

Highway Vehicle Fires (2008–2010)

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

- Approximately one in seven 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 (32 percent) was the leading cause of highway vehicle fires.
- Eighty-six percent of highway vehicle fires occurred in passenger vehicles.
- Sixty-one percent of highway vehicle fires and 35 percent of fatal highway vehicle fires originated in the engine, running gear or wheel area of the vehicle.
- The leading factor contributing to the ignition of highway vehicle fires was mechanical failure (44 percent).
- Insulation around electrical wiring (28 percent) and flammable liquids in the engine area (18 percent) were the most common items first ignited in highway vehicle fires.
- Fifty-seven percent of fatal vehicle fires were the result of a collision.

From 2008 to 2010, an estimated 194,000 highway vehicle fires occurred in the United States each year resulting in an annual average of approximately 300 deaths, 1,250 injuries and \$1.1 billion in property loss.¹ These highway vehicle fires accounted for 14 percent of fires responded to by fire departments across the nation.² Highway vehicle fires include 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 reported to the National Fire Incident Reporting System (NFIRS) from 2008 to 2010.

Loss Measures

Table 1 presents losses, averaged over the 3-year period from 2008 to 2010, of reported highway vehicle fires and all other fires (i.e., excluding highway vehicle fires).³ The average number of injuries per 1,000 highway vehicle fires as well as the dollar loss per fire were slightly lower than the same loss measures for all other fires.

Table 1. Loss Measures for Highway Vehicle Fires (3-year average, 2008–2010)

Measure	Highway Vehicle Fires	All Fires (Excluding Highway Vehicle Fires)
Average Loss:		
Fatalities/1,000 Fires	2.3	2.0
Injuries/1,000 Fires	4.5	11.3
Dollar Loss/Fire	\$4,870	\$8,700

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 2008–2010, the 2008 and 2009 dollar-loss values were adjusted to their equivalent 2010 dollar-loss values to account for inflation.

Types of Highway Vehicle Fires

The majority of highway vehicle fires, 86 percent, occurred in passenger road vehicles: 69 percent of highway vehicle fires occurred in standard passenger vehicles,⁴ another 16 percent occurred in some other type of passenger vehicle, and less than 1 percent occurred in buses. Only 8 percent of highway

vehicles occurred in nonpassenger vehicles: 7 percent of highway vehicle fires occurred in transport vehicles, with freight road transport vehicles⁵ accounting for the majority of these fires, and less than 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).⁶

Table 2. Types of Highway Vehicle Fires (2008–2010)

Type of Vehicle	Percent of Highway Vehicle Fires
Passenger road vehicle	85.8
<i>Passenger vehicle</i>	68.9
<i>Passenger or road vehicles, other</i>	16.2
<i>Buses</i>	0.7
Transport vehicle	6.9
<i>Freight road transport vehicle</i>	6.8
<i>Rail transport vehicle</i>	0.1
<i>Water transport vessel</i>	<0.1
<i>Air transport vehicle</i>	<0.1
Other vehicle	0.8
<i>Mobile property, other</i>	0.4
<i>Industrial, construction, agricultural vehicles</i>	0.3
<i>Special Purpose Vehicle</i>	0.1
No entry/Undetermined	6.5
Total	100.0

Source: NFIRS 5.0.

