PART5 USER'S MANUAL

(Guide to PART5 GUI application package)

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Preface

Introduction

Particulate matter (PM) from mobile sources is a matter of growing concern. PM is considered hazardous, since it aggravates the respiratory system especially for those with respiratory and cardiovascular conditions. Unlike other pollutants, PM is not a gas or chemical compound but is defined by its size. EPA has regulated this pollutant since the National Ambient Air Quality Standards (NAAQS) was set up. On modification the size classification of PM considered hazardous to human health was redefined to 10 μm and 2.5μm or less as the standard. For estimating the rate at which particulate matter is generated by mobile sources, PART5 model developed by the EPA is used.

PART5 is a computer model (programmed in Fortran) for calculating PM10 and PM2.5 emissions from vehicles. It calculates particulate emission factors in grams per mile (g/mi). PM emission factors include engine exhaust particulate, brake wear, tire wear, and re-entrained dust from both paved and unpaved roads. The following individual components of particulate matter must be evaluated to accurately account for PM emissions from mobile sources:

- emissions from mobile sources both primary and secondary (including exhaust)
- vehicle wear emissions (brake, tire and engine)
- fugitive dust emissions (pavement deterioration, wind blown dust)

The model is appropriate for comparative analyses, such as comparing the potential impact of one traffic control measure versus another.

Historical background

Historically, the PART5 model had a similar origin as the MOBILE model. They were developed based on the equations in EPA's emission factor document "AP-42". PART, like MOBILE was an attempt to "automate" or "computerize" the calculation of the emission factors rather than performing the task of using AP-42's look-up tables. PART was initially developed in 1985 but only calculated the emissions from exhaust and brake and tire wear. Subsequently PART was updated to incorporate new findings or to refine earlier emissions assumptions in the model. Changes were made in the current model to:

- reflect the low sulfur diesel standards regulated in 1993
- expansion heavy duty diesel vehicle classification into five sub-categories
- separation of light duty cars and trucks by fuel types (gasoline and diesel)
- option to print out the gaseous SO2
- calculating of fugitive dust for paved and unpaved roads
- option to calculate idle emissions developed from manufacturer's data
- mileage accumulation rate (updated to be consistent with MOBILE)
- vehicle counts (updated to be consistent with MOBILE)
- diesel sales fractions (updated to be consistent MOBILE)
- registration distributions (updated to be consistent MOBILE)
- catalyst fractions ((updated to be consistent MOBILE)

The estimation procedure of PART5 for determining the fugitive dust contribution was developed by the Office of Air Quality Planning and Standards (OAPQS) and not with the original developers in the Office of Mobile sources (now the Office of Transportation and Air Quality). The Office of Transportation and Air Quality typically answer questions pertaining to exhaust emissions; while the Office of Air Quality Planning and Standards answer questions relating to fugitive dust.

Categories and size characteristics of major components

Particulate matter consists of numerous inert or volatile. Majority of PM is composed of carbon and sulfur compounds and of material larger that results from the mechanical abrasion process viz. brake and tire wear. Airborne (fugitive) dust also comprises large quantities in some areas. Since all gasoline used lately by a vast number of vehicles is unleaded, the contribution of other constituents of PM such as lead is insignificant..

Carbon

Carbon is the emission typically associated with PM since it is the most easily recognized. In estimating emission factors using the PART5 model, carbon is subdivided into 2 subgroups:

- the soluble organic fraction (SOF) and
- the remaining carbon portion (RCF)

The SOF consists of hydrocarbons and unburned fuel and lubricating oil. The RCP fraction or “soot” material is typically seen being emitted from the tailpipes of diesel vehicles.

Sulfur

Sulfur component of tailpipe exhaust is greatest contributor of exhaust emission components. Sulfur particles are themselves not emitted in the atmosphere but are emitted as compounds such as SO2, SOx, sulfates and sulfides. Sulfur also reacts with hydrogen, oxygen and other elements to form either stable compounds or compounds that react with other gases or chemicals in the atmosphere. All of these compounds form particulate matter.

Sulfur enters the particle forming process through the fuel used during the combustion process. It is found in both gasoline and diesel fuels so both cars and trucks are sources of this component. Sulfur compounds are predominantly produced in the chemical reactions during catalytic conversions, where sulfur and hydrogen combine to form hydrogen sulfate and sulfuric acid. In diesel, sulfur compounds are formed through the normal combustion process. Sulfur is an impurity that is not removed in the refining process because it has no deteriorative effect on engines. Due to the 1993 reduced sulfur content in diesel

fuel, the percentage contribution of sulfur component of PM created by diesel has been reduced while sulfur PM generated by gasoline engines has increased. The provision for reformulated gasoline (RFG program) was made to remove sulfur impurities from gasoline, subsequent to the reduction in sulfur in diesel fuel as mandated by the CAA.

When discussing PM and sulfur's contribution to PM, it must be noted that the geographic region will have an influence because of particular weather patterns or because of specific resource use.

Fugitive road dust emissions from paved and unpaved roads

Dust (fugitive dust) is also a major contributor of PM although its contribution varies depending on the geographical location. It includes both larger (coarse, PM 10) particles of PM and smaller (fine PM 2.5) material. Several factors influence the amount of PM generated from roads including vehicle speed, vehicle weight and silt loading or amount of "silt-size" material that is on the road surface. The amount of precipitation contributes to the amount of PM both in the air and on a pavement surface and usually is responsible for reducing the concentration of particulates both in the air and on roadway surfaces. Unpaved roads supply a substantial amount of emissions. Roughly it is 100 to 1000 times greater than the emissions from a vehicle's exhaust. Paved roads are the second largest contributors of PM pollution following unpaved roads estimated to be 10 to 100 times as great as from exhaust emissions roughly.

PART5 model uses mathematical relationships between a vehicle's weight, number of tires, speed, amount of dust on the highway, the percent of silt comprising the amount of dust and number of days of precipitation, to calculate an emission rate. Emission factors are calculated and expressed as mass (weight) over a distance, usually grams per mile (g/mi). The emission factor is used to estimate a total quantity of an emission or a concentration of a pollutant, depending on the type of analysis being performed.

Particle size distributions

Particulate matter is defined as a pollutant based on its size. There are two standards, one for PM10 size material and one for PM2.5 size material. PM 10 consists of material 10 μm or less in size and is known as the “coarse” fraction while PM2.5 consists of material 2.5 μm or less in size and is known as the fine fraction.

