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# Nonresidential Building Fires (2017-2019)

The U.S. Fire Administration's (USFA's) topical reports are designed to explore facets of the U.S. fire problem as depicted through data collected in the USFA's National Fire Incident Reporting System (NFIRS) from incidents reported by local response agencies. 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 108,500 nonresidential building fires were reported to fire departments within the United States. These fires caused an estimated annual average of 90 deaths, 1,125 injuries and $2.8 billion in property loss.
- National estimates for 2017 to 2019 show that nonresidential buildings accounted for 20% of the total dollar loss from all fires.
- Nonresidential building fires increased by 8% from the previous 3-year period (2014 to 2016), when the estimated annual average of nonresidential building fires was 100,300.
- Outside and special properties accounted for the most nonresidential building fires (25%), while storage buildings accounted for the most nonresidential building fire deaths (22%).
- Nonresidential building fires occurred most frequently from 2 to 7 p.m.
- Cooking was the leading cause of all nonresidential building fires (30%). Nearly all nonresidential building cooking fires were small, confined fires (95%).
- Nonconfined nonresidential building fires most often started in vehicle storage areas (8%).
- In 58% of nonconfined nonresidential building fires, the fire extended beyond the room of origin. The leading causes of these larger fires were other unintentional or careless actions (25%), electrical malfunctions (11%) and exposures (11%).
- Misuse of material or product (31%) was the leading category of factors contributing to ignition in nonconfined nonresidential building fires.
- Smoke alarms were not present in 50% of the larger, nonconfined fires in occupied nonresidential buildings.
- Full or partial automatic extinguishing systems (AESs) were reported as present in only 22% of nonconfined fires in occupied nonresidential buildings.

From 2017 to 2019, fire departments responded to an estimated annual average of 108,500 fires in nonresidential buildings across the nation.[1, 2] These fires resulted in an estimated annual average of 90 deaths, 1,125 injuries and $2.8 billion in property loss. The term "nonresidential buildings," a subset of nonresidential structures, includes enclosed structures and fixed portable or mobile structures. The estimated annual average of 108,500 nonresidential building fires increased by 8% from the previous 3-year period (2014 to 2016), when the estimated annual average of nonresidential building fires was 100,300.[3] Although national estimates for 2017 to 2019 show that nonresidential building fires represented only 8% of all fires, 3% of fire deaths and 7% of fire injuries, they accounted for 20% of the total dollar loss from all fires.[4] Nonresidential building fires have a significant economic impact on a community as they may lead to lost jobs and closed businesses. In addition, because many nonresidential buildings are places where many people gather, they hold the greatest potential for a mass casualty incident to occur.

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The majority of nonresidential fires, deaths and injuries occur in buildings, and that is where prevention efforts are most often targeted. Specifically, nonresidential buildings include assembly places; eating and drinking establishments; educational and institutional facilities; stores and offices; detached garages; basic industry, manufacturing, and storage facilities; as well as outside and other miscellaneous nonresidential buildings. They also include institutions, such as prisons, nursing homes, juvenile care facilities and hospitals — though many people may temporarily reside there for short (or long) periods of time.

This report addresses the characteristics of all nonresidential building fires as reported to the USFA's NFIRS.[5] The NFIRS data are used for the analyses throughout this report. The focus is on fires reported from 2017 to 2019, the most current data available at the time of the analysis. Complete or full years of data are required for statistical analyses presented in these topical reports. Although 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 term "nonresidential fires" is synonymous with "nonresidential building fires." "Nonresidential fires" is used throughout the body of this report; the findings, tables, figures, headings and endnotes reflect the full category, "nonresidential 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.[6] 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.[7] 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, the smaller, confined fires accounted for 51% of nonresidential fires. Trash or rubbish fire was the predominant type of confined fire in nonresidential buildings. The larger, nonconfined fires accounted for the remaining 49% of nonresidential fires (Table 1).

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

| Incident type | Percent |
|---|---|
| Nonconfined fires | 48.6 |
| Confined fires | 51.4 |
| Cooking fire, confined to container | 18.5 |
| Chimney or flue fire, confined to chimney or flue | 1.1 |
| Incinerator overload or malfunction, fire confined | 0.5 |
| Fuel burner/boiler malfunction, fire confined | 1.7 |
| Commercial compactor fire, confined to rubbish | 0.8 |
| Trash or rubbish fire, contained | 28.8 |
| 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 nonresidential and residential building fires.[8] The average number of fatalities and injuries per 1,000 nonresidential fires was notably lower than the same loss measures for residential building fires. Fire evacuation procedures may be more likely to be in place in nonresidential buildings than in homes, which may be 1 reason for the lower rates of death and injury. Additionally, fire codes often require inspections of nonresidential buildings. These inspections are not as prevalent for residential buildings (especially one- and two-family dwellings). This may be another reason for the lower rates of fire incidence, death and injury in nonresidential buildings. Finally, occupants of nonresidential buildings are more likely to be awake and alert during all hours of the day as they typically relocate to residential buildings to sleep. As a result, occupants of nonresidential buildings are better able to identify incidents and quickly take action or take preventive measures before an incident occurs.

Nonresidential fires, however, tended to be the costliest fires. This was especially true for nonconfined nonresidential fires.[9] The higher property-loss values may be due to nonresidential buildings often being larger and therefore more expensive than residential buildings. In addition, the contents of nonresidential buildings are more likely to have a higher value than the contents of residential buildings.

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

| Measure | Nonresidential building fires | Confined nonresidential building fires | Nonconfined nonresidential building fires | Residential building fires |
|---|---|---|---|---|
| **Average loss:** | | | | |
| Fatalities/1,000 fires | 0.9 | 0.0 | 1.9 | 6.2 |
| Injuries/1,000 fires | 9.1 | 1.8 | 16.9 | 25.4 |
| Dollar loss/fire | $35,740 | $430 | $73,040 | $18,720 |

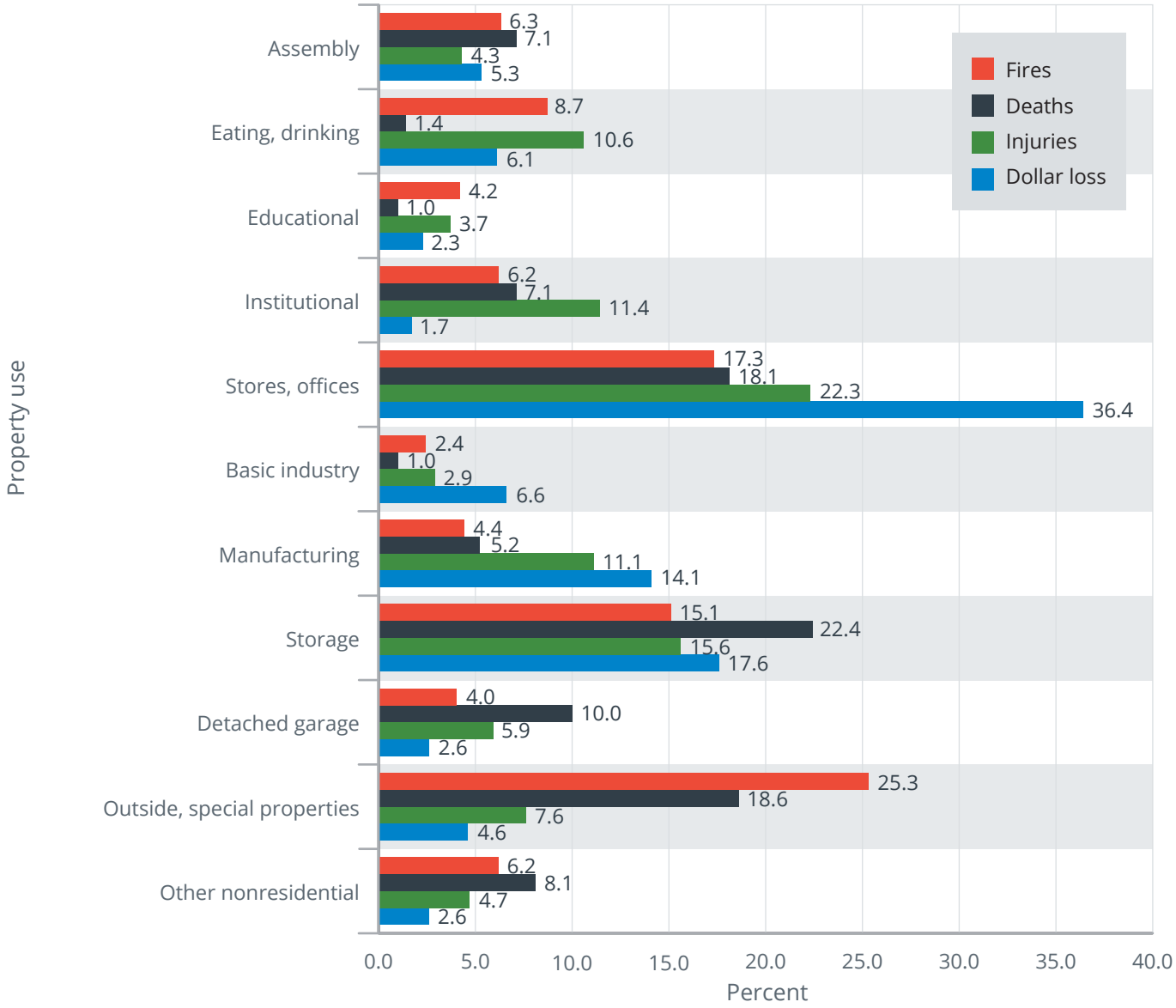
Source: NFIRS 5.0.

