Volume 11, Issue 6 / January 2011

Attic Fires in Residential Buildings

These topical reports are designed to explore facets of the U.S. fire problem as depicted through data collected in the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS). Each topical report briefly addresses the nature of the specific fire or fire-related topic, highlights important findings from the data, and may suggest other resources to consider for further information. Also included are recent examples of fire incidents that demonstrate some of the issues addressed in the report or that put the report topic in context.

Findings

- An estimated 10,000 residential building attic fires are reported to U.S. fire departments each year and cause an estimated 30 deaths, 125 injuries, and $477 million in property loss.
- Residential building attic fires are considered part of the residential fire problem and comprise approximately 2 percent of all residential building fires.
- Almost all residential building attic fires are nonconfined fires (99 percent).
- One- and two-family residential buildings account for 90 percent of residential attic fires.
- Electrical malfunction is the leading cause of residential building attic fires (43 percent), followed by natural fires (16 percent).
- A third of all residential building attic fires spread to involve the entire building. Only 2 percent extend beyond the building to adjacent properties.
- Residential building attic fires are most prevalent in December (12 percent) and January (11 percent) and peak between the hours of 4 and 8 p.m.
- Electrical arcing is the most common heat source in residential building attic fires (37 percent).

From 2006 to 2008, an estimated 10,000 residential building fires originating in attics were reported by U.S. fire departments annually. These fires caused an estimated 30 deaths, 125 injuries, and $477 million dollars in property damage.[1,2,3] Residential building attic fires are 2 percent of all residential building fires reported to the National Fire Incident Reporting System (NFIRS) from 2006 to 2008.

Attics are not commonly used as occupied spaces and, as a result, they usually do not have smoke alarms or heat sensors. When a fire occurs in an attic, it is common that it will go unnoticed until smoke or flames, escaping from the roof, are visible from the outside.[4] Sometimes, however, enough smoke will reach the smoke alarms on the lower levels, setting them off.[5]

Because they can take longer to detect, attic fires are very dangerous for firefighters and residents alike. The delayed detection allows the fire to become larger in size, ultimately causing more damage. The attic provides the fire with an array of fuel sources like open wood support beams and storage items.

In attic fires, multiple areas of the attic tend to be involved. The fire tends to spread amongst the wood fairly easily and can be concealed under the insulation. This makes it very important that firefighters perform a thorough check of the attic to ensure that no hotspots, embers, or smoldering debris are still present.[6]

The location of the attic provides many difficulties for firefighters when extinguishing the fire. Careful planning goes into deciding the best way to extinguish an attic fire. Firefighters must decide whether to fight the fire from above or below, both of which present many difficulties. In both instances, firefighters have to consider that roofs or ceilings may collapse. The large amounts of water used to extinguish the blaze causes the insulation and wood beams to become saturated. Firefighters have been known to fall through the roof into the attic or through the attic into the floor(s) below.[7] In addition, not all attics have flooring. If firefighters enter the attic, they must be careful not to step outside the flooring area since they risk falling through the ceiling.[8]

The construction of the attic is another area that presents difficulties to firefighters. Older and newer homes are constructed using different techniques. Older homes tend to have roofs that are framed with larger sized lumber, 2 by 6 inches. These attics usually provide a continuous attic space with a peak as high as 8 feet.[9] Conventional attics are not generally compartmentalized like many new home attics.[10] Newer home attics typically employ a truss-framed construction that involves smaller wood boards placed in "A" (or triangular) shapes throughout the attic from the ceiling to the floor. This construction can be difficult for a firefighter to navigate. In addition, wood members in truss-framed construction can conceal fires and make extinguishing the fire more difficult.[11] In large new homes and multifamily dwellings, many attics are constructed with fire stops, which can be as substantial as 2-hour, fire-resistance rated walls.[12] These help limit the spread of the fire from the attic to surrounding areas.

Because attic fires pose unique challenges, this topical report addresses the characteristics of residential building attic fires as reported to NFIRS from 2006 to 2008. The NFIRS data are used for the analyses presented throughout the report. For the purpose of the report, the terms "residential fires" and "attic fires" are synonymous with "residential building fires" and "residential building attic fires," respectively. "Attic fires" is used throughout the body of this report; the findings, tables, charts, headings, and footnotes reflect the full category, "residential building attic fires."

Type of Fire

Building fires are divided into two classes of severity in NFIRS: "Confined fires," which are those fires confined to certain types of equipment or objects, and "nonconfined fires," which are not. Confined building fires are small fire incidents that are limited in extent, staying within pots or fireplaces or certain other noncombustible containers.[13] Confined fires rarely result in serious injury or large content losses, and are expected to have no significant accompanying property losses due to flame damage.[14] Nonconfined fires account for nearly all attic fires (Table 1). Because there are so few confined attic fires (less than 1 percent), the subsequent analyses in this report include all attic fires and do not distinguish between confined and nonconfined fires.

Table 1. Residential Building Attic Fires by Type of Incident (2006–2008)

Incident Type	Percent	
Nonconfined fires	99.2	
Building fires		97.3
Fires in structures other than a building		1.1
Fires in mobile homes and other mobile/portable buildings		0.8
Confined fires	0.8	
Chimney or flue fire, confined to chimney or flue		0.6
Fuel burner/boiler malfunction		0.1
Trash or rubbish fire, contained		0.1
Total	100.0	

Source: NFIRS 5.0.
Note: Total may not add to 100 percent due to rounding.

