AGENDA

NFPA Technical Committee on Hazard and Risk of Contents and Furnishings (HAR-AAA)
NFPA 556 First Draft Meeting (A2023)
NFPA 557 Second Draft Meeting (A2022)

October 19, 2021
1:00 p.m. – 4:00 p.m. (ET)

Microsoft Teams Web Conference
To join the meeting, please contact kcarey@nfpa.org

1. **Call to order -** Chair Steven Wolin.
2. **Introductions.** See page 2.
3. **Chair report –** Steven Wolin.
4. **Staff liaison report -** Camille Levy.
   a. Presentation on document development process.
5. **Previous meeting minutes.** See page 4.
6. **NFPA 556 First Draft preparation.**
   a. NFPA 556 PIs. See page 5.
7. **NFPA 557 Second Draft preparation**
   a. NFPA 557 PCs. See page 133.
8. **Staff Items.**
   a. NFPA 557 table updates.
   b. Future document revision cycles.
9. **Other business.**
10. **Future meetings.**
11. **Adjournment.**

Steven D. Wolin — **M** 9/30/2004
Chair — **HAR-AAA**
Reliable Automatic Sprinkler Company, Inc.
1470 Smith Grove Road
Liberty, SC 29657-4305

Craig L. Beyler — **SE** 1/1/1992
Principal — **HAR-AAA**
JENSEN HUGHES
3610 Commerce Drive, Suite 817
Baltimore, MD 21227-1652
Alternate: Nestor R. Iwankiw

David A. Boverman — **E** 7/23/2008
Principal — **HAR-AAA**
NSW Rural Fire Service
15 Carter Street
Lidcombe, NSW, 2141 Australia
Alternate: Shaohua Xia

Elizabeth C. Buc — **RT** 4/17/2002
Principal — **HAR-AAA**
Fire & Materials Research Laboratory, LLC
33025 Industrial Road
Livonia, MI 48150-1619

David G. Bueche — **M** 3/15/2007
Principal — **HAR-AAA**
Hoover Treated Wood Products
13768 West Asbury Circle
Lakewood, CO 80228

Michael T. Burr — **RT** 10/18/2011
Principal — **HAR-AAA**
Safety Engineering Laboratories, Inc.
27803 College Park Drive
Warren, MI 48088-4879
Alternate: Jerry W. Wallace

Jason Daniels — **SE** 08/11/2014
Principal — **HAR-AAA**
Harrington Group, Inc.
Senior Fire Protection Engineer
3237 Satellite Boulevard
Building 300, Suite 525
Duluth, GA 30096

Richard J. Davis — **I** 07/29/2013
Principal — **HAR-AAA**
FM Global
PO Box 1735
Manomet, MA 02345-1735
FM Global

Marcelo M. Hirschler — **SE** 1/1/1991
Principal — **HAR-AAA**
GBH International
2 Friar's Lane
Mill Valley, CA 94941
Alternate: Timothy Earl

William E. Koffel — **SE** 1/1/1990
Principal — **HAR-AAA**
Koffel Associates, Inc.
8815 Centre Park Drive
Suite 200
Columbia, MD 21045-2107

Sergei V. Levchik — **M** 10/28/2008
Principal — **HAR-AAA**
Israel Chemicals Ltd. (ICL-IP)
769 Saw Mill River Road
4th Floor
Tarrytown, NY 10591

James R. Richardson — **E** 04/05/2016
Principal — **HAR-AAA**
Lisle Woodridge Fire District
1005 School Street
Lisle, IL 60532

Katherine S. Setser — **U** 08/24/2021
Principal — **HAR-AAA**
Miami University
101 Alumni Hall
350 E Spring Street
Oxford, OH 45056
American Society of Interior Designers

Xiaochuan Shi — **I** 08/24/2021
Principal — **HAR-AAA**
Verisk
545 Washington Boulevard
Jersey City, NJ 07310

Dwayne Sloan **RT** 3/4/2008
Principal **HAR-AAA**
UL LLC
12 Laboratory Drive
PO Box 13995
Research Triangle Park, NC 27709-3995

William Randall Edwards **M** 7/26/2007
Voting Alternate **HAR-AAA**
Alliance of Automobile Manufacturers
34167 Alta Loma Drive
Farmington, MI 48335
Alliance of Automobile Manufacturers

Timothy Earl **SE** 10/18/2011
Alternate **HAR-AAA**
GBH International
6862 Shallowford Way
Portage, MI 49024
Principal: Marcelo M. Hirschler

John A. Frank **I** 07/29/2013
Alternate **HAR-AAA**
Global Asset Protection Services, LLC
111 Club Circle
Stockbridge, GA 30281

Nestor R. Iwankiw **SE** 7/14/2004
Alternate **HAR-AAA**
JENSEN HUGHES
5953 North Oconto Avenue
Chicago, IL 60631
Principal: Craig L. Beyler

Jerry W. Wallace **RT** 10/18/2011
Alternate **HAR-AAA**
Safety Engineering Laboratories, Inc.
27803 College Park Drive
Warren, MI 48088-4879
Principal: Michael T. Burr

Shaohua Xia **E** 03/05/2012
Alternate **HAR-AAA**
Fire & Rescue New South Wales
Amarina Avenue, 2190
NSW
Greenacre, 2190 Australia
Principal: David A. Boverman

Camille Levy 3/31/2021
Staff Liaison **HAR-AAA**
National Fire Protection Association (NFPA)
One Batterymarch Park
Quincy, MA 02169

NFPA Technical Committee on Hazard and Risk of Contents and Furnishings
(HAR-AAA)
NFPA 557 FIRST DRAFT MEETING MINUTES

Web/Teleconference Meeting

Monday, October 12, 2020

1. Committee Chair Steven Wolin called the meeting to Order at 03:02 pm (EST).
2. Meeting Attendance and Introductions conducted.
3. First Draft meeting agenda was reviewed and accepted.
4. Minutes of previous second draft meeting held on November 13, 2018 was reviewed and approved.
5. NFPA Staff Liaison presented the Standards development process and reviewed key dates in current cycle.
6. Chairman made remarks regarding committee members.
7. Technical committee acted on six (6) public inputs for NFPA 557.
8. Meeting adjourned at – 4:08 pm (EST).

Attendance:
Steven Wolin, Chair
Farid Alfawakhiri
David A. Boverman
Elizabeth Buc
Jason Daniels
Marcelo Hirschler
Sergei Levchik
James Richardson
Jeffrey Santrock
Dwayne Sloan
Peter Willse
Xianxu (Sherri) Hu
John Frank
Baran Ozden (NFPA Staff Liaison)

Guest:
Michelle Sluga (UL)

Public Input No. 1-NFPA 556-2021 [Section No. 2.3.1]

2.3.1 ASTM Publications.

ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA, 19428-2959.

ASTM D2859, *Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials*, 2016 ~~.~~ (2021)

ASTM D3675, *Test Method for Surface Flammability of Flexible Cellular Materials Using a Radiant Heat Energy Source*, ~~2017~~ 2021a .

ASTM D6113, *Test Method for Using a Cone Calorimeter to Determine Fire-Test-Response Characteristics of Insulating Materials Contained in Electrical or Optical Fire Cables*, ~~2016~~ 2021 .

ASTM E84, *Test Method for Surface Burning Characteristics of Building Materials*, ~~2018b~~ 2021a .

ASTM E119, *Test Methods for Fire Tests of Building Construction and Materials*, ~~2018b~~ 2020 .

ASTM E136, *Test Method for ~~Behavior of~~ Assessing Combustibility of Materials ~~in~~ Using a Vertical Tube Furnace at 750°C*, ~~2016a~~ 2019a .

ASTM E162, *Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source*, 2016.

ASTM E603, *Guide for Room Fire Experiments*, 2017.

ASTM E648, *Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source*, ~~2017a~~ 2019a e1 .

ASTM E662, *Test Method for Specific Optical Density of Smoke Generated by Solid Materials*, ~~2017a~~ 2021 .

ASTM E814, *Test Method for Fire Tests of Penetration Firestop Systems*, 2013a (2017).

ASTM E1321, *Test Method for Determining Material Ignition and Flame Spread Properties*, 2018.

ASTM E1354, *Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter*, 2017.

ASTM E1474, *Test Method for Determining the Heat Release Rate of Upholstered Furniture and Mattress Components or Composites Using a Bench Scale Oxygen Consumption Calorimeter*, ~~2014~~ 2020a .

ASTM E1529, *Test Methods for Determining Effects of Large Hydrocarbon Pool Fires on Structural Members and Assemblies*, 2016e1.

ASTM E1546, *Guide for Development of Fire-Hazard-Assessment Standards*, 2015.

ASTM E1623, *Test Method for Determination of Fire and Thermal Parameters of Materials, Products, and Systems Using an Intermediate Scale Calorimeter (ICAL)*, 2016.

ASTM E1995, *Test Method for Measurement of Smoke Obscuration Using a Conical Radiant Source in a Single Closed Chamber, With the Test Specimen Oriented Horizontally*, ~~2016~~ 2018 .

ASTM E2061, *Guide for Fire Hazard Assessment of Rail Transportation Vehicles*, ~~2018~~ 2020 .

ASTM E2067, *Practice for Full-Scale Oxygen Consumption Calorimetry Fire Tests*, ~~2015~~ 2020 .

ASTM E2102, *Test Method for Measurement of Mass Loss and Ignitability for Screening Purposes Using a Conical Radiant Heater*, 2017.

ASTM E2280, *Guide for Fire Hazard Assessment of the Effect of Upholstered Seating Furniture Within Patient Rooms of Health Care Facilities*, 2017.

ASTM E2574/E2574M, *Test Method for Fire Testing of School Bus Seat Assemblies*, 2017 (2021) .

ASTM E2652, *Test Method for ~~Behavior of~~ Assessing Combustibility of Materials ~~in~~ using a Tube Furnace with a Cone-shaped Airflow Stabilizer, at 750°C*, ~~2016~~ 2018 .

ASTM E2965, *Test Method for Determination of Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter*, 2017.

Statement of Problem and Substantiation for Public Input

updates

Submitter Information Verification

Submitter Full Name: Marcelo Hirschler
Organization: GBH International
Street Address:
City:
State:
Zip:
Submittal Date: Fri May 21 14:43:59 EDT 2021
Committee: HAR-AAA

Public Input No. 4-NFPA 556-2021 [Section No. 2.3.5]

2.3.5 UL Publications.

Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 9, *Fire Tests of Window Assemblies*, 2009, revised ~~2015~~ 2019 .

UL 263, *Fire Tests of Building Construction and Materials*, 2011, revised 2018.

UL 723, *Test for Surface Burning Characteristics of Building Materials*, ~~2018~~ 2020 .

UL 1479, *Fire Tests of Through-Penetration Firestops*, 2015, revised 2021 .

UL 1685, *Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables*, 2015, revised 2020 .

UL 1709, *Rapid Rise Fire Tests of Protection Materials for Structural Steel*, 2017.

UL 2556, *Wire and Cable Test Methods*, ~~2015~~ 2021 .

Statement of Problem and Substantiation for Public Input

Update UL references to most recent editions

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 5-NFPA 556-2021 [Section No. C.1.2.5]	

Submitter Information Verification

Submitter Full Name: Kelly Nicolello
Organization: UL LLC
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jun 01 12:38:29 EDT 2021
Committee: HAR-AAA

Public Input No. 3-NFPA 556-2021 [Section No. 5.1]

5.1 Fire Statistics.***Update of these statistics is needed - Marty Ahrens - Vehicle Fires - March 2020 (attached)***

5.1.1

The United States National Highway Traffic Safety Administration (NHTSA) indicates that approximately 43,000 people were killed and approximately 2.6 million people were injured in motor vehicle crashes in 2006. [1] In addition, property damage losses from motor vehicle crashes totaled approximately $5.9 billion in 2000, the latest year for which statistics are available. [2] Fatal Accident Reporting System (FARS) data indicates that motor vehicle crashes where fire was the most harmful event result in approximately 430 fatally injured occupants [3] per year, corresponding to approximately 1 percent of the motor vehicle crash fatalities each year.

5.1.2

The NFPA survey indicates that approximately 278,000 vehicle fires occurred in 2006. [4] This is 17 percent of the total number of fires. The number of civilian deaths and injuries from vehicle fires in 2006 amounted to 490 (15 percent) and 1200 (7 percent), respectively. The direct property damage from vehicle fires in 2006 was $1.3 billion, or 12 percent of the total direct property damage from all fires. Table 5.1.2 illustrates annual average U.S. vehicle fire losses by type of vehicle for 2002 through 2005. The statistics indicate that road vehicle fires accounted for nearly 90 percent of civilian deaths in vehicle fires. Figure 5.1.2(a) through Figure 5.1.2(d) show the evolution of vehicle fire losses over the years.

Table 5.1.2 U.S. Vehicle Fire Losses by Type of Vehicle, 2002–2005 Annual Averages

Vehicle Type	Fires	Civilian Deaths	Civilian Injuries	Damage (millions)
Passenger cars	208,600	305	864	$549
	(68%)	(58%)	(53%)	(41%)
Other passenger road vehicles	54,770	103	392	$238
	(18%)	(20%)	(24%)	(18%)
Freight road vehicles	24,380	62	183	$240
	(8%)	(12%)	(11%)	(18%)
Other vehicles	19,060	52	205	$315
	(6%)	(10%)	(12%)	(23%)

Figure 5.1.2(a) U.S. Vehicle Fire Trend: Number of Fires.

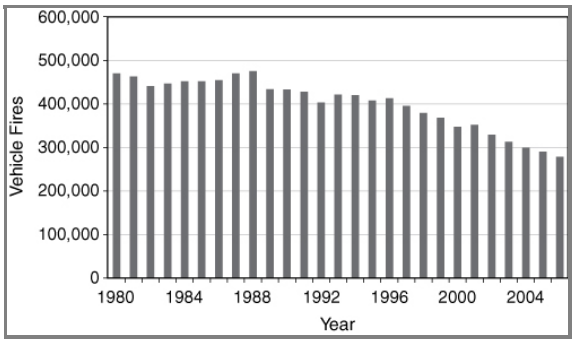


Figure 5.1.2(b) U.S. Vehicle Fire Trend: Number of Civilian Deaths.

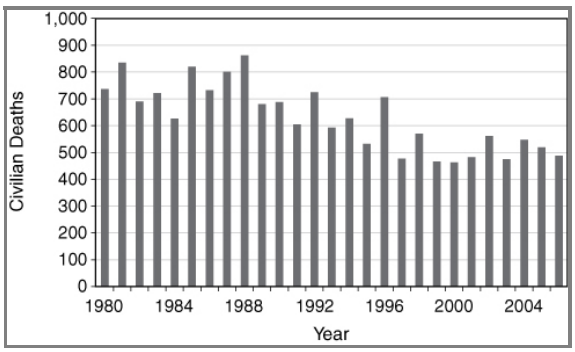


Figure 5.1.2(c) U.S. Vehicle Fire Trend: Number of Civilian Injuries.

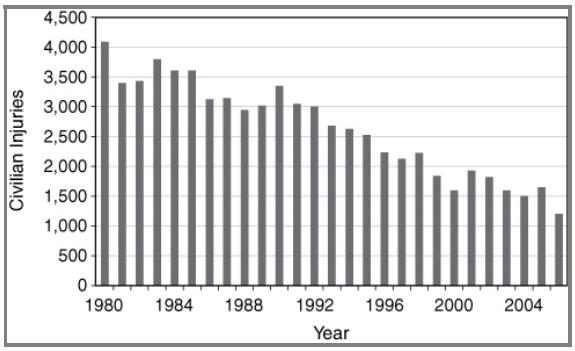
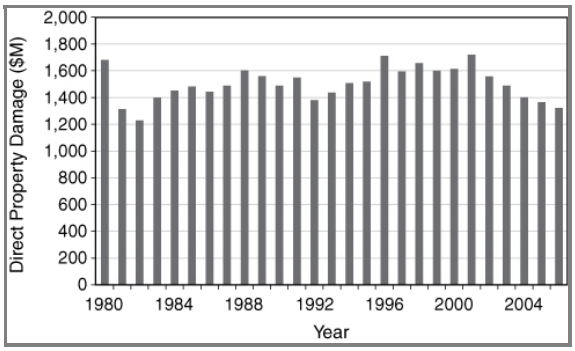


Figure 5.1.2(d) U.S. Vehicle Fire Trend: Direct Property Damage.



5.1.3

Passenger road vehicle fires can be grouped into the following three categories:

(1) Accidental fires following a collision

(2) Accidental fires without collision

(3) Arson fires

Table 5.1.3 gives the annual average number of fires, number of civilian deaths and injuries, and direct property damage for these three categories for 2002 through 2005. The table shows that the first two categories accounted for more than 90 percent of the civilian fire deaths. Since the objective of this document is to reduce the number of passenger road vehicle fire deaths, the focus is on these two categories.

Table 5.1.3 U.S. Highway Vehicle Fire Loss by Fire Category, 2002–2005 Annual Averages [4]

Fire Category	Number of Fires	Civilian Deaths	Civilian Injuries	Damage (millions)
Collision	8,100	268	219	$87
	(3%)	(57%)	(15%)	(8%)
No collision	255,700	160	1,157	$804
	(89%)	(34%)	(80%)	(78%)
Arson	23,900	43	63	$136
	(8%)	(9%)	(4%)	(13%)
Total	287,700	471	1,439	$1,027

5.1.4

Table 5.1.4(a) and Table 5.1.4(b) show collision and noncollision fire statistics by area of origin. Note that the "other" category consists primarily of fires with unknown area of origin. The data presented in these tables suggest that the focus of this document should be on the following four scenarios:

(1) Accidental fire following a collision originating in the engine compartment

(2) Accidental fire following a collision involving a fuel spill

(3) Accidental fire following a collision originating in the passenger compartment

(4) Accidental fire following a collision in other or unknown areas

Table 5.1.4(a) Collision Fire Statistics by Area of Origin, 2002–2005 Annual Averages [4]

Area of Fire Origin	Number of Fires	Civilian Deaths	Civilian Injuries	Damage (millions)
Engine compartment	5700 (70%)	112 (42%)	102 (47%)	$45 (52%)
Fuel tank or fuel line	700 (9%)	70 (26%)	52 (24%)	$14 (16%)
Passenger compartment	300 (4%)	19 (7%)	15 (7%)	$3 (3%)
Other	1400 (17%)	67 (25%)	50 (23%)	$25 (29%)

Table 5.1.4(b) Noncollision Fire Statistics by Area of Origin, 2002–2005 Annual Averages [4]

Area of Fire Origin	Number of Fires	Civilian Deaths	Civilian Injuries	Damage (millions)
Engine compartment	177,400 (69%)	50 (31%)	559 (48%)	$490 (61%)
Fuel tank or fuel line	3,800 (1%)	14 (9%)	93 (8%)	$17 (2%)
Passenger compartment	26,400 (10%)	40 (25%)	207 (18%)	$112 (14%)
Other	48,100 (19%)	56 (35%)	298 (26%)	$185 (23%)

5.1.5

Table 5.1.5 shows the number of fire deaths and injuries by reported cause. The data in this table suggest that thermal exposure (temperature and heat flux) as well as inhalation of toxic gases must be considered when establishing tenability criteria in a passenger road vehicle fire assessment.

Table 5.1.5 Vehicle Deaths and Injuries by Reported Cause, 2002–2005 Annual Averages [4]

Reported Cause	Civilian Deaths	Civilian Injuries
Burns and smoke inhalation	275 (58%)	209 (15%)
Burns only	99 (21%)	658 (46%)
Smoke inhalation only	20 (4%)	233 (16%)
Other	77 (16%)	339 (24%)
Total	471	1439

5.1.6

Figure 5.1.6(a) and Figure 5.1.6(b) show the number of vehicles in use in the United States, for 1991 through 2006, and the total miles of travel per year, for 1985 through 2006, respectively. [1] Table 5.1.6 shows a breakdown of material usage in the construction of passenger road vehicles based on vehicles retired from use. [5]

Figure 5.1.6(a) Number of Vehicles in Use in the United States, 1991-2006.

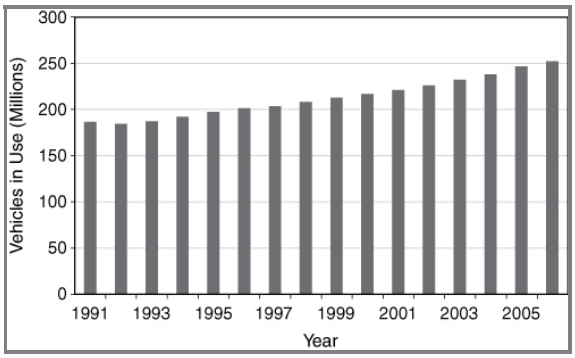


Figure 5.1.6(b) Total Travel Miles for Vehicles in Use in the United States [1], 1985-2006.

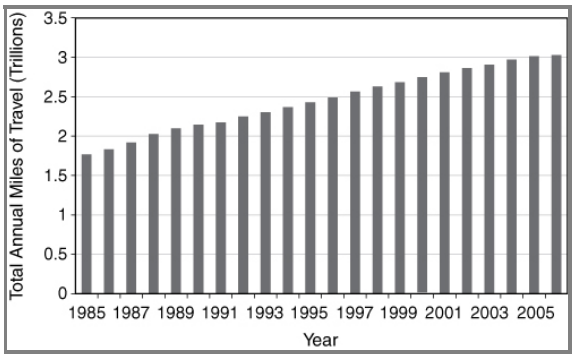


Table 5.1.6 Material Usage for Vehicles Retired from Use in the United States [5] (Percentage)

Year	Ferrous Metals	Non-ferrous Metals	Plastics	Rubber	Other Materials
1995	68.1	10.1	6.5	4.0	11.3
2000	66.3	10.6	7.3	4.3	11.5
2003	64.1	11.6	8.1	4.3	11.9
2004	63.8	11.8	8.3	4.3	11.8

Additional Proposed Changes

File Name	Description	Approved
Vehicle_Fires_Marty_Ahrens_March_2020.pdf	Vehicle fires March 2020	
Vehicle_Fires_Tables_Marty_Ahrens_March_2020.pdf	Vehicle fires tables	
Recreational_Vehicle_Fires_2020.pdf	recreational vehicles 2020	

Statement of Problem and Substantiation for Public Input

The statistics in this guide need to be updated, based on more recent information, including statistics published by Marty Ahrens in March 2020, attached. Three files are attached: the vehicle fires report,

the associated tables and a report on recreational vehicle fires.

Submitter Information Verification

Submitter Full Name: Marcelo Hirschler
Organization: GBH International
Street Address:
City:
State:
Zip:
Submittal Date: Mon May 24 13:51:19 EDT 2021
Committee: HAR-AAA



RESEARCH

Vehicle Fires

Marty Ahrens
March 2020

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Key findings

An estimated 212,500 vehicle fires caused 560 civilian deaths[i] 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. [ii] 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.

[i] Unless otherwise specified, firefighter deaths and injuries are excluded from casualty statistics.
[ii] 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.[1]

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

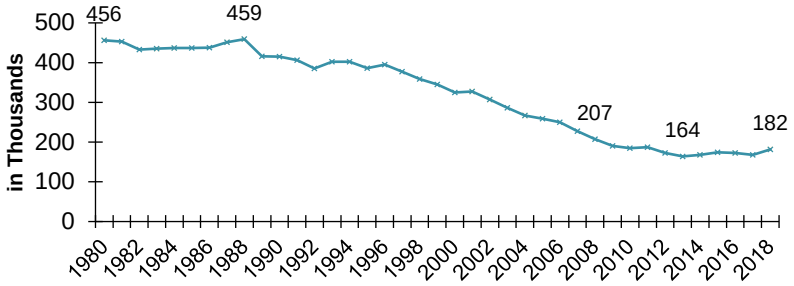
Highway vehicles, such as cars, trucks, buses, motorcycles, and recreational vehicles, accounted for the majority of vehicle fires. The term *highway vehicle fire* is used to describe fires in which road vehicles burned, regardless of where the fire occurred, including inside—if the fire did not spread 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.[2]

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.[3]

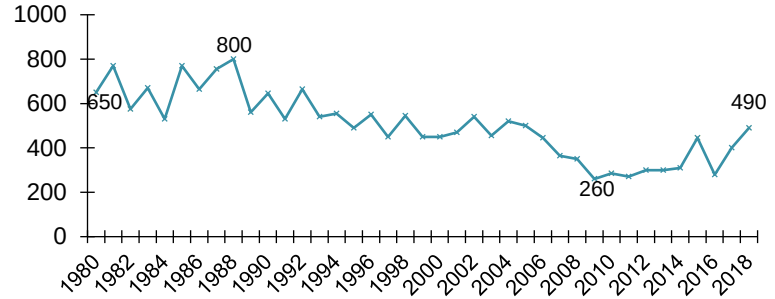
Despite the increase in highway vehicles, miles driven, and vehicle age, highway vehicle fires are less common than in the past. Figure 1 shows that the estimate of highway vehicle fires was 60 percent lower in 2018 than in 1980. Fewer than 200,000 such fires were reported annually in the past decade. 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.[4]

Figure 1. Highway vehicle fires by year



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.

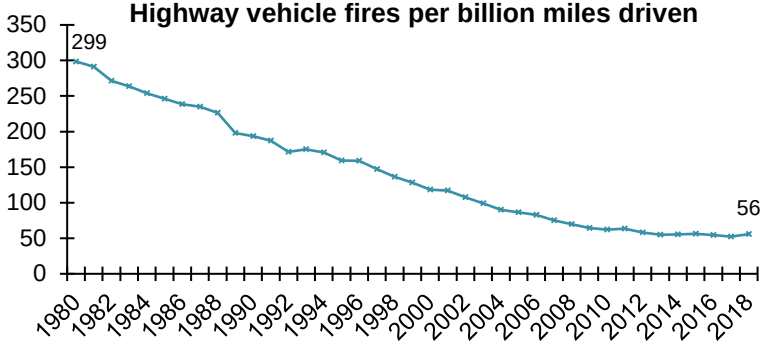
Figure 2. Highway vehicle fire deaths by year



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

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.

Figure 3.
Highway vehicle fires per billion miles driven

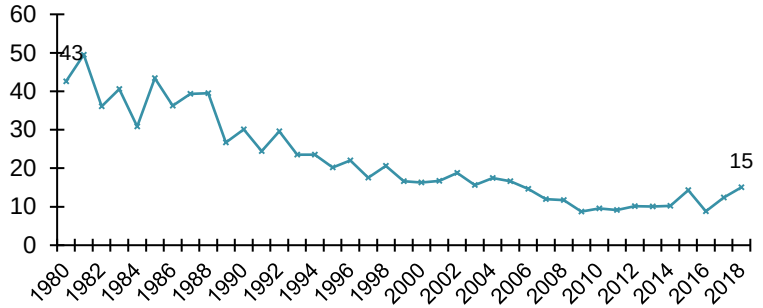


Sources: NFPA's *Fire Loss in the United States* series, US Department of Transportation, Federal Highway Administration Office of Highway Policy Information.

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[iii] 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.[iv] The remainder of this report will focus on highway vehicle fires.

Sources: NFPA's

[iii] If a vehicle inside a structure caught fire and spread to the structure or other contents, that fire would be considered a structure fire.
[iv] 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.[6]

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

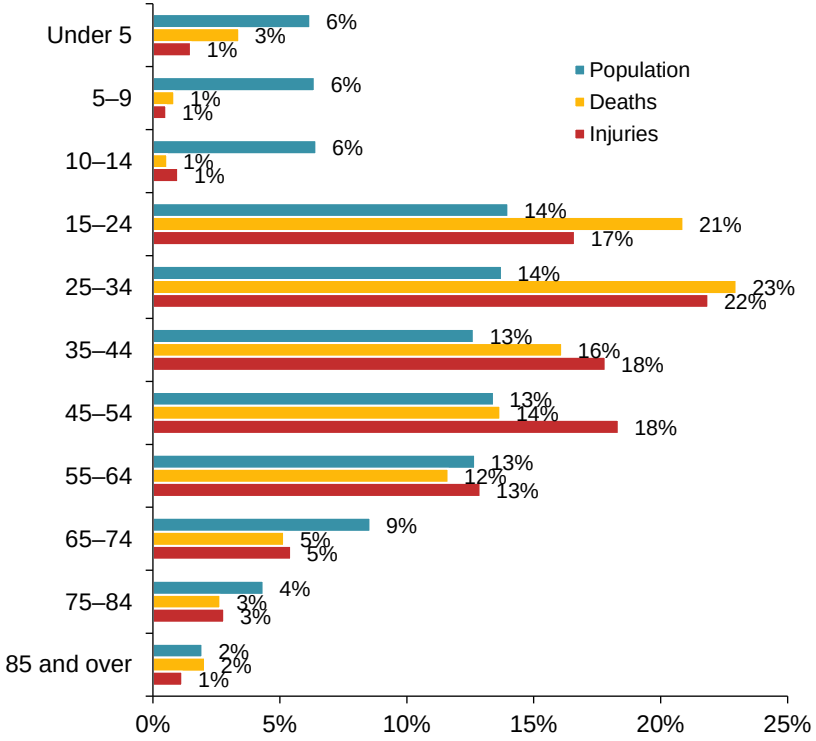


Figure 5 shows that almost half (44 percent) of the vehicle fire fatalities were between 15 and 34, compared to 38 percent of all crash victims.[7] Only 10 percent of highway vehicle fire fatalities and 18 percent of all crash victims were 65 years old or older.

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.