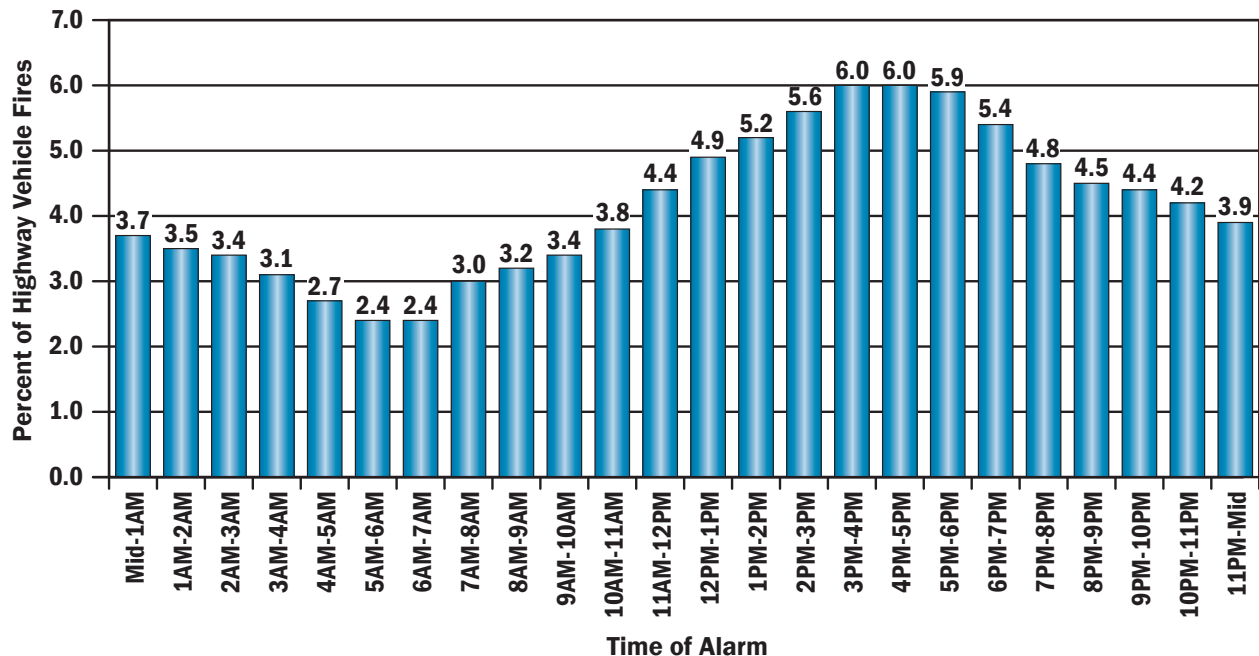
Note: No entry/Undetermined includes incidents where the mobile property type was designated as "None."

When Highway Vehicle Fires Occur

As shown in Figure 1, highway vehicle fires mainly occurred in the afternoon and evening hours, peaking from

3 to 6 (18 percent). Highway vehicle fires occurred the least often in the morning hours from 5 to 7 (5 percent).⁷

Figure 1. Highway Vehicle Fires by Time of Alarm (2008–2010)



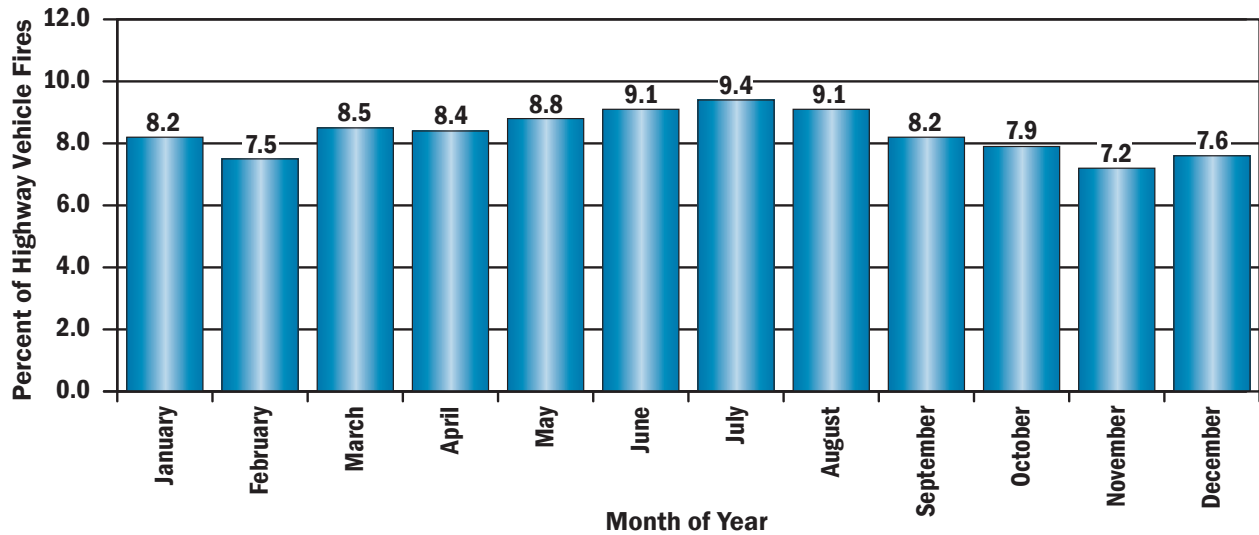
Source: NFIRS 5.0.

