

FIREWORKS

John R. Hall, Jr.
June 2012



National Fire Protection Association
Fire Analysis and Research Division

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Abstract

In 2010, 8,600 fireworks-related injuries were treated in U.S. hospital emergency rooms. The trend in fireworks-related injuries has been mostly in the range of 8,300 to 9,800 since 1996, except for spikes in 2000, primarily due to celebrations around the advent of a new millennium, and in 2004, and a sharp drop in 2008. The highest injury rates were for children aged 5 to 14. In 2010, an estimated 15,500 reported fires were started by fireworks. These fires resulted in an estimated eight reported civilian deaths, 60 civilian injuries and \$36 million in direct property damage. In 2010, five out of six (83%) emergency room fireworks injuries involved fireworks that Federal regulations permit consumers to use. The risk of fire death relative to usage shows fireworks to be more risky per hour of use than cigarettes.

Keywords: Fireworks, sparkler, fire statistics, NFIRS, NEISS

Acknowledgements

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We are also grateful to the U.S. Fire Administration for its work in developing, coordinating, and maintaining NFIRS. And we appreciate the important work done by the U.S. Consumer Product Safety Commission to develop, maintain, and support analysis of the National Electronic Injury Surveillance System (NEISS) and the National Center for Health Statistics and the National Safety Council for maintenance and analysis of the U.S. death certificate data base.

For more information about the National Fire Protection Association, visit www.nfpa.org or call 617-770-3000. To learn more about the One-Stop Data Shop go to www.nfpa.org/osds or call 617-984-7443.

Copies of this report are available from:

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Executive Summary

In 2010, 8,600 fireworks-related injuries were treated in U.S. hospital emergency rooms.

In 2010, an estimated 15,500 reported fires were started by fireworks. These fires resulted in an estimated eight reported civilian deaths, 60 civilian injuries and \$36 million in direct property damage.

Fires involving fireworks

During 2006-2010, the largest numbers of outdoor fires associated with fireworks involved grass fires (7,800 per year), brush fires (5,200), dumpster fires (2,000), unclassified or unknown-type natural or vegetation fires (1,500) and other outside trash, rubbish, or waste fires (1,400).

In 2006-2010, five people per year were killed in fires started by fireworks, while data from death certificates show that six people per year were killed directly by fireworks. These estimates may overlap, because fireworks can directly kill someone while also starting a fatal fire.

The risk of fire death relative to usage shows fireworks to be more risky per hour of usage than cigarettes. On Independence Day in a typical year, far more U.S. fires are reported than on any other day and more than twice as many as on an average day. Fireworks account for two out of five of those fires, more than any other cause of fires.

Emergency room injuries related to fireworks

The trend in fireworks-related injuries has been mostly in the range of 8,300 to 9,800 since 1996, except for spikes in 2000, primarily due to celebrations around the advent of a new millennium, and in 2004, and a sharp drop in 2008. Injuries were higher in 1984-1995 than in 1996 and later years.

Two of five (39%) victims of fireworks injuries in 2010 were under age 15. The highest rates of injuries per million population were for children aged 5 to 9 and 10 to 14. Males accounted for nearly two-thirds (65%) of fireworks injuries.

The majority (57%) of 2010 fireworks injuries were to extremities – hand or finger (30%), leg (22%), and arm, shoulder, or wrist (5%). Most of the rest (37% of total) were to parts of the head, including the eye (21% of total).

In 2010, five out of six (83%) emergency room fireworks injuries involved fireworks that Federal regulations permit consumers to use. Sparklers, fountains, and novelties alone accounted for two out of five (43%) emergency room fireworks injuries.

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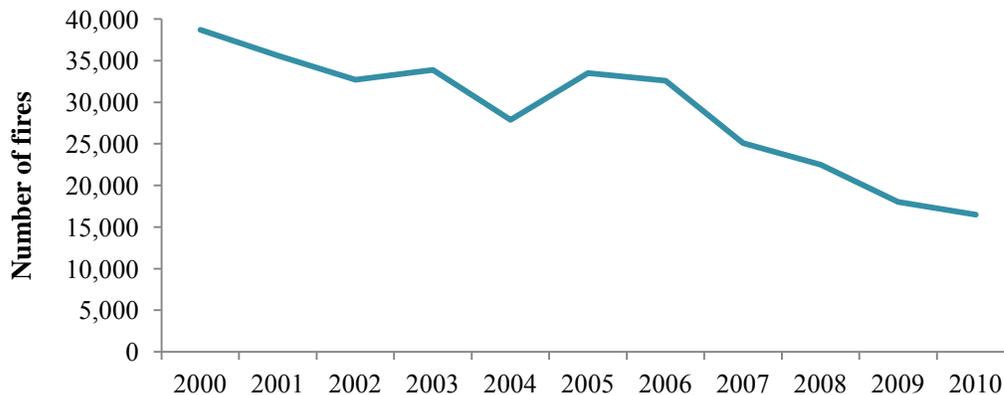
Fireworks Fact Sheet

Size of the Fireworks-Related Fire Problem

On Independence Day in a typical year, far more U.S. fires are reported than on any other day and more than twice as many as on an average day. Fireworks account for two out of five of those fires, more than any other cause of fires.

- In 2010, fireworks caused an estimated 15,500 reported fires, including 1,100 structure fires, 300 vehicle fires, and 14,100 outside and other fires.
- These fires resulted in an estimated eight reported deaths, 60 civilian injuries and \$36 million in direct property damage.

Reported Fires Related to Fireworks, 2000-2010



Risk of Private Fireworks Use

The risk of fire death relative to time of usage shows fireworks as the riskiest consumer product.

- The risk that someone will die from fire when fireworks are being used is higher relative to usage time than the risk of fire death when a cigarette is being smoked.
- The risks with fireworks are not limited to displays, public or private. Risks also exist wherever fireworks are manufactured, transported, stored or sold.
- “Safe and sane” fireworks are neither. Fountains, novelties, and sparklers are designed to throw off showers of hot sparks. Temperatures may exceed 1200°F.

NFPA encourages people to enjoy public displays of fireworks that comply with NFPA 1123.

NFPA is strongly opposed to any consumer use of fireworks.

FACT: The following four states have banned access by the public to all fireworks: **Delaware, Massachusetts, New Jersey and New York**

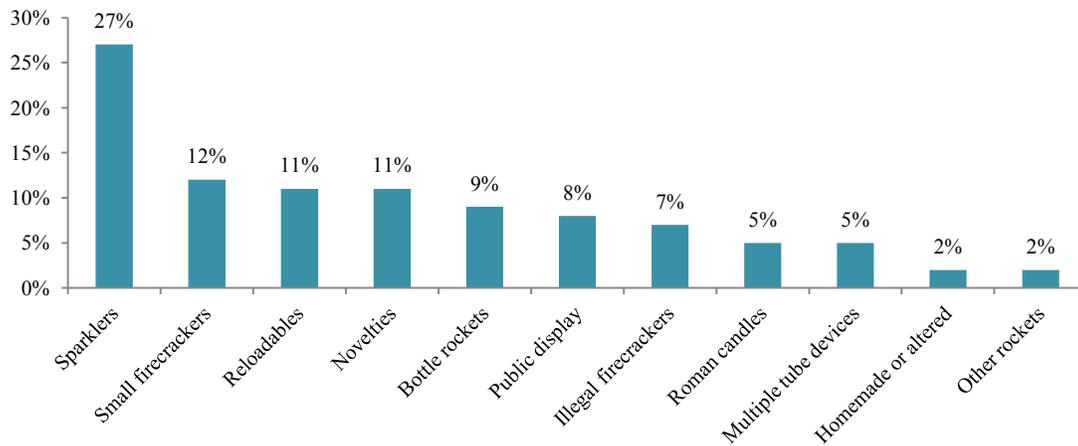
Characteristics of Fireworks Injuries Reported to Emergency Rooms

In 2010, U.S. hospital emergency rooms saw an estimated 8,600 people for fireworks-related injuries. (Source: CPSC's NEISS)

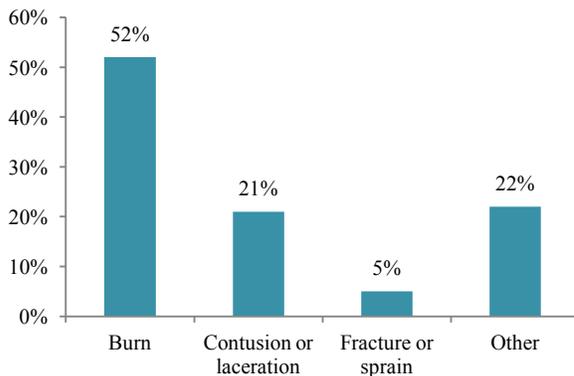
- Half (52%) of the 2010 fireworks injuries were burns, while one-fifth (21%) were contusions and lacerations.
- Two of five (39%) people injured by fireworks were under the age of 15.
- Males accounted for 65% of the injuries.
- The risk of fireworks injury was highest for children ages 5-14 with more than twice the risk for the general population.
- Sparklers, fountains and novelties alone accounted for 43% of the emergency room fireworks injuries in 2010.

FACT: 83% of the fireworks injuries treated in hospital emergency rooms involved fireworks that Federal regulations permit consumers to use.

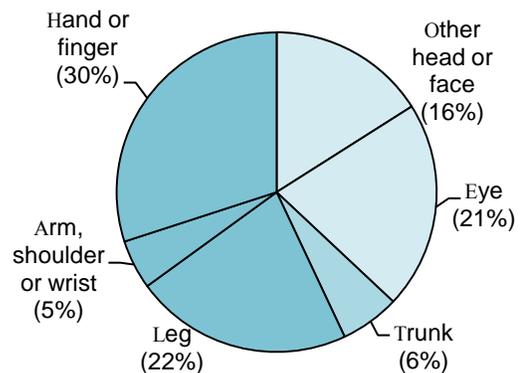
2010 Fireworks Related Injuries, by Type of Fireworks*



2010 Fireworks Related Injuries* by Type of Injury



2010 Fireworks-Related Injuries* By Part of Body Injured



Based on injuries during the month around July 4.

Note: The darkest areas are extremities (57% of total) and the lightest areas are parts of the head (37%).



Fireworks Safety

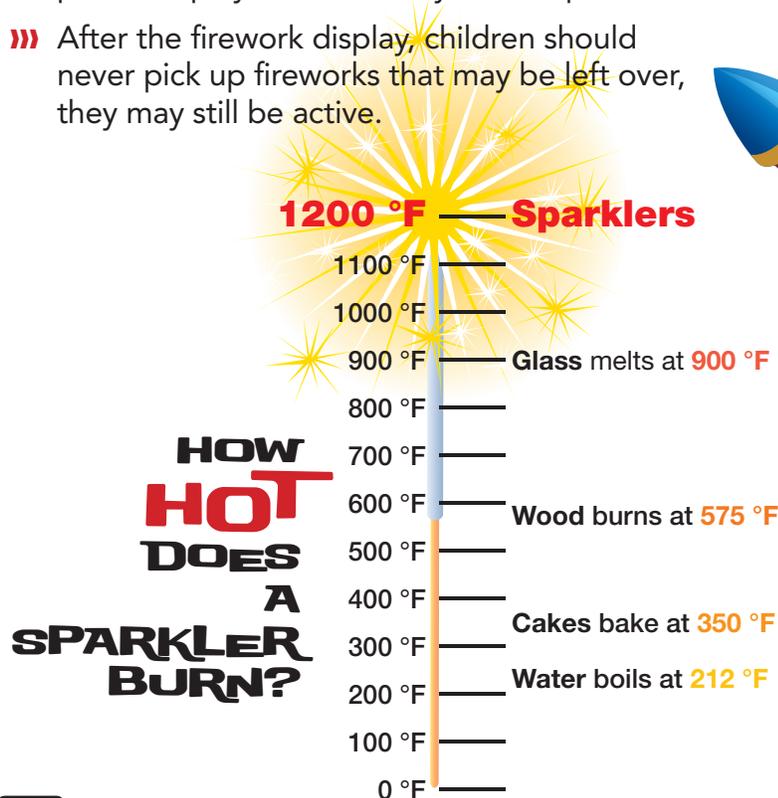
Fireworks during the Fourth of July are as American as apple-pie, but did you know that more than twice the number of fires are reported on that day than on any other day of the year in the United States? Two out of five of these fires are caused by fireworks. The good news is you can enjoy your holiday and the fireworks, with just a few simple safety tips:

PROCEED WITH CAUTION!

