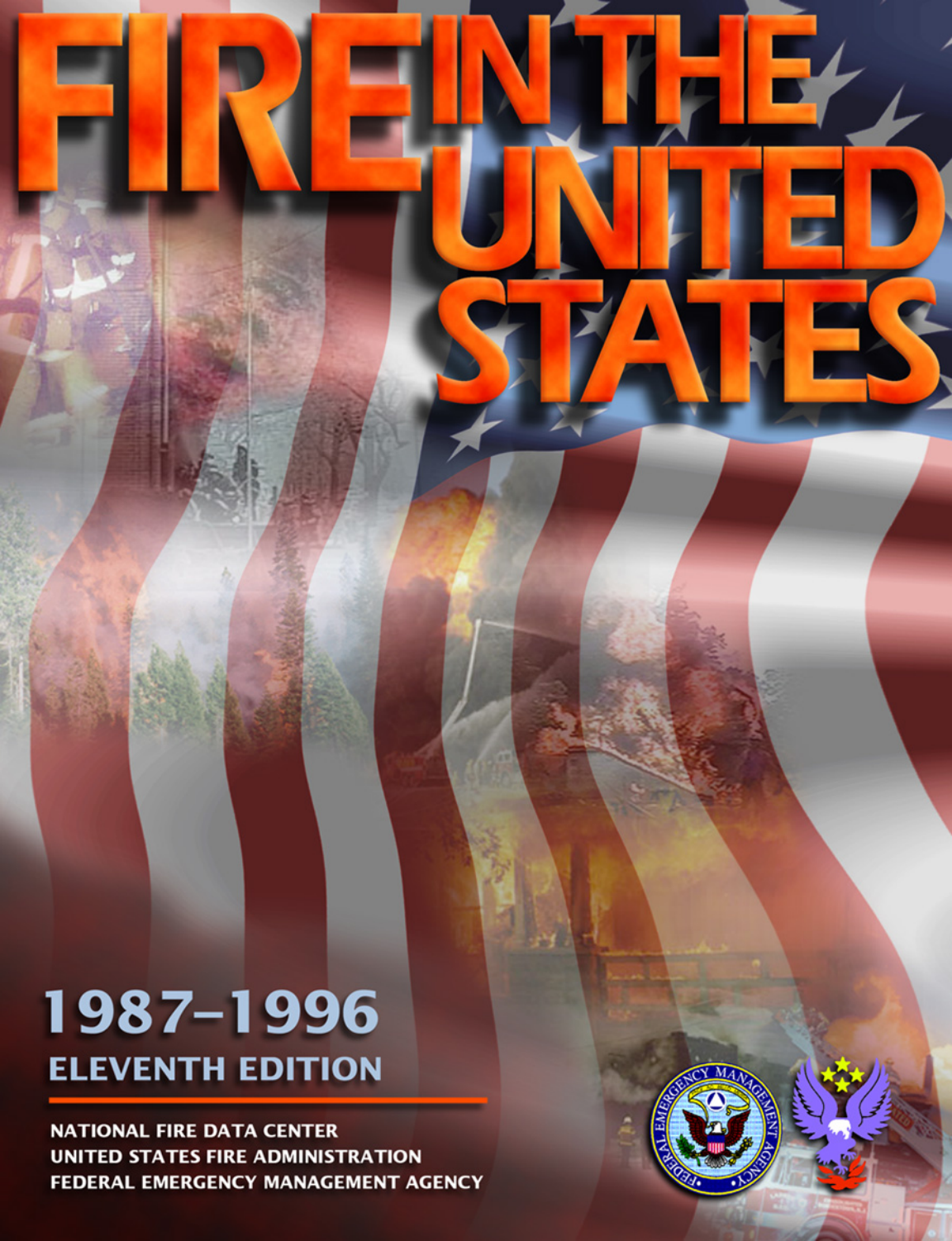
FIRE IN THE UNITED STATES



1987–1996

ELEVENTH EDITION

NATIONAL FIRE DATA CENTER
UNITED STATES FIRE ADMINISTRATION
FEDERAL EMERGENCY MANAGEMENT AGENCY

FA–173/August 1999

Fire in the United States

1987–1996

ELEVENTH EDITION

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Federal Emergency Management Agency
United States Fire Administration
National Fire Data Center

ACKNOWLEDGEMENTS

The United States Fire Administration greatly appreciates the participation in the National Fire Incident Reporting System (NFIRS) of nearly 13,000 fire departments across the United States. The NFIRS data, on which the bulk of this report is based, are available through the work of the staffs of the various state agencies and state fire marshal's offices responsible for fire data collection and on each and every fire officer who fills out an NFIRS form. Without their efforts to collect data, this report could not exist. Although the NFIRS is wholly voluntary, the information collected on nearly one million fires each year represents the most comprehensive set of fire data and statistics in the world.

The National Fire Information Council (NFIC), a nonprofit organization of the state and metro participants in NFIRS, helps coordinate and specify requirements for NFIRS and its operation. NFIC represents an outstanding example of local, state, and federal cooperation on a major, long-term undertaking.

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Documents may also be ordered on the World Wide Web: http://www.usfa.fema.gov/usfapubs.

The United States Fire Administration also thanks the many state fire marshal offices for their assistance with, and input to, the state fire death data presented in Chapter 2.

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EXECUTIVE SUMMARY

The fire problem in the United States, on a per capita basis, is one of the worst in the industrial world. Thousands of Americans die each year in fires, tens of thousands of people are injured, and property losses reach billions of dollars. To put this in context, the annual losses from floods, hurricanes, tornadoes, earthquakes, and other natural disasters combined in the United States average just a fraction of the losses from fires. The public in general, the media, and local governments, however, are generally unaware of the magnitude and seriousness of fire to communities and to the country.

PURPOSE AND SCOPE

Each year, the National Fire Data Center of the U.S. Fire Administration publishes a 10-year statistical overview of the fires in the United States, with focus on the latest year in which data were available at the time of preparation. This report is designed to arm the fire service and others with information that motivates corrective action, sets priorities, targets specific fire programs, serves as a model for state or local analyses of fire data, and provides a baseline for evaluating programs.

This Eleventh Edition of *Fire in the Unites States* covers the 10-year period from 1987 to 1996, with emphasis on 1996. The primary source of data is from the National Fire Incident Reporting System (NFIRS), but National Fire Protection Association (NFPA) annual survey results, mortality data from the National Center for Health Statistics, and data from the state fire marshals are also used. Because of the time it takes to collect data from nearly 13,000 fire departments that participate in NFIRS, edit and obtain corrections, and analyze and display the results, the publication lags the date of data collection.

Each edition of this report describes the overall national fire problem and casualties to firefighters. Biannually, the reports address either a state-by-state examination of fire or, alternatively, the problem of fire in residential and non-residential structures—the subject of this Eleventh Edition. And each year, an assessment of several specific special topics is performed; this year, these topics include multiple-fatality fires, urban area fires, and the relationship of alcohol consumption to fire deaths.

THE NATIONAL FIRE PROBLEM

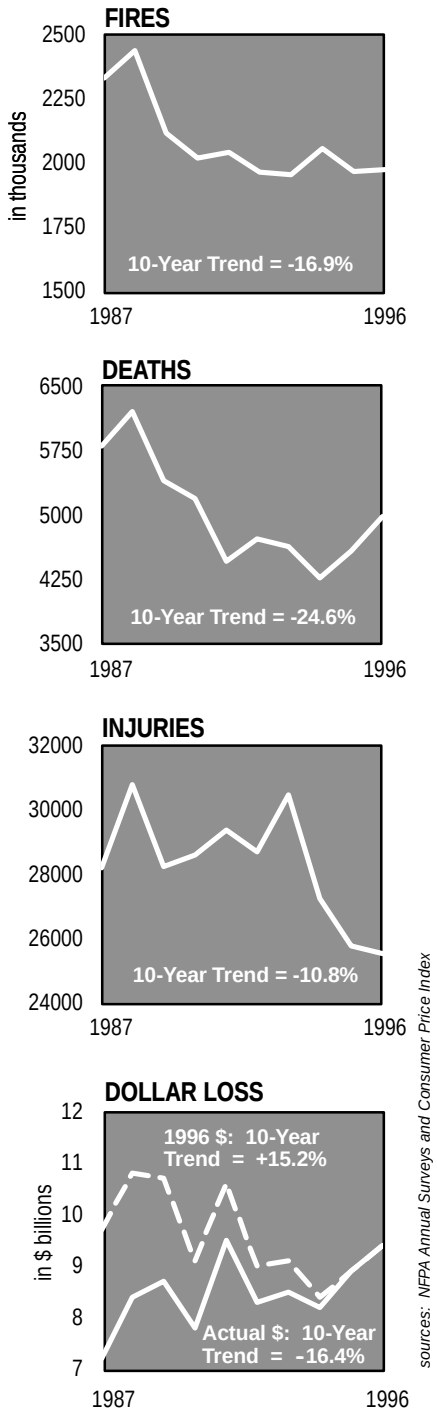


Figure 1. National Trends in Fires and Fire Losses

The 10-year trends continue to decline for the four measures used in this report: numbers of fires (17 percent), deaths (25 percent), injuries (11 percent), and total dollar loss to property (16 percent) (Figure 1).[1] Although this progress is encouraging, an average of 5,030 fire deaths occurred from 1987 to 1996 and in 1996 alone, 4,990 Americans died in fires. On average, more than 100 firefighters die each year fighting fires and protecting lives. Injuries to civilians averaged 28,300 per year and to firefighters, 54,500 per year. The number of fires reported to fire departments averaged 2.1 million annually, resulting in an average direct property loss of $9.8 billion a year in adjusted 1996 dollars. This cost is actually much higher when the cost of fire departments, built-in fire protection in buildings, insurance overhead, and other annual fire protection expenditures are included.

Figure 2 translates these data into per capita losses. Here again, the trends show that the fire problem is less severe than 10 years earlier: fires down by 25 percent, deaths by 32 percent, injuries by 19 percent, and dollar loss by 24 percent. These decreases reflect, in part, the fact that the U.S. population increased faster than did fires and fire casualties. Nevertheless, the death rate per fire in the United States is much higher than the yearly reported fire death rates in Australia, Japan, Hong Kong, and most of the countries in Western Europe. In general, the United States emphasizes the use of advanced fire suppression technology and fire service delivery mechanisms, while other nations emphasize fire prevention. The study and implementation of international approaches to fire prevention programs might help to lessen the U.S. fire problem.

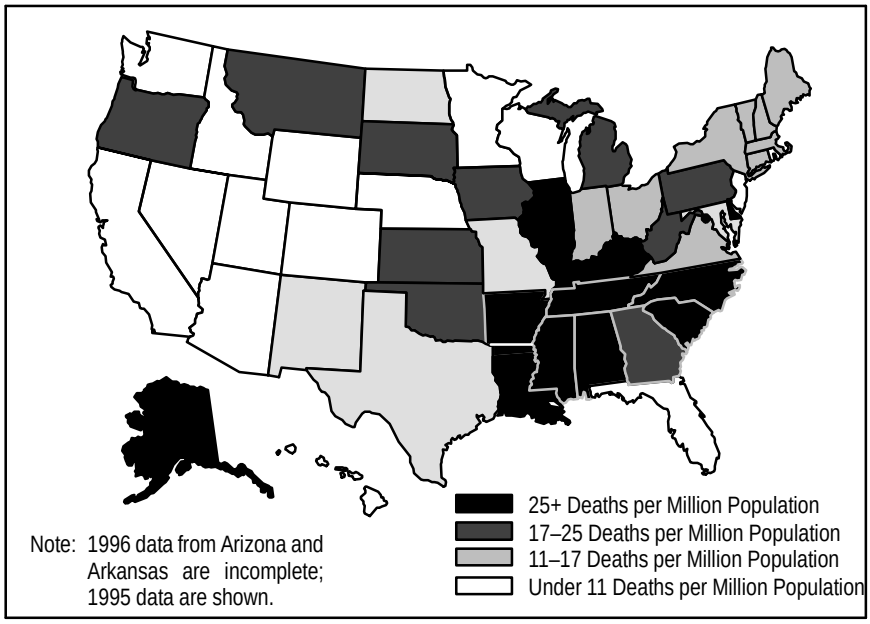
The fire problem varies from region to region and state to state because of variations in climate, poverty, education, demographics, and other factors. The Southeast and Alaska consistently have the highest death rate per capita in the nation (Figure 3). In 1996, Illinois, Kentucky, Delaware, and the District of Columbia also had more than 25 deaths per million population. The five states with the lowest death rate

1 The calculation of trend percentages is explained on page 21.

in 1996 were Hawaii, Utah, Idaho, California, and Wisconsin; Hawaii, Utah, and California were also among the lowest five in both 1994 and 1995.

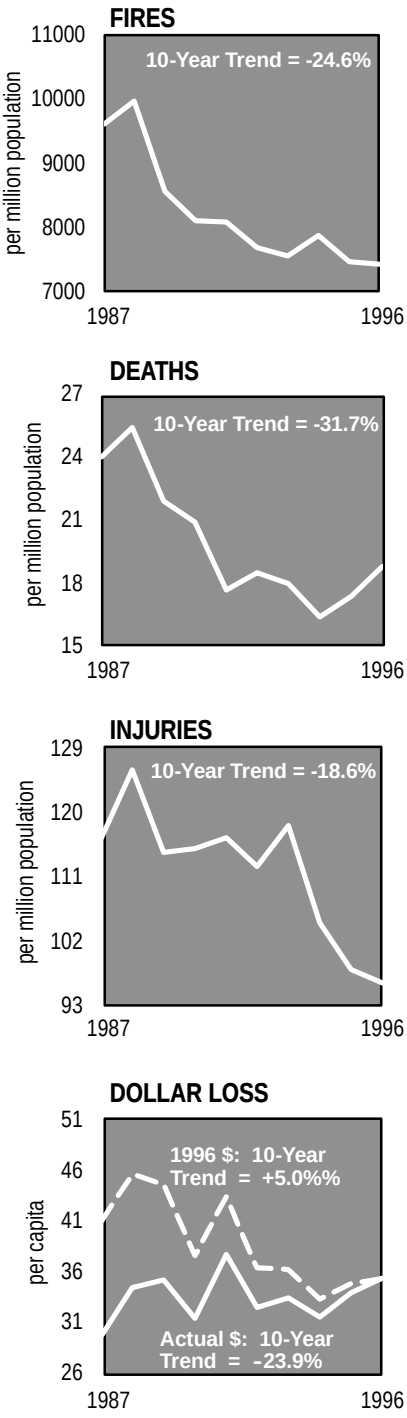
In terms of the absolute number of fire deaths, the 10 states with the most fire deaths account for nearly half of the national total. As expected, many of the large population states are in this top-ten list. Unless there is a considerable decrease of deaths in these states, it will be difficult to lower national totals.

The leading causes of fires in 1996 (arson, open flame, and cooking) and fire deaths (smoking, arson, and heating) are relatively similar around the nation. The rank order and magnitude of these causes vary from state to state and by whether fires, deaths, or injuries are used as the measure. Priorities for prevention programs, therefore, must be tailored to location and purpose.



Sources: State Fire Marshals and the United States Fire Administration

Figure 3. Fire Death Rate by State in 1996



Sources: NFPA Annual Surveys, Consumer Price Index, and Bureau of the Census

Figure 2. National Trends in Severity of Fires and Fire Losses

HOMES AND OTHER PROPERTIES

Twice as many fires occur outdoors than in any other property type (Figure 4). Many of these fires are intentionally set but do not cause much damage. About one in every four calls to a fire department is to respond to a vehicle fire. Depending on the data source, 70 to 80 percent of all civilian deaths and injuries in 1996 stemmed from residential fires. And half of all firefighter deaths and injuries occurred while fighting residential fires. Residences are where fire prevention efforts should be targeted.

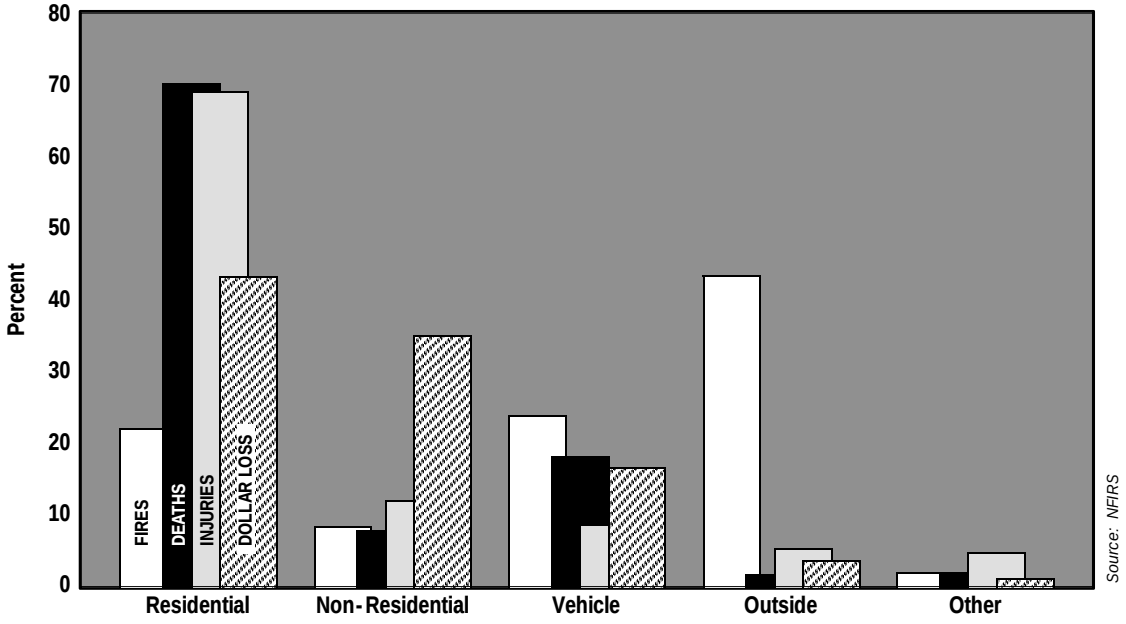


Figure 4. 1996 Fires and Fire Losses by General Property Type

Residential Properties

As defined in NFIRS, residential properties include homes—one- and two-family dwellings, apartments, and manufactured housing—as well as hotels/motels, dormitories, and other properties where people live temporarily. The majority of the U.S. population lives in a one- or two-family dwelling, and these properties dominate the 1996 residential statistics (Table 1). The 10-year trends in all categories of fire losses are down, with a significant decline in number of fires and deaths. The incidence of apartment injuries, relative to houses, is higher, probably because the total space and number of exits are significantly less in apartments than in dwellings. Manufactured housing has a much greater share of fire deaths (11 percent) relative to its share of fires (4 percent); deaths per fire in manufactured housing are approximately twice that of other dwelling categories.

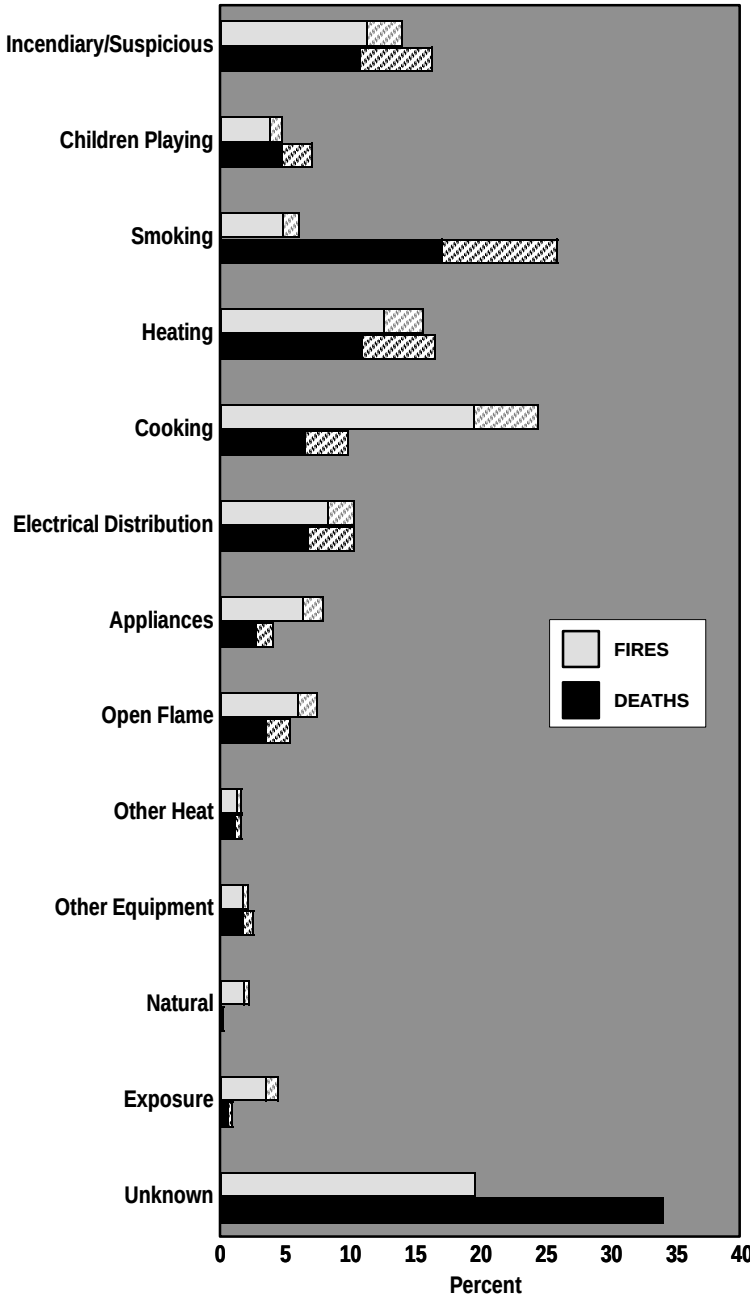
Table 1. 1996 Residential Fire Losses by Property Type (percent)

Residential Property Type	Fires	Deaths	Injuries	Dollar Loss
One-/Two-Family Dwellings	69.8	70.4	61.4	73.9
Apartments	23.1	15.8	31.1	18.9
Manufactured Housing	4.2	10.7	4.2	3.5
Other Residences	3.0	3.2	3.2	3.7
Overall Residential 10-Year Trend	**-23.2**	**-24.8**	**-8.2**	**-11.0**

Source: NFIRS

Figure 5 shows the causes of 1996 fires and deaths in residences. As in 1990 and 1994, cooking, heating, and arson were the three leading causes of fires. Although about one-quarter of all fires and injuries are attributed to cooking, relatively few deaths (10 percent) are reported from this cause. Most cooking fires come from unattended cooking rather than from equipment failures. Cooking injuries often occur when loose clothing such as bathrobes ignite. Greater public awareness of these problems, coupled with information about how to quickly extinguish a cooking fire, could reduce the incidence of such injuries. The leading causes of death, as in most years, are smoking, heating, and arson.

Over 10 years, two perceptible shifts have occurred in trends. Until 1990, heating was the leading cause of fires, due primarily to the surge in the use of alternative space heaters and wood heating in the late 1970s. Since 1987, for example, there were 133,600 heating fires; by 1996, the number had been halved, to 66,200. Considering only one- and two-family dwellings, heating has been the leading cause in all years but 1996 both because these structures predominate in the use of alternative heating sources—especially in the



Note: The crosshatched area represents the unknowns that have been apportioned to the other causes, as described in Chapter 1, page 20.

Figure 5. Causes of 1996 Residential Fires and Fatalities

case of chimney fires—and because maintenance of heating systems is handled by the homeowner rather than professionals.

The other sharp trend decline has been in the absolute number of smoking deaths, which reached a high in 1988 of 1,500 deaths and a low in 1994 of 817. Smoking, however, accounts for 26 percent of all residential fire deaths.

The profile for where fires occur has remained consistent over the past 10 years. Kitchens, bedrooms, and lounge areas such as living rooms, dens, and family rooms are the areas of the home where most fires, deaths, and injuries occur (Figure 6). The kitchen is the area in which most fires originate: 24 percent of all fires in one- and two-family dwellings and 46 percent in apartments. The second most common location is the bedroom in both types of dwellings, where children playing, arson, and electrical distribution are the three most common causes. Half of all fire deaths in one- and two-family dwellings occur in the sleeping area or lounge area, possibly because people fall asleep smoking in bed or on upholstered furniture. In apartments, 59 percent of deaths occur in these areas.

Figure 6. Leading Three Locations of Fire Orgin

Non-Residential Properties

Non-residential properties include industrial and commercial properties, institutions, educational establishments, vacant and under construction properties, mobile properties, and outside properties. Each category has a much different profile and is discussed separately. The overall 10-year trends for non-residential properties have decreased considerably: fires, 27 percent; deaths, 25 percent; injuries, 22 percent; and adjusted dollar loss, 27 percent.

STRUCTURES. Much of the effort in fire prevention, both public and private, has focused on protecting non-residential structures, and the results have been highly effective, especially relative to the residential fire problem. Over 10 years, non-residential structures accounted for 9 percent of all fires, 5–8 percent of deaths, 12–14 percent of injuries, and 32–47 percent of dollar loss.

Figure 7 shows the 1996 fires and deaths attributed to non-residential structure fires. Storage buildings, stores, and offices accounted for 42 percent of all fires, the same as in 1994. Because the number of deaths (111) represent less than 2 percent of all 1996 deaths, deaths by property type vary considerably from year to year; again, storage buildings, stores, and offices combined accounted for 62 percent of non-residential structure deaths.

Arson is the leading cause of fires, deaths, and dollar loss and the second leading cause of injuries after "other equipment" injuries.

VEHICLES AND OTHER MOBILE PROPERTIES. About one in four fires attended by the fire service involves vehicles, mainly cars and trucks, In 1996, the fire service responded to more vehicle fires than to residential fires. And this does not include the tens of thousands of fire department responses to vehicle accidents in which there was no fire.

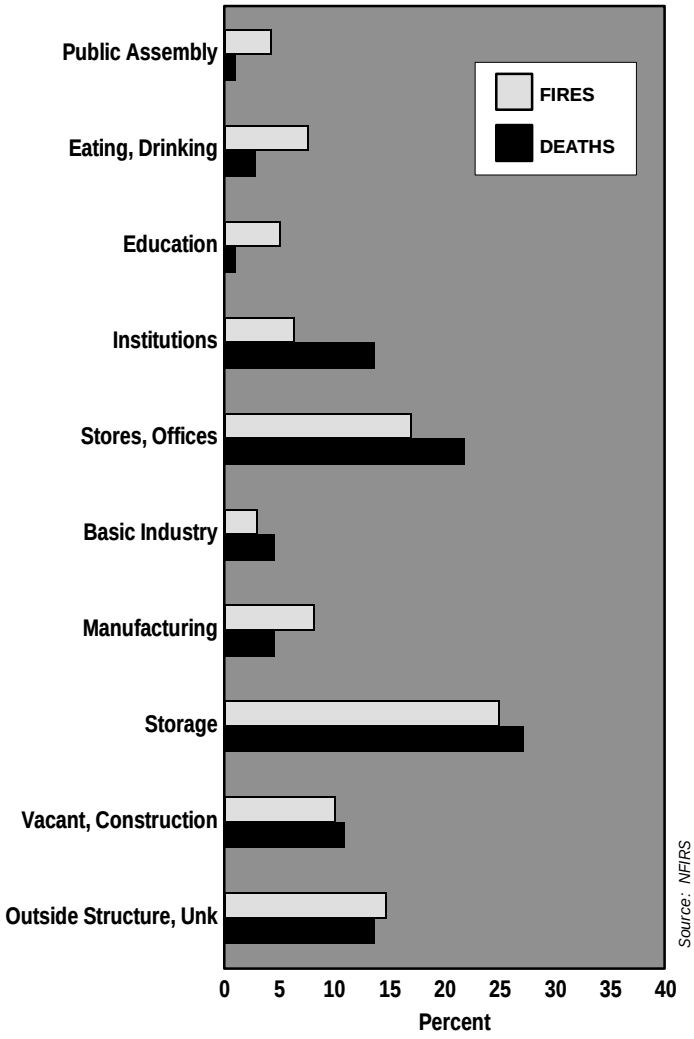


Figure 7. 1996 Non-Residential Fires and Deaths by Property Type

From 1987 to 1996, vehicles have averaged 24 percent of all fires, 17 percent of deaths, 11 percent of injuries, 14 percent of dollar loss. The 10-year trends are down for each; deaths and injuries are down 24 and 26 percent, respectively. These steady downward trends are perhaps due to better safety features that are being incorporated into newer vehicle designs.

More than two-thirds of mobile property fires in 1996 were attributed to mechanical or design problems. Arson accounts for only 18 percent of vehicle fires, but this may well be understated because many vehicle fires are not investigated as to cause. Sixty percent of deaths were caused by the vehicle collision. There can be a significant error in estimating fire deaths in vehicles because it is often difficult to determine whether the fatality was the result of the mechanical forces or from the fire that ensued.

The overall vehicle fire loss problem is large enough to warrant adding vehicle fire prevention and possibly even accident prevention to other fire service public education programs.

OUTSIDE PROPERTIES. Outside fires, which include wildland fires, comprise 44 percent of all fires in 1996 and represent a significant burden to the fire service. There has been a gradual downward (16 percent) trend in outside fires over the past 10 years while the proportion of the total number of fires has remained steady. Although outside fires result in a small percentage of the national total of deaths, injuries, and dollar loss, the problem may be understated because many such fires are not reported (e.g., many wildland fires are not reported to NFIRS or to the NFPA annual survey). Also, authorities have difficulty in determining the value of loss due to an outside fire.

As in all years, the leading cause of outside fires is arson, with many thought to be set by children. However, of the 376,779 outside fires reported to NFIRS in 1996, no cause was listed in 54 percent of the cases.

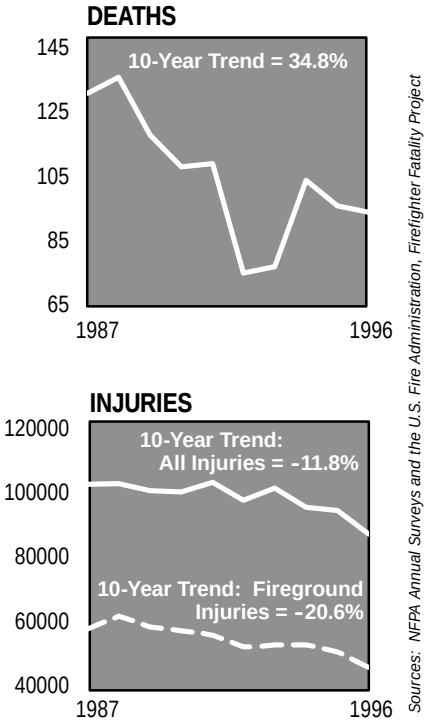


Figure 8. Trends in Firefighter Casualties

FIREFIGHTER DEATHS AND INJURIES

In 1996, 94 firefighters died while on duty; 68 on-duty deaths were directly associated with emergency indicents. Of these, 38 of the firefighter deaths occurred directly from fireground activity—19 fighting residential structure fires, 9 fighting commercial fires, and 10 at other locations. The fatalities included 23 career firefighters and 68 volunteers. The 94 deaths is the third lowest total over the past 20 years; over 10 years, the trend is down a significant 35 percent (Figure 8).

Firefighter injuries have also trended down (12 percent). More than 87,000 firefighters were injured on duty, 46,000 at the fireground. More injuries occurred in one- and two-family dwellings (52 percent) than in apartment fires (14 percent). As in previous years, twice as many firefighters are injured as civilians. The 1996 totals reflect the lowest number of firefighter injuries since NFPA Annual Survey statistics have been recorded.

ETHNIC, AGE, AND GENDER CHARACTERISTICS OF VICTIMS

Fire losses affect all groups and races, rich and poor, North and South, urban and rural. But the problem is higher for some groups than for others. African Americans and American Indians have significantly higher death rates per capita than the national average (Figure 9). African Americans comprise a large and disproportionate share of total fire deaths, accounting for 26 percent of fire deaths—twice as high as their share of the overall population. The elderly of all ethnic groups have the highest fire death rates. The statistics show that elderly African Americans suffer a death rate

that is more than ten times that of the U.S. average.

In all years, people aged under 5 and over 55 have a much higher death rate than the average population (Figure 10). These two age groups account for more than one-third of all deaths. On the other hand, two-thirds of the deaths fall in age groups that are not at high risk, so programs aimed only at the highest risk groups will not reach the majority of victims. In 1996, a slightly larger proportion of female deaths occurred in the young (through age 19) and again in the elderly. Male fire deaths, by contrast, are higher in the mid-life years (20–60).

The level of risk of injuries by age differs from that of death rate data. Young adults aged 20–29 and the elderly over 85 are at higher risk of fire injury than the rest of the population. It is believed that males in the 20–29 age group are greater risk takers during fires. Elderly females have a significantly larger proportion of injuries than elderly males.

Over the past 10 years, men have almost twice as many fire deaths as women (Figure 11). Injuries per capita for males are one and one-half to two times the female rate until age 65, which can be expected because of the longer lifespan of women. For the very old, however, the male injuries per capita are nearly double that of females. The reasons for the disparity of fire injuries between men and women are not known for certain. Suppositions include the greater likelihood of men being intoxicated, the more dangerous occupations of men (most industrial fire fatalities are males), and the greater use of flammable liquids by men.

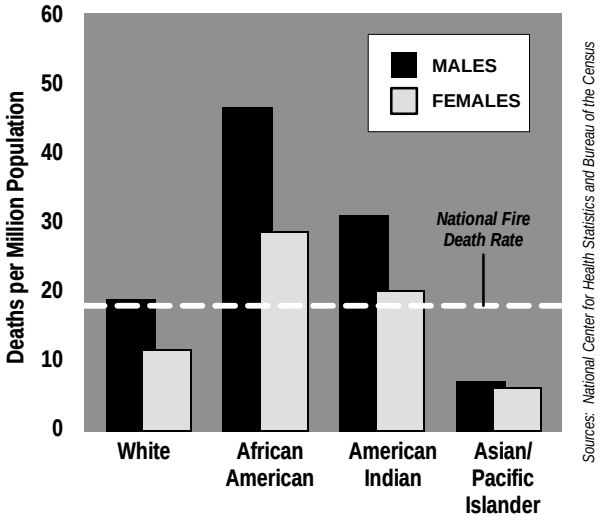


Figure 9. 1996 Fire Death Rate by Race and Gender

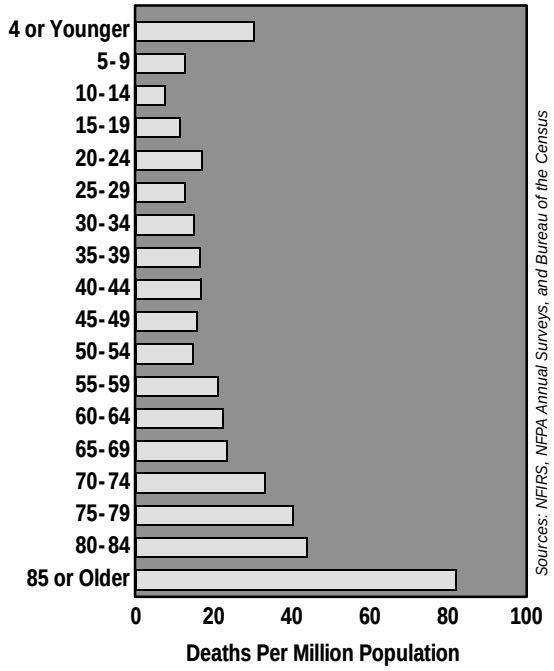


Figure 10. Severity of 1996 Fire Deaths by Age

WHEN FIRES OCCUR

This report examines the times of day, month of year, and, in some situations, the day of the week when fire and fire losses occur. Table 2 summarizes peak periods for the categories examined.

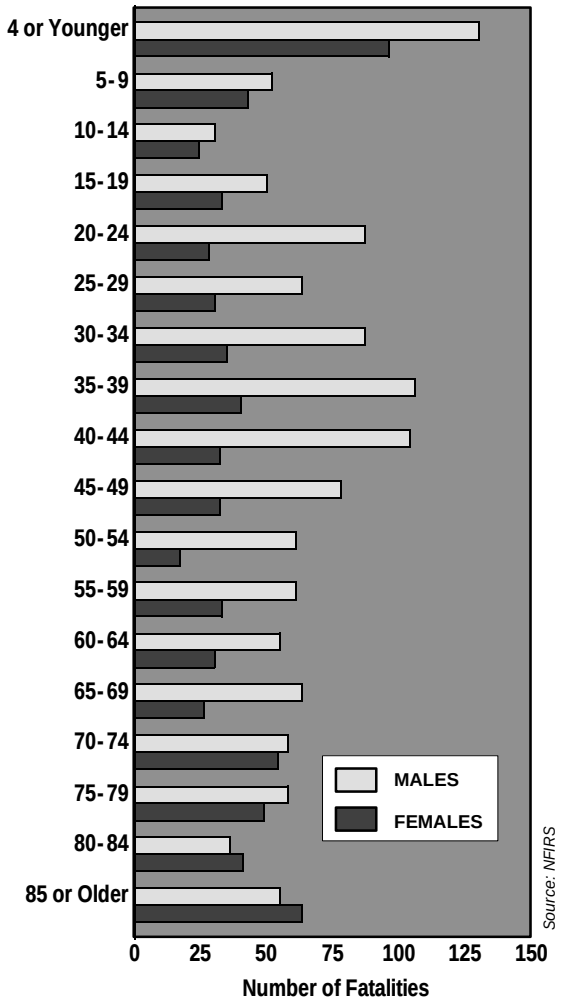


Figure 11. 1996 Fire Deaths by Age and Gender

In residences, fires and injuries peak in the early evening, which is the time when most cooking fires occur. Although fire incidents drop when people sleep, deaths are usually associated with fires that start late at night and early morning when people are most likely to be in deep sleep. These fires are often caused by smoking fires that smolder for several hours and then rapidly increase in smoke production and open flames.

Fires, deaths, and injuries peak in the early afternoon in non-residential structures. Although conjecture, this might be because workers are tiring on their job and are more accident prone or careless. Dollar losses are highest after hours, probably caused by arson.

Fires and deaths in residences and outside peak on the weekends when the populace is generally at home, and during the weekday at workplaces. The leading causes of residential fires (cooking, heating) are generally unaffected by the day of week.

The winter months are the peak period for fires and deaths in all categories except outside fires. Here, heating fires add to the other types of year-round fires causes.

Table 2. Peak Periods When 1996 Fires and Losses Occur

Period	Residential Structures			Non-Residential	
	All	1/2 Family	Apartments	Structures	Outside
Time of Day					
Fires	5–7 p.m	4–8 p.m.	4–9 p.m.	12–7 p.m.	2–6 p.m.
Deaths	11 p.m.–5 a.m.	11 p.m.–5 a.m.	3–5 a.m.	1–2 p.m. & 11–12 p.m.	N/A*
Injuries	4–5 p.m. & 3–4 a.m.	4–8 p.m.	3–4 a.m. & 3–11 p.m.	1–2 p.m.	N/A
Dollar Loss	7–8 p.m	1–5 p.m. & 1–3 a.m.	7–8 p.m. & 4–5 a.m.	10 p.m.–6 a.m.	N/A
Day of Week					
Fires	Sat & Sun	N/A	N/A	Mon–Fri	Sat–Sun
Deaths	Sat & Sun	N/A	N/A	N/A	N/A
Month of Year					
Fires	Nov–Mar	Dec–Mar	Jan–Mar	Jan–Apr	Apr
Deaths	Nov–Mar	Nov–Mar	Nov–Mar	N/A	N/A

*N/A = not analyzed

Source: NFIRS

SMOKE ALARMS AND SPRINKLERS

The greater use of smoke alarms are thought to account for a significant part of the decrease in reported fires and deaths. It is estimated that at least 88 percent of U.S. households have at least one smoke alarm. Households that have reported fires appear much less likely to have smoke alarms than others. Either people with alarms are more safety conscious or the alarms allow early detection and extinguishment so that the fires are not reported. Anecdotal information suggests that reported fires are more prevalent in older, less well cared for homes, and these are less likely to be equipped with an alarm. Table 3 presents the performance of smoke alarms in residential properties. As shown, about one-third of the reports to NFIRS did not indicate the presence or absence of an alarm.

Table 3. 1996 Smoke Alarm Performance in Residences (percent)

Residential Property Type	Presnet/ Operated		Present/Did Not Operate		No Alarm		Unknown	
	Fires	Deaths	Fires	Deaths	Fires	Deaths	Fires	Deaths
All Residences	24.4	13.1	15.1	11.5	27.9	38.5	32.6	36.9
One-/Two-Family Dwellings	20.7	10.0	14.1	10.2	31.6	42.3	33.6	37.5
Apartments	34.5	29.5	18.8	18.1	17.2	20.7	29.6	31.6

Source: NFIRS

The fact that smoke alarms worked in 30 percent of apartments in which a death occurred is troublesome. Explanations include the possibility that hallway or apartment alarms operated after the victims were overcome or that there are fewer ways to escape, especially on higher floors. This situation suggests the need to provide sprinklers in apartments and to emphasize fire prevention.

Residential sprinklers are found in under 2 percent of homes that had reported fires in 1996. This might understate the actual numbers installed in residences since an operating sprinkler could have extinguished a fire and no call made to the fire department. A higher percentage of apartments are equipped with sprinklers than one- or two-family dwellings (5 percent vs. 0.5 percent). Sprinklers are more prevalent in non-residential structures (13 percent), but over the past 3 years there has been no increase in their use.

Intuitively, the installation of sprinklers should be a significant protection solution against fire. However, this conclusion cannot be drawn from NFIRS data alone, since NFIRS combines properties of different size and values in the same property class. Sprinkler systems are more likely to be installed in large and highly valued properties than in small, inexpensive ones. One way around this problem is to compare losses when sprinklers were present and operated versus when they were present and did not operate. The presumption is that the places with sprinklers, whether they went off or not, are more similar to each other than to places that did not have sprinklers. In 1996, the losses per fire were less when sprinklers operated than when they did not (Figure 12). But the difference in 1996 is far less than in 1994 when the dollar lost per fire was twice as high when sprinklers did not operate. This

suggests the need for additional analysis as to the effectiveness of sprinklers where they are installed.

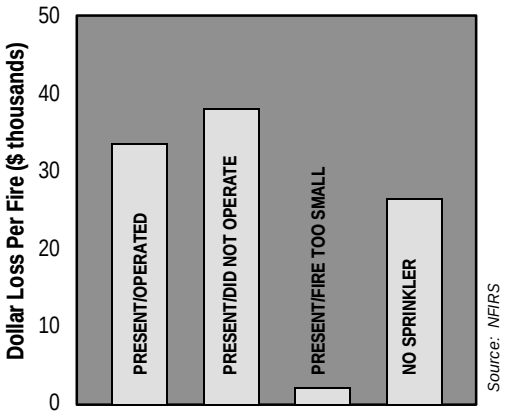


Figure 12. Sprinkler Performance in 1996 Non-Residential Dollar Loss Per Fire

SPECIAL INTEREST TOPICS

Multiple-Fatality Fires

More than one in six of the fatal home fires in this country claim more than one life, and these multiple-fatality fires are responsible for one-third of all residential fire deaths. An analysis of multiple-fatality fires in residences, which accounted for 95 percent of multiple-fatality victims, was conducted using 3 years of NFIRS and fire department data. From 1994 to 1996, 1,491 multiple-fatality fires were reported in residential structures. The data from these fires were compared to the 2,286 fires reported to NFIRS in which there was a single fatality, and the following differences were found:

- *Cause of Fire:* Heating, arson, and children playing with fire-setting materials were the three leading causes (vs. smoking, arson, and heating) accounting for more than half of the multiple-fatality home fires.
- *Area of Fire Origin*. Lounge areas were the leading area of fire ignition, accounting for 35 percent of fires, due in part to the increased likelihood of fires caused by heating systems, arson, and smoking in this area of the home. In single-fatality fires, cooking accounted for twice the number of deaths as in multiple-fatality fires.
- *Form of Ignition*. Open flame accounted for one-fourth of multiple-fatality fires, a high number of which were fires started by children playing with matches or lighters. Smoking materials were the leading form of ignition in single-fatality fires.
- *Time of Day*. More multiple-fatality fires occurred in the early morning hours than single-fatality fires.
- *Smoke Alarm Performance*. Although the proportion of homes with no smoke alarms was nearly the same for both single- and multiple-fatality fires, the incidence of an inoperable alarm was greater in multiple-fatality fires (17 percent in one-victim fires, 22 percent with two victims, and 28 percent with three or more victims).
- *Age*. Children under 10 made up 45 percent (vs. 14 percent) of all victims in multiple-fatality fires. Only 10 percent were age 70 or older, possibly because the elderly are more likely to live alone.
- *Gender*. Males were slightly more likely to die (13 percent) in multiple-fatality fires than women. In single-fatality fires, males were 70 percent more likely than females to die.

- *Condition of Victim*. Victims of multiple-fatality fires were more likely to have been asleep or too young to act than those of single-fatality fires. In the former, bedridden victims are vulnerable due to their physical limitations; in the latter, individuals impaired by alcohol or drugs are more likely to drop a lighted cigarette or have more difficulty detecting and escaping a fire.
- *Activity at Time of Injury*. Victims of multiple-fatality fires were more likely to be injured trying to escape than those of single-fatality fires. Multiple-fatality victims were more likely to be attempting a rescue and less likely to be extinguishing the fire.

Urban Fires

Because large population urban areas have higher densities of people and buildings than rural areas, the fire problem in urban areas was examined. In 1996, 42 percent of the urban fires were classified as outdoor fires, 29 percent were structure fires, and 27 percent were vehicle fires. In both outdoor and vehicle categories, arson was the leading cause of the urban fire. As described in the Ninth Edition of this report, arson takes a heavy toll in terms of cost and diminished quality of living in the United States. There is a broad range of motives for arson, including arson for profit, vandalism, spite or revenge, arson to conceal other crimes, or mental illness.

Although outside fires are the most numerous of the urban fire problem, structure fires account for the vast majority of deaths, injuries, and property loss. Cooking was the leading cause, primarily because residential fires dominate structure fires. Arson fires rank second and heating is third.

As in the national profile, cooking was the leading cause of residential fires in every U.S. urban region (divided into the Midwest, Northeast, South, and West). Arson was the second leading cause except in the Northeast, where heating was second. Smoking was the leading cause of fatal fires in each region except the West, where arson was the leading cause. Interestingly, heating was not a leading cause of fatal urban fires in any region of the United States, whereas it is the leading cause of fatal fires in rural areas. This is likely due to the widespread availability of central heating in urban areas.

Not surprisingly, apartments account for a higher proportion of fires in urban areas than in the country as a whole (35 vs. 20 percent). Heating and electrical distribution fires were far more common in one- and two-family dwellings than in apartments. And cooking accounted for a significantly higher proportion of urban fires in apartments than in one- and two-family dwellings (39 vs. 21 percent). This may in part reflect income differences between homeowners and renters. Low-income groups experienced a higher rate of cooking fires than higher income groups, and the rate of poverty is higher among renters than homeowners in the United States.

Compared to the national totals, more urban fires occur in homes that have at least one functional smoke alarm. The increased incidence of fires in urban homes where a working smoke alarm is present is a serious cause for concern and should be the subject of future research.

Effect of Alcohol

All evidence points to the fact that people who abuse alcohol are a growing high-risk fire group and that education and prevention programs should be targeted to this high-risk segment of the population. Most studies conducted by the medical and fire protection communities show a high percentage of victims had elevated blood alcohol levels (BALs). In fact, the results from one study indicated that there were nearly four times as many alcohol-impaired fire fatalities as nonimpaired fatalities. Clearly, alcohol exerts a strong influence on the areas of fire ignition, detection, and escape.

From a medical standpoint, burn patients with positive BALs have a significantly higher fatality rate than those with negative BALs, and those that do survive require more intravenous antibiotics and fluids, need longer hospital stays, and incur higher medical costs. Alcohol acts at the cellular level by preventing post-injury homeostasis; interferes with the body's vasoconstriction response to shock; not only impedes the detection of smoke, but also facilitates its passage into the body; and depresses the cough reflex.

Alcohol-impaired fire fatalities exhibit an age pattern that is quite the opposite of the overall fire death rate profile where the very young and the very old are at the highest risk. The majority of alcohol-impaired victims are between the ages of 18 and 40, which suggests a strong correlation between intoxication and the causation or ability to escape from a fire. But children, the elderly, and disabled are also the victims of alcohol-related fires because their caretakers may be too impaired to recognize the fire and render assistance.

Nationally, men suffer almost twice as many fire deaths as women among all age groups. When alcohol was involved, 75 percent of fatalities are men. A similar trend was found for fire injuries. Men accounted for 64 percent of all injuries in general, but 83 percent when alcohol was involved. Much of this difference can be explained by the drinking patterns that vary greatly by gender. Males tend to consume larger quantities of alcohol with greater frequency than females. Males also vastly outnumber women when identifying problematic drinking behaviors such as binge drinking or acute alcoholism.

Smoking combined with alcohol use creates an even greater risk for fire injuries and fatalities than the national statistics for smoking alone. Smokers consume more alcohol than do nonsmokers, heavy drinking tends to be associated with heavy smoking, and a large majority of alcoholics are smokers. Smoking is associated with the ignition of many fires where smokers are involved. Studies have shown that 53–65 percent of all alcohol-impaired fire deaths were caused by smoking as the cause of the fires.

The NFIRS requires participating fire departments to record the condition before injury of all civilian fire casualties; however, this information is not routinely reported. Investigators are reluctant to record alcohol abuse by those who cause or are injured by fires for several reasons: humanitarian concern for the victims of fire and their loved ones, lack of training and authorization to test people for alcohol, and the potential for legal ramifications.

1
INTRODUCTION

The United States continues to have one of the most severe fire problems in the world relative to its population size. Most Americans are not aware of this nor of the nature of the fire problem.

This report is a statistical portrait of the fire problem in the United States over the period 1987–96. It is intended for use by a wide audience, including the fire service, the media, researchers, industry, government agencies, and interested citizens. The report focuses on the national fire problem. The magnitude and trends of the fire problem, the causes of fires, where they occur, and who gets hurt are topics that are emphasized. One specific focus is on firefighter casualties—causes, types of injuries, etc.

This document represents the eighth major edition of *Fire in the United States* published by the U.S. Fire Administration: the First Edition, published in 1978, covered 1975–76 fire data; the Second Edition, published in 1982, covered 1977–78; the Sixth Edition, published in 1987, covered 1983; the Seventh Edition, published in 1990, covered 1983–87; the Eighth Edition, published in 1991, covered 1983–90; the Ninth Edition covered 1985–94 and focused on the residential and non-residential fire problem; the Tenth Edition covered 1986–95 and focused on state profiles; and this Eleventh Edition covers 1987–96 and again focuses on the residential and non-residential fire problem. There were also three editions—the Third, Fourth, and Fifth—produced and used as working papers though not published.

SOURCES

The report is primarily based on the National Fire Incident Reporting System (NFIRS) data, but uses other sources as well, especially the National Fire Protection Association's (NFPA's) annual survey of fire departments and mortality data from the National Center for Health Statistics.

National Fire Incident Reporting System

The National Fire Incident Reporting System was started in 1975 as one of the first programs of the National Fire Prevention and Control Administration, which later became the U.S. Fire Administration (USFA). The basic concept of NFIRS has not changed since the system's inception. All states and all fire departments within them have been invited to participate on a voluntary basis. Participating fire departments collect a common core of information on fire and casualty reports using a common set of definitions. The data may be written by hand on paper forms or entered

directly into a computer. Fire departments send these data as a bundle of paper reports, as an electronic file, or on a computer tape to their state fire data office, which edits and collates the data. Semiannually, the state's data are sent to the U.S. Fire Administration. There, the data are further validated. Data summaries and error reports may be sent back to the states to correct suspicious, incorrect, or incomplete information. Data on individual fire incidents and casualties are preserved incident by incident at local, state, and national levels.

The system has grown from an initial 6 states in 1976 to 41 states and the District of Columbia in 1986. Since 1986, the level of participation has remained relatively constant with an average of 40 states and the District of Columbia. In 1996, 39 states and the District of Columbia participated in NFIRS (Table 4). The number of fire departments participating within the states has grown to 13,000 in 1996 (Figure 13). Within participating states, approximately 40 percent of the fire departments report (Table 5). These participating departments represent 38 percent of the more than 33,000 fire departments in the United States. Though participation in NFIRS is voluntary, some states do require their departments to participate in the state system. The future goal is voluntary participation by all states and the District of Columbia.

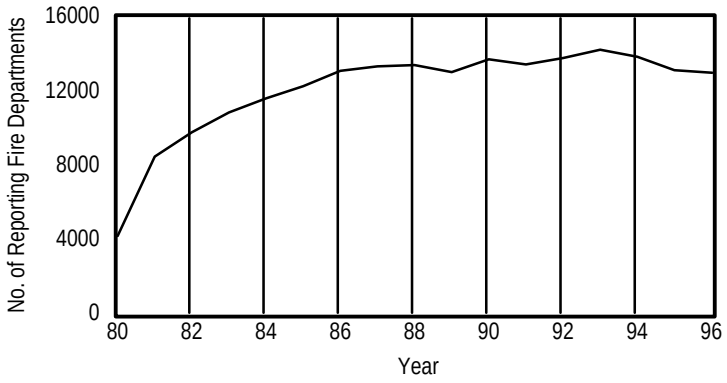


Figure 13. NFIRS Participation (1980–1996)

Corresponding to the increased participation, the number of fires, deaths, and injuries and the amount of dollar loss reported to NFIRS also grew considerably from 1975 to 1995. By the mid 1980s, nearly one million incidents were reported in NFIRS annually. In 1996, data on nearly 866,000 fire incidents were collected, roughly 44 percent of the estimated total responded to by fire departments.

There are, of course, many problems in assembling a real-world database, and NFIRS is no exception. Although NFIRS does not represent 100 percent of incidents reported to fire departments each year, the enormous sample size and good efforts by the fire service allow a tremendous amount of useful information to be collected and used. Because of the rapid advances in computer technology over the past 20 years, NFIRS has been revised to take advantage of these new capabilities and other improvements suggested by the participants. The system, NFIRS 5.0, became operational in January 1999 and is slowly being phased in around the country.

Table 4. States Participating in NFIRS, 1987–1996

State	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Alabama	X	X	X	X	X	X	X	X	X	X
Alaska	X	X	X	X	X	X	X	X	X	X
Arizona	X	X	X	X			X	X	X	
Arkansas	X	X	X	X	X	X	X	X	X	X
California	X	X	X	X	X	X	X	X	X	X
Colorado		X	X	X	X	X	X	X	X	X
Connecticut	X	X	X	X	X	X	X	X	X	X
Delaware	X	X	X	X					X	X
District of Columbia	X		X		X	X	X	X	X	X
Florida	X	X	X	X	X	X	X	X	X	X
Georgia			X	X	X	X	X	X	X	X
Hawaii	X	X	X	X	X	X				X
Idaho	X	X	X	X	X	X	X	X	X	X
Illinois	X	X	X	X	X	X	X	X	X	X
Indiana	X	X	X	X	X	X	X			
Iowa	X	X	X	X	X	X	X	X	X	X
Kansas	X	X	X	X	X	X	X	X	X	X
Kentucky	X	X	X	X	X	X	X	X	X	X
Louisiana	X	X	X	X	X	X	X	X	X	X
Maine	X	X	X	X						
Maryland	X	X	X	X	X	X	X	X	X	X
Massachusetts	X	X	X	X	X	X	X	X	X	X
Michigan	X	X	X	X	X	X	X	X	X	X
Minnesota	X	X	X	X	X	X	X	X	X	X
Mississippi										
Missouri										
Montana	X	X	X	X	X	X	X	X		X
Nebraska	X	X	X	X	X	X	X	X	X	X
Nevada										
New Hampshire	X	X	X	X	X	X	X	X	X	X
New Jersey	X	X	X	X	X	X	X	X	X	X
New Mexico								X		X
New York	X	X	X	X	X	X	X	X	X	X
North Carolina										
North Dakota										
Ohio	X	X	X	X	X	X	X	X	X	X
Oklahoma					X	X	X	X	X	X
Oregon	X	X	X	X	X	X	X	X	X	
Pennsylvania										
Rhode Island	X	X	X	X	X	X	X	X	X	
South Carolina	X	X	X	X	X	X	X	X	X	X
South Dakota	X	X	X	X	X	X	X	X	X	X
Tennessee	X	X	X	X	X	X	X	X	X	X
Texas	X	X	X	X	X	X	X	X	X	X
Utah	X	X	X	X	X	X	X	X	X	X
Vermont	X	X	X	X	X	X	X	X	X	X
Virginia	X	X	X	X	X	X	X	X	X	X
Washington	X	X	X		X	X	X	X	X	X
West Virginia	X	X	X	X	X	X	X	X	X	X
Wisconsin	X	X	X	X	X		X	X	X	X
Wyoming	X	X	X	X	X	X	X	X	X	X
Total	41	41	43	41	41	40	41	41	40	40

Table 5. Fire Departments Reporting to NFIRS—1996

State	No. of Participating Fire Departments	No. of Fire Departments in State*	Fire Departments Reporting (percent)
Alabama	1	1,038	0.1
Alaska	99	253	39
Arizona	0	258	0
Arkansas	412	824	50
California	328	930	35
Colorado	29	400	7
Connecticut	210	274	77
Delaware	37	61	61
District of Columbia	1	1	100
Florida	321	674	48
Georgia	154	718	21
Hawaii	3	4	75
Idaho	165	263	63
Illinois	879	1,330	66
Indiana	0	952	0
Iowa	513	869	59
Kansas	568	680	84
Kentucky	537	794	68
Louisiana	295	700	42
Maine	0	460	0
Maryland	341	370	92
Massachusetts	331	364	91
Michigan	933	1,030	91
Minnesota	659	804	82
Mississippi	0	735	0
Missouri	0	921	0
Montana	152	385	39
Nebraska	275	483	57
Nevada	0	210	0
New Hampshire	98	253	39
New Jersey	348	788	44
New Mexico	9	356	3
New York	1,634	1,834	89
North Carolina	0	1,400	0
North Dakota	0	390	0
Ohio	934	1,252	75
Oklahoma	100	863	12
Oregon	0	325	0
Pennsylvania	0	2,400	0
Rhode Island	0	81	0
South Carolina	157	655	24
South Dakota	218	343	64
Tennessee	207	655	32
Texas	607	2,317	26
Utah	146	211	69
Vermont	104	243	43
Virginia	422	600	70
Washington	58	655	9
West Virginia	425	442	96
Wisconsin	186	872	21
Wyoming	93	133	70
Total	12,989	33,656	38

* Data on the number of fire departments was provided by each State Fire Marshal's Office.

Uses of NFIRS

The NFIRS data are used extensively for major fire protection decisions. At the federal level, for example, the Consumer Product Safety Commission uses the data to identify problem products and to monitor corrective actions. The Department of Transportation uses NFIRS data to identify fire problems in automobiles, which has resulted in mandated recalls. The Department of Housing and Urban Development uses NFIRS to evaluate safety of manufactured housing (mobile homes). And of course the U.S. Fire Administration uses the data to design prevention programs, to order firefighter safety priorities, to assist in the development of training courses at the National Fire Academy, and for a host of other purposes. Thousands of fire departments, scores of states, and hundreds of industries have used the data. The potential for even greater use remains. One of the purposes of this report is to give some idea of the types of information available from NFIRS. The information here is highly summarized; much more detail is available. One particularly relevant USFA report is *Uses of NFIRS: The Many Uses of the National Fire Incident Reporting System*, which may be ordered directly from the USFA or is available online at http://www.usfa.fema.gov/nfdc/nfirsuse.htm.

NFPA and Other Data Sources

In addition to NFIRS, this report makes use of the summary numbers for fires, deaths, injuries, and dollar loss from the NFPA's annual survey of fire departments and NFPA's *Fire Command* and *Journal* articles on firefighter casualties.[1] It also uses data obtained from state fire marshals, the National Center for Health Statistics, the Bureau of the Census, and the Consumer Product Safety Commission. The U.S. Fire Administration gratefully acknowledges the use of their information. Sources are cited for each graph and table in the report.

METHODOLOGY

An attempt was made to keep the data presentation and analysis as straightforward as possible. It was also the desire of the USFA to make the report widely accessible to many different users and, therefore, an attempt was made to avoid unnecessarily complex methodology.

National Estimates

Most numbers in this report are national estimates or percentages, not raw totals from NFIRS. The reader does not have to scale the data.

Many of the estimates are derived by computing a percentage from NFIRS and multiplying it by the total number of fires, deaths, injuries, or dollar loss from the NFPA annual survey. For exam-

[1] Throughout this report, the term *fire losses* refers to deaths, injuries, and dollar loss; the term *fire casualties* refers to deaths and injuries.

ple, the national estimate for the number of residential cooking fires was computed by taking the percentage of NFIRS residential fires (with known causes) that were attributed to cooking and multiplying it by the estimated total number of residential fires from the NFPA survey.

Ideally, one would like to have all of the data come from one consistent data source. But because the "residential population protected" was not reported to NFIRS by many fire departments and the reliability of that data element is suspect in many other cases, especially where a county is served by several fire departments which each report their population protected independently, this data element was not used. Instead, extrapolations of the NFIRS sample to national estimates are made using the NFPA survey for the gross totals of fires, deaths, injuries, and dollar loss.

One problem with this approach is that the proportions of residential, non-residential, mobile property, and outside fires and fire deaths differ between the large NFIRS sample and the NFPA survey sample. To be consistent with approaches being used by the Consumer Products Safety Commission and NFPA, however, we have used the NFPA estimates of fires, deaths, injuries, and dollar loss for residential, non-residential, mobile, and outside properties as a starting point. The details of the national fire problem below this level are based on proportions from NFIRS. One will not get the same numbers starting from the NFIRS proportions of residential, non-residential, etc., as from the NFPA proportions. This inconsistency will remain until all estimates can be derived from NFIRS alone.

In the future, the national estimates will be derivable solely from NFIRS if a statistically sufficient number of fire departments participating in NFIRS provide reasonably accurate estimates of their population protected.

Unknowns

On a fraction of the incident reports or casualty reports sent to NFIRS, the desired information for many data items is either left blank or reported as "unknown." The total number of blank or "unknown" entries is often larger than some of the important subcategories. For example, 47 percent of the fires in 1996 do not have sufficient data reported to NFIRS to determine cause. The lack of data, especially for fatal fires, masks the true picture of the fire problem. Many prevention and public education programs use the NFIRS data to target at-risk groups or to address critical problems, fire officials use the data in decision making that affects the allocation of firefighting resources, and consumer groups and litigators use the data to assess product fire incidence. When the unknowns are large, the credibility of the data suffers. Fire departments need to be more aware of the effect of incomplete reporting.

Adjusted Percentages

In making national estimates, the unknowns should not be ignored. The approach taken in this report is to provide not only the "raw" percentages of each cause category, but also the "adjusted"

percentages computed using only those incidents for which the cause was provided. This in effect distributes the fires for which the cause is unknown in the same proportion as the fires for which the cause is known, which may or may not be approximately right. That is the best we can do without additional knowledge of the nature of the unknowns.

To illustrate: Children playing was reported as the fire cause for 2.7 percent of all reported fires; another 46.7 percent of reported fires had cause unknown; thus, the percent of fires that had their cause reported was 100 – 46.7 = 53.3 percent. With the unknown causes proportioned like the known causes, the adjusted percent of residential fire fatalities caused by children playing can then be computed as 2.7 ÷ 53.3 = 5.0 percent.

Representativeness of the Sample

The percentage of fire departments participating in NFIRS varies from state to state, with some states not participating at all. To the best that USFA can determine, the distribution of participants is at least reasonably representative of the entire nation, even though the sample is not random. The sample is so large—over 40 percent of all fires—and so well distributed geographically and by size of community that there is no known major bias that will affect the results. Most of the NFIRS data exhibit stability from one year to another, without radical changes, as will be observed from the 10-year trend lines presented throughout this report. Also, results based on the full data set are generally similar to those based on part of the data, another indication of data reliability. Although improvements could be made—the individual incident reports could and should be filled out more completely and more accurately than they are today (as can be said about most real-world data collections as large as NFIRS), and participating departments should have the same reporting requirements—the overall portrayal is a reasonably accurate description of the fire problem in the United States. It is the best one we have ever had.

Trend Data

A frequently asked question is how much a particular aspect of the fire problem has changed over time. The usual response is in terms of a percentage change from one year to another. As we are dealing with real-world data that fluctuate from year to year, a percent change from one specific year to another can be misleading. This is especially true when the beginning and ending data points are extremes—either high or low. For example, in Figure 14, "Trends in Fires and Fire Losses," the percent change from 1987 of 28,215 injuries to 1996 of 25,550 injuries would be a decrease of 9 percent. Yet, if we were to choose 1988 as the beginning data point (30,800 injuries), this change would show a 17 percent decrease. As we are interested in *trends* in the U.S. fire problem, this edition of *Fire in the United States* reports the overall change in a data series as a trend. We have computed the best-fit linear trend line (which accounts for the fluctuation in the year-to-year data) and have presented the change over time based on this trend line. In this example, the overall 10-year trend

is a decrease in injuries of 11 percent—not the 9 percent decrease calculated from only beginning and ending years.

Cause Categories

The causes of fires are often a complex chain of events. To make it easier to grasp the "big picture," 13 major categories of fire causes such as heating, cooking, and children playing are used by the U.S. Fire Administration here and in many other reports. The alternative is to present scores of detailed cause categories or scenarios, each of which would have a relatively small percentage of fires. For example, heating includes subcategories such as misuse of portable space heaters, wood stove chimney fires, and fires involving gas central heating systems. Experience has shown that the larger categories are useful for an initial presentation of the fire problem. It then can be followed by more detailed analysis.

The cause categories used in this project are listed in the same order on each graph to make comparisons easier from one to another. The order here also is the same as used in previous *Fire in the United States* editions. The particular order chosen was a combination of the ranking used in the cause sorting hierarchy and a desire to show the more important causes in the top half of the charts.

A problem to keep in mind when considering the rank order of causes in this report is that sufficient data to categorize the cause were not reported to NFIRS for 41 percent of the fatal fires in the database. The rank order of causes might be different than shown here if the cause profile for the fires whose causes were not reported to NFIRS were substantially different from the profile for the fires whose causes were reported. However, there is no information to indicate that there is a major difference between the knowns and the unknowns, and so our present best estimate of fire causes is based on the distribution of the fires with known causes.

Fires are assigned to one of the 13 general cause groupings using a hierarchy of definitions, approximately as shown in Table 6.[2] A fire is included in the highest category into which it fits on the list. If it does not fit the top category, then the second one is considered, and if not that one, the third, and so on. For example, a fire caused by an arsonist using a match to ignite a fuse is included in the incendiary or suspicious category and not in the open flame category. If the arsonist used a cigarette to ignite the fuse, the fire still is grouped with incendiary and suspicious fires and not with smoking fires.

The NFIRS fire data can be analyzed in many ways such as by the form of the heat of ignition, the material ignited, the ignition factor, or many other groupings. The hierarchy used in this report has proved useful in understanding the fire problem and targeting prevention, but other approaches

[2] The exact hierarchy and specific definition in terms of the NFIRS code may be found on pages 2–201 to 2–203 of the 1990 *NFIRS System Documentation Manual*, Version 4.1. The actual hierarchy involves a large number of subcategories that are later grouped into the 13 major categories.

Table 6. Hierarchy of Cause Groupings Used in This Report

Cause Category*	Definition
Exposure	Caused by heat spreading from another hostile fire
Incendiary/Suspicious	Fire deliberately set or suspicious circumstances
Children Playing	Includes all fires caused by children playing with any materials contained in the categories below
Natural	Caused by Sun's heat, spontaneous ignition, chemicals, lightning, static discharge
Smoking	Cigarettes, cigars, pipes as accidental heat of ignition
Heating	Includes central heating, fixed and portable local heating units, fireplaces and chimneys, water heaters as source of heat
Cooking	Includes stoves, ovens, fixed and portable warming units, deep fat fryers, open grills as source of heat
Electrical Distribution	Includes wiring, transformers, meter boxes, power switching gear, outlets, cords, plugs, lighting fixtures as source of heat
Appliances (including air conditioning/refrigeration)	Includes televisions, radios, phonographs, dryers, washing machines, vacuum cleaners, hand tools, electric blankets, irons, electric razors, can openers, dehumidifiers, water cooling devices, air conditioners, refrigeration equipment as source of heat
Other Equipment	Includes special equipment (radar, x-ray, computer, telephone, transmitters, vending machine, office machine, pumps, printing press), processing equipment (furnace, kiln, other industrial machines), service, maintenance equipment (incinerator, elevator), separate motor or generator, vehicle in a structure, unspecified equipment
Open Flame, Spark (heat from)	Includes torches, candles, matches, lighters, open fire, ember, ash, rekindled fire, backfire from internal combustion engine as source of heat
Other Heat	Includes fireworks, explosives, heat or spark from friction, molten material, hot material, all other fires caused by heat from fuel-powered objects, heat from electrical equipment arcing or overloading, heat from hot objects not covered by above groups
Unknown	Cause of fire undetermined or not reported

* Fires are assigned to a cause category in the hierarchical order shown. For example, if the fire is judged incendiary and a match was used to ignite it, it is classified as incendiary and not open flame because incendiary is higher on the list. One minor deviation: If the fire involves air conditioning or refrigeration, it is included in appliances and not in electrical distribution.

are certainly useful too. Because the NFIRS database stores records fire by fire and not just in summary statistics, a very wide variety of analyses are possible.

Ratio of NFIRS to NFPA Data

There is an inconsistency between the NFIRS sample and the NFPA annual survey data: In nearly every year, the deaths reported to NFIRS are a larger fraction of the NFPA estimate of deaths than the NFIRS fires are of the NFPA estimate of fires. NFIRS injuries and dollar loss are even larger fractions of the NFPA totals than are deaths or fires. This issue is discussed further in Appendix A.

Unreported Fires

NFIRS only includes fires to which the fire service responded. In some states, fires attended by state fire agencies (such as forestry) are included; in other states, they are not.

NFIRS does not include fires from 11 states and many fire departments within participating states. However, if the fires from the reporting departments are reasonably representative, this

omission does not cause a problem in making accurate national estimates for any but the smallest subcategories of data.

An enormous number of fires are not reported to the fire service at all. Most are small fires in the home or in industry which go out by themselves or are extinguished by the occupant. Based on a study done in the early 1970s, these unreported fires collectively cause a great deal of property loss and a large number of injuries requiring medical attention. The Consumer Product Safety Commission sponsored a study in 1984 on unreported fires. We do not have a current study that can be used to estimate the magnitude of the problem.

Perhaps the most disturbing type of unreported fires are those not submitted by fire departments that are participating in NFIRS. Some departments submit information on most but not all of their fires. Sometimes the confusion is systematic, as when no-loss cooking fires or chimney fires are not reported. Sometimes it is inadvertent, such as when incident reports are lost or accidentally not all submitted. The information that is received is assumed to be the total for the department and is extrapolated as such. Although there was measure of the extent of this problem in the past, the new NFIRS 5.0 provides fire departments with the capability to report this information in an easy, straightforward manner.

ORGANIZATION OF REPORT

This report is organized similarly to the Ninth Edition of *Fire in the United States*. Chapter 2 presents an overview of the national fire problem in terms of the total number of fires, deaths, injuries, and dollar loss—the four principal measures used to describe the fire problem.

Chapters 3 and 4 address the residential and non-residential fire problem, respectively. Chapter 5 addresses firefighter casualties. Chapter 6 focuses on special topics bearing on the fire problem: fires with multiple fatalities as reported in NFIRS, the relationship between alcohol and fire, and a profile of urban fires. USFA resources that provide in-depth information on specific topics are listed at the end of most chapters.

Appendix A discusses the differences between NFPA and NFIRS data.

Most of the data are presented graphically for ease of comprehension. The specific data associated with the graphs are provided directly with the chart. In those instances in which it was impractical to provide the data, references are made to data tables that are presented in Appendix B.

This edition of *Fire in the United States* concludes with an index to the topics of this report.

2

THE NATIONAL FIRE PROBLEM

OVERVIEW

The United States has a severe fire problem, more so than is generally perceived. Nationally, there are millions of fires, thousands of deaths, tens of thousands of injuries, and billions of dollars lost—which make the U.S. fire problem one of great national importance.

Although we have made much progress in the last decade, the United States continues to have one of the highest per capita fire death rates in the world. The United States had an average of 5,031 fire deaths a year from 1987 to 1996 (Figure 14). The number of deaths has been steadily trending down—25 percent over the past 10 years. In 1996, the number of deaths was 4,990.

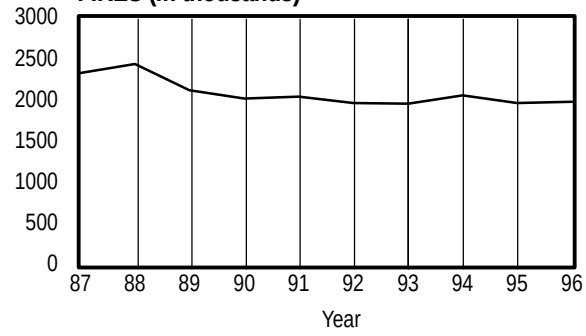
We are less certain of the injury statistics in Figure 14 because of ambiguity about the completeness of defining and reporting minor injuries and the fact that many injured people go directly to a medical care facility themselves without going through a fire department screening. There was an average of 28,300 reported civilian injuries per year from reported fires over the past 10 years and an average of 54,500 injuries to firefighters from those fires, as shown in Chapter 5, Figure 109. The actual totals for reported fires may be even higher. Furthermore, past studies suggest that the number of civilian injuries associated with fires that are not reported to the fire service might be several times that of the number from reported fires, as discussed in Chapter 1. Fire-caused injuries to civilians trended down by 11 percent over the 10-year period. Injuries were down for the third consecutive year and in 1996 were at their lowest level since 1986.

In terms of dollar loss, the estimated direct value of property destroyed in fires was $9.4 billion for 1996. The total cost of fire (direct losses, the cost of fire departments, built-in fire protection in new buildings, insurance overhead, and other annual fire protection expenditures) is much higher. The direct dollar loss increased 15 percent from 1987 to 1996, with the increase due to inflation. Using constant 1996 dollars, the loss was down by 16 percent over this period. Still, the direct dollar loss was enormously high at an average of $9.8 billion a year in adjusted 1996 dollars.

These casualties and losses come from an average of nearly 2.1 million fires annually. Fire incidents have declined 17 percent since 1987, with the sharpest decline in 1989 but remaining steady since then.

On a per capita basis, the fire problem appears less severe today than 10 years ago, partially because the population has been increasing and partially because of the overall decline in numbers of reported fires and fire casualties. Over this 10-year period, reported fires averaged 8.2 per thousand population (Figure 15).

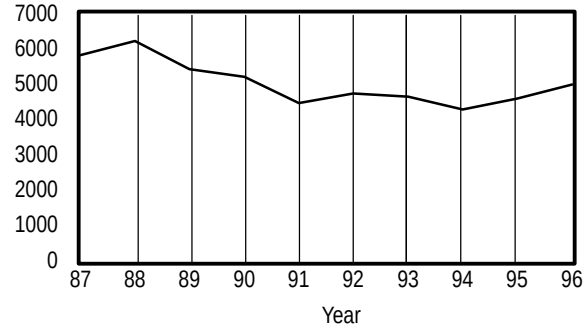
FIRES (in thousands)



1987	2,330	1992	1,965
1988	2,437	1993	1,953
1989	2,115	1994	2,055
1990	2,019	1995	1,966
1991	2,042	1996	1,975

10-Year Trend = -16.9%

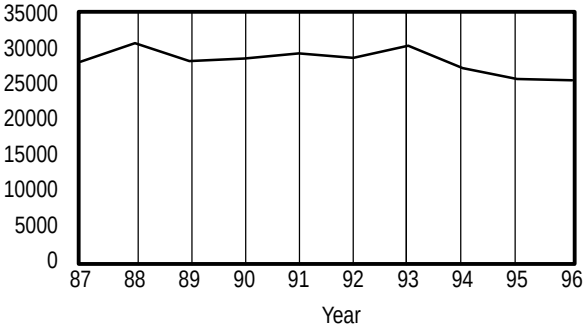
DEATHS



1987	5,810	1992	4,730
1988	6,215	1993	4,635
1989	5,410	1994	4,275
1990	5,195	1995	4,585
1991	4,465	1996	4,990

10-Year Trend = -24.6%

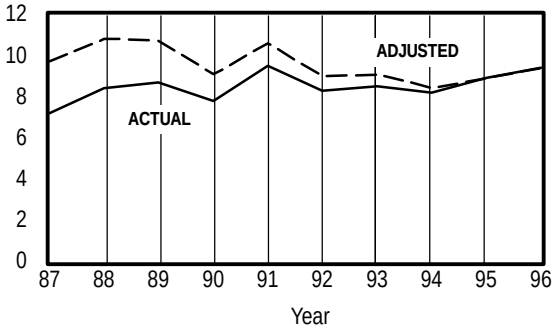
INJURIES



1987	28,215	1992	28,700
1988	30,800	1993	30,475
1989	28,250	1994	27,250
1990	28,600	1995	25,775
1991	29,375	1996	25,550

10-Year Trend = -10.8%

DOLLAR LOSS (in $ billions)

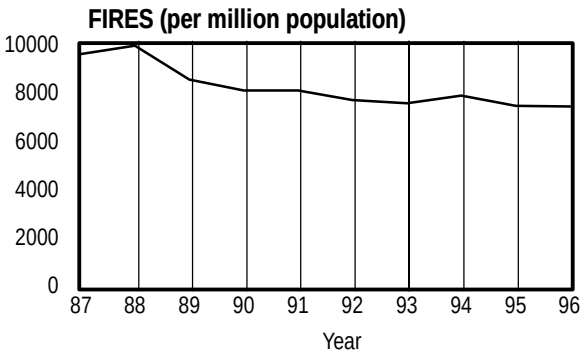


	Actual	Adjusted to 1996 Dollars
1987	$7.2	$ 9.9
1988	8.4	11.1
1989	8.7	11.0
1990	7.8	9.4
1991	9.5	10.9
1992	8.3	9.3
1993	8.5	9.3
1994	8.2	8.7
1995	8.9	9.2
1996	9.4	9.4

10-Year Actual Trend = +15.7%
10-Year Adjusted Trend = -16.2%

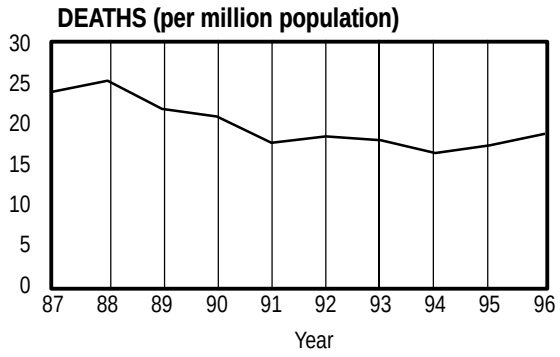
Sources: NFPA Annual Surveys and Consumer Price Index

Figure 14. Trends in Fires and Fire Losses



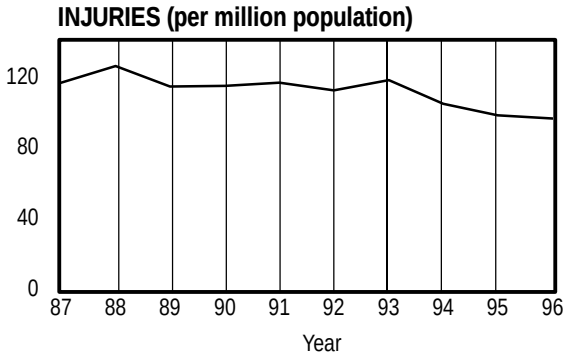
1987	9,620	1992	7,700
1988	9,970	1993	7,570
1989	8,570	1994	7,890
1990	8,120	1995	7,480
1991	8,100	1996	7,440

10-Year Trend = -24.6%



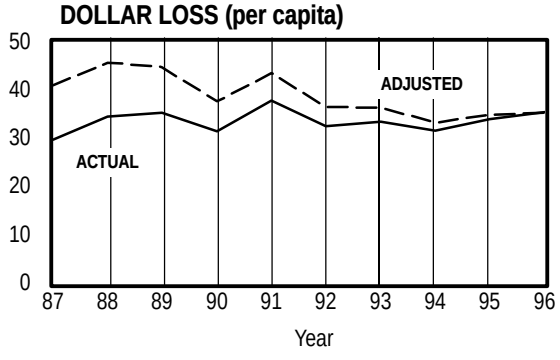
1987	24.0	1992	18.5
1988	25.4	1993	18.0
1989	21.9	1994	16.4
1990	20.9	1995	17.4
1991	17.7	1996	18.8

10-Year Trend = -31.7%



1987	116.5	1992	112.5
1988	126.0	1993	118.2
1989	114.5	1994	104.7
1990	115.0	1995	98.1
1991	116.5	1996	96.3

10-Year Trend = -18.6%



	Actual	Adjusted to 1996 Dollars
1987	$29.7	$41.0
1988	34.4	45.6
1989	35.2	44.6
1990	31.4	37.6
1991	37.7	43.4
1992	32.5	36.4
1993	33.4	36.2
1994	31.5	33.3
1995	33.9	34.9
1996	35.4	35.4

10-Year Actual Trend = +5.0%
10-Year Adjusted Trend = -23.9%

Sources: NFPA Annual Surveys, Consumer Price Index, and Bureau of the Census

Figure 15. Trends in Severity of Fires and Fire Losses

The fire death rate per million population has declined a significant 32 percent. In terms of injuries, the per capita rate was down 19 percent over 10 years largely because of the drop since 1993. Although dollar loss per capita was $35, up 5 percent unadjusted, it trended down 24 percent over the 10 years when adjusted for inflation.

