July 2018 | Volume 19, Issue 2

Highway Vehicle Fires (2014-2016)

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 National Fire Incident Reporting System. 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

- Approximately one in eight fires responded to by fire departments across the nation is a highway vehicle fire. This does not include the tens of thousands of fire department responses to highway vehicle accident sites.
- Unintentional action (38 percent) was the leading cause of highway vehicle fires.
- Eighty-three percent of highway vehicle fires occurred in passenger vehicles.
- Sixty-two percent of highway vehicle fires and 36 percent of fatal highway vehicle fires originated in the engine, running gear or wheel area of the vehicle.
- Mechanical failure was the leading factor contributing to the ignition of highway vehicle fires (45 percent).
- Insulation around electrical wiring (29 percent) and flammable liquids in the engine area (18 percent) were the most common items first ignited in highway vehicle fires.
- Sixty percent of fatal vehicle fires were the result of a collision.

Each year, from 2014 to 2016, an estimated 171,500 highway vehicle fires occurred in the United States, resulting in an annual average of 345 deaths; 1,300 injuries; and $1.1 billion in property loss.[1] These highway vehicle fires accounted for 13 percent of fires responded to by fire departments across the nation.[2] The term "highway vehicle fires" includes fires in passenger road vehicles (e.g., cars, motorcycles and off-road recreational vehicles), freight road transport vehicles (e.g., dump trucks, fire apparatus and tank trucks), and agricultural and construction vehicles.

This topical report addresses the characteristics of highway vehicle fires as reported to the U.S. Fire Administration's (USFA) National Fire Incident Reporting System (NFIRS) from 2014 to 2016, the most recent data available at the time of the analysis.[3] NFIRS data is used for the analyses throughout this report.

Loss measures

Table 1 presents losses, averaged over the three-year period from 2014 to 2016, of reported highway vehicle fires and all other fires (excluding highway vehicle fires).[4] The average number of fatalities per 1,000 highway vehicle fires was higher than for fatalities for all other fires. The average number of injuries per 1,000 highway vehicle fires, as well as the dollar loss per fire, were lower than the same loss measures for all other fires.

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Table 1. Loss measures for highway vehicle fires (three-year average, 2014-2016)

Measure	Highway vehicle fires	All fires (excluding highway vehicle fires)
Average loss:		
Fatalities/1,000 fires	2.9	2.2
Injuries/1,000 fires	4.4	10.7
Dollar loss/fire	$7,290	$10,290

Source: NFIRS 5.0.
Notes: 1. Average loss for fatalities and injuries is computed per 1,000 fires. Average dollar loss is computed **per fire** and is rounded to the nearest $10.
2. The 2014 and 2015 dollar-loss values were adjusted to 2016 dollars.

Types of highway vehicle fires

The majority of highway vehicle fires, 83 percent, occurred in passenger road vehicles: 66 percent occurred in standard passenger vehicles,[5] 17 percent occurred in some other type of passenger vehicle, and less than 1 percent occurred in buses. Only 10 percent of highway vehicle fires occurred in nonpassenger vehicles: 9 percent occurred in transport vehicles, with freight road transportation vehicles[6] accounting for the majority of these fires, and 1 percent occurred in other types of vehicles, such as construction vehicles, farm tractors and special purpose vehicles. In the remaining 7 percent of highway vehicle fires, the type of vehicle was not reported (Table 2).

Table 2. Types of highway vehicle fires (2014-2016)

