VACANT BUILDING FIRES

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April 2009

National Fire Protection Association
Fire Analysis and Research Division

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Abstract

In 2003-2006, U.S. fire departments responded to an estimated average of 31,000 structure fires in vacant buildings per year. These fires resulted in an average of 50 civilian deaths, 141 civilian, 4,500 firefighter injuries, and $642 million in direct property damage per year. Forty-three percent of these fires were intentionally set. From 2005 to 2006, vacant building fires in all properties rose 2%, while fires in vacant homes rose 11%. These estimates are based on data from Version 5.0 of the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA's) annual fire department experience survey.

Previously published incident descriptions are included in the Appendix to better illustrate how these fires can happen.

Keywords: fire statistics, vacant buildings,

Acknowledgements

The National Fire Protection Association thanks all the fire departments and state fire authorities who participate in the National Fire Incident Reporting System (NFIRS) and the annual NFPA fire experience survey. These firefighters are the original sources of the detailed data that make this analysis possible. Their contributions allow us to estimate the size of the fire problem.

We are also grateful to the U.S. Fire Administration for its work in developing, coordinating, and maintaining NFIRS.

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Executive Summary

Fires in vacant buildings have become a matter of increasing concern as the economy has weakened. In 2003-2006, U.S. fire departments responded to an estimated average of 31,000 structure fires in vacant buildings per year. These fires resulted in an average of 50 civilian deaths, 141 civilian injuries, and $642 million in direct property damage per year. Based on annual averages for 2003-2006, the 31,000 reported vacant structure fires accounted for 6% of the 520,100 structure fires, 2% of the 3,125 civilian structure fire deaths, 1% of the 15,200 civilian structure fire injuries, and 7% of the $9.0 billion in direct property loss.

These statistics are national estimates of fires reported to U.S. municipal fire departments based on the detailed information collected in Version 5.0 of the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS 5.0) and the National Fire Protection Association's (NFPA's) annual fire department experience survey.

Vacant building fires increased by 2% from 31,900 in 2005 to 32,700 in 2006. The increase was similar to the 3% increase in all structure fires. Fires in vacant homes increased more than vacant building fires overall. Vacant home fires increased 11% from 18,900 in 2005 to 21,000 in 2006 compared to a 4% increase in overall home fires during the same period. The U.S. Census Bureau's Housing Vacancy Survey found that the number of vacant housing units grew by 5% from 15.7 million in 2005 to 16.4 million in 2006, by 7% from 2006 to 17.7 million in 2007, and by 6% from 2007 to 18.7 million units in 2008.

During 2003-2006, 63% of the reported vacant building fires occurred in homes, including 58% in one-or two-family dwellings and 5% in apartments or multiple family properties. Home fires overall (including both vacant and occupied), accounted for 73% of reported structure fires during this time.[1]

Vacant buildings should be secured and combustible materials removed. Section 10.13 of the 2009 edition of NFPA® 1, *Fire Code* requires owners or those in charge of vacant properties to remove waste and combustible materials and to secure the building to prevent unauthorized people from entering. Fire protection systems are to be maintained unless the authority having jurisdiction grants permission to have them removed from service. Despite these requirements, half of the reported vacant building fires were in properties that were unsecured.

Automatic extinguishing equipment was found in only 2% of vacant building fires. The equipment operated in two-thirds (68%) of fires considered large enough to activate the equipment, but failed to operate in 31%. In 82% of the fires in which the equipment failed to operate, the system had been shut off.

Fires in vacant buildings pose a danger to the neighborhood. Flame damage spread beyond the structure in 9% of the fires in secured vacant properties and 12% of unsecured properties, compared to only 3% of structure fires overall.

[1] Marty Ahrens. *Home Structure Fires,* Quincy, MA: National Fire Protection Association, 2009, p. 3.

Fires in vacant buildings are more likely to have been intentionally set than other structure fires. Forty-three percent of reported vacant building fires during this period were intentionally set, compared to 10% of structure fires overall. Vacant buildings accounted for 25% of all intentionally set structure fires. Intentional fires were much more common in unsecured vacant properties (57%) than in those that had been secured (31%). Other leading causes of vacant building fires were exposure to other fires (8%), heating equipment (also 8%), electrical distribution or lighting equipment (7%), cooking equipment (5%), someone, typically a child, playing with heat source (4%), and smoking materials (3%). When equipment is listed as the cause of the fire, it means that the equipment provided the heat that started the fire. It does not mean that the equipment malfunctioned or failed. Hot embers and ashes were the most common heat source in vacant building fires.

Vacant building fires are more common on weekends and less common between 6:00 a.m. and noon. Vacant building fires were spread out throughout the year, but certain holidays with some more raucous traditions stand out. The four peak days were July 4, July 5, January 1, and October 31.

Vacant building fires pose a threat to firefighters. During the ten-year period 1998-2007, a total of 15 firefighters were fatally injured at the scene of vacant structure fires. On average, 4,500 firefighters were injured at vacant building fires annually during 2003-2006. These account for 13% of the reported firefighter injuries incurred at structure fires per year during this period.

InterFire has a number of resources related to vacant building fires and fire prevention on its website at http://www.interfire.org/features/vacantbuildings.asp, including a draft ordinance to address blight. The best way to prevent vacant building fires is to prevent vacant buildings. The National Vacant Properties Campaign's website http://vacantproperties.org/strategies/tools.html describes a number of strategies to address the problem of vacant properties and provides examples of how these strategies have been used. Based on the findings of the Urban Fire Safety Project, NFPA recommends that local fire departments and the national fire service partner with financial institutions and other organizations to prevent home foreclosures and home abandonment."[2] Vacant building arson is also addressed in the Arson Prevention PowerPoint Presentation developed by NFPA and Columbus Division of Fire. The presentation, intended for use by local fire departments and community organizations is available at www.nfpa.org/assets/files//PDF/Public%20Education/NFPAarsonpresentation.ppt.

[2] Robert Adams, Judy Comoletti, Sharon Gamache, John Hall, and Pat Mieszala**.** *Urban Fire Safety Project: Report to the NFPA Board of Directors and the Metropolitan Fire Chiefs Association*, November 2007, p. 26, online at http://www.nfpa.org/assets/files//PDF/Member%20Sections/Urban_Report.pdf.

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Vacant Building Fires Fact Sheet

In 2003-2006, U.S. fire departments responded to an estimated average of 31,000 structure fires in vacant buildings. These fires resulted in an average of 50 civilian deaths, 141 civilian injuries, and $642 million in direct property damage per year.

- 4,500 firefighters were injured annually at these incidents.
- Only 6% of all reported structure fires were at vacant buildings, but they accounted for 13% of the firefighter injuries incurred at structure fires.
- From 1998 to 2007, 15 firefighters were fatally injured at vacant building fires.

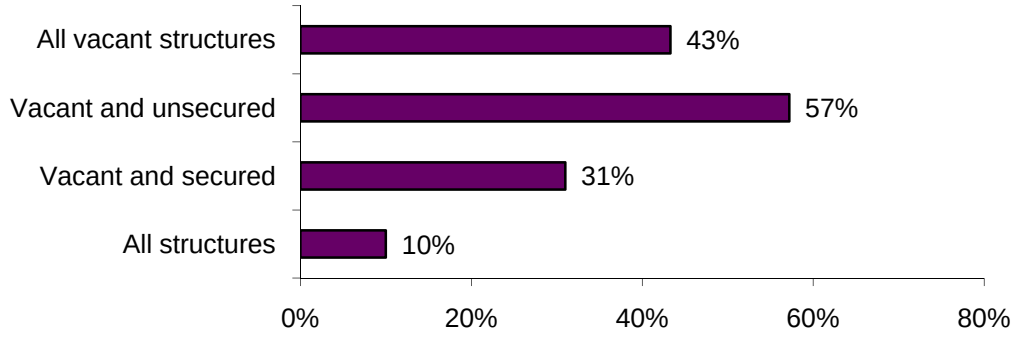
Vacant building fires increased by 2% from 31,900 in 2005 to 32,700 in 2006. The increase was similar to the 3% increase in all structure fires.

Sixty-three percent of vacant building fires in 2003-2006 occurred in homes, with 58% in one-or two-family dwellings and 5% in apartments.

- Vacant home fires increased 11% from 18,900 in 2005 to 21,000 in 2006. Home fires in general increased by only 4%.
- The U.S. Census Bureau's Housing Vacancy Survey found that the number and percent of housing units vacant has been increasing steadily since 2005.

The four peak days for vacant building fires were July 4, July 5, October 31, and January 1.

Intentional Structure Fires by Structure Status: 2003-2006



Forty-three percent of vacant building fires were intentionally set. Vacant buildings accounted for 25% of all intentionally set structure fires.

- In unsecured properties, 57% of the fires were intentional.
- Only 31% of the fires in secured properties were intentional.

Vacant buildings that burned were evenly divided into secured (15,400) and unsecured (15,600).

- Flame damage spread beyond the structure in 9% of the fires in secured and 12% of unsecured properties.
- Flame damage extended beyond the structure of origin in only 3% of structure fires overall.

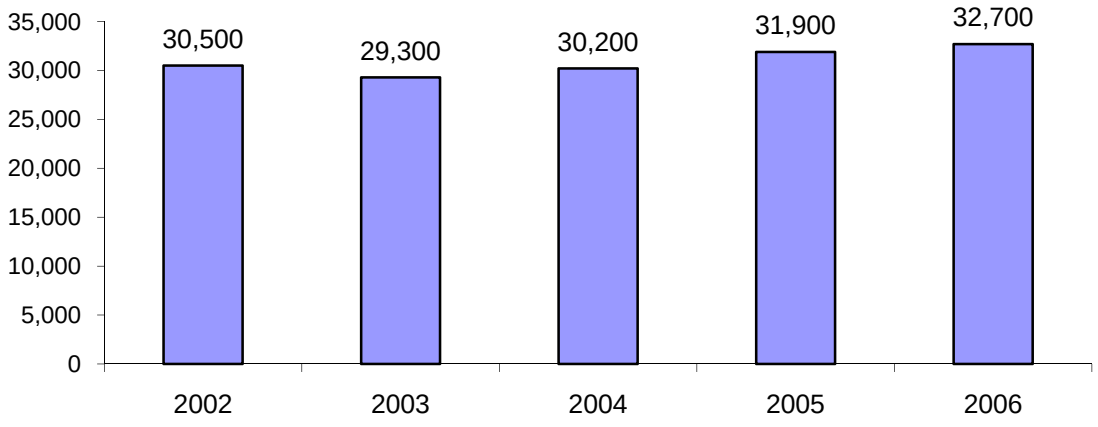
Vacant Building Fires

31,000 structure fires, on average, were reported in vacant buildings per year.
Fires in vacant buildings have become a matter of increasing concern as the economy has weakened. In 2003-2006, U.S. fire departments responded to an estimated average of 31,000 structure fires in vacant buildings per year. These fires resulted in an average of 50 civilian deaths, 141 civilian injuries, and $642 million in direct property damage per year.

Table 1 shows that the 31,000 reported vacant structure fires accounted for 6% of the 520,100 structure fires, 2% of the 3,125 civilian structure fire deaths, 1% of the 15,200 civilian structure fire injuries, and 7% of the $9.0 billion in direct property loss reported per year during that period.

Figure 1 shows that these fires increased by 2% from 31,900 in 2005 to 32,700 in 2006 and 7% from 30,500 in 2002 to the high in 2006. Total structure fires rose 3% from 2005 to 2006 and 1% from 2002 to 2006.

Figure 1. Structure Fires in Vacant Buildings by Year: 2002-2006



Source NFIRS 5.0 and NFPA survey.

Data sources, definitions and conventions used in this report.
The fire statistics in this analysis 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. These national estimates are projections based on the detailed information collected in Version 5.0 of the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS 5.0) and the National Fire Protection Association's (NFPA's) annual fire department experience survey. Firefighter fatality statistics are based on a census and are not estimates.

NFIRS Incident types in the range of 110-129 were used to identify structure fires. The structure type field was not used in this analysis.

Code 5: "vacant and secured" and code 6: "vacant and unsecured" in the building status field on the fire module were used to identify vacant buildings. The estimates include a proportional share of fires in which the building status was unknown or not reported (10% of non-confined fires and 97% of confined fires — see below). Unknown data were allocated proportionally in most fields analyzed except for property use and incident type. Prior to NFIRS 5.0, a separate property use code was used to identify vacant buildings. In many cases, however, the property use was recorded as the building's intended use. In NFIRS 5.0, the intended property use and structure status are recorded separately. These changes make long-term trend analysis impossible.

NFIRS 5.0, first introduced in 1999, brought major changes to fire incident data, including changes in some definitions and coding rules. Certain types of fires, collectively referred to as "confined fires," including confined cooking fires, chimney fires, trash fires, and fuel burner or boiler fires (incident types 113-118) can be documented more easily in NFIRS 5.0. Causal data, including building status, is generally not required for these incidents although it is provided in some cases. Non-confined structure fires (incident type 110-129 excluding 113-118) were analyzed separately from confined fires and summed when appropriate.

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 one, and direct property damage to the nearest million dollars. Property damage has not been adjusted for inflation. Details on the methodology used may be found in the Appendix.

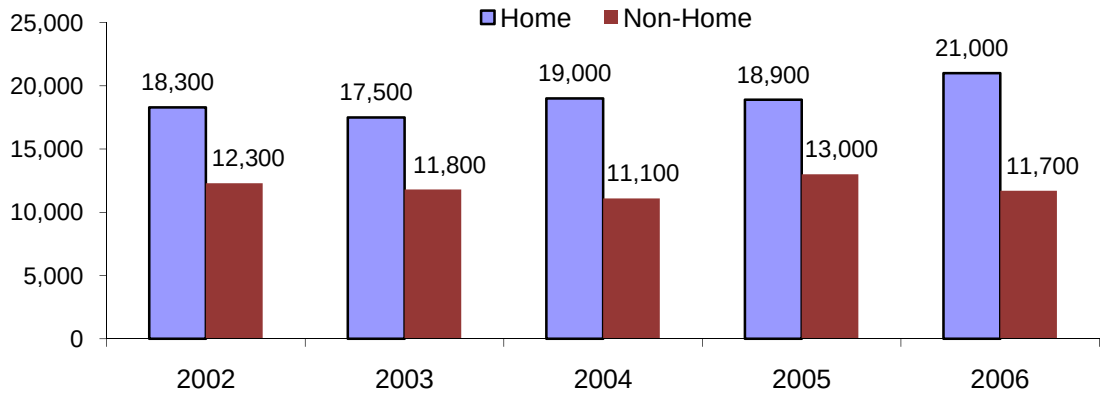
Homes accounted for almost two-thirds of vacant building fires.
Table 2 shows that in 2003-2006, 63% of the reported vacant building fires occurred in homes, including 58% in one-or two-family dwellings and 5% in apartments or multiple family properties. Five percent of vacant building fires occurred in unclassified residential properties. During the same period, home fires overall (including both vacant and occupied), accounted for 73% of reported structure fires.[3] Thirteen percent were in storage properties, including 8% in sheds, outbuildings, outside or unclassified storage; and 6% in vehicle storage. Subcategories of property types that rounded to less than 1% are not shown in the table.

Table 3 shows that 16% of the structure fires in storage properties involved vacant buildings. as did 7% of the fires in on one- or two-family dwellings, 7% of the structure fires in outside or special properties, and 7% in industrial, utility, defense, agriculture, or mining properties.

Fires in vacant homes increased more than vacant building fires overall.
Figure 2 shows that the increase in fires in vacant homes has been even larger than the increase in vacant structure fires overall. Vacant home fires increased 11% from 18,900 in 2005 to 21,000 in 2006 and 13% from 2002 to 2006. Total home fires rose 4% from 2005 to 2006 and 2% from 2002 to 2006. Vacant non-home building fires actually fell 10% from 13,000 in 2005 to 11,700 in 2006.

