Topical Fire Report Series Volume 14, Issue 13 / March 2014

Residential Building Electrical Fires (2009-2011)

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 25,900 residential building electrical fires were reported to fire departments within the United States each year. These fires caused an estimated 280 deaths, 1,125 injuries and $1.1 billion in property loss.
- Residential building electrical fires resulted in greater dollar loss per fire than residential building nonelectrical fires.
- Residential building electrical fires occurred most often in one- and two-family dwellings (84 percent).
- Residential building electrical fires occurred most often in the colder months of January and December (at 11 percent each month).
- In 79 percent of residential building electrical fires, the fire spread beyond the object where the fire started.
- The leading items most often first ignited in residential building electrical fires were electrical wire, cable insulation (30 percent) and structural member or framing (19 percent).
- The leading factors contributing to the ignition of residential building electrical fires were other electrical failure, malfunction (41 percent), unspecified short-circuit arc (25 percent), and short-circuit arc from defective, worn insulation (12 percent).
- Smoke alarms were present in 50 percent and automatic extinguishing systems were present in 2 percent of electrical fires that occurred in occupied residential buildings.

Electricity is a basic part of residential life in the U.S. It provides the energy for most powered items in a contemporary home, from lights to heating systems to televisions. Today it is hard to imagine a residence without electricity. It is a part of our homes and our activities that most of us take for granted. We rarely think how powerful electricity is.

Yet, using electricity can have dangerous consequences. Electrical fires occur frequently throughout the U.S., causing injury, claiming lives, and resulting in large losses of property.[1] From 2009 to 2011, an estimated 25,900 residential building electrical fires were reported by U.S. fire departments annually.[2, 3] These fires caused an estimated 280 deaths, 1,125 injuries and $1.1 billion in property damage.[4] Residential building electrical fires continue to be a part of the residential fire problem and accounted for 7 percent of all residential building fires.[5] The term electrical fires is defined as those fires that include electrical distribution, wiring, transformers, meter boxes, power switching gear, outlets, cords, plugs, surge protectors, electric fences, lighting fixtures, and electrical arcing as the source of heat.[6]

This topical report addresses the characteristics of electrical fires in residential buildings as reported to the National Fire Incident Reporting System (NFIRS) from 2009 to 2011.[7] The NFIRS data are used for the analyses presented throughout the report. For the purpose of the report, the terms "residential fires," "electrical fires," and "nonelectrical fires" are synonymous with "residential building fires," "residential building electrical fires" and "residential building nonelectrical fires" respectively. "Electrical fires" is used throughout the body of this report; the findings, tables, charts, headings and endnotes reflect the full category, "residential building electrical fires."

The Residential Building Electrical Fire Problem

Although electrical fires declined by 14 percent from 2007 to 2011,[8] electrical malfunction was the third leading cause of residential fires during these five years.[9] Electrical fires are fires that involve the flow of electric current or static electricity[10] and are caused by electrical system failures, appliance defects, incorrectly installed wiring, misuse and poor maintenance of electrical appliances, and overloaded circuits and extension cords.[11] These electrical fires can be unique. For example, electrical fires that start in walls can smolder for some time and cause smoke to not be seen immediately and detection to be delayed. By the time smoke is seen and fire is detected, the flames may have already spread behind and within walls.[12] As a result, electrical fires have the potential to spread further and cause more damage and injuries. In addition, electrical fires can be particularly tricky to put out. Since they involve electricity, and water conducts electricity, using water to put out the fire can cause electrocution unless power is reliably disconnected.

Over the last 30 years, our homes have been dramatically transformed by electrical devices. Today's electrical demands can overburden the electrical system in a home,[13] putting it at a higher risk of an electrical fire. This may be particularly true for homes more than 40 years old that have older wiring and electrical systems and devices. There is also the likelihood that older homes may not comply with more modern electric code requirements, which puts them at an elevated risk of hazardous conditions that could lead to an electrical fire.[14] Eventually, given enough time, any home can be at risk of an electrical fire as wire insulation ages, connections loosen, receptacles and switches come loose or wear out, and oil and dirt cause electrical components to overheat.[15]

Type of Fire

Building fires are divided into two classes of severity in NFIRS: "confined fires," which are 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, fireplaces or certain other noncombustible containers.[16] Confined fires rarely result in serious injury or large content loss and are expected to have no significant accompanying property loss due to flame damage.[17] Of the two classes of severity, nonconfined fires accounted for almost all of the electrical fires (Table 1). Because there were so few confined electrical fires, the subsequent analyses in this report include all electrical fires and do not distinguish between confined and nonconfined fires.

Table 1. Residential Building Electrical Fires by Type of Incident (2009-2011)

Incident Type	Percent
Nonconfined fires	99.83
Confined fires	0.17
Trash or rubbish, contained	0.13
Incinerator overload or malfunction, fire confined	0.04
Total	100.00

Source: NFIRS 5.0.