THE BROADER CONTEXT

Fires constitute a much larger problem than is generally known. Losses from all natural disasters combined—floods, hurricanes, tornadoes, earthquakes, etc.—average a fraction of the annual direct dollar losses from fire. Deaths from disasters have tended to be vastly fewer than from fires—on the order of 200 per year in disasters versus nearly 5,000 in fires.

Most fires are relatively small, and their cumulative impact is not easily recognized. There are only a few fires that have the huge dollar losses that are associated with tornados, hurricanes, or floods. The southern California wildland fires in the fall of 1993 resulted in over $800 million in losses. The Oakland East Bay Hills fire of October 1991 was estimated to have caused over $1 billion in losses. The Phillips petrochemical plant fire in the Houston ship channel in October 1989 caused several hundred million dollars in losses. But because most of the losses from fire are spread over the 2 million fires that are reported each year, the total loss is far more than the impression many people have of it from the anecdotal reporting of local fires in the media.

Fires also are an important cause of accidental deaths. The National Safety Council ranks fires as the fifth leading cause of accidental deaths, behind only vehicle accidents, falls, poisonings, and drownings.

Fire-related injuries to civilians and firefighters are reported with too much uncertainty to properly rank them with confidence, but it is clear that they number over 100,000 and possibly two or three times that many when injuries from unreported fires and unreported injuries from reported fires are taken into account. Burn injuries are particularly tragic because of the tremendous pain and suffering they cause. Serious burns tend to cause psychological damage as well as physical damage, and they may well involve not only the victims but also their family, friends, and fellow workers.

U.S. Fire Deaths Versus Other Nations

The United States has one of the most severe fire problems among the industrialized nations. Although our per capita death rate is nearly half what it was in the late 1970s, and down 32 percent since 1987, current international data (1993–1995) suggest that the United States still has a fire death rate two to three times that of several European nations and at least 20 percent higher than most. The average U.S. fire death rate for 1993–1995 was reported at 18.7 deaths per million popula-

tion.[1] Switzerland's rate was 5.5 per million population; Canada's was 15.0. In fact, of the 22 industrial nations that are examined by the World Fire Statistics Centre, the U.S. rate was higher than all but two—Finland and Hungary. This status has been virtually unchanged for the past decade.

The declining U.S. trend in fire death rate over the past 10 years was not a singular event; all countries except Hungry and Finland also trended downward. Furthermore, although statistical data are not available, the United States is widely believed to have many more residential fires on a per capita basis than any of the countries studied.

The United States has placed greater emphasis on improving the technology in fire suppression and fire service delivery mechanisms than other nations, but these nations tend to surpass the U.S. in practicing fire prevention. The United States would be well served by studying and implementing international fire prevention programs that have proved effective in reducing the number of fires and deaths.

Total Cost of Fire

The total cost of fire to society is staggering—over $100 billion per year.[2] This includes the cost of adding fire protection to buildings, the cost of paid fire departments, the equivalent cost of volunteer fire departments ($20 billion annually), the cost of insurance overhead, the direct cost of fire-related losses, the medical cost of fire injuries, and other direct and indirect costs. Even if these numbers are high by as much as 100 percent, the total cost of fire ranges from $50 to $100 billion, still enormous, and on the order of 1 to 2 percent of the gross domestic product, which was $7.66 trillion in 1996.[3] Thus from a monetary viewpoint, fire ranks as a significant national problem.

FIRE CASUALTIES BY POPULATION GROUP

The fire problem is more severe for certain groups than others. People in the Southeast, males, the old, and the very young all are at much higher risk from fires than the rest of the population. These groups have remained at risk despite the continuing downward trends.

Regional Differences

The Southeast of the United States continues to have the highest fire death rate in the nation and one of the highest in the world. Figure 16 shows the states with the highest fire death rates for 1996. Although improvements have been seen in the death rates of the southeastern states, nearly

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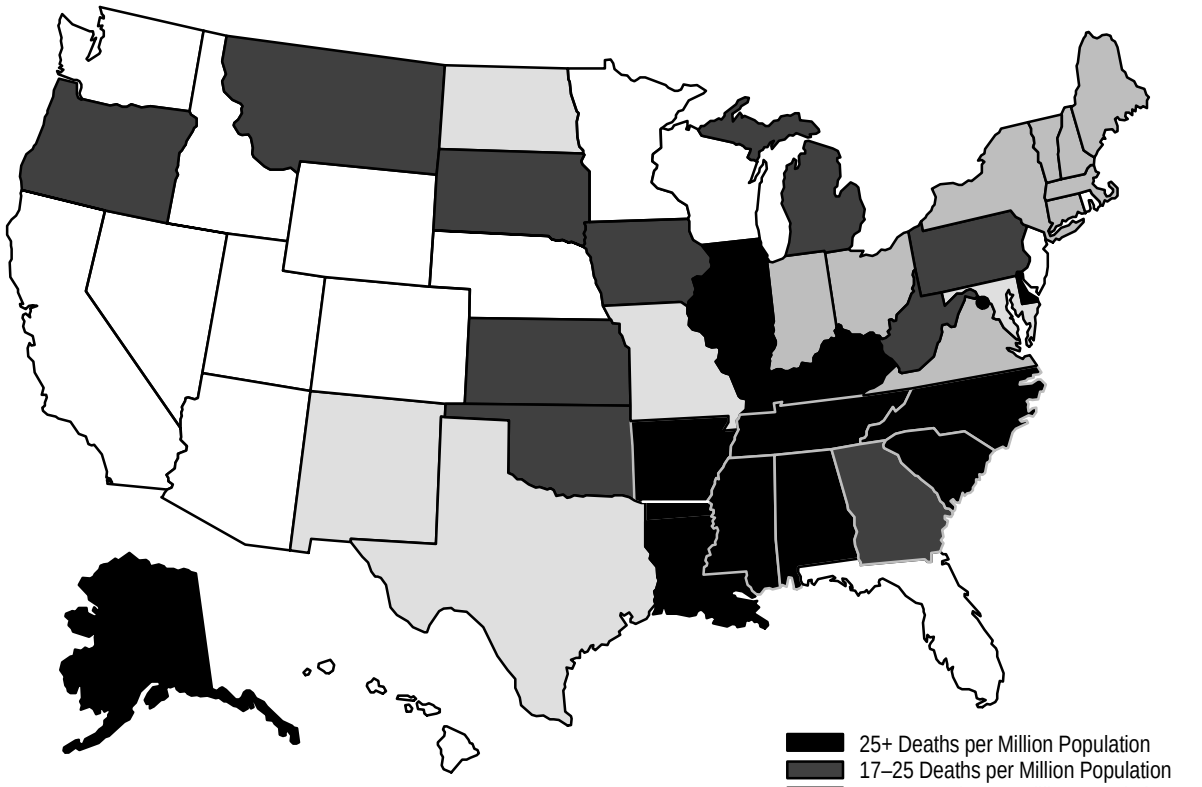
1 United Nations Economic and Social Council, as prepared by the World Fire Statistics Centre, August 1998. Using NFPA estimates and Bureau of the Census data, however, the 1993–1995 average U.S. fire death rate is computed at 17.3 per million population. The 1996 death rate is computed at 18.8 per million population.

2 Meade, William P., *A First Pass at Computing the Cost of Fire in a Modern Society*, The Herndon Group, Inc., February 1991.

3 U.S. Department of Commerce's Bureau of Economic Analysis.



Note: 1996 data from Arizona and Arkansas are incomplete; 1995 data are shown.

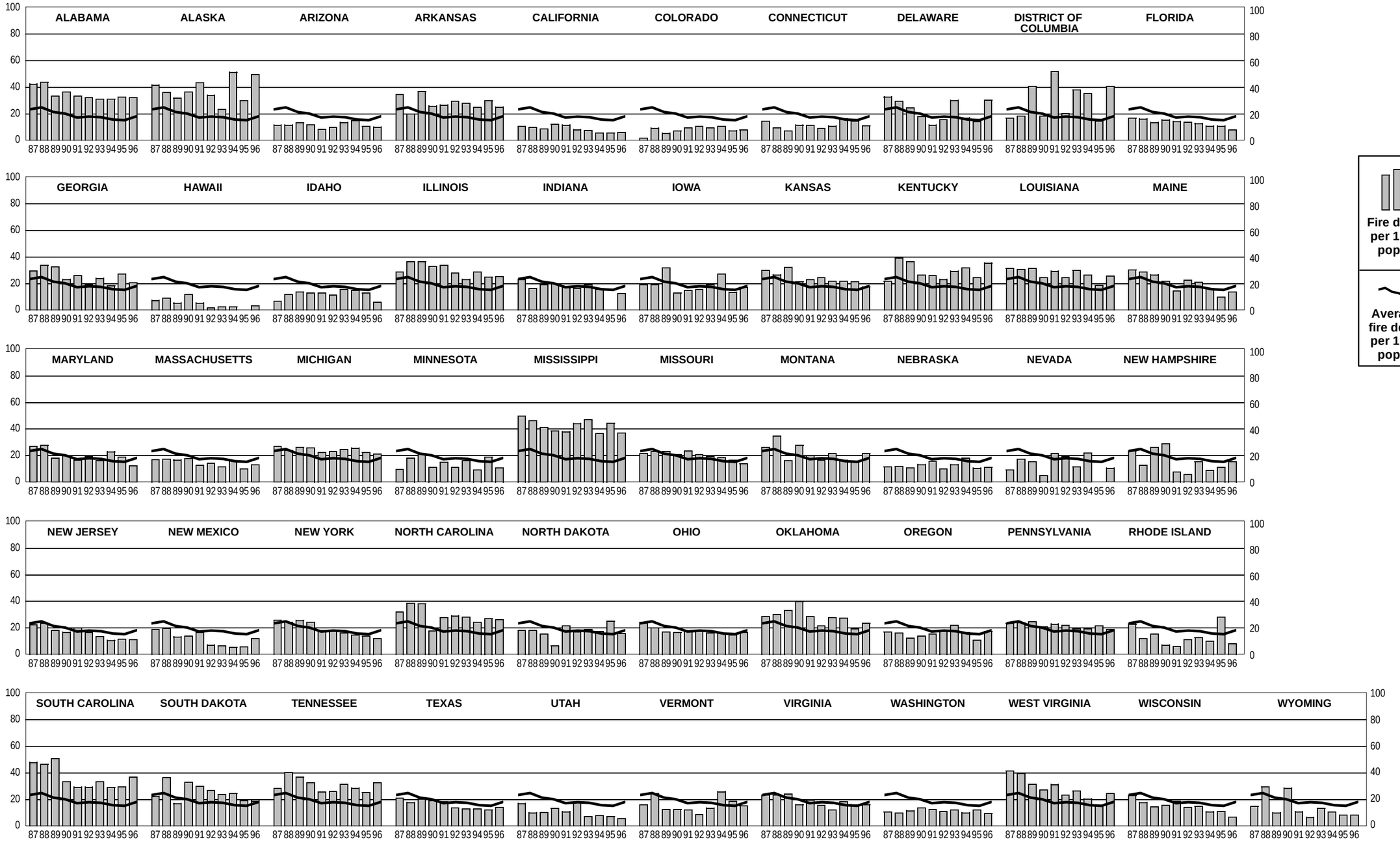
Sources: State Fire Marshals and the United States Fire Administration

Figure 16. Fire Death Rate by State in 1996

half of these still have death rates in the highest category, here at 25 or more deaths per million population. In addition to the Southeast, Alaska, Delaware, and the District of Columbia were in the highest fire death rate category in 1996. The Southeast and Alaska have been consistently among the highest fire death rate areas for many years; however, their rates have been dropping along with those of the whole nation.

The next two categories of states in Figure 16 (shaded) still have fire death rates higher than many of the developed nations in Europe and the Far East. At the other extreme are the states with no shading. These "best" states are in the general range of the nations of Europe and the Far East. They tend to be states in the Southwest and West, but there are some noteworthy exceptions: Florida, Nebraska, New Jersey, and Maine all had a low year in 1996. California and Florida continue to have the lowest death rates among the high population states.

Fire death rates for each state and the District of Columbia for the past 10 years are shown in Figure 17. An overlay on each state chart represents the national fire death rates. Nine states are consistently above the national average and 10 states are consistently below it.



Source: State Fire Marshals

Figure 17. 10-Year Fire Death Rate by State Compared to National Average

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Figure 17.

The rank order of state fire death rates per million population is shown in Figure 18. States with relatively small populations may move up and down on the list from year to year as a result of only a few deaths; their death rate should be considered averaged over time. For example, the District of Columbia changed from one of the highest death rates in 1994 to among the lowest in 1995; in 1996, it jumped to the second highest death rate in the nation. Rhode Island went from best (1994) to worst (1995) and back to best (1996). The highest states were Alaska, the District of Columbia, Mississippi, and South Carolina. The lowest were California, Idaho, Utah, and Hawaii; California, Utah, and Hawaii have consistently ranked as states with the lowest death rates.

Figure 19 shows the rank order of states in terms of the absolute number of fire deaths. Not surprisingly, large population states are at the top of the list. As in previous years, the 10 states with the most fire deaths account for nearly half of the national total. Unless their fire problems are significantly reduced, the national total will be difficult to lower.

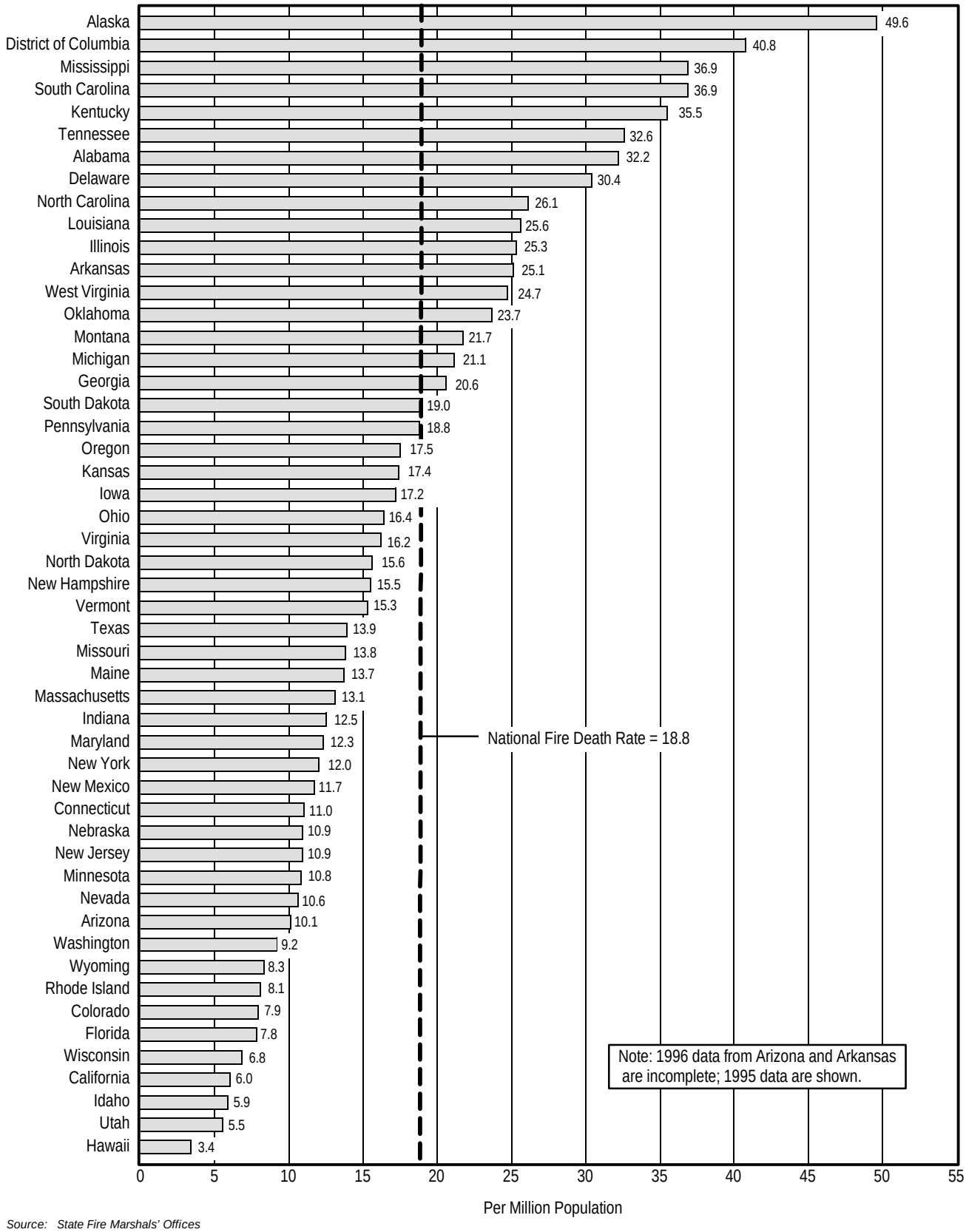
The sum of the state death estimates in Figure 19 is over 800 deaths below the estimate of 4,990 from the NFPA survey for 1996 and 500 deaths below death certificate data from the National Centers for Health Statistics. This difference may be due to some states underreporting their fire deaths or an overestimate from the extrapolation of the NFPA sample of fire departments, or a combination of both. Nevertheless, the correspondence between the sources, while not exact, should be considered good.

Gender

Men continue to have almost twice as many fire deaths as women. Figure 20 shows that the high proportion of male fire deaths has been remarkably steady over the past 10 years. The slight trend toward narrowing the gap between male and female fire deaths appears to have stopped in 1990. Males also have a higher fire death rate per capita than females for essentially all age groups. From the age of 20 on, males generally have twice the fire death rate as women (Figure 21).

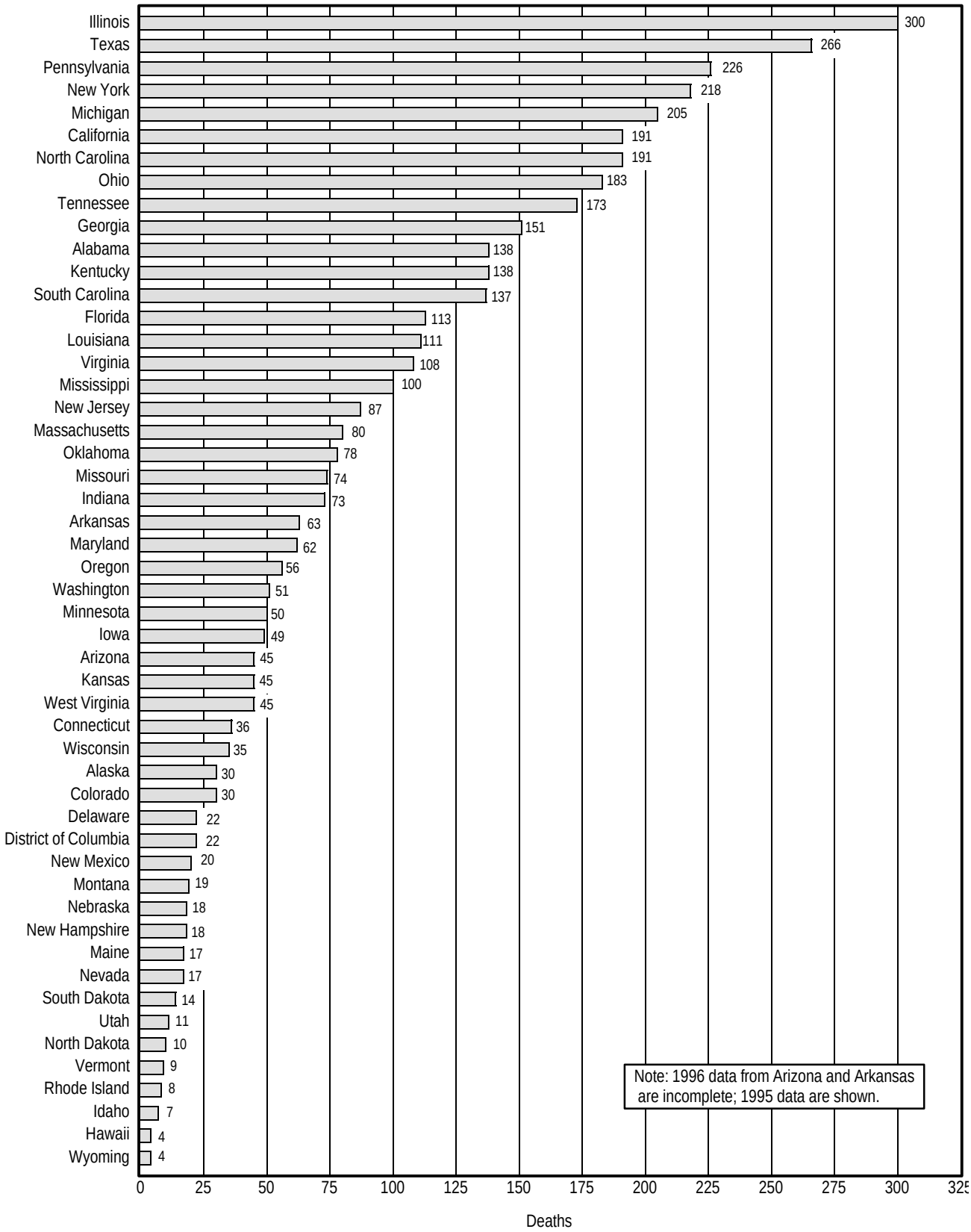
Figure 20 also shows that the male/female ratio for fire injuries is similar to that for fire deaths except that the gender gap has narrowed since the late 1980s. Injuries per capita for males are one and one-half to two times the female rate until age 65 (Figure 21), which can be expected because of the longer lifespan of women. For the very old, however, the male injuries per capita are nearly three times that of females.

The reasons for the disparity of fire injuries between men and women are not known for certain. Suppositions include the greater likelihood of men being intoxicated, the more dangerous occupations of men (most industrial fire fatalities are males), and the greater use of gasoline and other flammable liquids by men. We do know that men have more injuries trying to react to the fire than do women.



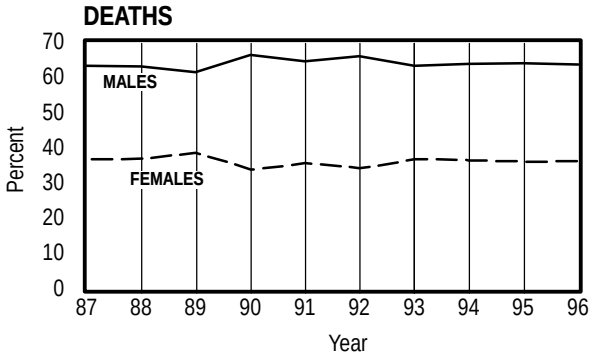
Source: State Fire Marshals' Offices

Figure 18. Rank Order of States by Fire Death Rate in 1996

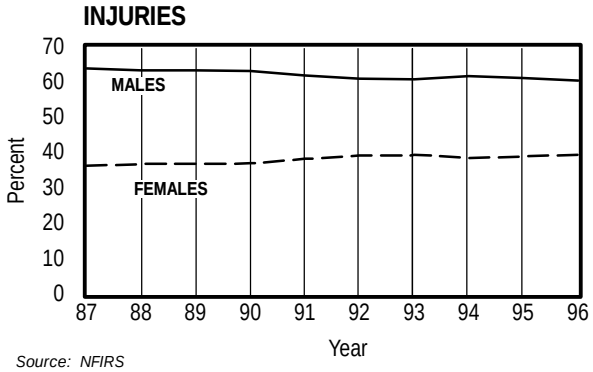


Source: State Fire Marshals' Offices

Figure 19. Rank Order of States by Civilian Deaths in 1996



	Males	Females		Males	Females
1987	63.2%	36.8%	1992	65.9	34.1
1988	63.1	36.9	1993	63.2	36.8
1989	61.4	38.6	1994	63.7	36.3
1990	66.2	33.8	1995	64.0	36.0
1991	64.4	35.6	1996	63.6	36.4



	Males	Females		Males	Females
1987	63.8%	36.2%	1992	60.8	39.2
1988	63.2	36.8	1993	60.6	39.4
1989	63.2	36.8	1994	61.6	38.4
1990	63.0	37.0	1995	61.1	38.9
1991	61.8	38.2	1996	60.4	39.6

Source: NFIRS

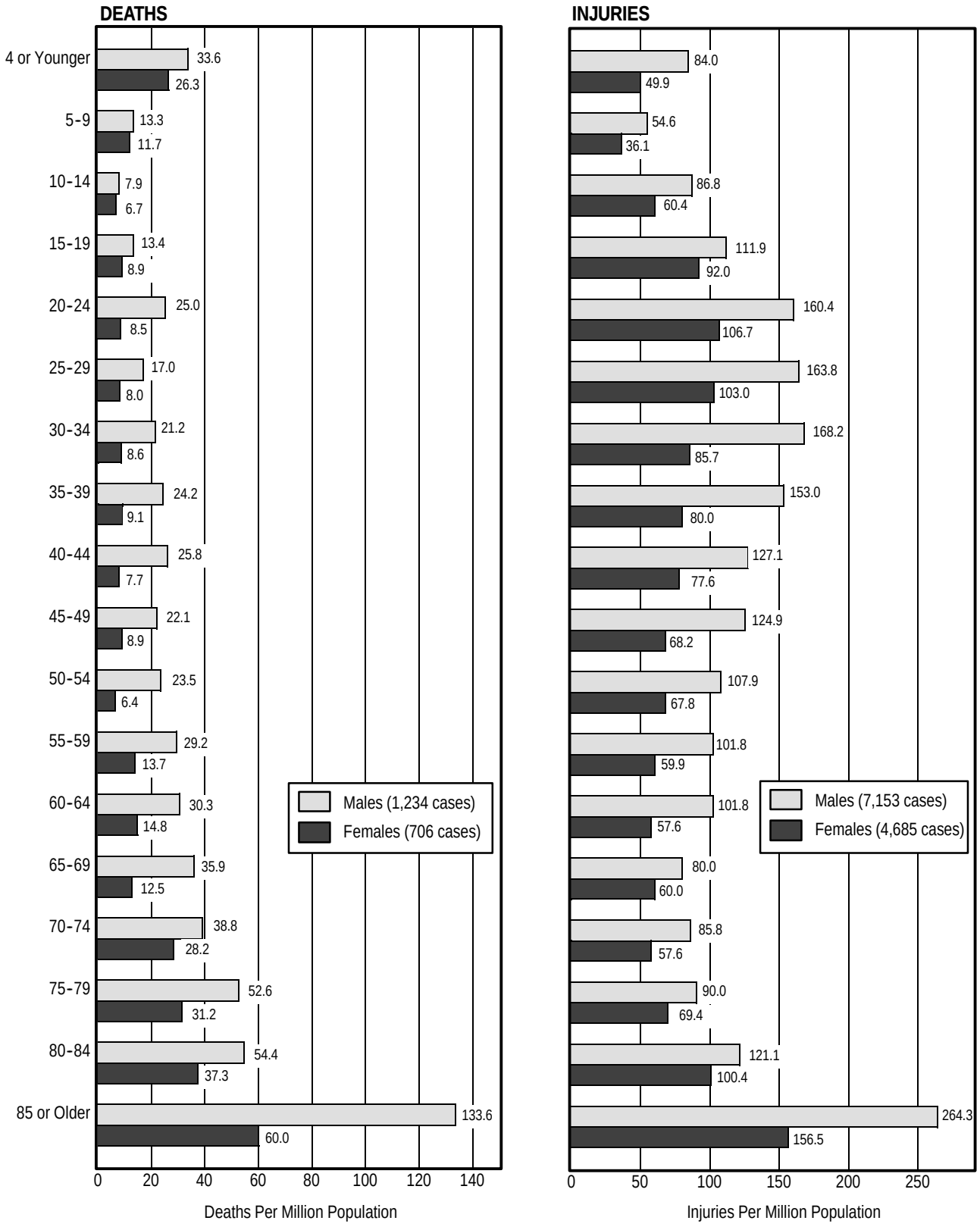
Figure 20. Trends in Male vs. Female Casualties

Age

People over 55 have a much higher fire death rate than the average population (18.8 deaths per million population), as shown in Figure 22. At the other end of the age spectrum, the very young (under 5) also have a much higher-than-average problem. The relative risk of dying and being injured in a fire for various age groups is shown in Figure 23. Children under 5 have nearly double the risk of death, children over 5 have less than average risk.[4] Risk of fire death drops off sharply between 5 and 14, then experiences inconsistent changes until age 55. At age 55, the risk begins to consistently increase. By age 70, there is another jump in risk and the risk is even higher than for the very young. These profiles remain relatively constant from year to year.

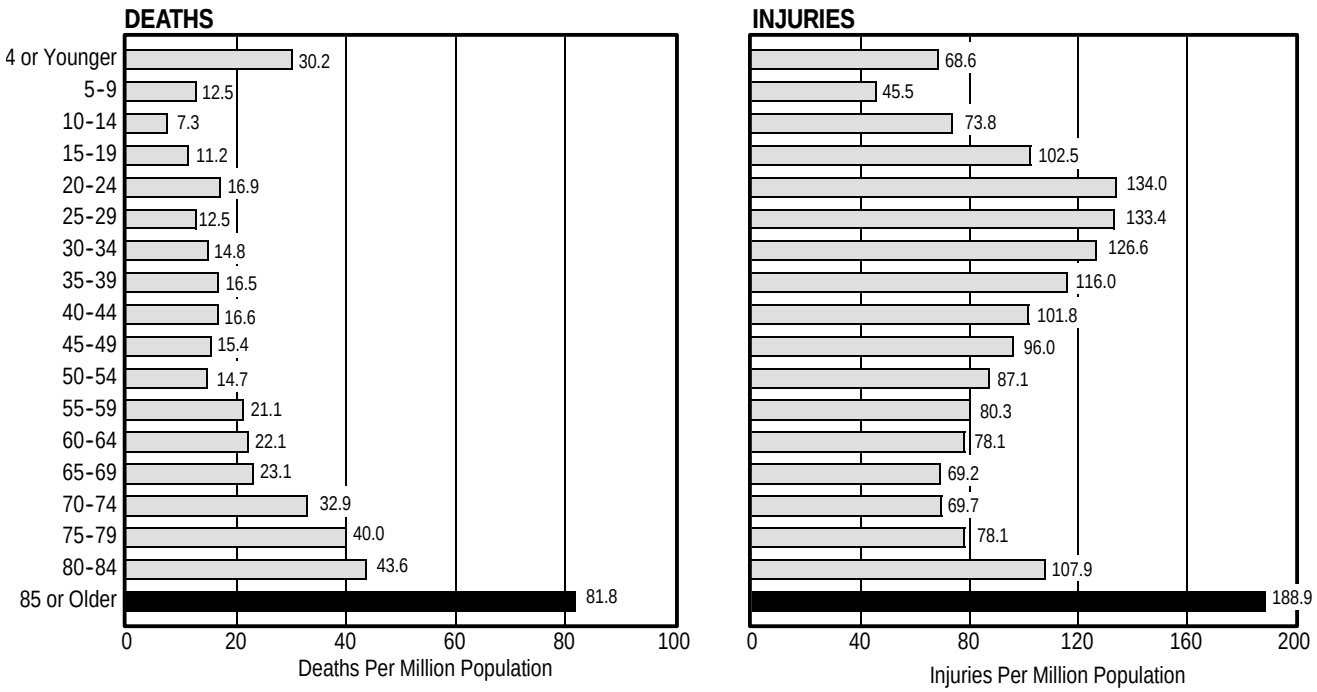
Contrary to what might be expected, the age profile of risk from injuries is very different from that for deaths. In 1996, the risk of injury in a fire was highest for young adults aged 20–34 and the elderly over 85. The risk of injury is below average (96 injuries per million population) for children and those aged 45–79.

[4] For those interested in data reliability issues, there is some concern over the coding of the ages of infants less than 1 year old. Some code them as 1, some as 0, and some to the nearest integer of 0 or 1. Also, some fire departments or states fill in blank fields with zeros. Thus, the number of casualties with age 0 has been suspect. By dropping age profiles with 0's, the difference was small; the category 0–4 still had a relative risk of nearly 2 for fire deaths.



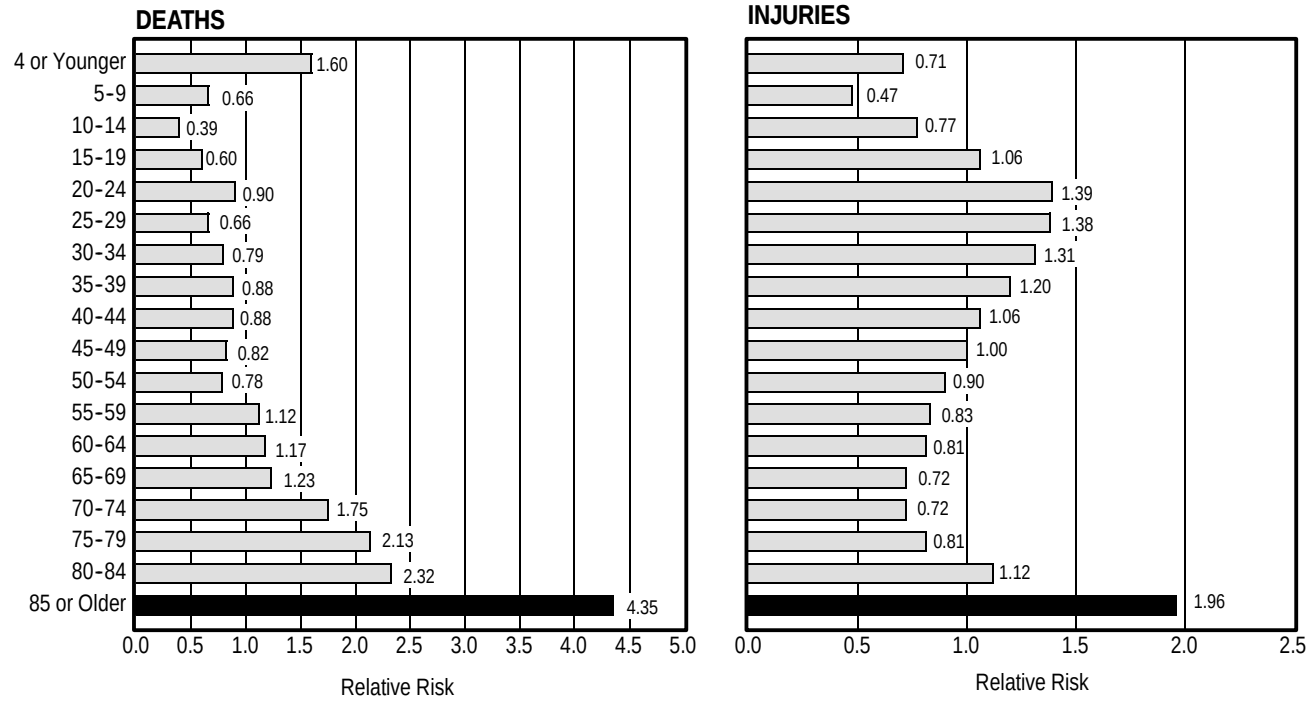
Sources: NFIRS, NFPA Annual Surveys, and Bureau of the Census

Figure 21. Severity of 1996 Fire Casualties by Age and Gender



Sources: NFIRS, NFPA Annual Surveys, and Bureau of the Census

Figure 22. Severity of 1996 Fire Casualties by Age



Note: The population as a whole has a relative risk of 1.

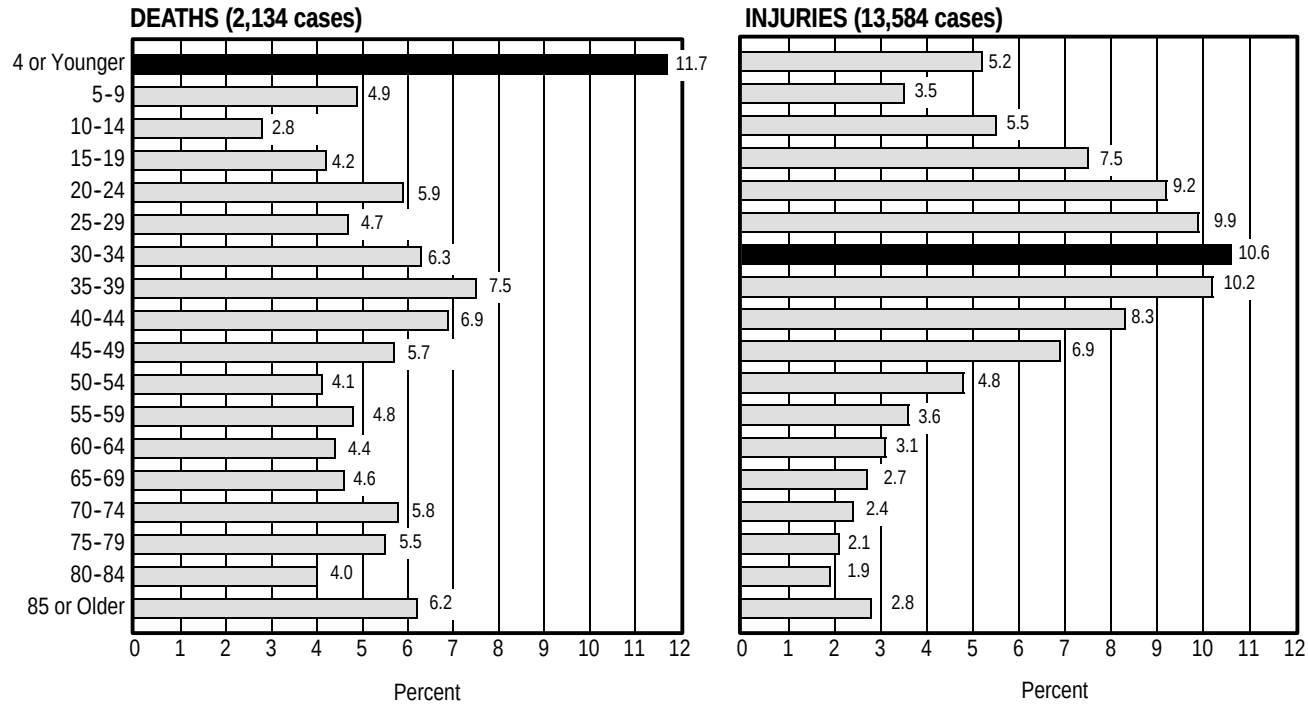
Sources: NFIRS, NFPA Annual Surveys, and Bureau of the Census

Figure 23. Relative Risk of 1996 Fire Casualties by Age

Figure 24 shows the percent of 1996 fire deaths and injuries falling into each age group. (This is not the same as risk.) Those under age 5 account for 12 percent of the deaths with age reported—by far the highest proportion for any age group. Those 70 and above comprise 20 percent of the fire deaths. These two peak risk groups comprise more than one-third of fire deaths. On the other hand, two-thirds of fire deaths fall in age groups that are not at high risk. The bulk of fire deaths occur to the not so young and not so old. Programs aimed only at the highest risk groups will not reach the majority of victims.

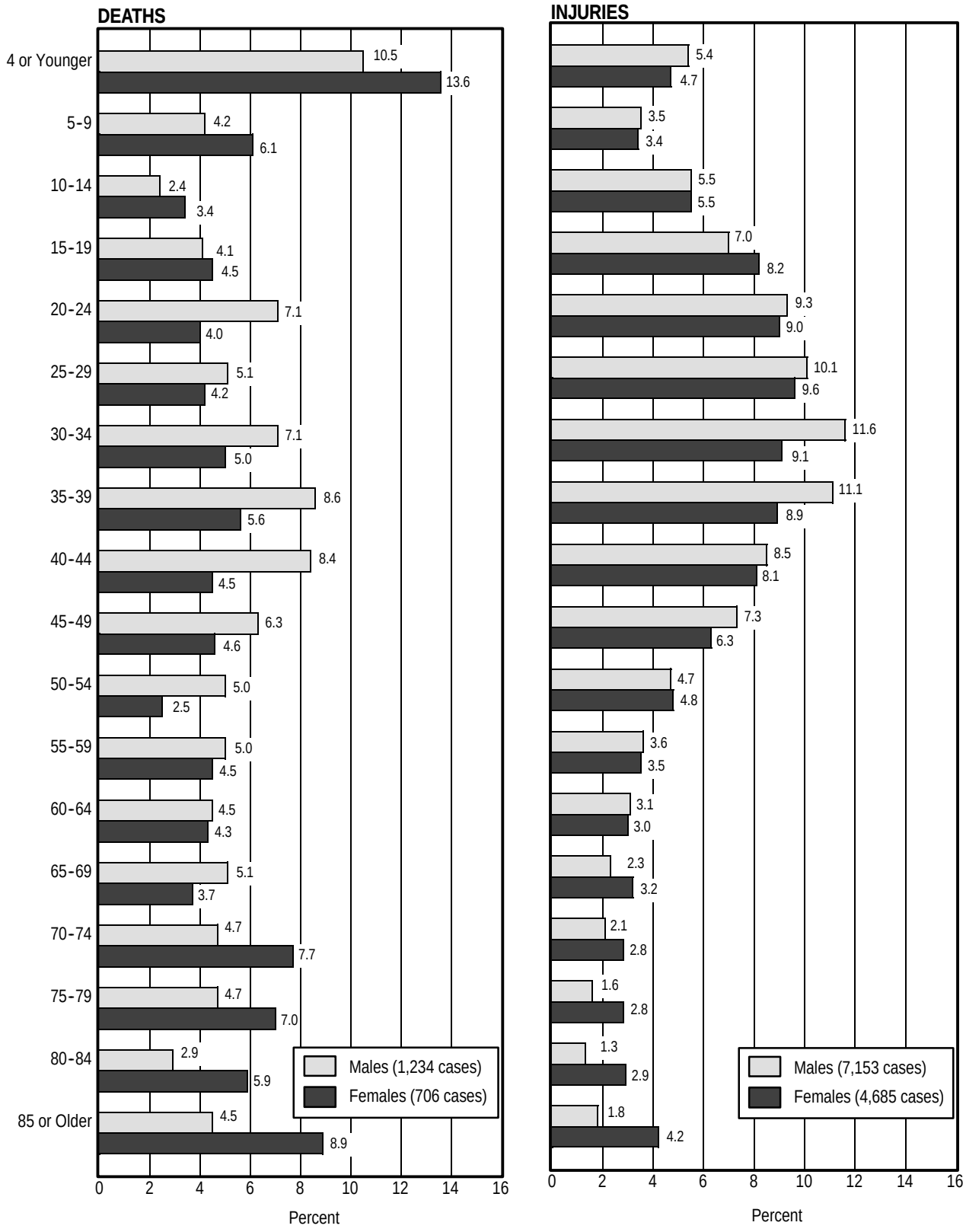
The injury distribution tracks closely the relative risk profile by age, except for the elderly (Figure 24). Ages 20–39 account for 40 percent of fire injuries in 1996. The young, under age 9, accounts for 9 percent; the elderly over age 70 accounts for 9 percent. Although the elderly are at high risk, there are fewer of them in the total population. If their risk continues to be the same, we could expect more and more elderly fire injuries and deaths as the elderly proportion of the population increases. In the meantime, the focus for injury prevention should be on young adults 20–39. It is believed that males in this age group are greater risk takers during fires, resulting in a higher proportion of injuries.

The distribution of fire deaths by age is somewhat different for males versus females. A slightly larger proportion of female deaths in 1996 occurred in the young (through age 19) and again in the elderly (Figure 25). Male fire deaths, by contrast, are higher in the mid-life years, ages 20 to 60. Elderly females have a significantly larger proportion of injuries than elderly males.



Sources: NFIRS

Figure 24. 1996 Fire Casualties by Age



Source: NFIRS

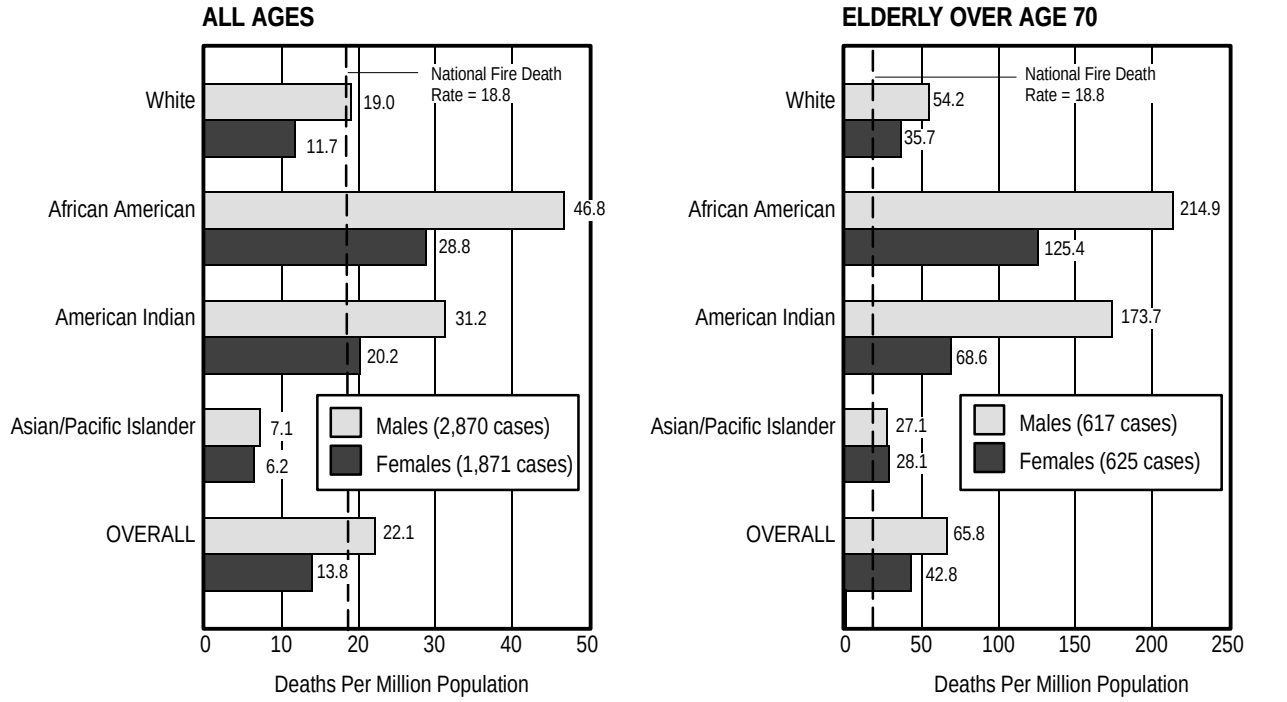
Figure 25. 1996 Fire Casualties by Age and Gender

Ethnic Groups

The fire problem cuts across all groups and races, rich and poor, North and South, urban and rural. But it is higher for some groups than for others.

Data on "race" or ethnic group of victims are somewhat ambiguous in a society where many people are of mixed heritages. And many citizens, including firefighters, find it distasteful to report on race. On the other hand, there does seem to be a higher fire problem for some groups, and it can be helpful to identify their problems for use within their own communities.

African Americans and American Indians have significantly higher death rates per capita than the national average (Figure 26). African American fire death victims comprise a large and disproportionate share of total fire deaths—although African Americans comprise 13 percent of the popu-



No. of Fire Deaths

Race	Males	Females	Total
White	2,057	1,312	3,369
African American	745	505	1,250
American Indian	35	23	58
Asian/Pacific Islander	33	31	64
Total	2,870	1,871	4,741

No. of Fire Deaths of Elderly Over Age 70

Race	Males	Females	Total
White	459	469	928
African American	146	145	291
American Indian	7	4	11
Asian/Pacific Islander	5	7	12
Total	617	625	1,242

Source: National Center for Health Statistics and Bureau of the Census

Note: The overall totals are derived from the mortality data and differ from death totals presented in Figures 14 (NFPA survey data) and 19 (state fire marshal data).

Figure 26. 1996 Fire Deaths by Race and Gender

lation, they account for 26 percent of fire deaths. For all ethnic groups, male fire death rates exceed that of females by 1.5 to 2 times. The elderly of all ethnic groups have the highest fire death rates. The result of these statistics is that elderly African Americans have the highest fire death rate in the nation at more than ten times the U.S. average fire death rate. This situation has remained unchanged.

KINDS OF PROPERTIES WHERE FIRES OCCUR

This section describes the proportions of the fire problem across major types of properties: residential structures, non-residential structures, vehicles, outside properties, and other or unknown properties.[5]

Property Types

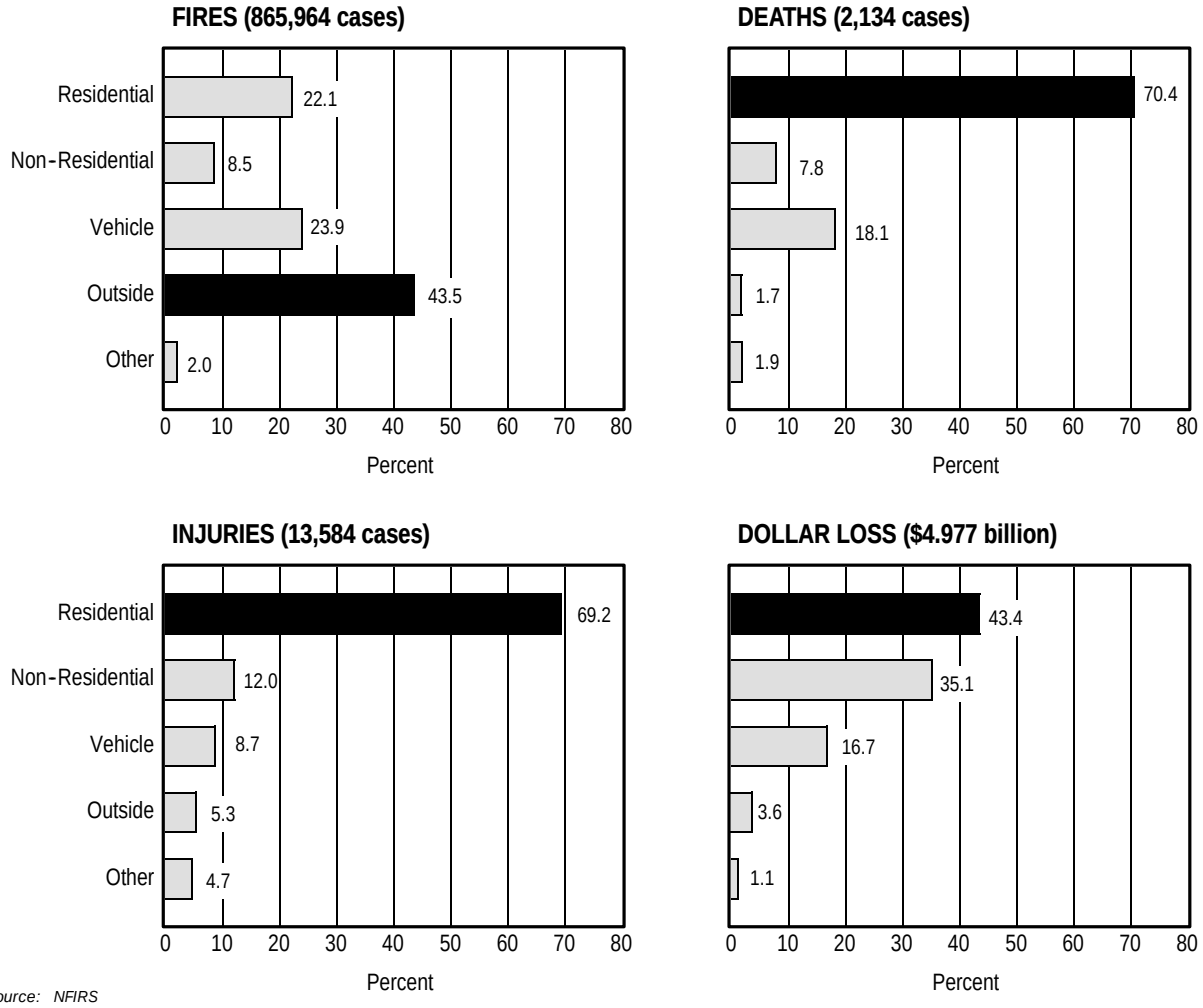
In terms of numbers of fires, the largest category in 1996 (as in all years) is outside fires (44 percent)—in fields, vacant lots, trash, etc. (Figure 27). Many of these fires are intentionally set but do not cause much damage. Residential and non-residential structure fires together comprise only about one-third of all fires. Residential fires outnumber non-residential structure fires by two and a half to one. What may surprise some is the large number of vehicle fires. In fact, one out of every four fires to which fire departments respond involves vehicles.

By far the largest percentage of deaths, 70 percent, occurs in residences, with the majority of these in one- and two-family dwellings. Vehicles accounted for the second largest percentage of fire deaths at 18 percent. Some may be unaware that such a large share of our fire deaths result from fires that occur in houses and apartments. Great attention is given to large, multiple death fires in public places such as hotels, nightclubs, and office buildings. But in fact, the major attention-getting fires that kill 10 or more people are few in number, and while tragic, constitute only a small portion of fire deaths. Firefighters generally are doing a good job in protecting public properties in this country. The area with the largest problem is where it is least suspected—in people's homes. Fire prevention efforts should be increasingly focused on this part of the overall fire problem.

Only 8 percent of the 1996 fire deaths occurred in commercial and public properties. Outside and other (unknown) fires, including wildfires, were a very small factor in fire deaths (4 percent).

As Figure 27 shows, the picture is somewhat similar for fire injuries, with more than two-thirds of all injuries occurring in residences. Non-residential structures are the location of 12 percent of all fire injuries. Vehicles account for another 9 percent. Outside and other fires account for just 10 percent of the fire injuries.

[5] The percentage of fire deaths in the major property types differs somewhat between NFIRS and the NFPA survey. These differences are discussed in Appendix A.



Source: NFIRS

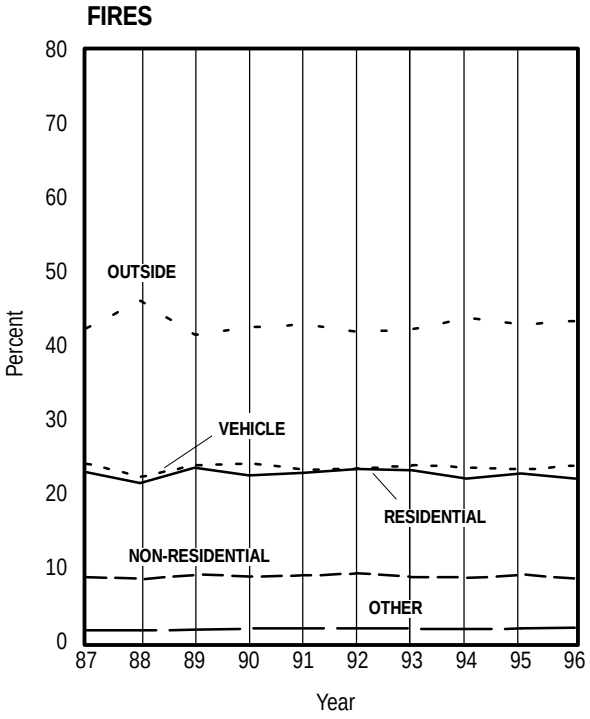
Figure 27. 1996 Fires and Fire Losses by General Property Type

The picture changes for dollar loss. Structures—residential and non-residential—are the leading properties for dollar loss. Moreover, when these two categories are combined, they account for nearly 80 percent of all dollar loss. The proportion of dollar loss from outside fires may be understated because the destruction of trees, grass, etc., is given zero value in fire reports if it is not commercial cropland or timber.

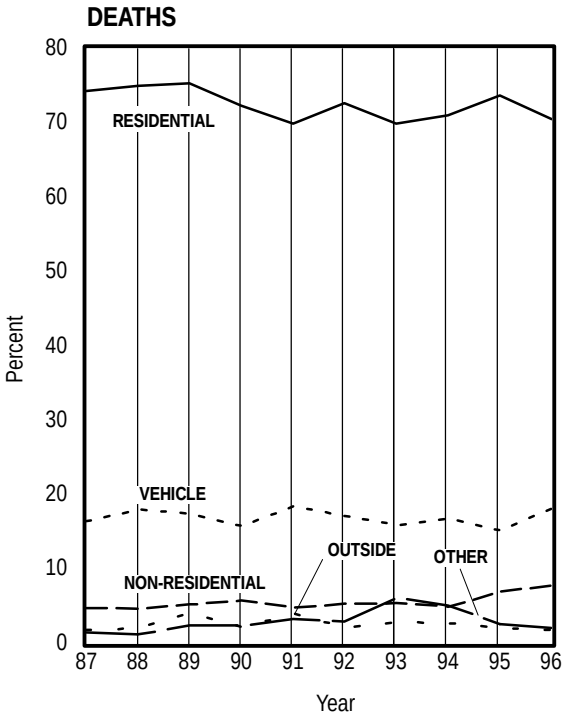
All relative percentages for property type fires were the same in 1996 as they were in 1995.

Trends

The proportions of the fire problem by property type have remained quite steady over time. This is another consistency check for NFIRS. In terms of numbers of fires, the proportion of the problem due to outside properties, residential structures, and non-residential structures has declined slightly over the 10-year period. The proportion of fires due to vehicles has risen slightly, and although the proportion of other fires is small, it also has increased by 20 percent (Figure 28). It has been



	Residential	Non-Residential	Vehicle	Outside	Other
1987	23.0%	8.8%	24.1%	42.4%	1.6%
1988	21.5	8.5	22.4	46.1	1.6
1989	23.6	9.1	23.9	41.6	1.7
1990	22.5	8.9	24.2	42.6	1.9
1991	22.9	9.0	23.3	42.9	1.9
1992	23.4	9.3	23.5	41.9	1.9
1993	23.2	8.8	23.9	42.3	1.8
1994	22.1	8.7	23.6	43.8	1.8
1995	22.8	9.1	23.3	42.9	1.9
1996	22.1	8.5	23.9	43.5	2.0



	Residential	Non-Residential	Vehicle	Outside	Other
1987	74.2%	4.7%	16.4%	1.8%	1.4%
1988	74.9	4.6	17.9	2.0	1.2
1989	75.2	5.2	17.3	4.1	2.4
1990	72.2	5.7	15.7	2.1	2.4
1991	69.8	4.8	18.4	3.9	3.2
1992	72.6	5.3	17.1	2.1	2.9
1993	69.8	5.4	15.9	2.8	6.1
1994	70.9	4.9	16.7	2.6	5.0
1995	73.6	6.9	15.1	2.0	2.5
1996	70.4	7.8	18.1	1.7	1.9

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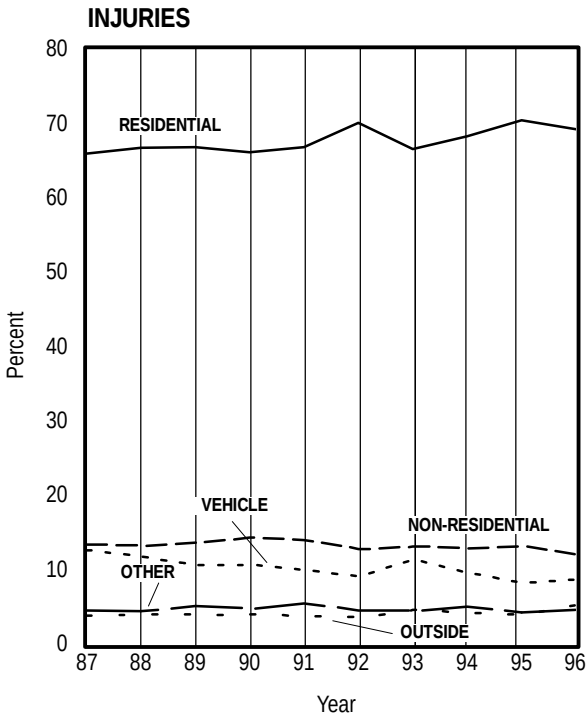
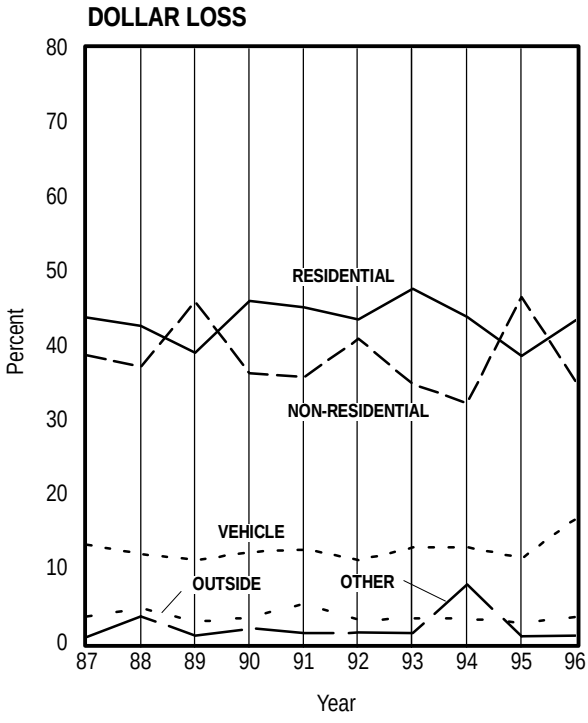
Figure 28. Trends in Fires and Fire Losses by General Property Type



	Residential	Non-Residential	Vehicle	Outside	Other
1987	65.9%	13.4%	12.6%	3.8%	4.5%
1988	66.7	13.2	11.7	4.0	4.4
1989	66.8	13.6	10.6	3.9	5.1
1990	66.1	14.3	10.7	4.0	4.8
1991	66.8	14.0	9.9	3.7	5.5
1992	70.1	12.8	9.1	3.6	4.5
1993	66.5	13.1	11.4	4.6	4.4
1994	68.3	12.9	9.6	4.2	5.0
1995	70.4	13.2	8.2	3.9	4.3
1996	69.2	12.0	8.7	5.3	4.7



	Residential	Non-Residential	Vehicle	Outside	Other
1987	43.7%	38.7%	13.2%	3.6%	0.8%
1988	42.6	37.1	11.9	4.7	3.6
1989	39.0	45.9	11.1	2.9	1.0
1990	46.0	36.3	12.3	3.5	1.9
1991	45.1	35.7	12.6	5.3	1.3
1992	43.5	40.9	11.1	3.1	1.4
1993	47.6	34.8	12.9	3.3	1.3
1994	43.8	32.2	12.9	3.2	7.9
1995	38.6	46.5	11.4	2.7	0.9
1996	43.4	35.1	16.7	3.6	1.1

Source: NFIRS

Figure 28. Trends in Fires and Fire Losses by General Property Type (cont'd)

suggested that the outside property increases might be due to an increasing number of rural departments reporting to NFIRS, increased automation, or more complete reporting.

Over the 10-year period, residential property fires have caused 70–75 percent of total fire deaths, with an overall downward trend. Non-residential structures and other fires represent a small, but increasing, proportion of deaths. The trend in the proportion of vehicle fire deaths, despite an increased share in 1996, has declined slightly. The proportion of outside fire deaths has also declined.

Except for residential and outside properties, the trends in property types for injuries have been slowly decreasing over the 10-year period. Injuries in residential properties have increased slightly over this period, while the proportion of injuries from outside fires increased by one-quarter.

Dollar loss has greater trend fluctuations because this measure is highly sensitive to a few very large fires and whether they are included or omitted in the sample of fires on which estimates are based. (The classic example is the 1986 pineapple fire in Hawaii (outside property type), which destroyed an enormous pineapple crop and caused a peak in outside fire losses that forced the other percentages downward. Similarly, in 1988 there was a $900 million fire reported in the Houston ship channel, and in 1994 there was a $300 million loss in the other fire category.)

Severity of Fires

Figure 29 shows the severity of fires in 1996 as measured by deaths and injuries per thousand fires and by dollar loss per fire. These indicators can increase if there are more casualties or more damage per fire (the numerator) or if fewer minor fires are reported (the denominator).

As shown, residential fires have the highest death and injury rates—another important reason for prevention programs to focus on home fire safety. Non-residential structure fires have by far the highest dollar loss per fire.

The trends in severity over the 10-year period are shown in Figure 30. Residential fire severity decreased 7 percent over the 10-year period in terms of deaths per fire and increased by 12 percent in terms of injuries per fire.

Non-residential severity increased in both deaths and injuries per fire. Other fire (including unspecified property types) has relatively high deaths per fire but represents only small numbers of fires, fire deaths, and injuries; it is a miscellaneous category.

Adjusted dollar loss per fire changed significantly. Non-residential fires averaged $24,500 over 10 years per fire with wide fluctuations: from a low of $19,300 per fire in 1994 to a high of $30,900 per fire in 1995. Fire loss increased for most categories. Residential losses increased a significant 10 percent, and from 1993 to 1994 there was an uncharacteristic increase (sixfold) in “other” fires due to one large ($300 million) explosion.

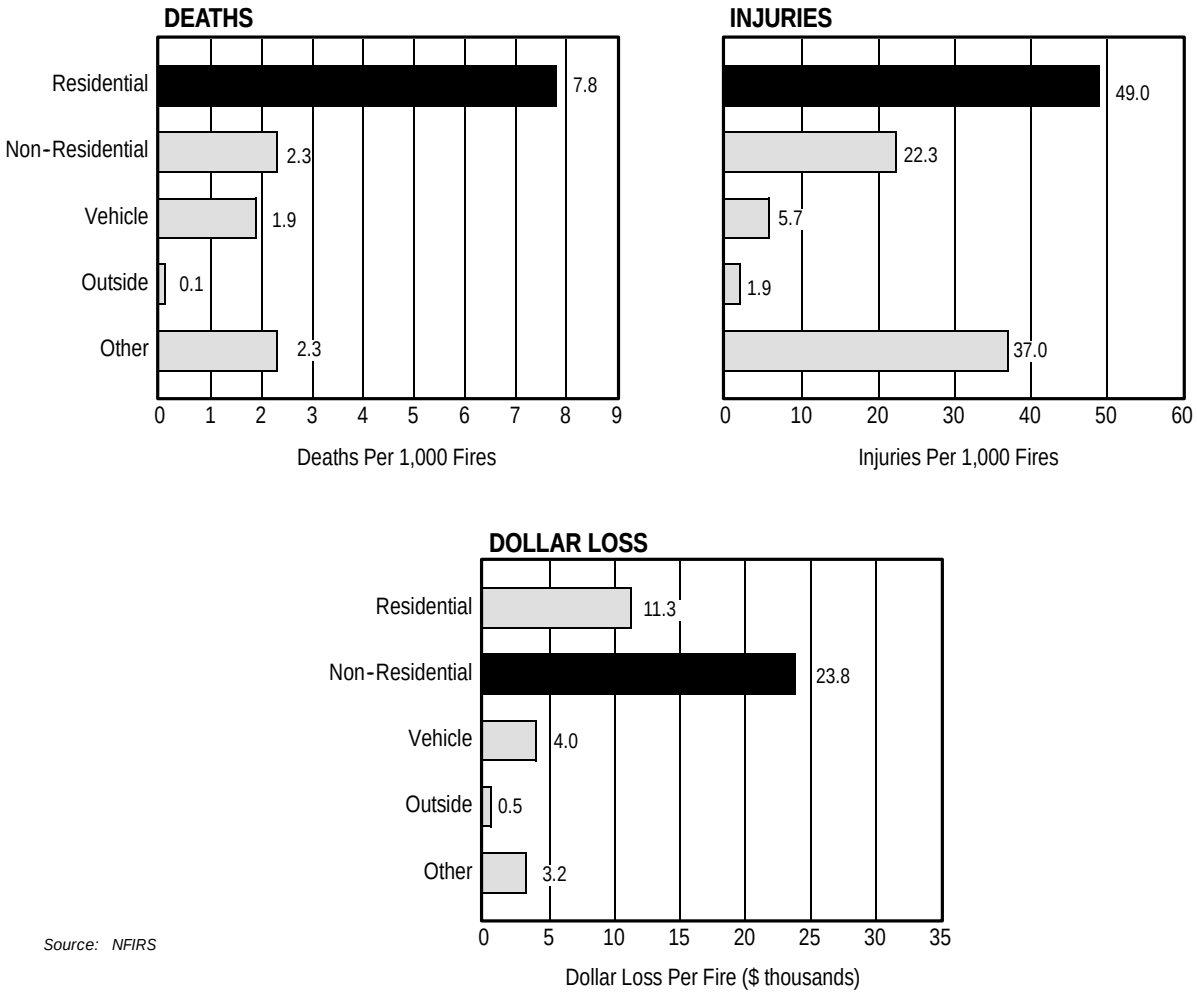
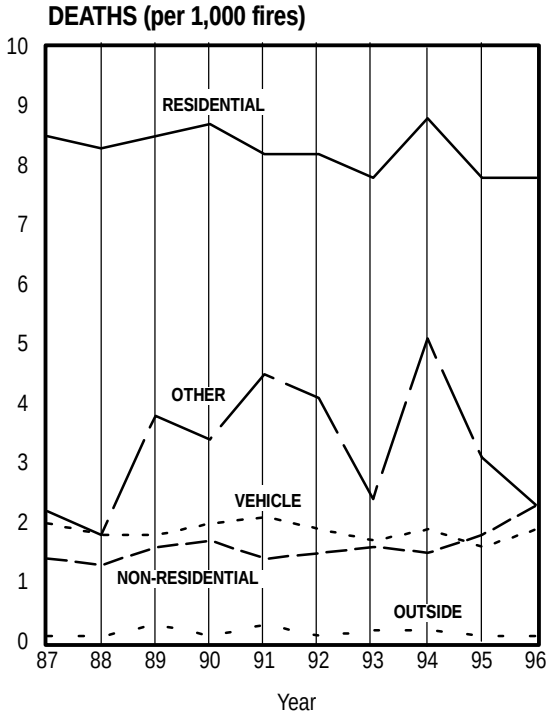
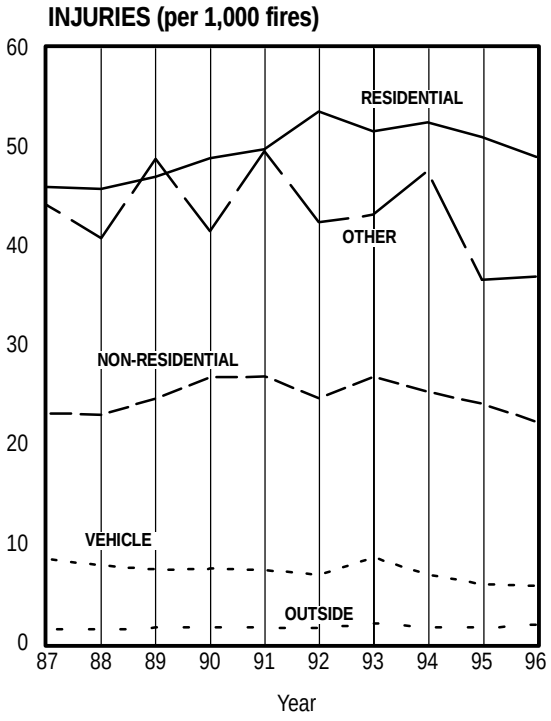


Figure 29. Severity of Fire Losses in 1996 by General Property Type

There are many reasons for increases in loss per fire in residential occupancies. It could reflect a more affluent society in part, but affluence has not increased as sharply as the losses per fire adjusted for inflation. More damage per fire also may be due to faster-spreading fires. One clue as to the underlying cause for the increase is that the percentage are of residential fires that spread to the whole structure (that is, were not confined to the floor of origin) increased from 1987 to 1996. The precise mechanisms that result in increased loss per fire are not clearly known, and this increase suggests that further study is warranted.



	Residential	Non-Residential	Vehicle	Outside	Other
1987	8.5	1.4	2.0	0.1	2.2
1988	8.3	1.3	1.8	0.1	1.8
1989	8.5	1.6	1.8	0.3	3.8
1990	8.7	1.7	2.0	0.1	3.4
1991	8.2	1.4	2.1	0.3	4.5
1992	8.2	1.5	1.9	0.1	4.1
1993	7.8	1.6	1.7	0.2	2.4
1994	8.8	1.5	1.9	0.2	5.1
1995	7.8	1.8	1.6	0.1	3.1
1996	7.8	2.3	1.9	0.1	2.3
10-Year Trend					
	-6.8%	**+45.2%**	**-9.0%**	**-11.4%**	**+24.2%**



	Residential	Non-Residential	Vehicle	Outside	Other
1987	46.0	23.1	8.4	1.4	44.1
1988	45.8	23.0	7.8	1.3	40.8
1989	47.0	24.7	7.4	1.6	48.8
1990	48.9	26.8	7.5	1.6	41.5
1991	49.8	26.9	7.3	1.5	49.6
1992	53.6	24.7	6.9	1.5	42.4
1993	51.6	26.9	8.6	2.0	43.2
1994	52.5	25.3	6.9	1.6	47.6
1995	51.0	24.1	5.9	1.5	36.6
1996	49.0	22.3	5.7	1.9	37.0
10-Year Trend					
	+12.1%	**+0.4%**	**-24.7%**	**+28.2%**	**-12.1%**

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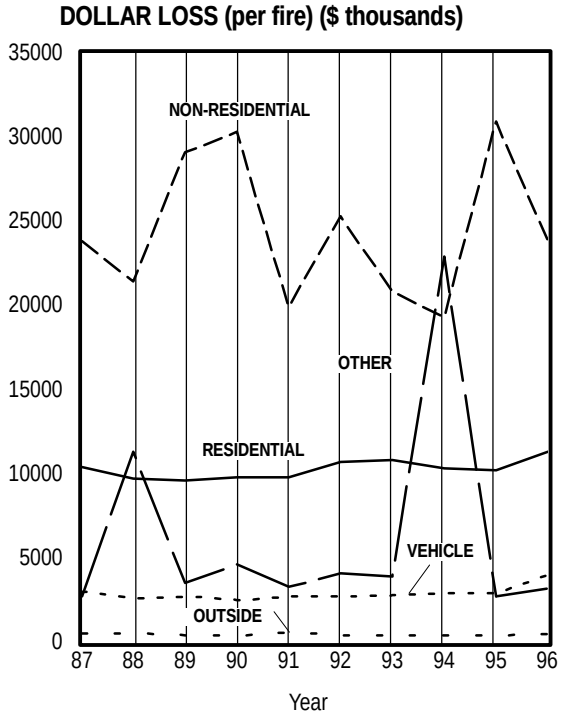
Figure 30. Trends in Severity of Fire Losses by General Property Type



	Residential	Non-Residential	Vehicle	Outside	Other
1987	$10,400	$23,800	$3,000	$500	$2,700
1988	9,700	21,400	2,600	500	11,300
1989	9,600	29,100	2,700	400	3,500
1990	9,800	30,300	2,500	400	4,600
1991	9,800	19,900	2,700	600	3,300
1992	10,700	25,300	2,700	400	4,100
1993	10,800	20,800	2,800	400	3,900
1994	10,300	19,300	2,900	400	22,900
1995	10,200	30,900	2,900	400	2,700
1996	11,300	23,800	4,000	500	3,200
10-Year Trend					
	+10.4%	**-1.2%**	**-29.2%**	**-14.4%**	**+43.3%**

Source: NFIRS

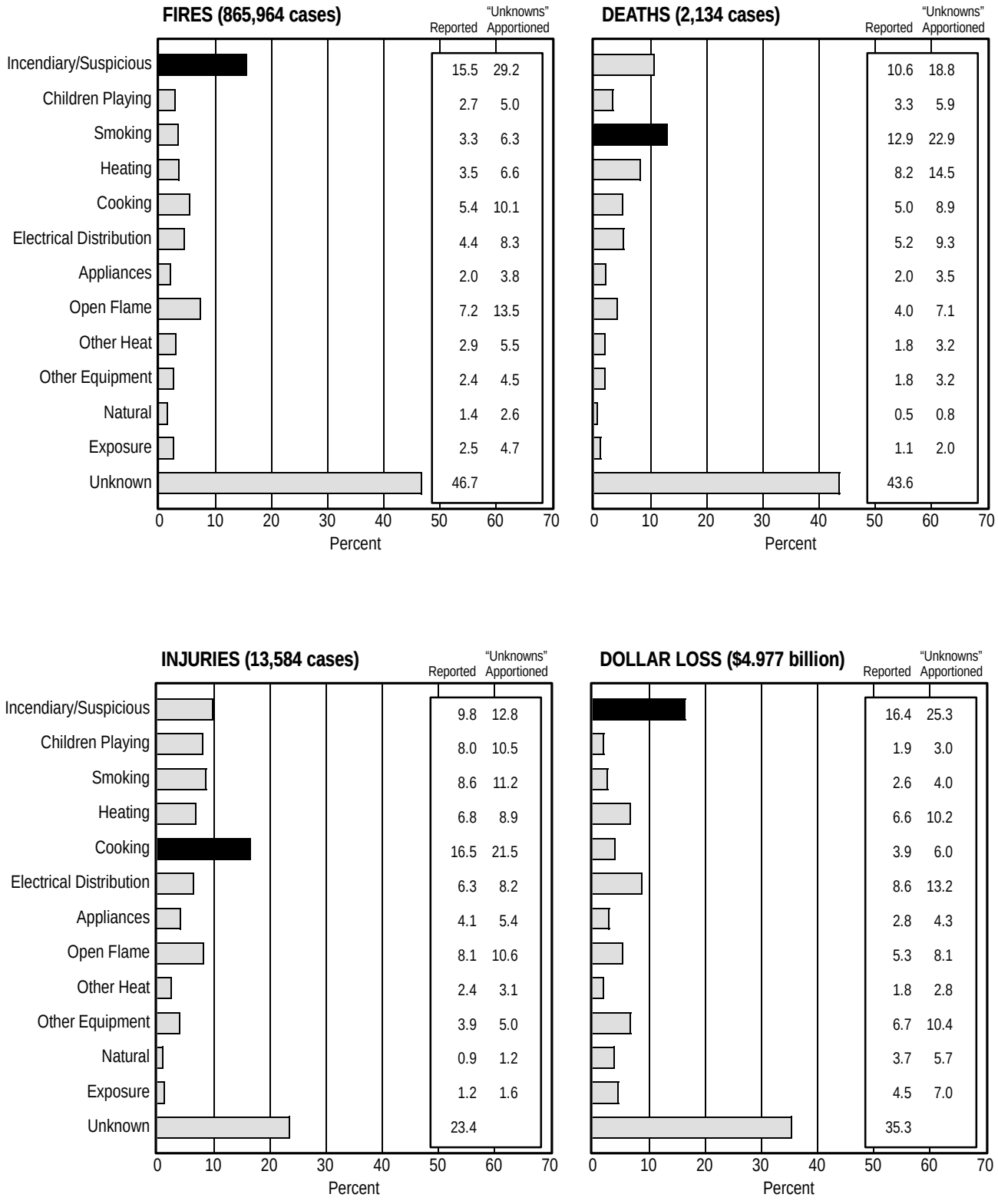
Figure 30. Trends in Severity of Fire Losses by General Property Type (cont'd)

CAUSES OF FIRES AND FIRE LOSSES

Figure 31 shows the profile of the major causes of fires, fire deaths and injuries, and direct dollar loss in 1996. Here, fire deaths occurring in all the different occupancies are grouped together. The top three causes are smoking (22 percent), incendiary and suspicious (or arson) (21 percent), and heating (11 percent). These percentages are adjusted, which proportionally spreads the unknowns over the other 12 causes. The leading cause of injuries is cooking (22 percent), followed by arson (13 percent) and children playing (11 percent).

