

**The following information is the statistical section of the One-Stop Data Shop's Special Information Data Package on candle fires. If you are interested in fire incidents involving candles, please contact Nancy Schwartz at 617-985-7450 or e-mail [osds@nfpa.org](mailto:osds@nfpa.org).**

**CANDLE FIRES IN U.S. HOMES  
AND OTHER OCCUPANCIES:  
A STATISTICAL ANALYSIS**

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## **Facts about Home Candle Fires**

From 1993 through 1997, candles in the home caused an annual average of:

- 8,690 fires,
- 104 civilian deaths,
- 947 injuries and
- Estimated direct property loss of \$126.0 million in direct property damage.

Home candle fires hit their 18-year peak (at 11,600) in 1997, the latest year for which data is available.

The share of home fires attributable to candles also hit a 18-year peak at 2.9% in 1997, twice the 18-year average share of 1.4%.

Almost half (44%) of the home candle fires started in the bedroom.

December had twice the number of home candle fires of an average month.

## **Causes of Home Candle Fires**

- 36% occurred because candles were left unattended, abandoned or inadequately controlled.
- 18% occurred because some form of combustible material was left too close to the candle.
- 9% were started by children playing with the candle.

## **Candle Fires in the Home**

### **Candles caused an annual average of 8,690 fires, 104 deaths, 948 injuries and \$126.0 million in damage.**

Between 1993 and 1997, an average of 8,690 home fires started by candles were reported to public fire departments each year. (Homes include dwellings, duplexes, manufactured housing and apartments.) These fires caused an annual average of 104 civilian deaths, 948 civilian injuries and an estimated direct property loss of \$126.0 million.

Candle fires accounted for an average of 2.0% of all reported home fires, 2.9% of the civilian home fire deaths, 4.9% of the civilian home fire injuries, and 2.8% of the direct property damage in home fires.

These percentages are even more disturbing when we look at data for 1997 only. In that year, the 11,600 candle fires accounted for 2.4% of the fires, 3.1% of the home fire deaths, 6.0% of the home civilian injuries, and 3.5% of the direct property damage in home fires.

### **Home candle fires and casualties hit new high in 1997.**

More home fires were started by candles in 1997 than in any of the 17 previous years. These fires also caused more deaths and injuries than in previous years. In 1980 (the first year of available data), candles started 8,240 home fires. These fires generally declined in the 1980's and fell to a low of 5,540 in 1990. However, these fires increased 12% from 1993 to 1994. In 1995, they went up 18%, and they jumped another 18% to the 9,930 reported in 1996. From 1996 to 1997, these fires increased by 17%, to more than double the 1990 low. (See Table 1 on page 10 and Figure 1 on page 11.)

Deaths from home candle fires jumped 24% to 156 in 1997 from the previous high of 126 in 1996. (See Table 1 on page 10 and Figure 2 on page 12.)

Beginning in 1994, civilian injuries caused by home candle fires have been hitting new highs each year. They jumped 36% from 627 in 1993 to 853 in 1994, rose 7% to 914 in 1995, and jumped another 25% to the 1,140 reported in 1996. They rose 5% from 1996 to 1997. (See Table 1 on page 10 and Figure 3 on page 13.)

Direct property damage from home candle fires jumped 35% from \$87.1 million in 1994 to \$117.6 million in 1995. It jumped 45% from 1995 to \$170.6 million in 1996. The graph shows a loss considerably higher in the 1990's than in the 1980's. Although dollar loss figures have not been adjusted for inflation, 1996

would still be the peak loss year with such an adjustment. From 1996 to 1997, direct property damage was virtually unchanged with a 0.3% increase. This would actually be a slight decrease when adjusted for inflation. However, losses in 1996 and in 1997 were both significantly higher than in any of the earlier years. (See Table 1 on page 10 and Figure 4 on page 14.)

**The share of home structure fires started by candles is growing.**

Partly because total home fires have declined in frequency and partly because of the increase in real numbers, the share of fires started by candles has almost tripled from 1.1% in the early 1980's up to 2.9% in 1996. (See Table 2 on page 15.) Home fires from all causes actually fell to their lowest point in 1997.

**National Candle Association reports an increase in candle sales.**

According to the National Candle Association (NCA), the industry has had an average annual growth of 10-15% since the early 1990's. It was also noted that growth has doubled in recent years. There are more than 200 commercial, religious and institutional manufacturers of candles in the United States, and a typical manufacturer offers between 1,000 and 2,000 varieties of candles. The NCA reports that candles are used in seven out of ten households in this country and that roughly 35% of the candle business is seasonal around the Christmas holiday.\*

**What do we know about candle fires in the home?**

Because data from one year may not be representative, the following statistics reflect the annual average percentages for fires that occurred during the five-year period from January 1993 through December 1997.

**Where do candle fires start?**

- 44% of these fires started in bedrooms;
- 19% started in living rooms, family rooms or dens;
- 11% started in bathrooms;
- 7% began in kitchens; and
- 4% started in dining rooms.

For more detailed information on area of origin in these fires, see Table 3 on page 16.

**How do they start?**

- 36% of the home candle fires occurred because candles were unattended, abandoned or inadequately controlled.
- 18% occurred because some form of combustible material was left too close to the candle.
- Children were playing with the candles or something flammable near the candles in 9% of these fires.

- 5% of the home candle fires started when the occupant fell asleep while the candle was burning.
- An unclassified or unknown-type misuse of the candle caused 11% of the fires.

\* Information was found at the National Candle Association's web site, [www.candles.org](http://www.candles.org) on September 30, 1999.

A more detailed listing of ignition factors can be found in Table 4 on page 17. The reference to “cutting or welding” may be a reminder that the term “candle” is sometimes applied to objects other than the traditional wax candle.

### **What do candles ignite?**

- Mattresses or bedding were first ignited in 13% of these fires;
- Cabinetry was the first item ignited in 10% of these incidents;
- Curtains and drapes were ignited first in 8% of these fires;
- Interior wall coverings were ignited first 6% of the time;
- Upholstered furniture was ignited first in 5% of the fires;
- In 5% of these fires, decorations for special events were first ignited;
- Clothing (not being worn at the time) was also ignited first in 5% of these incidents;
- Magazines, newspapers, and writing paper were first ignited 4% of the time;
- Rugs and other floor coverings were first ignited 4% of the time; and
- Towels and other linens (not bedding) were first ignited in 4% of the fires.

Please refer to Table 5 on page 18 for more detailed information about the form of material first ignited in home candle fires.

### **How big is the candle problem in terms of the different materials ignited?**

The *U.S. Home Product Report, 1992-1996: Forms and Types of Materials First Ignited in Fires\** provides information on the frequency of different forms of heat of ignition in fires involving different kinds of materials.

Candles provided the heat of ignition in:

- 41% of the decoration fires;
- 15% of the curtain and drape fires;
- 11% of the cabinetry fires;
- 11% of the book fires;
- 8% of the linen (towels, tablecloths, not bedding) fires;
- 4% of the mattress and bedding fires;
- 3% of the floor covering fires;
- 3% of the upholstered furniture fires;
- 3% of the interior wall covering fires;
- 3% of the box and bag fires; and
- 2% of the fires starting in clothing that was not being worn.

\*Kimberly D. Rohr, *U.S. Home Product Report, 1992-1996: Forms and Types of Materials First Ignited in Fires*, Quincy, MA: National Fire Protection Association, Fire Analysis and Research Division, June 1999.

**Flame damage from home candle fires was confined to the room of origin in 4/5 of fires.**

Table 6 (page 19) shows the extent of flame damage in home candle fires. In one out of five fires, the damage was confined to the object of origin. In one-third, damage was confined to the part of room or area of origin; and in one-quarter, it was confined to the room of origin.

**Candle fires had a higher death rate per fire than most other fire causes.**

Home candle fires had a higher death rate per 1,000 reported fires than home fires from any of the 12 major causes other than smoking or children playing with fire. Candle fires were comparable with incendiary or suspicious fires in their risk. During the five-year period from 1993 through 1997, an average of 8.52 civilian deaths resulted per 1,000 home structure fires reported to public fire departments. For home fires started by candles, the rate was 12.00 deaths per 1,000 reported home structure fires. (The cause categories except for candles are based on a hierarchy developed by the U.S. Fire Administration. Candles have not been removed from the other causes and are also captured in other categories, particularly: other heat source; open flame, ember or torch; and child playing.) It is important to note that specific parts of each category may have higher death rates than the category as a whole.

