National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02169-7471
www.nfpa.org

SELECTIONS FROM
U.S. VEHICLE FIRE TRENDS AND PATTERNS
WATER TRANSPORT VEHICLE FIRES

Prepared by: Marty Ahrens
National Fire Protection Association
One-Stop Data Shop
1 Batterymarch Park
Quincy, MA 02169-7471

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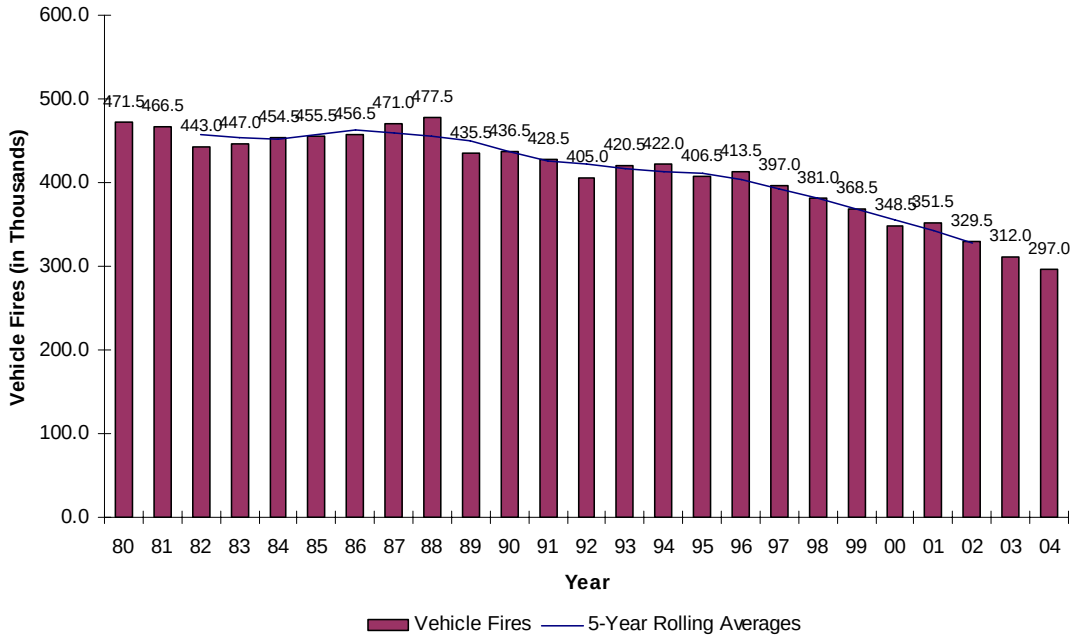
National Fire Protection Association
One-Stop Data Shop
1 Batterymarch Park
Quincy, MA 02169-7471
www.nfpa.org
e-mail: osds@nfpa.org
phone: 617-984-7450

Overview of the Vehicle Fire Problem

297,000 reported vehicle fires caused 550 civilian deaths in 2004.
Public fire departments responded to an estimated 297,000 vehicle fires in the United States during 2004. These fires caused an estimated 550 civilian deaths, 1,500 civilian injuries and $1.3 billion in direct property damage. Vehicle fires accounted for 19% of the 1,550,500 fires reported to U.S. fire departments that year. Vehicle fires also caused 14% of all civilian fire deaths, 8% of all civilian fire injuries, and 13% of the nation's property loss to fire in 2004. More people died from vehicle fires than from apartment fires; vehicle fires caused roughly seven times the number of deaths caused by non-residential structure fires.[1] Vehicles include: cars, trucks and other highway vehicles; boats and ships; railroad and mass-transit vehicles; aircraft; and agricultural, construction and yard vehicles.

Figure 1. U.S. Vehicle Fires by Year: 1980-2004



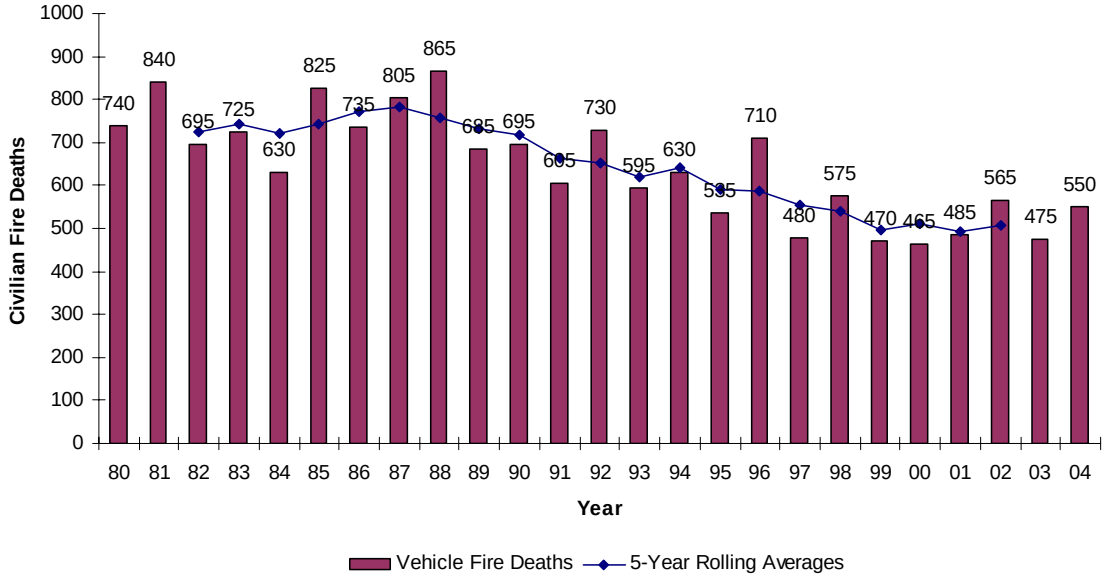
Source: *Fire Loss in the U.S.* series by Michael J. Karter, Jr.

Vehicle fires fell to a record low.
The total number of reported vehicle fires fell 5% from the 312,000 reported in 2003 to 297,000 in 2004. This was the smallest vehicle fire incidence since the National Fire Protection Association (NFPA) began tracking vehicle fires and losses with its current methods. After declining in the early eighties, vehicle fires began increasing in 1983 to a peak of 477,500 in 1988. The 9% drop from 1988 to 1989 was the largest one-year decline seen since NFPA began tracking this data. Since 1980, reported vehicle fires have fallen 37% compared to a 51% drop in reported structure fires and a 48% drop in fires of all types. Figure 1 shows the trend in vehicle fires since 1980.

[1] Michael J. Karter, Jr., *Fire in the United States during 2004: Abridged Report*, Quincy, MA: NFPA, June 2005. This report summarizes the results of the NFPA Annual Fire Department Survey and is the source for 2004 statistics. Overall vehicle fire trend data was obtained from the *Fire In the United States* annual reports for 1980-2004.

Figure 2 shows that the death toll due to vehicle fires fluctuates greatly from year to year. Vehicle fire deaths rose 16% from 475 in 2003 to 550 in 2004. A generally downward trend can be seen in the five-year rolling averages. Only fires and fire deaths reported to local public fire departments in the United States are counted. Fires or fire deaths on the open seas or not attended by local fire departments are not captured in these statistics.