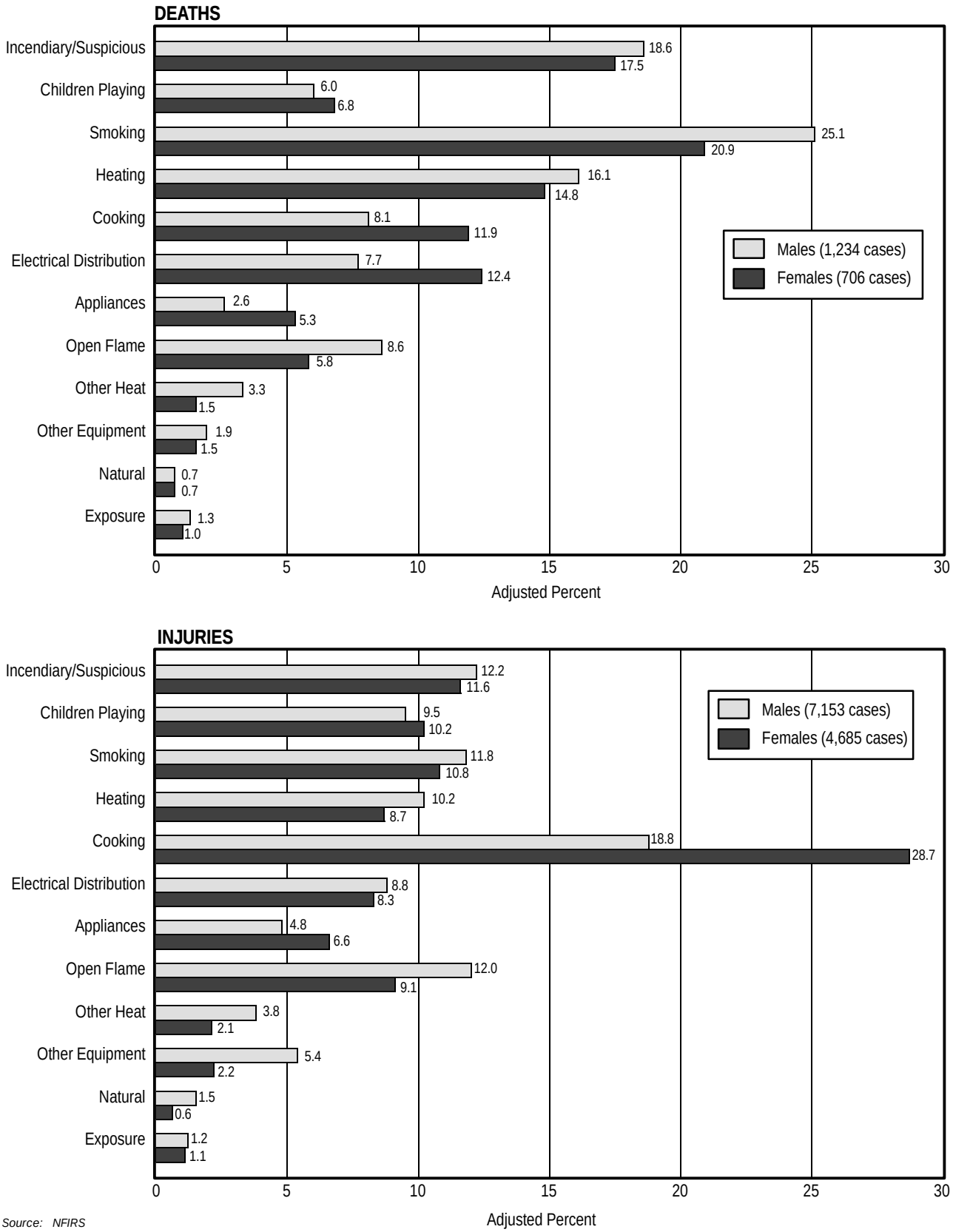
The three leading causes of fire deaths are similar for both sexes (Figure 32). The proportions of each of the remaining causes are surprisingly similar too. Males had 50 percent more fire deaths from open flame and other heat and females slightly more from cooking, electrical, and children playing fires.

Unlike fire deaths, there are sharp differences between the sexes in their injury cause profiles. The leading cause, cooking, is the same, but the relative role that the remaining causes play in fire injuries between men and women differs greatly in 1996. Moreover, while the leading cause for both sexes is cooking, nearly twice as many women are injured in cooking fires as men (28 vs. 18 percent). For women, children playing and arson are the second and third leading causes, although combined they account for fewer injuries than cooking. For men, arson is the second leading cause of fire injuries, followed by smoking and open flame. Arson is by far the leading cause of all fires and direct dollar loss.



Source: NFIRS

Figure 31. Causes of 1996 Fires and Fire Losses



Source: NFIRS

Figure 32. Causes of 1996 Fire Casualties by Gender

USFA RESOURCES ON THE NATIONAL FIRE PROBLEM

The following National Fire Data Center reports provide additional insight to the magnitude of the fire problem in the United States:

- *A Profile of Fire in the United States: 1986–1995* (#FA–184)
- *Fire in the United States: 1986–1995* (Tenth Edition) (#FA–183)
- *Profile of the Urban Fire Problem*
- *Rural Fire Problem in the United States* (#FA–180)
- *Multiple Fatality Fires Reported to NFIRS 1994–1996*
- *Establishing a Relationship Between Alcohol and Fires*
- *Seasonal Fires*
- *Arson in the United States* (#FA–174)
- *Socioeconomic Factors and the Incidence of Fire* (#FA–170)
- *Children and Fire: The Experiences of Children and Fire in the United States*

Two available U.S. Fire Administration reports have attracted nationwide attention. *America Burning* is probably the most widely quoted fire protection publication. This report set the stage for national consciousness-raising about the need for as much focus on fire prevention as on fire suppression. *Fire Death Rate Trends: An International Perspective* (#FA–169) explores the magnitude and the nature of the fire death problem in the United States. It provides a statistical portrait of fire death rates for 14 industrialized nations, and presents observations about key institutional and attitudinal differences between the U.S. and industrialized countries with significantly lower fire death rates. Another resource that is useful to the fire world is the *Fire Data Analysis Handbook*. The handbook describes statistical techniques for analyzing data typically collected in fire departments. The *Uses of NFIRS: The Many Uses of the National Fire Incident Reporting System* (#FA–171) details the variety and types of analyses that use the NFIRS data in specific and fire data in general.

Other books and reports produced by USFA not previously mentioned that pertain to the fire problem in the United States include:

- **Arson and Fire Investigation:** *Arson Forum Report* (#FA–134); *Arson Prosecution Issues* (#FA–78); *Arson Resource Directory* (#FA–74); *Basic Tools and Resources for Fire Investigators* (#FA–127); *Establishing an Arson Strike Force* (#FA–88); *Field Index Guide (Fire and Arson Investigators' Field Index Directory)* (#FA–91); *Fire/Arson Investigation Training Resource Catalog* (#FA–131); *USFA Fire Burn Pattern Tests* (#FA–178); *View of Management in Fire Investigation Units (Volume 1)* (#FA–93); and *View of Management in Fire Investigation Units (Volume 2)* (#FA–116).
- **Juvenile Fire Problem:** *Arson and Juveniles: Responding to the Violence* (#TR–095); *Firesetter Handbook Ages 0–7* (#FA–83); *Firesetter Handbook Ages 7–13* (#FA–82); *Firesetter Handbook Ages 14–18* (#FA–80); *Grems Case: How an Arson*

Case Was Solved and Prosecuted, Aurora, CO (#TR–047); *National Juvenile Firesetters/Arson Control and Prevention Program (NJF/ACPP) Executive Summary (Part 1 of 5)* (#FA–148); *NJF/ACPP Guidelines for Implementation (Part 2 of 5)* (#FA–147); *NJF/ACPP Juvenile Firesetter Early Intervention Program (Part 3 of 5)* (#FA–146); *NFJ/ACPP Trainer's Guide (Part 4 of 5)* (#FA–149); and *NFJ/ACPP User's Guide (Part 5 of 5)* (#FA–145).

- **Fire Data:** *America Burning Revisited;* and *NFIRS Analysis: Investigating City Characteristics and Residential Fire Rates* (#FA–179).
- **Others:** *After the Fire! Returning to Normal* (#FA–46); *Directory of National Community Volunteer Fire Prevention Programs* (#FA–92); *Fire Safety Education Resource Directory* (#FA–172); *Fire Service Resource Guide* (#FA–186); *Get Alarmed South Carolina—Lessons Learned from Its Success* (#TR–044*); Leadership in Public Fire Safety Education—2000* (#FA–135); *Recruitment and Retention in Volunteer Fire Service: Final Report* (#FA–185); *Smoke Detectors: What You Need to Know* (#L–220); *United States Fire Administration Brochure* (#L–230); and the *USFA Publications Order Form*.

These publications are available by writing to:

U.S. Fire Administration
Federal Emergency Management Agency
Publications Center, Room N310
16825 S. Seton Avenue
Emmitsburg, MD 21727

Please include the parenthetical publication number, if given, in your request.

Documents may also be ordered via the World Wide Web: http://www.usfa.fema.gov/usfapubs. USFA publications are free.

The USFA web site (http://www.usfa.fema.gov) also offers a wide variety of information on fire-related issues and is continually updated to provide information of interest. The web site also features sections on the Fire Data Center, Fire Safety, Arson Prevention, and a Kids' Page.

3

RESIDENTIAL PROPERTIES

OVERVIEW

The residential portion of the fire problem accounts for 82 percent of fire deaths and 76 percent of the injuries to civilians.[1] It also accounts for more firefighter injuries than any other category of occupancy. This section reviews the residential problem overall, and subsequent sections present details of the fire problem for major subcategories of residential properties (one- and two-family dwellings, apartments, and other types.)

The term *residential* as used in NFIRS includes what is commonly referred to as homes, whether they are one- or two-family dwellings or multifamily apartment buildings. It also includes manufactured housing, hotels and motels, residential hotels, dormitories, and much of what might be considered "halfway houses" for the care of people with problems but able to operate in the community. The term does not include institutions such as prisons, homes for the elderly, juvenile care facilities, or hospitals, though many people may reside in them for short or long periods of time.

Figure 33 shows the 10-year trend in residential fires, deaths, injuries, and dollar loss—and the overall trend is down in every area. The number of fires and deaths have trended downward dramatically over the past 10 years (23 percent and 25 percent, respectively). Injuries were down 8 percent, noticeably different from 1994 when they showed a 6 percent increase. The economic loss, when adjusted for inflation, trended down 11 percent. These results are based on the NFPA annual surveys of fire departments.

Types of Residences

Figure 34 shows the relative proportions of fires, fire deaths, injuries, and dollar loss among four residential categories in 1996. The percentages shown are relatively consistent over each of the previous 9 years.

One- and two-family dwellings, where the majority of the U.S. population lives, dominate the residential statistics: 70 percent of residential fires, 70 percent of residential deaths, 61 percent of residential injuries, and 74 percent of residential dollar loss.

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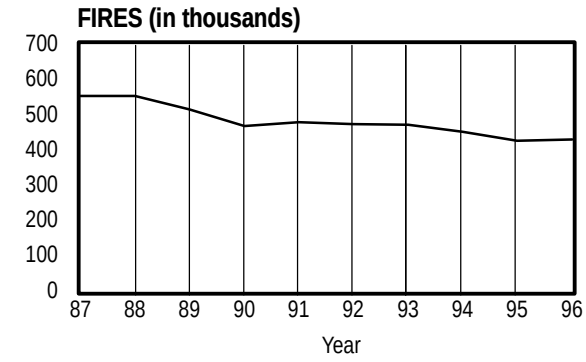
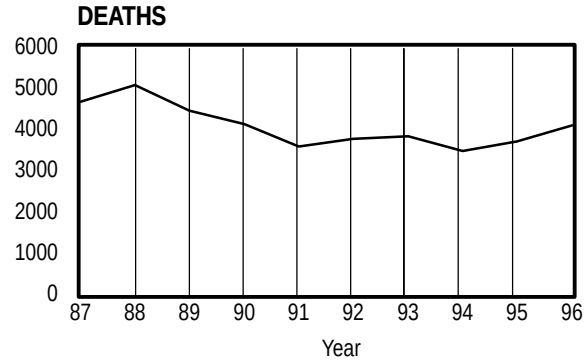
[1] A second approach to making these estimates is to use the percentage of fires that are residential from NFIRS (shown in Figure 27, Chapter 2), scaled up (multiplied by) the NFPA estimate of total fires. The results would be somewhat different from those using the NFPA subtotals. We have used the NFPA residential totals for scaling residential fires because they are consistent with the total number of fires from NFPA. Better estimates from NFIRS will not be available until more of the participating NFIRS departments provide accurate "population protected" data.



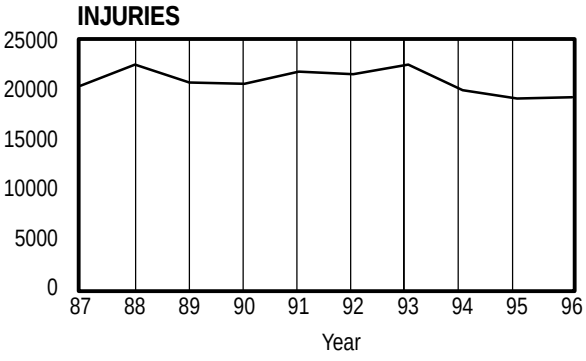
1987	551.5	1992	472.0
1988	552.5	1993	470.0
1989	513.5	1994	451.0
1990	467.0	1995	425.5
1991	478.0	1996	428.0

10-Year Trend = -23.2%



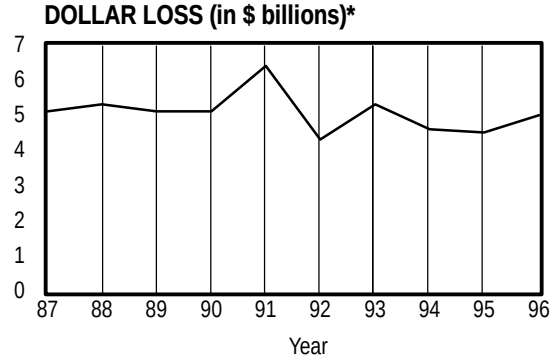
1987	4,660	1992	3,765
1988	5,065	1993	3,825
1989	4,435	1994	3,465
1990	4,115	1995	3,695
1991	3,575	1996	4,080

10-Year Trend = -24.0%



1987	20,440	1992	21,600
1988	22,600	1993	22,600
1989	20,750	1994	20,025
1990	20,650	1995	19,125
1991	21,850	1996	19,300

10-Year Trend = -8.2%



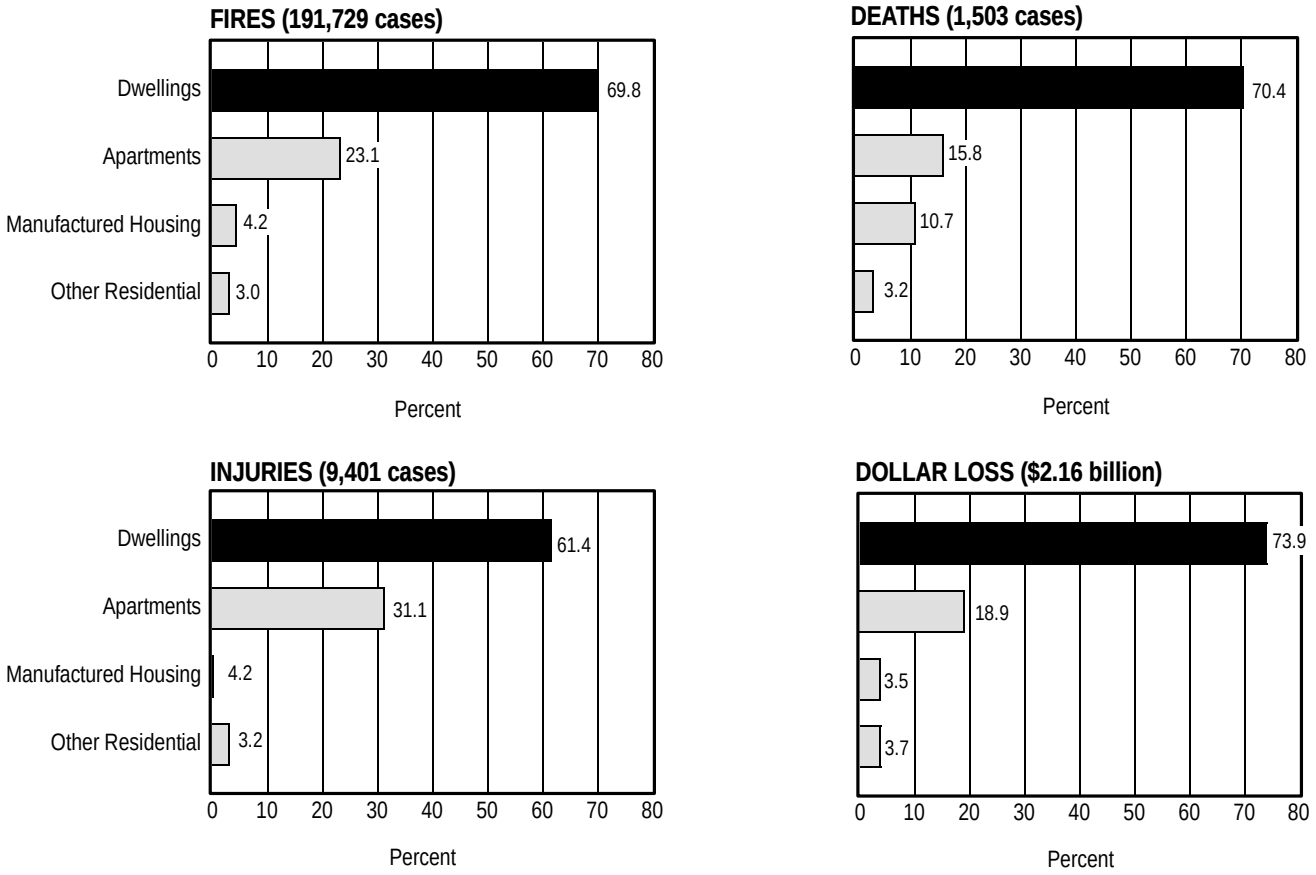
1987	$5.1	1992	$4.3
1988	5.3	1993	5.3
1989	5.1	1994	4.6
1990	5.1	1995	4.5
1991	6.4	1996	5.0

10-Year Trend = -11.4%

*Adjusted to 1996 dollars

Sources: NFPA Annual Surveys and Consumer Price Index

Figure 33. Trends in Residential Fires and Fire Losses



Source: NFIRS

Figure 34. 1996 Residential Fires and Fire Losses by Property Type

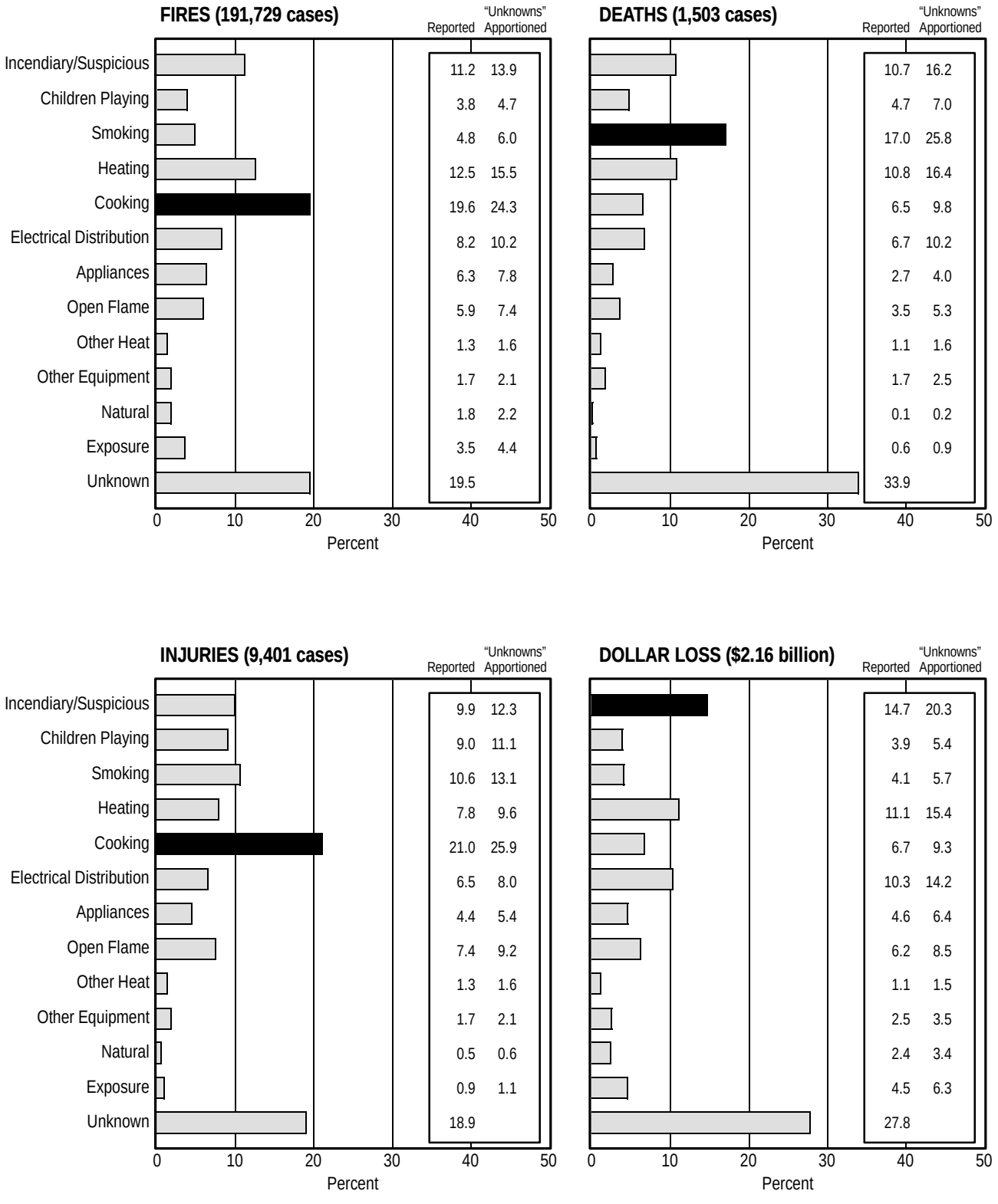
Apartments account for 23 percent of residential fires, 19 percent of the residential dollar loss, 16 percent of residential deaths, and 31 percent of injuries occurring in residential structure fires. This higher incident of injuries may be because the total space and number of exits are significantly less in apartments than in dwellings.

Manufactured housing, separated from the dwelling category, has a much greater share of fire deaths (11 percent) relative to its share of fires (4 percent). Deaths per fire are approximately twice as high for manufactured housing as for other dwellings.

Other residential properties account for between 3 and 4 percent of the residential fire problem in the various measures. About half of the losses in this category were from hotel and motel fires, which were the target of legislation requiring sprinklers in the mid 1980s.

Causes

Figure 35 shows the leading causes of fires, deaths, injuries, and dollar loss in 1996. They are dominated by the causes of one- and two-family dwellings, which account for the majority of residential fires. The overall residential figures and those for one- and two-family dwellings discussed in the



Source: NFIRS

Figure 35. Causes of 1996 Residential Fires and Fire Losses

following section will seem to be quite similar. Larger differences from the overall residential causes will be found as one looks at the smaller subcategories of residences such as apartments and manufactured housing. Considering residential property types as a whole, the leading causes of fires in 1996, as in 1994, are cooking, heating systems, and incendiary and suspicious.

Cooking has been the leading cause of residential fires most of the years since NFIRS inception. Heating passed cooking in the late 1970s when there was a surge in the use of alternative space heaters and wood heating. Cooking is by far is the leading cause of fire injuries, nearly twice that of any other cause. Many cooking fires come from unattended cooking. These fires can be lessened by emphasizing the importance of vigilance while cooking. Also, the public should be better informed as to how to extinguish small cooking fires (e.g., a pot or pan lid, dousing it with baking soda). Wearing loose-fitting clothing such as bathrobes can be dangerous around cooking areas. Cooking, however, is only the fifth leading cause of fire deaths.

Heating, the second leading cause of residential fires, includes those fires where the equipment involved in ignition is central heating, fireplaces, portable space heaters, fixed room heaters, wood stoves, and water heating. The central and water heating portions of the problem have remained relatively steady, while the portable space heater and wood burning stove portion of the problem, along with chimney fires, rose very sharply from the late 1970s to the early 1980s, but has since subsided. This last group seems to be the more volatile portion of this category of residential fires. Heating-related fires are also the second leading cause of dollar loss in residences and in fire deaths.

Incendiary and suspicious, which is called "arson" here even though that term has a narrower legal definition, is the leading cause of dollar loss and the third leading cause of fires, deaths, and injuries in residences. That arson is so prominent a factor in the residential fire problem may be a surprise to many. There are a number of factors to residential arson fires—vandalism, revenge, fraud, and quarrels are common motives according to fire officials.[2]

It is important to note that the leading causes are different depending on what measure is used, as can be seen from Figure 35. The top three causes from each measure are listed in Table 7.

Table 7. Leading Causes of 1996 Residential Fires and Fire Losses

[Numbers in parentheses reflect the 1990/1994 rankings]

Rank	Fires	Deaths	Injuries	Dollar Loss
1	Cooking (1/1)	Smoking (1/1)	Cooking (1/1)	Arson (1/1)
2	Heating (2/2)	Heating (3/3)	Smoking (2/4)	Heating (2/2)
3	Arson (3/3)	Arson (2/2)	Arson (3/3)	Electrical (3/3)

Sources: NFIRS and Eighth Edition, Fire in the United States

[2] Motives are not reported to NFIRS, but are tabulated by some arson units.

In terms of residential fire deaths (and fire deaths overall), smoking is the leading cause, up slightly from 1994, and accounts for 26 percent of residential fire deaths. In terms of injuries and total fires, cooking is by far the leading cause. For dollar loss in residences, arson is the leading cause. The rank order of causes also varies among subcategories of residences, as discussed later.

Trends of Residential Causes

Figure 36 on the following four pages shows the trends in the causes of residential fires and fire losses over the years 1987–1996.[3] All of these trends would appear lower if presented as per capita rather than in the absolute because the population increased by an estimated 9 percent over the 10 years. Any upward change less than this population increase or any downward change at all represents doing better than expected over this period. One significant change is that, starting in 1994, the hotel/motel category is now counted under other residences; therefore, certain data could not be collected for the hotel/motel category as of 1994.

The number of heating fires has decreased more than 50 percent over 10 years and in 1990 dropped to second place, where it has remained. Cooking has been relatively constant and has been the leading cause of residential fires since 1990. Arson increased slightly from 1994 and remains in third place. Electrical distribution fires remain in fourth place.

For fire deaths, smoking remains the leading cause. After reaching its lowest level in 1994 for fire-related deaths, smoking increased nearly 28 percent from the 1994 values to 1,052 deaths in 1996. Heating has surpassed arson as the second leading cause of deaths, although arson is in a close third.

By a wide margin, cooking has been the leading cause of fire injuries over the past 10 years. Smoking, the second leading cause of injuries through 1990, dropped to fourth in 1996. Incendiary injuries have risen steadily since 1985 and is the third leading cause of injuries in 1996. Injuries from children playing rank fourth in 1996, an encouraging drop from the second place ranking from 1992 to 1995.

For dollar loss, arson has dipped and risen, always maintaining its hold on first place. Heating also has gone up and down, but has been the second leading cause of dollar loss for most of the 10 years. Electrical distribution and cooking are in third and fourth places, respectively.[4]

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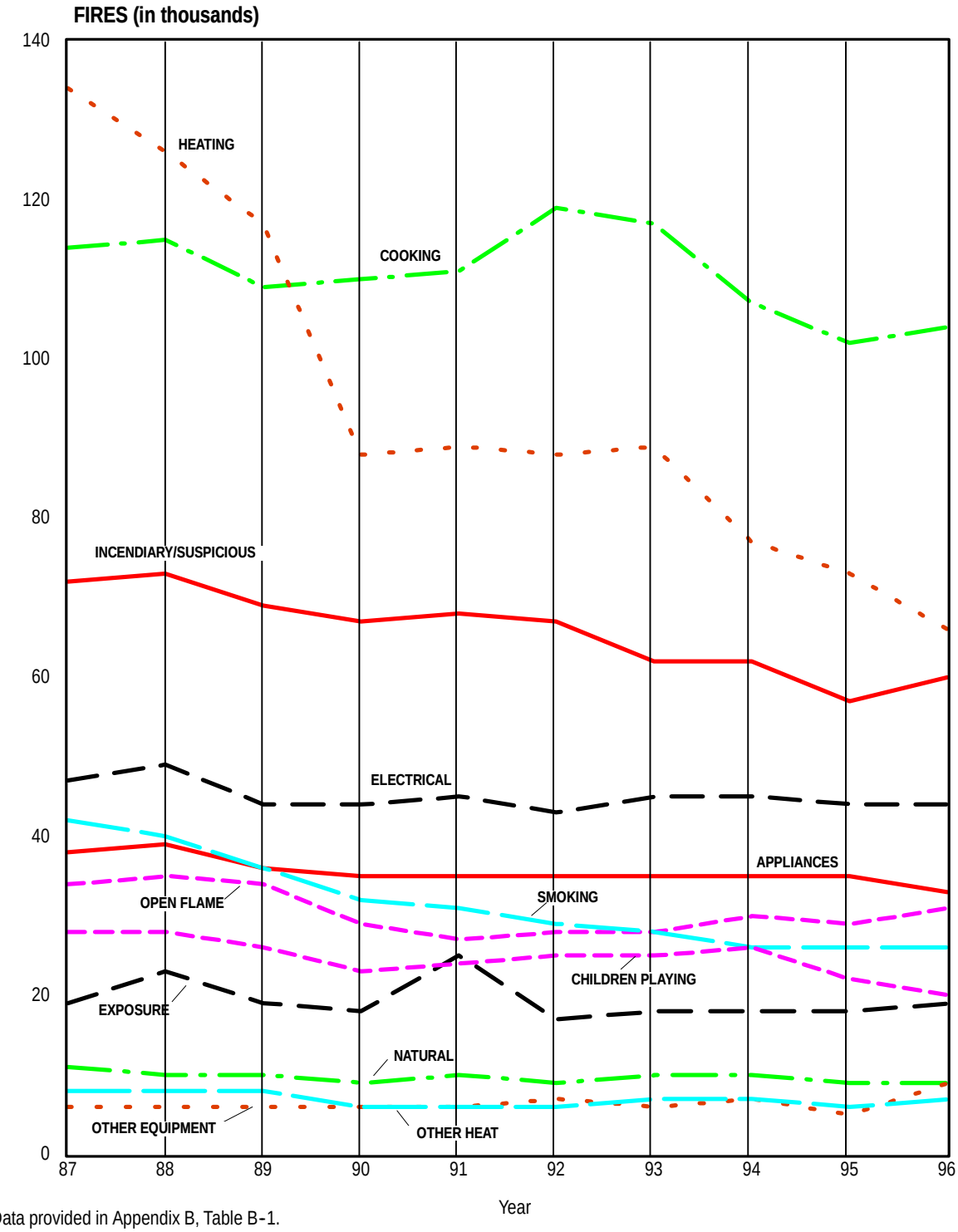
[3] The data for each point on these figures may be found in Table B–1, Appendix B. Similar tables are presented in Appendix B for other graphs where data cannot conveniently be shown on the graph itself.

[4] When analyzing dollar loss trends, any precipitous increases must be checked to see if they might be due to errors in entering data for one or two fires. Often this happens when the data are entered on the incident report form left-adjusted instead of right-adjusted. A $100 fire can be entered as a $100,000,000 fire.



Note: Data provided in Appendix B, Table B-1.

Sources: NFIRS and NFPA Annual Surveys

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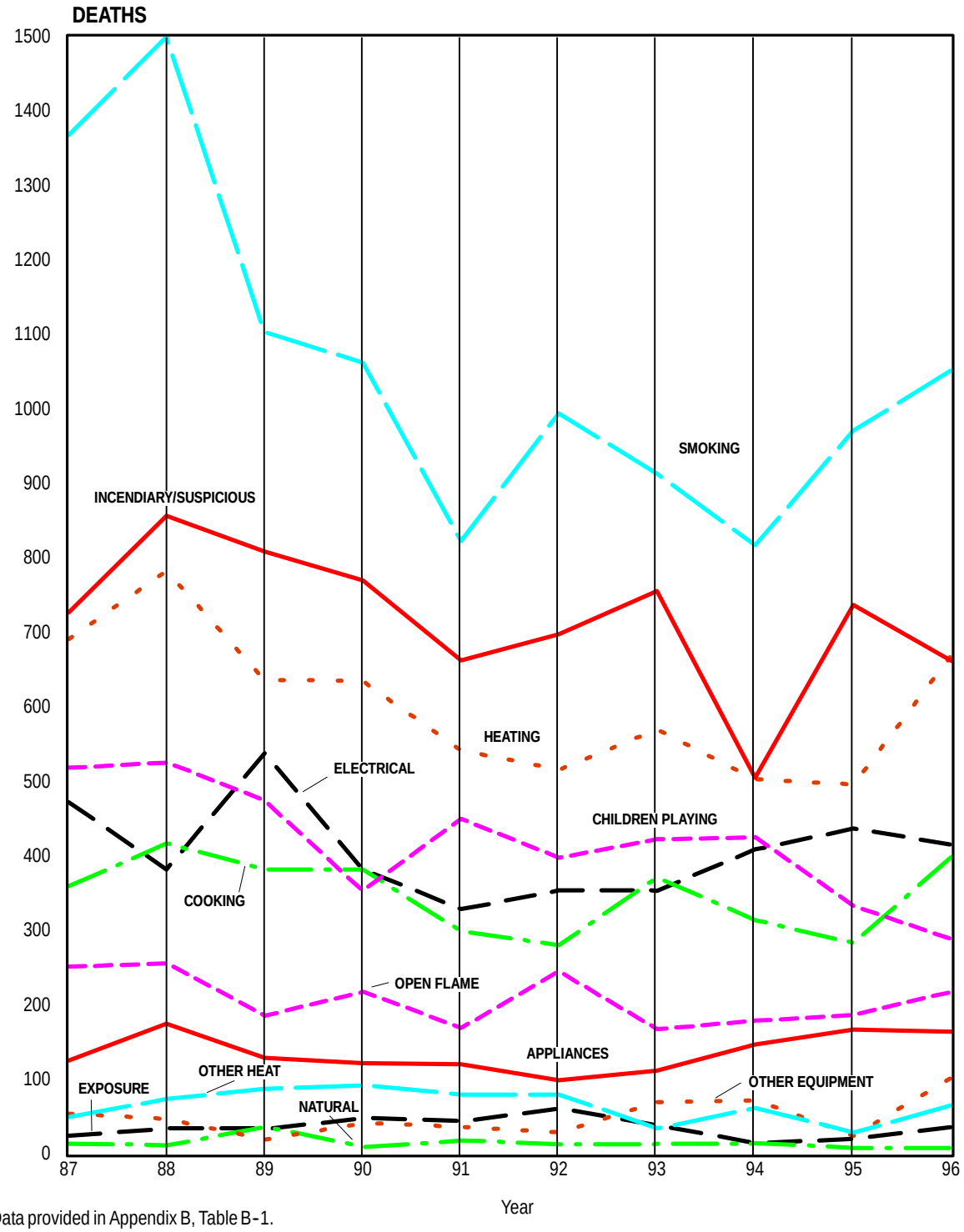
Figure 36. Trends in Causes of Residential Fires and Fire Losses



Note: Data provided in Appendix B, Table B-1.

Sources: NFIRS and NFPA Annual Surveys

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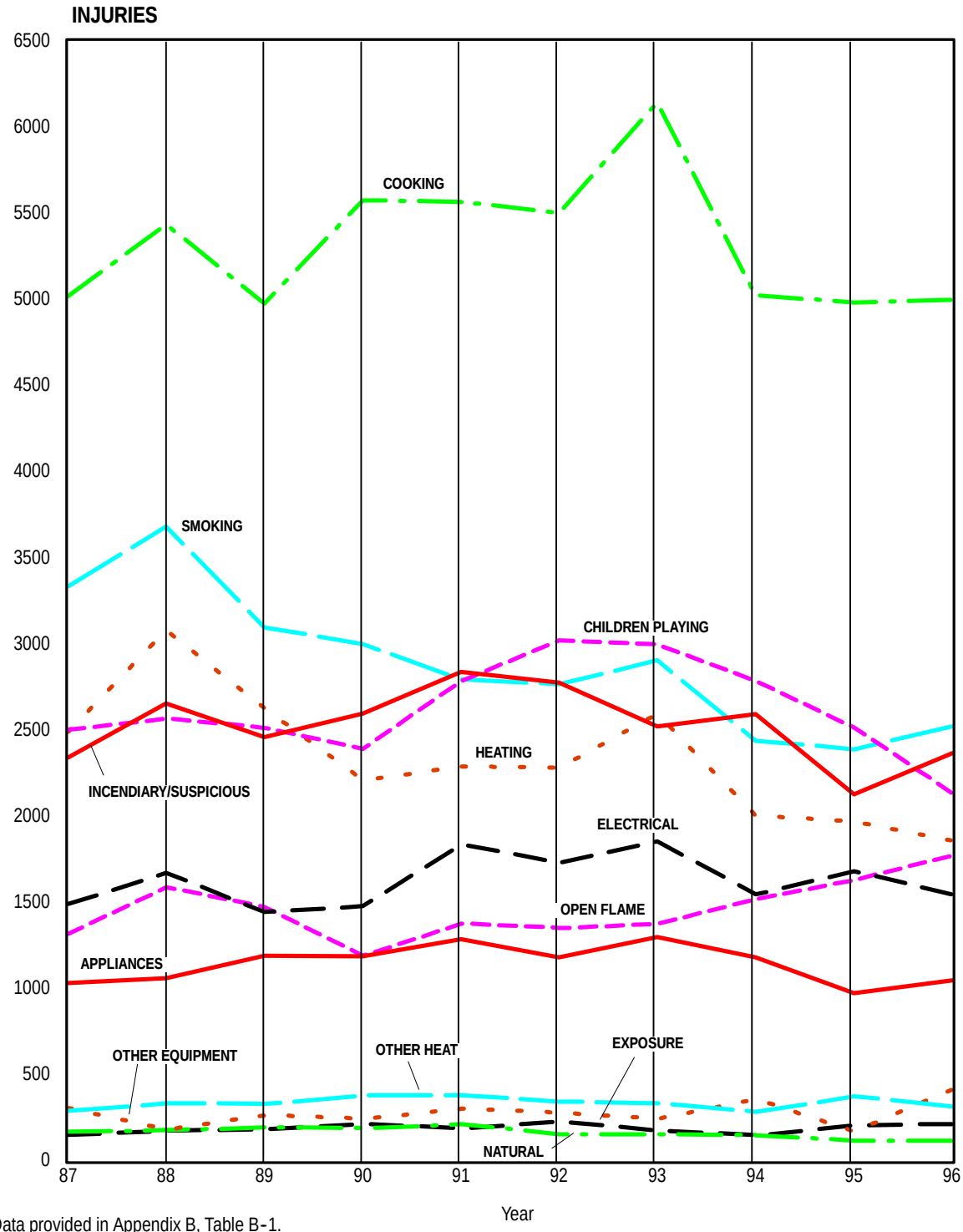
Figure 36. Trends in Causes of Residential Fires and Fire Losses (cont'd)



Note: Data provided in Appendix B, Table B-1.

Sources: NFIRS and NFPA Annual Surveys

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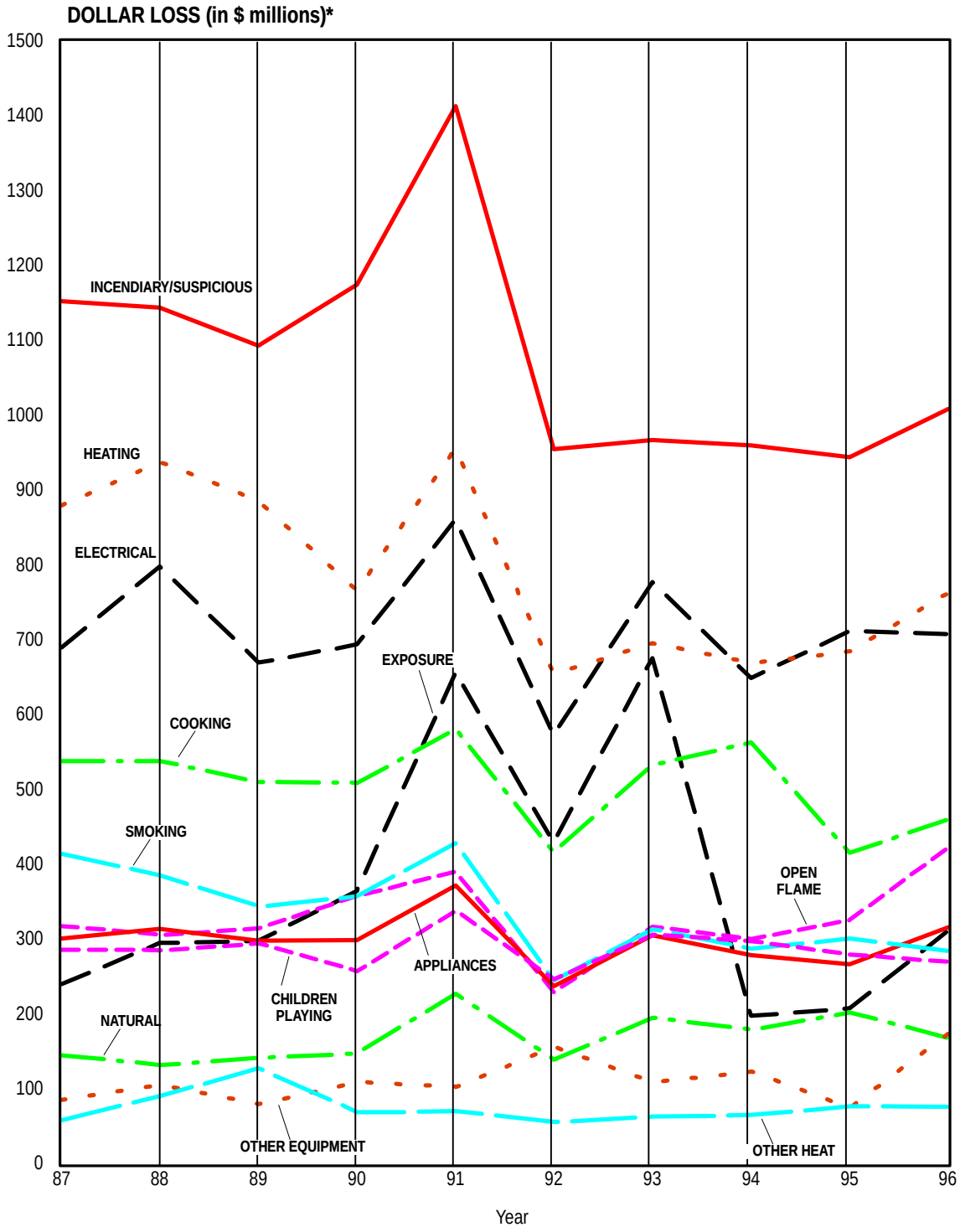
Figure 36. Trends in Causes of Residential Fires and Fire Losses (cont'd)



Note: Data provided in Appendix B, Table B-1.

*Adjusted to 1996 dollars

Sources: NFIRS, NFPA Annual Surveys, and Consumer Price Index

Figure 36. Trends in Causes of Residential Fires and Fire Losses (cont'd)

Smoke Alarm Performance[5]

Smoke alarms are thought to account for a significant part of the decrease in reported fires and fire deaths since the mid 1970s. From previous surveys, we know that at least 88 percent of U.S. households have at least one smoke alarm.[6] Only 40 percent of households that had fires were reported to have alarms (Figure 37); considering only the incidents where smoke alarm performance was reported, this percentage rises to 59 percent, still considerably less than the national average. Still, there has been a 37 percent rise in the presence of smoke alarms since 1990. Households that have reported fires appear much less likely to have smoke alarms than others. Either people with alarms are more safety conscious or the alarms allow early detection and extinguishment so that the fires are not reported. Also, anecdotal information indicates that reported fires are more prevalent in older, less well cared for homes, and these are less likely to be equipped with an alarm.

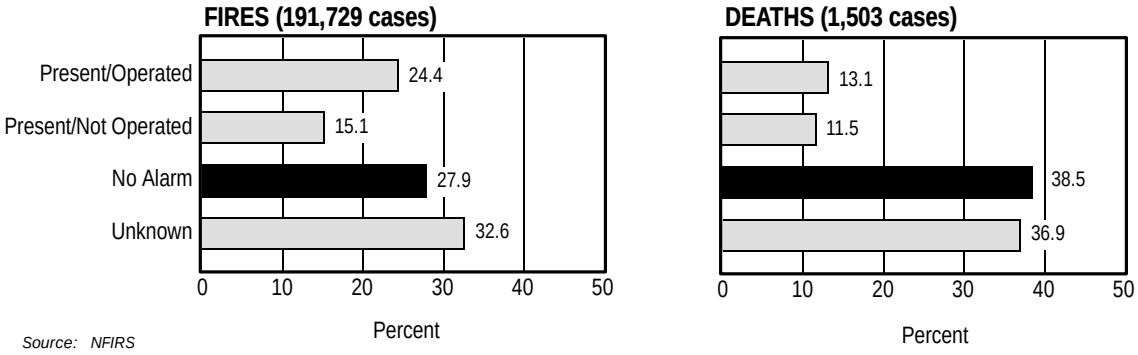


Figure 37. Smoke Alarm Performance in 1996 Residential Fires and Fire Deaths

In only 24 percent of the residential fires did an alarm operate in the fire. That is, there was no alarm, the alarm did not operate, or the presence of alarms was unknown in 76 percent of the reported household fires. These numbers remained virtually unchanged from the Ninth Edition. When only incidents where smoke alarm performance was reported, the percent of operating smoke alarms rises to 36 percent.

When the "unknowns" of Figure 37 are apportioned to the other three categories, alarms were not present in 61 percent of the fatalities in 1996; an additional 18 percent of the deaths in 1996 occurred in homes where smoke alarms were present but failed to operate. In 21 percent of fire deaths, an alarm did operate. This is somewhat disturbing since there is a widespread belief that an operating alarm will save lives. In some of these cases, the alarm may have gone off too late to help the victim, the victim may have been too inebriated or feeble to react, or the fire may have been too close to the victim. Such cases merit further study.

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5 The term "smoke alarm" encompasses a variety of devices intended to warn occupants of the presence of fire. It replaces the former term "smoke detector."

6 *The Smoke Detector Operability Survey Report on Findings*, Consumer Product Safety Commission, Revised October 1994.

The presence or absence of alarms was not reported to NFIRS in one-third of all residential fires. For the 59 percent ("unknowns" apportioned) of cases when alarms were present in fires, their performance based on where they were installed is shown in Table 8.

Table 8. Performance of Alarms in Fires When Present ("unknowns" apportioned)

Alarm Present	Present and Did Operate	Present but Did Not Operate	Total Present
In room of origin	20.7	7.2	27.9
Not in room of origin	15.4	11.0	26.4
In room, but fire too small	N/A	4.2	4.2
Total	36.1	22.4	58.6

Source: NFIRS

Figure 38 shows the 10-year trends of alarm performance in fires and fire deaths. There has been an encouraging drop over 10 years in the percent of fires as well as the percent of fire deaths with no alarm present—fires from 37 percent to 28 percent and fire deaths from 43 percent to 39 percent. Correspondingly, the percentage of fires where an alarm operated has increased from 16 percent to 24 percent. However, the percentage of fires where an alarm was present but did not operate also increased. While public education programs address the need to install smoke alarms, they also need to focus on their proper maintenance to reverse this trend.

Residential Sprinklers

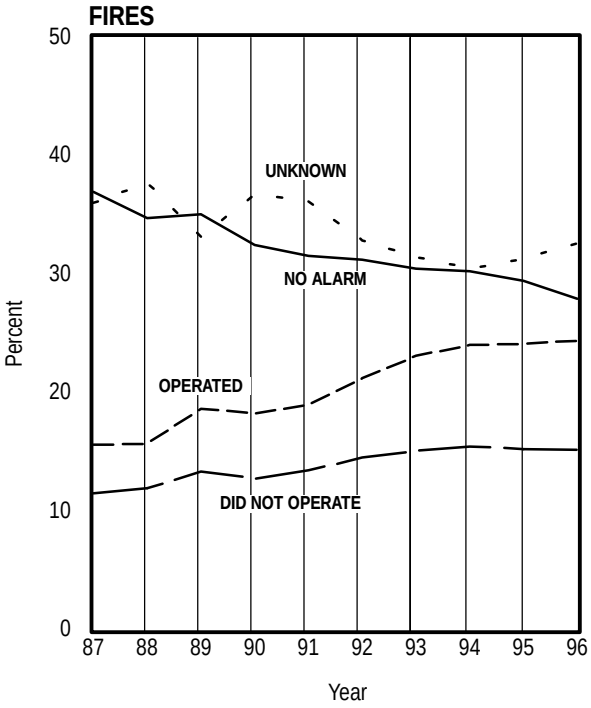
Residential sprinklers are found in only a small fraction (2 percent) of residences other than hotels and newer apartment buildings today. Therefore, it is no surprise that they are reported to be present in only a small percentage of residential fires nationally, though they represent a great potential in the future.

Sprinkler data were reported in 3,775 residential fires out of the 191,729 cases reported to NFIRS in 1996 (Figure 39). They operated in 1,274 cases and did not operate in 2,501 fires, mostly because the fire was too small. In 24 percent of the total cases, sprinkler performance was not reported, up 3 percentage points since 1994.

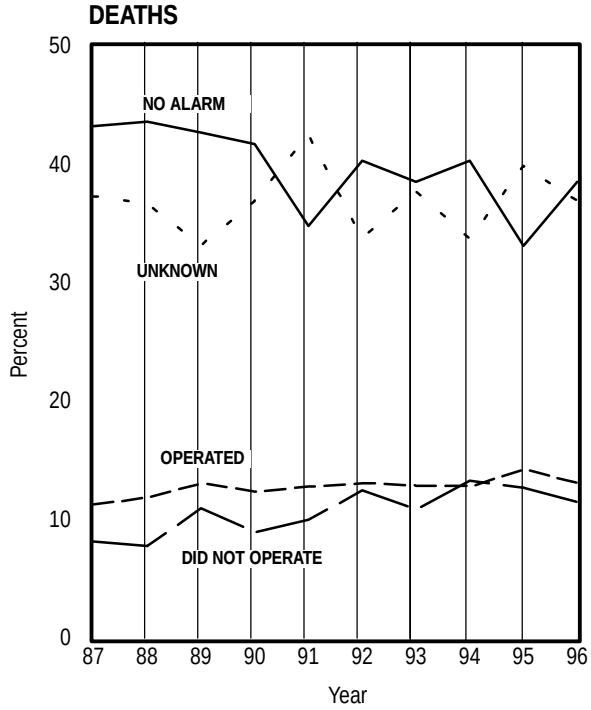
The trend in use of residential sprinklers has been upward (Figure 40). However, the percentages are still minuscule because most homes are not equipped with sprinklers. They were reported as present in 1 percent of the residential fires in 1987 versus 2 percent in 1996; they operated in less than 1 percent of fires in 1996.

When Fires Occur

TIME OF DAY. Fires do not occur uniformly throughout the day, as shown in Figure 41 (two pages). Fire incidents peak from 5:00 p.m. to 7:00 p.m., when cooking fires most often occur. Although fire incidents drop when people sleep, deaths are usually associated with fires that start



	No Alarm	Operated	Did Not Operate	Unknown
1987	36.9%	15.6%	11.5%	36.0%
1988	34.7	15.7	11.9	37.7
1989	35.0	18.6	13.3	33.1
1990	32.4	18.2	12.7	36.7
1991	31.5	19.0	13.4	36.1
1992	31.2	21.2	14.5	32.8
1993	30.4	23.1	15.1	31.4
1994	30.2	24.0	15.4	30.4
1995	29.4	24.1	15.2	31.3
1996	27.9	24.4	15.1	32.6



	No Alarm	Operated	Did Not Operate	Unknown
1987	43.2%	11.3%	8.2%	37.3%
1988	43.6	11.9	7.8	36.7
1989	42.7	13.1	11.0	33.2
1990	41.7	12.4	9.0	36.9
1991	34.8	12.8	10.0	42.5
1992	40.3	13.1	12.5	33.8
1993	38.5	12.9	10.9	37.7
1994	40.3	12.8	13.3	33.7
1995	33.1	14.3	12.7	39.9
1996	38.5	13.1	11.5	36.9

Source: NFIRS

Figure 38. Trends in Smoke Alarm Performance in Residential Fires and Fire Deaths

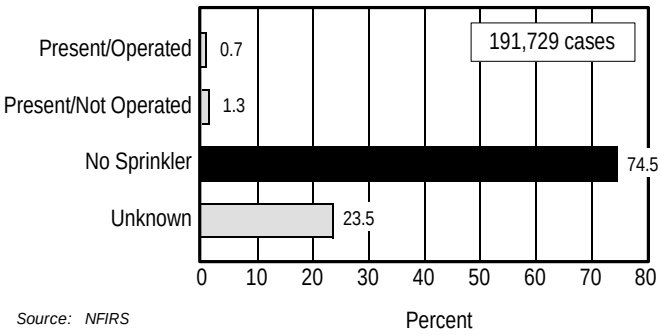
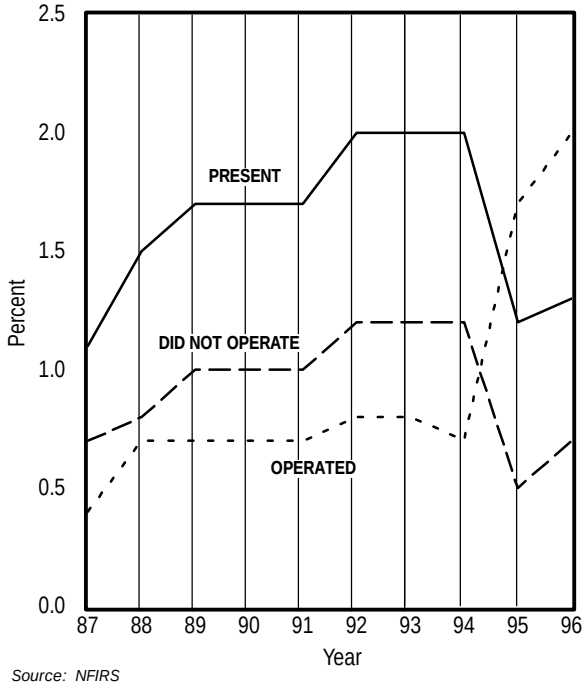


Figure 39. Sprinkler Performance in 1996 Residential Fires



	Present	Operated	Did Not Operate
1987	1.1%	0.4%	0.7%
1988	1.5	0.7	0.8
1989	1.7	0.7	1.0
1990	1.7	0.7	1.0
1991	1.7	0.7	1.0
1992	2.0	0.8	1.2
1993	2.0	0.8	1.2
1994	2.0	0.7	1.2
1995	1.7	0.5	1.2
1996	2.0	0.7	1.3

Figure 40. Trends in Sprinkler Performance in Residential Fires

late at night and early morning. Nearly half of residential fire deaths occur in fires that start from 11:00 p.m. to 6:00 a.m. The peak night hours are from 2:00 to 5:00 a.m. when most people are in deep sleep.

Fire injuries occur more uniformly throughout the day, peak slightly during dinner hours when people cook, and actually drop to their low point in the early morning hours.

The peak in dollar loss in 1996 is between 7:00 and 8:00 p.m. Dollar loss is otherwise relatively constant, again with a drop in the early morning hours.

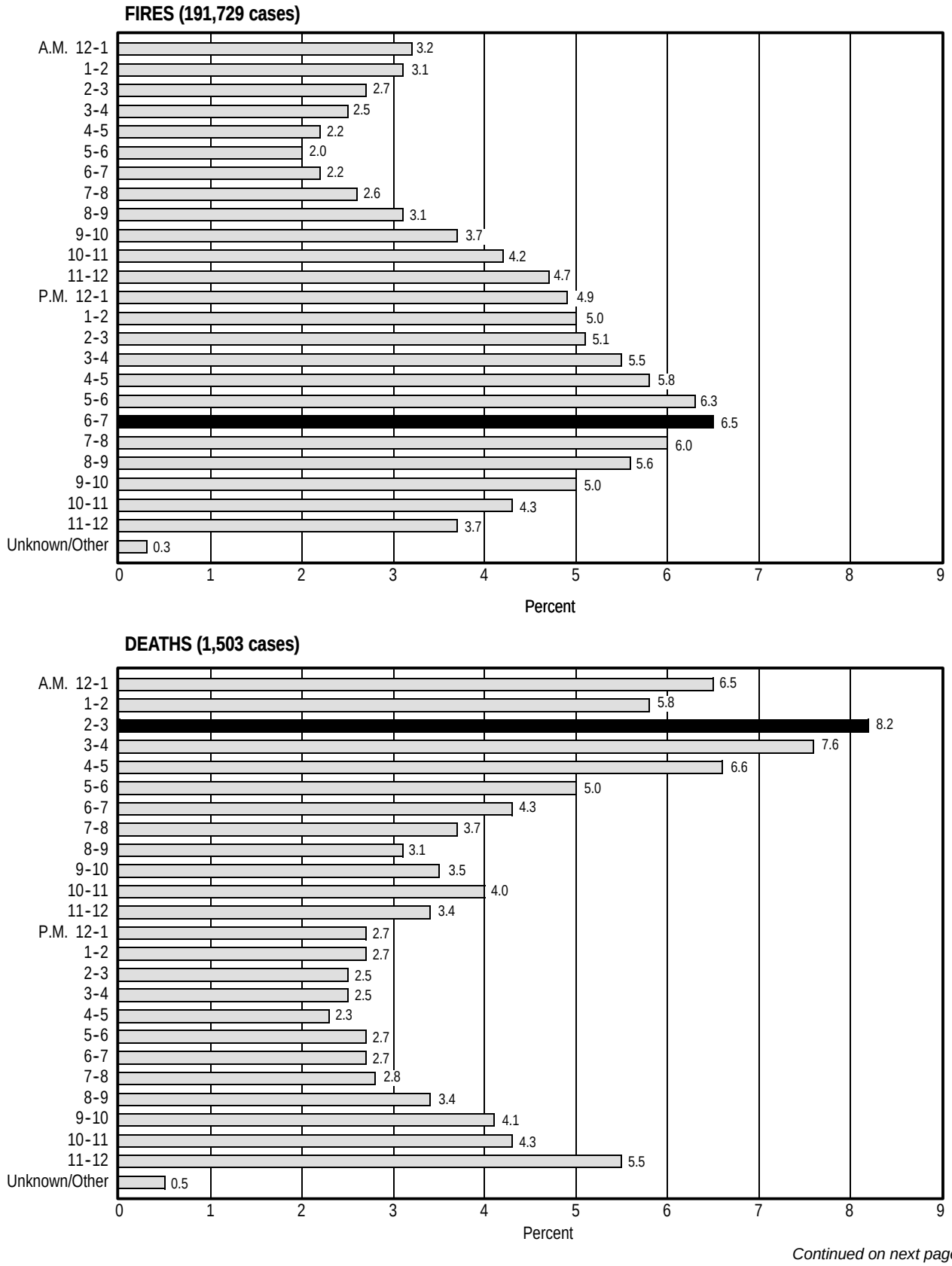


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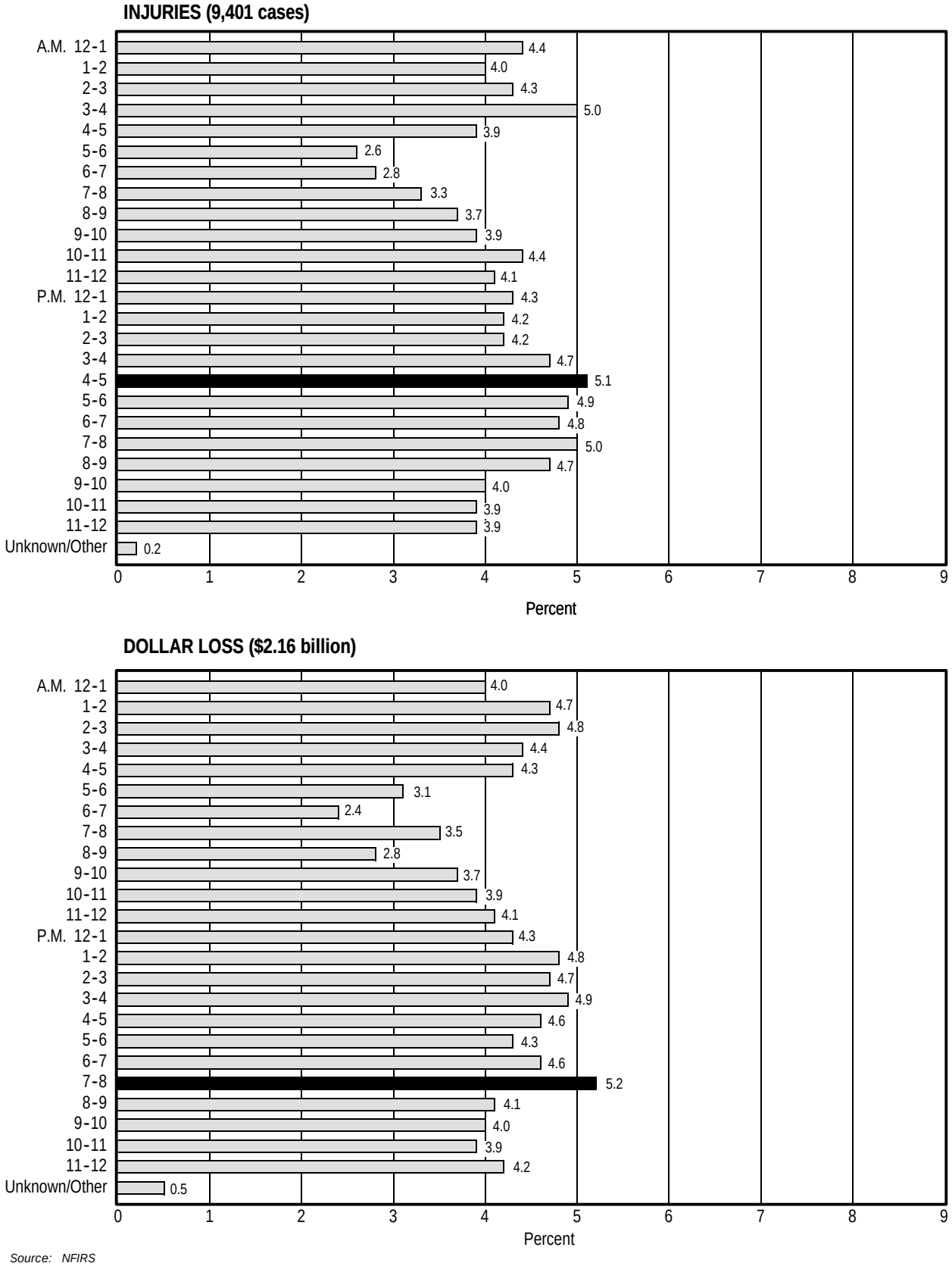
Figure 41. Time of Day of 1996 Residential Fires and Fire Losses



Source: NFIRS

Figure 41. Time of Day of 1996 Residential Fires and Fire Losses (cont'd)

MONTH OF THE YEAR. Residential fires and fire deaths are most frequent during winter months when heating systems play a dominant role. Forty percent of all deaths occur from December through February (Figure 42). This is essentially the same pattern as in 1994.

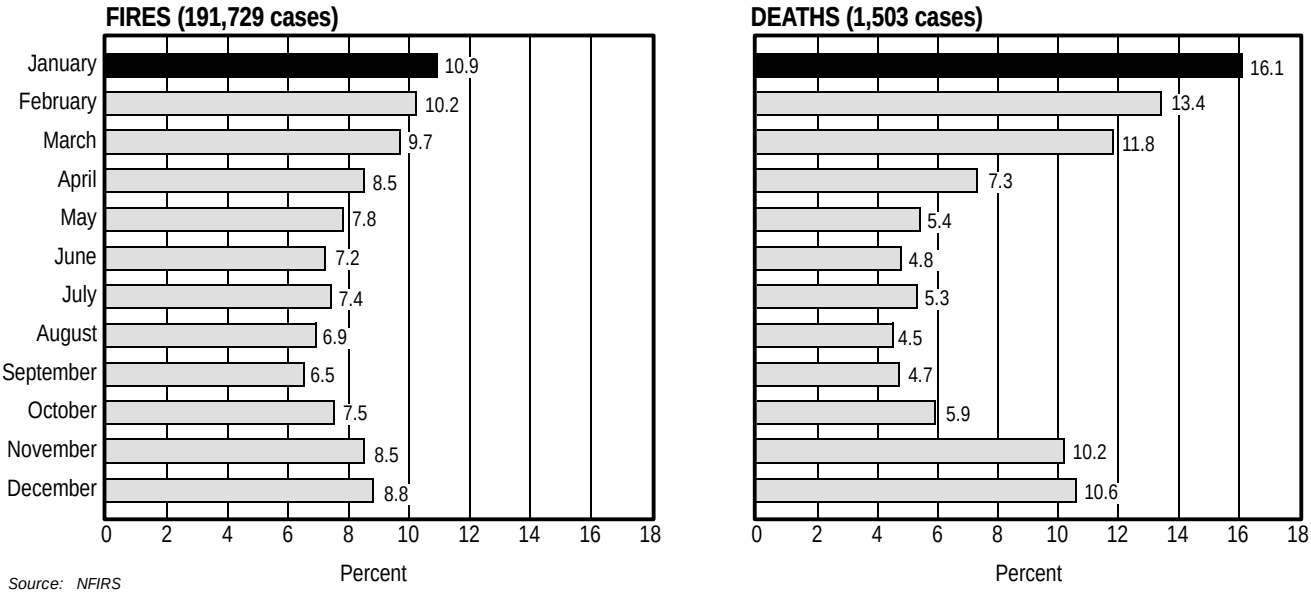


Figure 42. Month of Year of 1996 Residential Fires and Fire Deaths

DAY OF THE WEEK. The incidence of residential fires is uniformly spread over the entire week, but one-third of all deaths occur on the weekend when a large portion of the populace is at home (Figure 43). The leading causes of residential fires—cooking and heating—are generally unaffected by the day of the week.

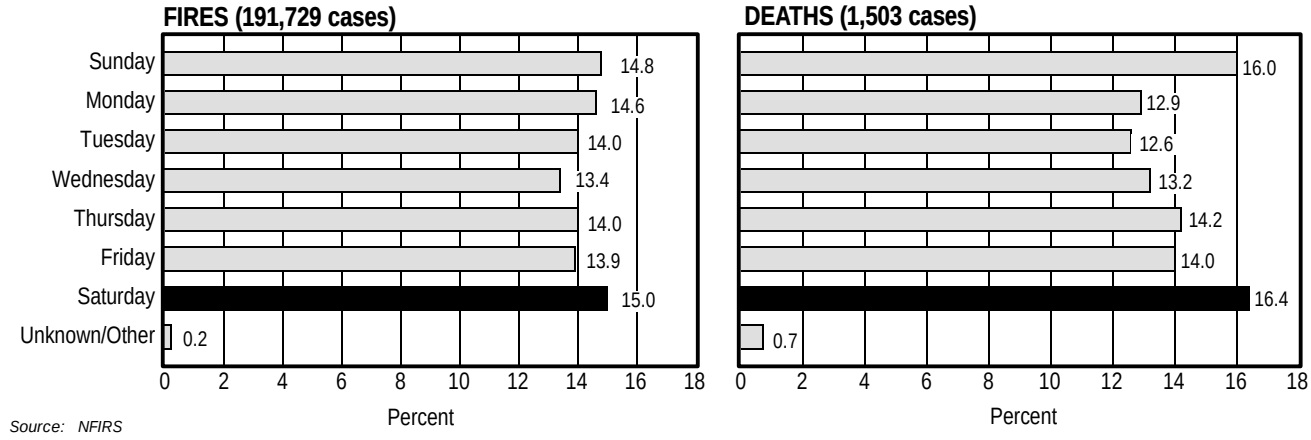


Figure 43. Day of Week of 1996 Residential Fires and Fire Deaths

ONE- AND TWO-FAMILY HOMES

One- and two-family homes are where two-thirds of the people in the United States reside. The fire profile, therefore, is similar to that for residences as a whole. Manufactured housing (mobile homes) is included in the profiles for one- and two-family homes unless otherwise noted. A separate examination of manufactured housing fires, as well as garage fires, is included at the end of this section (page 85).

Overview of Trends

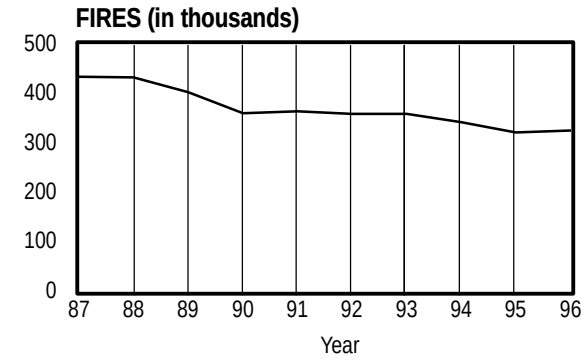
Figure 44 shows the numbers of fires, deaths, injuries, and adjusted dollar loss for single-family dwellings from 1987 to 1996. The number of fires has declined, with the 10-year trend at 27 percent. Deaths have also declined 18 percent over 10 years but, since the 10-year low in 1994, have increased over the next 2 years. Dollar losses and injuries also declined, by 7 and 15 percent, respectively.

Because the number of fires has dropped faster than injuries or dollar loss, the statistics per fire are getting worse. One reason for the decreased number of fires is that the increasing number of smoke alarms detects fires in the early stages. Fires that are detected early are often extinguished before they are reported to the fire department, and so the number of reported fires decreases. When alarms are not present, the fire burns longer before detection and does more damage. This situation results in fires attended by fire departments being, on average, more serious.

When Fires Occur

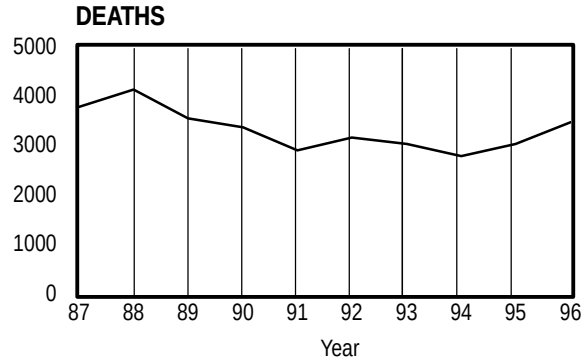
TIME OF DAY**.** Figure 45 shows that fires and injuries in one- and two-family dwellings are highest between 4:00 and 8:00 p.m., when cooking fires sharply increase. Fire deaths, on the other hand, peak late from 11:00 p.m. to 5:00 a.m. This result is often caused by smoking fires that smolder for several hours and then rapidly increase in smoke production and open flames. Also, the early morning hours are when most people are in deep sleep so they do not awake in time to escape. Dollar loss is fairly uniform throughout the day with peaks at 1:00–3:00 a.m. and 1:00–5:00 p.m. and nadirs at 6:00–9:00 a.m.

MONTH OF THE YEAR**.** Fires and fire deaths in one- and two-family homes peak in mid winter (December–March), when heating fires add to the other types of year-round fires (Figure 46).



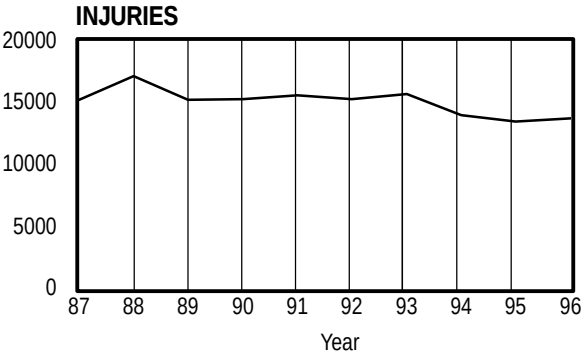
1987	433.0	1992	358.0
1988	432.0	1993	358.0
1989	402.5	1994	341.0
1990	359.0	1995	320.0
1991	363.0	1996	324.0

10-Year Trend = -26.7%



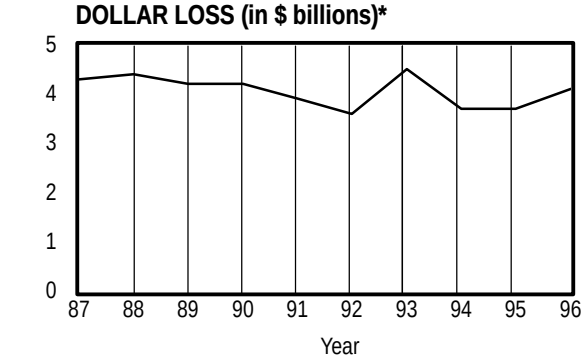
1987	3,780	1992	3,160
1988	4,125	1993	3,035
1989	3,545	1994	2,785
1990	3,370	1995	3,035
1991	2,905	1996	3,470

10-Year Trend = -17.6%



1987	15,200	1992	15,275
1988	17,125	1993	15,700
1989	15,225	1994	14,000
1990	15,250	1995	13,450
1991	15,600	1996	13,700

10-Year Trend = -14.9%



1987	$4.3	1992	$3.6
1988	4.4	1993	4.5
1989	4.2	1994	3.7
1990	4.2	1995	3.7
1991	3.9	1996	4.1

10-Year Trend = -6.8%

*Adjusted to 1996 dollars

Sources: NFPA Annual Surveys and Consumer Price Index

Figure 44. Trends in One- and Two-Family Dwelling Fires and Fire Losses

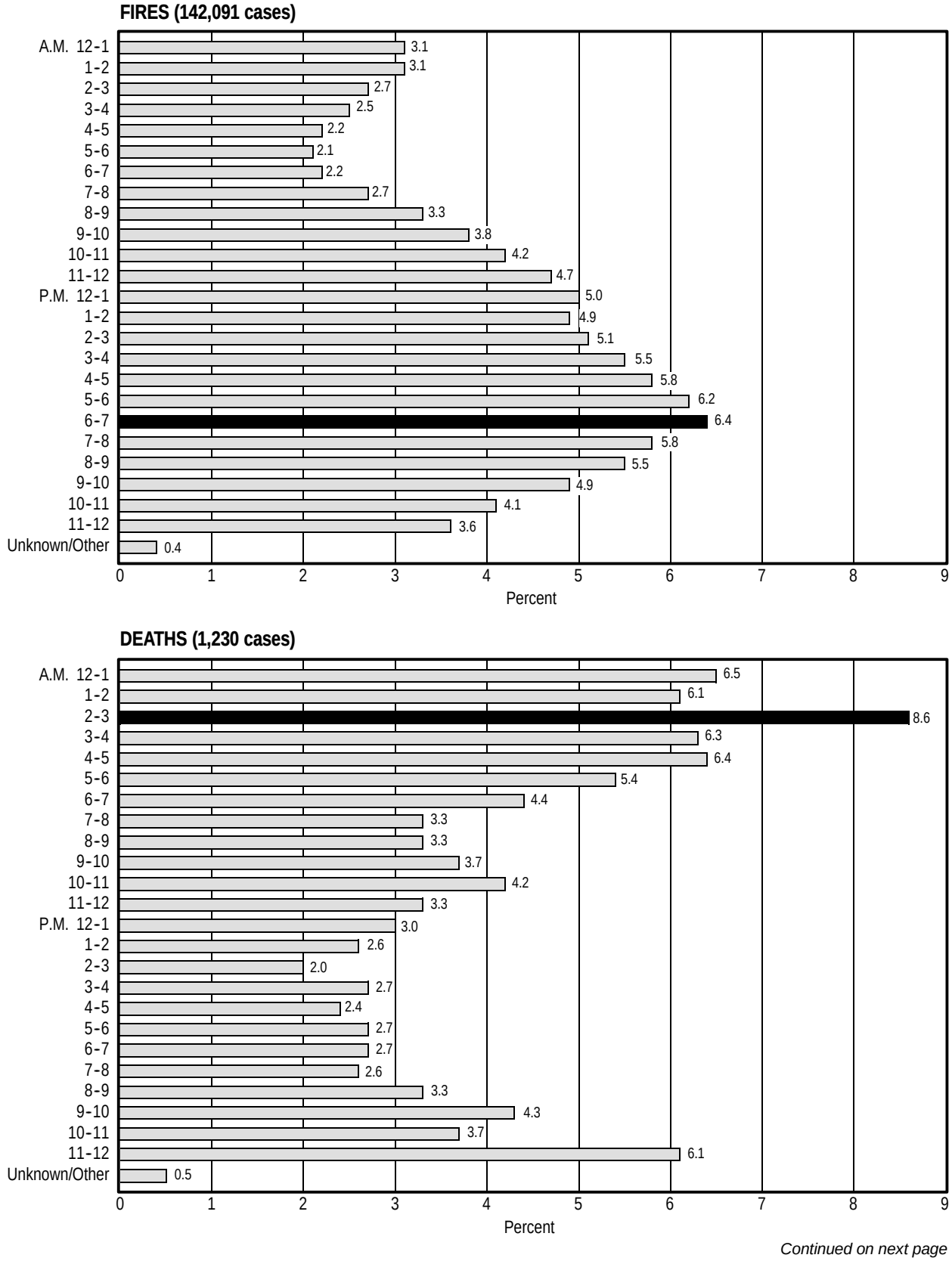


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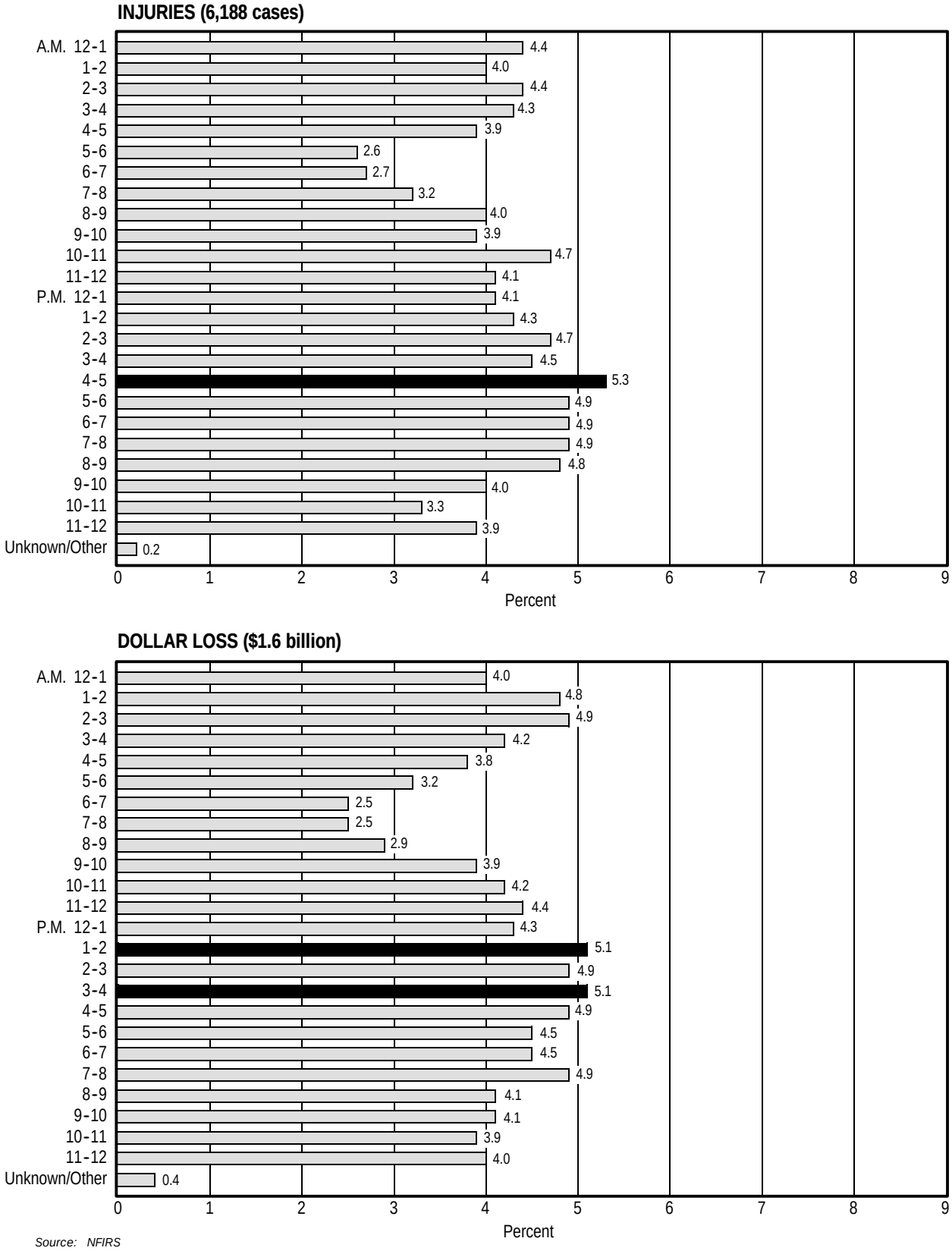
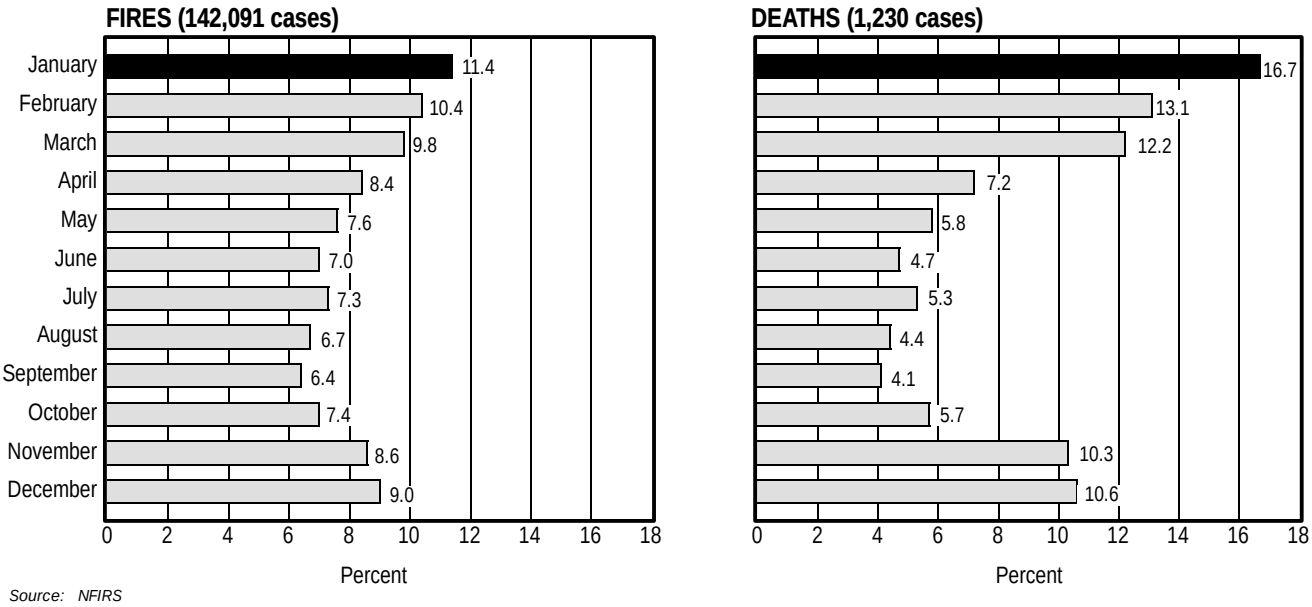
Figure 45. Time of Day of 1996 One- and Two-Family Dwelling Fires and Fire Losses



Source: NFIRS

Figure 45. Time of Day of 1996 One- and Two-Family Dwelling Fires and Fire Losses (cont'd)



Source: NFIRS

Figure 46. Month of Year of 1996 One- and Two-Family Dwelling Fires and Fire Deaths

Causes

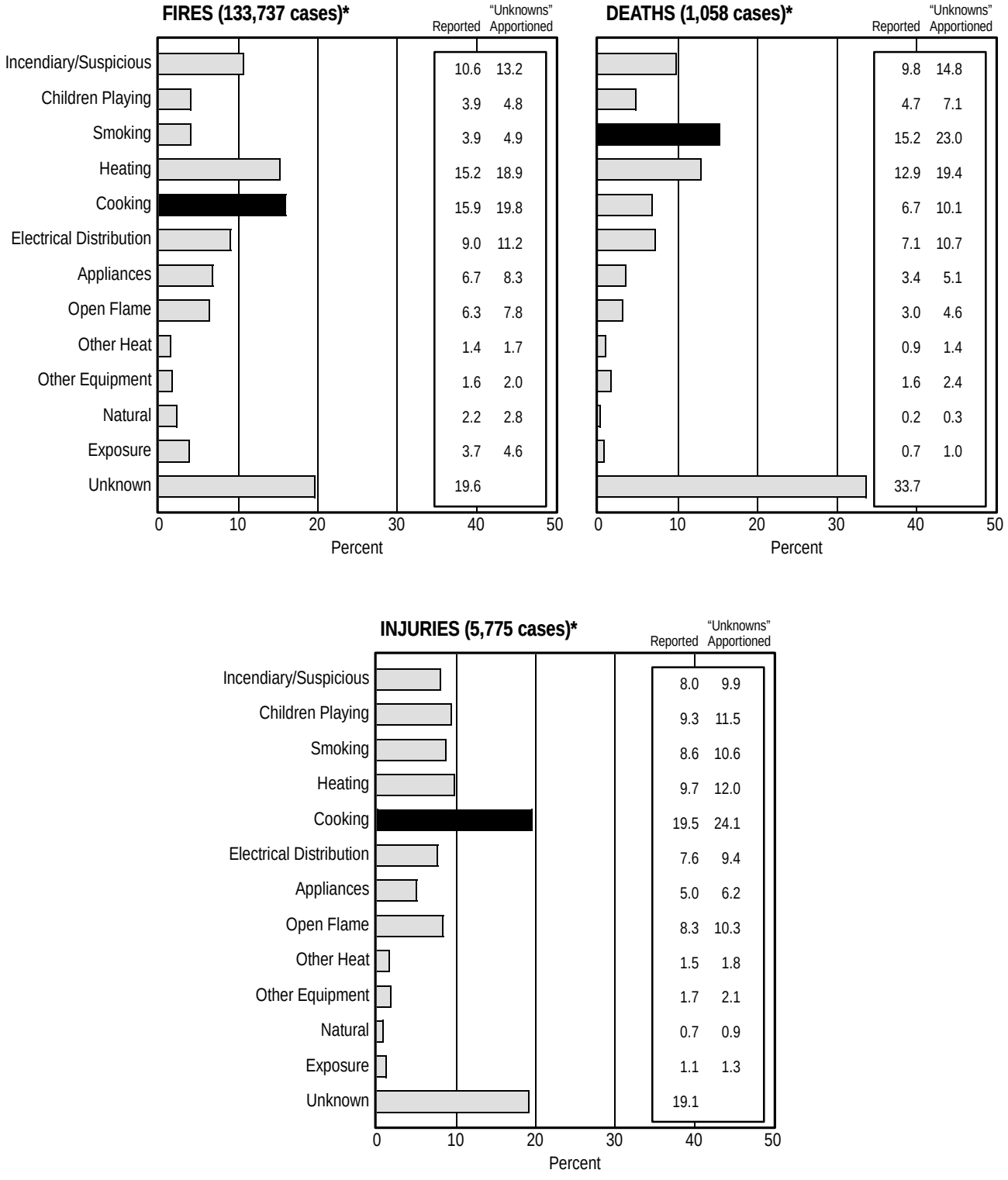
Cooking, up from second place in 1994, is the leading cause of fires in one- and two-family dwellings for 1996, at 20 percent (adjusted) (Figure 47). Heating (first in 1994) at 19 percent and arson at 13 percent are the next two leading causes. The difference between heating and cooking fires has narrowed to less than 1 percentage point in 1996, most likely because the use of wood stoves and kerosene heaters has diminished over the past 10 years.

