Standard (Post-1976) Fires		Post-Standard (Post-1976) Loss per Fire (in Thousands)
Confined to room of origin	1,040	(40%)	$2.9	1,210	(55%)	$5.8
Confined to building of origin but extended beyond room of origin	1,310	(51%)	$12.4	880	(40%)	$20.3
Extended beyond building of origin	230	(9%)	$13.4	110	(5%)	$20.4
All fires with known extent of flame damage and known year of manufacture	2,670	(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 ten, and direct property damage is estimated to the nearest million dollars. Property damage has not been adjusted for inflation. *Statistics do not include any proportional allocation of fires with unknown year of manufacture*. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey.

Table 2-2. Pre-Standard and Post-Standard Manufactured Home Fires, by Cause
Annual Average of Structure Fires Reported to U.S. Fire Departments in 1989-1998

Cause	Pre-Standard (Pre-1976)		Post-Standard (Post-1976)	
Electrical distribution or lighting equipment	540	(20%)	390	(17%)
Heating equipment	520	(19%)	290	(13%)
Intentional	300	(11%)	300	(13%)
Cooking equipment	290	(11%)	320	(14%)
Other equipment	230	(9%)	190	(8%)
Appliances, tools, or air conditioning	220	(8%)	260	(11%)
Smoking material (i.e., lighted tobacco product)	130	(5%)	130	(6%)
Child playing	120	(5%)	120	(5%)
Open flame	120	(5%)	100	(4%)
Exposure (to other hostile fire)	110	(4%)	120	(5%)
Other heat source	40	(1%)	50	(2%)
Natural causes	40	(1%)	40	(2%)
Total	2,670	(100%)	2,300	(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. National estimates are projections. Statistics include proportional allocation of fires not coded as any of the 12 major known causes listed above, i.e., unknown-cause fires relative to all these causes. *Statistics do not include an allocation of fires with unknown year of manufacture*. Fires are estimated to the nearest ten. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey.

Table 2-3. Pre-Standard and Post-Standard Manufactured Home Civilian Fire Deaths, by Cause Annual Average of Structure Fires Reported to U.S. Fire Departments in 1989-1998

Cause	Pre-Standard (Pre-1976)		Post-Standard (Post-1976)	
Heating equipment	50	(19%)	8	(8%)
Smoking material (i.e., lighted tobacco product)	46	(17%)	18	(17%)
Cooking equipment	40	(15%)	13	(12%)
Electrical distribution or lighting equipment	37	(14%)	6	(5%)
Child playing	29	(11%)	25	(24%)
Other equipment	26	(10%)	3	(2%)
Intentional	24	(9%)	13	(13%)
Appliances, tools, or air conditioning	4	(2%)	2	(2%)
Other heat source	4	(2%)	8	(8%)
Open flame	2	(1%)	10	(9%)
Exposure (to other hostile fire)	2	(1%)	0	(0%)
Natural causes	1	(0%)	0	(0%)
Total	267	(100%)	106	(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. National estimates are projections. Statistics include proportional allocation of fires not coded as any of the 12 major known causes listed above, i.e., unknown-cause fires relative to all these causes. *Statistics do not include an allocation of fires with unknown year of manufacture*. Civilian deaths are estimated to the nearest one. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey.

Table 2-4. Pre-Standard and Post-Standard Manufactured Home Civilian Fire Injuries, by Cause Annual Average of Structure Fires Reported to U.S. Fire Departments in 1989-1998

Cause	Pre-Standard (Pre-1976)		Post-Standard (Post-1976)	
Heating equipment	86	(17%)	38	(11%)
Cooking equipment	77	(16%)	82	(25%)
Child playing	62	(13%)	58	(17%)
Electrical distribution or lighting equipment	62	(13%)	27	(8%)
Appliances, tools, or air conditioning	47	(10%)	39	(12%)
Smoking material (i.e., lighted tobacco product)	46	(9%)	17	(5%)
Other equipment	42	(8%)	25	(7%)
Intentional	32	(7%)	16	(5%)
Other heat source	15	(3%)	21	(6%)
Open flame	14	(3%)	7	(2%)
Natural causes	6	(1%)	2	(1%)
Exposure (to other hostile fire)	3	(1%)	1	(0%)
Total	492	(100%)	333	(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. National estimates are projections. Statistics include proportional allocation of fires not coded as any of the 12 major known causes listed above, i.e., unknown-cause fires relative to all these causes. *Statistics do not include an allocation of fires with unknown year of manufacture*. Civilian injuries are estimated to the nearest one. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey.

Table 2-5. Pre-Standard and Post-Standard Manufactured Home Direct Property Damage (in Millions) From Fires, by Cause Annual Average of Structure Fires Reported to U.S. Fire Departments in 1989-1998

Cause	Pre-Standard (Pre-1976)		Post-Standard (Post-1976)	
Electrical distribution or lighting equipment	$16	(22%)	$21	(23%
Heating equipment	$14	(19%)	$10	(11%
Intentional	$8	(11%)	$15	(16%
Appliance, tool, or air conditioning	$7	(10%)	$8	(9%
Cooking equipment	$7	(9%)	$7	(8%
Other equipment	$6	(9%)	$10	(11%
Smoking material (i.e., lighted tobacco product)	$5	(7%)	$7	(7%
Child playing	$3	(5%)	$5	(5%
Open flame	$2	(3%)	$2	(3%
Exposure (to other hostile fire)	$2	(2%)	$3	(3%
Other heat source	$1	(1%)	$2	(2%
Natural causes	$1	(1%)	$2	(2%
Total	$73	(100%)	$92	(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. National estimates are projections. Statistics include proportional allocation of fires not coded as any of the 12 major known causes listed above, i.e., unknown-cause fires relative to all these causes. *Statistics do not include an allocation of fires with unknown year of manufacture*. Direct property damage is estimated to the nearest million dollars and has not been adjusted for inflation. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey.