<b>Cause</b>	<b>Civilian Deaths per 1,000 Reported Fires</b>
Smoking materials	37.35
Child playing	16.41
<i>Candles</i>	<i>12.00</i>
Incendiary or suspicious	11.96
Other heat source	10.44
Electrical distribution	9.14
Heating equipment	7.57
Other equipment	6.08
Open flame, ember or torch	5.83
Appliance, tool or air conditioning	4.29
Cooking equipment	3.31
Exposure (to other hostile fire)	2.08
Natural causes	1.30
All causes	8.52

**When do candle fires occur?**

December was the peak month for home candle fires with twice the average number of these incidents. These incidents were more frequent in the winter months than in spring, summer, or fall. (See Figure 5 on page 20.)

**December candle fires follow a somewhat different pattern.**

Although bedrooms were the leading areas of origin for home candle fires all year, Figure 6 (page 21) shows that this pattern was not as strong in December. From January through November, 47% of the candle fires started in bedrooms. Only 31% of the December candle fires started there. In December, 29% of the home candle fires started in living rooms or dens, compared to 17% during the rest of the year. Candle fires occurred in dining rooms and kitchens more frequently in December than they did the rest of the year.

Table 7 (page 22) shows that decorations for special events were the leading forms of material first ignited in December. During the rest of year, these decorations ranked thirteenth. This is consistent with the industry pattern of seasonal business.

**See Table 8 for candle fires in other occupancies.**

Almost nine of every ten (89%) fires started by candles occurred in homes (one- and two-family dwellings, manufactured housing and apartments). About 1.3% of candle fires occurred in dormitories, 0.9% occurred in hotels or motels and 0.8% occurred in churches and related properties. Table 8 (page 23) provides more detail on candle fires in different occupancies.

**CPSC has recalled several candles and candle-related products.**

The U.S. Consumer Product Safety Commission (CPSC) has issued a number of recalls of candles and candle-related products since 1994.\* The flames on some candles could shoot up seven inches or more. In some cases, candle holders or containers could overheat and shatter or catch on fire. Some candle holders had flammable paint. Paper candle shades have also been recalled. Other candles had material inside them that could catch on fire.

**This problem is not confined to the U.S.**

The candle fire problem is not confined to the United States. The United Kingdom reports that candle fires and candle fire injuries continue to rise.\*\* The Province of Ontario in Canada reports that candles caused 1.4% of their residential fires in 1990, 1.2% in 1991, 1.6% in 1992, and 1.9% in 1993 and 1994.\*\*\*

\*www.cpsc.gov. An October 18, 1999 search on 'candle' found these press releases about recalls: 00-004, 99-070, 99-096, 99-101, 99-126, 98-021, 98-039, 98-040, 98-044, 98-105, 98-114, 98-119, 98-152, 98-162, 97-005, 97-011, 97-017, 97-019, 97-044, 96-046, 96-051, 96-158, 96-195, 95-026, 95-046, and 94-007.

\*\*Patrick Collier and Lorraine Watson, *Home Office Statistical Bulletin: Fire Statistics, United Kingdom - 1997*, Research and Statistics Directorate, Issue 25/98, 3 November 1998, London, United Kingdom, page 23, 24.

\*\*\**Candle Fires in Ontario Homes: Fact Sheet*, Office of the Fire Marshal, Ministry of the Solicitor General and Correctional Services, Ontario, Canada

**Candles used for light caused a number of serious fires.**

A collection of previously published descriptions of fires caused by candles can be found at the end of this report. Our statistics do not provide the level of the detail found in these descriptions. While these fires tend to be more serious than most and not representative of the 'typical' candle fire, it is worth noting that many of the fatalities occurred when candles were used for light.

Sometimes this was because power had been shut off; sometimes there was a power outage. Clearly, this is a dangerous practice. Advice for using candles safely and special additional advice for situations in which candles must be used as emergency light sources are found on the following pages.

**More information is needed.**

We know quite a bit about candle fires. We know that they are increasing, that they occur most often in the bedroom, and that candle fires peak in December. However, we do not know the age of the individual who was using the candles, what type of candle was involved, or whether the candle holder was a factor.

The Massachusetts State Fire Marshal's Office and the NFPA are working together on a special study of 1999 Massachusetts candle fires that asks these and other questions. The Massachusetts fire service has approached this study with enthusiasm, and we are all looking forward to the results. We need to know more about the circumstances of these fires and the people who are having these fires to develop and target our educational messages effectively. Manufacturers and regulators also need to know if product issues are significant problems.

## **Use Candles Safely**

**Remember: A candle is an open flame. It can easily ignite any combustibles nearby.**

- Extinguish all candles when leaving the room or when going to sleep.
- Keep candles away from items that can catch fire such as clothing, books, paper, curtains, Christmas trees, flammable decorations or anything that burns.
- Make sure candles are placed on a secure piece of furniture in sturdy holders that won't tip over. Holders should be made from material that can't burn.
- Make sure the candle holder is big enough to collect dripping wax.
- Don't place lit candles in windows, where blinds or curtains can close over them.
- Do not use candles in places where they could be knocked over by children or pets.
- Keep candles and all open flames away from flammable liquids.
- When purchasing or using candles, consider what would happen if the candle burned low. Could it burn the candle holder or decorative material nearby? Extinguish candles when they get within two inches of the holder or decorative material.

### **Where young children are present:**

- Keep candles up high out of the reach of children.
- Never leave a child unattended in a room with a candle. A child should not sleep in a room with a lit candle.
- Keep all matches and lighters up high and out of the sight and reach of children, preferably in a locked cabinet.

## **If You Must Use Candles During Power Outages**

**Flashlights and other lights generated by batteries are much safer light sources than candles.**

Observe all the general candle safety tips. Also:

- Try to avoid carrying a lit candle. When you carry a candle, you are carrying something that could start a fire. Don't use a candle to go into a closet to look for things.
- Never use a candle for light when fueling equipment such as a kerosene heater or lantern. The flame may ignite the fumes.
- Extinguish all candles when leaving the home or when going to sleep.

**Table 1.**  
**Candle Fires in the Home by Year**  
**1980-1997**

<b>Year</b>	<b>Home Fires</b>	<b>Civilian Deaths</b>	<b>Civilian Injuries</b>	<b>Direct Property Damage (in millions)</b>
1980	8,240	32	506	\$38.1
1981	7,870	106	438	\$40.2
1982	7,270	81	462	\$39.2
1983	6,710	98	507	\$43.8
1984	6,690	97	559	\$48.7
1985	6,900	73	576	\$55.9
1986	6,520	111	563	\$70.4
1987	6,440	104	571	\$49.6
1988	6,650	81	679	\$60.3
1989	6,290	99	650	\$62.3
1990	5,460	89	559	\$62.5
1991	5,900	64	657	\$81.5
1992	6,090	102	601	\$61.0
1993	6,310	82	627	\$83.6
1994	7,160	81	853	\$87.1
1995	8,440	76	914	\$117.6
1996	9,930	126	1,140	\$170.6
1997	11,600	156	1,202	\$171.1
1980-1997 Annual average	7,250	92	670	\$74.6
1993-1997* Annual average	8,690	104	948	\$126.0

\*Detailed analysis of the candle fire problem is based on five year annual averages for 1993-1997.