Note: Total does not add 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 June through August (28 percent). This slight peak may possibly

be due to elevated outdoor temperatures or increased vehicle use as many individuals and families take vacations during these three months.

Figure 2. Highway Vehicle Fires by Month (2008–2010)



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

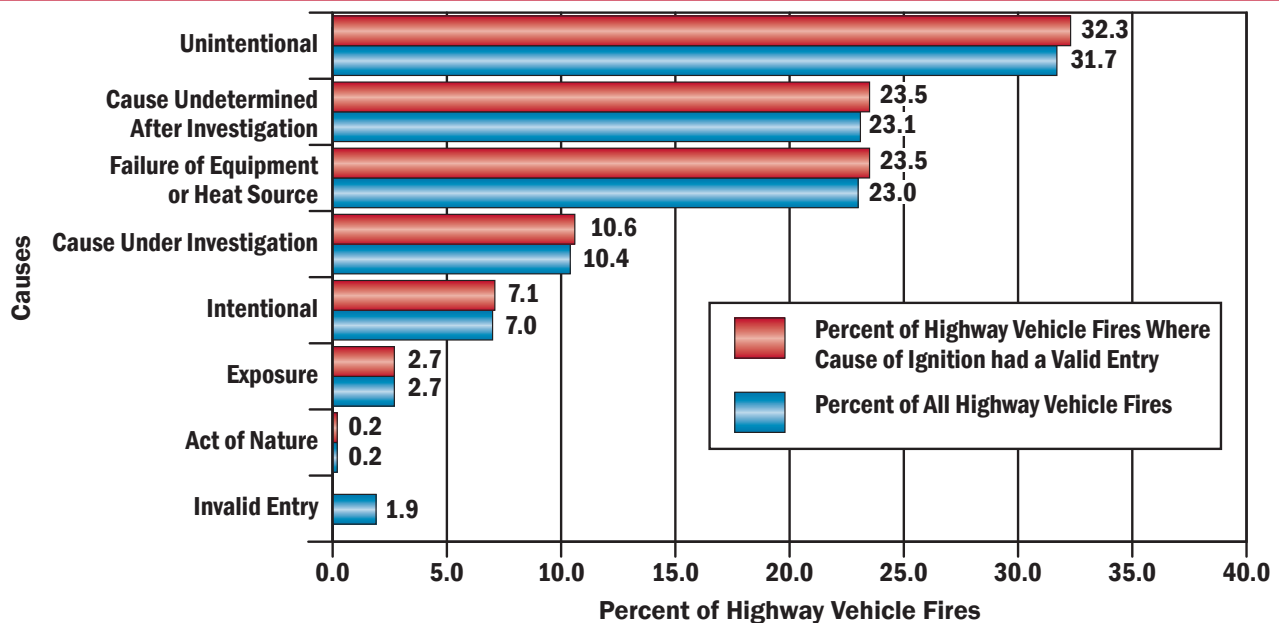
Causes of Highway Vehicle Fires

As shown in Figure 3, unintentionally caused fires accounted for 32 percent of highway vehicle fires. These fires may be the result of either careless behavior or accidental actions. Intentionally set fires constituted only 7 percent of highway vehicle fires. NFIRS no longer collects information on suspicious fires that may have been intentionally set.⁸ As a result, intentional fires 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 24 percent of highway vehicle fires, no cause was determined after investigation. The failure of equipment or the heat source was the cause in an additional 24 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 (2008–2010)



Source: NFIRS 5.0.
 Note: Total of highway vehicle fires where cause of ignition had a valid entry does not add 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, 61 percent

of highway vehicle fires originated specifically in the engine, running gear⁹ 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 (15 percent).

