Second Revision No. 5-NFPA 556-2022 [Chapter 2]

Chapter 2 Referenced Publications

2.1 General.

The documents or portions thereof listed in this chapter are referenced within this guide and should be considered part of the recommendations of this document.

2.2 NFPA Publications.

National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 253, *Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source,* 2023 edition.

NFPA 257, *Standard on Fire Test for Window and Glass Block Assemblies,* 2022 edition.

NFPA 259, *Standard Test Method for Potential Heat of Building Materials,* 2023 edition.

NFPA 260, *Standard Methods of Tests and Classification System for Cigarette Ignition Resistance of Components of Upholstered Furniture,* 2023 edition.

NFPA 261, *Standard Method of Test for Determining Resistance of Mock-Up Upholstered Furniture Material Assemblies to Ignition by Smoldering Cigarettes,* 2023 edition.

NFPA 270, *Standard Test Method for Measurement of Smoke Obscuration Using a Conical Radiant Source in a Single Closed Chamber,* 2023 edition.

NFPA 289, *Standard Method of Fire Test for Individual Fuel Packages,* 2023 edition.

NFPA 555, *Guide on Methods for Evaluating Potential for Room Flashover,* 2021 edition.

2.3 Other Publications.

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*, ~~2021a~~ 2022 .

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*, 2021.

ASTM E84, *Test Method for Surface Burning Characteristics of Building Materials*, ~~2021a~~ 2022 .

ASTM E119, *Test Methods for Fire Tests of Building Construction and Materials*, ~~2020~~ 2022 .

ASTM E136, *Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C*, ~~2019a~~ 2022 .

ASTM E162, *Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source*, ~~2021~~ 2022 .

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*, 2019a e1.

ASTM E662, *Test Method for Specific Optical Density of Smoke Generated by Solid Materials*, 2021a e1 .

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~~ 2022b .

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*, ~~2020a~~ 2022 .

ASTM E1529, *Test Methods for Determining Effects of Large Hydrocarbon Pool Fires on Structural Members and Assemblies*, ~~2016e1~~ 2022 .

ASTM E1546, *Guide for Development of Fire-Hazard-Assessment Standards*, ~~2015~~ 2021 .

ASTM E1623, *Test Method for Determination of Fire and Thermal Parameters of Materials, Products, and Systems Using an Intermediate Scale Calorimeter (ICAL)*, ~~2016~~ 2022 .

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*, ~~2018~~ 2021 .

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

ASTM E2067, *Practice for Full-Scale Oxygen Consumption Calorimetry Fire Tests*, ~~2020~~ 2022 .

ASTM E2102, *Test Method for Measurement of Mass Loss and Ignitability for Screening Purposes Using a Conical Radiant Heater*, ~~2017~~ 2021 .

ASTM E2280, *Guide for Fire Hazard Assessment of the Effect of Upholstered Seating Furniture Within Patient Rooms of Health Care Facilities*, ~~2017~~ 2021 .

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

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~~ 2022 .

2.3.2 ISO Publications.

International Organization for Standardization, ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland.

ISO 3795, *Road Vehicles, and Tractors and Machinery for Agriculture and Forestry — Determination of Burning Behaviour of Interior Materials*, 1989.

ISO TS 17431, *Fire Tests — Reduced Scale Model Box Test*, 2006.

2.3.3 SAE Publications.

SAE International, Society of Automotive Engineers, ~~400 Commonwealth Drive, Warrendale, PA 15096~~ 901 15th Street, NW, Suite 520, Washington, DC 20005 .

ANSI/SAE Z–26.1, *American National Standard for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways - Safety Standard*, 1996.

SAE J2464, *Electric and Hybrid Electric Vehicle Rechargeable Energy Storage System (RESS) Safety and Abuse Testing*, ~~2009~~ 2021 .

2.3.4 SFPE Publications.

Society of Fire Protection Engineers, 9711 Washingtonian Blvd, Suite 380, Gaithersburg, MD 20878.

SFPE Engineering Guide to Performance-Based Fire Protection, 2nd edition.

2.3.5 UL Publications.

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

UL 9, *Fire Tests of Window Assemblies*, 2009, revised 2020.

UL 263, *Fire Tests of Building Construction and Materials*, 2011, revised ~~2021~~ 2022 .

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

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~~ 2022 .

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

2.3.6 US DOT Publications.

Federal Motor Vehicle Safety Standards, US Department of Transportation/National Highway Traffic Safety Administration, 400 Seventh Street, SW, Washington, DC 20590.

49 CFR 571.302/FMVSS 302, “Flammability of Interior Materials,” October 1, 2011.

2.3.7 Other Publications.

BS EN 13823, *Reaction to fire tests for building products. Building products excluding floorings exposed to the thermal attack by a single burning item*, British Standards Institution, London, United Kingdom.

ECE R34.01, Annex 5, Fire Risks — European Economic Community Regulation — *Fire safety of plastic fuel tanks for automobiles* (ECE R34, Annex 5, RREG 70/221/EWG, 2000/8/EG).

JIS D 1201, *Road Vehicles, and Tractors and Machinery for Agriculture and Forestry — Determination of Burning Behaviour of Interior Materials*, Japanese Standards Association, Tokyo, Japan, 1998.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield MA, ~~2003~~ 2020 .