Installation

System requirements

To successfully run the PART5 model, the following are required:

- A PC with an Intel Pentium © processor (or 100% compatible)
- 32 MB RAM or higher recommended
- Hard disk (minimum 20 MB free space)
- CD – ROM
- Windows 95, 98, 2000 or Windows NT
- A VGA monitor (best viewed in a 17 inch SVGA or better monitor)
- Administrative account privileges

Installing PART5 (Set-up using application package)

- Exit all programs in the windows environment
- Uninstall any previously existing package of PART5
- Log - in as ‘administrative’ user if using Windows NT, to have all installation privileges and to avoid certain files not being installed correctly
- Download the package for PART5 onto the local system hard disk (where other program files exist) into a specific directory
- After downloading on the local system, open the directory
- Run (or double-click) the ‘setup.exe’ file to start installation
- Following are the steps involved in the setup:
- Proceed with the setup, on appearance of the ‘welcome’ screen
- On prompt for specification of root directory, click on the ‘installation’ icon.
- Click on the ’browse’ button to install PART5 the package in a directory other than the default directory (C:\Program Files)
- Say ‘yes’ to all prompts verifying if certain older system files be kept and not removed for proper functioning of the model
- On successful installation explore to confirm the installation of PART5 in the specified destination directory (C:\Program Files)
- Restart the system

Starting PART5

- Click on the ‘Start’ button on the screen
- Select ‘Programs’ from the menu
- Double-click on ‘PART5’ to run the model

Alternative to starting PART5

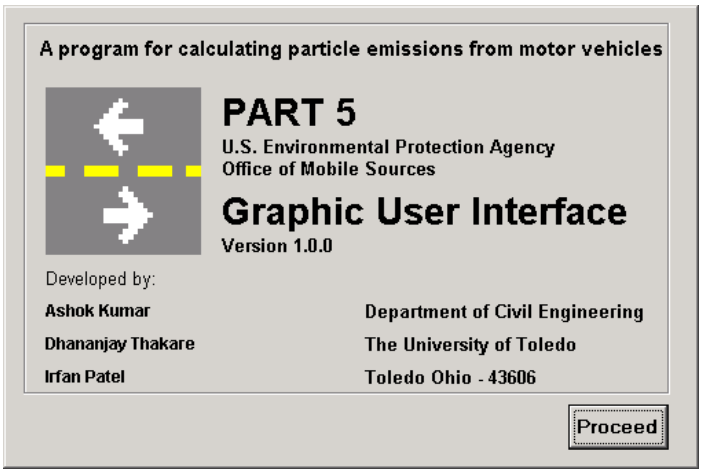
- Explore and open the ‘package’ folder after installation on the local system
- In the folder double-click on the ‘vbPart5.exe’ file to run the model

Uninstalling PART5 in Windows 95/98/2000/NT

1. Click on the ‘Start’ button
2. Select ‘Settings’
3. Double-click on the ‘Control Panel’ icon
4. Select ‘Add/Remove Programs’. The ‘Install/Uninstall’ tab is pre-selected
5. Select ‘PART5’ from the program list
6. Click on the ‘Add/Remove**’** button and follow the subsequent instructions

Working with PART5

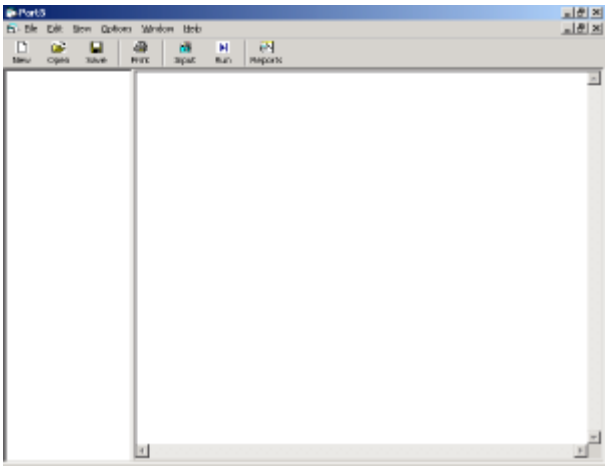
On running the PART5 model, the following splash screen appears. Click on the ‘proceed’ command button to start using the model.



(Opening screen of PART5 model)

Main form

The layout of the Main form simulates the Windows environment and enables the user to run the model like any Windows program.



(The main form with controls)

Pull – down menus

The following options appear on the menu bar:

- File

New: Creates a new input file. On click of '*New*' a sequence of input screens appear

Open: Opens a specified existing input file so it can be edited and t then re-run

Save: Saves a new input file or changes made to an existing input file

Save As: Saves a new input file in the desired directory

Print: Enables user to print the currently active form when creating input or to print reports (input, output or error files) when viewing reports

Exit: Used to quit the application

Edit

Copy: Allows the user to copy selected text

Paste: Allows the user to paste selected text

Select All: Selects all the text in the file

View

Reports: Enables the user to view the input, output and error files after the model is run for a specified input file.

Tool bar: Provides the option of viewing of the tool bar

Options

Input data: Starts the sequence of input forms for creation of a new input file

Model run: Runs the model for the created input file

Window

Tile

Horizontally: Juxtaposes the currently opened windows in an horizontal fashion

Vertically: Juxtaposes the currently opened windows in a vertical fashion

Help

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Control buttons

 Creates a new input file. On click of '*New*' a sequence of input screens appear

 Opens a specified existing input file so it can be edited and then re-run

 Saves a new input file or changes made to an existing input file

 Enables user to print the currently active form when creating input or to print reports (input, output or error files) when viewing reports

Allows user to re-open and edit existing input file

Executes the model run for supplied data

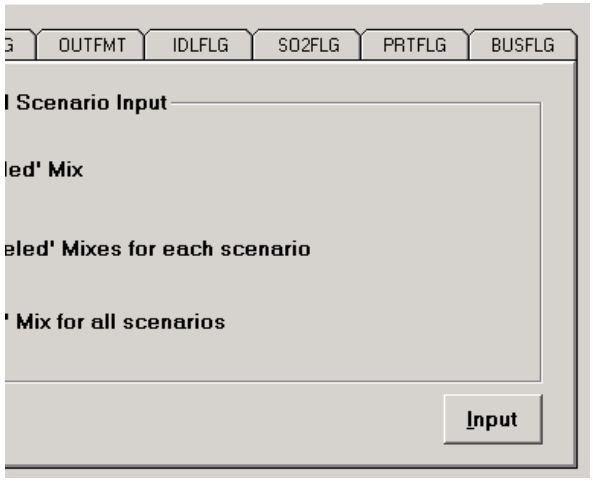
Displays list of generated input, output and error files. On click of any item of the list, the particular file is displayed in the text box

Using hotkeys

Hotkeys are key combinations that perform specific tasks on – screen, as shortcuts. Hotkeys appear as underlined.

