



**RESEARCH**



# Vehicle Fires

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March 2020



## Key findings

An estimated 212,500 vehicle fires caused 560 civilian deaths<sup>i</sup> 1,500 civilian injuries; and \$1.9 billion in direct property damage in the US during 2018.

In 2018, only fires in one- and two-family homes claimed more lives than vehicle fires. Vehicle fires caused 4.5 times the number of deaths as nonresidential structure fires and 1.6 times the number of apartment fire deaths.

Most of this report focuses on highway vehicle fires.<sup>ii</sup> The vast majority of vehicle fires and vehicle fire casualties involve highway vehicles (vehicles intended for use on roadways).

The 2018 estimate of highway vehicle fires was 60 percent lower than in 1980, and the rates of fires per billion miles driven and fire deaths per 100 billion miles driven were 81 percent and 65 percent lower, respectively.

Four of every five people killed or injured in highway vehicle fires in 2013–2017 were male. Almost half (44 percent) of the vehicle fire fatalities were between 15 and 34. Only 10 percent were at least 65 years of age.

Highway vehicle fires were most common between 3:00 p.m. and 6:00 p.m.

The leading causes of vehicle fires were mechanical failures or malfunctions and electrical failures or malfunctions. Older vehicles accounted for three-quarters of the highway vehicle fires caused by mechanical or electrical failures or malfunctions. Maintenance is important throughout the vehicle's years of use.

Collisions were the leading cause of vehicle fires that resulted in death.

Large trucks have a higher rate of deaths per 1,000 fires than highway vehicle fires overall. Tires play a larger role in large truck and bus fires than in car fires.

Additional information can be found in the [supporting tables](#) for this report.

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<sup>i</sup> Unless otherwise specified, firefighter deaths and injuries are excluded from casualty statistics.

<sup>ii</sup> The term *highway vehicle fire* is used to describe fires in which cars, trucks, motorcycles, buses, and other road vehicles burned, regardless of where the fire occurred. However, if a vehicle inside a structure caught fire and spread to the structure or other contents, that fire would be considered a structure fire.

## The big picture

US fire departments responded to an estimated 212,500 vehicle fires in the United States during 2018. These fires caused an estimated 560 civilian deaths; 1,500 civilian injuries; and \$1.9 billion in direct property damage.<sup>1</sup>

Vehicle fires accounted for 16 percent of the 1.3 million fires reported to US fire departments. Vehicle fires also caused 15 percent of all civilian fire deaths and 10 percent of all reported civilian fire injuries.

In 2018, only fires in one- and two-family homes claimed more lives than vehicle fires. Vehicle fires caused 4.5 times the number of deaths as nonresidential structure fires and 1.6 times the number of apartment fire deaths.

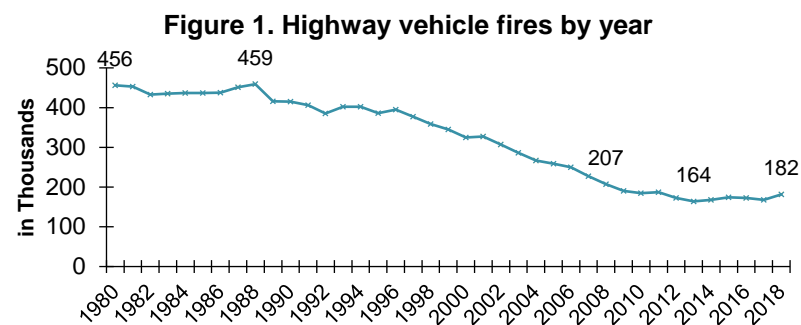
## Trends in highway vehicle use and fires

Highway vehicles, such as cars, trucks, buses, motorcycles, and recreational vehicles, accounted for the majority of vehicle fires. The term *highway vehicle fire* is used to describe fires in which road vehicles burned, regardless of where the fire occurred, including inside—if the fire did not spread from the vehicle to the structure.

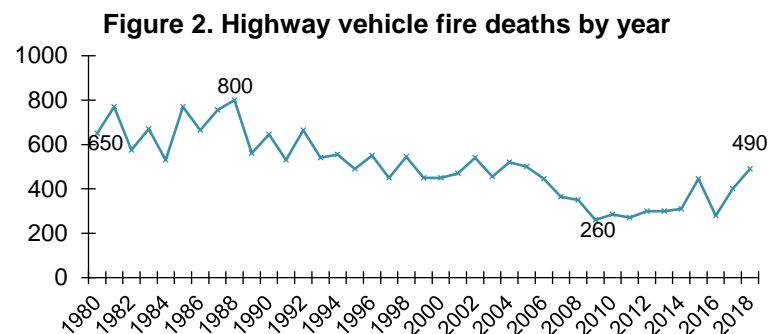
According to the National Highway Traffic Safety Administration's (NHTSA's) "Traffic Safety Facts 2017," in that year, the US had 225 million drivers with 290 million registered vehicles.<sup>2</sup>

Today's vehicles are older than in the past. According to the Federal Highway Administration (FHWA), there were 223 million household vehicles (as opposed to commercial vehicles) in the US in 2017, with an average of 1.9 vehicles and 1.9 licensed drivers per household. In 1983, the average household vehicle was 7.6 years old, compared to 10.3 years old in 2017.<sup>3</sup>