National School Transportation Specifications & Procedures, Adopted by the Fifteenth National Congress on School Transportation, 2010 revised edition.

2.3.8 List of Publications.

(1) “Traffic Safety Facts 2006.” National Center for Statistics and Analysis, National Highway Traffic Safety Administration.

(2) Blincoe, L. J., et al. “The Economic Impact of Motor Vehicle Crashes 2000.” DOT HS 809 446, US Department of Transportation, National Highway Traffic Safety Administration, May 2002.

(3) Digges, K. H. and Stephenson, R. R. “A Research Program to Study Impact Related Fire Safety.” Motor Vehicle Fire Research Institute (MVFRI) Paper Number 050448.

(4) Ahrens, M., “U.S. Vehicle Fire Trends and Patterns,” National Fire Protection Association, Quincy, MA, July 2008.

(5) Ahrens, M., “Vehicle Fires” National Fire Protection Association, Quincy, MA, March 2020.

(6) “Motor Vehicle Facts and Figures 2006,” Alliance of the Automobile Manufacturers, Ward’s, Southfield, MI, 2006.

(7) Committee on Fire Safety Aspects of Polymeric Materials. 1979. “Fire Safety Aspects of Polymeric Materials, Volume 8, Land Transportation Vehicles.” Washington, DC: National Materials Advisory Board, National Academy of Sciences, Publication NMAB 318-8: 158. [Original reference is Ward's *Automotive Yearbook*, 1975.]

(8) Abu-Isa, I. A., D. R. Cummings, D. E. LaDue, and A. Tewarson. June 1–4, 1998. “Thermal Properties and Flammability Behavior of Automotive Polymers,” Paper No. 98-54-P-17, 16th International Technical Conference on Enhanced Safety of Vehicles, Windsor, Canada. [References “Automotive Plastics Newsletter,” April 1996, Market Search, Inc.]

(9) Tewarson, A. October 1997. “A Study of the Flammability of Plastics in Vehicle Components and Parts.” Factory Mutual Research Corp. Technical Report FMRC J.I. 0B1R7.RC, on General Motors Corp. Research Project.

(10) Bundy, M., and Ohlemiller, T.J., “Bench-Scale Flammability Measures for Electronic Equipment, NISTIR-7031,” NIST, Gaithersburg, MD, 2003.

(11) Bundy, M., and Ohlemiller, T.J., “Full-Scale Flammability Measures for Electronic Equipment, NIST Technical Note 1461,” NIST, Gaithersburg, MD, 2004.

(12) “Recommendations for testing the flammability and smoke emission characteristics of transit bus and van materials such as seating, panels, flooring, insulation, and miscellaneous.” October 20, 1993. *Federal Register*, Vol. 58. No. 201.

(13) “Motor Vehicle Safety Standard No. 302, Flammability of Materials — Passenger Cars, Multipurpose Passenger Vehicles, Trucks and Buses.” Washington, DC: National Highway Traffic Safety Administration. [Code of Federal Regulations § 571.302, originally *Federal Register* 34, No. 229, pp. 20434–20436 (December 31, 1969).]

(14) Storrs, C. D. and O. H. Lindemann. July 1972. “Federal Flammability Standards for Interiors of Motor Vehicles.” *Fire Journal*, pp. 34–44.

(15) Hirschler, M. M. 1999. “Use of Heat Release Rate to Predict Whether Individual Furnishings Would Cause Self Propagating Fires.*” Fire Safety Journal*, Vol. 32, 273–296.

(16) Janssens, M. L., S. E. Dillon, and M. M. Hirschler. 2001. “Using the Cone Calorimeter as a Screening Tool for the NFPA 265 and NFPA 286 Room Test Procedures.” *Fire and Materials 2001 Conference*, San Francisco, CA, January 22–24, 2001. London: Interscience Communications, 529–540.

(17) Karlsson, B. 1994. “Models for Calculating Flame Spread on Wall Lining Materials and the Resulting Heat Release Rate in a Room.” *Fire Safety Journal*, Vol. 23, No. 4, 365–386.

(18) Hirschler, M. M. 1998. “How to Assess the Effect of an Individual Product on the Fire Hazard in a Real Occupancy, Based on Heat Release Rate.” *Flame Retardants ’98*, February 3–4, 1998, London. London: Interscience Communications, 225–240.

(19) Janssens, M. L. and Huczek, J. P., “Comparison of Fire Properties of Automotive Materials,” in Business Communications Company Fourteenth Ann. Conference on Recent Advances in Flame Retardancy of Polymeric Materials, June 2–4, 2003, Stamford, CT, Ed. M. Lewin, Norwalk, CT, 2003.

(20) Peacock, R. D., W. W. Jones, R. W. Bukowski, and C. L. Forney. 1991. “Technical Reference Guide for the HAZARD I Fire Hazard Assessment Method, Version 1.1.” In NIST Handbook 146, Vol. II. Gaithersburg, MD: National Institute of Standards and Technology.

(21) Peacock, R. D., W. W. Jones, G. P. Forney, R. W. Portier, P. A. Reneke, R. W. Bukowski, and J. H. Klote. 1994. “An Update Guide for HAZARD I, Version 1.2.” NISTIR 5410. Gaithersburg, MD: National Institute of Standards and Technology.

