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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, an estimated 368,500 residential building fires were reported to fire departments within the United States from 2017 to 2019. These fires caused an estimated 2,770 deaths, 11,650 injuries and $8.1 billion in property loss. From 2017 to 2019, 77% of all fire deaths and 75% of all fire injuries occurred in residential buildings.
- At 51%, cooking was the leading cause of residential building fires. Nearly all (93%) residential building cooking fires were small, confined fires.
- Residential building fire incidence was higher in the cooler months, peaking in January at 10%.
- Residential building fires occurred most frequently in the early evening, peaking during the dinner hours from 5 to 8 p.m., when cooking fire incidence is high.
- Nonconfined residential building fires most often started in cooking areas and kitchens (21%).
- In 50% of nonconfined residential building fires, the fire extended beyond the room of origin. The leading causes of these larger fires were unintentional or careless actions (21%), electrical malfunctions (14%), open flames (10%) and intentional actions (9%).
- The leading reported factor contributing to ignition category in nonconfined residential building fires was misuse of material or product (37%).
- Smoke alarms were not present in 21% of nonconfined fires in occupied residential buildings.
- Automatic extinguishing systems (AESs), including residential sprinklers, were present in only 5% of nonconfined fires in occupied residential buildings.

Each year from 2017 to 2019, fire departments responded to an estimated 368,500 fires in residential buildings across the nation.[1,2] These fires resulted in an annual average of 2,770 deaths, 11,650 injuries and $8.1 billion in property loss.

The residential building portion of the fire problem is of great national importance, as it accounts for the vast majority of civilian casualties. National estimates for 2017 to 2019 show that 77% of all fire deaths and 75% of all fire injuries occurred in residential buildings.[3]

The term "residential buildings" includes what are commonly referred to as "homes," whether they are 1- or 2-family dwellings or multifamily buildings. It also includes manufactured housing, hotels and motels, residential hotels, dormitories, assisted living facilities, and halfway houses — residences for formerly institutionalized individuals (patients with mental disabilities, drug addictions, or those formerly incarcerated) that are designed to facilitate their readjustment to private life. The term "residential buildings" does not include institutions, such as prisons, nursing homes, juvenile care facilities or hospitals, even though people may reside in these facilities for short or long periods of time.

As part of a series of topical reports that address fires in types of residential buildings, this report addresses the characteristics of all residential building fires as reported to NFIRS. The focus is on fires reported from 2017 to 2019, the most recent data available at the time of the analysis.[4] NFIRS data is used for the analyses throughout this report.

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For the purpose of this report, the term "residential fires" is synonymous with "residential building fires." "Residential fires" is used throughout the body of this report; the findings, tables, figures, headings and endnotes reflect the full category "residential building fires."

Type of fire

Building fires are divided into 2 classes of severity in 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.[5] 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.[6] 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 49% of residential fires. The smaller, confined fires accounted for the remaining 51% of residential fires. Cooking fires were the predominant type of confined fires in residential buildings (Table 1).

Table 1. Residential building fires by type of incident (2017-2019)

Incident type	Percent
Nonconfined fires	49.4
Confined fires	50.6
Cooking fire, confined to container	38.8
Chimney or flue fire, confined to chimney or flue	3.8
Incinerator overload or malfunction, fire confined	0.1
Fuel burner/boiler malfunction, fire confined	2.1
Commercial compactor fire, confined to rubbish	0.2
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, for residential and nonresidential building fires reported to NFIRS.[7] The average number of fatalities and injuries per 1,000 residential fires was notably higher than the same loss measures for nonresidential building fires.

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

Measure	Residential building fires	Confined residential building fires	Nonconfined residential building fires	Nonresidential building fires
Average loss				
Fatalities/1,000 fires	6.2	0.0	12.5	0.9
Injuries/1,000 fires	25.4	5.9	45.5	9.1
Dollar loss/fire	$18,720	$230	$37,660	$35,740

Source: NFIRS 5.0.

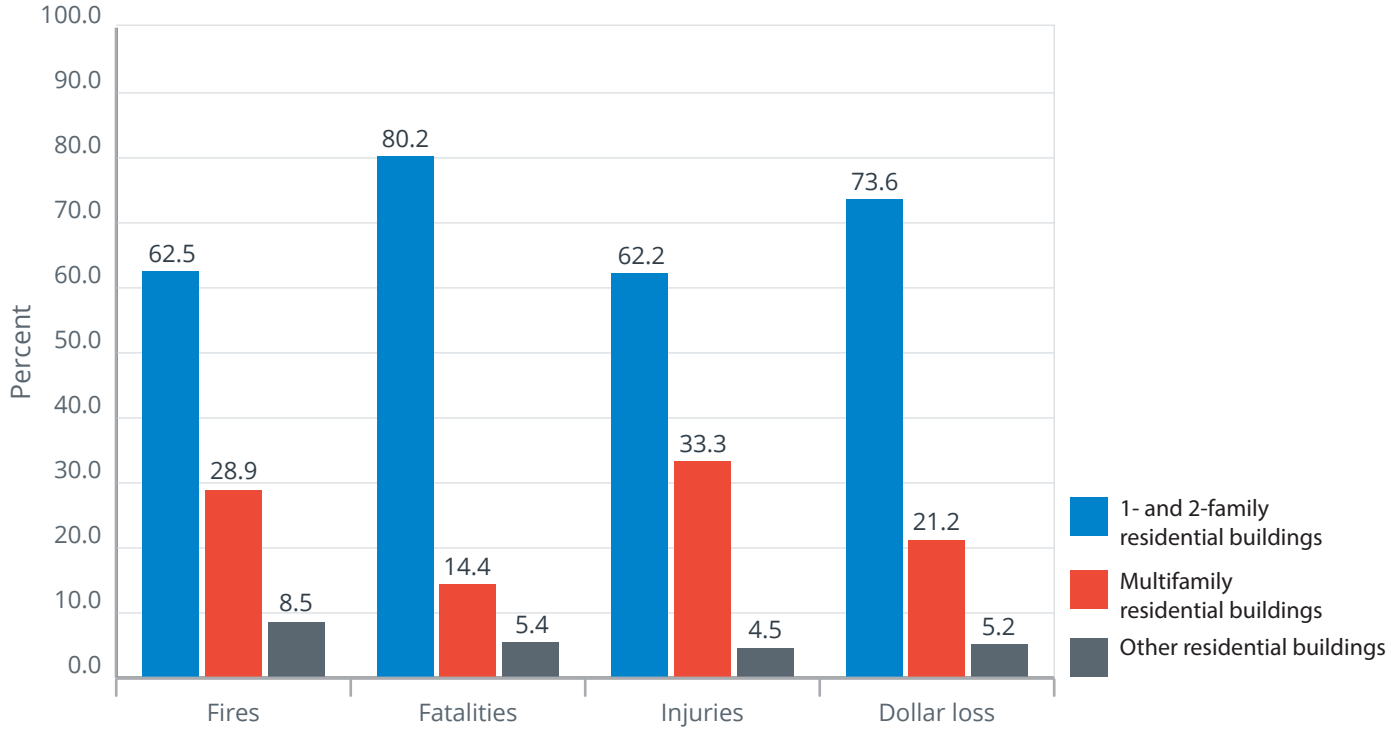
Notes:
1. Average loss for fatalities and injuries is computed per 1,000 fires. Average dollar loss is computed **per fire** and rounded to the nearest $10.
2. In 2018, there was 1 confined fire incident with a reported civilian fire death. By definition, confined fires should not have reported fire deaths. This death was excluded from the calculation of the fatalities/1,000 confined residential building fires.
3. The 2017 and 2018 dollar-loss values were adjusted to 2019 dollars.