Type of Property

Residential buildings are divided into three major property types: one- and two-family buildings, multifamily buildings, and other. One- and two-family residential buildings include detached single-family residences, manufactured homes, mobile homes not in transit, and duplexes. Multifamily residential buildings include apartments, condos, and town houses. Other residential buildings include all other types of residential buildings, such as hotels or motels, long-term care facilities, dormitories, and sorority or fraternity housing.

One- and two-family residential buildings account for nearly all (90 percent) of residential attic fires reported to NFIRS (Table 2). By comparison, one- and two-family residential buildings account for 65 percent of fires originating in other, nonattic areas of residential buildings, more in line with the occurrence of one- and two-family residential building fires overall (66 percent).[15]

Table 2. Attic and Nonattic Residential Building Fires by Property Type

Property Type	Percent of Residential Building Attic Fires	Percent of Nonattic Residential Building Fires
One- and Two- Family	89.5	65.4
Multifamily	7.3	28.2
Other	3.2	6.4
Total	100.0	100.0

Source: NFIRS 5.0.

Loss Measures

Table 3 presents losses, averaged over this 3-year-period, of reported attic and nonattic residential fires.[16] Attic fires cause less fatalities and injuries per thousand fires than nonattic residential building fires (Table 3). As attics tend to be unoccupied areas, the lower loss measures for fatalities and injuries may be a reflection of this occupancy status. Attic fires, however, do result in more dollar loss per fire than nonattic residential building fires. The increase in dollar loss per fire may ultimately be due to challenges in the detection of attic fires and to the fire location. The fires are harder to detect, become larger in size, and cause more widespread flame damage. Water damage also affects the dollar loss, since the fire is attacked at the highest level, affecting all of the floors below, as opposed to a fire that is attacked on lower floors only.

Table 3. Loss Measures for Attic and Nonattic Residential Building Fires (3-year-average, 2006–2008)

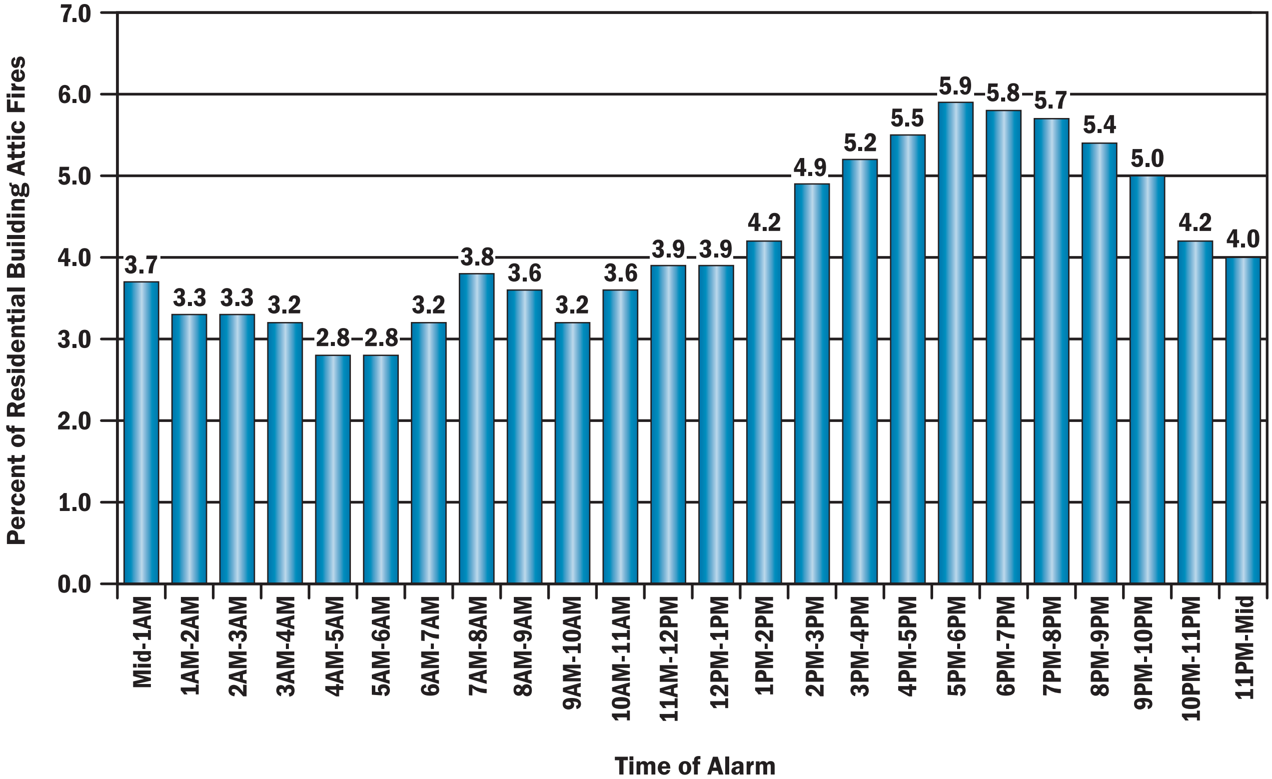
Measure	Attic Residential Building Fires	Nonattic Residential Building Fires
Average Loss:		
Fatalities/1,000 fires	2.5	5.5
Injuries/1,000 fires	11.2	28.6
Dollar loss/fire	$38,950	$15,550

Source: NFIRS 5.0.
Note: Average loss for fatalities and injuries is computed per 1,000 fires; average dollar loss is computed ***per fire*** and is rounded to the nearest $10.