The leading cause of death in 1996 is smoking, as in all NFIRS years, at 23 percent. Most of the smoking deaths come from cigarettes dropped on upholstered furniture or bedding, often by someone who has been drinking. Heating is the second leading cause of death at 19 percent and arson is third at 15 percent. These three causes account for more than half of the total deaths.

For injuries, cooking is first at 24 percent. The most common cooking fires result from unattended cooking, when oil or grease catches fire, and from the ignition of loose clothing. Heating and children playing are second and third, respectively, at about 12 percent. These profiles are similar to the 1990 and 1994 causes.

Trends in Causes

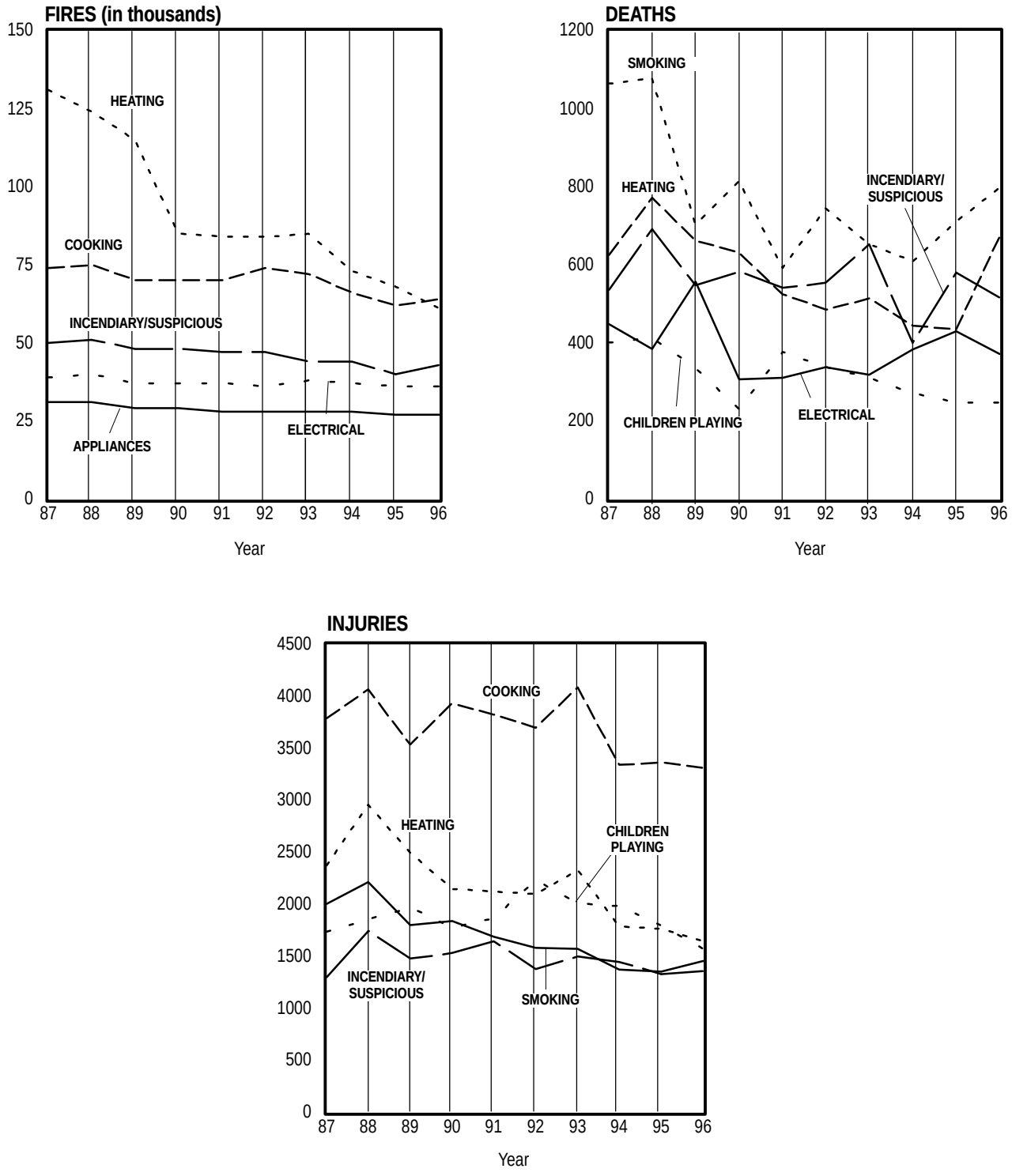
Heating fires continued to decrease, and for the first time in 10 years, another category, cooking, was the number one cause of residential fires, as shown in Figure 48.



* These totals are slightly smaller than those shown elsewhere due to the methodology used to determine the causes of one- and two-family residential fires.

Source: NFIRS

Figure 47. Causes of 1996 One- and Two-Family Dwelling Fires and Fire Casualties



Note : Data for all 12 causes are provided in Appendix B, Table B-2.

Sources: NFIRS and NFPA Annual Surveys

Figure 48. Trends in Leading Causes of One- and Two-Family Dwelling Fires and Fire Casualties

Smoking deaths dropped 25 percent between 1987 and 1996, although it continues as the leading cause of fire deaths.[7] Heating deaths jumped to the second leading cause of fire-related deaths after a sharp increase in 1996. Although dipping to 400 deaths in 1994, arson deaths rose to 580 in 1995 (second place), but fell back to 515 deaths in 1996 for the third leading cause of deaths. Electrical distribution fell slightly from the 1995 values to be the fourth leading cause of deaths.

Cooking has been the leading cause of fire injuries in all 10 years by a wide margin. For the period from 1987 to 1993, the amount of cooking injuries remained roughly the same; however cooking dropped 19 percent from 1993 to 1996. Heating, the second leading cause of injuries, has dropped 31 percent for the 10-year period. Children playing and smoking rank as the third and fourth leading causes of injuries, respectively.

Area of Home

To help people visualize the fire problem more personally, it is useful to describe it in terms of where different types of fires occur in the home and what types of fires occur in each room. Figure 49 shows the rooms or areas of origin for fires, deaths, and injuries in one- and two-family homes in 1996. There is little change from 1990 and 1994 in the overall rankings. Tables 9, 10, and 11 detail the leading causes of fires, deaths, and injuries, respectively, for each of the leading locations of fire origin shown in Figure 49.

Nearly twice as many fires occur in the kitchen than in any other area, most obviously those associated with cooking. The second most common location is the bedroom or sleeping area. Children playing, intentionally set fires, and electrical distribution are the three most common fire causes here. An encouraging statistic is that smoking in the bedroom dropped from third to fourth, now accounting for 11 percent of bedroom fires. Lounge areas (living rooms and family rooms) are third, with heating, suspicious fires, and electrical distribution as the primary causes. Chimney fires (fourth place) often result from creosote buildup that ignites when the chimney has not been cleaned often enough or well enough.

Garage/storage areas are not shown as one of the leading areas, but they are actually more significant than implied.[8] If these storage/garage fires were accurately counted, the total number of fires in dwellings would increase by about 8 percent. There were 24,700 such garage fires in 1996. This portion of the residential fire problem is sometimes overlooked. A fuller portrait of garage fires is presented on page 84.

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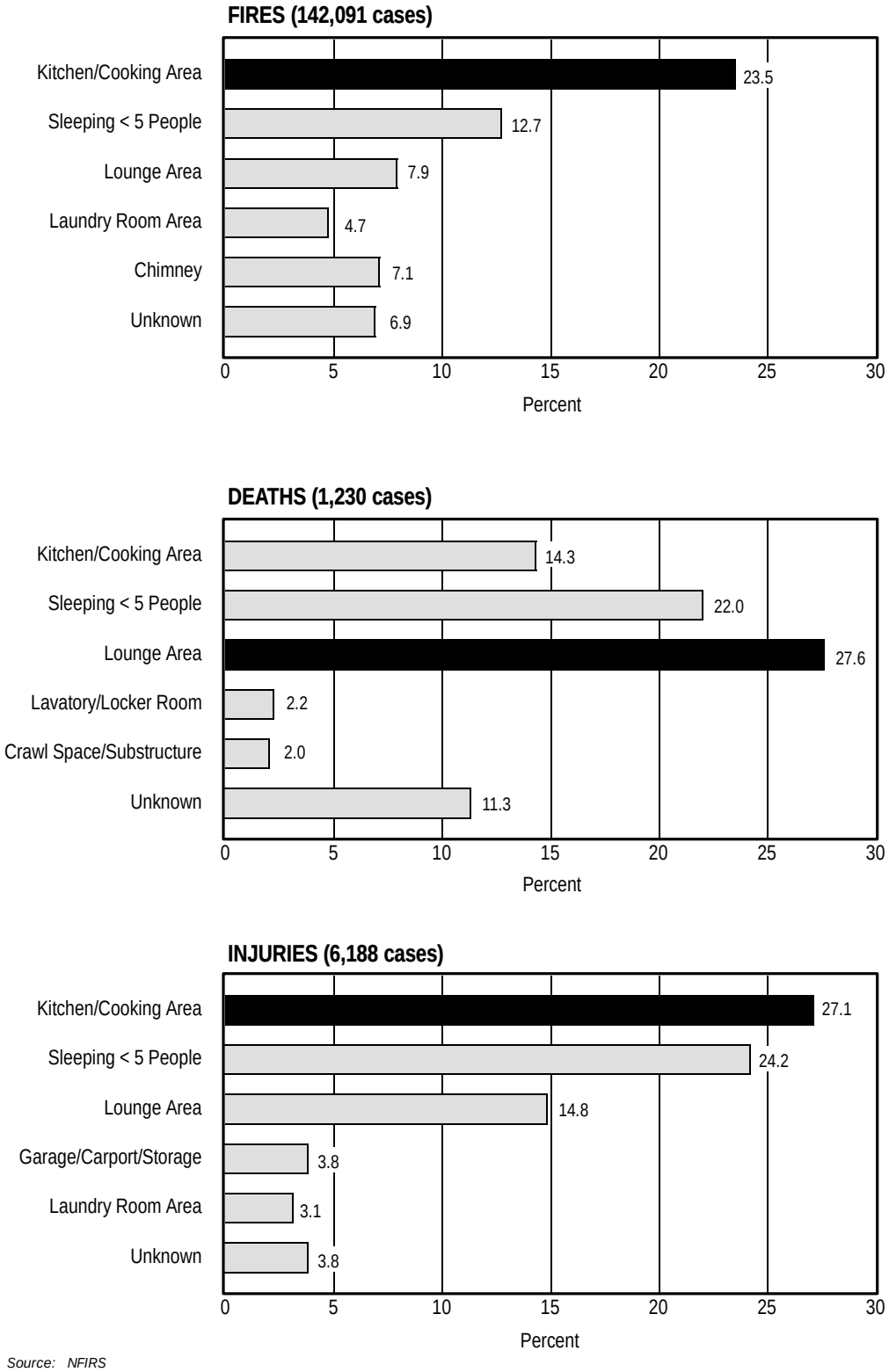
7 In 1993, arson and smoking tied at 653 for the leading cause of dwelling fire deaths.

8 In the version of the 1976 NFPA 901 reporting standard that is used in the National Fire Incident Reporting System, all residential garages were to be reported under storage properties. In later versions (e.g., NFPA 901, *Uniform Coding for Fire Protection*, 1981 and 1986), only detached garages are included in this category. Since not all reporting firefighters know that the old definition holds for NFIRS, and some never knew, there is some inconsistency in reporting these fires. The standard is under discussion for change in the future.



Source: NFIRS

Figure 49. Leading Locations of Fire Origin of 1996 One- and Two-Family Dwelling Fires and Fire Casualties

Table 9. Leading Locations of Fire Origin of 1996 Fires by Cause in One- and Two-Family Dwellings
[reported/"unknowns" apportioned]

Kitchen	Sleeping Room <5	Lounge	Chimney	Laundry
Cooking 21,038 (63.1%/74.4%)	Children Playing 2,783 (15.5%/19.1%)	Heating 2,403 (21.4%/26.4%	Heating 7,487 (74.7%/85.6%)	Appliances 3,965 (60.0%/67.8%)
Incendiary/Suspicious 1,378 (4.1%/4.9%)	Incendiary/Suspicious 2,774 (15.4%/19.1%)	Incendiary/Suspicious 1,818 (16.2%/20.0%)	Open Flame 615 (6.1%/7.0%)	Heating 590 (8.9%/10.1%)
Appliances 1,309 (3.9%/4.6%)	Electrical Distribution 2,594 (14.4%/17.8%)	Electrical Distribution 1,444 (12.9%/15.9%)	Other Heat 246 (2.5%/2.8%)	Electrical Distribution 487 (7.4%/8.3%)
Total Fires: 33,348 **Unknowns: 5,072**	**Total Fires: 17,994** **Unknowns: 3,442**	**Total Fires: 11,222** **Unknowns: 2,130**	**Total Fires: 10,021** **Unknowns: 1,275**	**Total Fires: 6,661** **Unknowns: 767**

Note: The five most common rooms or areas of origin reported are shown. Data here are NFIRS raw counts, *not* national estimates. Percentages shown are column percentages (e.g., percentages of lounge fires, not percentages of heating fires).

Source: NFIRS

Table 10. Leading Locations of Fire Origin of 1996 Deaths by Cause in One- and Two-Family Dwellings
[reported/"unknowns" apportioned]

Lounge	Sleeping Room <5	Kitchen	Lavatory/ Locker Room	Crawl Space/ Substructure
Smoking 78 (23.0%/36.3%)	Smoking 68 (25.1%/34.5%)	Cooking 76 (43.2%/55.9%)	Heating 10 (37.0%/43.5%)	Heating 7 (28.0%/46.7%)
Heating 43 (12.7%/20.0%)	Heating 36 (13.3%/18.3%)	Heating 19 (10.8%/14.0%)	Electrical Distribution 4 (14.8%/17.4%)	Smoking 4 (16.0%/26.7%)
Incendiary/Suspicious 28 (8.3%/13.0%)	Electrical Distribution 25 (9.2%/12.7%)	Appliances 11 (6.3%/8.1%)	Appliances 3 (15.8%)	Children Playing 2 (8.0%/13.3%)
Total Deaths: 339 **Unknowns: 124**	**Total Deaths: 271** **Unknowns: 74**	**Total Deaths: 176** **Unknowns: 40**	**Total Deaths: 27** **Unknowns: 4**	**Total Deaths: 25** **Unknowns: 10**

Note: The five most common rooms or areas of origin reported are shown. Data here are NFIRS raw counts, *not* national estimates. Percentages shown are column percentages (e.g., percentages of kitchen fires, not percentages of cooking fires).

Source: NFIRS

Table 11. Leading Locations of Fire Origin of 1996 Injuries by Cause in One- and Two-Family Dwellings
[reported/"unknowns" apportioned]

Kitchen	Sleeping Room <5	Lounge	Garage	Laundry
Cooking 1,135 (67.6%/78.2%)	Children Playing 337 (22.5%/27.2%)	Smoking 170 (18.5%/24.1%)	Heating 37 (15.7%/20.8%)	Appliances 95 (50.3%/58.6%)
Appliances 55 (3.3%/3.8%)	Smoking 224 (15.0%/18.0%)	Heating 122 (13.3%/17.3%)	Incendiary/Suspicious 28 (11.9%/15.7%)	Heating 29 (15.3%/17.9%)
Incendiary/Suspicious 49 (2.9%/3.4%)	Open Flame 213 (14.2%/17.2%)	Children Playing 99 (10.8%/14.0%)	Other Equipment 24 (10.2%/13.5%)	Incendiary/Suspicious 12 (6.3%/7.4%)
Total Injuries: 1,680 **Unknowns: 228**	**Total Injuries: 1,496** **Unknowns: 255**	**Total Injuries: 918** **Unknowns: 213**	**Total Injuries: 235** **Unknowns: 57**	**Total Injuries: 189** **Unknowns: 27**

Note: The five most common rooms or areas of origin reported are shown. Data here are NFIRS raw counts, *not* national estimates. Percentages shown are column percentages (e.g., percentages of lounge fires, not percentages of smoking fires).

Source: NFIRS

In one- and two-family dwellings, more than half of all deaths occur in lounge areas and bedrooms, possibly because people fall asleep smoking in bed or on upholstered furniture. For injuries, the kitchen is most common area because of the large number of burns associated with cooking. Sleeping areas rank a close second.

Slicing the problem a slightly different way, Tables 12, 13, and 14 show the leading causes of fires, deaths, and injuries (from Figure 47) by where these fires start. Cooking fires in the home overwhelmingly start in the kitchen (95 percent). For heating fires, the chimney accounts for 35 percent of the fires and heating equipment areas for another 16 percent. Arson fires in the home had the highest frequencies of occurrence in bedrooms and lounge areas. Electrical fires were most frequently reported in bedrooms, but large numbers were also in kitchens and lounge areas.

Smoking deaths occur most often in lounge areas and bedrooms (81 percent), often where the victims fall asleep on upholstered furniture or where the cigarette ignites the bedding material. Heating fire deaths are also from fires started in lounge areas and bedrooms. Portable and fixed space heaters play a big role here. Most arson and electrical distribution fire deaths are again most often in lounge areas and bedrooms. Cooking fire deaths occur almost exclusively in the kitchen.

Cooking fire injuries are obviously almost all from fires in the kitchen. Heating fire injuries occur almost equally in heating equipment areas and lounge areas (which include most fireplaces). As with deaths (and not coincidentally with fires), over half of children playing fire injuries occurred in bedrooms. Parent and care providers need to be particularly vigilant in the supervision of young children. Smoking fire injuries occur predominately in bedrooms and lounge areas (76 percent). Over half of open flame fire injuries occur in sleeping or lounge areas.

Table 12. Leading Causes of 1996 Fires by Location of Fire Origin in One- and Two-Family Dwellings
[reported/"unknowns" apportioned]

Cooking	Heating	Incendiary/ Suspicious	Electrical Distribution	Appliances
Kitchen 21,038 (95.1%/95.3%)	Chimney 7,487 (35.1%/35.5%)	Sleeping Room <5 2,774 (18.3%/20.4%)	Sleeping Room <5 2,594 (19.8%/20.1%)	Laundry Room 3,965 (41.9%/42.2%)
Exterior Balcony/ Open Porch 208 (0.9%/0.9%)	Heating Equipment Area 3,423 (16.1%/16.2%)	Lounge 1,818 (12.0%/13.3%)	Lounge 1,444 (11.0%/11.2%)	Kitchen 1,309 (13.8%/13.9%)
Garage 101 (0.5%/0.5%)	Lounge 2,043 (11.3%/11.4%)	Kitchen 1,378 (9.1%/10.1%)	Kitchen 1,191 (9.1%/9.2%)	Sleeping Room <5 1,018 (10.7%/10.8%)
Total Fires: 22,129 **Unknowns: 54**	**Total Fires: 21,313** **Unknowns: 222**	**Total Fires: 15,144** **Unknowns: 1,524**	**Total Fires: 13,118** **Unknowns: 205**	**Total Fires: 9,472** **Unknowns: 73**

Note: The five most common causes reported are shown. Data here are NFIRS raw counts, *not* national estimates. Percentages shown are column percentages (e.g., percentages of cooking fires, not percentages of kitchen fires).

Source: NFIRS

Table 13. Leading Causes of 1996 Deaths by Location of Fire Origin in One- and Two-Family Dwellings
[reported/"unknowns" apportioned]

Smoking	Heating	Incendiary/ Suspicious	Electrical Distribution	Cooking
Lounge 78 (42.6%/43.1%)	Lounge 43 (27.7%/28.1%)	Lounge 28 (24.1%/28.6%)	Lounge 27 (29.0%/30.0%)	Kitchen 76 (96.2%/96.2%)
Sleeping Room <5 68 (37.2%/37.6%)	Sleeping Room <5 36 (23.2%/23.5%)	Sleeping Room <5 19 (16.4%/19.4%)	Sleeping Room <5 25 (26.9%/27.8%)	Sleeping Room <5 2 (2.5%/2.5%)
Kitchen 7 (3.8%/3.9%)	Kitchen 19 (12.3%/12.4%)	Kitchen 7 (6.0%/7.1%)	Kitchen 7 (7.5%/7.8%)	Lavatory/ Locker Room 1 (1.3%/1.3%)
Total Deaths: 183 **Unknowns: 2**	**Total Deaths: 155** **Unknowns: 2**	**Total Deaths: 116** **Unknowns: 18**	**Total Deaths: 93** **Unknowns: 3**	**Total Deaths: 79** **Unknowns: 0**

Note: The five most common causes reported are shown. Data here are NFIRS raw counts, *not* national estimates. Percentages shown are column percentages (e.g., percentages of cooking fires, not percentages of kitchen fires).

Source: NFIRS

Table 14. Leading Causes of 1996 Injuries by Location of Fire Origin in One- and Two-Family Dwellings
[reported/"unknowns" apportioned]

Cooking	Heating	Children Playing	Smoking	Open Flame
Kitchen 1,135 (95.5%/95.5%)	Heating Equipment Area 125 (19.9%/20.3%)	Sleeping Room <5 337 (59.0%/59.6%)	Sleeping Room <5 224 (43.0%/43.3%)	Sleeping Room <5 213 (42.8%/43.3%)
Exterior Balcony 13 (1.1%/1.1%)	Lounge 122 (19.5%/19.8%)	Lounge 99 (17.3%/17.5%)	Lounge 170 (32.6%/32.9%)	Lounge 71 (14.3%/14.4%)
Court/Terrace/Patio 6 (0.5%/0.5%)	Sleeping Room <5 78 (12.4%/12.7%)	Closet 35 (6.1%/6.2%)	Kitchen 22 (4.2%/4.3%)	Kitchen 33 (6.6%/6.7%)
Total Injuries: 1,189 **Unknowns: 1**	**Total Injuries: 627** **Unknowns: 11**	**Total Injuries: 571** **Unknowns: 6**	**Total Injuries: 521** **Unknowns: 4**	**Total Injuries: 498** **Unknowns: 6**

Note: The five most common causes reported are shown. Data here are NFIRS raw counts, *not* national estimates. Percentages shown are column percentages (e.g., percentages of cooking fires, not percentages of kitchen fires).

Source: NFIRS

Smoke Alarm Performance

In 1996, alarms were present in 52 ("unknowns" apportioned) percent of homes that had fires and 32 percent of one- and two-family homes that had fire deaths (Figure 50). There are proportionally fewer alarms in homes than in apartments that have fires, primarily because alarms are often provided by landlords and more often required by law than in single-family houses. (See page 90 for more on apartments.)

Where present, the alarms operated about half the time for both fires and fire deaths, often because the fire was too small to activate the alarm. When present, alarms operated less often in homes than apartments, perhaps because fires are more spread out relative to the alarms and perhaps because the homeowner is solely responsible for their maintenance (e.g., battery replacement).

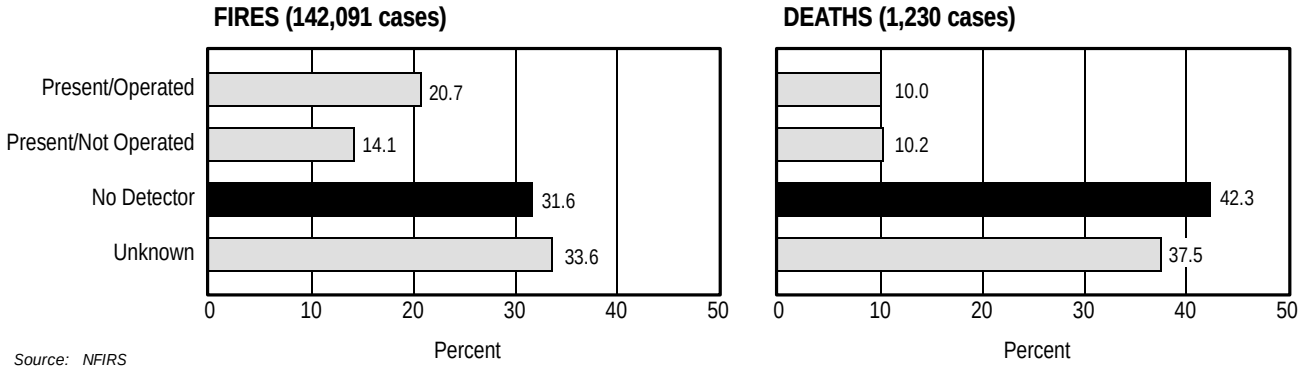


Figure 50. Smoke Alarm Performance in 1996 One- and Two-Family Dwelling Fires and Fire Deaths

There was no operating alarm in 48 percent ("unknowns" apportioned) of total fires and 68 percent of homes that had fire deaths. This is a minute improvement over 1994.

Sprinkler Performance

Sprinklers were present in less than 1 percent of fires or fire deaths in one- and two-family dwellings in 1996 (Figure 51). This is an insignificant amount. There were few deaths when sprinklers were present and operated, however.

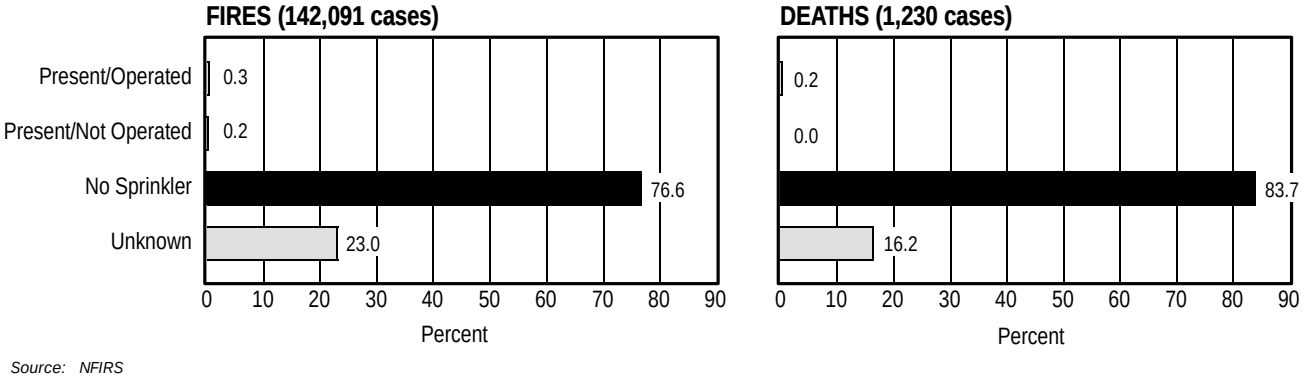


Figure 51. Sprinkler Performance in 1996 One- and Two-Family Dwelling Fires and Fire Deaths

Residential Garages

Not all residential garage fires are reported as they are supposed to be. A substantial number are reported as part of residential fires. The definition in the widely used early manual (1976) on NFPA 901 required that both attached and detached residential garages be included in the storage category. More recent versions of the 901 standard that are not in use by NFIRS require only detached garage fires to be included in the storage category. Undoubtedly, there is confusion in the field. To further complicate matters, the residential garage data often are overlooked or ignored altogether in discussions of residential fires.

Figure 52 shows the trends in fires and fire losses for residential garages in fixed property use category #881, "residential parking garages." The number of fires for 1996 reached a 10-year high, about 24,700 or 8 percent of the total in dwellings; the 10-year trend is down 2 percent.

Because the numbers of deaths are small, ranging from 11 to 25, there is considerable year-to-year variation; the 10-year downward trend is 38 percent. In every year, this was less than 1 percent of the fire deaths in one- and two-family dwellings.

Injuries in garage fires, which account for less than 2 percent of the injuries in dwelling fires, have trended downward sharply (46 percent). Dollar loss, about 3 percent of the total loss in dwelling fires, is up 17 percent.

Figure 53 shows that 29 percent of deaths in garage fires for 1996 is from open flame, and another 24 percent from arson. Many of the open flame fires are probably due to car engines as a source of heat. For injuries, the leading cause is heating, with arson and open flame tied for second. In terms of sheer numbers of fires, arson significantly leads the next leading cause—exposures to house or outside fires.

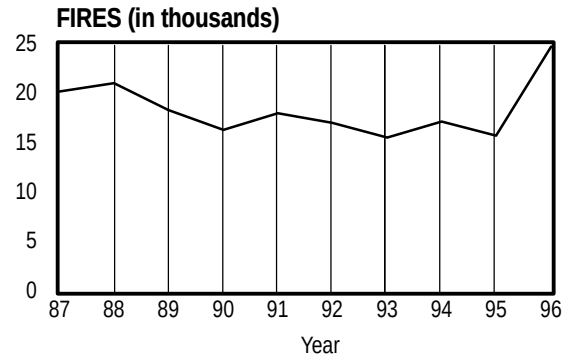
The past confusion about coding garage fires has not distorted the residential fire profiles in any significant way, but it does lead to understating the fire problem by 2 to 8 percent, depending on the measure used.

Manufactured Housing

Manufactured housing is a special category of one- and two-family dwellings. Although only a small fraction of the U.S. population lives in manufactured housing, it has represented a severe problem in terms of fire fatalities in the past—double the fatality rate per fire compared to other homes. This caused the U.S. Department of Housing and Urban Development in 1976 to establish strict standards for improving the fire safety of such homes (often called "mobile homes"). The HUD standard clearly made an impact. However, the manufactured housing fire problem is still significant.

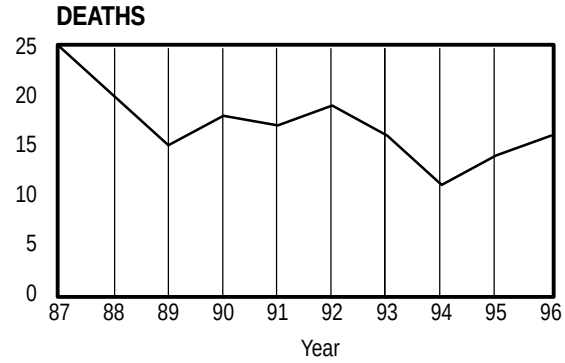
Figure 54 shows the magnitude and trends in manufactured housing fires. Despite an increase in the manufactured housing stock, fires decreased by 21 percent, deaths by 10 percent, injuries by 7 percent, and dollar loss by 18 percent over the last 10 years. These are all similar to other single-family dwelling changes during that period, except for dollar loss, which had a much sharper decline for manufactured housing. All categories of trends have been decreasing over the 10-year period.

Figure 55 shows the manufactured housing death and injury trends based on 1,000 fires. Deaths per 1,000 fires increased considerably in 1995 and 1996, bringing the 10-year trend up 16 percent. Injuries also have increased 16 percent. The dollar loss per fire ranges from $8,400 to $11,200, with a slight 3 percent upward trend.



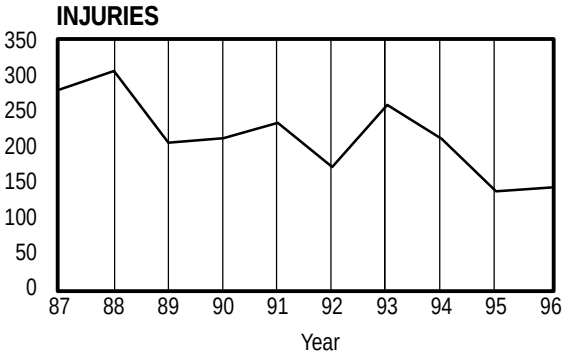
1987	20.2	1992	17.0
1988	21.0	1993	15.5
1989	18.3	1994	17.1
1990	16.3	1995	15.7
1991	18.0	1996	24.7

10-Year Trend = -1.6%



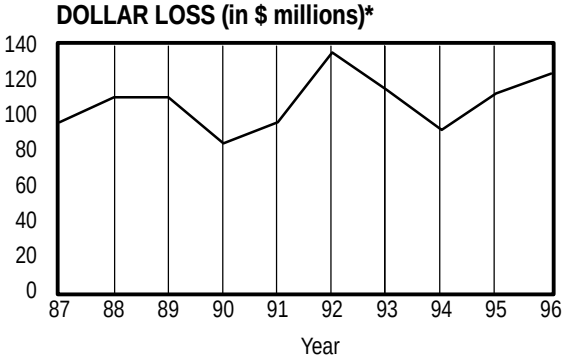
1987	25	1992	19
1988	20	1993	16
1989	15	1994	11
1990	18	1995	14
1991	17	1996	16

10-Year Trend = -38.0%



1987	281	1992	171
1988	307	1993	259
1989	206	1994	211
1990	212	1995	137
1991	234	1996	142

10-Year Trend = -45.6%



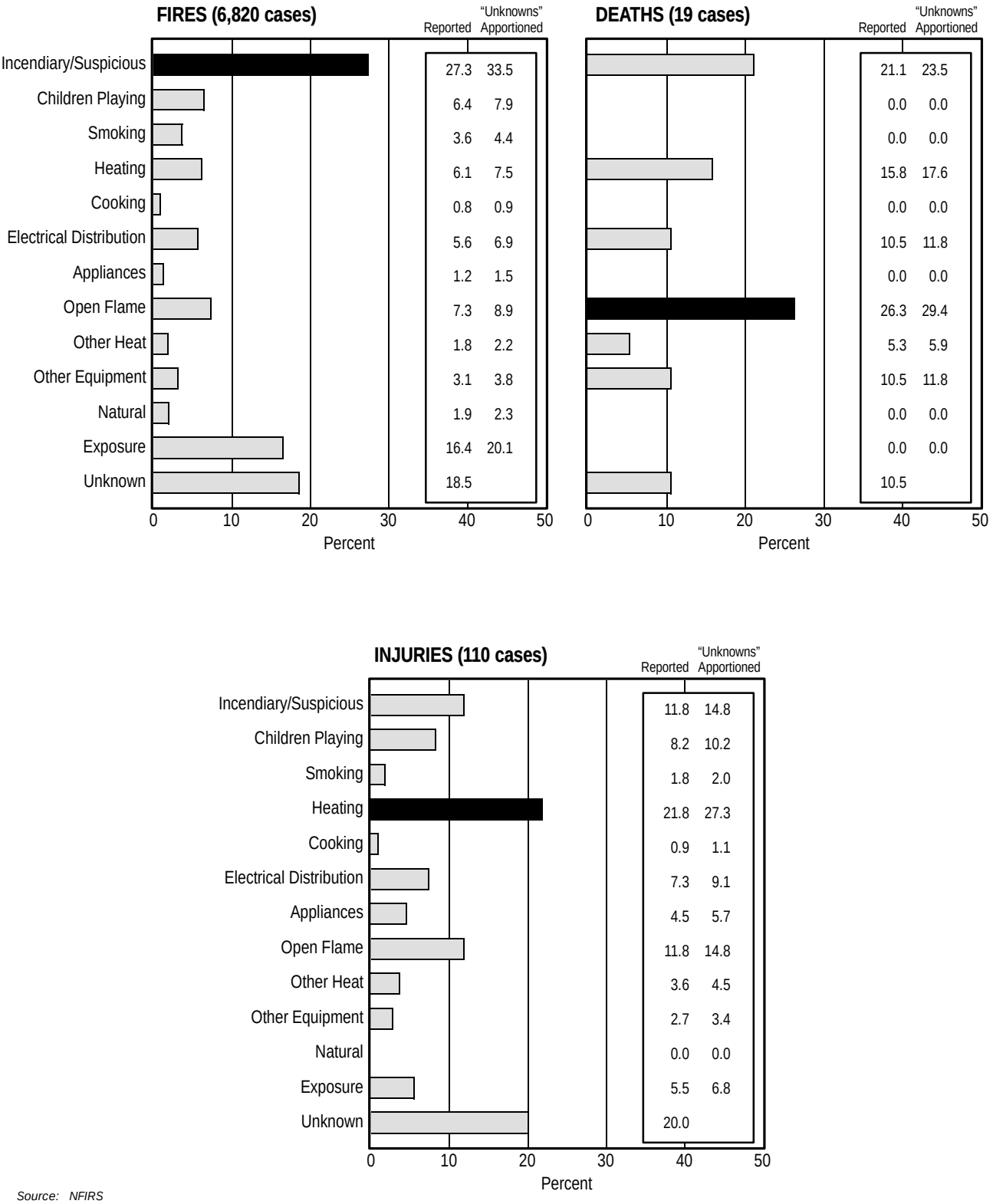
1987	$ 96.0	1992	$135.5
1988	110.1	1993	113.9
1989	110.1	1994	91.6
1990	83.8	1995	112.2
1991	96.0	1996	123.6

10-Year Trend = +16.6%

*Adjusted to 1996 dollars

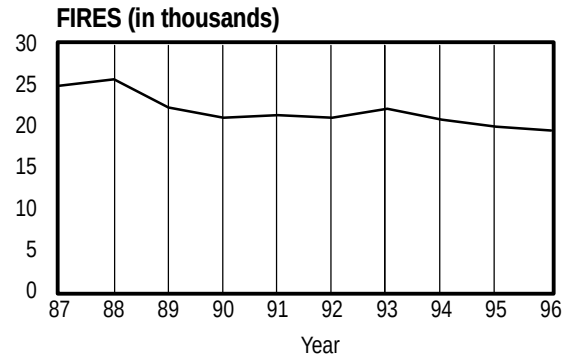
Sources: NFIRS, NFPA Annual Surveys, and Consumer Price Index

Figure 52. Trends in Residential Garage Fires and Fire Losses



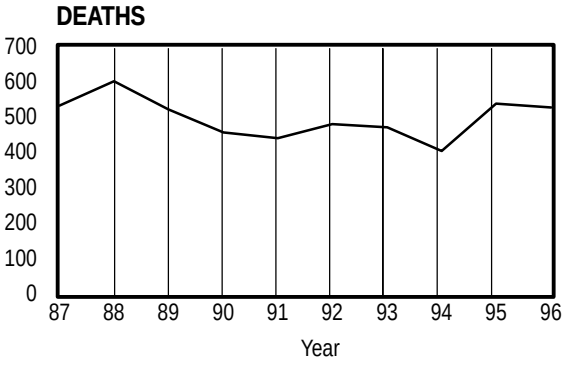
Source: NFIRS

Figure 53. Causes of 1996 Residential Garage Fires and Fire Casualties



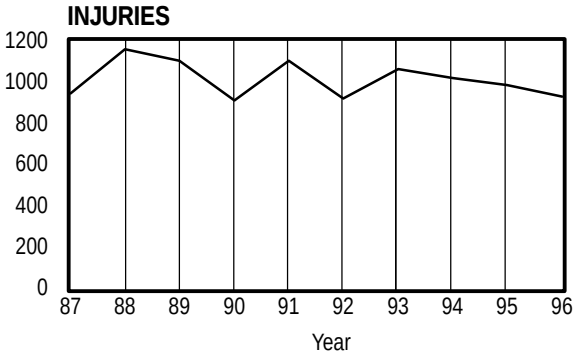
1987	24.9	1992	21.0
1988	25.7	1993	22.1
1989	22.3	1994	20.8
1990	21.0	1995	19.9
1991	21.3	1996	19.5

10-Year Trend = -20.9%



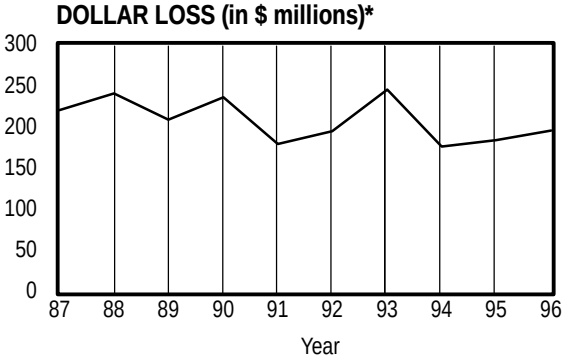
1987	532	1992	481
1988	602	1993	471
1989	521	1994	405
1990	457	1995	539
1991	441	1996	528

10-Year Trend = -10.1%



1987	945	1992	920
1988	1,159	1993	1,061
1989	1,103	1994	1,018
1990	910	1995	986
1991	1,101	1996	930

10-Year Trend = -7.2%



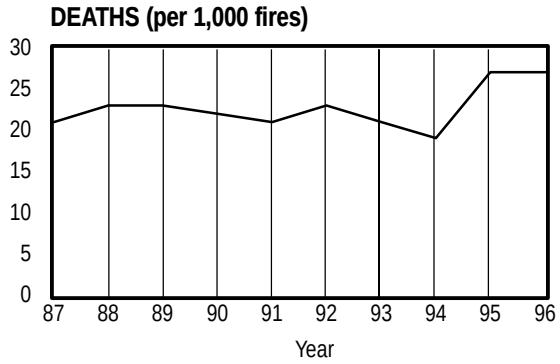
1985	$220.2	1990	$194.6
1986	240.3	1991	245.5
1987	208.9	1992	176.0
1988	235.6	1993	183.8
1989	179.0	1994	195.2

10-Year Trend = -17.7%

*Adjusted to 1996 dollars

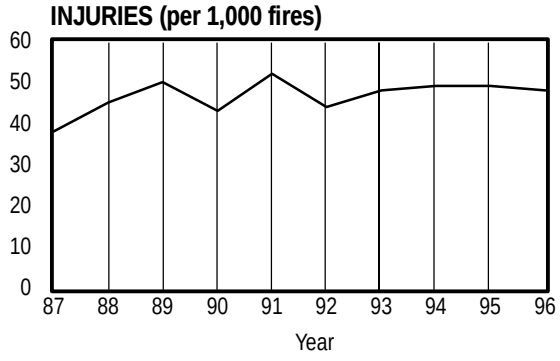
Sources: NFPA Annual Surveys and Consumer Price Index

Figure 54. Trends in Manufactured Housing Fires and Fire Losses



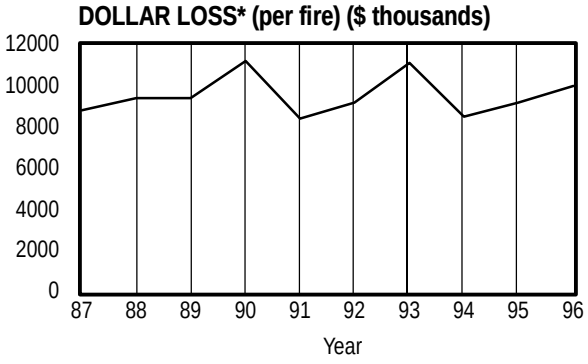
1987	21	1992	23
1988	23	1993	21
1989	23	1994	19
1990	22	1995	27
1991	21	1996	27

10-Year Trend = +15.8%



1987	38	1992	48
1988	45	1993	48
1989	50	1994	49
1990	43	1995	49
1991	51	1996	48

10-Year Trend = +15.7%



1987	$ 8,800	1992	$ 9,300
1988	9,400	1993	11,100
1989	9,400	1994	8,500
1990	11,200	1995	9,200
1991	8,400	1996	10,000

10-Year Trend = +3.3%

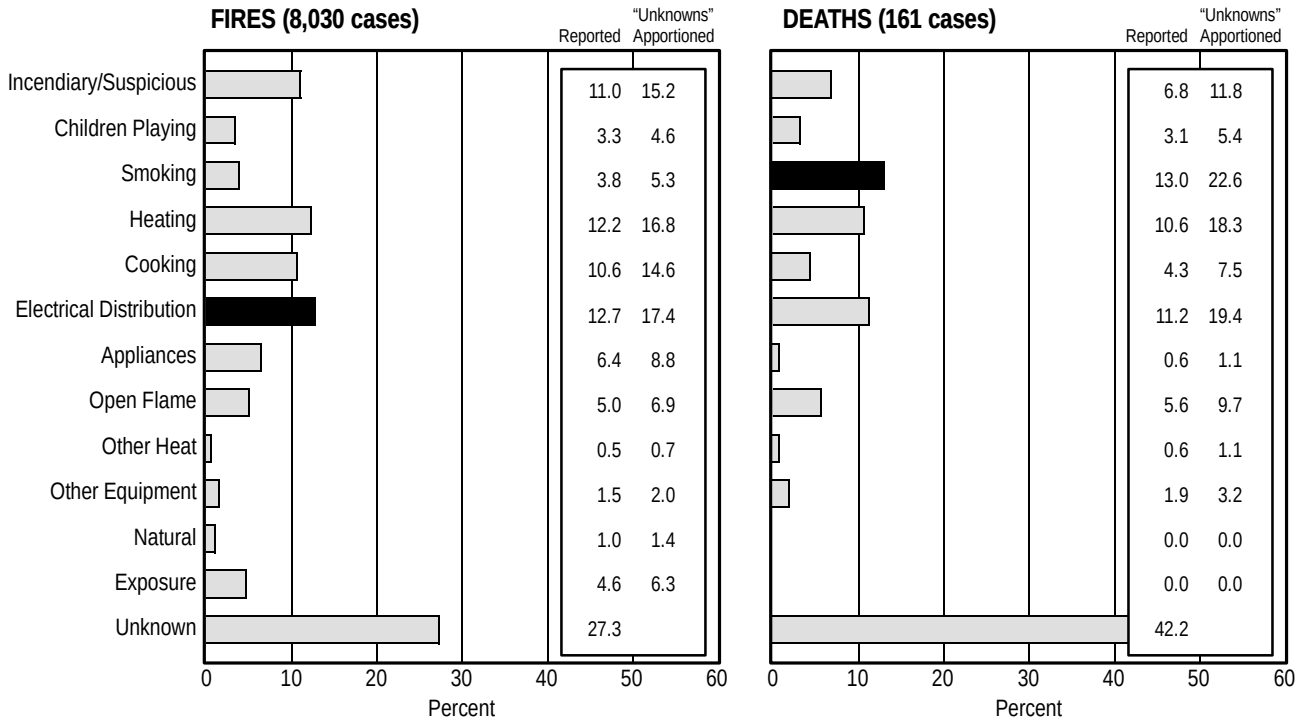
*Adjusted to 1996 dollars

Sources: NFPA Annual Surveys and Consumer Price Index

Figure 55. Trends in Severity of Manufactured Housing Fire Losses

The 1996 cause profile for manufactured housing fires is shown in Figure 56. Electrical distribution is the leading cause of fires in manufactured housing, with heating systems a close second. Arson and cooking were third and fourth, respectively. This cause profile is similar to 1994, although the first and second place rankings have reversed as have the third and fourth places.

For fire deaths, smoking leads other causes of deaths at 23 percent. Electrical distribution and heating systems are second and third in manufactured housing, respectively, whereas heating and arson are so ranked in dwellings. The cause of manufactured housing fires and deaths was not reported in a large number of cases.



Source: NFIRS

Figure 56. Causes of 1996 Manufactured Housing Fires and Fire Deaths

APARTMENTS

The fire problem in multifamily dwellings, referred to as apartments in this report, is generally similar to that of one- and two-family dwellings with the exception of one major category: heating-related fires. Because apartments generally have central heating systems that are professionally maintained, heating-related fires from misuse and poor maintenance are significantly less in apartments than in single-family dwellings. This changes the proportions of the causes for apartments, with heating becoming less significant and the other causes moving up in importance.

Apartment buildings tend to be more regulated by building codes than single-family dwellings. Many apartments are rental properties, which may also fall under more stringent fire prevention statutes. In many communities, apartments have a significantly different socio-economic mix of residents compared to single-family dwellings. They may have more low-income families in housing projects or more high-income families in luxury high rises, or they may be centers of living for the elderly. In large cities, they may have all of these groups.

Because apartment buildings have large clusters of similar people, they can be given special attention with prevention programs based on the cause profiles of apartment buildings in different areas of the community.

Trends

Figure 57 shows the 10-year trend in apartment fire incidence, deaths, injuries, and dollar loss. The number of fires dropped 9 percent in apartments, whereas dwelling fires dropped at nearly three times this rate. The trend for deaths was down 30 percent, nearly double that of one- and two-family dwellings. Injuries trended upwards 13 percent, considerably less than the 51 percent upward trend recorded for 1985–1994, while they fell 15 percent for dwellings. Adjusted dollar losses were down by 1 percent in apartments, while dollar losses in one- and two-family dwellings were down 7 percent.

Compliance with stricter codes and the presence of smoke alarms may be holding down the life loss in apartment fires. More detailed study of socio-economic and demographic changes over time might help explain some of the changes in fire incidence.

Causes

In terms of numbers of reported fires, cooking in apartments is by far the most frequent cause in 1996, accounting for 40 percent of all fires. Arson is a distant second at 15 percent, and smoking third at 9 percent in 1996 (Figure 58). This profile is similar to 1994.

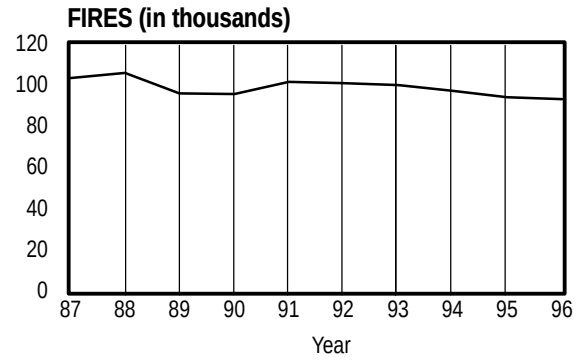
The leading cause of deaths in apartments is smoking, accounting for 38 percent of deaths (up 8 percentage points from 1994). Second was arson fires (20 percent), and third was cooking fires (11 percent). As in 1994, these three causes account for more than two-thirds of all fire deaths in apartments; all other causes are relatively small, including heating. In 1996, there was a significant drop from 1994 in children playing deaths (9 vs. 20 percent). For fire injuries, cooking was first in 1996 at 32 percent, with smoking second at 18 percent, arson third at 16 percent, and children playing fourth at 11 percent. These four causes account for more than three-quarters of all injuries.

Figure 59 shows the trends in the top fire causes of apartment fires and casualties from 1987 to 1996. In terms of fire incidence, the ranking of leading causes did not change over the 10 years. Cooking is the leading cause of apartment fires by a wide margin. Arson fires were down 24 percent, although arson injuries increased 10 percent. Smoking fires were down 44 percent.

Smoking deaths dropped sharply, by 30 percent. Arson deaths reached a peak in 1989 but have experienced an overall 10-year downward trend of 40 percent. Children playing deaths increased significantly between 1991 and 1994. Overall, however, children playing deaths have decreased by 35 percent since 1987.

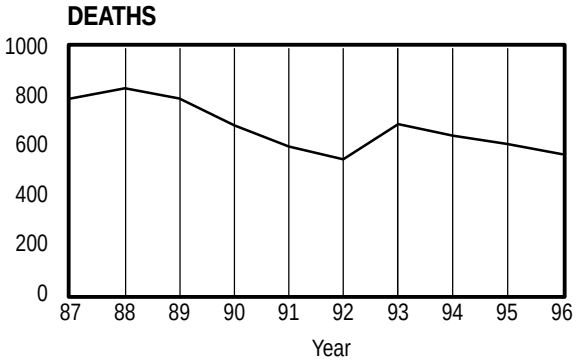
Injuries from cooking in apartments, by far the leading cause, has increased by 30 percent over 10 years. Arson injuries have risen 10 percent. However, open flame accounted for a sharply higher number of injuries, rising by 59 percent over the 10-year period. Children playing injuries have changed very little over the period.

The above data suggest that fire prevention programs aimed at apartment dwellers might emphasize the risk of smoking and the danger in leaving cooking unattended.



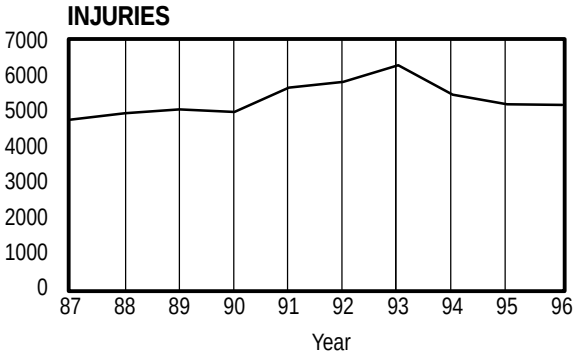
1987	103.5	1992	101.0
1988	106.0	1993	100.0
1989	96.0	1994	97.0
1990	95.5	1995	94.0
1991	101.5	1996	93.0

10-Year Trend = -8.5%



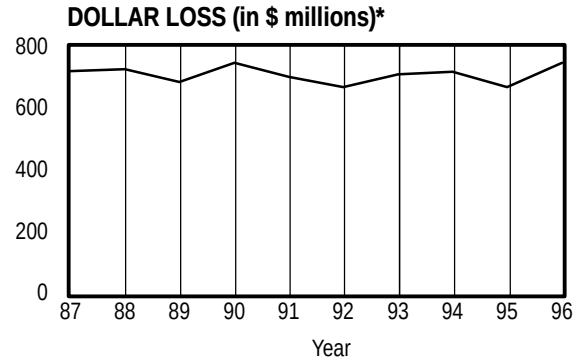
1987	790	1992	545
1988	830	1993	685
1989	790	1994	640
1990	680	1995	605
1991	595	1996	565

10-Year Trend = -30.2%



1987	4,765	1992	5,825
1988	4,950	1993	6,300
1989	5,050	1994	5,475
1990	4,975	1995	5,200
1991	5,675	1996	5,175

10-Year Trend = +12.7%



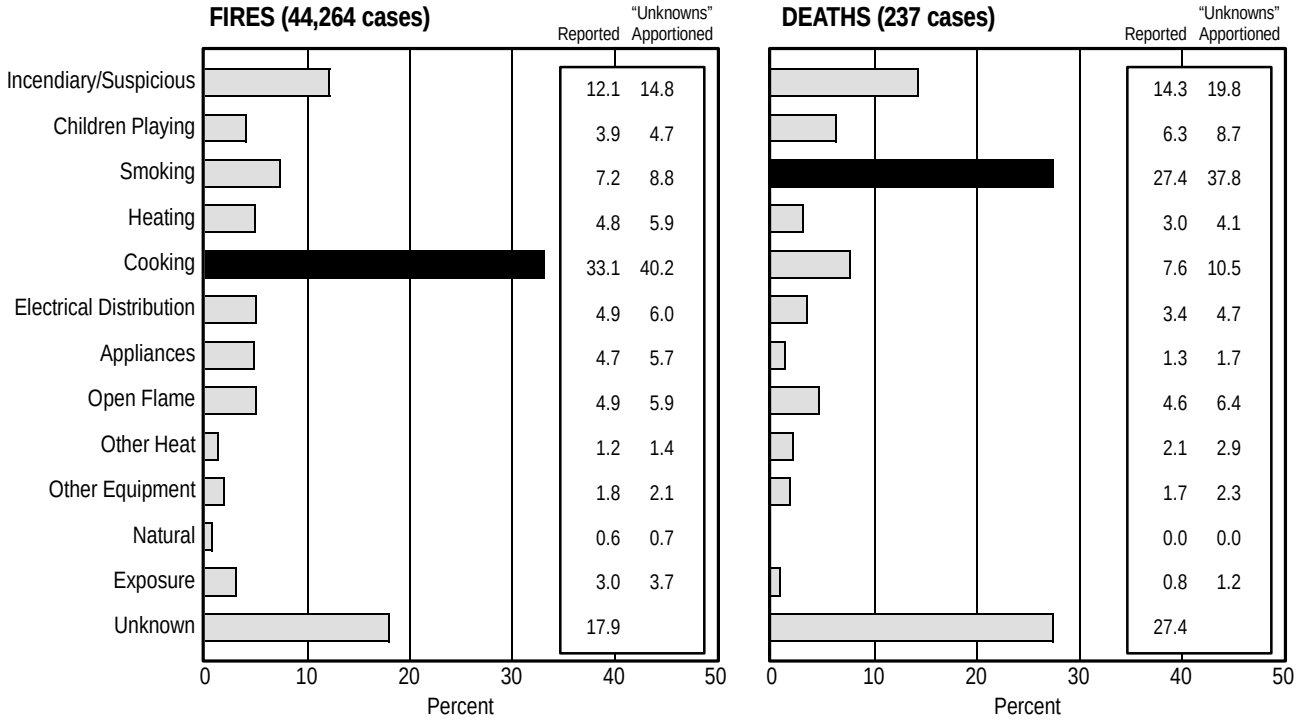
1987	$719.6	1992	$667.6
1988	726.8	1993	709.0
1989	684.5	1994	717.8
1990	747.9	1995	668.2
1991	701.6	1996	748.0

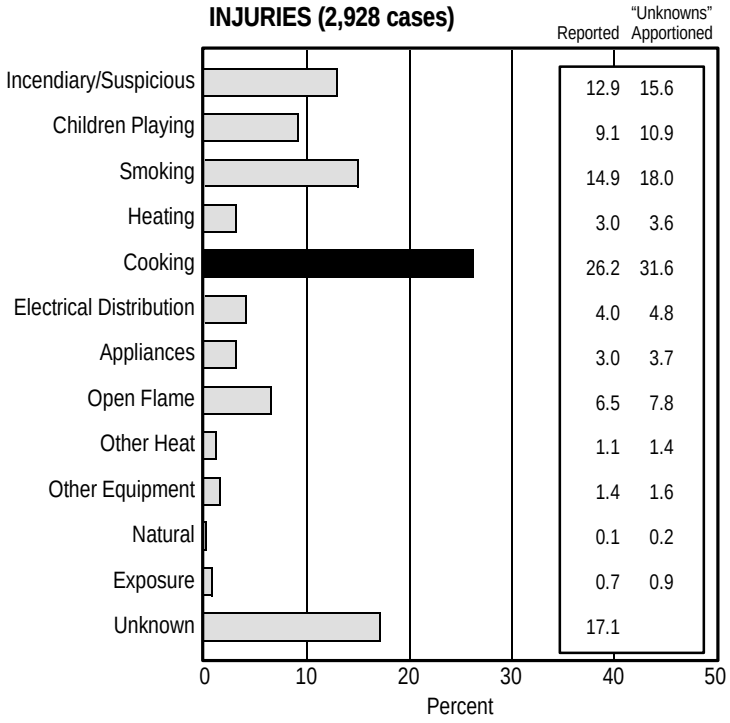
10-Year Trend = -1.1%

*Adjusted to 1996 dollars

Sources: NFPA Annual Surveys and Consumer Price Index

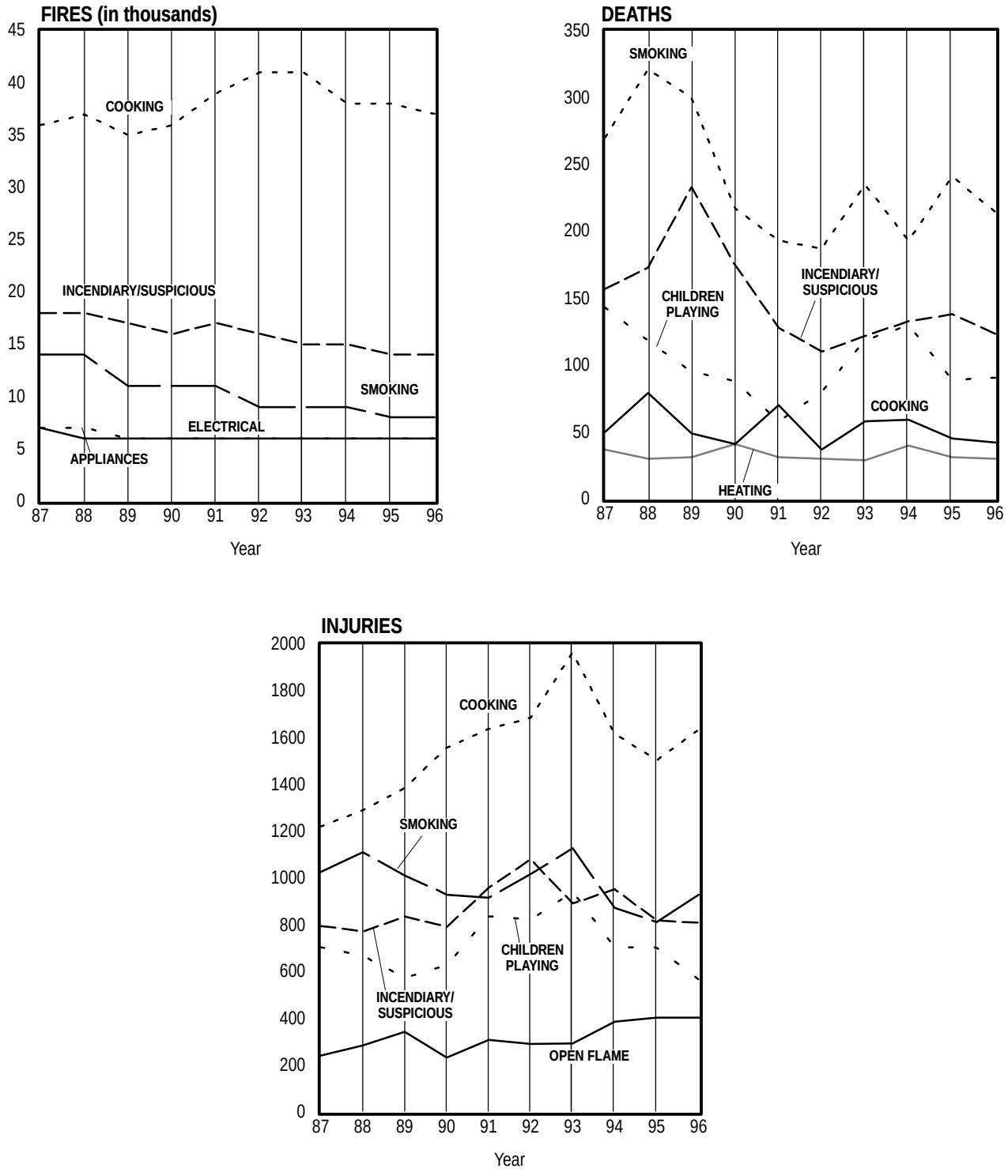
Figure 57. Trends in Apartment Fires and Fire Losses





Source: NFIRS

Figure 58. Causes of 1996 Apartment Fires and Fire Casualties



Note: Data for all 12 causes are provided in Appendix B, Table B-3.

Sources: NFIRS and NFPA Annual Surveys

Figure 59. Trends in Leading Causes of Apartment Fires and Fire Casualties

Smoke Alarm Performance

Figure 60 shows the performance of smoke alarms in apartments in 1996. Considering all fires, alarms were present 76 percent ("unknowns" apportioned) of the time. Alarms are more likely to be installed in apartments, where they are provided by landlords, than in dwellings, where the occupants/owners provide and maintain them.

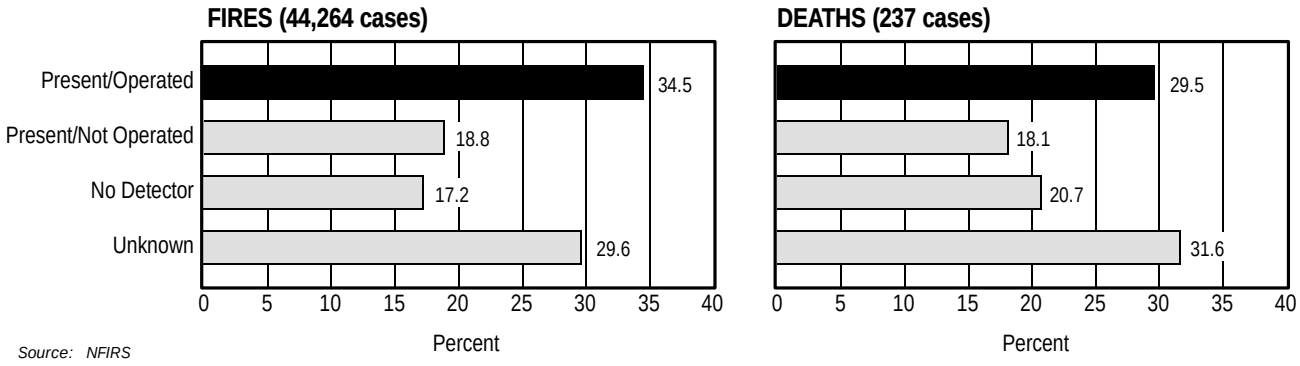


Figure 60. Smoke Alarm Performance in 1996 Apartment Fires and Fire Deaths

The usage of alarms where fires occur in apartments, as well as in one- and two-family dwellings, is considerably below the national average of over 88 percent of households having alarms according to recent national surveys. Apartment dwellers who have fires are probably less likely than average to be safety conscious and to provide and maintain alarms.

Smoke alarms in 1996 were present and operating in 43 percent ("unknowns" apportioned) of fire deaths in apartments. Why alarms worked and people still died is a subject for further study. One possibility is that hallway alarms or alarms in other apartments operated after the victims were overcome. Also, apartments have fewer ways to escape, especially apartments on higher floors; at night, escaping from an apartment can be particularly confusing when people are awakened suddenly. This situation suggests the need to provide sprinklers in apartments and to emphasize fire prevention.

Alarms were present but did not operate in 27 percent ("unknowns" apportioned) of deaths. This is over 50 percent higher than the rate of nonworking alarms in dwellings. These statistics are unexpected as apartment alarms are more likely to be hardwired into the electrical system and professionally maintained than alarms in dwellings.

Since the publication of the Ninth Edition, the presence of alarms in apartments with fire deaths has decreased from 72 to 70 percent. The percentage of alarms that were not working has decreased from 30 to 27 percent, an encouraging reversal of previous trends.

Sprinkler Performance

There are few fire deaths being reported in apartment buildings where sprinklers were present and operating (Figure 61), but it is not known from NFIRS whether the sprinklers were in the apartment of origin. Overall, there are more sprinklers present in apartment fires than in dwelling fires, but the percentage is still small in 1996—7 percent ("unknowns" apportioned) and is only a 5 percent increase since 1990.

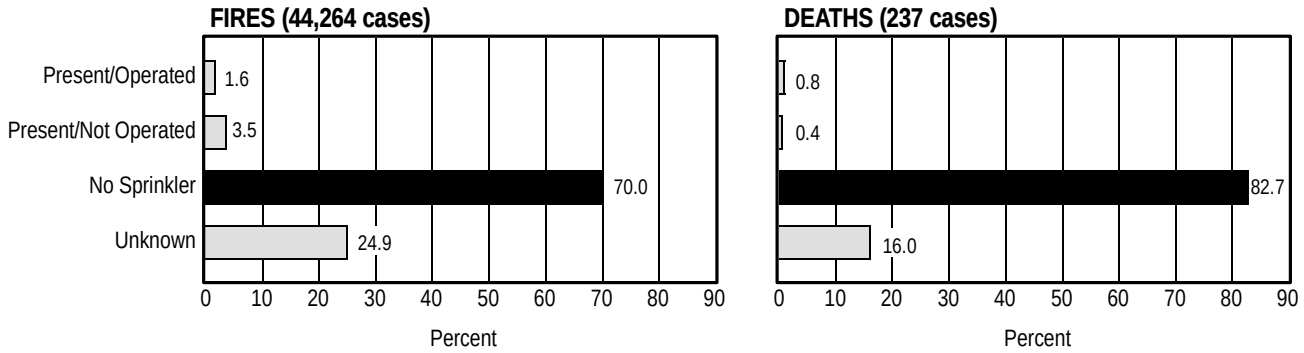


Figure 61. Sprinkler Performance in 1996 Apartment Fires and Fire Deaths

When Fires Occur

TIME OF DAY**.** Figure 62 shows the alarm times for fires, deaths, injuries, and dollar loss in apartment fires. The profiles are not as smooth as those for one- and two-family dwellings due to the smaller numbers of incidents involved.

Apartment fires peak from 5:00 to 8:00 p.m.—the cooking period—and are at a low from 3:00 to 8:00 a.m. As is the case in one- and two-family dwellings, the late night hours are most common for fire deaths, especially those associated with latent smoldering fires from smoking in the 10:00 p.m. to 5:00 a.m. period. Nearly 43 percent of all deaths occur in this 7-hour period.

Injuries have less pronounced peaks, with one from 3:00 to 4:00 a.m. and another from 3:00 to 11:00 p.m. Because cooking is the leading cause of injuries, this probably accounts for the evening peak. Except for the peak between 7:00 and 8:00 p.m. ($28 million combined loss), dollar loss is fairly uniform.

MONTH OF YEAR**.** Fires in apartments are more uniform throughout the year than in dwellings because of the reduced role that heating plays (Figure 63). Still, they are somewhat more common in winter than in summer, perhaps because of heating fire problems in low-income apartments and increased indoor activity such as children playing.

Apartment fire deaths are much more prevalent in the winter than in the summer, as they are for one-and two-family dwellings, even though heating is a relatively minor cause for apartment fire deaths. Clearly there are other seasonal factors in addition to heating—perhaps a greater propensity to stay at home.

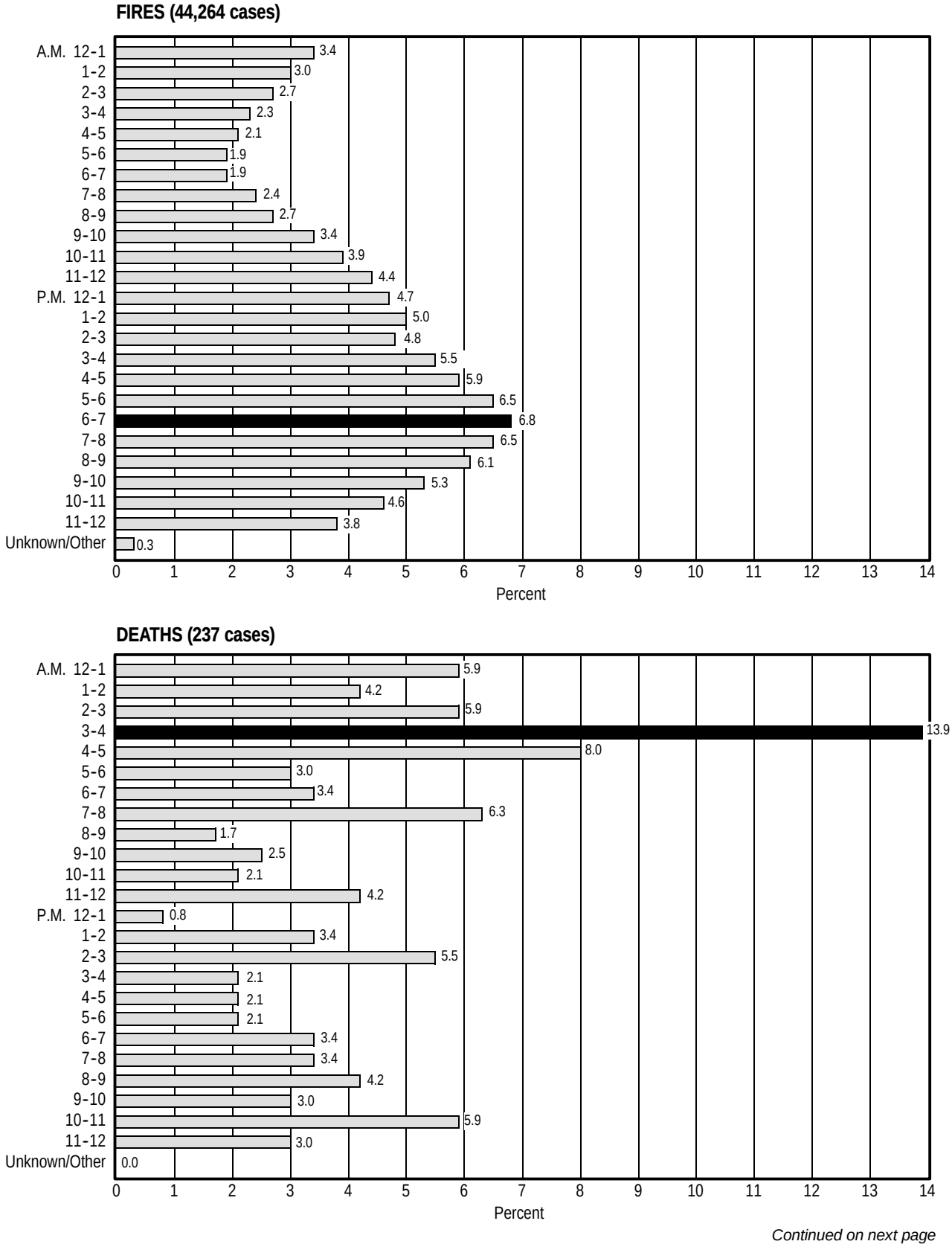


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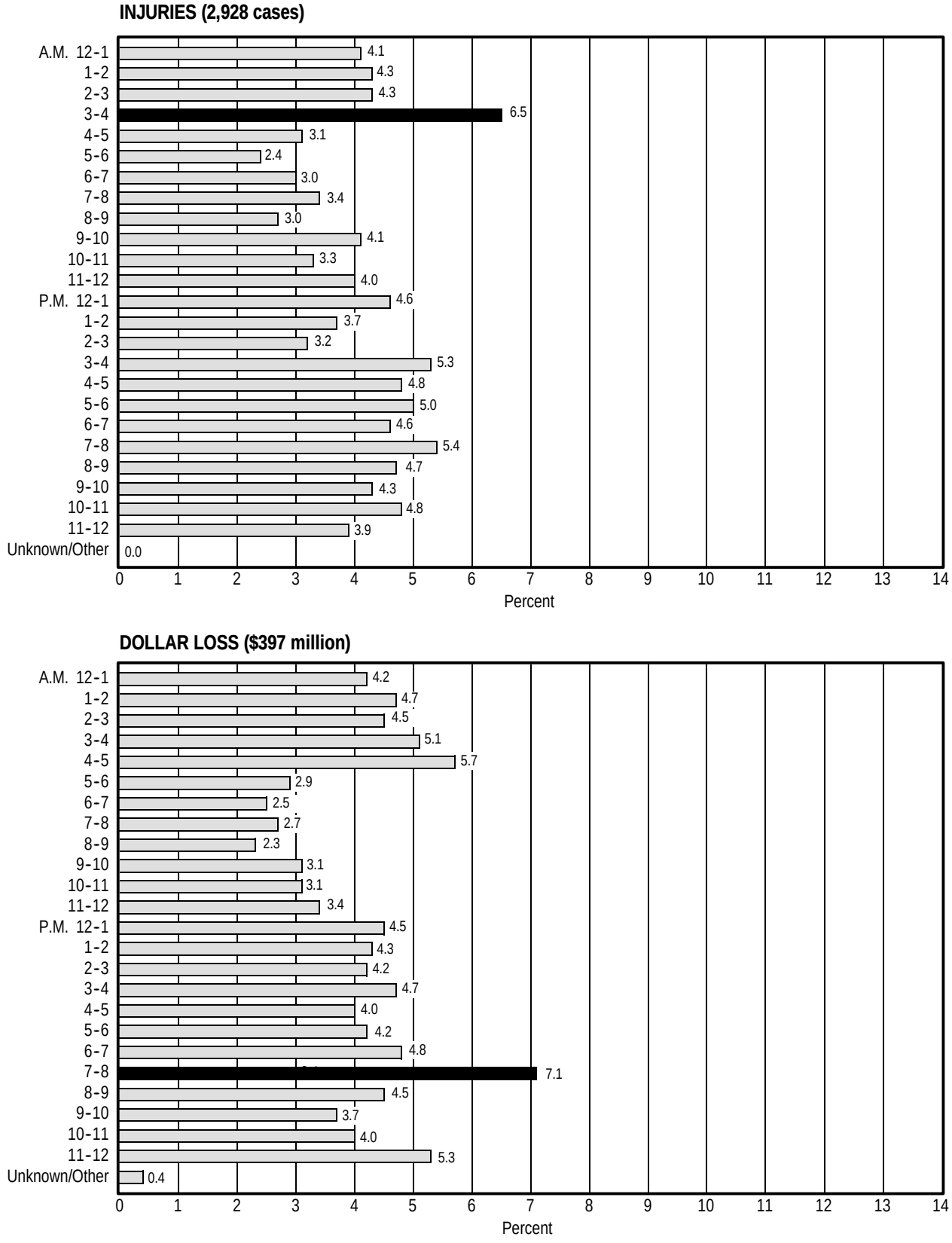
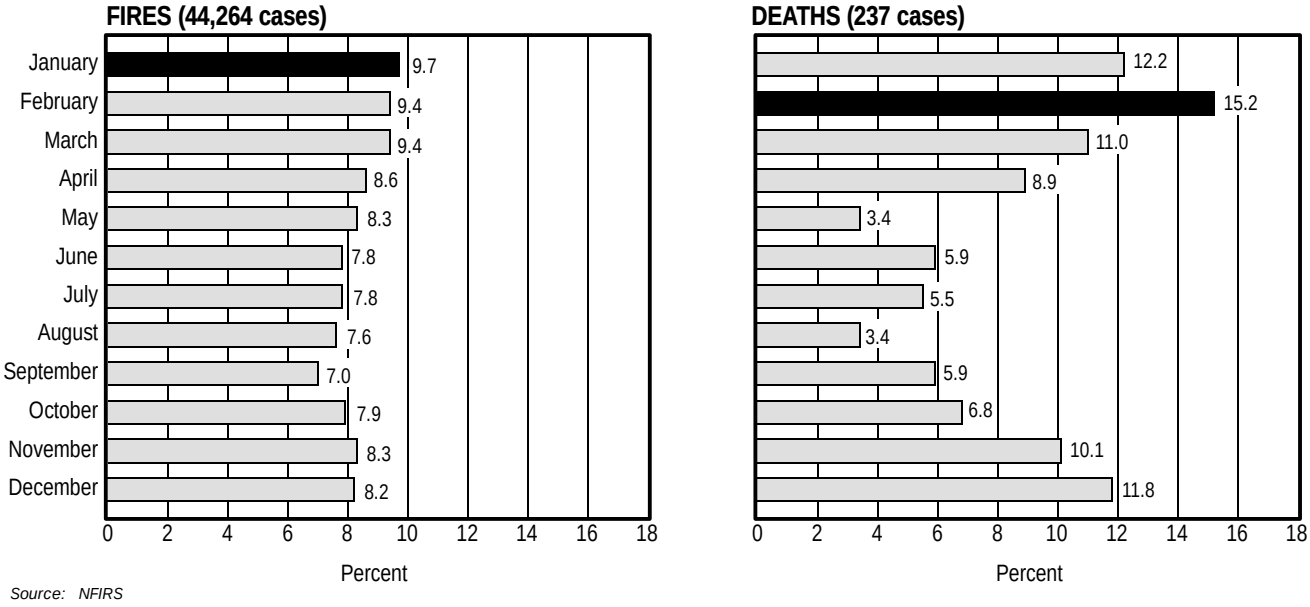
Figure 62. Time of Day of 1996 Apartment Fires and Fire Losses



Source: NFIRS

Figure 62. Time of Day of 1996 Apartment Fires and Fire Losses (cont'd)



Source: NFIRS

Figure 63. Month of Year of 1996 Apartment Fires and Fire Deaths

Room of Origin

Figure 64 shows the leading rooms of origin of fires, deaths, and injuries in apartments. As in every year for the past 10, the kitchen is the most common place for a fire and injury because of cooking. As in one- and two-family dwellings, the lounge area and bedrooms are the most common place for a fatal fire to start because of smoking on upholstered furniture.