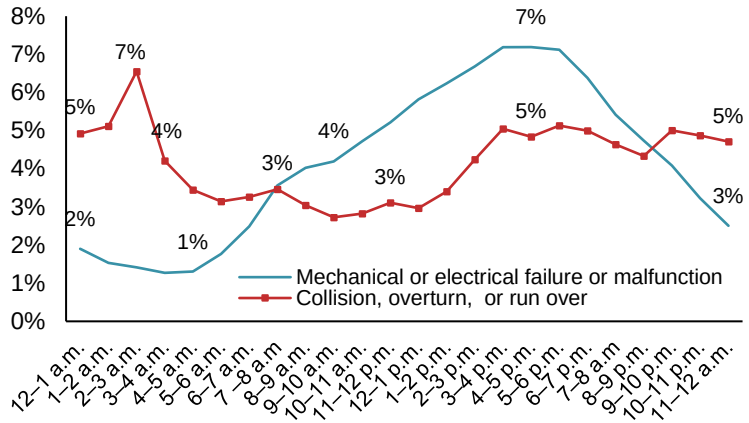
Highway vehicle fire times appear to correlate with the times vehicles are in use. The smallest number of fires occurred between 4:00 a.m. and 6:00 a.m. Fires increased steadily throughout the day, peaking between 3:00 p.m. and 6:00 p.m., likely due to rush hour traffic. From that point forward, fires 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.[8] 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.[9]

Figure 6.
Highway vehicle fires by major cause and alarm time 2013–2017



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.[10] A school bus driver and a 16-year-old student died in an Iowa fire in December 2017.[11] 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

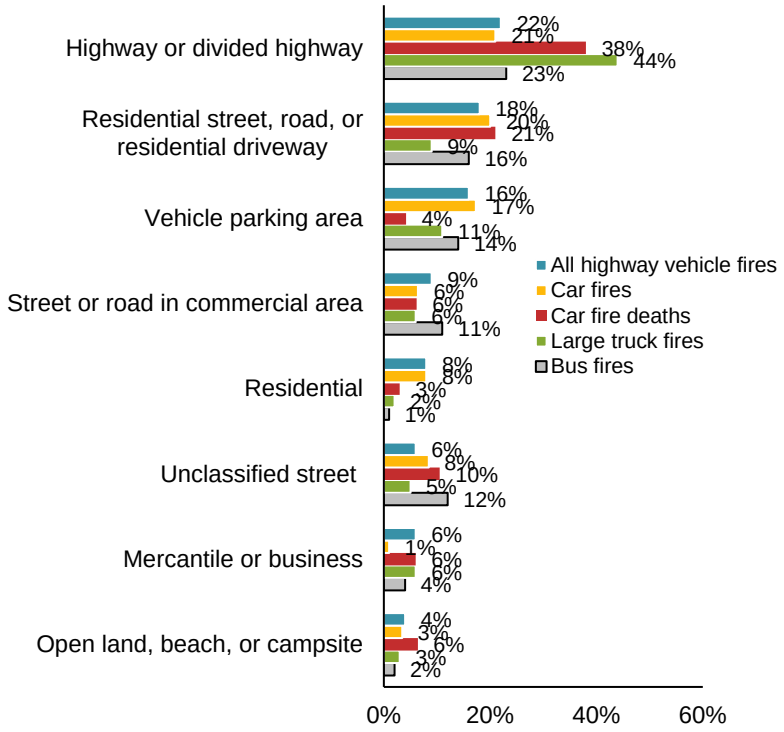
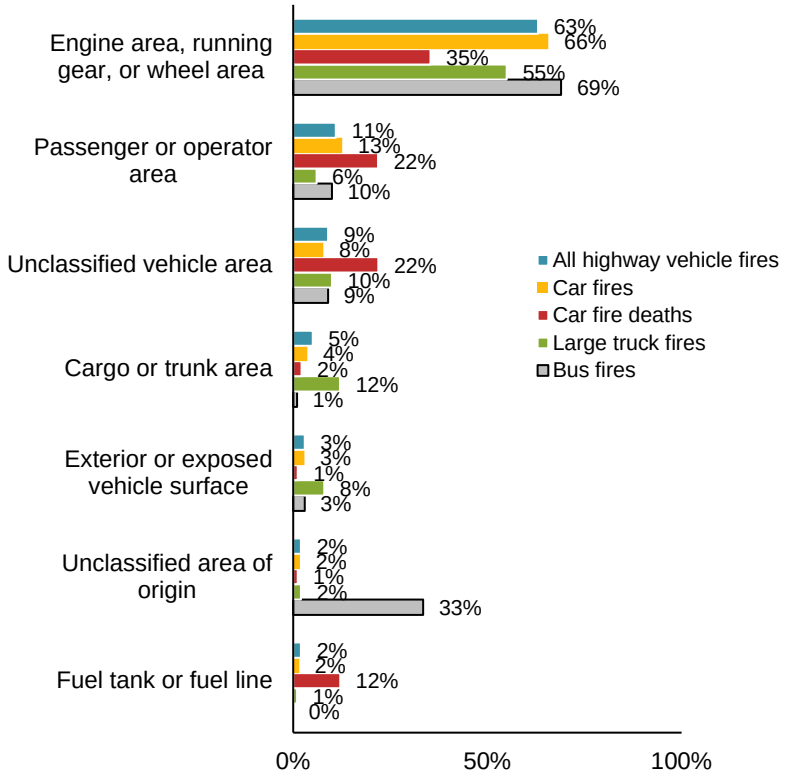


Figure 8 shows that fires most commonly began in the engine area, running gear, or wheel area. However, a disproportionate share of the car fire deaths resulted from fires that started around the fuel tank or fuel line or in the passenger area.

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 9.
Highway vehicle fires
by major causal factors, 2013–2017

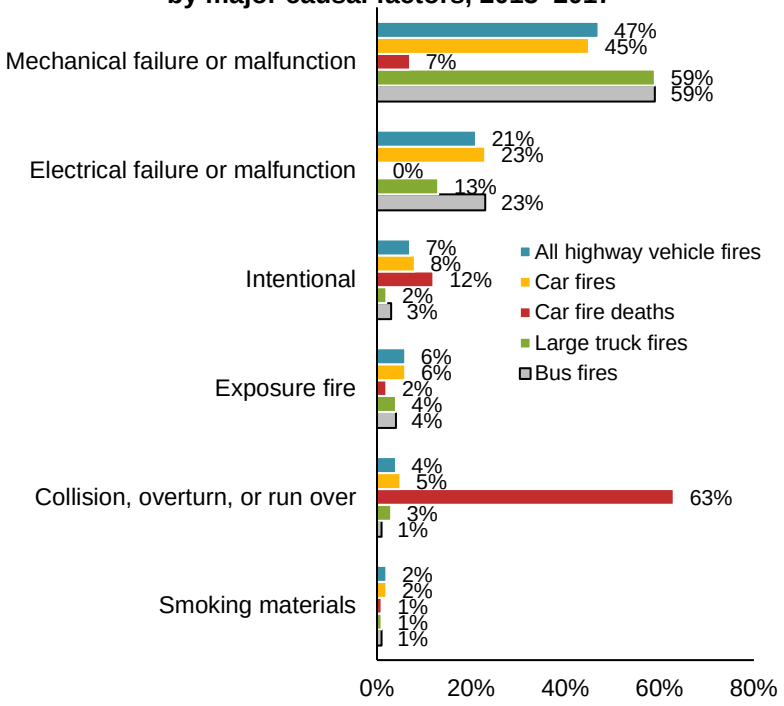
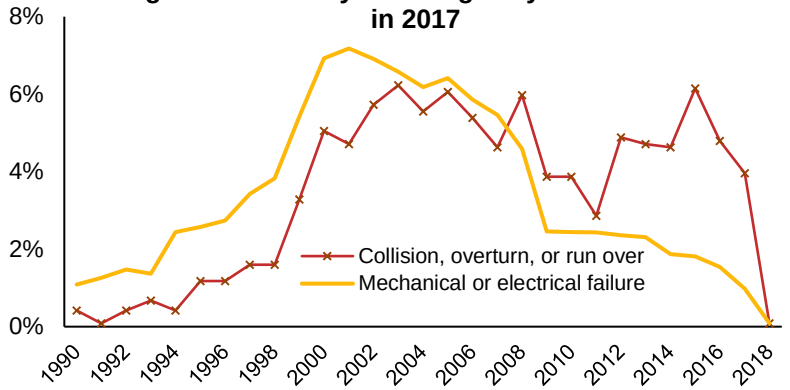


Figure 10 shows that roughly three-quarters of the highway vehicle fires reported in the US in 2017 that were caused by mechanical or electrical failures (77 percent) involved cars with model years of 2007 or earlier. This was true for only 54 percent of the fires resulting from collisions or overturns. 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.

Figure 10. Model year of highway vehicle fires in 2017

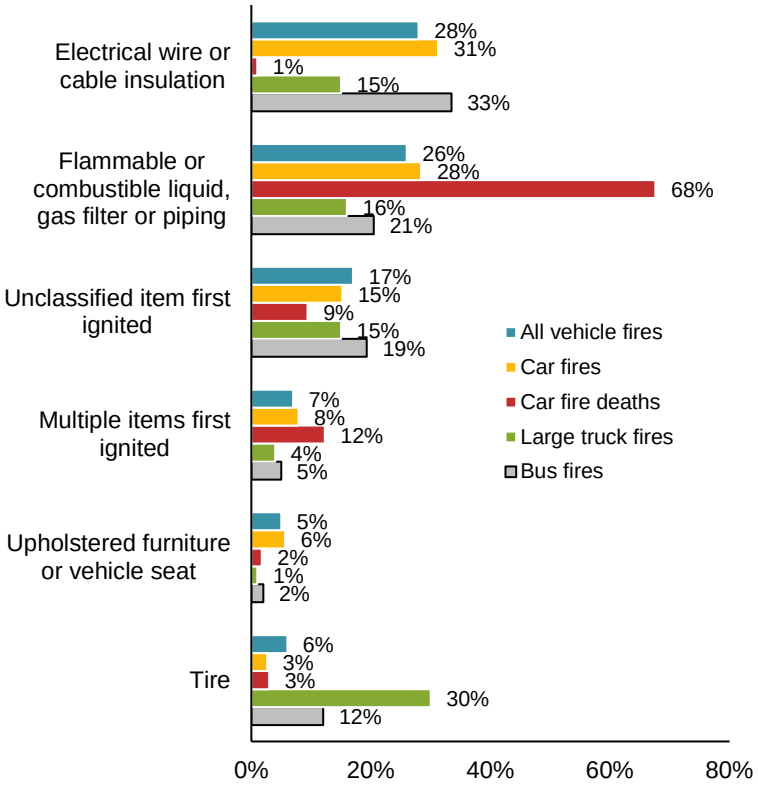


Highway vehicle fires were more likely to begin with the ignition of electrical wire or cable insulation than any other specific item.

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.[12] 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.[13] 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.[14] 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. [15] 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.[16]

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:[17]

- 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.[18] 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.[19] 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.[20] 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 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 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.

Email: research@nfpa.org

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RESEARCH

Vehicle Fires
Supporting Tables

Marty Ahrens
March 2020

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Vehicle Fires: Supporting Tables

The tables in this document are companions to the report of the same name. Firefighter deaths and injuries are excluded from this analysis.

Most tables, except fires by year, show estimates of 2013–2017 annual averages. All except Table 1 focus only on highway vehicle fires. Except for Table 3, all estimates were derived from the US Fire Administration's National Fire Incident Reporting System (NFIRS) and the NFPA annual fire department experience survey. Fires are rounded to the nearest 10, deaths and injuries are rounded to the nearest one, and property loss is rounded to the nearest million dollars. 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-off estimates might have different percentages. Except for trend tables, property loss is not adjusted for inflation. If a vehicle fire inside a structure spread to the structure itself, the incident would be considered a structure fire and would not be included in these tables. Inflation adjustments were made only for the trend tables.

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."

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. A highway vehicle fire is a fire involving a vehicle intended for highway use, including passenger road vehicles and trucks or freight road vehicles. The term *highway* is used to describe the vehicle, not the place where the fire occurred. Unknown data was allocated proportionally for each data element except for the incident type and property use. Major causal factors were pulled from several NFIRS data elements, including factors contributing to ignition, heat sources, and causes of ignition. Double counting might have occurred. Reports of fires from departments providing mutual aid were excluded from the analysis.

Highway vehicles were identified by NFIRS mobile property codes 10–29, which are used to classify passenger road and freight road transport vehicles. Cars, large trucks, and buses were also examined separately.

Cars or automobiles were identified by mobile property code 11, buses (including school buses, trackless trolleys, and motor coaches) by mobile property code 12, and large trucks by mobile property codes 21 and 23–27 (general use trucks, dump trucks, fire apparatus, trailers or semitrailers, and tank trucks. Pickup trucks and unclassified trucks were omitted.

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Table 1. Vehicle Fires by Type of Vehicle
2013–2017 Annual Averages

Vehicle Type	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Highway vehicles	**181,680**	**(92%)**	**355**	**(91%)**	**1,172**	**(81%)**	**$1,259**	**(74%)**
Passenger road vehicles	*161,060*	*(82%)*	*302*	*(77%)*	*1,105*	*(70%)*	*$844*	*(49%)*
Trucks or freight road vehicles	*20,620*	*(10%)*	*53*	*(14%)*	*156*	*(11%)*	*$415*	*(24%)*
Passenger road vehicles	161,060	(82%)	302	(77%)	1,105	(70%)	$844	(49%)
Automobile or passenger car	117,370	(59%)	230	(59%)	694	(48%)	$557	(33%)
Motor home, camper, or bookmobile	2,230	(1%)	8	(2%)	58	(4%)	$63	(4%)
Motorcycle or trail bike	1,720	(1%)	3	(1%)	29	(2%)	$5	(0%)
Bus, school bus, or trackless trolley	1,550	(1%)	0	(0%)	11	(1%)	$28	(2%)
Travel trailer designed to be towed	1,500	(1%)	3	(1%)	24	(2%)	$14	(1%)
Off-road recreational vehicle	1,450	(1%)	1	(0%)	13	(1%)	$7	(0%)
Collapsible camping trailer	190	(0%)	1	(0%)	1	(0%)	$1	(0%)
Mobile home or building or manufactured housing	140	(0%)	1	(0%)	4	(0%)	$3	(0%)
Unclassified passenger road vehicle	34,920	(18%)	55	(14%)	182	(13%)	$166	(10%)
Trucks or freight road vehicles	20,620	(10%)	53	(14%)	156	(11%)	$415	(24%)
Semitrailer with or without tractor	6,350	(3%)	22	(6%)	46	(3%)	$167	(10%)
General use truck, dump truck, or fire apparatus	3,780	(2%)	4	(1%)	35	(2%)	$54	(3%)
Pickup truck or non-motorized hauling rig	3,510	(2%)	9	(2%)	27	(2%)	$23	(1%)
Garbage, waste, or refuse truck	1,760	(1%)	0	(0%)	10	(1%)	$39	(2%)
Tank truck for flammable or combustible liquid or chemical cargo	350	(0%)	6	(2%)	8	(1%)	$13	(1%)
Tank truck for nonflammable cargo	290	(0%)	1	(0%)	2	(0%)	$6	(0%)
Tank truck for compressed or LP-gas	40	(0%)	0	(0%)	1	(0%)	$1	(0%)
Unclassified freight road transport vehicle	4,530	(2%)	11	(3%)	27	(2%)	$111	(6%)

Table 1. Vehicle Fires by Type of Vehicle
2013–2017 Annual Averages (Continued)

Vehicle Type	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Industrial, agricultural, and construction vehicles	8,230	(4%)	2	(1%)	47	(3%)	$262	(15%)
Agricultural vehicle, including baler or chopper	3,520	(2%)	1	(0%)	9	(1%)	$95	(6%)
Construction vehicle, including bulldozer, shovel grader, scraper, trencher, and plow	1,390	(1%)	1	(0%)	15	(1%)	$48	(3%)
Industrial loader, forklift, tow motor, or stacker	1,060	(1%)	0	(0%)	5	(0%)	$32	(2%)
Timber harvest vehicle	440	(0%)	0	(0%)	2	(0%)	$24	(1%)
Crane	50	(0%)	0	(0%)	1	(0%)	$8	(0%)
Unclassified industrial, agricultural, or construction vehicle	1,760	(1%)	1	(0%)	14	(1%)	$55	(3%)
Water vehicles	1,560	(1%)	3	(1%)	99	(7%)	$33	(2%)
Boat under 65 ft	1,120	(1%)	2	(0%)	73	(5%)	$21	(1%)
Personal watercraft	200	(0%)	0	(0%)	15	(1%)	$1	(0%)
Boat or ship 65 ft or more and under 1,000 tons	40	(0%)	0	(0%)	0	(0%)	$5	(0%)
Sailboat	40	(0%)	0	(0%)	5	(0%)	$1	(0%)
Commercial fishing or processing vessel	30	(0%)	0	(0%)	2	(0%)	$1	(0%)
Barge, petroleum balloon, or towable water vessel	20	(0%)	0	(0%)	0	(0%)	$0	(0%)
Cargo or military ship of 1,000 tons or more	10	(0%)	0	(0%)	0	(0%)	$0	(0%)
Cruise liner or passenger ship of 1,000 tons or more	0	(0%)	0	(0%)	0	(0%)	$0	(0%)
Tankship	0	(0%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified water transport vessel	80	(0%)	1	(0%)	3	(0%)	$1	(0%)
Rail vehicles	760	(0%)	1	(0%)	76	(5%)	$23	(1%)
Engine or locomotive	290	(0%)	0	(0%)	0	(0%)	$10	(1%)
Box, freight, or hopper car	180	(0%)	0	(0%)	0	(0%)	$2	(0%)
Maintenance equipment car, including caboose or crane	80	(0%)	0	(0%)	0	(0%)	$1	(0%)
Diner or passenger car	60	(0%)	0	(0%)	1	(0%)	$1	(0%)

Table 1. Vehicle Fires by Type of Vehicle
2013–2017 Annual Averages (Continued)

Vehicle Type	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Container or piggyback car	20	(0%)	0	(0%)	0	(0%)	$0	(0%)
Rapid transit car or self-powered trolley	20	(0%)	0	(0%)	0	(0%)	$0	(0%)
Tank car	10	(0%)	0	(0%)	75	(5%)	$5	(0%)
Unclassified rail transport vehicle	100	(0%)	0	(0%)	0	(0%)	$2	(0%)
Aircraft	310	(0%)	29	(6%)	21	(1%)	$44	(3%)
Personal, business or utility aircraft under 12,500 pounds	160	(0%)	18	(4%)	12	(1%)	$6	(0%)
Jet or turbine-powered fixed-wing commercial aircraft	40	(0%)	1	(0%)	1	(0%)	$15	(1%)
Personal, business, or utility aircraft of 12,500 pounds or more	30	(0%)	5	(1%)	4	(0%)	$12	(1%)
Propeller-driven or turboprop fixed-wing commercial aircraft	30	(0%)	0	(0%)	0	(0%)	$1	(0%)
Military fixed-wing aircraft	10	(0%)	1	(0%)	1	(0%)	$8	(1%)
Non-military helicopter or gyrocopter	10	(0%)	1	(0%)	0	(0%)	$1	(0%)
Military non-fixed-wing aircraft	0	(0%)	0	(0%)	0	(0%)	$0	(0%)
Balloon	0	(0%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified air transport vehicle	30	(0%)	3	(1%)	2	(0%)	$1	(0%)
Miscellaneous vehicles	5,050	(3%)	3	(1%)	37	(3%)	$72	(4%)
Home or garden vehicle	1,810	(1%)	0	(0%)	19	(1%)	$5	(0%)
Mechanically moved shipping contain	40	(0%)	0	(0%)	1	(0%)	$1	(0%)
Armored vehicle	30	(0%)	0	(0%)	1	(0%)	$2	(0%)
Aerial tramway vehicle	10	(0%)	0	(0%)	0	(0%)	$0	(0%)
Missile, rocket, or space vehicle	0	(0%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified mobile property	3,160	(2%)	3	(1%)	16	(1%)	$65	(4%)
Total	197,500	(100%)	392	(100%)	1,442	(100%)	$1,711	(100%)

Note: Subcategories are only shown if they account for at least 1 percent of the fires. Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 2. Highway Vehicle Fires by Year
1980–2018

Year	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)	Loss in 2018 Dollars (in Millions)
1980	456,000	650	2,850	$0.5	$1.4
1981	453,000	770	2,900	$0.5	$1.4
1982	433,000	575	3,250	$0.5	$1.4
1983	435,500	670	3,400	$0.6	$1.5
1984	437,000	530	3,250	$0.6	$1.5
1985	437,000	770	3,250	$0.7	$1.6
1986	438,000	665	2,850	$0.7	$1.5
1987	451,000	755	2,900	$0.7	$1.6
1988	459,000	800	2,750	$0.8	$1.7
1989	415,500	560	2,750	$0.8	$1.6
1990	415,000	645	3,025	$0.8	$1.6
1991	406,500	530	2,675	$0.8	$1.5
1992	385,500	665	2,750	$0.8	$1.5
1993	402,000	540	2,400	$0.9	$1.5
1994	402,000	555	2,325	$1.0	$1.6
1995	386,000	490	2,275	$1.0	$1.7
1996	395,000	550	2,075	$1.1	$1.8
1997	377,000	450	1,950	$1.1	$1.7
1998	358,500	545	2,050	$1.1	$1.7
1999	345,000	450	1,600	$1.1	$1.7
2000	325,000	450	1,325	$1.2	$1.7
2001	327,000	470	1,750	$1.3	$1.8
2002	307,000	540	1,700	$1.2	$1.7
2003	286,000	455	1,400	$1.1	$1.5
2004	266,500	520	1,300	$1.0	$1.3
2005	259,000	500	1,450	$1.0	$1.3
2006	250,000	445	1,075	$1.0	$1.2
2007	227,500	365	1,500	$1.1	$1.3
2008	207,000	350	850	$1.2	$1.4
2009	190,500	260	1,455	$1.0	$1.2
2010	184,500	285	1,440	$1.0	$1.1
2011	187,500	270	1,020	$1.0	$1.1
2012	172,500	300	800	$1.3	$1.2
2013	164,000	300	925	$1.1	$1.1
2014	167,500	310	1,275	$1.1	$1.2
2015	174,000	445	1,550	$1.2	$1.4
2016	173,000	280	1,075	$1.3	$1.4
2017	168,000	400	1,370	$1.4	$1.5
2018	181,500	490	1,300	$1.4	$1.4

Source: NFPA fire department experience survey as presented in NFPA's *Fire Loss in the United States* series of reports. Inflation adjustments were based on the consumer price index purchasing power of the dollar.

Table 3. US Highway Vehicle Fire Problem by Type of Vehicle
2013–2017 Annual Averages

Vehicle Type	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Passenger road vehicles	161,100	(89%)	302	(85%)	1,015	(87%)	$844	(67%)
Automobile or passenger car	117,400	(65%)	230	(65%)	694	(59%)	$557	(44%)
Motor home, camper, or bookmobile	2,200	(1%)	8	(2%)	58	(5%)	$63	(5%)
Motorcycle or trail bike	1,700	(1%)	3	(1%)	29	(2%)	$5	(0%)
Bus, school bus, or trackless trolley	1,500	(1%)	0	(0%)	11	(1%)	$28	(2%)
Travel trailer designed to be towed	1,500	(1%)	3	(1%)	24	(2%)	$14	(1%)
Off-road recreational vehicle	1,400	(1%)	1	(0%)	13	(1%)	$7	(1%)
Collapsible camping trailer	200	(0%)	1	(0%)	1	(0%)	$1	(0%)
Mobile home or building or manufactured housing	100	(0%)	1	(0%)	4	(0%)	$3	(0%)
Unclassified passenger road vehicle	34,900	(19%)	55	(16%)	182	(16%)	$166	(13%)
Trucks or freight road vehicles	20,600	(11%)	53	(15%)	156	(13%)	$415	(33%)
Semitrailer with or without tractor	6,400	(3%)	22	(6%)	46	(4%)	$167	(13%)
General use truck, dump truck, or fire apparatus	3,800	(2%)	4	(1%)	35	(3%)	$54	(4%)
Pickup truck or non-motorized hauling rig	3,500	(2%)	9	(2%)	27	(2%)	$23	(2%)
Garbage, waste, or refuse truck	1,800	(1%)	0	(0%)	10	(1%)	$39	(3%)
Tank truck for flammable or combustible liquid or chemical cargo	300	(0%)	6	(2%)	8	(1%)	$13	(1%)
Tank truck for nonflammable cargo	300	(0%)	1	(0%)	2	(0%)	$6	(1%)
Tank truck for compressed or LP-gas	0	(0%)	0	(0%)	1	(0%)	$1	(0%)
Unclassified freight road transport vehicle	4,500	(2%)	11	(3%)	27	(2%)	$111	(9%)
Total	181,700	(100%)	355	(100%)	1,172	(100%)	$1,259	(100%)

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 4. Highway Vehicle Fires by Month
2013–2017 Annual Averages

Month	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
January	14,900	(8%)	23	(6%)	80	(7%)	$95	(8%)
February	13,900	(8%)	29	(8%)	89	(8%)	$91	(7%)
March	15,100	(8%)	27	(8%)	98	(8%)	$126	(10%)
April	14,900	(8%)	32	(9%)	99	(8%)	$103	(8%)
May	16,000	(9%)	29	(8%)	104	(9%)	$109	(9%)
June	16,200	(9%)	24	(7%)	110	(9%)	$110	(9%)
July	17,000	(9%)	31	(9%)	113	(10%)	$112	(9%)
August	16,200	(9%)	32	(9%)	111	(10%)	$109	(9%)
September	15,000	(8%)	28	(8%)	104	(9%)	$95	(8%)
October	14,900	(8%)	37	(10%)	98	(8%)	$111	(9%)
November	13,800	(8%)	35	(10%)	77	(7%)	$103	(8%)
December	13,700	(8%)	29	(8%)	88	(8%)	$94	(7%)
Total	181,700	(100%)	355	(100%)	1,172	(100%)	$1,259	(100%)
Average per month	15,100	(8%)	30	(8%)	98	(8%)	$105	(8%)

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 5. Highway Vehicle Fires by Day of Week
2013–2017 Annual Averages

Day of Week	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Sunday	24,100	(13%)	60	(17%)	155	(13%)	$174	(14%)
Monday	26,400	(15%)	57	(16%)	156	(13%)	$196	(16%)
Tuesday	25,800	(14%)	40	(11%)	163	(14%)	$179	(14%)
Wednesday	25,700	(14%)	40	(11%)	163	(14%)	$169	(13%)
Thursday	25,700	(14%)	45	(13%)	175	(15%)	$175	(14%)
Friday	27,600	(15%)	51	(14%)	172	(15%)	$182	(14%)
Saturday	26,300	(14%)	62	(18%)	188	(16%)	$184	(15%)
Total	181,700	(100%)	355	(100%)	1,172	(100%)	$1,259	(100%)
Average per day of week	26,000	(14%)	51	(14%)	167	(14%)	$180	(14%)

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 6. Highway Vehicle Fires by Time of Day
2013–2017 Annual Averages

Time of Day	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Midnight–12:59 a.m.	5,700	(3%)	26	(7%)	38	(3%)	$51	(4%)
1:00–1:59 a.m.	5,200	(3%)	20	(6%)	31	(3%)	$45	(4%)
2:00–2:59 a.m.	5,100	(3%)	27	(8%)	43	(4%)	$49	(4%)
3:00–3:59 a.m.	4,700	(3%)	24	(7%)	30	(3%)	$52	(4%)
4:00–4:59 a.m.	4,400	(2%)	19	(5%)	19	(2%)	$72	(6%)
5:00–5:59 a.m.	4,400	(2%)	11	(3%)	24	(2%)	$43	(3%)
6:00–6:59 a.m.	4,900	(3%)	15	(4%)	23	(2%)	$34	(3%)
7:00–7:59 a.m.	5,800	(3%)	8	(2%)	24	(2%)	$35	(3%)
8:00–8:59 a.m.	6,300	(3%)	10	(3%)	33	(3%)	$39	(3%)
9:00–9:59 a.m.	6,600	(4%)	11	(3%)	39	(3%)	$46	(4%)
10:00–10:59 a.m.	7,400	(4%)	15	(4%)	55	(5%)	$45	(4%)
11:00–11:59 a.m.	8,400	(5%)	11	(3%)	59	(5%)	$52	(4%)
Noon–12:59 p.m.	9,400	(5%)	10	(3%)	74	(6%)	$58	(5%)
1:00–1:59 p.m.	10,000	(6%)	9	(3%)	65	(6%)	$64	(5%)
2:00–2:59 p.m.	10,800	(6%)	15	(4%)	83	(7%)	$73	(6%)
3:00–3:59 p.m.	11,500	(6%)	11	(3%)	73	(6%)	$68	(5%)
4:00–4:59 p.m.	11,400	(6%)	12	(3%)	80	(7%)	$59	(5%)
5:00–5:59 p.m.	11,200	(6%)	13	(4%)	79	(7%)	$65	(5%)
6:00–6:59 p.m.	10,200	(6%)	15	(4%)	77	(7%)	$56	(4%)
7:00–7:59 p.m.	9,000	(5%)	13	(4%)	56	(5%)	$53	(4%)
8:00–8:59 p.m.	8,300	(5%)	11	(3%)	54	(5%)	$48	(4%)
9:00–9:59 p.m.	7,700	(4%)	15	(4%)	42	(4%)	$48	(4%)
10:00–10:59 p.m.	6,900	(4%)	19	(5%)	30	(3%)	$51	(4%)
11:00–11:59 p.m.	6,200	(3%)	15	(4%)	42	(4%)	$54	(4%)
Total	181,700	(100%)	355	(100%)	1,172	(100%)	$1,259	(100%)
Average per hour of alarm	7,600	(4%)	15	(4%)	49	(4%)	$52	(4%)

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 7. Highway Vehicle Fires by Property Use Where Fire Occurred
2013–2017 Annual Averages

