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Update Heavy-Duty Engine Emission Conversion Factors for MOBILE6

Analysis of Fuel Economy, Non-Engine Fuel Economy Improvements and Fuel Densities

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Assessment and Modeling Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

Prepared for EPA by
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UPDATE HEAVY-DUTY ENGINE EMISSION CONVERSION FACTORS FOR MOBILE6

Analysis of Fuel Economy, Non-Engine Fuel Economy Improvements and Fuel Densities

05 May 1998

PREPARED FOR

U.S. Environmental Protection Agency
Motor Vehicle Emissions Laboratory
2565 Plymouth Road
Ann Arbor, Michigan 48105

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I. INTRODUCTION

The USEPA highway emission factor model, MOBILE5a, calculates average in-use emission factors for hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NO_x) for eight categories of vehicles including heavy-duty gasoline (HDGV) and heavy-duty diesel (HDDV) vehicles (all vehicles with a gross vehicle weight of 8501 pounds or more). These emission factors are expressed in units of grams per mile (g/mi) and are used in combination with data on vehicle miles traveled (VMT) to estimate highway vehicle contributions to mobile source emission inventories. However, since emission standards for both gasoline and diesel heavy-duty vehicles are expressed in terms of grams per brake-horsepower-hour (g/bhp-hr), conversion factors in terms of brake-horsepower-hour per mile (bhp-hr/mi) must be used to convert the emission certification data from engine testing to in-use grams per mile. These conversion factors have been calculated several times over the last 15 years with the last update completed by USEPA in 1988 for all heavy-duty vehicles [1][1].

The conversion factors used in MOBILE5a were calculated from the following expression:

$$\text{Conversion Factor (bhp-hr/mi)} = \frac{\text{Fuel Density (lb/gal)}}{\text{BSFC (lb/bhp-hr) x Fuel Economy (mi/gal)}}$$

where BSFC is brake specific fuel consumption.

It is the intent of Work Assignments 0-03 and 1-02 to update these conversion factors for all weight classes listed in Table 1. Since the last update calculated conversion factors through the 1986 model year, it is the purpose of this work to calculate conversion factors for model years 1987 through 1996 and project conversion factors for model years 1997 through 2050.

This report discusses the analysis of fuel economy for model years 1987 through 1996 and fuel density for gasoline and diesel. Furthermore, it examines the use of non-engine fuel economy improvement devices for forecasting conversion factors in the future.

This report first discusses the data sets used in analyzing fuel economy and fuel density, then describes analysis methodology and results. Further details of the analyses can be found in the appendices. A second report, "Update Heavy-Duty Engine Emission Conversion Factors for MOBILE6: Analysis of BSFCs and Calculation of Heavy-Duty Engine Emission Conversion Factors," discusses the analysis of brake specific fuel consumption data and provides the calculation of updated engine emission conversion factors.

II. DATA SETS

A. Truck Fuel Economy and Non-Engine Fuel Economy Improvements

Average truck fuel economy and non-engine fuel economy improvements were calculated using the 1992 Truck Inventory and Use Survey (TIUS) Microdata File [2]. The 1992 TIUS survey was

[1] Numbers in brackets refer to references listed in Section V.

conducted during the 1992-1993 time frame by the U.S. Bureau of the Census. The database, which was supplied on CD-ROM, compiles a statistically significant sample of on-road light-duty and heavy-duty trucks. The data includes the attributes of age, gross vehicle weight, fuel type, fuel economy, average operating weight, travel type fraction, and mileage accumulation during 1992 for each truck surveyed. The Census Bureau has also assigned an expansion factor on each record to extrapolate the information in their database to represent the entire US truck population. The data also includes information on use of non-engine fuel economy improvements such as aerodynamic devices, drive train optimization, radial tires, governors and variable fan drives. This data set was used for both gasoline and diesel trucks.

Table 1. Vehicle weight classes

Designation	Description	Gross Vehicle Weight (lb)
HDGV (class 2B)	Light heavy-duty gasoline vehicles	8501-10,000
HDGV (class 3)	Light heavy-duty gasoline vehicles	10,001-14,000
HDGV (class 4)	Heavy heavy-duty gasoline vehicles	14,001-16,000
HDGV (class 5)	Heavy heavy-duty gasoline vehicles	16,001-19,500
HDGV (class 6)	Heavy heavy-duty gasoline vehicles	19,501-26,000
HDGV (class 7)	Heavy heavy-duty gasoline vehicles	26,001-33,000
HDGV (class 8A)	Heavy heavy-duty gasoline vehicles	33,001-60,000
HDGV (class 8B)	Heavy heavy-duty gasoline vehicles	>60,000
HDGTB	Gasoline transit buses	all
HDGSB	Gasoline school buses	all
HDGCB	Gasoline intercity buses	all
HDDV (class 2B)	Light heavy-duty diesel trucks	8501-10,000
HDDV (class 3)	Light heavy-duty diesel trucks	10,001-14,000
HDDV (class 4)	Light heavy-duty diesel trucks	14,001-16,000
HDDV (class 5)	Light heavy-duty diesel trucks	16,001-19,500
HDDV (class 6)	Medium heavy-duty diesel trucks	19,501-26,000
HDDV (class 7)	Medium heavy-duty diesel trucks	26,001-33,000
HDDV (class 8A)	Heavy heavy-duty diesel trucks	33,001-60,000
HDDV (class 8B)	Heavy heavy-duty diesel trucks	>60,000
HDDTB	Diesel transit buses	all
HDDSB	Diesel school buses	all
HDDCB	Diesel intercity buses	all

B. Bus Fuel Economy

Data on in-use bus fuel economy was not as readily available as that for trucks. Counts of transit buses by model year and engine type was obtained from the American Public Transit Association (APTA) *1995 Transit Passenger Vehicle Fleet Inventory* [3]. Fuel economy for the various common engine types was taken from a National Renewable Energy Laboratory (NREL) study

of transit buses [4]. The APTA *1996 Transit Fact Book* [5] was used to confirm calculations against average fuel economy figures.

For school buses, limited data from the *National Transportation Statistics 1997*[6] together with data from a school bus vehicle demonstration program [7] and school bus type counts by model year from *School Bus Fleet Magazine* [8] were used to characterize gasoline and diesel school bus fuel economy. Diesel intercity bus fuel economy was estimated from comparisons of similar buses with DDC 6V-92TA engines (the most common engine prior to 1994) during a central business district (CBD) cycle and an commuter cycle (COM) [9].

Gasoline fuel economies for transit and intercity buses by model year could not be located. Since these represent a small portion of the inventory, previous work by Machiele [1] was used to estimate gasoline transit and intercity bus fuel economies. Further discussion of these assumptions and calculations are described in Section III(B).

C. Fuel Density

Fuel densities were determined from National Institute for Petroleum and Energy Research (NIPER) Petroleum Product Surveys (PPS) for years 1987 through 1996 [10-26]. These documents list diesel and summer and winter gasoline properties.

III. METHODOLOGY

Methodologies to determine fuel economy, non-engine fuel economy improvement penetration and fuel density data are presented below.

A. TIUS Methodology

To provide the best analysis of the TIUS data for the purposes needed by this work assignment, ARCADIS Geraghty & Miller manipulated the TIUS data on a record-by-record basis. Pertinent data from the TIUS data file TI92MDF.DAT was converted into a comma-delimited file using a C program (TIHDCF.C), which is listed in the appendices. The comma-delimited file was then appended to a dBASE file (TIUSHDCF.DBF) with the structure presented in Table 2. Two additional fields were added to TIUSHDCF.DBF to further help in the manipulation of the data for this work assignment. They are listed in Table 3.

The TIUS data set contains 247,282 records. These records were separated into the various truck weight classes listed in Table 1 using the TIUS gross vehicle weight class (TIUGVW), the fuel type (ENGTYP), and the average operating weight (AVGWT). The parameters TIUGVW and AVGWT were used to determine weight class since these parameters are cross checked by the Census Bureau and gave consistent results in terms of fuel economy versus weight class. Since TIUGVW does not differentiate between classes 2A (6,001 - 8,500 lbs) and 2B (8,501 -10,000 lbs), AVGWT was used to determine which trucks were class 2B. Records which did not fall into one of the classes defined in Table 1, were incomplete, or used a fuel other than gasoline or diesel, were eliminated. In addition, since the last model year of data included model years 1982 and older, these data were also eliminated as they could not be assigned to a specific model year. This resulted in 59,046 records for the analysis.

Results defined by 2 or less records were also deleted. The data were then used to characterize average fuel economy, travel fractions, average operating weight, vehicle miles traveled (VMT) and penetration of non-engine fuel economy improvements for the classes of vehicles listed in Table 1.

Table 2. TIUSHDCF.DBF data structure

Field Name	Description
EXPANF	Expansion factor
MDLYR	Model year
AVGWT	Average operating weight
ENGTYP	Fuel type
PKCID	Engine size code
AERODN	Aerodynamic device?
AXLRAT	Optimized axle ratio?
ECOENG	Fuel economy engine?
RADIAL	Radial tires?
GOVNOR	Road speed governor?
VARFAN	Variable fan drives?
OTHFUEL	Other fuel conservation features?
ANNMIL	Annual Mileage during 1992
MPG	Fuel Economy
PLOCAL	% of mileage for trips < 50 miles from home
PSHORT	% of mileage for trips 50-100 miles from home
PSMED	% of mileage for trips 100-200 miles from home
PLMED	% of mileage for trips 200-500 miles from home
PLONG	% of mileage for trips > 500 miles from home
TIUGVW	TIUS gross vehicle weight class
PKGVW	Polk gross vehicle weight class
PKRWGT	Polk registered weight

Table 3. Additional fields in TIUSHDCF.DBF

Field Name	Description
WGTCLASS	Vehicle class description
TRIP CODE	Trip type description

Trip types were broken into four trip categories as shown in Table 4 for further analysis. It was believed that fuel economies would be different for trucks that operated locally to those that operated

in long-haul applications. Vehicle characteristics versus trip type were determined from records in which over 75 percent of the VMT represented that trip type. All values were averaged by vehicle miles traveled (registrations times annual average mileage). The program to manipulate the database, HDCF.PRG, is listed in the appendices.

Table 4. Trip type descriptions

Trip Type	Description
Local	Trips less than 50 miles from home base
Short	Trips between 50 and 100 miles from home base
Medium	Trips between 100 and 200 miles from home base
Long	Trips over 200 miles from home base

A regression analysis was performed for fuel economies by model year for each weight class and a power curve fit ($y = ax^b$) was generated to extrapolate values beyond 1992. Curve fits for each weight class are shown in Table 5. TIUS provided the most complete set of in-use fuel economy data for trucks, but since it only described trucks for 1992 model year and older, the fuel economy curves needed to be extrapolated to provide data for model years 1993 through 1996. In all cases the equations resulted in about a 1% improvement in fuel economy per year which seemed reasonable given current truck fuel economy trends. TIUS provided no data for Class 8B gasoline trucks and therefore no fuel economies were calculated for that class. No extrapolation beyond 1996 was done for fuel economy since BSFCs beyond 1996 were not available. Future projections of conversion factors were made based upon conversion factors calculated between 1987 and 1996, similar to the methodology applied by Machiele [1].

Table 5. Curve fits of fuel economy
(y is fuel economy in mpg and x is [model year - 1900])

Weight Class	Gasoline	Diesel
2B	$y = 0.1253x^{0.9624}$	$y = 0.1072x^{1.0506}$
3	$y = 0.1157x^{0.9632}$	$y = 0.0989x^{1.045}$
4	$y = 0.0409x^{1.1902}$	$y = 0.502x^{0.6598}$
5	$y = 0.4416x^{0.6348}$	$y = 0.2474x^{0.8078}$
6	$y = 0.0338x^{1.2015}$	$y = 0.5336x^{0.6117}$
7	$y = 0.1277x^{0.8909}$	$y = 4.0206x^{0.1374}$
8A	$y = 0.0647x^{1.0285}$	$y = 0.15485x^{0.8194}$
8B	--	$y = 0.0119x^{1.3742}$

Non-engine fuel economy improvement penetration versus model year for model years 1983 through 1992 were curve fit using a logarithmic curve ($y = a + b*\ln(x)$). Usage of non-engine fuel

economy improvements for the 1996 model year were then calculated using the curve fits and compared against MOBILE4 estimates [1]. Discussion of these results can be found in Section IV. Raw averaged TIUS data for each weight class and fuel can be found in the appendices (Tables A-1 through A-15). Blank entries indicate no data.