- » Leave fireworks to the professionals. Do not use consumer fireworks.
- » The safest way to enjoy fireworks is to attend a public display conducted by trained professionals.
- » After the firework display, children should never pick up fireworks that may be left over, they may still be active.

CONSUMER FIREWORKS

include sparklers and firecrackers. The tip of a sparkler burns at a temperature of more than **1,200 degrees Fahrenheit**, which is hot enough to cause third-degree burns.



FACTS

- ! Each July Fourth, thousands of people, most often children and teens, are injured while using consumer fireworks.
- ! The risk of fireworks injury is highest for children ages 5–14.
- ! More than 80% of emergency room fireworks injuries involve fireworks consumers are permitted to use.



Your Source for SAFETY Information

NFPA Public Education Division • 1 Batterymarch Park, Quincy, MA 02169

www.nfpa.org/education

NFPA's Fire Safety Resources

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

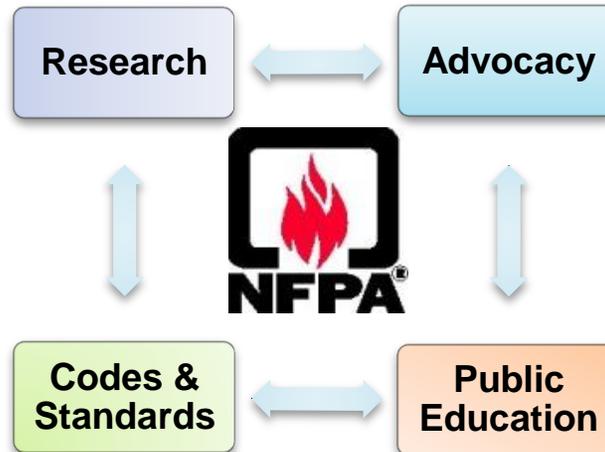
www.nfpa.org/research

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

[NFPA 1123: Code for Fireworks Display:](#)

[NFPA 1124: Code for the Manufacture, Transportation, Storage and Retail Side of Fireworks and Pyrotechnic Articles](#)

[NFPA 1126: Standard for the Use of Pyrotechnics Before a Proximate Audience](#)



For more than a century, NFPA has advocated an end to the dangerous private use of fireworks, which accounts for nearly all of the injuries from fireworks in most years. Many states still permit untrained citizens to purchase and use fireworks. The thousands of serious injuries and extensive property loss nearly all arise from this misguided activity, rather than the only acceptably safe way to enjoy fireworks, which is in public fireworks displays. Anything else is inconsistent with IFMA's (International Fire Marshals Association's) *Model Fireworks Law*, which reflects NFPA's zero-tolerance policy for consumer use of fireworks. More information may be found at www.nfpa.org/fireworks.

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

[For Kids:](#) Sparky.org has important information for kids delivered via fun games, activities, and cartoons.

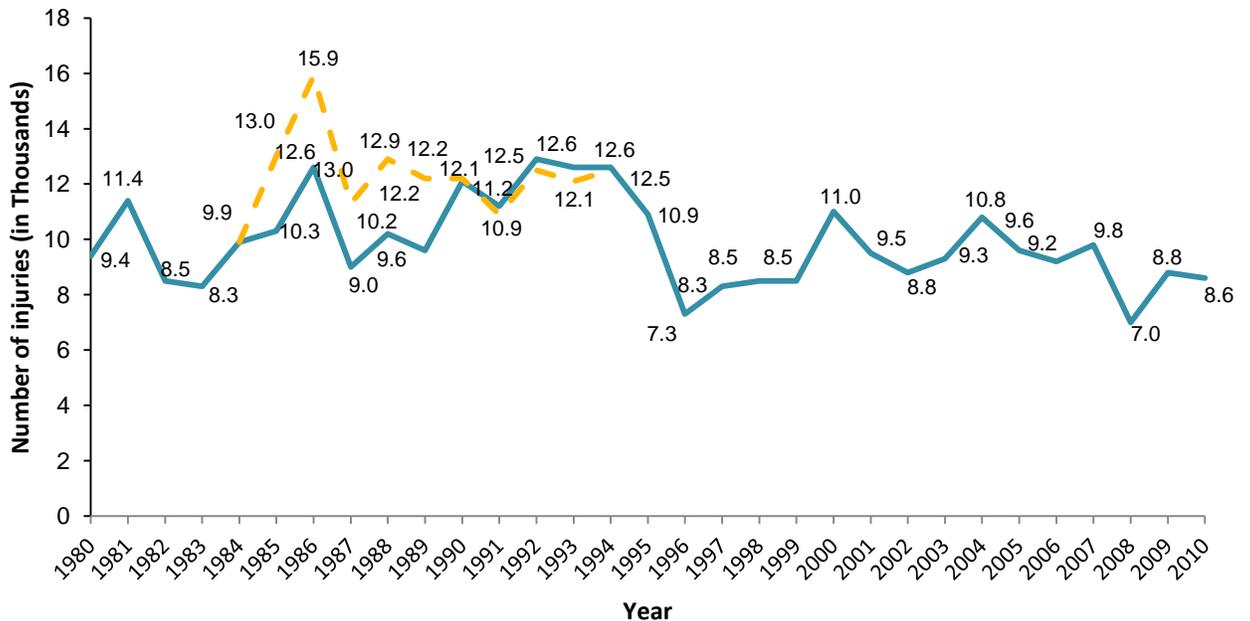
[For public educators:](#) Resources on fire safety education programs, educational messaging, grants & awards, and many other topics.

Size of the Fireworks Problem

In 2010, 8,600 fireworks-related injuries were treated in U.S. hospital emergency rooms.

After an atypically low year in 2008, fireworks-related injuries returned in 2009 and 2010 to the range of 8,300 to 9,800. That range has held since 1996, except for the highs in 2000 and 2004 and the low in 2008. Injuries were generally higher in 1984-1995 than in 1996 and later years. (See Figure 1.) These statistics are estimates based on the U.S. Consumer Product Safety Commission's National Electronic Injury Surveillance System (NEISS) sample of hospital emergency rooms.

Figure 1.
Fireworks-Related Injuries Reported to Hospital Emergency Rooms
1974-2010



Note: The NEISS sample has been revised twice. The dotted lines show recalculation of earlier estimates using the revised samples.

Source: CPSC's National Electronic Injury Surveillance System (NEISS).

In 2010, an estimated 15,500 reported fires were ignited by fireworks.

These fires resulted in an estimated eight reported civilian deaths, 60 civilian injuries and \$36 million in direct property damage. Most fires were outdoor fires, while most associated deaths and property damage and over half of associated injuries were in structures and specifically homes. Table 1 shows fires and fire losses by year since 1980.

These estimates do not include any proportional allocation of fires involving explosives of unknown type. A side analysis indicates such an allocation would add 10-15% to the estimates of structure fires started by fireworks in a typical year. These estimates also do not include estimates of loss from fireworks explosions with no after-fire.

In 2006-2010, an estimated five people per year were killed in reported fires started by fireworks, while data from death certificates show that six people per year were killed directly by fireworks.

Deaths involving fireworks are identified from two data sources – the national database of death certificates and NFIRS. These databases may partially or largely overlap, because fireworks can directly kill someone while also starting a fatal fire. (See Table 2.) In both data bases, the death toll varies substantially from year to year.

Every year, the number of fireworks-related injuries reported to hospital emergency rooms is at least ten times the estimated number of civilian injuries in fires due to fireworks reported to fire departments. Most incidents where fireworks injure people do not involve a fire that needs a fire department response. For both fatal and non-fatal injuries, it is clear that fireworks can injure directly via a traumatic injury or indirectly via a fire injury from a fire initiated by the fireworks. As for non-fatal injuries, the available statistics also omit injuries that are treated in doctor's offices or are left untreated.

Indoor use of fireworks in nightclubs and bars has accounted for several of the deadliest world fires in recent years.

In 2003, 100 people were killed in a Rhode Island nightclub fire ignited by the indoor use of pyrotechnics in a crowded room with interior finish that promoted rapid flame spread. The facility had no sprinkler protection. These deaths were not reported to the National Fire Incident Reporting System (NFIRS) and are not reflected in the national estimates. In just 2008 and 2009, three other nightclub or bar fires started by indoor use of fireworks (in Russia, Thailand, and China) killed a combined 263 people. These incidents all underscore the need for wider use of and compliance with [NFPA 1126](#), *Standard for the Use of Pyrotechnics Before a Proximate Audience*.

Also in 2009, an illegal fireworks display at a television complex building in China led to a fire that gutted a neighboring 520 foot (159 meter) tall hotel weeks before its scheduled opening. Direct property damage was estimated at 5 billion yuan or \$730 million. One firefighter was killed.

Grass and brush fires accounted for most fireworks-related outside or other fires.

In 2006-2010, grass and brush fires accounted for 63% of all fireworks-related outside or other fires plus some, probably most, of the 7% attributed to fireworks fires in unclassified or unknown-type natural vegetation. (See Table A.) Dumpster fires and other rubbish or trash fires accounted for 20% of all fireworks-related outside or other fires.

Each year, most fireworks-related fires begin outside, but most of the deaths, injuries, and property damage occurs in fires with structures involved. Structure fires can start with outside use of fireworks, as when a bottle rocket, launched outside, lands on a roof, or when an outdoor grass or trash fire started by fireworks spreads to a structure. (The latter fire may be coded as a structure fire that started outside due to fireworks or it may be coded as an exposure fire with no direct coding of the cause of the original fire.) Because cause information is no longer required for outside refuse fires, only a small fraction of reported outside refuse fires have known heat source. This fact means that single-year estimates for outside and other fireworks fires can be highly variable. A multi-year average is more stable and is what is shown in Table A.

**Table A. Estimated Outside and Other Fires Associated With Fireworks
Annual Average of 2006-2010 Fires Reported to U.S. Fire Departments**

Incident Type	Fires	
Grass	7,800	(38%)
Brush or brush/grass mixture	5,200	(25%)
Dumpster or other outside trash receptacle	2,000	(10%)
Unclassified or unknown-type natural or vegetation	1,500	(7%)
Other outside trash, rubbish, or waste	1,400	(7%)
Forest, woods, or wildland	800	(4%)
Unclassified or unknown-type outside rubbish	600	(3%)
Unclassified or unknown-type special outside	400	(2%)
Unclassified or unknown-type outside or other	300	(1%)
Outside mailbox	200	(1%)
Unclassified or unknown-type cultivated vegetation or crop	100	(1%)
Cultivated grain or crop	100	(0%)
Cultivated trees, orchard, vineyard or nursery stock	100	(0%)
Outside storage	100	(0%)
Other classified outside	100	(0%)
Total	20,600	(100%)
All outside vegetation fires	16,300	(80%)
All outside trash fires	4,100	(20%)
Unclassified or unknown-type outside or other fires	300	(1%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Figures reflect a proportional share of fires with heat source unknown. Totals may not equal sums because of rounding error.

Source: NFIRS and NFPA survey.