Table 2-6. Risk Index for U.S. Manufactured Home Fire Rates per 1,000 Occupied Manufactured Homes, by Year of Manufacture, 2005-2009

Year of Manufacture	Percent of Fires	Percent of Occupied Manufactured Homes	Risk Index
1995-present	31%	36%	0.9
1985-1994	20%	23%	0.9
1975-1984	21%	22%	1.0
1970-1974	16%	12%	1.4
Before 1970	12%	8%	1.5
Total	100%	100%	1.0

Note: These are based on national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Sums may not equal totals because of rounding error.

Manufactured home fires are identified as Incident Type 121 with any Property Use or Incident Type 120 with Property Use 400-429. Manufactured home fires coded as Incident Type 110-118 with Mobile Property Type 17 are not included because nearly all fires with Incident Type 113-118 (confined fires) have Mobile Property Type blank, making it impossible to estimate relevant fires of this type. For this reason, fires coded as confined fires are excluded from comparisons of manufactured home fires to fires in other one- or two-family homes.

Percent of occupied manufactured homes in 2005-2009 is calculated as a weighted average of available percentages in 2005, 2007 and 2009. This calculation assumes that the average number of manufactured homes in 2005 and 2007 is a good estimate of the number in 2006, and the average number in 2007 and 2009 is a good estimate of the number in 2008. 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, 2005, 2007, 2009,* U.S. Census Bureau website, Table 2-1.

Table 2-7. U.S. Manufactured Homes vs. Other One- or Two-Family Homes Fire Experience Rates (Excluding Fires Reported as Confined Fires and Fires in Buildings That Are Vacant or Under Construction or Demolition), 2005-2009

Measure	Manufactured Homes	Other One- or Two-Family Homes
Fires (2005-2009 annual average)	10,500	141,600
Civilian deaths (2005-2009 annual average)	231	1,999
Civilian injuries (2005-2009 annual average)	444	7,478
Number of housing units (in millions) (2006 estimated as average of 2005 and 2007, and 2008 estimated as average of 2007 and 2009)	6.9*	77.6 – 86.1**
Civilian deaths per 100 fires	2.2	1.4
Civilian injuries per 100 fires	4.2	5.3
Fires per 1,000 housing units	1.5	1.6 – 1.8
Civilian deaths per 100,000 housing units	3.4	2.3 – 2.6
Civilian injuries per 100,000 housing units	6.4	8.7 – 9.6

WARNING: Because of limits of analysis forcing exclusion of confined fires, only the statistics on deaths per 100,000 housing units are considered reliable. The other statistics are provided for comparability between manufactured homes and other one- or two-family homes. The relative comparisons should be in the right direction even if the actual magnitudes are off.

*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 one.

Manufactured home fires are identified as Incident Type 121 with any Property Use or Incident Type 120 with Property Use 400-429. Manufactured home fires coded as Incident Type 110-118 with Mobile Property Type 17 are not included because nearly all fires with Incident Type 113-118 (confined fires) have Mobile Property Type blank, making it impossible to estimate relevant fires of this type. Statistics for other one- or two-family homes include a proportional share of fires with Property Use 400, for greater comparability with the manufactured home fire statistics. Fires coded as confined fires are excluded from comparisons of manufactured home fires to fires in other one- or two-family dwellings.

Sources: NFIRS and NFPA Survey; *American Housing Survey*, Washington: U.S. Bureau of the Census, 2005, 2007 and 2009.

Table 2-8. Fires in Manufactured Homes vs. Other One- or Two-Family Homes, by Leading Cause Annual Average of Structure Fires Reported to U.S. Fire Departments in 2005-2009 (Excluding Confined Fires)

Cause	Manufactured Homes		Other One- or Two-Family Homes	
Heating equipment	2,300	(19%)	23,400	(14%)
Cooking equipment	1,800	(14%)	27,700	(17%)
Electrical distribution or lighting equipment	1,500	(13%)	21,100	(13%)
Intentional	1,100	(9%)	15,200	(9%)
Clothes dryer or washer	1,000	(8%)	13,100	(8%)
Exposure (to other hostile fire)	800	(6%)	10,200	(6%)
Smoking material (i.e., lighted tobacco product)	700	(5%)	9,300	(6%)
Hot ember or ash	600	(5%)	10,700	(6%)
Candle	600	(4%)	9,400	(6%)
Playing with fire	400	(3%)	5,000	(3%)

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. Not all causes are shown, and the same fire may be counted under more than one cause. Statistics include proportional allocation of fires coded as unknown equipment involved in ignition, unknown Cause, unknown heat source, or unknown or none under factor contributing to ignition, as appropriate.

Manufactured home fires are identified as Incident Type 121 with any Property Use or Incident Type 120 with Property Use 400-429. Manufactured home fires coded as Incident Type 110-118 with Mobile Property Type 17 are not included because nearly all fires with Incident Type 113-118 (confined fires) have Mobile Property Type blank, making it impossible to estimate relevant fires of this type. For this reason, fires coded as confined fires are excluded from comparisons of manufactured home fires to fires in other one- or two-family homes.

Source: NFIRS and NFPA survey.