B. Bus Fuel Economy Methodology

Diesel transit bus fuel economy is highly dependent on the type of engine used. Prior to 1993, 68 to 87% of the diesel bus inventory used the DDC 6V-92TA two-stroke engine. The Cummins L-10 four-stroke engine was the second most used engine in transit buses during that time period. The Cummins L-10 has approximately 14% better fuel economy than the DDC 6V-92TA [4]. In 1992, DDC introduced the Series 50 four stroke engine for the bus market with approximately 16% better fuel economy than the 6V-92TA [27]. Due to more stringent emission regulations, the 6V-92 is being phased out and will not be built after 1998 for the on-road market. The penetration of the four stroke engines into the bus market each model year is a larger driver of average fleet fuel economy than the minor changes that occur from year to year in a given engine line. Thus to calculate fuel economy for this work assignment, bus engine counts for model years 1987 through 1995 were taken from the APTA *1995 Transit Passenger Vehicle Fleet Inventory* [2]. These are listed in Table 6. As transit buses are defined in the Code of Federal Regulations (Title 40 §86.093-2) as having a load capacity of 15 passengers or more, buses that held fewer than 15 passengers were not counted. In addition, trolleys and streetcars also were not counted. The numbers in Table 6 represent active buses for model years 1987 through 1994 and purchases for 1995.

Table 6. Diesel transit bus inventory by engine type (U.S. in-service population)

Model Year	DDC			Cummins L-10	Other Engines
	Series 50	6V-92TA	8V-92TA		
1987		2189	33	355	238
1988		1826	5	683	142
1989		2983	102	239	96
1990		2910	34	1087	204
1991		1979	1	189	180
1992		1394	50	365	78
1993	257	1473	12	361	148
1994	1604	243	11	603	28
1995	1370	200		333	21

Average fuel economies for the DDC 6V-92TA and the Cummins L-10 were derived from a transit bus study done by NREL [4] and are listed in Tables 7 and 8 respectively. Average fuel economies were determined by weighting each transit district average diesel fuel economy by the fleet

mileage. This resulted in a 14% increase in fuel economy for the four stroke L-10 over the two stroke 6V-92TA.

Comparisons of certification BSFCs for the 6V-92 and the Series 50 showed a 16% improvement in fuel economy for the newer four stroke Series 50. The DDC 8V-92TA was assumed to have the same fuel economy as the DDC 6V-92TA since the DDC 8V-92TA has slightly better BSFC but is usually used in heavier buses. The other engines in Table 6 were also mostly four stroke engines (mostly Caterpillar 3306). Using this information, fuel economies for two-stroke buses were estimated to be 3.4 mpg (DDC 6V-92 and 8V-92) and four-stroke buses were estimated to be 3.9 mpg (DDC Series 50, Cummins L-10 and others). Fuel economy by model year for diesel transit buses was then weighted by the vehicle counts listed in Table 6.

Table 7. Determination of average diesel transit bus fuel economies for the DDC 6V-92TA (Taken from Reference 4)

Transit District	No. of Buses	Fleet Miles (miles)	Average Fuel Economy (mpg)
Houston TX	5	282,881	3.63
Miami FL	5	380,453	3.32
Peoria IL	3	225,377	3.51
Minneapolis/St. Paul MN	5	266,338	3.14
VMT Weighted Average			3.39

Table 8. Determination of average diesel transit bus fuel economies for the Cummins L-10 (Taken from Reference 4)

Transit District	No. of Buses	Fleet Miles (miles)	Average Fuel Economy (mpg)
Portland OR	5	203,007	4.30
Miami FL	5	330,342	3.61
VMT Weighted Average			3.87

Intercity bus fuel economy was estimated from transit bus fuel economy by applying the percent increase in fuel economy between a transit bus operating on the central business district (CBD) driving cycle and the commuter (COM) cycle. Intercity buses are similar to transit buses, but stop less and usually travel at higher speeds. Since intercity buses travel freeways and arterials between cities, the COM driving cycle is a good representation of intercity bus use. The CBD is used to represent in-city driving by transit buses. Battelle Columbus Laboratories tested six transit buses with 6V-92TA

engines on both the CBD and COM cycles [9]. Averaged results from that study is shown in Table 9. Diesel buses driven on the COM cycle had a 35.2% increase in fuel economy over that for the same bus driven on the CBD cycle. Thus fuel economies for diesel transit buses by model year were then multiplied by 1.352 to determine intercity bus fuel economies.

Gasoline school bus fuel economies were calculated from fuel usage and vehicle-mile statistics for school buses from the *National Transportation Statistics 1997* [6]. Gasoline school buses werel assumed to be mostly Type A&B[2]. To calculate diesel school bus fuel economy for Type A&B, the ratio of diesel to gasoline fuel economies for school buses was determined from a 1988 report on conversion factors [1] and applied to fuel economies calculated for gasoline Type A&B school buses. This resulted in an estimate of 8.2 mpg for Type A&B diesel school buses. Fuel economies for Type C and D buses were taken from a California Energy Commission school bus demonstration program [7]. Average fuel economy for Type C & D buses from that study was approximately 6.0 mpg. Using these estimates together with the school bus populations by vehicle type from *School Bus Fleet* [8] (shown in Table 10), diesel school bus fuel economy was calculated.

Table 9. Fuel economy difference between CBD and COM driving cycles
(Taken from Reference 9)

Driving Cycle	**Miles between Stops**	**Average Speed** (mph)	**Top Speed** (mph)	**Fuel Economy** (mpg)
CBD	0.142	12.9	20	3.69
COM	4.000	46.5	55	4.99
Ratio of COM to CBD fuel economy				1.352

Table 10. Diesel school bus inventory by model year and type
(Taken from Reference 8)

Model Year	**School Bus Type**			
	A&B	**C**	**D**	**Total**
90	2225	23670	6286	32181
91	3756	21370	6864	31990
92	3820	16444	5444	25708
93	3535	18928	6734	29197
94	3215	21005	7321	31541
95	2216	20861	9671	32748
96	2225	22016	9270	33511

[2] Types A & B are generally smaller school buses with the engine in the front. Types C and D are generally larger school buses, Type C has a front engine and Type D has an engine in the rear or midship.

The gasoline transit bus inventory amounted to approximately 0.5% of the diesel transit bus inventory [3]. To calculate gasoline transit bus fuel economies, the ratio of diesel to gasoline fuel economies for transit buses was determined from a 1988 report on conversion factors [1]. That report indicated that gasoline transit buses fuel economies were approximately 90.8% of diesel transit bus fuel economies. This factor was applied to the previously calculated diesel transit bus fuel economies to determine gasoline transit bus fuel economies. A similar procedure was used for gasoline intercity buses, but in this case, the ratio was determined between gasoline transit and intercity buses. It was determined from Reference 9 that gasoline intercity buses had 16.7% better fuel economy than gasoline transit buses. Thus gasoline transit bus fuel economy by model year was multiplied by 1.167 to determine gasoline intercity bus fuel economies.

C. Fuel Density Methodology

1. Gasoline

Gasoline American Petroleum Institute (API) gravity was extracted from NIPER publications on summer and winter motor gasoline properties. It was assumed that all heavy-duty gasoline trucks use regular unleaded gasoline. Low altitude values were used for all years. Summer and winter values were averaged (added together and divided by two) for each year in question. Fuel densities in pounds per gallon were then calculated from API gravity using the following formula [28]:

$$\text{Fuel Density (lbs/gal)} = \frac{141.5 \times 8.328}{(131.5 + \text{API})}$$

2. Diesel

Diesel API gravity was extracted from NIPER publications on diesel properties. It was assumed that all heavy-duty diesel trucks and buses use #2 diesel fuel. Nationwide average values were used to calculate fuel densities for each year. Fuel densities in pounds per gallon were then calculated from API gravity using the above formula.

IV. RESULTS

A. Truck Fuel Economy

Average heavy-duty gasoline truck operation by weight class during 1992 (1992 TIUS data) is presented in Table 11. Both fuel economy and average operating weight are VMT weighted averages. In all weight classes except 4, over 60% of the VMT occurred in trips within 50 miles of the home base of the vehicle (Local). All weight classes except 4 had over 80% of the VMT within 100 miles from the home base of the vehicle (Local + Short). Class 4 vehicles had only 66% of the VMT within 100 miles from the home base.

Gasoline truck fuel economy was calculated for 1987 through 1996 model year trucks using the curve fits listed in Table 5 (derived from TIUS data). The results are shown in Table 12.

Table 13 shows average heavy-duty diesel truck operation by weight class during 1992 (1992 TIUS data). Both fuel economy and average operating weight are VMT weighted averages. As with gasoline vehicles, local operation (Local) was compared with long-haul (Long) operation to determine trends in fuel economy. Data in Tables 11 and 13 indicate that diesel trucks tended to operate over a greater radius from home base than gasoline trucks. Weight classes 2B through 7 drove over 40% of their VMT on trips within 50 miles of the home base of the vehicle (Local). These trips accounted for only 23% and 7% of their VMT for weight classes 8A and 8B, respectively. Class 8A had almost 50% of VMT in trips over 200 miles from the home base (Long), while class 8B drove over 70% of the VMT in trips over 200 miles from the home base. The TIUS data also show that for class 8 trucks, fuel economy for local trips was approximately equal to fuel economy for long-haul trips. It is expected that these results would be different for trucks with newer, electronically-controlled engines.

Table 11. Heavy-duty gasoline vehicle averages in 1992 (taken from 1992 TIUS[2])

Weight Class	VMT (Mil Miles)	Travel Fraction (%)				FE[a] (mpg)	Wgt[b] (lbs)
		Local	Short	Med	Long		
2B	3283.02	64.3	25.7	8.8	1.2	9.2	9490
3	4194.68	65.9	16.2	7.4	10.4	9.0	11997
4	1224.18	46.4	19.8	7.4	26.5	8.2	15274
5	765.40	72.4	19.3	5.9	2.5	7.4	17877
6	1301.57	68.9	17.1	2.3	11.7	7.3	22289
7	443.19	76.6	10.6	10.2	2.6	6.7	29068
8A	165.04	73.0	19.3	5.3	2.4	6.6	39838

[a] Average weight class fuel economy in miles per gallon
[b] Average weight class operating weight in pounds

Table 12. Projected gasoline heavy-duty vehicle fuel economies (mpg)

Model Year	Weight Class						
	2B	3	4	5	6	7	8A
87	9.22	8.54	8.32	7.52	7.23	6.83	6.39
88	9.32	8.63	8.43	7.58	7.33	6.89	6.47
89	9.42	8.73	8.55	7.63	7.43	6.96	6.54
90	9.52	8.82	8.66	7.68	7.53	7.03	6.62
91	9.62	8.92	8.78	7.74	7.63	7.10	6.70
92	9.73	9.01	8.89	7.79	7.73	7.17	6.77
93	9.83	9.11	9.01	7.85	7.84	7.24	6.85
94	9.93	9.20	9.12	7.90	7.94	7.31	6.92
95	10.03	9.30	9.24	7.95	8.04	7.38	7.00
96	10.13	9.39	9.35	8.01	8.14	7.45	7.07

Table 14 shows calculated fuel economy for model year 1987 through 1996 diesel trucks, derived from the curve fits listed in Table 5.

Table 13. Heavy-duty diesel vehicle averages in 1992 (taken from 1992 TIUS [2])

Wgt	VMT	Travel Fractions (%)				Fuel Economy[a] (mpg)			Average Weight[b] (lbs)		
Class	Mil Miles	Local	Short	Med	Long	Ave	Local	Long	Ave	Local	Long
2B	1857.59	55.0	31.4	9.0	4.5	11.9	12.0		9591	9544	
3	3751.85	49.2	30.2	8.5	12.1	11.2	12.1		12219	12262	
4	1479.63	47.2	37.2	8.1	7.5	9.7	9.5		15123	15185	
5	1857.42	55.9	18.8	9.3	15.9	9.4	9.4	9.6	17814	17812	17916
6	5492.44	47.9	28.8	12.8	10.5	8.2	8.0	8.5	22935	22829	23366
7	4768.90	44.0	22.6	10.2	23.2	7.4	7.7	6.6	29906	30074	30350
8A	25088.28	22.7	10.7	9.9	56.6	6.0	6.0	6.0	48881	47622	49900
8B	65513.19	7.3	8.8	9.4	74.4	5.7	5.6	5.7	75784	76575	75063

[a] Average weight class fuel economy in miles per gallon
[b] Average weight class operating weight in pounds

Table 14. Projected diesel heavy-duty vehicle fuel economies (mpg)

Model	Weight Class							
Year	2B	3	4	5	6	7	8A	8B
87	11.69	10.52	9.56	9.12	8.20	7.43	5.96	5.51
88	11.83	10.65	9.63	9.21	8.25	7.44	6.03	5.59
89	11.97	10.77	9.70	9.29	8.31	7.45	6.10	5.68
90	12.11	10.90	9.77	9.38	8.37	7.46	6.17	5.77
91	12.26	11.03	9.85	9.46	8.42	7.47	6.24	5.86
92	12.40	11.15	9.92	9.54	8.48	7.48	6.31	5.95
93	12.54	11.28	9.99	9.63	8.54	7.49	6.38	6.03
94	12.68	11.41	10.06	9.71	8.59	7.51	6.45	6.12
95	12.82	11.53	10.13	9.80	8.65	7.52	6.52	6.21
96	12.96	11.66	10.20	9.88	8.71	7.53	6.59	6.30

B. Bus Fuel Economy

Calculated fuel economies for transit, intercity and school buses are shown in Table 15. The average for the calculated fuel economy from Table 15 for diesel transit buses for model years 1987 through 1995 is 3.61 mpg. This is reasonably close to the 3.68 mpg for all diesel transit buses in operation in 1994 calculated from data given in the *1996 Transit Fact Book* [5] and therefore seems reasonable.

