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One- and Two-Family Residential Building Fires (2017-2019)

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

- Each year, from 2017 to 2019, an estimated average of 230,500 one- and two-family residential building fires were reported to fire departments in the United States. These fires caused an estimated annual average of 2,220 deaths, 7,250 injuries and $6 billion in property loss.
- Deaths in one- and two-family residential building fires accounted for far more deaths in most years than all natural disasters combined.
- One- and two-family residential building fires accounted for 63% of all residential building fires, representing the largest subgroup of residential building fires.
- Cooking, at 37%, was the leading cause of one- and two-family residential building fires. Of these cooking fires, 90% were small, confined fires with limited damage.
- One- and two-family residential building fires occurred more often in the cooler months, peaking in January at 11%.
- In 54% of nonconfined one- and two-family residential building fires, the fire extended beyond the room of fire origin. The leading causes of these larger fires were other unintentional, careless actions (21%); electrical malfunctions (15%); open flames (10%); and intentional actions (9%).
- Smoke alarms were not present in 23% of nonconfined fires in occupied one- and two-family residential buildings.
- Automatic extinguishing systems (AESs), including residential sprinklers, were present in only 1% of nonconfined fires in occupied one- and two-family residential buildings.

From 2017 to 2019, fire departments responded to an estimated average of 230,500 fires in one- and two-family residences each year across the nation.[1, 2] These fires resulted in an estimated annual average of 2,220 deaths, 7,250 injuries and $6 billion in property loss. One- and two-family residential building fires accounted for 63% of all residential building fires and dominated the overall residential building fire profile.[3] One- and two-family residential buildings include detached dwellings, manufactured homes, mobile homes not in transit, and duplexes.

From 2017 to 2019, 62% of all fire deaths in the nation occurred in one- and two-family dwellings.[4] Because these fatalities occurred throughout the year and all over the country, they often did not make national headlines. Nevertheless, fire deaths in one- and two-family dwellings accounted for far more deaths in most years than all natural disasters combined.[5]

Most one- and two-family residential building fires (60%) were larger, nonconfined fires; they were not contained in pots, garbage containers or other types of noncombustible containers that confine them (Table 1). Fires in all other types of residential buildings, by contrast, were mostly small and confined to noncombustible containers (69%).

One- and two-family residential building fires also differed from all other residential building fires in their cause profiles. While cooking, at 37%, was the leading cause of all one- and two-family residential building fires, it accounted for 71% of all other types of residential building fires. However, heating and electrical malfunction causes, such as short circuits, arcing and the like, accounted for larger percentages of one- and two-family residential building fires than for all other types of residential building fires.

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This topical report is an update to the "One- and Two-Family Residential Building Fires (2013-2015)" (Volume 18, Issue 2) report, which was released in June 2017. As part of a series of topical reports that address fires in the major residential building types, the remainder of this report addresses the characteristics of one- and two-family residential building fires as reported to NFIRS. This data is useful by itself and as a point of comparison with other residential building categories. Comparisons to multifamily residential building fires noted throughout the report are based on analyses from the "Multifamily Residential Building Fires (2017-2019)" (Volume 21, Issue 7) topical report.[6]

The focus is on fires reported from 2017 to 2019, the most current data available at the time of the analysis.[7] Complete or full years of data are required for statistical analyses presented in these topical reports. Although the NFIRS data for a calendar year are often reported to the USFA throughout the year, fire departments and or states have until the official cutoff date as set forth by the National Fire Data Center to submit their data to the USFA. Typically, this cutoff date is July 1 after the end of the previous calendar year. This provides states with ample time to perform data quality checks and correct questionable incidents before they are set to released status in the national production database and Enterprise Data Warehouse. Once the data are released to the USFA, additional data quality reviews are completed before the data are prepared for public release.

For this report, the terms "residential fires" and "one- and two-family fires" are synonymous with "residential building fires" and "one- and two-family residential building fires," respectively. "one- and two-family fires" is used throughout the body of this report; the findings, tables, figures, headings and endnotes reflect the full category, "one- and two-family residential building fires."

Type of fire

Building fires are divided into 2 classes of severity in the NFIRS: confined fires and nonconfined fires. Confined building fires are small fire incidents that are limited in extent to specific types of equipment or objects, staying within pots, fireplaces or certain other noncombustible containers.[8] 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.[9] Nonconfined fires extend beyond certain types of equipment or objects. They are generally larger fires resulting in more serious injury and larger losses of property and content.

Of the 2 classes of severity, nonconfined fires accounted for 60% of one- and two-family fires. The smaller, confined fires accounted for the remaining 40% of one- and two-family fires. Cooking fires were the predominant type of confined fires in one- and two-family dwellings, as they were in most residential occupancies (Table 1).

Table 1. One- and two-family residential building fires by type of incident (2017-2019)

Incident type	Percent
Nonconfined fires	60.2
Confined fires	39.8
Cooking fire, confined to container	26.4
Chimney or flue fire, confined to chimney or flue	5.5
Incinerator overload or malfunction, fire confined	0.1
Fuel burner/boiler malfunction, fire confined	2.2
Commercial compactor fire, confined to rubbish	0.0
Trash or rubbish fire, contained	5.6
Total	100.0

Source: NFIRS 5.0.

Loss measures

Table 2 presents losses, averaged over the 3-year period from 2017 to 2019, of reported one- and two-family fires and all other residential fires.[10] The average number of fatalities per 1,000 fires and average dollar loss per fire for one- and two-family fires were about 2 times as high as the same loss measures for all other residential building fires. In addition, all the average loss measures associated with nonconfined one- and two-family fires were notably higher than the same loss measures for confined one- and two-family fires. This can be expected, however, as nonconfined fires are generally larger fires that often result in serious injuries and more content loss.

Table 2. Loss measures for one- and two-family residential building fires (3-year average, 2017-2019)