Table 2-9. Civilian Fire Deaths in Manufactured Homes vs. Other One- or Two-Family Homes, by Leading Cause Annual Average of Structure Fires Reported to U.S. Fire Departments in 2005-2009 (Excluding Confined Fires)

Cause	Manufactured Home		Other One- or Two-Family Homes	
Heating equipment	69	(29%)	550	(25%)
Smoking material (i.e., lighted tobacco product)	60	(26%)	510	(23%)
Electrical distribution or lighting equipment	44	(19%)	350	(16%)
Cooking equipment	29	(12%)	260	(12%)
Intentional	25	(11%)	280	(13%)
Hot ember or ash	12	(5%)	100	(5%)
Clothes dryer or washer	7	(3%)	30	(1%)
Exposure (to other hostile fire)	5	(2%)	10	(0%)
Candle	4	(2%)	110	(5%)
Playing with heat source	4	(2%)	90	(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. Not all causes are shown, and the same fire may be counted under more than one cause. Statistics include proportional allocation of fires coded as unknown equipment involved in ignition, unknown Cause, unknown heat source, or unknown or none under factor contributing to ignition, as appropriate.

Manufactured home fires are identified as Incident Type 121 with any Property Use or Incident Type 120 with Property Use 400-429. Manufactured home fires coded as Incident Type 110-118 with Mobile Property Type 17 are not included because nearly all fires with Incident Type 113-118 (confined fires) have Mobile Property Type blank, making it impossible to estimate relevant fires of this type. For this reason, fires coded as confined fires are excluded from comparisons of manufactured home fires to fires in other one- or two-family homes.

Source: NFIRS and NFPA survey.

Table 2-10. Civilian Fire Injuries in Manufactured Homes vs. Other One- or Two-Family Homes, by Leading Cause Annual Average of Structure Fires Reported to U.S. Fire Departments in 2005-2009 (Excluding Confined Fires)

Cause	Manufactured Homes		Other One- or Two-Family Homes	
Cooking equipment	94	(21%)	2,080	(26%)
Heating equipment	79	(18%)	1,180	(15%)
Smoking material (i.e., lighted tobacco product)	58	(13%)	740	(9%)
Electrical distribution or lighting equipment	31	(7%)	770	(10%)
Candle	28	(6%)	740	(9%)
Clothes dryer or washer	24	(5%)	370	(5%)
Intentional	23	(5%)	570	(7%)
Playing with heat source	23	(5%)	530	(7%)
Hot ember or ash	15	(3%)	340	(4%)
Exposure (to other hostile fire)	3	(1%)	50	(1%)

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. Injuries are shown to the nearest one for manufactured homes and the nearest ten for other one- or two-family homes. Not all causes are shown and the same fire may be counted under more than one cause. Statistics include proportional allocation of fires coded as unknown equipment involved in ignition, unknown Cause, unknown heat source, or unknown or none under factor contributing to ignition, as appropriate.

Manufactured home fires are identified as Incident Type 121 with any Property Use or Incident Type 120 with Property Use 400-429. Manufactured home fires coded as Incident Type 110-118 with Mobile Property Type 17 are not included because nearly all fires with Incident Type 113-118 (confined fires) have Mobile Property Type blank, making it impossible to estimate relevant fires of this type. For this reason, fires coded as confined fires are excluded from comparisons of manufactured home fires to fires in other one- or two-family dwellings.

Source: NFIRS and NFPA survey.

Table 2-11. Direct Property Damage (in Millions) in Fires in Manufactured Homes vs. Other One- or Two-Family Homes, by Leading Cause Annual Average of Structure Fires Reported to U.S. Fire Departments in 2005-2009 (Excluding Confined Fires)

Cause	Manufactured Homes		Other One- or Two- Family Homes	
Candle	$39	(21%)	$384	(7%)
Heating equipment	$23	(13%)	$776	(13%)
Cooking equipment	$13	(7%)	$541	(9%)
Electrical distribution or lighting equipment	$13	(7%)	$690	(12%)
Clothes dryer or washer	$13	(7%)	$176	(3%)
Intentional	$12	(7%)	$490	(8%)
Exposure (to other hostile fire)	$11	(6%)	$384	(7%)
Smoking material (i.e., lighted tobacco product)	$9	(5%)	$294	(5%)
Hot ember or ash	$8	(4%)	$356	(6%)
Playing with fire	$6	(3%)	$139	(2%)

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. Damages are shown to the nearest million dollars and are not adjusted for inflation. Not all causes are shown, and the same fire may be counted under more than one cause. Statistics include proportional allocation of fires coded as unknown equipment involved in ignition, unknown Cause, unknown heat source, or unknown or none under factor contributing to ignition, as appropriate.

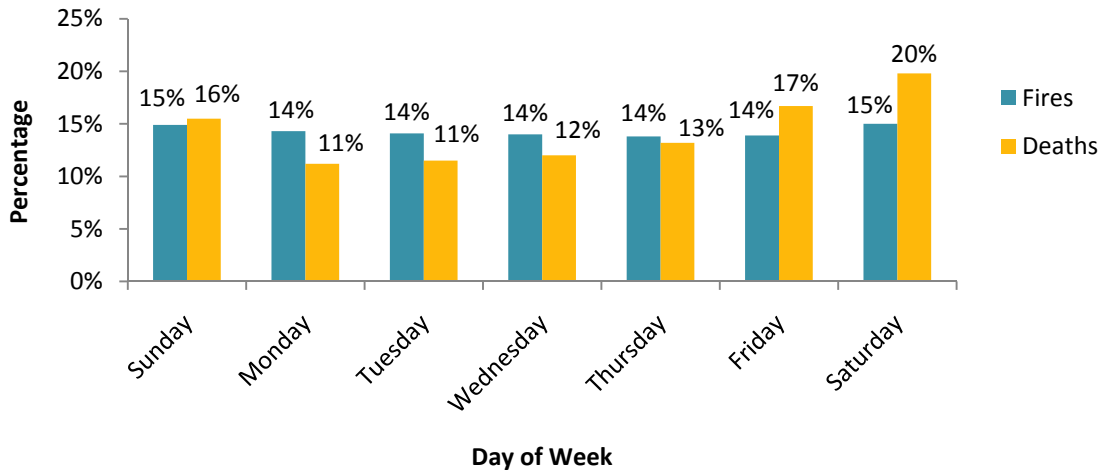
Manufactured home fires are identified as Incident Type 121 with any Property Use or Incident Type 120 with Property Use 400-429. Manufactured home fires coded as Incident Type 110-118 with Mobile Property Type 17 are not included because nearly all fires with Incident Type 113-118 (confined fires) have Mobile Property Type blank, making it impossible to estimate relevant fires of this type. For this reason, fires coded as confined fires are excluded from comparisons of manufactured home fires to fires in other one- or two-family homes.

