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Structure Fires in Schools

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Key Findings

- Local fire departments in the United States responded to an estimated average of 3,230 fires in school properties from preschool through grade twelve from 2014 to 2018.
- The fires in these school properties caused an estimated average of one civilian death, 39 civilian injuries, and $37 million in direct property damage per year.
- School property fires accounted for one percent of all US structure fires during this period and less than one percent of the accompanying civilian fatalities, injuries, and direct property damage.
- Three in five school fires were small fire incidents identified as confined fires, meaning they were confined to the cooking equipment, chimneys, fireplaces, boilers or trash in which they ignited.
- Two in five school fires (43%) were intentionally set. Fires with an intentional cause were more prevalent in high school and middle schools (44% of total) than in elementary schools (33%).
- Almost one-third of school fires were caused by cooking equipment (31%) and 10 percent by heating equipment.

High School and Middle School Fires

- In high school and middle school fires, one-third of the property damage (34%) was caused by the small number of fires that occurred between midnight and 4 a.m., when buildings were unlikely to be occupied.
- More than two in five fires (44%) in high schools and middle schools were intentionally set and one in five was caused by playing with a heat source.
- Fires in high schools and middle schools were much more likely to originate in a lavatory or locker room (32%) than any other area.

Elementary School Fires

- Elementary school fires most often began with the ignition of trash or cooking materials.
- Several leading factors contributing to the ignition of elementary school fires had behavioral implications, including playing with a heat source (22%), unclassified misuse of a material or product (8%), abandoned or discarded material or product (7%), and unattended equipment (6%).
- Electrical failures or malfunctions (17%) and mechanical failures or malfunctions (14%) also contributed to a substantial share of fires and they suggest that there might be gaps in the maintenance and repair of school equipment or infrastructure.
- Lighters and matches together provided the heat source in one-quarter of elementary school fires.

Part 1. Structure Fires in Schools

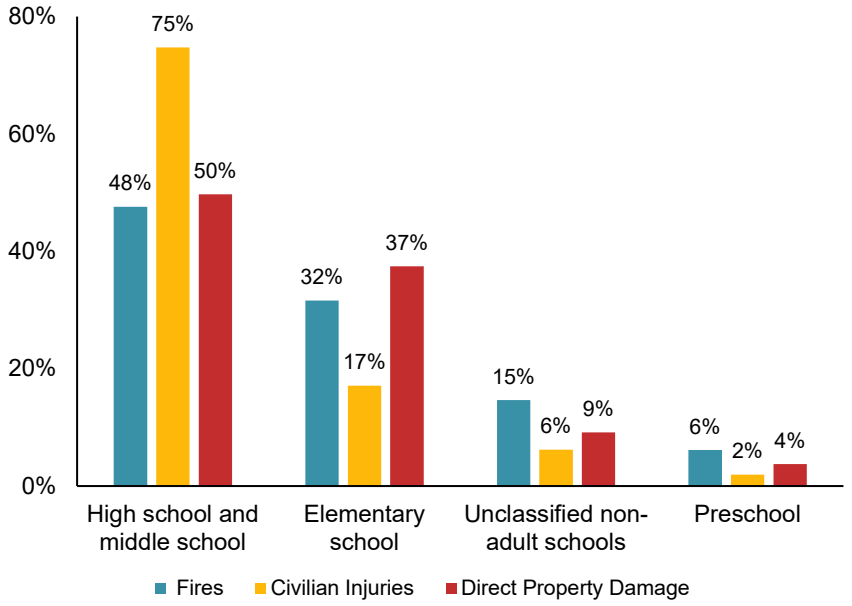
This report presents data on structure fires in school properties for the five-year period from 2014 through 2018. School properties include high school and middle schools, elementary schools (including kindergarten), preschools, and unclassified non-adult schools. Fires in vehicles or non-structure fires on school grounds are not included in this report.

US fire departments responded to an estimated 3,230 structure fires in schools each year from 2014 to 2018. These fires resulted in an average of one civilian death, 39 civilian injuries, and $37 million in direct property damage a year. As indicated in Table 1 in the accompanying tables, the fires in school properties represented one percent of all the structure fires in the US during this period and less than one percent of the civilian deaths, injuries, and direct property damage. Due to the low numbers, civilian deaths are not included in the analysis in this report.

Most school fires occurred in either high schools and middle schools or elementary schools, as shown in Figure 1. Unclassified non-adult schools and preschools accounted for the remaining school fires and had comparatively smaller shares of the civilian injuries and direct property damage. School fire civilian injuries were concentrated in high school and middle school fires, and fires in these schools also accounted for half of the direct property damage in school fires.

In 2014–2018, three in five school fires were small fire incidents identified as confined fires. These fires were confined to the cooking equipment, chimneys, fireplaces, or boilers or trash in which they ignited. Accordingly, the 40 percent of school fires classified as non-confined fires" accounted for the vast majority of the civilian injuries and direct property damage.