Fixed Property Use	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Outside or special property	139,500	(77%)	313	(88%)	879	(75%)	$921	(73%)
Highway, street, or parking area	*128,900*	*(71%)*	*280*	*(79%)*	*806*	*(69%)*	*$834*	*(66%)*
Highway or divided highway	40,800	(22%)	155	(44%)	251	(21%)	$352	(28%)
Residential street, road, or residential driveway	32,500	(18%)	59	(17%)	196	(17%)	$159	(13%)
Vehicle parking area	29,000	(16%)	14	(4%)	203	(17%)	$181	(14%)
Street or road in commercial area	15,600	(9%)	33	(9%)	70	(6%)	$77	(6%)
Unclassified street	11,000	(6%)	19	(5%)	87	(7%)	$65	(5%)
Open land, beach, or campsite	*6,800*	*(4%)*	*21*	*(6%)*	*55*	*(5%)*	*$50*	*(4%)*
Open land or field	3,700	(2%)	12	(3%)	24	(2%)	$28	(2%)
Vacant lot	1,600	(1%)	5	(2%)	6	(1%)	$11	(1%)
Graded or cared-for plot of land	1,300	(1%)	3	(1%)	16	(1%)	$8	(1%)
Unclassified outside or special property	*2,600*	*(1%)*	*5*	*(1%)*	*5*	*(0%)*	*$14*	*(1%)*
Residential	14,200	(8%)	13	(4%)	114,	(10%)	$87	(7%)
One- or two-family home	11,100	(6%)	10	(3%)	93	(8%)	$66	(5%)
Apartment or multifamily home	1,600	(1%)	1	(0%)	10	(1%)	$9	(1%)
Unclassified or unknown-type residential	1,300	(1%)	2	(1%)	11	(1%)	$11	(1%)
Mercantile or business	10,500	(6%)	5	(1%)	86	(7%)	$90	(7%)
Service station or gas station	2,300	(1%)	1	(0%)	23	(2%)	$12	(1%)
Grocery or convenience store	2,200	(1%)	2	(1%)	25	(2%)	$46	(4%)
Motor vehicle or boat sales, service or repair	2,200	(1%)	1	(0%)	16	(1%)	$8	(1%)
Storage	3,100	(2%)	2	(0%)	38	(3%)	$56	(4%)
Vehicle storage, garage, or fire station	2,200	(1%)	0	(0%)	25	(2%)	$42	(3%)
Public assembly	2,300	(1%)	6	(2%)	15	(1%)	$13	(1%)
Industrial, utility, defense, agriculture, or mining	1,100	(1%)	2	(1%)	4	(0%)	$19	(2%)
Educational	800	(0%)	0	(0%)	4	(0%)	$3	(0%)

Table 7. Highway Vehicle Fires by Property Use Where Fire Occurred
2013–2017 Annual Averages (Continued)

Fixed Property Use	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Health care, detention, and correction	600	(0%)	1	(0%)	2	(0%)	$3	(0%)
Manufacturing or processing	500	(0%)	0	(0%)	2	(0%)	$8	(1%)
Unclassified or unknown property use	9,100	(5%)	13	(4%)	27	(2%)	$59	(5%)
Total	181,700	(100%)	355	(100%)	1,172	(100%)	$1,259	(100%)

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 8. Highway Vehicle Fires by Cause of Ignition
2013–2017 Annual Averages

Cause	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unintentional	102,600	(56%)	285	(80%)	845	(72%)	$677	(54%)
Failure of equipment or heat source	58,700	(32%)	23	(6%)	245	(21%)	$377	(30%)
Intentional	12,200	(7%)	34	(9%)	59	(5%)	$99	(8%)
Unclassified	7,400	(4%)	10	(3%)	21	(2%)	$102	(8%)
Act of nature	700	(0%)	3	(1%)	1	(0%)	$4	(0%)
Total	181,700	(100%)	355	(100%)	1,172	(100%)	$1,259	(100%)

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 9. Highway Vehicle Fires by Factor Contributing to Ignition
2013–2017 Annual Averages

Factor Contributing to Ignition	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Mechanical failure or malfunction	84,700	(47%)	28	(8%)	304	(26%)	$502	(40%)
Unclassified mechanical failure or malfunction	60,300	(33%)	13	(4%)	177	(15%)	$386	(31%)
Leak or break	14,100	(8%)	14	(4%)	83	(7%)	$72	(6%)
Worn out	6,200	(3%)	0	(0%)	8	(1%)	$26	(2%)
Backfire	2,900	(2%)	0	(0%)	27	(2%)	$9	(1%)
Electrical failure or malfunction	38,500	(21%)	3	(1%)	124	(11%)	$221	(18%)
Other factors	65,400	(36%)	340	(96%)	800	(68%)	$589	(47%)
Unclassified factor contributed to ignition	11,700	(6%)	55	(16%)	90	(8%)	$111	(9%)
Exposure fire	10,500	(6%)	5	(1%)	18	(2%)	$150	(12%)
Collision, knockdown, run over, or overturn	7,800	(4%)	212	(60%)	220	(19%)	$110	(9%)
Heat source too close to combustibles	6,500	(4%)	9	(3%)	89	(8%)	$42	(3%)
Unclassified misuse of material or product	4,600	(3%)	13	(4%)	74	(6%)	$23	(2%)
Flammable liquid or gas spilled	4,600	(3%)	21	(6%)	94	(8%)	$36	(3%)
Abandoned or discarded material or product	3,500	(2%)	1	(0%)	24	(2%)	$14	(1%)
Unclassified operational deficiency	2,400	(1%)	2	(1%)	9	(1%)	$11	(1%)
Equipment not being operated properly	1,800	(1%)	6	(2%)	25	(2%)	$13	(1%)
Flammable liquid used to kindle fire	1,700	(1%)	4	(1%)	9	(1%)	$13	(1%)
Unclassified fire spread or control	1,100	(1%)	5	(2%)	6	(1%)	$9	(1%)
Cutting or welding too close to combustible	1,000	(1%)	0	(0%)	28	(2%)	$4	(0%)
Equipment overloaded	900	(1%)	0	(0%)	3	(0%)	$5	(0%)
Total fires*	181,700	(100%)	355	(100%)	1,172	(100%)	$1,259	(100%)
Total factors*	188,700	(104%)	372	(105%)	1,227	(105%)	$1,312	(104%)

* Multiple entries are allowed, resulting in more factors than fires.

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 10. Highway Vehicle Fires by Heat Source
2013–2017 Annual Averages

Heat Source	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified heat from powered equipment	40,800	(22%)	64	(18%)	206	(18%)	$276	(22%)
Radiated or conducted heat from operating equipment	32,600	(18%)	48	(14%)	186	(16%)	$191	(15%)
Arcing	29,200	(16%)	8	(2%)	123	(10%)	$168	(13%)
Unclassified heat source	16,000	(9%)	59	(17%)	80	(7%)	$120	(10%)
Spark, ember, or flame from operating equipment	13,600	(8%)	53	(15%)	186	(16%)	$96	(8%)
Unclassified hot or smoldering object	10,400	(6%)	13	(4%)	35	(3%)	$66	(5%)
Heat or spark from friction	10,300	(6%)	33	(9%)	69	(6%)	$85	(7%)
Backfire from internal combustion engine	3,900	(2%)	1	(0%)	28	(2%)	$18	(1%)
Radiated heat from another fire	3,300	(2%)	1	(0%)	4	(0%)	$59	(5%)
Smoking materials	2,900	(2%)	3	(1%)	40	(3%)	$13	(1%)
Heat from direct flame or convection currents	2,800	(2%)	4	(1%)	20	(2%)	$33	(3%)
Lighter	2,200	(1%)	12	(3%)	68	(6%)	$15	(1%)
Hot ember or ash	2,000	(1%)	1	(0%)	20	(2%)	$9	(1%)
Multiple heat sources, including multiple ignitions	1,800	(1%)	38	(11%)	21	(2%)	$30	(2%)
Molten or hot material	1,600	(1%)	1	(0%)	5	(0%)	$12	(1%)
Unclassified heat spread from another fire	1,400	(1%)	1	(0%)	7	(1%)	$19	(2%)
Flame or torch used for lighting	1,200	(1%)	2	(1%)	16	(1%)	$9	(1%)
Match	1,200	(1%)	3	(1%)	8	(1%)	$9	(1%)
Incendiary device	1,200	(1%)	1	(0%)	2	(0%)	$9	(1%)
Other known heat source	3,200	(2%)	11	(3%)	47	(4%)	$22	(2%)
Total	181,700	(100%)	355	(100%)	1,172	(100%)	$1,259	(100%)

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 11. Highway Vehicle Fires by Area of Fire Origin
2013–2017 Annual Averages

Area of Fire Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Engine area, running gear, or wheel area	113,600	(63%)	122	(34%)	505	(43%)	$695	(55%)
Passenger area	20,500	(11%)	71	(20%)	214	(18%)	$156	(12%)
Unclassified vehicle area	16,900	(9%)	75	(21%)	100	(9%)	$126	(10%)
Cargo or trunk area	8,400	(5%)	7	(2%)	105	(9%)	$81	(6%)
Exterior or exposed vehicle surface	6,100	(3%)	4	(1%)	35	(3%)	$37	(3%)
Unclassified area of origin	3,900	(2%)	7	(2%)	17	(1%)	$30	(2%)
Fuel tank or fuel line	3,000	(2%)	45	(13%)	95	(8%)	$33	(3%)
On or near highway, parking lot, or street	2,800	(2%)	10	(3%)	19	(2%)	$19	(1%)
Unclassified outside area	1,900	(1%)	1	(0%)	13	(1%)	$12	(1%)
Garage or vehicle storage area*	900	(1%)	0	(0%)	22	(2%)	$13	(1%)
Other known area	3,600	(2%)	12	(3%)	46	(4%)	$58	(5%)
Total	181,700	(100%)	355	(100%)	1,172	(100%)	$1,259	(100%)

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 12. Highway Vehicle Fires by Item First Ignited
2013–2017 Annual Averages

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Electrical wire or cable insulation	51,500	(28%)	4	(1%)	142	(12%)	$308	(24%)
Flammable or combustible liquid, gas filter, or piping	47,900	(26%)	232	(65%)	595	(51%)	$331	(26%)
Unclassified item first ignited	30,000	(17%)	39	(11%)	120	(10%)	$217	(17%)
Multiple items first ignited	12,800	(7%)	46	(13%)	86	(7%)	$109	(9%)
Tire	11,300	(6%)	7	(2%)	31	(3%)	$130	(10%)
Upholstered furniture or vehicle seat	8,500	(5%)	9	(3%)	58	(5%)	$54	(4%)
Light vegetation, including grass	3,300	(2%)	6	(2%)	24	(2%)	$18	(1%)
Rubbish, trash, or waste	2,900	(2%)	0	(0%)	11	(1%)	$13	(1%)
Conveyor belt, drive belt, or V-belt	1,800	(1%)	1	(0%)	3	(0%)	$8	(1%)
Magazine, newspaper, or writing paper	1,200	(1%)	1	(0%)	14	(1%)	$6	(0%)
Unclassified organic materials	1,200	(1%)	0	(0%)	8	(1%)	$5	(0%)
Box, carton, bag, basket, or barrel	1,000	(1%)	0	(0%)	12	(1%)	$5	(0%)
Other known item	8,200	(5%)	10	(3%)	67	(6%)	$55	(4%)
Total	181,700	(100%)	355	(100%)	1,172	(100%)	$1,259	(100%)

Note: Sums might not equal totals due to rounding errors.

Sources*:* NFIRS and NFPA fire department experience survey.

Table 13. Highway Vehicle Fires in Which Flammable or Combustible Liquids or Gases or Piping or Filters Were the Items First Ignited by Type of Material First Ignited 2013–2017 Annual Averages

Type of Material	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Flammable or combustible liquid	34,400	(72%)	200	(86%)	445	(75%)	$251	(76%)
Gasoline	19,700	(41%)	154	(67%)	329	(55%)	$122	(37%)
Class IIIB combustible liquid, including lubricating, transformer, or cooking oil	4,100	(8%)	0	(0%)	5	(1%)	$13	(4%)
Class II combustible liquid, including kerosene, numbers 1 and 2 fuel oil, and diesel-type liquid	900	(2%)	14	(6%)	14	(2%)	$38	(12%)
Unclassified flammable or combustible liquid	9,300	(19%)	30	(13%)	92	(15%)	$76	(23%)
Flammable gas	5,000	(10%)	21	(9%)	102	(17%)	$33	(10%)
Plastic	3,900	(8%)	2	(1%)	22	(4%)	$19	(6%)
Multiple types of material	1,600	(3%)	7	(3%)	9	(1%)	$12	(4%)
Unclassified material compounded with oil	800	(2%)	0	(0%)	2	(0%)	$3	(1%)
Unclassified type of material	700	(2%)	2	(1%)	1	(0%)	$4	(1%)
Rubber, excluding synthetic rubber	600	(1%)	0	(0%)	4	(1%)	$3	(1%)
Other known type of material	900	(2%)	1	(0%)	12	(2%)	$5	(2%)
Total	47,900	(100%)	232	(100%)	595	(100%)	$331	(100%)

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 14. Fire Deaths and Injuries in Reported Highway Vehicle Fires by Age Group
2013–2017 Annual Averages

Age	Population in Millions		Civilian Deaths		Deaths per Million	Relative Risk	Civilian Injuries		Injuries per Million	Relative Risk
Under 5	20	(6%)	12	(3%)	0.6	0.5	18	(1%)	0.9	0.2
5–9	20	(6%)	3	(1%)	0.1	0.1	6	(1%)	0.3	0.1
10–14	21	(6%)	2	(1%)	0.1	0.1	12	(1%)	0.6	0.2
15–24	44	(14%)	74	(21%)	1.7	1.5	195	(17%)	4.5	1.2
25–34	44	(14%)	82	(23%)	1.9	1.7	256	(22%)	5.8	1.6
35–44	41	(13%)	57	(16%)	1.4	1.3	209	(18%)	5.1	1.4
45–54	43	(13%)	49	(14%)	1.1	1.0	215	(18%)	5.0	1.4
55–64	41	(13%)	41	(12%)	1.0	0.9	151	(13%)	3.7	1.0
65–74	27	(9%)	18	(5%)	0.7	0.6	64	(5%)	2.3	0.6
75–84	14	(4%)	9	(3%)	0.7	0.6	33	(3%)	2.4	0.6
85+	6	(2%)	7	(2%)	1.2	1.1	14	(1%)	2.2	0.6
Total	321	100%)	355	(100%)	1.1	1.0	1,172	(100%)	3.6	1.0
Selected age groups										
14 and under	61	(19%)	17	(5%)	0.3	0.3	35	(3%)	0.6	0.2
65 and over	48	(15%)	35	(10%)	0.7	0.7	110	(9%)	2.3	0.6

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS 5.0 and NFPA survey, US Census Bureau.

Table 15. Car Fires by Property Use Where Fire Occurred
2013–2017 Annual Averages

Fixed Property Use	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Outside or special property	91,400	(78%)	204	(89%)	524	(76%)	$432	(78%)
Highway, street, or parking area	*85,500*	*(73%)*	*182*	*(79%)*	*493*	*(71%)*	*$399*	*(72%)*
Highway or divided highway	24,200	(21%)	86	(38%)	140	(20%)	$122	(22%)
Residential street, road, or residential driveway	23,600	(20%)	48	(21%)	129	(19%)	$101	(18%)
Vehicle parking area	20,300	(17%)	10	(4%)	128	(18%)	$94	(17%)
Unclassified street	9,900	(8%)	24	(10%)	43	(6%)	$44	(8%)
Street or road in commercial area	7,500	(6%)	14	(6%)	53	(8%)	$38	(7%)
Highway or divided highway	24,200	(21%)	86	(38%)	140	(20%)	$122	(22%)
Open land, beach, or campsite	*4,000*	*(3%)*	*15*	*(6%)*	*23*	*(3%)*	*$24*	*(4%)*
Open land or field	2,200	(2%)	9	(4%)	10	(2%)	$15	(3%)
Vacant lot	1,000	(1%)	3	(1%)	2	(0%)	$6	(1%)
Graded or cared-for plot of land	800	(1%)	2	(1%)	9	(1%)	$4	(1%)
Unclassified outside or special property	*1,300*	*(1%)*	*2*	*(1%)*	*2*	*(0%)*	*$5*	*(1%)*
Residential	9,300	(8%)	6	(3%)	66	(10%)	$51	(9%)
One- or two-family home	7,400	(6%)	6	(2%)	53	(8%)	$38	(7%)
Apartment or multifamily home	1,200	(1%)	0	(0%)	7	(1%)	$6	(1%)
Mercantile or business	6,600	(6%)	3	(1%)	49	(7%)	$26	(5%)
Service station or gas station	1,500	(1%)	1	(0%)	13	(2%)	$5	(1%)
Grocery or convenience store	1,400	(1%)	0	(0%)	10	(2%)	$4	(1%)
Motor vehicle or boat sales, service, or repair	1,400	(1%)	1	(1%)	14	(2%)	$9	(2%)
Unclassified or unknown-type mercanti or business	600	(1%)	0	(0%)	2	(0%)	$2	(0%)
Storage	1,700	(1%)	1	(1%)	25	(4%)	$11	(2%)
Vehicle storage, garage, or fire station	1,300	(1%)	0	(0%)	17	(2%)	$9	(2%)
Public assembly	1,500	(1%)	5	(2%)	11	(2%)	$6	(1%)
Industrial, utility, defense, agriculture, or mining	500	(0%)	2	(1%)	2	(0%)	$3	(1%)
Educational	500	(0%)	0	(0%)	3	(0%)	$2	(0%)

Table 15. Car Fires by Property Use Where Fire Occurred
2013–2017 Annual Averages (Continued)

Fixed Property Use	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Health care, detention, and correction	400	(0%)	0	(0%)	2	(0%)	$2	(0%)
Manufacturing or processing	200	(0%)	0	(0%)	0	(0%)	$1	(0%)
Unclassified or unknown property use	5,200	(4%)	8	(3%)	13	(2%)	$23	(4%)
Total	117,400	(100%)	230	(100%)	694	(100%)	$557	(100%)

Note: Subcategories are only shown if they account for at least 1 percent of the fires. Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table16. Car Fires by Cause of Ignition
2013–2017 Annual Averages

Cause	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unintentional	65,400	(56%)	183	(79%)	500	(72%)	$299	(54%)
Failure of equipment or heat source	37,400	(32%)	11	(5%)	138	(20%)	$150	(27%)
Intentional	9,200	(8%)	28	(12%)	46	(7%)	$72	(13%)
Unclassified	5,000	(4%)	6	(3%)	10	(1%)	$33	(6%)
Act of nature	400	(0%)	1	(1%)	0	(0%)	$2	(0%)
Total	117,400	(100%)	230	(100%)	694	(100%)	$557	(100%)

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 17. Car Fires by Factor Contributing to Ignition
2013–2017 Annual Averages

Factor Contributing to Ignition	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Mechanical failure or malfunction	52,500	(45%)	15	(7%)	168	(24%)	$193	(35%)
Unclassified mechanical failure or malfunction	36,100	(31%)	6	(2%)	109	(16%)	$139	(25%)
Leak or break	9,900	(8%)	8	(4%)	40	(6%)	$33	(6%)
Worn out	3,900	(3%)	0	(0%)	4	(1%)	$13	(2%)
Backfire	2,000	(2%)	0	(0%)	10	(1%)	$5	(1%)
Electrical failure or malfunction	26,600	(23%)	0	(0%)	70	(10%)	$111	(20%)
Other factors	65,400	(36%)	340	(96%)	800	(68%)	$589	(47%)
Unclassified factor contributed to ignition	7,600	(6%)	34	(15%)	61	(9%)	$71	(13%)
Exposure fire	7,400	(6%)	4	(2%)	9	(1%)	$51	(9%)
Collision, knockdown, run over, or overturn	6,000	(5%)	145	(63%)	163	(24%)	$56	(10%)
Heat source too close to combustibles	3,800	(3%)	4	(2%)	41	(6%)	$15	(3%)
Unclassified misuse of material or product	3,100	(3%)	10	(4%)	53	(8%)	$15	(3%)
Flammable liquid or gas spilled	3,000	(3%)	12	(5%)	52	(7%)	$15	(3%)
Abandoned or discarded material or product	2,200	(2%)	0	(0%)	12	(2%)	$8	(2%)
Unclassified operational deficiency	1,400	(1%)	1	(1%)	4	(1%)	$5	(1%)
Flammable liquid used to kindle fire	1,400	(1%)	2	(1%)	4	(1%)	$9	(2%)
Equipment not being operated properly	1,100	(1%)	3	(1%)	13	(2%)	$5	(1%)
Unclassified fire spread or control	600	(1%)	1	(1%)	3	(0%)	$4	(1%)
Other known factor	5,200	(4%)	6	(3%)	75	(11%)	$21	(4%)
Total fires	117,400	(100%)	230	(100%)	694	(100%)	$557	(100%)
Total factors*	121,900	(104%)	239	(104%)	729	(105%)	$579	(104%)

* Multiple entries are allowed, resulting in more factors than fires.

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 18. Car Fires by Heat Source
2013–2017 Annual Averages

Heat Source	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified heat from powered equipment	26,500	(23%)	45	(19%)	111	(16%)	$113	(20%)
Radiated or conducted heat from operating equipment	21,200	(18%)	36	(15%)	112	(16%)	$79	(14%)
Arcing	20,200	(17%)	4	(2%)	74	(11%)	$82	(15%)
Spark, ember, or flame from operating equipment	9,500	(8%)	33	(14%)	116	(17%)	$45	(8%)
Unclassified heat source	9,500	(8%)	31	(14%)	41	(6%)	$69	(12%)
Unclassified hot or smoldering object	5,900	(5%)	10	(4%)	20	(3%)	$23	(4%)
Heat or spark from friction	4,900	(4%)	22	(9%)	40	(6%)	$21	(4%)
Backfire from internal combustion engine	2,600	(2%)	1	(0%)	16	(2%)	$10	(2%)
Radiated heat from another fire	2,400	(2%)	1	(0%)	2	(0%)	$11	(2%)
Heat from direct flame or convection currents	2,000	(2%)	1	(0%)	10	(1%)	$16	(3%)
Smoking materials	1,900	(2%)	2	(1%)	26	(4%)	$8	(1%)
Lighter	1,700	(1%)	11	(5%)	49	(7%)	$11	(2%)
Multiple heat sources, including multiple ignitions	1,200	(1%)	22	(10%)	11	(2%)	$17	(3%)
Hot ember or ash	1,200	(1%)	0	(0%)	17	(2%)	$5	(1%)
Molten or hot material	1,000	(1%)	1	(0%)	3	(0%)	$8	(1%)
Incendiary device	1,000	(1%)	1	(0%)	2	(0%)	$8	(1%)
Match	1,000	(1%)	3	(1%)	6	(1%)	$7	(1%)
Flame or torch used for lighting	800	(1%)	1	(0%)	6	(1%)	$6	(1%)
Unclassified heat spread from another fire	800	(1%)	1	(0%)	3	(0%)	$7	(1%)
Other known heat source	1,900	(2%)	6	(3%)	29	(4%)	$10	(2%)
Total	117,400	(100%)	230	(100%)	694	(100%)	$557	(100%)

Note: Sums might not equal totals due to rounding errors.

Sources*:* NFIRS and NFPA fire department experience survey.

Table 19. Car Fires by Area of Fire Origin
2013–2017 Annual Averages

Area of Fire Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Engine area, running gear, or wheel area	77,100	(66%)	81	(35%)	329	(47%)	$324	(58%)
Passenger area	14,800	(13%)	50	(22%)	146	(21%)	$83	(15%)
Unclassified vehicle area	9,100	(8%)	50	(22%)	49	(7%)	$43	(8%)
Cargo or trunk area	4,300	(4%)	5	(2%)	55	(8%)	$30	(5%)
Exterior or exposed vehicle surface	3,400	(3%)	3	(1%)	16	(2%)	$15	(3%)
Unclassified area of origin	2,100	(2%)	3	(1%)	10	(1%)	$19	(3%)
Fuel tank or fuel line	1,800	(2%)	28	(12%)	52	(8%)	$14	(2%)
On or near a highway, parking lot, or street	1,700	(1%)	5	(2%)	10	(2%)	$9	(2%)
Unclassified outside area	900	(1%)	1	(0%)	5	(1%)	$4	(1%)
Other known area	2,000	(2%)	5	(2%)	21	(3%)	$16	(3%)
Total	117,400	(100%)	230	(100%)	694	(100%)	$557	(100%)

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 20. Car Fires by Item First Ignited
2013–2017 Annual Averages

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property (in Millions)	
Electrical wire or cable insulation	36,600	(31%)	2	(1%)	85	(12%)	$148	(27%)
Flammable or combustible liquid, gas filter, or piping	33,400	(28%)	156	(68%)	340	(49%)	$158	(28%)
Unclassified item first ignited	17,900	(15%)	22	(9%)	72	(10%)	$105	(19%)
Multiple items first ignited	9,300	(8%)	28	(12%)	65	(9%)	$52	(9%)
Upholstered furniture or vehicle seat	6,600	(6%)	4	(2%)	44	(6%)	$39	(7%)
Tire	3,100	(3%)	7	(3%)	12	(2%)	$18	(3%)
Light vegetation, including grass	2,100	(2%)	4	(2%)	18	(3%)	$10	(2%)
Drive belt or V-belt	1,300	(1%)	1	(0%)	3	(0%)	$4	(1%)
Rubbish, trash, or waste	1,100	(1%)	0	(0%)	3	(0%)	$4	(1%)
Magazine, newspaper, or writing paper	600	(1%)	1	(0%)	10	(2%)	$2	(0%)
Clothing	600	(1%)	0	(0%)	6	(1%)	$2	(0%)
Other known item	4,700	(4%)	5	(2%)	37	(5%)	$16	(3%)
Total	117,400	(100%)	230	(100%)	694	(100%)	$557	(100%)

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 21. Large Truck Fires by Property Use Where Fire Occurred
2013–2017 Annual Averages

Fixed Property Use	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Outside or special property	10,100	(81%)	31	(91%)	87	(85%)	$211	(75%)
Highway, street, or parking area	*9,400*	*(75%)*	*30*	*(89%)*	*80*	*(78%)*	*$188*	*(67%)*
Highway or divided highway	5,500	(44%)	26	(79%)	42	(41%)	$121	(43%)
Vehicle parking area	1,400	(11%)	0	(1%)	17	(17%)	$35	(13%)
Residential street, road, or residential driveway	1,100	(9%)	1	(4%)	15	(15%)	$15	(5%)
Street or road in commercial area	800	(6%)	1	(3%)	3	(3%)	$9	(3%)
Unclassified street	600	(5%)	0	(1%)	2	(2%)	$7	(3%)
Open land, beach, or campsite	*300*	*(3%)*	*0*	*(1%)*	*4*	*(4%)*	*$6*	*(2%)*
Dump or sanitary landfill	*100*	*(1%)*	*0*	*(0%)*	*0*	*(0%)*	*$3*	*(1%)*
Industrial plant yard or area	*100*	*(1%)*	*0*	*(0%)*	*2*	*(2%)*	*$5*	*(2%)*
Unclassified or unknown-type special property	*100*	*(1%)*	*0*	*(0%)*	*0*	*(0%)*	*$3*	*(1%)*
Mercantile or business	700	(6%)	1	(2%)	5	(4%)	$13	(5%)
Service station or gas station	200	(2%)	0	(1%)	2	(2%)	$3	(1%)
Motor vehicle or boat sales, service, or repair	200	(1%)	0	(1%)	1	(1%)	$4	(1%)
Grocery or convenience store	100	(1%)	0	(1%)	0	(0%)	$1	(0%)
Unclassified or unknown-type mercantile business	100	(1%)	0	(0%)	0	(0%)	$2	(1%)
Storage	400	(3%)	0	(1%)	2	(2%)	$26	(9%)
Vehicle storage, garage, or fire station	200	(2%)	0	(0%)	1	(1%)	$21	(7%)
Warehouse	100	(1%)	0	(0%)	1	(1%)	$3	(1%)
Residential	200	(2%)	0	(0%)	4	(4%)	$3	(1%)
One- or two-family home	200	(1%)	0	(0%)	4	(4%)	$3	(1%)
Industrial, utility, defense, agriculture, or mining	200	(2%)	0	(0%)	2	(2%)	$8	(3%)
Utility or distribution system	100	(1%)	0	(0%)	1	(1%)	$4	(1%)
Manufacturing or processing	100	(1%)	0	(0%)	0	(0%)	$5	(2%)
Public assembly	100	(1%)	0	(0%)	0	(0%)	$2	(1%)
Other, unclassified, or unknown property	600	(5%)	2	(6%)	2	(2%)	$12	(4%)
Total	12,600	(100%)	33	(100%)	102	(100%)	$281	(100%)

Note: Subcategories are only shown if they account for at least 1 percent of the fires. Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 22. Large Truck Fires by Cause of Ignition
2013–2017 Annual Averages

Cause	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Unintentional	6,700	(54%)	29	(86%)	70	(69%)	$158	(56%)
Failure of equipment or heat source	5,300	(42%)	2	(7%)	28	(27%)	$108	(39%)
Intentional	300	(3%)	1	(3%)	2	(2%)	$10	(3%)
Unclassified	200	(2%)	0	(1%)	2	(2%)	$5	(2%)
Act of nature	100	(1%)	1	(3%)	0	(0%)	$1	(0%)
Total	12,600	(100%)	33	(100%)	102	(100%)	$281	(100%)

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 23. Large Truck Fires by Factor Contributing to Ignition
2013–2017 Annual Averages

Factor Contributing to Ignition	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Mechanical failure or malfunction	7,400	(59%)	4	(11%)	39	(38%)	$156	(56%)
Unclassified mechanical failure or malfunction	5,400	(43%)	1	(4%)	18	(17%)	$122	(43%)
Leak or break	900	(7%)	2	(6%)	17	(16%)	$22	(8%)
Wear out	900	(7%)	0	(0%)	3	(3%)	$9	(3%)
Automatic control failure	100	(1%)	0	(0%)	0	(0%)	$1	(0%)
Manual control failure	100	(1%)	0	(0%)	0	(0%)	$1	(0%)
Backfire	100	(1%)	0	(0%)	2	(2%)	$1	(0%)
Electrical failure or malfunction	1,700	(13%)	0	(0%)	7	(7%)	$35	(12%)
Other factors	3,800	(30%)	32	(96%)	60	(58%)	$106	(38%)
Unclassified factor contributed to ignition	600	(5%)	4	(11%)	9	(9%)	$15	(5%)
Heat source too close to combustible	500	(4%)	1	(2%)	7	(6%)	$8	(3%)
Exposure fire	400	(4%)	1	(3%)	3	(3%)	$15	(5%)
Collision, knockdown, run over, or overturn	300	(3%)	21	(64%)	17	(17%)	$31	(11%)
Abandoned or discarded material or product	300	(2%)	0	(0%)	2	(2%)	$2	(1%)
Unclassified operational deficiency	200	(2%)	0	(1%)	1	(1%)	$3	(1%)
Equipment not being operated properly	200	(1%)	0	(1%)	0	(0%)	$4	(2%)
Equipment overloaded	100	(1%)	0	(0%)	0	(0%)	$1	(0%)
Flammable liquid or gas spilled	100	(1%)	3	(10%)	3	(3%)	$11	(4%)
Cutting or welding too close to combustible materials	100	(1%)	0	(0%)	2	(2%)	$1	(0%)
Unclassified misuse of material or product	100	(1%)	0	(0%)	3	(3%)	$2	(1%)
Failure to clean	100	(1%)	0	(0%)	0	(0%)	$0	(0%)
Unclassified natural condition	100	(1%)	0	(0%)	0	(0%)	$1	(0%)
Rekindle	100	(1%)	0	(0%)	0	(0%)	$1	(0%)
Other known factor	500	(4%)	1	(4%)	12	(12%)	$11	(4%)
Total fires	12,600	(100%)	33	(100%)	102	(100%)	$281	(100%)
Total factors*	12,900	(103%)	36	(107%)	106	(104%)	$296	(106%)

* Multiple entries are allowed, resulting in more factors than fires.