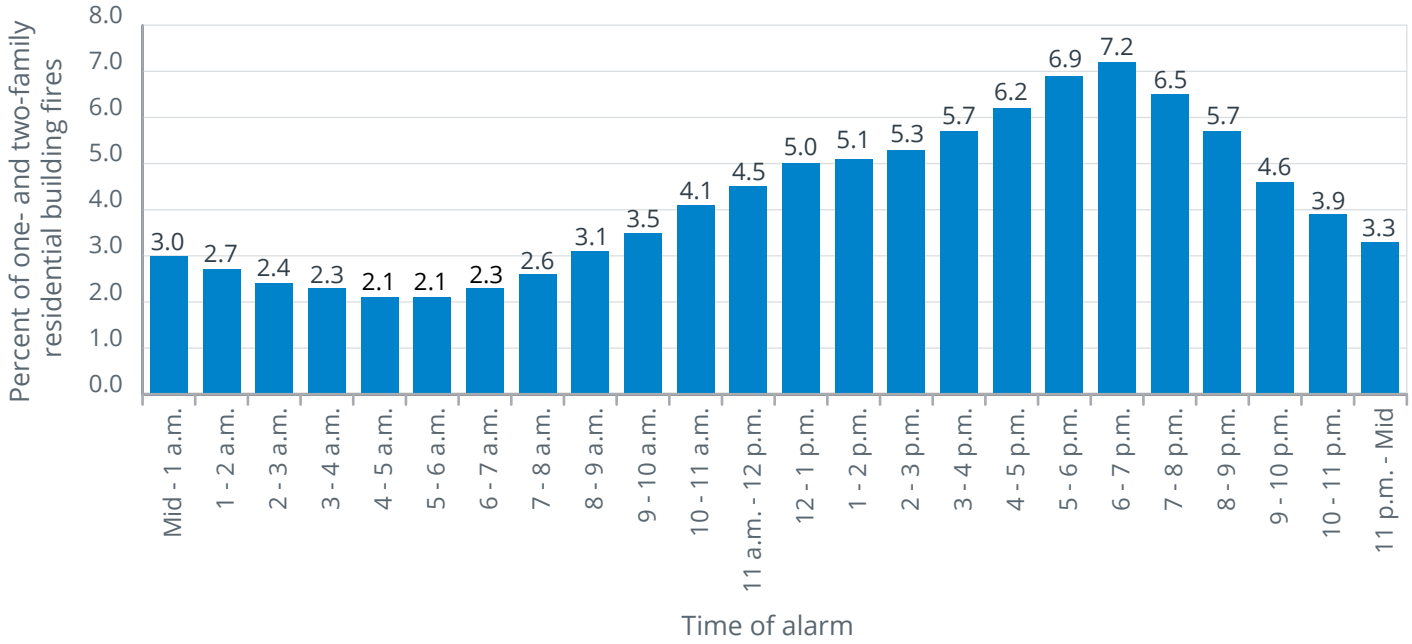
Measure	One- and two-family residential building fires	Confined one- and two-family residential building fires	Nonconfined one- and two-family residential building fires	Residential building fires (excluding one- and two-family)
Average Loss				
Fatalities/1,000 fires	7.9	0.0	13.2	3.3
Injuries/1,000 fires	25.3	5.5	38.4	25.7
Dollar loss/fire	$22,030	$290	$36,390	$13,190

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 rounded to the nearest $10.
2. The 2017 and 2018 dollar-loss values were adjusted to 2019 dollars.

When one- and two-family residential building fires occur

As shown in Figure 1, one- and two-family fires occurred most frequently in the early evening hours, peaking during dinner from 5 to 8 p.m., when cooking fire incidence was high.[11,12] Cooking fires, discussed later in the "Causes of one- and two-family residential building fires" section, accounted for 37% of one- and two-family fires. Fires then declined throughout the night, reaching the lowest point during the early morning hours from 4 to 6 a.m.

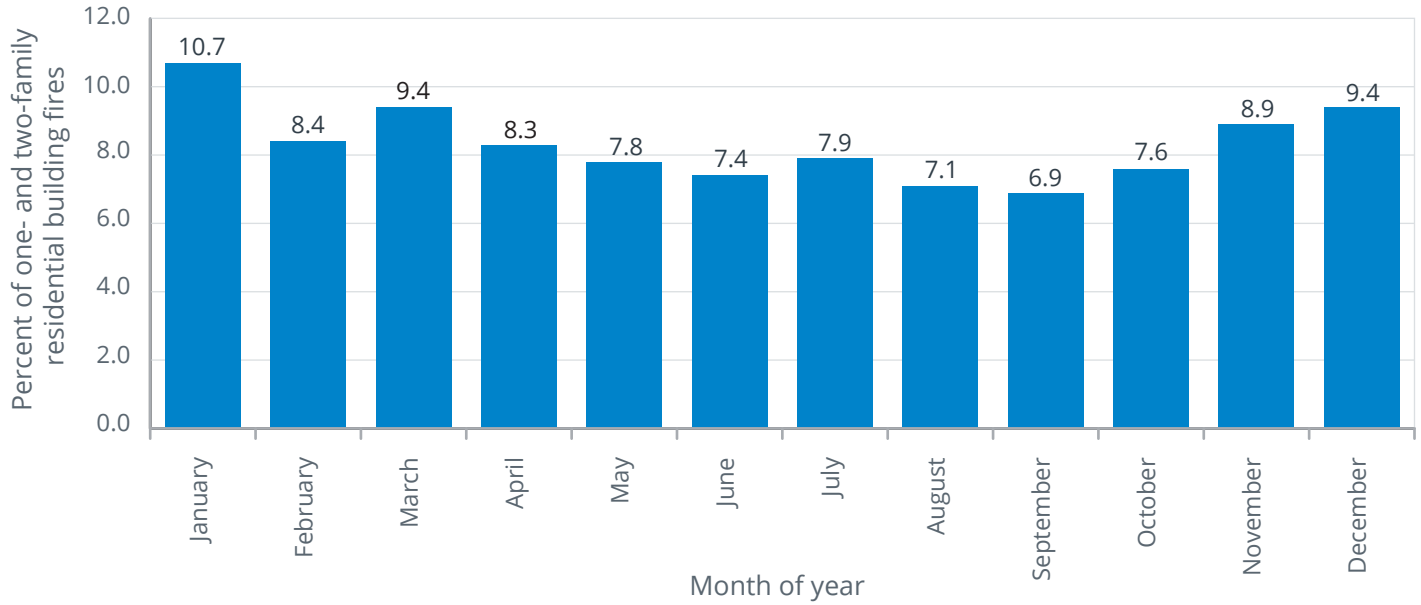
Figure 1. One- and two-family residential building fires by time of alarm (2017-2019)



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

Figure 2 illustrates that one- and two-family fire incidence was higher in the cooler months, peaking in January at 11%. Winter peaks are often explained by the increase in heating fires. The increase in fires in the cooler months may also be the result of more indoor activities in general, as well as more indoor seasonal and holiday activities. During the spring and summer months, the fire incidence generally declined, reaching a low in September.

Figure 2. One- and two-family residential building fires by month (2017-2019)



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

Causes of one- and two-family residential building fires

Cooking was the leading cause of one- and two-family fires and accounted for 37% of all one- and two-family fires, as shown in Table 3.[13] Of these cooking fires, 90% were small, confined fires with limited damage.

Heating, at 12%, was the second leading cause of one- and two-family fires. The next 4 causes combined accounted for 30% of one- and two-family fires: other unintentional, careless actions, a miscellaneous group (10%); fires caused by electrical malfunctions, such as short circuits and wiring problems (9%); open flames that resulted from candles, matches and the like (6%); and intentional actions (5%).[14]

Table 3. Leading causes of one- and two-family residential building fires (2017-2019)

Cause	Percent (unknowns apportioned)
Cooking	37.3
Heating	12.4
Other unintentional, careless	9.6
Electrical malfunction	9.2
Open flame	5.5
Intentional	5.4

Source: NFIRS 5.0.

