**⭥EPA**

# User's Guide to MOBILE6

# Mobile Source Emission Factor Model

# DRAFT

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# User's Guide to MOBILE6
(Mobile Source Emission Factor Model)

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Disclaimer

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## Abstract

This document is the <u>USER'S GUIDE to MOBILE6</u>. MOBILE6 is a computer program that estimates hydrocarbon (HC), carbon monoxide (CO), and oxides of nitrogen (NOx) emission factors for gasoline-fueled and diesel highway motor vehicles, and for certain specialized vehicles such as natural gas fueled or electric vehicles that may replace them. The program uses the calculation procedures presented in technical reports posted on EPA's MOBILE6 web page http://www.epa.gov/otaq/models.htm.

MOBILE6 calculates emission factors for 28 individual vehicle types in low- and high-altitude regions of the United States. MOBILE6 emission factor estimates depend on various conditions such as ambient temperatures, travel speeds, operating modes, fuel volatility, and mileage accrual rates.  Many of the variables affecting vehicle emissions can be specified by the user.  MOBILE6 will estimate emission factors for any calendar year between 1952 and 2050, inclusive.  Vehicles from the 25 most recent model years are considered to be in operation in each calendar year. MOBILE6 supersedes MOBILE5, and is to be used by the states in the preparation of the highway mobile source portion of the 1990 base year emission inventories required by the Clean Air Act Amendments of 1990.

The MOBILE6 program was initially released xxxxxx  and a <u>Federal</u> <u>Register</u> notice of its availability was published xxx xx, 2000 (xx FR xxxx).

## Document and Support Availability

The following documents are available on the EPA website
http://www.epa.gov/otaq/models.htm

- the source code and compiled (executable) code for MOBILE6 for DOS.
- this User's Guide
- example input and output files

See Chapter 1, section 1.3, for details on accessing MOBILE6 and related documentation using the EPA web site.

Requests for hard copies of the MOBILE6 program diskette or tape, or for paper copies of this User's Guide, should be directed to:

National Technical Information Service (NTIS)

U.S. Department of Commerce
5285 Port Royal Road
Springfield, Virginia  22161
Telephone:  (703) 487-4650

Questions concerning MOBILE6 or this User's Guide should be directed to:

U.S. EPA National Vehicle and Fuel Emissions Laboratory
Office of Transportation and Air Quality
2000 Traverwood Drive
Ann Arbor,  MI  48105
Attn:  MOBILE6 Project

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Email:  mobile@epa.gov

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**CHAPTER 1**

**CHAPTER 1**

**INTRODUCTION**

## 1.0    <u>BACKGROUND</u>

MOBILE6 is a software application program that provides estimates of current and future emissions from highway motor vehicles. The latest in a series of MOBILE models dating back to 1978, MOBILE6 calculates average in-use fleet emission factors for:

- three criteria pollutants: hydrocarbons (HC); carbon monoxide (CO); and oxides of nitrogen (NOx)
- gas, diesel, and natural gas-fueled cars, trucks, buses, and motorcycles
- calendar years between 1952 and 2050

MOBILE6 is designed by the U.S. Environmental Protection Agency (EPA) to address a wide variety of air pollution modeling needs. Written in FORTRAN and compiled for use in the desktop computer environment, the model calculates emission rates under various conditions affecting in-use emission levels (e.g., ambient temperatures, traffic speeds) as specified by the modeler. MOBILE models have been used by EPA in evaluating highway mobile source control strategies; by states (except California) and local and regional planning agencies in developing emission inventories and control strategies for State Implementation Plans (SIPs) under the Clean Air Act; by academic and industry investigators conducting research; and in the development of environmental impact statements.

Each new version of MOBILE reflects the collection and analysis of new test data. It also incorporates changes in vehicle, engine, and emission control system technologies, changes in applicable regulations and emission standards and test procedures, and improved understanding of in-use emission levels and the factors that influence them. MOBILE6 represents the first major update to EPA's emission factor model since the release of MOBILE5b in 1996. This latest version of MOBILE differs significantly in both structure and data requirements from previous versions of the model. It  incorporates updated information on basic emission rates, more realistic driving patterns, separation of start and running emissions, improved correction factors, and changing fleet composition.  It also includes impacts of new regulations promulgated since MOBILE5b and provides users with more sophisticated options for tailoring emission factor estimates to specific times and geographic locations.

The output from MOBILE6 takes the form of emission rates expressed as grams of pollutant per vehicle mile traveled (g/mi). Database output can also be reported as grams per vehicle per unit time (day or hour). The change in emission rates for a given vehicle category over time is due to fleet turnover, through which older vehicles built to less stringent emission

standards are replaced by newer vehicles built in compliance with more stringent standards. Thus, emission rates from MOBILE can be combined with estimates of travel activity (total vehicle miles traveled, or "VMT"), which also change over time, to develop highway vehicle emission inventories expressed in terms of tons per hour, day, month, season, or year.

MOBILE6 allows users to calculate and report sub-components of total emissions. For example, non-exhaust (often described as "evaporative") hydrocarbon emissions from gasoline-fueled vehicles include: diurnal emissions (emissions generated by the rise in temperature over the course of a day when the vehicle is not being driven); hot soak emissions (emissions occurring after the end of a vehicle trip, due to the heating of the fuel, fuel lines, fuel vapors); running losses (emissions occurring while a vehicle is driven, due to the heating of the fuel and fuel lines); resting losses (small but continuous seepage and minor leakage of gasoline vapor through faulty connections, permeable hoses and other components of the fuel system), and refueling emissions (vapors that escape into the atmosphere when incoming liquid fuel displaces vapors in the vehicle fuel tank). Similarly, MOBILE6 can break out emissions by roadway type, time of day, vehicle category and other characteristics that allow for very detailed modeling of specific local situations.

This User's Guide outlines technical requirements for MOBILE6 and describes options for setting up and running the model. It will be of particular assistance to users who wish to model local scenarios that differ from the "national average" conditions MOBILE6 defaults assume.

## 1.1     USER'S GUIDE STRUCTURE

The User's Guide is structured into five chapters plus appendices. The first chapter is this introduction. Chapter 2 describes how to use the model, outlines model input requirements, and provides a description of each command, the required computer syntax, and tips for ease of use. Chapter 3 describes the output and the possible output formats. Chapter 4 describes how to install the program on commonly used computers and provides a description of the minimum computer requirements needed to execute MOBILE6, as well as other technical details. Chapter 5 outlines differences between MOBILE6 and the previous version of the model, MOBILE5. The Appendices include an alphabetical list of all MOBILE6 commands and various reference tables. Example input files will be distributed with MOBILE6.

## 1.2     MOBILE6 SCOPE

MOBILE6 includes default values for a wide range of conditions that affect emissions. These defaults are designed to model "national average" emission rates. Users who desire a more precise estimate of local emissions can substitute information that more specifically reflects local conditions. A list of MOBILE6 input parameters is provided below. Most of these inputs are

optional, that is, the model will supply default values unless alternate data are provided. At a minimum, users must provide input data for calendar year, minimum and maximum daily temperature, and fuel volatility.

### 1.2.1   MOBILE6 Input Parameters

o Calendar year
o Month (January, July)
o Hourly Temperature
o Altitude (High, Low)
o Weekend/Weekday
o Fuel characteristics (RVP, sulfur, RFG)
o Humidity, solar load and air conditioning fractions
o Registration (age) distribution by vehicle class
o Annual mileage accumulation by vehicle class
o Diesel sales fractions by vehicle class and model year
o Average speed distribution by hour and roadway
o Distribution of vehicle miles traveled by roadway type
o Engine starts per day and distribution by hour
o Engine start soak time distribution by hour
o Trip end distribution by hour
o Average trip length distribution
o Hot soak duration
o Distribution of vehicle miles traveled by vehicle class
o Full, partial and multiple diurnal distribution by hour
o Inspection and maintenance program description
o Anti-tampering inspection program description
o Stage 2 refueling emissions inspection program description
o Air conditioning usage rates
o Natural gas vehicle fractions
o Hydrocarbon species output
o Output format specifications and selections

### 1.2.2   Adjustments to the Basic Emission Rates

MOBILE6 basic emission rates are derived from emissions tests conducted under standard conditions such as temperature, fuel, and driving cycle. Emission rates further assume a pattern of deterioration in emissions performance over time, again based on results of standardized emission tests. MOBILE6 calculates adjustments to basic emission rates for conditions that differ from typical standard testing.

Adjustments are calculated for:

o Speed by roadway type
o Temperature
o Air conditioning
o Humidity
o Fuel volatility
o Fuel oxygen content
o Fuel sulfur content
o Reformulated gasoline
o Detergent gasoline rule
o Cold CO Rule
o Off-cycle driving and Supplemental Federal Test Procedure (SFTP) rule
o Tampering
o Excess emissions (defeat device)
o Inspection and maintenance programs
o Anti-tampering programs
o Stage 2 refueling control programs
o On-board diagnostics

Some adjustments do not affect all emission types or all emissions. Some adjustments (such as inspection and maintenance programs) require detailed user supplied information and complex calculation of the effect.

### 1.2.3   MOBILE6 Vehicle Classifications

| | | MOBILE6 Vehicle Classifications | |
|---|---|---|---|
| *Number* | *Abbreviation* | *Description* | |
| 1 | LDGV | Light-Duty Gasoline Vehicles (Passenger Cars) | |
| 2 | LDGT1 | Light-Duty Gasoline Trucks 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW) | |
| 3 | LDGT2 | Light Duty Gasoline Trucks 2 (0-6,001 lbs. GVWR, 3751-5750 lbs. LVW) | |
| 4 | LDGT3 | Light Duty Gasoline Trucks 3 (6,001-8500 lbs. GVWR, 0-3750 lbs. LVW) | |
| 5 | LDGT4 | Light Duty Gasoline Trucks 4 (6,001-8500 lbs. GVWR, 3751-5750 lbs. LVW) | |
| 6 | HDGV2B | Class 2b Heavy Duty Gasoline Vehicles (8501-10,000 lbs. GVWR) | |
| 7 | HDGV3 | Class 3 Heavy Duty Gasoline Vehicles (10,001-14,000 lbs. GVWR) | |
| 8 | HDGV4 | Class 4 Heavy Duty Gasoline Vehicles (14,001-16,000 lbs. GVWR) | |
| 9 | HDGV5 | Class 5 Heavy Duty Gasoline Vehicles (16,001-19,500 lbs. GVWR) | |
| 10 | HDGV6 | Class 6 Heavy Duty Gasoline Vehicles (19,501-26,000 lbs. GVWR) | |
| 11 | HDGV7 | Class 7 Heavy Duty Gasoline Vehicles (26,001-33,000 lbs. GVWR) | |
| 12 | HDGV8A | Class 8a Heavy Duty Gasoline Vehicles (33,001-60,000 lbs. GVWR) | |
| 13 | HDGV8B | Class 8b Heavy Duty Gasoline Vehicles (>60,000 lbs. GVWR) | |
| 14 | LDDV | Light Duty Diesel Vehicles (Passenger Cars) | |
| 15 | LDDT12 | Light Duty Diesel Trucks 1and 2 (0-6,000 lbs. GVWR) | |
| 16 | HDDV2B | Class 2b Heavy Duty Diesel Vehicles (8501-10,000 lbs. GVWR) | |
| 17 | HDDV3 | Class 3 Heavy Duty Diesel Vehicles (10,001-14,000 lbs. GVWR) | |
| 18 | HDDV4 | Class 4 Heavy Duty Diesel Vehicles (14,001-16,000 lbs. GVWR) | |
| 19 | HDDV5 | Class 5 Heavy Duty Diesel Vehicles (16,001-19,500 lbs. GVWR) | |
| 20 | HDDV6 | Class 6 Heavy Duty Diesel Vehicles (19,501-26,000 lbs. GVWR) | |
| 21 | HDDV7 | Class 7 Heavy Duty Diesel Vehicles (26,001-33,000 lbs. GVWR) | |
| 22 | HDDV8A | Class 8a Heavy Duty Diesel Vehicles (33,001-60,000 lbs. GVWR) | |
| 23 | HDDV8B | Class 8b Heavy Duty Diesel Vehicles (>60,000 lbs. GVWR) | |
| 24 | MC | Motorcycles (Gasoline) | |
| 25 | HDGB | Gasoline Buses (School, Transit and Urban) | |
| 26 | HDDBT | Diesel Transit and Urban Buses | |
| 27 | HDDBS | Diesel School Buses | |
| 28 | LDDT34 | Light Duty Diesel Trucks 3 and 4 (6,001-8500 lbs. GVWR) | |

### 1.2.4   MOBILE6 Emission Type Classifications

| | | MOBILE6 Emission Type Classifications | |
|---|---|---|---|
| *Number* | *Abbreviation* | *Description* | |
| 1 | Running | Exhaust Running Emissions | |
| 2 | Start | Exhaust Engine Start Emissions (trip start) | |
| 3 | Hot Soak | Evaporative Hot Soak Emissions (trip end) | |
| 4 | Diurnal | Evaporative Diurnal Emissions (heat rise) | |
| 5 | Resting | Evaporative Resting Loss Emissions (leaks and seepage) | |
| 6 | Run Loss | Evaporative Running Loss Emissions | |
| 7 | Crankcase | Evaporative Crankcase Emissions (blow-by) | |
| 8 | Refueling | Evaporative Refueling Emissions (fuel displacement) | |

### 1.2.5   MOBILE6 Roadway Classifications

| MOBILE6 Roadway Classifications | | |
|---|---|---|
| | | |
| *Number* | *Abbreviation* | *Description* |
| 1 | Freeway | High Speed Limited Access Roadways |
| 2 | Arterial | Arterial and Collector Roadways |
| 3 | Local | Urban Local Roadways |
| 4 | Fwy Ramp | Freeway on and off ramps |
| 5 | None | Not Applicable (For start and some evaporative emissions) |

### 1.2.6   MOBILE6 Hydrocarbon Categories

| MOBILE6 (FID) Hydrocarbon Categories | | |
|---|---|---|
| | | |
| *Number* | *Abbreviation* | *Description* |
| 1 | THC | Total  (includes methane and ethane) |
| 2 | NMHC | Non-Methane (includes ethane) |
| 3 | VOC | Volatile Organic Compounds (includes aldehydes) |
| 4 | TOG | Total Organic Gases (includes methane, ethane and aldehydes) |
| 5 | NMOG | Non-Methane Organic Gases (includes ethane and aldehydes) |

### 1.3   SOURCES FOR USER SUPPORT AND TRAINING

Due to resource constraints, EPA's Office of Transportation and Air Quality can provide only minimal user support. EPA encourages MOBILE6 users seeking assistance beyond this User's Guide to take advantage of the following sources of information:

1.  EPA Web site
The Modeling Page within the Office of Transportation and Air Quality Web site: http://www.epa.gov/otaq/models.htm offers the most complete documentation of MOBILE6 and earlier versions of the model. This includes users' guides, technical reports, fact sheets, presentations, peer review comments, and other materials. Numerous examples of input files for running the model and the corresponding output produced are also accessible through this site. The Web site offers links to related information such as emissions test data contained in the Mobile Source Observation Database.

2.  Air Pollution Training Institute (APTI)
EPA is working with the Air Pollution Training Institute to provide a computer-based training product for MOBILE6.

## 1.4      COMMENTS ON MOBILE6

EPA welcomes user comments and especially seeks specific suggestions for future versions of the model. We encourage you to tell us what in MOBILE6 works and what doesn't relative to your most significant modeling needs. Please send your comments to the Assessment and Standards Division, U.S. Environmental Protection Agency Office of Transportation and Air Quality, 2000 Traverwood, Ann Arbor, MI 48105, or e-mail your comments to mobile@epa.gov.

**CHAPTER 2**

**MOBILE6 INPUTS**

## 2.0     <u>INTRODUCTION</u>

This chapter explains the input files used to run MOBILE6. It is through input files that users can tailor MOBILE6 to best meet their needs. Input command choices allow modelers to specify the format and content of the output MOBILE6 reports. Input choices also allow modelers to override MOBILE6 default inputs, which are often designed to automatically produce "national average" emission results. Users who wish to input local data and/or specifically model local conditions can do so via commands that allow users to supply alternate data.

Sections 2.1 through 2.7 present general information about input file structure and command requirements. Section 2.8 presents a detailed discussion of each input command. The commands are grouped by their function in MOBILE6. Section 2.1 provides an overview of MOBILE6 commands in the order they are presented in this chapter. Appendix A lists all MOBILE6 input commands alphabetically, with cross-references to their function and requirements.

The reader is also encouraged to refer to the sample input files that are included with MOBILE6 when reading this inputs chapter. These examples provide illustrations of the use of MOBILE6 options and data input requirements. However, reference to the examples alone cannot substitute for a thorough reading of this chapter.

## 2.1    OVERVIEW OF MOBILE6 COMMANDS

| Command Name | Users' Guide Section | Command Input File Section | Exhaust or Evap. | Command Parameter Type | Required command? | Command Function |
|---|---|---|---|---|---|---|
| MOBILE6 INPUT FILE | Separators | Header | Both | | Yes | Identifies M6 input file as regular command input file as opposed to a batch file. |
| MOBILE6 BATCH FILE | Separators | Header | Both | | | Identifies M6 input file as batch file as opposed to a regular command input file. |
| RUN DATA | Separators | end of Header | Both | | Yes | Marks end of header section and beginning of run section of regular M6 command input file. |
| SCENARIO RECORD | Separators | start of Scenario | Both | | Yes | Allows user to label individual scenario results. Marks start of new scenario. |
| END OF RUN | Separators | end of Run | Both | | | Required to separate multiple runs in command input files. |
| POLLUTANTS | All Output | Header | Both | pollutant choice | | Controls which pollutants will be calculated and output to the database report and descriptive output. |
| EXPRESS HC AS NMHC | All Output | Run | Exhaust | on/off | | Directs M6 to output exhaust HC as non-methane hydrocarbons. |
| EXPRESS HC AS NMOG | All Output | Run | Exhaust | on/off | | Directs M6 to output exhaust HC as non-methane organic gases |
| EXPRESS HC AS THC | All Output | Run | Exhaust | on/off | | Directs M6 to output exhaust HC as total hydrocarbons |
| EXPRESS HC AS TOG | All Output | Run | Exhaust | on/off | | Directs M6 to output exhaust HC as total organic gases |
| EXPRESS HC AS VOC | All Output | Run | Exhaust | on/off | | Directs M6 to output exhaust HC as volatile organic compounds |
| NO REFUELING | All Output | Run | Both | on/off | | Allows user to "zero out" refueling (Stage II) emissions,  which then must be accounted for in stationary source part of SIP. |
| REPORT FILE | Descriptive Output | Header | Both | file name | | Specifies name for descriptive output file. |

| Command Name | Users' Guide Section | Command Input File Section | Exhaust or Evap. | Command Parameter Type | Required command? | Command Function |
|---|---|---|---|---|---|---|
| NO DESC OUTPUT | Descriptive Output | Header | Both | on/off | | Prevents production of descriptive output. |
| EXPAND BUS EFS | Descriptive Output | Run | Both | on/off | | Directs M6 to report gas, urban and school bus categories separately. |
| EXPAND EVAPORATIVE | Descriptive Output | Run | Evap | on/off | | Display all 6 evaporative emission types in descriptive output. |
| EXPAND EXHAUST | Descriptive Output | Run | Exhaust | on/off | | Causes start, running and total exhaust EFs to be displayed in descriptive output. |
| EXPAND HDDV EFS | Descriptive Output | Run | Exhaust | on/off | | Directs M6 to display EFs by 8 HDDV classes. |
| EXPAND HDGV EFS | Descriptive Output | Run | Both | on/off | | Directs M6 to display EFs by 8 HDGV classes. |
| EXPAND LDT EFS | Descriptive Output | Run | Exhaust | on/off | | Directs M6 to display EFs by 6 LDT classes. |
| DATABASE OUTPUT | Database Output | Header | Both | on/off | | Specifies M6 to report output in database format. |
| EMISSIONS TABLE | Database Output | Header | Both | file name | | Specifies a filename for EMISSIONS database table output file. |
| WITH FIELDNAMES | Database Output | Header | Both | on/off | | Specifies that a header record of field names is to be generated for the database output. |
| DATABASE EMISSIONS | Database Output | Header | Both | Etype choice | | Limits which of 8 types of emissions are reported in database output format. |
| DATABASE FACILITIES | Database Output | Header | Both | Facility choice | | Limits which of 5 roadway types have emissions reported. |
| DATABASE VEHICLES | Database Output | Header | Both | Vehicle choice | | Limits which of 28 vehicle types have emissions reported in database output format. |
| DAILY OUTPUT | Database Output | Header | Both | on/off | | Database output by daily time periods. |
| AGGREGATED OUTPUT | Database Output | Header | Both | on/off | | Database output by daily time periods aggregated to the level of the description output. |

| Command Name | Users' Guide Section | Command Input File Section | Exhaust or Evap. | Command Parameter Type | Required command? | Command Function |
|---|---|---|---|---|---|---|
| DATABASE OPTIONS | Database Output | Header | Both | file name | | Specifies name for external file holding a set of database output selection records. |
| CALENDAR YEAR | External Conditions | Scenario | Both | value | Yes | Calendar year of scenario evaluated. |
| EVALUATION MONTH | External Conditions | Scenario | Both | value | | Specifies January 1 or July 1 for calendar year of interest. |
| MIN/MAX TEMP | External Conditions | Run or Scenario | Both | values | Yes* | Specifies minimum and maximum daily temperatures.<br>* This command is required unless HOURLY TEMPERATURES is used. |
| HOURLY TEMPERATURES | External Conditions | Run or Scenario | Both | values | Yes* | Allows entry of 24 hourly temperatures.<br>* This command is required unless MIN/MAX TEMP is used. |
| ALTITUDE | External Conditions | Scenario | Both | option | | High or low altitude of area evaluated. |
| ABSOLUTE HUMIDITY | External Conditions | Run or Scenario | Exhaust | value | | Absolute humidity in grains/pounds. |
| CLOUD COVER | External Conditions | Run or Scenario | Exhaust | value | | Allows user to input fraction of cloud cover for a given day. |
| PEAK SUN | External Conditions | Run or Scenario | Exhaust | value | | Allows input of 2 daily times demarcating period of peak sun. |
| SUNRISE/SUNSET | External Conditions | Run or Scenario | Exhaust | values | | Specifies times for sunrise and sunset for A/C calculations. |
| REG DIST | Fleets | Run | Both | ext file | | Allows user to supply vehicle registration distributions by age for all 16 composite vehicles types. |
| DIESEL FRACTIONS | Fleets | Run or Scenario | Both | ext file | | Allows user-supplied alternate diesel sales fractions. |
| MILE ACCUM RATE | Fleets | Run | Both | ext file | | Allows user to supply annual accumulation rates by age for each of the 28 vehicle types. |

| Command Name | Users' Guide Section | Command Input File Section | Exhaust or Evap. | Command Parameter Type | Required command? | Command Function |
|---|---|---|---|---|---|---|
| VMT FRACTIONS | Fleets | Run or Scenario | Both | values | | Allows user to apply alternate vehicle miles traveled fractions by each of 16 combined vehicle types. |
| NGV FRACTION | Fleets | Run | Both | ext file | | Indicates percentage of natural gas vehicles in each of the 28 vehicles classes. |
| VMT FRACTIONS | Activity | Run or Scenario | Both | values | | Allows user to apply alternate vehicle miles traveled fractions by each of 16 combined vehicle types. |
| VMT BY HOUR | Activity | Run or Scenario | Both | ext file | | Allows user to supply alternate hourly distributions of VMT that override M6 defaults for each scenario. |
| VMT BY FACILITY | Activity | Run or Scenario | Both | ext file | | Allows user to supply alternate VMT distributions by facility type that override M6 defaults for each scenario. |
| SPEED VMT | Activity | Run or Scenario | Exhaust | ext file | | Allows user to enter VMT distribution across 14 preselected speed ranges for each of the 24 hours of the day for each scenario. |
| STARTS PER DAY | Activity | Run | Both | ext file | | Allows user to change default average number of engine starts per day per vehicle. |
| START DIST | Activity | Run | Both | ext file | | Allows user to change the default for the hourly temporal distribution of engine starts (trips) across the day. |
| SOAK DISTRIBUTION | Activity | Scenario | Exhaust | ext file | | Allows user to enter soak duration distributions for each hour of day that will override M6 defaults. |
| HOT SOAK ACTIVITY | Activity | Scenario | Evap | ext. file | | Specify alternative distribution of lengths of hot soaks.. |
| DIURN SOAK ACTIVITY | Activity | Scenario | Evap | ext. file | | Specify alternative distribution of diurnal soak |

| Command Name | Users' Guide Section | Command Input File Section | Exhaust or Evap. | Command Parameter Type | Required command? | Command Function |
|---|---|---|---|---|---|---|
| | | | | | | times. |
| WE DA TRI LEN DI | Activity | Run or Scenario | Both | ext file | | Used to read in the weekday hourly running loss trip length percentages |
| WE EN TRI LEN DI | Activity | Run or Scenario | Both | ext file | | Used to read in the weekend hourly running loss trip length percentages |
| WE VEH US | Activity | Scenario | Both | on/off | | Directs M6 to use the weekend activity fractions in its calculations. |
| FUEL PROGRAM | State Programs | Run or Scenario | Both | pgm descrip | | Designates fuel sulfur level of gasoline and whether RFG use should be assumed. |
| STAGE II REFUELING | State Programs | Run | Evap | pgm descrip | | Allows modeling of impact of stage II "at-the-pump" vapor recovery system for refueling emissions. |
| ANTI-TAMP PROG | State Programs | Run | Both | pgm descrip | | Anti-Tampering Programs |
| I/M PROGRAM | State Programs | Run | Both | values | | Required record, if I/M program being modeled, indicating program start and end dates, frequency and test type. |
| I/M MODEL YEARS | State Programs | Run | Both | values | | Required record, if I/M program being modeled, indicating vehicle model years subject to I/M program. |
| I/M VEHICLES | State Programs | Run | Exhaust | Vehicle choice | | Required record, if I/M program being modeled, indicating vehicle types subject to I/M. |
| I/M EXEMPTION AGE | State Programs | Run | Both | value | | Optional record indicating age that vehicle automatically becomes exempt from I/M program. |
| I/M GRACE PERIOD | State Programs | Run | Both | value | | Optional record indicating when vehicle first becomes subject to I/M program. |
| I/M EFFECTIVENESS | State Programs | Run | Both | value | | Reduce I/M effectiveness to account for Test |

| Command Name | Users' Guide Section | Command Input File Section | Exhaust or Evap. | Command Parameter Type | Required command? | Command Function |
|---|---|---|---|---|---|---|
| | | | | | | and Repair losses. |
| I/M COMPLIANCE | State Programs | Run | Both | value | | Required input, if I/M program is modeled, indicating percentage of total vehicle fleet certified or waived by I/M program. |
| I/M WAIVER RATES | State Programs | Run | Exhaust | values | | Required record, if I/M program is modeled, indicating percentage of vehicles failing initial I/M test and do not have to pass a retest. |
| I/M CUTPOINTS | State Programs | Run | Exhaust | ext file | | Optional record for cutpoints if I/M 240 used. |
| NO I/M TTC CREDITS | State Programs | Run | Exhaust | on/off | | Optional record to eliminate credit for a technician training program. |
| I/M STRINGENCY | State Programs | Run | Exhaust | values | | Required record indicating initial test failure rate (%) for pre-1981 LDGVs and pre-1984 LDGTs |
| I/M DESC FILE | State Programs | Run | Both | file name | | Optional external input file containing I/M program description records. |
| FUEL PROGRAM | Fuels | Run or Scenario | Both | pgm descrip | | Designates fuel sulfur level of gasoline and whether RFG use should be assumed. |
| SULFUR CONTENT | Fuels | Scenario | Exhaust | value | | Allows user to enter alternate sulfur content of gasoline (ppm) that overrides M6 default of 300 ppm for year prior to 2000. |
| OXYGENATED FUELS | Fuels | Run or Scenario | Both | values | | Allows modeling of the effects of use of oxygenated fuels on exhaust emissions. |
| FUEL RVP | Fuels | Run or Scenario | Both | values | Yes | Required input of average fuel Reid Vapor Pressure. |
| SEASON | Fuels | Run or Scenario | Both | value | | Allows users to specify winter or summer RVP, independent of evaluation month. |

## 2.2    RUNNING MOBILE6: MODEL INTERFACE

When MOBILE6 is started, the user will be prompted to enter the name of a MOBILE6 input file. In response to this prompt, the user may enter a DOS path name followed by a file name. Most users will probably want to place the input file in the same directory as the MOBILE6 executable, have this be the current DOS directory, and enter a simple file name.

Another option is to enter a blank line, in which case MOBILE6 uses the default input file name, MOBILE6.IN, and expects the file to be located in the current DOS directory. In either case, MOBILE6 cannot run without a valid input file at the expected location. If the named input file does not exist, MOBILE6 prompts the user to enter another input file name. If the user enters a blank line in response to this second prompt, the program stops. Otherwise, the program continues prompting until the user enters the name of an existing file. Assuming MOBILE6 finds the input file, MOBILE6 creates a corresponding descriptive output file. See Chapter 3 for detailed information on MOBILE6 output. See Section 4.5 for detailed information on MOBILE6 input and output file names and extensions.

MOBILE6 commences the run as soon as the user enters the name of a valid (i.e., existing) input file. Messages indicating that the model is reading input information and performing calculations will appear on the screen. Run duration depends on the complexity of the input file. If there have been no errors, the message, "driver calls completed" will appear, indicating that MOBILE6 has completed the calculations and has produced its output.

EPA is aware that many users would prefer an interactive, menu-driven interface that would construct input files on the basis of selections made by the user. Such an interface is beyond the scope of MOBILE6 but will be considered for future versions of the model.

## 2.3    HOW TO CREATE AN INPUT FILE

1. Open a software application capable of creating text files (e.g., editor, notepad, word processor). Create a text file and give it a name. Note that MOBILE6 input file names must follow DOS file naming syntax; they must be limited to eight characters or less, plus an extension of up to three characters.

   The user may choose a input file name that either includes or does not include a period with a file name extension. If the file name contains a period, it will be used by MOBILE6 exactly as written. If the file name does *not* contain a period, the program first searches for a file with the specified name and an extension of "IN". If that file is not found, the program then searches for a file with the name exactly as specified.

2. Specify the input commands you wish to enter. A few commands are required.

Please see Section 2.4 Input Structure and Section 2.5 Input Content for command definitions and detailed information on creating command input files. Note that the model supports the creation of multiple sets of results from within a single command or batch input file.