(22) Battipaglia, K., J. Huczek, M. L. Janssens, and G. Miller. 2004. “Development of a Method to Assess the Fire Hazard of Automotive Materials.” *Proceedings Interflam 2004*. Interscience Communications Ltd.

(23) Santrock J., August 2002. “Evaluation of Motor Vehicle Fire Initiation and Propagation, Part 7: Propagation of an Engine Compartment Fire in a 1997 Rear Wheel Drive Passenger Car.” Docket # NHTSA-1998-178, General Motors Corporation.

(24) Shields, L., R. Scheibe, and T. Angelos. November 17, 1998. “Motor-Vehicle Collision — Fire Analysis Methods and Results.” Washington State Transportation Center, 1–18.

(25) Karter, M. J. September/October 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001. “U.S. Fire Loss.” *NFPA Journal*.

(26) “Traffic Safety Facts,” Fatal Analysis Reporting System (FARS). 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001. Washington, DC, US Department of Transportation, National Highway Traffic Safety Administration.

(27) Cole, L. S. 1992. *Investigation of Motor Vehicle Fires*, Novato, CA: Lee Books, 27–63.

(28) Ahrens, M. February 2004. “U.S. Vehicle Fire Trends and Patterns.” Quincy, MA: National Fire Protection Association.

(29) Trisko, E. March 1975. “Results of the 1973 National Survey of Motor Vehicle Fires.” *Fire Journal*, 19–27.

(30) “Ontario Fire Losses by Property Class — 1990 to 1999.” Office of the Ontario Province Fire Marshal.

2.4 References for Extracts in Advisory Sections.

NFPA 268, *Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source,* ~~2017~~ 2022 edition.

NFPA 270, *Standard Test Method for Measurement of Smoke Obscuration Using a Conical Radiant Source in a Single Closed Chamber,* ~~2018~~ 2023 edition.

NFPA 289, *Standard Method of Fire Test for Individual Fuel Packages,* ~~2019~~ 2023 edition.

NFPA 318, *Standard for the Protection of Semiconductor Fabrication Facilities,* ~~2018~~ 2022 edition.

NFPA 555, *Guide on Methods for Evaluating Potential for Room Flashover,* ~~2017~~ 2021 edition.

NFPA 921, *Guide for Fire and Explosion Investigations,* ~~2017~~ 2021 edition.

NFPA 5000®, *Building Construction and Safety Code®,* ~~2018~~ 2024 edition.

Supplemental Information

File Name	Description	Approved
556-2020_Chapter_2_SR.docx	Chapter 2 updates	

Submitter Information Verification

Committee: HAR-AAA

Submittal Date: Tue Nov 15 11:53:11 EST 2022

Committee Statement

Committee Statement: Updated reference publications to the most recent editions.

Response Message: SR-5-NFPA 556-2022

Public Comment No. 3-NFPA 556-2022 [Section No. 2.3.1]

Second Revision No. 11-NFPA 556-2022 [Section No. 3.3.6]

3.3.6 Cause.

The circumstances, conditions, or agencies that brought about or resulted in the fire or explosion incident, damage to property, ~~resulting from the fire or explosion incident, or~~ bodily injury, or loss of life ~~resulting from the fire or explosion incident~~ . [**921,**~~2017~~ 2021]

Submitter Information Verification

Committee: HAR-AAA

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Committee Statement

Committee Statement: Extract update for consistency with the latest edition of the extract document.

Response Message: SR-11-NFPA 556-2022

Second Revision No. 12-NFPA 556-2022 [Section No. 3.3.39]

3.3.39 Radiant Heat.

~~Heat energy carried by electromagnetic waves that are longer than light waves and shorter than radio waves; radiant heat (electromagnetic radiation)~~ Electromagnetic transmission of heat energy; increases the sensible temperature of any substance capable of absorbing the radiation, especially solid and opaque objects. [**921,**~~2017~~ 2021]

Submitter Information Verification

Committee: HAR-AAA

Submittal Date: Wed Nov 30 17:40:31 EST 2022

Committee Statement

Committee Statement: Extract update for consistency with the latest edition of the extract document.

Response Message: SR-12-NFPA 556-2022

Second Revision No. 13-NFPA 556-2022 [Section No. 3.3.40]

3.3.40 Radiation.

Heat transfer by way of electromagnetic ~~energy~~ waves that are longer than visible light waves and shorter than radio waves . [**921,**~~2017~~ 2021]

Submitter Information Verification

Committee: HAR-AAA
Submittal Date: Wed Nov 30 17:44:20 EST 2022

Committee Statement

Committee Statement: Extract update for consistency with the latest edition of the extract document.
Response Message: SR-13-NFPA 556-2022

Second Revision No. 2-NFPA 556-2022 [Section No. 5.1.2.1]

5.1.2.1*

NFPA statistics indicate that an estimated 212,500 vehicle fires caused 560 civilian deaths, 1,500 civilian injuries, and $1.9 billion in direct property damage in the US during 2018 [5]. 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~~ as many deaths as nonresidential structure fires and 1.6 times ~~the number of~~ as many deaths as apartment ~~fire deaths~~ fires . The leading causes of vehicle fires were mechanical failures or malfunctions and electrical failures or malfunctions. It is important to maintain a vehicle throughout its years of use. Older vehicles accounted for three-quarters of the highway vehicle fires caused by mechanical or electrical failures or malfunctions. Collisions were the leading cause of vehicle fires that resulted in death (63 percent). For additional details and information on 2013-2017 vehicle fire statistics, see A.5.1.2.1.