There was a striking difference between one- and two-family and all other residential occupancies in the prevalence of cooking as a fire cause. While cooking accounted for 37% of one- and two-family fires, it accounted for 74% of multifamily residential building fires and 58% of other residential building fires.[15] The most persuasive explanation for this difference may be that the smaller, confined fires in one- and two-family dwellings are not reported as often to fire departments. They are small and contained, and they often do not cause much damage. In addition, if it is activated, only the residents hear the smoke alarm. However, these same confined fires in multifamily residences may be reported if someone else in the complex hears the alarm or smells the smoke. Alternatively, if it is a newer complex, the alarms may be connected to the building alarm system, and the fire department may automatically be called.

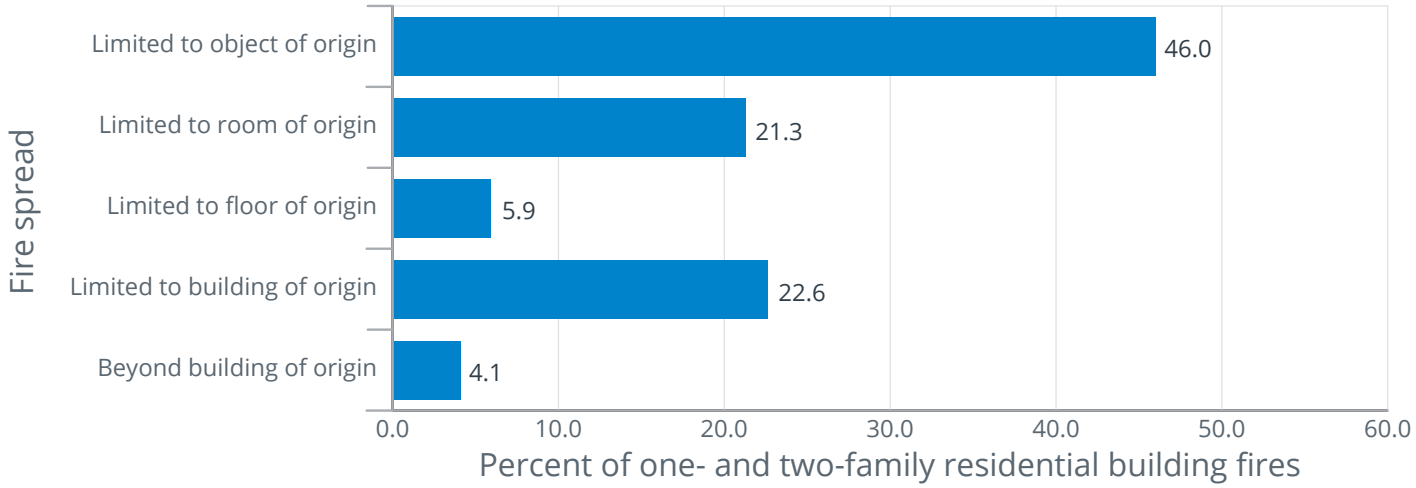
Heating and electrical malfunction causes accounted for larger percentages of one- and two-family fires than of multifamily fires. One reason for this may be that many one- and two-family residential buildings have fireplaces, chimneys and fireplace-related equipment that most other types of residential properties do not have.[16]

A strong relationship between housing age and the rate of electrical fires has been observed, with housing over 40 years old having the strongest association with electrical distribution fires.[17, 18] As of 2019, the median age of one- and two-family housing was over 40 years. With more than half of the housing stock older than 40 years, electrical fires will continue to be an issue in residential buildings.[19] In addition, a 2008 study concluded that there are 3 major areas in older properties that contribute to compromised electrical systems: the effects of aging on the wiring itself, misuse and abuse of the electrical components, and non-code-compliant installations.[20] Codes, including the National Electrical Code®, are comprehensive and standard in nearly every community. "Non-code" improvements or changes, however, are difficult to track and, therefore, difficult to enforce.

Fire spread in one- and two-family residential building fires

In 46% of one- and two-family fires, the fire was limited to the object of origin (Figure 3). Included in these fires are those coded as confined fires in the NFIRS. Additionally, 33% of the fires extended beyond the room of origin.

Figure 3. Extent of fire spread in one- and two-family residential building fires (2017-2019)



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

Confined fires

The NFIRS allows abbreviated reporting for confined fires, and many reporting details of these fires are not required, nor are they reported. (Not all fires limited to the object of origin are counted as confined fires.[21]) For example, a fire contained to a chair or clothes dryer is not defined as a confined fire in the NFIRS because of the greater potential for spread. Unlike fires in pots or chimneys, there is no container to stop the fire, even though the fire did not spread beyond the object of origin.

As previously discussed, however, it is known that confined fires accounted for 40% of all one- and two-family fires. Cooking fires — those fires confined to pots or pans, for example — accounted for 66% of these confined fires (Table 1).

In addition, the number of confined one- and two-family fires was greatest from 5 to 8 p.m.; these fires accounted for 53% of the one- and two-family fires in this time period. Moreover, confined cooking fires accounted for 71% of the confined fires and 38% of all fires that occurred from 5 to 8 p.m. in one- and two-family buildings.

Confined one- and two-family fires peaked in January, then declined through the spring and reached the lowest incidence in August.

