

Frequently Asked Questions on MOBILE6

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Introduction

This document contains EPA's responses to questions that are frequently asked about MOBILE6. New questions will be added to future versions of this document. Therefore, this is not intended to be a "final" report; it will be continually evolving.

This version contains responses to questions received through September 5, 2003.

To submit questions for possible inclusion in future versions of this document, send them by email to: [**mobile@epa.gov**](mailto:mobile@epa.gov).

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General Questions / Overview

Q. What is MOBILE6?

MOBILE is an EPA model for estimating pollution from highway vehicles. MOBILE calculates emissions of hydrocarbons (HC), oxides of nitrogen (NO_x), and carbon monoxide (CO) from passenger cars, motorcycles, light- and heavy-duty trucks. The model accounts for the emission impacts of factors such as changes in vehicle emission standards, changes in vehicle populations and activity, and variation in local conditions such as temperature, humidity and fuel quality.

MOBILE is used to calculate current and future emission inventories of these emissions at the national and local level. These inventories are used to make decisions about air pollution policy at the local, state and national level. Inventories based on MOBILE are also used to meet the federal Clean Air Act's State Implementation Plan (SIP) and transportation conformity requirements, and are sometimes used to meet requirements of the National Environmental Protection Act (NEPA).

The MOBILE model was first developed in 1978. Since that time, it has been updated many times to reflect our growing understanding of vehicle emissions, and to cover new emissions regulations and modeling needs. Although some updates were made in 1996 with the release of MOBILE5b, MOBILE6 is the first major revision to MOBILE since MOBILE5a was released in 1993.

Q. How is MOBILE6 different from MOBILE5?

MOBILE6 is a major revision of the MOBILE model. The revision is based on much new data, but also on new understanding of vehicle emission processes. It also includes the effects of regulations that have been issued since MOBILE5b was released, and it includes new features designed to make the model more useful.

The improvements in the data and calculations have led to improved estimates of highway vehicle emissions. In some cases, the updated MOBILE6 emissions are significantly different from the emissions estimated with MOBILE5.

The new features of the model make the model easier to use. The model's input structure is more straightforward, easing data entry. Users can enter more detailed vehicle activity information to better tailor their estimates to local area conditions. Also, the model's new output structure makes it easier for users to automate the processing of MOBILE6 results using spreadsheet and database tools.

Q. What are the major factors driving the change in results between MOBILE5 and MOBILE6? (Why are the numbers different?)

There are a number of reasons why emissions estimates are different in MOBILE5 and MOBILE6. Some changes drive the estimates down; others drive the estimates up. This means that the overall comparison can vary greatly depending on the pollutant of interest, the calendar year being considered, and the local fuel, local driving activity and other local user inputs.

Here are some of the most important quantitative changes to the MOBILE model and their general impact on emission results:

Tailpipe emissions from light-duty cars and trucks

Basic Emission Rates

MOBILE6 "basic emission rates" (exhaust emissions expected from driving a "Federal Test Procedure" (FTP) driving cycle under specific laboratory conditions) for light-duty cars and trucks are lower than those predicted in MOBILE5 for late 1980s and early 1990s model year vehicles. This is because new data from in-use vehicles shows that the pollution control technologies that came into widespread use in the late 1980s are more durable than had been expected when MOBILE5 was developed. MOBILE6 also includes new, lower, basic emission rates for 2001-and-newer vehicles subject to the National Low Emission Vehicle and Tier 2 emission standards.

Real World Driving

In addition to the basic emissions, MOBILE calculates corrections to the FTP driving cycle estimates to account for various factors that impact emissions in the real world. Many of these factors have changed in MOBILE6.

Air Conditioning and Acceleration: One major improvement is the inclusion in MOBILE6 of high emissions due the effects of air conditioning and high acceleration driving. MOBILE6 adds an "off-cycle" correction to account for these emissions. Studies show these off-cycle emissions are high for vehicles built before 2001, but they are expected to decline as the "Supplemental Federal Test Procedure" regulations to reduce these emissions are phased in. This tends to make emission estimates for older vehicles higher in MOBILE6 than in MOBILE5.

Fuel Content: The emission corrections to account for fuel content are also improved. MOBILE6 explicitly accounts for the damage inflicted by high levels of sulfur in gasoline in vehicles with advanced catalysts. This leads to increased emission estimates in the late 1990s and early 2000s. This effect declines as the Tier 2 regulations phase in lower sulfur

fuel. Meanwhile, evidence shows that oxygenated fuels do not improve CO emissions from advanced catalyst vehicles; so, in MOBILE6 the CO benefits of oxygenated fuel programs will phase out as these more technologically advanced vehicles become more prominent in the fleet.

Speed and driving habits: Other changes also affect the light-duty results in MOBILE6. New data on speed effects shows that vehicle emissions are generally less sensitive to speed changes than previously thought. New data on driving activity shows that today's vehicles are driven more miles-per-year than in the past. Today's vehicles are used to make more trips, increasing the number of vehicle starts per day and the associated start emissions. EPA also changed the default car/truck ratio in MOBILE6 to account for the growing number of light-duty trucks.

Heavy-Duty Exhaust

In MOBILE6, basic emissions for 1987-and-later heavy-duty trucks and buses were derived from new certification data that shows emissions are much lower than predicted by MOBILE5. Also, since MOBILE5 was developed, EPA learned that in certain driving conditions, many 1988-2000 model year heavy-duty trucks emit much more NO_x than they do in certification testing. MOBILE6 takes account of the lower base-rate emissions, the excess NO_x emissions under steady state driving conditions, and the reduction in NO_x emissions expected in future years as a result of a consent decree with engine manufacturers. Thus, MOBILE6 heavy-duty truck emissions are significantly higher than MOBILE5 for some model years and pollutants, and significantly lower for others.

Evaporative Emissions

Evaporative emissions are hydrocarbon emissions from evaporated fuel. These emissions are due to changes in ambient and engine temperatures and to small leaks and seepages in the fuel system (in contrast to "tailpipe" emissions of exhaust from combustion.) Much new data has been collected on evaporative emissions. MOBILE6 takes account of new data that show that a small fraction of vehicles with leaks in their fuel systems contribute a large quantity of evaporative emissions. At the same time, MOBILE6 also takes advantage of data from new tests that better mimic real-world evaporative conditions and accounts for new regulations that require lower emissions and more durable fuel systems-effects that reduce evaporative emissions.

Q. How do we know MOBILE6 estimates are better than MOBILE5?

Every MOBILE model is based on the best information available at the time the model is developed. Since vehicle technology changes over time, and our understanding of emissions improves, it is not surprising that there were areas in MOBILE5 that needed

improvement. In time, MOBILE6 will also become outdated. That said, MOBILE6 is the most thoroughly documented and tested model in the MOBILE series, and it provides a valuable tool for national and local-area mobile source emission inventories.

EPA has gone to great lengths to assure that MOBILE6 is based on the best data and calculation methodologies available. EPA staff produced nearly 50 technical reports explaining the data analysis behind the MOBILE6 estimates and the methods to be used in the model. These are posted on the EPA's MOBILE6 Web site (www.epa.gov/otaq/m6.htm) for comment and review. All papers were extensively reviewed within EPA, and many were sent to external experts for an independent peer review. All comments were considered, and MOBILE6 methodologies were revised in response to comment as necessary.

After MOBILE6 was coded, the model was subject to a battery of tests to make sure the results were consistent with the underlying data. The model was also released for limited pilot testing to make sure the model could be used in real-life conditions by real-life modelers.

Even after the release of MOBILE6, EPA will continue to validate MOBILE estimates by comparing them with real-world emission measurements.

Q. What will be different for MOBILE6 users?

MOBILE6 has a different input structure than MOBILE5. Where MOBILE5 and previous versions of MOBILE used fixed formats, numerical flags and obscure acronyms, MOBILE6 uses English language cues, external data files, and flexible formatting. Transforming old input files into the new structure will require effort, but the new structure is much more "friendly" and should be much easier for new users to learn.

More importantly, MOBILE6 allows users to provide much more detailed local inputs than were allowed in MOBILE5. This permits users to adapt model to local conditions and to model special situations that are not reflected in the model's defaults.