Loss Measures

Table 2 presents losses, averaged over the three-year period of 2009 to 2011, of reported electrical and nonelectrical residential fires.[18] Electrical fires caused a similar number of fatalities and injuries per thousand fires as did nonelectrical fires (Table 2). Electrical fires, however, resulted in greater dollar loss (70 percent higher) per fire than nonelectrical fires. The increase in dollar loss per fire may ultimately be due to challenges in the detection and location of some electrical fires.

Table 2. Loss Measures for Residential Building Electrical and Nonelectrical Fires (Three-year Average, 2009-2011)

Measure	Residential Building Electrical Fires	Residential Building Nonelectrical Fires
Average Loss:		
Fatalities/1,000 fires	5.5	5.4
Injuries/1,000 fires	31.7	29.1
Dollar loss/fire	$25,140	$14,820

Source: NFIRS 5.0.
Notes: 1. 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.
2. When calculating the average dollar loss per fire for 2009-2011, the 2009 and 2010 dollar-loss values were adjusted to their equivalent 2011 dollar-loss values to account for inflation.

Property Use

Residential buildings are divided into three major property types: one- and two-family residential buildings, multifamily residential buildings, and other residential buildings. 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, condominiums and town houses. Other residential buildings include all other types of residences, such as hotels or motels, long-term care facilities, dormitories, and sorority or fraternity housing.

One- and two-family residential buildings accounted for 84 percent of electrical fires reported to NFIRS (Table 3). By comparison, one- and two-family residential buildings accounted for 64 percent of nonelectrical fires, more in line with the occurrence of one- and two-family residential building fires overall (65 percent).[19] Multifamily residential buildings accounted for only 12 percent of electrical fires while they accounted for 29 percent of nonelectrical fires. Finally, all other residential buildings accounted for 4 percent of electrical fires while they accounted for 6 percent of nonelectrical fires. One explanation for the lower percentage of electrical fires in multifamily and other dwellings may be that more stringent building and fire codes that require regular fire and safety inspections (which include the inspection of wiring and electrical components) are often imposed on these types of residential buildings. In addition, multifamily dwellings and other residential buildings may more often be professionally maintained.

Table 3. Residential Building Electrical and Nonelectrical Fires by Property Use (2009-2011)

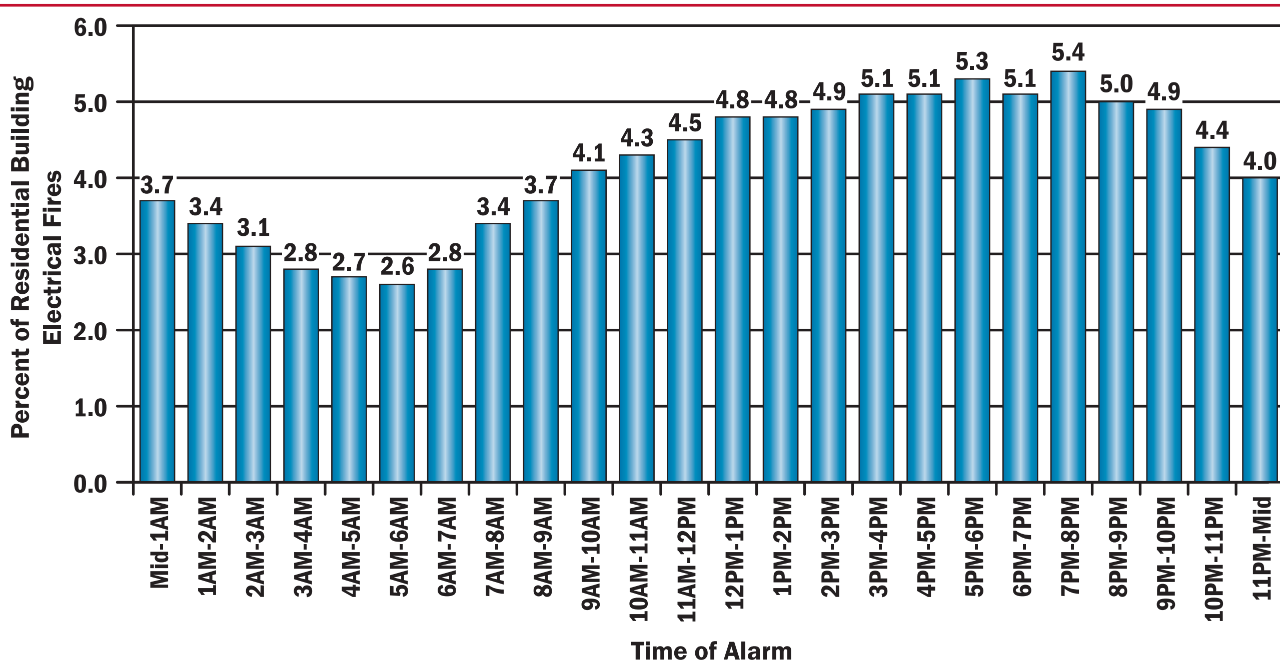
Property Type	Percent of Residential Building Electrical Fires	Percent of Residential Building Nonelectrical Fires
One- and Two-Family	83.7	64.3
Multifamily	12.1	29.3
Other	4.2	6.4
Total	100.0	100.0

Source: NFIRS 5.0.