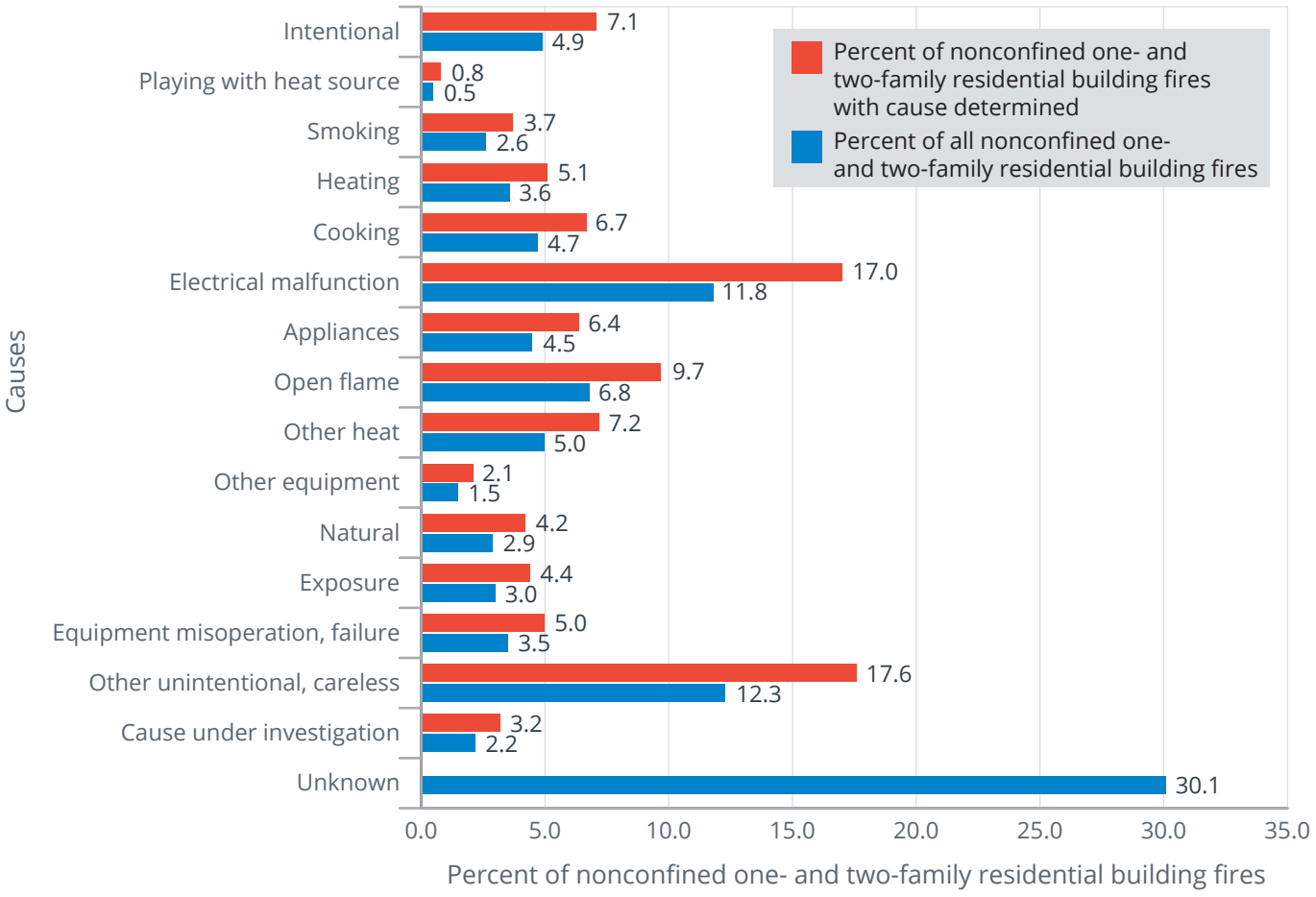
Nonconfined fires

The next sections of this topical report address nonconfined residential fires — the larger and more serious fires — where more detailed fire data are available, as they are required to be reported in the NFIRS.

Causes of nonconfined one- and two-family residential building fires

While cooking was the leading cause of one- and two-family fires overall, it was the sixth leading cause of all nonconfined one- and two-family fires, and it only accounted for 7% of these fires (Figure 4). At 18%, other unintentional, careless actions was the leading cause of nonconfined one- and two-family fires, followed by electrical malfunctions (17%).

Figure 4. Causes of nonconfined one- and two-family residential building fires (2017-2019)



Source: NFIRS 5.0.

Notes:
1. Causes are listed in order of the U.S. Fire Administration (USFA) Structure Fire Cause Hierarchy for ease of comparison of fire causes across different aspects of the fire problem. Fires are assigned to 1 of 16 cause groupings using a hierarchy of definitions, as shown in this figure. A fire is included in the highest category into which it fits. If it does not fit the top category, then the second one is considered, and if not that one, the third, and so on. For example, if the fire is judged to be intentionally set and a match was used to ignite it, it is classified as intentional and not open flame because intentional is higher in the hierarchy.
2. Total percentages do not add up to 100% due to rounding.

Where nonconfined one- and two-family residential building fires start (area of fire origin)

Nonconfined one- and two-family fires most often started in cooking areas and kitchens (18%) as shown in Table 4. Bedrooms (12%) and family rooms or living rooms (7%) were the next most common areas of fire origin in the home. Smaller but not minor percentages of fires started in vehicle storage areas, such as garages and carports (6%); exterior wall surfaces (6%); attics and vacant spaces (6%); and laundry areas (5%).

These areas of origin do not include areas associated with confined fires. Cooking was the leading cause of all one- and two-family fires at 37%, and it is not surprising that kitchens were the leading area of fire origin. However, the percentages were not identical between cooking and kitchen fires because some cooking fires started outside the kitchen, some areas of origin for cooking fires were not reported (as in most confined cooking fires), and some kitchen fires were not due to cooking. In fact, only 35% of nonconfined one- and two-family fires that started in the kitchen were cooking fires. Other unintentional, careless actions accounted for 19% and equipment misoperation or failure accounted for an additional 11% of nonconfined one- and two-family fires that started in the kitchen.

Table 4. Leading areas of fire origin in nonconfined one- and two-family residential building fires (2017-2019)

Areas of fire origin	Percent (unknowns apportioned)
Cooking area, kitchen	17.9
Bedrooms	12.2
Common room, den, family room, living room, lounge	6.6
Vehicle storage area: garage, carport	6.1
Exterior wall surface	5.7
Attic, vacant spaces	5.6
Laundry area	4.5

Source: NFIRS 5.0.

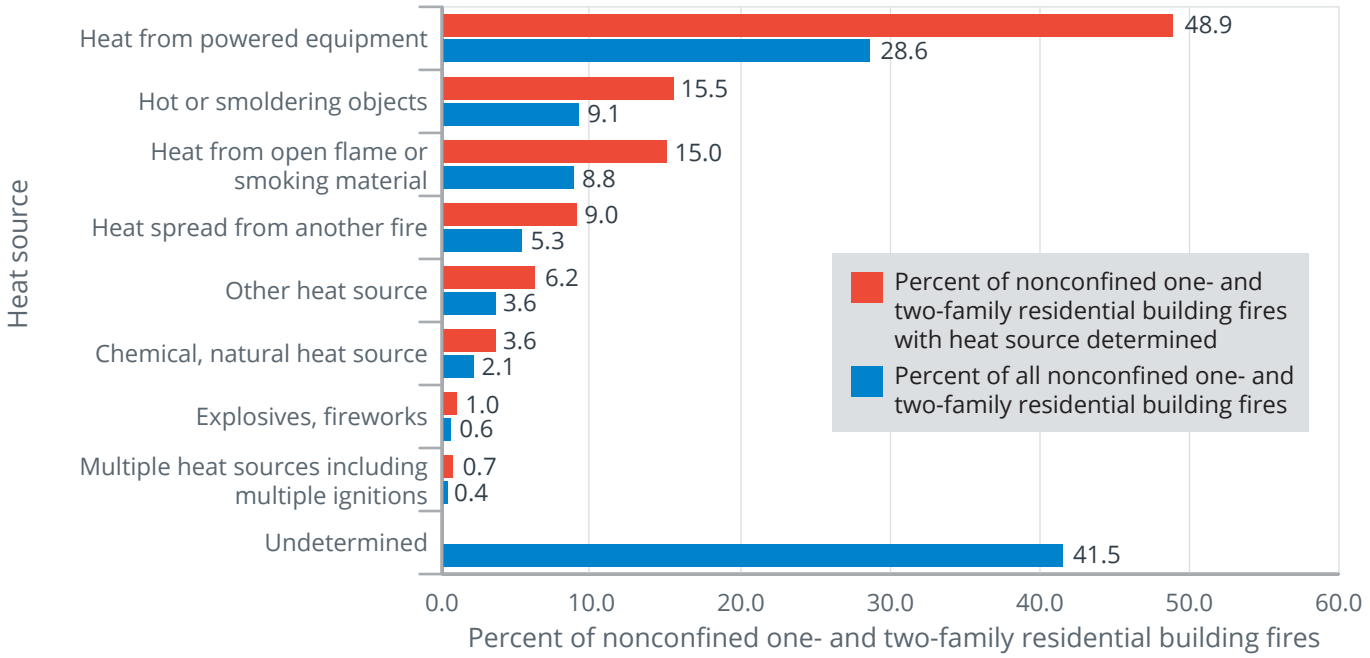
How nonconfined one- and two-family residential building fires start (heat source)