Table 15. Estimated bus fuel economies (mpg)

Model Year	Diesel			Gasoline		
	Transit	Intercity	School	Transit	Intercity	School
1987	3.43	4.64	6.29	3.11	3.64	6.18
1988	3.47	4.69	6.28	3.15	3.68	6.21
1989	3.51	4.75	6.27	3.19	3.72	6.24
1990	3.55	4.80	6.25	3.22	3.76	6.27
1991	3.59	4.85	6.24	3.26	3.80	6.30
1992	3.63	4.91	6.23	3.30	3.85	6.33
1993	3.67	4.96	6.22	3.33	3.89	6.37
1994	3.71	5.01	6.20	3.37	3.93	6.40
1995	3.75	5.07	6.19	3.40	3.97	6.42
1996	3.79	5.12	6.18	3.44	4.01	6.45

C. Use of Non-Engine Fuel Economy Improvement Devices

For previous versions of MOBILE, projections of conversion factors for future model years were determined by examining increased use estimates of fuel economy improvement devices that were not engine related (aerodynamic devices, drive train optimization, radial tires, speed control and variable speed fan drives). It was thought that if the fuel economy of an engine line improved due to engine improvements (such as better fuel injection control, combustion optimization, turbocharging), these changes would be reflected both in the fuel economy of the vehicle and the BSFC of the engine, and that these effects would more or less offset one another. However, non-engine related fuel economy improvement devices could improve the fuel economy of the vehicle without affecting engine BSFC. Since improving fuel economy without a corresponding reduction in BSFC would decrease conversion factors, these non-engine fuel economy improvement devices could affect conversion factors for future model years and need to be taken into account.

As part of this study, the 1992 TIUS data was used to determine the extent to which non-engine related devices were used by the various weight classes in the U.S. heavy-duty vehicle fleet. Regression analyses were performed on data for model years 1983 through 1992 to determine use trends of these devices and project those trends to the 1996 model year. These devices are the most beneficial on longer-haul, higher speed trips. Therefore, if the number of trucks that use these devices is less than the number of trucks that operate on long-haul trips, one can assume that there may be increased use of these devices in the future, which would affect truck fleet fuel economy and thus conversion factors. To test this assumption, predicted use of non-engine fuel economy improvement devices were compared against the VMT fraction of long-haul trips.

Table 16 shows the percent of use of non-engine fuel economy improvement devices for heavy-duty gasoline trucks. As may be seen in this table, in all classes except 3 and 4, data projected out for 1996 model year trucks shows that, in fact, the use percent of non-engine related devices exceeds the

percent of trucks that operate on long-haul trips. Thus, it is unlikely that there will be further increased use of these devices past the 1996 model year and therefore need not be considered in conversion factor calculations for future model years. Since class 3 and 4 vehicles still spend most of their travel in shorter trips, it is not likely that there will be much increased use of these devices in those weight classes over the 1996 model year levels, either.

A similar trend in the use of non-engine related devices is illustrated in Table 17 for 1996 model year heavy-duty diesel trucks. For diesel trucks, however, the percent of use of non-engine fuel economy improvement devices for the 1996 model year greatly exceeds the long-haul travel fraction for all weight classes. Thus, it is unlikely that there will be much further use of non-engine fuel economy improvement devices in diesel trucks beyond those already in use on 1996 model year trucks. Therefore, increased use of these devices need not be figured into calculations of conversion factors beyond the 1996 model year**.**

Table 16. Estimated percent of use of non-engine fuel economy improvements in each weight class of 1996 model year heavy-duty gasoline vehicles

Weight Class	**2B**	**3**	**4**	**5**	**6**	**7**	**8A**
Long-Haul VMT Fraction	1%	10%	27%	3%	12%	3%	2%
Aero Devices							
TIUS	18%	9%	11%	33%	34%	24%	38%
MOBILE4	0%	0%	0%	7%	7%	7%	7%
Drive Train Optimization							
TIUS	22%	12%	32%	23%	39%	37%	31%
MOBILE4	27%	27%	27%	27%	27%	27%	27%
Radial Tires							
TIUS	96%	100%	77%	73%	100%	86%	91%
MOBILE4	67%	67%	67%	14%	14%	14%	14%
Speed Control							
TIUS	12%	5%	10%	62%	32%	44%	42%
MOBILE4	13%	13%	13%	4%	4%	4%	4%
Fan Drives							
TIUS	18%	9%	18%	26%	10%	25%	15%
MOBILE4	0%	0%	0%	90%	90%	90%	90%

D. Fuel Densities

Fuel densities for unleaded gasoline, taken from the NIPER publications, are shown in Table 18. Fuel densities for #2 diesel are shown in Table 19. These fuel densities are similar to those used in MOBILE4 emission factor calculations [1].

Table 17. Estimated percent of use of non-engine fuel economy improvements in each weight class of 1996 model year heavy-duty diesel vehicles

Weight Class	2B	3	4	5	6	7	8A	8B
Long-Haul VMT Fraction	5%	12%	8%	16%	11%	23%	57%	74%
Aero Devices								
TIUS	17%	21%	18%	17%	28%	48%	87%	100%
MOBILE4	0%	0%	0%	7%	7%	7%	7%	32%
Drive Train Optimization								
TIUS	30%	40%	38%	56%	46%	59%	80%	100%
MOBILE4	27%	27%	27%	27%	27%	27%	27%	27%
Radial Tires								
TIUS	91%	91%	100%	100%	92%	94%	90%	95%
MOBILE4	67%	67%	67%	14%	14%	14%	14%	50%
Speed Control								
TIUS	39%	28%	41%	35%	41%	41%	71%	81%
MOBILE4	13%	13%	13%	4%	4%	4%	4%	14%
Fan Drives								
TIUS	41%	42%	28%	40%	46%	46%	80%	85%
MOBILE4	0%	0%	0%	90%	90%	90%	90%	100%

Table 18. Gasoline Fuel Densities

	API Gravity			Density
Year	Winter	Summer	Average	lb/gal
1987	62.3	59.2	60.75	6.130
1988	62.5	58.9	60.70	6.131
1989	61.8	58.2	60.00	6.154
1990	62.2	58.2	60.20	6.147
1991	61.8	58.0	59.90	6.157
1992	61.2	57.4	59.30	6.176
1993	61.2	56.1	58.65	6.197
1994	60.8	55.7	58.25	6.210
1995	59.4	56.1	57.75	6.227
1996	60.2	56.9	58.55	6.201
Average				6.173
MOBILE4				6.09

Table 19. Diesel Fuel Densities

Year	API Gravity	Density lb/gal
1987	34.2	7.112
1988	34.5	7.099
1989	33.8	7.129
1990	34.3	7.107
1991	34.0	7.120
1992	33.7	7.133
1993	34.3	7.107
1994	35.3	7.065
1995	35.4	7.061
1996	35.6	7.052
Average		7.099
MOBILE4		7.11

