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DRAFT USER'S GUIDE TO PART5: A PROGRAM FOR CALCULATING PARTICLE EMISSIONS FROM MOTOR VEHICLES

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1 INTRODUCTION

DESCRIPTION OF THE MODEL

PART5 is a Fortran program for use in the analysis of the particulate air pollution impact of in-use gasoline-fueled and diesel-fueled motor vehicles which supercedes the 1985 particulate emission factor model. It calculates particle emission factors in grams per mile (g/mi) from on-road automobiles, trucks, and motorcycles, for particle sizes of 1-10 µm. The particulate matter emission factors include exhaust particulate, exhaust particulate components, brakewear, tirewear, and reentrained road dust, all of which are required for PM10 inventories and analyses. The model is appropriate for comparative analyses, such as comparing the potential impact of one traffic control measure versus another.

PART5 differs from the previous particulate model (released in 1985) in the following ways: It reflects the low sulfur diesel fuel regulation of October 1993, it reflects lower particulate standards, there is an expansion of the heavy-duty diesel vehicle classification into five sub-categories and a separation of the light-duty cars and trucks by gasoline and diesel. Additions in the new model include an option to print gaseous SO2, the calculation of fugitive dust for paved and unpaved roads based on algorithms developed by the Office of Air Quality Planning and Standards (Unpaved Roads - AP42, section 11.2.1, 9/88, Paved Roads - draft AP42, section 11.2.x, 3/93), and an option to calculate idle emissions developed from manufacturers' data. The mileage accumulation rates, vehicle counts, diesel sales fractions, registration distributions and catalyst fractions also were updated to be consistent with MOBILE5.

The program contains default values for most data required for the calculation of all the emission factors, but it also allows for user-supplied data in many cases. All of the required inputs and optional inputs are described in detail in this guide. The methodology for the calculation of the emission factors is described in the appendix.

Questions about this document or the PART5 model can be addressed to:

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GETTING STARTED

To run the model the user must change to the directory in which the executable file, PART5.EXE and the driver file, PART5.IN, reside. After editing the driver file PART5.IN (see the discussion of how to set up the driver file below), the user can run the model by typing "PART5" at the DOS prompt.

The first four lines of the driver file (PART5.IN, when running non-interactively) instruct the particulate model how to run. The first line is a single character "N" or "Y" for no or yes to the question "Do you want to run interactively?" If the first line was "N", then the second line is the name of the *input file*. The next line of the driver file contains the name of the *report file*, which will contain all the computed emission factors. The last line is the name of the *error output file*, which will contain all the error and warning messages from the program. If there are no errors the error output file will be empty.

An example driver file, PART5.IN is:

```
N
BUS2.IN
BUS2.OUT
ERR.OUT
```

If the user wishes to run PART5 interactively, the driver file (PART5.IN) must still be used. "Y" is entered in the first line, the remaining lines in the driver file (PART5.IN) are not used. The program will require each line of the input interactively, starting with the name of the *report file* and the name of the *error input file*. The user will not be prompted for those file names. This is not the preferred method of running the model due to the complexity of the input. It is recommended that the non-interactive approach be used, which will provide a record of the input file that can be used in review and in detecting and correcting any errors.

INPUTS

The reader is encouraged to refer to the examples in Chapter 5 when reading this section. These examples provide illustrations of the use of PART5 options and data input requirements. The sample input files contain default data, showing the actual values which are internal to the model. The corresponding output files echo the input with the emission factors in the chosen formats. However, reference to the examples in Chapter 5 cannot substitute for a thorough reading of chapters 2 and 3. PART5 utilizes an input file that provides program control information and the data describing the scenarios for which emission factors are to be estimated. The input information consists of three distinct sections: the Control section, the One-time Data section, and the Scenario section.

The Control section is the portion of the input file that controls the input, output, and execution of the program. For example, the Control section indicates whether PART5 will require the user to supply additional input data, or analyze a scenario that includes an inspection and maintenance program, or output the emission factors in a format suitable for visual inspection or in a format suitable as input to another program.

Some parameters used in the emission factor calculations have internal values built into PART5. The One-time Data section is the portion of the input that allows the user to define parameter values different from those internal to PART5, which will be used in the calculations for all of the scenarios within a given run. For example, in the One-time Data section the user can specify alternate annual mileage accumulation rates or registration distributions by age for each vehicle type.

The Scenario section is the portion of the PART5 input that details the individual scenarios for which emission factors are to be calculated. For example, in the Scenario section the user specifies

the calendar year of evaluation and the particle size cuttoff to be assumed. Each PART5 run can include many scenarios, and each scenario can have different scenario parameters.

The Control section specifies values for variables termed flags. In Chapter 2 each flag is named, and the range of possible settings for that flag and the resulting action is noted. The One-time Data required for certain flags is also described in Chapter 2. In Chapter 3, the Scenario section is described line by line.

FORTRAN FORMAT SPECIFICATIONS

The descriptors used in Chapters 2 and 3 to define and describe the input field specifications are FORTRAN format specifications. Following is a brief key for interpretation. Additional detail can be found in any FORTRAN manual.

Descriptor	Definition and Interpretation
'I w'	The next w characters (columns; includes blank spaces) will be read in as an integer value. Leading blanks are ignored, but trailing blanks are read as zeroes; thus, integer input values should be "right-justified" within the input field (i.e., if a value of "2" is to be entered in a field specified as I2, the two columns should be filled in "blank,2", not "2,blank" which will be interpreted as "20").
'F w.d'	The next w characters will be read in as a floating-point real number, where d is the number of digits to the right of (following) the decimal point. If the field contains an explicit decimal point, the value will be read as specified and the implied point specified by d in the descriptor will be overridden. The decimal point, if present, is considered a character in the overall field width, w.
'A w'	The next w characters will be interpreted and stored as alphanumeric (i.e., labels, text; any keyboard character can be entered).
'w X'	The next w characters will be ignored; they are not read by PART5.
'/'	The field separator, used to indicate the end of one record (line of input). Input after the '/' will be read from the next record.

2 PROGRAM CONTROLS AND USER-SUPPLIED DATA

The program control flags instruct the program whether user-supplied or default values are to be used for the fraction of the total vehicle miles traveled by each vehicle class (VMT mixes), mileage accumulation rates, and registration distributions. The flags also control whether or not an inspection and maintenance (I/M) program is assumed, whether reformulated fuel effects are required, and the type of information and format desired in the report file.

If any of the above user-specified input data are required, such as a VMT mix, this information will come after all the control flags have been entered and before the scenario inputs are entered. If you specify user-supplied data for more than one control flag, the data pertaining to each flag shall be entered in the same order in which the corresponding flags are entered in the control section.

The PART5 control flags are:

VMFLAG
MYMRFG
IMFLAG
RFGFLG
OUTFMT
IDLFLG
SO2FLG
PRTFLG
BUSFLG

Following is a description of each control flag and any user-supplied data required for certain flag settings.

VMFLAG is the first control flag and specifies whether default or user-supplied VMT (vehicle miles traveled) mixes are used. The VMT "mix" is the fraction of the total VMT of all motor vehicles contributed by each vehicle class. The fractions from all the vehicle classes must sum to 1.

The VMT mix in PART5 is based on national averages and changes over time (calender years). There are three main trends driving the shifts in VMT. The first is the shift in sales from light duty passenger cars to light duty trucks. The next two have to do with the dieselization of trucks in general. Light duty diesel trucks are increasing in sales over time as compared to light duty gasoline trucks. The same trend can be seen even more noticeably, with heavy duty diesel trucks replacing heavy duty gasoline trucks.

The only place in which the program uses VMT is to weight all the emission factors for each individual vehicle class together into the "All Vehicles" emission factor numbers shown in the output.

The legal values for VMFLAG are:

1 = use default VMT mix
2 = user supplies a different VMT mix for each scenario
3 = user supplies one VMT mix for all scenarios.

If you enter 2, the VMT mix must be entered for each scenario. In this case the data are entered for each scenario in the scenario section.

If you enter 3, the program requires input of the fraction of VMT contributed by each vehicle class after all the control flags are entered.

The format for a user-supplied VMT mix is the same for options 2 and 3. This format is (6(F6.4,1X)). Two lines of data are entered, each consisting of six fractions, for a total of 12 fractions corresponding to the 12 vehicle classes. The data must be entered in the same order as the vehicle classes. The order of the vehicle classes with the corresponding Federal Highway Administration (FHA) Class and gross vehicle weight (GVW) is:

Vehicle Class	FHA Class	GVW (lbs)
1 = LDGV (light-duty gasoline vehicle)		
2 = LDGT1 (light-duty gasoline truck, I)	1	< 6,000
3 = LDGT2 (light-duty gasoline truck, II)	2A	6,001 - 8,500
4 = HDGV (heavy-duty gasoline truck)	2B-8B	> 8,500
5 = MC (motor cycle)		
6 = LDDV (light-duty diesel vehicle)	1	< 6,000
7 = LDDT (light-duty diesel truck)	2A	6,001 - 8,500
8 = 2BHDDV (class 2B heavy duty diesel vehicle)	2B	8,501 -10,000
9 = LHDDV (light heavy-duty diesel vehicle)	3,4,5	10,001 - 19,500
10 = MHDDV (medium heavy-duty diesel vehicle)	6,7,8A	19,501 - 33,000
11 = HHDDV (heavy heavy-duty diesel vehicle)	8B	33,000+
12 = BUSES (buses)		

Figure 1 (all figures are in Chapter 5, "Examples") shows an example of different VMT mixes used for two different scenarios (VMFLAG = 2), and Figure 2 shows an example of a single VMT mix used for both scenarios (VMFLAG = 3). The default values are shown in both figures.

MYMRFG is the second control flag and specifies whether default or user-supplied mileage accumulation rates and registration distributions will be used. The legal values for MYMRFG are:

1 = use default registration distributions and mileage accrual rates
2 = user supplies mileage accumulation rates; default registration distributions used
3 = user supplies registration distributions; default mileage accumulation rates used
4 = user supplies both the mileage accumulation rates and the registration distributions

The mileage accumulation rate is the expected number of miles a vehicle will travel in one year, divided by 100,000. The rates are assumed to vary by vehicle class and the age of the vehicle. For example, if a light-duty gasoline vehicle is expected to accumulate 13,118 miles in its first year of ownership, the average mileage accumulation rate for this first year would be 0.13118. The program requires mileage accumulation data for vehicles ages 1 to 25 years for each vehicle class, with the exception of motorcycles which are 1 to 12 years. Hence, if you wish to enter your own

mileage accumulation rates but use the default registration distributions (MYMRFG = 2), you will be asked to enter 25 mileage accumulation rates for each of the 12 vehicle classes (only the first 12 will be read for motorcycles, but the input must include spaces or zeros to fill out the 25 values, as in the other vehicle type records). The data must be entered from newest to oldest vehicle. The format for entering the data is **10F7.5/10F7.5/5F7.5**, where "/" indicates end of record. So for each vehicle class you would enter two lines of 10 rates each and one line of five rates. Once these 25 rates are entered for LDGVs, then the 25 rates for the next vehicle class (LDGT1s) should be entered. This process should be repeated until the rates for all 12 vehicle classes are entered. The order of the classes must follow the sequence listed above.

The registration distribution contains the fractions of the total number of vehicles in a particular class that are of ages 1 through 25+. Thus the first number in the registration distribution for LDGVs represents the fraction of all LDGVs that are one year old, and the 25th entry represents the fraction of all LDGVs that are 25 or more years old. The sum of the 25 fractions must be 1 for each vehicle class.

If you wish to enter your own registration distributions but use default mileage accumulation rates, select MYMRFG = 3. In this case you must enter the registration distribution for each vehicle class. The format for entering the distributions is **10F5.3/10F5.3/5F5.3**, so for each vehicle class you would enter two lines of 10 fractions each and one line of five fractions. The order of the fractions is newest to oldest vehicle. The order of the classes is as listed on page 4.

If you wish to enter both your own mileage accumulation rates and registration distributions, select MYMRFG = 4. In this case you must first enter the average mileage accumulation rates, and then the registration distributions. A sample input file using MYMRFG = 4 is shown with the default values in Figure 3.

IMFLAG is the third control flag and specifies whether or not an inspection and maintenance (I/M) program is assumed. The I/M program in the model will only affect emissions from gasoline-fueled vehicles. I/M programs reduce particulate emissions by having a deterrent effect on tampering. The reductions in tampering and misfueling rates will have a slight effect on lead and sulfate particulate emissions. The legal values for IMFLAG are:

1 = no I/M program
2 = I/M program.

No user-supplied data is required for this flag.

> **NOTE:** This flag will only affect lead and sulfate particulate emission factors for gasoline vehicles. Unless you are modeling calendar years in which a substantial fraction of the in-use fleet is pre-1985 model year vehicles, the effects will most likely be very insignificant.

RFGFLG specifies whether reformulated gasoline effects are required. The legal values for RFGFLG are:

1 = no reformulated gasoline
2 = reformulated gasoline

The reformulated gasoline effects for particulate emissions are partially based on the sulfur content of the gasoline used. The average sulfur weight percent is .034 for any gasoline fuel in any calendar years preceding 2000. When reformulated fuel is used (RFGFLG = 2) and the calendar year is set to 2000 and later (Federal Phase II), the sulfur weight percent is .0138. The remaining

effects of reformulated gasoline are consistent with the reformulated gasoline reductions for total hydrocarbons as modeled in MOBILE5.

OUTFMT specifies the output format of the report file. The output format selections are:

1 = long (235 - 250 column) numerical format
2 = short (204 - 221 column) numerical format
3 = 115 - 133 column text format
5 = 115 - 133 column text format, plus tables of data by model-year.

The numerical format is useful when using the output of this program as input for other programs. The text format has more detailed headers and longer titles. The by model-year tables show the emission factors for vehicles of each model-year in a particular vehicle class, multiplied by the corresponding travel fractions, as well as the composite emission factors for all vehicle classes.

No additional data are required for any of the OUTFMT selections, with the exception of OUTFMT = 5. In this case an extra line must be input (at the end of the user-supplied data section, immediately before the scenario inputs section) with either a 1 or a 2 entered for each vehicle class, denoting whether or not to print a table for that class (1 = do not print, 2 = print). The format for this input is **12I1** (when BUSFLG = 1), **14I1** (when BUSFLG = 2), or **13I1** (when BUSFLG = 3). See "BUSFLG" on page 8 of this section. Sample input files using OUTFMT = 5 appear in Figures 4 and 8.

IDLFLG specifies whether or not to print the idle emission factors. The legal values are:

1 = do not print idle emission factors
2 = print idle emission factors

Currently, idle emission factors are calculated in PART5 only for heavy-duty diesel vehicles.

SO2FLG specifies whether or not to print gaseous SO_2 emission factors. The legal values are:

1 = do not print gaseous SO_2 emission factors
2 = print gaseous SO_2 emission factors

NOTE: Setting SO2FLG = 2 will not print gaseous SO_2 when PRTFLG = 2. Set PRTFLG to 1 or 3 when gaseous SO_2 emission factors are required.

PRTFLG specifies the pollutant information to be reported. The legal values for PRTFLG are:

1 = all particulate emission factors (including dust)
2 = exhaust PM factors only
3 = exhaust PM, brake-wear, tire-wear, total PM and fugitive dust.