MOBILE6 also has an updated structure that allows users to output emissions by hour of the day and to segregate start and running emissions. The new output uses standard database formats to allow users to easily post-process their results. These features will be useful for entering the emissions data into air quality models and other tools that make use of mobile source emission inventories.

Q. Where can I learn more about MOBILE6?

- (1) Check our Web site: www.epa.gov/otaq/m6.htm
- (2) Read the User Guide for MOBILE6 (available on that MOBILE6 Web site).
- (3) Try the computer based training (CBT) (also available on that MOBILE6 Web site).
- (4) See the MOBILE6 Technical Guidance document (available on the MOBILE6 Web site) on the use of MOBILE6 for emission inventory preparation.
- (5) If these resources do not address your questions or concerns, send questions or comments to: mobile@epa.gov

Program Will Not Run

Q. We recently converted to Windows XP. When we attempt to run MOBILE6 in Windows XP, we get an error message about "Memory Protection Faults."

We have tried to address this problem by recompiling the source code. We found that we eliminated the problem by recompiling *without* using the "trace" option. The version of MOBILE6 currently on our Web site should run without having this problem. Download the current version of MOBILE6 and try it.

Files

Files / Names / Path Names

Q. Input file names that are read by a batch file cannot have more than 8 characters before the decimal. Is this also true for all other external files?

Yes this is true for all MOBILE6 file names. MOBILE6 is really a "DOS" program and so really only understands the DOS convention of file naming.

Q. With Windows95 and later Windows operating systems, directories/folders can have spaces in their names. Does this create a problem for MOBILE6 when reading the path for a file? Are there any restrictions on path names other than the 80-character limit?

Spaces in pathnames seem likely to cause problems. Again, MOBILE6 is really a DOS program and so really only understands the DOS convention of file naming.

Files / Names / Reading (Opening)

Q. MS Windows applications will not automatically open the MOBILE6 database output file, since it uses a non-standard "TB1" extension. Why doesn't MOBILE6 use a standard extension?

There really is no "standard" extension that will work with all, or even most, applications. If the user prefers a different extension, the user may alter the output file name extension after the MOBILE6 model has run. (Please see the following question.)

Q. How can we open the database reports? (Should we rename the file with a new extension rather than use the "TB1" extension?)

The files with the "TB1" extension are simply ASCII text files containing a table with fields separated by tab characters. The extension TB1 is **not** a standard software extension, so most software (with default configuration) will not know how to open them.

A solution for some applications is to rename the file with an extension of "TXT" indicating that the file is a text file. However, since this new name would duplicate the file name being used for the MOBILE6 descriptive output, the descriptive output file should first be moved (or copied) into another directory.

Another solution for some applications is to associate the "tb1" extension with a specific application.

Files / Names / Samples

Q. What does the file extension "DEF" mean?

Files ending with the DEF extension are example MOBILE6 external data files. These files have been created to replicate the same default (DEF) values that are contained in the MOBILE6 code. Use of these inputs should produce results identical to runs without the input. These files are included to provide an example of what an external file of that type might look like. They can be used as a template for user supplied values. External files may have **any** file extension the user wishes. However, all external data files we provide end with either a DEF (external data, default values) extension or D (external data) extension.

- Q. Where can I find brief overview and explanation of the example files? Could one example be a detailed template of what an input file contains, with suitable explanation for each entry?**

The README.TXT file distributed with MOBILE6 contains a listing and brief explanation of each of the example files. The MOBILE6.IN file is intended to be a kind of template showing a nearly full range of what an input file can do. It is not a "typical" input file, however, and contains non-default data. (We have received different comments on what people would like this file to be).

Files / Location

- Q. How do I get the model to put my input and output files in different directories? Can I use a "relative path" with two dots?**

No. MOBILE6 can process the input file name assuming a default *.IN extension. In order to do this, it must note the location of the decimal ("dot") character in the input files with non-default extensions. Thus, DOS navigation commands that include decimals may not operate correctly.

- Q. The User Guide suggests that "all example external data files be placed in the directory containing the MOBILE6 executable application file." Elsewhere, it is suggested that the user put example input files in the EXAMPLES directory for use as references. Which statement is correct? Is the second statement actually directing users to keep copies of input files in EXAMPLES subdirectory (which is located in the RUN directory) as well as in the RUN directory on an equal level with the executable file?**

Yes. The external data files and input file(s) may be located anywhere, as long as they are properly referenced (including the proper DOS path). However, if no path is supplied, MOBILE6 will expect that the data file is located in the same directory as the application. When constructing command input files, it will be easier for users if the external data files they intend to use are located in the same directory as the application. Since users may inadvertently make changes to the external data files and example input files when creating custom versions, it is also wise to keep an unaltered copy of the example input files external data files in the EXAMPLES directory for future reference.

Files / External

- Q. Do the terms external data input file and alternate external input file refer to the same entity?**

Yes. External data input files are used to substitute local values for the default values contained in MOBILE6. As a result, these external files are sometimes referred to as "alternate" data files, since they contain alternate values to be used in place of the default values.

Input

Input File / Structure

- Q. Would it be correct and helpful to say that the beginning of a new run data section restores all defaults?**

It is actually not true that all defaults get restored at this point. Header level defaults are not restored.

- Q. What is the difference between a "Run" and a "Scenario"?**

"Run" refers to a group of scenarios which share certain parameters. For example, the scenarios within a run can be a series of calendar years or a series of different average speeds for a single calendar year. MOBILE6 produces emission result reports for each scenario. This arrangement was intended to provide maximum flexibility while reducing the amount of input that is required for each scenario.

Input / Commands

- Q. Where can we find a sample template for the users to begin developing our own input files?**

The "Table of Required MOBILE6 Input Records" (Section 2.5 of the User Guide) provides one starting point. It shows the minimal set of commands in an order which is acceptable to the program. Also the EXAMPLE3.IN file distributed with MOBILE might be a good starting point. Starting with a minimal input file, commands can be added one at a time.

For commands which require an external data file, example files containing the MOBILE6 default information are provided. These have the .DEF extension. These can be used as "templates" for external data files.

Input / Problems

Q. If a MOBILE6 input file does not process, what are some common errors to look for?

Here are some common errors and approaches to try:

- 1) There may be too many spaces (or not enough spaces) between the command text and the colon character, which is intended to mark column 20 (i.e., the twentieth character on the line). You will need to keep track of which column you are in for each line, either by using a fixed width font such as Courier or by counting characters (including spaces as characters). A suggestion is to use a text editor such as the NOTEPAD.EXE application that comes with MS Windows, which automatically uses a fixed width font.
- 2) In general, your input may be too complex. Until you get more experience, try creating an input file with the minimum number of inputs. Then expand your inputs to include more parameters of interest, one at a time.
- 3) You may have forgotten the END OF RUN command.
- 4) You may have a TAB in your input file. TAB characters are not allowed.

Input Data

Input Data / Hourly Temperatures

Q. For hourly temperatures (User Guide, Sections 2.8.6.4 and Appendix B Table 4), it's not altogether clear exactly what temps are required. Suppose we're using the 24 hourly temperature observations reported by a nearby National Weather Service [NWS] site. Temperatures are generally reported on the hour (in NWS practice), such that the 8 AM temperature (actually measured a few minutes before 8 AM) might be 75 degrees. Is that the number we should put in the input for 8 AM?

We are using the observed temperatures at the beginning of each hour not the average temperature during the hour. For more information on temperature, see the MOBILE6 Technical Guidance document (available on the MOBILE6 Web site).

- Q. What about Daylight Savings Time and hourly temperature inputs? This question may be important when using MOBILE6 outputs as inputs to ozone models, since ozone models use Standard time. Do you mean Daylight time (Standard time plus 1 hour), such as prevails during the summer over most of the US, or do you mean actual Standard time? Normally, NWS historical data are reported as at Standard time--if it's in Daylight time, the report will usually say so.**

The difference between Standard and Daylight time may also be important when users put in fractions of VMT by hour of the day (User Guide, Section 2.8.8.2.b) and similar inputs.

Both the activity data and the temperature data assume that the times (i.e., hours of the day) are "clock time" which in the summer is usually Daylight Savings Time. However, practically speaking, shifting the hourly temperatures by 30 to 60 minutes should make little difference. The most important thing is to make sure the inputs are all consistent with each other and with the models that generate MOBILE inputs and process MOBILE results.

