

School Building Fires (2009–2011)

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

Findings

- An estimated 4,000 school building fires were reported by United States fire departments each year and caused an estimated 75 injuries and \$66.1 million in property loss.
- Fatalities resulting from school building fires were rare.
- There was a general increase in school building fires toward the beginning and end of the academic year.
- The three leading causes of school building fires were cooking (42 percent), intentional action (24 percent) and heating (10 percent). At 41 percent, intentional action was the leading cause of nonconfined school building fires.
- The leading area of fire origin in nonconfined school building fires was the bathroom at 25 percent.
- In 75 percent of school building fires, the fire spread was limited to the object of origin.
- Smoke alarms were reported as present in 66 percent of nonconfined school building fires.

School building fires are a subset of school property fires (i.e., school structure fires).¹ School property fires may include structure fires; vehicle and outside fires that occur outdoors on school property; and other, miscellaneous fires. It is important to note that not all structures on school properties are necessarily school buildings. For example, other structures on school properties may include maintenance buildings or playground structures. This report includes brief background information on all school property fires, with the focus of the report on school building fires.

Using the latest available three years of data for 2009 to 2011, from the National Fire Incident Reporting System (NFIRS) database, the average annual national fire loss from school property fires was estimated at \$84.6 million. Such losses were the result of an estimated annual average of 10,300 school property fires that required a fire department response. These school property fires caused an estimated annual average of 75 injuries and five fatalities.^{2, 3} For this

topical report, school properties include preschools and day cares; kindergartens; elementary, middle, junior and high schools; and other, nonadult schools. Of all school property fires, 41 percent occurred outdoors.⁴ Trash or rubbish fires accounted for 58 percent of these outside fires, and fires in open fields or woods accounted for an additional 30 percent. Vehicle fires accounted for only 6 percent of all school property fires.

From 2009 to 2011, 39 percent of all school property fires, an estimated annual average of 4,000 fires, were building fires. Annually, these school building fires resulted in an estimated 75 injuries and \$66.1 million in property loss.⁵ Because the majority of school property fire injuries and dollar loss occurred in school buildings, this topical report addresses the characteristics of school building fires as reported to NFIRS from 2009 to 2011.⁶ The NFIRS data are used for the analyses presented throughout this report.

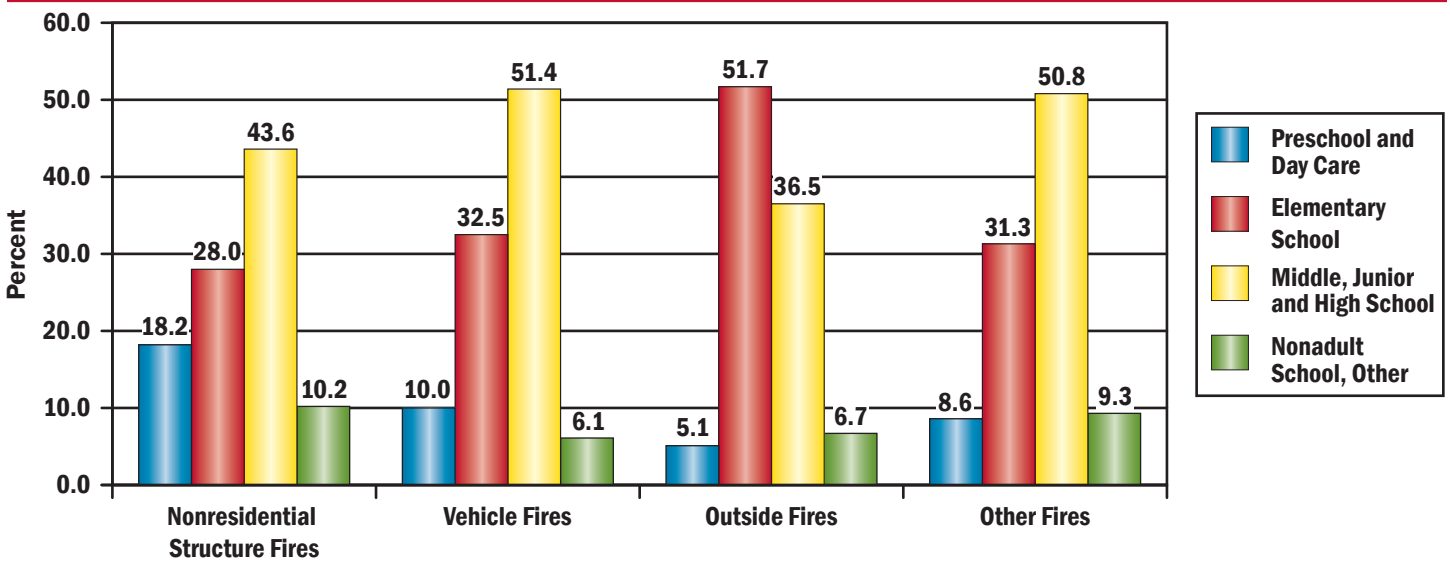
School Fires by General Property Type

Figure 1 presents the percentage distribution of different types of schools (middle, junior and high schools; elementary schools, including kindergartens; preschools and day cares; and other, nonadult schools) by general property type fires (i.e., nonresidential structure fires, vehicle fires, outside fires and other fires). Overall, the most fires occurred at middle, junior and high schools (42 percent), followed by elementary schools (38 percent); preschools and day cares (12 percent); and other, nonadult schools (8 percent). In reviewing Figure 1, it is apparent that most distributions of general property type fires by school type typically mimic the overall distribution noted above. The distribution of

outside fires, however, does not fit the same basic trend — elementary schools lead the outside fire category with 52 percent of the total; followed by middle, junior and high schools (36 percent); other, nonadult schools (7 percent); and preschools and day cares (5 percent).

During the months of June through August, 41 percent of outside fires occurred at elementary schools; 18 percent of outside fires at these elementary schools occurred during the month of July alone (Figure 2). One potential explanation for this may be that elementary schools are more attractive targets for intentionally set fires during the summer months since there are normally fewer school staff members present to monitor the grounds.

Figure 1. Fires by General Property Type and School Type (2009-2011)



Source: NFIRS 5.0.

Generally, school property fires, as seen in Figure 2, follow a seasonal trend. Nonresidential structure fires, vehicle fires and other fires were more prevalent during the school year, while outside fires occurred most frequently

during the summer months. Outside fires peaked during the month of July and occurred at a much higher rate on elementary school properties than on all other types of school properties.

Figure 2. School Property Fires by School Type and Month (2009-2011)



Source: NFIRS 5.0.

School Building Fires

For the remainder of the report, the term “school fires” indicates “school building fires” as opposed to “school property fires” or all school fires.

Type of School Building Fires

School fires can be divided into two classes of severity in NFIRS: “confined fires,” which are fires confined to certain types of equipment or objects, and “nonconfined fires.” Confined building fires are small fire incidents that are

limited in extent, staying within cooking pots, fireplaces or certain other noncombustible containers.⁷ 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.⁸ Of the two classes of severity, nonconfined fires accounted for 37 percent of school fires (Table 1). The smaller confined fires accounted for the remaining 63 percent. Cooking fires (30 percent) were the predominant type of confined fires in school buildings, followed by fires confined to a trash can (26 percent).

