Linking FHWA and NHTSA Vehicle Types and Deciphering Various Truck Weight Data

Methodology for Linking Vehicle Types

U.S. Department of Transportation
Federal Highway Administration

June 2021

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16. Abstract

One of the challenges in conducting freight transportation planning and policy analysis is the variation in the types of vehicles that are considered trucks and the manner in which distinctions are made between various types of trucks. The public sector has varying standards by which trucks are distinguished from other vehicle types and are further classified as a distinct vehicle class. Some classification schemes focus on the number and spacing of axles, while others may focus on gross vehicle weight. This presents a challenge to conducting transportation policy and technical analyses.

This report develops methodologies for classifying vehicle registration data according to Federal Highway Administration (FHWA) and National Highway Traffic Safety Administration (NHTSA) classification systems. Using vehicle characteristics typically observed in registration data, these methodologies determine classification according the thirteen FHWA vehicle types in the FHWA Traffic Monitoring Guide appendix C, the six FHWA vehicle groups in the VM-1 table of the annual Highway Statistics publication, and the NHTSA vehicle types as prescribed in 49 Code of Federal Regulations Part 523. Overall, the results demonstrated that vehicle class can be determined using registration data. However, vehicle registration data has limitations in its ability to accurately reflect FHWA and NHTSA classes.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS				
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in²	square inches	645.2	square millimeters	mm^2
ft²	square feet	0.093	square meters	m^2
yd²	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi²	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft³	cubic feet	0.028	cubic meters	m^3
yd³	cubic yards	0.765	cubic meters	m^3
	NOTE: volumes greater than 1000 L shall be shown in m^3			
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in²	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS				
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

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List of Acronyms

CFR	Code of Federal Regulations
DOT	Department of Transportation
FHWA	Federal Highway Administration
FHWA-6	Federal Highway Administration 6-Vehicle Classification System
FHWA-13	Federal Highway Administration 13-Vehicle Classification System
GVWR	Gross Vehicle Weight Rating
NAICS	North American Industry Classification System
NHTSA	National Highway Traffic Safety Administration
NHTSA-8	National Highway Traffic Safety Administration 8-Vehicle Gross Vehicle Weight Rating Classification System
NRC	National Research Council
TMAS	Travel Monitoring Analysis System
TMG	Traffic Monitoring Guide
VIUS	Vehicle Inventory and Use Survey
VTRIS	Vehicle Travel Information System

1.0 Introduction

One of the challenges in conducting freight transportation planning and policy analysis is the variation in the types of vehicles that are considered trucks and the manner in which distinctions are made between various types of trucks. The trucking industry is extremely large but certainly not homogeneous in its operations, equipment, customers, or travel patterns. For example, the industry can be characterized by the type of cargo hauled (general or specialized), equipment used, type of load carried, short haul versus long haul, less-than-truckload versus full-truckload, or fleet size. For each, vehicles used can vary significantly. It remains highly competitive and dynamic, reflecting the changing logistic trends in the industries it in turn supports, respond to vital national and regional economies. In order to evaluate the impact of changing policies and/or regulations on consumers all along the supply chain, for example, it is important to have a clear understanding of the vehicles currently in use and the distinctions behind those inventories. Further, given the importance of having a safe transportation system and the disproportionate impacts trucks have on fatalities, it is vital to be able to integrate data from Federal Highway Administration (FHWA) and National Highway Traffic Safety Administration (NHTSA). This allows analytical and policy tools to be built that can be comprehensive in providing decisionmakers the best data for policy-making to improve safety and economic development.

Reflecting the variation among vehicle types and how those vehicles are classified within the private sector, the public sector also has varying standards by which trucks are distinguished from other vehicle types and are further classified as a distinct vehicle class. Some classification schemes focus on the number and spacing of axles, while others may focus on gross vehicle weight. Even within the U.S. Department of Transportation (DOT), various agencies have different criteria for determining which vehicles are considered trucks and, once determined that they are trucks, distinguishing between different types of trucks. The variation in classification schemes is sensible at it reflects the unique needs, priorities, and missions of the entities that developed the system. However, it presents a significant challenge to conducting the type of cross-cutting policy and technical analyses that are increasingly important in transportation planning.

The purpose of this task order is to obtain gross vehicle weight rating (GVWR) and curb weight data for each distinct vehicle included in four (4) private vehicle registration data sets acquired by the FHWA. In addition, this task order determines the correct vehicle type classification for each distinct vehicle included in the databases according to:

- The 13 FHWA vehicle types as documented in the FHWA Traffic Monitoring Guide (TMG) appendix C—Vehicle Types.
- The six FHWA vehicle groups as included in the VM-1 table of the annual Highway Statistics publication.
- The NHTSA vehicle types as prescribed in 49 Code of Federal Regulations (CFR) Part 523—VEHICLE CLASSIFICATION which determines vehicle type by GVWR.

There are three key objectives to this memorandum: (1) describe the private vehicle registration data so that users understand its contents; (2) provide detailed outlines of the methodologies used for classifying the private vehicle registration data vehicles according to the FHWA 13-vehicle, FHWA 6-vehicle, and NHTSA classification systems so that it is reproducible for linking potential future data sets; and (3) document how the FHWA 13-vehicle classification system aligns with the FHWA 6-vehicle classification system in the context of the private vehicle registration data. To this end, the memorandum is organized into five sections, including this introduction: section 2 provides an overview of the data, including summary statistics and descriptions of variables; section 3 describes in detail the methodologies for classifying the vehicle registration data according to the classification systems, including flowcharts that outline their assumptions and steps; section 4 presents the results of the analysis, including summary statistics on vehicle counts per NHTSA classification, FHWA 13-vehicle classification, and FHWA 6-vehicle classification as well as summary statistics on GVWR and curb weight; section 5 of the memorandum summarizes the information provided in sections 2 through 4.

2.0 Overview of the Data

This section of the report provides an overview of the data. The data contains vehicle registration records for the years 2017, 2018, and 2019 for all 50 U.S. States plus the District of Columbia. The data is divided into distinct subsets for the following high-level vehicle categories:

- Cars—This data subset generally contains coupes, sedans, and other smaller vehicles for transporting passengers.
- Motorcycles—This data subset generally contains two- and three-wheeled motorized vehicles that can carry one or two people.
- Mixed-Duty Vehicles—This data subset generally contains a mix of midsized vehicles that may primarily be used to transport passengers or cargo and equipment.
- Heavy-Duty Vehicles—This data subset generally contains larger, heavier vehicles that may primarily be used to transport cargo.

Cars Data Subsets

There are 1,335,925 observations in the 2017 cars data subset, 1,365,594 observations in the 2018 cars data subset, and 1,387,482 observations in the 2019 cars data subset. As shown in figure 1, the following body types (as indicated by the "BODY_STYLE" field) are included in the 2017–2019 cars data subsets:

- Commercial Chassis.
- Convertible.
- Coupe.
- Hatchback.
- Hearse.
- Sedan.
- Limousine.
- Wagon.
- Null or Unknown.

Among those body types, sedans and coupes are the most prevalent accounting for approximately 68 percent of observations across the three data subsets.

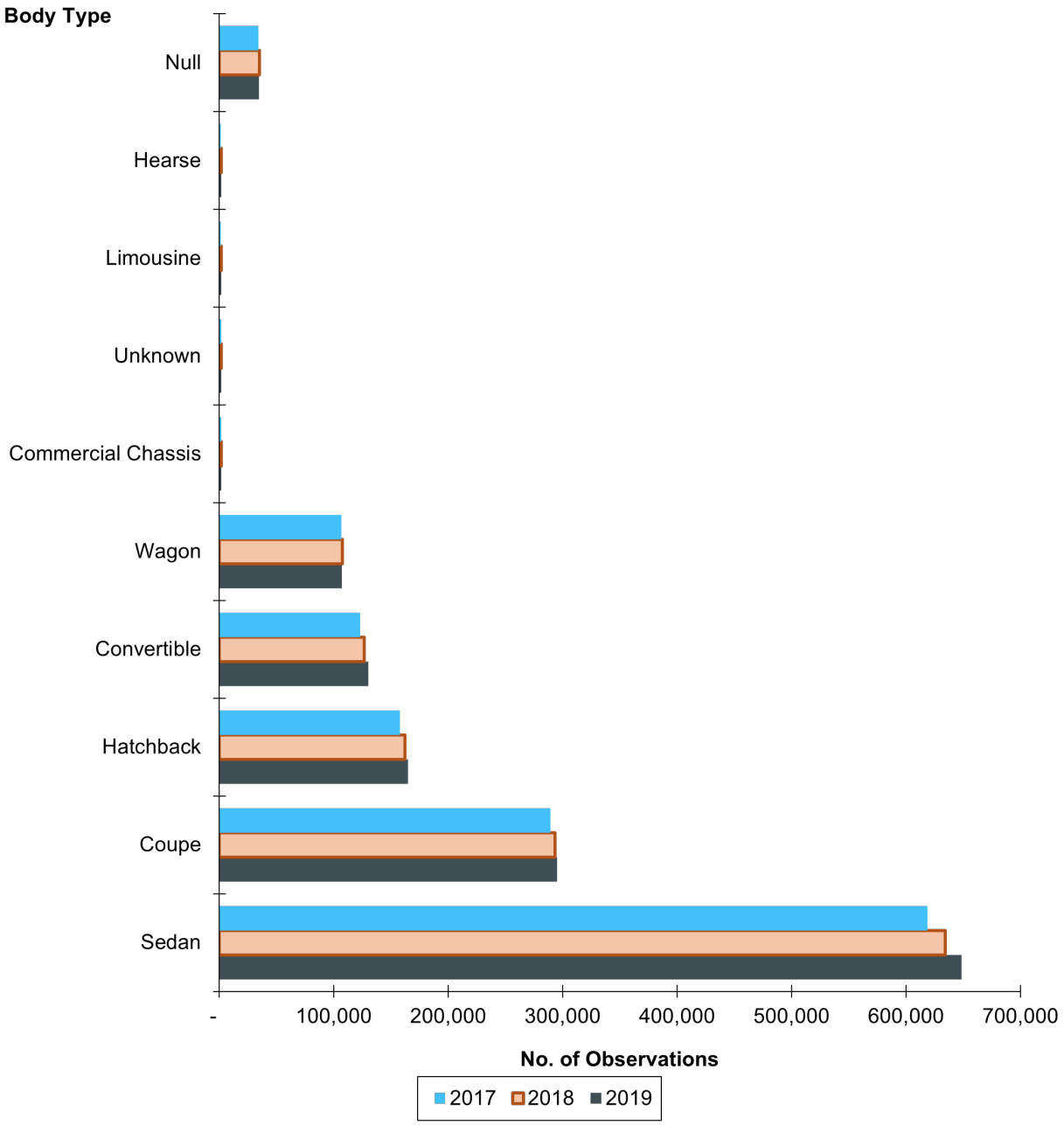

Figure 1. Chart. Distribution of vehicles in the 2017–2019 cars data sets by body type.

(Source: Federal Highway Administration.)

The cars data subsets also report information on the type of fuel used by the vehicles represented in the data. As shown in figure 2, the vast majority of observations use gasoline as fuel. On average, about 92 percent of observations across the data subsets use gasoline. Following gasoline, the most prevalent fuel types are flexible fuel (i.e., a combination of gasoline and ethanol or methanol), electric and gasoline hybrid, diesel, and electric. On average, those fuel types comprise approximately 1.7 percent, 1.5 percent, 1.6 percent, and 0.5 percent of the data, respectively.

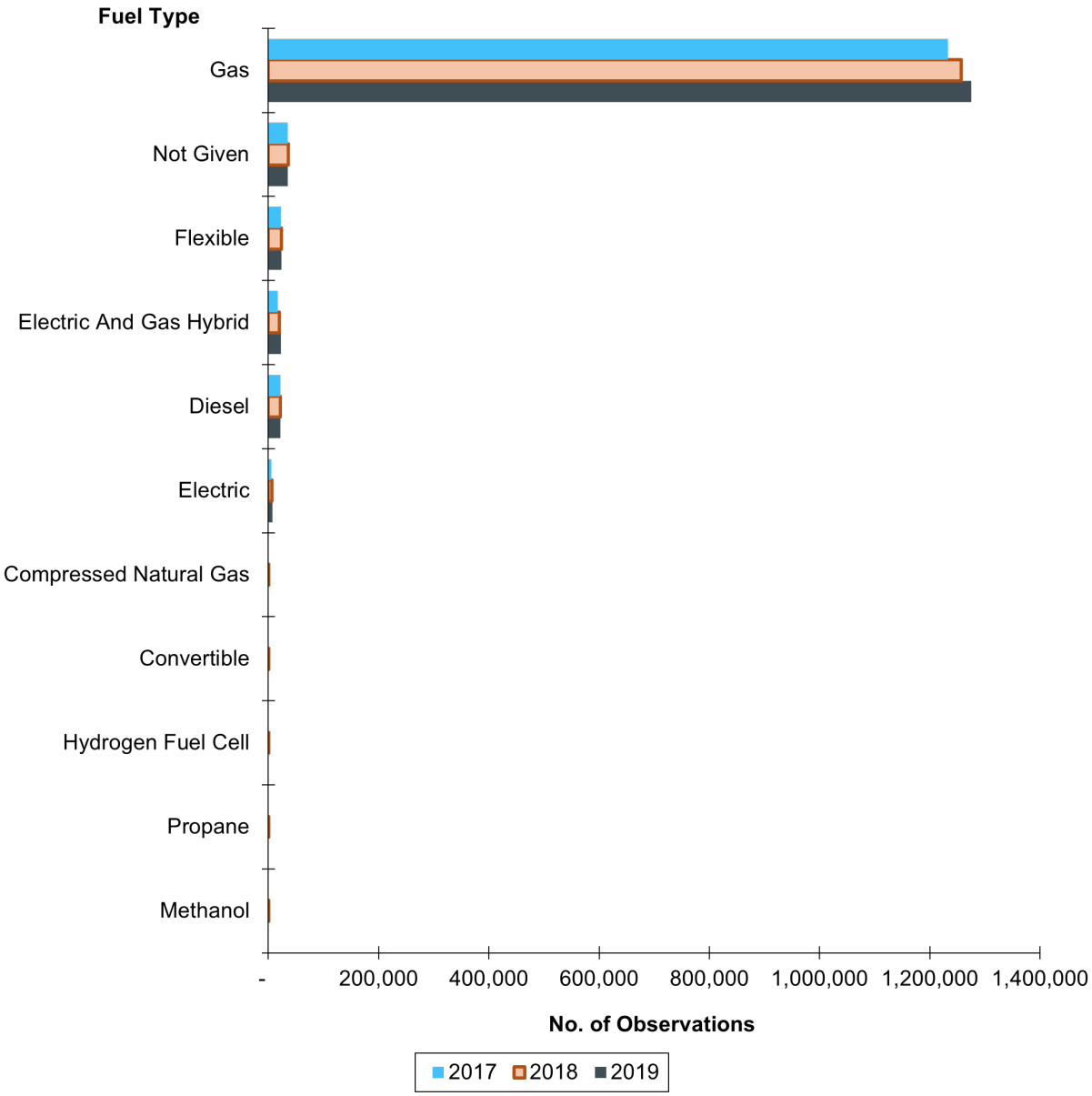

Figure 2. Chart. Distribution of vehicles in the 2017–2019 cars data sets by fuel type.

(Source: Federal Highway Administration.)

The cars data subsets also report information on curb weight (i.e., the "CURB_WEIGHT" field) and wheelbase dimensions (i.e., the "WHEELBASE_LOW" and "WHEELBASE_HIGH" fields). Curb weight is the weight of a vehicle without occupants or cargo. Wheelbase is the horizontal distance between the centers of the front and rear wheels. Both are important variables in the context of this study. Curb weight factors into the calculation of gross vehicle weight rating (GVWR), which is the key vehicle characteristic for determining vehicle class according to the National Highway Traffic Safety Administration (NHTSA) classification system. Wheelbase is important because it is a determining factor in the Federal Highway Administration (FHWA) 6-vehicle classification system (FHWA-6).

Across the 2017–2019 data subsets, the average wheelbase across the cars data subsets is about 107 inches as shown in figure 3, figure 4, and table 1. The longest reported wheelbase in the data subsets is 270 inches while the shortest reported wheelbase is 10 inches, which is likely an erroneous value. The average curb weight for vehicles in the cars data subsets ranges from 3,240 to 3,264 lbs as shown in figure 5 with additional detail provided in table 1. Overall, curb weight values range from 1,078 to 7,420 lbs.

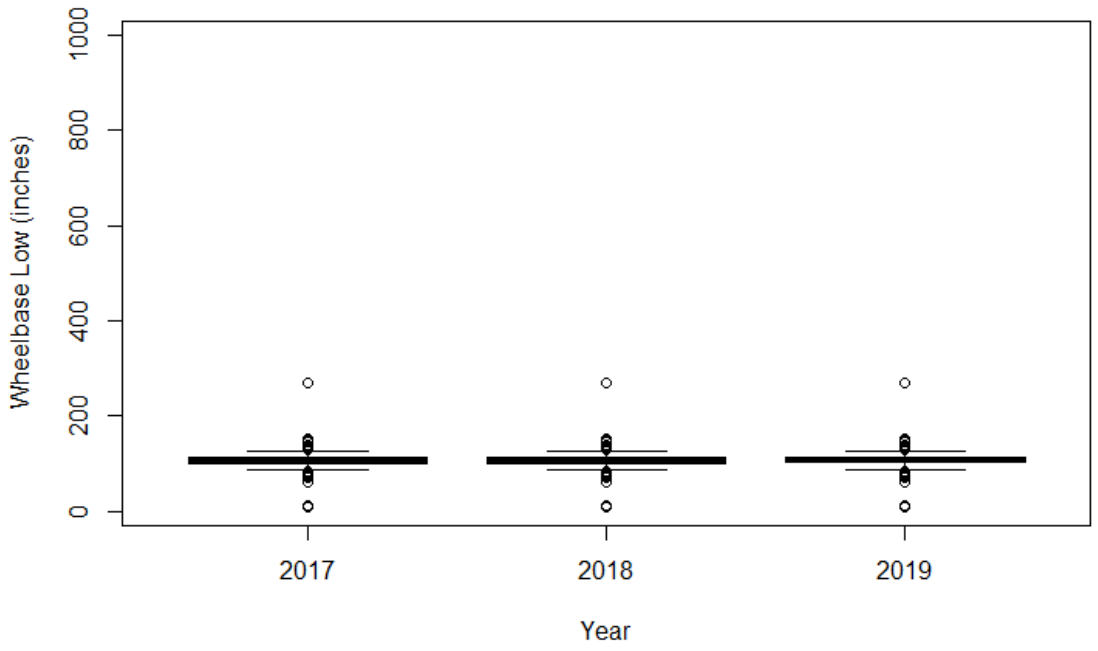

Figure 3. Graph. Boxplot of wheelbase (low) in the 2017–2019 cars data subsets.

(Source: Federal Highway Administration.)

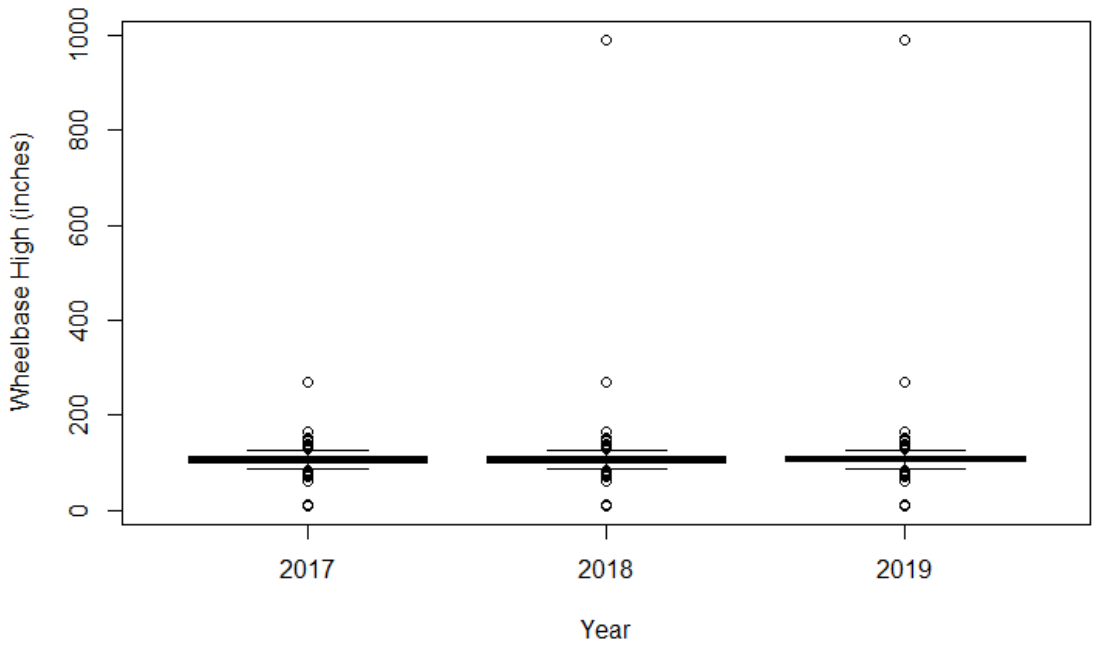

Figure 4. Graph. Boxplot of wheelbase (high) in the 2017–2019 cars data subsets.

(Source: Federal Highway Administration.)

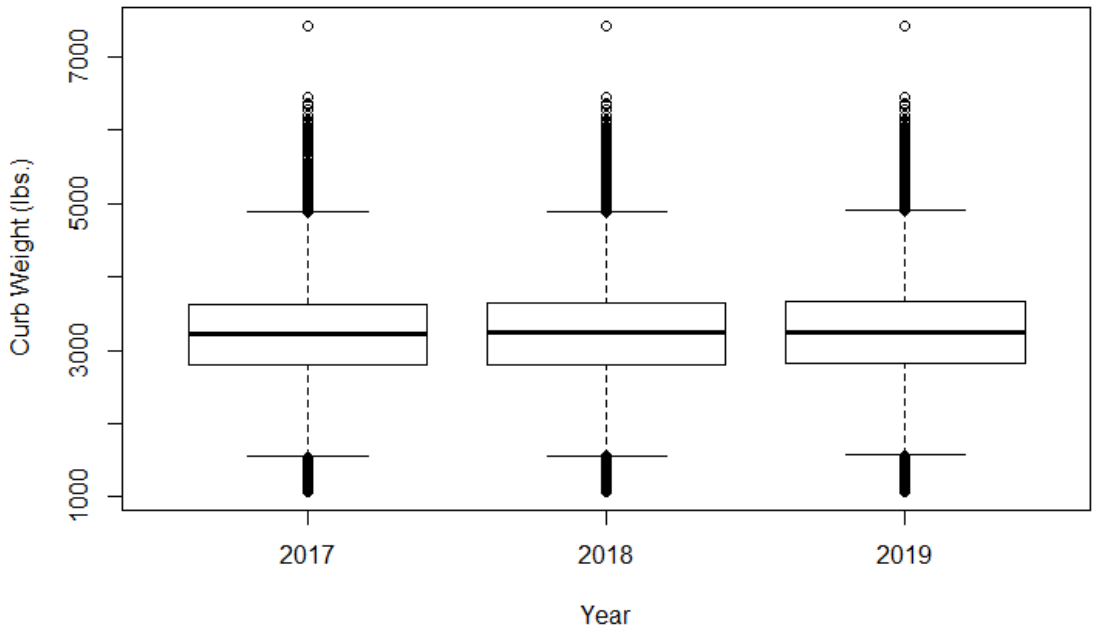

Figure 5. Graph. Boxplot of curb weight in the 2017–2019 cars data subsets.

(Source: Federal Highway Administration.)

Table 1. Summary statistics for the curb weight and wheelbase variables for the 2017–2019 cars data subsets.

Variable	No. of Missing or 0 Observations	Minimum	25th Percentile	Mean	75th Percentile	Maximum
2017 Data—Curb Weight (lbs)	77,937	1,078	2,795	3,240	3,633	7,420
2017 Data—Wheelbase Low (inches)	83,504	10.0	101.4	106.8	112.0	270.0
2017 Data—Wheelbase High (inches)	83,546	10.0	101.4	107.0	112.2	270.0
2018 Data—Curb Weight (lbs)	87,763	1,078	2,807	3,249	3,642	7,420
2018 Data—Wheelbase Low (inches)	101,071	10.0	101.5	106.9	112.0	270.0
2018 Data—Wheelbase High (inches)	101,113	10.0	101.5	107.1	112.2	990
2019 Data—Curb Weight (lbs)	85,427	1,078	2,822	3,264	3,657	7,420
2019 Data—Wheelbase Low (inches)	97,298	10	101.6	107.0	112.0	270
2019 Data—Wheelbase High (inches)	97,241	10	101.6	107.2	112.2	990.0

As shown in figure 6, observations in the cars data subsets have model years that range from 1961 to 2021. On average, about 50 percent of the data across the subsets have model years of 2000 or later. Generally, the 2015 model year is the most frequently observed across the data subsets. On average, about 3.3 percent of observations across the data subsets have a 2015 model year.

As shown in figure 7, the cars data subsets are nearly uniformly distributed across States and the District of Columbia. Generally, registrations for each State represent about 1.25 to 2.5 percent of the data. The average across States for each data subset is approximately 1.96 percent, which would equal a uniform distribution across the 50 States and District of Columbia.

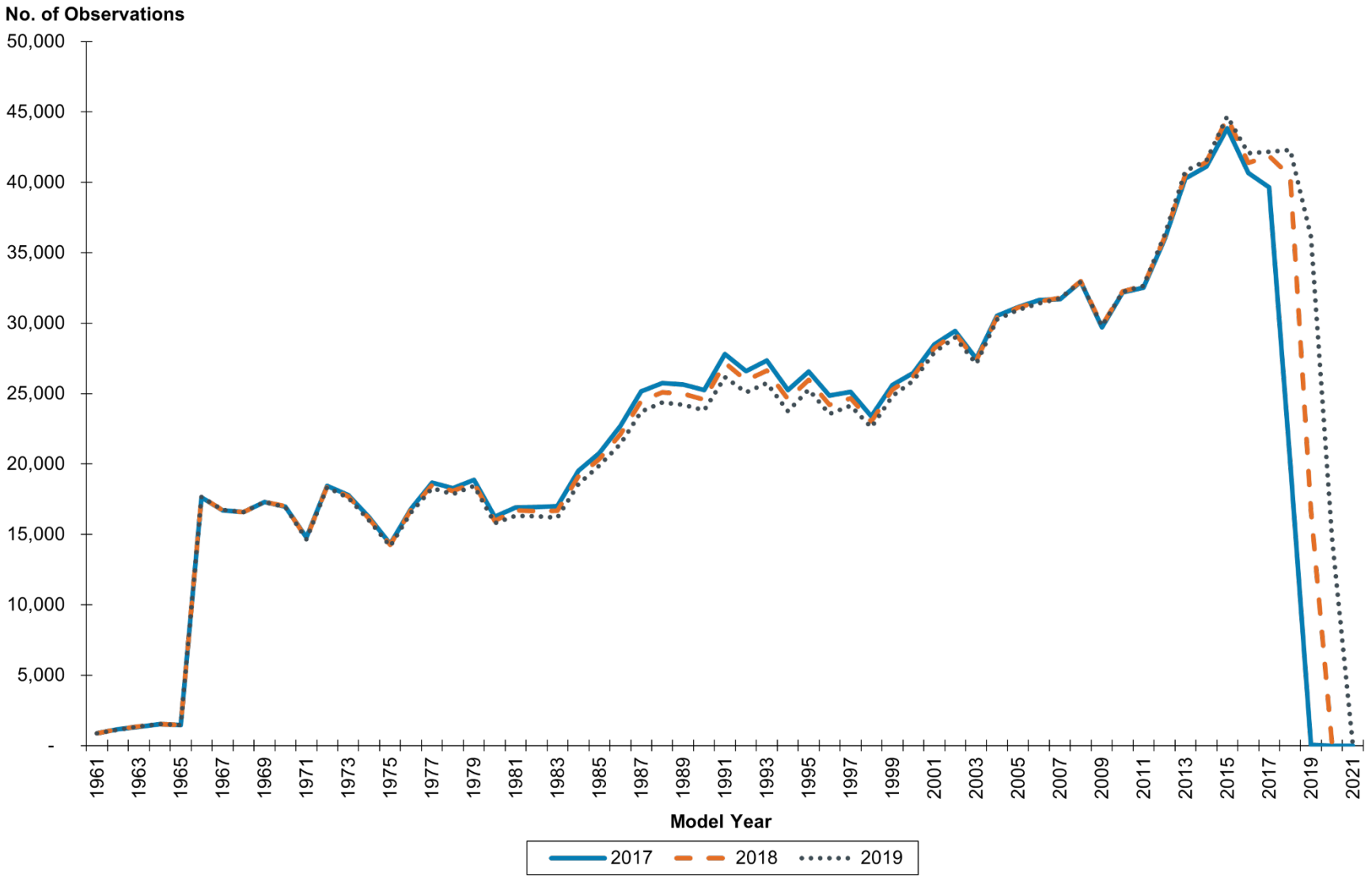

Figure 6. Chart. Distribution of model year in the 2017–2019 cars data subsets.

(Source: Federal Highway Administration.)

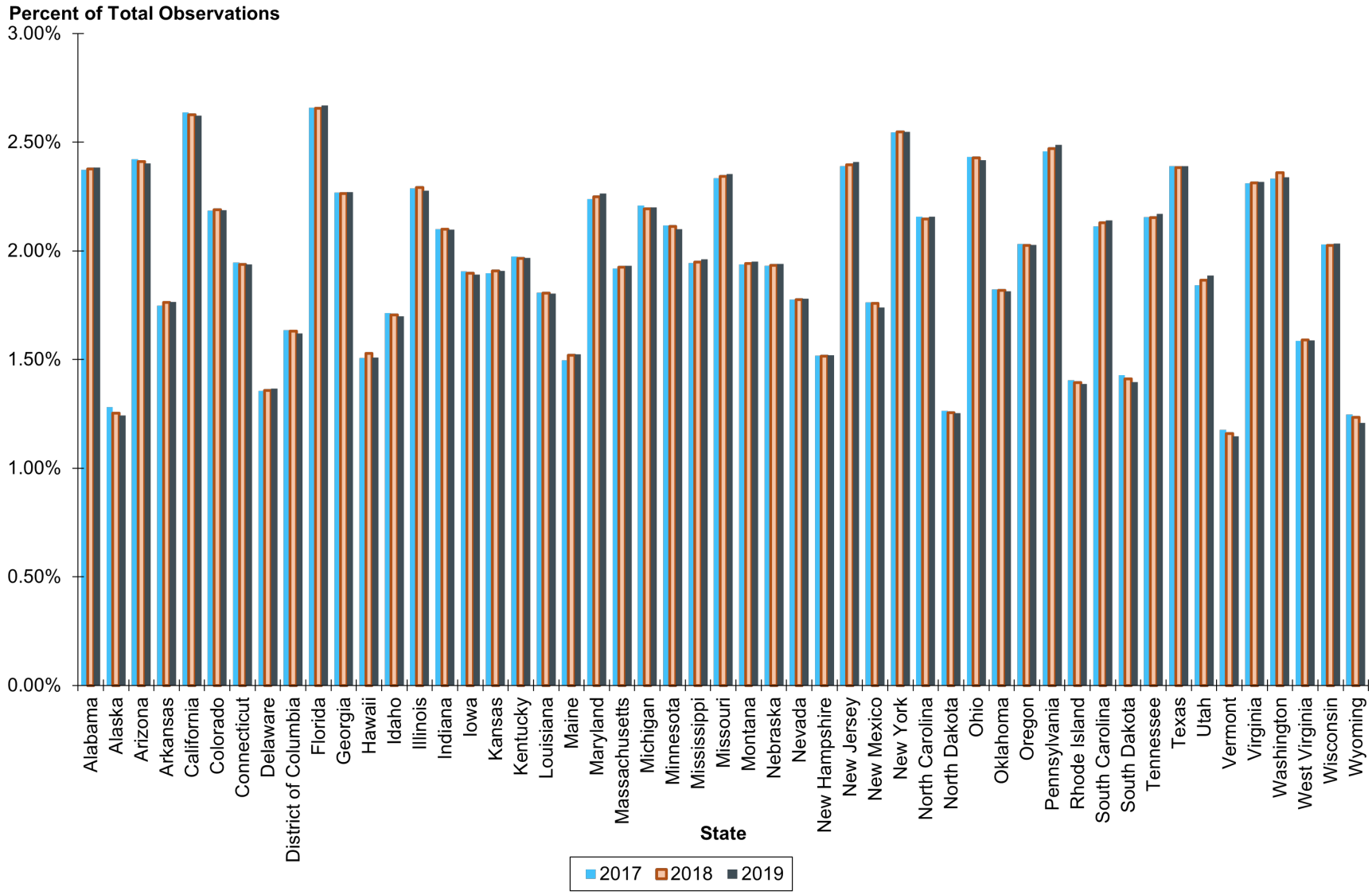

Figure 7. Chart. Distribution of vehicle registration by State plus the District of Columbia in the 2017–2019 cars data subsets.

(Source: Federal Highway Administration.)

Motorcycles Data Subsets

There are 412,858 observations in the 2017 motorcycles data subset; 428,171 observations in the 2018 motorcycles data subset; and 443,042 observations in the 2019 motorcycles data subset. As shown in figure 8, the following vehicle categories (as indicated by the "VEHCAT" field) are included in the 2017–2019 motorcycles data subsets:

- On-Highway.
- All-Terrain Vehicle.
- Off-Highway.
- Scooter.
- Dual Sport.
- Unknown.

Among those body types, on-highway are the most prevalent accounting for nearly 50 percent of observations across the three data subsets. No information on wheelbase, curb weight, or gross vehicle weight is reported in the motorcycles data subsets.

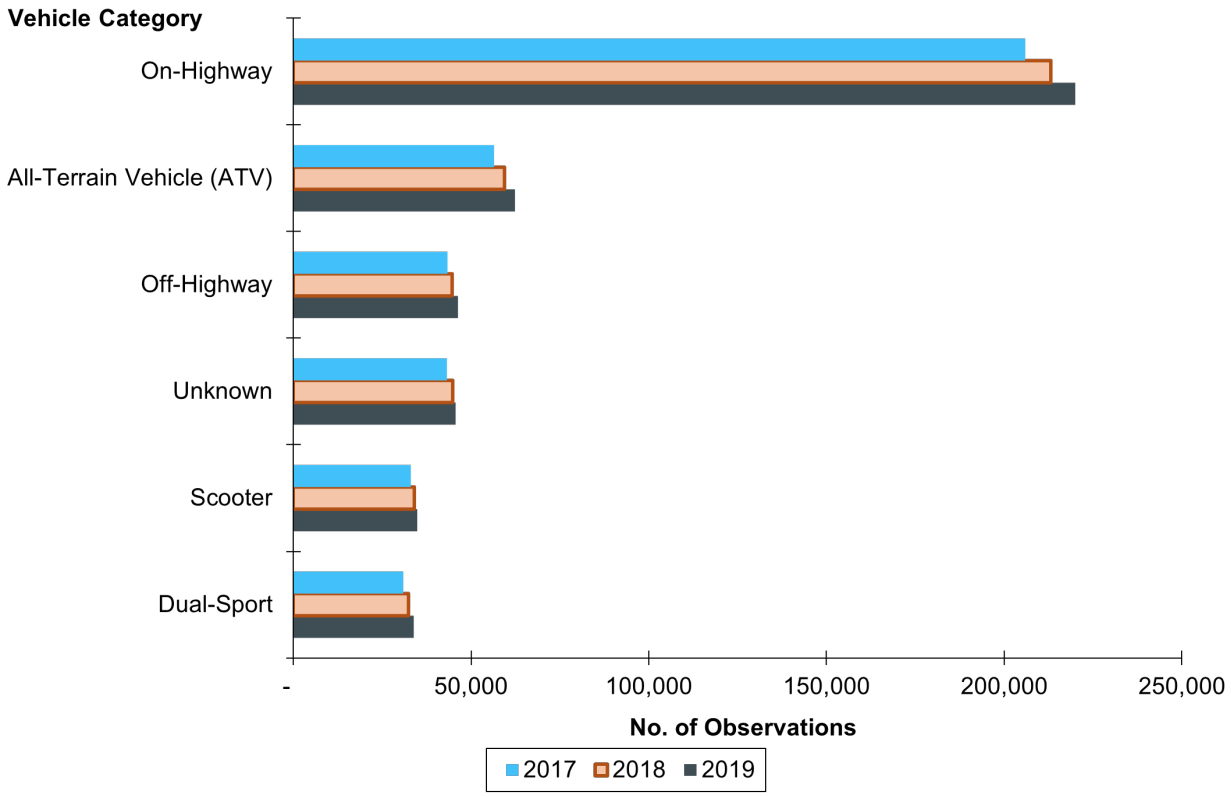

Figure 8. Chart. Distribution of vehicle categories in the 2017–2019 motorcycle data set.

(Source: Federal Highway Administration.)

As shown in figure 9, observations in the motorcycles data subsets have model years that range from 1968 to 2021. On average, about 70 percent of the data across the subsets have model years of 2000 or later. Interestingly, across the motorcycle data subsets the year 2006 represents the peak model year followed by a slightly smaller peak in 2016.

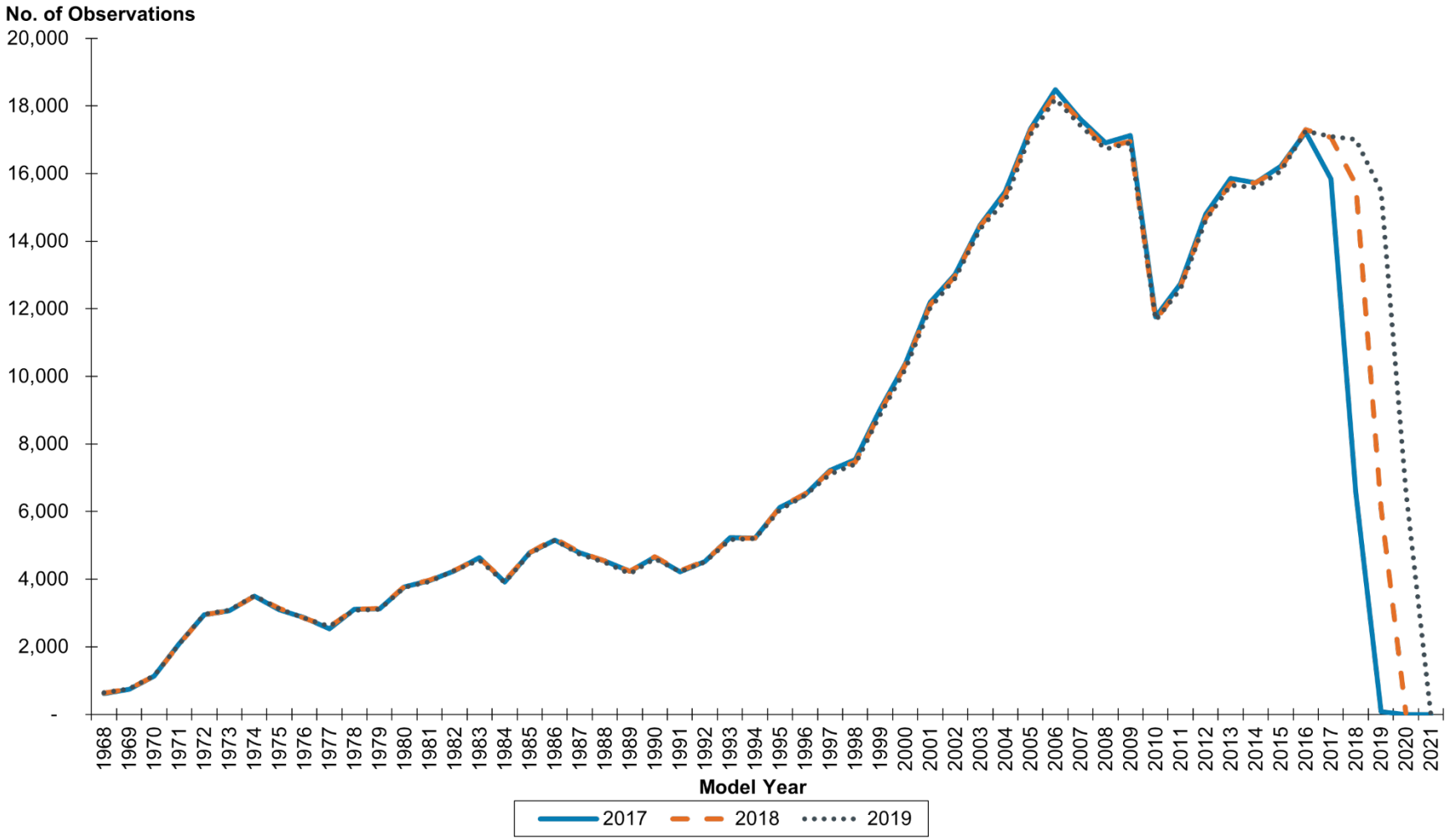

Figure 9. Chart. Distribution of model year in the 2017–2019 motorcycles data subsets.