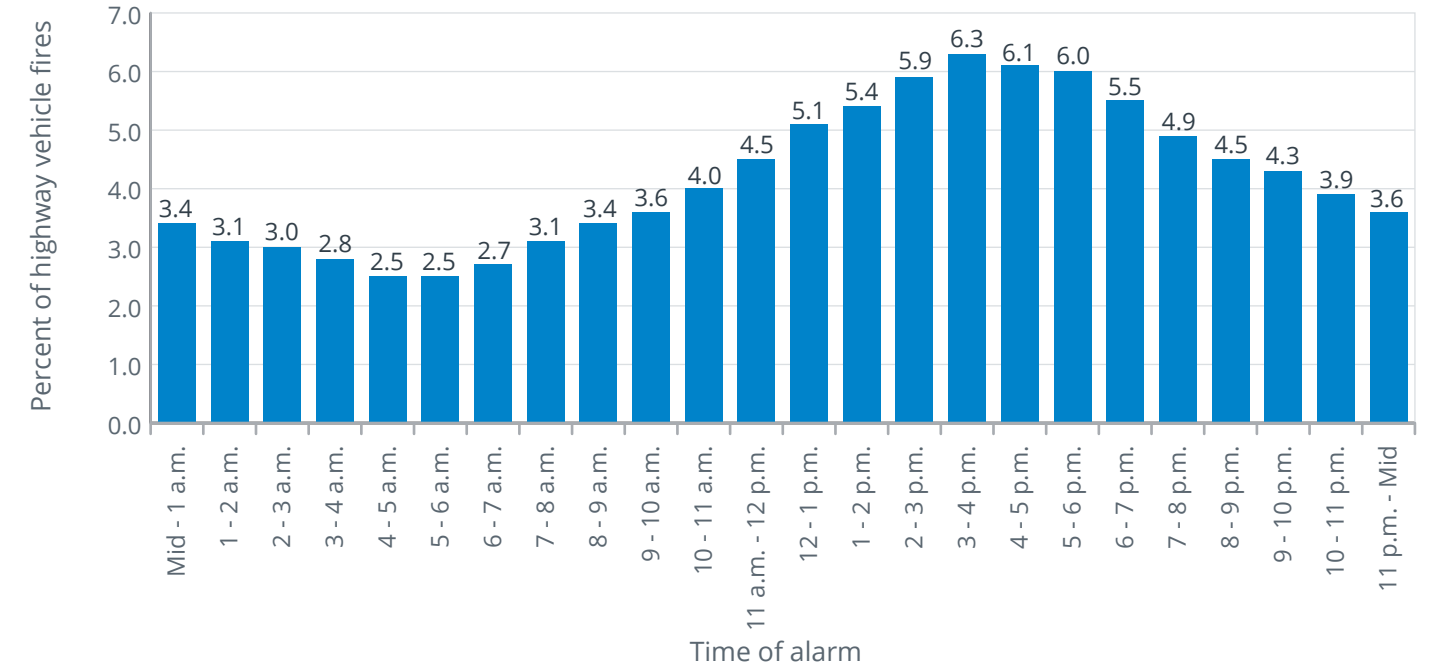
Type of vehicle	Percent of highway vehicle fires
Passenger road vehicle	83.3
Passenger vehicle	65.8
Passenger or road vehicles, other	16.9
Buses	0.6
Transport vehicle	8.9
Freight road transport vehicle	8.8
Rail transport vehicle	0.1
Water transport vessel	<0.1
Air transport vehicle	<0.1
Other vehicle	0.8
Mobile property, other	0.4
Industrial, construction, agricultural vehicles	0.3
Special purpose vehicle	0.1
No entry/Undetermined	7.0
Total	**100.0**

Source: NFIRS 5.0.
Note: No entry/Undetermined includes incidents where the mobile property type was designated as "None."

When highway vehicle fires occur

As shown in Figure 1, highway vehicle fires mainly occurred in the afternoon and evening hours, peaking from 2 to 6 p.m. (24 percent). Highway vehicle fires occurred the least often in the morning hours from 4 to 6 a.m. (5 percent).[7]

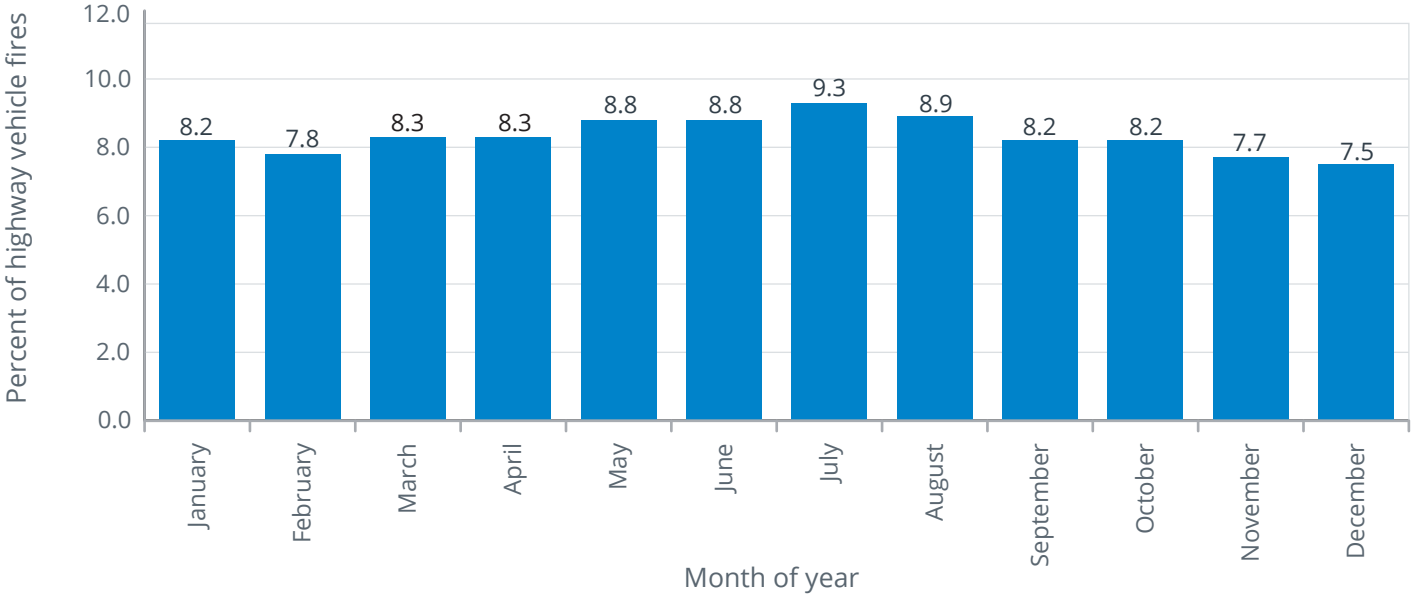
Figure 1. Highway vehicle fires by time of alarm (2014-2016)



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

Figure 2 shows that while highway vehicle fires occurred nearly uniformly throughout the year, the number of these fires were slightly higher during the months of May through August (36 percent). It is possible this slight peak may be due to elevated outdoor temperatures or increased vehicle use, as many individuals and families take vacations during these months.