A.5.1.2.1

Ahrens (2020) includes full statistics for the years 2013 through 2017[1]. The average 181,700 highway vehicle fires per year in 2013 through 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.

An NFPA survey indicates that US fire departments responded to an estimated 212,500 vehicle fires in the US during 2018. These fires caused an estimated 560 civilian deaths, 1,500 civilian injuries, and $1.9 billion in direct property damage. 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 as many deaths as nonresidential structure fires and 1.6 times as many deaths as apartment fires.

Table A.5.1.2.1(a) illustrates the annual average US vehicle fire losses by type of vehicle for 2013 through 2017. Figure A.5.1.2.1(a) and Figure A.5.1.2.1(b) show the evolution of vehicle fire losses over those years.

Passenger road vehicle fires during those years can be grouped into the following five categories by cause of ignition:

(1) Unintentional

(2) Failure of equipment or heat source

(3) Intentional

(4) Unclassified

(5) Act of nature

Table A.5.1.2.1(b) gives the annual average number of fires, number of civilian deaths and injuries, and direct property damage for these five categories for 2013 through 2017. The table shows that the first category accounted for 80 percent of the civilian fire deaths. Since the objective of this guide is to reduce the number of passenger road vehicle fire deaths, the focus is on this category.

Figure A.5.1.2.1(c) shows collision fire statistics by area of origin. Figure A.5.1.2.1(d) distributes these highway vehicle fires by major causal factors. The data 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.

Figure A.5.1.2.1(e) shows highway vehicle fires by item first ignited for the period of 2013 through 2017.

Table A.5.1.2.1(a) US Vehicle Fire Losses by Type of Vehicle, 2013–2017 Annual Averages

Vehicle Type	Fires	Civilian Deaths	Civilian Injuries	Damage (millions)
Passenger cars	117,370	230	694	$557
	(59%)	(59%)	(48%)	(33%)
Other passenger road vehicles	43,690	72	411	$287
	(23%)	(18%)	(28%)	(17%)
Freight road vehicles	20,620	53	156	$415
	(10%)	(14%)	(11%)	(24%)

Vehicle Type	Fires	Civilian Deaths	Civilian Injuries	Damage (millions)
Other vehicles	15,820	37	181	$452
	(8%)	(9%)	(13%)	(26%)

Figure A.5.1.2.1(a) US Vehicle Fire Trend: Number of Fires.

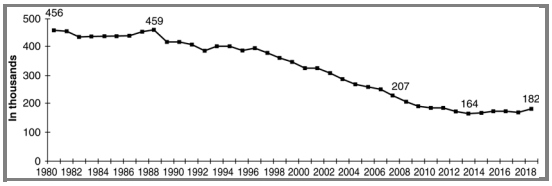


Figure A.5.1.2.1(b) US Vehicle Fire Trend: Number of Civilian Deaths.

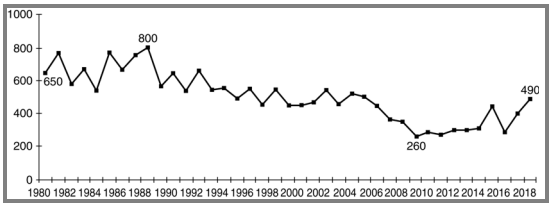


Table A.5.1.2.1(b) Highway Vehicle Fires by Cause of Ignition, 2013–2017 Annual Averages

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%)

Figure A.5.1.2.1(c) Highway Vehicle Fires by Area of Fire Origin, 2013–2017 Annual Averages.

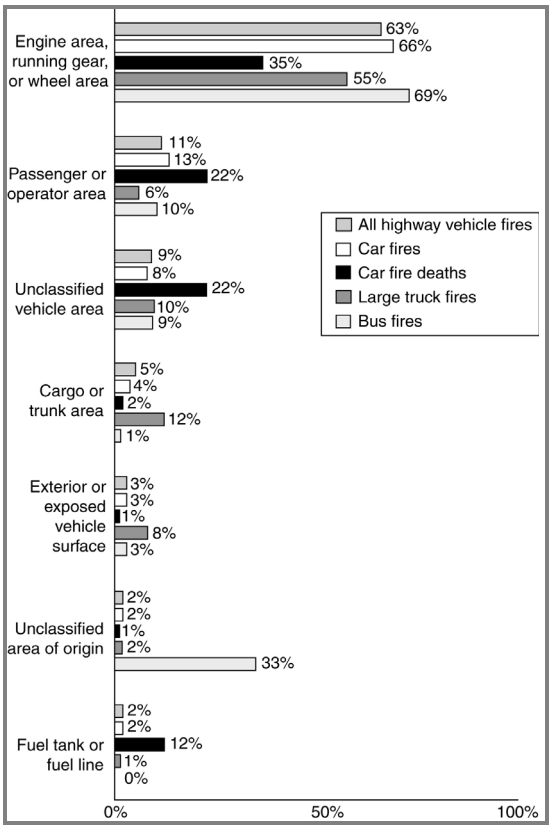


Figure A.5.1.2.1(d) Highway Vehicle Fires by Major Causal Factors, 2013–2017 Annual Averages.