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 24. Large Truck Fires by Heat Source
2013–2017 Annual Averages

Heat Source	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Radiated or conducted heat from operating equipment	3,500	(28%)	3	(9%)	26	(25%)	$58	(21%)
Heat or spark from friction	2,100	(17%)	6	(17%)	12	(12%)	$38	(13%)
Unclassified heat from powered equipment	1,800	(14%)	2	(7%)	15	(14%)	$70	(25%)
Arcing	1,300	(10%)	1	(4%)	7	(7%)	$27	(10%)
Unclassified heat source	1,000	(8%)	6	(18%)	11	(11%)	$18	(7%)
Unclassified hot or smoldering object	800	(7%)	1	(2%)	1	(1%)	$16	(6%)
Spark, ember, or flame from operating equipment	700	(5%)	7	(21%)	13	(12%)	$24	(8%)
Hot ember or ash	200	(2%)	0	(0%)	1	(1%)	$1	(0%)
Molten or hot material	200	(2%)	0	(0%)	0	(0%)	$2	(1%)
Radiated heat from another fire	100	(1%)	0	(0%)	0	(0%)	$4	(2%)
Heat from direct flame or convection current	100	(1%)	0	(0%)	2	(2%)	$4	(1%)
Smoking materials	100	(1%)	0	(0%)	1	(1%)	$1	(0%)
Backfire from internal combustion engine	100	(1%)	0	(0%)	1	(1%)	$2	(1%)
Chemical reaction or spontaneous combustion	100	(1%)	1	(2%)	2	(2%)	$1	(0%)
Multiple heat sources, including multiple ignitions	100	(1%)	5	(16%)	2	(2%)	$5	(2%)
Unclassified heat spread from another fire	100	(1%)	0	(0%)	0	(0%)	$3	(1%)
Other known heat source	200	(2%)	1	(4%)	10	(10%)	$6	(2%)
Total	12,600	(100%)	33	(100%)	102	(100%)	$281	(100%)

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 25. Large Truck Fires by Area of Fire Origin
2013–2017 Annual Averages

Area of Fire Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Engine area, running gear, or wheel area	6,900	(55%)	10	(31%)	38	(37%)	$147	(52%)
Cargo or trunk area	1,600	(12%)	1	(4%)	18	(18%)	$30	(11%)
Unclassified vehicle area	1,200	(10%)	3	(10%)	9	(9%)	$26	(9%)
Exterior or exposed vehicle surface	1,000	(8%)	1	(3%)	5	(5%)	$11	(4%)
Operator or passenger area	800	(6%)	6	(17%)	5	(4%)	$23	(8%)
Unclassified area of origin	200	(2%)	1	(3%)	2	(2%)	$2	(1%)
Separate operating or control area of vehicle	200	(2%)	1	(3%)	8	(8%)	$20	(7%)
On or near a highway, parking lot, or street	200	(2%)	2	(7%)	2	(2%)	$3	(1%)
Fuel tank or fuel line	200	(1%)	7	(21%)	13	(13%)	$9	(3%)
Unclassified outside area	100	(1%)	0	(0%)	0	(0%)	$2	(1%)
Trash or rubbish chute, area, or container	100	(1%)	0	(0%)	0	(0%)	$0	(0%)
Other known area	200	(2%)	0	(1%)	3	(3%)	$5	(2%)
Total	12,600	(100%)	33	(100%)	102	(100%)	$281	(100%)

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 26. Large Truck Fires by Item First Ignited
2013–2017 Annual Averages

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Tire	3,800	(30%)	0	(1%)	14	(14%)	$66	(24%)
Flammable or combustible liquid, gas filter, or piping	2,000	(16%)	23	(70%)	56	(55%)	$69	(25%)
Unclassified item first ignited	1,900	(15%)	3	(10%)	6	(5%)	$36	(13%)
Electrical wire or cable insulation	1,900	(15%)	1	(2%)	7	(7%)	$62	(22%)
Rubbish, trash, or waste	800	(7%)	0	(0%)	3	(3%)	$7	(2%)
Multiple items first ignited	500	(4%)	5	(16%)	7	(7%)	$17	(6%)
Magazine, newspaper, or writing paper	200	(2%)	0	(0%)	2	(2%)	$2	(1%)
Box, carton, bag, basket, or barrel	200	(1%)	0	(0%)	0	(0%)	$2	(1%)
Light vegetation, including grass	200	(1%)	0	(1%)	0	(0%)	$1	(0%)
Unclassified organic materials	100	(1%)	0	(0%)	1	(1%)	$1	(0%)
Upholstered furniture or vehicle seat	100	(1%)	0	(0%)	3	(3%)	$2	(1%)
Dust, fiber, or lint, including sawdust or excelsior	100	(1%)	0	(0%)	0	(0%)	$0	(0%)
Agricultural crops, including fruits and vegetables	100	(1%)	0	(0%)	0	(0%)	$2	(1%)
Film or residue, including paint, resin, and creosote	100	(1%)	0	(0%)	0	(0%)	$1	(0%)
Other known item	600	(5%)	0	(0%)	4	(4%)	$13	(4%)
Total	12,600	(100%)	33	(100%)	102	(100%)	$281	(100%)

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 27. Bus Fires by Property Use Where Fire Occurred
2013–2017 Annual Averages

Fixed Property Use	Fires		Civilian Injuries		Direct Property Damage (in Millions)	
Outside or special property	1,230	(80%)	9	(86%)	$20	(72%)
Highway, street, or parking area	*1,190*	*(76%)*	*9*	*(86%)*	*$20*	*(70%)*
Highway or divided highway	360	(23%)	2	(23%)	$8	(29%)
Residential street, road, or residential driveway	240	(16%)	1	(10%)	$2	(8%)
Vehicle parking area	220	(14%)	1	(11%)	$5	(16%)
Street or road in commercial area	190	(12%)	0	(5%)	$3	(11%)
Unclassified street	180	(11%)	4	(38%)	$2	(6%)
Open land, beach, or campsite	*20*	*(2%)*	*0*	*(0%)*	*$0*	*(1%)*
Unclassified or unknown-type special property	*20*	*(1%)*	(	*(0%)*	*$0*	*(0%)*
Mercantile or business	60	(4%)	1	(9%)	$2	(8%)
Motor vehicle or boat sales, service, or repair	30	(2%)	1	(5%)	$1	(2%)
Office, bank, or mail facility	10	(1%)	0	(0%)	$0	(1%)
Service station or gas station	10	(1%)	0	(0%)	$0	(1%)
Educational	60	(4%)	0	(0%)	$1	(3%)
Preschool through grade 12	50	(3%)	0	(0%)	$1	(2%)
Public assembly	50	(3%)	0	(0%)	$1	(5%)
Passenger terminal	20	(1%)	0	(0%)	$1	(2%)
Church, mosque, synagogue, temple, o chapel	10	(1%)	0	(0%)	$0	(1%)
Storage	40	(3%)	0	(0%)	$2	(7%)
Vehicle storage, garage, or fire station	40	(2%)	0	(0%)	$2	(5%)
Residential	20	(1%)	0	(0%)	$0	(1%)
One- or two-family home	10	(1%)	0	(0%)	$0	(1%)
Health care, detention, and correction	10	(0%)	0	(0%)	$0	(1%)
Other known occupancy	10	(0%)	0	(0%)	$0	(1%)
Unclassified or unknown property use	70	(4%)	1	(5%)	$1	(3%)
Total	1,550	(100%)	11	(100%)	$28	(100%)

Note: Subcategories are only shown if they account for at least 1 percent of the fires. Sums might not equal totals due to rounding errors.
Sources: NFIRS and NFPA fire department experience survey.

Table 28. Bus Fires by Cause of Ignition
2013–2017 Annual Averages

Cause of Ignition	Fires		Civilian Injuries		Direct Property Damage (in Millions)	
Failure of equipment or heat source	750	(48%)	7	(65%)	$12	(42%)
Unintentional	690	(45%)	4	(35%)	$11	(40%)
Unclassified	60	(4%)	0	(0%)	$4	(14%)
Intentional	40	(3%)	0	(0%)	$1	(4%)
Act of nature	10	(0%)	0	(0%)	$0	(0%)
Total	1,550	(100%)	11	(100%)	$28	(100%)

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 29. Bus Fires by Factor Contributing to Ignition
2013–2017 Annual Averages

Factor Contributing to Ignition	Fires		Civilian Injuries		Direct Property Damage (in Millions)	
Mechanical failure or malfunction	920	(59%)	3	(32%)	$15	(53%)
Leak or break	140	(9%)	0	(0%)	$1	(3%)
Worn out	80	(5%)	0	(0%)	$1	(5%)
Automatic control failure	10	(1%)	0	(0%)	$0	(0%)
Manual control failure	10	(1%)	0	(0%)	$0	(0%)
Backfire	10	(1%)	0	(0%)	$0	(0%)
Unclassified mechanical failure or malfunction	680	(44%)	3	(32%)	$12	(44%)
Electrical failure or malfunction	350	(23%)	5	(45%)	$5	(18%)
Other factors	330	(22%)	2	(23%)	$10	(35%)
Exposure fire	60	(4%)	0	(0%)	$6	(20%)
Unclassified factor contributed to ignition	60	(4%)	0	(0%)	$1	(4%)
Heat source too close to combustibles	40	(2%)	0	(0%)	$1	(2%)
Unclassified operational deficiency	20	(2%)	0	(0%)	$0	(1%)
Equipment overloaded	20	(1%)	0	(0%)	$0	(1%)
Flammable liquid or gas spilled	20	(1%)	0	(0%)	$0	(1%)
Unclassified misuse of material or product	20	(1%)	0	(0%)	$0	(1%)
Equipment not being operated properly	20	(1%)	0	(0%)	$0	(1%)
Abandoned or discarded material or product	10	(1%)	2	(23%)	$0	(0%)
Unclassified design, manufacturing, or installation deficiency	10	(1%)	0	(0%)	$0	(0%)
Collision, knockdown, run over, or overturn	10	(1%)	0	(0%)	$0	(2%)
Other known factors	60	(4%)	0	(0%)	$0	(2%)
Total fires	1,550	(100%)	11	(100%)	$28	(100%)
Total entries*	1,610	(104%)	11	(100%)	$30	(107%)

* Multiple entries are allowed, resulting in sums greater than the totals.

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 30. Bus Fires by Heat Source
2013–2017 Annual Averages

Heat Source	Fires		Civilian Injuries		Direct Property Damage (in Millions)	
Unclassified heat from powered equipment	400	(26%)	5	(48%)	$8	(28%)
Radiated or conducted heat from operating equipment	340	(22%)	1	(10%)	$5	(16%)
Arcing	270	(17%)	3	(28%)	$5	(17%)
Unclassified heat source	130	(8%)	0	(0%)	$1	(3%)
Heat or spark from friction	130	(8%)	0	(0%)	$3	(9%)
Spark, ember, or flame from operating equipment	80	(5%)	0	(0%)	$3	(9%)
Unclassified hot or smoldering object	80	(5%)	0	(0%)	$1	(3%)
Heat from direct flame or convection current	20	(1%)	0	(0%)	$1	(3%)
Smoking materials	20	(1%)	2	(14%)	$2	(6%)
Candle	20	(1%)	0	(0%)	$1	(3%)
Molten or hot material	20	(1%)	0	(0%)	$0	(0%)
Flame or torch used for lighting	10	(1%)	0	(0%)	$0	(0%)
Radiated heat from another fire	10	(1%)	0	(0%)	$0	(1%)
Multiple heat sources, including multiple ignitions	10	(1%)	0	(0%)	$0	(1%)
Other known heat source	30	(2%)	0	(0%)	$0	(1%)
Total	1,550	(100%)	11	(100%)	$28	(100%)

Note: Sums might not equal totals due to rounding errors.

Sources: NFIRS and NFPA fire department experience survey.

Table 31. Bus Fires by Area of Fire Origin
2013–2017 Annual Averages

Area of Fire Origin	Fires		Civilian Injuries		Direct Property Damage (in Millions)	
Engine area, running gear, or wheel area	1,070	(69%)	8	(75%)	$19	(70%)
Operator or passenger area	160	(10%)	1	(5%)	$4	(15%)
Unclassified vehicle area	140	(9%)	2	(16%)	$2	(9%)
Exterior or exposed vehicle surface	50	(3%)	0	(0%)	$1	(2%)
Unclassified area of origin	50	(3%)	0	(0%)	$0	(1%)
On or near a highway, parking lot, or street	20	(1%)	0	(0%)	$0	(1%)
Cargo or trunk area	20	(1%)	0	(0%)	$0	(1%)
Separate operating or control area of vehicle	10	(1%)	0	(0%)	$0	(0%)
Unclassified outside area	10	(1%)	0	(0%)	$0	(0%)
Other known area	30	(2%)	1	(5%)	$0	(1%)
Total	1,550	(100%)	11	(100%)	$28	(100%)

Note: Sums might not equal totals due to rounding errors.

Sources*:* NFIRS and NFPA fire department experience survey.

Table 32. Bus Fires by Item First Ignited
2013–2017 Annual Averages

Item First Ignited	Fires		Civilian Injuries		Direct Property Damage (in Millions)	
Electrical wire or cable insulation	520	(33%)	6	(55%)	$10	(34%)
Flammable or combustible liquid, gas filter, or piping	320	(21%)	1	(13%)	$4	(15%)
Unclassified item first ignited	300	(19%)	0	(0%)	$4	(14%)
Tire	190	(12%)	1	(13%)	$5	(18%)
Multiple items first ignited	70	(5%)	0	(0%)	$4	(13%)
Conveyor belt, drive belt, or V-belt	40	(3%)	0	(0%)	$0	(2%)
Upholstered furniture or vehicle seat	30	(2%)	0	(0%)	$0	(1%)
Light vegetation, including grass	10	(1%)	0	(0%)	$0	(1%)
Film or residue, including paint, resin, and creosote	10	(1%)	0	(0%)	$0	(0%)
Other known item	60	(4%)	2	(19%)	$0	(2%)
Total	1,550	(100%)	11	(100%)	$28	(100%)

Note: Sums might not equal totals due to rounding errors.

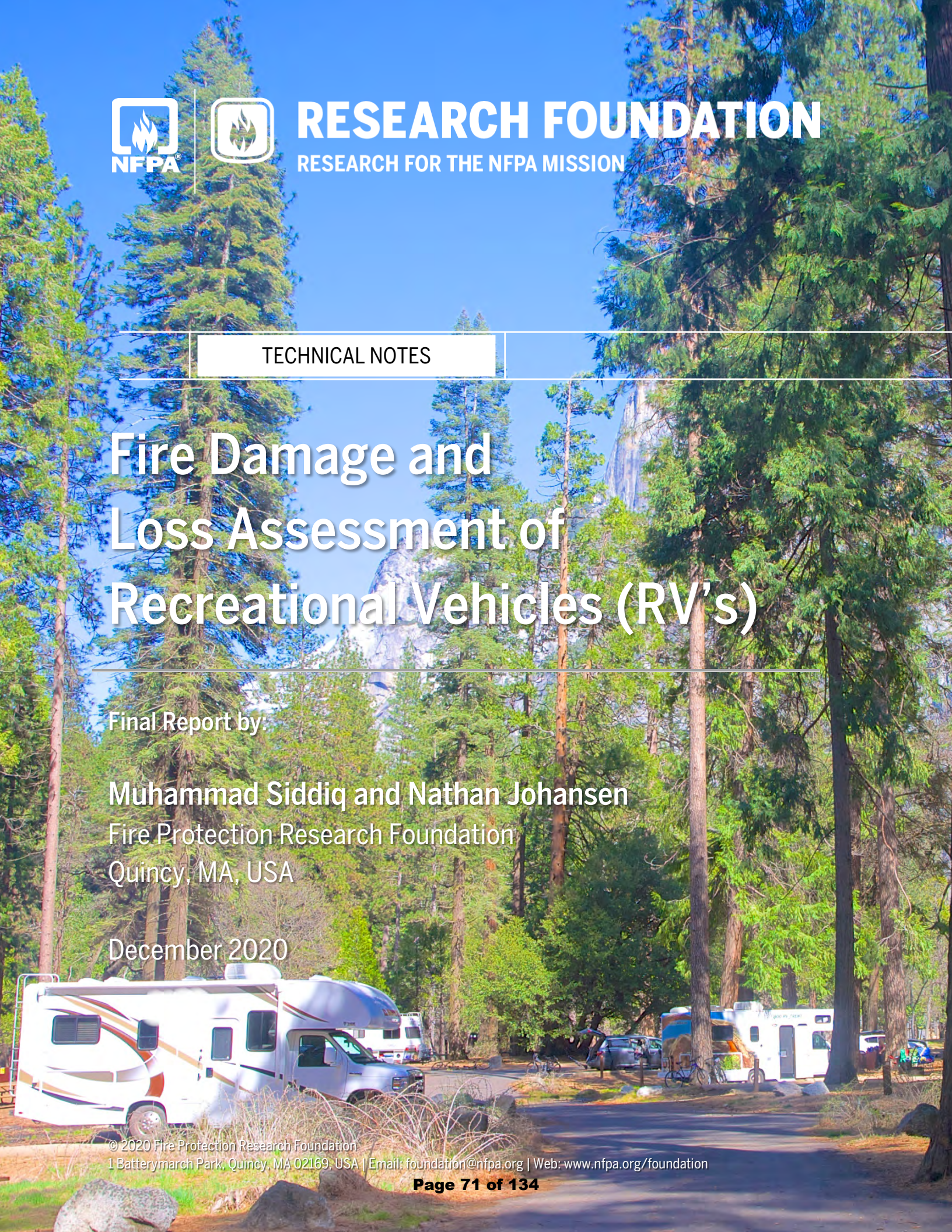
Sources: NFIRS and NFPA fire department experience survey.

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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 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.

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TECHNICAL NOTES

Fire Damage and Loss Assessment of Recreational Vehicles (RV's)

Final Report by:

Muhammad Siddiq and Nathan Johansen

Fire Protection Research Foundation

Quincy, MA, USA

December 2020

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1 Batterymarch Park, Quincy, MA 02169, USA | Email: foundation@nfpa.org | Web: www.nfpa.org/foundation

Foreword

The Technical Committee for the NFPA 1192 *Standard for Recreational Vehicles* requested an analysis that identifies the trends in the fire damage and loss incidents of recreational vehicles over the last ten years, which excludes mobile property types that are outside the scope of the standard. In order to address this need, this project collected and analyzed statistical fire incident data on recreational vehicles to better define the fire experience and further inform future editions of the NFPA 1192 Standard and fire safety for recreational vehicles.

The Fire Protection Research Foundation expresses gratitude to the report authors Muhammad Siddiq and Nathan Johansen, who are with the Fire Protection Research Foundation located in Quincy, MA. We would also like to thank Ms. Marty Ahrens, from NFPA's Applied Research division, for her assistance in deriving national estimates of causes and circumstances of RV fires from the detailed data collected by the National Fire Incident Reporting System (NFIRS) and NFPA's fire experience survey to support this analysis. The Research Foundation appreciates the guidance provided by the Project Technical Panelists and all others that contributed to this research effort. Thanks are also expressed to the National Fire Protection Association (NFPA) for providing the project funding through the NFPA Annual Research Fund.

The Fire Protection Research Foundation and 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 U.S. Fire Administration for its work in developing, coordinating, and maintaining NFIRS.

To obtain a copy of the custom analysis of "Fires in or Involving Motor Homes, Travel Trailers and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types)" produced by Ahrens in support of this project, contact:

Applied Research
National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02169-7471
www.nfpa.org
e-mail: research@nfpa.org

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The Fire Protection Research Foundation plans, manages, and communicates research on a broad range of fire safety issues in collaboration with scientists and laboratories around the world. The Foundation is an affiliate of NFPA.



About the National Fire Protection Association (NFPA)

Founded in 1896, NFPA is a global, nonprofit organization devoted to eliminating death, injury, property and economic loss due to fire, electrical and related hazards. The association delivers information and knowledge through more than 300 consensus codes and standards, research, training, education, outreach and advocacy; and by partnering with others who share an interest in furthering the NFPA mission.



All NFPA codes and standards can be viewed online for free.

NFPA's membership totals more than 65,000 individuals around the world.

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Report number: FPRF-2020-14

Project Manager: Victoria Hutchison

Project Technical Panel

Marty Ahrens, NFPA

Doug Mulvaney, Kampgrounds of America, NFPA 1192/1194 Chair

Kent Perkins, Recreational Vehicle Industry Association (RVIA)

Jacqueline Wilmot, NFPA

Project Sponsors



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1. Introduction

According to the 2017 North American Camping Report, approximately 68 million people in the United States consider themselves campers, either frequent or occasional. Of those considering themselves campers, approximately 22% take or stay in an RV during their trip. However, approximately 40% of campers that are 55 years of age or over utilize RV's as their primary means of accommodation at a campground (Kampgrounds of America 2017). The 2017 North American Recreational Vehicle Market report estimates that over 10 million US households own a recreational vehicle (RV) and nearly 17 million homeowners are looking to purchase an RV. The market trends show a growth in camping and RV sales, especially from younger populations. To keep up with this demand, approximately 3.2 million new RV's were manufactured between 2008 and 2017 in the US. With these market trends, it is critical that we understand the fire experience in recreational vehicles and any affiliated safety concerns.

The Technical Committees of NFPA 1192 *Standard on Recreational Vehicles* and NFPA 1194 *Standard for Recreational Vehicle Parks and Campgrounds* requested statistical data on recreational vehicle fire losses and damage reports to inform the development of the 2021-cycle standards. The need for this study stemmed from previous statistical analyses that included data from a range of vehicles such as mobile medical vehicles, bookmobiles, and food trucks, which restricted the committee's ability to assess the fire experience in recreational vehicles only.

To address this need, this project collected and analyzed data on recreational vehicle incidents that fall within the scope of the NFPA 1192 standard to help inform appropriate actions and proposed changes to the next edition of the NFPA 1192 *Standard on Recreational Vehicles*.

This report focuses on the following key areas:

- Regulations that govern recreational vehicles throughout the US. RV Market Information, including classifications and the demographics of the users, to provide additional context to the data presented in subsequent sections (*refer to section Regulations and Market Analysis*).
- National estimates of the RV fire incidents between 2008 and 2017 derived from the National Fire Incident Reporting System (NFIRS) and NFPA's fire experience survey. This analysis does not include information from official fire investigations of RV incidents, according to the fire investigation protocols laid out in NFPA 921.

2. Objective and Scope

2.1 Objective

The goal of this project is to use historical data to disclose the origin and causation of RV fires between 2008 and 2017 as determined by the fire service[1] through the National Fire Incident Reporting System (NFIRS)[2].

2.2 Scope

The scope of this report is limited to the definition of RVs provided in NFPA 1192. According to NFPA 1192 (2018 edition), section 3.3.52, a recreational vehicle is defined as "a vehicle or slide-in camper that is primarily designed as temporary living quarters for recreational, camping, or seasonal use; has its own motive power or is mounted on or towed by another vehicle; is regulated by the National High Traffic Safety Administration as a vehicle or vehicle equipment; does not require a special highway use permit for operation on the highways; and can be easily transported and set up on a daily basis by an individual" (National Fire Protection Association 2018). As further clarified by the Department of Housing and Urban Development (HUD), motorhomes that meet the following criteria are not required to comply with applicable HUD regulations because they are classified as recreational vehicles , which is the scope of this study and the NFPA 1192 standard (Manufactured Home Procedural and Enforcement Regulations 2016):

- Built on a single chassis
- 400 square feet or less when measured at the largest horizontal projections
- Self-propelled or permanently towable by a light duty truck
- Designed primarily as temporary living quarters for recreational camping, travel, or season use, not for use as a permanent dwelling

This is further explained in section A.3.3.52, where it clarifies that the term recreational vehicle is an umbrella term, which fall under the following categories (reproduced from NFPA 1192 A.3.3.52):

[1] Fire service personnel, as referenced within this document is intended to refer to the fire department personnel that are either filling out the fire incident report or checking the data before being sent to the state agency.

[2] NFIRS 5.0 was designed by the United States Fire Administration (USFA), which is part of the Federal Emergency Management Agency (FEMA), but is jointly managed by USFA and the National Fire Information Council (NFIC). NFIRS was intended to be a nationwide, standardized, all-incident reporting system. But the fire incident data within the NFIRS system comes from the fire departments throughout the country that participate in NFIRS. After responding to an incident, the applicable fire service personnel fill out the applicable NFIRS module. The fire incident data then gets aggregated at the state and national level, which is how we can establish national estimates.

"**Motorhome***: *a recreational vehicle built on a self-propelled motor vehicle chassis. The product-type categories are as follows:*

- ***Type A Motorhome****. A motorhome constructed on a bare motor vehicle chassis.*
- ***Type B Motorhome****. A motorhome constructed on an automotive-manufactured van-type vehicle.*
- ***Type C Motorhome****. A motorhome constructed on a cutaway automotive-manufactured truck chassis.*
- ***Truck Camper (Slide-In Camper)****. An RV designed to be placed in the bed of a pickup truck.*

Towable RV: a recreational vehicle that is mounted on wheels and designed to be towed by a motorized vehicle or a portable unit that is designed to be placed in the bed of a pickup truck. The product-type categories are as follow:

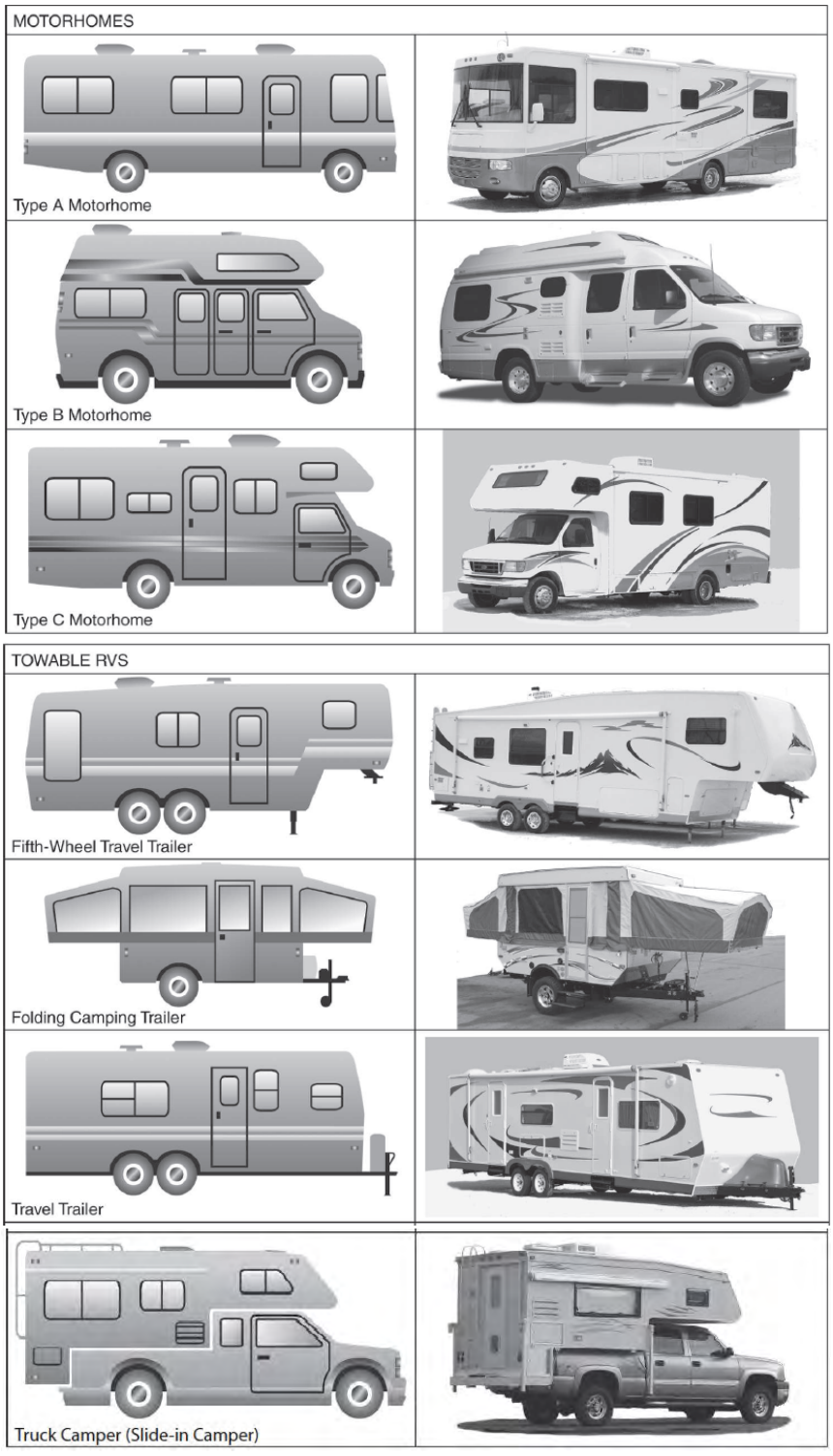
- **Fifth-wheel travel trailer**. A towable RV mounted on wheels and designed to be towed by a motorized vehicle by means of a towing mechanism that is mounted above or forward of the tow vehicle's rear axle.
- **Folding camping trailer**. A towable RV mounted on wheels and designed to be towed by a motorized vehicle that is constructed with a collapsible roof and collapsible partial sidewalls that unfold and extend in the set-up mode and fold back up for travel.
- **Travel trailer**. A towable RV mounted on wheels and designed to be towed by a motorized vehicle that is constructed with a roof and sidewalls made of rigid materials.
- **Truck camper**. A towable RV designed to be placed in the bed of a pickup truck.