Figure 2. Highway vehicle fires by month (2014-2016)



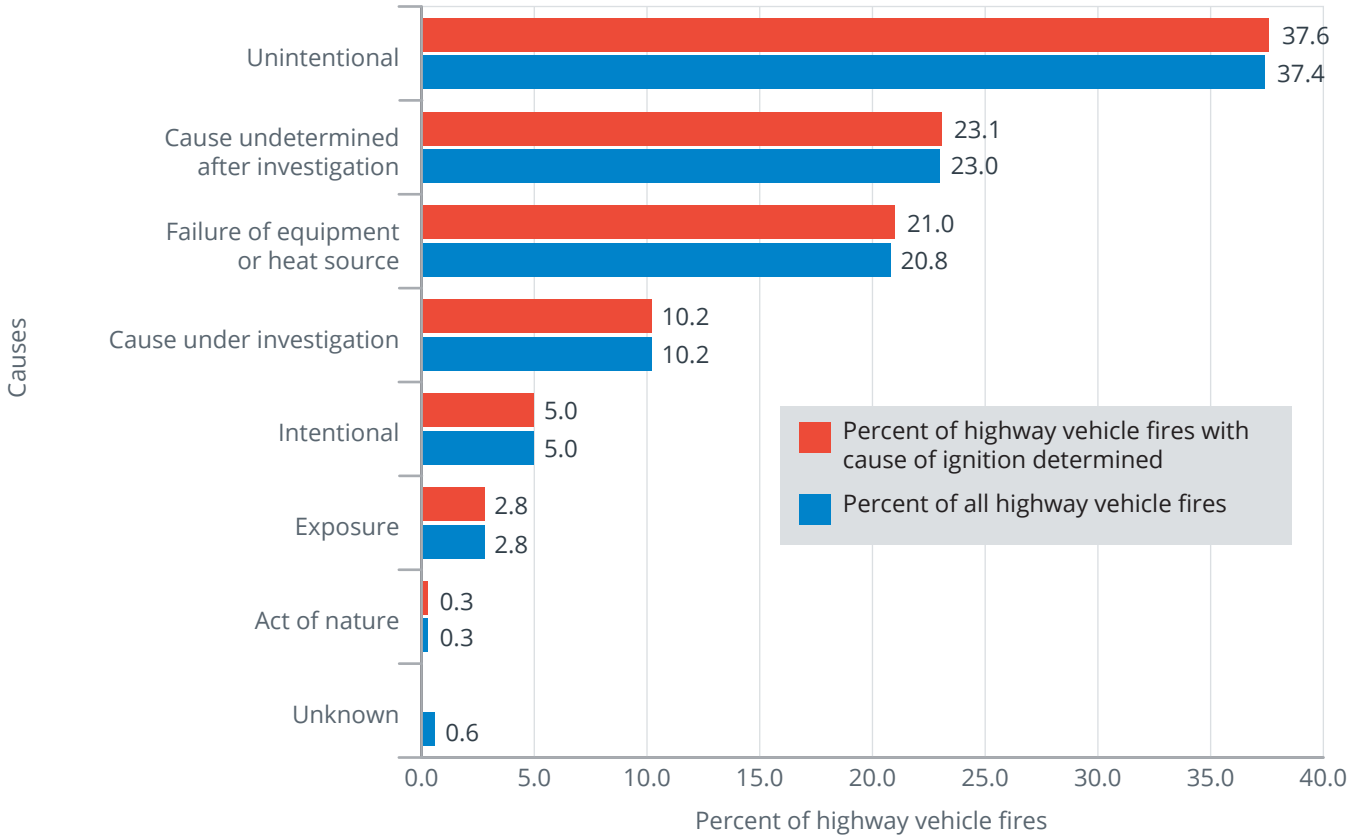
Source: NFIRS 5.0.

Causes of highway vehicle fires

As shown in Figure 3, unintentional actions accounted for 38 percent of highway vehicle fires. These fires may be the result of either careless behavior or accidental actions. Fires caused by intentional actions constituted only 5 percent of highway vehicle fires.[8] The NFIRS no longer collects information on suspicious fires that may have been intentionally set.[9] As a result, fires caused by intentional actions may be undercounted. Moreover, due to the volume of fires, many automobile fires are not investigated for possible arson.