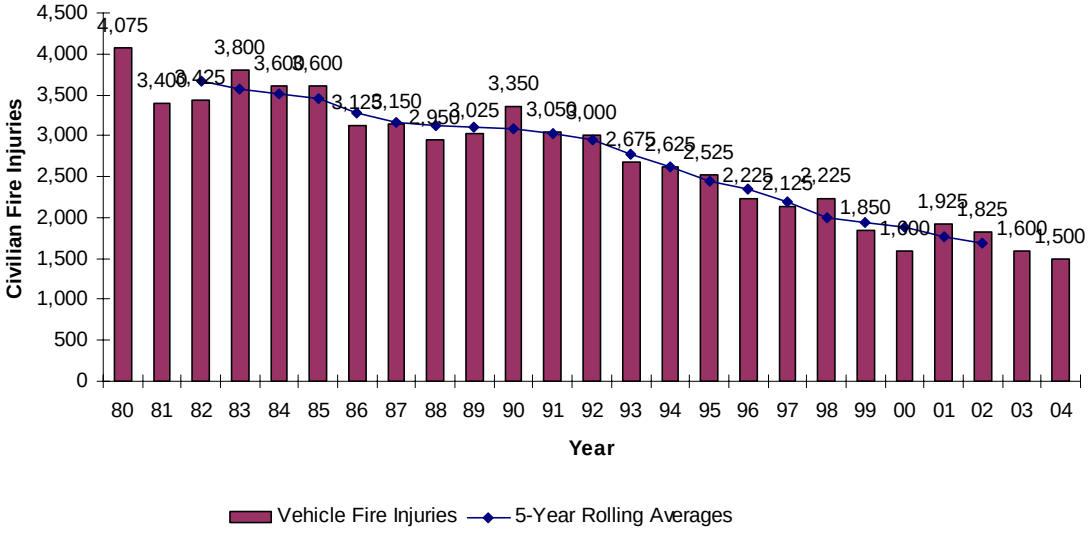
Figure 2. U.S. Vehicle Fire Deaths by Year: 1980-2004



Source: *Fire Loss in the U.S.* series by Michael J. Karter, Jr.

Civilian injuries in vehicle fires fell 6% from 1,600 in 2003 to 1,500 in 2004; the lowest point since tracking began. The 63% drop in reported civilian vehicle fire injuries from 1980 to 2004 is m larger than the 37% drop in reported vehicle fires and larger still than the 26% drop in reported civilian vehicle fire deaths during the same period.

Figure 3. U.S. Vehicle Fire Injuries by Year: 1980-2004



Source: *Fire Loss in the U.S.* series by Michael J. Karter, Jr.

2004 data came from the NFPA Fire Experience Survey.
The NFPA Fire Analysis and Research Division use two data sources in most of its analyses. The first, the NFPA Annual Fire Experience Survey, provides an overview of the fire experience in the previous year. Each year, all large departments serving populations over 100,000 and one-third of the smaller departments, in a sample stratified by size, are asked about their fire and firefighter injury experience. The final sample of respondents contains roughly one-tenth of all local fire departments. A summary of the fire experience for the previous year is issued in the summer or fall of the following year. The 2004 data cited in this report came from the NFPA survey.

NFIRS data provide the details.
The survey provides the big picture; data from the National Fire Incident Reporting System (NFIRS) fill in the details. Local fire officers complete fire reports describing the facts of the incident – the when, where, what and how of each fire. These reports (or data from these reports) are forwarded to or submitted through state fire agencies. After the states process the data, they forward or release it to the U.S. Fire Administration (USFA). NFIRS is the largest, most detailed source of incident information about fire in the world.

Unfortunately, this data is not available as early as the data from the survey. At the time this report was written, the most current available NFIRS data was from 2002.

Version 5.0 of NFIRS was first introduced in 1999, and NFPA received the national 1999-2002 databases in the Version 5.0 format. However, in 1999, more than 90% of the fires were collected in an older format and converted to Version 5.0. In 2002, 62% of the vehicle fires were originally collected in the Version 5.0 format. The share in Version 5.0 has increased each year. Data definitions and coding rules are not identical in the different versions. Some codes have been added, some combined, and others dropped. New incident types have been introduced to describe specific types of vehicle fires. These include:

Code:	Incident Type
131	Passenger vehicle fire, including cars, buses, and pickup trucks
132	Road freight or transport vehicle fire
133	Rail vehicle fire
134	Water vehicle fire
135	Aircraft fire
136	Self-propelled motor home or recreational vehicle fire
137	Camper or recreational vehicle fire in non-self-propelled vehicle
138	Off-road vehicle or heavy equipment fire
130	Unclassified vehicle fire, including all vehicle fires originally collected in an older version of NFIRS

Some inconsistencies exist between the mobile property type and incident type. As noted earlier, this analysis uses mobile property type for categorization. However, a new field asks if mobile property was or was not involved in ignition and if it burned. Information on the type of vehicle is only required if the vehicle was involved in the ignition. If it was not involved in ignition, the mobile property type is likely to be unreported.

NFIRS and the NFPA Survey were used to develop national estimates.
Because some states and some departments do not participate in NFIRS every year, and reporting practices are not uniform among those who do participate, the raw NFIRS numbers would dramatically underestimate the extent of the fire problem. Total fires, casualties and losses reported to NFIRS are compared to those found in the NFPA Fire Experience Survey. Scaling ratios are then derived to apply to the raw NFIRS numbers to develop national estimates. Analysts from the USFA, the U.S. Consumer Product Safety Commission (CPSC) and the NFPA developed this method of calculating national estimates. A more detailed description of this methodology is found in the appendix.

Five categories of vehicles are discussed in this report.
The remainder of this report details the causes of fires, civilian deaths and injuries, and direct property damage in five separate mobile property classes, as defined by NFIRS. Table 2 gives an overview of fire experience by general class of mobile property. About four of every five vehicle fires involved highway vehicles. To prevent this category of vehicles from obscuring patterns in other types of vehicles, the rest of this report has been divided into sections specific to each class of vehicle.

The broad categories of vehicle types are listed below:

Code	Mobile Property Type
10 - 29	Highway vehicles
30 - 39	Rail transport vehicles
40 - 49	Water transport vehicles
50 - 59	Aircraft
60 - 79	Industrial, agricultural, construction, special and miscellaneous vehicles.

Most of the tables in the remainder of the report show national estimates based on 1999-2002 data. The first table in each section shows estimates of fires and associated losses by year for 1980-2002. The second shows the estimated annual averages of fires, civilian deaths and injuries, and direct property damage for each type of vehicle in that category. Subsequent tables show patterns by month, day of week and time of day. These are followed by tables on the property use where the fire occured and the causal factors: cause, factor contributing to ignition, factor contributing to ignition grouping, heat source, area of origin, and item first ignited. All vehicle fires identified in the NFPA Survey are classified as either highway or other vehicles. In NFIRS, the mobile property type was unknown, unclassified or not reported in 20% of the vehicle fires. These incidents were not allocated proportionally. Consequently, the national estimate of highway vehicle fires is lower in the detailed breakdowns found in this report than in the *Fire Loss in the United States* series of reports.

It is important to remember that there is a certain amount of overlap in the fire cause categories. A short circuit or a part failure may have occurred because the car was not maintained properly or something had worn out. A mechanical malfunction or failure may have resulted from poor maintenance or improper use, or it could be a manufacturer's defect.

Department of Transportation (DOT) has regulatory authority.
The Department of Transportation (DOT) and its divisions regulate vehicles. Questions about regulations or specific makes and models should be addressed to the DOT or its subdivisions. Larry Strawhorn's chapter on "Motor Vehicles" in the 19th edition of NFPA's *Fire Protection Handbook* provides information on the agencies, regulations and standards that pertain to vehicle fires, details on vehicle systems and hazards, information on tank trucks and a bibliography for further reading.[2]

Strawhorn reports that the National Highway Traffic Safety Administration (NHTSA) of DOT is authorized to set minimum safety standards for new motor vehicles and motor vehicle equipment and to investigate defects in motor vehicles, including fire hazards. It may order recalls when necessary.