When Residential Building Attic Fires Occur

As shown in Figure 1, attic fires occur most frequently in the late afternoon to early evening hours, peaking from 4 to 8 p.m. They gradually decline throughout the late evening and early morning hours. The lowest point is reached between 4 and 6 a.m. The fire incidences then begin to rise gradually until 7 a.m. where a small peak is observed. A small decrease is seen from 8 to 10 a.m. Beginning at 10 a.m., the number of fire incidences start to increase until the peak hours are reached. The peak period (4 to 8 p.m.) accounts for 23 percent of attic fires.[17]

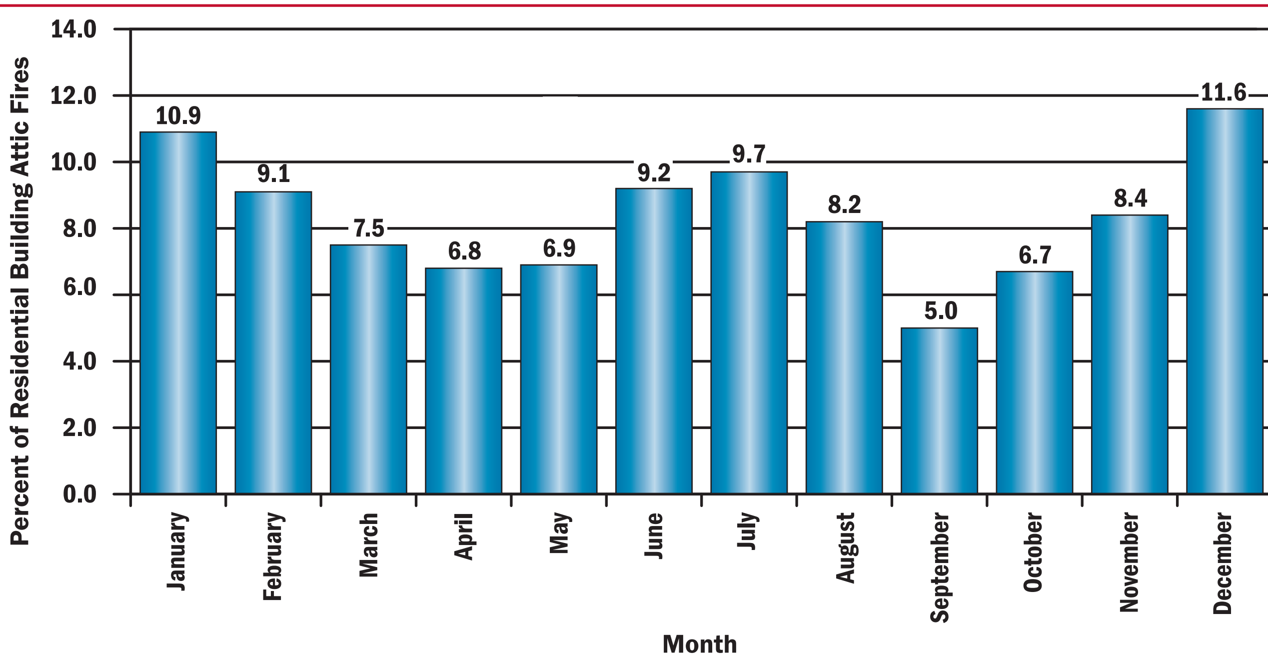
Figure 1. Residential Building Attic Fires by Time of Alarm (2006–2008)



Source: NFIRS 5.0.

Figure 2 illustrates that attic fires peak twice during the year, once in the colder months and again in the summer. The cold weather peak, which is the highest peak, occurs during the months of December (12 percent) and January (11 percent). The increase in attic fires during these 2 months is partially a result of electrical malfunction fires. The second peak in attic fires is seen during the months of June (9 percent) and July (10 percent). This summer peak is primarily a result of natural fires, which are highest during these 2 months. The majority of these natural fires are the result of lightning discharge. The lowest number of fire incidents is seen in September which sees the least number of attic fires caused by electrical malfunctions.

Figure 2. Residential Building Attic Fires by Month (2006–2008)