Property use

Figure 1 presents the percentage distribution of fire losses by property use (i.e., 1- and 2-family residential buildings, multifamily residential buildings, and other residential buildings).[8] Consistent with the fact that the majority of residential fires took place in 1- and 2-family residential buildings (63%), the percentages of fatalities (80%), injuries (62%) and dollar loss (74%) were also highest in these types of residences.

One explanation for the higher percentages of fires and subsequent losses in 1- and 2-family dwellings may be that more stringent building and fire codes, which require detection and suppression systems, as well as regular fire inspections, are imposed on multifamily dwellings and other residential buildings. In addition, multifamily dwellings and other residential buildings may be professionally maintained more often.

Figure 1. Fire losses by property use (2017-2019)

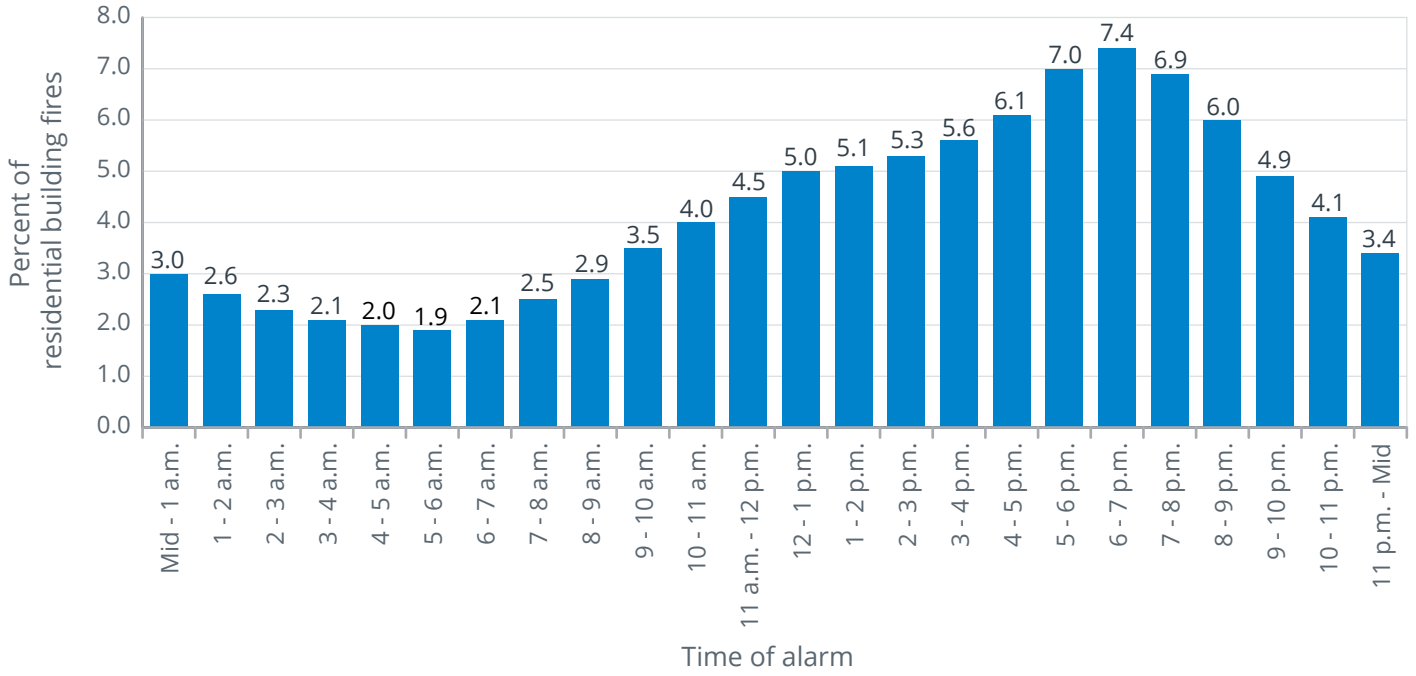


Source: NFIRS 5.0.
Notes: 1. Total percent of fires does not add up to 100% due to rounding.
2. The 2017 and 2018 dollar-loss values were adjusted to 2019 dollars.

When residential building fires occur

As shown in Figure 2, residential fires occurred most frequently in the early evening, peaking during the dinner hours from 5 to 8 p.m., when cooking fire incidence is high.[9,10] Cooking fires, discussed next in the "Causes of residential building fires" section, accounted for 51% of residential fires. Fires then declined throughout the night, reaching the lowest point during the early to midmorning hours (4 to 6 a.m.).

