EPA-AA-TEB-91-01

# USER'S GUIDE

# to

# MOBILE4.1

# (MOBILE SOURCE EMISSION FACTOR MODEL)

JULY 1991

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF AIR AND RADIATION
OFFICE OF MOBILE SOURCES
EMISSION CONTROL TECHNOLOGY DIVISION
TEST AND EVALUATION BRANCH
2565 PLYMOUTH ROAD
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## ABSTRACT

This document is the USER'S GUIDE to MOBILE4.1. MOBILE4.1 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. The program uses the calculation procedures and emission factors presented in Compilation of Air Pollutant Emission Factors - Volume II: Highway Mobile Sources (AP-42, Fourth Edition, September 1985; Supplement A to AP-42 Volume II, January 1991).

MOBILE4.1 calculates emission factors for eight individual vehicle types in two regions (low- and high-altitude) of the country. MOBILE4.1 emission estimates depend on various conditions such as ambient temperature, speed, and mileage accrual rates. Many of the variables affecting vehicle emissions can be specified by the user. MOBILE4.1 will estimate emission factors for any calendar year between 1960 and 2020, inclusive. The 25 most recent model years are considered to be in operation in each calendar year. MOBILE4.1 supercedes MOBILE4, 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. Compared to MOBILE4, MOBILE4.1 incorporates several new options, calculating methodologies, emission factor estimates, emission control regulations, and internal program designs.

Requests for copies of the MOBILE4.1 program diskettes or tape, and for additional 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 MOBILE4.1 or this User's Guide should be directed to:

U. S. EPA Motor Vehicle Emission Laboratory
Office of Mobile Sources
2565 Plymouth Road
Ann Arbor, MI 48105
Attn: MOBILE4.1

Telephone: (313) 668-4325 (FTS 374-8325)
(313) 668-4462 (FTS 374-8462)

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# Chapter 1

# GENERAL DESCRIPTION OF MOBILE4.1

## 1.0 INTRODUCTION

MOBILE4.1 is an integrated set of FORTRAN routines for use in the analysis of the air pollution impact of gasoline-fueled and diesel highway mobile sources. The program provides the user with a flexible analytical tool which can be applied in a wide variety of air quality planning functions. MOBILE4.1 updates and supercedes the previous version of the model (MOBILE4), and is to be used in the preparation of the motor vehicle portion of all base year 1990 emission inventories required by the Clean Air Act Amendments of 1990 for non-California areas. It should also be used to prepare future year CO emission inventory projections.

MOBILE4.1 calculates emission factors for gasoline-fueled light-duty vehicles (LDVs), light-duty trucks (LDTs), heavy-duty vehicles (HDVs), and motorcycles, and for diesel LDVs, LDTs, and HDVs. MOBILE4.1 also includes provisions for modeling the effects of oxygenated fuels (gasoline-alcohol and gasoline-ether blends) on exhaust CO emissions, as described in section 1.1.1.

This chapter briefly explains most of the differences between MOBILE4.1 and MOBILE4. Many revisions are transparent to the user, in that no input data changes are required and the physical appearance of the output is unchanged. Other revisions to the program provide the user with previously unavailable options or require that additional input data be provided. Throughout Chapters 2 (Input) and 3 (Output), note is made of changes that affect the preparation of the input data stream and/or result in differences in the output files.

Most of the revisions that have been made to the emission factor model since the release of MOBILE4 will have an impact on the emission factor estimates for any year. EPA's intent in developing MOBILE4.1 was to make any revisions and updates that would assist in making the 1990 base year emission factors, and hence mobile source inventories, as accurate as was possible. Due to time constraints and the necessity of providing an updated model to the States for use in preparing these base year inventories, many of the pending future requirements of the Clean Air Act Amendments of 1990 are not reflected in MOBILE4.1. (Revised carbon monoxide emission standards for light-duty vehicles and trucks are an exception, as discussed in section 1.1.12.) EPA intends to continue work on incorporating the many future requirements of the CAAA in another update to the model.

Instructions on how to use the program are contained in Chapters 2, 3, and 4 (Implementation). Chapter 5 (Examples) contains listings of several input files and the resulting program output, with descriptions of the features being illustrated. The source code listing of MOBILE4.1 will be printed under separate cover, rather than included herein, due to its length. Of course, copies of MOBILE4.1 on magnetic tape or diskette can be used to generate source code listings.

This User's Guide is a self-contained document, such that earlier versions of the User's Guide are not necessary for operating MOBILE4.1.

## 1.1 TECHNICAL DIFFERENCES FROM MOBILE4

In addition to updates that have been made to the emission factor data base as a result of the considerable amount of new test data collected since the development of MOBILE4, there have been a number of changes to the methodology used to calculate some of the emission factors and correction factors. This section does not attempt to detail every case where the data base has been updated. The sections below describe (1) those features that are entirely new to MOBILE4.1, and thus have no direct corollary in earlier versions of the model, and (2) those features that have been significantly revised since MOBILE4. The "new" features are described in sections 1.1.1 thorough 1.1.4, and the significantly revised features are described in sections 1.1.5 through 1.1.21.

### 1.1.1 Impact of Oxygenated Fuels on Emissions

In using MOBILE4, those wishing to model the impacts of an oxygenated fuel program on exhaust or evaporative emissions were directed to use the model output, in conjunction with the "Guidance Document"[1] for oxygenated fuel benefit calculations, to calculate the effects outside of the program. MOBILE4.1 incorporates the ability to model the direct impact of oxygenated fuels on exhaust carbon monoxide (CO) emissions, and the indirect impact of changes in fuel volatility (as measured by Reid vapor pressure, or RVP) due to oxygen content on exhaust hydrocarbon (HC), CO, and oxides of nitrogen (NOx) emissions, and on evaporative, refueling, and running loss (section 1.1.8) HC emissions.

Distinct multiplicative corrections for exhaust CO emissions have been developed for each vehicle type, model year, and fuel type. Since straight gasoline contains no oxygen, the fuel types for which adjustment factors have been developed are alcohol blends (gasoline blended with alcohol, such as ethanol)

and ether blends [gasoline blended with ether compounds, such as methyl tertiary butyl ether (MTBE) or ethyl tertiary butyl ether (ETBE)]. The adjustments are a function of the oxygen content of the fuel.

EPA has decided not to incorporate the direct effects of oxygenated fuels on exhaust HC and NOx emissions in MOBILE4.1 for several reasons. The impact of oxygenated fuels is greatest on CO emissions, there is less uncertainty involved in modeling these effects, and there are fewer implications for other emission control strategies of small errors here than in the case of exhaust HC or NOx. As part of the ongoing regulatory negotiation process on reformulated gasolines, EPA continues to develop and to be provided with data on the exhaust HC and NOx effects of oxygenated fuels. Consideration will be given to including such effects in a subsequent model update.*

The various components of evaporative HC emissions (hot soak, diurnal, refueling, running loss) are adjusted for fuel oxygen content on the basis of the volatility effect of the oxygenate on the fuel, accounting for commingling effects and the possible presence of RVP waivers for oxygenated blends. An example of commingling is the volatility increase of the fuel in a vehicle's fuel tank (over what would be predicted from a purely linear relationship) when a vehicle containing some gasoline in the tank is refueled with a gasoline/alcohol blend. These adjustments affect all gasoline-fueled vehicle types in all model years.

The user who wishes to model the effects of oxygenated fuels must supply five new pieces of input data: the fraction of fuel sold in the area being modeled that is ether blends, the fraction of fuel sold in the area that is alcohol blends, the average oxygen content (fraction by weight) of the ether blend fuels, the average oxygen content of the alcohol blend fuels, and whether or not an RVP waiver for alcohol-based oxygenated fuels is in effect. There are maximum oxygen contents for which emission benefits will be calculated by MOBILE4.1 (3.5 wgt percent for alcohol blends and 2.7 wgt percent for ether blends), since these are the maximum oxygen contents of commonly marketed blended fuels.

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* A few users should be alert to the fact that the absence of an estimate of the direct effect of oxygenated fuels on exhaust HC and NOx emissions is a shortcoming of MOBILE4.1 that may be of significance in the preparation of typical 1990 summer day ozone precursor emission inventories for ozone nonattainment areas with substantial oxygenated fuel market share in the summer (e.g., the Chicago CMSA). Such areas should contact EPA to discuss how to proceed with inventory preparation in light of this shortcoming.

The input changes required for this feature of MOBILE4.1 to be used are discussed in detail in section 2.2.14. If the modeler does not wish to include oxygenated fuels effects, no changes to the input are required; as discussed in Chapter 2, the program has been designed to assume that no oxygenated fuel effects are to be modeled if the required flag and associated input data are missing.

### 1.1.2 Options for Composition of Exhaust HC Emission Factors

Past versions of the emission factor model have provided the user with two options for the calculation of HC emissions, either total HC (THC) or non-methane HC (NMHC). This selection is controlled by the input flag NMHFLG (see section 2.1.18). The only difference in these two emission factor estimates is that methane ($CH_4$) was included in the THC emission factors and not included in the NMHC emission factors.

EPA has determined that VOC, which consists of any organic compounds that participate in atmospheric photochemical reactions, includes all organic compounds with the exception of those listed in Table 1.1-1:

Table 1.1-1

Non-Reactive Organic Compounds

methane
ethane
methylene chloride
1,1,1-trichloroethane (methyl chloroform)
trichlorotrifluoroethane (CFC-113)
trichlorofluoromethane (CFC-11)
dichlorodifluoromethane (CFC-12)
chlorodifluoromethane (CFC-22)
trifluoromethane (FC-23)
dichlorotetrafluoroethane (CFC-114)
chloropentafluoroethane (CFC-115)
dichlorotrifluoroethane (HCFC-123)
tetrafluoroethane (HFC-134a)
dichlorofluoroethane (HCFC-141b)
chlorodifluoroethane (HCFC-142b)
2-chloro-1,1,1,2-tetrafluoroethane (HCFC-124)
pentafluoroethane (HFC-125)
1,1,2,2-tetrafluoroethane (HFC-134)
1,1,1-trifluoroethane (HFC-143a)
1,1-difluoroethane (HFC-152a)
and certain perfluorocarbon compounds

The compounds listed in Table 1.1-1 have been determined to have negligible photochemical reactivity, that is, they do not contribute significantly to ozone formation. Of the compounds listed in Table 1.1-1, methane and ethane are present in motor vehicle exhaust emissions. States have been advised that these compounds should be excluded from baseline emission inventories to be used for Reasonable Further Progress determinations. However, ethane is to be included in both EKMA and Airshed air quality modeling.

The emission factors for HC which underlie the modeling of in-use emission factors are based on measurements using a flame ionization detector (FID). The FID measurements include methane and ethane, but do not include formaldehyde and (to a lesser extent) acetaldehyde. Formaldehyde and acetaldehyde are reactive compounds. To accomodate various intended uses for inventory preparation and air quality modeling, several adjustments have been made to MOBILE4.1 to allow estimation of highway vehicle emission factors.

MOBILE4.1 provides the user with five options for the calculation of HC emission factors: total hydrocarbons (THC), non-methane hydrocarbons (NMHC), volatile organic compounds (VOC), total organic gasses (TOG), and non-methane organic gasses (NMOG). Evaporative emissions (hot soak, diurnal, refueling, running loss, and resting loss) do not contain methane, ethane, or aldehydes, although they do contain ethers and/or alcohols if these compounds are present in the fuel. Thus for evaporative emissions, there is no difference with these correction factors in the emission factor as a function of the composition option chosen; only exhaust HC emission factors are affected by the inclusion or exclusion of methane, ethane, and aldehydes.

The options are accessed through HCFLAG, as in MOBILE4 (see section 2.1.19). Each option is somewhat different:

Total hydrocarbons (THC): The total hydrocarbon emission factors from MOBILE4.1 are defined consistently with THC in earlier versions of the model. These emission factors are based on laboratory test data using the FID to measure hydrocarbons. As such, THC emission factors include methane and ethane, but do not account for formaldehyde and about half of the acetaldehyde.

Non-methane hydrocarbons (NMHC): The definition of non-methane hydrocarbon (NMHC) exhaust emission factors in MOBILE4.1 is the same as that used in earlier versions of the model. The NMHC exhaust emission factors are defined as THC (as defined above) minus methane emissions. (As described in section 1.1.11, the methane offsets also have been updated in MOBILE4.1.) This

is calculated in MOBILE4.1 by subtracting methane emissions from THC emissions. All evaporative HC emissions (hot soak, diurnal, refueling, running loss, and resting loss) are composed entirely of NMHC.

Volatile organic compounds (VOC): This option is new to MOBILE4.1, and provides emission factors that exclude the designated nonreactive compounds measured by the FID (methane and ethane) while including two reactive compounds not measured, or only partially measured, by the FID (formaldehyde and acetaldehyde). This is accomplished by subtracting methane from the THC exhaust emission factor, then adjusting the result to exclude the ethane and account for the aldehydes.

The adjustment factor is based on vehicle emissions test data, and differs by technology group (non-catalyst, oxidation catalyst, three-way catalyst, three-way-plus-oxidation catalyst, diesel) and by fuel type (gasoline, diesel, gasoline/alcohol blends, and gasoline/ether blends). At this time, the only correction factor available is based on testing of gasoline-fueled and diesel vehicles; it is also used in MOBILE4.1 for gasoline/alcohol and gasoline/ether blends. EPA plans to develop specific correction factors for these fuel blends for inclusion in a subsequent update to the model. The adjustments are also model-year specific.

Total organic gasses (TOG): The fourth option for hydrocarbon emission factors is that they be expressed as TOG. In this case, THC emission factors are corrected to account for formaldehyde and acetaldehyde emissions. The form of the adjustment and the specificity (technology groups, model years, fuel types) are as described above, with the calculation performed as (THC emissions minus methane) times (adjustment factor, determined on the basis of test data, to convert non-methane HC to total organic gases), then adding back the methane emissions. Emission speciation profiles generally use TOG as the denominator for the profile mass fractions, so TOG output from MOBILE4.1 will be useful in the development of speciated emission inventories.

Non-methane organic gasses (NMOG): The final option available is to express the HC emission factors in terms of NMOG. This option includes HC as measured by the FID in laboratory tests, and accounts for aldehydes, but does not include methane. In other words, NMOG is TOG without adding back the methane emissions.

It is worth noting that the VOC, TOG, and NMOG emission factors calculated by MOBILE4.1 are in no way adjusted for ozone-forming reactivity. Also, all of the HC composition

output options calculate mass based on FID-measured elemental carbon emissions and a long-assumed average hydrogen/carbon ratio for hydrocarbons (plus aldehydes). Subsequent revisions to the model may reassess the use of this historical ratio on the basis of more recent test data.

The selection of the appropriate option for estimating "HC" emissions depends on the use for which the emission factors are being calculated. Additional information and guidance appears in the revised edition of the base year emission inventory preparation guidance.[2]

### 1.1.3 Expanded Evaporative Emissions Output

Many of the areas required to prepare base year emission inventories in response to the requirements of the CAAA of 1990 are also required to use photochemical grid modeling (e.g., the Urban Airshed Model) in attainment projection demonstrations. Such models require that the emission inventory be described with much finer spatial and temporal resolution than is required of inventories used for simpler models (e.g., Empirical Kinetic Modeling Approach or "rollback" models). Typically, emissions from all sources, including highway vehicles, must be specified on an hourly basis for each grid cell, which generally is no larger than 5 km x 5 km.

MOBILE4 and earlier versions of the model have generally been developed to provide emission factors for an entire area (national, state, or urban area) on a daily basis. This was particularly true of MOBILE4, in which the user was required to supply as input three temperature values including the daily minimum and maximum temperatures, which are used to calculate trip- and emission-weighted daily average temperatures for use in correcting exhaust, hot soak evaporative, and running loss emissions. The daily minimum and maximum temperature also define the diurnal temperature rise, which is used in the estimation of in-use diurnal evaporative emissions.