Table 1. Fires and Losses Associated With Fireworks, 1980-2010
Fires Reported to U.S. Fire Departments

A. Fires

Year	Home Structures		Other Residential Structures		Nonresidential Structures		Total Structures		Vehicles	Outdoor and Other	Total
1980	2,900		100		1,100		4,000	500	21,800	26,400	
1981	2,800		100		1,300		4,200	500	27,100	31,800	
1982	1,700		100		1,000		2,700	500	24,600	27,800	
1983	1,400		100		800		2,300	500	25,300	28,000	
1984	2,400		100		1,200		3,700	1,000	34,700	39,400	
1985	2,600		100		1,500		4,100	900	46,600	51,600	
1986	2,300		100		1,200		3,600	1,000	30,500	35,100	
1987	1,900		100		1,100		3,100	800	33,200	37,100	
1988	2,300		100		1,400		3,700	900	47,400	52,100	
1989	1,700		100		900		2,700	800	29,900	33,400	
1990	1,600		100		800		2,500	800	30,000	33,300	
1991	1,600		100		900		2,600	900	24,900	28,400	
1992	1,400		0		900		2,300	700	22,500	25,500	
1993	1,300		0		800		2,100	800	27,300	30,200	
1994	1,300		0		900		2,200	700	35,100	38,000	
1995	1,100		0		700		1,900	700	24,900	27,500	
1996	1,100		0		600		1,700	600	22,500	24,800	
1997	1,000		0		700		1,700	500	17,900	20,100	
1998	800		0		500		1,400	500	19,800	21,700	
1999	1,700	(1,600)	0	(0)	1,200	(600)	2,800	(2,200)	900	29,000	32,700
2000	1,500	(1,400)	100	(100)	1,200	(700)	2,800	(2,200)	900	35,000	38,700
2001	1,200	(1,100)	100	(100)	1,000	(700)	2,200	(1,900)	900	32,600	35,600

**Table 1. Fires and Losses Associated With Fireworks, 1980-2010
Fires Reported to U.S. Fire Departments (Continued)**

A. Fires (Continued)

Year	Home Structures		Other Residential Structures		Nonresidential Structures		Total Structures		Vehicles	Outdoor and Other	Total
2002	1,100	(1,000)	100	(100)	700	(600)	1,900	(1,600)	900	29,900	32,700
2003	1,000	(900)	100	(100)	700	(600)	1,800	(1,600)	800	31,300	33,900
2004	900	(800)	100	(100)	600	(400)	1,500	(1,300)	600	25,800	27,900
2005	1,000	(900)	100	(0)	700	(500)	1,800	(1,400)	700	31,000	33,500
2006	900	(800)	100	(0)	700	(500)	1,700	(1,300)	600	30,300	32,600
2007	1,000	(800)	100	(100)	700	(400)	1,700	(1,300)	600	22,700	25,100
2008	900	(700)	0	(0)	500	(400)	1,400	(1,100)	500	20,600	22,500
2009	700	(600)	0	(0)	600	(300)	1,300	(900)	400	16,300	18,000
2010	600	(600)	0	(0)	400	(300)	1,100	(900)	300	14,100	15,500

Note: Numbers in parentheses exclude fires reported as confined to cooking vessel, chimney or flue, fuel burner or boiler, compactor, incinerator or trash. Detailed reporting is not required and is much less often provided for fires coded as confined fires. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred. Figures reflect a proportional share of fires with heat source unknown. *Because of low participation in NFIRS Version 5.0 during 1999-2001, estimates for those years are highly uncertain and must be used with caution.* Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 4.1 (1980-1998) and Version 5.0 (1999-2010) and NFPA survey.

**Table 1. Fires and Losses Associated With Fireworks, 1980-2010
Fires Reported to U.S. Fire Departments (Continued)**

B. Civilian Deaths

Year	Home Structures		Other Residential Structures		Nonresidential Structures		Total Structures		Vehicles	Outdoor and Other	Total
1980	0		0		0		0		0	0	0
1981	0		0		0		0		0	0	0
1982	0		0		0		0		0	0	0
1983	0		0		0		0		0	0	0
1984	3		0		0		3		0	0	3
1985	8		0		0		8	3	4		15
1986	4		0		0		4	0	0		4
1987	4		0		3		7	0	0		7
1988	20		0		0		20	0	0		20
1989	4		0		0		4	0	0		4
1990	3		0		0		3	0	0		3
1991	0		0		0		0	2	0		2
1992	0		0		0		0	0	1		1
1993	0		0		0		0	0	3		3
1994	12		0		0		12	0	0		12
1995	0		0		0		0	0	2		2
1996	9		0		18*		27	0	0		27
1997	0		0		0		0	0	3		3
1998	0		0		0		0	0	0		0
1999	43	(43)	0	(0)	0	(0)	43	(43)	0	0	43
2000	29	(29)	0	(0)	0	(0)	29	(29)	0	0	29
2001	0	(0)	0	(0)	0	(0)	0	(0)	0	0	0

**Table 1. Fires and Losses Associated With Fireworks, 1980-2010
Fires Reported to U.S. Fire Departments (Continued)**

B. Civilian Deaths (Continued)

Year	Home Structures		Other Residential Structures		Nonresidential Structures		Total Structures		Vehicles	Outdoor and Other	Total
		()		()		()		()			
2002	0	(0)	0	(0)	0	(0)	0	(0)	0	0	0
2003	7	(7)	0	(0)	0**	(0)	7**	(7)	0	0	7
2004	0	(0)	0	(0)	0	(0)	0	(0)	0	0	0
2005	0	(0)	0	(0)	0	(0)	0	(0)	0	0	0
2006	4	(4)	0	(0)	0	(0)	4	(4)	0	2	6
2007	9	(9)	0	(0)	0	(0)	9	(9)	0	0	9
2008	0	(0)	0	(0)	0	(0)	0	(0)	0	1	1
2009	0	(0)	0	(0)	0	(0)	0	(0)	0	0	0
2010	8	(8)	0	(0)	0	(0)	8	(8)	0	0	8

* 1996 total is inflated by statistical projection of one Ohio fire with nine deaths.

** Does not include 100 deaths in the Station night club fire.

Note: Numbers in parentheses exclude fires reported as confined to cooking vessel, chimney or flue, fuel burner or boiler, compactor, incinerator or trash. Detailed reporting is not required and is much less often provided for fires coded as confined fires. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Civilian deaths are expressed to the nearest one. Figures reflect a proportional share of fires with heat source unknown. *Because of low participation in NFIRS Version 5.0 during 1999-2001, estimates for those years are highly uncertain and must be used with caution.* Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 4.1 (1980-1998) and Version 5.0 (1999-2010) and NFPA survey.

**Table 1. Fires and Losses Associated With Fireworks, 1980-2010
Fires Reported to U.S. Fire Departments (Continued)**

C. Civilian Injuries

Year	Home Structures		Other Residential Structures		Nonresidential Structures		Total Structures		Vehicles	Outside and Other	Total
1980	30		10		0		30		0	20	50
1981	30		0		20		50		0	20	70
1982	10		0		20		30		0	60	100
1983	50		0		0		50		0	30	80
1984	40		0		10		50	10		30	90
1985	70		10		10		80	30		30	140
1986	50		10		50		100	0		20	130
1987	50		10		10		70	0		30	90
1988	40		0		20		50	20		30	100
1989	50		0		0		50	20		30	110
1990	30		10		10		50	0		60	110
1991	50		10		10		70	10		30	110
1992	40		0		10		50	10		40	100
1993	20		0		20		40	0		20	70
1994	90		0		10		100	10		50	150
1995	50		0		0		50	0		40	90
1996	20		0		20		40	0		20	70
1997	20		0		10		30	20		20	70
1998	10		0		0		10	10		30	40
1999	0	(0)	0	(0)	0	(0)	0	(0)	0	80	80
2000	30	(30)	0	(0)	0	(0)	30	(30)	0	40	70
2001	40	(40)	0	(0)	10	(10)	50	(50)	10	20	80

**Table 1. Fires and Losses Associated With Fireworks, 1980-2010
Fires Reported to U.S. Fire Departments (Continued)**

C. Civilian Injuries (Continued)

Year	Home Structures		Other Residential Structures		Nonresidential Structures		Total Structures		Vehicles	Outside and Other	Total
2002	20	(20)	10	(10)	0	(0)	30	(30)	20	10	60
2003	40	(40)	0	(0)	10*	(10)	50*	(50)	0	30	80
2004	10	(10)	0	(0)	0	(0)	10	(10)	0	30	50
2005	50	(50)	0	(0)	0	(0)	50	(50)	10	40	90
2006	20	(20)	10	(0)	0	(0)	30	(20)	10	30	70
2007	20	(20)	0	(0)	0	(0)	30	(30)	10	20	50
2008	10	(10)	10	(10)	10	(10)	20	(20)	10	10	40
2009	20	(20)	0	(0)	10	(10)	30	(30)	0	10	30
2010	30	(30)	0	(0)	0	(0)	30	(30)	0	20	60

*Does not include injuries in the Station night club fire.

Note: Numbers in parentheses exclude fires reported as confined to cooking vessel, chimney or flue, fuel burner or boiler, compactor, incinerator or trash. Detailed reporting is not required and is much less often provided for fires coded as confined fires. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Civilian injuries are expressed to the nearest ten. Figures reflect a proportional share of fires with heat source unknown. *Because of low participation in NFIRS Version 5.0 during 1999-2001, estimates for those years are highly uncertain and must be used with caution.* Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 4.1 (1980-1998) and Version 5.0 (1999-2010) and NFPA survey.

**Table 1. Fires and Losses Associated With Fireworks, 1980-2010
Fires Reported to U.S. Fire Departments (Continued)**

D. Direct Property Damage (in Millions)

Year	Home Structures		Other Residential Structures		Nonresidential Structures		Total Structures		Vehicles	Outdoor and Total	Total	Total in 2010 Dollars
1980	\$12		\$0		\$3		\$15		\$0	\$0	\$16	\$41
1981	\$12		\$0		\$6		\$18		\$0	\$1	\$19	\$44
1982	\$9		\$0		\$2		\$11		\$0	\$0	\$11	\$26
1983	\$7		\$0		\$5		\$12		\$0	\$0	\$13	\$28
1984	\$19		\$0		\$6		\$25		\$2	\$1	\$27	\$56
1985	\$22		\$1		\$7		\$30		\$1	\$5	\$36	\$74
1986	\$24		\$0		\$29		\$53		\$2	\$1	\$56	\$111
1987	\$17		\$0		\$7		\$24		\$1	\$0	\$25	\$49
1988	\$22		\$0		\$14		\$37		\$1	\$1	\$39	\$72
1989	\$56		\$0		\$3		\$59		\$1	\$2	\$62	\$109
1990	\$22		\$1		\$4		\$26		\$2	\$1	\$28	\$47
1991	\$17		\$0		\$5		\$21		\$2	\$0	\$23	\$37
1992	\$13		\$0		\$16		\$29		\$1	\$3	\$33	\$52
1993	\$12		\$0		\$6		\$19		\$1	\$1	\$21	\$32
1994	\$10		\$0		\$8		\$18		\$2	\$2	\$22	\$32
1995	\$21		\$1		\$9		\$30		\$2	\$1	\$32	\$46
1996	\$12		\$0		\$7		\$19		\$1	\$6	\$27	\$37
1997	\$13		\$0		\$8		\$21		\$1	\$0	\$23	\$31
1998	\$9		\$0		\$3		\$12		\$1	\$2	\$16	\$21
1999	\$17	(\$17)	\$0	(\$0)	\$1	(\$1)	\$19	(\$19)	\$3	\$1	\$23	\$30
2000	\$36	(\$36)	\$0	(\$0)	\$6	(\$6)	\$42	(\$42)	\$3	\$3	\$48	\$61
2001	\$32	(\$32)	\$1	(\$1)	\$17	(\$17)	\$50	(\$50)	\$5	\$4	\$59	\$72

**Table 1. Fires and Losses Associated With Fireworks, 1980-2010
Fires Reported to U.S. Fire Departments (Continued)**

D. Direct Property Damage (in Millions) (Continued)

Year	Home Structures		Other Residential Structures		Nonresidential Structures		Total Structures		Vehicles	Outdoor and Total	Total	Total in 2010 Dollars
2002	\$25	(\$25)	\$1	(\$1)	\$5	(\$5)	\$31	(\$31)	\$4	\$1	\$35	\$43
2003	\$47	(\$47)	\$1	(\$1)	\$13*	(\$13)	\$60*	(\$60)	\$4	\$1	\$65	\$77
2004	\$15	(\$15)	\$0	(\$0)	\$5	(\$5)	\$20	(\$20)	\$2	\$1	\$22	\$25
2005	\$26	(\$26)	\$0	(\$0)	\$10	(\$10)	\$37	(\$37)	\$2	\$1	\$41	\$45
2006	\$28	(\$28)	\$0	(\$0)	\$3	(\$3)	\$31	(\$31)	\$1	\$1	\$34	\$36
2007	\$39	(\$39)	\$1	(\$1)	\$4	(\$4)	\$43	(\$43)	\$76**	\$1	\$119**	\$125**
2008	\$23	(\$23)	\$1	(\$1)	\$8	(\$8)	\$32	(\$32)	\$1	\$9	\$42	\$43
2009	\$28	(\$28)	\$1	(\$1)	\$7	(\$7)	\$35	(\$35)	\$1	\$1	\$38	\$39
2010	\$19	(\$19)	\$0	(\$0)	\$13	(\$13)	\$32	(\$32)	\$1	\$3	\$36	\$36

*Does not include damages in the Station night club fire.