The following are the different pollutant categories (in g/mi) as they are labeled in the output for OUTFMT = 3:

Lead	=	exhausted lead
SOF	=	soluble organic fraction
RCP	=	remaining carbon portion
Direct SO4	=	direct sulfate emissions, exhausted as sulfuric acid (H_2SO_4)
Exhaust PM	=	lead + SOF + RCP + Direct SO_4
Indirect SO4	=	estimated indirect sulfate material [(NH_4) $2SO_4$]
Sulfate PM	=	indirect sulfate + direct sulfate
Brake	=	brake wear emissions
Tire	=	tire wear emissions
Total PM	=	Exhaust PM + brake + tire + indirect SO_4
Unpaved dust	=	road dust from unpaved roads
Paved dust	=	road dust from paved roads

PRTFLG = 1 will print all pollutants above; PRTFLG = 2 will print Lead, SOF, RCP, Direct SO_4 and Exhaust PM; and PRTFLG = 3 will print Exhaust PM, Brake-wear, Tire-wear, Total PM, and Fugitive Dust (paved and unpaved).

Figures 5 and 6 show examples of PRTFLG = 2 and 1 respectively.

BUSFLG determines which alternative bus cycle emission factors to print out when using OUTFMT=3. The legal values for BUSFLG are:

1 = Do not print alternative bus cycle emission factors.

2 = Print transit and CBD (Central Business District) bus cycle emission factors.

The transit usage category is based on the truck chassis cycle which is representative of inter-city bus routes. This cycle is intended to represent the same vehicle operations as the EPA heavy-duty transient engine dynamometer test for heavy-duty diesel engines which is used to certify bus engines to Federal emissions standards.

The CBD usage category is based on an equal contribution of both the Central Business District cycle (CBD) and the New York Bus Composite cycle (NYBC). The CBD cycle simulates driving in a heavily built up urban environment. It is a simplified simulation of urban bus operation on a fixed route with fairly frequent, equidistant stops. The NYBC cycle is a "compressed" version of the EPA unfiltered bus test cycle. The first part of the cycle simulates non-freeway driving with large amounts of idle time, while the second part simulates freeway driving of a highly variable transient nature.

3 = Print heavy urban bus cycle emission factors. Based on the New York City cycle which is representative of driving in heavily congested inner city areas. A lot of stop and go with large amounts of acceleration and deceleration, resulting in very low fuel economy, is represented in the heavy urban usage category.

The alternative emission factors are calculated using different conversion factors from grams per brake-horsepower per hour (g/bhp-hr) to grams per mile that reflect different driving behavior than the EPA heavy-duty truck transient test cycle. The conversion factors developed for the bus usage categories are inversely proportionate to fuel consumption. In general, the lower the fuel economy the more severe the conversion factor.

Figure 7 shows an example of BUSFLG = 2.

> **NOTE:** BUSFLG = 3 is not recommended. The situation this flag represents very rarely occurs. The cycle was developed to represent heavy urban bus routes in downtown Manhatten (NY,NY). Submissions to EPA using this flag will be examined carefully. Modelers should supply justification for the use of BUSFLG = 3 in any State Implementation Plan (SIP) - related modeling.

3 SCENARIO INPUTS

The scenario section always consists of six input lines for each scenario. Several different scenarios may be modeled using one set of control flags. The only control flag that affects the input of the scenario section is VMFLAG: If VMFLAG = 2, a VMT mix must be supplied for each scenario. The VMT mix data in this case are entered following the six lines of each scenario section, instead of in the user-defined data input section (see section 2, VMFLAG).

Line 1. The first line of the scenario inputs contains the region, calendar year of evaluation, speed cycle, and vehicle speed. The value of region must be either 1 or 2: 1 for low altitude and 2 for high altitude. Currently the program produces the same emission factors for low and high altitude, but we plan to implement regional effects in the future if data warrants. The calendar year of evaluation is the year for which emission factors are being modeled. The speed cycle is either 1 or 2: 1 is for transient (cyclical) driving, and 2 is for steady (cruise). The choice of speed cycle only effects lead emission factors, so there will be no significant effect in current or future calender years. The average vehicle speed must be between 2.5 and 55.0 miles per hour. Lead and sulfates are affected by speed in opposing directions, therefore relatively little variation will be seen in total exhaust PM. The format for this first scenario input line is:

I1,1X,I4,1X,I1,1X,F4.1

A sample line specifying low-altitude (region = 1), calender year of evaluation 1991, steady (cruise) driving (speed cycle = 2), and an average speed of 19.6 mph, is:

```
1 1991 2 19.6          :region, year, speed cycle, speed
```

Line 2. The second input line contains three inputs for the calculation of the fugitive dust emission factors. The first input is the unpaved road silt percent; the lower and upper bounds for this number are 4.3 and 20.0 percent. The second input is the paved road silt loading in g/m^2; the lower and upper bounds for the paved road silt loading are 0.02 and 400 g/m^2. The third input is an optional flag, WHEELFLG, to tell the program that the user would like to input the fleet average number of wheels for use in unpaved road dust calculations (note that tire-wear emissions calculations use vehicle class specific average number of wheels which are not affected by this input).

Fugitive dust emission factors are very sensitive to the silt percent (used in unpaved road calculations) and silt loading (used in paved road calculations). Due to the large variability in silt loadings and percents, it is highly recommended that the user supply loadings from actual measurements of the roadways to be modeled. If no measurements are readily available, the user is highly encouraged to study the AP-42 references 1988a and 1993b given on page 67, to determine appropriate input values to model specific situations based on region, traffic volume, road type, etc.

Ranges of unpaved road silt percents are (see references page 67, EPA 1988a):

Copper smelting: 15.9% - 19.1%
Iron and steel production: 4.0% - 16.0%
Sand and gravel processing: 4.1% - 6.0%
Stone quarrying and processing: 10.5% - 15.6%
Taconite mining and processing: 3.7% - 9.7% for a haul road, 2.4% - 7.1% for a service road
Western surface coal mining: 4.9% - 5.3% for an access road, 2.8% - 18% for a haul road, 7.2% - 25.0% for a scraper road, and 18.0% - 29.0% for a freshly graded haul road
Rural roads: 5.8% - 68% for dirt, and 7.7% - 13.0% for crushed limestone.

Ranges of different paved road silt loadings are (in g/m^2):

Copper smelting: 188 - 400
Iron and steel production: 0.09 - 79
Asphalt batching: 76 - 193
Concrete batching: 11 - 12
Sand and gravel processing: 53 - 95
Municipal solid waste landfill: 1.1 - 32
Quarry: 2.4 - 14

When WHEELFLG is set to blank or "1", the model will not require any additional user input and the model will assume the default values for average number of wheels in each vehicle class to be as listed in the sample of line 7 on page 12. When WHEELFLG is set to "2", the model will expect a seventh line of output at the end of that scenario. The format for line 2 is:

F4.1,1X,F6.2,1X,I1

A sample input line specifying 4.3 % unpaved silt, and 5.1 g/m^2 paved silt, is:

04.3 05.1 2 :unpaved silt%, paved silt (g/m^2), WHEELFLG

Line 3. The third input line also has information for the fugitive dust emission factor calculations. The input is the number of precipitation days with more than 0.01 inches of rain per year. The fugitive dust emission factors are average day emission factors for the entire year, and thus are affected by precipitation patterns: the more frequent the annual precipitation days, the lower the fugitive dust emission factors will be, and conversely.

The format for this input line is:

I3

A sample input line specifying 140 annual days of precipitation, is:

140 :number of precipitation days

An optional input for this line (after number of precipitation days) is a value for TRAPFLG, where a blank or 1 = no trap emission control technology for buses for model years 1992 and 1993. If

nothing is entered for TRAPFLG, no trap technology is assumed. Setting TRAPFLG = 2 indicates there is some fraction of buses for model years 1992 and 1993 which are maintaining traps. TRAPFLG = 2 should only be used when there is a maintenance program enforced, in which the traps are subject to stringent maintenance procedures. When a "2" is used, the program will look for a set of two percentages: one for traps maintained on 1992 model year buses and another percentage for traps maintained on 1993 model year buses.

The format for the third scenario record when the TRAPFLG option is set, is:

I3,1X,I1,2(1X,F5.1)

A sample line utilizing the optional bus trap emission control technology input, specifying 140 annual days of precipitation, 100% of buses with trap technology for which there is a maintenance program for model year 1992, and 50% of buses with trap technology for which there is a maintenance program for model year 1993, is:

140 2 100.0 050.0	:number of precipitation days, TRAPFLG, % 1992 buses equipped with maintained traps, % 1993 buses equipped with maintained traps

Line 4. The fourth input line is the scenario name, up to 32 characters. The name should be different for each scenario and is echoed back as part of the output labeling. The format is:

A32

A sample input line is

Scenario 1	:scenario name

Line 5. The fifth input line is the particle size cutoff (PSC). The emission factors reported represent the estimated grams per mile of particles with aerodynamic diameter less than or equal to the PSC. The maximum PSC allowed is 10.0 μm, the minimum is 1.0 μm. The lower limit for the PSC for fugitive dust is 2.5 μm. When less than 2.5 μm is entered, the program will reflect emissions for 2.5 μm PSC for fugitive dust only. The format for this input is:

F5.2

A sample input line specifying 10 microns, is:

10.00	:Particle size cutoff (in μm).

Line 6. The sixth input line is the fleet average vehicle weights which is used for the calculation of fugitive dust emissions.

The format for this input is:

I6

A sample line specifying a standard fleet average vehicle weight (lbs), is:

6000

Line 7. The seventh input line is only required when WHEELFLG = 2 in line 2 of that scenario. The fleet average number of wheels will be used in calculations for unpaved road dust only.

The format for this input is:

I2

A sample line specifying the fleet average number of wheels, is:

04

4 OUTPUT

The output for PART5 is determined by the user-specified combination of the values assigned to the control flags OUTFMT, PRTFLG, IDLFLG, SO2FLG, and BUSFLG.

The particulate emission factor "Exhaust PM" (as printed in the output), is a summation of four components in the model: lead, soluble organic fraction (SOF), remaining carbon portion (RCP), and direct sulfate (SO_4).

Lead particulate emission factors are based on the assumption that virtually all the lead in the fuel is exhausted. As a result, the emission factors depend principally on the lead content in the fuel and the fuel economy of the vehicle. The lead content of diesel fuel is negligible, so it is assumed that the lead emissions from diesel-fueled vehicles are also negligible. The lead content of leaded gasoline is substantially greater than that of unleaded fuel, so the fraction of vehicles that have had their catalysts removed (and thus are assumed to be using leaded fuel in most cases) can also be an important factor in determining the lead emission factor from a vehicle that is representative of the entire fleet. See discussions on lead emission factors and "Lead Derivation" on pages 48-52 of the appendix.

The carbon portion of particulate emissions is broken down in the output as soluble organic fraction ("SOF", printed when PRTFLG = 1 or 2) and remaining carbon portion ("RCP", printed when PRTFLG = 1 or 2) for diesel vehicles (see page 58 of appendix). Carbon emission factors for gasoline vehicles are very small, and it is hard to distinguish between organic carbon and remaining carbon based on the available data. Table 1 of the appendix (page 56) shows the carbon component for gasoline vehicles used in the model. This component is not printed for gasoline vehicles, but is included in the total "Exhaust PM" in the output.

The direct sulfate ("Direct SO4", printed when PRTFLG = 1 or 2) is also a component of the exhausted particulate matter. The model assumes that all of the sulfur in the fuel is exhausted as either direct SO_4 or gaseous SO_2. See page 52 of appendix for a discussion of gasoline sulfate emission factors, and page 57 of the appendix for a discussion of diesel sulfate emission factors.

Gaseous sulfur dioxide (SO_2) is an optional output, produced by setting the SO2FLG to "2" and the PRTFLG to "1" or "3", in the control flag section of the input. The remaining sulfur in the fuel (which was not exhausted as SO_4) is considered to be exhausted as gaseous SO_2. Gaseous SO_2 acts as a precursor to form additional SO_4 in the atmosphere.

"Indirect SO4" (printed only when PRTFLG = 1) is calculated in the model based on measurements of ambient sulfur and sulfate from 11 cities in the United States. The model assumes that 12 percent of the gaseous SO_2 reacts in the atmosphere to form SO_4.

The "Sulfate PM" (printed only when PRTFLG = 1) is the sum of direct and indirect SO_4.

The brake-wear emission factor (printed when PRTFLG = 1 or 3) is assumed to be the same for all vehicle classes in the model. The only input which will affect brake-wear emissions is the particle size cutoff. See the discussion on brake-wear emissions on page 63 of the appendix, and Table 4 for particle size cutoffs, page 66 of the appendix.

The tire-wear emission factor (printed when PRTFLG = 1 or 3) varies with the number of wheels designated for that vehicle class (optional input), and the particle size cutoff. See the discussion on tire-wear emissions on page 63 of the appendix, and Table 4 for particle size cutoffs, page 66 of the appendix.

The "Total PM" (printed when PRTFLG = 1 or 3) is the sum of exhaust PM, brake-wear, tire-wear, and indirect SO_4.

There are two fugitive dust categories, "Unpaved Dust" and "Paved Dust," to represent reentrained road dust emission factors. The formulas used in the model for fugitive dust are based on AP-42 Sections 11.2.1 (EPA 1985b), and 11.2.5 and 11.2.6 (EPA 1993b). See page 62 of appendix for a discussion of the fugitive dust emission factors in the model.

5 EXAMPLES

INTRODUCTION

Inputs and outputs for nine examples (Figures 1-9a) are provided to illustrate various aspects of PART5. The user is encouraged to try two or more of these examples to ensure that the model as compiled is running properly. In addition, the reader is encouraged to run the example input file MANY.IN, after reading Chapters 2 and 3, in order to get a global sense of the options and data input requirements. All files listed in the example index below are available on disk and on the Technology Transfer Network (TTN) Bulletin Board System (BBS).

Any word processing software or other test editor can be used to modify the example PART5 input files to match user requirements. This is the easiest way to insure that the proper formats and record orders are maintained. However, when using word processing software the user should be careful to save input files only as DOS text documents (ASCII text). Converting and saving input files as word-processing documents will add hidden characters to the file which will not be properly processed by the PART5 model.

You can determine if an input has had hidden characters by using the TYPE command available in DOS to list the input file to the screen. Any characters shown which were not intended to be in the file will cause problems when the file is read by PART5. An example of the TYPE command, with an option to pause after each screen of characters would be:

TYPE <filename>| MORE

Another problem that may occur when editing PART5 input files is determining proper column location. When using word-processing software to edit these input files, if the file is viewed or printed using a proportional font, some characters in each row will take up more or less column space than other characters. All PART5 input and output files assume that all characters take up equal column space (non-proportional spacing). It is helpful then to always use a non-proportional font (such as Courier) when viewing or printing PART5 input or output files.

EXAMPLE INDEX

The following files are included with electronic copies of PART5 (either on disk or via the bulletin board system). A brief description accompanies each filename to help the user find specific examples.