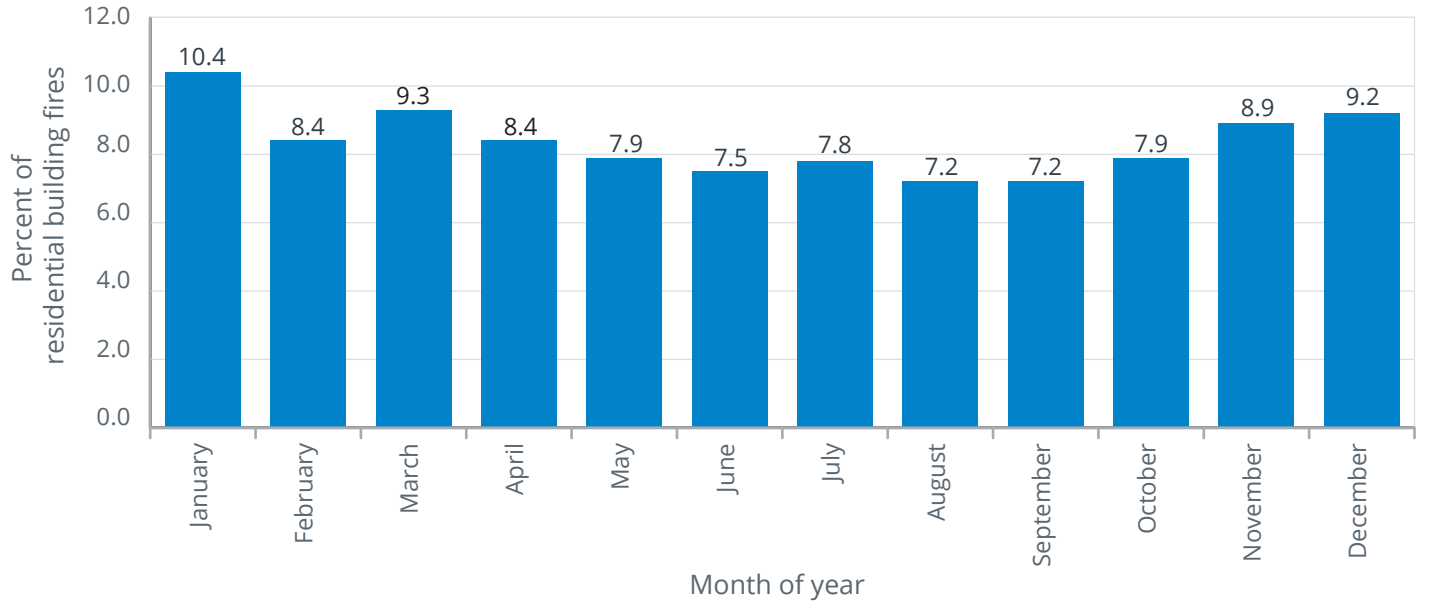
Figure 2. Residential building fires by time of alarm (2017-2019)



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

Figure 3 illustrates that residential fire incidence was higher in the cooler months, peaking in January at 10%. The increase in fires in the cooler months may be explained by the increase in heating fires.[11] In addition, the increase may also be due to more indoor activities in general, as well as more indoor seasonal and holiday activities. During the spring and summer months, fire incidence was generally lower, reaching a low in August and September.

Figure 3. Residential building fires by month (2017-2019)



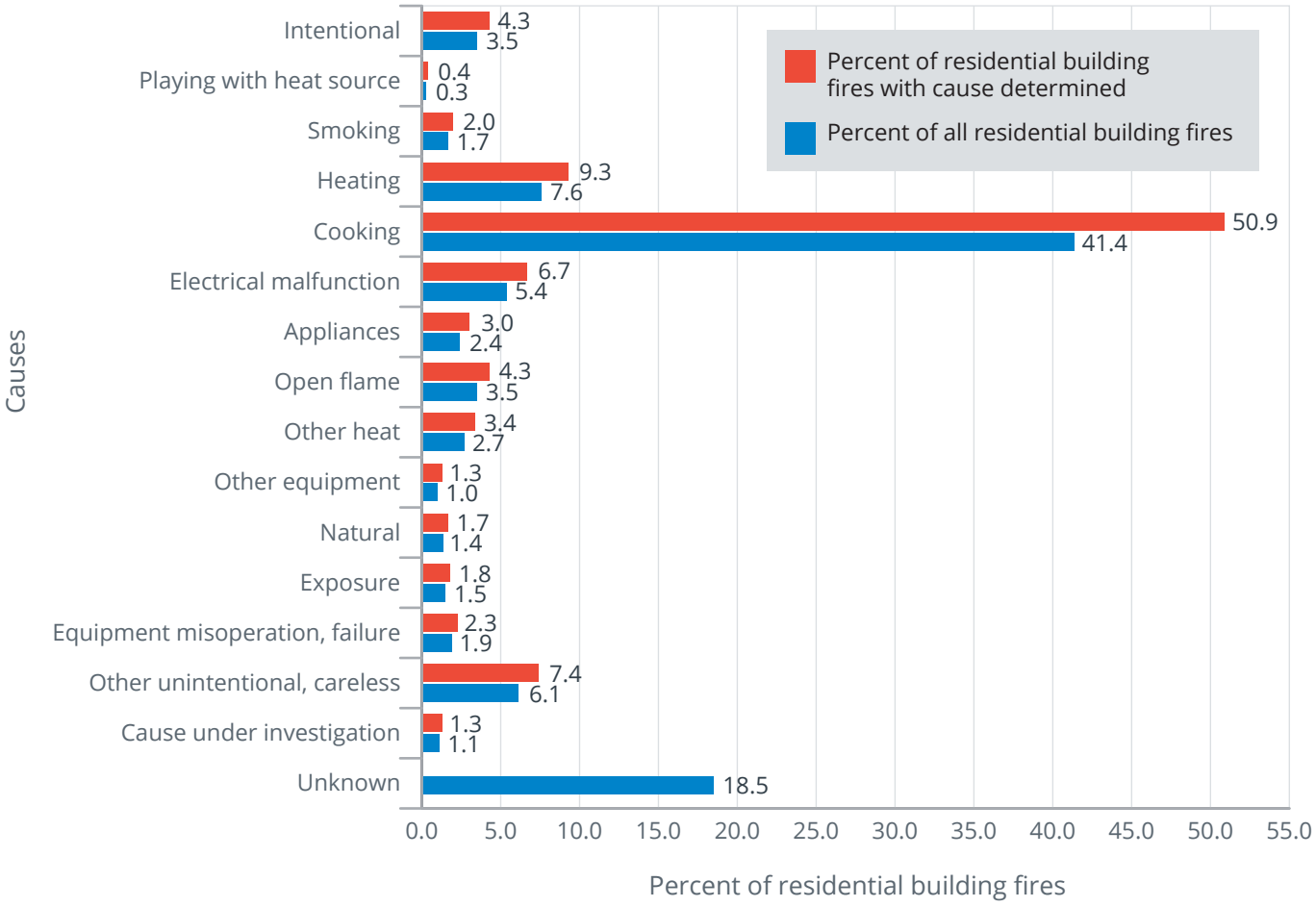
Source: NFIRS 5.0.
Note: Total does not add up to 100% due to rounding.