Figure 5 shows sources of heat categories for nonconfined one- and two-family fires. Heat from powered equipment accounted for 49% of nonconfined one- and two-family fires. This category includes electrical arcing (19%); radiated or conducted heat from operating equipment (13%); heat from other powered equipment (12%); and spark, ember or flame from operating equipment (5%).

Heat from hot or smoldering objects accounted for 16% of nonconfined one- and two-family fires. This category includes miscellaneous hot or smoldering objects (7%) and hot embers or ashes (7%).

The third largest category pertained to open flame or smoking materials (15%). This category includes items such as cigarettes (4%), miscellaneous open flame or smoking materials (4%), lighters and matches (combined, 3%), and candles (3%).

Figure 5. Sources of heat in nonconfined one- and two-family residential building fires by major category (2017-2019)



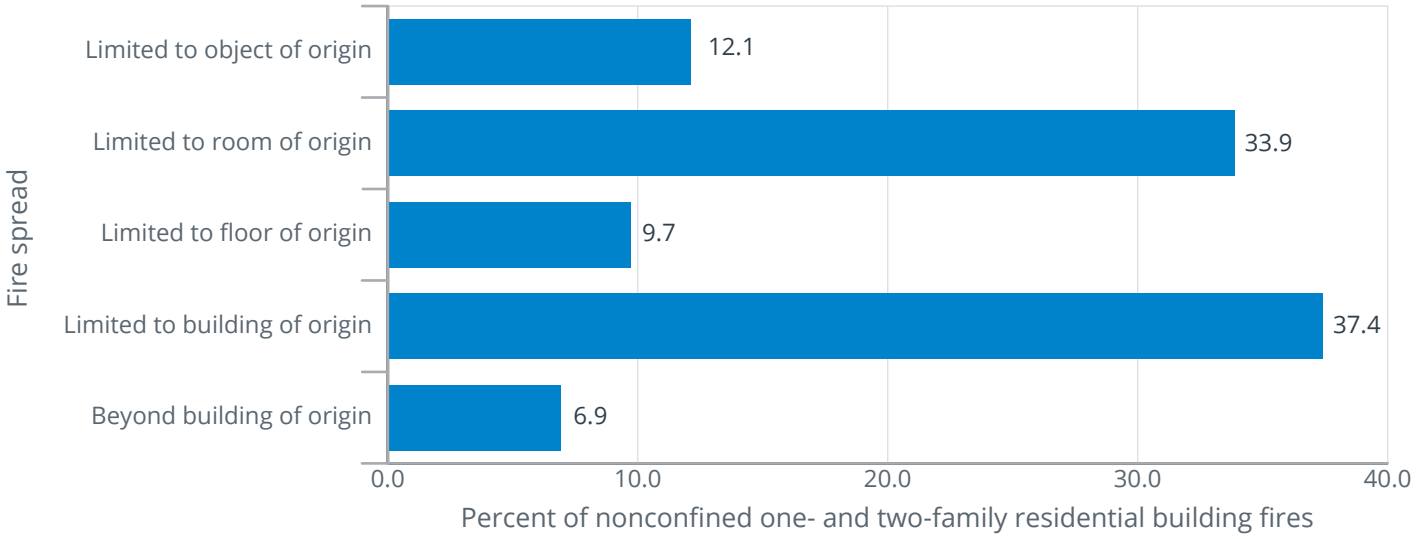
Source: NFIRS 5.0.
Note: Total percentage for nonconfined one- and two-family residential building fires with heat source determined does not add up to 100% due to rounding.

Fire spread in nonconfined one- and two-family residential building fires

Figure 6 shows the extent of fire spread in nonconfined one- and two-family fires. In 46% of the nonconfined fires, the fire was limited to the object or room of fire origin; in 34% of nonconfined fires, the fire was limited to the room of origin; and in another 12% of fires, the fire was limited to the object of origin.

In 54% of nonconfined one- and two-family fires, the fire extended beyond the room of origin. The leading causes of these larger fires were other unintentional, careless actions (21%); electrical malfunctions (15%); open flames (10%); and intentional actions (9%).

Figure 6. Extent of fire spread in nonconfined one- and two-family residential building fires (2017-2019)



Source: NFIRS 5.0.

Factors contributing to ignition in nonconfined one- and two-family residential building fires

Table 5 shows the categories of factors contributing to ignition in nonconfined one- and two-family fires. The leading category was the misuse of material or product (35%). In this category, the leading specific factors contributing to ignition were a heat source too close to combustible materials (13% of all nonconfined one- and two-family fires) and abandoned or discarded materials, such as matches or cigarettes (10% of all nonconfined one- and two-family fires).

Electrical failures and malfunctions contributed to 26% of nonconfined one- and two-family fires. Operational deficiency was the third leading category at 13%. Unattended equipment was the leading factor in the operational deficiency category and accounted for 6% of all nonconfined one- and two-family fires.

Table 5. Factors contributing to ignition for nonconfined one- and two-family residential building fires by major category (where factors contributing to ignition were specified, 2017-2019)

Factors contributing to ignition category	Percent of nonconfined one- and two-family residential building fires (unknowns apportioned)
Misuse of material or product	34.5
Electrical failure, malfunction	25.7
Operational deficiency	12.8
Fire spread or control	11.8
Mechanical failure, malfunction	7.5
Other factors contributing to ignition	5.8
Natural condition	4.5
Design, manufacture, installation deficiency	1.8

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; the total will exceed 100%.