Use of hotkeys:

Press ‘Alt’ and at the same time the hotkey from that menu. For example, to bring-up the input form, press Alt + I.



Files associated with PART5 model

For every run of the model four (text) files are created.

*.in	–	this is the input file for which the program is executed
*.out	–	this is the output file created as a result of the model run
*err.out	–	this is the error file and contains description of technical errors, if any that arise during the execution of the program

- Note:

If the program is executed successfully (without any technical errors, the error (*err.out) file is blank.

*.par	–	this is the 'master' file created as provision to edit input data

Note:

On its creation the (*,par) file should not be opened (except for editing) in any application (except PART5) to avoid tampering of data and setting of an application as default viewer.

Test – run

1. Remove any older versions of PART5 from the system.
   (Use Start – Settings – Control Panel – Add/Remove Programs)
2. Create two folders: PART5 and P5RESULTS on your drive.
3. Download contents from the u.r.l. **www.utoledo.edu/~aprg/part5/** into PART5 folder.
4. Download or save sample files in P5RESULTS.
5. Unzip PART5.ZIP using an unzip software click on the file 'setup.exe'.
6. Follow the set – up instructions to install PART5 on the system.
7. Run PART5 from Start – Programs – Part5 or run VBPART5.exe from PART5 folder.
8. Click 'Proceed' on the opening screen to start using PART5
9. Click on OPEN and browse to open the P5RESULTS folder.
10. Select any *.PAR file from this folder. The (*.par) file should not be opened (except for editing) in any application (except PART5) to avoid tampering of data and setting of an application (like Notepad) as default viewer.
11. Review input data in the GUI using appropriate controls and click on 'Done' after editing.
12. Click on 'Run' on the toolbar or pull – down menu. A dialog box for saving the file will appear. Browse to select the P5RESULTS folder.
13. 'Run' the program and click on Reports to enlist the resulting files (input, output and error).
14. Review all the three files on the R.H.S. of the splitter control in the main form.
15. Results can be printed using the 'Print' option from the tool – bar or the pull – down menu. They can also be printed using a text – editing application

(It is recommended that results (files stored in P5RESULTS folder) be printed in landscape mode using MS WORD and choosing the following settings:
Text type - plain text
Font type and size - courier new (8))

Creating Input file and entering model data

A sequence of data entry forms can be started for creating an input file and entering model data. To start creating an input file click on:

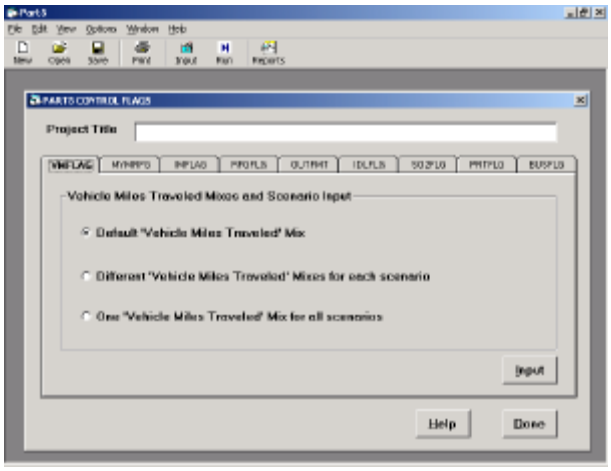
- *File >> New* or
- *Options >> Add Input* or
-  (New)
- 

Program controls flags

The program control flags instruct the program whether default or user-supplied values are to be used for:

- fraction of the total vehicle miles traveled by each vehicle class (VMT mixes)
- mileage accrual 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 to be displayed in a specific format in the report file.



(Program control flags form)

Field definitions and data entry

‘Project title’ text box

Enter the desired project title. This title appears as the first line of the input file and also appears as a reference in the output file.

VMFLAG and Scenario input

(VMFLAG on the program control flag form)

It 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 user supplies a total of 12 fractions corresponding to the 12 vehicles classes viz.

LDGV – light-duty gasoline vehicle

LDGT1 – light-duty gasoline truck I

LDGT2 – light-duty gasoline truck II

HDGV – heavy-duty gasoline truck

MC – motor cycle

LDDV – light-duty diesel vehicle

LDDT – light-duty diesel truck

2BHDDV – class 2B heavy-duty diesel vehicle

LHDDV – light heavy-duty diesel vehicle

MHDDV – medium heavy-duty diesel vehicle

BUSES – buses

The fractions from all the vehicle classes must sum to 1.

Field definitions and data entry

'VMFLAG' option buttons:

The legal choices are

1 = default VMT mix

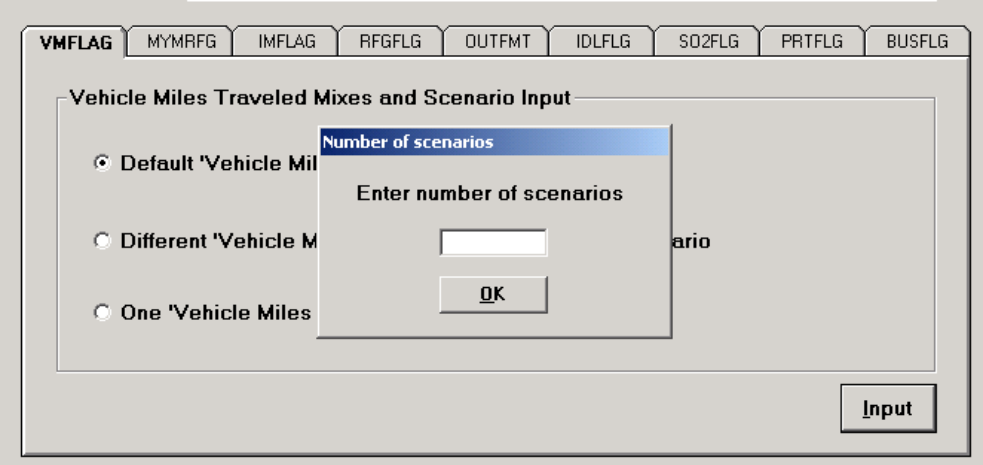
2 = user-supplied different VMT mix for each scenario

3 = user-supplied one VMT mix for all scenarios

Several different scenarios may be modeled, so the user may supply one VMT mix for all scenarios modeled or different VMT mix values for each scenario. Click on any one of the VMFLAG option buttons to specify a choice. The format for a user-supplied VMT mix is '0.0000'. The data must be entered in the same order as the vehicle classes.