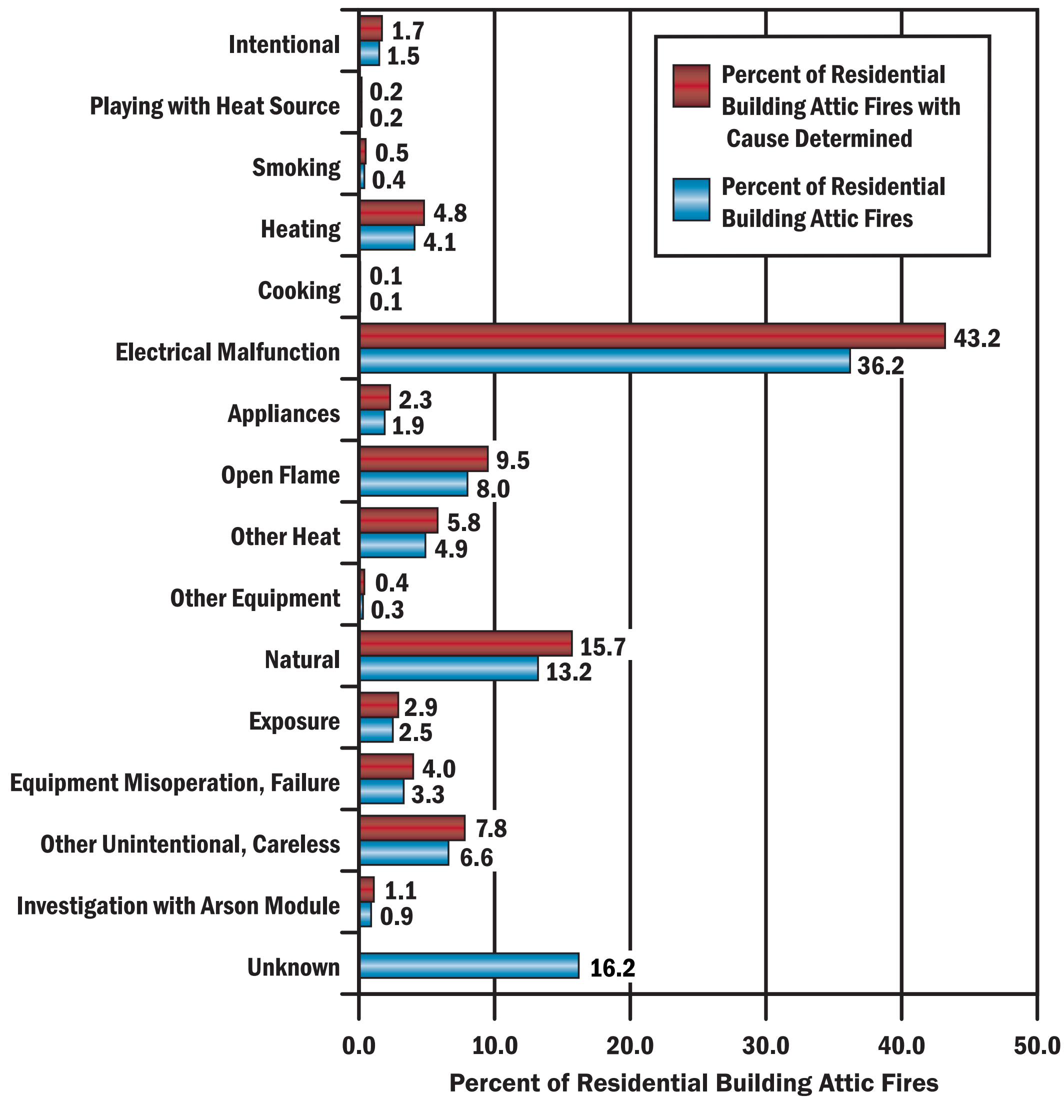
Source: NFIRS 5.0.

Causes of Residential Building Attic Fires

Forty-three percent of all attic fires are electrical malfunction fires as shown in Figure 3. This finding suggests that homeowners and residents should make it a priority to have electrical equipment and electrical wiring in the attic inspected and properly maintained.

The next four leading causes combined account for 40 percent of attic fires: natural fires (16 percent), open flame fires (10 percent), other unintentional, careless fires (8 percent), and other heat fires (6 percent).[18]

Figure 3. Residential Building Attic Fires by Cause (2006–2008)

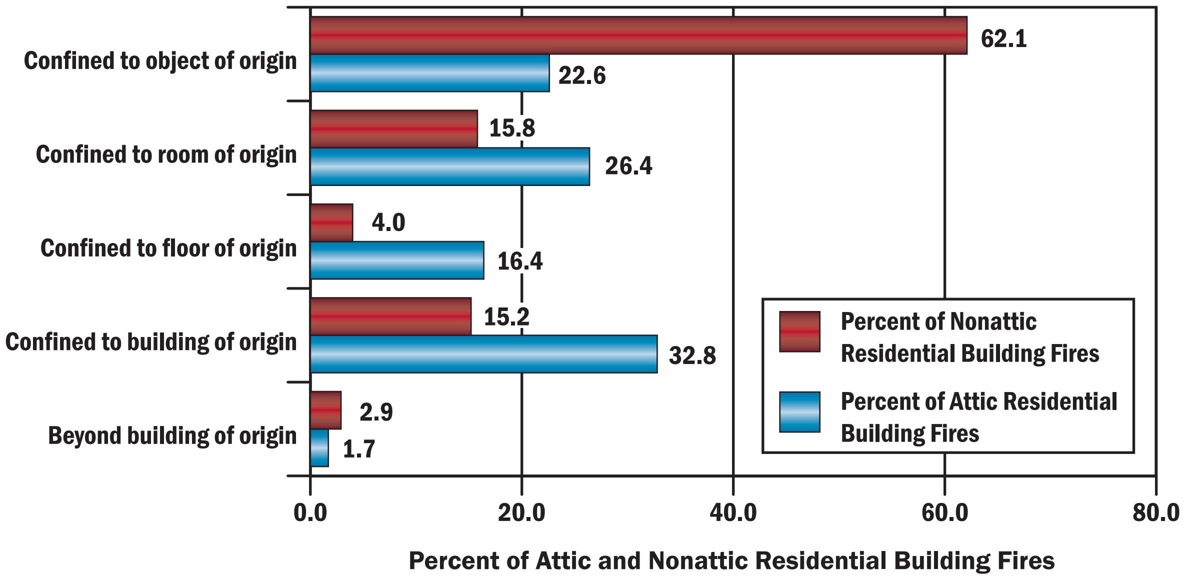


Source: NFIRS 5.0.

Fire Spread in Residential Building Attic Fires

While 98 percent of attic fires never leave the building of origin (Figure 4), a third of the fires involve the entire building. An additional 2 percent extend beyond the building to adjacent properties. The fire spread in attic fires is in contrast to nonattic residential building fires where most fires are confined to the object of origin (62 percent) and only 15 percent involve the entire building.