Determining the cause of vehicle fires is often challenging. As a result, in 23 percent of highway vehicle fires, no cause was determined after an investigation. The failure of equipment or the heat source was the cause in an additional 21 percent of highway vehicle fires. These fires are generally a result of mechanical problems, ranging from a faulty design in the vehicle to an improperly installed device.

Figure 3. Causes of highway vehicle fires (2014-2016)



Source: NFIRS 5.0.
Note: Total percent of all highway vehicle fires does not add up to 100 percent due to rounding.

Where highway vehicle fires start (area of fire origin)

As expected, the majority (93 percent) of highway vehicle fires originated within the vehicle itself. In fact, 62 percent of highway vehicle fires originated specifically in the engine, running gear,[10] or wheel areas of the vehicle (Table 3). The second most common area of fire origin was in the operator/passenger area of the vehicle (12 percent).

Table 3. Areas of fire origin in highway vehicle fires (2014-2016)

Areas of fire origin	Percent of highway vehicle fires (unknowns apportioned)
Transportation, vehicle areas	93.1
Engine area, running gear, wheel area	62.2
Operator/Passenger area of transportation equipment	12.3
Other vehicle areas	8.7
Cargo/Trunk area — all vehicles	4.6
Exterior, exposed surface of vehicle	3.4
Fuel tank, fuel line	1.6
Separate operator/control area of transportation equipment	0.3
All other areas	6.9
Total	100.0

Source: NFIRS 5.0.

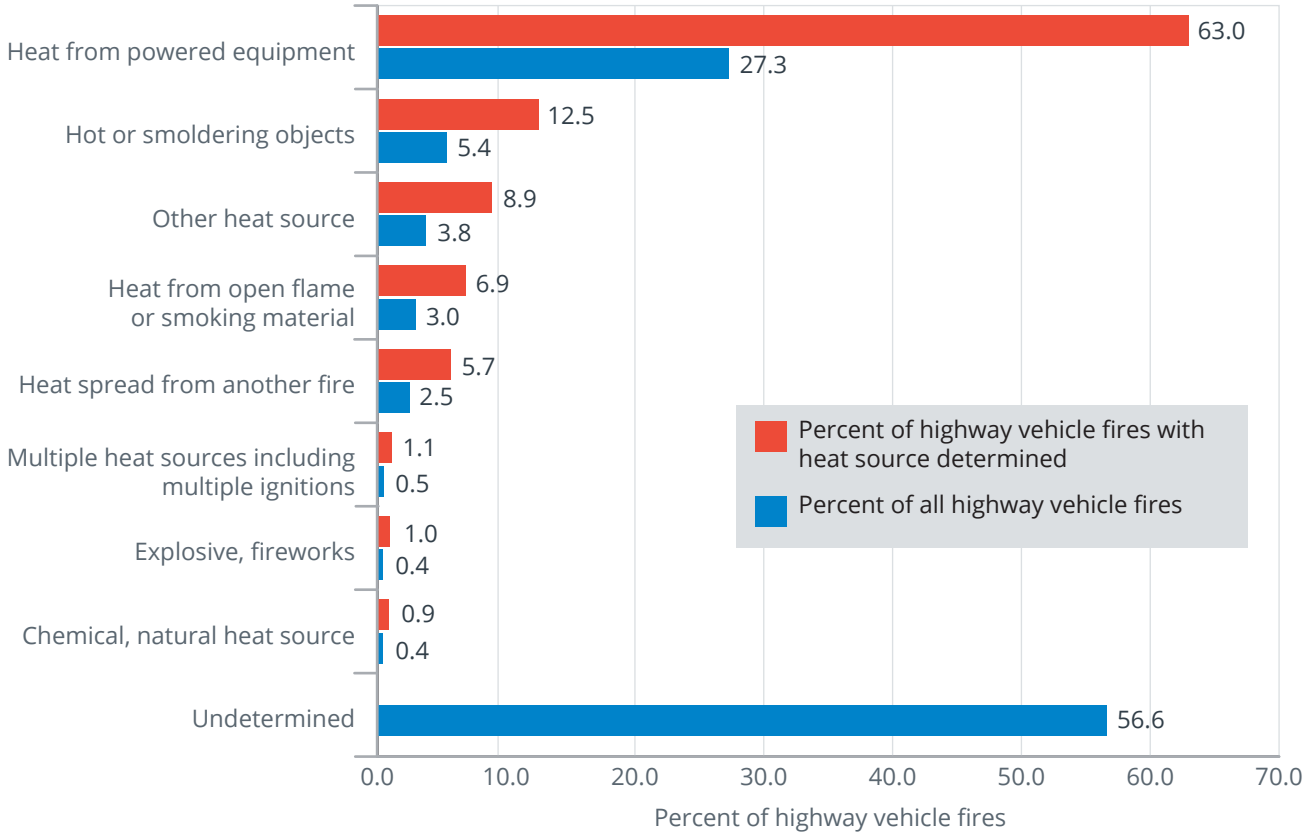
How highway vehicle fires start (heat source)

Figure 4 shows heat source categories for highway vehicle fires. The "heat from powered equipment" category accounted for 63 percent of highway vehicle fires.[11] Fittingly, the subcomponents of this category are comprised of four of the top five specific sources of heat in all highway vehicle fires — heat from miscellaneous powered equipment (22 percent); radiated or conducted heat from operating equipment (17 percent); electrical arcing (16 percent); and spark, ember or flame from operating equipment (8 percent).