Other motorhome and towable RV products include the following:

- **Expandable Travel Trailer**. A travel trailer constructed with at least one collapsible partial sidewall that unfolds for additional sleeping space in the set-up mode and folds back up for travel.
- **Horse (Livestock) RV**. A motorhome or towable RV that contains a designated area for transporting horses (or other livestock).
- **Sport Utility RV**. A motorhome or towable RV that has an entrance door wider than 36 in. (0.91 m) accessible by means of an access ramp or is promoted as having the ability to transport or store internal combustion engine vehicles or equipment".

The figure below is extracted from NPFA 1192 Figure A.3.3.52 *Profiles of Each Type of RV* to provide additional context to the types of recreational vehicles within the scope of NFPA 1192 and this analysis.

Figure 1: Profile of RV Types



Note: Image extracted from NPFA 1192 Figure A.3.3.52 Profiles of Each Type of RV (NFPA 1192 Standard for Recreational Vehicles)

3. Regulations, Classifications, and Consumer Demographics

3.1 Regulations

The Recreation Vehicle Industry Association (RVIA) is a member organization for the RV Industry. As a condition of membership, RVIA members are required to build and certify their vehicles to the national standards recognized by RVIA. RVIA inspectors monitor their compliance during regularly scheduled unannounced inspections at member production facilities. However, it should be noted that all RV manufacturers are not members of the RVIA. Additionally, to ensure their members' commitment to and compliance with the association's adopted safety standards, the RVIA conducts unannounced compliance audits at its members manufacturing facilities approximately six to eight times per year. They also put a large focus on education about RV safety issues, common deviations, updates to codes and standards to promote safety. (Recreation Vehicles Industry Association 2019). The RVIA notes that, "…most public and private campgrounds in the United States require that RVs and Park Model RVs have an affixed standard seal to obtain entry" to ensure safety and compliance of the RV entering the park (Recreation Vehicles Industry Association 2019).

The following standards have been accepted by the Recreation Vehicle Industry Association for the construction of RVs and Park Model RVs (Recreation Vehicle Industry Association n.d.):

- NFPA 1192 *Standard on Recreational Vehicles* (2018 edition)
- ANSI A119.5 *Park Model RV Standard* (2015 edition)
- National Electric Code (2017 edition)
- ANSI/RVIA LV *Standard Low Voltage Electrical Systems* (2018 edition)

The RVIA, as a recognized American National Standards Institute (ANSI) standards organization, has developed the following codes for manufacturers (Recreation Vehicle Industry Association n.d.):

- ANSI/RVIA LV *Standard Low Voltage Electrical Systems* (2018 edition)
- ANSI TSIC – 1 *Process Control for Assembly of Wheels on Trailers* (2018 edition)
- ANSI/RVIA EGS-1 *Engine Generator Sets for RV Safety Requirements* (2018 edition)
- ANSI RVIA UPA-1 *Uniform Plan Approval for RVs* (2014 edition)
- ANSI A119.5 *Park Model RV Standard* (2015 edition)

3.2 RV Market and Market Distribution

According to the Department of Commerce an overwhelming majority (80%) of RV's manufactured in the US are manufactured in the state of Indiana (Vanderwolf, Rast and International Trade Administration 2016). It is reported by Curtin, that the highest number

of shipments of manufactured RVs are to Texas, California, Florida, Ohio and Michigan (Curtin, The RV Consumer in 2011 2011).

The National Household Travel Survey (NHTS) for 2017 gives vehicle information with regards to travel in the US, the survey provides statistical data on personal travel in the US, and pertinent to this report, the survey includes information on RV's. Table 1 *Distribution of Vehicles by Vehicle Type* provides information on vehicles in the household-based fleet by vehicle type and age— it shows the average age of all kinds of vehicles since the 1970s, including RV's.

Table 1: Distribution of Vehicles by Vehicle Type and Vehicle Age

Distribution of Vehicles by Vehicle Type									
Category	1977	1983	1990	1995	2001	2009	2009 MOE[1]	2017	2017 MOE[1]
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%
Auto	79.6%	75.9%	74.7%	64.3%	56.8%	49.9%	0.45	49.5%	0.44
Van	2.8%	3.6%	5.5%	7.8%	9.0%	8.2%	0.28	6.1%	0.28
Sport Utility	NA	NA	NA	6.9%	12.1%	19.4%	0.35	23.7%	0.46
Pickup	12.8%	15.2%	17.2%	17.7%	18.4%	17.8%	0.29	15.9%	0.21
Other Truck	1.3%	1.5%	0.6%	0.4%	0.5%	0.4%	0.08	0.5%	0.10
RV/Motor Home	**0.4%**	**0.5%**	**0.5%**	**0.5%**	**0.7%**	**0.5%**	**0.06**	**0.6%**	**0.07**
Motorcycle/Moped	2.9%	3.1%	1.4%	0.9%	2.1%	3.3%	0.24	3.3%	0.14
Other	0.2%	0.2%	0.1%	0.1%	0.5%	0.3%	0.05	0.4%	0.04
Average Vehicle Age									
Category	1977	1983	1990	1995	2001	2009	2009 MOE[1]	2017	2017 MOE[1]
All	6.60	7.60	7.71	8.33	8.87	9.38	0.10	10.27	0.12
Auto	6.40	7.20	7.61	8.24	8.98	9.57	0.11	10.10	0.18
Van	5.50	8.45	5.88	6.68	7.56	8.68	0.18	10.65	0.27
Sport Utility	NA	NA	NA	6.56	6.44	7.09	0.15	8.34	0.13
Pickup	7.30	8.54	8.43	9.65	10.05	11.10	0.21	13.12	0.17
Other Truck	11.60	12.39	14.48	14.93	17.72	17.76	1.74	17.29	1.04
RV/Motor Home	**4.50**	**10.69**	**10.44**	**13.21**	**13.49**	**15.46**	**1.47**	**15.77**	**1.29**

[1]The report comments on the estimates provided in the table, stating that the Margin of Error (MOE) is defined as the half-confidence interval at the 95% confidence level. The MOE shown in tables is added to and subtracted from the estimate given

[2] Note: This data was extracted from Table 20: Household-Based Vehicle Distribution and Average Vehicle Age by Vehicle Type of the following report: "McGuckin, N, and A Fucci. 2017. Summary of Travel Trends: 2017 National Household Travel Survey. National Household Travel Survey"

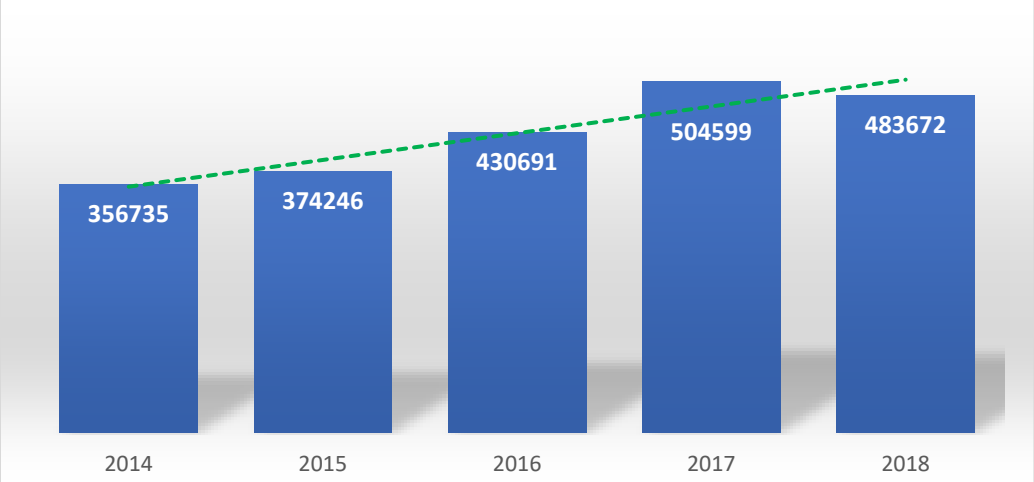
Table 1 helps provide an estimate of the total number of RV's in the United States. McGuckin and Fucci gather that in 2017, RV's accounted for about 0.6% of the total number of vehicles in the US (McGuckin and Fucci 2017). It may be of note that RV's and motorhomes have consistently, through the last 40-50 years in the US, been around 0.5-0.7% percent of the total number of vehicles. The Department of Commerce report states that there were shipments of RVs totaling 374,246 units in 2015, which accounted for a nearly 5-percent growth from 2014 (Vanderwolf, Rast and International Trade Administration 2016). This data is presented more consistently in RVIA's *Annual Report 2018*.

The average age of recreational vehicles in 2017 was approximately 16 years old (15.77 years) (McGuckin and Fucci 2017). A more in-depth survey of RVs in 2011 found that the average age of RVs— both new and purchased— was 14.2 years, and the median age of RVs at the time of purchase was 9.2 years (Curtin, The RV Consumer in 2011 2011).

The distribution of use for motorhomes and travel trailers was greater than this average age, and the distribution of use for folding camping trailers and truck camper owners was less than this average age. It was also found that RV owners were keeping their RVs for longer periods of time; the median number of years the RV was owned was 6.4 years in 2011, which was an increase from the preceding years (Curtin, The RV Consumer in 2011 2011). Shorter ownership periods were much less common, where only 16% of RV users owned their RV for less than three years.

However, this trend may be contrasted with the finding that, in terms of use, it was found that RV owners, "[…] on average use their vehicles for a total of three weeks per year (Curtin, The RV Consumer in 2011 2011)." In addition, it was found that only one-third of RV owners purchased their RV new, and most RVs (54%) were purchased directly from the previous owner.

Figure 2: Market Data for Shipments of RVs from 2014 to 2018



* Note: Data from "Reports and Trends: RV Shipments (Recreation Vehicle Industry Association 2018)

Regarding shipments, towable RV's accounted for 87-percent of total shipments, and motorhomes accounted for the remaining 13-percent (Vanderwolf, Rast and International Trade Administration 2016). The market data for RV shipments between 2014 and 2018 are shown in Figure 2. According to RVIA, the projected trends indicate RV shipments to be around 416,300 units in 2019, which would be a 13.9-percent decrease from 2018. Projections for 2020 indicate unit shipments of 426,700 (Curtin, Slight Uptick in RV Shipments Expected Through 2020 2019).

3.3 Demographics

Based on the 2011 national survey of RV owners, and commissioned by the RVIA, the study *The RV Consumer in 2011* breaks down the RV consumer demographics. This study provides an understanding of how RV's are used in the United States. This study is summarized below.

The RV market is highly dependent on the particular demographics and the income of the consumers. An observed trend is that the number of consumers interested in traveling and using RVs is increasing (Vanderwolf, Rast and International Trade Administration 2016). According to *The RV Consumer in 2011*, it was found that there are about 10 million households that own an RV. The survey provides detailed information about the distribution, demographics and the conditions of the RV consumer in the US until 2011.

3.3.1 Age Profile

The study provides an age profile of the RV consumer. It was found that the average age of an owner of an RV was 48, where the largest growth in the number of RV owners was in the age range of 35-54 (Curtin, The RV Consumer in 2011 2011). In terms of the median age of RV owners, the largest change was found in motorhome vehicles— it was found that there was a decline in the age of consumers owning a motorhome, and there was an overall reduction in how many consumers purchased motorhomes. The study also indicated that 29% of RV owners had children under the age of 18 living at home. In terms of specific types RV's, owners of motorhomes and truck campers were less likely to have children living at home than travel trailers of any kind. (Curtin, The RV Consumer in 2011 2011)

3.3.2 Income Profile

This University of Michigan study indicated that the income profile of RV consumers was $75,000— which was relatively higher than the mean income determined by the Census Bureau of $67,530 (in 2010). It should be noted, however, that the study found that the largest growth in the ownership of RVs was among households with below median income. On the same note, the report identifies that the Census Bureau reported the largest percent decline in household incomes in 2009 and 2010 among the age group 45 to 64, concurrently this age range was reported to have the highest RV ownership rates (Curtin, The RV Consumer in 2011 2011).

3.3.3 Shipments and Sales

The report also breaks down the owners of RVs in terms of geographic location within the continental US, the geographic locations are divided into four different regions. It was found that the West had the highest ownership rate at 12.8%, with a trend indicating an

increase in ownership rates (Curtin, The RV Consumer in 2011 2011). Ownership rate is the measure of the number of people purchasing RVs. However, the West did not contain the highest number of owners, attributing to a 22% ownership of all RV's. The Midwest had the second highest ownership rate at 10%. The Midwest had the highest number of owners at 23%. The South and Northeast had the lowest ownership rates, with about 6% attributed to each geographic location (Curtin, The RV Consumer in 2011 2011). The Northeast had the least number of number of people who owned RVs at 18%. However, the South had the largest ownership percentage among the four locations, at 37% (Curtin, The RV Consumer in 2011 2011).

3.3.4 Ownership Profiles

Motorhomes

Ownership of motorhomes in 2011 was highest among householders in the age group 55-64. The second highest age group was 35-44 (Curtin, The RV Consumer in 2011 2011). Motorhome ownership rates by income was seen as an upward trend. Households of incomes greater than $125,000 had the highest ownership rate at 4.1%, whereas households of incomes under $30,000 had the lowest ownership rate at 0.9% (Curtin, The RV Consumer in 2011 2011).

Travel Trailers and Fifth-wheel Travel Trailers

Ownership of this type of RVs was highest among householders in the age group of 45-54 at 6.9%, followed by the age group of 55-64 at 6.3% (Curtin, The RV Consumer in 2011 2011). the report indicates that use of these RVs spans a wide age group, and it further suggests that the popularity of vehicles capable of towing trailers contributed to the use of this type of RV (Curtin, The RV Consumer in 2011 2011).

It was observed that this type of RV only varies slightly with respect to income. The peak ownership rate was 5.8% among the upper middle-income household bracket of $50,000 to $75,000, followed by 5.3% ownership rate among households within the $30,000 to $50,000 income bracket (Curtin, The RV Consumer in 2011 2011).

Folding Camping Trailers

The report clearly shows that folding camping trailers are most popular among younger consumers, age groups 35-44 and 45-54 had the highest ownership rates with 2.9% and 2.8% respectively. Looking at the data, it is may be observed that these types of RVs are not popular among the older demographic, the report suggests that this may be due to the physical difficulties associated with the set-up of these trailers (Curtin, The RV Consumer in 2011 2011). The report notes that folding camping trailers can sometimes be an entry vehicle to purchasing other types of RVs, i.e. the trend indicated that many of

the first-time buyers of RVs often purchased folding camping trailers for their first RV, before moving to other types of RVs (Curtin, The RV Consumer in 2011 2011).

Ownership rates were highest in the income groups $50,000 and upwards; the highest was for the income group $50,000-74,999 at 2.1% followed by the group $125,000 or more at 2.0% (Curtin, The RV Consumer in 2011 2011). The report further notes that in support of the trend that folding camping trailers were sometimes an entry vehicle to other types of RVs, the statistical fact that ownership rates were highest in higher income households that would be able to purchase large/more expensive RVs (Curtin, The RV Consumer in 2011 2011).

Truck Campers

The results of the study showed that trucker campers are not popular among RV owners. The highest ownership rate belonged to the age group 65-74, which was at 1%, while across all other age groups, truck campers were not popular (Curtin, The RV Consumer in 2011 2011). A possible explanation given in the report, highlighting the incompatibility of newer model pickup trucks— which sometimes include a shortened truck bed— with truck campers.

Ownership rates were highest in households with incomes between $30,000 and $50,000 at 0.7%, followed by income groups $50,000-74,999 and under $30,000 at 0.5% (Curtin, The RV Consumer in 2011 2011). One of the conclusions made by the study is that owners of truck campers had relatively low incomes given their age (Curtin, The RV Consumer in 2011 2011).

4. Data Sources and Limitations

The primary source of data presented in this report is from a custom NFPA Applied Research report, titled "*Fires in or Involving Motor Homes, Travel Trailers and Related Vehicles".* The data contained in this report summarizes recreational vehicle incidents documented through the National Fire Incident Reporting System (NFIRS), which is a national reporting system that collects information on fire incidents in the United States.

The data and content within the NFIRS database are collected by the fire service who complete a NFIRS report or module to document their response to a fire incident. The information contained in these modules pertain to the "[…] kind of incident responded to, where it occurred, the resources used to mitigate it, and how losses and other information designed specifically to understand the nature and causes of fire, hazardous material (HazMat), and emergency medical service (EMS) incidents (U.S. Fire Administration National Fire Data Center 2015)." Additional information such as property losses and casualties from each incident are also collected.

The data that is retrieved from NFIRS corresponds to how an incident is reported. Thus, a brief overview of how NFIRS classifies incidents is provided herein. On the NFIRS form, the section titled "Incident Type" (sometimes referenced as "Type of Situation Found") refers to the on-the-ground situation the responder finds upon arrival to the scene. *The National Fire Incident Reporting System: Complete Reference Guide* notes that the type of incident reported may not always be the same as the incident dispatched, based on what is found upon arrival at the scene of the incident.

Recreational vehicles share characteristics between structure and vehicle, therefore RV incidents within NFIRS can be classified as either category. However, its classification is typically based on how the RV is being used at the time of the incident. Thus, in order to get the full picture of recreational vehicle incidents, the following two incident categories from NFIRS were used in this analysis: Structure fires (Code 122) and Vehicle fires (which includes all vehicle types (codes 130 - 139), restricted by mobile property types (14-16). This report consolidates fire incident data involving recreational vehicles and provides further analysis of all fire incidents and fires with casualties.

It is important to note that terms such as "structure", "mobile home", and "trailer" are not officially defined in NFIRS. Furthermore, the reference guide states that incidents should be recorded per how NFIRS uses them, and not by any other definition. It is also important to understand how the fire service categorizes incidents at the operational level, as it impacts the data reported for RV incidents.

The following are some important findings from the report *NFIRS Incident Types*. The purpose of the report was to identify and evaluate issues related to gathering data for one of the fields in the NFIRS form: incident type. There are many important observations and

recommendations made in the report especially on how the fire service categorizes incidents.

- There can be inconsistency in how individuals input data to the same *type* of incident.
- Long code lists may make it more difficult to find the most appropriate code for the incident.
- The current version of NFIRS is not always clear and ambiguities may lead to misinterpretations of the emergency incident.
- People may focus on different aspects of the same incident, which is how they perceive what is important to them.

The above information and observations are intended to disclose potential inconsistency issues with the NFIRS data. This section is intended to show the potential reasons for inconsistencies in data reporting for recreational vehicle incidents. Therefore, the fire incident data retrieved from NFIRS is not independent from how NFIRS works, because it is burdened by the limitations with which it is associated. However, there are edit checks in place to assess and validate the quality of the data contained within the database. Although there are limitations to NFIRS, it remains the optimal dataset to provide a statistical assessment of RV fire incidents.

5. Data Analysis

To address the primary goal of the study, data was collected on RV fires for the period of 2008 through 2017 and analyzed to determine the origin and causation of RV fires. Data from the National Fire Incident Reporting System (NFIRS) and NFPA's fire experience survey from 2008-2017 were used to create these estimates. Section 5.1 focuses on all recreational vehicle fires, with breakdowns of those coded as structures[3] and those coded as vehicles[4]. Section 5.2 examines causes and circumstances of deaths from RV fires.

5.1 All RV Fires

This section herein presents data from an NFPA analysis, titled, *Fires in or Involving Motor Homes, Travel Trailers, and Related Vehicles*. This information is significant to the study as this presents data from NFIRS and a NFPA survey for fires in various types of RVs—refer to each table/fire for the specific RV types. The dates for the data provided below are for incidents reported in NFIRS between 2008 and 2017. Please note that the numbers in the figures and tables may not equal totals due to rounding errors. It should also be noted data presented in this section includes bookmobiles in the same category as motor homes or campers. Because bookmobiles are rare, they are considered to have an insignificant impact on this analysis.

The statistics in this analysis are national estimates of fires reported to U.S. municipal fire departments and therefore exclude fires reported only to Federal or State agencies or industrial fire brigades. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one. It should be noted that casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Except for incident type, fires with unknown or missing data were allocated proportionally. When the mobile property type was coded as none, it was treated as unknown.

Table 2 below provides the data from the overall number of fires in RVs from 2008—2017. The data also displays how many civilian deaths and civilian injuries occurred during this time. The following tables and figures are derivative analyses of the total fires reported in Table 2. Each focuses on a particular aspect of the incident, such as area of origin, cause of ignition, heat source, etc.

[3] Data classified as "fires in RV's used as structures" means that at the time of the fire incident, the recreational vehicle was being used as a structure. Thus, it is typically parked at some location, such as an RV park or campground. For these incidents, occupants are often cooking, sleeping, or doing some other activity while the RV is in a stationary position.

[4] Data classified as "fires in RV's used as vehicles" means that at the time of the fire incident, the recreational vehicle was being used as a vehicle. Thus, these incidents often occurred while driving or alongside the road.

Table 2: Fires in RVs per Incident Type: 2008-2017 Annual Averages

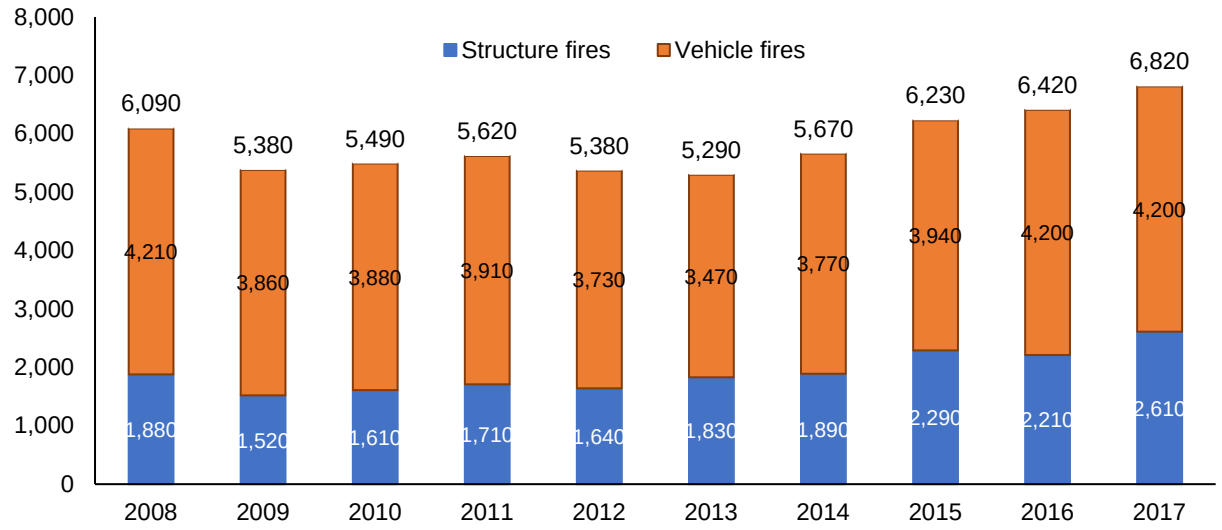
Incident Type	Fires		Civilian Deaths		Civilian Injuries	
Fire in motor home, camper or recreational vehicle used as a structure, excluding fires with unrelated mobile property type	1,920	(33%)	24	(69%)	64	(44%)
Vehicle fire involving motor home, travel trailer or related vehicle	3,920	(67%)	11	(31%)	80	(56%)
Total	5,840	(100%)	35	(100%)	144	(100%)

**Note*: Data from *Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Table A. Fires in or Involving Motor Homes, Travel Trailers and Related Vehicles by Incident Type: 2008-2017 Annual Averages*

One important piece of information that is identified in the data is the number of incidents that were identified as vehicle fires compared to the number of incidents that were identified as occurring in structures. The data indicates that approximately 67% of the fires in RV's are classified as vehicle fires, where only 33% of the fires were in RV's that were classified as a structure fire.

Figure 3 below shows the number of fires that occurred each year between 2008 and 2017, and categorizes that data into two incident categories, structure fires and vehicle fires. It may be important to observe that RVs are largely identified as vehicle fires. Additionally, between 2013 and 2017 there was a slight increase in the total number of RV fire incidents.

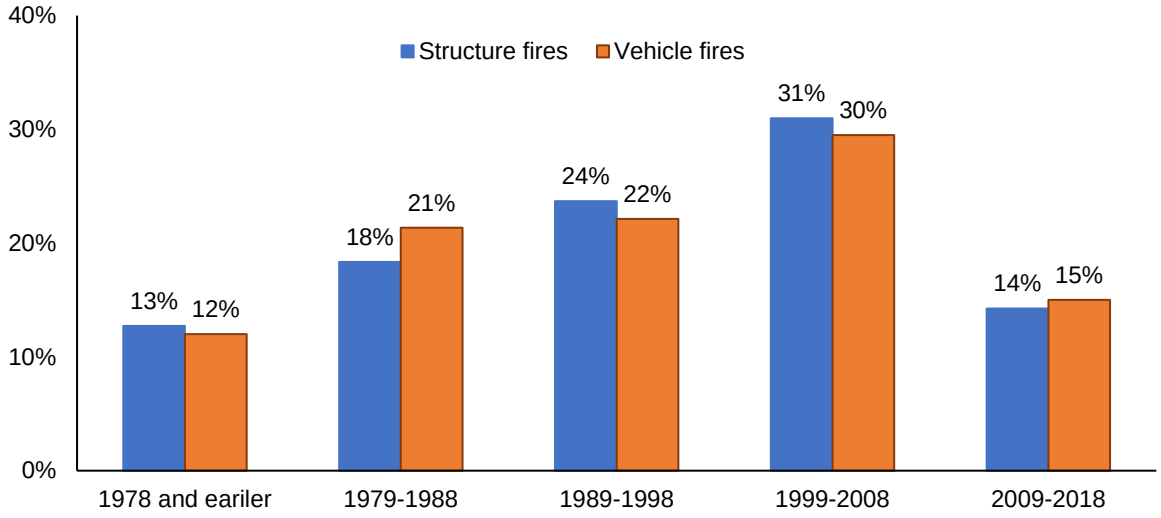
Figure 3: Fires in RVs per Year and Incident Type



**Note*: Data from *Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Figure 1 Fires in Motor Homes, Campers or Recreational Vehicles by Year of Fire and Incident Type*

Figure 4 below depicts the same data categorizing the type of incident according to the model year of the RV for fires in 2027. While the data shows relative consistency among the number of fires among the various model years, RV's that were manufactured between 1999 and 2008 experience the highest rate of fires. With the average age of RV's being approximately 16 years as noted previously in this report, the majority of RV's within the US fall within this manufacturing range of 1999 – 2008, which could be related to why this category experiences the largest portion of RV fires.