3.  Save the file as an ASCII DOS text file. MOBILE6 cannot recognize other file types.

NOTE:    MOBILE6 input files may not contain "tab" characters or non-ASCII characters in any input command line.

## 2.4    **INPUT STRUCTURE**

There are three types of MOBILE6 input files: command files, batch files, and external data files. All three types must be ASCII DOS text files and may not contain "tab" characters or non-ASCII characters in any input line. Standard command input files are intended to be the method for users to specify what sort of results are needed from MOBILE6. External data files are associated with some individual commands. The content and format for external data files are discussed in Section 2.7 and 2.8 along with the specific commands that require them.

### 2.4.1   **Command Input Files**

All command input files begin with the MOBILE6 INPUT FILE command. Command input files provide program control information and data describing the scenarios for which emission factors are to be estimated. The input information consists of three distinct sections:

• The "Header" section controls the overall input, output, and execution of the program. For example, the header section may direct MOBILE6 to output emission factors in a format suitable for visual inspection (descriptive output) and/or in a format suitable as input to another program (database output). Information supplied in the "header" section will apply to all runs and scenarios described in the command input file. Commands which may appear in the header section are indicated in Section 2.1 above. The RUN DATA command indicates the end of the header section of the command input file.

• The "Run" section allows users to define parameter values that localize or customize their MOBILE6 runs. For example, in the "run" section users can specify alternate annual mileage accumulation rates or registration distributions by age for each vehicle type. In addition, the "run" section allows users to specify further control program parameters, such as description(s) of inspection and maintenance program(s). Information supplied in the "run" section is specified once and applies to all scenarios in that run. Commands which may appear in the run section are indicated in Section 2.1 above. Some commands may appear in either the run or scenario sections. A

command input file may contain multiple runs. The first run section begins with the RUN DATA command and ends with the first SCENARIO RECORD command. The next run section begins with the END OF RUN command from the previous run and ends with the next SCENARIO RECORD command.

• The "Scenario" section details the individual scenarios for which emission factors are to be calculated. For example, the scenario section must specify the calendar year of evaluation. The scenario section may also specify other information such as the month of evaluation and temperatures. Each MOBILE6 run can include many scenarios. Information supplied in the "scenario" section is applied only to results from that scenario. Commands which may appear in the scenario section are indicated in Section 2.1 above. Some commands may appear in either the run or scenario sections. Each scenario begins with the SCENARIO RECORD command and ends with the next SCENARIO RECORD command or ends with an END OF RUN command (indicating the end of all scenarios within that run).

A MOBILE6 command input file must begin with a header section and may contain many separate run sections called runs. Each command input file must contain at least one run. Each run section must contain at least one or more scenarios. Any data item entered in the run data section is used for every scenario within the run, unless it is replaced in any scenario by a local value as described below. The end of the command input file is considered as the end of the last run. The END OF RUN record at the end of the last scenario in the command input file is therefore optional, but recommended. Therefore, the overall structure of a MOBILE6 command input file is:

▸        Header Section

   ▸   First Run Data Section

      ▸   First Scenario Data Section
      ▸   Second Scenario Data Section

            •
            •

      ▸   Last Scenario Data Section

   ▸   Second Run Data Section

      ▸   First Scenario Data Section
      ▸   Second Scenario Data Section

            •
            •

> ► Last Scenario Data Section

•

•

> ► Last Run Data Section

> ► First Scenario Data Section
> ► Second Scenario Data Section

•

•

> ► Last Scenario Data Section

MOBILE6 assigns default values for most of the data items that may appear in a MOBILE6 command input file. It is not necessary to enter data for these items if the default value is acceptable for all scenarios in that run. Since all of the input commands that appear in the run sections have default values, it is not necessary to enter any records in the run section of a MOBILE6 command input file. A run may begin with a SCENARIO RECORD command.

## 2.4.2   **Batch Input Files**

All batch input files begin with the MOBILE6 BATCH FILE command. This is the only MOBILE6 command allowed in a batch input file. The purpose of a batch input file is to direct the MOBILE6 model to execute a series of command input files without interaction with the user. This allows for a large and complex series of MOBILE6 results to be generated from a single input file. Many users will not need to use this option, since the command input file structure allows for multiple runs and scenarios (see Section 2.4.1 above).

The structure of a batch input file is simple. A batch file consists of any number of lines that name command input files to be processed, along with any number of blank and comment lines. Each active line in the file will contain a file name (with or without the DOS path). The file name is expected to be the name of an existing MOBILE6 command input file. MOBILE6 will read and execute the commands in the specified command input file and generate results. After completion of each command input file, MOBILE6 will read the file name found on the next line in the batch input file and execute the commands in the next command input file specified there. In this way, a series of separate MOBILE6 command input files can be completed with a single execution of the MOBILE6 application.

After the entry of the MOBILE6 BATCH FILE command, the only other active lines in the file contain file names. No other MOBILE6 commands may appear in a batch input file, other than comments and blank lines. All input file names in the batch input file must be existing MOBILE6 command input files. The indicated file names may not be other batch input files. All the input files indicated in the batch input file will be run until all command input files have been

completed or an error occurs.

See Section 2.8.2.2 for more details about the MOBILE6 BATCH FILE command.

## 2.5    COMMAND INPUT FILE CONTENT

This section describes the contents of valid MOBILE6 command input files.

Users specify what sort of results are desired by putting "commands" in a standard command input file. Section 2.1 provides an overview of the  valid MOBILE6 commands. Section 2.8 presents a detailed discussion of each valid input command.

Most commands are optional in MOBILE6 command input files. The seven commands that are required in every command input file are given in the following table:

### Table of Required MOBILE6 Input Records

| Command Name (full text) | MOBILE6 Section | User Guide Section |
|---|---|---|
| MOBILE6 INPUT FILE | Header | 2.8.2.1 |
| RUN DATA | Header | 2.8.2.3 |
| FUEL RVP | Run or Scenario | 2.8.10.4 |
| Temperature either as: <br>    MIN/MAX TEMPERATURE <br>    HOURLY TEMPERATURE | Run or Scenario | 2.8.6.3, 2.8.6.4 |
| SCENARIO RECORD | Scenario only | 2.8.2.4 |
| CALENDAR YEAR | Scenario only | 2.8.6.1 |
| END OF RUN | Scenario only | 2.8.2.5 |

As discussed in Section 2.4, particular commands may appear only in particular sections of the command input file. However, within a section, the order of the commands does not matter. For example, it does not matter whether the FUEL RVP command appears before or after the CALENDAR YEAR command in the Scenario section of the input. If a command appears more than once within a section, only the last occurrence will be used. This should be avoided, since it may cause confusion and inappropriate results.

Commands may only contain ASCII characters.  MOBILE6 command input files may not

contain "tab" characters or non-ASCII characters in any input command or line. However, commands may be entered in upper, lower or mixed case.

Command input files may also contain blank lines and comments. Using blank lines and comments appropriately within command input files is encouraged to make the command input files more easily read and understood. The use of comments is described in Section 2.6.3 below.

## 2.6    INPUT FORMAT

There are specific content and format requirements for the commands in a MOBILE6 command input file.

Each command has a unique name that should appear precisely as specified (e.g., "MOBILE6 INPUT FILE"). In some cases, the command name itself acts as an on/off switch that signals MOBILE6 to take a given action. In many cases however, users must supply additional information. This can take the form of data parameters that follow the command name. Such entries are considered to be "internal" because the information is provided within the command input file. In contrast, many MOBILE6 commands require extensive user-supplied data that users must provide in separate files called "external" data files, which are discussed in Section 3.7.

MOBILE6 reads up to 150 characters of any input line, including comments, commands, and data lines. There are three types of input lines allowed by MOBILE6. These are:

> ▸ Command lines - these lines give information that controls the calculations or output of MOBILE6 runs and scenarios. Command lines consist of a command name, sometimes followed by a data field.
>
> A command name always appears in columns 1 through 19 of a MOBILE6 command line. The command name may appear in upper or lower case and any number of blanks may appear preceding the first word of the command or between the words of commands that use more than one word.
>
> By convention, a colon (:) appears in column 20 of the command line, but is not required. Column 21, by convention, is usually left blank to separate the data from the colon. Any data that appears on the command line usually starts in column 22.
>
> ▸ Data lines - these are lines that follow an associated command name. They provide data associated with the command.
>
> The data may usually occur in any column, including columns 1 through 19. All data must appear within the 150 characters read by MOBILE6 from each line. Users should consult with the specific format requirements for data lines

discussed with the associated commands in Section 2.8 below.  Section 2.6.1
discusses the types of data formats used in MOBILE6.

▶    Comment lines - these are optional lines that allow users to document or describe
the MOBILE6 scenario or run. Comment lines are only included if the user wishes
to use them.

Except within blocks of data, or between a data line and the command that defines
it, any number of blank lines or comment lines are allowed anywhere in the
command input file. This allows MOBILE6 command input files to contain
documentation so that they are easy to read and understand by those who develop,
maintain, and use the files.

## 2.6.1    Free Versus Fixed Format Data Entry

There are two basic formats that the model use to read data values provided by the user,
"free"  and "fixed" column formats. A "free" column format allows the values to occur in any
column in the data space, as long as individual values are separated by a separating character
(usually a blank space). A "fixed" column format requires that the data be located in a specific
column or group of columns in the data space. MOBILE6 utilizes both types of user input format.
The user must be aware of the differences between these input types and the limitations of each
in order to avoid errors when entering data values.

Free format allows the data values to be entered into any column in the data space. If the
data follows a command on the same line, the data space is the columns following the command,
beginning in column 21. If the data may follow the command line or is located in an external file,
then the data values may appear in any column, including columns 1 through 21. No data may
appear after column 150 in any case. File names, including path, are usually limited to 80
characters. Each data value entered must be separated from other values by a separating
character, either a blank space or a comma. If blanks are used, as many blank characters may
separate vales as desired. If a comma is used, only one comma may occur between values. We
suggest that only blank spaces be used to separate values when using free column format entry.
If the data value is text, the specified text may not contain a blank character, unless the entire text
string is enclosed in single quote characters (i.e., 'My Name'). Values that are intended to be
integers may be entered including a decimal (i.e., 2.0), however, any fractional value included
after the decimal will be dropped from the value used by the model. For example, entering the
value 1.9 into a field intended to be an integer will result in the value used being 1.0, and the
fractional portion of the value (0.9) will not be used. Values that are intended to be real numbers
are not required to include a decimal if the value is a whole number. The values may have as
many numbers after the decimal as desired, however, the use of the values is limited by the
precision of the computer itself.  If there is a series of value to be entered and the data may follow
the command line or the data is located in an external file, the number of lines on which the data

is entered may vary. For example, if 24 values are to be entered, they may be on a single line with all 24 values, on two lines with 12 values each, on 6 lines with 4 values on each or in any other combination so long as the total of 24 values appear in the proper sequence.

Fixed format requires that all values be located in specific locations on the command line or other data lines. The locations are specified in the model by a FORTRAN format statement which is sometimes included with the description of the data entry. Decoding the FORTRAN format statement is described in Section 2.6.2. Each value must occur wholly within the columns specified. For example, if an integer value must be entered within two columns, it is impossible to enter a three digit value, since the third digit character will not be read if it lies outside the two columns. Real values which contain a decimal can alter the default decimal places specified by the format, but the total number of characters used must fall within the specified columns. If an integer value is expected and a value is entered which contains a decimal within the specified columns, the model cannot read the value and will give an error message. The values must be entered in the columns, rows and order specified by the format description.

## 2.6.2   How to Read FORTRAN Format Specifications

Some of the descriptors used in Section 2.8 to define and describe the input field specifications are FORTRAN format specifications. Following is a brief key for interpretation. Additional detail can be found in any FORTRAN manual.

| Descriptor | Definition and Interpretation |
|---|---|
| '**Iw**' | The next **w** characters (columns; includes blank spaces) will be read in as an integer value. Leading blanks are ignored, but trailing blanks are read as zeroes; thus, integer input values should be "right-justified" within the input field (i.e., if a value of "2" is to be entered in a field specified as I2, the two columns should be filled in "blank,2", not "2,blank" which will be interpreted as "20"). |
| '**Fw.d**' | The next **w** characters will be read in as a floating-point real number, where **d** is the number of digits to the right of (following) the decimal point. If the field contains an explicit decimal point, the value will be read as specified and the implied point specified by **d** in the descriptor will be overridden. The decimal point, if present, is considered a character in the overall field width, **w**. If the field does not contain an explicit decimal point (which is not recommended), then **d** places are considered to be to the right of an "implied" decimal point. |
| '**Aw**' | The next **w** characters will be interpreted and stored as alphanumeric (i.e., labels or text. Control characters, such as tabs, and non-ASCII characters may not be used. |

'**wX**'                     The next **w** characters will be ignored; they are not read by MOBILE5.

'**/**'                      The field separator, used to indicate the end of one record (line of input). Input after the '/' will be read from the next record.

'**n( )**'                   The format specification inside the parentheses is repeated 'n' times.

## 2.6.3   COMMENTS

Input files are able to contain comment lines. The results of a MOBILE6 run are not affected by the text on any line that begins with an asterisk (*) or right caret(>). This permits extensive documentation to be included within input files.

Two types of comment lines are supported in MOBILE6 command input files. The first type of comment is a line that has an asterisk (*) in the first column of the line. This type of comment line is ignored by the model, just like a blank line, and does not affect the output in any way. The second type of comment line has a right caret (>, i.e., a 'greater than' symbol) in the first column. This type of comment line is read by the model, and printed to the output. If the comment is in the "header section," the comment appears only on the monitor screen. The right caret is changed to an asterisk before the line is printed, but otherwise it is copied exactly as it is found in the command input file. If the comment containing a right caret appears in either the Run or Scenario section of the command input file, the comment is written to the descriptive output file. Comments are never written to the database output file.

Comment lines may be used to add documentation to the descriptive output file and to annotate the command input file. Blank lines are sometimes useful to help organize the command input file material. Comments should never be placed within a block of data which follows a command within a command input file, unless this feature is explicitly noted in the description of the command.

## 2.7   EXTERNAL DATA FILES

MOBILE6 reads certain types of data from external data files. These data include user-supplied tampering rates, mileage accumulation rates, and vehicle registration distributions. In fact, most commands that require significant amounts of user-supplied data rely on external data files.

When external files are employed, MOBILE6 expects to find a file name in the data field to the right of the colon on the command line. File names can be given in either upper or lower case; they may include path information; and they may appear anywhere in the data field of the input record starting at or to the right of column 21. MOBILE6 always prints the names of any external data files it uses in the descriptive output report. MOBILE6 accepts filenames up to 80

characters in length, including file path information. External data file names which do not include path information are assumed by the model to appear in the same directory as the application.

Normally blank or comment lines may appear in front of the header in the external data file, or between the header and the data, or at the end of the file after the data is complete. However, no blank or comment lines may appear between the first line and the last line of the data block unless specifically indicated in the description for the command. Blank lines and comment lines in external data files can provide annotation for internal documentation or provide text that will be echoed to the descriptive output file.

The specific content and format for external data files are described with the commands that require the data. The descriptions for each command are found in Section 2.8 below.

## 2.8    MOBILE6 COMMANDS

### 2.8.1   Overview

MOBILE6 users can tailor modeling results to reflect specific local conditions by means of model inputs called "commands." MOBILE6 commands also serve certain administrative functions such as marking the beginning or end of a modeling exercise. A complete list of MOBILE6 input commands organized by function appears in Section 2.1. An alphabetical list appears in APPENDIX A. This section presents each MOBILE6 command in detail. The following general format is used:

Name:          Full name and allowable abbreviations

Status:         Required or Optional

Section:        Header, Run, or Scenario

Description:   Brief summary of what the command does.

Default:        The action MOBILE6 takes or value it applies unless the user supplies alternative information.

Explanation:  Detailed, "how-to" information for users. Covers user options, model calculations, information requirements, and format specifications.

Example:      Example of properly-formatted input for the command.

Tips:            Suggestions for facilitating MOBILE6 operation.

References to technical documentation occur throughout this section. Sample external data files will be distributed with the model and MOBILE6 technical reports can be found on the EPA's MOBILE6 web page http://www.epa.gov/otaq/models.htm.

## 2.8.2   Separator Commands

As explained in Section 2.4, a MOBILE6 command input file consists of three sections. Separator commands mark the beginning or end of a MOBILE6 command input file, as well as a header, run, and/or scenario section within a MOBILE6 command input file.

### 2.8.2.1          First Record of a Regular Command Input File

Name:            MOBILE6 INPUT FILE

Status:          Required for all regular command input files.

Section:         Header

Description:     Identifies MOBILE6 command input file as a regular file as opposed to a batch file.

Default:         There is no MOBILE6 default. Users must supply this information in all input files except batch files.

Explanation:     This command must be the first data record in a MOBILE6 input file. The data field of this record is not used and should be left blank. No additional information is required or allowed.

Example:     `MOBILE6 INPUT FILE`

### 2.8.2.2          First Record of a Batch File

Name:            MOBILE6 BATCH FILE

Status:          Required for MOBILE6 batch files

Section:         Header

Description:     Identifies a MOBILE6 input file as a list of command input file names as opposed to a standard command input file.

Default:         There is no MOBILE6 default. Users must supply this command as the first and

only command in all batch input files.

Explanation:   This command must be the first record in a MOBILE6 batch input file. The data field of this record is not used and should be left blank. No additional information is required or allowed on the command line.

The MOBILE6 BATCH FILE command is the only command allowed in the batch input file. The remaining lines in the batch file must either be blank, comments or identify standard command input files for MOBILE6 to process. Nesting of batch input files (listing another batch input file name within a batch input file) is not allowed. All comments using a right caret will be written to the monitor screen during execution.

MOBILE6 expects to find each command input file name in a separate line within the batch input file. Any number of lines containing valid command input file names may appear following the MOBILE6 BATCH FILE command. File names can be given in either upper or lower case; they may include path information; and they may appear anywhere in the input record, beginning with column 1. The actual file names cannot have more than 8 characters before the decimal. MOBILE6 accepts filename entries up to 80 characters in length, including file path information. File names which do not include path information are assumed by the model to appear in the same directory as the application. MOBILE6 will echo the names of the command input files being processed to the monitor screen during execution.

Additional features for designation of input and output file names in MOBILE6 batch input files is discussed in Section 4.5 of this guide.

Example:   
```
MOBILE6 BATCH FILE
FILE1.IN
FILE2.TXT
.
.
.
LASTFILE
```

## 2.8.2.3          End of Header Section

Name:          RUN DATA

Status:          Required

Section:          Header

Description:     This command marks the end of the header section and the beginning of the first run section of a regular MOBILE6 command input file.

Default:         There is no MOBILE6 default. Users must supply this information in all command input files.

Explanation:     This command has a purely administrative function. No information is required besides the command name.

Example:         RUN DATA

## 2.8.2.4          Scenario Record

Name:            SCENARIO RECORD

Status:          Required

Section:         Scenario

Description:     This command serves two purposes. It marks the beginning of a new scenario and it allows the user to enter text to be printed at an appropriate location in the descriptive output file.

Default:         There is no default. This command must be present.

Explanation:     This feature permits the user to specify individual scenario calculations. The only required information is the command name, followed by whatever scenario-identifying text the user wants to appear in the descriptive output. The text must begin in column 22 of the line. At least one SCENARIO RECORD command is required in every regular MOBILE6 command input file.  Additional SCENARIO RECORD commands are necessary to generate multiple output results (e.g., multiple calendar years).

Example:         SCENARIO RECORD    : Washington DC

                 This input indicates the beginning of a modeling exercise specific to Washington DC and causes the text "Washington DC" to appear before results in the output file.

## 2.8.2.5          End of Run

Name:            END OF RUN

Status:        Required

Section:       Run

Description:    This command marks the end of each "run data" section of a MOBILE6 command
                input file and is used to separate multiple MOBILE6 runs.

Default:        There is no MOBILE6 default.

Explanation:    This command must appear at the end of the last scenario of each "run data"
                section of a command input file.

Example:        END OF RUN              :

### 2.8.3   <u>All Output Commands</u>

        Output commands allow the user to specify the format and content of  MOBILE6 report
files. The commands in this section apply to both database and descriptive forms of output.

### 2.8.3.1        **Limiting which Pollutants are Reported**

Name:          POLLUTANTS

Status:        Optional

Section:       Header

Description:    Defines the set of pollutants MOBILE6 reports.

Default:        MOBILE6 calculates three pollutants (HC, CO, NOx) and writes results for all
                three to any output files produced.

Explanation:    If the user selects this command, at least one pollutant must be specified in the
                data field. The pollutant types are specified by the character strings HC, CO, and
                NOX. The three pollutant types may be appear in mixed case, but each value must
                be separated from the next by one or more blanks. If the users selects this
                command but does not specify a pollutant, the program will stop.

Example:        POLLUTANTS        : NOX CO

                This input specifies that calculations and output will be restricted to the pollutants
                CO and NOX.

**2.8.3.2          Hydrocarbon (HC) Emissions Speciation**

NOTE: This section covers five commands with similar functions and requirements.

Name: (1)     EXPRESS HC AS NMHC

(2)     EXPRESS HC AS NMOG

(3)     EXPRESS HC AS THC

(4)     EXPRESS HC AS TOG

(5)     EXPRESS HC AS VOC

Status:         Optional

Section:        Run

Description:    These commands allow users to specify the particular hydrocarbon species which is reported in the exhaust emission output.

Default:        If the user does not enter a hydrocarbon speciation command, MOBILE6 will report the exhaust hydrocarbon emissions in terms of volatile organic compounds (VOC).

Explanation:    MOBILE6 allows the user to choose one from among five options for reporting hydrocarbon emissions. These are summarized below:

| Species | | FID HC | Methane | Ethane | Aldehydes | Definition |
|---|---|---|---|---|---|---|
| Total Hydrocarbons | (THC) | Yes | Yes | Yes | No | Includes methane |
| Non-methane Hydrocarbons | (NMHC) | Yes | No | Yes | No | THC minus methane |
| Volatile Organic Compounds | (VOC) | Yes | No | No | Yes | NMHC minus ethane, corrected for aldehydes |
| Total Organic Gases | (TOG) | Yes | Yes | Yes | Yes | THC corrected for aldehydes |
| Non-methane Organic Gases | (NMOG) | Yes | No | Yes | Yes | NMHC corrected for non-hydrocarbon reactive compounds |

In the table above, "FID HC" refers to the hydrocarbon emissions as measured by the flame ionization detector (FID) used in testing. The FID detects a portion of the aldehydes emitted by the vehicle. Thus the first two options above (THC and NMHC) account for a portion of aldehyde emissions; the other options include a correction for that portion of aldehyde emissions not registered by the FID.

Only one of the HC speciation commands may be used in a single run. If the user attempts to enter more, MOBILE6 will use the one that appears last. The only required information for each of these five commands is the command name.

Example:      EXPRESS HC AS NMHC :
              EXPRESS HC AS NMOG :
              EXPRESS HC AS THC  :
              EXPRESS HC AS TOG  :
              EXPRESS HC AS VOC  :

### 2.8.3.3      No Refueling Emissions

Name:        NO REFUELING

Status:      Optional

Section:     Run

Description: This command directs MOBILE6 <u>not</u> to calculate the refueling emissions (also referred to as Stage II emissions) from gasoline-fueled vehicles. Thus, the composite hydrocarbon emissions reported to descriptive output will not include refueling emissions.

Default:     MOBILE6 reports refueling emissions if this command is not specified.

Explanation: The command name is the only required information.

Example:     NO REFUELING           :

Tips:        This command should <u>not</u> be used if the user wishes to model the effects of on-board vapor recovery systems, which were required on vehicles beginning in 1994.  MOBILE6 accounts for the benefits of these systems in its calculation of refueling emissions.

### 2.8.4   <u>Descriptive Output Commands</u>

Descriptive output commands allow users to specify the name and content of descriptive output files.

### 2.8.4.1       Report (Descriptive Output) File

Name:       REPORT FILE

Status:       Optional

Section:       Header

Description:       This command names the descriptive output file.

Default:       The output will be written to a descriptive file named with the input file name root plus the extension, ".TXT." The default open action is REPLACE.

Explanation:       The file name is the only required data item for this record and can be placed anywhere in the data field of the record. The user may provide a file name with an explicit extension, or with a period as the last non-blank character, if the user wishes to override the default naming convention.

An open action of APPEND or REPLACE may appear following the file name, separated from it by one or more blanks. The APPEND action adds new modeling results to a previously created report file of the same name. The REPLACE action erases old results and replaces them with new ones. The open action may appear in mixed case and may be abbreviated to a single character (i.e., A or R). The default action, if none is specified, is REPLACE.

Example:       `REPORT FILE        :   feb02.txt`

This example directs results to a descriptive output file named "feb02.txt." Because no open action is specified, the MOBILE6 default open action would apply and any previous modeling results in the file would be replaced by the new ones.

### 2.8.4.2       No Descriptive Output

Name:       NO DESC OUTPUT

Status:       Optional

Section:       Header

Description:     This command prevents MOBILE6 from producing descriptive output.

Default:          MOBILE6 produces descriptive output if this command is not specified.

Explanation:    The only required information is the command name. When this command is
                 present, MOBILE6 will produce a text output file containing identifying
                 information (MOBILE6 version, input file, some run and scenario details) and
                 warning messages.  However, the text  file will not include scenario description
                 (calendar year, temperature, etc.) or emissions data.

                 If the user selects this command but does not request database output, the
                 MOBILE6 run will terminate without generating emission factor output.

Example:         NO DESC OUTPUT          :

### 2.8.4.3          Expanding Vehicle Class Descriptive Output

        NOTE: This section covers four commands with similar functions and requirements.

Name: (1)        EXPAND BUS EFS

      (2)        EXPAND HDDV EFS

      (3)        EXPAND HDGV EFS

      (4)        EXPAND LDT EFS

Status:          Optional

Section:         Run

Description:     These four commands permit users to expand the descriptive MOBILE6 output to
                 include a more detailed breakdown of truck classes.

Default:          MOBILE6 reports emissions only in terms of the eight overall vehicle categories.

Explanation:    The command EXPAND BUS EFS causes MOBILE6 to report separate emission
                 results for gas bus, urban diesel bus, and diesel school bus categories.

                 The command EXPAND HDDV EFS causes MOBILE6 to report emissions
                 produced by heavy-duty diesels (HDDV) for each of the eight distinct HDDV
                 classes (See Section 1.2.3).

The command EXPAND HDGV EFS causes MOBILE6 to report emissions produced by heavy-duty gasoline-fueled vehicles (HDGV) for each of the eight distinct HDGV classes.

The command EXPAND LDT EFS causes MOBILE6 to report emissions produced by light-duty trucks (LDT) for each of the six distinct LDT classes.

Note: When the commands that expand vehicle classes are selected along with other expansion commands (e.g., EXPAND EXHAUST), expanded emissions will be reported for each vehicle sub-category as well as for each sub-category of the other expand command. The command name is the only required information for these commands.

Example:     `EXPAND BUS EFS      :`
             `EXPAND HDDV EFS     :`
             `EXPAND HDGV EFS     :`
             `EXPAND LDT EFS      :`

## 2.8.4.4        Expand Exhaust Emissions Descriptive Output

Name:        EXPAND EXHAUST

Status:      Optional

Section:     Run

Description: This command directs MOBILE6 to display separate start, running, and total (running + start) exhaust emission factors in the descriptive output.

Default:     The default output displays only composite emission factors.

Explanation: Composite emissions are the sum of total exhaust emissions, plus evaporative emissions. The only required information for this command is the command name.

Example:     `EXPAND EXHAUST       :`

## 2.8.4.5        Expand Evaporative Emissions Descriptive Output

Name:        EXPAND EVAPORATIVE

Status:      Optional

Section:        Run

Description:    This command directs MOBILE6 to display total non-exhaust emissions plus the
                six separate types of non-exhaust emissions in the descriptive output.

Default:        The default output displays only composite emission factors.

Explanation:    When the user selects this command, MOBILE6 will report separate emissions for
                hot soak, diurnal, resting, running, crankcase, and refueling losses, as well as a
                total for all those sources. The only requirement for this command is the
                command name.

Example:        `EXPAND EVAPORATIVE :`

## 2.8.5   Database Output Commands

Database output commands allow the user to specify the name, format, and content of the
database output file.

### 2.8.5.1         Control of Output in Database Form

NOTE: This section describes commands that permit users to obtain MOBILE6 output in
a database format and to limit the variables in that database output. These limitations may be
critical since the hourly output from a single unlimited scenario will typically produce 217,800
records for exhaust emissions and another 78,000 records for evaporative emissions. This
requires about 35 megabytes per scenario. Users are advised to limit their output to only the
records necessary for their analyses.

2.8.5.1.a
Name:           DATABASE OUTPUT

Status:         Optional

Section:        Header

Description:    This command directs MOBILE6 to produce database output for all scenarios of
                each run in the command input file.

Default:        MOBILE6 will not produce database output unless this command is selected.

Explanation:    The command name is the only required information. The data field of this record
                is not used and should be left blank.

Example:        `DATABASE OUTPUT      :`

2.8.5.1.b
Name:           WITH FIELDNAMES

Status:         Optional

Section:        Header

Description:    This command directs MOBILE6 to place a row of column names in the first row
                of the database output table.

Default:        The database output will contain only unlabeled values unless this command is
                selected.

Explanation:    The command name is the only required information. The data field of this record
                is not used and should be left blank.

Tips:           This option is helpful for users who intend to export results to a spreadsheet. It is
                also helpful for users who intend to export results to database applications capable
                of handling text fields in the first row of a numerical table.

Example:        `WITH FIELDNAMES      :`

2.8.5.1.c
Name:           DATABASE OPTIONS

Description:    This command provides an alternative option for specifying content and/or format
                of database output. It allows users to place the commands listed below in an
                external file rather than in the command input file.

Default:        Database output content and format is specified only through command input file
                data.

Explanation:    This command creates a name for an external file that may contain the following
                commands. The first record in this external file must restate the name of this
                command, DATABASE OPTIONS:

                DATABASE EMISSIONS
                DATABASE FACILITIES
                POLLUTANTS
                DATABASE VEHICLES

DAILY OUTPUT
AGGREGATED OUTPUT
WITH FIELDNAMES

The external file contains the same information the user would otherwise specify in the command input file.

The only required data are the command name and the file name, which may include its path. The file name can be placed anywhere in the data field of the record.

Example:       `DATABASE OPTIONS   : C:\MOBILE\MOBILE6\DATA\DBASE.OPT`

This example directs MOBILE6 to look for a file called "DBASE.OPT" which contains one or more of the commands listed above.