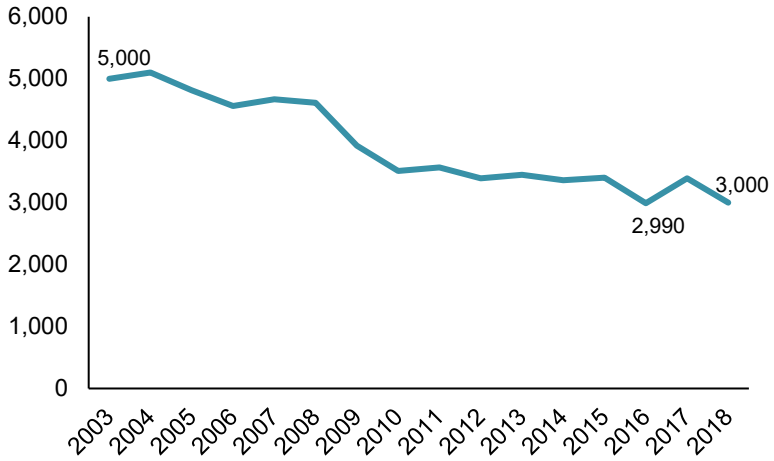
Figure 1. Structure Fires in School Properties by School Type 2014–2018 Annual Averages



School Fires by Year

As shown in Figure 2, the number of structure fires that occur annually in schools has seen a distinct downward trend since 2003, with the sharpest decrease between 2004 and 2010. The annual number of school fires has generally been stable since 2010, although it is encouraging that the estimated 2,990 fires in 2016 and 3,000 fires in 2018 represent the low points for this period. Injuries and direct property damage have shown substantial year-to-year fluctuation, as indicated in Table 3 of the accompanying tables.

Figure 2. Structure Fires in School Properties by Year
2003–2018 Annual Averages



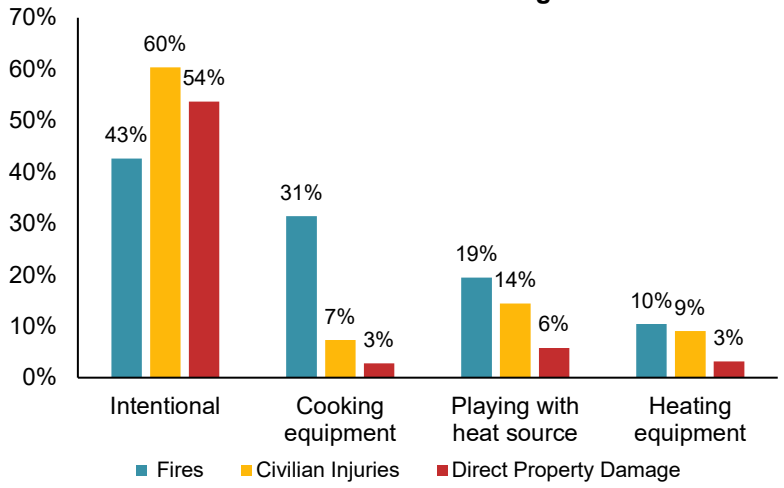
Leading Causes of Structure Fires in Schools

Figure 3 shows the leading causes of fires in school properties. The data in this table comes from several National Fire Incident Reporting System (NFIRS) data elements. Double counting is possible, particularly for playing with a heat source and fires that were intentionally set. For more information see Methodology and Definitions Used in "Leading Causes of Structure Fires".

Fires that were intentionally set were the leading cause of school fires, accounting for over two in five fires, as shown in Figure 3. These fires also caused the majority of the injuries and over half of the property damage from school fires.

Fires that were caused by cooking equipment were the second leading cause of school fires, but these were largely confined fires resulting in little property damage. The ongoing presence of kitchen and other staff in schools is likely to be a factor that differentiates cooking-related fires in schools from those in homes, where cooking fires might be unattended and more likely to cause damage. Fires that involved playing with a heat source were responsible for another one-fifth of the fires, while heating equipment accounted for one in 10 school fires. See Table 4 of the accompanying tables for additional details on the leading causes of fires.

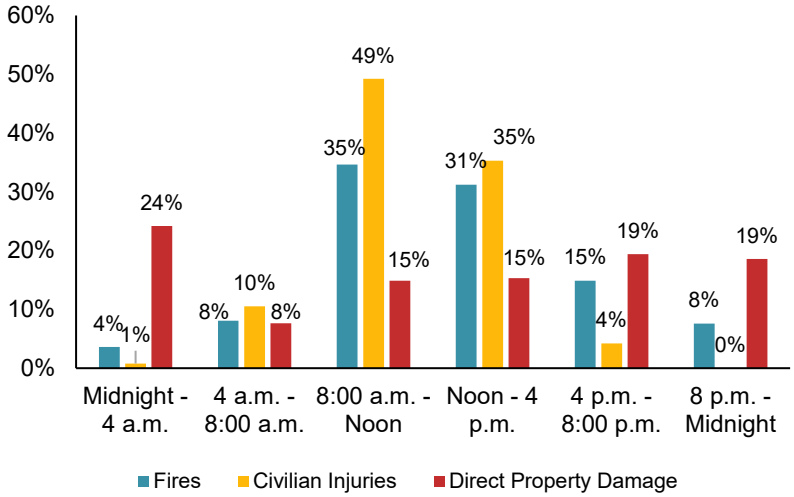
Figure 3. Structure Fires in School Properties by Leading Cause
2014–2018 Annual Averages



Timing of School Fires

School fires were most likely to occur during the daytime hours when the facilities were at their peak occupancy, as shown in Figure 4. Two-thirds of school fires occurred between 8 a.m. and 4 p.m., but these fires accounted for less than one-third of the direct property damage, indicating that many of the fires were detected and extinguished relatively quickly. A comparatively small share of fires occurred in the twelve-hour period between 8 p.m. and 8 a.m., as shown in Figure 3. Significantly, four percent of the fires that occurred between midnight and 4 a.m. accounted for approximately one-quarter (24%) of the direct property damage.

Figure 4. Structure Fire School Properties by Time of Day 2014–2018 Annual Averages



Sprinklers can control a fire until the fire department arrives. A report by Marty Ahrens on the *US Experience with Sprinklers* found that sprinklers were present in only 39 percent of the reported fires in educational properties. A recent *report* from the UK found that sprinkler systems were not present in any of 46 school fires attended by London firefighters in 2019.