Source: NFIRS and NFPA survey.

Chapter 3. Other Characteristics of Manufactured Home Fires

Manufactured home fires and associated civilian deaths are more frequent on weekends than on weekdays.
See Figure 3-1. This pattern is also seen in other one- or two-family home structure fires.

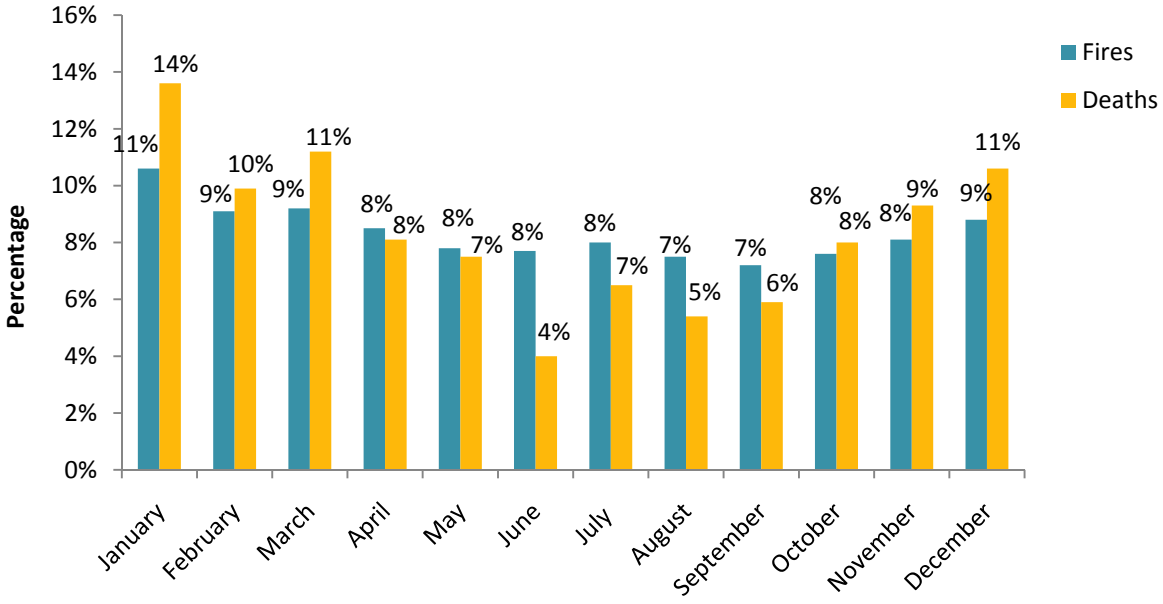
Figure 3-1. Manufactured Home Fires and Deaths, 2005-2009, by Day of Week



Source: NFIRS and NFPA survey.

Manufactured home fires and associated civilian deaths peak during the winter months, when heating equipment fires are added to other, less seasonal types of fires.
See Figure 3-2. This pattern is also seen in other one- or two-family home structure fires.

Figure 3-2. Manufactured Home Fires and Deaths, 2005-2009, by Month of Year



Source: NFIRS and NFPA survey.

Manufactured home fires peak in the afternoon and evening, while associated civilian deaths peak after midnight.
See Table 3-1. This pattern is also seen in other one- or two-family home structure fires.

The leading items first ignited in manufactured home fires are very similar to the leading items first ignited in non-confined fires in other one- or two-family homes.
See Table 3-2. There also are no dramatic differences in leading areas of origin between manufactured home fires and fires involving other one- or two-family homes, as Table 3-3 shows.

Table 3-1.
Manufactured Home Fires, by Hour of Day
Annual Average of 2005-2009 Structure Fires Reported to U.S. Fire Departments