Input command button:

On click of the 'input' command button, the 'number of scenarios' entry form is displayed.



(Number of scenario form)

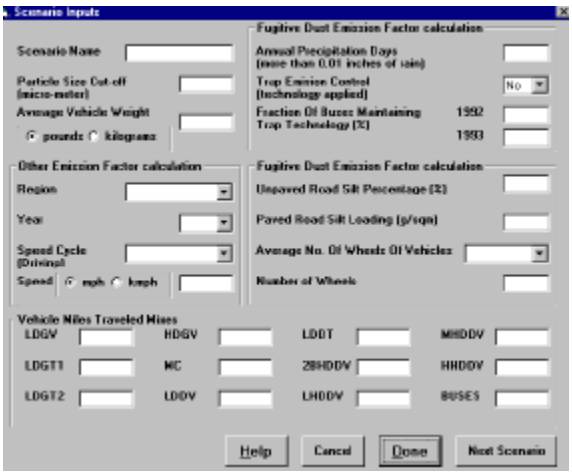
Number of scenario text box:

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 cut – off to be assumed. Each PART5 run can include many scenarios, and each scenario can have different scenario parameters.

PART5 can be run for as many as 50 scenarios. In the text box for number of scenarios enter the desired value in the range of 1 to 50. Click OK when done to bring up the form for VMT mix and scenario data entry.

Scenario Inputs



(VMT mix input and scenario input form)

The scenario inputs consist of six (seven in certain cases) sets of data for each scenario. The control flag VMFLAG affects the scenario inputs.

o SET 1

The first set of the scenario inputs contains the region, calendar year of evaluation, speed cycle, and vehicle speed. The region could be low-altitude or high-altitude. The calendar year of evaluation is the year for which the emission factors are being modeled. The speed cycle is either transient (cyclical) driving or a steady (cruise) driving, which affects the lead emission factors. The average vehicle speed must be between 2.5 and 55 miles per hour.

Field definitions and data entry

‘Region’ drop – down list:

Select the specified region

‘Year’ drop – down list:

Select the specified year between 1964 and 2020

‘Speed-cycle’ drop – down list:

Specify whether transient (cyclical) or steady (cruise)

‘Speed’ text box and ‘unit’ option buttons:

Choose the desired system of units and enter the speed in mph or kmph. It must be between 2.5 and 55 if entered in miles per hour.

o SET 2

The second set contains three inputs for the calculation of fugitive dust emission factors. The first input is the unpaved road silt percent. The second input is the paved road silt loading in g/m^2. The third input is optional and is called WHEELFLG, which indicates if the user wants to specify the fleet average number of wheels. This information is used in the calculation of unpaved road dust emission.

Field definitions and data entry

‘Unpaved road silt percentage’ text box:

Must be between 4.3 and 20 percent

‘Paved road silt loading’ text box:

Must be between 0.02 and 400 g/ m^2

‘WHEELFLG’ drop – down list:

Select ‘Yes’ to specify number of vehicles or ‘No’ to assume default

o SET 3

The third input line also has information of the fugitive dust emission factor calculations. The input is the number of precipitation days with precipitation more than 0.01 inches rain per year. In addition to the precipitation data, there is an optional input for specifying whether, or not, trap emission control technology for the buses of model years 1992 and 1993 has been applied.

It is called TRAPFLG. If trap control emission control technology has been applied, the user specifies two percentages:

- for fraction of buses maintaining traps for model year 1992 and
- for fraction of buses maintaining traps for model year 1993.

Field definitions and data entry

'Annual precipitation days' text box:

Enter no. days with precipitation in excess of inches rain per year (between 0 and 365)

'Trap emission control' drop – down list:

Select 'Yes' or 'No' from drop – down list to specify if this technology has been applied or not. If 'Yes' also specify the fraction of buses maintaining trap technology for the years 1992 and 1993 in the respective text boxes

o SET 4

The fourth input set consists only of the scenario name, with a limitation of 32 characters. Each scenario should have a different name, so it can be labeled back as part of output.

Field definitions and data entry

'Scenario name' text box:

Enter a desired name for a particular scenario (not more than 32 characters)

o SET 5

This set specifies the particle size cut-off (PSC). The emission factors 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 micrometer and the minimum allowed is1.0 micrometer. The lower bound for the PSC for fugitive dust is 2.5 micrometer. When a value of less than 2.5 micrometer is entered, the program will reflect emissions for 2.5 micrometer PSC, for fugitive dust only.

Field definitions and data entry

'Particle size cut – off' text box:

In the text box enter the value for PSC between 1 micrometer and 10 micrometer.

o SET 6

The sixth set is the fleet average vehicle weight, which is used for the calculations for fugitive dust. The weight is specified in pounds.

Field definitions and data entry

'Average vehicle weight' text box:

Choose the desired unit (pounds or kilograms) and specify the average fleet vehicle weight

o SET 7

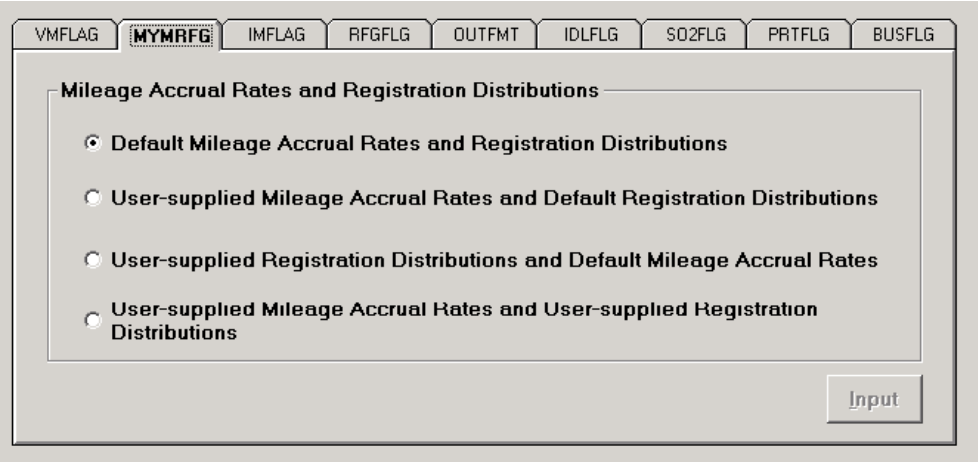
This set is the user-specified fleet average number of wheels for vehicles, used in the calculation of unpaved road dust only.

Field definitions and data entry

'Number of wheels' text box:

If WHEELFLG is set to 'Yes' specify the fleet average number of wheels.