Despite the increase in highway vehicles, miles driven, and vehicle age, highway vehicle fires are less common than in the past. Figure 1 shows that the estimate of highway vehicle fires was 60 percent lower in 2018 than in 1980. Fewer than 200,000 such fires were reported annually in the past decade. In 2018, an estimated 181,500 highway vehicle fires caused 490 deaths; 1,300 injuries; and \$1.4 billion in direct property damage. The fire trend data in this section is based on national estimates from the NFPA fire experience survey as presented in NFPA's *Fire Loss in the United States* series.<sup>4</sup>

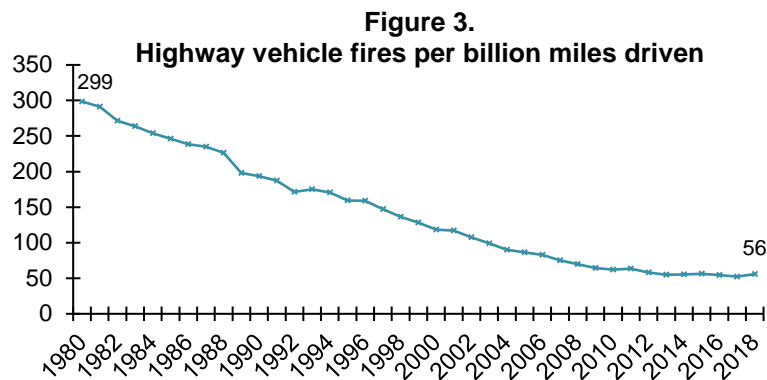


Because fire deaths are less common than fires, it is not surprising that death estimates are more volatile. Figure 2 shows that the estimated annual fire deaths had settled in the range of 260–310 for most of the past decade. However, estimates for 2015, 2017, and 2018 were substantially higher. The 2018 estimate was the highest since 2005.



The number of miles driven by highway vehicles has more than doubled from 1,527 billion in 1980 to 3,255 billion in 2018.<sup>5</sup>

Figure 3 shows that the number of vehicle fires per billion miles driven has fallen 81 percent over the same period. The decline has been fairly steady over time.

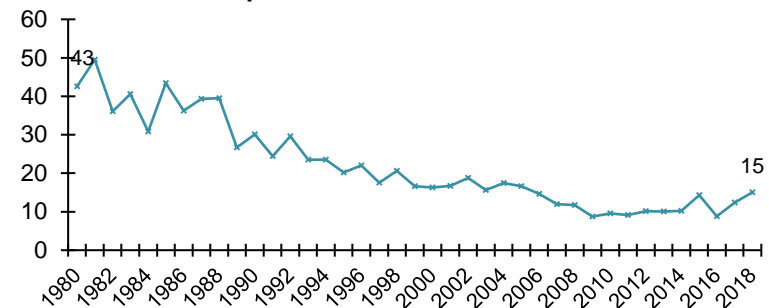


Sources: NFPA's *Fire Loss in the United States* series, US Department of Transportation, Federal Highway Administration Office of Highway Policy Information.

Figure 4 shows that even with the recent increases in highway vehicle fire deaths, the fire death rate per 100 billion miles was still 65 percent lower in 2018 than in 1980.

The 2013–2017 estimates that follow were derived from NFPA's annual fire department experience survey and the detailed data from the US Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS). At the time this analysis was done, NFIRS data for 2018 was not yet available.

**Figure 4. Highway vehicle fire deaths per 100 billion miles driven**



*Fire Loss in the United States* series, US Department of Transportation, Federal Highway Administration Office of Highway Policy Information.

## Patterns of highway vehicle fires

The 181,700 highway vehicle fires<sup>iii</sup> per year in 2013–2017 caused an average of 355 civilian deaths; 1,172 civilian injuries; and \$1.3 billion in direct property damage. These fires accounted for 92 percent of all reported vehicle fires, 91 percent of vehicle fire deaths, 81 percent of vehicle fire injuries, and 74 percent of vehicle fire dollar loss.

Highway vehicle fires accounted for 14 percent of reported fires of all types, 11 percent of fire deaths, 8 percent of fire injuries, and 9 percent of total fire dollar loss.<sup>iv</sup> The remainder of this report will focus on highway vehicle fires.

Sources: NFPA's

<sup>iii</sup> If a vehicle inside a structure caught fire and spread to the structure or other contents, that fire would be considered a structure fire.

<sup>iv</sup> Percentages were calculated from the 2013–2017 total vehicle fire estimates derived from NFIRS and the NFPA fire experience survey.

## The victims of highway vehicle fires

Four out of five fatal highway vehicle fire victims (79 percent) and the non-fatally injured (80 percent) were male. This is somewhat higher than the 71 percent of all highway crash fatalities who were male.<sup>6</sup>

Victims of fatal highway vehicle fires tend to be close in age to overall crash victims. This is consistent with the fact that three of every five highway vehicle fire deaths resulted from fires caused by collisions or overturns.