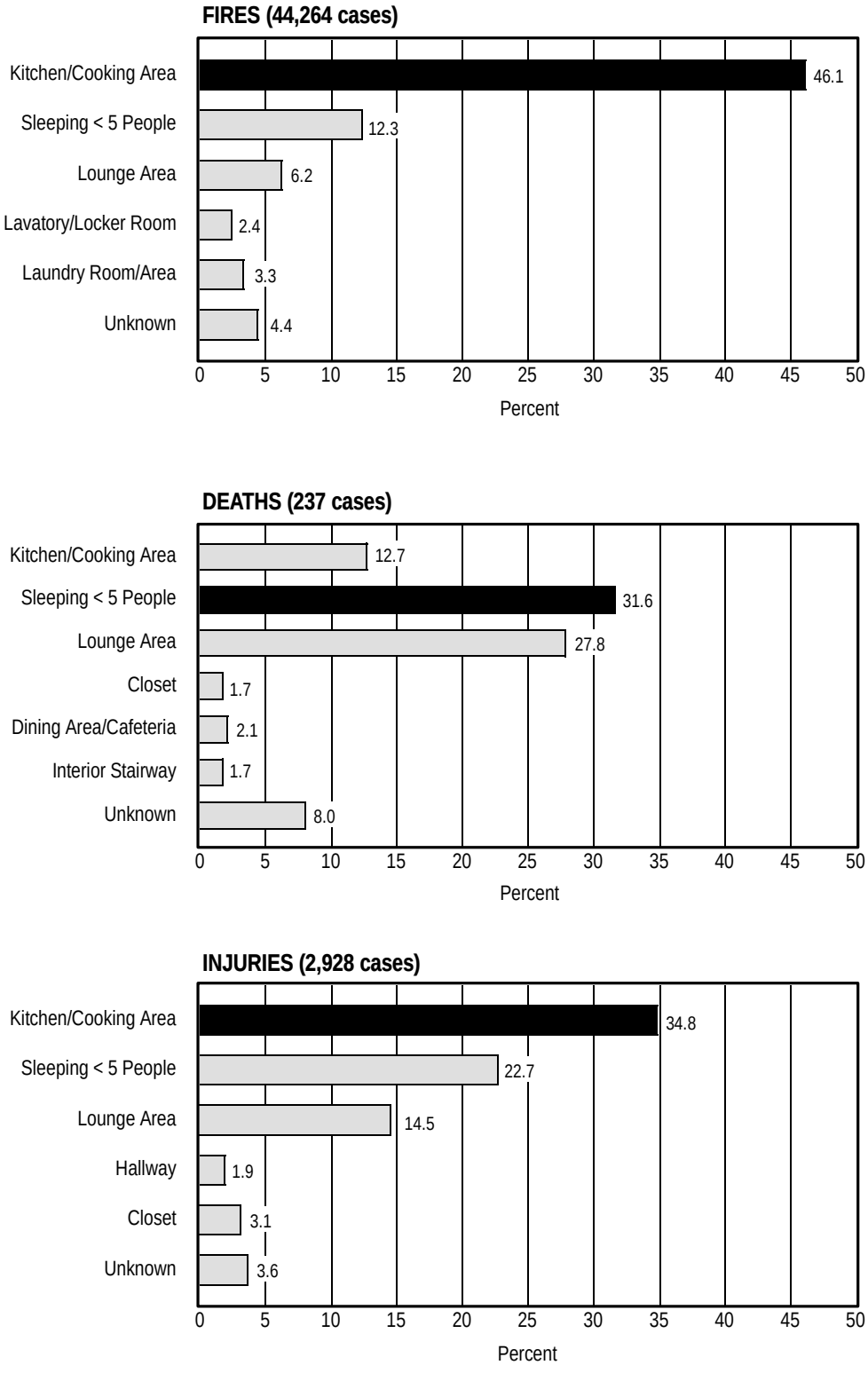
Tables 15, 16, and 17 show the leading location of fire origin from Figure 64 and the leading causes of fire in that location. Tables 18, 19, and 20 detail the leading location of fire origin for the leading causes of apartment fires, deaths, and injuries, as shown in Figure 58. Although the leading causes differ somewhat in apartments versus dwellings, the rooms for each cause are generally similar.

Table 15. Leading Locations of Fire Origin of 1996 Fires by Cause in Apartments
[reported/"unknowns" apportioned]

Kitchen	Sleeping Room <5	Lounge	Laundry Room	Lavatory/ Locker Room
Cooking 14,225 (69.7%/84.4%)	Smoking 1,065 (19.5%/22.7%)	Smoking 633 (23.0%/26.6%)	Appliances 788 (53.7%/58.8%)	Open Flame 217 (20.8%/23.6%)
Incendiary/Suspicious 536 (2.6%/3.2%)	Children Playing 910 (16.7%/19.4%)	Incendiary/Suspicious 481 (17.5%/20.2%)	Incendiary/Suspicious 244 (16.6%/18.2%)	Electrical Distribution 139 (13.3%/15.1%)
Appliances 366 (1.8%/2.2%)	Incendiary/Suspicious 891 (16.3%/19.0%)	Open Flame 288 (10.5%/12.1%)	Heating 79 (5.4%/5.9%)	Smoking 125 (12.0%/13.6%)
Total Fires: 20,419 **Unknowns: 3,555**	**Total Fires: 5,457** **Unknowns: 762**	**Total Fires: 2,749** **Unknowns: 371**	**Total Fires: 1,467** **Unknowns: 127**	**Total Fires: 1,043** **Unknowns: 124**

Note: The five most common rooms or areas of origin reported are shown. Data here are NFIRS raw counts, not national estimates. Percentages shown are column percentages (e.g., percentages of lounge fires, not percentages of smoking fires).

Source: NFIRS



Source: NFIRS

Figure 64. Leading Locations of Fire Origin of 1996 Apartment Fires and Fire Casualties

Table 16. Leading Locations of Fire Origin of 1996 Deaths by Cause in Apartments
[reported/"unknowns" apportioned]

Sleeping Room <5	Lounge	Kitchen		
Smoking 26 (34.7%/48.1%)	Smoking 31 (47.0%/59.6%)	Cooking 15 (50%/71.4%)		
Children Playing 5 (6.7%/9.3%)	Children Playing 7 (10.6%/13.5%)	Incendiary/Suspicious 3 (10.0%/14.3%)		
Electrical Distribution 5 (6.7%/9.3%)	Incendiary/Suspicious 5 (7.6%/9.6%)	Other Heat 2 (6.7%/9.5%)		
	Open Flame 5 (7.6%/9.6%)			
Total Deaths: 75 **Unknowns: 21**	**Total Deaths: 66** **Unknowns: 14**	**Total Deaths: 30** **Unknowns: 9**		

Note: Only the three most common rooms or areas of origin reported are shown since these rooms account for nearly 83% ("unknowns" apportioned) of all apartment fire deaths. There were six deaths in "multiple" areas and five deaths in the dining room. Data here are NFIRS raw counts, *not* national estimates. Percentages shown are column percentages (e.g., percentages of lounge fires, not percentages of smoking fires).

Source: NFIRS

Table 17. Leading Locations of Fire Origin of 1996 Injuries by Cause in Apartments
[reported/"unknowns" apportioned]

Kitchen	Sleeping Room <5	Lounge	Closet	Hallway/ Corridor/Mall
Cooking 742 (72.9%/85.5%)	Children Playing 160 (24.1%/28.4%)	Smoking 150 (35.4%/41.4%)	Smoking 42 (46.2%/51.2%)	Incendiary/Suspicious 40 (71.4%/78.4%)
Children Playing 22 (2.2%/2.5%)	Smoking 143 (21.5%/25.4%)	Open Flame 52 (12.3%/14.4%)	Incendiary/Suspicious 20 (22.0%/24.4%)	Smoking 6 (10.7%/11.8%)
Incendiary/Suspicious 21 (2.1%/2.4%)	Incendiary/Suspicious 82 (12.3%/14.6%)	Incendiary/Suspicious 43 (10.1%/11.9%)	Children Playing 14 (15.4%/17.1%)	Children Playing 2 (3.6%/3.9%)
		Children Playing 43 (10.1%/11.9%)		
Total Injuries: 1,018 **Unknowns: 150**	**Total Injuries: 664** **Unknowns: 101**	**Total Injuries: 424** **Unknowns: 62**	**Total Injuries: 91** **Unknowns: 9**	**Total Injuries: 56** **Unknowns: 5**

Note: The five most common rooms or areas of origin reported are shown. Data here are NFIRS raw counts, *not* national estimates. Percentages shown are column percentages (e.g., percentages of lounge fires, not percentages of smoking fires).

Source: NFIRS

Table 18. Leading Causes of Fire Origin of 1996 Fires by Location in Apartments
[reported/"unknowns" apportioned]

Cooking	Incendiary/ Suspicious	Smoking	Electrical Distribution	Open Flame
Kitchen 14,225 (97.2%/97.4%)	Sleeping Room <5 891 (16.6%/17.3%)	Sleeping Room <5 1,065 (33.4%/33.7%)	Sleeping Room <5 587 (26.9%/27.1%)	Sleeping Room <5 525 (24.4%/24.9%)
Exterior Balcony 92 (0.6%/0.6%)	Kitchen 536 (10.0%/10.4%)	Lounge 633 (19.9%/20.0%)	Lounge 271 (12.4%/12.5%)	Lounge 288 (13.4%/13.7%)
Sleeping Room <5 44 (0.3%/0.3%)	Hallway/Corridor/Mall 488 (9.1%/9.5%)	Kitchen 260 (8.2%/8.2%)	Kitchen 218 (10.0%/10.1%)	Kitchen 247 (11.5%/11.7%)
Total Fires: 14,630 **Unknowns: 27**	**Total Fires: 5,375** **Unknowns: 223**	**Total Fires: 3,188** **Unknowns: 26**	**Total Fires: 2,185** **Unknowns: 22**	**Total Fires: 2,148** **Unknowns: 39**

Note: The five most common causes reported are shown. Data here are NFIRS raw counts, *not* national estimates. Percentages shown are column percentages (e.g., percentages of smoking fires, not percentages of lounge fires).

Source: NFIRS

Table 19. Leading Causes of Fire Origin of 1996 Deaths by Location in Apartments
[reported/"unknowns" apportioned]

Smoking	Incendiary/ Suspicious	Cooking	Children Playing	Open Flame
Lounge 31 (47.7%/47.7%)	Lounge 5 (14.7%/16.1%)	Kitchen 15 (83.3%/83.3%)	Lounge 7 (46.7%/46.7%)	Lounge 5 (45.5%/45.5%)
Sleeping Room <5 26 (40.0%/40.0%)	Sleeping Room <5 4 (11.8%/12.9%)	Sleeping Room <5 2 (11.1%/11.1%)	Sleeping Room <5 5 (33.3%/33.3%)	Sleeping Room <5 4 (36.4%/36.4)
Closet 4 (6.2%/6.2%)	Interior Stairway 4 (11.8%/12.9%)			
	Dining Area 4 (11.8%/12.9%)			
Total Deaths: 65 **Unknowns: 0**	**Total Deaths 34** **Unknowns: 3**	**Total Deaths: 18** **Unknowns: 0**	**Total Deaths: 15** **Unknowns: 0**	**Total Deaths: 11** **Unknowns: 0**

Note: The five most common causes reported are shown. Data here are NFIRS raw counts, *not* national estimates. Percentages shown are column percentages (e.g., percentages of smoking fires, not percentages of lounge fires).

Source: NFIRS

Table 20. Leading Causes of Fire Origin of 1996 Injuries by Location in Apartments
[reported/"unknowns" apportioned]

Cooking	Smoking	Incendiary/ Suspicious	Children Playing	Open Flame
Kitchen 742 (96.7%/96.7%)	Lounge 150 (34.3%/34.5%)	Sleeping Room <5 82 (21.6%/22.5%)	Sleeping Room <5 160 (60.4%/60.6%)	Sleeping Room <5 71 (37.6%/37.8%)
	Sleeping Room <5 143 (32.7%/32.9%)	Lounge 43 (11.3%/11.8%)	Lounge 43 (16.2%/16.3%)	Lounge 53 (27.5%/27.7%)
	Closet 42 (9.6%/9.7%)	Hallway/ Corridor/Mall 40 (10.6%/11.0%)	Kitchen 22 (8.3%/8.3%)	Lavatory/ Locker Room 15 (7.9%/8.0%)
Total Injuries: 767 **Unknowns: 0**	**Total Injuries: 437** **Unknowns: 2**	**Total Injuries: 379** **Unknowns: 15**	**Total Injuries: 265** **Unknowns: 1**	**Total Deaths: 192** **Unknowns: 4**

Note: The five most common causes reported are shown. Data here are NFIRS raw counts, *not* national estimates. Percentages shown are column percentages (e.g., percentages of smoking fires, not percentages of lounge fires).

Source: NFIRS

OTHER RESIDENTIAL PROPERTIES

Other residential properties include rooming houses, dormitories, home hotels, halfway houses, hotels and motels, and miscellaneous and unclassified properties reported as residences. Prior to 1994, the other residential properties category did not include fires and fire losses for hotels and motels in the yearly NFPA estimates of fires and fire losses. Since 1994, however, hotels and motels have included as part of the other residential category. In this edition of *Fire in the United States*, other residential fires and fire losses have been recompiled to present a consistent series that includes hotels and motels. Therefore, the trends shown in Figure 54 are not compatible with previous editions of *Fire in the United States*. The other residential properties category does not include homes for the elderly, prisons, orphanages, or other "institutions"; these have their own categories and are addressed in Chapter 4.

Trends

Figure 65 shows that the number of fires in the other residential category rose and fell over the 10-year period, spiking in 1993 due to the Branch Davidian Compound fire in Waco, TX (47 deaths) and the Paxton Hotel fire in Chicago (20 deaths). Fire deaths ranged from 40 to 110 a year. Injuries ranged from 425 to 600 and adjusted dollar loss from $86 to $163 million.

Property Types

Figure 66 shows that hotels and motels in 1996 accounted for more fires, deaths, injuries, and dollar loss than all of the miscellaneous other residential categories combined, but far less than one- and two-family dwellings or apartments. Dormitory fires do cause deaths, of course, despite their being none in the NFIRS sample in 1996.

Causes

As in 1990 and 1994, arson was the leading cause of fires in other residential occupancies in 1996. Nearly half of the deaths were also attributed to arson (in 1994 smoking was the leading cause) as well as over one-quarter of fire injuries (Figure 67).

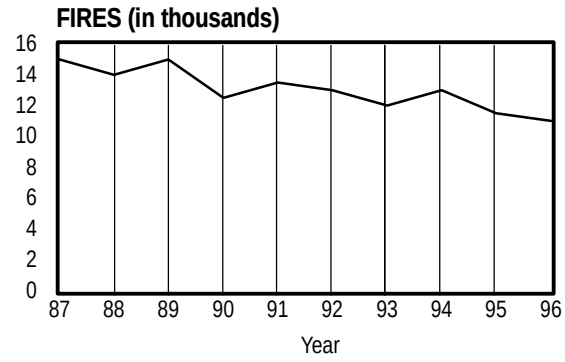
Hotels and Motels

Because of the notable improvement in the number of hotel and motel fires and fire losses, NFPA no longer tabulates this residential category separately. Although national numbers are no longer available for hotels and motels, NFIRS data are still tabulated separately and allows for the determination of the causes of hotel and motel fires, deaths, and injuries.

CAUSES. Most fires in hotels start in the guest rooms. Cooking is the leading cause of fires, but these usually originate in the hotel's centralized restaurant, not in the rooms (Figure 68). Since heating is central and professionally maintained, the leading causes tend to be careless acts that guests can commit in hotel rooms. These acts are intentional acts (arson, the second leading cause) by employees or guests and the careless use of smoking materials (smoking, the third leading cause).

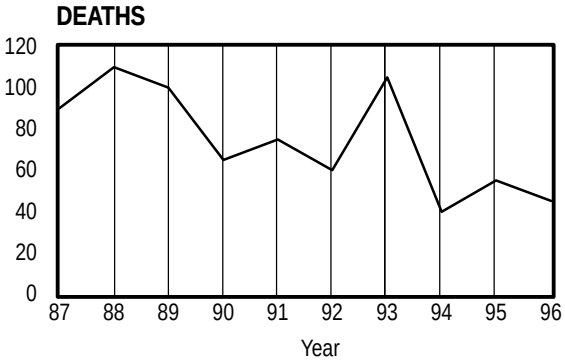
Only 16 hotel fire deaths were reported to NFIRS in 1996. The overwhelming leading cause is smoking at 60 percent. Arson and other equipment are the only other causes of hotel fire deaths. For fire injuries, arson is first, followed by smoking.

TRENDS. Causes of hotel and motel fires, deaths, and injuries change from year to year because of the small numbers of fires, deaths, and injuries associated with this residential category. Table 21 compares the top three causes of fires, deaths, and injuries from the last three editions of *Fire in the United States* in which these data were presented (1990, 1994, and 1996).



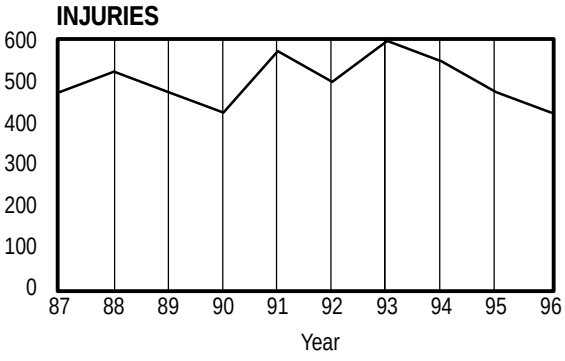
1987	15.0	1992	13.0
1988	14.0	1993	12.0
1989	15.0	1994	13.0
1990	12.5	1995	11.5
1991	13.5	1996	11.0

10-Year Trend = -24.1%



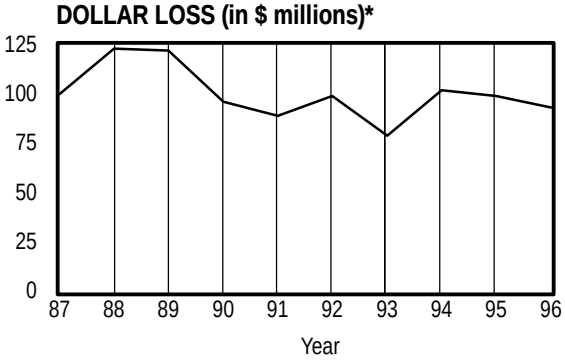
1987	90	1992	60
1988	110	1993	105
1989	100	1994	40
1990	65	1995	55
1991	75	1996	45

10-Year Trend = -53.0%



1987	475	1992	500
1988	525	1993	600
1989	475	1994	550
1990	425	1995	475
1991	575	1996	425

10-Year Trend = +0.3%



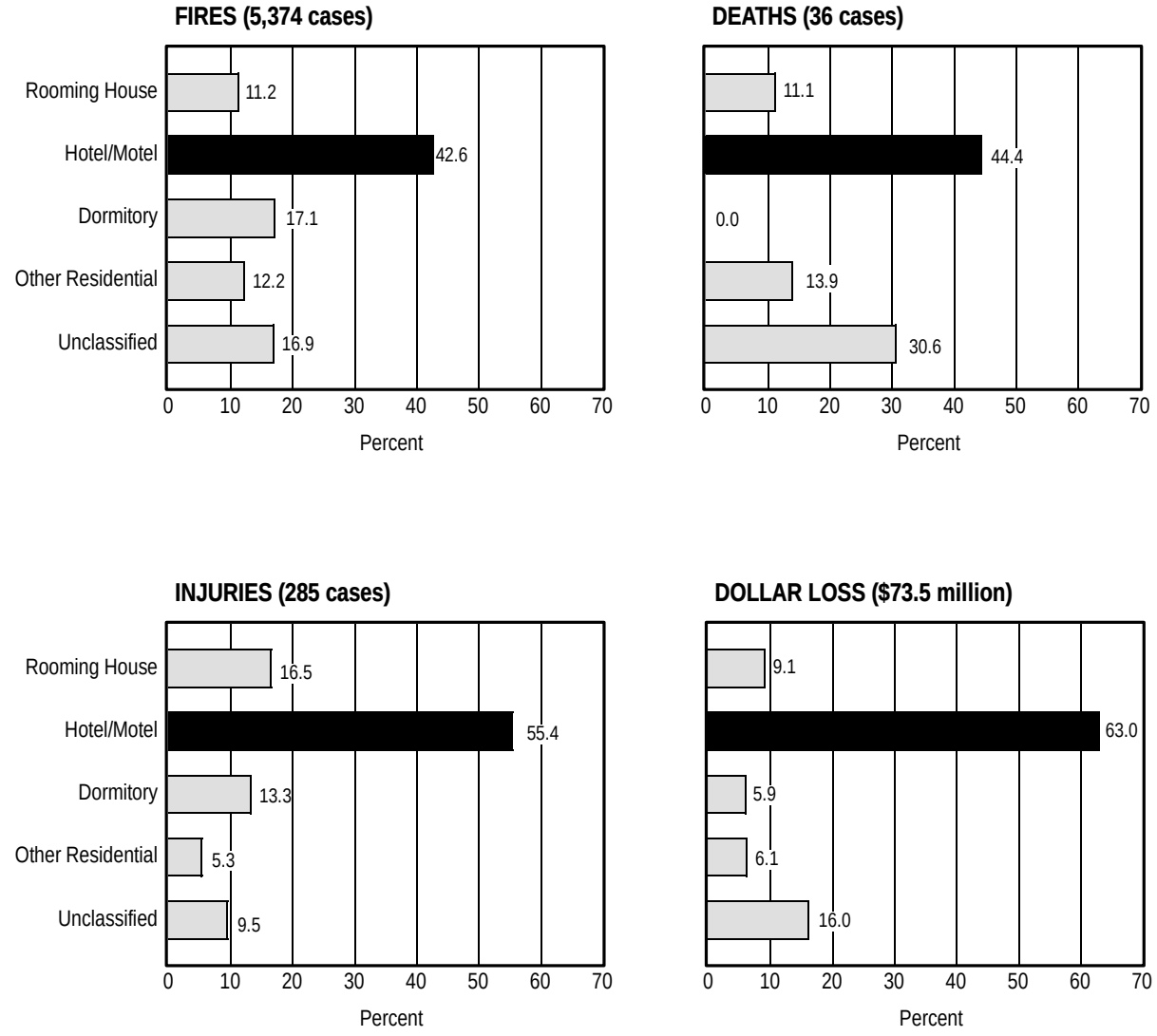
1987	$ 100.0	1992	$ 99.0
1988	123.0	1993	79.0
1989	122.0	1994	102.0
1990	96.0	1995	99.0
1991	89.0	1996	93.0

10-Year Trend = -18.4%

*Adjusted to 1996 dollars

Sources: NFPA Annual Surveys and Consumer Price Index

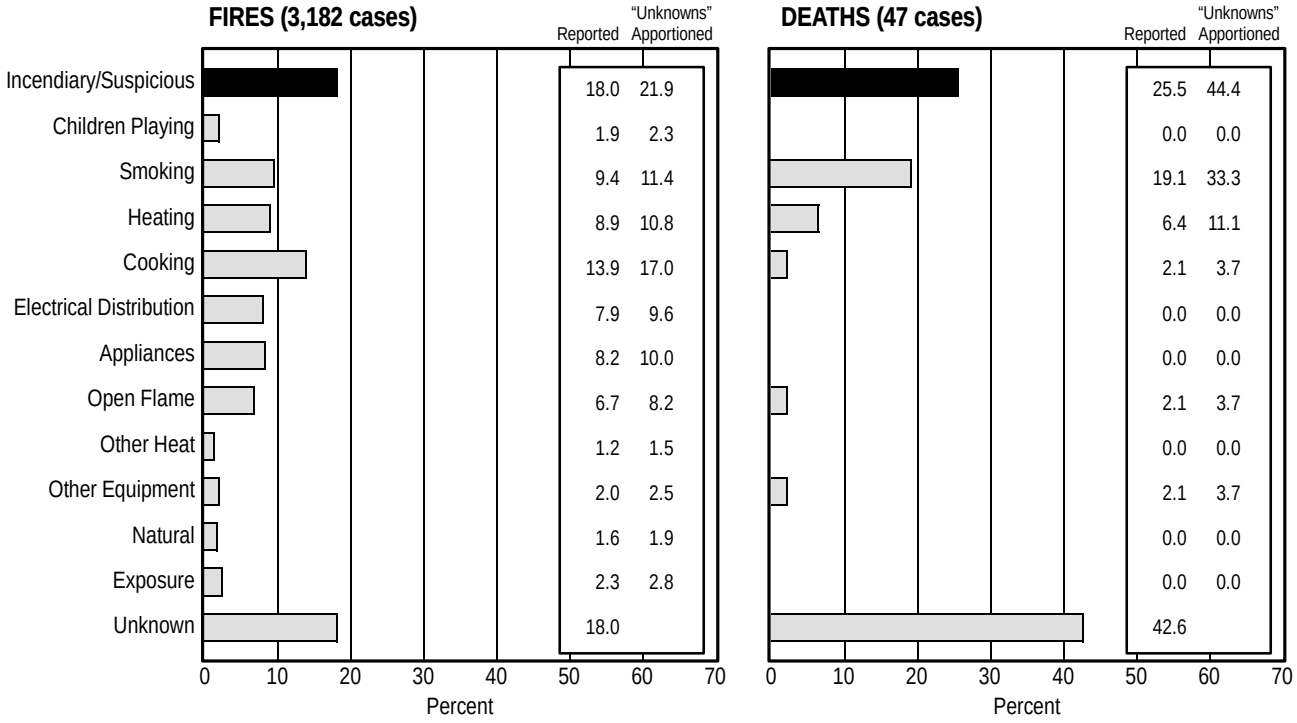
Figure 65. Trends in Other Residential Property Fires and Fire Losses

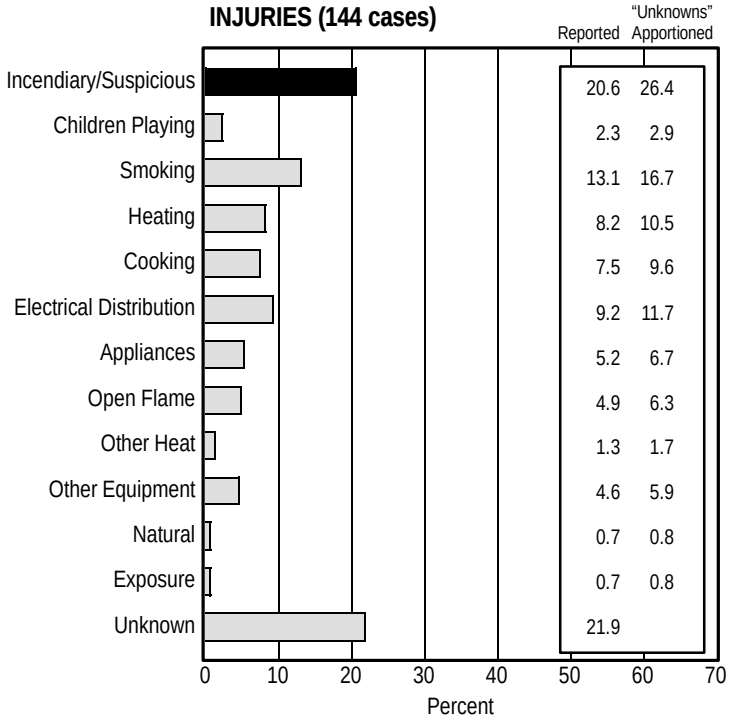


Source: NFIRS

Figure 66. 1996 Other Residential Property Fires and Fire Losses by Property Type

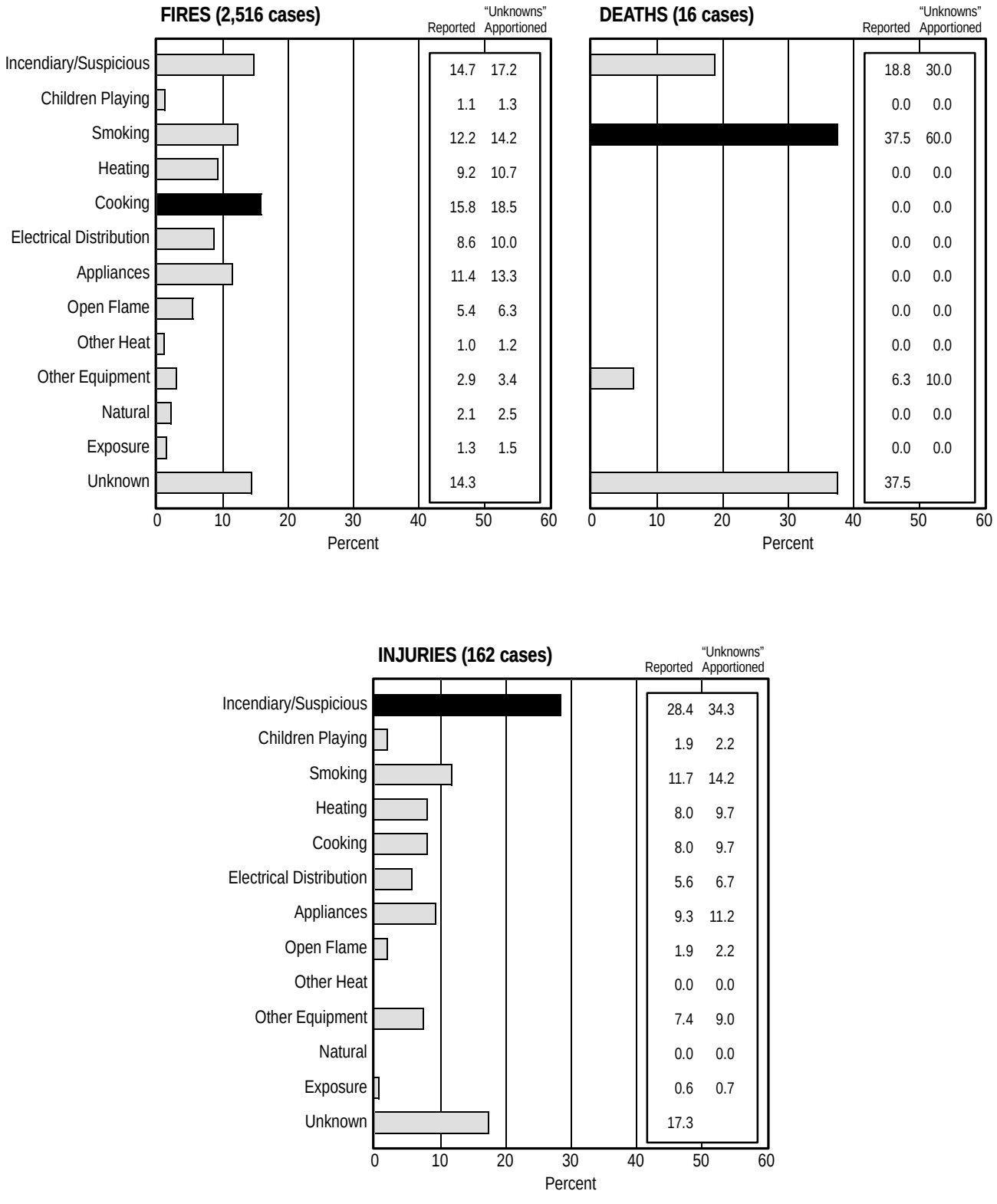
Although the causes change from year to year, arson, smoking, and cooking clearly play large roles in hotel and motel fires, deaths, and injuries. The hotel and motel industry has instituted major changes—built-in fire protection systems and employee fire-awareness are but two examples — that have been instrumental in the overall decline of hotel and motel fire statistics.





Source: NFIRS

Figure 67. Causes of 1996 Other Residential Property Fires and Fire Casualties



Source: NFIRS

Figure 68. Causes of 1996 Hotel/Motel Fires and Fire Casualties

Table 21. Leading Causes of Hotel and Motel Fires and Casualties

Rank	1990	1994	1996
Fires			
1	Arson	Arson	Cooking
2	Smoking	Cooking	Arson
3	Cooking	Appliances	Smoking
Deaths			
1	Arson/Smoking	Smoking	Smoking
2	Heating	Cooking/ Electrical Distribution/ Other Heat	Arson
3	Children Playing	N/A	Other Equipment
Injuries			
1	Arson	Smoking	Arson
2	Smoking	Arson	Smoking
3	Cooking	Cooking	Appliances

USFA RESOURCES ON FIRES IN RESIDENCES

The vast majority of civilian fire deaths and injuries continue to occur in residences. Residential occupancies also account for the largest annual dollar loss, and more firefighter injuries occur fighting fires in residences than in any other type of occupancies. For these reasons, the U.S. Fire Administration has a variety of initiatives that focus on reducing residential fires and the deaths and injuries that they cause.

Public fire education is a corner stone of USFA's fire prevention programs. USFA continues to attack barriers to public fire education programs at the state and local levels by developing public education tools, public awareness campaigns, and technical materials. USFA also promotes school system acceptance of fire safety education in K–12 and encourages private sector commitment and support for community fire prevention.

Many of the following topics are addressed at USFA's Web site http://www.usfa.fema.gov.

Publications

To support and encourage public fire education, USFA has developed a series of public awareness campaign kits, which are described below. Each campaign kit has a variety of high-quality, ready-to-use materials for use by educators, community organizations, fire departments, and the private sector. Most campaigns promote home fire safety, primarily in one- and two-family dwellings, where about 70 percent of residential fires, deaths, and dollar loss occur.

USFA also produces a number of materials designed to improve the quantity and quality of public fire education efforts throughout the country. *Leadership in Public Fire Safety Education—2000* (#FA–135) presents the findings of a national public education conference held at the National

Emergency Training Center. *Directory of National Community Volunteer Fire Prevention Programs* (#FA–92) is a catalog of local fire safety education programs addressing such issues as fire and burn prevention in the home, eliminating hazards, fire survival and escape, smoke detections and fire extinguishers, and the proper use of home heating devices. *America Burning* and the updated version, *America Burning Revisited*, emphasize the importance of fire prevention and put it on the same level of importance as fire suppression. The *Firesetter Handbook* series (for ages 0–7, 7–13, and 14–18, #FA–83, #FA–82, and #FA–80, respectively) offers concrete strategies on how to recognize a problem, interview children and their families, educate children not to set fires, and determine when a case calls for referral to a mental health professional. And finally, USFA offers the *Fire Safety Education Resource Directory* (#FA–172) as a compendium of materials that may be useful in building and supplementing a public education program for fire safety.

There is a myriad of other valuable reports and books produced and endorsed by USFA. The following list is by no means exhaustive, but it is intended to highlight some of the USFA literature not previously mentioned: *After the Fire! Returning to Normal* (#FA–046); *Rural Fire Problem in the United States* (#FA–180); *Rural Arson Control* (#FA–87); *NFIRS Analysis: Investigating City Characteristics and Residential Fire Rates* (#FA–179); *Rural Fire Problem in the United States* (#FA–180); *Socioeconomic Factors and the Incidence of Fire* (#FA–170); *Board and Care Facility Evacuation Guide.*

These USFA publications are available by writing to:

U. S. Fire Administration
Federal Emergency Management Agency
Publications Center, Room N310
16825 South Seton Avenue
Emmitsburg, MD 21727

Please include the parenthetical publication number, if given, in your request.

Documents may also be ordered via the World Wide Web: http://www.usfa.fema.gov/usfapubs. USFA publications are free.

National Fire Academy Courses

In the 20-year history of its National Fire Academy (NFA), the U.S. Fire Administration has educated more than 1,300,000 people in a wide variety of courses. The NFA works to enhance the ability of the fire service and allied professions to deal more effectively with fire and related emergencies. Courses are delivered on campus at the resident facility in Emmitsburg, Maryland, and off campus throughout the nation in cooperation with state and local fire training officials and local colleges and universities. An initiative begun in 1992 offers NFA resident courses on a regional basis.

Although issues related to fires in residences and fire prevention are addressed in numerous academy courses, several offerings include these issues as a major topic. It has become apparent that

the key to fire prevention is education. NFA offers several courses in how to educate the public on life safety issues. *Presenting Effective Public Education Programs* (Resident Course #R116) is a 5-day course that provides fundamental knowledge, skills, and attitudes to deliver fire and life safety educational programs in the community. *Strategic Analysis of Community Risk Reduction* (Resident Course #R309) is a 2-week course that provides senior fire executives with vital information necessary to implement community-wide, risk-reduction activities. The course includes contemporary approaches that emergency services organizations can use successfully to compete for dwindling resources, mechanisms to gather and analyze critical life safety data, and proven actions to target community injury reduction. *Management for Arson Prevention and Control* (Resident Course #R207) focuses on innovative concepts and practical skills for managing a synergistic response to arson prevention and control. NFA also offers numerous courses in both the management and the technical sides of fire prevention. *Code Management: A Systems Approach* (Resident Course #R101), though requiring previous fire prevention experience, focuses on the management of code development, evaluation, and enforcement processes. *Fire Inspection Principles* (Resident Course #R220) provides the student with the fundamental information, ability, and comprehension to conduct both basic and intermediate-level fire safety inspections. *Principles of Fire Protection: Structures and Systems* (Resident Course #R222) provides the student with the advanced understanding, expertise, and demeanor to conduct detailed fire safety inspections, analyze the level of fire and life safety in buildings, and understand operating principles, application, acceptance and testing, and inspection of fire protection systems and equipment.

For information about course offerings, eligibility, and application procedures, write to:

The National Fire Academy
U.S. Fire Academy
16825 South Seton Avenue
Emmitsburg, MD 21727

Information on NFA course offerings can also be obtained on USFA Web site http://www.usfa.fema.gov/nfa.

Campaign Materials

USFA has developed a series of public awareness campaign kits with a variety of high-quality materials for use by educators, community organizations, fire departments, and the private sector. The current public education initiative, *Fire Stops With You*, is a compilation of 5 years' worth of research that targets fire safety through empowerment: the individual's behavior is what must be addressed to prevent fire. It includes radio and print public service announcements (PSAs), factsheets, and technical reports.

Most campaigns promote home fire safety, primarily in one- and two-family houses, where most residential fires, deaths, and dollar loss occur. A recent campaign, *Home Fire Safety: Act On It*, was developed in cooperation with the Sleep Products Safety Council, the National Association of Broad-

casters, the National Board of Realtors, and the "Just Say No" campaign. It contains a variety of materials on general home fire safety themes, and includes radio and print PSAs, sample letters to the editor, a fill-in-the-blank press release, factsheets, and a resource guide. The factsheets and other fire safety information are available on the USFA Web site http://www.usfa.fema.gov/safety.

Major Fires Investigations

USFA also conducts special studies to address specific problems and current issues facing the nation's fire and rescue service. The technical reports produced under the Major Fires Investigations series analyze major or unusual fires with emphasis on sharing lessons learned. They are directed primarily to chief officers, training officers, fire marshals, and investigators as a resource for training and prevention.

APARTMENTS. USFA has some recent Major Fires Investigation reports that address major fires in apartment buildings: *Apartment Building Fire—East 50th Street, New York City, January 1988* (#TR–019); *Nine-Fatality Apartment House Fire, Ludington, MI, February 1993* (#TR–072); *Old Buckingham Station, Chesterfield, VA* (#TR–105); *Schomberg Plaza Fire, New York City, Harlem, March 1987* (#TR–004); *Fire, Police and EMS Coordination at Apartment Building Explosion, New York City, November 1992* (#TR–068); and *Apartment Complex Fire, 66 Units Destroyed, Seattle, WA, September 1991* (#TR–059).

HOTELS AND MOTELS. USFA has worked diligently in the implementation of PL 101–391, The Hotel/Motel Fire Safety Act of 1990. By working closely with the American Hotel and Motel Association and the National Association of State Fire Marshals, USFA provided a variety of support services to states to help them identify facilities that meet the fire safety requirements of the act. Refer to the USFA Web site where they have a specific link addressing hotels and motels: http://www.usfa.fema.gov/hotel.

Major Fires Investigation reports studying fires in hotels and motels include the following: *Doubletree Hotel Fire, New Orleans, LA, July 1987* (#TR–008); *Ramada Inn Air Crash and Fire, Wayne Township, IN, October 1987* (#TR–014); *St. George Hotel Complex 16 Alarm Fire, Brooklyn, NY* (#TR–108); *LaPosada Hotel Fire, McAllen, TX, February 1987* (#TR–001); *National Guard Plane Crash at Hotel Site, Evansville, IN, February 1992* (#TR–064); and *Nine Elderly Fire Victims in Residential Hotel, Miami Beach, FL, April 1990* (#TR–041).

ONE- AND TWO-FAMILY DWELLINGS. A number of Major Fires Investigations reports focus on residential fires in one- and two-family homes: *Power Off to Hard-Wired Detector in Nine-Fatality House Fire, Peoria, IL, April 1989* (#TR–031); *Four House Fires That Killed 28 Children, September–December 1987* (#TR–020); *Nine-Fatality Mobile Home Fire, Maxton, NC, November 1989* (#TR–037); *Children Left Home Alone: Eleven Die in Two Fires, Detroit, MI, February 1993* (#TR–070); *Eight-Fatality Row House Fire: Lessons Learned from Residential Fires With Five or More Fatalities, Chester, PA, December 1992* (#TR–067); *Seven-Fatality Christmas Tree Fire, Canton, MI, December 1990* (#TR–046); *Seven-Fatality Fire at Remote Wilderness Lodge, Grand*

Marais, MN, July 1991 (#TR–055); and *Eight Children and Two Adults Die in Rural House Fire, Remer, MN, January 1989* (#TR–028).

OTHER RESIDENTIAL PROPERTIES. Several Major Fires Investigation reports share lessons learned in major fires in other types of residential properties, including *Two Fatality Board and Care Facility Fire, Salvation Army Rehabilitation Center, Miami, Florida* (#TR–090); *College Dormitory Fires in Dover, Delaware and Farmville, VA, April 1987* (#TR–006); *Hospital Fire Kills Four Patients, Southside Regional Medical Center, Petersburg, VA* (#TR–080); *Shenandoah Retirement Home Fire, Roanoke County, VA, December 1989* (#TR–038); *Sixteen-Fatality Fire in Highrise Residence for the Elderly, Johnson City, TN, December 1989,* (#TR–039); *Success Story at Retirement Home Fire, Sterling, VA, December 1989* (#TR–040); *Ten-Fatality Board and Care Facility Fire, Detroit, MI, June 1992* (#TR–066); *Twelve-Fatality Nursing Home Fire, Norfolk, VA, October 1989* (#TR–034); *Spanish/English Door Knob Hanger; Class A Foam for Structural Firefighting* (#TR083); *Compressed Air Foam Use for Structural Fire Fighting: A Field Test, Boston Fire Department, June 1993* (#TR–074)*; Winter Fires—Safety Tips for the Home* (#L–097); and *Ten Elderly Fire Victims in Intermediate Care Facility, Colorado Springs, CO, March 1991* (#TR–050).

Residential Sprinklers

USFA has completed extensive research to develop installation and application standards for quick-acting residential sprinklers and has conducted a variety of demonstrations of the quick-response sprinkler technology to demonstrate the practicality of these systems. USFA's report *Residential Fire Sprinklers Retrofit Demonstration Project Final Report and Case Studies* (#FA–89, #FA–90, #FA–97) describes a multiple-stage demonstration project in multifamily residences undergoing rehabilitation where quick-response residential fire sprinklers were installed.

USFA also worked with Factory Mutual and Underwriters Laboratories to complete design and testing of new limited-water-supply fire sprinkler systems for manufactured housing.

There are a number of other publications on sprinklers available from USFA. *An Ounce of Prevention—Residential Sprinklers* (#FA–76) is an 18-page booklet for homeowners, insurance underwriters, building designers and developers, legislators, and building officials. The booklet provides a comprehensive discussion of why and how the combination of automatic sprinklers and early warning systems in all types of buildings can have a major impact on fire-related deaths injuries and property loss. Another report of note is *Home Fire Protection—Residential Fire Sprinkler Systems* (#FA–43), a five-page pamphlet for the general public explaining the merits of home sprinklers and the financial and insurance benefits.

Other reports USFA has produced on residential sprinklers include the following: *Comparison of Fire Sprinkler Piping Materials* (#FA–150); *Backflow Protection for Residential Sprinkler Systems; Board and Care Homes: Sprinklered vs. Nonsprinklered;* and *Reducing America's Fire Losses With Residential Fire Sprinkler Systems.*

4

NON-RESIDENTIAL PROPERTIES

The non-residential property category includes industrial and commercial properties, institutions (such as hospitals, nursing homes, prisons), educational establishments (from preschool through university), mobile properties, and properties that are vacant or under construction. Each category corresponds to one of the major divisions of the NFPA 901 coding system used by NFIRS. Each is quite different, and their cause profiles and magnitudes need to be examined separately.

This chapter focuses on non-residential properties over the 10-year period from 1987 to 1996, with specific attention on 1996. Significant changes from the last published statistics on non-residential properties—the Ninth Edition, 1985–1994—are noted.

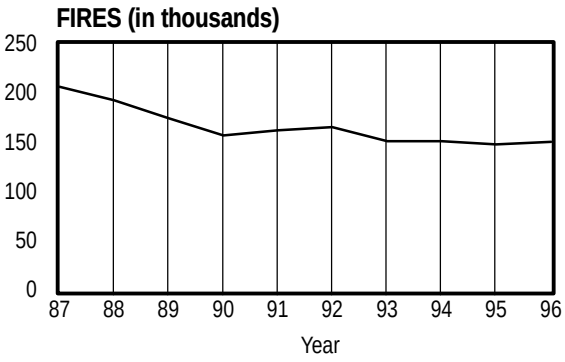
NON-RESIDENTIAL STRUCTURES

Magnitude and Trends

Much of the effort in fire prevention, both public and private, has focused on protecting non-residential structures, and the results have been highly effective in the main, especially relative to the residential fire problem. Even with all the diverse properties included here, non-residential structures consistently accounted for 5–8 percent of the fire deaths annually, as was shown in Figure 28, Chapter 2. They also accounted for 12–14 percent of all fire injuries, 32–47 percent of total fire dollar loss, and 8–9 percent of all fires.

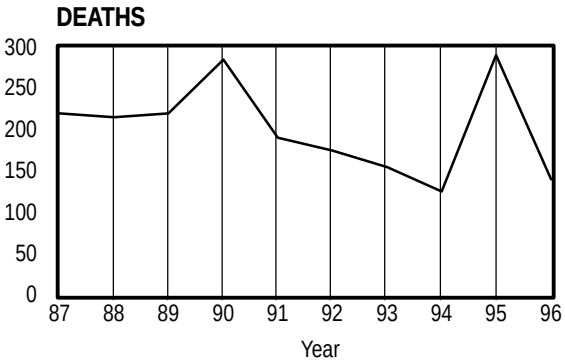
In absolute numbers, non-residential fire deaths from 1987 to 1996 dropped from 220 to 140, or 36 percent (Figure 69). During that 10-year period, there were two high peaks for deaths: 285 in 1990 and 290 in 1995. The 290 in 1995 can be attributed to the 165 people killed in the bombing of the Federal Building in Oklahoma City, and the 285 deaths in 1990 can be attributed to 87 people killed in a New York City social club. Figure 70 also shows that non-residential dollar loss adjusted to 1996 dollars and total fires trended downward, both by 27 percent. Deaths and injuries also declined significantly at 25 and 22 percent, respectively.

Figure 70 shows the relative magnitudes of the fire problem in non-residential structures by its component property categories for 1996. Fifty-six percent of the 73,325 reported non-residential property fires were at storage facilities, stores and offices, and outside or unknown structures. This is the same pattern as in the previous edition (1994). More than 60 percent of fire-related deaths occurred in storage facilities, stores and offices, and institutional properties. These numbers are not



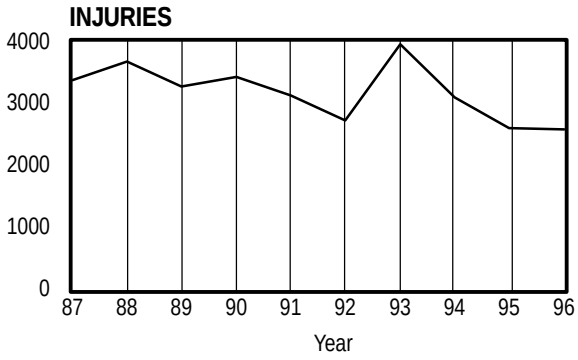
1987	206.5	1992	165.5
1988	192.5	1993	151.5
1989	174.5	1994	151.5
1990	157.0	1995	148.0
1991	162.5	1996	150.5

10-Year Trend = -26.9%



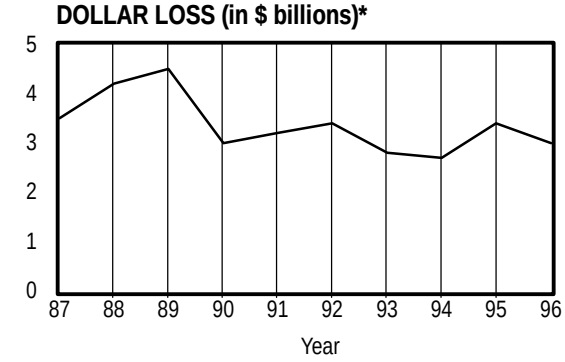
1987	220	1992	175
1988	215	1993	155
1989	220	1994	125
1990	285	1995	290
1991	190	1996	140

10-Year Trend = -25.4%



1987	3,375	1992	2,725
1988	3,675	1993	3,950
1989	3,275	1994	3,100
1990	3,425	1995	2,600
1991	3,125	1996	2,575

10-Year Trend = -22.0%



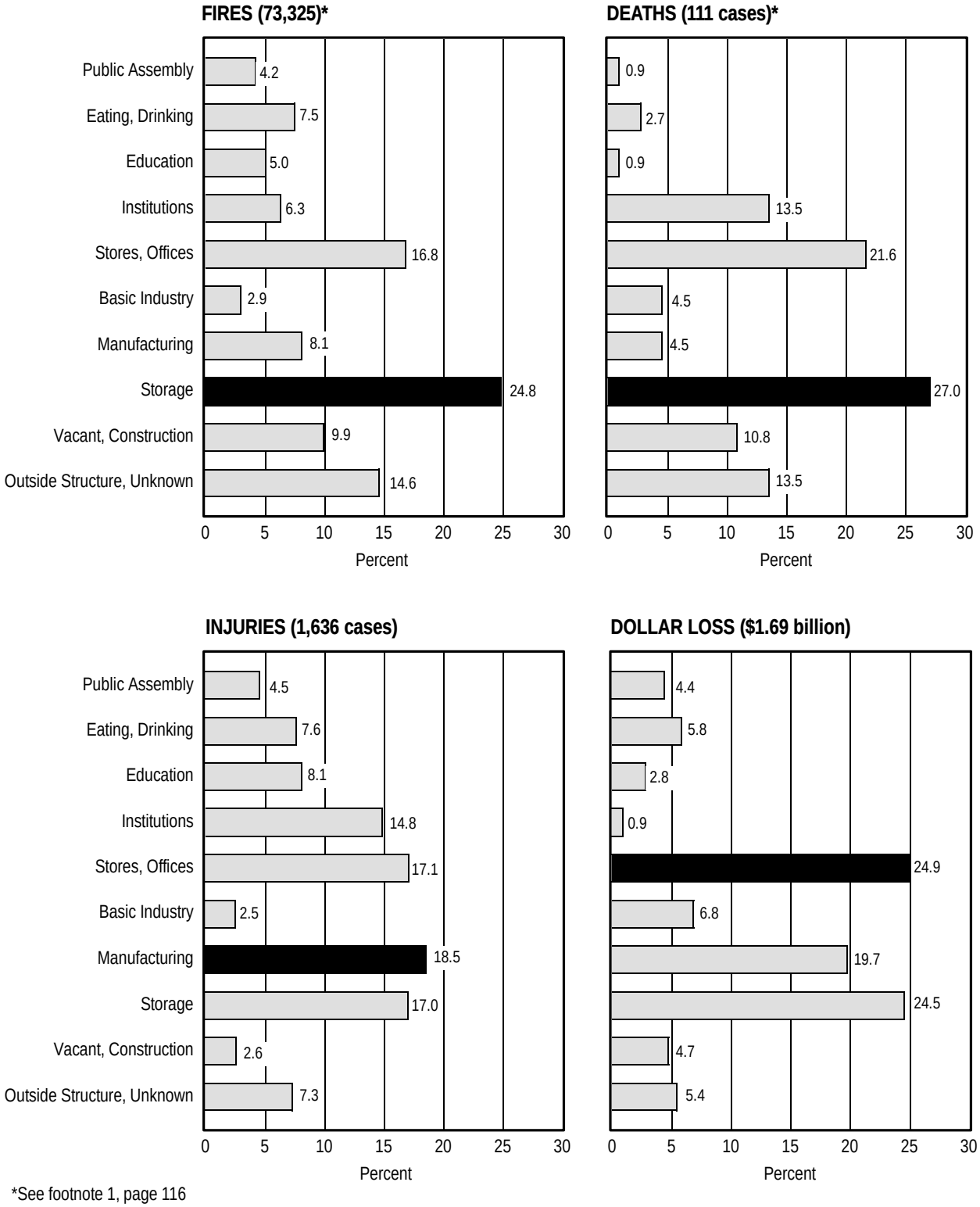
1987	$3.5	1992	$3.4
1988	4.2	1993	2.8
1989	4.5	1994	2.7
1990	3.0	1995	3.4
1991	3.2	1996	3.0

10-Year Trend = -27.0%

*Adjusted to 1996 dollars

Sources: NFPA Annual Surveys and Consumer Price Index

Figure 69. Trends in Non-Residential Structure Fires and Fire Losses



*See footnote 1, page 116

Source: NFIRS

Figure 70. 1996 Non-Residential Structure Fires and Fire Losses by Property Type

adjusted to reflect the 14 percent of deaths that were outside the structure or unknown—a category that decreased from 24 percent in 1994.[1] In 1996, deaths in storage fires ranked first, unchanged from 1994. Deaths in institutions dropped from 19 percent in 1994 to 14 percent in 1996.

The rank order of property types for fire injuries is as follows: manufacturing (19 percent), stores and offices (17 percent), storage facilities (17 percent), and institutional properties (15 percent). The only significant change from the 1994 statistics is that institutional properties fell from first place accounting for 21 percent of injuries in 1994 to fourth place in 1996. Of note is the high rate of fire-related injuries in manufacturing properties compared to the death totals in the same category (3 percent, down from 10 percent in 1994).

In terms of dollar loss, stores and offices and storage facilities accounted for nearly 50 percent of the total dollar loss; manufacturing properties accounted for an additional 20 percent of the loss.

The low rank ordering of some property categories should not obscure the fact that all of the categories have thousands of fires, multimillions of dollar loss, and hundreds of casualties. All parts of the fire problem need to be addressed. The relative magnitudes might help suggest where the greatest effort is needed.

When Fires Occur

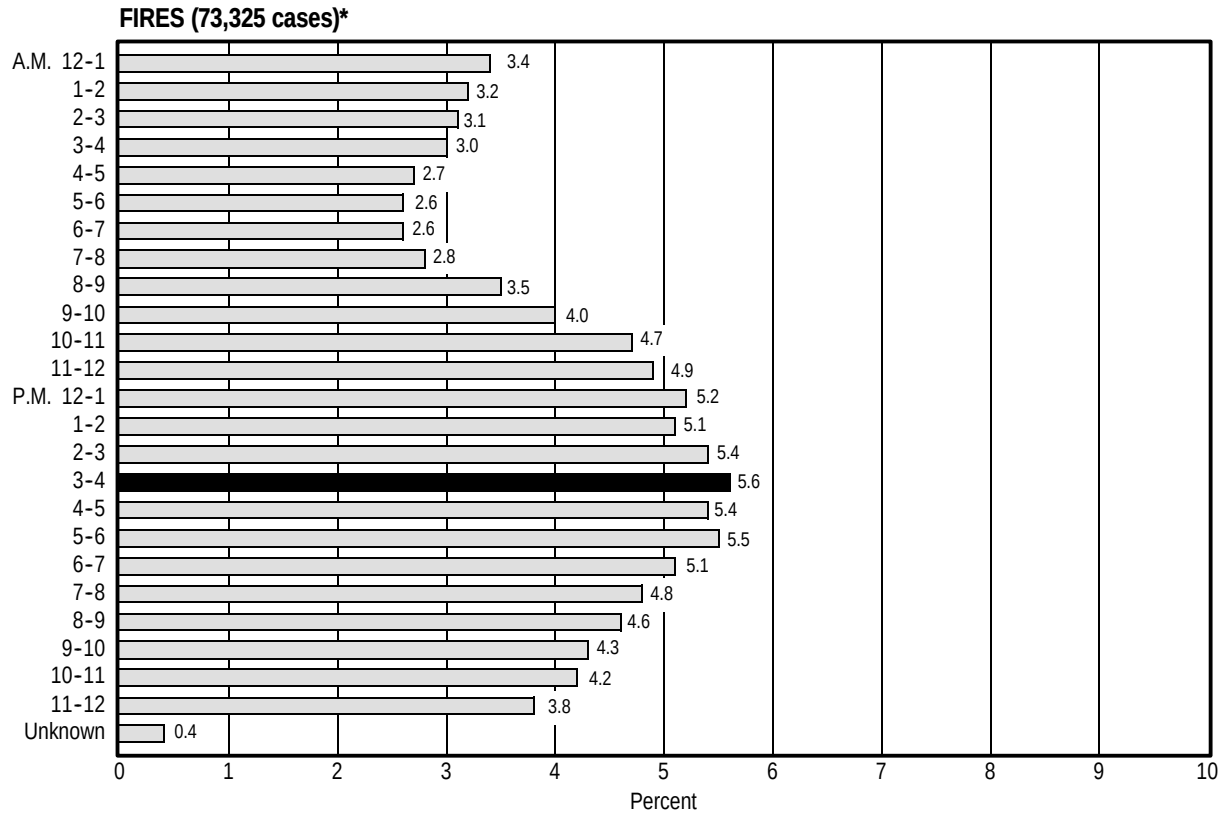
TIME OF DAY. Non-residential fires are a heterogeneous category, and the time of day when each of its different component property types peak may not agree with the overall picture, which is depicted in Figure 71. The incidence of all fires has the smoothest shape variation because it is based on the largest sample. Fires peak in the afternoon and evening, from noon to 7 p.m. Perhaps this is when workers are tiring on their job and are more accident prone or careless—but that is speculation.

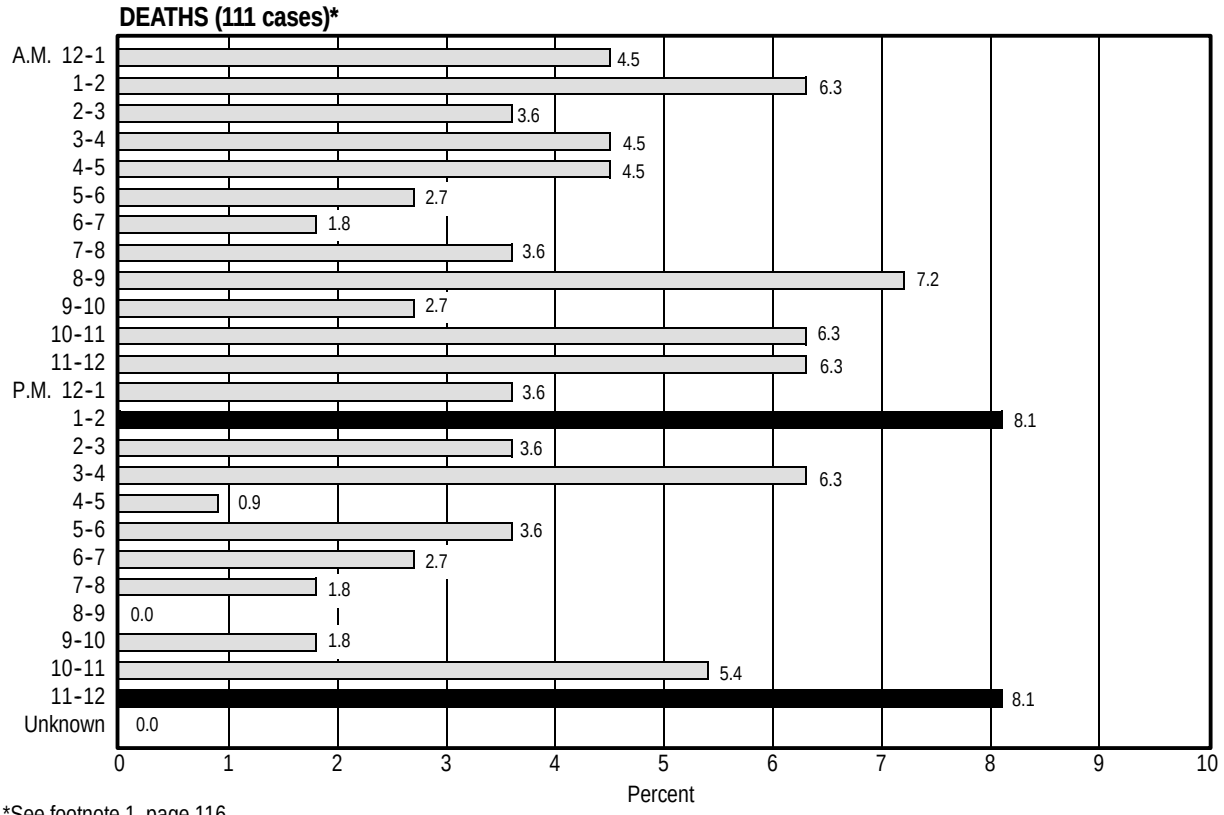
Fire deaths often fluctuate greatly because the sample of deaths in NFIRS is fewer than ten for most 1-hour intervals. Time of day for non-residential fire deaths, unlike residential fire deaths, roughly track the time of fires. Fire deaths have two high periods—late morning/early afternoon and late night. Peaks included 1–2 p.m. and 11–12 p.m., each accounting for 8 percent of the fires.

Injuries tend to be at fairly high levels throughout the normal workday and evening hours, with the highest concentration during the workday itself, 8 a.m.–5 p.m. Injuries peaked at 1–2 p.m., an hour later than 1994. Fire injuries are relatively low in the nighttime and early morning period when the majority of the workforce is at home.

Peak dollar losses occur after hours, especially between 10 p.m. and 6 a.m. The leading cause is suspected to be arson.

[1] The NFIRS total non-residential fire deaths have been adjusted for 56 structure fire deaths reported by the State of Michigan with no fixed property type, no cause, and no dollar loss.





*See footnote 1, page 116

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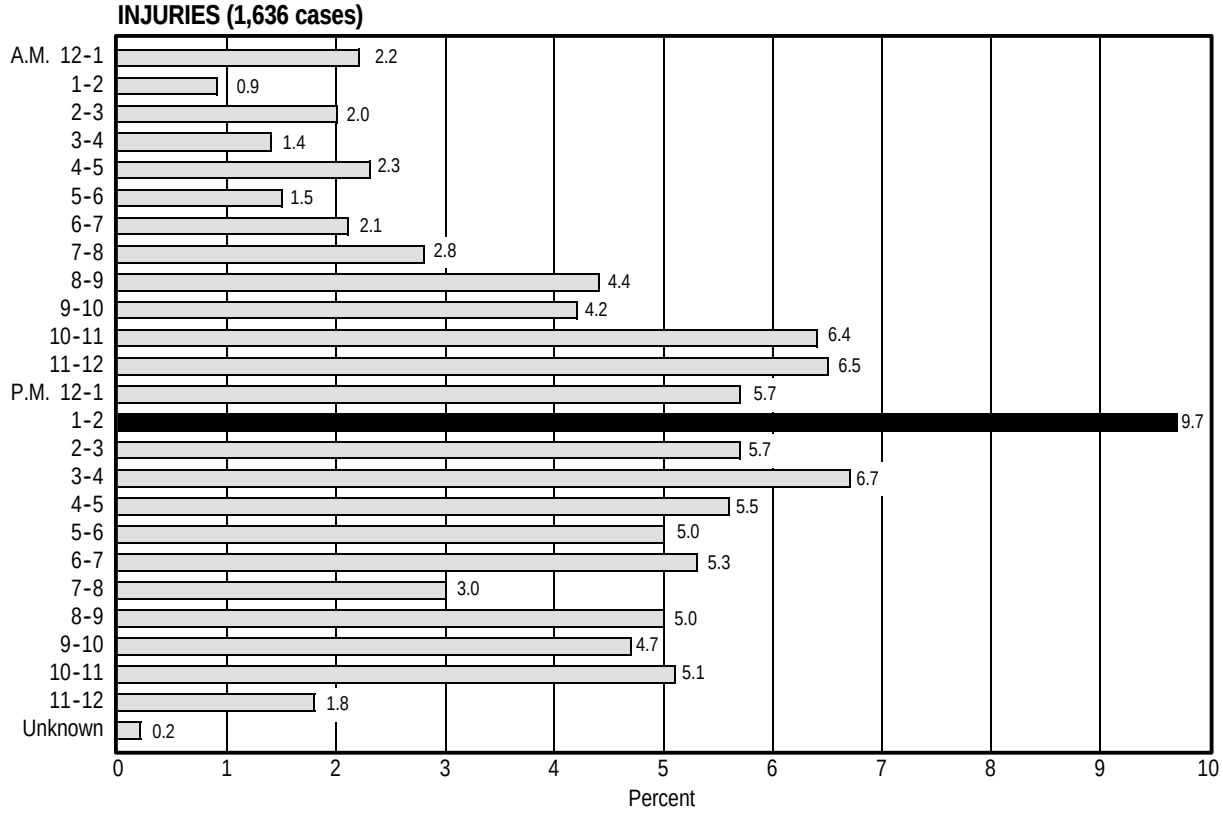
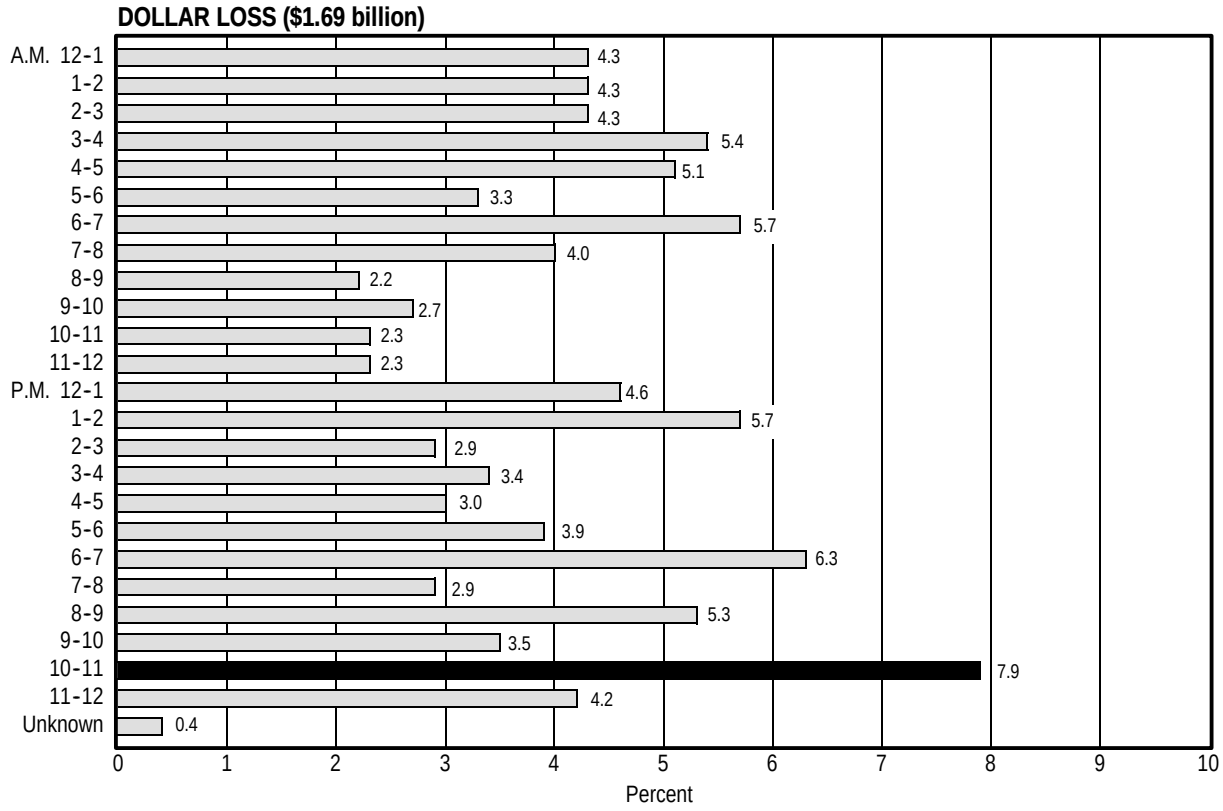
Figure 71. Time of Day of 1996 Non-Residential Structure Fires and Fire Losses

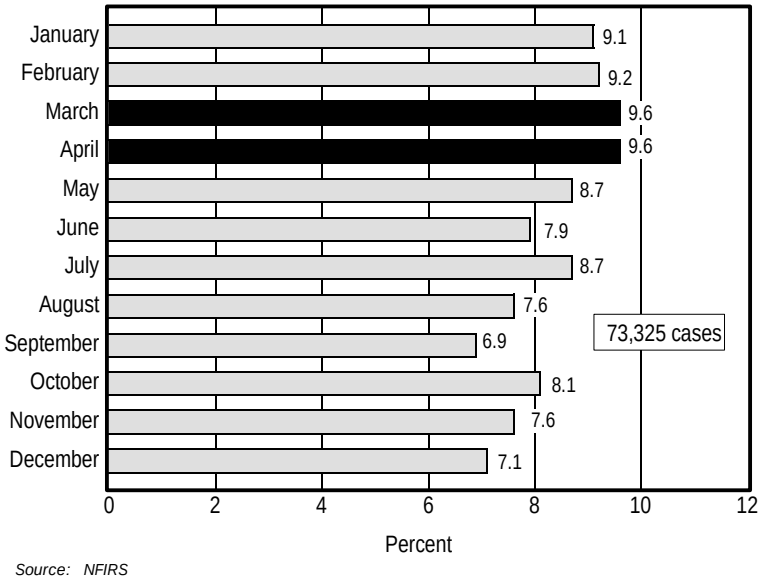




Source: NFIRS

Figure 71. Time of Day of 1996 Non-Residential Structure Fires and Fire Losses (cont'd)

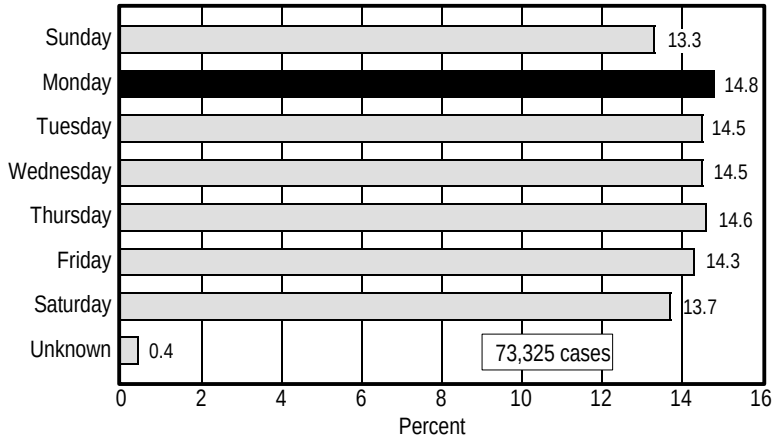
MONTH OF YEAR. Fires in non-residential properties are relatively uniform throughout the year (Figure 72). This pattern is consistent with previous years.



Source: NFIRS

Figure 72. Month of Year of 1996 Non-Residential Structure Fires

DAY OF WEEK. Non-residential fires are almost uniform by day of week, except that there are slightly fewer on Saturdays and Sundays when fewer people are at work (Figure 73). The profile is probably less uniform for subcategories of occupancies such as restaurants. There were no significant changes from the 1994 percentages.



Source: NFIRS

Figure 73. Day of Week of 1996 Non-Residential Structure Fires

Causes

As in all years, arson is by far the leading cause of non-residential fires (Figure 74). Arson also accounts for 28 percent (adjusted for unknowns) of the dollar loss and 34 percent of deaths. Historically, arson has accounted for the highest dollar loss and, like the overall number of fires, it has trended downward. An encouraging statistic is that incidents of smoking resulted in 9 percent of the deaths, a 10 percent drop over 1994. However, the incidents, injuries, and dollar loss associated with smoking remains the same as in years past.

The 10-year trends in causes of non-residential fires, deaths, injuries, and dollar loss are shown in Figure 75. In most years, arson was the leading cause in all fire and fire loss categories. The causes for deaths fluctuate considerably because of the smaller numbers of cases involved. Without question, arson is the major problem in non-residential occupancies, accounting for nearly three times the number of fires as any other cause.

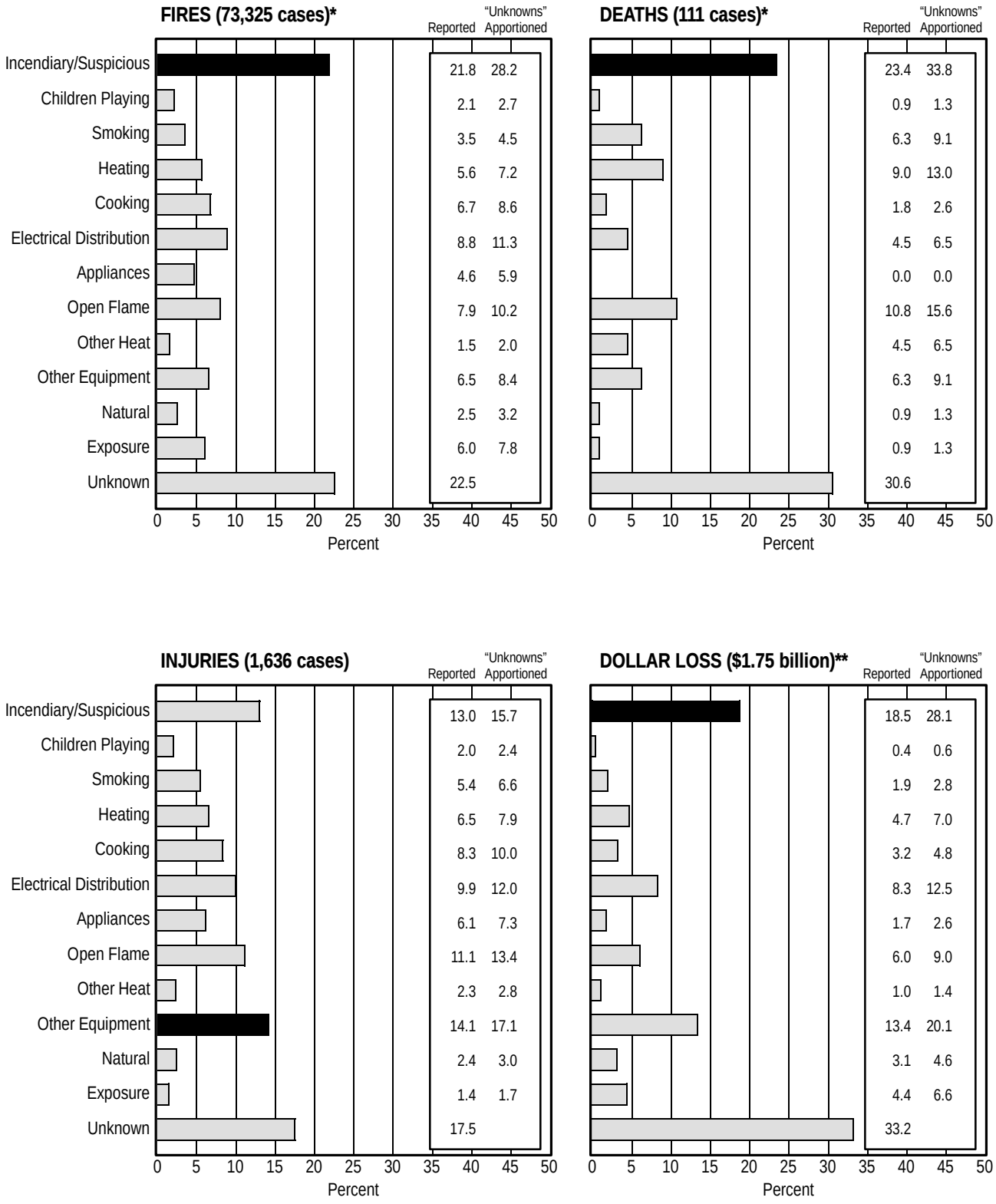
Causes by Detailed Property Type

Because the dollar loss and numbers of fires in non-residential occupancies are high, the causes in terms of these two measures are given in Figures 76–85 for each non-residential category. With minor variations, the data in 1996 are similar to each of the preceding 9 years. Table 22 summarizes the leading cause of fires and fire dollar loss for each non-residential property type in 1996. Arson was the leading cause of fires and dollar loss in six of the ten property types. Electrical distribution and open flame were also major contributors to fires and losses, and cooking was a factor in those non-residential structures that had kitchens.