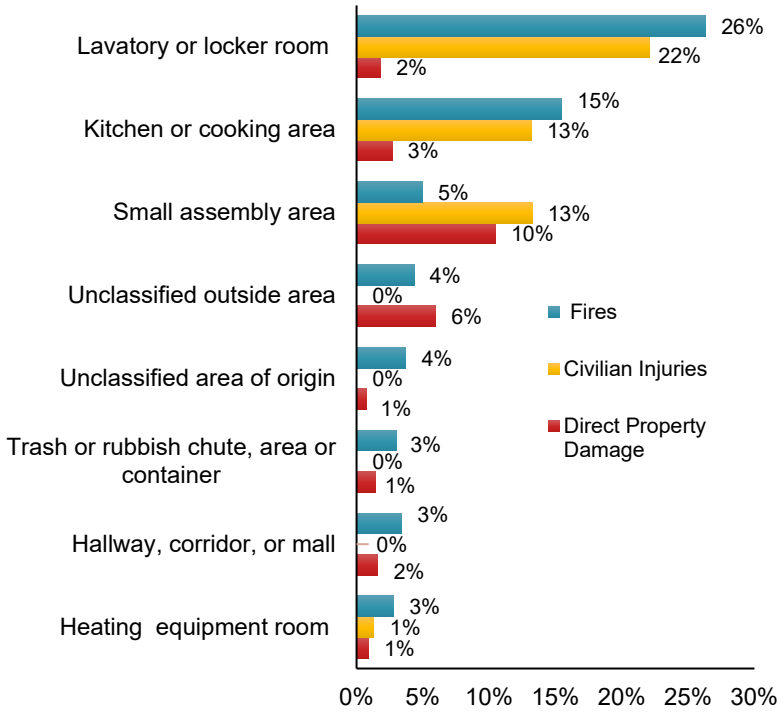
Area of Fire Origin

School fires most often originated in a lavatory or locker room, as shown in Figure 5. This is consistent with the intentional causes of many school fires and suggests that they frequently involved student fire play or arson. The majority of these fires were small confined fires and caused little property damage. However, they were likely to result in injuries (22% of total), underscoring the importance of education and intervention strategies to prevent intentional fire setting.

A kitchen or cooking area was the second leading area of origin for school fires. Confined fires were again predominant, and these fires resulted in little direct property damage. Fires in small assembly areas accounted for five percent of fires, but disproportionately higher shares of injuries and direct property damage.

The remaining fires were distributed among a variety of areas of origin. Just two percent of fires originated on an exterior roof surface, but these accounted for 10 percent of direct property damage. See Table 9 of the supporting tables for additional details.

Figure 5. Structure Fires in School Properties by Area of Origin 2014–2018 Annual Averages



Item First Ignited

Reflecting the predominance of intentionally set fires and cooking fires, the items most often first ignited in school fires were trash and cooking materials. Other leading items of ignition included magazines, newspapers, or writing paper; electrical wire or cable insulation; rolled or wound material; flammable or combustible liquids or gases; and appliance housings or casings.

Factor Contributing to Ignition

Human behavior was involved in two of the leading factors contributing to the ignition of school fires — playing with a heat source and unclassified misuse of materials or products, as shown in Figure 6. Electrical failures or malfunctions and mechanical failures or malfunctions were other leading factors and accounted for the largest share of the direct property damage.

Human behavior also appeared to be involved in a number fires caused by other leading factors, including fires involving abandoned or discarded materials or products, heat sources being too close to combustible materials, unattended equipment, failure to clean equipment, equipment not properly operated, and equipment accidentally turned on or not turned off, suggesting that many school fires could be prevented with enhanced training and education efforts. See Table 11 for additional details.

Heat Source

Figure 7 shows that heat from powered equipment and radiated or conducted heat from operating equipment together served as the heat sources in approximately one-third of school fires, while electrical arcing acted as the heat source in approximately one in 10 fires. Lighters and matches served as the heat source in over one-quarter of school fires, and those fires together accounted for a somewhat higher share of injuries (30%), likely because injury victims were intimate with the heat source. See Table 12 of the accompanying tables for additional details.

Figure 6. Structure Fires in School Properties by Factor Contributing to Ignition, 2014–2018 Annual Averages