[3] Marty Ahrens. *Home Structure Fires,* Quincy, MA: National Fire Protection Association, 2009, p. 3.

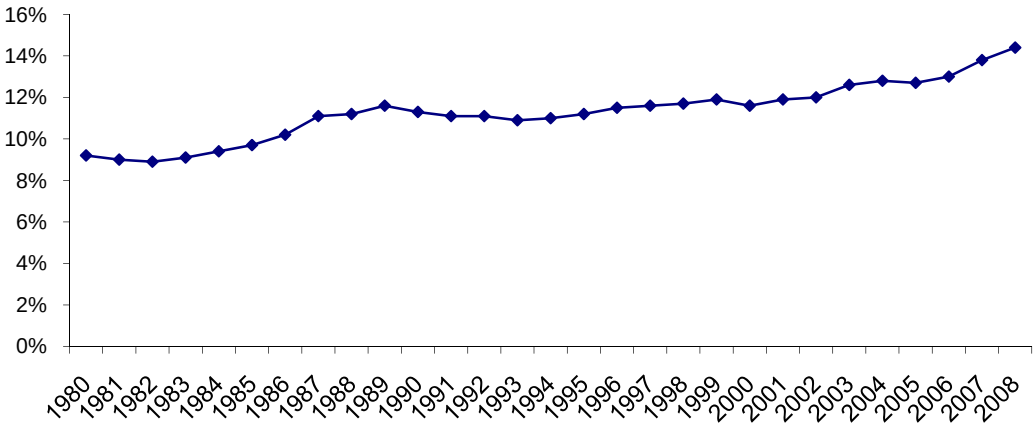
Figure 2. Vacant Home and Non-Home Structure Fires by Year: 2002-2006



Source NFIRS 5.0 and NFPA survey.

According to the U.S. Census, 18,704,000 housing units were vacant in 2008.[4] Housing units are considered vacant if "no one is living in it at the time of the interview, unless its occupants are temporarily absent. In addition, housing units where all the occupants have a usual residence elsewhere are grouped with vacant units." Figure 3 and Table 4 show that that the percentage of vacant housing units, including vacant units in apartment buildings, has been steadily rising since 2005, hitting a new high of 14.4% in 2008.

Figure 3. Percent of Housing Units that Were Vacant, by Year: 1980-2008

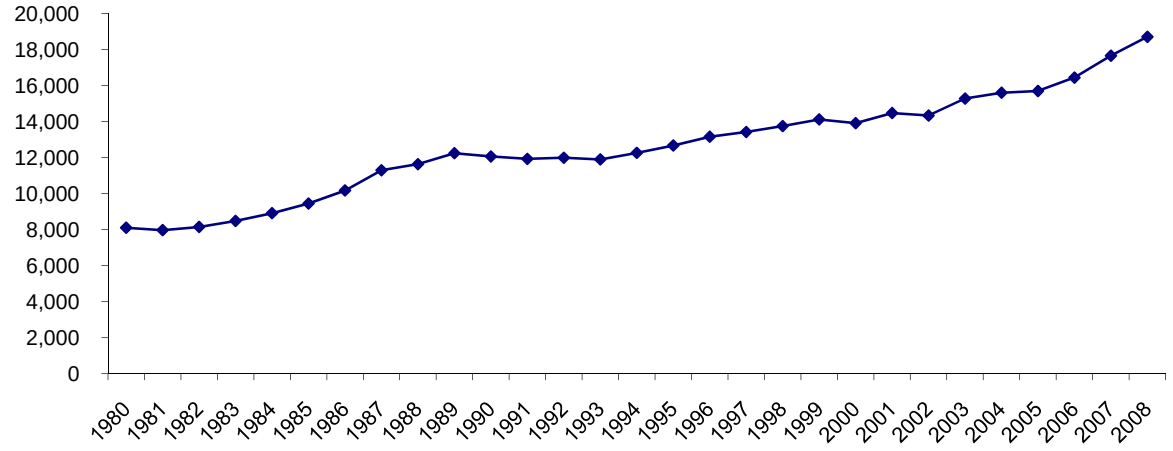


Source: U.S. Census Bureau's Housing Vacancy Survey.

Figure 4 shows that the estimated actual number of vacant units grew by 5% from 15.7 million in 2005 to 16.4 million in 2006, by 7% from 2006 to 17.7 million in 2007, and by 6% from 2007 to 18.7 million units in 2008.

[4] U.S. Census Bureau. Housing Vacancy Survey. "Table 7. Estimates of the Total Housing Inventory for the United States: 1965 to Present," accessed at http://www.census.gov/hhes/www/housing/hvs/historic/histtab7.html on March 10, 2009.

Figure 4. Vacant Housing Units, by Year: 1980-2008



Source: U.S. Census Bureau's Housing Vacancy Survey. "

Vacant buildings can harm the surrounding neighborhood.
In their report on the costs of vacant properties, the National Vacant Properties Campaign reports that crime rates are higher in areas with vacant or abandoned buildings. The authors quote George Kelling and James Q. Wilson's Broken Window Theory described in a 1989 article in the *Atlantic Monthly*: "If the first broken window in a building is not repaired, then people who like breaking windows will assume that no one cares about the building and more windows will be broken… the disorder escalates, possibly to serious crime." In some cases, the properties may be used for prostitution, drug dealing and other crimes. Fires are common, both due to arson and to makeshift attempts by individuals inside to obtain light or heat. Trash build-up and illegal dumping can pose a public health threat to the surrounding neighborhood. Back taxes may be owed. If they are allowed to deteriorate, their poor condition can result in lower assessed value on the vacant structure and depresses the value of nearby properties. Insurance companies may raise premiums or cancel policies on those near abandoned property. It can be time consuming to acquire the title and costly to demolish the property. Many local agencies may be needed to handle vacant buildings, including police and fire departments, code enforcement, legal, public works, and others.[5]

Vacant buildings should be secured and combustible materials removed.
Section 10.13 of the 2009 edition of NFPA® 1, *Fire Code*, requires owners or those in charge of vacant properties to remove waste and combustible materials and to secure the building to prevent unauthorized people from entering. Fire protection systems are to be maintained unless the authority having jurisdiction grants permission to have them removed from service.

[5] National Vacant Properties Campaign. "*Vacant Properties: The True Costs to Communities*, Washington, DC, 2005, accessed online at http://www.vacantproperties.org/latestreports/True%20Costs_Aug05.pdf on March 13, 2009.

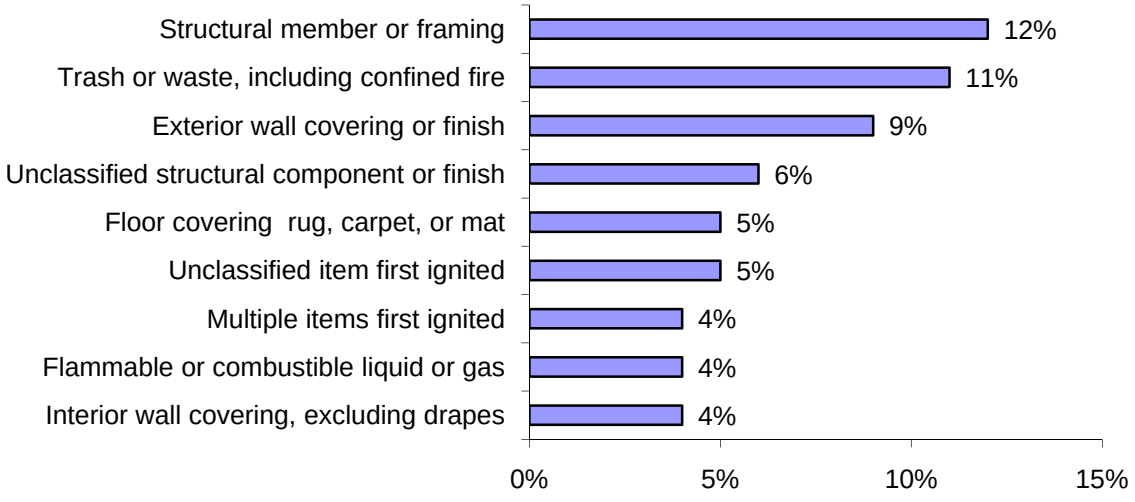
Data suggest that codes were not followed in many vacant building fires.
Despite these requirements, half of the reported vacant building fires were in properties that were unsecured. Table 1 showed that an estimated average of 15,600 fires in *unsecured* vacant buildings caused an average of 32 civilian deaths, 50 civilian injuries, and $206 million in direct property damage annually. The 15,400 reported fires in vacant and *secured* properties caused an average of 18 civilian deaths, 91 civilian injuries, $436 million in direct property damage per year. Security provisions reduce the likelihood of crime and fire, but if a fire should occur, it may be discovered later and it may be more difficult for firefighters to get in and anyone inside to get out.

- Three people died in a boarded-up vacant South Carolina bar and grill fire that started when vagrants lit a warming fire on the second floor. Because it was boarded up, firefighters had difficulty getting into the structure.[6]

Automatic extinguishing equipment was rare in vacant building fires.
Automatic extinguishing equipment was found in only 2% of vacant building fires. During 2003-2006, this equipment was found in 9-11% of all reported structure fires.[7] The equipment operated in two-thirds (68%) of vacant building fires considered large enough to activate the equipment, but failed to operate in 31%. In 82% of the fires in which the equipment failed to operate, the system had been shut off.

- The sprinkler system in a vacant Florida hotel had been shut down because of rusted pipes. The detection system had also been disabled. A 2007 incendiary fire in the property caused $15 million in direct property damage.[8]

Figure 5. Reported Structure Fires in Vacant Buildings by Leading Items First Ignited: 2003-2006

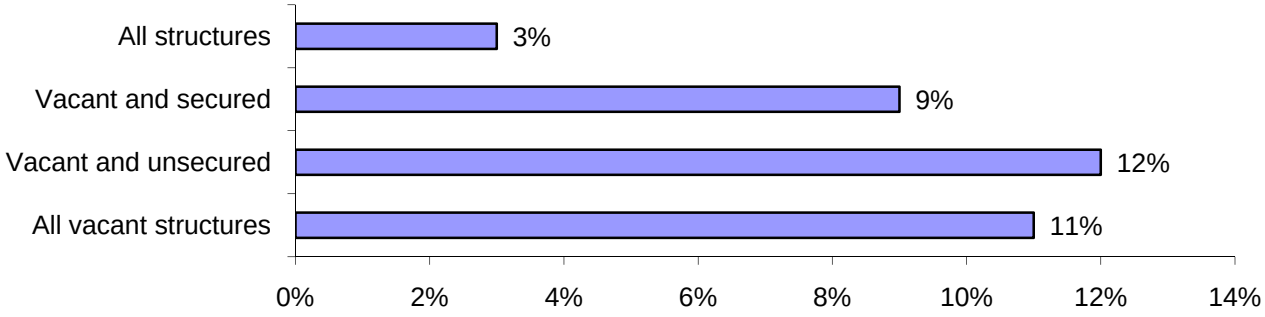


Source: NFIRS 5.0 and NFPA survey.

[6] Robert S. McCarthy. "1999 Catastrophic Multiple-Death Fires in the United States," *NFPA Journal*, September/October 2000, p. 60.
[7] John R, Hall, Jr. *U.S. Experience with Sprinklers and Other Automatic Extinguishing Equipment,* Quincy, MA: National Fire Protection Association, 2009, p. 8.
[8] Stephen G. Badger. *Large-Loss Fires in the United States in 2007*, NFPA Quincy, MA: Fire Analysis and Research, 2008.

Fires in vacant buildings are more likely to spread than other structure fires.
In all reported structure fires, flame damage extended beyond the structure of origin in only 3% of the incidents. Table 6 and Figure 6 show that flame damage spread beyond the structure in 9% of the fires in secured vacant properties and 12% of unsecured properties.

Figure 6. Flame Damage Spread beyond Building of Origin, by Structure Status 2003-2006



Source: NFIRS 5.0 and NFPA survey

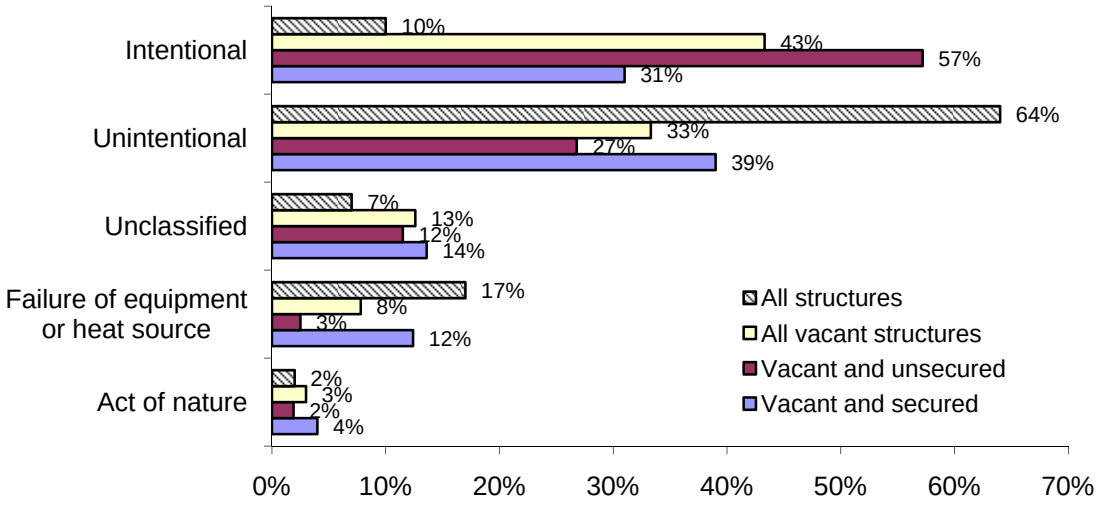
Fires in vacant buildings are more likely to have been intentionally set than other structure fires.
Tables 7-11 show the causal factors found in these fires, summarizing causal factors from a variety of fields. Many of these causes are not mutually exclusive. Causal factors that lack detail (such as unintentional or failure of equipment or heat source in the cause field, or heat from operating or powered equipment or arcing in the heat source field) were not included in this summary table. Detailed information about the methodology and what is included in each category may be found in the Appendix. The estimate for intentional fires includes both confined and non-confined fires. (See Table 8). Confined fires are listed only by incident type in tables showing equipment involved in ignition (Table 9), factor contributing to ignition, (Table 10), and heat source (Table 11) and not analyzed further for these data elements.

In 2003-2006, on average, 13,400 (43%) vacant structure fires were intentionally set per year. These fires caused an average of 16 civilian deaths, 34 civilian injuries, and $248 million in direct property damage annually. During the same period, 10% of all reported structure fires were intentionally set. One-quarter (25%) of all intentionally set structure fires involved vacant buildings. In Version 5.0 of the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS 5.0), intentional "includes deliberate misuse of heat source or a fire of an incendiary nature." While the percentage of intentional fires in vacant buildings is high regardless of whether the property had been secured, Figure 7 and Table 8 show that intentional fires were much more common in unsecured properties (57%) than in those that had been secured (31%).

Other leading causes of vacant building fires were exposure to other fires (8%), heating equipment (also 8%), electrical distribution or lighting equipment (7%), cooking equipment (5%), someone, typically a child, playing with heat source (4%), and smoking materials (3%).

When equipment is listed as the cause of the fire, it means that the equipment provided the heat that started the fire. It does not mean that equipment malfunctioned or failed.