Figure 4. Extent of Fire Spread in Attic and Nonattic Residential Building Fires (2006–2008)



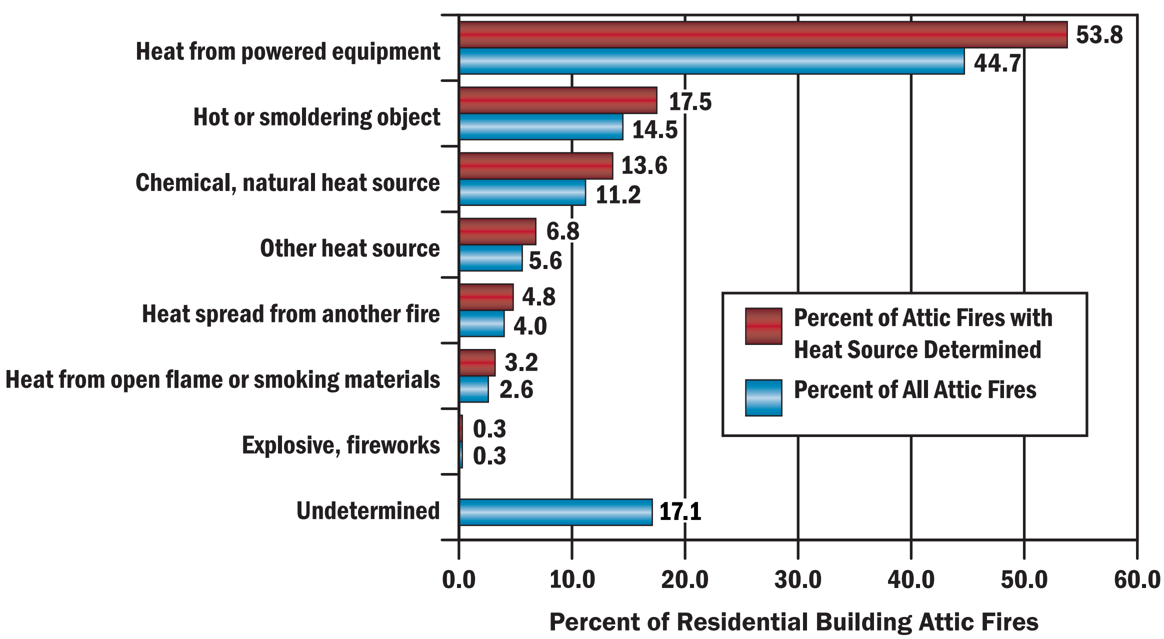
Source: NFIRS 5.0.

How Residential Building Attic Fires Start (Heat Source)

Figure 5 shows sources of heat categories in attic fires. The "heat from powered equipment" category, predominately electrical distribution-related equipment, accounts for 54 percent of all attic fires. Within this category, electrical arcing accounts for 37 percent, radiated or conducted heat from operating equipment accounts for 8 percent, heat from other powered equipment accounts for 6 percent, and sparks, embers, or flames from operating equipment account for 3 percent of all attic fires.

The "hot or smoldering objects" category accounts for 18 percent of attic fires. This category includes fires started by miscellaneous hot or smoldering objects (8 percent) and hot embers or ashes (8 percent). The third largest category "chemical, natural heat sources" (14 percent) is primarily lightning discharge (13 percent).

Figure 5. Sources of Heat Categories in Residential Building Attic Fires (2006–2008)



Source: NFIRS 5.0.

What Ignites First in Residential Building Attic Fires

Structural member or framing (39 percent), thermal, acoustical insulation within wall, partition, or floor/ceiling space (23 percent), and electrical wire, cable insulation (13 percent) are the specific items most often first ignited in attic fires (Table 4). Other structure component or finish accounts for 5 percent of the items first ignited. The exterior roof covering, surface, or finish accounts for an additional 5 percent.

Table 4. Leading Items First Ignited in Residential Building Attic Fires (2006–2008)

Area of Fire Origin	Percent (Unknowns Apportioned)
Structural member or framing	39.1
Thermal, acoustical insulation within wall, partition, or floor/ceiling space	23.0
Electrical wire, cable insulation	12.9
Structure component or finish, other	4.9
Exterior roof covering, surface, or finish	4.8
Interior ceiling cover or finish	3.4

Source: NFIRS 5.0.

Factors Contributing to Ignition in Residential Building Attic Fires

Table 5 shows the categories of factors contributing to ignition in attic fires. By far, the leading category is "electrical failure, malfunction" (50 percent). Unspecified electrical failure or malfunction (21 percent), unspecified short-circuit arc (14 percent), and short-circuit arc from defective, worn insulation (10 percent) account for the majority of the fires in this category.

The "natural condition" category is a contributing factor in 15 percent of attic fires. Storms (12 percent) are the leading specific factor contributing to ignition in this category.

The categories "fire spread or control" and "misuse of material or product" are the third and fourth leading factors at 11 and 10 percent, respectively. The remaining categories are contributing factors in 20 percent of attic fires.