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

| Incident Type | Percent |
|----------------------------------------------------|---------|
| Nonconfined fires | 37.1 |
| Confined fires | 62.9 |
| Cooking fire, confined to container | 29.9 |
| Chimney or flue fire, confined to chimney or flue | 0.4 |
| Incinerator overload or malfunction, fire confined | 0.5 |
| Fuel burner/boiler malfunction, fire confined | 5.8 |
| Commercial compactor fire, confined to rubbish | 0.3 |
| Trash or rubbish fire, contained | 26.1 |
| Total | 100.0 |

Source: NFIRS 5.0.

Note: Confined fire incident type percentages do not add up to the total confined fires percentage due to rounding.

Loss Measures for School Building Fires

Table 2 presents losses, averaged over the three-year period from 2009-2011, of reported nonresidential and school building fires.⁹ The average number of injuries per 1,000 school fires was higher than the same loss measure for fires in nonresidential buildings (excluding schools). However,

the average dollar loss per fire for nonresidential buildings was nearly twice that of school buildings. Perhaps one explanation for this difference in dollar loss per fire is that 63 percent of school fires were confined, generally resulting in no significant property loss due to flame damage. By comparison, confined fires accounted for 49 percent of all nonresidential building fires.¹⁰

Table 2. Loss Measures for School Building Fires and All Other Nonresidential Building Fires (Three-Year Average, 2009-2011)

| Measure | School Building Fires | Nonresidential Building Fires (Excludes School Building Fires) |
|------------------------|-----------------------|----------------------------------------------------------------|
| Average Loss: | | |
| Fatalities/1,000 fires | 0.4 | 1.0 |
| Injuries/1,000 fires | 13.5 | 9.8 |
| Dollar loss/fire | 14,060 | 27,350 |

Source: NFIRS 5.0.

Notes: 1. Average loss for fatalities and injuries is computed per 1,000 fires. Average dollar loss is computed per fire and is rounded to the nearest \$10.

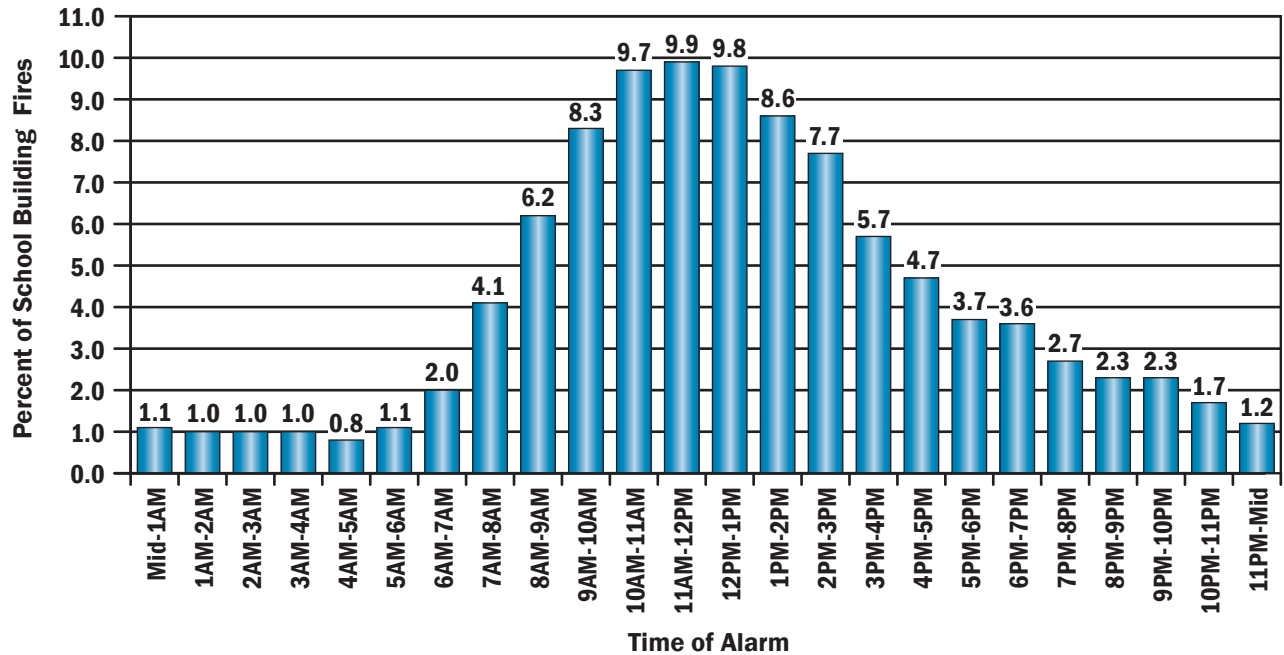
2. When calculating the average dollar loss per fire for 2009-2011, the 2009 and 2010 dollar-loss values were adjusted to their equivalent 2011 dollar-loss values to account for inflation.

When School Building Fires Start

In 71 percent of school fires, the fires occurred between 8 a.m. and 5 p.m., the hours that students are most likely to be in school, as shown in Figure 3.¹¹ In 18 percent of the school fires, the fires occurred between 5 p.m. and midnight, and 12 percent occurred between midnight and 8 a.m.¹²

Overall, the average peak months for school fires in the years 2009-2011 were January and March (10 percent each), driven by a proportionately large number of fires in middle, junior and high schools. On average, less than half (44 percent) of all school fires occurred in middle, junior and high schools. Fire incidence in school buildings was at its lowest during the months of July and August, when classes are generally not in session, as shown in Figure 4.

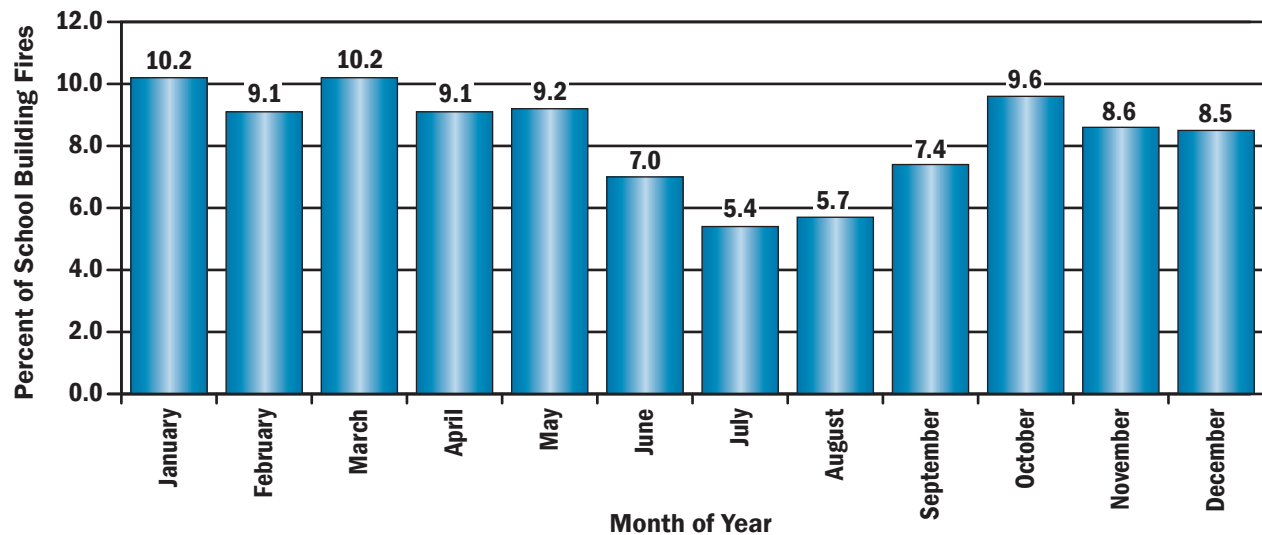
Figure 3. School Building Fires by Time of Alarm (2009-2011)



Source: NFIRS 5.0.