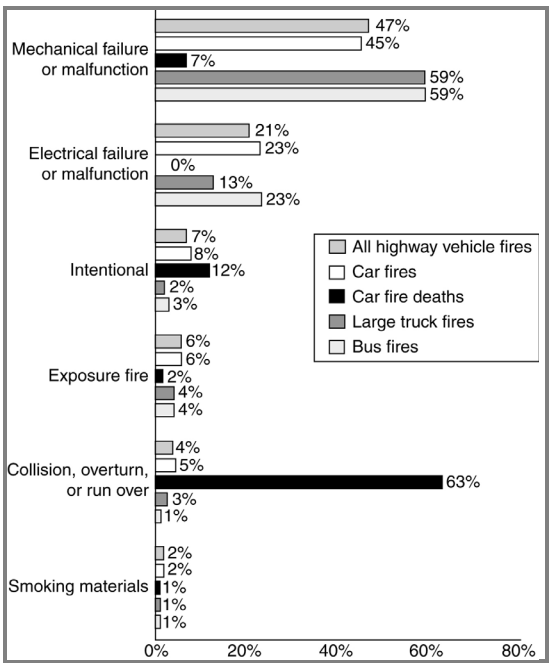
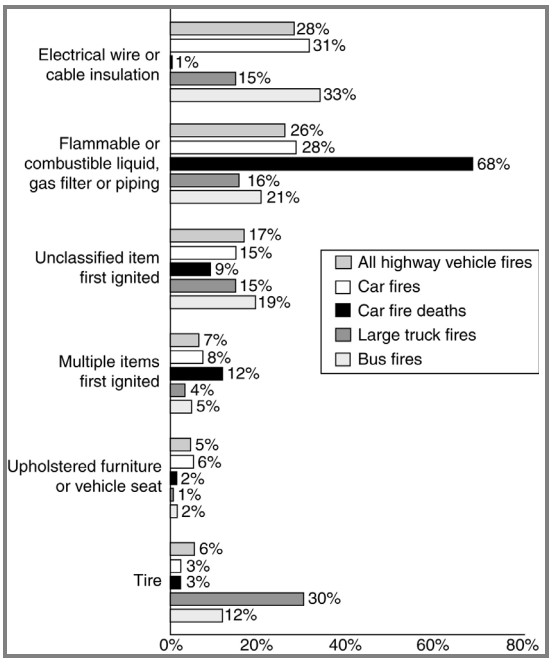


Figure A.5.1.2.1(e) Highway Vehicle Fires by Item First Ignited, 2013–2017 Annual Averages.



Supplemental Information

File Name	Description	Approved
NFPA_556_5.1.2.1_A.5.1.2.1.docx		

Submitter Information Verification

Committee: HAR-AAA

Submittal Date: Mon Nov 07 13:27:53 EST 2022

Committee Statement

Committee Statement: At the First Draft meeting, a task group was formed to include updated statistics from the 2020 Vehicle Fires report by Ahrens. The new annex section provides these updated statistics.

Response Message: SR-2-NFPA 556-2022

Public Comment No. 1-NFPA 556-2022 [Section No. 5.1.2.1]

Public Comment No. 2-NFPA 556-2022 [New Section after A.3.3.47]

Second Revision No. 8-NFPA 556-2022 [Section No. 5.5]

5.5 Limited-Combustible Material.

5.5.1

This section is part of an NFPA guide and, therefore, is not mandatory. The term *shall* in this section is used to indicate that if provisions relating to limited-combustible materials are applied, the material needs to meet the definition of a limited-combustible material.

5.5.2*

A material shall be considered a limited-combustible material where ~~both~~ one of the following ~~conditions of 5.5.2(1) , and 5.5.2(2) , and the conditions of either 5.5.2.1 or 5.5.2.2 are~~ is met:

(1) ~~The material does not comply with the requirements for noncombustible material in accordance with 5.4~~ The conditions of 5.5.2.1 and 5.5.2.2 , and the conditions of either 5.5.2.3 or 5.5.2.4 , shall be met .

(2) ~~The material, in the form in which it is used, exhibits a potential heat value not exceeding 3500 Btu/lb (8141 kJ/kg) when tested in accordance with NFPA 259~~ The conditions of 5.5.2.5 shall be met .