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APPENDIX

TIHDCF.C

```
/* TIHDCF
   Converts the TIUS dataset TI92MDF.DAT to a comma delimited file for
   importing into dBASE file TIUSHDCF
*/
#include <stdio.h>
#include <ctype.h>

#define comma   44

char buffer[625];
char bufout[110];
FILE *fin,*fout;
int count;
long n;
int idex,odex;

void main()
{
    fin = fopen("E:TI92MDF.DAT","rb");
    fout = fopen("C:TIHDCF1.DAT","wb");
    n = 0;
    while (n < 125000) {
       fgets(buffer,625,fin);
       n++;
       odex = 0;
       idex = 14;
       /* EXPANF    15-21  */
       for (count=1; count <=7; count++) {
          bufout[odex] = buffer[idex];
          odex++;
          idex++;
       }
       bufout[odex] = comma;
       odex++;
       /* MDLYR    24-25  */
       idex = 23;
       for (count=1; count <=2; count++) {
          bufout[odex] = buffer[idex];
          odex++;
          idex++;
       }
       bufout[odex] = comma;
       odex++;
   /* AVGWT  99-104  */
       idex = 98;
       for (count=1; count <=6; count++) {
          bufout[odex] = buffer[idex];
          odex++;
          idex++;
       }
       bufout[odex] = comma;
       odex++;
       /* EngTyp  112  */
       idex = 111;
       bufout[odex] = buffer[idex];
       odex++;
       bufout[odex] = comma;
       odex++;
```

```
/* PKCID   114-115  */
idex = 113;
for (count=1; count <=2; count++) {
   bufout[odex] = buffer[idex];
   odex++;
   idex++;
}
bufout[odex] = comma;
odex++;
/* AERODN  119  */
idex = 118;
bufout[odex] = buffer[idex];
odex++;
bufout[odex] = comma;
odex++;
/* AXLRAT  120  */
idex++;
bufout[odex] = buffer[idex];
odex++;
bufout[odex] = comma;
odex++;
/* ECOENG  121  */
idex++;
bufout[odex] = buffer[idex];
odex++;
bufout[odex] = comma;
odex++;
/* RADIAL  123  */
idex = 122;
bufout[odex] = buffer[idex];
odex++;
bufout[odex] = comma;
odex++;
/* GOVNOR  124  */
idex++;
bufout[odex] = buffer[idex];
odex++;
bufout[odex] = comma;
odex++;
/* VARFAN  125  */
idex++;
bufout[odex] = buffer[idex];
odex++;
bufout[odex] = comma;
odex++;
/* OTHFUEL  126  */
idex++;
bufout[odex] = buffer[idex];
odex++;
bufout[odex] = comma;
odex++;
/* ANNMIL  155-160 */
idex = 154;
for (count=1; count <=6; count++) {
   bufout[odex] = buffer[idex];
   odex++;
   idex++;
}
```

```
      bufout[odex] = comma;
      odex++;
      /* MPG 170-172 */
      idex = 169;
      for (count=1; count <=3; count++) {
         bufout[odex] = buffer[idex];
         odex++;
         idex++;
      }
      bufout[odex] = comma;
      odex++;
   /* PLOCAL  183-185 */
      idex = 182;
      for (count=1; count <=3; count++) {
         bufout[odex] = buffer[idex];
         odex++;
         idex++;
      }
      bufout[odex] = comma;
      odex++;
    /* PSHORT  186-188 */
      for (count=1; count <=3; count++) {
         bufout[odex] = buffer[idex];
         odex++;
         idex++;
      }
      bufout[odex] = comma;
      odex++;
     /* PSMED  189-191 */
      for (count=1; count <=3; count++) {
         bufout[odex] = buffer[idex];
         odex++;
         idex++;
      }
      bufout[odex] = comma;
      odex++;
    /* PLMED  192-194 */
      for (count=1; count <=3; count++) {
         bufout[odex] = buffer[idex];
         odex++;
         idex++;
      }
      bufout[odex] = comma;
      odex++;
    /* PLONG  195-197 */
      for (count=1; count <=3; count++) {
         bufout[odex] = buffer[idex];
         odex++;
         idex++;
      }
      bufout[odex] = comma;
      odex++;
      /* TIUGVW  421-422 */
      idex = 420;
      for (count=1; count <=2; count++) {
         bufout[odex] = buffer[idex];
         odex++;
         idex++;
```

```
      }
      bufout[odex] = comma;
      odex++;
      /* PKGVW  423 */
      bufout[odex] = buffer[idex];
      odex++;
      idex++;
      bufout[odex] = comma;
      odex++;
      /* PKRWGT  424-429  */
      for (count=1; count <=6; count++) {
         bufout[odex] = buffer[idex];
         odex++;
         idex++;
      }
      bufout[odex] = '\n';
      odex++;
      bufout[odex] = '\0';
      fputs(bufout,fout);
   }
   fclose(fout);
   puts("\nfile 1 written");
   fout = fopen("C:TIHDCF2.DAT","wb");
   while (fgets(buffer,625,fin)) {
      odex = 0;
      idex = 14;
      /* EXPANF    15-21  */
      for (count=1; count <=7; count++) {
         bufout[odex] = buffer[idex];
         odex++;
         idex++;
      }
      bufout[odex] = comma;
      odex++;
      /* MDLYR    24-25  */
      idex = 23;
      for (count=1; count <=2; count++) {
         bufout[odex] = buffer[idex];
         odex++;
         idex++;
      }
      bufout[odex] = comma;
      odex++;
         /* AVGWT  99-104  */
      idex = 98;
      for (count=1; count <=6; count++) {
         bufout[odex] = buffer[idex];
         odex++;
         idex++;
      }
      bufout[odex] = comma;
      odex++;
      /* EngTyp  112  */
      idex = 111;
      bufout[odex] = buffer[idex];
      odex++;
      bufout[odex] = comma;
      odex++;
```

```
/* PKCID   114-115  */
idex = 113;
for (count=1; count <=2; count++) {
   bufout[odex] = buffer[idex];
   odex++;
   idex++;
}
bufout[odex] = comma;
odex++;
/* AERODN  119  */
idex = 118;
bufout[odex] = buffer[idex];
odex++;
bufout[odex] = comma;
odex++;
/* AXLRAT  120  */
idex++;
bufout[odex] = buffer[idex];
odex++;
bufout[odex] = comma;
odex++;
/* ECOENG  121  */
idex++;
bufout[odex] = buffer[idex];
odex++;
bufout[odex] = comma;
odex++;
/* RADIAL  123  */
idex = 122;
bufout[odex] = buffer[idex];
odex++;
bufout[odex] = comma;
odex++;
/* GOVNOR  124  */
idex++;
bufout[odex] = buffer[idex];
odex++;
bufout[odex] = comma;
odex++;
/* VARFAN  125  */
idex++;
bufout[odex] = buffer[idex];
odex++;
bufout[odex] = comma;
odex++;
/* OTHFUEL  126  */
idex++;
bufout[odex] = buffer[idex];
odex++;
bufout[odex] = comma;
odex++;
/* ANNMIL  155-160 */
idex = 154;
for (count=1; count <=6; count++) {
   bufout[odex] = buffer[idex];
   odex++;
   idex++;
}
```

```
bufout[odex] = comma;
odex++;
   /* MPG 170-172 */
   idex = 169;
for (count=1; count <=3; count++) {
   bufout[odex] = buffer[idex];
   odex++;
   idex++;
}
bufout[odex] = comma;
odex++;
   /* PLOCAL  183-185 */
   idex = 182;
for (count=1; count <=3; count++) {
   bufout[odex] = buffer[idex];
   odex++;
   idex++;
}
bufout[odex] = comma;
odex++;
   /* PSHORT  186-188 */
for (count=1; count <=3; count++) {
   bufout[odex] = buffer[idex];
   odex++;
   idex++;
}
bufout[odex] = comma;
odex++;
   /* PSMED  189-191 */
for (count=1; count <=3; count++) {
   bufout[odex] = buffer[idex];
   odex++;
   idex++;
}
bufout[odex] = comma;
odex++;
   /* PLMED  192-194 */
for (count=1; count <=3; count++) {
   bufout[odex] = buffer[idex];
   odex++;
   idex++;
}
bufout[odex] = comma;
odex++;
   /* PLONG  195-197 */
for (count=1; count <=3; count++) {
   bufout[odex] = buffer[idex];
   odex++;
   idex++;
}
bufout[odex] = comma;
odex++;
/* TIUGVW  421-422 */
idex = 420;
for (count=1; count <=2; count++) {
   bufout[odex] = buffer[idex];
   odex++;
   idex++;
```

```
        }
        bufout[odex] = comma;
        odex++;
        /* PKGVW  423 */
        bufout[odex] = buffer[idex];
        odex++;
        idex++;
        bufout[odex] = comma;
        odex++;
        /* PKRWGT  424-429  */
        for (count=1; count <=6; count++) {
           bufout[odex] = buffer[idex];
           odex++;
           idex++;
        }
        bufout[odex] = '\n';
        odex++;
        bufout[odex] = '\0';
        fputs(bufout,fout);
    }
    fclose(fout);
    puts("\nfile 2 written");
    fclose(fin);
}
```

HDCF.PRG

```
*
* Determines VMT, travel fractions, fuel economy and non-engine fuel economy
*   improvement penetration for each weight class and fuel
*
set talk off
use TIUSHDCF alias TIUS
select 2
use HDCF alias CF
zap
select TIUS
MYTest = 92
WTCLTest = "HDDV(2B)"
T = "AL"
store 0 to VMT_LC,VMT_SH,VMT_MD,VMT_LN,N,AM,MG,MGR,AVWGT,AWR,CID,CIDR
store 0 to AD,AR,ECO,RAD,GOV,VAR,OTH
do while .not. eof()
    M = 93 - MDLYR
    if WGTCLASS <> WTCLTest .or. M <> MYTest .or. TRAV_CODE <> T
        select CF
        append blank
        replace WGTCLASS with WTCLTest
        replace MY with MYTest
        replace TRAV_CODE with T
        replace RECS with N
        if MGR > 0
            replace MPG with MG/MGR
        endif
        if AWR > 0
            replace AVGWT with AVWGT/AWR
        endif
        if CIDR > 0
            replace PKCID with CID/CIDR
        endif
        VMT_TOT = VMT_LC+VMT_SH+VMT_MD+VMT_LN
        if VMT_TOT > 0
            replace TF_LOCAL with VMT_LC/VMT_TOT*100.00
            replace TF_SHORT with VMT_SH/VMT_TOT*100.00
            replace TF_MEDIUM with VMT_MD/VMT_TOT*100.00
            replace TF_LONG with VMT_LN/VMT_TOT*100.00
        else
            replace TF_LOCAL with 0
            replace TF_SHORT with 0
            replace TF_MEDIUM with 0
            replace TF_LONG with 0
        endif
        replace VMT_LOCAL with VMT_LC/1000000.00/100.00
        replace VMT_SHORT with VMT_SH/1000000.00/100.00
        replace VMT_MEDIUM with VMT_MD/1000000.00/100.00
        replace VMT_LONG with VMT_LN/1000000.00/100.00
        if AM > 0
            replace AERODN with AD/AM*100
            replace AXLRAT with AR/AM*100
            replace ECOENG with ECO/AM*100
            replace RADIAL with RAD/AM*100
            replace GOVNOR with GOV/AM*100
            replace VARFAN with VAR/AM*100
            replace OTHFUEL with OTH/AM*100
        endif
```

```
            select TIUS
            MYTest = M
            WTCLTest = WGTCLASS
            T = TRAV_CODE
            store 0 to VMT_LC,VMT_SH,VMT_MD,VMT_LN,N,AM,MG,MGR,AVWGT
            store 0 to AD,AR,ECO,RAD,GOV,VAR,OTH,AWR,CID,CIDR
        endif
        VMT_LC = VMT_LC + PLOCAL*EXPANF*ANNMIL
        VMT_SH = VMT_SH + PSHORT*EXPANF*ANNMIL
        VMT_MD = VMT_MD + PSMED*EXPANF*ANNMIL
        VMT_LN = VMT_LN + (PLMED+PLONG)*EXPANF*ANNMIL
        AM = AM + ANNMIL*EXPANF
        if MPG > 0
            MGR = MGR + EXPANF*ANNMIL
            MG = MG + MPG*EXPANF*ANNMIL
        endif
        if AVGWT > 0
            AVWGT = AVWGT + AVGWT*EXPANF*ANNMIL
            AWR = AWR + EXPANF*ANNMIL
        endif
        if PKCID > 0
            CID = CID + PKCID*EXPANF*ANNMIL
            CIDR = CIDR + EXPANF*ANNMIL
        endif
        N = N + 1
        if AERODN = 1
            AD = AD + EXPANF*ANNMIL
        endif
        if AXLRAT = 1
            AR = AR + EXPANF*ANNMIL
        endif
        if ECOENG = 1
            ECO = ECO + EXPANF*ANNMIL
        endif
        if RADIAL = 1
            RAD = RAD + EXPANF*ANNMIL
        endif
        if GOVNOR = 1
            GOV = GOV + EXPANF*ANNMIL
        endif
        if VARFAN = 1
            VAR = VAR + EXPANF*ANNMIL
        endif
        if OTHFUEL = 1
            OTH = OTH + EXPANF*ANNMIL
        endif
        skip
    enddo
    select CF
    append blank
    replace WGTCLASS with WTCLTest
    replace MY with MYTest
    replace TRAV_CODE with T
    replace RECS with N
    replace MPG with MG/MGR
    replace AVGWT with AVWGT/AWR
    replace PKCID with CID/CIDR
    VMT_TOT = VMT_LC+VMT_SH+VMT_MD+VMT_LN
```

HDCF.PRG

```
if VMT_TOT > 0
    replace TF_LOCAL with VMT_LC/VMT_TOT*100.00
    replace TF_SHORT with VMT_SH/VMT_TOT*100.00
    replace TF_MEDIUM with VMT_MD/VMT_TOT*100.00
    replace TF_LONG with VMT_LN/VMT_TOT*100.00
else
    replace TF_LOCAL with 0
    replace TF_SHORT with 0
    replace TF_MEDIUM with 0
    replace TF_LONG with 0
endif
replace VMT_LOCAL with VMT_LC/1000000.00/100.00
replace VMT_SHORT with VMT_SH/1000000.00/100.00
replace VMT_MEDIUM with VMT_MD/1000000.00/100.00
replace VMT_LONG with VMT_LN/1000000.00/100.00
replace AERODN with AD/AM*100
replace AXLRAT with AR/AM*100
replace ECOENG with ECO/AM*100
replace RADIAL with RAD/AM*100
replace GOVNOR with GOV/AM*100
replace VARFAN with VAR/AM*100
replace OTHFUEL with OTH/AM*100
select 2
use
select 1
use
quit
```

Table A-1. Heavy Duty Gasoline Vehicles Class 2B

	Total VMT (million miles)					Fuel Economy (mpg)					Average Weight (lbs)					Travel Fractions (%)				
MY	Local	Short	Med	Long	Total	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Total
92	56.19	16.65	5.74	5.71	84.29	10.0	11.3	11.9		10.4	9616	9393	9911		9620	66.663	19.751	6.808	6.779	100.001
91	71.12	73.57	8.96	0.00	153.65	9.4	7.8	10.0		8.7	9446	9060	9048		9250	46.288	47.883	5.829	0.000	100.000
90	201.56	79.95	22.04	4.14	307.69	10.0	9.7	6.7	9.9	9.7	9560	9654	9797	9494	9599	65.508	25.983	7.164	1.345	100.000
89	181.44	34.02	19.24	7.90	242.60	9.6	9.0	8.4	9.2	9.4	9584	8857	9269	9930	9483	74.789	14.025	7.930	3.256	100.000
88	298.38	71.39	108.85	0.46	479.08	9.6	9.5	10.0		9.7	9528	9505	9003		9406	62.282	14.901	22.721	0.096	100.000
87	275.44	83.20	48.24	1.88	408.76	9.8	7.8	9.7	18.0	9.4	9636	9496	9040	10000	9547	67.384	20.354	11.802	0.460	100.000
86	289.40	91.30	25.30	4.08	410.08	8.6	9.6	8.2	10.0	8.7	9666	9146	10000	10000	9598	70.570	22.264	6.170	0.996	100.000
85	287.06	186.38	20.90	16.60	510.94	8.7	8.8	8.3	15.0	9.0	9514	9382	9835	9146	9467	56.182	36.477	4.091	3.250	100.000
84	363.38	152.90	14.57	0.00	530.85	8.8	8.2	8.4		8.6	9484	9380	9636		9460	68.452	28.803	2.745	0.000	100.000
83	86.21	53.37	15.49	0.01	155.08	9.1	10.5	5.1		9.2	9549	9394	9000		9445	55.592	34.413	9.987	0.008	100.000