(Source: Federal Highway Administration.)

As shown in figure 10, the motorcycles data subsets are generally evenly distributed across States and the District of Columbia. Generally, registrations for each State represent about 1.25 to 2.5 percent of the data. The average across States for each data subset is

approximately 1.96 percent, which would equal a uniform distribution across the 50 States and District of Columbia. Thus, the data does not appear to be biased towards any single State.

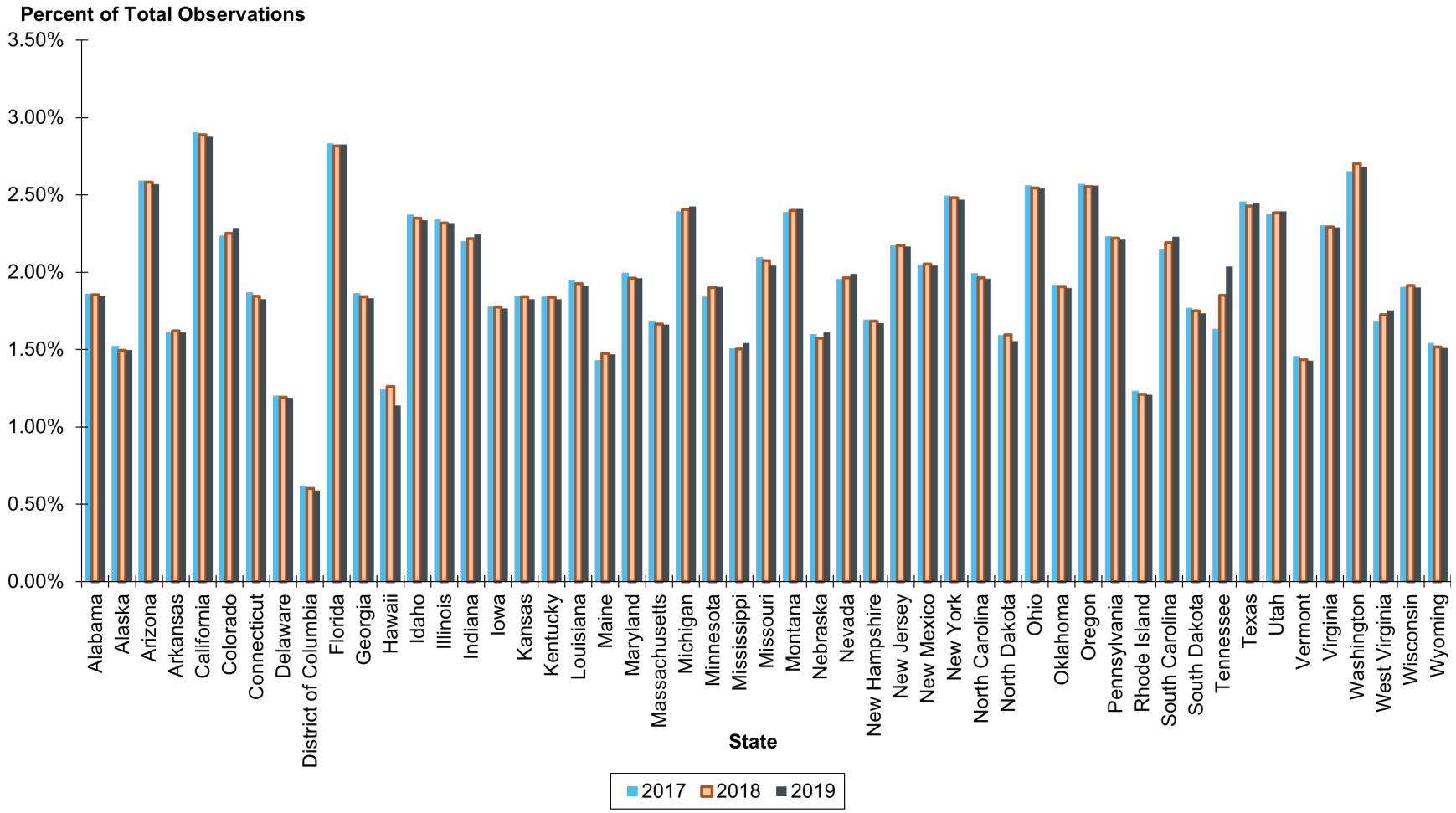

Figure 10. Chart. Distribution of vehicle registration by State plus the District of Columbia in the 2017–2019 motorcycles data subsets.

(Source: Federal Highway Administration.)

Mixed-Duty Vehicles Data Subsets

It is important to note that the mixed-duty vehicle data subsets contain duplicates of observations found in the heavy-duty vehicle data subsets for vehicles with GVWRs equal to 3. Because of this, those observations were deleted from the mixed-duty vehicles data subsets and are not reported in the analysis. Based on the modified mixed-duty vehicle data subsets, there are 1,492,223 observations in the 2017 mixed-duty vehicles data subset; 1,554,042 observations in the 2018 mixed-duty vehicles data subset; and 1,613,551 observations in the 2019 mixed-duty vehicles data subset. As shown in figure 11, there are 29 body types reported in the 2017–2019 mixed-duty vehicles data subsets, including:

- Gliders.
- Tractor Truck.
- Straight Truck.
- Van Cutaway.
- Van Camper.
- Van Cargo.
- Van Passenger.
- Fire Truck.
- Bus School.
- Bus Non School.
- Pickup Van.
- Pickup Sport Utility.
- Pickup.
- Pickup Crew Cab.
- Pickup Extended Cab.
- Pickup Conventional.
- Incomplete Pickup.
- Pickup Unknown.
- Convertible.
- Sport Utility Truck.
- Sport Utility Vehicle.
- Step Van.
- Motor Home.
- Incomplete (Strip Chassis).
- Cab Chassis.
- Cutaway.
- Limousine.
- Not Given.
- Unknown.

Among those body types, sport utility vehicle, pickup conventional, pickup extended cab, and pickup crew cab are the most prevalent accounting for nearly two-thirds of observations across the three data subsets.

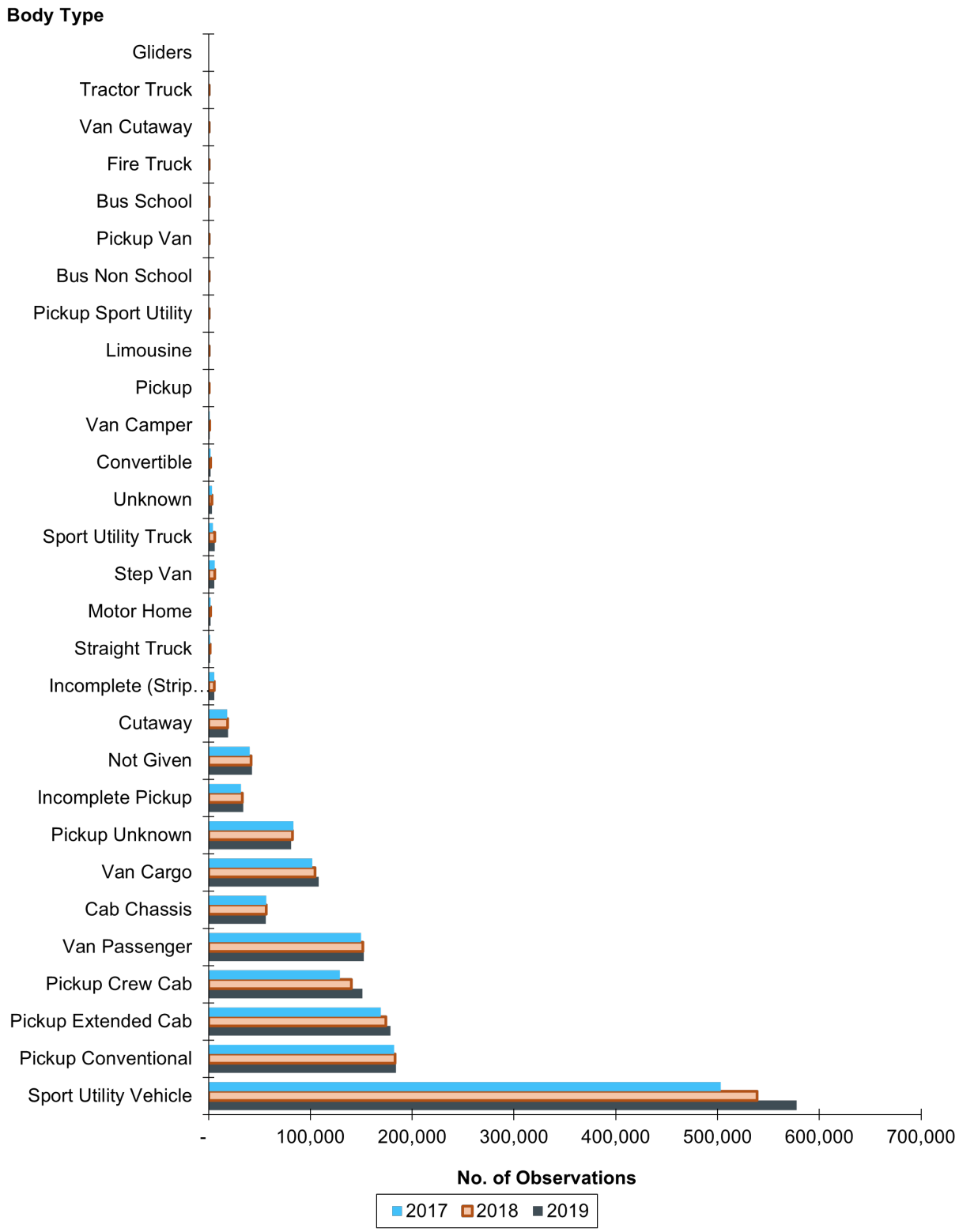

Figure 11. Chart. Distribution of vehicles in the 2017–2019 mixed-duty vehicle data subsets by body type.

(Source: Federal Highway Administration.)

The mixed-duty vehicles data subsets also report information on the type of fuel used by the vehicles represented in the data. As shown in figure 12, the majority of observations use gasoline as fuel. On average, about 75 percent of observations across the data subsets use gasoline. Following gasoline, the most prevalent fuel types are diesel, flexible fuel, and electric and gasoline hybrid. On average, those fuel types comprise approximately 13 percent, 9 percent, and 0.6 percent of the data, respectively.

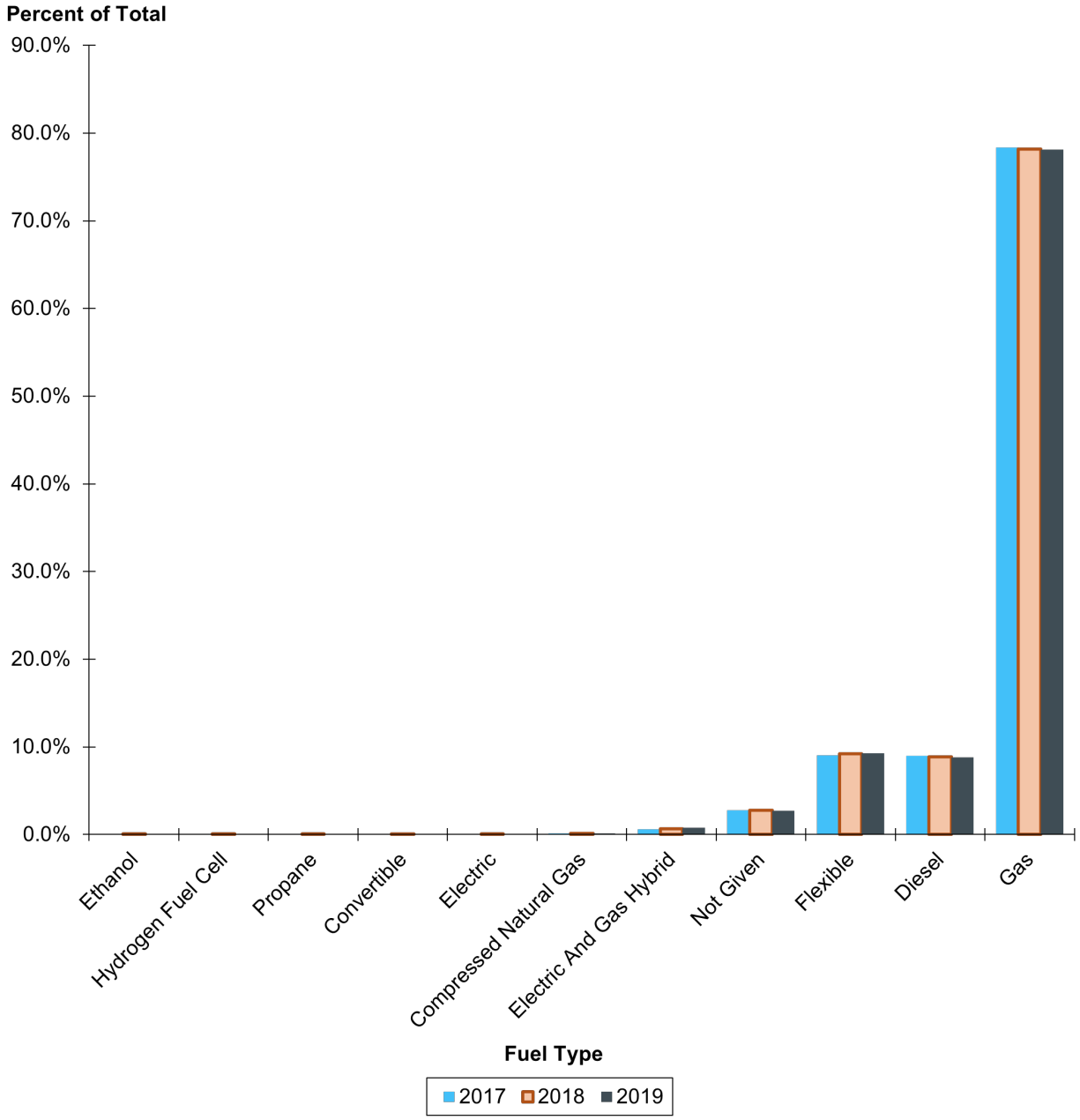

Figure 12. Chart. Distribution of fuel types in the 2017–2019 mixed-duty vehicles data subsets.

(Source: Federal Highway Administration.)

Like the cars data subsets, the mixed-duty vehicles data subsets also report information on curb weight and wheelbase dimensions (as contained in the "CURB_WEIGHT," "WHEELBASE_LOW," and "WHEELBASE_HIGH" fields, respectively). Across the 2017–2019 data, average curb weight for vehicles in the mixed-duty vehicles data subsets is just over 4,400 lbs as shown in figure 13 and also in table 2. The average wheelbase across the mixed-duty vehicles data subsets is about 124 to 130 inches as shown in figure 14, figure 15, and table 2. The longest reported wheelbase in the data subsets is 275 inches while the shortest reported wheelbase is 9 inches, which is likely an erroneous value. On average, about 15 percent of curb weight values and 5 percent of wheelbase values are either missing or reported as 0 in the data. Missing or 0 values are not reported in table 2.

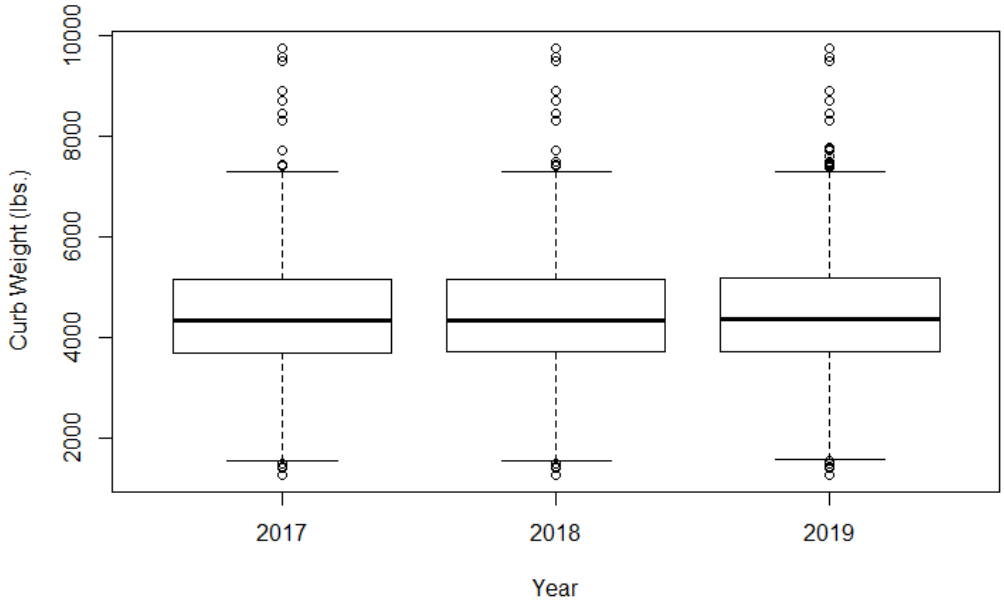

Figure 13. Graph. Boxplot of curb weight in the 2017–2019 mixed-duty vehicles data subsets.

(Source: Federal Highway Administration.)

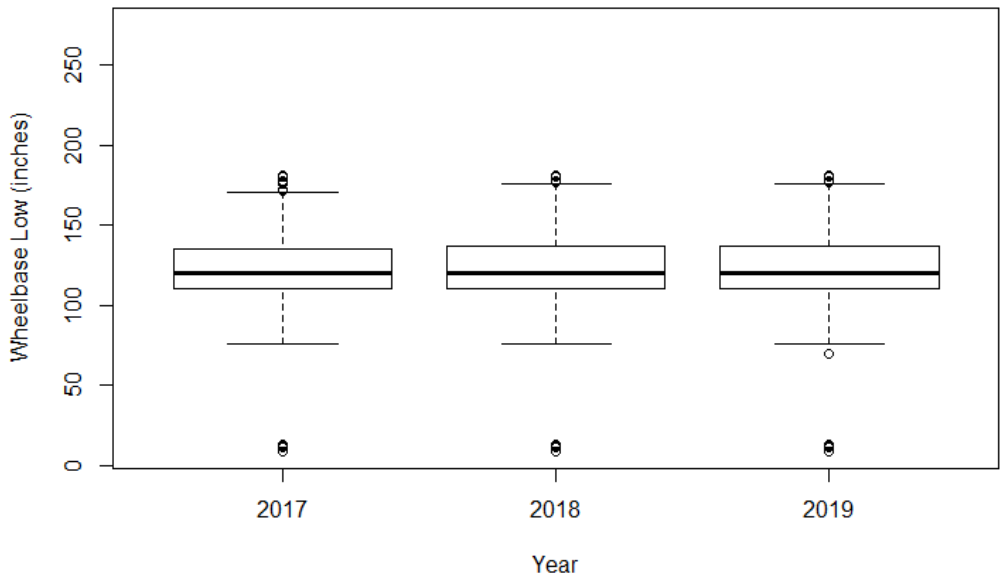

Figure 14. Graph. Boxplot of wheelbase low in the 2017–2019 mixed-duty vehicles data subsets.

(Source: Federal Highway Administration.)

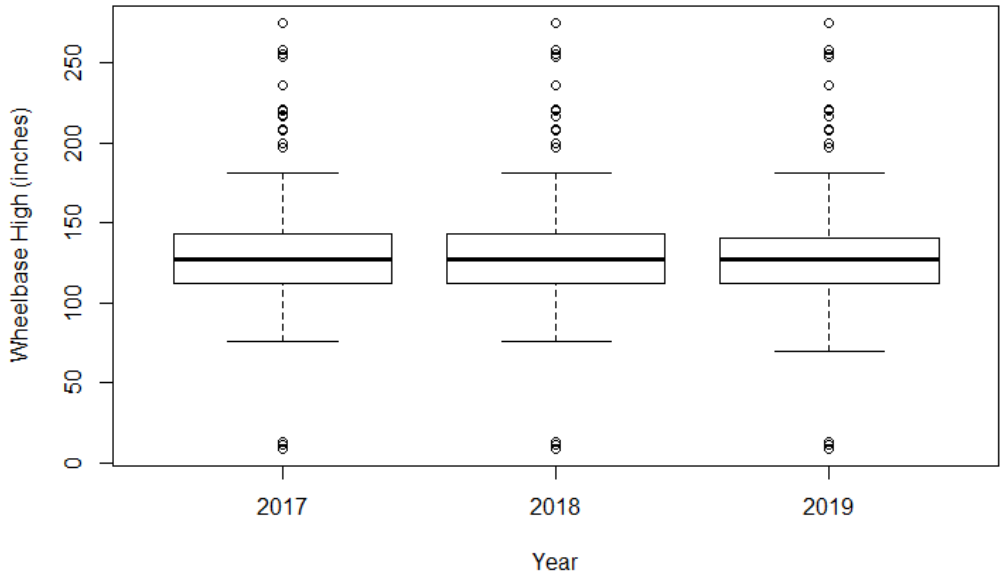

Figure 15. Graph. Boxplot of wheelbase high in the 2017–2019 mixed-duty vehicles data subsets.

(Source: Federal Highway Administration.)

Table 2. Summary statistics for the curb weight and wheelbase variables for the 2017–2019 mixed-duty vehicles data subsets.

Variable	Minimum	25th Percentile	Mean	75th Percentile	Maximum
2017 Data—Curb Weight (lbs)	1,272	3,700	4,437	5,147	9,745
2017 Data—Wheelbase Low (inches)	9	110.8	123.9	135.0	181.3
2017 Data—Wheelbase High (inches)	9	112.3	129.3	143.5	275.0
2018 Data—Curb Weight (lbs)	1,272	3,707	4,451	5,161	9,745
2018 Data—Wheelbase Low (inches)	9	110.8	123.9	137.0	181.3
2018 Data—Wheelbase High (inches)	9	112.2	129.2	143.5	275.0
2019 Data—Curb Weight (lbs)	1,272	3,723	4,470	5,179	9,745
2019 Data—Wheelbase Low (inches)	9	110.8	123.9	137.0	181.3
2019 Data—Wheelbase High (inches)	9	112.2	128.9	141.0	275.0

In addition to curb weight and wheelbase, the mixed-duty vehicles data subsets also report information on GVWR as indicated by the "GVW" field in the data subsets. As shown in table 3, this value ranges from 1 to 2 in the mixed-duty vehicles data subsets (and up to 8 in the heavy-duty vehicles data subsets) and corresponds to the NHTSA 8-vehicle GVWR classification system (NHTSA-8).[1] Across the three data subsets, about 41 percent of observations are classified as NHTSA-8 class 1 (<6,000 lbs); about 56 percent of observations are classified as NHTSA-8 class 2 (6,001–10,000 lbs); and nearly 3 percent of observations do not report a gross vehicle weight value.

Table 3. Summary of the 2017–2019 mixed-duty vehicles data subsets by gross vehicle weight.

National Highway Traffic Safety Administration 8-Vehicle Gross Vehicle Weight Rating Class	2017—Vehicle Count	2017—Percent of Total	2018—Vehicle Count	2018—Percent of Total	2019—Vehicle Count	2019—Percent of Total
1	609,208	40.83%	637,723	41.04%	665,277	41.23%
2	841,095	56.37%	873,417	56.20%	904,493	56.06%
Not Given	41,920	2.81%	42,902	2.76%	43,781	2.71%
Total	**1,492,223**	**100.00%**	**1,554,042**	**100.00%**	**1,613,551**	**100.00%**

[1] https://afdc.energy.gov/data/.

Figure 16 shows the distribution of engine sizes in terms of number of cylinders in the mixed-duty vehicles data subsets. The majority of observations in the data are comprised of eight-, six-, and four-cylinder engines. Those engine sizes represent on average 50 percent, 31 percent, and 14 percent of the data, respectively. Collectively, those engine sizes account for approximately 95 percent of observations across the 2017–2019 data subsets. About 3 percent of the data does not report information on engine size.

Table 4 focuses in on the 2019 data and shows the distribution of engine sizes in relation to body type. Engines with 5, 8, or 10 cylinders are generally more broadly distributed across the 26 body styles represented in the 2019 data than other engine sizes. All of the three- and 12-cylinder engines correspond to sport utility vehicle body types. About 65 percent of four-cylinder engines in the 2019 mixed-duty vehicles data also have sport utility vehicle body types. Engines with six cylinders also have a greater concentration of sport utility vehicle (about 44 percent) along with passenger van (about 15 percent) body types. For five-cylinder engines, there is much greater variation in body styles as cargo vans, extended cab pickups, crew cab pickups, and conventional pickups comprise 23 percent, 17 percent, 17 percent, and 12 percent of five-cylinder engines, respectively. Engines with eight cylinders also show greater variation as sport utility vehicle, crew cab pickups, conventional pickups, extended cab pickups, cab chassis body types each comprise 10 to 18 percent of those observations. A similar distribution was observed for 10-cylinder engines across the same body types as eight-cylinder engines.

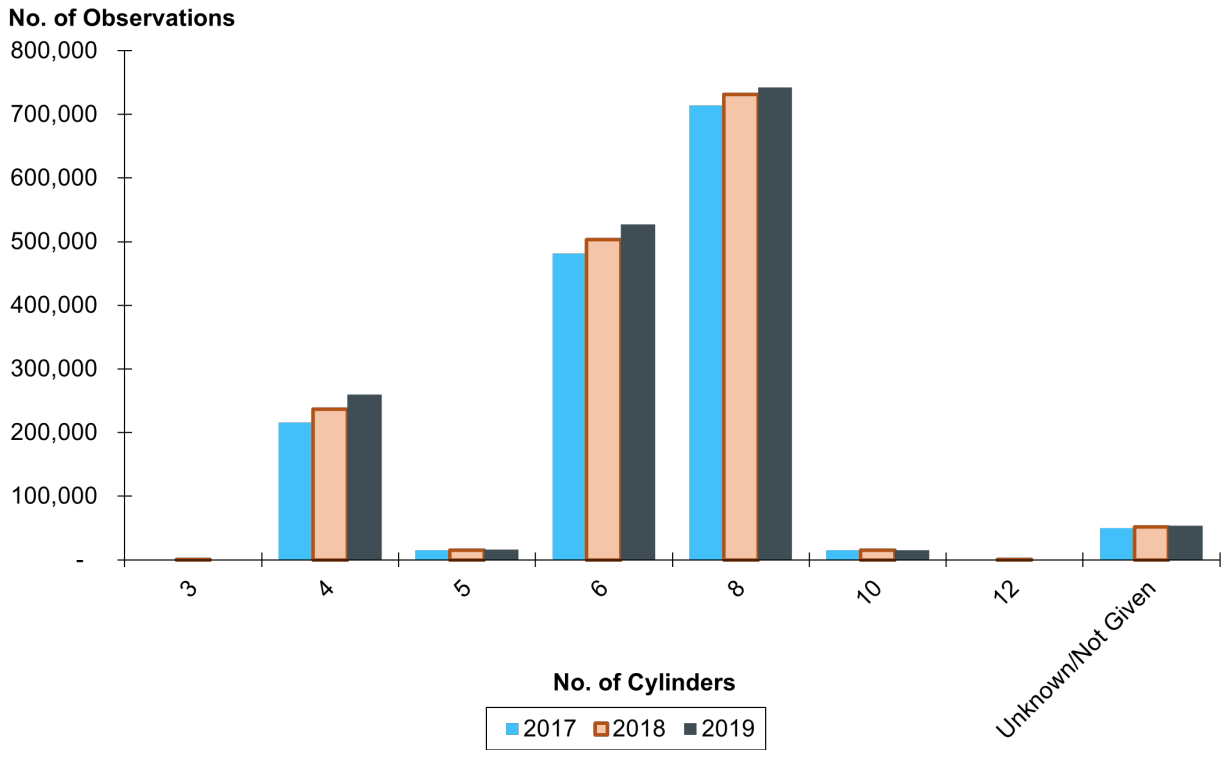

Figure 16. Chart. Distribution of engine size in the 2017–2019 mixed-duty vehicle data subsets.

(Source: Federal Highway Administration.)

Table 4. Distribution of engine size by body type in the 2019 mixed-duty vehicles data subset.

	No. of Cylinders							
Body Style	**3**	**4**	**5**	**6**	**8**	**10**	**12**	**Not Given/ Unknown**
Sport Utility Vehicle	325	173,433	1,700	241,340	154,195	1,636	230	5,020
Pickup Conventional	–	18,724	1,967	44,909	115,563	2,663	–	88
Pickup Extended Cab	–	17,598	2,994	47,677	107,428	2,837	–	–
Pickup Crew Cab	–	5,302	2,949	37,745	103,279	1,960	–	–
Van Passenger	–	14,977	1,280	79,280	55,391	1,381	–	380
Cab Chassis	1	1,197	652	8,777	42,553	1,700	–	1,291
Van Cargo	–	5,988	3,547	36,867	59,907	1,655	–	148
Pickup Unknown	–	19,400	–	19,250	40,031	–	–	2,335
Incomplete Pickup	–	55	222	1,125	31,714	917	–	–
Cutaway	–	29	248	2,461	15,876	299	–	13
Incomplete (Strip Chassis)	–	289	–	1,124	4,117	1	–	41
Straight Truck	–	–	–	318	610	–	–	406
Motor Home	–	306	–	89	1,508	53	–	30
Step Van	–	343	–	1,901	3,187	–	–	316
Sport Utility Truck	–	–	–	1,364	4,854	–	–	–
Unknown	–	52	–	1,297	1,817	–	–	42,803
Convertible	–	1,410	–	577	–	–	–	9
Van Camper	–	484	95	292	–	–	–	–
Limousine	–	–	–	237	194	–	–	–
Pickup Sport Utility	–	282	–	50	–	–	–	–
Pickup	–	4	–	53	129	–	–	270
Pickup Van	–	67	3	–	–	–	–	–
Bus Non School	–	–	–	–	–	–	–	15
Bus School	–	–	–	1	33	–	–	–
Van Cutaway	–	–	–	–	1	–	–	–
Tractor Truck	–	–	–	1	–	–	–	–
Fire Truck	0	0	0	0	0	0	0	9
Total	**326**	**259,940**	**15,657**	**526,735**	**742,387**	**15,102**	**230**	**53,174**

(Source: Federal Highway Administration.)

Displacement also is another measure of engine size that is included in the mixed-duty vehicles data subsets. The "DISPLACEMENT_CID" field included in the data reports engine displacement in units of cubic inches. As shown in table 5, in terms of displacement engine sizes range from 59 to 998 cubic inches across the 2017–2019 mixed-duty vehicles data subsets. Engines with larger displacement values may be indicative of vehicles that are capable of carrying larger loads or those that are capable of traveling at higher speeds. It also should be noted that on average across the data sets, about 4 percent of engine displacement values are either missing or reported as 0 and are not reported in table 5.

Table 5. Summary statistics for engine displacement (cubic inches) for the 2017–2019 mixed-duty vehicles data subsets.

Year	Minimum	25th Percentile	Mean	75th Percentile	Maximum
2017	59.0	213.0	278.4	350.0	998.0
2018	59.0	207.0	275.8	350.0	903.0
2019	59.0	201.0	273.1	350.0	903.0

As shown in figure 17, observations in the mixed-duty vehicles data subsets have model years that range from 1961 to 2021. On average, about 64 percent of the data across the subsets have model years of 2000 or later. Compared to observations in the cars data subsets, the mixed-duty vehicles data subsets indicate a much newer fleet. Generally, the 2007 model year is the most frequently observed across the data subsets. On average, about 3.5 percent of observations across the data subsets have a 2007 model year.

The mixed-duty vehicles data subsets are nearly uniformly distributed across States and the District of Columbia as shown in figure 18. Generally, registrations for each State represent about 1 to 2.5 percent of the data. The average across States for each data subset is approximately 1.96 percent, which would equal a uniform distribution across the 50 States and District of Columbia.

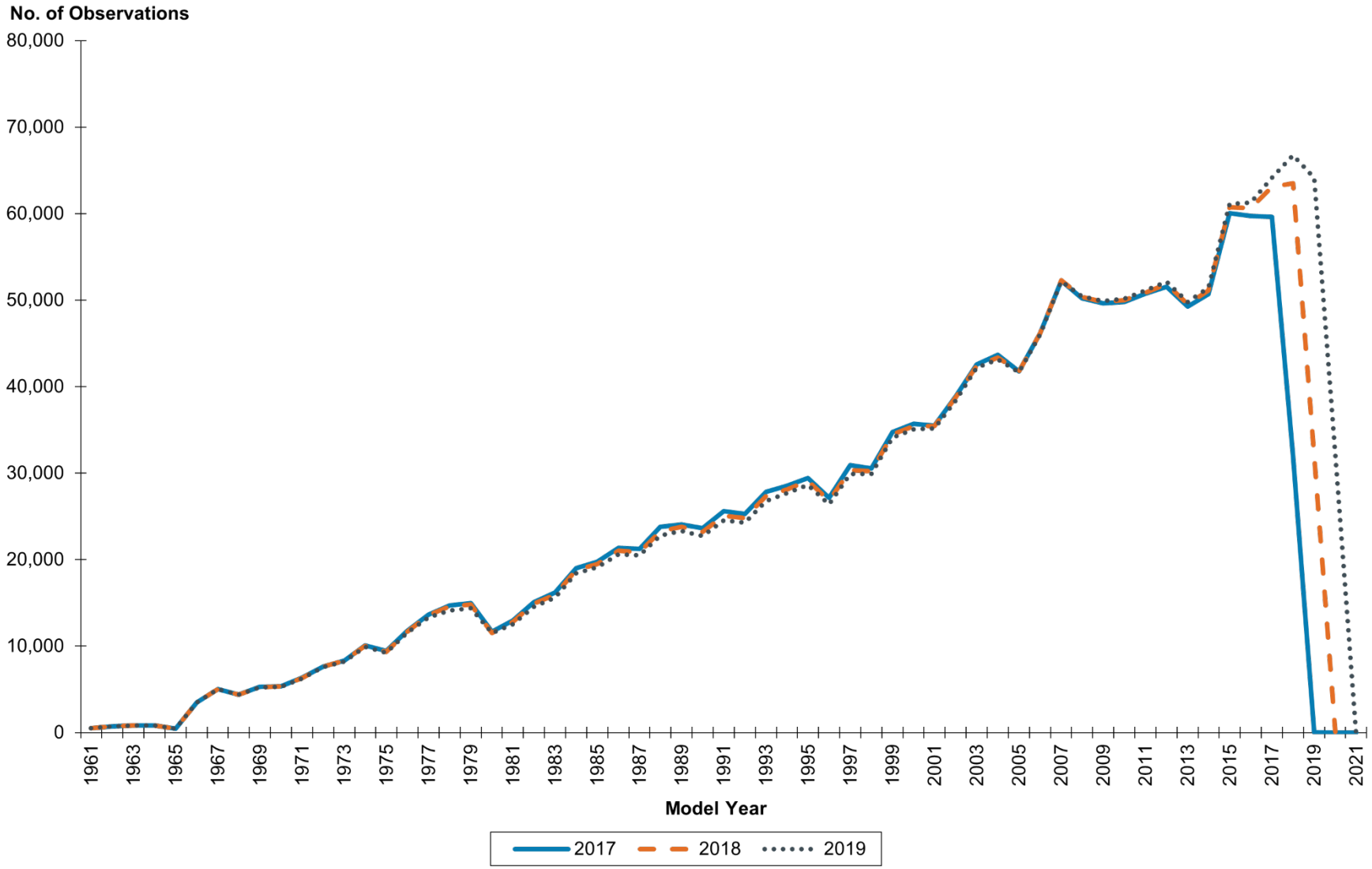

Figure 17. Chart. Distribution of model year in the 2017–2019 mixed-duty vehicle data subsets.

(Source: Federal Highway Administration.)

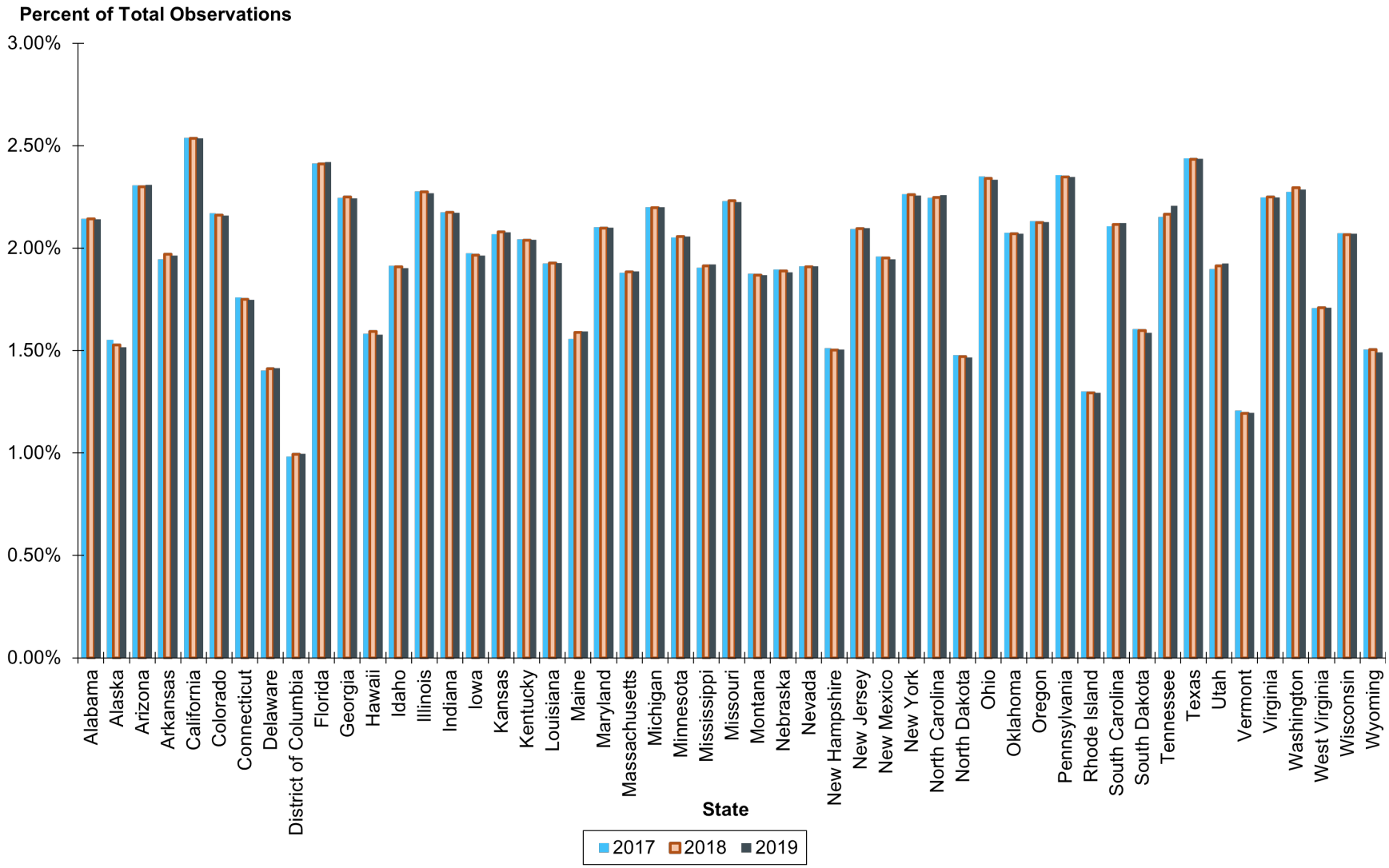

Figure 18. Chart. Distribution of vehicle registration by State plus the District of Columbia in the 2017–2019 mixed-duty vehicles data subsets.