Since its inception in 1966, the NHTSA has issued four fire-safety standards for new motor vehicles. The Federal Motor Vehicle Safety Standard (FMVSS) 301 was developed to reduce the danger from fuel leakage following crashes involving cars, trucks and buses weighing less than 10,000 pounds.

Federal Motor Vehicle Safety Standard 302 sets flammability standards for the materials used in the driver and passenger area of vehicles. This standard aims to reduce the danger of interior fires caused by matches or smoking. The other two standards address vehicles using compressed natural gas.

Multiple strategies are needed to reduce losses from vehicle fires.
The thrust of efforts to prevent fire and associated losses in the United States has primarily been in making structures (and their occupants and contents) less fire-prone and more fire-safe. The emphasis in home fire safety has focused on installing smoke alarms and home fire sprinklers, redesigning products, and educating the public to take action to protect themselves through fire safety and fire prevention messages. Building codes and standards, safety guidelines, fire detection equipment, and sprinklers have all contributed to more fire-safe non-residential structures.

The fire community has given only intermittent attention to vehicle fires, and that attention has typically focused narrowly on major multiple-death incidents. As in buildings, most vehicle fire deaths occur in ones and twos in private settings such as personal cars. Attempts to further reduce fires and their related losses necessitate strategies that reduce both the occurrence and the severity of vehicle fires.

Vehicle fires are a major component of the fire death problem. In 1999-2002, three-quarters of vehicle fire deaths resulted from highway vehicles fires, with the largest share resulting from automobile fires. Additional and more in-depth fire testing of automobiles can increase our knowledge of how these fires develop. This detailed information can provide engineers with the information needed to develop solutions to the automobile fire death problem (similar to the advances, such as the airbag, which have resulted from collision testing). Through redesign, we can produce more fire-safe automobiles.

[2] Larry Strawhorn, "Motor Vehicles," *Fire Protection Handbook*, 19th edition, Section 14, Chapter 1, p. 14-5, Quincy, MA: NFPA, 2003.

The Society of Automotive Engineers (SAE) sponsored its first program on fire safety at its 2005 World Congress in Detroit in April 2005.

In most categories of vehicles, many, if not most, fire deaths occur in fires following survivable collisions. Additional reductions in vehicle fire deaths may result from public safety programs and studies designed to reduce the number of collisions that occur in the United States. This two-pronged approach would very likely produce a positive impact on the vehicle fire death problem.

The NFPA is a partner in Healthy People 2010. Several objectives pertain to deaths and injuries from motor vehicle crashes. Reducing deaths and injuries from motor vehicle crashes in general and from alcohol-related crashes, reducing the proportion of adolescents who rode with a driver who had been drinking, and making the maximum blood alcohol concentration 0.08% for drivers over 21 years old could decrease the number of people who are killed by fires caused by collisions.[3]

The National Transportation Safety Board released its *Evaluation of U.S. Department of Transportation Efforts in the 1990s to Address Operator Fatigue* in May of 1999. The U.S. Department of Transportation began conducting research on operator fatigue in transportation in 1989. Several transportation agencies have developed public education materials on the subject. Although fatigue is an acknowledged factor in transportation incidents, it was felt that the hours-of-service regulations do not incorporate the latest research findings on fatigue and sleep. The report makes recommendations for improved regulations in this area to several federal agencies involved in transportation. However, these regulations would not apply to the private individual in a personal vehicle.[4]

It is hoped that the information in this report will help individuals, industry and regulatory bodies to devise new ways to lessen the vehicle fire problem.

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[3] Task Force on Community Preventive Services, "Motor-Vehicle Occupant Injury: Strategies for Increasing Use of Child Safety Seats, Increasing Use of Safety Belts, and Reducing Alcohol-Impaired Driving." *MMWR Recommendations and Reports*, May 18, 2001, from http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5007a1.htm.

[4] National Transportation Safety Board, *Safety Report – Evaluation of U.S. Department of Transportation Efforts in the 1990s to Address Operator Fatigue*, Washington, D.C.: NTSB/SR-99/01, PB99-917002, Notation 7155, May 1999, pp. 25-28, from http://www.ntsb.gov/publictn/1999/SR9901.pdf.

U.S. Vehicle Fire Problem, by Year: 1980-2004

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)	Direct Property Damage (in Millions of 2004 Dollars)
1980	471,500	740	4,075	$685	$1,570
1981	466,500	840	3,400	$594	$1,231
1982	443,000	695	3,425	$591	$1,154
1983	447,000	725	3,800	$694	$1,313
1984	454,500	630	3,600	$749	$1,358
1985	455,500	825	3,600	$792	$1,387
1986	456,500	735	3,125	$783	$1,349
1987	471,000	805	3,150	$842	$1,398
1988	477,500	865	2,950	$941	$1,502
1989	435,500	685	3,025	$963	$1,466
1990	436,500	695	3,350	$967	$1,398
1991	428,500	605	3,050	$1,049	$1,453
1992	405,000	730	3,000	$965	$1,298
1993	420,500	595	2,675	$1,030	$1,345
1994	422,000	630	2,625	$1,111	$1,415
1995	406,500	535	2,525	$1,152	$1,426
1996	413,500	710	2,225	$1,333	$1,605
1997	397,000	480	2,125	$1,269	$1,492
1998	381,000	575	2,225	$1,337	$1,549
1999*	368,500	470	1,850	$1,324	$1,499
2000	348,500	465	1,600	$1,381	$1,514
2001	351,500	485	1,925	$1,512	$1,612
2002	329,500	565	1,825	$1,392	$1,460
2003**	312,000	475	1,600	$1,356	$1,392
2004**	297,000	550	1,500	$1,304	$1,304

* Changes introduced in 1999 with Version 5.0 of NFIRS can make it advisable to analyze data from 1999 on separately from earlier years. Most of the statistical information in the remainder of this report is presented as 1999-2002 annual averages. The 2002 data is the most recent available from NFIRS.

**Data from the NFPA survey gives us the statistics on total vehicle fires for 2003 and 2004.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires were estimated to the nearest five hundred, civilian deaths to the nearest five, civilian injuries to the nearest twenty-five, and direct property damage was rounded to the nearest million dollars.

Source: NFPA survey, and "Purchasing Power of the Dollar" custom table from Bureau of Labor Statistics at http://www.bls.gov/cpi/. (Accessed on June 23, 2005).

U.S. Vehicle Fire Problem, by Type of Vehicle
1999-2002 Annual Averages

Vehicle Type	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Highway vehicle	269,890	(77%)	383	(77%)	1,309	(73%)	$1,005	(72%)
Passenger road vehicle	243,830	(70%)	316	(64%)	1,099	(61%)	$796	(57%)
Freight road transport vehicle	26,060	(7%)	67	(13%)	210	(12%)	$209	(15%)
Industrial, agricultural, construction or miscellaneous vehicle	8,350	(2%)	8	(2%)	59	(3%)	$103	(7%)
Industrial, agricultural or construction vehicle	6,930	(2%)	6	(1%)	44	(2%)	$99	(7%)
Miscellaneous mobile property, including home or garden vehicles, armored vehicles, shipping containers, aerial tramways, missiles and space vehicles	1,420	(0%)	1	(0%)	16	(1%)	$4	(0%)
Water vessel	1,490	(0%)	3	(1%)	58	(3%)	$24	(2%)
Rail transport vehicle	770	(0%)	6	(1%)	79	(4%)	$17	(1%)
Aircraft	230	(0%)	35	(7%)	19	(1%)	$12	(1%)
Unclassified or unknown-type mobile property	68,850	(20%)	61	(12%)	278	(15%)	$240	(17%)
Total	349,570	(100%)	496	(100%)	1,802	(100%)	$1,403	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage is rounded to the nearest million dollars. Sums may not equal totals due to rounding errors. Property damage figures are not adjusted for inflation. Percentages were calculated on the actual estimates, so two figures with the same rounded-off estimates may have different percentages.