Causes of residential building fires

Cooking was the leading cause and accounted for 51% of all residential fires, as shown in Figure 4.[12] Nearly all of these cooking fires (93%) were small, confined fires with limited damage.

The next 3 causes combined accounted for nearly one quarter of residential fires: fires caused by heating (9%); other unintentional or careless actions, a miscellaneous group (7%); and electrical malfunctions, such as short circuits and wiring problems (7%). Unintentional or careless actions include misuse of material or product; abandoned or discarded materials or products; heat source placed too close to combustibles; and other miscellaneous, unintentional actions. Intentional actions (4%) and open flames (4%) together caused an additional 8% of residential fires.[13]

Figure 4. Causes of residential building fires (2017-2019)



Source: NFIRS 5.0.

Notes: 1. Causes are listed in order of the 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 percent of residential building fires with cause determined does not add up to 100% due to rounding.

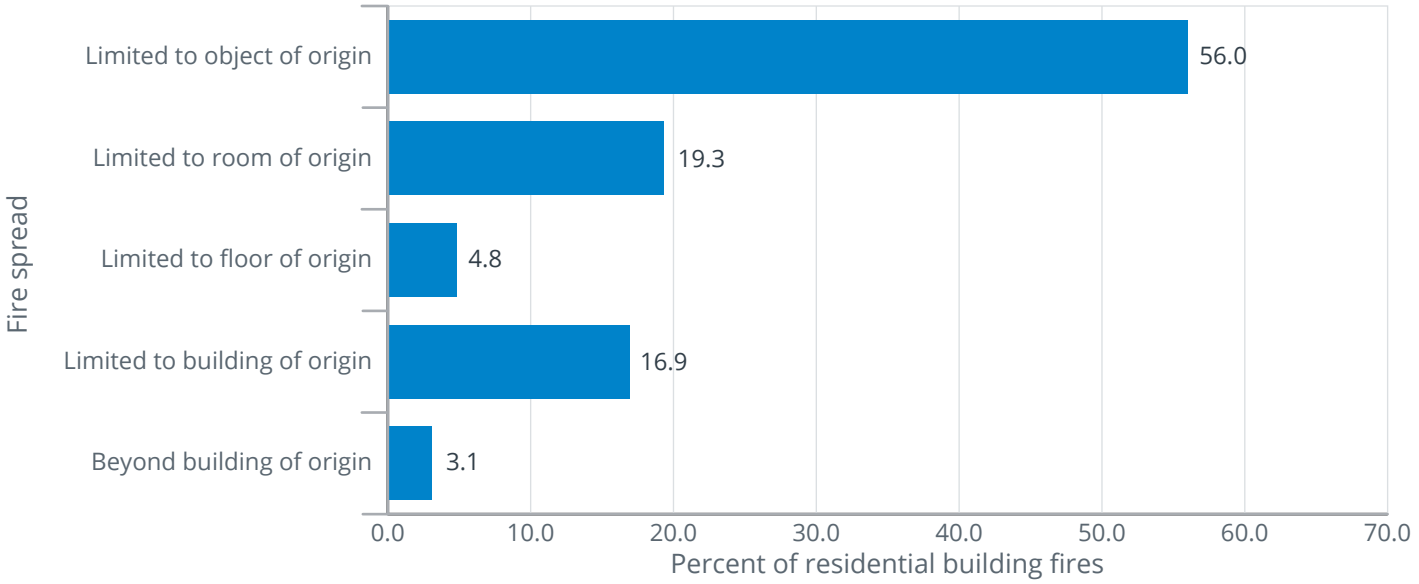
However, when looking at the different types of property use (i.e., 1- and 2-family, multifamily, and other residential buildings), there are striking differences in the prevalence of cooking as a fire cause. Cooking accounted for 74% of multifamily residential building fires and 58% of other residential building fires, but only 37% of 1- and 2-family building fires. The most persuasive explanation for this difference may be that the smaller confined fires in 1- and 2-family dwellings are not reported as often to fire departments. They are small and contained, and they do not cause much damage. In addition, only the residents hear the smoke alarm if it is activated. However, these same confined fires in multifamily residences may be reported if someone else in the complex hears the alarm or smells the fire. Alternatively, if it is a newer complex, the alarms are connected to the building alarm system, and the fire department may be called automatically.

Heating and electrical malfunctions played a larger role in 1- and 2-family fires than in multifamily fires. One reason for this may be that many 1- and 2-family residential buildings have fireplaces, chimneys and fireplace-related equipment that most other types of residential properties do not have.[14] This heating equipment difference may also be the explanation for the slight increase in confined chimney and flue fires (a component of heating fires) seen in 1- and 2-family fires (5%) as compared to multifamily fires (less than 1%).

Fire spread in residential building fires

As shown in Figure 5, 56% of residential fires were limited to the object of origin. Included in these fires were those coded as "confined fires" in NFIRS. In addition, 25% of fires extended beyond the room of origin.

Figure 5. Extent of fire spread in residential building fires (2017-2019)



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

Confined fires

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.[15]) For example, a fire contained to a chair or clothes dryer is not defined as a "confined fire" in 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 51% of all residential fires. Confined cooking fires — those cooking fires confined to a pot or the oven, for example — accounted for the majority of these confined fires (Table 1).

In addition, the number of confined residential fires was greatest from 5 to 8 p.m. These fires accounted for 62% of all residential fires occurring in this time period. Moreover, confined cooking fires accounted for 79% of the confined fires and 49% of all fires in residential buildings that occurred between 5 and 8 p.m.

Like all residential fires, confined residential fires peaked in January, then steadily declined until reaching the lowest incidences in July and August.