Notes: 1. Average loss for fatalities and injuries is computed per 1,000 fires; average dollar loss is computed **per fire** and is rounded to the nearest $10.
2. The 2017 and 2018 dollar-loss values were adjusted to 2019 dollars.

## Property use

Figure 1 presents the percentage distribution of fires and fire losses by major nonresidential property use category (e.g., assembly places, eating and drinking establishments, educational facilities, etc.).[10] Buildings on outside and special properties accounted for 25% of nonresidential fires. The second- and third-leading property use categories, stores and offices (17%) and storage facilities (15%), respectively, accounted for an additional 32% of nonresidential fires. Storage buildings accounted for 22% of the fire deaths, followed by outside and special properties (19%) and stores and offices (18%). In addition, 22% of injuries and 36% of dollar losses associated with nonresidential fires occurred in stores and offices.[11]

**Figure 1. Nonresidential building fires and fire losses by property use (2017-2019)**



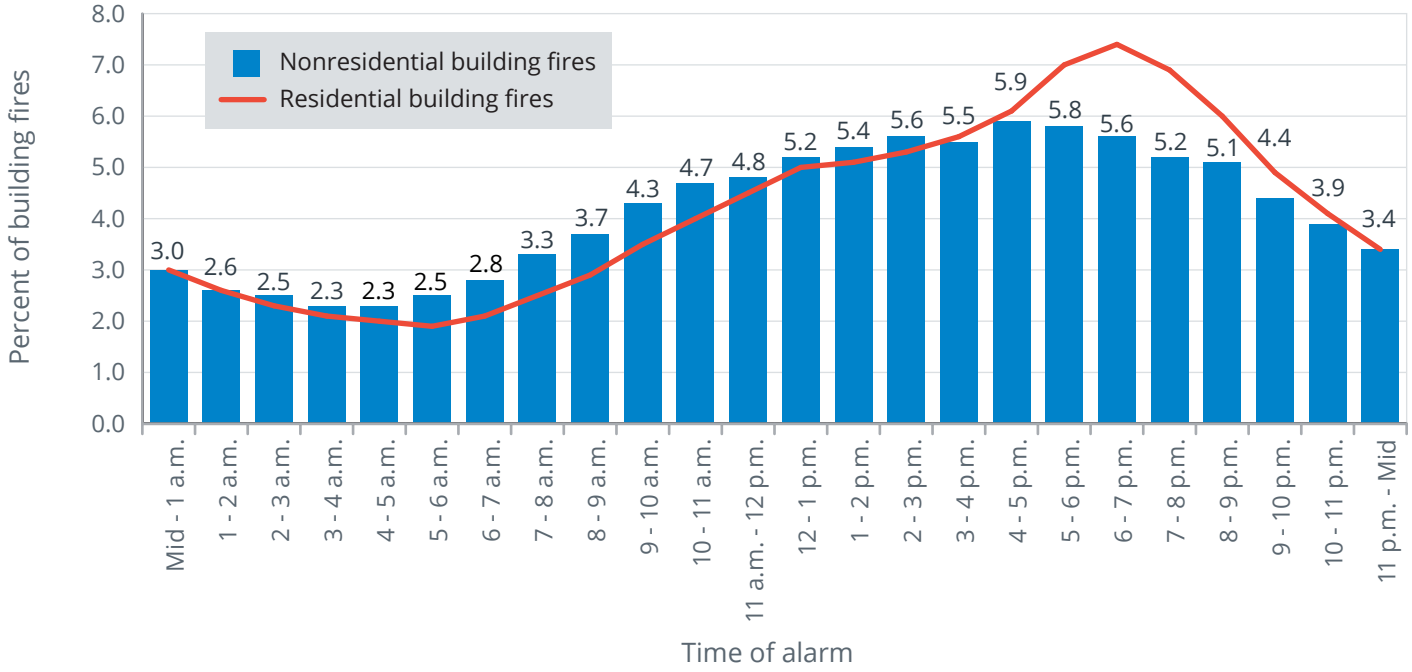

Source: NFIRS 5.0.

Notes: 1. Total percentages of fires, injuries and dollar losses do not add up to 100% due to rounding.
2. The 2017 and 2018 dollar-loss values were adjusted to 2019 dollars.

## When nonresidential building fires occur

As shown in Figure 2, nonresidential fires occurred most frequently from 2 to 7 p.m., accounting for 28% of the fires.[12] Fires then declined throughout the night, reaching the lowest point during the early morning hours (3 to 5 a.m.). Nonresidential fire incidence was similar to that of residential building fires, with the exception of residential building fire incidence peaking in the early evening hours.

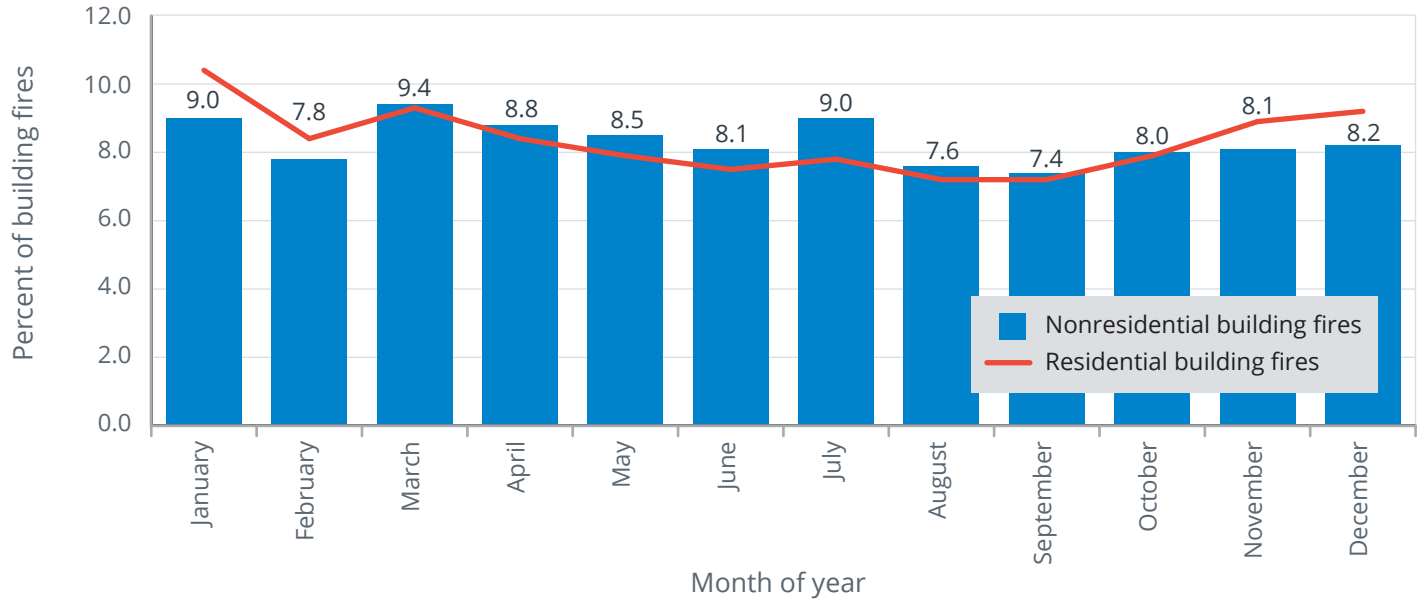
## Figure 2. Nonresidential building fires by time of alarm (2017-2019)




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

Figure 3 illustrates that, unlike residential building fires, which followed a seasonal trend and were higher in the cooler months, nonresidential fires occurred without much variation throughout the year. Nonresidential fire incidence was highest in March and lowest in September.