Tips:          This command can be used to avoid having to respecify a frequently-used set of database options in multiple command input files.

2.8.5.1.d
Name:          DATABASE EMISSIONS

Status:        Optional

Section:       Header

Description:   This command limits which of the eight potential types of emissions are reported.

Default:       MOBILE6 will report all eight emission types unless this command is selected.

Explanation:   MOBILE6 can report separate emissions for the following emission types:

Exhaust Running Emissions
Exhaust Start Emissions
Evaporative Hot Soak Emissions
Evaporative Diurnal Emissions

Evaporative Resting Loss Emissions
Evaporative Running Loss Emissions
Evaporative Crankcase Emissions
Evaporative Refueling Emissions

Users specify whether they want to include each type of emission through an off-on switch indicated by the digits '1' or '2' respectively. A '1' means that the designated emission type should not be included in the output and a '2' means that it should be included. If the user selects this command, a value (1 or 2) must be entered for each emission type in the order listed above.

The format specification requires values to be entered in two groups of four. The groups must be separated by one or more blank spaces. The values identifying emission types may be placed anywhere in the data field. The only other requirement is the command name itself.

Example:       DATABASE EMISSIONS : 1221   1111

This example specifies that database output to the EMISSIONS database output table should be restricted to records pertaining to the Exhaust Start and Evaporative Hot Soak emission types.

Tips:          This option may alternatively be specified using the DATABASE OPTION command described above.

2.8.5.1.e
Name:          DATABASE FACILITIES

Status:        Optional

Section:       Header

Description:   This command allows users to specify the roadway or facility types for which they wish MOBILE6 to report emissions in the database output table. It is most useful for modelers who wish to analyze facility-specific emissions.

Default:       MOBILE6 will report emissions for each facility type.

Explanation:   This command directs MOBILE6 to report database output only for user-selected roadway types.  The command can take on five values, represented by character strings.  Four of the values,  ARTERIAL, FREEWAY, LOCAL and RAMP, represent specific facility or roadway types where emissions occur. The fifth value, NONE, does not specify a specific facility type. Rather, it represents emissions that occur <u>independent</u> of roadway type. These include engine start emissions and all evaporative emissions except running losses.

One or more of these values can be listed in the data field of the DATABASE

FACILITIES command. The values may be in mixed case, but each value must be separated from the next by one or more blanks. No abbreviations are allowed for these values. The character strings may appear anywhere in the data field of the command. The only other required data is the command name.

Example:     `DATABASE FACILITIES: RAMP freeway None`

This sample input specifies that database output should be restricted to the results for the facility types RAMP and FREEWAY, and for engine start and evaporative (except running loss) emissions.

Tips:        This option may alternatively be specified using the DATABASE OPTIONS command described above.

The value "NONE" can be used to suppress reporting of all emission types other than engine start and five of the six evaporative emission types. However, the DATABASE EMISSIONS command offers a more straightforward way to accomplish the same purpose.

2.8.5.1.f

Name:        DATABASE VEHICLES

Status:      Optional

Section:     Header

Description: This command indicates which of the 28 individual vehicle types are reported.

Default:     MOBILE6 reports records for all vehicle types in the database output file.

Explanation: Users can specify whether to include each type of vehicle through an off-on switch indicated by the digits '1' or '2' respectively. A '1' means that the designated vehicle type should not be included in the output and a '2' means that it should be included. If the user selects this command, a value (1 or 2) must be entered for each vehicle  type in the order listed below.

The vehicle types are specified by six groups of values. The first group contains five values for each type of light-duty gasoline (LDG) vehicles and trucks; the second group contains eight values for the heavy-duty gasoline (HDG) vehicles; the third group is a single value for motorcycles (MC); the fourth group contains three values for each type of light-duty diesel (LDD) vehicles and trucks; the fifth contains eight values for the heavy-duty diesel (HDD) vehicles; and the last group

contains three values for buses. Each group of values must be separated from the next by one or more blank spaces.

| Vehicle Types | VType |
|---|---|
| Light-Duty Gasoline Vehicle | 1 |
| Light-Duty Gasoline Truck 1 | 2 |
| Light-Duty Gasoline Truck 2 | 3 |
| Light-Duty Gasoline Truck 3 | 4 |
| Light-Duty Gasoline Truck 4 | 5 |
| | |
| Heavy-Duty Gasoline Vehicle 2B | 6 |
| Heavy-Duty Gasoline Vehicle 3 | 7 |
| Heavy-Duty Gasoline Vehicle 4 | 8 |
| Heavy-Duty Gasoline Vehicle 5 | 9 |
| Heavy-Duty Gasoline Vehicle 6 | 10 |
| Heavy-Duty Gasoline Vehicle 7 | 11 |
| Heavy-Duty Gasoline Vehicle 8A | 12 |
| Heavy-Duty Gasoline Vehicle 8B | 13 |
| | |
| Motorcycle (MC) | 24 |
| | |
| Light-Duty Diesel Vehicle | 14 |
| Light-Duty Diesel Truck 1 and 2 | 15 |
| Light-Duty Diesel Truck 3 and 4 | 28 |
| | |
| Heavy-Duty Diesel Vehicle 2B | 16 |
| Heavy-Duty Diesel Vehicle 3 | 17 |
| Heavy-Duty Diesel Vehicle 4 | 18 |
| Heavy-Duty Diesel Vehicle 5 | 19 |
| Heavy-Duty Diesel Vehicle 6 | 20 |
| Heavy-Duty Diesel Vehicle 7 | 21 |
| Heavy-Duty Diesel Vehicle 8A | 22 |
| Heavy-Duty Diesel Vehicle 8B | 23 |

| **Vehicle Types** | **VType** |
|---|---|
| All Gasoline Bus | 25 |
| Diesel Commercial Bus | 26 |
| Diesel School Bus | 27 |

The only required data for this command are the command name and the string of six groups of vehicle type flags which can be placed anywhere in the data field.

Example:     `DATABASE VEHICLES  : 21111 11111111 1 222 11111111 111`

This example specifies that database output should be restricted to records pertaining to light-duty gasoline vehicles, light-duty diesel vehicles, and both light-duty diesel truck categories.

Tips:        This option may alternatively be specified using the DATABASE OPTIONS command described above.

2.8.5.1.g
Name:        DAILY OUTPUT

Status:      Optional

Section:     Header

Description: This command specifies that database output will represent daily rather than hourly time periods.

Default:     MOBILE6 will report hourly time periods to the database output table.

Explanation: The command name is the only required information. The data field of this record is not used and should be left blank.

Example:     `DAILY OUTPUT          :`

Tips:        Daily output reduces the volume of reported output by a factor of about 30.

            This option may alternatively be specified using the DATABASE OPTIONS command described above.

2.8.5.1.h

Name:           AGGREGATED OUTPUT

Status:         Optional

Section:        Header

Description:    This command specifies that database output will represent daily rather than
                hourly time periods, and that it will be aggregated over age, facility (roadway)
                type,  and emission type for each vehicle class and pollutant. The emission types
                included in the aggregation are controlled by user input.

                This output option allows the user to obtain most of the aggregated numeric
                values found in the descriptive output in a database format suitable for electronic
                processing.

Default:        MOBILE6 will report unaggregated emission factors for hourly time periods to
                the database output table.

Explanation:    The command name is the only required information. The data field of this record
                is not used and should be left blank.

                Unlike the "hourly" and "daily" database output formats, the emission values
                within the output produced by the "aggregated" format option are affected by
                other database output options. This allows the user to specify which emission type
                results are included in the aggregation. The following commands will affect the
                emission result values:

                NO REFUELING
                DATABASE EMISSIONS

                The NO REFUELING command will prevent the emissions reported from
                including the portion from refueling. Similarly, the DATABASE EMISSIONS
                command can eliminate the emissions from any of the Etype categories from the
                reported aggregated results. Since the user may affect the aggregated emission
                values, caution should be used in selecting desired combinations. For example,
                selecting only non-exhaust emission types will result in zero emissions for
                database output lines referring to CO and NOx.

                The DATABASE VEHICLES and POLLUTANTS commands can be used to
                restrict the number of lines written to the database output file by restricting the
                vehicle classes and pollutants to be written.

The DATABASE FACILITIES command has no effect on aggregated emissions and will not restrict the emissions by roadway type. This may be done using the VMT BY FACILITY command.

Example:     `AGGREGATED OUTPUT          :`

Tips:        AGGREGATED OUTPUT reduces the volume of reported output to a maximum of 84 lines per scenario.

Heavy duty vehicles have no separate estimates for running and engine start emissions. Any composite emission results which include running emissions will include all exhaust emissions of heavy duty vehicles.

## 2.8.5.2        Database Output Files Identification

Name:        EMISSIONS TABLE

Status:      Optional

Section:     Header

Description: This command permits the user to name the database output file.

Default:     Output will be written to a database table named with the input file name root plus the extension, ".TB1."

Explanation: The file name is the only required data item for this command and can be placed anywhere in the data field of the record. The user may provide a file name with an explicit extension, or with a period as the last non-blank character, if the user wants to override the default naming convention.

An open action of APPEND or REPLACE may appear following the file name, separated from it by one or more blanks. The APPEND action adds new modeling results to a previously created report file of the same name. The REPLACE action erases old results and replaces them with new ones. The open action may appear in mixed case and may be abbreviated to a single character (i.e., A or R). The default action, if none is specified, is REPLACE.

Example:     `EMISSIONS TABLE     : C:\MOBILE6\TESTING2\TEST1B.TB1 REPLACE`

This example directs MOBILE6 to write results to a table called "test1b.tb1" which is found in the C:\\MOBILE6\TESTING2 folder. The replace action causes

MOBILE6 to overwrite any previous modeling results found in that file.

## 2.8.6.  <u>External Condition Commands</u>

External condition commands allow users to specify the time frame, altitude, and weather conditions they wish to model.

### 2.8.6.1          Calendar Year of Evaluation

Name:          CALENDAR YEAR

Status:          Required

Section:          Scenario

Description:          This command identifies the calendar year for which emission factors are to be calculated, often referred to as "calendar year of evaluation."

Default:          There is no MOBILE6 default. Users must supply this information.

Explanation:          MOBILE6 can model emission factors for the calendar years 1952 to 2050, inclusive. A four-digit value for the calendar year of evaluation must be entered anywhere in the data portion of the record.

Example:          `CALENDAR YEAR        : 2015`

This input directs MOBILE6 to report emissions for the calendar year 2015.

### 2.8.6.2          Month of Evaluation  (January or July)

Name:          EVALUATION MONTH

Status:          Optional

Section:          Scenario

Description:          This command provides the option of calculating emission factors for January 1 or July 1 of the calendar year of evaluation.

Default:          January or "1"

Explanation:          MOBILE6 allows the choice of January 1 or July 1. The specified month will

affect emissions calculations in two ways: (1) by changing the composition of the fleet (July 1 emission factors will reflect an additional six months of fleet turnover, or replacement of older vehicles by new vehicles), and (2) by changing how the effects of reformulated gasoline (RFG) are modeled. If the user selects January, MOBILE6 will apply winter season RFG rules. If the user selects July, the model will apply summer season RFG rules (see section 2.8.10).

To select July, enter a value of "7" anywhere in the data portion of the record. To select January, the user can either enter a value of "1" or simply omit this command. No other information is required except the command name.

Example:       EVALUATION MONTH   :      7

This example directs MOBILE6 to produce emission results for July 1 of the calendar year of evaluation.

Tips:          The value of month is independent of temperature, fuel volatility, and other inputs, which users still must select in a way that is consistent with the evaluation month.  Section 2.8.10.1 provides cautions concerning the use of the July 1 option.

### 2.8.6.3        Daily Temperature Range

Name:          MIN/MAX TEMPERATURE

Status:        Required, unless HOURLY TEMPERATURE command is selected

Section:       Run or Scenario

Description:   This command sets the minimum and maximum daily temperatures the user wishes to model in a given run or scenario.

Default:       There is no MOBILE6 default. Users must supply either daily minium and maximum temperatures with this command, or 24 hourly temperatures with the HOURLY TEMPERATURE command.

Explanation:   MOBILE6 uses the minimum and maximum daily temperatures to perform several types of calculations:

▸       temperature corrections to exhaust HC, CO, and NOx
▸       diurnal, hot soak, running loss, and resting loss portions of evaporative HC
▸       temperature of dispensed fuel to calculate refueling emissions

Users must enter values for the minimum and maximum ambient temperatures they wish to model in a given run or scenario. The maximum temperature cannot be lower than the minimum temperature. The two values may be equal, indicating no temperature change occurred during the entire day.

- ▸ the allowable minium temperature range is 0 F to 100 F (-18  to 38 C)
- ▸ the allowable maximum temperature range is 10 F to120 F (-12  to 49 C)

If the user selects this command, MOBILE6 will calculate hourly temperatures based on a typical pattern of temperatures over the day, given the maximum and minimum values provided.

The format for this command is the command name, followed by the minimum and then the maximum temperatures in degrees Fahrenheit.  Numbers representing the temperatures must be separated by a blank space but may appear anywhere in the data field of the record.

Example:      `MIN/MAX TEMPERATURE: 60.  84.`

This input models a day in which the low temperature is 60 degrees Fahrenheit and the high temperature is 84.

Tips:         If the user inputs minium and maximum daily temperatures, do not input separate hourly temperatures. If the user does input both sets of temperatures, MOBILE6 will use the set that appears last in the scenario (or run) section of the command input file.

MOBILE6 will not correct for effects of fuel volatility (RVP) at very cold ambient temperatures.

**2.8.6.4       Ambient Temperature for Each of 24 Hours of the Day**

Name:         HOURLY TEMPERATURES

Status:       Required, unless MIN/MAX TEMPERATURE command is selected.

Section:      Run or Scenario

Description:  This command allows users to enter temperatures for each hour of the day.

Default:      MOBILE6 calculates hourly temperatures based on a typical pattern of

temperatures over the day, given the maximum and minimum values provided in the "MIN/MAX TEMPERATURE" command.

Explanation:   If the user selects this command, MOBILE6 will use the 24 values entered by the user to calculate the minimum and maximum daily temperatures. The minimum/maximum temperatures will then be used to calculate the hourly diurnal emissions, as described in Section 2.8.6.3. MOBILE6 will also perform hour-specific calculations with the specified hourly values rather than with values calculated from a default temperature pattern for all of the non-diurnal emissions described in the previous section.

This command requires the command name followed by the 24 hourly temperatures in the data field. The temperatures must be listed beginning with 6 am and continuing through 5 am the next day (See Table 4, Appendix B). The temperatures for each hour must be separated by a blank space. The first twelve values must be on the same line as the command; the remaining twelve must be on the next line.

Example:   `HOURLY TEMPERATURES: 75.0 75.0 75.0 75.0 75.0 75.0 75.0 75.0 75.0 75.0 75.0 75.0`
`75.0 75.0 75.0 75.0 75.0 75.0 75.0 75.0 75.0 75.0 75.0 75.0`

This example would model a day in which the temperature remained 75 degrees Fahrenheit for every hour between 6 am one day and 5 am the next day.

Tips:   If the user inputs hourly temperatures, do not input daily minimum and maximum temperatures. If the user does input both sets of temperatures, MOBILE6 will use the set that appears last in the command input file.

## 2.8.6.5   Altitude

Name:   ALTITUDE

Status:   Optional

Section:   Scenario

Description:   This command indicates whether MOBILE6 will calculate emissions for a high or a low altitude region.

Default:   Low altitude

Explanation:   MOBILE6 can calculate separate emission rates for high and low altitude regions.

Low-altitude emission factors are based on conditions representative of approximately 500 feet above mean sea level. High-altitude factors are based on conditions representative of approximately 5500 feet above mean sea level.  When high-altitude region emission factors are requested, MOBILE6 also includes vehicles that were built to meet specific high-altitude emission standards.

To select high altitude, enter a value of "2" anywhere in the data field. To select low altitude, the user can either enter a value of "1" or simply omit this command. No other information is required except the command name.

Example:      ALTITUDE                : 2

This example models a high-altitude area.

### 2.8.6.6        Absolute Humidity

Name:         ABSOLUTE HUMIDITY

Status:       Optional

Section:      Run or Scenario

Description:  This command is used to specify a daily average for humidity.

Default:      75 grains/pound absolute or specific humidity

Explanation:  MOBILE6 converts the specified absolute humidity to relative humidity, which in turn is used to calculate a heat index.

The heat index affects HC and CO emissions only if the air conditioning is on, but it affects NOX emissions regardless of the air conditioning setting.

This command requires one value in the data portion of the record that represents the absolute humidity in grains of water per pound of dry air. The value must be between 20.0 and 528.0.

Example:      ABSOLUTE HUMIDITY   : 115.0

This example models a day in which the absolute humidity is 115 grains per pound.

Tips:         MOBILE6 ceases to function when the specified specific humidity creates a

relative humidity that exceeds 100 percent.

### 2.8.6.7        Environmental Effects on Air Conditioning

NOTE:        The commands in this section only have an effect if the air conditioning is modeled as on.  They serve no purpose to users who are not modeling air conditioning.


2.8.6.7.a
Name:         CLOUD COVER

Status:       Optional

Section:      Run or Scenario

Description:  This command allows users to specify an average percent cloud cover for a given day. This feature only affects the air conditioning correction.

Default:      Zero percent.

Explanation:  The CLOUD COVER command requires one value in the data portion of the record that signifies the average fraction of cloud coverage. This value must be between 0.0 and 1.0, inclusive.

Example:      `CLOUD COVER       : 0.90`

              This example would model a day in which the cloud cover is 90 percent.

2.8.6.7.b
Name:         PEAK SUN

Status:       Optional

Section:      Run or Scenario

Description:  This command allows users to specify the midday hours when the sun is at peak intensity. This feature only affects the air conditioning correction.

Default:      10 AM for start of peak sun and 4 PM for end of peak sun.

Explanation:  The PEAK SUN command requires two integers in the data portion of the record.

The first peak sun integer represents the beginning of peak sun and the second integer represents the end of peak sun. The first value (beginning of peak sun) must be no earlier than 9 AM. The second value (end of peak sun) must be no later than 5 PM. The integers must be separated by one or more blank spaces.

Example:        `PEAK SUN            :   10 4`

This example would model a day in which the peak sun occurs between 10 AM and 4 PM.  Note that these are also the default hours.

2.8.6.7.c
Name:           SUNRISE/SUNSET

Status:         Optional

Section:        Run or Scenario

Description:    This command allows users to specify the time of sunrise and sunset. This feature only affects the air conditioning correction.

Default:        6 AM for sunrise and 9 PM for sunset.

Explanation:    The SUNRISE/SUNSET command requires two integers in the data portion of the record. The first one represents the hour of sunrise and the second represents the hour of sunset. The first value (sunrise) must be between 5 AM and 9 AM.  The second value (sunset) must be between 5 PM and 9 PM. The integers must be separated by one or more blank spaces.

Example:        `SUNRISE/SUNSET     :   6   9`

This example would model a day in which the sunrise occurs at 6 AM and the sunset occurs at 9 PM. Note that these are also the default hours; thus, alternatively, the modeler need only enter the command name to achieve the same modeling result.

Tips:           Although most of the units for time of day (in MOBILE6) count from 6 AM, both of the preceding commands (SUNRISE/SUNSET and PEAK SUN) use the traditional clock time (counting from midnight).

## 2.8.7   Vehicle Fleet Characteristic Commands

Fleet characteristic commands allow users to profile a given fleet by vehicle age, power

source, and activity level. Several of these commands involve vehicle age.  In MOBILE6, vehicle age always involves a 25 year range, with vehicles 25 years and older grouped together. The range may be expressed as 0-24 years (age = calendar year - model year), alternatively its values may be considered to range from 1-25 years (age = calendar year - model year +1). Calendar year is the year being modeled and may vary by MOBILE6 scenario.

### 2.8.7.1          Distribution of Vehicle Registrations

Name:          REG DIST

Status:          Optional

Section:          Run

Description:     This command allows users to supply vehicle registration distributions by vehicle age for any of the 16 composite (combined gas and diesel) vehicle types.

Default:          MOBILE6 applies a registration distribution for each composite vehicle type based on U.S. vehicle fleet data. Technical report M6.FLT.007 contains these default age distributions.

Explanation:     MOBILE6 users may specify vehicle registration data for each of 25 vehicle ages for one or more of the 16 composite vehicle types listed in Table 1, Appendix B.

This command requires use of an external data file. The command line in the command input file contains the command and external data file names. The format for the external data file is as follows:

- ▸    The first line contains the command name.
- ▸    The next line contains the composite vehicle type followed by 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 date is requested, or will convert them to January if the user requests that evaluation date.
- ▸    This line is repeated for any vehicle categories the user wishes to specify (override the MOBILE6 default).
- ▸    The vehicle type is represented by an integer from 1 to 16. See Table 1, Appendix B for the number associated with each of the 16 composite vehicle types.
- ▸    The vehicle age fractions are represented by decimals (0.000 through 1.000) for each of the 25 model years, starting with the youngest. The last fraction represents vehicles aged 25 years and older in the fleet being

modeled.

The values may appear in any row with as many characters as needed, as long as 25 values follow the integer value separated by at least one blank space. Comment lines may not appear within the lines containing the 25 values for each vehicle class. However, comments may occur between the data for each vehicle class. The data for the vehicle classes may occur in any order and not all vehicle classes must be entered. However, all 25 values of the distribution must be entered for any vehicle class.

Example:     REG DIST                  : REGDATA.D

In this example, the external file "REGDATA.D" contains the user supplied age distributions.  Below is an example of an external data file for this command:

```
REG DIST
* LDV
 1 0.0530 0.0706 0.0706 0.0705 0.0703 0.0698
   0.0689 0.0676 0.0655 0.0627 0.0588 0.0539
   0.0458 0.0363 0.0288 0.0228 0.0181 0.0144
   0.0114 0.0090 0.0072 0.0057 0.0045 0.0036 0.0102
* LDT1
 2 0.0581 0.0774 0.0769 0.0760 0.0745 0.0723
   0.0693 0.0656 0.0610 0.0557 0.0498 0.0436
   0.0372 0.0309 0.0249 0.0195 0.0147 0.0107
   0.0085 0.0081 0.0078 0.0075 0.0072 0.0069 0.0359
```

The sample external data file starts with the command name "REG DIST" followed by a comment line (denoted by a '*' character). The next three lines contain the 25 registration by age fractions, arranged in three lines of 6 and one line of seven following the integer'1', for light duty vehicles. The last four lines present similar information for the composite vehicle category LDT1.

### 2.8.7.2     Diesel Fractions

Name:        DIESEL FRACTIONS

Status:      Optional

Section:     Run or Scenario

Description: This command permits users to supply locality-specific diesel fractions for 14 of the 16 composite vehicle categories by vehicle age.

Default:        MOBILE6 assigns default diesel fractions for all model years. Please see the
                technical report, "M6.FLT.007" for the specific gasoline/diesel splits for 1972
                through 1996 model years.

                ▸        1971 and earlier model years are assumed to have the same diesel fraction
                         as the 1972 model year
                ▸        1997 and later model years are assumed to have the same diesel fraction as
                         the 1996 model year.

Explanation:    The use of diesel fractions allows MOBILE6 to perform separate calculations for
                gas and diesel sub-categories, which have distinctly different emission rates. Note
                that Urban/Transit buses are assumed to be all diesel and motorcycles are assumed
                to be all gasoline fueled, so these two categories do not require a diesel fraction.
                That leaves 14 composite vehicle categories for which users can specify a diesel
                fraction.

                The diesel fraction represents the percent of diesels in a composite vehicle
                category for any vehicle age. The model year MOBILE applies to each value
                depends on the calendar year of evaluation. This means that the user must provide
                separate input for each calendar year to be modeled. MOBILE6 assumes that all
                non-diesel vehicle sales are gasoline-fueled vehicles.

                If the user selects this command, diesel fractions must be provided by age of
                vehicle and for each of 14 composite vehicle types. With 14 vehicle categories
                and 25 vehicle ages, the user needs to enter 350 separate diesel fractions. The user
                must provide separate input for each scenario to run multiple calendar years.

                The format for this command is as follows:

                The 350 diesel fractions immediately follow the command name within the
                MOBILE6 command input file. The values are entered in free column format,
                with one or more blank spaces separating each numerical value. The data must be
                ordered in terms of 14 groups of 25 values (representing vehicle ages) by
                composite vehicle type in the order presented in Table 2, APPENDIX B.

                Within each vehicle class, MOBILE6 reads the 25 diesel fractions by age in order
                from the youngest to the oldest. The numbers may appear in as many rows as
                desired, with as many values in each row as desired, as long as the values appear
                in the proper sequence. No comments may appear between the rows containing
                the diesel fraction values. All values entered must be less than or equal to 1 and
                greater than or equal to zero.

Example:    DIESEL FRACTIONS     :

The command name would be followed by 350 decimals representing the 25 diesel fractions for each composite vehicle category). The file DIESFRAC.DEF contains a complete example.

Tips:       The data may be included in the run data section if all scenarios have the same calendar year.

**2.8.7.3        Annual Mileage Accumulation Rates**

Name:       MILE ACCUM RATE

Status:     Optional

Section:    Run

Description:    This command allows users to supply the annual mileage accumulation rates by vehicle age for any or all of the 28 individual vehicle types.

Default:    A default set of rates, based on U.S. fleet data, is described in technical report M6FLT.007.

Explanation:    The mileage accumulation rate represents the total annual travel accumulated per vehicle of a given age and individual vehicle category. The user does not need to enter mileages for all categories. MOBILE6 will apply default values for any vehicle type that the user does not specify.

The format for this command is as follows:

▸       The first line contains the command name.
▸       The next lines contain the vehicle type and mileage accumulation data.
▸       The vehicle type is represented by the number associated with each of the 28 individual vehicle types listed in Table 3, APPENDIX B. That value is followed by the mileage accumulations for each of the 25 ages, starting with the youngest. These values are input as miles divided by 100,000 (e.g., 12,000 miles is input as 0.12000).
▸       The above item is then repeated for each individual vehicle type for which the default distribution will not be used.

Example:    MILE ACCUM RATE     : miledat.d

This example directs MOBILE6 to look for an external file named "miledat.d," which contains the command name followed by mileage accumulation rates. A complete example is contained in the file, MARDATA.DEF

### 2.8.7.4      Vehicle Miles Traveled (VMT) Fraction

Name:          VMT FRACTIONS

NOTE:          This command is cross-listed below under commands covering activity. Please see section 2.8.8.1 for detailed information

### 2.8.7.5      Natural Gas Vehicles (NGVs) Fraction

Name:          NGV FRACTION

Status:        Optional

Section:       Run

Description:   This command is used to indicate the percent of vehicles in the fleet certified to operate on (not retrofitted for) either compressed or liquefied natural gas.

Default:       Zero

Explanation:   This command allows the user to specify the percent of NGVs in each of the 28 individual vehicle classes beginning with the 1994 model year. If the user enters 100% NGV, MOBILE6 will report the basic NGV emission rate. Any other percentage will simulate a fleet that is part NGV and part gasoline / diesel.

The NGV FRACTION command also affects evaporative emissions. Evaporative emissions from NGVs are assumed to be zero. Thus, if the user enters 5 percent for the NGV penetration of a particular gasoline vehicle class, MOBILE6 will assume that 5 percent of that class will have zero evaporative emissions.

The NGV FRACTION command requires an external file containing the NGV fractions for each vehicle type and model year from 1994 through 2050. The external file must contain the command name NGV FRACTION at the top of the file starting in column 1. The command name must be followed by 28 separate blocks of NGV fractions. Each block contains 57 values of NGV fleet penetration percentages. Each block must contain a value for all 57 calendar years.  The values can range from 0.0000 to 100.0000. Each value must be separated from the next by a space. Blank rows and comment rows can be added to the external NGV

data file prior to the data blocks or between data blocks, but not inside the individual data blocks.

Example:   NGV FRACTION       : ngvfr.d

This example directs MOBILE6 to look up NGV fractions in an external file called "ngvfr.d." A sample file will be distributed with MOBILE6.

Tips:      Note that although the command name uses the word fraction, the input values must be percentages.

The percentage of NGVs in the fleet is very small. MOBILE6 provides this option for special cases in which it is necessary to model the effects of NGVs on a small percentage of the fleet, or to generate the basic NGV emission factors by entering 100 percent penetration.

## 2.8.8   Activity Commands

Activity commands allow users to allocate vehicle travel by time of day, day of week, type of road, speed, and other factors affecting emissions.

### 2.8.8.1        Fractions of Vehicle Miles Traveled  (VMT)

Name:      VMT FRACTIONS

Status:    Optional

Section:   Run or Scenario

Description:  This command and the three that follow, along with the mileage accumulation rate option, allow users to supply vehicle travel data that is specific to the geographical location they wish to model. The VMT FRACTIONS command allows users to allocate VMT to specific vehicle types. The VMT fractions are used to weight together the emissions of the various vehicle types into the average emissions of the "All Veh" category in the output.

Default:   MOBILE6 calculates a default VMT mileage distribution from national average data and/or user-supplied information, specifically:

1.  The calendar year of evaluation.
2.  Default vehicle population data for the 16 (See Table 1, Appendix B) composite vehicle classes.

    3.  Default or user-supplied vehicle registration by age distribution data.

    4.  Default or user-supplied diesel fractions.

    5.  Default, or user-supplied mileage accumulation data.

The default data for items 2-5 are described in technical report M6.FLT.007. Note that MOBILE6 users are not allowed to change data item 2 as such; this command is provided instead. Note also that the total vehicle population, per se, is not significant in MOBILE6 since all emission results are expressed on a per vehicle basis. Therefore, only the fraction of vehicles of each age actually affects the results.

Explanation:    The VMT mix specifies the fraction of total highway VMT that is accumulated by each of the 16 composite vehicle types.

Each VMT mix supplied as input must consist of a set of 16 fractional values, representing the fraction of total highway VMT accumulated by each of 16 combined vehicle types. All values must be between zero and one, and the 16 values must sum to 1.0. MOBILE6 produces an error message and does not execute the run if these constraints are not met.

This command requires a free column format consisting of 16 fractions (values from 0.000 to 1.000) with one or more spaces between fractions. The 16 values represent the distribution of all vehicle miles traveled (VMT) by each of 16 vehicle classes.

The order in which the numbers are presented is critical. The values must be entered in the order presented in Table 1, APPENDIX B.

This command must appear in the scenario section if different VMT mixes are to be applied to each scenario, but can appear in the run section if the same VMT mix is to be applied to all scenarios.