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

Figure 4. School Building Fires by Month (2009-2011)



Source: NFIRS 5.0.

Causes of School Building Fires

Overall, the three leading causes of school fires were cooking (42 percent), intentional action (24 percent) and heating (10 percent).¹³ Fires in preschools and day cares were predominantly due to cooking (73 percent), followed by heating (6 percent) and electrical malfunction (5 percent), as shown in Table 3. The causes for fires in elementary schools mostly involved cooking (37 percent), intentional activity (24 percent) and heating (12 percent). The primary cause of fires in middle, junior and high schools was due to intentional activity (40 percent), followed by cooking (26 percent) and heating (8 percent).

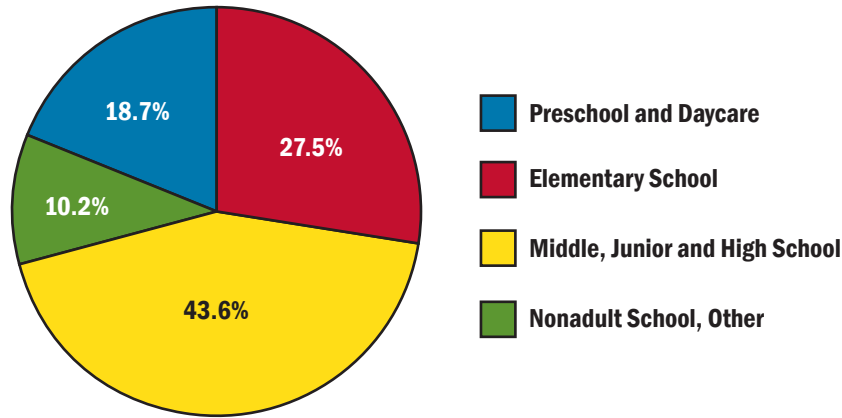
Children may be the primary group involved in setting arson fires in schools; unfortunately, this cannot be determined from NFIRS data alone. As shown in Figure 5, the highest percentage of fires occurred in middle, junior and high schools, followed by elementary schools. This distribution does not imply an associated age for a juvenile involved in the firesetting, but it does suggest the potential for middle and high school age involvement.

Table 3. Top Three Leading Causes of School Building Fires by School Type (2009-2011)

| Preschool and Day Care | Elementary School | Middle, Junior and High School | Nonadult School, Other |
|-------------------------------|---------------------|--------------------------------|------------------------|
| Cooking (73.3%) | Cooking (36.5%) | Intentional (40.1%) | Cooking (46.2%) |
| Heating (6.4%) | Intentional (23.5%) | Cooking (25.5%) | Heating (21.7%) |
| Electrical malfunction (5.2%) | Heating (12.4%) | Heating (7.9%) | Intentional (11.2%) |

Source: NFIRS 5.0.
 Note: Percentages reflect unknowns apportioned.

Figure 5. School Building Fires by School Type (2009-2011)



Source: NFIRS 5.0.

Youth Firesetting

Intentional activity accounted for 40 percent of all fires in middle, junior and high schools and 24 percent of all fires in elementary schools. While 44 percent of school fires occurred in middle, junior and high schools, 28 percent occurred in elementary schools. This could explain the difference between intentional firesetting in older students and outdoor firesetting in younger students. In order to discourage fires initiated by young people, many studies and fire education programs target juveniles under the age of 18.

Youths involved in firesetting generally fall into four basic psychological classifications: (1) curious; (2) crisis; (3) delinquent; and (4) pathological.¹⁴ The first group normally involves younger children who experiment out of curiosity with common sources of ignition, such as matches or lighters, and lack supervision. These children usually do not understand the danger associated with their actions. Children who misuse fire once are five times more likely to experiment with fire again unless professional intervention takes place.¹⁵

The second group includes youths in crises. In general, these youths do not have adequate problem-solving skills or cannot sufficiently express their feelings. As a result, they may use fire in a reactionary way to convey their feelings. This group also lacks supervision and has easy access to sources of ignition.

The third group, classified as delinquent, is typically comprised of older adolescents who, exhibiting antisocial behavior, set fires with the intent of causing destruction. Their fires may be peer-driven, for example, pranks, dares or showing off. Many members of this group do not realize the legal repercussions associated with setting fires.

However, adolescents who do understand the legal repercussions yet continue to set fires also represent a serious problem. These fires qualify as intentional, with little respect for life or property. Youths in this group are more likely to associate with gangs and other gang-like activity, and they may possess a potential for future violent behavior.¹⁶

The fourth group consists of pathological firesetters, who are typically teenagers. Members of this group generally have mental disorders, few social skills, and rarely any personal relationships with their peers. Firesetting tends to be a coping mechanism for these individuals.

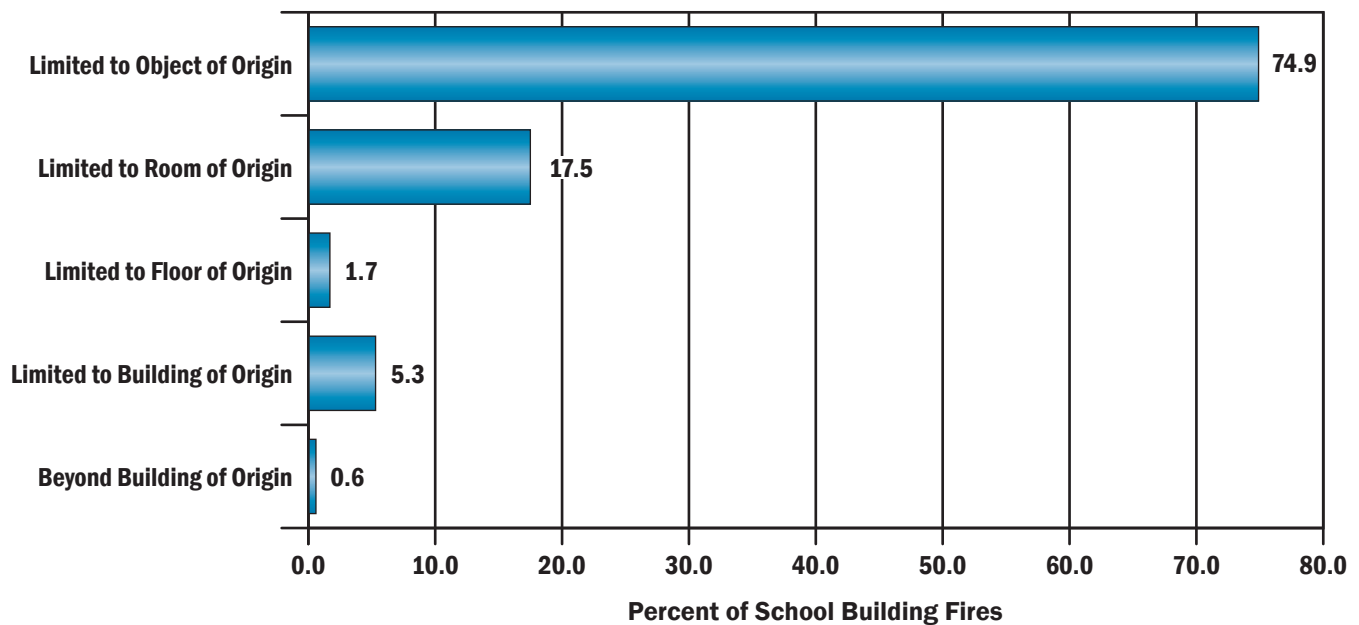
These four categories are not always mutually exclusive. A firesetter may use fire for multiple reasons simultaneously. At any rate, references to psychological typology appear widely in the literature.¹⁷