Source: NFIRS and NFPA survey.

U.S. Water Transport Vehicle Fire Problem

1,490 of these fires, on average, were reported annually in 1999-2002.
During the four-year period of 1999-2002, local fire departments responded to an estimated average of 1,490 water transport vehicle fires per year. These fires caused an estimated annual average of three civilian deaths, 58 civilian fire injuries and $24.4 million in direct property damage. These figures reflect estimates of water transport vehicle fires reported to U.S. fire departments. They do not include fires on the open seas outside of the jurisdiction of a local fire department. Water transport vehicle fires rose 11% from 1,630 in 2001 to 1,810 in 2002. In 1988, the peak year for these incidents, 2,640 water transport vehicle fires were reported. These fires were generally declining through the 1990s, hitting lows of 1,260 in 1999 and 2000. They started to increase again in 2001 and 2002. The estimated total of 1,810 fires in 2002 is only 25% lower than the 2,430 in 1980.

Water transport vehicle fires were a small share of the vehicle fire problem.
In 1999-2002, water transport vehicles accounted for less than 1% of the 349,570 reported vehicle fires, 1% of the 496 vehicle fire deaths, 3% of the 1,802 civilian injuries, and 2% of the $1.4 billion in direct property damage.

Sixty-nine percent of the water transport vehicle fires involved motor craft vessels under 65 feet in length. Personal watercrafts were involved in 7% of these incidents.

Water transport vehicle fires were more common in summer and on weekends.
July was the peak month for these incidents. June ranked second and August was third. These fires were much less common from November through February. The fewest water transport vehicle fires occurred in January and February.

Twenty percent of these fires occurred on Saturday and 17% occurred on Sunday. Water transport vehicle fires were more common in the afternoon and evening. They peaked between 3:00 and 5:59 p.m. The period from noon to 2:59 p.m. ranked second. The smallest share of these fires occurred between 6:00 a.m. and 8:59 a.m.

Water transport vehicle fires occurred on or in a variety of properties.
Many water transport vehicle fires occurred in places other than water properties. Roughly one-quarter (26%) of these vehicle fires began in or on some sort of water property; 11% occurred at one- or two-family dwellings; 10% were on a street, road, or driveway; 8% were at docks, marinas, piers or wharves, 7% were in vehicle parking areas; and 5% were at facilities engaged in motor vehicle or boat sales, service or repair. As previously mentioned, these statistics reflect fires reported to public fire departments only. Fires outside of their jurisdictions are not included.

More than one-third of these fires resulted from equipment failure.
Thirty-seven percent of the water transport vehicle fires were caused by equipment or heat source failures. This was the smallest share of equipment failures seen in the five vehicle groups studied. Some form of electrical failure or malfunction contributed to 27% of these

ignitions. Some form of mechanical factor or malfunction contributed to 15% of these incidents. Exposure to another fire was a contributing factor in 27% of these ignitions, a larger share than was seen for any other type of vehicle. The misuse of a material or product was a contributing factor in 19%. Eighteen percent of these fires were intentionally set, a larger share than was seen in the other vehicle groupings.

Radiated or conducted heat from operating equipment was the heat source in 23% of these fires; arcing was the heat source in 17%.

Thirty percent of the water transport vehicle fires began in the engine, running gear, or wheel area. Fifteen percent originated in the operator or passenger area and 11% started along the exterior or exposed surface of the vessel.

The most common item first ignited was a flammable or combustible liquid or gas.
In roughly one-fourth (24%) of these fires, a flammable or combustible liquid or gas was the item first ignited. These incidents caused 79% of the civilian fire injuries associated with this type of vehicle fire. In 65% of the fires starting with a flammable or combustible liquid or gas, gasoline was the type of material first ignited.

Electrical wire or cable insulation was first ignited in 16% of water transport vehicle fires.

***Fire Protection Handbook's* chapter "Marine Vessels" has more information.**
The chapter "Marine Vessels," revised by Randall Eberly and Guy Colonna, in the 19th edition of the *NFPA Fire Protection Handbook,* provides information on fire prevention and protection in pleasure and small commercial boats as well as ships. A bibliography is included.

Reports of the U.S. National Transportation Safety Board's (NTSB's) recent investigations into marine accidents, including fires, are available on-line at http://www.ntsb.gov/Publictn/M_Acc.htm. In the United Kingdom, the Marine Accident Investigative Branch (MAIB) publishes several editions of *Safety Digest: Lessons from Marine Accident Reports* each year. These reports are available on-line at http://www.maib.gov.uk/home/index.cfm.

U.S. Water Transport Vehicle Fires by Year: 1980-2002

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)	Direct Property Damage (in Millions of 2004 Dollars)
1980	2,430	8	157	$18.8	$41.1
1981	2,500	9	182	$15.5	$30.6
1982	2,260	7	154	$61.8	$115.0
1983	2,260	11	215	$27.4	$49.4
1984	2,360	9	168	$27.9	$48.2
1985	2,250	7	174	$10.5	$17.5
1986	2,390	6	245	$11.9	$19.5
1987	2,420	9	155	$17.6	$27.9
1988	2,640	10	187	$27.7	$42.1
1989	2,170	10	99	$41.1	$59.7
1990	2,280	14	123	$37.5	$51.7
1991	2,150	7	118	$25.9	$34.2
1992	1,820	4	127	$24.6	$31.5
1993	1,710	10	71	$20.3	$25.3
1994	1,620	11	81	$21.9	$26.6
1995	1,710	3	67	$22.7	$26.8
1996	1,470	13	58	$31.4	$36.0
1997	1,530	4	82	$17.7	$19.8
1998	1,370	0	78	$10.7	$11.8
1999*	1,260	2	72	$20.6	$22.3
2000	1,260	6	36	$22.8	$23.9
2001	1,630	0	52	$31.9	$32.4
2002	1,810	4	74	$22.4	$22.4
1980-2002 Annual average	1,970	7	121	$24.8	$35.5
1999-2002 Annual average	1,490	3	58	$24.4	$25.2

* NFIRS data for 1999 and later was received in the Version 5.0 format. Due to the many coding changes, the 1999-2002 data can better be analyzed separately from data from previous years.
Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage is rounded to the nearest hundred thousand dollars. Sums may not equal totals due to rounding errors.
Source: NFIRS and NFPA survey; Table 697 "Purchasing Power of the Dollar: 1950 to 2003" U.S. Census Bureau's *Statistical Abstract of the United Sates: 2004-2005 (124th Edition).*

U.S. Water Transport Vehicle Fires, by Type of Vehicle
1999-2002 Annual Averages

Vehicle Type	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Motor craft under 65 feet in length	1,030	(69%)	1	(48%)	43	(74%)	$12.4	(51%)
Personal water craft*	100	(7%)	0	(0%)	4	(6%)	$0.5	(2%)
Sailboat*	50	(3%)	1	(16%)	2	(4%)	$1.2	(5%)
Commercial fishing or processing vessel	50	(3%)	0	(0%)	2	(4%)	$2.2	(9%)
Vessel over 65 feet but under 1,000 gross tons	30	(2%)	0	(0%)	2	(4%)	$1.1	(4%)
Barge, petroleum balloon or towable water vessel or other non-self propelled vessel	20	(1%)	0	(0%)	0	(0%)	$0.6	(2%)
Cargo or military ship of at least 1,000 tons	10	(1%)	0	(0%)	2	(4%)	$0.4	(2%)
Tank ship	10	(0%)	0	(0%)	0	(0%)	$0.7	(3%)
Unclassified, other or unknown-type water transport vessel	190	(13%)	1	(35%)	2	(4%)	$5.5	(22%)
Total	1,490	(100%)	3	(100%)	58	(100%)	$24.4	(100%)

* The codes for sailboats and personal watercraft are new in Version 5.0 of NFIRS. In earlier versions, sailboats were captured under unclassified water vessels.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage is rounded to the nearest hundred thousand dollars. Sums may not equal totals due to rounding errors. Property damage figures are not adjusted for inflation. Percentages were calculated on the actual estimates, so two figures with the same rounded-off estimates may have different percentages.