Table 5. Factors Contributing to Ignition for Residential Building Attic Fires by Major Category (Where Factors Contributing to Ignition are Specified, 2006–2008)

Factors Contributing to Ignition Category	Percent of Attic Residential Fires
Electrical failure, malfunction	49.6
Natural condition	14.8
Fire spread or control	11.1
Misuse of material or product	9.5
Mechanical failure, malfunction	6.6
Design, manufacture, installation deficiency	5.2
Operational deficiency	4.9
Other factors contributing to ignition	3.0

Source: NFIRS 5.0.
Notes: 1) Includes only incidents where factors that contributed to the ignition of the fire were specified.
2) Multiple factors contributing to fire ignition may be noted for each incident; total will exceed 100 percent.

Alerting/Suppression Systems in Residential Building Attic Fires

Smoke Alarm Data

Smoke alarm data presented in Tables 6 and 7 are the raw counts from the NFIRS data set and are not scaled to national estimates of smoke alarms in attic fires. In addition, NFIRS does not allow for the determination of the type of smoke alarm—that is, if the smoke alarm was photoelectric or ionization—or the location of the smoke alarm with respect to the area of fire origin.

Overall, smoke alarms were present in 50 percent of attic fires and were known to have operated in 20 percent of the fires. By comparison, smoke alarms were present in 43 percent of nonconfined, nonattic residential fires and operated in 24 percent. In 23 percent of attic fires, there were no smoke alarms present. In another 27 percent of these fires, firefighters were unable to determine if a smoke alarm was present (Table 6).

There is a contradiction between firefighters' experiences in attic fires and what the NFIRS data suggest. Firefighters, both in published media and in interviews for this report, note that smoke alarms are generally not in the attic area itself but are most often on the ceiling of the story below the attic. Smoke and heat rise; if the alarm is activated, it is often because of smoke seepage from the attic opening. Hence, if smoke alarms operate, they are generally late in the detection and notification of attic fires.

The data, however, suggest that a *larger* proportion of smoke alarms are present in attic fires than in other residential fires, contrary to experience. Yet, consistent with experience, is that a smaller proportion of the alarms operate and that the overall damage is higher.

While veteran firefighters note that a smoke alarm present in the occupied area beneath an attic may detect smoke seeping into the occupied space and may provide adequate warning time to *escape* the fire, it is not adequate for the early fire *detection* smoke alarms afford.

Few, if any, smoke alarms are Underwriters Laboratories (UL)-listed for use in the temperature extremes an attic can experience. Few, if any, codes require alarms in one- and two- family residential attics where nearly all (90 percent) of attic fires occur. As a result, very few attics have smoke alarms installed.

Table 6. NFIRS Smoke Alarm Presence in Residential Building Attic Fires (NFIRS, 2006–2008)

Presence of Smoke Alarms	Count	Percent
Present	8,007	49.7
None present	3,726	23.1
Undetermined	4,293	26.6
Null/Blank	95	0.6
Total Incidents	16,121	100.0

Source: NFIRS 5.0.

Notes: The data presented in this table are raw data counts from the NFIRS data set. They do not represent national estimates of smoke alarms in residential building attic fires. They are presented for informational purposes. Total may not add to 100 percent due to rounding.

Smoke Alarms in Occupied Housing

One of the most important values of smoke alarms is detecting smoldering fires before they break into open flame or produce large volumes of smoke. Smoke alarms could be especially useful in early detection of attic fires, if the alarm is properly placed.

Smoke alarms were reported as present in 54 percent of attic fires in occupied housing (Table 7). Smoke alarms are known to have operated in 22 percent of attic fires in occupied housing and were known to be absent in 20 percent. Firefighters were unable to determine if a smoke alarm was present in another 27 percent of these fires.

When operational status is considered for attic fires in occupied housing, the percentage of smoke alarms reported as present (54 percent) consists of:

- smoke alarms present and operated—22 percent;
- present, but did not operate—22 percent (fire too small, 13 percent; alarm did not operate, 9 percent); and
- present, but operational status unknown—10 percent.

When the subset of incidents where smoke alarms were reported as present is analyzed separately, smoke alarms were reported to have operated in 42 percent of the incidents. The alarms failed to operate, however, in 17 percent of the incidents. In 24 percent of this subset, the fire was too small to activate the alarm. The operational status of the alarm was undetermined in an additional 18 percent of the incidents.

Table 7. NFIRS Smoke Alarm Data for Residential Building Attic Fires (NFIRS, 2006–2008) Occupied Housing

Presence of Smoke Alarms	Smoke Alarm Operational Status	Smoke Alarm Effectiveness	Count	Percent
Present	Fire too small to activate smoke alarm		1,732	12.6
	Smoke alarm operated	Smoke alarm alerted occupants, occupants responded	1,950	14.2
		Smoke alarm alerted occupants, occupants failed to respond	87	0.6
		No occupants	429	3.1
		Smoke alarm failed to alert occupants	184	1.3
		Undetermined	403	2.9
	Smoke alarm failed to operate		1,255	9.1
	Undetermined		1,315	9.6
None present			2,729	19.8
Undetermined			3,673	26.7
Total Incidents			13,757	100.0

Source: NFIRS 5.0.
Notes: The data presented in this table are raw data counts from the NFIRS data set. They do not represent national estimates of smoke alarms in residential building attic fires. They are presented for informational purposes. Total may not add to 100 percent due to rounding.

Automatic Extinguishment System Data

Overall, full or partial automatic extinguishing systems (AESs), mainly sprinklers, were present in just 1 percent of attic fires (Table 8). The lack of suppression equipment (sprinklers) in attic properties is not unexpected as sprinklers are largely absent nationwide in residential buildings. As well, none of the of the national model codes require sprinklers in attics in one- and two-family residences, the location of 90 percent of attic fires reported to NFIRS. Note that the data presented in Table 8 are the raw counts from the NFIRS data set and are not scaled to national estimates of AES in attic fires.