**Vehicle estimate inflated by one apparently miscoded incident showing a \$20 million loss, which would project to a \$75 million estimate from that one incident.

Note: Numbers in parentheses exclude fires reported as confined to cooking vessel, chimney or flue, fuel burner or boiler, compactor, incinerator or trash. Detailed reporting is not required and is much less often provided for fires coded as confined fires. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Direct property damage is rounded to the nearest million dollars. Figures reflect a proportional share of fires with heat source unknown. Inflation adjustment to 2006 dollars is done using the consumer price index. *Because of low participation in NFIRS Version 5.0 during 1999-2001, estimates for those years are highly uncertain and must be used with caution.* Totals may not equal sums because of rounding error.

Source: Data from NFIRS Version 4.1 (1980-1998) and Version 5.0 (1999-2010) and NFPA survey.

**Table 2. Deaths Associated With Fireworks Incidents
1981-2010**

Year	Estimated Civilian Deaths in Fireworks-Related Fires Reported to U.S. Fire Departments	Recorded on U.S. Death Certificates
1981	0	4
1982	0	5
1983	0	13
1984	3	7
1985	15	11
1986	4	8
1987	7	5
1988	20	4
1989	4	5
1990	3	5
1991	2	4
1992	1	2
1993	3	10
1994	12	4
1995	2	2
1996	27*	9
1997	3	8
1998	0	9
1999	43*	7
2000	29*	5
2001	0	6
2002	0	5
2003	7**	11**
2004	0	2
2005	0	4
2006	6	8
2007	9	10
2008	1	7***
2009	0	2***
2010	8	3***

* 1996 total is inflated by statistical projection of one Ohio fire with nine deaths. Estimates for 1999-2001 are subject to greater uncertainty because of limited participation in NFIRS Version 5.0 in those years.

** Does not include 100 deaths in the Station night club fire.

*** Death certificate figures for 2008-2010 are preliminary based on reports to the U.S. Consumer Product Safety Commission and exclude fireworks-caused fires.

Note: In any year, the figures in these two columns may partially overlap if fireworks that directly cause a fatality also ignite a reported fire.

Sources: For death certificate tallies, *Accident Facts* and *Injury Facts*, Chicago (1985-1992) and Itasca, IL (1993-2011): National Safety Council, 1985-2011. For national estimates of fire deaths, data from NFIRS and NFPA survey.

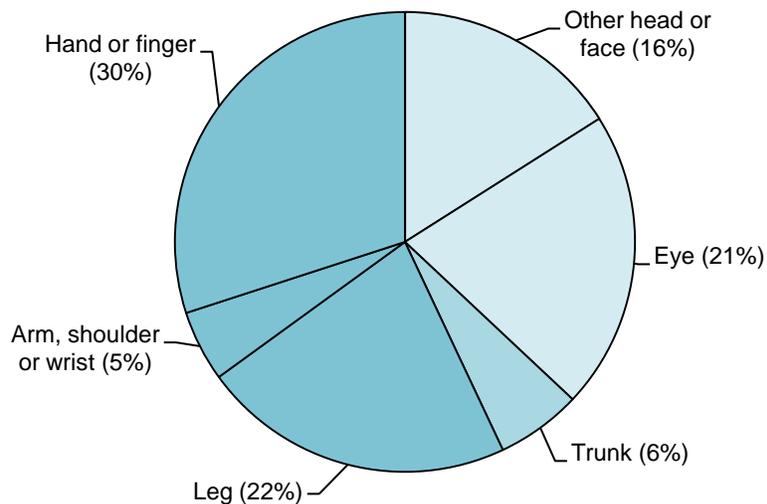
Characteristics of Fireworks Injuries Reported to Emergency Rooms

All statistics in this section are taken from the CPSC's National Electronic Injury Surveillance System (NEISS) database and specifically from CPSC's published analysis of 2010 injuries in that database. CPSC's analysis of detailed characteristics was done on injuries during the month centered on July 4, not all the injuries.

More than half (57%) of 2010 emergency room fireworks injuries were to extremities and two out of five (37%) were to the head.

Injuries to extremities were primarily to hand or finger (30% of total emergency room fireworks injuries) or leg (22%). (See Figure 2.) One-fifth (21%) of injuries were to the eye, and 16% were to other parts of the head or face.

Figure 2.
2010 Fireworks-Related Injuries*
By Part of Body Injured



Source: CPSC's NEISS

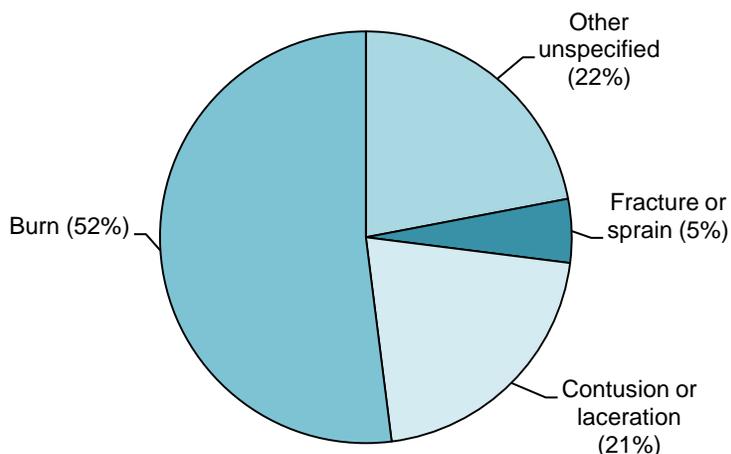
* Based on injuries during the month around July 4

Note: The darkest areas are extremities (57% of total) and the lightest areas are parts of the head (37% of total).

Half (52%) of 2010 fireworks injuries were burns.

Contusions and lacerations accounted for the next largest share among specified diagnoses (21%). (See Figure 3.) Contusions and lacerations were more numerous than burns when the injury was to the eye.

Figure 3.
2010 Fireworks-Related Injuries*
by Type of Injury



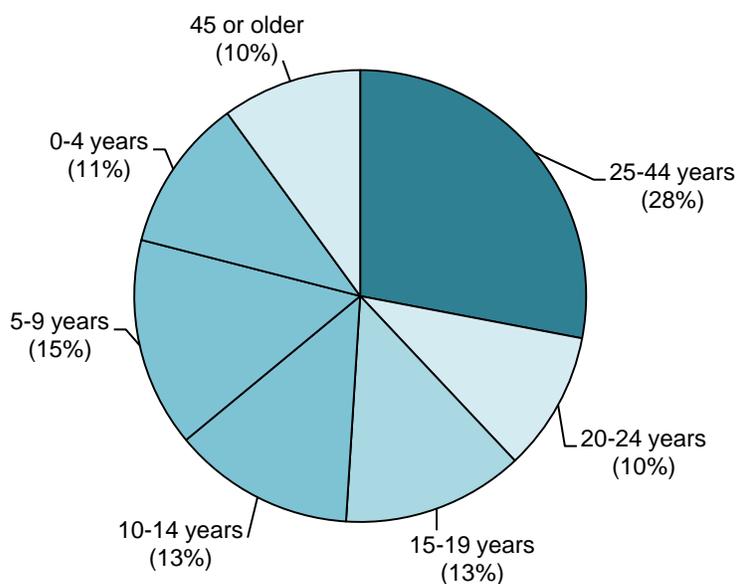
Source: CPSC's NEISS

*Based on injuries during the month around July 4.

Highest risks of fireworks injury are to school-age children.

Two of five (39%) victims of fireworks injuries in 2010 were under age 15. (See Figure 4.) The highest relative risks of fireworks injury (see Figure 5) were for children aged 5 to 9 and 10 to 14. (Relative risk of injury is defined as injuries per million population for an age range divided by injuries per million population for all ages.) Males accounted for two-thirds (65%) of fireworks injuries.

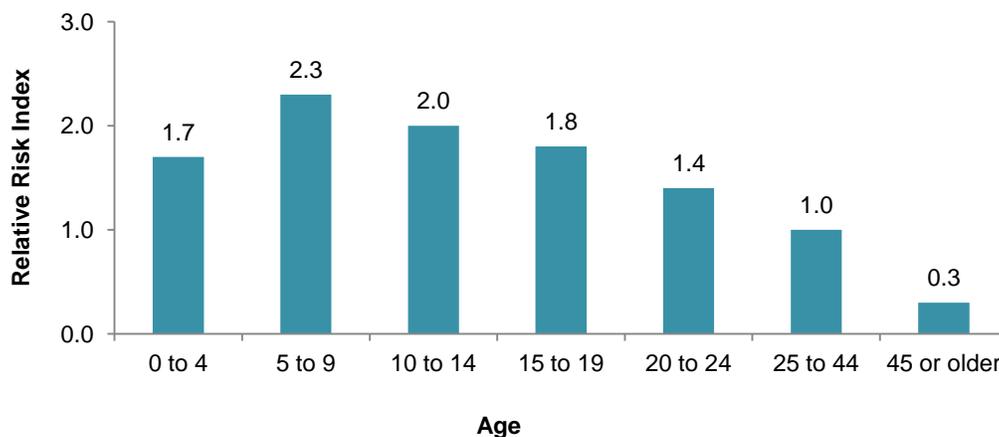
Figure 4.
2010 Fireworks-Related Injuries*
by Age of Victim



Source: CPSC's NEISS

*Based on injuries during the month around July 4.