Example:    
```
VMT FRACTIONS         :
0.354 0.089 0.297 0.092 0.041 0.040 0.004 0.003
0.002 0.008 0.010 0.012 0.040 0.002 0.001 0.005
```

This example shows the command name plus two lines of data providing VMT fractions for the 16 vehicle categories. Another example is contained in the file VMTMIX.DEF.

Tips:    This command specifies fleet as well as activity information.

**2.8.8.2          VMT by Facility**

2.8.8.2.a
Name:            VMT BY FACILITY

Status:          Optional

Section:         Run or Scenario

Description:     This command allows users to allocate VMT to various roadway or facility types.

Default:         MOBILE6 uses national estimates of the distribution of VMT by facility type.
                 Technical report M6.SPD.03 provides an explanation of methodology.

Explanation:     The command VMT BY FACILITY allows users to enter VMT distributions
                 across four roadway types for each of the 24 hours of the day. This data must be
                 entered in an external data file, which contains the command name, VMT BY
                 FACILITY, in the first column of the first row. Following the command name, the
                 user must enter the 96 VMT fractions representing the fraction of travel on each
                 roadway type at each hour of the day.

                 The VMT fractions must be entered as 24 values for each successive hour of the
                 day starting with 6 AM (See Table 4, Appendix B). There must be four sets of 24
                 values corresponding to the four facility types. The sets of 24 values must be
                 entered in the following order: freeway, arterial, local, and ramp.

                 Within the external file, the input may appear in free column format but at least
                 one space must separate each numerical value. The distributions for each hour
                 must add up to one. If they do not, MOBILE6 will automatically normalize them.

Example:         VMT BY FACILITY       : FVMT.def

                 This example directs MOBILE6 to call an external file called "FVMT.def" which
                 contains the VMT distributions by facility. A sample file by this name will be
                 distributed with MOBILE6.

Tips:            The name used for this command and the two that follow could lead to a
                 misinterpretation of their function. The command VMT BY FACILITY is the
                 distribution of VMT by facility type. It is calculated at each of the 24 hours of the
                 day.  The user cannot use the data in this command alone to calculate the daily
                 distribution of VMT by facility type. Nor can the data be used in this command
                 alone to calculate the hourly distribution of VMT.

The data in this command and the "VMT BY HOUR" command can be combined (by multiplication) to obtain the distribution of VMT over both the 24 hours of the day and over each facility type.

2.8.8.2.b

Name:          VMT BY HOUR

Status:        Optional

Section:       Run or Scenario

Description:   This command allows users to allocate the fraction of VMT that occurs at each hour of the day.

Default:       MOBILE6 uses national data for the default distribution of VMT by facility type, as described in technical report M6.SPD.003.

Explanation:   This command permits the user to allocate total VMT among the 24 hours of each day. The values for the command are independent of facility type, that is, the VMT fraction covers all facility types.

Format for this command calls for use of an external file, which contains the command name VMT BY HOUR as its first entry, starting in the first column of the first row. This must be followed by the 24 VMT fractions for each of the 24 hours of the day. At least one space must separate each numerical value.

The 24 values must add up to one. If they do not, MOBILE6  will automatically normalize them.

Example:       `VMT BY HOUR          : HVMT.def`

Where the external file "HVMT.def" has as its first entry: VMT BY HOUR. A sample file by this name will be distributed with MOBILE6.

2.8.8.2.c

Name:          SPEED VMT

Status:        Optional

Section:       Run or Scenario

Description:    This command allows users to allocate VMT by speed.

Default:        MOBILE6 uses national fleet data for the default distribution of VMT by speed for two facility types, as described in technical report M6.SPD.003.

Explanation:    The command SPEED VMT permits the user to enter the VMT distribution over preselected speed ranges. MOBILE6 calculates these distributions for each of the 24 hours of the day and for the two facility cycles that allow speed to vary (producing 48 separate distributions, each containing 14 fractions). The data in this array are not sufficient to estimate either hourly VMT distribution or the VMT distributions by facility type.

This command requires use of an external data file which must contain the following information in a multi-line record:

- ▸    The first line contains the command name ("SPEED VMT").
- ▸    Each of the next 48 lines contain:

   --    first, an integer for facility type, where "1"=Arterial and "2"=Freeway
   --    second, an integer for hour of the day (1 through 24), with 6 am = "1"
   --    the next fourteen numbers represent VMT fractions at each of 14 speeds.

The fourteen speed fractions (0.0000 through 1.0000) must add up to one. The pre-set speeds are idle and speeds ranging from 5 mph to 65 mph in 5 mph increments.

This pattern must be repeated for each combination of roadway type (Arterial and Freeway) and time of day to create the 48 lines. Distributions must be entered for all facility types and hours.

Example:        `SPEED VMT            : SVMT.def`

This example references data stored in the external file "SVMT.def" which has the command name SPEED VMT as its first entry, followed by the 48 VMT distributions (one for each combination of the two facility cycles and each of the 24 hours of the day). The file will be distributed with MOBILE6.

**2.8.8.3        Starts Per Day**

Name:           STARTS PER DAY

Status:         Optional

Section:        Run

Description:    This command allows users to specify the average number of engine starts (trips) per vehicle per day for a given modeling exercise.

Default:        MOBILE6 assigns each of the 28 individual vehicle classes a separate default for number of engine starts per day. The defaults differ for weekdays and weekends. Please see technical report M6.FLT.003 for the value of the defaults.

Explanation:    MOBILE6 separates exhaust emissions into two components, those that occur when the vehicle is first started, and those that occur while the vehicle is running. The number of engine starts in a given day is essentially the same as the number of trips the vehicle takes per day. Start emissions are independent of VMT.

There is a separate estimate for the number of engine starts per day for each of the 28 individual vehicle classes for weekdays and weekend. This requires users to supply 56 values to replace the default values in MOBILE6. Each value represents the average number of trips vehicles of each vehicle class take in a 24 hour day. MOBILE6 assumes that, within each vehicle class, vehicles of all ages take the same number of trips per day. Since the value is an average, it may be other than a whole number and may be less than one.

The values for this command must be entered in an external data file. The first entry in the external file must be the command name, "STARTS PER DAY," placed in the first column of the first row of the file. This entry is followed by the 56 values described above.

The order in which the numbers appear is critical. The first 28 values must be the weekday starts per day for each of the 28 individual vehicle classes. The second 28 values represent the weekend starts per day for each of the vehicle classes. In both cases, the values for vehicle classes must be entered in the order provided in Table 3, APPENDIX B.

As long as the user enters the values in the required order, and each value is separated by a delimiter character such as a blank space, any format may be used. For example, the user may enter all 56 values on one line, divide them into two lines of 28, etc.

Example:        STARTS PER DAY        : FTP_SPD.D

                Where the external data file "FTP_SPD.D" contains the following records:

                STARTS PER DAY
                 1.0   1.0   1.0   1.0   1.0   1.0   1.0
                 1.0   1.0   1.0   1.0   1.0   1.0   1.0
                 1.0   1.0   1.0   1.0   1.0   1.0   1.0
                 1.0   1.0   1.0   1.0   1.0   1.0   1.0
                 2.0   2.0   2.0   2.0   2.0   2.0   2.0
                 2.0   2.0   2.0   2.0   2.0   2.0   2.0
                 2.0   2.0   2.0   2.0   2.0   2.0   2.0
                 2.0   2.0   2.0   2.0   2.0   2.0   2.0

                In this example the number of engine starts per day for each vehicle class is set to
                1.0 for weekdays and 2.0 for weekends.

Tips:           It is generally best to enter values with logical groupings and spacings that in this
                case, for example, would distinguish weekday from weekend values.

**2.8.8.4        Distribution of Vehicle Starts During the Day**

Name:           START DIST

Status:         Optional

Section:        Run

Description:    This command allows users to allocate engine starts by hour of the day.

Default:        Default values are explained in technical report M6.FLT.003.

Explanation:    The START DIST command allows users to change the default values for the
                hourly distribution of engine starts (trips) across the day. Users must supply 48
                values to replace the MOBILE6 defaults. Each value represents the average
                fraction of all engine starts that occur in each hour of a 24 hour day, for both
                weekdays and weekends. All values must be less than or equal to 1 and greater
                than or equal to zero. The sum of all of the 24 values for a day must equal one. If
                they do not, MOBILE6 will normalize the values to one without issuing a
                warning.

                The values for this command must be entered in an external data file. The first

entry in the external file must be the command name, START DIST, placed in the first column of the first row of the file. This entry is followed by the 48 values described above.

The order in which the 48 values appear is critical. The first 24 values must be the temporal distribution for a <u>weekday</u>. The second 24 values represent the <u>weekend</u>. The data for the 24 hour periods must be entered in the order presented in Table 4, APPENDIX B.

As long as the user enters the values in the required order, and separated by a delimiter character such as a blank space, any format may be used. For example, the user may enter all 48 values on one line, divide them into two lines of 24, etc.

Example:       START DIST        : SDIST.D

Where the external data file "SDIST.D" contains the following records:

```
START DIST
0.020 0.055 0.060 0.047 0.052 0.067 0.081 0.073
0.080 0.090 0.084 0.077 0.060 0.014 0.014 0.014
0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014
0.010 0.019 0.031 0.065 0.069 0.080 0.102 0.073
0.089 0.074 0.080 0.071 0.061 0.016 0.016 0.016
0.016 0.016 0.016 0.016 0.016 0.016 0.016 0.016
```

In this example the first 24 values (for a weekday) are contained in the first three lines, followed by the weekend values in the second three lines. This entry would direct MOBILE6 to allocate 2% of weekday starts to the time period between 6 am and 6:59 am, and 1% of weekend starts to the same time period.

Tips:       As with the other external data files, users may enter comment lines (i.e., lines beginning with an asterisk "*") between the header line and the block of data. However, with this command, users should not enter comment line(s) within the numerical data.

**2.8.8.5       Soak Distribution**

Name:       SOAK DISTRIBUTION

Status:       Optional

Section:       Scenario

Description:   This command allows users to enter vehicle soak duration distributions that override MOBILE6 defaults. The soak time affects exhaust start and exhaust running emissions.

Default:   Default information is provided in technical reports M6.FLT.003 and M6.FLT.004.

Explanation:   An engine is considered to be "soaking" if its engine is not running. Soak time is the length of time between when an engine is turned off and the next time it is started. MOBILE6 uses soak time data to determine, for each hour of the day, the percentage of vehicles that have been soaking a given amount of time prior to an engine start. This in turn affects start emissions, which depend on length of soak time.  The same soak time distributions are applied to all vehicle classes and all vehicle ages.

The command SOAK DISTRIBUTION requires the user to enter values for each of 70 soak durations for each of the 24 hours of the day for week and weekend days (3,360 values). The 70 soak duration values correspond to specific soak length intervals as defined in the table below. The 70 values for each hour must sum to one. This information must be located in an external data file.

The external data file must index the 24 hours first and then the 70 soak times. That is, the first 24 values are the soak time distribution values for only the first soak time interval. The second set of 24 values are for the second soak time interval, and onward until all 70 sets of 24 soak time intervals have been included. The first of each set of 24 values is for the first hour (6 AM to 6:59 AM)  through hour 24 (5 AM to 5:59 AM). The soak time intervals are:

| Interval | Description |
|----------|-------------|
| 1 | Greater than .01 minutes to 1.0 minutes |
| 2  to 30 | Greater than N-1 minutes to N minutes, *where N is any minute between* 2 and 30 |
| 31 to 45 | Greater than 2N-32 minutes to 2N-30 minutes, *ditto* 31-45 |
| 46 to 67 | Greater than 30N-1320 minutes to 30n-1290 minutes, *ditto* 46-67 |
| 68 | Greater than 720 minutes |
| 69 | Greater than zero minutes to .01 minutes (Restarts) |
| 70 | Zero Minutes (stalls) (Not used) |

Once the weekday values have been entered, the weekend day values must be entered using the same format as for the weekday values.

The data values themselves are read from an external file in free column format.

The fractions may occur in one or many records and can occur in any column of the file, as long as each value is separated from other values by a space. For example, the 3,360 values could be entered all on one line, on 140 lines (with 24 values each line) or on 240 lines (with twelve values on each line).

Example:      SOAK DISTRIBUTION   :  SOAKDST.D

Where the external file "SOAKDST.D" has the command name as its first entry

```
SOAK DISTRIBUTION
 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.57
 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0
 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0
 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0
 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0
 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0
 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.43 24*0.0 24*0.0
 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0,0 24*0.57
 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0
 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0
 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0
 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0
 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0
 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.0 24*0.43 24*0.0 24*0.0
```

In this example the distribution of soak times is the same on the weekend as on weekdays and it is the same for every hour of the day. In the example, 57% of the soak times are between 9 and 10 minutes long and 43% are greater than 720 minutes (12 hours). Each of the 48 sets of 70 values sum to one.

## 2.8.8.6      Hot Soak Activity

Name:        HOT SOAK ACTIVITY

Status:       Optional

Section:      Scenario

Description:  This command allows users to specify a hot soak duration distribution for each of 14 daily time periods.

Default:      Please see technical reports M6.FLT.003 and M6.FLT.004 for further information. Sample files containing default values will be distributed with MOBILE6.

HSACTDAY.D:      weekday rates
HSACTEND.D:      weekend rates

Explanation:   Hot soak emissions occur when fuel vapors escape from a hot vehicle that has just been turned off. The emissions are highest immediately after engine shut down and decrease over time, reaching a baseline level in about an hour. Hot soak emissions are truncated if the engine is turned on again before the baseline has been reached (before an hour has elapsed). MOBILE6 assumes that hot soak durations range from one minute at minium to a maximum of 60 minutes.

The hot soak time distributions reflect the number of vehicles experiencing a hot soak of a given duration (1 to 60 minutes) at each hour of the day. MOBILE6 divides the day into 14 time periods, one for each hour between 6 AM and 7 PM, plus one for the hours from 7 PM through 5 AM the next day. MOBILE6 computes hot soak emissions for each minute of each hour, and weights these emissions by the fraction of vehicles experiencing a hot soak at that time. If this command is used, 840 values must be entered representing the fraction of vehicles experiencing a hot soak of each duration (60) at each time period of the day (14).

This command requires use of an external data file. Format for the command is as follows:

The command name HOT SOAK ACTIVITY is followed by the name of the external file containing the user-supplied hot soak activity values. Each value is a fraction between 0 and 1 and the values must sum to one for each time period. The values must be arranged in columns of 60 fractions, with one column for each time period starting with 6 AM. The rows represent the time periods from 1 to 60 minutes.

Example:       `HOT SOAK ACTIVITY   : HSACT.D`

This example directs MOBILE6 to look for alternate hot soak activity data in an external file called "HSACT.D." Within the file, the first line would be the command name. The second line would be 14 values representing the fraction of vehicles experiencing a 1 minute hot soak at each time period of the day. The second line would contain values for a 2 minute hot soak, and so on. Examples of properly formatted input can be found in the files:

HSACTDAY.D:       Default MOBILE6 weekday rates.
HSACTEND.D:       Default MOBILE6 weekend rates.

## 2.8.8.7       Diurnal Soak Activity

Name:       DIURN SOAK ACTIVITY

Status:         Optional

Section:        Scenario

Description:    This command allows users to specify a diurnal soak time distribution for each of 18 daily time periods.

Default:        Please see technical report M6.FLT.006

Explanation:    Diurnal emissions vary with the length of time a vehicle has been soaking (that is, the length of time it has been parked). The diurnal ends with the start of a new trip. MOBILE6 assumes that diurnal soak times range from one hour at a minimum to a maximum of 72 hours.

Diurnal soak time distributions reflect the fraction of vehicles experiencing a diurnal of a given duration (MOBILE6 considers 72 soak durations) at each hour of the day. MOBILE6 divides the day into 18 time periods, one for each hour between 6 AM and 11 PM, and one from 11 PM until 5 AM the next day. For each hour of the day, MOBILE6 computes emissions separately for the 72 different soak durations, and weights them by the fraction of vehicles experiencing a diurnal of that duration. If the user chooses this command, 1,296 values must be entered representing the fraction of vehicles experiencing a diurnal of each duration (72) at each time period of the day (18).

This command requires use of an external data file. Format for the command is as follows:

The command name ("DIURN SOAK ACTIVITY") is followed by the name of an external data file containing the alternate diurnal activity values. The values must be arranged in columns, with one column for each time period starting with 6 AM. Each column contains 72 rows. The values must fall between 0 and 1. Note that the sum of each hourly column does not need to sum to one. The rows represent the 72 MOBILE6 diurnal soak durations.

Example:        DIURN SOAK ACTIVITY      : DSACT.D

This example directs MOBILE6 to look for user-supplied diurnal distribution data in an external file called "DSACT.D." Within the file, the first line would be the command name. The second line contain 18 values representing the fraction of vehicles experiencing the first diurnal soak duration at each time period of the day. The second line would contain values for the second soak duration, and so on. Examples of properly formatted input can be found in the files:

DSACT.D: MOBILE6 defaults

### 2.8.8.8          **Weekday Trip Length Distribution**

Name:           WE DA TRI LEN DI
Status:         Optional

Section:        Run or Scenario

Description:    This command allows users to specify the fraction of  weekday VMT that occurs
                during trips of various durations at each hour of the day.

Default:        Please see the example file below. These values are based on national data.

Explanation:    The duration of a vehicle trip affects running loss evaporative emissions, which
                depend on the amount of time the vehicle has been running. This command is
                used to change the default values for the distributions of VMT by trip duration (in
                time) for week days. MOBILE6 uses these distributions to calculate running loss
                emissions. There is a separate distribution of VMT by trip duration for each hour
                of the day.

                If the user chooses to use this command, percentages must be entered for six trip
                length ranges and 14 hourly groups, resulting in a total of 84 values. The trip
                length ranges are 10 minutes or less; 11-20 minutes; 21-30 minutes; 31-40
                minutes; 41-50 minutes; 51 or more minutes. The percent of VMT in each of
                these six trip length ranges is required for each hour of the day from 6 AM
                through 7 PM, plus an average distribution for the 11-hour block from 7 PM
                through 6 AM.

                This command requires fixed column format data entry. Data must be entered in a
                precise order and location in the external data file. The required format is as
                follows:

                ▸       The first line consists of the command name.

                ▸       The second line consists of the percent of VMT for hour #1 (6-7am) for
                        each of the six trip length ranges in order of increasing trip length. The six
                        individual percentages vary from 0.00 through 100.0 inclusive with their
                        sum totaling 100.0.

                ▸       The next twelve lines provide the corresponding information for hours #2

(7-8am) through #13 (6-7 PM).

▸      The next (last) line provides the corresponding information for the 11-hour block of time from 7 PM through 6 AM.

Each data line contains six blocks of numbers, where the first character of each block is left blank and the remaining five characters are read as the value for that block. In FORTRAN code this is represented as 6(1X,F5.2). Each value must contain a decimal. Each row must sum to one hundred.

Example:       WE DA TRI LEN DI    : WEDATRIP.D

Where data is supplied in an external file, "WEDATRIP.D" formatted as follows:

```
WE DA TRI LEN DI
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
```

This sample shows the default values used by MOBILE6 for the distributions of trip lengths for weekdays.

Tips:          This command uses a highly specialized definition of "trip." For more information, please refer to the MOBILE6 document "Trip Length Activity Factors for Running Loss and Exhaust Running Emissions" (document number M6.FLT.005). If the user plans to change the VMT by trip length, this specialized definition of trip length must be used in determination of the VMT distributions.

## 2.8.8.9          Weekend Trip Length Distribution

Name:          WE EN TRI LEN DI

Status:          Optional

Section:         Run or Scenario

Description:     This command allows users to specify the fraction of weekend VMT that occurs
                 during trips of various durations at each hour of the day.

Default:         Please see the example file below. These values are based on national data.

Explanation:     The duration of a vehicle trip affects running loss evaporative emissions, which
                 depend on the amount of time the vehicle has been running. This command is
                 used to change the default values for the distributions of VMT by trip duration for
                 week days. MOBILE6 uses these distributions to calculate running loss emissions.
                 There is a separate distribution of VMT by trip duration for each hour of the day.

                 If the user elects to use this command, percentages must be entered for six trip
                 length ranges and 14 hourly groups, resulting in a total of 84 values. The trip
                 length ranges are 10 minutes or less; 11-20 minutes; 21-30 minutes; 31-40
                 minutes; 41-50 minutes; 51 or more minutes. The percent of VMT in each of
                 these six ranges is required for each hour of the day from 6 AM through 7 PM,
                 plus an average distribution for the 11-hour block from 7 PM through 6 AM.

                 This command requires fixed column format data entry. Data must be entered in a
                 precise order and location in the external data file. The required format is as
                 follows:

                 ▸        The first line consists of the command name.

                 ▸        The second line consists of the percent of VMT for hour #1 (6-7 AM) for
                          each of the six trip length groups in order of increasing trip length. The six
                          individual percentages vary from 0.00 through 100.0 inclusive with their
                          sum totaling 100.0.

                 ▸        The next twelve lines provide the corresponding information for hours #2
                          (7-8 AM) through #13 (6-7 PM).

                 ▸        The next (last) line provides the corresponding information for the 11-hour
                          block of time from 7 PM through 6 AM.

                 Each data line contains six blocks of numbers, where the first character of each
                 block is left blank and the remaining five characters are read as the value for that
                 block. In FORTRAN code this is represented as  6(1X,F5.2). Each value must

contain a decimal, and each row must sum to one hundred.

Example:      WE EN TRI LEN DI    : WEENTRIP.D

Where data is supplied in an external file, "WEENTRIP.D" formatted as follows:

```
WE EN TRI LEN DI
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
 06.74 18.51 16.78 13.11 08.33 36.53
```

This sample shows the default values used by MOBILE6 for the distributions of trip lengths for weekend days.

Tips:        The MOBILE6 default case uses only weekday activity data. If the user wishes to use the weekend activity values, the "use weekend vehicle activity" (WE VEH US) command must be executed.

The WE EN TRI LEN DI command uses a highly specialized definition of "trip." For more information, please refer to the MOBILE6 document "Trip Length Activity Factors for Running Loss and Exhaust Running Emissions" (document number M6.FLT.005). If the user plans to change the VMT by trip length, this specialized definition of trip length must be used in determination of the VMT distributions.

## 2.8.8.10        Use Weekend Vehicle Activity

Name:        WE VEH US

Status:       Optional

Section:      Scenario

Description:  This command directs MOBILE6 to apply weekend activity information in calculating emissions that depend on vehicle usage rates.

Default:  MOBILE6 applies weekday activity information to calculations.

Explanation:  MOBILE6 activity values for vehicle usage affect engine start emissions (affected by starts per day distributions), hot soak evaporative emissions (affected by hot soak duration distributions), and running loss evaporative emissions (affected by trip length distributions).  This command directs MOBILE6 to use weekend-specific activity values.

The only requirement for this command is the command name. There is no data input required.

Example:        WE VEH US              :

### 2.8.9   <u>State Programs</u>

State program commands allow users to model the impact of state-specific emission control programs such as Inspection and Maintenance.

### 2.8.9.1        **Effects of Fuel Program on Emissions**

Name:  FUEL PROGRAM

NOTE:  This command is cross-listed below under commands covering fuels. Please see section 2.8.10.1 for detailed information

### 2.8.9.2        **Effects of Stage II on Refueling Emissions**

Name:  STAGE II REFUELING

Status:  Optional

Section:  Run

Description:  This command allows users to model the impact of a Stage II ("at-the-pump") vapor recovery system requirement on refueling emissions (also referred to as Stage II emissions) from gasoline-fueled vehicles.

Default:  If the user does not use this command, then MOBILE6 does <u>not</u> calculate impact of a Stage II program.

Explanation:   Stage II systems reduce hydrocarbon emissions by reducing the amount of gasoline vapor that escapes to the atmosphere during refueling. The amount of reduction depends on whether an onboard recovery system is on the vehicle and the level of uncontrolled emissions. The uncontrolled emissions are calculated in MOBILE6 from inputs such as fuel RVP, fuel economy, and various fuel temperature parameters.

This command requires fixed column format data entry. The FORTRAN format is I2,1X,I1,2(1X,F3.0). The first line must contain the command name STAGE II REFUELING. The second line contains the following four items:

▸   The first number supplies the last two digits of the calendar year in which the Stage II program began or will begin. The eligible calendar years are 1989 through 2050, inclusive. Therefore, this variable may be any two-digit integer except 51 through 88.

▸   The second number is a one-digit integer for the number of phase-in years of the program. This value can range from 1 through 9, inclusive.

▸   The third number is a three-digit integer for the percent efficiency for the LDGV/Ts in the program. This value can range from 0 through 100.

▸   The fourth number is a three-digit integer for the percent efficiency for the HDGVs in the program. This value can range from 0 through 100.