Table 8. NFIRS Automatic Extinguishing System Presence in Residential Building Attic Fires (2006–2008)

Presence of Automatic Extinguishing Systems	Count	Percent
AES present	199	1.2
Partial system present	6	0.0
AES not present	15,027	93.2
Unknown	794	4.9
Null/Blank	95	0.6
Total Incidents	16,121	100.0

Source: NFIRS 5.0.
Notes: The data presented in this table are raw data counts from the NFIRS data set. They do not represent national estimates of AESs in residential building attic fires. They are presented for informational purposes. Totals may not add to 100 percent due to rounding.

Examples

The following are some recent examples of attic fires reported by the media:

- July 2010: An attic fire in a Fresno, CA, home started around 2 a.m. and is believed to have been caused by an electrical problem. Eight family members were home when the fire took place but no injuries or deaths occurred. The fire caused between $15,000 to $20,000 worth of damage. The firefighters were able to keep the fire contained to the attic.[19]
- June 2010: A fire that started in the attic at a family's home in East Windsor, NJ, is said to have been caused by faulty wiring in a second-story ceiling fan. The fire was brought under control in about 30 minutes and was contained to the attic and roof areas. The homeowner and a contractor who was working on the back porch were home when the fire started. Both were alerted to the fire by a smoke alarm and were able to escape safely.[20]
- June 2010: A four-alarm fire in Weatherford, TX, started when a lighting strike hit a house, causing a fire to start in its attic. The fire ended up destroying the home despite firefighters efforts to combat the blaze. The fact that the fire department had no access to water at the home's location had a significant effect on the outcome. No deaths or injuries were reported as a result of the incident.[21]
- April 2010: A neighbor called 9-1-1 shortly after 10 p.m. when he smelled smoke coming from a neighboring house in Racine, WI. The fire is believed to have been caused by an electrical malfunction in the attic. No one was home when the fire started and no injuries were reported. It is estimated that the house sustained $30,000 worth of damage from the fire.[22]

NFIRS Data Specifications for Residential Building Attic Fires

Data for this report were extracted from the NFIRS annual Public Data Release (PDR) files for 2006, 2007, and 2008. Only version 5.0 data were extracted.

Attic fires are defined as:

- Incident Types 111 to 123:

Incident Type	Description
111	Building fire
112	Fires in structure other than in a building
113	Cooking fire, confined to container
114	Chimney or flue fire, confined to chimney or flue
115	Incinerator overload or malfunction, fire confined
116	Fuel burner/boiler malfunction, fire confined
117	Commercial compactor fire, confined to rubbish
118	Trash or rubbish fire, contained
120	Fire in mobile property used as a fixed structure, other
121	Fire in mobile home used as fixed residence
122	Fire in motor home, camper, recreational vehicle
123	Fire in portable building, fixed location

  Note that Incident Types 113 to 118 do not specify if the structure is a building.

  Incident Type 112 is included prior to 2008 as previous analyses have shown that Incident Types 111 and 112 were used interchangeably. As of 2008, Incident Type 112 is excluded.

- Aid Types 3 (mutual aid given) and 4 (automatic aid given) are excluded to avoid double counting of incidents.
- Property Use 400 to 464 is included to specify residential buildings:

Property Use	Description
400	Residential, other
419	One- or two-family dwelling
429	Multifamily dwelling
439	Boarding/Rooming house, residential hotels
449	Hotel/Motel, commercial
459	Residential board and care
460	Dormitory-type residence, other
462	Sorority house, fraternity house
464	Barracks, dormitory

- Structure Type:
  - For Incident Types 113 to 118:
    - 1—Enclosed building,
    - 2—Fixed portable or mobile structure, and
    - Structure Type not specified (null entry).
  - For Incident Types 111, 112, and 120 to 123:
    - 1—Enclosed building, and
    - 2—Fixed portable or mobile structure.
- Area of Fire Origin code 74 (Attic: vacant, crawl space above top story).

The analyses contained in this report reflect the current methodologies used by the U.S. Fire Administration (USFA). The USFA is committed to providing the best and most current information on the United States fire problem, continually examining its data and methodology to fulfill this goal. Because of this commitment, data collection strategies and methodological changes are possible and do occur. As a result, analyses and estimates of the fire problem may change slightly over time. Previous analyses and estimates on specific issues (or similar issues) may have used different methodologies or data definitions and may not be directly comparable to the current ones.

To request additional information or to comment on this report, visit http://www.usfa.fema.gov/applications/feedback/index.jsp

Notes:

1 National estimates are based on 2006 to 2008 native version 5.0 data from the National Fire Incident Reporting System (NFIRS) and residential structure fire loss estimates from the National Fire Protection Association's (NFPA's) annual surveys of fire loss. Fires are rounded to the nearest 100, deaths to the nearest 5, injuries to the nearest 25, and loss to the nearest $million.

2 In NFIRS, version 5.0, a structure is a constructed item of which a building is one type. In previous versions of NFIRS, the term "residential structure" commonly referred to buildings where people live. To coincide with this concept, the definition of a residential structure fire for NFIRS 5.0 has, therefore, changed to include only those fires where the NFIRS 5.0 Structure Type is 1 or 2 (enclosed building and fixed portable or mobile structure) with a residential property use. Such fires are referred to as "residential buildings" to distinguish these buildings from other structures on residential properties that may include fences, sheds, and other uninhabitable structures. Confined fire incidents that have a residential property use, but do not have a structure type specified are presumed to be buildings. Nonconfined fire incidents without a structure type specified are considered to be invalid incidents (structure type is a required field) and are not included.