The temperature control flag TEMFLG in MOBILE4 could be used to override the calculation of trip- and emission-weighted average daily temperatures, forcing the input value of ambient temperature to be used to correct exhaust, hot soak, and running loss emissions. This permitted the calculation of exhaust and running loss emission factors that are specific to conditions over a shorter time, such as an hour. However, the diurnal component of evaporative HC emissions in MOBILE4 is only calculated as a function of the user input minimum and maximum temperatures, regardless of the value assigned to TEMFLG. In addition, all of the components of evaporative emissions (hot soaks, diurnals, and crankcase emissions) were then combined,

using data on the typical trips per day and miles per day driven by vehicles of different ages, to provided average fleetwide evaporative emission factors in units of grams per mile.

In order to provide the user of the model with information that can be used to develop hourly specific emission factors for all emission components (exhaust, evaporative, refueling, running loss, and resting loss), a new option has been provided in the output. This "expanded evaporative emission factor report" is accessed through the use of the control flag HCFLAG (see section 2.1.19). Where MOBILE4 provided two options using HCFLAG, MOBILE4.1 provides three: (1) all types of HC emissions summed together in a single gram-per-mile emission factor, (2) separate listing of exhaust HC, evaporative (hot soak and diurnal) HC, refueling loss HC, resting loss HC, and running loss HC, with both the combined total and each component given in grams per mile, and (3) expanded evaporative emission factor output, which includes all of the information listed in (2) as well as another block of output per scenario providing detail on the evaporative emission breakdown in grams, as described below.

If the expanded evaporative emission factor output option is selected by the user, an additional block of emission factors is provided for each scenario. For each gasoline-fueled vehicle type, this output provides estimates for hot soak emissions in grams per trip (trip end), diurnal emissions (based on the diurnal temperature rise as determined from the input minimum and maximum temperatures) in grams per vehicle per day, multiple diurnal emissions also in grams per vehicle per day, and crankcase emissions in grams per mile. Refueling emissions are provided in grams per gallon of dispensed fuel, and resting loss emissions in grams per vehicle per hour. An example of this output is included in Chapter 5 (Examples), and the output block is discussed in Chapter 3 (Outputs).

As discussed in the User's Guide to MOBILE4,[3] the diurnal emission factors produced by the model take into account four different types of daily trip patterns, each of which leads to a different type of diurnal emission generation:

(1) "Single" or "full" diurnal emissions are what most people intuitively understand diurnal emissions to be; the vehicle is not driven during the period of rising temperatures, generally between 6-7 AM and 4-5 PM during the summer, and so the fuel tank essentially experiences the entire rise in temperature for the day.

(2) "Multiple" diurnals refer to conditions in which a vehicle is not operated at all for two or more consecutive days; after the first day, the evaporative control canister

(carbon canister) is largely loaded, and without driving to provide an opportunity for it to purge vapors to the engine, the canister will not have as great a capacity to capture and hold the vapors generated on the second or subsequent no-driving days.

(3) "Partial" diurnals refer to cases in which the vehicle is driven on one or more trips in a given day, but is not operated for a long enough time within the period of rising ambient temperatures to entirely overcome diurnal fuel tank heating, and thus generates some diurnal emissions.

(4) Finally, some vehicles are driven on so many trips so frequently over the course of a day that purging of vapors generated by fuel tank heating entirely eliminates diurnal emissions.

Each of these patterns was accounted for in MOBILE4, and weighted appropriately on the basis of trip pattern survey data to provide the overall diurnal emission factor. MOBILE4.1 does the same, with the further refinement that the probability of a vehicle being driven in a given day has been made a function of vehicle age.

The model used in MOBILE4 and MOBILE4.1 to estimate diurnal emissions as a function of temperature rise and fuel volatility does not work well when based on the very small temperature rises typical of a single hour. In addition, the trip pattern survey data used to weight together the various diurnal emission events does not provide sufficient detail to similarly weight the events on an hourly basis. The partial diurnals in particular are difficult to disassociate into hour-by-hour occurrences, so they are combined (by appropriate weighting factors) in the "Full diurnal" emission factors produced by the expanded evaporative output option.

The use of the temperature control option and the expanded evaporative emission factor output described here together can be used to estimate hourly emission factors. Exhaust, running loss, resting loss, and hot soak evaporative emissions can be modeled directly as hourly emissions through the use of TEMFLG (see section 2.1.14) and the appropriate hourly temperatures to calculate emission factors which then are multiplied by hourly activity rates. The estimation of hourly diurnal and refueling HC emissions are discussed below.

The conversion of MOBILE4.1 daily diurnal emission factors to hourly emission factors is more problematic. Among the the applicable considerations are that hourly emissions are sensitive to (1) hourly temperatures (which determine fuel vapor

density in the vehicle fuel tank), (2) temperature rise over the course of an hour (which determines vapor expansion and expulsion), and (3) the fact that near the end of the day the carbon canister may be approaching its vapor capacity, such that incremental additions of vapor are more likely to be released to the atmosphere.

As of this writing, EPA recommends that daily diurnal emissions be calculated from the minimum and maximum temperatures, and that these emissions be allocated to specific hours on the basis of the fraction of the day's temperature rise that occurs within the given hour. (For example, if the daily minimum and maximum temperatures are 60° and 84°F (16° and 29°C), and the temperatures at 12 noon and 1 PM are 77° and 80°F (25° and 27°C), then the diurnal emissions occurring between 12 noon and 1 PM are one-eighth (3F°/24F°) of the daily diurnal emissions. EPA will provide additional guidance on the subject of hourly allocation of diurnal emissions as it is developed.

Refueling emissions should also be based on daily minimum and maximum temperatures in most cases. The algorithm used in MOBILE4.1 to calculate refueling emissions uses the temperature of the dispensed fuel (the new fuel being added to the vehicle) and the difference in temperature between the dispensed fuel and the residual fuel (the fuel remaining in the vehicle fuel tank when the refueling occurs), with each of these being estimated from the minimum and maximum temperatures.

MOBILE4.1 will estimate refueling emission factors using the ambient temperature, rather than the minimum and maximum temperatures, if TEMFLG = 2 (see section 2.1.14). However, if this approach is taken, the temperature used should be the daily or (preferred) monthly average temperature. This is because underground tank temperatures (and hence the dispensed fuel temperature) do not vary as hourly temperatures vary over the course of a day.

In estimating refueling emissions on an hourly basis, EPA recommends that refueling emission factors on a daily basis for the day of interest be calculated, and allocated to specific hours taking into account the following: Emissions are proportional to fuel sales. Typical fuel sales over the course of a day would have both morning and afternoon/early evening peaks, with slower mid-day sales and very low sales between approximately 10-11 PM and 5-6 AM. In allocating fuel sales by hour, use reasonable judgment and document assumptions made in the emission inventory submitted to EPA. If any hourly fuel sales data are available for the area being modeled, such data should be accounted for. A relatively simple, short-term survey of refueling activity at a small number of service stations also would be adequate to estimate relative sales by hours.

### 1.1.4 Twenty-Five Model Years in Operation in the Fleet

In MOBILE4 and earlier versions of the emission factor model, a 20-model-year "window" of vehicles was considered to comprise the in-use fleet in any given calendar year. For example, if the calendar year of evaluation was 1990, then vehicles ranging in age from one (model year 1990) to 20 (model year 1971) were assumed to make up the fleet. Any vehicles over 20 years of age were grouped together with 20-year-old vehicles; thus the registration fraction of age 20 vehicles is higher than that of age 19 vehicles, and all vehicles more than 20 years old were modeled as being 20 years old.

The registration distributions by age had 20 values for each vehicle type, corresponding to ages 1, 2, 3, ... , 20+. Similarly, annual mileage accumulation rates by age were provided for vehicles of ages 1, 2, ... , 20+. If the user desired to input registration distributions and/or annual mileage accumulation rates differing from the national values built into the code, then 20 values were required for each variable, for each vehicle type. (The exception is motorcycles; while the arrays in the code provide for up to 20 values of registration fraction and annual mileage accumulation for motorcycles, only 12 values for each were provided in the code, with the 12th values applied to motorcycles of ages 12 and up.)

These arrays have been expanded to 25 model years in MOBILE4.1. As before, the relatively small number of vehicles in-use that are older than this upper limit are combined with the 25-year-old vehicles in the age 25+ category. Also as in MOBILE4, only registration fractions and mileage accumulation rates for motorcycles of ages 1 to 12+ are actually used in MOBILE4.1, although the array sizes have been expanded to 25 values each for all eight vehicle types.

If the user of the model wishes to use the nationwide average (default) values for registration distributions and annual mileage accumulation rates by age, then this change is transparent to the user. However, when the user elects to supply one or both of these variables as input, the input must now consist of 25 (rather than 20) values for each variable being input for each vehicle type. See section 2.2.3 for discussion of the input changes.

### 1.1.5 Basic Emission Rates for 1981 and Later Model Year LDGVs

The basic emission rates for 1981 and later model year light-duty gasoline-fueled vehicles and trucks have been updated in MOBILE4.1 on the basis on analysis of emission factor program testing results obtained since the release of MOBILE4. These changes will affect all exhaust emission factors for all pollutants for any calendar year of evaluation after 1981.

### 1.1.6 Incorporation of Pass/Fail Purge/Pressure Effects on Evaporative and Running Loss Emission Factors

EPA has conducted extensive testing of in-use vehicles in conjunction with the State of Indiana's centralized inspection/maintenance program over the last two years. This program provided the opportunity to test an unbiased sample of in-use vehicles at the time that they were brought in for mandatory I/M testing. As part of the testing under this program, EPA conducted "purge/pressure" tests of participating vehicles' evaporative emission control systems. These tests determined whether there were any leaks in the vehicles' fuel and evaporative control systems (pressure test), and whether the system was capable of purging the canister of vapors (purge test). (Tampering rates for evaporative emission control systems generally have been based on visual inspections rather than functional testing of the components of the system.)

Data from these tests have been used to explicitly account for the number of vehicles with significant evaporative control system problems, and the emissions impact of those problems. The results of this testing and analysis are reflected in revisions to the evaporative (hot soak and diurnal) and running loss emission rates used in MOBILE4.1. All model year vehicles and calendar years of evaluation are affected by these changes.

### 1.1.7 Tampering Revisions

As in MOBILE4, there are nine tampering rate equations used to model the impact of vehicle tampering on the emissions of light-duty gasoline-fueled vehicles and trucks. Each of the tampering rate equations has the form of a zero-mile level and a deterioration rate (representing the increase in the rate of that type of tampering with accumulated mileage). Each tampering rate is combined with an associated tampering offset (increase in emissions for vehicles exhibiting a given type of tampering) in order to estimate the effect of tampering on the modeled emission factors.

Eight of the nine tampering rate equations can be supplied by the user with adequate locality-specific information (see section 2.1.4). (The ninth category, "other misfueling," is derived as the difference between "overall misfueling" and "fuel inlet restrictor disablement." See section 2.2.1.)

Three relatively minor revisions have been made to the tampering-related calculations in MOBILE4.1. In addition, the tampering rates themselves have been updated to reflect newer survey data available since the release of MOBILE4. The three revisions are described below.

In MOBILE4, tampering rates were defined for two distinct LDGV model year groups, pre-1981 model years and 1981 and later model years. MOBILE4.1 uses three model year groups: pre-1981 model year, 1981-83 model years, and 1984 and later model years. This revision may affect the input data, since the replacement of the tampering rate equations with locality-specific data now requires three sets of equations. See section 2.2.1 for additional details.

In MOBILE4, only 1981 and later model year LDGVs and LDGTs had a two-step tampering rate equation, with one deterioration rate applicable to vehicles with up to 50,000 accumulated miles and a second (greater) rate of increase in tampering applicable to vehicles after 50,000 miles. In MOBILE4.1, tampering rates for all model years of LDGVs, LDGTs, and HDGVs exhibit this behavior, with the deterioration rate above 50K mi defined as a function of the rate applicable up to 50K mi:

(Rate of increase for > 50K mi) =
[(Rate of increase for $\leq$ 50K mi) * (adjustment)].

There are different adjustments for each of the nine tampering types, for each vehicle type (LDGV, LDGT, HDGV), for each model year group defined above, and for I/M and non-I/M areas. The adjustment factors for the tampering deterioration rates are coded in the model; only one deterioration rate is required for each case if alternate tampering rate equations are provided as input data.

Finally, all tampering rates reach a maximum at 130,000 accumulated miles. This means that whatever rate of tampering is reached at 130,000 mi (by tampering type, vehicle type, model year group, and I/M or non-I/M case) will be applied for all mileages in excess of 130,000.

### 1.1.8 Revisions to Running Loss Emission Factors

Running loss emissions, defined as evaporative emissions occuring while the vehicle is in is being driven, were included in MOBILE4 for the first time. The occurrence of running loss emissions appears to be at least in part the result of inadequate evaporative canister purging during vehicle operation; when the canister reaches saturation and evaporative emissions continue to be generated as a result of fuel tank temperature increases, these emissions are released from the vehicle into the atmosphere. Vehicle fuel system leaks, and possibly other sources, may also contribute to the generation of running loss emissions.

Running loss emissions are higher at higher temperatures and higher volatilities (as are other evaporative emissions),

and are higher at lower average speeds (reflecting the lesser canister purging that occurs at low speeds). Running losses also are known to be a function of trip length (duration in time, not distance travelled). The levels also depend on vehicle type, vehicle age (older vehicles have higher rates of failure on purge and pressure tests; see section 1.1.6), and evaporative control system type.

The running loss emission factors estimated by MOBILE4 were based on data obtained during testing over three driving cycles of low, moderate, and high average speeds (7.1, 19.6, and 47.9 mph), with the emissions representing each average speed weighted together to represent typical urban traffic patterns. In MOBILE4.1, running loss emission factors are a function of four variables: average speed, temperature, fuel volatility, and (as a user option) distribution of average trip lengths. It is important to note that trip length here refers to trip duration (length of time driving), not to total distance travelled in the trip. Each of the variables now used to estimate running loss emission factors is discussed below.

In MOBILE4, an average urban area driving distribution was used to weight together the three "levels" of running loss emissions into a single value for each gasoline-fueled vehicle type. In MOBILE4.1, the average speed specified by the user in the input is used to estimate running loss emissions as a function of speed, with the same **gram per minute** (not gram per mile) emission factors applied to speeds outside of the limits of the test data (under 7.1 mph or over than 47.9 mph). Average speeds of less than 7.1 mph have the same running loss emissions per unit time as are associated with an average speed of 7.1 mph, meaning that the **g/mi** emission factors continue to increase as speed decreases down to the global minimum speed of 2.5 mph. Similarly, average speeds greater than 47.9 mph have the same running loss emissions per unit time as are associated with an average speed of 47.9 mph, such that the g/mi emission factors continue to slowly decrease as speed increases up to the global maximum speed of 65 mph.

The effects of temperature on running losses are handled in the same manner as was done in MOBILE4: If TEMFLG = 1 in the input, then a trip- and emission-weighted temperature is calculated and used to correct running loss emissions to temperatures other than 75°F. If TEMFLG = 2, then the value of ambient temperature specified by the user in the Scenario Record (see section 2.3) is instead used as the temperature for correction of the running loss emission factors.

The effects of fuel volatility on running loss emissions were modeled in MOBILE4 for input (dispensed fuel) RVP in the range of 7.0 to 11.7 psi. This has been revised in MOBILE4.1, in

that the volatility effect of oxygenated fuels is accounted for (see section 1.1.1), and that the minimum (weathered, or in-tank) RVP for which running loss emission factors are calculated is now 6.5 psi. The upper limit of 11.7 psi RVP (weathered) for calculating running loss emission factors is unchanged from MOBILE4.