[**5000:**7.1.4.2]

5.5.2.1

The material does not comply with the requirements for ~~a~~ a noncombustible material in accordance with 5.4.[**5000:** 7.1.4.2.1]

5.5.2.2

The material, in the form in which it is used, exhibits a potential heat value not exceeding 3500 Btu/lb (8141 kJ/kg) when tested in accordance with NFPA 259.[**5000:** 7.1.4.2.2]

5.5.2.3

The material shall have a structural base of noncombustible material with a surfacing not exceeding a thickness of ⅛ in. (3.2 mm) where the surfacing exhibits a flame spread index not greater than 50 when tested in accordance with ASTM E84 , *Standard Test Method for Surface Burning Characteristics of Building Materials* , or UL 723, *Test for Surface Burning Characteristics of Building Materials* . [**5000:**~~7.1.4.2.1~~ 7.1.4.2.3]

5.5.2.4

The material shall be composed of materials that in the form and thickness used~~,~~ neither exhibit a flame spread index greater than 25 nor exhibit evidence of continued progressive combustion when tested in accordance with ASTM E84 or UL 723 and are of such composition that all surfaces that would be exposed by cutting through the material on any plane would neither exhibit a flame spread index greater than 25 nor exhibit evidence of continued progressive combustion when tested in accordance with ASTM E84 or UL 723. [**5000:**~~7.1.4.2.2~~ 7.1.4.2.4]

5.5.2.5

Materials shall be considered limited-combustible materials where tested in accordance with ASTM E2965 , *Standard Test Method for Determination of Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter* , at an incident heat flux of 75 kW/m^2 for a 20-minute exposure and both the following conditions are met:

(1) The peak heat release rate shall not exceed 150 kW/m^2 for longer than 10 seconds.

(2) The total heat released shall not exceed 8 MJ/m^2.

[**5000:**~~7.1.4.2.3~~ 7.1.4.2.5]

5.5.2.6

Where the term *limited-combustible* is used in this document, it shall also include the term *noncombustible*. [**5000:**~~7.1.4.2.4~~ 7.1.4.2.6]

Supplemental Information

File Name	Description	Approved
556-2020_Chapter_5_Extracts.docx		

Submitter Information Verification

Committee: HAR-AAA

Submittal Date: Tue Nov 15 12:21:55 EST 2022

Committee Statement

Committee Statement: Updated extracted text for consistency with the most recent edition of NFPA 5000.

Response Message: SR-8-NFPA 556-2022

Second Revision No. 3-NFPA 556-2022 [Section No. 11.4.2]

11.4.2 Hazard.

The hazard posed by the pool fire depends, in large part, on the volume of the fluid spill. The hazard to occupants due to large pool fires involving a substantial portion of the passenger road vehicle is primarily due to the external fuel load and associated fire, with the fire performance of the vehicle itself being of secondary importance. The hazard of pool fires can increase if the fire consumes other fuel sources, such as trash or other debris underneath a vehicle (see Section 11.5).

Submitter Information Verification

Committee: HAR-AAA

Submittal Date: Mon Nov 07 13:55:50 EST 2022

Committee Statement

Committee Statement: The submitter of PC-6 has identified an additional hazard associated with pool fires. Unidentified combustible materials that can be found in trash under the vehicle pose an additional fire hazard that may need to be considered.

Response Message: SR-3-NFPA 556-2022

Public Comment No. 6-NFPA 556-2022 [New Section after 11.4.5.1]

Second Revision No. 1-NFPA 556-2022 [Section No. 11.5.3.1]

11.5.3.1

If the information in Table 11.5.2 is applied to the 1994 through 1998 US averages, it appears that vehicle malfunction would correspond to the results in Table 11.5.3.1.

Table 11.5.3.1 Distribution of Loss Data from ~~Tables~~ Table 5.1.2 and Figures 5.1.2(a) Through 5.1.2(d) by Ignition Factor

Ignition Factor	Fires (%)	Civilian Deaths (%)	Civilian Injuries (%)	Property Damage (%)
Vehicle malfunction	66.20	10.80	47.80	54.80
Human action	18.70	14.20	12.90	27.70
External heat source	4.00	3.50	4.00	3.80
Collision	1.90	60.60	15.80	5.90
Abandoned material	1.60	1.40	3.00	1.10
Unknown	7.60	9.40	16.50	6.70

Submitter Information Verification

Committee: HAR-AAA

Submittal Date: Fri Oct 21 11:33:58 EDT 2022

Committee Statement

Committee Statement: This change corrects the references to 5.1.2 in the title of the table.

Response Message: SR-1-NFPA 556-2022

Second Revision No. 10-NFPA 556-2022 [Section No. A.5.5.2]

A.5.5.2

Material subject to increase in combustibility or flame spread index beyond the limits herein established through the effects of age, moisture, or other atmospheric condition is considered combustible. (See NFPA 259~~,~~ and NFPA 220.) [**5000:**A.7.1.4.2]

Submitter Information Verification

Committee: HAR-AAA

Submittal Date: Tue Nov 15 12:26:40 EST 2022

Committee Statement

Committee Statement: Update to align the extracted text with the latest edition of NFPA 5000.

Response Message: SR-10-NFPA 556-2022

Second Revision No. 6-NFPA 556-2022 [Chapter C]

Annex C Informational References

C.1 Referenced Publications.

The documents or portions thereof listed in this annex are referenced within the informational sections of this guide and are not advisory in nature unless also listed in Chapter 2 for other reasons.

C.1.1 NFPA Publications.

National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA *101*®, *Life Safety Code*®, 2024 edition.

NFPA 220, *Standard on Types of Building Construction*, 2024 edition.

NFPA 253, *Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source*, 2023 edition.