(Source: Federal Highway Administration.)

Figure 19 and figure 20 examine how the wheelbase measures across the mixed-duty vehicles data subsets change in relation to GVWR. Both figures indicate that wheelbase is positively correlated with GVWR. As GVWR increases so too does wheelbase. This result suggests that longer wheelbases are indicative of vehicles capable of transporting heavier loads.

Figure 21 and figure 22 depict the relationship between wheelbase and engine size in terms of number of cylinders. Though less clear than the relationship with GVWR, there is a positive correlation between wheelbase and number of cylinders. As the number of cylinders increase so too does wheelbase. Vehicles with six- and 10-cylinder engines appear to deviate from the generally upward trend in median wheelbase measures with increasing numbers of cylinders. However, this deviation may actually be attributed to five- and 12-cylinder engine vehicles and the relatively small number of body styles comprising those observations. For example, in the 2019 data there are only 21 different body styles for five-cylinder engines and 1 for 12-cylinder engines (i.e., sport utility vehicles). However, the overall trend is positive.

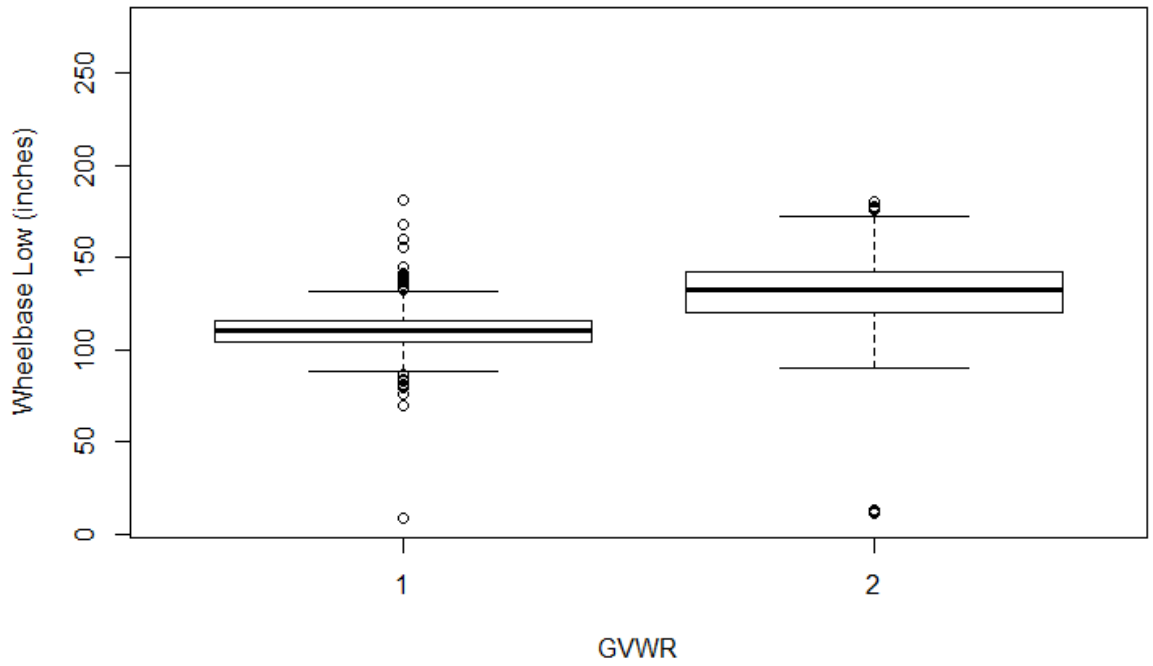

Figure 19. Graph. Boxplot of wheelbase low by gross vehicle weight rating in the 2017–2019 mixed-duty vehicles data subsets.

(Source: Federal Highway Administration.)

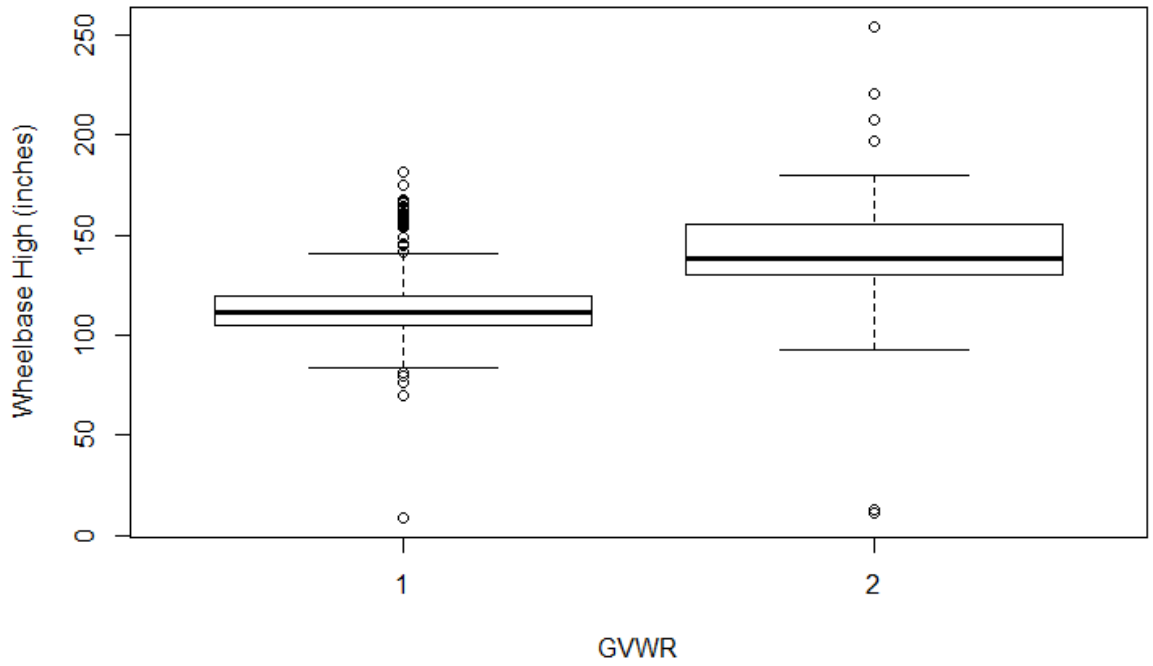

Figure 20. Graph. Boxplot of wheelbase high by gross vehicle weight rating in the 2017–2019 mixed-duty vehicles data subsets.

(Source: Federal Highway Administration.)

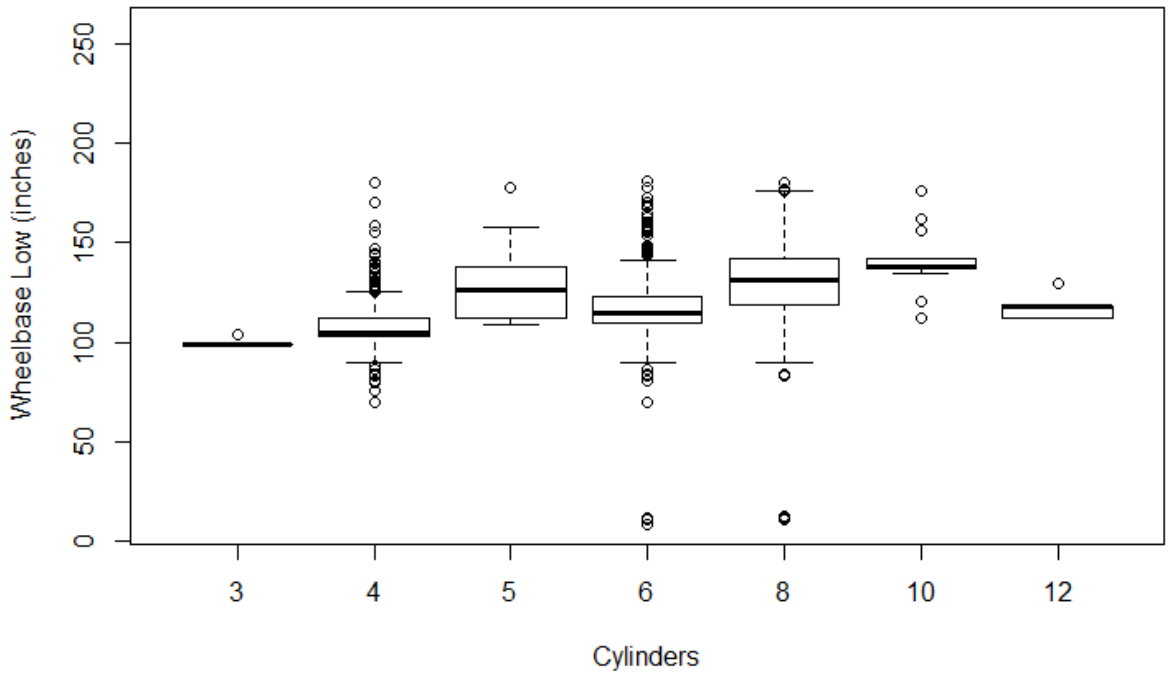

Figure 21. Graph. Boxplot of wheelbase low by number of engine cylinders in the 2017–2019 mixed-duty vehicles data subsets.

(Source: Federal Highway Administration.)

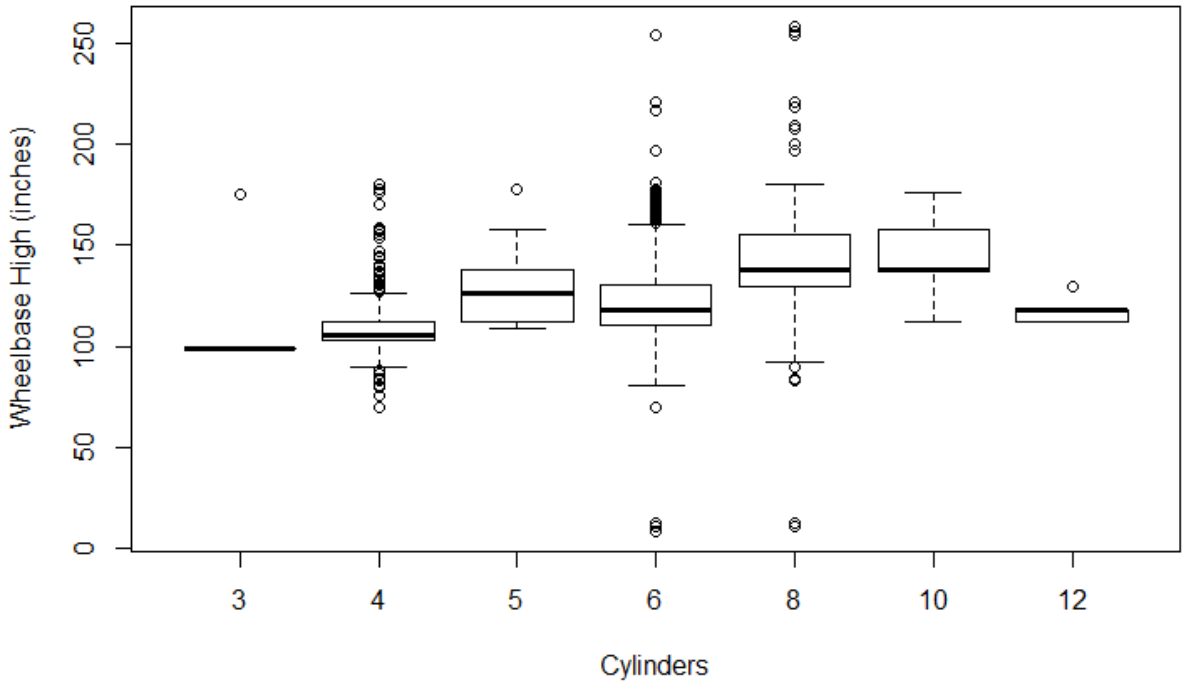

Figure 22. Graph. Boxplot of wheelbase high by number of engine cylinders in the 2017–2019 mixed-duty vehicles data subsets.

(Source: Federal Highway Administration.)

Figure 23 examines how curb weight across the mixed-duty vehicles data subsets change in relation to engine size as measured by number of cylinders. It indicates that curb weight is positively correlated with number of cylinders. Curb weight increases with greater numbers of cylinders. This result suggests that larger engine sizes are indicative of heavier vehicles.

A similar result was found when the GVWR across the mixed-duty vehicles data subsets was examined in relation to engine size as measured by cubic inches of displacement. Figure 24 indicates that GVWR is positively correlated with displacement. The GVWR increases with greater engine displacement. This result suggests that larger engine sizes are indicative of vehicles capable of carrying larger loads.

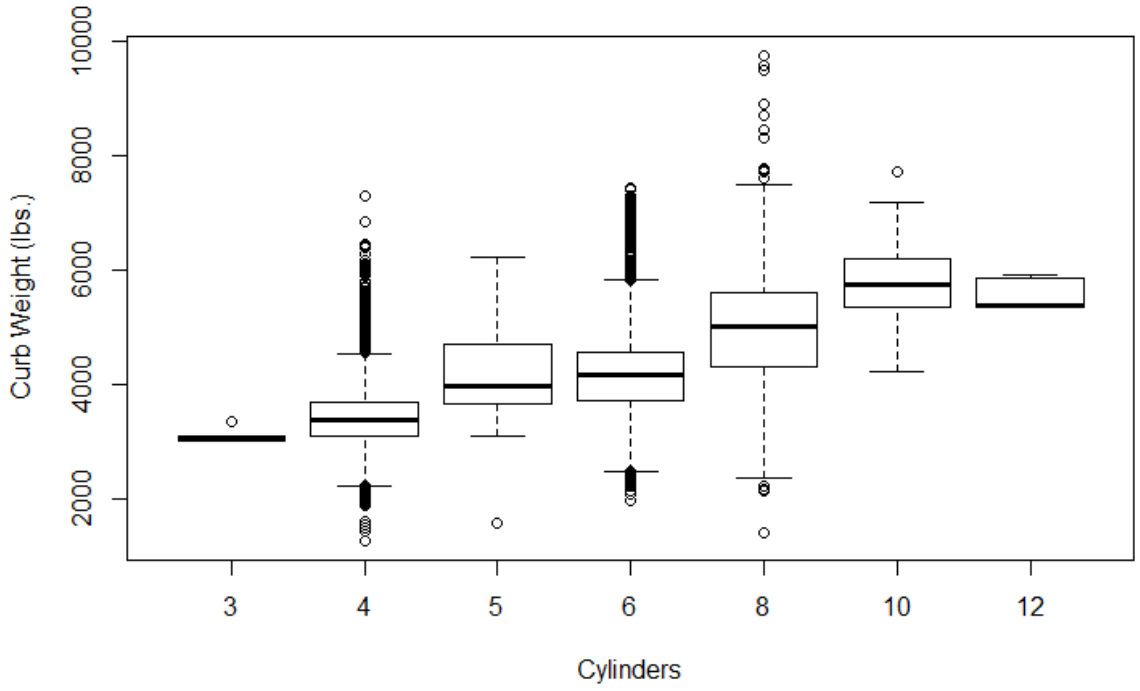

Figure 23. Graph. Boxplot of curb weight by number of engine cylinders in the 2017–2019 mixed-duty vehicles data subsets.

(Source: Federal Highway Administration.)

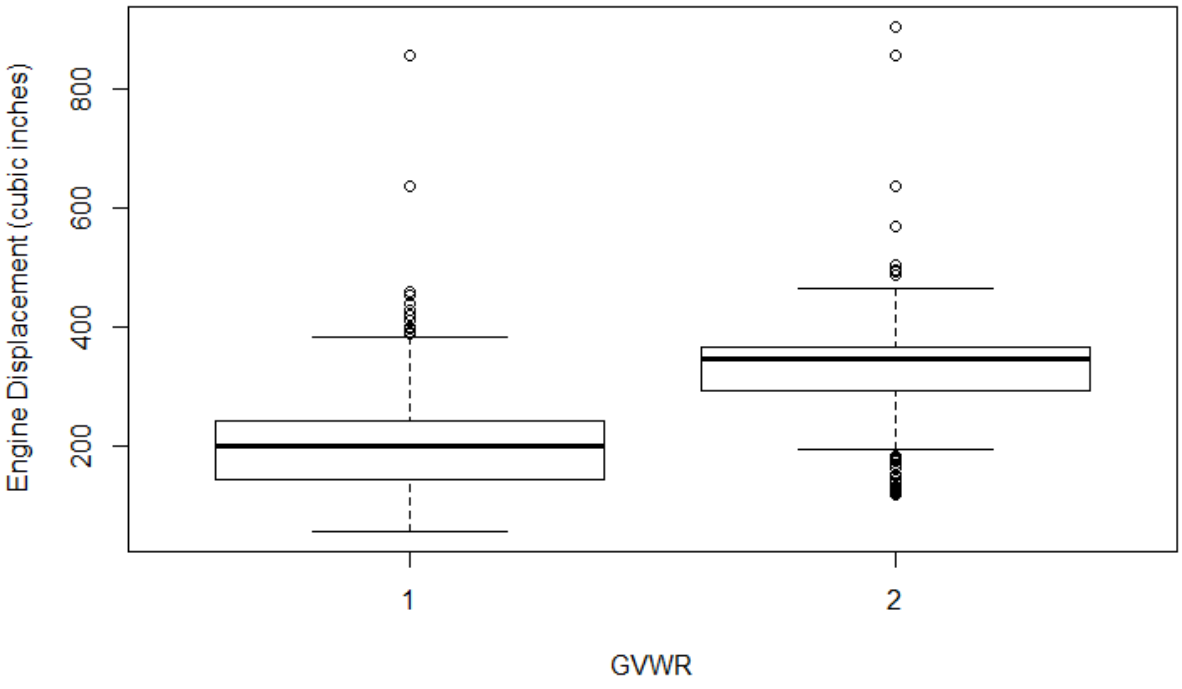

Figure 24. Graph. Boxplot of engine displacement by gross vehicle weight rating in the 2017–2019 mixed-duty vehicles data subsets.

(Source: Federal Highway Administration.)

Heavy-Duty Vehicles Data Subsets

There are 9,453,381 observations in the 2018 heavy-duty vehicles data subset and 9,731,454 observations in the 2019 heavy-duty vehicles data subset. As shown in figure 25, there are 17 body types reported in the 2017–2019 heavy-duty vehicles data subsets, including:

- Bus Non School.
- Bus School.
- Gliders.
- Tractor Truck.
- Straight Truck.
- Van Cargo.
- Van Passenger.
- Fire Truck.
- Sport Utility Vehicle.
- Pickup.
- Incomplete Pickup.
- Step Van.
- Motor Home.
- Incomplete (Strip Chassis).
- Cab Chassis.
- Cutaway.
- Unknown.

Among those body types, straight truck, tractor truck, cab chassis, and pickup are the most prevalent accounting for over 75 percent of observations across the heavy-duty vehicle data subsets.

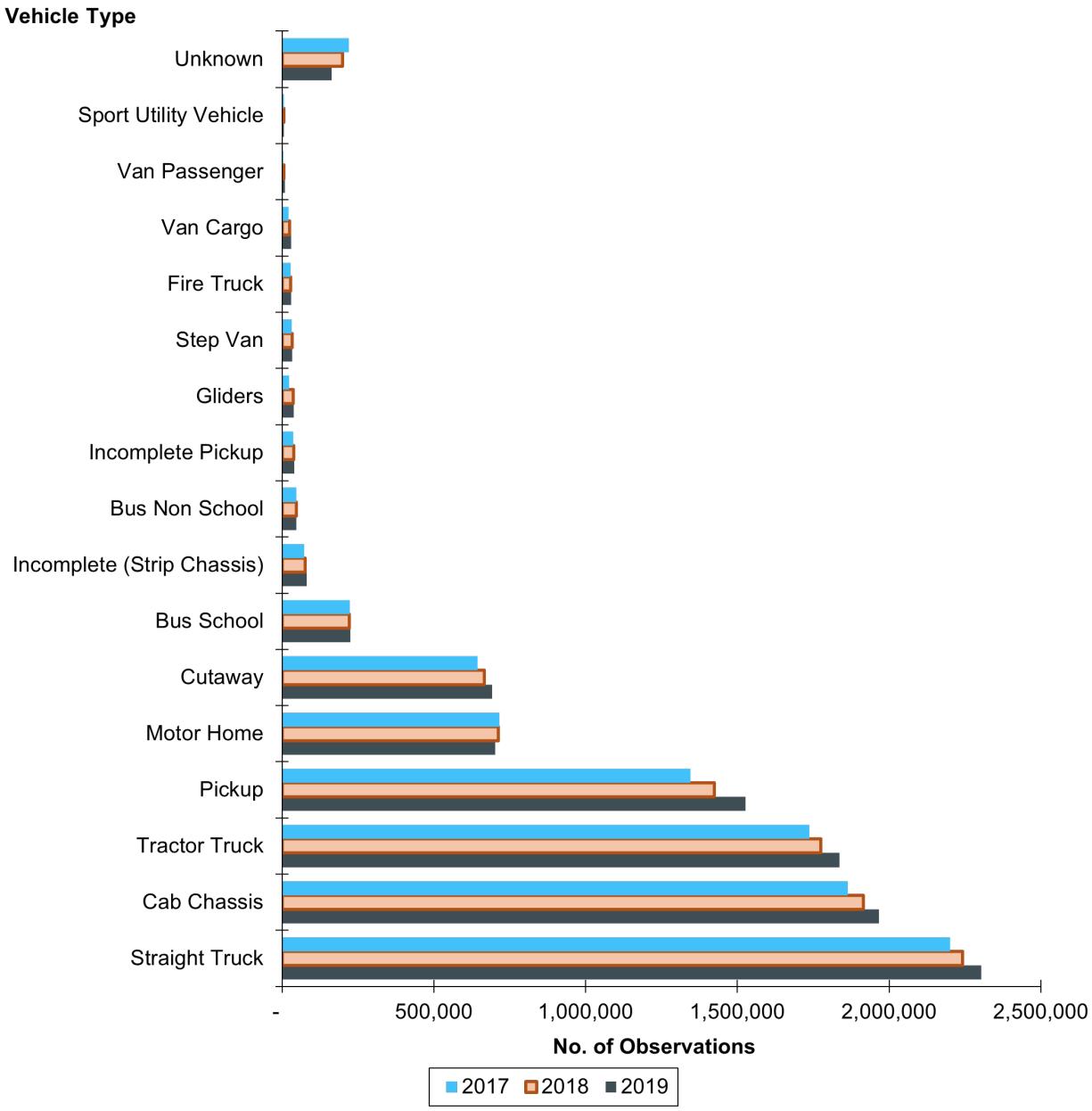

Figure 25. Chart. Distribution of vehicles in the 2017–2019 heavy-duty vehicles data subsets by body type.

(Source: Federal Highway Administration.)

Though the heavy-duty vehicles data subsets do not report curb weight or gross vehicle weight, they do report the NHTSA-8 GVWR classification and drivetrain configuration (refer to section 3 for more detailed information on this classification system). These are important variables for determining the appropriate FHWA 13-vehicle classification system (FHWA-13), FHWA-6, and NHTSA class. As shown in table 6, over 50 percent of the observations in the heavy-duty vehicles data subsets are classified as either NHTSA-8 class 3 (10,001–14,000 lbs) or class 8 (> 33,001 lbs).

Table 6. Summary of the heavy-duty vehicles data subsets by gross vehicle weight rating.

Gross Vehicle Weight Rating Class	2017—Vehicle Count	2017—Percent of Total	2018—Vehicle Count	2018—Percent of Total	2019—Vehicle Count	2019—Percent of Total
Class 3 (10,001–14,000 lbs)	2,990,533	32.42%	3,097,901	32.77%	3,227,177	33.16%
Class 4 (14,001–16,000 lbs)	916,249	9.93%	926,254	9.80%	938,926	9.65%
Class 5 (16,001–19,500 lbs)	708,044	7.68%	747,067	7.90%	789,295	8.11%
Class 6 (19,501–26,000 lbs)	1,036,250	11.23%	1,037,720	10.98%	1,040,103	10.69%
Class 7 (26,001–33,000 lbs)	1,010,590	10.96%	1,009,258	10.68%	1,013,123	10.41%
Class 8 (> 33,001 lbs)	2,562,412	27.78%	2,635,181	27.88%	2,722,830	27.98%
Total	**9,224,078**	**100.00%**	**9,453,381**	**100.00%**	**9,731,454**	**100.00%**

As shown in figure 26, 18 different drivetrain configurations (reported under the "Wheels" field in the registration data) are reported in the heavy-duty vehicles data subsets with '4 x 2', '4 x 4', and '6 x 4' being the most prevalent. In the "A x B" format, the drivetrain configuration indicates the total number of wheels on the vehicle (i.e., "A") and the number of wheels receiving power from the engine (i.e., "B"). This is important for classifying vehicles in these subsets as the number of axles can be inferred from the drivetrain configuration by dividing the total number of reported wheels by 2. Taken together with the number of wheels receiving power, these two pieces of information are indicative of heavy-duty vehicle configurations (e.g., single trailer versus multi-trailer) and are thus useful for classifying vehicles.

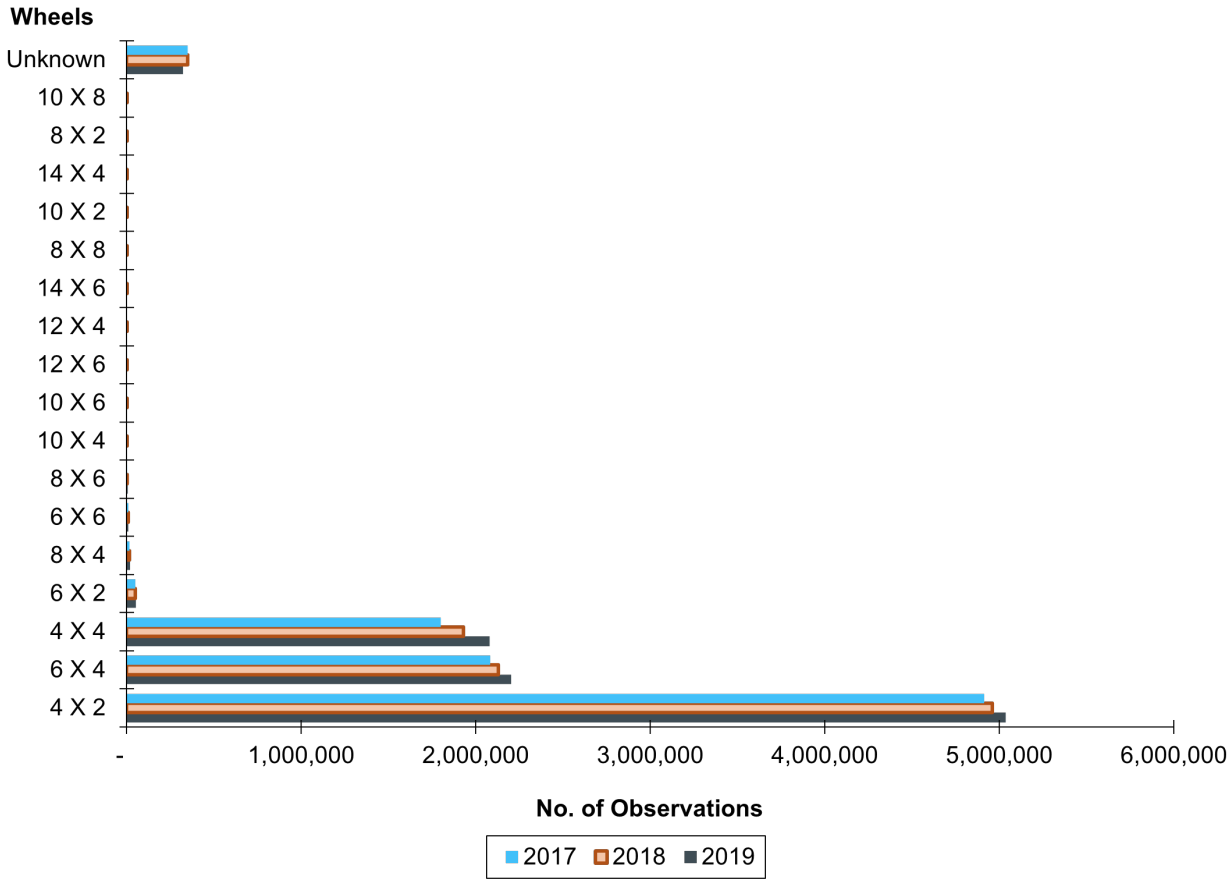

Figure 26. Chart. Distribution of drivetrain configurations in the 2017–2019 heavy-duty vehicles data sets.

(Source: Federal Highway Administration.)

Figure 27 and figure 28 show the distribution of number of axles (as derived from the "Wheels" variable) along with body type and GVWR, respectively. These figures are useful for observing how some of the key variables that determine vehicle classification (in terms of FHWA-13, FHWA-6, and NHTSA) relate to one another. For example, the most prevalent body type in the heavy-duty vehicles data subsets is the straight truck configuration. As shown in figure 27, the majority of straight trucks in the 2019 data subset have two-axle configurations with a smaller (but still significant) portion with three-axle configurations. Pickup body styles are exclusively two-axle vehicles with the vast majority of cab chassis vehicles having that axle configuration as well. In contrast, truck tractor body styles are nearly all three-axle vehicles.

As shown in figure 28, two-axle vehicles comprise the majority of observations in the heavy-duty vehicles data subsets with nearly half of those vehicles with a GVWR equal to 3. The remaining half of two-axle vehicles in the heavy-duty vehicles data subsets are nearly equally divided between GVWRs of 4, 5, 6, and 7. Vehicles with three-axle configurations overwhelmingly report a GVWR equal to 3 (over 99 percent of three-axle vehicles). Observations in the heavy-duty vehicles data subsets with four or more axles nearly exclusively report a GVWR of 8.

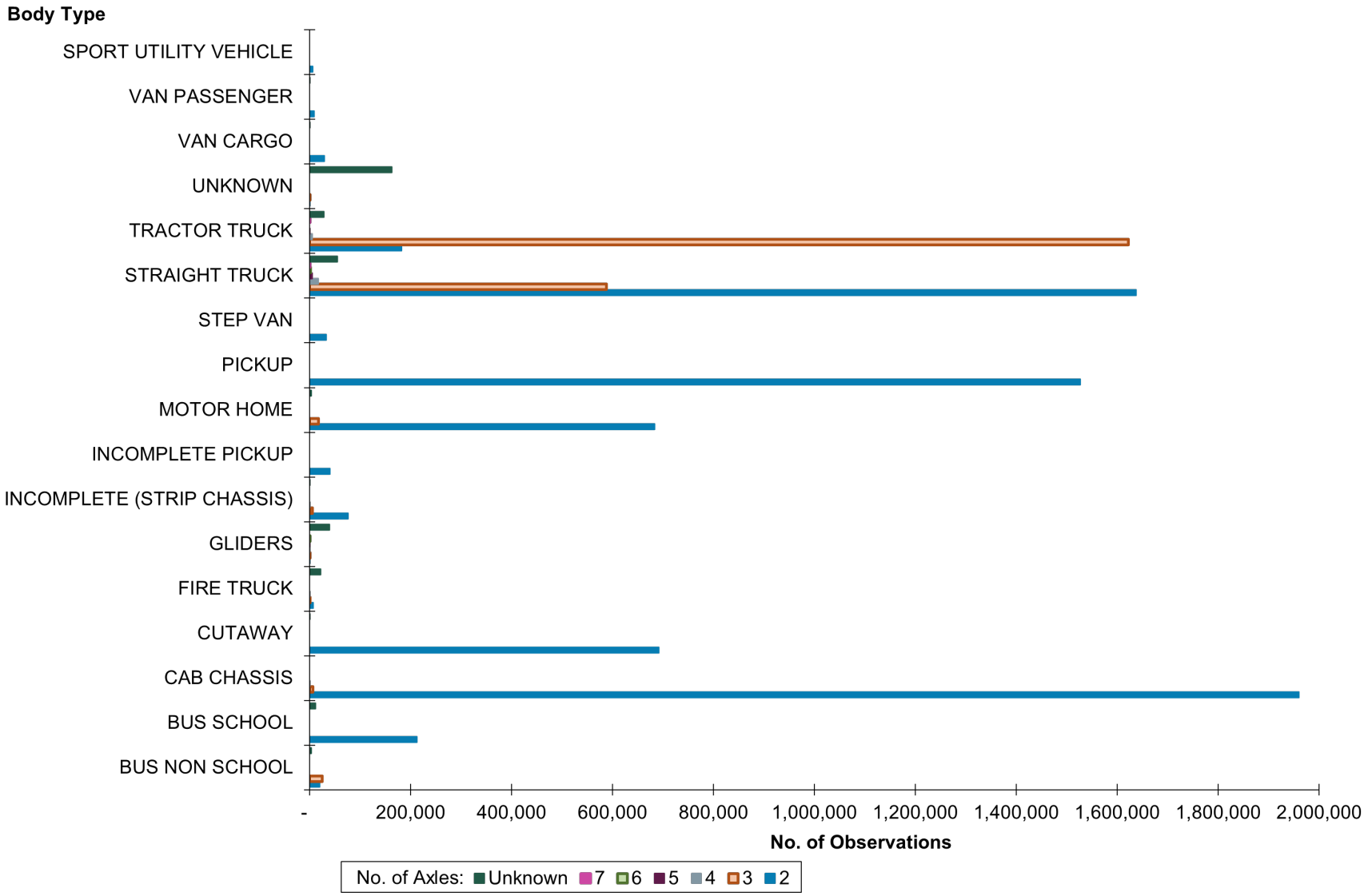

Figure 27. Chart. Distribution of body type and number of axles in the 2019 heavy-duty vehicles data subset.

(Source: Federal Highway Administration.)

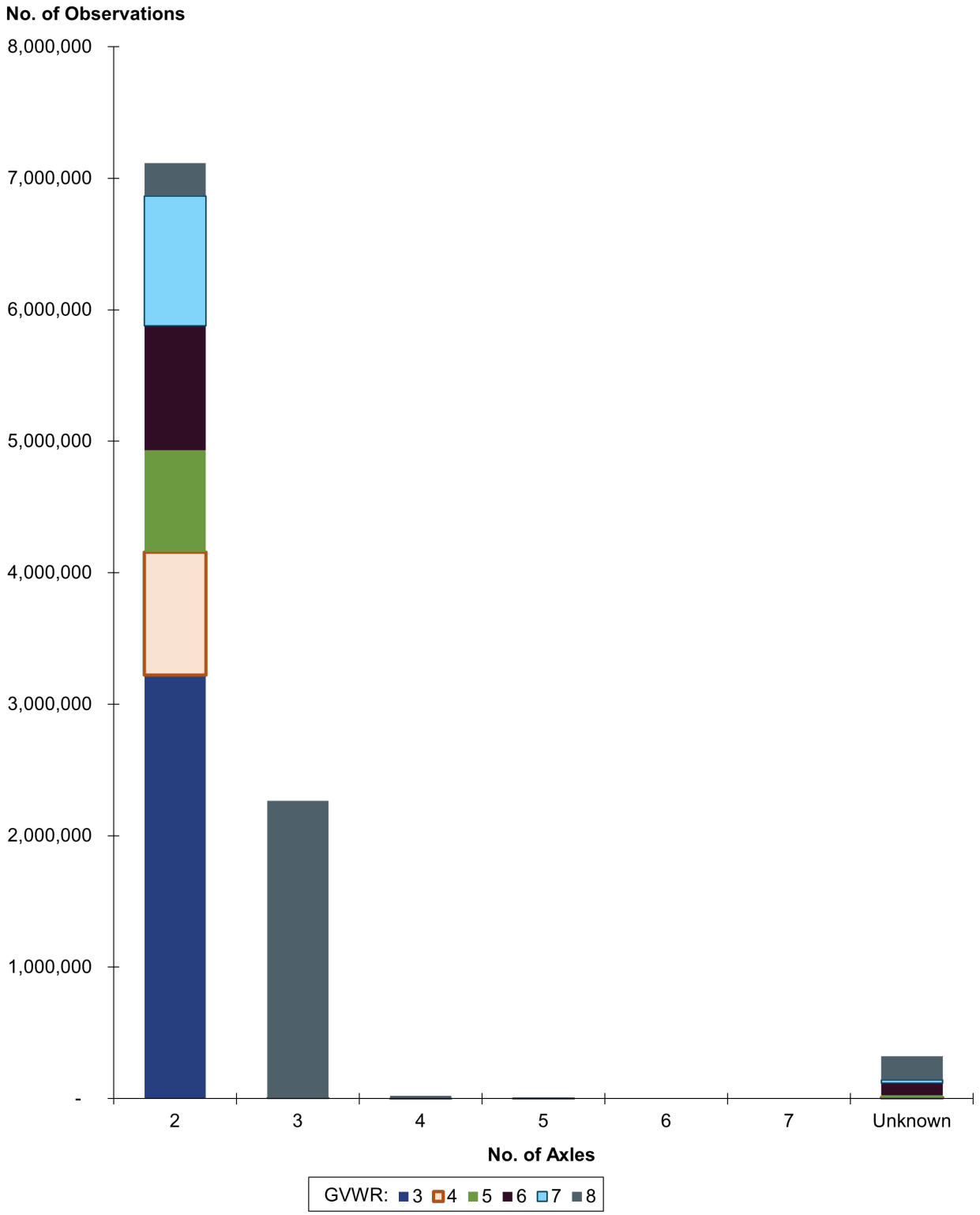

Figure 28. Chart. Distribution of number of axles and gross vehicle weight rating in the 2019 heavy-duty vehicles data subset.

(Source: Federal Highway Administration.)

The heavy-duty vehicles data subsets also contain information on the types of rear and front axles used by vehicles in the registration data. As shown in figure 29, the majority of observations across the heavy-duty vehicles data subsets are vehicles with single rear axles. On average, they account for about 72 percent of vehicles in the heavy-duty vehicles data subsets. Vehicles with tandem axles account for approximately 23 percent of observations on average in the heavy-duty vehicles data subsets. Tandem rear axles generally allow for vehicles to carry heavier loads.

Figure 30 shows the distribution of front axle types in the heavy-duty vehicles data subsets. About 70 percent of observations are vehicles with standard front axles. Setforward and setback front axle types comprise about 1 percent and 10 percent of the data on average, respectively. Setback front axles generally allow for tighter turning radii which may be preferable for trucks operating in urban areas, construction sites, and other environments with limited space.

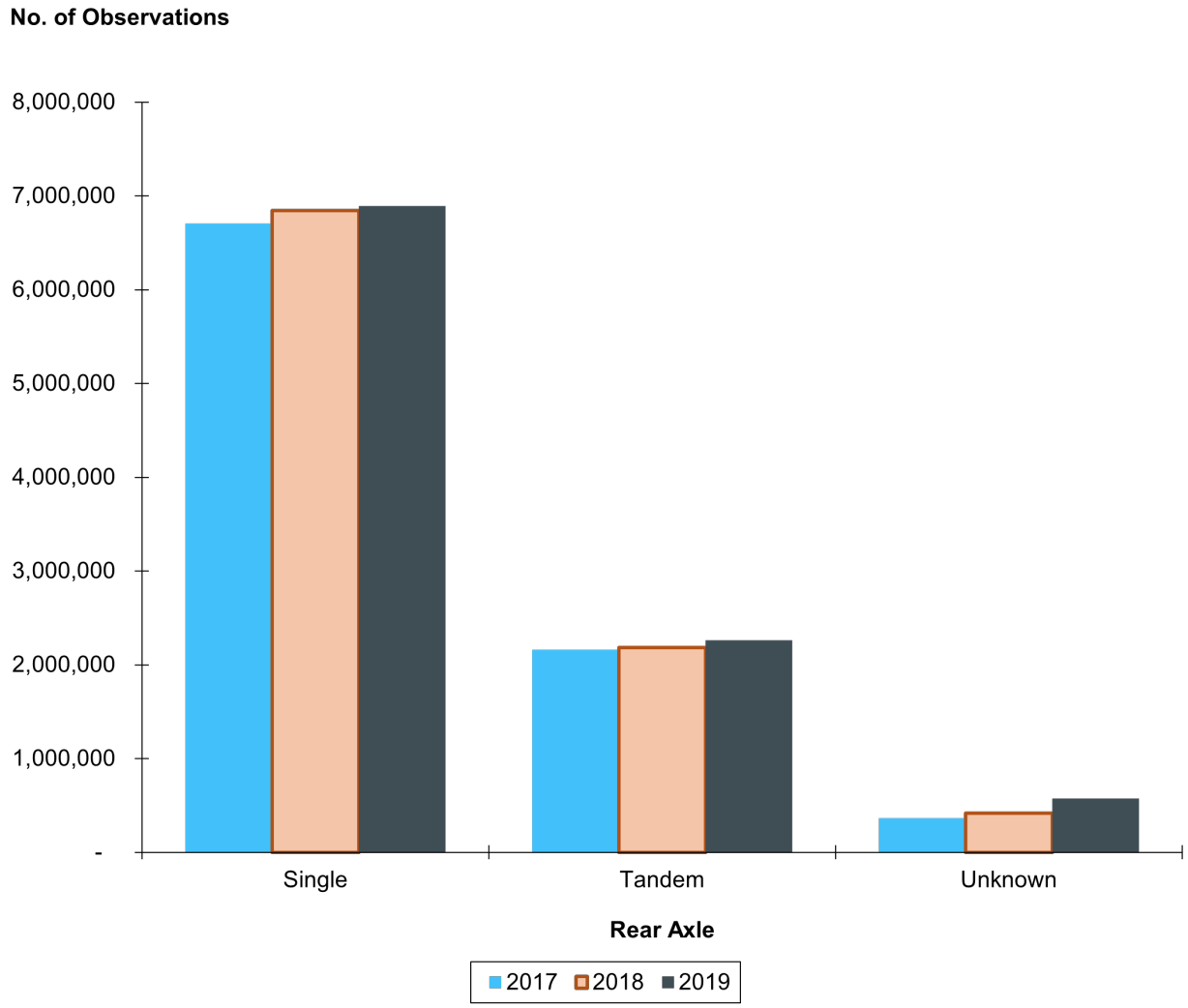

Figure 29. Chart. Distribution of rear axle types in the 2017–2019 heavy-duty vehicles data subsets.