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




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

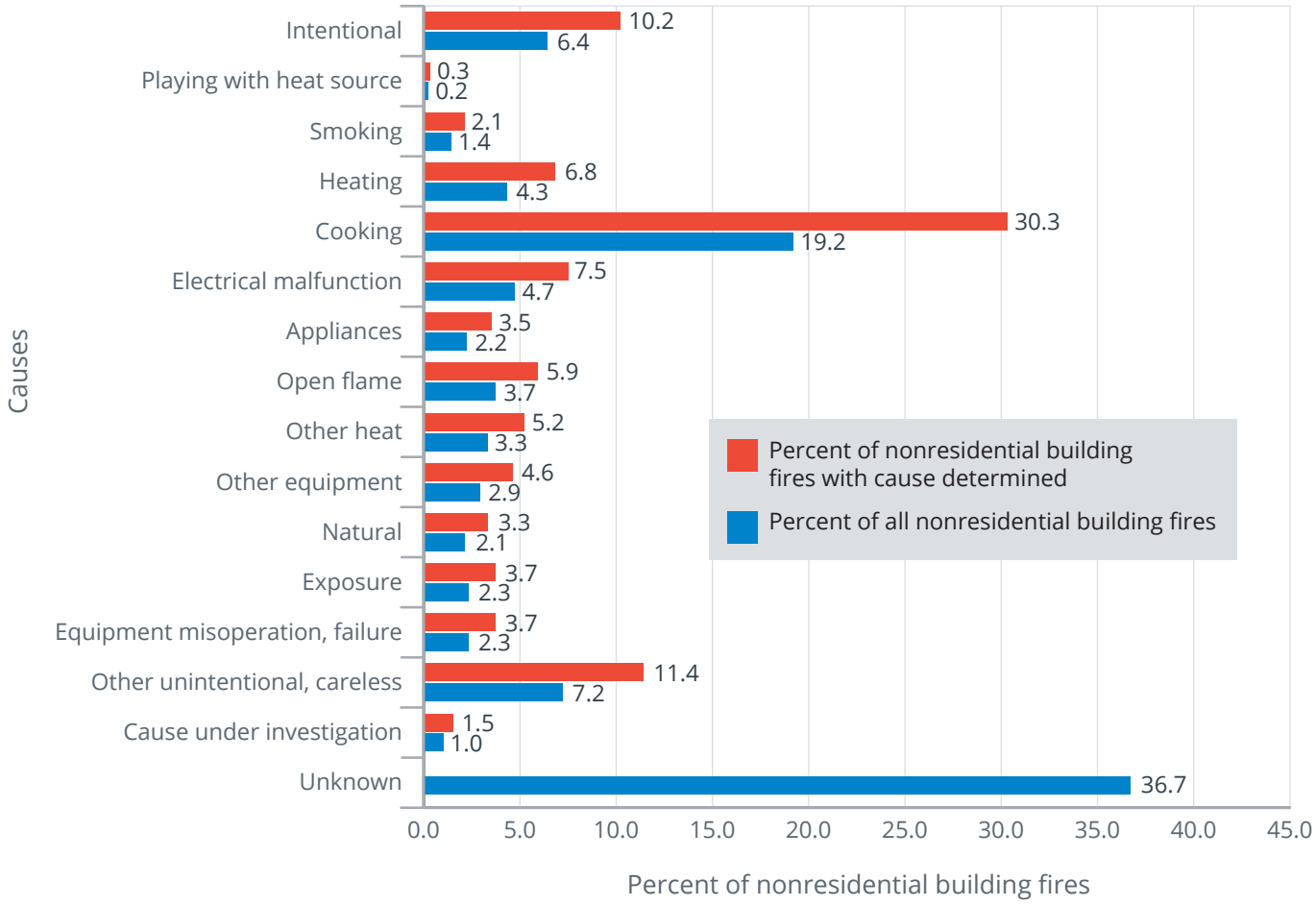
## Causes of nonresidential building fires

Cooking was the leading cause and accounted for 30% of all nonresidential fires, as shown in Figure 4.[13] Nearly all of these cooking fires (95%) were small, confined fires with limited damage.

The next 4 causes combined accounted for 36% of nonresidential fires: other unintentional or careless actions (11%); intentional actions (10%);[14] electrical malfunctions, such as short circuits or wiring problems (8%); and heating (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.

Comparatively, cooking (51%) and heating (9%) were the leading causes of residential building fires from 2017 to 2019.[15] However, a higher percentage of residential building fires resulted from cooking.

**Figure 4. Causes of nonresidential 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 all nonresidential building fires does not add up to 100% due to rounding.

When looking at the different categories of property use (e.g., assembly, eating and drinking, education, etc.), there were some differences in leading fire causes, as shown in Table 3. As for all nonresidential fires, cooking was, by far, the leading cause for assembly (40%), eating and drinking (64%), educational (50%), institutional (69%), stores and offices (33%), and other nonresidential (26%) building fires. The leading causes for basic industry, manufacturing, storage, detached garage, and outside or special property fires, however, were different than cooking. The leading cause for industrial fires was other unintentional or careless actions (18%). For manufacturing fires, the leading causes were other equipment (17%) and heating (15%). Other unintentional or careless actions (26%) were the leading causes of storage fires. The leading causes of detached garage fires were other unintentional or careless actions (19%) and exposures (also 19%), followed by electrical malfunctions (11%). Finally, intentional actions (28%) were the leading causes of outside or special property fires.