When Residential Building Electrical Fires Occur

As shown in Figure 1, electrical fires occurred most frequently in the late afternoon to early evening hours.[20] They gradually declined throughout the late evening and early morning hours reaching the lowest point from 5 to 6 a.m. Beginning at 6 a.m., fire incidence started to increase until the peak hours were reached.

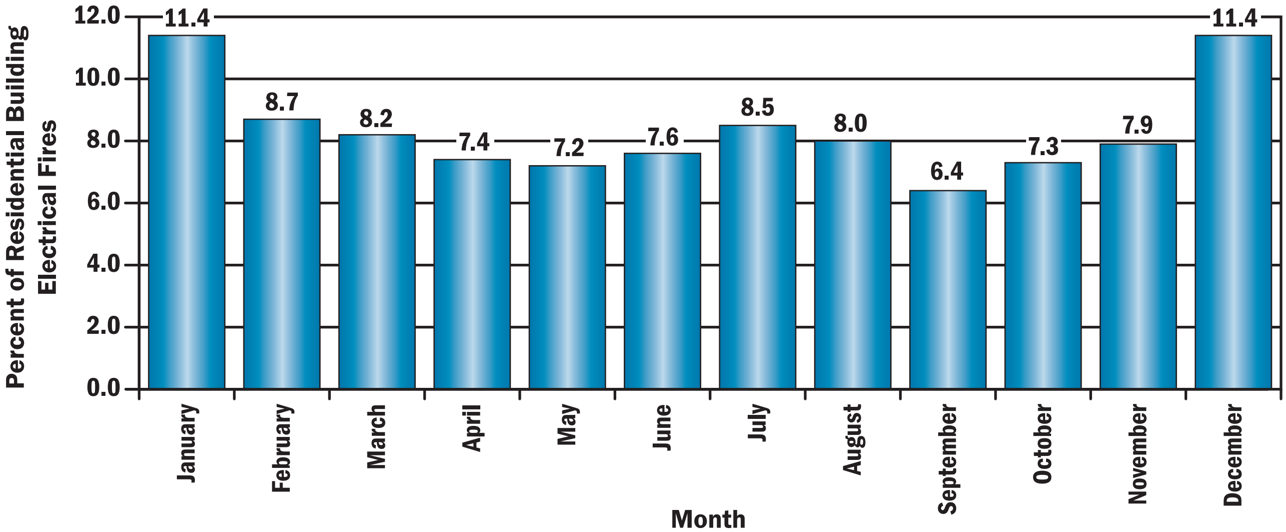
Figure 1. Residential Building Electrical Fires by Time of Alarm (2009-2011)



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

Figure 2 illustrates that electrical fire incidence was highest during the months of December and January, each at 11 percent. This is not surprising as cooler weather in these months typically results in more indoor activities which leads to an increase in lighting, heating and appliance use. In addition, low humidity within a home is most likely to occur in winter, particularly when a house is being heated,[21] which results in wood studs and framing drying out and being somewhat more easily ignited by an arcing current or electrical overheating. The lowest incidence of electrical fires occurred in September at 6 percent.

Figure 2. Residential Building Electrical Fires by Month (2009-2011)

