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Fleet Characterization Data for MOBILE6:

Development and Use of Age Distributions, Average Annual Mileage Accumulation Rates, and Projected Vehicle Counts for Use in MOBILE6

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NOTICE

This technical report does not necessarily represent final EPA decisions or positions. It is intended to present technical analysis of issues using data that are currently available. The purpose in the release of such reports is to facilitate the exchange of technical information and to inform the public of technical developments which may form the basis for a final EPA decision, position, or regulatory action.

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ABSTRACT

The MOBILE model requires estimates of a distribution of registered vehicles by age, average annual mileage accumulation rates by age and vehicle category, and estimates of the projected size of the fleet in future years. While this type of information exists in the current version of the model, MOBILE5, the data contained in that model is outdated. Therefore it was necessary to develop new estimates for use in the new version of the model MOBILE6. The new estimates are largely based on work done by Arcadis, Geraghty & Miller in a report entitled "Update of Fleet Characterization Data for Use in MOBILE6." The Arcadis report describes the number of vehicles registered by age and class and the average mileage accumulation rates on July 1, 1996. The following report describes the methodology EPA used to convert the July 1, 1996 registration profile into a generally-applicable registration distribution by age, the use of the average annual mileage accumulation rates, and the methodology for projecting the size of future vehicle fleets by vehicle category. The report also describes how the results of this analysis will be applied in the model**.**

1.0 Introduction

The United States Environmental Protection Agency's (USEPA) Highway Vehicle Emissions Modeling Team is currently developing an updated version of its on-highway emission factor model, known as MOBILE6. To estimate emission rates of hydrocarbons, carbon monoxide, and oxides of nitrogen from the U.S. motor vehicle population, the model requires data that characterizes the size, composition and driving attributes of current and future vehicle fleets. As part of its effort to obtain this data, EPA contracted with Arcadis, Geraghty & Miller to analyze the most up-to-date sources of data describing the number of vehicles registered in the United States and the average mileage these vehicles drive annually. The results of this analysis are detailed in EPA report # EPA420-P-98-016, entitled "Update of Fleet Characterization Data for Use in MOBILE6."[1] This report, hereafter referred to as the "Arcadis Report," may be found on the World Wide Web at *http://www.epa.gov/OMSWWW/m6.htm* under document number M6.FLT.002.

The Arcadis report provides an estimate of the number of vehicles of various ages in operation in the United States as of July 1, 1996, as well as the average annual mileage accumulation rate per vehicle, for gasoline- and diesel-fueled cars, trucks and buses. July data is used because this data is considered most representative of the months most commonly modeled. Due to limitations in the data sources used to develop their analysis, Arcadis, Geraghty & Miller grouped several GVWR classes together, thus providing only eighteen different vehicle categories. These categories are listed in Table 1, and are defined based on EPA-specified gross-vehicle weight ratings (GVWR), fuel type and vehicle type.

Table 1. Eighteen Vehicle Class Categories as Defined in Arcadis Report

Designation	Description	Gross Vehicle Weight (lbs)
LDGV	Light-duty gasoline vehicles	0-6000
LDDV	Light-duty diesel vehicles	0-6000
LDGT (0-6,000 lbs)	Light-duty gasoline trucks	<6000
LDGT (6,001-8,500)	Light-duty gasoline trucks	6001-8500
LDDT (0-6,000 lbs)	Light-duty diesel trucks	<6000
LDDT (6,001-8,500)	Light-duty diesel trucks	6001-8500
HDGV (classes 2B-3)	Heavy-duty gasoline vehicles	8500-14000
HDGV (classes 4-8)	Heavy-duty gasoline vehicles	>14000
HDDV(class 2B)	Light heavy-duty diesel trucks	8501-10000
HDDV(class 3)	Light heavy-duty diesel trucks	10001-14000
HDDV(class 4-5)	Light heavy-duty diesel trucks	14001-19500
HDDV(class 6-7)	Medium heavy-duty diesel trucks	19500-33000
HDDV(class 8A)	Heavy heavy-duty diesel trucks	33000-60000
HDDV(class 8B)	Heavy heavy-duty diesel trucks	>60000
HDGB (school)	Heavy-duty gasoline school buses	all
HDGB (transit)	Heavy-duty gasoline transit buses	all
HDDB (school)	Heavy-duty diesel school buses	all
HDDB (transit)	Heavy-duty diesel transit buses	all

The MOBILE6 model requires a fractional distribution of vehicles by age and average annual mileage accumulation rates for each vehicle, ages 1 through 25, to determine the fraction of travel attributed to each age of vehicle. MOBILE6 also requires projections of future vehicle fleet size. This information is required for thirty separate vehicle categories, as listed in Table 2. These modeling requirements necessitated further EPA analysis, using the results of the Arcadis report as a starting point. Hence, the following report documents how EPA will use the results of the Arcadis, Geraghty & Miller fleet characteristic analysis in MOBILE6. The current document describes the methodology used to develop a general vehicle registration distribution by age, reproduces the results of the Arcadis analysis of average annual mileage accumulation rates by age, the development of projected vehicle population estimates, and the application of these analyses in MOBILE6.

Table 2. MOBILE6 Vehicle Categories

Gasoline Vehicle Categories	Diesel Vehicle Categories
Light-duty gasoline vehicle	Light-duty diesel vehicle
Light-duty gasoline truck 1	Light-duty diesel truck 1
Light-duty gasoline truck 2	Light-duty diesel truck 2
Light-duty gasoline truck 3	Light-duty diesel truck 3
Light-duty gasoline truck 4	Light-duty diesel truck 4
Heavy-duty gasoline vehicle class 2B	Heavy-duty diesel vehicle class 2B
Heavy-duty gasoline vehicle class 3	Heavy-duty diesel vehicle class 3
Heavy-duty gasoline vehicle class 4	Heavy-duty diesel vehicle class 4
Heavy-duty gasoline vehicle class 5	Heavy-duty diesel vehicle class 5
Heavy-duty gasoline vehicle class 6	Heavy-duty diesel vehicle class 6
Heavy-duty gasoline vehicle class 7	Heavy-duty diesel vehicle class 7
Heavy-duty gasoline vehicle class 8A	Heavy-duty diesel vehicle class 8A
Heavy-duty gasoline vehicle class 8B	Heavy-duty diesel vehicle class 8B
Heavy-duty gasoline Bus *	Heavy-duty diesel School Bus
Motorcycle	Heavy-duty diesel Transit Bus

* Note: MOBILE6 will only contain one heavy-duty gasoline bus category; this category contains all heavy-duty gasoline buses.

2.0 Development of U.S. Fleet Registration Distribution by Age

The Arcadis report provides an estimate of the number of vehicles of various ages in operation in the United States as of July 1, 1996 for eighteen GVWR-based vehicle categories, which are listed in Table 1. These data were compiled using a vehicle registration database purchased from the R.L. Polk Company, a widely recognized resource in the field of collection of vehicular statistics. Several modifications to the Polk database were required to respond to comments made by EPA experts on expected fleet composition; these modifications are detailed in the Arcadis Report (M6.FLT.003, EPA420-P-98-016).

The data provided in the Arcadis report represent a “snapshot” in time, and, as such, include the residual impacts of several historical events (which were economically, politically and/or resource-driven) that have affected motor vehicles sales volumes. However, the MOBILE model is used to describe the emissions effects incurred as a result of the vehicle fleet in future years as well as past years. Therefore, use of this “snapshot” vehicle age-based registration distribution to represent the fleet in any year other than 1996 would provide inaccurate results, as there is no reason to expect that the economic and political factors which have resulted in the 1996 vehicle age-based registration distribution will occur in exactly the same way again.

In an effort to present a “generic” vehicle-registration distribution by age for modeling purposes, and to mitigate the effects of these isolated events on the distribution of vehicles in the in-use fleet, EPA has opted to fit curves through the 1996 snapshot data. Curves were fit through the registration data for each vehicle class and fuel type category, as well as for aggregated vehicle category combinations (e.g., all light-duty vehicles, all light-duty *diesel* vehicles, etc). Several types of curves were explored (e.g., linear, polynomial, exponential, Weibull) in an effort to find the best fit. Due to extreme variability in the distribution of the vehicle population in 1996, many of the fuel-type specific curves were deemed useless and discarded; it was the conclusion of EPA staff that the best, most representative curves were those derived from the following aggregate vehicle categories: light-duty vehicles (All), light-duty trucks (0- 6,000 lbs GVWR), light-duty trucks (6,001-8,500 lbs GVWR), heavy-duty vehicles classes 2B-3 (8,501-14,000 lbs GVWR), heavy-duty vehicles classes 4-8 (14, 001 lbs GVWR and greater), heavy-duty school buses (All), and heavy-duty transit buses (All). To develop a general curve, in each case, the current model year vehicle population data (1996) was removed from the sample because it did not represent a full year, and a best fit analysis was performed on the remaining population data. The best fit analyses resulted in age distribution estimates for vehicles ages 1 through 25+ (where age is calendar year minus model year). However, since the vehicle sales year begins in October, the estimated age 1 population was multiplied by 0.75 to account for the fact that approximately 75% of the year’s sales will have occurred by July 1st of a given calendar year.

Exponential curve fitting was used for light-duty trucks 6,001-8,500 lbs, heavy-duty vehicles classes 2B-3, heavy-duty vehicles classes 4-8, and heavy-duty school buses. For light-duty vehicles, light-duty trucks 0-6,000 lbs, and heavy-duty transit buses, both Weibull curve fitting and exponential curve fitting were used to create the final age distributions. The nature of the Weibull curve fitting formula is to produce an “S” shaped curve, which is relatively flat for the first third of the data, decreases rapidly for the next third, and flattens again for the final third. While using this formula resulted in a better overall fit for the light-duty vehicle, light-duty truck 0-6,000 lbs, and heavy-duty transit bus categories, the flatness of the final third for each curve resulted in unrealistically low vehicle populations for the older vehicle ages. For this reason, the original Weibull curve was used where it fit best, and exponential curves were fit through the data at the age where the Weibull curves began to flatten. Table 3 presents the equations used to create the age distribution, and the years in which the equations were used. Note that MOBILE6 will use the MOBILE5 age distribution for motorcycles; this age distribution is presented in Appendix A.[1]

Table 3. Curve Fit Equations for Registration Distribution by Age

Aggregate Vehicle Category	Equation	Vehicle Ages
Light-duty vehicle	$y= (8{,}517{,}910 * e^{(-((age/16.10050554) \wedge 4.45489164))})$ $y = 112855609.5568e^{(-0.2321*age)}$	1-12 13-25
Light-duty truck 0-6,000 lbs	$y= (3{,}386{,}682 * e^{(-((age/14.38211814) \wedge 3.04037069))})$ $y = 805298.7399e^{(-0.0409*age)}$	1-18 19-25
Light-duty trucks 6,001-8,500 lbs	$y = 1305324.4e^{(-0.070863*age)}$	1-25
Heavy-duty vehicles classes 2B-3	$y = 732326.5e^{(-0.09455*age)}$	1-25
Heavy-duty vehicles classes 4-8	$y = 404143.88e^{(-0.066843*age)}$	1-25
Heavy-duty school buses	$y = 38982e^{(-0.068092*age)}$	1-25
Heavy-duty transit buses	$y= (3462 * e^{(-((age/17.16909475) \wedge 12.53214119))})$ $y = 24987.0776\, e^{(-0.2000*age)}$	1-17 18-25

Table 4 lists the vehicle populations by age that were derived from curve fitting the original July 1, 1996 “snapshot” data. Table 5 presents this data converted to distributions of registration fractions by age for each of the seven vehicle categories that were chosen for use in the model. Figures 1 through 7 display the curve fits associated with these distributions. These distributions will be used for the vehicle subclasses that fall into these larger groups, as described in Section 5.2. Note that each vehicle category includes both gasoline and diesel vehicles.

[1]Due to data and time constraints, EPA has assumed that the data for motorcycles derived for MOBILE5 are generally consistent with current trends; therefore, all motorcycle data is from MOBILE5.

Table 4. U.S. Vehicles in Operation--Results of Curve Fitting for Selected Vehicle Categories as of July 1.

Vehicle Age	LDV All	LDT 0-6,000	LDT 6,001-8,500	HDV 2B-3 8,501-14,000	HDV 4-8B 14,001+	HD School Bus(All)	HD Transit Bus(All)
1*	6,388,406	2,539,245	912,020	499,694	283,511	27,312	2,597
2	8,517,125	3,378,282	1,132,838	606,149	353,571	34,019	3,463
3	8,513,130	3,357,951	1,055,340	551,464	330,710	31,780	3,463
4	8,500,705	3,318,193	983,143	501,712	309,327	29,688	3,463
5	8,471,497	3,253,029	915,886	456,449	289,327	27,733	3,463
6	8,413,702	3,157,436	853,230	415,269	270,619	25,908	3,463
7	8,312,078	3,027,857	794,860	377,804	253,122	24,203	3,463
8	8,148,449	2,862,713	740,483	343,720	236,755	22,609	3,462
9	7,902,918	2,662,837	689,826	312,710	221,447	21,121	3,462
10	7,556,020	2,431,716	642,635	284,498	207,129	19,731	3,459
11	7,091,945	2,175,488	598,672	258,831	193,736	18,432	3,450
12	6,502,671	1,902,590	557,717	235,480	181,210	17,219	3,424
13	5,522,382	1,623,100	519,563	214,236	169,493	16,085	3,358
14	4,378,513	1,347,783	484,019	194,908	158,534	15,026	3,204
15	3,471,578	1,086,999	450,907	177,324	148,283	14,037	2,881
16	2,752,499	849,631	420,061	161,326	138,696	13,113	2,291
17	2,182,365	642,213	391,324	146,771	129,728	12,250	1,431
18	1,730,325	468,411	364,553	133,530	121,340	11,444	683
19	1,371,917	370,226	339,614	121,483	113,494	10,690	559
20	1,087,748	355,389	316,381	110,523	106,156	9,987	458
21	862,439	341,147	294,737	100,552	99,292	9,329	375
22	683,799	327,476	274,574	91,481	92,872	8,715	307
23	542,162	314,352	255,790	83,227	86,867	8,142	251
24	429,862	301,754	238,292	75,719	81,251	7,606	206
25+	1,236,658	1,572,875	1,123,883	330,585	388,328	36,200	649

LDV	Light-duty vehicle
LDT	Light-duty truck
HDV (2B-3)	Heavy-duty vehicles 8,500-14,000 lbs GVWR
HDV (4-8B)	Heavy-duty vehicles greater than 14,000 lbs GVWR
HD Sch. Bus	Heavy-duty school buses
HD Tran. Bus	Heavy-duty transit buses

* Age 1 = 75% of Age 1 as predicted by the curve fit analysis to reflect a July 1 population of age 1 vehicles

Table 5. U.S. Vehicle Fleet Distribution of Registration Fractions by Age for Selected Vehicle Categories as of July 1.