**Table 3. Leading causes of nonresidential building fires by property use (2017-2019)**

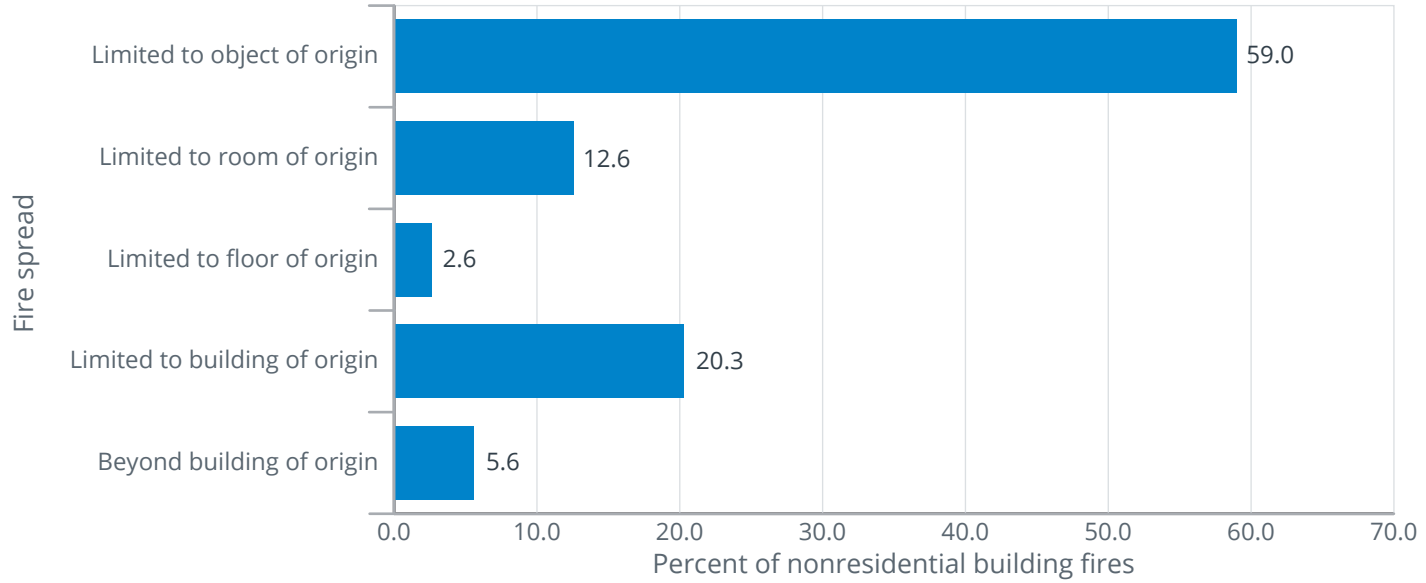
| Property use category | Leading fire causes | Percent (unknowns apportioned) |
|---|---|---|
| Assembly | Cooking | 40.2 |
| | Intentional | 10.5 |
| | Electrical malfunction | 8.6 |
| | Heating | 8.6 |
| Eating, drinking | Cooking | 63.8 |
| | Heating | 6.4 |
| | Electrical malfunction | 5.6 |
| Educational | Cooking | 50.3 |
| | Intentional | 13.1 |
| | Heating | 9.3 |
| Institutional | Cooking | 69.0 |
| | Electrical malfunction | 5.2 |
| | Appliances | 5.1 |
| Stores, offices | Cooking | 32.7 |
| | Electrical malfunction | 11.0 |
| | Heating | 8.3 |
| Basic industry | Other unintentional, careless | 18.1 |
| | Electrical malfunction | 12.6 |
| | Heating | 11.9 |
| Manufacturing | Other equipment | 16.5 |
| | Heating | 15.4 |
| | Equipment misoperation, failure | 13.9 |
| Storage | Other unintentional, careless | 26.0 |
| | Open flame | 10.8 |
| | Electrical malfunction | 9.7 |
| Detached garage | Other unintentional, careless | 19.1 |
| | Exposure | 18.6 |
| | Electrical malfunction | 11.2 |
| Outside, special properties | Intentional | 27.9 |
| | Cooking | 18.3 |
| | Other unintentional, careless | 10.5 |
| Other nonresidential | Cooking | 25.8 |
| | Other unintentional, careless | 19.5 |
| | Intentional | 13.7 |

Source: NFIRS 5.0.

## Fire spread in nonresidential building fires

In 59% of nonresidential fires, the fire was limited to the object of origin (Figure 5). Included in these fires are those coded as "confined fires" in the NFIRS. Additionally, 29% of fires extended beyond the room of origin.

**Figure 5. Extent of fire spread in nonresidential 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. Note that not all fires limited to the object of origin are counted as confined fires in the NFIRS.[16] 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, it is known that confined fires accounted for 51% of all nonresidential fires (Table 1). Trash or rubbish fires accounted for 56% of these confined fires, while cooking fires — those cooking fires confined to a pot on the stove, for example — accounted for an additional 36%.

Confined nonresidential fires occurred most frequently in the late afternoon and evening hours from 4 to 7 p.m. In addition, like all nonresidential fires, confined nonresidential fires occurred without much variation throughout the year, with a slight peak occurring in July.

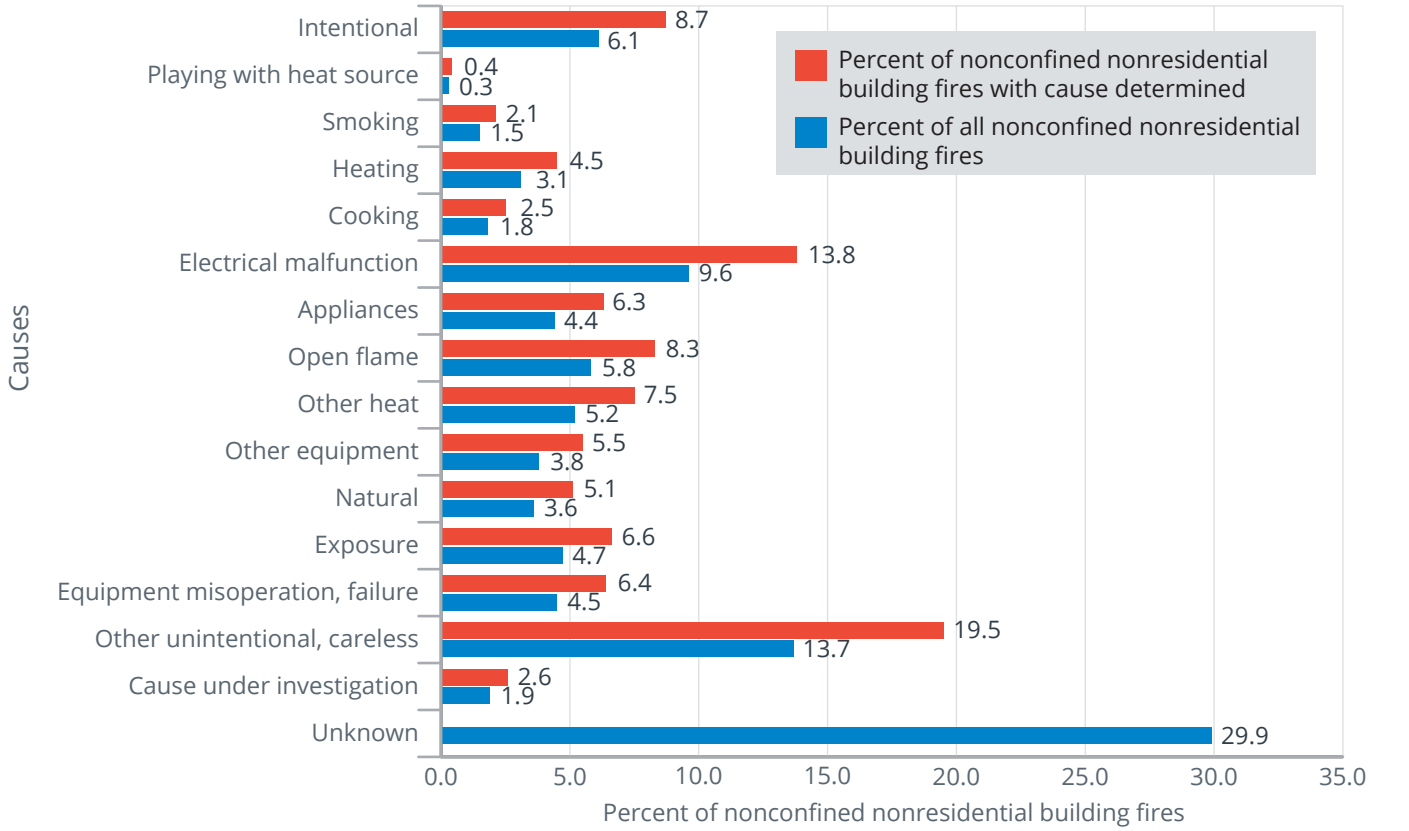
## Nonconfined fires

The next sections of this topical report address nonconfined nonresidential 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 nonresidential building fires

While cooking was the leading cause of nonresidential fires overall, it only accounted for 3% of all nonconfined nonresidential fires. Other unintentional or careless actions (20%) and electrical malfunctions (14%) were the leading causes of nonconfined nonresidential fires (Figure 6). Other leading causes of nonconfined nonresidential fires were intentional actions, a group that includes fires commonly called arson fires (9%), and open flames, a group that includes candles, matches and lighters (8%).

**Figure 6. Causes of nonconfined nonresidential 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. Totals do not add up to 100% due to rounding.