- Q. Are the temperature limits for the HOURLY TEMPERATURES command the same as for Min/Max Temperatures?**

Yes.

Input Data / Fuel Parameters

- Q. MOBILE6 requires the user to enter a nominal fuel RVP; however, the (descriptive) output shows both a nominal RVP and a weathered RVP. What is the difference? How has this changed since MOBILE5?**

The Reid Vapor Pressure (RVP) of the fuel is a measure (in units of pounds per square inch) of the volatility of the fuel.

The "Nominal RVP" represents the volatility of the fuel when it is first pumped into the vehicle. The most volatile components of this fuel begin to evaporate shortly after the fuel is dispensed, resulting in a lower volatility for the fuel remaining in the vehicle's gas tank. The "Weathered RVP" is the RVP of this usually less volatile "tank" fuel. This use of "Weathered RVP" in MOBILE6 is identical to its use in the previous version of MOBILE (i.e., MOBILE5).

Q. Are there any user inputs in MOBILE6 for diesel fuel that I need, such as diesel fuel sulfur level, ULSD, or cetane number?

The sulfur content of the diesel fuel is a required input when you estimate particulate matter (PM) or toxics (HAPs) emissions. You would then use the command:

```
DIESEL SULFUR : 340
```

Assuming (of course) the sulfur content of the fuel were 340 ppm. (See Section 2.8.10.3 of the MOBILE6.2 User Guide.) That is the only command for fuel properties of diesel fuel in MOBILE6.

Q. When I use the OXYGENATED FUELS command the output does not match the input numbers. What is wrong?

You are correct. MOBILE6 is ignoring the OXYGENATED FUELS command because you also specified an RFG program using the FUEL PROGRAM command. (See "Tips" in Section 2.8.10.4 of the Users Guide.) In this case, the oxygenated fuel parameters of your RFG program take precedence over the OXYGENATED FUELS command.

Q. I am trying to calculate the individual benefits of Phase II RFG and NLEV programs in year 2002. While results for RFG benefits looked OK, a NOx disbenefit (i.e., increase) was observed in the case of NLEVs. What is the reason behind an increase in NOx emission factors instead of an expected decrease when "NLEV" is used?

You are seeing the effect of gasoline sulfur on NLEV vehicles. NLEVs are designed to work with low sulfur fuel and do not tolerate high sulfur levels well. As a result, NLEV vehicles run on high sulfur fuel often exhibit higher emission levels than Tier 1 vehicles run on the same fuel, even though their emission standards are tighter. This disbenefit will disappear once low sulfur fuels (required by the Tier 2 rules) become available.

Q. Will MOBILE6 allow me to change "x" percent of certain vehicle classes to run on ethanol?

You can control the "market share" of oxygenated fuels in MOBILE6 using the OXYGENATED FUELS command (or the OXYGENATE command if air toxics are needed). The market share controls the fraction of all vehicles which use an oxygenated fuel. Although you cannot restrict the use of oxygenated fuels to specific vehicle classes,

you can always run the model multiple times, where each run uses a different fuel assumption and then retain only certain vehicle class results from that run.

- Q. I am using MOBILE6.2 to estimate toxic emissions. The Users Guide indicates that I must use the OXYGENATE command to do this. Since the local gasoline is not oxygenated, I specified a market share of zero for each of the four oxygenates. However, MOBILE6.2 generated the following error message:**

**"M 9 Error:
Inconsistent Alcohol Blend input encountered"**

What am I doing wrong?

With the OXYGENATE command, you are required to enter (as you did), for each of four (4) oxygenates, both the oxygenate content in the fuel (by volume percentage) and the market share.

It seems to make sense that if the market share is zero then the oxygenate content is irrelevant. However, as a hold over from the MOBILE5 code, when the market share is zero the oxygenate content must also be zero. Therefore, if you change all four of the contents to zero, then your input file should run.

Input Data / Time of Day

- Q. Does the data entry for VMT by Hour start at 6 a.m.?**

Yes. As with the other MOBILE6 commands, hour starts at 6:00 a.m.

Input Data / Air Conditioning

- Q. Will we be able to put in a percent AC use in order to see what effect [i.e., increase in emissions] will occur with and without AC use?**

Not directly. Air conditioning activity is controlled by user inputs of temperature, sun/cloud parameters, and humidity. As a practical matter, however, input of a low temperature, e.g. below 70 degrees, will eliminate any effects of air conditioning usage from the emission estimations.

Input Data / Altitude

- Q. "ALTITUDE" is a parameter that won't change for an area from one scenario to another, but the documentation requires this to be in the scenario section. Does it need to be repeated with each scenario record? Can it be moved to the RUN section to apply to all scenarios?**

For high altitude areas, the ALTITUDE input does need to be input for each scenario. However, EPA can see that making "ALTITUDE" a run level command would be more convenient since it's not likely to change and we have added that to our list of changes desired for future versions of the model.

- Q. Is there a recommended division for which altitudes use "Low" and above which altitude you use "High"? We have traditionally used the "High Altitude" option even though at 4500 feet we are below the 5500 foot threshold defined in the documentation. What is the appropriate altitude parameter for us?**

See the MOBILE6 Technical Guidance document (available on the MOBILE6 Web site).

Input Data / I/M Programs

- Q. How do I model a traditional I/M program that transitions to an OBD I/M program?**

You need to model two I/M programs. You can refer to the User Guide "Tip" for the I/M MODEL YEARS command.

- Q. It is said that the files ASMDATA.D and TECH12.D are required if the user wants to model the effects of I/M programs. Is modeling the effects of I/M programs a standard feature of the MOBILE6 model and must those two files be accessible by the command input files?**

Since modeling the effects of I/M programs is a standard feature of the MOBILE6 model, it makes sense to consider these two files (ASMDATA.D and TECH12.D) as files that are necessary to use the MOBILE6 application. If I/M programs are not described in the command input files, then these two files are not used.

Q. Can MOBILE6 be used to model I/M programs based on remote sensing and "clean screening" as well as the ability to change the ASM cutpoints?

No. These capabilities were in EPA's original plan for MOBILE6, but are quite complicated to model and were eventually dropped for lack of resources. They will be considered in future versions of the model.

Q. For an IM240 program, why do you have to use both the I/M CUTPOINTS and I/M STRINGENCY commands? Shouldn't the cutpoint command replace the stringency input?

This is an unfortunate artifact of MOBILE5. We have added this to the list of possible changes for future versions of MOBILE6.

Q. With respect to I/M cutpoints in MOBILE6:

a. Will the MOBILE6 "package" include a sample or typical I/M CUTPOINTS table CUTPOINT.D?

b. I'd like to suggest that these sample "external" files (like CUTPOINT.D) contain comments which explain their purpose and where additional information can be found.

The MOBILE6 package contains CUTPOINT.D and example files for most of the input commands which require an external data file. These files are examples only and do not necessarily represent "typical" inputs, unless they have the file extension .DEF indicating that they are intended to replicate the default data contained in MOBILE6. They are commented to aid users wishing to modify them for their own use.

Q. In MOBILE5 the user specified the program start year as the first year that an I/M program was in place, regardless of whether it had changed over the years. This was necessary because of the way in which the tampering offset was handled. Does this still hold for MOBILE6, or is it OK to set the program start year to the actual year of the program when multiple programs are implemented?

In order to obtain the full effect of tampering deterrence and to correctly model an uninterrupted I/M program, users will still have to enter the program start year as the first year that an I/M program was in place (not just the current version of the I/M program). (This is explained in more detail in the Users Guide.)

- Q. In the I/M program portion of the users' guide for MOBILE6, there is a frequent mention of a column number. I would like to know if the values entered in the I/M descriptive file would have to be repeated in the columns specified and where they exist.**

The I/M DESC FILE command allows you to describe the I/M program in an "external" data file rather than within the command input file. You would enter the I/M DESC FILE command in the command input file along with the file name (and path, if necessary) to locate the file containing the I/M program description. No other I/M command (other than the I/M DESC FILE command) needs to be located in the command input file. All of the other I/M commands which describe the program (i.e., I/M Program, I/M MODEL YEARS, etc.) can be located in the external file. All of the commands located in the external data file must be in the same format that they would appear if you had entered them in the command input file.