3 Residential buildings include, but are not limited to, one- or two-family dwellings, multifamily dwellings, boarding houses or residential hotels, commercial hotels, college dormitories, and sorority/fraternity houses.

4 Doug Leihbacher, "Roof Ventilation at Attic Fires," fireengineering.com, September 1, 2003. http://www.fireengineering.com/index/articles/display/190976/articles/fire-engineering/volume-156/issue-9/departments/training-notebook/roof-ventilation-at-attic-fires.html (accessed August 23, 2010).

5 Matt Fair, "Attic fire displaces family," nj.com, June 17, 2010. http://www.nj.com/news/times/regional/index.ssf?/base/news-20/1276753527184840.xml&coll=5 (accessed July 29, 2010).

6 Jeff S. Case, "Residential Attic Fires," fireengineering.com, April 1, 2010. http://www.fireengineering.com/index/articles/display/4059918418/articles/fire-engineering/volume-163/Issue-4/Features/Residential-Attic-Fires.html (accessed August 23, 2010).

7 Dan Atkinson, "Newton firefighter Richard Busa survives two-story fall," wickedlocal.com, February 12, 2009. http://www.wickedlocal.com/newton/news/x2142440845/Jake-survives-two-story-fall (accessed August 23, 2010).

8 Doug Leihbacher, "Roof Ventilation at Attic Fires," fireengineering.com, September 1, 2003. http://www.fireengineering.com/index/articles/display/190976/articles/fire-engineering/volume-156/issue-9/departments/training-notebook/roof-ventilation-at-attic-fires.html (accessed August 23, 2010).

9 Jeff S. Case, "Residential Attic Fires," fireengineering.com, April 1, 2010. http://www.fireengineering.com/index/articles/display/4059918418/articles/fire-engineering/volume-163/Issue-4/Features/Residential-Attic-Fires.html (accessed August 23, 2010).

10 Jeff S. Case, "Residential Attic Fires," fireengineering.com, April 1, 2010. http://www.fireengineering.com/index/articles/display/4059918418/articles/fire-engineering/volume-163/Issue-4/Features/Residential-Attic-Fires.html (accessed August 23, 2010).

11 Jeff S. Case, "Residential Attic Fires," fireengineering.com, April 1, 2010. http://www.fireengineering.com/index/articles/display/4059918418/articles/fire-engineering/volume-163/Issue-4/Features/Residential-Attic-Fires.html (accessed August 23, 2010).

[12] Jeff S. Case, "Residential Attic Fires," fireengineering.com, April 1, 2010. http://www.fireengineering.com/index/articles/display/4059918418/articles/fire-engineering/volume-163/Issue-4/Features/Residential-Attic-Fires.html (accessed August 23, 2010).

[13] In NFIRS, confined fires are defined by Incident Type codes 113 to 118.

[14] NFIRS distinguishes between "content" and "property" loss. Content loss includes loss to the contents of a structure due to damage by fire, smoke, water, and overhaul. Property loss includes losses to the structure itself or to the property itself. Total loss is the sum of the content loss and the property loss. For confined fires, the expectation is that the fire did not spread beyond the container (or rubbish for Incident Type 118) and hence, there was no property damage (damage to the structure itself) from the flames. There could be, however, property damage as a result of smoke, water, and overhaul.

[15] *One- and Two-Family Residential Building Fires*, Topical Fire Report Series, U.S. Fire Administration, June 2010, Volume 10, Issue 7, http://www.usfa.dhs.gov/downloads/pdf/tfrs/v10i7.pdf.

[16] The average fire death and fire injury loss rates computed from the national estimates will not agree with average fire death and fire injury loss rates computed from NFIRS data alone. The fire death rate computed from national estimates would be (1,000*(30/10,000)) = 3.0 deaths per 1,000 attic residential building fires and the fire injury rate would be (1,000*(125/10,000) = 12.5 injuries per 1,000 attic residential building fires.

[17] For the purposes of this report, the time of the fire alarm is used as an approximation for the general time the fire started. However, in NFIRS, it is the time the fire was reported to the fire department.

[18] The U.S. Fire Administration cause hierarchy was used to determine the cause of attic fire incidents: http://www.usfa.fema.gov/fireservice/nfirs/tools/fire_cause_category_matrix.shtm.

[19] "Attic fire in Central Fresno," abclocal.go.com, July 26, 2010. http://abclocal.go.com/kfsn/story?section=news/local&id=7572423 (accessed July 29, 2010).

[20] Matt Fair, "Attic fire displaces family," nj.com, June 17, 2010. http://www.nj.com/news/times/regional/index.ssf?/base/news-20/1276753527184840.xml&coll=5 (accessed July 29, 2010).

[21] Crystal Brown, "House fire caused by lightning strike Wednesday night," weatherforddemocrat.com, June 3, 2010. http://weatherforddemocrat.com/homepage/x93700942/House-fire-caused-by-lightning-strike-Wednesday-night (accessed August 16, 2010).

[22] "Fire caused by electrical malfunction," journaltimes.com, April 19, 2010. http://www.journaltimes.com/news/local/crime-and-courts/article_5dc96e58-4bb3-11df-90e0-001cc4c002e0.html (accessed August 16, 2010).