Figure 4: 2017 Fires in RVs per Model Year and Incident Type



**Note*: Data from *Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Figure 2 Fires in Motor Homes, Campers or Recreational Vehicles in 2017 by Model Year and Incident Type*

5.1.1 All RV Incidents reported as Structure Fires

Tables 3-11 focus on RV fires that are were reported as structure fire incidents. The intent of the following information is to provide insight on the factors contributing to ignition and spread in RV incidents reported as structure fires. A summary of the data analysis on RV incidents reported as structure fires is provided below:

- In the RV fires classified as structure fires, three of the five leading areas of origin were areas associated with the vehicle. (Table 4).
- The data shows that the leading first items ignited were electrical wiring (16%) which resulted in minimal deaths or injuries and flammable/combustible liquids (14%) which resulted in 52% of the civilian injuries in RV fires. While the mattress was only the first item ignited in 5% of the fires, this resulted in 33% of the deaths. (Table 5).
- Plastic is the most common material first ignited; however, fabrics or fibers are attributed with causing the largest number of civilian deaths. (Table 6)
- The data shows that most fires were ignited unintentionally, and that the second highest ignition source was failure of equipment or a heat source. (Table 7)
- Arcing and heat from powered equipment was the leading heat source that resulted in the greatest number of fires and a significant number of civilian deaths. (Table 9)
- An overwhelming number of fire incidents involved no equipment at the time of ignition (Table 10)
- In 84% of the fires in RV's, where it was being used as a structure, smoke alarms were not present (Table 11)

Table 3: Fires in RVs Used as Structures by Mobile Property Type

Mobile Property Type	Fires		Civilian Deaths		Civilian Injuries	
Motor home or camper	1,140	(60%)	13	(55%)	38	(59%)
Travel trailer designed to be towed	610	(32%)	10	(41%)	21	(33%)
Unclassified mobile property	90	(5%)	0	(2%)	4	(6%)
Collapsible camping trailer designed to be towed	80	(4%)	0	(2%)	1	(2%)
Total	1,920	(100%)	24	(100%)	64	(100%)

*Note: *Data from Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Table 1 Fires in Motor Homes, Campers or Recreational Vehicles by Mobile Property Type. The data contained herein are 2008-2017 annual averages.*

Table 4: Fires in RVs Used as Structures by Area of Origin

Area of Origin	Fires		Civilian Deaths		Civilian Injuries	
Vehicle engine area, running gear, or wheel area	310	(16%)	1	(2%)	12	(19%)
Kitchen or cooking area	300	(16%)	4	(15%)	16	(25%)
Unclassified vehicle area	260	(14%)	5	(20%)	8	(12%)
Passenger area of vehicle	160	(8%)	2	(8%)	4	(7%)
Bedroom	90	(4%)	5	(22%)	3	(5%)
Unclassified area of origin	80	(4%)	0	(1%)	3	(4%)
Unclassified function area	80	(4%)	5	(22%)	3	(5%)
Exterior surface of vehicle	80	(4%)	0	(0%)	1	(1%)
Living room	70	(4%)	1	(4%)	5	(7%)
Cargo or trunk area of vehicle	50	(3%)	0	(0%)	0	(1%)
Unclassified outside area	50	(3%)	0	(2%)	0	(0%)
Unclassified structural area	40	(2%)	0	(2%)	0	(1%)
Wall assembly or concealed space	40	(2%)	0	(0%)	1	(1%)
Exterior wall surface	40	(2%)	0	(0%)	0	(0%)
Bathroom	30	(1%)	0	(0%)	1	(1%)
Lawn, field, or open area	20	(1%)	0	(0%)	1	(1%)
Unclassified equipment or service area	20	(1%)	0	(0%)	0	(0%)
Dining room, bar or beverage area, cafeteria	20	(1%)	0	(2%)	0	(0%)
Heating equipment room	20	(1%)	0	(0%)	2	(2%)
Garage or vehicle storage area	20	(1%)	0	(0%)	0	(1%)
Unclassified storage area	10	(1%)	0	(0%)	0	(0%)
Fuel tank or fuel line of vehicle	10	(1%)	0	(0%)	2	(2%)
Duct for HVAC, cable, exhaust, heating, or air conditioning	10	(1%)	0	(0%)	0	(1%)
Crawl space or substructure space	10	(1%)	0	(0%)	0	(0%)
Vacant structural area	10	(1%)	0	(0%)	0	(0%)
Separate operating or control area of vehicle	10	(1%)	0	(0%)	0	(0%)
Other known area of origin	90	(5%)	0	(0%)	2	(3%)
Total	1,920	(100%)	24	(100%)	64	(100%)

*Note: *Data from Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Table 2 Fires in Motor Homes, Campers or Recreational Vehicles by Area of Origin. The data contained herein are 2008-2017 annual averages.*

Table 5: Fires in RVs Used as Structures by Item First Ignited

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries	
Electrical wire or cable insulation	300	(16%)	2	(7%)	1	(1%)
Flammable or combustible liquids or gases, piping or filter	280	(14%)	3	(12%)	34	(52%)
Unclassified item first ignited	130	(7%)	2	(9%)	1	(1%)
Multiple items first ignited	120	(6%)	4	(18%)	3	(5%)
Upholstered furniture or vehicle seat	110	(6%)	1	(5%)	4	(6%)
Exterior wall covering or finish	100	(5%)	0	(0%)	0	(0%)
Mattress or bedding	90	(5%)	8	(33%)	3	(5%)
Interior wall covering, excluding drapes	80	(4%)	0	(0%)	3	(4%)
Unclassified structural component or finish	80	(4%)	0	(0%)	1	(2%)
Cabinetry	70	(4%)	0	(0%)	1	(1%)
Structural member or framing	60	(3%)	2	(9%)	1	(1%)
Appliance housing or casing	60	(3%)	0	(0%)	2	(3%)
Insulation within structural area	50	(3%)	0	(0%)	1	(2%)
Floor covering, rug, carpet, or mat	40	(2%)	0	(0%)	2	(4%)
Tire	40	(2%)	0	(0%)	0	(0%)
Light vegetation, including grass	30	(2%)	0	(0%)	0	(0%)
Unclassified furniture or utensils	30	(1%)	0	(0%)	2	(3%)
Unclassified soft goods or wearing apparel	20	(1%)	2	(8%)	3	(5%)
Cooking materials, including food	20	(1%)	0	(0%)	1	(1%)
Clothing	20	(1%)	0	(0%)	0	(0%)
Interior ceiling cover or finish	20	(1%)	0	(0%)	1	(1%)
Rubbish, trash, or waste	20	(1%)	0	(0%)	0	(0%)
Magazine, newspaper, or writing paper	20	(1%)	0	(0%)	0	(0%)
Exterior roof covering or finish	20	(1%)	0	(0%)	0	(0%)
Curtains, blinds, drapery, or tapestry	10	(1%)	0	(0%)	0	(0%)
Linen (other than bedding)	10	(1%)	0	(0%)	1	(1%)
Unclassified organic materials	10	(1%)	0	(0%)	0	(0%)
Other known item first ignited	70	(4%)	0	(0%)	1	(1%)
Total	1,920	(100%)	24	(100%)	64	(100%)

*Note: *Data from Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Table 3 Fires in Motor Homes, Campers or Recreational Vehicles Used as Structures by Item First Ignited. The data contained herein are 2008-2017 annual averages.*

Table 6: Fires in RVs Used as Structures by Material First Ignited

Type of Material First Ignited	Fires		Civilian Deaths		Civilian Injuries	
Plastic	290	(15%)	3	(12%)	4	(6%)
Multiple types of material	270	(14%)	2	(8%)	5	(7%)
Fabric or fiber	270	(14%)	10	(41%)	6	(9%)
Fiberboard, particleboard or hardboard	150	(8%)	2	(9%)	2	(3%)
Unclassified type of material first ignited	140	(7%)	1	(5%)	4	(6%)
Gasoline	130	(7%)	0	(0%)	9	(14%)
LP gas	120	(6%)	2	(7%)	25	(38%)
Plywood	90	(5%)	0	(0%)	0	(0%)
Sawn wood, including finished lumber	90	(4%)	0	(0%)	0	(0%)
Unclassified flammable gas	60	(3%)	0	(0%)	5	(8%)
Unclassified processed wood or paper	40	(2%)	0	(0%)	0	(0%)
Unclassified flammable or combustible liquid	40	(2%)	0	(0%)	1	(2%)
Unclassified fabric, textile, fur	30	(2%)	2	(9%)	1	(1%)
Rubber, excluding synthetic rubber	30	(2%)	0	(0%)	0	(0%)
Paper, including cellulose or waxed paper	30	(1%)	0	(0%)	0	(0%)
Unclassified natural product	30	(1%)	0	(0%)	0	(0%)
Cooking oil, transformer or lubricating oil	20	(1%)	0	(0%)	1	(1%)
Plastic-coated fabric	10	(1%)	2	(9%)	1	(1%)
Other known type of material	80	(4%)	0	(0%)	2	(2%)
Total	1,920	(100%)	24	(100%)	64	(100%)

Note: *Data from Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Table 4 Fires in Motor Homes, Campers or Recreational Vehicles Used as Structures by Type of Material First Ignited. The data contained herein are 2008-2017 annual averages.*

Table 7: Fires in RVs Used as Structures by Cause of Ignition

Cause of Ignition	Fires		Civilian Deaths		Civilian Injuries	
Unintentional	1,090	(57%)	19	(78%)	49	(77%)
Failure of equipment or heat source	510	(27%)	2	(8%)	11	(17%)
Unclassified	160	(8%)	1	(6%)	1	(2%)
Intentional	140	(7%)	2	(8%)	2	(3%)
Act of nature	20	(1%)	0	(0%)	0	(0%)
Total	1,920	(100%)	24	(100%)	64	(100%)

Note: *Data from Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Table 5 Fires in Motor Homes, Campers or Recreational Vehicles by Cause of Ignition. The data contained herein are 2008-2017 annual averages.*

Table 8: Fires in RVs Used as Structures by Factor Contributing to Ignition

Factor Contributing	Fires		Civilian Deaths		Civilian Injuries	
Electrical failure or malfunction	500	(26%)	3	(15%)	4	(5%)
Unclassified mechanical failure or malfunction	300	(16%)	1	(4%)	8	(12%)
Heat source too close to combustibles	220	(12%)	8	(35%)	8	(12%)
Exposure fire	200	(11%)	0	(0%)	0	(0%)
Unclassified misuse of material or product	90	(5%)	3	(11%)	11	(16%)
Unclassified factor contributed to ignition	80	(4%)	3	(12%)	3	(5%)
Leak or break	80	(4%)	1	(6%)	8	(12%)
Abandoned or discarded material or product	70	(4%)	4	(17%)	0	(0%)
Flammable liquid or gas spilled	50	(3%)	0	(0%)	9	(15%)
Backfire	40	(2%)	0	(0%)	2	(4%)
Equipment unattended	40	(2%)	0	(0%)	1	(1%)
Cutting or welding too close to combustibles	30	(2%)	1	(5%)	1	(1%)
Playing with heat source	30	(1%)	1	(6%)	0	(0%)
Worn out	30	(1%)	0	(0%)	1	(2%)
Unclassified operational deficiency	30	(1%)	0	(0%)	2	(3%)
Outside/open fire for debris or waste disposal	20	(1%)	0	(0%)	0	(0%)
Fire spread or control, other	20	(1%)	0	(0%)	1	(1%)
Improper fueling technique	20	(1%)	0	(0%)	2	(4%)
Equipment overloaded	20	(1%)	0	(0%)	1	(1%)
High wind	10	(1%)	0	(0%)	0	(0%)
Accidentally turned on, not turned off	10	(1%)	0	(0%)	0	(0%)
Improper container or storage	10	(1%)	0	(0%)	1	(2%)
Automatic control failure	10	(1%)	0	(0%)	0	(0%)
Storm	10	(1%)	0	(0%)	0	(0%)
Other known factor	90	(5%)	0	(0%)	4	(6%)
Total fires*	1,920	(100%)	24	(100%)	64	(100%)
Total factors*	2,030	(106%)	26	(109%)	65	(102%)

*Note: *Data from Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Table 6 Fires in Motor Homes, Campers or Recreational Vehicles Used as Structures by Factor Contributing to Ignition. The data contained herein are 2008-2017 annual averages.*

Table 9: Fires in RVs Used as Structures by Heat Source

Heat Source	Fires		Civilian Deaths		Civilian Injuries	
Arcing	310	(16%)	3	(14%)	2	(3%)
Unclassified heat from powered equipment	260	(14%)	5	(23%)	8	(13%)
Radiated or conducted heat from operating equipment	210	(11%)	1	(6%)	5	(7%)
Unclassified heat source	190	(10%)	1	(3%)	6	(10%)
Spark, ember or flame from operating equipment	150	(8%)	0	(0%)	8	(13%)
Unclassified hot or smoldering object	90	(4%)	1	(6%)	3	(5%)
Candle	80	(4%)	0	(0%)	3	(5%)
Radiated heat from another fire	70	(4%)	0	(0%)	0	(0%)
Lighter	70	(3%)	6	(23%)	8	(12%)
Smoking materials	60	(3%)	2	(7%)	3	(5%)
Backfire from internal combustion engine	60	(3%)	0	(0%)	6	(10%)
Heat from direct flame or convection currents	60	(3%)	0	(0%)	1	(1%)
Hot ember or ash	50	(3%)	2	(10%)	0	(0%)
Heat or spark from friction	40	(2%)	0	(0%)	0	(0%)
Match	40	(2%)	0	(0%)	6	(9%)
Unclassified heat spread from another fire	30	(2%)	0	(0%)	0	(0%)
Flame or torch used for lighting	30	(2%)	2	(7%)	2	(3%)
Molten or hot material	20	(1%)	0	(0%)	0	(0%)
Conducted heat from another fire	20	(1%)	0	(0%)	0	(0%)
Multiple heat sources including multiple ignitions	10	(1%)	0	(0%)	1	(1%)
Flying brand, ember, or spark	10	(1%)	0	(0%)	0	(0%)
Lightning	10	(1%)	0	(0%)	0	(0%)
Other known heat source	30	(1%)	0	(0%)	2	(3%)
Total	1,920	(100%)	24	(100%)	64	(100%)

*Note: *Data from Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Table 7 Fires in Motor Homes, Campers or Recreational Vehicles Used as Structures by Heat Source. The data contained herein are 2008-2017 annual averages.*

Table 10: Fires in RVs Used as Structures by Equipment Involved in Ignition

Equipment Involved	Fires		Civilian Deaths		Civilian Injuries	
No equipment involved	790	(41%)	15	(63%)	36	(57%)
Refrigerator or refrigerator/freezer	260	(14%)	0	(0%)	2	(2%)
Wiring and related equipment	170	(9%)	0	(0%)	2	(3%)
Fixed or portable space heater	170	(9%)	6	(26%)	12	(18%)
Unclassified equipment involved in ignition	90	(5%)	0	(0%)	0	(0%)
Range or cooktop	50	(2%)	0	(0%)	5	(8%)
Cord or plug	50	(2%)	0	(0%)	0	(0%)
Air conditioner	30	(2%)	0	(0%)	0	(0%)
Generator	30	(2%)	0	(0%)	2	(3%)
Water heater	30	(1%)	0	(0%)	2	(3%)
Battery	20	(1%)	0	(0%)	0	(0%)
Unclassified portable appliance designed to produce heat	20	(1%)	0	(0%)	2	(2%)
Inverter	20	(1%)	0	(0%)	0	(0%)
Torch, burner, or soldering iron	20	(1%)	0	(0%)	0	(0%)
Fan	10	(1%)	0	(0%)	0	(0%)
Battery charger or rectifier	10	(1%)	3	(12%	0	(0%)
Television	10	(1%)	0	(0%)	0	(0%)
Surge protector	10	(1%)	0	(0%)	0	(0%)
Lamp, bulb or lighting	10	(1%)	0	(0%)	0	(0%)
Portable cooking or warming equipment	10	(1%)	0	(0%)	0	(0%)
Other known equipment	100	(5%)	0	(0%)	2	(4%)
Total	1,920	(100%)	24	(100%)	64	(100%)

*Note: *Data from Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Table 8 Fires in Motor Homes, Campers or Recreational Vehicles Used as Structures by Equipment Involved in Ignition. The data contained herein are 2008-2017 annual averages.*

Table 11 Fires in RVs Used as Structures by Smoke Alarm Status

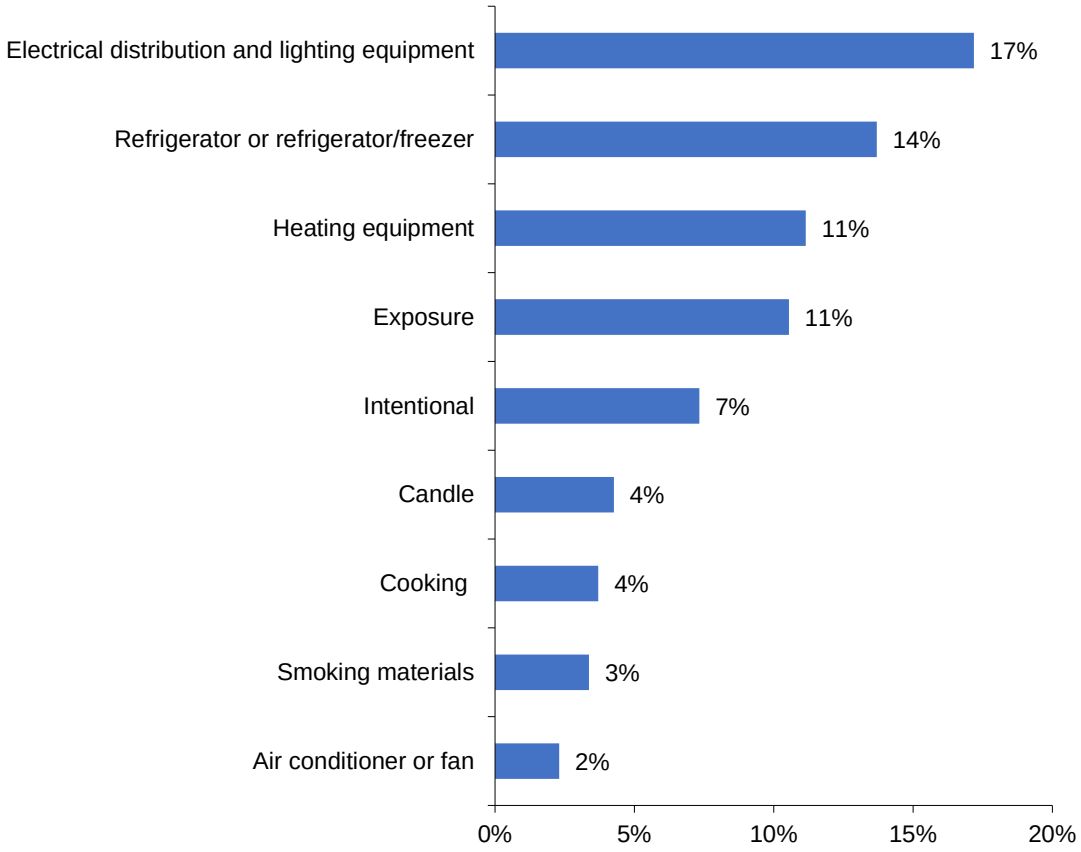
Smoke Alarm Status	Fires		Civilian Deaths		Civilian Injuries	
Operated	230	(12%)	1	(6%)	4	(6%)
Failed to operate	50	(2%)	2	(8%)	5	(8%)
Fire too small to operate	30	(1%)	0	(0%)	0	(0%)
Subtotal-Smoke alarm present	*300*	*(16%)*	*3*	*(14%)*	*4*	*(8%)*
None present	1,620	(84%)	20	(86%)	55	(86%)
Total	1,920	(100%)	24	(100%)	64	(100%)

*Note: *Data from Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Table 9 Fires in Motor Homes, Campers or Recreational Vehicles Used as Structures by Smoke Alarm Status. The data contained herein are 2008-2017 annual averages.*

Table 11 above shows the smoke alarm status in RV fire incidents that were being used as structures. For context, NFPA 1192 required smoke alarms to be installed in recreational vehicles in 1984, so all RV's manufactured in the last 30+ years are equipped with smoke detectors when they are put out on the market. Therefore, the statistic indicating that 84% of RV fires did not have a smoke alarm present, may be surprising. However, nuisance alarms appear to be a serious issue in RV's. Due to the small footprint within an RV, something as simple as making a piece of toast or grilling outside could be enough to set off the smoke alarm (Dougherty 2019). As a result, it appears that occupants may remove the RV's smoke alarm to avoid nuisance alarms (if the alarm doesn't have a silence button), which could explain the high percentage of RVs without a smoke alarm present at the time of the incident.

Figure 5 below identifies and ranks the leading causal factors in RV fire incidents, where electrical distribution and lighting equipment (17%), refrigerators (14%), heating equipment (11%) and exposure fires (11%) are the leading causal factors, when the RV is being used as a structure.

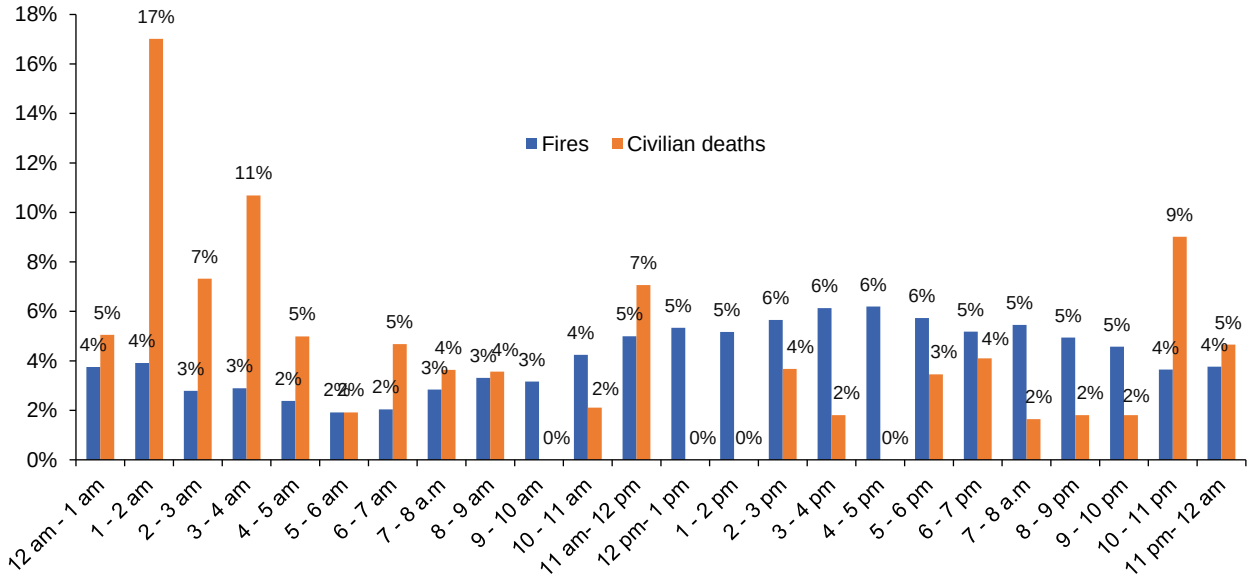
Figure 5: Fires in RVs used as Structures by Causal Factors



*Note: *Data from Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Figure 3 Leading Causal Factors in Fires in Motor Homes, Campers or Recreational Vehicles Used as a Structure. The data contained herein are 2008-2017 annual averages.*

Figure 6 reports RV fire incidents according to alarm time. It should be noted that the time period with the highest incidence of fires is in the evening around dinner time, while the largest incidence of death is during sleeping hours (10-11 pm, 1-2 am, and 3-4 am).

Figure 6: Fires in RVs used as Structures by Alarm Time: 2008-2017



Note: *Data from Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Figure 4 Fires in Motor Homes, Campers or Recreational Vehicles Used as a Structure by Alarm Time. The data contained herein are 2008-2017 annual averages.*

5.1.2 All RV fire incidents reported as Vehicle Fires

Tables 12-18 are more focused on RV fires that are were reported as vehicle fire incidents. The intent is to provide insight on the factors that present the greatest risk and under which circumstances RVs are most vulnerable. For RV incidents classified as vehicle fires:

- It was found that fires in the vehicle engine area had the greatest number of fires (31%) which caused the greatest number of civilian injuries (25%). However, the greatest number of civilian deaths occurred in the passenger areas of the recreational vehicles. (Table 13)
- The most common first items ignited were flammable/combustible materials and electrical wiring (similar to the previous dataset for RV structure fires), which resulted in the highest number of civilian injuries. (Table 14)
- The type of material first ignited is typically plastic (15%) or gasoline (12%), with the ignition of gasoline resulting one of the highest numbers of civilian injuries. (Table 15)
- A mechanical malfunction was the leading factor contributing to ignition in most of the RV vehicle fires. However, a heat source being too close to combustibles was the leading factor contributing to ignition that resulted in the highest number of civilian deaths and civilian injuries (Table 17). This agrees with the information provided in Table 19 in Section 5.2.
- The leading heat sources for vehicle fires is consistent with that provided in the previous section in Table 9.

Table 12: Vehicle Fires in RVs by Mobile Property Type

Mobile Property Type	Fires		Civilian Deaths		Civilian Injuries	
Motor home, camper mounted on pickup,	2,340	(60%)	7	(66%)	55	(69%)
Travel trailer designed to be towed	1,380	(35%)	3	(29%)	23	(28%)
Collapsible camping trailer designed to be towed	190	(5%)	1	(5%)	2	(3%)
Total	3,920	(100%)	11	(100%)	80	(100%)

*Note: *Data from Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Table 10 Vehicle Fires involving Motor Homes, Travel Trailers and Related Vehicles by Mobile Property Type. The data contained herein are 2008-2017 annual averages.*

Table 13: Vehicle Fires in RVs by Area of Origin

Area of Origin	Fires		Civilian Deaths		Civilian Injuries	
Vehicle engine area, running gear, or wheel area	1,220	(31%)	1	(11%)	20	(25%)
Unclassified vehicle area	600	(15%)	2	(21%)	8	(11%)
Passenger area of vehicle	330	(9%)	3	(25%)	14	(17%)
Exterior surface of vehicle	300	(8%)	0	(0%)	3	(4%)
Kitchen or cooking area	270	(7%)	0	(5%)	12	(15%)
Cargo or trunk area of vehicle	240	(6%)	0	(0%)	5	(7%)
Unclassified area of origin	140	(4%)	1	(6%)	2	(2%)
Unclassified outside area	100	(2%)	0	(0%)	1	(1%)
On or near highway, public way, or street	60	(1%)	0	(0%)	0	(1%)
Unclassified function area	60	(1%)	1	(5%)	1	(2%)
Lawn, field, or open area	50	(1%)	0	(0%)	0	(0%)
Bedroom or sleeping area	50	(1%)	0	(3%)	3	(3%)
Separate operating or control area of vehicle	50	(1%)	0	(0%)	0	(0%)
Fuel tank or fuel line of vehicle	40	(1%)	1	(6%)	2	(2%)
Wall assembly or concealed space	40	(1%)	0	(0%)	0	(1%)
Unclassified equipment or service area	40	(1%)	0	(0%)	0	(0%)
Exterior wall surface	30	(1%)	0	(0%)	0	(0%)
Unclassified storage area	30	(1%)	0	(0%)	0	(0%)
Garage or vehicle storage area	30	(1%)	0	(0%)	0	(0%)
Living room	30	(1%)	0	(4%)	2	(2%)
Unclassified structural area	30	(1%)	0	(3%)	0	(0%)
Heating equipment room	20	(1%)	0	(0%)	1	(1%)
Other known area	170	(4%)	1	(12%)	4	(5%)
Total	3,920	(100%)	11	(100%)	80	(100%)

Note: *Data from Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Table 11 Vehicle Fires involving Vehicle Fires involving Motor Homes, Travel Trailers and Related Vehicles by Area of Origin. The data contained herein are 2008-2017 annual averages.*

Table 14: Vehicle Fires in RVs by Item First Ignited

Item First Ignited	Fires		Civilian Deaths		Civilian Injuries	
Flammable or combustible liquids or gases, piping or filter	740	(19%)	3	(26%)	46	(57%)
Electrical wire or cable insulation	690	(18%)	0	(4%)	8	(11%)
Unclassified item first ignited	610	(16%)	0	(4%)	5	(7%)
Tire	450	(11%)	0	(0%)	2	(2%)
Multiple items first ignited	230	(6%)	1	(8%)	3	(4%)
Upholstered furniture or vehicle seat	160	(4%)	3	(32%)	3	(4%)
Light vegetation, including grass	130	(3%)	0	(0%)	1	(1%)
Appliance housing or casing	120	(3%)	0	(4%)	2	(2%)
Cabinetry	120	(3%)	0	(0%)	2	(3%)
Mattress or bedding	90	(2%)	1	(8%)	3	(4%)
Rubbish, trash, or waste	90	(2%)	0	(4%)	0	(1%)
Unclassified organic material	60	(1%)	0	(0%)	1	(1%)
Unclassified furniture or utensil	40	(1%)	1	(9%)	2	(2%)
Agricultural crop, including fruits and vegetables	40	(1%)	0	(0%)	0	(0%)
Box, carton, bag, basket, or barrel	40	(1%)	0	(0%)	0	(0%)
Cooking materials, including food	30	(1%)	0	(0%)	1	(1%)
Clothing	20	(1%)	0	(0%)	0	(0%)
Unclassified soft goods or wearing apparel	20	(1%)	0	(0%)	0	(0%)
Unclassified storage supplies	20	(1%)	0	(0%)	0	(0%)
Other known item	220	(5%)	0	(0%)	1	(1%)
Total	3,920	(100%)	11	(100%)	80	(100%)

Note: *Data from Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Table 12 Vehicle Fires involving Motor Homes, Travel Trailers and Related Vehicles by Item First Ignited. The data contained herein are 2008-2017 annual averages.*

Table 15: Vehicle Fires in RVs by Type of Material First Ignited

Type of Material First Ignited	Fires		Civilian Deaths		Civilian Injuries	
Plastic	580	(15%)	1	(8%)	8	(10%)
Gasoline	470	(12%)	1	(12%)	18	(22%)
Multiple types of material	430	(11%)	0	(4%)	5	(6%)
Unclassified type of material first ignited	410	(11%)	0	(5%)	3	(4%)
Fabric or fiber	350	(9%)	2	(18%)	7	(8%)
Rubber, excluding synthetic rubber	160	(4%)	0	(0%)	1	(1%)
Fiberboard, particleboard, or hardboard	160	(4%)	0	(4%)	0	(1%)
Unclassified flammable or combustible liquid	160	(4%)	0	(0%)	1	(1%)
Plywood	150	(4%)	0	(0%)	1	(1%)
LP gas	150	(4%)	1	(13%)	23	(29%)
Unclassified flammable gas	140	(4%)	0	(4%)	7	(9%)
Sawn wood, including finished lumber	130	(3%)	0	(0%)	2	(2%)
Hay or straw	90	(2%)	0	(0%)	1	(1%)
Unclassified processed wood or paper	90	(2%)	0	(4%)	0	(0%)
Unclassified fabric, textile or fur	60	(2%)	2	(14%)	1	(1%)
Unclassified natural product	60	(2%)	0	(0%)	0	(1%)
Cooking oil, transformer, or lubricating oil	60	(1%)	0	(0%)	0	(0%)
Unclassified material compounded with oil	40	(1%)	0	(4%)	0	(0%)
Cardboard	40	(1%)	0	(0%)	0	(0%)
Paper, including cellulose and waxed paper	30	(1%)	0	(0%)	0	(0%)
Plastic coated fabric	20	(1%)	0	(4%)	0	(0%)
Other known type of material	140	(3%)	0	(4%)	1	(1%)
Total	3,920	(100%)	11	(100%)	80	(100%)