A partnership between schools, the fire service, and the judicial system allows for early identification of firesetters. In particular, schools should report all fires immediately to the local fire service. Quick and full reporting helps the community recognize children using fire in inappropriate and unsafe ways. Early identification of a fire and its ignition source can lead to successful community-based intervention strategies for juvenile firesetting.¹⁸

Fire Spread in School Building Fires

As shown in Figure 6, 75 percent of school fires were limited to the object of origin. Included in these fires were those coded as “confined fires” in NFIRS. In 18 percent of fires, the fire was limited to the room of origin. In addition, only 8 percent of fires extended beyond the room of origin.¹⁹

Figure 6. Extent of Fire Spread in School Building Fires (2009-2011)



Source: NFIRS 5.0.

Confined Fires

NFIRS allows abbreviated reporting for smaller, confined fires, and many details of these fires are not required to be reported. It is important to note that not all fires where the extent of fire spread is limited to the object of origin are counted as NFIRS confined fires.²⁰ For example, a fire in which the fire spread is limited to a chair or desk is not defined as a “confined fire” in NFIRS because of the greater potential for spread. As noted earlier in this report, it is known that confined fires accounted for 63 percent of all school fires (Table 1). Confined cooking fires — those cooking fires confined to a pot or the oven, for example — accounted for 48 percent of these confined fires.

In addition, the number of confined school fires was greatest from 8 a.m. to 5 p.m., peaking between the hours of 11 a.m. and 12 p.m. These fires accounted for 47 percent of all school fires. Moreover, confined cooking fires in school buildings accounted for 50 percent of all confined fires and 34 percent of all fires in school buildings that occurred between 8 a.m. and 5 p.m.

Confined school fires peaked in January and March (11 percent each), then steadily declined until reaching the lowest incidence in July and August (5 percent each). Fires then increased, peaking again in October at 10 percent.

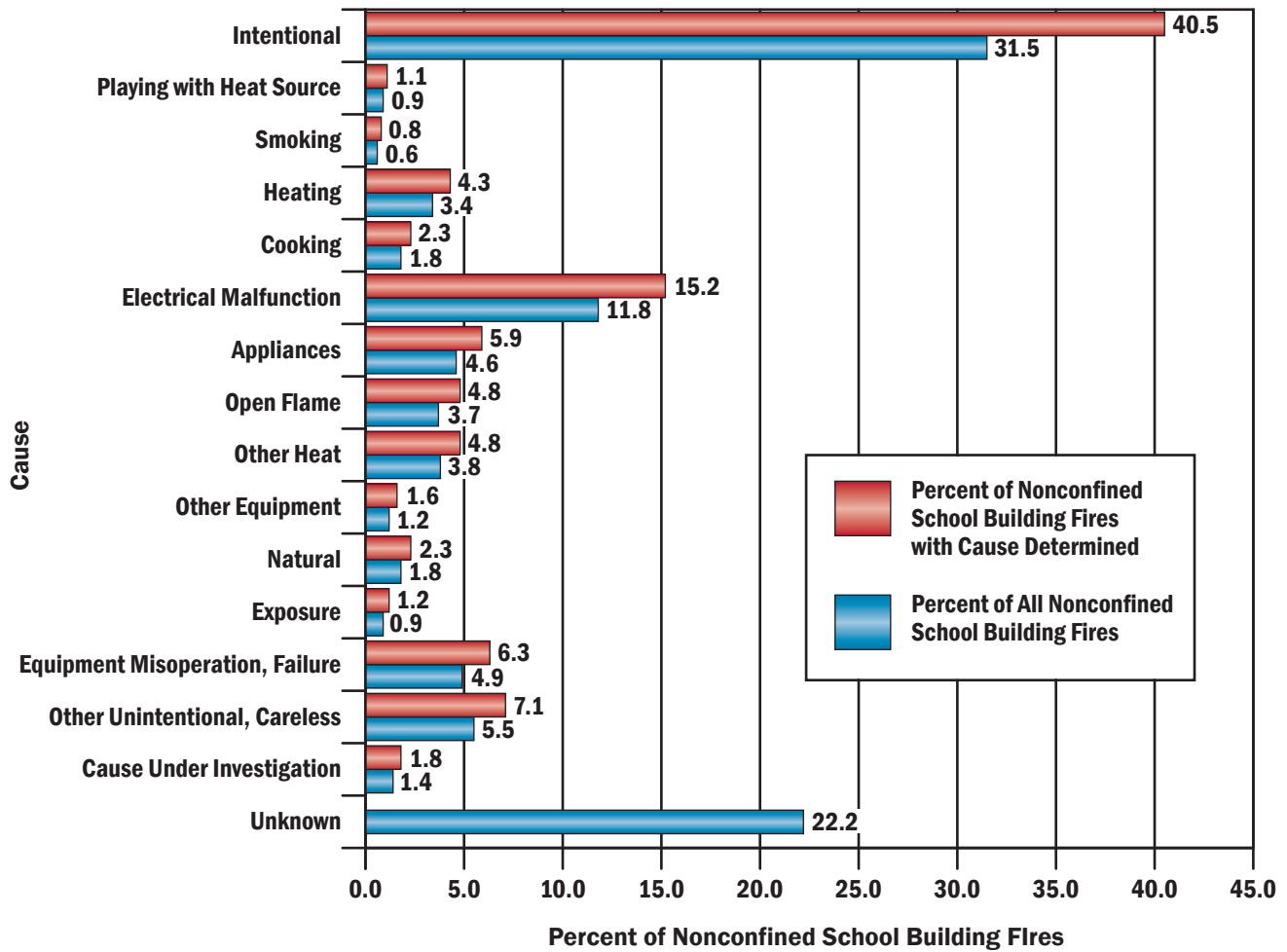
Nonconfined Fires

The next sections of this topical report address nonconfined school fires — the larger and more serious fires that are not confined to a noncombustible container — where more detailed fire data are available, as they are required to be reported in NFIRS.