(Source: Federal Highway Administration.)

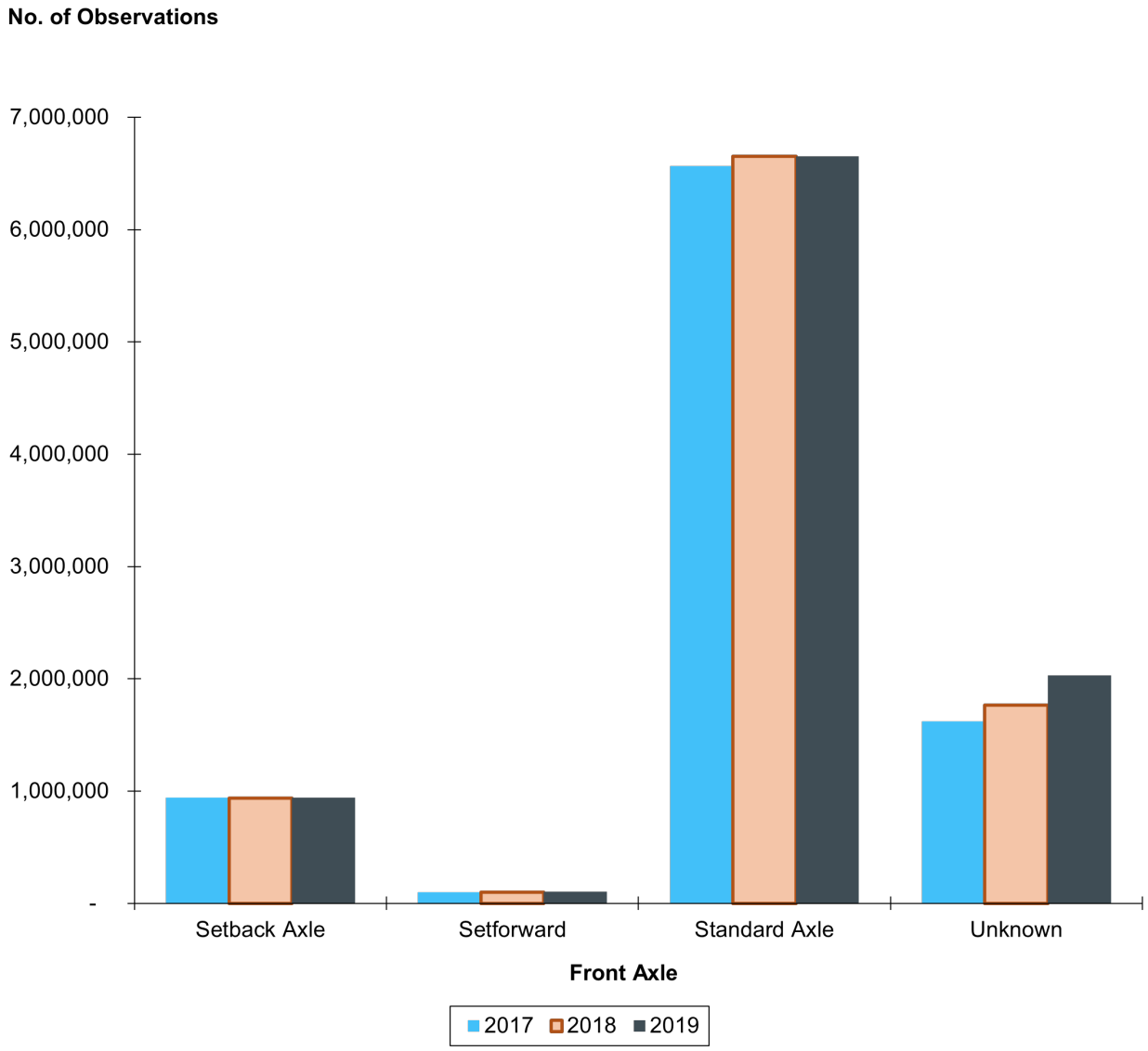

Figure 30. Chart. Distribution of front axle types in the 2017–2019 heavy-duty vehicles data subsets.

(Source: Federal Highway Administration.)

Figure 31 and figure 32 show the distribution of GVWR along with rear and front axle types, respectively, in the 2019 data. These figures are useful for understanding how some of the key vehicle characteristics in the registration data relate to each another. For example, tandem rear axles are nearly exclusively associated with a GVWR equal to 8 as shown in figure 31. In contrast, single rear axles are broadly distributed across GVWRs.

As shown in figure 32, nonstandard front axle types (both setback and setforward) are generally associated with higher GVWRs. Over 99 percent of observations with setback front axles have GVWRs of 6 or higher. About 94 percent of observations with setforward front axle vehicles have a GVWR of 6 or more. For vehicles with a GVWR equal to 8, about 40 percent do not report the front axle type.

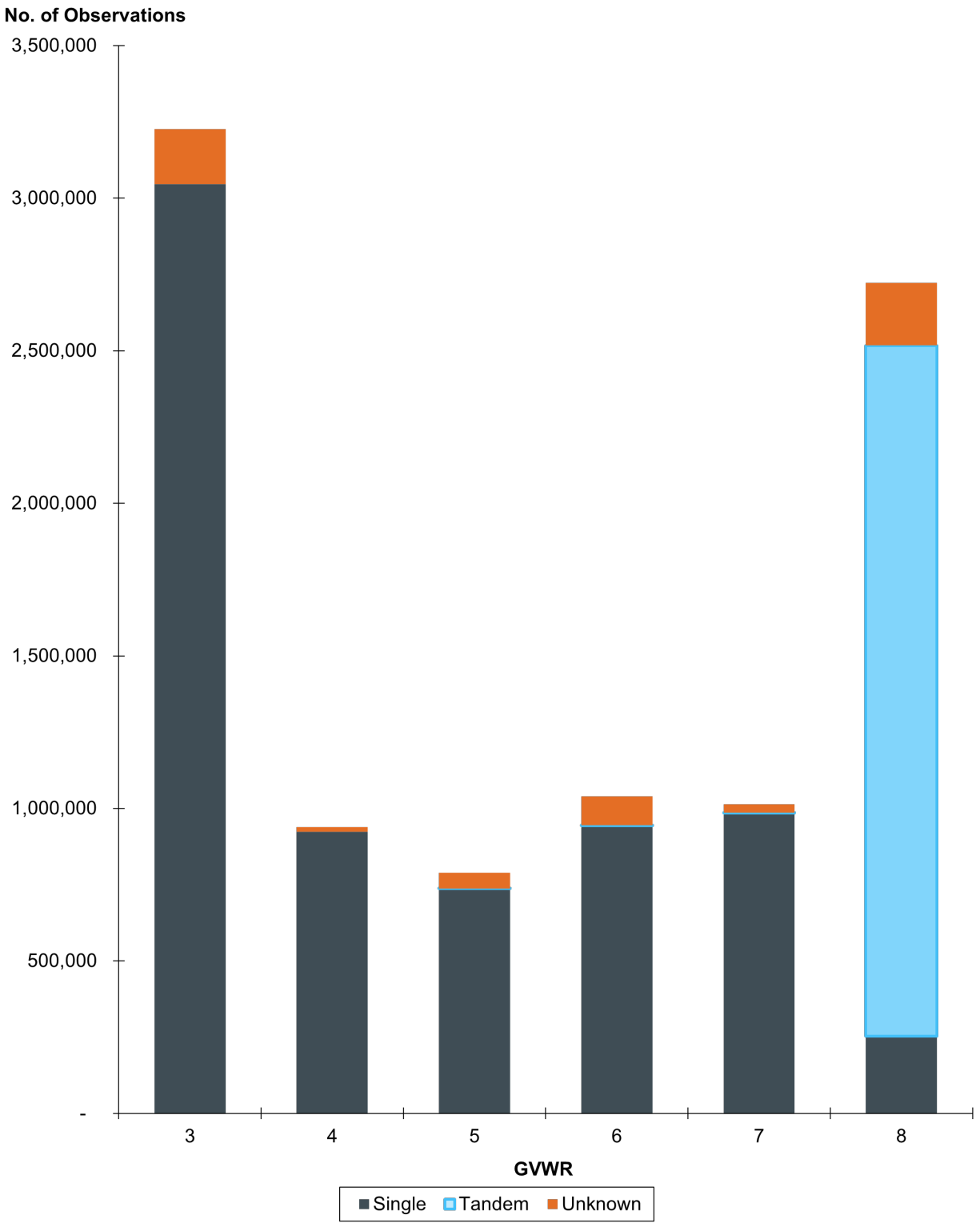

Figure 31. Chart. Distribution of rear axle types and gross vehicle weight rating in the 2019 heavy-duty vehicles data subset.

(Source: Federal Highway Administration.)

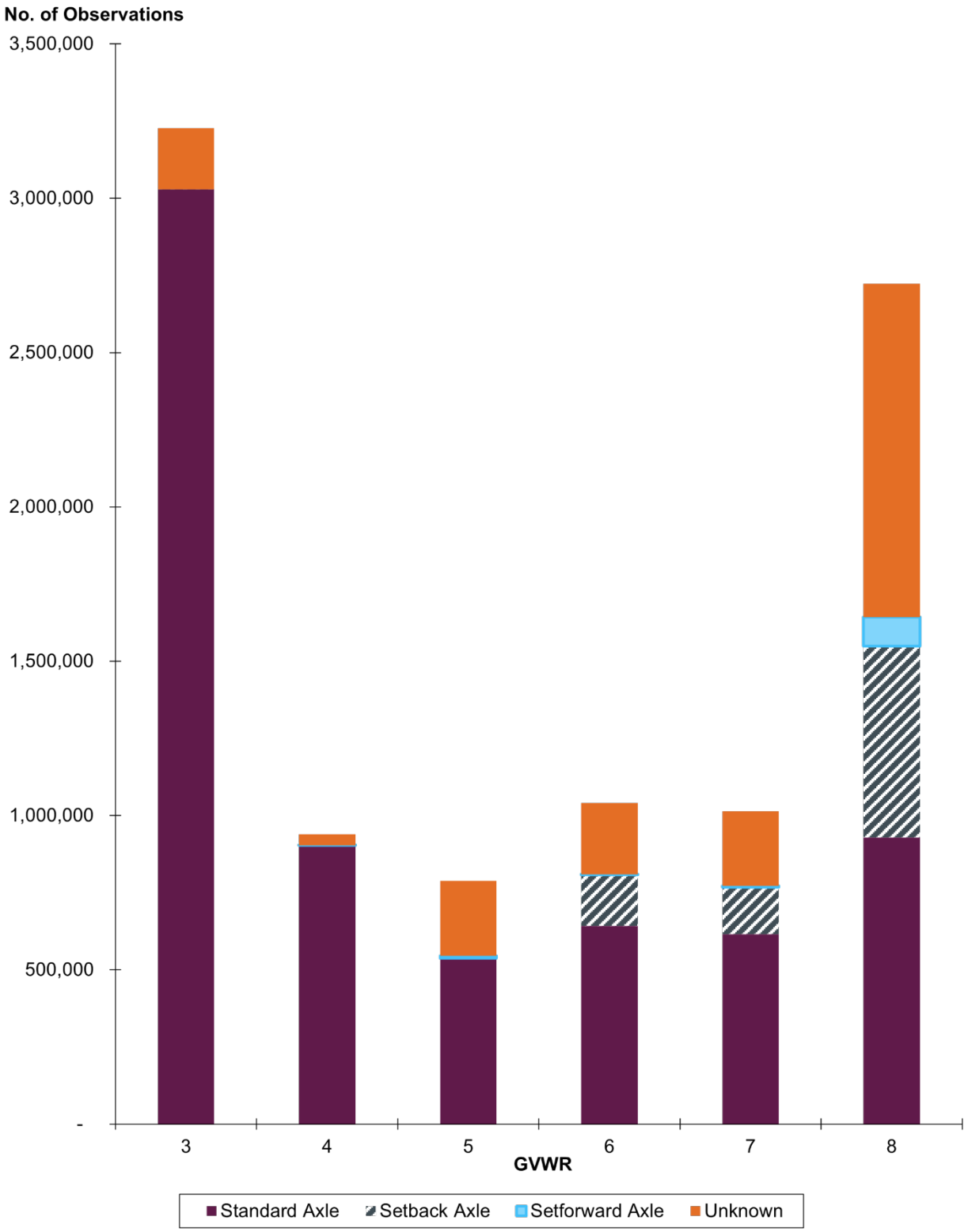

Figure 32. Chart. Distribution of front axle type and gross vehicle weight rating in the 2019 heavy-duty vehicles data subset.

(Source: Federal Highway Administration.)

The heavy-duty vehicles data subsets report the type of fuel used by the vehicles represented in the data. As shown in figure 33, the majority of observations use diesel as fuel—on average about 74 percent of observations across the data subsets. Gasoline is the second most prevalent fuel type comprising on average about 22 percent of observations. Nearly 2 percent of observations across the data subsets use flexible fuel. Interestingly, the data indicates that over time increasingly smaller shares of vehicles in the heavy-duty vehicles data subsets using gasoline as fuel while flexible fuel has been increasing its share of the fleet between 2017 and 2019. The share of vehicles in the heavy-duty vehicles data set using gasoline decreased by about 0.42 percentage points between 2017 and 2019 while the share of vehicles using flexible fuel increased by approximately 0.39 percentage points.

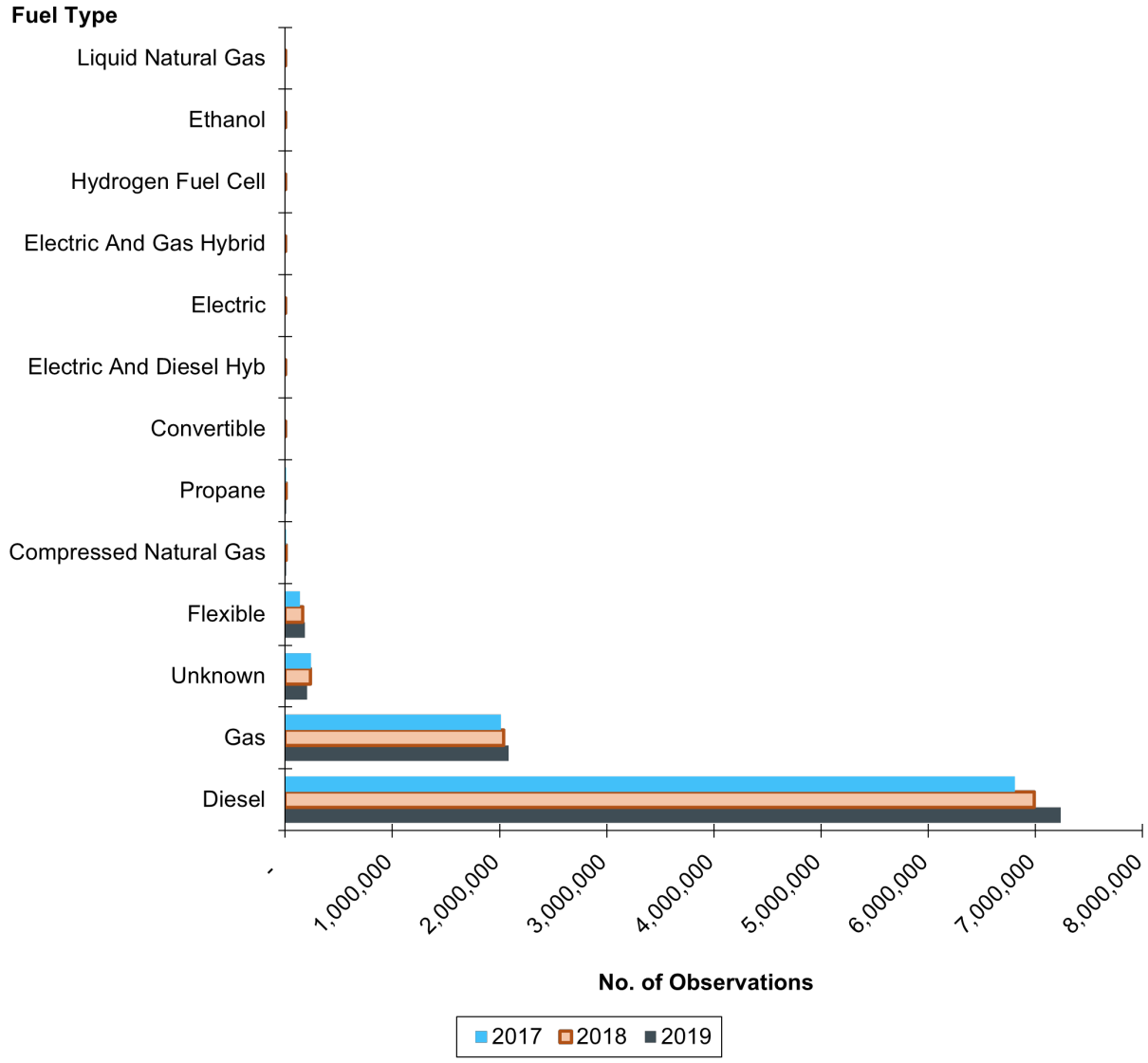

Figure 33. Chart. Distribution of fuel types in the 2017–2019 heavy-duty vehicles data subsets.

(Source: Federal Highway Administration.)

Table 7 and table 8 show the distribution of fuel types in relation to GVWR and number of axles, respectively, for the 2019 data. As shown in table 7, while diesel and gasoline comprise the majority of observations across GVWRs, as GVWR increases so too does the share of vehicles that use diesel as fuel. Over 90 percent of GVWR equal to 7 or 8 use diesel as fuel compared to 60 percent of those with a GVWR of 3.

A similar analysis was performed for number of axles as shown in table 8. The use of fuels other than diesel and gasoline is largely limited to two-axle vehicles. Though the vast majority of two-axle vehicles in the data use diesel or gasoline as fuel (over 97 percent), all of the alternative fuel types (e.g., flexible, compressed natural gas, electric, etc.) are represented in this subset of vehicles. Vehicles with 3- or more axle configurations nearly exclusively use diesel as fuel.

Table 7. Distribution of fuel types and gross vehicle weight rating in the 2019 heavy-duty vehicles data subset.

	Gross Vehicle Weight Rating					
Fuel Type	**3**	**4**	**5**	**6**	**7**	**8**
Compressed Natural Gas	110	621	45	206	1,295	8,131
Convertible	511	3,583	–	783	–	–
Diesel	1,943,370	431,197	558,989	726,014	935,615	2,643,364
Electric	31	15	8	4	24	192
Electric and Diesel Hybrid	–	–	1,309	32	102	266
Electric and Gas Hybrid	–	–	–	–	–	–
Ethanol	–	–	–	–	–	1
Flexible	162,659	21,415	–	–	–	5
Gas	1,114,132	479,511	211,493	221,773	51,983	3,252
Hydrogen Fuel Cell	–	–	–	–	–	4
Liquid Natural Gas	–	–	–	–	–	1
Propane	128	271	212	976	5,457	35
Unknown	6,236	2,313	17,239	90,315	18,647	67,579
Total	**3,227,177**	**938,926**	**789,295**	**1,040,103**	**1,013,123**	**2,722,830**

(Source: Federal Highway Administration.)

Table 8. Distribution of fuel types and number of axles in the 2019 heavy-duty vehicles data subset.

	Axles						
Fuel Type	**2**	**3**	**4**	**5**	**6**	**7**	**Unknown**
Compressed Natural Gas	3,540	5,846	42	–	–	–	980
Convertible	4,877	–	–	–	–	–	–
Diesel	4,831,669	2,254,339	22,180	4,773	1,576	223	123,789
Electric	91	–	–	–	–	–	183
Electric and Diesel Hybrid	1,702	7	–	–	–	–	–
Electric and Gas Hybrid	–	–	–	–	–	–	–
Ethanol	1	–	–	–	–	–	–
Flexible	184,079	–	–	–	–	–	–
Gas	2,080,271	1,779	–	–	–	–	94
Hydrogen Fuel Cell	4	–	–	–	–	–	–
Liquid Natural Gas	1	–	–	–	–	–	–
Propane	7,067	12	–	–	–	–	–
Unknown	1,163	2,398	18	14	–	–	198,736
Total	**7,114,465**	**2,264,381**	**22,240**	**4,787**	**1,576**	**223**	**323,782**

(Source: Federal Highway Administration.)

Observations in the heavy-duty vehicles data subsets have model years that range from 1966 to 2021 as shown in figure 34. On average, about 69 percent of the data across the subsets have model years of 2000 or later. Compared to observations in the cars and mixed-duty vehicles data subsets, the heavy-duty vehicles data subsets indicate a much newer fleet. Generally, the 2006 model year is the most frequently observed across the data subsets. On average, about 5.3 percent of observations across the data subsets have a 2006 model year.

There is much less uniformity in vehicle registrations across States and the District of Columbia when compared to the cars, motorcycles, and mixed-duty vehicles data subsets. As shown in figure 35, on average over 10 percent of observations represent California vehicles. Texas, Pennsylvania, and Florida follow California for the highest shares of vehicle registrations in the heavy-duty vehicles data subsets. On average, those States represent 8 percent, 4.6 percent, 4.5 percent of vehicle registrations, respectively. However, it should be noted that the State of registration does not necessarily indicate where a truck primarily operates. For large carriers, their fleets may be registered in the State in which the company is headquartered though they operate over a much larger geography.

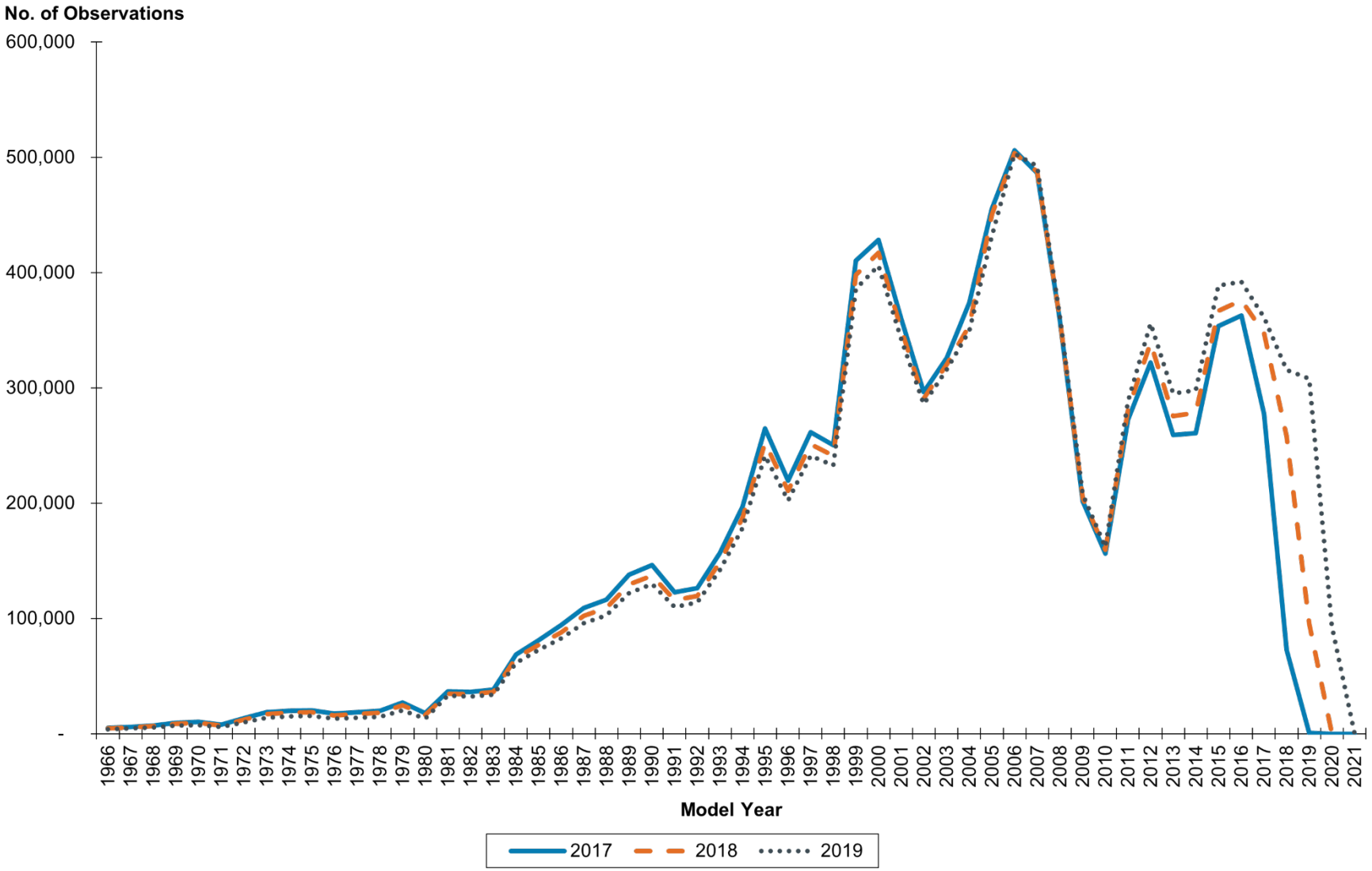

Figure 34. Chart. Distribution of model years in the 2017–2019 heavy-duty vehicles data subsets.

(Source: Federal Highway Administration.)

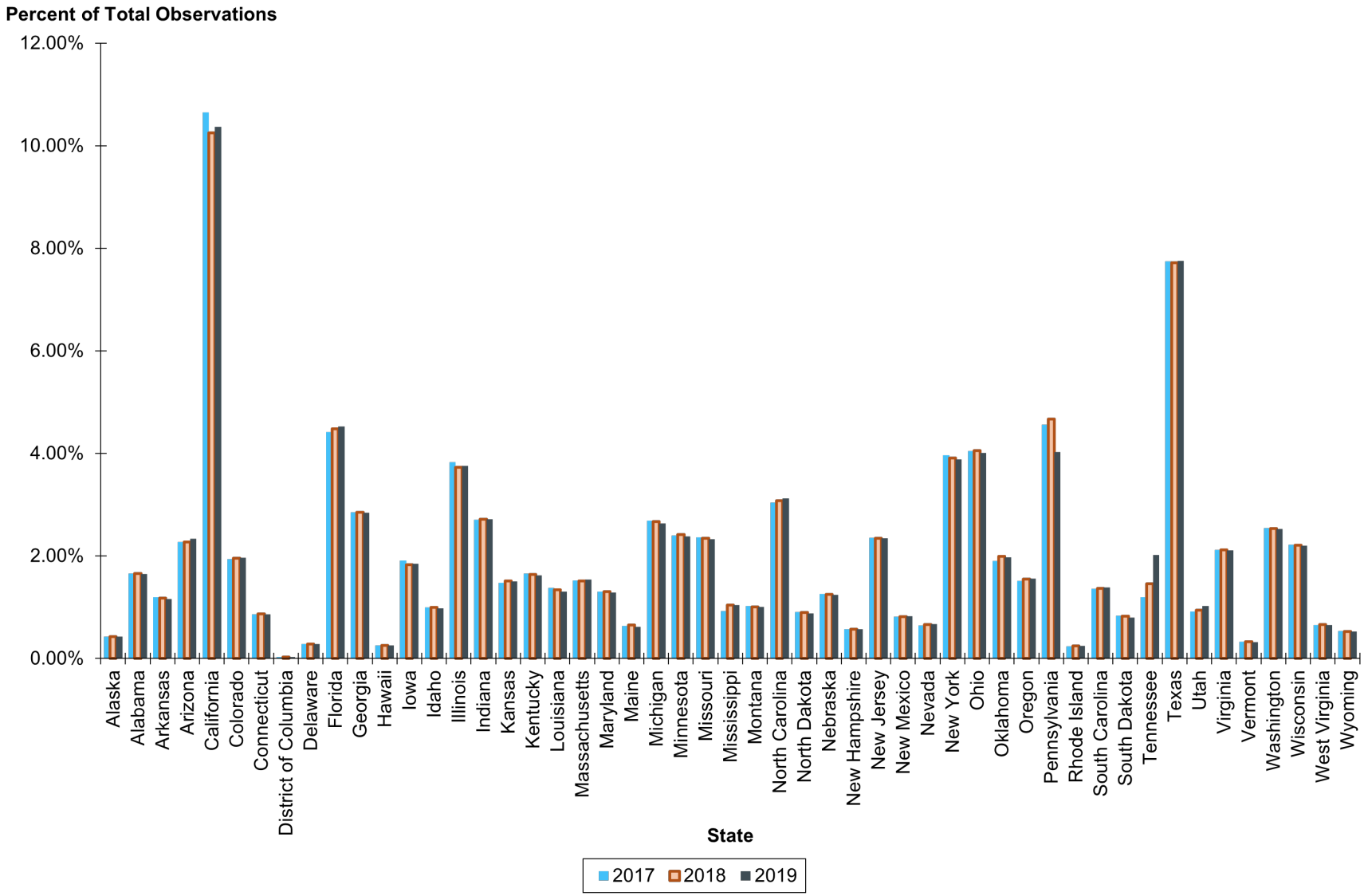

Figure 35. Chart. Distribution of vehicle registration by State plus the District of Columbia in the 2017–2019 heavy-duty vehicles data subsets.

(Source: Federal Highway Administration.)

The heavy-duty vehicles data subsets also contain information on how the vehicles in the registration data may actually be used in terms of vocation and industry sector. Table 9 contains a summary analysis of the "Vocation" variable in the heavy-duty vehicles data subsets. In total, 33 different vocations were contained in the data ranging from construction to sanitation. The most frequent vocation provided in the data was "Individual," which is believed to represent an owner/operator. On average, about 43 percent of the observations across the heavy-duty vehicles data subsets listed "Individual" as the vocation. The construction, services, and general freight vocations also feature prominently in the data representing on average about 9 percent, 8 percent, and 7 percent of vehicles, respectively.

Table 9. Summary of the heavy-duty vehicles data subsets by vocation.

Vocation	2017—Vehicle Count	2017—Percent of Total	2018—Vehicle Count	2018—Percent of Total	2019—Vehicle Count	2019—Percent of Total
Individual	3,941,458	42.73%	4,063,636	42.99%	4,150,740	42.65%
Construction	811,674	8.80%	844,444	8.93%	874,671	8.99%
Services	758,139	8.22%	785,172	8.31%	818,087	8.41%
General Freight	623,322	6.76%	658,372	6.96%	698,153	7.17%
Wholesale/Retail	412,851	4.48%	403,293	4.27%	409,602	4.21%
Government/ Miscellaneous	313,440	3.40%	317,310	3.36%	317,892	3.27%
Bus Transportation	283,352	3.07%	285,703	3.02%	289,585	2.98%
Agriculture/Farm	272,041	2.95%	278,366	2.94%	284,554	2.92%
Landscaping/ Horticulture	224,687	2.44%	235,061	2.49%	246,406	2.53%
Unclassified	208,802	2.26%	199,491	2.11%	227,492	2.34%
Manufacturing	211,559	2.29%	214,573	2.27%	220,973	2.27%
Lease/Finance	172,454	1.87%	170,383	1.80%	172,692	1.77%
Lease/Rental	130,404	1.41%	129,627	1.37%	134,138	1.38%
Petroleum	123,154	1.34%	126,451	1.34%	128,356	1.32%
Sanitation/Refuse	123,085	1.33%	118,362	1.25%	121,640	1.25%
Food Processing and Distribution	111,897	1.21%	112,733	1.19%	115,641	1.19%
Utility Services	99,054	1.07%	102,401	1.08%	106,576	1.10%
Dealer	89,412	0.97%	90,113	0.95%	90,727	0.93%

Table 9. Summary of the heavy-duty vehicles data subsets by vocation (continuation).

Vocation	2017—Vehicle Count	2017—Percent of Total	2018—Vehicle Count	2018—Percent of Total	2019—Vehicle Count	2019—Percent of Total
Emergency Vehicles	75,072	0.81%	75,367	0.80%	75,842	0.78%
Forestry/Lumber Products	62,806	0.68%	64,739	0.68%	65,831	0.68%
Road/Highway Maintenance	33,442	0.36%	33,447	0.35%	34,821	0.36%
Specialized/Heavy Hauling	32,964	0.36%	33,849	0.36%	34,682	0.36%
Moving and Storage	27,227	0.30%	27,527	0.29%	28,232	0.29%
Beverage Processing and Distribution	26,634	0.29%	26,660	0.28%	26,252	0.27%
Miscellaneous	22,246	0.24%	22,677	0.24%	22,876	0.24%
Mining/Quarrying	7,724	0.08%	7,735	0.08%	7,726	0.08%
Vehicle Transporter	6,143	0.07%	6,440	0.07%	6,689	0.07%
General Freight/Hazardous Materials	5,449	0.06%	5,826	0.06%	6,338	0.07%
Lease/Manufacturer Sponsored	6,099	0.07%	5,790	0.06%	5,745	0.06%
Hazardous Materials	3,557	0.04%	3,637	0.04%	3,705	0.04%
Sanitation/Hazardous Material	1,798	0.02%	1,977	0.02%	2,519	0.03%
Petroleum/Hazardous Material	2,127	0.02%	2,212	0.02%	2,263	0.02%
Utility/Hazardous Material	5	0.00%	7	0.00%	8	0.00%
Total	**9,224,078**	**100.00%**	**9,453,381**	**100.00%**	**9,731,454**	**100.00%**

The "NAICSCode" field in the heavy-duty vehicles data subsets contain the six-digit North American Industry Classification System (NAICS) code, indicating the primary industry sector to which the vehicle belongs. The NAICS is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy.[2] Figure 36 shows the distribution of vehicles across the heavy-duty vehicles data subsets using the first two digits of their reported NAICS codes, which provides a more general overview of their primary industry sectors.

While the majority of observations in the heavy-duty vehicles data subsets either do not report any information on primary industry (i.e., "Not Given") or correspond to establishments that are nonclassifiable (i.e., a 2-digit NAICS equal to 99), there is some information that may be useful

[2] https://www.census.gov/eos/www/naics/.

for determining FHWA and NHTSA classifications. For instance, construction (NAICS 23), transportation (NAICS 48), wholesale trade (NAICS 42), public administration (NAICS 92), waste management (NAICS 56), and agriculture (NAICS 11) feature prominently in the data as shown in figure 36. Collectively, these industries comprise about 19 percent of the data.

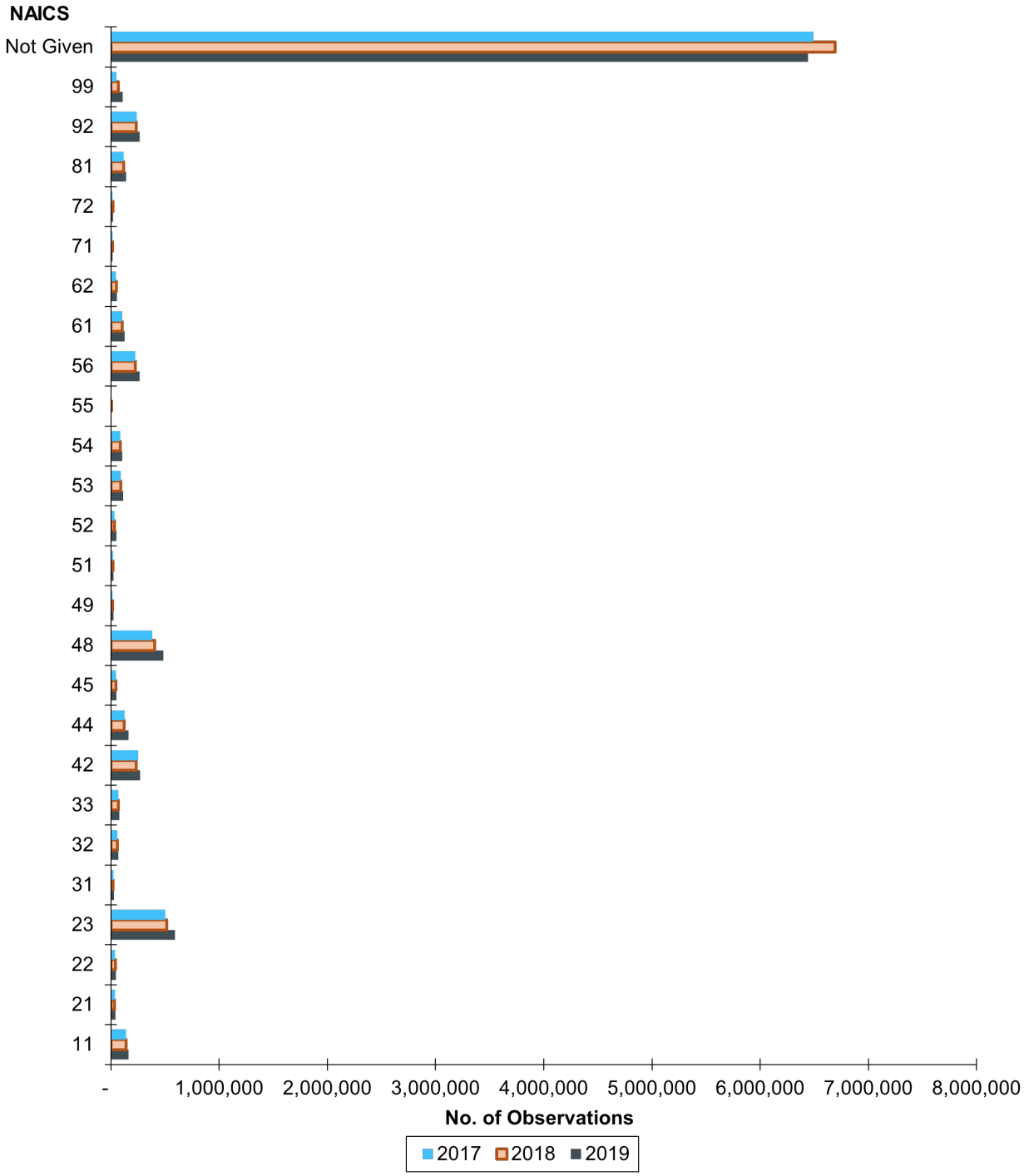

Figure 36. Chart. Distribution of industries in the 2017–2019 heavy-duty vehicles data sets.

(Source: Federal Highway Administration.)

3.0 Classifying the Vehicle Data

This section of the report outlines the process by which the observations in the vehicle registration data subsets were assigned to a Federal Highway Administration (FHWA) 13-vehicle classification system (FHWA-13), FHWA 6-vehicle classification system (FHWA-6), and National Highway Traffic Safety Administration (NHTSA) classification. But, it first begins with a discussion of those classification systems, including the definitions used to distinguish between classes as contained in the documents that establish the classification systems. In addition to the classification systems that are the primary subject of this study, the report also includes a discussion of the NHTSA 8-vehicle gross vehicle weight rating (GVWR) classification system (NHTSA-8). This system is important as the vehicle registration data contains that classification as a data field.