Table 3. Areas of Fire Origin in Highway Vehicle Fires (2008–2010)

Areas of Fire Origin	Percent of Highway Vehicle Fires (Unknowns Apportioned)
Transportation, Vehicle Areas	93.4
<i>Engine area, running gear, wheel area</i>	60.6
<i>Operator/Passenger area of transportation equipment</i>	15.2
<i>Other vehicle areas</i>	8.2
<i>Cargo/Trunk area — all vehicles</i>	4.0
<i>Exterior, exposed surface of vehicle</i>	3.4
<i>Fuel tank, fuel line</i>	1.7
<i>Separate operator/control area of transportation equipment</i>	0.3
All other areas	6.6
Total	100.0

Source: NFIRS 5.0.

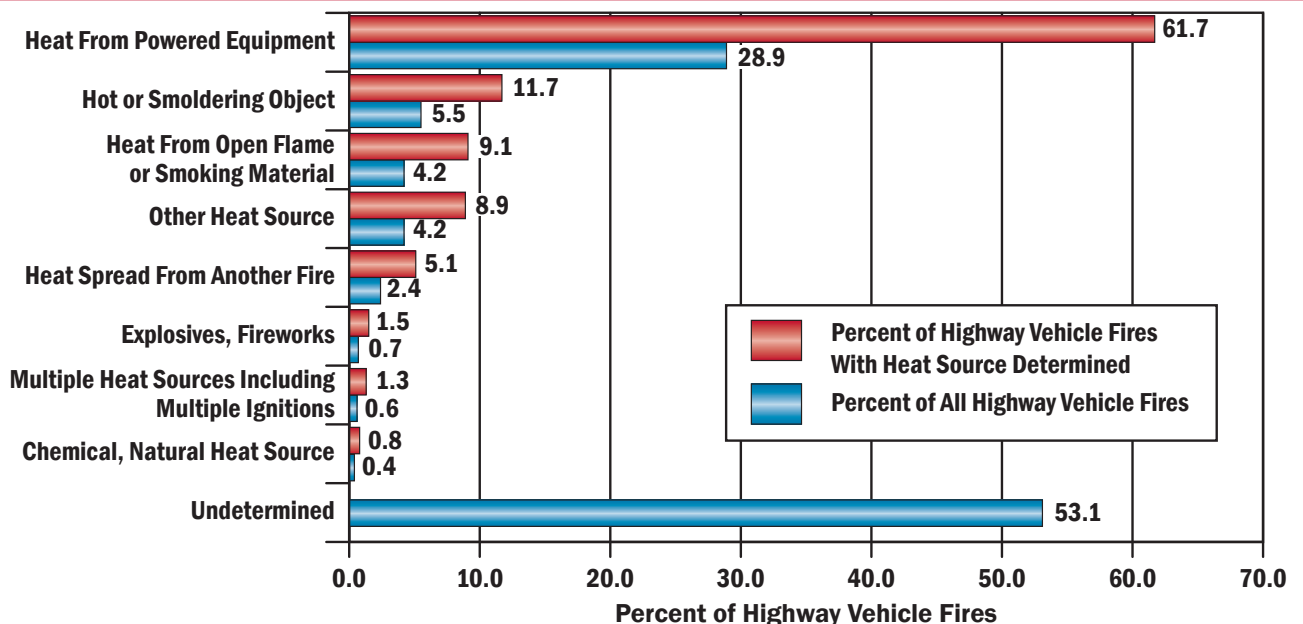
How Highway Vehicle Fires Start (Heat Source)

Figure 4 shows sources of heat categories for highway vehicle fires. The “heat from powered equipment” category accounted for 62 percent of highway vehicle fires.¹⁰ Fittingly, the subcomponents of this category comprised four of the top five specific sources of heat in all highway vehicle fires — heat from miscellaneous powered equipment (21 percent), electrical arcing (17 percent), radiated or conducted heat from operating equipment (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” (12 percent). This category includes items such as hot or smoldering objects (5 percent) and sparks that result from friction, including overheated tires (4 percent).