Note: Each vehicle category includes both gasoline and diesel vehicles

Vehicle Age	LDV ALL	LDT 0 -6,000	LDT 6,001-8,500	HDV 2B-3 8,501-14,000	HDV 4-8B 14,001+	HD School Bus (All)	HD Transit. Bus (All)	MC
1*	0.0530	0.0581	0.0594	0.0503	0.0364	0.0368	0.0307	0.1440
2	0.0706	0.0774	0.0738	0.0916	0.0728	0.0736	0.0614	0.1680
3	0.0706	0.0769	0.0688	0.0833	0.0681	0.0688	0.0614	0.1350
4	0.0705	0.0760	0.0640	0.0758	0.0637	0.0642	0.0614	0.1090
5	0.0703	0.0745	0.0597	0.0690	0.0596	0.0600	0.0614	0.0880
6	0.0698	0.0723	0.0556	0.0627	0.0557	0.0561	0.0614	0.0700
7	0.0689	0.0693	0.0518	0.0571	0.0521	0.0524	0.0614	0.0560
8	0.0676	0.0656	0.0482	0.0519	0.0487	0.0489	0.0614	0.0450
9	0.0655	0.0610	0.0449	0.0472	0.0456	0.0457	0.0614	0.0360
10	0.0627	0.0557	0.0419	0.0430	0.0426	0.0427	0.0613	0.0290
11	0.0588	0.0498	0.0390	0.0391	0.0399	0.0399	0.0611	0.0230
12	0.0539	0.0436	0.0363	0.0356	0.0373	0.0373	0.0607	0.0970
13	0.0458	0.0372	0.0338	0.0324	0.0349	0.0348	0.0595	0.0000
14	0.0363	0.0309	0.0315	0.0294	0.0326	0.0325	0.0568	0.0000
15	0.0288	0.0249	0.0294	0.0268	0.0305	0.0304	0.0511	0.0000
16	0.0228	0.0195	0.0274	0.0244	0.0285	0.0284	0.0406	0.0000
17	0.0181	0.0147	0.0255	0.0222	0.0267	0.0265	0.0254	0.0000
18	0.0144	0.0107	0.0237	0.0202	0.0250	0.0248	0.0121	0.0000
19	0.0114	0.0085	0.0221	0.0184	0.0234	0.0231	0.0099	0.0000
20	0.0090	0.0081	0.0206	0.0167	0.0219	0.0216	0.0081	0.0000
21	0.0072	0.0078	0.0192	0.0152	0.0204	0.0202	0.0066	0.0000
22	0.0057	0.0075	0.0179	0.0138	0.0191	0.0189	0.0054	0.0000
23	0.0045	0.0072	0.0167	0.0126	0.0179	0.0176	0.0044	0.0000
24	0.0036	0.0069	0.0155	0.0114	0.0167	0.0165	0.0037	0.0000
25	0.0103	0.0360	0.0732	0.0499	0.0799	0.0783	0.0115	0.0000

LDV	Light-duty vehicle
LDT	Light-duty truck
HDV (2B-3)	Heavy-duty vehicles 8,500-14,000 lbs GVWR
HDV (4-8B)	Heavy-duty vehicles greater than 14,000 lbs GVWR
HD Sch. Bus	Heavy-duty school buses
HD Tran. Bus	Heavy-duty transit buses

* Age 1 = 75% of Age 1 as predicted by the curve fit analysis to reflect a July 1 population of age 1 vehicles

Figure 1. July 1, 1996 Age Distribution Curve Fit For Light-duty Vehicles
(Comparison of Arcadis In-Use Data to Curve Fit)

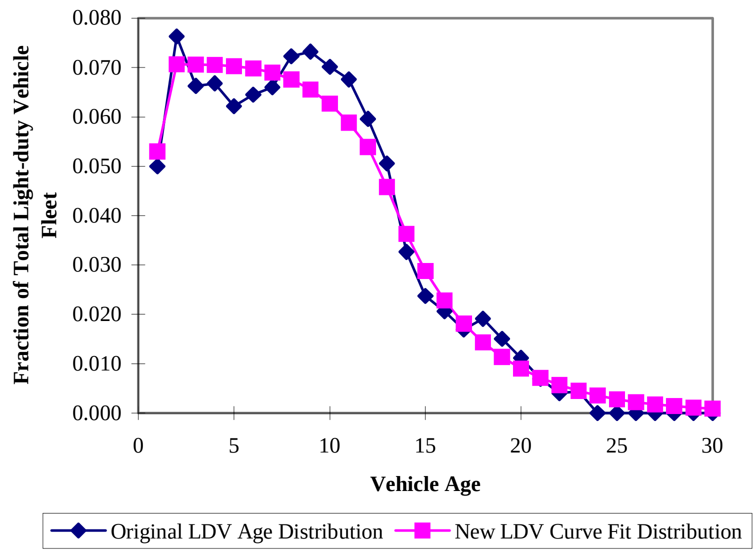
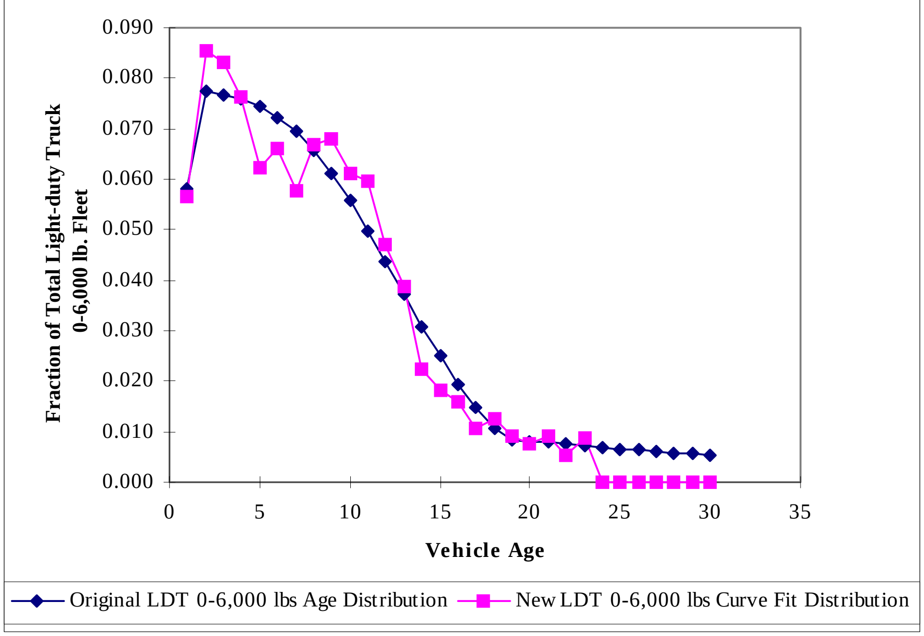


Figure 2. July 1, 1996 Age Distribution Curve Fit for Light-duty Trucks 0-6,000 lbs
(Comparison of Arcadis In-Use Data to Curve Fit)



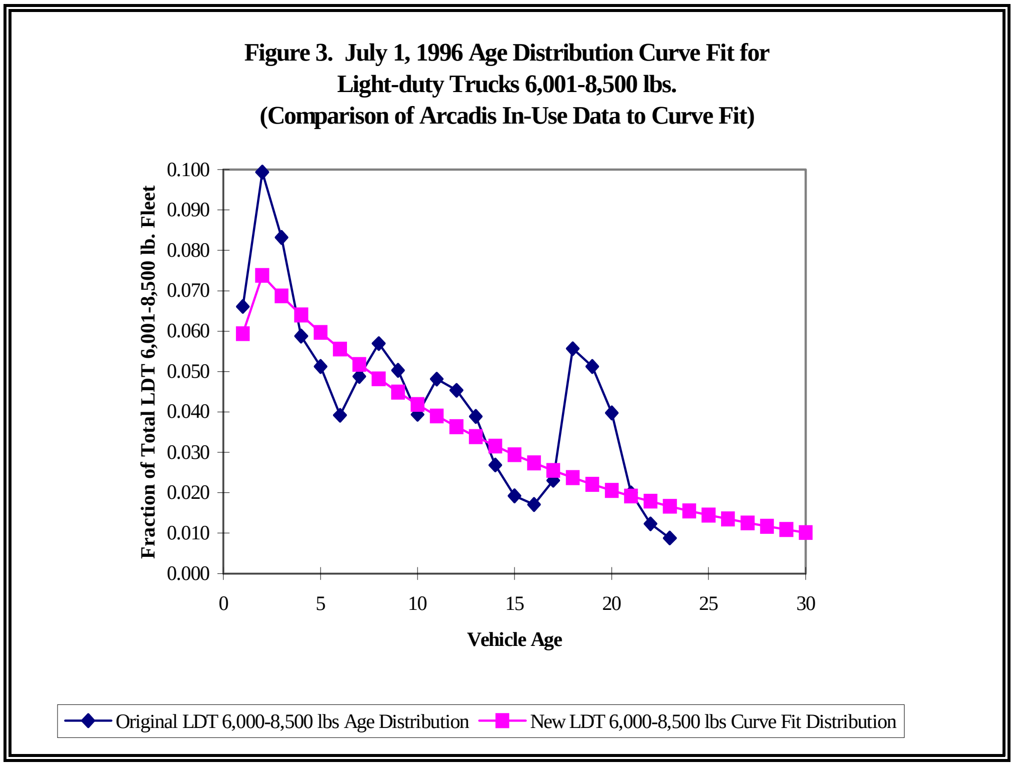


Figure 3. July 1, 1996 Age Distribution Curve Fit for
Light-duty Trucks 6,001-8,500 lbs.
(Comparison of Arcadis In-Use Data to Curve Fit)
Fraction of Total LDT 6,001-8,500 lb. Fleet
0.100
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
0
5
10
15
20
25
30
Vehicle Age
Original LDT 6,000-8,500 lbs Age Distribution
New LDT 6,000-8,500 lbs Curve Fit Distribution

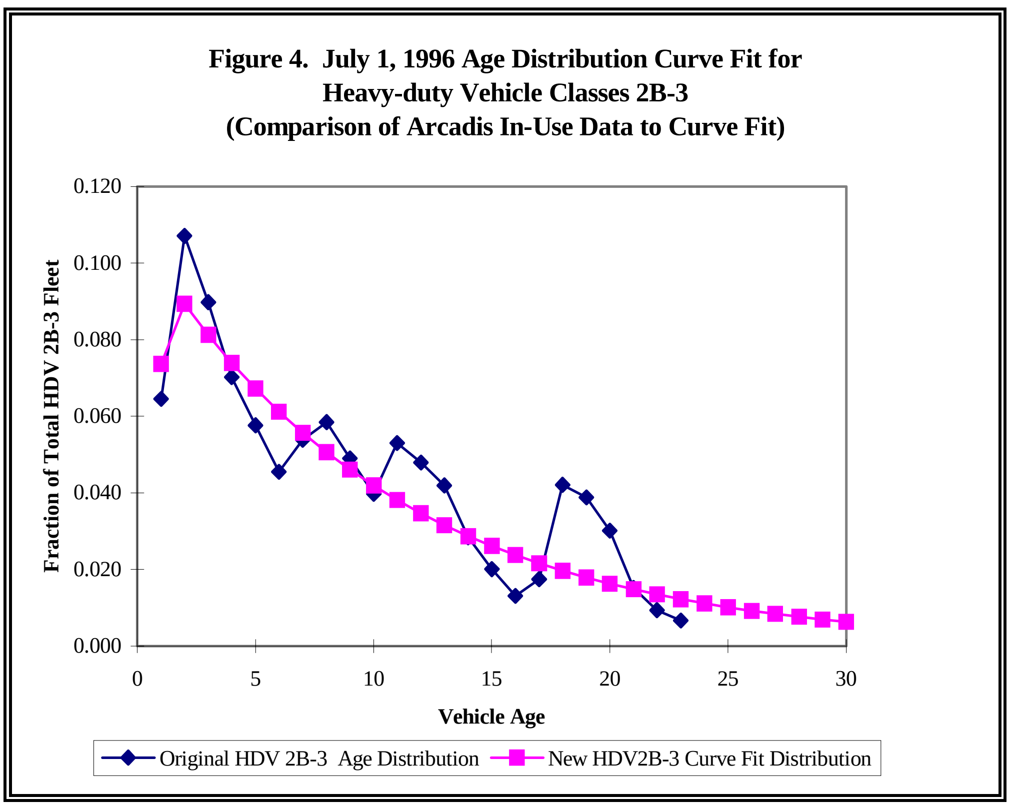


Figure 4. July 1, 1996 Age Distribution Curve Fit for
Heavy-duty Vehicle Classes 2B-3
(Comparison of Arcadis In-Use Data to Curve Fit)
Fraction of Total HDV 2B-3 Fleet
0.120
0.100
0.080
0.060
0.040
0.020
0.000
0
5
10
15
20
25
30
Vehicle Age
Original HDV 2B-3 Age Distribution
New HDV2B-3 Curve Fit Distribution

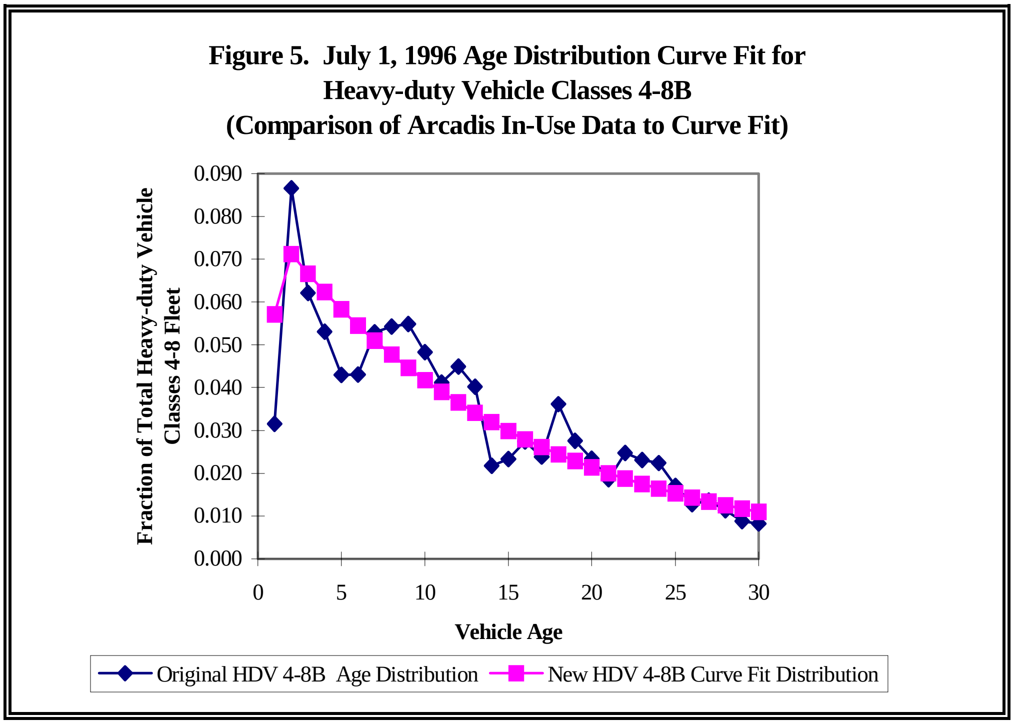


Figure 5. July 1, 1996 Age Distribution Curve Fit for
Heavy-duty Vehicle Classes 4-8B
(Comparison of Arcadis In-Use Data to Curve Fit)
Fraction of Total Heavy-duty Vehicle Classes 4-8 Fleet
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
0
5
10
15
20
25
30
Vehicle Age
Original HDV 4-8B Age Distribution
New HDV 4-8B Curve Fit Distribution