Hour of Day	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Midnight – 12:59 a.m.	500	(4%)	17	(7%)	25	(6%)	$22	(12%)
1:00 – 1:59 a.m.	470	(4%)	17	(7%)	26	(6%)	$8	(4%)
2:00 – 2:59 a.m.	430	(3%)	20	(8%)	25	(6%)	$8	(4%)
3:00 – 3:59 a.m.	410	(3%)	17	(7%)	26	(6%)	$7	(4%)
4:00 – 4:59 a.m.	360	(3%)	28	(12%)	23	(5%)	$5	(3%)
5:00 – 5:59 a.m.	320	(3%)	12	(5%)	10	(2%)	$5	(3%)
6:00 – 6:59 a.m.	300	(2%)	12	(5%)	11	(2%)	$5	(3%)
7:00 – 7:59 a.m.	320	(3%)	12	(5%)	15	(3%)	$4	(2%)
8:00 – 8:59 a.m.	410	(3%)	7	(3%)	23	(5%)	$6	(3%)
9:00 – 9:59 a.m.	450	(4%)	4	(2%)	19	(4%)	$6	(3%)
10:00 – 10:59 a.m.	500	(4%)	8	(4%)	20	(4%)	$9	(5%)
11:00 – 11:59 a.m.	530	(4%)	5	(2%)	13	(3%)	$9	(5%)
Noon – 12:59 p.m.	590	(5%)	4	(2%)	18	(4%)	$8	(4%)
1:00 – 1:59 p.m.	630	(5%)	3	(1%)	18	(4%)	$8	(4%)
2:00 – 2:59 p.m.	660	(5%)	7	(3%)	16	(4%)	$8	(4%)
3:00 – 3:59 p.m.	660	(5%)	4	(2%)	21	(5%)	$8	(4%)
4:00 – 4:59 p.m.	670	(5%)	7	(3%)	20	(4%)	$8	(4%)
5:00 – 5:59 p.m.	620	(5%)	5	(2%)	19	(4%)	$8	(4%)
6:00 – 6:59 p.m.	620	(5%)	5	(2%)	15	(3%)	$8	(4%)
7:00 – 7:59 p.m.	610	(5%)	4	(2%)	17	(4%)	$8	(4%)
8:00 – 8:59 p.m.	620	(5%)	7	(3%)	17	(4%)	$7	(4%)
9:00 – 9:59 p.m.	610	(5%)	12	(5%)	18	(4%)	$8	(4%)
10:00 – 10:59 p.m.	560	(5%)	10	(4%)	20	(4%)	$8	(4%)
11:00 – 11:59 p.m.	510	(4%)	9	(4%)	19	(4%)	$7	(4%)
Total	12,370	(100%)	234	(100%)	453	(100%)	$186	(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. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fire estimated to the nearest ten for manufactured homes. Civilian deaths and injuries are estimated to the nearest one for manufactured homes. Direct property damage has been estimated to the nearest million dollars.

Manufactured home fires are identified as Incident Type 121 with any Property Use or Incident Type 120 with Property Use 400-429. Manufactured home fires coded as Incident Type 110-118 with Mobile Property Type 17 are not included because nearly all fires with Incident Type 113-118 (confined fires) have Mobile Property Type blank, making it impossible to estimate relevant fires of this type. For this reason, fires coded as confined fires are excluded from comparisons of manufactured home fires to fires in other one- or two-family dwellings.

Source: NFIRS and NFPA survey.

Table 3-2. Leading Items First Ignited in Fires in Manufactured Homes and Other One- or Two-Family Homes Annual Average of 2005-2009 Structure Fires Reported to Fire Departments

A. Manufactured Homes

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	1,380	(11%)	16	(7%)	32	(7%)	$13	(7%)
Unclassified item first ignited	990	(8%)	13	(6%)	24	(5%)	$11	(6%)
Cooking materials	860	(7%)	13	(5%)	57	(13%)	$10	(5%)
Structural material or framing	760	(6%)	11	(5%)	17	(4%)	$13	(7%)
Interior wall covering	760	(6%)	12	(5%)	23	(5%)	$19	(10%)
Exterior wall covering	660	(5%)	5	(2%)	9	(2%)	$10	(5%)
Mattress or bedding	580	(5%)	37	(16%)	47	(10%)	$9	(5%)
Appliance housing or casing	500	(4%)	3	(1%)	15	(3%)	$5	(3%)
Upholstered furniture	500	(4%)	32	(14%)	29	(6%)	$14	(7%)
Insulation within structural area	480	(4%)	1	(0%)	6	(1%)	$4	(2%)
Floor covering	470	(4%)	19	(8%)	16	(3%)	$8	(4%)

B. Other One- or Two-Family Homes, All Structure Fires

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	15,200	(6%)	90	(4%)	360	(4%)	$353	(6%)
Unclassified item first ignited	23,600	(9%)	80	(4%)	340	(4%)	$290	(5%)
Cooking materials	53,300	(20%)	90	(4%)	2,000	(23%)	$293	(5%)
Structural material or framing	18,500	(7%)	120	(6%)	330	(4%)	$920	(16%)
Interior wall covering	7,100	(3%)	70	(3%)	220	(3%)	$274	(5%)
Exterior wall covering	12,000	(5%)	30	(1%)	140	(2%)	$370	(6%)
Mattress or bedding	8,000	(3%)	280	(13%)	910	(10%)	$277	(5%)
Appliance housing	8,700	(3%)	30	(2%)	200	(2%)	$102	(2%)
Upholstered furniture	5,400	(2%)	420	(19%)	560	(6%)	$349	(6%)
Insulation within structural area	5,500	(2%)	10	(0%)	80	(1%)	$128	(2%)
Floor covering	4,500	(2%)	110	(5%)	200	(2%)	$150	(3%)

Table 3-2. Leading Items First Ignited in Fires in Manufactured Homes and Other One- or Two-Family Homes Annual Average of 2005-2009 Structure Fires Reported to Fire Departments (Continued)