The next leading heat source category in highway vehicle fires was "hot or smoldering object" (13 percent). This category includes items such as hot or smoldering objects (5 percent) and sparks that result from friction, including overheated tires (5 percent). The third leading heat source category is "other heat source" (9 percent), which includes miscellaneous items.

An additional 7 percent of highway vehicle fires derived their heat source from items that fell under the "heat from open flame or smoking material" category. This category includes backfire from the engine and heat from cigarettes, cigars, matches, torches and the like.

Figure 4. Sources of heat in highway vehicle fires by major category (2014-2016)



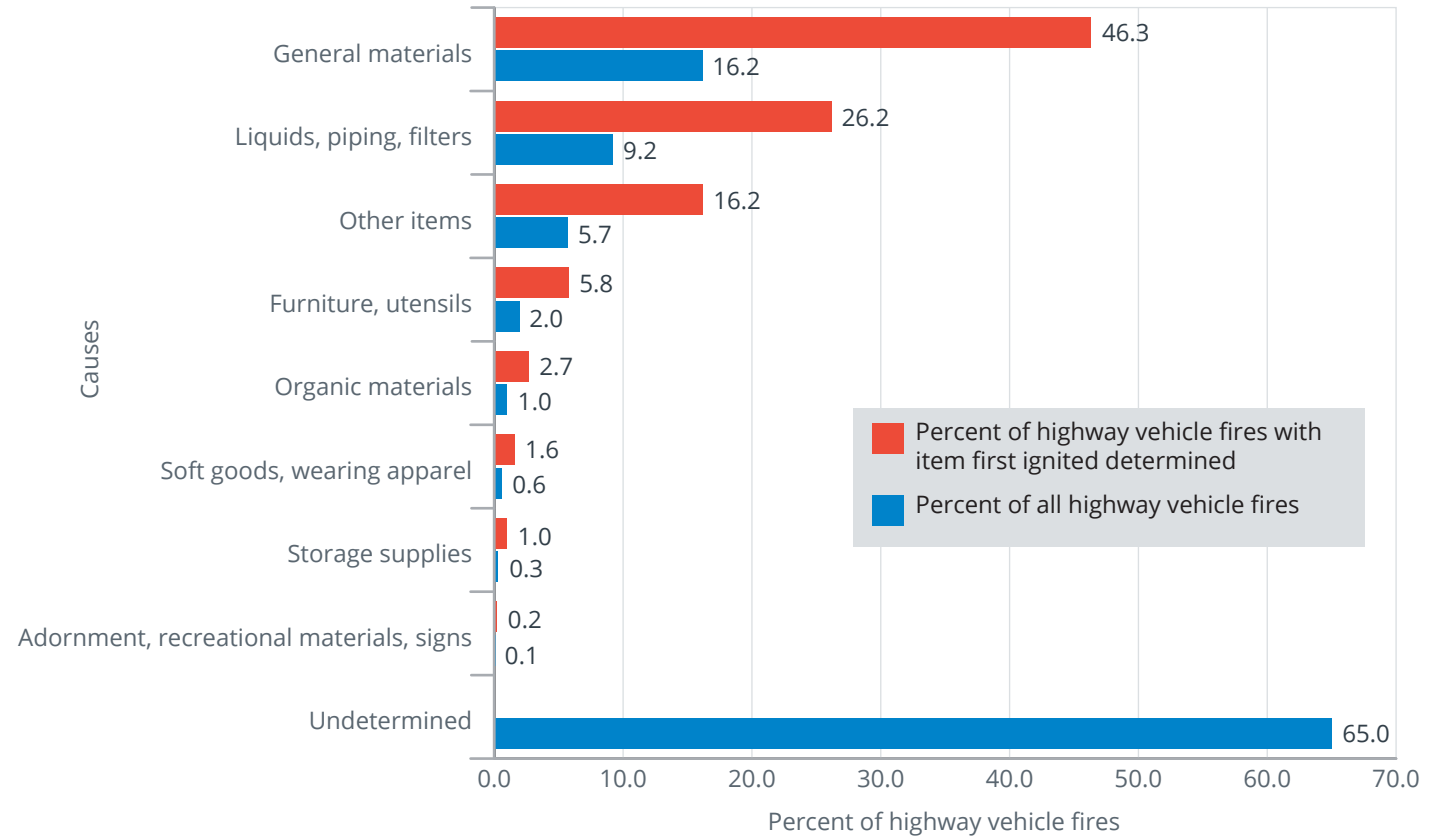
Source: NFIRS 5.0.
Note: Total percent of all highway vehicle fires does not add up to 100 percent due to rounding.