Figure	Filename:	Description:
1	VMT2.IN	VMFLAG=2 showing alternate VMT mixes for each scenario.
2	VMT3.IN	VMFLAG=3 showing alternate VMT mix once per run.
3	MY.IN	MYMRFG=4 showing input for alternate mileage accumulation rates and registration distributions.
4	FM5.IN	OUTFMT=5 showing by-model-year input for LDGV.
5	PRT2.IN	PRTFLG=2 showing only Exhaust PM and components printed in output.
6	PRT1.IN	PRTFLG=1 showing Exhaust PM and components, Indirect Sulfate, Sulfate PM, Brake, Tire, Total Particulate and Fugitive Dust emissions factors pinted in output.
7	BUS2.IN	BUSFLG=2 showing Transit and CBD bus usage categories.
8	MANY.IN	VMFLAG=3, MYMRFG=4, RFGFLG=2, OUTFMT=5, showing order of one-time data inputs.
9	TRAP.IN	BUSFLG=2, TRAPFLG=2 showing different scenarios of traps on buses for model years 1992 and 1993.

Figure 1

```
Sample Using Alternate VMT Mixes for each scenario
2      :VMFLAG (alternate VMT mixes)
1      :MYMRFG (alternate mileage accumulation rates & registration)
1      :IMFLAG (Inspection and maintenance)
1      :RFGFLG (2 to apply reformulated gasoline effects, 1 not to)
3      :OUTFMT (indicates type of output format)
1      :IDLFLG (2 to print, 1 not to print idle emission factors)
1      :SO2FLG (2 to print Gaseous SO2 emissions, 1 not to print them)
3      :PRTFLG (determines which pollutants to print out)
1      :BUSFLG (determines which alternative bus cycle to print out)
1 1994 1 19.6     : region, year, speed cycle, speed
04.3 05.1   2     : unpaved silt%, ind. silt g/m^2, WHEELFLG
140               : number of precip. days
scene1                            :scene name
10.   -- Particle size cutoff
6000
04
0.6340 0.1760 0.0830 0.0310 0.0070 0.0040
0.0020 0.0100 0.0010 0.0140 0.0340 0.0040
1 2000 1 19.6     : region, year, speed cycle, speed
04.3 05.1   2     : unpaved silt%, ind. silt g/m^2, WHEELFLG
140               : number of precip. days
scene2                            :scene name
10.   -- Particle size cutoff
6000
04
0.6150 0.1900 0.0860 0.0310 0.0060 0.0010
0.0010 0.0130 0.0010 0.0170 0.0360 0.0030
```

Figure 1a

PART5 Revised 02-24-95

Sample Using Alternate VMT Mixes for each scenario

User supplied veh miles traveled mixture .

scene1

Particle Size Cutoff 10.00 Microns Altitude: 500. Ft. Driving: Transient RFG:No

Cal. Year: 1994 I/M Program: No Region: Low

Veh. Type:	LDGV	LDGT1	LDGT2	HDGV	MC	LDDV	LDDT	2BHDDV	LHDDV	MHDDV	HHDDV	BUSES	All Veh.
Veh. Speeds:	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6
VMT Mix:	0.6340	0.1760	0.0830	0.0310	0.0070	0.0040	0.0020	0.0100	0.0010	0.0140	0.0340	0.0040	
Composite Emission Factors (g/mi)													
Exhaust PM:	0.014	0.018	0.040	0.154	0.020	0.288	0.346	0.324	0.921	1.156	1.380	1.260	0.094
Brake:	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Tire:	0.008	0.008	0.008	0.012	0.004	0.008	0.008	0.008	0.012	0.012	0.036	0.008	0.009
Total PM:	0.058	0.070	0.092	0.237	0.046	0.341	0.405	0.409	1.042	1.306	1.583	1.430	0.149

Fugitive Dust: Unpaved Roads Fleet Average 139.04 g/mi (as calculated in AP42 Vol 1 9/88)*

Paved Roads Fleet Average 13.41 g/mi (as calculated in draft AP42 Vol 1 3/93)*

Unpaved Roads Fleet Average 138.83 g/mi (as calculated ~~in AP42~~ Vol 1 9/88, minus tailpipe and tire-wear emissions)**

Paved Roads Fleet Average 13.21 g/mi (as calculated in draft AP42 Vol 1 3/93, minus tailpipe and tire-wear emissions)**

* Includes fleet average tailpipe, tire-wear and brake-wear emissions.

** Includes fleet average brake-wear emissions.

Paved Road Silt: 5.10 (g/m^2) Fleet average vehicle weight: 6000

Unpaved Silt: 4.3% Fleet average number of wheels: 4

Precipitation Days: 140 >0.01 in. (per year)

Figure 2

```
Sample Using Alternate VMT Mixes once per run
3      :VMFLAG (alternate VMT mixes)
1      :MYMRFG (alternate mileage accumulation rates & registration)
1      :IMFLAG (Inspection and maintenance)
1      :RFGFLG (2 to apply reformulated gasoline effects, 1 not to)
3      :OUTFMT (indicates type of output format)
1      :IDLFLG (2 to print, 1 not to print idle emission factors)
1      :SO2FLG (2 to print Gaseous SO2 emissions, 1 not to print them)
3      :PRTFLG (determines which pollutants to print out)
1      :BUSFLG (determines which alternative bus cycles to print out)
0.6340 0.1760 0.0830 0.0310 0.0070 0.0040
0.0020 0.0100 0.0010 0.0140 0.0340 0.0040
1 1994 1 19.6     : region, year, speed cycle, speed
04.3 05.1   2     : unpaved silt%, ind. silt g/m^2, WHEELFLG
140               : number of precip. days
scene1                            :scene name
10.   -- Particle size cutoff
6000
04
```

Figure 2a

PART5 Revised 02-24-95

Sample Using Alternate VMT Mixes once per run

User supplied veh miles traveled mixture .

scene1

Particle Size Cutoff 10.00 Microns — Altitude: 500. Ft. — Driving: Transient RFG:No

Cal. Year: 1994 — I/M Program: No — Region: Low — All

Veh. Type:	LDGV	LDGT1	LDGT2	HDGV	MC	LDDV	LDDT	2BHDDV	LHDDV	MHDDV	HHDDV	BUSES	Veh.
Veh. Speeds:	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6
VMT Mix:	0.6340	0.1760	0.0830	0.0310	0.0070	0.0040	0.0020	0.0100	0.0010	0.0140	0.0340	0.0040	
Composite Emission Factors (g/mi)													
Exhaust PM:	0.014	0.018	0.040	0.154	0.020	0.288	0.346	0.324	0.921	1.156	1.380	1.260	0.094
Brake:	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Tire:	0.008	0.008	0.008	0.012	0.004	0.008	0.008	0.008	0.012	0.012	0.036	0.008	0.009
Total PM:	0.058	0.070	0.092	0.237	0.046	0.341	0.405	0.409	1.042	1.306	1.583	1.430	0.149

Fugitive Dust: Unpaved Roads Fleet Average 139.04 g/mi (as calculated in AP42 Vol 1 9/88)*

Paved Roads Fleet Average 13.41 g/mi (as calculated in draft AP42 Vol 1 3/93)*

Unpaved Roads Fleet Average 138.83 g/mi (as calculated ~~in AP42~~ Vol 1 9/88, minus tailpipe and tire-wear emissions)**

Paved Roads Fleet Average 13.21 g/mi (as calculated in draft AP42 Vol 1 3/93, minus tailpipe and tire-wear emissions)**

* Includes fleet average tailpipe, tire-wear and brake-wear emissions.

** Includes fleet average brake-wear emissions.

Paved Road Silt: 5.10 (g/m^2)

Unpaved Silt: 4.3%

Precipitation Days: 140 >0.01 in. (per year)

Fleet average vehicle weight: 6000

Fleet average number of wheels: 4

Figure 3

```
Sample Input File Using Alternate Mil. Accum. Rates & Reg. Dist.
1      :VMFLAG (alternate VMT mixes)
4      :MYMRFG (alternate mileage accumulation rates & registration)
1      :IMFLAG (Inspection and maintenance)
1      :RFGFLG (2 to apply reformulated gasoline effects, 1 not to)
3      :OUTFMT (indicates type of output format)
1      :IDLFLG (2 to print, 1 not to print idle emission factors)
1      :SO2FLG (2 to print Gaseous SO2 emissions, 1 not to print them)
3      :PRTFLG (determines which pollutants to print out)
1      :BUSFLG (determines which alternative bus cycles to print out)
14390 .13612 .12875 .12180 .11522 .10899 .10310 .09751 .09225 .08726
08254 .07807 .07386 .06987 .06608 .06251 .05913 .05594 .05291 .05005
04735 .04478 .04237 .04007 .03790                                LDGV
15442 .14508 .13631 .12807 .12032 .11305 .10621 .09979 .09376 .08809
08276 .07776 .07306 .06864 .06449 .06059 .05693 .05348 .05025 .04721
04436 .04168 .03916 .03679 .03456                                LDGT1
14779 .14259 .13758 .13275 .12809 .12359 .11924 .11505 .11101 .10711
10335 .09972 .09621 .09283 .08957 .08642 .08339 .08046 .07763 .07490
07227 .06973 .06728 .06492 .06264                                LDGT2
17251 .16185 .15185 .14246 .13365 .12539 .11764 .11037 .10355 .09715
09114 .08551 .08022 .07526 .07061 .06625 .06215 .05831 .05471 .05132
04815 .04517 .04238 .03976 .03730                                HDGV
04786 .04475 .04164 .03853 .03543 .03232 .02921 .02611 .02300 .01989
01678 .01368 .00000 .00000 .00000 .00000 .00000 .00000 .00000 .00000
00000 .00000 .00000 .00000 .00000                                MC
17825 .16478 .15233 .14081 .13017 .12033 .11124 .10283 .09506 .08788
08123 .07509 .06942 .06417 .05932 .05484 .05069 .04686 .04332 .04005
03702 .03422 .03163 .02924 .02703                                LDDV
20140 .17572 .15432 .13639 .12133 .10863 .09788 .08877 .08103 .07444
06883 .06405 .05999 .05655 .05365 .05123 .04924 .04763 .04637 .04543
03342 .03080 .02839 .02616 .02411                                LDDT
22517 .20009 .17779 .15798 .14038 .12474 .11084 .09849 .08752 .07777
06910 .06140 .05456 .04848 .04308 .03828 .03402 .03023 .02686 .02387
02121 .01884 .01675 .01488 .01322                                2BHDDV
24239 .23273 .22346 .21455 .20600 .19779 .18990 .18233 .17507 .16809
16139 .15496 .14878 .14285 .13716 .13169 .12644 .12140 .11656 .11192
10746 .10317 .09906 .09511 .09132                                LHDVM
26081 .25204 .24357 .23538 .22746 .21982 .21243 .20528 .19838 .19171
18527 .17904 .17302 .16720 .16158 .15614 .15089 .14582 .14092 .13618
13160 .12718 .12290 .11877 .11478                                MHDVM
62176 .58663 .55348 .52220 .49269 .46485 .43858 .41380 .39042 .36836
34754 .32790 .30937 .29189 .27540 .25983 .24515 .23130 .21823 .20590
19426 .18328 .17293 .16315 .15393                                HHDVM
25354 .23317 .21443 .19720 .18135 .16678 .15338 .14106 .12972 .11929
10971 .10090 .09279 .08533 .07847 .07216 .06637 .06103 .05613 .05161
04760 .04397 .04074 .03787 .03541                                BUSES
049 .079 .083 .082 .084 .081 .077 .056 .050 .051
050 .054 .047 .037 .024 .019 .014 .015 .011 .008
006 .005 .004 .003 .010                                  LDGV
063 .084 .084 .084 .084 .069 .059 .044 .036 .031
030 .053 .047 .046 .036 .028 .017 .022 .017 .014
009 .008 .008 .005 .025                                  LDGT1
```

Figure 3 (continued)

```
054 .072 .072 .072 .072 .052 .050 .034 .054 .031
028 .080 .084 .049 .039 .030 .018 .023 .018 .015
009 .008 .009 .006 .026                                LDGT2
023 .047 .047 .047 .047 .038 .033 .021 .026 .029
034 .064 .054 .058 .051 .038 .043 .041 .035 .029
021 .022 .022 .014 .117                                HDGV
144 .168 .135 .109 .088 .070 .056 .045 .036 .029
023 .097 .000 .000 .000 .000 .000 .000 .000 .000
000 .000 .000 .000 .000                                MC
049 .079 .083 .082 .084 .081 .077 .056 .050 .051
050 .054 .047 .037 .024 .019 .014 .015 .011 .008
006 .005 .004 .003 .010                                LDDV
063 .084 .084 .084 .084 .069 .059 .044 .036 .031
030 .053 .047 .046 .036 .028 .017 .022 .017 .014
009 .008 .008 .005 .025                                LDDT
043 .084 .084 .084 .084 .091 .076 .050 .051 .064
066 .083 .069 .071 .000 .000 .000 .000 .000 .000
000 .000 .000 .000 .000                                2BHDDV
000 .000 .000 .000 .000 .000 .000 .000 .000 .000
000 .000 .000 .000 .000 .000 .000 .000 .273 .182
125 .102 .080 .057 .182                                LHDVV
034 .067 .067 .067 .067 .073 .061 .040 .041 .051
053 .066 .055 .057 .045 .019 .023 .028 .024 .016
011 .009 .007 .005 .016                                MHDVV
034 .067 .067 .067 .067 .073 .061 .040 .041 .051
053 .066 .055 .057 .045 .019 .023 .028 .024 .016
011 .009 .007 .005 .016                                HHDVV
030 .060 .059 .058 .057 .055 .054 .053 .052 .050
050 .049 .047 .046 .045 .044 .044 .043 .042 .010
008 .007 .006 .005 .025                                BUSES
1 1994 1 19.6     : region, year, speed cycle, speed
04.3 05.1   2     : unpaved silt%, ind. silt g/m^2, WHEELFLG
140               : number of precip. days
scene1                          :scene name
10.   -- Particle size cutoff
6000
04
```

Figure 3a

WARNING: According to historical records
there are no Class 2B Heavy Duty Diesel vehicles
for model years before 1981 or Light Heavy Duty
Diesel vehicles after 1976. PART5 will always
assume 0.0 registration for these vehicles
during those periods.

PART5 Revised 02-24-95

Sample Input File Using Alternate Mil. Accum. Rates & Reg. Dist.

User supplied mileage accrual distributions , veh registration distributions.

scene1

Particle Size Cutoff 10.00 Microns Altitude: 500. Ft. Driving: Transient RFG:No

Cal. Year: 1994 I/M Program: No Region: Low All

Veh. Type:	LDGV	LDGT1	LDGT2	HDGV	MC	LDDV	LDDT	2BHDDV	LHDDV	MHDDV	HHDDV	BUSES	Veh.
Veh. Speeds:	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6
VMT Mix:	0.6337	0.1760	0.0831	0.0307	0.0072	0.0045	0.0017	0.0102	0.0012	0.0137	0.0344	0.0035	
Composite Emission Factors (g/mi)													
Exhaust PM:	0.014	0.018	0.040	0.154	0.020	0.288	0.346	0.324	0.921	1.156	1.380	1.260	0.094
Brake:	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Tire:	0.008	0.008	0.008	0.012	0.004	0.008	0.008	0.008	0.012	0.012	0.036	0.008	0.009
Total PM:	0.058	0.070	0.092	0.237	0.046	0.341	0.405	0.409	1.042	1.306	1.583	1.430	0.149

Fugitive Dust: Unpaved Roads Fleet Average 139.04 g/mi (as calculated in AP42 Vol 1 9/88)*
Paved Roads Fleet Average 13.41 g/mi (as calculated in draft AP42 Vol 1 3/93)*
Unpaved Roads Fleet Average 138.83 g/mi (as calculated in AP42 Vol 1 9/88, minus tailpipe and tire-wear emissions)**
Paved Roads Fleet Average 13.21 g/mi (as calculated in draft AP42 Vol 1 3/93, minus tailpipe and tire-wear emissions)**

* Includes fleet average tailpipe, tire-wear and brake-wear emissions.