Figure 5.
Relative Risk of 2010 Fireworks-Related Injury*
by Age of Victim

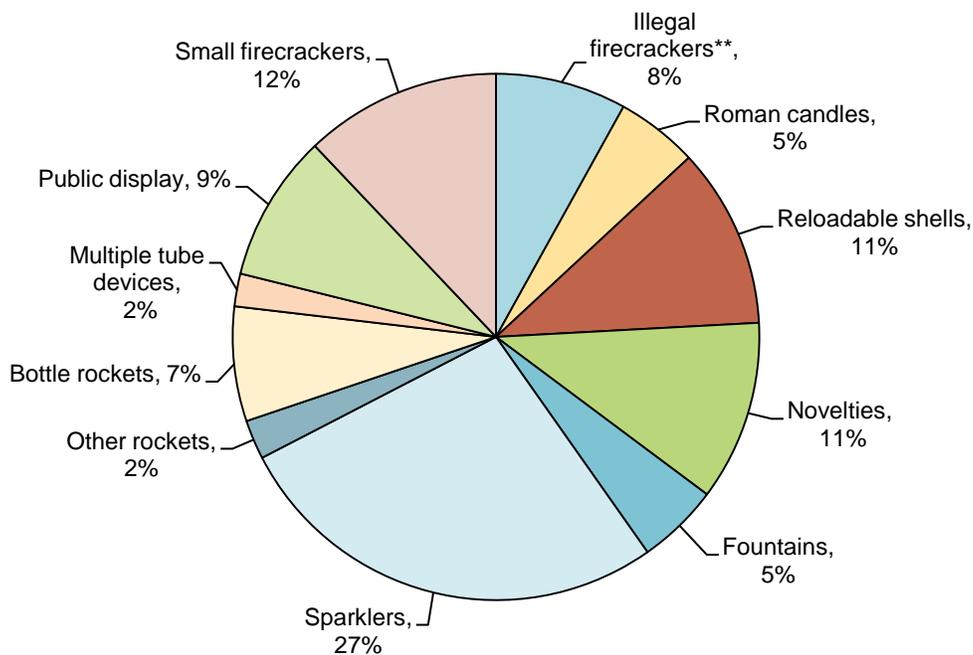


Note: Relative risk index is injuries per million population for the age group divided by injuries per million population for all ages combined. The relative risk is 1.0 for all ages combined.

Source: CPSC's NEISS

*Based on injuries during the month around July 4.

Figure 6.
2010 Fireworks-Related Injuries* by Type of Fireworks
(Unknowns Allocated)



Source: CPSC's NEISS

*Based on injuries during the month around July 4.

**Illegal under Federal law.

In 2010, five out of six (83%) emergency room fireworks injuries involved fireworks that Federal regulations permit consumers to use. (See Figure 6.)

The other 17% were large/illegal firecrackers (8%) and public display fireworks (9%). Federal law permits public use of what are now referred to as “consumer fireworks” (formerly known as “common” or Class C fireworks), which are defined in NFPA 1124 as “small fireworks device containing restricted amounts of pyrotechnic composition, designed primarily to produce visible or audible effects by combustion” that comply with specific construction, chemical composition, and labeling regulations of the U.S. Consumer Product Safety Commission. These include a 50-mg maximum limit of explosive composition for ground devices and a 130-mg maximum limit of explosive composition for aerial devices.

Some states further restrict the public’s access to fireworks. The following four states have banned access by the public to all fireworks except for attendance at public displays by licensed operators – Delaware, Massachusetts, New Jersey, and New York.

“Safe and sane” fireworks caused more injuries than illegal fireworks, especially to preschool children.

Five states – Illinois, Iowa, Maine, Ohio, and Vermont – permit sale of sparklers and some other devices of comparable strength such as fountains, snakes, party poppers, and ground spinners. Arizona permits sale of the same items excluding sparklers. As a promotional technique, the fireworks allowed under rules of this type have been labeled “safe and sane” fireworks by their advocates. Laws based on this approach allow considerable private use of fireworks, but exclude any explosive type devices that lift off the ground that are allowed under Federal law.

In 2010, sparklers, fountains, and novelties alone accounted for more than two out of five (43%) emergency-room fireworks injuries, including more than half of all fireworks injuries to pre-school children (ages 4 and under) where the type of fireworks device was specified.

Here is a sample of NEISS incident narratives involving pre-school children and fireworks injuries in 2010:

- A 2-month-old girl was burned on her leg when a firework device landed on her car seat. A 2-month-old boy was burned when a firecracker landed on his chest.
- A 5-month-old girl being held by her aunt was struck in the eye by a fireworks device that flew into their yard. A 2-year-old girl was in a stroller watching fireworks when a device jumped up from the street, striking and burning her on her thigh and hand. A 3-year-old girl was in a pool when she was struck and burned on her face and chest by a bottle rocket inadvertently shot in her direction.
- A 21-month-old girl grabbed a sparkler and brought it into contact with herself, burning her face. A 20-month-old boy was struck and burned on the

wrist by a sparkler held by one of several surrounding children playing with sparklers. In separate incidents, a 2-year-old boy and a 15-month-old boy burned their hands picking up sparklers.

- In separate incidents, two 2-year old boys were burned on their feet when they stepped on sparklers.

Sparklers can also start very large fires, e.g.:

- A fire started in the bedroom of a first-floor apartment when a lit sparkler ignited a combustible bed skirt. The apartment's resident had placed the sparkler on a cupcake for her 10-year-old daughter's birthday. After sparks ignited the bed skirt, flames spread to bedding and other combustibles. The occupants detected the fire before smoke alarms could operate and escaped. Flames heavily damaged the bedroom of origin and other rooms in the apartment, while the structural steel elements sustained significant heat damage. Smoke extensively damaged the first floor and spread to the upper floors through a construction deficiency around a vertical ventilation shaft. Water damaged the lower floors. Damages were estimated at \$1.6 million.¹

“Safe and sane” fireworks are neither. When things go wrong with fireworks, they typically go very wrong very fast, far faster than any fire protection can reliably respond. And fireworks are a classic attractive nuisance for children. If children are present to watch, they may be tempted to touch. Children can move too fast and be badly hurt too quickly if they are close to fireworks, as they inevitably are at home fireworks displays.

State laws to restrict fireworks use by the public are very difficult to enforce.

While four states ban all consumer use of fireworks, five states permit sparklers and like devices, and Arizona permits sale of devices with strength comparable to sparklers but not sparklers, the other 40 states and the District of Columbia impose no restrictions beyond the Federal requirements. This patchwork approach means that people living in a state that prohibits fireworks can often cross a state border to buy fireworks, thereby violating a state law that is difficult to enforce. Every year, for example, people from Massachusetts drive into neighboring New Hampshire – a trip of at most a couple of hours – and buy fireworks from rows of retail stands set up near the border for the convenience of the scofflaw trade.

It is possible that limited laws, such as the current Federal law, are actually more difficult to enforce than a broader law would be, because the existence of some legal fireworks for the public encourages a climate of acceptance and creates a distribution network, both of which make it easier for amateurs to obtain illegal fireworks.

¹ Adapted from Kenneth J. Tremblay, “Firewatch,” *NFPA Journal*, March/April 1997, p. 21.

For more than a century, NFPA has advocated an end to the dangerous private use of fireworks, which as noted accounts for nearly all of the injuries from fireworks in most years. Many states still permit untrained citizens to purchase and use fireworks – objects designed to explode, throw off showers of hot sparks, or reach surface temperatures as high as 1,200°F (nearly 650°C). The thousands of serious injuries and extensive property loss nearly all arise from this misguided activity, rather than the only acceptably safe way to enjoy fireworks, which is in public fireworks displays conducted in accordance with NFPA 1123, *Code for Fireworks Display*. Anything else is inconsistent with IFMA's (International Fire Marshals Association's) *Model Fireworks Law*, which reflects NFPA's zero-tolerance policy for consumer use of fireworks. More information may be found at www.nfpa.org/fireworks.

Risks of Private Fireworks Use

The usage and risks of fireworks are primarily concentrated around holiday celebrations.

More than half (57%) of all reported fireworks fires occur during the 15-day period (June 27 to July 11) centered on the July 4th Independence Day holiday, and two-thirds (64%) occur in the 31-day month centered on July 4 (June 18-July 19). Another 9% occur during the period from December 30 through January 3, with the peak on New Year's Day. (See Table B.)

**Table B. Leading Dates for Fires Started by Fireworks
Annual Average of 2006-2010 Fires Reported to U.S. Fire Departments**

Date	Fires	Percent of Fires
July 4	5,290	(23.5%)
July 5	2,220	(9.9%)
July 3	1,220	(5.4%)
January 1	970	(4.3%)
July 2	750	(3.3%)
December 31	660	(2.9%)
July 1	590	(2.6%)
July 6	560	(2.5%)
June 30	390	(1.7%)
July 7	360	(1.6%)
June 29	310	(1.4%)
July 8	250	(1.1%)
June 28	230	(1.0%)
January 2	220	(1.0%)
July 9	210	(0.9%)
July 10	190	(0.8%)
June 27	170	(0.8%)
June 26	170	(0.7%)
July 11	140	(0.6%)
June 25	140	(0.6%)
July 13	140	(0.6%)
June 24	130	(0.6%)
July 12	130	(0.6%)
July 15	100	(0.5%)
July 14	90	(0.4%)
January 3	90	(0.4%)
June 23	90	(0.4%)
July 16	80	(0.4%)
July 19	80	(0.4%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest ten. Figures reflect a proportional share of fires with heat source unknown.

Source: NFIRS and NFPA survey

On July 4 alone, reported fireworks fires accounted for 42% of the average of all 2006-2010 reported fires combined for that day (July 4). On July 4 in 2006-2010, the peak day for usage of consumer fireworks, fireworks not only were the leading cause of fires but also accounted for nearly one-fifth of associated civilian deaths, civilian injuries and direct property damage. For most people, exposure to fireworks is limited to a very short period of time.

Some neighborhoods may see heightened fireworks usage on Chinese or Indian New Year or Mardi Gras – dates that vary from year to year – but these events do not account for a national-level spike in fireworks fires.

In the United Kingdom, a tradition exists for fireworks use on November 5, sometimes called “Bonfire Night.” In Canada, fireworks injuries peak on the days surrounding Halloween (20%), Victoria Day (a Monday in late May) (15%), and Canada Day (July 1) (9%).² Many countries see heightened fireworks use around Chinese New Year (late January or early February), and India uses fireworks to celebrate the new year. Greeks see a jump in usage and injuries on Greek Orthodox Easter. But relatively few countries see substantial fireworks use year-round.

The risk of fire death relative to usage (3.6 deaths per hundred million person-hours of usage) shows fireworks as the most risky consumer product.

Risk estimates relative to exposure time are very rough, but even an estimate designed to give fireworks the benefit of the doubt supports the above conclusion.

For example, the risk of fire death from cigarettes relative to time people spend in the vicinity of lit cigarettes can be compared to the analogous risk from time spent in the vicinity of ignited fireworks. In 2004, an estimated 388 billion cigarettes were smoked by a smoker population that numbered roughly 46 million adults.³ Cigarette consumption figures have not been published after 2006, and so risk calculation for cigarettes is calculated here using consumption in the center year of a range. This translates into 23 cigarettes per smoker per day. Assuming it takes at least 5 minutes on average to smoke a cigarette, this translates into 1.95 hours per day of exposure to fire risk from a burning cigarette. (Cigarettes that are abandoned rather than being put out would add to the exposure time, hence reduce the estimated risk relative to exposure time, and abandoned cigarettes account for most of the cigarette fires.) The 2004 cigarette fire death toll was estimated as 770. The risk is therefore estimated as $(770 \text{ deaths}) / (1.95 \text{ hours/day} \times 365 \text{ days}) / (46 \text{ million smokers}) = 2.4 \text{ deaths per hundred million person-hours of exposure}$.

Now consider fireworks. Consumption in 2000-2008 averaged 222 million pounds, including 36 million pounds of display fireworks per year and 186 million pounds of consumer fireworks per year.⁴ (The APA website does not list consumption figures

² Health Canada, “Injuries associated with fireworks,” at <http://www.phac-aspc.gc.ca/injury-bles/chirpp/injrep-rapbles/firwrk-eng.php>.

³ John R. Hall, Jr., *The Smoking-Material Fire Problem*, NFPA Fire Analysis and Research Division, Quincy, MA, March 2010, Table 8B.

⁴ American Pyrotechnics Association website, <http://www.americanpyro.com>.

before 2000 or after 2009. Therefore, the largest range of years with an odd number of year and so with a center year is 2000-2008. Because fireworks-related fire deaths vary so much year-to-year, the nine-year average is used to smooth out the average.)