In MOBILE4.1 as in MOBILE4, a ceiling is placed on the increase in running losses with increasing temperature and volatility, to avoid unreasonable extrapolation based on limited data. Maximum running losses as a function of temperature occur at 105°F (41°C), with higher temperatures resulting in no further increase in running losses. Maximum running losses as a function of volatility occur at 11.7 psi RVP, which is the highest volatility fuel for which EPA has collected data. (This limit, as most other minimum/maximum RVP limits cited elsewhere in this document, refers to the weathered in-tank level. This could correspond to an input RVP as high as 13 psi given high temperatures and resulting increased weathering, although such temperature/volatility combinations are not realistic.)

The longer that a trip lasts, in terms of total time for any single trip at a given average speed, the more likely running loss emissions are to be generated. MOBILE4.1 uses national average (default) trip duration statistics to estimate the fleet average running losses. No changes are required to the model input to have these default values used. For areas having detailed data on the the trip distribution by length, the user can supply a trip duration distribution to be used in calculating running losses. See section 2.3.11 for more information on this option and the required form of the additional input data.

Separate running loss emission factors are calculated for each gasoline-fueled vehicle type except motorcycles (which represent a very small fraction of VMT).

### 1.1.9 Revisions to Refueling Emission Factors

Refueling emissions, also termed "Stage II" emissions, are generated when vehicles are refueled. (Stage I emissions are HC vapor emissions displaced to the atmosphere from underground service station gasoline storage tanks when these tanks are refilled.) Stage II refueling emissions consist primarily of displacement losses, which occur during vehicle refueling when the gasoline vapor filling the vehicle fuel tank vapor space (that space remaining above whatever liquid fuel remains in the tank) are displaced by incoming fuel and released to the atmosphere, and to a lesser extent of spillage losses (whatever fuel is spilled, or dripped from the dispensing nozzle, during

vehicle refueling, which completely evaporates). EPA has estimated that vehicle refueling emissions account for as much as two percent of the overall HC emissions inventory in urban areas.

In MOBILE4, refueling emission factors were calculated on the basis of nationwide average fuel consumption-weighted (by region) values of the variables used in the equation for calculating the displacement component of the emissions. (For additional information on the equation and the values used in it in MOBILE4, see [3] and [4].) The impact of changes in fuel RVP were modeled indirectly, on the basis of the ASTM Class for a given area. The ASTM Class is specified by a letter (A, B, C, D, E), with each letter associated with a voluntary maximum limit on gasoline volatility for a given state or part of state for each month. This approach was used as a surrogate for the user-input values of gasoline RVP to model the impacts of different RVP levels on refueling emissions. There was no temperature dependence of refueling emissions modeled in MOBILE4, although the model did not provide refueling emission factors at temperatures under 40°F.

Several revisions to the refueling emission calculation have been made in MOBILE4.1 which allow the impacts of the RVP and temperatures supplied by the user to be modeled directly. There are three variables in the equation: RVP of the dispensed fuel, the temperature of the dispensed fuel ($T_D$), and the difference in temperature between the dispensed fuel and the residual fuel that remains in the vehicle tank before the refueling event begins. In MOBILE4.1, each of these is a direct function of user input data. The value of RVP in the equation is that specified by the user as applying to the year of evaluation, the dispensed fuel temperature is estimated as either the average of the minimum and maximum temperatures specified by the user (if TEMFLG = 1) or the ambient temperature specified by the user (if TEMFLG = 2), and the difference in temperature is a function of dispensed fuel temperature.[5]

The effect of these revisions is to make the MOBILE4.1 refueling emission factors vary with the conditions that are being modeled. To prevent unrealistic values from being calculated, there are limits set on the calculated grams per gallon displacement factor. No revisions have been made to the spillage component of these emissions, the algorithm used to convert gram/gallon emission factors to grams per mile, or to the modeling of the effects of vapor recovery systems (onboard or Stage II) for the control of these emissions. The net effect is that refueling emissions, at a given RVP, will vary with temperature from a minimum of 1.8 g/gal (winter conditions) to a maximum of approximately 9 g/gal (extreme summer conditions).

### 1.1.10 Resting Loss Emissions

Resting loss emissions are another form of evaporative HC emissions which have not been explicitly accounted for in previous versions of the emission factor model. Resting losses can be defined as those emissions resulting from vapors permeating parts of the evaporative emission control system (e.g., rubber vapor routing hoses), migrating out of the carbon canister, or evaporating liquid fuel leaks. They are distinct in definition, although not in measurement, from both diurnal emissions (in that the temperature need not be increasing for resting losses to occur) and hot soak emissions (which occur when fuel evaporates from the engine and fuel line due to the heating of the fuel and fuel system that occurs during a trip). However, they are not entirely distinct from these other types of evaporative emissions, in that some of what are now explicitly labeled resting losses have previously been included in hot soak, diurnal, and running loss emission measurements.

Resting losses are a function of two factors in MOBILE4.1, the temperature and the type of carbon canister used in the vehicle evaporative emission control system. Like other forms of evaporative emissions, higher temperatures result in higher rates of resting losses. The two types of canister are "open-bottom" and "closed-bottom." An open-bottom canister, as the term implies, does not have an vapor-impermeable bottom, while a closed-bottom canister does. Resting losses are greater from open-bottom canisters, which are being phased out. EPA believes that open-bottom canisters will no longer be a part of the new-car fleet in the future, but a considerable number of such vehicles exist in today's fleet, and will be a steadily decreasing fraction of the fleet for some years to come. The estimated fraction of vehicles by model year using each of the two canister types is coded into the model.

Typical resting loss emissions are on the order of 0.08 grams per hour from vehicles with closed-bottom canisters at a temperature of 75°F (24°C). The separation of these emissions into a distinct category is more an effort to provide the modeler with the greatest possible accuracy in the allocation of emissions by time and location than it is an increase in the overall total of evaporative emissions. As noted above, a portion of what are now termed resting losses were accounted for previously in the hot soak, diurnal, and running loss emission factors, which have been adjusted slightly downward to account for that fact. However, because resting losses occur over all 24 hours of the day, there is a net increase in non-exhaust HC emissions with the treatment included in MOBILE4.1. If the emission factors are based on the daily minimum and maximum temperatures, the resting loss emission factors will reflect the average daily losses, including the effects of lower nighttime temperatures.

### 1.1.11 Methane Corrections

In MOBILE4, the difference between total HC and non-methane HC emission factors was calculated through the use of methane offsets, or the g/mi of methane typically present in each test segment (bag) of the FTP. These offsets were constant for each vehicle type and model year. In other words, the methane offset applicable to a given vehicle and model year did not change as a function of accumulated mileage or increased total HC emissions, meaning that the fraction of methane included in the exhaust HC emission factors decreased over time.

In MOBILE4.1, the methane offsets have been replaced by methane emission rate equations, similar to those used for other exhaust emissions. These equations, which are technology and model year specific for 1981 and later LDGVs, consist of a zero-mile level (ZML) in grams per mi (g/mi) and a deterioration rate (DR) in g/mi/10K mi. Data indicate that as total HC emissions increase, methane emissions also increase, although at a slower rate; thus, the fraction of total HC that is methane decreases over time. The non-methane emission factors from MOBILE4.1 are then determined by subtracting the appropriate values from the total HC emission factors, as before (see section 1.1.2).

### 1.1.12 New Carbon Monoxide Emission Standards

The Clean Air Act Amendments of 1990 (CAAA) include many new requirements for vehicles, including new tailpipe emission standards to be phased in beginning with the 1993 model year. As previously noted, most of the requirements of the CAAA applicable to the future have not been incorporated in MOBILE4.1. However, those areas in nonattainment with the National Ambient Air Quality Standard (NAAQS) for carbon monoxide (CO) have been given a State Implementation Plan (SIP) development schedule that is considerably shorter than that for ozone nonattainment areas. For this reason, the new CO emission standards for light-duty gas vehicles (LDGVs) and trucks (LDGTs) have been incorporated in MOBILE4.1.

There are two new CO emission standards of interest here: the so-called "Tier I" tailpipe standards, which are applicable at standard FTP conditions, and the "cold CO" standard, which is applicable over the FTP cycle at 20°F (-7°C). Each of these standards is phased in over several model years, with each manufacturer required to certify a specified percentage of the model year's production to the new standard. This means that the overall fleet fraction certified to the new standard in each model year of the phase-in period is the same.

For LDGVs, the Tier I CO standard is the same as the current standard (3.4 g/mi), thus no changes to the MOBILE4 basic emission rate equations were necessary. For LDGTs, there are actually two sets of Tier I CO standards, the certification standards in §202 of the revised Clean Air Act (CAA), and a set of intermediate certification standards which are given in §207 of the new CAA. All of this has been accounted for in the new BERs for model years 1994 and later in MOBILE4.1.*

The cold CO standards represent the first time that tailpipe emissions have been controlled at conditions other than those of the FTP. These standards (10 g/mi for LDGVs, 12 g/mi for LDGTs at 20°F) are accounted for in MOBILE4.1 by assuming that the necessary reductions will come from the cold-start (bag 1) portion of the FTP, when CO emissions are the greatest.

### 1.1.13 Idle Emission Factor Adjustments Programmed

The idle emission factors that were produced by MOBILE4 represent emissions at idle from engines in stabilized mode (thoroughly heated engine and catalyst). Due to lack of idle data at other temperatures, operating modes, and fuel volatility levels, the same idle emission factors were produced regardless of the conditions specified by the user. In response to the need for modeling idle emissions (particularly CO) at other conditions, primarily at cold temperatures and in cold-start mode, EPA developed an algorithm by which the stabilized idle emission factors at 75°F and 9.0 psi RVP could be adjusted to other conditions outside of the model.[6] While the method was somewhat cumbersome, it allowed a reasonable estimate of idle emissions at non-standard conditions to be calculated.

MOBILE4.1 has been revised to incorporate a similar algorithm. When idle emission factors are requested, they will be adjusted to the conditions specified in the input data file. Note that this adjustment is essentially the same as that recommended for use with MOBILE4; EPA still does not have sufficient idle emission data over a range of operating conditions to develop idle-specific temperature, operating mode, or fuel volatility correction factors.

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* In actuality, the BERs for LDT CO emissions for 1994 and later model years are no different than those used for model year 1993. Analysis of in-use vehicle emission data revealed that manufacturers have already achieved compliance with the "Tier I" CO standard with fuel-injected LDTs, which will be fully phased into the new vehicle fleet by 1994.

### 1.1.14 By Model Year Optional Output

For previous releases of the mobile source emission factor model, EPA later developed "by model year versions." This version of MOBILE4 provided an expanded type of emission factor output table in which the emission factor for each model years' vehicles, for each vehicle type, in the calendar year of evaluation was provided. For example, if the calendar year was 1990, the by model year output would show the emission factors for model year (MY) 1990 vehicles in 1990, MY 1989 vehicles in 1990, and so on through MY 1971 and earlier vehicles in 1990. The appropriate travel fraction weightings were also provided, as well as the weighted contribution of vehicles of each model year to the calendar year fleet emission factor. Such a version of the model's output is particularly useful when there is a need to examine the impact of a given emission control strategy (e.g., enhancement of an I/M program) on vehicles of different ages.

In the development of MOBILE4.1, EPA started out with the by model year version of MOBILE4, since the ability to see the differences in the emission factors for each model year due to each revision to the code is useful in error checking. With the deletion of unnecessary sections of code (see section 1.1.19) and some efficiency improvements, EPA was able to maintain the by model year option in the final MOBILE4.1 code. This option is accessed through the OUTFMT flag (see section 2.1.15). With the by model year output available through release MOBILE4.1, no development or release of a separate by model year version of the program will be required.

### 1.1.15 Revised Speed Correction Factors

Speed correction factors are used by the model to correct exhaust emissions for average speeds other than that of the FTP (19.6 mph). These correction factors have been significantly revised in MOBILE4.1. The revisions made are based on additional testing performed since MOBILE4, including testing over cycles with average speeds higher than 50 mph, and a reanalysis of all available speed data.

The revised speed correction factors are different in several ways. In MOBILE4, there were two speed regimes for which different correction factor models were used, low speed (less than 19.6 mph, to a minimum of 2.5 mph) and high speed (over 19.6 mph, to a maximum of 55 mph). MOBILE4.1 uses three speed correction models: low speeds (2.5-19.6 mph), moderate speeds (19.6-48 mph) and high speeds (48-65 mph), an approach that showed improved agreement between modeled and measured emissions at the speeds for which test data are available.

This approach addresses one area of concern with respect to the MOBILE4 speed corrections. At high speeds (greater than 48 mph), MOBILE4 extrapolated the correction factors developed from test data at speeds from 19.6 to 48 mph, to a maximum of 55 mph. Since emissions were lower at higher speeds within the range of the data, this extrapolation led to a continued decrease in the emission factors as speeds went from 48 to 55 mph. With new test data available from testing over cycles with average speeds as high as 62 mph, EPA was able to quantify the increase in emissions that occurs as vehicles travel at higher speeds. Thus, the limits on the average speed for which MOBILE4.1 can estimate emission factors have been increased, from 2.5-55 mph to 2.5-65 mph.

Speed correction factors have been developed for different model year groups, technologies, and emission levels (i.e., normal emitters versus high emitters). These corrections are weighted together by the fractions appropriate for each model years' vehicles and each calendar years' fleet to derive the speed corrections applied to the basic emission rates. The factors are also pollutant-specific. The pattern of emissions as a function of vehicle speed is similar for all pollutants, technologies, and model year groups: Emissions are greatest at the minimum speed of 2.5 mph, decline relatively rapidly as speeds increase from 2.5 to 19.6 mph, decline more slowly as speeds increase from 19.6 to 48 mph, and then increase with increasing speed to the maximum speed of 65 mph.

### 1.1.16 Revisions to Volatility Impact on Exhaust Emissions

Two relatively minor revisions have been made to the algorithms by which the impact of gasoline volatility (RVP) on exhaust emissions is estimated. First, the minimum temperature at which RVP is assumed to have an impact on exhaust emissions (higher emissions at higher RVP) has been raised slightly, from 40°F (4°C) to 45°F (8°C). This change was made on the basis of analyses showing that no consistent trends could be discerned in exhaust levels as a function of fuel volatility in data collected at 42-43°F (6°C). Data at 50° and 55°F (10° and 13°C) do show relatively small, but generally directionally consistent, RVP effects on exhaust. The increase in the lower-bound temperature from 40° to 45°F means that, since the volatility corrections at temperatures between the lower temperature limit and 75°F (24°C) are based on a linear interpolation from 1.0 (no impact) at the lower bound, the volatility corrections at temperatures under 75°F are slightly less than were estimated by MOBILE4.

At the other temperature extreme, the change is more subtle. In MOBILE4, no additional exhaust reductions were modeled for reducing RVP below the test standard level of

9.0 psi, unless the temperature was greater than 95°F (35°C), in which case further RVP reductions (to a minimum of 7.0 psi) provided additional reductions in exhaust emissions. The underlying logic, that at very high temperatures even certification fuel (at 9.0 psi RVP) would generate more vapor than is generated during certification to the evaporative emission standards, and hence that RVPs below 9.0 psi partially compensate for this effect, was valid. However, the 95°F "cut-off" in MOBILE4 resulted in a step-function change in the emission factors under certain of conditions (i.e., 94°F vs 95°F at RVP < 9.0).

In MOBILE4.1, the minimum RVP below which no further reduction can be expected in exhaust emissions remains 9.0 psi at 75°F, but as the temperature increases above that, the minimum RVP for which an effect is modeled decreases. The precise minimum RVP associated with each temperature in the 75°-95° range is based on the model year group- and technology-specific RVP/temperature correction factor equation, and so cannot be stated simply. However, the absolute minimum RVP beyond which no further decrease in exhaust emissions will result remains at 7.0 psi regardless of how high the temperature rises. This smooths the step-change at 95°F, and more accurately reflects the data and its analysis as expressed by the RVP/temperature correction factor model.