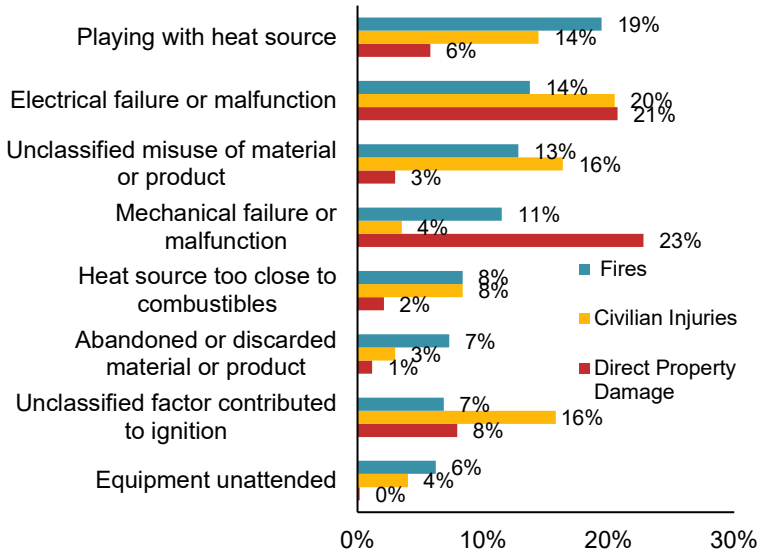
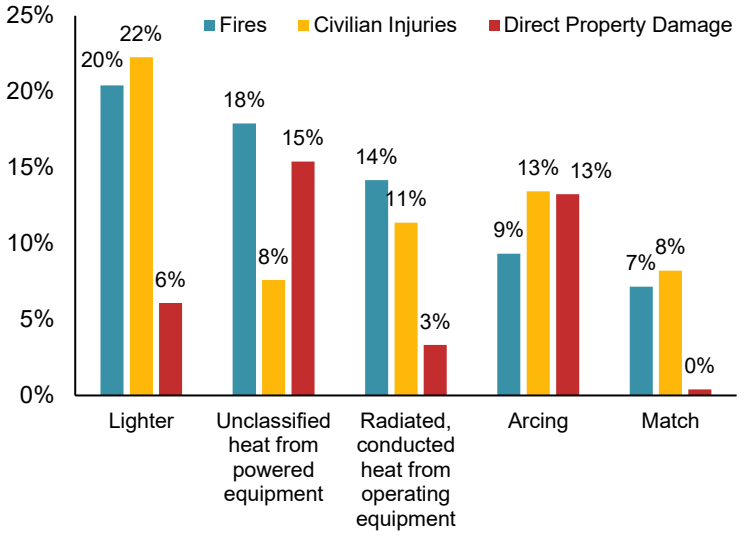


Figure 7. Structure Fires in School Properties by Heat Source, 2014–2018



Part 2: Structure Fires in High Schools and Middle Schools

Because high schools and middle schools include distinctly different student populations than elementary schools, it is useful to analyze the key data elements of these two school groups separately. Note that high schools and middle schools represent a single code in the NFIRS and that data cannot be further disaggregated between the two levels of schooling.

Leading Causes of Structure Fires in High Schools and Middle Schools

Fires with an intentional cause were the leading cause of fires in high schools and middle schools, accounting for more than two in five fires (44%), as shown in Figure 8. Fires caused by cooking equipment and fires caused by playing with a heat source were additional leading causes, followed by fires caused by electrical distribution and lighting equipment and heating equipment.

Although just one in 10 fires were caused by electrical distribution and lighting equipment, these fires were responsible for approximately one-quarter of the injuries (24%). It is likely that the injury victims were workers engaged in electrical work. It is also notable that fires caused by a torch, burner, or soldering iron accounted for just one percent of these fires, but one-fifth of the direct property damage, as indicated by Table 14 in the accompanying tables. Hot work should only be performed by those who have the requisite permits and safety and fire prevention training.

It is worth noting that the prevalence of intentional fires in schools is not a problem unique to the United States. For instance, a *report* from Sweden in 2012 found that 40 percent of fires in Swedish school buildings were caused by arson.

Sprinkler extinguishes fire in high school lab

A fire that started in a high school science laboratory during an experiment involving a Bunsen burner was quickly extinguished by an overhead sprinkler.

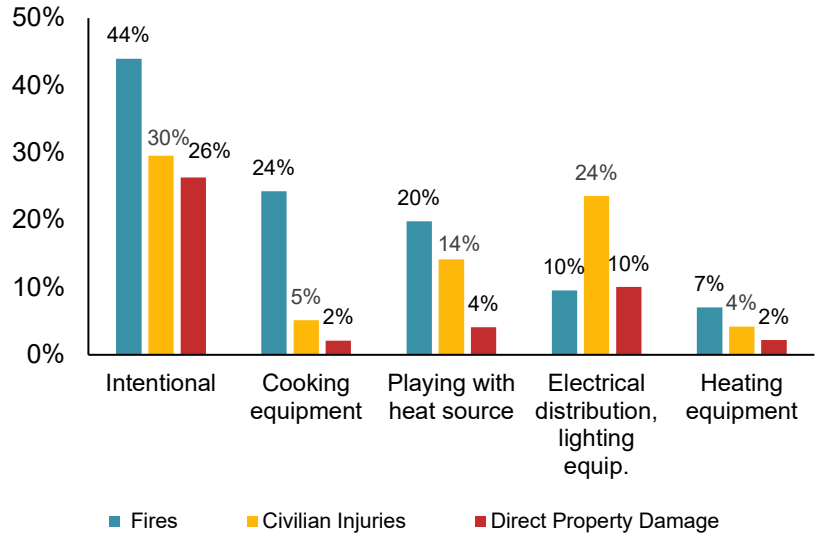
Firefighters were dispatched to the school after a sprinkler head activated and triggered the alarm.

On arrival, crews were advised by school officials that the fire was out, but they proceeded to the lab to confirm extinguishment, remaining on the scene until the alarms were silenced. Investigators determined that the fire was caused by the ignition of fuel inside the Bunsen burner.

The fire caused an estimated $500 in damage to classroom contents.