	Aerodynamic Devices (% usage)						DriveTrain Optimization (% usage)						Radial Tires (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	25	0	20		18	0	3	0	20		4	27	85	100	100		90	67
91	29	0	5		15	0	14	0	5		7	27	86	100	100		93	67
90	0	4	0	0	1	0	14	19	0	0	14	27	90	100	20	3	86	67
89	0	7	0	0	1	0	20	0	0	0	15	27	78	100	87	65	81	67
88	22	21	0		17	0	13	48	0		14	27	84	98	5		68	67
87	2	0	87	66	11	0	4	22	93	0	17	27	58	58	100	100	63	67
86	8	0	0	0	6	0	6	0	0	0	4	27	58	93	20	100	62	67
85	7	1	0	59	7	0	9	25	0	0	14	20	72	91	35	100	79	64
84	0	9	64		4	0	4	42	0		14	13	76	100	78		82	61
83	0	0	0		0	0	0	8	0		3	7	59	93	4		65	58

	Speed Control (% usage)						Fan Drives (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	0	0	0		7	13	1	0	0		1	0
91	0	0	0		0	13	14	0	0		7	0
90	0	16	0	0	4	13	17	16	0	97	17	0
89	1	0	0	0	1	13	6	2	13	35	7	0
88	2	31	0		5	13	26	67	0		25	0
87	15	7	6	0	13	13	2	25	6	66	7	0
86	6	0	0	0	5	13	6	4	46	0	8	0
85	3	42	0	0	17	10	4	9	91	0	9	0
84	1	21	0		6	6	23	32	0		25	0
83	0	0	0		0	3	23	0	0		13	0

Table A-2. Heavy-Duty Gasoline Vehicles Class 3

	Total VMT (million miles)					Fuel Economy (mpg)					Average Weight (lbs)					Travel Fractions (%)				
MY	Local	Short	Med	Long	Total	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Total
92	66.11	19.75	20.26	151.17	257.29	11.0	10.5			10.7	11615	11924			11660	25.694	7.675	7.874	58.757	100.000
91	204.29	30.26	34.74	1.25	270.54	9.0	8.1	8.4	9.2	8.9	11693	11966	11189	13636	11622	75.513	11.184	12.842	0.462	100.001
90	217.67	81.72	14.09	179.30	492.78	9.7	9.6		10.0	9.6	12171	11336		11500	11793	44.171	16.584	2.859	36.386	100.000
89	317.97	144.81	10.91	22.25	495.94	8.6	14.2	8.0	10.2	10.2	11901	11924	12500	11181	11882	64.114	29.199	2.200	4.487	100.000
88	743.61	94.58	98.83	0.01	937.03	9.0	6.8	11.0		8.8	12221	12938	12589		12360	79.359	10.093	10.547	0.001	100.000
87	197.57	55.34	41.06	12.23	306.20	9.0	9.2	9.0	10.1	9.1	11953	11168	12080	11963	11830	64.524	18.073	13.409	3.994	100.000
86	386.74	101.55	25.90	13.78	527.97	8.2	7.7	10.5	7.5	8.2	11840	12788	11666	12375	11991	73.250	19.233	4.906	2.611	100.000
85	331.62	57.60	0.71	4.19	394.12	8.2	9.1		9.7	8.3	12052	12175		13091	12078	84.144	14.614	0.179	1.063	100.000
84	266.58	42.44	24.03	4.27	337.32	8.7	8.6	5.0		8.4	11905	11944	13266		12031	79.031	12.581	7.123	1.266	100.001
83	33.54	52.29	40.99	48.67	175.49	9.9	6.4		6.3	7.1	12049	12402		11813	12093	19.114	29.796	23.356	27.734	100.000

	Aerodynamic Devices (% usage)						DriveTrain Optimization (% usage)						Radial Tires (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	33	0		0	8	0	29	41		0	10	27	84	100		100	96	67
91	6	0	0	0	5	0	10	0	27	82	12	27	93	100	100	100	95	67
90	0	31		0	5	0	14	5		1	7	27	95	88		100	96	67
89	2	2	80	0	3	0	10	5	100	88	13	27	67	96	80	94	76	67
88	4	2	0		3	0	7	2	4		7	27	43	76	91		51	67
87	3	48	0	0	10	0	9	8	0	0	7	27	92	100	100	100	95	67
86	5	4	0	0	5	0	1	8	10	0	3	27	81	84	100	100	83	67
85	0	0		0	0	0	1	29		0	4	20	63	80		96	66	64
84	3	22	0		5	0	3	22	0		5	13	68	43	64		65	61
83	0	0		0	0	0	18	22		0	10	7	36	42		0	48	58

	Speed Control (% usage)						Fan Drives (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	0	21		0	2	13	3	39		0	4	0
91	8	0	0	0	6	13	15	12	0	0	13	0
90	0	0		0	0	13	0	28		0	5	0
89	1	14	20	0	5	13	4	6	0	0	4	0
88	4	0	17		5	13	9	2	0		7	0
87	5	0	0	0	3	13	17	22	0	42	16	0
86	3	4	0	0	3	13	6	10	10	0	7	0
85	4	28		0	7	10	8	27		45	11	0
84	10	13	36		12	6	6	22	0		8	0
83	2	46		81	34	3	2	20		0	6	0

Table A-3. Heavy Duty Gasoline Vehicles Class 4

	Total VMT (million miles)					Fuel Economy (mpg)					Average Weight (lbs)					Travel Fractions (%)				
MY	Local	Short	Med	Long	Total	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Total
92	28.26	1.40	0.00	0.00	29.66	8.9				8.9	15243				15246	95.274	4.726	0.000	0.000	100.000
91	52.00	37.44	6.69	10.37	106.50	11.6	6.5		8.2	9.5	15755	15303		15115	15530	48.824	35.158	6.278	9.740	100.000
90	41.19	55.60	0.84	31.30	128.93	8.8	10.5			9.9	15365	14685			14907	31.945	43.126	0.652	24.277	100.000
89	66.04	33.64	2.55	0.13	102.36	9.1	9.2			9.0	15303	14785			15148	64.519	32.863	2.487	0.132	100.001
88	57.54	15.39	8.12	8.64	89.69	7.3	9.3		12.0	8.1	15082	15668		16000	15361	64.156	17.157	9.058	9.629	100.000
87	77.60	31.41	14.91	259.32	383.24	7.8	9.7		6.0	7.9	15358	15000		15038	15269	20.248	8.196	3.891	67.665	100.000
86	79.64	25.01	7.36	0.97	112.98	8.1	6.0			7.7	15505	14761		15000	15391	70.491	22.141	6.510	0.857	99.999
85	92.20	29.73	7.74	6.39	136.06	8.1	9.5		5.8	8.1	15454	15288		15154	15441	67.763	21.852	5.689	4.696	100.000
84	19.34	2.21	41.95	0.00	63.50	7.8	7.2			6.3	15440	15922			15417	30.460	3.478	66.061	0.000	99.999
83	53.83	10.44	0.00	6.99	71.26	6.2	7.7			6.5	15104	14653			15028	75.540	14.654	0.000	9.807	100.001

	Aerodynamic Devices (% usage)						DriveTrain Optimization (% usage)						Radial Tires (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	0				0	0	15				15	27	49				49	67
91	0	30		7	11	0	85	0		7	47	27	100	100		100	100	67
90	2	7			4	0	18	6			7	27	82	39			66	67
89	0	0			0	0	16	25			18	27	53	0			38	67
88	14	44		0	16	0	9	37		0	20	27	65	82		0	62	67
87	23	16		0	5	0	22	0		0	4	27	62	94		100	93	67
86	14	0			10	0	38	8			36	27	88	61			84	67
85	12	0		0	8	0	41	0		0	35	20	87	75		83	85	64
84	0	0			66	0	0	0			0	13	29	92			78	61
83	0	0			0	0	3	0			2	7	67	8			57	58

	Speed Control (% usage)						Fan Drives (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	0				0	13	7				7	0
91	5	0		44	7	13	0	70		0	24	0
90	6	1			2	13	20	0			5	0
89	19	0			13	13	11	0			7	0
88	11	18		0	18	13	0	59		0	18	0
87	24	16		2	6	13	16	16		0	3	0
86	0	11			10	13	14	11			19	0
85	44	28		0	42	10	6	0		0	10	0
84	9	0			3	6	0	0			0	0
83	12	67			21	3	0	4			1	0

Table A-4. Heavy-Duty Gasoline Vehicles Class 5

	Total VMT (million miles)					Fuel Economy (mpg)					Average Weight (lbs)					Travel Fractions (%)				
MY	Local	Short	Med	Long	Total	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Total
92	0.99	5.50	0.09	0.00	6.58	8.3	6.0			7.3	17575	18000			17755	15.088	83.596	1.316	0.000	100.000
91	32.49	9.92	0.21	10.50	53.12	7.0	12.4			7.6	17823	17149			17733	61.163	18.674	0.392	19.770	99.999
90	51.68	13.37	3.64	0.00	68.69	8.5				8.5	18383				18156	75.240	19.461	5.299	0.000	100.000
89	55.51	18.09	0.26	0.00	73.86	6.2	6.5			6.3	18273	18390			18298	75.160	24.495	0.345	0.000	100.000
88	39.59	22.15	0.00	0.00	61.74	6.7	8.2			7.2	17411	18000			17612	64.123	35.877	0.000	0.000	100.000
87	60.00	17.57	0.61	0.00	78.18	8.8	6.9			8.4	17298	17648			17365	76.743	22.473	0.784	0.000	100.000
86	101.20	35.62	7.93	0.09	144.84	6.9	8.4			7.3	17618	18588			17884	69.868	24.595	5.477	0.060	100.000
85	75.51	6.61	22.28	0.66	105.06	6.9	7.6			7.0	18207	17934			18157	71.872	6.289	21.211	0.628	100.000
84	68.39	14.36	0.42	0.03	83.20	8.4	7.4			8.2	18002	17610			17932	82.200	17.257	0.510	0.033	100.000
83	68.61	4.64	9.39	7.49	90.13	6.6	9.2			6.7	17716	18020			17649	76.124	5.151	10.419	8.306	100.000

	Aerodynamic Devices (% usage)						DriveTrain Optimization (% usage)						Radial Tires (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	0	0			0	7	73	0			13	27	0	84			70	14
91	0	0			0	7	24	0			15	27	30	100			57	14
90	1				6	7	37				35	27	49				58	14
89	25	0			20	7	14	0			11	27	34	67			41	14
88	0	0			0	7	38	0			25	27	71	100			81	14
87	18	0			15	7	39	43			40	27	70	54			67	14
86	7	0			5	7	7	0			5	27	45	77			54	14
85	0	0			0	6	3	0			3	20	39	31			31	14
84	3	0			2	6	21	73			30	13	74	46			69	14
83	35	0			27	5	27	0			20	7	34	4			36	14

	Speed Control (% usage)						Fan Drives (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	27	0			5	4	0	0			0	90
91	1	0			21	4	0	0			0	90
90	28				23	4	2				15	90
89	49	10			41	4	25	10			22	90
88	0	0			0	4	7	19			11	90
87	46	65			49	4	29	0			24	90
86	45	0			33	4	6	0			4	90
85	4	0			3	3	8	0			6	80
84	32	24			31	2	6	23			9	70
83	57	96			48	1	9	0			17	60

Table A-5. Heavy-Duty Gasoline Vehicles Class 6

	Total VMT (million miles)					Fuel Economy (mpg)					Average Weight (lbs)					Travel Fractions (%)				
MY	Local	Short	Med	Long	Total	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Total
92	20.01	10.19	0.00	0.19	30.39	8.1	6.8			7.6	20455	20357			20421	65.829	33.532	0.000	0.639	100.000
91	31.98	1.92	0.30	0.00	34.20	8.9	4.8			8.8	24320	25886			24339	93.498	5.620	0.881	0.000	99.999
90	114.23	34.75	0.05	0.00	149.03	7.1	9.5			7.7	21381	22409			21620	76.648	23.318	0.035	0.000	100.001
89	93.89	13.06	0.57	1.35	108.87	7.2	4.8			6.9	23098	22233			23039	86.239	11.997	0.523	1.241	100.000
88	61.15	37.12	3.85	0.01	102.13	8.3	6.7			7.9	22592	20359			21888	59.877	36.349	3.768	0.007	100.001
87	135.81	11.68	3.24	0.21	150.94	6.9	5.3	6.3		6.8	22685	21200	25355		22664	89.975	7.739	2.146	0.140	100.000
86	138.11	41.93	13.88	2.63	196.55	7.3	7.7		7.5	7.5	21750	21421		22912	21843	70.264	21.334	7.063	1.339	100.000
85	139.51	11.35	0.13	0.14	151.13	7.3	7.5			7.3	22522	21649			22476	92.307	7.511	0.087	0.095	100.000
84	98.63	26.80	1.51	147.85	274.79	7.1	7.1		7.3	7.2	22626	22087		21798	22132	35.891	9.753	0.551	53.805	100.000
83	63.37	33.14	7.03	0.00	103.54	6.9	4.5			6.3	22324	25950			23176	61.204	32.009	6.787	0.000	100.000