What ignites first in highway vehicle fires

Forty-six percent of the items first ignited in highway vehicle fires fell under the category of "general materials" (Figure 5).[12] This category includes materials such as tires, insulation around electric wire and cables, trash, and fabric. Specifically, insulation around the electrical wiring or other cables was the most common item to initially ignite, not only within this category but in all highway vehicle fires (29 percent). While it is often assumed that vehicle fires commonly originate with the tires of the vehicle, tires were the item first ignited in only 6 percent of all highway vehicle fires.

The second leading category of items first ignited was "liquids, piping, filters" (26 percent). This category primarily includes fuel in various locations in the vehicle. Due to its combustibility, fuel from the engine area was the leading specific item first ignited within this category and was the second most common specific item first ignited in highway vehicle fires overall (18 percent). In general, flammable liquids and gases accounted for 24 percent of items first ignited.

Figure 5. Item first ignited in highway vehicle fires by major category (2014-2016)



Source: NFIRS 5.0.
Note: Total percent of all highway vehicle fires does not add up to 100 percent due to rounding.

Factors contributing to ignition in highway vehicle fires

Table 4 shows categories of the factors contributing to the ignition of highway vehicle fires. Mechanical failure or malfunction was the leading contributing factor of highway vehicle fires (45 percent). These mechanical failures include a leak or break in a component of the vehicle, automatic or manual control failures, or the use of an improper type of fuel. An electrical failure or malfunction, such as a short circuit, was a contributing factor in 21 percent of highway vehicle fires. The misuse of a material or product, such as spilling flammable liquid or gas too close to the vehicle, was the third leading factor contributing to the ignition of the fires (13 percent). These three leading contributing factors played a role in 79 percent of highway vehicle fires.

Table 4. Factors contributing to ignition for highway vehicle fires by major category (where factors contributing to ignition are specified, 2014-2016)

Factor contributing to ignition category	Percent of highway vehicle fires (unknowns apportioned)
Mechanical failure, malfunction	44.8
Electrical failure, malfunction	21.4
Misuse of material or product	12.9
Fire spread or control	8.5
Operational deficiency	8.4
Other factors contributing to ignition	6.6
Natural condition	0.8
Design, manufacture, installation deficiency	0.7

Source: NFIRS 5.0.

Notes: 1. Includes only incidents where factors that contributed to the ignition of the fire were specified.
2. Multiple factors contributing to fire ignition may be noted for each incident; total will exceed 100 percent.

Fatal highway vehicle fires

Less than 1 percent of all highway vehicle fires were fatal. Of the fatal highway vehicle fires, 86 percent resulted in a single fatality and 14 percent resulted in multiple fatalities. While some of the characteristics of these fatal highway vehicle fires are similar to all highway vehicle fires, others are markedly different.

Unlike all highway vehicle fires, fatal highway vehicle fires mainly occurred in the very early morning hours between midnight and 5 a.m. (33 percent). The highest percentages of deaths occurred between midnight and 1 a.m. (8 percent), 2 to 3 a.m. (7 percent), and 3 to 4 a.m. (7 percent). In addition, unlike all highway vehicle fires that occurred more uniformly, fatal highway vehicle fires occurred with more variation throughout the year. Noticeable peaks occurred in May (10 percent), August (10 percent), and October and November (each at 11 percent). Additionally, fatal highway vehicles fires occurred least often in January (5 percent).

Unintentional action was the leading cause, as it was for all highway vehicle fires, and accounted for 42 percent of fatal highway vehicle fires. In 35 percent of fatal highway vehicle fires, the cause was still under investigation. The cause was undetermined in 12 percent, while intentional action was the cause in 6 percent of fatal highway vehicle fires.

Where the information on the area of fire origin was available, 93 percent of fatal highway fires originated in the vehicle area and resulted in 93 percent of highway vehicle fire deaths. The leading specific area of origin in both fatal highway vehicle fires and all highway vehicle fires was the engine area, at 36 percent and 62 percent, respectively. Fires that originated in the engine area were by far the deadliest, accounting for 35 percent of all deaths. Fires that originated in the fuel tank accounted for only 2 percent of all highway vehicle fires but 12 percent of fatal highway vehicle fires and 14 percent of deaths.

The leading heat source category for fatal highway vehicle fires with a known origin was “powered equipment” (48 percent), accounting for 47 percent of highway vehicle fire deaths. The leading specific heat sources for fatal highway vehicle fires were heat from miscellaneous powered equipment (15 percent); spark, ember or flame from powered equipment (15 percent); and radiated or conducted heat (15 percent).

Where the necessary data were available, the leading category of items first ignited in fatal highway vehicle fires was “liquids, piping, filters” (65 percent). Flammable liquids and gases in general were, by far, the most deadly (67 percent of deaths). Specifically, fuel in or from the engine area was the second leading item first ignited in all highway vehicle fires (18 percent) but was, by far, the leading item in both fatal fires (43 percent) and deaths (45 percent). Additionally, insulation around electrical wiring or cables was responsible for 29 percent of all highway vehicle fires, but only 2 percent of fatal fires and 2 percent of deaths.