Source: "Firewatch," *NFPA Journal*. May/June 2017

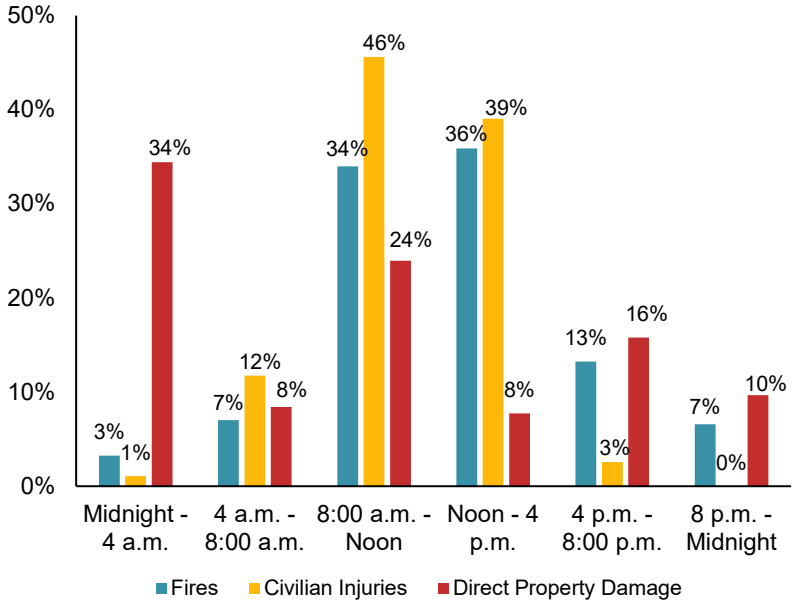
Figure 8. Structure Fires in High Schools and Middle Schools by Leading Cause 2014–2018 Annual Averages



Timing of Fires in High Schools and Middle Schools

The vast majority (70%) of fires in high schools and middle schools occurred during the peak occupancy hours between 8 a.m. and 4 p.m., and these fires also accounted for most of the injuries (85%), as shown in Figure 9. One-third of the property damage (34%) was caused by a small share of fires that occurred between midnight and 4 a.m., when buildings were unlikely to be occupied.

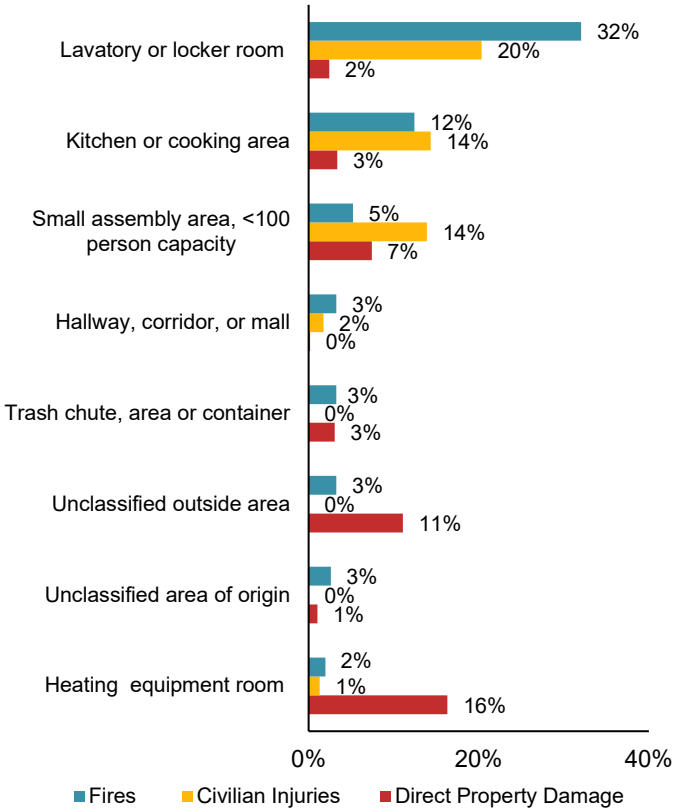
Figure 9. Structure Fires in High Schools and Middle Schools by Time of Day, 2014–2018 Annual Averages



Area of Origin

Fires in high schools and middle schools were substantially more likely to originate in a lavatory or locker room than any other area, serving as the area of origin in approximately one-third of fires. That is more than two and a half times more the number of fires that originated in a kitchen or cooking area, the second leading area of origin. Other leading areas of origin included small assembly areas, hallways, trash chutes, outdoor areas, and heating equipment rooms. Fires originating in a heating equipment room accounted for a disproportionate share of direct property damage, but these losses might have been influenced by a small number of fires.

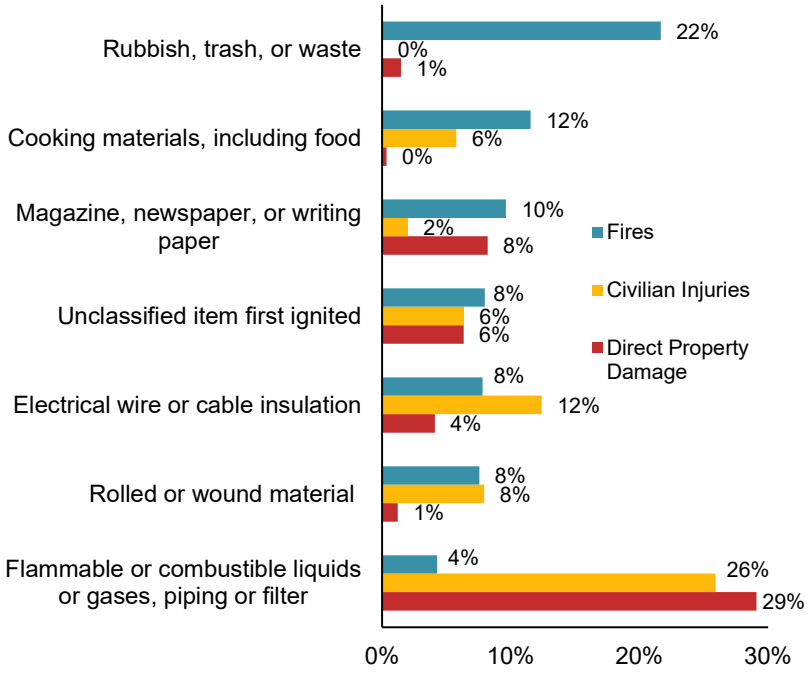
Figure 10. Structure Fires in High Schools and Middle Schools by Area of Origin, 2014–2018 Annual Averages



Item First Ignited

The leading items first ignited in high school and middle school fires were rubbish, trash, or waste; cooking materials; and magazines, newspapers, or writing paper. Many of these items were likely involved in fires that were intentionally set or those caused by cooking equipment. Fires in which flammable or combustible liquids or gases, piping and filters were first ignited —– just four percent of the total — caused one-quarter of the injuries and 29 percent of the property losses.