There were also differences in leading fire causes for nonconfined nonresidential fires than for all nonresidential fires when looking at the different categories of property use (Table 4). For example, while the leading causes of all nonresidential fires in assembly places were cooking (40%), intentional actions (11%), electrical malfunctions (9%) and heating (9%), the leading causes of nonconfined nonresidential fires in assembly places were electrical malfunctions (19%), intentional actions (15%), and other unintentional or careless actions (12%). In addition, while the 3 leading causes of all nonresidential fires in institutional facilities were cooking (69%), electrical malfunctions (5%) and appliances (5%), the leading causes of nonconfined nonresidential fires in institutional facilities were electrical malfunctions (19%), appliances (19%) and intentional actions (11%).

**Table 4. Leading causes of nonconfined nonresidential building fires by property use category (2017-2019)**

| Property use category | Leading fire causes | Percent (unknowns apportioned) |
|---|---|---|
| Assembly | Electrical malfunction | 19.2 |
| | Intentional | 15.1 |
| | Other unintentional, careless | 12.0 |
| Eating, drinking | Electrical malfunction | 15.9 |
| | Cooking | 15.9 |
| | Other unintentional, careless | 13.7 |
| Educational | Intentional | 24.0 |
| | Electrical malfunction | 18.7 |
| | Appliances | 10.5 |
| Institutional | Electrical malfunction | 19.3 |
| | Appliances | 18.5 |
| | Intentional | 10.9 |
| Stores, offices | Electrical malfunction | 19.3 |
| | Appliances | 12.7 |
| | Other unintentional, careless | 12.6 |
| Basic industry | Other unintentional, careless | 24.5 |
| | Electrical malfunction | 17.2 |
| | Equipment misoperation, failure | 11.0 |
| Manufacturing | Equipment misoperation, failure | 18.6 |
| | Other unintentional, careless | 14.2 |
| | Other heat | 12.0 |
| Storage | Other unintentional, careless | 27.8 |
| | Open flame | 11.1 |
| | Electrical malfunction | 10.4 |
| Detached garage | Other unintentional, careless | 19.5 |
| | Exposure | 19.0 |
| | Electrical malfunction | 11.4 |
| Outside, special properties | Other unintentional, careless | 21.6 |
| | Other equipment | 14.1 |
| | Exposure | 11.8 |
| Other nonresidential | Other unintentional, careless | 33.5 |
| | Other heat | 11.3 |
| | Intentional | 11.2 |

Source: NFIRS 5.0.

## Where nonconfined nonresidential building fires start (area of fire origin)

Vehicle storage area (8%) was the leading area of fire origin in nonconfined nonresidential fires, as shown in Table 5. Other storage areas (7%), cooking areas and kitchens (7%), and exterior wall surfaces (6%) were the next most common areas of fire origin in nonresidential buildings.

**Table 5. Leading areas of fire origin in nonconfined nonresidential building fires (2017-2019)**

| Areas of fire origin | Percent (unknowns apportioned) |
|---|---|
| Vehicle storage area: garage, carport | 8.4 |
| Storage area, other | 7.2 |
| Cooking area, kitchen | 6.9 |
| Exterior wall surface | 6.0 |

Source: NFIRS 5.0.

The leading areas of fire origin, however, varied among the different categories of nonresidential property use (Table 6). For example, the leading areas of fire origin for eating and drinking establishments, as expected, were cooking areas and kitchens (40%). Also as expected, the leading area of fire origin for detached garages was vehicle storage area (55%). For both assembly places and educational facilities, however, the leading area of fire origin was bathrooms, checkrooms, and locker rooms (8% and 17%, respectively). In addition, laundry areas (14%) and bedrooms (14%) were the 2 leading areas of fire origin for institutional facilities, while processing and manufacturing areas (27%), machinery rooms (9%), and other service or equipment areas (8%) were the leading areas of fire origin for manufacturing buildings.

**Table 6. Leading areas of fire origin in nonconfined nonresidential building fires by property use (2017-2019)**

| Property use category | Leading area of fire origin — percent (unknowns apportioned) | Second leading area of fire origin — percent (unknowns apportioned) | Third leading area of fire origin — percent (unknowns apportioned) |
|---|---|---|---|
| Assembly | Bathroom, checkroom, locker room 8.4 | Cooking area, kitchen 8.4 | Exterior roof surface 5.3 |
| Eating, drinking | Cooking area, kitchen 40.4 | Exterior wall surface 7.0 | Wall assembly, concealed wall space 4.8 |
| Educational | Bathroom, checkroom, locker room 17.1 | Assembly area without fixed seats 6.8 | Cooking area, kitchen 6.5 |
| Institutional | Laundry area 13.8 | Bedrooms 13.6 | Cooking area, kitchen 9.5 |
| Stores, offices | Laundry area 8.0 | Cooking area, kitchen 6.3 | Office 5.0 |
| Basic industry | Storage area, other 8.9 | Structural area, other 7.7 | Service or equipment area, other 6.8 |
| Manufacturing | Processing/manufacturing area 27.1 | Machinery room or area 8.9 | Service or equipment area, other 8.3 |
| Storage | Storage area, other 18.2 | Supplies or tools storage area 11.3 | Vehicle storage area: garage, carport 11.0 |
| Detached garage | Vehicle storage area: garage, carport 54.8 | Exterior wall surface 12.7 | Outside area, other 4.1 |
| Outside, special properties | Outside area, other 7.9 | Exterior wall surface 7.6 | Cooking area, kitchen 6.6 |
| Other nonresidential | Function area, other 16.5 | Outside area, other 9.0 | Cooking area, kitchen 8.6 |

Source: NFIRS 5.0.

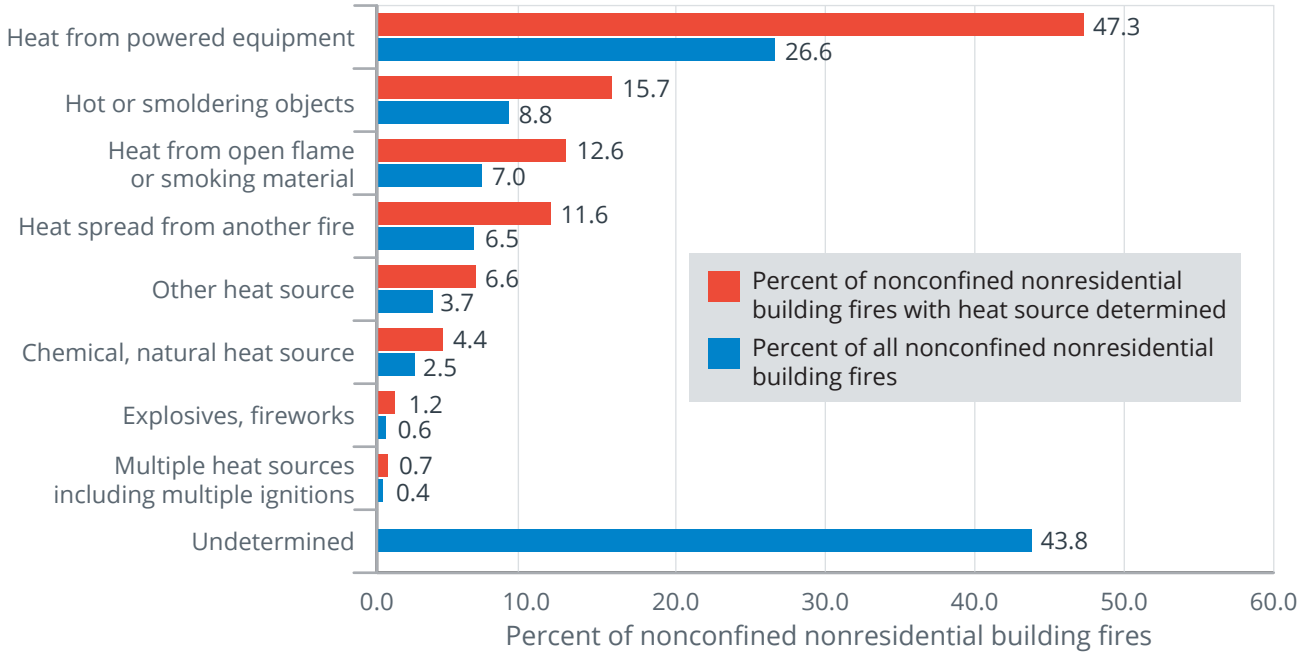
## How nonconfined nonresidential building fires start (heat source)

Figure 7 shows sources of heat categories for nonconfined nonresidential fires. Heat from powered equipment accounted for 47% of nonconfined nonresidential fires. This category includes electrical arcing (16%), heat from other powered equipment (13%), radiated or conducted heat from operating equipment (11%), and spark, ember, or flame from operating equipment (7%).