**Figure 5.**  
**Highway vehicle fire deaths and injuries**  
**by age group: 2013–2017**

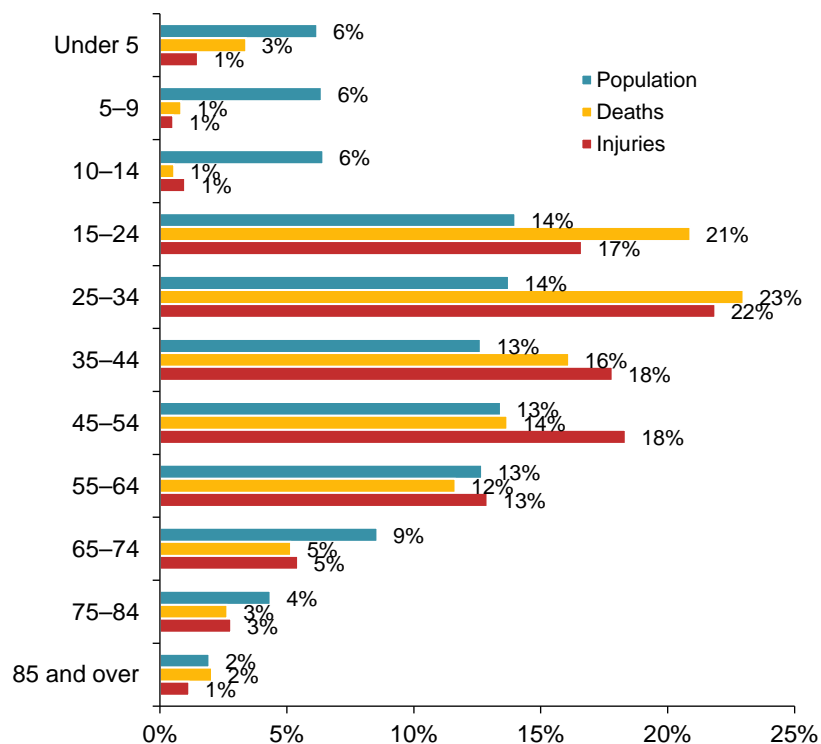


Figure 5 shows that almost half (44 percent) of the vehicle fire fatalities were between 15 and 34, compared to 38 percent of all crash victims.<sup>7</sup> Only 10 percent of highway vehicle fire fatalities and 18 percent of all crash victims were 65 years old or older.

## When are highway vehicle fires most common?

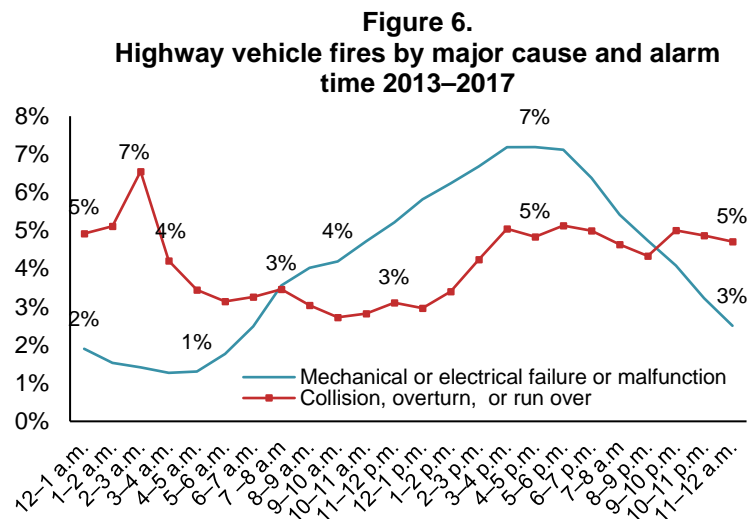
Highway vehicle fires were most common from May through August, peaking in July. Vehicle fire deaths were more common in fires on Saturdays and Sundays. According to NHTSA, Saturday was the peak day for fatal vehicle crashes in 2017, followed by Sunday and Friday. Eighteen percent of the fatal crashes on Sundays occurred between midnight and 3:00 a.m. This suggests a continuation of Saturday night activities might have been a factor in Sunday's larger share of deaths.

Highway vehicle fire times appear to correlate with the times vehicles are in use. The smallest number of fires occurred between 4:00 a.m. and 6:00 a.m. Fires increased steadily throughout the day, peaking between 3:00 p.m. and 6:00 p.m., likely due to rush hour traffic. From that point forward, fires steadily decreased.

Only 9 percent of the highway vehicle fires occurred between midnight and 3:00 a.m., but these hours accounted for 21 percent of the highway vehicle fire deaths. The 2017 “National Household Travel Survey” (NHTS) collected information about the time of day people were on the road in vehicles. Only 2 percent of all trips began between 1:00 a.m. and 6:00 a.m.<sup>8</sup> With fewer vehicles on the road, greater speeds are possible, resulting in higher impact collisions. Driver fatigue and impairment can also play a role in these post-collision fire deaths.

Figure 6 shows that the time at which a highway vehicle fire occurs varies by the cause of the fire. Vehicle fires resulting from collision or overturns peaked between 2:00 a.m. and 3:00 a.m. However, the

variation by time of day was smaller and less consistent with fires caused by mechanical or electrical failures. Fires resulting from mechanical or electrical failures or malfunctions began increasing in frequency during the morning commute and peaked between 2:00 p.m. and 6:00 p.m. NHTS found that 86 percent of trips started between the hours of 6:00 a.m. and 7:00 p.m. These fires were more common when more vehicles are on the road.<sup>9</sup>



## Fire causes and circumstances

The leading causes of vehicle fires varied based on the type of vehicle and whether fires or fire deaths were being considered. This section will focus on the causes and circumstances of all types of highway vehicle fires, and, more specifically, car fires, car fire deaths, large truck fires, and bus fires (including school buses).

- The 117,400 car fires (65 percent of highway vehicle fires) per year caused an average of 230 fire deaths (65 percent), 694 fire injuries (59 percent), and \$557 million in direct property damage (44 percent) annually in 2013–2017.