Understanding the Federal Highway Administration and National Highway Traffic Safety Administration Classification Systems

Federal Highway Administration 6-Vehicle Classification System

The 6-vehicle classification used by the FHWA is defined in table VM-1 of the Highway Statistics publication.[3] It includes the following vehicle categories: Motorcycles, Buses, Light-Duty Vehicles Short Wheelbase, Light-Duty Vehicles Long Wheelbase, Single-Unit Trucks, and Combination Trucks. Each vehicle category is described in greater detail below:

- Motorcycles—Two- or three-wheel motorized vehicles.
- Buses include all buses, including passenger carrying vehicles.
- Light-Duty Vehicles Short Wheelbase represents passenger cars, light trucks, and sport utility vehicles with a wheelbase less than or equal to 121 inches.
- Light-Duty Long Wheelbase represents large passenger cars, vans, pickup trucks, and sport utility vehicles with wheelbase greater than 121 inches.
- Single-unit trucks are single frame trucks that have 2 axles and at least 6 tires or a GVWR exceeding 10,000 lbs.
- Combination trucks are all trucks which do not fall under single unit trucks.

Federal Highway Administration 13-Vehicle Classification System

In addition to the 6-vehicle classification system, the FHWA also uses a 13-vehicle classification system as described in the Traffic Monitoring Guide (TMG). This system distinguishes between vehicle types primarily on the basis of number of tires, number of axles, and the type of body frame (i.e., single or multiple units). Figure 37 depicts the types of vehicles that fall under the 13 categories included in the classification system.

[3] Federal Highway Administration, Highway Statistics, 2016.

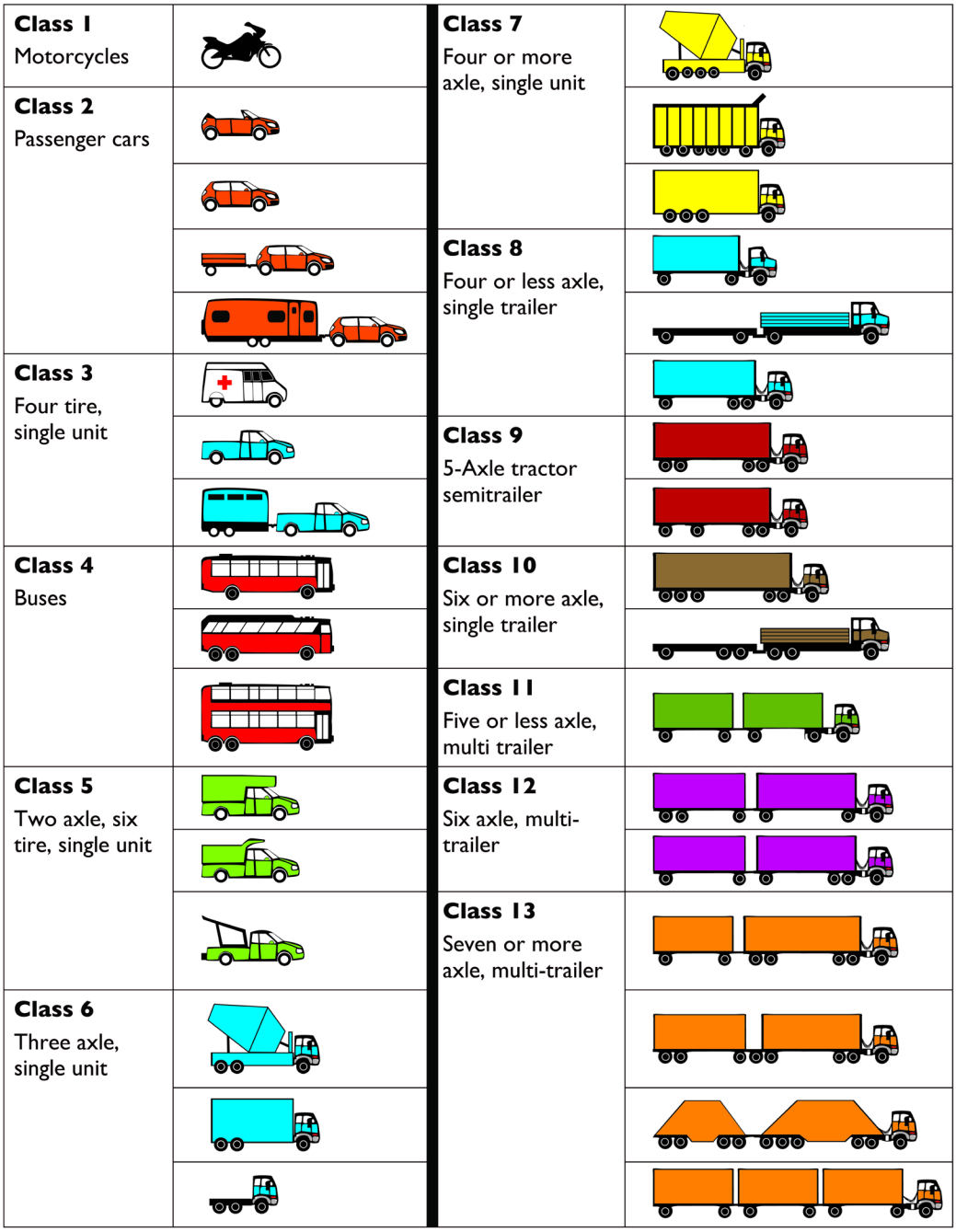

Figure 37. Illustration. Federal Highway Administration 13-vehicle category classification.

(Source: Federal Highway Administration, Figure C-1, Traffic Monitoring Guide, Updated: October 2016.)

The specific categories included in the 13-vehicle system are described below:

- Class 1 vehicles consist of Motorcycles which are defined two or three wheeled motorized vehicles. This includes motorcycles, mopeds, motor-powered, bicycles and three-wheel motorcycles.

- Class 2 vehicles consist of sedans, coupes, and station wagons that are manufactured to be used to transport passengers but also may be used to tow recreational or other light trailers. All these vehicle types are considered passenger cars in the 13-vehicle system.
- Class 3 vehicles are all four-tire, single-unit vehicles not considered to be passenger cars. These include pick-up trucks, panels, vans, campers, motor homes, ambulances, hearses, carryalls, and minibuses.
- Class 4 vehicles are all buses, including school buses used as passenger carrying vehicles.
- Class 5 vehicles consist of two-axle, six-tire, single-unit trucks. It includes all vehicles with a single frame, including trucks, camping and recreational vehicles, and motor homes with two axles and dual rear wheels.
- Class 6 vehicles are single-unit vehicles with three axles. They include all vehicles on a single frame, including trucks, camping and recreational vehicles, and motor homes.
- Class 7 vehicles are single-unit vehicles with four or more axles. This category includes all trucks on a single frame with four or more axles.
- Class 8 vehicles are single-trailer trucks with four or fewer axles. This category includes all vehicles consisting of two units, one of which is a tractor or straight truck power unit.
- Class 9 vehicles are those with five axles and two units, one of which is a tractor or straight truck power unit.
- Class 10 vehicles are those with six or more axles consisting of two units, one of which is a tractor or straight truck power unit.
- Class 11 vehicles are all vehicles with five or fewer axles and three or more units. One of the three units in class 11 vehicles is a tractor or straight truck power unit.
- Class 12 vehicles are all vehicles with six axles and consist of three more units. One of the units is a tractor or straight truck power unit.
- Class 13 vehicles are those with seven or more axles and three or more units. One of the units is a tractor or straight truck power unit.

National Highway Traffic Safety Administration Classification System

The U.S. Department of Transportation (DOT) NHTSA classifies vehicles based on specifications prescribed in 49 Code of Federal Regulations (CFR) Part 523—VEHICLE CLASSIFICATION. The NHTSA gross vehicle weight classification system to be used in this scope of work is defined in table II of 49 CFR Part 565 as shown in table 10. It divides vehicles into 14 different classes based solely on their GVWRs.

Table 10. Gross vehicle weight rating classes.

Vehicle Class	Description
Class A	Not greater than 1,360 kg (3,000 lbs)
Class B	Greater than 1,360 kg to 1,814 kg (3,001–4,000 lbs)
Class C	Greater than 1,814 kg to 2,268 kg (4,001–5,000 lbs)
Class D	Greater than 2,268 kg to 2,722 kg (5,001–6,000 lbs)
Class E	Greater than 2,722 kg to 3,175 kg (6,001–7,000 lbs)
Class F	Greater than 3,175 kg to 3,629 kg (7,001–8,000 lbs)
Class G	Greater than 3,629 kg to 4,082 kg (8,001–9,000 lbs)
Class H	Greater than 4,082 kg to 4,536 kg (9,001–10,000 lbs)
Class 3	Greater than 4,536 kg to 6,350 kg (10,001–14,000 lbs)
Class 4	Greater than 6,350 kg to 7,257 kg (14,001–16,000 lbs)
Class 5	Greater than 7,257 kg to 8,845 kg (16,001–19,500 lbs)
Class 6	Greater than 8,845 kg to 11,793 kg (19,501–26,000 lbs)
Class 7	Greater than 11,793 kg to 14,968 kg (26,001–33,000 lbs)
Class 8	Greater than 14,968 kg (33,001 lbs and over)

The NHTSA classification is often condensed into an 8-vehicle system (NHTSA-8) that categorizes vehicles by GVWR.[4] Table 11 shows the 8-vehicle gross vehicle weight rating classification system. This vehicle class is important because the vehicle registration data includes it as a field in the mixed-duty vehicles and heavy-duty vehicles data subsets.

Table 11. National Highway Traffic Safety Administration 8-vehicle gross vehicle weight rating classes.

Vehicle Class	Description
Class 1	< 6,000 lbs
Class 2	6,001–10,000 lbs
Class 3	10,001–14,000 lbs
Class 4	14,001–16,000 lbs
Class 5	16,001–19,500 lbs
Class 6	19,501–26,000 lbs
Class 7	26,001–33,000 lbs
Class 8	> 33,001 lbs

[4] https://afdc.energy.gov/data/.

Vehicle Classification as Registered Versus Classification as Typically Used

It is important to note a limitation of using vehicle registration data to determine FHWA-13 class. There is a difference between vehicle classification as registered versus vehicle classification as used in travel or goods movement. Vehicle classification as registered depends on the physical characteristics (e.g., number of tires, number of axles, and body style, etc.) of a vehicle as manufactured, while the FHWA classification systems consider both physical characteristics and usage. For example, some vehicles are equipped with floating axles that can be raised or lowered depending on the needs of the driver. With the floating axles raised, a vehicle may correspond to a different classification than if they were lowered. Vehicle registration data, however, reports the total number of axles and does not provide information on how often those axles may be raised or lowered when in use. This impacts the ability of vehicle registration data to accurately reflect the FHWA classes.

In addition, trailers may be registered separately from vehicles. In the case of truck tractors hauling trailers, States allow for trailers to be registered along with the power unit. As a result, the characteristics of the trailer are included along with information on the power unit as part of vehicle registration data sets. However, for pickup trucks, motor homes, and other vehicle types, trailers are registered separately. Thus, certain configurations will not be present in vehicle registration data sets, such as a full-size pickup hauling a one-axle camper and a one-axle boat, which would be recorded as a FHWA-13 class 5 vehicle. Similarly, a two-axle truck tractor hauling two two-axle truck tractors in a piggyback configuration would not be captured in vehicle registration data, but would be classified as FHWA-13 class 5.

Process for Assigning the Federal Highway Administration 13-Vehicle Classification to the Vehicle Registration Data

This section of the report outlines the processes by which the vehicles in the vehicle registration data set were assigned to an FHWA-13 classification. It is organized by data subset: Motorcycles, Cars, Mixed-Duty Vehicles, and Heavy-Duty Vehicles.

Assigning Federal Highway Administration 13-Vehicle Classification for the Motorcycles Data Subsets

The motorcycles data subsets includes vehicles that may be considered motorcycles as defined in appendix C of the TMG, as well as off-roadway recreational vehicles that would not be considered motorcycles. The “VEHCAT” field in the Motorcycles data file is used to make the distinction between motorcycles as defined in the 13-vehicle classification system and all other two- or three-wheeled motorized vehicles. Note that off-highway and all-terrain vehicles may have three or four tires and are typically restricted to off-road travel. However, for this analysis off-highway and all-terrain vehicles are included as motorcycles as defined in the 13-vehicle classification system.

Assigning Federal Highway Administration 13-Vehicle Classification for the Cars Data Subsets

The cars data subsets only contains vehicles that may be considered class 2 Passenger Cars as defined in appendix C of the TMG. However, some body styles as contained in the field "BODY_TYPE" may not be considered vehicles in their current State. Specifically, the "COMMERCIAL CHASSIS" body style may not be considered a vehicle as it cannot be driven on a public roadway. However, the analysis assumes that these will eventually be completed and operable on a public roadway. The analysis further assumes that all observations in these data subsets meet the FHWA-13 classification system definition of passenger cars as defined in appendix C of the TMG. This includes all sedans, coupes, and station wagons manufactured primarily for the purpose of carrying passengers and including those passenger cars pulling recreational or other light trailers.

Assigning Federal Highway Administration 13-Vehicle Classification for the Mixed-Duty Vehicles Data Subsets

The mixed-duty vehicles data subsets contain vehicles that may be considered FHWA-13 class 3, class 4, or class 5 in the FHWA-13 classification system. Importantly, observations in the mixed-duty vehicles data files with a reported GVWR equal to 3 are duplicated in the heavy-duty vehicles data subsets. Because of this, those observations were deleted in the mixed-duty vehicles data subsets.

Vehicles in FHWA-13 classes 3, 4, and 5 are distinguished from each other using two vehicle characteristics: body style and number of tires. While body style is observed in the vehicle registration data, number of tires is not. This section of the report describes the methodology used to assign the FHWA-13 vehicle classification to observations in the mixed-duty vehicles data files, including its approach for distinguishing between two-axle, four-tire and two-axle, six-tire vehicles (i.e., FHWA-13 class 3 and 5). Importantly, the methodology relied on information contained in the 2002 Vehicle Inventory and Use Survey (VIUS) which is described in greater detail in the section that follows.

Insights from the 2002 Vehicle Inventory and Use Survey

One of the primary challenges in classifying vehicle registration data for observations in the mixed-duty vehicles data subsets was distinguishing between FHWA-13 class 3 and 5 vehicles. According to the FHWA-13 classification scheme, these vehicles are distinguished by number of tires. Vehicles in FHWA-13 class 3 have two-axle configurations with four tires while those in class 5 have two-axle configurations with six tires (see figure 38 for examples of class 5 vehicles). The vehicle registration data does not report number of tires. As a result, the methodology relied on different vehicle characteristics identified in the 2002 VIUS that may act as a proxy for number of tires.

Figure 38. Photograph. Examples of class 5 vehicles.

(Source: Tires & Wheels Step Van in South Philly by Ezra Wolfe, licensed under CC BY-SA 2.0, https://www.flickr.com/photos/ezraw/3759784455/; White Super Duty Dually by Truck Hardware, licensed under CC BY 2.0., https://www.flickr.com/photos/truckhardware/47632213221; and Fire Truck by Ewan Traveler, licensed under CC BY 2.0, https://www.flickr.com/photos/ewan_traveler/2639115382/.)

The VIUS has been the principal data source on the physical and operational characteristics of the United States truck population.[5] Its primary goal is to gain an understanding nationally and statewide on how trucks are being utilized for various goods transport. The VIUS is the only publicly available database with vehicle attributes that are both operational and administrative. As a result, it is the only opportunity to observe both the missing and present variables and determine the relationships between the two for an accurate classification of the data. Though more recent data would have been preferred, 2002 was the most recent data available. The process by which data from the 2002 VIUS was used to identify those characteristics is shown in figure 39.

[5] https://www.bts.gov/vius.

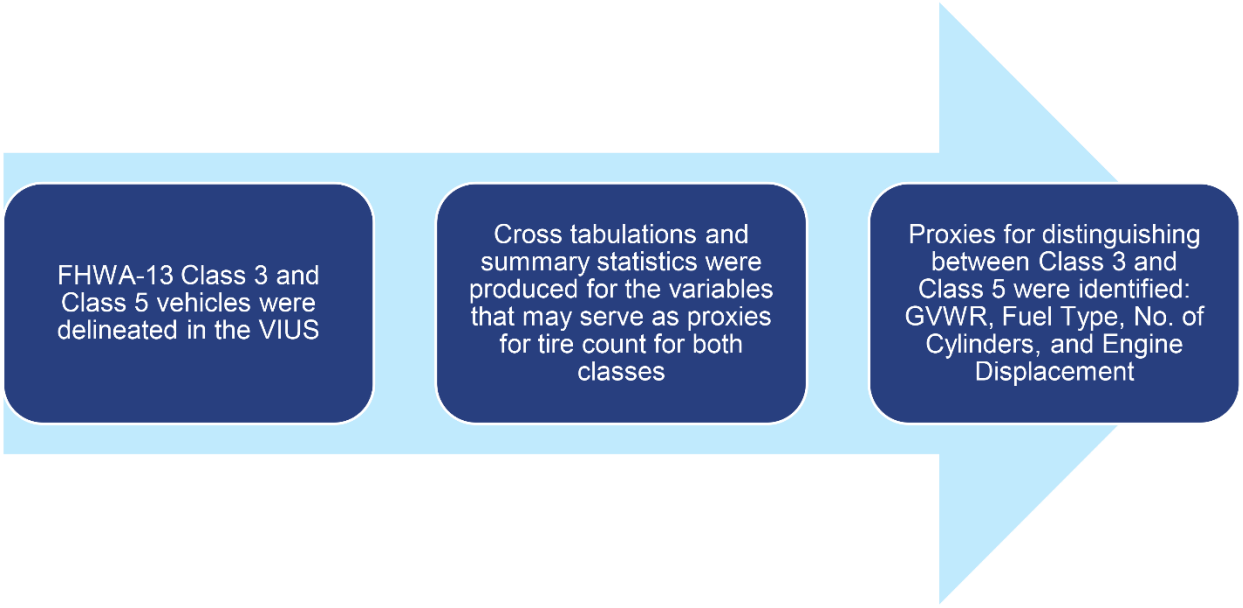

Figure 39. Flowchart. Process for identifying proxy variables for tire count in 2002 Vehicle Inventory and Use Survey.

(Source: Federal Highway Administration.)

First, using information on tire count and axle configurations, FHWA-13 class 3 and 5 vehicles were identified in the VIUS. Next, cross-tabulations and summary statistics were produced for a number of variables that would potentially be good candidates as proxies for tire count. From the analysis results, a set of proxy variables for tire count were selected and a strategy for using them within the assignment methodology was developed. Ultimately, vehicle characteristics, including GVWR, fuel type, engine size in terms of number of cylinders, and vehicle length were selected as the set of proxy variables based on the information in the VIUS. The figures and paragraphs that follow illustrate why those variables were selected and the insights gleaned from the analysis that are useful for distinguishing between FHWA-13 class 3 and 5 vehicles in the vehicle registration data.

The first vehicle characteristic identified to serve as a proxy variable for tire count was GVWR. As the GVWR indicates the maximum safe weight of the vehicle (i.e., curb weight plus fuel, passengers, equipment, and cargo), it is related to tire count as vehicles with more tires can typically carry more weight than those with fewer tires. The analysis of the 2002 VIUS results indicated that approximately 99 percent of two-axle, four-tire vehicles have a GVWR of 1 or 2, while only about 35 percent of two-axle, six-tire vehicles have a GVWR of 2 or less (see figure 40). This result implies that observations in the mixed-duty vehicles data files of the vehicle registration data with a GVWR greater than or equal to 3 are indicative of a two-axle, six-tire configuration (i.e., FHWA-13 class 5). However, further analysis was needed to determine what additional factors are needed to distinguish the 35 percent of two-axle, six-tire with a GVWR of 2 or less from two-axle, four-tire vehicles.

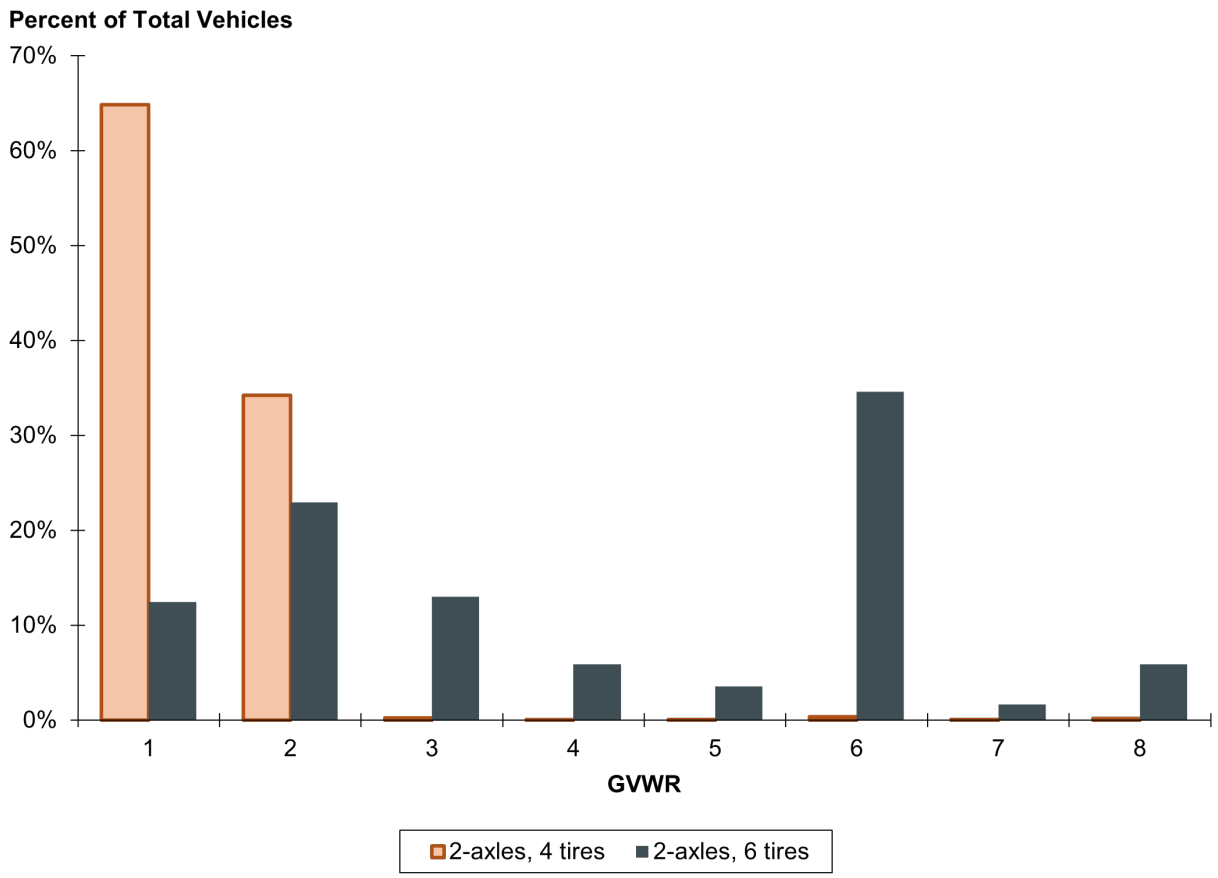

Figure 40. Chart. Gross vehicle weight rating for two-axle, four-tire and two-axle, six-tire vehicles in the 2002 Vehicle Inventory and Use Survey.

(Source: Federal Highway Administration 2002 Vehicle Inventory and Use Survey; Federal Highway Administration.)

To determine the vehicle characteristics that may be used to distinguish the 35 percent of two-axle, six-tire vehicles observed in VIUS with a GVWR ≤ 2, the analysis was narrowed to focus in on this subset of the data. The next vehicle characteristic examined in the analysis was fuel type. As shown in figure 41, the data showed that 94 percent of these vehicles used diesel or gasoline as fuel types while other types of fuel (e.g., propane, natural gas, electricity, etc.) were much less prevalent. Thus, the assignment methodology for mixed-duty vehicles assumes that a vehicle included in the mixed-duty vehicles registration data subset with a GVWR ≤ 2 and with a diesel or gasoline fuel type is indicative of a two-axle, six-tire vehicle (i.e., FHWA-13 class 5). Though these two characteristics in combination may be indicative of a FHWA-13 class 5 vehicle, they are not sufficient on their own for distinguishing FHWA-13 class 5 vehicles from class 3.

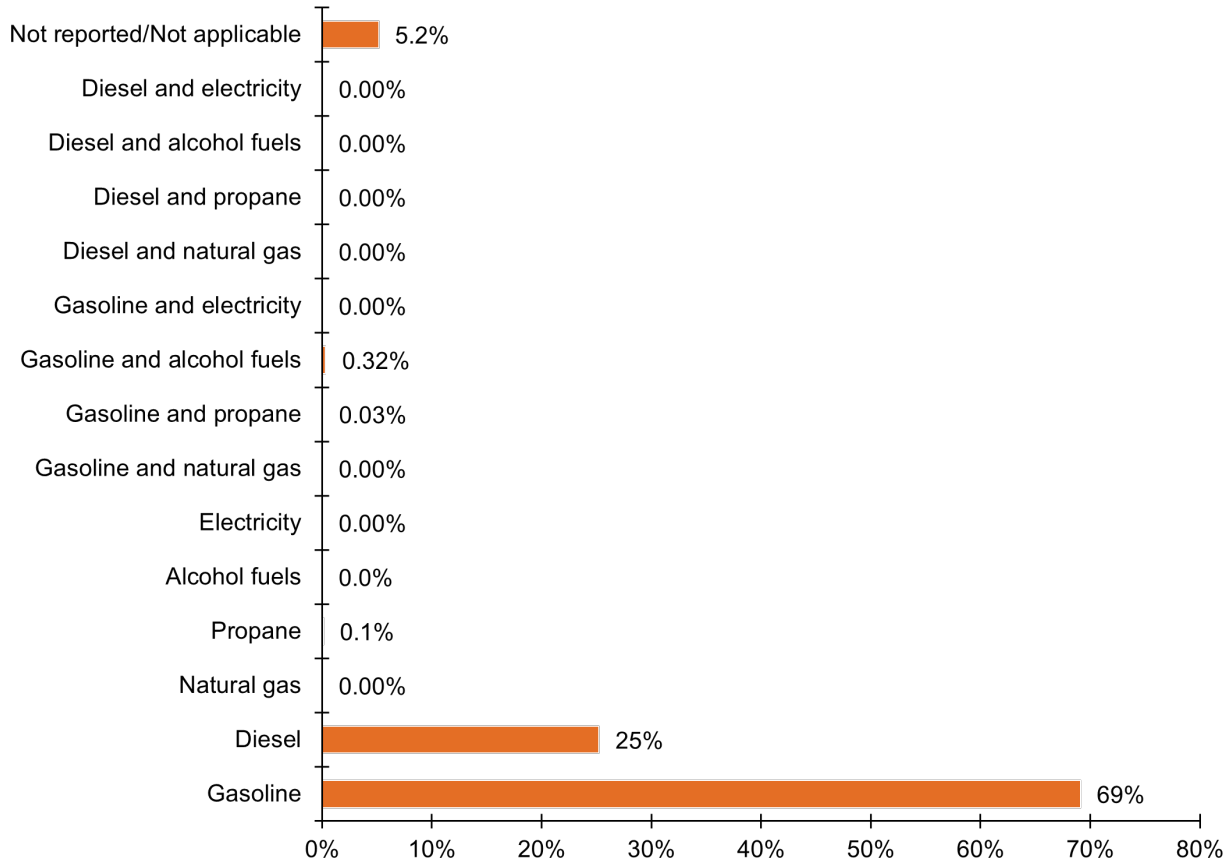

Figure 41. Chart. Fuel type for two-axle, six-tire vehicles with gross vehicle weight rating ≤ 2 in the 2002 Vehicle Inventory and Use Survey.

(Source: Federal Highway Administration 2002 Vehicle Inventory and Use Survey; Federal Highway Administration.)

The next vehicle characteristic examined was engine size as captured by number of cylinders. Of the 35 percent of two-axle, six-tire vehicles with a GVWR ≤ 2, over two-thirds use diesel as fuel (see figure 41). Within that group, the vast majority of vehicles have six- or more cylinder engines (see figure 42). This suggests that a vehicle included in the mixed-duty vehicles registration data subset with a GVWR ≤ 2 and that uses diesel as fuel is indicative of a FHWA-13 class 5 (i.e., two-axle, six-tire) vehicle.

Of the 35 percent of two-axle, six-tire vehicles with a GVWR ≤ 2, about one-quarter use gasoline as fuel (see figure 41). Within that group, the majority have six- or more cylinder engines but a significant portion have four-cylinder engines (see figure 42). This suggests that while a vehicle in the mixed-duty vehicles data subset with a GVWR ≤ 2 and that uses gasoline as fuel also is indicative of a FHWA-13 class 5, the combination of those factors alone is not sufficient to distinguish it from FHWA-13 class 3.

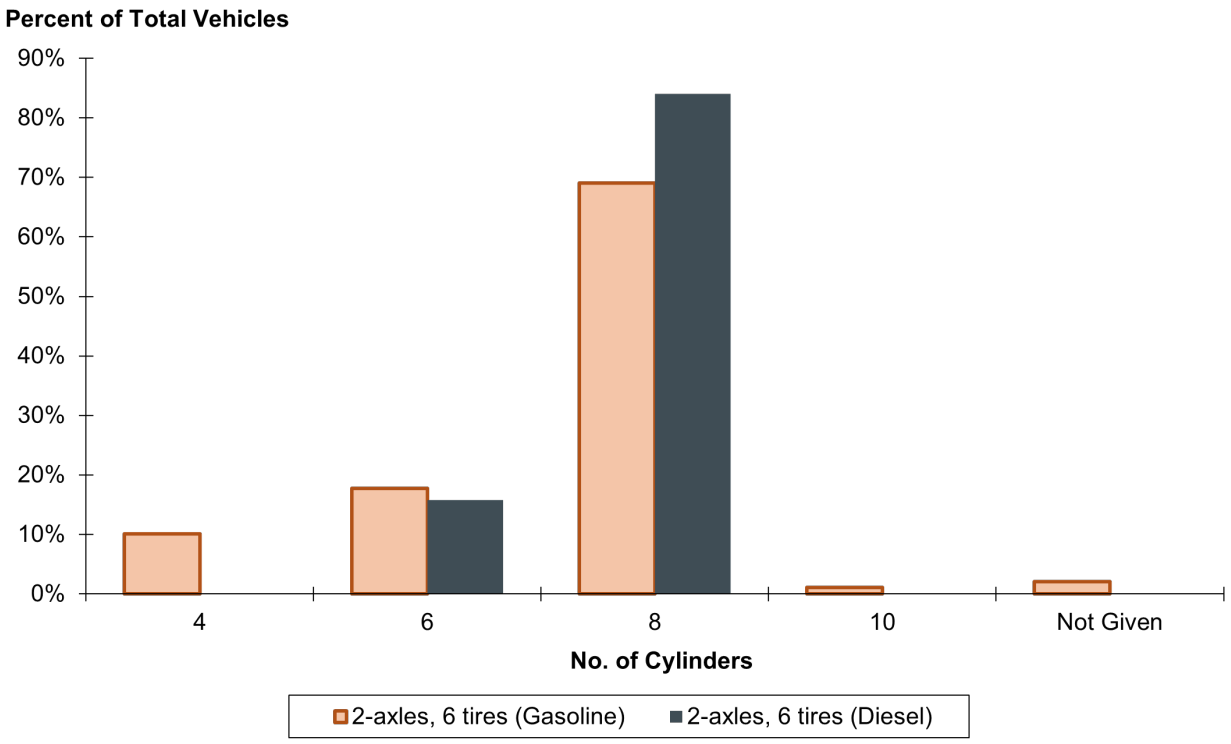

Figure 42. Chart. Fuel type and number of cylinders for two-axle, six-tire vehicles with gross vehicle weight rating ≤ 2 in the 2002 Vehicle Inventory and Use Survey.

(Source: Federal Highway Administration 2002 Vehicle Inventory and Use Survey; Federal Highway Administration.)

The next vehicle characteristic examined was engine displacement, specifically for two-axle, six-tire vehicles with GVWR ≤ 2 and four-cylinder gasoline engines. The purpose was to determine if engine displacement could be used to further distinguish this subset of FHWA-13 class 5 vehicles from FHWA-13 class 3. The analysis showed that all of these vehicles have engines that can displace at least 100 cubic inches of fuel. This suggests that engine displacement in combination with GVWR, fuel type, and engine size in terms of number of cylinders could be used to distinguish them from FHWA-13 class 3.

Figure 43 summarizes all of the information above. It depicts how the analysis of VIUS data of two-axle, six-tire and two-axle, four-tire vehicles increasingly narrowed its focus down to the key vehicle characteristics that may be used to distinguish FHWA-13 class 5 (i.e., two-axle, six-tire vehicles) from class 3 (i.e., two-axle, four-tire vehicles). It also shows the key assumptions made during this process that were ultimately incorporated into the FHWA-13 classification assignment methodology for observations in the mixed-duty vehicles data files.

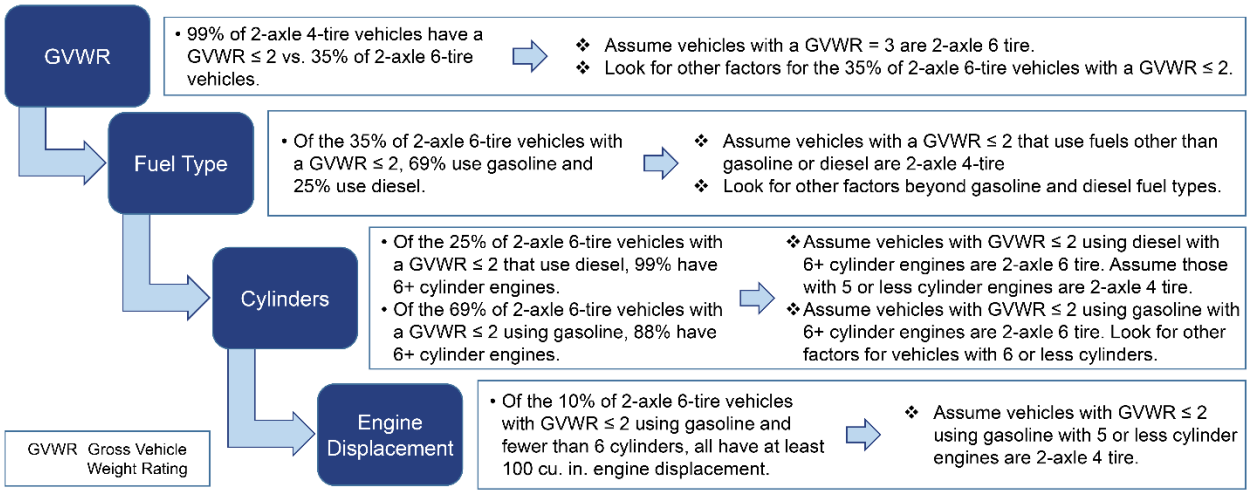

Figure 43. Flowchart. Incorporating the proxy variables into the mixed-duty vehicles assignment methodology.

(Source: Federal Highway Administration.)

Methodology

There are four characteristics in the registration data that the methodology used to distinguish observations in the mixed-duty vehicles data files among the three relevant FHWA-13 classes (i.e., class 3, 4, and 5): body style, fuel type, engine size in terms of number of cylinders, and wheelbase length. As shown in figure 44, the process began by observing that vehicles with certain body styles are readily identifiable as class 4 or are generally likely to have six-tire configurations. Specifically, observations in the mixed-duty vehicle registration data sets that report a body type of "Bus School" or "Bus Non School" as contained in the "BODY_STYLE" field were classified as FHWA-13 class 4 as body type is the sole determining characteristic for that class. For observations that report a body type of "Fire Truck" or "Tractor Truck," the methodology assigned these vehicles to FHWA-13 class 5 as these body types are believed to generally have six-tire configurations.

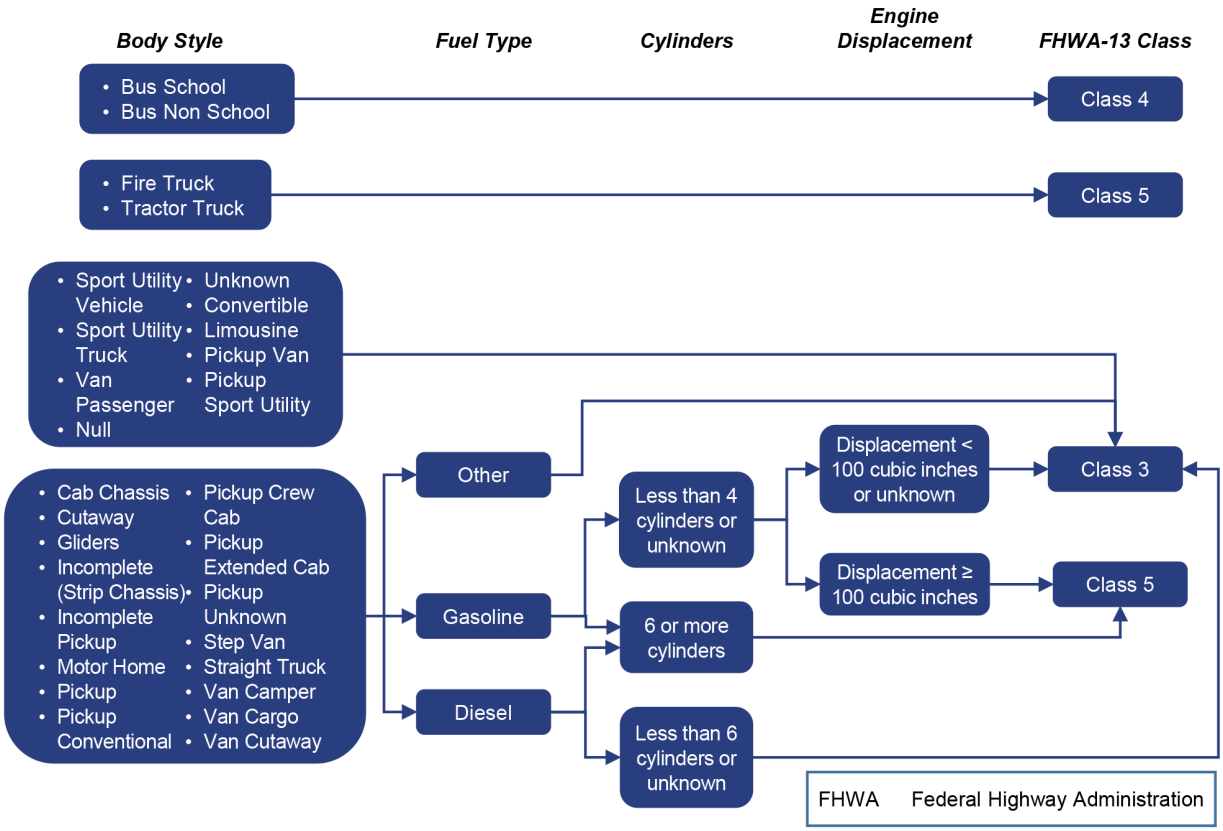

Figure 44. Flowchart. Process for classifying observations in the mixed-duty vehicles data files.

(Source: Federal Highway Administration.)

Just as some body types were assumed to generally have six-tire configurations, others were assumed to have four-tire configurations while some may have either configuration. These assumptions were incorporated in the assignment methodology (see figure 45). Body types such as sport utility vehicles, passenger vans, and limousines, among others, were assumed to have four-tire configurations. Thus, observations in the mixed-duty vehicles data subsets with those body types were assigned to FHWA-13 class 3.