C. Other One- or Two-Family Homes, Excluding Confined Fires

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wire or cable insulation	13,700	(8%)	90	(4%)	360	(5%)	$352	(6%)
Unclassified item first ignited	9,000	(5%)	80	(4%)	280	(4%)	$287	(5%)
Cooking materials	14,400	(9%)	80	(4%)	1,380	(17%)	$282	(5%)
Structural material or framing	18,000	(11%)	120	(6%)	330	(4%)	$920	(16%)
Interior wall covering	6,900	(4%)	70	(3%)	220	(3%)	$273	(5%)
Exterior wall covering	11,800	(7%)	30	(1%)	140	(2%)	$370	(6%)
Mattress or bedding	7,700	(5%)	280	(13%)	910	(11%)	$277	(5%)
Appliance housing	4,700	(3%)	30	(2%)	170	(2%)	$101	(2%)
Upholstered furniture	5,300	(3%)	420	(19%)	560	(7%)	$349	(6%)
Insulation within structural area	5,400	(3%)	10	(0%)	70	(1%)	$128	(2%)
Floor covering	4,400	(3%)	110	(5%)	200	(3%)	$149	(3%)

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 ten for manufactured homes and the nearest hundred for other one- or two-family homes. Civilian deaths and injuries are estimated to the nearest one for manufactured homes and the nearest ten for other one- or two-family homes. Direct property damage has been estimated to the nearest million dollars. Statistics include proportional allocation of fires coded as item first ignited unknown. Statistics for other one- or two-family homes do not include an allocation of fires in unknown-type residential properties.

Manufactured home fires are identified as Incident Type 121 with any Property Use or Incident Type 120 with Property Use 400-429. Manufactured home fires coded as Incident Type 110-118 with Mobile Property Type 17 are not included because nearly all fires with Incident Type 113-118 (confined fires) have Mobile Property Type blank, making it impossible to estimate relevant fires of this type. For this reason, fires coded as confined fires are excluded from comparisons of manufactured home fires to fires in other one- or two-family dwellings.

Source: NFIRS and NFPA survey.

Table 3-3. Leading Areas of Origin in Fires in Manufactured Homes and Other One- or Two-Family Homes Annual Average of 2005-2009 Structure Fires Reported to Fire Departments

A. Manufactured Homes

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Kitchen	2,350	(19%)	35	(15%)	134	(36%)	$32	(17%)
Bedroom	1,740	(14%)	50	(21%)	97	(21%)	$31	(17%)
Living room, family room or den	890	(7%)	64	(27%)	59	(13%)	$20	(11%)
Unclassified function area	690	(6%)	26	(11%)	42	(9%)	$13	(7%)
Crawl space or substructure space	600	(5%)	2	(1%)	10	(2%)	$5	(3%)
Unclassified area of origin	600	(5%)	6	(3%)	4	(1%)	$8	(4%)
Laundry room or area	580	(5%)	8	(4%)	12	(3%)	$7	(4%)
Unclassified structural area	530	(4%)	10	(4%)	10	(2%)	$9	(5%)
Bathroom	480	(4%)	3	(1%)	13	(3%)	$6	(3%)
Exterior wall surface	480	(4%)	2	(1%)	6	(1%)	$5	(3%)
Heating equipment room or area	440	(4%)	3	(1%)	9	(2%)	$4	(2%)
Wall assembly or concealed space	440	(4%)	2	(1%)	7	(2%)	$8	(4%)

B. Other One- or Two-Family Homes, All Structure Fires

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Kitchen	85,600	(32%)	310	(14%)	2,870	(32%)	$736	(12%)
Bedroom	22,300	(8%)	540	(24%)	1,810	(20%)	$789	(13%)
Living room, family room or den	11,300	(4%)	540	(24%)	990	(11%)	$488	(8%)
Unclassified function area	7,900	(3%)	240	(11%)	480	(5%)	$313	(5%)
Crawl space or substructure space	5,000	(2%)	50	(2%)	190	(2%)	$171	(3%)
Unclassified area of origin	6,500	(2%)	40	(2%)	70	(1%)	$135	(2%)
Laundry room or area	8,900	(3%)	40	(2%)	280	(3%)	$185	(3%)
Unclassified structural area	5,200	(2%)	80	(4%)	150	(2%)	$246	(4%)
Bathroom	5,500	(2%)	30	(1%)	200	(2%)	$99	(2%)
Exterior wall surface	8,500	(3%)	10	(0%)	90	(1%)	$167	(3%)
Heating equipment room or area	6,000	(2%)	20	(1%)	140	(2%)	$99	(2%)
Wall assembly or concealed space	6,400	(2%)	30	(1%)	110	(1%)	$201	(3%)

Table 3-3. Leading Areas of Origin in Fires in Manufactured Homes and Other One- or Two-Family Homes Annual Average of 2005-2009 Structure Fires Reported to Fire Departments (Continued)

C. Other One- or Two-Family Homes, Excluding Confined Fires

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Kitchen	30,500	(18%)	310	(14%)	2,080	(26%)	$721	(12%)
Bedroom	21,800	(13%)	540	(24%)	1,810	(23%)	$788	(13%)
Living room, family room, or den	10,800	(6%)	540	(24%)	980	(12%)	$488	(8%)
Unclassified function area	7,300	(4%)	240	(11%)	470	(6%)	$312	(5%)
Crawl space or substructure space	4,600	(3%)	50	(2%)	180	(2%)	$171	(3%)
Unclassified area of origin	4,600	(3%)	40	(2%)	70	(1%)	$135	(2%)
Laundry room or area	8,300	(5%)	40	(2%)	280	(4%)	$185	(3%)
Unclassified structural area	4,800	(3%)	80	(4%)	140	(2%)	$246	(4%)
Bathroom	5,100	(3%)	30	(1%)	200	(3%)	$99	(2%)
Exterior wall surface	8,300	(5%)	10	(0%)	90	(1%)	$167	(3%)
Heating equipment room or area	3,100	(2%)	20	(1%)	120	(2%)	$98	(2%)
Wall assembly or concealed space	6,400	(4%)	30	(1%)	110	(1%)	$200	(3%)

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 ten for manufactured homes and the nearest hundred for other one- or two-family homes. Civilian deaths and injuries are estimated to the nearest one for manufactured homes and the nearest ten for other one- or two-family homes. Direct property damage has been estimated to the nearest million dollars. Statistics include proportional allocation of fires coded as area of origin unknown. Statistics for other one- or two-family homes do not include an allocation of fires in unknown-type residential properties.