- **MYMRFG**



(Mileage accrual rates and registration distributions flag)

This control flag specifies whether default or user-supplied mileage accrual rates (MAR) and registration distributions (RD) will be used.

The mileage accrual rate is the expected number of miles a vehicle will travel in one year, divided by 1,00,000. If a light-duty gasoline vehicle were 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 rates are assumed to vary with vehicle class and the age of the vehicle. The input requires mileage accrual rates for vehicle ages 1 to 25 years for each vehicle class, with the exception of motorcycles (class MC) for which the input is for ages 1 to 12 years. 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 entry in the registration distribution for LDGVs represents the fraction of all LDGVs that are one year old. The classes MC (requiring input only for years up to 12) and LHDDV (requiring input only from 19 onwards) are exceptions. The sum of the 25 fractions must be 1 for each vehicle class.

Field definitions and data entry

'MAL and RD' option buttons:

The legal values for MYMRFG are:

1 = default registration distributions and mileage accrual rates

2 = user supplied mileage accrual rates; default registration distribution

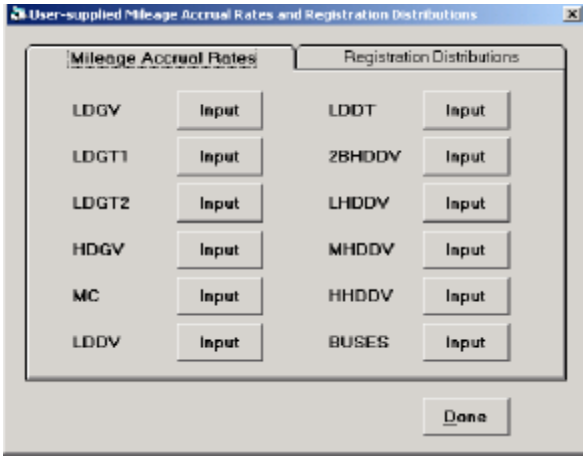
3 = user supplied registration distributions; default mileage accrual rates

4 = user supplied mileage accrual rates and registration distribution both.

To specify a choice, click on the corresponding option button.

'Input' command button:

For the default mileage accrual rates and default registration distributions, no additional input form is required, and hence the 'Input' command button on the Control Flag form is disabled for that option. However to handle the voluminous input in case of user-supplied values for mileage accrual rates and/or registration distributions (options with legal values 2, 3, and 4), an input form appears on click of the now enabled 'Input' button.



(User –supplied mileage accrual rates and registration distributions)

The form mainly consists of two tabs representing the two input types of 'Mileage Accrual Rates' and 'Registration Distributions'.

Field definitions and data entry

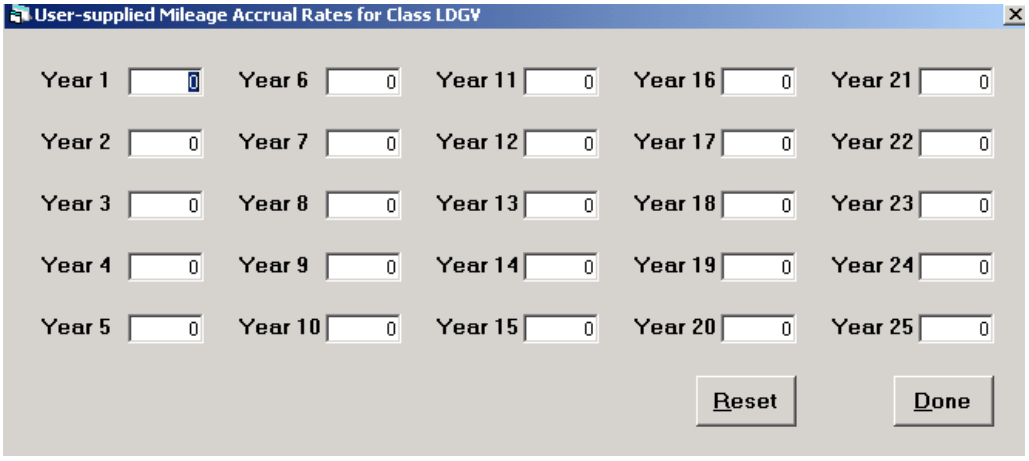
'Input' command buttons:

To input data for mileage accrual rates only, or registration distributions, or both (the option already chosen on the MYMRFG flag tab) for each vehicle class separately, click on the input buttons placed against each vehicle class on the MAR or RD tab. On click of a class - specific input button, an input form for entry of mileage accrual rates and/or registration distributions are displayed. Once 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.

'Done' command button:

Click on done when the data input is completed to return to the control flags form.

o Mileage Accrual Rate data entry form



(Mileage Accrual Rates data entry form)

Field definitions and data entry

‘Yearly mileage accrual rates entry’ text box:

Enter 25 mileage accumulation rates for each of the 12 vehicle classes (only the first 12 will be read for motorcycles (class MC). The data must be entered from newest to oldest vehicle. The format for entering the data is “0.00000”.

‘Reset’ command button:

Use the ‘reset’ command button to clear all data fields and re-enter data.

‘Done’ command button:

When the MAR data for each class is completed click the ‘done’ command button to return to the ‘user – supplied MAR and RD form’ and choose the next or another vehicle class for data entry.

o Registration Distribution data entry form

(Registration Distribution data entry form)

Field definitions and data entry

‘Yearly registration distribution entry’ text box:

The format for entering the distributions is “0.000”. Enter the registration distributions for each vehicle class such that the sum for 25 years equals 1.000

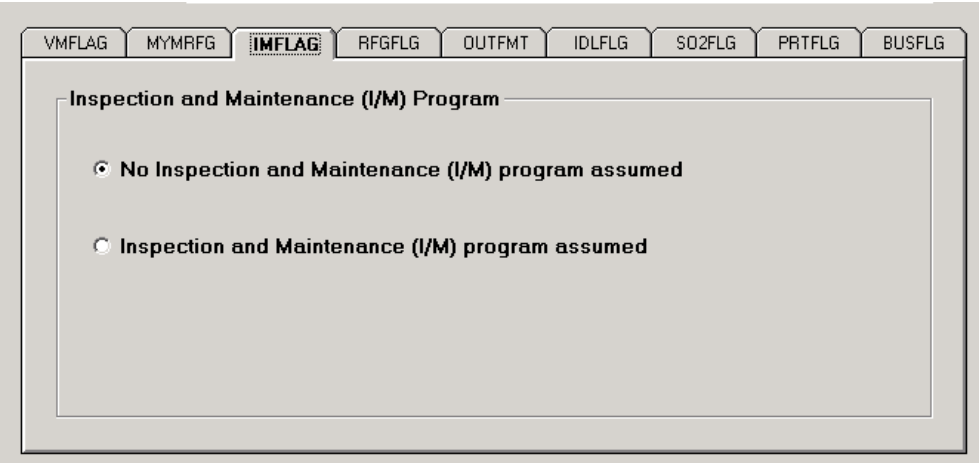
‘Reset’ command button:

Use the ‘reset’ command button to clear all data fields and re-enter data.