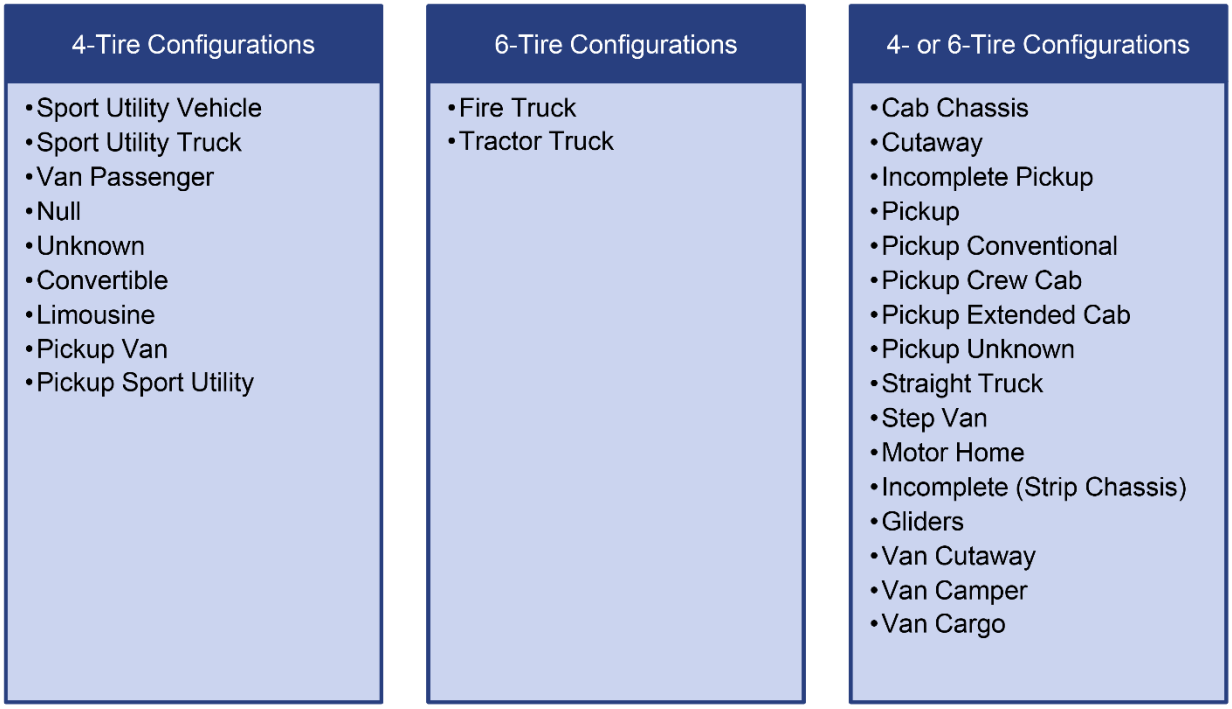

Figure 45. Graphic. Assumed number of tires and axles for mixed-duty vehicles based on body style.

(Source: Federal Highway Administration.)

Other vehicles in the mixed-duty vehicles data subsets may have four- or six-tire configurations (e.g., straight trucks, step vans, motor homes, and pickups, etc.). For observations with body types that may feature four- or six-tire configurations as contained in figure 45, additional characteristics were examined in order to distinguish four-tire configurations from six-tire configurations and ultimately determine their FHWA-13 classification. These included fuel type, engine size in terms of number of cylinders, and wheelbase and were identified using the results of the analysis of VIUS data as previously discussed.

The portion of the assignment process for vehicles that may have four- or six-tire configurations began by examining their fuel type. As the results of the VIUS analysis indicated that the vast majority of two-axle, six-tire vehicles use gasoline or diesel as fuel, those that use other fuel types were assigned to FHWA-13 class 3. The process then moved on to vehicles with diesel and gasoline fuel types. For both of these fuel types, the assignment process examined the engine size of the vehicles in terms of number of cylinders. Diesel vehicles with six- or more cylinder engines were assigned to FHWA-13 class 5 as the analysis of VIUS data suggested that engines of that size or larger are indicative of a two-axle, six-tire configuration. Those with engine sizes below the six-cylinder threshold were assigned to FHWA-13 class 3.

Like the portion of the assignment process for diesel vehicles, gasoline vehicles with engine sizes exceeding the six-cylinder threshold were assigned to FHWA-13 class 5. However, for

those with engine sizes smaller than six cylinders, the process examined the engine displacement prior to determining FHWA-13 class. The analysis of VIUS data showed that engines that can displace at least 100 cubic inches total volume of fuel/air mixture were indicative of FHWA-13 class 5, while those below that threshold suggested class 3. The methodology assigned FHWA-13 class based on that observation from the VIUS.

Two body styles represented in the mixed-duty vehicles data subsets would not be considered a vehicle under the FHWA-13 classification system, Strip Chassis and Gliders. Strip Chassis are incomplete vehicles consisting of a ladder frame truck chassis equipped with engine, transmission, steering, brakes, alternator, wiring assemblies, fuel tanks, wheels, and tires.[6] Similarly, Gliders are incomplete vehicles from a manufacturer that lack an engine and transmission.[7] Manufacturer-designated modifiers, motorhome manufacturers, and others later build finished vehicles on the chassis or glider kit. However, this study assumes that these vehicles will eventually be completed and thus assigned them to an FHWA-13 class.

Assigning Federal Highway Administration 13-Vehicle Classification for the Heavy-Duty Vehicles Data Subsets

The heavy-duty vehicles data subsets contain vehicles that may be considered FHWA-13 class 3 to 13 based on characteristics, including body style ("VehicleType"), drivetrain configuration ("Wheels"), GVWR ("GVW"), and rear axle type ("RearAxle") (e.g., single or tandem). In the "A x B" format, the drivetrain configuration indicates the total number of wheels on the vehicle (i.e., "A") and the number of wheels receiving power from the engine (i.e., "B"). This information allows us to infer the number of axles by dividing the total number of reported wheels by 2 as shown in table 12. With the number of axles known, the potential 13-vehicle classifications for each vehicle in the data sets narrows.

[6] https://media.ford.com/content/fordmedia/fna/us/en/products/commercial/stripped-chassis/2018-ford-f53-f59-stripped-chassis.html#:~:text=Called%20stripped%20chassis%2C%20these%20incomplete,fuel%20tank%2C%20wheels%20and%20tires.

[7] https://www.fitzgeraldgliderkits.com/what-is-a-glider-kit/#:~:text=A%20glider%20kit%20is%20a,of%201%20year%2F%20100k%20miles.

Table 12. Assumptions on the number of axles and tires from the wheels field.

Wheels	No. of Axles	Potential Federal Highway Administration 13-Vehicle Classification System Class
4 x 2	2	Class 3, 4, 5, 8, or 11
4 x 4	2	Class 3, 4, 5, 8, or 11
6 x 4	3	Class 4, 6, 8, or 11
6 x 2	3	Class 4, 6, 8, or 11
6 x 6	3	Class 4, 6, 8, or 11
8 x 4	4	Class 7, 8, or 11
8 x 6	4	Class 7, 8, or 11
8 x 8	4	Class 7, 8, or 11
8 x 2	4	Class 7, 8, or 11
10 x 4	5	Class 7, 9, or 11
10 x 6	5	Class 7, 9, or 11
10 x 2	5	Class 7, 9, or 11
10 x 8	5	Class 7, 9, or 11
12 x 6	6	Class 7, 10, or 12
12 x 4	6	Class 7, 10, or 12
14 x 6	7	Class 7, 10, or 13
14 x 4	7	Class 7, 10, or 13
Unknown		

The general approach for classifying the vehicles in the heavy-duty vehicle data sets first segments the data based on number of axles—two to seven axles. Within each axle count segment, the approach then develops a process specific to body types within those segments. The remainder of this section of the report outlines those processes for classifying heavy-duty vehicles within the axle count segments. Importantly, the processes outlined in the subsections that follow also relied on insights from the *FHWA Vehicle Inventory, Data for Efficient Goods Movement and Freight Analysis* report. Given the significant changes in vehicle configurations and various new vehicles on the roadway since the last update of the VIUS, the *FHWA Vehicle Inventory, Data for Efficient Goods Movement and Freight Analysis* report was conducted to enhance FHWA's vehicle inventory with pictorial illustrations and associated body, axle, and tire dimensions. As a result, it was a valuable source of information on how the physical characteristics observed in the vehicle registration data may correspond to heavy-duty vehicles observed on the roadway.

Importantly, it should be noted that the registration data does not report information on the presence or number of trailers. Without this information, it is difficult to distinguish between single- and multi-trailer configurations with certainty. Because of this, the classification processes outlined in the following sections aggregates FHWA-13 classes 8 through 13 into a single group (i.e., "class 8–13").

Two-Axle Heavy-Duty Vehicles

The *FHWA Vehicle Inventory, Data for Efficient Goods Movement and Freight Analysis* report found 19 different vehicle configurations that may be categorized as FHWA-13 class 5. As shown in table 13, these include vehicles ranging from full-size "dually" pickup trucks to cranes. It should be noted that table 13 reduces the number of vehicle configurations to 17 as some configurations are very similar.

Table 13. Federal Highway Administration 13-vehicle classification system class 5 vehicle configurations.

Vehicle Configuration	Description
Full-Size "Dually" Pickup	Pickup trucks with six tires.
Small Mini Motorhome	Motorhomes with a length of about 18 feet and a height of about 9 feet.
Small Full-Size Motorhome	Motorhomes with a length of about 26 feet and a height of about 10 feet.
Small Delivery Van	Delivery vans with a length of about 16 feet and a height of about 8 feet (such as a U.S. Postal Service delivery vehicle).
Mid Size Delivery Van	Delivery vans with a length of about 14 feet and a height of about 5 feet with sliding door entry to the cargo compartment.
Full-Size Delivery	Delivery vans with a length of about 20 feet and a height of about 7.5 feet with rear door entry to the cargo compartment.
Grain Truck	Trucks with an open bed and a hydraulic lift typically used to transport grains and other agricultural goods.
Concrete Truck	Trucks with concrete mixers.
Short Flatbed Truck	Truck with a flat, level bed with no sides or roof that measures about 22 feet in length and 10 feet in height.
Long Flatbed Truck	Truck with a flat, level bed with no sides or roof that measures about 33 feet in length and 8 feet in height.
Tanker Truck	Trucks with a tank as a bed to transport liquids.
Road Maintenance (Front and Rear Bumpers)	Trucks with features for road maintenance work (e.g., water sprayers, paint stripers, street sweepers, etc.).
Cab Over Tractor	Tractor power unit with the driver compartment directly above the front axle.
Conventional Tractor	Tractor power unit with the driver compartment set back from the front axle.
Fire Truck	Trucks that may be commonly referred to as fire engines as they do not feature hydraulic ladders and primarily are used to transport equipment (e.g., hoses and tools) and pump water.
Fire Truck (Ladder)	Trucks that may be commonly referred to as fire trucks and that feature hydraulic ladders.
Crane	Trucks with a hydraulic crane.

Across the 2017–2019 heavy-duty vehicle data sets, generally over 73 percent of the data consists of two-axle vehicles. These vehicles may be classified as class 3, 4, 5, 8, or 11 based on the definitions in appendix C of the TMG. However, for two-axle heavy-duty vehicles, class 8 (e.g., a two-axle, single trailer vehicle) and class 11 (e.g., a two-axle, multi-trailer vehicle) are not likely vehicle configurations to be observed in the real world. Thus, these classes were excluded from contention. The process for classifying two-axle heavy-duty vehicles according to the FHWA-13 classification system is depicted in figure 46.

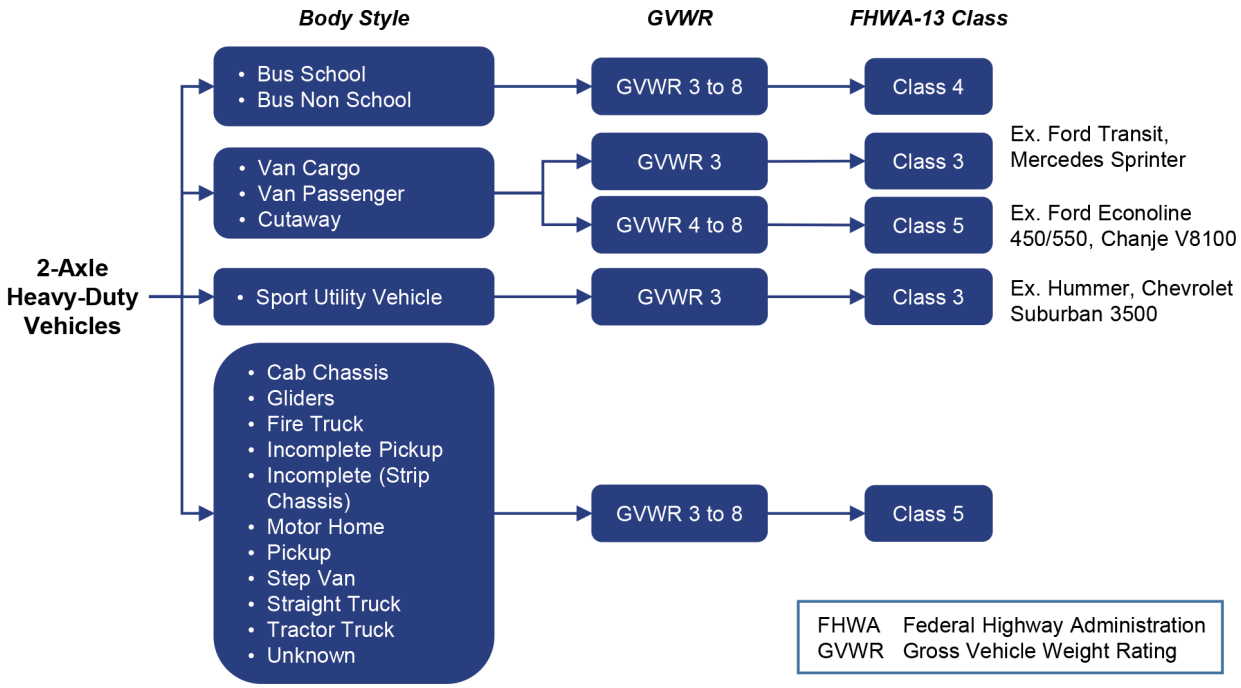

Figure 46. Flowchart. Process for classifying two-axle vehicles in the heavy-duty vehicles data subsets.

(Source: Federal Highway Administration.)

The process shown in figure 46 uses information on the body type (as contained in the "VehicleType" field) and GVWR (as contained in the "GVW" field) to classify the data. Vehicles with a "Bus School" or "Bus Non School" body type are assigned to class 4, regardless of GVWR. Similarly, vehicles with a "Sport Utility Vehicle" body type were assigned to class 3, regardless of GVWR. The key assumption is that vehicles with this body type typically do not feature six tires. Examples of vehicles in this category include Chevrolet Suburbans, Cadillac Escalades, and Hummers.

Vehicles with a "Van Cargo," "Van Passenger," or "Cutaway" body type may be assigned to either class 3 or 5 based on GVWR. Vehicles with those body types and a GVWR value equal to 3 are assigned to class 3. Those with GVWR values of 4 or higher were assigned to class 5.

The remaining body types consist of vehicles that are assumed to feature six tires for GVWR values of 3 or higher. These include "Pickup," "Fire Truck," "Straight Truck," and "Tractor Truck," among others. These vehicles were assigned to FHWA class 5.

Three-Axle Heavy-Duty Vehicles

Across the 2017–2019 heavy-duty vehicles data sets, generally over 23 percent of the data consists of three-axle vehicles. Combined, two- and three-axle vehicles comprise over 95 percent of the data across the heavy-duty vehicle data sets. Three-axle vehicles may be classified as class 4, 6, or 8 based on the definitions in appendix C of the TMG with class 4 vehicles being more appropriately described as buses. From the *FHWA Vehicle Inventory, Data for Efficient Goods Movement and Freight Analysis* report, multiple three-axle configurations of buses were identified.

For class 6, the *FHWA Vehicle Inventory, Data for Efficient Goods Movement and Freight Analysis* report identified several configurations:

- Cab over tractor.
- Conventional tractor.
- Dump truck.
- Concrete truck.
- Tanker truck.
- Flatbed truck.
- Grain truck.
- Garbage truck.
- Crane truck (1-2) = Crane truck with one front axle and two rear axles.
- Crane truck (1-1-1) = Crane truck with the cab set forward from the front axle with two equally spaced rear axles.
- Winch truck = Truck outfitted with a winch for pulling heavy objects and equipment.

For class 8 vehicles, the *FHWA Vehicle Inventory, Data for Efficient Goods Movement and Freight Analysis* report identified various body styles all with 2-S1 configurations. These included vans, auto transport, dump, grain, garbage, livestock, logging, and tankers. In addition to these, there were various configurations consisting of pickups and motor homes towing trailers and truck tractors towing other truck tractors in a piggyback configuration. The process for classifying three-axle heavy-duty vehicles according to the FHWA-13 classification system is depicted in figure 47.

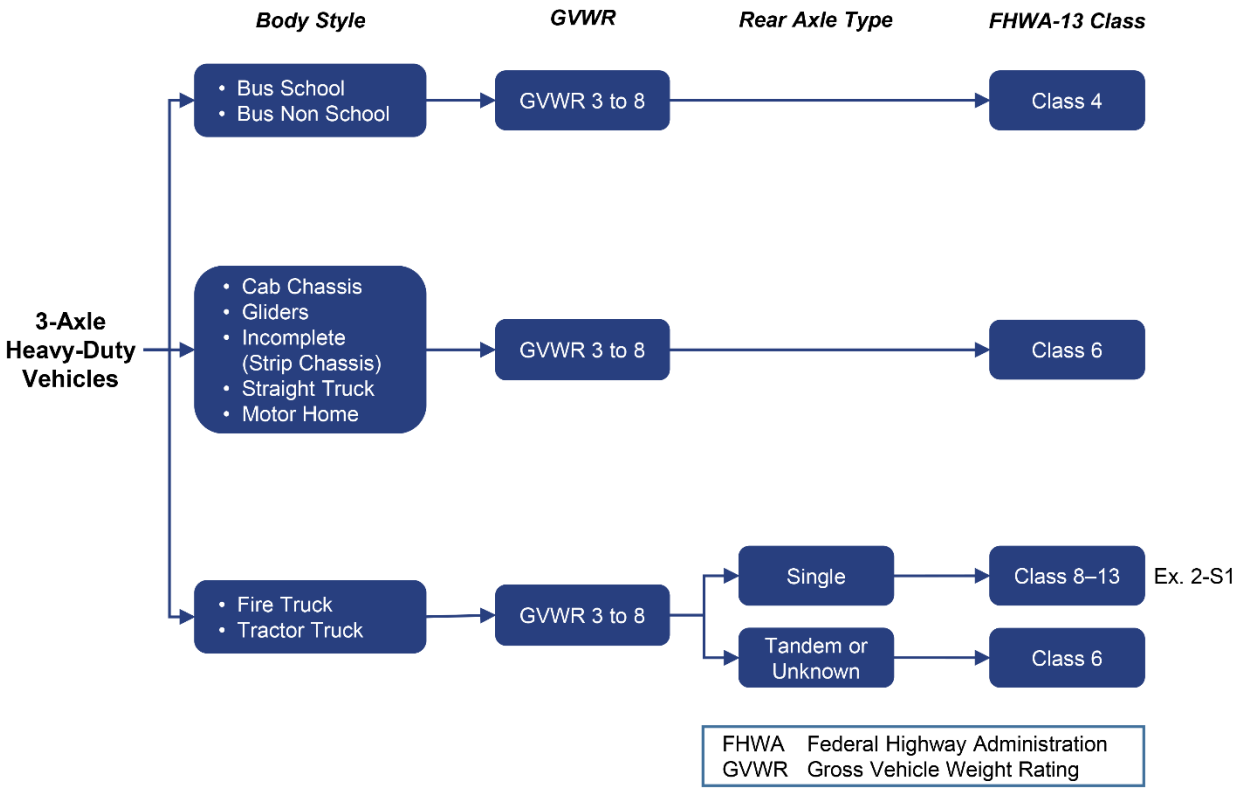

Figure 47. Flowchart. Process for classifying three-axle vehicles in the heavy-duty vehicles data subsets.

(Source: Federal Highway Administration.)

The process shown in figure 47 uses information on the body type (as contained in the "VehicleType" field), GVWR (as contained in the "GVW" field), and rear axle type (as contained in the "RearAxle" field) to classify the data. Vehicles with a "Bus School" or "Bus Non School" body type were assigned to class 4, regardless of GVWR and rear axle type. Vehicles with a "Cab Chassis" body type were assigned to class 3 as these vehicles only report a GVWR value of 3 with tandem axles. Vehicles with a "Straight Truck" body type were assigned to class 6.

The remaining body types ("Fire Truck," "Motor Home," "Tractor Truck," and "Unknown") were assigned to either class 6 or 8–13, regardless of their GVWR value. Instead, the rear axle configuration is used to determine their classification. Those with a tandem rear axle are assumed to feature a single-unit frame, while those with a single axle are assumed to have a combination style frame. Thus, three-axle heavy-duty vehicles with tandem rear axles were assigned to class 6 while those with a single rear axle were assigned to class 8–13.

Four-Axle Heavy-Duty Vehicles

Less than one percent of the heavy-duty vehicle data across the 2017–2019 data sets consist of four-axle vehicles. These vehicles may be classified as class 7, 8, or 11. From the *FHWA Vehicle*

Inventory, Data for Efficient Goods Movement and Freight Analysis report, multiple four-axle configurations of buses were identified. For class 7 these included:

- Cab over Tractor.
- Conventional Tractor.
- Crane (2-2).
- Crane (1-3).
- Dump Truck (1-3).
- Concrete Truck (2-2).
- Concrete Truck (1-3).
- Fire Truck (2-2).
- Garbage Truck (2-2).

For class 8, the *FHWA Vehicle Inventory, Data for Efficient Goods Movement and Freight Analysis* report identified the following four-axle configurations:

- 2-S2 = two-axle power unit pulling a two-axle towed unit.
- 3-S1 = three-axle power unit pulling a one-axle towed unit.
- Pickups and motorhomes pulling a two-axle towed unit.
- Various piggyback configurations consisting of truck tractor power units towing other power units.

For class 11 vehicles, all four-axle configurations reported in the *FHWA Vehicle Inventory, Data for Efficient Goods Movement and Freight Analysis* report consisted of 1 of 2 types: (1) pickups and motorhomes pulling two towed units each with one axle; and (2) two-axle truck tractor power units towing 2 additional two-axle truck tractor units in a piggyback formation. Importantly, these types of configurations would not be contained in vehicle registration data. Of the four-axle observations in the heavy-duty vehicles data subsets, over 99 percent consist of vehicles with a "Straight Truck" or "Tractor Truck" body type. Similarly, over 99 percent of observations have a GVWR value of 8, with a small portion of four-axle observations reporting GVWR values of 6 or 7.

As shown in figure 48, the process for assigning the FHWA-13 class to four-axle heavy-duty vehicles relies solely on body type. Vehicles with a "Tractor Truck" body type were assigned to class 8–13. These vehicles represent power units unattached from trailers (e.g., "bobtails"). Vehicles with a "Straight Truck," "Cab Chassis," or "Fire Truck" body type are assigned to class 7.

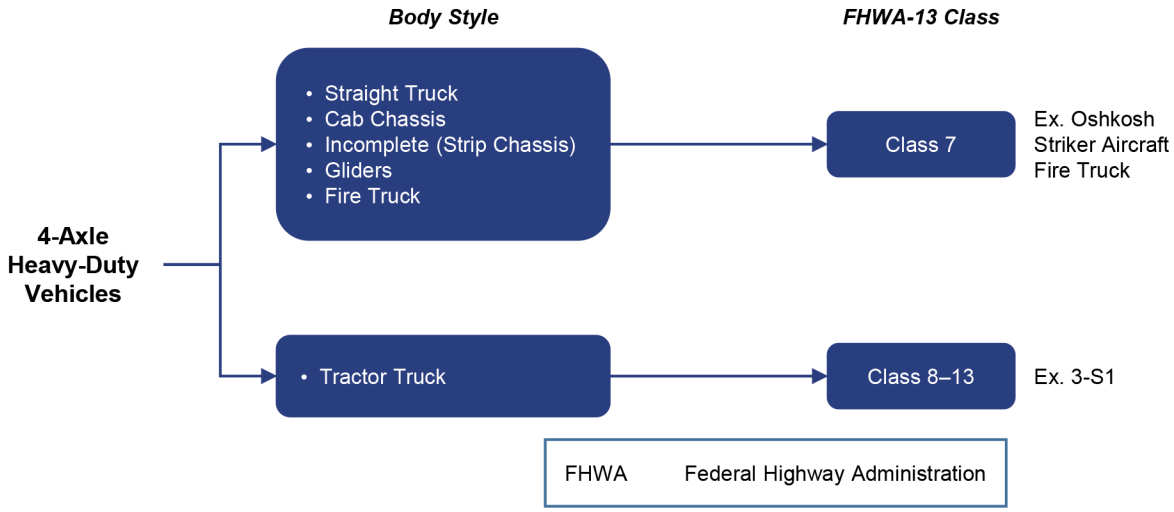

Figure 48. Flowchart. Process for classifying four-axle vehicles in the heavy-duty vehicles data subsets.

(Source: Federal Highway Administration.)

Five-Axle Heavy-Duty Vehicles

There is significant variation in the vehicle configurations for five-axle trucks, which may be classified as FHWA-13 class 7, class 9, and class 11. From the *FHWA Vehicle Inventory, Data for Efficient Goods Movement and Freight Analysis* report, there were 8 configurations for FHWA-13 class 7 trucks, 67 different configurations for class 9 trucks, and 28 configurations for class 11 trucks. FHWA-13 class 7 vehicles primarily consist of trucks with the following body types: conventional tractors, cranes, dump trucks, and concrete trucks.

The vehicle inventory report found numerous body types for class 9 trucks, including vans, tanker trucks, and grain trucks, among others. Within the FHWA-13 class 9 category, those body types were deployed with the following configurations:

- 2 + 3 = two-axle power unit pulling a three-axle towed unit via a standard hitch.
- 3 + 2 = three-axle power unit pulling a two-axle towed unit via a standard hitch.
- 2-S3 = two-axle power unit pulling a three-axle towed unit via a fifth wheel connector.
- 3-S2 = three-axle power unit pulling a two-axle towed unit via a fifth wheel connector.
- 4-S1 = four-axle power unit pulling a one-axle towed unit.

Several body types also were identified in the *FHWA Vehicle Inventory, Data for Efficient Goods Movement and Freight Analysis* report for class 11 trucks. They were deployed with the following configurations:

- 2-S1-2 = two-axle power unit pulling a one-axle towed unit and a two-axle towed unit.

- 3-S1-2 = three-axle power unit pulling a one-axle towed unit and a two-axle towed unit.
- Various piggyback configurations consisting of truck tractor power units towing other power units.

Notably, none of these configurations of truck tractors in the vehicle inventory report appeared to have 10 x 4 or 10 x 6 drivetrains. All appeared to have 10 x 2 drivetrains.

Less than 1 percent of the heavy-duty vehicle data across the 2017–2019 data sets consist of five-axle vehicles. As shown in table 14, of the five-axle heavy-duty vehicle data, over 99 percent consist of vehicles with a "Straight Truck" or "Tractor Truck" body type. Similarly, over 99 percent of observations have a GVWR value of 8, with a small portion of five-axle heavy-duty vehicles reporting GVWR value of 7.

Table 14. Summary of the five-axle heavy-duty vehicles data subsets by gross vehicle weight rating.

Drivetrain	Vehicle Type	2017—Vehicle Count	2017—Percent of Total	2018—Vehicle Count	2018—Percent of Total	2019—Vehicle Count	2019—Percent of Total
10 x 2	Straight Truck	82	2.16%	72	1.70%	64	1.34%
10 x 4	Gliders	16	0.42%	14	0.33%	14	0.29%
10 x 4	Straight Truck	2,133	56.22%	2,599	61.40%	3,116	65.09%
10 x 4	Tractor Truck	10	0.26%	11	0.26%	13	0.27%
10 x 6	Gliders	36	0.95%	32	0.76%	32	0.67%
10 x 6	Straight Truck	1,500	39.54%	1,488	35.15%	1,532	32.00%
10 x 6	Tractor Truck	12	0.32%	14	0.33%	15	0.31%
10 x 8	Straight Truck	5	0.13%	3	0.07%	1	0.02%
Total		**3,794**	**100.00%**	**4,233**	**100.00%**	**4,787**	**100.00%**

All of the 10 x 2 observations across the 2017–2019 data subsets have "Straight Truck" body types and are the Advance Mixer make and model, which is a concrete truck. Similarly, all of the 10 x 8 observations across the 2017–2019 data subsets have "Straight Truck" body types and are the Oshkosh Motor Truck Company S Series make and model, which also is a concrete truck. The 10 x 4 and 10 x 6 observations are distributed across glider, straight, and tractor truck body types.

The process for assigning the FHWA-13 class to five-axle heavy-duty vehicles, shown in figure 49, relies on body type. Observations with a "Tractor Truck" body type were assigned to class 8–13. Those with a "Gliders" or "Straight Truck" body type were assigned to class 7.

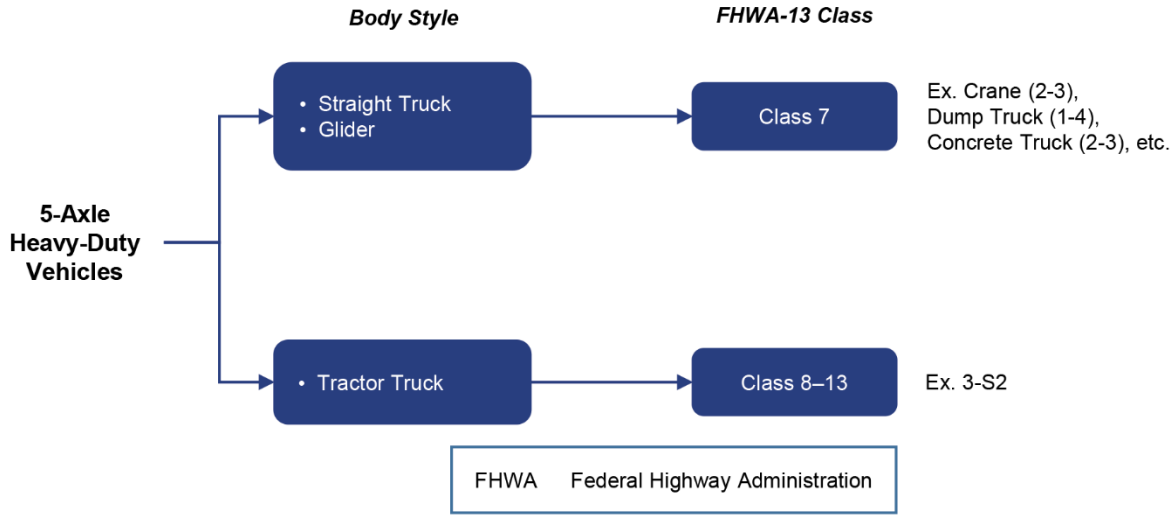

Figure 49. Flowchart. Process for classifying five-axle heavy-duty vehicles.

(Source: Federal Highway Administration.)

Six-Axle Heavy-Duty Vehicles

Observations of six-axle vehicles in the heavy-duty vehicles data subsets may classified as FHWA-13 class 7, 10, or 12. From the *FHWA Vehicle Inventory, Data for Efficient Goods Movement and Freight Analysis* report, the six-axle configurations of class 7 trucks observed were Dump Truck (1-5) (i.e., one front axle and five rear axles) and Concrete Truck (1-5). For class 10 vehicles, the following six-axle configurations were observed:

- 3-S3 = three-axle power unit pulling a three-axle towed unit.
- 4-S2 = four-axle power unit pulling a two-axle towed unit.
- 3+3 = three-axle power unit pulling a three-axle towed unit via a standard hitch.
- 4+2 = four-axle power unit pulling a two-axle towed unit via a standard hitch.

The following configurations were observed for class 12:

- 3-S1-2 = three-axle power unit pulling a one-axle towed unit and a two-axle towed unit.
- 2-S2-2 = two-axle power unit pulling two two-axle towed units.
- Pickups pulling two two-axle towed units.
- Various piggyback configurations consisting of truck tractor power units towing other power units.

Less than one percent of the observations in the heavy-duty vehicles data subsets consist of six-axle vehicles. No truck tractor body types were reported in the heavy-duty vehicles data subsets. Furthermore, information in the data on the vehicle make and model (as contained in the "Make" and "Model" fields) suggest that all the observations consist of concrete mixer trucks (refer to figure 50 for an example). Because class 10 and 12 six-axle configurations require the use of towed units, it is assumed that these classes are not observed in the heavy-duty vehicles data subsets as the vehicle registration data does include trailers or other towed units. Thus, all six-axle vehicles were assigned to class 7.

Figure 50. Photograph. Example of a six-axle concrete mixer.

(Source: McNeilus Truck and Manufacturing, Inc. https://www.mcneiluscompanies.com/mcneilus-unveils-newly-redesigned-oshkosh-s-series-front-discharge-concrete-mixer/.)

Seven-Axle Heavy-Duty Vehicles

Heavy duty vehicles with seven axles may fall under FHWA-13 class 7, 10, or 13. From the *FHWA Vehicle Inventory, Data for Efficient Goods Movement and Freight Analysis* report,

seven-axle trucks were observed with dump, concrete, and tractor body types. They were deployed with the following configurations for class 7:

- Dump Truck (1-6) = Dump trucks with one front axle, four liftable axles, and a tandem rear axle.
- Concrete Truck (1-6) = Concrete trucks with one front axle and six rear axles.

For class 10, the following configurations were observed:

- 3-S4 = three-axle power unit pulling a four-axle towed unit.
- 4-S3 = four-axle power unit pulling a three-axle towed unit.
- 3 + 4 = three-axle power unit pulling a four-axle towed unit via a standard hitch.
- 4 + 3 = four-axle power unit pulling a three-axle towed unit via a standard hitch.
- Various piggyback configurations consisting of truck tractor power units towing other power units.

The following configurations were observed for class 13:

- 3-S2-2 = three-axle power unit pulling two two-axle towed units.
- 53’ and 28.5’ Trailers and One-Axle Dolly = 53’ truck tractor with trailer pulling a 28.5’ trailer and a one-axle dolly via hitch.
- 2-S1-2-2 = two-axle power unit pulling a one-axle and two two-axle towed units.
- Various piggyback configurations consisting of truck tractor power units towing other power units.

Less than one percent of the heavy-duty vehicle data across the 2017–2019 data sets consist of seven-axle vehicles. These vehicles may be classified as class 7 or 13. All seven-axle heavy-duty vehicles report a “Straight Truck” or “Tractor Truck” body type. The process for assigning the FHWA-13 class to seven-axle heavy-duty vehicles, shown in figure 51, relies on body type. Vehicles with a “Tractor Truck” body type were assigned to class 8–13. Vehicles with a “Straight Truck” body type were assigned to class 7. Based on information in the data on vehicle make and model, all seven-axle straight trucks appear to be concrete mixers.

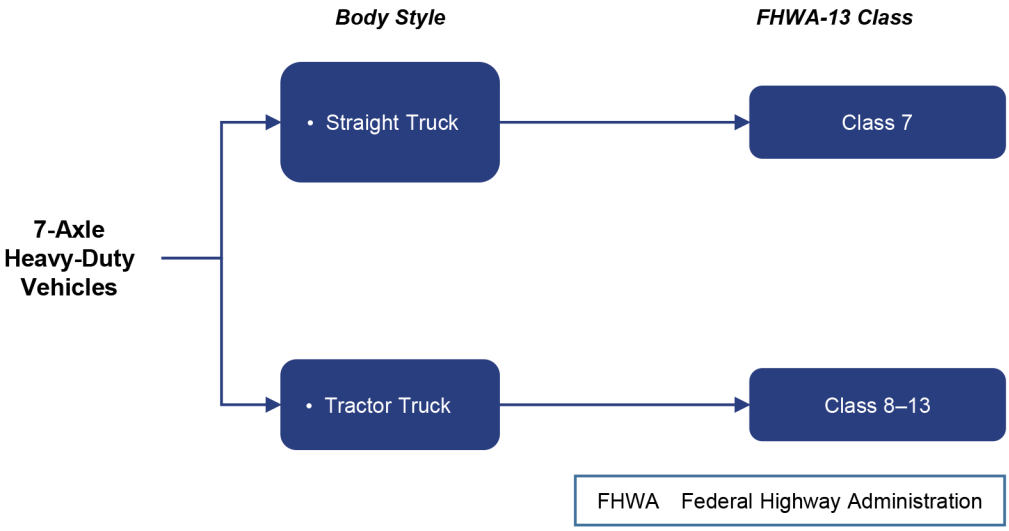

Figure 51. Flowchart. Process for classifying seven-axle heavy-duty vehicles.

(Source: Federal Highway Administration.)

Crosswalk between the Federal Highway Administration 13-Vehicle and Federal Highway Administration 6-Vehicle Classification Systems

After vehicles were assigned their FHWA-13 classification, they were assigned their FHWA-6 classification by crosswalking the two schemes. This crosswalk, shown in figure 52, was developed based on the definitions of the vehicle class categories as defined in appendix C in the TMG for the FHWA-13 classification system and table VM-1 of the Highway Statistics publication. As shown in figure 52, the FHWA-13 class 1 category crosswalks to the FHWA-6 Motorcycles category. The FHWA-13 class 4 category crosswalks to the FHWA-6 Buses category. Classes 5, 6, and 7 in the FHWA-13 system crosswalk to the FHWA-6 Single Unit Trucks category as those FHWA-13 classes all consist of vehicles with a single frame body type. Similarly, classes 8 to 13 in the FHWA-13 system crosswalk to the FHWA-6 Combination Trucks category as those FHWA-13 classes all consist of vehicles with multiple frame body types.

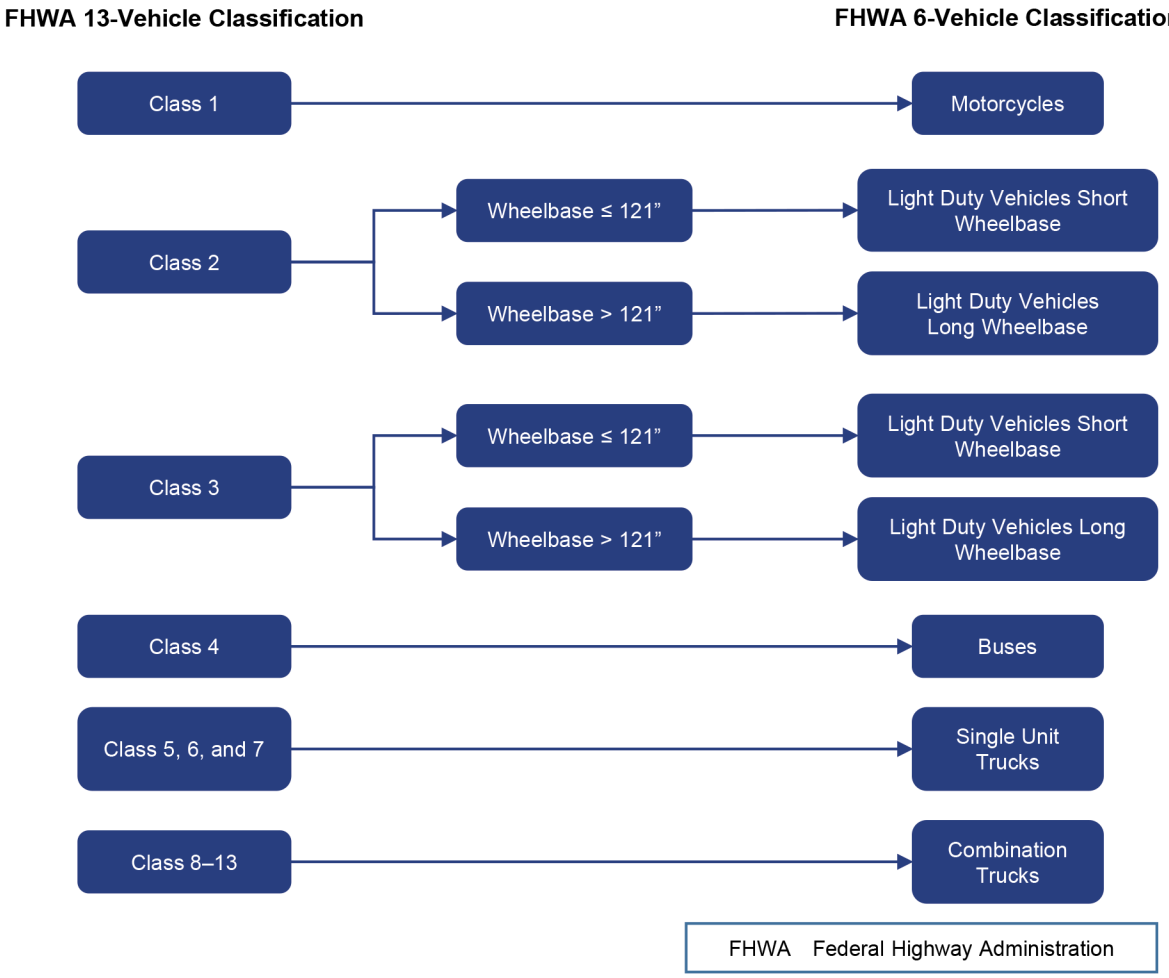

Figure 52. Flowchart. Crosswalk between the Federal Highway Administration 13-vehicle and 6-Vehicle classification systems.