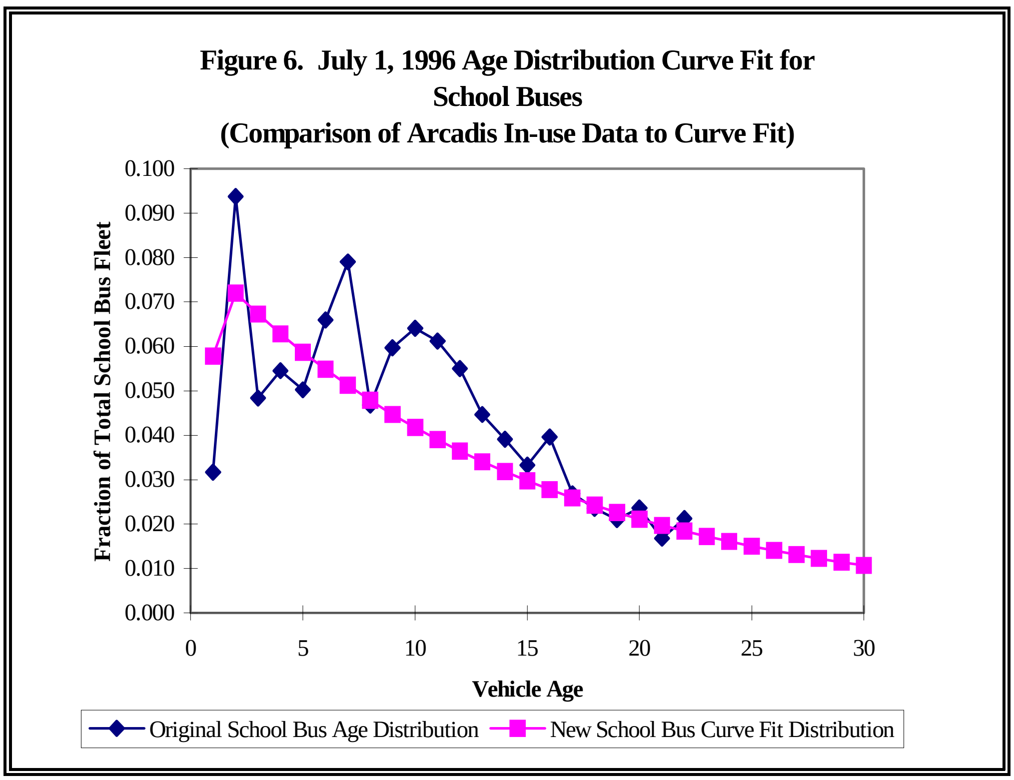


Figure 6. July 1, 1996 Age Distribution Curve Fit for
School Buses
(Comparison of Arcadis In-use Data to Curve Fit)
Fraction of Total School Bus Fleet
0.100
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
0
5
10
15
20
25
30
Vehicle Age
Original School Bus Age Distribution
New School Bus Curve Fit Distribution

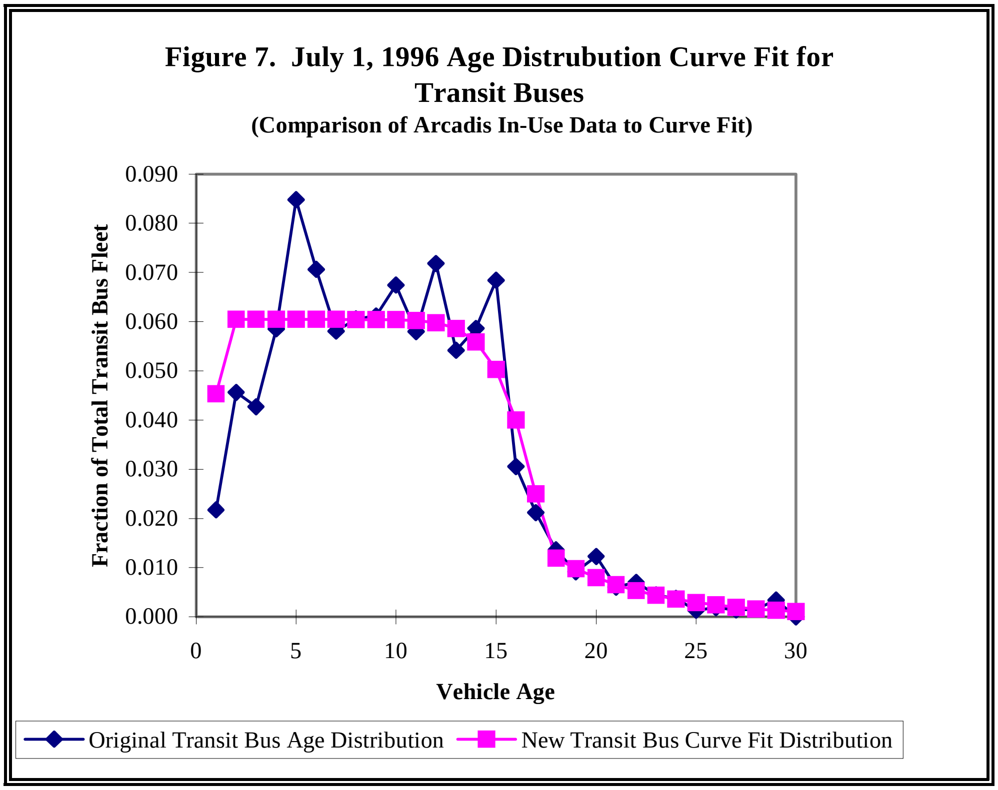


Figure 7. July 1, 1996 Age Distrubution Curve Fit for Transit Buses
(Comparison of Arcadis In-Use Data to Curve Fit)
Fraction of Total Transit Bus Fleet
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
0
5
10
15
20
25
30
Vehicle Age
Original Transit Bus Age Distribution
New Transit Bus Curve Fit Distribution

3.0 Development of Average Annual Mileage Accumulation Rates by Age

The Arcadis report provides estimated average annual mileage accumulation rates for 18 vehicle categories. The non-bus estimates were generated from data contained in two travel behavior surveys, namely the Department of Transportation's "1995 Nationwide Personal Transportation Survey" for light duty vehicles and the U.S. Bureau of the Census' "1992 Truck Inventory and Use Survey." Mileage data for school buses and transit buses were obtained from Bobit Publication's "School Bus Fleet 1997 Fact Book Issue" and a data file provided by the Federal Transportation Administration. Arcadis evaluated the data from these sources on a line-by-line basis, eliminating any data records that were incomplete. Those records that were retained were entered into a database, sorted into gross vehicle weight rating categories, plotted graphically and the results were smoothed using linear and exponential best fit curve analyses. The raw data and the equations for the curves are listed in Appendix B. A detailed explanation of the analysis methods used to obtain average annual mileage accumulation rates can be found in the Arcadis Report.

The curve-fit average annual mileage accumulation rates presented in the report are reproduced here in Table 6. These age-specific average annual mileage accumulation rates represent the 1996 calendar year; in MOBILE6, these default rates will be applied to appropriate vehicle categories as specified in Section 5.2, and will be used for all past, present and future calendar years unless the model user provides their own data. Note that motorcycle mileage accumulation rates are from MOBILE5; these are listed in Appendix A.

Table 6. Average Annual Mileage Accumulation (Curve Fit Data)
U.S. Levels
(12 months estimate)

Vehicle Age	LDV		LDGT		LDDT		HDGV		HDGB	
	LDGV	LDDV	LDGT 0-6000	LDGT 6001-8500	LDDT 0-6000	LDDT 6001-8500	2B-3 8501-14000	4-8 >14000	S.BUS ANY WGT.	T.BUS ANY WGT.
1	14910	14910	19496	21331	27059	26040	19977	21394	(a)	35123
2	14174	14174	18384	19865	24384	24018	18779	19692		31914
3	13475	13475	17308	18500	21973	22154	17654	18125		28999
4	12810	12810	16267	17228	19801	20434	16596	16683		26350
5	12178	12178	15260	16044	17843	18848	15601	15356		23942
6	11577	11577	14289	14942	16079	17385	14666	14134		21755
7	11006	11006	13352	13915	14490	16036	13787	13010		19768
8	10463	10463	12451	12959	13057	14791	12961	11975		17962
9	9947	9947	11584	12068	11766	13643	12184	11022		16321
10	9456	9456	10752	11239	10603	12584	11454	10145		14830
11	8989	8989	9955	10466	9555	11607	10768	9338		13475
12	8546	8546	9194	9747	8610	10706	10122	8595		12244
13	8124	8124	8467	9077	7759	9875	9516	7911		11126
14	7723	7723	7775	8453	6992	9109	8946	7282		10109
15	7342	7342	7118	7872	6301	8402	8409	6703		9186
16	6980	6980	6496	7331	5678	7749	7905	6169		8347
17	6636	6636	5909	6827	5116	7148	7432	5679		7584
18	6308	6308	5356	6358	4610	6593	6986	5227		6891
19	5997	5997	4839	5921	4155	6081	6568	4811		6262
20	5701	5701	4357	5514	3744	5609	6174	4428		5690
21	5420	5420	3909	5135	3374	5174	5804	4076		5170
22	5152	5152	3497	4782	3040	4772	5456	3752		4698
23	4898	4898	3120	4454	2740	4402	5129	3453		4268
24	4656	4656	2777	4148	2469	4060	4822	3178		3879
25	4427	4427	2470	3863	2225	3745	4533	2926		3524
26	4208	4208	2197	3597	2005	3454	4261	2693		3202
27	4001	4001	1959	3350	1807	3186	4006	2479		2910
28	3803	3803	1756	3120	1628	2939	3766	2281		2644
29	3616	3616	1589	2905	1467	2711	3540	2100		2402
30	3437	3437	1456	2706	1322	2500	3328	1933		2183

LDV Light duty vehicle
LDGV Light duty gasoline vehicle
LDDV Light duty diesel vehicle
LDGT Light duty gasoline truck
LDDT Light duty diesel truck
HDGV Heavy duty gasoline vehicle
HDGB Heavy duty gasoline bus

(a) Average school bus mileage for all ages = 9,939

Table 6. Annual Mileage Accumulation (Curve Fit Data)
(12 months estimate)
(continued)
U.S. Levels

Vehicle Age	HDDV						HDDB	
	2B 8501-10000	3 10001-14000	4-5 14001-19500	6-7 19501-33000	8A 33001-60000	8B >60000	S.BUS ANY WGT.	T.BUS ANY WGT.
1	27137	32751	30563	40681	87821	124208	(a)	45171
2	24831	28984	28622	36872	78257	112590		43731
3	22721	25650	26805	33420	69735	102060		42337
4	20791	22699	25103	30291	62141	92514		40987
5	19024	20088	23509	27455	55374	83861		39681
6	17407	17778	22016	24885	49343	76017		38416
7	15928	15733	20618	22555	43970	68907		37191
8	14575	13923	19309	20443	39181	62462		36005
9	13336	12321	18083	18529	34915	56620		34857
10	12203	10904	16935	16795	31112	51324		33746
11	11166	9650	15860	15222	27724	46523		32670
12	10217	8540	14853	13797	24705	42172		31629
13	9349	7557	13910	12505	22015	38228		30620
14	8555	6688	13026	11335	19617	34652		29644
15	7828	5919	12199	10273	17481	31411		28699
16	7163	5238	11425	9312	15577	28473		27784
17	6554	4635	10699	8440	13881	25810		26898
18	5997	4102	10020	7650	12369	23396		26041
19	5488	3630	9384	6933	11022	21208		25211
20	5021	3213	8788	6284	9822	19224		24407
21	4595	2843	8230	5696	8752	17426		23629
22	4204	2516	7707	5163	7799	15796		22875
23	3847	2227	7218	4679	6950	14319		22146
24	3520	1971	6760	4241	6193	12979		21440
25	3221	1744	6331	3844	5518	11765		20757
26	2947	1543	5929	3484	4918	10665		20095
27	2697	1366	5552	3158	4382	9667		19454
28	2468	1209	5200	2862	3905	8763		18834
29	2258	1070	4869	2594	3480	7944		18234
30	2066	947	4560	2352	3101	7201		17652

HDDV Heavy duty diesel vehicle
HDDB Heavy duty diesel bus

(a) Average school bus mileage for all ages = 9,939

4.0 Vehicle Counts for VMT Weighting Calculations

In addition to providing emission factors, MOBILE6 also provides the user with a distribution of the vehicle miles traveled (VMT) by each vehicle type for a given calendar year. This is known as the VMT mix. To calculate the VMT mix, the model requires an estimate of the total vehicle population, or “vehicle count,” by vehicle class for each calendar year. MOBILE5 contained vehicle counts for calendar years 1982 through 2020; 1982 vehicle counts were used for all pre-1982 vehicle counts. MOBILE6 will use the 1982 through 1990 vehicle counts from MOBILE5 because1990 is the last year for which actual in-use vehicle data was collected for MOBILE5. However, MOBILE6 requires additional vehicle count estimates for 1991 and later calendar years. The methodology for obtaining these vehicle counts is explained below.

The following general formula describes how total vehicle count for a future calendar year would ideally be determined for each vehicle category:

$$VC_{x} = (VC_{x-1} + Sales_{x}) - (Scrappage_{x})$$

where: VC = total vehicle count for that vehicle category
Sales = number of new vehicles sold
Scrappage = number of vehicles removed from fleet
x = the calendar year in question

In the above scenario, the vehicle count for a future year would be calculated by adding an estimated number of new vehicle sales to the previous year’s total fleet and subtracting an estimated number of vehicles that were likely to be removed from the fleet during that year; this is known as scrappage.

Estimating vehicle populations for future calender years requires some engineering judgements regarding changes in the number of new vehicles being sold and driven each year, as well as the number of vehicles being removed from the road due to scrappage. Making such judgements requires an analysis of the most current sources of data characterizing in-use vehicle population size, sales growth estimates, and scrappage rates for light-and heavy-duty vehicles. Sections 4.1 describes the methodologies EPA used to determine future vehicle counts for calendar years 1996 through 2050, Section 4.2 presents fuel splits by vehicle class, and Section 4.3 describes the method EPA used to interpolate between the MOBILE5 data and the new data for the missing years (1991 through 1995).