As was true in MOBILE4, there is no effect modeled for RVP being less than the certification level of 9.0 psi when the temperature is less than 75°F (24°C). Some test data indicate that possibility that, at temperatures in the range of 50-55°F (10-13°C), the use of fuel with RVP < 9.0 psi not only does not result in emission benefits, but may actually result in emission increases. The data available at this time are inadequate for modeling this possible effect, but modelers are cautioned to carefully consider the plausibility of the combination of temperature and fuel RVP that is modeled, and to be aware of the chance that MOBILE4.1 may underestimate emission factors for conditions combining low temperatures (less than about 55°F) and low volatilities (less than 9.0 psi RVP).

Finally, an additional explanatory note concerning RVP limits in MOBILE4.1 and their discussion in this document. As was true in MOBILE4, there are actually two sets of limits on RVP, those applicable to the user input values ("period 1" and "period 2" in MOBILE4.1, formerly "base" and "in-use"), and those applicable to the RVP actually used to calculate emission factor effects (e.g., on exhaust emissions or on running losses). The global limits, which are used to test whether the user-supplied values are valid, are 7.0 to 15.2 psi RVP. These values represent the volatility of fuel at the pump -- as it is dispensed to the vehicle.

Local limits, which are used to define the range for which emission factor effects are modeled, refer to "weathered" or "in-tank" volatility. As was explained in the User's Guide to MOBILE4,[2] the model accounts for the fact that fuels "weather" (experience a decrease in volatility) as they are driven around in the fuel tank of a vehicle. The extent of weathering is a function of both initial RVP (more volatile fuels weather more) and temperature (weathering is greater at higher temperatures).

The explanation of the preceding two paragraphs does not change anything that was true of MOBILE4, but is included here to ensure that the difference between the RVP specified as input (dispensed fuel) and the RVP used to calculate emission factor effects (weathered, in-tank fuel) is clearly stated.

### 1.1.17 New Registration Distributions

EPA has updated the registration distributions for all vehicle types. These distributions describe the fraction of vehicles of a specific type (e.g., LDGVs) that are of each age from one to 25-and-older. MOBILE4 used "smoothed" registration distribution curves, based on analyses of the actual fleet registration distribution data for recent years. These distributions represented the best average distribution for all calendar years modeled, although not necessarily the best possible fit for any specific year.

In MOBILE4.1, with the focus on accurate characterization of calendar year 1990 emissions, these distributions are not smoothed; they reflect the estimated nationwide registration distributions for 1990.

### 1.1.18 Variable Vehicle Counts

Vehicle counts represent the total number of registered vehicles for each of the eight vehicle types. These counts have been revised and updated in MOBILE4.1. The vehicle counts contained in MOBILE4.1 were developed using the MOBILE4 Fuel Consumption Model. That model uses historical vehicle registrations and sales and scrappage rate data to estimate vehicle counts as part of modeling highway vehicle fuel consumption. The model uses data from a number of sources, including analyses and publications by the Federal Highway Administration (Department of Transportation), the Oak Ridge National Laboratory (Department of Energy), the Bureau of Economic Analysis (Department of Commerce), the Motor Vehicle Manufacturers Association, and R. L. Polk and Co.

The vehicle counts in MOBILE4.1, in addition to being revised to reflect the current (1990 base year) fleet, also

change over time to reflect projected changes in total registrations. Additional information on the development of vehicle counts by calendar year in included in the Fuel Consumption Model documentation.[7]

### 1.1.19 Updated Dieselization Rates for LDVs and LDTs

The series of mobile source emission factor models has used dieselization rates to indicate the fraction of vehicles of a given type that are gasoline-fueled and the fraction that are diesels. This approach is used only for light-duty vehicles and light-duty trucks, since no data are available to indicate that a car or light truck is used any differently whether it is gasoline-fueled or diesel-powered. The fleet characterization data (e.g., annual mileage accumulation rates, average trips per day and miles per day by vehicle age) are applicable to the entire LDV or LDT fleet, as are the registration distributions by age. Dieselization rates are used to distinguish the registration distributions of gas vs. diesel LDVs or LDTs on the basis of the fraction of vehicle sales of each type that were diesel in each model year. This is not done for heavy-duty gas and diesel vehicles, since the usage patterns, registrations, mileage accumulation rates, and other fleet characterization data are clearly different for the two types of vehicle and the data necessary to characterize these differences are routinely collected and available from a number of sources.

The dieselization rates are a series of fractions, each associated with an individual model year, that describe what fraction of all LDVs or LDTs are diesels. For example, in MOBILE4, the 1985 model year diesel fractions were 0.009 for LDVs (0.9% of MY 1985 LDV sales were diesels), and the LDT diesel fraction was 0.011 (1.1% of MY 1985 LDT sales were diesels). In each new release of the model, these fractions are updated on the basis of actual sales to the most recent model year for which data are available, and projections are made of the diesel fractions for all later model years.

After reaching peaks of about six percent of LDV sales in the 1981 model year and about nine percent of LDT sales in the 1982 model year, sales of diesel LDVs and LDTs have dropped precipitously. The latest data available for use in MOBILE4.1 show that the sales of diesel LDVs in 1988 and later model years have been less than 0.005 of one percent, and the diesel share of LDT sales has fallen to about two-tenths of one percent. The dieselization rates in MOBILE4.1 have been revised to reflect this information.

The problem of forecasting future diesel sales fractions is illustrated by the rapid rise and fall of diesel sales in the late 1970s and early 1980s. In MOBILE4, EPA projected a

resurgence of diesel car and light truck sales would occur by the mid 1990s; a scenario that few find plausible today. This problem is handled in two ways in MOBILE4.1. First, much more modest future diesel sales fractions for model years 1991 through 2020 are included in MOBILE4.1, based on manufacturer projections of the future market. While not foolproof, these projections are the consensus of a number of diesel engine manufacturers, and are at least as likely to be borne out as were earlier projections. In these projections, diesel sales increase slowly in the 1990s and the first 15 years of the next century, reaching 0.3 percent for LDVs and 2.15 percent for LDTs by model year 2015. The model year 2015 sales fractions are held constant for model years 2016-2020.

Second, MOBILE4.1 includes provisions for the modeler to supply diesel sales fractions as input. This feature allows the modeler to account for diesel sales fractions over the past 25 years, if they differ significantly from the national levels, thus enhancing the accuracy of the base year 1990 emission factors and inventories. This feature also allows actual sales fractions for the next few model years to be included in the modeling as the data become available. Additional information on user input of diesel sales fractions is in section 2.2.15 of this document.

Time did not permit EPA to provide the model user with a feature that would allow the recombining of gas and diesel cars and light trucks. Generally, users will have available VMT estimates for LDVs (cars) and LDTs (light trucks) that do not distinguish between VMT accumulated by gas or diesel vehicles of each type. The scrupulous inventory developer will use the VMT mix provided in the MOBILE4.1 output to combine the gas and diesel LDV (LDT) emission factors for a given calendar year before multiplying the combined all-LDV (all-LDT) emission factor by the overall VMT for that vehicle type. Users who supply diesel sales fractions as MOBILE4.1 input in calculating base year 1990 emission factors should document how the inventory estimates were developed for LDVs and LDTs, noting in particular how the emission factors for gas and diesel LDVs (LDTs) were used to derive inventories for all LDVs (LDTs).

### 1.1.20 I/M Benefits for Decentralized Programs

In MOBILE4, the benefits (emission reductions) attributed to I/M programs were in part a function of the type of program being modeled: centralized, decentralized computerized, and decentralized manual. The centralized program was considered to get the maximum benefit from a program with the specified parameters; decentralized computerized programs were allowed the same benefit, while decentralized manual programs had the benefits reduced by 50 percent (relative to the maximum level achieved by centralized programs).

### 1.1.19 Updated Dieselization Rates for LDVs and LDTs

The series of mobile source emission factor models has used dieselization rates to indicate the fraction of vehicles of a given type that are gasoline-fueled and the fraction that are diesels. This approach is used only for light-duty vehicles and light-duty trucks, since no data are available to indicate that a car or light truck is used any differently whether it is gasoline-fueled or diesel-powered. The fleet characterization data (e.g., annual mileage accumulation rates, average trips per day and miles per day by vehicle age) are applicable to the entire LDV or LDT fleet, as are the registration distributions by age. Dieselization rates are used to distinguish the registration distributions of gas vs. diesel LDVs or LDTs on the basis of the fraction of vehicle sales of each type that were diesel in each model year. This is not done for heavy-duty gas and diesel vehicles, since the usage patterns, registrations, mileage accumulation rates, and other fleet characterization data are clearly different for the two types of vehicle and the data necessary to characterize these differences are routinely collected and available from a number of sources.

The dieselization rates are a series of fractions, each associated with an individual model year, that describe what fraction of all LDVs or LDTs are diesels. For example, in MOBILE4, the 1985 model year diesel fractions were 0.009 for LDVs (0.9% of MY 1985 LDV sales were diesels), and the LDT diesel fraction was 0.011 (1.1% of MY 1985 LDT sales were diesels). In each new release of the model, these fractions are updated on the basis of actual sales to the most recent model year for which data are available, and projections are made of the diesel fractions for all later model years.

After reaching peaks of about six percent of LDV sales in the 1981 model year and about nine percent of LDT sales in the 1982 model year, sales of diesel LDVs and LDTs have dropped precipitously. The latest data available for use in MOBILE4.1 show that the sales of diesel LDVs in 1988 and later model years have been less than 0.005 of one percent, and the diesel share of LDT sales has fallen to about two-tenths of one percent. The dieselization rates in MOBILE4.1 have been revised to reflect this information.

The problem of forecasting future diesel sales fractions is illustrated by the rapid rise and fall of diesel sales in the late 1970s and early 1980s. In MOBILE4, EPA projected a resurgence of diesel car and light truck sales would occur by the mid 1990s; a scenario that few, if any, find plausible today. This problem is handled in two ways in MOBILE4.1. First, much more modest future diesel sales fractions for model

years 1991 through 2020 are included in MOBILE4.1, based on manufacturer projections of the future market. While not foolproof, these projections are the consensus of a number of diesel engine manufacturers, and are at least as likely to be borne out as were earlier projections. In these projections, diesel sales increase slowly in the 1990s and the first 15 years of the next century, reaching 0.3 percent for LDVs and 2.15 percent for LDTs by model year 2015. The model year 2015 sales fractions are held constant for model years 2016-2020.

Second, MOBILE4.1 includes provisions for the modeler to supply diesel sales fractions as input. This feature allows the modeler to account for diesel sales fractions over the past 25 years, if they differ significantly from the national levels, thus enhancing the accuracy of the base year 1990 emission factors and inventories. This feature also allows actual sales fractions for the next few model years to be included in the modeling as the data become available. Additional information on user input of diesel sales fractions is in section 2.2.15 of this document.

Time did not permit EPA to provide the model user with a feature that would allow the recombining of gas and diesel cars and light trucks. Generally, users will have available VMT estimates for LDVs (cars) and LDTs (light trucks) that do not distinguish between VMT accumulated by gas or diesel vehicles of each type. The scrupulous inventory developer will use the VMT mix provided in the MOBILE4.1 output to combine the gas and diesel LDV (LDT) emission factors for a given calendar year before multiplying the combined all-LDV (all-LDT) emission factor by the overall VMT for that vehicle type. Users who supply diesel sales fractions as MOBILE4.1 input in calculating base year 1990 emission factors should document how the inventory estimates were developed for LDVs and LDTs, noting in particular how the emission factors for gas and diesel LDVs (LDTs) were used to derive inventories for all LDVs (LDTs).

### 1.1.20 I/M Benefits for Decentralized Programs

In MOBILE4, the benefits (emission reductions) attributed to I/M programs were in part a function of the type of program being modeled: centralized, decentralized computerized, and decentralized manual. The centralized program was considered to get the maximum benefit from a program with the specified parameters; decentralized computerized programs were allowed the same benefit, while decentralized manual programs had the benefits reduced by 50 percent (relative to the maximum level achieved by centralized programs).

This has been revised in MOBILE4.1, in that decentralized computerized programs are now also subject to the loss of 50 percent of the benefits from the tailpipe inspection portion of the program, as was done for decentralized manual programs in MOBILE4. Modelers who believe that higher efficiencies can be demonstrated for a specific decentralized computerized I/M program are encouraged to contact EPA to discuss the issue; see sections 2.2.5 and 2A.1.12-14 for additional information.

### 1.1.21 Miscellaneous Revisions

Finally, a number of smaller revisions and corrections to the code were made for MOBILE4.1. Sections of code that were blocked from execution in release MOBILE4, but which had been used for EPA's in-house modeling at different times, have been deleted to provide additional capacity for new features (i.e., 25-model-year arrays) while maintaining portability to personal computers. Efficiency improvements (having no impact on the estimated emission factors) were implemented in some sections of the code.

As noted in section 1.1, many of the requirements for the future contained in the CAAA have not been implemented in MOBILE4.1 (the LDT Tier I CO emission standards and the cold-temperature CO standards for LDVs and LDTs are exceptions). For this reason, EPA has added a new warning message that will be generated whenever the calendar year of evaluation is after 1993. This message simply notes that, since all of the requirements contained in the CAAA have not yet been coded into the model, emission factor projections for years beyond 1993 may not be reliable. This does not mean that the model cannot be used to estimate emission factors for later years, but is intended to serve as a reminder to the user that not all CAAA requirements are modeled and that HC and NOx emission factors for later model years must be viewed with caution.