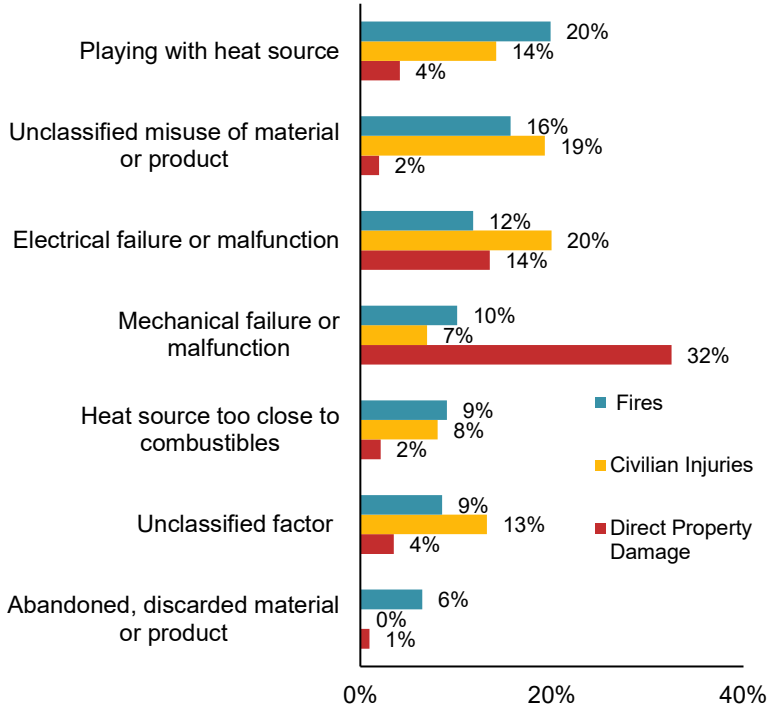
Figure 11. Structure Fires in High Schools and Middle Schools by Item First Ignited, 2014–2018 Annual Averages



Factor Contributing to Ignition

Factors relating to human behavior were the two leading causes of middle and high school fires — playing with a heat source, which contributed to the ignition of one-fifth of the fires, and some form of misuse of a material or product, which contributed to the ignition of another 16 percent of the fires. Electrical and mechanical failures or malfunctions together contributed to the ignition of one in five fires in high schools and middle schools.

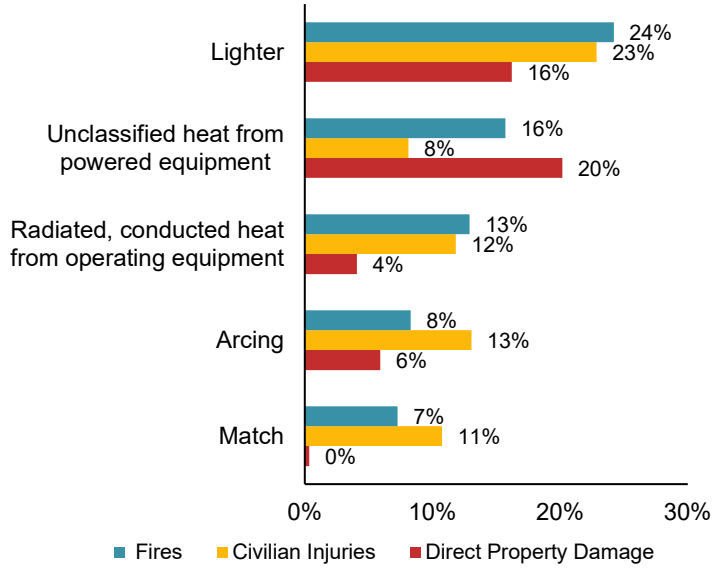
Figure 12. Structure Fires in High Schools and Middle Schools by Factor Contributing to Ignition, 2014–2018 Annual Averages



Heat Source

As shown in Figure 13, almost one-third of the fires in high schools and middle schools were started by a lighter or a match. However, powered equipment and operating equipment together provided the heat for almost three in 10 fires and produced one-quarter of the direct property damage. Arcing also served as a leading heat source in high school and middle school fires, underscoring the need for proper maintenance of electrical equipment and use of power cords, as well as the importance of caution with electrical hazards in schools. Fires started by spontaneous combustion or a chemical reaction contributed to a minor share of the fires but caused the greatest amount of direct property damage (29%), as shown in Table 22. However, a small number of large loss fires could explain this disparity.