- Q. In the "Grace Period" field, is the number of years specified, deducted from the last model year entered in the "I/M Model Year" field or is it considered from the current year? Example: In calendar year 2001, if the model years subject to the I/M Program are 1967 - 1996, and if the Grace Period is set to 5 years, is 5 deducted from 1996 to set the effective coverage up to the model year 1991 or is it deducted from 2001 to set the effective coverage to the model year 1996?**

In the case of the I/M GRACE PERIOD command, age 1 refers to the current model year (same as the evaluation calendar year). So, if the grace period is set to 5 in calendar year 2001, then there will be no I/M benefit from model years 1997 through 2001. The grace period calculations are independent of the I/M MODEL YEAR command values. So, in your example, where only 1967 through 1996 model years are included in the I/M program, setting the grace period to 5 in calendar year 2001 will have no effect on I/M benefits.

Input Data / Mileage Accumulation Rates

- Q. Are comments allowed before each block of data in an external file used with the MILE ACCUM RATE command?**

Yes, as shown in the MILEDAT.D example file.

Input Data / Natural Gas Vehicle (NGV) Fractions

Q. Do you have to provide data for all 28 vehicle types when using the NGV FRACTION command?

Yes. One way to deal with this is to construct a "template" file of all zeros from the NGVFR.D file provided, and then to change the fractions for the vehicle types you want.

Input Data / Starts per Day

Q. Relative to the STARTS PER DAY command, what exactly is a "trip"? Does your definition of an engine start refer to a round trip? I ask because your example uses 1.0 for weekday starts which says to me that the average driver goes some place and does not come back.

A trip in MOBILE6 is defined by whatever travel occurs from when the engine is turned on to when it is turned off. You have correctly interpreted the example file, but these files are not intended to demonstrate the full range of the program or even to be realistic. They are simply examples of valid input data to the model.

Input Data / Barometric Pressure

Q. Now that MOBILE6.2 has an input for barometric pressure, can I use this parameter to determine the effects of changes in altitude?

No, the new BAROMETRIC PRES command ambient pressure value is **only** used to convert hourly relative humidity values provided by the user with the RELATIVE HUMIDITY command to absolute humidity units. The absolute humidity values are needed to calculate the NO_x humidity corrections. No other adjustments use the barometric pressure value. The effects of changes in altitude on emissions can **only** be modeled using the ALTITUDE command.

Output

Q. Can the same run produce both a descriptive output and a database output?

Yes. If the DATABASE OUTPUT command is used, and nothing is done to suppress the descriptive output, then both outputs will be produced.

Q. In the descriptive output, is there a way for MOBILE6 to output the emission rates for all exhaust, all evaporative (evap), and exhaust+evap as three separate values, without the full detail? Is it true that with either the "EXPAND EVAP" or the "EXPAND EXHAUST" command, you still get composite emissions, plus the extra detail?

There is no way to show the emissions rates for all evap, all exhaust, and exhaust plus evap, without using both the EXPAND EVAP and the EXPAND EXHAUST commands. Composite emissions are always reported.

Q. The use of 6 am as the starting point, as discussed in the User Guide Section 2.6.6.3, may cause confusion. Does the hourly output also start there, such that emissions are reported over parts of two days?

The hourly output does also start at 6 AM, as explained in Chapter 3 of the User's Guide. This may be somewhat confusing, but is at least consistent.

Q. DATABASE FACILITIES - If this command is used, do you still get an all facilities output?

This command has **NO** effect on the aggregated output and should not be used with the aggregated database command. It should only be used with the daily or hourly database output formats. "All facilities" results do not exist in these output formats. Instead, every database output record includes a value of FTYPE. A particular value of FTYPE, namely "NONE," is used to report emission types, such as hot soak losses which do not occur on roadways.

Q. DATABASE VEHICLES and AGGREGATED OUTPUT - Can you use these commands to get an "all vehicles" output?

These commands **ONLY** affect the database output. The database output never includes "all vehicle" results. To get "all vehicle" results, you must either use the descriptive output, or externally manipulate the aggregated database output to sum emission factors across vehicle classes.

NOTE: The "all vehicle" emissions should be computed as a weighted sum across vehicle classes, with weighting by VMT fractions ("VMT").

- Q. Will there be a way to get hourly emission factors that are aggregated by age and emission type? Section 3.1.3 of the User Guide implies that we will only be able to aggregate *daily* emissions by age, roadway and emission type.**

While MOBILE6 does not directly produce this output, it is possible to derive it from the hourly database output.

We realized early in the MOBILE6 process that we would not be able to produce a result output format that would meet every need. Instead of expanding the number of output options, we now have a "database" output which is designed to include everything that should be needed to create a variety of output formats by aggregating the database output results.

Output / Alternate Units

- Q. Are all emissions always reported in g/mile, including non-running emissions? If the output is always in g/mile, how can a user get a "per start" (or "per trip" or whatever) emission mass, or total start emissions mass, in a logically consistent way?**

MOBILE6 does always report emissions in terms of grams per mile per vehicle. In the database output results also are reported in grams per time period per vehicle. While MOBILE6 never reports in units such as "per start" or "per trip," the user can get "per start" results by using the database output of emissions and the number of starts to calculate the desired result. (See also the questions under the "**Emissions / Start Emissions**" heading.)

- Q. Why does MOBILE6 calculate emission rates (grams per mile) instead of inventories (tons per day)?**

MOBILE6 database output is intended to facilitate user calculation of a wide variety of alternate output results. With emissions in grams per mile, users can easily apply the results to their own VMT per day estimates to calculate inventory results.

- Q. How can I best convert MOBILE output from grams per mile (g/mi) to other units such as "tons per million VMT," pounds per thousand VMT, and grams per vehicle kilometer traveled?**

As your question makes clear, there are a lot of output options that people might find useful. The database output lets you produce results in an electronic form that can be

opened in a spreadsheet. Then you can easily apply the VMT estimates and units conversion of your choice.

Q. I need to calculate refueling loss emissions in grams per gallon units. With MOBILE5b I set HCFLAG=3. How do I do this in MOBILE6?

MOBILE6 will produce estimates of refueling emissions in units of grams per mile. Multiplying those values by fuel economy (in units of miles per gallon) will give you refueling emissions in terms of grams per gallon. Thus, the question is how to obtain the fuel economy estimates.

If you are working with the database output, the fuel economy estimates are provided.

If you are working with the descriptive output, you can direct MOBILE6 to print out the fuel economy values by using the POLLUTANTS command and specifying CO2. If you are interested in only refueling emissions, you would need to specify only the CO2 and HC.

NOTE: The POLLUTANTS command should be added to the "header" section of your input file. (See Section 2.8.3.1 of the User Guide.)

Output / Evaporative Emissions

Q. Is composite VOC assumed to be exhaust VOC only? Are evaporative emissions included? Do I need to subtract evaporative emissions from VOC to avoid double counting?

As in MOBILE5 output, the composite VOC output, which is always displayed in the descriptive output, contains both exhaust and evaporative emissions. The EXPAND EXHAUST and EXPAND EVAPORATIVE commands add more detail but do not affect the composite VOC output values. If you need evaporative and exhaust VOC emissions separately, you will need to either subtract the total evaporative emissions (obtained by using the "EXPAND EVAP" command) from the composite VOC values or expand the exhaust emissions (using the "EXPAND EXHAUST" command) and subtract the total exhaust VOC value.

Output / Vehicle Types

- Q. The MOBILE6 User Guide sometimes categorizes vehicles into 16 vehicle categories, yet Table 1.2.3 lists 28 vehicle classifications. What is the proper (best) breakdown for registration data input?**

MOBILE6 calculates emission factors for 28 individual vehicle categories. However, many of these categories form gasoline/diesel pairs (e.g., light-duty gasoline-fueled vehicles / light-duty diesel-fueled vehicles). Registration data are often available only for these 16 composite (i.e., paired) vehicle categories. Thus, when registration data are entered into MOBILE, they are in the form of these 16 composite vehicle categories. MOBILE uses these data plus the diesel sales fractions to calculate (internally) the vehicle distributions for all 28 individual vehicle categories

Appendix B of the MOBILE6 User Guide defines the 16 composite registration categories, 14 composite vehicle types used for diesel sales fractions, and the full 28 individual vehicle class categories.