4.1 Methodology for Estimating Vehicle Counts for Calendar Years 1996 through 2050

As noted in Section 1.0, EPA contracted with Arcadis, Geraghty & Miller in 1998 to assess the actual in-use vehicle fleet for eighteen vehicle categories (see Table 1) as of July 1, 1996. These data serve as the baseline for all future vehicle count calculations presented in the current report.

The Arcadis report provides total in-use vehicles by eighteen vehicle class categories. Ideally, separate vehicle class-specific sales growth and scrappage rates would have been applied to each of the vehicle categories to provide a relative sense of the effects of vehicle-type-specific trends. For example, there is some evidence that suggests that sales of several heavy-duty truck categories have slowed considerably in recent years, and will continue to decline in the future; it may be speculated that these vehicles are being replaced by smaller or larger heavy-duty trucks.[2] Unfortunately, at the time of this analysis, adequate sales growth and scrappage rates for individual vehicle categories were not available. Therefore, EPA has evaluated *general* sales growth and vehicle scrappage trends for the total light-duty vehicle in-use fleet and the total heavy-duty vehicle in-use fleet, and has attempted, where possible, to reflect some of the differences between vehicle categories.

The following two sections detail the methods used to characterize light-duty future vehicle counts and heavy-duty future vehicle counts, respectively.

4.1.1 Light-duty Vehicle Counts for 1996 through 2050

To calculate future light-duty vehicle counts, EPA began this analysis with the total number of light-duty vehicles for July 1, 1996, which is the sum of all of the light-duty categories specified in the Arcadis Report (176,375,176 light-duty vehicles,).

Estimates of total light-duty vehicle sales were needed for calendar years 1997 through 2050. Baseline sales data were derived from the EPA's Certification and Fuel Economy Information System (CFEIS) database[3]. Due to reporting problems, complete sales data for 1997 was not available; therefore, for this analysis, the most up-to-data sales data was a *projected* 1998 sales estimate (14,633,231). To determine annual sales of light-duty vehicles beyond 1998 (and to estimate the missing 1997 sales total), EPA consulted the 1999 Department of Energy Annual Energy Outlook (AEO99)[4]. AEO99 reports a light-duty vehicle sales growth rate of 0.5% annually for 1997 through 2020. By applying this growth rate to the light-duty unit sales reported for 1998 in the CFEIS database, EPA determined unit sales estimates for calendar years 1997 through 2020.

To determine the effects of annual vehicle scrappage on the light-duty fleet, EPA employed scrappage rates reported in the 1996 World Vehicle Forecasts and Strategies[5] report. This document defines scrappage as "the number of vehicles scrapped or otherwise removed from circulation in any given year;" this value is reported as a percentage of the "parc," or number of vehicles in use in any given year. The 1996 World Vehicle Forecasts and Strategies document does not provide vehicle class-specific scrappage rates, instead reporting scrappage rates for "passenger cars" and "commercial vehicles." EPA has assumed the scrappage rates presented for "passenger cars" to be representative of the light-duty vehicle fleet for this analysis; these rates are listed in Table 7.

Table 7. “Passenger Car” Scrappage Rates used for Light-duty Vehicle Scrappage.

Calendar Year*	Annual Rate of Scrappage (as % of “Parc”)
1995-1999	5.77
2000-2004	5.70
2005-2009	6.09
2010-2014	6.34
2015-2020	6.56

* =The 1996 World Vehicle Forecasts and Strategies document reports “scrappage rates as % of parc” for calendar years 1995, 2000, 2005, 2010, and 2015. EPA has assumed that the annual scrappage rate remains the same for years not explicitly stated (i.e., 1996 through 1999 have the same scrappage rate as 1995, etc).

It is important to note that these scrappage rates represent the percentage of the *total in-use fleet* that is removed from circulation; therefore, scrappage becomes a function of the previous years fleet total plus the current year’s calculated sales. The general vehicle count formula therefore becomes:

$$VC_x = (VC_{x-1} + Sales_x) \times (1 - SR_x)$$

where: VC = vehicle count
Sales = number of vehicle sold
SR = % of in-use fleet that is scrapped
x = the current calendar year

To illustrate the calculation, starting with the 1996 total light-duty vehicle count:

$$VC_{1997} = (VC_{1996} + Sales_{1997}) \times (1 - SR_{1997})$$
$$VC_{1997} = (VC_{1996} + Sales_{1997}) - ((VC_{1996} + Sales_{1997}) \times SR_{1997})$$
$$VC_{1997} = (176,385,176 + 14,560,429) - ((176,385,176 + 14,560,429) \times 5.77\%)$$
$$VC_{19977} = 190,945,605 - (190,945,605 - 11,017,561)$$
$$VC_{1997} = 179,928,044$$

This calculation was performed for all calendar years 1997 through 2020. Since none of the data sources used here projected beyond the year 2020, MOBILE6 will use the 2020 vehicle count for calendar years 2021 through 2050. Table 8 lists the calculated unit sales, the scrappage rates, and total light-duty vehicle count projections for 1997 through 2050.

Table 8. Calculated Sales, Scrappage Rates, and Vehicle Counts for Light-duty Vehicles by Calendar Year

Calendar Year	Calculated Sales	Scrappage (% of in-use fleet)	Total LD Vehicles
1996	N/A	N/A	176,385,176
1997	14,560,429	5.77	179,928,044
1998	14,633,231	5.77	183,335,089
1999	14,706,397	5.77	186,614,492
2000	14,779,929	5.70	189,914,940
2001	14,853,829	5.70	193,096,949
2002	14,928,098	5.70	196,167,619
2003	15,002,738	5.70	199,133,647
2004	15,077,752	5.70	202,001,349
2005	15,153,141	6.09	203,929,782
2006	15,228,907	6.09	205,811,924
2007	15,305,051	6.09	207,650,951
2008	15,381,576	6.09	209,449,847
2009	15,458,484	6.09	211,211,414
2010	15,535,777	6.34	212,371,419
2011	15,613,456	6.34	213,530,633
2012	15,691,523	6.34	214,689,471
2013	15,769,980	6.34	215,848,322
2014	15,848,830	6.34	217,007,553
2015	15,928,074	6.56	217,655,051
2016	16,007,715	6.56	218,334,488
2017	16,087,753	6.56	219,044,142
2018	16,168,192	6.56	219,782,406
2019	16,249,033	6.56	220,547,776
2020-2050	16,330,278	6.56	221,338,854

Note: 1998 Sales are "projected sales" and represent the base sales for calculating sales in all other years. Sales are grown at a rate of 0.5% annually. 1997 sales are estimated from the 1998 base sales using the following formula: 1998 Sales/1.005.

Total light-duty vehicle counts by calendar year were then split into cars and trucks (hereafter referred to as "light-duty vehicles" and "light-duty trucks," respectively). To do this, EPA used a methodology for predicting car/truck proportions outlined in an EPA report entitled "VMT and Emission Implications of Growth in Light Truck Sales."[6] This method assumes that sales of light-duty trucks will increase and ultimately surpass sales of light-duty cars in the near future. In keeping with other agency analyses, EPA assumed that the car to truck sales ratio will ultimately stabilize at 40:60 for calendar years 2008 on.[7] These sales rates were then used to calculate light-duty vehicle to light-duty truck "stock" splits, or the relative relationship of car to truck registrations in the total fleet. Due to assumptions inherent in this methodology, the predicted 1996 stock split did not exactly match the split determined by Arcadis for July 1, 1996. To account for this difference, EPA fit a line through the Arcadis 1996 splits and the predicted 2000 split to join the two sources of data. As a result, EPA calculated the following car to truck stock (in-use fleet) relationships:

Table 9. Light-duty Vehicle / Light-duty Truck Fleet Distribution Split

Calendar Year	Percentage of Total Light-duty Class	
	Light-duty Vehicles	Light-duty Trucks
1996	68.2%	31.8%
1997	66.0%	34.0%
1998	63.9%	36.1%
1999	61.7%	38.3%
2000	59.6%	40.4%
2001	58.0%	42.0%
2002	56.6%	43.4%
2003	55.0%	45.0%
2004	53.4%	46.6%
2005	52.0%	48.0%
2006	50.3%	49.7%
2007	48.7%	51.3%
2008	47.0%	53.0%
2009	45.5%	54.5%
2010	44.1%	55.9%
2011	42.8%	57.2%
2012	41.6%	58.4%
2013	40.5%	59.5%
2014	39.6%	60.4%
2015	38.8%	61.2%
2016	38.0%	62.0%
2017	37.3%	62.7%
2018	36.8%	63.2%
2019	36.3%	63.7%
2020-2050	35.9%	64.1%

Light-duty trucks are further disaggregated into two categories: light-duty trucks less than 6,000 lbs GVWR and light-duty trucks greater than 6,000 lbs GVWR. These two categories correspond with the federal regulatory weight classes that were in place at the time that MOBILE5 and older versions of the model were released. This split is made by again referring the 1996 Arcadis report. The Arcadis report indicated that, as of July 1, 1996, 73.72% of all light-duty trucks were rated as less than 6,000 lbs GVWR, and 26.28% were rated as greater than 6,000 lbs GVWR. Due to a lack of data characterizing this split in future years, EPA has assumed this ratio for all future years as well as 1996.

Federal regulations implemented in1994 redefined the light-duty truck classes. As a result of these new definitions, the MOBILE model requires further disaggregation of the two light-duty truck groupings into four regulatory classes: light-duty trucks class 1 (LDT1), light-duty trucks class 2 (LDT2), light-duty trucks class 3 (LDT3) and light-duty trucks class 4 (LDT4) for calendar years 1994 through 2050. Table 10 briefly describes the new light-duty truck classes; a detailed explanation of the new definitions is provided in Appendix C.

Table 10. Description of New EPA Light-duty Truck Classifications

MOBILE5 Category	MOBILE6 Category	Gross Vehicle Weight Rating	Loaded Vehicle Weight Rating	Description
Light-duty truck 1	Light-duty truck 1	≤6000 lbs	≤3750 lbs	Most small SUVs, most small pickups
Light-duty truck 1	Light-duty truck 2	≤6000 lbs	>3750 lbs	All minivans, “Compact” SUVs (e.g., Explorer), most Dakota and T100 pickups
Light-duty truck 2	Light duty truck 3	>6000 lbs	0-5750 lbs (Average Loaded Vehicle Weight)*	Most 1/2-ton pickups, Base full-size vans, and intermediate SUVs (e.g., Land Cruiser)
Light-duty truck 2	Light duty truck 4	>6000 lbs	>5750 lbs (Average Loaded Vehicle Weight)*	Some 1/2 and 3/4 ton pickups, some full-size vans, and larger SUVs (e.g., Expedition)

* Average Loaded Vehicle Weight is the average of the gross vehicle weight and the curb weight

As these truck class definitions are relatively new, little data exists to allow for splitting trucks into these categories. To get a sense of how the older light-duty truck category should be distributed into the four federal categories, EPA again used the 1998 Certification and Fuel Economy Information System (CFEIS) database[8]. Using 1998 sales data, EPA was able to determine that in 1998, 23.1% of all light-duty trucks *less* than 6,000 lbs GVWR would be classified as LDT1 and 76.9% of all light-duty trucks *less* than 6,000 lbs GVWR would be classified as LDT2. Further, 68.5% of all light-duty trucks *greater* than 6,000 lbs GVWR would be classified as LDT3 and 31.5% of all light-duty trucks *greater* than 6,000 lbs GVWR would be classified as LDT4.

Table 11. Distribution of Light-duty Trucks <6,000 lbs GVWR into Federally-defined Light-duty Truck Classes LDT1 and LDT2

Federally Defined Light-duty Truck Category	Percentage of Total LDT<6000 lbs
LDT1	23.1
LDT2	76.9

Table 12 Distribution of Light-duty Trucks >6,000 lbs GVWR into Federally-defined Light-duty Truck Classes LDT3 and LDT4

Federally Defined Light-duty Truck Category	Percentage of Total LDT>6000 lbs
LDT3	68.5
LDT4	31.5

In lieu of other sources of data, these sales relationships were assumed to represent the general vehicle class splits in the total vehicle fleet. Therefore, the above ratios were applied to light-duty trucks in calendar years 1996 through 2050. The final class-specific vehicle counts for all light duty classes in calendar years 1996 though 2050 are presented in Table 13.

Table 13. Vehicle Counts by Calendar Year for Light-duty Vehicles

	Light-duty Vehicle Class					
Calendar Year	**Light-duty Vehicles**	**Light-duty Truck Class 1**	**Light-duty Truck Class 2**	**Light-duty Truck Class 3**	**Light-duty Truck Class 4**	**Total Light-duty Vehicles and Trucks**
1996	120,213,037	9,566,078	31,845,513	10,110,975	4,649,573	176,385,176
1997	118,773,800	10,414,527	34,670,004	11,007,753	5,061,960	179,928,044
1998	117,096,045	11,280,465	37,552,716	11,923,017	5,482,847	183,335,089
1999	115,193,551	12,162,938	40,490,475	12,855,757	5,911,772	186,614,492
2000	113,163,114	13,070,784	43,512,698	13,815,316	6,353,028	189,914,940
2001	112,067,320	13,799,291	45,937,900	14,585,319	6,707,118	193,096,949
2002	110,950,294	14,512,453	48,312,019	15,339,104	7,053,749	196,167,619
2003	109,439,432	15,274,865	50,850,090	16,144,943	7,424,317	199,133,647
2004	107,898,603	16,025,634	53,349,406	16,938,478	7,789,227	202,001,349
2005	105,955,155	16,685,013	55,544,480	17,635,416	8,109,717	203,929,782
2006	103,575,222	17,410,842	57,960,767	18,402,589	8,462,504	205,811,924
2007	101,040,538	18,155,682	60,440,343	19,189,856	8,824,532	207,650,951
2008	98,431,413	18,906,365	62,939,370	19,983,299	9,189,400	209,449,847
2009	96,043,330	19,613,047	65,291,919	20,730,235	9,532,882	211,211,414
2010	93,587,131	20,228,884	67,342,044	21,381,152	9,832,208	212,371,419
2011	91,290,697	20,817,379	69,301,145	22,003,168	10,118,245	213,530,633
2012	89,345,016	21,346,077	71,061,181	22,561,981	10,375,217	214,689,471
2013	87,503,888	21,856,971	72,761,950	23,101,976	10,623,537	215,848,322
2014	85,917,827	22,324,492	74,318,331	23,596,128	10,850,774	217,007,553
2015	84,384,402	22,695,902	75,554,755	23,988,694	11,031,297	217,655,051
2016	82,971,891	23,052,159	76,740,738	24,365,244	11,204,455	218,334,488
2017	81,805,681	23,371,618	77,804,216	24,702,900	11,359,728	219,044,142
2018	80,793,310	23,669,750	78,796,699	25,018,014	11,504,634	219,782,406
2019	79,950,083	23,943,693	79,708,656	25,307,561	11,637,783	220,547,776
2020 - 2050	79,436,359	24,165,899	80,448,384	25,542,425	11,745,787	221,338,854

For motorcycles, MOBILE6 will use the same vehicle count assumptions that were developed for MOBILE5, as noted in Appendix A.