Source: NFIRS and NFPA survey.

U.S. Water Transport Vehicle Fires, by Month
1999-2002 Annual Averages

Month	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
January	60	(4%)	0	(0%)	0	(0%)	$1.3	(5%)
February	60	(4%)	1	(16%)	0	(0%)	$2.4	(10%)
March	100	(7%)	1	(35%)	3	(4%)	$1.2	(5%)
April	130	(9%)	0	(0%)	1	(1%)	$3.1	(13%)
May	130	(9%)	0	(0%)	7	(12%)	$0.8	(3%)
June	210	(14%)	0	(14%)	7	(12%)	$6.1	(25%)
July	230	(15%)	1	(18%)	8	(14%)	$1.7	(7%)
August	180	(12%)	0	(0%)	18	(31%)	$1.3	(5%)
September	130	(9%)	0	(0%)	9	(15%)	$1.8	(8%)
October	100	(7%)	0	(0%)	3	(5%)	$2.3	(9%)
November	80	(6%)	0	(0%)	3	(5%)	$1.1	(5%)
December	70	(5%)	1	(16%)	1	(1%)	$1.3	(5%)
Total	1,490	(100%)	3	(100%)	58	(100%)	$24.4	(100%)
Monthly average	120	(8%)	0	(8%)	5	(8%)	$2.0	(8%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage is rounded to the nearest hundred thousand dollars. Sums may not equal totals due to rounding errors. Property damage figures are not adjusted for inflation. Percentages were calculated on the actual estimates, so two figures with the same rounded-off estimates may have different percentages.

Source: NFIRS and NFPA survey.

U.S. Water Transport Vehicle Fires, by Day of Week
1999-2002 Annual Averages

Day of Week	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)
Sunday	250 (17%)	1 (48%)	9 (15%)	$2.6 (11%)
Monday	190 (13%)	0 (0%)	6 (10%)	$3.0 (12%)
Tuesday	170 (12%)	0 (0%)	1 (2%)	$3.6 (15%)
Wednesday	200 (13%)	1 (16%)	10 (17%)	$3.0 (12%)
Thursday	180 (12%)	0 (0%)	4 (7%)	$3.7 (15%)
Friday	200 (14%)	1 (35%)	8 (14%)	$2.6 (11%)
Saturday	290 (20%)	0 (0%)	20 (34%)	$5.9 (24%)
Total	1,490 (100%)	3 (100%)	58 (100%)	$24.4 (100%)
Daily average	210 (14%)	0 (14%)	8 (14%)	$3.5 (14%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage is rounded to the nearest hundred thousand dollars. Sums may not equal totals due to rounding errors. Property damage figures are not adjusted for inflation. Percentages were calculated on the actual estimates, so two figures with the same rounded-off estimates may have different percentages. Fires in which the day of week was unknown or not reported have been allocated proportionally among fires with known day of week.

Source: NFIRS and NFPA survey.

U.S. Water Transport Vehicle Fires, by Time of Day
1999-2002 Annual Averages

Time of Day	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)
12:00 - 2:59 a.m.	160 (11%)	2 (66%)	2 (3%)	$2.6 (11%)
3:00 - 5:59 a.m.	140 (10%)	0 (0%)	1 (2%)	$6.3 (26%)
6:00 - 8:59 a.m.	90 (6%)	0 (0%)	4 (7%)	$1.7 (7%)
9:00 - 11:59 a.m.	180 (12%)	1 (16%)	14 (24%)	$2.8 (11%)
Noon - 2:59 p.m.	240 (16%)	0 (0%)	7 (12%)	$3.4 (14%)
3:00 - 5:59 p.m.	300 (20%)	0 (0%)	14 (23%)	$3.4 (14%)
6:00 - 8:59 p.m.	220 (14%)	1 (18%)	11 (18%)	$1.8 (7%)
9:00 - 11:59 p.m.	160 (11%)	0 (0%)	6 (10%)	$2.4 (10%)
Total	1,490 (100%)	3 (100%)	58 (100%)	$24.4 (100%)
Average	190 (13%)	0 (13%)	7 (13%)	$3.1 (13%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage is rounded to the nearest hundred thousand dollars. Sums may not equal totals due to rounding errors. Property damage figures are not adjusted for inflation. Percentages were calculated on the actual estimates, so two figures with the same rounded-off estimates may have different percentages.

Source: NFIRS and NFPA survey.

U.S. Water Transport Vehicle Fires, by Fixed Property Use
1999-2002 Annual Averages

Fixed Property Use	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified or unknown-type water area	180	(12%)	1	(30%)	12	(21%)	$5.4	(22%)
Lake, river or stream	160	(11%)	0	(0%)	8	(13%)	$1.1	(4%)
One- or two-family dwelling	160	(11%)	0	(0%)	5	(8%)	$1.6	(6%)
Street, road or driveway	150	(10%)	0	(0%)	2	(3%)	$1.5	(6%)
Dock, marina, pier or wharf	120	(8%)	1	(16%)	13	(23%)	$2.9	(12%)
Vehicle parking area	100	(7%)	0	(0%)	1	(1%)	$0.6	(2%)
Motor vehicle or boat sales, services or repair	80	(5%)	0	(0%)	3	(5%)	$3.3	(14%)
Open land or field	60	(4%)	1	(18%)	0	(0%)	$0.2	(1%)
Open ocean, sea or tidal waters	60	(4%)	0	(0%)	2	(4%)	$1.8	(7%)
Unclassified outside or special property	50	(4%)	1	(35%)	2	(3%)	$0.9	(4%)
Vehicle storage or parking garage	30	(2%)	0	(0%)	2	(3%)	$0.2	(1%)
Highway or divided highway	30	(2%)	0	(0%)	0	(0%)	$0.1	(0%)
Unclassified or unknown-type road property	30	(2%)	0	(0%)	0	(0%)	$0.2	(1%)
Manufacturing or processing	20	(1%)	0	(0%)	4	(7%)	$0.5	(2%)
Graded or cared-for plot of land*	20	(1%)	0	(0%)	0	(0%)	$0.1	(0%)
Unclassified or unknown-type residential property	20	(1%)	0	(0%)	0	(0%)	$0.1	(1%)
Vacant lot	20	(1%)	0	(0%)	0	(0%)	$0.1	(1%)
Yacht club	10	(1%)	0	(0%)	0	(0%)	$0.1	(0%)
Service station or gas station	10	(1%)	0	(0%)	1	(2%)	$0.1	(0%)
Other known property use	60	(4%)	0	(0%)	4	(7%)	$0.7	(3%)
Unclassified or unknown-type property use	130	(9%)	0	(0%)	1	(1%)	$2.8	(11%)
Total	1,490	(100%)	3	(100%)	58	(100%)	$24.4	(100%)

* This is a new code in Version 5.0 and is consequently underreported relative to the others.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage is rounded to the nearest hundred thousand dollars. Sums may not equal totals due to rounding errors. Property damage figures are not adjusted for inflation. Percentages were calculated on the actual estimates, so two figures with the same rounded-off estimates may have different percentages.