- Q. If I change only the VMT fractions (which should only affect the resultant "All Veh" composite EFs, not individual vehicle type EFs), why does the output file indicate changes for the LDDT and the LDGT(all) vehicle categories?**

You are partially correct. Changing the VMT fractions will not affect the emission factors for the individual vehicle classes. However, the classes "LDDT" and "LDGT" are composite (not individual) classes of two and four individual LDT classes, respectively and, therefore, will change with changing VMT fractions. Similar situations exist with the busses and heavy-duty truck classes.

Output / Messages (Error / Warning)

- Q. Why do I always get a warning message regarding no sales for HDGV8b? The default input data does not include any of these vehicles.**

If a user supplied their own inputs which caused no sales for some other vehicle category, one would want to see such a warning.

Output / Spreadsheet

- Q. How do I obtain just the exhaust HC emissions using the spreadsheet output?**

The Spreadsheet output was designed to report the same numbers as the descriptive output. Since the descriptive output reports the HC results as the sum of the evaporative and exhaust HC emissions, so does the spreadsheet output. To obtain the exhaust (only) HC, subtract the sum of the evaporative components from the total HC emissions.

Output / Aggregating

Q. Can Mobile6 produce TRAVEL WEIGHTED EMISSION RATES BY MODEL YEAR (as in Mobile5)? Can Mobile6 CONSOLIDATE emissions by VEHICLE CLASSES in the output?

MOBILE6 can generate emission rates by model year and vehicle class, using the DATABASE OUTPUT command option. This additional output, however, is in an disaggregate form and must be aggregated either by hand (such as in a spreadsheet) or electronically (using database software). This aggregation process must use VMT weighted sums, rather than simple sums. All of the fields that you may need to make any sort of custom aggregation report are available in the database output. MOBILE6 does do some simple aggregations, such as DAILY OUTPUT, which aggregates over the hours of the day, and AGGREGATE OUTPUT, which aggregates over the model years, roadway types and emission types.

Q. I have had extreme difficulty in aggregating some of the database output information. How do you calculate emissions for each facility type and vehicle type?

There are two solutions to your problem.

- 1) You can restrict the output of the model to a single facility type using the VMT BY FACILITY command. For example, if you wanted freeway emissions, you would enter fractions for freeway and freeway ramp VMT and set the arterial/collector and local fractions to zero. This will require more MOBILE6 runs, (separately for each roadway type) rather than processing the full database output. The AGGREGATED OUTPUT command could still be used to create aggregated machine readable output using this approach. If you are uncomfortable using database or statistical applications, I would strongly urge you to consider this option.
- 2) If you plan to regularly produce the same type of output repeatedly, you could create a database application (using applications such as FoxPro or MS Access) which will do the appropriate aggregation of the database output. This approach would require acquiring the necessary skilled workers (perhaps using a contractor) to create the database application and would require knowing the proper way to

aggregate the values. But once the application was available, you would be able to run MOBILE6, then run the database application to create the custom output anytime you needed. We anticipate that such custom applications might be needed and hope that as States (and others) created these tools, that they will share them with other MOBILE6 users. The needs of States vary so widely that it is not possible for EPA to create custom output for every possible situation.

Q. I am going to do some MOBILE6 runs to try and estimate annual emissions for each vehicle per facility type. In order to minimize having to aggregate data in the database output, I plan to do runs for one facility type at a time and then use the descriptive output. I am using external data files for VMT for each facility, and specifying that 100 percent of the travel is in that facility type. Why does this need to be done? I want to be sure my results are reflecting real life type emissions where the VMT is actually split amongst the different facility types, even though I am only looking at one of the facilities.

Remember that MOBILE6 only reports emission *rates*, not tons. The emission rate for each roadway is unaffected by whether more or less travel occurs on other roadway types. Only when you combine the rates (to get an overall emission rate) do you need to know how much of the total travel (VMT) occurs on each roadway type. This is the VMT distribution by facility. You don't get tons until you multiply the emission rate (in grams per mile) times the appropriate miles traveled.

If you want to demonstrate this, you can run MOBILE6 four times (once for each roadway class, setting the VMT BY FACILITY command input file to 100 percent of the roadway type of interest) and then again setting the VMT by facility to a fixed distribution for every hour. The weighted sum (using the VMT by facility distribution values) of the individual roadway runs and the single MOBILE6 run using the VMT by facility should be the same. It is the VMT by facility distribution weighting that allows MOBILE6 to report a single emission rate (in grams per mile) that reflects all roadway types. But this distribution is not needed if you intend to combine the roadway types outside of MOBILE6.

MOBILE5 Versus MOBILE6

Q. Do I need to understand MOBILE5 in order to use MOBILE6?

No. It is not necessary to understand MOBILE5 to understand and use MOBILE6. The MOBILE6 User Guide does not assume that readers are already familiar with MOBILE5.

If, for whatever reason, people need to understand MOBILE5, it has its own User Guide, which is EPA report number EPA-AA-AQAB-94-01. Chapter 5 of the MOBILE6 User's Guide explains how to translate MOBILE5 input files to MOBILE6.

MOBILE5 v. MOBILE6 / MOBILE6 Function Like MOBILE5

Q. Is it possible to use MOBILE6 with only the 8 vehicle types familiar to MOBILE5? How is this done?

MOBILE6 descriptive output has the familiar eight vehicle types as output. However, users must address all of the 28 MOBILE6 individual vehicle types when entering local data. The MOBILE6 database output uses all 28 vehicle classes but users can manipulate the database externally to aggregate to the eight MOBILE5 types.

Q. Can the user model multiple calendar year scenarios under a single set of input parameters similar to MOBILE5?

Yes. As in MOBILE5, there are parameters that can be entered once for all scenarios (where each scenario represents a calendar year) in the run section of a MOBILE6 input (similar to the "one time data" section in MOBILE5). There are also, however, parameters that must be entered for each scenario.

Distributions

Q. How do the REG DIST, MILE ACCUM RATE, AND VMT FRACTIONS inputs interact in the model? Are there potential problems with conflicts between these inputs? For example, if I use local information for VMT FRACTIONS and the defaults for the other two inputs, am I presenting the model with contradictory information?

Disregarding the VMT FRACTIONS input for a moment, the way this information interacts in the model is as follows: For a given calendar year MOBILE6 contains vehicle count information for the 16 combined vehicle classes. A default registration distribution allocates these vehicle counts to the 25 most recent model years; the diesel fraction information then splits the 16 combined vehicle classes into the 28 individual vehicle classes for all 25 model years; and finally the mileage accumulation information is applied to that 28 x 25 matrix.

User input of REG DIST, MILE ACCUM RATE, and DIESEL FRACTION information presents no special problems. The user input information is just used instead of the default information in the process described above.

Note that the user is not allowed to supply new vehicle count information as such.

If VMT FRACTION information is input, which is done in terms of the 16 combined vehicle classes, MOBILE6 internally adjusts its vehicle counts to avoid the problem with "*contradictory information*" that you are concerned about.

However, it is possible for contradictory vehicle activity information to be input that MOBILE6 does not check for. It would be contradictory for example to input low mileage accumulation rates in combination with a high numbers of starts per day and high percentages of mileage being accumulated on long trips.

Distributions / VMT

Q. Am I correct in understanding that the VMT and speed profiles used in M6 will generate a single emission rate for the total daily VMT for the year being modeled, and that the rate will reflect all of the speed variations during the course of a day?

Yes.

Q. VMT profiles (by speed, hour, and facility) change over time. Can multiple years be combined in the same file, or is it necessary to create a separate file for each year that is profiled?

You will need a separate VMT profile for each calendar year.

Q. What is the default VMT mix for MOBILE6 for ALL years - 19xx to 2050? This question refers to the VMT FRACTION record of VMT accumulation data by the 16 vehicle types that is coded directly into the scenario section of the model, not to the mileage accumulation rate data by model year (MILE ACCUM RATE).

The default VMT mix is calculated by MOBILE6 and changes by calendar year. A table of the VMT mix can be created using the AGGREGATED OUTPUT command, which generates a database output that includes the VMT by vehicle class.