4.1.2 Heavy-duty Vehicle Counts for 1996 through 2050

To estimate future vehicle counts for heavy-duty vehicles, EPA again used the data provided in the Arcadis report for July 1, 1996 to obtain a heavy-duty vehicle total (11,897,859 heavy-duty vehicles). Confidential sales data supplied by heavy-duty truck manufacturers were used to determine heavy-duty gasoline vehicle sales for 1996. Unfortunately, at the time of this analysis, heavy-duty diesel sales data were only available from the confidential sales data for 1995. To calculate total heavy-duty diesel sales for 1996, a 2% sales growth rate was assumed between 1995 and 1996, and this growth rate was applied to the 1995 heavy-duty diesel sales total. This figure was then added to the 1996 heavy-duty gasoline sales, resulting in a total heavy-duty vehicle sales figure for 1996 of 1,071,131 vehicles.

The 1997 Regulatory Impact Analysis for heavy-duty engines predicts a linear growth rate of 2.0% for heavy-duty vehicles annually through the year 2020 (see reference 2 in bibliography). This rate was used to calculate total heavy-duty sales for calendar years 1997 through 2020. As with light-duty vehicles, EPA relied on the 1996 World Vehicle Forecasts and Strategies report for heavy-duty scrappage rates. Again, note that this document defines scrappage as "the number of vehicles scrapped or otherwise removed from circulation in any given year;" this value is reported as a percentage of the "parc," or number of vehicles in use in any given year. The report contains "commercial vehicle" scrappage rates; for this analysis, EPA assumed commercial vehicles were equivalent to all heavy-duty vehicle categories. These scrappage rates are listed in Table 14.

Table 14. "Commercial Vehicle" Scrappage Rates used for Heavy-duty Vehicle Scrappage

Calendar Year*	Annual Rate of Scrappage (as % of "Parc")
1995-1999	4.39
2000-2004	5.55
2005-2009	6.45
2010-2014	7.12
2015-2020	7.57

As described in Section 4.1.1., the following formula is used to calculate vehicle counts for future calendar years:

$$VC_x = (VC_{x-1} + Sales_x) \times (1 - SR_x)$$

where: VC = vehicle count
Sales = number of vehicle sold
SR = % of in-use fleet that is scrapped
x = the calendar year in question

This calculation was performed for calendar years 1997 through 2020 to obtain total heavy-duty vehicle counts. The calculated sales, scrappage rates, and total heavy-duty vehicle counts are listed in Table 15.

Table 15. Calculated Sales, Scrappage Rates, and Vehicle Counts for Heavy-duty Vehicles by Calendar Year

Calendar Year	Calculated Sales	Scrappage (% of in-use fleet)	Total Heavy-duty Vehicles
1996	N/A	N/A	11,897,859
1997	1,092,554	4.39%	12,420,134
1998	1,113,976	4.39%	12,939,962
1999	1,135,399	4.39%	13,457,453
2000	1,156,821	5.55%	13,803,182
2001	1,178,244	5.55%	14,149,957
2002	1,199,667	5.55%	14,497,720
2003	1,221,089	5.55%	14,846,415
2004	1,242,512	5.55%	15,195,992
2005	1,263,935	6.45%	15,398,261
2006	1,285,357	6.45%	15,607,525
2007	1,306,780	6.45%	15,823,332
2008	1,328,202	6.45%	16,045,260
2009	1,349,625	6.45%	16,272,915
2010	1,371,048	7.12%	16,387,713
2011	1,392,470	7.12%	16,514,234
2012	1,413,893	7.12%	16,651,644
2013	1,435,316	7.12%	16,799,168
2014	1,456,738	7.12%	16,956,086
2015	1,478,161	7.57%	17,038,774
2016	1,499,583	7.57%	17,135,004
2017	1,521,006	7.57%	17,243,750
2018	1,542,429	7.57%	17,364,065
2019	1,563,851	7.57%	17,495,073
2020 - 2050	1,585,274	7.57%	17,635,965

To provide vehicle counts for the ten heavy-duty vehicle categories (class 2B, class 3, class 4, class 5, class 6, class 7, class 8A, class 8B, school buses and transit buses), the 1996 Arcadis report was used. Ratios of vehicle population in each of the heavy-duty vehicle categories to the total heavy-duty vehicle population were calculated for the heavy-duty vehicle categories reported in the Arcadis report for the total in-use vehicle populations as of July 1, 1996. However, several of the Arcadis report categories represented aggregate classes, specifically heavy-duty gasoline vehicles classes 2B-3, heavy-duty gasoline vehicles classes 4-8, heavy-duty diesel vehicles classes 4-5, and heavy-duty diesel vehicles classes 6-7. To provide vehicle counts for the ten non-fuel specific heavy-duty vehicle classes represented in MOBILE6, these aggregate classes were split using ratios of projected 1996 sales in each of the ten categories to the total projected 1996 sales from a 1992 Navistar study.[9] These percentages are listed in Table 16. The final splits were computed by summing the individual fuel-specific categories to determine the total for each of the ten categories.

Table 16. Percentage of Total Heavy-duty Vehicles by Vehicle Class

Heavy-Duty Class	% of Total Heavy-duty Vehicle by Class
2B	50.20%
3	4.44%
4	3.29%
5	2.93%
6	9.15%
7	9.65%
8A	4.96%
8B	11.43%
School Bus	3.48%
Transit Bus	0.47%

As with light-duty vehicles, due to a lack of other predictors, the above ratios were applied to heavy-duty trucks in calendar years 1996 through 2050. The final class-specific vehicle counts for all light duty classes in calendar years 1996 though 2050 are presented in Table 17.

Table 17. Vehicle Counts by Calendar Year for Heavy-duty Vehicles

	Heavy-duty Vehicle Class										
Calendar Year	Class 2B	Class 3	Class 4	Class 5	Class 6	Class 7	Class 8A	Class 8B	School Buses	Transit Buses	Total
1996	5,972,563	528,582	391,443	348,582	1,089,074	1,147,715	589,867	1,360,346	413,819	55,869	11,897,859
1997	6,234,738	551,785	408,626	363,883	1,136,881	1,198,095	615,760	1,420,060	431,984	58,321	12,420,134
1998	6,495,685	574,879	425,728	379,113	1,184,464	1,248,240	641,531	1,479,495	450,064	60,762	12,939,962
1999	6,755,458	597,870	442,754	394,274	1,231,832	1,298,159	667,187	1,538,663	468,063	63,192	13,457,453
2000	6,929,009	613,229	454,129	404,404	1,263,479	1,331,510	684,328	1,578,192	480,088	64,816	13,803,182
2001	7,103,086	628,635	465,538	414,563	1,295,221	1,364,961	701,520	1,617,840	492,149	66,444	14,149,957
2002	7,277,658	644,085	476,979	424,752	1,327,053	1,398,507	718,761	1,657,602	504,245	68,077	14,497,720
2003	7,452,698	659,576	488,451	434,968	1,358,971	1,432,144	736,049	1,697,470	516,373	69,715	14,846,415
2004	7,628,181	675,107	499,952	445,210	1,390,970	1,465,865	753,380	1,737,439	528,531	71,356	15,195,992
2005	7,729,717	684,093	506,607	451,136	1,409,485	1,485,377	763,408	1,760,566	535,566	72,306	15,398,261
2006	7,834,765	693,390	513,492	457,267	1,428,640	1,505,564	773,783	1,784,492	542,845	73,289	15,607,525
2007	7,943,097	702,978	520,592	463,590	1,448,394	1,526,381	784,482	1,809,166	550,351	74,302	15,823,332
2008	8,054,502	712,837	527,894	470,092	1,468,708	1,547,789	795,484	1,834,541	558,070	75,344	16,045,260
2009	8,168,782	722,951	535,383	476,761	1,489,547	1,569,750	806,771	1,860,570	565,988	76,413	16,272,915
2010	8,226,408	728,051	539,160	480,125	1,500,055	1,580,824	812,462	1,873,695	569,980	76,952	16,387,713
2011	8,289,920	733,672	543,323	483,832	1,511,636	1,593,028	818,735	1,888,161	574,381	77,546	16,514,234
2012	8,358,898	739,777	547,844	487,857	1,524,214	1,606,283	825,547	1,903,872	579,160	78,191	16,651,644
2013	8,432,953	746,331	552,697	492,180	1,537,717	1,620,514	832,861	1,920,739	584,291	78,884	16,799,168
2014	8,511,724	753,302	557,860	496,777	1,552,081	1,635,651	840,641	1,938,680	589,749	79,621	16,956,086
2015	8,553,232	756,976	560,580	499,199	1,559,650	1,643,628	844,740	1,948,134	592,625	80,009	17,038,774
2016	8,601,538	761,251	563,746	502,019	1,568,458	1,652,910	849,511	1,959,137	595,972	80,461	17,135,004
2017	8,656,127	766,082	567,324	505,205	1,578,412	1,663,400	854,903	1,971,570	599,754	80,972	17,243,750
2018	8,716,524	771,427	571,283	508,730	1,589,425	1,675,006	860,868	1,985,327	603,939	81,537	17,364,065
2019	8,782,288	777,247	575,593	512,568	1,601,417	1,687,644	867,363	2,000,305	608,495	82,152	17,495,073
2020 -2050	8,853,014	783,507	580,228	516,696	1,614,314	1,701,235	874,348	2,016,414	613,396	82,814	17,635,965

4.2. Gasoline/Diesel Fuel Ratios

The MOBILE model provides vehicle counts by fuel type (i.e., gasoline or diesel). Therefore, it is necessary to provide class specific gasoline to diesel vehicle ratios for each of the five light-duty vehicle types and the eight heavy-duty vehicle types represented in MOBILE6. Again, data from the Arcadis report was used. The Arcadis report contains fuel-specific vehicle counts as of July 1, 1996 by model year. Using this data, ratios of gasoline vehicles to diesel vehicles for each vehicle category and model years 1972 through 1996 were obtained. For modeling purposes, vehicles produced in model years later than 1996 are assumed to have the same gasoline to diesel ratio as the 1996 vehicles. This assumption was necessary as there were no known sources of data predicting future trends in sales of trucks by fuel type. The gasoline/diesel ratios for all vehicle classes are presented in Table 18.

Table 18. Gasoline/ Diesel Fractions for All Vehicle Classes

	LIGHT-DUTY VEHICLE CLASSES					
	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel
MODEL YEAR	Vehicles	Vehicles	Trucks 1 and 2	Trucks 1 and 2	Trucks 3 and 4	Trucks 3 and 4
1996 and later	99.91%	0.09%	100.00%	0.00%	98.74%	1.26%
1995	99.94%	0.06%	100.00%	0.00%	98.85%	1.15%
1994	99.99%	0.01%	100.00%	0.00%	98.89%	1.11%
1993	99.97%	0.03%	100.00%	0.00%	98.55%	1.45%
1992	99.94%	0.06%	100.00%	0.00%	98.85%	1.15%
1991	99.87%	0.13%	100.00%	0.00%	98.71%	1.29%
1990	99.96%	0.04%	100.00%	0.00%	99.04%	0.96%
1989	99.96%	0.04%	100.00%	0.00%	99.17%	0.83%
1988	99.99%	0.01%	100.00%	0.00%	99.28%	0.72%
1987	99.73%	0.27%	99.93%	0.07%	99.18%	0.82%
1986	99.68%	0.32%	99.67%	0.33%	98.76%	1.24%
1985	99.03%	0.97%	99.52%	0.48%	98.65%	1.35%
1984	98.38%	1.62%	98.80%	1.20%	98.31%	1.69%
1983	97.59%	2.41%	97.77%	2.23%	97.91%	2.09%
1982	94.90%	5.10%	93.44%	6.56%	97.44%	2.56%
1981	92.94%	7.06%	93.84%	6.16%	99.87%	0.13%
1980	96.10%	3.90%	95.61%	4.39%	99.94%	0.06%
1979	97.31%	2.69%	96.84%	3.16%	99.89%	0.11%
1978	98.86%	1.14%	97.41%	2.59%	99.99%	0.01%
1977	99.07%	0.93%	100.00%	0.00%	100.00%	0.00%
1976	98.63%	1.37%	98.13%	1.87%	100.00%	0.00%
1975	98.45%	1.55%	89.62%	10.38%	100.00%	0.00%
1974	99.33%	0.67%	88.30%	11.70%	99.99%	0.01%
1973	99.33%	0.67%	88.30%	11.70%	99.99%	0.01%
1972 and earlier	99.33%	0.67%	88.30%	11.70%	99.99%	0.01%

Table 18. Gasoline/ Diesel Fractions for All Vehicle Classes (continued)