Example:      ```
STAGE II REFUELING :
89 4 80. 60.
```

This example would model a Stage II program that started in 1989, was phased in over four years, and was 80% efficient for LDGV/Ts and 60% efficient for HDGVs.

### 2.8.9.3          Anti-Tampering Programs

Name:         ANTI-TAMP PROG

Status:       Optional

Section:      Run

Description:  This command allows users to model the impact of an anti-tampering program (ATP) and should only be used if the area being modeled has or expects to have

such a program.

Default:          MOBILE6 assumes there is no anti-tampering program present.

Explanation:   Some parts of the United States have implemented anti-tampering programs to
reduce the frequency and emissions impact of emission control system tampering,
such as misfueling, removal, or disablement of catalytic converters. This
command allows users to include the effects of such a program on calculated
emission factors.

Selecting this command requires providing some basic information about the anti-
tampering program to be modeled. The required information includes the calendar
year that the program began (start year), the earliest model year which is covered
by the program, the latest model year covered by the program, on/off toggle values
that determine if a particular vehicle class is included in the program, the
frequency of inspection, the compliance rate for the anti-tampering program, and
on/off toggle values that determine which vehicle components are to be inspected.

This command requires <u>fixed column format</u> data entry. Any columns not
mentioned must be left blank. The FORTRAN type format that must be observed
is:

> 3(I2,1X),5I1,1X,8I1,1X,I1,1X,2I1,1X,F4.0,1X,8I1)

In the first line, the command name must start in column one. The second line
contains the program parameters:

> ▸       The first number is the last two digits of the calendar year in which the
>         anti-tampering program began or will begin. The calendar year input can
>         range from (19)60 to (20)50.

> ▸       The second number is the earliest model year to be covered by the
>         program. This input is the last two digits of the model year. The model
>         year range can be from (19)60 to (20)50.

> ▸       The third number is the last two digits of the final model year covered by
>         the program. The model year range can be from (19)60 to (20)50.

Following these first three numbers, there are fourteen individual vehicle ATP
program coverage toggle fields that contain either a value of 1 or 2. A value of 1
indicates that the particular vehicle type is NOT subject to an ATP inspection, and
a 2 indicates that the particular vehicle type is subject to the inspection.

▸          The first five ATP program coverage toggle fields correspond to the light-duty gasoline vehicle classes. These five values for ATP vehicle coverage must be given in the following order:

         LDGV, LDGT1, LDGT2, LDGT3, LDGT4.

▸          The next eight vehicle ATP program coverage toggle fields correspond to the eight heavy-duty gasoline vehicle classes. The order of these values is:

         HDGV2B, HDGV3, HDGV4, HDGV5, HDGV6, HDGV7, HDGV8A, HDGV8B

▸          The final vehicle ATP coverage toggle field corresponds to the gasoline buses.

         GAS BUS

▸          The next entry must be the number '1'.

▸          The next data parameter is the ATP inspection program frequency. A value must be either '1' (annual frequency) or '2' (biennial - every other year frequency).

▸          The next data parameter is the program compliance rate. This value must be from 0 to 100 percent inclusive.

▸          The last eight data parameters are the toggles indicating which inspections the anti-tampering program will conduct. The value must be either 1 (no) or 2 (yes). The values correspond to component  inspections in the following order.

▸          Air pump system disablement
▸          Catalyst removal
▸          Fuel inlet restrictor disablement (requiring catalyst replacement)

▸          Tailpipe lead deposit test (requiring catalyst replacement)
▸          EGR disablement
▸          Evaporative system disablement
▸          PCV system disablement
▸          Missing gas cap

Example:     ANTI-TAMP PROG    :
             83 75 50 22222 22222222 2 11 096. 22222222

This example models an ATP that starts in 1983, covers 1975 through 2050 model years, inspects all 14 gasoline vehicle types, has an annual frequency, a compliance rate 96.0 percent and does all of the anti-tampering inspection types.

Tips:       The mere presence of an I/M program is expected to act as a deterrent to tampering. Therefore, if the "IM PROGRAM" command is present, MOBILE6 will alter the tampering rates even if there is no anti-tampering program.

            All 1996 and newer model year vehicles are assumed to have negligible tampering effects. As a result, there is no tampering reduction benefit associated with the 1996 and newer vehicles

### 2.8.9.4        Inspection/Maintenance (I/M) Programs

Many areas of the country have implemented inspection and maintenance (I/M) programs as a means of further reducing mobile source air pollution. MOBILE6 has the capability of modeling the impact of up to seven different exhaust and evaporative emission I/M programs on calculated emission factors.

MOBILE6 also allows users to enter in a number of I/M program parameters to better model specific I/M program features. These parameters include:

- ▸ Ability to model Annual or Biennial I/M programs.
- ▸ Ability to model Idle, 2500/Idle, ASM, IM240 and OBD exhaust I/M programs.
- ▸ Ability to model Gas Cap (GC), Fill-pipe Pressure Test (FP) and OBD check evaporative I/M programs.
- ▸ Ability to control model year coverage.
- ▸ Ability to control vehicle class coverage (only gasoline-fueled vehicles can be modeled for I/M).
- ▸ Ability to vary the failure rate of the exhaust I/M program for pre-1981 model year vehicles.
- ▸ Ability to vary the compliance rate of the I/M program.
- ▸ Ability to vary the waiver rate of the I/M program.
- ▸ Ability to vary the cutpoints used in an IM240 program.
- ▸ Ability to account for the effect of exempting old vehicles from program requirements.
- ▸ Ability to account for the effect of exempting new vehicles from program requirements (referred to here as a "grace period").
- ▸ Ability to eliminate the effects of technician training on exhaust I/M performance.
- ▸ Ability to assemble all of the I/M program parameters into a single external input file.

MOBILE6 provides 12 separate commands that allow users to specify I/M features. The commands are listed and described below. The list begins with the required I/M commands (these are required if the user wants to model any I/M program), and finishes with the lesser used I/M commands.

List of I/M Commands

| | |
|---|---|
| I/M PROGRAM | Required to model Exhaust and Evaporative I/M Programs |
| I/M MODEL YEARS | Required for Exhaust and Evaporative I/M Programs |
| I/M VEHICLES | Required for Exhaust and Evaporative I/M Programs |
| I/M STRINGENCY | Required for Exhaust I/M programs. Not applicable for evaporative programs. |
| I/M COMPLIANCE | Required for Exhaust I/M programs. Optional for Evaporative I/M programs. |
| I/M WAIVER RATES | Required for Exhaust I/M programs. Optional for Evaporative I/M programs. |
| I/M CUTPOINTS | Optional for Exhaust  I/M programs. Not applicable for evaporative programs. |
| I/M EXEMPTION AGE | Optional for both exhaust and evaporative I/M programs. |
| I/M GRACE PERIOD | Optional for both exhaust and evaporative I/M programs. |
| NO I/M TTC CREDITS | Optional for Exhaust I/M programs.  Not applicable for evaporative programs. |
| I/M EFFECTIVENESS | Optional for Exhaust I/M programs.  Not applicable for evaporative programs. |
| I/M DESCRIPT FILE | Optional for both exhaust and evaporative I/M programs. |

Note:        In general, if a parameter is input for an exhaust program, the user-input value will replace the MOBILE6 default value for any simultaneous evaporative programs on the same model year vehicle. The opposite is <u>not</u> true. However, explicitly providing values for an evaporative I/M program will override both the default and the exhaust values for the evaporative I/M calculations.

2.8.9.4.a
Name:        I/M PROGRAM

Status:        Optional   (required <u>if</u> the user is modeling exhaust or evaporative I/M)

Section:        Run

Description:    This command directs MOBILE6 to model an I/M program and defines some

basic information about the program to be modeled.

Default:         MOBILE6 assumes no I/M program is in place.

Explanation:   If the user wishes to model an I/M program, this command must be executed. This is where the user defines basic information such as the type of I/M program in place, the calendar year that the I/M program began (start year), the final calendar year that the I/M program is to run, and the program inspection frequency.

The format requirement for this command is free column format.

▸        The command name, I/M program, must appear first.

▸        The  first data parameter is the I/M program number. This equals "1" to identify the first program the user is modeling, "2" to identify the second, etc. The valid range of numbers for this input is from 1 to 7, and any series of values must be sequential (i.e., there must be a program 1 before there is a program 2).

▸        The second and third data parameters in the I/M PROGRAM command are the I/M program start year and the I/M program end year. Both of these parameters can range from calendar year 1960 through calendar year 2051. All four digits are required, and the I/M program start year must precede or at least equal the I/M program end year.

▸        The fourth data parameter in the I/M PROGRAM command is the I/M frequency parameter. A value of 1 is entered if the user desires an annual program, a value of 2 is entered if the user desires a biennial program (vehicles are inspected every other year).

▸        The fifth data parameter in the I/M PROGRAM command is the I/M program type. An entry is required, but has no effect on the exhaust I/M program benefits unless the I/M EFFECTIVENESS command is used. This entry is required for evaporative I/M programs as well, but has no effect on evaporative emissions, even with the I/M EFFECTIVENESS command. The possible entries are:

TRC    for a "Test and Repair (computerized)" program.
TRM    for a "Test and Repair (manual)" program.
T/O     for a "Test Only" program.

▸        The sixth and final data parameter in the I/M PROGRAM command is the I/M inspection test type. This is an alphanumeric input with the following choices for an exhaust I/M program.

IDLE
2500/IDLE
IM240
ASM 2525 PHASE-IN
ASM 2525 FINAL
ASM 5015 PHASE-IN
ASM 5015 FINAL
ASM 2525/5015 PHASE-IN
ASM 2525/5015 FINAL
OBD I/M

And, the following choices are for an evaporative I/M program:

EVAP OBD
EVAP OBD & GC
FP & GC
GC

Example:    I/M PROGRAM        : 1 1981 2050 2 T/O IM240

This example means that I/M program number one begins in calendar year 1981 and ends in calendar year 2050. It is a biennial IM240 program. The T/O stands for "test only" and is a required input, but has no effect on the results.

Tip:        To model both the exhaust and evaporative benefits of an I/M program, the user must enter (at least) two separate I/M Programs. For example, to model the exhaust and evaporative benefits of an OBD check program, the user must set up two simultaneous I/M programs. One for "EVAP OBD" (for evaporative benefits) and one for "OBD I/M" (for exhaust benefits).

2.8.9.4.b
Name:              I/M MODEL YEARS

Status:      Optional (required if the user is modeling exhaust or evaporative I/M)

Section:     Run

Description:  This command allows the user to provide the first and last model years which are

to be covered by the I/M program to be modeled.

Default:        There is no default for this command. It is a required input if the user wishes to model an I/M program. If the I/M PROGRAM command is present and this command is not, MOBILE6 will issue an error message and the run will be aborted.

Explanation:    The format requirement for this command is free column format.

The command name, I/M program, must appear first.

> ◂        The  first data parameter is the I/M program number used for the corresponding I/M PROGRAM command. The valid range of numbers for this input is from 1 to 7, and any series of values must be sequential (i.e., there must be a program 1 before there is a program 2).

> ◂        The second and third data parameters are the first model year that is covered by an I/M program and the last model year that is covered by an I/M program. Both of these parameters can range from model year 1941 through model year 2050. All four digits are required, and the first model year coverage value must precede or equal the last model year of coverage.

Example:        `I/M MODEL YEARS    : 1 1996 2050`

This example means that I/M program number one tests model years 1996 through 2050.

Tips:           The user <u>cannot</u> enter a traditional exhaust I/M program (i.e., IDLE, IDLE/2500, ASM, or IM240) using the I/M PROGRAM command and have model year coverage greater than 1995 in the I/M MODEL YEARS command. If this is done, the program will stop and issue the user an error message.

Similarly, the user <u>cannot</u> enter an OBD exhaust or evaporative I/M program and have model year coverage less than the 1996 model year. If this is done, the program will stop and issue the user an error message.

2.8.9.4.c
Name:           I/M VEHICLES

Status:         Optional (required <u>if</u> the user is modeling exhaust or evaporative I/M)

Section:        Run

Description:     This command identifies which vehicle types are subject to the specified I/M program.

Default:         There is no default for this command. It is a required input if the user wishes to model an I/M program. If the I/M PROGRAM command is present and this command is not, MOBILE6 will issue an error message and the run will be aborted.

Explanation:     This command allows users to specify which of the fourteen individual vehicle types potentially subject to I/M are covered by a given I/M program.

                 The format requirement for this command is fixed column format. Columns not discussed below must be left blank.

                 ▸        The first data parameter is the I/M program number used for the corresponding I/M PROGRAM command. The number is entered in column 22.

                 ▸        Following the I/M program number field, there are fourteen individual vehicle I/M program coverage toggle fields that contain either a value of 1 or 2. A value of 1 indicates that the particular vehicle type is NOT subject to an I/M inspection, and a 2 indicates that the particular vehicle type is subject to the inspection.

                 The first five vehicle I/M program coverage toggle fields correspond to the light-duty gasoline vehicle classes beginning in column 24.

                     LDGV
                     LDGT1
                     LDGT2
                     LDGT3
                     LDGT4

                 The next eight vehicle I/M program coverage toggle fields correspond to the eight heavy-duty gasoline vehicle classes beginning in column 30.

                     HDGV2B
                     HDGV3
                     HDGV4
                     HDGV5
                     HDGV6
                     HDGV7

HDGV8A
HDGV8B

The final vehicle I/M program coverage toggle field corresponds to the gasoline buses in column 39.

GAS BUS

Note that there is a blank space between the first five toggles and the eight toggles, and a blank space between the eight toggles and the final gas bus toggle. An error will result if this exact format is not followed.

Example:     I/M VEHICLES         : 1 22222 11111111 1

This example instructs MOBILE6 to calculate I/M benefits for light-duty gasoline vehicles (cars and light-duty trucks) for I/M program number one.

Tips:          The user may choose any combination of vehicle types. However, the user must enter a value of 2 for at least one of the vehicle types to get meaningful I/M output.

2.8.9.4.d
Name:          I/M STRINGENCY

Status:        Optional (required <u>if</u> the user is modeling exhaust I/M; not used for evaporative I/M)

Section:       Run

Description:   This command defines the expected exhaust inspection failure rate for pre-1981 model year vehicles covered by the I/M program.

Default:       There is no default for this command. It is a required input if the user wishes to model an exhaust I/M program. If the I/M PROGRAM command describes an exhaust program and this command is not present, MOBILE6 will issue an error message and the run will be aborted.

Explanation:   The format requirement for this command is free column format.

The command name, I/M STRINGENCY, must appear first

▸          The  first data parameter is the I/M program number used for the

corresponding I/M PROGRAM command.

▸    The second data parameter is the level of I/M stringency. The I/M
     stringency rate is the test failure rate expected in pre-1981 model year
     passenger cars or light trucks expressed as a percentage of tests
     administered. <u>The value the user enters has no effect on model years
     greater than 1980</u>.

The valid stringency range is from 10 percent stringency to 50 percent stringency.
Entry of a value outside of this range will generate an error message. The value is
entered into the program as a percentage including a decimal.

Example:    `I/M STRINGENCY    : 1 50.0`

This example instructs the computer for I/M program number one to set the
stringency at 50.0 percent.

Tips:       This command is required even in exhaust cases where it does not directly apply,
            such as I/M programs where pre-1981 model year vehicles are not tested or even
            in calendar years such as 2050 where pre-1981 vehicles do not exist.

            The command is not needed for evaporative I/M programs.  If it is provided with
            an evaporative I/M program number, the inputs will be ignored.

            If the program stringency is greater than 50 percent, enter 50 percent.  If the
            stringency is less than 10 percent use 10 percent as the value.

2.8.9.4.e
Name:       I/M COMPLIANCE

Status:     Optional (required <u>if</u> the user is modeling exhaust I/M programs; optional for
            evaporative I/M)

Section:    Run

Description: This command describes the expected compliance with a given I/M program. The
            compliance rate is the percentage of vehicles in the fleet that complete the I/M
            program and receive either a certificate of compliance or a waiver.

Default:    There is no default for this command for exhaust I/M programs. It is a required
            input to model an exhaust I/M program. If the I/M PROGRAM command
            describes an exhaust program and this command is not present, MOBILE6 will

issue an error message and the run will be aborted.

If the I/M PROGRAM command describes an evaporative program, and a compliance rate is not specified for the evaporative program, and an exhaust program is not in effect for a specific vehicle class and model year, MOBILE will use a default value of 85 percent for the evaporative program.  However, if a compliance rate is not provided for an evaporative program, but one is provided for a simultaneous exhaust program, MOBILE6 will use the exhaust program compliance rate to compute evaporative benefits on the vehicles and model years covered by both the exhaust and evaporative programs.

Explanation:   The format requirement for this command is free column format.

The command name, I/M COMPLIANCE, must appear first.

▸      The  first data parameter is the I/M program number used for the corresponding I/M PROGRAM command.

▸      The second data parameter is the level of I/M compliance the user wishes to use. The compliance rate value is entered into MOBILE6 as a percentage of the total fleet. The valid compliance rate range is from 50 percent compliance to 100 percent. The I/M credit is reduced in proportion to a reduction in the compliance rate. The value is entered into the program as a percentage that includes a decimal.

Example:       `I/M COMPLIANCE     : 1 85.0`

This example instructs the computer for I/M program number one to set the compliance at 85.0 percent.

2.8.9.4.f
Name:          I/M WAIVER RATES

Status:        Optional (required for modeling exhaust I/M programs; optional for evaporative I/M)

Section:       Run

Description:   This command specifies the percentage of vehicles that fail an initial I/M test and do NOT pass a retest but receive a certificate of compliance.

Default:       There is no default for this command for exhaust I/M programs. It is a required input if the user wishes to model an exhaust I/M program. If the I/M PROGRAM

command describes an exhaust program and this command is not present, MOBILE6 will issue an error message and the run will be aborted.

If the I/M PROGRAM command describes an evaporative program, and waiver rates are not specified for the evaporative program, and an exhaust program is not in effect for a specific vehicle class and model year, MOBILE will use default values of 5 percent for the evaporative program.  However, if waiver rates are not provided for an evaporative program, but are provided for a simultaneous exhaust program, MOBILE6 will use the exhaust program waiver rates to compute evaporative benefits on the vehicles and model years covered by both the exhaust and evaporative programs.

Explanation:   The format requirement for this command is free column format.

The command name, I/M WAIVER RATES, must appear first.

- ► The  first data parameter is the I/M program number used for the corresponding I/M PROGRAM command.

- ► The second data parameter is the waiver rate for the pre-1981 model year vehicles

- ► The third data parameter in the I/M WAIVER RATES command is the waiver rate for 1981 and later model year vehicles.

The valid input range for waiver rate percentages are between 0 and 50 percent. The values are entered into the program as percentages that include a decimal. If either of the waiver rates exceed 50.0 percent the program will issue an error message.

Example:   I/M WAIVER RATES   : 1 5.0 3.0

This example instructs MOBILE6 to set the waiver rate at 5.0 percent for pre-1981 model years and 3.0 percent for 1981 and later model years for I/M program number one.

Tips:   I/M Waiver Rates inputs must be expressed as a percentage of the vehicles that FAIL the I/M program and not as a percentage of the entire fleet.

2.8.9.4.g
Name:   I/M CUTPOINTS

Status:          Optional (required if the user is running an IM240 program)

Section:         Run

Description:     This command specifies the emission level "cutpoints" which determine whether
                 a vehicle passes or fails an I/M test. The I/M CUTPOINTS command is only
                 required if the user is modeling an IM240 program.

Default:         There is no default for this command. If the user wishes to model an I/M240
                 program, this command must be used to enter cutpoint values.

                 The command is not needed for evaporative I/M programs.  If it is provided with
                 an evaporative I/M program number, the inputs will be ignored.

Explanation:     The format requirement for this command is free column format.

                 The command name, I/M CUTPOINTS, must appear first

                 ►        The  first data parameter is the I/M program number used for the
                          corresponding I/M PROGRAM command.

                 ►        The second data parameter is the name of an external file that contains the
                          cutpoint information. The complete path information must be provided if
                          the file is not in the same subdirectory as the MOBILE6 program.

                 ►        The format requirements for data within the external file are free column
                          format.

                 The label I/M CUTPOINTS needs to appear at the top of the file and begin in
                 column one. Following the I/M CUTPOINTS label, are the IM240 cutpoints.
                 These are entered in blocks of 75 cutpoints. The first block of cutpoints are for the
                 passenger cars and light duty gas truck 1s (LDGT1). The second block of
                 cutpoints are for the light-duty gas trucks 2 and 3s (LDGT2 and LDGT3). The
                 third block of cutpoints are for the light-duty gas trucks 4's (LDGT4). The fourth
                 and final block are for the heavy-duty gas vehicles (HDGV).

                 Each of the four blocks mentioned above consist of three blocks of 25 values
                 each. These three sub-blocks are the HC, CO, and NOx cutpoints, respectively.
                 The first value in a group of 25 is associated with the age starting with the
                 youngest vehicle.

Example:         I/M CUTPOINTS        : 1 C:\MOBILE\CUTPOINT.D

This command directs MOBILE6 to look for the appropriate I/M cutpoints in the external file "CUTPOINT.D."  An example of proper format for the external file can be found in the file,  CUTPOINT.D.

Tips:          If the user enters IM240 cutpoints that are more stringent (lower) than 0.80 / 15.0 / 2.0 grams per mile (HC, CO, and NOx respectively), MOBILE6 will set the cutpoints to these levels and issue a warning.

               Although cutpoints for heavy-duty vehicles are required inputs for I/M 240 programs, they have no effect on MOBILE6 emission results.

2.8.9.4.h
Name:          I/M EXEMPTION AGE

Status:        Optional

Section:       Run

Description:   This command allows users to specify the age at which vehicles become exempt from the I/M program they wish to model.

Default:       25 years old (in effect, under a default scenario, vehicles never become exempt from I/M because of age).

               If an exhaust I/M program is in effect, and the user enters an exemption age for the program, the exhaust program exemption age will apply to the same vehicles and model years in any simultaneous evaporative I/M program, unless a different exemption age is explicitly entered for the evaporative I/M program.

Explanation:   The format requirement for this command is as follows:

               The command name, I/M EXEMPTION AGE, must appear first.

               ▸      The  first data parameter is the I/M program number used for the corresponding I/M PROGRAM command.

               ▸      The second data parameter is the I/M exemption age. This is age at which vehicles no longer are subject to mandatory I/M requirements. The valid range for this input is 1 through 25. A value of 1 would exempt the entire fleet from the I/M requirements (age 0 vehicles are never subject to I/M), and a value of 25 would exempt only vehicles of age 25 and older. Exempted vehicles lose all potential I/M credit. The exemption age input value must be entered into MOBILE6 as an integer.

Example:      I/M EXEMPTION AGE : 1 21

This example instructs MOBILE6 to set the I/M exemption age to 21 years old for I/M program number one.

Tips:         Including or exempting vehicles over 25 years old has no effect on I/M program benefits, since MOBILE6 only calculates emissions for vehicles up to 25 years old.

2.8.9.4.i
Name:         I/M GRACE PERIOD

Status:       Optional

Section:      Run

Description:  This command allows users to specify the age at which vehicles first become subject to I/M testing (newer vehicles are exempt).

Default:      One year old.

              If an exhaust I/M program is in effect, and the user enters a grace period for the exhaust program, the exhaust program grace period will apply to the same vehicles and model years in any simultaneous evaporative I/M program, unless a different exemption age is explicitly entered for the evaporative I/M program.

Explanation:  The format requirement for this command is as follows:

              The command name, I/M GRACE PERIOD, must appear first.

              ▸     The  first data parameter is the I/M program number used for the corresponding I/M PROGRAM command.

              ▸     The second data parameter is the I/M grace period. This is the age at which vehicles are first subject to mandatory I/M requirements. This input allows users to model programs which exempt the newest vehicles from the requirements. The valid range for this input is 1 through 25. A value of 1 would exempt only vehicles which are less than one year old (the default), and a value of 25 would exempt all but the oldest model year vehicle. Exempted vehicles lose all I/M credit. The exemption age input value must be entered into MOBILE6 as an integer.

Example:      `I/M GRACE PERIOD    :  1   5`

This example instructs MOBILE6 to set the I/M grace period to 5 years old for I/M program number one.

2.8.9.4.j
Name:         NO I/M TTC CREDITS

Status:       Optional for exhaust I/M.  Not used for evaporative I/M programs.

Section:      Run

Description:  This command eliminates the I/M credit MOBILE6 assigns to a  technician training program.

Default:      MOBILE6 assigns full I/M credit for technician training. This command is only appropriate if the I/M program does not conduct nor does not plan to conduct a technician training program.

Explanation:  This command only requires the command name and I/M program number to be entered.

              The command is not needed for evaporative I/M programs.  If it is provided with an evaporative I/M program number, the inputs will be ignored.

Example:      `NO I/M TTC CREDITS : 1`

              This example instructs the computer to remove the I/M technician training credits from the I/M benefits for I/M program number one.

2.8.9.4.k
Name:         I/M EFFECTIVENESS

Status:       Optional

Section:      Run

Description:  This command is a correction factor that reduces the exhaust I/M credit for test and repair programs by the specified input percentage.

Default:      100 percent or full credit to all I/M program types.

Explanation:    This command allows entry of separate effectiveness values for each of the three pollutants. These values will apply to all exhaust I/M programs in that run. Within a run, it is not possible to model separate effectiveness levels for each I/M program element.  The command does not affect evaporative I/M calculations.

The format requirement for this command is free column format. The command name, I/M EFFECTIVENESS, must appear first.

▸         The next three inputs are the I/M effectiveness values for HC, CO and NOx pollutants, respectively. The effectiveness values are entered as fractions. For example, if a value of 0.80 is entered for the first parameter, then the HC I/M benefits are reduced by 0.20 or 20 percent (1.0 - 0.80 = 0.20). All values are entered into the program as fractions from 0.0 to 1.0, and include a decimal. Values outside the range of 0.0 to 1.0  will produce error messages.

Example:     `I/M EFFECTIVENESS : 0.80 0.70 0.72`

2.8.9.4.l
Name:          I/M DESCRIPT FILE

Status:         Optional

Section:        Run

Description:   This command allows users to enter any set of I/M commands in an external file rather than in the MOBILE6 command input file.

Default:        There is no MOBILE6 default for this command.

Explanation:   This command instructs MOBILE6 to read I/M records from an external data file. When the model finds this command in the command input file, it opens the external file named in the command and continues reading I/M program description commands from that file. The external file can contain any of the I/M commands except another I/M DESCRIPT FILE command. It may also contain any number of blank and comment lines. Comment lines read from the external file will be treated exactly as though they had been read from the command input file. Comments beginning with a '>' character will be echoed to the output file. Blank lines and comments beginning with the character '*' will be ignored.

The format requirement for this command is the command name, followed by the name of the external file as the first data parameter. The complete path name of

the file is required if the file is not in the same subdirectory as the MOBILE6 program.

Unlike most other external files, the one for this command does not repeat the command name on the first line.

Example:      I/M DESCRIPT FILE  : IMTEST.D

This example instructs MOBILE6 to read I/M program descriptions from an external file called "IMTEST.D." A sample data set can be found in the file, IMTEST.D.

Tips:          This option is useful to avoid retyping a long set of repetitive I/M commands each time the user runs the model. If the user decides to use this option, all of the I/M inputs should be included for a given run, rather than split them between an external file and the MOBILE6 command input file.

## 2.8.10  <u>Fuel Commands</u>

Fuel commands allow users to model the impact of various gasoline fuel parameters.

### 2.8.10.1        **Fuel Program**

Name:          FUEL PROGRAM

Status:        Optional

Section:       Run or Scenario

Description:   This command allows users to specify one of two Tier 2 sulfur phase-in schedules, to model the impact of a reformulated gasoline (RFG) program, or to specify sulfur content for gasoline after 1999.

Default:       MOBILE6 assumes that there is no RFG program in place and applies the standard Tier 2 gasoline sulfur phase-in schedule for calendar years after 1999. This default condition is described below as "Conventional Gasoline East."

Explanation:   This command allows four options. Users may specify one of two Tier 2 sulfur phase-in schedules, model the effect of an RFG program, or directly supply values for gasoline sulfur content after 1999.

Users select the desired option by entering an integer following the command name. This data entry is in free column format. Some options also require

additional input data, as described below. The options and their associated numbers are:

1        Conventional Gasoline East
2        Reformulated Gasoline
3        Conventional Gasoline West
4        User-supplied gasoline sulfur levels

Each of these options and its input requirements are described in detail below.

Conventional Gasoline East - This is the MOBILE6 default. It supplies post 1999 gasoline sulfur levels by year under the phase-in schedule prescribed by the Tier 2 rule for most states.
(See http://www.epa.gov/otaq/tr2home.htm#documents for more information on the Tier 2 rule.)

The user may select Conventional Gasoline East by omitting the FUEL PROGRAM command (since this is the default option) or by placing the integer "1" on the command line after the FUEL PROGRAM command.

Conventional Gasoline West - This option supplies post-1999 gasoline sulfur levels by year under the phase-in schedule prescribed by the Tier 2 rule for specific western states (i.e., Alaska, Colorado, Idaho, Montana, New Mexico, North Dakota, Utah, Wyoming).
(See http://www.epa.gov/otaq/tr2home.htm#documents for more information on the Tier 2 rule.)

The user may select Conventional Gasoline West by placing the integer "3" on the command line after the FUEL PROGRAM command.

Reformulated Gasoline (RFG) - This option should be used to model the effects of an RFG program. The option sets 1995-and-later gasoline sulfur content, oxygen content and fuel volatility values for the MOBILE6 calculations,  generally overriding default  fuel parameters and parameters set with the FUEL RVP, SULFUR CONTENT and OXYGENATED FUELS commands. While the exact composition of RFG fuel may vary by refiner; the RFG fuel values modeled in MOBILE6 are consistent with the RFG requirements, and represent the typical values expected in an RFG area.

Like conventional gasoline, RFG must meet fuel volatility requirements that vary by geographic region. (See "Volatility Regulations for Gasoline

and Alcohol Blends Sold in Calendar Years 1992 and Beyond," 55 FR 23658, June 11, 1990.) Since the RFG option often sets fuel volatility and overrides the FUEL RVP label, the RFG option requires the user to indicate which region (north or south) is being modeled. The user may select Reformulated Gasoline by placing the integer "2" on the command line after the FUEL PROGRAM command, followed by the appropriate letter "S" (for south) or "N" (for north).  The value designating the fuel volatility region must be separated from the program value "2" by at least one blank space.

The exact fuel parameters modeled for RFG depend on the geographic region, the calendar year and the season of the year. The values used in MOBILE6 are listed in the tables below. Explanatory notes follow the tables.

| Reformulated Gasoline Parameters– Summer (1) | | | | | | |
|---|---|---|---|---|---|---|
| Year (2) | RVP (psi) | | Oxygenated Fuels | | Sulfur Content (ppm) | |
| | North | South | Ether Oxygen Content (% by weight) | Ether Market Share (%) | Average | Max |
| 1995-1999 | 8.0 | 7.1 | 2.1 | 100 | 300 | na |
| 2000 | 6.7 | 6.7 | 2.1 | 100 | 150 | 500 |
| 2001 | 6.7 | 6.7 | 2.1 | 100 | 149 | 500 |
| 2002 | 6.7 | 6.7 | 2.1 | 100 | 129 | 500 |
| 2003 | 6.7 | 6.7 | 2.1 | 100 | 120 | 500 |
| 2004 | 6.7 | 6.7 | 2.1 | 100 | 120 | 300 |
| 2005 | 6.7 | 6.7 | 2.1 | 100 | 90 | 300 |
| 2006 | 6.7 | 6.7 | 2.1 | 100 | 30 | 80 |
| 2007 | 6.7 | 6.7 | 2.1 | 100 | 30 | 80 |
| 2008 | 6.7 | 6.7 | 2.1 | 100 | 30 | 80 |

| Reformulated Gasoline Parameters– Winter(1) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Year (2) | RVP (psi) | Oxygenated Fuels(3) | | | | Sulfur Content (ppm)(4) | |
| | North or South | Ether Oxygen Content (% by weight) | Ether Market Share (%) | Ethanol Oxygen Content (% by weight) | Ethanol Market Share | Average | Max |
| 1995-1999 | as set by user | 1.5 | 70 | 3.5 | 30 | 300 (5) | na |
| 2000 | | 1.5 | 70 | 3.5 | 30 | 300 | 1000 |
| 2001 | | 1.5 | 70 | 3.5 | 30 | 299 | 1000 |
| 2002 | | 1.5 | 70 | 3.5 | 30 | 279 | 1000 |
| 2003 | | 1.5 | 70 | 3.5 | 30 | 259 | 1000 |
| 2004 | | 1.5 | 70 | 3.5 | 30 | 121 | 303 |
| 2005 | | 1.5 | 70 | 3.5 | 30 | 92 | 303 |
| 2006 | | 1.5 | 70 | 3.5 | 30 | 33 | 87 |
| 2007 | | 1.5 | 70 | 3.5 | 30 | 33 | 87 |
| 2008 | | 1.5 | 70 | 3.5 | 30 | 30 | 80 |

Notes for Reformulated Gasoline Parameter tables:

(1) The Clean Air Act defines the RFG "Summer" as May 1 through September 15. "Winter" is the rest of the year. MOBILE will generally determine which fuel season to model using the value input for EVALUATION MONTH (1=January, indicates winter; 7=July, indicates summer). However, the user can override the fuel season indicated by the EVALUATION MONTH by using the SEASON command described later in this chapter.

(2) For most of the fuel parameters, the year listed here indicates the *calendar year* for which the fuel parameter is typical. However, the "Maximum Sulfur,"value represents the maximum sulfur level ever experienced by a vehicle, regardless of the fuel level in the calendar year

of the MOBILE run. Thus, the "year" in these tables is used to assign the maximum sulfur values to the appropriate vehicle model year. (Note, the maximum sulfur effect is not calculated for 1999-and-earlier vehicles, so no maximum sulfur level is needed for these years.)

(3) During the winter fuel season, the user may override the default RFG parameters for oxygenated fuels **if** the user-supplied oxygenated fuel parameters have a combined oxygenate for ethanol and ether blends greater than 2.1 percent by weight and the combined oxygenate market share is 100%.

(4) The winter RFG sulfur values listed here and used in MOBILE when the RFG option is selected are appropriate for most of the United States, but they are not correct for states with "Western" Tier 2 fuel (see "Conventional Gasoline West" above). A "Tip" below explains how to model winter RFG for these western states.

(5) In the winter RFG season, user input for SULFUR CONTENT will override the default average fuel sulfur for calendar years 1999-and-earlier. This is not true for summer RFG.

User-supplied Gasoline Sulfur Levels – This option allows the user to directly specify the average and maximum sulfur levels for calendar years 2000-and-later if these are known to differ from RFG or the conventional fuels programmed into the model. For calendar years prior to 2000, the SULFUR CONTENT command must be used.

The user may select user-supplied sulfur levels for 2000-and-later by placing the integer "4" on the command line after the FUEL PROGRAM command. On the following lines the user must enter 32 values, indicating average and maximum fuel sulfur contents (ppm) in the lines following the command. The first 16 values are the average fuel sulfur content for gasoline in calendar years 2000 through 2015. The next 16 values are the maximum sulfur levels to which the model years 2000 through 2015 are exposed. These values should represent the maximum sulfur in any batch of fuel sold in the modeled area. The 2015 value is used for all 2015 and newer model years. Values from 30 ppm to 1000 ppm are valid inputs for both the average and the maximum sulfur levels, but the MOBILE model calculated identical sulfur effects for all values above 600 ppm. All values are in parts per million (ppm) and must be entered including a decimal point. Each value must be separated by at least one space.

Examples:    ```
FUEL PROGRAM           :   1
```

The preceding example calls for the Conventional Gasoline East fuel program.


```
FUEL PROGRAM           :   3
```

The preceding example calls for the Conventional Gasoline West fuel program.

```
FUEL PROGRAM           :   2   S
```

The preceding example calls for a reformulated gasoline (RFG) fuel program for a southern region

```
FUEL PROGRAM           :   2   N
```

The preceding example calls for RFG fuel program for a northern region.

```
FUEL PROGRAM         :   4
 300.0   299.0   279.0   259.0   121.0    92.0    33.0    33.0
  30.0    30.0    30.0    30.0    30.0    30.0    30.0    30.0
1000.0  1000.0  1000.0  1000.0   303.0   303.0    87.0    87.0
  80.0    80.0    80.0    80.0    80.0    80.0    80.0    80.0
```

This final example demonstrates user supplied gasoline sulfur levels. The values provided here are the same sulfur levels used for the MOBILE6 default (conventional gasoline east).