Note: *Data from Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Table 13 Vehicle Fires Involving Motor Homes, Travel Trailers and Related Vehicles by Type of Material First Ignited. The data contained herein are 2008-2017 annual averages.*

Table 16: Vehicle Fires in RVs by Cause of Ignition

Cause of Ignition	Fires		Civilian Deaths		Civilian Injuries	
Unintentional	2,180	(56%)	10	(92%)	61	(76%)
Failure of equipment or heat source	1,190	(30%)	0	(2%)	18	(23%)
Unclassified cause of ignition	320	(8%)	0	(2%)	1	(1%)
Intentional	210	(5%)	0	(3%)	1	(1%)
Act of nature	20	(1%)	0	(0%)	0	(0%)
Total	3,920	(100%)	11	(100%)	80	(100%)

Note: *Data from Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Table 14 Vehicle Fires Involving Motor Homes, Travel Trailers and Related Vehicles by Cause of Ignition. The data contained herein are 2008-2017 annual averages.*

Table 17: Vehicle Fires in RVs by Factor Contributing to Ignition

Factors Contributing	Fires		Civilian Deaths		Civilian Injuries	
Unclassified mechanical failure or malfunction	920	(23%)	1	(5%)	8	(10%)
Electrical failure or malfunction	770	(20%)	1	(10%)	10	(13%)
Exposure fire	430	(11%)	0	(0%)	0	(0%)
Heat source too close to combustible	300	(8%)	3	(25%)	12	(16%)
Leak or break	200	(5%)	0	(0%)	7	(8%)
Unclassified factor	190	(5%)	1	(8%)	2	(2%)
Worn out	150	(4%)	0	(0%)	1	(1%)
Backfire	130	(3%)	0	(0%)	7	(8%)
Unclassified misuse of material or product	120	(3%)	1	(11%)	5	(6%)
Abandoned or discarded material or product	110	(3%)	0	(3%)	2	(2%)
Flammable liquid or gas spilled	90	(2%)	0	(2%)	7	(9%)
Cutting or welding too close to combustible	60	(2%)	0	(0%)	0	(1%)
Unclassified operational deficiency	50	(1%)	0	(0%)	1	(2%)
Equipment unattended	50	(1%)	0	(3%)	0	(0%)
Outside or open fire for debris or waste disposal	40	(1%)	0	(0%)	0	(1%)
Equipment not being operated properly	30	(1%)	0	(0%)	2	(2%)
Improper fueling technique	30	(1%)	0	(0%)	6	(7%)
Unclassified fire spread or control	30	(1%)	1	(14%)	0	(1%)
Rekindle	30	(1%)	0	(0%)	0	(0%)
Playing with heat source	30	(1%)	0	(0%)	1	(1%)
Equipment overloaded	30	(1%)	0	(0%)	0	(0%)
High wind	20	(1%)	0	(0%)	2	(2%)
Improper container or storage	20	(1%)	0	(0%)	1	(1%)
Automatic control failure	20	(1%)	0	(0%)	0	(0%)
Failure to clean	20	(1%)	0	(0%)	0	(0%)
Installation deficiency	20	(1%)	0	(0%)	2	(2%)
Unclassified natural condition	20	(1%)	0	(0%)	0	(1%)
Other known factor	150	(4%)	2	(21%)	7	(9%)
Total fires*	3,920	(100%)	11	(100%)	80	(100%)
Total factors*	4,060	(104%)	11	(102%)	84	(105%)

Note: *Data from Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Table 15 Vehicle Fires Involving Motor Homes, Travel Trailers and Related Vehicles by Factor Contributing to Ignition. The data contained herein are 2008-2017 annual averages.*

Table 18: Vehicle Fires Involving RVs by Heat Source

Heat Source	Fires		Civilian Deaths		Civilian Injuries	
Unclassified heat from powered equipment	620	(16%)	1	(12%)	9	(12%)
Radiated or conducted heat from operating equipment	580	(15%)	2	(18%)	9	(12%)
Arcing	550	(14%)	1	(6%)	6	(8%)
Spark, ember, or flame from operating equipment	340	(9%)	1	(8%)	19	(23%)
Unclassified heat source	330	(8%)	3	(26%)	5	(6%)
Heat or spark from friction	280	(7%)	1	(9%)	3	(3%)
Unclassified hot or smoldering object	210	(5%)	0	(3%)	4	(5%)
Radiated heat from another fire	130	(3%)	0	(0%)	0	(0%)
Heat from direct flame or convection currents	120	(3%)	0	(0%)	1	(1%)
Backfire from internal combustion engine	120	(3%)	0	(0%)	7	(8%)
Hot ember or ash	100	(3%)	0	(3%)	0	(0%)
Smoking materials	80	(2%)	1	(8%)	2	(3%)
Flame or torch used for lighting	60	(1%)	0	(0%)	3	(3%)
Candle	60	(1%)	0	(4%)	3	(3%)
Unclassified heat spread from another fire	50	(1%)	0	(0%)	0	(0%)
Lighter	50	(1%)	0	(4%)	4	(5%)
Molten or hot material	40	(1%)	0	(0%)	0	(0%)
Match	40	(1%)	0	(0%)	4	(5%)
Multiple heat sources including multiple ignitions	30	(1%)	0	(0%)	0	(0%)
Flying brand, ember, or spark	30	(1%)	0	(0%)	0	(0%)
Chemical reaction or spontaneous combustion	20	(1%)	0	(0%)	0	(1%)
Other known heat source	70	(2%)	0	(0%)	1	(1%)
Total	3,920	(100%)	11	(100%)	80	(100%)

*Note: *Data from Ahrens, Fires in or Involving Motor Homes Travel Trailer and Related Vehicles (Excluding Fires Coded with Unrelated Mobile Property Types) 2019 – Table 16 Vehicle Fires Involving Motor Homes, Travel Trailers and Related Vehicles by Heat Source. The data contained herein are 2008-2017 annual averages.*

5.2 Deaths Caused by RV fires

This section focuses solely on the deaths resulting from RV fires. During this ten-year period, an estimated average of 34 people per year died as a result of these fires. An average of 11 per year died in structure fires, and 24 per year were fatally injured in vehicle fires. (Rounding errors can cause sums to differ slightly from totals.) These estimates were derived from ten-year raw totals of 92 vehicle fire deaths and 60 structure fire deaths annually. Some fires caused more than one death.

Table 19: Fire Death Trends in RV Structure and Vehicle Fires

Alarm Year	Structure Deaths	Percent	Vehicle Deaths	Percent	Total Deaths	Percent
2008	25	(10%)	9	(9%)	34	(10%)
2009	28	(12%)	5	(5%)	34	(10%)
2010	17	(7%)	12	(11%)	29	(8%)
2011	29	(12%)	8	(8%)	38	(11%)
2012	32	(13%)	12	(11%)	44	(12%)
2013	18	(7%)	7	(7%)	25	(7%)
2014	29	(12%)	10	(9%)	39	(11%)
2015	17	(7%)	16	(15%)	33	(9%)
2016	22	(9%)	8	(7%)	30	(8%)
2017	29	(12%)	19	(18%)	48	(13%)
Total	247	(100%)	106	(100%)	354	(100%)

5.2.1 Data Relating to Ignition

The following information focuses on categorizing the data that identifies the causal factors which contributed to the fire.

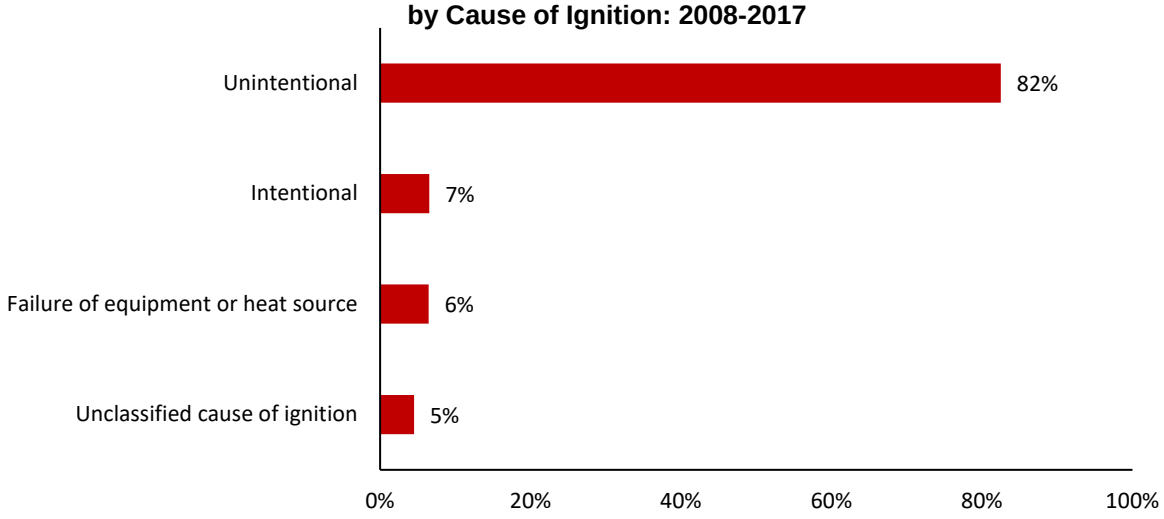
Figure 7 shows the causes of ignition, a specific data element in NFIRS, when deaths resulted from these fires. NFIRS defines *cause of ignition* as:

> "A general casual factor that results in a heat source igniting a combustible material, the cause could be the result of a deliberate act, mechanical failure, or act of nature" (4-24, (U.S. Fire Administration National Fire Data Center 2015)).

Only seven percent (7%) of these fires were intentional.

Figure 7: Fire Deaths by Cause of Ignition: 2008 -2017

Figure 7.
Fire Deaths in Motor Homes, Travel Trailers, or Collapsible Camping Trailer by Cause of Ignition: 2008-2017



NFIRS defines factors contributing to ignition as "the contributing factors that allowed the heat source and combustible material to combine to ignite the fire" (4-25, (U.S. Fire Administration National Fire Data Center 2015)).

Figure 8 above shows that many of the contributing factors to ignition, are related to materials, and inappropriate placement/use of a material. Electrical and mechanical issues were also common.

Figure 8: Fire Deaths by Leading Factors Contributing to Ignition: 2008-2017

Figure 8.
Fire Deaths in Motor Homes, Travel Trailers, or Collapsible Camping Trailer by Leading Factors Contributing to Ignition: 2008-2017

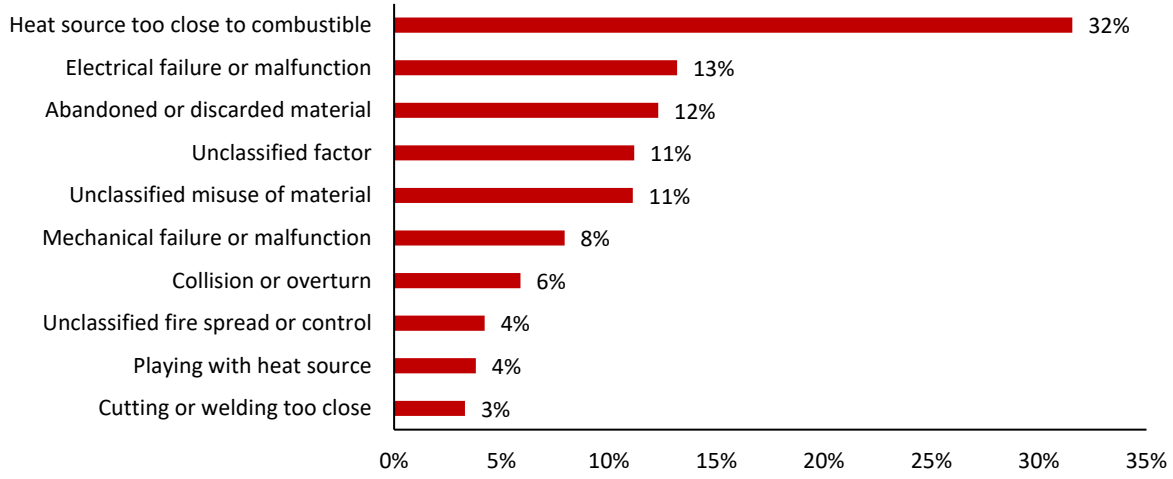


Figure 9 shows the leading areas of origin associated with RV fire deaths. NFIRS defines area of origin as “the primary use of the area where the fire started within the property. The area of origin may be a room, a portion of a room, a vehicle, a portion of a vehicle, or an open area devoted to a specific use. Every fire has an area of fire origin (4-13 (U.S. Fire Administration National Fire Data Center 2015)).”

Although twice as many deaths resulted from incidents coded as structure fires, vehicle and structural areas of origin were fairly evenly split in areas of origin for these deaths. As with home structure fires, bedrooms and kitchens are among the leading structural areas associated with RV fire deaths (Ahrens, Home Structure Fires 2019). Unlike homes, living rooms account for a much smaller percentage. Unfortunately, unclassified function areas and vehicle areas lack necessary specificity. The passenger area is another leading area of origin for RV fire deaths.

Figure 9: Fire Deaths by Leading Areas of Origin: 2008-2017

Figure 9.
Fire Deaths in Motor Homes, Travel Trailers, or Collapsible Camping Trailer by Leading Areas of Origin: 2008-2017

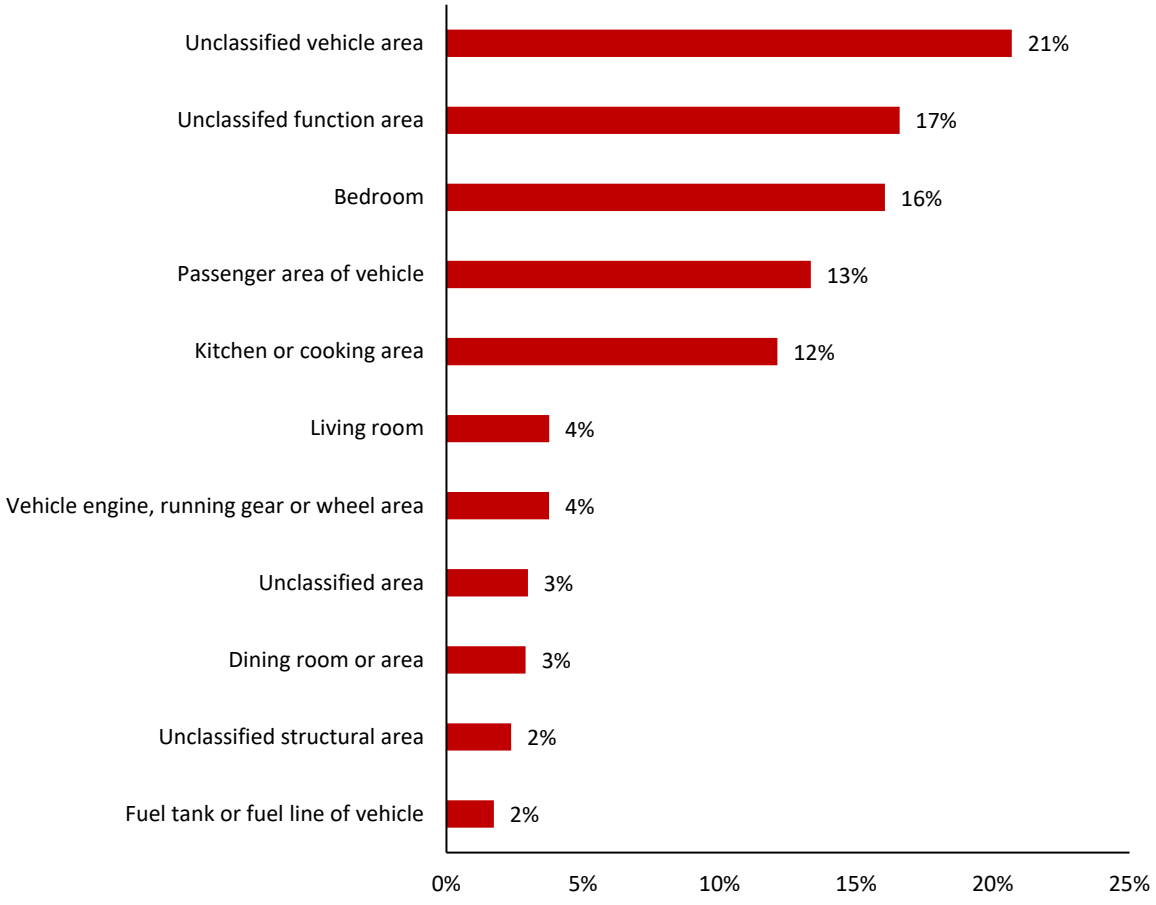
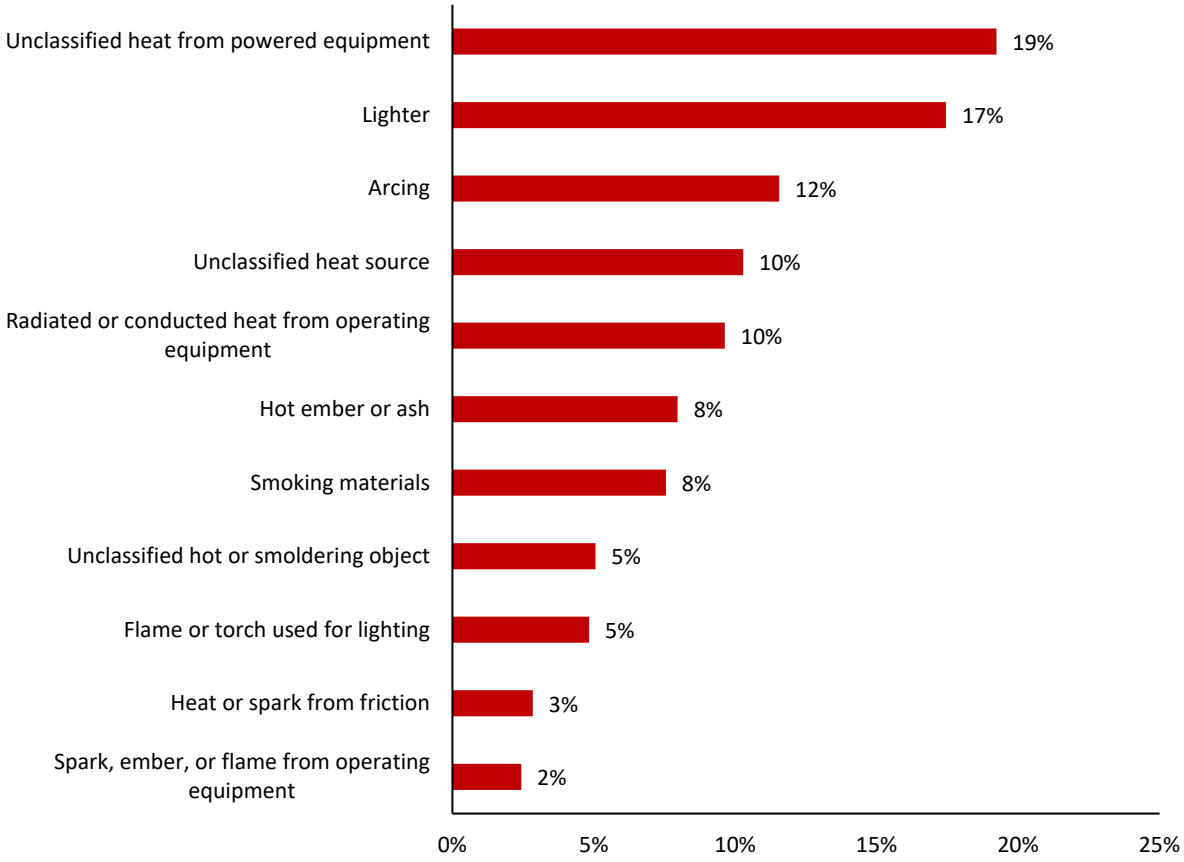


Figure 10 shows the heat source that started the fire. NFIRS defines heat source as “the heat source that ignited the ‘item first ignited’ to cause the fire (4-28, (U.S. Fire Administration National Fire Data Center 2015)).”

More than two of every five deaths from RV fires resulted from fires started by some type of operating, powered or arcing equipment.

Figure 10: Fire Death by Leading Heat Sources: 2008-2017

Figure 10.
Fire Deaths in Motor Homes, Travel Trailers, or Collapsible Camping Trailer by Leading Heat Sources: 2008-2017



5.2.2 Data Relating to Time

Figure 11 shows considerable variation in fire death frequency by day of week with lowest estimates on Saturday and Sunday. In some cases, these *may* have been travel days in which the vehicle was only used for part of the day.

Figure 11: Fire Deaths by Day of Week: 2008-2017

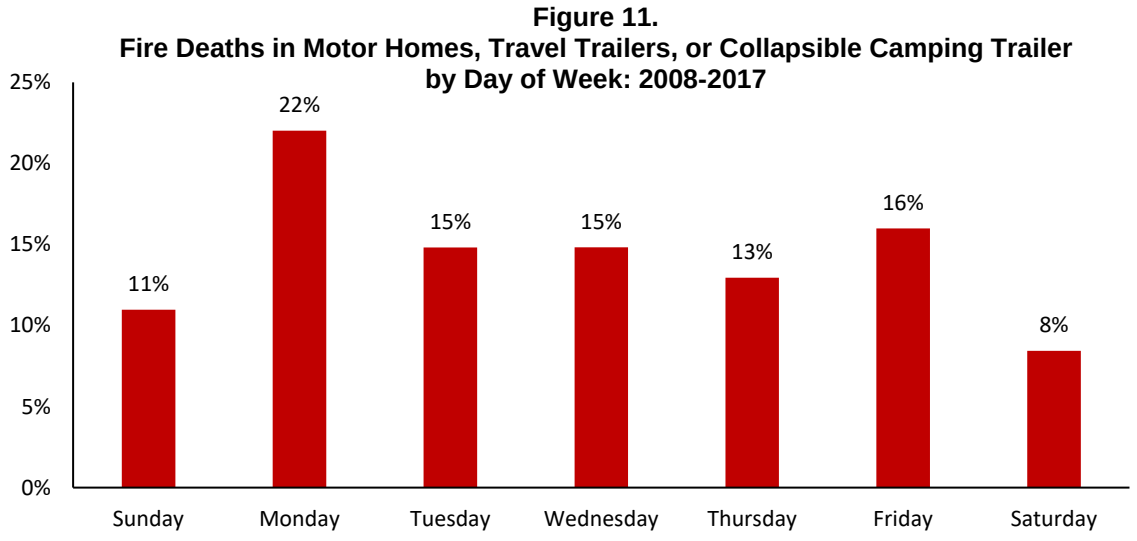


Figure 12 shows that January and February were the peak months for these deaths. Table 10 showed that fixed or portable space heaters caused one-quarter of the RV structure fires.

Figure 12: Fire Deaths by Month: 2008-2017

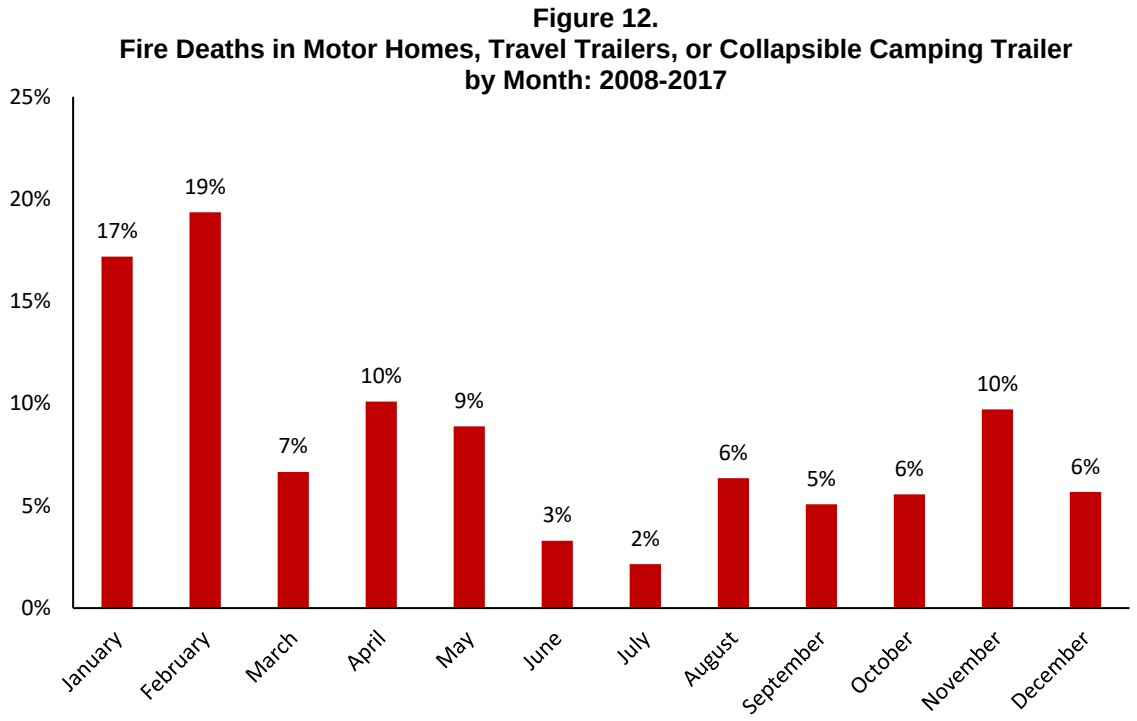
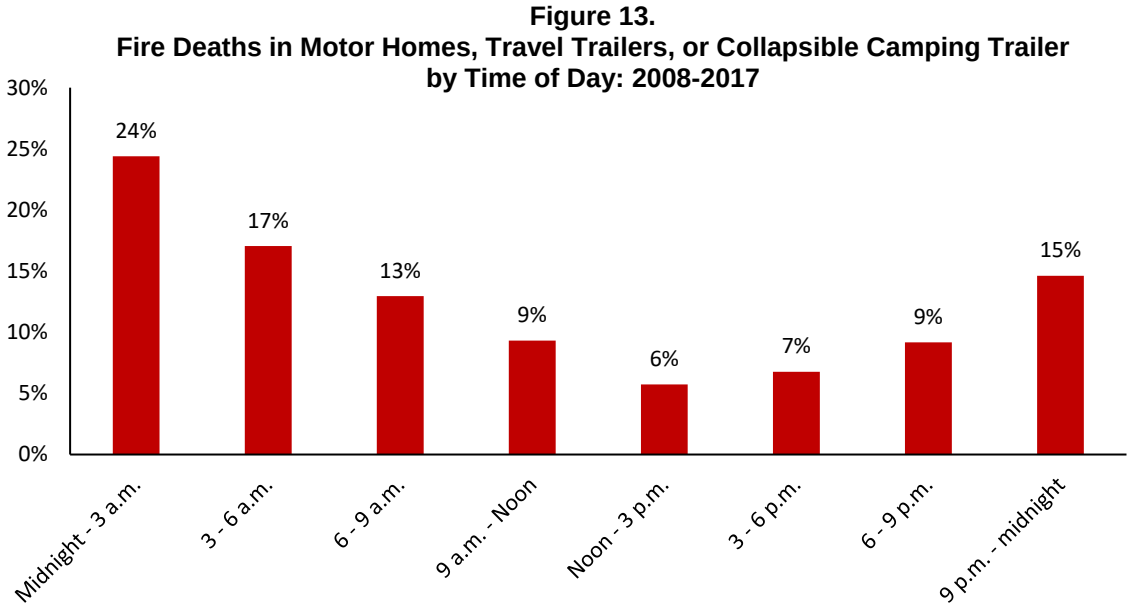


Figure 13 shows that deaths were less likely to result from RV fires reported between 9:00 a.m. and 9:00 p.m.

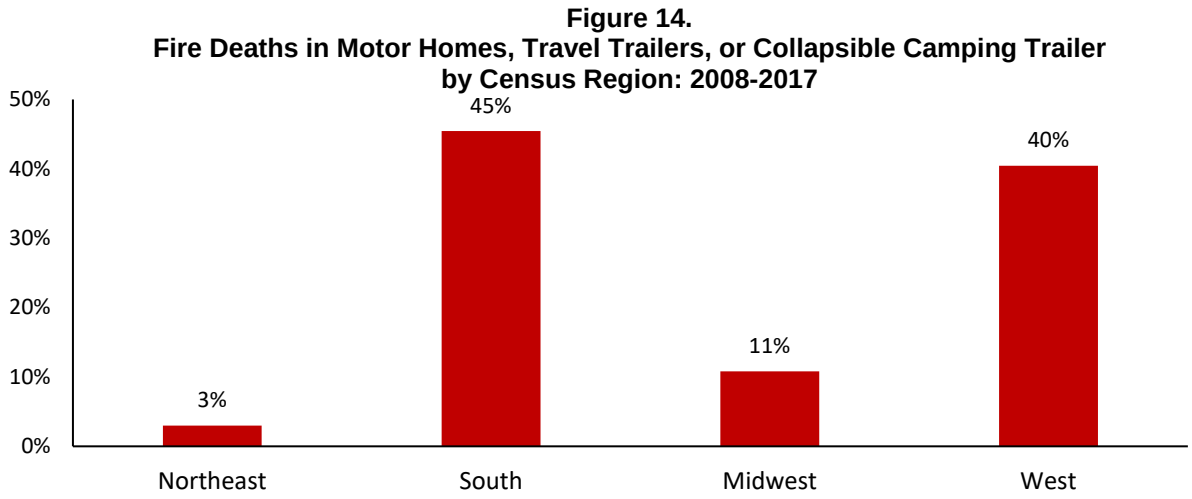
Figure 13: Fire Deaths by Time of Day: 2008-2017



5.2.3 Data Relating to Census Region

Figure 14 shows that RV fire deaths were much more common in the Southern and Western states. This correlates with what was found by Curtin, that the majority of RV shipments go to Texas, California, Florida, Ohio, and Michigan (Curtin, The RV Consumer in 2011 2011).