	HEAVY-DUTY VEHICLE CATEGORIES											
	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel
MODEL YEAR	2B	2B	3	3	4	4	5	5	6	6	7	7
1996 and later	80.02%	19.98%	32.26%	67.74%	13.94%	86.06%	53.53%	46.47%	37.00%	63.00%	14.37%	85.63%
1995	74.22%	25.78%	22.85%	77.15%	15.27%	84.73%	56.16%	43.84%	39.22%	60.78%	15.57%	84.43%
1994	74.85%	25.15%	20.90%	79.10%	19.52%	80.48%	63.30%	36.70%	47.54%	52.46%	20.57%	79.43%
1993	67.37%	32.63%	18.95%	81.05%	16.69%	83.31%	58.75%	41.25%	42.33%	57.67%	17.34%	82.66%
1992	72.16%	27.84%	19.32%	80.68%	20.99%	79.01%	65.38%	34.62%	47.11%	52.89%	20.28%	79.72%
1991	70.37%	29.63%	17.20%	82.80%	26.84%	73.16%	72.29%	27.71%	42.12%	57.88%	17.21%	82.79%
1990	76.16%	23.84%	15.23%	84.77%	27.25%	72.75%	72.70%	27.30%	43.83%	56.17%	18.23%	81.77%
1989	79.42%	20.58%	20.60%	79.40%	28.42%	71.58%	73.84%	26.16%	54.63%	45.37%	25.60%	74.40%
1988	82.44%	17.56%	25.12%	74.88%	43.53%	56.47%	84.57%	15.43%	57.84%	42.16%	28.16%	71.84%
1987	80.42%	19.58%	22.11%	77.89%	68.22%	31.78%	93.85%	6.15%	52.66%	47.34%	24.12%	75.88%
1986	72.74%	27.26%	21.58%	78.42%	77.93%	22.07%	96.17%	3.83%	52.95%	47.05%	24.33%	75.67%
1985	72.57%	27.43%	38.55%	61.45%	80.32%	19.68%	96.67%	3.33%	54.75%	45.25%	25.69%	74.31%
1984	69.96%	30.04%	48.61%	51.39%	84.30%	15.70%	97.45%	2.55%	56.90%	43.10%	27.39%	72.61%
1983	70.82%	29.18%	49.68%	50.32%	92.62%	7.38%	98.89%	1.11%	64.31%	35.69%	33.98%	66.02%
1982	71.41%	28.59%	57.23%	42.77%	96.59%	3.41%	99.51%	0.49%	63.10%	36.90%	32.83%	67.17%
1981	98.62%	1.38%	99.21%	0.79%	95.86%	4.14%	99.40%	0.60%	55.87%	44.13%	26.56%	73.44%
1980	100.00%	0.00%	100.00%	0.00%	99.97%	0.03%	100.00%	0.00%	69.06%	30.94%	38.93%	61.07%
1979	100.00%	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.00%	83.21%	16.79%	58.60%	41.40%
1978	100.00%	0.00%	99.99%	0.01%	100.00%	0.00%	100.00%	0.00%	86.10%	13.90%	63.90%	36.10%
1977	100.00%	0.00%	99.97%	0.03%	100.00%	0.00%	100.00%	0.00%	91.92%	8.08%	76.47%	23.53%
1976	100.00%	0.00%	99.90%	0.10%	97.41%	2.59%	99.63%	0.37%	95.24%	4.76%	85.11%	14.89%
1975	100.00%	0.00%	99.72%	0.28%	99.22%	0.78%	99.89%	0.11%	96.35%	3.65%	88.30%	11.70%
1974	100.00%	0.00%	97.52%	2.48%	99.96%	0.04%	99.99%	0.01%	97.12%	2.88%	90.60%	9.40%
1973	100.00%	0.00%	100.00%	0.00%	99.10%	0.90%	99.87%	0.13%	97.26%	2.74%	91.03%	8.97%
1972 and earlier	100.00%	0.00%	100.00%	0.00%	98.88%	1.12%	99.84%	0.16%	97.03%	2.97%	90.34%	9.66%

Table 18. Gasoline/ Diesel Fractions for All Vehicle Classes (continued)

	HEAVY-DUTY VEHICLE CATEGORIES			
	Gasoline	Diesel	Gasoline	Diesel
MODEL YEAR	8A	8A	8A	8B*
1996 and later	0.08%	99.92%	0.00%	100.00%
1995	0.11%	99.89%	0.00%	100.00%
1994	0.13%	99.87%	0.00%	100.00%
1993	0.11%	99.89%	0.00%	100.00%
1992	0.23%	99.77%	0.00%	100.00%
1991	0.16%	99.84%	0.00%	100.00%
1990	0.18%	99.82%	0.00%	100.00%
1989	0.21%	99.79%	0.00%	100.00%
1988	0.31%	99.69%	0.00%	100.00%
1987	0.22%	99.78%	0.00%	100.00%
1986	0.20%	99.80%	0.00%	100.00%
1985	0.21%	99.79%	0.00%	100.00%
1984	0.24%	99.76%	0.00%	100.00%
1983	0.31%	99.69%	0.00%	100.00%
1982	0.22%	99.78%	0.00%	100.00%
1981	0.18%	99.82%	0.00%	100.00%
1980	0.26%	99.74%	0.00%	100.00%
1979	0.35%	99.65%	0.00%	100.00%
1978	0.36%	99.64%	0.00%	100.00%
1977	0.51%	99.49%	0.00%	100.00%
1976	0.80%	99.20%	0.00%	100.00%
1975	0.64%	99.36%	0.00%	100.00%
1974	1.81%	98.19%	0.00%	100.00%
1973	1.88%	98.12%	0.00%	100.00%
1972 and earlier	2.80%	97.20%	0.00%	100.00%

4.3 Interpolating Between MOBILE5 and MOBILE6 Vehicle Counts

MOBILE5 contains vehicle counts for calendar years 1982 through 2050 for three different light-duty vehicle classes (light-duty vehicles, light-duty trucks <6,000 lbs, and light-duty gasoline trucks >6,000 lbs,) and two heavy-duty truck categories (heavy-duty gasoline trucks and heavy-duty diesel trucks). MOBILE5 uses a special algorithm to split the light-duty classes into gasoline and diesel fuel categories. The MOBILE5 vehicle counts were based on actual data through calendar year 1990, and projections were made for 1990 and later calendar years.

MOBILE6 will include vehicle counts for five light-duty vehicle classes, eight heavy-duty truck classes, and two heavy-duty bus classes. These classes are not fuel specific; an algorithm similar to that used in MOBILE5 for light-duty vehicles will be used in MOBILE6 to split the fifteen classes into gasoline and diesel fuel categories using the gasoline/ diesel splits calculated in Section 4.2. These vehicle counts are based on actual data from 1996 Arcadis report and vehicle counts for 1996 and later calendar years are projected.

Since the MOBILE model is designed to allow the user to make VMT split calculations for calendar years 1982 through 2050, data from MOBILE5 will also be included in MOBILE6 to cover earlier model years. This poses two challenges: 1) expanding the MOBILE5 vehicle classes to match those in MOBILE6; and 2) addressing the 1991 through 1995 data gap which exists between the MOBILE5 vehicle counts for 1990 and earlier (which are based on actual data) and the 1996 and later projections presented in this report (which are also based on actual data).

To expand the 1982 through 1990 calendar years vehicle count data for the three MOBILE5 light-duty vehicle classes to the five MOBILE6 categories, EPA has maintained the relative relationship between light-duty trucks less than 6,000 lbs and light-duty trucks greater than 6,000 lbs for the MOBILE5 data, but has used the CFEIS data described in Section 4.1.1 to separate this data into the new regulatory categories for 1994 and 1995 calendar years. Expansion of the heavy-duty categories required more effort. Since MOBILE5 reports heavy-duty gasoline vehicle counts and heavy-duty diesel vehicle counts separately, it was necessary to add these counts together to get total heavy-duty vehicle counts for calendar years 1982 through 1990. These vehicle counts were then split using the same class ratios used in this analysis for 1996 and later vehicle counts as per Section 4.1.2.

Linear interpolation was used to fill in the data gap between the 1990 data in MOBILE5 and the 1996 data used in this analysis. The results of these adjustments are contained in Appendix D.

5.0 Integration of Registration Distribution by Age, Average Annual Mileage Accumulation Rates by Age, and Future Vehicle Count Data in MOBILE6

One of the most significant changes to the fleet characterization calculations from MOBILE5 to MOBILE6 is an increase in the number of vehicle categories considered (from eight to twenty-eight). This change has been made both to facilitate greater representation of class-specific fleet trends (i.e., differences between mileage accumulation in certain heavy-duty vehicle categories, etc) and to allow for greater flexibility in future fleet calculations as additional data becomes available.

The data that was used in this analysis, however, was not directly available for *each* of the twenty-eight vehicle classes. Hence, for many categories, it was necessary to apply the available data to more than one vehicle class. The following sections will describe the twenty-eight vehicle classes, and the ways that fleet characterization data presented in the report will be used in the model.

5.1 Expansion of Vehicle Categories

In MOBILE5, the eight vehicle categories considered separately were light-duty gasoline vehicles, light-duty diesel vehicles, light-duty gasoline trucks 1 (0-6,000 lbs GVWR), light-duty gasoline trucks 2 (6,001-8,500 lbs GVWR), light-duty diesel trucks (0-8500 lbs GVWR), heavy-duty gasoline vehicles, heavy-duty diesel vehicles, and motorcycles. The light-duty truck category was split into trucks 1 and 2 to correspond with EPA regulatory definitions, which state different emission standards for the two gross-vehicle weight categories. However, starting with a phase-in period in 1994, EPA expanded its regulatory classifications to include four light-duty truck categories. MOBILE6 only makes this distinction for gasoline-fueled trucks. These changes effectively increase the number of light-duty truck categories in the model from two to six. These categories are described in Appendix C in detail; Table 10 from Section 4.1.1. is reproduced here for reference.

Table 10. Description of New EPA Light-duty Truck Classifications

MOBILE5 Category	MOBILE6 Category	Gross Vehicle Weight Rating	Loaded Vehicle Weight Rating	Description
Light-duty truck 1	Light-duty truck 1	≤6000 lbs	≤3750 lbs	Most small SUVs, most small pickups
Light-duty truck 1	Light-duty truck 2	≤6000 lbs	>3750 lbs	All minivans, “Compact” SUVs (e.g., Explorer), most Dakota and T100 pickups
Light-duty truck 2	Light duty truck 3	>6000 lbs	0-750 lbs (Average Loaded Vehicle Weight)*	Most 1/2-ton pickups, Base full-size vans, and intermediate SUVs (e.g., Land Cruiser)
Light-duty truck 2	Light duty truck 4	>6000 lbs	>5750 lbs (Average Loaded Vehicle Weight)*	Some 1/2 and 3/4 ton pickups, some full-size vans, and larger SUVs (e.g., Expedition)

* Average Loaded Vehicle Weight is the average of the gross vehicle weight and the curb weight

In addition to including the new light-truck categories to MOBILE6, EPA has also expanded the heavy-duty gasoline vehicle and heavy-duty diesel vehicle categories to include a finer gradation by gross-vehicle weight class. The addition of new categories increases the total number of heavy-duty categories from two to nineteen. Note that EPA has included only one heavy-duty gasoline bus category. This is due to the fact that, according to the Arcadis report, heavy-duty transit buses accounted for less than 1% of the all gasoline buses in 1996. EPA has therefore grouped gasoline school buses into a single category, known as "heavy-duty gasoline bus." Table 19 lists the new heavy-duty categories.

Table 19. Description of New EPA Heavy-duty Truck Classifications

MOBILE6 Categories	Gross Vehicle Weight Ratings
Heavy-duty gasoline vehicle class 2B	8,501-10,000 lbs
Heavy-duty gasoline vehicle class 3	10,001-14,000 lbs
Heavy-duty gasoline vehicle class 4	14,001-16,000 lbs
Heavy-duty gasoline vehicle class 5	16,001-19,500 lbs
Heavy-duty gasoline vehicle class 6	19,501-26,000
Heavy-duty gasoline vehicle class 7	26,001-33,000
Heavy-duty gasoline vehicle class 8A	33,001-60,000
Heavy-duty gasoline vehicle class 8B	>60,000
Heavy-duty gasoline bus	All
Heavy-duty diesel vehicle class 2B	8,501-10,000 lbs
Heavy-duty diesel vehicle class 3	10,001-14,000 lbs
Heavy-duty diesel vehicle class 4	14,001-16,000 lbs
Heavy-duty diesel vehicle class 5	16,001-19,500 lbs
Heavy-duty diesel vehicle class 6	19,501-26,000
Heavy-duty diesel vehicle class 7	26,001-33,000
Heavy-duty diesel vehicle class 8A	33,001-60,000
Heavy-duty diesel vehicle class 8B	>60,000
Heavy-duty diesel school bus	All
Heavy-duty diesel transit Bus	All

5.2 Use of Registration Distribution by Age and Average Annual Mileage Accumulation by Age in MOBILE6

The emission factor calculations in MOBILE6 will rely in part on travel fractions for vehicles at each of twenty-five ages and for each of the twenty-eight vehicle types. These travel fractions are calculated from estimates of the registration distribution by age (age 0-1 through age 25) and average annual mileage accumulation rates by age for twenty-eight vehicle types (registration distribution and average annual mileage accumulation rates for motorcycles, are only provided for the first through 12+ years of operation).

The registration distributions by age and average annual mileage accumulation rates by age presented in Section 2.0 and Section 3.0 of this report represent the national defaults MOBILE6 will use for generation of travel fractions. However, as noted in these sections, there are only seven categories for registration distributions by age, and only eighteen categories for average annual mileage accumulation rates by age. Therefore, it was necessary to assume that the estimated registration distributions and mileage accumulation rates would be representative of other categories. Table 16 illustrates the application of the calculated registration distribution by age and average annual mileage accumulation rates by age to the twenty-eight MOBILE6 categories. Note that due to the lack of significant changes in the U.S. motorcycle age distribution, mileage accumulation, and vehicle count characteristics, EPA has opted to use the MOBILE5 motorcycle age and mileage estimates in MOBILE6. The MOBILE5 motorcycle data is reported in Appendix A.

MOBILE6 will apply the gasoline/ diesel fuel ratios presented in Section 4.2 to the vehicle counts to calculate fuel-specific vehicle counts by calendar year and vehicle class. The model will assume that 50% of the HDV4-5 class should be attributed to classes 4 and 5 respectively; the same assumption will be made for HDV6-7 vehicle counts. This is again due to the inability to weight theses classes separately due to data constraints.

Table 20. Use of Registration Distribution by Age, Mileage Accumulation, and Vehicle Count Data in MOBILE6

MOBILE6 category description	MOBILE6 category designation	Registration Distribution (Table 5)	Mileage Accumulation (Table 6)	Vehicle Counts (Tables 13 and 17)
Gasoline Fueled Vehicles				
Light-duty gasoline vehicle	LDGV	LDV	LDGV	LDV
Light-duty gasoline truck 1	LDGT1	LDT 0-6000 lbs	LDGT1	LDT1
Light-duty gasoline truck 2	LDGT2	LDT 0-6000 lbs	LDGT1	LDT2
Light-duty gasoline truck 3	LDGT3	LDT 6000-8500 lbs	LDGT2	LDT3
Light-duty gasoline truck 4	LDGT4	LDT 6000-8500 lbs	LDGT2	LDT4
Heavy-duty gasoline vehicle class 2B	HDGV2B	HDV (2B-3)	HDGV (2B-3)	HDV2B
Heavy-duty gasoline vehicle class 3	HDGV3	HDV (2B-3)	HDGV (2B-3)	HDV3
Heavy-duty gasoline vehicle class 4	HDGV4	HDV (4-8)	HDGV (4-8)	½ HDV4-5
Heavy-duty gasoline vehicle class 5	HDGV5	HDV (4-8)	HDGV (4-8)	½ HDV4-5
Heavy-duty gasoline vehicle class 6	HDGV6	HDV (4-8)	HDGV (4-8)	½ HDV6-7
Heavy-duty gasoline vehicle class 7	HDGV7	HDV (4-8)	HDGV (4-8)	½ HDV6-7
Heavy-duty gasoline vehicle class 8A	HDGV8A	HDV (4-8)	HDGV (4-8)	HDV8A
Heavy-duty gasoline vehicle class 8B	HDGV8B	HDV (4-8)	HDGV (4-8)	HDV8B
Heavy-duty gasoline Bus *	HDGas Bus	HDB School	HDGB School	HD School Bus
Motorcycle	Motorcycle	MOBILE5	MOBILE5	MOBILE5
Diesel Fueled Vehicles				
Light-duty diesel vehicle	LDDV	LDV	LDDV	LDV
Light-duty diesel truck 1	LDDT1	LDT1	LDDT1	LDT1
Light-duty diesel truck 2	LDDT2	LDT1	LDDT1	LDT2
Light-duty diesel truck 3	LDDT3	LDT2	LDDT2	LDT3
Light-duty diesel truck 4	LDDT4	LDT2	LDDT2	LDT4
Heavy-duty diesel vehicle class 2B	HDDV2B	HDV (2B-3)	HDDV (2B)	HDV2B
Heavy-duty diesel vehicle class 3	HDDV3	HDV (2B-3)	HDDV (2B)	HDV3
Heavy-duty diesel vehicle class 4	HDDV4	HDV (4-8)	HDDV (4-5)	½ HDV4-5
Heavy-duty diesel vehicle class 5	HDDV5	HDV (4-8)	HDDV (4-5)	½ HDV4-5
Heavy-duty diesel vehicle class 6	HDDV6	HDV (4-8)	HDDV (6-7)	½ HDV6-7
Heavy-duty diesel vehicle class 7	HDDV7	HDV (4-8)	HDDV (6-7)	½ HDV6-7
Heavy-duty diesel vehicle class 8A	HDDV8A	HDV (4-8)	HDDV (8A)	HDV8A
Heavy-duty diesel vehicle class 8B	HDDV8B	HDV (4-8)	HDDV (8B)	HDV8B
Heavy-duty diesel School Bus	Diesel School Bus	HDB School	HDDB School	HD School Bus
Heavy-duty diesel Transit Bus	Diesel Transit Bus	HDB Transit	HDDB Transit	HD Transit Bus

* Note: MOBILE6 will only contain one heavy-duty gasoline bus category, containing all heavy-duty gasoline buses.