** Includes fleet average brake-wear emissions.

Paved Road Silt: 5.10 (g/m^2)
Unpaved Silt: 4.3%
Precipitation Days: 140 >0.01 in. (per year)

Fleet average vehicle weight: 6000
Fleet average number of wheels: 4

Figure 4

```
Sample with OUTFMT = 5
1      :VMFLAG (alternate VMT mixes)
1      :MYMRFG (alternate mileage accumulation rates & registration)
1      :IMFLAG (Inspection and maintenance)
1      :RFGFLG (2 to apply reformulated gasoline effects, 1 not to)
5      :OUTFMT (indicates type of output format)
1      :IDLFLG (2 to print, 1 not to print idle emission factors)
1      :SO2FLG (2 to print Gaseous SO2 emissions, 1 not to print them)
3      :PRTFLG (determines which pollutants to print out)
1      :BUSFLG (determines which alternative bus cycles to print out)
211111111111
1 1994 1 19.6     : region, year, speed cycle, speed
04.3 05.1   2     : unpaved silt%, ind. silt g/m^2, WHEELFLG
140               : number of precip. days
scene1                            :scene name
10.   -- Particle size cutoff
6000
04
```

Figure 4a

PART5 Revised 02-24-95

Sample with OUTFMT = 5

scene1

Particle Size Cutoff 10.00 Microns — Altitude: 500. Ft. — Driving: Transient RFG:No

Cal. Year: 1994 — I/M Program: No — Region: Low

Veh. Type:	LDGV	LDGT1	LDGT2	HDGV	MC	LDDV	LDDT	2BHDDV	LHDDV	MHDDV	HHDDV	BUSES	All Veh.
Veh. Speeds:	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6
VMT Mix:	0.6337	0.1760	0.0831	0.0307	0.0072	0.0045	0.0017	0.0102	0.0012	0.0137	0.0344	0.0035	
Composite Emission Factors (g/mi)													
Exhaust PM:	0.014	0.018	0.040	0.154	0.020	0.288	0.346	0.324	0.921	1.156	1.380	1.260	0.094
Brake:	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Tire:	0.008	0.008	0.008	0.012	0.004	0.008	0.008	0.008	0.012	0.012	0.036	0.008	0.009
Total PM:	0.058	0.070	0.092	0.237	0.046	0.341	0.405	0.409	1.042	1.306	1.583	1.430	0.149

Fugitive Dust: Unpaved Roads Fleet Average 139.04 g/mi (as calculated in AP42 Vol 1 9/88)*

Paved Roads Fleet Average 13.41 g/mi (as calculated in draft AP42 Vol 1 3/93)*

Unpaved Roads Fleet Average 138.83 g/mi (as calculated in AP42 Vol 1 9/88, minus tailpipe and tire-wear emissions)**

Paved Roads Fleet Average 13.21 g/mi (as calculated in draft AP42 Vol 1 3/93, minus tailpipe and tire-wear emissions)**

* Includes fleet average tailpipe, tire-wear and brake-wear emissions.

** Includes fleet average brake-wear emissions.

Paved Road Silt: 5.10 (g/m^2)

Unpaved Silt: 4.3%

Precipitation Days: 140 >0.01 in. (per year)

Fleet average vehicle weight: 6000

Fleet average number of wheels: 4

Figure 4a (continued)

PART5 Revised 02-24-95

Sample with OUTFMT = 5

scene1

Emission Factors (Gm/Mile)

Light Duty Gas Vehicles

January 1, 1994

Model Year	TF	Miles	Exhaust PM: Emiss Rate	Brake: Emiss Rate	Tire: Emiss Rate
1994	0.02	1799.	0.012	0.013	0.008
1993	0.11	10768.	0.012	0.013	0.008
1992	0.11	24576.	0.012	0.013	0.008
1991	0.11	37637.	0.012	0.013	0.008
1990	0.10	49991.	0.012	0.013	0.008
1989	0.09	61679.	0.012	0.013	0.008
1988	0.08	72735.	0.012	0.013	0.008
1987	0.06	83193.	0.012	0.013	0.008
1986	0.05	93085.	0.014	0.013	0.008
1985	0.05	102442.	0.016	0.013	0.008
1984	0.04	111294.	0.016	0.013	0.008
1983	0.04	119667.	0.015	0.013	0.008
1982	0.03	127586.	0.016	0.013	0.008
1981	0.03	135078.	0.017	0.013	0.008
1980	0.02	142165.	0.026	0.013	0.008
1979	0.01	148869.	0.019	0.013	0.008
1978	0.01	155210.	0.019	0.013	0.008
1977	0.01	161208.	0.018	0.013	0.008
1976	0.01	166882.	0.019	0.013	0.008
1975	0.00	172249.	0.019	0.013	0.008
1974	0.00	177326.	0.043	0.013	0.008
1973	0.00	182129.	0.043	0.013	0.008
1972	0.00	186672.	0.043	0.013	0.008
1971	0.00	190970.	0.043	0.013	0.008
1970	0.00	195034.	0.043	0.013	0.008
Composite:			0.014	0.013	0.008

Figure 4a (continued)

...Continued

PART5 Revised 02-24-95

Sample with OUTFMT = 5

scenel

Emission Factors (Gm/Mile)

Light Duty Gas Vehicles

January 1, 1994

Model Year	TF	Miles	Total PM: Emiss Rate
1994	0.02	1799.	0.055
1993	0.11	10768.	0.055
1992	0.11	24576.	0.055
1991	0.11	37637.	0.055
1990	0.10	49991.	0.055
1989	0.09	61679.	0.055
1988	0.08	72735.	0.055
1987	0.06	83193.	0.055
1986	0.05	93085.	0.057
1985	0.05	102442.	0.059
1984	0.04	111294.	0.060
1983	0.04	119667.	0.060
1982	0.03	127586.	0.061
1981	0.03	135078.	0.062
1980	0.02	142165.	0.073
1979	0.01	148869.	0.070
1978	0.01	155210.	0.071
1977	0.01	161208.	0.073
1976	0.01	166882.	0.076
1975	0.00	172249.	0.080
1974	0.00	177326.	0.108
1973	0.00	182129.	0.108
1972	0.00	186672.	0.107
1971	0.00	190970.	0.108
1970	0.00	195034.	0.105
Composite:			0.058

Figure 5

```
Sample with PRTFLG = 2
1      :VMFLAG (alternate VMT mixes)
1      :MYMRFG (alternate mileage accumulation rates & registration)
1      :IMFLAG (Inspection and maintenance)
1      :RFGFLG (2 to apply reformulated gasoline effects, 1 not to)
3      :OUTFMT (indicates type of output format)
1      :IDLFLG (2 to print, 1 not to print idle emission factors)
1      :SO2FLG (2 to print Gaseous SO2 emissions, 1 not to print them)
2      :PRTFLG (determines which pollutants to print out)
1      :BUSFLG (determines which alternative bus cycles to print out)
1 1994 1 19.6     : region, year, speed cycle, speed
04.3 05.1   2     : unpaved silt%, ind. silt g/m^2, WHEELFLG
140               : number of precip. days
scene1                            :scene name
10.   -- Particle size cutoff
6000
04
```

Figure 5a

PART5 Revised 02-24-95

Sample with PRTFLG = 2

scene1

Particle Size Cutoff 10.00 Microns Altitude: 500. Ft. Driving: Transient RFG:No

Cal. Year: 1994 I/M Program: No Region: Low

Veh. Type:	LDGV	LDGT1	LDGT2	HDGV	MC	LDDV	LDDT	2BHDDV	LHDDV	MHDDV	HHDDV	BUSES	All Veh.
Veh. Speeds:	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6
VMT Mix:	0.6337	0.1760	0.0831	0.0307	0.0072	0.0045	0.0017	0.0102	0.0012	0.0137	0.0344	0.0035	
Composite Emission Factors (g/mi)													
Lead:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SOF:	-	-	-	-	-	0.062	0.200	0.157	0.457	0.495	0.322	0.539	-
RCP:	-	-	-	-	-	0.220	0.139	0.151	0.440	0.630	1.021	0.685	-
Direct SO4:	0.009	0.010	0.009	0.008	0.002	0.006	0.007	0.016	0.024	0.030	0.037	0.036	0.010
Exhaust PM:	0.014	0.018	0.040	0.154	0.020	0.288	0.346	0.324	0.921	1.156	1.380	1.260	0.094

Figure 6

```
Sample with PRTFLG = 1
1      :VMFLAG (alternate VMT mixes)
1      :MYMRFG (alternate mileage accumulation rates & registration)
1      :IMFLAG (Inspection and maintenance)
1      :RFGFLG (2 to apply reformulated gasoline effects, 1 not to)
3      :OUTFMT (indicates type of output format)
1      :IDLFLG (2 to print, 1 not to print idle emission factors)
1      :SO2FLG (2 to print Gaseous SO2 emissions, 1 not to print them)
1      :PRTFLG (determines which pollutants to print out)
1      :BUSFLG (determines which alternative bus cycles to print out)
1 1994 1 19.6     : region, year, speed cycle, speed
04.3 05.1   2     : unpaved silt%, ind. silt g/m^2, WHEELFLG
140               : number of precip. days
scene1                            :scene name
10.   -- Particle size cutoff
6000
04
```

Figure 6a

PART5 Revised 02-24-95

Sample with PRTFLG = 1

scene1

Particle Size Cutoff 10.00 Microns — Altitude: 500. Ft. — Driving: Transient RFG:No

Cal. Year: 1994 — I/M Program: No — Region: Low

Veh. Type:	LDGV	LDGT1	LDGT2	HDGV	MC	LDDV	LDDT	2BHDDV	LHDDV	MHDDV	HHDDV	BUSES	All Veh.
Veh. Speeds:	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6
VMT Mix:	0.6337	0.1760	0.0831	0.0307	0.0072	0.0045	0.0017	0.0102	0.0012	0.0137	0.0344	0.0035	
Composite Emission Factors (g/mi)													
Lead:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SOF:	-	-	-	-	-	0.062	0.200	0.157	0.457	0.495	0.322	0.539	-
RCP:	-	-	-	-	-	0.220	0.139	0.151	0.440	0.630	1.021	0.685	-
Direct SO4:	0.009	0.010	0.009	0.008	0.002	0.006	0.007	0.016	0.024	0.030	0.037	0.036	0.010
Exhaust PM:	0.014	0.018	0.040	0.154	0.020	0.288	0.346	0.324	0.921	1.156	1.380	1.260	0.094
Indir. SO4:	0.023	0.031	0.032	0.059	0.009	0.032	0.039	0.064	0.097	0.125	0.154	0.149	0.033
Sulfate PM:	0.032	0.040	0.041	0.067	0.011	0.038	0.046	0.080	0.120	0.156	0.191	0.186	0.043
Brake:	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Tire:	0.008	0.008	0.008	0.012	0.004	0.008	0.008	0.008	0.012	0.012	0.036	0.008	0.009
Total PM:	0.058	0.070	0.092	0.237	0.046	0.341	0.405	0.409	1.042	1.306	1.583	1.430	0.149

Fugitive Dust: Unpaved Roads Fleet Average 139.04 g/mi (as calculated in AP42 Vol 1 9/88)*

Paved Roads Fleet Average 13.41 g/mi (as calculated in draft AP42 Vol 1 3/93)*

Unpaved Roads Fleet Average 138.83 g/mi (as calculated in AP42 Vol 1 9/88, minus tailpipe and tire-wear emissions)**

Paved Roads Fleet Average 13.21 g/mi (as calculated in draft AP42 Vol 1 3/93, minus tailpipe and tire-wear emissions)**

* Includes fleet average tailpipe, tire-wear and brake-wear emissions.

** Includes fleet average brake-wear emissions.

Paved Road Silt: 5.10 (g/m^2)

Unpaved Silt: 4.3%

Precipitation Days: 140 >0.01 in. (per year)

Fleet average vehicle weight: 6000

Fleet average number of wheels: 4

Figure 7

```
Sample with OUTFMT = 3 and BUSFLG=2
1      :VMFLAG (alternate VMT mixes)
1      :MYMRFG (alternate mileage accumulation rates & registration)
1      :IMFLAG (Inspection and maintenance)
1      :RFGFLG (2 to apply reformulated gasoline effects, 1 not to)
3      :OUTFMT (indicates type of output format)
1      :IDLFLG (2 to print idle emissions, 1 not to print them)
1      :SO2FLG (2 to print Gaseous SO2 emissions, 1 not to print them)
3      :PRTFLG (determines which pollutants to print out)
2      :BUSFLG (determines which alternative bus cycles to print out)
1 1994 1 19.6     : region, year, speed cycle, speed
04.3 05.1   2     : unpaved silt%, ind. silt g/m^2, WHEELFLG
140               : number of precip. days
scene1                            :scene name
10.   -- Particle size cutoff
6000              : fleet average vehicle weight
04                : fleet average vehicle wheels
```

Figure 7a

PART5 Revised 02-24-95

Sample with OUTFMT = 3 and BUSFLG=2

scene1

Particle Size Cutoff 10.00 Microns — Altitude: 500. Ft. — Driving: Transient RFG:No

Cal. Year: 1994 — I/M Program: No — Region: Low

Veh. Type:	LDGV	LDGT1	LDGT2	HDGV	MC	LDDV	LDDT	2BHDDV	LHDDV	MHDDV	HHDDV	BUSES	All Veh.	Transit Buses**	CBD Buses*
Veh. Speeds:	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	18.5	10.6
VMT Mix:	0.6337	0.1760	0.0831	0.0307	0.0072	0.0045	0.0017	0.0102	0.0012	0.0137	0.0344	0.0035			
Composite Emission Factors (g/mi)															
Exhaust PM:	0.014	0.018	0.040	0.154	0.020	0.288	0.346	0.324	0.921	1.156	1.380	1.260	0.094	1.477	3.536
Brake:	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Tire:	0.008	0.008	0.008	0.012	0.004	0.008	0.008	0.008	0.012	0.012	0.036	0.008	0.009	0.008	0.008
Total PM:	0.058	0.070	0.092	0.237	0.046	0.341	0.405	0.409	1.042	1.306	1.583	1.430	0.149	1.723	3.830

Fugitive Dust: Unpaved Roads Fleet Average 139.04 g/mi (as calculated in AP42 Vol 1 9/88)*

Paved Roads Fleet Average 13.41 g/mi (as calculated in draft AP42 Vol 1 3/93)*

Unpaved Roads Fleet Average 138.83 g/mi (as calculated in AP42 Vol 1 9/88, minus tailpipe and tire-wear emissions)**

Paved Roads Fleet Average 13.21 g/mi (as calculated in draft AP42 Vol 1 3/93, minus tailpipe and tire-wear emissions)**

* Includes fleet average tailpipe, tire-wear and brake-wear emissions.