Alerting/suppression systems in one- and two-family residential building fires

Fire fatalities and injuries have declined over the last 40 years, partly due to new technologies to detect and extinguish fires. Residential sprinklers have gained support from the fire service and many residential communities.

Smoke alarm data are available for both confined and nonconfined fires, although for confined fires, the data are very limited in scope. Since different levels of data are reported on smoke alarms in confined and nonconfined fires, the analyses are performed separately. The data presented in Tables 7 and 8 show the raw counts from the NFIRS dataset and are not scaled to national estimates of smoke alarms in one- and two-family fires. In addition, the 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.

Smoke alarms in nonconfined fires

Overall, smoke alarms were reported as present in 39% of nonconfined one- and two-family fires (Table 6). In 28% of nonconfined one- and two-family fires, there were no smoke alarms present. In another 34% of these fires, firefighters were unable to determine if a smoke alarm was present.[22] Therefore, smoke alarms were potentially missing in 28% to 62% of fires with the ability to spread and possibly result in fatalities.

Table 6. Presence of smoke alarms in nonconfined one- and two-family residential building fires (2017-2019)

Presence of smoke alarms	Percent
Present	38.6
None present	27.8
Undetermined	33.6
Total	100.0

Source: NFIRS 5.0.

While 18% of all nonconfined one- and two-family fires occurred in residential buildings that are **not** currently or routinely occupied, these occupancies — 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 are operational. In fact, only 7% of nonconfined fires in unoccupied one- and two-family residential buildings were reported as having smoke alarms that operated. As a result, the detailed smoke alarm analyses in the next section focus on nonconfined fires in occupied one- and two-family residential buildings only.

Smoke alarms in nonconfined fires in occupied one- and two-family residential buildings

Smoke alarms were reported as present in 44% of nonconfined fires in occupied one- and two-family residential buildings (Table 7). In 23% of nonconfined fires in occupied one- and two-family residential buildings, there were no smoke alarms present. In another 33% of these fires, firefighters were unable to determine if a smoke alarm was present. Unfortunately, in over half (52%) of the fires where the presence of a smoke alarm was undetermined, either the flames involved the building of origin or spread beyond it. These fires were so large and destructive that it is unlikely the presence of a smoke alarm could be determined.

When smoke alarms were present (44%) and the alarm operational status is considered, the percentage of smoke alarms reported as present consisted of:

- Present and operated — 26%.
- Present, but did not operate — 11% (fire too small, 6%; alarm failed to operate, 5%).
- Present, but operational status unknown — 7%.

When the subset of incidents where smoke alarms were reported as present was analyzed separately as a whole, smoke alarms were reported to have operated in 59% of these incidents. The alarms failed to operate in 10% of these incidents, and the fire was too small to activate the alarm in another 14%. The operational status of the alarm was undetermined in an additional 17% of these incidents.

At least 23% of nonconfined fires in occupied one- and two-family residential buildings had no smoke alarms present — and perhaps more if fires without information on smoke alarms were also considered.[23] A large proportion of reported fires without smoke alarms may reflect the effectiveness of the alarms themselves; smoke alarms do not prevent fires, but they may prevent a fire from being reported if it is detected at an early stage and extinguished before the fire department becomes involved. Alternatively, fires in homes without smoke alarms may **not** be detected at an early stage, causing them to grow large, require fire department intervention, and thus be reported.[24]

Properly installed and maintained smoke alarms provide an early warning signal to everyone in a home if a fire occurs. Smoke alarms help save lives and property. The USFA continues to partner with other government agencies and fire service organizations to improve and develop new smoke alarm technologies. More information on smoke alarm technologies, performance, training bulletins, and public education and outreach materials can be found at http://www.usfa.fema.gov/prevention/technology/smoke_fire_alarms.html. Additionally, the USFA's position statement on home smoke alarms is available at https://www.usfa.fema.gov/about/smoke_alarms_position.html.

Table 7. NFIRS smoke alarm data for nonconfined fires in occupied one- and two-family residential buildings (2017-2019)

Presence of smoke alarms	Smoke alarm operational status	Smoke alarm effectiveness	Count	Percent
Present	Fire too small to activate smoke alarm		14,948	6.2
	Smoke alarm operated	Smoke alarm alerted occupants, occupants responded	43,856	18.3
		Smoke alarm alerted occupants, occupants failed to respond	1,585	0.7
		No occupants	8,694	3.6
		Smoke alarm failed to alert occupants	1,546	0.6
		Undetermined	7,022	2.9
	Smoke alarm failed to operate		10,878	4.5
	Undetermined		17,831	7.4
None present			54,812	22.8
Undetermined			79,040	32.9
Total reported incidents			240,212	100.0

Source: NFIRS 5.0.

Notes: 1. The data presented in this table are raw data counts from the NFIRS dataset summed (not averaged) from 2017 to 2019. They do not represent national estimates of smoke alarms in nonconfined fires in occupied one- and two-family residential buildings. They are presented for informational purposes.
2. Total does not add up to 100% due to rounding.

Smoke alarms in confined fires

Less information about smoke alarm status is collected for confined fires, but the data still give important insights about the effectiveness of alerting occupants in these types of fires. The analyses presented here do not differentiate between occupied and unoccupied one- and two-family residential buildings, as this data detail is not required when reporting confined fires in the NFIRS. However, an assumption may be made that confined fires are fires in occupied housing, as these types of fires are unlikely to be reported in one- and two-family residential buildings that are not occupied.

Smoke alarms alerted occupants in 34% of the reported confined one- and two-family fires (Table 8). In other words, in about one-third of fires in these types of homes, residents received a warning from a smoke alarm. The data suggest that smoke alarms may alert residents to confined fires, as the early alerting allowed the occupants to extinguish the fires, or the fires self-extinguished. If this is the case, it is an example of the contribution to overall safety and the ability to rapidly respond to fires in early stages that smoke alarms afford. Details on smoke alarm effectiveness for confined fires are needed to pursue this analysis further.

Occupants were not alerted by smoke alarms in 20% of confined one- and two-family fires.[25] In 46% of these confined fires, the smoke alarm effectiveness was unknown.

Table 8. NFIRS smoke alarm data for confined one- and two-family residential building fires (2017-2019)

Smoke alarm effectiveness	Count	Percent
Smoke alarm alerted occupants	66,269	34.4
Smoke alarm did not alert occupants	37,588	19.5
Unknown	88,725	46.1
Total reported incidents	192,582	100.0

Source: NFIRS 5.0.

Note: The data presented in this table are raw data counts from the NFIRS dataset summed (not averaged) from 2017 to 2019. They do not represent national estimates of smoke alarms in confined one- and two-family residential building fires. They are presented for informational purposes.

Automatic extinguishing systems in nonconfined fires in occupied one- and two-family residential buildings

AES data are available for both confined and nonconfined fires, although for confined fires, the data are also very limited in scope. In confined one- and two-family residential building fires, an AES was present in less than 1% of reported incidents.[26] In addition, the following AES analyses focus on nonconfined fires in occupied one- and two-family buildings only, as even fewer AESs are present in unoccupied housing.