Manufactured home fires are identified as Incident Type 121 with any Property Use or Incident Type 120 with Property Use 400-429. Manufactured home fires coded as Incident Type 110-118 with Mobile Property Type 17 are not included because nearly all fires with Incident Type 113-118 (confined fires) have Mobile Property Type blank, making it impossible to estimate relevant fires of this type. For this reason, fires coded as confined fires are excluded from comparisons of manufactured home fires to fires in other one- or two-family dwellings.

Source: NFIRS 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. Fires reported to federal or state fire departments or industrial fire brigades are not included in these estimates.

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/documentation/design/NFIRS_Paper_Forms_2008.pdf.

NFIRS has a wide variety of data elements and code choices. The NFIRS database contains coded information. Many code choices describe several conditions. These cannot be broken down further. For example, area of origin code 83 captures fires starting in vehicle engine areas, running gear areas or wheel areas. It is impossible to tell the portion of each from the coded data.

Methodology may change slightly from year to year.
NFPA is continually examining its methodology to provide the best possible answers to specific questions, methodological and definitional changes can occur. *Earlier editions of the same report may have used different methodologies to produce the same analysis, meaning that the estimates are not directly comparable from year to year.*

NFPA's fire department experience survey provides estimates of the big picture.
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; 3) the number and nature of non-fire incidents; and (4) 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.

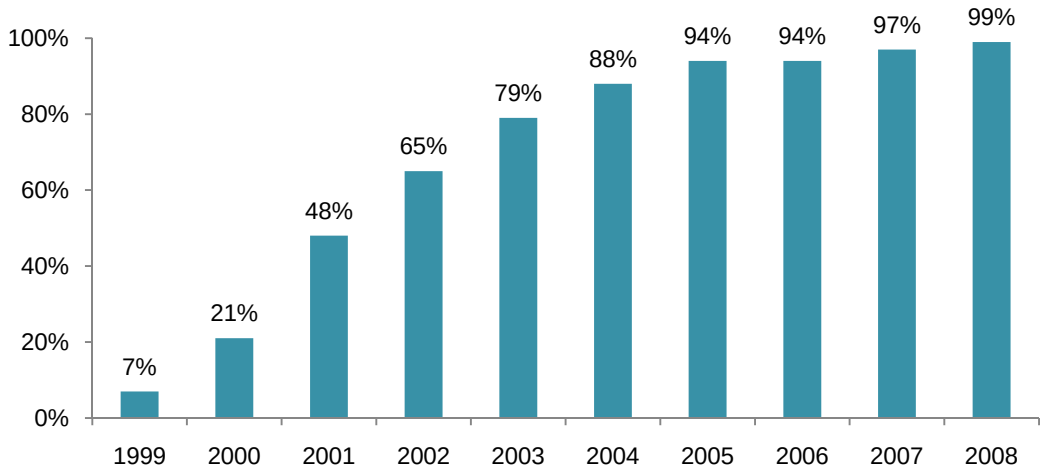
Scaling ratios are obtained by comparing NFPA's projected totals of residential structure fires, non-residential structure fires, vehicle fires, and outside and other fires, and associated civilian deaths, civilian injuries, and direct property damage with comparable totals in NFIRS. Estimates of specific fire problems and circumstances are obtained by multiplying the NFIRS data by the scaling ratios. Reports for incidents in which mutual aid was given are excluded from NFPA's analyses.

Analysts at the NFPA, the USFA and the Consumer Product Safety Commission developed the specific basic 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. The essentials of the approach described by Hall and Harwood are still used, but some modifications have been necessary to accommodate the changes in NFIRS 5.0.

Figure A.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.

Figure A.1. Fires Originally Collected in NFIRS 5.0 by Year



From 1999 data on, analyses are based on scaling ratios using only data originally collected in NFIRS 5.0:

NFPA survey projections
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.

NFIRS 5.0 introduced 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. Some analyses, particularly those that examine cooking equipment, heating equipment, fires caused by smoking materials, and fires started by playing with fire, may examine the confined fires in greater detail. Because the confined fire incident types describe certain scenarios, the distribution of unknown data differs from that of all fires. Consequently, allocation of unknowns must be done separately.

Some analyses of structure fires show only non-confined fires. In these tables, percentages shown are of non-confined structure fires rather than all structure fires. This approach has the advantage of showing the frequency of specific factors in fire causes, but the disadvantage of possibly overstating the percentage of factors that are seldom seen in the confined fire incident types and of understating the factors specifically associated with the confined fire incident types.

Other analyses include entries for confined fire incident types in the causal tables and show percentages based on total structure fires. In these cases, the confined fire incident type is treated as a general causal factor.

For most fields other than Property Use and Incident Type, 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. *Casualty and loss projections can be heavily influenced by the inclusion or exclusion of unusually serious fire.*

In the formulas that follow, the term "all fires" refers to all fires in NFIRS on the dimension studied. The percentages of fires with known or unknown data are provided for non-confined fires and associated losses, and for confined fires only.