## 1.2 LIST OF ABBREVIATIONS USED IN THIS DOCUMENT

There are a large number of abbreviations and acronyms used throughout this document. While efforts have been made to define all abbreviations and acronyms the first time that they appear, readers may find the following alphabetized reference list useful. Further information on those abbreviations representing MOBILE4.1 control flags and other variable names appears in the sections listed at the end of those definitions.

| | |
|---|---|
| **A/C** or **AC** | Air conditioning, air conditioner |
| **ALHFLG** | Control flag for application of optional additional corrections to light-duty gasoline-fueled vehicle emission factors (section 2.1.10) |
| **alt** | Altitude |
| **amb** | Ambient |
| **AMBT** | Variable name for user-specified ambient temperature (section 2.3.4) |
| **ANSI** | American National Standards Institute |
| **AP** | Airport |
| **ASCII** | American Standard Code for Information Interchange |
| **ASTM** | American Society for Testing and Materials |
| **ATP** | Anti-tampering program |
| **ATPFLG** | Control flag for determination of whether effects of an ATP on emission factors is to be modeled (section 2.1.11) |
| **BER** | Basic emission rate |
| **bpi** | Bytes per inch |
| **CAAA** | Clean Air Act Amendments of 1990 |
| **CO** | Carbon monoxide |
| **CPU** | Central processing unit |
| **CVS** | Constant volume sampler (sampling) |
| **CY** | Calendar year; also, variable name for calendar year of evaluation (section 2.3.2) |
| **DB** | Dry bulb temperature |
| **deg** | Degree(s) |
| **DR** | Deterioration rate |
| **DR1** | Deterioration rate applicable up to 50,000 miles accumulated mileage |
| **DR2** | Deterioration rate applicable after 50,000 miles accumulated mileage |
| **DSFLAG** | Control flag indicating whether alternate diesel sales fractions by model year for LDVs and LDTs are being supplied as input (see section 2.2.15) |
| **e.f., EF** | Emission factor(s) |
| **EGR** | Exhaust gas recirculation |
| **EKMA** | Empirical Kinetic Modeling Approach |
| **EPA** | Environmental Protection Agency |

| | |
|---|---|
| **FID** | Flame ionization detector |
| **ft** | Feet |
| **FTP** | Federal Test Procedure |
| **FTS** | Federal telephone system |
| **°F** | Degrees Fahrenheit |
| **g/BHP-hr** | Grams per brake horsepower-hour |
| **g/hr** | Grams per hour |
| **g/mi** | Grams per mile |
| **g/min** | Grams per minute |
| **GVW** | Gross vehicle weight |
| **HC** | Hydrocarbon(s) |
| **HCFLAG** | Control flag determining format of HC emission factors in output (section 2.1.19) |
| **HDD, HDDV** | Heavy-duty diesel vehicle(s) (over 8500 lb GVW) |
| **HDG, HDGV** | Heavy-duty gasoline-fueled vehicle(s) (over 8500 lb GVW) |
| **HDV** | Heavy-duty vehicle(s) |
| **IDLFLG** | Control flag for output of idle emission factors (section 2.1.17) |
| **I/M** | Inspection and maintenance |
| **IMFLAG** | Control flag for determination of whether effects of an I/M program on emission factors is to be modeled (section 2.1.9) |
| **Int'l** | International |
| **I/O** | Input/Output |
| **IOUNEW** | Input record for reassignment of I/O units (section 2.1.2) |
| **JCL** | Job control language |
| **K** | Thousand(s) (e.g., 50K = 50,000) |
| **kg** | Kilogram(s) |
| **LAP** | Local area parameter (record) (section 2.2.8) |
| **lb, lbs** | Pound(s) |
| **LDD** | Light-duty diesel(s) |
| **LDDT** | Light-duty diesel truck(s) (0-8500 lbs GVW) |
| **LDDV** | Light-duty diesel vehicle(s) |
| **LDG** | Light-duty gas |
| **LDGT** | Light-duty gasoline-fueled truck(s) (0-8500 lbs GVW) |
| **LDGT1** | LDGT(s) up to 6,000 lbs GVW |
| **LDGT2** | LDGT(s) 6,001-8,500 lbs GVW |
| **LDGV** | Light-duty gasoline-fueled vehicle(s) |
| **LDT** | Light-duty truck(s) |
| **LDV** | Light-duty vehicle(s) |
| **LOCFLG** | Control flag for location of local area parameter record in input stream (section 2.1.13) |

| | |
|---|---|
| **max** | Maximum |
| **MC** | Motorcycle(s) |
| **min** | Minimum |
| **MPD** | Miles per day |
| **mph** | Miles per hour |
| **MSL** | Mean sea level |
| **MVMA** | Motor Vehicle Manufacturer's Association |
| **myg** | Model year group |
| **MY, MYR** | Model year(s) |
| **MYMRFG** | Control flag for input of annual mileage accumulation rate data or registration distribution data (section 2.1.7) |
| **NAAQS** | National Ambient Air Quality Standard |
| **NEWFLG** | Control flag indicating whether user is entering modifications to BERs (section 2.1.8) |
| **NIPER** | National Institute for Petroleum and Energy Research |
| **NMHC** | Non-methane hydrocarbons |
| **NMHFLG** | Control flag determining whether total HC or NMHC emission factors will be provided in output (section 2.1.18) |
| **NMOG** | Non-methane organic gasses |
| **NOx** | Oxides of nitrogen |
| **NTIS** | National Technical Information Service |
| **OAQPS** | Office of Air Quality Planning and Standards |
| **OAR** | Office of Air and Radiation |
| **OEM** | Original equipment manufacture(r) |
| **OMS** | Office of Mobile Sources |
| **OUTFMT** | Control flag indicating type of formatted output report to be produced (section 2.1.15) |
| **OXYFLG** | Control flag indicating whether information on oxygenated fuels (gasoline/alcohol and gasoline/ether blends) is being supplied as input (see section 2.2.14) |
| **PC** | Personal computer(s) |
| **PCCC** | Variable name for percent of VMT accumulated by catalyst-equipped vehicles in cold-start mode (section 2.3.5) |
| **PCCN** | Variable name for percent of VMT accumulated by non-catalyst vehicles in cold-start mode (section 2.3.5) |
| **PCHC** | Variable name for percent of VMT accumulated by catalyst-equipped vehicles in hot-start mode (section 2.3.5) |
| **PCV** | Positive crankcase ventilation |
| **PROJID** | Variable name for MOBILE4 run title (section 2.1.3) |
| **PROMPT** | Control flag determining if user will be prompted for remaining MOBILE4 input (section 2.1.1) |

| | |
|---|---|
| **PRTFLG** | Control flag determining which pollutants will be included in output (section 2.1.16) |
| **psi** | Pounds per square inch |
| **R** | Refueling HC emission factor label in numeric formatted output reports (sections 3.3.1, 3.3.2) |
| **Reg** | Region |
| **RLFLAG** | Control flag determining how refueling emission factors will be calculated (section 2.1.12) |
| **rpm** | Revolutions per minute |
| **RVP** | Reid vapor pressure |
| **S** | Resting loss HC emission factor label in numeric formatted output reports (sections 3.3.1, 3.3.2) |
| **SIP** | State Implementation Plan |
| **SPDFLG** | Control flag indicating how average vehicle speed is to be specified (section 2.1.5) |
| **T** | Running loss HC emission factor label in numeric formatted output reports (sections 3.3.1, 3.3.2) |
| **TAMFLG** | Control flag indicating whether alternate tampering rates are to be input (section 2.1.4) |
| **TCF** | Temperature correction factor |
| **Tech I-II, Tech IV+** | Vehicle technology groups for which different I/M emission credits have been developed (sect 2A.1.15) |
| **TEMFLG** | Control flag indicating how temperatures for use in correcting emission factors are to be determined (section 2.1.14) |
| **temp** | Temperature(s) |
| **THC** | Total hydrocarbons |
| **TOG** | Total organic gasses |
| **TPD** | Trips per day |
| **UAM** | Urban Airshed Model |
| **ub** | Upper bound |
| **UDI** | Uncontrolled diurnal index |
| **V** | Evaporative HC emission factor label in numeric formatted output reports (sections 3.3.1, 3.3.2) |
| **veh** | Vehicle(s) |
| **VOC** | Volatile organic compounds |
| **VMFLAG** | Control flag determining if alternate VMT mix(es) must be supplied as input (section 2.1.6) |
| **VMT** | Vehicle miles travelled |
| **VRS** | Vapor recovery system |
| **WB** | Wet bulb temperature |
| **X** | Exhaust HC emission factor label in numeric formatted output reports (sections 3.3.1, 3.3.2) |
| **ZML** | Zero-mile level |

## References for Chapter 1

1. "Guidance on Estimating Motor Vehicle Emission Reductions from the Use of Alternative Fuels and Fuel Blends," U.S. EPA, Office of Air and Radiation, Office of Mobile Sources, January 1988, EPA-AA-TSS-PA-87-4.

2. "Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources," U.S. EPA, Office of Air and Radiation, Office of Air Quality Planning and Standards and Office of Mobile Sources, May 1991, EPA-450/4-81-026d (revised).

3. "User's Guide to MOBILE4," U.S. EPA, Office of Air and Radiation, Office of Mobile Sources, May 1989, EPA-AA-TEB-89-01.

4. "Refueling Emissions from Uncontrolled Vehicles," U.S. EPA, Office of Air and Radiation, Office of Mobile Sources, 1985, EPA-AA-SDSB-85-6.

5. Letter from Philip S. Bush, Amoco Oil Co., to Charles L. Gray, Jr., Director, Emission Control Technology Division, January 7, 1987.

6. "Adjustment of MOBILE4 Idle CO Emission Factors to Non-Standard Operating Conditions," U.S. EPA, Office of Air and Radiation, Office of Mobile Sources, November 1989.

7. "The MOBILE4 Fuel Consumption Model," U.S. EPA, Office of Air and Radiation, Office of Mobile Sources, 1991 [DRAFT].

# Chapter 2

# MOBILE4.1 INPUTS

## 2.0 INTRODUCTION

The reader is encouraged to refer to the examples in Chapter 5 when reading this chapter. These examples provide illustrations of the use of MOBILE4.1 options and data input requirements.

MOBILE4.1 utilizes one input data set that provides program control information and the data describing the scenarios for which emission factors are to be estimated. The input data set consists of three distinct sections: the Control section, the One-time data section, and the Scenario section.

The Control section is the portion of the input data that controls the input, output, and execution of the program. For example, the Control section indicates whether MOBILE4.1 will prompt the user for input data, or analyze a scenario that includes an inspection and maintenance program, or output the emission factors in a format suitable for visual inspection or in a format suitable as input for another program.

Some of the parameters used in the emission factor calculations have internal, or default, values built into MOBILE4.1. The One-time data section is the portion of the input data that allows the user to define parameter values different from those internal to MOBILE4.1, which will be used in the calculations for all of the scenarios within a given run. For example, in the One-time data section the user can specify annual mileage accumulation rates or registration distributions by age for each vehicle type.

The Scenario section is the portion of the MOBILE4.1 input data that details the individual scenarios for which emission factors are to be calculated. For example, in the Scenario section the user specifies the calendar year of evaluation, the average speed(s) to be assumed, and the region (low- or high-altitude).

In a few cases, the placement of data in either the One-time data section or the Scenario data section is determined by the setting assigned to a flag in the Control section of the input stream. In such cases, discussion of the variable(s) involved is provided once (usually in the One-time section), and is referenced in the other (usually the Scenario) section.

The Control section consists primarily of specified values for variables termed flags. In section 2.1 each flag is named, and the range of possible settings for that flag and the resulting action is noted. In the One-time and Scenario data sections (sections 2.2 and 2.3 respectively), the following general format is used. (Depending on the variable being discussed, not every item noted below is included for every variable.)

**Description**: A brief description of what the variable means, and how it is used by MOBILE4.1.

**Options**: A summary of choices available to the MOBILE4.1 user.

**Use in MOBILE4.1**: A description of the value(s) used in MOBILE4.1 for the variable(s) if the user does not input locality-specific information, where applicable, and discussion of how the information is used in the emission factor calculations.

**Required Information**: A specific description of exactly what information is required of the user, where applicable, including format specifications.

**Changes Since MOBILE4**: A statement summarizing exactly what changes have been made in the variable since MOBILE4. Not every variable has been revised. For those that have changed, this section highlights exactly what is different in MOBILE4.1 relative to MOBILE4 (options, format requirements, or use within the model).

**Guidance**: Where applicable, EPA's recommendations and suggestions with respect to the determination of user-supplied values for the variable(s) under discussion. Many users of MOBILE4.1 will be involved in the development of base-year (1990) emission inventories for use in the State Implementation Plan (SIP) process. In many cases, there is no single correct answer or recommendation that will be the best answer for all areas. For those using MOBILE4.1 to estimate highway mobile source base-year emission inventories in response to the requirements of the Clean Air Act Amendments of 1990, it is important that the appropriate EPA Regional Office personnel be kept involved in decisions concerning questionable or controversial assumptions and steps in the modeling.

There is also an appendix to this chapter which discusses the terminology used to describe inspection and maintenance (I/M) programs and anti-tampering programs. Appendices 2B and 2C from the User's Guide to MOBILE4 have been deleted: Guidance on the determination of appropriate values for temperatures and fuel volatility (RVP) appears in the revised emission inventory

guidance ("Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources," EPA-450/4-81-026d (revised), July 1991), and there is no longer any need to determine the ASTM volatility class in modeling emission factors (see section 2.2.10).

Questions about the material in this document, and suggestions as to how the MOBILE4.1 User's Guide may be made clearer and more useful, should be addressed to:

Terry P. Newell (TEB-13)
U.S. EPA Motor Vehicle Emission Laboratory
2565 Plymouth Road
Ann Arbor, MI 48105

(313) 668-4462 or FTS 374-8462

The remainder of Chapter 2 is structured as it was in the User's Guide to MOBILE4. For the most part, the same section numbers correspond to the same inputs and discussions as in the previous User's Guide. Where applicable, new subsections have been added to clearly indicate changes relative to MOBILE4.

## 2.1 CONTROL SECTION

The first portion of the input stream for a MOBILE4.1 run consists primarily of a series of flag settings. These flags control the format (and in some cases the content) of the remainder of the input stream, influence the execution of the program, and determine the content and format of the program's output. Each flag is named, defined, and its possible values listed, along with the effect of each setting.

### 2.1.1 PROMPT

#### 2.1.1.1 Description

This flag determines whether the user will be prompted for the remainder of the input stream, and the arrangement of the remaining Control data section input.

#### 2.1.1.2 Values/Actions

This flag can be set to 1, 2, 3, or 4:

| Value | Action |
|---|---|
| 1 | No prompting; after PROJID record (section 2.1.3), vertical format (one value per line/record) used for remainder of Flags input |
| 2 | MOBILE4 prompts for each input; vertical format |
| 3 | No prompting; after PROJID record, horizontal format (all values on one line/record) used for remainder of Flags input |
| 4 | MOBILE4 prompts for each input; horizontal format |

It is suggested that the input prompting options (PROMPT = 2 or 4) be used only when the user is uncertain as to the order of the remaining inputs in the Control data section.

#### 2.1.1.3 Changes Since MOBILE4

If the value of PROMPT is either 2 or 4, indicating that the user wishes to be prompted for the remaining input data, the data to be entered is entered on the same line as the prompting message. (In MOBILE4, the user was to enter the requested data on the line following each prompting message.)

## 2.1.2 IOUNEW

### 2.1.2.1 Description

The IOUNEW flag allows reassignment of output unit device numbers. There are three different types of program output, and the default value for all three is unit 6. This flag is only useful when the mainframe computer version of MOBILE4.1 (9-track magnetic tape) is being operated. The personal computer version of MOBILE4.1 does not permit the reassignment of I/O devices.

### 2.1.2.2 Values/Actions

The three types of program output are: formatted reports (emission factor results), diagnostic messages (error and warning messages), and prompting messages (such as are issued if the value of the PROMPT flag above is 2 or 4). Single integer values representing other I/O device numbers may be assigned for any or all of these, in the order listed. If no device reassignments are desired, these fields may be left blank.

Values of 1, 2, 3, 6, 7, and 8 are allowed by MOBILE4.1 for assignment of any of the three possible output units. Values of 4 and 5 are reserved as input device codes in MOBILE4.1, and thus may not be assigned by the user for any IOUNEW field. If an illegal or missing IOUNEW value is encountered, MOBILE4.1 will revert to the default value (unit 6). The user is cautioned that IOUNEW values considered valid by MOBILE4.1 may not be appropriate for a given computer system.

## 2.1.3 PROJID

### 2.1.3.1 Description

MOBILE4.1 provides an 80-character alphanumeric field for the user to input a descriptive title for the MOBILE4.1 run.

### 2.1.3.2 Values/Action

The project title is an 80-column blank record. The user may use up to 80 characters for the title. The character string does not have to be left-justified. Whatever title is input by the user is echoed as the heading of the formatted reports section of the program output. If no title is desired, a blank record must be entered here.

## 2.1.4 TAMFLG

### 2.1.4.1 Description

This flag provides the option of supplying tampering rates that differ from those included in the MOBILE4.1 code.

### 2.1.4.2 Values/Action

This flag can be set to 1 or 2:

| Value | Action |
|---|---|
| 1 | Use MOBILE4.1 tampering rates |
| 2 | User supplies tampering rates for eight categories of tampering, for each of the four vehicle types affected by tampering (LDGV, LDGT1, LDGT2, HDGV) |

The user-supplied tampering rate data, required if TAMFLG = 2, are placed in the One-time data section. Section 2.2.1 discusses tampering rates as program input.

### 2.1.4.3 Changes Since MOBILE4

As discussed in section 2.2.1, tampering rates are now applicable to three model year groups of light-duty vehicles, rather than the two model year groups used in MOBILE4. This means that if the user sets the value of TAMFLG = 2, additional sets of tampering rate equations must be supplied. See section 2.2.1 for additional information.