Source: NFIRS and NFPA survey.

U.S. Water Transport Vehicle Fires, by Cause
1999-2002 Annual Averages

Cause	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)
Failure of equipment or heat source	550 (37%)	* (*%)	22 (38%)	$8.4 (34%)
Unintentional	450 (30%)	* (*%)	34 (58%)	$8.2 (33%)
Intentional	270 (18%)	* (*%)	1 (1%)	$2.4 (10%)
Act of nature	20 (1%)	* (*%)	1 (2%)	$0.1 (0%)
Unclassified cause	200 (13%)	* (*%)	1 (1%)	$5.4 (22%)
Total	1,490 (100%)	3 (100%)	58 (100%)	$24.4 (100%)

*The causes of all fire deaths in these vehicles during this period were undetermined or not reported.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage is rounded to the nearest hundred thousand dollars. Sums may not equal totals due to rounding errors. Property damage figures are not adjusted for inflation. Percentages were calculated on the actual estimates, so two figures with the same rounded-off estimates may have different percentages. Fires in which the cause was under investigation, undetermined or not reported were allocated proportionally among fires with known cause.

Source: NFIRS and NFPA survey.

U.S. Water Transport Vehicle Fires, by Factor Contributing to Ignition
1999-2002 Fires Reported to U.S. Fire Departments in NFIRS Version 5.0

Factor Contributing to Ignition	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage
Exposure fire	27%	*%	0%	34%
Unclassified electrical failure or malfunction	11%	*%	4%	8%
Unclassified mechanical failure or malfunction	8%	*%	4%	3%
Unclassified factor contributed to ignition	8%	*%	4%	20%
Unspecified short circuit arc	7%	*%	16%	6%
Heat source too close to combustible material.	6%	*%	12%	13%
Flammable liquid or gas spilled	4%	*%	20%	7%
Short circuit arc from defective, worn insulation	3%	*%	0%	0%
Leak or break	3%	*%	3%	1%
Backfire	3%	*%	4%	1%
Unclassified misuse of material or product	2%	*%	0%	2%
Arc or spark from operating equipment	2%	*%	4%	1%
Abandoned or discarded material or product	2%	*%	0%	2%
Cutting or welding too close to combustible material	2%	*%	0%	0%
Improper startup	2%	*%	12%	0%
Unclassified operational deficiency	2%	*%	0%	0%
Short circuit arc from mechanical damage	1%	*%	0%	0%
Water caused short-circuit arc	1%	*%	0%	0%
Playing with heat source	1%	*%	0%	0%
Unattended equipment	1%	*%	0%	0%
Arc from faulty contact or broken conductor	1%	*%	4%	0%
Flammable liquid used to kindle fire	1%	*%	0%	0%
Collision, knock-down or overturn	1%	*%	0%	0%
Improper fueling technique	1%	*%	15%	0%
Storm	1%	*%	0%	0%
Outside or open fire for debris or waste disposal	1%	*%	0%	0%
Equipment not operated properly	1%	*%	0%	0%
Unintentionally turned on or not turned off	1%	*%	8%	0%
Automatic control failure	1%	*%	0%	1%
Worn out	1%	*%	0%	0%
Equipment not used for intended purpose	1%	*%	0%	0%
Installation deficiency	1%	*%	0%	3%
Other known factor	1%	*%	4%	0%

U.S. Water Transport Vehicle Fires, by Factor Contributing to Ignition
Version 5.0 Data Only
1999-2002 Fires Reported to U.S. Fire Departments in NFIRS Version 5.0
(Continued)

* Factors contributing to ignition in all fire deaths in these vehicles during this period were undetermined or not reported.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. More than one factor contributing to ignition may be entered per incident. Fires, in which the factor contributing to ignition was undetermined, not reported, or coded as "none" were allocated proportionally among fires with known factor contributing to ignition. Although this field is not required for fires that were coded as intentionally set or attributed to a cause of "other", the share of incidents with unreported data (fires - 17%, deaths - 100%, injuries – 18%, property damage – 9%) or fires with "none" (fires - 26%, deaths - 0%, injuries – 6%, property damage – 15%) generally exceeded those for undetermined (fires - 8%, deaths - 0%, injuries – 8%, property damage – 8%) suggesting that this type of allocation would be most appropriate.

Source: NFIRS and NFPA survey.

U.S. Water Transport Vehicle Fires, by Factor Contributing to Ignition Grouping
1999-2002 Fires Reported to U.S. Fire Departments in NFIRS Version 5.0

Factor Contributing to Ignition	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage
Fire spread or control	**28%**	***%**	**0%**	**34%**
Exposure fire	27%	*%	0%	34%
Outside or open fire for debris or waste disposal	1%	*%	0%	0%
Electrical failure or malfunction	**27%**	***%**	**29%**	**16%**
Unclassified electrical failure or malfunction	11%	*%	4%	8%
Unspecified short circuit arc	7%	*%	16%	6%
Short circuit arc from defective, worn insulation	3%	*%	0%	0%
Arc or spark from operating equipment	2%	*%	4%	1%
Short circuit arc from mechanical damage	1%	*%	0%	0%
Water caused short-circuit arc	1%	*%	0%	0%
Arc from faulty contact or broken conductor	1%	*%	4%	0%
Misuse of material or product	**19%**	***%**	**46%**	**25%**
Heat source too close to combustible material.	6%	*%	12%	13%
Flammable liquid or gas spilled	4%	*%	20%	7%
Unclassified misuse of material or product, other	2%	*%	0%	2%
Abandoned or discarded material or product	2%	*%	0%	2%
Cutting or welding too close to combustible material	2%	*%	0%	0%
Playing with heat source	1%	*%	0%	0%
Flammable liquid used to kindle fire	1%	*%	0%	0%
Improper fueling technique	1%	*%	15%	0%
Mechanical failure or malfunction	**15%**	***%**	**12%**	**5%**
Unclassified mechanical failure or malfunction	8%	*%	4%	3%
Leak or break	3%	*%	3%	1%
Backfire	3%	*%	4%	1%
Automatic control failure	1%	*%	0%	1%
Worn out	1%	*%	0%	0%

U.S. Water Transport Vehicle Fires, by Factor Contributing to Ignition Grouping
1999-2002 Fires Reported to U.S. Fire Departments in NFIRS Version 5.0
(Continued)

Factor Contributing to Ignition	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage
Operational deficiency	**7%**	***%**	**24%**	**1%**
Improper startup	2%	*%	12%	0%
Unclassified operational deficiency	2%	*%	0%	0%
Unattended equipment	1%	*%	0%	0%
Collision, knock-down or overturn	1%	*%	0%	0%
Equipment not operated properly	1%	*%	0%	0%
Unintentionally turned on or not turned off	1%	*%	8%	0%
Equipment not used for intended purpose	1%	*%	0%	0%
Natural condition	**1%**	***%**	**0%**	**0%**
Storm	1%	*%	0%	0%
Design, manufacturing or installation deficiency	**1%**	***%**	**0%**	**3%**
Installation deficiency	1%	*%	0%	3%
Unclassified factor contributed to ignition	**8%**	***%**	**4%**	**20%**

* Factors contributing to ignition in all fire deaths in these vehicles during this period were undetermined or not reported.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. More than one factor contributing to ignition may be entered per incident. Fires, in which the factor contributing to ignition was undetermined, not reported, or coded as "none" were allocated proportionally among fires with known factor contributing to ignition. Although this field is not required for fires that were coded as intentionally set or attributed to a cause of "other", the share of incidents with unreported data (fires - 17%, deaths - 100%, injuries – 18%, property damage – 9%) or fires with "none" (fires - 26%, deaths - 0%, injuries – 6%, property damage – 15%) generally exceeded those for undetermined (fires - 8%, deaths - 0%, injuries – 8%, property damage – 8%) suggesting that this type of allocation would be most appropriate.