Figure 7. Reported Structure Fires in Vacant Buildings by Cause of Ignition and Structure Status: 2003-2006

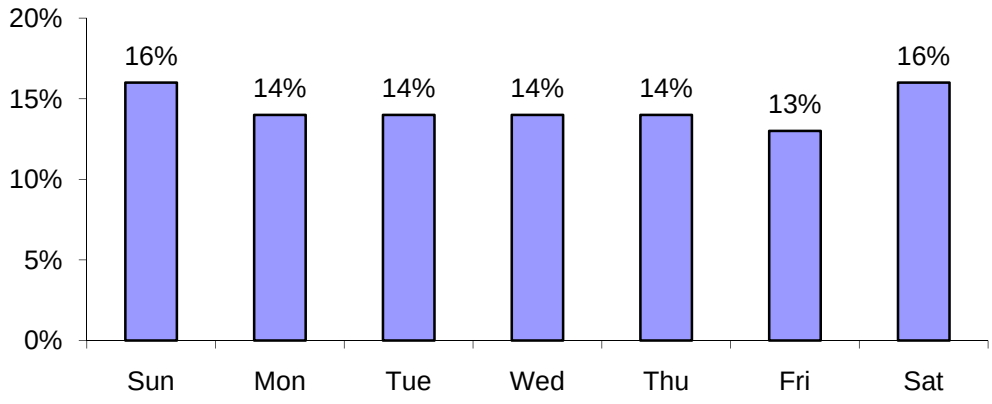


Source: NFIRS 5.0 and NFPA survey

Table 11 shows that hot embers and ashes were the most common heat source in vacant building fires. These may result from fires that were set for heat or cooking.

Leading areas of origin were inside the structure.
Although Table 12 shows no clear pattern in where vacant building fires start, the three leading areas of origin -- bedroom (9%); living room, family room, den, lounge or common room (7%); and kitchen or cooking area (6%) -- were all inside the structure. This underscores the importance of securing the properties against unauthorized entry.

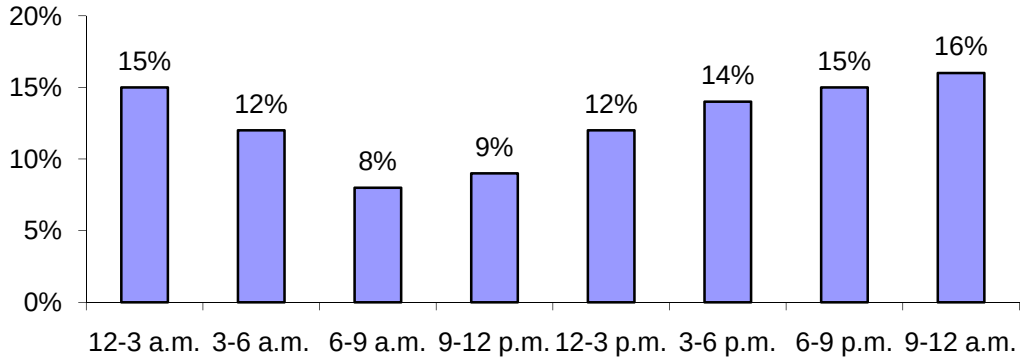
Figure 8. Structure Fires in Vacant Buildings by Day of Week: 2003-2006



Source: NFIRS 5.0 and NFPA survey

Vacant building fires are more common on weekends and less common between 6:00 a.m. and noon.
Figure 8 shows that Saturday and Sunday were the peak days for vacant building fires. Figure 9 shows that these fires peak between 9:00 p.m. and midnight with 6:00 to 9:00 p.m. ranking second, while midnight to 3:00 a.m. ranked third. These fires are much less frequent between 6:00 a.m. and noon.

Figure 9. Structure Fires in Vacant Buildings by Alarm Time: 2003-2006



Source: NFIRS 5.0 and NFPA survey

Vacant building fires peaked around certain holidays.
Vacant building fires were spread out throughout the year, but some holidays with more raucous traditions stand out. July 4th was the peak day for vacant building fires in 2003-2006 (average of 190 per year), followed by July 5th (average of 160 per year). October 31st (Halloween) ranked third and January 1st ranked fourth, with annual averages of 150 and 130 fires, respectively.

NFPA's Urban Fire Safety Project identified home foreclosures and abandoned homes as an emerging fire problem.
In 2007, NFPA partnered with Louisville, Kentucky and Milwaukee, Wisconsin in 2007 to learn more about the causes of fire deaths and injuries among urban high risk populations and the challenges in preventing these fires and casualties. Both fire departments were concerned about the impact of the subprime lending crisis and other housing issues. The report authors noted that:

> "More abandoned homes can lead to homeless people living in those homes or children vandalizing or playing in abandoned homes. These structures present additional hazards to firefighters and contribute to the juvenile firesetter problem.
>
> In colder climates, abandoned homes must be kept heated and therefore invite squatters and drug dealers to use these buildings illegally. When these buildings are involved in fire, the risk of serious injury to fire personnel increases."[9]

[9] Robert Adams, Judy Comoletti, Sharon Gamache, John Hall, and Pat Mieszala**.** *Urban Fire Safety Project: Report to the NFPA Board of Directors and the Metropolitan Fire Chiefs Association*, November 2007, p. 26, online at http://www.nfpa.org/assets/files//PDF/Member%20Sections/Urban_Report.pdf.

Vacant building fires pose a threat to firefighters.
Fifteen, or 6%, of 248 firefighter fatalities at the scene of structure fires between 1998 and 2007 (excluding the events of September 11, 2001) occurred in vacant buildings.[10] Seven deaths resulted from two warehouse or storage facility fires, six resulted from six separate vacant dwelling fires, one from a vacant health care facility fire, and one from a vacant service station fire.

On average, 4,500 firefighters were injured at vacant building fires annually during 2003-2006. These accounted for 13% of the reported firefighter injuries incurred at structure fires per year during this period.[11]

Philadelphia Deputy Fire Chief James Smith described two basic types of vacant buildings.[12] The first is awaiting resale and is basically the same as any other building. The second type has been vacant for a longer period. The building has been stripped of things that could be sold, such as piping and cabinetry. The building could not be used for legitimate occupancy without extensive renovation and may be abandoned by the owner. These properties are particularly dangerous to firefighters. Because the homeless often seek shelter in such buildings, firefighters cannot assume that such a building is empty. To avoid trouble from trespassing, squatters may flee before the fire department arrives, causing an unnecessary and dangerous search. The properties may contain illegal electric hook-ups which increase the risk of bare wires and electric shock. Weather damage, accompanied by neglect, rots wood, erodes mortar, and weakens the structure. Some fire departments mark vacant buildings to indicate if the structure can be entered in event of a fire.

- Six firefighters were killed in a 1999 fire in a vacant six-story Massachusetts cold storage warehouse. The property had been abandoned since 1989. The owner of a neighboring business told firefighters that two homeless individuals may have been living inside the property. Investigators learned that a candle used for light had been knocked over during a fight between a homeless man and his former girlfriend. Their attempts to put out the fire were unsuccessful and they left without reporting the fire.[13]

Retired New York City Fire Department Deputy Chief Vincent Dunn wrote that many vacant buildings have had a series of fires and fire department overhauls.[14] With no repairs made after these fires, holes in floors, walls, stairs, and roofs are common. Stripping metal for scrap also causes damage. Sealed buildings may be vandalized and re-opened. Regular inspections are needed to ensure that properties are continually resealed. Pre-fire planning is critical for large vacant properties such as warehouses and factories.

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[10] Rita F. Fahy. Unpublished analysis, Quincy, MA: National Fire Protection Association, March 2009.
[11] Michael J. Karter, Jr. *Patterns of Firefighter Injuries*, Quincy, MA: National Fire Protection Association, 2009 (publication pending).
[12] James P. Smith. "Fire Studies: Vacant Buildings," *Firehouse*, December 2004, pp. 14-21.
[13] John R. Anderson. *Abandoned Cold Storage Warehouse Multi-Firefighter Fatality Fire: Worcester, MA*, Varley Campbell and Associates, Inc./TriData Corporation under contract EME-97-CO-0506 to the United States Fire Administration, Federal Emergency Management Agency, 1999, accessed online at http://www.usfa.dhs.gov/downloads/pdf/publications/tr-134.pdf on March 16, 2009.
[14] Vincent Dunn. "Safety & Survival: Vacant Building Fires" *Firehouse*, May 2000, pp. 20-26.

The best way to prevent vacant building fires is to prevent vacant buildings.
The National Vacant Properties Campaign describes a number of strategies to address the problem of vacant properties and provides examples of how these strategies have been used.[15] These include:

- Vacant property registration ordinances that provide contact information and may generate fees to cover municipal costs associated with these properties.
- Landbanks for property seized for nonpayment of taxes.
- Rental and point of sale inspection ordinances that ensure the property has been maintained when the occupants change.
- Rehabilitation programs for owner-occupied housing and home repair programs;
- Homeownership and landlord training programs.
- Foreclosure prevention;
- Information systems capturing data about individual properties and neighborhoods that allow developing problems to be identified, tracked and addressed.
- Code enforcement that is typically complaint driven but may be institutionalized.
- Vacant property coordinators that interact with owners and municipal departments, emphasizing compliance more than enforcement.
- Property maintenance codes related to occupied housing that reduce the likelihood a property will fall into serious disrepair and abandonment.
- Nuisance abatement authority that allows municipalities to address threats to the general public, typically through administrative hearings rather than courts.
- Receivership.

Fire departments should partner with other groups to prevent home foreclosures.
NFPA's Urban Fire Safety Project, discussed previously, developed 11 recommendations to help urban fire departments reduce fires and associated losses. The 11th addresses the vacant building issue.

> "Local fire departments and the national fire service should partner both nationally and locally with lending institutions and housing and community organizations to develop strategies to prevent home foreclosures and abandoning of homes."[16]

In 2008, NFPA partnered with the Columbus, Ohio Division of Fire in a continuation of the Urban Fire Safety Project to implement three of the 11 recommended strategies of the fire department's choice. The recommendation above was one of the three selected. NFPA aided the Columbus Division of Fire in developing a relationship with Rebuild Ohio, an organization of local government agencies, non-profits, and civic groups concerned about vacant and abandoned properties. According to Chief Ned Pettus, the Division of Fire was able to obtain access to the Columbus Department of Development's vacant home database. This information will assist the

[15] National Vacant Properties Campaign. "Strategies and Technical Tools" accessed online at http://vacantproperties.org/strategies/tools.html on March 13, 2009.
[16] Robert Adams, Judy Comoletti, Sharon Gamache, John Hall, and Pat Mieszala. *Urban Fire Safety Project: Report to the NFPA Board of Directors and the Metropolitan Fire Chiefs Association*, November 2007, p. 26, online at http://www.nfpa.org/assets/files//PDF/Member%20Sections/Urban_Report.pdf.

fire department with pre-planning and monitoring. The fire department now has contact information at the Development Department to report properties that need to be secured or show signs of tampering. The Division of Fire is also exploring a vacant building signage system that would indicate severe structural compromise and the need to avoid interior firefighting as much as possible.

Several issues relating to vacant building arson were included in the Arson Prevention PowerPoint Presentation developed by NFPA and Columbus Division of Fire. The presentation, available at www.nfpa.org/assets/files//PDF/Public%20Education/NFPAarsonpresentation.ppt, provides tips on how to prevent arson.

Changing circumstances and regulations impact prevention.
In an ideal world, all properties would be well maintained and secure until the day they are demolished. In practice, circumstances change. Health and financial issues may cause maintenance to be deferred. Changes in market conditions may prevent the sale or rental of the property. Communities may lack the resources to enforce codes or to deal promptly with buildings that have become derelict. New regulations may increase costs. For example, the city of Flint, Michigan had a successful program to abolish abandoned buildings in the early 1990s. In a 1995 paper, David Wolfenden examined why very few had been demolished in the previous two years. In 1993, The Department of Community Development notified Flint that it must comply with three acts: the Asbestos Hazard Emergency Response Act, the National Emission Standards for Hazardous Air Pollutants, and the Protection of Cultural Resources Act if it wished to be eligible for block grants from the Department of Housing and Urban Development (HUD). These regulations made the process much more costly and time consuming than it had been in the past. Three-quarters of the Flint properties slated for demolition in 1995 held asbestos containing material (ACM). Wolfenden noted that Flint employed no certified ACM inspectors at the time, thus requiring bids for both inspections and abatements.[17]

InterFIRE has additional resources on its website.
On its website, interFIRE provides a draft ordinance to address blighted structures and vacant lots based on Bridgeport, Connecticut's Anti-Blight Law, Aberdeen, Texas's vacant lot ordinance, and procedures to secure buildings developed by the Department of Housing and Urban Development and the Federal Emergency Management Agency.[18] InterFIRE has several other items from various sources relating to vacant buildings on its website at http://www.interfire.org/features/vacantbuildings.asp, including materials developed on the subject by the International Association of Arson Investigators and the U.S. Fire Administration.

Incident narratives provide more details about vacant building fires.
A collection of previously published descriptions of vacant building fires is included in Appendix C. It is important to remember that these descriptions provide anecdotal information. Anecdotes show what can happen; they are not a source to learn about what typically occurs. Most of the fires in this collection were more severe than the typical incident.

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[17] David L. Wolfenden, *Razing Hell in Flint, Michigan: the Dilemma of Asbestos Abatement of Abandoned Dwellings*. Emmitsburg, MD: Executive Fire Officer Paper for National Fire Academy, 1995.
[18] InterFIRE "Suggested Draft Ordinance of Public Law, " accessed at http://www.interfire.org/res_file/ord.asp on March 13, 2009.

Table 1.
Reported Structure Fires by Building Status
2003-2006 Annual Averages

A. Non-Confined Fires

Building Status	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Occupied and operating	242,100	(83%)	3,011	(97%)	12,870	(97%)	$7,564	(85%)
Vacant and unsecured	14,300	(5%)	32	(1%)	50	(0%)	$206	(2%)
Vacant and secured	13,700	(5%)	18	(1%)	91	(1%)	$436	(5%)
Idle, not routinely used	8,500	(3%)	11	(0%)	60	(0%)	$141	(2%)
Unclassified building status	6,100	(2%)	20	(1%)	101	(1%)	$115	(1%)
Under construction	3,400	(1%)	7	(0%)	66	(0%)	$294	(3%)
Under major renovation	2,800	(1%)	6	(0%)	65	(0%)	$111	(1%)
Being demolished	1,900	(1%)	6	(0%)	12	(0%)	$24	(0%)
Total	292,800	(100%)	3,112	(100%)	13,315	(100%)	$8,890	(100%)
Total vacant	28,000	(10%)	50	(2%)	141	(1%)	641	(7%)

B. Confined Fires

Building Status	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Occupied and operating	216,900	(95%)	13	(100%)	1,865	(99%)	$63	(96%)
Unclassified building status	4,500	(2%)	0	(0%)	11	(1%)	$0	(0%)
Vacant and secured	1,700	(1%)	0	(0%)	0	(0%)	$0	(0%)
Vacant and unsecured	1,300	(1%)	0	(0%)	0	(0%)	$0	(0%)
Under construction	1,100	(0%)	0	(0%)	5	(0%)	$0	(0%)
Idle, not routinely used	1,000	(0%)	0	(0%)	0	(0%)	$1	(2%)
Under major renovation	500	(0%)	0	(0%)	4	(0%)	$0	(1%)
Being demolished	300	(0%)	0	(0%)	0	(0%)	$0	(0%)
Total	227,300	(100%)	13	(100%)	1,885	(100%)	$65	(100%)
Total vacant	3,000	(1%)	0	(0%)	0	(0%)	$0	(1%)

Table 1.
Reported Structure Fires by Building Status
2003-2006 Annual Averages
(Continued)

C. All Structure Fires

Building Status	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Occupied and operating	459,100	(88%)	3,025	(97%)	14,734	(97%)	$7,627	(85%)
Vacant and unsecured	15,600	(3%)	32	(1%)	50	(0%)	$206	(2%)
Vacant and secured	15,400	(3%)	18	(1%)	91	(1%)	$436	(5%)
Unclassified building status	10,600	(2%)	20	(1%)	112	(1%)	$115	(1%)
Idle, not routinely used	9,600	(2%)	11	(0%)	60	(0%)	$143	(2%)
Under construction	4,500	(1%)	7	(0%)	71	(0%)	$294	(3%)
Under major renovation	3,300	(1%)	6	(0%)	69	(0%)	$111	(1%)
Being demolished	2,100	(0%)	6	(0%)	12	(0%)	$24	(0%)
Total	520,100	(100%)	3,125	(100%)	15,200	(100%)	$8,955	(100%)
Total vacant	31,000	(6%)	50	(2%)	141	(1%)	$642	(7%)

Note: Sums may not equal totals due to rounding errors. Fires with unknown building status were allocated proportionally.
Source: NFIRS 5.0 and NFPA survey.