Cause of Ignition: This field is used chiefly to identify intentional fires. "Unintentional" in this field is a specific entry and does not include other fires that were not intentionally set: failure of equipment or heat source, act of nature, or "other" (unclassified)." The last should be used for exposures but has been used for other situations as well. Fires that were coded as under investigation and those that were coded as undetermined after investigation were treated as unknown.

Factor Contributing to Ignition: In this field, 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%. Although Factor Contributing to Ignition is only required when the cause of ignition was coded as: 2) unintentional, 3) failure of equipment or heat source; or 4) act of nature, data is often present when not required. Consequently, any fire in which no factor contributing to ignition was entered was treated as unknown.

In some analyses, all entries in the category of mechanical failure, malfunction (factor contributing to ignition 20-29) are combined and shown as one entry, "mechanical failure or malfunction." This category includes:

21. Automatic control failure;
22. Manual control failure;
23. Leak or break. Includes leaks or breaks from containers or pipes. Excludes operational deficiencies and spill mishaps;
25. Worn out;
26. Backfire. Excludes fires originating as a result of hot catalytic converters;
27. Improper fuel used; Includes the use of gasoline in a kerosene heater and the like; and
20. Mechanical failure or malfunction, other.

Entries in "electrical failure, malfunction" (factor contributing to ignition 30-39) may also be combined into one entry, "electrical failure or malfunction." This category includes:

31. Water-caused short circuit arc;
32. Short-circuit arc from mechanical damage;
33. Short-circuit arc from defective or worn insulation;
34. Unspecified short circuit arc;
35. Arc from faulty contact or broken connector, including broken power lines and loose connections;
36. Arc or spark from operating equipment, switch, or electric fence;
37. Fluorescent light ballast; and
30. Electrical failure or malfunction, other.

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, fuse;
68. Backfire from internal combustion engine. Excludes flames and sparks from an exhaust system, (11); and
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, much of the data predates the change. Individuals who have already been trained with the older definition may not change their practices. 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

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

In addition, the partially unclassified codes for broad equipment groupings (i.e., code 100 - heating, ventilation, and air conditioning, other; code 200 - electrical distribution, lighting and power transfer, other; etc.) were allocated proportionally across the individual code choices in their respective broad groupings (heating, ventilation, and air conditioning; electrical distribution, lighting and power transfer, other; etc.). Equipment that is totally unclassified is not allocated further. This approach has the same downside as the allocation of heat source 60 described above. Equipment that is truly different is erroneously assigned to other categories.

In some analyses, various types of equipment are grouped together.

Code Grouping	EII Code	NFIRS Definitions
Central heat	132	Furnace or central heating unit
	133	Boiler (power, process or heating)
Fixed or portable space heater	131	Furnace, local heating unit, built-in
	123	Fireplace with insert or stove
	124	Heating stove
	141	Heater, excluding catalytic and oil-filled
	142	Catalytic heater
	143	Oil-filled heater
Fireplace or chimney	120	Fireplace or chimney
	121	Fireplace, masonry
	122	Fireplace, factory-built
	125	Chimney connector or vent connector
	126	Chimney – brick, stone or masonry
	127	Chimney-metal, including stovepipe or flue
Wiring, switch or outlet	210	Unclassified electrical wiring
	211	Electrical power or utility line
	212	Electrical service supply wires from utility
	214	Wiring from meter box to circuit breaker
	216	Electrical branch circuit
	217	Outlet, receptacle
	218	Wall switch
Power switch gear or overcurrent protection device	215	Panel board, switch board, circuit breaker board
	219	Ground fault interrupter
	222	Overcurrent, disconnect equipment
	227	Surge protector
Lamp, bulb or lighting	230	Unclassified lamp or lighting
	231	Lamp-tabletop, floor or desk
	232	Lantern or flashlight
	233	Incandescent lighting fixture
	234	Fluorescent light fixture or ballast
	235	Halogen light fixture or lamp
	236	Sodium or mercury vapor light fixture or lamp
	237	Work or trouble light

Code Grouping	EII Code	NFIRS Definitions
	238	Light bulb
	241	Nightlight
	242	Decorative lights – line voltage
	243	Decorative or landscape lighting – low voltage
	244	Sign
Cord or plug	260	Unclassified cord or plug
	261	Power cord or plug, detachable from appliance
	262	Power cord or plug- permanently attached
	263	Extension cord
Torch, burner or soldering iron	331	Welding torch
	332	Cutting torch
	333	Burner, including Bunsen burners
	334	Soldering equipment
Portable cooking or warming equipment	631	Coffee maker or teapot
	632	Food warmer or hot plate
	633	Kettle
	634	Popcorn popper
	635	Pressure cooker or canner
	636	Slow cooker
	637	Toaster, toaster oven, counter-top broiler
	638	Waffle iron, griddle
	639	Wok, frying pan, skillet
	641	Breadmaking machine

Equipment was not analyzed separately for confined fires. Instead, each confined fire incident type was listed with the equipment or as other known equipment.

Item First Ignited. In most analyses, mattress and pillows (item first ignited 31) and bedding, blankets, sheets, and comforters (item first ignited 32) are combined and shown as "mattresses and bedding." In many analyses, wearing apparel not on a person (code 34) and wearing apparel on a person (code 35) are combined and shown as "clothing." In some analyses, flammable and combustible liquids and gases, piping and filters (item first ignited 60-69) are combined and shown together.

Area of Origin. Two areas of origin: bedroom for more than five people (code 21) and bedroom for less than five people (code 22) are combined and shown as simply "bedroom." Chimney is no longer a valid area of origin code for non-confined fires.

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. The same rounded value may account for a slightly different percentage share. Because percentages are expressed in integers and not carried out to several decimal places, percentages that appear identical may be associated with slightly different values.