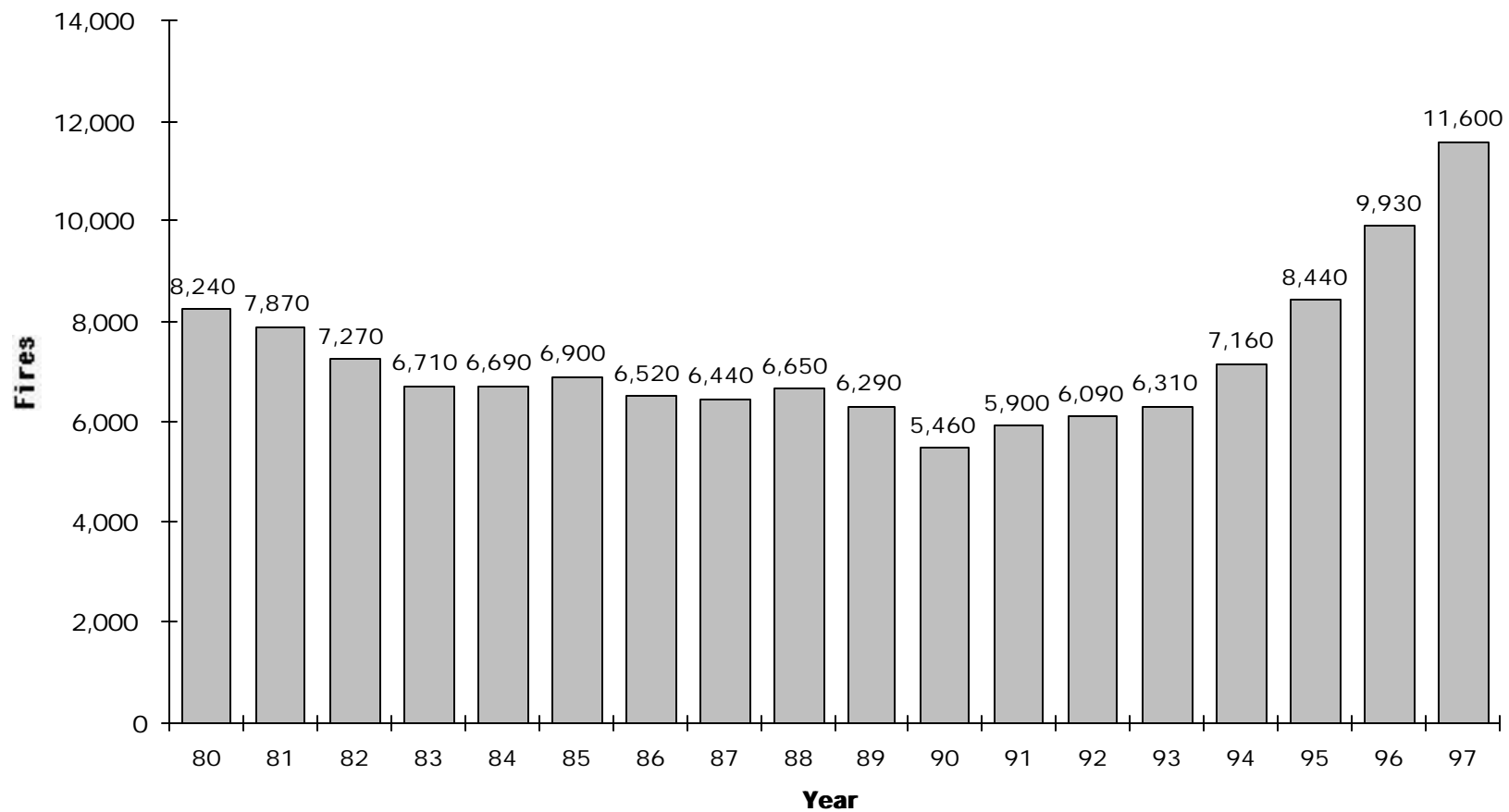
These are fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Fires are rounded to the nearest ten, civilian deaths and injuries are rounded to the nearest one, and direct property damage is rounded to the nearest hundred thousand. Property damage has not been adjusted for inflation. A proportional share of fires in which the form of heat of ignition was unknown or unreported is included in these totals.

Homes include dwellings, duplexes, manufactured housing and apartments.

Source: National estimates based on NFIRS and NFPA survey.

**Figure 1.**

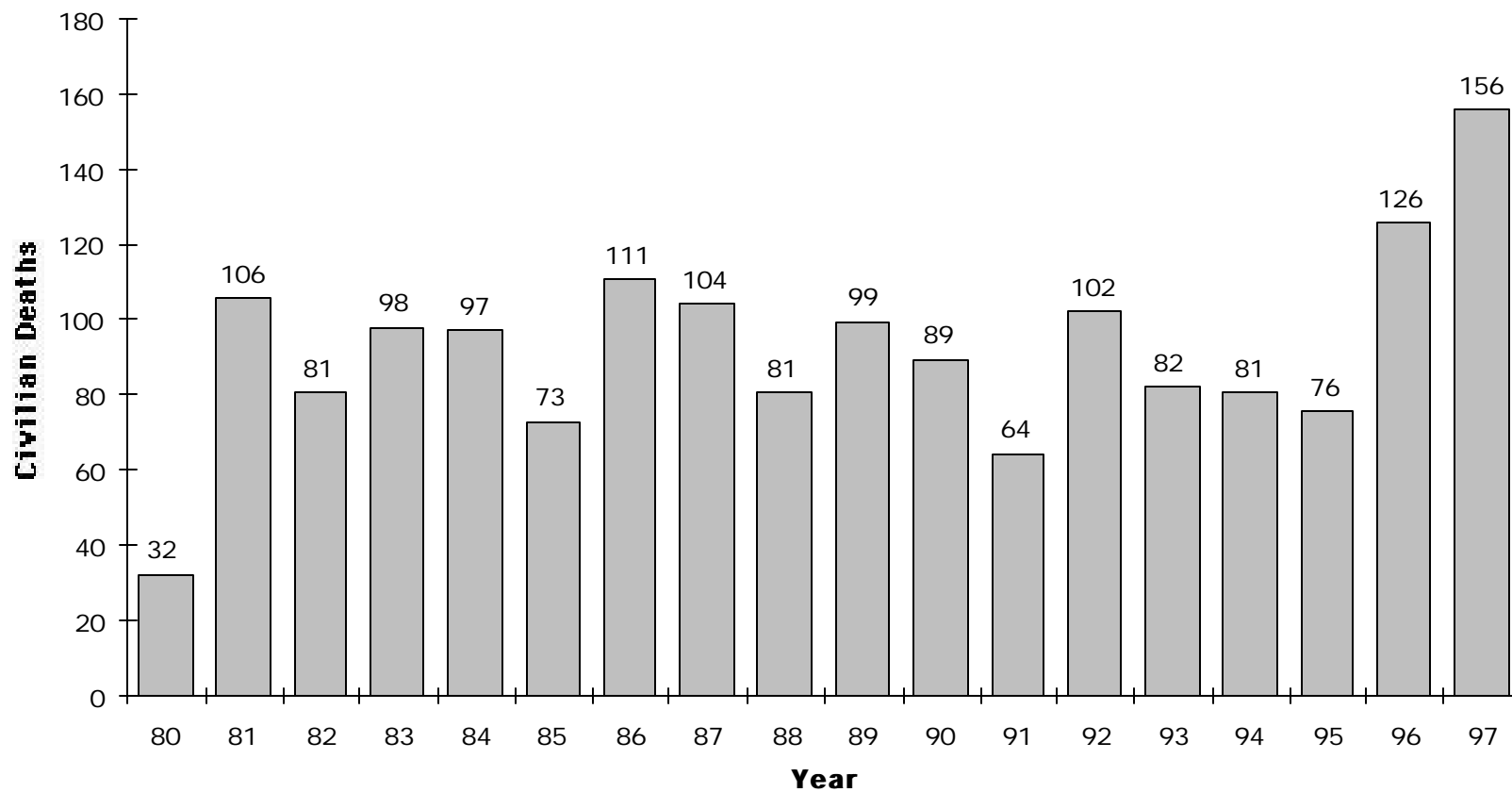
**Home Candle Fires by Year: 1980-1997**



Source: National estimates based on NFIRS and NFPA survey.