Collisions, as a factor contributing to ignition, resulted in 5 percent of all highway vehicle fires but were responsible for 60 percent of fatal highway vehicle fires. Fatal fires resulting from collisions accounted for 62 percent of highway vehicle fire deaths. Determining the cause of death following a collision can be difficult as the death may have been either the direct result of the collision or the fire that ensued. A fire fatality should be counted only if a person was trapped and killed by the fire, rather than killed on impact and subsequently exposed to the fire. Unspecified mechanical failures contributed to 32 percent of all highway vehicle fires but are rarely fatal, accounting for 4 percent of fatal highway vehicle fires and 3 percent of deaths.

Examples

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

- March 2018: A truck fire caused all southbound lanes of Interstate 85 in Davidson County, North Carolina, to be closed to traffic. The truck was involved in an accident around 7:08 a.m. Soon thereafter, two men who were inside the truck noticed the hood on fire. Fire crews arrived on scene and removed a leaking propane tank from the truck. No injuries were reported.[13]
- February 2018: A motorcycle beside a house in Greensboro, North Carolina, caught fire and caused one injury. When firefighters arrived to the early evening fire, it was already extinguished. However, they found one person who suffered burns while trying to put out the fire. The condition of the injured person who was transported to a hospital was unknown. In addition, the cause of the fire was not reported.[14]
- January 2018: After going in for routine maintenance a day earlier, a Lakeside, California, fire truck caught fire while parked in a repair garage behind a fire station. Paramedics discovered smoke coming from the repair garage and found the cab of the fire truck engulfed in flames. Firefighters were able to quickly extinguish the blaze and kept it from spreading beyond the truck. Fire officials said that it appeared the fire was electrical in nature and started underneath the cab area. While no injuries were reported, the truck, worth approximately $550,000, was a total loss. In addition, damage to items inside the truck were estimated to be between $60,000 and $100,000.[15]
- May 2017: A vehicle was parked on a city block in New York, New York, and had not been driven for about a week. When the owner of the vehicle went to drive it, he noticed his engine was overheating and then abruptly caught fire. He exited the vehicle, opened the hood, and discovered two deceased baby rats on the ledge of the engine. Firefighters soon arrived at the scene and extinguished the fire. Further investigation by firefighters found additional rats in the rims of the vehicle's tire.[16]

What to do in case of a highway vehicle fire

It is important to know what to do in the event that you have a highway vehicle fire. First, get yourself and all others out of and safely away from the vehicle. Never attempt to get back into the vehicle to retrieve personal property. Call your fire department at 911 or your local emergency telephone number. Next, if you choose to use a fire extinguisher, do so at a safe distance from the vehicle and use a fire extinguisher approved for Class B and Class C fires. In addition, never open the hood or trunk if you suspect a fire under it, as air could cause the fire to enlarge. Finally, at all times, be aware of other vehicles on the roadway and never stand on an active roadway as there is the potential danger of being struck by another vehicle. For more information on the prevention of and actions to take when you have a highway vehicle fire, visit https://www.usfa.fema.gov/downloads/pdf/publications/fa-243.pdf.

NFIRS data specifications for highway vehicle fires

Data for this report were extracted from the NFIRS annual Public Data Release files for 2014, 2015 and 2016. Only version 5.0 data were extracted.

Highway vehicle fires were defined by the following criteria:

- Aid Types 3 (mutual aid given) and 4 (automatic aid given) were excluded to avoid double counting of incidents.

- Incident Types 131, 132, 136 and 137:

Incident Type	Description
131	Passenger vehicle fire
132	Road freight or transport vehicle fire
136	Self-propelled motor home or recreational vehicle when being used in a transport mode
137	Camper or recreational vehicle, (RV), not self-propelled (includes trailers)

- Mobile property involved codes 1 (not involved in ignition but burned) and 3 (involved in ignition and burned).

Special considerations

One of the challenges in the analysis of NFIRS highway vehicle fire data is the large number of unknown or undetermined entries reported, as well as missing data values. For example, in the analysis of the heat source and items first ignited in highway vehicle fires, the undetermined entries comprise 57 percent and 65 percent of the data, respectively. The large percentages of unknown and missing data make it difficult to establish any concrete conclusions in these particular analyses.

The analyses contained in this report reflect the current methodologies used by the USFA. The USFA is committed to providing the best and most current information on the U.S. fire problem and continually examines its data and methodology to fulfill this goal. Because of this commitment, data collection strategies and methodological changes are possible and do occur. As a result, analyses and estimates of the fire problem may change slightly over time. Previous analyses and estimates on specific issues (or similar issues) may have used different methodologies or data definitions and may not be directly comparable to the current ones.