Tips:    The FUEL PROGRAM command affects sulfur content prior to calendar year 2000 only when RFG is selected. In general, to define the sulfur content of gasoline in calendar years before 2000, use the SULFUR CONTENT command.

MOBILE6 treats FUEL PROGRAM command option 4 as a conventional gasoline program with alternate sulfur levels. If an RFG program is desired with alternate sulfur levels, users can use FUEL PROGRAM command option 4 to enter the sulfur levels and alter the other non-sulfur fuel parameters through the FUEL RVP and OXYGENATED FUELS commands to approximate the non-sulfur effects of RFG.

It is not possible using the FUEL PROGRAM command to choose a winter, western RFG program. Users wishing to model western winter RFG should use the FUEL PROGRAM command to choose "Conventional Gasoline West". Then, using the OXYGENATED FUELS command, users must enter either the winter

RFG oxygenated fuel parameters described above or a local oxygenated fuels program that satisfies the RFG rule. Modeling western RFG is not a problem in summer, since the summer RFG program has its own mandatory sulfur levels that override both the east and the west sulfur levels.

### 2.8.10.2    Sulfur Content of Gasoline

Name:          SULFUR CONTENT

Status:        Optional

Section:       Scenario

Description:   This command allows the user to enter the sulfur content of gasoline fuel for calendar years through 1999. Note that this input is valid only through the 1999 calendar year. For calendar years after 1999, MOBILE6 will <u>ignore</u> this input.

Default:       300 ppm

Explanation:   MOBILE6 will accept sulfur contents for 30.0 through 600.0 ppm. If a sulfur level outside that range is entered, MOBILE6 will round to the (appropriate) end point (30 or 600 ppm) and generate a warning message.

               This command only requires one value in the data field of the command, namely the sulfur content of the fuel in parts per million (ppm).

Example:       `SULFUR CONTENT       :    50.0`

Tips:          To enter values for years after 1999, the command "FUEL PROGRAM" must be used.

               In the winter RFG season, this command will override the FUEL PROGRAM RFG sulfur levels. In the summer RFG season, the RFG sulfur levels will override the value entered here if an RFG program is selected.

### 2.8.10.3    Oxygenated Fuels Programs

Name:          OXYGENATED FUELS

Status:        Optional

Section:          Run or Scenario

Description:      This command permits users to model the effects of oxygenated gasoline on
                  exhaust emissions for all gasoline-fueled vehicle types.

Default:          If the OXYGENATED FUELS command is not used and the FUELS PROGRAM
                  command is not used to select a reformulated gas program, MOBILE6 assumes
                  that the fuel used by gasoline-fueled vehicles does not contain an oxygenate and
                  no oxygenated fuels benefit is calculated.

Explanation:      The effect of oxygenated fuels on emissions depends on several fuel parameters
                  that are specified by this command. These include whether the oxygenate is an
                  alcohol or ether blend; the amount of oxygenate in the fuel; and the market share
                  of oxygenated fuels. In certain cases, the presence of oxygenate in fuel can affect
                  fuel RVP, generating an additional emissions effect. (See "Tips" below.)

                  The command requires five numbers be provided by the user in the data field
                  portion of the command record. Each of the five values must be separated from
                  the others by at least one blank space:

                  ▸       The first number specifies the ether blend market share (expressed as a
                          decimal fraction). The range is 0.000 to 1.000.

                  ▸       The second number specifies the alcohol blend market share (expressed as
                          a decimal fraction). The range is 0.000 to 1.000.

                  ▸       The third number specifies the average oxygen content of ether blend fuels
                          (percent weight, expressed as a decimal fraction). The range is 0.000 to
                          0.027.

                  ▸       The fourth number specifies the average oxygen content of alcohol blend
                          fuels (percent weight, expressed as a decimal fraction). The range is 0.000
                          to 0.035.

                  ▸       The fifth number specifies whether or not a Reid vapor pressure (RVP)
                          waiver has been granted to allow "splash" blending of alcohol-based
                          oxygenates. If a waiver has not been granted (value = 1), then alcohol-
                          based oxygenated fuels must meet the same RVP requirements as non-
                          oxygenated fuels sold in the area. If a waiver has been granted (value = 2),

then alcohol-based oxygenated fuels are allowed to exceed the RVP requirements by up to 1 psi, and the user-input RVP is adjusted upwards to account for the market share of the higher RVP fuel.

Example:     OXYGENATED FUELS   : .035 .129 .027 .031 2

This example states that 3.5 percent of the fuel sold in the area is an ether blend with an average oxygen content of 2.7 percent weight; that 12.9 percent of the fuel sold in the area is an alcohol blend with an average oxygen content of 3.1 percent by weight; and that an RVP waiver is in effect allowing the volatility of the alcohol-based oxygenated fuels to be up to 1.0 psi RVP greater than the limit applicable to straight gasoline.

Tips:        If the user specifies a Reformulated Gasoline (RFG) program using the FUEL PROGRAM command, then the oxygenated fuel parameters of that program take precedence over the OXYGENATED FUELS command. See Section 2.8.10.1, which describes the FUEL PROGRAM command, for more information on the RFG program parameters and their effects.

Use of the OXYGENATED FUELS command may change the expected effects of the mandatory user input for the FUEL RVP command. For more details, see the above discussion of the RVP waiver for "splash" fuels.

## 2.8.10.4        Fuel Reid Vapor Pressure (RVP)

Name:        FUEL RVP

Status:      Required

Section:     Run or Scenario

Description: This command allows users to specify fuel RVP for the area to be modeled

Default:     There is no MOBILE6 default for fuel RVP. Users must enter a value for all scenarios (in the Run section) or for each scenario (in the Scenario section) of each MOBILE6 command input file.

Explanation: RVP is one measure of the volatility of gasoline. Exhaust and especially non-exhaust emissions vary with fuel volatility. The FUEL RVP command specifies

the value of RVP (in pounds per square inch, or psi) representing the prevailing average fuel volatility for the geographic area of interest.

The RVP value entered must reflect the average in-use RVP of gasoline in the area being modeled. The RVP value can be between 6.5 psi and 15.2 psi inclusive. If the user enters a value outside this range, MOBILE will round to the appropriate endpoint (6.5 psi or 15.2 psi) and will generate a warning message.

However, there are federal limits on fuel RVP in ozone-producing months (May through September) starting in 1989. For the calendar years 1989-1991, the RVP limit is 10.5, 9.5, or 9.0 psi depending on the area of the country or summer month (See Federal Register 54 FR 11868, March 22, 1989.). For calendar years 1992 and beyond, the summer RVP limit is either 9.0 or 7.8 psi depending on the area or month (See Federal Register 54 FR 23658, June 11, 1990.).

The only required data are the command name ("FUEL RVP") and the fuel RVP (in psi) which can be placed anywhere in the data field of the command record.

Example:      `FUEL RVP              : 9.0`

This example would model an area where the prevailing fuel RVP was 9.0 psi

Tips:         At temperatures below 45 degrees Fahrenheit, fuel evaporation becomes negligible and RVP is assumed to have no effect on emissions. It is still a required input.

The RVP effects are the same for all RVP values greater than 11.7 psi.

The OXYGENATED FUELS and the FUEL PROGRAM commands may affect the RVP used in the model calculations. See the sections on these commands for more details.

## 2.8.10.5        Effective Season for RFGs Calculation

Name:         SEASON

Status:       Optional

Section:      Run or Scenario

Description:   This command identifies the effective season (winter or summer) for the RFG calculation regardless of the month being modeled.

Default:   MOBILE6 assumes the season is winter when January is selected as the evaluation month, and that the season is summer when July is selected as the evaluation month. The MOBILE6 default evaluation month is January, so winter RFG will be modeled unless the user selects July using the EVALUATION MONTH command or selects summer using this command.

Explanation:   The effect of RFG on emissions differs in summer and winter. The SEASON command allows the user to override the effect of EVALUATION MONTH on RFG calculations, either specifying that summer RFG rules be applied when the evaluation month is January or that winter RFG rules be applied when the evaluation month is July. This command only affects RFG-related emission results.

The SEASON command can assume only two values, a "1" denoting summer or a "2" denoting winter. This information must appear in the data portion of the record following the command name.

Example:   `SEASON               :  1`

This example directs MOBILE6 to use summer RFG values.

Tips:   The SEASON command only affects results relating to RFG. Use of the SEASON command will have no effect on results unless the input includes a FUEL PROGRAM command indicating that an RFG program is in place.

## CHAPTER 3

## MOBILE6 OUTPUTS

### 3.0    INTRODUCTION

This chapter describes the output that can be produced by the MOBILE6 highway vehicle emission factor model. There are four basic kinds of output:

1. The Database Output Report
2. The Descriptive Output Report
3. Warning and Error Messages
4. User Screen Dialog

The database output report contains detailed emission results in a form suitable for use with database management or spreadsheet software.

The descriptive output report contains summary-level emission results in a format suitable for printing. This report also contains any Warning or Error Messages pertaining to user-supplied input values.

During execution of the MOBILE6 program a few simple prompting and status messages are displayed on the computer screen. Certain error messages related to the interaction between the computer software operating system and the MOBILE6 program may also appear on the screen.

### 3.1    DATABASE OUTPUT REPORT

The user has the option (by using the DATABASE OUTPUT command) of creating a tab-separated variable, ASCII text file which can then be imported into various database or spreadsheet programs. Database output is not produced unless this command is specified in the header section of the command input file. By default the database output file is given the base name of the command input file with a .TB1 filename extension. The user can give the file any desired DOS file name with the EMISSIONS TABLE command.

### 3.1.1   Database Output Formatting Options

There are three forms of the database output. The default form is an "Hourly"

format which reports all emission factors for each hour of the 24 hour day. This output is often quite voluminous and suitable only for use with database management software. A "Daily" format is also available, however, which summarizes the hourly information into emission factors pertaining to the entire 24 hour day. This significantly reduces the amount of output produced and often produces output which can be analyzed with spreadsheet software. An "Aggregated" format is also available which aggregates the daily results into values similar to those reported in the descriptive output option. By default, (assuming the DATABASE OUTPUT command has been specified), MOBILE6 produces the Hourly format. The DAILY OUTPUT or the AGGREGATED OUTPUT command can be specified in the header section of the command input file to produce the daily or aggregated database format instead. The user cannot specify both the DAILY OUTPUT and the AGGREGATED OUTPUT commands in the same MOBILE6 input file.

By default the database output table, whether in hourly, daily or aggregated format, is a purely "flat" file in which every record has the same format and contains only result information. The WITH FIELDNAMES command can be used to add an initial record to the database output file containing short names for each column of information it contains.

The hourly database output file contains 22 fields; the daily format contains 18 of these. The aggregated format contains only 13 fields. The fields can be considered to be of three kinds: key fields, echoed fields, and calculated fields. In the following section, command input refers to non-batch input.

### 3.1.1.1    Key Fields

These nine key fields serve, in combination, to uniquely identify a particular record in the output.

-- File Number (FILE). The number of the command input file, beginning with 1. Batch Input Files may contain more than one command input file.

-- Run Number (RUN). The run number within the input file, beginning with 1. Command input files may contain multiple runs.

-- Scenario Number (SCEN). The scenario number within the run, beginning with 1. Runs may contain multiple scenarios.

-- Hour of the Day (HOUR) 1 through 24. Note that hour "1" begins at 6:00 AM and extends until 7:00 AM. This field is not present in the daily or aggregated format.

-- Vehicle Type (VTYPE) (Values 1 through 28 as shown Table 3, Appendix B.)

-- Vehicle Age in Years (AGE)  (0 through 24). This age is relative to the Calendar Year for which the scenario is being run. Note that age value 24 actually represents vehicles of age 24 or more. This field is not present in the aggregated format.

-- Pollutants (POL)  (values of 1 through 3)
   1. HC
   2. CO
   3. NOx

-- Emission Types (ETYPE)  (values of 1 through 8)
   1. Exhaust emissions nominally from running operations, including start emissions from heavy-duty vehicles. (All exhaust emission not included in type 2 below.)
   2. Exhaust emissions from the engine start operations of light duty vehicles and motorcycles.

> **Note:** Emission types 1 and 2 have a slightly different meaning in the database output than they do in the descriptive output.

   3. Evaporative emissions from hot soak conditions.
   4. Evaporative emissions from diurnal conditions.
   5. Evaporative emissions from resting loss conditions.
   6. Evaporative emissions from running loss conditions.
   7. Evaporative emissions from crankcase emissions.
   8. Evaporative emissions from refueling conditions.

   This field is not present in the aggregated format.

-- Roadway or "Facility" Types (FTYPE)  (1 through 5)
   1. freeway,
   2. arterial,
   3. local,
   4. ramp,
   5. none or "not applicable" (e.g., for emissions *independent* of facility type, such as engine start emissions and most evaporative etypes.)

This field is not present in the aggregated format.

### 3.1.1.2     Echoed Fields Carried To Output From Input

Eleven fields of the database output are "echoed" from MOBILE6 inputs. It is important for users of MOBILE6 to understand that these information items are not substantively calculated or modeled by MOBILE6, i.e. they are essentially independent rather than dependent variables. They are provided in the database output to facilitate conversion of the emission factor results into alternative units, such as grams/engine start, grams per gallon, etc. These fields also are provided to facilitate the calculation of average emissions for non-standard combinations of vehicle types.

The "echoed" fields include the following:

-- STARTS: The average number of engine starts per vehicle in the time period (hour or day) represented by the record.

-- ENDS: The average number of trip ends per vehicle in the time period (hour or day) represented by the record. The number of trip ENDS is generally less than the number of STARTS because very short periods of engine operation are not considered a "trip" by MOBILE6 in calculating hot soak emissions.

-- MILES: Miles traveled per vehicle of this type and age in the time period (hour or day) represented by the record.

-- MPG: Miles per gallon per vehicle of this type. Note: For motorcycles and diesel-fueled vehicles a value of "0.0" is output, indicating that MOBILE6 does not have this information.

-- HRVMT: Percentage of daily vehicle miles traveled in the HOUR to which this record pertains. This field is not present in the daily or aggregated database output.

-- FACVMT: Percentage of vehicle miles traveled in the time period (day or hour) represented by this record on the indicated facility (roadway type). This field is not present in the aggregated format.

-- REG_DIST: Percentage of vehicles of this type which are of this age. This field is not present in the aggregated format.

-- VCOUNT: Number of vehicles of this VTYPE used by MOBILE6 to calculate these results. Note: The absolute number of vehicles is not significant in MOBILE6, which expresses all emission results on a per vehicle basis. Ratios or percentages of VCOUNT numbers can be useful, however, when combining vehicle classes. This field is not present in the aggregated format.

-- AMBTEMP: Ambient temperature during this hour expressed in degrees Fahrenheit. This field is not present in the daily output format. This field is not present in the aggregated format.

-- DIURTEMP: Temperature used for diurnal evaporative emission calculations during this hour, expressed in degrees Fahrenheit. Normally this equals AMBTEMP, but may differ if the user has supplied alternate hourly temperature information. This field is not present in the daily or aggregated output format.

-- MYR: Model Year. This is calculated as Calendar Year - Age. This field is not present in the aggregated output.

-- The aggregated output includes an echoed field, the fraction of vehicle miles traveled (VMT) , which is not included in either the hourly or daily format.

-- The aggregated output includes another echoed field, calendar year (CAL_YEAR), which is not included in either the hourly or daily format.

### 3.1.1.3    Calculated Fields

These two fields are calculated by the MOBILE6 model.

-- G_MI: Emissions of the given emission type (e.g., start, running loss, hot soak) and pollutant in grams per mile per average vehicle of the given type (e.g., LDGV) and age on the given facility (roadway) type during the given time period (hour or day).

-- G_HR or G_DAY: Emissions of the given emission type and pollutant in grams per hour or day per average vehicle of the given type and age on the given facility (roadway) type.

> **Note:** These calculated values are emission rates. They are not simple mass values that can easily be summed up. Calculations which involve combinations of these values require considerable care that proper weighting factors are used.

In the aggregated format option, the content of the calculated fields can be controlled by the DATABASE EMISSIONS and NO REFUELING commands. By default, the aggregated results by pollutant and vehicle class are the combination of all emission types summed over all vehicle ages and roadway types. Using the DATABASE EMISSIONS or NO REFUELING command, the emission types included in the aggregated results can be restricted.

### 3.1.2   Database Output Structure

The database output file is a highly "flattened" table structure. As a result many of its non-key field values do not depend upon all of its key fields. The technical term for this is that the table extensively violates second normal form. It is important for users to understand these field dependencies (or the lack of them) when working with the database output tables. All of the non-key fields depend upon FILE, RUN and SCEN. Beyond this their dependencies are as follows:

CAL_YEAR depends upon no other field.
STARTS and ENDS depend only upon HOUR (if present) and VTYPE.
MILES depends only upon HOUR (if present), VTYPE and AGE.
MPG depends only upon VTYPE and AGE.
HRVMT depends only upon HOUR.
FACVMT depends only upon HOUR (if present) and FTYPE
REG_DIST depends only upon VTYPE and AGE.
VCOUNT depends only upon VTYPE.
AMBTEMP and DIURTEMP depend only upon HOUR.
G_MI, G_HR and G_DAY depend upon all the key fields.
VMT depends upon VTYPE.
MYR depends upon AGE.

### 3.1.3   Restricting the Set Of Database Output Records Produced

If users request hourly database output and do nothing to restrict which records are produced, MOBILE6 produces a truly huge output file (about 35 megabytes per scenario). Therefore, users are advised to limit their requested data by using commands that limit the set of output records produced.

The POLLUTANTS command limits which of the three pollutants records are produced. This command also affects the descriptive output.

The DATABASE EMISSIONS command specifies which of the eight emission types records are produced.

The DATABASE FACILITIES command specifies which of the five values of facility type records are produced.

The DATABASE VEHICLES command specifies which of the 28 vehicle types records are produced.

As discussed above the DAILY OUTPUT command may be used to produce output in which the hourly data is aggregated to the daily level. This reduces the volume of the database output by a factor of about 30. Any combination of the above commands can be used.

The AGGREGATED OUTPUT command option allows the user to further aggregate the daily results by age, roadway and emission type. This reduces the number of data lines per scenario to a maximum of 84 lines (not including the optional field names). This can further be reduced by restricting the vehicle classes and the pollutants to be written using the DATABASE VEHICLES and POLLUTANTS commands.

## 3.2     DESCRIPTIVE OUTPUT

The default output for MOBILE6 is a basic descriptive output report which includes (following any error or warning messages and some introductory scenario identifying information) only the composite emission rates calculated for basic eight vehicle classes. Several of these classes are combinations of individual vehicle classes and are explained later in this section.

By default the descriptive output file is given the base name of the command input file with a .TXT filename extension. The user can give the file any desired DOS file name with the REPORT FILE Command.

A sample MOBILE6 descriptive output file is shown below in Figure 1:

Figure 1

```
*******************************************************************************
* MOBILE6 Draft (28-Aug-2000)                                                 *
* Input file: TESTAIR4.IN (file 1, run 1).                                    *
*******************************************************************************
  M603 Comment:
             User has disabled the calculation of REFUELING emissions.


* # # # # # # # # # # # # # # # # # # # # # # # # #
*
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M 48 Warning:
             there are no sales for vehicle class HDGV8b


              Calendar Year:  2000
                      Month:  Jan.
                   Altitude:  Low
        Minimum Temperature:   60. (F)
        Maximum Temperature:   84. (F)
          Nominal Fuel RVP:   11.5 psi
            Weathered RVP:    11.2 psi
        Fuel Sulfur Content:  300. ppm


                I/M Program:  No
                ATP Program:  No
           Reformulated Gas:  No


        Following assumptions made for air conditioning adjustments:
            Absolute Humidity:   75. grains/lb
            Sun rise at  600; Sun set at 2100
            Peak sun occurring between 1000 and 1600.
            Fraction of cloud cover equal to  0.00
```

| Vehicle Type: | LDGV | LDGT12 | LDGT34 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | All Veh |
|---|---|---|---|---|---|---|---|---|---|---|
| GVWR: | | <6000 | >6000 | (All) | | | | | | |
| | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ |
| VMT Distribution: | 0.494 | 0.283 | 0.097 | | 0.036 | 0.001 | 0.002 | 0.081 | 0.006 | 1.000 |

```
-----------------------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
```

| | LDGV | LDGT12 | LDGT34 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | All Veh |
|---|---|---|---|---|---|---|---|---|---|---|
| Composite THC : | 2.45 | 2.57 | 3.92 | 2.92 | 3.30 | 0.76 | 0.92 | 0.82 | 2.93 | 2.524 |
| Composite CO  : | 29.38 | 35.34 | 49.07 | 38.84 | 36.05 | 1.77 | 1.65 | 4.25 | 14.73 | 30.997 |
| Composite NOX : | 1.33 | 1.46 | 1.85 | 1.56 | 5.10 | 1.81 | 1.81 | 18.47 | 1.25 | 2.948 |

```
-----------------------------------------------------------------------------------------------
```

The main portion of the report is essentially a table with rows that represent different kinds (or combinations of kinds) of emissions and columns that are vehicle types (or combinations of vehicle types). This information is at a much more summary level than in the database output.  In particular, the descriptive output values are always aggregated by hour, facility (roadway) type, and age. So if detailed information is needed by hour, facility (roadway) type, or age, then the database output must be used. (A detailed description of the meaning of these terms is found in the Section 3.1.)

### 3.2.1  Descriptive Output Formatting Options

Users can suppress calculated descriptive outputs by including an optional command NO DESC OUTPUT in the header portion of the command input file. Presumably the user will also specify in this case that database output be produced. Otherwise the model will run without reporting any results.

Users can produce an expanded list of exhaust emission rates (engine start and running) by including an optional run-level command EXPAND EXHAUST in the command input file. These values are in addition to the basic descriptive output of composite emission rates. The start and running exhaust emissions are split for only the LDVs and LDTs. A total exhaust line is also printed that is the simple sum of the start and running exhaust emissions. Note that, the total exhaust differs from the composite exhaust for any HC output for gasoline vehicles. This is because the composite values include evaporative emissions while the total exhaust values do not.

Users can produce expanded rows detailing the evaporative emissions by type by including the optional run-level command EXPAND EVAP in the command input file. These values are in addition to the basic descriptive output of composite emission rates.

Users can produce an extra descriptive page of light-duty truck emission rates by weight (LDGT1, LDGT2, LDGT3, LDGT4, LDDT12 and LDDT34) by including an optional run-level command ("EXPAND LDT EFS") in the command input file. The user will get the basic descriptive output (composite) emission rates for these vehicle classes. This additional page will also be affected by the user options for expanded exhaust or evap emissions, as well as by user options controlling pollutants and speciation.

Users can produce an extra descriptive page of heavy-duty gasoline fueled truck emission rates by weight by including an optional run-level command ("EXPAND HDGV EFS") in the command input file. Users will get the basic descriptive output (composite) emission rates for these vehicle classes. This additional page will also be affected by  user options for expanded exhaust or evap emissions, as well as by user options controlling pollutants and speciation.

Users can produce an extra descriptive page of heavy-duty diesel-fueled truck emission rates by weight by including an optional run-level command ("EXPAND HDDV EFS") in the command input file. Users will get the basic descriptive output (composite) emission rates for these vehicle classes. This additional page will also be affected by user options for expanded exhaust or evap emissions, as well as by user options controlling pollutants and speciation.

Users can produce an extra descriptive page of diesel and gasoline fueled bus emission

rates (both school bus and transit bus) by including an optional run-level command ("EXPAND BUS EFS") in the command input file. Users will get the basic descriptive output (composite) emission rates for these vehicle classes. This additional page will also be affected by user options for expanded exhaust or evap emissions, as well as by user options controlling pollutants and speciation.

Users can select which pollutants will appear in all of the descriptive output options by including an optional command ("POLLUTANTS") in the header portion of the command input file. This option will allow any combination of pollutants (e.g., HC and NOx) and will suppress the output of pollutants not selected. The default is to include all pollutants (HC, CO and NOx). It should be noted that not selecting HC when using the POLLUTANTS command will result in MOBILE6 not reporting any HC emissions, even if the user has specified the reporting of expanded evaporative emission rates.

Users may select which variety of HC emissions (THC, NMHC, VOC, TOG and NMOG) will be calculated and reported in the descriptive output by including one of five optional run-level commands ("EXPRESS HC AS  ...") in the command input file. The default value for HC speciation will be VOC.  The descriptive output labeling reflects the selection of species by the user.

### 3.2.2   Explanation Of Additional  Items In The Descriptive Output

The descriptive output report includes a preliminary information section containing:

- Calendar year,
- Evaluation Month,
- Altitude,
- Min and Max Temperatures,
- Nominal Fuel RVP (user-supplied),
- Weathered RVP, and
- Fuel Sulfur Content.

The minimum and maximum temperatures reported in this section are selected from the hourly temperatures if the user supplies hourly temperatures. Otherwise, they are the values specified by the user with the MIN/MAX TEMP Command.

The vehicle classes and combinations of classes which appear in the default descriptive output are listed below:

- LDGV

--      LDGT 1 and 2 together (LDGT 1-2),

--      LDGT 3 and 4 together (LDGT 3-4),

--      LDGT 1,2, 3 and 4 together (LDGT),

--      LDDV

--      LDDT 1-2 and 3-4 together (LDDT),

--      All HDGV and HDGB together (HDG)

--      All HDDV and HDDB together (HDD),

--      All 28 sub-types together: (All Vehicles).


All 28 sub-type classes (LDGV, LDGT1, LDGT2, LDGT3, LDGT4, HDGV2b, HDGV3, HDGV4, HDGV5, HDGV6, HDGV7, HDGV8a, HDGV8b, LDDV1-2,LDDT1-2, HDDV2b, HDDV3, HDDV4, HDDV5, HDDV6, HDDV7, HDDV8a, HDDV8b, MC, HDGB, HDDB-T, HDDB-S, LDDT3-4.) can appear, separately, in the descriptive output with the use of the EXPAND LDT EFS, EXPAND HDGV EFS, EXPAND HDDV EFS, and EXPAND BUS EFS commands.


Any comments users place at the top of the command input file (before any command) are echoed immediately after the run header and before any error or warning messages or any other type of program output. There are other options for users to annotate the output using comments in the command input file as explained in Chapter 2.


The header is enclosed in a frame of asterisks (See Section 3.2, Figure 1). The eye-catching effect of the new header can be very useful when paging through long output files.


An output line that is printed before each scenario which includes the file number, run number, and scenario number. Again, this feature can be very useful when going through large output files.


To obtain the "by-model-year" results, users must specify the database output (see Sections 2.8.5.1 and 3.1).


## 3.3     **WARNING AND ERROR MESSAGES**


Diagnostic messages are used to caution users concerning user-supplied information. They are written to the descriptive output file and are produced even if the NO DESC OUTPUT command has been specified.


There are three types of diagnostic messages: errors, warnings, and comments. An error will in all cases terminate processing of the current scenario, and in most cases will terminate

processing of the entire run. In such cases, however, the program will print out all error messages for the run, not just the first one. Warnings and comments are included to assist users in the interpretation of the results.

Error messages indicate either that invalid input data were entered into MOBILE6, or MOBILE6 attempted to perform invalid operations. If the error message is due to an input value that is out of bounds, the range of acceptable values is also printed.

Warning messages indicate that MOBILE6 input data caused an operation not necessarily intended by the user, although the situation is not serious enough to necessarily be considered an error. Nonetheless, users should examine the warning messages to ascertain the conditions that were modeled, since these may be different from what was expected.

Comments are a type of diagnostic warning message that are printed for the user's information. Neither warning nor a comment will stop a MOBILE6 run.  *Would it be helpful to have examples of these messages here?*

## 3.4    USER SCREEN OUTPUT

As the MOBILE6 program executes, a very simple textual display is produced on the computer screen. The program announces itself, including giving version date information, then prompts for a batch or command input file name. Once this is entered by the user, the program displays some basic status information as it processes each scenario and run.

Of particular interest is that, following each run, a value of INERR is shown. Normally this value is zero. If a number other than zero is reported, this is the number of errors found in the input for that run.

## CHAPTER 4

## MOBILE6 INSTALLATION AND COMPUTER REQUIREMENTS

## 4.0      INTRODUCTION

This chapter contains technical information on how to install MOBILE6 that may be useful in implementing MOBILE6 on various computer systems. Although an attempt has been made to make this information clear to novice computer users as well as veteran MOBILE model users, this section cannot and does not attempt to train users on all aspects of every computer system. Some knowledge of the system onto which the MOBILE model is to be loaded and operated is required on the part of the user.

## 4.1      GENERAL INFORMATION

MOBILE6, the latest update to the highway vehicle emission factor model, is an official release of the Office of Transportation and Air Quality (OTAQ), U. S. Environmental Protection Agency (EPA), for use in State Implementation Plans and other official EPA business. MOBILE6 is provided without restrictions. That is, the software application, source code, and all related files may be copied and distributed freely and may be used as a basis for other work. However, any unauthorized modifications to the program may nullify its usefulness for official EPA business.

## 4.2      PROGRAM AVAILABILITY

Initial draft versions of MOBILE6 will be distributed via CD-ROM. Once an "official" version of is available, MOBILE6, along with the related external data files and the User's Guide document, will be available directly from EPA via the EPA/OTAQ web site shown below.

http://www.epa.gov/otaq/m6.htm

All versions of the distributed MOBILE6 executable application will only run on DOS-based PCs. All FORTRAN source code and external data files are in ASCII text format. The User Guide document is available in WordPerfect 8.0 for Windows and in Adobe Acrobat (PDF multi-platform) format.  There is no fee for these files. As stated in the above section, MOBILE6 is provided without restrictions.

Removable media (i.e., disks) containing this information may also be requested from EPA Regional offices or any of the other usual sources for EPA models. The model may also be requested directly from the Office of Transportation and Air Quality (OTAQ):

MOBILE6 Model
U.S. EPA, OTAQ, ASD
2000 Traverwood
Ann Arbor, MI 48105-2498
(734) 214-4892
mobile@epa.gov

Versions of MOBILE6 which can be run on platforms other than DOS-based PCs have not been prepared by EPA. However, as discussed in Section 4.1, it should be possible to create executable applications for any platform, as long as a FORTRAN90 compiler application is available to the user for that platform. However, EPA cannot assist users in their choice of a compiler or with running compiler software.

## 4.3     SYSTEM REQUIREMENTS

The executable DOS application version of MOBILE6 was compiled using the Lahey FORTRAN90 Version 4.0e compiler. The source code for this version of MOBILE6 is identical to the source code made available for other computer platforms. This is the platform that was used to develop the initial code for MOBILE6 and is the only executable application initially intended to be distributed.