APPENDIX A: Motorcycle Age Distribution, Mileage Accumulation Rates, and Vehicle Counts

Motorcycle Age Distribution and Mileage Accumulation Rates for Use in MOBILE6

Age	Registration Distribution	Mileage Accumulation Rates
1	0.144	4,786
2	0.168	4,475
3	0.135	4,164
4	0.109	3,853
5	0.088	3,543
6	0.07	3,232
7	0.056	2,921
8	0.045	2,611
9	0.036	2,300
10	0.029	1,989
11	0.023	1,678
12+	0.097	1,368

NOTE: Motorcycle vehicle count is 4,219,000 for all years, pre-1982 through 2050.

Source: 1987 Motorcycle Statistical Annual, Motorcycle Industry Council, Inc.

APPENDIX B: Vehicles in Operation, Raw Mileage Accumulation Rate, and Curve Fitting Equations from the Arcadis Report

Table 4-2. Vehicles in Operation as of July 1996
U.S. Levels

Model	LDV		LDGT		LDDT		HDGV		HDGB	
	LDGV	LDDV	LDGT1	LDGT2	LDDT1	LDDT2	2B-3	4-8	S.BUS	T.BUS
Year			<6000	6001-8500	<6000	6001-8500	8501-14000	>14000	ANY WGT.	ANY WGT.
96	5999331	5330	2475332	963616	0	12298	321205	16273	516	0
95	9166694	5425	3723979	1450819	0	16827	483606	54732	4408	0
94	7966182	630	3636380	1214578	1	13634	404859	47587	2926	30
93	8027524	2715	3338741	855812	0	12582	285271	35154	2673	54
92	7468105	4432	2716821	748099	0	8703	249366	36885	102	108
91	7742072	9746	2893672	570854	0	7481	190285	35345	2368	83
90	7927068	3280	2517145	712943	0	6943	237648	47336	4009	55
89	8687143	3676	2922994	833087	0	6934	277696	55083	4342	116
88	8800821	568	2961942	737315	0	5338	245772	70682	6115	78
87	8403556	23000	2666470	576923	1937	4760	192308	58113	6980	84
86	8093892	26380	2600147	701241	8701	8808	233747	51373	8209	87
85	7090963	69659	2040755	661168	9754	9038	220389	56147	11009	28
84	5978688	98664	1670540	564080	20230	9680	188027	55959	11363	34
83	3831635	94461	948999	388127	21601	8271	129376	37983	10931	23
82	2710825	145689	739107	277091	51916	7279	92364	37446	9270	11
81	2305351	175194	651163	251737	42762	329	83912	37952	12053	4
80	1953647	79200	446378	340398	20482	217	113466	45494	10434	9
79	2237823	61862	529703	820584	17283	917	273528	88619	9290	13
78	1785913	20597	384720	756833	10222	93	252278	69373	8459	2
77	1335445	12593	328772	587410	0	21	195803	67918	9547	1
76	824579	11453	389724	295581	7408	12	98527	67102	6915	2
75	477882	7505	210964	181913	24441	8	60638	90069	8715	3
74	532240	3599	335900	130161	44505	7	43387	94921	0	1
73	0	0	0	0	0	0	0	93372	0	0
72	0	0	0	0	0	0	0	72328	0	0
71	0	0	0	0	0	0	0	54597	0	0
70	0	0	0	0	0	0	0	57955	0	0
69	0	0	0	0	0	0	0	50761	0	0
68	0	0	0	0	0	0	0	39588	0	0
67	0	0	0	0	0	0	0	38887	0	0
66	0	0	0	0	0	0	0	34371	0	0
TOTAL	**119347379**	**865658**	**41130348**	**14620369**	**281243**	**140179**	**4873456**	**1699401**	**150634**	**826**

LDV Light duty vehicle
LDGV Light duty gasoline vehicle
LDDV Light duty diesel vehicle
LDGT Light duty gasoline truck
LDDT Light duty diesel truck
HDGV Heavy duty gasoline vehicle
HDGB Heavy duty gasoline bus

Table 4-2. Vehicles in operation as of July 1996 (continued)
U.S. Levels

Model Year	HDDV 2B 8501-10000	3 10001-14000	4-5 14001-19500	6-7 19501-33000	8A* 33001-60000	8B* >60000	HDDB S.BUS ANY WGT.	T.BUS** ANY WGT.	ALL VEHICLES TOTAL
96	77760	20611	15084	36848	22858	63398	12592		10043049
95	162857	49894	45619	112777	55767	154674	34395		15522473
94	131869	46825	29457	69815	41561	115272	17088	1186	13739879
93	133923	37278	26359	63675	35682	98966	19899	2496	12978803
92	93290	31827	20855	55070	18191	79092	20696	2278	11553918
91	77685	28002	14467	64578	25051	71036	24920	3188	11760833
90	72117	40421	18977	80650	28786	83175	28698	4682	11813932
89	69774	32708	20834	60814	29759	98894	15007	3829	13122690
88	50752	22387	13770	68499	25953	89567	18602	3167	13121329
87	45383	20704	4064	69454	29736	74622	19539	3299	12200932
86	84934	25966	2184	60684	28204	59103	17097	3330	12014086
85	80761	10736	2066	61696	30539	69423	11743	3741	10439615
84	78286	6075	1565	56347	25970	56621	7120	3206	8832456
83	51681	4005	454	28033	13613	26483	5245	3989	5604910
82	35845	2110	198	29110	18921	28273	4488	3017	4192960
81	1135	21	246	39861	23076	33078	4324	3270	3665466
80	0	0	2	27106	19685	24454	659	3811	3085441
79	0	0	0	23784	28160	36212	448	1695	4129922
78	0	1	0	14891	21616	29266	253	1182	3355700
77	0	2	0	7938	14940	23464	235	760	2584847
76	0	3	268	4459	9327	9767	60	510	1725698
75	0	5	106	4534	15695	10430	77	682	1093667
74	0	34	6	3740	5779	8590	0	338	1203209
73	0	20	127	3497	5492	7013	0	393	109914
72	0	0	118	2601	4445	3650	0	247	83389
71	0	0	60	1905	3799	1980	0	211	62551
70	0	0	38	4447	3386	791	0	73	66691
69	0	0	116	2618	850	1205	0	106	55655
68	0	0	95	2007	655	605	0	78	43028
67	0	0	94	321	186	946	0	90	40524
66	0	4	71	261	277	298	0	189	35470
TOTAL	**1248050**	**379639**	**217303**	**1062021**	**587955**	**1360346**	**263185**	**55043**	**188283036**

HDDV Heavy duty diesel vehicle
HDDB Heavy duty diesel bus

* in MY 93-96, assumed 26.5% of Class 8 vehicles are Class 8A; for all other MY, percentage based upon 1992 TIUS data
** transit bus registrations are from FTA data

Table 4-5. Annual mileage accumulation curve fit equations

Vehicle Class	Equation
LDGV	$y = 15684e^{-0.0506x}$
LDDV	$y = 15684e^{-0.0506x}$
LDGT1	$y = 17.472x^2 - 1163.7x + 20642$
LDGT2	$y = 22905e^{-0.0712x}$
LDDT1	$y = 30028e^{-0.1041x}$
LDDT2	$y = 28231e^{-0.0808x}$
HDGV (2B-3)	$y = 21250e^{-0.0618x}$
HDGV (4-8)	$y = 23243e^{-0.0829x}$
HDGSB	$y = 9939$
HDGTB	$y = 38654e^{-0.0958x}$
HDDV (2B)	$y = 29657e^{-0.0888x}$
HDDV (3)	$y = 37008e^{-0.1222x}$
HDDV (4-5)	$y = 32635e^{-0.0656x}$
HDDV (6-7)	$y = 44883e^{-0.0983x}$
HDDV (8A)	$y = 98554e^{-0.1153x}$
HDDV (8B)	$y = 137024e^{-0.0982x}$
HDDSB	$y = 9939$
HDDTB	$y = 46659e^{-0.0324x}$

x = Model year - 1900
y = Annual mileage (miles)

APPENDIX C: **Federal Definitions for Light-duty Vehicles**

FEDERAL DEFINITIONS OF LIGHT-DUTY VEHICLES

Light-Duty Truck (LDT)

Any motor vehicle rated at 8,500 pounds GVWR or less which has a vehicle curb weight of 6,000 pounds or less and which has a basic vehicle frontal area of 45 square feet or

less, which is:

(1) Designed primarily for purposes of transportation of property or is a derivation of such a vehicle, or

(2) Designed primarily for transportation of persons and has a capacity of more than 12 persons, or

(3) Available with special features enabling off-street or off-highway operation and use. (40 CFR 86.082-2)

Light Light-Duty Truck (LLDT)

Light light-duty truck means any light-duty truck rated up through 6,000 lbs GVWR. (40 CFR 86.094-2)

[Note: The definition for this category of trucks is essentially identical to the California definition for "light-duty truck.")

Heavy Light-Duty Truck (HLDT)

Heavy light-duty truck means any light-duty truck rated greater than 6,000 lbs GVWR. (40 CFR 86.094-2)

Light-Duty Truck 1 (LDT1)

Any light light-duty truck up through 3,750 lbs loaded vehicle weight. (40 CFR 86.094-2)

Light-Duty Truck 2 (LDT2)

Any light light-duty truck greater than 3,750 lbs loaded vehicle weight. (40 CFR 86.094-2)

Light-Duty Truck 3 (LDT3)

Any heavy light-duty truck up through 5,750 lbs adjusted loaded vehicle weight. (40 CFR 86.094-2)

Light-Duty Truck 4 (LDT4)

Any heavy light-duty truck greater than 5,750 lbs adjusted loaded vehicle weight. (40 CFR 86.094-2)

Light-Duty Vehicle (LDV)

A passenger car or passenger car derivative capable of seating 12 passengers or less.
[Note: The federal "light-duty vehicle" definition is essentially identical to the California definition for "passenger car."]

Loaded Vehicle Weight (LVW)

The vehicle curb weight plus 300 pounds. (40 CFR 86.082-2)

APPENDIX D: **Complete Tables of Vehicle Counts, pre-1982-2050**

HT-DUTY VEHICLE CLASS VEHICLE COUNTS, PRE-1982 THROUGH 2050

	Calendar Year	Light-duty Vehicles	Light-duty Truck Class 1	Light-duty Truck Class 2	Light-duty Truck Class 3	Light-duty Truck Class 4	Light-duty Total
***From MOBILE5* ➩**	**pre-1982**	106,867,000	4,801,335	15,983,665	6,969,875	3,205,125	137,827,000
	1983	108,960,000	4,857,006	16,168,994	7,154,140	3,289,860	140,430,000
	1984	112,018,000	5,065,830	16,864,170	7,495,270	3,446,730	144,890,000
	1985	114,662,000	5,336,562	17,765,438	7,676,795	3,530,205	148,971,000
	1986	117,268,000	5,676,594	18,897,406	8,141,910	3,744,090	153,728,000
	1987	119,849,000	6,006,462	19,995,538	8,480,985	3,900,015	158,232,000
	1988	121,519,000	6,343,260	21,116,740	9,159,820	4,212,180	162,351,000
	1989	122,758,000	6,759,984	22,504,016	9,548,900	4,391,100	165,962,000
	1990	124,658,000	7,058,898	23,499,102	9,640,005	4,432,995	169,289,000
Interpolated ➩	***1991***	123,917,173	7,495,735	24,953,334	9,662,236	4,443,218	170,471,696
	1992	123,176,346	7,932,572	26,407,567	9,684,467	4,453,441	171,654,392
	1993	122,435,519	8,369,409	27,861,799	9,706,698	4,463,664	172,837,088
	1994	121,694,691	8,806,246	29,316,031	9,728,929	4,473,887	174,019,784
	1995	120,953,864	9,243,083	30,770,263	9,751,160	4,484,110	175,202,480
***Arcadis Report* ➩**	**1996**	120,213,037	9,566,078	31,845,513	10,110,975	4,649,573	176,385,176
***Calculated* ➩**	**1997**	118,773,800	10,414,527	34,670,004	11,007,753	5,061,960	179,928,044
	1998	117,096,045	11,280,465	37,552,716	11,923,017	5,482,847	183,335,089
	1999	115,193,551	12,162,938	40,490,475	12,855,757	5,911,772	186,614,492
	2000	113,163,114	13,070,784	43,512,698	13,815,316	6,353,028	189,914,940
	2001	112,067,320	13,799,291	45,937,900	14,585,319	6,707,118	193,096,949
	2002	110,950,294	14,512,453	48,312,019	15,339,104	7,053,749	196,167,619
	2003	109,439,432	15,274,865	50,850,090	16,144,943	7,424,317	199,133,647
	2004	107,898,603	16,025,634	53,349,406	16,938,478	7,789,227	202,001,349
	2005	105,955,155	16,685,013	55,544,480	17,635,416	8,109,717	203,929,782
	2006	103,575,222	17,410,842	57,960,767	18,402,589	8,462,504	205,811,924
	2007	101,040,538	18,155,682	60,440,343	19,189,856	8,824,532	207,650,951
	2008	98,431,413	18,906,365	62,939,370	19,983,299	9,189,400	209,449,847
	2009	96,043,330	19,613,047	65,291,919	20,730,235	9,532,882	211,211,414
	2010	93,587,131	20,228,884	67,342,044	21,381,152	9,832,208	212,371,419
	2011	91,290,697	20,817,379	69,301,145	22,003,168	10,118,245	213,530,633
	2012	89,345,016	21,346,077	71,061,181	22,561,981	10,375,217	214,689,471
	2013	87,503,888	21,856,971	72,761,950	23,101,976	10,623,537	215,848,322
	2014	85,917,827	22,324,492	74,318,331	23,596,128	10,850,774	217,007,553
	2015	84,384,402	22,695,902	75,554,755	23,988,694	11,031,297	217,655,051
	2016	82,971,891	23,052,159	76,740,738	24,365,244	11,204,455	218,334,488
	2017	81,805,681	23,371,618	77,804,216	24,702,900	11,359,728	219,044,142
	2018	80,793,310	23,669,750	78,796,699	25,018,014	11,504,634	219,782,406
	2019	79,950,083	23,943,693	79,708,656	25,307,561	11,637,783	220,547,776
	2020 - 2050	79,436,359	24,165,899	80,448,384	25,542,425	11,745,787	221,338,854