- The 12,600 large truck fires per year (6 percent) caused an average of 33 fire deaths (9 percent), 102 injuries (7 percent), and \$281 million in direct property damage (16 percent). The large truck category includes semi-trailers with or without tractors, general use trucks, dump trucks, fire apparatus, garbage trucks, and tank trucks.
- The 1,550 bus fires per year (1 percent) caused an average of 11 injuries (1 percent) and \$28 million in direct property damage (2 percent) annually. Because participation in NFIRS is voluntary at the federal level, estimates of rare events, such as fatal bus fires, might be artificially inflated when such a death is reported, or it might underestimate the problem when such fires are not reported. Although no bus fire deaths were reported to NFIRS during this time period, seven passengers died of asphyxiation and burns as a result of an April 2014 California fire that started after a bus was hit by a tractor-trailer.<sup>10</sup> A school bus driver and a 16-year-old student died in an Iowa fire in December 2017.<sup>11</sup> These fires will be discussed in more detail later in the report.

Figure 7 shows that roughly three-quarters of the highway vehicle fires occurred on some type of highway, street, or parking area. While highways or divided highways were the most common locations for these events, the percentage of car fire deaths and large truck fires that occurred on these properties was approximately twice that of car and bus fires.

In addition, 4 percent of bus fires occurred on educational properties and 3 percent occurred on public assembly properties, including passenger terminals and places of worship. In some cases, fire departments might have listed the location or property use as the main occupancy when the fire actually occurred in a parking lot or driveway.

**Figure 7.**  
Highway vehicle fires by property use  
where the fire occurred: 2013–2017

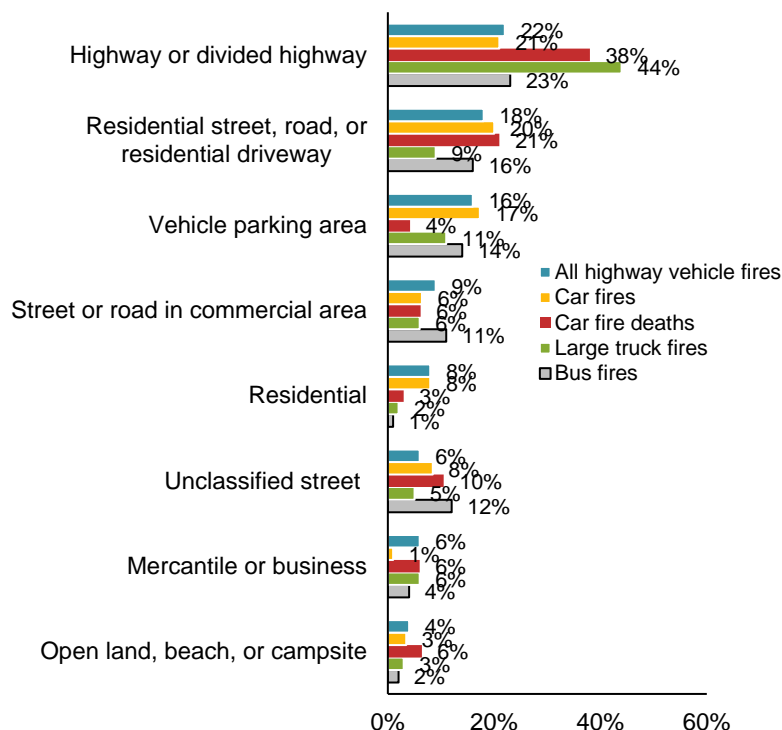
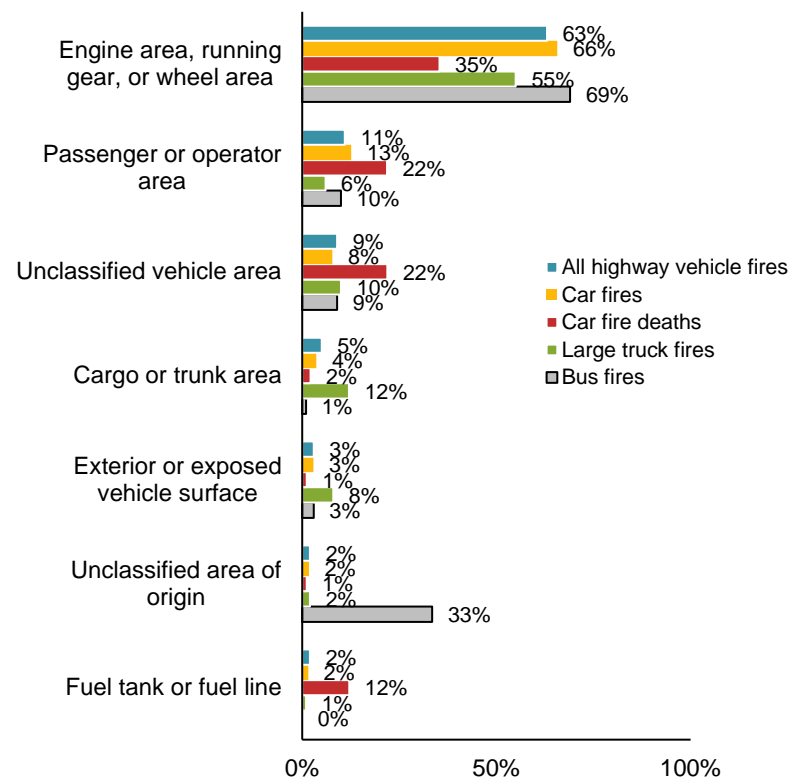


Figure 8 shows that fires most commonly began in the engine area, running gear, or wheel area. However, a disproportionate share of the car fire deaths resulted from fires that started around the fuel tank or fuel line or in the passenger area.