**Figure 2.**

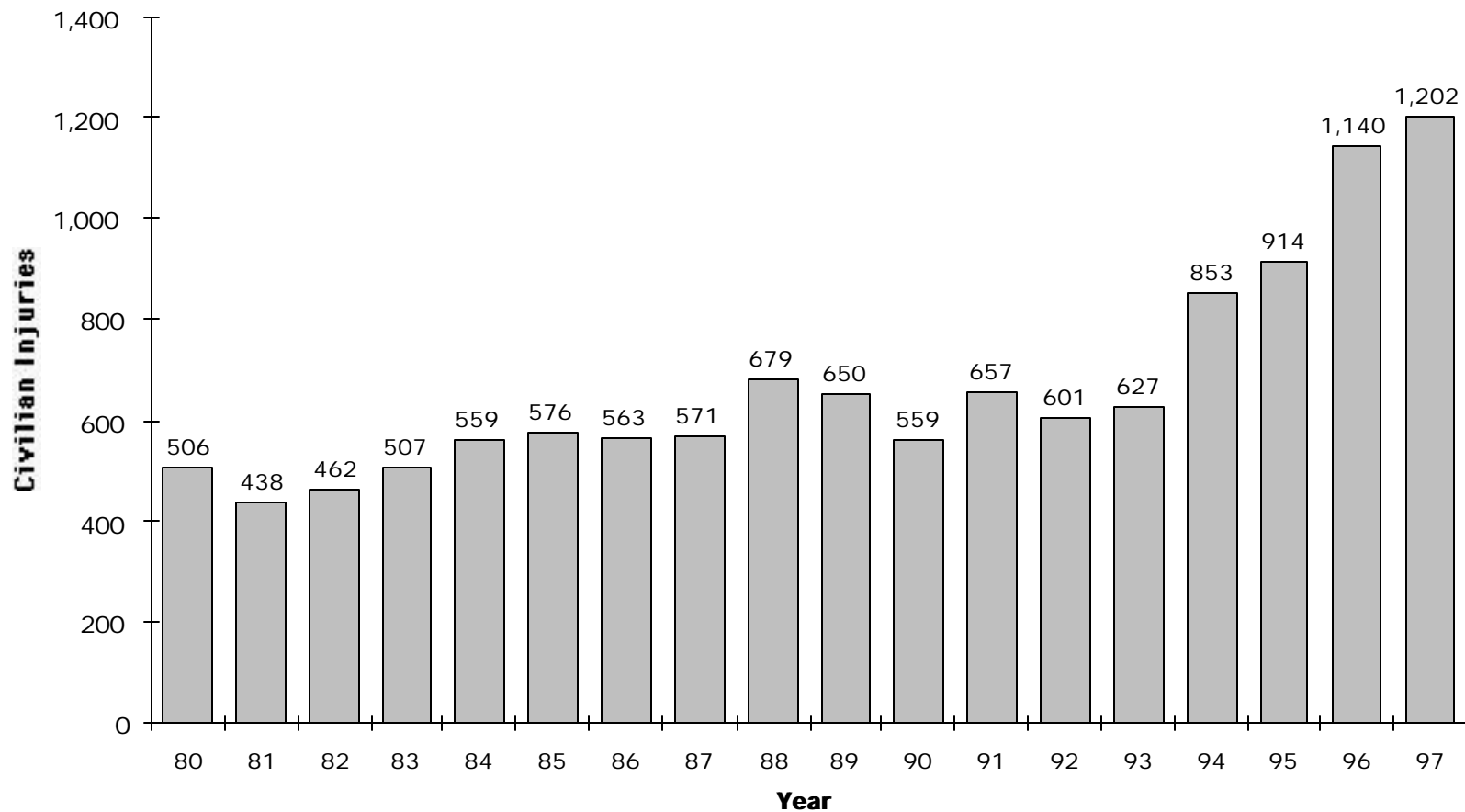
**Civilian Fire Deaths from Home Candle Fires by Year: 1980-97**



Source: National estimates based on NFIRS and NFPA survey.

**Figure 3.**

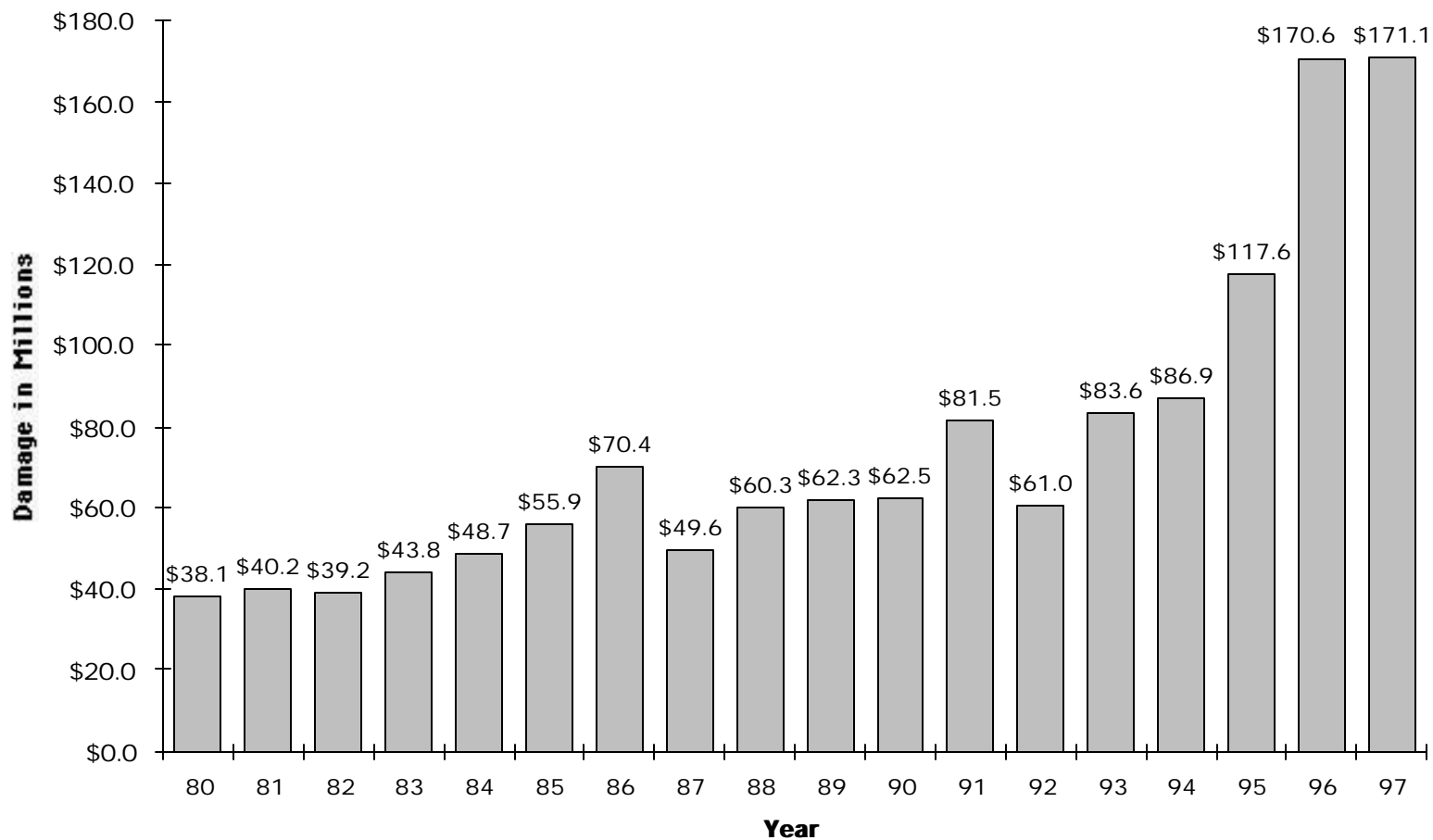
**Civilian Injuries from Home Candle Fires by Year: 1980-1997**



Source: National estimates based on NFIRS and NFPA survey.

**Figure 4.**

**Direct Property Damage from Home Candle Fires by Year: 1980-97**



Source: National estimates based on NFIRS and NFPA survey.

**Table 2.**  
**Candle Fires in the Home as a Share of All Home Fires**  
**1980-1997**

<b>Year</b>	<b>Home Fires</b>	<b>Home Candle Fires</b>	<b>Percent of Home Fires Started by Candles</b>
1980	733,370	8,240	(1.1%)
1981	711,080	7,870	(1.1%)
1982	659,000	7,270	(1.1%)
1983	626,590	6,710	(1.1%)
1984	606,450	6,690	(1.1%)
1985	607,100	6,900	(1.1%)
1986	566,710	6,520	(1.2%)
1987	537,200	6,440	(1.2%)
1988	537,960	6,650	(1.2%)
1989	499,840	6,290	(1.3%)
1990	454,890	5,460	(1.2%)
1991	465,530	5,900	(1.3%)
1992	459,280	6,090	(1.3%)
1993	457,720	6,310	(1.4%)
1994	439,280	7,160	(1.6%)
1995	414,350	8,440	(2.0%)
1996	417,020	9,930	(2.4%)
1997	395,490	11,600	(2.9%)
1980-1997			
Annual average	532,710	7,250	(1.4%)
1993-1997*			
Annual average	424,770	8,690	(2.0%)

\*Detailed analysis of the candle fire problem is based on five year annual averages for 1993-1997.