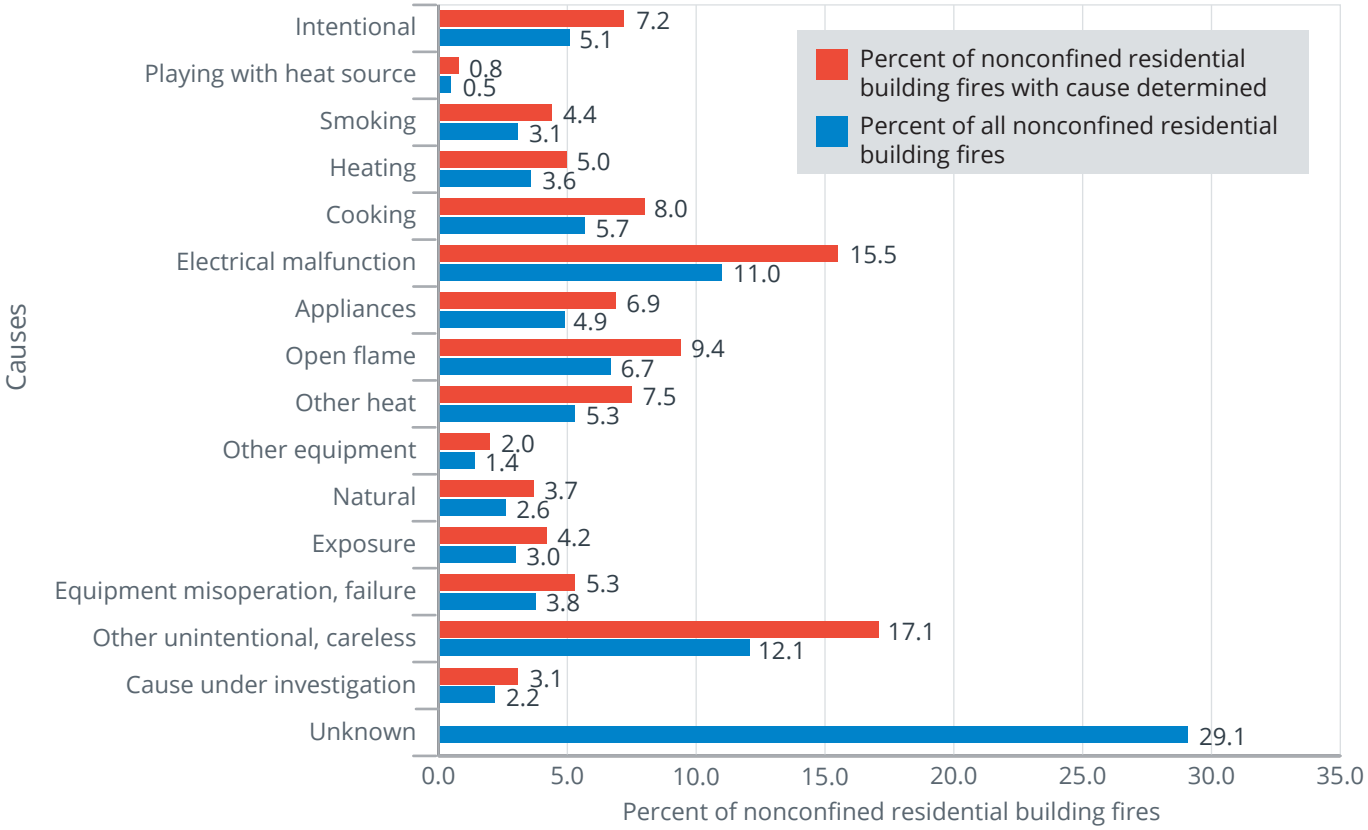
Nonconfined fires

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 NFIRS.

Causes of nonconfined residential building fires

While cooking was the leading cause of residential fires overall, it only accounted for 8% of all nonconfined residential fires. At 17%, careless or other unintentional actions was the leading cause of nonconfined residential fires. The second leading cause of these fires was electrical malfunction at 16% (Figure 6).

Figure 6. Causes of nonconfined residential building fires (2017-2019)



Source: NFIRS 5.0.

Notes: 1. Causes are listed in order of the 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 residential building fires start (area of fire origin)

Nonconfined residential fires most often started in cooking areas and kitchens (21%), as shown in Table 3. Bedrooms (12%) and family rooms or living rooms (6%) were the next most common areas of fire origin in the home. Smaller but not minor percentages of fires started in garages and carports (5%), exterior wall surfaces (5%), vacant spaces and attics (5%), and laundry areas (5%).

Note that these areas of origin do not include areas associated with confined fires. Cooking was the leading cause of all residential fires at 51%, and it is not surprising that kitchens were the leading area of fire origin. 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 is the case in most confined cooking fires), and some kitchen fires did not start due to cooking. In fact, only 36% of nonconfined residential fires that started in the kitchen were cooking fires. Other unintentional or careless actions accounted for 19%, equipment misoperation or failure accounted for 11%, heat from other sources (such as flames/torches or hot materials) accounted for 9%, and appliances (such as freezers and refrigerators) accounted for 6% of kitchen fires as did electrical malfunctions (6%).

Table 3. Leading areas of fire origin in nonconfined residential building fires (2017-2019)

Areas of fire origin	Percent (unknowns apportioned)
Cooking area, kitchen	20.6
Bedrooms	12.4
Common room, den, family room, living room, lounge	6.4

Source: NFIRS 5.0.

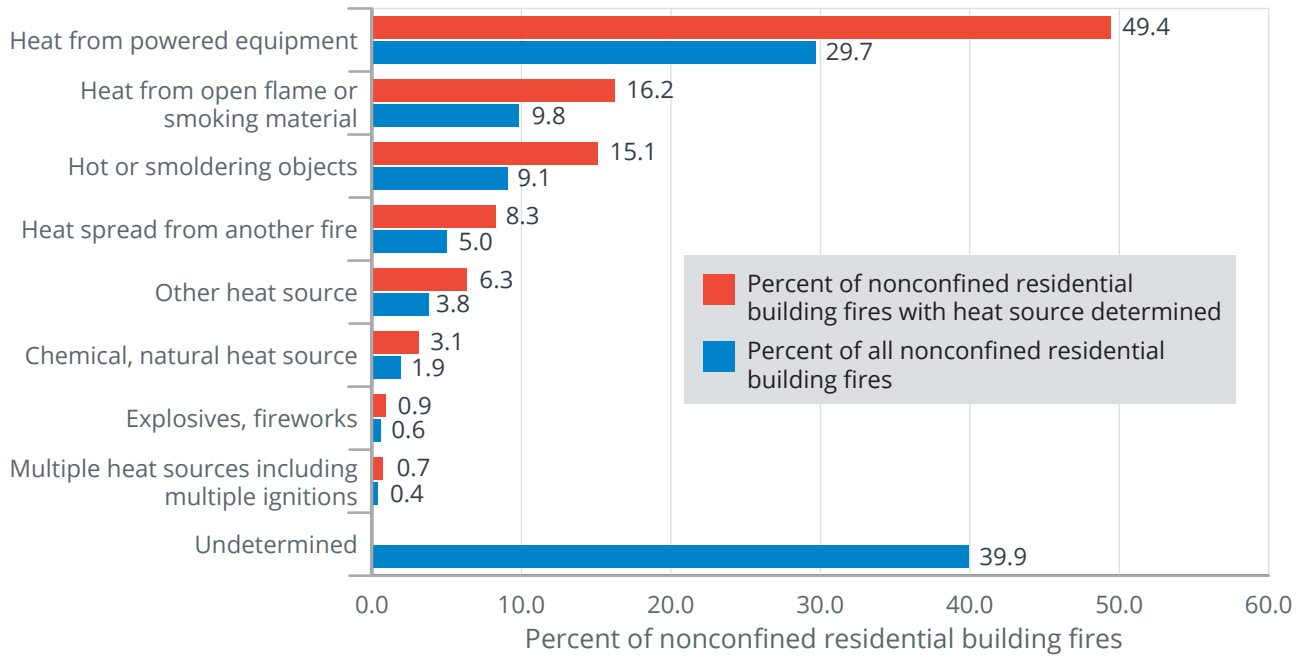
How nonconfined residential building fires start (heat source)