Table 22. Leading Causes of 1996 Non-Residential Structure Fires and Dollar Loss

Property Type	Fires	Dollar Loss
Public Assembly	Arson	Arson
Eating, Drinking	Cooking	Cooking
Education	Arson	Arson
Institutions	Arson	Arson
Stores, Offices	Electrical Distribution	Arson
Basic Industry	Electrical Distribution	Other Equipment
Manufacturing	Other Equipment	Other Equipment
Storage	Arson	Other Equipment
Vacant, Construction	Arson	Arson
Outside Structures, Unknown	Arson	Arson

Source: NFIRS

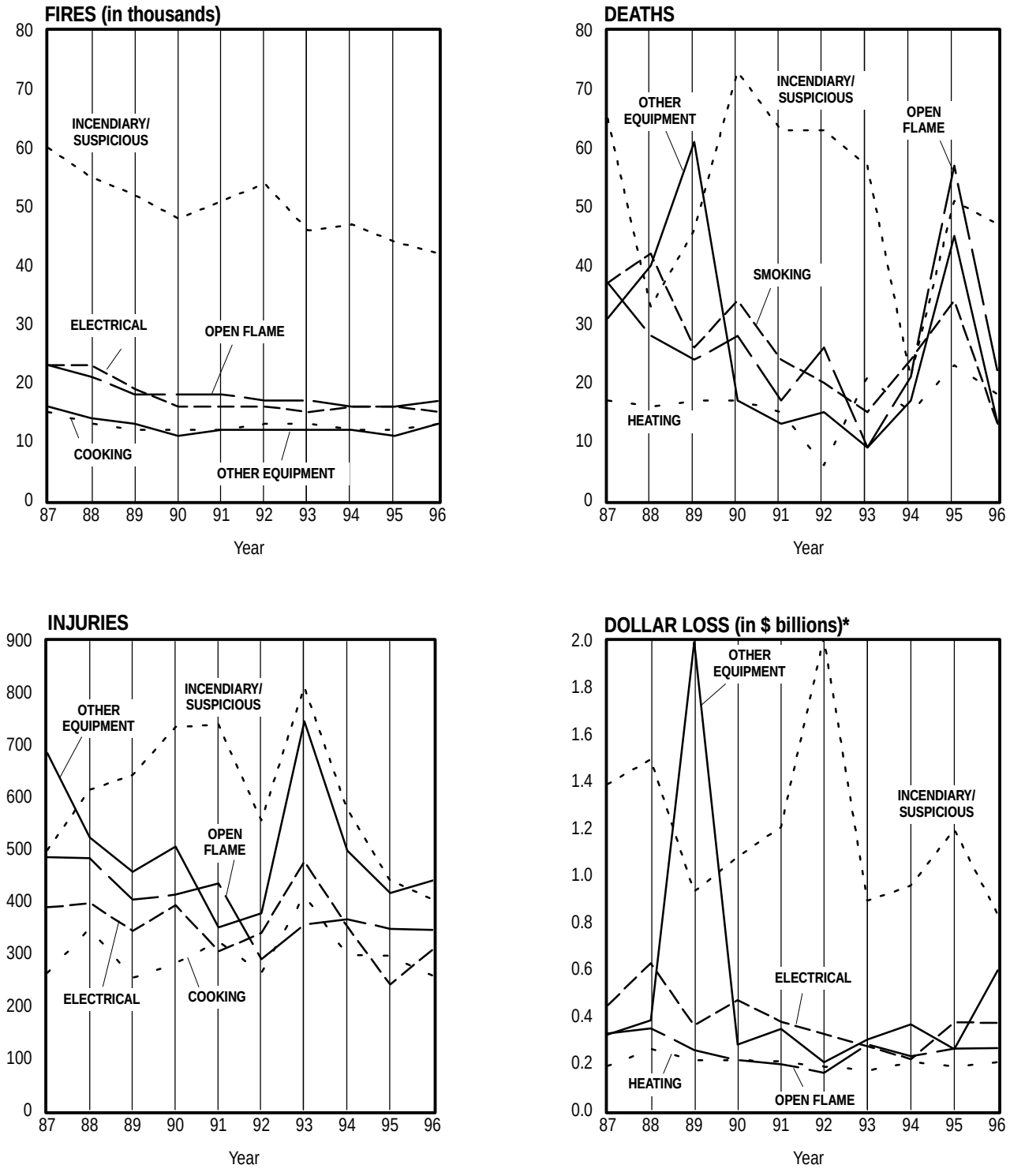


*See footnote 1, page 116

** For those fires where no property loss estimate was documented, an average loss was assumed.

Source: NFIRS

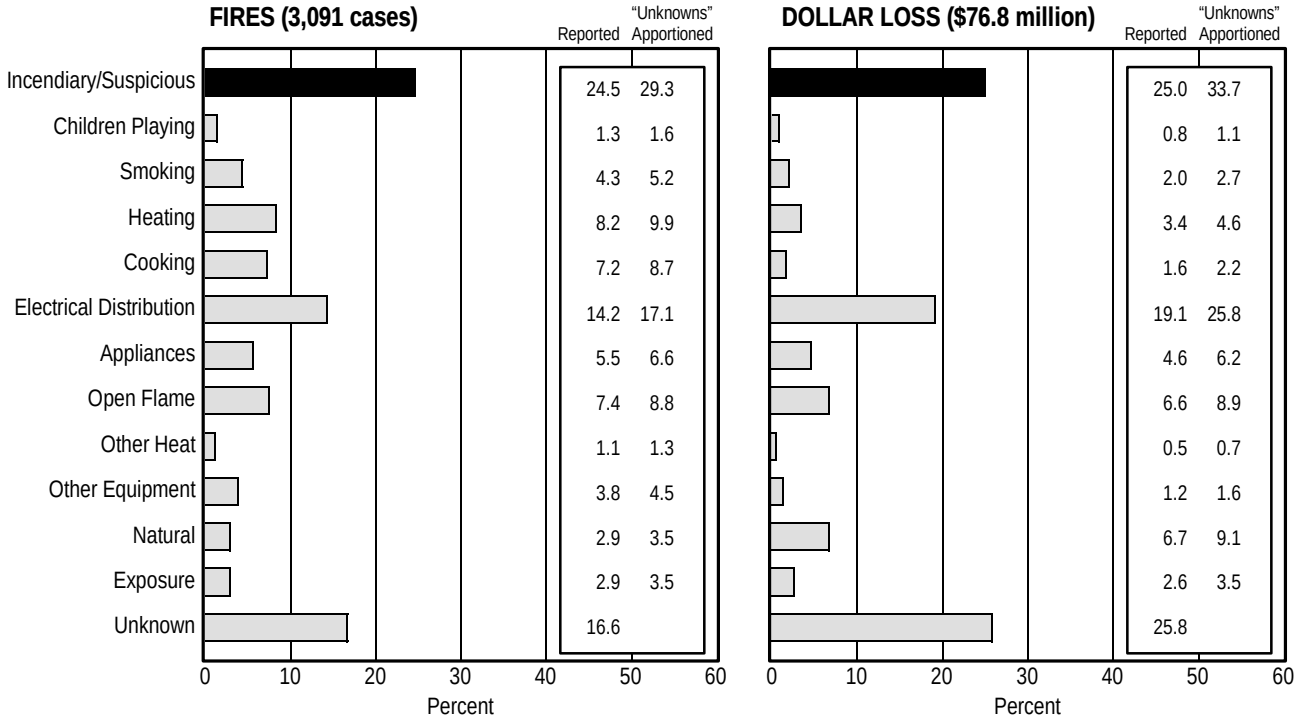
Figure 74. Causes of 1996 Non-Residential Structure Fires and Fire Losses



Note: Data for all 12 causes are provided in Appendix B, Table B-4.

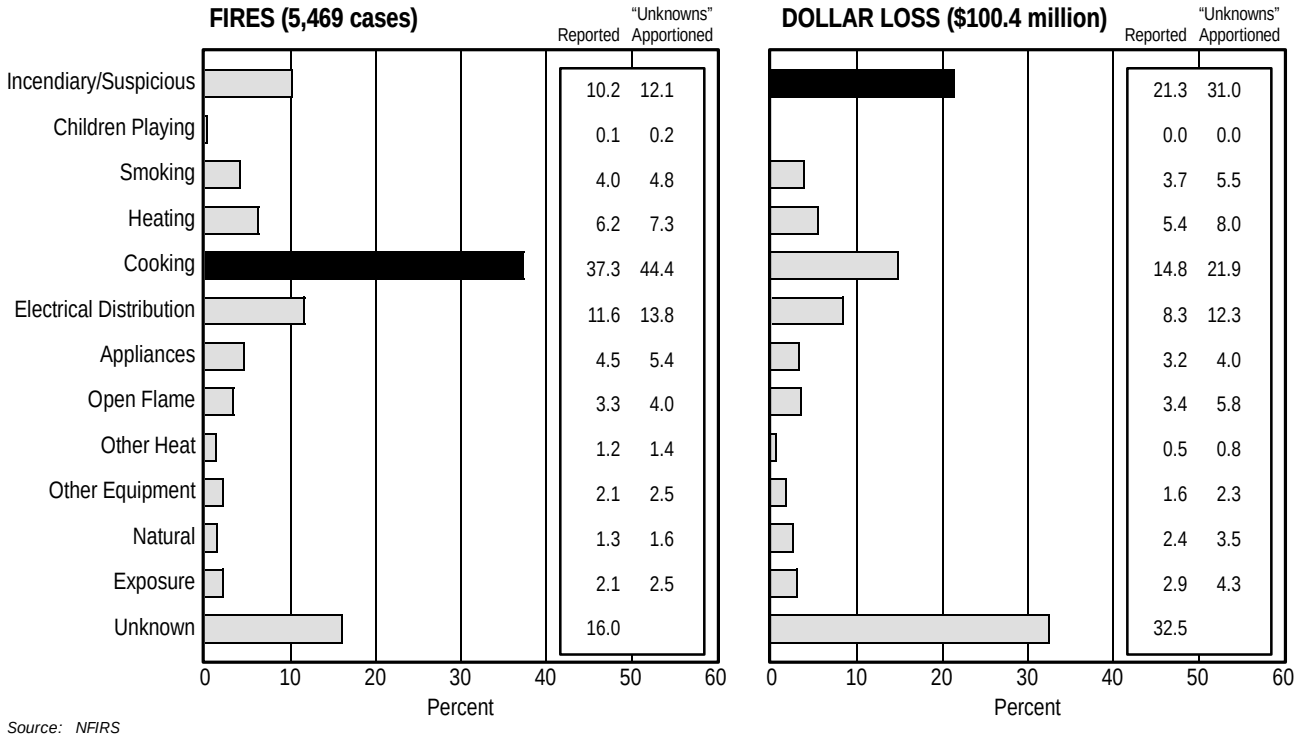
Sources: NFIRS and NFPA Annual Surveys

Figure 75. Trends in Leading Causes of Non-Residential Structure Fires and Fire Losses



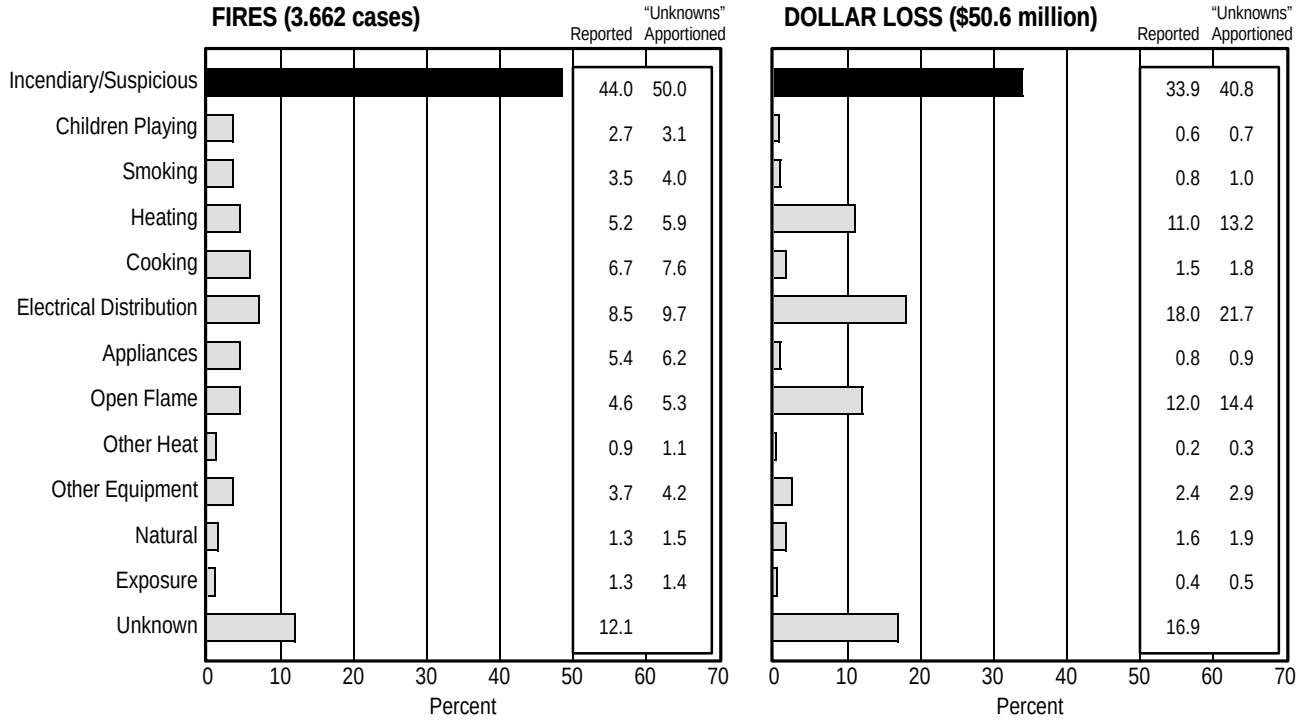
Source: NFIRS

Figure 76. Causes of 1996 Public Assembly Structure Fires and Dollar Loss



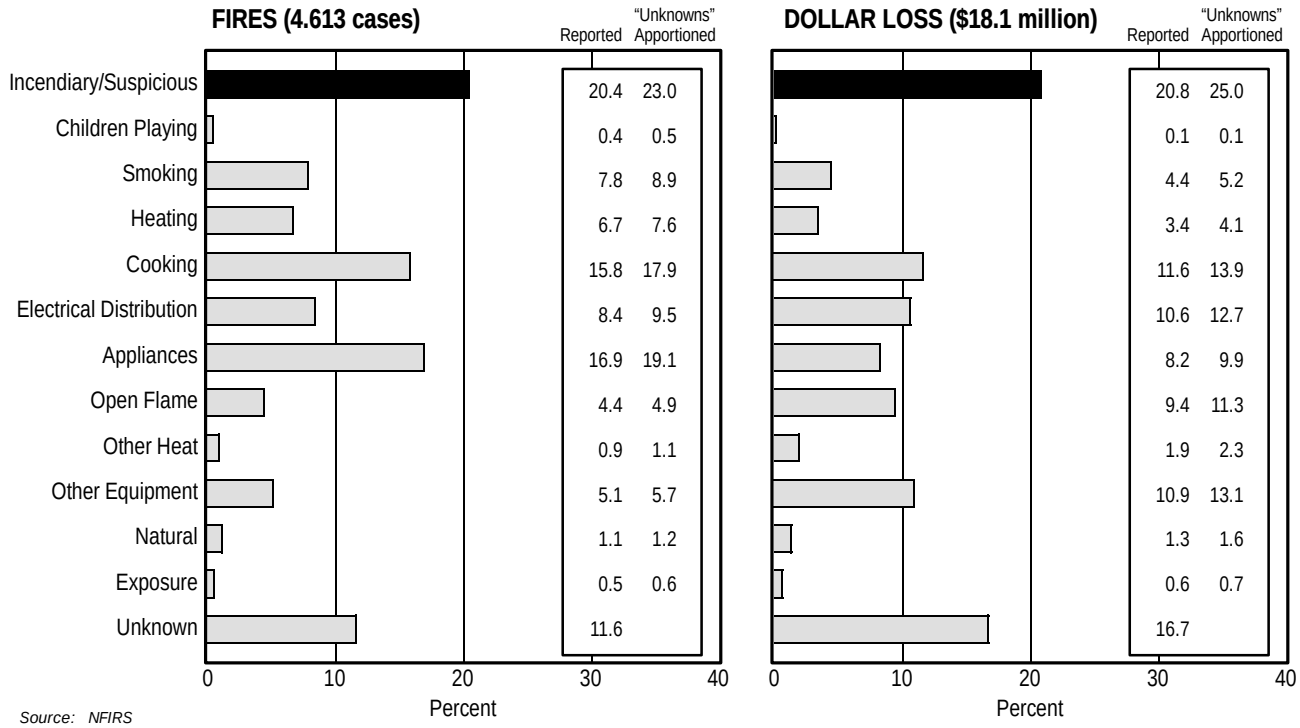
Source: NFIRS

Figure 77. Causes of 1996 Eating and Drinking Establishment Fires and Dollar Loss



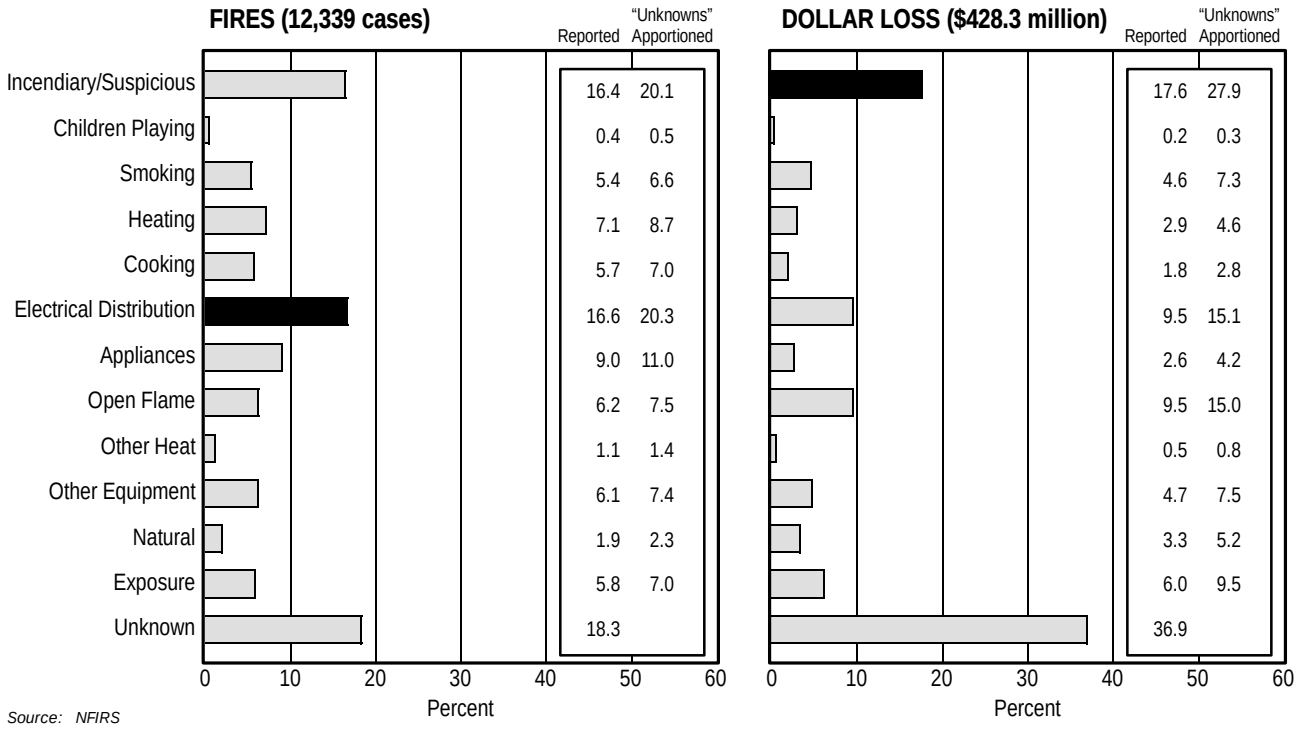
Source: NFIRS

Figure 78. Causes of 1996 Education Structure Fires and Dollar Loss



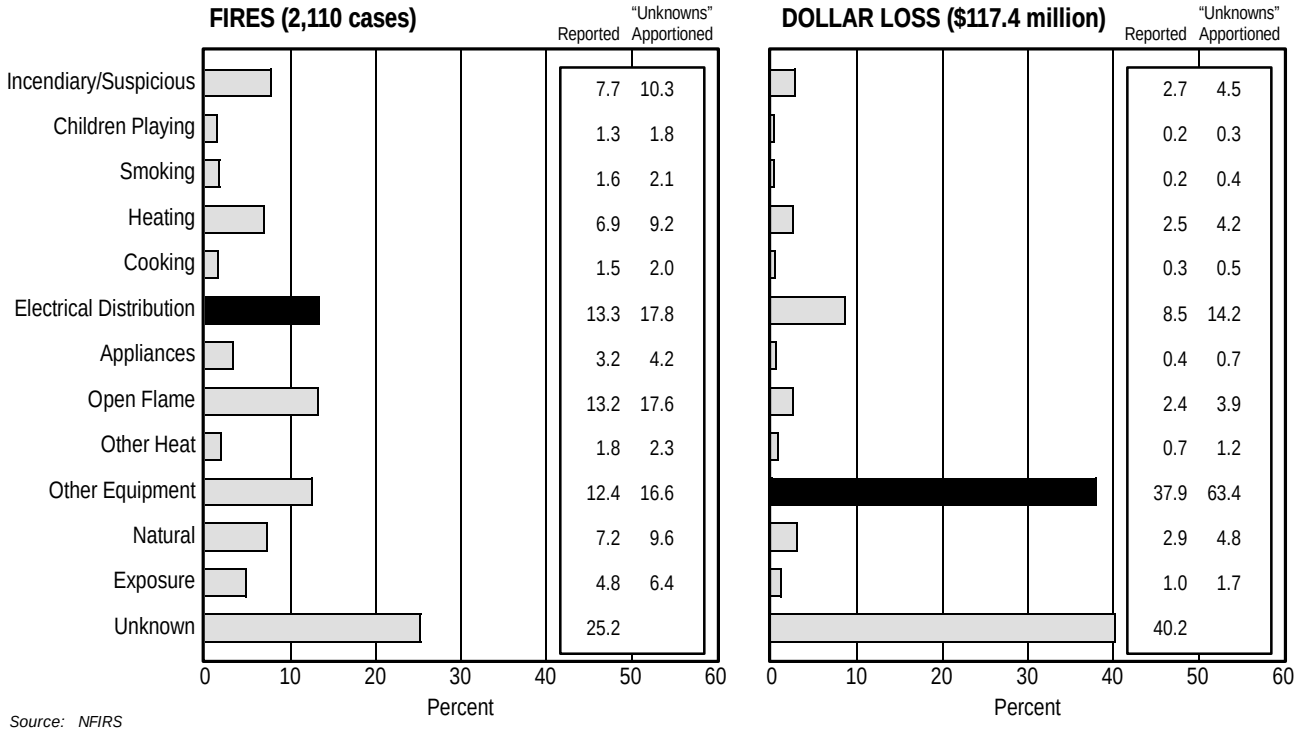
Source: NFIRS

Figure 79. Causes of 1996 Institutional Structure Fires and Dollar Loss



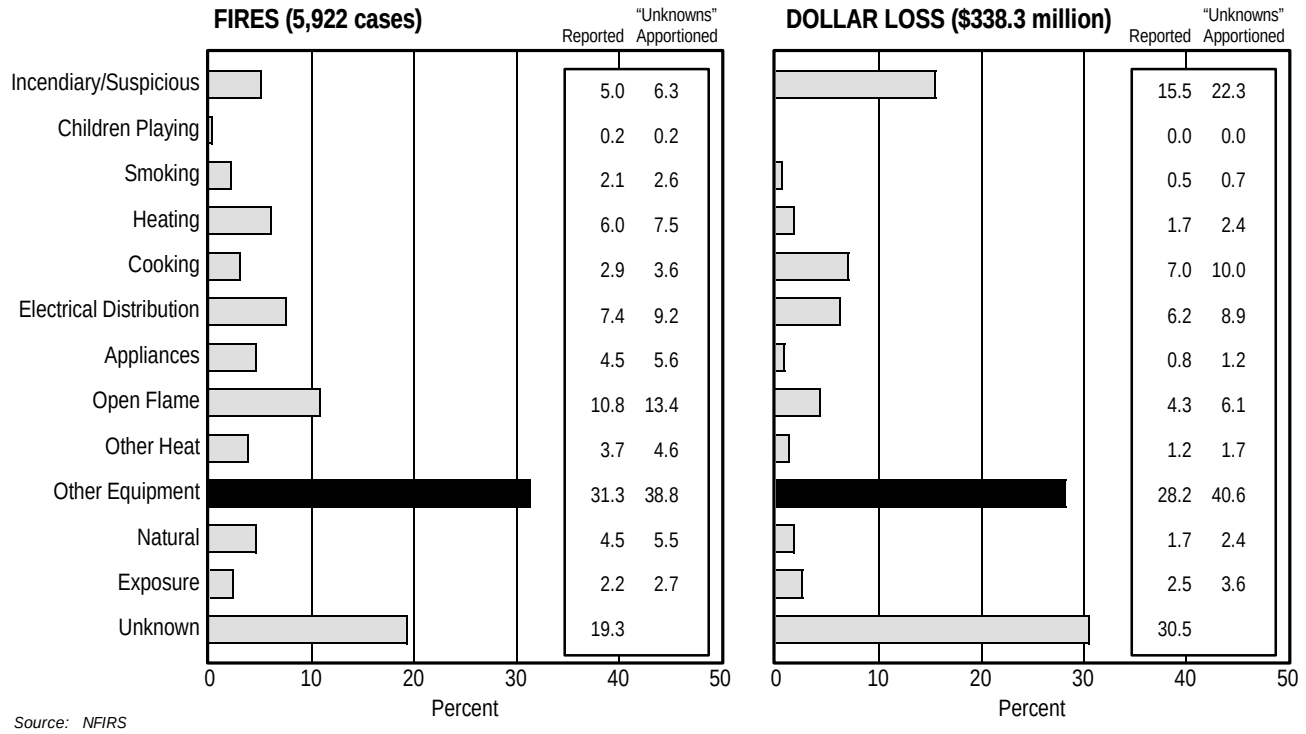
Source: NFIRS

Figure 80. Causes of 1996 Store and Office Fires and Dollar Loss



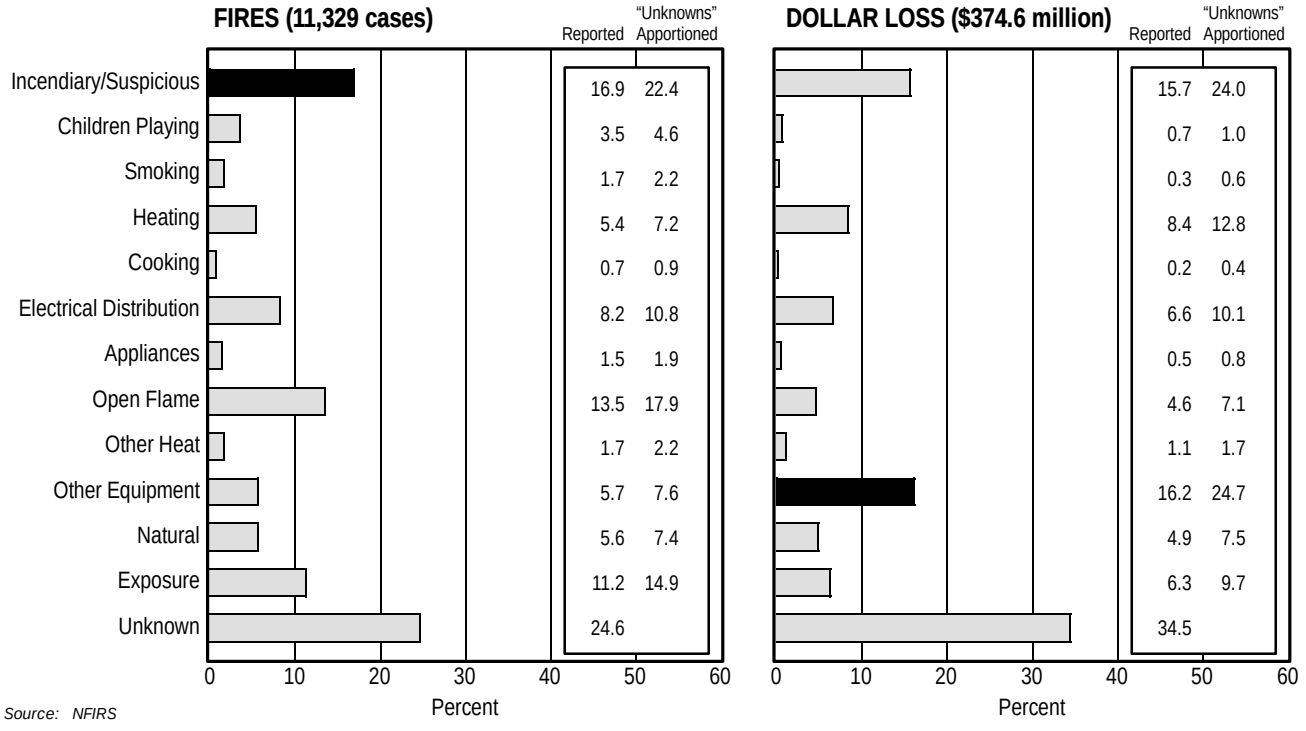
Source: NFIRS

Figure 81. Causes of 1996 Basic Industry Structure Fires and Dollar Loss



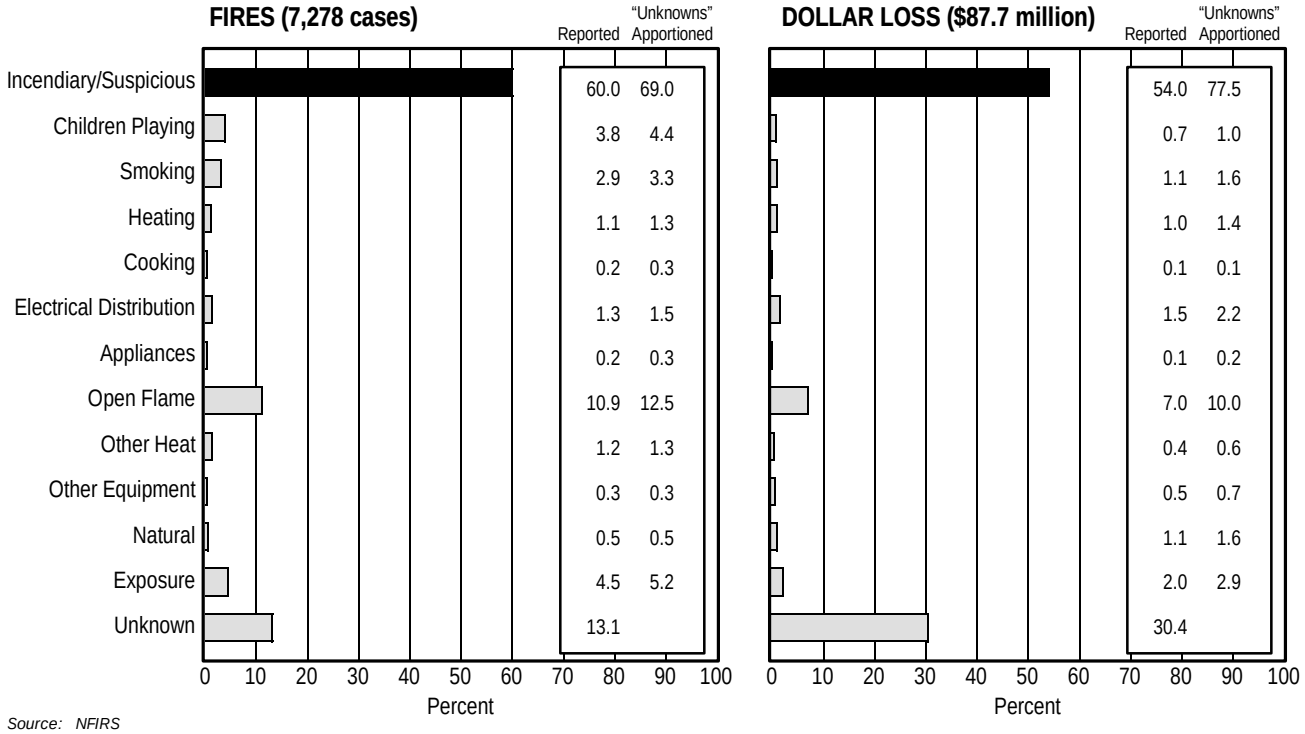
Source: NFIRS

Figure 82. Causes of 1996 Manufacturing Structure Fires and Dollar Loss



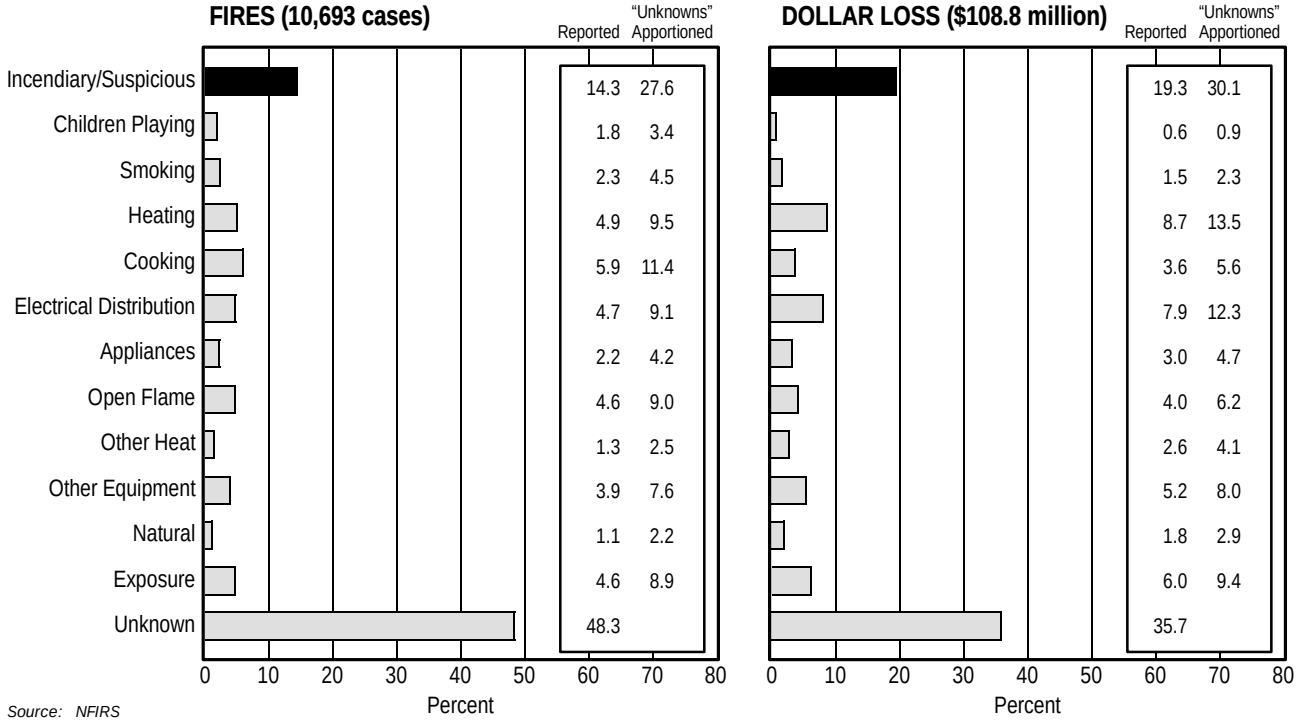
Source: NFIRS

Figure 83. Causes of 1996 Storage Structure Fires and Dollar Loss



Source: NFIRS

Figure 84. Causes of 1996 Vacant and Construction Structure Fires and Dollar Loss



Source: NFIRS

Figure 85. Causes of 1996 Outside Structure and Unknown Fires and Dollar Loss

Sprinkler Performance

Sprinkler systems with partial or complete coverage were reported being present in just 13 percent (unadjusted) of all non-residential structure fires in 1996 (Figure 86). Over 10 years, the trend in sprinkler installation has increased (Figure 87), but there has been little change since 1994.

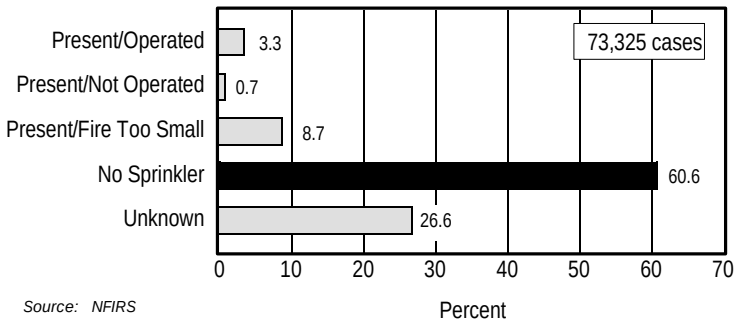
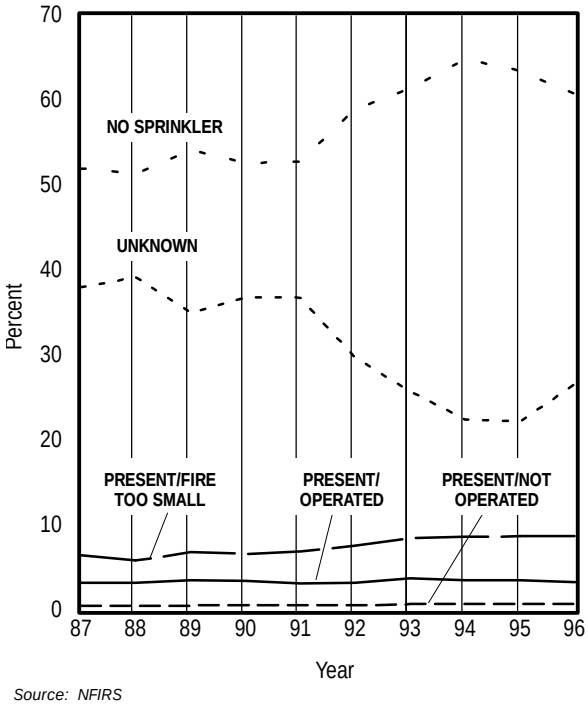


Figure 86. Sprinkler Performance in 1996 Non-Residential Structure Fires

Over the past 10 years, sprinklers were reported to have operated in only 3–4 percent of fires. In 9 percent of non-residential structure fires, sprinkler systems were in place, but the system failed to activate because the fire was too small or the fire was in a part of the building away from the sprinklered area.

How effective are sprinklers? It is hard to tell from the NFIRS data alone because the comparisons need to be made for similar properties with similar fire loads, with and without sprinklers. Since NFIRS combines properties of different size and values in the same fixed property class, the data

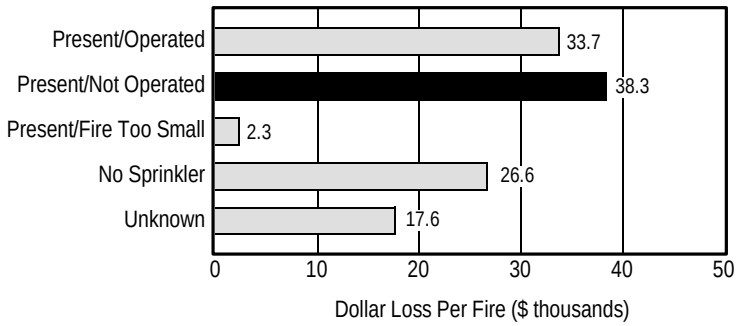


	Present/ Operated	Present/ Not Operated	Present/ Fire Too Small	No Sprinkler	Unknown
1987	3.2%	0.5%	6.4%	51.9%	38.0%
1988	3.2	0.5	5.8	51.3	39.2
1989	3.5	0.6	6.8	54.1	35.0
1990	3.4	0.6	6.6	52.6	36.8
1991	3.1	0.6	6.9	52.8	36.7
1992	3.2	0.6	7.6	58.9	29.7
1993	3.7	0.7	8.5	61.4	25.7
1994	3.5	0.7	8.6	64.8	22.4
1995	3.5	0.7	8.7	63.4	22.2
1996	3.3	0.7	8.7	60.6	26.6

Figure 87. Trends in Sprinkler Performance in Non-Residential Structure Fires

need to be viewed cautiously. Sprinkler systems are more likely to be installed in large and highly valued properties than in small, inexpensive ones. The sprinkler system in a large warehouse may do an excellent job of containing a fire and yet the loss for the fire may be larger than for a fire in an unsprinklered small storage building.

One way around this problem is to compare losses when sprinklers were present and operated versus when they were present and did not operate for a reason other than the fire being too small (that is, the cases where the sprinkler failed or the fire was not near the sprinklered area). The presumption is that the places with sprinklers, whether they went off or not, are more similar to each other than to places that did not have sprinklers. As shown in Figure 88, the losses per fire were less when sprinklers operated than when they did not. However, the difference in 1996 is far less than in 1994 when the dollar loss per fire was twice as high when sprinklers did not operate. This suggests the need for additional analysis as to the effectiveness of sprinklers in the properties where they are installed.



Source: NFIRS

Figure 88. Sprinkler Performance in 1996 Non-Residential Structure Dollar Loss Per Fire

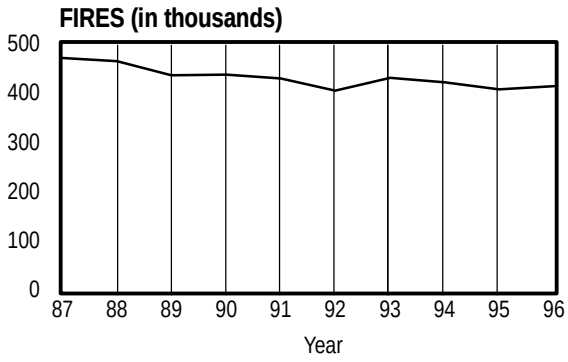
VEHICLES AND OTHER MOBILE PROPERTIES

Vehicles and other types of mobile properties include all means of transportation. They account for a larger portion of the fire problem than most people realize. From 1987 to 1996, vehicles have averaged 17 percent of fire deaths, 11 percent of fire injuries, 14 percent of fire losses, and 24 percent of all reported fires—nearly one in every four fires.

The vast majority of fires, casualties, and property loss from mobile property involves cars and trucks, with cars clearly dominating this group. Fire departments respond to about as many fires involving vehicles as they do involving residences.

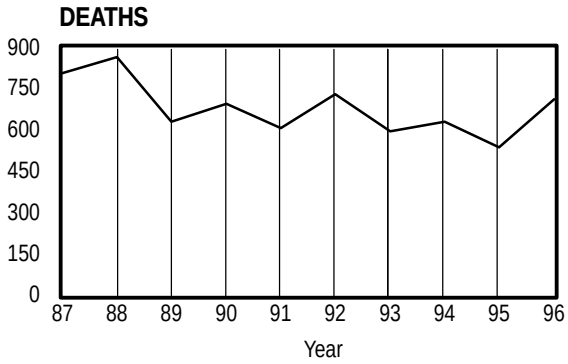
Overview of Trends

The trends in mobile property fires, fire deaths, injuries, and property loss are shown in Figure 89. Total fires decreased 13 percent over the 10-year period 1987–1996 according to NFPA annual surveys. Fire deaths and injuries have trended down sharply (24 and 26 percent, respectively). The downward trend of mobile property fire deaths would have been even greater, but in 1996



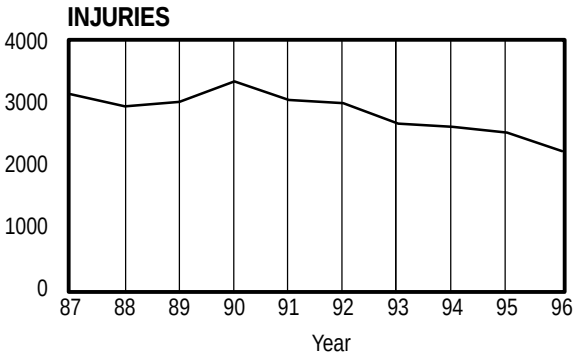
1987	471	1992	405
1988	464	1993	421
1989	436	1994	422
1990	437	1995	407
1991	429	1996	414

10-Year Trend = -12.6%



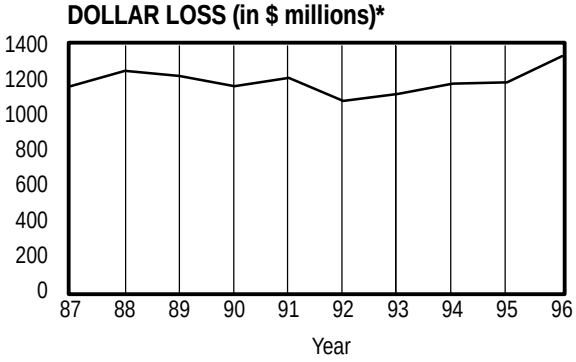
1987	805	1992	730
1988	865	1993	595
1989	630	1994	630
1990	695	1995	535
1991	605	1996	710

10-Year Trend = -23.6%



1987	3,150	1992	3,000
1988	2,950	1993	2,675
1989	3,025	1994	2,625
1990	3,350	1995	2,525
1991	3,050	1996	2,225

10-Year Trend = -25.6%



1987	$1,163	1992	$1,079
1988	1,248	1993	1,118
1989	1,219	1994	1,176
1990	1,161	1995	1,186
1991	1,208	1996	1,333

10-Year Trend = -2.9%

*Adjusted to 1996 dollars

Sources: NFPA Annual Surveys and Consumer Price Index

Figure 89. Trends in Mobile Property Fires and Fire Losses

the aviation industry suffered two catastrophes: the ValueJet crash in May, killing 109 people, and the TWA crash in July, resulting in 230 deaths. These two disasters account for nearly 48 percent of the 710 mobile property fire-related deaths reported in the NFPA annual survey.

Types of Vehicles

Figure 90 shows that the vast majority of mobile property deaths, fires, injuries, and dollar loss are highway vehicles. The complexity and ambiguity in counting plane and boat fires associated with accidents are described in a later section titled "Special Data Problems."

Although the 10-year trend in highway vehicle fires, deaths, and injuries show substantial decreases (13–46 percent), the dollar loss has trended up 4 percent. This may be due to the rising cost of automobiles and trucks. The increase in the death trend in the other category is due to the small numbers involved.

Figure 91 gives more details on the relative proportions of the reported fire problem by type of vehicle in 1996. Automobiles and other passenger vehicles such as vans and buses outnumber trucks by three to one in fire deaths and four to one in both injuries and property loss. And automobiles have eight times as many fires as trucks. On a per-incident basis, trucks have the more serious problem, but there are vastly more car fires than truck fires. These statistics are relatively unchanged from 1994.

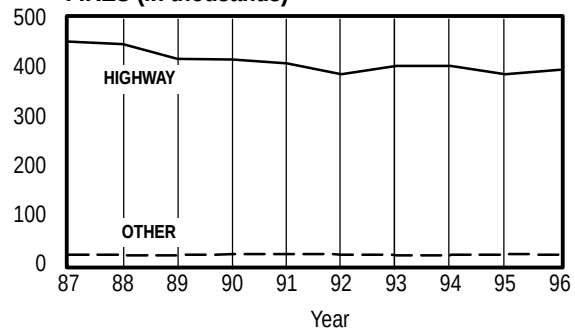
Causes

For the most part, vehicle fires have one of four origins: the aftermath of a collision, the result of a mechanical failure, the result of an act of carelessness, or the result of arson. In 1996, most vehicle fire deaths (61 percent) follow collisions, even though collisions are the cause of only 2 percent of vehicle fires (Figure 92). These numbers are largely unchanged from 1994. Preventing such fires is largely the purview of the U.S. Department of Transportation, state and local motor vehicle agencies, and the police, but fire departments are almost always called to the scene when there is a fire or the potential of a fire.

Adjusted for unknowns, 67 percent of all fires in vehicles and 45 percent of the associated injuries come from mechanical or design problems such as broken fuel lines, faulty catalytic converters, overheating, etc.

Fires of incendiary or suspicious origin account for one in six automobile and mobile property fires. Many vehicle fires are not even investigated for arson, though some insurance companies are at least investigating the most suspicious or obviously incendiary fires before paying insurance claims. However, the arson problem may well be understated from the noninvestigation of these incidents.

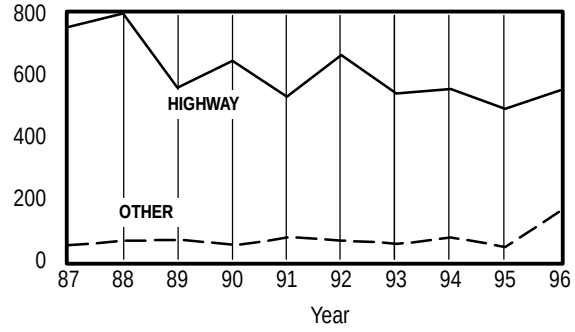
FIRES (in thousands)



	Highway	Other		Highway	Other
1987	451	20	1992	386	20
1988	446	19	1993	402	19
1989	416	20	1994	402	20
1990	415	22	1995	386	21
1991	407	22	1996	395	19

10-Year Highway Trend = -13.1%
10-Year Other Trend = -3.0%

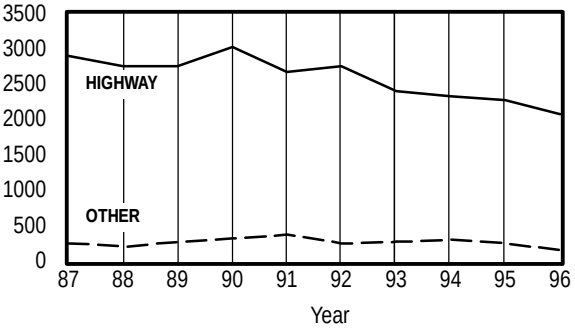
DEATHS



	Highway	Other		Highway	Other
1987	755	50	1992	665	65
1988	800	65	1993	540	55
1989	560	70	1994	555	75
1990	645	50	1995	490	45
1991	530	75	1996	550	160

10-Year Highway Trend = -46.6%
10-Year Other Trend = +68.8%

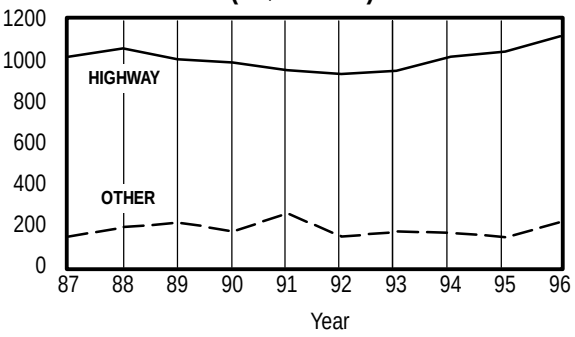
INJURIES



	Highway	Other		Highway	Other
1987	2,900	250	1992	2,750	250
1988	2,750	200	1993	2,400	275
1989	2,750	275	1994	2,325	300
1990	3,025	325	1995	2,275	250
1991	2,765	375	1996	2,075	150

10-Year Highway Trend = -26.7%
10-Year Other Trend = -13.4%

DOLLAR LOSS (in $ millions)*



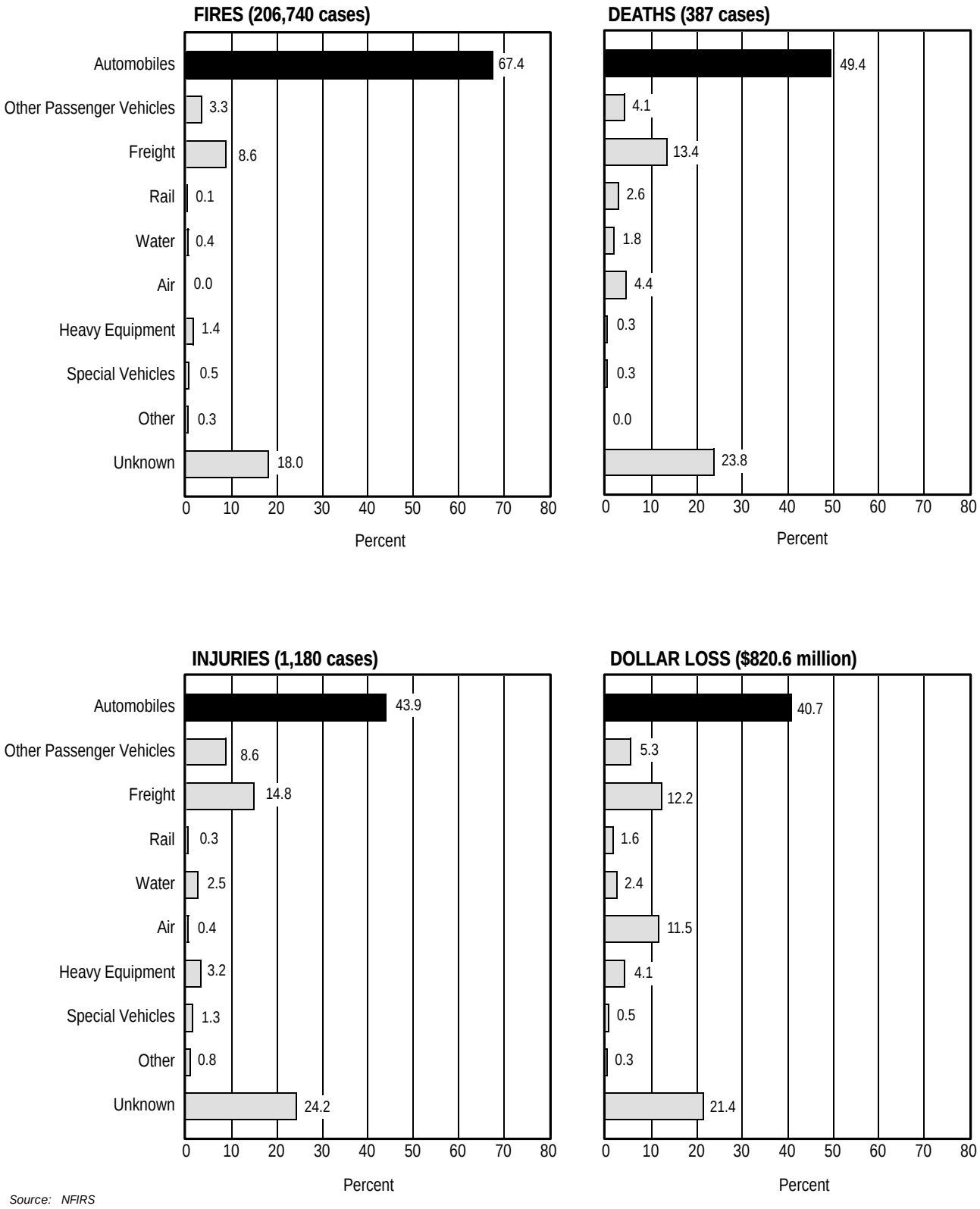
	Highway	Other		Highway	Other
1987	$1,019	144	1992	$ 933	146
1988	1,058	190	1993	950	168
1989	1,006	213	1994	1,017	159
1990	990	170	1995	1,043	143
1991	953	256	1996	1,117	216

10-Year Highway Trend = +3.8%
10-Year Other Trend = -1.8%

*Adjusted to 1996 dollars

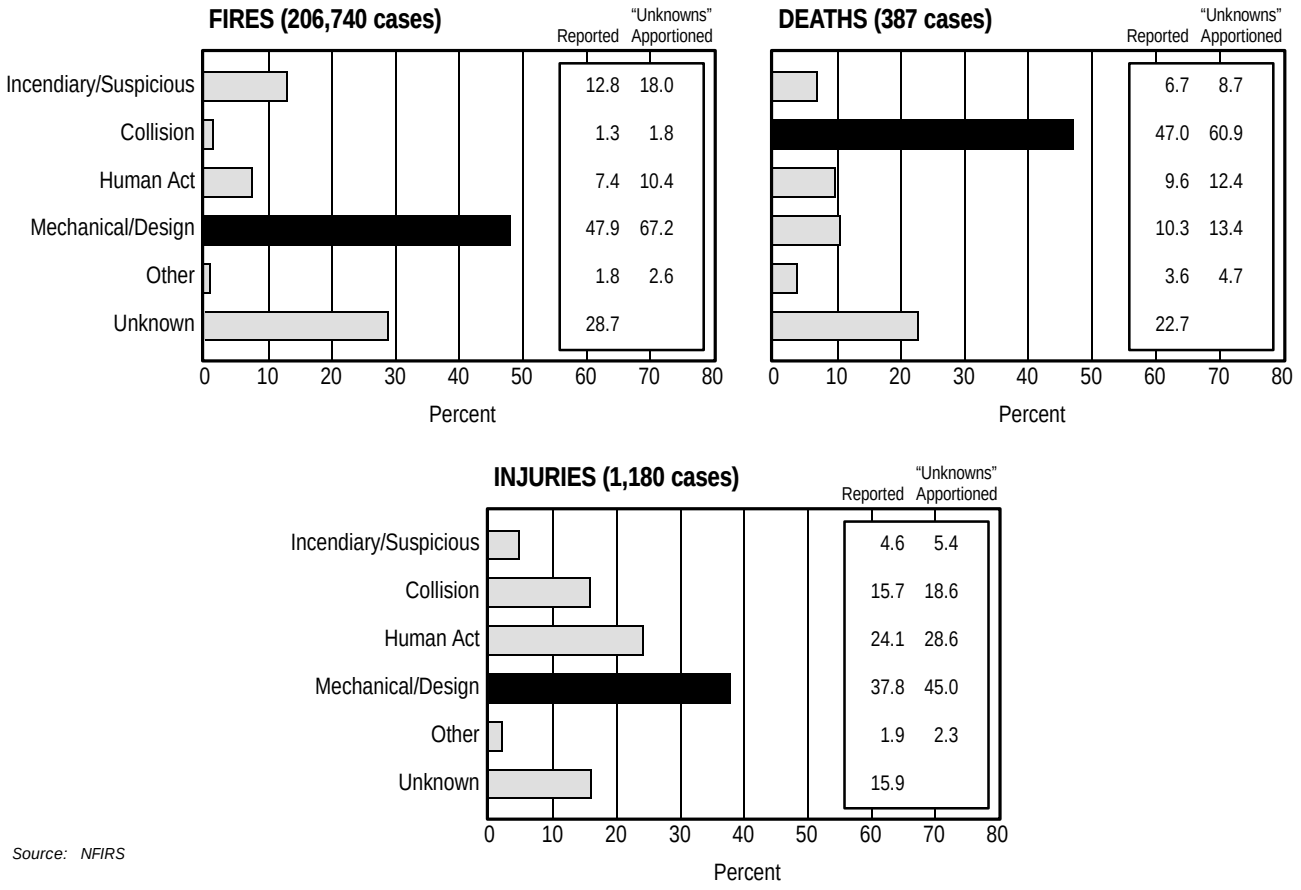
Sources: NFPA Annual Surveys and Consumer Price Index

Figure 90. Trends in Highway vs. Other Mobile Property Fires and Fire Losses



Source: NFIRS

Figure 91. 1996 Mobile Property Fires and Fire Losses by Vehicle Type



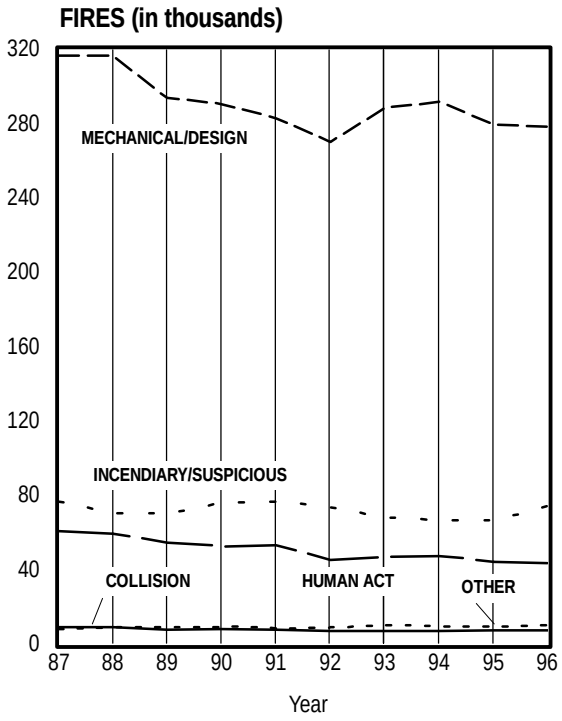
Source: NFIRS

Figure 92. Ignition Factors for 1996 Mobile Property Fires and Fire Casualties

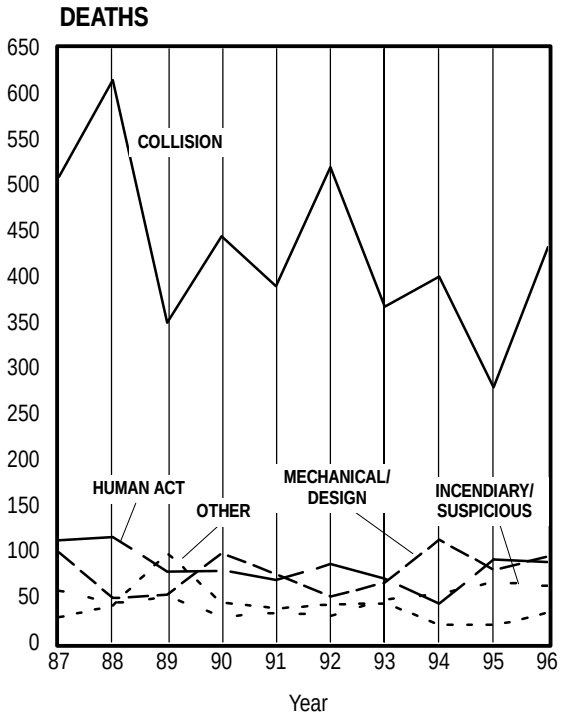
Carelessness (human act), including causes such as dropped or discarded cigarettes on the upholstery, parking over dry leaves with a hot catalytic converter, and misuse of flammable liquids, especially gasoline, while servicing or maintaining the car, is another major cause of vehicle fires. Carelessness accounts for 29 percent of vehicle fire injuries, though only 10 percent of fires.

In each of the past 10 years, the top ignition factors for fires (mechanical/design), deaths (collision), and injuries (mechanical/design) have remained the same (Figure 93). The upward trend of deaths from collisions was interrupted in 1989 and again in 1995, which saw sharp drops, but deaths increased in each of the following years. Injuries from mechanical or design factors reached their highest level in 1993 but dropped to their lowest level in 1996. The 10-year arson-related trend has remained somewhat steady.

Because automobile fires are such a large part of the entire mobile property fire problem, the cause profiles for automobile fires in 1996 are extremely similar to those for mobile properties (Figure 94 compared to Figure 92).



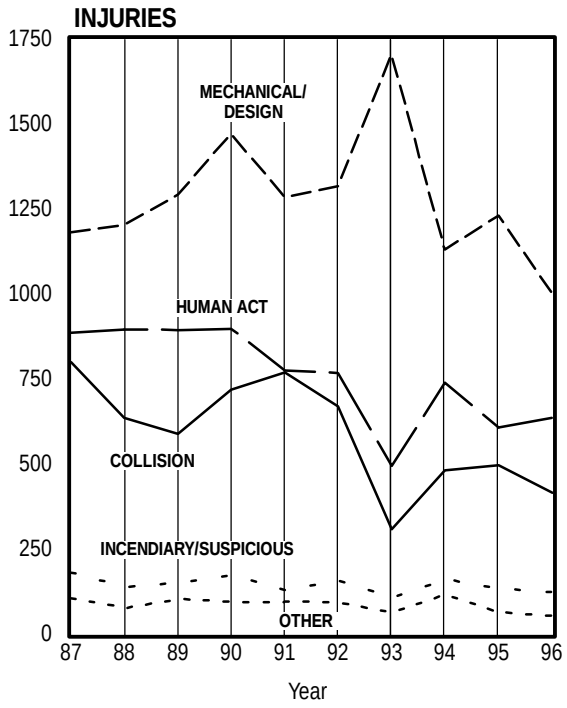
	Incendiary/ Suspicious	Collision	Human Act	Mechanical Design	Other
1987	76.4	9.1	60.9	316.5	8.2
1988	70.4	9.2	59.3	316.4	9.1
1989	70.1	7.9	54.7	293.7	9.2
1990	76.2	8.1	52.5	290.3	9.4
1991	76.9	7.6	53.1	282.6	8.4
1992	73.4	6.9	45.4	270.1	9.2
1993	68.1	6.9	46.9	288.4	10.2
1994	66.5	7.1	47.3	291.6	9.5
1995	66.2	7.4	44.1	279.3	9.5
1996	74.4	7.4	43.1	277.9	10.6



	Incendiary/ Suspicious	Collision	Human Act	Mechanical Design	Other
1987	57	509	112	99	28
1988	44	615	116	49	41
1989	51	350	78	53	98
1990	29	444	79	98	44
1991	33	390	69	75	38
1992	30	520	86	51	42
1993	48	367	70	66	44
1994	54	400	43	113	20
1995	67	279	91	80	19
1996	62	432	88	95	33

Continued on next page

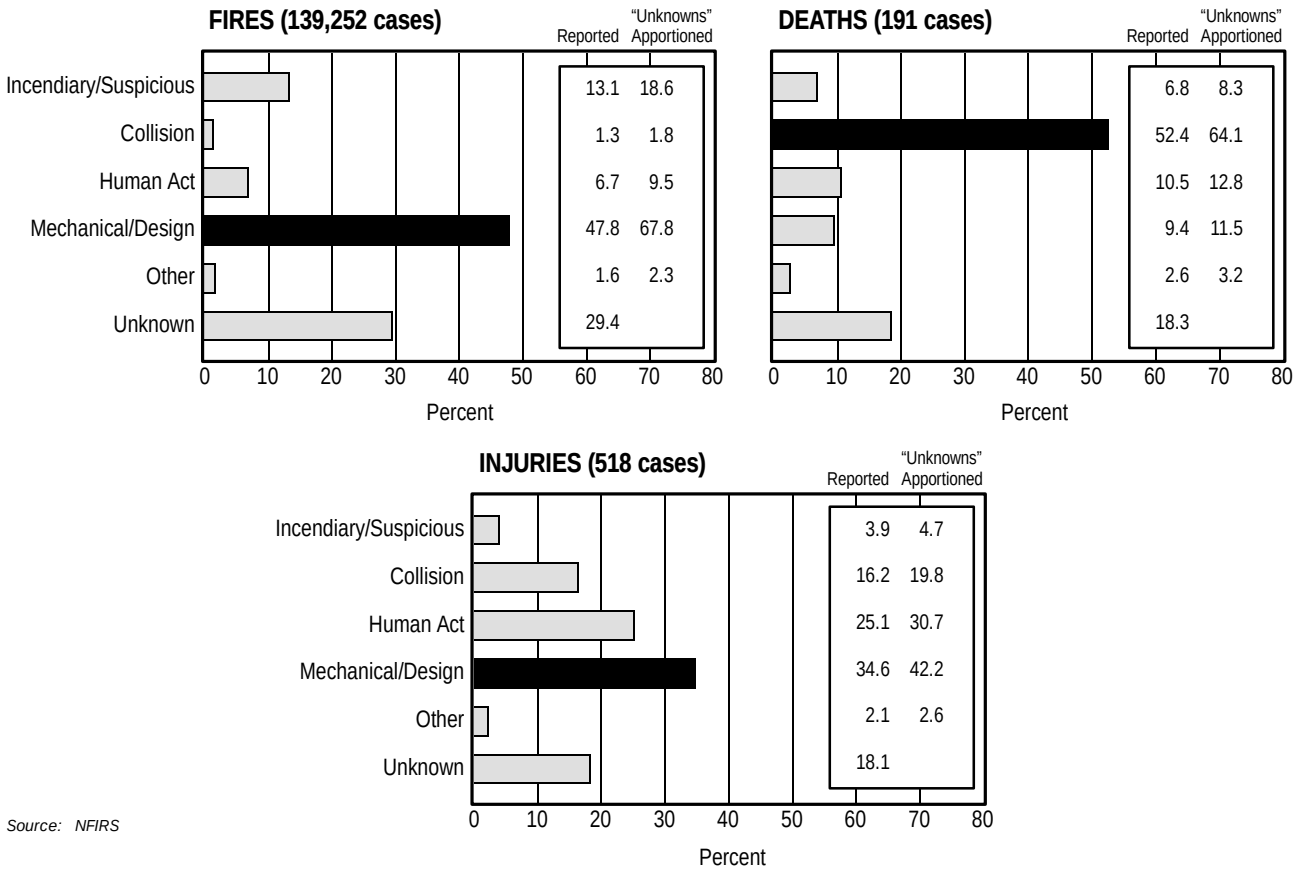
Figure 93. Trends in Ignition Factor Causes of Mobile Property Fires and Fire Casualties



	Incendiary/ Suspicious	Collision	Human Act	Mechanical Design	Other
1987	179	799	886	1,181	105
1988	139	635	895	1,203	77
1989	151	588	892	1,292	103
1990	172	717	896	1,471	94
1991	128	769	774	1,284	95
1992	158	669	766	1,316	92
1993	107	308	494	1,703	63
1994	161	480	738	1,130	116
1995	133	495	606	1,229	63
1996	121	415	637	1,000	52

Sources: NFPA Annual Surveys and NFIRS

Figure 93. Trends in Ignition Factor Causes of Mobile Property Fires and Fire Casualties (cont'd)



Source: NFIRS

Figure 94. Ignition Factors for 1996 Automobile Fires and Fire Casualties

Special Data Problems

When there are fatalities associated with a mobile property accident such as a collision between two cars, it is often difficult to determine whether the fatalities were the result of the mechanical forces or the fire that ensued. Because of the very large number of vehicle fatalities occurring in this country each year and the frequency of fires associated with these accidents, there can be a significant error in estimating the total number of fire deaths if this problem is not carefully addressed. A fire fatality should be counted only if a person was trapped and killed by the fire, rather than killed on impact and subsequently exposed to the fire.

In plane crashes, it is thought that fewer people would die each year if the fire hazard could be reduced. It is not clear how well plane crashes are reported to NFIRS. In 1996, the NFIRS-based plane fire deaths were 18, while the number from the Federal Aviation Administration count was 319—a substantial difference. Missing even one large crash with fire fatalities could change the mobile property fire death statistics by 20–40 percent in a given year, so it is important that these all be reported.

OUTSIDE AND OTHER PROPERTIES

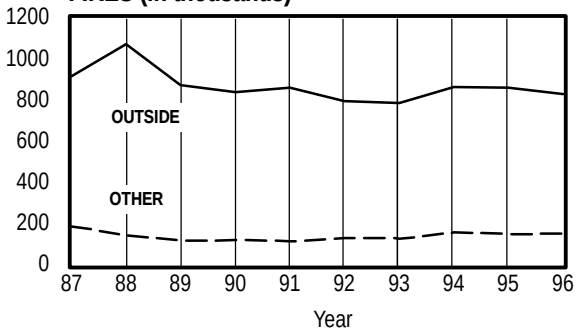
The outside and other properties category includes all fires that are not structure or vehicle fires. In NFIRS terminology, this includes fires where the type of situation found either is outside of the structure where the burning material has a value or are tree, brush, grass fires, or refuse fires. Grouped in the other category are fires whose situation found is not classified, flammable liquid spills out of doors with ensuing fires, and explosions. A subset of outside fires is wildland fires.

Outside fires comprise 44 percent of all fires. Outside fires have been decreasing slowly in number while the proportion of the total number of fires, as was seen in Figure 28, Chapter 2, remains fairly steady. Although large in number, they account for only 2 percent of fire deaths in 1996, nearly 6 percent of reported injuries, and, in most years, roughly 3–5 percent of reported property loss. These numbers may not, however, reflect the true nature of the problem because of underreporting and the difficulty in setting a price tag on outside fires. Also, many wildland fires are not reported to agencies reporting to NFIRS or to the NFPA annual survey.

Overview of Trends

Figure 95 shows the trends in outside fires. The numbers of fires are enormous—from 800,000 to 1 million. For the 10-year period 1987–1996, deaths from outside fires plus miscellaneous other properties not covered elsewhere range from 55 to 125 a year; injuries, from 1,175 to 1,575. Although deaths have a significant 10-year downward trend of 47 percent, this is due primarily to the fluctuations in the small numbers of deaths; injuries have a slight upward trend of 14 percent. Over the 10 years, adjusted dollar loss for outside properties with value has an overall downward trend. The two

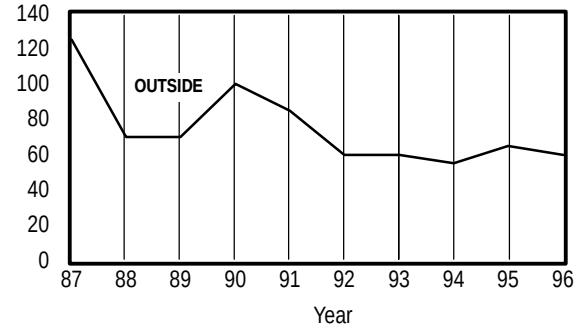
FIRES (in thousands)



	Outside	Other		Outside	Other
1987	916.5	184.5	1992	793.5	128.5
1988	1,072.0	142.0	1993	783.5	127.0
1989	873.5	118.0	1994	861.5	157.0
1990	838.5	120.0	1995	858.5	147.0
1991	859.5	113.0	1996	828.5	154.5

10-Year Outside Trend = -15.8%
10-Year Other Trend = -0.1%

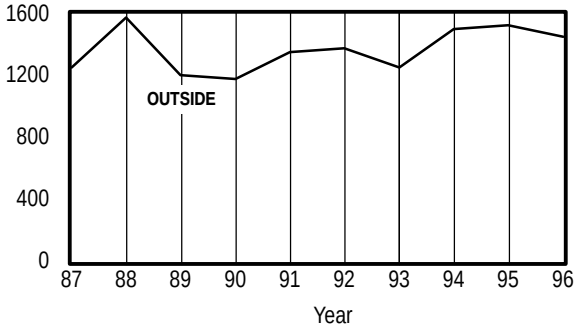
DEATHS



1987	125	1992	60
1988	70	1993	60
1989	70	1994	55
1990	100	1995	65
1991	95	1996	60

10-Year Outside Trend = -46.7%

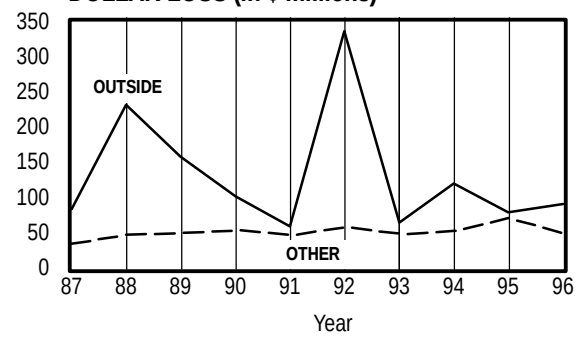
INJURIES



1987	1,250	1992	1,375
1988	1,575	1993	1,250
1989	1,200	1994	1,500
1990	1,175	1995	1,525
1991	1,350	1995	1,450

10-Year Outside Trend = +13.7%

DOLLAR LOSS (in $ millions)*



	Outside	Other		Outside	Other
1987	$ 88.4	$37.3	1992	$355.6	$61.5
1988	245.4	50.4	1993	68.4	51.0
1989	167.0	53.1	1994	127.0	56.1
1990	108.0	57.6	1995	79.3	71.0
1991	63.4	49.5	1996	91.0	49.0

10-Year Outside Trend = -34.4%
10-Year Other Trend = +11.9%

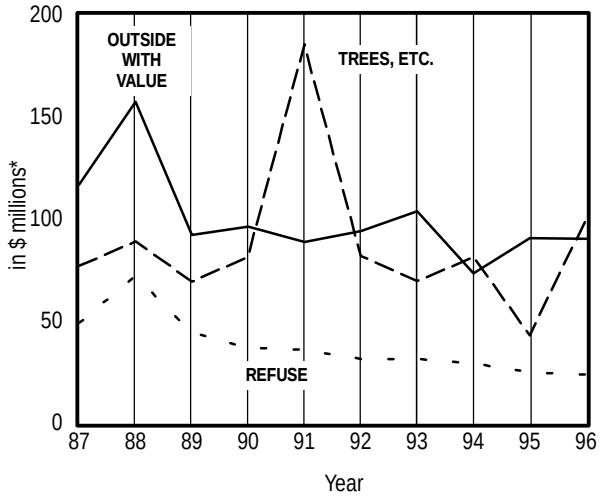
*Adjusted to 1996 dollars

Sources: NFPA Annual Surveys and Consumer Price Index

Figure 95. Trends in Outside and Other Property Type Fires and Fire Losses

large spikes in 1988 and 1992 reflect an exceptionally high agricultural loss and a high timber loss, respectively.

Estimating dollar loss for outside fires is difficult. To illustrate this problem, consider Figure 96, derived from unscaled (raw) NFIRS data. NFPA estimates a dollar loss range from $110 to $420 million. The estimated dollar loss reported in NFIRS for slightly less than half as many fires is in the same range, from $180 to $320 million. Which is correct? Both are based on estimates and neither may be definitive. Note that the large timber fire reported by NFPA is not reported in NFIRS.



	Outside With Value	Trees, Etc.	Refuse
1987	$116.8	$ 76.9	$ 49.2
1988	157.3	89.0	72.1
1989	91.9	69.1	44.1
1990	96.0	81.3	36.5
1991	88.7	185.5	35.7
1992	94.0	81.6	31.2
1993	103.6	69.3	31.2
1994	73.2	81.5	29.1
1995	90.3	42.8	24.6
1996	90.1	99.4	23.3

10-Year Outside With Value Trend = -34.8%
10-Year Trees, Etc. Trend = -11.6%
10-Year Refuse Trend = -64.7%

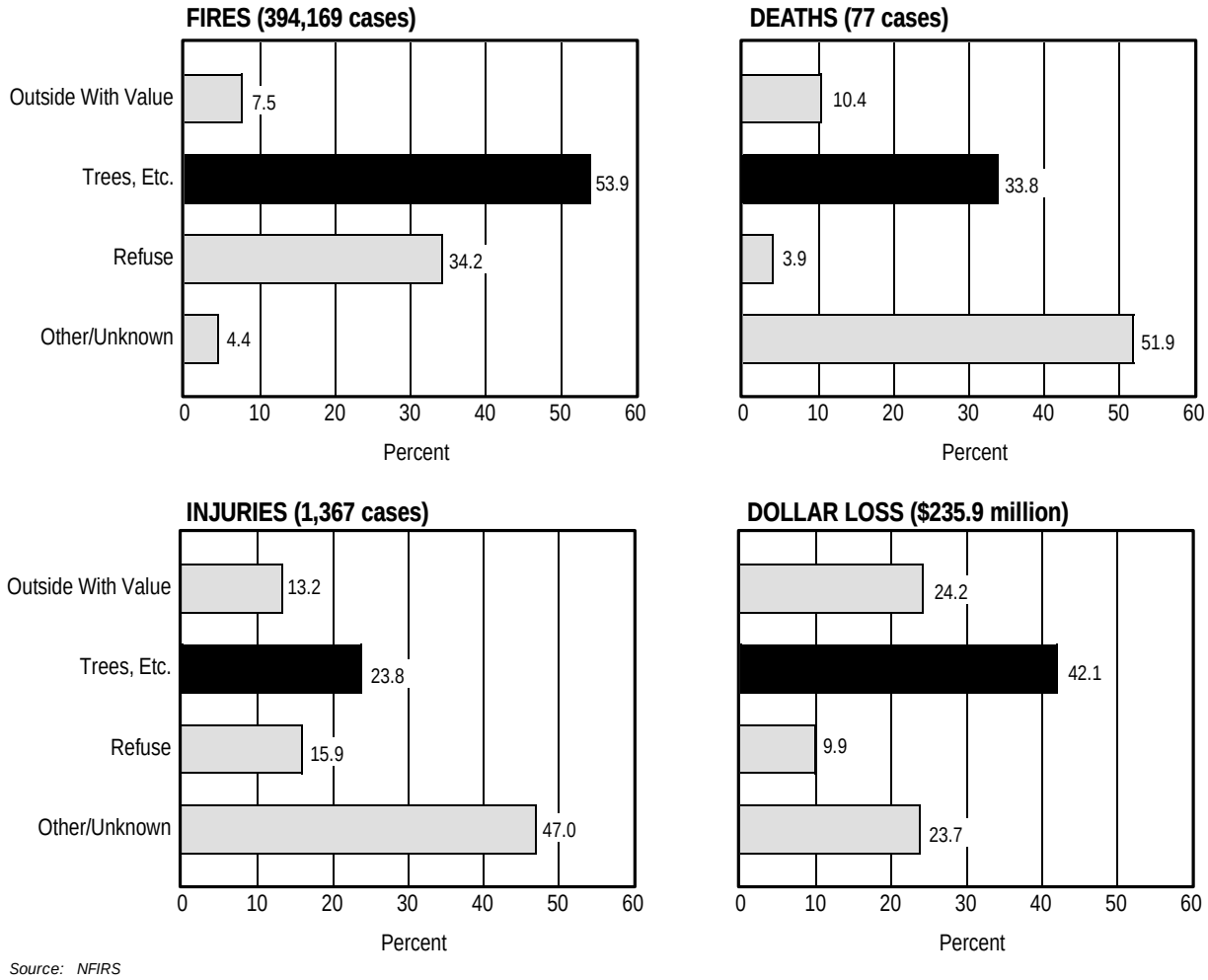
Sources: NFIRS and Consumer Price Index

*Adjusted to 1996 dollars

Figure 96. Trends in Outside Fire Dollar Loss by Property Type

Property Types

Figure 97 shows the relative proportions of the three components of reported outside fires for 1996. Trees, brush, and grass fires account for the greatest number of fires and fire losses. A large portion of deaths and injuries, however, are unknown. Better reporting to NFIRS is required for outside fires.