These are fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Fires are rounded to the nearest ten.. A proportional share of fires in which the form of heat of ignition was unknown or unreported is included in the candle fires.

Homes include dwellings, duplexes, manufactured housing and apartments.

Source: National estimates based on NFIRS and NFPA survey.

**Table 3.**  
**Area of Origin in Home Candle Fires**  
**1993-1997 Annual Averages**

<b>Area of Origin</b>	<b>Candle Fires</b>		<b>Civilian Deaths</b>		<b>Civilian Injuries</b>		<b>Direct Property Damage (in millions)</b>	
Bedroom	3,830	(44.1%)	41	(39.4%)	513	(54.2%)	\$63.2	(50.1%)
Living room	1,670	(19.2%)	48	(45.9%)	209	(22.0%)	\$28.9	(22.9%)
Lavatory	970	(11.2%)	3	(2.7%)	51	(5.4%)	\$6.5	(5.1%)
Kitchen	610	(7.0%)	2	(1.7%)	40	(4.2%)	\$4.8	(3.8%)
Dining room	340	(3.9%)	4	(3.4%)	38	(4.0%)	\$3.7	(3.0%)
Closet	130	(1.5%)	4	(3.7%)	14	(1.5%)	\$2.2	(1.8%)
Exterior balcony or open porch	100	(1.2%)	0	(0.0%)	6	(0.6%)	\$2.4	(1.9%)
Garage or carport*	90	(1.1%)	0	(0.0%)	9	(1.0%)	\$2.1	(1.6%)
Crawl space or substructure space	90	(1.1%)	0	(0.0%)	9	(0.9%)	\$1.6	(1.3%)
Other known area	840	(9.7%)	3	(3.1%)	59	(6.2%)	\$10.7	(8.5%)
<b>Total</b>	<b>8,690</b>	<b>(100.0%)</b>	<b>104</b>	<b>(100.0%)</b>	<b>948</b>	<b>(100.0%)</b>	<b>\$126.0</b>	<b>(100.0%)</b>

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

These are fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Fires are rounded to the nearest ten, civilian deaths and injuries are rounded to the nearest one, and direct property damage is rounded to the nearest hundred thousand. Property damage has not been adjusted for inflation. A proportional share of fires in which the form of heat of ignition was unknown or unreported is included in these totals. Candle fires in which the area of origin was unknown or not reported have been allocated proportionally among fires with known area of origin.

Homes include dwellings, duplexes, manufactured housing and apartments.

Source: National estimates based on NFIRS and NFPA survey.

**Table 4.**  
**Ignition Factors in Home Candle Fires**  
**1993-1997 Annual Averages**

<b>Ignition Factor</b>	<b>Candle Fires</b>		<b>Civilian Deaths</b>		<b>Civilian Injuries</b>		<b>Direct Property Damage (in millions)</b>	
Unattended	1,620	(18.6%)	9	(9.1%)	155	(16.3%)	\$22.8	(18.1%)
Combustible too close to heat	1,600	(18.5%)	26	(24.8%)	173	(18.2%)	\$22.2	(17.6%)
Unclassified or unknown-type misuse of heat	1,000	(11.5%)	14	(13.1%)	116	(12.3%)	\$14.2	(11.3%)
Inadequate control of open fire	900	(10.4%)	6	(5.8%)	97	(10.2%)	\$14.9	(11.8%)
Child playing	800	(9.2%)	8	(7.9%)	90	(9.5%)	\$13.5	(10.7%)
Abandoned material	640	(7.4%)	3	(2.7%)	53	(5.6%)	\$8.1	(6.4%)
Falling asleep	390	(4.5%)	7	(7.0%)	87	(9.2%)	\$5.8	(4.6%)
Unclassified or unknown-type misuse of material ignited	370	(4.3%)	10	(9.4%)	33	(3.4%)	\$4.9	(3.9%)
Incendiary or suspicious	300	(3.4%)	3	(2.6%)	21	(2.2%)	\$3.9	(3.1%)
Cutting or welding too close	250	(2.9%)	3	(3.2%)	26	(2.8%)	\$3.9	(3.1%)
Unclassified ignition factor	180	(2.1%)	4	(3.6%)	14	(1.5%)	\$2.1	(1.6%)
Collision or overturn	160	(1.8%)	2	(1.7%)	17	(1.8%)	\$2.8	(2.3%)
Other known ignition factor	480	(5.5%)	9	(9.1%)	65	(6.9%)	\$6.9	(5.5%)
<b>Total</b>	<b>8,690</b>	<b>(100.0%)</b>	<b>104</b>	<b>(100.0%)</b>	<b>948</b>	<b>(100.0%)</b>	<b>\$126.0</b>	<b>(100.0%)</b>

These are fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Fires are rounded to the nearest ten, civilian deaths and injuries are rounded to the nearest one, and direct property damage is rounded to the nearest hundred thousand. Property damage has not been adjusted for inflation. A proportional share of fires in which the form of heat of ignition was unknown or unreported is included in these totals. Candle fires in which the ignition factor was unknown or not reported have been allocated proportionally among fires with known ignition factor.

Homes include dwellings, duplexes, manufactured housing and apartments.

Source: National estimates based on NFIRS and NFPA survey.

**Table 5.**  
**Form of Material First Ignited in Home Candle Fires**  
**1993-1997 Annual Averages**

<b>Form of Material Ignited</b>	<b>Candle Fires</b>		<b>Civilian Deaths</b>		<b>Civilian Injuries</b>		<b>Direct Property Damage (in millions)</b>	
Mattress or bedding	1,130	(13.0%)	19	(18.2%)	184	(19.4%)	\$22.0	(17.5%)
Cabinetry	860	(9.9%)	6	(5.5%)	79	(8.3%)	\$11.5	(9.1%)
Curtain, blind or drapery	720	(8.3%)	2	(2.2%)	88	(9.3%)	\$9.5	(7.6%)
Unclassified form of material	530	(6.1%)	4	(4.1%)	40	(4.2%)	\$5.6	(4.4%)
Interior wall covering	520	(6.0%)	11	(10.7%)	36	(3.8%)	\$5.7	(4.5%)
Upholstered furniture	460	(5.3%)	21	(19.8%)	79	(8.4%)	\$10.2	(8.1%)
Decoration for special event	440	(5.1%)	1	(0.9%)	34	(3.6%)	\$3.8	(3.0%)
Unclassified or unknown-type furniture	440	(5.0%)	2	(1.7%)	38	(4.0%)	\$7.2	(5.7%)
Clothing (worn or not worn)	430	(5.0%)	11	(10.8%)	47	(5.0%)	\$7.0	(5.6%)
Magazine, newspaper or writing paper	390	(4.5%)	2	(2.3%)	36	(3.8%)	\$5.3	(4.2%)
Floor covering or surface	360	(4.2%)	4	(3.9%)	51	(5.4%)	\$5.4	(4.3%)
Linen other than bedding	340	(3.9%)	0	(0.0%)	30	(3.2%)	\$3.1	(2.5%)
Unclassified or unknown-type adornment or recreational material	290	(3.3%)	0	(0.0%)	25	(2.6%)	\$2.0	(1.6%)
Multiple forms of material ignited	230	(2.7%)	5	(4.3%)	24	(2.6%)	\$5.0	(4.0%)
Appliance housing or casing	210	(2.4%)	1	(1.1%)	24	(2.5%)	\$1.1	(0.9%)
Rubbish, trash or waste	160	(1.8%)	1	(0.9%)	13	(1.3%)	\$2.2	(1.7%)
Structural member or framing	140	(1.6%)	2	(1.8%)	10	(1.0%)	\$3.2	(2.6%)
Box, carton or bag	130	(1.5%)	0	(0.0%)	14	(1.4%)	\$1.7	(1.4%)
Unclassified or unknown-type soft goods or apparel	110	(1.2%)	7	(6.5%)	11	(1.2%)	\$4.6	(3.6%)
Other known form	800	(9.2%)	5	(5.2%)	85	(9.0%)	\$9.7	(7.7%)
<b>Total</b>	<b>8,690</b>	<b>(100.0%)</b>	<b>104</b>	<b>(100.0%)</b>	<b>948</b>	<b>(100.0%)</b>	<b>\$126.0</b>	<b>(100.0%)</b>

These are fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Fires are rounded to the nearest ten, civilian deaths and injuries are rounded to the nearest one, and direct property damage is rounded to the nearest hundred thousand. Property damage has not been adjusted for inflation. A proportional share of fires in which the form of heat of ignition was unknown or unreported is included in these totals. Candle fires in which the form of material first ignited was unknown or not reported have been allocated proportionally among fires with known form of material first ignited.