	Aerodynamic Devices (% usage)						DriveTrain Optimization (% usage)						Radial Tires (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	24	0			16	7	1	91			30	27	83	100			88	14
91	45	0			44	7	12	77			13	27	90	23			90	14
90	0	53			12	7	15	53			24	27	72	98			78	14
89	4	0			4	7	32	0			28	27	73	0			66	14
88	18	0			11	7	42	48			43	27	75	66			72	14
87	2	0	0		2	7	12	0	0		11	27	31	100	35		35	14
86	3	0		0	8	7	25	13		73	27	27	58	86		100	66	14
85	0	0			0	6	5	5			5	20	50	55			50	14
84	0	0		0	0	6	19	2		0	7	13	36	41		100	71	14
83	2	0			1	5	6	0			4	7	11	100			42	14

	Speed Control (% usage)						Fan Drives (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	13	91			38	4	0	0			0	90
91	11	23			11	4	8	23			8	90
90	20	78			33	4	11	0			8	90
89	12	77			20	4	5	0			4	90
88	29	9			21	4	9	0			6	90
87	32	3	0		30	4	6	0	0		6	90
86	46	31		0	45	4	9	0		0	12	90
85	20	72			23	3	1	0			1	80
84	34	14		2	15	2	7	22		0	4	70
83	14	97			36	1	6	0			4	60

Table A-6. Heavy-Duty Gasoline Vehicles Class 7

	Total VMT (million miles)					Fuel Economy (mpg)					Average Weight (lbs)					Travel Fractions (%)				
MY	Local	Short	Med	Long	Total	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Total
92	8.68	0.99	5.86	0.00	15.53	11.8				13.8	27934				28148	55.873	6.379	37.748	0.000	100.000
91	28.70	4.26	0.47	0.00	33.43	7.7				7.7	29899				29899	85.866	12.733	1.401	0.000	100.000
90	8.90	0.68	0.02	0.00	9.60	7.9				7.7	28859				28747	92.727	7.052	0.221	0.000	100.000
89	33.09	5.49	0.03	1.94	40.55	6.0	3.5		6.4	5.7	29390	28963		30511	29384	81.598	13.530	0.083	4.789	100.000
88	35.74	15.13	7.68	0.00	58.55	5.9	10.5			7.7	29305	27794			28735	61.041	25.834	13.125	0.000	100.000
87	60.75	4.27	0.04	8.32	73.38	6.3				6.1	28915				28824	82.802	5.814	0.048	11.336	100.000
86	48.71	5.32	28.52	0.97	83.52	7.6	4.0	5.3		6.6	28914	28000	30000		29237	58.333	6.366	34.146	1.156	100.001
85	65.04	4.72	2.78	0.00	72.54	6.9	4.8	4.8		6.7	29285	28005	31993		29312	89.659	6.513	3.828	0.000	100.000
84	36.85	2.09	0.00	0.00	38.94	5.5	13.3			6.0	28751	28358			28728	94.644	5.356	0.000	0.000	100.000
83	13.00	4.07	0.00	0.08	17.15	7.2	8.7			7.6	28889	28579			28814	75.776	23.750	0.000	0.474	100.000

	Aerodynamic Devices (% usage)						DriveTrain Optimization (% usage)						Radial Tires (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	44				27	7	0				38	27	100				100	14
91	0				0	7	3				3	27	92				92	14
90	29				27	7	17				16	27	87				88	14
89	3	0		38	4	7	32	0		38	28	27	64	0		100	57	14
88	7	0			17	7	39	0			37	27	26	100			55	14
87	0				0	7	22				30	27	41				36	14
86	0	0	56		19	7	22	0	0		13	27	48	0	56		48	14
85	20	0	0		18	6	25	8	0		23	20	66	92	100		68	14
84	0	0			0	6	0	0			0	13	73	80			73	14
83	0	0			0	5	1	0			1	7	99	87			96	14

	Speed Control (% usage)						Fan Drives (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	0				0	4	0				0	90
91	10				10	4	0				0	90
90	18				17	4	13				12	90
89	59	21		34	52	4	8	28		38	12	90
88	18	0			24	4	3	0			15	90
87	29				38	4	16				25	90
86	37	0	44		38	4	23	0	0		14	90
85	47	8	0		44	3	30	0	0		27	80
84	20	20			20	2	3	4			3	70
83	1	53			14	1	0	0			0	60

Table 7. Heavy-Duty Gasoline Vehicles Class 8A

	Total VMT (million miles)					Fuel Economy (mpg)					Average Weight (lbs)					Travel Fractions (%)				
MY	Local	Short	Med	Long	Total	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Total
92	2.45	9.65	0.00	0.00	12.10	6.3				6.3	39343	37816			38126	20.261	79.739	0.000	0.000	100.000
91	3.03	3.11	0.70	3.96	10.80	12.1			6.2	7.8	38164			35000	40272	28.035	28.767	6.479	36.718	99.999
90	10.98	0.49	0.17	0.00	11.64	7.2				7.2	37235				37235	94.321	4.210	1.469	0.000	100.000
89	5.97	0.21	0.09	0.00	6.27	5.1				5.1	42006				42135	95.203	3.381	1.416	0.000	100.000
88	23.28	3.85	0.00	0.00	27.13	5.8				5.6	36059				35771	85.820	14.180	0.000	0.000	100.000
87	23.92	0.40	0.29	0.00	24.61	8.5				8.5	37461				37461	97.205	1.626	1.168	0.000	99.999
86	22.74	1.11	0.00	0.00	23.85	6.1	12.4			6.4	44328	48339			44524	95.349	4.651	0.000	0.000	100.000
85	12.13	10.27	0.00	0.00	22.40	6.4				5.8	41427				41662	54.148	45.852	0.000	0.000	100.000
84	4.16	2.71	4.46	0.00	11.33	7.2	4.2			8.5	40583	39324			40870	36.729	23.928	39.343	0.000	100.000
83	11.89	0.01	3.01	0.00	14.91	4.6				4.5	42355				42285	79.747	0.053	20.199	0.000	99.999

	Aerodynamic Devices (% usage)						DriveTrain Optimization (% usage)						Radial Tires (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	0	0			0	7	0	0			0	27	88	100			98	14
91	18			100	73	7	82			100	71	27	18			100	75	14
90	9				9	7	42				42	27	10				10	14
89	11				11	7	11				11	27	100				98	14
88	0				0	7	0				0	27	83				85	14
87	0				0	7	4				4	27	16				16	14
86	0	8			0	7	39	0			37	27	39	67			40	14
85	0				0	6	0				0	20	25				56	14
84	4	0			2	6	4	6			41	13	0	34			7	14
83	0				0	5	21				17	7	64				71	14

	Speed Control (% usage)						Fan Drives (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	0	0			0	4	0	0			0	90
91	18			0	29	4	0			100	46	90
90	52				52	4	9				9	90
89	82				80	4	7				7	90
88	2				16	4	0				14	90
87	78				78	4	5				5	90
86	67	33			65	4	0	8			0	90
85	2				1	3	1				0	80
84	4	72			16	2	5	21			44	70
83	8				26	1	6				5	60

Table A-8. Heavy-duty Diesel Vehicles Class 2B

	Total VMT (million miles)					Fuel Economy (mpg)					Average Weight (lbs)					Travel Fractions (%)				
MY	Local	Short	Med	Long	Total	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Total
92	119.63	46.04	7.44	8.12	181.23	12.5	12.3	13.5	10.6	12.4	9458	9791	8814	10000	9542	66.008	25.406	4.105	4.480	99.999
91	64.43	33.89	9.29	9.23	116.84	10.6	15.6	9.5	13.4	12.0	9617	9503	10000	9897	9642	55.144	29.004	7.952	7.900	100.000
90	179.13	107.11	28.65	15.07	329.96	10.9	12.4	13.6		11.6	9537	9632	9313		9563	54.287	32.461	8.684	4.568	100.000
89	144.88	81.41	6.01	4.16	236.46	11.9	13.0	13.2		12.4	9491	9464	10000		9486	61.270	34.429	2.541	1.760	100.000
88	109.61	87.95	62.49	22.33	282.38	13.8	10.5	10.1	12.3	11.8	9571	9661	9815	9582	9655	38.818	31.146	22.129	7.907	100.000
87	69.80	128.16	3.64	0.00	201.60	13.1	10.8			11.7	9675	9697			9690	34.624	63.572	1.804	0.000	100.000
86	198.46	46.13	27.39	0.13	272.11	11.6	12.4	16.4		12.2	9451	9523	9860		9502	72.935	16.952	10.066	0.048	100.001
85	49.53	11.38	7.97	17.97	86.85	12.3	10.0			11.3	9631	10000		10000	9782	57.029	13.105	9.176	20.690	100.000
84	48.13	4.76	11.37	6.98	71.24	13.8	7.9	15.0	9.2	13.2	9798	9908	9008	9825	9680	67.559	6.686	15.962	9.793	100.000
83	38.68	37.29	2.92	0.03	78.92	10.4	11.4			10.8	9643	9551			9594	49.011	47.251	3.706	0.032	100.000

	Aerodynamic Devices (% usage)						DriveTrain Optimization (% usage)						Radial Tires (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	5	41	88	0	17	0	16	52	91	0	27	27	58	78	100	95	66	67
91	4	0	0	0	2	0	13	9	100	0	19	27	80	92	100	79	85	67
90	6	10	51		10	0	30	10	51		29	27	76	87	100		83	67
89	1	3	0		3	0	7	23	0		13	27	75	83	70		78	67
88	1	29	23	0	15	0	37	42	58	0	41	27	82	70	65	100	76	67
87	12	0			5	0	16	4			8	27	83	83			82	67
86	1	25	0		5	0	7	20	0		9	27	85	66	90		83	67
85	0	0			0	0	30	18			20	20	61	45			61	64
84	8	0	0	0	6	0	8	0	0	0	6	13	49	91	100	100	64	61
83	0	0			0	0	0	27			13	7	44	57			52	58

	Speed Control (% usage)						Fan Drives (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	18	7	88	0	17	13	4	8	0	95	9	0
91	7	55	40	24	24	13	8	55	23	0	21	0
90	33	9	49		25	13	26	11	51		22	0
89	21	20	0		19	13	3	9	70		6	0
88	54	4	43	17	33	13	14	7	14	0	11	0
87	17	30			25	13	8	70			47	0
86	17	44	0		20	13	8	20	78		17	0
85	0	45			5	10	27	0			36	0
84	8	91	99	13	26	6	18	0	0	87	21	0
83	38	57			46	3	29	27			27	0

Table A-9. Heavy-Duty Diesel Vehicles Class 3

	Total VMT (million miles)					Fuel Economy (mpg)					Average Weight (lbs)					Travel Fractions (%)				
MY	Local	Short	Med	Long	Total	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Total
92	202.96	167.60	47.77	181.12	599.45	12.9	10.4	12.5	9.5	11.1	11840	12919	12253	11151	11959	33.859	27.959	7.969	30.214	100.001
91	149.50	79.85	60.75	38.95	329.05	11.5	11.6	9.9	11.1	11.2	12570	12178	13233	11492	12454	45.432	24.267	18.463	11.837	99.999
90	295.52	199.16	52.50	89.25	636.43	12.0	11.3	11.5	10.9	11.6	12462	11840	12316	11489	12121	46.434	31.293	8.250	14.023	100.000
89	328.51	234.86	23.45	86.04	672.86	11.5	9.1	9.1	13.5	10.6	12108	12843	13024	11338	12369	48.822	34.905	3.486	12.788	100.001
88	165.52	71.00	23.87	26.99	287.38	13.1	11.3	6.5	10.3	11.8	12340	12171	12744	12656	12362	57.596	24.705	8.306	9.393	100.000
87	186.79	154.17	20.04	0.47	361.47	10.7	10.3	12.0		10.6	12001	11319	12150		11730	51.674	42.652	5.543	0.131	100.000
86	321.20	129.42	68.76	26.41	545.79	13.7	9.6	7.9	9.7	11.9	12211	13407	11200	13000	12384	58.851	23.712	12.597	4.839	99.999
85	85.06	64.82	13.78	1.75	165.41	11.2	10.6	12.4		11.0	12292	12310	12000		12280	51.425	39.185	8.333	1.057	100.000
84	63.70	26.18	6.30	1.66	97.84	9.8	9.3		12.1	9.6	12393	12146		13000	12276	65.107	26.756	6.439	1.698	100.000
83	47.41	4.48	2.99	1.29	56.17	9.4	14.7	8.5		9.8	13789	11778	11198		13468	84.411	7.980	5.320	2.289	100.000