** Includes fleet average brake-wear emissions.

Paved Road Silt: 5.10 (g/m^2)

Unpaved Silt: 4.3%

Precipitation Days: 140 >0.01 in. (per year)

Fleet average vehicle weight: 6000

Fleet average number of wheels: 4

** Not Included in All Veh.

Figure 8

```
Sample Input File Using Many User Optional Inputs
3      :VMFLAG (alternate VMT mixes)
4      :MYMRFG (alternate mileage accumulation rates & registration)
1      :IMFLAG (Inspection and maintenance)
2      :RFGFLG (2 to apply reformulated gasoline effects, 1 not to)
5      :OUTFMT (indicates type of output format)
1      :IDLFLG (2 to print, 1 not to print idle emission factors)
1      :SO2FLG (2 to print Gaseous SO2 emissions, 1 not to print them)
3      :PRTFLG (determines which pollutants to print out)
1      :BUSFLG (determines which alternative bus cycles to print out)
0.6340 0.1760 0.0830 0.0310 0.0070 0.0040            :VMT MIX
0.0020 0.0100 0.0010 0.0140 0.0340 0.0040            :VMT MIX
14390 .13612 .12875 .12180 .11522 .10899 .10310 .09751 .09225 .08726
08254 .07807 .07386 .06987 .06608 .06251 .05913 .05594 .05291 .05005
04735 .04478 .04237 .04007 .03790                                LDGV
15442 .14508 .13631 .12807 .12032 .11305 .10621 .09979 .09376 .08809
08276 .07776 .07306 .06864 .06449 .06059 .05693 .05348 .05025 .04721
04436 .04168 .03916 .03679 .03456                                LDGT1
14779 .14259 .13758 .13275 .12809 .12359 .11924 .11505 .11101 .10711
10335 .09972 .09621 .09283 .08957 .08642 .08339 .08046 .07763 .07490
07227 .06973 .06728 .06492 .06264                                LDGT2
17251 .16185 .15185 .14246 .13365 .12539 .11764 .11037 .10355 .09715
09114 .08551 .08022 .07526 .07061 .06625 .06215 .05831 .05471 .05132
04815 .04517 .04238 .03976 .03730                                HDGV
04786 .04475 .04164 .03853 .03543 .03232 .02921 .02611 .02300 .01989
01678 .01368 .00000 .00000 .00000 .00000 .00000 .00000 .00000 .00000
00000 .00000 .00000 .00000 .00000                               MC
17825 .16478 .15233 .14081 .13017 .12033 .11124 .10283 .09506 .08788
08123 .07509 .06942 .06417 .05932 .05484 .05069 .04686 .04332 .04005
03702 .03422 .03163 .02924 .02703                                LDDV
20140 .17572 .15432 .13639 .12133 .10863 .09788 .08877 .08103 .07444
06883 .06405 .05999 .05655 .05365 .05123 .04924 .04763 .04637 .04543
03342 .03080 .02839 .02616 .02411                                LDDT
22517 .20009 .17779 .15798 .14038 .12474 .11084 .09849 .08752 .07777
06910 .06140 .05456 .04848 .04308 .03828 .03402 .03023 .02686 .02387
02121 .01884 .01675 .01488 .01322                                2BHDDV
24239 .23273 .22346 .21455 .20600 .19779 .18990 .18233 .17507 .16809
16139 .15496 .14878 .14285 .13716 .13169 .12644 .12140 .11656 .11192
10746 .10317 .09906 .09511 .09132                                LHDVM
26081 .25204 .24357 .23538 .22746 .21982 .21243 .20528 .19838 .19171
18527 .17904 .17302 .16720 .16158 .15614 .15089 .14582 .14092 .13618
13160 .12718 .12290 .11877 .11478                                MHDVM
62176 .58663 .55348 .52220 .49269 .46485 .43858 .41380 .39042 .36836
34754 .32790 .30937 .29189 .27540 .25983 .24515 .23130 .21823 .20590
19426 .18328 .17293 .16315 .15393                                HHDVM
25354 .23317 .21443 .19720 .18135 .16678 .15338 .14106 .12972 .11929
10971 .10090 .09279 .08533 .07847 .07216 .06637 .06103 .05613 .05161
04760 .04397 .04074 .03787 .03541                                BUSES
049 .079 .083 .082 .084 .081 .077 .056 .050 .051
050 .054 .047 .037 .024 .019 .014 .015 .011 .008
006 .005 .004 .003 .010                                LDGV
063 .084 .084 .084 .084 .069 .059 .044 .036 .031
```

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Figure 8 (continued)

```
030 .053 .047 .046 .036 .028 .017 .022 .017 .014
009 .008 .008 .005 .025                                  LDGT1
054 .072 .072 .072 .072 .052 .050 .034 .054 .031
028 .080 .084 .049 .039 .030 .018 .023 .018 .015
009 .008 .009 .006 .026                                  LDGT2
023 .047 .047 .047 .047 .038 .033 .021 .026 .029
034 .064 .054 .058 .051 .038 .043 .041 .035 .029
021 .022 .022 .014 .117                                  HDGV
144 .168 .135 .109 .088 .070 .056 .045 .036 .029
023 .097 .000 .000 .000 .000 .000 .000 .000 .000
000 .000 .000 .000 .000                                  MC
049 .079 .083 .082 .084 .081 .077 .056 .050 .051
050 .054 .047 .037 .024 .019 .014 .015 .011 .008
006 .005 .004 .003 .010                                  LDDV
063 .084 .084 .084 .084 .069 .059 .044 .036 .031
030 .053 .047 .046 .036 .028 .017 .022 .017 .014
009 .008 .008 .005 .025                                  LDDT
043 .084 .084 .084 .084 .091 .076 .050 .051 .064
066 .083 .069 .071 .000 .000 .000 .000 .000 .000
000 .000 .000 .000 .000                                  2BHDDV
000 .000 .000 .000 .000 .000 .000 .000 .000 .000
000 .000 .000 .000 .000 .000 .000 .000 .273 .182
125 .102 .080 .057 .182                                  LHDVV
034 .067 .067 .067 .067 .073 .061 .040 .041 .051
053 .066 .055 .057 .045 .019 .023 .028 .024 .016
011 .009 .007 .005 .016                                  MHDVV
034 .067 .067 .067 .067 .073 .061 .040 .041 .051
053 .066 .055 .057 .045 .019 .023 .028 .024 .016
011 .009 .007 .005 .016                                  HHDVV
030 .060 .059 .058 .057 .055 .054 .053 .052 .050
050 .049 .047 .046 .045 .044 .044 .043 .042 .010
008 .007 .006 .005 .025                                  BUSES
211111111111
1 1994 1 19.6     : region, year, speed cycle, speed
04.3 05.1   2     : unpaved silt%, ind. silt g/m^2, WHEELFLG
140               : number of precip. days
scene1                          :scene name
10.   -- Particle size cutoff
6000
04
```

Figure 8a

WARNING: According to historical records
there are no Class 2B Heavy Duty Diesel vehicles
for model years before 1981 or Light Heavy Duty
Diesel vehicles after 1976. PART5 will always
assume 0.0 registration for these vehicles
during those periods.

PART5 Revised 02-24-95
Sample Input File Using Many User Optional Inputs

User supplied veh miles traveled mixture , mileage accrual distributions , veh registration distributions.

scene1
Particle Size Cutoff 10.00 Microns Altitude: 500. Ft. Driving: Transient RFG:No
Cal. Year: 1994 I/M Program: No Region: Low

Veh. Type:	LDGV	LDGT1	LDGT2	HDGV	MC	LDDV	LDDT	2BHDDV	LHDDV	MHDDV	HHDDV	BUSES	All Veh.
Veh. Speeds:	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6
VMT Mix:	0.6340	0.1760	0.0830	0.0310	0.0070	0.0040	0.0020	0.0100	0.0010	0.0140	0.0340	0.0040	
Composite Emission Factors (g/mi)													
Exhaust PM:	0.014	0.018	0.040	0.154	0.020	0.288	0.346	0.324	0.921	1.156	1.380	1.260	0.094
Brake:	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Tire:	0.008	0.008	0.008	0.012	0.004	0.008	0.008	0.008	0.012	0.012	0.036	0.008	0.009
Total PM:	0.058	0.070	0.092	0.237	0.046	0.341	0.405	0.409	1.042	1.306	1.583	1.430	0.149

Fugitive Dust: Unpaved Roads Fleet Average 139.04 g/mi (as calculated in AP42 Vol 1 9/88)*
Paved Roads Fleet Average 13.41 g/mi (as calculated in draft AP42 Vol 1 3/93)*
Unpaved Roads Fleet Average 138.83 g/mi (as calculated in AP42 Vol 1 9/88, minus tailpipe and tire-wear emissions)**
Paved Roads Fleet Average 13.21 g/mi (as calculated in draft AP42 Vol 1 3/93, minus tailpipe and tire-wear emissions)**

* Includes fleet average tailpipe, tire-wear and brake-wear emissions.
** Includes fleet average brake-wear emissions.

Paved Road Silt: 5.10 (g/m^2) Fleet average vehicle weight: 6000
Unpaved Silt: 4.3% Fleet average number of wheels: 4
Precipitation Days: 140 >0.01 in. (per year)

Figure 8a (continued)

PART5 Revised 02-24-95

Sample Input File Using Many User Optional Inputs

scene1

Emission Factors (Gm/Mile)

Light Duty Gas Vehicles

January 1, 1994

Model Year	TF	Miles	Exhaust PM: Emiss Rate	Brake: Emiss Rate	Tire: Emiss Rate
1994	0.02	1799.	0.012	0.013	0.008
1993	0.11	10768.	0.012	0.013	0.008
1992	0.11	24576.	0.012	0.013	0.008
1991	0.11	37637.	0.012	0.013	0.008
1990	0.10	49991.	0.012	0.013	0.008
1989	0.09	61679.	0.012	0.013	0.008
1988	0.08	72735.	0.012	0.013	0.008
1987	0.06	83193.	0.012	0.013	0.008
1986	0.05	93085.	0.014	0.013	0.008
1985	0.05	102442.	0.016	0.013	0.008
1984	0.04	111294.	0.016	0.013	0.008
1983	0.04	119667.	0.015	0.013	0.008
1982	0.03	127586.	0.016	0.013	0.008
1981	0.03	135078.	0.017	0.013	0.008
1980	0.02	142165.	0.026	0.013	0.008
1979	0.01	148869.	0.019	0.013	0.008
1978	0.01	155210.	0.019	0.013	0.008
1977	0.01	161208.	0.018	0.013	0.008
1976	0.01	166882.	0.019	0.013	0.008
1975	0.00	172249.	0.019	0.013	0.008
1974	0.00	177326.	0.043	0.013	0.008
1973	0.00	182129.	0.043	0.013	0.008
1972	0.00	186672.	0.043	0.013	0.008
1971	0.00	190970.	0.043	0.013	0.008
1970	0.00	195034.	0.043	0.013	0.008
Composite:			0.014	0.013	0.008

Figure 8a (continued)

...Continued

PART5 Revised 02-24-95

Sample Input File Using Many User Optional Inputs

scene1

Emission Factors (Gm/Mile)

Light Duty Gas Vehicles

January 1, 1994

Model Year	TF	Miles	Total PM: Emiss Rate
1994	0.02	1799.	0.055
1993	0.11	10768.	0.055
1992	0.11	24576.	0.055
1991	0.11	37637.	0.055
1990	0.10	49991.	0.055
1989	0.09	61679.	0.055
1988	0.08	72735.	0.055
1987	0.06	83193.	0.055
1986	0.05	93085.	0.057
1985	0.05	102442.	0.059
1984	0.04	111294.	0.060
1983	0.04	119667.	0.060
1982	0.03	127586.	0.061
1981	0.03	135078.	0.062
1980	0.02	142165.	0.073
1979	0.01	148869.	0.070
1978	0.01	155210.	0.071
1977	0.01	161208.	0.073
1976	0.01	166882.	0.076
1975	0.00	172249.	0.080
1974	0.00	177326.	0.108
1973	0.00	182129.	0.108
1972	0.00	186672.	0.107
1971	0.00	190970.	0.108
1970	0.00	195034.	0.105
Composite:			0.058

Figure 9

```
Sample with TRAPFLG=2, showing percentages of bus traps
1      :VMFLAG (alternate VMT mixes)
1      :MYMRFG (alternate mileage accumulation rates & registration)
1      :IMFLAG (Inspection and maintenance)
1      :RFGFLG (2 to apply reformulated gasoline effects, 1 not to)
3      :OUTFMT (indicates type of output format)
1      :IDLFLG (2 to print, 1 not to print idle emission factors)
1      :SO2FLG (2 to print, 1 not to print Gaseous SO2 emission factors)
3      :PRTFLG (determines which pollutants to print out)
2      :BUSFLG (determines which alternative bus cycles to print out)
1 1998 1 19.6     : region, year, speed cycle, speed
04.3 05.1   2     : unpaved silt%, ind. silt g/m^2, WHEELFLG
140 2 100.0 100.0: number of precip. days, TRAPFLG, 92 TRAP %, 93 TRAP %
100% trap ef's, 0% no trap ef's
10.   -- Particle size cutoff
6000
04
1 1998 1 19.6     : region, year, speed cycle, speed
04.3 05.1   2     : unpaved silt%, ind. silt g/m^2, WHEELFLG
140 1             : number of precip. days, TRAPFLG
100% no traps for buses
10.   -- Particle size cutoff
6000
04
1 1998 1 19.6     : region, year, speed cycle, speed
04.3 05.1   2     : unpaved silt%, ind. silt g/m^2, WHEELFLG
140 2 000.0 000.0: number of precip. days, TRAPFLG, 92 TRAP %, 93 TRAP %
0% trap ef's, 100% no trap ef's
10.   -- Particle size cutoff
6000
04
1 1998 1 19.6     : region, year, speed cycle, speed
04.3 05.1   2     : unpaved silt%, ind. silt g/m^2, WHEELFLG
140 2 050.0 050.0: number of precip. days, TRAPFLG, 92 TRAP %, 93 TRAP %
50% trap ef's, 50% no trap ef's
10.   -- Particle size cutoff
6000
04
```

Figure 9a

PART5 Revised 02-24-95

Sample with TRAPFLG=2, showing percentages of bus traps

100% trap ef's, 0% no trap ef's

Particle Size Cutoff 10.00 Microns — Altitude: 500. Ft. — Driving: Transient RFG:No

Cal. Year: 1998 — I/M Program: No — Region: Low

Veh. Type:	LDGV	LDGT1	LDGT2	HDGV	MC	LDDV	LDDT	2BHDDV	LHDDV	MHDDV	HHDDV	BUSES	All Veh.	Transit Buses**	CBD Buses*
Veh. Speeds:	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	18.5	10.6
VMT Mix:	0.6203	0.1864	0.0849	0.0309	0.0066	0.0019	0.0011	0.0123	0.0013	0.0157	0.0354	0.0032			
Composite Emission Factors (g/mi)															
Exhaust PM:	0.013	0.017	0.026	0.121	0.020	0.238	0.274	0.206	0.894	0.796	0.928	0.737	0.069	0.871	2.086
Brake:	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Tire:	0.008	0.008	0.008	0.012	0.004	0.008	0.008	0.008	0.012	0.012	0.036	0.008	0.009	0.008	0.008
Total PM:	0.056	0.067	0.077	0.200	0.046	0.290	0.333	0.289	1.017	0.942	1.125	0.902	0.124	1.117	2.380

Fugitive Dust: Unpaved Roads Fleet Average 139.04 g/mi (as calculated in AP42 Vol 1 9/88)*

Paved Roads Fleet Average 13.41 g/mi (as calculated in draft AP42 Vol 1 3/93)*

Unpaved Roads Fleet Average 138.83 g/mi (as calculated in AP42 Vol 1 9/88, minus tailpipe and tire-wear emissions)**

Paved Roads Fleet Average 13.21 g/mi (as calculated in draft AP42 Vol 1 3/93, minus tailpipe and tire-wear emissions)**

* Includes fleet average tailpipe, tire-wear and brake-wear emissions.