Source: NFIRS

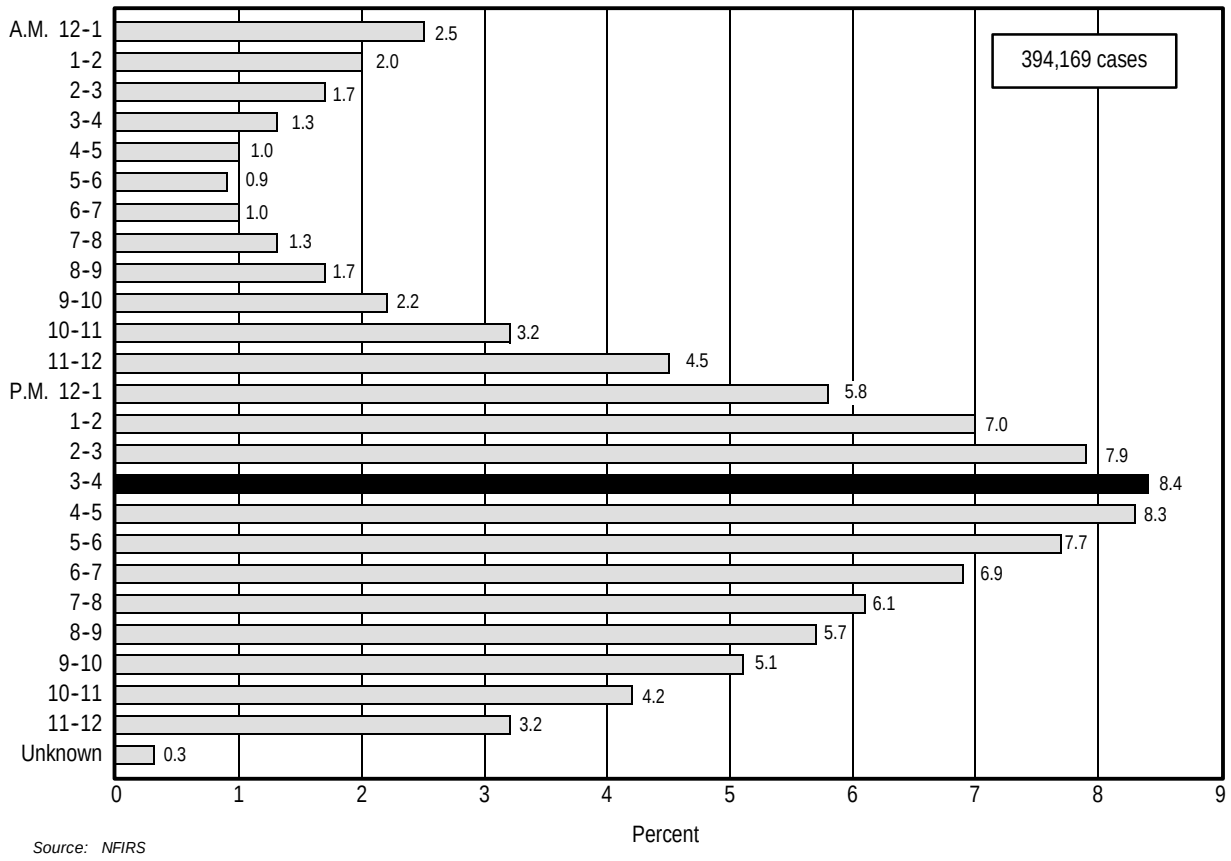
Figure 97. 1996 Outside Fires and Fire Loss by Property Type

When Fires Occur

TIME OF DAY. Sixty-four percent of all outside fires occur from noon to 9:00 p.m. (Figure 98). They are very low in the early hours of the morning when few people are outside. This profile is unchanged from 1994.

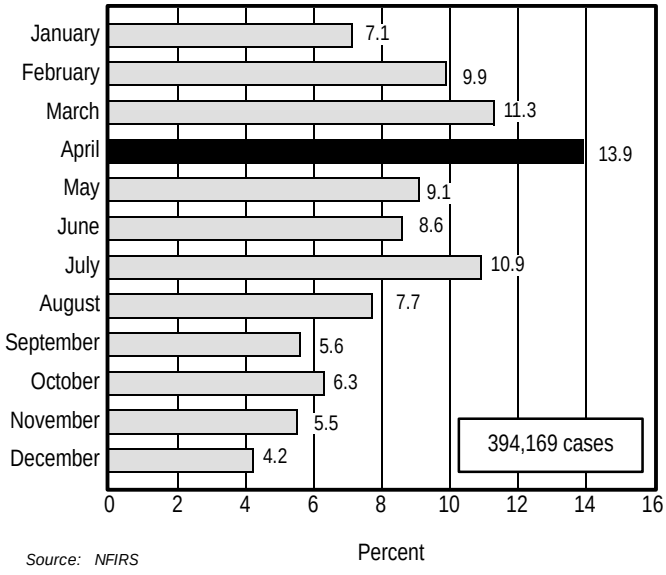
MONTH OF YEAR. Outside fires are usually lowest in the fall and winter months and high during spring and summer (Figure 99). In 1996, April and July were the months with the highest numbers of fires, the same as in 1994. In recent years, local and state governments have placed more rigorous restrictions on burning leaves, which might account for the low autumn numbers. Wetter-than-usual weather, too, may have played a role. What is known is that wildland fires tend to have two peaks—one in the spring and one in the fall.

DAY OF WEEK. As in 1994 and 1990, outside fires in 1996 are highest on the weekend, a time when more people are outdoors (Figure 100).



Source: NFIRS

Figure 98. Time of Day of 1996 Outside and Other Fires



Source: NFIRS

Figure 99. Month of Year of 1996 Outside and Other Fires

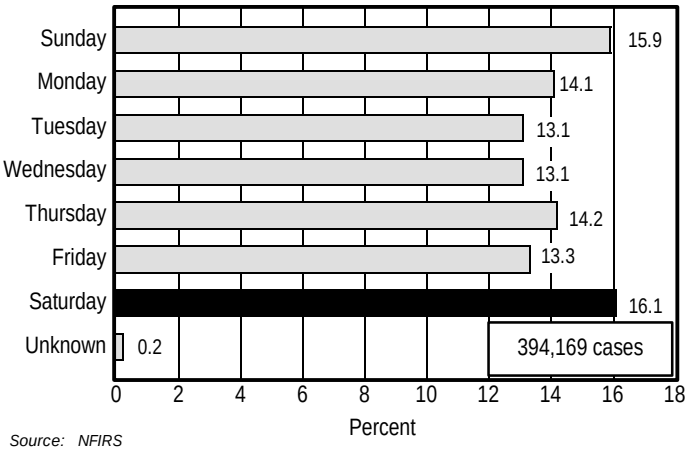


Figure 100. Day of Week of 1996 Outside and Other Fires

Causes

As in all years, the leading cause of outside fires is arson, with many thought to be set by children. Figure 101 shows the cause profiles for each outside fire category. Again, a large percentage of outside fires have unknown causes and the 1996 statistics are little changed from 1994 and 1990.

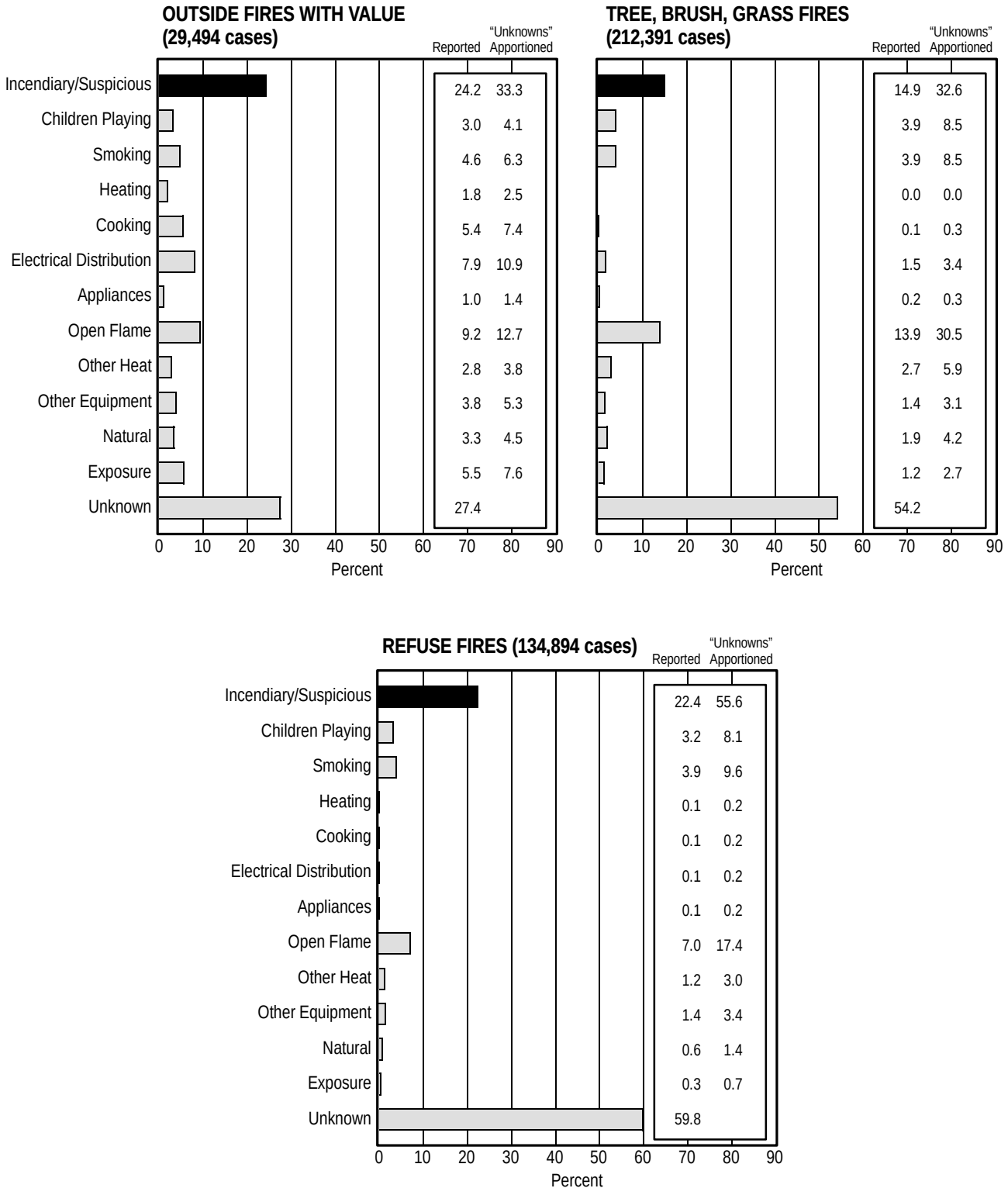
For outside fires with value, 33 percent (adjusted for unknowns) of fires are attributed to arson. The rest of the fires are scattered across many categories, with open flame and electrical problems in second and third place, respectively.

More than half (54 percent) of tree, brush, and grass fires had unknown cause. Among the known causes, the two that stand out are arson and open flame, which includes open fires used for cooking. These two causes account for 63 percent of fires with cause. Following these, but at much lower rates, are children playing and smoking.

For refuse fires, 60 percent had no reported cause. More than half of the reported causes in 1996 were reported as arson, with another 17 percent from open flame (e.g., matches), 10 percent from smoking, and 8 percent from children playing. Note that refuse fires set inside buildings are structural fires, even if they do no damage, and are reported as part of the property type in which they occur.

Special Data Problems

Setting a value for outside fire damage is a perennial problem. Although it is difficult to assign a dollar value to grass, tree, and rubbish fires, the damage from these fires often requires labor beyond that of the fire department to clean up and restore the area and also causes esthetic problems that are intangible. Also, some outside fires spread to structural properties and may be reported as structural fires rather than an outside fire with exposure to structures.



Source: NFIRS

Figure 101. Causes of 1996 Outside Fires

Forest fires and other wildfires to which local departments are not called will not be reported to NFIRS if the state or federal agency with principal authority for fighting the fire does not participating in NFIRS. Data from the Departments of Agriculture and Interior are needed to complete the picture.

Another significant problem with data on outside fires is determining their cause. Often the area of origin is obliterated, the people involved have fled, and one is not sure exactly what caused the fire—an unattended campfire, a discarded match or cigarette, lightning strikes, children playing, or even an intentionally set fire. Thus, the percent of causes left as unknown is especially high for this category of fires.

USFA RESOURCES ON FIRES IN NON-RESIDENTIAL PROPERTIES

USFA conducts special studies to address specific problems and current issues facing the nation's fire and rescue service. The technical reports produced under the Major Fires Investigations series analyze major or unusual fires with emphasis on sharing lessons learned. They are directed primarily to chief fire officers, training officers, fire marshals, and investigators as a resource for training and prevention.

Major Fire Investigation reports on fires and other significant incidents in non-residential properties include the following: *Tire Fires: A Report to Congress* (#FA–187); *Sprinklers Control Arson Fire in Rack-Storage Warehouse, Mt. Prospect, IL, October, 1988* (#TR–030); *World Trade Center Bombing: Report and Analysis* (#TR–076); *Industrial Plastics Fire Major Triage Operation, Flint, MI, November 1988* (#TR–025); *$15 Million Sight and Sound Theater Fire and Building Collapse* (#TR–097); *New York City Bank Building Fire: Compartmentation vs. Sprinklers, New York, January 1993* (#TR–071); *Broward Marine Fire, Ft. Lauderdale, FL* (#TR–101); *Chicken Processing Plant Fires, Hamlet, NC and North Little Rock, AR, September 1991* (#TR–057); *Five-Fatality High-rise Office Building Fire, Atlanta, GA, November 1989* (#TR–033); *Interstate Bank Building Fire, Los Angeles, CA, May 1988* (#TR–022); *Logan Valley Mall Fire, Altoona, PA* (#TR–085); *Major Ship Fire Extinguished by Carbon Dioxide, Seattle, WA, September 1991* (#TR–058); *Ten Million Dollar Marina Fire, Bohemia Bay, MD, January 1989* (#TR–026); *Urban Wildlands Fire, Pebble Beach, CA, May 1987* (#TR–007); *Crash of Two Subway Trains on the Williamsburg Bridge, New York City, NY* (#FA–163F); *Derailment of the Sunset Limited, Big Bayou Canot, AL* (#FA–163B); *Search and Rescue Operations Following the Northridge Earthquake, Los Angeles, CA* (#FA–163C); *Search and Rescue Operations in California During Flooding* (#FA–163E); *Search and Rescue Operations in Georgia During Major Floods* (#FA–163D); *Evacuation of Nanticoke, PA Due to Metal Processing Plant Fire, March 1987* (#TR–005); *Fire and Explosions at Rocket Fuel Plant, Henderson, NV, May 1988* (#TR–021); *Major Propane Gas Explosion and Fire, Perryville, MD, July 1991* (#TR–053); *Phillips Petroleum Chemical Plant Explosion and Fire, Pasadena, TX, October 1989* (#TR–035); *Conservative Approach to Chemical Plant Fire, Ventura County, CA, April 1989* (#TR–029); *East Bay Hills Fire, Oakland–Berkeley, CA, October 1991* (#TR–060); *Gasoline Tanker Incidents in Chicago, IL and Fairfax County, VA: Case Studies in Hazardous Materials Planning, March/May 1989*

(#TR–032); *Highrise Office Building Fire, One Meridian Plaza, Philadelphia, PA, February 1991* (#TR–049); *Indianapolis Athletic Club Fire, Indianapolis, IN, February 1992* (#TR–063); *Major Ship Fire Extinguished by Carbon Dioxide, Seattle, WA, September 1991* (#TR–058); *Massive Leak of Liquified Chlorine Gas, Henderson, NV, May 1991* (#TR–052); *Sherwin–Williams Paint Warehouse Fire, Dayton, OH, May 1987* (#TR–009); *Swimming Pool Chemical Plant Fire, Springfield, MA, June 1988* (#TR–027); and *Fire Apparatus/Train Collision, Catlett, VA, September 1989* (#TR–048).

Other works published by USFA that would be helpful while analyzing the fire problem in non-residential areas include the following works: *Handbook for Assisting in a Wildland Fire Investigation; Rural Arson Control* (#FA–87); *Comparison of Fire Sprinkler Piping Materials* (#FA–150); *Emergency Procedures for Employees with Disabilities in Office Occupancies* (English, Braille, Cassette, and Spanish; #FA–154, #FA–154B, #FA–154C, #FA–154S, respectively); *Planning for Water Supply and Distribution in the Wildland/Urban Interface; Wildfire Strikes Home Second Edition; Wildlands Fire Management: Federal Policies and Their Implications for Local Fire Departments* (#TR–045); *Motor Vehicle Fires—What You Need to Know* (#L–202); *Arson Victims* (#FA–177); *Wildfire—Are You Prepared?* (#L–203); *Compressed Air Foam Use for Structural Fire Fighting: A Field Test, Boston Fire Department, June 1993* (#TR–074); *Confined Space Rescue on SS Gem State, Tacoma, WA* (#FA–163A); *Technical Rescue Program Development Manual* (#FA–159); *Technical Rescue Technology Assessment* (#FA–153); *Fire Protection in the Wildfire/Urban Interface;* and *Report of the Operation Urban Wildfire Task Force* (#FA–115).

These USFA publications are available by writing to:

U. S. Fire Administration
Federal Emergency Management Agency
Publications Center, Room N310
16825 South Seton Avenue
Emmitsburg, MD 21727

Please include the parenthetical publication number, if given, in your request.

Documents may also be ordered via the World Wide Web: http://www.usfa.fema.gov/usfapubs. USFA publications are free.

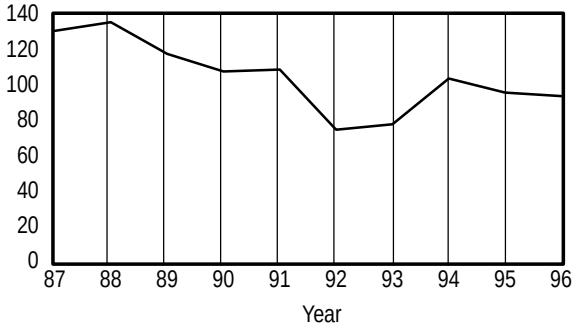
5

FIREFIGHTER CASUALTIES

There has been much progress in reducing on-duty firefighter deaths and injuries over the 10 years 1987–1996. Deaths have dropped from 136 in 1998 to 94 in 1996. Deaths in 1992 and 1993 reached all-time lows at 75 and 77, respectively. Injuries declined nearly 10 percent and ranged from 87,150 (1996)—the lowest number of injuries over the 10-year period—to 103,100 (1991). These firefighter deaths and injuries include casualties from fires, EMS incidents, training, and all other on-duty activities.

DEATHS

Ninety-four firefighters died while on duty in 1996[1] (Figure 102), two fewer than in 1995 and the third lowest number recorded in the 20 years that these data have been collected. 1996 represents only the fourth time in the 20 years that fatalities have been less than 100. The lowest years were 1992 with 75 fatalities and 1993 with 77 fatalities.



1987	131	1992	75
1988	136	1993	77
1989	118	1994	104
1990	108	1995	96
1991	109	1996	94

10-Year Trend = -34.8%

Sources: NFPA Annual Surveys and the United States Fire Administration, Firefighter Fatality Project

Figure 102. Trends in Firefighter Deaths

The fatalities included 68 volunteer firefighters and 26 career firefighters. The fatalities by firefighter type and gender are presented in Table 23.

[1] The 94 on-duty fatalities in 1996 does not include one firefighter who died during the year from injuries sustained in 1982. This firefighter was injured when a concrete loading dock collapsed at a paper warehouse fire. He was in a coma for 13 years before he died.

Table 23. 1996 Firefighter Deaths

Firefighter Type/Gender	Fatality
Firefighter	
Volunteer	68
Career	26
Wildland Firefighter	
Career	0
Seasonal/Part Time	3
Municipal/Local Fire Departments	
Career/Military	26
Volunteer	62
Industrial Brigade (volunteer)	0
Fire Police (volunteer)	3
Men	91
Women	3

Source: United States Fire Administration, Firefighter Fatality Project

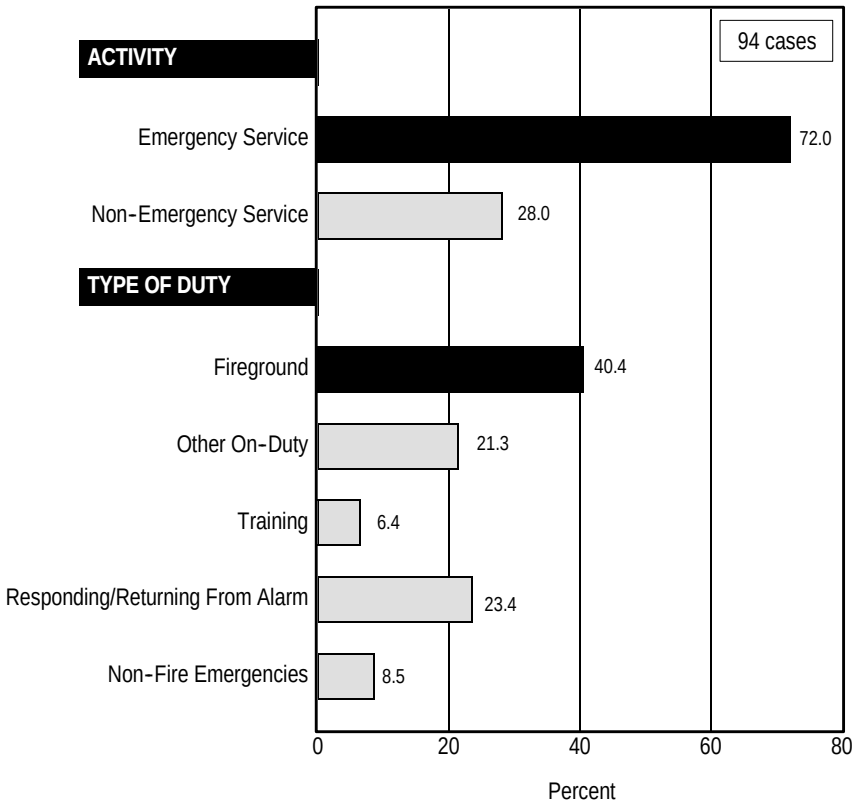
The number of deaths associated with brush, grass, or wildland firefighting dropped significantly from 18 in 1995 to 5 in 1996. One firefighter died as a result of dehydration when she became separated from her group on a training run. Four firefighters died of heart attacks, one while repairing a water tender between fires, one after fighting a wildland fire for 5 hours, one while fighting a wildland fire, and one during a tree-felling class. Female firefighter deaths decreased from 6 percent of total deaths in 1995 (six deaths) to 3 percent (three deaths) in 1996.

Activity and Type of Duty

In 1996, 68 firefighter on-duty deaths were associated with emergency incidents, accounting for 72 percent of the 94 fatalities (Figure 103). This number includes all firefighters who died while responding to an emergency, while at the emergency scene, or after the emergency incident. Non-emergency activities accounted for 26 fatalities (28 percent). Non-emergency duties include training, administrative activities, or performing other functions not related to an emergency incident. One firefighter working at a department fund raiser and another firefighter directing parade traffic are included in the non-emergency category.

Firefighter deaths by type of duty are also shown in Figure 103. As in previous years, the largest number of deaths, 40 percent, occurred during fireground operations. Of the 38 fireground deaths, 23 resulted from heart attacks on the scene, 8 from asphyxiation, 3 from internal trauma, 2 from electrocution, 1 from pulmonary edema, and 1 from burn injuries.

From 1993 to 1996, "responding to or returning from" emergency incidents has been the second largest category, accounting for 22 deaths in 1996. Six firefighters suffered fatal heart attacks while responding to or returning from emergency incidents. Eight firefighters were killed in fire apparatus accidents while en route to emergency incidents. At least five of these deaths involved apparatus rollovers. Eight firefighters were killed in accidents involving their personal vehicles while en route to



Source: United States Fire Administration, Firefighter Fatality Project

Figure 103. 1996 Firefighter Deaths by Activity and Type of Duty

emergency calls. Of these eight deaths, one firefighter drowned in a roadside lake after running off the road.

Eight deaths were related to activities at the scene of non-fire emergency incidents. This is down from 13 deaths in 1995. Three firefighters died of heart attacks during EMS incidents, one was killed when he was electrocuted at a motor vehicle accident, one died of asphyxiation during a technical rescue in a grain bin, one died after being shot by an irate victim at the scene of a motor vehicle accident (MVA), another died due to complications from an injury sustained at an MVA that occurred while transporting a patient to the hospital, and one died after being hit by a passing motorist while extricating a patient from a vehicle.

Twenty-six deaths occurred during non-emergency duty activities. These deaths included nine firefighters who died from heart attacks while on duty—two at fire department fund raisers, two during the night at the fire department, two while exercising, one while performing a stress and agility test, one while repairing apparatus between calls, and one while directing traffic at a parade as part of his fire police duties. One firefighter died of a stroke while inspecting fire hydrants. Ten of the 26 non-emergency duty deaths were a result of internal trauma: four firefighters were shot and killed by a disgruntled firefighter during an administrative meeting at the fire department, one firefighter was stabbed to death on the way to storm duty, two firefighters died in motor vehicle accidents (one

in transit between station assignments and another while returning from a non-emergency service call), one firefighter was struck by a vehicle while directing traffic, one firefighter fell 20 feet down a fire pole hole in the station, and one was killed during a Fourth of July celebration sponsored by the fire department. This last firefighter was a licensed pyrotechnician who was killed when the fireworks prematurely detonated.

Six deaths were attributed to training activities, including one death from dehydration when the firefighter became separated from the group during a training run. Four firefighters died as a result of heart attacks during training—one at a live burn training session, one after an EMS training event, one during a vehicle extrication drill, and one during a wildland tree-felling class. One firefighter died during recruit training from massive organ failure due to a preexisting condition of sickle cell anemia.[2]

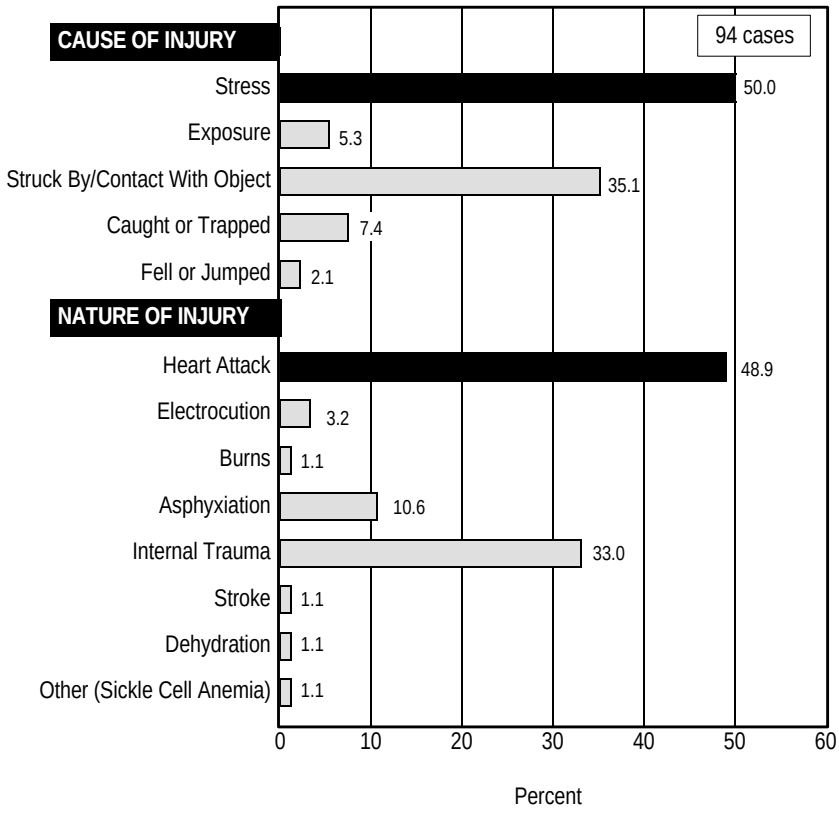
Cause and Nature of Fatal Injury or Illness

The term *cause* refers to the action, lack of action, or circumstances that directly resulted in the fatal injury, while the term *nature* refers to the medical nature of the fatal injury or illness, or what is often referred to as the cause of death. The fatal injury usually is the result of a chain of events, the first of which is recorded as the cause. For example, if a firefighter is struck by a collapsing wall, becomes trapped in the debris, runs out of air before being rescued, and died of asphyxiation, the cause of the fatal injury is recorded as "struck by collapsing wall" and the nature of the fatal injury is "asphyxiation." Likewise, if a wildland firefighter is overrun by a fire and dies of burns, the cause of death would be listed as "caught/trapped," and the nature of death would be "burns." This follows the convention used in NFIRS casualty reports, which are based on NFPA fire reporting standards.

Figure 104 shows the distribution of deaths by cause of fatal injury or illness. As in most previous years, the largest category (50 percent in 1996) is stress or overexertion. Firefighting has been shown to be one of the most physically demanding activities that the human body performs, and most deaths attributed to stress are from heart attacks. Of the 47 stress-related fatalities in 1996, 44 firefighters died of heart attacks, 1 died of a stroke, 1 died from complications with sickle cell anemia, and 1 died of dehydration. Sixteen of the 47 deaths whose cause is listed as stress/exertion occurred during non-emergency activities.

The second leading cause of firefighter fatalities was struck by or coming in contact with an object. Of the 33 firefighters (35.1 percent) killed, 17 were involved in vehicle accidents, 6 were murdered, 4 were struck by vehicles while on emergency scenes, 2 were electrocuted, 2 were killed when their truck was struck by a falling tree, 1 was struck by detonated fireworks, and 1 was killed by a collapsing wall.

[2] Due to the preexisting condition of sickle cell anemia, the firefighter after intense exertion went into a state of rahbomyolosis (internal heating and buildup of acid in the heart muscle). This condition caused several major organs to fail, resulting in death.



Source: United States Fire Administration, Firefighter Fatality Project

Figure 104. 1996 Firefighter Deaths by Cause and Nature of Injury

The third leading cause of firefighter fatalities was being caught or trapped, which accounted for seven deaths (7.4 percent), down 14 percent from 1995. Six firefighters died after becoming trapped by roof collapses—five were in commercial structures and one in a townhouse. One firefighter drowned when trapped in his car after running off the road into a lake.

Three asphyxiation deaths were attributed to exposure.[3] One was a firefighter who died when he removed his SCBA (self-contained breathing apparatus) mask in an oxygen-deficient atmosphere. One firefighter died from an asthma attack after being exposed to toxic substances at a fire, and another died after inhaling too much smoke while attempting a rescue at a structure fire. Two firefighters died from exposure, one as a result of burns after he was caught in a flashover, and the other from cardiac arrest/pulmonary edema after being exposed to a cloud of unknown chemical vapors at a commercial structure fire.

Two firefighters died as a result of falls. One firefighter slipped and fell 20 feet down a fire pole; the other died after falling and striking his head.

[3] "Exposure/Contact with" follows NFIRS 4.0 definitions under "Cause of Fatal Injury."

Internal trauma was the second leading nature of death, responsible for 32 deaths (9 more than 1995). This total includes 18 firefighters who were involved in vehicle accidents, four who were hit by vehicles while on the emergency scene, and six who were victims of violence. Four other firefighters died as a result of internal trauma: one firefighter died after falling down a fire pole hole, one died when fireworks detonated at a Fourth of July celebration, one was crushed by a collapsing wall, and one was killed when a tree fell on the fire apparatus.

Asphyxiation, the third leading medical reason for firefighter deaths, was responsible for 10 deaths (50 percent less than in 1995). Eight of these were from carbon monoxide poisoning or inhalation of smoke or superheated gases during structural firefighting. These deaths occurred when the firefighters were caught and trapped by rapidly spreading fires or structural collapses.

Three firefighters died from electrocution, one whose SCBA became caught in downed power lines, one who came into contact with downed power lines at an automobile accident, and one who had power lines fall on him when a pole broke and fell to the ground.

Only one of the 94 firefighter fatalities was attributed to burns; the firefighter was caught in a flashover in a two-alarm apartment fire.

The medical causes of death for the final three firefighters were dehydration, stroke, and organ failure due to a preexisting condition of sickle cell anemia.

Age of Firefighters

Table 24 shows the distribution of firefighter deaths by age and nature and cause of death in 1996. Age information was available for 91 of the 94 fatalities. Statistics show that younger firefighters were more likely to have died as a result of traumatic injuries from an apparatus accident or after becoming caught or trapped during firefighting operations. Stress was shown to play an increasing role in firefighter deaths as ages increased. Trauma and asphyxiation were the primary natures of death among younger firefighters, and heart attacks were much more prevalent among older firefighters. Heart attacks accounted for 16 of the 26 firefighters who were older than 50, and all 12 of the firefighters over 60 years old.

There were two major differences in 1996 over that of 1995. Deaths due to being caught or trapped were down considerably in 1996 (7 deaths compared to 21 deaths) and asphyxiation deaths were 50 percent lower (10 versus 20 deaths).

Fireground Deaths

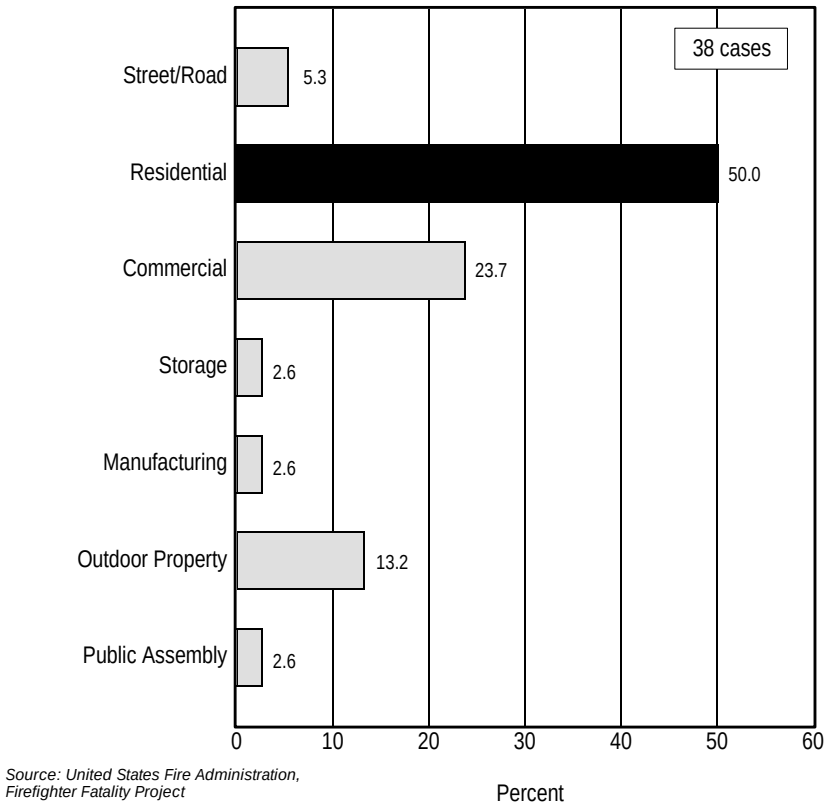
There were 38 fireground deaths in 1996, a decrease of two from 1995. Figure 105 shows the distribution of fireground deaths by fixed property use.

Table 24. Age of Firefighter at Time of Death by Cause and Nature in 1996

	Age*										
	Under 21	21 to 25	26 to 30	31 to 35	36 to 40	41 to 45	46 to 50	51 to 55	56 to 60	Over 60	Total
Cause											
Stress	0	2	1	3	4	6	7	6	3	12	44
Exposure	0	0	0	0	2	1	1	0	1	0	5
Struck/Contact With Object	6	7	1	4	4	4	4	2	1	0	33
Caught/Trapped	1	0	0	1	4	1	0	0	0	0	7
Fell or Jumped	0	0	0	0	0	1	0	0	1	0	2
Nature											
Heart Attack	0	0	1	3	4	6	6	6	5	12	43
Electrocution	0	1	0	0	1	1	0	0	0	0	3
Burns	0	0	0	0	1	0	0	0	0	0	1
Asphyxiation	1	0	0	1	5	2	1	0	0	0	10
Internal Trauma	6	6	1	4	3	4	4	2	1	0	31
Stroke	0	0	0	0	0	0	1	0	0	0	1
Dehydration	0	1	0	0	0	0	0	0	0	0	1
Other (Sickle Cell Anemia)	0	1	0	0	0	0	0	0	0	0	1

* Age was reported in 91 of the 94 deaths.

Source: United States Fire Administration, Firefighter Fatality Project



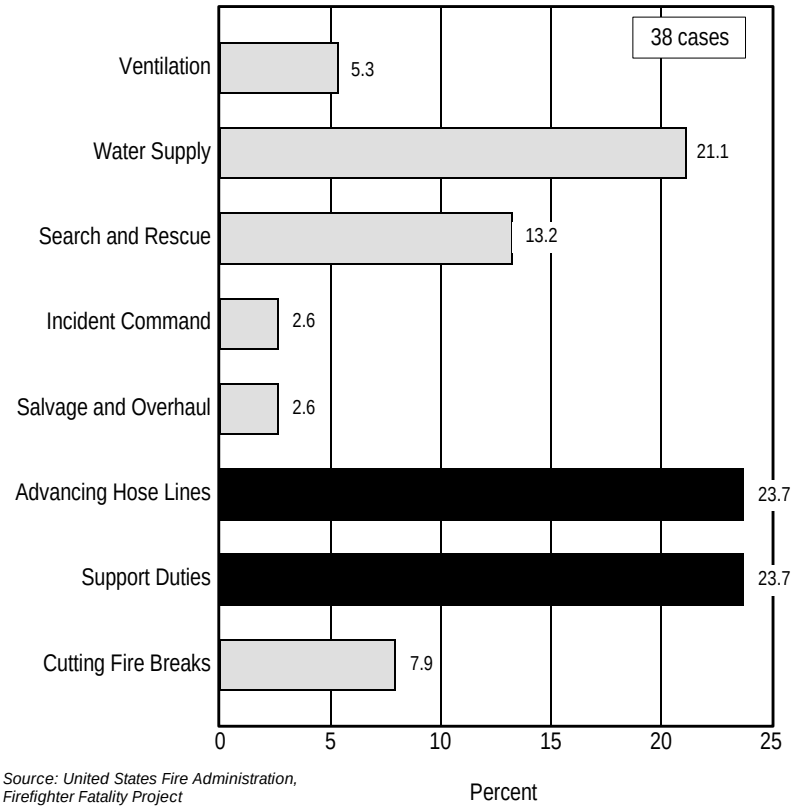
Source: United States Fire Administration, Firefighter Fatality Project

Figure 105. 1996 Firefighter Deaths on Fireground by Fixed Property Use

Thirty-one of the 38 fireground deaths occurred at structure fires. Of these, residential occupancies accounted for the highest number of fireground fatalities with 19 deaths (50 percent). This is consistent with most prior years. It is not that residential fires are necessarily more dangerous, but rather that they are more common. (Residential occupancies usually account for 70–80 percent of all structure fires and a similar percentage of the civilian fire deaths each year; 50 percent of the firefighter deaths in 1996 occurred in residential structures.) The frequency of firefighter deaths in relation to the number of fires is much higher for non-residential structures. One firefighter died in 1996 in a storage occupancy compared to six in 1995. Nine firefighters died in commercial structures, one in a public assembly fire, and one in a manufacturing plant fire.

Outdoor properties and "street/road" accounted for seven deaths. Four of the five outside property deaths were from heart attacks; the fifth was a firefighter who was pinned between two trucks at a wildland fire. The two street/road deaths consisted of a firefighter who was electrocuted when a power line fell on him at a utility pole fire and one who had a heart attack while directing traffic at an emergency scene.

Figure 106 illustrates the activities the 38 firefighters were engaged in at the time they sustained their fatal fireground injuries or illnesses. There was a substantial decrease (14) compared to 1995 in the number of firefighters who died while engaged in traditional engine company duties of



Source: United States Fire Administration, Firefighter Fatality Project

Figure 106. 1996 Firefighter Deaths on Fireground by Type of Activity

fire attack and advancing hose lines. Nine firefighters died while performing these fireground operations, including six who died from asphyxiation after becoming trapped by rapid fire spread or structural collapse while advancing hose lines. Three other firefighters suffered heart attacks while performing similar functions. Eight firefighters died while performing water supply operations on the fireground: five from heart attacks, one from electrocution, one from being pinned between two fire apparatus, and one from being struck by a passing motorist.

Traditional truck and ladder company duties accounted for eight deaths. Search-and-rescue operations in burning structures were in progress when five deaths occurred—unchanged from 1995. Three of the search-and-rescue deaths were from heart attacks, one from burns after being caught in a flashover, and one from asphyxiation. Two firefighters died while ventilating structure fires: one from a heart attack and one from internal trauma when a wall collapsed. One firefighter was electrocuted during salvage and overhaul operations when a power line came into contact with his SCBA.

Nine firefighters died while performing support functions or standing by on the fireground: seven from heart attacks, one from asphyxiation, and one from internal trauma.

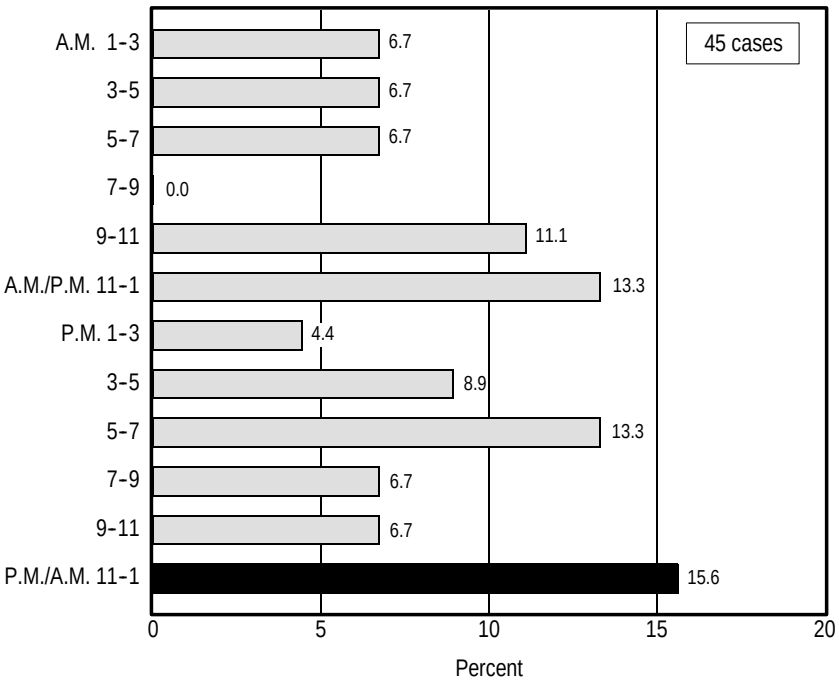
Cutting fire lines to contain grass, brush, and forest fires accounted for three firefighter fatalities. All died as a result of heart attacks.

One incident commander suffered a fatal heart attack at a fire incident.

When Deaths Occur

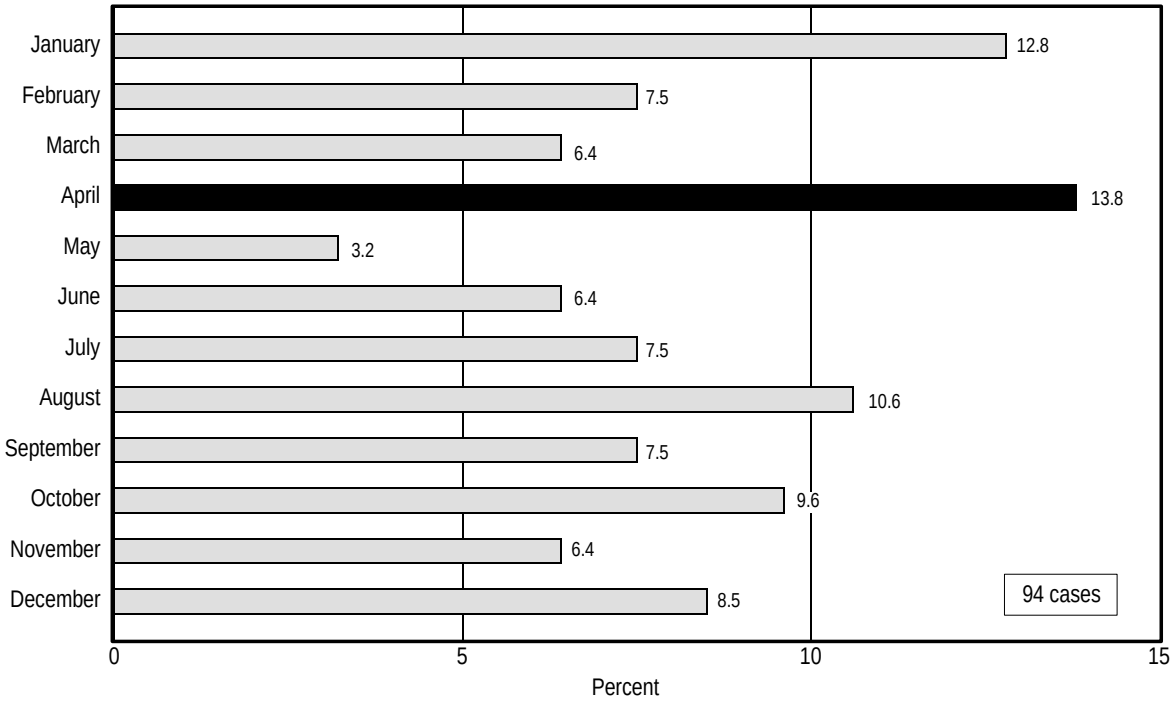
TIME OF ALARM. The distribution of 1996 deaths according to the time of day when the incidents were reported is shown in Figure 107 (time of day was not reported in 49 cases). The highest number of fireground deaths occurred for alarms that were received between 11 p.m. and 1 .am. The second highest number was a tie between 5 and 7 p.m. and 11 a.m. and 1 p.m. There were no fireground deaths between the hours of 7 and 9 a.m.

MONTH OF YEAR. Figure 108 illustrates firefighter fatalities by month of the year in 1996. Firefighter fatalities peaked in January and April. Other high months were recorded in August and October. The early summer months (May, June, and July) were among the lowest months. (Conversely the number of residential fires peaked during the winter and was lowest during June and July.) In contrast, July 1995 was the month of highest firefighter deaths.



Source: United States Fire Administration, Firefighter Fatality Project

Figure 107. 1996 Firefighter Deaths by Time of Alarm

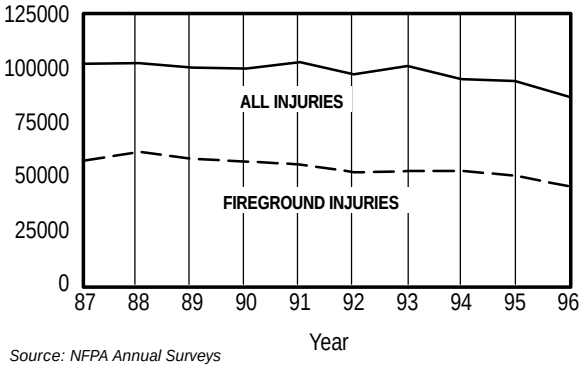


Source: United States Fire Administration, Firefighter Fatality Project

Figure 108. 1996 Firefighter Deaths by Month of Year

INJURIES

Fireground injuries constitute roughly 53 percent of all firefighter injuries, and numbered just shy of 46,000 in 1996.[4] As in previous years, in 1996 there were twice as many reported firefighter injuries as civilian injuries. Figure 109 shows the 21 percent downward trend in the fireground portion of these injuries.



Source: NFPA Annual Surveys

	All Injuries	Fireground		All Injuries	Fireground
1987	102,600	57,800	1992	97,700	52,300
1988	102,900	61,800	1993	101,500	52,900
1989	100,700	58,300	1994	95,400	52,900
1990	100,300	57,100	1995	94,500	50,600
1991	103,300	55,800	1996	87,100	45,700

10-Year All Injuries Trend = -11.8%
10-Year Fireground Injuries Trend = -20.6%

Figure 109. Trends in Firefighter Injuries

Injuries by Property Type

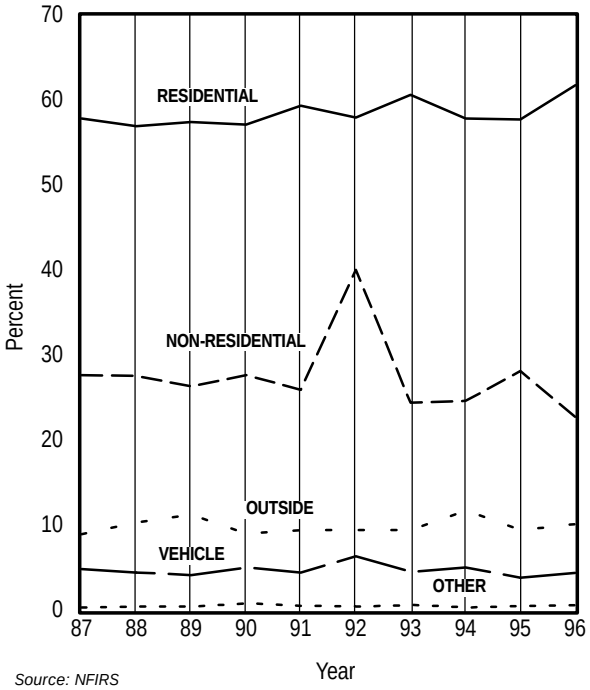
The majority of firefighter injuries reported to NFIRS are associated with residential fires, largely because that is the largest single subcategory of structural fires (Figure 110).

Residential structure fires account for roughly 62 percent of firefighter injuries, nearly triple the number of firefighter injuries (23 percent) sustained at non-residential structure fires. The proportions have been quite consistent over the 10-year period 1987–1996. Outside, vehicle, and other fires combined are 15 percent of firefighter injuries.

Figure 111 gives a more detailed look at the relative proportion of firefighter injuries by property type. Just over half of all firefighter injuries occur in structures at one- and two-family dwelling fires. Apartments account for another 19 percent.

The proportions of injuries by property type are similar over 1987–1996. Figures 112 and 113 show these proportions for residential and non-residential properties.

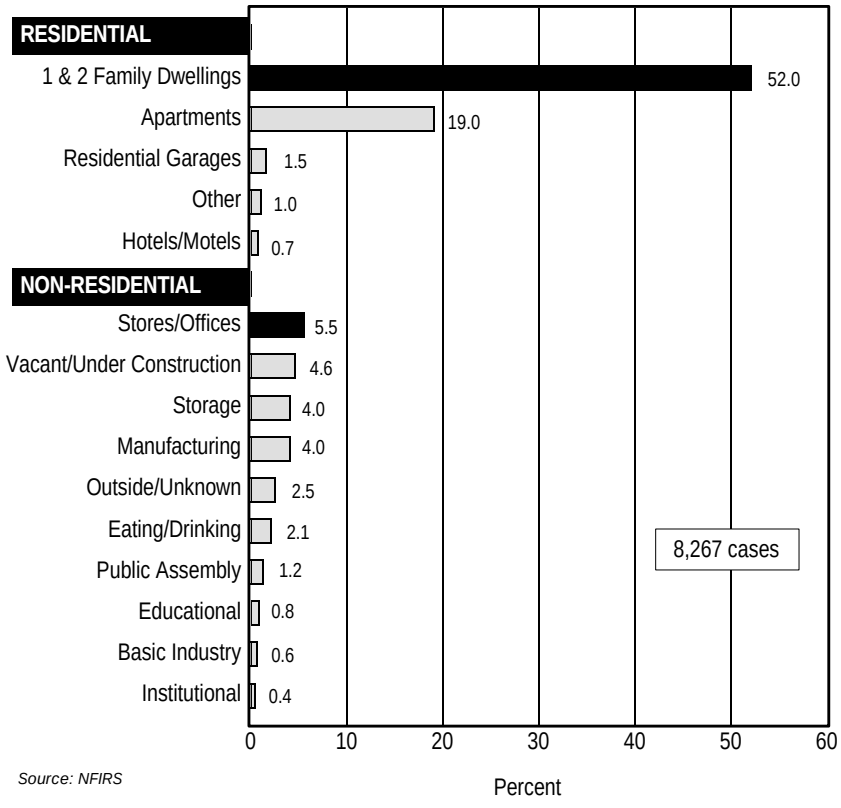
[4] NFPA reports fireground injuries as 45,725. To this should be added a portion of the injuries categorized as responding to or from an incident (which includes, but is not limited to fires).



Source: NFIRS

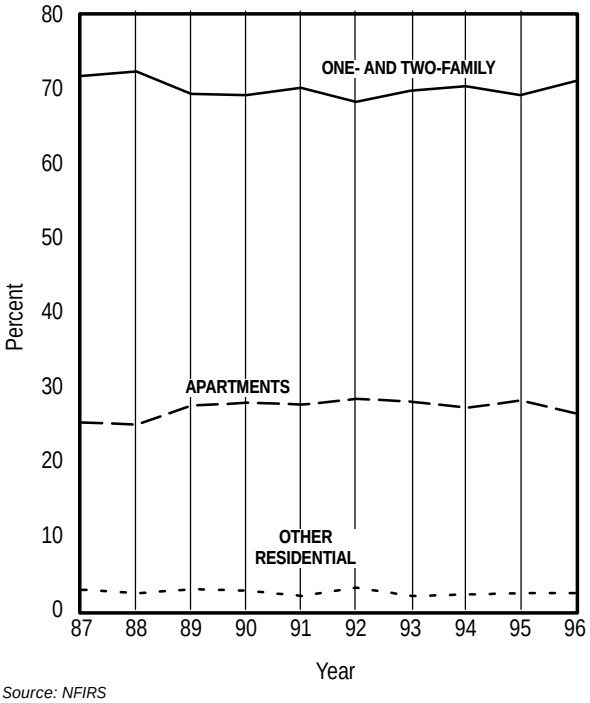
	Residential	Non-Residential	Vehicle	Outside	Other
1987	57.9%	27.7%	4.9%	9.0%	0.4%
1988	57.0	27.6	4.5	10.4	0.5
1989	57.5	26.4	4.2	11.3	0.5
1990	57.2	27.7	5.1	9.1	0.9
1991	59.4	26.0	4.5	9.5	0.6
1992	58.0	40.1	6.4	9.5	0.5
1993	60.7	24.5	4.6	9.5	0.7
1994	57.9	24.7	5.1	11.8	0.5
1995	57.8	28.2	3.9	9.5	0.6
1996	61.8	22.8	4.5	10.2	0.7

Figure 110. Trends in Firefighter Injuries by General Property Type



Source: NFIRS

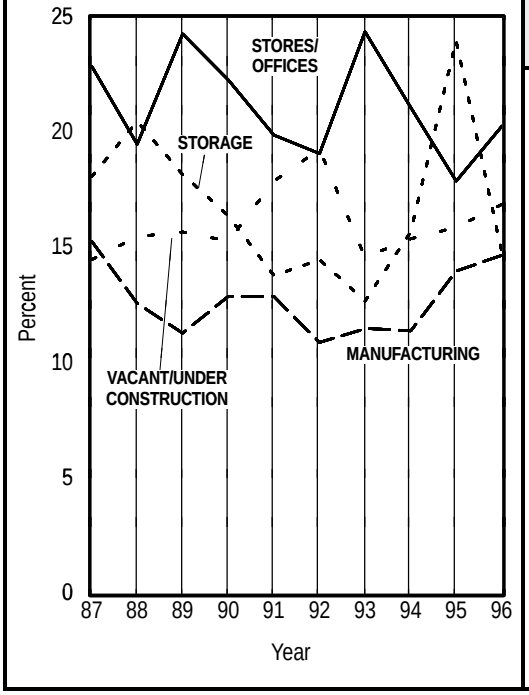
Figure 111. 1996 Firefighter Injuries by Property Type (Structure Fires Only)



	One- and Two-Family	Apartments	Other Residential
1987	71.9%	25.3%	2.8%
1988	72.5	25.0	2.4
1989	69.5	27.6	2.9
1990	69.3	28.0	2.7
1991	70.3	27.7	2.0
1992	68.4	28.5	3.1
1993	69.9	28.1	2.0
1994	70.5	27.3	2.2
1995	69.3	28.3	2.4
1996	71.2	26.5	2.4

Source: NFIRS

Figure 112. Trends in Firefighter Injuries in Residential Structure Fires



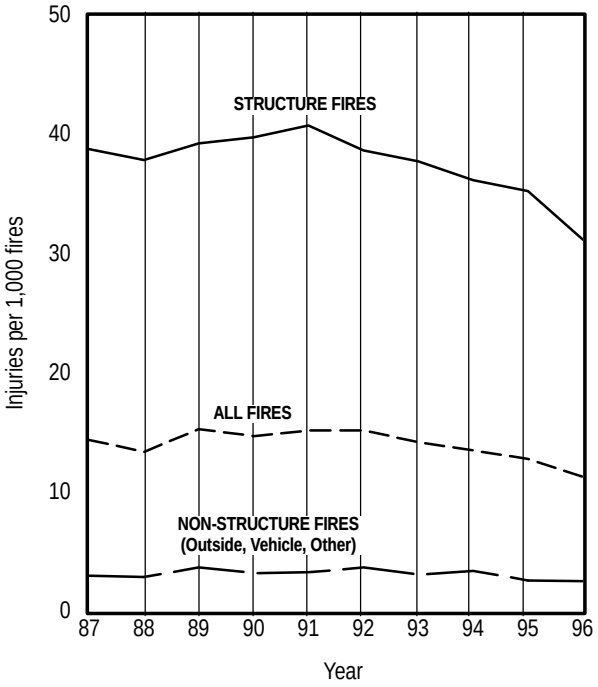
Type of Non-Residential Structures	Percent of Injuries in Fires									
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Public Assembly	6.0	4.5	5.0	5.4	5.3	4.6	4.0	3.7	3.8	4.3
Eating, Drinking	5.6	6.3	5.8	7.6	5.5	7.4	5.5	6.0	5.7	7.6
Educational	2.3	2.5	3.3	3.3	2.4	3.6	2.2	2.6	1.7	2.8
Institutions	2.5	2.1	1.5	2.1	3.0	2.8	2.7	3.1	1.1	1.3
Stores, Offices	22.9	19.5	24.3	22.3	19.9	19.1	24.4	21.1	17.9	20.3
Basic Industry	1.0	2.4	4.1	3.0	2.8	2.8	2.2	3.5	2.1	2.2
Manufacturing	15.3	12.6	11.3	12.9	12.9	10.9	11.5	11.4	14.0	14.7
Residential Garage	5.3	6.8	5.3	4.9	8.6	6.6	7.3	7.7	4.8	5.5
Storage	18.1	20.5	18.2	16.4	13.8	14.5	12.7	15.7	24.0	14.8
Vacant, Construction	14.5	15.5	15.7	15.3	17.9	19.3	14.6	15.4	15.9	16.9
Outside Structure, Unknown	6.4	7.4	5.6	6.8	7.8	9.4	12.8	9.7	9.0	9.4

Sources: NFIRS and NFPA Annual Surveys

Figure 113. Trends in Firefighter Injuries by Type of Non-Residential Structure Fires

Injuries per Fire

Firefighter injuries per fire have been gradually trending downward.[5] The injury rates for structure fires are more than ten times those for outside, vehicle, and other fires (Figure 114).



	Injuries Per 1,000 Fires		
	Structure Fires	All Fires	Non-Structure Fires
1987	38.8	14.4	3.0
1988	37.9	13.4	2.9
1989	39.3	15.3	3.7
1990	39.8	14.7	3.2
1991	40.8	15.2	3.3
1992	38.7	15.2	3.7
1993	37.8	14.2	3.1
1994	36.2	13.5	3.4
1995	35.3	12.8	2.6
1996	31.2	11.3	2.5
10-Year Trend	**-14.8%**	**-15.4%**	**-13.0%**

Source: NFIRS

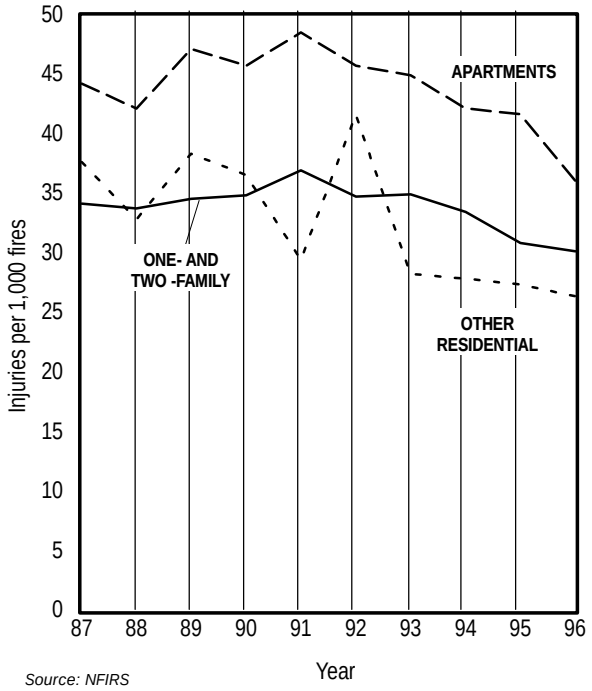
Figure 114. Trends in Severity of Firefighter Injuries by Type of Fire

Figure 115 shows that the firefighter injuries per fire in apartments and one- and two-family homes declined over the 10-year period with the exception of an unexplained large increase in 1996. The injury rate for hotel/motel fires and other residential structures is down sharply, but both of these categories fluctuate considerably from year to year because of small sample sizes.

Figure 116 shows the injury rates per 1,000 fires for structural occupancies. Several types of non-residential properties, especially manufacturing (56 deaths per 1,000 fires), vacant/under construction (52), and stores/offices (37), posed the greatest risk in 1996. Residential properties had less risk per fire than these non-residential properties.

Vacant properties have long been a firefighting concern (Figure 117). In the mid 1970s, the most dangerous fires were those in vacant properties and properties under construction. The layout of these structures is often unfamiliar and continually changing from week to week. Fire defenses built

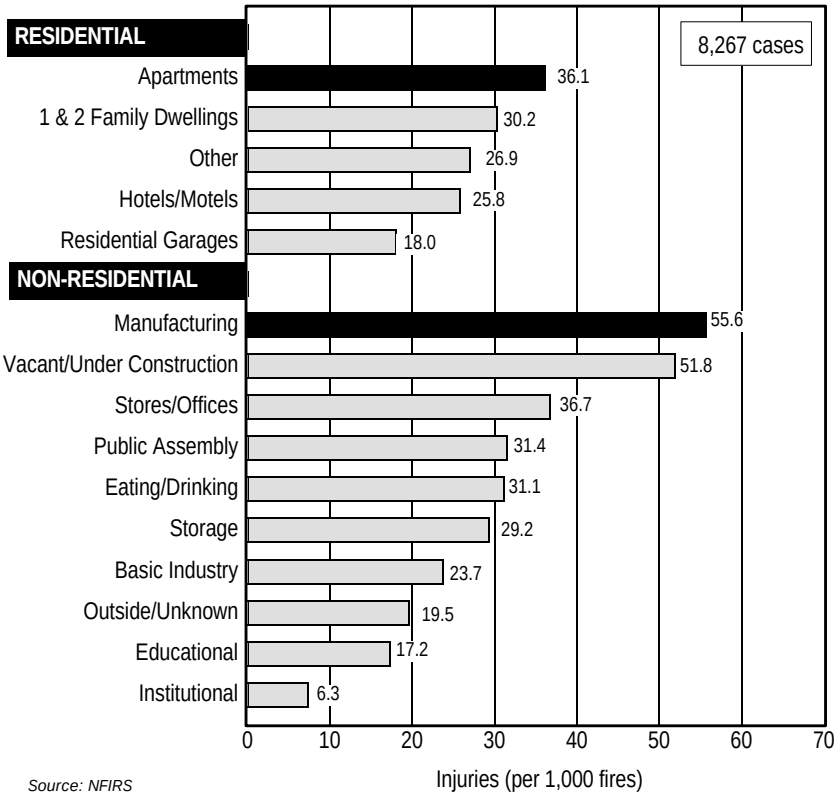
[5] The 1987–1996 NFPA *Fire Command* and NFPA *Journal* articles on firefighter injuries show a downward trend in injuries; however, little change was noted in the injury rate over the 10-year period 1987–1996. The NFPA firefighter injury rate on the fireground averaged 23 injuries per 1,000 fires during this period—twice that of the NFIRS data.



	Injuries Per 1,000 Fires		
	One/Two-Family	Apartments	Other Residential
1987	34.2	44.3	37.7
1988	33.8	42.2	32.9
1989	34.6	47.2	38.4
1990	34.9	45.8	36.6
1991	37.0	48.6	29.5
1992	34.8	45.8	41.7
1993	35.0	45.0	28.3
1994	33.5	42.2	27.9
1995	30.9	41.7	27.4
1996	30.2	36.1	26.4
10-Year Trend	**-9.7%**	**-12.5%**	**-29.3%**

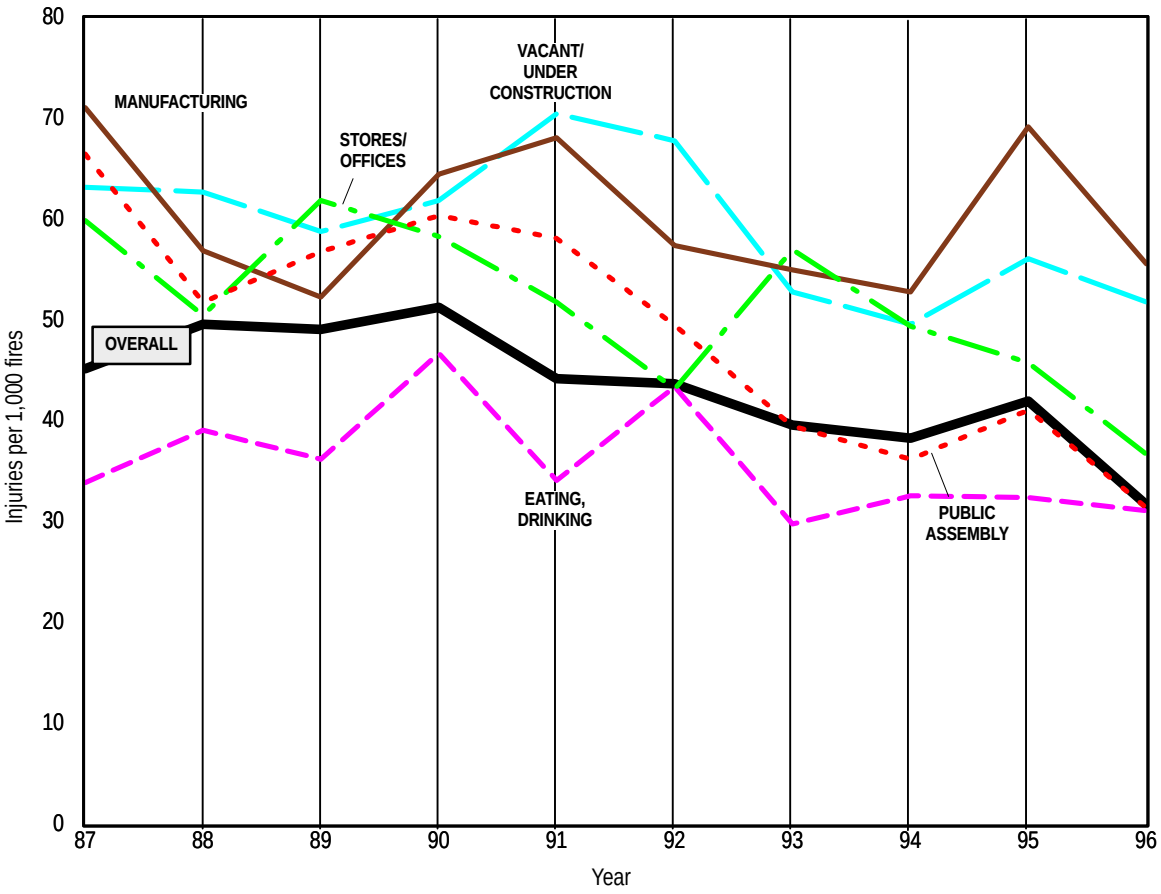
Source: NFIRS

Figure 115. Trends in Severity of Firefighter Injuries in Residential Structure Fires



Source: NFIRS

Figure 116. Severity of 1996 Firefighter Injuries by Property Type (Structure Fires Only)



Type of Non-Residential Structures	Number of Injuries Per 1,000 Fires									
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Public Assembly	66.5	51.8	56.8	60.4	58.1	49.5	39.5	36.2	41.1	31.4
Eating, Drinking	33.9	39.1	36.2	46.7	34.1	43.4	29.8	32.6	32.4	31.1
Educational	24.8	26.0	33.8	34.3	22.5	38.8	16.6	19.5	12.9	17.2
Institutions	14.6	12.4	8.8	12.7	18.6	17.2	15.0	18.1	7.3	6.3
Stores, Offices	59.9	50.5	61.9	58.3	51.8	43.2	57.0	49.4	45.8	36.7
Basic Industry	16.4	36.9	60.7	50.0	42.6	43.3	34.0	48.3	30.8	23.7
Manufacturing	71.1	56.9	52.3	64.5	68.1	57.4	55.0	52.8	69.2	55.6
Storage	52.1	55.3	51.9	50.4	39.2	36.9	33.2	54.9	66.1	29.2
Vacant, Construction	63.2	62.7	58.8	61.9	70.5	67.8	52.8	49.6	56.1	51.8
Outside Structure, Unknown	31.0	33.9	25.0	30.8	28.7	29.3	37.5	29.3	25.3	19.5
Average	45.2	49.6	49.1	51.3	44.2	43.7	39.6	38.3	38.7	31.7

Sources: NFIRS and NFPA Annual Surveys

Figure 117. Trends in Severity of Firefighter Injuries in Non-Residential Structure Fires

into such structures are often not working or only working partially. Also, there are many pitfalls where a misstep can cause serious injury. Many of these fires are started when no one is around and the fire gets considerable headway before the fire department is called. This combination continues to make these properties hazardous, and in 1996 they ranked second only to manufacturing structures. A promising sign is that injuries at both manufacturing and vacant/under construction structures are down from 69 to 56 injuries per 1,000 fires and from 56 to 52 injuries per 1,000 fires, respectively. When fighting fires in vacant properties, there is less of an inclination to risk firefighters' lives.

For non-residential properties in general, the injury rate per fire fluctuates widely from year to year, but the four highest risk properties (public assembly, manufacturing, vacant/under construction, and stores) are all trending downward—a promising pattern for firefighter fireground safety.

Age

Figure 118 shows the profile of firefighter injuries by age for all property types. As in 1995, roughly one-third of all injuries occur to firefighters aged 30–39. The types of injuries incurred by firefighters vary with age. Typically, the leading cause of injury among younger firefighters relates to smoke inhalation, and among older firefighters strains and sprains are more common injuries. These results relate to physical fitness variations with age, to the effect of age on assignments, and perhaps to the bravado of younger firefighters.

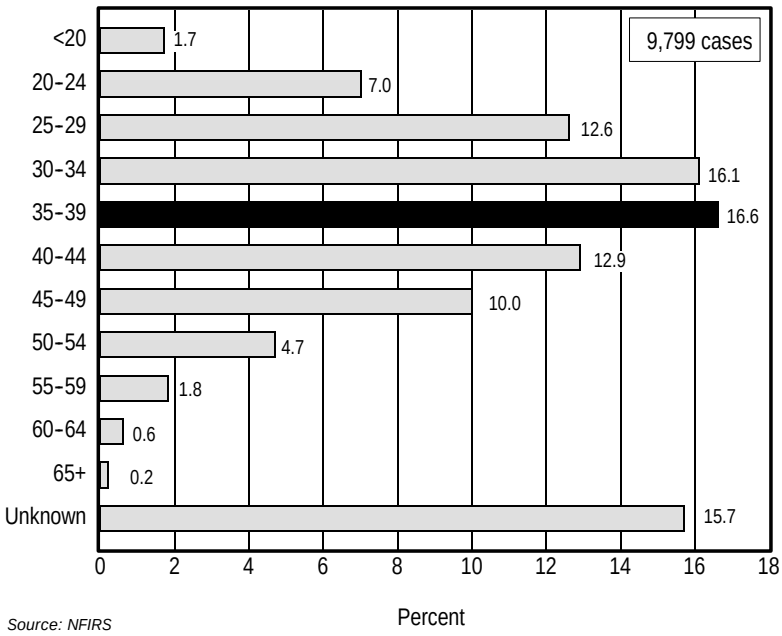


Figure 118. 1996 Firefighter Injuries by Age

When Injuries Occur

TIME OF DAY. More firefighter injuries occur after noon than before (51 percent with 11 percent unknown). However, there is no sharp peak. The times that are most hazardous to civilians (evening meal times for injuries) are not the same as the times firefighters get injured (Figure 119).

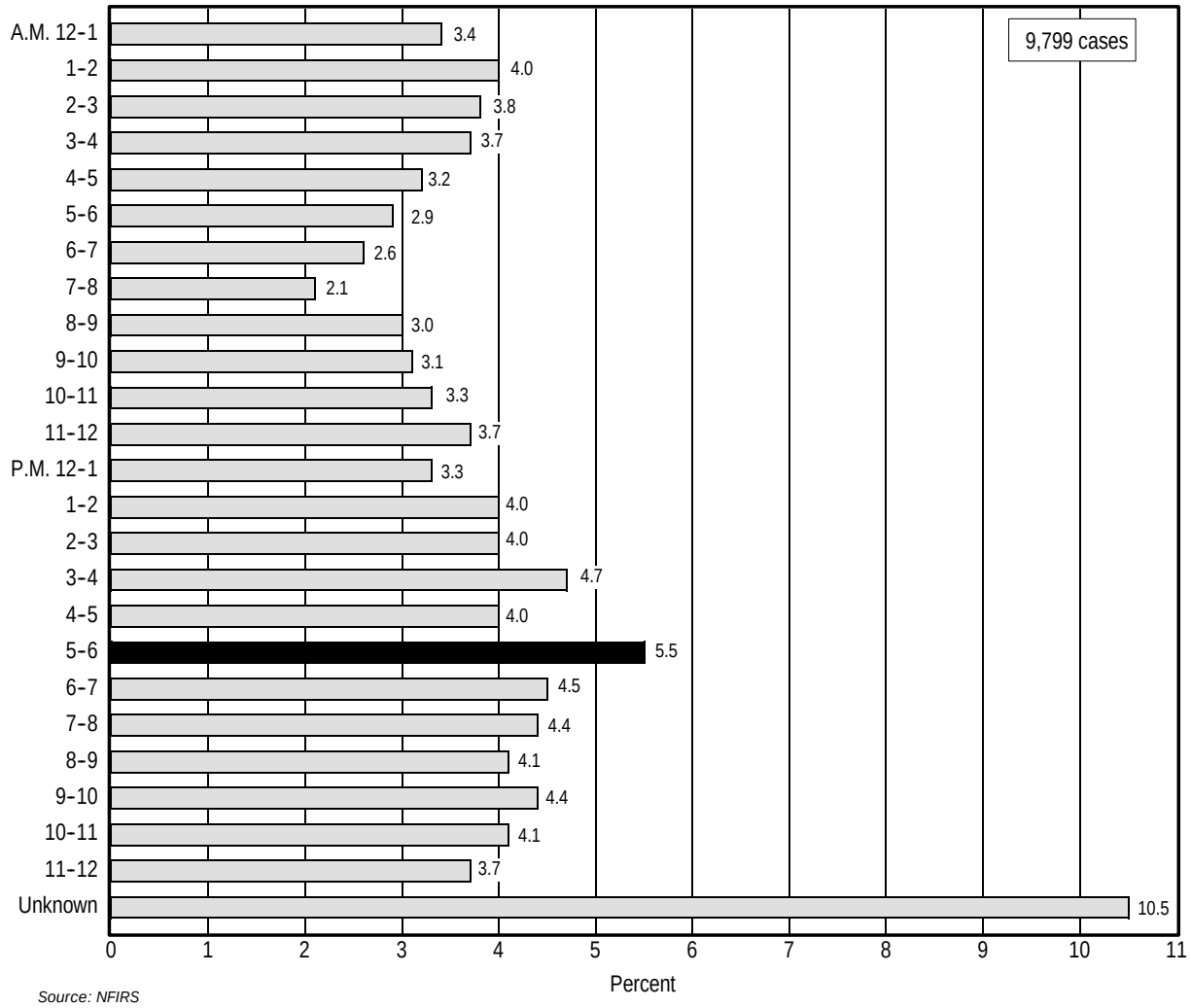


Figure 119. 1996 Firefighter Injuries by Time of Day

MONTH OF YEAR. Firefighter injuries are somewhat higher in the winter (December–March) when residential fires peak and again in June–August when fire incidence peaks and the warmer weather intensifies the stress effects of firefighting (Figure 120).

Part of Body Injured

The most common firefighter injuries in 1996 were to the torso (trunk), followed closely by arm/hand and leg/foot. All areas of the body are vulnerable, including internal injuries from smoke inhalation (Figure 121).

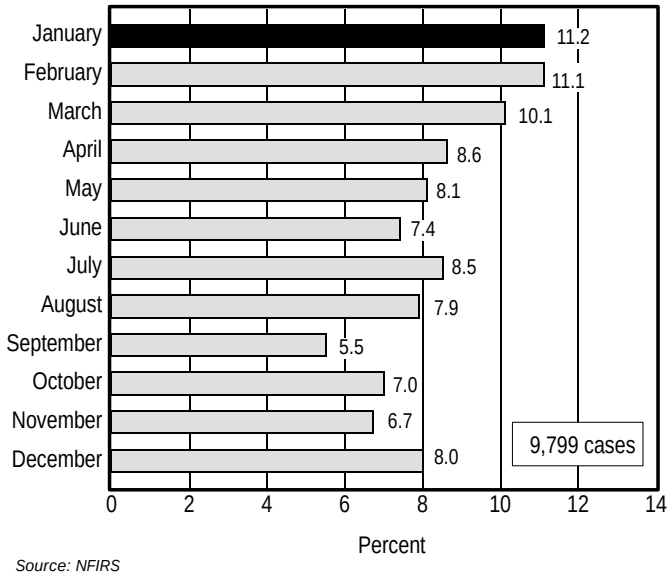


Figure 120. 1996 Firefighter Injuries by Month of Year

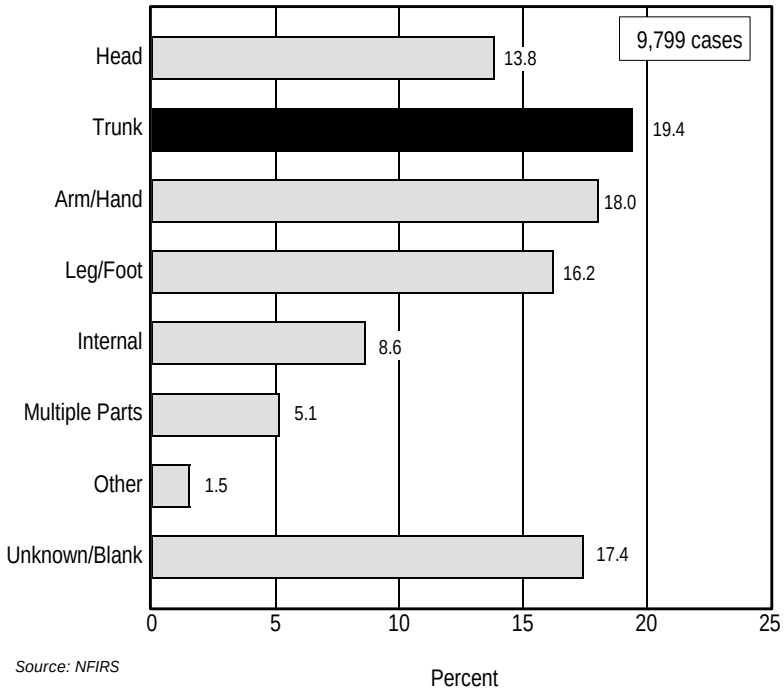


Figure 121. 1996 Firefighter Injuries by Part of Body Injured

Causes

As shown in Figure 122, the largest category by far of firefighter injuries associated with fires was reported to be contact with or exposure to flames or smoke (34 percent of injuries, adjusted, down slightly from 1995). The second highest category was overexertion and strains (23 percent), followed closely by fell or slipped (21 percent). No cause was reported for 23 percent of the injuries.