## 2.1.5 SPDFLG

### 2.1.5.1 Description

MOBILE4.1 requires that vehicle average speed be specified in the program input, since exhaust and running loss emissions vary considerably with speed. This flag provides the option of specifying one speed for all eight vehicle types, or of specifying different speeds for each vehicle type. In addition, in MOBILE4.1 there are two new values of SPDFLG that can be used to indicate that the user wishes to supply data on the distribution of trips by length (of time) for use in the estimation of running loss emission factors.

#### 2.1.5.2 Values/Action

This flag can be set to 1, 2, 3, or 4:

| Value | Action |
|---|---|
| 1 | User supplies one value for speed to be applied to all vehicle types |
| 2 | User supplies eight values for speed, one to be applied to each vehicle type |
| 3 | User supplies one value for speed to be applied to all vehicle types, and a different set of locality-specific VMT fractions by trip length (for use in running loss emission factor calculations) for each scenario in the Scenario data section |
| 4 | User supplies one value for speed to be applied to all vehicle types, and a single set of values for locality-specific VMT fractions by trip length (for use in running loss emission factor calculations) in the One-Time data section |

#### 2.1.5.3 Changes Since MOBILE4

If the value of SPDFLG is 1 or 2, there are no differences from MOBILE4 in how the speed data are located or formatted in the input file. The values of 3 and 4 are new options in MOBILE4.1. If either of these values is selected, only a single speed input to be used for all eight vehicle classes can be used (equivalent to SPDFLG = 1), and the user must supply alternate information on the fraction of VMT that is accumulated in trips of different lengths. The alternate locality-specific VMT fractions by trip length may be placed in the One-Time data section, in which case those values will be used in all scenarios of the run, or in the Scenario data section. Section 2.3.3 and 2.3.11 discuss speed and VMT fractions by trip length, respectively, as program input.

### 2.1.6 VMFLAG

#### 2.1.6.1 Description

The setting of VMFLAG determines the vehicle miles travelled (VMT) mix (fraction of total VMT accumulated by vehicles of each of the eight types) that will be used in MOBILE4.1 to estimate the composite emission factor for a given scenario.

2.1.6.2 Values/Action

This flag can be set to 1, 2, or 3:

| Value | Action |
|---|---|
| 1 | Use MOBILE4 VMT mix |
| 2 | User supplies a different VMT mix for each scenario |
| 3 | User supplies a single VMT mix for all scenarios |

If VMFLAG = 2, the VMT mix input data are placed in the Scenario data section. If VMFLAG = 3, the VMT mix input data are placed in the One-time data section. Sections 2.2.2 and 2.3.6 discuss VMT mix as program input. There have been no revisions to this flag since MOBILE4.

## 2.1.7 MYMRFG

2.1.7.1 Description

This flag controls the use of annual mileage accumulation rates by age and registration distributions by age. These parameters define the composition and travel characteristics of the fleet, and so affect the resulting emission factors.

2.1.7.2 Values/Action

This flag can be set to 1, 2, 3, or 4:

| Value | Action |
|---|---|
| 1 | Use MOBILE4.1 (national average) annual mileage accumulation rates and registration distributions |
| 2 | User supplies annual mileage accumulation rates; use MOBILE4.1 registration distributions |
| 3 | User supplies registration distributions; use MOBILE4.1 annual mileage accumulation rates |
| 4 | User supplies both annual mileage accumulation rates and registration distributions |

The input data required if MYMRFG = 2, 3, or 4 are placed in the One-time data section. Section 2.2.3 discusses the input and use of annual mileage accumulation rates and registration distributions. There have been no revisions to this flag since MOBILE4.

## 2.1.8 NEWFLG

### 2.1.8.1 Description

This flag provides the option of modifying the basic exhaust emission rates by model year.

### 2.1.8.2 Values/Action

This flag can be set to either 1 or 2:

| Value | Action |
|---|---|
| 1 | Use MOBILE4.1 basic exhaust emission rates |
| 2 | User supplies one or more modifications to the MOBILE4.1 basic exhaust emission rates |

The user-supplied modifications to the basic emission rates, required if NEWFLG = 2, are placed in the One-time data section. Section 2.2.4 discusses basic exhaust emission rates and their modification by the user. There have been no revisions to this flag since MOBILE4.

## 2.1.9 IMFLAG

### 2.1.9.1 Description

This flag allows the option of having MOBILE4.1 include the emission benefits of an operating inspection and maintenance (I/M) program on the emission factors.

### 2.1.9.2 Values/Action

This flag can be set to 1 or 2:

| Value | Action |
|---|---|
| 1 | No I/M program is assumed to be operating |
| 2 | User specifies an I/M program and MOBILE4.1 models its impact on emissions |

The data specifying an I/M program, required if IMFLAG = 2, are placed in the One-time data section. Section 2.2.5 and Appendix 2A discuss the specification of I/M programs and their use in MOBILE4.1. There have been no revisions to this flag since MOBILE4.

## 2.1.10 ALHFLG

### 2.1.10.1 Description

This flag provides the ability to have MOBILE4.1 adjust some exhaust emission factors to account for certain conditions: air conditioning (A/C) usage, extra loading, trailer towing, and humidity. These additional corrections apply only to exhaust emission factors (HC, CO, and NOx), and only to the light-duty gasoline-fueled vehicle types (LDGVs, LDGT1s, and LDGT2s), with the exception that the humidity correction affects only NOx emission factors and is also applied to motorcycle emissions.

### 2.1.10.2 Values/Action

This flag can be set to 1, 2, or 3:

| Value | Action |
|---|---|
| 1 | Do not apply these additional correction factors (no additional inputs required) |
| 2 | Six additional input values required |
| 3 | Ten additional input values required |

The additional data required if ALHFLG = 2 or 3 are placed in the Scenario data section. The specific inputs required when ALHFLG = 2 or 3 are discussed in section 2.3.8. There have been no revisions to this flag since MOBILE4.

## 2.1.11 ATPFLG

### 2.1.11.1 Description

This flag allows for the benefits of an operating anti-tampering program (ATP) to be included in the emission factor calculations.

### 2.1.11.2 Values/Action

This flag can be set to 1 or 2:

| Value | Action |
|---|---|
| 1 | No ATP is assumed |
| 2 | User specifies an ATP and MOBILE4.1 accounts for its impact on emissions |

The data specifying the characteristics of the ATP to be modeled, required when ATPFLG = 2, are placed in the One-time data section. Section 2.2.6 and Appendix 2A discuss user specification of ATPs. There have been no revisions to this flag since MOBILE4.

## 2.1.12 RLFLAG

### 2.1.12.1 Description

This flag controls whether and how MOBILE4.1 models refueling emissions (also referred to as Stage II emissions) from gasoline-fueled vehicles.

### 2.1.12.2 Values/Action

This flag can be set to 1, 2, 3, 4, or 5:

| Value | Action |
|---|---|
| 1 | Use uncontrolled refueling emission rates for all model years |
| 2 | Model the impact of Stage II vapor recovery system (VRS) requirement on refueling emissions |
| 3 | Model impact of onboard VRS requirement on refueling emissions |
| 4 | Model impact of both Stage II and onboard VRS requirements on refueling emissions |
| 5 | Zero-out refueling emissions completely (effectively the approach taken in MOBILE3); in this case, Stage II emissions must be accounted for in the stationary source portion of the emission inventory |

The data describing the characteristics of either or both vapor recovery systems, required if RLFLAG = 2, 3, or 4, are placed in the One-time data section. Refueling emissions and their modeling in MOBILE4.1 are discussed in section 2.2.7. There have been no revisions to this flag since MOBILE4.

## 2.1.13 LOCFLG

### 2.1.13.1 Description

This flag controls the input by the user of the local area parameters (LAP) record. This record contains six to eight fields: scenario name, minimum and maximum daily temperatures, base (or pre-control) RVP, in-use (or control) RVP, in-use RVP control start year, and possibly values for OXYFLG and DSFLAG. The ASTM volatility class, which was a required part of the LAP record for MOBILE4, is no longer necessary. However, the format of the remainder of the record is unchanged, so that a MOBILE4 LAP record that includes ASTM class will function as MOBILE4.1 input. The two optional "flag" values, OXYFLG and DSFLAG, are used to indicate whether the user is inputting data on an oxygenated fuels program and on alternate diesel sales fractions by model year.

They follow the in-use RVP control start year, and if missing are interpreted by MOBILE4.1 as indicating that neither type of data are included. Thus, a LAP record from a MOBILE4 input file will work in MOBILE4.1.

2.1.13.2 Values/Action

This flag can be set to 1 or 2:

| Value | Action |
|---|---|
| 1 | User enters a distinct LAP record for each scenario of the MOBILE4.1 run |
| 2 | User enters one LAP record to apply to all scenarios of the MOBILE4.1 run |

If LOCFLG = 1, the LAP records are placed in the Scenario data section. If LOCFLG = 2, the LAP record is placed in the One-time data section. The content of the LAP record is discussed in section 2.2.8, and the individual variables comprising the LAP are discussed in sections 2.2.9 through 2.2.15. Table 2.2-5 provides a summary of and specifications for the LAP record in the MOBILE4.1 input stream.

There have been no revisions to LOCFLG since MOBILE4. The revisions to the content of the LAP record are discussed in sections 2.2.8 through 2.2.15.

## 2.1.14 TEMFLG

2.1.14.1 Description

This flag controls the determination of temperatures to be used in the correction of the exhaust emission factors (HC, CO, and NOx), the hot soak and diurnal components of the evaporative HC emission factors, and the running loss and resting loss HC emission factors. All of these are dependent on temperature.

2.1.14.2 Values/Action

This flag can be set to 1 or 2:

| Value | Action |
|---|---|
| 1 | MOBILE4.1 will determine the temperatures to be used in correcting emission factors on the basis of the input values of minimum and maximum daily temperature. The input value of ambient temperature will not be used in calculating temperature corrections to |

| Value | Action |
|---|---|
| 1 | (continued) emissions if TEMFLG = 1; it will be overridden by specific values calculated individually for exhaust HC, exhaust CO, exhaust NOx, hot soak evaporative HC, and running loss HC. |
| 2 | The input value of ambient temperature will be used in calculating the temperature corrections to all exhaust emissions, hot soak evaporative emissions, and running and resting loss emissions. The input values of minimum and maximum daily temperature will still be used to calculate diurnal evaporative emissions. |

The temperatures used to correct exhaust, hot soak evaporative, and running loss and resting loss emissions are determined in a way that accounts for variation in emission levels with daily variation in temperature if TEMFLG = 1. The result is that the temperature corrections are weighted to reflect average emissions over a period of time (i.e., one day) where the temperature range is from the minimum to the maximum temperature. Thus the use of TEMFLG = 1 is recommended for daily emission inventory preparation and SIP-related modeling by the States.

For those areas modeling emission factors on an hourly basis, whether required for input to other air quality models (such as Urban Airshed) or for some other purpose, the use of TEMFLG = 2 will be more appropriate. When TEMFLG = 2, the input value of ambient temperature should be selected to represent conditions in the short time period (one hour) being modeled. This temperature will then be used to correct exhaust, hot soak evaporative, and running loss and resting loss emission factors.

The input of minimum and maximum daily temperatures is discussed in section 2.2.11. The input of ambient temperature is discussed in section 2.3.4. Additional guidance on the determination of appropriate values for use as temperature inputs to MOBILE4 when the model is being used for SIP-related emission inventory development and attainment planning is provided in "Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources," EPA-450/4-81-026d (revised), July 1991.

There have been no revisions to TEMFLG since MOBILE4.

Table 2.1-1 summarizes the flags controlling the input requirements and execution of MOBILE4.

## 2.1.15 OUTFMT

### 2.1.15.1 Description

This flag controls the format structure of the formatted output report. Different formats are appropriate depending on the intended use of the MOBILE4.1 output.

### 2.1.15.2 Values/Action

This flag can be set to 1, 2, 3, 4, or 5:

| Value | Action |
|---|---|
| 1 | 222-column numerical format |
| 2 | 140-column numerical format |
| 3 | 112-column descriptive format |
| 4 | 80-column descriptive format |
| 5 | By-Model Year output (in addition to standard 112-column descriptive format) |

The numerical formats are generally used when the output of the MOBILE4 run is to be used as input for another program (e.g., air quality simulations). The descriptive formats contain all of the same information, with more complete labels and headings for ease of visual inspection. Illustrative examples are shown in Chapter 5 (MOBILE4.1 Examples).

### 2.1.15.3 Changes Since MOBILE4

The first four options for output format are exactly as they were in MOBILE4. The last option (OUTFMT = 5) provides the user the ability to obtain additional output tables listing the emission factors for vehicles of each model year (vehicles of ages 1, 2, ..., 25+ in the calendar year of evaluation). If this option is selected additional input must be provided, in the form of one additional record in the One-Time data section. This additional record tells MOBILE4.1 which vehicle types the by-model year output is desired for, and is described in section 2.2.16.

## 2.1.16 PRTFLG

### 2.1.16.1 Description

This flag determines which pollutants will have emission factor calculations performed, and thus will be included in the program output. This feature enables the user to avoid the time and expense of calculating all emission factors when the results for only one of the pollutants are all that is necessary for some applications.

2.1.16.2 Values/Action

This flag can be set to 1, 2, 3, or 4:

| Value | Action |
|---|---|
| 1 | HC (hydrocarbon) emission factors only |
| 2 | CO (carbon monoxide) emission factors only |
| 3 | NOx (oxides of nitrogen) emission factors only |
| 4 | All three pollutants |

There have been no revisions to this flag since MOBILE4.

## 2.1.17 IDLFLG

2.1.17.1 Description

This flag controls the calculation and output of idle emission factors (emissions at idle in terms of mass pollutant per unit time (g/hr) for each pollutant).

2.1.17.2 Values/Action

This flag can be set to 1 or 2:

| Value | Action |
|---|---|
| 1 | No idle emission factors calculated or printed (exhaust emission factors only) |
| 2 | Idle emission factors calculated and printed (in addition to exhaust emission factors) |

There have been no revisions to this flag since MOBILE4.

## 2.1.18 NMHFLG

2.1.18.1 Description

This flag determines which of five possible options for the hydrocarbon emissions factors will be used in the calculations: total hydrocarbons, including methane (THC); non-methane hydrocarbons, defined as THC minus methane (NMHC); volatile organic compounds, defined as NMHC minus ethane corrected for aldehydes (VOC); total organic gases, defined as THC corrected for aldehydes (TOG); or non-methane organic gases, defined as NMHC corrected for non-hydrocarbon reactive compounds, i.e., formaldehyde and acetaldehyde (NMOG). These are summarized below:

| Option | Compounds included in the emission factors: FID HC | Methane | Ethane | Aldehydes |
|---|---|---|---|---|
| THC | Yes | Yes | Yes | No |
| NMHC | Yes | No | Yes | No |
| VOC | Yes | No | No | Yes |
| TOG | Yes | Yes | Yes | Yes |
| NMOG | Yes | No | Yes | Yes |

2.1.18.2 Values/Action

This flag can be set to 1, 2, 3, 4, or 5:

| Value | Action |
|---|---|
| 1 | Total hydrocarbon emission factors (THC) |
| 2 | Non-methane hydrocarbon emission factors (NMHC) |
| 3 | Volatile organic compounds (VOC) |
| 4 | Total organic gases (TOG) |
| 5 | Non-methane organic gasses (NMOG) |

2.1.18.3 Changes Since MOBILE4

The first two options for NMHFLG have the same meaning and result as in MOBILE4. The last three options are new in MOBILE4.1, and provide the user the ability to estimate highway motor vehicle HC emission factors that include or exclude various compounds depending on the application intended for the results. See section 1.1.2 for additional discussion of these options. For guidance on the most appropriate choice for the preparation of base year emission inventories, see "Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources," EPA-450/4-81-026d (revised), July 1991.