Causes of Nonconfined School Building Fires

While cooking was the leading cause of school fires overall, it only accounted for 2 percent of all nonconfined school fires (Figure 7). At 41 percent, intentional was the leading cause of nonconfined school fires. Other leading causes of nonconfined school fires were electrical malfunction (15 percent); other unintentional, careless action (7 percent); equipment misoperation, failure (6 percent); and appliances (6 percent).

Figure 7. Causes of Nonconfined School Building Fires (2009-2011)



Source: NFIRS 5.0.

Note: Causes are listed in order of the U.S. Fire Administration (USFA) Structure Fire Cause Hierarchy for ease of comparison of fire causes across different aspects of the fire problem. Fires are assigned to one of 16 cause groupings using a hierarchy of definitions, approximately as shown in the chart above. 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.

Where Nonconfined School Building Fires Start

Overall, the three leading areas of fire origin in nonconfined school fires were bathrooms, small assembly areas, and kitchens (Table 4). Nearly one quarter of nonconfined school fires started in bathrooms. Almost 80 percent of these bathroom fires were intentional in nature. Older students smoking in bathrooms also may increase the risk of such fires — 67 percent of nonconfined fires in school bathrooms occurred in middle, junior and high schools. Bathrooms present children and young teens with a place to set a fire without having to contend with constant adult

supervision. Small assembly areas for less than 100 people (6 percent) were the second most frequent place for nonconfined school fires and typically occurred in middle, junior and high schools as well as elementary schools. Kitchens (6 percent) were the third leading area of origin for nonconfined school fires, reflecting cooking fires. With the exception of nonadult schools (4 percent), kitchen fires occurred in roughly equal proportions in the different school types. Middle, junior and high schools accounted for 33 percent of kitchen fires; elementary schools had 32 percent; and 31 percent occurred in preschools.

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

| Type of School | Areas of Fire Origin (Percent, Unknowns Apportioned) | | |
|--------------------------------|------------------------------------------------------|----------------------------|---------|
| | Bathroom | Assembly Area < 100 People | Kitchen |
| Overall | 24.5 | 5.9 | 5.7 |
| Preschool and day care | 12.4 | 4.0 | 13.1 |
| Elementary school | 18.3 | 8.6 | 6.2 |
| Middle, junior and high school | 32.4 | 5.0 | 3.7 |
| Nonadult school, other | 16.5 | 4.3 | 3.0 |

Source: NFIRS 5.0.

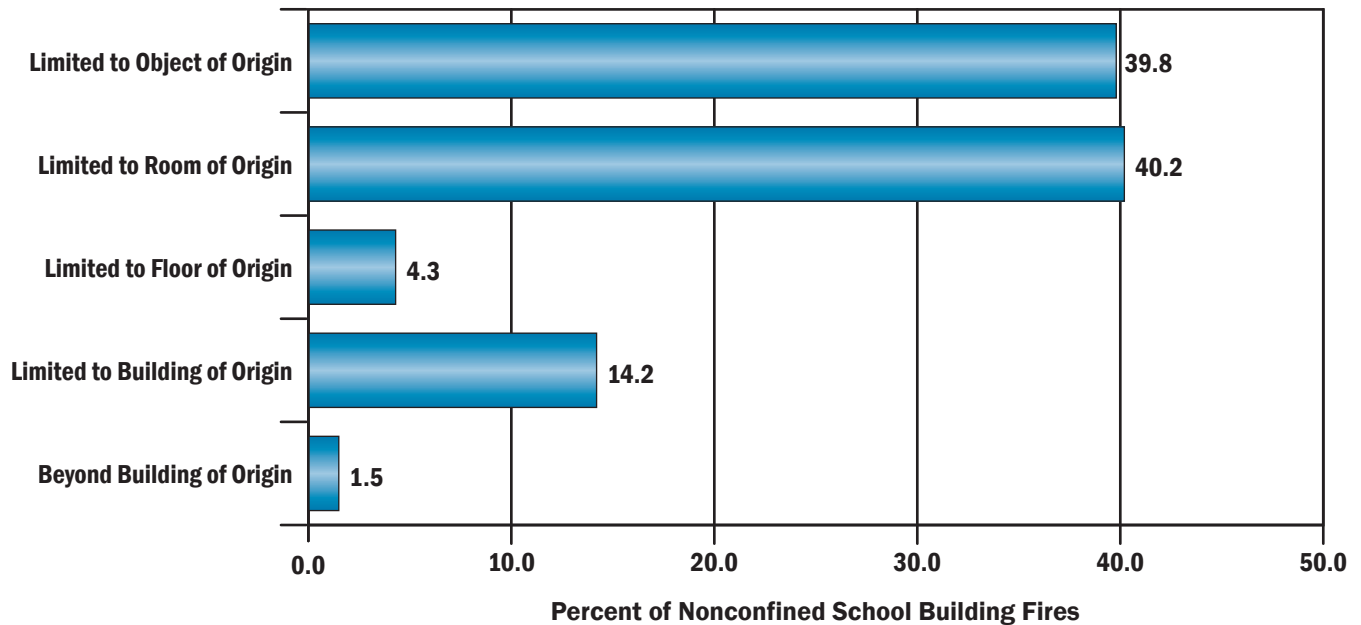
Fire Spread in Nonconfined School Building Fires

Figure 8 shows the extent of fire spread in nonconfined school fires. In 80 percent of nonconfined fires, the fire was limited to the object or room of fire origin — in 40 percent of nonconfined fires, the fire was limited to the room of origin; in another 40 percent of fires, the fire was limited to the object of origin. (Note that a fire confined to a chair or desk 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 20 percent of nonconfined school fires, the fire extended beyond the room of origin. The leading causes of these larger nonconfined fires were intentional (37 percent); electrical malfunction (12 percent); other unintentional, careless actions (9 percent); and other heat (8 percent).

Figure 8. Extent of Fire Spread in Nonconfined School Building Fires (2009-2011)



Source: NFIRS 5.0.

Factors Contributing to Ignition in Nonconfined School Building Fires

Table 5 shows the categories of factors contributing to ignition in nonconfined school building fires. The leading category was the misuse of material or product (45 percent). In this category, the leading specific factors contributing to ignition were playing with heat source (15 percent) and misuse of material or product, other (11 percent).

Electrical failures and malfunctions contributed to 25 percent of nonconfined school fires. Electrical failure, malfunction, other was the specific leading factor in the electrical failure category and accounted for 12 percent of all nonconfined school fires. Mechanical failure, malfunction was the third leading category at 12 percent.