In an SP Technical Research Institute of Sweden pre-study of post-collision fires, Ochoterena, et al., noted that real situation tests showed that fire spreads faster when an engine has been running, and the type of crash can affect the fire spread. Vehicle components that were most critical to fire safety included the fuel system and tank and passenger area items such as the seats, inner roof, dashboard, and door covers. The

**Figure 8.**  
Highway vehicle fires by leading area of origin  
2013–2017



materials in vehicle seats were identified as the greatest potential source of toxic compounds.

Figure 9 shows that mechanical failures or malfunctions were the leading factors in all types of vehicle fires, followed by electrical failures or malfunctions. These fires were much less likely to be fatal than fires resulting from collisions.

Almost two-thirds of car fire deaths resulted from fires caused by collisions or related events. In addition, 79 percent of the deaths from large truck fires were caused by collisions. As noted earlier, a

disproportionate share of car fire deaths and large truck fires occurred on highways or divided highways, suggesting a link between fires and high-speed impacts.

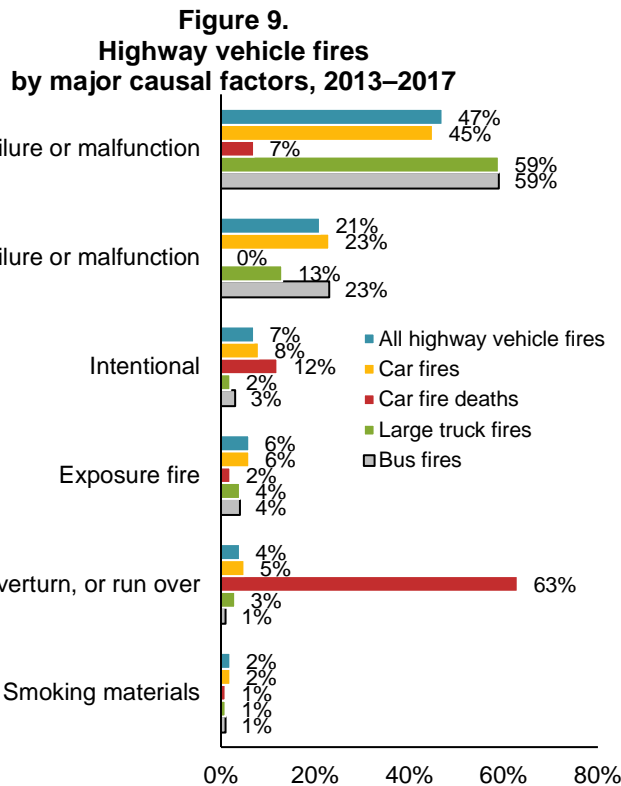
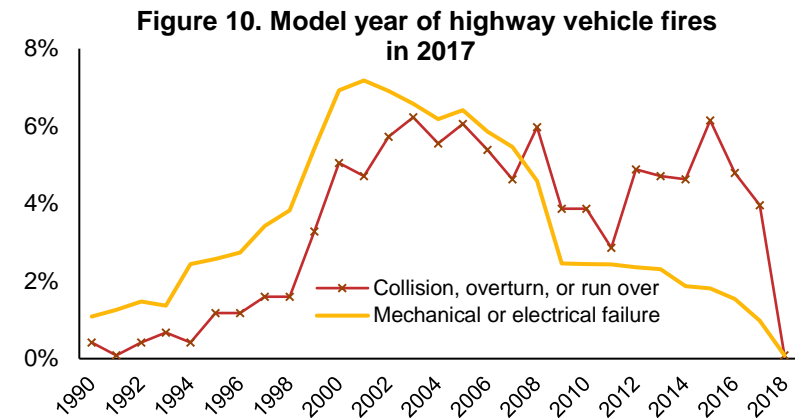


Figure 10 shows that roughly three-quarters of the highway vehicle fires reported in the US in 2017 that were caused by mechanical or electrical failures (77 percent) involved cars with model years of 2007 or earlier. This was true for only 54 percent of the fires resulting from collisions or overturns. As vehicles age, parts wear out, extended maintenance plans expire, and maintenance can be overlooked.

Consequently, it is not surprising that vehicles that are at least 10 years old are at greater risk of a fire started by a mechanical or electrical failure or malfunction.



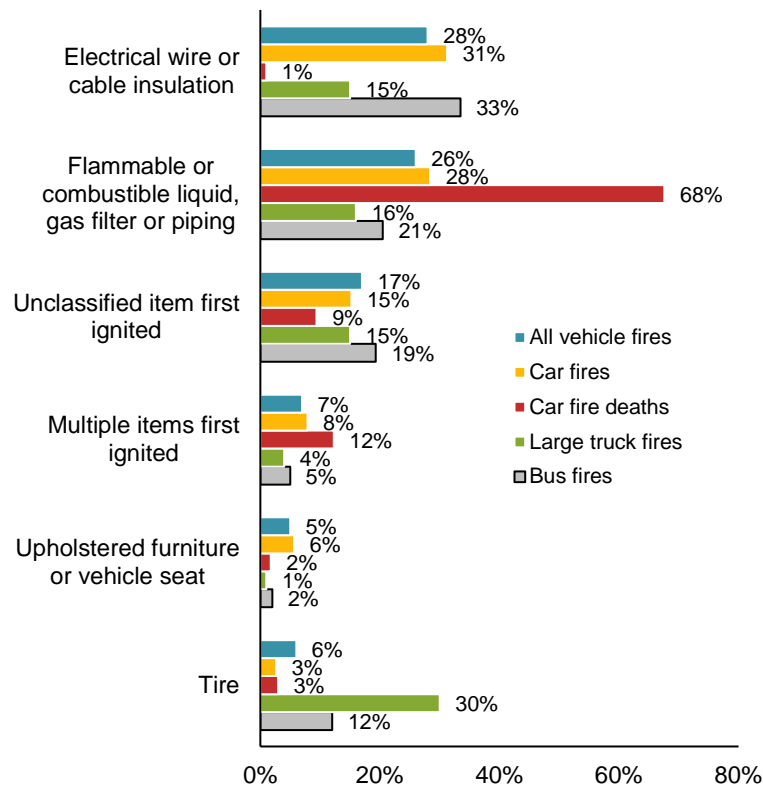
Highway vehicle fires were more likely to begin with the ignition of electrical wire or cable insulation than any other specific item.