Homes include dwellings, duplexes, manufactured housing and apartments.

Source: National estimates based on NFIRS and NFPA survey.

**Table 6.**  
**Extent of Flame Damage in Home Candle Fires**  
**1993-1997 Annual Averages**

<b>Extent of Flame Damage</b>	<b>Candle Fires</b>		<b>Civilian Deaths</b>		<b>Civilian Injuries</b>		<b>Direct Property Damage (in millions)</b>	
Confined to object of origin	1,860	(21.4%)	2	(1.5%)	110	(11.6%)	\$3.8	(3.0%)
Confined to part of room or area of origin	2,950	(33.9%)	8	(7.5%)	244	(25.7%)	\$13.2	(10.5%)
Confined to room of origin	2,060	(23.8%)	17	(16.5%)	249	(26.2%)	\$26.4	(21.0%)
Confined to fire-rated compartment of origin	100	(1.1%)	0	(0.0%)	28	(2.9%)	\$2.8	(2.2%)
Confined to floor or origin	530	(6.1%)	12	(11.8%)	99	(10.4%)	\$18.4	(14.6%)
Confined to structure of origin	1,050	(12.1%)	62	(59.8%)	193	(20.4%)	\$52.3	(41.5%)
Extended beyond structure of origin	140	(1.6%)	3	(2.8%)	26	(2.7%)	\$9.1	(7.2%)
<b>Total</b>	<b>8,690</b>	<b>(100.0%)</b>	<b>104</b>	<b>(100.0%)</b>	<b>948</b>	<b>(100.0%)</b>	<b>\$126.0</b>	<b>(100.0%)</b>

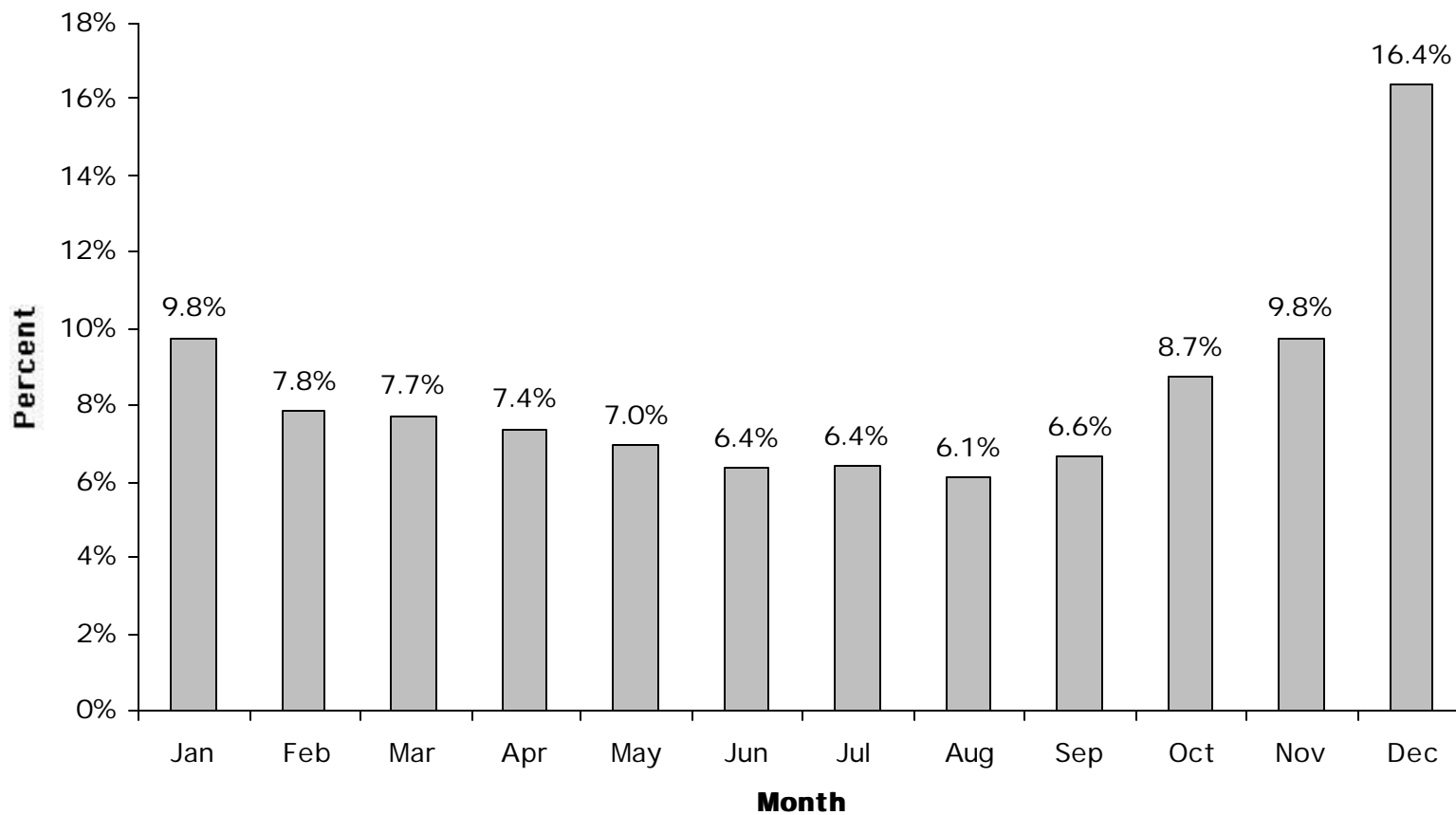
These are fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Fires are rounded to the nearest ten, civilian deaths and injuries are rounded to the nearest one, and direct property damage is rounded to the nearest hundred thousand. Property damage has not been adjusted for inflation. A proportional share of fires in which the form of heat of ignition was unknown or unreported is included in these totals. Candle fires in which the extent of flame damage was unknown or not reported have been allocated proportionally among fires with known extent of flame damage.

Homes include dwellings, duplexes, manufactured housing and apartments.

Source: National estimates based on NFIRS and NFPA survey.

**Figure 5.**

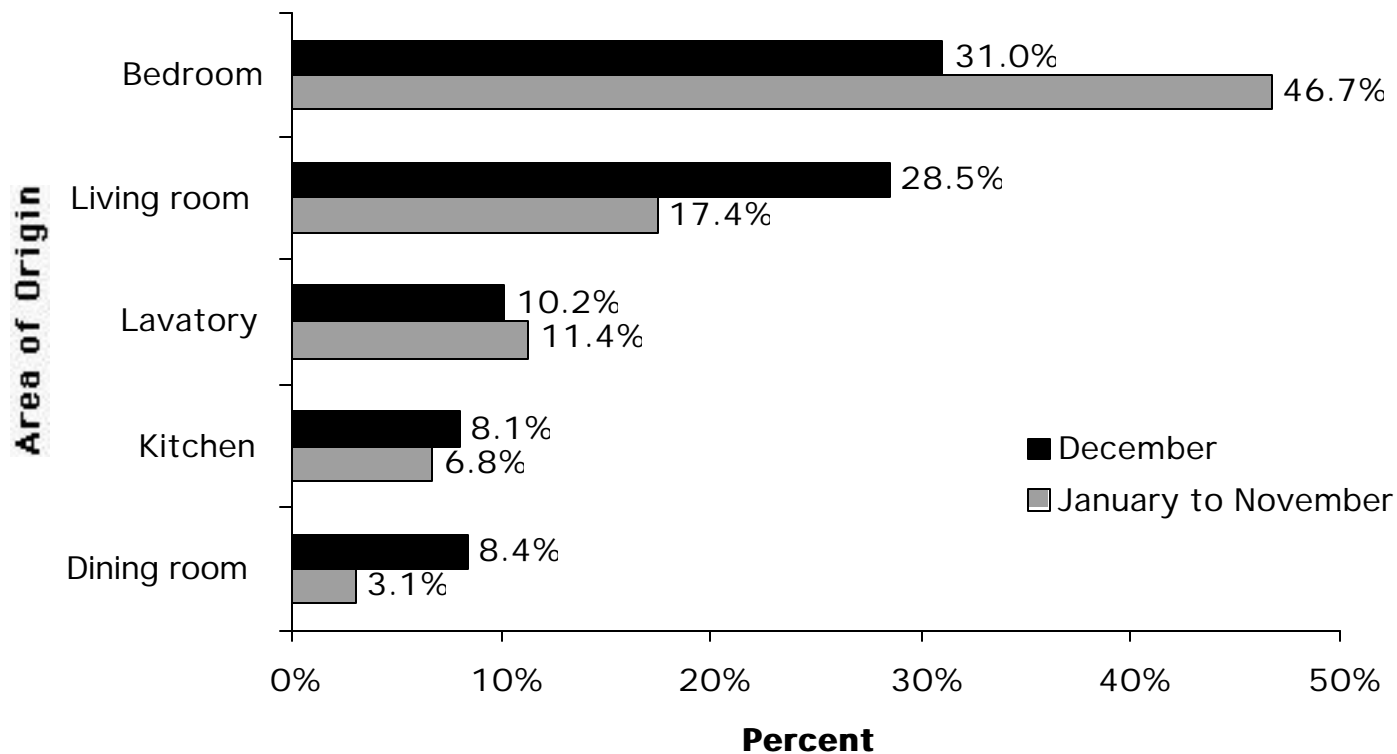
**Home Candle Fires by Month, 1993-1997**