Table 5. Factors Contributing to Ignition for Nonconfined School Building Fires by Major Category (Where Factors Contributing to Ignition are Specified, (2009-2011))

| Factors Contributing to Ignition Category | Percent of Nonconfined School Building Fires (Unknowns Apportioned) |
|----------------------------------------------|---------------------------------------------------------------------|
| Misuse of material or product | 44.5 |
| Electrical failure, malfunction | 24.9 |
| Mechanical failure, malfunction | 12.0 |
| Other factors contributing to ignition | 11.3 |
| Operational deficiency | 7.2 |
| Fire spread or control | 3.0 |
| Design, manufacture, installation deficiency | 1.7 |
| Natural condition | 1.3 |

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 percent.

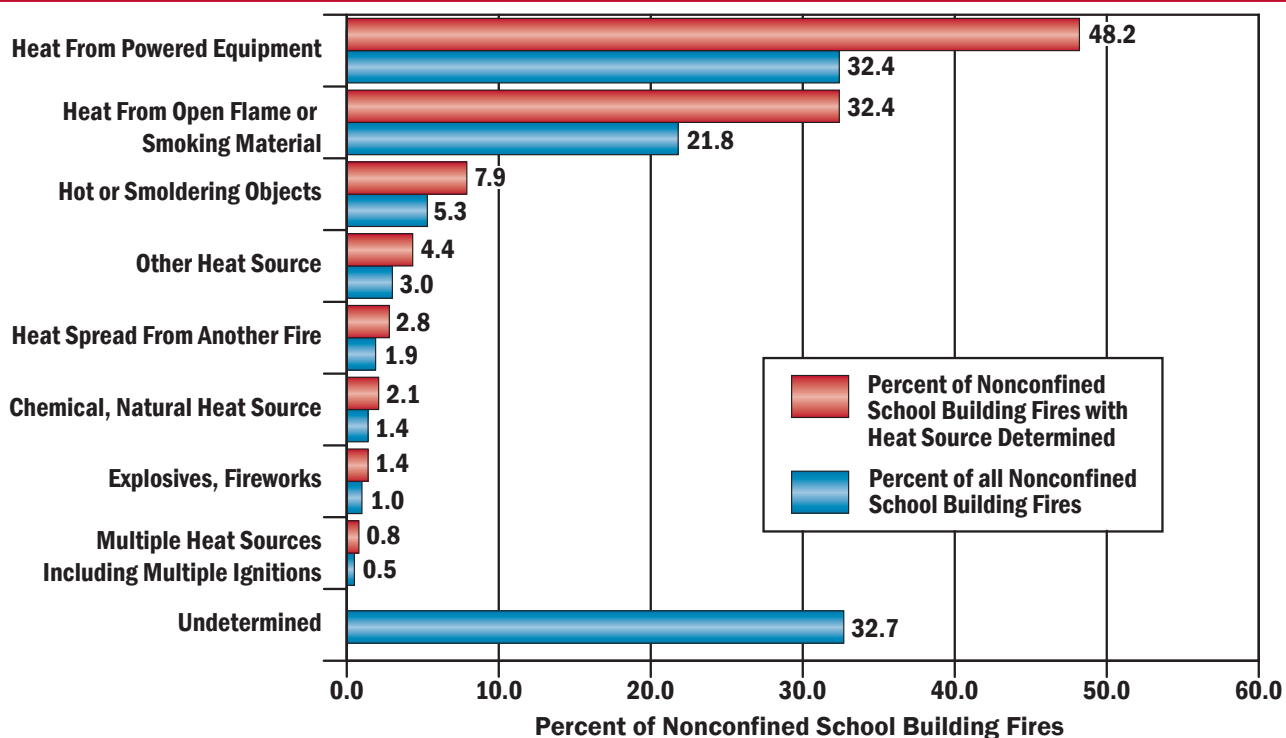
How Nonconfined School Building Fires Start (Heat Source)

Figure 9 shows sources of heat categories for nonconfined school fires. Heat from powered equipment accounted for 48 percent of nonconfined school fires. This category includes heat from other powered equipment (15 percent); electrical arcing (15 percent); radiated or conducted heat from operating equipment (12 percent); and spark, ember or flame from operating equipment (6 percent).

Heat from open flame or smoking materials accounted for 32 percent of nonconfined school fires. This category includes such items as lighters and matches (combined, 18 percent), other miscellaneous open flame or smoking materials (10 percent), and open flame lanterns (2 percent).

The third largest category pertains to hot or smoldering objects (8 percent). This category includes miscellaneous hot or smoldering objects (4 percent) and hot embers or ashes, molten hot material, and heat spark from friction (combined, 4 percent).

Figure 9. Sources of Heat in Nonconfined School Building Fires by Major Category (2009-2011)



Source: NFIRS 5.0.

Alerting/Suppression Systems in School Building Fires

Technologies to detect and extinguish fires have been a major contributor to the drop in fire fatalities and injuries over the past 35 years. In addition, the installation of smoke alarms and fire sprinklers is generally required in schools where an increased risk to life is present.

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 collected on smoke alarms in confined and nonconfined fires, the analyses are performed separately. Note that the data presented in Tables 6 to 8 are the raw counts from the NFIRS

dataset and are not scaled to national estimates of smoke alarms in school 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 66 percent of nonconfined school fires (Table 6). In 22 percent of nonconfined school fires, there were no smoke alarms present. In another 12 percent of these fires, firefighters were unable to determine if a smoke alarm was present. Thus, smoke alarms were potentially missing in between 12 and 34 percent of fires with the ability to spread and possibly result in fatalities.

Table 6. Presence of Smoke Alarms in Nonconfined School Building Fires (2009-2011)

| Presence of Smoke Alarms | Percent |
|--------------------------|---------|
| Present | 66.4 |
| None present | 22.1 |
| Undetermined | 11.5 |
| Total | 100.0 |

Source: NFIRS 5.0.

While 17 percent of all nonconfined school fires occurred in school buildings that are **not** currently or routinely occupied, these buildings — which are under construction, undergoing major renovation, vacant and the like — are unlikely to have alerting and suppression systems that are in place and, if in place, that are operational. In fact, only 17 percent of all nonconfined fires in unoccupied school 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 school buildings only.²¹

Smoke Alarms in Nonconfined Fires in Occupied School Buildings

Smoke alarms were reported as present in 73 percent of nonconfined fires in occupied school buildings (Table 7). In 17 percent of nonconfined fires in occupied school buildings, there were no smoke alarms present. In another 11 percent of these fires, firefighters were unable to determine if a smoke alarm was present; unfortunately, in 27 percent 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 (73 percent) and the alarm operational status is considered, the percentage of smoke alarms reported as present consisted of:

- Present and operated — 45 percent.
- Present but did not operate — 20 percent (fire too small, 17 percent; alarm failed to operate, 3 percent).
- Present but operational status unknown — 7 percent.²²

When the subset of incidents where smoke alarms were reported as present are analyzed separately and as a whole, smoke alarms were reported to have operated in 62 percent of the incidents and failed to operate in 5 percent. In 23 percent of this subset, the fire was too small to activate the alarm. The operational status of the alarm was undetermined in 10 percent of these incidents.