## 2.1.19 HCFLAG

2.1.19.1 Description

This flag determines whether the HC emission factors displayed in the output will include only the sum of all components of HC emissions (whichever composition option for these emissions is selected) or will also include the various component emission factors (exhaust, evaporative, refueling, running loss, and total HC emissions). This flag also allows the user to select an expanded printout of the various components of "evaporative" HC emissions, as discussed in section 1.1.3.

2.1.19.2 Values/Action

This flag can be set to 1, 2, or 3:

| Value | Action |
|---|---|
| 1 | No component output (print only sum of all HC components) |
| 2 | Print sum and components (exhaust, evaporative, refueling, running loss, and resting loss HC) |
| 3 | Print sum and components (exhaust, evaporative, refueling, running loss, and resting loss HC), and a detailed evaporative breakdown in grams |

2.1.19.3 Changes Since MOBILE4

The first two options for this flag have the same meaning and result as in MOBILE4. The last option provides the user with a detailed breakdown of the various types of "evaporative" emissions. The emission factors presented in the expanded evaporative emission factor table are in grams per event (trip end) for hot soak evaporative emissions, grams per event (period of rising ambient temperature without trips) for diurnal emissions, grams per gallon of fuel dispensed for refueling emissions, and grams per hour for resting losses. The running loss emission factors can only be expressed as grams per mile, and are shown in the component output produced when HCFLAG = 2 or 3.

Table 2.1-2 summarizes the flags controlling the output of MOBILE4.

## 2.1.20 Inter-Flag Dependencies

2.1.20.1 Description

There are cases where the value assigned to one flag in the Flags section either determines the value that must be assigned to another flag, or precludes the use of one or more possible values for another flag. Certain combinations of flag settings also impose requirements on other inputs in either the One-time or Scenario data sections. While careful consideration of the input file prepared for a MOBILE4.1 run makes such situations clear, a short listing is provided here for the convenience of the user.

2.1.20.2 List

2.1.20.2.1 If TAMFLG = 2 (user-supplied tampering rates) and IMFLAG = 1 (no I/M program assumed), supply only one set of alternate tampering rates (non-I/M rates).

2.1.20.2.2 If TAMFLG = 2 and IMFLAG = 2 (specify and model an I/M program), two sets of alternate tampering rates must be supplied (non-I/M and I/M rates).

2.1.20.2.3 If PRTFLG = 2 or 3 (no HC emission factors requested), then the flags dealing with details of the HC emission factor calculation should be set as follows: NMHFLG = 1, HCFLAG = 1, and RLFLAG = 5.

2.1.20.2.4 Conversely, if NMHFLG $\geq$ 2 and/or HCFLAG = 2 and/or RLFLAG = 1, 2, 3, or 4, then PRTFLG = 1 or PRTFLG = 4 is necessary.

2.1.20.2.5 If the user has elected to input alternate diesel sales fractions by model year for LDVs and LDTs, then LOCFLG = 1 (a separate LAP record to be entered for each scenario) is mandatory.

The last of these restrictions is new in MOBILE4.1. See sections 2.2.8 and 2.3.10 for additional information.

This concludes the Control data section.

## 2.2 ONE-TIME DATA SECTION

As suggested by its name, the One-Time data section contains information which is input only once in a given MOBILE4.1 input file. This input information is used to alter data internal to MOBILE4.1 to reflect locality-specific information when such information is available for use. For example, a user can incorporate VMT mix, mileage accumulation, and/or registration distributions that are specific to the area of concern. These records are all optional, their use being dictated by the values of some of the flags in the Control section. (Thus, in some MOBILE4.1 runs the One-Time data section will not be included in the input sequence.) If any of these records are included in the input, they follow immediately after the Control section and in the order in which they are discussed below.

The One-time data section must be included if one or more of the following MOBILE4.1 options are selected:

1. The user is supplying local tampering rates (TAMFLG = 2).

2. The user is suppling a VMT mix which will be applied to all emission factor calculations (VMFLAG = 3).

3. The user is supplying local mileage accumulation and/or registration distributions by age (MYMRFG = 2, 3, or 4).

4. The user is modifying the basic exhaust emission rates used in to calculate the emission factors (NEWFLG = 2).

5. The user is including an Inspection/Maintenance program in the emission factor calculations (IMFLAG = 2).

6. The user is including an anti-tampering program in the emission factor calculations (ATPFLG = 2).

7. The user is including the effects of Stage II and/or onboard vapor recovery systems on the refueling HC emission factors (RLFLAG = 2, 3, or 4).

8. The user is having the same local area parameter (LAP) record input values applied to all scenarios of a MOBILE4 run (LOCFLG = 2).

9. The user is supplying a single set of values on trip length distribution to be used in the calculation of running loss emissions for all scenarios (SPDFLG = 4).

Any data in the One-Time data section is listed in the same order as the order of the associated flags in the Control data section.

## 2.2.1 TAMPERING RATES

### 2.2.1.1 Description

MOBILE4.1 calculates tampering rates as a piecewise linear function of accumulated mileage for each gasoline-fueled vehicle type (LDGV, LDGT1, LDGT2, and HDGV) and for eight types of tampering [air pump disablement, catalyst removal, overall misfueling, fuel inlet restrictor disablement, exhaust gas recirculation (EGR) system disablement, evaporative control system disablement, positive crankcase ventilation (PCV) system disablement, and missing gas caps]. These rates are combined with the corresponding fractions of vehicles equipped with the given control technology and the emissions impact rates to obtain the tampering offsets (the increase in emissions that results from the given type of tampering). These offsets are later added to the non-tampered emission factors.

### 2.2.1.2 Options

MOBILE4.1 uses tampering rates based on OMS analysis of multi-city tampering survey results if no locality-specific alternate rates are supplied as input (TAMFLG = 1). The use of the rates included in MOBILE4.1 is recommended for most situations.

EPA has determined through its tampering surveys that tampering rates are lower in areas with operating inspection and maintenance (I/M) programs than in areas without such programs. Provisions exist within MOBILE4.1 for the input of alternate tampering rates (by setting TAMFLG = 2). Thus, if TAMFLG = 2 and IMFLAG = 1, the user must supply one set of alternate tampering rates, representing the case where no I/M program is in effect. If TAMFLG = 2 and IMFLAG = 2, the user must supply two sets of alternate rates, representing both the non-I/M and I/M cases. The non-I/M rates are used to account for tampering that occurs before the I/M program is operating.

**Before approving the use of alternate tampering rates in the development of base-year highway vehicle emission factors and mobile source emission inventories, EPA must review and approve of the tampering survey(s) on which such rates are based.**

### 2.2.1.3 MOBILE4.1 Tampering Rates

MOBILE4 uses three or six rate equations for each type of tampering stored within the model, for each of the vehicle types subject to tampering (one each for pre-1981 model year vehicles, for 1981-83 model year vehicles, and for 1984 and later model year vehicles; for either the non-I/M case only, or for both the non-I/M and I/M cases). These rate equations are based on OMS analysis of national tampering survey data.

### 2.2.1.4 Required Information

The following information is required for input of alternate tampering rates: For each combination of vehicle type (pre-1981, 1981-83, 1984 and later model year), tampering type, and non-I/M or I/M case, you must supply a zero-mile level (ZML) and deterioration rate (DR; the rate of increase in the tampering rate per 10,000 miles accumulated mileage). This deterioration rate defines the increase in tampering over the first 50,000 accumulated miles. MOBILE4.1 adjusts these deterioration rates internally to account for the rate of increase in tampering at mileages greater than 50,000 mi. All tampering rates are assumed to stop increasing after 130,000 accumulated miles. All input values must be in fractional units.

The order of the tampering types within each record is:

1) air pump disablement
2) catalyst removal
3) fuel inlet restrictor disablement
4) overall misfueling
5) EGR system disablement
6) evaporative control system disablement
7) PCV system disablement
8) missing gas caps.

A complete set of alternate tampering rate input data for the non-I/M case consists of a total of 24 records, and a complete set of inputs for both the non-I/M and I/M cases consists of 48 records. There are six records for each of the four gasoline-fueled vehicle types for each case (non-I/M, I/M). The six records required for each vehicle type are listed below. Each record listed occurs four times (once each for LDGVs, LDGT1s, LDGT2s, and HDGVs, in that order).

| Non-I/M Case Records | Non-I/M and I/M Records | Description | Format |
|---|---|---|---|
| ( 1- 4) | ( 1- 4) | ZML for pre-1981 MY vehicles (non-I/M) | 8F8.4 |
| ( 5- 8) | ( 5- 8) | ZML for 1981-83 MY vehicles (non-I/M) | 8F8.4 |
| ( 9-12) | ( 9-12) | ZML for 1984+ MY vehicles (non-I/M) | 8F8.4 |
| | (13-16) | ZML for pre-1981 MY vehicles (I/M) | 8F8.4 |
| | (17-20) | ZML for 1981-83 MY vehicles (I/M) | 8F8.4 |
| | (21-24) | ZML for 1984+ MY vehicles (I/M) | 8F8.4 |
| (13-16) | (25-28) | DR for pre-1981 vehicles (non-I/M) | 8F9.5 |
| (17-20) | (29-32) | DR for 1981-83 vehicles (non-I/M) | 8F9.5 |
| (21-24) | (33-36) | DR for 1984+ MY vehicles (non-I/M) | 8F9.5 |
| | (37-40) | DR for pre-1981 MY vehicles (I/M) | 8F9.5 |
| | (41-44) | DR for 1981-83 MY vehicles (I/M) | 8F9.5 |
| | (45-48) | DR for 1984+ MY vehicles (I/M) | 8F9.5 |

#### 2.2.1.5 Changes Since MOBILE4.1

In terms of user input to the model, the major change is that when the user elects to use alternate tampering rates, additional equations are required. This is due to the increase in model year groups (from two in MOBILE4 to three here). In addition, MOBILE4.1 adjusts the deterioration rates internally for accumulated mileage over 50,000 mi. In MOBILE4, the user supplying tampering rate equations was required to input an additional deterioration rate for LDGVs for mileages over 50,000. As noted above, MOBILE4.1 assumes the maximum rate of tampering for vehicles of any given model year is the rate occurring at 130,000 accumulated miles. This has no impact on the input data.

#### 2.2.1.6 Guidance

The tampering rates built into MOBILE4.1 are the rates that should be used in all Clean Air Act (CAA) mandated development of mobile source emission inventories. Use of any other tampering rates in CAA-related work must be based on actual in-use tampering surveys, and the surveys must be approved in advance by EPA. For guidance regarding EPA approval of local tampering surveys, contact the Office of Mobile Sources' Field Operations and Support Division, 202/382-2633 or FTS 382-2633. For guidance on analysis of the data collected in a local tampering survey, contact OMS' Emission Control Technology Division, 313/668-4367 or FTS 374-8367.

### 2.2.2 VEHICLE MILES TRAVELLED MIX by vehicle type

#### 2.2.2.1 Description

The vehicle miles travelled (VMT) mix specifies the fraction of total highway VMT that is accumulated by each of the eight regulated vehicle types. The VMT mix is used in MOBILE4.1 only to calculate the composite (all vehicle, or fleetwide) emission factor for a given scenario on the basis of the eight vehicle class-specific emission factors.

#### 2.2.2.2 Options

You can choose between the use of the MOBILE4.1 national VMT mix (by setting VMFLAG = 1), the input of one locality-specific VMT mix for use in all scenarios of a given MOBILE4.1 run (by setting VMFLAG = 3), or the input of a distinct locality-specific VMT mix for each scenario (by setting VMFLAG = 2).

For highway vehicle emission inventory development, EPA generally expects States to develop and use their own specific estimates of VMT by vehicle type. In such cases, VMT fractions

based on those estimates of VMT by vehicle type should be calculated and used here as input. A VMT mix used as input should reflect they year for which emission factors are being calculated.

2.2.2.3 MOBILE4.1 VMT Mix

MOBILE4.1 calculates a typical urban area VMT mix based on national data characterizing registration distributions and annual mileage accumulation rates by age for each vehicle type, diesel sales fractions by model year (for LDVs and LDTs only), total HDDV registrations and annual mileage accumulations by weight class, the fraction of travel by each vehicle type that is typical of urban areas, and total vehicle counts (fleet size) by vehicle type. Considering the dependence of the calculated VMT mix on the annual mileage accumulation rates and registration distributions by age, the use of the MOBILE4 VMT mix is generally recommended in cases where the focus is on direct comparison of national or area-wide emission factors under different assumptions.

As noted above, for highway vehicle emission inventory development, EPA expects that States will generally develop and apply their own estimates of VMT by vehicle type for specific highway facility types, sub-zones, times of day, and so on. The use of an alternate VMT mix can result in minor inconsistencies; for example, assumptions that are used in the emission factor calculations concerning the gas/diesel LDV sales fractions are not altered through the use of different VMT fractions for LDGVs and LDDVs. In part for this reason, MOBILE4.1 has the added capability for the user to also input a locality-specific set of gas/diesel LDV and LDT sales fractions by model year, as discussed in section 2.3.10.

However, such inconsistencies will not significantly affect emission inventory construction unless the inventory is based only on the fleetwide composite emission factor and total mobile source VMT. Inventory construction based on vehicle-type-specific emission factors and VMT estimates, as EPA expects of States for SIP-related inventory development, will not use the composite fleetwide emission factor.

2.2.2.4 Required Information

Each VMT mix supplied as input must consist of a set of eight fractional values, representing the fraction of total mobile source VMT accumulated by each of the eight vehicle types. All values must be between zero and one ($0.0 \leq$ VMT fraction for any vehicle type $\leq 1.0$), and the eight values must sum to 1.0 (MOBILE4.1 produces an error message and does not execute the run if these constraints are not met).

The format of the VMT mix record(s) is 8F4.3. The values correspond to the eight vehicle types in this order: LDGV, LDGT1, LDGT2, HDGV, LDDV, LDDT, HDDV, and MC.

#### 2.2.2.5 Changes Since MOBILE4

There have been no revisions to how an alternate VMT mix is supplied to the program as input data since the release of MOBILE4.

#### 2.2.2.6 Guidance

States are generally required to develop estimates of VMT by vehicle type for use in construction of highway vehicle emission inventories for CAA-mandated and SIP-related purposes. Given such estimates of VMT by vehicle type, and thus of total highway VMT, it is straightforward to calculate a VMT mix and that mix should be used as input in MOBILE4.1 runs. Techniques for calculating estimated VMT by vehicle type (and thus, total VMT and the VMT mix fractions) from available data sources are described in Chapter 6 of the report, "Techniques for Estimating MOBILE2 Variables."*

### 2.2.3 ANNUAL MILEAGE ACCUMULATION RATES and/or REGISTRATION DISTRIBUTIONS by vehicle type and age

#### 2.2.3.1 Description

MOBILE4.1's emission factor calculations rely in part on travel fractions for vehicles of each given age and type, which in turn are based on estimates of the average annual mileage accumulation by age (first year to 25th-and-greater years of operation) for each of the eight vehicle types, and the registration distribution by age (age 0-1 to age 24-25+) for each vehicle type, except motorcycles, for which annual mileage accumulation rates and registration distributions are only provided for the first to 12th-and-later years of operation (ages 0-1 to 11-12+). For all vehicle types except motorcycles, this represents an increase from the 20 years of operation accounted for in MOBILE4.

#### 2.2.3.2 Options

MOBILE4.1 uses national average annual mileage accumulation rates by age and registration distributions by age, and has provisions allowing the input of locality-specific data for either or both of these. The use of the annual mileage accumulation rates by age included in MOBILE4.1 is strongly recommended. Users may develop registration distributions by age on the basis of

* See section 2.5 for information on obtaining referenced reports.

locality-specific data, and the States are strongly encouraged to do so in developing highway vehicle emission inventories in response to the requirements of the new CAA for SIP purposes.