NFPA 257, *Standard on Fire Test for Window and Glass Block Assemblies*, 2022 edition.

NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, 2023 edition.

NFPA 260, *Standard Methods of Tests and Classification System for Cigarette Ignition Resistance of Components of Upholstered Furniture*, 2023 edition.

NFPA 261, *Standard Method of Test for Determining Resistance of Mock-Up Upholstered Furniture Material Assemblies to Ignition by Smoldering Cigarettes*, 2023 edition.

NFPA 270, *Standard Test Method for Measurement of Smoke Obscuration Using a Conical Radiant Source in a Single Closed Chamber*, 2023 edition.

NFPA 286, *Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth*, 2023 edition.

NFPA 289, *Standard Method of Fire Test for Individual Fuel Packages*, 2023 edition.

C.1.2 Other Publications.

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*, 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*, 2021.

ASTM E119, *Test Methods for Fire Tests of Building Construction and Materials*, ~~2020~~ 2022 .

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*, 2019a e1.

ASTM E662, *Test Method for Specific Optical Density of Smoke Generated by Solid Materials*, ~~2021~~ 2021a e1 .

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~~ 2022b .

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*, ~~2020a~~ 2022 .

ASTM E1529, *Test Methods for Determining Effects of Large Hydrocarbon Pool Fires on Structural Members and Assemblies*, ~~2016e1~~ 2022 .

ASTM E1537, *Test Method for Fire Testing of Upholstered Furniture*, ~~2016~~ 2022 .

ASTM E1546, *Guide for Development of Fire-Hazard-Assessment Standards*, ~~2015~~ 2021 .

ASTM E1623, *Test Method for Determination of Fire and Thermal Parameters of Materials, Products, and Systems Using an Intermediate Scale Calorimeter (ICAL)*, ~~2016~~ 2022 .

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*, ~~2018~~ 2021 .

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

ASTM E2067, *Practice for Full-Scale Oxygen Consumption Calorimetry Fire Tests*, ~~2020~~ 2022 .

ASTM E2102, *Test Method for Measurement of Mass Loss and Ignitability for Screening Purposes Using a Conical Radiant Heater*, ~~2017~~ 2021 .

ASTM E2280, *Guide for Fire Hazard Assessment of the Effect of Upholstered Seating Furniture Within Patient Rooms of Health Care Facilities*, ~~2017~~ 2021 .

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~~ 2022 .

C.1.2.2 ISO Publications.

International Organization for Standardization, ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland.

ISO TS 17431, Fire tests. Reduced-Scale Model Box Test, 2006.

C.1.2.3 SAE Publications.

SAE International, Society of Automotive Engineers, ~~400 Commonwealth Drive, Warrendale, PA 15096~~ 901 15th Street, NW, Suite 520, Washington, DC 20005 .

SAE J2464, *Electric and Hybrid Vehicle Electric Rechargeable Energy Storage System (RESS) Safety and Abuse Testing,*~~2009~~ 2021 .

C.1.2.4 SFPE Publications.

Society of Fire Protection Engineers, 9711 Washingtonian Blvd, Suite 380, Gaithersburg, MD 20878.

SFPE Handbook of Fire Protection Engineering, 5th edition.

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 2020.

UL 94, *Test for Flammability of Plastic Materials for Parts, Devices, and Appliances*, 2013, revised ~~2021~~ 2022 .

UL 263, *Fire Tests of Building Construction and Materials*, 2011, revised ~~2021~~ 2022 .

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~~ 2022 .

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

C.1.2.6 US DOT Publications.

Federal Motor Vehicle Safety Standards, US Department of Transportation/National Highway Traffic Safety Administration, 400 Seventh Street, SW, Washington, DC 20590.

49 CFR 571.302/FMVSS 302, “Flammability of Interior Materials,” October 1, 2011.

C.1.2.7 Other Publications.

Andersson, P., M. Simonsen, C. Tullin, H. Stripple, J. O. Sundqvist, and T. Paloposki. 2004 "Fire-LGA Guidelines, NICe Project 04053." *SP Fire Technology*, SP Report 2004, p. 43.

Blundell, C., and L. Tange, "Evaluation of the Environmental Impact of Upholstered Furniture through the use of LCA," Fire Retardant Chemicals Association Conference, New Orleans, LA, March 9-12, 2003, pp. 101–103.

BS EN 13823 Reaction to fire tests for building products. Building products excluding floorings exposed to the thermal attack by a single burning item, 2002.

Drohmann, D., and N. Westrop. "Release and Exposure of Flame Retardants Used in Upholstered Furniture Materials," Fire Retardant Chemicals Association Conference, New Orleans, LA, March 9-12, 2003, pp. 93–99.

ECE R34.01, Amending Series 34.01, January 13, 1979.

~~Blundell, C., and L. Tange, "Evaluation of the Environmental Impact of Upholstered Furniture through the use of LCA," Fire Retardant Chemicals Association Conference, New Orleans, LA, March 9-12, 2003, pp. 101–103.~~

~~Drohmann, D., and N. Westrop. "Release and Exposure of Flame Retardants Used in Upholstered Furniture Materials," Fire Retardant Chemicals Association Conference, New Orleans, LA, March 9-12, 2003, pp. 93–99.~~

National School Transportation Specifications & Procedures, Adopted by the Fifteenth National Congress on School Transportation, 2010 revised edition.