Q. Does the EPA default VMT mix change over time? In particular, does EPA anticipate a higher percentage of trucks in the future?

The default VMT distribution by vehicle class will change over time, since the default values are computed from the annual mileage accumulation rates, registration distributions, diesel sales fractions and the vehicle counts by calendar year. The vehicle counts also change over time. The default data do anticipate a higher percentage of trucks in the future.

Q. Our local traffic data show that VMT mix (vehicle types) varies greatly by facility class. To model this with M5 we have defined a different local area VMT for each facility class. How would this be done with MOBILE6? Would it be necessary to run three scenarios for each calendar year - one for freeways & ramps, one for arterials, and one for locals - apply the corresponding VMT mix, and adjust the VMT profiles accordingly? Or would we have to develop a single composite VMT mix from the three facility classes, weighted by the relative traffic volume of each class?

Technically, you could do either. However, a third option might be better. You can use the VMT BY FACILITY command to enter different distributions for each of the 28 vehicle classes.

Q. Does the (national) default VMT mix change by road type?

While it seems common sense that HDVs are more common on freeways than on local roads, we lacked the data necessary to determine national default VMTs by both vehicle type and roadway type. Our approach was to have the defaults NOT vary by roadway type, but to give the users the capability to vary their VMT mix by roadway type, using the VMT BY FACILITY command.

Q. The User Guide explanation of the VMT by Facility states that the distribution fractions are for "freeway, arterial, local, and ramp". Are collectors included as arterials or as locals?

As arterials. The User Guide provides more detail in Section 1.2.5 which introduces "Roadway Classifications."

Q. The VMT BY FACILITY command is expressed in terms of hours of the day. So what does VMT BY HOUR do? Would you ever want to use both? Do these inputs have an impact on CO and NOx emissions, or just HC?

VMT BY HOUR takes daily VMT and distributes it by hour. VMT BY FACILITY distributes each hour's VMT among the facility types. We expect most users will use both. The inputs affect all pollutants because VMT BY HOUR determines the relevant hourly temperature and VMT BY FACILITY allocates emissions among different speed curves.

Q. Can MOBILE6 show me what would happen if people switched their mode of transportation to walking or the bus?

All results from MOBILE6 are in terms of grams per mile of travel per vehicle. Inventories (in tons) are determined by multiplying the grams per mile times the total vehicular travel during the time period of interest. If walking reduces the total miles of vehicular travel needed, then this adjustment is made outside the MOBILE6 model. However, it may be necessary to reduce the fraction of all miles traveled by passenger cars to account for the reduction in total miles driven in relation to other vehicle classes. For this same reason, it may be necessary to increase the fraction of vehicle miles traveled (VMT) for buses to account for the increase in the number of buses utilized to carry the additional passengers. Changes in the distribution of VMT between vehicle classes is done using the VMT FRACTIONS command. Additional changes may be needed in the number of trips per day per vehicle (STARTS PER DAY command), the distribution of VMT by hour of the day (VMT BY HOUR command), the engine soak time (START DIST command and the SOAK DISTRIBUTION command) and perhaps even the roadway speeds (SPEED VMT command) to account for the change in the congestion levels on roadways. I would suggest that you use an activity "model" that properly accounts for the interaction between all of these activities, even if it is just a spreadsheet.

Distributions / Speed

Q. I do not understand the MOBILE6 assumptions about speeds and roadway types. Since MOBILE5 did not have roadway type as integral to the outputs, it would be helpful to get more information on this. It wasn't clear to me what speed fractions are, or what is meant by the phrase "allocate VMT by speed."

MOBILE6 computes emissions on four roadway (or "facility") types. These are listed in Section 1.2.5 of the MOBILE6 User Guide. Local roadways and (freeway) ramps have default average speeds that cannot be changed. Freeways (excluding ramps) and arterials have a distribution of average speeds that the user can change with the "SPEED VMT" command.

Basically, there are fourteen average speed bins, where each bin represents a range of average speeds. The values in the fourteen bins represent the distribution of those average speeds by the vehicle miles traveled at those speeds. In a traffic network model, each link usually has a distance (miles), load (number of vehicles) and average speed. The distance times the number of vehicles is the vehicle miles traveled (VMT). The average speed determines into which bin the VMT is placed. Once all of the VMT is placed, the sum of the VMT in each bin is divided by the sum of all VMT in all bins to give a distribution. The sum of the distribution values should be one.

Q. Why is there no speed distribution input for ramps and local class facilities? What is the assumed speed profile for these roads?

The document, "*Development of Speed Correction Cycles*," (M6.SPD.001) found on our web site (www.epa.gov/otaq/m6.htm) discusses how the local roadway and freeway ramp cycles were developed, the details of the cycle profiles, and why these two roadway types do not have a dependence on average speed. There are several reasons. The most critical was that developing a speed dependence would have required additional vehicle testing. Instead, we decided to focus our testing on the freeway and arterial/collector cycle testing. The default daily average speeds for each roadway type are given in the MOBILE6 User Guide (Section 5.3.4).

Q. Can I trick the model into giving me Local Facility emission rates by using Arterial/Collector Facilities at a low average speed?

It is technically possible to model arterial/collector facilities at low speeds. See the MOBILE6 Technical Guidance document (available on the MOBILE6 Web site) for information on correctly assigning facility type to local roadways.

Q. In Chapter 5 of the User Guide, the section headed Average Speed for Freeways states: "When modeling freeways exclusively, if current estimates of average speed do not include freeway ramp travel, then the current speed estimate should be directly used for the SPEED VMT command input. The speed may need to be distributed among the average speed bins..."

Does this mean that, assuming my freeway average speeds do not include freeway ramp travel, I could use Table 3 in Appendix F, the Arterial/Collector Average Speed table, to convert MOBILE5 average freeway speeds to MOBILE6 freeway speeds?

Yes. If your freeway distribution of average speeds does not include ramps, then you can use the arterial table.

Q. Is it possible to model a single average speed using MOBILE6 the same way that it was used in MOBILE5?

Yes, use the AVERAGE SPEED command.

However it is important to note that even a single average speed represents a trip-length average of many cars traveling over a driving schedule, not the instantaneous speed of a single vehicle. Like MOBILE5, MOBILE6 is not really designed for micro-scale modeling.

Q. Is the "SPEED VMT" command the only way to change roadway speeds? This is very detailed, requiring over 600 data entries.

The AVERAGE SPEED command can be used in some cases. When using the SPEED VMT command, the best approach is to modify an existing external input file for this command rather than building one from scratch.

Distributions / Soak Time

Q. Do the various SOAK inputs affect CO and NOx emissions, or just HC?

SOAK DISTRIBUTION is used to allocate hot and cold starts, so it affects all exhaust start emissions (HC, CO and NOx). HOT SOAK ACTIVITY and DIURN SOAK ACTIVITY affect hot soak and diurnal evaporative emissions (HC only).

Distributions / Diesel Sales

Q. To calculate the diesel sales fraction for LDDTs, the User Guide asks you to consider the total sales of LDTs for both gas and diesel. Does that mean we should include LDGT2s as well?

MOBILE6 needs *four* sets of diesel sales fractions for light-duty trucks, one for each of the four weight categories:

- o LDT1 (0-6000 lbs GVWR, 0-3750 lbs LVW)
- o LDT2 (0-6000 lbs GVWR, 3751-5750 lbs LVW)
- o LDT3 (6001-8500 lbs GVWR, 0-3750 lbs LVW)

o LDT4 (6001-8500 lbs GVWR, 3751-5750 lbs LVW)

So, you need to know the total sales for all trucks (gasoline and diesel) for each model year within a weight category. Then, you need to determine for each model year what the fraction of total sales were diesels.

Ideally, you would have the necessary vehicle counts to do this. However, in calculating our national default diesel sales fractions, we could not find sales data split by loaded vehicle weight (LVW), so our diesel sales fractions are the same for LDT1 and LDT2 and are the same for LDT3 and LDT4. We expect this will be true for many users.

Q. Please clarify the last paragraph in the Users Guide's discussion of "Diesel Sales Fractions" (Section 5.3.2).

That paragraph references Appendix E which provides the default MOBILE6 diesel sales fractions by model year. In copying these values to a command input file, the user must begin with the scenario calendar year and select values for 25 vehicle ages (i.e., model year). The values in that appendix are identical to the values in example file, DIESFRAC.DEF, which is provided as part of the distribution of the MOBILE6 program."