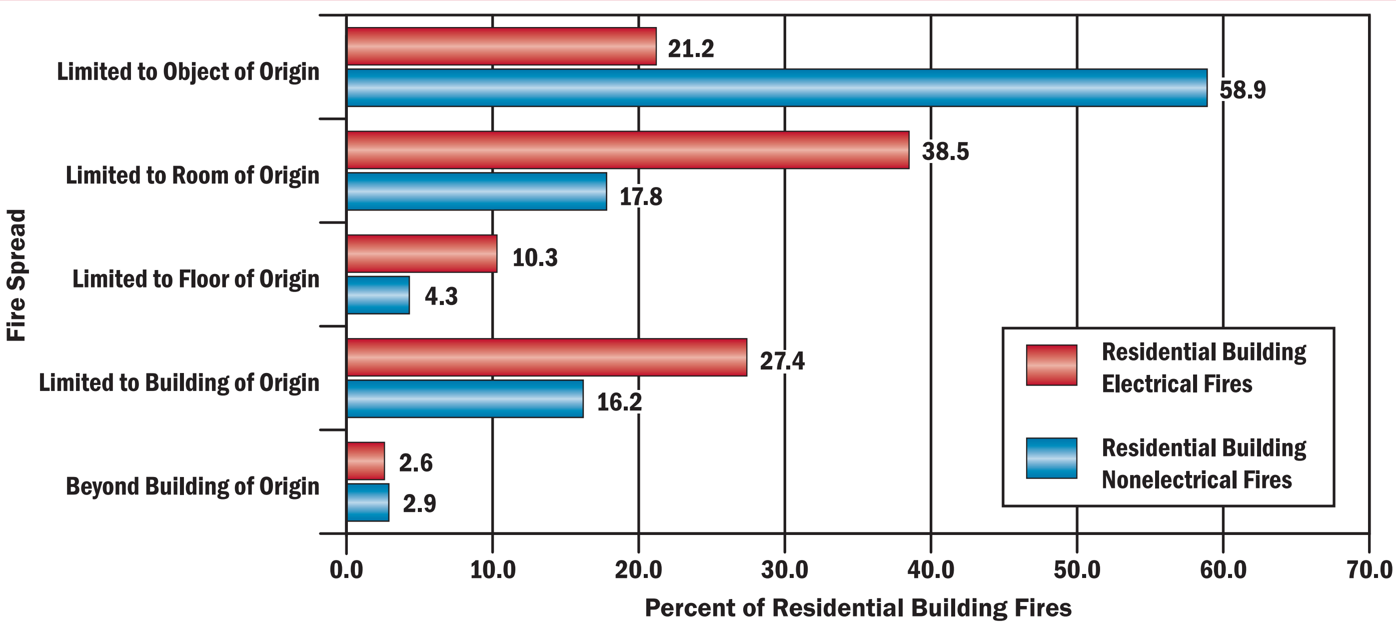


Source: NFIRS 5.0.

Fire Spread in Residential Building Electrical Fires

While 59 percent of nonelectrical fires were limited to the object of origin, only 21 percent of electrical fires were limited to the object of origin (Figure 3). Of the remaining 79 percent of electrical fires that spread beyond the object of origin, 39 percent were limited to the room of origin, 10 percent were limited to the floor of origin, and 27 percent were limited to the building of origin. An additional 3 percent of electrical fires spread beyond the building of origin. The larger fire spread may be partly due to challenges in the detection of some electrical fires (i.e., fires within walls) as previously discussed.

Figure 3. Extent of Fire Spread in Residential Building Electrical and Nonelectrical Fires (2009-2011)



Source: NFIRS 5.0.
Note: Total for residential building nonelectrical fires does not add up to 100 percent due to rounding.

Where Residential Building Electrical Fires Start (Area of Fire Origin)

Five areas in the home — bedrooms (15 percent); attics or vacant crawl spaces (13 percent); walls or concealed wall spaces (9 percent); cooking areas and kitchens (8 percent); and common rooms or lounge areas (7 percent) — accounted for 52 percent of electrical fires (Table 4).

Table 4. Leading Areas of Fire Origin in Residential Building Electrical Fires (2009-2011)

Area of Origin	Percent of Residential Building Electrical Fires (Unknowns Apportioned)
Bedrooms	15.3
Attic: vacant, crawl space above top story	13.4
Wall assembly, concealed wall space	8.6
Cooking area, kitchen	8.4
Common room, den, family room, living room, lounge	6.7

Source: NFIRS 5.0.

How Residential Building Electrical Fires Start (Heat Source)

The "heat from powered equipment" category accounted for the majority (89 percent) of all electrical fires (Table 5). Within this category, electrical arcing accounted for 82 percent, heat from other powered equipment accounted for 3 percent, radiated or conducted heat from operating equipment also accounted for 3 percent, and sparks, embers or flames from operating equipment accounted for 1 percent of all electrical fires. The "hot or smoldering object" category accounted for an additional 6 percent of electrical fires, while the heat source for the remaining 6 percent of electrical fires fell into other categories.

Table 5. Sources of Heat in Residential Building Electrical Fires by Major Category (2009-2011)

Heat Source Category	Percent of Residential Building Electrical Fires (Unknowns Apportioned)
Heat from powered equipment	88.6
Hot or smoldering object	5.8
All other heat source categories	5.7

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

What Ignites First in Residential Building Electrical Fires

Electrical wire, cable insulation (30 percent) and structural member or framing (19 percent) were the specific items most often first ignited in electrical fires (Table 6). Although less prominent, thermal, acoustical insulation (7 percent), interior wall covering (6 percent), exterior sidewall covering, surface or finish and other types of structural component or finish were also leading items first ignited (each at 5 percent).

Table 6. Leading Items First Ignited in Residential Building Electrical Fires (2009-2011)

Item First Ignited	Percent of Residential Building Electrical Fires (Unknowns Apportioned)
Electrical wire, cable insulation	29.8
Structural member or framing	18.5
Thermal, acoustical insulation within wall, partition, or floor/ceiling	7.3
Interior wall covering	6.3
Exterior sidewall covering, surface, finish	5.1
Other structural component or finish	4.6

Source: NFIRS 5.0.

Factors Contributing to Ignition in Residential Building Electrical Fires

Table 7 shows the categories of factors contributing to ignition in electrical fires. As expected, the leading category, by far, was "electrical failure, malfunction" (90 percent). In this category, other electrical failure, malfunction (41 percent), unspecified short-circuit arc (25 percent), and short-circuit arc from defective, worn insulation (12 percent) were the specific factors that accounted for 78 percent of electrical fires.