Simonsen, M., P. Andersson, and M. van den Berg. "Cost Benefit Analysis Model for Fire Safety; Methodology and TV (DecaBDE) Case Study," *SP Fire Technology,* SP Report 2006, p. 28.

Stevens, G. C., and A. H. Mann. "Risks and Benefits in the Use of Flame Retardants in Consumer Products: A Report for the UK Department of Trade and Industry," University of Surrey, Polymer Research Center Report, January 1999.

Tange, L., Drohmann, D., "End-of-Life Options of Plastics Containing Brominated Flame Retardants," Fire and Materials, Vol. 28, Issue 5, 2004, pp. 403–410.

C.1.2.8 Lists of Publications.

(1) Ahrens, M., "Vehicle Fires." National Fire Protection Association, Quincy, MA, March 2020.

(2) ASTM D1692, *Method of Test for Rate of Burning or Extent and Time of Burning of Cellular Plastics Using a Specimen Horizontal* (withdrawn 1976 without replacement, later replaced by ASTM D5132).

(3) US Federal Trade Commission Complaint and Consent Decree against the Society of the Plastics Industry, American Society for Testing and Materials et al., associated with testing and offering for sale some plastic products (1972–1973).

(4) Hirschler, M. M. "New NFPA Proposed Guide for Identification and Development of Mitigation Strategies for Fire Hazard to Occupants of Road Vehicles." Fire and Materials 2005, San Francisco, CA, January 31–February 1, 2005, 457–468.

(5) Hirschler, M. M. "Fire Hazard of Automotive Interiors." In Fire Risk & Hazard Assessment Symposium, National Fire Protection Research Foundation, June 24–26, 1998, San Francisco, CA, 164–195.

(6) Grayson, S. J., and M. M. Hirschler. "Fire Performance of Plastics in Car Interiors," Proceedings from Flame Retardants 2002, Interscience Communications London, Feb. 5–6, 2002. London: Interscience Communications, 197–207.

(7) Hirschler, M. M., D. J. Hoffmann, J. M. Hoffmann, and E. C. Kroll. 2002. "Rate of Heat Release of Plastic Materials From Car Interiors." Business Communications Company Conference on Recent Advances in Flame Retardancy of Polymeric Materials, June 3–5, 2002, Stamford, CT. Ed. M. Lewin, Norwalk, CT.

(8) Bundy, M. "Fire Performance of Flame Retarded Polymers Used in Consumer Electronics," Fire and Materials 2005, Interscience Communications. UK 85–97.

(9) Shields, L., R. Scheibe, and T. Angelos. November 17, 1998. "Motor-Vehicle Collision-Fire Analysis Methods and Results," Washington State Transportation Center, Prepared for NFPA Fall Meeting, Atlanta, GA, 1–18.

(10) Santrock, J. 2003a. "Evaluation of Motor Vehicle Fire Initiation and Propagation Part 12: Propagation of an Underbody Gasoline Pool Fire in a 1998 Front-Wheel Drive Passenger Vehicle." Docket # NHTSA-98-3588-201. General Motors Corporation.

(11) Santrock, J., A. Tewarson, and P. K. S. Wu. November 18–20, 2002. "Flammability Testing of Automotive Heating Ventilation and Air Conditioning Modules Made from Polymers Containing Flame Retardant Chemicals." International Truck and Bus Meeting and Exhibition, Detroit, Michigan. SAE International, Document # 2002-01-3091.

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(13) Jenson, J. L., and J. Santrock. May 1998. "Evaluation of Motor Vehicle Fire Initiation and Propagation, Vehicle Crash and Fire Propagation Test Program." Docket # NHTSA-1998-3588-38, General Motors Corporation, ESV Paper Number 98-S4-O-04.

(14) Santrock, J. August 2002. "Evaluation of Motor Vehicle Fire Initiation and Propagation Part 7: Propagation of an Engine Compartment Fire in a 1997 Rear Wheel Drive Passenger Car." Docket # NHTSA-1998-3588-178, General Motors Corporation.

(15) Santrock, J. August 2001. "Evaluation of Motor Vehicle Fire Initiation and Propagation Part 3: Propagation of an Engine Compartment Fire in a 1996 Van Passenger." Docket # NHTSA-1998-3588-119, General Motors Corporation.

(16) Santrock, J. November 2003. "Evaluation of Motor Vehicle Fire Initiation and Propagation Part 13: Propagation of an Engine Compartment Fire in a 1998 Front-Wheel Drive Passenger Vehicle." Docket # NHTSA-1998-3588-203, General Motors Corporation.

(17) Jenson, J. L., and J. Santrock. June 2002. "Evaluation of Motor Vehicle Fire Initiation and Propagation 6: Propagation of an Underbody Gasoline Pool Fire in a 1997 Rear Wheel Drive Passenger Car." Docket # NHTSA-1998-3588-158, General Motors Corporation.

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Ahrens, M. May 2000. “U.S. Vehicle Fire Trends and Patterns.” Quincy, MA: National Fire Protection Association.

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