Fireworks are typically used by households, so assume that, on average, 2.6 people (the average size of a household in 2000-2008) are exposed in any use of fireworks.⁵ A pound of fireworks will translate into a range of different numbers of different devices, but estimate that on average a pound of fireworks burns for no more than 20 minutes. (The real average is probably shorter, which means this assumption is conservative on the side of under-estimating the risk relative to exposure time.) In 2000-2008, fires started by fireworks caused an estimated 5.8 deaths per year. (See Table 2.) The risk is therefore estimated as

$(5.8 \text{ deaths}) / (2.6 \text{ people/exposure} \times 1/3 \text{ exposure-hour/pound} \times 186 \text{ million pounds}) = 3.6 \text{ deaths per hundred million person-hours of exposure.}$

The cigarette calculation errs on the side of overestimating the risk, because 5 minutes is a low-end estimate of smoking time per cigarette, particularly if one factors in the long smolder time of imperfectly extinguished cigarettes, which are a common scenario for fire. The fireworks calculation errs on the side of underestimating the risk, because 20 minutes is a high-end estimate of the average burn time for a pound of fireworks. The fireworks fire death toll varies considerably from year to year but does not include deaths directly due to fireworks with no larger fire. Yet, even with these assumptions, the risk while fireworks are burning that a fire death will result is considerably higher than the corresponding risk when cigarettes are burning.

In recent years, the industry has asserted a risk-type argument based on the fact that fireworks consumption (in pounds) is many times as high as it was in 1976 while hospital emergency-room injuries due to fireworks have shown no consistent increase over the same period. The above calculation shows the fallacy of this reasoning. The risk relative to exposure time may not be increasing, but it is and always has been extremely high.

The risks associated with fireworks are not limited to displays, public or private.

Risks also exist wherever fireworks are manufactured, transported, stored or sold. Most but not all such losses in recent decades have occurred in other countries, where fireworks activity is not controlled as tightly – or kept as separate from highly populated areas – as it tends to be in the U.S. The following incident descriptions are taken from NFPA’s Fire Incident Data Organization (FIDO) database:

Fireworks factories

- In 2009, multiple death explosions or fires occurred in fireworks factories in India (23 deaths), China (13 deaths, in a manufacturing facility located in a house), the Philippines (8 deaths), and India again (7 deaths).
- In 2008, there were incidents in fireworks factories in Turkey (20 deaths) and China (15 deaths). In 2007, there were incidents in China (13 deaths) and Malta (5 deaths). In 2006, there was an incident in Mexico (4 deaths).

⁵ *Statistical Abstract of the United States 2010*, U.S. Census Bureau, October 2009, Table 59.

Fireworks transport

- In 2005, three people died in Kansas during transfer of fireworks from one trailer to another, when a lift charge for a fireworks show exploded, igniting adjacent fireworks and propelling debris and shells into one of the trailers, which blew up with two people inside and killed one person in the other trailer.
- In 2005 in Florida, five people were killed by an explosion that occurred during transfer of fireworks between two trucks.

Fireworks storage

- In 2009, there were multiple-death explosions or fires in fireworks storage in India (33 deaths) and Brazil (11 deaths).
- In 2006, 36 people were killed in Linqi, China, when fireworks ignited an explosion at a fireworks warehouse, resulting in a pressure wave that flattened a nearby temple. The victims had been in the temple at the time and were killed.
- In 2003, three people were killed in a Texas fireworks warehouse explosion and fire, which also destroyed the complete-coverage sprinkler system. Fires involving at least three deaths in a fully sprinklered property are quite rare and typically involve explosions and/or firefighting activity by the victims.
- In 2002, three separate incidents in India involved explosions at fireworks storage facilities, killing 14, 13, and 12 people, respectively. The first incident involved storage at an ordinary home, while the last incident involved storage in a straw-thatched warehouse where a short circuit ignited a fire that then led to an explosion when fire spread to fireworks.
- In 2000, 18-20 people were killed in the Netherlands when a residential fire spread to a fireworks warehouse located next to the neighborhood.
- In 1983, two separate massive fireworks explosion incidents in Mexico killed 34 and 21 people, respectively, the latter reportedly coming when a fireworks display flare ignited fireworks stored in the back room of a church. Fireworks displays are a traditional part of a religious festival called the Feast of the Holy Cross.

Fireworks sales

- In 2006, 16 people were reportedly killed in a Guatemala incident when a lit cigarette blew back into one of several clustered fireworks stands.
- In 1996, nine people died in an Ohio fire when a customer ignited a fireworks device in the sales display area of a fireworks retail facility. The resulting fire quickly spread to the entire store inventory. (See *NFPA Journal*, September/October 1997, p. 52.)

Data Sources

Changes in NFIRS pose opportunities and challenges in describing and tracking the problem.

The statistics in this report are national estimates derived from the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) in combination with NFPA's annual fire department survey. In Version 4.1, "fireworks" were usually understood to include two categories under form of heat of ignition – code 63 (fireworks) and code 64 (paper cap or party popper). In Version 5.0, these two groups of devices are combined into one – Heat Source code 54 (fireworks). Detailed information about NFIRS, including Version 4.1 and 5.0 codes and conversion tables, can be obtained from <http://www.usfa.fema.gov/>.

Data on injuries at hospital emergency rooms come from NEISS.

All fireworks-related injury statistics from hospital emergency rooms come from reports by the U.S. Consumer Product Safety Commission (CPSC) and private communications from Linda Smith and Michael Greene of the CPSC. Linda Smith also provided the rules for setting the range of fireworks injury estimates during the period from 1985 to 1989, reflecting the change in the sample, and in 1991 to 1996, reflecting the latest change in the sample. Reports referenced include Yongling Tu and Demar V. Granados, *2010 Fireworks Annual Report*; Michael A. Greene, Yongling Tu, and Demar V. Granados, *2009 Fireworks Annual Report*; Michael A. Greene and Demar V. Granados, *2008 Fireworks Annual Report*; Michael A. Greene and James Joholske, *2007, 2006, 2005, 2004 and 2003 Fireworks Annual Report*; Michael A. Greene and Patrick M. Race, *1999 Fireworks Annual Report*; Michael A. Greene, *1998 Fireworks-Related Injuries*; Ron Monticone and Linda Smith, *1997 Fireworks-Related Injuries*; Sheila L. Kelly, *Fireworks Injuries, 1994*; Dr. Terry L. Kissinger, *Fireworks Injuries - Results of a 1992 NEISS Study*; Linda Smith and Sheila Kelly, *Fireworks Injuries, 1990*; Deborah Kale and Beatrice Harwood, *Fireworks Injuries - 1981*; and the May/June 1974 issue of *NEISS News*. All were published by CPSC.

Data on deaths directly attributable to fireworks come from NCHS.

The National Center for Health Statistics maintains the death certificate database. Since 1999, fireworks discharge has been coded as External Cause of Mortality W39. From 1980 to 1999, firework discharge was coded as E923.0.

Appendix A.

How National Estimates Statistics Are Calculated

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

NFIRS provides the most detailed incident information of any national database not limited to large fires. NFIRS is the only database capable of addressing national patterns for fires of all sizes by specific property use and specific fire cause. NFIRS also captures information on the extent of flame spread, and automatic detection and suppression equipment. For more information about NFIRS visit <http://www.nfirs.fema.gov/>. Copies of the paper forms may be downloaded from http://www.nfirs.fema.gov/documentation/design/NFIRS_Paper_Forms_2008.pdf.

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

Methodology may change slightly from year to year.

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

NFPA's fire department experience survey provides estimates of the big picture.

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

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

such a large proportion of the total U.S. population that it makes sense to survey all of them. Most respond, resulting in excellent precision for their part of the final estimate.

The survey includes the following information: (1) the total number of fire incidents, civilian deaths, and civilian injuries, and the total estimated property damage (in dollars), for each of the major property use classes defined in NFIRS; (2) the number of on-duty firefighter injuries, by type of duty and nature of illness; 3) the number and nature of non-fire incidents; and (4) information on the type of community protected (e.g., county versus township versus city) and the size of the population protected, which is used in the statistical formula for projecting national totals from sample results. The results of the survey are published in the annual report *Fire Loss in the United States*. To download a free copy of the report, visit <http://www.nfpa.org/assets/files/PDF/OS.fireloss.pdf>.

Projecting NFIRS to National Estimates

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

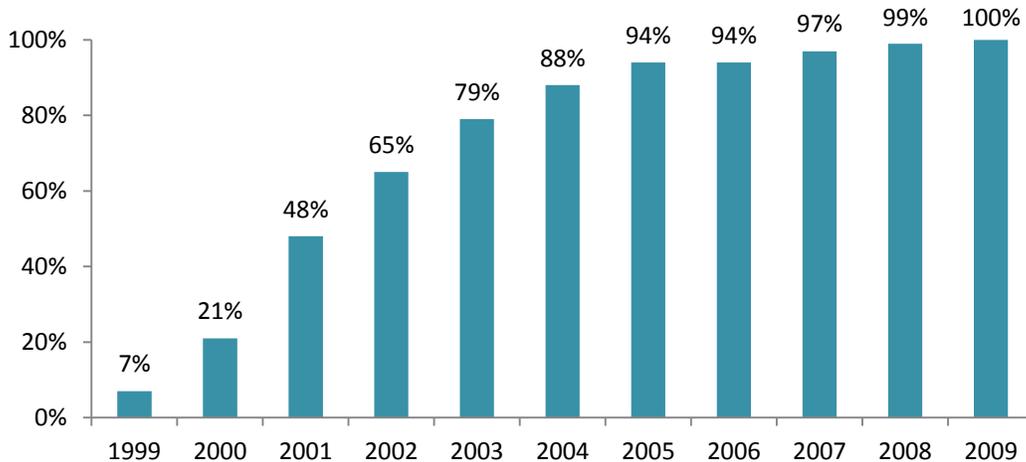
Scaling ratios are obtained by comparing NFPA's projected totals of residential structure fires, non-residential structure fires, vehicle fires, and outside and other fires, and associated civilian deaths, civilian injuries, and direct property damage with comparable totals in NFIRS. Estimates of specific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

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

Version 5.0 of NFIRS, first introduced in 1999, used a different coding structure for many data elements, added some property use codes, and dropped others. The essentials of the approach described by Hall and Harwood are still used, but some modifications have been necessary to accommodate the changes in NFIRS 5.0.

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

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



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

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

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

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

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

Although causal and other detailed information is typically not required for these incidents, it is provided in some cases. Some analyses, particularly those that examine cooking equipment, heating equipment, fires caused by smoking materials, and fires started by playing with fire, may examine the confined fires in greater detail. Because the confined fire incident types describe certain scenarios, the distribution of unknown data differs from that of all fires. Consequently, allocation of unknowns must be done separately.

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

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

For most fields other than Property Use and Incident Type, NFPA allocates unknown data proportionally among known data. This approach assumes that if the missing data were known, it would be distributed in the same manner as the known data. NFPA makes additional adjustments to several fields. *Casualty and loss projections can be heavily influenced by the inclusion or exclusion of unusually serious fire.*

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

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

Factor Contributing to Ignition: In this field, the code “none” is treated as an unknown and allocated proportionally. For Human Factor Contributing to Ignition, NFPA enters a code for “not reported” when no factors are recorded. “Not reported” is treated as an unknown, but the code “none” is treated as a known code and not allocated. Multiple entries are allowed in both of these fields. Percentages are calculated on the total number of fires, not entries, resulting in sums greater than 100%. Although Factor Contributing to Ignition is only required when the cause of ignition was coded as: 2) unintentional, 3) failure of equipment or heat source; or 4) act of nature, data is often present when not required. Consequently, any fire in which no factor contributing to ignition was entered was treated as unknown.