At least 17 percent of nonconfined fires in occupied school buildings had no smoke alarms present — and perhaps more if fires without information on smoke alarms could be factored in.²³ A large proportion of reported fires without smoke alarms may reflect the effectiveness of the alarms themselves: Smoke alarms do not prevent fires, but they may prevent a fire from being reported if it is detected at an early stage and extinguished before the fire department becomes involved. Alternatively, fires in schools without smoke alarms may **not** be detected at an early stage, causing them to grow large, require fire department intervention, and thus be reported.

Table 7. NFIRS Smoke Alarm Data for Nonconfined Fires in Occupied School Buildings (2009-2011)

| Presence of Smoke Alarms | Smoke Alarm Operational Status | Smoke Alarm Effectiveness | Count | Percent |
|--------------------------|----------------------------------------|------------------------------------------------------------|--------------|--------------|
| Present | Fire too small to activate smoke alarm | | 476 | 16.9 |
| | Smoke alarm operated | Smoke alarm alerted occupants, occupants responded | 952 | 33.9 |
| | | Smoke alarm alerted occupants, occupants failed to respond | 29 | 1.0 |
| | | No occupants | 250 | 8.9 |
| | | Smoke alarm failed to alert occupants | 6 | 0.2 |
| | | Undetermined | 34 | 1.2 |
| | Smoke alarm failed to operate | | 92 | 3.3 |
| Undetermined | | 200 | 7.1 | |
| None present | | | 469 | 16.7 |
| Undetermined | | | 301 | 10.7 |
| Total incidents | | | 2,809 | 100.0 |

Source: NFIRS 5.0.

Note: The data presented in this table are raw data counts from the NFIRS dataset. They do not represent national estimates of smoke alarms in nonconfined fires in occupied school buildings. They are presented for informational purposes. Total does not add to 100 percent 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 school 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 buildings, since these types of fires are unlikely to be reported in school buildings that are not occupied.²⁴

Smoke alarms alerted occupants in 56 percent of the reported confined school fires (Table 8). In other words,

students and staff received a warning from a smoke alarm in just over half of these fires. The data suggest that smoke alarms may alert individuals 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 17 percent of confined school fires.²⁵ In 27 percent of these confined fires, the smoke alarm effectiveness was unknown.

Table 8. NFIRS Smoke Alarm Data for Confined School Building Fires (2009-2011)

| Smoke Alarm Effectiveness | Count | Percent |
|-------------------------------------|--------------|--------------|
| Smoke alarm alerted occupants | 3,201 | 56.1 |
| Smoke alarm did not alert occupants | 956 | 16.7 |
| Unknown | 1,553 | 27.2 |
| Total incidents | 5,710 | 100.0 |

Source: NFIRS 5.0.

Note: The data presented in this table are raw data counts from the NFIRS dataset. They do not represent national estimates of smoke alarms in confined school building fires. They are presented for informational purposes.

Automatic Extinguishing Systems in Nonconfined Fires in Occupied School Buildings

Automatic extinguishing system (AES) data are available for both confined and nonconfined fires, although for confined fires the data are also very limited in scope. In confined school fires, a full or partial AES was present in only 4 percent of reported incidents.²⁶ As a result, the analyses here focus on nonconfined fires. In addition, the analyses

presented here focus on occupied buildings, as unoccupied buildings, such as those that are under construction, are less likely to have AESs present.

Although model building codes require sprinklers in most new school construction, full or partial AESs were reported as present in only 33 percent of nonconfined fires in occupied school buildings (Table 9). AESs were not present in 58 percent of these fires. Many school buildings are older, and their construction predates the current building codes.

Table 9. NFIRS AES Data for Nonconfined Fires in Occupied School Buildings (2009-2011)

| AES Presence | Count | Percent |
|------------------------|--------------|--------------|
| AES present | 861 | 30.7 |
| Partial system present | 58 | 2.1 |
| AES not present | 1,636 | 58.2 |
| Unknown | 254 | 9.0 |
| Total incidents | 2,809 | 100.0 |

Source: NFIRS 5.0.

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

Examples

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

- September 2013: In Collin County, Texas, two teenagers were arrested for starting a fire inside a bathroom of Farmersville Junior High School. The suspects, both 16 years old, were taken into custody, and one of them confessed to the crime. According to police, the heat from the flames caused damage to some pipes and severe flooding, resulting in extensive damage to the building.²⁷
- September 2013: Two students and a teacher at Roach Middle School in Frisco, Texas, were injured as a result of a fire caused by an accident during a classroom science experiment. Authorities said the experiment involved strontium chloride, methyl alcohol and a lighter. One student was flown to a Dallas hospital for treatment of first and second degree burns, while the teacher and other student were treated at the scene. Investigators said the teacher used the classroom’s fire extinguisher to put the flame out before firefighters arrived.²⁸
- September 2013: An early morning, two-alarm fire destroyed a Jewish girls’ school outside Monticello, New York. Firefighters from Monticello and several other departments responded to the blaze that was reported at 4:21 a.m. No injuries were reported as the building was unoccupied when the fire broke out; however, the building was a total loss. The cause of the fire remained under investigation.²⁹

NFIRS Data Specifications for School Building Fires

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

School building fires were defined using the following criteria:

- Aid Types 3 (mutual aid given) and 4 (automatic aid given) were excluded to avoid double counting of incidents.
- Incident Types 111-123 (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 113-118 do not specify if the structure is a building.

- Property use codes from the 200 series, consisting of the following:

| Property Use | Description |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| 210 | Schools, nonadult, other |
| 211 | Preschool, not in same facility with other grades; includes nursery schools; excludes kindergartens (213) and day care facilities (254, 255) |
| 213 | Elementary school; includes kindergarten |
| 215 | High school, junior high, middle school |
| 254 | Day care in commercial property |
| 255 | Day care in residence, licensed |
| 256 | Day care in residence, unlicensed |

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

fire problem and continually examines its data and methodology to fulfill this goal. Because of this commitment, data collection strategies and methodological changes are possible and do occur. As a result, analyses and estimates of the fire problem may change slightly over time. Previous analyses and estimates on specific issues (or similar issues) may have used different methodologies or data definitions and may not be directly comparable to the current ones.

To request additional information or to comment on this report, visit <https://apps.usfa.fema.gov/feedback/>.

The analyses contained in this report reflect the current methodologies used by USFA. USFA is committed to providing the best and most current information on the U.S.

Notes:

¹ In NFIRS Version 5.0, a structure is a constructed item of which a building is one type. In previous versions of NFIRS, the term “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 NFIRS 5.0 has, therefore, changed to include only those fires where the NFIRS 5.0 Structure Type is 1 or 2 (enclosed building and fixed portable or mobile structure) with a 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, bridges and other various open structures. Confined fire incidents without a structure type specified are presumed to occur in buildings. Nonconfined fire incidents without a structure type specified are considered to be invalid incidents (structure type is a required field) and are not included.