-DUTY VEHICLE CLASS VEHICLE COUNTS, PRE-1982 THROUGH 2050

	Calendar Year	2B	3	4	5	6	7	8A	8B	School Bus	Transit Bus	Heavy-duty Total
From MOBILE5 ⇨	**pre-1982**	3,025,472	267,759	198,290	176,578	551,683	581,388	298,804	689,099	209,625	28,301	6,027,000
	1983	3,350,257	296,503	219,576	195,534	610,907	643,800	330,880	763,074	232,128	31,339	6,674,000
	1984	3,650,445	323,071	239,251	213,054	665,645	701,486	360,528	831,447	252,927	34,147	7,272,000
	1985	4,056,552	359,012	265,867	236,756	739,697	779,525	400,636	923,944	281,065	37,946	8,081,000
	1986	4,200,622	371,762	275,310	245,164	765,968	807,210	414,865	956,758	291,047	39,294	8,368,000
	1987	4,498,300	398,107	294,819	262,538	820,248	864,414	444,264	1,024,559	311,672	42,078	8,961,000
	1988	4,714,656	417,255	308,999	275,165	859,700	905,989	465,632	1,073,838	326,663	44,102	9,392,000
	1989	5,018,358	444,133	328,904	292,891	915,079	964,350	495,627	1,143,011	347,705	46,943	9,997,000
	1990	5,173,471	457,861	339,070	301,944	943,363	994,158	510,946	1,178,340	358,453	48,394	10,306,000
Interpolated ⇨	***1991***	5,306,653	469,648	347,799	309,717	967,648	1,019,750	524,099	1,208,675	367,680	49,640	10,571,310
	1992	5,439,835	481,435	356,528	317,490	991,933	1,045,343	537,253	1,239,009	376,908	50,886	10,836,620
	1993	5,573,017	493,222	365,257	325,263	1,016,219	1,070,936	550,406	1,269,343	386,136	52,132	11,101,930
	1994	5,706,199	505,008	373,985	333,036	1,040,504	1,096,529	563,560	1,299,677	395,364	53,377	11,367,239
	1995	5,839,381	516,795	382,714	340,809	1,064,789	1,122,122	576,713	1,330,012	404,591	54,623	11,632,54
Arcadis Report ⇨	**1996**	5,972,563	528,582	391,443	348,582	1,089,074	1,147,715	589,867	1,360,346	413,819	55,869	11,897,859
Calculated ⇨	**1997**	6,234,738	551,785	408,626	363,883	1,136,881	1,198,095	615,760	1,420,060	431,984	58,321	12,420,134
	1998	6,495,685	574,879	425,728	379,113	1,184,464	1,248,240	641,531	1,479,495	450,064	60,762	12,939,962
	1999	6,755,458	597,870	442,754	394,274	1,231,832	1,298,159	667,187	1,538,663	468,063	63,192	13,457,453
	2000	6,929,009	613,229	454,129	404,404	1,263,479	1,331,510	684,328	1,578,192	480,088	64,816	13,803,182
	2001	7,103,086	628,635	465,538	414,563	1,295,221	1,364,961	701,520	1,617,840	492,149	66,444	14,149,957
	2002	7,277,658	644,085	476,979	424,752	1,327,053	1,398,507	718,761	1,657,602	504,245	68,077	14,497,720
	2003	7,452,698	659,576	488,451	434,968	1,358,971	1,432,144	736,049	1,697,470	516,373	69,715	14,846,415
	2004	7,628,181	675,107	499,952	445,210	1,390,970	1,465,865	753,380	1,737,439	528,531	71,356	15,195,992
	2005	7,729,717	684,093	506,607	451,136	1,409,485	1,485,377	763,408	1,760,566	535,566	72,306	15,398,261
	2006	7,834,765	693,390	513,492	457,267	1,428,640	1,505,564	773,783	1,784,492	542,845	73,289	15,607,525
	2007	7,943,097	702,978	520,592	463,590	1,448,394	1,526,381	784,482	1,809,166	550,351	74,302	15,823,332
	2008	8,054,502	712,837	527,894	470,092	1,468,708	1,547,789	795,484	1,834,541	558,070	75,344	16,045,260
	2009	8,168,782	722,951	535,383	476,761	1,489,547	1,569,750	806,771	1,860,570	565,988	76,413	16,272,915
	2010	8,226,408	728,051	539,160	480,125	1,500,055	1,580,824	812,462	1,873,695	569,980	76,952	16,387,713
	2011	8,289,920	733,672	543,323	483,832	1,511,636	1,593,028	818,735	1,888,161	574,381	77,546	16,514,234
	2012	8,358,898	739,777	547,844	487,857	1,524,214	1,606,283	825,547	1,903,872	579,160	78,191	16,651,644
	2013	8,432,953	746,331	552,697	492,180	1,537,717	1,620,514	832,861	1,920,739	584,291	78,884	16,799,168
	2014	8,511,724	753,302	557,860	496,777	1,552,081	1,635,651	840,641	1,938,680	589,749	79,621	16,956,086
	2015	8,553,232	756,976	560,580	499,199	1,559,650	1,643,628	844,740	1,948,134	592,625	80,009	17,038,774
	2016	8,601,538	761,251	563,746	502,019	1,568,458	1,652,910	849,511	1,959,137	595,972	80,461	17,135,004
	2017	8,656,127	766,082	567,324	505,205	1,578,412	1,663,400	854,903	1,971,570	599,754	80,972	17,243,750
	2018	8,716,524	771,427	571,283	508,730	1,589,425	1,675,006	860,868	1,985,327	603,939	81,537	17,364,065
	2019	8,782,288	777,247	575,593	512,568	1,601,417	1,687,644	867,363	2,000,305	608,495	82,152	17,495,073
	2020-2050	8,853,014	783,507	580,228	516,696	1,614,314	1,701,235	874,348	2,016,414	613,396	82,814	17,635,965

APPENDIX E: **Weibull Curve Fit Equations**

Coefficient estimates for Weibull functions of the form:

Y = C*exp(-(age/B)**A)

LDV

Parameter	Estimate	Asymptotic Std. Error	Asymptotic 95 % Confidence Interval Lower	Upper
A	4.45489164	0.70017482296	2.989419360	5.920363911
B	16.10050554	0.40065655086	15.261927730	16.939083343
C	0.92867417	0.03440839615	0.856657084	1.000691256

LDT1

Parameter	Estimate	Asymptotic Std. Error	Asymptotic 95 % Confidence Interval Lower	Upper
A	3.04037069	0.46146759119	2.074514822	4.006226557
B	14.38211814	0.49379193519	13.348607123	15.415629150
C	0.90942551	0.04258841553	0.820287569	0.998563451

Bus

Parameter	Estimate	Asymptotic Std. Error	Asymptotic 95 % Confidence Interval Lower	Upper
A	12.53214119	4.5674746494	3.105412739	21.958869632
B	17.16909475	0.3882036229	16.367888301	17.970301195
C	0.73096392	0.0336316293	0.661552210	0.800375635

```
CURVE FITTING ROUTINE
STARTING VALUES ARE CRITICAL

data a; set a.T;
pldv=ldv/9172119;
pldt1=ldt1/3723979;
pbus=bus/4737;
proc means; run;
data a; set a; drop pbus1; run;

*LDV*;
symbol i=join;
proc nlin data=a; parm a=2.5 b=11 C=.8;
model pldv =C*exp(-(age/b)**a); output out=b p=prldv ;
proc gplot; plot (pldv  prldv)*age/overlay; run;
data a; set b;

*LDT1*;
proc nlin data=a; parm a=2.5 b=11;
model pldt1 =exp(-(age/b)**a); output out=b p=prldt1 ;
proc gplot; plot (pldt1  prldt1)*age/overlay; run;
data a; set b;

*BUS*;
proc nlin data=a; parm a=2.5 b=11;
model pbus =exp(-(age/b)**a); output out=b p=prbus ;
proc gplot; plot (pbus  prbus)*age/overlay; run;
data a; set b;

*BUS APPLIED TO MOVING AVERAGE*;
data a; set a;
sbus=(pbus+lag(pbus)+lag2(pbus)+lag3(pbus)+lag4(pbus))/5;run;
proc nlin data=a; parm a=2.5 b=11;
model sbus =exp(-(age/b)**aGE); output out=b p=prbus1 ;
proc gplot; plot (sbus  prbus1)*age/overlay; run;
```

APPENDIX F: **Stakeholder Comments and Response to Comments**

Source of Comment	Comment	Response
Marcel Halberstadt, AAMA, MI	".... EPA is planning on using the most recent NPTS to determine mileage accumulation rates. The NPTS surveys have the drawback that they are telephone surveys, in which respondents are asked how many miles they drove in a particular vehicle the previous year. Respondents tend to give very common replies, for example 5,000 miles, 10,000 miles, or 15,000 miles. These are very rough educated guesses, at best. AAMA believes that the instrumented car data analyzed by Sierra may be a more accurate reflection of mileage accumulation than these owner surveys. AAMA recommends that EPA carefully compare the instrumented data to the NPTS surveys to determine the differences, before deciding which mileage accumulation rates to use in MOBILE6."	Due to time constraints, EPA opted to use the data supplied by Arcadis.
Sam Long, Illinois EPA	It is useful to have emission rates available for different types of HDVs, both trucks and buses; but I'm glad that such outputs will be optional. I suggest you also draw up a list of examples of the HDVs of the various subdivisions you have mentioned, illustrated if possible. (A similar list of LDTs types 1 and 2 would be useful too, especially to those just coming into MOBILE modeling.) Do your proposed subdivisions of the HDV category match those of PART5?	Creation of a list of examples of the various HDV vehicles in each class has been added to the EPA "wish list" and will be considered for future versions of the MOBILE model and guidance materials. Each PART5 vehicle category corresponds to one, or to a group of several, MOBILE6 vehicle categories.

Sam Long, Illinois EPA	"Do they match those of (many) state vehicle registration authorities? (I haven't checked on this.) Where will the VMT mix data for such vehicles come from? See - *Illinois Travel Statistics*, Table VFC-1, p.14, mentioned above, which gives what are in effect VMT mixes for various HDV types for different functional classes of roads. I know that publications MD and/or MC may have information on this subject." "The Trip Characteristic tables and graphs shown in the handout are very interesting. They show that people are driving more now, making more trips, and are getting more use out of older cars. This is not surprising: there has been a considerable improve-ment in the quality, and hence longevity—and an even more considerable increase in the price—of new cars since the '70s. People are keeping their old cars longer, and driving them more; they can hardly afford to do otherwise. How have the deterioration rates been affected by this? Cars are obviously more durable these days; how about their emission control systems?"	Unfortunately, we do not have any data at this time to address the effects of increased driving and age of on-road vehicles on deterioration; EPA will consider addressing this issue in future versions of the model.
Dale Aspy, EPA Region 4, GA	"The Region makes the comment that the ratios of light duty vehicles versus light duty trucks has changed significantly due to the popularity of minivans, sport utility vehicles, and small pickup trucks. MOBILE6 needs to reflect this effect. It is also noted that some of these vehicles that are classified as light duty trucks are built on light duty vehicle platforms or use light duty vehicle engines. It is believed that some states are registering these "trucks" as light duty vehicles. Also requested is the fleet characteristic by roadway type. This includes both VMT accumulation rates and vehicle class as different types of vehicle classes tend to use different types of roads. The Region also notes the research conducted by Georgia Tech which implies different I/M effects depending upon fleet classification. It is suggested that OMS contact Georgia Tech on this issue."	This issue has been addressed at length in Chapter 4.0 of the document.
Gary Flispart, Jefferson County, KY	"Motorcycles are not addressed in EPA's issue discussion. Has any new data been generated?"	Due to data and time constraints, EPA has assumed that the data for motorcycles derived for MOBILE5 are generally consistent with current trends; therefore, all motorcycle data is from MOBILE5.

John German, Former EPA Staff; Currently with Honda, MI	Regarding] the split between light trucks above and below 8500 GVWR: "...It does not appear that this is being done properly, as there are way too many diesel trucks below 8500 GVW and not enough gasoline trucks above 8500. This is probably not the contractors fault (it's likely the result of how vehicles are registered) so there may not be any reason to ask the contractor to do additional work, but I want to make sure people are aware of this." "The larger issue is that Acurex doesn't even mention one of the primary sources of data on VMT, the Residential Transportation Energy Consumption Survey (RTECS), conducted by DOE's EIA. This doesn't impact the registration work as RTECS doesn't address that, but one of the strengths of the RTECS data is that they collect actual odometer measurements, not just someone's recollection of how much they drove. NHTSA has done it's own assessment of VMT by age, during which it considered RTECS, NPTS, and TIUS and selected RTECS as the most reliable data of the three (some scoundrel borrowed my copy of the report and hasn't returned it, but if anyone is interested they can get a copy from Orrin Kee of NHTSA). I have also heard transportation people express concern that NPTS overstates VMT, as a simple multiplication of the average VMT from NPTS by the actual stock overstates the VMT reported by FHWA. In addition, the VMT rates from TIUS for older trucks seem to be extremely low. In summary, I have concerns that Acurex, by not even considering the RTECS data, may not have done an adequate job of assessing VMT by age."	Due to data and time constraints, EPA used the data supplied by Arcadis and adjusted it (as described throughout the text) where applicable to better reflect expected "real world" conditions.
John Walsh, EPA Regions 2, NY	"Can local data that EPA collects be made available to users?"	EPA did not use local data, but instead used nationwide survey data. Local data may be substituted in the model, but must be supplied by the individual states.
John Walsh, EPA Regions 2, NY	"Consideration should be given to characterizing data for other months besides January and July."	The MOBILE model was, and is, originally structured for January/July data. Changing this was not a part of the scope for this version of the model. This comment has been recorded, and may be considered for future versions of the model.

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