Hot or smoldering objects accounted for 16% of nonconfined nonresidential fires. This category includes such items as hot embers or ashes (6%) and miscellaneous hot or smoldering objects (6%).

Additionally, heat from open flames or smoking materials (13%) and heat spread from another fire (12%) accounted for 24% of nonresidential fires.[17] The heat from open flame category includes such items as other miscellaneous open flames or smoking materials (4%), lighters and matches (combined, 3%), and cigarettes (2%). The heat spread from another fire category includes heat from direct flames (4%) and radiated heat from another fire (3%).

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



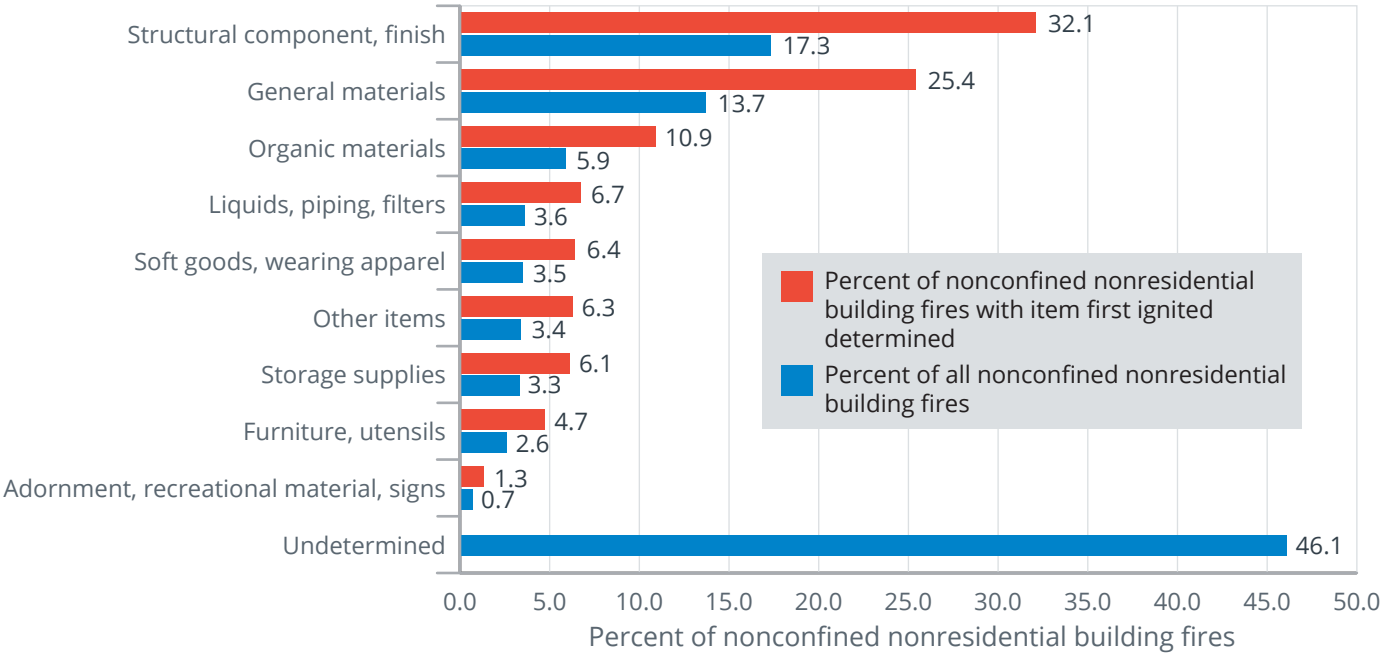

Source: NFIRS 5.0.
Note: Totals do not add up to 100% due to rounding.

## What ignites first in nonconfined nonresidential building fires

Of the items first ignited in nonconfined nonresidential fires where the item first ignited was determined, 32% fell under the structural component and finish category (Figure 8). This category includes exterior sidewall covering (9%) and structural member or framing (7%). The second leading category of items first ignited in nonconfined nonresidential fires was the general materials category, which accounted for 25% of these fires. The general materials category includes items such as electrical wire, cable insulation (11%), and trash or rubbish (4%). At 11%, organic materials was the next leading category of nonconfined nonresidential fires. This category includes items such as light vegetation, including grass and leaves (4%), and cooking materials (4%).

Electrical wire, cable insulation (11%), exterior sidewall covering (9%), and structural member or framing (7%) were the specific items most often first ignited in nonconfined nonresidential fires.

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



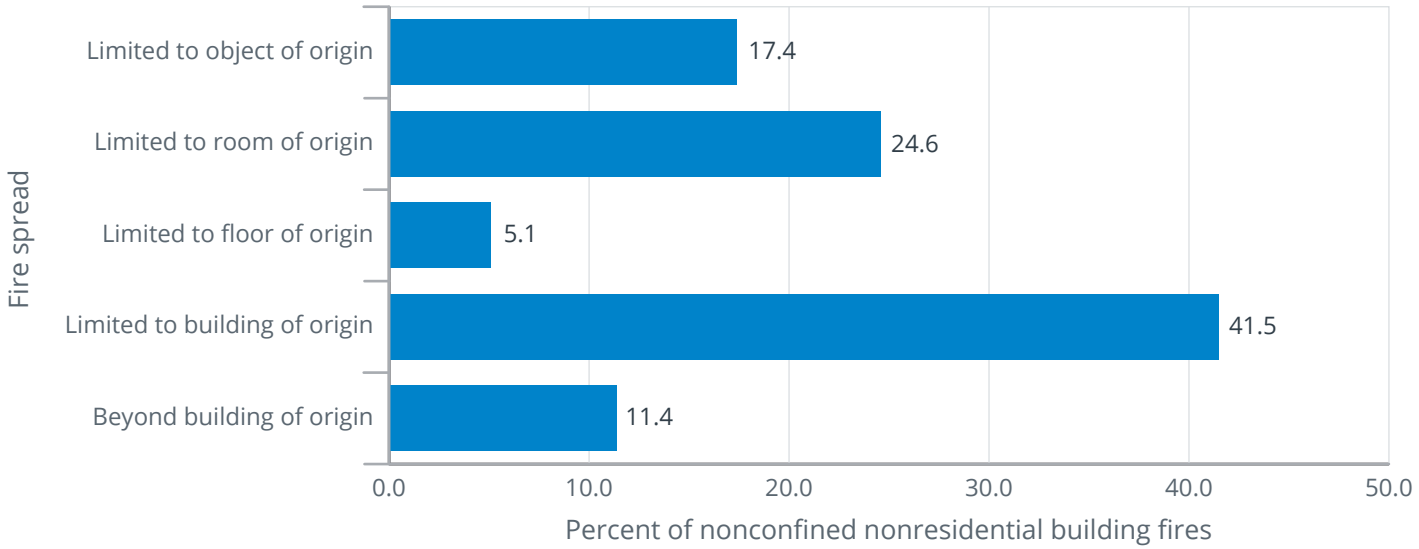

Source: NFIRS 5.0.
Note: Totals do not add up to 100% due to rounding.

## Fire spread in nonconfined nonresidential building fires

Figure 9 shows the extent of fire spread in nonconfined nonresidential fires. Of these nonconfined fires, 42% were limited to the object or room of fire origin — in 25% of these fires, the fire was limited to the room of origin; in another 17%, 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.)