	Aerodynamic Devices (% usage)						DriveTrain Optimization (% usage)						Radial Tires (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	10	4	0	3	5	0	29	26	0	22	24	27	62	71	84	84	73	67
91	28	22	69	15	32	0	39	30	69	94	48	27	84	93	100	100	90	67
90	26	34	1	19	25	0	31	19	6	94	34	27	75	72	100	100	80	67
89	4	29	20	0	12	0	21	61	20	14	33	27	88	71	66	99	83	67
88	7	0	0	0	4	0	10	14	0	6	10	27	81	64	72	100	78	67
87	8	68	58		36	0	21	12	32		18	27	66	93	79		78	67
86	2	2	0	0	2	0	4	5	0	0	3	27	92	93	68	3	85	67
85	1	11	0		5	0	35	19	65		30	20	91	94	100		93	64
84	0	3		0	1	0	0	0		0	0	13	65	100		100	78	61
83	7	0	0		6	0	26	0	0		22	7	40	81	100		47	58

	Speed Control (% usage)						Fan Drives (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	16	34	45	7	20	13	15	15	9	0	10	0
91	34	40	0	0	26	13	32	25	0	15	23	0
90	38	46	85	2	40	13	27	24	10	19	23	0
89	25	17	29	0	19	13	25	9	17	2	17	0
88	22	17	68	6	23	13	16	1	0	0	10	0
87	20	35	95		31	13	5	34	32		18	0
86	8	79	14	0	25	13	7	0	14	0	6	0
85	19	11	65		19	10	13	40	65		27	0
84	23	5		49	17	6	20	0		49	20	0
83	26	0	100		28	3	0	0	0		0	0

Table A-10. Heavy-Duty Diesel Vehicles Class 4

	Total VMT (million miles)					Fuel Economy (mpg)					Average Weight (lbs)					Travel Fractions (%)				
MY	Local	Short	Med	Long	Total	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Total
92	34.22	81.94	2.09	14.81	133.06	9.9	9.9		9.5	9.9	15069	15006		14250	15014	25.717	61.584	1.568	11.131	100.000
91	82.39	24.28	9.54	23.92	140.13	11.6	10.2	9.1		12.9	15077	15544	15780		15339	58.797	17.328	6.807	17.069	100.001
90	141.20	79.55	40.76	18.39	279.90	9.9	11.2	8.1	11.2	10.1	15035	14933	15170	15032	15027	50.447	28.420	14.563	6.570	100.000
89	67.34	109.48	3.63	7.45	187.90	11.1	9.6		16.0	10.4	15349	14891		16000	15105	35.838	58.266	1.930	3.965	99.999
88	141.63	76.79	9.71	24.23	252.36	8.4	11.4	7.9	8.7	9.7	15033	14551	15075	15366	14883	56.124	30.428	3.847	9.601	100.000
87	75.72	28.04	8.75	9.15	121.66	9.8	8.9	5.7	11.4	9.5	15498	15111	15000	14853	15334	62.238	23.045	7.195	7.522	100.000
86	39.26	85.34	12.78	1.14	138.52	9.3	8.8			9.0	15313	15590			15461	28.343	61.609	9.223	0.825	100.000
85	44.44	16.64	0.34	11.82	73.24	8.2	9.0		7.9	8.3	15217	14659		15536	15168	60.681	22.722	0.465	16.133	100.001
84	39.97	44.57	31.96	0.08	116.58	7.0	7.0	4.7		6.4	15459	14732	15076		15065	34.286	38.236	27.413	0.065	100.000
83	31.85	4.36	0.07	0.00	36.28	8.3	4.5			8.1	15285	15133			15272	87.782	12.014	0.204	0.000	100.000

	Aerodynamic Devices (% usage)						DriveTrain Optimization (% usage)						Radial Tires (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	6	11		0	9	0	27	33		0	28	27	78	76		100	79	67
91	4	75	16		11	0	4	7	78		9	27	87	100	94		91	67
90	5	83	3	0	25	0	20	42	99	6	36	27	36	100	73	100	62	67
89	22	0		0	8	0	27	27		100	31	27	80	73		100	77	67
88	6	0	0	73	9	0	15	0	0	78	15	27	67	99	100	78	78	67
87	0	15	0	0	3	0	18	39	0	0	20	27	51	97	14	100	62	67
86	19	21			18	0	10	35			24	27	90	88			81	67
85	23	0		0	15	0	40	0		0	26	20	36	28		100	45	64
84	0	0	0		0	0	2	0	0		1	13	23	6	10		13	61
83	2	0			2	0	0	0			0	7	58	87			61	58

	Speed Control (% usage)						Fan Drives (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	12	32		0	23	13	41	14		11	21	0
91	4	0	78		27	13	0	0	78		5	0
90	7	47	28	0	20	13	12	42	72	94	34	0
89	28	0		0	10	13	17	27		100	27	0
88	16	2	0	73	16	13	4	0	8	22	4	0
87	19	30	6	0	19	13	16	16	0	0	13	0
86	33	27			26	13	20	39			29	0
85	45	0		0	29	10	37	0		0	24	0
84	37	3	2		14	6	5	0	2		2	0
83	23	87			29	3	0	0			0	0

Table A-11. Heavy-Duty Diesel Vehicles Class 5

	Total VMT (million miles)					Fuel Economy (mpg)					Average Weight (lbs)					Travel Fractions (%)				
MY	Local	Short	Med	Long	Total	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Total
92	108.33	18.16	0.19	72.11	198.79	9.5			9.2	9.7	17392			18625	17795	54.498	9.134	0.093	36.275	100.000
91	125.81	73.72	26.18	80.35	306.06	8.9		10.6	10.0	9.4	17574		17327	17263	17537	41.105	24.088	8.555	26.253	100.001
90	189.90	54.99	12.47	43.57	300.93	9.3		11.9	10.2	9.2	17644		18010	17293	17693	63.104	18.273	4.144	14.479	100.000
89	123.10	65.49	9.36	21.25	219.20	11.8		7.9	10.8	10.7	18162		18779	18867	18096	56.159	29.876	4.270	9.696	100.001
88	112.16	19.54	36.63	29.08	197.41	10.0		9.2	10.1	9.9	18316		17892	17975	18146	56.816	9.896	18.557	14.731	100.000
87	89.06	23.10	16.28	11.59	140.03	8.5		11.9	7.5	9.2	17958		17213	18194	17920	63.601	16.495	11.629	8.275	100.000
86	89.83	42.00	21.89	12.26	165.98	9.0		7.6	4.5	8.4	17851		17524	17565	17778	54.123	25.302	13.189	7.386	100.000
85	83.70	27.08	25.33	16.88	152.99	9.5		10.4	10.7	9.9	17779		17141	18819	17709	54.712	17.701	16.554	11.033	100.000
84	64.96	13.04	0.05	6.76	84.81	7.4			9.2	8.1	18210			16800	18136	76.587	15.380	0.064	7.969	100.000
83	52.29	12.35	24.76	1.82	91.22	7.4		8.1		7.6	17197		18185		17575	57.319	13.542	27.142	1.997	100.000

	Aerodynamic Devices (% usage)						DriveTrain Optimization (% usage)						Radial Tires (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	2	86		20	16	7	37	92		63	51	27	81	92		100	89	14
91	9	2	31	9	9	7	34	0	4	89	39	27	98	76	100	89	91	14
90	9	37	0	14	15	7	34	17	0	61	33	27	100	91	100	100	98	14
89	10	7	0	13	9	7	16	27	44	87	27	27	95	46	100	100	81	14
88	8	0	9	2	6	7	26	0	0	0	16	27	62	44	100	77	70	14
87	5	0	0	43	6	7	24	0	1	69	22	27	44	93	76	69	57	14
86	4	0	0	0	2	7	17	6	76	0	21	27	88	23	81	38	68	14
85	0	14	0	0	2	6	34	50	0	14	29	20	87	85	5	100	76	14
84	15	6		0	12	6	15	0		74	18	13	88	83		27	83	14
83	0	8	0		1	5	1	0	3		2	7	28	100	100		55	14

	Speed Control (% Penetration)						Fan Drives (% Penetration)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	77	6		18	49	4	30	86		20	31	90
91	29	39	2	0	22	4	13	76	2	0	24	90
90	3	8	0	14	5	4	10	26	0	36	16	90
89	33	3	44	13	23	4	31	7	0	0	20	90
88	31	86	0	0	25	4	54	0	53	0	42	90
87	25	13	0	31	20	4	28	0	3	43	22	90
86	27	23	0	0	21	4	16	0	0	38	12	90
85	42	54	5	82	43	3	8	4	0	68	13	80
84	31	77		73	41	2	2	0		0	1	70
83	22	0	3		15	1	1	66	0		7	60

Table A-12. Heavy-Duty Diesel Vehicles Class 6

	Total VMT (million miles)					Fuel Economy (mpg)					Average Weight (lbs)					Travel Fractions (%)				
MY	Local	Short	Med	Long	Total	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Total
92	114.13	37.83	106.97	89.35	348.28	7.9	10.3	8.1	8.3	8.3	23533	22788	21860	22212	22587	32.769	10.862	30.714	25.655	100.000
91	305.30	146.70	134.02	110.71	696.73	7.8	8.0	9.4	8.4	8.2	22675	23459	23297	23881	23146	43.819	21.056	19.235	15.890	100.000
90	258.07	204.93	45.55	98.85	607.40	8.1	7.7	8.1	8.8	8.1	22047	23513	21513	22536	22595	42.487	33.739	7.499	16.274	99.999
89	245.80	216.89	40.60	58.96	562.25	8.2	8.9	7.5	11.8	8.8	23194	22610	23919	24590	23163	43.718	38.575	7.221	10.487	100.001
88	356.96	133.85	70.56	63.74	625.11	8.8	9.3	8.6	8.7	8.9	23117	22828	22466	24456	23131	57.103	21.412	11.288	10.196	99.999
87	283.78	150.81	56.97	62.73	554.29	7.9	8.5	8.9	8.8	8.3	22580	22938	24194	24242	23025	51.197	27.207	10.278	11.317	99.999
86	345.20	272.40	80.85	26.00	724.45	7.6	8.8	8.0	7.2	8.1	22513	22114	21512	23534	22291	47.650	37.601	11.160	3.589	100.000
85	340.51	149.33	76.17	38.91	604.92	7.6	8.2	7.2	6.1	7.6	22958	23022	25292	21933	23253	56.290	24.686	12.592	6.432	100.000
84	296.21	235.79	80.73	16.89	629.62	8.1	7.9	8.6	5.0	8.0	23370	22511	23970	23479	23145	47.046	37.449	12.822	2.682	99.999
83	84.86	33.40	13.11	8.02	139.39	9.1	6.7	6.3	5.5	8.0	22256	25125	25019	20973	23109	60.877	23.961	9.405	5.757	100.000

	Aerodynamic Devices (% usage)						DriveTrain Optimization (% usage)						Radial Tires (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	13	8	6	32	16	7	16	33	8	45	23	27	72	100	86	91	84	14
91	8	24	19	78	25	7	17	39	35	95	38	27	65	92	99	100	83	14
90	28	13	6	5	18	7	44	63	39	25	47	27	75	92	71	85	82	14
89	24	11	9	19	17	7	31	22	43	2	25	27	72	90	100	100	84	14
88	3	7	5	7	5	7	26	11	24	7	21	27	82	88	73	75	81	14
87	14	28	9	0	15	7	31	16	49	0	26	27	72	82	97	92	79	14
86	8	3	8	38	7	7	15	11	15	34	14	27	73	87	95	51	80	14
85	6	1	65	67	16	6	16	15	11	54	17	20	62	64	100	79	69	14
84	1	8	9	10	5	6	11	9	22	26	12	13	73	86	87	80	79	14
83	1	0	0	19	1	5	2	11	98	0	12	7	76	22	98	100	66	14