The "mechanical failure, malfunction" category was a contributing factor in 6 percent of electrical fires. The leading specific factor contributing to ignition in this category was other mechanical failure, malfunction at 4 percent.

Table 7. Factors Contributing to Ignition for Residential Building Electrical Fires by Major Category (Where Factors Contributing to Ignition are Specified, 2009-2011)

Factors Contributing to Ignition Category	Percent of Residential Building Electrical Fires
Electrical failure, malfunction	89.5
Mechanical failure, malfunction	6.1
Misuse of material or product	4.3
Operational deficiency	3.7
Design, manufacture, installation deficiency	1.3
Natural condition	1.0
Other factors contributing to ignition	0.9
Fire spread or control	0.2

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.

Equipment Involved in Ignition in Residential Building Electrical Fires

Three types of equipment played a leading role in the ignition of 39 percent of all residential electrical fires. These leading types of equipment involved in ignition, as shown in Table 8, were other electrical wiring (22 percent), outlets and receptacles (10 percent), and electrical branch circuits (8 percent).[22] Of interest, extension cords, panel (fuse) boards, and other lamps and lighting were also leading types of equipment involved in ignition (each at 5 percent).

Table 8. Leading Equipment Involved in Ignition of Residential Building Electrical Fires (2009-2011)

Equipment Involved in Ignition	Percent of Residential Building Electrical Fires
Electrical wiring, other	21.8
Outlet, receptacle	9.6
Electrical branch circuit	7.7

Source: NFIRS 5.0.

Alerting/Suppression Systems in Residential Building Electrical Fires

Technologies to detect and extinguish fires have been a major contributor to the drop in fire fatalities and injuries over the past 35 years. Smoke alarms, which aim to detect smoldering fires before they break into open flame or produce large volumes of smoke, are now present in the majority of residential buildings. In addition, the use of residential sprinklers is widely supported by the fire service and is gaining support within residential communities.

Smoke alarm data presented in Tables 9 and 10 are the raw counts from the NFIRS dataset and are not scaled to national estimates of smoke alarms in residential buildings where electrical fires occurred. 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. The data presented in Table 11 are also the raw counts from the NFIRS dataset and are not scaled to national estimates of automatic extinguishing systems (AESs) in residential buildings where electrical fires occurred.

Smoke Alarm Data

Overall, smoke alarms were present in 48 percent of residences where electrical fires occurred and were known to have operated in 24 percent of the fires. By comparison, smoke alarms were present in 41 percent of nonconfined, nonelectrical fires and operated in 25 percent. In 26 percent of electrical fires, no smoke alarms were present. In another 25 percent of these fires, firefighters were unable to determine if a smoke alarm was present (Table 9).

Table 9. NFIRS Smoke Alarm Presence in Residential Building Electrical Fires (2009-2011)

Presence of Smoke Alarms	Count	Percent
Present	22,487	48.4
None present	12,103	26.0
Undetermined	11,824	25.4
Null/Blank	57	0.1
Total incidents	46,471	100.0

Source: NFIRS 5.0.
Notes: 1. The data presented in this table are raw data counts from the NFIRS dataset. They do not represent national estimates of smoke alarms in residential building electrical fires. They are presented for informational purposes.
2. Total does not add up to 100 percent due to rounding.

While 7 percent of electrical fires occurred in residential buildings that are **not** currently or routinely occupied, these buildings — which are under construction, undergoing major renovation, vacant and the like — are unlikely to have alerting and suppression systems that are in place and, if in place, that operate. In fact, only 13 percent of all electrical fires in unoccupied residential buildings were reported as having smoke alarms that operated. In addition, AESs were reported as present in only 1 percent of electrical fires in residential buildings that were not routinely occupied. As a result, the detailed analyses in the next sections focus on electrical fires in occupied residential buildings only.[23]

Smoke Alarms in Occupied Residential Building Electrical Fires

Smoke alarms were reported as present in 50 percent of electrical fires in occupied residential buildings and were known to have operated in 25 percent of the fires (Table 10). Smoke alarms were known to be absent in 25 percent of electrical fires in occupied residential buildings. Firefighters were unable to determine if a smoke alarm was present in another 25 percent of these fires.

When operational status is considered, the percentage of smoke alarms reported as present (50 percent) consisted of:

- Present and operated — 25 percent.
- Present, but did not operate — 17 percent (fire too small, 10 percent; alarm failed to operate, 8 percent).[24]
- Present, but operational status unknown — 8 percent.

When the subset of incidents where smoke alarms were reported as present was analyzed separately, smoke alarms were reported to have operated in 51 percent of the incidents. The alarms failed to operate in 15 percent of the incidents. In 19 percent of the subset, the fire was too small to activate the alarm. The operational status of the alarm was undetermined in an additional 15 percent of the incidents.