(Source: Federal Highway Administration.)

FHWA-13 class 2 and 3 vehicles can be categorized as either Light-Duty Vehicles Short Wheelbase or Light-Duty Vehicles Long Wheelbase in the FHWA-6 classification system. Those with wheelbases less than or equal to 121 inches are assigned to the Light-Duty Vehicles Short Wheelbase category, while vehicles with wheelbases greater than 121 inches are assigned to the Light-Duty Vehicles Long Wheelbase category. The “WHEELBASE_HIGH” variable within the mixed-duty vehicles data subsets was used to make this determination.

Process for Assigning the National Highway Traffic Safety Administration Classification to the Vehicle Registration Data

Figure 53 depicts the alignment between the NHTSA-8 and NHTSA classification systems. Class 3 and above in the NHTSA-8 classification system and class 3 and above in the NHTSA classification fully align. However, class 1 in the NHTSA-8 system is an aggregation of NHTSA

classes A to D. Similarly, class 2 in the NHTSA-8 system is an aggregation of NHTSA classes E to H. Because the vehicle registration data reports NHTSA-8 class, the appropriate NHTSA vehicle class must be discerned using other information in the data.

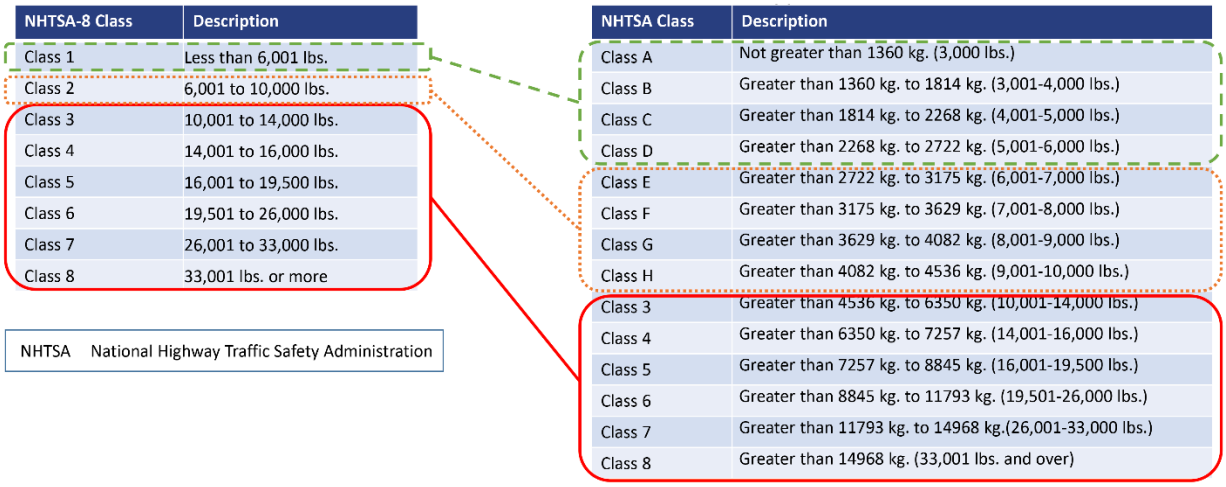

Figure 53. Diagram. Crosswalk between the National Highway Traffic Safety Administration 8-vehicle gross vehicle weight classification system and the National Highway Traffic Safety Administration classification systems.

(Source: Federal Highway Administration.)

The remainder of this section of the report outlines the process used to assign the NHTSA classification to the vehicle registration data. The process relies on information in the vehicle registration data on GVWR, body type, and curb weight. Furthermore, the process makes assumptions on the payloads that certain body types are capable of handling.

Estimating Typical Payloads

In order to discern NHTSA class from the NHTSA-8 class that is reported in the registration data, assumptions were made on the typical payloads carried by vehicles of various body types and curb weights. Data from multiple sources were examined in order to develop typical payload estimates. Table 15 contains data on the typical maximum payload capacity by NHTSA-8 gross vehicle weight class from the National Research Council's (NRC) Committee to Assess Fuel Economy Technologies for Medium- and Heavy-Duty Vehicles 2010 report, *Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles*.

Table 15. Typical payload capacities by National Highway Traffic Safety Administration 8-vehicle gross vehicle weight classification system class.

Class	Applications	Gross Weight Range (lb)	Empty Weight Range (lb)	Typical Payload Capacity Max (lb)	Payload Capacity Max (% of Empty)	2006 Unit Sales Volume	2006 Fleet Registrations (millions)	Typical Milesper Gallon Range 2007	Typical Ton-Milesper Gallon	Typical Fuel Consumed (1,000 gals/ Ton-Mi) x 1,000	Annual Fuel Consumption Range (gal)	Annual Fleet Fuel Consumption (Bgal)	Annual Mileage Range (1,000 mi) est.	Annual Fleet Miles Traveled 2006 (B)
1c	Cars *only*	(3,200)–6,000	2,400–5,000	250–1,000	10–20	7,781,000	135	25–33	15	69.0	250–750	74.979	6–25	1,682
1t	Minivans, Small Sport Utility Vehicles, Small Pick-ups	(4,000)–6,000	3,200–4,500	250–1,500	8–33	6,148,000	70	20–25	17	58.8	300–1k	37.400	6–25	813
2a	Large Sport Utility Vehicles, Standard Pick-ups	6,001–8,500	4,500–6,000	250–2,500	6–40	2,030,000	23	20–21	26	38.5	500–1.2k	18.000	10–25	305
2b	Large Pick-up, Utility Van, Multi-Purpose, Mini-Bus, Step Van	8,501–10,000	5,000–6,300	3,700	60	545,000	6.2	10–15	26	38.5	1.5k–2.7k	5.500	15–40	93
3	Utility Van, Multi-Purpose, Mini-Bus, Step Van	10,001–14,000	7,650–8,750	5,250	60	137,000	0.69	8–13	30	33.3	2.5k–3.8k	1.462	20–50	12
4	City Delivery, Parcel Delivery, Large Walk-in, Bucket, Landscaping	14,001–16,000	7,650–8,750	7,250	80	48,000	0.29	7–12	42	23.8	2.9k–5k	0.533	20–60	4
5	City Delivery, Parcel Delivery, Large Walk-in, Bucket	16,001–19,500	9,500–10,800	8,700	80	41,000	0.17	6–12	39	25.6	3.3k–5k	0.258	20–60	2
6	City Delivery, School Bus, Large Walk-in, Bucket	19,501–26,000	11,500–14,500	11,500	80	65,000	1.71	5–12	49	20.4	5k–7k	6.020	25–75	41
7	City Bus, Furniture, Refrigerated, Refuse, Fuel Tanker, Dump, Tow, Concrete, Fire Engine, Tractor-Trailer	26,001–33,000	11,500–14,500	18,500	125	82,411	0.18	4–8	55	18.2	6k–8k	1.926	75–200	9
8a	Dump, Refuse, Concrete, Furniture, City Bus, Tow, Fire Engine (straight trucks)	33,001–80,000	20,000–34,000	20,000–50,000	100–150	45,600	0.43	2.5–6	115	8.7	10k–13k	3.509	25–75	12
8b	Tractor-Trailer: Van, Refrigerated, Bulk Tanker, Flat Bed (combination trucks)	33,001–80,000	23,500–34,000	40,000–54,000	125–200	182,395	1.72	4–7.5	155	6.5	19k–27k	28.075	75–200	142

(Source: National Research Council Committee to Assess Fuel Economy Technologies for Medium- and Heavy-Duty Vehicles, Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles, 2010.)

The NRC report determined that NHTSA-8 class 1 vehicles that are cars have payload capacities that range from 250 to 1,000 lbs (about 10 to 20 percent of curb weight). Larger NHTSA-8 class 1 vehicles (such as minivans and sport utility vehicles) were estimated to have payload capacities that range from 250 to 1,500 lbs (about 8 to 33 percent of curb weight). For NHTSA-8 class 2 vehicles that can be characterized as primarily used for passenger travel (e.g., sport utility vehicles, standard pick-ups, etc.), the NRC study estimated that payload capacities vary between 250 to 2,500 lbs. This is equivalent to about 6–40 percent of curb weight. For NHTSA-8 class 2 vehicles that can be characterized as primarily used for transporting cargo and/or equipment (e.g., large pick-ups, utility vans, step vans, etc.), the NRC report estimated that 3,700 lbs (about 60 percent of curb weight) is a typical maximum payload.

Data from the former Vehicle Travel Information System (VTRIS), now the Travel Monitoring Analysis System (TMAS), also was examined in order to understand typical payloads of vehicles included in the mixed-duty vehicles data subsets. As shown in table 16, 2002 data for two-axle, six-tire vehicles (i.e., FHWA-13 class 5) with GVWR ≤ 2 indicate average payloads that range from about 4,000 to 8,000 lbs. For all vehicles with GVWR equal to 3, average payloads range from about 3,400 to 9,300 lbs as shown in table 17. Importantly, the data also indicated that within this vehicle class, average payloads decrease with increasing curb weight. This is likely due to the need to carry smaller amounts of cargo and/or equipment in order to not exceed the GVWR.

Table 16. Average payloads for Federal Highway Administration 13-vehicle classification system class 5 vehicles with gross vehicle weight rating ≤ 2 by curb weight from 2002 Vehicle Travel Information System/Travel Monitoring Analysis System.

Curb Weight	Average Payload (lbs)
1,500 lbs or Less	8,267
1,500 to 3,000 lbs	5,170
3,000 to 5,000 lbs	4,048

Table 17. Average payloads for all vehicles with gross vehicle weight rating = 3 by curb weight from 2002 Vehicle Travel Information System/Travel Monitoring Analysis System.

Curb Weight	Average Payload (lbs)
1,500 lbs or Less	9,307
1,500 to 3,000 lbs	7,626
3,000 to 5,000 lbs	7,009
5,000 to 7,000 lbs	3,387
7,000 to 8,000 lbs	3,081

In addition to the VTRIS/TMAS data, data from the 2002 VIUS also was examined in order to understand typical payloads of vehicles included in the mixed-duty vehicles data subsets. As

shown in table 18, data for two-axle, six-tire vehicles (i.e., FHWA-13 class 5) indicate average payloads that range from about 3,000 to 4,000 lbs. Importantly, the same trend of average payloads decreasing with increasing curb weight within the vehicle class was observed. Likewise, this trend is likely due to the need to carry smaller amounts of cargo and/or equipment in order to not exceed the GVWR.

Table 18. Average payloads for Federal Highway Administration 13-vehicle classification system class 5 vehicles with gross vehicle weight rating ≤ 2 by curb weight from 2002 Vehicle Inventory and Use Survey.

Curb Weight	Average Payload (lbs)
1,500 to 3,000 lbs	3,876
3,000 to 5,000 lbs	3,266
5,000 to 7,000 lbs	2,806
7,000 to 8,000 lbs	2,972
8,000 to 10,000 lbs	2,983

Assigning National Highway Traffic Safety Administration Vehicle Classification for the Motorcycle Data Subsets

The vehicle registration data set does not report any information on GVWR or curb weight for motorcycles. However, motorcycles typically only carry one or two passengers and usually do not exceed 1,000 pounds. Because of these observations, the process assigned all vehicles in the motorcycles data sets to NHTSA class A.

Assigning National Highway Traffic Safety Administration Vehicle Classification for the Cars Data Subsets

The vehicle registration data sets do not report any information on GVWR for vehicles in the cars data subsets. However, the data subsets do report information on curb weight and body type. As shown in figure 54, data on curb weight and body type along with assumptions on the typical payloads certain body types can handle was used to determine the NHTSA class.

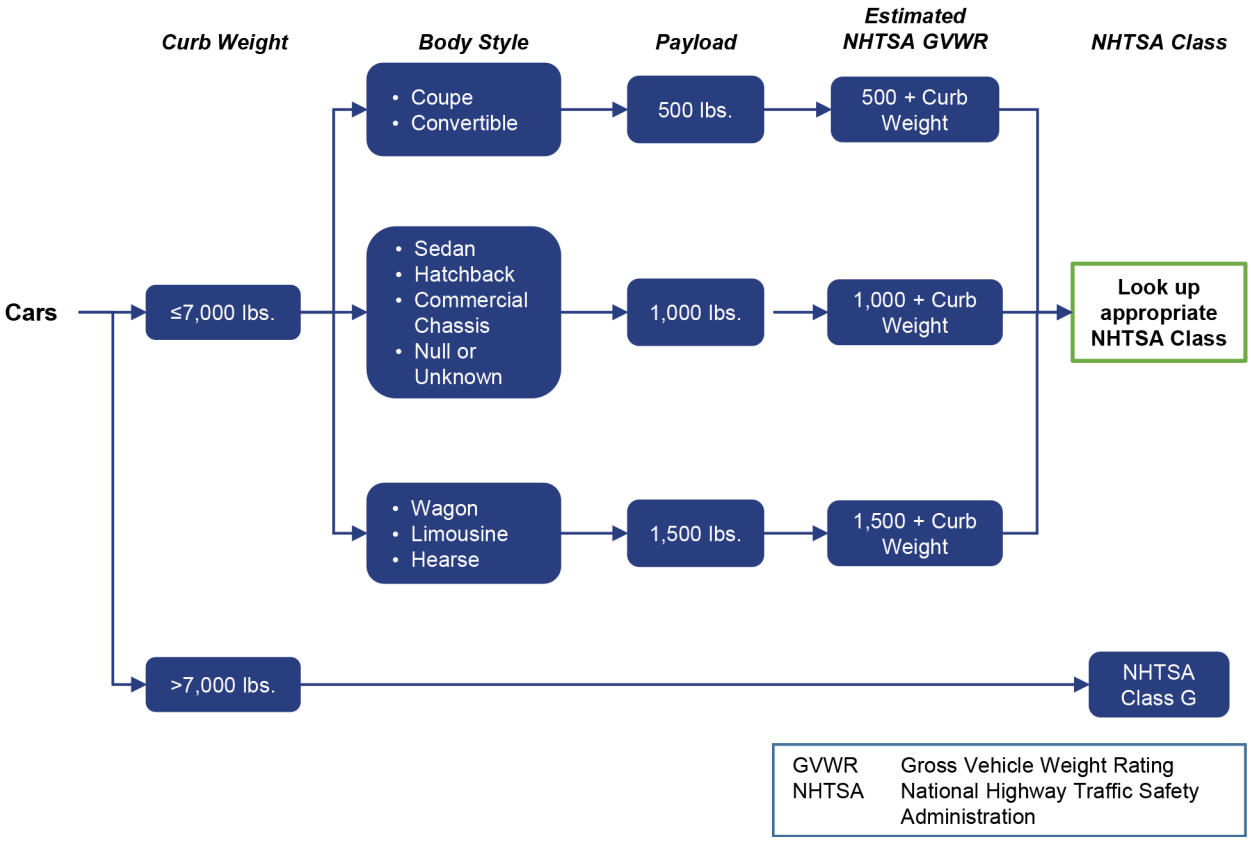

Figure 54. Flowchart. Process for determining National Highway Traffic Safety Administration classification for cars.

(Source: Federal Highway Administration.)

The process shown in figure 54 begins by determining the vehicle body type as contained in the "BODY_STYLE" field. Once the body type was determined, an assumption was made on the typical payload for that style of vehicle. Based on the data from the NRC report and the analysis of VTRIS/TMAS and VIUS data, vehicles with a "Coupe" or "Convertible" body types were assumed have maximum payload capacities toward the lower end of those reported for passenger vehicles (i.e., class 1c in the NRC study). Specifically, they were assumed to be able to have maximum payloads of 500 pounds. Vehicles with a "Sedan," "Hatchback," "Null," or "Unknown" body types were assumed to have maximum payloads near the center of the range for class 1c vehicles, specifically 1,000 pounds. Vehicles with a "Wagon," "Limousine," or "Hearse" body type were assumed to have maximum payloads at the top end of the range for class 1c and 1t vehicles, specifically 1,500 pounds.

Next, the process estimated the GVWR by adding the assumed payload to the curb weight value reported in the vehicle registration data set (i.e., the "CURB_WEIGHT" field). Importantly, for observations with missing or 0 curb weight values, the process assumes a curb weight equal to the average for that body type. Lastly, the process looked up the appropriate NHTSA class based on the estimated GVWR.

Assigning National Highway Traffic Safety Administration Vehicle Classification for the Mixed-Duty Vehicles Data Subsets

Observations in the mixed-duty vehicles data sets may be classified as NHTSA class A to 3. Generally, vehicles in these data sets have a curb weight that ranges from about 1,250 to 9,750 pounds (see figure 13). The average curb weight is approximately 4,600 pounds. The process for assigning the NHTSA class for mixed-duty vehicles begins by segmenting the data into those vehicles with body types that typically transport passengers versus those that usually carry cargo. The body types assumed to primarily transport passengers include:

- Convertible.
- Pickup Sport Utility Vehicle.
- Sport Utility Vehicle.
- Van Passenger.
- Cutaway.
- Sport Utility Truck.
- Van Camper.
- Limousine.
- Motor Home.
- Unknown.

Cargo-carrying body types are assumed to include:

- Cab Chassis.
- Incomplete Pickup.
- Pickup.
- Pickup Conventional.
- Pickup Crew Cab.
- Pickup Extended Cab.
- Pickup Unknown.
- Step Van.
- Van Cargo.
- Incomplete Pickup.
- Straight Truck.

Within those segments, the data is further divided into the reported NHTSA-8 classes in the registration data—NHTSA-8 class 1 and 2. The remainder of this section of the report outlines the processes for assigning NHTSA vehicle classes for mixed-duty vehicles for each segment.

Mixed-Duty Vehicles with Passenger Body Types and National Highway Traffic Safety Administration 8-Vehicle Gross Vehicle Weight Classification System Class 1

The process for assigning NHTSA-8 class 1 passenger-carrying mixed-duty vehicles to the appropriate NHTSA class is depicted in figure 55. Data from the NRC *Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles* report for class 1t to 2b vehicles (see table 15) was primarily used to estimate a typical payload for these vehicles as they are not represented in VTRIS/TMAS or VIUS data. Generally, class 1t vehicles (as included in the NRC report) correspond to vehicles that primarily carry passengers with some overlap in class 2b between passenger- and cargo-oriented vehicles. For these vehicles, a typical payload capacity of 1,500 lbs was assumed.

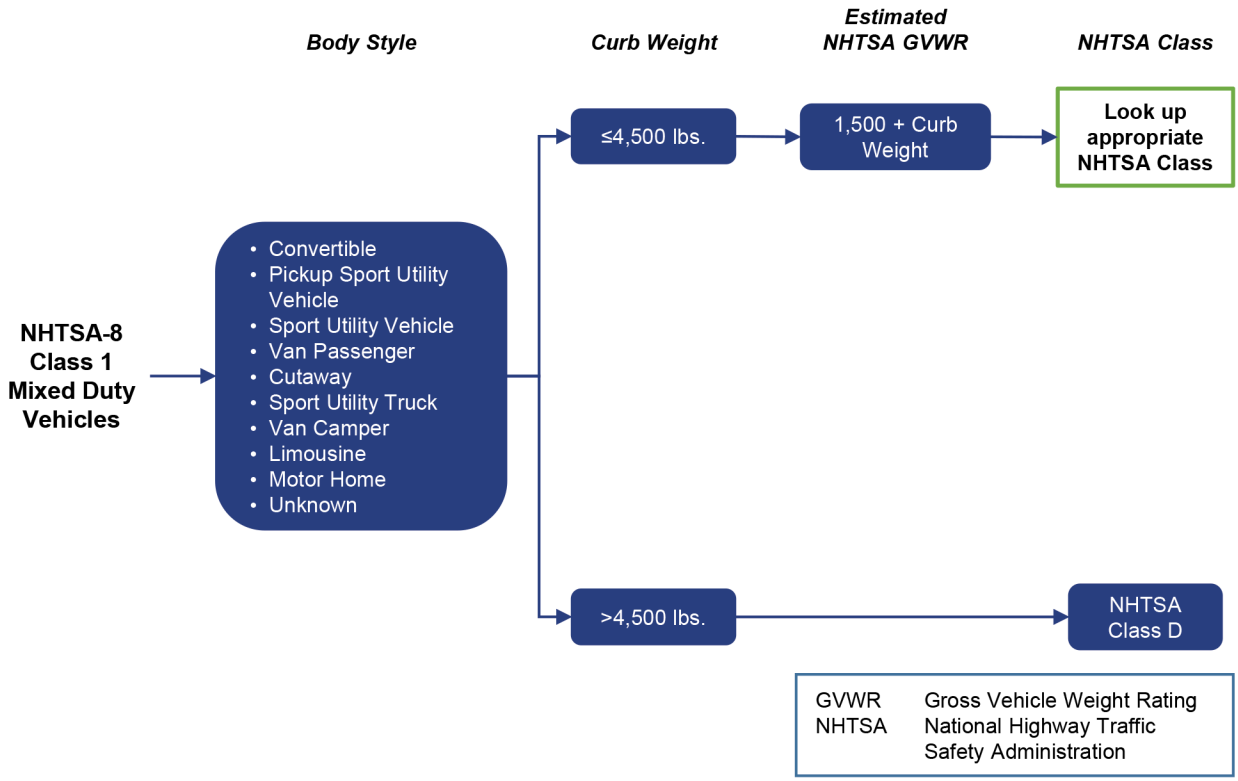

Figure 55. Flowchart. Process for determining National Highway Traffic Safety Administration classification for National Highway Traffic Safety Administration 8-vehicle gross vehicle weight classification system class 1 passenger mixed-duty vehicles.

(Source: Federal Highway Administration.)

The process shown in figure 55 then estimated the GVWR by adding the reported curb weight (as indicated by the "CURB_WEIGHT" field) to the assumed payload for vehicles with curb

weights less than or equal to 4,500 lbs. A threshold value of 4,500 lbs was selected in order to ensure the estimated GVWR for NHTSA classification does not exceed the reported GVWR for NHTSA-8 classification (i.e., 6,000 lbs or less for NHTSA-8 class 1). As the vehicle registration data is believed to have arrived at the GVWR for NHTSA-8 classification using a decoded vehicle identification number, the GVWR values that form the upper and lower bounds for the NHTSA-8 class act as limits for the estimated NHTSA GVWR. The process then looks up the NHTSA class based on the estimated GVWR. For observations with curb weights exceeding the 4,500 lb threshold, they were assigned to NHTSA class D, which contains the maximum GVWR that still aligns with NHTSA-8 class 1. For those with missing or 0 curb weight values, the process assumes a curb weight equal to the average for that body type.

Mixed-Duty Vehicles with Passenger Body Types and National Highway Traffic Safety Administration 8-Vehicle Gross Vehicle Weight Classification System Class 2

The process for assigning NHTSA-8 class 2 passenger-carrying mixed-duty vehicles to the appropriate NHTSA class is depicted in figure 56. Information from the NRC report for class 2a to 2b vehicles (see table 15), VTRIS/TMAS, and VIUS was used to estimate typical payloads for these vehicles. For these vehicles, assumed typical payload capacities range from 2,000 lbs to 4,000 lbs and vary with curb weight. The following payload capacities were assumed based on the curb weight range under which a passenger-carrying mixed-duty vehicle falls:

- Vehicles with a curb weight of 2,000 to 3,500 lbs have a payload of 4,000 lbs.
- Vehicles with a curb weight 3,501 to 5,000 lbs have a payload of 3,000 lbs.
- Vehicles with a curb weight 5,001 to 7,000 lbs have a payload of 2,500 lbs.
- Vehicles with a curb weight 7,001 to 8,000 lbs have a payload of 2,000 lbs.

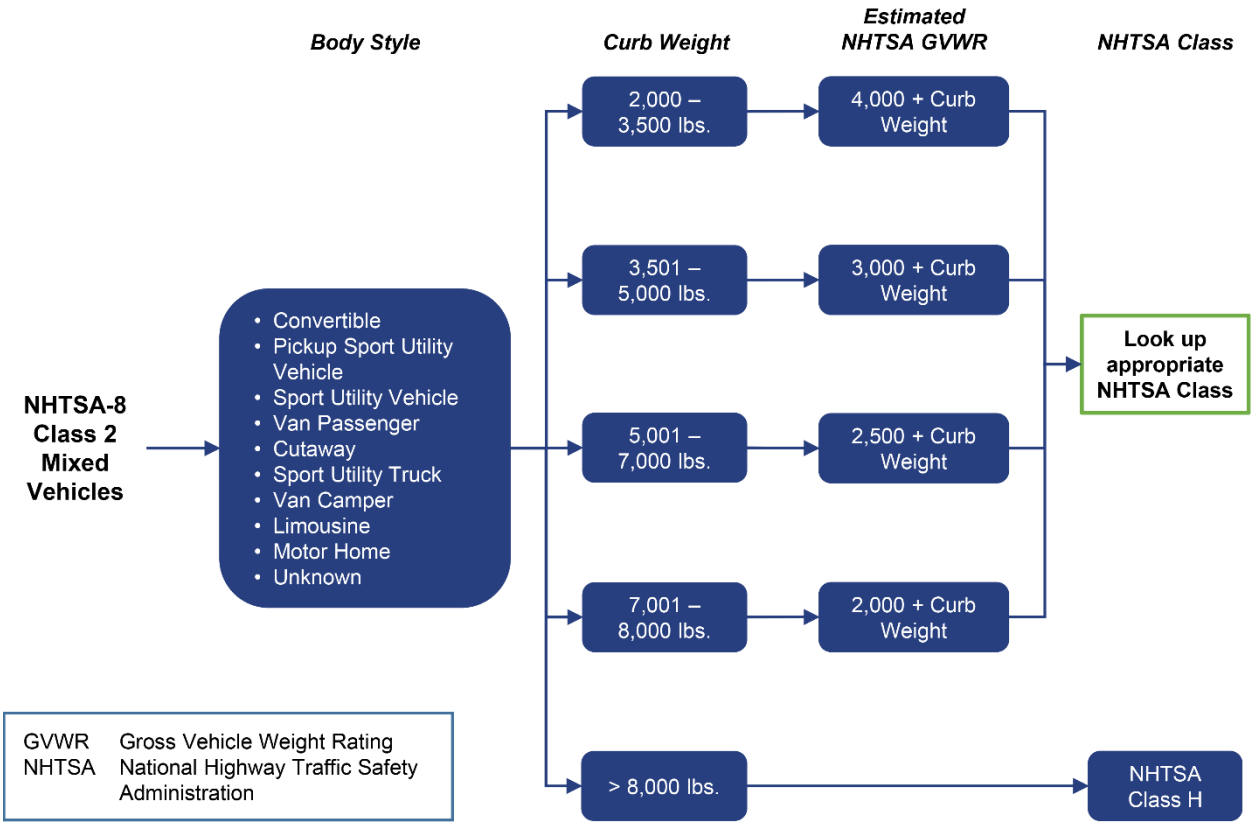

Figure 56. Flowchart. Process for determining National Highway Traffic Safety Administration classification for National Highway Traffic Safety Administration 8-vehicle gross vehicle weight classification system class 2 passenger mixed-duty vehicles.

(Source: Federal Highway Administration.)

Like the process for NHTSA-8 class 1 passenger mixed-duty vehicles, the assumed payload capacities and curb weight ranges ensure that the estimated NHTSA GVWR does not fall outside the NHTSA-8 GVWR range reported in the registration data. For observations with missing or 0 curb weight values, the process assumes a curb weight equal to the average for that body type. The assignment methodology then looks up the NHTSA class based on GVWR. For observations with curb weights exceeding the 8,000 lb threshold, they were assigned to NHTSA class H, which contains the maximum GVWR that still aligns with NHTSA-8 class 2.

Mixed-Duty Vehicles with Cargo Body Types and National Highway Traffic Safety Administration 8-Vehicle Gross Vehicle Weight Classification System Class 1

The process for assigning NHTSA-8 class 1 cargo mixed-duty vehicles to the appropriate NHTSA class is depicted in figure 57. Information from the NRC report for class 2a to 2b vehicles (see table 15), VTRIS/TMAS, and VIUS was used to estimate typical payloads for these vehicles. For these vehicles, assumed typical payload capacities range from 2,500 lbs to

3,500 lbs and vary with curb weight mixed-duty. The following payloads are assumed based on the curb weight range under which a cargo-carrying mixed-duty vehicle falls:

- Vehicles with a curb weight of 2,000 lbs or less have a payload of 3,500 lbs.
- Vehicles with a curb weight 2,001 to 3,000 lbs have a payload of 2,500 lbs.

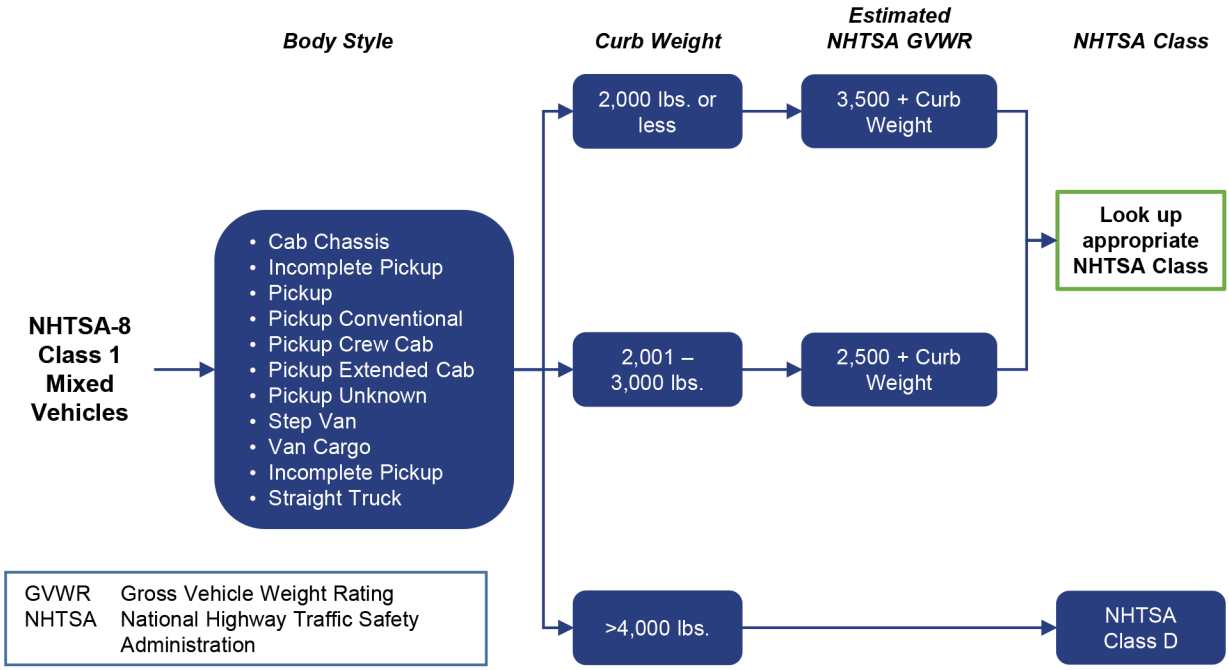

Figure 57. Flowchart. Process for determining National Highway Traffic Safety Administration classification for National Highway Traffic Safety Administration 8-vehicle gross vehicle weight classification system class 1 cargo mixed-duty vehicles.

(Source: Federal Highway Administration.)

Like the process for NHTSA-8 class 1 passenger mixed-duty vehicles, the assumed payload capacities and curb weight ranges ensure that the estimated NHTSA GVWR does not fall outside the NHTSA-8 GVWR range reported in the registration data. For observations with missing or 0 curb weight values, the process assumes a curb weight equal to the average for that body type. The assignment methodology then looks up the NHTSA class based on GVWR. For observations with curb weights exceeding the 4,000 lb threshold, they were assigned to NHTSA class D which contains the maximum GVWR that still aligns with NHTSA-8 class 1.

Mixed-Duty Vehicles with Cargo Body Types and National Highway Traffic Safety Administration 8-Vehicle Gross Vehicle Weight Classification System Class 2

The process for assigning NHTSA-8 class 2 cargo mixed-duty vehicles to the appropriate NHTSA class is depicted in figure 58. Information from the NRC report for class 2a to 2b vehicles (see table 15), VTRIS/TMAS, and VIUS was used to estimate typical payloads for these vehicles. For these vehicles, assumed typical payload capacities range from 2,500 lbs to

3,500 lbs and vary with curb weight. The following payloads are assumed based on the curb weight range under which a cargo-carrying mixed-duty vehicle falls:

- Vehicles with a curb weight of 4,000 lbs or less have a payload of 3,600 lbs.
- Vehicles with a curb weight 4,001 to 5,000 lbs have a payload of 3,100 lbs.
- Vehicles with a curb weight 5,001 to 6,000 lbs have a payload of 2,700 lbs.

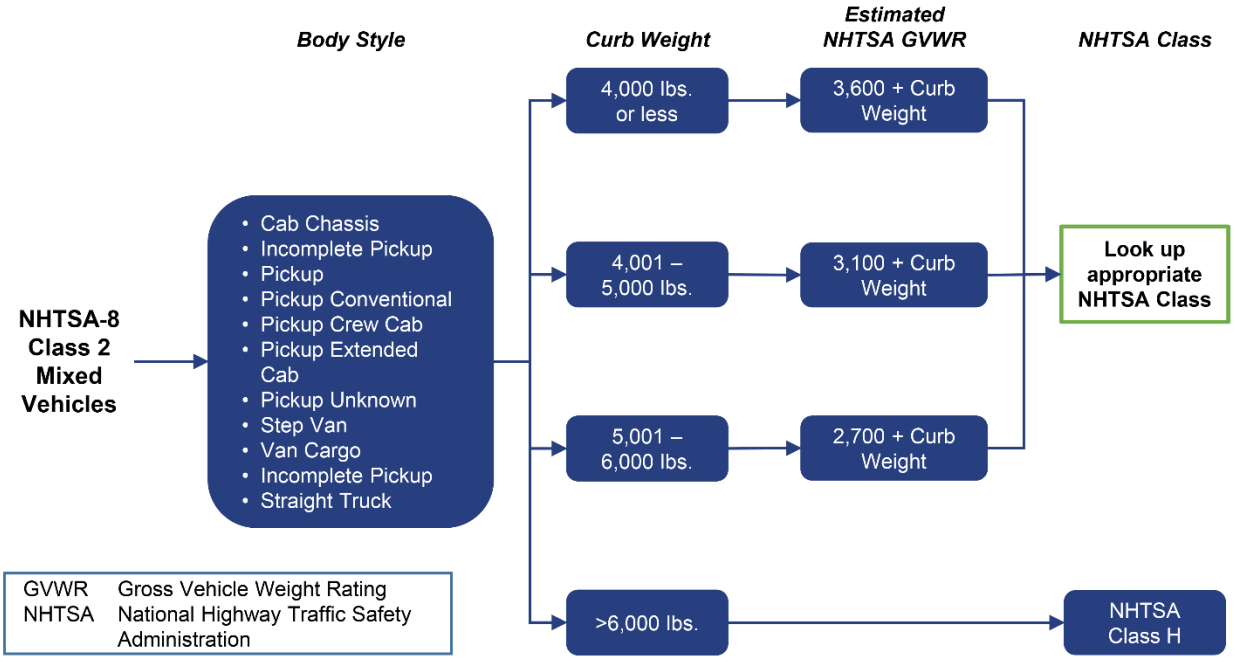

Figure 58. Flowchart. Process for determining National Highway Traffic Safety Administration classification for National Highway Traffic Safety Administration 8-vehicle gross vehicle weight classification system class 2 cargo mixed-duty vehicles.

(Source: Federal Highway Administration.)

For observations with missing or 0 curb weight values, the process assumes a curb weight equal to the average for that body type. The assignment methodology then looks up the NHTSA class based on GVWR. For observations with curb weights exceeding the 6,000 lb threshold, they were assigned to NHTSA class H which contains the maximum GVWR that still aligns with NHTSA-8 class 2.

Assigning National Highway Traffic Safety Administration Vehicle Classification for the Heavy-Duty Vehicles Data Subsets

Class 3 and above in the NHTSA-8 classification system and class 3 and above in the NHTSA classification fully align. Because the observations in the heavy-duty vehicles data subsets are all NHTSA-8 class 3 and above, they can be directly crosswalked to the corresponding NHTSA classification. Thus, the process looks up the corresponding NHTSA class based on the NHTSA-8 GVWR class for all vehicles in the heavy-duty vehicles data subsets.

4.0 Results

This section of the report presents the results of the methodologies outlined in section 3. Overall, the results demonstrate that observations in the private vehicle registration data set can be assigned an Federal Highway Administration (FHWA) 13-vehicle classification system (FHWA-13), FHWA 6-vehicle classification system (FHWA-6), and National Highway Traffic Safety Administration (NHTSA) vehicle class.[8] However, vehicle registration data has limitations in its ability to accurately reflect FHWA-13 and FHWA-6 classes which are based on operational characteristics (e.g., number of trailers, raised or lowered axles). Note that vehicle counts reported in this section of the report are the expanded vehicle counts included in the vehicle registration data subsets (as indicated by the "VEHCNT," "COUNT," and "Count" fields in the motorcycles, cars and mixed-duty vehicles, and heavy-duty vehicles data subsets, respectively).

Results for the Motorcycles Data Subsets

The results of the assignment process for the motorcycles data subsets are shown in table 19. All observations in the data set were assigned to FHWA-13 class 1, FHWA-6 class 1, and NHTSA class A. No information on curb weight or gross vehicle weight rating (GVWR) was reported in the vehicle registration data sets.

Table 19. Expanded vehicle counts per Federal Highway Administration 13-vehicle classification system and National Highway Traffic Safety Administration class for motorcycles, 2017–2019.

Year	FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Expanded Vehicle Count
2017	Class 1	Motorcycle	Class A	9,635,472
2018	Class 1	Motorcycle	Class A	9,611,977
2019	Class 1	Motorcycle	Class A	9,740,825

Results for the Cars Data Subsets

The results of the assignment process for the cars data subsets are shown in table 20 through table 22. All observations in the data subsets were assigned to FHWA-13 class 1 and to FHWA-6 Light-Duty Vehicles Short Wheelbase and Light-Duty Vehicles Long Wheelbase. For the NHTSA classification system, observations were assigned to classes A through G. Among those NHTSA vehicle classes, class B and C were the most frequently assigned, indicating GVWR values of 3,001 to 5,000 lbs.

[8] Note that the vehicle group names for FHWA-6 class as reported in tables 15 to 36 are based on table VM-1 of the Highway Statistics publication.