The changes to the MOBILE model since the release of MOBILE4.1 (December 1991) have increased the size of the executable code such that it will no longer run within the base DOS 640K memory limit.  MOBILE6 requires that the program be run on a machine provided with and capable of using extended/expanded memory. In addition, the FORTRAN compiler used by EPA to produce MOBILE6 will only produce executable code which requires both a machine which uses a 80386 (or better) microprocessor and which has a math coprocessor chip installed.

As a result, with the given understanding of the limitations of the compiler and the size of the program, MOBILE6 will require at minimum the following microcomputer hardware configuration for DOS machines:

IBM-compatible 80386 (or better, such as 80486 or Pentium)
At least five megabytes of RAM memory.
Math coprocessor chip (such as Intel 80387)

Microcomputers using the 80286 microprocessor will not be able to run the MOBILE6 model.  Microcomputers using 80386- or 80486-based microcomputers without a math coprocessor also will not be able to run MOBILE6. MOBILE6 likely will not run in a DOS window of machines using the OS-2 operating system, since earlier versions of MOBILE were

observed to have this problem.

Because the scope of the MOBILE6 model has increased, the time required to run individual scenarios has increased over earlier versions. It is recommended that users consider the time it takes to execute runs of the model when selecting the appropriate machine for running MOBILE6. Using a 400 MHZ Pentium machine, typical scenarios take about 30 seconds each. The time necessary to run the model using older, slower machines, may be intolerable.  EPA recommends that only Pentium (or better) machines be used to run MOBILE6.

Since some of these system requirements may be a result of the particular FORTRAN compiler that was used, users with FORTRAN compilers may attempt to compile the source code themselves to have greater control over the characteristics of the final executable application. Users should refer to their compiler software documentation for further guidance.

## 4.4      INSTALLATION

MOBILE6 does not include an installation application. The necessary directories must be created by the user and the appropriate files must be copied by the user to the created directories. However, improper installation will not harm the files used by the model, although it may be necessary to relocate files in order to operate the model.

### 4.4.1   Basic Installation

For purposes of this section, it is assumed that the user has all of the files available from EPA related to MOBILE6. These files may have been downloaded from the EPA web site or available on a removable media (i.e., disk or CD-ROM). Some downloaded files may have been included in a compressed (ZIP) file. Such files must be removed from the compressed file (decompressed, "un-ZIP'd") before they can be used. There are publically available applications for this purpose, and obtaining and using those applications will not be discussed here.

The MOBILE6 program and related materials are distributed in the following DOS directory structure:

```
MOBILE6
      RUN
              EXAMPLES
      UGUIDE
      SOURCE
```

The simplest installation procedure is to copy this entire structure to the user's hard drive.

## 4.4.1.1    The RUN Subdirectory - The Executable Program

The MOBILE6 executable application file will run from any directory on any available drive, as long as the appropriate external data files requested by user input are available to the application. However, for practical purposes the user will probably want to locate commonly used files in the same directory as the executable application file in order to reduce the length of the combined file name and directory path name when specifying external data files in the input. The limitations are:

-- The file LF90.EER must reside in the same directory as the executable application file. This is an error description file used by the Lahey compiler and MOBILE6 will automatically look for this file in the local directory if a FORTRAN error occurs. MOBILE6 will run without this file being available, but some error messages will become cryptic, making diagnostics difficult.

-- All data and input files must have the read-only attribute set to "off." MOBILE6 will not read a file which has been set to read only status. This attribute can be changed by the user through the file properties.

The only critical file necessary to run MOBILE6 is the executable application file itself (M6DRAFT.EXE or MOBILE6.EXE) and the default example command input file, MOBILE6.IN. The command input file does not need to reside in the same directory as the MOBILE6 application to be used. Files ASMDATA.D and TECH12.D are also required if the effect of I/M programs are to be modeled.

It is recommended that users install more than simply the MOBILE6 application. In particular, it is recommended that users have the complete set of example inputs available for reference and for use as templates to create more complex command input files. Also, users will want a complete set of alternate external input files for use as templates for creating data inputs using local information. A set of alternate external data input files are provided with of MOBILE6. These alternate example files are useful as templates for construction of external data files which contain local data. The example external input files are set up assuming that they are available in the same directory as the MOBILE6 application. As a result, these example external data files should all be placed in the directory containing the MOBILE6 executable application file. These files will not interfere with any other input files and will only take effect if invoked within a command input file. It is recommended that these files not be changed. If they are used as templates, a copy should be made with a different filename and changes made to the copy. However, since they are invoked by the command input files, they must not be read only, since MOBILE6 will not read "read only" external data files.

### 4.4.1.2    The Examples Subdirectory

An additional subdirectory (i.e., EXAMPLES) should be created to contain example command input files. All of the example command input files provided should be placed in this directory for reference. It is recommended that these files be read only and not be changed. If they are used as templates, a copy should be made with a different filename and changes made to the copy. A complete list of the example command input files has been made available with the initial release of MOBILE6 and are available at the MOBILE6 web page (http://www.epa.gov/oms/m6.htm).

### 4.4.1.3    The UGUIDE Subdirectory

The MOBILE6 User Guide is made available electronically. Although it may be convenient to have a printed copy of the User Guide, it is recommended that the user keep a copy of the electronic version of the User Guide with the copy of MOBILE6. An additional subdirectory (e.g., UGUIDE) containing the MOBILE6 User Guide document files is recommended. There are two files:

UGMOBIL6.WPD (UGDRAFT.WPD for draft version)
UGMOBIL6.PDF (UGDRAFT.PDF for draft version).

### 4.4.1.4    The SOURCE Subdirectory

EPA will make available the FORTRAN source code for the "final" MOBILE6 application. This source code is provided to allow user to recompile the application for different platforms and to optimize the application for specific operating systems. However, unauthorized modifications to the program source code may nullify its usefulness for official EPA business. EPA cannot assist users in their choice of a compiler or with running compiler software. In most instances, users will not need to keep a copy of the MOBILE6 source code available. It is not needed to run the application and is not needed to understand how to run the model. It is not recommended that the source code be stored by the user. However, if the user wishes to keep a copy of the source code locally, it is recommended that a separate subdirectory (i.e., SOURCE) be created to keep the source code files.

### 4.4.2   Advanced Options

Users may want to share command input files and external data files to avoid duplication and confusion.  This is possible by locating these files on a network (shared) drive. Since MOBILE6 allows file names to include drive and directory path information, users will be able to share these files as long as they are properly identified in the command input file and specified in the keyboard entry of the file name. Some systems, however, specify shared drive locations differently for different users on the network. Caution should be taken to assure that all users

share the same location designation as well as simple access.

The MOBILE6 executable application file itself can be located on a shared drive. However, running MOBILE6 through a network will further slow the execution time. Since the MOBILE6 application file itself is not large and can be copied without restriction, it may make more sense to provide each user with their own copy on their local hard drive. The application itself does not change and does not need to be shared.

MOBILE6 cannot read directory names that are more than 8 characters or which contain characters that cannot be read by DOS. Some operating systems allow longer names and non-standard characters. Do not take advantage of these features.

## 4.5      RUNNING MOBILE6

MOBILE6 cannot be run in a full interactive mode. The user must provide a text file (i.e., a command input file) containing control information (i.e., commands, data) that MOBILE6 uses to determine what sort of output to produce. If such a file does not exist, MOBILE6 will not run. The user should read Chapter 2  to learn more about how to create an appropriate command input file. MOBILE6 is also distributed with many example command and external input data files. Users may want to use these example files to test or practice using MOBILE6. The command and external input files must exist on a drive available to the user and must not be compressed or set to read only.

### 4.5.1   Basic Run

To execute the application in DOS mode, invoke the application name at the DOS prompt by typing the name MOBILE6 and returning (the enter key). The program will return with a prompt:

```
"Enter the name of the Mobile6 input file:"
```

The file name the user enters will determine the source of input information used by MOBILE6. The user must enter the location of the input information and press the "enter" or "return" key. The program will prompt the user in the same way on all computer platforms. If the user enters an invalid file name or the name of a file that does not exist, MOBILE6 will prompt the user for a valid file name. If the user does not enter a file name at all (i.e., leave it blank) and presses return, the MOBILE6 application will quit. Valid file names are discussed in Section 4.5.5 below.

When using a version of MS Windows, double clicking on the MOBILE6 application icon will start a DOS window which will include the DOS prompt described above. The user will then enter the input information the same way as if running MOBILE6 from DOS.

MOBILE6 has been written to attempt to make use of the ability of DOS-based machines to access information that does not reside in the local directory. As a result, any time the MOBILE model asks for a file name, the user may also supply a DOS path with the file name. This will allow input and output file information to reside in directories other than the one in which the MOBILE6 model resides.

For example, the user has a command input file which is named TEST.IN on their hard drive at the location:

```
c:\mobile6\run\test.in
```

When MOBILE6 is invoked, the prompt will ask (prompt) for the location of the command input file. The user should enter the full drive, path and file name. It will not matter where the MOBILE6 application is located or where the command input file is located, as long as the full drive, path, and file name is entered when prompted.

Windows users can place "shortcuts" to the MOBILE6 application in convenient locations (i.e., the desktop) to make it easier to invoke the MOBILE6 application. The name of the directory which contains the MOBILE6.EXE file can be added to the PATH statement in the AUTOEXEC.BAT file, which will allow MOBILE6 to be invoked from any directory when in DOS mode. This will be of no advantage to users in Windows.

If the command input file is in a subdirectory of the directory which contains the actual MOBILE6 application (not a shortcut to the MOBILE6 application), then the full path name does not need to be used. This can reduce the amount of required typing by the user to enter the file name. For example, if in the above example the MOBILE6 application is in the directory c:\mobile6, then the file name can be entered (at the prompt) as:

```
run/test.in
```

MOBILE6 will search for a subdirectory of that name and locate the file there. The drive designation and the primary directory location are not needed. A slash (/) character may be substituted for the normal backslash (\) character for this purpose.

MOBILE6 will automatically label the output file names and choose file name extensions for the output files by default. For more information, see Section 4.5.3 below. This means that if the user does not specify the output file names and locations, all output will automatically be located in the same directory as the command input file. The output file names will also be the same as the command input file name, but with the different file name extensions. This feature allows users to run MOBILE6 without designating output file names. However, it is possible for users to designate output file names and locations. This feature is discussed in Section 4.5.5 below.

Another feature further allows shortening of the typing required by the user. MOBILE6 expects that all command input files have a file name extension of IN. For example, the above command input file prompt can further be shortened to:

```
run/test
```

In this case all output will be written to the c:\mobile6\run directory and all output files will have TEST file names with different file name extensions (depending on the type of output).

### 4.5.2   <u>Input</u>

Any word processing software or other text editor can be used to create or modify the example MOBILE6 command and external input files to match user requirements. Editing an example command or external input file with careful reading of the relevant sections of Chapter 2 as an aid is the easiest way to insure that the proper commands, locations and formats are maintained. However, when using word processing software the user should be careful to always save input files only as DOS text documents (ASCII text). MOIBLE6 expects all input files to be in text. Converting and saving MOBILE6 input files as word processing documents will add hidden characters to the file which will not be properly processed by the MOBILE model. Command and external input files which have been inadvertently converted to a word processing document can be recovered by saving the file again as a DOS text file. Simple text editors (such as NOTEPAD) will not normally add unwanted characters to a file. Do not add hidden characters (such as tabs) to MOBILE6 input files. MOBILE6 cannot read them properly.

The user can determine if an input file has hidden characters by using the TYPE command available in DOS to list the input file to the screen. Any characters shown which were not intended to be in the file will likely cause problems when the file is read by the MOBILE6 model. An example of the TYPE command, with an option to pause after each screen of characters would be:

```
TYPE <file name> | MORE
```

Most word processors and editors also have features that allow the user to see hidden characters. These features can also be used to identify and remove hidden characters.

When altering or creating MOBILE model command or external input files, the user should be aware of the rules for annotating the input and output text (described in Sections 2.6.3 and 2.7). MOBILE6 allows liberal inclusion of descriptive text in command and external input files and allows text to be added to the output by the command input file. EPA encourages users to take advantage of this feature of MOBILE6.

### 4.5.3   Output

All results from MOBILE6 are written to ASCII text files. There are two basic output types, descriptive and database. Descriptive output is appropriate to be printed and includes sufficient labeling and notation to be interpreted without extensive knowledge of MOBILE6. The database output is intended to be processed using applications such as database software or spreadsheets. Interpretation of the database output will require advanced understanding of MOBILE6. Both output options are described in more detail in Chapter 3.

By default, MOBILE6 uses two file name extensions, TXT and TB1. The descriptive output will be found in the file name with the TXT extension. The database output will be found in the file name with the TB1 extension. The user has the option to specify the file name of the output file. This feature is discussed in Section 4.5.5 below.  EPA recommends that the output file names be the same as the input file name to avoid confusion when matching MOBILE6 results with the corresponding command input file that was used to create it. By default, output files are written to the same directory location as the command input file. This location can be altered by providing the output file name and indicating a different path for output file names.

The descriptive output file can be printed, once it has been opened by an application, such as a word processor. For best results EPA recommends that the font used be non-proportional (such as COURIER font), since the output file design contains no formatting characters (such as tabs). Since the output is 120 characters wide, EPA recommends that the pages be printed "landscape" (11" by 8-1/2"), the font size be reduced to 10-point, and that both the left and right margins be set to 0.5 inches. In this case the full width of the descriptive output should fit on a standard page. Since the length of the output is determined by a great variety of parameters, it is likely that the text of the output will run over several pages. EPA recommends that automatic page numbering be added to the output document by the user using options available in the application used for printing. A run and scenario number will be indicated in the text within the output itself.

The database output file is not intended to be printed. Unless the user specifies the WITH FIELDNAMES command in the header section of the command input file (see Section 2.8.5.1.b), the database output will be an ASCII text file containing thousands of numbers and no text. EPA recommends that applications designed to process numbers be used to access this information, such as database, spreadsheet or statistical applications. A detailed description of the content of the database output is found in Chapter 3 above.

### 4.5.4   Batch Input

"Batch" input, in terms of MOBILE6, is used to refer to the ability to run several command input files together with a single invocation of the MOBILE6 application. Each command input file can contain several runs with multiple scenarios, where each scenario

produces a separate result. In this way, many results can be obtained by either multiple runs in an command input file or by running multiple command input files using the batch option. Setting up a batch input file is described in Section 2.8.2.2.

Running a batch input file is done exactly the same as any input file. The first line of any MOBILE6 input file must contain the command which describes what sort of data is contained in the file. A batch input file announces itself to the MOBILE6 program using the MOBILE6 BATCH FILE command. MOBILE6 will then process the input and output file names it contains. If, for example, the user created a batch input file with the name TESTBAT.IN, at the file name prompt, the user could type:

```
run/testbat
```

This assumes that the TESTBAT.IN file is located in a subdirectory named RUN and that the MOBILE6 application is located in the directory which has the subdirectory RUN. None of the files (input or output) which are listed in the TESTBAT.IN file need to be in either directory as long as the path is included with each file name.

### 4.5.5   Input and Output File Names

Input and output file names cannot contain more than eight characters, followed by a decimal and an optional three character extension. The names must contain only valid DOS file name characters.  A batch or command input file name must be provided or MOBILE6 will not run. The content of input and output files is discussed in Chapters 2 and 3 above.

The user may specify a name for any MOBILE6 output file or elect to have MOBILE6 assign a default name. By default, all output file names will use the same initial eight characters to name output files, but will add extensions which indicate the type of output contained in each file.

- The extension TXT is used for descriptive output files
- The extension TB1 is used for database output files

Although the user cannot change the default extension used for output files, the eight character name may be specified for any MOBILE6 output file. The file will still have either the TXT or TB1 extension, but will have the name the user has specified. To avoid confusion, it is recommended that all output file names be the same (except for the extensions) as the names of the command input files that were used to generate the results. This will make it easier to associate the resulting data with the associated command input file. However, there may be cases where the user wishes the name and/or location of the output files to be different than that of the command input file that created them.

To name output files when using a standard (non-batch) command input file, the user can simply enter the desired output file name next to the user-supplied input file name when entering the command input file name after the initial "Enter the name of the MOBILE6 input file:" prompt. The user must leave at least one blank space between the input and output file names and may only specify an output file name if the command input file name has already been specified. The output file name used with the initial prompt will take precedence over the file name specified using the REPORT FILE command (See Section 2.8.4.1). If the output file name is not specified as part of the response to the initial prompt, then the optional REPORT FILE command can be used from within the command input file to name the output file. If the name entered is for a batch input file (See Section 2.8.2.2), adding an output file name after the name of the batch input file will have no effect.  Naming output files using a batch input file is discussed below.

By default, if no output file name is specified, the output file will be written to the same directory as the location of the command input file (as indicated in the path portion of the file name). If an output file name is specified, but does not contain a path, the output file will not be written to the same directory as the command input file. Instead, it will be written to the same directory as the MOBILE6 application. If the user wishes to have the output written to another directory, the path to the directory must be specified in the output file name. MOBILE6 will treat slashes (/) and backslashes (\) interchangeably in the path names. The user does not need to include the full path (i.e., including the drive designation and the root directories) if the directory in which the user wishes to write the output file is a subdirectory of the directory which contains the MOBILE6 application. For example:

```
Enter the name of the MOBILE6 input file:
c:\city\data

Enter the name of the MOBILE6 input file:
c:\city\input.in  c:\results\output

Enter the name of the MOBILE6 input file:
test/m6in  m6out
```

The first example indicates that the input file (DATA.IN) is located in the C:\CITY directory. The descriptive output file will be written to the C:\CITY directory and will be named DATA.TXT and DATA.TB1 if database output is specified. The second example indicates that the command input file (INPUT.IN) is located in the C:\CITY directory. The descriptive output file will be written to the C:\RESULTS directory and will be named OUTPUT.TXT and OUTPUT.TB1 if database output is specified. The last example indicates that the command input file (file M6IN.IN) must be located in the \TEST subdirectory of the directory in which the MOBILE6 application is located.  The results will be written to the same directory as the MOBILE6 application and will have the default names (M6OUT.TXT and M6OUT.TB1).

Database output file names (with the TB1 extension) can be specified from within a

command input file using the EMISSIONS TABLE command (See Section 2.8.5.2). However, specifying the output file names using any of the other methods discussed in this section will take precedence over the EMISSIONS TABLE command. For example, the output file name added to the entry of the command input file name after the initial prompt will be used instead of any output file name entered using the EMISSIONS TABLE command. Similarly, entry of output file names from within a batch input file (discussed below) will take precedence over the EMISSIONS TABLE command.  The output file name specified using the REPORT FILE command will not affect the EMISSIONS TABLE command.

       To name output files within a batch input file, enter the desired output file name(s) following any corresponding command input file name. The user must leave at least one blank space between the input and output file names. By default, if an output file name is not specified, the output file will be written to the same directory as the location of the command input file (as indicated in the path portion of the file name). If the user specifies an output file name, but does not include a path, the output files will not be written to the same directory as the command input file. Instead, the output files will be written to the same directory as the MOBILE6 program. If the user wishes to have the output written to another directory, the path to the directory must be specified in the output file name.  MOBILE6 will treat slashes (/) and backslashes (\) interchangeably in the path names. The user does not need to include the full path (i.e., including the drive designation and the root directories) if the directory in which the command input file is located is a subdirectory of the directory which contains the MOBILE6 application. An example of this is shown below.

```
MOBILE6 BATCH INPUT
c:\town\input
c:\village\data.inp  c:\results\output.dat
run12
test/m6in  m6out
```

       The results from the first command input file (file INPUT.IN, located in the C:\TOWN directory) will be written to the file INPUT.TXT (and INPUT.TB1), located in the C:\TOWN directory.  The results from the second command input file (file DATA.INP, located in the C:\VILLLAGE directory) will be written to the file OUTPUT.TXT (and OUTPUT.TB1), located in the C:\RESULTS directory. Note that although the DAT extension is used on the output file name, the extension is ignored by MOBILE6 and the default extensions (TXT and TB1) are used instead. The third command input file (file RUN12.IN) must be located in the same directory as the MOBILE6 application, since the user did not specify a path. The results will be written to the same directory and will have the default names (RUN12.TXT and RUN12.TB1). The last example indicates that the command input file (file M6IN.IN) must be located in the \TEST subdirectory of the directory in which the MOBILE6 program is located. The results will be written to the same directory as the MOBILE6 application and will have the default names (M6OUT.TXT and M6OUT.TB1).

To help avoid confusion as to which files it is using, MOBILE6 displays the names of both the command input file and the descriptive output file on the monitor screen before it processes the file. In batch mode, the names of all the command input files and the descriptive output files are displayed on the monitor screen before the model begins to process each command input file. Database output file names are not displayed on the monitor screen.

### 4.5.6   Open Actions

The user may optionally specify open actions for output files. These actions dictate whether MOBILE6 creates a new output file or inserts modeling results into an existing output file. The legal open action options are APPEND and REPLACE. Both options create a new file if the specified output file name does not already exist. If the output file does already exist:

- The APPEND action adds  new output to the end of the output file. Thus, results from previous MOBILE6 runs using the same output file name are retained.

- The REPLACE action deletes existing text in the output file, so that only new modeling results are retained. REPLACE is the default open action.

To avoid confusion, it is recommended that the APPEND action be used only in special circumstances. This will assure that the output files contain only the results from the most recent running of the associated command input file. These options may be entered in mixed case. If no open action is specified, the action will default to REPLACE.

In order specify the open action, the user must enter both the command input file name and the output file name. The open action is entered on the same line, following the output file name. The open action must be separated from the output file name by at least one blank space and may be specified in mixed case.

### 4.6    OTHER PLATFORMS

An executable application of MOBILE6 is not provided for any other platforms. Since the source code for all computer platforms is identical, a source code file available on one platform (such as DOS-based microcomputers) may be used on another platform (such as a mainframe computer or mini-computer) as long as any appropriate changes for that platform are made to the device allocations. This will require the user to have access to a FORTRAN90 compiler capable of handling the MOBILE6 source code in order to re-create the executable application from the (altered) source code.

EPA cannot assist users in their choice of a compiler or with running compiler software. EPA will not be able to assist users with problems resulting from conflicts with the platform operating system. MOBILE6 will run the same way on all computer platforms and have all of the

same options and capabilities. As a result, the same User's Guide may be used for all versions. See Section 4.1 for additional cautions about using MOBILE6 on other platforms.

Below are some considerations that may be helpful for users who intend to create MOBILE6 executable applications for their own platforms.

### 4.6.1   Apple Macintosh Microcomputers

Macintosh operating systems use different default device assignments than DOS-based machines. This will likely require changes to the default device assignments in MOBILE6. In particular the assignment of the keyboard input may be different. Below is the correct assignment for the keyboard input variable:

Keyboard input        (IOUIN)        Device 9

The location of files in the Macintosh operating system works differently than in DOS. As a result, it is recommended that all input and external data files be placed in the same folder as the MOBILE6 application. In this way, only the file name (and not the path) is needed for the command input file prompt.

To execute the application, double-click on the MOBILE6 icon or choose FILE OPEN from the system menu. A window will appear with the MOBILE6 standard prompts. The program will prompt the user in the same way on all computer platforms.

### 4.6.2   Mainframe and Minicomputers

The MOBILE6 model was developed and compiled for DOS-base microcomputers. For users who would like to install MOBILE6 on their own mainframe (or minicomputer) system, a FORTRAN90 compiler program will be necessary to create an executable application on the destination system. The source code for the mainframe version of MOBILE6 is identical to the source code made available for other computer platforms, except perhaps for the default settings for the input and output (I/O) devices, depending on the specific requirements of the system. It will be necessary for the MOBILE6 source code and other files to be uploaded to a mainframe or minicomputer from the web site or other source (i.e., removable media).

The default device assignments for MOBILE6 will likely cause problems on some minicomputers. Although the Office of Transportation and Air Quality (OTAQ) has not run MOBILE6 on a minicomputer, the following comments have been received from users with SUN Sparc systems using the UNIX operating system with earlier versions of MOBILE. The modifications discussed in this section are known to be useful only for SUN workstations; other systems may require different device assignments. Since the only difference between the source code for the various platforms is in the device assignments, the source code used for a

minicomputer can come from any of the available platforms.

Standard device assignments for the SUN machines are "5" for input, "6" for output and "0" for error messages. This suggest that the following device assignments be made in the main program:

| | | |
|---|---|---|
| Keyboard input | (IOUIN) | Device 5 |
| Control file input | (IOUGEN) | Device 11 |
| Error message output to file | (IOUERR) | Device 0 |
| Program descriptive output | (IOUREP) | Device 0 |

It is important to remember that some external data files are read using device assignments "101" and "3". These values, therefore, should not be used for any other devices. Also, external data file names entered as part of the input must match the case of the actual file names since UNIX machine operating systems are case sensitive.

The changes mentioned above have not been tested. Other minicomputer systems may require different device assignments that those given above for SUN systems; however, any changes in the device assignments will not affect the validity of the results of the model.

## 4.7      MOBILE6 CODE

### 4.7.1   Source Code

The MOBILE6 model as released was written in standard FORTRAN90 computer language, using the ANSI X3.9-1978 standard published by the American National Standards Institute.

The source code is distributed in ASCII text files. Most subroutines and functions have been separated into separate text files, although some files may contain more than one function or subroutine.  All subroutine and function files have the filename extension *.FOR. Files which have the extension *.I are "include" files , which contain information used in common blocks. MOBILE6 was compiled using an option (MAKE) which allowed the various subroutines to be compiled separately and "linked" at the end to make the executable application. The various function and subroutine files may be combined, if the user wishes, to reduce the number of files that must be compiled without affecting the results from the program.

The identical source code (including all comment records) was used for all official versions of the model made available, with the exception of necessary changes in the input/output (I/O) device allocations for different platforms. There are sixteen (16)  device assignments. Many of these device assignments are handled using variables. The variable name used to represent the device assignment in the program code is listed below. Some of these connections are made to the same device number using a different variable name. Some device

assignments were done using hard coded values, as indicated below.

| Description | Variable Name | Default Device Number |
|---|---|---|
| Control file input | (IOUGEN) | 1 |
| I/M parameters input | (IOUXIM) | 3 |
| I/M credit input | (IOUIMD) | 4 |
| Keyboard input | (IOUIN) | 5 |
| External data file input | (IOUALT) | 7 |
| Batch control file input | (IOBAT) | 19 |
| Program descriptive output | (IOUREP) | 2 |
| Error message output to file | (IOUERR) | 2 |
| Monitor screen output | (IOUOUT) | 6 |
| Program database output | (DBUNIT) | 51 - 57 |
| Unneeded output | (IOUNULL) | - 1 |

The device assignment variables are initialized in Block Data Subprogram 16. The device assignment variables are also reset in the "driver" program when the application is invoked.

The default setting for these devices are optimized for the DOS platform. If a user wishes to change the default settings, care should be taken that the settings are changed at all points where the device allocations are made. Otherwise, it is likely that the settings will revert back to the default values unexpectedly. In general, it is prudent for users not to attempt to change the device settings unless it is absolutely necessary. The hard coded values must be changed in the subroutines where they are used. Device assignment 101 is used in GETM5IM and device assignment 3 is used in RDT12C.

Since the source code for all computer platforms is identical, a source code file available on one platform (such as DOS-based microcomputers) may be used on another platform (such as a mainframe computer or mini-computer) as long as any appropriate changes for that platform are made to the device allocations. However, this will require the user to have access to a FORTRAN90 compiler capable of handling the MOBILE6 source code in order to re-create the executable application from the (altered) source code.

MOBILE6 will run the same way on all computer platforms and have all of the same options and capabilities. As a result, the same User's Guide may be used for all versions. There are some minor considerations that are platform-specific and are discussed in the remainder of this section.

### 4.7.2   <u>**Platform Specific Differences**</u>

There sometimes will be a negligible difference in the model results (the emission factors calculated by MOBILE6) as run on DOS-based microcomputers, compared to results obtained from running the model on other platforms. This discrepancy is likely due to the number of significant digits that the computer system carries when doing calculations. The differences are usually small (less than one half of one percent), but they sometimes will show up in larger numbers in the last digit of MOBILE6 output. As a result, for the sake of consistency, comparison or mixing of results from MOBILE6 runs executed on different computer platforms is not recommended.

Also, the FORTRAN compilers available to EPA for development of the release version of MOBILE6 are not the only ones available. However, there are limits to the amount of exploration into compiler differences that can be done by EPA. It may be possible to re-compile MOBILE6 source code using a different compiler to avoid limitations in the distributed version of MOBILE6. However, EPA cannot assist users in their choice of a compiler or with running compiler software.

Although the MOBILE6 code accepts file names and pathway information up to 80 characters in length, some FORTRAN compilers (for example, Lahey F77 v5.10) are more restrictive. The code produced by that compiler for the file OPEN and INQUIRE functions will fail if it tries to process file names that are longer than 50 characters. This restriction does not show up in the later Lahey FORTRAN90 compiler. Executable modules built with the LF90 compiler, like the executable copy of MOBILE6 distributed by EPA, accept file names of 80 characters or more.

# CHAPTER 5

# CHANGES SINCE MOBILE5

## 5.0    INTRODUCTION

This chapter discusses the differences between MOBILE5 and MOBILE6 in preparing a command input file. As stated in Chapter 2, MOBILE6 uses commands for the input of file, output, and run and scenario-level options, thereby eliminating the need for the control flags used in MOBILE5. Some MOBILE6 commands reduce the amount of required input by allowing for the use of external files to contain input data, whereas MOBILE5 required all of the input data to be included within the MOBILE5 equivalent of the command input file. Below is a listing of the differences by MOBILE6 command relative to MOBILE5 (i.e., options, format requirements, and/or use within the model). For detailed information on MOBILE6 commands, please refer back to Section 2.8.