An additional 9 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 (2008–2010)



Source: NFIRS 5.0.

Note: Total of highway vehicle fires with heat source determined does not add to 100 percent due to rounding.

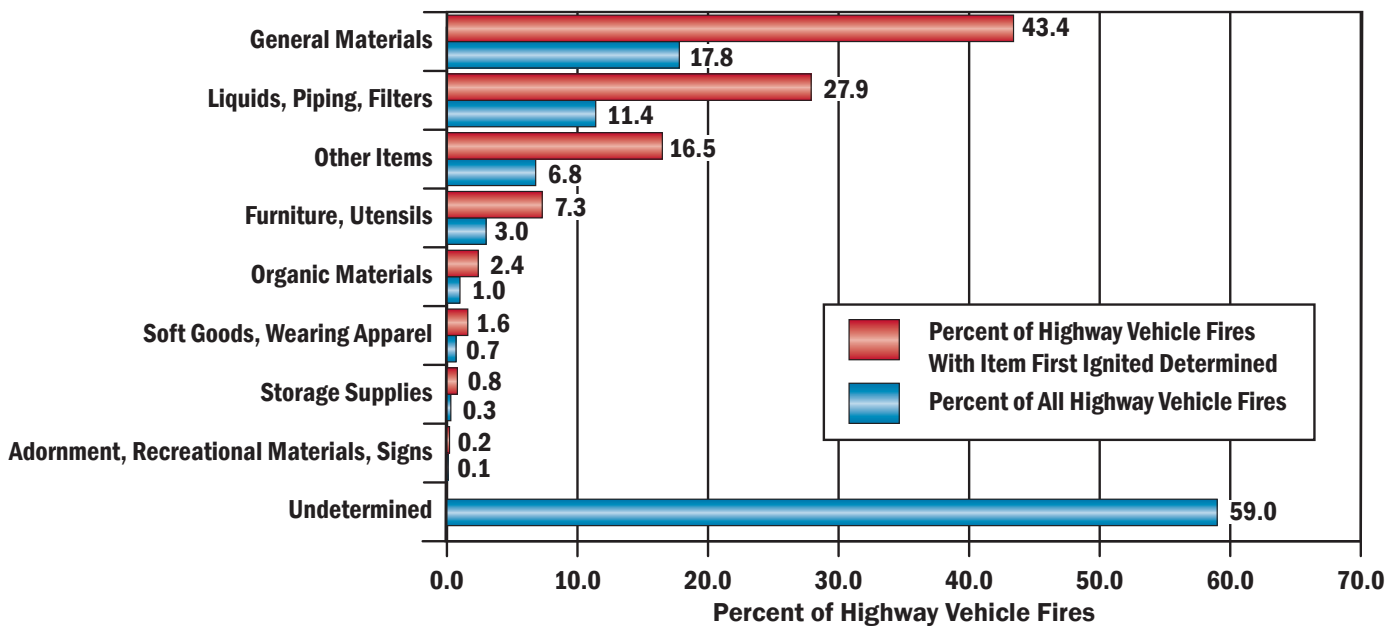
What Ignites First in Highway Vehicle Fires

Forty-three percent of the items first ignited in highway vehicle fires fell under the category of “general materials” (Figure 5).¹¹ This category includes materials such as tires, insulation around electric wire and cables, trash and fabric. The insulation around electrical wiring or other cables was the most common specific item to be initially ignited not only within this category but in all highway vehicle fires (28 percent). Interestingly, while it is often assumed that vehicle fires commonly originate with the tires of the

vehicle, tires were the item first ignited in only 4 percent of all highway vehicle fires.