	Speed Control (% usage)						Fan Drives (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	33	31	55	23	37	4	31	47	18	45	32	90
91	36	28	51	43	38	4	36	49	23	54	39	90
90	45	37	29	21	37	4	44	55	6	18	41	90
89	32	41	63	39	39	4	32	10	35	18	22	90
88	33	13	41	14	28	4	35	4	29	8	26	90
87	36	41	92	23	42	4	22	13	17	2	17	90
86	19	33	93	15	32	4	21	18	4	37	19	90
85	25	16	11	13	21	3	26	30	11	15	24	80
84	37	59	3	13	40	2	18	33	9	8	22	70
83	40	73	98	95	56	1	7	2	0	95	10	60

Table A-13. Heavy-Duty Diesel Vehicles Class 7

	Total VMT (million miles)					Fuel Economy (mpg)					Average Weight (lbs)					Travel Fractions (%)				
MY	Local	Short	Med	Long	Total	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Total
92	97.07	154.94	30.21	192.84	475.06	7.9	7.2	8.0	7.5	7.5	30307	28747	27996	30672	29837	20.433	32.615	6.360	40.592	100.000
91	158.69	58.76	33.68	123.02	374.15	7.9	8.0	6.5	6.5	7.3	29557	29071	31633	30436	29955	42.413	15.704	9.003	32.879	99.999
90	201.51	73.90	135.06	145.98	556.45	7.3	6.7	8.5	6.8	7.4	30146	30298	28515	31101	29994	36.213	13.281	24.272	26.234	100.000
89	177.12	101.31	33.56	158.02	470.01	7.1	7.8	7.7	6.9	7.2	30661	28879	29740	30071	30025	37.683	21.556	7.140	33.621	100.000
88	319.51	154.35	60.34	125.86	660.06	8.9	7.3	8.0	6.3	8.0	30420	29881	29182	30023	30132	48.406	23.384	9.141	19.068	99.999
87	292.60	156.28	91.34	44.94	585.16	7.8	8.1	6.4	7.1	7.6	29966	29067	29717	30594	29744	50.004	26.708	15.609	7.679	100.000
86	256.23	144.22	16.90	103.81	521.16	7.6	7.3	5.9	6.6	7.3	29836	29015	30651	29650	29583	49.166	27.673	3.242	19.919	100.000
85	239.77	133.39	37.51	90.31	500.98	7.2	10.0	5.9	6.4	7.7	30525	28993	29302	29473	29865	47.859	26.626	7.488	18.027	100.000
84	256.74	76.02	36.22	68.32	437.30	7.3	7.6	6.4	5.9	7.0	29662	30389	30240	29796	29836	58.710	17.385	8.282	15.624	100.001
83	97.32	23.97	12.63	54.65	188.57	6.6	6.6	5.2	4.6	5.9	29253	31104	30839	31836	30314	51.608	12.709	6.699	28.984	100.000

	Aerodynamic Devices (% usage)						DriveTrain Optimization (% usage)						Radial Tires (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	26	14	7	46	30	7	40	48	47	55	49	27	87	62	100	77	75	14
91	26	17	24	57	35	7	37	65	19	26	36	27	75	94	74	100	86	14
90	30	17	33	65	39	7	27	37	60	63	47	27	84	98	100	85	90	14
89	14	3	17	51	24	7	22	33	29	37	30	27	81	97	99	80	85	14
88	4	14	14	49	16	7	15	38	60	44	29	27	83	68	95	93	83	14
87	6	19	52	61	21	7	19	45	16	49	28	27	76	70	75	93	76	14
86	21	3	42	65	25	7	19	20	0	46	24	27	72	79	95	100	80	14
85	5	5	46	12	9	6	54	15	65	13	37	20	84	95	99	53	82	14
84	8	7	38	23	13	6	14	13	39	27	18	13	84	90	87	83	85	14
83	1	0	27	8	5	5	10	0	1	8	7	7	51	100	100	18	50	14

	Speed Control (% Penetration)						Fan Drives (% Penetration)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	28	40	11	38	36	4	39	23	43	62	43	90
91	36	67	19	24	35	4	32	32	62	19	30	90
90	23	36	83	39	44	4	28	69	37	66	45	90
89	33	47	1	25	31	4	24	31	31	43	33	90
88	14	37	24	43	25	4	25	29	48	43	31	90
87	23	41	56	48	35	4	15	48	33	36	28	90
86	52	35	6	50	46	4	19	10	5	70	26	90
85	28	84	19	6	37	3	59	77	54	31	58	80
84	23	35	42	35	28	2	19	12	34	56	25	70
83	22	91	6	4	24	1	8	0	31	25	14	60

Table A-14. Heavy-Duty Diesel Vehicles Class 8A

	Total VMT (million miles)					Fuel Economy (mpg)					Average Weight (lbs)					Travel Fractions (%)				
MY	Local	Short	Med	Long	Total	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Total
92	259.60	229.35	184.99	1651.38	2325.32	5.7	6.5	6.8	6.2	6.2	48657	49922	47803	51876	51054	11.164	9.863	7.956	71.017	100.000
91	459.87	235.57	312.95	1450.57	2458.96	6.6	6.0	6.9	6.2	6.4	48179	48562	47890	50870	49790	18.702	9.580	12.727	58.991	100.000
90	758.70	376.24	187.91	2142.29	3465.14	6.2	6.0	6.4	6.0	6.1	45746	46805	49339	51323	49544	21.895	10.858	5.423	61.824	100.000
89	654.51	218.46	247.22	2322.66	3442.85	5.7	5.8	6.3	6.0	5.9	48711	49991	50889	49565	49503	19.011	6.345	7.181	67.463	100.000
88	678.28	261.95	248.72	1837.51	3026.46	6.2	6.0	6.6	6.0	6.1	48256	46550	49679	49798	49168	22.412	8.655	8.218	60.715	100.000
87	739.57	369.69	267.94	1305.78	2682.98	6.0	6.1	6.4	6.1	6.1	48152	46481	46712	47465	47459	27.565	13.779	9.987	48.669	100.000
86	641.48	286.46	316.88	1226.69	2471.51	6.2	6.0	6.0	5.9	6.0	48057	47437	47078	48991	48353	25.955	11.591	12.821	49.633	100.000
85	607.61	288.81	414.96	1067.65	2379.03	6.1	6.3	5.9	5.7	5.9	47276	46391	43691	49111	47412	25.540	12.140	17.442	44.877	99.999
84	611.44	276.24	235.21	979.30	2102.19	5.6	6.1	5.5	5.7	5.7	47361	47141	47108	47925	47574	29.086	13.141	11.189	46.585	100.001
83	292.06	145.12	68.19	228.47	733.84	5.3	5.7	6.1	5.5	5.5	45750	43497	46912	51320	47202	39.798	19.776	9.292	31.133	99.999

	Aerodynamic Devices (% usage)						DriveTrain Optimization (% usage)						Radial Tires (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	42	42	41	80	70	7	48	50	83	78	73	27	85	85	86	89	88	14
91	23	41	64	82	65	7	36	34	48	76	62	27	89	80	97	89	89	14
90	24	25	73	79	61	7	27	31	58	69	55	27	85	87	98	94	92	14
89	11	17	49	63	49	7	23	34	69	64	55	27	78	84	89	88	86	14
88	10	29	53	69	52	7	26	36	47	58	48	27	77	87	80	86	84	14
87	20	15	33	60	41	7	36	32	33	49	42	27	83	89	95	84	85	14
86	11	29	38	51	37	7	21	43	56	51	43	27	76	90	94	92	88	14
85	13	26	25	54	35	6	27	18	61	47	41	20	78	90	87	84	84	14
84	4	20	28	61	35	6	22	26	25	61	41	13	82	87	96	91	88	14
83	9	34	40	28	22	5	27	44	42	29	32	7	75	88	97	95	86	14

	Speed Control (% Penetration)						Fan Drives (% Penetration)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	50	48	65	73	68	4	48	44	70	75	69	90
91	46	52	61	67	61	4	48	51	79	72	66	90
90	42	36	46	67	58	4	38	48	68	69	60	90
89	34	40	34	50	46	4	45	52	71	71	65	90
88	41	45	19	43	41	4	42	53	59	62	57	90
87	36	41	56	36	39	4	41	52	49	57	51	90
86	38	36	35	43	40	4	40	50	69	67	58	90
85	37	37	19	36	33	3	40	41	72	49	49	80
84	34	58	24	46	42	2	34	38	41	63	49	70
83	44	56	49	36	44	1	32	34	65	42	38	60

Table A-15. Heavy-Duty Diesel Vehicles Class 8B

	Total VMT (millions of vehicle miles)					Fuel Economy (mpg)					Average Weight (lbs)					Travel Fractions (%)				
MY	Local	Short	Med	Long	Total	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Ave	Local	Short	Med	Long	Total
92	194.63	439.95	649.36	8188.38	9472.32	5.9	6.0	6.0	6.0	6.0	81820	81058	78677	74555	75173	2.055	4.645	6.855	86.445	100.000
91	381.69	542.67	694.46	6686.13	8304.95	5.4	5.7	6.1	5.9	5.9	76735	81164	78803	75293	75960	4.596	6.534	8.362	80.508	100.000
90	544.32	625.62	737.69	7237.08	9144.71	5.9	5.5	5.8	5.8	5.8	79391	80396	78654	75238	76028	5.952	6.841	8.067	79.140	100.000
89	589.13	711.01	946.72	8146.60	10393.46	5.4	5.7	5.6	5.7	5.7	76554	78683	79713	74549	75324	5.668	6.841	9.109	78.382	100.000
88	704.37	698.81	675.46	5475.33	7553.97	5.5	5.3	5.6	5.6	5.5	75823	80547	78529	75563	76234	9.325	9.251	8.942	72.483	100.001
87	651.83	764.43	681.17	4148.53	6245.96	6.0	5.3	5.4	5.5	5.5	75681	79375	76625	74961	75716	10.436	12.239	10.906	66.419	100.000
86	463.59	613.74	519.17	2845.66	4442.16	5.5	5.6	5.7	5.4	5.5	77097	78203	77148	75726	76361	10.436	13.816	11.687	64.060	99.999
85	479.00	475.28	538.21	2812.09	4304.58	5.1	5.5	5.4	5.3	5.3	75689	77984	75349	75258	75608	11.128	11.041	12.503	65.328	100.000
84	609.88	581.40	471.89	2433.14	4096.31	5.6	5.2	5.4	5.3	5.3	74808	79700	77984	75385	76148	14.889	14.193	11.520	59.398	100.000
83	164.96	343.66	256.58	789.57	1554.77	5.2	5.3	5.4	5.2	5.2	75169	78371	77387	75066	76161	10.610	22.104	16.503	50.784	100.001

	Aerodynamic Devices (% usage)						DriveTrain Optimization (% usage)						Radial Tires (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	42	39	58	88	83	32	55	56	60	86	83	27	92	86	96	94	94	50
91	36	47	45	83	76	32	46	58	64	81	77	27	89	94	95	92	93	50
90	27	25	58	80	72	32	46	67	58	69	67	27	75	93	87	92	91	50
89	23	25	43	75	66	32	40	44	55	69	65	27	93	84	96	93	93	50
88	18	20	31	65	54	32	37	36	40	66	59	27	82	96	76	93	91	50
87	13	23	43	58	48	32	34	36	62	57	53	27	87	91	94	91	91	50
86	16	21	27	51	41	32	32	46	46	53	49	27	94	93	92	90	91	50
85	10	17	30	37	31	29	24	28	45	43	40	20	93	90	93	90	91	54
84	5	13	17	30	22	27	32	37	32	39	37	13	82	90	92	86	87	58
83	13	8	11	27	19	24	16	26	31	32	29	7	89	91	96	90	91	62

	Speed Control (% usage)						Fan Drives (% usage)					
MY	Local	Short	Med	Long	Ave	Mobile4	Local	Short	Med	Long	Ave	Mobile4
92	44	47	51	72	70	14	52	55	77	81	79	100
91	36	40	42	64	59	14	41	69	66	75	72	100
90	33	41	50	57	54	14	55	65	60	70	68	100
89	34	41	31	50	47	14	68	59	72	66	66	100
88	32	38	36	49	45	14	62	54	59	66	64	100
87	28	39	44	42	41	14	54	69	71	64	64	100
86	32	32	39	36	35	14	45	67	61	65	63	100
85	30	28	30	22	24	13	62	56	61	55	56	99
84	31	27	31	32	31	11	53	57	69	57	58	99
83	35	30	24	29	29	10	42	47	61	48	49	98