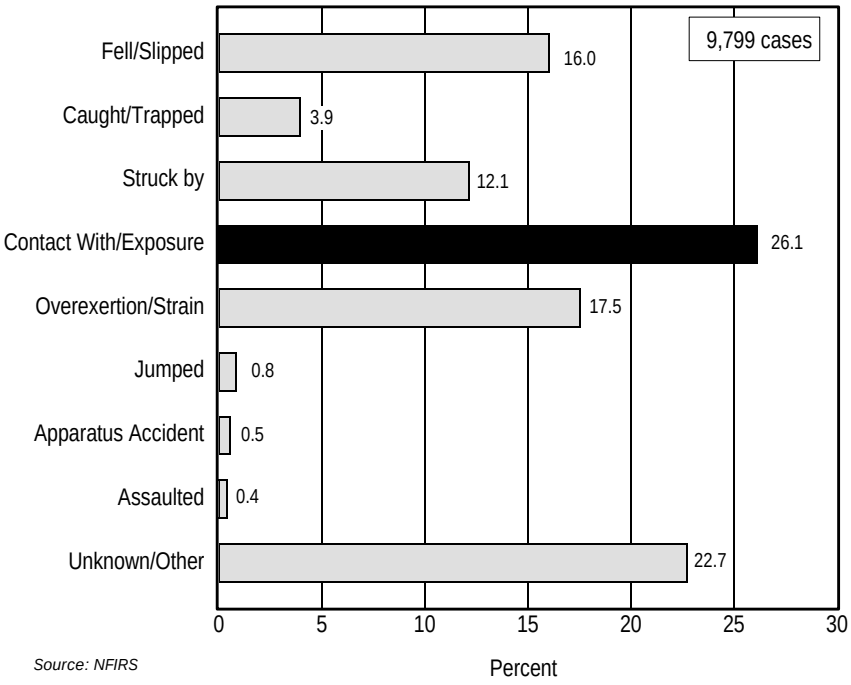


Figure 122. 1996 Firefighter Injuries by Cause

Where Injuries Occur

According to NFIRS, 90 percent of the 1996 firefighter injuries associated with reported fires occur on the scene above ground (Figure 123). This percentage is nearly equally divided between injuries occurring inside and outside the structure. Significantly smaller percentages are reported as occurring while en route to the fire scene or below ground level. (As a reminder, there also are many firefighter injuries not associated with fires, which are not included here.) More than one-quarter of injuries did not have a reported location.

The striking point here is that many firefighter injuries (48 percent) occur in areas outside the fire building, a place where the firefighter may feel relatively safe. There often are more firefighters operating outside the fire building and exposed to injury than there are inside. Outside fires include vehicle fires, which contribute to this high incidence of injuries.

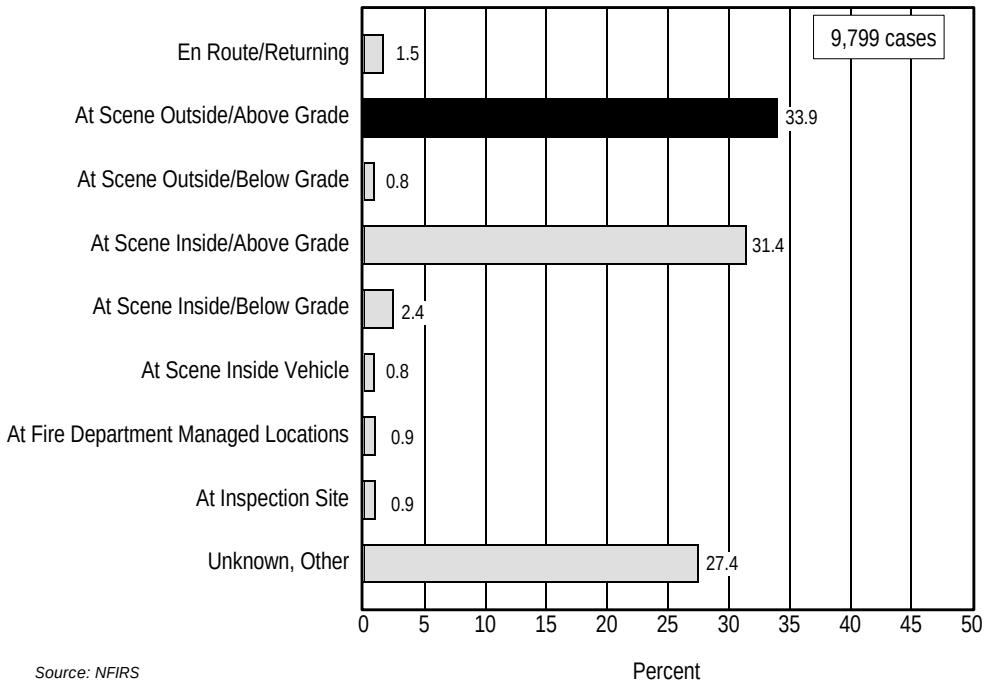


Figure 123. 1996 Firefighter Injuries (All Fires) by Where Injury Occurs

Type of Activity When Injured

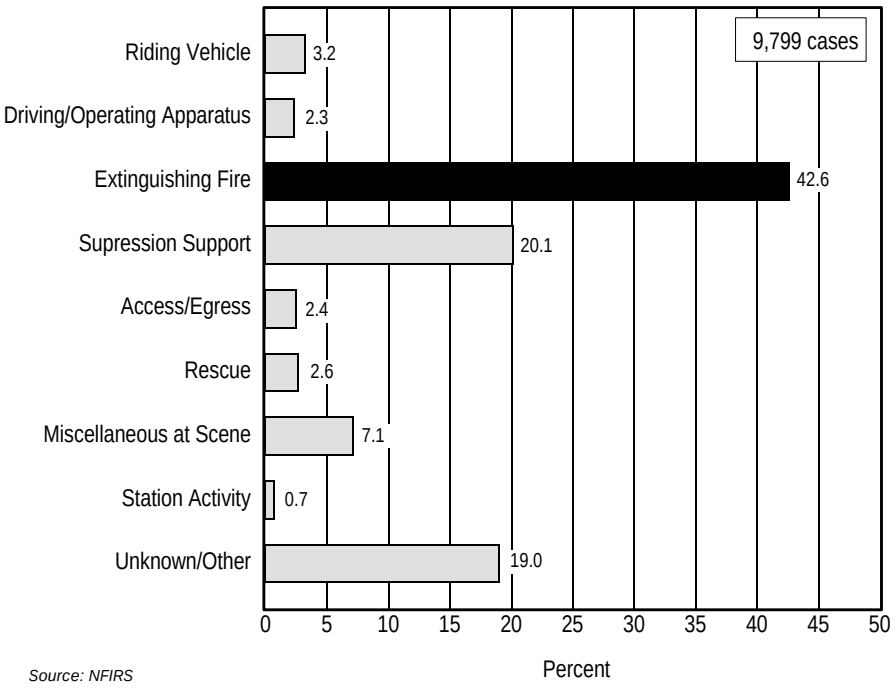
More than half of firefighter injuries occurred while extinguishing the fire; suppression support accounted for 25 percent (Figure 124).

Nature of Injury

Unlike firefighter fatalities, asphyxiation, heart attacks, and internal trauma combined account for less than 10 percent of firefighter injuries (Figure 125). (Internal trauma is included in the "other" category.) These same categories accounted for more than 90 percent of firefighter fatalities. In 1996, cuts and wounds and sprains and strains accounted for 44 percent of injuries. Burns and pain combined accounted for an additional 31 percent.

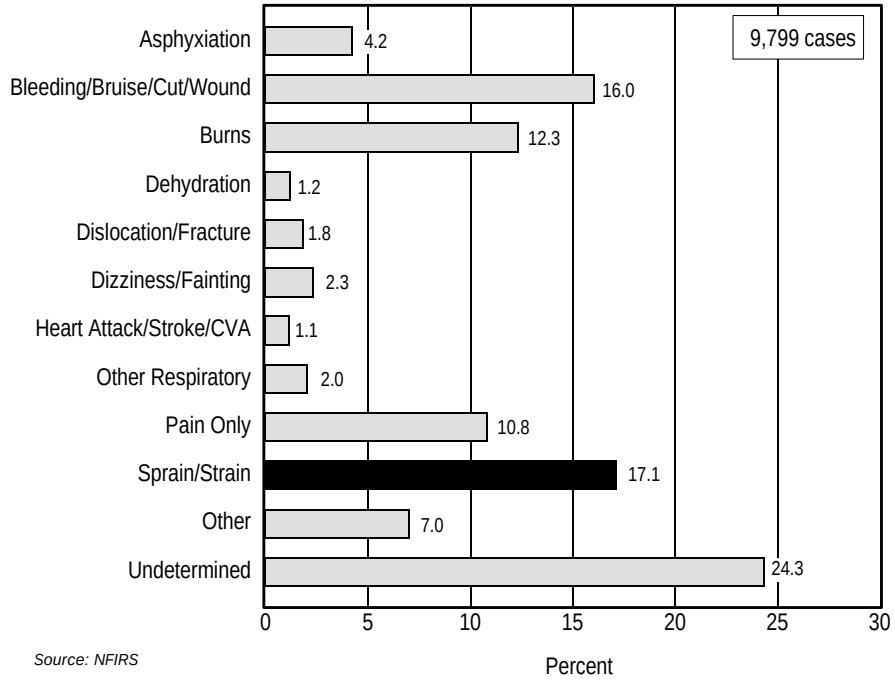
Type of Medical Care

Over half of the reported fire injuries associated with fires were treated at hospitals. Another 40 percent were treated but not transported. A small percentage (roughly 8 percent) of firefighters were treated elsewhere (Figure 126).



Source: NFIRS

Figure 124. 1996 Firefighter Injuries by Type of Activity



Source: NFIRS

Figure 125. 1996 Firefighter Injuries by Nature of Injury

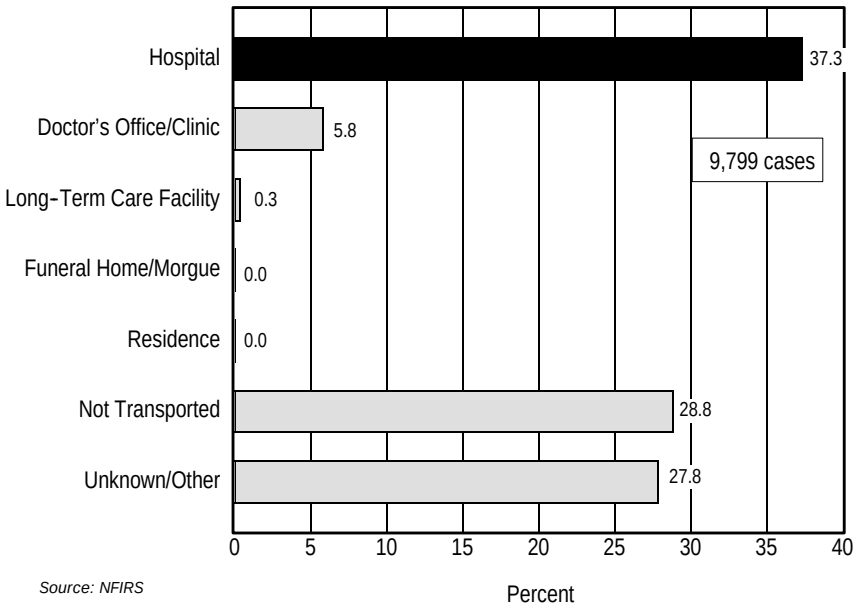


Figure 126. 1996 Firefighter Injuries by Where Treated

USFA RESOURCES ON FIREFIGHTER CASUALTIES

Publications

The U.S. Fire Administration recently revised its NFIRS Firefighter Casualty Report to improve the quality of available data in its annual review of firefighter line-of-duty deaths. The 1997 report of the Firefighter Fatality Project, *Firefighter Fatalities in the United States in 1997*, describes in detail the data collected on the line-of-duty firefighter deaths. This and other USFA-supported research and development are intended to increase the safety and well-being of emergency response personnel. USFA encourages sharing of research findings and incorporation of innovations in equipment available to firefighters and other responders through programs that focus on health and safety studies; research, training, and awareness; emergency medical services; search and rescue; and equipment and technology development.

Because accidents involving emergency vehicles are one of the leading causes of firefighter death and injury, USFA has several resources on the subject for fire departments and emergency medical services departments. *Emergency Vehicle Driver Training* (#FA–110) is a 220-page training package that includes both an instructor manual and a student workbook designed to assist fire and emergency medical service (EMS) departments with training in emergency vehicle operations. *Alive on Arrival—Tips of Safe Emergency Vehicle Operations* (#L–195) is a pamphlet detailing actions that emergency vehicle operators, passengers, and officers-in-charge can do to improve safe operation of emergency vehicles. Also available is a 48-page special report titled *Fire Apparatus/Train Collision* (#FA–104), which presents the investigation of the collision near Catlett, Virginia, on September 28, 1989.

Publications addressing incident response issues have been developed for fire and EMS departments. Among these are *Emergency Incident Rehabilitation* (# FA–114), a short booklet that includes a sample standard operating procedure and guidelines for establishing a rehab area to reduce heat- or cold-related injuries to emergency response personnel operating in labor-intensive or extreme climate conditions.

Guides are also available on recommended safe practices, including response to crashes involving cars equipped with air bags and on a comprehensive safety program designed for fire department safety officers.

USFA also emphasizes research and development of protective clothing for chemical, emergency medical, and search-and-rescue emergencies as well as structural firefighting protective clothing and self-contained breathing apparatus (SCBA). For example, USFA has been involved in the development of a new test method for evaluating the performance of complete firefighter protective clothing ensembles. A suit integrity field test was conducted during hazardous materials training for USFA's study, *Qualitatively Evaluating the Comfort, Fit, Function, and Integrity of Chemical Protective Suit Ensembles* (# FA–107). Three protective clothing ensembles were evaluated in *Physiological Field Evaluation of Hazardous Materials Protective Ensembles* (# FA–109). Another study, the *Non-Destructive Testing and Field Evaluation of Chemical Protective Clothing* (# FA–106), details a procedure, field tested by the Cambridge, Massachusetts, Fire Department, developed for assessing the presence of contamination before or after decontamination of chemical protective clothing.

USFA has supported research into health hazards faced by firefighters, including the *Northwest Firefighters Mortality Study: 1945–1989* (# FA–105). USFA also supports symposia on the occupational health and hazards of the fire service focusing on emerging firefighter safety and health issues.

A manual has been prepared for emergency response managers on infection control programs based on federal laws, regulations, and standards. The *Guide to Developing and Managing an Emergency Service Infection Control Program* (# FA–112) addresses modes of disease transmission, measures for prevention, incident response and recovery, station issues, and training/role modeling. The 200-page manual provides a step-by-step approach to designing, implementing, managing, and evaluating a fire or emergency medical services department infection control program. The guide also is a key resource in a National Fire Academy course on infection control.

USFA has developed a series of comprehensive manuals for fire service and EMS managers interested in instituting programs for firefighter health promotion and injury prevention. The 80-page *Fire and Emergency Service Hearing Conservation Program Manual* (# FA–118) outlines measures to reduce the risk of occupationally induced hearing loss. USFA also is conducting research to identify causes and to develop solutions to reduce the stress level in EMS providers. A 175-page *Stress Management Model Program* (# FA–100) is available.

Reports produced under the USFA's Major Fires Investigation series are directed primarily to chief fire officers, training officers, fire marshals, and investigators as a resource for training and prevention. Recent reports on incidents with firefighter deaths and injuries include: *Four Firefighters*

Die in Seattle Warehouse Fire, Seattle, WA (#TR–077); *Wood Truss Roof Collapse Claims Two Firefighters, Memphis, TN, December 1992* (#TR–069); *Detroit Warehouse Fire Claims Three Firefighters, March 1987* (#TR–003); *Confined Space Rescue on SS Gem State, Tacoma, WA* (#FA–163A); *Floor Collapse Claims Two Firefighters, Pittston, PA, March 1993* (#TR–073); *Four Firefighters Killed, Trapped by Floor Collapse, Brackenridge, PA, December 1991* (#TR–061); *Three Firefighter Fatalities in Training Exercise, Milford, MI, October 1987* (#TR–015); *Indianapolis Athletic Club Fire, Indianapolis, IN, February 1992* (#TR–063); *Three Firefighters Die in Pittsburgh House Fire* (#TR–078); *Six Firefighter Fatalities in Construction Site Explosion, Kansas City, MO, November 1988* (#TR–024); *Entrapment in Garage Kills One Firefighter, San Francisco, California* (#TR–084); and *Sodium Explosion Critically Burns Firefighters, Newton, MA, October 1993* (#TR–075).

A few other works published by USFA that would be helpful while analyzing firefighter casualties include the following works: *EMS Safety Techniques and Applications* (#FA–144); *Firefighter Fatalities in the United States in 1997; Firefighter Autopsy Protocol* (#FA–156); *Aftermath of Firefighter Fatality Incidents: Preparing for the Worst* (#TR–089); *Fire and Emergency Medical Services Ergonomics—A Guide for Understanding and Implementing An Ergonomics Program in Your Department* (#FA–161); *Health and Safety Issues of the Female Emergency Responder* (#FA–162); and *Safety and Health Considerations for the Design of Fire and Emergency Medical Services Stations* (#FA–168).

These USFA publications are available by writing to:

U.S. Fire Administration
Federal Emergency Management Agency
Publications Center, Room N310
16825 S. Seton Avenue
Emmitsburg, MD 21727

Please include the parenthetical publication number, if given, in your request.

Documents may also be ordered via the World Wide Web: http://www.usfa.fema.gov/usfapubs. USFA publications are free.

National Fire Academy Courses

USFA's National Fire Academy (NFA) of the U.S. Fire Administration has educated more than 1,300,000 people in a wide variety of courses. The NFA works to enhance the ability of the fire service and allied professions to deal more effectively with fire and related emergencies. Courses are delivered on campus at the resident facility in Emmitsburg, Maryland, and off campus throughout the nation in cooperation with state and local fire training officials and local colleges and universities. An initiative begun in 1992 offers NFA resident courses on a regional basis.

Issues relating to firefighter safety are indirectly covered in several on-campus courses, but are more directly offered through "Distance Delivery Courses and Programs." These courses were estab-

lished for the student's convenience being taught either at a local department or at a number of local colleges or public service training facilities. NFA offers several courses relevant to firefighter safety on incident scenes. Fireground safety is key in any operating incident. NFA offers two off-campus courses on managing scene safety. *Incident Safety Officer (ISO)* (Off-Campus Course #F719) examines the safety officer's role at emergency responses. A specific focus of this course is operations within an Incident Command System as the safety officer. *Health and Safety Officer (HSO)* (Off-Campus Course #F720) is a 2-day course that examines the health and safety officer's role in identifying, evaluating, and implementing policy and procedures that affect health and safety aspects for emergency responders. The course emphasizes risk analysis, wellness and other occupational safety issues. NFA also offers several courses in emergency response to terrorism. *Emergency Response to Terrorism: Incident Management (ERT:IM)* (Resident Course #R817), the only resident course on this topic offered by the NFA, is a 6-day course focusing on incident management on suspected terrorist incidents involving biological, nuclear, incendiary, chemical, and explosive (B–NICE) attacks. *Emergency Response to Terrorism: Basic Concepts (ERT:BC)* (Off-Campus Course #F531) is a 2-day course designed to prepare first-responder personnel to take the appropriate course of action at the scene of a potential terrorist incident. The *Emergency Response to Terrorism: Tactical Considerations (ERT:TC) Courses* are upcoming classes that will be offered by NFA after April 1, 2000. This topic will be divided into three courses dedicated to company officers, emergency medical services, and hazardous materials. *Emergency Response to Terrorism: Self Study (ERT:SS)* is a self-paced, paper-based course that provides basic awareness training to prepare first responders to respond to incidents of terrorism safely and effectively. Finally, selected NFA course materials are available for purchase for locally sponsored delivery from the National Technical Information Service. One relevant course to this topic is titled *The Firefighter Safety and Survival*. Contact NFA for course materials on this topic.

For information about course offerings, eligibility, and application procedures, write to:

The National Fire Academy
U.S. Fire Academy
16825 South Seton Avenue
Emmitsburg, Maryland 21727

Information on National Fire Academy course offerings can also be obtained on the USFA Web site http://www.usfa.fema.gov/nfa.

6

SPECIAL TOPICS

Each edition of *Fire in the United States* considers several topics of special interest related to the severity of the fire problem. The ninth edition (1985–1994) presented four special topics: (1) a comparative analysis of the fire problem in the United States and 13 other industrial nations; (2) an analysis of the arson problem; (3) an investigation of wildland fires, which have become an important and visible problem with the rapid expansion of the urban population to rural areas; and (4) an aggregation of the hidden cost of fires with the known costs to better understand the magnitude of the fire problem.

The tenth edition presented two new topics: (1) an overview of the uses of the National Fire Incident Reporting System (NFIRS)—its history, how it works, and who uses it; and (2) an assessment of the socioeconomic factors and the incidence of fire through a review of building stock characteristics and human factors as they relate to increased incidences of fires and the resulting deaths, injuries, and financial costs.

This edition presents three new topics:

- The factors involved in fires that cause multiple fatalities in residential structures.
- The fire problem in urban areas.
- The connection between alcohol consumption and fire deaths.

MULTIPLE-FATALITY FIRES IN RESIDENTIAL STRUCTURES[1]

Each year, more than 4,500 Americans die as a result of fires. Of these deaths, approximately 80 percent occur in the victim's home. More than one in six of the fatal home fires in this country claim more than one life. These multiple-fatality fires are responsible for one-third of the nation's residential fire deaths.

For the purposes of this analysis, a *multiple-fatality fire* refers to a fire incident in which there were two or more fatalities. The victims are all civilians, not firefighters. In a few cases, multiple-fatality fires are separated to investigate differences between those with two fatalities and those with three or more fatalities. Residential structures are the focus of the analysis since they accounted for 95 percent of victims of multiple-fatality house fires.

[1] This section summarizes a report published by the U.S. Fire Administration. In lieu of citing all references, refer to the document *Multiple Fatality Fires Reported to NFIRS 1994–1996*. This report, in its entirety, may be viewed on the USFA Web site or ordered free of charge from USFA at http://www.usfa.fema.gov.

Research over the years has provided the fire service with a multitude of details pertaining to the characteristics of a fatal house fire. We know the most common causes, the time of day when the fire is most likely to occur, and the demographics of the most common victims. Less is known about the unique traits of multiple-fatality fires.

Based on a 3-year analysis of NFIRS residential fire data and reports from fire departments across the country, several distinct characteristics of multiple-fatality fires emerge. NFIRS provides information on the number and characteristics of multiple-fatality fires. Characteristics include where the fires occurred, their causes, and the victims' age, gender, and activity at the time of the fire. Fire department accounts of fires offer insight into the types of circumstances surrounding a multiple-fatality fire.

From 1994 to 1996, 1,491 multiple-fatality fires occurring in residential structures were reported to NFIRS—an average of 497 incidents per year. By comparison, an average of 2,286 single-fatality fires were reported during the same period. Comparisons of single- and multiple-fatality residential fires revealed significant differences in nine descriptive criteria:

- Cause of fire
- Area of fire origin
- Time of day of fire
- Form of ignition
- Form of material ignited
- Performance of any smoke alarms
- Age of victim(s)
- Gender of victim(s)
- Condition of victim(s) before injury.

The analysis also identified similarities between single- and multiple-fatality fires, including:

- Type of residence
- Level of residence where fire began
- Type of material ignited
- Time of year
- Nature of injuries of victim(s).

Differences Between Single- and Multiple-Fatality Fires

CAUSE OF FIRE. The three leading causes of multiple-fatality residential fires for 1994–1996 were heating systems, arson, and children playing with fire-setting materials. Combined, these three causes accounted for over half of all multiple-fatality home fires. The frequency of fires due to arson and children playing is particularly troublesome since they are entirely avoidable.

In comparison, the leading causes of single-fatality fires were smoking, arson, and heating systems. These three causes accounted for almost 60 percent of all fires in which one fatality occurred.

Smoking alone accounted for 30 percent of single-fatality fires and 15 percent of multiple-fatality fires.

Heating systems were the leading cause of multiple-fatality fires, accounting for 19 percent. When considering only those fires with three or more victims, however, arson was the leading cause, accounting for 22 percent compared to 16 percent for heating systems. The frequency of fires caused by children playing and smoking was slightly lower for fires with three or more victims, whereas the frequency of fires caused by cooking and appliances was slightly higher.

AREA OF FIRE ORIGIN. The leading area of fire origin for multiple-fatality fires was a lounge area, such as the living room or family room. Lounge areas accounted for 35 percent of all multiple-fatality fires. This may be attributed to the increased likelihood of fires caused by heating systems, arson, and smoking beginning in lounge areas. Bedrooms, followed by hallways and stairways, were the second and third leading areas of fire origin.

For single-fatality fires, lounge areas and bedrooms tied as the leading areas of fire origin, followed by kitchens. One-third more single-fatality fires originated in the kitchen than multiple-fatality fires. This finding reflects the fact that cooking fires accounted for twice as many single-fatality than multiple-fatality fires.

FORM OF IGNITION AND FORM OF MATERIAL IGNITED. Open flame accounted for one-fourth of all multiple-fatality fires, due to the high proportion of these fires started by children playing with matches or lighters. The leading forms of material ignited in multiple-fatality fires were structural components, which reflected the incidence of heating fires. Furniture and soft goods ranked second and third. Children playing with fire are particularly likely to ignite soft goods such as clothing and bedding.

In single-fatality fires, the leading form of heat of ignition was smoking materials. This reflected the dominance of smoking as the leading cause of single-fatality fires. Similarly, the leading forms of material ignited were soft goods and furniture. The second leading form of material ignited was furniture, which includes upholstered items—another household item closely related to fires caused by smoking.

TIME OF DAY. Fire data analysts have long known that fatal fires are far more likely to occur at night and in the early morning hours than nonfatal fires. More multiple-fatality fires occurred in the early morning hours than single-fatality fires. Fires occurring between midnight and 6:00 a.m. accounted for 46 percent of all multiple-fatality fires. These fires may be more deadly not only because people are sleeping, but also because they are likely to be in a deeper sleep than at other times during the night.

Multiple-fatality fires were much less likely to occur between noon and 6:00 p.m. than single-fatality fires. Household residents are generally awake during these hours, and it is easier to notice a fire earlier and escape before the flames or smoke overwhelms victims.

PERFORMANCE OF SMOKE ALARMS. Year after year in the United States, a significant number of all fatal fires occur in homes without working smoke alarms. Interestingly, the proportion of missing smoke alarms was about the same in multiple- and single-fatality fire incidents. About 60 percent of fatal fires occurred in homes where no smoke alarms were present.

Although similar proportions of multiple- and single-fatality fires occurred in homes lacking working smoke alarms, multiple-fatality fires were more likely to have an alarm present but not operating. This percentage increased from 17 percent of single-fatality fires, to 22 percent of fires with two victims, to 28 percent of fires with three or more victims.

AGE. The very young and the very old have the highest fire death rates in the United States. This study found dramatic differences in the age profiles of multiple- and single-fatality fire victims. Children under age 10 made up 45 percent of all victims in multiple-fatality fires. Only 10 percent were age 70 or older. The proportion of all fire victims under age 10 increased as the total number of victims rose. Over half of all victims of fires with three or more fatalities were under the age of 10.

Among single-fatality fire victims, only 14 percent were under age 10, while 27 percent were 70 and older. The elderly are more likely to die as the result of single-fatality fires because they often live alone. Like the elderly, persons in the middle age groups—those ranging from age 30 through 59—made up a higher proportion of victims in single-fatality fires (36 percent) than in multiple-fatality fires (22 percent).

The leading cause of multiple-fatality fires that killed persons under age 10 was children playing with fire-setting materials, followed by arson and heating fires. The leading causes of multiple-fatality fires that killed persons 70 and older were smoking and heating systems.

GENDER. The gender of victims was closely related to their ages. In multiple-fatality fires, males were slightly more likely (13 percent) to die than females. In contrast, males were 70 percent more likely than females to die as the result of single-fatality fires. These findings support previous research indicating that male and female fire death rates are relatively similar among children, whereas fire death rates are significantly higher for men than for women among older persons.

Males and females were at equal risk to die in multiple-fatality fires where there were three or more victims. This was due to the increasing proportion of victims who were children and the similarity in their fire death risks by gender.

CONDITION OF VICTIM(S) BEFORE INJURY. Victims of multiple-fatality fires were more likely to have been asleep or too young to act at the time of the fire. This factor is closely related to the age of victims. In single-fatality fires, victims were several times more likely to have been impaired by alcohol or drugs or bedridden. They were also more likely to have been what NFIRS classifies as “too old to act” or “mentally handicapped.”

The fire victim’s condition before injury was also linked to the cause of fires. For example, the leading cause of single-fatality fires was smoking. Individuals who are impaired by alcohol or drugs are not only more likely to drop a lighted cigarette on clothing or upholstery, but also more likely

to experience difficulty in detecting and escaping a fire. Bedridden fire victims, although not impaired by alcohol, are vulnerable due to their physical limitations.

ACTIVITY AT TIME OF INJURY. Victims of multiple-facility fires were more likely to be injured trying to escape than victims of single-fatality fires. In addition, multiple-fatality victims were more likely to be attempting a rescue and less likely to be attempting to extinguish the fire.

The fire victim's activity was also linked to gender. Females were more likely to try to escape the fire than males and less likely to attempt to extinguish it.

Similarities Between Single- and Multiple-Fatality Fires

TYPE OF RESIDENCE. The vast majority (about 80 percent) of all single- and multiple-fatality fires occurred in one- and two- family dwellings; 17 to 18 percent occurred in apartments. However, if just those multiple-fatality fires with three or more fatalities are considered, the proportion that occurred in apartments rises slightly to 21 percent. This finding is consistent with the proportion of all residential fires and fire deaths that typically occur in apartments each year.

LEVEL OF RESIDENCE WHERE FIRE BEGAN. Approximately three-quarters of all single- and multiple-fatality fires started on the ground floor (grade to 9 feet above). The next most common level of fire origin was the second floor (10 to 19 feet above grade).

TYPE OF MATERIAL IGNITED. Fabric was the leading type of material ignited in both single- and multiple-fatality fires. Fires in which fabric is the type of material first ignited are commonly associated with smoking, children playing, and heating fires, all of which factored heavily in the profile of multiple- and single-fatality fires between 1994 and 1996. Wood and paper was the second leading category of material ignited, followed by the other category.

MONTH OF YEAR. More single- and multiple-fatality fires occurred during the winter months than at any other time during the year; winter is when fires caused by heating systems occur. Also, people spend more time indoors during the winter months, thus increasing the likelihood of fires due to smoking and children playing.

A higher proportion of multiple-fatality fires occurred in January than did single-fatality fires (19 percent versus 14 percent). This is consistent with the fact that heating system fires factored more heavily in multiple- than single-fatality fires, as January is one of the coldest months.

NATURE OF INJURIES. The nature of the injuries leading to fire deaths was similar among victims of multiple- and single-fatality fires. Over 70 percent of victims experienced both burns and asphyxia; another 20 percent died as the result of asphyxia alone. Fewer than 5 percent of the victims in both single- and multiple-fatality fires died as the result of burns only.

PROFILE OF THE URBAN FIRE PROBLEM[2]

This section characterizes the nature of the fire problem in urban areas of the United States. Because large population urban areas have higher densities of people and buildings than rural areas, the fire problem in urban areas is worthy of separate study. For example, research has shown that the rate of structure fires due to incendiary or suspicious origin is a greater problem in communities with populations of 100,000 or more than it is in smaller towns and rural areas. On the other hand, heating fires are typically less of a problem in urban areas than rural areas. The information presented in this section is derived from 1996 NFIRS data to develop a general profile of urban fires.

While it is important to profile urban fires, it is also interesting to look for variations within this category. Differences in climate and building stock across regions could lead to slightly different urban fire profiles. For example, it is likely that home fires related to heating occur more frequently in the northern areas of the United States. Similarly, electrical distribution fires are likely to be more common in the Northeast and South where the housing stocks are older on average than in areas of the Midwest and West. Regional differences in fire death rates area are also presented.

In 1996, 29 percent of the urban fires were classified as structure fires, 42 percent were outdoor fires, and 27 percent were vehicle fires. Two percent of the urban fires occurred in "other locations." Although outside fires are the most numerous of the urban fire problem, structure fires account for the vast majority of fire deaths, fire injuries, and property loss.

For both outdoor and vehicle fires, incendiary or suspicious origin was the leading cause of fire. This is a cause for concern. One concern is that some juvenile firesetters use outdoor fires as "get-away" fires. They move from setting fires outdoors to setting fires in vehicles or structures. Arson in structures increases the likelihood that someone will be injured or killed as a consequence of the fire (whether intentional or not).

All Americans pay the cost of vehicle arson in the form of increased insurance premiums. Insurance fraud is an important motive in vehicle arson. Another problem is the negative impact vehicle arson has on neighborhoods. This dynamic is exemplified by the Dudley neighborhood in Boston. During the 1980s, Dudley, a low-income, predominantly African–American neighborhood, served as a dumping ground for cars abandoned by their owners or stolen and stripped of parts. These cars were often burned. As a result of these activities, the residents of the neighborhood paid a high cost in terms of a diminished quality of living in the area.

Unlike outdoor and vehicle fires, cooking is the leading cause of structure fires. Fires of incendiary or suspicious origin rank second, and heating is third. The distribution of structure fires by cause is complicated by the diverse types of building occupancies. In particular, it is useful to analyze residential and non-residential structures separately.

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[2] This section summarizes a report published by the U.S. Fire Administration. In lieu of citing all references, refer to the document *Profile of the Urban Fire Problem in the United States*. This report, in its entirety, may be viewed on the USFA Web site or ordered free of charge from USFA at http://www.usfa.fema.gov.

Non-Residential Structure Fires

Among non-residential fires in urban areas, incendiary or suspicious origin is most prevalent. This is significant because it indicates that a high proportion of the property loss due to fires in non-residential fires is avoidable. There are a broad range of motives for arson, including arson for profit, vandalism, spite or revenge, arson to conceal other crimes, or mental illness. NFIRS does not collect data on the suspected motive of arson fires.

Residential Structure Fires

In residential structures, by contrast, cooking, arson, heating, and electrical distribution were the leading causes of fires. Cooking fires accounted for over one-quarter of all residential structure fires in urban areas. Arson ranked second at 14 percent, while heating and electrical distribution tied for third at 10 percent. Since the majority of fire deaths and injuries each year result from fires in residential structures, the next several sections deal specifically with the characteristics of these fires.

REGION**.** Expanding on the causes of residential structure fires, Table 25 shows the causes by region. Cooking was the leading cause in every region, and incendiary or suspicious origin was second except in the Northeast, where heating was second.

Table 25. Leading Causes of 1996 Urban Residential Structure Fires by Region

Midwest	Northeast	South	West*
1. Cooking	1. Cooking	1. Cooking	1. Cooking
2. Arson	2. Heating	2. Arson	2. Arson
3. Smoking	3. Electrical distribution	3. Electrical distribution	3. Open flame
4. Heating, electrical distribution	4. Arson	4. Heating, open flame	4. Heating, electrical distribution

* In the West, some of the data for California were adjusted for conversion problems. Based on discussions with California fire analysts, the leading cause of residential structure fires is cooking. For several fire departments, however, the majority of these fires showed up in the other equipment category. Since the Los Angeles City Fire Department represented the vast majority of records with conversion problems, that city's data were adjusted to account for the conversion problem. Also, the Pacific Northwest was not represented in the analysis because there was insufficient NFIRS participation in 1996 from major metropolitan areas in the region.

Source: NFIRS

The leading causes of fatal fires tend to be different than the leading causes of fires in general. In particular, smoking is typically the nation's leading cause of fatal fires. As with all fires, the top two leading causes of fire-related deaths in residential structures are fairly consistent across regions. In the Northeast, the Midwest, and the South, smoking was the leading cause of fatal fires. In the West, arson was the leading cause of fatal residential fires.

Interestingly, heating does not appear as a leading cause of fatal urban fires in any region of the country. This is likely due to the widespread availability of central heating in urban areas where the climate is cold enough to warrant it. This is an important difference from the cause of rural fires, where heating is the leading cause of fatal fires, followed by smoking.

TYPE OF RESIDENCE. One unique feature of urban fires is where they occur. In the United States as a whole, 70 percent of residential structure fires occur in one- or two-family dwellings and 20 percent occur in apartments. In urban areas, however, apartments account for a higher proportion of fires. In 1996, 35 percent of urban home fires occurred in apartments and 58 percent occurred in one- and two-family structures. This finding is not surprising given that apartments make up a higher proportion of the housing stock in urban areas than in rural areas.

As is the case with U.S. home fires in general, there are important differences in the causes of urban fires in one- and two-family dwellings versus apartments. Heating and electrical distribution fires account for more fires in one- and two-family dwellings than in apartments. In 1996, heating fires were over two and a half times more likely in one- and two-family dwellings than in apartments (accounting for 13 percent versus 5 percent of fires). Similarly, electrical distribution fires occurred twice as often in one- and two-family dwellings than in apartments (12 percent versus 6 percent).

Cooking fires, however, accounted for a significantly higher proportion of fires in apartments than in one- and two-family dwellings (39 percent versus 21 percent). With relatively low incidences of heating and electrical distribution fires, cooking, as the leading cause of all residential fires in the United States, takes on added prominence as the leading cause of apartment fires. This may in part reflect income differences between homeowners and renters. Low-income groups experienced a higher rate of cooking fires than higher income groups, and the rate of poverty is higher among renters than homeowners in the United States.

MONTH OF THE YEAR. Home fires in urban areas are less sensitive to time of year than residential structure fires in general. This is largely due to the effect of heating fires, which account for fewer fires in urban areas than in rural areas. Although more fires occur during the winter months than any other time of year, the difference between warm and cold months is modest. In contrast, a recent study of rural fires showed a more dramatic difference in the number of fires from December through March compared to the warmer months.

SMOKE ALARM PERFORMANCE. Throughout the United States, homes without working smoke alarms account for a disproportionate share of fires reported to local fire departments. Typically about two-thirds of all home fires each year occur in dwellings without working smoke alarms. Similarly, about three-quarters of fatal fires occurred in dwellings where smoke alarms were not present or were not in operational condition. The same pattern applies to urban areas. Fifty-four percent of home fires in urban areas that were reported in NFIRS did not have the protection of working smoke alarms. In addition, 69 percent of fatal urban residential fires occurred in a home without a functioning smoke alarm.

It is interesting that, compared to the United States as a whole, more urban fires occur in homes that have at least one functioning smoke alarm. Smoke alarms are intended to provide residents with early warning, ideally identifying a source of smoke before a fire starts. The increased incidence of fires in urban homes where a working smoke alarm is present is a serious cause for concern, and it should be the subject of future research.

ALCOHOL AND FIRES[3]

The connection between alcohol consumption and fire deaths has been examined extensively in the medical and fire protection communities. Alcohol exerts a strong influence on the areas of fire ignition, detection, and escape through a variety of mechanisms. Alcohol depresses the central nervous system, potentially to the point of stupor, coma, and death. Individuals who consume large quantities of alcohol experience disordered thought patterns, impaired judgment, impaired perception, and a decrease in generalized motor control. By altering one's cognitive, physiological, and motor functions, alcohol increases the probability of starting a fire while reducing the chance of surviving a fire or the resulting injuries.

Furthermore, long-term alcohol abuse weakens the body's healing mechanisms and leaves the individual vulnerable to many complications. Alcohol acts at the cellular level by preventing post-injury homeostasis. It also acts systemically by interfering with the body's vasoconstriction response to shock, a common complication of serious burn injuries. Burn patients with positive blood alcohol levels (BALs) have a significantly higher fatality rate than do patients with negative BALs. Surviving alcoholic burn patients require significantly more intravenous antibiotics and fluids, need longer hospitalization stays, and incur significantly higher medical costs.

Research has shown that alcoholics may be as much as 8–10 times more likely to be injured or killed in fires than the average population. In 1987, researchers from the Boston University Medical School's Public Health Department concluded that a significant portion of the fire fatalities screened for BALs were legally drunk at 0.08 or 0.1 percent, depending on jurisdictional standards, or had an elevated BAL. In fact, nearly half of all people over the age of 15 who died in fires had elevated BALs.

An earlier study found that 83 percent of fire fatalities examined between the ages of 16 and 60 had been drinking at the time of their death. A more recent study revealed that, for fire fatalities age 18 and older, 53 percent had BALs greater than or equal to 0.1, and 28 percent had histories of alcoholism. A 5-year study that examined fire fatalities in Ontario, Canada, revealed that approximately 22 percent were impaired by alcohol at the time of death. In fact, there were nearly four times as many alcohol-impaired fatalities as nonimpaired fatalities. Thus, it would appear that alcohol impairment led to more serious, even fatal, injuries from fires in the 5-year study period.

In a similar analysis of fire deaths in Minnesota, 30 percent of all fire fatalities and 40 percent of all fire deaths over the age of 15 were found to have positive BALs. These data were based on autopsy reports. Ninety percent of these fatalities met or exceeded the legal drunk-driving limit of 0.1 percent BAL, and the BAL for more than half of the impaired fatalities was between two and four times that limit. This evidence further supports the contention that most impaired fire fatalities are severely intoxicated, often to the point of stupor.

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[3] This section summarizes a report published by the U.S. Fire Administration. In lieu of citing all references, refer to the document *An Investigation Into the Relationship Between Alcohol and Fire Casualties*. This report, in its entirety, may be viewed on the USFA Web site or ordered free of charge from USFA at http://www.usfa.fema.gov.

In addition to fire fatalities, alcohol use and abuse have been shown to exhibit detrimental effects on burn injuries as well. Acute alcohol intoxication leaves an individual severely impaired, thus predisposing him or her to harmful acts of carelessness with fire. The subsequent lapse in judgment and coordination leave the impaired person susceptible to severe burns, not only from smoking but also from careless cooking, heating, and hot water scalds and contact burns.

The overwhelming majority of fire fatalities perish as a result of smoke and toxic fume inhalation as opposed to burn injuries. Sensitivity to smoke is a key means by which humans detect a fire. Alcohol not only impedes the detection of smoke, but also helps to facilitate its passage into the body. In addition to enhancing the toxic effects of gases such as carbon monoxide, elevated BALs also depress the cough reflex.

Age

Evidence from numerous studies supports the contention that fire fatalities under the age of 50 represent a disproportionately high number of alcohol-impaired fire deaths. In 1996, researchers from the Edwin Albano Institute of Forensic Science performed a study aimed at quantifying the role of substance abuse in fatal fires occurring in New Jersey over a 7-year period. Records of fire fatalities of all ages were retrospectively examined for the nearly 30 percent of fire victims who tested positive for blood alcohol levels of any concentration. Of these victims, 58 percent were between the ages of 21 and 50. That very same year, the National Center for Health Statistics reported that only 37 percent of all fire fatalities were age 21 to 50. This comparison suggests that inebriation may impair one's ability to escape a fire.

The analysis of fire deaths in Ontario showed that alcohol-impaired fire deaths accounted for 27 percent of fatalities over the age of 15. In fact, one-quarter of alcohol impaired fire fatalities were age 25 to 34, despite the fact that the same age group accounted for only 16 percent of fire deaths overall. Fatalities aged 25 to 54 accounted for 60 percent of all alcohol-impaired fire deaths in Ontario.

The Minnesota State Fire Marshal reported that fire victims aged 15 to 44 accounted for approximately 70 percent of all fire fatalities with measurable BALs. Young drinkers aged 18 to 34 in Minnesota constitute the largest percentage of binge drinkers. It is not surprising that this age group also represents the largest number of alcohol-impaired fire fatalities. The rapid and excessive consumption of alcohol typified by binge drinking is known for creating the high BALs seen in the majority of impaired fire deaths.

Fifty percent of fire fatalities in Maryland over the age of 20 during 1972–77 were intoxicated with BALs in excess of 0.1 percent (the legal drunk-driving limit in Maryland). In fact, 68 percent of the fire fatalities aged 30 to 59 were intoxicated at that same level.

The very young and the very old have a much higher fire death rate than the average population. The risk of fire death drops considerably after the age of 5 and experiences minimal change until the

age of 55, at which point the risk begins to rise exponentially. Young children and older adults are typically high-risk groups because they are physically unable to escape a fire. Most people in between these age brackets do not suffer from physical inability and can often escape a fire.

Alcohol-impaired fire fatalities exhibit an age pattern that is quite the opposite of the overall fire death rate profile. The majority of alcohol-impaired deaths are between the ages of 18 to 40, the most salvageable population from fires. This pattern suggests a strong correlation between intoxication and the causation or ability to escape from a fire.

Although not traditionally considered in studies examining alcohol and fire deaths, children are often victims of alcohol-related fires. A small child often will hide behind a bed or in a corner during a fire while awaiting help from parents or caretakers. When the caretake is alcohol impaired, he is often incapable of providing help, and the child is left behind. Furthermore, a rapidly evolving fire leaves little chance for a firefighter to find and rescue the child in time. Of the juvenile fatalities examined in one study, approximately 15 percent died in fires where the surviving adult was impaired by alcohol or other drugs. In another study, the authors stated that in a review of case files of fire fatalities under age 16 or over age 60, "case after case revealed that fire deaths of children were attributed to the parents' failure to perceive and respond to a fire emergency because of impairment of their sensory, judgment, or physical functions by alcohol consumption."

Elderly and disabled individuals who need help are also at high risk for death from fires. An assistant fire marshal of the Memphis Fire Department stated that many elderly individuals in that region had died in fires because their caretakers, often their own children, were too impaired by alcohol to recognize the fire and render assistance in time.

Gender

Men suffer almost twice as many fire deaths as women among nearly all age groups. Data from NFIRS indicate that men outnumber women by nearly two to one for fire injuries as well. Medical data corroborate both these findings. In one such study, male fire injuries outnumbered female fire injuries by about 3-1/2 times. Results from the 5-year study of Ontario fire casualties showed that men had almost twice as many fire deaths as women. This ratio rose, as did the disparity, between male and female fatalities when alcohol was involved. Among the alcohol-impaired fatalities, men outnumbered women by nearly 3 to 1 and accounted for 75 percent of alcohol-impaired fatalities. A similar trend was found for all fire injuries and for alcohol-impaired fire injuries. Although men already outnumbered women in all fire-related injuries by 1.8 to 1, this ratio soared to 4.8 when the injured parties were impaired by alcohol.

A similar study of fire fatalities in Minnesota found that men represented 65 percent of total fire fatalities and 80 percent of fire fatalities with positive BALs. The male-to-female ratio for fire deaths in general was 1.9 to 1, but when alcohol was involved, the ratio rose to 3.9. For those fatalities with BALs meeting or exceeding the legal drunk-driving limit of 0.1 percent, 87 percent were men. In addition, alcohol-impaired fire fatalities with BALs equal to or greater than 0.4 percent consisted

entirely of men. Women outnumbered men for fatalities that had BALs below the legal limit, accounting for 74 percent of deaths with BALs less than 0.1 percent.

Alcohol and drinking patterns also vary with gender and may help explain the differing casualty rates. National estimates show that males tend to consume larger quantities of alcohol with greater frequency than females. Men also vastly outnumber women when identifying problematic drinking behaviors, such as binge drinking. This evidence suggests that men in the United States drink more intensely and more frequently than their female counterparts.

It has been theorized that the drinking behavior commonly seen in the male population is directly related to their high risk for injuries and fatalities. There is reason to believe that a greater number of fire fatalities that were under the influence of alcohol are male as well. Males comprised 72 percent of fire fatalities in Maryland with BALs over 0.1 percent. Minnesota, one of the only states requiring blood alcohol levels to be recorded for all fire deaths, found similar results. From 1993 to 1996, approximately 80 percent of fatalities in Minnesota with positive BALs were men.

Smoking

Nationally, fire-reporting agencies have identified smoking as the fourth most frequent cause of residential fires, the leading cause of fire fatalities, and the second most common cause of fire-related injuries. Smoking combined with alcohol use creates an even greater risk for fire injuries and fatalities, as evidence suggests that the two have a synergistic effect on the user. Smokers consume more alcohol than do non-smokers, heavy drinking tends to be associated with heavy smoking, and a large majority of alcoholics are smokers.

Alcohol and smoking each represent independent fire safety risks. Alcohol intoxication leaves the drinker bereft of control and mental acuity. Smoking has been associated with the ignition of many fires in which the smoker is intimately involved, a factor that significantly contributes to the severity of smoking fire-related injuries and deaths. When used together, alcohol and smoking increase one's chance of starting a fire while decreasing the chance of detecting, mitigating, and escaping it.

In the study of fire deaths in Ontario, smoking fires accounted for 53 percent of all alcohol-impaired fire deaths. For fire deaths in general, the leading cause was again smoking fires, but only accounted for 35 percent. It was also discovered that although not the majority, alcohol-impaired fire fatalities constituted 34 percent of all deaths caused by a smoking fire.

Similar results were discovered during the analysis of fire deaths in Minnesota. Sixty-five percent of the impaired fire deaths were attributed to smoking, as opposed to 37 percent of the non-impaired fatalities. In addition, approximately 46 percent of all deaths caused by smoking fires had positive BALs.

The relation of alcohol to fire casualties has been examined in many countries. Alcohol appears to be a significant factor in explaining fire death rates throughout the world. Approximately 80 per-

cent of male fire fatalities in Finland were found to have been drinking at the time of their death. The association between house fire fatalities and high blood alcohol concentrations has also been recognized as a particular problem in Scotland. And the death rate for fatal fire accidents in Denmark has doubled since 1951, attributed mostly to fire accidents associated with smoking, which often included alcohol intoxication.

Smoke Alarms

Quantifying the extent to which alcohol impairs one's ability to detect and escape a fire is difficult. To establish a clear relationship between the ability to perceive a fire and subsequently escape it, researchers have examined the relationship between alcohol impairment and the function of smoke alarms. The presence of a working smoke alarm significantly reduces the risk of becoming a fire fatality. A working smoke alarm can reduce the risk of death from a fire by about 50 percent. However, evidence points to alcohol impairment as the strongest independent risk factor for deaths caused by fires. In one study, the fire fatality risk ratio for an alcohol-impaired person was more than double the risk ratio of a person living without a smoke alarm.

Smoke alarms have been found to be most effective in preventing deaths of small children, but only when alcohol or drugs do not impair the caretaker. Children who are unable to help themselves depend on their parents for escaping a fire. Failure to respond to a smoke alarm in adequate time allows a fire to rapidly evolve and significantly reduce one's chances of escaping. Even if an impaired parent survives, it is often too late to retrieve the child, or escape together.

Methodological Limitations

Much of what we now know about alcohol's involvement in fires has stemmed from medical literature and research rather than fire research. The results of such studies are limited and tenuous. Medical studies have traditionally been sporadic and usually confined to a city's or state's medical records. In addition, not all burn centers routinely screen their burn or fire-related injury patients for alcohol use, so the number of missed patients varies greatly.

The NFIRS requires participating fire departments to record the condition before injury for all civilian fire casualties. Reporting agencies may speculate as to whether drugs or alcohol impaired the victim; however, this information is not routinely reported. Fire departments and investigators tend to be reluctant to record alcohol abuse by those who cause or are injured by fires. The reasoning behind their reluctance has ranged from a humanitarian concern for the victims of fire and their loved ones already suffering from the effects of a fire to a lack of training and authorization to test people for alcohol or drugs. In addition, there is the potential for legal ramifications concerning wrongful accusations about intoxication.

In addition to reporting problems, data assessment has proved difficult. There is no universal definition of "legally intoxicated," making it difficult for independent studies to compare results due

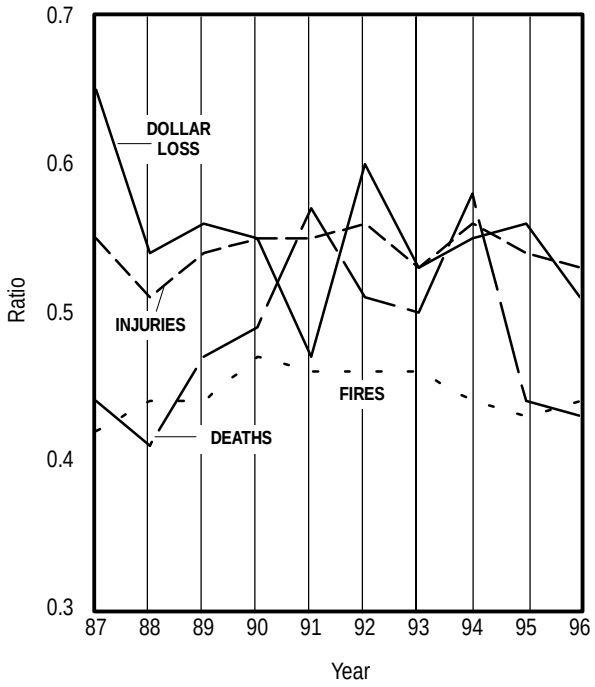
to the variation in the definition of alcohol impairment and in measurements made of blood alcohol levels. In other cases, the sample size is simply too small to derive any statistical significance in itself, but is still suggestive of a pattern.

Despite the problems associated with methodology, the number of studies that examine alcohol and fires is increasing. Now more than ever, evidence suggests alcohol's detrimental effects on fire losses, and people around the world who use and abuse alcohol are being identified as a growing high-risk fire group that must be targeted.

Appendix A

DIFFERENCES BETWEEN NFPA AND NFIRS ESTIMATES

The National Fire Incident Reporting System collects data from an average of 13,000 fire departments each year. The National Fire Protection Association annual survey of fire departments collects data from more than 3,000 fire departments. Neither is a perfect random sample; not all fire departments asked to participate do so. As one might expect, the distribution of fire departments is not the same in the two samples. And the NFPA survey collects tallied totals whereas NFIRS collects individual incident reports. Not surprisingly, therefore, there are differences between the NFPA annual survey results and the NFIRS results. In 8 of the 10 years examined (1987–96), the deaths reported to NFIRS represent a larger fraction of the NFPA national estimate of deaths than the NFIRS number of fires is of the NFPA estimate of fires. NFIRS injuries and dollar loss are even larger fractions of the NFPA totals than are deaths or fires (Figure A–1).



	Dollar Loss	Injuries	Deaths	Fires
1987	0.65	0.55	0.44	0.42
1988	0.54	0.51	0.41	0.44
1989	0.56	0.54	0.47	0.44
1990	0.55	0.55	0.49	0.47
1991	0.47	0.55	0.57	0.46
1992	0.60	0.56	0.51	0.46
1993	0.53	0.53	0.50	0.46
1994	0.55	0.56	0.58	0.44
1995	0.56	0.54	0.44	0.43
1996	0.51	0.53	0.43	0.44

Sources: NFPA Annual Surveys and NFIRS

Figure A–1. Ratio of Raw NFIRS Sample to NFPA National Estimates

Looking at the problem another way, Figure A–2 shows the number of deaths per fire, injuries per fire, and dollar loss per fire from NFIRS and NFPA from 1987 to 1996. Deaths per fire are similar for NFIRS and NFPA, with an average difference of 10 percent and a maximum difference of 32 percent in 1994. Injuries and dollar loss per fire are lower in the NFPA sample than in the NFIRS sample by an average of 22 percent for injuries and 25 perecent for dollar loss.

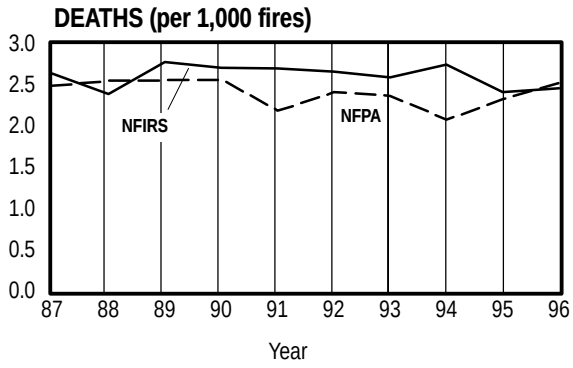
The reasons for these differences are not known. One possibility is that some departments that report summary data to NFPA may undercount their casualties and losses when reporting on the NFPA survey forms. Another possibility is that there are data entry errors in NFIRS, with larger numbers of deaths, injuries, and dollar loss creeping into the database despite edit checks at state and federal levels. (It appears that at least some of the dollar loss difference is due to this.)

A third possibility for the differences is that fire departments might not report some minor fires to NFIRS that they include in their own totals that are reported to NFPA. We know that some departments do not fill out NFIRS forms for minor fires such as food on stove or chimney fires, but we are unsure whether these fires are or are not included in the department's report to NFPA nor the extent of the problem.

A fourth possibility is that some jurisdictions use NFIRS as a tracking system for fire casualty information without providing the related incident data. We know that this possibility does indeed occur from time to time in NFIRS. Again, we are unsure of how these deaths and their corresponding incidents are reported to NFPA.

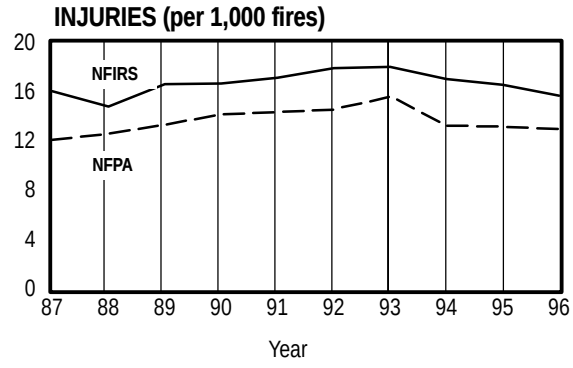
Resolving the differences between the two major sources of fire statistics in the United States is important to prevent confusion among the users of the data. With the new NFIRS, more complete data on the population protected by participating departments is possible, and the NFIRS estimates will be able to be made independent of other sources. This should improve consistency.

Figure A–3 represents the NFPA survey trends for non-residential property fires and dollar loss.



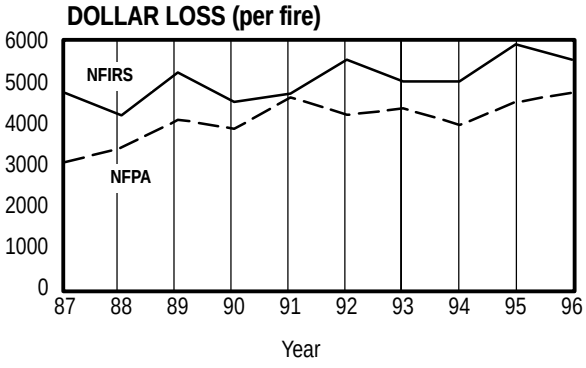
	NFIRS	NFPA
1987	2.64	2.49
1988	2.39	2.55
1989	2.78	2.56
1990	2.71	2.57
1991	2.70	2.19
1992	2.66	2.41
1993	2.59	2.37
1994	2.75	2.08
1995	2.41	2.33
1996	2.46	2.53

10-Year NFIRS Trend = -4.0%
10-Year NFPA Trend = -8.6%



	NFIRS	NFPA
1987	16.02	12.11
1988	14.77	12.64
1989	16.62	13.36
1990	16.68	14.17
1991	17.12	14.39
1992	17.92	14.61
1993	18.01	15.61
1994	17.02	13.26
1995	16.57	13.11
1996	15.69	12.94

10-Year NFIRS Trend = +5.5%
10-Year NFPA Trend = +6.1%

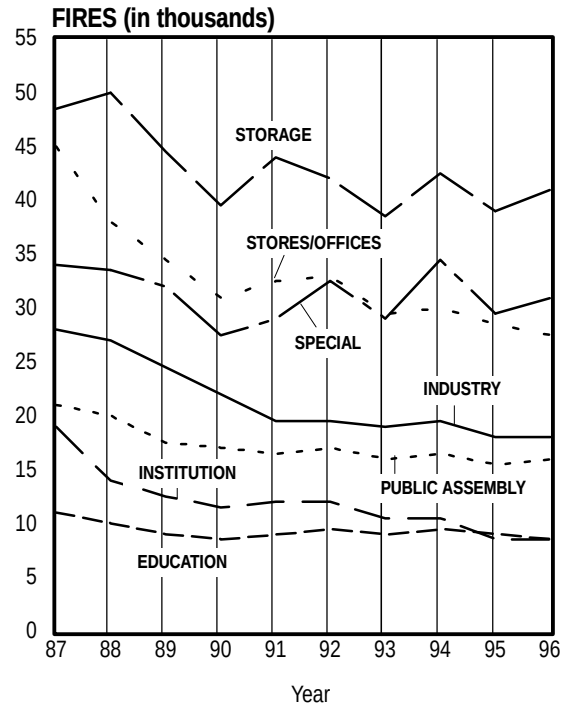


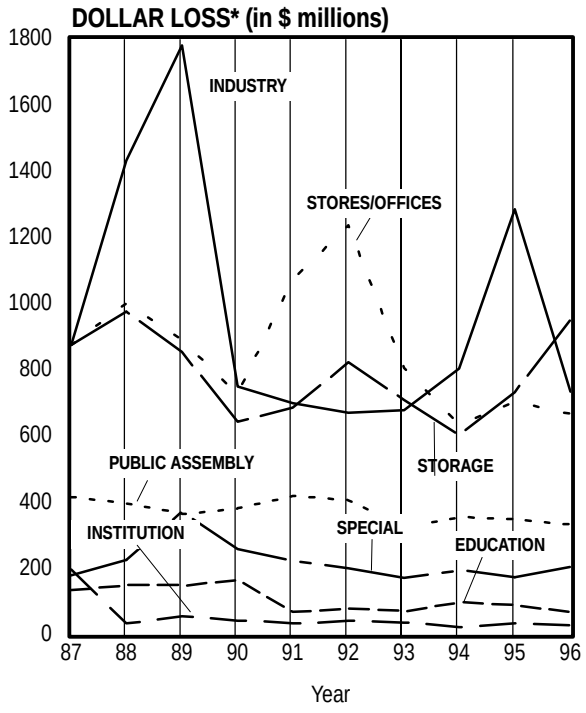
	NFIRS	NFPA
1987	$4,744	$3,073
1988	4,211	3,428
1989	5,247	4,092
1990	4,532	3,872
1991	4,734	4,637
1992	5,560	4,222
1993	5,035	4,377
1994	5,031	3,967
1995	5,931	4,538
1996	5,564	4,763

10-Year NFIRS Trend = +25.3%
10-Year NFPA Trend = +37.0%

Sources: NFPA Annual Surveys and NFIRS

Figure A–2. NFIRS vs. NFPA Survey: Severity of Losses





Year	Public Assembly	Education	Institution	Stores/Offices	Industry	Storage	Special
Fires							
1987	21,000	11,000	19,000	45,000	28,000	48,500	34,000
1988	20,000	10,000	14,000	38,000	27,000	50,000	33,500
1989	17,500	9,000	12,500	34,500	24,500	44,500	32,000
1990	17,000	8,500	11,500	31,000	22,000	39,500	27,500
1991	16,500	9,000	12,000	32,500	19,500	44,000	29,000
1992	17,000	9,500	12,000	33,000	19,500	42,000	32,500
1993	16,000	9,000	10,500	29,500	19,000	38,500	29,000
1994	16,500	9,500	10,500	30,000	19,500	42,500	34,500
1995	15,500	9,000	8,500	28,500	18,000	39,000	29,500
1996	16,000	8,500	8,500	27,500	18,000	41,000	31,000
Dollar Loss* ($ millions)							
1987	$414	$133	$195	$ 873	$ 823	$874	$178
1988	394	149	31	1,000	1,431	975	223
1989	362	147	54	890	1,779	852	371
1990	381	163	40	724	748	641	257
1991	417	67	32	1,072	697	684	219
1992	404	76	39	1,236	668	821	198
1993	324	69	33	805	676	707	169
1994	354	96	21	633	802	601	192
1995	346	86	32	701	1,285	731	172
1996	330	65	24	665	733	949	205

* Adjusted to 1996 dollars.

Source: NFPA Annual Surveys

Figure A–3. Trends in NFPA Non-Residential Structure Fires and Dollar Loss by Property Type

Appendix B

DATA SUPPORTING CAUSES OF FIRES AND LOSSES

The four tables in this appendix provide the actual cause data used in developing the 10-year trend charts in Chapters 3 and 4 where there was no room to present the numbers.

Table B–1. Causes of Residential Fires and Fire Losses

Cause	1987*	1988	1989	1990	1991	1992	1993	1994	1995	1996
Fires										
Incendiary/Suspicious	72,202	73,236	68,847	67,467	67,738	66,589	61,888	61,966	56,761	59,607
Children Playing	27,890	27,880	25,952	23,207	24,102	25,463	25,215	25,876	21,545	20,081
Smoking	41,291	40,439	35,533	31,707	30,559	28,814	27,931	26,498	26,056	25,714
Heating	133,623	125,945	116,939	88,339	89,163	87,728	88,695	77,439	73,352	66,228
Cooking	113,723	115,056	109,183	109,741	111,140	118,605	116,919	107,408	101,988	104,024
Electrical	47,222	49,162	44,197	43,662	45,091	43,084	45,089	44,552	44,117	43,586
Appliances	37,542	38,581	35,777	35,395	35,401	34,748	35,322	35,094	34,532	33,278
Open Flame	34,372	35,050	34,253	28,590	27,386	27,797	28,232	30,050	28,468	31,495
Other Heat	7,691	8,072	7,670	6,263	6,318	6,417	6,641	6,927	6,293	6,904
Other Equipment	6,170	6,401	5,547	5,584	5,885	6,564	6,020	7,017	4,983	8,820
Natural	10,569	9,895	10,413	8,820	9,985	8,951	10,164	10,197	9,359	9,485
Exposure	19,206	22,784	19,187	18,226	25,232	17,241	17,885	17,975	18,046	18,779
Total	551,500	552,500	513,500	467,000	478,000	472,000	470,000	451,000	425,500	428,000
Deaths										
Incendiary/Suspicious	727	857	809	770	663	698	756	505	737	662
Children Playing	519	526	474	353	450	398	423	426	333	288
Smoking	1,368	1,500	1,103	1,062	823	994	913	817	971	1,052
Heating	691	783	636	635	542	516	570	503	496	670
Cooking	360	417	382	382	299	280	371	314	283	399
Electrical	472	382	538	382	329	354	353	409	437	415
Appliances	126	175	129	122	121	99	112	147	167	164
Open Flame	252	257	186	218	169	245	168	179	187	218
Other Heat	50	74	88	93	80	80	35	62	29	66
Other Equipment	54	47	20	42	36	29	70	73	25	103
Natural	14	12	37	10	18	13	14	15	8	8
Exposure	25	35	34	48	44	61	38	15	21	37
Total	4,660	5,065	4,435	4,115	3,575	3,765	3,825	3,465	3,695	4,080
Injuries										
Incendiary/Suspicious	2,342	2,655	2,460	2,595	2,836	2,772	2,521	2,593	2,126	2,366
Children Playing	2,501	2,567	2,513	2,391	2,786	3,019	2,997	2,784	2,514	2,133
Smoking	3,334	3,681	3,095	3,000	2,793	2,767	2,907	2,436	2,388	2,523
Heating	2,489	3,079	2,627	2,211	2,287	2,278	2,595	2,003	1,970	1,858
Cooking	5,019	5,435	4,975	5,573	5,564	5,499	6,143	5,022	4,982	5,001
Electrical	1,490	1,671	1,444	1,477	1,836	1,730	1,854	1,546	1,680	1,544
Appliances	1,033	1,058	1,191	1,186	1,286	1,180	1,300	1,518	972	1,048
Open Flame	1,316	1,586	1,471	1,190	1,375	1,352	1,377	1,514	1,629	1,772
Other Heat	290	332	330	381	381	343	332	285	374	311
Other Equipment	307	183	265	245	304	277	245	359	170	413
Natural	169	178	193	189	212	153	154	148	116	116
Exposure	150	175	186	211	189	228	175	148	205	215
Total	20,440	22,600	20,750	20,650	21,850	21,600	22,600	20,025	19,125	19,300
Dollar Loss ($ millions){										
Incendiary/Suspicious	$1,152.7	$1,143.5	$1,092.7	$1,174.7	$1,413.1	$955.0	$967.3	$959.8	$943.7	$1,008.7
Children Playing	286.3	285.1	294.9	257.3	337.9	246.4	306.0	297.4	279.8	269.7
Smoking	414.0	385.3	343.1	357.8	428.2	245.4	313.3	287.2	300.9	283.7
Heating	879.6	937.6	886.1	765.5	955.9	654.9	695.3	668.8	684.8	762.9
Cooking	538.2	537.9	510.0	508.4	581.0	416.1	533.4	563.0	415.7	460.9
Electrical	690.2	798.3	670.2	693.9	860.7	573.0	777.5	648.8	712.1	706.8
Appliances	301.1	314.0	298.6	299.0	372.1	237.1	305.2	279.0	266.5	316.3
Open Flame	317.3	306.4	315.1	358.0	390.4	229.5	317.1	300.4	326.2	423.2
Other Heat	58.5	90.5	128.2	69.1	70.5	56.5	63.4	65.6	77.3	75.7
Other Equipment	85.8	105.6	79.8	109.2	102.7	156.6	109.5	123.4	74.8	174.3
Natural	144.9	131.9	141.8	147.8	227.0	139.5	195.3	179.4	202.2	168.2
Exposure	240.3	295.5	298.4	364.8	656.2	428.9	675.4	197.7	207.9	311.5
Total	$5,109.0	$5,332.0	$5,059.0	$5,106.0	$6,396.0	$4,339.0	$5,259.0	$4,570.0	$4,492.0	$4,962.0

Note: These data support the Figure 36 chart. Columns may not add exactly to the totals due to rounding.
* Adjusted for $150 million questionable fire loss.
{ Adjusted to 1996 dollars.

Sources: NFIRS and NFPA Annual Surveys

Table B–2. Causes of One- and Two-Family Dwelling Fires and Fire Casualties

Cause	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Fires										
Incendiary/Suspicious	49,795	51,276	47,660	47,762	46,686	46,977	43,838	43,811	39,721	42,841
Children Playing	20.795	20,994	19,276	17,004	17,567	18,722	18,519	18,981	16,228	15,554
Smoking	23,572	23,119	20,194	18,055	17,564	16,761	16,339	16,057	16,079	15,804
Heating	130,894	123,452	115,185	85,443	84,208	84,132	84,730	72,554	67,831	61,090
Cooking	73,941	74,652	69,445	70,160	69,447	73,887	72,053	66,283	62,723	64,037
Electrical	39,129	40,366	37,319	36,530	37,094	35,855	37,539	36,904	36,082	36,376
Appliances	30,496	30,930	28,929	28,592	28,216	27,746	28,284	27,824	27,212	26,959
Open Flame	27,938	28,597	28,315	23,257	21,834	22,562	23,264	24,332	23,054	25,383
Other Heat	6,208	6,664	6,251	5,070	5,102	5,122	5,419	5,484	4,888	5,591
Other Equipment	4,629	4,809	4,262	4,208	4,304	4,682	4,478	5,403	3,774	6,540
Natural	9,911	9,307	9,972	8,375	9,309	8,498	9,669	9,659	8,695	8,971
Exposure	15,694	18,335	15,693	14,543	21,670	13,055	13,868	13,708	13,713	14,855
Total	433,000	432,500	402,500	359,000	363,000	358,000	358,000	341,000	320,000	324,000
Deaths										
Incendiary/Suspicious	536	691	548	583	541	554	653	400	580	515
Children Playing	401	413	335	230	376	338	310	270	247	248
Smoking	1,064	1,079	703	814	592	745	653	608	711	797
Heating	625	772	661	631	524	485	514	444	434	673
Cooking	270	264	314	314	205	248	269	236	202	351
Electrical	448	384	557	306	311	338	318	383	429	371
Appliances	93	168	126	119	96	86	65	120	161	178
Open Flame	215	216	151	206	133	212	147	174	192	158
Other Heat	38	67	67	87	65	61	24	48	35	50
Other Equipment	55	34	17	36	24	29	53	68	25	84
Natural	17	10	46	12	17	16	16	17	5	10
Exposure	17	29	21	32	21	49	12	17	15	35
Total	3,780	4,125	3,545	3,370	2,905	3,160	3,035	2,785	3,035	3,470
Injuries										
Incendiary/Suspicious	1,297	1,737	1,477	1,529	1,643	1,375	1,498	1,441	1,326	1,360
Children Playing	1,736	1,856	1,969	1,772	1,864	2,229	2,009	1,976	1,792	1,571
Smoking	2,003	2,209	1,797	1,837	1,687	1,581	1,569	1,370	1,351	1,451
Heating	2,370	2,954	2,493	2,141	2,120	2,093	2,327	1,783	1,758	1,642
Cooking	3,788	4,065	3,535	3,928	3,819	3,693	4,083	3,340	3,364	3,307
Electrical	1,311	1,378	1,158	1,245	1,557	1,450	1,480	1,320	1,224	1,281
Appliances	812	902	945	1,012	950	960	1,055	874	707	844
Open Flame	1,076	1,307	1,039	941	1,085	1,057	1,055	1,146	1,216	1,410
Other Heat	250	289	275	275	286	287	235	231	291	246
Other Equipment	278	148	243	234	242	234	169	311	198	290
Natural	155	132	160	172	195	161	128	124	85	117
Exposure	123	148	133	166	153	156	92	83	139	179
Total	15,200	17,125	15,225	15,250	15,600	15,275	15,700	14,000	13,450	13,700

Note: These data support the Figure 48 chart. Columns may not add exactly to the totals due to rounding.

Sources: NFIRS and NFPA Annual Surveys

Table B-3. Causes of Apartment Fires and Fire Casualties

Cause	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Fires										
Incendiary/Suspicious	17,775	17,764	16,494	15,913	16,943	16,014	14,571	14,693	13,736	13,750
Children Playing	6,569	6,568	6,066	5,786	6,134	6,263	6,230	6,400	5,105	4,362
Smoking	13,787	13,565	11,345	10,526	10,475	9,306	9,228	8,573	8,366	8,155
Heating	6,695	6,244	5,847	5,647	5,999	5,647	5,940	5,362	5,528	5,441
Cooking	35,615	37,178	34,798	36,070	38,750	41,060	41,376	38,306	37,553	37,426
Electrical	5,637	6,023	4,980	5,250	5,678	5,406	5,775	5,700	6,017	5,590
Appliances	5,323	5,700	5,125	5,391	5,715	5,587	5,581	5,681	5,895	5,316
Open Flame	5,765	5,831	5,241	4,828	4,863	4,794	4,643	5,274	4,945	5,495
Other Heat	1,311	1,398	1,276	1,133	1,153	1,225	1,198	1,347	1,279	1,338
Other Equipment	1,223	1,347	1,024	1,066	1,288	1,539	1,211	1,321	953	1,990
Natural	783	684	694	646	775	631	719	641	720	696
Exposure	3,018	3,698	3,109	3,243	3,725	3,528	3,526	3,701	3,905	3,441
Total	103,500	106,000	96,000	95,500	101,500	101,000	100,000	97,000	94,000	93,000
Deaths										
Incendiary/Suspicious	157	173	233	175	128	110	122	133	138	112
Children Playing	143	118	95	88	58	80	119	130	89	49
Smoking	270	321	300	217	193	187	235	193	241	214
Heating	37	30	31	41	31	30	29	40	31	23
Cooking	50	79	49	41	70	37	58	59	45	59
Electrical	30	30	33	41	19	24	42	40	28	26
Appliances	23	15	8	12	27	11	16	6	21	10
Open Flame	53	42	26	32	24	32	23	25	10	36
Other Heat	13	15	3	15	19	19	10	14	0	16
Other Equipment	3	0	3	0	10	4	6	0	0	13
Natural	0	0	0	0	0	0	0	0	0	0
Exposure	10	6	10	17	15	11	26	0	3	7
Total	790	830	790	680	595	545	685	640	605	565
Injuries										
Incendiary/Suspicious	795	771	835	791	960	1,080	892	952	819	808
Children Playing	704	668	573	628	835	823	941	704	702	565
Smoking	1,026	1,111	1,011	929	916	1,017	1,128	872	811	931
Heating	248	262	289	212	242	255	266	223	190	188
Cooking	1,221	1,289	1,384	1,557	1,638	1,685	1,965	1,616	1,504	1,635
Electrical	189	262	242	226	302	267	357	277	314	247
Appliances	197	164	186	201	270	200	224	255	205	190
Open Flame	242	284	343	232	309	291	293	385	403	403
Other Heat	49	63	60	93	89	74	91	52	92	70
Other Equipment	45	17	45	29	61	51	58	56	51	85
Natural	23	31	35	27	20	10	20	22	28	9
Exposure	26	29	58	49	32	72	64	62	81	45
Total	4,765	4,950	5,050	4,975	5,675	5,825	6,300	5,475	5,200	5,175

Note: These data support the Figure 59 chart. Columns may not add exactly to the totals due to rounding.

Sources: NFIRS and NFPA Annual Surveys

Table B–4. Causes of Non-Residential Fire and Fire Losses

Cause	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Fires										
Incendiary/Suspicious	59,720	55,063	52,390	48,222	50,871	53,794	45,888	46,472	43,859	42,404
Children Playing	7,714	6,955	5,553	4,522	4,887	5,235	4,550	4,934	5,085	4,114
Smoking	12,783	11,297	9,673	8,713	8,658	7,933	7,410	6,794	6,520	6,792
Heating	13,903	12,780	12,688	10,113	10,350	11,024	10,798	9,927	10,676	10,874
Cooking	14,677	13,304	12,285	11,927	12,277	13,239	12,617	11,959	12,298	13,016
Electrical	22,647	20,977	18,159	17,674	17,618	17,198	16,765	15,871	15,656	17,053
Appliances	11,455	10,498	9,724	9,265	9,344	9,613	9,442	8,849	8,801	8,854
Open Flame	22,991	22,288	19,1813,	15,805	16,053	16,435	14,447	15,934	15,739	15,279
Other Heat	3,883	3,668	235	2,908	3,017	2,956	2,769	2,999	2,838	2,938
Other Equipment	15,445	14,158	13,163	11,404	11,734	11,782	11,650	11,879	10,850	12,627
Natural	7,315	6,801	6,308	5,722	5,900	5,133	5,277	5,417	5,082	4,834
Exposure	13,967	14,711	12,140	10,725	11,791	11,158	9,888	10,463	10,595	11,716
Total	206,500	192,500	174,500	157,000	162,500	165,500	151,500	151,500	148,000	150,500
Deaths										
Incendiary/Suspicious	65	33	46	73	63	63	57	21	51	47
Children Playing	8	2	4	6	26	4	4	0	0	2
Smoking	37	42	26	34	24	20	15	24	34	13
Heating	17	16	17	17	15	6	21	15	23	18
Cooking	8	12	7	17	4	4	6	10	6	4
Electrical	8	21	4	14	15	20	15	12	40	9
Appliances	0	2	9	17	4	6	6	0	6	0
Open Flame	37	28	24	28	17	26	9	21	57	22
Other Heat	3	9	9	8	4	9	3	5	0	9
Other Equipment	31	40	61	17	13	15	9	17	45	13
Natural	3	2	4	56	4	0	7	0	28	2
Exposure	3	7	9	0	0	4	3	0	2	2
Total	220	215	220	285	190	175	155	125	290	140
Injuries										
Incendiary/Suspicious	499	615	643	735	740	556	811	577	441	404
Children Playing	80	96	140	122	70	65	102	76	55	63
Smoking	215	389	268	231	286	214	285	182	132	170
Heating	357	312	214	263	211	255	326	227	259	204
Cooking	264	349	254	282	324	264	413	298	296	258
Electrical	390	397	344	393	305	340	478	353	241	309
Appliances	142	251	223	198	160	166	196	284	200	189
Open Flame	485	483	404	414	435	290	357	366	348	345
Other Heat	72	96	69	71	81	74	78	60	73	72
Other Equipment	685	523	457	506	351	378	746	498	417	441
Natural	165	113	198	168	144	90	122	156	107	76
Exposure	21	50	62	42	19	32	37	22	32	44
Total	3,375	3,675	3,275	3,425	3,125	2,725	3,950	3,100	2,600	2,575
Dollar Loss ($ millions)*										
Incendiary/Suspicious	$1,005.6	$1,128.0	$737.6	$899.4	$1,047.6	$1,802.2	$823.7	$905.2	$1,197.2	$834.5
Children Playing	21.5	30.1	13.8	20.1	19.3	18.5	27.9	22.9	25.6	17.2
Smoking	71.7	97.7	139.1	56.5	87.0	50.8	50.7	70.6	166.0	83.1
Heating	137.7	196.6	169.5	179.2	180.9	167.4	156.3	194.9	184.6	207.1
Cooking	64.5	144.6	80.1	77.2	102.3	85.4	68.9	96.5	118.6	141.2
Electrical	325.2	472.9	286.1	391.1	327.7	290.2	402.4	314.8	375.1	370.4
Appliances	87.3	119.1	72.9	83.7	101.3	76.9	86.0	76.1	89.0	76.4
Open Flame	237.6	262.8	203.5	177.2	170.1	143.2	257.5	217.9	262.6	268.1
Other Heat	46.7	50.4	28.2	59.5	55.3	39.4	42.9	43.3	357.0	42.4
Other Equipment	234.4	289.7	1,576.9	234.4	300.9	183.2	277.8	345.8	261.4	597.3
Natural	107.2	168.9	90.9	151.8	232.9	91.1	126.1	143.4	135.1	138.1
Exposure	187.6	207.2	121.4	130.1	142.7	128.9	242.8	104.7	181.9	195.3
Total	$3,490.2	$4,201.7	$4,453.9	$2,953.1	$3,188.7	$3,441.1	$2,782.9	$2,713.5	$3,353.2	$2,971.0

Note: These data support the Figure 75 chart. Columns may not add exactly to the totals due to rounding.
* Adjusted to 1996 dollars

Sources: NFIRS and NFPA Annual Surveys

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