** Includes fleet average brake-wear emissions.

Paved Road Silt: 5.10 (g/m^2)

Unpaved Silt: 4.3%

Precipitation Days: 140 >0.01 in. (per year)

Fleet average vehicle weight: 6000

Fleet average number of wheels: 4

** Not Included in All Veh.

Figure 9a (continued)

100% no traps for buses

Particle Size Cutoff 10.00 Microns — Altitude: 500. Ft. — Driving: Transient RFG:No

Cal. Year: 1998 — I/M Program: No — Region: Low

Veh. Type:	LDGV	LDGT1	LDGT2	HDGV	MC	LDDV	LDDT	2BHDDV	LHDDV	MHDDV	HHDDV	BUSES	All Veh.	Transit Buses**	CBD Buses*
Veh. Speeds:	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	18.5	10.6
VMT Mix:	0.6203	0.1864	0.0849	0.0309	0.0066	0.0019	0.0011	0.0123	0.0013	0.0157	0.0354	0.0032			
Composite Emission Factors (g/mi)															
Exhaust PM:	0.013	0.017	0.026	0.121	0.020	0.238	0.274	0.206	0.894	0.796	0.928	0.788	0.070	0.934	2.237
Brake:	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Tire:	0.008	0.008	0.008	0.012	0.004	0.008	0.008	0.008	0.012	0.012	0.036	0.008	0.009	0.008	0.008
Total PM:	0.056	0.067	0.077	0.200	0.046	0.290	0.333	0.289	1.017	0.942	1.125	0.953	0.124	1.180	2.530

Fugitive Dust: Unpaved Roads Fleet Average 139.04 g/mi (as calculated in AP42 Vol 1 9/88)*

Paved Roads Fleet Average 13.41 g/mi (as calculated in draft AP42 Vol 1 3/93)*

Unpaved Roads Fleet Average 138.83 g/mi (as calculated in AP42 Vol 1 9/88, minus tailpipe and tire-wear emissions)**

Paved Roads Fleet Average 13.21 g/mi (as calculated in draft AP42 Vol 1 3/93, minus tailpipe and tire-wear emissions)**

* Includes fleet average tailpipe, tire-wear and brake-wear emissions.

** Includes fleet average brake-wear emissions.

Paved Road Silt: 5.10 (g/m^2)

Unpaved Silt: 4.3%

Precipitation Days: 140 >0.01 in. (per year)

Fleet average vehicle weight: 6000

Fleet average number of wheels: 4

** Not Included in All Veh.

Figure 9a (continued)

0% trap ef's, 100% no trap ef's

Particle Size Cutoff 10.00 Microns — Altitude: 500. Ft. — Driving: Transient RFG:No

Cal. Year: 1998 — I/M Program: No — Region: Low

Veh. Type:	LDGV	LDGT1	LDGT2	HDGV	MC	LDDV	LDDT	2BHDDV	LHDDV	MHDDV	HHDDV	BUSES	All Veh.	Transit Buses**	CBD Buses*
Veh. Speeds:	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	18.5	10.6
VMT Mix:	0.6203	0.1864	0.0849	0.0309	0.0066	0.0019	0.0011	0.0123	0.0013	0.0157	0.0354	0.0032			
Composite Emission Factors (g/mi)															
Exhaust PM:	0.013	0.017	0.026	0.121	0.020	0.238	0.274	0.206	0.894	0.796	0.928	0.788	0.070	0.934	2.237
Brake:	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Tire:	0.008	0.008	0.008	0.012	0.004	0.008	0.008	0.008	0.012	0.012	0.036	0.008	0.009	0.008	0.008
Total PM:	0.056	0.067	0.077	0.200	0.046	0.290	0.333	0.289	1.017	0.942	1.125	0.953	0.124	1.180	2.530

Fugitive Dust: Unpaved Roads Fleet Average 139.04 g/mi (as calculated in AP42 Vol 1 9/88)*

Paved Roads Fleet Average 13.41 g/mi (as calculated in draft AP42 Vol 1 3/93)*

Unpaved Roads Fleet Average 138.83 g/mi (as calculated in AP42 Vol 1 9/88, minus tailpipe and tire-wear emissions)**

Paved Roads Fleet Average 13.21 g/mi (as calculated in draft AP42 Vol 1 3/93, minus tailpipe and tire-wear emissions)**

* Includes fleet average tailpipe, tire-wear and brake-wear emissions.

** Includes fleet average brake-wear emissions.

Paved Road Silt: 5.10 (g/m^2)

Unpaved Silt: 4.3%

Precipitation Days: 140 >0.01 in. (per year)

Fleet average vehicle weight: 6000

Fleet average number of wheels: 4

** Not Included in All Veh.

Figure 9a (continued)

50% trap ef's, 50% no trap ef's

Particle Size Cutoff 10.00 Microns — Altitude: 500. Ft. — Driving: Transient RFG:No

Cal. Year: 1998 — I/M Program: No — Region: Low

Veh. Type:	LDGV	LDGT1	LDGT2	HDGV	MC	LDDV	LDDT	2BHDDV	LHDDV	MHDDV	HHDDV	BUSES	All Veh.	Transit Buses**	CBD Buses*
Veh. Speeds:	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	18.5	10.6
VMT Mix:	0.6203	0.1864	0.0849	0.0309	0.0066	0.0019	0.0011	0.0123	0.0013	0.0157	0.0354	0.0032			
Composite Emission Factors (g/mi)															
Exhaust PM:	0.013	0.017	0.026	0.121	0.020	0.238	0.274	0.206	0.894	0.796	0.928	0.763	0.070	0.903	2.161
Brake:	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Tire:	0.008	0.008	0.008	0.012	0.004	0.008	0.008	0.008	0.012	0.012	0.036	0.008	0.009	0.008	0.008
Total PM:	0.056	0.067	0.077	0.200	0.046	0.290	0.333	0.289	1.017	0.942	1.125	0.927	0.124	1.149	2.455

Fugitive Dust: Unpaved Roads Fleet Average 139.04 g/mi (as calculated in AP42 Vol 1 9/88)*

Paved Roads Fleet Average 13.41 g/mi (as calculated in draft AP42 Vol 1 3/93)*

Unpaved Roads Fleet Average 138.83 g/mi (as calculated in AP42 Vol 1 9/88, minus tailpipe and tire-wear emissions)**

Paved Roads Fleet Average 13.21 g/mi (as calculated in draft AP42 Vol 1 3/93, minus tailpipe and tire-wear emissions)**

* Includes fleet average tailpipe, tire-wear and brake-wear emissions.

** Includes fleet average brake-wear emissions.

Paved Road Silt: 5.10 (g/m^2)

Unpaved Silt: 4.3%

Precipitation Days: 140 >0.01 in. (per year)

Fleet average vehicle weight: 6000

Fleet average number of wheels: 4

** Not Included in All Veh.

Appendix

PARTICULATE EMISSION FACTORS FOR MOBILE SOURCES AS CALCULATED IN THE MODEL PART5

1 INTRODUCTION

This appendix describes the methodologies used to calculate particulate emission factors from motor vehicles in the computer model PART5. PART5 is designed to estimate particulate emission factors for a representative vehicle in an average fleet. The model calculates these fleet characteristics, such as the travel fractions, from data that are representative of national averages. The user has the option, in many cases, to input data that represents more closely the characteristics of the region being modeled instead of using the model defaults.

The emission factors calculated by PART5 include the particulate pollutant compounds of lead, sulfate, soluble organic fraction particulate, remaining carbon portion particulate, and total exhausted particulate. The lead and sulfate are formed from the lead and sulfur contained in the fuel. The soluble organic fraction consists primarily of hydrocarbons coming from unburned or partially burned fuel and lubricating oil. The remaining carbon portion consists of soot-like carbon (elemental carbon) and trace amounts of other components from the fuel and lubricating oil. The total exhaust particulate is the sum of these four categories. In addition to these categories of exhaust emissions, idle exhaust emissions[1], brake wear, tire wear, fugitive dust, indirect sulfate, and gaseous sulfur dioxide are also calculated.

The model calculates the emission factors for 12 vehicle classes and a fleet-wide average (estimated by vehicle miles traveled (VMT) weighting of the emission factors for all 12 classes). The vehicle classes include light-duty gasoline vehicles, two classes of light-duty gasoline trucks, heavy-duty gasoline trucks, motorcycles, light-duty diesel vehicles, light-duty diesel trucks, four classes of heavy-duty diesel trucks, and buses. To account for older vehicles on the road, the emission factors reported for each vehicle class are composites of emission factors for vehicles 25+ years old through the calendar year of evaluation (the calendar year of evaluation is provided by the user.) The composite emission factor for each vehicle class is calculated by weighting the emission factor calculated for each model year by the travel fraction for that model year, and then summing the 25 weighted factors. The travel fraction of a model year is the fraction of miles traveled by a vehicle of that model year out of the total number of miles traveled by all model years' vehicles in that vehicle class:

$$EFCOMP_v = \sum_{m=1}^{25} EF_{m,v} * TF_{m,v} \qquad (1)$$

where

$EFCOMP_v$ = the composite emission factor for vehicle class v,
$EF_{m,v}$ = the emission factor for vehicle class v, model-year m,
$TF_{m,v}$ = the travel fraction for vehicle class v, model-year m.

In turn, the overall travel fraction of a vehicle class represents the fraction of the total number of vehicle miles traveled (VMT) of that class out of the total highway VMT (from all 12 classes). The

[1]* Idle emissions are calculated only for heavy-duty diesel vehicles.

VMT fractions for each vehicle class are multiplied by the corresponding composite emission factors ($EFCOMP_v$), then the sum of these adjusted emission factors is reported as the emission factor for all vehicles:

$$EFALL = \sum_{v=1}^{12} EFCOMP_v * TFCLASS_v \qquad (2)$$

where

$EFALL$ = the weighted emission factor for all vehicles,
$TFCLASS_v$ = the vehicle miles traveled of vehicle class v.

The emission factor for all vehicles, *EFALL*, represents the average g/mi emissions from the entire fleet, so this emission factor, when multiplied by the total number of vehicle miles traveled in a particular region, provides an estimate of the total grams of particulate emissions contributed by the entire on-road motor vehicle fleet.

The rest of this appendix describes in detail the methodologies used to calculate the emission factors for each pollutant category for gasoline-fueled and diesel-fueled vehicles, as well as the factors for dust, brake wear, and tire wear emissions. The adjustment factors for different vehicle speeds and particle size cutoffs are also described.

2 GASOLINE-FUELED VEHICLES

LEAD EMISSION FACTORS

Lead particulate emission factors are based on the assumption that virtually all the lead in fuel is exhausted. As a result, the emission factors (in units of grams per mile) depend principally on the lead content in the fuel and the fuel economy of the vehicle (in miles per gallon). The lead content of leaded fuel is substantially greater than that of unleaded fuel, so the fraction of vehicles that have had their catalysts removed (and thus are assumed to be using leaded fuel in most cases) can also be an important factor in determining the lead emission factor from a vehicle that is representative of the entire fleet.

The lead emission factors for a vehicle of model year *m* and vehicle class *v* (with the exception of motorcycles; see discussion in the next section) are computed in PART5 using the following formula (see the following section, "Lead Particulate Derivation," page 50, for the derivation of all variables and further explanations):

$$\begin{aligned} LEAD_{m,v} = \; & PLNOCT_{m,v} * VLNOCT_{m,v} \\ & + PUNOCT_{m,v} * VUNOCT_{m,v} \\ & + PLYSCT_{m,v} * VLYSCT_{m,v} \\ & + PUYSCT_{m,v} * VUYSCT_{m,v} \end{aligned} \qquad (3)$$

where

$LEAD_{m,v}$ = the lead particulate emissions for a vehicle of model year *m* and vehicle class *v* (g/mi)

$PLNOCT_{m,v}$ = the emissions for a non-catalyst, leaded fuel vehicle of model year *m* and vehicle class *v* (g/mi)

$PUNOCT_{m,v}$ = the emissions for a non-catalyst, unleaded fuel vehicle of model year *m* and vehicle class *v* (g/mi)

$PLYSCT_{m,v}$ = the emissions for a catalyst, leaded fuel vehicle of model year *m* and vehicle class *v* (g/mi)

$PUYSCT_{m,v}$ = the emissions for a catalyst, unleaded fuel vehicle of model year *m* and vehicle class *v* (g/mi)

$VLNOCT_{m,v}$ = the fraction of non-catalyst, leaded fuel vehicles of model year *m* and vehicle class *v*

$VUNOCT_{m,v}$ = the fraction of non-catalyst, unleaded fuel vehicles of model year *m* and vehicle class *v*

$VLYSCT_{m,v}$ = the fraction of catalyst, leaded fuel vehicles of model year *m* and vehicle class *v*

$VUYSCT_{m,v}$ = the fraction of catalyst, unleaded fuel vehicles of model year *m* and vehicle class *v*

This emission rate is adjusted for speed by the factor *FEC* so that:

$$CLEAD_{m,v} = FEC * LEAD_{m,v} \quad (4)$$

where

$CLEAD_{m,v}$ = the lead emissions for a vehicle of model year m and vehicle class v, which has been adjusted for the speed effect (g/mi)

$$FEC = 1 / SCF_c \quad (5)$$

SCF_c = the speed correction factor, based on either transient driving cycle (c=1) or steady cruise driving cycle (c=2):

$$SCF_1 = 0.17930 + (0.038561 * SPEED_v) - (0.00041067 * SPEED_v^2) \quad (6)$$

$$SCF_2 = 0.26929 + (0.054607 * SPEED_v) - (0.00069818 * SPEED_v^2) \quad (7)$$

$SPEED_v$ = the average speed for vehicle class v, user input (mph)

Motorcycles

Due to the absence of catalyst emission controls on motorcycles, organic emission factors are not calculated and sulfate emission factors are negligible. The exhaust particulate printed in the output is almost exclusively lead. The lead particulate emission factor for 2-stroke engines is 0.33 g/mi and for 4-stroke engines is 0.046 g/mi. For pre-1978 model years there were 51% 4-stroke engines and 49% 2-stroke engines (see references page 67, EPA 1985a):

$$LEAD_{m,motorcycle} = [\ (0.49 * 0.33) + (0.51 * 0.046)\ ] * PSL \quad (8)$$

For 1978 and later motorcycles are assumed to consist of 100% 4-stroke engines:

$$LEAD_{m,motorcycle} = 0.046 * PSL \quad (9)$$

where

PSL = the fraction of all particles that are emitted based on user input of the particle size cutoff

Lead Particulate Derivation

The original formulae for lead particulate are found and described in reference EPA 1985a, equation numbers 2-3, 2-4, and 2-5. All of these equations appropriately combine the amount of particulates per vehicle of a given category (i.e., model year group, catalyst or non-catalyst, leaded or unleaded fuel) with the fraction of vehicles in that category. The basic form of the portion of the equation which determines the amount of lead particulate per vehicle is:

$$LEAD_{m,v} = (ABURN * PWR / FE_{m,v}) * PB * PS \qquad (10)$$

where

$ABURN$	=	the fraction of lead burned that is exhausted ($ABURN(1) = 0.75$ for non-catalyst and catalyst vehicles using leaded fuel, $ABURN(2) = 0.40$ for catalyst vehicles using unleaded fuel in calender years 1975-1980, $ABURN(3) = 0.44$ for catalyst vehicles using unleaded fuel in calender years 1981 and later)
PWR	=	particle weight ratio (1.557 = PbClBr/Pb)
$FE_{m,v}$	=	fuel economy for vehicles of class v and model year m (mi/gal)
PB	=	fuel lead content (g/gal) [*PBL* and *PBNL* in formulae below, National Fuel Survey, AAMA 1993]
PS	=	the fraction of all particles that are emitted (*PSL*, *PSNL* and *PSNLCT* in formulae below), based on user input of the particle size cutoff.