‘Done’ command button:

When the RD data for each class is completed click the ‘done’ command button to return to the ‘user – supplied MAR and RD form’ and choose the next or another vehicle class for data entry.

- **IMFLAG:**



(The inspection and maintenance program option tab)

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

1 = no I/M program assumed

2 = I/M program assumed

This flag requires no user-supplied data.

Field definitions and data entry

'IMFLAG' option buttons:

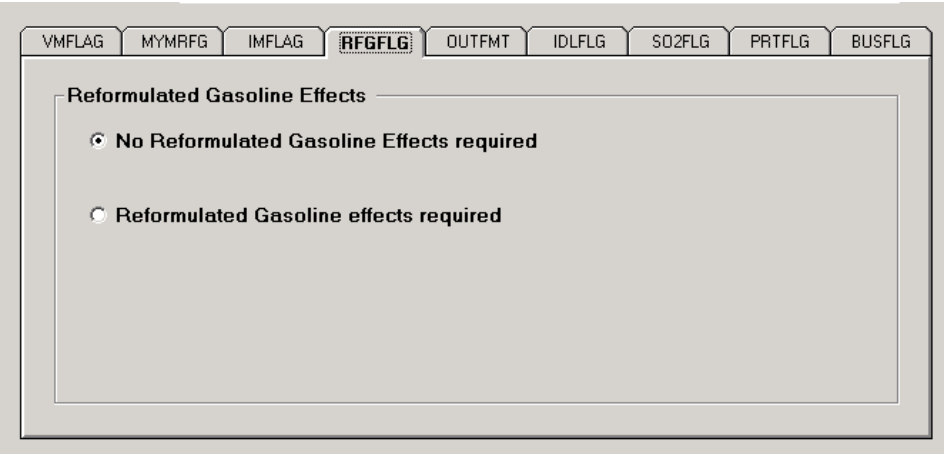
The legal values for IMFLAG are:

1 = no I/M program assumed

2 = I/M program assumed

This flag requires no user-supplied data.

- **RFGFLG**



(The reformulated gasoline effect option tab)

RFGFLG specifies whether reformulated gasoline effects are required to be reflected in the output or not. These reformulated gasoline effects for particulate emissions are partially based on sulfur content of the gasoline used.

Field definitions and data entry

'RFGFLG' option buttons:

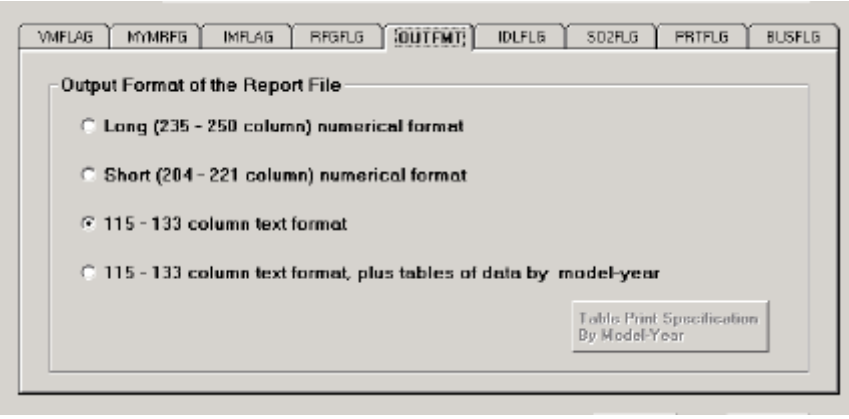
The legal values are:

1 = no reformulated gasoline effects required

2 = reformulated gasoline effects required

This flag requires no user-supplied data.

- **OUTFMT:**



(The output format option tab)

This control flag specifies the output format of the report file. The numerical format is suitable when the report file is intended to be used as input for other programs. The text format provides more detailed headers and footers. 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 factors for all vehicle classes.

Field definitions and data entry

'OUTFMT' option buttons:

The output can be obtained in the following formats:

1 = long (235 – 250 column) numerical format

2 = short (204 – 221 column) numerical format

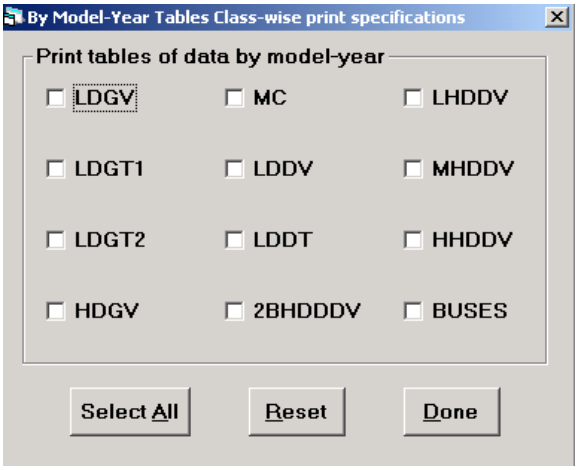
3 = 115 – 133 column text format

5 = 115 – 133 column text format, plus tables of data by model-year

'Table print specification by model – year' command button:

If format 5 is the desired format, additional data are required. The user is required to denote whether or not to print a table of emission factors for each class of vehicles for each model – year.

For this purpose a command button ‘By model-year table print specification’ is provided, on click of which the following form is displayed:



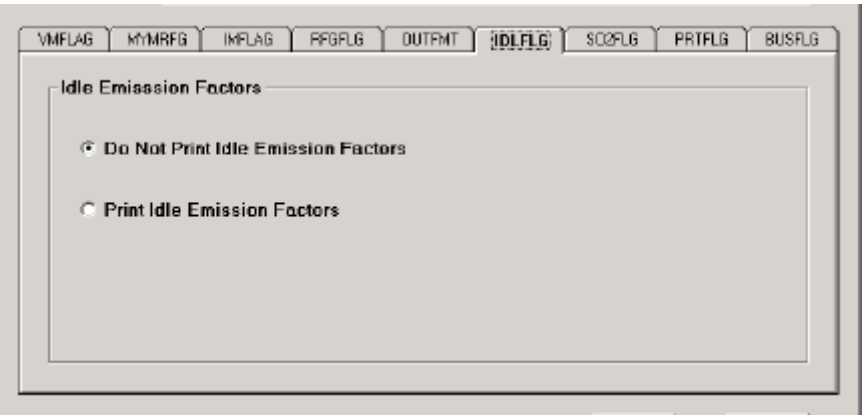
(Table by – model year specification form)

Field definitions and data entry

‘Class – wise print specification’ check boxes:

To denote printing of tables of emission factors by model – year, for a particular vehicle class or not, check the corresponding check – box.