Roughly two-thirds of the car fire deaths specifically and highway vehicle fire deaths overall in the US during 2013–2017 resulted from fires that began with a flammable or combustible liquid or gas. Gasoline was first ignited in more than half of all the highway vehicle fire deaths. Ochoterena, et al., noted that the item that first ignited and the subsequent fuels are important components of fire scenarios.

Figure 11 shows that large truck fires were more likely to begin with the ignition of a tire than other items. Tire ignitions were also more common in bus fires than car fires.



**Figure 11.**  
**Highway vehicle fires**  
**by leading item first ignited, 2013–2017**



Bunn, Slavova, and Robertson reviewed data about post-collision fires that occurred on Kentucky highways with speed limits of at least 55 miles per hour.<sup>12</sup> Large trucks accounted for 14 percent of the post-crash fires but only 8 percent of the crashes with no fire. Drivers in large truck post-crash fires were more likely to have been fatigued or asleep than drivers in non-fire crashes. The greater weight of large trucks results in more impact force. These trucks also have much larger fuel tanks. The authors recommended that an automatic inertia fuel

switch, which is already required in cars, should also be required in large trucks.

The Kentucky study also found that fire in any type of vehicle was more likely in single vehicle and head-on crashes. This was especially true for large trucks. Drivers of vehicles that caught fire post-collision were less likely to have been wearing seat belts. Such drivers would seem to pay less attention to safety. Crashes that caused fires were more likely to result in death or severe injury than other crashes. Older vehicles were also more likely to catch fire.

According to data collected by the National Highway Traffic Safety Administration, fire occurred in 3 percent of the vehicles involved in fatal traffic crashes in the US.<sup>13</sup> As in the Kentucky research, fires were more common in fatal large truck crashes (6 percent) than in other vehicle crashes.

## Large truck and bus fires

While large truck fires caused an average of only 33 of the 355 highway vehicle fire deaths per year in 2013–2017 (9 percent), the large truck fire death rate of 2.7 deaths per 1,000 fires was 36 percent higher than the 2.0 deaths per 1,000 highway vehicle fires of all types.

As mentioned previously, no bus fire deaths were reported to NFIRS in the US during 2013–2017, although some did occur. Because of the number of passengers, the potential for many deaths from a bus fire is higher than for other road vehicles. Evacuation from a bus fire is often difficult, particularly if the main entrance has been damaged. Tires and collisions were both common factors in the fatal bus fires narratives that follow.

In his 2016 report on truck, trailer, and bus fires, Peter Hart identified five potential causes of truck trailer and bus fires: electrical, turbocharger and exhaust systems, hot brakes and wheel

bearings, tires, and road debris.<sup>14</sup> He noted that flat or underinflated truck tires can catch fire, as can tires that rub against hard surfaces. Brake and wheel bearing failures can also cause tire ignitions. Tires can be the cause of a fire, a fuel, or both. Figure 11 shows that tires were the item first ignited in 30 percent of large truck fires and 12 percent of bus fires.

The deadliest US bus fire in this century occurred in Wilmer, Texas, on September 23, 2005 during the evacuation before Hurricane Rita. The accident killed 23 passengers from an assisted living/nursing home complex. Two additional passengers were seriously injured. In their investigation, the National Transportation Safety Board (NTSB) learned that the bus was carrying 44 residents and nursing staff.<sup>15</sup> Another motorist alerted the bus driver that the right rear tire hub was glowing red. The driver and nursing staff got out of the vehicle and saw flames coming from the right rear wheel well. Passers-by assisted them with the evacuation of the bus. Insufficient lubrication in the right tax axle wheel bearing assembly was indicated as the probable cause. This led to higher temperatures, failure of the wheel bearings, tire ignition, and deadly fire. Other contributing factors included a lack of maintenance, pre-and post-trip inspections, and fire-retardant construction in the wheel well area. Investigators also learned that it had taken between 1½ to 2 hours to get the residents onboard the bus. Cognitive and mobility impairments were among the factors that hindered the evacuation.