Table 20. Expanded vehicle counts per Federal Highway Administration 6-vehicle classification system and National Highway Traffic Safety Administration class for cars, 2017.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Expanded Vehicle Count
Class 2	Light-Duty Vehicles Short Wheelbase	Class A	1,754,243
Class 2	Light-Duty Vehicles Short Wheelbase	Class B	45,049,593
Class 2	Light Duty Vehicles Short Wheelbase	Class C	66,986,824
Class 2	Light-Duty Vehicles Short Wheelbase	Class D	4,986,346
Class 2	Light-Duty Vehicles Short Wheelbase	Class E	26,204
Class 2	Light-Duty Vehicles Short Wheelbase	Class F	233
Class 2	Light-Duty Vehicles Long Wheelbase	Class A	295
Class 2	Light-Duty Vehicles Long Wheelbase	Class B	2,196
Class 2	Light-Duty Vehicles Long Wheelbase	Class C	231,270
Class 2	Light-Duty Vehicles Long Wheelbase	Class D	669,635
Class 2	Light-Duty Vehicles Long Wheelbase	Class E	31,660
Class 2	Light-Duty Vehicles Long Wheelbase	Class F	581
Class 2	Light-Duty Vehicles Long Wheelbase	Class G	866
Total			**119,739,946**

Table 21. Expanded vehicle counts per Federal Highway Administration 6-vehicle classification system and National Highway Traffic Safety Administration class for cars, 2018.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Expanded Vehicle Count
Class 2	Light-Duty Vehicles Short Wheelbase	Class A	1,646,568
Class 2	Light-Duty Vehicles Short Wheelbase	Class B	44,095,937
Class 2	Light-Duty Vehicles Short Wheelbase	Class C	67,047,448
Class 2	Light-Duty Vehicles Short Wheelbase	Class D	5,026,997
Class 2	Light-Duty Vehicles Short Wheelbase	Class E	25,233
Class 2	Light-Duty Vehicles Short Wheelbase	Class F	217
Class 2	Light-Duty Vehicles Long Wheelbase	Class A	587
Class 2	Light-Duty Vehicles Long Wheelbase	Class B	2,794
Class 2	Light-Duty Vehicles Long Wheelbase	Class C	229,090
Class 2	Light-Duty Vehicles Long Wheelbase	Class D	691,080
Class 2	Light-Duty Vehicles Long Wheelbase	Class E	32,520
Class 2	Light-Duty Vehicles Long Wheelbase	Class F	567
Class 2	Light-Duty Vehicles Long Wheelbase	Class G	865
Total			**118,799,903**

Table 22. Expanded vehicle counts per Federal Highway Administration 6-vehicle classification system and National Highway Traffic Safety Administration class for cars, 2019.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Expanded Vehicle Count
Class 2	Light-Duty Vehicles Short Wheelbase	Class A	1,520,628
Class 2	Light-Duty Vehicles Short Wheelbase	Class B	42,387,425
Class 2	Light-Duty Vehicles Short Wheelbase	Class C	65,636,007
Class 2	Light-Duty Vehicles Short Wheelbase	Class D	5,276,550
Class 2	Light-Duty Vehicles Short Wheelbase	Class E	25,443
Class 2	Light-Duty Vehicles Short Wheelbase	Class F	194
Class 2	Light-Duty Vehicles Long Wheelbase	Class A	1,420
Class 2	Light-Duty Vehicles Long Wheelbase	Class B	1,706
Class 2	Light-Duty Vehicles Long Wheelbase	Class C	215,695
Class 2	Light-Duty Vehicles Long Wheelbase	Class D	670,059
Class 2	Light-Duty Vehicles Long Wheelbase	Class E	34,392
Class 2	Light-Duty Vehicles Long Wheelbase	Class F	535
Class 2	Light-Duty Vehicles Long Wheelbase	Class G	849
Total			**115,770,903**

Summary statistics for GVWR for the cars data subsets are shown in table 23 through table 25. The values shown in those tables are weighted by the count field (i.e., “COUNT”) provided in the vehicle registration data. For GVWR, values range from about 2,800 to 8,400 lbs.

Table 23. Weighted average gross vehicle weight rating per Federal Highway Administration 13-vehicle classification system, Federal Highway Administration 6-vehicle classification system, and National Highway Traffic Safety Administration class for cars, 2017.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Weighted Average of GVWR (lbs)	GVWR Range (lbs)
Class 2	Light-Duty Vehicles Short Wheelbase	Class A	2,787	1,578–3,000
Class 2	Light-Duty Vehicles Short Wheelbase	Class B	3,595	3,001–4,000
Class 2	Light-Duty Vehicles Short Wheelbase	Class C	4,421	4,001–5,000
Class 2	Light-Duty Vehicles Short Wheelbase	Class D	5,283	5,001–5,990
Class 2	Light-Duty Vehicles Short Wheelbase	Class E	6,224	6,001–6,853
Class 2	Light-Duty Vehicles Short Wheelbase	Class F	7,236	7,196–7,360
Class 2	Light-Duty Vehicles Long Wheelbase	Class A	2,804	2,804–2,804
Class 2	Light-Duty Vehicles Long Wheelbase	Class B	3,469	3,050–3,945
Class 2	Light-Duty Vehicles Long Wheelbase	Class C	4,672	4,016–5,000
Class 2	Light-Duty Vehicles Long Wheelbase	Class D	5,411	5,001–5,990
Class 2	Light-Duty Vehicles Long Wheelbase	Class E	6,354	6,001–6,977
Class 2	Light-Duty Vehicles Long Wheelbase	Class F	7,152	7,010–7,610
Class 2	Light-Duty Vehicles Long Wheelbase	Class G	8,420	8,420–8,420

Table 24. Weighted average gross vehicle weight rating per Federal Highway Administration 13-vehicle classification system, Federal Highway Administration 6-vehicle classification system, and National Highway Traffic Safety Administration class for cars, 2018.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Weighted Average of GVWR (lbs)	GVWR Range (lbs)
Class 2	Light-Duty Vehicles Short Wheelbase	Class A	2,786	1,578–3,000
Class 2	Light-Duty Vehicles Short Wheelbase	Class B	3,599	3,001–4,000
Class 2	Light-Duty Vehicles Short Wheelbase	Class C	4,423	4,001–5,000
Class 2	Light-Duty Vehicles Short Wheelbase	Class D	5,282	5,001–5,990
Class 2	Light-Duty Vehicles Short Wheelbase	Class E	6,219	6,001–6,853
Class 2	Light-Duty Vehicles Short Wheelbase	Class F	7,232	7,196–7,360
Class 2	Light-Duty Vehicles Long Wheelbase	Class A	2,804	2,804–2,804
Class 2	Light-Duty Vehicles Long Wheelbase	Class B	3,499	3,050–3,945
Class 2	Light-Duty Vehicles Long Wheelbase	Class C	4,676	4,016–5,000
Class 2	Light-Duty Vehicles Long Wheelbase	Class D	5,412	5,001–5,990
Class 2	Light-Duty Vehicles Long Wheelbase	Class E	6,352	6,001–6,977
Class 2	Light-Duty Vehicles Long Wheelbase	Class F	7,149	7,010–7,610
Class 2	Light-Duty Vehicles Long Wheelbase	Class G	8,420	8,420–8,420

Table 25. Weighted average gross vehicle weight rating per Federal Highway Administration 13-vehicle classification system, Federal Highway Administration 6-vehicle classification system, and National Highway Traffic Safety Administration class for cars, 2019.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Weighted Average of GVWR (lbs)	GVWR Range (lbs)
Class 2	Light-Duty Vehicles Short Wheelbase	Class A	2,785	1,578–3,000
Class 2	Light-Duty Vehicles Short Wheelbase	Class B	3,602	3,001–4,000
Class 2	Light-Duty Vehicles Short Wheelbase	Class C	4,427	4,001–5,000
Class 2	Light-Duty Vehicles Short Wheelbase	Class D	5,283	5,001–5,990
Class 2	Light-Duty Vehicles Short Wheelbase	Class E	6,213	6,001–6,853
Class 2	Light-Duty Vehicles Short Wheelbase	Class F	7,233	7,196–7,360
Class 2	Light-Duty Vehicles Long Wheelbase	Class A	2,836	2,804–2,894
Class 2	Light-Duty Vehicles Long Wheelbase	Class B	3,398	3,050–3,945
Class 2	Light-Duty Vehicles Long Wheelbase	Class C	4,683	4,016–5,000
Class 2	Light-Duty Vehicles Long Wheelbase	Class D	5,415	5,001–5,990
Class 2	Light-Duty Vehicles Long Wheelbase	Class E	6,348	6,001–6,977
Class 2	Light-Duty Vehicles Long Wheelbase	Class F	7,150	7,010–7,610
Class 2	Light-Duty Vehicles Long Wheelbase	Class G	8,420	8,420–8,420

Summary statistics for curb weight for the cars data subsets are shown in table 26 through table 28. The values shown in those tables are weighted by the count field (i.e., “COUNT”) provided in the vehicle registration data. The estimated curb weight values range from about 1,300 to 7,400 lbs.

Table 26. Weighted average curb weight per Federal Highway Administration 13-vehicle classification system, Federal Highway Administration 6-vehicle classification system, and National Highway Traffic Safety Administration class for cars, 2017.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Weighted Average of Curb Weight (lbs)	Curb Weight Range (lbs)
Class 2	Light-Duty Vehicles Short Wheelbase	Class A	2,104	1,078–2,500
Class 2	Light-Duty Vehicles Short Wheelbase	Class B	2,799	1,535–3,500
Class 2	Light-Duty Vehicles Short Wheelbase	Class C	3,466	2,501–4,485
Class 2	Light-Duty Vehicles Short Wheelbase	Class D	4,142	3,502–5,478
Class 2	Light-Duty Vehicles Short Wheelbase	Class E	5,089	4,512–6,031
Class 2	Light-Duty Vehicles Short Wheelbase	Class F	6,236	6,196–6,360
Class 2	Light-Duty Vehicles Long Wheelbase	Class A	1,304	1,304–1,304
Class 2	Light-Duty Vehicles Long Wheelbase	Class B	2,353	1,620–3,365
Class 2	Light-Duty Vehicles Long Wheelbase	Class C	3,994	2,583–4,500
Class 2	Light-Duty Vehicles Long Wheelbase	Class D	4,470	3,505–5,480
Class 2	Light-Duty Vehicles Long Wheelbase	Class E	5,200	4,517–5,995
Class 2	Light-Duty Vehicles Long Wheelbase	Class F	5,936	5,510–6,449
Class 2	Light-Duty Vehicles Long Wheelbase	Class G	7,420	7,420–7,420

Table 27. Weighted average curb weight per Federal Highway Administration 13-vehicle classification system, Federal Highway Administration 6-vehicle classification system, and National Highway Traffic Safety Administration class for cars, 2018.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Weighted Average of Curb Weight (lbs)	Curb Weight Range (lbs)
Class 2	Light-Duty Vehicles Short Wheelbase	Class A	2,104	1,078–2,500
Class 2	Light-Duty Vehicles Short Wheelbase	Class B	2,805	1,535–3,500
Class 2	Light-Duty Vehicles Short Wheelbase	Class C	3,468	2,501–4,485
Class 2	Light-Duty Vehicles Short Wheelbase	Class D	4,144	3,502–5,478
Class 2	Light-Duty Vehicles Short Wheelbase	Class E	5,089	4,512–6,031
Class 2	Light-Duty Vehicles Short Wheelbase	Class F	6,232	6,196–6,360
Class 2	Light-Duty Vehicles Long Wheelbase	Class A	1,304	1,304–1,304
Class 2	Light-Duty Vehicles Long Wheelbase	Class B	2,438	1,620–3,374
Class 2	Light-Duty Vehicles Long Wheelbase	Class C	3,997	2,583–4,500
Class 2	Light-Duty Vehicles Long Wheelbase	Class D	4,469	3,505–5,480
Class 2	Light-Duty Vehicles Long Wheelbase	Class E	5,203	4,517–5,995
Class 2	Light-Duty Vehicles Long Wheelbase	Class F	5,935	5,510–6,449
Class 2	Light-Duty Vehicles Long Wheelbase	Class G	7,420	7,420–7,420

Table 28. Weighted average curb weight per Federal Highway Administration 13-vehicle classification system, Federal Highway Administration 6-vehicle classification system, and National Highway Traffic Safety Administration class for cars, 2019.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Weighted Average of Curb Weight (lbs)	Curb Weight Range (lbs)
Class 2	Light-Duty Vehicles Short Wheelbase	Class A	2,106	1,078–2,500
Class 2	Light-Duty Vehicles Short Wheelbase	Class B	2,810	1,535–3,500
Class 2	Light-Duty Vehicles Short Wheelbase	Class C	3,475	2,501–4,497
Class 2	Light-Duty Vehicles Short Wheelbase	Class D	4,152	3,502–5,478
Class 2	Light-Duty Vehicles Short Wheelbase	Class E	5,099	4,512–6,031
Class 2	Light-Duty Vehicles Short Wheelbase	Class F	6,233	6,196–6,360
Class 2	Light-Duty Vehicles Long Wheelbase	Class A	1,568	1,304–1,894
Class 2	Light-Duty Vehicles Long Wheelbase	Class B	2,177	1,620–3,382
Class 2	Light-Duty Vehicles Long Wheelbase	Class C	4,008	2,583–4,500
Class 2	Light-Duty Vehicles Long Wheelbase	Class D	4,470	3,505–5,480
Class 2	Light-Duty Vehicles Long Wheelbase	Class E	5,216	4,517–5,995
Class 2	Light-Duty Vehicles Long Wheelbase	Class F	5,931	5,510–6,449
Class 2	Light-Duty Vehicles Long Wheelbase	Class G	7,420	7,420–7,420

Results for the Mixed-Duty Vehicles Data Subsets

Table 29 through table 31 contain the results of the assignment process for mixed-duty vehicles. For the FHWA-13 assignment, vehicles were determined to belong to classes 3, 4, and 5. The majority of vehicles were determined to be FHWA-13 class 3. For the FHWA-6 assignment, vehicles were classified as either Light-Duty Vehicles Short Wheelbase, Light-Duty Vehicles Long Wheelbase, Buses, or Single-Unit Trucks. Vehicles in the mixed-duty vehicles data subsets also were assigned to NHTSA class A through 3, indicating a broad range of GVWR. However, most vehicles in the data belonged to either NHTSA class C or D, indicating GVWR values of 4,001 to 6,000 lbs.

Table 29. Expanded vehicle counts per Federal Highway Administration 13-vehicle classification system, Federal Highway Administration 6-vehicle classification system, and National Highway Traffic Safety Administration class for mixed-duty vehicles, 2017.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Expanded Vehicle Count
Class 3	Light-Duty Vehicles Short Wheelbase	Class A	896
Class 3	Light-Duty Vehicles Short Wheelbase	Class B	234,894
Class 3	Light-Duty Vehicles Short Wheelbase	Class C	19,106,473
Class 3	Light-Duty Vehicles Short Wheelbase	Class D	48,463,926
Class 3	Light-Duty Vehicles Short Wheelbase	Class E	170,983
Class 3	Light-Duty Vehicles Short Wheelbase	Class F	15,175,619
Class 3	Light-Duty Vehicles Short Wheelbase	Class G	2,423,661
Class 3	Light-Duty Vehicles Short Wheelbase	Class H	13,846
Class 3	Light-Duty Vehicles Long Wheelbase	Class B	3
Class 3	Light-Duty Vehicles Long Wheelbase	Class C	5,102
Class 3	Light-Duty Vehicles Long Wheelbase	Class D	1,460,759
Class 3	Light-Duty Vehicles Long Wheelbase	Class E	20,616
Class 3	Light-Duty Vehicles Long Wheelbase	Class F	6,989,595
Class 3	Light-Duty Vehicles Long Wheelbase	Class G	5,570,344
Class 3	Light-Duty Vehicles Long Wheelbase	Class H	677,132
Class 4	Buses	Class F	171
Class 5	Single-Unit Trucks	Class C	168,687
Class 5	Single-Unit Trucks	Class D	13,619,079
Class 5	Single-Unit Trucks	Class E	171,496
Class 5	Single-Unit Trucks	Class F	22,688,942
Class 5	Single-Unit Trucks	Class G	9,117,097
Class 5	Single-Unit Trucks	Class H	3,041,703
Total			**149,121,024**

Table 30. Expanded vehicle counts per Federal Highway Administration 13-vehicle classification system, Federal Highway Administration 6-vehicle classification system, and National Highway Traffic Safety Administration class for mixed-duty vehicles, 2018.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Expanded Vehicle Count
Class 3	Light-Duty Vehicles Short Wheelbase	Class A	1,123
Class 3	Light-Duty Vehicles Short Wheelbase	Class B	226,724
Class 3	Light-Duty Vehicles Short Wheelbase	Class C	20,499,913
Class 3	Light-Duty Vehicles Short Wheelbase	Class D	50,934,185
Class 3	Light-Duty Vehicles Short Wheelbase	Class E	255,263
Class 3	Light-Duty Vehicles Short Wheelbase	Class F	16,254,308
Class 3	Light-Duty Vehicles Short Wheelbase	Class G	2,524,629
Class 3	Light-Duty Vehicles Short Wheelbase	Class H	16,308
Class 3	Light-Duty Vehicles Long Wheelbase	Class B	2,550
Class 3	Light-Duty Vehicles Long Wheelbase	Class C	5,036
Class 3	Light-Duty Vehicles Long Wheelbase	Class D	1,424,579
Class 3	Light-Duty Vehicles Long Wheelbase	Class E	19,780
Class 3	Light-Duty Vehicles Long Wheelbase	Class F	7,165,994
Class 3	Light-Duty Vehicles Long Wheelbase	Class G	5,774,025
Class 3	Light-Duty Vehicles Long Wheelbase	Class H	729,373
Class 4	Buses	Class F	156
Class 5	Single-Unit Trucks	Class C	157,746
Class 5	Single-Unit Trucks	Class D	13,566,254
Class 5	Single-Unit Trucks	Class E	163,378
Class 5	Single-Unit Trucks	Class F	23,284,231
Class 5	Single-Unit Trucks	Class G	9,337,138
Class 5	Single-Unit Trucks	Class H	3,419,808
Total			**155,762,501**

Table 31. Expanded vehicle counts per Federal Highway Administration 13-vehicle classification system, Federal Highway Administration 6-vehicle classification system, and National Highway Traffic Safety Administration class for mixed-duty vehicles, 2019.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Expanded Vehicle Count
Class 3	Light-Duty Vehicles Short Wheelbase	Class A	1,134
Class 3	Light-Duty Vehicles Short Wheelbase	Class B	214,530
Class 3	Light-Duty Vehicles Short Wheelbase	Class C	22,125,962
Class 3	Light-Duty Vehicles Short Wheelbase	Class D	52,405,675
Class 3	Light-Duty Vehicles Short Wheelbase	Class E	380,019
Class 3	Light-Duty Vehicles Short Wheelbase	Class F	17,019,716
Class 3	Light-Duty Vehicles Short Wheelbase	Class G	2,631,372
Class 3	Light-Duty Vehicles Short Wheelbase	Class H	26,880
Class 3	Light-Duty Vehicles Long Wheelbase	Class B	2,362
Class 3	Light-Duty Vehicles Long Wheelbase	Class C	4,986
Class 3	Light-Duty Vehicles Long Wheelbase	Class D	1,371,550
Class 3	Light-Duty Vehicles Long Wheelbase	Class E	21,792
Class 3	Light-Duty Vehicles Long Wheelbase	Class F	7,322,284
Class 3	Light-Duty Vehicles Long Wheelbase	Class G	6,096,045
Class 3	Light-Duty Vehicles Long Wheelbase	Class H	810,385
Class 4	Buses	Class F	150
Class 5	Single-Unit Trucks	Class C	145,629
Class 5	Single-Unit Trucks	Class D	13,375,568
Class 5	Single-Unit Trucks	Class E	392,341
Class 5	Single-Unit Trucks	Class F	23,325,848
Class 5	Single-Unit Trucks	Class G	9,824,525
Class 5	Single-Unit Trucks	Class H	3,758,708
Total			**161,257,461**

Summary statistics for GVWR for the mixed-duty vehicles data subsets are shown in table 32 through table 34. GVWR values range from about 2,900 to 13,000 lbs. These values are weighted by the count field (i.e., “COUNT”) provided in the vehicle registration data.

Table 32. Weighted average of gross vehicle weight rating per Federal Highway Administration 13-vehicle classification system, Federal Highway Administration 6-vehicle classification system, and National Highway Traffic Safety Administration class for mixed-duty vehicles, 2017.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Weighted Average of GVWR (lbs)	GVWR Range (lbs)
Class 3	Light-Duty Vehicles Short Wheelbase	Class A	2,892	2,772–2,974
Class 3	Light-Duty Vehicles Short Wheelbase	Class B	3,842	3,033–4,000
Class 3	Light-Duty Vehicles Short Wheelbase	Class C	4,683	4,003–5,000
Class 3	Light-Duty Vehicles Short Wheelbase	Class D	5,557	5,001–6,000
Class 3	Light-Duty Vehicles Short Wheelbase	Class E	6,787	6,125–6,993
Class 3	Light-Duty Vehicles Short Wheelbase	Class F	7,527	7,006–8,000
Class 3	Light-Duty Vehicles Short Wheelbase	Class G	8,225	8,005–8,993
Class 3	Light-Duty Vehicles Short Wheelbase	Class H	9,277	9,003–9,445
Class 3	Light-Duty Vehicles Long Wheelbase	Class B	3,069	3,069–3,069
Class 3	Light-Duty Vehicles Long Wheelbase	Class C	4,976	4,676–4,997
Class 3	Light-Duty Vehicles Long Wheelbase	Class D	5,850	5,099–6,000
Class 3	Light-Duty Vehicles Long Wheelbase	Class E	6,840	6,570–6,993
Class 3	Light-Duty Vehicles Long Wheelbase	Class F	7,626	7,004–8,000
Class 3	Light-Duty Vehicles Long Wheelbase	Class G	8,350	8,003–8,980
Class 3	Light-Duty Vehicles Long Wheelbase	Class H	9,758	9,011–10,000
Class 4	Buses	Class F	7,600	7,600–7,600
Class 5	Single-Unit Trucks	Class C	4,875	4,502–4,992
Class 5	Single-Unit Trucks	Class D	5,898	5,002–6,000
Class 5	Single-Unit Trucks	Class E	6,780	6,046–6,998
Class 5	Single-Unit Trucks	Class F	7,546	7,001–8,000
Class 5	Single-Unit Trucks	Class G	8,250	8,002–8,700
Class 5	Single-Unit Trucks	Class H	10,000	10,000–10,000

Table 33. Weighted average of gross vehicle weight rating per Federal Highway Administration 13-vehicle classification system, Federal Highway Administration 6-vehicle classification system, and National Highway Traffic Safety Administration class for mixed-duty vehicles, 2018.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Weighted Average of GVWR (lbs)	GVWR Range (lbs)
Class 3	Light-Duty Vehicles Short Wheelbase	Class A	2,872	2,772–2,974
Class 3	Light-Duty Vehicles Short Wheelbase	Class B	3,843	3,033–4,000
Class 3	Light-Duty Vehicles Short Wheelbase	Class C	4,687	4,003–5,000
Class 3	Light-Duty Vehicles Short Wheelbase	Class D	5,563	5,001–6,000
Class 3	Light-Duty Vehicles Short Wheelbase	Class E	6,792	6,125–6,993
Class 3	Light-Duty Vehicles Short Wheelbase	Class F	7,517	7,006–8,000
Class 3	Light-Duty Vehicles Short Wheelbase	Class G	8,220	8,005–8,993
Class 3	Light-Duty Vehicles Short Wheelbase	Class H	9,283	9,003–9,445
Class 3	Light-Duty Vehicles Long Wheelbase	Class B	3,682	3,069–3,706
Class 3	Light-Duty Vehicles Long Wheelbase	Class C	4,976	4,676–4,997
Class 3	Light-Duty Vehicles Long Wheelbase	Class D	5,841	5,012–6,000
Class 3	Light-Duty Vehicles Long Wheelbase	Class E	6,840	6,570–6,993
Class 3	Light-Duty Vehicles Long Wheelbase	Class F	7,631	7,004–8,000
Class 3	Light-Duty Vehicles Long Wheelbase	Class G	8,353	8,003–8,980
Class 3	Light-Duty Vehicles Long Wheelbase	Class H	9,767	9,011–10,000
Class 4	Buses	Class F	7,600	7,600–7,600
Class 5	Single-Unit Trucks	Class C	4,875	4,502–4,992
Class 5	Single-Unit Trucks	Class D	5,901	5,002–6,000
Class 5	Single-Unit Trucks	Class E	6,780	6,046–6,998
Class 5	Single-Unit Trucks	Class F	7,555	7,001–8,000
Class 5	Single-Unit Trucks	Class G	8,256	8,002–8,700
Class 5	Single-Unit Trucks	Class H	10,000	10,000–10,000

Table 34. Weighted average of gross vehicle weight rating per Federal Highway Administration 13-vehicle classification system, Federal Highway Administration 6-vehicle classification system, and National Highway Traffic Safety Administration class for mixed-duty vehicles, 2019.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Weighted Average of GVWR (lbs)	GVWR Range (lbs)
Class 3	Light-Duty Vehicles Short Wheelbase	Class A	2,863	2,772–2,974
Class 3	Light-Duty Vehicles Short Wheelbase	Class B	3,844	3,033–4,000
Class 3	Light-Duty Vehicles Short Wheelbase	Class C	4,693	4,003–5,000
Class 3	Light-Duty Vehicles Short Wheelbase	Class D	5,566	5,001–6,000
Class 3	Light-Duty Vehicles Short Wheelbase	Class E	6,818	6,079–7,000
Class 3	Light-Duty Vehicles Short Wheelbase	Class F	7,527	7,006–8,000
Class 3	Light-Duty Vehicles Short Wheelbase	Class G	8,221	8,005–8,993
Class 3	Light-Duty Vehicles Short Wheelbase	Class H	9,692	9,003–10,000
Class 3	Light-Duty Vehicles Long Wheelbase	Class B	3,672	3,069–3,708
Class 3	Light-Duty Vehicles Long Wheelbase	Class C	4,973	4,676–4,997
Class 3	Light-Duty Vehicles Long Wheelbase	Class D	5,847	5,012–6,000
Class 3	Light-Duty Vehicles Long Wheelbase	Class E	6,845	6,570–7,000
Class 3	Light-Duty Vehicles Long Wheelbase	Class F	7,638	7,004–8,000
Class 3	Light-Duty Vehicles Long Wheelbase	Class G	8,353	8,003–8,980
Class 3	Light-Duty Vehicles Long Wheelbase	Class H	9,781	9,011–10,000
Class 4	Buses	Class F	7,600	7,600–7,600
Class 5	Single-Unit Trucks	Class C	4,875	4,502–4,992
Class 5	Single-Unit Trucks	Class D	5,903	5,002–6,000
Class 5	Single-Unit Trucks	Class E	6,858	6,046–7,000
Class 5	Single-Unit Trucks	Class F	7,577	7,001–8,000
Class 5	Single-Unit Trucks	Class G	8,251	8,002–8,700
Class 5	Single-Unit Trucks	Class H	10,000	10,000–10,000

Average curb weight values, weighted by the count field in the vehicle registration data, are shown in table 35 through table 37. As shown in those tables, curb weight values range from about 1,400 to 7,000 lbs.

Table 35. Weighted average of curb weight per Federal Highway Administration 13-vehicle classification system, Federal Highway Administration 6-vehicle classification system, and National Highway Traffic Safety Administration class for mixed-duty vehicles, 2017.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Weighted Average of Curb Weight (lbs)	Curb Weight Range (lbs)
Class 3	Light-Duty Vehicles Short Wheelbase	Class A	1,392	1,272–1,474
Class 3	Light-Duty Vehicles Short Wheelbase	Class B	2,342	1,533–2,500
Class 3	Light-Duty Vehicles Short Wheelbase	Class C	3,171	2,004–3,500
Class 3	Light-Duty Vehicles Short Wheelbase	Class D	4,074	1,940–6,541
Class 3	Light-Duty Vehicles Short Wheelbase	Class E	3,761	2,315–3,993
Class 3	Light-Duty Vehicles Short Wheelbase	Class F	4,579	3,237–5,496
Class 3	Light-Duty Vehicles Short Wheelbase	Class G	5,720	4,933–6,493
Class 3	Light-Duty Vehicles Short Wheelbase	Class H	6,777	6,503–6,945
Class 3	Light-Duty Vehicles Long Wheelbase	Class B	1,569	1,569–1,569
Class 3	Light-Duty Vehicles Long Wheelbase	Class C	3,476	3,176–3,497
Class 3	Light-Duty Vehicles Long Wheelbase	Class D	4,501	3,085–5,903
Class 3	Light-Duty Vehicles Long Wheelbase	Class E	3,823	2,970–3,993
Class 3	Light-Duty Vehicles Long Wheelbase	Class F	4,747	3,417–5,499
Class 3	Light-Duty Vehicles Long Wheelbase	Class G	5,751	4,904–6,480
Class 3	Light-Duty Vehicles Long Wheelbase	Class H	6,543	6,020–9,575
Class 4	Buses	Class F	5,100	5,100–5,100
Class 5	Single-Unit Trucks	Class C	2,409	2,002–3,486
Class 5	Single-Unit Trucks	Class D	3,601	1,403–5,690
Class 5	Single-Unit Trucks	Class E	3,325	2,446–3,982
Class 5	Single-Unit Trucks	Class F	4,409	3,046–5,378
Class 5	Single-Unit Trucks	Class G	5,503	4,904–6,000
Class 5	Single-Unit Trucks	Class H	6,515	6,006–9,745

Table 36. Weighted average of curb weight per Federal Highway Administration 13-vehicle classification system, Federal Highway Administration 6-vehicle classification system, and National Highway Traffic Safety Administration class for mixed-duty vehicles, 2018.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Weighted Average of Curb Weight (lbs)	Curb Weight Range (lbs)
Class 3	Light-Duty Vehicles Short Wheelbase	Class A	1,372	1,272–1,474
Class 3	Light-Duty Vehicles Short Wheelbase	Class B	2,343	1,533–2,500
Class 3	Light-Duty Vehicles Short Wheelbase	Class C	3,176	2,004–3,500
Class 3	Light-Duty Vehicles Short Wheelbase	Class D	4,079	1,940–6,541
Class 3	Light-Duty Vehicles Short Wheelbase	Class E	3,766	2,218–3,993
Class 3	Light-Duty Vehicles Short Wheelbase	Class F	4,568	3,237–5,496
Class 3	Light-Duty Vehicles Short Wheelbase	Class G	5,708	4,933–6,493
Class 3	Light-Duty Vehicles Short Wheelbase	Class H	6,783	6,503–6,945
Class 3	Light-Duty Vehicles Long Wheelbase	Class B	2,182	1,569–2,206
Class 3	Light-Duty Vehicles Long Wheelbase	Class C	3,476	3,176–3,497
Class 3	Light-Duty Vehicles Long Wheelbase	Class D	4,501	3,085–5,903
Class 3	Light-Duty Vehicles Long Wheelbase	Class E	3,824	2,970–3,993
Class 3	Light-Duty Vehicles Long Wheelbase	Class F	4,751	3,419–5,499
Class 3	Light-Duty Vehicles Long Wheelbase	Class G	5,752	4,904–6,480
Class 3	Light-Duty Vehicles Long Wheelbase	Class H	6,539	6,020–9,575
Class 4	Buses	Class F	5,100	5,100–5,100
Class 5	Single-Unit Trucks	Class C	2,408	2,002–3,486
Class 5	Single-Unit Trucks	Class D	3,617	1,403–5,690
Class 5	Single-Unit Trucks	Class E	3,323	2,446–3,982
Class 5	Single-Unit Trucks	Class F	4,423	3,046–5,378
Class 5	Single-Unit Trucks	Class G	5,506	4,904–6,000
Class 5	Single-Unit Trucks	Class H	6,532	6,006–9,745

Table 37. Weighted average of curb weight per Federal Highway Administration 13-vehicle classification system, Federal Highway Administration 6-vehicle classification system, and National Highway Traffic Safety Administration class for mixed-duty vehicles, 2019.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Weighted Average of Curb Weight (lbs)	Curb Weight Range (lbs)
Class 3	Light-Duty Vehicles Short Wheelbase	Class A	1,363	1,272–1,474
Class 3	Light-Duty Vehicles Short Wheelbase	Class B	2,344	1,533–2,500
Class 3	Light-Duty Vehicles Short Wheelbase	Class C	3,182	2,004–3,500
Class 3	Light-Duty Vehicles Short Wheelbase	Class D	4,083	1,940–6,825
Class 3	Light-Duty Vehicles Short Wheelbase	Class E	3,739	2,079–3,993
Class 3	Light-Duty Vehicles Short Wheelbase	Class F	4,585	3,237–5,496
Class 3	Light-Duty Vehicles Short Wheelbase	Class G	5,711	4,933–6,493
Class 3	Light-Duty Vehicles Short Wheelbase	Class H	6,606	6,065–6,948
Class 3	Light-Duty Vehicles Long Wheelbase	Class B	2,172	1,569–2,208
Class 3	Light-Duty Vehicles Long Wheelbase	Class C	3,473	3,176–3,497
Class 3	Light-Duty Vehicles Long Wheelbase	Class D	4,523	2,285–5,926
Class 3	Light-Duty Vehicles Long Wheelbase	Class E	3,808	2,970–3,993
Class 3	Light-Duty Vehicles Long Wheelbase	Class F	4,763	3,476–5,499
Class 3	Light-Duty Vehicles Long Wheelbase	Class G	5,752	4,904–6,480
Class 3	Light-Duty Vehicles Long Wheelbase	Class H	6,523	6,020–9,575
Class 4	Buses	Class F	5,100	5,100–5,100
Class 5	Single-Unit Trucks	Class C	2,407	2,002–3,486
Class 5	Single-Unit Trucks	Class D	3,631	1,403–5,690
Class 5	Single-Unit Trucks	Class E	3,351	2,446–3,982
Class 5	Single-Unit Trucks	Class F	4,464	3,046–5,378
Class 5	Single-Unit Trucks	Class G	5,494	4,903–6,000
Class 5	Single-Unit Trucks	Class H	6,543	6,006–9,745

Results for the Heavy-Duty Vehicles Data Subsets

Table 38 through table 40 contain the results of the assignment process for heavy-duty vehicles. For the FHWA-13 assignment, individual classes were assigned for vehicles that could reasonably be determined to belong to classes 3 through 7. As previously discussed, because the

registration data does not report information on the presence or number of trailers, FHWA-13 classes 8 through 13 are aggregated into a single group (i.e., "class 8–13"). The majority of vehicles were determined to be FHWA-13 class 5. For the FHWA-6 assignment, vehicles were classified as either Light-Duty Vehicles Long Wheelbase, Buses, Single-Unit Trucks, or Combination Trucks. Vehicles in the heavy-duty data subsets also were assigned to NHTSA class 3 through 8, with NHTSA classes 3 and 8 being the most prevalent.

Table 38. Expanded vehicle counts per Federal Highway Administration 13-vehicle classification system and National Highway Traffic Safety Administration class for heavy-duty vehicles, 2017.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Expanded Vehicle Count
Class 3	Light-Duty Vehicles Long Wheelbase	Class 3	602,631
Class 4	Buses	Class 3	16
Class 4	Buses	Class 4	467
Class 4	Buses	Class 5	5,828
Class 4	Buses	Class 6	54,108
Class 4	Buses	Class 7	482,942
Class 4	Buses	Class 8	132,574
Class 5	Single-Unit Trucks	Class 3	3,382,321
Class 5	Single-Unit Trucks	Class 4	1,299,867
Class 5	Single-Unit Trucks	Class 5	926,070
Class 5	Single-Unit Trucks	Class 6	1,376,696
Class 5	Single-Unit Trucks	Class 7	1,107,393
Class 5	Single-Unit Trucks	Class 8	547,458
Class 6	Single-Unit Trucks	Class 5	17
Class 6	Single-Unit Trucks	Class 6	534
Class 6	Single-Unit Trucks	Class 7	625
Class 6	Single-Unit Trucks	Class 8	3,365,672
Class 7	Single-Unit Trucks	Class 7	17
Class 7	Single-Unit Trucks	Class 8	33,221
Class 8 to 13	Combination Trucks	Class 6	70
Class 8 to 13	Combination Trucks	Class 7	239
Class 8 to 13	Combination Trucks	Class 8	8,425
Total			**13,327,191**

Table 39. Expanded vehicle counts per Federal Highway Administration 13-vehicle classification system and National Highway Traffic Safety Administration class for heavy-duty vehicles, 2018.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Expanded Vehicle Count
Class 3	Light-Duty Vehicles Long Wheelbase	Class 3	629,046
Class 4	Buses	Class 3	13
Class 4	Buses	Class 4	457
Class 4	Buses	Class 5	5,580
Class 4	Buses	Class 6	50,389
Class 4	Buses	Class 7	488,015
Class 4	Buses	Class 8	131,667
Class 5	Single-Unit Trucks	Class 3	3,530,591
Class 5	Single-Unit Trucks	Class 4	1,317,821
Class 5	Single-Unit Trucks	Class 5	983,544
Class 5	Single-Unit Trucks	Class 6	1,398,486
Class 5	Single-Unit Trucks	Class 7	1,112,709
Class 5	Single-Unit Trucks	Class 8	582,547
Class 6	Single-Unit Trucks	Class 5	16
Class 6	Single-Unit Trucks	Class 6	504
Class 6	Single-Unit Trucks	Class 7	585
Class 6	Single-Unit Trucks	Class 8	3,484,794
Class 7	Single-Unit Trucks	Class 7	13
Class 7	Single-Unit Trucks	Class 8	36,431
Class 8 to 13	Combination Trucks	Class 6	67
Class 8 to 13	Combination Trucks	Class 7	245
Class 8 to 13	Combination Trucks	Class 8	9,020
Total			**13,762,540**

Table 40. Expanded vehicle counts per Federal Highway Administration 13-vehicle classification system and National Highway Traffic Safety Administration class for heavy-duty vehicles, 2019.

FHWA 13-Vehicle Class	FHWA 6-Vehicle Class	NHTSA Class	Expanded Vehicle Count
Class 3	Light-Duty Vehicles Long Wheelbase	Class 3	651,530
Class 4	Buses	Class 3	11
Class 4	Buses	Class 4	441
Class 4	Buses	Class 5	5,364
Class 4	Buses	Class 6	47,853
Class 4	Buses	Class 7	498,024
Class 4	Buses	Class 8	136,688
Class 5	Single-Unit Trucks	Class 3	3,711,880
Class 5	Single-Unit Trucks	Class 4	1,337,937
Class 5	Single-Unit Trucks	Class 5	1,042,200
Class 5	Single-Unit Trucks	Class 6	1,425,137
Class 5	Single-Unit Trucks	Class 7	1,118,866
Class 5	Single-Unit Trucks	Class 8	601,913
Class 6	Single-Unit Trucks	Class 5	14
Class 6	Single-Unit Trucks	Class 6	499
Class 6	Single-Unit Trucks	Class 7	704
Class 6	Single-Unit Trucks	Class 8	3,652,930
Class 7	Single-Unit Trucks	Class 7	12
Class 7	Single-Unit Trucks	Class 8	40,152
Class 8 to 13	Combination Trucks	Class 6	67
Class 8 to 13	Combination Trucks	Class 7	222
Class 8 to 13	Combination Trucks	Class 8	10,030
Total			**14,282,474**

5.0 Summary

This technical memorandum outlined the process for determining the correct Federal Highway Administration (FHWA) 13-vehicle classification system (FHWA-13), FHWA 6-vehicle classification system (FHWA-6), and National Highway Traffic Safety Administration (NHTSA) classification for observations in a private vehicle registration data set. The methodology, outlined in section 3 of the report, uses information in the data set on body type, drivetrain configuration, rear axle type, and gross vehicle weight classification (according to the NHTSA 8-vehicle gross vehicle weight rating [GVWR] classification system [NHTSA-8]), among others. In addition, the report documents how the FHWA-13 classification system aligns with the FHWA-6 classification system in the context of the private vehicle registration database.

The report went on to demonstrate the effectiveness of the methodology by assigning observations in the private vehicle registration data to their FHWA-13, FHWA-6, and NHTSA classes. For observations in the cars and mixed-duty vehicles data subsets, the results also report average gross vehicle weight and curb weight values as information on those variables were included in the registration data. No information on gross vehicle weight or curb weight were reported for observations in the motorcycles and heavy-duty vehicles data subsets. However, the NHTSA-8 and NHTSA classes for these were able to be estimated based on other information in the data, namely body type and reported NHTSA-8 values.

Overall, the results demonstrate that observations in the private vehicle registration data set can be assigned an FHWA-13, FHWA-6, and NHTSA vehicle class using the methodologies outlined in this report. However, as discussed in section 3 of the report, vehicle registration data has limitations in its ability to accurately reflect FHWA-13 and FHWA-6 classes. Specifically, vehicle classification as registered depends on the physical characteristics of a vehicle (e.g., number of tires, number of axles, and body style, etc.) whereas the FHWA classifications are based on both physical characteristics and usage (e.g., a vehicle operating with a lifted axle or attached trailer). This impacts the ability of the data to accurately reflect the FHWA classes.

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