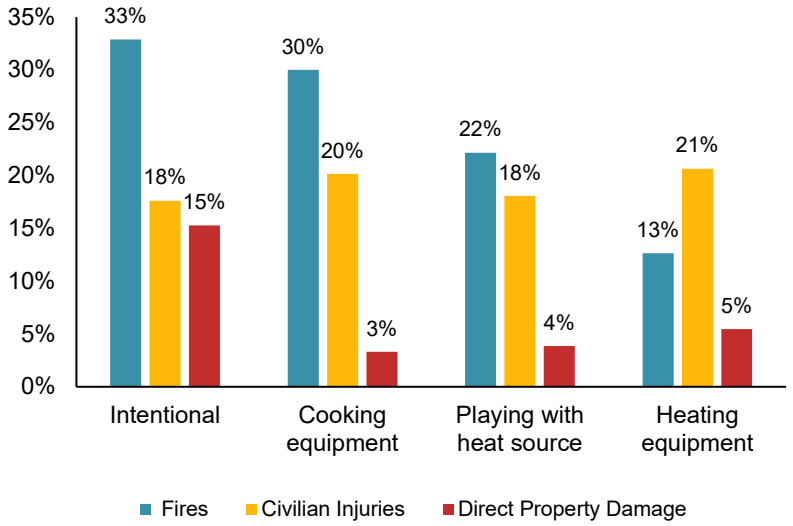
Figure 13. Structure Fires in High Schools and Middle Schools by Heat Source, 2014–2018 Annual Averages



Part 3: Structure Fires in Elementary Schools

As with fires in high schools and middle schools, the leading causes of fires in elementary schools were intentionally set fires, fires caused by cooking equipment, and fires caused by playing with a heat source (Figure 11).

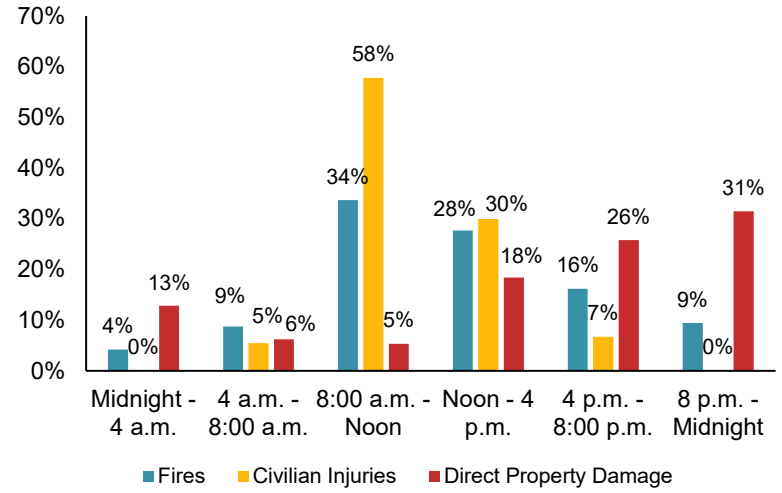
Figure 14. Structure Fires in Elementary Schools by Leading Cause, 2014–2018 Annual Averages



Timing of Fires in Elementary Schools

The peak time period of fires in elementary schools was the eight-hour period between 8 a.m. and 4 p.m., but the share of fires occurring during these school hours was lower than that in high schools. The greatest share of direct property damage was associated with fires occurring between 8 p.m. and midnight (31%), a time interval that accounted for fewer than one in 10 fires.

Figure 15. Structure Fires in Elementary Schools by Time of Day 2014–2018 Annual Averages



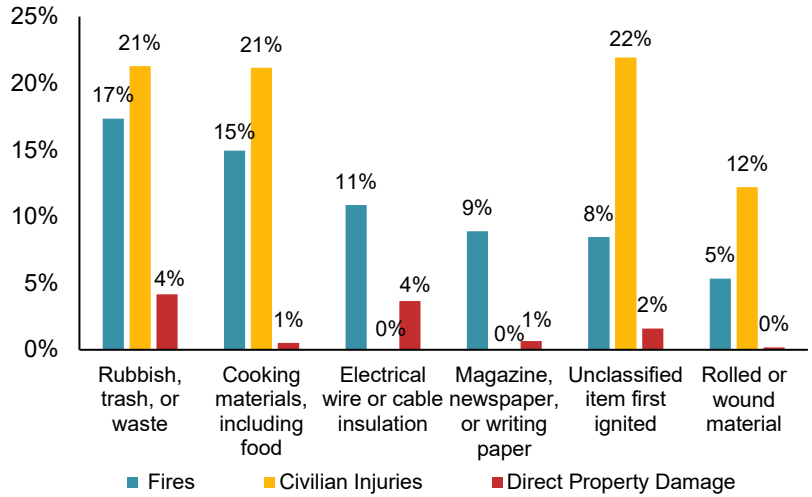
Area of Fire Origin

Fires in elementary schools were most likely to start in the lavatory or locker room or kitchen or cooking area, though the share of lavatory or locker room fires was substantially lower than in high schools, reflecting the lower prevalence of intentional fires at the elementary school level. A small share of fires starting on an exterior roof surface caused nearly one-quarter of the direct property damage, as shown in Table 29. Fires starting in a small assembly area also accounted for a disproportionate share of the direct property damage.

Item First Ignited

Elementary school fires were most often ignited in trash or by cooking materials. Fires ignited in cooking materials were primarily minor fires and did not result in property damage. The ongoing presence of kitchen staff in schools is likely to be a factor that differentiates cooking-related fires in schools from those in homes, where cooking fires might be unattended and are more likely to cause damage. Fires ignited on a roof covering or finish represented a small share of fires but accounted for a disproportionately large share of direct property damage, as indicated in Table 30. It should again be noted that the disparity could be influenced by a small number of fires with larger losses.