The National Institute of Standards and Technology (NIST) studied the growth of a bus tire fire that could be caused by failed bearings, locked brakes, or dragged blown tires. In the experiment, conditions reached tenability limits in the fire area within eight minutes of fire penetration in the passenger compartment and in the whole compartment within 11 minutes.<sup>16</sup>

In April 2014, a tractor pulling two 28-foot trailers on a California highway left the travel lanes and crossed the median, where it struck

a car. The car spun around and off the highway. The truck then collided with a bus containing 42 high school students and three adult chaperones. The resulting fire destroyed the tractor, large parts of the trailer, and the interior of the bus. The truck driver died of asphyxiation. The bus driver, although severely burned, died of blunt force trauma. Six passengers died from asphyxiation, one passenger was fatally burned, and one died of blunt force trauma. Ten seriously injured passengers suffered both fire injuries and injuries from the collision or exit process. The NTSB made several additional observations as part of their report:<sup>17</sup>

- The emergency exit windows were roughly seven feet above the ground. The height was challenging, and passengers had difficulty keeping the windows open.
- The collision was almost head-on, creating a large hole in the front of the bus and rupturing the right fuel tank of the tractor. This allowed fuel to get inside the bus. The interior of the bus filled with smoke very quickly.
- Burning diesel fuel, tires, and material in the front of the bus, rather than the interior materials, created the untenable conditions. FMVSS 302, the current flammability standard for highway vehicle interiors, was designed to protect against small ignition sources, such as matches, lighters, and smoking materials, not the more frequent bus fire scenarios. Modern vehicles have greater crash survivability.

Forty-three people died after a truck crashed into a bus in France and a fire erupted.<sup>18</sup> The driver of the truck, which was pulling an empty wood trailer, lost control of the vehicle when navigating a tight bend on a French road on October 23, 2015. His vehicle jackknifed and crashed into a bus heading in the opposite direction, crushing one of the bus's fuel tanks and damaging the tractor unit's added tank. A fire erupted between the truck and the bus almost immediately.

Interior materials in the bus caught fire, resulting in toxic smoke. The smoke extraction vents were never opened.

Forty-nine people were on the bus, including members of an older adult club on an excursion and their tour leader. After the crash, the lights on the bus went out. The driver used the manual emergency system to open the front door, exited, and opened the central door from outside. Only one passenger escaped out the front door. Six evacuated through a side door. The stairs were narrow and steep, posing challenges for those with limited mobility. The impact also damaged a safety barrier, partially obstructing the stairwell. A passenger broke a window by that door with an emergency hammer to create an escape hole, out of which one person escaped. Forty-one passengers died, as did the truck driver and his passenger.

Investigators believe that the truck driver was traveling at an excessive speed for the location. The tractor also had an unapproved fuel tank installed in the back of its cabin.

Investigators recommended that vehicle manufactures do the following:

- Inspect any added fuel tanks after installation.
- Use materials that are more fire-resistant and less toxic if burned.
- Make smoke extraction devices easier to use.
- Add emergency exit doors at the rear of coaches. If this is not possible, make emergency exits more accessible and easier to use.
- Reinforce legislation on emergency lighting systems to ensure that emergency exits and equipment remain visible.

Investigators also encouraged authorities to consider reducing the speed limit at the crash site, suggested large truck driver unions communicate the importance of following the rules for additional

fuel tanks, and encouraged the development of a brochure about emergency evacuation and what to do in the event of a fire.

Rakovic, Försth, and Brandt reviewed the data on commercial bus fires in Sweden in 2005–2013.<sup>19</sup> They found that 61 percent of the commercial bus fires started in the engine compartment, 20 percent began in the wheel well, 5 percent started inside the bus or other area, and 14 percent began in an unknown location. Figure 8 shows that this is fairly consistent with the 69 percent of US bus fires that began in the engine area, running gear, or wheel area, and the 10 percent that started in the passenger or operator area.

## Electric vehicle fires

While hybrid and electric vehicles have become more common, existing data collection systems have not yet adequately captured the frequency of fires involving these specific vehicles.

In a recently published *Fire Technology* invited paper, Sun, Bisschop, Niu, and Huang provided a comprehensive overview of battery fires in electric vehicles.<sup>20</sup> Most fire incidents involving battery electric vehicles or plug-in hybrid electric vehicles began in the battery power system. The battery system could, in terms of propulsion, be compared to gasoline capacity in internal combustion engine vehicles (ICEVs). Electric vehicle (EV) fire risk increases with more batteries and with batteries containing more energy.

In addition to trauma from impact, batteries can be stressed by temperature extremes and fluctuations, heavy rain, overcharging, or charging too quickly. Manufacturing and design issues can also play a role.

As manufacturers increase the range of EVs by adding more lithium-ion batteries (LIBs), the potential heat that could be released in a fire grows.

EV fires can occur:

1. When a vehicle is stationary. Extreme temperatures, high humidity, internal cell failure, and abuse of a LIB at some prior time can all cause such fires.
2. When the EV is charging due to overcharging or problems with the charging stations or cables.
3. After a traffic crash or other abuse does sufficient damage to cause ignition during or immediately after the crash.
4. When an LIB reignites after an initial fire has been handled.
5. Due to external factors, such as arson or other fires (wildland, structure, or other vehicles) nearby.

It takes some time for enough energy to accumulate to trigger thermal runaway in a battery. This makes them different from ICEVs, which can be quickly ignited by a spark or flame. Fire development in a LIB battery pack might not be obvious in the early stages. The authors recommend fire detection and extinguishing systems to prevent such scenarios.

Mechanical and electrical fires, the most common fires in ICEVs, become more common as the vehicles age. EVs have not yet reached the ages where these conditions are more commonly seen.

Plans must be made and procedures established to protect the environment and those involved in the collection of batteries during the disposal stages. The risk of fire increases when battery packs accumulate, as is likely during the disposal process.

The authors also noted the challenges faced by the fire service when fighting fires in these vehicles. Consumers reporting fires in these vehicles are advised to indicate if a vehicle is electric or hybrid when reporting them.