The default diesel sales fractions are associated to model years, not ages. Consequently, if you plan to model several different calendar years (each year being a separate scenario), you would need to create a different set of diesel sales fractions (i.e., a separate external file) for each calendar year, if the internal default values are not used.

The reference (in Section 5.3.2) to having sales fractions repeated refers to the fact that the default diesel sales fractions used in MOBILE6 for model years before 1972 are the same as for the 1972 model year (repeated) and those for model years newer than 1996 are the same as for the 1996 model year.

You can test your understanding of how this works by entering the default values as a user input. You must shift the numbers for each calendar year in order that the diesel sales fraction for each model years aligns with the appropriate age for that calendar year. You will know that you did it right if the VMT fractions are identical to the case where you do not use the DIESEL FRACTIONS command.

Distributions / Vehicle Mix

Q. In MOBILE5, vehicle mix was used *only* to create aggregated emission factors across all vehicle types. Is this still true?

Yes, though such aggregations do not need to involve all vehicle types. They are, for example, used to estimate the LDGT (all) emissions in the descriptive output. Also, the command "vehicle mix" was the term used in MOBILE5. In MOBILE6, the command is "VMT FRACTIONS."

Distributions / Registration Data

- Q. The technical guidance and the MOBILE6 User Guide Chapter 5.0 both say to use the table in Appendix D to weight together MOBILE5 based gasoline and diesel heavy duty registration distributions to get MOBILE6 heavy duty age distributions. However, some areas may have additional local information about the populations of gasoline and diesel heavy duty vehicles, in addition to the MOBILE5 heavy duty age distributions. Should areas use their local populations of gasoline and diesel heavy duty vehicles or use the values in Appendix D instead?**

Areas *should* use their local populations of gasoline and diesel heavy duty vehicles to weight together the age distributions, if such information is available. The values in Appendix D should only be used if better (local) information is not available, which would be true if the user only had the MOBILE5 input files.

- Q. Since I am modeling a typical summer day inventory, I am running MOBILE6 with the evaluation month being July. When I obtain the age distribution of the fleet from the Department of Finance and Administration, do I obtain January fleet ages and then MOBILE6 will automatically grow the fleet the 6 months, or do I obtain July fleet ages and MOBILE6? I am confused how the model does grow the fleet, if it does. Or, should I obtain both January and July fleet ages and use the appropriate data depending on the evaluation month?**

In order to override the default distributions in MOBILE6, you need to use the REG DIST command along with an external data file. That file contains (for each vehicle class) the 25 age fractions, representing the fraction of vehicles of that age in that composite vehicle class in July. MOBILE6 will use these fractions directly if a July evaluation month is requested or will convert them to January if the user requests that evaluation month. Therefore, you need only obtain/determine the fleet distributions for the month of July (regardless of which month the model is evaluating).

Emissions

Emissions / At Single Average Speed

- Q. Can MOBILE6 be used to model a single average speed?**

Yes, there are two approaches to modeling a single average speed in MOBILE6. Note, neither of these methods produce an "instantaneous" or "steady-state" speed, rather the result is an average over a driving cycle.

One approach is to use the speed distribution input using the instructions in Chapter 5.

A second (and less complicated) approach is to use the **AVERAGE SPEED** command. This command still uses the same 14 speed bins, so it interpolates to get the specific speed value. This method automates the approach described in Chapter 5 (and referenced in the previous paragraph). Therefore, these two approaches will produce identical results.

Emissions / At Idle

Q. How can MOBILE6 be used to estimate vehicle idle emission rates?

We did not include the calculation of idle emission rates as such in MOBILE6. See the MOBILE6 Technical Guidance document (available on the MOBILE6 Web site) for information on how to estimate idle emission rates.

Emissions / Start Emissions

Q. Can MOBILE6 be used to estimate start emissions in grams per start?

Yes. They can be calculated from the database output. The values in the database output for GM_DAY (for daily) or GM_HOUR (for hourly) are the grams independent of miles (VMT). The STARTS column indicates, for that row, the number of engine starts assumed for that unit of time (daily or hourly). Grams per engine start would be the grams value divided by the number of engine starts. This calculation can be done in a spreadsheet.

However, MOBILE6 does not generate a grams per start estimate for heavy-duty vehicles or buses. This is **NOT** because heavy-duty vehicles do not have engine start emissions, but because we were not able to split the emission rates for the heavy-duty vehicles into engine start and running portions. This means that any aggregation of engine start emissions can only apply to motorcycles and to light-duty vehicles and trucks. *(See also the questions under the "Output / Alternate Units" heading.)*

Q. When I used the database output to calculate start emission in units of "grams per start" [see preceding question], I found that the value varied significantly hour by

hour (3.83 g/start - 1.39 g/start). Is this due to the increased fractions of hot starts? If so, where does the model indicate the cold and hot operating mode fractions? How do MOBILE6 model users input locally drawn cold and hot operating mode fractions? All the previous MOBILE model series provided this optional input, "operating mode fractions."

The grams per engine start emissions vary because of the change in both the distribution of engine soak times and the change in ambient temperature by hour. The operating mode fractions used in MOBILE5 have been dropped in favor of a combination of the distribution of soak times (entered using the SOAK DISTRIBUTION command) and the starts per day (entered using the STARTS PER DAY command). This allows a more precise determination of the effects of changes in the engine soak time than the 10 minute (hot start) versus 12 hour (cold start) capability reflected in the operating mode approach used in MOBILE5. Converting operating mode information from a MOBILE5 input for use in MOBILE6 is discussed in Chapter 5 of the MOBILE6 User Guide.

Q. Can MOBILE6 output hot starts and cold starts separately?

MOBILE6 calculates engine start emissions at *all* soak times from 1 to 720 minutes. You can see the emissions for a specific soak time by setting the SOAK DISTRIBUTION to 100 percent at the soak time of interest.

Q. MOBILE6 provides exhaust start emissions separately from the running emissions; however, the start emissions are dispersed throughout the entire time period (i.e., hour or day) and the database output table shows the start emissions rate per vehicle mile. If the trip length (VMT distribution either from the model default or user supplied input) is the variable distributing the start emissions per VMT, it may cause serious consequences for the ozone conformity analysis for rural non-attainment areas. For instance, external to external (E-E) trip VMT (usually interstate freeways) contributes a large portion of regional VMT total, the equal distribution of non-existent start emissions to E-E VMT would overestimate regional total emissions.

The engine start emissions from MOBILE6 are also reported in the database output in units of grams per hour. This can be used to distribute the emissions from engine starts spatially (i.e., rural versus urban), instead of by vehicle miles traveled. Note, MOBILE5 always reported engine start emissions as grams per mile.

- Q. In the descriptive format output, start emissions are reported ONLY at the vehicle type level. It would be very helpful for modelers if start emissions are reported for "All Vehicles."**

While MOBILE6 introduces the reporting of start emissions, it only calculates start emissions separately for light-duty vehicles and motorcycles. It cannot calculate them for "all vehicles", because they are not calculated for heavy-duty vehicles. We believe that MOBILE6 is an improvement in this area relative to MOBILE5, which did not calculate separate start emissions at all.

- Q. Why does the DATABASE OUTPUT provide the split between start and running emissions differently than the DESCRIPTIVE OUTPUT?**

We believe that the arrangement we adopted is the best compromise, given the two different output formats and the limitations of MOBILE6.

The problem is that MOBILE6 is only able to break exhaust emissions into start emissions and running emissions for light-duty vehicles and motorcycles. So in the descriptive output, which is rather "loose" and can contain additional information, we chose to display a "composite" emissions result for the heavy-duty vehicle classes and to leave blank their "start" and their "running" emissions. This is not possible in the database output, however, because there is no place in its database scheme for "composite" results. Every row in the database output must have a value of ETYPE and we feel that, all things considered, there should not be an ETYPE for "Composite" because it would overlap with "Start" and "Running". So in the database output we report the total exhaust emissions of heavy-duty vehicles as "Running." Admittedly this is not ideal, but, on balance, we feel it is preferable to having a "Composite" value of ETYPE.