All of the other terms in the equations relate to the fraction of vehicles which exhibit each specific particulate emission rate.

For the case of non-catalyst vehicles using leaded fuel, the amount of lead particulates comes from the first term of equations 2-3 and 2-4 of reference EPA 1985a. The speed correction to the fuel economy is handled later in the program by the factor *FEC*, and therefore is not discussed here. We will also drop the discretionary fuel switching term from the equation. This term will be used later to determine the fraction of non-catalyst vehicles using leaded and unleaded fuel. The final form is:

$$PLNOCT_{m,v} = (ABURN(1) * 1.557 / FE_{m,v}) * PBL * PSL \qquad (11)$$

For the case of non-catalyst vehicles using unleaded fuel, the amount of lead particulates comes from the second term of equation 2-3 and 2-4 of reference EPA 1985a. Again the discretionary fuel switching and the speed correction to fuel economy terms are dropped from the equation here (they are handled later in the program). The final form is:

$$PUNOCT_{m,v} = (ABURN(1) * 1.557 / FE_{m,v}) * PBNL * PSNL \qquad (12)$$

For the case of catalyst equipped vehicles using unleaded fuel, the amount of lead particulates comes from the first term of equation 2-5 of reference EPA 1985a. The speed correction to the fuel economy is handled later in the program by the factor *FEC*, and therefore can be ignored here. The term for misfueling can also be removed, since it will be used later to determine the fraction of catalyst equipped vehicles using leaded and unleaded fuel. The final form as:

$$PUYSCT_{m,v} = (ABURN(2 \text{ or } 3) * 1.557 / FE_{m,v}) * PBNL * PSNLCT \qquad (13)$$

Note that catalyst equipped vehicles burning unleaded fuel have a different fraction of lead burned exhausted (*ABURN*) than the other categories and that it depends on the model year of the vehicle.

For the case of catalyst-equipped vehicles using leaded fuel, the amount of lead particulates comes from the remaining terms of equation 2-5 of reference EPA 1985b. The speed correction to the fuel economy is handled later in the program by the factor *FEC*, and therefore can be ignored here. The terms for misfueling and for catalyst removal can also be ignored here, since these will be used later to determine the fraction of vehicles which are catalyst equipped and what fraction of catalyst-equipped vehicles use leaded and unleaded fuel. The final form is:

$$PLYSCT_{m,v} = (ABURN(1) * 1.557 / FE_{m,v}) * PBL * PSL \qquad (14)$$

There are four different combinations of catalyst and misfueling which will each have a separate estimate of particulate emissions. They are:

Catalyst-equipped vehicles using unleaded fuel
Catalyst-equipped vehicles using leaded fuel
Non-catalyst vehicles using unleaded fuel
Non-catalyst vehicles using leaded fuel

First the number of catalyst equipped vehicles must be determined. $CATFCT_{m,v}$ is the fraction of all vehicles which are originally catalyst equipped and $TAMFRC_{m,v}$ is the fraction of originally catalyst equipped vehicles which have had their catalyst removed for model year *m* and vehicle class *v*. Therefore, the remaining catalyst equipped vehicles are:

$$CATS_{m,v} = CATFCT_{m,v} * (1.-TAMFRC_{m,v}) \qquad (15)$$

The fraction of non-catalyst vehicles using leaded gasoline, then, would be:

$$VLNOCT_{m,v} = (1.-CATS_{m,v}) * (1.-DFS_{m,v}) \qquad (16)$$

Where $DFS_{m,v}$ is discretionary fuel switching (use of unleaded fuel by non-catalyst vehicles) for model year *m* and vehicle class *v*. The fraction of non-catalyst vehicles using unleaded gasoline is then:

$$VUNOCT_{m,v} = (1.-CATS_{m,v}) * DFS_{m,v} \qquad (17)$$

The fraction of all vehicles equipped with catalysts, but using leaded fuel, would be:

$$VLYSCT_{m,v} = CATFCT_{m,v} * (RMIS_{m,v} - TAMFRC_{m,v}) \qquad (18)$$

This assumes that all vehicles with removed catalysts are a subset of $RMIS_{m,v}$, the misfueling rate for model year *m* and vehicle class *v*. The catalyst removed vehicles are treated as non-catalyst vehicles in the equations above. The remaining vehicles will all be catalyst-equipped vehicles using unleaded fuel. That fraction is:

$$VUYSCT_{m,v} = (1. - VLNOCT_{m,v} - VUNOCT_{m,v} - VLYSCT_{m,v}) \qquad (19)$$

Finally, all of the terms can be combined to give the composite lead particulate emission rate for this vehicle/model year (compare to equation 3):

$$LEAD_{m,v} = PLNOCT_{m,v} * VLNOCT_{m,v} + PUNOCT_{m,v} * VUNOCT_{m,v} + PLYSCT_{m,v} * VLYSCT_{m,v} + PUYSCT_{m,v} * VUYSCT_{m,v} \quad (20)$$

This rate is adjusted for speed by the factor *FEC* so that:

$$CLEAD_{m,v} = FEC * LEAD_{m,v} \quad (21)$$

SULFATE EMISSION FACTORS

The particulate sulfate emission factors consist of direct and indirect sulfate material. The direct sulfate is exhausted as sulfuric acid, and the indirect sulfate is formed later in the atmosphere from exhausted SO_2. The indirect sulfate in the model is calculated based on the assumption that it consists entirely of ammonium sulfate and ammonium bisulfate. The direct sulfate, indirect sulfate, and gaseous sulfur are all computed in the model, and the emission factors are reported as g/mi (EPA 1990).

The direct sulfate from non-catalyst vehicles using leaded fuel (includes catalyst-equipped vehicles which are misfueled, making the catalyst ineffective) is calculated as:

$$DSULFN = .002, \text{ for speeds at or} < 19.6 \text{ mph} \quad (22)$$

$$DSULFN = .001, \text{ for speeds at or} > 34.8 \text{ mph} \quad (23)$$

The direct sulfate from catalyst vehicles is calculated as:

$$DSULFC_{m,v} = [FRAC_{cat/no\ air}(.005) + FRAC_{cat/air}(.016)], \text{ for speeds at or} < 19.6 \text{ mph} \quad (24)$$

$$DSULFC_{m,v} = [FRAC_{ox/noair}(.005) + FRAC_{3w/noair}(.001) + FRAC_{ox/air}(.020) + FRAC_{3w/air}(.025)], \text{ for speeds at or} > 34.8 \text{ mph} \quad (25)$$

For speeds between 19.6 and 34.8 mph, *DSULFN* and *DSULFC* are interpolated between equations 22 and 23, and 24 and 25, respectively (EPA 1985a).

where

$FRAC_{cat/noair}$ = the fraction of vehicles which are catalyst equipped with no air pump, for vehicles of class *v* and model year *m*

$FRAC_{cat/air}$ = the fraction of vehicles which are catalyst equipped with air pump, for vehicles of class *v* and model year *m*

$FRAC_{ox/noair}$ = the fraction of vehicles which are oxidation catalyst equipped with no air pump, for vehicles of class *v* and model year *m*

$FRAC_{3w/noair}$ = the fraction of vehicles which are 3-way catalyst equipped with no air pump, for vehicles of class *v* and model year *m*

$FRAC_{ox/air}$ = the fraction of vehicles which are oxidation catalyst equipped with air pump, for vehicles of class v and model year m

$FRAC_{3w/air}$ = the fraction of vehicles which are 3-way catalyst equipped with air pump, for vehicles of class v and model year m

The direct sulfate from all gasoline-fueled vehicles is computed as:

$$DSULF_{m,v} = CTLFRC_{m,v} * DSULFC_{m,v} + (1. - CTLFRC_{m,v}) * DSULFN \qquad (26)$$

where

$CTLFRC_{m,v}$ = $CATFCT_{m,v}(1 - RMIS_{m,v})$, the fraction of the vehicle class that has an effective catalyst

The model assumes that all the sulfur in the fuel is exhausted as either sulfate or gaseous sulfur dioxide, so once the direct sulfate emission factor is calculated, the remaining sulfur in the fuel is considered to be exhausted as SO_2. To calculate the amount of sulfur exhausted as SO_2 in g/mi, the amount of sulfur remaining in the fuel after the direct sulfate emission factor has been found must be calculated.

The following equation is used to derive the fraction of sulfur in the fuel that has been directly converted to sulfate ($DSULF_{m,v}$ calculated in equation 26 above). This equation calculates direct sulfate as a function of the fuel sulfur content, *DCNVRT* (which is the fraction of sulfur in the fuel that is converted to direct sulfate), and the fuel economy.

$$DSULF_{m,v} = 13.6078 * (1. + WATER) * FDNSTY * SWGHT * DCNVRT / FE_{m,v} \qquad (27)$$

where

$DSULF_{m,v}$ = the direct sulfate emission factor of a vehicle in class v and of model-year m (g/mi)

$WATER$ = weight ratio of seven water molecules to sulfate, 7.18 / 98 = 1.2857 (this weight ratio comes from the estimate that, at 50% humidity, seven water molecules bond with each sulfuric acid molecule; EPA 1990, p.6-25)

$FDNSTY$ = fuel density in lb/gal (6.09 lb/gal, EPA 1988).

$FE_{m,v}$ = fuel economy for vehicles of class v and model year m (mi/gal)

$SWGHT$ = weight percent of sulfur content in fuel (.034, except reformulated fuel phase II, 2000 and later calendar years .0138, AAMA 1993)

$DCNVRT$ = percent of sulfur in the fuel that is directly converted into sulfate (2%, EPA 1990)

13.6078 = unit conversion factor = (453.592 * 3.)/100., where 453.592 = number of grams in a pound, 3. = weight ratio of SO_4 to sulfur, and the division by 100 is to correct for the weight percent of sulfur, *SWGHT* (EPA 1990)

Substituting $DSULFC_{m,v}$ and $DSULFN$ (from equations 22 through 25) in equation 27, we can solve for the fractions of sulfur in the fuel that are converted to sulfate separately for catalyst, and noncatalyst vehicles:

$$FCNVRC_{m,v}=DSULFC_{m,v} * FE_{m,v} / (13.6078 * (1.+WATER) * FDNSTY * SWGHT) \quad (28)$$

$$FCNVRN_{m,v}= DSULFN * FE_{m,v} / (13.6078 * (1.+WATER) * FDNSTY * SWGHT) \quad (29)$$

where

$FCNVRC_{m,v}$= the fraction of the percent of fuel that is directly converted into sulfate for catalyst vehicles of class v and model year m

$FCNVRN_{m,v}$= the fraction of the percent of fuel that is directly converted into sulfate for non-catalyst vehicles of class v and model year m

The gaseous sulfur emission factors, which are dependent on these fractions, are calculated from the equation

$$SO2_{m,v} = 9.072 * FDNSTY * SWGHT * (1. - DCNVRT) / FE_{m,v} \quad (30)$$

where the new terms are

$SO2_{m,v}$ = the gaseous sulfur emission factor of a vehicle in class v of model-year m (g/mi)

9.072 = unit conversion factor = (453.592 * 2.)/100., where 453.592 = number of grams in a pound, 2. = weight ratio of SO_2 to sulfur, and the division by 100 is to correct for the weight percent of sulfur, *SWGHT*.

The gaseous sulfur emission factor is calculated in the model as the combination of the sulfur emission factor from both catalyst and noncatalyst vehicles as follows:

$$SO2C_{m,v}= 9.072 * FDNSTY * SWGHT * (1.0 - FCNVRC_{m,v}) / FE_{m,v} \quad (31)$$

$$SO2N_{m,v}= 9.072 * FDNSTY * SWGHT * (1.0 - FCNVRN_{m,v}) / FE_{m,v} \quad (32)$$

and

$$SO2_{m,v} = (CTLFRC_{m,v} * SO2C_{m,v}) + [(1. - CTLFRC_{m,v}) * SO2N_{m,v}] \quad (33)$$

where

$SO2C_{m,v}$ = the SO_2 emission factor from catalyst vehicles in class v of model-year m (g/mi)

$SO2N_{m,v}$ = the SO_2 emission factor from non-catalyst vehicles in class v of model-year m (g/mi)

In addition to the direct sulfate emission factors, the model estimates an indirect sulfate emission factor by assuming that a fraction of the gaseous sulfur dioxide emissions is later converted in the atmosphere to sulfate material. Based on ambient sulfur and sulfate measurements in 11 cities, EPA estimates that 12 percent of all gaseous sulfur is converted to sulfate (EPA 1990, pp. 6-28 to

6-30). Thus, the PART5 model calculates the indirect sulfate emission factors as 12 percent of the gaseous SO_2 motor vehicle emissions.

The model uses the following general formula to derive the emission factors for indirect sulfate, which consists of ammonium sulfate and ammonium bisulfate (EPA 1990, page 6-30):

$$ISULF = ICNVRT * SO2 * (3 / 2) * AMNWGT \quad (34)$$

where

$ISULF$	=	the estimated indirect sulfate emission factor (g/mi)
$SO2$	=	the gaseous sulfur emission factor (g/mi)
$3 / 2$	=	weight ratio of SO_4 to SO_2
$AMNWGT$	=	the estimated weight ratio of the combination of ammonium bisulfate and ammonium sulfate in the atmosphere to SO_4 (1.6, EPA 1990, p. 6-25)
$ICNVRT$	=	the fraction of SO_2 converted to sulfate (.12 is the national average, EPA 1990, page 6-29, Table 6-13)

The actual computation is performed in the model for each vehicle type (catalyst and non-catalyst):

$$ISULFC_{m,v} = ICNVRT * SO2C_{m,v} * (3 / 2) * AMNWGT \quad (35)$$

$$ISULFN_{m,v} = ICNVRT * SO2N_{m,v} * (3 / 2) * AMNWGT \quad (36)$$

$$ISULF_{m,v} = (CTLFRC_{m,v} * ISULFC_{m,v}) + [(1.0 - CTLFRC_{m,v}) * ISULFN_{m,v}] \quad (37)$$

where

$ISULFC_{m,v}$	=	the estimated indirect sulfate from catalyst vehicles in class *v* of model-year *m* (g/mi)
$ISULFN_{m,v}$	=	the estimated indirect sulfate from non-catalyst vehicles in class *v* of model-year *m* (g/mi)
$ISULF_{m,v}$	=	the estimated indirect sulfate emission factor of a vehicle in class *v* of model-year *m* (g/mi)

TOTAL EXHAUST PARTICULATE

The total exhaust particulate emission factors for light-duty gasoline vehicles are calculated from the sum of lead, direct sulfate, and a carbon emission factor which includes soluble organics and other remaining carbon. The carbon emission factor has been determined based on reference EPA 1985a and the updated information in EPA 1993a. Table 1 summarizes the carbon emission factors by model year and technology type.