## NHTSA regulates vehicles

Occasionally, defects in the manufacturing process cause fire hazards. Consumers can enter their Vehicle Identification Number (VIN) at [nhtsa.gov/recalls](https://www.nhtsa.gov/recalls) to learn of any safety recalls. Consumers can report safety-related complaints at <https://www-odi.nhtsa.dot.gov/VehicleComplaint/> or search complaints at <https://www.nhtsa.gov/recalls#vehicle>.

## Methodology

Supporting tables for the information found in this report are [available here](#). Vehicle fires were identified by NFIRS incident type codes 130–139. The NFIRS Mobile property data element was used to classify vehicles by type, regardless of the vehicle fire incident type. Highway vehicles were identified by mobile property codes 10–29. Cars were identified by mobile property 11, buses by mobile property 12, and large trucks by mobile property 21 and 23–27. Unknown data, except for the incident type and property use, were allocated proportionally for each data element. Major causal factors were pulled from several NFIRS data elements, including factors contributing to ignition, heat sources, and causes of ignition. Double counting can occur. Reports of fires from departments providing mutual aid were excluded from the analysis.

National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Percentages were calculated on the actual estimates, so two figures with the same rounded estimates could have different percentages. Except for trend tables, property loss was not adjusted for inflation.

To compensate for fires that were reported to local fire departments but not captured in NFIRS, estimates from NFPA's fire department experience survey are divided by totals in NFIRS. The resulting



multipliers are applied to the NFIRS data. For more information on how national estimates of fires are calculated, see “[How NFPA’s National Estimates Are Calculated for Home Structure Fires.](#)”

## Acknowledgements

The National Fire Protection Association thanks all the fire departments and state fire authorities who participate in NFIRS and the annual NFPA Survey of Fire Departments for US Fire Experience During 2018. These firefighters are the original sources

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<sup>1</sup>Evarts, Ben. *Fire Loss in the United States During 2018*. Quincy, MA: NFPA, 2019. Available at [nfpa.org/News-and-Research/Data-research-and-tools/US-Fire-Problem/Fire-loss-in-the-United-States](https://nfpa.org/News-and-Research/Data-research-and-tools/US-Fire-Problem/Fire-loss-in-the-United-States).

<sup>2</sup>National Highway Traffic Safety Administration (NHTSA), *Traffic Safety Facts 2017: A Compilation of Motor Vehicle Crash Data*, DOT HS 812 806, 2019. p. 10. Accessed at [crashstats.nhtsa.dot.gov/#/DocumentTypeList/12](https://crashstats.nhtsa.dot.gov/#/DocumentTypeList/12) on January 28, 2020.

<sup>3</sup>McGuckin, N. and Fucci, A., *Summary of Travel Trends: 2017 National Household Travel Survey*. Rockville, MD: US Department of Transportation, Federal Highway Administration, 2018, FHWA-PL-18-019. Accessed at [nhts.ornl.gov/assets/2017\\_nhts\\_summary\\_travel\\_trends.pdf](https://nhts.ornl.gov/assets/2017_nhts_summary_travel_trends.pdf) on January 29, 2020.

<sup>4</sup>Evarts, Ben. *Fire Loss in the United States During 2018*. Quincy, MA: NFPA, 2019. Also, earlier annual reports in series by Michael Karter and Hylton Haynes. See [nfpa.org/News-and-Research/Data-research-and-tools/US-Fire-Problem/Fire-loss-in-the-United-States](https://nfpa.org/News-and-Research/Data-research-and-tools/US-Fire-Problem/Fire-loss-in-the-United-States).

<sup>5</sup>“Highway Statistics 2018: Public Road Mileage, Lane-Miles, and VMT – 1900-2018,” US Department of Transportation Federal Highway Administration, Office of Highway Policy Information. Chart VMT-422 Highway Statistics 2018 Accessed at <https://www.fhwa.dot.gov/policyinformation/statistics/2018/vmt421c.cfm> on March 18, 2020.

<sup>6</sup>NHTSA, 2017, Table 68, p. 108.

<sup>7</sup>NHTSA, 2017, Table 69, p. 109.

<sup>8</sup>McGuckin and Fucci. Table 29, p. 86.

<sup>9</sup>McGuckin and Fucci. Table 29, p. 86.

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. To learn more about research at NFPA visit [nfpa.org/News-and-Research](https://nfpa.org/News-and-Research).

Email: [research@nfpa.org](mailto:research@nfpa.org)

NFPA No. USS27

<sup>10</sup>Panagiotou, Joseph and Kelly, Joseph, “Case Study of Recent Accidents Investigated by the NTSB.” *Proceedings from 4<sup>th</sup> International Conference on Fires in Vehicles – FIVE 2016 Baltimore, MD, USA*. pp. 171-182. Accessed at [ri.diva-portal.org/smash/get/diva2:1120218/FULLTEXT01.pdf](https://ri.diva-portal.org/smash/get/diva2:1120218/FULLTEXT01.pdf) on February 6, 2020.

<sup>11</sup>National Transportation Safety Board. *School Bus Run-Off-Road and Fire: Oakland, Iowa: December 12, 2017*. Highway Accident Report. NTSB/HAR – 19/01 PB 2019-100808, 2019. Accessed at [ntsb.gov/investigations/AccidentReports/Reports/HAR1901.pdf](https://ntsb.gov/investigations/AccidentReports/Reports/HAR1901.pdf) on February 6, 2020.

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