Table 2.
Reported Structure Fires in Vacant Buildings by Property Use
2003-2006 Annual Averages

Property Use	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Residential	**21,500**	**(69%)**	**42**	**(83%)**	**107**	**(76%)**	**$459**	**(72%)**
Home	19,600	(63%)	36	(72%)	97	(69%)	$427	(67%)
One- or two-family dwelling	*18,100*	*(58%)*	*33*	*(65%)*	*83*	*(59%)*	*$394*	*(61%)*
Apartment or multi-family home	*1,600*	*(5%)*	*4*	*(7%)*	*14*	*(10%)*	*$33*	*(5%)*
Unclassified or unknown-type residential	1,600	(5%)	5	(9%)	7	(5%)	$23	(4%)
Storage	**3,900**	**(13%)**	**3**	**(6%)**	**19**	**(13%)**	**$44**	**(7%)**
Shed, outbuilding, outside, or unclassified storage	2,400	(8%)	2	(3%)	12	(8%)	$17	(3%)
Vehicle storage, garage or fire station	900	(3%)	1	(3%)	4	(3%)	$11	(2%)
Warehouse, residential or self-storage	400	(1%)	0	(0%)	3	(2%)	$13	(2%)
Barn, grain or livestock storage	200	(1%)	0	(0%)	0	(0%)	$3	(0%)
Outside or special property	**1,500**	**(5%)**	**0**	**(1%)**	**2**	**(1%)**	**$8**	**(1%)**
Open land, beach, or campsite	500	(2%)	0	(0%)	0	(0%)	$3	(1%)
Bridge, tunnel, or outbuilding	500	(2%)	0	(1%)	0	(0%)	$2	(0%)
Highway, street, or parking area	200	(1%)	0	(0%)	0	(0%)	$1	(0%)
Unclassified or unknown-type special property	200	(1%)	0	(0%)	0	(0%)	$1	(0%)
Mercantile or business property	**1,200**	**(4%)**	**2**	**(3%)**	**4**	**(3%)**	**$39**	**(6%)**
Office, bank or mail facility	300	(1%)	0	(0%)	1	(1%)	$10	(2%)
Service station or vehicle sales, service or repair	200	(1%)	0	(0%)	1	(1%)	$5	(1%)
Grocery or convenience store	200	(1%)	1	(1%)	0	(0%)	$5	(1%)
Unclassified or unknown-type mercantile or business	300	(1%)	1	(2%)	2	(1%)	$10	(2%)
Public assembly	**800**	**(3%)**	**0**	**(1%)**	**2**	**(2%)**	**$46**	**(7%)**
Eating or drinking place	400	(1%)	0	(0%)	2	(1%)	$22	(3%)
Educational	**300**	**(1%)**	**0**	**(0%)**	**0**	**(0%)**	**$9**	**(1%)**
Preschool through grade 12	300	(1%)	0	(0%)	0	(0%)	$8	(1%)
Manufacturing or processing	**300**	**(1%)**	**0**	**(1%)**	**0**	**(0%)**	**$17**	**(3%)**
Industrial, utility, defense, agriculture or mining	**200**	**(1%)**	**0**	**(0%)**	**2**	**(1%)**	**$7**	**(1%)**
Institutional	**100**	**(0%)**	**0**	**(0%)**	**0**	**(0%)**	**$2**	**(0%)**
Unclassified or unknown-type property use	**1,200**	**(4%)**	**3**	**(6%)**	**5**	**(4%)**	**$11**	**(2%)**
Total	**31,000**	**(100%)**	**50**	**(100%)**	**141**	**(100%)**	**$642**	**(100%)**

Note: Only subcategories with 1% or more of the fires are shown. Sums may not equal totals due to rounding errors. This table includes a proportional share of fires with unknown building status.
Source: NFIRS 5.0 and NFPA survey.

Table 3.
Percent of Reported Structure Fires by Property Use in Buildings that Are Vacant
2003-2006 Annual Averages

Property Use	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage
Residential	**5%**	**1%**	**1%**	**7%**
Home	5%	1%	1%	7%
One- or two-family dwelling	*7%*	*1%*	*1%*	*8%*
Apartment or multi-family home	*1%*	*1%*	*0%*	*3%*
Unclassified or unknown-type residential	12%	4%	2%	12%
Storage	**16%**	**8%**	**6%**	**9%**
Shed, outbuilding, outside, or unclassified storage	17%	13%	12%	10%
Vehicle storage, garage or fire station	14%	9%	3%	9%
Warehouse, residential or self-storage	19%	0%	11%	10%
Barn, grain or livestock storage	12%	0%	0%	6%
Outside or special property	**7%**	**4%**	**3%**	**7%**
Open land, beach, or campsite	10%	0%	3%	39%
Bridge, tunnel, or outbuilding	18%	13%	3%	9%
Highway, street, or parking area	2%	0%	0%	11%
Unclassified or unknown-type special property	8%	(NA)	7%	12%
Industrial, utility, defense, agriculture or mining	**7%**	**0%**	**3%**	**5%**
Mercantile or business property	**6%**	**12%**	**2%**	**5%**
Office, bank or mail facility	7%	0%	4%	10%
Service station or vehicle sales, service or repair	7%	0%	1%	4%
Grocery or convenience store	3%	28%	0%	3%
Unclassified or unknown-type mercantile or business	10%	46%	7%	8%
Public assembly	**5%**	**5%**	**2%**	**11%**
Eating or drinking place	5%	0%	2%	11%
Educational	**5%**	**(NA)**	**0%**	**10%**
Preschool through grade 12	6%	(NA)	0%	11%
Manufacturing or processing	**4%**	**9%**	**0%**	**5%**
Institutional	**1%**	**0%**	**0%**	**5%**
Unclassified or unknown-type property use	**14%**	**26%**	**9%**	**10%**
Total	**6%**	**2%**	**1%**	**7%**

NA- No deaths were reported in these properties.
Source: NFIRS 5.0 and NFPA survey.
Note: Sums may not equal totals due to rounding errors.

Table 4.
U.S. Total and Vacant Housing Units

Year	All Housing Units (in Thousands)	Vacant Units (in Thousands)	Percent Housing Units Vacant
1980	87,739	8,101	9.2%
1981	88,988	7,967	9.0%
1982	91,876	8,145	8.9%
1983	93,044	8,479	9.1%
1984	95,256	8,910	9.4%
1985	97,333	9,446	9.7%
1986	99,318	10,173	10.2%
1987	101,811	11,294	11.1%
1988	103,653	11,633	11.2%
1989	105,729	12,240	11.6%
1990	106,283	12,059	11.3%
1991	107,276	11,926	11.1%
1992	108,316	11,988	11.1%
1993	109,611	11,894	10.9%
1994	110,952	12,257	11.0%
1995	112,655	12,669	11.2%
1996	114,139	13,155	11.5%
1997	115,621	13,419	11.6%
1998	117,282	13,748	11.7%
1999	119,044	14,116	11.9%
2000	119,628	13,908	11.6%
2001	121,480	14,470	11.9%
2002	119,297	14,332	12.0%
2003	120,834	15,274	12.6%
2004	122,187	15,599	12.8%
2005	123,925	15,694	12.7%
2006	126,012	16,437	13.0%
2007	127,958	17,652	13.8%
2008	130,113	18,704	13.8%

Source: U.S. Census Bureau. Housing Vacancy Survey. "Table 7. Estimates of the Total Housing Inventory for the United States: 1965 to Present," accessed at http://www.census.gov/hhes/www/housing/hvs/historic/histtab7.html on March 10, 2009.

Table 5.
Reported Structure Fires in Vacant Buildings by Item First Ignited
2003-2006 Annual Averages

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Structural member or framing	3,700	(12%)	4	(7%)	7	(5%)	$102	(16%)
Exterior wall covering or finish	2,900	(9%)	1	(2%)	7	(5%)	$47	(7%)
Contained trash or rubbish fire	1,800	(6%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified structural component or finish	1,800	(6%)	2	(3%)	3	(2%)	$55	(9%)
Rubbish, trash, or waste	1,700	(5%)	0	(0%)	5	(3%)	$22	(3%)
Floor covering rug, carpet, or mat	1,400	(5%)	4	(8%)	10	(7%)	$24	(4%)
Unclassified item first ignited	1,400	(5%)	3	(6%)	6	(4%)	$38	(6%)
Multiple items first ignited	1,400	(4%)	0	(0%)	8	(6%)	$42	(6%)
Flammable or combustible liquid or gas	1,300	(4%)	7	(14%)	21	(15%)	$51	(8%)
Interior wall covering	1,200	(4%)	0	(0%)	5	(3%)	$28	(4%)
Mattress or bedding	1,000	(3%)	7	(13%)	12	(8%)	$18	(3%)
Upholstered furniture	1,000	(3%)	8	(16%)	9	(7%)	$21	(3%)
Electrical wire or cable insulation	900	(3%)	0	(0%)	5	(4%)	$37	(6%)
Exterior roof covering or finish	800	(3%)	0	(0%)	1	(0%)	$16	(2%)
Light vegetation, including grass	800	(2%)	3	(5%)	3	(2%)	$7	(1%)
Magazine, newspaper or writing paper	800	(2%)	2	(4%)	2	(1%)	$10	(2%)
Confined cooking fire	600	(2%)	0	(0%)	0	(0%)	$0	(0%)
Insulation within structural area	600	(2%)	0	(0%)	3	(2%)	$11	(2%)
Unclassified furniture or utensil	600	(2%)	5	(10%)	6	(4%)	$14	(2%)
Clothing	500	(2%)	1	(2%)	2	(2%)	$7	(1%)
Interior ceiling cover or finish	400	(1%)	2	(5%)	1	(0%)	$10	(2%)
Exterior trim, including doors	400	(1%)	0	(0%)	2	(2%)	$3	(1%)
Box, carton, bag, basket or barrel	400	(1%)	0	(0%)	1	(1%)	$8	(1%)
Unclassified soft goods or wearing apparel	300	(1%)	0	(0%)	5	(3%)	$6	(1%)
Cabinetry	300	(1%)	0	(0%)	3	(2%)	$10	(2%)
Confined chimney or flue fire	300	(1%)	0	(0%)	0	(0%)	$0	(0%)
Confined fuel burner or boiler fire	300	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified organic materials	300	(1%)	0	(0%)	1	(0%)	$3	(0%)
Appliance housing or casing	200	(1%)	0	(0%)	4	(3%)	$4	(1%)
Unclassified storage supplies	200	(1%)	0	(0%)	0	(0%)	$9	(1%)
Curtain, blind or drapery	200	(1%)	0	(0%)	2	(1%)	$1	(0%)
Other known item or confined fire	1,700	(5%)	1	(2%)	9	(6%)	$37	(6%)
Total	31,000	(100%)	50	(100%)	141	(100%)	$642	(100%)

Note: Sums may not equal totals due to rounding errors. This table includes a proportional share of fires with unknown building status. Fires in which the item first ignited were unknown or not reported were allocated proportionally across fires with known data.-
Source: NFIRS 5.0 and NFPA survey.

Table 6.
Reported Structure Fires in Vacant Buildings by Extent of Flame Damage
2003-2006 Annual Averages

A. Secured Vacant Buildings

Extent of Flame Damage	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Confined fire identified by incident type	1,700	(11%)	0	(0%)	0	(0%)	$0	(0%)
Confined to object of origin	2,700	(17%)	1	(5%)	11	(12%)	$30	(7%)
Confined to room of origin	2,200	(15%)	2	(11%)	15	(16%)	$29	(7%)
Confined to floor of origin	1,000	(6%)	1	(7%)	12	(13%)	$26	(6%)
Confined to building of origin	6,500	(42%)	11	(62%)	40	(44%)	$290	(66%)
Extended beyond building of origin	1,400	(9%)	3	(16%)	13	(14%)	$61	(14%)
Total	15,400	(100%)	18	(100%)	91	(100%)	$436	(100%)

B. Unsecured Vacant Buildings

Extent of Flame Damage	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Confined fire identified by incident type	1,300	(8%)	0	(0%)	0	(0%)	$0	(0%)
Confined to object of origin	2,500	(16%)	3	(9%)	3	(7%)	$13	(6%)
Confined to room of origin	1,900	(12%)	2	(7%)	9	(18%)	$9	(4%)
Confined to floor of origin	800	(5%)	2	(7%)	4	(8%)	$11	(5%)
Confined to building of origin	7,100	(46%)	20	(63%)	22	(44%)	$131	(64%)
Extended beyond building of origin	1,900	(12%)	4	(13%)	12	(24%)	$42	(20%)
Total	15,600	(100%)	32	(100%)	50	(100%)	$206	(100%)

C. All Vacant Buildings

Extent of Flame Damage	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Confined fire identified by incident type	3,000	(10%)	0	(0%)	0	(0%)	0	(0%)
Confined to object of origin	5,200	(17%)	4	(7%)	14	(10%)	43	(7%)
Confined to room of origin	4,200	(14%)	4	(9%)	24	(17%)	38	(6%)
Confined to floor of origin	1,800	(6%)	3	(7%)	16	(11%)	37	(6%)
Confined to building of origin	13,600	(44%)	32	(63%)	62	(44%)	420	(65%)
Extended beyond building of origin	3,300	(11%)	7	(14%)	24	(17%)	103	(16%)
Total	31,000	(100%)	50	(100%)	141	(100%)	642	(100%)

Note: Sums may not equal totals due to rounding errors. This table includes a proportional share of fires with unknown building status. Non-confined fires in which the extent of flame damage were unknown or not reported were allocated proportionally across non-confined fires with known data.-
Source: NFIRS 5.0 and NFPA survey.

Table 7.
Leading Causes of Reported Structure Fires in Vacant Buildings
2003-2006 Annual Averages

Cause	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Intentional	13,400	(43%)	16	(33%)	34	(24%)	$248	(39%)
Exposure to other fire	2,400	(8%)	0	(0%)	6	(4%)	$34	(5%)
Heating equipment fire	2,400	(8%)	13	(25%)	21	(15%)	$78	(12%)
Heating equipment in non-confined fire	*1,800*	*(6%)*	*13*	*(25%)*	*21*	*(15%)*	*$78*	*(12%)*
Confined heating equipment fire	*600*	*(2%)*	*0*	*(0%)*	*0*	*(0%)*	*$0*	*(0%)*
Electrical distribution or lighting equipment	2,200	(7%)	0	(0%)	19	(14%)	$77	(12%)
Cooking equipment	1,500	(5%)	0	(0%)	12	(9%)	$20	(3%)
Cooking equipment in non-confined fire	*900*	*(3%)*	*0*	*(0%)*	*12*	*(9%)*	*$19*	*(3%)*
Confined cooking fire	*600*	*(2%)*	*0*	*(0%)*	*0*	*(0%)*	*$0*	*(0%)*
Playing with heat source	1,400	(4%)	3	(5%)	4	(3%)	$15	(2%)
Smoking materials	800	(3%)	9	(17%)	9	(7%)	$11	(2%)

Note: This table includes a proportional share of fires with unknown building status. The estimates for intentional fires and losses include both confined and non-confined fires, which were analyzed separately and include a proportional allocation of unknown data. See Table 8. Estimates of fires caused by exposure to other fires, electrical distribution or lighting equipment, playing with heat source and smoking materials are based on non-confined fires only. Percentages were calculated from the total of both confined and non-confined fires. Because this table summarizes findings from multiple fields, the same fire may be listed under multiple causes. Non-confined fires in which the heat source, factor contributing to ignition, and equipment involved in ignition, were unknown or not reported were allocated proportionally across non-confined fires with known data.-

Source: NFIRS 5.0 and NFPA survey.
The methodology is described in the appendix.