Figure 7 shows sources of heat categories for nonconfined residential fires. Heat from powered equipment accounted for 49% of nonconfined residential fires. This category includes electrical arcing (17%); radiated or conducted heat from operating equipment (14%); heat from other powered equipment (13%); and spark, ember or flame from operating equipment (5%).

Heat from open flame or smoking materials accounted for 16% of nonconfined residential fires. This category includes items such as cigarettes (5%), other miscellaneous open flame or smoking materials (4%), lighters and matches (combined, 3%), and candles (3%).

The third largest category pertains to hot or smoldering objects (15%). This category includes miscellaneous hot or smoldering objects (7%) and hot embers or ashes (6%).

Figure 7. Sources of heat in nonconfined residential building fires by major category (2017-2019)



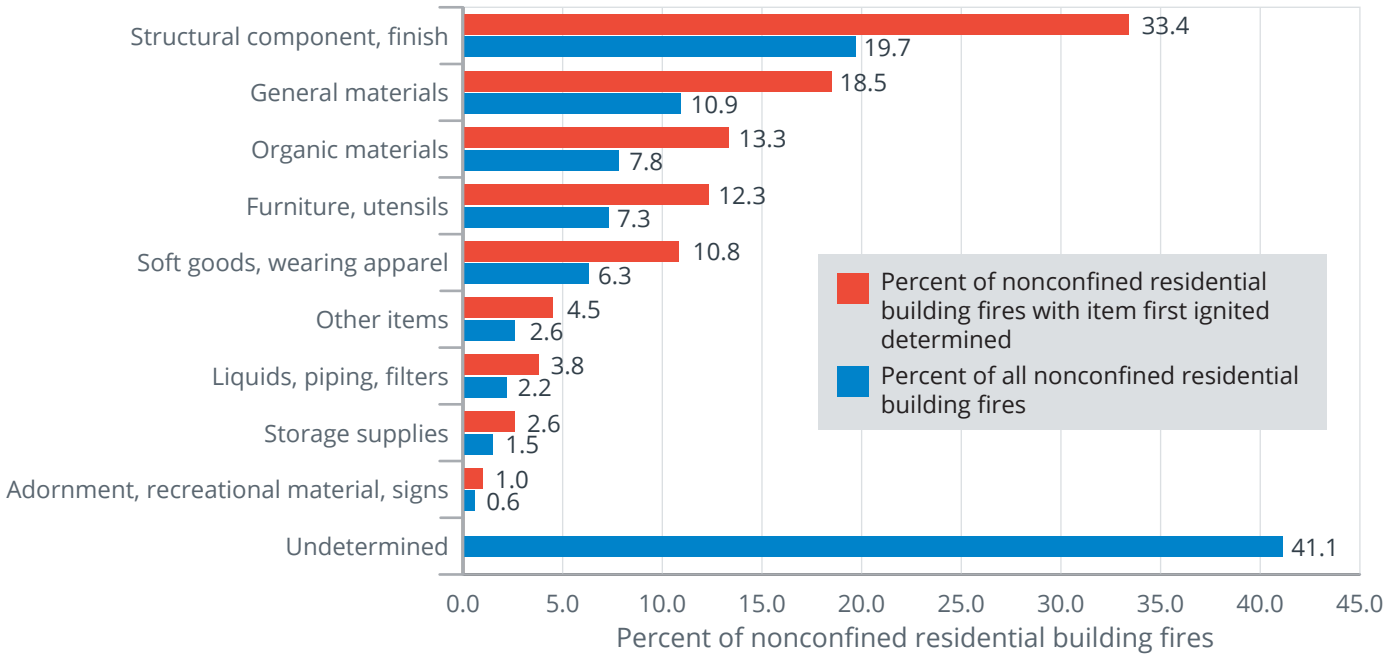
Source: NFIRS 5.0.
Note: Total percent of all nonconfined residential building fires does not add up to 100% due to rounding.

What ignites first in nonconfined residential building fires

As shown in Figure 8, 33% of the items first ignited in nonconfined residential fires, where the item was determined, fell under the "structural component, finish" category. This category includes structural members or framing and exterior sidewall coverings. The second leading category of items first ignited in nonconfined residential fires was "general materials," which accounted for 19% of these fires. "General materials" includes items such as electrical wire, cable insulation, and trash or rubbish. The next 3 leading categories of nonconfined residential fires were "organic materials" at 13%, plus "furniture, utensils" at 12% and "soft goods, wearing apparel" at 11%. These categories include items such as cooking materials, upholstered sofas and chairs, and clothing and bedding.

The specific items most often first ignited in nonconfined residential fires were cooking materials (10%); electrical wires, cable insulation (9%); structural members and framing (9%); and exterior sidewall coverings (7%).