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

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

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

31. Water-caused short circuit arc;
32. Short-circuit arc from mechanical damage;

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

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

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

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

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

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

Equipment Involved in Ignition (EII). NFIRS 5.0 originally defined EII as the piece of equipment that provided the principal heat source to cause ignition if the equipment malfunctioned or was used improperly. In 2006, the definition was modified to “the piece of equipment that provided the principal heat source to cause ignition.” However, much of the data predates the change. Individuals who have already been trained with the older definition may not change their practices. To compensate, NFPA treats fires in which EII = NNN and heat source is not in the range of 40-99 as an additional unknown.

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

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

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

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

Code Grouping	EII Code	NFIRS definitions
Central heat	132	Furnace or central heating unit
	133	Boiler (power, process or heating)
Fixed or portable space heater	131	Furnace, local heating unit, built-in
	123	Fireplace with insert or stove
	124	Heating stove
	141	Heater, excluding catalytic and oil-filled
	142	Catalytic heater
	143	Oil-filled heater
Fireplace or chimney	120	Fireplace or chimney
	121	Fireplace, masonry
	122	Fireplace, factory-built
	125	Chimney connector or vent connector
	126	Chimney – brick, stone or masonry
	127	Chimney-metal, including stovepipe or flue
Fixed wiring and related equipment	210	Unclassified electrical wiring
	211	Electrical power or utility line
	212	Electrical service supply wires from utility
	213	Electric meter or meter box
	214	Wiring from meter box to circuit breaker
	215	Panel board, switch board or circuit breaker board
	216	Electrical branch circuit
	217	Outlet or receptacle
	218	Wall switch
	219	Ground fault interrupter
Transformers and power supplies	221	Distribution-type transformer
	222	Overcurrent, disconnect equipment
	223	Low-voltage transformer
	224	Generator
	225	Inverter
	226	Uninterrupted power supply (UPS)
	227	Surge protector
	228	Battery charger or rectifier
229	Battery (all types)	
Lamp, bulb or lighting	230	Unclassified lamp or lighting
	231	Lamp-tabletop, floor or desk
	232	Lantern or flashlight
	233	Incandescent lighting fixture
	234	Fluorescent light fixture or ballast

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

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

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

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

Rounding and percentages. The data shown are estimates and generally rounded. An entry of zero may be a true zero or it may mean that the value rounds to zero. Percentages are calculated from unrounded values. It is quite possible to have a percentage entry of up to 100% even if the rounded number entry is zero. The same rounded value may account for a slightly different percentage share. Because percentages are expressed in integers and not carried out to several decimal places, percentages that appear identical may be associated with slightly different values.

Appendix B.

Selected Published Incidents Involving Fireworks

Included are articles from NFPA publications about fires involving fireworks. Included are short articles from the “Firewatch” or “Bi-monthly” columns in *NFPA Journal* or its predecessor *Fire Journal* and incidents from either the large-loss fires report or catastrophic fires report. If available, investigation reports or NFPA Alert Bulletins are included and provide detailed information about the fires.

It is important to remember that this is anecdotal information. Anecdotes show what can happen; they are not a source to learn about what typically occurs.

NFPA’s Fire Incident Data Organization (FIDO) identifies significant fires through a clipping service, the Internet and other sources. Additional information is obtained from the fire service and federal and state agencies. FIDO is the source for articles published in the “Firewatch” column of the *NFPA Journal* and many of the articles in this report.

Sprinklers limit roof fire at assisted living facility, Oregon

A dry-pipe sprinkler system limited property loss and prevented injuries during a rooftop fire at an assisted-living center. The staff initially thought the alarm was false and canceled the first fire department response. However, subsequent alarms and water flowing from the sprinklers led staffers to call 911 at 10:02 p.m.

The two-story, Type-V building, which covered approximately 70,000 square feet (6,503 square meters), had a pitched wood truss roof covered with composite asphalt shingles. The facility had four individual wings, each separated by two-hour fire barrier walls with protected openings. The exit corridors, which also had protected openings, had a one-hour fire rating, and all the building’s stairs were enclosed. The property was protected by a monitored dry-pipe sprinkler system, as well as a manual fire alarm and monitored smoke detection system.

The facility was holding a Fourth of July celebration outside on a patio, igniting legally bought consumer fireworks from a table that staff members had covered with aluminum foil. Fireworks were also being used elsewhere in the neighborhood.

When the smoke detection system first sounded at roughly 9:44 p.m., facility administration assumed that the haze in the building was a normal byproduct of the fireworks that had entered through open doors and windows. The monitoring service was called and the fire department response canceled.

When the detection system sounded again a short time later, however, the smoke was heavier. A broken water pipe was reported on the second floor, but the leaking water was actually coming from operating sprinklers.

The fire department response was resumed at 10:02 p.m., and first-arriving firefighters noted light smoke coming from the roof. They helped evacuate the residents and began to attack the fire in the attic.

After the fire was extinguished, investigators determined that the fireworks had ignited a large amount of lint that had been blown from the dryer exhaust and built up on the roof. The fire spread from the lint to the roof covering and underlayment before moving into the attic.

The blaze also spread into the dryer's exhaust system, which accommodated smaller exhaust ducts from four gas-fired dryers, each of which connected to the larger, single duct that rose from the lower floors of the facility to the mechanical exhaust motor and housing on the roof.

When the investigators removed and examined the ductwork, they found that nearly 50 percent of it was occluded by an accumulation of lint. They also found partially burned lint in the exhaust duct assembly and in the bell housing. Although the roof exhaust fan and the electric motor showed no signs of direct flame involvement, smoke damage was clearly visible. The investigators' report cited the management's failure to clean the lint out of the dryer's exhaust system as a contributing factor to the blaze.

The building and its contents, which together were valued at more than \$6.9 million, sustained a combined property loss of \$1.5 million. There were no injuries reported.

Kenneth J. Tremblay, 2011, "Firewatch", *NFPA Journal*, July/August, 22-23.

Children playing with fireworks start fire in house, Maryland

An 11-year-old boy and his brother were playing with firecrackers in one of the boy's bedrooms when they started a fire that heavily damaged the second floor of their townhouse.

The two-story, wood-frame townhouse was a middle unit with similar units on either side. Hardwired smoke alarms were located on each level of the home and worked as designed. There were no sprinklers.

The boys ignited a firecracker with a butane lighter and put it in a dresser drawer, where it exploded and ignited the contents of the drawer. One of the boys tried to extinguish the blaze by throwing a cupful of water onto it, but he was unsuccessful. At some point, the smoke alarm operated, and their father, who was on the first floor, went to investigate. When he spotted the fire, he tried to control it using a portable fire extinguisher before calling 911 around 11:53 a.m.

Arriving firefighters, who found heavy smoke coming from the front and rear of the house, put out the blaze with interior hose lines. By the time they extinguished the fire, it had spread to the attic and roof trusses. The second floor sustained heavy smoke and fire damage, while smoke and water damaged the first floor.

Neither the boys nor their father was hurt, but the house, valued at \$130,000, and its contents, valued at \$30,000, sustained losses of \$50,000 and \$20,000, respectively.

Kenneth J. Tremblay, 2009, "Firewatch", *NFPA Journal*, September/October, 23-24.

Fireworks start fatal fire, Illinois

A 19-year-old man died and two firefighters suffered minor injuries during a fire that began when fireworks ignited at floor level in his second-story bedroom.

The two-story, wood-frame house was 52 feet (16 meters) long and 25 feet (8 meters) wide. The single-family home had smoke alarms, but there were none on the second floor.

Occupants of the home called 911 at 4:30 a.m. to report the blaze, and firefighters arriving about seven minutes later extinguished the fire. They found the victim lying on the floor of his bedroom and took him to the hospital, where he succumbed to his injuries.

The house and its contents, valued at \$125,000, sustained damage estimated at \$50,000. The fire department and the police were involved in the investigation.

Kenneth J. Tremblay, 2008, "Firewatch," *NFPA Journal*, September/October, 24.

Fireworks inside a residence ignite deadly fire, Missouri

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

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

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

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

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

Fireworks ignite plastic bins, Washington

Two juveniles were charged with arson when fireworks they ignited spread to large plastic trash bins and then to the exterior of an elementary school. Fire spread to the wooden roof structure and to the interior of the school before being detected and extinguished.

The single-story school was constructed in phases over several years with concrete block walls, a brick veneer, and a wooden roof with a built-up roof deck. There were no detection or suppression systems installed in the school, only a burglar alarm that sounded only after the fire was well developed.

The plastic recycle bins with hinged-plastic covers were placed against the school. A lit firework was placed within a bin and it ignited the combustibles and spread to the bin itself.

Flame heights reached the roofline and spread to concealed spaces involving structural wood framing.

Police investigating the burglar alarm arrived at 10:34 p.m. and alerted the fire department when smoke and fire was observed. Four minutes later, firefighters arrived and found heavy smoke and fire coming from the north section of the school. They advanced an interior hose line. Crews had some success in extinguishing fire in two of the classrooms and alcove, but fire spread in the concealed ceiling and roof spaces was too extensive. Command ordered an evacuation and began a defensive attack.

A trench cut separated the involved north section of the school from the main building, as aerial master streams were used to control the fire. Firefighters fought the fire for four hours before it was declared under control. Damage to the school was estimated at \$2.5 million for combined structural and contents losses. One firefighter suffered minor injuries during suppression activities.

Kenneth J. Tremblay, 2007, "Firewatch", *NFPA Journal*, May/June, 24.

Fireworks kill 4-year-old, Missouri

A family celebration at which people were setting off consumer fireworks ended tragically when a 4-year-old girl was killed by a projectile launched from a mortar. The girl was on a walkway near a porch 148 feet (45 meters) from the area where fireworks were being ignited when she was struck in the face.

There were no other injuries or property damage.

Kenneth J. Tremblay, 2005, "Firewatch," *NFPA Journal*, July /August, 20.

Disco fire in Buenos Aires, Argentina

[On] December 30 [2004], a fire at a rock concert in an unsprinklered disco in Buenos Aires, killed 191 people, the largest loss of life in a fire in Argentina's history. The Republica Cromagnon disco was a one-story building of approximately 1,500 square meters (16,150 square feet), with an occupancy permit for 1,037 spectators, but an estimated 3,000 people were inside on the night of the fire.

The fire started at 10:50 p.m., a few minutes after the concert had started, when fireworks thrown by a spectator set fire to the combustible acoustic lining of the ceiling, presumably made with polyurethane foam. The fire spread quickly through the ceiling. Smoke inhalation claimed the most victims. There was a lack of compliance with local codes regarding the combustible acoustic lining and the use of fireworks inside buildings.

Other factors contributing to the large loss of life included a main exit door that had been closed with a padlock, and the lack of emergency lighting and exit signs. In fact, a few minutes after the fire had started, electrical power was cut off and there was total darkness inside the overcrowded space, making a chaotic situation even worse.

Eduardo Alvarez, 2005, "Disco fire in Buenos Aires, Argentina," *NFPA Journal*, March/April, 52.

Fireworks ignited during transfer, three deaths, Kansas

At 10:00 a.m. in August, fireworks were being transferred from a storage trailer to a 29-foot goose neck trailer for transport to a fireworks show.

As a safety officer for the loading stood outside the goose neck trailer, he heard a lift charge from one of the boxed fireworks function. As the box was set down, it began to burn, and then exploded, igniting the 17 other boxes that had been transferred. As these fireworks began to ignite and explode, flaming debris and shells were propelled into the storage trailer. The storage trailer then exploded. Investigators believe the pre-wiring of the fireworks was the most plausible ignition source in the box.

Two of the victims were in the storage trailer and the third was located in the goose neck trailer.

Based on Stephen G. Badger, *Multiple-Death Fires For 2005*, September, 2006, NFPA Fire Analysis and Research, 14.

Fireworks explosion in Florida causes five deaths

Around 2:10 p.m. on a sunny and warm July day, workers unloaded fireworks from one truck to another. An explosion occurred in the cargo area of the truck. Five people were killed when the explosion prevented their escape. The cause is under investigation.