Source: National estimates based on NFIRS and NFPA survey.

**Figure 6.**

**Leading Areas of Origin in Home Candle Fires: Dec. vs. Jan.-Nov.  
1993-1997**



Source: National estimates based on NFIRS and NFPA survey.

**Table 7.**  
**Form of Material First Ignited in Home Candle Fires**  
**January-November and December**  
**1993-1997 Annual Averages**

<b>January-November</b>	<b>Fires</b>		<b>December</b>	<b>Fires</b>	
Mattress or bedding	1,000	(13.7%)	Decoration for special event	210	(14.6%)
Cabinetry	720	(9.9%)	Cabinetry	140	(10.2%)
Curtain, blind or drapery	630	(8.7%)	Mattress or bedding	130	(9.0%)
Unclassified form of material	450	(6.2%)	Curtain, blind or drapery	90	(6.7%)
Interior wall covering	450	(6.1%)	Upholstered furniture	80	(5.7%)
Upholstered furniture	380	(5.2%)	Interior wall covering	80	(5.5%)
Wearing apparel not worn	370	(5.1%)	other form of material	80	(5.4%)
Unclassified or unknown-type furniture	360	(5.0%)	Unclassified or unknown-type furniture	80	(5.3%)
Magazine, newspaper or writing paper	330	(4.6%)	Floor covering or surface	70	(5.1%)
Floor covering or surface	290	(4.0%)	Linen other than bedding	60	(4.0%)
Linen other than bedding	290	(3.9%)	Magazine, newspaper or writing paper	50	(3.9%)
Unclassified or unknown-type adornment or recreational material	240	(3.3%)	Unclassified or unknown-type adornment or recreational material	50	(3.4%)
Decoration for special event	230	(3.2%)	Multiple forms of material	40	(2.8%)
Multiple forms of material	190	(2.7%)	Wearing apparel not worn	40	(2.8%)
Appliance housing or casing	170	(2.4%)	Appliance housing or casing	40	(2.5%)
Rubbish, trash or waste	140	(1.9%)	Box, carton or bag	20	(1.5%)
Structural member or framing	130	(1.7%)	Rubbish, trash or waste	20	(1.4%)
Box, carton or bag	110	(1.5%)	Structural member or framing	20	(1.1%)
Unclassified or unknown-type soft goods or apparel	90	(1.3%)	Christmas tree	10	(1.0%)
Other known form	700	(9.7%)	Unclassified or unknown-type structural component or framing	10	(1.0%)
			Unclassified or unknown-type apparel or soft goods	10	(1.0%)
<b>Total</b>	<b>7,260</b>	<b>(100.0%)</b>	<b>Other known</b>	<b>90</b>	<b>(6.3%)</b>
January-November average	660		<b>Total</b>	<b>1,420</b>	<b>(100.0%)</b>

These are fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Fires are rounded to the nearest ten, civilian deaths and injuries are rounded to the nearest one, and direct property damage is rounded to the nearest thousand. Property damage has not been adjusted for inflation. A proportional share of fires in which the form of heat of ignition was unknown or unreported is included in

these totals. Candle fires in which the form of material first ignited was unknown or not reported have been allocated proportionally among fires with known form of material first ignited.

Homes include dwellings, duplexes, manufactured housing and apartments.

Source: National estimates based on NFIRS and NFPA survey.

**Table 8.  
Candle Fires by Occupancy Class  
1993-1997 Annual Averages**

<b>Occupancy</b>	<b>Candle Fires</b>		<b>Civilian Deaths</b>		<b>Civilian Injuries</b>		<b>Direct Property Damage (in millions)</b>	
<b>Residential Properties</b>	<b>9,000</b>	<b>(92.4%)</b>	<b>106</b>	<b>(95.7%)</b>	<b>983</b>	<b>(96.8%)</b>	<b>\$130.1</b>	<b>(93.0%)</b>
One and two-family homes	6,550	(67.3%)	82	(73.8%)	679	(66.9%)	\$95.0	(67.9%)
Apartments	2,130	(21.9%)	22	(20.1%)	268	(26.4%)	\$30.9	(22.1%)
Dormitories	130	(1.3%)	1	(1.0%)	22	(2.2%)	\$2.2	(1.5%)
Hotels or motels	90	(0.9%)	0	(0.0%)	7	(0.7%)	\$1.1	(0.8%)
Rooming or lodging houses	30	(0.3%)	0	(0.0%)	4	(0.4%)	\$0.3	(0.2%)
Home hotels	10	(0.1%)	1	(0.8%)	0	(0.0%)	\$0.2	(0.1%)
Unclassified or unknown-type residential properties	50	(0.5%)	0	(0.0%)	2	(0.1%)	\$0.4	(0.3%)
<b>Store or Office Properties</b>	<b>160</b>	<b>(1.7%)</b>	<b>0</b>	<b>(0.3%)</b>	<b>3</b>	<b>(0.2%)</b>	<b>\$1.8</b>	<b>(1.3%)</b>
Offices	50	(0.5%)	0	(0.0%)	1	(0.1%)	\$0.4	(0.3%)
Specialty shops	40	(0.4%)	0	(0.0%)	0	(0.0%)	\$0.6	(0.4%)
Recreation, hobby or home repair sales or personal services	20	(0.2%)	0	(0.3%)	0	(0.0%)	\$0.1	(0.1%)
General item stores	10	(0.1%)	0	(0.0%)	0	(0.0%)	\$0.1	(0.1%)
Food or beverage sales	10	(0.1%)	0	(0.0%)	0	(0.0%)	\$0.0	(0.0%)
Textile or wearing apparel sales	10	(0.1%)	0	(0.0%)	1	(0.1%)	\$0.4	(0.3%)
Motor vehicle or boat sales or services	10	(0.1%)	0	(0.0%)	0	(0.0%)	\$0.0	(0.0%)
Professional supplies or services	10	(0.1%)	0	(0.0%)	0	(0.0%)	\$0.0	(0.0%)
<b>Storage properties</b>	<b>130</b>	<b>(1.4%)</b>	<b>1</b>	<b>(0.6%)</b>	<b>9</b>	<b>(0.9%)</b>	<b>\$0.8</b>	<b>(0.5%)</b>
Vehicle storage	60	(0.6%)	1	(0.6%)	4	(0.4%)	\$0.3	(0.2%)
Unclassified or unknown-type storage property	30	(0.3%)	0	(0.0%)	1	(0.1%)	\$0.0	(0.0%)
Agricultural product storage	20	(0.2%)	0	(0.0%)	0	(0.0%)	\$0.3	(0.2%)
General item storage	10	(0.1%)	0	(0.0%)	3	(0.3%)	\$0.1	(0.1%)
<b>Public Assembly Properties</b>	<b>130</b>	<b>(1.3%)</b>	<b>0</b>	<b>(0.3%)</b>	<b>4</b>	<b>(0.4%)</b>	<b>\$2.8</b>	<b>(2.0%)</b>
Places of worship or funeral parlors	80	(0.8%)	0	(0.3%)	2	(0.2%)	\$1.9	(1.4%)