Figure 8. Item first ignited in nonconfined residential building fires by major category (2017-2019)



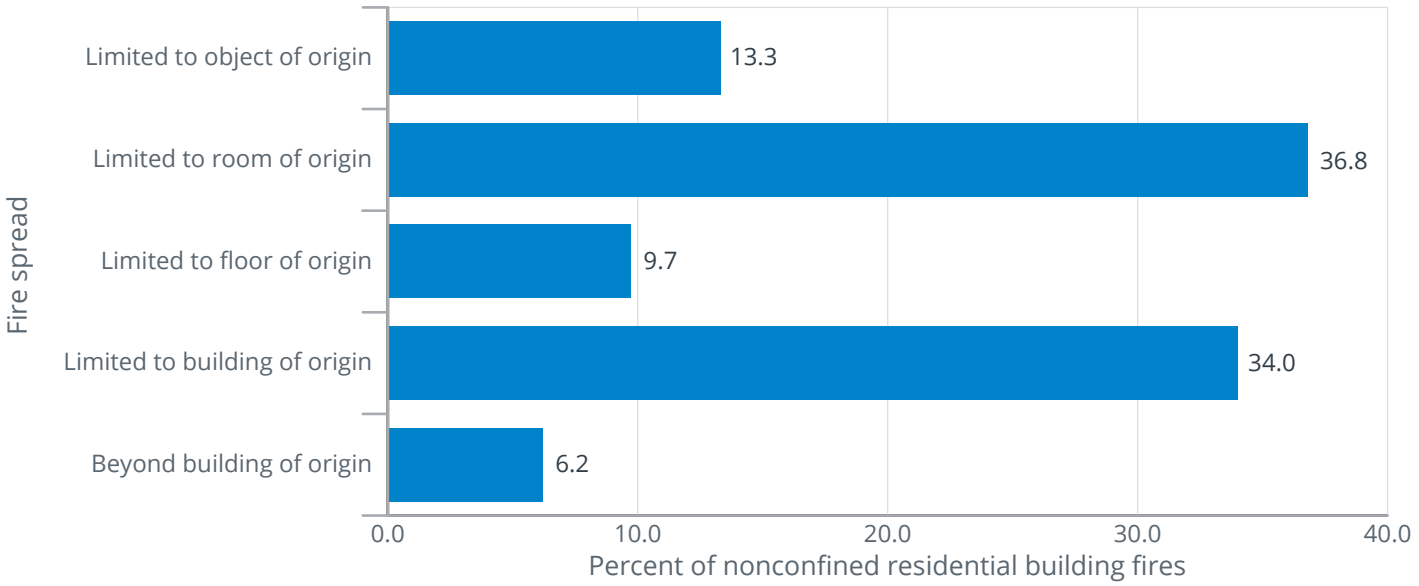
Source: NFIRS 5.0.
Note: Total percent of nonconfined residential building fires with item first ignited determined does not add up to 100% due to rounding.

Fire spread in nonconfined residential building fires

Figure 9 shows the extent of fire spread in nonconfined residential fires. In 50% of nonconfined fires, the fire was limited to the object or room of fire origin. In 37% of nonconfined fires, the fire was limited to the room of origin; in another 13% of fires, the fire was limited to the object of origin. (Note that a fire limited to a sofa or bed is not defined as a "confined fire" 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.)

In another 50% of nonconfined residential fires, the fire extended beyond the room of origin. The leading causes of these larger fires were unintentional or careless actions (21%), electrical malfunctions (14%), open flames (10%), and intentional actions (9%).

Figure 9. Extent of fire spread in nonconfined residential building fires (2017-2019)



Source: NFIRS 5.0.

Factors contributing to ignition in nonconfined residential building fires

Table 4 shows the categories of factors contributing to ignition in nonconfined residential fires. The leading category was the misuse of material or product (37%). In this category, the leading specific factors contributing to ignition were a heat source too close to combustible materials (14%) and abandoned or discarded materials, such as matches or cigarettes (11%).

Electrical failures and malfunctions contributed to 24% of nonconfined residential fires. Operational deficiency was the third leading category at 14%. Unattended equipment was the leading factor in the operational deficiency category and accounted for 7% of all nonconfined residential fires.

Table 4. Factors contributing to ignition for nonconfined residential building fires by major category (where factors contributing to ignition are specified, 2017-2019)

Factors contributing to ignition category	Percent of nonconfined residential building fires (unknowns apportioned)
Misuse of material or product	36.7
Electrical failure, malfunction	23.7
Operational deficiency	14.2
Fire spread or control	10.8
Mechanical failure, malfunction	7.4
Other factors contributing to ignition	6.1
Natural condition	3.9
Design, manufacture, installation deficiency	1.6

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 residential building fires

Fire fatalities and injuries have declined over the last 40 years, partly due to new technologies to detect and extinguish fires. Smoke alarms are present in most homes. In addition, the use of residential sprinklers is widely supported by the fire service and is gaining support within residential communities.

Smoke alarm data is available for both confined and nonconfined fires, although for confined fires, the data is very limited in scope. Since different levels of data are reported on smoke alarms in confined and nonconfined fires, the analyses are performed separately. Note that the data presented in Tables 5, 6 and 7 are the raw counts from the NFIRS dataset and are not scaled to national estimates of smoke alarms in residential fires. In addition, NFIRS does not allow for the determination of the type of smoke alarm (i.e., 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 43% of nonconfined residential fires (Table 5). In 26% of nonconfined residential fires, there were no smoke alarms present. In another 31% of these fires, firefighters were unable to determine if a smoke alarm was present. Thus, smoke alarms were potentially missing in 26% to 57% of fires with the ability to spread and possibly result in fatalities.

Table 5. Presence of smoke alarms in nonconfined residential building fires (2017-2019)

Presence of smoke alarms	Percent
Present	43.1
None present	26.1
Undetermined	30.8
Total	100.0

Source: NFIRS 5.0.

While 16% of all nonconfined residential fires occurred in residential buildings that are **not** currently or routinely occupied, these buildings — which are under construction, undergoing major renovations, 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 8% of all nonconfined fires in unoccupied 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 residential buildings only.

Smoke alarms in nonconfined fires in occupied residential buildings

Smoke alarms were reported as present in 49% of nonconfined fires in occupied residential buildings (Table 6). In 21% of nonconfined fires in occupied residential buildings, there were no smoke alarms present. In another 30% of these fires, firefighters were unable to determine if a smoke alarm was present; unfortunately, in 50% of fires where the presence of a smoke alarm was undetermined, either the flames involved the building of origin or spread beyond it. The fires were so large and destructive that it is unlikely the presence of a smoke alarm could be determined.

When smoke alarms were present (49%) and the alarm's operational status is considered, the percentage of smoke alarms reported as present consisted of:

- Present and operated — 30%.
- Present but did not operate — 11% (fire too small, 7%; alarm failed to operate, 5%).[16]
- Present but operational status unknown — 8%.

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 61% of the incidents and failed to operate in 10%. In another 13% of this subset, the fire was too small to activate the alarm. The operational status of the alarm was undetermined in 16% of these incidents.