Emissions / Refueling Emissions

- Q. How will the benefits of stage II refueling emissions be replaced by those of Onboard Refueling Vapor Recovery (ORVR) systems. Are there any ideas as to how to model ORVR penetration? Also is there a projection as to when the effects of stage II will be totally replaced by those shown by ORVR systems?**

MOBILE6 handles ORVR systems the same way as ORVR was handled in MOBILE5. We have proposed no changes in the methods for calculation of refueling emissions or the effects of ORVR systems on refueling emissions.

Refueling emissions are basically the average displaced grams (5.26) per gallon of dispensed fuel, plus a small amount of grams (0.31) for spillage. The ORVR effectiveness is assumed to be 98 percent on the portion of refueling emissions that does not include

spillage. However, ORVR is also assumed to reduce spillage by 50 percent. Stage 2 controls only affect the portion of the fleet which does not have ORVR systems. No additional benefits are assumed from Stage 2 for vehicles with ORVR systems. Tampering with the evaporative control canister is assumed to make the ORVR system ineffective in reducing refueling emissions, however, these emissions will be affected by Stage 2 controls.

The effects of ORVR technology is phased in over several model years. For passenger cars, 40, 80, and 100 percent of 1998, 1999, and 2000 and newer model year cars respectively will have ORVR. For light duty trucks up to 6000 pounds gross vehicle weight, 40, 80, and 100 percent of 2001, 2002, and 2003 and newer model year trucks will have ORVR. For light duty trucks between 6001 and 8500 pounds gross vehicle weight, 40, 80, and 100 percent of 2004, 2005, and 2006 and newer model year trucks will have ORVR. All gasoline fueled trucks and busses over 8,500 pounds GVWR are assumed not to use ORVR technology.

The 2004 HD vehicle regulations extended the effects of ORVR to heavy-duty vehicles, ORVR is required on all complete HD gasoline vehicles up to 10,000 pounds. The standard is 0.20 grams per gallon of fuel dispensed. The phase-in is 80 percent in 2005 and 100 percent in 2006, although there will probably be 40 percent "optional" compliance in 2004.

With all of these phase-in periods, the full fleet effect of ORVR will not be in place until 2030, assuming all vehicles over 25 years old are negligible.

Q. I am trying to estimate the benefits of Stage II using MOBILE6 for analysis year 2007. I added the command "STAGE II REFUELING" to my run and the results show a reduction (benefit) in VOC emissions. My question is: Of that VOC benefit, what can be attributed to Stage II and what to ORVR?

Since the MOBILE6 results (without the STAGE II REFUELING command) already include the effects of ORVR, the entire reduction in VOC is attributed to Stage II. (If you need to know the effect of ORVR on refueling emissions you would need to use the NO CLEAN AIR ACT command to turn off ORVR and observe the effect on refueling emissions.)

Emissions / Heavy-Duty / Consent Decrees

- Q. Does MOBILE6 include the assumption that there will be an early 2002 introduction of cleaner HDDV engines (2004 standards)?**

The model contains the latest version of the defeat device, pull ahead, and rebuild information that was available as of March 2001. For more information, see report M6.HDE.003 on the MOBILE Web site.

- Q. What does Mobile6 include for the 2005 and 2006 years after the Consent Decree requirements end and the 2007 standards begin? Is it assumed that NOx emissions from HDDV remain constant or the current worst-case that emissions would increase because the Consent Decrees end?**

MOBILE6 models no defeat device effects for MY 2005 and 2006. Emissions for those model years are estimated using regular emission factors based on the 2004 standards.

- Q. If DOJ/EPA agree to any delays or changes to the Consent Decrees, will EPA or the states have to modify Mobile 6 to reflect the assumptions put into the model that reflect the current decrees?**

We expect that any changes would have a small impact on emissions and would not require a change to the model. If a change did have a large impact on emissions, EPA would provide guidance and/or modeling tools for properly calculating emission estimates.

Emissions / Carbon Dioxide (CO₂) Emissions

- Q. What is the difference between "atmospheric" and "tailpipe" CO₂? What is reported by MOBILE6.2? How should these values be used?**

MOBILE6 reports "atmospheric" CO₂ as determined by a carbon mass balance equation. This includes not only the emissions of CO₂ formed during combustion (tailpipe CO₂) but also the CO₂ formed later in the atmosphere by the natural oxidation of the vehicles' HC and CO emissions. (See Report Number M6.GHG.001, "Updating Fuel Economy Estimates in MOBILE6.2".) Current guidelines issued by the Intergovernmental Panel on Climate Change (IPCC) suggest that estimates of carbon dioxide from petroleum products such as the CO₂ estimates reported by MOBILE6 should be decreased by one percent (1%) to account for carbon that is never oxidized (i.e., particulate matter). This has not been done in MOBILE6 to avoid double-counting and to allow the user maximum flexibility in selecting a reduction factor.

Note that the estimates for CO2 differ from all of the other pollutant values in MOBILE6 which are estimates of what is produced by the vehicle in evaporation and combustion processes and do not account for later chemical reactions in the atmosphere.

Emissions / Natural Gas Vehicle (NGV) Emissions

Q. I ran scenarios comparing 100 percent new LDGVs to 100 percent new NGVs. I was surprised that NOx emissions for NGVs exceed LDGVs NOx after 2005. Is this correct or was TIER2 or some other correction omitted from the NGVs rates?

This is correct. NGV NOx emission rates are higher than those of Tier2 vehicles after 2005.

Modeling / For Sensitivity Testing

Q. It would be helpful to know the effects of user input compared to defaults -- How large a change in emissions can be expected when the user changes hourly temperatures, clouds, sunset and rise, etc.?

We have performed sensitivity testing on MOBILE6 and compiled the results into a technical report entitled "Sensitivity Analysis of MOBILE6.0" (EPA Report Number EPA420-R-02-035). This report can be found on (and downloaded from) our Web site that contains the documentation for MOBILE6 at:
www.epa.gov/otaq/models/mobile6/m6tech.htm.

Miscellaneous

Misc / Programming

Q. The two-valued inputs still use "1" (for "off") and "2" (for "on"). Why not use the more intuitive "1" for on and "0" for off?

Historically the MOBILE has used the "1"/"2" values for on and off. Because MOBILE6 uses much of the MOBILE5 code, we continued to use the old system.

Q. The discussion on the Anti-Tampering option states that a "1" must be entered after the GAS BUS toggle. What is this for?

This number originally represented the Program Type (as in MOBILE5). Program Type is no longer a parameter of this command in MOBILE6, but the input for it was not removed.

Q. Is it necessary to know FORTRAN to use the model?

MOBILE6 was written using the computer language FORTRAN90. We then compiled it (to run on Windows or DOS PCs) to create the executable program Mobile62.exe. Therefore, if you plan to simply run MOBILE6 on a PC with DOS or Windows, you need to do nothing in FORTRAN, simply run that executable.

If you plan on modifying the program itself (i.e., the source code) or running it on some other platform (e.g., mainframe computer, Macintosh, Unix, etc.), then you will need some knowledge of FORTRAN. (See Chapter 4 of the Users Guide.) This is not trivial.

No knowledge of FORTRAN is necessary to input data. See:

- the file named Readme3.txt
- the example files in the "Examples" folder within the "Run" folder
- Chapter 2 of the Users Guide.

Misc / Documentation

Q. We think there is a need to present and discuss some of the important underlying technical assumptions supporting the validity of MOBILE6. Is there a separate document that does this? A single report summarizing the major workings of the model and perhaps exploring some of the issues regarding use of local inputs would be very useful. We realize that there are a series of technical reports that address some or all of these assumptions, but we are thinking here of something not quite so technical, but summarizing the workings of the most important technical features. It would explore the concepts and limitations of such models, including examples of appropriate and inappropriate applications.

We have a number of documents available on MOBILE6. The most technical information is in the individual technical reports. More general information is on our Web site in the form of presentations given at various meetings. While there may not be a single

document that addresses all your questions, you should be able to find the information you need without too much trouble. (The MOBILE6 Web site is located at: www.epa.gov/otaq/m6.htm)

Q. Have you considered using hypertext in developing your documentation? It would make for easier cross-referencing between sections (although you do a good job of indicating where related additional information is available).

We are considering this option for future versions of our documentation.