Source: NFIRS and NFPA survey.

U.S. Water Transport Vehicle Fires, by Heat Source
1999-2002 Annual Averages

Heat Source	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)
Arcing	250 (17%)	* (*%)	24 (41%)	$2.7 (11%)
Heat from unclassified powered equipment	170 (12%)	* (*%)	6 (10%)	$2.5 (10%)
Spark, ember or flame from operating equipment	170 (11%)	* (*%)	12 (20%)	$4.5 (18%)
Heat from direct flame or convection currents	150 (10%)	* (*%)	0 (0%)	$5.5 (23%)
Radiated or conducted heat from operating equipment	120 (8%)	* (*%)	8 (13%)	$3.5 (14%)
Radiated heat from another fire	100 (7%)	* (*%)	0 (0%)	$1.0 (4%)
Unclassified heat source	80 (5%)	* (*%)	1 (2%)	$1.3 (5%)
Heat from unclassified or unknown-type open flame or smoking materials	80 (5%)	* (*%)	2 (4%)	$0.7 (3%)
Unclassified heat spread from another fire	70 (5%)	* (*%)	2 (3%)	$0.8 (3%)
Match	50 (3%)	* (*%)	0 (0%)	$0.3 (1%)
Unclassified hot or smoldering object	40 (3%)	* (*%)	1 (2%)	$0.6 (2%)
Backfire from internal combustion engine	40 (3%)	* (*%)	1 (2%)	$0.2 (1%)
Fireworks	20 (1%)	* (*%)	0 (0%)	$0.0 (0%)
Cigarette lighter	20 (1%)	* (*%)	0 (0%)	$0.1 (0%)
Cigarette	20 (1%)	* (*%)	0 (0%)	$0.1 (0%)
Hot ember or ash	20 (1%)	* (*%)	0 (0%)	$0.0 (0%)
Heat or spark from friction	10 (1%)	* (*%)	1 (2%)	$0.0 (0%)
Lightning	10 (1%)	* (*%)	1 (2%)	$0.1 (0%)
Molten or hot material	10 (1%)	* (*%)	0 (0%)	$0.0 (0%)
Multiple heat sources, including multiple ignitions	10 (1%)	* (*%)	0 (0%)	$0.2 (1%)
Incendiary device	10 (1%)	* (*%)	0 (0%)	$0.1 (0%)
Flying brand, ember or spark	10 (1%)	* (*%)	0 (0%)	$0.2 (1%)
Other known heat source	30 (2%)	* (*%)	0 (0%)	$0.1 (0%)
Total	1,490 (100%)	3 (100%)	58 (100%)	$24.4 (100%)

* The heat sources were unreported or undetermined in all water transport vehicle fire deaths during this time period.
Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and an injury to the nearest one and direct property is rounded damage to the nearest hundred thousand dollars. Sums may not equal totals due to rounding errors. Property damage figures are not adjusted for inflation. Percentages were calculated on the actual estimates, so two figures with the same rounded-off estimates may have different percentages. Fires in which the heat source was undetermined or not reported were allocated proportionally among fires with known heat source.
Source: NFIRS and NFPA survey.

U.S. Water Transport Vehicle Fires, by Area of Fire Origin
1999-2002 Annual Averages

Area of Fire Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Engine area, running gear or wheel area	450	(30%)	0	(0%)	28	(49%)	$7.1	(29%)
Operator or passenger area of vehicle	220	(15%)	1	(20%)	5	(8%)	$3.4	(14%)
Exterior or exposed surface of vehicle	160	(11%)	0	(0%)	0	(0%)	$1.4	(6%)
Unclassified vehicle area	120	(8%)	1	(17%)	2	(4%)	$1.4	(6%)
Fuel tank or fuel line	70	(5%)	0	(0%)	12	(20%)	$0.5	(2%)
Separate operator or control area of vehicle	70	(4%)	1	(43%)	1	(1%)	$0.6	(3%)
Unclassified area of origin	60	(4%)	0	(0%)	1	(2%)	$1.2	(5%)
Unclassified outside area	40	(3%)	0	(0%)	0	(0%)	$0.2	(1%)
Vehicle storage area, garage or carport	40	(2%)	0	(0%)	0	(0%)	$1.4	(6%)
Open outside area, including farmland or field	30	(2%)	0	(0%)	0	(0%)	$0.1	(0%)
Kitchen or cooking area	30	(2%)	0	(0%)	3	(6%)	$2.8	(11%)
Unclassified storage area	20	(2%)	0	(0%)	0	(0%)	$0.1	(0%)
Bedroom or sleeping area	20	(1%)	1	(20%)	1	(1%)	$0.5	(2%)
Cargo or trunk area of vehicle	20	(1%)	0	(0%)	0	(0%)	$0.1	(0%)
Exterior wall surface	20	(1%)	0	(0%)	2	(3%)	$0.1	(0%)
Machinery room or area	10	(1%)	0	(0%)	0	(0%)	$0.1	(0%)
Multiple areas of origin	10	(1%)	0	(0%)	0	(0%)	$0.6	(2%)
Unclassified function area	10	(1%)	0	(0%)	1	(1%)	$0.4	(2%)
On or near highway, parking lot or street	10	(1%)	0	(0%)	0	(0%)	$0.1	(0%)
Bathroom, lavatory, locker room or check room	10	(1%)	0	(0%)	1	(1%)	$0.4	(2%)
Other known area	80	(5%)	0	(0%)	2	(4%)	$2.3	(9%)
Total	1,490	(100%)	3	(100%)	58	(100%)	$24.4	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage is rounded to the nearest hundred thousand dollars. Sums may not equal totals due to rounding errors. Property damage figures are not adjusted for inflation. Percentages were calculated on the actual estimates, so two figures with the same rounded-off estimates may have different percentages. Fires in which the area or origin was unknown or not reported were allocated proportionally among fires with known area of origin.

Source: NFIRS and NFPA survey.

U.S. Water Transport Vehicle Fires, by Item First Ignited
1999-2002 Annual Averages

Item First Ignited	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)
Flammable or combustible liquid or gas, including accelerants, aerosols, and atomized vapor	360 (24%)	0 (0%)	46 (79%)	$4.8 (20%)
Unclassified item first ignited	250 (16%)	0 (0%)	4 (6%)	$2.9 (12%)
Electrical wire or cable insulation	230 (16%)	0 (0%)	0 (0%)	$2.6 (11%)
Multiple items first ignited	150 (10%)	0 (0%)	0 (0%)	$6.5 (27%)
Unclassified structural component or finish	60 (4%)	0 (0%)	1 (2%)	$2.6 (10%)
Upholstered sofa, chair or vehicle seat	60 (4%)	3 (100%)	1 (1%)	$0.7 (3%)
Tarpaulin or tent	60 (4%)	0 (0%)	0 (0%)	$0.3 (1%)
Exterior wall covering or finish	40 (2%)	0 (0%)	0 (0%)	$0.2 (1%)
Rubbish, trash, or waste	20 (1%)	0 (0%)	0 (0%)	$0.1 (0%)
Cabinetry, including built-in cabinetry	20 (1%)	0 (0%)	1 (2%)	$0.4 (2%)
Unclassified flammable or combustible liquid, piping or filter	20 (1%)	0 (0%)	2 (4%)	$0.1 (0%)
Floor covering, rug, carpet or mat	20 (1%)	0 (0%)	0 (0%)	$0.1 (0%)
Awning or canopy	20 (1%)	0 (0%)	0 (0%)	$0.1 (0%)
Grass or light vegetation, excluding crops	10 (1%)	0 (0%)	0 (0%)	$0.0 (0%)
Structural member or framing	10 (1%)	0 (0%)	0 (0%)	$0.1 (0%)
Mattress or bedding	10 (1%)	0 (0%)	1 (1%)	$0.6 (3%)
Box, carton, bag, basket or barrel	10 (1%)	0 (0%)	0 (0%)	$0.0 (0%)
Unclassified adornment or recreational material or sign	10 (1%)	0 (0%)	0 (0%)	$0.0 (0%)
Unclassified furniture or utensil	10 (1%)	0 (0%)	0 (0%)	$0.0 (0%)
Other known item	120 (8%)	0 (0%)	3 (6%)	$2.3 (10%)
Total	1,490 (100%)	3 (100%)	58 (100%)	$24.4 (100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one, and direct property damage is rounded to the nearest hundred thousand dollars. Sums may not equal totals due to rounding errors. Property damage figures are not adjusted for inflation. Percentages were calculated on the actual estimates, so two figures with the same rounded-off estimates may have different percentages. Fires in which the item first ignited was unknown or not reported were allocated proportionally among fires with known item first ignited.