Additionally, 58% of nonconfined nonresidential fires extended beyond the room of origin. The leading causes of these larger fires were unintentional or careless actions (25%), electrical malfunctions (11%) and exposures (11%).

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




Source: NFIRS 5.0.

### Factors contributing to ignition in nonconfined nonresidential building fires

Table 7 shows the categories of factors contributing to ignition in nonconfined nonresidential fires. The leading category was the misuse of material or product (31%). In this category, the leading specific factors contributing to ignition were a heat source too close to combustible materials (12%) and abandoned or discarded materials, such as matches or cigarettes (7%).

Electrical failures and malfunctions contributed to 22% of nonconfined nonresidential fires. Fire spread or control was the third-leading category at 17%. Exposure was the leading specific factor in the fire spread or control category and accounted for 9% of all nonconfined nonresidential fires.

**Table 7. Factors contributing to ignition for nonconfined nonresidential building fires by major category (where factors contributing to ignition were specified, 2017-2019)**

| Factors contributing to ignition category | Percent of nonconfined nonresidential building fires (unknowns apportioned) |
|---|---|
| Misuse of material or product | 31.0 |
| Electrical failure, malfunction | 22.3 |
| Fire spread or control | 17.2 |
| Mechanical failure, malfunction | 11.7 |
| Operational deficiency | 9.2 |
| Other factors contributing to ignition | 6.3 |
| Natural condition | 4.9 |
| Design, manufacture, installation deficiency | 1.7 |

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 nonresidential building fires

Partly due to early detection and fire extinguishing systems, fire fatalities and injuries have declined over the last 40 years.[18] In addition, the installation of smoke alarms and fire sprinklers is generally required in nonresidential buildings such as hospitals, prisons or educational facilities where an increased risk to life is present. Smoke alarms are also required in nonresidential buildings that present an increased fire hazard to occupants and firefighters, such as high-rise buildings and industrial facilities.

In this report, "smoke alarms" refer to both smoke alarms and smoke detectors. Smoke alarms are stand-alone devices with their own power source and notification capability. Smoke detectors detect smoke as a component of a larger system containing separate notification capability, typically in larger areas or structures.

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 9 and 10 are the reported counts from the NFIRS dataset and are not scaled to national estimates of smoke alarms in nonresidential fires. In addition, while NFIRS allows for the determination of the type of detector (i.e., smoke, heat or combination), 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 only 25% of nonconfined nonresidential fires (Table 8). By comparison, because building codes generally require smoke alarms to be installed in locations where people

sleep, smoke alarms were reported as present in 43% of nonconfined residential fires.[19] In 54% of nonconfined nonresidential fires, there were no smoke alarms present. In another 20% of these fires, firefighters were unable to determine if a smoke alarm was present. Therefore, smoke alarms were potentially missing in 54% to 75% of these fires with the ability to spread and possibly result in fatalities.

**Table 8. Presence of smoke alarms in nonconfined nonresidential building fires (2017-2019)**

| Presence of smoke alarms | Percent |
|---|---|
| Present | 25.2 |
| None present | 54.4 |
| Undetermined | 20.4 |
| Total | 100.0 |

Source: NFIRS 5.0.

While 22% of all nonconfined nonresidential fires occurred in 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 4% of all nonconfined fires in unoccupied nonresidential buildings were reported as having smoke alarms that were present and that operated. As a result, the detailed smoke alarm analyses in the next section focus on nonconfined fires in occupied nonresidential buildings only.[20]

## Smoke alarms in nonconfined fires in occupied nonresidential buildings

Smoke alarms were reported as present in 30% of nonconfined fires in occupied nonresidential buildings (Table 9). In 50% of nonconfined fires in occupied nonresidential buildings, there were no smoke alarms present. In another 20% of these fires, firefighters were unable to determine if a smoke alarm was present; unfortunately, in 55% of the 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 (30%) and the alarm's operational status is considered, the percentage of smoke alarms reported as present consisted of the following:

- Present and operated — 17%.
- Present but did not operate — 8% (fire too small, 7%; alarm failed to operate, 2%).[21]
- Present but operational status unknown — 5%.

When only the subset of incidents where smoke alarms were reported as present was analyzed, smoke alarms were reported to have operated in 56% of the incidents and failed to operate in 6%. In 22% of this subset, the fire was too small to activate the alarm. The operational status of the alarm was undetermined in 15% of these incidents.[22]

Again, in at least half of nonconfined fires in occupied nonresidential buildings, there were no smoke alarms present — and perhaps more if fires without information on smoke alarms could be factored in.[23] A portion 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.

If a fire occurs, properly installed and maintained smoke alarms provide an early warning signal. Smoke alarms help save lives and property.

The USFA continues to partner with other government agencies, nongovernment organizations 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 https://www.usfa.fema.gov/prevention/technology/smoke_fire_alarms.html.

**Table 9. NFIRS smoke alarm data for nonconfined fires in occupied nonresidential buildings (2017-2019)**

| Presence of smoke alarms | Smoke alarm operational status | Smoke alarm effectiveness | Count | Percent |
|---|---|---|---|---|
| Present | Fire too small to activate smoke alarm | | 5,706 | 6.7 |
| | Smoke alarm operated | Smoke alarm alerted occupants, occupants responded | 10,089 | 11.9 |
| | | Smoke alarm alerted occupants, occupants failed to respond | 382 | 0.5 |
| | | No occupants | 2,830 | 3.3 |
| | | Smoke alarm failed to alert occupants | 142 | 0.2 |
| | | Undetermined | 948 | 1.1 |
| | Smoke alarm failed to operate | | 1,486 | 1.8 |
| | Undetermined | | 3,908 | 4.6 |
| None present | | | 42,528 | 50.2 |
| Undetermined | | | 16,674 | 19.7 |
| Total reported incidents | | | 84,693 | 100.0 |

Source: NFIRS 5.0.

Note: The data presented in this table are reported 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 nonresidential buildings. They are presented for informational purposes.

## 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 nonresidential 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 buildings, as these types of fires are unlikely to be reported in buildings that are not occupied.

Smoke alarms alerted occupants in 23% of the reported confined nonresidential fires (Table 10). Occupants were not alerted by smoke alarms in 24% of confined nonresidential fires.[24] In 52% of the confined fires, the smoke alarm effectiveness was unknown.[25]

**Table 10. NFIRS smoke alarm data for confined nonresidential building fires (2017-2019)**

| Smoke alarm effectiveness | Count | Percent |
|---|---|---|
| Smoke alarm alerted occupants | 26,573 | 23.2 |
| Smoke alarm did not alert occupants | 27,937 | 24.4 |
| Unknown | 59,791 | 52.3 |
| Total reported incidents | 114,301 | 100.0 |

Source: NFIRS 5.0.

Notes:
1. The data presented in this table are reported counts from the NFIRS dataset summed (not averaged) from 2017 to 2019. They do not represent national estimates of smoke alarms in confined nonresidential building fires. They are presented for informational purposes.
2. Total does not add up to 100% due to rounding.

### Automatic extinguishing systems in nonconfined fires in occupied nonresidential 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 nonresidential building fires, an AES was present in only 2% of reported incidents.[26] As a result, the analyses here focus on nonconfined fires. In addition, the following analyses focus on occupied buildings since unoccupied buildings, such as those that are under construction, are less likely to have AESs present.

Although fire sprinklers are required by code in many nonresidential buildings that present an increased fire hazard or risk to life, full or partial AESs were reported as present in only 22% of nonconfined fires in occupied nonresidential buildings (Table 11). AESs were reported as not present in 68% of these fires.

**Table 11. NFIRS automatic extinguishing system data for nonconfined fires in occupied nonresidential buildings (2017-2019)**

| AES presence | Count | Percent |
|---|---|---|
| AES present | 17,528 | 20.7 |
| Partial system present | 988 | 1.2 |
| AES not present | 57,694 | 68.1 |
| Unknown | 8,483 | 10.0 |
| Total reported incidents | 84,693 | 100.0 |

Source: NFIRS 5.0.

Note: The data presented in this table are reported 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 nonresidential buildings. They are presented for informational purposes.