Residential sprinklers are the primary AES in one- and two-family residences but are not yet widely installed. In fact, full or partial AESs were reported as present in only 1% of nonconfined fires in occupied one- and two-family buildings (Table 9). This was the lowest reported presence of sprinklers in nonconfined fires in any occupied residential occupancy.

Residential sprinkler systems help to reduce the risk of deaths and injuries, homeowners insurance premiums, and uninsured property losses. Despite these advantages, many homes do not have AESs, although they are often found in hotels and businesses. Sprinklers are required by code in hotels and many multifamily residences. There are major movements in the U.S. fire service to require sprinklers in all new homes. At present, however, they are largely absent in residences nationwide.[27]

The USFA and fire service officials across the nation are working to promote and advance residential fire sprinklers. More information on costs and benefits, performance, training bulletins, and public education and outreach materials regarding residential sprinklers is available at http://www.usfa.fema.gov/prevention/technology/home_fire_sprinklers.html. Additionally, the USFA's position statement on residential sprinklers is available at http://www.usfa.fema.gov/about/sprinklers_position.html.

Table 9. NFIRS automatic extinguishing system data for nonconfined fires in occupied one- and two-family residential buildings (2017-2019)

Automatic extinguishing system presence	Count	Percent
Automatic extinguishing system present	3,155	1.3
Partial system present	121	0.1
Automatic extinguishing system not present	215,357	89.7
Unknown	21,579	9.0
Total reported incidents	240,212	100.0

Source: NFIRS 5.0.

Notes: 1. The data presented in this table are raw data counts from the NFIRS dataset summed (not averaged) from 2017 to 2019. They do not represent national estimates of AESs in nonconfined fires in occupied one- and two-family residential buildings. They are presented for informational purposes.
2. Total does not add up to 100% due to rounding.

Examples

The following are recent examples of one- and two-family fires reported by the media:

- February 2021: A Cadiz, Kentucky, duplex was destroyed after a Monday afternoon fire. Firefighters reported that the fire started because of unattended cooking and quickly spread throughout the structure. No injuries were reported, but both families living in the duplex were displaced due to damage caused by the fire.[28]
- April 2021: A single-story house fire in Milwaukee, Wisconsin, resulted in the death of a 10-year-old boy. When firefighters arrived on scene, the boy was trapped in the house where he, his 14-year-old sister and his mother lived. While searching, firefighters found the boy unconscious in the home's kitchen near a locked back door where he reportedly was trying to escape. Despite all efforts, firefighters were unable to revive him. The boy's sister and mother were able to escape, but the mother was treated at a local hospital and released. The family also had 3 dogs, 2 of which escaped and 1 of which died. The fire reportedly started after a lit candle on top of a living room ottoman ignited the furniture. Most of the fire damage was contained to the living room area. Firefighters reported that the home had a working smoke alarm.[29]
- May 2021: A single-family home in Ashburn, Virginia, was damaged in a Wednesday night fire. Upon arrival shortly after 8 p.m., firefighters found heavy fire and smoke coming from the second floor and roof area of the home. Two residents of the home were located outside, and firefighters were able to quickly control the fire. The fire started in the attic and was caused by a mechanical malfunction in the air handler system. Although the fire resulted in over $759,000 in damage, there were no reported injuries.[30]

NFIRS data specifications for one- and two-family residential building fires

Data for this report were extracted from the NFIRS annual Public Data Release files for 2017, 2018 and 2019. Only Version 5.0 data were extracted.

One- and two-family residential building fires were defined using the following criteria:

- Incidents with Aid Types 3 (mutual aid given) and 4 (automatic aid given) were excluded to avoid counting a single incident more than once.
- 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 419:

Property Use	Description
419	One- or two-family dwelling, detached, manufactured home, mobile home not in transit, duplex

- Structure Type:
  - For Incident Types 113 to 118:
    - 1 — Enclosed building, or
    - 2 — Fixed portable or mobile structure, or
    - Structure Type not specified (null entry).
  - For Incident Types 111 and 120 to 123:
    - 1 — Enclosed building, or
    - 2 — Fixed portable or mobile structure.

The analyses contained in this report reflect the current methodologies used by the USFA. The 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.

Information regarding the USFA's national estimates for residential building fires, as well as the data sources used to derive the estimates, can be found in the document "Data Sources and National Estimates Methodology Overview for the U.S. Fire Administration's Topical Fire Report Series (Volume 21)" (https://www.usfa.fema.gov/downloads/pdf/statistics/data-sources-and-national-estimates-methodology-vol21.pdf). This document also addresses the specific NFIRS data elements analyzed in the topical reports, as well as "unknown" data entries and missing data.

To request additional information, visit: http://www.usfa.fema.gov/contact.html. Provide feedback on this report.

Notes:

[1]National estimates are based on 2017 to 2019 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/data/statistics/order_download_data.html. Further information on the USFA's residential building fire loss estimates can be 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 detailed information regarding the NFPA's survey methodology, see the NFPA's "Methodology used in calculating national estimates from NFPA's fire experience survey," August 2020, https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics-and-reports/US-Fire-Problem/Methodsfirelossandothers.ashx. In this topical report, fires are rounded to the nearest 100, deaths to the nearest 5, injuries to the nearest 25 and dollar loss to the nearest $100 million.

[2]In NFIRS Version 5.0, a structure is a constructed item of which a building is one type. In previous versions of the 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 the NFIRS 5.0 includes 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 occur in 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.

[3]USFA, Topical Fire Report Series, "Residential Building Fires (2017-2019)," Volume 21, Issue 2, May 2021, https://www.usfa.fema.gov/downloads/pdf/statistics/v21i2.pdf.

[4]The percentages shown here are derived from the national estimates of one- and two-family residential building fires as explained in Endnote 1 and the summary data resulting from the NFPA's annual fire loss surveys (Ahrens, Marty and Evarts, Ben, "Fire Loss in the United States During 2019," NFPA, September 2020; Evarts, Ben, "Fire Loss in the United States During 2018," NFPA, October 2019; Evarts, Ben, "Fire Loss in the United States During 2017," NFPA, October 2018).

[5]National Oceanic and Atmospheric Administration's National Weather Service, "Summary of Natural Hazard Statistics for 2019 in the United States," https://www.weather.gov/media/hazstat/sum19.pdf (accessed June 2, 2021).