The second leading category of items first ignited was “liquids, piping, and filters” (28 percent). This category primarily includes fuel in various locations in the vehicle. Not unexpectedly 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 item first ignited in highway vehicle fires overall (18 percent). Flammable liquids and gases in general accounted for 25 percent of items first ignited.

Figure 5. Item First Ignited in Highway Vehicle Fires by Major Category (2008–2010)



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

Factors Contributing to Ignition in Highway Vehicle Fires

Table 4 shows the factors contributing to ignition categories of highway vehicle fires. Mechanical failure or malfunction was the leading contributing factor to ignition of highway vehicle fires (44 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 another 22 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 (14 percent). These three leading contributing factors played a role in 81 percent of highway vehicle fires.¹²

Table 4. Factors Contributing to Ignition for Highway Vehicle Fires by Major Category (Where Factor Contributing to Ignition Specified, 2008–2010)

Factor Contributing to Ignition Category	Percent of Highway Vehicle Fires (Unknowns Apportioned)
Mechanical failure, malfunction	44.1
Electrical failure, malfunction	22.3
Misuse of material or product	14.2
Other factors contributing to ignition	7.7
Fire spread or control	7.6
Operational deficiency	7.3
Design, manufacture, installation deficiency	0.8
Natural condition	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, 89 percent resulted in a single fatality and 11 percent resulted in multiple fatalities. While some of the characteristics of these fatal highway vehicle fires are similar to all highway vehicle fires, others, however, are markedly different.

Unlike all highway vehicle fires, fatal highway vehicle fires mainly occurred in the very late evening and early morning hours between 11 p.m. and 5 a.m. (40 percent). The highest percentages of deaths occurred between midnight and 1 a.m., 2 to 3 a.m. and 3 to 4 a.m. (each at 7 percent). In addition, like all highway vehicle fires, fatal highway vehicle fires occurred with little variation throughout the year. A noticeable peak, however, occurred in August (11 percent). Additionally, fatal highway vehicles fires occurred least often in May (6 percent).

Unintentional action was the leading cause, as it was for all highway vehicle fires, and accounted for 43 percent of fatal highway vehicle fires. In another 31 percent of fatal highway vehicle fires, the cause was still under investigation. The cause was undetermined in an additional 13 percent, while intentional action was the cause in 7 percent of fatal highway vehicle fires.

Where the information on the area of fire origin was available, 92 percent of fatal highway fires originated in the vehicle area and resulted in 92 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 35 percent and 61 percent, respectively. Fires that originated in the engine area were by far the deadliest, accounting for 34 percent of all deaths. Fires that originated in the fuel tank accounted for only 2 percent of all highway vehicle fires but 13 percent of fatal highway vehicle fires and 14 percent of deaths.

As for all highway vehicle fires, the leading sources of heat category for fatal highway vehicle fires with a known origin was “powered equipment” (44 percent) accounting for 42 percent of highway vehicle fire deaths. The leading specific heat sources for fatal highway vehicle fires were heat from miscellaneous powered equipment (20 percent), other miscellaneous heat sources (18 percent), and heat or spark from friction (16 percent).

Where the necessary data were available, the leading category of items first ignited in fatal highway vehicle fires was “liquids, piping, and filters” (60 percent), causing 65 percent of deaths. Flammable liquids and gases in general were, by far, the most deadly (63 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 (36 percent) and deaths (37 percent). Additionally, insulation around electrical wiring or cables was responsible for 28 percent of all highway vehicle fires but only 2 percent of fatal fires and 1 percent of deaths.

Collisions, as a factor contributing to ignition, resulted in 4 percent of all highway vehicle fires but were responsible for 57 percent of fatal highway vehicle fires. Fatal fires resulting from collisions accounted for 60 percent of highway vehicle fire deaths. Determining the cause of death following a collision, however, 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 30 percent of all highway vehicle fires but are rarely fatal, accounting for 5 percent of fatal highway vehicle fires and 4 percent of deaths.