Source: NFIRS 5.0 and NFPA survey.

Table 8.
Reported Structure Fires in Vacant Buildings by Cause of Ignition
2003-2006 Annual Averages

A. Non-Confined Vacant Building Fires

Cause of Ignition	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Intentional	12,300	(44%)	16	(33%)	34	(24%)	$248	(39%)
Unintentional	8,900	(32%)	28	(55%)	80	(56%)	$219	(34%)
Unclassified	3,700	(13%)	4	(8%)	14	(10%)	$53	(8%)
Failure of equipment or heat source	2,200	(8%)	2	(4%)	14	(10%)	$92	(14%)
Act of nature	900	(3%)	0	(0%)	0	(0%)	$29	(5%)
Total	28,000	(100%)	50	(100%)	141	(100%)	$641	(100%)

B. Confined Vacant Building Fires

Cause of Ignition	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unintentional	1,500	(49%)	0	(NA)	0	(NA)	$0	(43%)
Intentional	1,200	(38%)	0	(NA)	0	(NA)	$0	(14%)
Failure of equipment or heat source	200	(7%)	0	(NA)	0	(NA)	$0	(5%)
Unclassified	200	(6%)	0	(NA)	0	(NA)	$0	(38%)
Total	3,000	(100%)	0	(NA)	1	(NA)	$0	(100%)

NA- Not applicable because no deaths were reported in these fires.

C. All Vacant Building Fires

Cause of Ignition	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Intentional	13,400	(43%)	16	(33%)	34	(24%)	$248	(39%)
Unintentional	10,300	(33%)	28	(55%)	80	(56%)	$219	(34%)
Unclassified	3,900	(13%)	4	(8%)	14	(10%)	$53	(8%)
Failure of equipment or heat source	2,400	(8%)	2	(4%)	14	(10%)	$92	(14%)
Act of nature	900	(3%)	0	(0%)	0	(0%)	$29	(5%)
Total	31,000	(100%)	50	(100%)	141	(100%)	$642	(100%)

Table 8.
Reported Structure Fires in Vacant Buildings by Cause of Ignition
2003-2006 Annual Averages
(Continued)

D. Fires in Secured Vacant Buildings (including confined and non-confined fires)

Cause of Ignition	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unintentional	6,000	(39%)	11	(61%)	55	(61%)	$160	(37%)
Intentional	4,800	(31%)	4	(22%)	14	(16%)	$132	(30%)
Unclassified	2,100	(14%)	1	(8%)	9	(10%)	$40	(9%)
Failure of equipment or heat source	1,900	(12%)	1	(8%)	12	(13%)	$79	(18%)
Act of nature	600	(4%)	0	(0%)	0	(0%)	$26	(6%)
Total	15,400	(100%)	18	(100%)	91	(100%)	$436	(100%)

E. Fires in Unsecured Vacant Buildings (including confined and non-confined fires)

Cause of Ignition	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Intentional	8,900	(57%)	13	(42%)	22	(43%)	$122	(59%)
Unintentional	4,200	(27%)	16	(50%)	24	(47%)	$58	(28%)
Unclassified	1,800	(12%)	2	(8%)	4	(8%)	$13	(6%)
Failure of equipment or heat source	400	(2%)	0	(0%)	1	(2%)	$10	(5%)
Act of nature	300	(2%)	0	(0%)	0	(0%)	$3	(1%)
Total	15,600	(100%)	32	(100%)	50	(100%)	$206	(100%)

E. Fires in All Structure Fires (including confined and non-confined fires)

Cause of Ignition	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unintentional	335,400	64%	2,268	(73%)	12,010	(79%)	$5,373	(60%)
Failure of equipment or heat source	87,900	17%	392	(13%)	1,670	(11%)	$1,689	(19%)
Intentional	53,400	10%	377	(12%)	1,117	(7%)	$896	(10%)
Unclassified	34,100	7%	69	(2%)	340	(2%)	$600	(7%)
Act of nature	9,300	2%	20	(1%)	63	(0%)	$397	(4%)
Total	520,100	(100%)	3,125	(100%)	15,200	(100%)	$8,955	(100%)

Note: Vacant building fire tables includes a proportional share of fires with unknown building status. Non-confined and confined fires were analyzed separately and then summed. Fires in which the cause of ignition was unknown or not reported were allocated proportionally across fires with known cause of ignition.-
Source: NFIRS 5.0 and NFPA survey.

Table 9.
Reported Structure Fires in Vacant Buildings by Equipment Involved in Ignition
2003-2006 Annual Averages

Equipment Involved in Ignition	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
No equipment involved	20,700	(67%)	37	(75%)	64	(46%)	$328	(51%)
Confined trash or rubbish fire	1,800	(6%)	0	(0%)	0	(0%)	$0	(0%)
Wiring, switch or outlet	1,200	(4%)	0	(0%)	3	(2%)	$50	(8%)
Fixed or portable space heater	1,100	(4%)	7	(13%)	6	(4%)	$32	(5%)
Range or cooktop	600	(2%)	0	(0%)	9	(6%)	$12	(2%)
Confined cooking fire	600	(2%)	0	(0%)	0	(0%)	$0	(0%)
Lamp, bulb or lighting	500	(1%)	0	(0%)	6	(4%)	$9	(1%)
Air conditioner or fan	400	(1%)	0	(0%)	0	(0%)	$10	(2%)
Unclassified equipment	400	(1%)	0	(0%)	21	(15%)	$16	(2%)
Torch, burner or soldering iron	300	(1%)	0	(0%)	3	(2%)	$10	(2%)
Confined chimney or flue fire	300	(1%)	0	(0%)	0	(0%)	$0	(0%)
Confined fuel burner or boiler fire	300	(1%)	0	(0%)	0	(0%)	$0	(0%)
Clothes dryer or washer	200	(1%)	0	(0%)	0	(0%)	$14	(2%)
Water heater	200	(1%)	0	(0%)	7	(5%)	$25	(4%)
Central heat	200	(1%)	6	(12%)	0	(0%)	$15	(2%)
Refrigerator or freezer	200	(1%)	0	(0%)	0	(0%)	$50	(8%)
Cord or plug	200	(1%)	0	(0%)	7	(5%)	$8	(1%)
Other known equipment or confined fire	1,800	(6%)	0	(0%)	14	(10%)	$62	(10%)
Total	31,000	(100%)	50	(100%)	141	(100%)	$642	(100%)

Note: This table includes a proportional share of fires with unknown building status. Non-confined fires in which the equipment involved in ignition was unknown or not reported have been allocated proportionally among fires with known equipment involved. Fires in which the equipment involved in ignition was entered as none but the heat source indicated equipment involvement or the heat source was unknown were also treated as unknown and allocated proportionally among fires with known equipment involved. Non-confined fires in which the equipment was partially unclassified (i.e., unclassified kitchen or cooking equipment, unclassified heating, cooling or air condition equipment, etc.) were allocated proportionally among fires that grouping (kitchen or cooking equipment; heating, cooling or air conditioning equipment, etc.). Sums may not equal totals due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

Table 10.
Reported Structure Fires in Vacant Buildings by Factor Contributing to Ignition
2003-2006 Annual Averages

Factor Contributing to Ignition	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Electrical failure or malfunction	4,000	(13%)	0	(0%)	13	(10%)	$127	(20%)
Exposure fire*	3,600	(12%)	0	(0%)	6	(4%)	$43	(7%)
Unclassified factor	3,500	(11%)	1	(3%)	18	(13%)	$84	(13%)
Abandoned or discarded material	2,900	(9%)	10	(20%)	7	(5%)	$59	(9%)
Rekindle	2,800	(9%)	0	(0%)	0	(0%)	$27	(4%)
Unclassified misuse of material or product	2,000	(7%)	8	(17%)	25	(18%)	$37	(6%)
Heat source too close to combustible	2,000	(6%)	2	(5%)	33	(23%)	$54	(8%)
Confined trash or rubbish fire	1,800	(6%)	0	(0%)	0	(0%)	$0	(0%)
Playing with heat source	1,400	(4%)	3	(5%)	4	(3%)	$15	(2%)
Storm	900	(3%)	0	(0%)	0	(0%)	$27	(4%)
Outside or open fire for debris or waste disposal	900	(3%)	4	(8%)	4	(3%)	$5	(1%)
Flammable liquid used to kindle fire	700	(2%)	0	(0%)	10	(7%)	$23	(4%)
Unclassified mechanical failure or malfunction	700	(2%)	0	(0%)	2	(2%)	$47	(7%)
Confined cooking fire	600	(2%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified fire spread or control	500	(2%)	0	(0%)	2	(1%)	$18	(3%)
Equipment unattended	400	(1%)	0	(0%)	2	(1%)	$11	(2%)
High wind	400	(1%)	0	(0%)	5	(3%)	$6	(1%)
Cutting or welding too close	400	(1%)	0	(0%)	1	(1%)	$12	(2%)
Flammable liquid or gas spilled	300	(1%)	10	(20%)	2	(2%)	$18	(3%)
Unclassified natural condition	300	(1%)	0	(0%)	0	(0%)	$12	(2%)
Confined chimney or flue fire	300	(1%)	0	(0%)	0	(0%)	$0	(0%)
Confined fuel burner or boiler fire	300	(1%)	0	(0%)	0	(0%)	$0	(0%)
Leak or break	200	(1%)	0	(0%)	6	(4%)	$9	(1%)
Improper container or storage	200	(1%)	0	(0%)	1	(1%)	$5	(1%)
Accidentally turned on, not turned off	200	(1%)	0	(0%)	0	(0%)	$5	(1%)
Other known factor or confined fire	1,300	(4%)	12	(23%)	14	(10%)	$41	(6%)
Total entries**	32,400	(105%)	50	(100%)	155	(110%)	$685	(107%)
Total fires	31,000	(100%)	50	(100%)	141	(100%)	$641	(100%)

*Fires in which the exposure number was greater than zero are automatically assigned this factor. When unknown data are allocated proportionally, the results for this factor are artificially high. The estimate of exposures in Table 5 is based on a hierarchical sort and is considered more reliable.
** Multiple entries are allowed which can result in sums higher than totals.
Note: This table includes a proportional share of fires with unknown building status. Sums may not equal totals due to rounding errors. Non-confined structure fires in which the factor contributing to ignition was coded as "none," unknown, or not reported have been allocated proportionally among fires with known factor contributing to ignition.
Source: NFIRS 5.0 and NFPA survey.

Table 11.
Reported Structure Fires in Vacant Buildings by Heat Source
2003-2006 Annual Averages

Heat Source	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Hot ember or ash	3,700	(12%)	0	(0%)	10	(7%)	$39	(6%)
Unclassified heat source	3,200	(10%)	9	(18%)	9	(6%)	$75	(12%)
Arcing	2,800	(9%)	0	(0%)	17	(12%)	$98	(15%)
Unclassified hot or smoldering object	2,800	(9%)	3	(6%)	5	(3%)	$38	(6%)
Confined trash or rubbish fire	1,800	(6%)	0	(0%)	0	(0%)	$0	(0%)
Match	1,700	(5%)	2	(5%)	7	(5%)	$28	(4%)
Radiated or conducted heat from operating equipment	1,600	(5%)	5	(11%)	14	(10%)	$62	(10%)
Unclassified heat from powered equipment	1,600	(5%)	2	(4%)	11	(8%)	$63	(10%)
Multiple heat sources including multiple ignitions	1,400	(5%)	3	(6%)	11	(8%)	$47	(7%)
Lightning	1,000	(3%)	0	(0%)	2	(2%)	$36	(6%)
Incendiary device	1,000	(3%)	9	(17%)	5	(3%)	$18	(3%)
Spark, ember or flame from operating equipment	1,000	(3%)	4	(8%)	19	(13%)	$40	(6%)
Heat from direct flame or convection currents	900	(3%)	0	(0%)	1	(1%)	$15	(2%)
Lighter	900	(3%)	2	(4%)	7	(5%)	$14	(2%)
Radiated heat from another fire	900	(3%)	0	(0%)	0	(0%)	$12	(2%)
Smoking materials	800	(3%)	9	(17%)	9	(7%)	$11	(2%)
Confined cooking fire	600	(2%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified heat spread from another fire	500	(2%)	0	(0%)	1	(1%)	$7	(1%)
Fireworks	400	(1%)	0	(0%)	0	(0%)	$4	(1%)
Flame or torch used for lighting	400	(1%)	2	(4%)	3	(2%)	$6	(1%)
Candle	300	(1%)	0	(0%)	6	(4%)	$12	(2%)
Confined chimney or flue fire	300	(1%)	0	(0%)	0	(0%)	$0	(0%)
Confined fuel burner or boiler fire	300	(1%)	0	(0%)	0	(0%)	$0	(0%)
Spontaneous ignition or chemical reaction	200	(1%)	0	(0%)	0	(0%)	$4	(1%)
Molten or hot material	200	(1%)	0	(0%)	0	(0%)	$3	(0%)
Heat or spark from friction	200	(1%)	0	(0%)	2	(2%)	$3	(0%)
Other known heat source or confined fire	500	(2%)	0	(0%)	0	(0%)	$7	(1%)
Total	31,000	(100%)	50	(100%)	141	(100%)	$642	(100%)

Note: This table includes a proportional share of fires with unknown building status. Sums may not equal totals due to rounding errors. Non-confined fires in which the heat source was unknown or not reported were allocated proportionally across non-confined fires with known heat source.-The statistics on matches, lighters, smoking materials and candles include a proportional share of fires in which the heat source was heat from an unclassified open flame or smoking material.
Source: NFIRS 5.0 and NFPA survey.