- **IDLFLG:**



(IDLFLG tab)

IDLFLG specifies whether or not to print the idle emission factors.

Idle emission factors are calculated only for heavy-duty diesel vehicles.

Field definitions and data entry

'Idle emission factor print' option buttons:

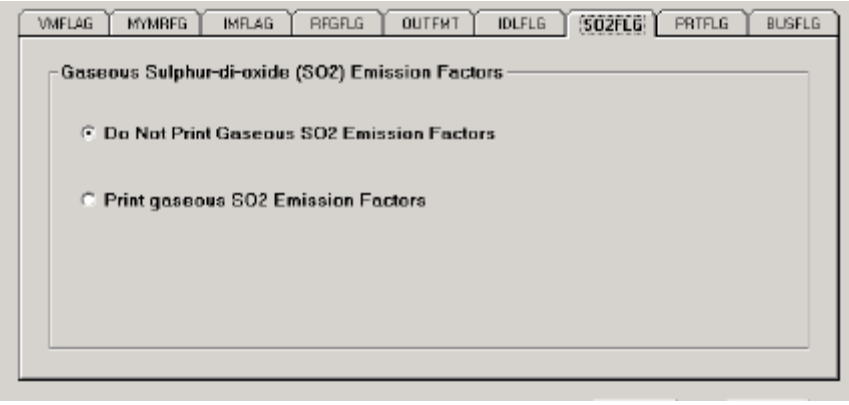
The legal values are:

1 = do not print idle emission factors

2 = print idle emission factors

Indicate whether or not to print idle emission factors by choosing the appropriate option buttons. This flag requires no user-supplied data.

- **SO_2FLG:**



(SO2FLG tab)

SO_2FLG specifies whether or not to print gaseous SO_2 emissions.

Field definitions and data entry

'SO2' emission factor print' option buttons:

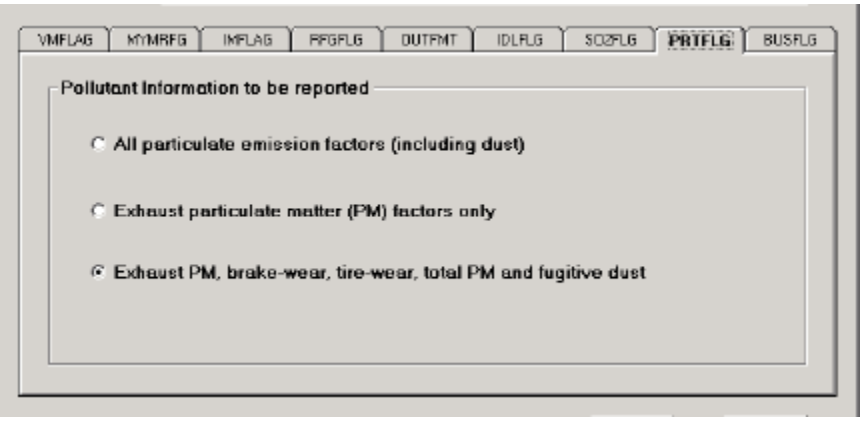
The legal values are:

1 = do not print gaseous SO_2 emission factors

2 = print gaseous SO_2 emission factors

Indicate whether or not to print SO2 emission factors by choosing the appropriate option.

- **PRTFLG:**



(PRTFLG tab)

PRTFLG specifies the pollutant information to be reported. The following pollutant categories (in g/mi) are included in the output when OUTFMT = 3:

Lead – exhausted lead

SOF – soluble organic fraction

RCP – remaining carbon portion

Direct SO_4 – direct sulfate emissions, exhausted as sulfuric acid (H_2SO_4)

Exhaust PM – lead + SOF + RCP + Direct SO_4

Indirect SO_4 – estimated indirect sulfate material $[(NH_4)_2\ SO_4$

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.

Field definitions and data entry

‘Pollutant print information’ option buttons:

The legal values for PRTFLG are:

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

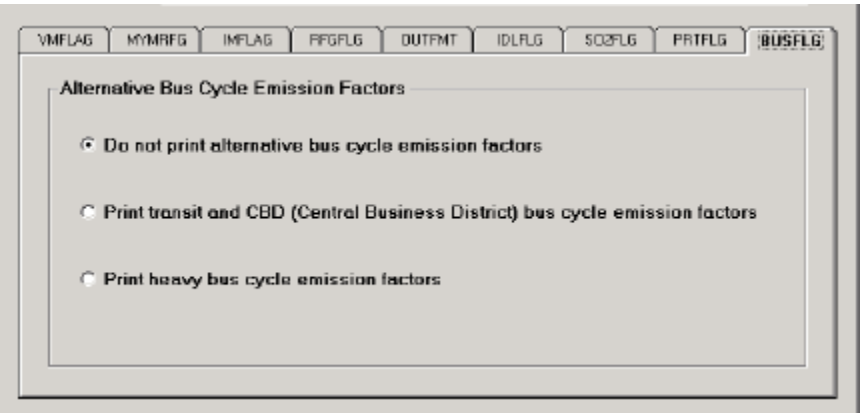
PRTFLG = 1 prints all pollutants listed above;

PRTFLG = 2 prints lead, SOF, RCF, Direct SO_4 and exhaust PM;

PRTFLG = 3 prints Exhaust PM, Brake-wear, Tire-wear, Total PM and fugitive dust (paved and unpaved).

A point to be noted is that PRTFLG has to be set to 1 or 3 when gaseous SO_2 emission factors are required i.e. when SO_2FLG = 2.

- **BUSFLG:**



(BUSFLG tab)

-

It determines which alternative bus cycle emission factors to print out when using OUTFMT = 3.

Field definitions and data entry

‘Bus cycle emission factor’ option buttons:

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 emission standards. The CBD usage category is based on an equal contribution of both the Central Business District (CBD) cycle 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 of a highly variable transient nature).

3 = Print heavy urban cycle emission factors.

(These are 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, causing very low fuel economy. This flag is not recommended since the condition it simulates rarely occurs).