² National estimates are based on 2009-2011 native Version 5.0 data from NFIRS, nonresidential structure fire loss estimates from the National Fire Protection Association’s (NFPA’s) annual surveys of fire loss, and USFA’s nonresidential building fire loss estimates: <http://www.usfa.fema.gov/statistics/estimates/index.shtm>. Further information on USFA’s nonresidential building fire loss estimates is found in the “National Estimates Methodology for Building Fires and Losses,” August 2012, http://www.usfa.fema.gov/downloads/pdf/statistics/national_estimate_methodology.pdf. For information on NFPA’s survey methodology, see NFPA’s report on fire loss in the U.S.: <http://www.nfpa.org/~media/Files/Research/NFPA%20reports/Overall%20Fire%20Statistics/osfireloss.pdf>. In this school building fires topical report, fires are rounded to the nearest 100, deaths to the nearest five, injuries to the nearest 25, and losses to the nearest \$100 million.

³ The estimate of fire deaths on school properties reflects the data as it is reported to NFIRS. One reported fire death occurred outside on school property resulting from suicide by fire, with the other reported deaths occurring in a residential day care facility.

⁴ Distribution statistics and per-fire losses are based on 2009-2011 NFIRS 5.0 data.

⁵ The annual average estimate for school building fire deaths rounded to zero, as national fire death estimates are rounded to the nearest five deaths. This estimate reflects the data as it is reported to NFIRS. For the years studied, there were four reported fire deaths occurring in a residential day care facility in 2011. No other fire deaths in school buildings were reported to NFIRS in 2009 or 2010.

⁶ Participation in NFIRS is voluntary; however, some states do require their departments to participate in the state system. Additionally, if a fire department is a recipient of a Fire Act Grant, participation is required. From 2009 to 2011, 70 percent of NFPA’s annual average estimated 1,356,500 fires to which fire departments responded were captured in NFIRS. Thus, NFIRS is not representative of all fire incidents in the U.S. and is not a “complete” census of fire incidents. Although NFIRS does not represent 100 percent of the incidents reported to fire departments each year, the enormous dataset exhibits stability from one year to the next without radical changes. Results based on the full dataset are generally similar to those based on part of the data.

⁷ In NFIRS, confined fires are defined by Incident Type codes 113-118.

⁸ NFIRS distinguishes between “content” and “property” loss. Content loss includes losses to the contents of a structure due to damage by fire, smoke, water and overhaul. Property loss includes losses to the structure itself or to the property itself. Total loss is the sum of the content loss and the property loss. For confined fires, the expectation is that the fire did not spread beyond the container (or rubbish for Incident Type code 118) and hence, there was no property damage (damage to the structure itself) from the flames. There could be, however, property damage as a result of smoke, water and overhaul.

⁹ 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 $(1,000 \times (0/4,000)) = 0.0$ deaths per 1,000 school building fires, and the fire injury rate is $(1,000 \times (75/4,000)) = 18.8$ injuries per 1,000 school building fires.

¹⁰ USFA, “Nonresidential Building Fires (2009-2011),” Volume 14, Issue 5, June 2013: <http://www.usfa.fema.gov/downloads/pdf/statistics/v14i5.pdf>.

¹¹ For the purposes of this report, the time of the fire alarm is used as an approximation for the general time the fire started. However, in NFIRS, it is the time that the fire was reported to the fire department.

¹² Total does not add up to 100 percent due to rounding.

¹³ The USFA Structure Fire Cause Methodology was used to determine the cause of school building fires: www.usfa.fema.gov/fireservice/nfirs/tools/fire_cause_category_matrix.shtm. In 27 percent of reported school building fire incidents, the cause of the fire was undetermined. The cause percentages presented here are “adjusted” percentages using only those incidents for which causal data were provided. This calculation, in effect, distributes the fires for which the cause data are unknown in the same proportion as the fires for which the causes are known.

¹⁴ G. Scott Burlin, SOS Fires: Youth Intervention Programs, “An Examination of Juvenile Firesetting and the Reasons that Kids Set Fires,” January 2007, http://sos.strateja-xl.com/professional-information/Articles/Burlin_final_paper.pdf (accessed Nov. 4, 2013).

¹⁵ Office of the Washington State Fire Marshal, “Reporting School Fires,” http://www.wsp.wa.gov/fire/docs/prevention/report_school_fires.pdf (accessed Nov. 4, 2013).

¹⁶ Jamie Fry, SOS Fires: Youth Intervention Programs, “Youth Firesetting: Collaboration Between Teachers and Fire Service Personnel for Early Identification and Intervention,” http://sos.strateja-xl.com/professional-information/Articles/Collaboration_between_teachers_and_fire_service.pdf (accessed Nov. 4, 2013).

¹⁷ U.S. Department of Justice, “Juvenile Firesetting: A Research Overview,” <https://www.ncjrs.gov/pdffiles1/ojdp/207606.pdf> (accessed Jan.10, 2014).

¹⁸ Office of the Washington State Fire Marshal, “Reporting School Fires,” http://www.wsp.wa.gov/fire/docs/prevention/report_school_fires.pdf (accessed Nov. 4, 2013).

¹⁹ Total does not add up to 100 percent due to rounding.

²⁰ As noted previously, in NFIRS, confined building fires are small fire incidents that are limited in scope, confined to non-combustible containers, rarely result in serious injury or large content losses, and are expected to have no significant accompanying property losses due to flame damage. In NFIRS, confined fires are defined by Incident Type codes 113-118.

²¹ The term “occupied” implies that the building is operational or in normal use. This includes buildings that are closed or unoccupied for a brief period of time, such as businesses that are closed for the weekend.

²² The percentages for the categories of present and operated, present but did not operate, and present but operational status unknown do not sum to 73 percent due to rounding.

²³ Here, **at least** 17 percent of nonconfined fires in occupied school buildings had no smoke alarms present — the 17 percent 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 The term “occupied” implies that the building is operational or in normal use. This includes buildings that are closed or unoccupied for a brief period of time, such as businesses that are closed for the weekend.
- ²⁵ In confined fires, the entry “smoke alarm did not alert occupants” can mean that no smoke alarm was present; the smoke alarm was present but did not operate; the smoke alarm was present and operated, but the occupant was already aware of the fire; or there were no occupants present at the time of the fire.
- ²⁶ As confined fires 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 “Two Teens Arrested For Setting Fire To Farmersville School,” [www.dfw.cbslocal.com](http://www.dfw.cbslocal.com/2013/09/18/two-juveniles-arrested-for-setting-fire-to-farmersville-school/), Sep. 18, 2013, <http://dfw.cbslocal.com/2013/09/18/two-juveniles-arrested-for-setting-fire-to-farmersville-school/> (accessed Sep. 20, 2013).
- ²⁸ “Frisco Student Hospitalized After Science Experiment Catches Fire,” [www.wfaa.com](http://www.wfaa.com/news/education/Frisco-student-hospitalized-after-science-experiment-catches-fire-223042611.html), Sep. 9, 2013, <http://www.wfaa.com/news/education/Frisco-student-hospitalized-after-science-experiment-catches-fire-223042611.html> (accessed Oct. 28, 2013).
- ²⁹ Tracy Baxter and Nathan Brown, “Jewish Girls’ School Destroyed by Fire,” [www.recordonline.com](http://www.recordonline.com/apps/pbcs.dll/article?AID=/20130904/NEWS/130909930), Sep. 4, 2013, <http://www.recordonline.com/apps/pbcs.dll/article?AID=/20130904/NEWS/130909930> (accessed Sep. 20, 2013).