Table 12.
Reported Structure Fires in Vacant Buildings by Area of Origin
2003-2006 Annual Averages

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Bedroom	2,700	(9%)	10	(19%)	33	(23%)	$56	(9%)
Living room, family room, lounge, den or common room	2,100	(7%)	8	(17%)	11	(8%)	$47	(7%)
Kitchen or cooking area	1,900	(6%)	4	(8%)	22	(15%)	$56	(9%)
Confined trash or rubbish fire	1,800	(6%)	0	(0%)	0	(0%)	$0	(0%)
Exterior wall surface	1,600	(5%)	1	(1%)	4	(3%)	$22	(3%)
Unclassified function area	1,600	(5%)	9	(17%)	5	(4%)	$38	(6%)
Vacant structural area	1,600	(5%)	2	(3%)	5	(3%)	$22	(3%)
Unclassified structural area	1,400	(4%)	3	(6%)	5	(4%)	$28	(4%)
Garage or vehicle storage area*	1,200	(4%)	1	(1%)	5	(3%)	$27	(4%)
Unclassified storage area	1,100	(4%)	2	(5%)	6	(4%)	$24	(4%)
Attic or ceiling/roof assembly or concealed space	1,000	(3%)	0	(0%)	1	(1%)	$34	(5%)
Unclassified area of origin	1,000	(3%)	2	(3%)	4	(3%)	$20	(3%)
Wall assembly or concealed space	900	(3%)	0	(0%)	2	(1%)	$18	(3%)
Multiple areas of origin	800	(3%)	1	(3%)	8	(5%)	$25	(4%)
Unclassified outside area	800	(3%)	1	(2%)	5	(3%)	$9	(1%)
Ceiling/floor assembly or concealed space	700	(2%)	1	(2%)	1	(1%)	$16	(2%)
Crawl space or substructure space	700	(2%)	0	(0%)	3	(2%)	$26	(4%)
Bathroom	600	(2%)	1	(1%)	3	(2%)	$10	(2%)
Confined cooking fire	600	(2%)	0	(0%)	0	(0%)	$0	(0%)
Lobby or entrance way	500	(2%)	0	(0%)	1	(1%)	$11	(2%)
Storage of supplies or tools or dead storage	500	(2%)	0	(0%)	1	(1%)	$9	(1%)
Exterior roof surface	500	(2%)	0	(0%)	0	(0%)	$5	(1%)
Exterior balcony or unenclosed porch	500	(2%)	0	(0%)	2	(1%)	$12	(2%)
Unclassified means of egress	400	(1%)	2	(3%)	2	(1%)	$6	(1%)
Storage room, area, tank, or bin	400	(1%)	0	(0%)	0	(0%)	$7	(1%)
Interior stairway or ramp	300	(1%)	0	(0%)	1	(0%)	$7	(1%)
Lawn, field or open area	300	(1%)	0	(0%)	1	(1%)	$2	(0%)
Closet	300	(1%)	0	(0%)	0	(0%)	$6	(1%)
Confined chimney or flue fire	300	(1%)	0	(0%)	0	(0%)	$0	(0%)
Laundry room or area	300	(1%)	2	(3%)	1	(1%)	$10	(1%)
Confined fuel burner or boiler fire	300	(1%)	0	(0%)	0	(0%)	$0	(0%)
Heating equipment room	300	(1%)	0	(0%)	2	(2%)	$7	(1%)

Table 12.
Reported Structure Fires in Vacant Buildings by Area of Origin
2003-2006 Annual Averages
(Continued)

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Office	200	(1%)	0	(0%)	0	(0%)	$9	(1%)
Courtyard, terrace or patio	200	(1%)	1	(2%)	0	(0%)	$4	(1%)
Exterior stairway, ramp, or fire escape	200	(1%)	0	(0%)	0	(0%)	$2	(0%)
Hallway, corridor, mall	200	(1%)	0	(0%)	2	(1%)	$4	(1%)
Other known area or confined fire	1,500	(5%)	1	(2%)	6	(4%)	$62	(10%)
Total	31,000	(100%)	50	(100%)	141	(100%)	$642	(100%)

Note: This table includes a proportional share of fires with unknown building status. Sums may not equal totals due to rounding errors. Non-confined fires in which the area of origin was unknown or not reported were allocated proportionally across non-confined fires with known area of origin.-

Source: NFIRS 5.0 and NFPA survey.

Appendix A.
How National Estimates Statistics Are Calculated

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

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

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

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

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

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

population that it makes sense to survey all of them. Most respond, resulting in excellent precision for their part of the final estimate.

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

Projecting NFIRS to National Estimates

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

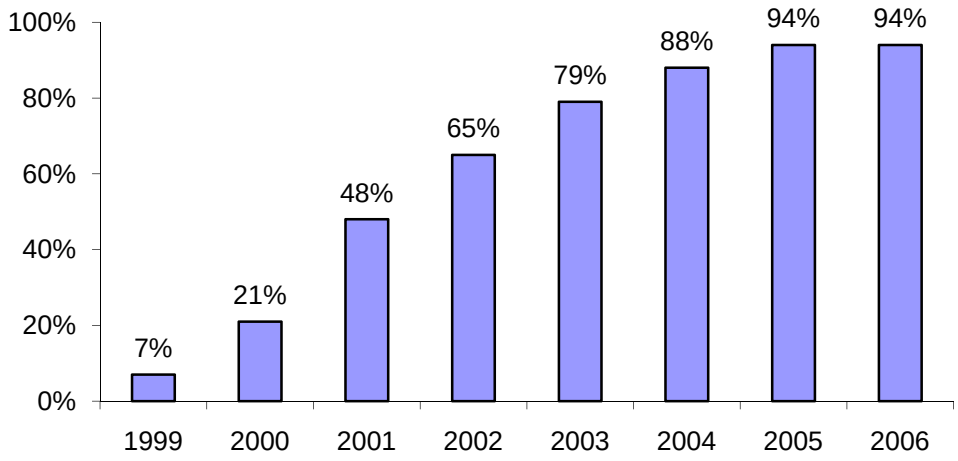
Scaling ratios are obtained by comparing NFPA's projected totals of residential structure fires, non-residential structure fires, vehicle fires, and outside and other fires, and associated civilian deaths, civilian injuries, and direct property damage with comparable totals in NFIRS. Estimates of specific fire problems and circumstances are obtained by multiplying the NFIRS data by the scaling ratios. Reports for incidents in which mutual aid was given are excluded 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 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 1. Fires Originally Collected in NFIRS 5.0 by Year



For 2002 data on, analyses are based on scaling ratios using only data originally collected in NFIRS 5.0:

NFPA survey projections
NFIRS totals (Version 5.0)

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

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

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

Although causal and other detailed information is typically not required for these incidents, it is provided in some cases (typically 10-20%). 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 alls 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.

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, 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.

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 electrical failure or malfunction (factor contributing to ignition 30-39) are combined and shown as "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.

Type of Material First Ignited (TMI). This field is required only if the Item First Ignited falls within the code range of 00-69. NFPA has created a new code "not required" for this field that is applied when Item First Ignited is in code 70-99 (organic materials, including cooking materials and vegetation, and general materials, such as electrical wire, cable insulation, transformers, tires, books, newspaper, dust, rubbish, etc..) and TMI is blank. The ratio for allocation of unknown data is:

$$\frac{\text{(All fires – TMI Not required)}}{\text{(All fires – TMI Not Required – Undetermined – Blank)}}$$

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

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

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

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

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

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

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

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

In addition, the partially unclassified codes for broad equipment groupings (i.e., code 100, - heating, ventilation, and air conditioning, other; code 200- electrical distribution, lighting and power transfer, other; etc.) were allocated proportionally across the individual code choices in their respective broad groupings (heating, ventilation, and air conditioning; electrical

distribution, lighting and power transfer, other; etc.). Equipment that is totally unclassified is not allocated further. This approach as 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. (Confined fire incident types are not discussed here)

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	121	Fireplace, masonry
	122	Fireplace, factory-built
	125	Chimney connector or vent connector
	126	Chimney – brick, stone or masonry
	127	Chimney-metal, including stovepipe or flue
Wiring, switch or outlet	210	Unclassified electrical wiring
	211	Electrical power or utility line
	212	Electrical service supply wires from utility
	214	Wiring from meter box to circuit breaker
	216	Electrical branch circuit
	217	Outlet, receptacle
	218	Wall switch
Power switch gear or overcurrent protection device	215	Panel board, switch board, circuit breaker board
	219	Ground fault interrupter
	222	Overcurrent, disconnect equipment
	227	Surge protector
Lamp, bulb or lighting	230	Unclassified lamp or lighting
	231	Lamp-tabletop, floor or desk
	232	Lantern or flashlight
	233	Incandescent lighting fixture
	234	Fluorescent light fixture or ballast
	235	Halogen light fixture or lamp
	236	Sodium or mercury vapor light fixture or

		lamp
	237	Work or trouble light
	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

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."

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.

Inflation. Property damage estimates are not adjusted for inflation unless so indicated.

Appendix B.
Methodology and Definitions Used in "Leading Cause" Table

The cause table reflects relevant causal factors that accounted for at least 2% of the fires in a given occupancy. Only those causes that seemed to describe a scenario are included. Because the causal factors are taken from different fields, some double counting is possible. Percentages are calculated against the total number of structure fires, including both confined and non-confined fires. Bear in mind that every fire has at least three "causes" in the sense that it could have been prevented by changing behavior, heat source, or ignitability of first fuel, the last an aspect not reflected in any of the major cause categories. For example, several of the cause categories in this system refer to types of equipment (cooking, heating, electrical distribution and lighting, clothes dryers and washers, torches). However, the problem may be not with the equipment but with the way it is used. The details in national estimates are derived from the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS). This methodology is based on the coding system used in Version 5.0 of NFIRS. The *NFIRS 5.0 Reference Guide*, containing all of the codes, can be downloaded from http://www.nfirs.fema.gov/documentation/reference/.

Intentional fires are identified by fires with a "1" (intentional) in the field "cause." The estimate includes a proportional share of fires in which the cause was undetermined after investigation, under investigation, or not reported. All fires with intentional causes are included in this category regardless of the age of the person involved. Intentional fires were deliberately set; they may or may not be incendiary in a legal sense. No age restriction is applied. Confined and non-confined structure fires were analyzed separately.

Cooking equipment and heating equipment are calculated by summing fires identified by equipment involved in ignition and relevant confined fires. Confined fires will be shown if they account for at least 1% of the incidents. **Confined cooking fires** (cooking fires involving the contents of a cooking vessel without fie extension beyond the vessel) are identified by NFIRS incident type 113;

Confined heating equipment fires include **confined chimney or flue fires (**incident type 114) and **confined fuel burner or boiler** fires (incident type 116). The latter includes delayed ignitions and incidents where flames caused no damage outside the fire box. The two types of confined heating fires may be combined or listed separately, depending on the numbers involved.

Confined or contained fires (incident type 113-118) are excluded from the remaining estimates. Unknown data is allocated proportionally among non-confined fires.

Fires caused by **playing with heat source** (typically matches or lighters) are identified by code 19 in the field "factor contributing to ignition." Because of conversion issues, only data originally collected in Version 5.0 of NFIRS is used in the initial calculation. It appears that "none" is often being used in place of "unknown." Fires in which the factor contribution to ignition was undetermined (UU), entered as none (NN) or left blank are considered unknown and allocated proportionally. Because factor contributing to ignition is not required for intentional fires, the share unknown, by these definitions, is somewhat larger than it should be. After the

Version 5.0 only data has been run for non-confined fires and the unknown data allocated, percentages are calculated for each code of Version 5.0 non-confined fires. Total non-confined structure fires (all versions) are multiplied by these percentages to obtain national estimates. The final percentage of fires is calculated by dividing these estimates by the total number of confined and non-confined fires from all versions.

The heat source field is used to identify fires started by: **smoking materials** (cigarette, code 61; pipe or cigar, code 62; and heat from undetermined smoking material, code 63); **candles** (code 66), **lightning** (code 73); and **spontaneous combustion or chemical reaction** (code 72). Fires started by heat from unclassified open flame or smoking materials (code 60) are allocated proportionally among the "other open flame or smoking material" codes (codes 61-69) in an allocation of partial unknown data. This includes smoking materials and candles. This approach results in any true unclassified smoking or open flame heat sources such as incense being inappropriately allocated. However, in many fires, this code was used as an unknown.

The equipment involved in ignition field is used to find several cause categories. This category includes equipment that functioned properly and equipment that malfunctioned.

Identified cooking equipment refers to equipment used to cook, heat or warm food (codes 600, 620-649 and 654). Fire in which ranges, ovens or microwave ovens, food warming appliances, fixed or portable cooking appliances, deep fat fryers, open fired charcoal or gas grills, grease hoods or ducts, or other cooking appliances) were involved in the ignition are said to be caused by cooking equipment. Food preparation devices that do not involve heating, such as can openers or food processors, are not included here. Unclassified kitchen and cooking equipment (code 600) is included here because a larger share of the whole category involved cooking rather than kitchen equipment.

Identified heating equipment (codes 100 and 120-199) includes central heat, portable and fixed heaters (including wood stoves), fireplaces, chimneys, hot water heaters, and heat transfer equipment such as hot air ducts or hot water pipes. Heat pumps are not included. Unclassified heating, ventilation and air condition equipment (code 100) is included here because a larger share of the whole category involved heating rather than air conditioning or ventilation equipment.

Electrical distribution and lighting equipment (codes 200-299) include: fixed wiring; transformers; associated overcurrent or disconnect equipment such as fuses or circuit breakers; meters; meter boxes; power switch gear; switches, receptacles and outlets; light fixtures, lamps, bulbs or lighting; signs; cords and plugs; generators, transformers, inverters, batteries and battery charges.

Torch, burner or soldering iron (codes 331-334) includes welding torches, cutting torches, Bunsen burners, plumber furnaces, blowtorches, and soldering equipment.

Clothes dryer or washer (codes 811, 813 and 814) includes clothes dryers alone, washer and dryer combinations within one frame, and washing machines for clothes.

Electronic, office or entertainment equipment (codes 700-799) includes: computers and related equipment; calculators and adding machines;, telephones or answering machines; copiers; fax machines; paper shredders; typewriters; postage meters; other office equipment; musical instruments; stereo systems and/or components; televisions and cable TV converter boxes,, cameras, excluding professional television studio cameras, video equipment and other electronic equipment. Older versions of NFIRS had a code for electronic equipment that included radar, X-rays, computers, telephones, and transmitter equipment. Because this code was so broad, it unfortunately converts to equipment involved undetermined.

Shop tools and industrial equipment excluding torches, burners or soldering irons (codes 300-330, 335-399) includes power tools; painting equipment; compressors; atomizing equipment; pumps; wet/dry vacuums; hoists, lifts or cranes; powered jacking equipment; water or gas drilling equipment; unclassified hydraulic equipment; heat-treating equipment; incinerators, industrial furnaces, ovens or kilns; pumps; compressors; internal combustion engines; conveyors; printing presses; casting, molding; or forging equipment; heat treating equipment; tar kettles; working or shaping machines; coating machines; chemical process equipment; waste recovery equipment; power transfer equipment; power takeoff; powered valves; bearings or brakes; picking, carding or weaving machines; testing equipment; gas regulators; separate motors; non-vehicular internal combustion engines; and unclassified shop tools and industrial equipment.

Medical equipment (codes 410-419) includes: dental, medical or other powered bed, chair or wheelchair; dental equipment; dialysis equipment; medical monitoring and imaging equipment; oxygen administration equipment; radiological equipment; medical sterilizers, therapeutic equipment and unclassified medical equipment.

Mobile property (vehicle) describes fires in which some type of mobile property was involved in ignition, regardless of whether the mobile property itself burned. Mobile property includes: highway-type vehicles such as cars, trucks, recreational vehicles, and motorcycles; trains, trolleys and subways; boats and ships; aircraft; industrial, agricultural and construction vehicles; and riding lawn mowers, snow removal vehicles and tractors. Because of conversion issues, only data originally collected in Version 5.0 of NFIRS is used in the initial calculation. The data was obtained by first running Version 5.0 non confined fires only to identify vehicles that were involved in ignition whether or not they burned themselves (mobile property involved codes 2 and 3). After the unknown data was allocated, percentages are calculated for each code of Version 5.0 non-confined fires. Total non-confined structure fires (all versions) are multiplied by these percentages to obtain national estimates. The final percentage of fires is calculated by dividing these estimates by the total number of confined and non-confined fires from all versions.

Exposures are fires that are caused by the spread of or from another fire. These include fires in which the exposure number is greater than 0; the factor contributing to ignition is property too close (code 71); or heat source is heat spreading from another fire via direct flame or convection current (code 80-89). Because exposures are identified by the older hierarchical sort, all non-confined fires with exposure number greater than zero are counted as exposures, but those

identified by heat source and factor contributing to ignition include only fires that were not grouped in other categories such as cooking or heating equipment.

Appendix C.
Previously Published Incident Descriptions

Vacant hotel fire causes $15 million in direct property damage, Florida
In February 2007, a fire was reported at 1:19 p.m. in a three-story vacant Florida hotel of unprotected ordinary construction. No one was in the building at the time of the fire. There was a complete coverage detection system but its type was not reported. The detection system had been manually disabled because it was a vacant building. There was an unknown type complete-coverage sprinkler system present. The system had been shut down prior to the fire due to rusted pipes in the entire pipe grid. This incendiary fire was set on the first story after gasoline was spread throughout the building. As a result, fire spread rapidly to the upper stories. Firefighters initiated an interior attack, but withdrew when ceiling pieces started to fall. Direct property damage was estimated at $15,000,000.