Figure 14: Fire Deaths by Census Region: 2008-2017

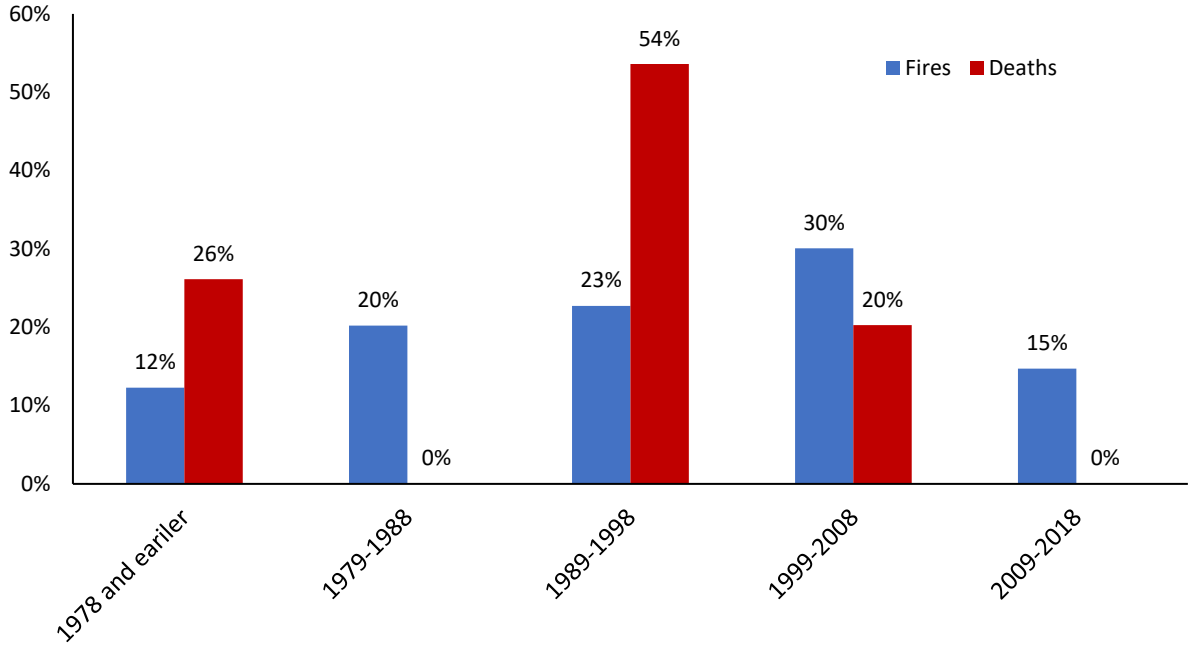


5.2.4 Data Relating to Model Year

Figure 15 shows that four out five RV fire deaths in 2017 resulted from fires in vehicles that were of model years 1998 or earlier. None resulted from vehicles with model years of 2009 or later. Fifty-five percent of total RV fires were in vehicles from these earlier years.

Figure 15: Fires and Fire Deaths in 2017 by Model Year

Figure 15.
Fires and Fire Deaths
in Motor Homes, Travel Trailers, or Collapsible Camping Trailers
in 2017 by Model Year



Although the figure indicates that newer RV's may have better fire and life safety measures incorporated into the designs, an important question that arises is the distribution of newer RVs compared to older RVs across the country. This question was addressed earlier in Section 3 of this report. It is also a reminder that code changes will not apply to the many RVs currently in use, only to those manufactured after the changes take effect. The percentages calculated in Figure 15 only illustrate the incidents for which the model year was recorded within the data set; this figure represents 43 percent of the RV fires and 53 percent of the RV fire deaths in 2017.

6. Trends and Summary Observations from the Data Analysis

Of the nearly 10 million households that spend time in an RV every year, only approximately 0.06% experienced a fire between 2008 and 2017. Although these incidents are relatively rare, some key trends and takeaways regarding the cause of origin, ignition sources and factors contributing to RV fire incidents are summarized below.

Location and Times of Fires

Three-quarters (76 percent) of the RV fires and 86 percent of the associated deaths were in the Southern or Western regions of the country. Although RV fires were most common in the warmer months, RV fire deaths were most common in January and February. The winter death peak is likely caused by the increased use of heaters. RV fires are most fatal during typical sleeping hours, specifically between midnight and 6:00 a.m. It was found that fires in the vehicle engine area had the greatest number of fires which caused the greatest number of civilian injuries (Table 4 and Table 13). However, fire deaths were more likely to result from fires that began in the bedroom, kitchen, and passenger area (Figure 9).

Causal Factors

Mechanical and electrical failures or malfunctions were the leading causes of RV fires, while a heat source too close to something combustible was the most common factor in RV fire deaths (Figure 8). Predictably, the heat source was often some type of operating equipment. The most common types of material first item ignited were plastic; gasoline; fabric or fiber; and particleboard, fiberboard, or hardboard. (Table 6 and Table 15).

Exacerbating Factors

Most fatal fires occur in older models of RVs, as they have fewer and less advanced fire safety measures. They also have older engines and equipment that are more likely to fail, which is a common cause of fires. Smoke alarms, or the lack thereof, plays a huge role in fires. Although they are required by code, 84% of fires in RV's being used as a structure occurred when no smoke alarm was present, at the time the fire service was at the scene of the incident. These fires resulted in 20 deaths and 55 injuries. Out of the 230 fires where the was an operating smoke alarm present, there was only 1 death and 4 injuries. There were 50 fires when a smoke alarm that wasn't working was present, but there was 2 deaths and 5 injuries (Table 11). These statistics demonstrate the importance of a working smoke alarm. Many of the casualties that were reported were attributed to asphyxiation and carbon monoxide poisoning, which could have likely been avoided with a smoke detector.

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Appendix A: Methodology

The detailed data collected in the Version 5.0 of the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS) and the results of NFPA's annual fire department experience survey were used to project national estimates of two categories of fires for 2008-2017:

1. Structure fires coded with NFIRS incident type 122 – "Fire in a motor home, camper, or recreational vehicle when used as a structure. Includes motor homes when not in transit and use as a structure for residential purposes." When a mobile property type other than the four below was specified, the fire was not included. Because the incident type clearly specified a motor home, camper, or recreational vehicle, fires in which the mobile property type was coded as none or was unreported were allocated proportionally among the four mobile property types below.

    Code 14. Motor home (has own engine) or camper mounted on pickup;[5]
    Code 15. Trailer, travel; designed to be towed;
    Code 16. Trailer, camping; collapsible, designed to be towed; and
    Code 00. Unclassified mobile property type.

2. Vehicle fires (NFIRS incident type 130-139) in which the mobile property type was coded with one of three codes:
    Code 14. "Motor home (has own engine) or camper mounted on pickup,"
    Code 15. "Trailer, travel; designed to be towed;" or
    Code 16. Trailer, camping; collapsible, designed to be towed.

Methodology

The statistics in this analysis are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Fires are rounded to the nearest ten, civilian deaths and injuries to the nearest one and direct property damage to the nearest hundred thousand dollars. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire.

Except for incident type, fires with unknown or missing data were allocated proportionally. When the mobile property type was coded as none, it was treated as unknown.

Certain types of structure fires, collectively referred to as "confined fires," including confined cooking fires, chimney fires, trash fires, and fuel burner or boiler fires are identified by incident type 113-118 in NFIRS 5.0. Causal data, including mobile property type, is not routinely captures for these incidents. Because the structure fires in this analysis were identified by incident type 122, none of these confined fires were included in this analysis. Consequently, scenarios such as minor cooking or heating equipment fires are likely underrepresented in the structure fire analysis.

[5] Although the NFIRS 5.0 definition also includes bookmobiles, these are assumed to be rare and irrelevant to this discussion.

Appendix B: How National Estimates Statistics Are Calculated

The statistics in this analysis are estimates derived from the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA's) annual survey of U.S. fire departments. NFIRS is a voluntary system through which participating fire departments report detailed factors about the fires to which they respond. Roughly two-thirds of U.S. fire departments participate, although not all of these departments provide data every year. Fires reported to federal or state fire departments or industrial fire brigades are not included in these estimates.

NFIRS provides the most detailed incident information of any national database not limited to large fires. NFIRS is the only database capable of addressing national patterns for fires of all sizes by specific property use and specific fire cause. NFIRS also captures information on the extent of flame spread, and automatic detection and suppression equipment. For more information about NFIRS visit https://www.usfa.fema.gov/data/nfirs/.

NFIRS has a wide variety of data elements and codes. Many code choices describe several conditions. These cannot be broken down further. For example, area of origin code 83 captures fires starting in vehicle engine areas, running gear areas or wheel areas. It is not possible to tell the portion of each from the coded data.

Methodology may change slightly from year to year. NFPA is continually examining its methodology to provide the best possible answers to specific questions. From time to time, changes are made to methodologies or groupings. *Earlier editions of the same report may have used different methodologies to produce the same analysis, meaning that the estimates are not directly comparable from year to year.* Readers should use the latest report available and contact us if clarification is needed.

NFPA's fire department experience survey provides estimates of the big picture. Each year, NFPA conducts an annual survey of fire departments which enables us to capture a summary of fire department experience on a larger scale. Surveys are sent to all municipal departments protecting populations of 5,000 or more and a random sample, stratified by community size, of the smaller departments. Typically, a total of roughly 3,000 surveys are returned, representing about one of every ten U.S. municipal fire departments serving about one third of the U.S. population.

The survey is stratified by size of population protected to reduce the uncertainty of the final estimate. Small rural communities have fewer people protected per department and are less likely to respond to the survey. A larger number must be surveyed to obtain an adequate sample of those departments. (NFPA also makes follow-up calls to a sample of

the smaller fire departments that do not respond, to confirm that those that did respond are truly representative of fire departments their size.) On the other hand, large city departments are so few in number and protect such a large proportion of the total U.S. population that it makes sense to survey all of them. Most respond, resulting in excellent precision for their part of the final estimate.

The survey includes the following information: (1) the total number of fire incidents, civilian deaths, and civilian injuries, and the total estimated property damage (in dollars), for each of the major property use classes defined in NFIRS; (2) the number of on-duty firefighter injuries, by type of duty and nature of illness; 3) the number and nature of non-fire incidents; and (4) information on the type of community protected (e.g., county versus township versus city) and the size of the population protected, which is used in the statistical formula for projecting national totals from sample results. The results of the survey are published in the annual report *Fire Loss in the United States*.

Projecting NFIRS to National Estimates

As noted, NFIRS is a voluntary reporting system. Different states and jurisdictions have different reporting requirements and practices. Participation rates in NFIRS are not necessarily uniform across regions and community sizes, both factors correlated with frequency and severity of fires. This means NFIRS may be susceptible to systematic biases. No one at present can quantify the size of these deviations from the ideal, representative sample. But there is enough reason for concern so that a second database -- the NFPA's fire experience survey -- is needed to project NFIRS to national estimates and to project different parts of NFIRS separately. This multiple calibration approach makes use of the annual NFPA's fire experience survey where its statistical design advantages are strongest.

Scaling ratios are obtained by comparing NFPA's projected totals of residential structure fires, non-residential structure fires, vehicle fires, and outside and other fires, and associated civilian deaths, civilian injuries, and direct property damage with comparable totals in NFIRS. Estimates of specific fire problems and circumstances are obtained by multiplying the NFIRS data by the scaling ratios. Reports for incidents in which mutual aid was given are excluded from NFPA's analyses.

Analysts at the NFPA, the USFA and the Consumer Product Safety Commission developed the analytical rules used in analyzing data from the two data sets. "The National Estimates Approach to U.S. Fire Statistics," by John R. Hall, Jr. and Beatrice Harwood, provides a more detailed explanation of national estimates.

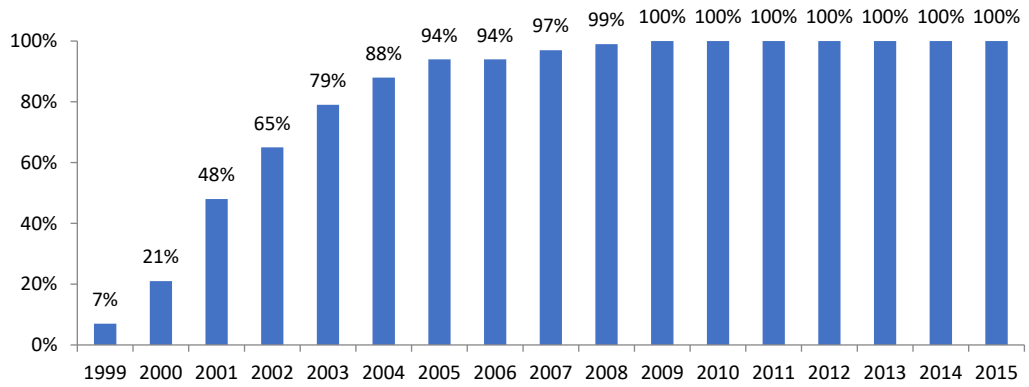
Version 5.0 of NFIRS, first introduced in 1999, used a different coding structure for many data elements, added some property use codes, and dropped others. The essentials of the approach described by Hall and Harwood are still used, but some modifications have

been necessary to accommodate the changes in NFIRS 5.0. For 2002 data on, analyses are based on scaling ratios using only data originally collected in NFIRS 5.0:

NFPA's fire experience survey projections
NFIRS totals (Version 5.0)

For 1999 to 2001, the same rules may be applied, but estimates for these years in this form will be less reliable due to the smaller amount of data originally collected in NFIRS 5.0; they should be viewed with extreme caution.

Figure A.1. Fires Originally Collected in NFIRS 5.0 by Year



NFIRS 5.0 introduced six categories of confined structure fires, including:

- cooking fires confined to the cooking vessel,
- confined chimney or flue fires,
- confined incinerator fire,
- confined fuel burner or boiler fire or delayed ignition,
- confined commercial compactor fire, and
- trash or rubbish fires in a structure with no flame damage to the structure or its contents.

Although causal and other detailed information is typically not required for these incidents, it is provided in some cases. Some analyses, particularly those that examine cooking equipment, heating equipment, fires caused by smoking materials, and fires started by playing with fire, may examine the confined fires in greater detail. Because the confined fire incident types describe certain scenarios, the distribution of unknown data differs from that of all fires. Consequently, allocation of unknowns must be done separately.

Some analyses of structure fires show only non-confined fires. In these tables, percentages shown are of non-confined structure fires rather than all structure fires. This approach has the advantage of showing the frequency of specific factors in fire causes, but the disadvantage of possibly overstating the percentage of factors that are seldom seen in the confined fire incident types and of understating the factors specifically

associated with the confined fire incident types. Other analyses include entries for confined fire incident types in the causal tables and show percentages based on total structure fires. In these cases, the confined fire incident type is treated as a general causal factor.

For most fields other than Property Use and Incident Type, NFPA allocates unknown data proportionally among known data. This approach assumes that if the missing data were known, it would be distributed in the same manner as the known data. NFPA makes additional adjustments to several fields. *Casualty and loss projections can be heavily influenced by the inclusion or exclusion of unusually serious fire.*

Specific Data Elements

In the formulas that follow, the term "all fires" refers to all fires in NFIRS on the dimension studied. The percentages of fires with known or unknown data are provided for non-confined fires and associated losses, and for confined fires only.

Cause of Ignition: This field is used chiefly to identify intentional fires. "Unintentional" in this field is a specific entry and does not include other fires that were not intentionally set: failure of equipment or heat source, act of nature, or "other" (unclassified)." The last should be used for exposures but has been used for other situations as well. Fires that were coded as under investigation and those that were coded as undetermined after investigation were treated as unknown.

Factor Contributing to Ignition: In this field, the code "none" is treated as an unknown and allocated proportionally. For Human Factor Contributing to Ignition, NFPA enters a code for "not reported" when no factors are recorded. "Not reported" is treated as an unknown, but the code "none" is treated as a known code and not allocated. Multiple entries are allowed in both of these fields. Percentages are calculated on the total number of fires, not entries, resulting in sums greater than 100%. Although Factor Contributing to Ignition is only required when the cause of ignition was coded as: 2) unintentional, 3) failure of equipment or heat source; or 4) act of nature, data is often present when not required. Consequently, any fire in which no factor contributing to ignition was entered was treated as unknown.

In some analyses, all entries in the category of mechanical failure, malfunction (factor contributing to ignition 20-29) are combined and shown as one entry, "mechanical failure or malfunction." This category includes:

21. Automatic control failure;
22. Manual control failure;
23. Leak or break. Includes leaks or breaks from containers or pipes. Excludes operational deficiencies and spill mishaps;
25. Worn out;
26. Backfire. Excludes fires originating as a result of hot catalytic converters;

27. Improper fuel used; Includes the use of gasoline in a kerosene heater and the like; and
20. Mechanical failure or malfunction, other.

Entries in “electrical failure, malfunction” (factor contributing to ignition 30-39) may also be combined into one entry, “electrical failure or malfunction.” This category includes:

31. Water-caused short circuit arc;
32. Short-circuit arc from mechanical damage;
33. Short-circuit arc from defective or worn insulation;
34. Unspecified short circuit arc;
35. Arc from faulty contact or broken connector, including broken power lines and loose connections;
36. Arc or spark from operating equipment, switch, or electric fence;
37. Fluorescent light ballast; and
30. Electrical failure or malfunction, other.

Heat Source. In NFIRS 5.0, one grouping of codes encompasses various types of open flames and smoking materials. In the past, these had been two separate groupings. A new code was added to NFIRS 5.0, which is code 60: “Heat from open flame or smoking material, other.” NFPA treats this code as a partial unknown and allocates it proportionally across the codes in the 61-69 range, shown below.

61. Cigarette;
62. Pipe or cigar;
63. Heat from undetermined smoking material;
64. Match;
65. Lighter: cigarette lighter, cigar lighter;
66. Candle;
67 Warning or road flare, fuse;
68. Backfire from internal combustion engine. Excludes flames and sparks from an exhaust system, (11); and
69. Flame/torch used for lighting. Includes gas light and gas-/liquid-fueled lantern.

In addition to the conventional allocation of missing and undetermined fires, NFPA multiplies fires with codes in the 61-69 range by:

$$\frac{\text{All fires in range 60-69}}{\text{All fires in range 61-69}}$$

The downside of this approach is that heat sources that are truly a different type of open flame or smoking material are erroneously assigned to other categories. The grouping “smoking materials” includes codes 61-63 (cigarettes, pipes or cigars, and heat from

undetermined smoking material, with a proportional share of the code 60s and true unknown data.

Equipment Involved in Ignition (EII). NFIRS 5.0 originally defined EII as the piece of equipment that provided the principal heat source to cause ignition if the equipment malfunctioned or was used improperly. In 2006, the definition was modified to "the piece of equipment that provided the principal heat source to cause ignition." However, much of the data predates the change. Individuals who have already been trained with the older definition may not change their practices. To compensate, NFPA treats fires in which EII = NNN and heat source is not in the range of 40-99 as an additional unknown.

To allocate unknown data for EII, the known data is multiplied by

$$\frac{\text{All fires}}{\text{(All fires – blank – undetermined – [fires in which EII =NNN and heat source <>40-99])}}$$

In addition, the partially unclassified codes for broad equipment groupings (i.e., code 100 - heating, ventilation, and air conditioning, other; code 200 - electrical distribution, lighting and power transfer, other; etc.) were allocated proportionally across the individual code choices in their respective broad groupings (heating, ventilation, and air conditioning; electrical distribution, lighting and power transfer, other; etc.). Equipment that is totally unclassified is not allocated further. This approach has the same downside as the allocation of heat source 60 described above. Equipment that is truly different is erroneously assigned to other categories.

In some analyses, various types of equipment are grouped together.

Code Grouping	EII Code	NFIRS definitions
Central heat	132	Furnace or central heating unit
	133	Boiler (power, process or heating)
Fixed or portable space heater	131	Furnace, local heating unit, built-in
	123	Fireplace with insert or stove
	124	Heating stove
	141	Heater, excluding catalytic and oil-filled
	142	Catalytic heater
	143	Oil-filled heater
Fireplace or chimney	120	Fireplace or chimney
	121	Fireplace, masonry
	122	Fireplace, factory-built
	125	Chimney connector or vent connector
	126	Chimney – brick, stone or masonry

	127	Chimney-metal, including stovepipe or flue
Fixed wiring and related equipment	210	Unclassified electrical wiring
	211	Electrical power or utility line
	212	Electrical service supply wires from utility
	213	Electric meter or meter box
	214	Wiring from meter box to circuit breaker
	215	Panel board, switch board or circuit breaker board
	216	Electrical branch circuit
	217	Outlet or receptacle
	218	Wall switch
	219	Ground fault interrupter
Transformers and power supplies	221	Distribution-type transformer
	222	Overcurrent, disconnect equipment
	223	Low-voltage transformer
	224	Generator
	225	Inverter
	226	Uninterrupted power supply (UPS)
	227	Surge protector
	228	Battery charger or rectifier
	229	Battery (all types)

Code Grouping	EII Code	NFIRS definitions
Lamp, bulb or lighting	230	Unclassified lamp or lighting
	231	Lamp-tabletop, floor or desk
	232	Lantern or flashlight
	233	Incandescent lighting fixture
	234	Fluorescent light fixture or ballast
	235	Halogen light fixture or lamp
	236	Sodium or mercury vapor light fixture or lamp
	237	Work or trouble light
	238	Light bulb
	241	Nightlight

	242	Decorative lights – line voltage
	243	Decorative or landscape lighting – low voltage
	244	Sign
Cord or plug	260	Unclassified cord or plug
	261	Power cord or plug, detachable from appliance
	262	Power cord or plug- permanently attached
	263	Extension cord
Torch, burner or soldering iron	331	Welding torch
	332	Cutting torch
	333	Burner, including Bunsen burners
	334	Soldering equipment
Portable cooking or warming equipment	631	Coffee maker or teapot
	632	Food warmer or hot plate
	633	Kettle
	634	Popcorn popper
	635	Pressure cooker or canner
	636	Slow cooker
	637	Toaster, toaster oven, counter-top broiler
	638	Waffle iron, griddle
	639	Wok, frying pan, skillet
	641	Breadmaking machine

Area of Origin. Two areas of origin: bedroom for more than five people (code 21) and bedroom for less than five people (code 22) are combined and shown as simply "bedroom." Chimney is no longer a valid area of origin code for non-confined fires.

Item First Ignited. In most analyses, mattress and pillows (item first ignited 31) and bedding, blankets, sheets, and comforters (item first ignited 32) are combined and shown as "mattresses and bedding." In many analyses, wearing apparel not on a person (code 34) and wearing apparel on a person (code 35) are combined and shown as "clothing." In some analyses, flammable and combustible liquids and gases, piping and filters (item first ignited 60-69) are combined and shown together.

Rounding and percentages. The data shown are estimates and generally rounded. An entry of zero may be a true zero or it may mean that the value rounds to zero. Percentages are calculated from unrounded values. It is quite possible to have a

percentage entry of up to 100% even if the rounded number entry is zero. The same rounded value may account for a slightly different percentage share. Because percentages are expressed in integers and not carried out to several decimal places, percentages that appear identical may be associated with slightly different values.

Inflation. Property damage estimates are not adjusted for inflation unless so indicated.

Public Input No. 2-NFPA 556-2021 [Section No. C.1.2.1]

C.1.2.1 ASTM Publications.

ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM D2859, *Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials*, 2016 (2021) .

ASTM D5537, *Test Method for Heat Release, Flame Spread, Smoke Obscuration, and Mass Loss Testing of Insulating Materials Contained in Electrical or Optical Fiber Cables When Burning in a Vertical Cable Tray Configuration*, ~~2014~~ 2018 .

ASTM D6113, *Test Method for Using a Cone Calorimeter to Determine Fire-Test-Response Characteristics of Insulating Materials Contained in Electrical or Optical Fire Cables*, ~~2016~~ 2021 .

ASTM E119, *Test Methods for Fire Tests of Building Construction and Materials*, ~~2018b~~ 2020 .

ASTM E603, *Guide for Room Fire Experiments*, 2017.

ASTM E648, *Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source*, ~~2017a~~ 2019a e1 .

ASTM E662, *Test Method for Specific Optical Density of Smoke Generated by Solid Materials*, ~~2017a~~ 2021 .

ASTM E814, *Test Method for Fire Tests of Penetration Firestop Systems*, 2013a (2017).

ASTM E1321, *Test Method for Determining Material Ignition and Flame Spread Properties*, 2018.

ASTM E1354, *Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter*, 2017.

ASTM E1474, *Test Method for Determining the Heat Release Rate of Upholstered Furniture and Mattress Components or Composites Using a Bench Scale Oxygen Consumption Calorimeter*, ~~2014~~ 2020a .

ASTM E1529, *Test Methods for Determining Effects of Large Hydrocarbon Pool Fires on Structural Members and Assemblies*, 2016e1.

ASTM E1537, *Test Method for Fire Testing of Upholstered Furniture*, 2016.

ASTM E1546, *Guide for Development of Fire-Hazard-Assessment Standards*, 2015.

ASTM E1623, *Test Method for Determination of Fire and Thermal Parameters of Materials, Products, and Systems Using an Intermediate Scale Calorimeter (ICAL)*, 2016.

ASTM E1995, *Test Method for Measurement of Smoke Obscuration Using a Conical Radiant Source in a Single Closed Chamber, With the Test Specimen Oriented Horizontally*, ~~2016~~ 2018 .

ASTM E2061, *Guide for Fire Hazard Assessment of Rail Transportation Vehicles*, ~~2018~~ 2020 .

ASTM E2067, *Practice for Full-Scale Oxygen Consumption Calorimetry Fire Tests*, ~~2015~~ 2020 .

ASTM E2102, *Test Method for Measurement of Mass Loss and Ignitability for Screening Purposes Using a Conical Radiant Heater*, 2017.

ASTM E2280, *Guide for Fire Hazard Assessment of the Effect of Upholstered Seating Furniture Within Patient Rooms of Health Care Facilities*, 2017.

ASTM E2574/E2574M, *Test Method for Fire Testing of School Bus Seat Assemblies*, 2017 (2021) .

ASTM E2965, *Test Method for Determination of Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter*, 2017.

Statement of Problem and Substantiation for Public Input

updates

Submitter Information Verification

Submitter Full Name: Marcelo Hirschler
Organization: GBH International
Street Address:
City:
State:
Zip:
Submittal Date: Fri May 21 16:53:53 EDT 2021
Committee: HAR-AAA

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C.1.2.5 UL Publications.

Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 9, *Fire Tests of Window Assemblies*, 2009, revised ~~2015~~ 2019 .

UL 94, *Test for Flammability of Plastic Materials for Parts, Devices, and Appliances*, 2013, revised ~~2017~~ 2021 .

UL 263, *Fire Tests of Building Construction and Materials*, 2011, revised ~~2018~~ 2020 .

UL 1479, *Fire Tests of Through-Penetration Firestops*, 2015, revised 2021 .

UL 1685, *Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables*, 2015, revised 2020 .

UL 1709, *Rapid Rise Fire Tests of Protection Materials for Structural Steel*, 2017.

UL 2556, *Wire and Cable Test Methods*, ~~2015~~ 2021 .

Statement of Problem and Substantiation for Public Input

Update UL references to most recent editions

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 4-NFPA 556-2021 [Section No. 2.3.5]	

Submitter Information Verification

Submitter Full Name: Kelly Nicolello
Organization: UL LLC
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jun 01 12:40:30 EDT 2021
Committee: HAR-AAA

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2.3.2 ASTM Publications.

ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959. www.astm.org

ASTM E84, *Test Method for Surface Burning Characteristics of Building Materials*, ~~2020~~ 2021 .

ASTM E136, *Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C*, 2019a.

ASTM E2652, *Test Method for Assessing Combustibility of Materials Using a Tube Furnace with a Cone-shaped Airflow Stabilizer, at 750°C*, 2018.

ASTM E2965, *Test Method for Determination of Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter*, 2017.

ASTM E2768, *Test Method for Extended Duration Surface Burning Characteristics of Building Materials (30 min Tunnel Test)*, 2011 (2018).

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date update

Related Item

• fr1

Submitter Information Verification

Submitter Full Name: Marcelo Hirschler
Organization: GBH International
Street Address:
City:
State:
Zip:
Submittal Date: Wed Apr 28 17:50:41 EDT 2021
Committee: HAR-AAA

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E.1.2.2 ASTM Publications.

ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428–2959.

ASTM E84, *Test Method for Surface Burning Characteristics of Building Materials*, ~~2020~~ 2021 .

ASTM E1537, *Test Method for Fire Testing of Upholstered Furniture*, 2016.

ASTM E1590, *Test Method for Fire Testing of Mattresses*, 2017.

ASTM E2768, *Test Method for Extended Duration Surface Burning Characteristics of Building Materials (30 min Tunnel Test)*, 2011 (2018).

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• fr7

Submitter Information Verification

Submitter Full Name: Marcelo Hirschler
Organization: GBH International
Street Address:
City:
State:
Zip:
Submittal Date: Wed Apr 28 17:52:57 EDT 2021
Committee: HAR-AAA