Table 10. NFIRS Smoke Alarm Data for Occupied Residential Building Electrical Fires (2009-2011)

<table>
<tr><th>Presence of Smoke Alarms</th><th>Smoke Alarm Operational Status</th><th>Smoke Alarm Effectiveness</th><th>Count</th><th>Percent</th></tr>
<tr><td rowspan="8">Present</td><td>Fire too small to activate smoke alarm</td><td></td><td>4,080</td><td>9.5</td></tr>
<tr><td rowspan="5">Smoke alarm operated</td><td>Smoke alarm alerted occupants, occupants responded</td><td>7,678</td><td>17.8</td></tr>
<tr><td>Smoke alarm alerted occupants, occupants failed to respond</td><td>274</td><td>0.6</td></tr>
<tr><td>No occupants</td><td>1,515</td><td>3.5</td></tr>
<tr><td>Smoke alarm failed to alert occupants</td><td>362</td><td>0.8</td></tr>
<tr><td>Undetermined</td><td>1,038</td><td>2.4</td></tr>
<tr><td>Smoke alarm failed to operate</td><td></td><td>3,251</td><td>7.5</td></tr>
<tr><td>Undetermined</td><td></td><td>3,270</td><td>7.6</td></tr>
<tr><td colspan="3">None present</td><td>10,664</td><td>24.8</td></tr>
<tr><td colspan="3">Undetermined</td><td>10,930</td><td>25.4</td></tr>
<tr><td colspan="3">Total incidents</td><td>43,062</td><td>100.0</td></tr>
</table>

Source: NFIRS 5.0.
Notes: 1. The data presented in this table are raw data counts from the NFIRS dataset. They do not represent national estimates of smoke alarms in occupied residential building electrical fires. They are presented for informational purposes.
2. Total does not add up to 100 percent due to rounding.

Automatic Extinguishment System Data

Overall, full or partial AESs, mainly sprinklers, were present in just 2 percent of occupied residential buildings where electrical fires occurred (Table 11). The lack of suppression equipment (sprinklers) in homes experiencing electrical fires is not unexpected as sprinklers are largely absent nationwide in residential buildings.[25]

Table 11. NFIRS Automatic Extinguishing System Data for Occupied Residential Building Electrical Fires (2009-2011)

Presence of Automatic Extinguishing Systems	Count	Percent
AES present	914	2.1
Partial system present	36	0.1
AES not present	39,777	92.4
Unknown	2,335	5.4
Total incidents	43,062	100.0

Source: NFIRS 5.0.

Note: The data presented in this table are raw data counts from the NFIRS dataset. They do not represent national estimates of AESs in occupied residential building electrical fires. They are presented for informational purposes.

Examples

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

- October 2013: A family of four was displaced when a midday fire destroyed their home in Ravena, New York. The intense blaze, which was blowing out windows as fire crews arrived on-scene, took about an hour to get under control. Fire investigators determined the fire was caused by an electrical problem that originated in the cellar. There were no injuries reported as the occupants of the residence were not at home when the fire started.[26]
- October 2013: Six units in a Louisville, Kentucky, apartment complex were damaged by a fire caused by an electrical malfunction involving an old air conditioning unit. The air conditioning unit was located in between the ceiling of the second floor unit and the floor of the unit above it. The fire then spread through the walls between the apartments. All six units that were damaged were considered a total loss. No injuries were reported as a result of the fire.[27]
- October 2013: Firefighters extinguished a late night fire in Belleville, New Jersey, which resulted in a residence being deemed uninhabitable. The cause of the blaze was determined to be electrical. An oil-filled space heater was pushed to a higher setting resulting in the overloading of the home's electrical junction box. No injuries were reported.[28]
- October 2013: A late morning electrical fire broke out at a residential high-rise building in La Jolla, California, injuring two people. The fire started while two electricians were working in the electrical room when, for unknown reasons, the electrical panel exploded. One of the workers was severely burned while the second worker sustained minor burns. No other injuries were reported. In addition, while the electrical fire caused some smoke and damage, the structure of the building, which houses approximately 200 residents, was not affected.[29]

Preventing Electrical Fires

Residential electrical fires can be prevented by understanding basic electrical safety principles and following certain prevention and preparation strategies as identified by the Electrical Safety Foundation International:

- **Understand the basics of your home's electrical system** (above or below ground power lines, electric meter, electrical service panel, wiring system, outlets, switches and appliances).
- **Install advanced electrical safety technologies** (Arc Fault Circuit Interrupters (AFCIs), Ground Fault Circuit Interrupters (GFCIs) and Tamper Resistant Receptacles).
- **Properly maintain your electrical system and components by**:
  - Ensuring all residential work is performed by a qualified, licensed electrician and complies with codes and standards.
  - Testing electrical safety devices (AFCIs, GFCIs, smoke alarms, etc.) on a monthly basis.
  - Properly labeling electrical panel circuits.
  - Replacing fuses or circuit breakers with the correct size and amperage.
  - Keeping your electrical panel accessible.
  - Getting a professional electrical system inspection if your home:
    - Is 40 years or older.
    - Is previously owned.