Adapted from Stephen G. Badger's *Large-Loss Fires in the United States in 2007,* NFPA Fire Analysis and Research, Quincy, MA, 2008.

Vacant hospital fire causes $60 million in direct property damage, New York
A New York fire in a vacant, six-story, historic psychiatric hospital made of unprotected, ordinary construction was reported at 7:32 p.m. on a May 2007 evening. No one was in the building at the time of the fire. No automatic detection or suppression equipment was present. This fire started when lightning struck the building during a thunderstorm. Firefighters were faced with a rapidly spreading fire and approximately 26 exposed buildings, many of which were interconnected. The yard hydrant system had been shut down years earlier, forcing firefighters to locate hydrants a distance away. The fire caused $60,000,000 in direct property damage.

Adapted from Stephen G. Badger's "*Large-Loss Fires in the United States in 2007,"* NFPA Fire Analysis and Research, Quincy, MA, 2008.

Vacant supermarket fire causes $5.5 million in direct property damage.
At 3:33 p.m. on a November afternoon a fire was reported in a vacant one-story New York supermarket of heavy-timber construction. The market covered 25,000 square feet (2,322 square meters) and was closed and boarded up. There was no detection equipment present. There was a partial coverage dry pipe sprinkler system, which did operate but its effectiveness was not reported.

A shopping cart full of refuse was ignited and pushed into the middle of the store. The refuse inside the building ignited and fire spread throughout. Due to the degree of fire involvement

upon firefighter's arrival, they initiated an exterior attack. The building was mostly boarded up and vacant, resulting in a delay in discovery of the fire. A poor water supply allowed the fire to spread rapidly. One firefighter was injured. Direct property damage was estimated at $5,500,000.

Adapted from Stephen G. Badger's 2006 article, "Large-Loss Fires of 2005," *NFPA Journal*, November/December, pg. 69.

Vacant warehouse fire causes $11 million in direct property damage, Maryland
A fire was reported in a Maryland storage complex at 7:00 p.m. on a May evening. The complex consisted of a one-story vacant warehouse of unprotected ordinary construction and a second warehouse of unprotected noncombustible construction and covered 100,000 square feet (9,290 square meters). No detection equipment was present. A complete coverage dry-pipe sprinkler system was present, but the system was not operational, as it had been shut down when building became vacant.

This was an incendiary fire. The fire caused a complete collapse of the older brick building and fire damage to the steel storage building. Four firefighters were injured. The loss was $10,000,000 to the structure and $1,000,000 to the contents.

Adapted from Stephen G. Badger's 2006 article, "Large-Loss for 2005," *NFPA Journal*, November/December, 68.

Vacant home burns, Rhode Island
Unauthorized use of a Victorian mansion that was being converted into a group home as a clubhouse led to a fire in a knee wall on the third floor that heavily damaged the building.

The three-story, wood-framed house, which was 50 feet (15 meters) long and 30 feet (9 meters) wide, had a pitched wooden roof covered by slate shingles. Its heat and smoke detection systems had been disconnected during the renovation, and the sprinklers designed for the project had not yet been installed.

A 6:10 p.m., calls brought two fire departments to the scene, as the house was on the line between two cities. Arriving within minutes, firefighters saw heavy smoke coming from the building's upper floors and entered the house to find fire on the third floor. However, they were pushed back to the stairwell by the heat and flames, which were held within the building by its heavy slate roof and planking.

On their second attempt to reach the third floor, firefighters discovered that the fire had spread from the third floor to the attic. Within 30 minutes, and the roof collapsed.

Neighbors told investigators that youths had been seen entering the building on a regular basis. The investigators found drug paraphernalia, smoking materials, and other items throughout the house. The enclosed space had no windows, which may have concealed the fire from neighbors, allowing it to burn for some time before it was detected. Once the fire broke out of the knee wall and into a room with windows, it spread rapidly throughout the entire floor and up to the attic.

Two firefighters received minor injuries. Damage to the building is estimated at $150,000.

Kenneth J. Tremblay, 2004, "Firewatch," NFPA Journal, May/June, 24.

Arsonist destroys vacant house, New Jersey
A home the fire department had acquired for use in training before it was demolished was destroyed when someone intentionally set fire to it before the drill.

The two-and-a-half-story, single-family, wood-framed home was 150 feet (46 meters) long and 50 feet (15 meters) wide. It had an asphalt roof, and asphalt siding the exterior walls. There were no fire detection or suppression systems, and the property was vacant when the fire broke out.

Firefighters were called to the scene around 3:00 a.m. by a neighbor. Furniture piled up in the living room had been ignited with a lighter, and fire spread to the second floor up an open stairwell and through open windows. The building was destroyed and had to be torn down. It had no value. Investigators determined that a former member of the fire department had set the fire.

Kenneth J. Tremblay, "Firewatch," *NFPA Journal*, March/April, 2004, Special On-Line Edition, www.nfpa.org.

Vacant warehouse fire causes $10,010,000 in direct property damage, Minnesota
At 7:52 p.m. on a September evening, a fire was reported in a vacant three-story Minnesota warehouse. The building was of heavy timber construction and covered 18,480 square feet (1,716 square meters). This structure was one of many on the grounds of a historical prison facility. There was no automatic detection or suppression system present. This incendiary fire had grown rapidly before the arrival of firefighters. Upon arrival firefighters had to make a defensive attack on this fire. Direct damage was estimated at $10,010,000.

Adapted from Stephen G. Badger's 2003 article, *"*2002 Large-Loss Fires*"*, *NFPA Journal*, November/December, p. 79.

Juveniles ignite vacant manufacturing plant, Alabama
A fire in a vacant plant in which cotton gins had once been manufactured smoldered undetected for nearly six hours until it burst into flame and reached flashover.

The three-story plant, which had been vacant for years, was part of a complex of interconnected buildings of a heavy, timber construction. It was 160 feet (49 meters) long and 60 feet (18 meters) wide, with heavy wooden structural framing, wood plank floors and roof, and brick walls. The plant had no fire detection system and its dry-pipe fire sprinkler system was no longer operational.

A police officer on patrol discovered the fire and radioed in the alarm at 10:59 p.m. Fire units responded within a minute, but flashover had already occurred in the building of origin, and the fire was spreading to another building, which became fully involved 20 to 30 minutes after firefighters arrived.

Investigators determined that juveniles ignited cotton cloth on the first floor of the plant near a corridor that connected it with another large building and left the cloth smoldering on the floor. The size of the two buildings concealed the smoke and flames until the fire reached flashover.

Direct property damage to the uninsured property was estimated at more than $1 million.

Kenneth J. Tremblay, 2003, "Firewatch," *NFPA Journal*, September/October, 18.

Winds spread fire, Pennsylvania

An incendiary fire within the center unit of five connected row homes spread to all dwellings and to four exposures, as high winds fanned flames. The fire started in a vacant dwelling and was heavily involved before being observed by a passerby. The fire department fought the fire using 34 pieces of fire apparatus and 95 firefighters.

The row houses were constructed of wood framing with asphalt-shingled roofs, the exterior siding was a faux brick product except for one end unit that had real brick exterior. The unit where the fire occurred was vacant and did not contain any fire detection equipment or sprinklers.

A passerby saw the fire and called the fire department at 2:46 a.m. to report the fire. Command was first to arrive within five minutes of the alarm and began to order companies to lay feeder lines down streets and advance multiple hose lines to protect exposures. A second alarm was called for within 10 minutes of arrival and a third alarm 13 minutes later, as fire had crossed the street and was now burning another group of similarly built-row houses. The fire was primarily fought defensively as high winds fanned flames and helped spread the fire.

In total, nine homes were heavily damaged as structural losses were estimated at $200,000 and contents losses of $250,000. Two firefighters suffered minor injuries including a twisted ankle and a broken arm. Six civilians were also hurt but their injuries were not reported.

Kenneth J. Tremblay, 2003, "Firewatch," *NFPA Journal*, March/April, 22.

Vacant building target of juvenile arson, Massachusetts

Juveniles using an aerosol paint can and matches or a lighter ignited combustibles on the second floor of a vacant seven-story apartment building. Firefighters prepared for an interior attack, but flames spread quickly to the upper floors, so the incident commander shifted to a defensive attack, then sounded additional alarms.

The 46-unit, wood-frame, brick-veneered building was 77 feet (23 meters) long and 50 feet (15 meters) wide with 3,850 square feet (358 square meters) of space per floor. It was unsprinklered and had no fire- or smoke-detection systems. The police indicated that vagrants using the building tended to use the rear door, which was secure when firefighters arrived.

The fire department was called to the blaze at 10:26 p.m., and fire crews saw heavy smoke coming from the building as they left the station. The incident commander ordered a second

alarm and additional resources when he saw flames on the second floor in the middle of the building spreading to the upper floors.

As first-alarm engine companies established a water supply; ladder companies forced their way into the building with attack lines. A third alarm was sounded when the incident commander decided to switch to a defensive attack using exterior master streams as flames vented through the roof. All companies were ordered to defensive positions outside a collapse zone to protect exposures as two additional alarms were ordered.

It took 60 firefighters from 5 communities with 12 engines and 4 ladder trucks to bring the fire under control. Two firefighters suffered minor injuries. The value of the building's contents wasn't reported, but the structural damage was estimated at $75,000.

Kenneth J. Tremblay, 2002, Fire Watch, "Firewatch," *NFPA Journal*, November/December, 18, 20

Incendiary fire destroys vacant building, Massachusetts

An incendiary fire set in a large vacant building during a snowstorm heavily damaged the structure and required three alarms before it was extinguished.

The four-story, wood-and-brick structure was 100 feet (30 meters) long and 40 feet (12 meters) wide and had brick walls. Although the structure had a sprinkler system, it wasn't in service. There were no smoke alarms.

A snowplow operator noticed flames coming from the house at 9:12 p.m. and radioed in the alarm. When firefighters arrived three minutes later, they reported flames coming through the roof.

Due to the buildings condition, the severity of the fire, and the adverse weather, the incident commander immediately set up a defensive attack and called for additional resources. A ladder company was positioned in front of the building, and its aerial was extended for master stream operation, while three engines established water supply and fed the ladder pipe. At the height of the blaze, more than 1,000 gallons (3,785 liters) per minute of water pressure was applied.

Fire crews tried to feed the sprinkler system, but falling debris near the connection forced them to abandon the task. Flaming brands also threatened several nearby buildings. It took crews more than three hours to bring the fire under control.

Investigators determined that the fire had been intentionally set in a third-floor room. The house, valued at $200,000, was total loss.

Kenneth J. Tremblay, 2002, "Firewatch," *NFPA Journal*, March/April, 25.

Fire destroys vacant mansion, Massachusetts
A vacant mansion built in 1839 was destroyed when transients camping out inside lit a warming fire. The mansion's remote site hampered firefighters because it lacked a nearby water supply. Despite a fast interior attack, firefighters quickly expended the water in their tankers, and the fire continued to burn, consuming the structure.

Built originally as a modest 10-room colonial, the wood-frame house had been enlarged to three stories and had a total area of nearly 20,000 square feet (1,858 square meters). The main floor contained numerous rooms, a grand staircase, a kitchen, dining rooms, and servants' quarters. A large ballroom was at one corner of the house and several porches were on two sides of the building. The second and third floors contained many bedrooms and bathrooms. There was no fire detection system or sprinklers.

A passerby reported the fire at 4:09 p.m., and firefighters arrived shortly thereafter to find flames showing from the ballroom. Attacking the blaze with a 2 1/2-inch hose line, the interior crew knocked down the heavy fire and stopped its spread. However, they also depleted the tank water. Crews had to stretch a water supply line by hand through heavy brush to a hydrant 400 feet (122 meters) away

By the time this water supply was established, the fire had regained strength and spread to all three floors. The closest hydrant supplied a water flow of only 500 gpm (1.89 kpm), so crews established three, 4-inch supply lines and began relay pumping from a nearby pond. At the height of the incident, nearly 4,000 gallons (15,142 liters) of water per minute were flowing into the house.

Despite this, flames spread along the floor-to-ceiling drapes, the wood paneling and flooring, and the decorative wainscoting and moldings. The grand staircase, open from the first to the third floor, allowed for rapid fire spread.

Investigators determined that two men illegally occupying the mansion started the fire. Although the ballroom had a fireplace, the men lit a warming fire in the middle of the floor, using rubbish and paper. Both men have been charged with arson. The house, valued at $2 million, had to be torn down.

Kenneth J. Tremblay, 2001, “Firewatch,” *NFPA Journal*, November/December, 18, 20.

Electrically charged aluminum siding delays fire attack, New York
While battling an arson fire in a vacant farmhouse, firefighters had to change their extinguishment strategy when the main power supply to the structure arced and energized the building's exterior metal siding.

The 3½-story, wood-frame farmhouse, which was 60 feet (18 meters) long and 50 feet (15 meters) wide, was unsprinklered and had no fire detection system.

A passing fire official spotted the fire and notified the fire department at 6:31 p.m., sending the first of 65 firefighters to the scene. On arrival, crews found that the front door had been forced open and that the fire was spreading from the basement to the upper floors through concealed

voids in the balloon frame. Firefighters attacked the fire aggressively, but withdrew when the house's siding became energized in a shower of sparks.

Once the crews moved to defensive positions, the structure became heavily involved in flames. Fire crews lost nearly an hour waiting for the utility company to arrive and cut power to the house so they could complete extinguishment.

Investigators determined that the fire had been deliberately set in the basement.

The house, valued at $225,000, sustained structural losses of $150,000. Its contents, valued at $20,000, sustained losses of $10,000. One firefighter was injured.

Kenneth J. Tremblay, 2001, "Firewatch," *NFPA Journal* September/October, 26.

Vacant tenement building fire causes $10 million in direct property damage, Massachusetts
At 7:11 p.m. on an August evening, a Massachusetts fire was reported in a five-story, vacant, 10-unit tenement building of unprotected, ordinary construction. The structure covered a ground-floor area of 5,200 square feet (483 meters). The building didn't have automatic detection or suppression equipment. This incendiary fire burned undetected for some time. A fire company returning from another call spotted the smoke and investigated and ordered a full response. An offensive attack was initiated. With deteriorating conditions, firefighters were ordered out of the building and went to a defensive attack. Winds were blowing at 29 miles (46.7 kilometers) per hour, spreading the flames to several structures. Nine alarms were ordered and apparatus responded from 16 cities and towns. Five firefighters were injured. Direct property damage was estimated at $10,000,000.

Adapted from Stephen G. Badger's 2000 article, "1999 Large-Loss Fires and Explosions," *NFPA Journal*, November/December, pg. 95.

Four die in vacant home fire, Virginia
A March fire in a two-story, vacant single-family home of unprotected wood-frame construction; was reported at 12:24 a.m. When firefighters arrived, they found the house fully involved in fire and initiated a defensive attack. Within three minutes, the building collapsed. Investigators don't know where or how the fire started. This vacant structure had no smoke detectors, and all the doors and windows had been boarded up. The fire claimed four lives. The victims, who were homeless, had elevated blood alcohol levels.

Adapted from Robert S. McCarthy's 2000 article, "1999 Catastrophic Multiple-Death Fires in the United States," *NFPA Journal*, September/October 60.

Vacant bar and grill fire kills three, South Carolina
A January fire reported at 4:04 a.m. in a three-story vacant South Carolina bar and grill of heavy timber construction killed three people. No smoke alarms or sprinklers were present.