At least 21% of nonconfined fires in occupied residential buildings had no smoke alarms present — and perhaps more if fires without information on smoke alarms could be factored in.[17] 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.[18]

If a fire occurs, properly installed and maintained smoke alarms provide an early warning signal to everyone in a home. 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 6. NFIRS smoke alarm data for nonconfined fires in occupied 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		21,072	6.6
	Smoke alarm operated	Smoke alarm alerted occupants, occupants responded	68,760	21.4
		Smoke alarm alerted occupants, occupants failed to respond	2,990	0.9
		No occupants	11,684	3.6
		Smoke alarm failed to alert occupants	2,083	0.6
		Undetermined	9,995	3.1
	Smoke alarm failed to operate		15,057	4.7
	Undetermined		25,107	7.8
None present			68,712	21.4
Undetermined			95,336	29.7
Total reported incidents			320,796	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 residential buildings. They are presented for informational purposes.
2. Total percent 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 residential buildings, as this data detail is not required when reporting confined fires in 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 residential buildings that are not occupied.

Smoke alarms alerted occupants in 45% of the reported confined residential fires (Table 7). In other words, residents received a warning from a smoke alarm in almost half of these fires. 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 16% of confined residential fires.[19] In 40% of these confined fires, the smoke alarm effectiveness was unknown.[20]

Table 7. NFIRS smoke alarm data for confined residential building fires (2017-2019)

Smoke alarm effectiveness	Count	Percent
Smoke alarm alerted occupants	175,171	44.7
Smoke alarm did not alert occupants	61,081	15.6
Unknown	155,571	39.7
Total reported incidents	391,823	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 residential building fires. They are presented for informational purposes.

Automatic extinguishing systems in nonconfined fires in occupied residential buildings

AES data are available for both confined and nonconfined fires, although for confined fires, the data is also very limited in scope. In confined residential building fires, an AES was present in only 1% of reported incidents.[21] In addition, the following AES analyses focus on nonconfined fires in occupied residential buildings only, as even fewer AESs are present in unoccupied housing.

Residential sprinklers are the primary AES in residences but are not yet widely installed. In fact, AESs were reported as present in only 5% of nonconfined fires in occupied residential buildings (Table 8).

Residential sprinkler systems help to reduce the risk of deaths and injuries, homeowner insurance premiums, and uninsured property losses. Yet 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. In addition, there are major movements in the U.S. fire service to require sprinklers in all new homes.

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 8. NFIRS automatic extinguishing system data for nonconfined fires in occupied residential building fires (2017-2019)

Automatic extinguishing system presence	Count	Percent
AES present	14,990	4.7
Partial system present	615	0.2
AES not present	277,388	86.5
Unknown	27,803	8.7
Total reported incidents	320,796	100.0

Source: NFIRS 5.0.
Note: 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 residential buildings. They are presented for informational purposes.
2. Total percent does not add up to 100% due to rounding.

Examples

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

- March 2021: A single-family house fire in Plymouth, Massachusetts, led to an estimated $223,000 in damages to the home. Upon arrival on scene, firefighters found the front porch and front interior of the house in flames. After the fire was extinguished, firefighters determined that the fire was accidental and likely the result of improper disposal of smoking materials on the front porch. No injuries were reported.[22]
- March 2021: A 9-year old boy was transported to a hospital after being burned in a Carroll County, Ohio, mobile home fire. The fire started in the kitchen by unattended food left in hot cooking oil. The mobile home sustained smoke damage as well as minor fire damage. The residents had to vacate the mobile home because of the fire. No other injuries were reported.[23]
- March 2021: An early morning high-rise apartment fire in the Medical District of Memphis, Tennessee, led to the death of 1 elderly man. Upon arrival, firefighters were able to extinguish the fire within 21 minutes. The fire started on the ninth floor and spread to the eighth floor. An additional woman who suffered smoke inhalation was taken to the hospital as a precaution. The cause of the fire has not yet been reported.[24]

NFIRS data specifications for residential building fires

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

Residential building fires were defined using the following criteria:

- 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 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, 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)," http://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: https://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 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 the NFPA's fire experience survey," September 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 1 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]The percentages shown here are derived from the national estimates of 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).

[4]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.

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

[6]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.

[7]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 (2,770/368,500)) = 7.5 deaths per 1,000 residential building fires, and the fire injury rate is (1,000 x (11,650/368,500)) = 31.6 injuries per 1,000 residential building fires.

[8]"1- and 2-family residential buildings" include detached dwellings, manufactured homes, mobile homes not in transit, and duplexes. "Multifamily residential buildings" include apartments, town houses, row houses, condominiums and other tenement properties. "Other residential buildings" include boarding/rooming houses, hotels/motels, residential board and care facilities, dormitory-type residences, sorority/fraternity houses, and barracks.

[9]For the purposes of 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.

[10]USFA, "Cooking Fires in Residential Buildings (2014-2016)," Volume 19, Issue 9, December 2018, https://www.usfa.fema.gov/downloads/pdf/statistics/v19i9.pdf.

[11]USFA, "Heating Fires in Residential Buildings (2013-2015)," Volume 18, Issue 7, October 2017, https://www.usfa.fema.gov/downloads/pdf/statistics/v18i7.pdf.

[12]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.

[13]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.

[14]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 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.

[15]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.

[16]Total does not add up to 11% due to rounding.

[17]Here, **at least** 21% of nonconfined fires in occupied residential buildings had no smoke alarms present — the 21% 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.

[18]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."

[19]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.

[20]Total does not add up to 100% due to rounding.

[21]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 automatic extinguishing system (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.

[22]Harbert, Rich, "Plymouth House Fire Linked to Smoking," www.wickedlocal.com, March 15, 2021, https://www.wickedlocal.com/story/old-colony-memorial/2021/03/15/plymouth-house-fire-linked-smoking/4694725001/.

[23]"Hot Grease Fire Injures 9-Year-Old Carroll County Boy," www.cantonrep.com, March 11, 2021, https://www.cantonrep.com/story/news/2021/03/11/cooking-oil-fire-injures-9-year-old-malvern-area-boy/4645435001/.

[24]Wilborn, Quametra, "One Man Dead, Another Person Injured After Fire at Medical District High-Rise Apartment Building," wreg.com, March 12, 2021, https://wreg.com/news/one-man-dead-another-person-injured-after-fire-at-medical-district-high-rise-apartment-building/.