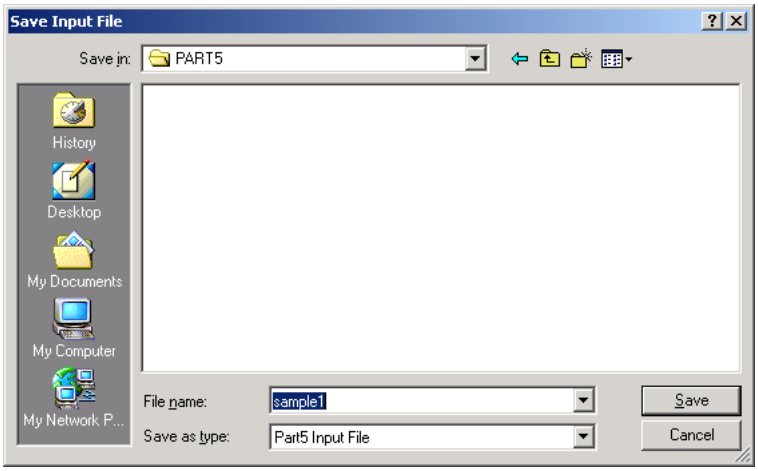
Saving the created input file

After data input or editing is completed, it needs to be saved in order to create a corresponding input file.

To save a newly created file or an edited existing file:

- Click on any of the following:
- *File* >> *Save* As or
-  (Save)

The ‘Save Input File’ dialog box appears:



- Create or choose a folder (preferably only for saving PART5 input files) and save the file with a depictive name in that location.

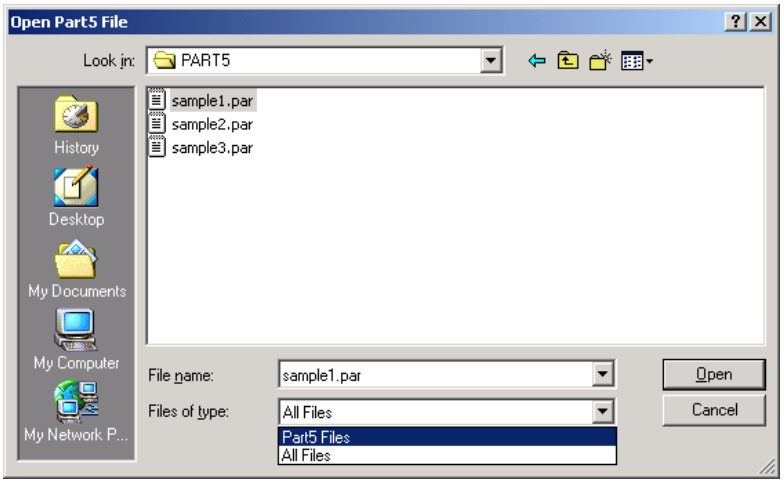
Note:

Due to program restrictions, ensure that the file name and the path (the directory structure) for a given set of saved data is short. Preferably the file name should not be more than eight characters long.

Opening an existing data (*.par) file

This provision is made for the purpose of editing input variables in an existing file and re – running the PART5 program for the same. Thus the tedious task of creating a new file with voluminous data is eliminated.

1. To open an existing (*.par) input file click on:
   - *File* >> *Open* or
   -  (Open)
2. On click of any of the above, the ‘Open PART5 File’ dialog box appears



3. In the ‘Files of type:’ drop – down list select the item ‘Part5 Files’. All the PART5 input files in the selected folder with the extension ‘.par’ will appear in the dialog box
   - Open the desired file to be edited
4. On opening the file all the data is loaded in the corresponding controls of the PART5 GUI. To edit data select the corresponding control
5. On editing save the edited file as an input (*.in) file and run the model

Running PART5

After data entry or editing is completed, the data is saved as an input file. The model is now ready to be run for that specific input file.

To run the model click on any of the following:

- *Options* >> *Run Model* or
-  (Run)

If data is not saved as an input file before running the model, the 'Save Input File' dialog box appears by default.

If data has already been saved as an input file, and the model run, the PART5 program is executed.

Note:

To run PART5 for a different set of data after every run, close the application and restart it. This ensures that the new files generated can be updated and the corresponding new reports viewed correctly.

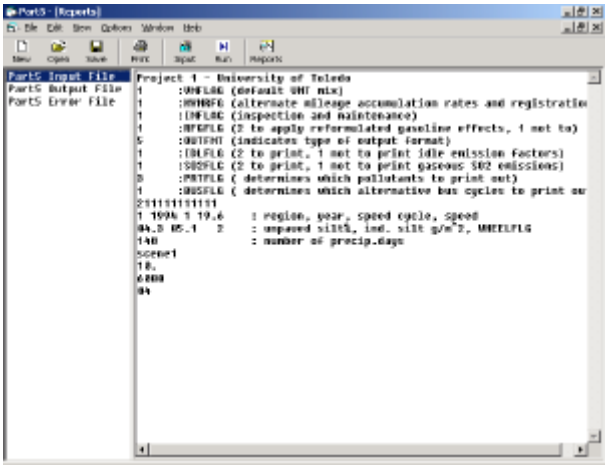
Viewing PART5 Output

The output of a PART5 model run may be viewed in report format in any one of the following ways. Click on:

- *View >> Reports*
- 

(Reports)

On click a list of the input file (*.in) and the output files (*.out and *er.out) is displayed on the L.H.S. of the splitter on the main form. On selection the highlighted file is displayed in text format on the R.H.S. of the splitter on the form.



Printing in PART5

Provisions have been made in the PART5 GUI to print both forms and the files generated (input, output and error) as a result of the program execution.

- Printing can be done in any of the following ways by clicking:
- *File* >> *Print* or
- (Print)

If printing is done during user – interface while entering data, the currently active form is printed.

Once the model is run and reports viewed, the currently displayed file in the R.H.S. of the splitter in the main form is printed.

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 (SO4).

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.

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. 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 SO4 or gaseous SO2.

Gaseous sulfur dioxide (SO2) 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 SO4) is considered to be exhausted as gaseous SO2. Gaseous SO2 acts as a precursor to form additional SO4 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 SO2 reacts in the atmosphere to form SO4. The 'Sulfate PM' (printed only when PRTFLG = 1) is the sum of direct and indirect SO4.

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 affects brake-wear emissions, is the particle size cutoff.

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.

The 'Total PM' (printed when PRTFLG = 1 or 3) is the sum of exhaust PM, brake-wear, tire- wear, and indirect SO4. There are two fugitive dust categories, 'Unpaved Dust' and 'Paved Dust,' to represent re-entrained 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).