Vagrants lit a fire to stay warm on the second floor of the vacant restaurant. By the time firefighters arrived, the first and second floors were engulfed in flames. Firefighters had trouble getting into the building because it was boarded up. About an hour later, the second and third floors collapsed. All three victims were intoxicated.

Adapted from Robert S. McCarthy's 2000 article, "1999 Catastrophic Multiple-Death Fires in the United States," *NFPA Journal*, September/October 60.

Homeless man's smoking materials start fire, Minnesota

A homeless man using the rear loading dock of a vacant furniture store as a shelter is believed to have started a fire by his careless use of smoking materials. The fire heavily damaged the store and other occupancies in the large building.

The two-story building, which was approximately 120 feet (37 meters) long by 50 feet (15 meters) deep, was of heavy timber construction and the extent of coverage provided by the dry-pipe sprinkler system wasn't reported. The building contained six storefront businesses on the first floor and several offices on the second. The fire started in an area formerly occupied by a furniture store and spread to other parts of the building, which were in use but closed for the night.

A neighbor saw flames shooting three stories above the structure and called 911 at 2:42 a.m. Several additional calls to 911 sent firefighters to the scene as fire heavily involved the rear of the structure. A total of four alarms were sounded to bring firefighters to control the blaze, which was largely limited to the exterior loading dock and first floor. No sprinklers operated on the first floor, although they did operate on the second floor.

Investigators determined that the fire began by the rear loading dock near an area occupied by vagrants. In the area, they found a mattress, clothing, and other personal items. Unable to locate any other source of ignition, they believe the fire was caused by careless use of smoking materials, which ignited the combustibles. The fire caused an estimated loss of $1 million.

Kenneth J. Tremblay, 1999, "Firewatch", *NFPA Journal*, November/December, 20.

Four die in fire, Massachusetts

Vagrants occupying a former construction office in a vacant unprotected wood frame construction trailer overloaded the electrical circuits, igniting the room's contents. The resulting fire spread rapidly, trapping the four occupants. The fire was reported at 12:15 a.m. on a January morning. No detection or suppression equipment was present. Three men and a woman died in the fire. Their ages weren't reported.

Adapted from Kenneth J. Tremblay's 1999 article, "The Catastrophic Fires of 1998", *NFPA Journal*, September/October 55.

Six firefighters die in vacant cold storage facility fire, Massachusetts
At 6:13 p.m. on a December evening, a fire was reported in a vacant, five-story, cold storage warehouse of heavy timber construction. The fire started when a homeless couple knocked over a candle. Two firefighters became lost searching for the two occupants, and four others died searching for their colleagues. This vacant building was a known hangout for homeless people. The interior of the building was maze-like, and fire conditions changed rapidly. Six firefighters died in this fire.

Adapted from Robert S. McCarthy's 2000, "1999 Catastrophic Fires" *NFPA Journal*, September/October 59.

Sprinklers control arson fire, California
Three sprinklers controlled a fire that was deliberately set in a former dance studio in a shopping center.

The studio, which was vacant at the time of the fire, was on the lower level of a two-story, (10,000-square-meter) shopping center of heavy timber construction. The studio was protected by an unmonitored, wet-pipe sprinkler system that was connected to a water-flow bell located outside. It had no detectors.

An arsonist used a flammable liquid to set a fire in five to seven different places in the studio. A passerby heard the sprinkler system's audible water flow alarm and, thinking it was a burglar alarm, called the police department. A responding police officer notified the fire department.

Three sprinklers extinguished most of the blaze, confining it to the room of origin, and responding firefighters extinguished the remaining fire. Fire from three points of origin spread into the walls, damaging an adjacent business. Damage to the shopping center, valued at $500,000, was estimated at $15,000.

Kenneth J. Tremblay, 1999, "Firewatch," NFPA Journal, July/August 21-22.

Vacant building set afire in act of revenge, Illinois
A homeless man seeking revenge against another homeless man set fire to a vacant tavern, killing the transient and destroying the building.

The two-story building was of protected, wood-frame construction and measured 100 by 30 feet (30 by 9 meters). It had no alarms or sprinklers. The two homeless men had been living illegally in the building, which was scheduled for demolition.

One of the homeless men used a lighter to ignite ordinary combustibles in a below-grade exterior stairwell. The resulting fire engulfed the entire structure, killing an intoxicated 44-year-old man who was still inside. The firesetter fled the scene, but he was later arrested and charged with arson and murder. He awaits prosecution. The building, valued at $50,000, was a total loss.

Kenneth J. Tremblay, 1999, "Firewatch," *NFPA Journal*, July/August 21-22.

Fire in vacant seafood processing plant causes $5 million loss, Alaska
At 6:05 p.m. on an April evening, a fire was reported in a vacant two-story seafood processing plant. The facility, which had been shut down for about a year and a half, was constructed of unprotected wood frame with a ground-floor area of 25,730 square feet (2,400 square meters). No one was in the building at the time of the fire. The building had no automatic detection or suppression equipment. The fire, which began when a short circuit in a second-floor office ignited the wall covering, burned for 45 minutes before a passerby spotted it. Several responding firefighters tried to extinguish the blaze from a boat using hand-held extinguishers, and several tugs applied water from the ocean side of the plant. No injuries were reported. Direct property damage was estimated at $5,000,000.

Because the building was unoccupied, the fire burned undetected for 45 minutes. A fire hydrant used during the initial fire attack malfunctioned, forcing firefighters to attach their hose lines to a hydrant much further from the structure.

Adapted from Stephen G. Badger's 1998 article "Large-Loss Fires and Explosions," *NFPA Journal*, November/December, p. 93.

Arson fire destroys vacant mill complex, Connecticut
An arson fire that took firefighters more than I0 hours to control destroyed a large 19th-century mill complex.

Because the complex had experienced an increasing number of fires and false alarms, local fire officials had developed a five-alarm pre-fire plan that involved 75 pieces of apparatus from 35 departments, and firefighters had conducted drills to learn how best to protect the complex.

Built in 1864, the mill complex was constructed of heavy timber beams, oak floors, and a brick veneer. Its four buildings ranged from three to five stories high and contained approximately 300,000 square feet of floor space. Originally designed to manufacture cotton products, the mill became a textile storage facility in the 1960s and had since housed a variety of occupants, including, most recently, a cabinet company. At the time of the fire, the complex had been vacant for about a year. The buildings contained wet-pipe sprinkler systems, but they were in disrepair and had been shut down.

At approximately 11:41 a.m. on a Sunday, a 911 operator began to receive several calls reporting a fire in the vacant mill. The dispatcher immediately activated the first alarm of the pre-fire plan. One minute later, a deputy chief who could see the blaze from his home called for two additional alarms.

By the time firefighters arrived, a two-story maintenance building that was attached to a five-story mill building was fully involved. Following the initial strategy of the pre-fire plan, firefighters set up an offensive operation to prevent the fire from spreading to the larger building through overhead catwalks. Meanwhile, other companies established water supplies and drafting operations at predetermined positions.

The fire was spreading from two separate locations, requiring all companies to attack the blaze with ladder pipes, deck guns, and portable master streams. A chief en route could see the smoke plume from a distance and struck the remaining two alarms of the pre-fire plan. Nine minutes after the fire was reported, overhead windows blew out, forcing firefighters to evacuate. As they pulled back, other engine companies attacked the fire with additional master streams. The chief arrived only 22 minutes after the blaze was first reported, but the building was completely involved.

Firefighters were able to confine the fire to the complex and hold the predetermined perimeter. Using 12 ladder pipes, 23 master streams, and multiple handlines flowing over 25,000 gpm, it took them more than 10 hours to extinguish the blaze. A demolition company was called in to knock down dangerous walls as firefighters continued to pour water over the still-burning building. The fire wasn't completely extinguished for two weeks.

Investigators believe the fire started when someone intentionally ignited trash and wood pallets in two separate locations. The disabled sprinkler system and sabotaged interior fire doors allowed the fire to progress unimpeded.

The complex, valued at an estimated $1.5 million, was a total loss. A few nearby exposures sustained radiant heat damage. Eight firefighters suffered injuries ranging from sprains to heart and stress problems.

Kenneth J. Tremblay, 1997, "Firewatch" *NFPA Journal*, March/April, pg. 25-26.

Dumpster Fire Spreads to Vacant Manufacturing Building, New York
A fire that started in a dumpster spread rapidly into a vacant furniture manufacturing building, destroying the structure.

The single-story building covered 144,920 square feet and was irregularly shaped. It was constructed of heavy timber with concrete block walls and a built-up roof. A sprinkler system provided full coverage, but the water and all the other utilities had been shut off due to lack of payment. The building had no detection systems.

A neighbor noticed a fire in a dumpster behind the building and immediately called the fire department. However, the blaze spread so quickly that by the time the neighbor got off the phone, it was already inside the structure. When a fire chief arrived to set up command two minutes later, the blaze had spread throughout the building.

The cause of the fire wasn't determined, but investigators believe a discarded cigarette may have ignited trash and wood scraps in the dumpster.

The building, valued at $225,000, and its contents, valued at $75,000, were destroyed. No one was injured.

Kenneth J. Tremblay, 1996, "Firewatch," *NFPA Journal*, September/October 26.

Sprinklers control fire in vacant school, Virginia
Sprinklers controlled a blaze in a vacant high school scheduled for renovations. The fire began when a fluorescent light ballast overheated and ignited ceiling tiles.

The three-story structure, which measured 300 by 200 feet, was constructed of heavy timber and concrete block walls with a brick veneer. The roof was built up over wood decking. An unsupervised, wet-pipe sprinkler system protected the building, which had no detectors.

It was a Sunday and the school was unoccupied when a passerby noticed smoke issuing from the building and called 911 at 6:49 a.m. Firefighters arrived two minutes later and found light smoke coming from the rear of the school. Entering through the back, they found heavy smoke on the first floor and two sprinklers operating to control a small fire in a storage room. Firefighters used a 1 1/2-inch handline to complete extinguishment and positive-pressure ventilation to remove the smoke from the building.

Firefighters determined that a fluorescent light fixture in the storage room had been left on and that the ballast had overheated and ignited low-density fiberboard ceiling tiles. Heat from the fire fused two sprinklers, which activated to control the blaze.

Fire damage was limited to the room of origin, but smoke spread throughout the entire building. Damage to the school, valued at $4 million, was estimated at only $500. However, the storage room in which the blaze started contained new electronic voting machines, which were damaged by smoke and by water from the sprinklers and the firefighters' handline. The contents of the room, valued at $500,000, were a total loss.

Kenneth J. Tremblay, 1996, "Firewatch," *NFPA Journal*, September/October 25.

$8 million loss in vacant shoe manufacturing mill fire, New York
At 6:34 p.m. on a December evening, a fire was reported in a former shoe manufacturing mill complex comprised of five interconnected three-and four-story buildings of heavy timber construction. The ground-floor area of the entire mill complex was 175,000 square feet. The plant was vacant at the time of the fire. There was no automatic detection equipment in the complex. All buildings in the complex had been equipped with automatic sprinkler systems, but the systems had been shut off when the complex was vacated. All sprinkler systems in the complex had been taken out of service before the fire.

Patrolling police officers discovered smoke coming from one of the mill buildings and notified the fire department. Firefighters arrived within 3 minutes to find that the fire was rapidly spreading from west to east through the complex. Mutual aid was requested from 23 departments as the fire extended across the street into two additional buildings. The entire complex, as well as two additional buildings, were destroyed. The blaze was started by several children who had built a campfire inside one of the buildings.

Over the years, the wood floors of the mill buildings had become saturated with oils, glue, and dyes, which contributed to the rapid spread of fire once ignition occurred. A 10 to 15-mph wind

and a wind generated by the developing conflagration spread the fire throughout the complex and across the street. Direct property damage was estimated at $8 million dollars.

Adapted from Michael J. Sullivan's 1994 article "Property Loss Rises in Large-Loss Fires", *NFPA Journal*, November/December, pg. 98.

Squatters' candle starts fatal vacant building fire, Pennsylvania

Around 4:00 a.m. on an August morning, a fire was reported in a three-story, vacant single-family dwelling of unprotected ordinary construction. The property was abandoned. It did not have electricity, heat, or water utilities and was in very poor condition. No smoke alarms or sprinklers were present.

A candle being used by squatters ignited adjacent combustibles in a second-floor bedroom. The fire spread to an interior stairway and vertically to the third floor, where the victims were found. The 38-year-old mother, who had evidence of PCP, a controlled substance, in her blood; a 13-year-old; a 10-year-old; and a 3-year-old died. A 17-year-old escaped by jumping from a third-floor window.

Adapted from Kenneth J. Tremblay's 1993 article, "Catastrophic Fires and Deaths Drop in 1992" *NFPA Journal*, September/October 67.

Three die in vacant department store fire, California

At 12:37 a.m., a fire was reported in a one-story, vacant department store of unprotected ordinary construction. No automatic detection or suppression systems were present. Gasoline-soaked combustibles were deliberately ignited. The fire burned through a small room and mezzanine and spread to heavy timber roof members. The building was being demolished due to damage from a previous fire. Vagrants and illegal drug activity had been a problem in the past. The fire killed three people.

Adapted from Alison L. Miller's and Kenneth J. Tremblay's 1992 article, "342 Die in Catastrophic Fires in 1991" *NFPA Journal*, July/August 71.

Four die in vacant nightclub fire, Georgia

At 7:19 a.m. on a December morning, a fire was reported in a vacant nightclub of unprotected ordinary construction. The sprinkler system was no longer in service. There was no automatic detection system. A cooking or warming fire got out of control and ignited the wooden interior walls and roof structure. All doors but one were secured with locks or welds and windows were covered with wire mesh, limiting egress and fire department access. Four people died in the fire.

Adapted from Rita F. Fahy's and Kenneth J. Tremblay's 1991 article, "The Catastrophic Fires of 1990" *NFPA Journal*, July/August 68.

Four die in vacant dwelling fire, Texas
At 12:57 a.m. on a November morning a fire was reported in a one-story, vacant single-family dwelling of unprotected wood-frame construction. No smoke alarms or sprinklers were present. Someone used a lighter to ignite rubbish on the back porch of this vacant dwelling occupied by homeless people. Fire spread into the structure and quickly consumed the entire dwelling. The four victims were found to have blood alcohol levels of 0.12 to 0.40 percent. A sliding bolt and a hasp lock prevented the victims from escaping.

Adapted from Rita F. Fahy's and Kenneth J. Tremblay's 1991 article, "The Catastrophic Fires of 1990" *NFPA Journal,* July/August 68.

Vacant dwelling fire kills four, California
At 1:48 p.m. on a July afternoon, a fire was reported in a two-story, vacant single-family dwelling or unprotected wood-frame construction. No smoke alarms or sprinklers were present. The victims were removing the fuel tank from an automobile in the enclosed garage of this vacant dwelling. Gasoline vapors from the fuel tank were ignited by the pilot light on a natural gas-fueled water heater located nearby. The flash fire quickly ignited the clothing of the victims and small area in the garage. The fire claimed four lives.

Adapted from Rita F. Fahy's and Kenneth J. Tremblay's 1991 article, "The Catastrophic Fires of 1990" *NFPA Journal,* July/August 67.

Smoking materials start fatal vacant dwelling fire, Maryland
At 3:38 p.m. on a March afternoon, a fire was reported in a vacant, three-story, single-family dwelling of unprotected wood-frame construction. No smoke alarms or sprinklers were present.

One of several homeless people taking shelter in a vacant dwelling fell asleep while smoking, igniting bedding in a second-floor room. Fire spread to the next room and up the stairs. The four victims were asleep at the time of the fire. They were found on the third floor.

The building was reportedly boarded up, which may have prevented escape.

Adapted from Rita F. Fahy's and Kenneth J. Tremblay's 1991 article, "The Catastrophic Fires of 1990" *NFPA Journal,* July/August 67.