  - Has undergone a major renovation.
  - Has been outfitted with major new appliances in the last 10 years.
- **Identify and correct potential electrical hazards.**
- **Install smoke alarms according to current recommendations and test monthly.**
- **Prepare and practice a fire escape plan that includes two ways out of each room.**[30]

For additional electrical home fire prevention tips and information, please visit the U.S. Fire Administration's (USFA's) electrical fire safety Web page at http://www.usfa.fema.gov/citizens/home_fire_prev/electrical.shtm.

NFIRS Data Specifications for Residential Building Electrical Fires

Data for this report were extracted from the NFIRS annual Public Data Release files for 2009, 2010 and 2011. Only version 5.0 data was extracted.

Residential building electrical fires were defined using the following criteria:

- Aid Types 3 (mutual aid given) and 4 (automatic aid given) were excluded to avoid double counting of incidents.
- Incident Types 111 to 123 (excluding Incident Type 112):

Incident Type	Description
111	Building fire
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: Incident Types 113 to 118 do not specify if the structure is a building.

- Property Use Series 400 which consists of the following:

Property Use	Description
400	Residential, other
419	One- or two-family dwelling, detached, manufactured home, mobile home not in transit, duplex
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 and 120 to 123:
    - 1—Enclosed building.
    - 2—Fixed portable or mobile structure.
- The USFA Structure Fire Cause Methodology was used to determine residential building electrical malfunction fire incidents (i.e., cause code = '06').[31]

The analyses contained in this report reflect the current methodologies used by the USFA. USFA is committed to providing the best and most current information on the U.S. fire problem and continually examines 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 https://apps.usfa.fema.gov/feedback/.

Notes:

[1] "Residential Building Electrical Fires," Topical Fire Report Series, U.S. Fire Administration (USFA), March 2008, Volume 8, Issue 2, http://www.usfa.fema.gov/downloads/pdf/statistics/v8i2.pdf.

[2] 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.

[3] In National Fire Incident Reporting System (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 structures 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. In addition, 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 that have a residential property use without a structure type specified are considered to be invalid incidents (structure type is a required field) and are not included.

[4] National estimates are based on 2009-2011 native version 5.0 data from the NFIRS, residential structure fire-loss estimates from the National Fire Protection Association's (NFPA's) annual surveys of fire loss, and the USFA's residential building fire-loss estimates: http://www.usfa.fema.gov/statistics/estimates/index.shtm. Electrical fires and losses in residential buildings are determined by USFA's Structure Fire Cause Methodology. From 2009 to 2011, the fire cause was unknown for 18.1 percent of fires, 47.0 percent of deaths, 25.2 percent of injuries, and 38.0 percent of property damage in residential buildings. In computing national estimates, fires and losses with unknown causes are not ignored. The approach taken by USFA is to compute "adjusted" percentages using only those incidents for which causal data were provided. This calculation, in effect, distributes the fires and losses for which the cause data are unknown in the same proportion as the fires and losses for which the causes are known. These adjusted percentages are then scaled up to reflect results from NFPA's annual surveys of fire loss. Further information on USFA's residential building fire-loss estimates is found in the "National Estimates Methodology for Building Fires and Losses," August 2012, http://www.usfa.fema.gov/downloads/pdf/statistics/national_estimate_methodology.pdf. For information on NFPA's survey methodology, see NFPA's report on "Fire Loss in the United States": http://www.nfpa.org/~/media/Files /Research/NFPA%20reports/Overall%20Fire%20Statistics/osfireloss.pdf. In this residential building electrical fires topical report, estimates of fires are rounded to the nearest 100, deaths to the nearest five, injuries to the nearest 25, and losses to the nearest 100 million dollars.

[5] "Residential Building Fires (2009-2011)," Topical Fire Report Series, U.S. Fire Administration, May 2013, Volume 14, Issue 4, http://www.usfa.fema.gov/downloads/pdf/statistics/v14i4.pdf.

[6] The term "electrical fires" is an abbreviated form of the original term "electrical malfunction fires" as defined by USFA's Structure Fire Cause Methodology. The cause definitions can be found at http://www.usfa.fema.gov/fireservice/nfirs/tools/fire_cause_category_matrix.shtm.

[7] Participation in NFIRS is voluntary, however, some states do require their departments to participate in the state system. Additionally, if a fire department is a recipient of a Fire Act Grant, participation is required. From 2009 to 2011, 70 percent of NFPA's annual average estimated 1,356,500 fires to which fire departments responded were captured in NFIRS. Thus, NFIRS is not representative of all fire incidents in the U.S. and is not a "complete" census of fire incidents. Although NFIRS does not represent 100 percent of the incidents reported to fire departments each year, the enormous dataset exhibits stability from one year to the next, without radical changes. Results based on the full dataset are generally similar to those based on part of the data.

[8] "Residential Building Electrical Malfunction Fire Trends (2007-2011)," USFA Fire Estimate Summary, U.S. Fire Administration, February 2013, http://www.usfa.fema.gov/downloads/pdf/statistics/res_bldg_electrical_fire_trends.pdf.

[9] "Residential Building Fire Causes (2007-2011)," USFA Fire Estimate Summary, U.S. Fire Administration, February 2013, http://www.usfa.fema.gov/downloads/pdf/statistics/res_bldg_fire_causes.pdf.