Eating or drinking places	30	(0.3%)	0	(0.0%)	0	(0.0%)	\$0.6	(0.4%)
Clubs	10	(0.1%)	0	(0.0%)	1	(0.1%)	\$0.1	(0.1%)
Variable use amusement or recreational places	10	(0.1%)	0	(0.0%)	0	(0.0%)	\$0.1	(0.1%)

**Table 8.  
Candle Fires by Occupancy Class  
1993-1997 Annual Averages  
(Continued)**

Occupancy	Candle Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in millions)	
<b>Special Properties</b>	<b>90</b>	<b>(0.9%)</b>	<b>1</b>	<b>(0.7%)</b>	<b>5</b>	<b>(0.5%)</b>	<b>\$0.5</b>	<b>(0.4%)</b>
Special structures	40	(0.4%)	0	(0.0%)	3	(0.3%)	\$0.1	(0.1%)
Construction or unoccupied structures	30	(0.4%)	1	(0.7%)	1	(0.1%)	\$0.3	(0.2%)
Outdoor properties	10	(0.1%)	0	(0.0%)	0	(0.0%)	\$0.0	(0.0%)
Road properties	10	(0.1%)	0	(0.0%)	0	(0.0%)	\$0.0	(0.0%)
<b>Educational Properties</b>	<b>50</b>	<b>(0.5%)</b>	<b>0</b>	<b>(0.0%)</b>	<b>0</b>	<b>(0.0%)</b>	<b>\$1.2</b>	<b>(0.9%)</b>
Non-residential schools	20	(0.2%)	0	(0.0%)	0	(0.0%)	\$0.0	(0.0%)
Colleges or universities (not dormitories)	20	(0.2%)	0	(0.0%)	0	(0.0%)	\$1.1	(0.8%)
<b>Institutional Properties</b>	<b>40</b>	<b>(0.5%)</b>	<b>2</b>	<b>(1.7%)</b>	<b>3</b>	<b>(0.3%)</b>	<b>\$0.2</b>	<b>(0.2%)</b>
Care of the aged	20	(0.2%)	2	(1.7%)	1	(0.1%)	\$0.1	(0.1%)
Care of the sick	10	(0.1%)	0	(0.0%)	2	(0.2%)	\$0.1	(0.1%)
<b>Manufacturing Properties</b>	<b>10</b>	<b>(0.1%)</b>	<b>0</b>	<b>(0.0%)</b>	<b>0</b>	<b>(0.0%)</b>	<b>\$0.0</b>	<b>(0.0%)</b>
<b>Basic Industry, Utility and Defense Properties</b>	<b>10</b>	<b>(0.1%)</b>	<b>0</b>	<b>(0.0%)</b>	<b>0</b>	<b>(0.0%)</b>	<b>\$0.0</b>	<b>(0.0%)</b>
<b>Unknown or Unreported Fixed Property Use</b>	<b>120</b>	<b>(1.2%)</b>	<b>1</b>	<b>(0.9%)</b>	<b>10</b>	<b>(1.0%)</b>	<b>\$2.5</b>	<b>(1.8%)</b>
<b>Total</b>	<b>9,740</b>	<b>(100.0%)</b>	<b>111</b>	<b>(100.0%)</b>	<b>1,016</b>	<b>(100.0%)</b>	<b>\$139.9</b>	<b>(100.0%)</b>

These are fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Fires are rounded to the nearest ten, civilian deaths and injuries are rounded to the nearest one, and direct property damage is rounded to the nearest hundred thousand. Property damage has not been adjusted for inflation. A proportional share of fires in which the form of heat of ignition was unknown or unreported is included in these totals.

Homes include dwellings, duplexes, manufactured housing and apartments.

Source: National estimates based on NFIRS and NFPA survey.

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

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

### **Data Bases Used**

NFIRS provides annual computerized data bases of fire incidents, with data classified according to a standard format based on the NFPA 901 Standard. Roughly three-fourths of all states have NFIRS coordinators, who receive fire incident data from participating fire departments and combine the data into a state data base. These data are then transmitted to FEMA/USFA.

Participation by the states, and by local fire departments within participating states, is voluntary. NFIRS captures roughly one-third to one-half of all U.S. fires each year. More than one-third of all U.S. fire departments are listed as participants in NFIRS, although not all of these departments provide data every year.

The strength of NFIRS is that it provides the most detailed incident information of any national data base not limited to large fires. NFIRS is the only data base capable of addressing national patterns for fires of all sizes by specific property use and specific fire cause. (The NFPA survey separates fewer than 20 of the hundreds of property use categories defined by NFPA 901 and solicits no cause-related information except for incendiary and suspicious fires.) NFIRS also captures information on the avenues and extent of flame spread and smoke spread and on the performance of detectors and sprinklers.

The NFPA survey is based on a stratified random sample of roughly 3,000 U.S. fire departments (or just over one of every ten fire departments in the country). The survey includes the following information: (1) the total number of fire incidents, civilian deaths, and civilian injuries, and the total estimated property damage (in dollars), for each of the major property use classes defined by the NFPA 901 Standard; (2) the number of on-duty fire fighter injuries, by type of duty and nature of illness; and (3) information on the type of community protected (e.g., county versus township versus city) and the size of

the population protected, which is used in the statistical formula for projecting national totals from sample results.

The NFPA survey begins with the NFPA Fire Service Inventory, a computerized file of about 30,000 U.S. fire departments, which is the most complete and thoroughly validated such listing in existence. The survey is stratified by size of population protected to reduce the uncertainty of the final estimate. Small rural communities protect fewer people per department and are less likely to respond to the survey, so a large number must be surveyed to obtain an adequate sample of those departments. (NFPA also makes follow-up calls to a sample of the smaller fire departments that do not respond, to confirm that those that did respond are truly representative of fire departments their size.) On the other hand, large city departments are so few in number and protect such a large proportion of the total U.S. population that it makes sense to survey all of them. Most respond, resulting in excellent precision for their part of the final estimate.

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

To project NFIRS results to national estimates, one needs at least an estimate of the NFIRS fires as a fraction of the total so that the fraction can be inverted and used as a multiplier or scaling ratio to generate national estimates from NFIRS data. But NFIRS is a sample from a universe whose size cannot be inferred from NFIRS alone. Also, participation rates in NFIRS are not necessarily uniform across regions and sizes of community, both of which are factors correlated with frequency and severity of fires. This means NFIRS may be susceptible to systematic biases. No one at present can quantify the size of these deviations from the ideal, representative sample, so no one can say with confidence that they are or are not serious problems. But there is enough reason for concern so that a second data base - the NFPA survey - is needed to project NFIRS to national estimates and to project different parts of NFIRS separately. This multiple calibration approach makes use of the annual NFPA survey where its statistical design advantages are strongest.

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

For example, the scaling ratio for 1996 civilian deaths in residential structures is equal to the total number of 1996 civilian deaths in residential structure fires reported to fire departments, according to the NFPA survey (4,080), divided by the total number of 1996 civilian deaths in residential structure

fires reported to NFIRS (1,504). Therefore, the scaling ratio is  $4,080/1,504 = 2.71$ .

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

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

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

Most analyses of interest involve the calculation of the estimated number of fires not only within a particular occupancy but also of a particular type. The types that are mostly frequently of interest are those defined by some ignition-cause characteristic. The six cause-related characteristics most commonly used to describe fires are: form of the heat that caused the ignition, equipment involved in ignition, form or type of material first ignited, the ignition factor that brought heat source and ignited material together, and area of origin. Other characteristics of interest are victim characteristics, such as ages of persons killed or injured in fire.

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

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

## **Rounding Errors**

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

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

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

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

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

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

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

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

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

## **Fire Fighter Deaths and Injuries**

There are special procedures for fire service deaths and injuries. NFPA maintains a comprehensive listing of fire service on-duty deaths which can be used to produce answers not dependent on projection from samples. This is desirable because the number of fire service deaths at the fireground for fires of a particular cause is typically very small - less than 10 a year - so sample-based estimates would have very large uncertainty ranges, relative to the statistics being estimated.

For fire service injuries, the NFPA survey does not produce projections of fire service injuries at the fireground by major property type. Therefore, one must use a single scaling ratio instead of the four ratios (one each for residential structures, non-residential structures, vehicles, and other properties) that are used to scale up the other measures of fire severity.