Adapted from Stephen G. Badger 2004, "Catastrophic Multi-Death Fires of 2003," *NFPA Journal*, September/October, 73.

Fireworks ignite roof, Michigan

Fireworks from a private, unpermitted Independence Day display ignited the roof of a single-family house, nearly destroying the \$3 million home. A neighbor alerted a resident, and then called 911 at 11 p.m.

The two-story, wood-framed dwelling, each floor of which covered approximately 2,400 square feet (222 square meters), had a wood-flamed roof topped with cedar-shake shingles. Smoke detectors had been installed in the unsprinklered house, but they didn't sound since the fire started on the roof.

A fireworks shell, blown onto the roof, ignited the shingles. The fire burned through the roof into the attic. From there, the blaze spread throughout the house at roof level, doing nearly \$2.5 million in damage to the home. Before the fire, the home and its contents were valued at \$3 million. No injuries were reported.

Kenneth J. Tremblay, 2004, *NFPA Journal*, July/August, 16.

Night club pyrotechnics display ignites wall covering, kills 100, Rhode Island

At 11:00 pm on a day in February, in an unsprinklered one-story nightclub of unprotected wood-frame construction, a rock band's pyrotechnics display ignited foam material used on the wall of the stage for soundproofing. The fire spread throughout the structure in a matter of minutes.

Stephen G. Badger, 2004, "Catastrophic Multiple-Death Fires 2003," NFPA Fire Analysis and Research, September, 14.

Fireworks ignite roof, California

A fire that began when a bottle rocket landed on the wood-shake roof of a single-family home burned for nearly 30 minutes before neighbors smelled smoke and called 911. No one was home when the fire started. The ranch-style, wood-framed house and its attached garage covered approximately 2,330 square feet (217 square meters). It had no smoke alarms or sprinklers.

The fire department received several 911 calls around 1:30 p.m. from passersby and neighbors reporting the fire. An off-duty battalion chief also saw the smoke and drove to the house, where he found flames coming from the rear roof of the home. Before fire crews reached the scene, the battalion chief entered the house to confirm that no one was inside. Firefighters arrived within five minutes and deployed several hose lines to protect the exposures and attack the fire.

The flames burned through the roof into the attic and spread down to the living and sleeping areas. A 14-mile-per-hour (22.5-kilometer-an-hour) wind contributed to the fire spread, carrying flying brands into the neighborhood. The house, valued at an estimated \$300,000, sustained losses of \$200,000. Its contents, valued at \$50,000, were destroyed. There were no injuries.

NFPA'S Fire Incident Data Organization, 2003, Fire Analysis and Research Division, May 2004.

Fireworks starts house fire, Michigan

A family using legal fireworks on the rear deck of their single-family home to celebrate Independence Day may have inadvertently ignited the deck, sunroom, and rear of their house. However, a number of people in the neighborhood were using illegal fireworks at the same time, so it remains unclear which fireworks actually started the fire.

The two-story, wood-framed house was 35 feet (11 meters) long and 45 feet (14 meters) wide with a wood-truss roof and aluminum and brick siding. There were no fire sprinklers, but smoke alarms had been installed on both floors.

The family used the fireworks between 10 and 11 p.m. Hours later, a resident was awoken by the sound of scratching at the back of the house and went to investigate. When she discovered the fire, she called 911 and roused the other four residents, all of whom escaped.

Firefighters arrived four minutes after the 4:22 a.m. call and found smoke and flames coming from the back of the house and the roof of the attached garage. They stretched a hose line to the second floor, where the smoke, which was light on the first floor, became thicker as fire spread through the attic. When the firefighters opened the ceiling, they encountered heavy fire.

The incident commander evacuated the building when the fire crews failed to extinguish the blaze and used a ladder pipe to knock the fire down. Firefighters then reentered the house and extinguished hot spots.

Investigators believe the fire started when lit fireworks ignited the wooden deck and spread up the decorative wooden lattice into the attic above the sunroom, garage, and family room.

The house, valued at \$186,000, had \$100,000 in damage, and its contents, valued at \$90,000, suffered a \$45,000 loss. Radiant heat did \$5,000 damage to an adjacent home. There were no injuries.

Kenneth J. Tremblay, 2003, "Firewatch," *NFPA Journal*, July/August, 14.

Explosion in home kills one, Missouri

A 41-year-old man died when ingredients used to manufacture fireworks exploded in the basement of his single-family house. The man conducted fireworks displays and illegally manufactured and stored his homemade fireworks in his dwelling. The one-story, wood-framed house had a concrete block foundation and a brick veneer on the front. It had no smoke alarms or sprinklers.

At 5:50 p.m., firefighters responded to an alarm sounded by a passerby, who reported the explosion and fire. The house sustained major structural damage, as flames spread first to a detached garage, then to another house to the east, and ultimately throughout a six-block area.

Firefighters, who controlled the blaze with large-diameter deck guns and small attack lines, discovered the victim in the basement, along with fireworks manufacturing supplies. Several explosive items were discovered, including flash powder, metallic chlorates, antimony sulfides, barium/calcium carbonate, potassium nitrate, red gum, sulfur powder, and potassium chlorate.

Damage to the house, valued at \$80,000, was \$34,000. Damage to its contents was extensive but not reported. Total loss estimates to all affected properties weren't disclosed. In addition to the fatality, two other people suffered minor cuts.

Kenneth J. Tremblay, 2001, "Firewatch," *NFPA Journal*, January/February, 21.

Fireworks start fire on apartment roof, Ohio

One or more airborne fireworks landed on the roof of an apartment building, starting a fire that burned into the attic, heavily damaging the building. Firefighters tried an interior fire attack, but partial collapses forced them down and finally out, into a defensive attack.

The two-story; 12-unit, wood-framed apartment building had a brick veneer and an asphalt shingle-on-plywood roof. There were smoke alarms in the hallways, but none in the units or attic and there were no sprinklers.

A resident reported seeing a glow on a balcony and called 911 at 12:57 a.m. Firefighters arrived four minutes later to find that flames were showing from a second-story balcony and that the building's occupants had reportedly been evacuated. Advancing a preconnected hose line into the unit of origin, they discovered that the fire on the balcony had spread along the soffit from a well-involved attic fire.

Pulling the ceiling down to gain access to the attic, the firefighters attacked the flames until they were driven out by a partial roof collapse. A second collapse forced them from the second floor, and so firefighters moved to the southern section of the building, where a fire wall held the flames in check. When they opened ceilings, however, they found that the fire had burned off the roof and circumvented the fire wall, forcing them to leave as the ceilings began to collapse.

Firefighters used elevated master streams and deck guns to knock down the fire in the attic and second floor, allowing crews to re-enter the building. They extinguished the blaze in four second-floor units, which were heavily damaged.

Investigators determined fireworks ignited the roofing material. They declared the fire incendiary. Damage to the building and its contents, which had an estimated combined value of \$800,000, came to \$320,000. One firefighter suffered heat related injuries. All the residents escaped safely from the building.

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

Mortar round misfires, ignites stored fireworks, kills three, Arkansas

At 9:00 pm on a day in July a mortar round misfired, shooting into an open trailer where fireworks were stored at a speedway. When the rocket misfired, the victims sought refuge in the trailer.

Based on Robert S. McCarthy, 2000, "1999 Catastrophic Fires", *NFPA Journal*, September/October, 60.

Firefighter struck by fireworks

At approximately 9:45 one night in July, a firefighter in full protective clothing was acting as fire watch at the control panel of a public fire works display. His duty was to extinguish any grass fires that errant sparks might ignite with a 1 1/2-inch handline. To do this, he held the handle of a gate valve to the handline's pistol-grip nozzle in his left hand and the pistol grip in his right. An ember from one of the expended fireworks fell into a ready box, igniting a shell 10 inches (254 millimeters) in diameter. The shell rocketed out of the box into the firefighter's left hand, shredding his middle and ring fingers, then flew up to strike his helmet and face shield, tearing the helmet from the foam liner. The shell also ignited 10 to 12 other boxes of unexpended shells.

The firefighter was taken to the local hospital, where he remained for two weeks. The remaining portions of his middle and ring fingers were surgically removed, and he lost the hearing in his left ear. He also sustained minor burns and contusions to the left side of his face. Fortunately, his protective coat and trousers protected him from further burns, although the clothing itself was burned in several places. He has yet to return to duty.

Michael J. Karter, Jr. and Paul R. LeBlanc, 1999, "1998 Firefighter Injuries", *NFPA Journal*, November/December, 55

Fireworks plant explosion kills seven, Michigan

At 2:00 pm on an afternoon in December an unknown source ignited an assortment of explosive powders used to manufacture fireworks. The explosion destroyed the one-story fireworks manufacturing plant; which had unprotected wood-frame construction. Material that had been in the building was found up to 900 feet (274 meters) from the concrete foundation.

Based on Kenneth J. Tremblay, 1999, "The Catastrophic Fires of 1998", *NFPA Journal*, September/October, 54.

Fireworks ignite deadly blaze, Arkansas

Fireworks started a fire that killed a 39-year-old man and destroyed a single-story, 1,200-square-foot (111.5-squaremeter) house of unprotected, wood-frame construction. The dwelling had no smoke detectors or sprinklers.

Occupants of the single-family home were discharging fireworks when one of the rockets landed on a couch on the front porch. Thinking that heat from the rocket wasn't significant

enough to cause damage, they retired for the evening. The couch smoldered for hours before flames spread inside the house, waking the occupants, who called 911 at 1:56 a.m.

Arriving firefighters found that the fire had consumed the entire house, which was valued at \$25,000. The man who died of smoke inhalation is believed to have been under the influence of alcohol, which may have contributed to his inability to escape.

Kenneth J. Tremblay, 1998, "Firewatch," *NFPA Journal*, July/August, 19.

Fireworks ignite barge, Massachusetts

Shortly after a public fireworks display began off a heavy steel barge anchored off the coast, a rocket exploded in the air prematurely, showering the barge and cardboard boxes containing reserve fireworks with sparks. Numerous fireworks detonated, burning all 10 people aboard the barge. Rescue personnel had to rescue the workers, including three who jumped into the ocean to escape.

The state fire marshal later cited several violations on board the barge. The deputy chief said two contributing factors were the improper storage of reserve fireworks and inadequate spacing between fireworks for separate displays.

Kenneth J. Tremblay, 1998, "Firewatch," *NFPA Journal*, July/August, 22.

Customer ignites fireworks in retail outlet, nine killed, Ohio

At 1:59 pm on an afternoon in July, a customer lit a fireworks item in the sales display area of a one story fireworks retail sales store, built with unprotected ordinary construction. The initial combustion ignited other stored fireworks, consuming the entire inventory in a matter of seconds. There was a wet-pipe sprinkler system, but it had been shut off. The store was crowded with pre-holiday customers. When the fire started, many were able to escape, but nine died, including four children, ages 2, 8, 9, and 14. Five adults, whose ages ranged from 21 to 71, also died.

Kenneth J. Tremblay, 1997, "1996 Catastrophic Fires", *NFPA Journal*, September/October, 52.

Arson blaze started by fireworks kills three, Ohio

According to news accounts, a 13-year-old threw six fireworks through the broken windows of an apartment, starting a fire that blocked the apartment's only exit, killing three occupants.

The single-story building, which measured 75 by 24 feet, was constructed of concrete block walls and wood roof framing and decking. Asphalt shingles covered the roof. A single battery-operated smoke detector was in the room of origin, but it's not known whether it operated. There were no sprinklers.

A neighbor detected the blaze and called 911 at 2:42 p.m. The fireworks ignited drapes and a couch, and the fire quickly reached flashover, then spread down the hall to the kitchen. Because the blaze spread so quickly, firefighters couldn't save the three trapped occupants.

Flames, smoke, and heat spread from the apartment to the attic. The extent of the property damage wasn't reported.

Kenneth J. Tremblay, 1997, "Firewatch," *NFPA Journal*, July/August, 20.