To request additional information, visit https://www.usfa.fema.gov/contact.html. To comment on this specific report, visit https://apps.usfa.fema.gov/contact/dataReportEval?reportTitle= Highway%20Vehicle%20Fires%20(2014-2016).

Notes:

[1]As highway vehicles are a major property class, the national estimates are based only on the National Fire Protection Association's (NFPA) annual survey, "Fire Loss in the United States." Fires are rounded to the nearest 100, deaths to the nearest five, injuries to the nearest 25, and loss to the nearest hundred million dollars.

[2]The percentage shown here is derived from the NFPA's national estimate of highway vehicle fires and the summary data resulting from NFPA's annual fire-loss surveys (Haynes, Hylton, J.G., "Fire Loss in the United States During 2016," NFPA, September 2017; "Fire Loss in the United States During 2015," NFPA, September 2016; "Fire Loss in the United States During 2014," NFPA, September 2015). This percentage differs from that derived from the NFIRS data alone. Highway vehicle fires accounted for 12 percent of all fires reported to the NFIRS.

[3]Fire department participation in the NFIRS is voluntary; however, some states do require their departments to participate in the state system. Additionally, if a fire department is a recipient of a Fire Act Grant, participation is required. From 2014 to 2016, 68 percent of the NFPA's annual average estimated 1,328,500 fires, to which fire departments responded, were captured in the NFIRS. Thus, the NFIRS is not representative of all fire incidents in the U.S. and is not a "complete" census of fire incidents. Although the NFIRS does not represent 100 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.

[4]The average fire death and fire injury loss rates, computed from the NFPA estimates above, do not agree with average fire death and fire injury loss rates computed from the NFIRS data alone. The fire death rate computed from NFPA estimates is (1,000 x (345/171,500)) = 2.0 deaths per 1,000 highway vehicle fires, and the fire injury rate is (1,000 x (1,300/171,500)) = 7.6 injuries per 1,000 highway vehicle fires.

[5]Based on the mobile property type field in the NFIRS, standard passenger vehicles include cars, ambulances, limousines, race cars, taxis, off-road recreational vehicles, motor homes, travel trailers, camping trailers, mobile homes and motorcycles. Pickup trucks, however, are excluded from this category but are included with the freight road transport vehicles. For more specific definitions of vehicle types, please see the mobile property type codes in the NFIRS 5.0 Complete Reference Guide (CRG): http://www.nfirs.fema.gov/documentation/reference/.

[6]Based on the mobile property type field in the NFIRS, freight road transport vehicles include general use trucks, dump trucks, pickup trucks, fire apparatus, trailers, tank trucks and garbage trucks.

[7]For the purposes of this report, the time of the fire alarm is used as an approximation for the general time at which the fire started. However, in the NFIRS, it is the time at which the fire was reported to the fire department.

[8]Fires caused by intentional actions include, but are not limited to, fires that are deemed to be arson. Intentional fires are those fires that are deliberately set and include fires that result from the deliberate misuse of a heat source and fires of an incendiary nature (arson) that require fire service intervention. For information and statistics on arson fires only, refer to the Uniform Crime Reporting Program arson statistics from the U.S. Department of Justice, FBI, Criminal Justice Information Services Division, http://www.fbi.gov/about-us/cjis/ucr/ucr.

[9]While the term "suspicious" is not used in NFIRS Version 5.0, information is collected on fires that may be intentionally set and may be suspicious or believed to be arson. These fires can be coded as fires "under investigation." However, not all fires coded as "under investigation" are necessarily suspicious or believed to be arson.

[10]The running gear of a vehicle generally refers to components that transfer power from the engine and deliver it to the wheels, e.g., transmission, drive shaft, differential.

[11]See the Special Considerations section at the end of this report for a discussion of unknown, undetermined and missing data.

[12]See the Special Considerations section at the end of this report for a discussion of unknown, undetermined and missing data.

[13]"Vehicle Fire Closes All Lanes of I-85 Southbound in Davidson County; SkyView8 Video Shows Huge Backup," www.myfox8.com, March 22, 2018, http://myfox8.com/2018/03/22/vehicle-fire-closes-all-lanes-of-i-85-southbound-in-davidson-county/ (accessed March 28, 2018).

[14]"Person Injured After Motorcycle Catches Fire In Greensboro," www.myfox8.com, February 27, 2018, http://myfox8.com/2018/02/27/person-injured-after-motorcycle-catches-fire-in-greensboro/ (accessed March 28, 2018).

[15]Teri Figueroa, "Lakeside Fire Truck Destroyed In Possible Electrical Fire," www.sandiegouniontribune.com, January 26, 2018, http://www.sandiegouniontribune.com/news/public-safety/sd-me-fire-truck-fire-20180126-story.html, (accessed March 28, 2018).

[16]Ben Hooper, "Rats Blamed for New York Car Fire That Drew Tony Hawk's Attention," www.upi.com, May 3, 2017, https://www.upi.com/Rats-blamed-for-New-York-car-fire-that-drew-Tony-Hawks-attention/2991493828395/ (accessed March 28, 2018).