## Examples

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

- September 2021: A storage barn was destroyed by fire in Easton, Maryland. Fire crews were called to the scene around 2:14 p.m. after a passerby reported the incident. The barn was unoccupied, and no livestock were injured as a result of the fire. The cause of the blaze that resulted in $150,000 in damage is under investigation.[27]
- September 2021: A family-owned restaurant in Walnut Grove, California, was destroyed by a fire that was believed to have started by a propane water heater. The restaurant owner reported smelling a strange odor in the building, and his son discovered several small fires around the water heater which he put out with a fire extinguisher. The fire, however, had already gotten into a rear wall and quickly spread to the attic. The fire was reported around 3 p.m. According to fire department personnel at the scene, the over 100-year-old building was of old construction and was quickly engulfed in flames. While no injuries were reported, the building was deemed a total loss.[28]
- September 2021: A church sanctuary sustained heavy damage from a fire that may have started because of a lightning strike on James Island, South Carolina. The fire was reported around 8:38 a.m. A church member believed that lightning struck the church steeple the night before and smoldered until flames broke out the next morning. The fire caused the roof of the building to collapse, and sanctuary pews sustained water damage from fire hoses and heavy rain. According to firefighters on scene, the fire was extinguished just before 10 a.m. No injuries were reported. The blaze is under investigation to determine if lightning was the cause.[29]

## NFIRS data specifications for nonresidential 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.

Nonresidential building fires were defined using the following criteria:

- 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.

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

- Property Use 100 to 399, 500 to 999, 000 to 009, NNN and UUU:

| Property Use | Description |
|---|---|
| 100-159, 163-199 | Assembly |
| 160-162 | Eating and drinking establishments |
| 200-299 | Educational |
| 300-399 | Health care, detention and correction |
| 500-599 | Stores and offices |
| 600-699 | Industrial, utility, defense, agriculture, mining |
| 700 | Manufacturing, processing |
| 800-880, 882-899 | Storage |
| 881 | Detached garage |
| 900-999 | Outside or special property |
| 000-009, NNN, UUU | Property use, other |

Note: For a complete listing of the NFIRS Property Use Codes, view the NFIRS 5.0 Complete Reference Guide: https://www.usfa.fema.gov/downloads/pdf/nfirs/NFIRS_Complete_Reference_Guide_2015.pdf (January 2015).

- 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.

Although voluntary, the NFIRS is the world's largest national database of fire incident information. By contributing to the NFIRS, the fire service is helping to make data informed decisions ranging from local budget development to the identification of national preparedness initiatives. It is important that fire departments participate in the NFIRS and critical that the data they report are complete and accurate for sound decision making that has an impact on community risk and emergency response at the local level.

## Analysis Disclaimer

The analyses contained in this report reflect the current methods 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 data received from participating fire departments and the analytical methods used to fulfill this goal. Because of this commitment and the variation in the quality of the reported data as well as any changes in the fire problem from year to year, data collection strategies and methodological changes are possible and do occur. As a result, analyses and estimates of the fire problem may vary over time. Previous analyses and estimates for specific issues (or similar issues) may have used different methodologies or different data definitions and therefore may not be directly comparable to the current analyses and estimates.

Information regarding the USFA's national estimates for nonresidential 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, nonresidential structure fire loss estimates from the National Fire Protection Association's (NFPA) annual surveys of fire loss, and the USFA's nonresidential building fire loss estimates: https://www.usfa.fema.gov/data/statistics/order_download_data.html. Further information on the USFA's nonresidential building fire loss estimates can be found in the "National Estimates Methodology for Building Fires and Losses," August 2012, https://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 2020 fire experience survey," August 2021, 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 losses 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 "nonresidential structure" commonly referred to buildings where people work, gather, learn, dine, shop, etc. To coincide with this concept, the definition of a nonresidential 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 nonresidential property use. Such structures are referred to as "nonresidential buildings" to distinguish these buildings from other structures on nonresidential properties that may include fences, telephone poles and other various open structures. In addition, confined fire incidents that have a nonresidential property use, but do not have a structure type specified, are presumed to occur in buildings. Nonconfined fire incidents that have a nonresidential 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, "Nonresidential Building Fires (2014-2016)," Volume 19, Issue 3, July 2018, https://www.usfa.fema.gov/downloads/pdf/statistics/v19i3.pdf.

[4]The percentages shown here are derived from the national estimates of nonresidential 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). The computation of the percentage for dollar loss excludes the NFPA direct dollar loss of $10 billion in wildfires in Northern California in 2017 and the NFPA direct dollar loss of $12.4 billion in wildfires in California in 2018.

[5]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.

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

[7]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.

[8]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 the NFIRS data alone. The fire death rate computed from national estimates is (1,000 x (90/108,500)) = 0.8 death per 1,000 nonresidential building fires, and the fire injury rate is (1,000 x (1,125/108,500)) = 10.4 injuries per 1,000 nonresidential building fires.

[9]The large dollar loss per nonconfined nonresidential building fire includes a fire at the Railway Specialties Corporation in Croydon, Pennsylvania, that resulted in $800 million in property loss and $300 million in contents loss in 2017; a $100,500,000 transmitter building fire in Tustin, Michigan, in 2018; and a $70 million fire at a Kansas State University library in 2018.

[10]There are 11 major nonresidential building property use categories. "Assembly" buildings include places where people gather, such as fixed-use recreational facilities, places of worship, public or government buildings, and ballrooms and gymnasiums, but do not include eating and drinking establishments. "Eating and drinking" establishments include places specializing in on-premise consumption of food, including carryout and drive-thru restaurants, as well as bars and nightclubs. "Educational" buildings include schools for children and adults, such as day care; preschool; elementary, middle and high school; college; and adult education centers. "Institutional" buildings include health care, detention and correctional facilities. "Stores and offices" include stores, specialty shops, personal services and offices. "Basic industry" buildings include industrial, utility, defense, agriculture and mining facilities. "Manufacturing" buildings include processing facilities and factories. "Storage" buildings include outside material storage areas, livestock, poultry storage, warehouses, fire stations and commercial parking structures for vehicles, such as buses and trucks. "Detached garages" include parking garages, detached residential garages and detached parking structures associated with multifamily housing. "Outside and special properties" include facilities, such as guard posts, outside kiosks and the like. "Other nonresidential" buildings include nonresidential buildings not classified with any other property use category.

[11]In 2017, a fire at the Railway Specialties Corporation in Croydon, Pennsylvania, resulted in $800 million in property loss and $300 million in contents loss that contributed to the large percentage of dollar loss in stores and offices.

[12]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.

[13]The USFA Structure Fire Cause Methodology was used to determine the cause of nonresidential 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.

[15]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.

[16]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.

[17]Total does not add up to 24% due to rounding.

[18]Smoke alarms in the context of this report refer to both smoke alarms and smoke detectors. This distinction is **not** made within the NFIRS, as the NFIRS refers only to "detectors," and semantically these are really "alarms."

[19]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.

[20]"Occupied" implies that the building is operational or in normal use. This includes properties that are closed or unoccupied for a brief period of time, such as businesses that are closed for the weekend.

[21]Total does not add up to 8% due to rounding.

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

[23]Here, **at least** 50% of nonconfined fires in occupied nonresidential buildings had no smoke alarms present — the 50% 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]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.
[25]Total does not add up to 100% due to rounding.
[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]"Fire destroys barn in Talbot County, cause under investigation," www.wbaltv.com, September 22, 2021, https://www.wbaltv.com/article/talbot-county-barn-fire-september-21/37689834 (accessed September 22, 2021).
[28]Barmann, Jay, "Century-old Giusti's Restaurant destroyed by fire in the Delta," sfist.com, September 10, 2021, https://sfist.com/2021/09/10/century-old-giustis-restaurant-destroyed-by-fire-in-the-delta/ (accessed September 22, 2021).
[29]Phillips, Patrick and Seat, Danielle, "Lightning strike may have sparked 'devastating' fire at church on James Island," www.live5news.com, September 9, 2021, https://www.live5news.com/2021/09/09/crews-extinguish-fire-james-island-church/ (accessed September 22, 2021).