Figure 16. Structure Fires in Elementary Schools by Item First Ignited, 2014–2018 Annual Averages

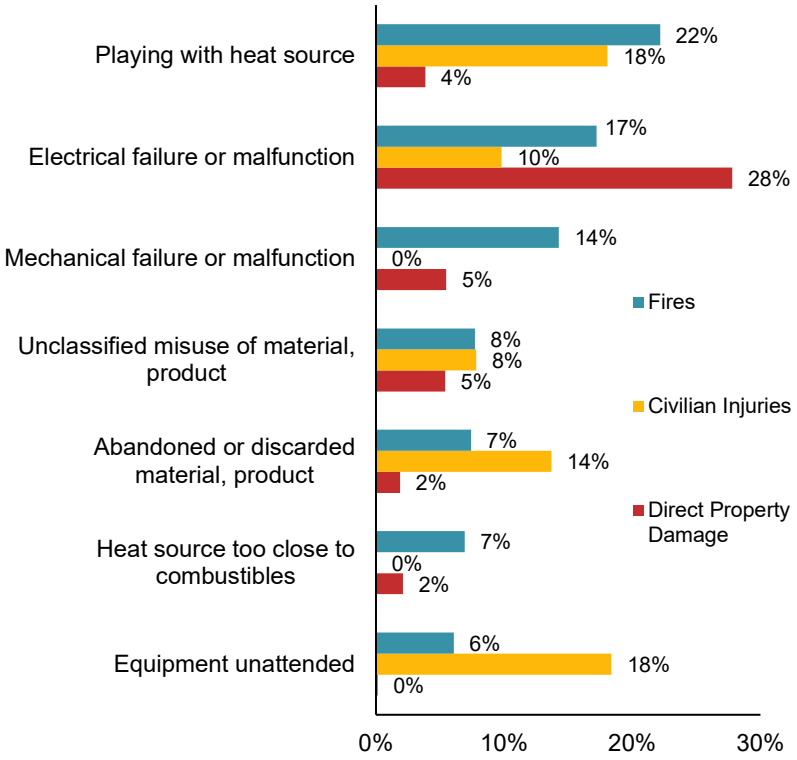


Factor Contributing to Ignition

Several leading factors that contributed to the ignition of fires in elementary schools had behavioral implications, including playing with a heat source, misuse of a material or product, unattended equipment, and abandoned or discarded material or product. Playing with a heat source was a particular issue at the elementary school level, serving as a factor contributing to ignition of just over one-fifth of the fires (22%).

Fires involving electrical and mechanical equipment were also leading causes of fires in elementary schools, suggesting gaps in the maintenance and repair of school equipment or infrastructure. Fires involving electrical failures or malfunctions, which contributed to slightly less than one-fifth of the fires, accounted for the highest share of the direct property damage. While responsible for fewer than one in 10 fires, those involving unattended equipment resulted in a disproportionately large share of injuries (18%), possibly because those attending to the equipment were injured while trying to put the fire out.

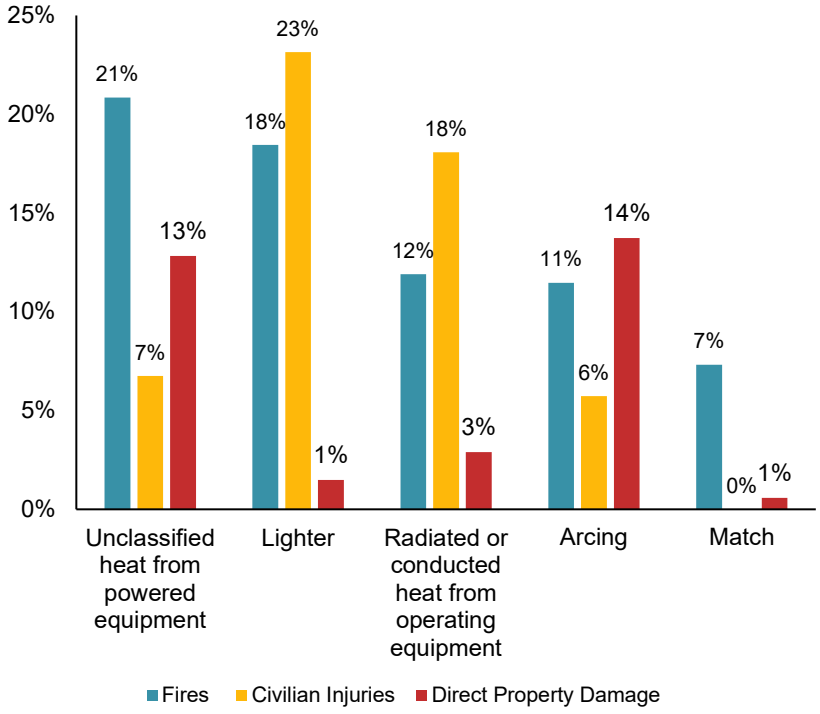
Figure 17. Structure Fires in Elementary Schools by Factor Contributing to Ignition, 2014–2018 Annual Averages



Heat Source

Lighters and matches together provided the heat source in one-quarter of elementary school fires, which is consistent with intentional fires and fires involving fire play (Figure 18). Other leading heat sources of elementary school fires involved equipment or electrical sources, including heat from powered or operating equipment and electrical arcing.

Figure 18. Structure Fires in Elementary Schools by Heat Source, 2014–2018 Annual Averages



Additional Information

See *Structure Fires in Schools: Supporting Tables* by Richard Campbell, September 2020, for more detailed information about the material presented in this report.

Acknowledgments

The National Fire Protection Association® thanks all the fire departments and state fire authorities who participate in the National Fire Incident Reporting System (NFIRS) and the annual NFPA® fire experience survey. These firefighters are the original sources of the detailed data that make this analysis possible. Their contributions allow us to estimate the size of the fire problem. We are also grateful to the US Fire Administration for its work in developing, coordinating, and maintaining NFIRS.

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