[10] Babrauskas, Vytenis, 2008. Research on Electrical Fires: The State of the Art. "Fire Safety Science" 9: 3-18. doi:10.3801/IAFSS.FSS.9-3, http://www.iafss.org/publications/fss/9/3# (accessed Nov. 19, 2013).

[11] "Common causes of home electrical fires," vancouverelectricianblog.com, Feb. 4, 2011, http://www.vancouverelectricianblog.com/common-home-electrical-fires/ (accessed Nov. 4, 2013).

[12] Mike Holmes, "Dangers of electrical fires: Ditch DIY when fixing faulty wiring," canada.com, Aug. 7, 2012, http://www.canada.com/news/Dangers+electrical+fires/7051750/story.html (accessed Nov. 4, 2013).

[13] "Arc Fault Circuit Interrupters," Arc Fault Circuit Interrupter (ARCI) Fact Sheet, Electrical Safety Foundation International, 2011, http://esfi.org/index.cfm/page/Arc-Fault-Circuit-Interrupter-(AFCI)-Fact-Sheet/cdid/11865/pid/10272 (accessed Nov. 19, 2013).

[14] "Residential Electrical System Aging Research Project," The Code Authority, Underwriters Laboratories, Issue 2, 2008, http://www.ul.com/global/documents/offerings/perspectives/regulators/technical/ul_ResidentialElectricalSystemResearch.pdf (accessed Nov. 19, 2013).

[15] Mike Holmes, "Dangers of electrical fires: Ditch DIY when fixing faulty wiring," canada.com, Aug. 7, 2012, http://www.canada.com/news/Dangers+electrical+fires/7051750/story.html (accessed Nov. 4, 2013).

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

[17] NFIRS distinguishes between "content" and "property" loss. Content loss includes losses 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 Code 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.

[18] The average fire death and fire injury loss rates computed from the national estimates do not agree with average fire death and fire injury loss rates computed from NFIRS data alone. The fire death rate computed from national estimates is (1,000*(280/25,900)) = 10.8 deaths per 1,000 residential building electrical fires and the fire injury rate is (1,000*(1,125/25,900)) = 43.4 injuries per 1,000 residential building electrical fires.

[19] "One- and Two-Family Residential Building Fires (2009-2011)," Topical Fire Report Series, U.S. Fire Administration, September 2013, Volume 14, Issue 10, http://www.usfa.fema.gov/downloads/pdf/statistics/v14i10.pdf.

[20] 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.

[21] "Humidity," science.howstuffworks.com, http://science.howstuffworks.com/dictionary/meteorological-terms/humidity-info.htm (accessed Nov. 21, 2013).

[22] The three leading types of equipment involved in ignition do not add up to 39 percent due to rounding.

[23] The term "occupied" implies that the building is operational or in normal use. This includes residences that are unoccupied for a brief period of time such as when household members are away at work, school or on vacation.

[24] Total percentage of smoke alarms that were present but did not operate does not equal 17 percent due to rounding.

[25] "Residential Building Fires (2009-2011)," Topical Fire Report Series, U.S. Fire Administration, May 2013, Volume 14, Issue 4, http://www.usfa.fema.gov/downloads/pdf/statistics/v14i4.pdf.

[26] Paul Nelson, "Chief: Electrical fire destroys Ravena home," timesunion.com, Oct. 30, 2013, http://www.timesunion.com/local/article/Chief-Electrical-fire-destroys-Ravena-home-4941277.php (accessed Nov. 1, 2013).

[27] Brittany Gonzalez, "Fire chief: Electrical malfunction causes fire at Legacy Apartments," whas11.com, Oct. 29, 2013, http://www.whas11.com/news/local/Fire-chief-Electrical-malfunction-causes-fire-at-Legacy-Apartments-229736551.html (accessed Nov. 1, 2013).

[28] Roman Uschak, "Electrical fire damages Belleville home," northjersey.com, Oct. 25, 2013, http://www.northjersey.com/news/229306611_Electrical_fire_damages_Belleville_home.html (accessed Nov. 1, 2013).

[29] Monica Garske and Chris Chan, "2 injured in La Jolla high-rise fire," nbcsandiego.com, Oct. 2, 2013, http://www.nbcsandiego.com/news/local/Electrical-Fire-La-Jolla-High-Rise-Coast-Blvd-226010051.html (accessed Nov. 1, 2013).

[30] "Electrical Fire Safety," Electrical Fire Safety Presentation, Electrical Safety Foundation International, Fire Prevention Week 2012, http://esfi.org/index.cfm/page/Electrical-Fire-Safety-Presentation-Fire-Prevention-Week-2012/cdid/12666/pid/10272 (accessed Nov. 19, 2013).

[31] The USFA Structure Fire Cause Methodology is designed for structure fires of which building fires are a subset. The cause definitions can be found at http://www.usfa.fema.gov/fireservice/nfirs/tools/fire_cause_category_matrix.shtm.