[6]Multifamily residential buildings include structures such as apartments, town houses, row houses, condominiums and other tenement properties.
[7]Fire department participation in the 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 2017 to 2019, 68% of the NFPA's annual average estimated 1,309,800 fires to which fire departments responded were captured in the NFIRS. Thus, the NFIRS is not representative of all fire incidents in the U.S. and is not a "complete" census of fire incidents. Although the NFIRS does not represent 100% 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]In the NFIRS, confined fires are defined by Incident Type Codes 113 to 118.
[9]The 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. However, there could be property damage as a result of smoke, water and overhaul.
[10]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 x (2,220/230,500) = 9.6 deaths per 1,000 one- and two-family residential building fires, and the fire injury rate is 1,000 x (7,250/230,500) = 31.5 injuries per 1,000 one- and two-family residential building fires.
[11]For this report, the time of the fire alarm is used as an approximation for the general time at which the fire started. However, in the NFIRS, it is the time at which the fire was reported to the fire department.
[12]USFA, "Cooking Fires in Residential Buildings (2017-2019)," Volume 21, Issue 5, July 2021, http://www.usfa.fema.gov/downloads/pdf/statistics/v21i5.pdf.
[13]The USFA Structure Fire Cause Methodology was used to determine the cause of residential building fires. The cause methodology and definitions can be found in the document "National Fire Incident Reporting System Version 5.0 Fire Data Analysis Guidelines and Issues," July 2011, https://www.usfa.fema.gov/downloads/pdf/nfirs/nfirs_data_analysis_guidelines_issues.pdf.
[14]Fires caused by intentional actions include, but are not limited to, fires that are deemed to be arson. Intentional fires are those fires that are deliberately set and include fires that result from the deliberate misuse of a heat source and fires of an incendiary nature (arson) that require fire service intervention. For information and statistics on arson fires only, refer to the Uniform Crime Reporting Program arson statistics from the U.S. Department of Justice, FBI, Criminal Justice Information Services Division, https://www.fbi.gov/about-us/cjis/ucr/ucr (accessed June 2, 2021).
[15]Other residential buildings include boarding houses (e.g., shelters), hotels/motels (i.e., residential and commercial), residential board and care facilities (e.g., long-term care and assisted living facilities), dormitories, sorority and fraternity houses, and barracks.
[16]The American Housing Survey does not indicate the number of fireplaces, chimneys and fireplace-related equipment; however, it does collect data on fireplaces, etc., as the primary heating unit, which applies to this analysis. U.S. Department of Housing and Urban Development (HUD) and U.S. Census Bureau, 2019 American Housing Survey – Table Creator, select "2019 (Year) National (Area) Housing Unit Characteristics (Table); Units by Structure Type (Variable 1)," https://www.census.gov/programs-surveys/ahs/data/interactive/ahstablecreator.html?s_areas=00000&s_year=2019&s_tablename=TABLE0&s_bygroup1=3&s_bygroup2=1&s_filtergroup1=1&s_filtergroup2=1 (accessed June 2, 2021).
[17]Smith, Linda E. and McCoskrie, Dennis, "What Causes Wiring Fires in Residences?" Fire Journal, January/February 1990.
[18]Dini, David A., "Residential Electrical System Aging Research Project," Fire Protection Research Foundation, Quincy, Massachusetts, July 1, 2008, https://ewh.ieee.org/cmte/pses/ffat/support/RESAReport.pdf (accessed June 2, 2021).
[19]The American Housing Survey does not have a category for one- and two-family residences that conforms to the definition used by NFIRS. Housing age given here is an estimate based on the information presented for single-family attached and detached housing. HUD and U.S. Census Bureau, 2019 American Housing Survey — Table Creator, select "2019 (Year) National (Area) Housing Unit Characteristics (Table); Units by Structure Type (Variable 1)," https://www.census.gov/programs-surveys/ahs/data/interactive/ahstablecreator.html?s_areas=00000&s_year=2019&s_tablename=TABLE1&s_bygroup1=1&s_bygroup2=1&s_filtergroup1=1&s_filtergroup2=1 (accessed June 2, 2021).
[20]Dini, David A., "Residential Electrical System Aging Research Project," Fire Protection Research Foundation, Quincy, Massachusetts, July 1, 2008, https://ewh.ieee.org/cmte/pses/ffat/support/RESAReport.pdf (accessed June 2, 2021).
[21]As noted previously, confined building fires are small fire incidents that are limited in scope, are confined to noncombustible containers, rarely result in serious injury or large content loss, and are expected to have no significant accompanying property loss due to flame damage. In the NFIRS, confined fires are defined by Incident Type Codes 113 to 118.
[22]Total does not add up to 100% due to rounding.
[23]Here, **at least** 23% of nonconfined fires in occupied one- and two-family residential buildings had no smoke alarms present — the 23% that were known to not have smoke alarms and some portion (or as many as all) of the fires where the smoke alarm presence was undetermined.
[24]Greene, Michael and Andres, Craig, "2004-2005 National Sample Survey of Unreported Residential Fires,"
Division of Hazard Analysis, Directorate for Epidemiology, U.S. Consumer Product Safety Commission, July 2009. The "2004-2005 National Sample Survey of Unreported Residential Fires," however, suggests that this may not be the case. It is observed that "if this conjecture is true, it would suggest that the percentage decrease in fire department-attended fires would have been greater than unattended fires in the 20-year period between the surveys."
[25]In confined fires, the entry "smoke alarm did not alert occupants" can mean no smoke alarm was present; the smoke alarm was present but did not operate; the smoke alarm was present and operated, but the occupant(s) was already aware of the fire; or there were no occupants present at the time of the fire.

[26]As confined fire codes are designed to capture fires contained to noncombustible containers, it is not recommended to code a fire incident as a small-, low- or no-loss confined fire incident if the AES operated and contained the fire as a result. The preferred method is to code the fire as a standard fire incident with fire spread confined to the object of origin and provide the relevant information on AES presence and operation.
[27]HUD and U.S. Census Bureau, American Housing Survey for the United States: 2011, September 2013, "Health and Safety Characteristics-All Occupied Units (National)," Table S-01-AO, https://www.census.gov/content/dam/Census/library/publications/2013/demo/h150-11.pdf (accessed June 2, 2021).
[28]Claussen, Joshua, "Cadiz Duplex Destroyed in Fire," www.wkdzradio.com, Feb. 15, 2021, https://www.wkdzradio.com/2021/02/15/cadiz-duplex-destroyed-in-fire/ (accessed June 2, 2021).
[29]Volpenhein, Sarah, "Milwaukee House Fire that Killed 10-Year Old Boy Likely Caused by a Candle," www.msn.com, April 26, 2021, https://www.msn.com/en-us/news/us/milwaukee-house-fire-that-killed-10-year-old-boy-likely-caused-by-a-candle/ar-BB1g4OkQ (accessed June 2, 2021).
[30]"UPDATED: HVAC Issue to Blame for Ashburn House Fire," www.insidenova.com, May 20, 2021, https://www.insidenova.com/headlines/updated-hvac-issue-to-blame-for-ashburn-house-fire/article_7f0a96d6-b908-11eb-ae62-3f22c7518e31.html (accessed June 2, 2021).