TABLE 1

Carbon Emission Factors for Gasoline Vehicles (g/mi)

Vehicle Type/ Model Year Group	Leaded	Unleaded Catalyst (No-Air)	Unleaded Catalyst (Air)	Unleaded Non-catalyst
Light Duty Gasoline Vehicles:				
pre-1970	.193			.030
1970-1974	.068	.0060	.0250	.030
1975-1980	.030	.0060	.0250	.030
1981+	.017	.0043	.0043	.017
Light Duty Gasoline Trucks I:				
pre-1970	.193			.030
1970-1974	.068	.0060	.0250	.030
1975-1986	.030	.0060	.0250	.030
1987+	.017	.0043	.0043	.017
Light Duty Gasoline Trucks II:				
pre-1979	.370			.054
1979-1986	.068	.0060	.0250	.030
1987+	.030	.0043	.0043	.017
Heavy Duty Gasoline Vehicles:				
pre-1987	.370	.054	.054	.054
1987+	.163	.054	.054	.054

Motorcycles: see page 49 for description of motorcycle emission factors in PART5.

DIESEL-FUELED VEHICLES

LEAD EMISSION FACTORS

No lead emission factors for diesel-fueled vehicles are calculated in the model. The lead emissions result almost exclusively from the lead content of the fuel; and since the lead content of diesel fuel is negligible, it is assumed that the lead emissions from diesel-fueled vehicles are also negligible.

SULFATE EMISSION FACTORS

The sulfate emission factors are calculated assuming all sulfur in the fuel is exhausted as either sulfuric acid or gaseous sulfur dioxide (EPA 1990).

The direct sulfate emission factor (g/mi) is calculated as follows:

$$DSULF_{m,v} = 13.6078 * (1.0 + WATER) * FDNSTY * SWGHTD * DCNVRT / FE_{m,v} \quad (38)$$

where

$DSULF_{m,v}$	=	the direct sulfate emission factor for a vehicle of class *v* and model year *m* (g/mi)
DCNVRT	=	the fraction of sulfur in the fuel that is converted directly to sulfate (2.0 percent, EPA 1990, page 3-4)
FDNSTY	=	the density of diesel fuel (7.11 lb/gal, EPA 1988b)
$FE_{m,v}$	=	the fuel economy for a vehicle of class *v* and model year *m* (mi/gal, EPA 1990, Table 6-A-1; note that the same fuel economies are used for both 2BHDDV and LHDDV for all model years)
SWGHTD	=	the weight percent of sulfur in diesel fuel (0.25 for high sulfur fuel, .05 for low sulfur fuel used for calendar years 1993 and later)
WATER	=	weight ratio of seven water molecules to sulfate, 7.18 / 98 = 1.2857 (EPA 1990, p. 6-25)
13.6078	=	units conversion factor = (453.592 * 3.)/100., where 453.592 = number of grams in a pound, 3 = weight ratio of SO_4 to sulfur, and the division by 100 is to correct for the weight percent of sulfur, *SWGHTD*

The gaseous sulfur emission factor is calculated as follows:

$$SO2_{m,v} = 9.072 * FDNSTY * SWGHTD * (1. - DCNVRT) / FE_{m,v} \quad (39)$$

where the new terms are

$SO2_{m,v}$	=	the sulfur emission factor (g/mi) of a vehicle in class *v* and of model-year *m*
9.072	=	units conversion factor = (453.592 * 2)/100., where 453.592 = number of grams in a pound, 2 = weight ratio of SO_2 to sulfur, and the division by 100 is to correct for the weight percent of sulfur, *SWGHTD*.

The indirect sulfate emission factor, which consists mostly of ammonium sulfate and ammonium bisulfate (EPA 1990, Chapter 6), is calculated as follows:

$$ISULF_{m,v} = ICNVRT * SO2_{m,v} * (3/2) * AMNWGT \quad (40)$$

where

$ISULF_{m,v}$	=	the indirect sulfate emission factor of a vehicle in class *v* and of model-year *m* (g/mi)
$ICNVRT$	=	the fraction of SO_2 that is converted to sulfate (either ammonium sulfate or ammonium bisulfate) in the atmosphere (12 percent)
$3/2$	=	weight ratio of SO_2 to SO_4,
$AMNWGT$	=	the estimated weight ratio of the combination of ammonium bisulfate and ammonium sulfate in the atmosphere to SO_4 (1.6)

TOTAL EXHAUST PARTICULATE

The initial total exhaust particulate emission factors for diesel-fueled vehicle classes ($EFDPM_{m,v}$) are from reference EPA 1990. The emission factors for heavy-duty vehicles are expressed in g/BHP-hr, which are converted to g/mi in PART5. The conversion factors (EPA 1988b and EPA 1992) and emission factors both vary by model year. The emission factors for light-duty diesel vehicles and trucks are in units of g/mi. The total exhaust emission factors given in Table 2 are based on high sulfur fuel. The sulfur content in diesel fuel is being forced down in 1993 by EPA regulatory requirements. When the user requests a calendar year of evaluation of 1993 or later, the program will make the appropriate adjustments to the exhaust emission factors for low sulfur fuel effects.

The only other adjustment that is made to the total exhaust emission factor is the multiplication by the particle size cutoff fraction (see page 65). Particulate emission factors for diesel-powered vehicles are not adjusted for vehicle speed.

SOLUBLE ORGANIC FRACTION AND REMAINING CARBON PORTION

The soluble organic fraction (*SOF*) is calculated as a fraction of the remaining mass:

$$SOF_{m,v} = [EF_{m,v} - DSULF_{m,v}] * (fraction_{SOF,v}) \quad (41)$$

The remaining carbon portion (*RCP*) is defined to be everything else:

$$RCP_{m,v} = EF_{m,v} - DSULF_{m,v} - SOF_{m,v} \quad (42)$$

The soluble organic fractions ($fraction_{SOF,v}$) for different vehicle classes are as follows: 0.51 for LHDDVs, 0.44 for MHDDVs, and 0.24 for HHDDVs. The fraction 0.51 is also used for the 2BHDDV vehicle class. The fraction 0.44 is also used for the vehicle class BUSES. The fractions for LDDVs, LDDT1s, and LDDT2s are 0.18, .5, and .48 respectively (EPA 1990, Table 3-9).

where

$SOF_{m,v}$ = the soluble organic fraction of the exhaust particulate emission factor for a vehicle in class v and of model-year m (g/mi)

$RCP_{m,v}$ = the remaining carbon portion (elemental carbon) of the exhaust particulate emission factor for a vehicle in class v and of model-year m (g/mi)

$EF_{m,v}$ = $EFDPM_{m,v} * CF_{m,v}$, exhaust particulate emission factor for a vehicle in class v and of model-year m (g/mi)

$EFDPM_{m,v}$ = exhaust particulate emission factor for a vehicle in class v and of model-year m (g/BHp-hr)

$CF_{m,v}$ = conversion factor from g/BHp-hr to g/mi of a vehicle in class v and of model-year m (BHp-hr/mi)

$fraction_{sof,v}$ = the fraction of the non-sulfate portion (equivalent to the carbon portion) of the diesel exhaust particulate emission factor which is organic carbon, for vehicle in class v (BHp-hr/mi)

TABLE 2

Exhaust Particulate Emission Factors for Diesel Vehicles

Vehicle Type/ Model Year Group	Exhaust Particulate Emission Factor ($EFDPM_{m,v}$)
Light Duty Diesel Vehicles (g/mi):	
pre-1981	.700
1981	.259
1982-1984	.256
1985-1986	.255
1987	.134
1988-1990	.132
1991-1993	.131
1994-1995	.128
1996+	.100
Light Duty Diesel Trucks (g/mi):	
pre-1981	.700
1981	.309
1982-1984	.354
1985-1986	.358
1987	.334
1988-1990	.291
1991-1993	.294
1994-1996	.130
1997+	.109
Class 2B of Heavy Duty Diesel Vehicles (g/BHp-hr):	
pre-1988	.5156
1988-1990	.5140
1991-1993	.2873
1994+	.1011
Light Heavy Duty Diesel Vehicles (g/BHp-hr):	
pre-1988	.5156
1988-1990	.5140
1991-1993	.2873
1994+	.1011

TABLE 2 (cont'd)

Exhaust Particulate Emission Factors for Diesel Vehicles

Vehicle Type/ Model Year Group	Exhaust Particulate Emission Factor ($EFDPM_{m,v}$)
Medium Heavy Duty Diesel Vehicles (g/BHp-hr):	
pre-1987	.6946
1988-1990	.4790
1991-1993	.2747
1994+	.0948
Heavy Heavy Duty Diesel Vehicles (g/BHp-hr):	
pre-1987	.6444
1988-1990	.4360
1991-1993	.2709
1994+	.0836
Buses (g/BHp-hr):	
pre-1987	.6931
1988-1990	.4790
1991	.2772
1992 without traps	.1716
1992 with traps	.0257
1993 without traps	.1457
1993 with traps	.0240
1994+	.0591

4 OTHER EMISSION FACTORS

FUGITIVE DUST

Reentrained road dust emission factors are calculated for both unpaved and paved roads. The fugitive dust emission calculations for unpaved roads are from an empirical formula from the AP-42 Section 11.2.1 (EPA 1988a), and the generic paved road dust calculation formula is from AP-42 Sections 11.2.5 and 11.2.6 (EPA 1993b).

The particulate emission factor for unpaved roads is calculated as

$$UNPVD = PSDUNP * 5.9 * (UNSILT / 12.0) * (SPD / 30.0) * (WEIGHT / 3.0)^{0.7} * (VWHEEL / 4.)^{0.5} * (365 - IPDAYS) / 365 * 453.592 \quad (43)$$

where

UNPVD	=	the fleet average unpaved road dust emission factor (g/mi)
PSDUNP	=	the fraction of particles less than or equal to the particle size cutoff
UNSILT	=	the percent silt content of the surface material (input by the user)
SPD	=	the average vehicle speed (mph, input by the user)
WEIGHT	=	the fleet average vehicle weight (tons, input by the user in lbs)
VWHEEL	=	the fleet average number of wheels (input by the user)
IPDAYS	=	the average number of precipitation days per year with greater than 0.01 inches of rain (input by the user)
453.592	=	the number of grams in a pound

The particulate emissions factor for generic paved roads is calculated as

$$PAVED = PSDPVD * (PVSILT / 2)^{0.65} * (WEIGHT / 3)^{1.5} \quad (44)$$

where

PAVED	=	the fleet average paved road dust emission factor (g/mi)
PSDPVD	=	the base emission factor for the particle size cutoff (input by the user)
PVSILT	=	the road surface silt loading (g/m^2, input by the user)
WEIGHT	=	the fleet average vehicle weight (tons, input by the user in lbs)

BRAKE WEAR

The brake wear emission factor is assumed to be the same for all vehicle classes in the model. It is set equal to

$$BRAKE = 0.0128 * PSBRK, \quad (45)$$

where

$PSBRK$ = the fraction of particles less than or equal to the particle size cutoff.

The emission factor 0.0128 g/mi was measured by Cha, Carter, and Bradow (EPA 1985a).

TIRE WEAR

The tire wear emission factor is calculated as

$$EFTIRE_v = 0.002 * PSTIRE * IVEHWL_v \quad (46)$$

where

$EFTIRE_v$ = tire wear emission factor for a vehicle in class v (g/mi)
0.002 = emission rate of airborne particulates from tire wear for light duty-vehicles (EPA 1985b)
$PSTIRE$ = the fraction of particles less than or equal to the particle size cutoff
$IVEHWL_v$ = the average number of wheels on a vehicle of class v: LDGV = 4, LDGT1, 2 = 4, HDGV = 6, MC = 2, LDDV = 4, LDDT = 4, 2BHDDV = 4, LHDDV = 6, MHDDV = 6, HHDDV = 18, BUSES = 4

IDLE EMISSIONS

The idle emission factor data in grams per hour was collected from manufacturers. The factors are reported only for the heavy-duty diesel vehicle classes, and as such, are not factored into the overall vehicle ("All veh.") emissions category. The vehicle class emission factors are calculated by averaging together model-year-specific emissions data, where the model-year-specific emissions data are weighted by the estimated travel fraction of that model year within the vehicle class.

Currently the idle emission rates are model-year-specific but the model year emission rates do not vary by vehicle class. Hence, the same model year emission factors are used for all the heavy duty diesel classes, and the differences between the idle emission factors between classes is a reflection only of the differing travel fractions from model year to model year within that class (where the travel fractions are the $TF_{m,v}$'s in equation (1)). As a result, the emission factors reported for the smaller of the heavy duty diesel vehicle classes, such as 2BHDDV and LHDDV, may be over-predicted.

The base idle emission factors in PART5 for all heavy-duty diesel vehicles are shown in Table 3.

TABLE 3

Model Years	Emission Factor (g/hr)
pre-1988	5.370
1988-1990	3.174
1991-1993	1.860
1994	1.004

5 ADJUSTMENTS AND CORRECTION FACTORS

All the emission factors-exhaust PM, direct and indirect sulfate, lead, SOF, RCP, brake-wear, tire-wear, and fugitive dust-are adjusted for the particle size cutoff (PSC).

PARTICLE SIZE CUTOFF

The user of the PART5 model must enter a particle size cutoff. This cutoff is defined to be the maximum aerodynamic diameter (between 1.0 and 10.0 μm) of the particles in the emission factors. Each emission factor is then multiplied by the fraction of particles less than or equal to the PSC.

The fraction of particles less than or equal to the PSC is determined from the fractions in Table 4 (EPA 1985a). When a user inputs a PSC, the program linearly interpolates the appropriate fraction of mass less than or equal to that cutoff based on the data in Table 4 (but not less than the lowest cutoff listed). PART5 has a lower limit of 1.0 for the PSC.

As can be seen in Table 4, the lowest PSC is 2.5 μm for fugitive dust. The program will print a note for the user to be aware that the fugitive dust emission factors are based on 2.5 μm when the user inputs values between 1.0 and 2.4 μm as a PSC.

TABLE 4

Fraction of Particles Less than or Equal to the Particle Size Cutoff

Vehicle Type/ Particulate Component	Particle Size Cutoff (PSC)	Fraction of Particles less than or equal to the Particle Size Cutoff
Gasoline vehicles using leaded fuel/ Lead, Carbon	10.0	0.64
	2.0	0.43
	0.2	0.23
Gasoline vehicles with catalyst, using unleaded fuel/ Lead, Carbon	10.0	0.97
	2.0	0.89
	0.2	0.87
Gasoline vehicles without a catalyst, using unleaded fuel/ Lead, Carbon	10.0	0.90
	2.0	0.66
	0.2	0.42
Diesel vehicles/ Exhaust PM	10.0	1.00
	2.5	0.92
	2.0	0.90
	1.0	0.86
All vehicles/ Brake-wear	10.0	0.98
	7.0	0.90
	4.7	0.82
	1.1	0.16
	0.43	0.09
All vehicles/ Tire-wear	10.0	1.00
	0.10	0.01
All vehicles/ Unpaved Road Dust	10.0	0.36
	5.0	0.20
	2.5	.095
All vehicles/ Paved Road Dust	10.0	7.3*
	2.5	3.3*

*Note: Paved Road Dust values are actual emission factors in g/mi.

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