## 5.1    SEPARATOR COMMANDS

| MOBILE6 Command | Difference Between MOBILE5 and MOBILE6 |
|---|---|
| MOBILE6 INPUT FILE | MOBILE5 did not have this command. |
| MOBILE6 BATCH FILE | MOBILE5 did not have this command. |
| RUN DATA | MOBILE5 did not have this command. |
| SCENARIO RECORD | This is somewhat analogous to the "scenario description record" in MOBILE5. In MOBILE6, only a title for the scenario may be specified with the SCENARIO RECORD command. The other data items, formerly supplied in MOBILE5, are now handled by separate MOBILE6 commands. |
| END OF RUN | In MOBILE5, this feature was triggered using a row of zeros. |

## 5.2    ALL OUTPUT COMMANDS

| MOBILE6 Command | Difference Between MOBILE5 and MOBILE6 |
|---|---|
| POLLUTANTS | In MOBILE5, this feature of limiting the calculations to only HC, CO, or NOx was triggered using the flags PRTFLG=1, 2, or 3, respectively. |
| EXPRESS HC AS NMHC<br>EXPRESS HC AS NMOG<br>EXPRESS HC AS THC<br>EXPRESS HC AS TOG<br>EXPRESS HC AS VOC | Specifying which form of HC MOBILE5 produced in the output was done using the flag NMHFLG=2,3,4,5, or 6. |
| NO REFUELING | In MOBILE5, zeroing out the refueling (i.e., Stage II) emissions was triggered using the flag RLFLAG=5. |

## 5.3    DESCRIPTIVE OUTPUT COMMANDS

| MOBILE6 Command | Difference Between MOBILE5 and MOBILE6 |
|---|---|
| REPORT FILE | New feature, no precedent in MOBILE5. |
| NO DESC OUTPUT | New feature, no precedent in MOBILE5. |
| EXPAND BUS EFS<br>EXPAND HDDV EFS<br>EXPAND HDGV EFS<br>EXPAND LDT EFS | New feature, no precedent in MOBILE5. |
| EXPAND EXHAUST | New feature, no precedent in MOBILE5. |
| EXPAND EVAPORATIVE | In MOBILE5, this feature was triggered using the flag HCFLAG=3. |

## 5.4     DATABASE OUTPUT COMMANDS

| MOBILE6 Command | Difference Between MOBILE5 and MOBILE6 |
|---|---|
| DATABASE OUTPUT<br>WITH FIELDNAMES<br>DATABASE OPTIONS<br>DATABASE EMISSIONS<br>DATABASE FACILITIES<br>DATABASE VEHICLES<br>DAILY OUTPUT | New feature, no precedent in MOBILE5. |
| EMISSIONS TABLE | New feature, no precedent in MOBILE5. |

## 5.5     EXTERNAL CONDITION COMMANDS

| MOBILE6 Command | Difference Between MOBILE5 and MOBILE6 |
|---|---|
| CALENDAR YEAR | Two changes have been made to the calendar year of evaluation. First, years are treated as four-digit inputs. Second, the window of years for which emission factors can be estimated has been extended by 30 years, such that MOBILE6 will calculate emission factors for any year up through 2050 (as in MOBILE5b). In MOBILE5, the calendar year was input via the Scenario Record. In MOBILE6, only a title for the scenario may be specified with the SCENARIO RECORD command. Data items formerly entered via the scenario record in MOBILE5 are now handled by separate MOBILE6 commands. |
| EVALUATION MONTH | In MOBILE5, the evaluation month was entered via the Scenario Record. In MOBILE6, only a title for the scenario may be specified with the SCENARIO RECORD command. Data items formerly input via the scenario record in MOBILE5 are now handled by separate MOBILE6 commands. |
| MIN/MAX TEMPERATURE | In MOBILE5, this feature was triggered using the local area parameter (LAP) record. |
| HOURLY TEMPERATURES | New feature, no precedent in MOBILE5. |

| MOBILE6 Command | Difference Between MOBILE5 and MOBILE6 |
|---|---|
| ALTITUDE | In MOBILE5, this feature was included in the "REGION" variable in the Scenario section. |
| ABSOLUTE HUMIDITY | Humidity was specified in MOBILE5 via the ALHFLG. |
| CLOUD COVER<br>PEAK SUN<br>SUNRISE/SUNSET | New inputs, no precedent in MOBILE5. |

## 5.6    VEHICLE FLEET CHARACTERISTIC COMMANDS

| MOBILE6 Command | Difference Between MOBILE5 and MOBILE6 |
|---|---|
| REG DIST | In MOBILE5, this feature was triggered using the flag MYMRFG=2,4. |
| DIESEL FRACTIONS | In MOBILE5, this feature was triggered using the field DSFLAG on the local area parameter (LAP) record. In MOBILE5, the smaller number of vehicle classes resulted in only 50 (instead of 350) sales fractions being needed. MOBILE6 diesel sales fractions now apply to heavy-duty vehicle classes as well as the light-duty vehicle classes affected in MOBILE5. |
| MILE ACCUM RATE | In MOBILE5, this feature was triggered using the flag MYMRFG=2,4. In MOBILE6, the user must enter this information from an external data file. The option of reading it directly from the input has been removed. |
| NGV FRACTION | New feature, no precedent in MOBILE5. |

## 5.7    ACTIVITY COMMANDS

| MOBILE6 Command | Difference Between MOBILE5 and MOBILE6 |
|---|---|
| VMT FRACTIONS | In MOBILE5, there were only eight vehicle classes; therefore, this feature required only eight VMT fractions instead of the 28 fractions needed for MOBILE6. Also, in MOBILE5, this feature was triggered using the flag VMFLAG=2,3. |

| MOBILE6 Command | Difference Between MOBILE5 and MOBILE6 |
|---|---|
| VMT BY FACILITY<br>VMT BY HOUR | New features, no precedent in MOBILE5. |
| SPEED VMT | In MOBILE5, a single average speed could be specified for all or for eight individual vehicle types. This was done with the SPDFLG. MOBILE6 requires speed <u>distributions</u> for each <u>hour</u>. |
| STARTS PER DAY | MOBILE5 computed the number of trips per day by vehicle class. These values varied by vehicle age for light-duty gasoline fueled cars and trucks.  There was no user input for these values. MOBILE6 uses a single number for trips per day for each vehicle class. These values do not vary by vehicle age. There are separate values for weekdays and weekends. The user may substitute local data for the default values. |
| START DIST | MOBILE5 computed the number of trips per day by vehicle class. These values varied by vehicle age for light-duty gasoline fueled cars and trucks. There was no user input for these values. Since only daily averages were calculated, there was no need for a temporal distribution of engine starts. MOBILE6 uses a temporal distribution of the engine starts per day. These values do not vary by vehicle class or vehicle age. There are separate values for weekdays and weekends. The user may substitute local data for the default values. Factors that affect engine start emissions that change over the day, such as ambient temperature, will affect the overall estimate of emissions from engine starts. |
| SOAK DISTRIBUTION | MOBILE5 did not have hourly distributions. MOBILE5 did not allow user input of this information. The engine start soak time distribution in MOBILE5 was controlled indirectly using the operating mode inputs on the scenario record. Only two points on the soak time distribution, at 10 minutes (hot start) and 12 hours (cold start), were available. In MOBILE5, the distribution was used for the full day. |
| HOT SOAK ACTIVITY | New feature, no precedent in MOBILE5. |

| MOBILE6 Command | Difference Between MOBILE5 and MOBILE6 |
|---|---|
| DIURN SOAK ACTIVITY | New feature, no precedent in MOBILE5. |
| WE DA TRI LEN DI<br>WE EN TRI LEN DI | A single trip length distribution could be specified in MOBILE5 with SPDFLG = 3 or 4. MOBILE5 did not have separate distributions for weekdays and weekends. |
| WE VEH US | New feature, no precedent in MOBILE5 |

## 5.8     STATE PROGRAM COMMANDS

| MOBILE6 Command | Difference Between MOBILE5 and MOBILE6 |
|---|---|
| STAGE II REFUELING | In MOBILE5, this feature was triggered using the flag RLFLAG=2,4. |
| ANTI-TAMP PGM | In MOBILE5, this feature was triggered using the flag ATPFLG=2,5,6,8. |
| I/M PROGRAM<br>I/M MODEL YEARS<br>I/M VEHICLES<br>I/M STRINGENCY<br>I/M COMPLIANCE<br>I/M WAIVER RATES<br>I/M CUTPOINTS<br>I/M EXEMPTION AGE<br>I/M GRACE PERIOD<br>I/M DESC FILE<br>NO I/M TTC CREDITS | When there is more than one item in the data field of these I/M program input labels, the formatting requirements are different than for MOBILE5. In MOBILE5, it was often possible to leave data items blank in order to allow the MOBILE5 model to assign default values for them. This is not possible in MOBILE6 for exhaust I/M parameters.<br><br>Purge tests are not modeled in MOBILE6.  In MOBILE5, "Functional Pressure" (now "Fill-pipe pressure") tests were accessed by setting ATPFLG=3,5,7 or 8.  In MOBILE5, the characteristics of the pressure tests were controlled with a "functional pressure test input record".<br><br>OBD checks and gas cap checks are new features in MOBILE6.<br><br>***This needs to be reviewed and revised for exhaust I/M*** |
| I/M EFFECTIVENESS | The Program Effectiveness Flag on the I/M Descriptive Record required the input of the Program Effectiveness Record in MOBILE5b. This record contained the effectiveness rates for I/M programs. |

| MOBILE6 Command | Difference Between MOBILE5 and MOBILE6 |
|---|---|
| I/M TTC EFF | When the IMFLAG control flag was set to "6" in MOBILE5b, it required the input of the I/M Program Control Flag Record, which contained the Technician Training and Certification benefits (TTC) flag. |

## 5.9    FUEL INPUT COMMANDS

| MOBILE6 Command | Difference Between MOBILE5 and MOBILE6 |
|---|---|
| FUEL PROGRAM | In MOBILE5, this feature was triggered using the field RFGFLG on the local area parameter (LAP) record. The RFG region was triggered using the ASTM label. Areas using ASTM classes A and B were assumed to be Southern (Region 1) areas and areas using ASTM classes C, D and E were assumed to be Northern (Region 2) areas for purposes of RFG calculations. "ASTM" is no longer an input to MOBILE6. |
| SULFUR CONTENT | New feature, no precedent in MOBILE5. |
| OXYGENATED FUELS | In MOBILE5, this feature was triggered using the field OXYFLG on the local area parameter (LAP) record. |
| FUEL RVP | The inputs for MOBILE5 allowed for a "Period 1" and "Period 2" RVP and "Period 2" Start Year. These flags are dropped from MOBILE6 and replaced with a single user-specified value for RVP. This feature was triggered using the local area parameter (LAP) record. In addition, the range of RVP has been increased in MOBILE6 by reducing the lower bound of the range from 7.0 to 6.5 psi. |
| SEASON (WINFLG) | New feature, no precedent in MOBILE5. |

## Appendix A

## Alphabetical List of MOBILE6 Commands

| Command Name | Users' Guide Section | Command Input File Section | Exhaust or Evap | Command Parameter Type | Required Command? | Command Function |
|---|---|---|---|---|---|---|
| ABSOLUTE HUMIDITY | External Conditions | Run or Scenario | Exhaust | value | | Absolute humidity in grains/pounds. |
| AGGREGATED OUTPUT | Database Output | Header | Both | on/off | | Database output by daily time periods aggregated to the level of the descriptive output. |
| ALTITUDE | External Conditions | Scenario | Both | option | | High or low altitude of area evaluated. |
| ANTI-TAMP PROG | State Programs | Run | Both | pgm descrip | | Anti-Tampering Programs |
| CALENDAR YEAR | External Conditions | Scenario | Both | value | Yes | Calendar year of scenario evaluated. |
| CLOUD COVER | External Conditions | Run or Scenario | Exhaust | value | | Allows user to input fraction of cloud cover for a given day. |
| DAILY OUTPUT | Database Output | Header | Both | on/off | | Database output by time periods. |
| DATABASE EMISSIONS | Database Output | Header | Both | Etype choice | | Limits which of 8 types of emissions are reported in database output format. |
| DATABASE FACILITIES | Database Output | Header | Both | Facility choice | | Limits which of 5 roadway types have emissions reported. |
| DATABASE OPTIONS | Database Output | Header | Both | file name | | Specifies name for external file holding a set of database output selection records. |
| DATABASE OUTPUT | Database Output | Header | Both | on/off | | Specifies M6 to report output in database format. |
| DATABASE VEHICLES | Database Output | Header | Both | Vehicle choice | | Limits which of 28 vehicle types have emissions reported in database output format. |
| DIESEL FRACTIONS | Fleets | Run or Scenario | Both | ext file | | Allows user-supplied alternate diesel sales fractions. |
| DIURN SOAK ACTIVITY | Activity | Scenario | Evap | ext. file | | Specify alternative distribution of diurnal soak times. |
| EMISSIONS TABLE | Database Output | Header | Both | file name | | Specifies a filename for EMISSIONS database table output file. |
| END OF RUN | Separators | End of Run | Both | | | Required to separate multiple runs in command input files. |
| EVALUATION MONTH | External Conditions | Scenario | Both | value | | Specifies January 1 or July 1 for calendar year of interest. |
| EXPAND BUS EFS | Descriptive Output | Run | Both | on/off | | Directs M6 to report gas, urban and school bus categories |

| Command Name | Users' Guide Section | Command Input File Section | Exhaust or Evap | Command Parameter Type | Required Command? | Command Function |
|---|---|---|---|---|---|---|
| | | | | | | separately. |
| EXPAND EVAPORATIVE | Descriptive Output | Run | Evap | on/off | | Display all 6 evaporative emission types in descriptive output. |
| EXPAND EXHAUST | Descriptive Output | Run | Exhaust | on/off | | Causes start, running and total exhaust EFs to be displayed in descriptive output. |
| EXPAND HDDV EFS | Descriptive Output | Run | Exhaust | on/off | | Directs M6 to display EFs by 8 HDDV classes. |
| EXPAND HDGV EFS | Descriptive Output | Run | Both | on/off | | Directs M6 to display EFs by 8 HDGV classes. |
| EXPAND LDT EFS | Descriptive Output | Run | Exhaust | on/off | | Directs M6 to display EFs by 6 LDT classes. |
| EXPRESS HC AS NMHC | All Output | Run | Exhaust | on/off | | Directs M6 to output exhaust HC as non-methane hydrocarbons. |
| EXPRESS HC AS NMOG | All Output | Run | Exhaust | on/off | | Directs M6 to output exhaust HC as non-methane organic gases |
| EXPRESS HC AS THC | All Output | Run | Exhaust | on/off | | Directs M6 to output exhaust HC as total hydrocarbons |
| EXPRESS HC AS TOG | All Output | Run | Exhaust | on/off | | Directs M6 to output exhaust HC as total organic gases |
| EXPRESS HC AS VOC | All Output | Run | Exhaust | on/off | | Directs M6 to output exhaust HC as volatile organic compounds |
| FUEL PROGRAM | State Programs | Run or Scenario | Both | pgm descrip | | Designates fuel sulfur level of gasoline and whether RFG use should be assumed. |
| FUEL PROGRAM | Fuels | Run or Scenario | Both | pgm descrip | | Designates fuel sulfur level of gasoline and whether RFG use should be assumed. |
| FUEL RVP | Fuels | Run or Scenario | Both | values | Yes | Required input of average fuel Reid Vapor Pressure. |
| HOT SOAK ACTIVITY | Activity | Scenario | Evap | ext. file | | Specify alternative distribution of lengths of hot soaks. |
| HOURLY TEMPERATURES | External Conditions | Run or Scenario | Both | values | Yes* | Allows entry of 24 hourly temperatures. *Required unless MIN/MAX TEMP is used. |
| I/M COMPLIANCE | State Programs | Run | Both | value | | Required input indicating percentage of total vehicle fleet certified or waived by I/M program. |
| I/M CUTPOINTS | State Programs | Run | Exhaust | ext file | | Optional command for cutpoints if I/M 240 used. |
| I/M DESC FILE | State Programs | Run | Both | file name | | Optional external input file containing I/M program description records. |
| I/M EFFECTIVENESS | State Programs | Run | Both | value | | Reduce I/M effectiveness to account for Test and Repair losses. |
| I/M EXEMPTION AGE | State Programs | Run | Both | value | | Optional command indicating age that vehicle automatically becomes exempt from I/M program. |

| Command Name | Users' Guide Section | Command Input File Section | Exhaust or Evap | Command Parameter Type | Required Command? | Command Function |
|---|---|---|---|---|---|---|
| I/M GRACE PERIOD | State Programs | Run | Both | value | | Optional command indicating when vehicle first becomes subject to I/M program. |
| I/M MODEL YEARS | State Programs | Run | Both | values | | Required command indicating vehicle model years subject to I/M program. |
| I/M PROGRAM | State Programs | Run | Both | values | | Required command indicating program start and end dates, frequency and test type |
| I/M STRINGENCY | State Programs | Run | Exhaust | values | | Required command indicating initial test failure rate (%) for pre-1981 LDGVs and pre-1984 LDGTs |
| I/M VEHICLES | State Programs | Run | Exhaust | vehicle choice | | Required command indicating vehicle types subject to I/M. |
| I/M WAIVER RATES | State Programs | Run | Exhaust | values | | Required command indicating percentage of vehicles failing initial I/M test and do not have to pass a retest. |
| MILE ACCUM RATE | Fleets | Run | Both | ext file | | Allows user to supply annual accumulation rates by age for each of the 28 vehicle types. |
| MIN/MAX TEMP | External Conditions | Run or Scenario | Both | values | Yes* | Specifies minimum and maximum daily temperature. * This command is required unless HOURLY TEMPERATURES is used. |
| MOBILE6 BATCH FILE | Separators | Header | Both | on/off | | Identifies M6 input file as batch file as opposed to a regular command input file. |
| MOBILE6 INPUT FILE | Separators | Header | Both | | Yes | Identifies M6 input file as a regular command input file as opposed to a batch input file. |
| NGV FRACTION | Fleets | Run | Both | ext file | | Indicates percentage of natural gas vehicles in each of the 28 vehicles classes. |
| NO DESC OUTPUT | Descriptive Output | Header | Both | on/off | | Optional command that prevents production of descriptive output. |
| NO I/M TTC CREDITS | State Programs | Run | Exhaust | on/off | | Optional command to eliminate credit for a technician training program. |
| NO REFUELING | All Output | Run | Both | on/off | | Allows user to "zero out" refueling (Stage II) emissions, which then must be accounted for in stationary source part of SIP. |
| OXYGENATED FUELS | Fuels | Run or Scenario | Both | values | | Allows modeling of the effects of use of oxygenated fuels on exhaust emissions. |

| Command Name | Users' Guide Section | Command Input File Section | Exhaust or Evap | Command Parameter Type | Required Command? | Command Function |
|---|---|---|---|---|---|---|
| PEAK SUN | External Conditions | Run or Scenario | Exhaust | value | | Allows input of 2 daily times demarcating period of peak sun (e.g. |
| POLLUTANTS | All Output | Header | Both | pollutant choice | | Controls which pollutants will be calculated and output to the database report and descriptive output. |
| REG DIST | Fleets | Run | Both | ext file | | Allows user to supply vehicle registration distributions by age for all 16 composite vehicles types. |
| REPORT FILE | Descriptive Output | Header | Both | file name | | Specifies name for descriptive output file. |
| RUN DATA | Separators | End of Header | Both | | Yes | Marks end of header section and beginning of run section of regular M6 command input file. |
| SCENARIO RECORD | Separators | Start of Scenario | Both | | Yes | Allows user to label individual scenario results. Marks start of new scenario. |
| SEASON | Fuels | Run or Scenario | Both | value | | Allows users to specify winter or summer RVP independent of evaluation month. |
| SOAK DISTRIBUTION | Activity | Scenario | Exhaust | ext file | | Allows user to enter soak duration distributions for each hour of day that will override M6 defaults. |
| SPEED VMT | Activity | Run or Scenario | Exhaust | ext file | | Allows user to enter VMT distribution across 14 preselected speed ranges for each of the 24 hours of the day for each scenario. |
| STAGE II REFUELING | State Programs | Run | Evap | pgm descrip | | Allows modeling of impact of stage II "at-the-pump" vapor recovery system for refueling emissions. |
| STAR DIST | Activity | Run | Both | ext file | | Allows user to change the default for the hourly temporal distribution of engine starts (trips) across the day. |
| STARTS PER DAY | Activity | Run | Both | ext file | | Allows user to change default average number of engine starts per day per vehicle. |
| SULFUR CONTENT | Fuels | Scenario | Exhaust | value | | Allows user to enter alternate sulfur content of gasoline (ppm) that overrides M6 default of 300 ppm. |
| SUNRISE/SUNSET | External Conditions | Run or Scenario | Exhaust | values | | Specifies times for sunrise and sunset for A/C calculations. |
| VMT BY FACILITY | Activity | Run or Scenario | Both | ext file | | Allows user to supply alternate VMT distributions by facility type that override M6 defaults for each scenario. |

| Command Name | Users' Guide Section | Command Input File Section | Exhaust or Evap | Command Parameter Type | Required Command? | Command Function |
|---|---|---|---|---|---|---|
| VMT BY HOUR | Activity | Run or Scenario | Both | ext file | | Allows user to supply alternate hourly distributions of VMT that override M6 defaults for each scenario. |
| VMT FRACTIONS | Fleets | Run or Scenario | Both | values | | Allows user to apply alternate vehicle miles traveled fractions by each of 16 combined vehicle types. |
| VMT FRACTIONS | Activity | Run or Scenario | Both | values | | Allows user to apply alternate vehicle miles traveled fractions by each of 16 combined vehicle types. |
| WE DA TRI LEN DI | Activity | Run or Scenario | Both | ext file | | Used to read in the weekday hourly running loss trip length percentages |
| WE EN TRI LEN DI | Activity | Run or Scenario | Both | ext file | | Used to read in the weekend hourly running loss trip length percentages |
| WE VEH US | Activity | Scenario | Both | on/off | | Directs M6 to use the weekend activity fractions in its calculations. |
| SEASON | Fuels | Run or Scenario | Both | value | | Specifies winter RVP. |
| WITH FIELDNAMES | Database Output | Header | Both | on/off | | Specifies that a header record of field names is to be generated for the database output. |

## Appendix B

## MOBILE6 Input Data Format Reference Tables

**Table 1:   Composite Vehicle Classes For Vehicle Registration Data and Vehicle Miles Traveled Fractions (REG DIST and VMT FRACTIONS Commands)**

| Number | Abbreviation | Description |
|--------|--------------|-------------|
| 1 | LDV | Light-Duty Vehicles (Passenger Cars) |
| 2 | LDT1 | Light-Duty Trucks 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW) |
| 3 | LDT2 | Light Duty Trucks 2 (0-6,001 lbs. GVWR, 3751-5750 lbs. LVW) |
| 4 | LDT3 | Light Duty Trucks 3 (6,001-8500 lbs. GVWR, 0-3750 lbs. LVW) |
| 5 | LDT4 | Light Duty Trucks 4 (6,001-8500 lbs. GVWR, 3751-5750 lbs. LVW) |
| 6 | HDV2B | Class 2b Heavy Duty Vehicles (8501-10,000 lbs. GVWR) |
| 7 | HDV3 | Class 3 Heavy Duty Vehicles (10,001-14,000 lbs. GVWR) |
| 8 | HDV4 | Class 4 Heavy Duty Vehicles (14,001-16,000 lbs. GVWR) |
| 9 | HDV5 | Class 5 Heavy Duty Vehicles (16,001-19,500 lbs. GVWR) |
| 10 | HDV6 | Class 6 Heavy Duty Vehicles (19,501-26,000 lbs. GVWR) |
| 11 | HDV7 | Class 7 Heavy Duty Vehicles (26,001-33,000 lbs. GVWR) |
| 12 | HDV8A | Class 8a Heavy Duty Vehicles (33,001-60,000 lbs. GVWR) |
| 13 | HDV8B | Class 8b Heavy Duty Vehicles (>60,000 lbs. GVWR) |
| 14 | HDBS | School Buses |
| 15 | HDBT | Transit and Urban Buses |
| 16 | MC | Motorcycles (All) |

**Table 2:   Composite Vehicle Types For Diesel Sales Fractions (DIESEL FRACTIONS Command)**

| Number | Abbreviation | Description |
|--------|--------------|-------------|
| 1 | LDV | Light-Duty Vehicles (Passenger Cars) |
| 2 | LDT1 | Light-Duty Trucks 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW) |
| 3 | LDT2 | Light-Duty Trucks 2 (0-6,001 lbs. GVWR, 3751-5750 lbs. LVW) |
| 4 | LDT3 | Light-Duty Trucks 3 (6,001-8500 lbs. GVWR, 0-3750 lbs. LVW) |
| 5 | LDT4 | Light-Duty Trucks 4 (6,001-8500 lbs. GVWR, 3751-5750 lbs. LVW) |
| 6 | HDV2B | Class 2b Heavy-Duty Vehicles (8501-10,000 lbs. GVWR) |
| 7 | HDV3 | Class 3 Heavy-Duty Vehicles (10,001-14,000 lbs. GVWR) |
| 8 | HDV4 | Class 4 Heavy-Duty Vehicles (14,001-16,000 lbs. GVWR) |
| 9 | HDV5 | Class 5 Heavy-Duty Vehicles (16,001-19,500 lbs. GVWR) |
| 10 | HDV6 | Class 6 Heavy-Duty Vehicles (19,501-26,000 lbs. GVWR) |
| 11 | HDV7 | Class 7 Heavy Duty Vehicles (26,001-33,000 lbs. GVWR) |
| 12 | HDV8A | Class 8a Heavy Duty Vehicles (33,001-60,000 lbs. GVWR) |
| 13 | HDV8B | Class 8b Heavy Duty Vehicles (>60,000 lbs. GVWR) |
| 14 | HDBS | School Buses |

**Table 3:   Complete MOBILE6 Vehicle Classifications**
    **(STARTS PER DAY Command)**

| Number | Abbreviation | Description |
|--------|-------------|-------------|
| 1 | LDGV | Light-Duty Gasoline Vehicles (Passenger Cars) |
| 2 | LDGT1 | Light-Duty Gasoline Trucks 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW) |
| 3 | LDGT2 | Light Duty Gasoline Trucks 2 (0-6,001 lbs. GVWR, 3751-5750 lbs. LVW) |
| 4 | LDGT3 | Light Duty Gasoline Trucks 3 (6,001-8500 lbs. GVWR, 0-3750 lbs. LVW) |
| 5 | LDGT4 | Light Duty Gasoline Trucks 4 (6,001-8500 lbs. GVWR, 3751-5750 lbs. LVW) |
| 6 | HDGV2B | Class 2b Heavy Duty Gasoline Vehicles (8501-10,000 lbs. GVWR) |
| 7 | HDGV3 | Class 3 Heavy Duty Gasoline Vehicles (10,001-14,000 lbs. GVWR) |
| 8 | HDGV4 | Class 4 Heavy Duty Gasoline Vehicles (14,001-16,000 lbs. GVWR) |
| 9 | HDGV5 | Class 5 Heavy Duty Gasoline Vehicles (16,001-19,500 lbs. GVWR) |
| 10 | HDGV6 | Class 6 Heavy Duty Gasoline Vehicles (19,501-26,000 lbs. GVWR) |
| 11 | HDGV7 | Class 7 Heavy Duty Gasoline Vehicles (26,001-33,000 lbs. GVWR) |
| 12 | HDGV8A | Class 8a Heavy Duty Gasoline Vehicles (33,001-60,000 lbs. GVWR) |
| 13 | HDGV8B | Class 8b Heavy Duty Gasoline Vehicles (>60,000 lbs. GVWR) |
| 14 | LDDV | Light Duty Diesel Vehicles (Passenger Cars) |
| 15 | LDDT12 | Light Duty Diesel Trucks 1 and 2 (0-6,000 lbs. GVWR) |
| 16 | HDDV2B | Class 2b Heavy Duty Diesel Vehicles (8501-10,000 lbs. GVWR) |
| 17 | HDDV3 | Class 3 Heavy Duty Diesel Vehicles (10,001-14,000 lbs. GVWR) |
| 18 | HDDV4 | Class 4 Heavy Duty Diesel Vehicles (14,001-16,000 lbs. GVWR) |
| 19 | HDDV5 | Class 5 Heavy Duty Diesel Vehicles (16,001-19,500 lbs. GVWR) |
| 20 | HDDV6 | Class 6 Heavy Duty Diesel Vehicles (19,501-26,000 lbs. GVWR) |
| 21 | HDDV7 | Class 7 Heavy Duty Diesel Vehicles (26,001-33,000 lbs. GVWR) |
| 22 | HDDV8A | Class 8a Heavy Duty Diesel Vehicles (33,001-60,000 lbs. GVWR) |
| 23 | HDDV8B | Class 8b Heavy Duty Diesel Vehicles (>60,000 lbs. GVWR) |
| 24 | MC | Motorcycles (Gasoline) |
| 25 | HDGB | Gasoline Buses (School, Transit and Urban) |
| 26 | HDDBT | Diesel Transit and Urban Buses |
| 27 | HDDBS | Diesel School Buses |
| 28 | LDDT34 | Light Duty Diesel Trucks 3 and 4 (6,001-8500 lbs. GVWR) |

**Table 4:   Daily Hour Mapping For Distribution of Vehicle Starts During the Day**
**(START DIST and HOURLY TEMPERATURE Commands)**

| Number | Abbreviation | Description |
|--------|--------------|-------------|
| 1 | 6 a.m. | 6 a.m. through 6:59 a.m. |
| 2 | 7a.m. | 7 a.m. through 7:59 a.m. |
| 3 | 8 a.m | 8 a.m. through 8:59 a.m. |
| 4 | 9 a.m. | 9 a.m. through 9:59 a.m. |
| 5 | 10 a.m | 10 a.m. through 10:59 a.m. |
| 6 | 11 a.m. | 11 a.m. through 11:59 a.m. |
| 7 | 12 Noon | 12 Noon through 12:59 p.m. |
| 8 | 1 p.m. | 1 p.m. through 1:59 p.m. |
| 9 | 2 p.m. | 2 p.m. through 2:59 p.m. |
| 10 | 3 p.m. | 3 p.m. through 3:59 p.m. |
| 11 | 4 p.m. | 4 p.m. through 4:59 p.m. |
| 12 | 5 p.m. | 5 p.m. through 5:59 p.m. |
| 13 | 6 p.m. | 6 p.m. through 6:59 p.m. |
| 14 | 7 p.m. | 7 p.m. through 7:59 p.m. |
| 15 | 8 p.m. | 8 p.m. through 8:59 p.m. |
| 16 | 9 p.m. | 9 p.m. through 9:59 p.m. |
| 17 | 10 p.m | 10 p.m. through 10:59 p.m. |
| 18 | 11 p.m. | 11 p.m. through 11:59 p.m. |
| 19 | 12 Midnight | 12 Midnight through 12:59 a.m. |
| 20 | 1 a.m. | 1 a.m. through 1:59 a.m. |
| 21 | 2 a.m. | 2 a.m. through 2:59 a.m. |
| 22 | 3 a.m. | 3 a.m. through 3:59 a.m. |
| 23 | 4 a.m. | 4 a.m. through 4:59 a.m. |
| 24 | 5 a.m. | 5 a.m. through 5:59 a.m. |