Examples

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

- September 2012: Southbound traffic along Interstate 15 north of Helena, Mont., was stalled as emergency crews worked to extinguish a fire that engulfed a van. Initial reports indicate that the cause of the fire was equipment failure when the van’s muffler came loose, started dragging along the ground, and sparked. No injuries were reported and crews were able to prevent the fire from spreading beyond the vehicle. The van, however, was a total loss.¹³
- August 2012: A burning pickup truck sparked a vegetation fire on the west side of Interstate 5 in La Jolla, Calif. A witness at the scene reported that the driver noticed smoke entering the cab of the truck, immediately pulled over and exited just as flames engulfed the vehicle. The blaze then tore up a brushy hillside near the freeway. The San Diego Fire-Rescue Department responded to the fire which threatened nearly a half-dozen homes and extinguished it from the ground and aboard an emergency services helicopter. One firefighter was taken to a hospital for evaluation of an eye injury. No other injuries were reported.¹⁴
- August 2012: Capital City Fire and Rescue responded to a vehicle fire on Glacier Highway in Juneau, Alaska, and found a van completely engulfed in flames. A man and his two dogs were able to escape the vehicle fire without injury, and firefighters put out the fire with about a half-tank of water. The cause of the fire was unknown, but the man reported hearing a noise, smelling “something funny,” and then seeing flames coming from under the hood while he was driving. Damage to the van was estimated at \$8,000.¹⁵

NFIRS Data Specifications for Highway Vehicle Fires

Data for this report were extracted from the NFIRS annual Public Data Release (PDR) files for 2008, 2009 and 2010. 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 53 percent and 59 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 U.S. Fire Administration (USFA). The USFA is committed to providing the best and most current information on the United States 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 <http://apps.usfa.fema.gov/feedback/>

Notes:

¹As 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 5, injuries to the nearest 25, and loss to the nearest hundred million dollars.

²The 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 (Karter, Jr., Michael, J., *Fire Loss in the United States During 2010*, NFPA, September 2011; *Fire Loss in the United States During 2009*, NFPA, August 2010; *Fire Loss in the United States During 2008*, NFPA, August 2009). This percentage differs from that derived from NFIRS data alone. Highway vehicle fires accounted for 12 percent of all fires reported to the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS).

³The average fire death and fire injury loss rates computed from the NFPA estimates above will not agree with average fire death and fire injury loss rates computed from NFIRS data alone. The fire death rate computed from NFPA estimates is $(1,000 * (300 / 194,000)) = 1.5$ deaths per 1,000 highway vehicle fires, and the fire injury rate is $(1,000 * (1,250 / 194,000)) = 6.4$ injuries per 1,000 highway vehicle fires.

⁴Based on the mobile property type field in 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/>.

⁵Based on the mobile property type field in NFIRS, freight road transport vehicles include general use trucks, dump trucks, pickup trucks, fire apparatus, trailers, tank trucks and garbage trucks.

⁶Total does not add to 100 percent due to rounding.

⁷For 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 the fire was reported to the fire department.

⁸While the term "suspicious" is not currently used in NFIRS 5.0, information is still 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.

⁹The 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.

¹⁰See the Special Considerations section at the end of this report for a discussion of unknown, undetermined and missing data.

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

¹²The total of the three leading categories of factors contributing to fire ignition does not add to 81 percent due to rounding.

¹³Evan Weborg, "Vehicle Fire Stops Traffic Along I-15," www.kxllh.com, September 19, 2012, <http://www.kxllh.com/news/vehicle-fire-stops-traffic-along-i-15/> (accessed September 24, 2012).

¹⁴"Vehicle Fire Sparks Brush Fire in La Jolla Area," www.10news.com, August 2012, <http://www.10news.com/news/vehicle-fire-sparks-brush-fire-in-la-jolla-area> (accessed September 24, 2012).

¹⁵Emily Russo Miller, "Man, 2 Dogs Escape Wednesday Vehicle Fire Unscathed," www.juneauempire.com, August 9, 2012, <http://www.juneauempire.com/local/2012-08-09/man-2-dogs-escape-wednesday-vehicle-fire-unscathed> (accessed September 24, 2012).