Source: NFIRS and NFPA survey.

U.S. Water Transport Vehicle Fires in which a Flammable or Combustible Liquid or Gas was the Item First Ignited by Type of Material First Ignited 1999-2002 Annual Averages

Type of Material	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Gasoline	230	(65%)	0	(NA)	25	(54%)	$2.1	(43%)
Unclassified or unknown-type flammable gas	40	(12%)	0	(NA)	4	(8%)	$0.4	(9%)
Unclassified or unknown-type flammable or combustible liquid	20	(6%)	0	(NA)	1	(2%)	$1.1	(22%)
Class II combustible liquid, including kerosene, numbers 1 and 2 fuel oil and diesel fuel	10	(4%)	0	(NA)	0	(0%)	$0.9	(18%)
Plastic	10	(3%)	0	(NA)	0	(0%)	$0.0	(1%)
Class IA flammable liquid, including ether and pentane	10	(2%)	0	(NA)	10	(22%)	$0.1	(3%)
LP gas	10	(2%)	0	(NA)	3	(7%)	$0.0	(1%)
Other known type of material	20	(6%)	0	(NA)	3	(7%)	$0.1	(2%)
Total	360	(100%)	0	(NA)	46	(100%)	$4.8	(100%)

NA – Not applicable.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, civilian deaths and injuries to the nearest ten, and direct property damage is rounded to the nearest million dollars. Sums may not equal totals due to rounding errors. Property damage figures are not adjusted for inflation. Percentages were calculated on the actual estimates, so two figures with the same rounded-off estimates may have different percentages. This table includes a proportional share of fires in which the item first ignited was unknown or not reported. Fires in which the type of material first ignited was unknown or not reported were allocated proportionally among fires with known type of material first ignited.

Source: NFIRS and NFPA survey.

Appendix A: How National Estimates Statistics Are Calculated

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

Databases Used

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

The strength of NFIRS is that it provides the most detailed incident information of any national 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. (The NFPA survey separates fewer than 20 property use categories and solicits no cause-related information except for intentional fires.) NFIRS also captures information on area of origin, material first ignited and on the performance of detectors and sprinklers.

The NFPA survey is based on a stratified random sample of roughly 3,000 U.S. fire departments (or just over one of every ten fire departments in the country). The survey includes the following information: (1) the total number of fire incidents, civilian deaths, and civilian injuries, and the total estimated property damage (in dollars), for each of the major property use classes defined by the NFPA 901 Standard or Version 5.0 of NFIRS; (2) the number of on-duty firefighter injuries, by type of duty and nature of illness; and (3) information on the type of community protected (e.g., county versus township versus city) and the size of the population protected, which is used in the statistical formula for projecting national totals from sample results.

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

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

Projecting NFIRS to National Estimates

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

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

For example, the scaling ratio for 1998 civilian deaths in residential structures is equal to the total number of 1998 civilian deaths in residential structure fires reported to fire departments, according to the NFPA survey (3,250), divided by the total number of 1998 civilian deaths in residential structure fires reported to NFIRS (1,224). Therefore, the scaling ratio is 3,250/1,224 = 2.66.

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

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

Calculating National Estimates of Particular Types of Fires

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

cause-related characteristics most commonly used to describe fires are: form of heat of ignition or heat source that caused the ignition, equipment involved in ignition, form or item and type of material first ignited, the ignition factor or factor contributing to ignition that brought heat source and ignited material together, and area of origin. Version 5.0 added a cause field in which fires can be classified as intentional, unintentional, or resulting from the failure of equipment or heat source. Other characteristics of interest are victim characteristics, such as ages of persons killed or injured in fire.

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

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

In this report, unknown areas of origin, ignition factors or factors contributing to ignition, forms or items of material first ignited, and types of material first ignited were allocated over the known. Only those factors which rounded to at least 100 fires for highway vehicles or 10 fires (i.e., averaged at least 5 fires a year) for other vehicles and had a 1% or greater share of fires were listed separately. Anything else was grouped in the “other known” category.

On the tables showing ignition factor groupings, the group or category heading was listed even if the number of fires rounded to less than ten or one percent. The values listed in the ignition factor group headings add up to the total for that vehicle classification. Specific factors contributing to ignition were included in these tables only if they met the threshold cited in the previous paragraph. Consequently, the entries within a factor contributing to ignition group often do not sum to the group total. If the unclassified and unknown-type data combination in a group met or exceeded the threshold, this value was listed after those for which the specific ignition factor or type of material was known.

In the highway vehicle section, fires were rounded to the nearest hundred, civilian deaths and injuries were rounded to the nearest ten, and direct property damage was rounded to the nearest million. In all other sections, fires were rounded to the nearest ten, deaths and injuries were rounded off to the nearest one, and direct property damage was rounded to

the nearest hundred thousand. Inflation adjustments are provided in trend tables only. The annual averages are not adjusted for inflation. Because of rounding errors, the four-year annual averages may differ slightly from that obtained from averages based on the fire problem by year.

Version 5.0 of NFIRS changed, added and dropped some of the codes used and some of the coding rules. Much of the former "Ignition Factor" converts to "Factor Contributing to Ignition." However, incendiary and suspicious convert to intentional in the cause category. Fires that had been coded as incendiary or suspicious or that resulted from one of several human factors have been removed from and left blank in "Factor Contributing to Ignition" because they are captured elsewhere. Some codes from Form of Heat of Ignition (particularly electrical codes) convert to "Factor Contributing to Ignition." Because two entries are allowed for this field, the conversion process causes some double counting of certain factors. In Version 5.0, "none" is also a valid choice for this field.

Version 5.0 also introduced three digit incident types, which in some cases; identify a class of mobile property type. However, all vehicle fires that were collected in an older version converted to "other vehicle fire." In addition, the mobile property type is no longer required if the vehicle was not involved in the ignition. In practice, it appears that fire departments are entering this information for most fires. This analysis used mobile property type to assign the vehicles to a specific property class.

No allocation of unknowns was done for mobile property type or fixed property use. Consequently, the estimated number of highway vehicles is lower in this analysis than in the estimates derived from NFPA's annual fire department survey.

Rounding Errors

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

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

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

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

In case 2, suppose 15 of the possible items first ignited each accounted for 2 deaths in 5 years. Then there would be 15 entries of 215 = 0.4, rounded to 0, and the sum would be 0, compared to the true total of 6.

Here is another example: Suppose there was an estimate of 7 deaths total in 1994 through 1998. The 5-year average would be 1.4, which would round to 1; the number we would show as the total. Each death would represent a 5-year average of 0.2.

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

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

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