#### 2.2.3.3 MOBILE4 Annual Mileage Accumulation Rates and Registration Distributions

If you do not provide locality-specific mileage accumulation rates and/or registration distributions by age, MOBILE4.1 uses national average values.

This information is used for all calendar years evaluated. The annual milege accumulation rates are based on analyses of information developed over a long period of time, and the registration distributions are based on analysis of calendar year 1990 registration data. Due to the importance of this information in characterizing the in-use fleet, the need to avoid basing such information on data collected over a short period of time (thereby increasing the risk of reflecting atypical or cyclical use or sale patterns), and the inherent difficulty of developing accurate locality-specific data describing annual mileage accumulation rates by age, the use of the MOBILE4.1 annual mileage accumulation rates by age is recommended. The use of locality-specific data to derive registration distributions by age is more appropriate for some applications, particularly those cases where such data reflect significant differences from the national average.

If local annual mileage accumulation rates or registration distributions are used, they normally should not change across calendar years. In particular, EPA will not accept SIP-related modeling that includes assumptions that the vehicle fleet will be newer (have a lower average age) in the future than is reflected in the registration distributions used for the base year emission factor modeling and inventory development. Modeling that assumes no further aging of the fleet from the current characterization will be accepted by EPA for SIP purposes.

#### 2.2.3.4 Required Information

These records are required if MYMRFG is set to 2, 3, or 4 (see section 2.1.7).

To use locality-specific annual mileage accumulation rates by age, a total of 200 input values are required: the estimated annual mileage accumulated by vehicles of each of the eight types for each of 25 ages (except 12 ages for motorcycles; use ".00000" as the annual mileage accumulation rate for motorcycles of ages 13 through 25). These values are input as miles divided by 100,000 (e.g., 12,637 miles is input as 0.12637).

To use locality-specific registration distributions by age, again a total of 200 input values are required. For each vehicle type, a set of 25 values (except 12 values for motorcycles; use ".000" as the registration distribution fraction for motorcycles of ages 13 through 25) are required to represent the fraction of all vehicles of the given type that are of a given age. These registration distributions should be based on July 1 of the year being modeled; MOBILE4.1, as previous versions of the model, converts this distribution to a January 1 distribution.

Any individual value must be between zero and one. The sum of the registration distribution values for a given vehicle type must equal 1.0; if they do not, MOBILE4.1 normalizes the input values so that the sum for each vehicle type is equal to 1.0, and a warning message is produced for each occurrence. The same registration distribution by age must be entered for LDGVs and LDDVs, and for LDGT1s and LDDTs. MOBILE4.1 uses an internal function to separate these pairs of vehicle types into distinct gas and diesel distributions, based on diesel sales fractions by model year. (For information on user input of alternate diesel sales fractions by model year, see section 2.3.10.) If this constraint is not met, the error message(s) M65 and/or M66 will be produced (see Chapter 3), and the MOBILE4.1 run will not execute.

In addition, in the case where you supply both the annual mileage accumulation rates by age and the registration distributions by age, the annual mileage accumulation rate corresponding to any vehicle type/age combination accounting for a non-zero fraction of registrations must be positive (i.e., if vehicles of a certain type and age exist in the fleet, then they must accumulate some mileage). If this constraint is not met, MOBILE4.1 will generate one or more error messages and the run will not be executed.

The annual mileage accumulation rates are entered as 24 records, in sets of three records per vehicle type. The format of these records is (10F7.5, 10F7.5, 5F7.5), repeated eight times. Registration distributions by age are also entered as 24 records, in sets of three records per vehicle type of format (10F5.3,, 10F5.3, 5F5.3). If both annual mileage accumulation rates and registration distributions are being supplied by the user, the annual mileage accumulation rates precede the registration distributions [24 records, format (10F7.5, 10F7.5, 5F7.5) repeated eight times, followed by 24 records, format (10F5.3,, 10F5.3, 5F5.3) repeated eight times].

In both cases, the 24 records represent three records per vehicle type for each of eight vehicle types in this order: LDGV, LDGT1, LDGT2, HDGV, LDDV, LDDT, HDDV, and MC. Each of the three records per vehicle type contains the annual mileage accumulation rate by age, or the registration distribution by age, as follows:

First record - age 1, age 2, age 3, . . . , age 10
Second record - age 11, age 12, age 13, . . . , age 20
Third record - age 21, age 22, age 23, age 24, age 25.

2.2.3.5 Changes Since MOBILE4

The changes required for the user input of annual mileage accumulation rates and/or registration distributions by age consist of the necessity of supplying three records (up from two in MOBILE4) for each parameter for each vehicle type. The format of the individual records is the same, with the exception that the third record for each parameter for each vehicle type contains five, rather than ten, values.

2.2.3.6 Guidance

For most users in most applications, the use of the annual mileage accumulation rates by age included in MOBILE4.1 is recommended. Most local sources of mileage accumulation rate by age data are subject to sampling bias or data entry errors, and the use of such data should be approached with caution. States in their development of highway vehicle emission inventories in response to the requirements of the new CAA should obtain prior approval of alternate mileage accumulation rates and their derivation from EPA before using such rates in their emission factor modeling.

The use of locality-specific data to derive registration distributions by age is more appropriate for many applications, particularly those cases where such data reflect significant differences from the national average. EPA encourages and recommends the use of actual locality-specific calendar year 1990 registration distributions by age in the development of SIP emission inventories. One exception to this would be areas having relatively few local HDDV registrations, but significant interstate trucking activity within the local area. Such areas may want to retain and use the MOBILE4.1 national registration distributions. EPA will issue additional guidance on how locality-specific calendar year 1990 registration distributions by age may be adjusted to reflect future years at a later date.

In many situations, registration distributions by age may be developed from data available through State motor vehicle registration records. Especially when such data reflect registration distributions that are substantially different from the national average, such distributions should be developed and used. In particular, the States in preparing highway vehicle emission inventories in response to the requirements of the new CAA should obtain the data necessary to develop State- or locality-specific registration distributions, as applicable,

subject to the caveat in the preceding paragraph. Note that in MOBILE4.1, it is necessary to develop such data for the 25 model years ending with the calendar year of evaluation, rather than the 20 years of data required for MOBILE4.

If local annual mileage accumulation rates or registration distributions are used, they normally should not change across calendar years. In particular, EPA will not accept SIP-related modeling that includes assumptions that the vehicle fleet will be newer (have a lower average age) in the future than is reflected in the registration distributions used for the base year emission factor modeling and inventory development. The use of registration distributions that indicates that the vehicle fleet is newer than that reflected in the MOBILE4.1 distributions will only be accepted if the area supplies adequate documentation to support this assumption. Modeling that assumes no further aging of the fleet from the current (base year) characterization will be accepted by EPA for SIP inventory purposes.

Methods for estimating the annual mileage accumulation rates by age and the registration distributions by vehicle type and age are presented in Chapters 2 and 3, respectively, of the report "Techniques for Estimating MOBILE2 Variables."

## 2.2.4 BASIC EMISSION RATES

### 2.2.4.1 Description

The basic emission rates (BERs) in MOBILE4.1 are expressed in the form of linear equations, consisting of a zero-mile level (ZML), or y-intercept, and one or two deterioration rates (DR), or slopes (increase in emissions per 10,000 miles accumulated mileage). The units used for all vehicle types except heavy-duty vehicles (HDGV, HDDV) are grams per mile (g/mi) for the ZMLs and g/mi per 10,000 miles (g/mi-10K mi) for the DRs. For HDGVs and HDDVs, the units are grams per brake horsepower-hour (g/BHP-hr). There are different BER equations in MOBILE4.1 for each vehicle type/pollutant/model year group, with the model year groups defined on the basis of applicable emission standards and emission control technologies used.

For light-duty gas vehicles (LDGVs), there are two deterioration rates in each BER equation. In each such BER equation, there one DR is applicable to mileage accumulated between zero and 50,000 miles, and a second (higher) DR is applicable to mileage accumulated beyond 50,000 miles. This feature is applicable only to LDGVs.

### 2.2.4.2 Options

MOBILE4.1 provides the capability to input alternate BER equations (by setting NEWFLG = 2). However, the BERs in MOBILE4.1 accurately reflect all promulgated emission standards as of late 1990, and no locality-specific changes to these equations are warranted for use in developing emission factors or inventories for calendar years through 1992, or for CO projection inventories through calendar year 1996 (as noted below). This specifically includes the development of base year 1990 emission inventories by the States in response to the requirements of the Clean Air Act. The option of alternate BERs is intended for use only in the situation where new or revised emission standards are promulgated by EPA after release of MOBILE4.1. As noted in section 1.1.12, the carbon monoxide (CO) and "cold CO" emission standards mandated by the new CAA for LDVs and LDTs are reflected in MOBILE4.1, allowing MOBILE4.1 to be used to project CO emission factors through 1996. Other new emission standards and test requirements (which will affect the BERs corresponding to a given standard) are not included here.

### 2.2.4.3 MOBILE4.1 Basic Emission Rates

The BER equations in MOBILE4.1 are based on the applicable Federal emission standards and the emission control technologies characterizing the fleet in various model years (for example, different types of catalytic converters exhibit different rates of deterioration). These equations are applicable for all non-California areas, both low- and high-altitude, and **should not be altered by the user without EPA guidance.**

### 2.2.4.4 Required Information

If alternate BER equations are to be used, the information that must be supplied includes: the number of alternate BER equations that are to be entered, the region (low- or high-altitude) to which the alternate BERs apply, the vehicle type(s) affected, the first and last model years for which the alternate equations apply, the ZML (g/mi), and the DR (g/mi per 10K mi).

If the vehicle type affected is LDGVs,then two deterioration rates must be supplied. The first is used to calculate emissions deterioration through 50,000 accumulated miles, and the second (higher) rate is applied to accumulated mileage beyond 50,000 mi. If the vehicle type affected is HDGV or HDDV, units of g/BHP-hr must be used for the ZML and units of (g/BHP-hr)/10K mi must be used for the DR, since MOBILE4.1 converts g/BHP-hr rates to g/mi rates internally.

The new BER input consists of a set of **N+1** records, where **N** is the number of new BERs (records) that follow the first record. The maximum number of new BERs permitted in a MOBILE4.1 run is 100. In addition, for each combination of region/vehicle type/pollutant, no more than 12 new BERs are permitted. The format specifications, allowable ranges, and codes for these records are summarized in Table 2.2-1.

#### 2.2.4.5 Changes Since MOBILE4

There have been no revisions to the content or format of user input alternate BERs since the release of MOBILE4.

#### 2.2.4.6 Guidance

No need exists for modification of the BERs in MOBILE4.1 in order to develop emission factors for any pollutant for any calendar year through 1992 inclusive, or for CO emission factors for any calendar year through 1996 inclusive. EPA expects to release another model update that will incorporate all of the requirements of the November 1990 CAA in time for States to use in projection year modeling. If the use of alternate BER equations in MOBILE4.1 is being contemplated, the Office of Mobile Sources (Test and Evaluation Branch, 313/668-4325 or FTS 374-8325) should be contacted for additional guidance.

### 2.2.5 INSPECTION AND MAINTENANCE PROGRAMS

#### 2.2.5.1 Description

Many areas of the country have implemented inspection and maintenance (I/M) programs as a means of further reducing mobile source air pollution. MOBILE4.1 has the capability of modeling the impact of an operating I/M program on the calculated emission factors, based on user specification of certain parameters describing the program to be modeled.

#### 2.2.5.2 Options

The user has the option of either accounting for the effects of an I/M program (by setting IMFLAG = 2), or of assuming that there is no I/M program in effect (by setting IMFLAG = 1). Standard low-altitude area emission reduction credits are contained in the MOBILE4.1 code, and standard high-altitude area emission credits are included as a separate file on the MOBILE4.1 diskettes and tapes. The model is also capable of accepting alternate credit matrices **developed by EPA** as input data.

2.2.5.3 Required Information

If IMFLAG = 2, all of the following I/M program parameters must be specified by the user in the order shown:

- Program start year (calendar year that program begins)
- Stringency level (percent)
- First (earliest) and last (latest) model years of vehicles subject to the requirements of the program
- Waiver rates (percent of failed vehicles; one rate applicable to pre-model year 1981 vehicles and one applicable to 1981 and later model year vehicles)
- Compliance rate (percent)
- Program type (centralized; decentralized and computerized; or decentralized and manual)
- Frequency of inspection (annual or biennial)
- Whether or not each of four possible vehicle types (LDGV, LDGT1, LDGT2, HDGV) are covered by the program
- Test type (idle, 2500/idle, loaded/idle)
- Whether or not alternate I/M credits are to be supplied for each of two technology groups (Tech I-II, Tech IV+)

The format of this record is:

```
4(I2,1X),2(F2.0,1X),F3.0,1X,2(I1,1X),4I1,1X,I1,1X,2I1
```

Table 2.2-2 summarizes the I/M descriptive input record required if IMFLAG = 2, including the codes and allowable values for each field of the record. See Appendix 2A to this chapter for more detailed discussion of each of the parameters listed above.

2.2.5.4 Changes Since MOBILE4

There have been no revisions to the information required to model the benefits of I/M programs, or to the format requirements of this record, since the release of MOBILE4.

#### 2.2.5.5 Guidance

Additional information on the modeling of I/M program benefits in MOBILE4.1 is provided in Appendix 2A. For those cases where the emission reduction credit matrices included with MOBILE4.1 are inappropriate for the I/M program being modeled, contact the Office of Mobile Sources (Technical Support Staff, 313/668-4367 or FTS 374-8367) to obtain the required matrices.

## 2.2.6 ANTI-TAMPERING PROGRAMS

### 2.2.6.1 Description

Some areas of the country have implemented anti-tampering programs (ATPs) to reduce the frequency and resulting emission impact of emission control tampering (e.g., misfueling, removal or disablement of catalytic converters). MOBILE4.1 allows the user to include the effects of such a program on the calculated emission factors.

### 2.2.6.2 Options

You can choose to model the effects of an ATP on the emission factors (by setting ATPFLG = 2), or to assume that no ATP is in effect (by setting ATPFLG = 1). The information required of the user if ATPFLG = 2 is discussed below. MOBILE4.1 contains a subroutine that will generate the applicable emission factor credit matrices based on the information that you provide on the characteristics of the ATP.

### 2.2.6.3 Required Information

The following must be specified by the user in order to have MOBILE4.1 model the effects of an ATP, in the order shown:

- Start year (calendar year in which the program begins)
- First (earliest) and last (most recent) model years of vehicles subject to the program
- Whether or not each of four possible vehicle types (LDGV, LDGT1, LDGT2, HDGV) are covered by the program
- Program type (centralized or decentralized)
- Frequency of inspection (annual or biennial)
- Compliance rate (percent)

- Inspections performed (air system, catalyst, fuel inlet restrictor, tailpipe lead deposit test, EGR system, evaporative system, PCV, gas cap)

The format of this record is:

3(I2,1X),4I1,1X,I1,1X,2I1,1X,F4.0,1X,8I1.

Table 2.2-3 summarizes the ATP descriptive input record required if ATPFLG = 2, including the variable names, codes, and allowable values for each field of the record. See Appendix 2A for more detailed discussion of each of these parameters.

#### 2.2.6.4 Changes Since MOBILE4

There have been no revisions to the information required to model ATP effects, or to the format requirements of that data, since the release of MOBILE4.

However, MOBILE4.1 will only model an ATP with an evaporative system inspection (sixth in the list of inspections performed) and provide appropriate emission credits if a gas cap inspection (last in the list of inspections performed) is also included. If the user indicates that an evaporative system inspection is performed, but that a gas cap inspection is not performed, an error message will be issued and execution of the run will stop. The converse is not true: It is allowable to have a gas cap inspection without having an evaporative system inspection.

#### 2.2.6.5 Guidance

Additional information on the modeling of ATP program benefits in MOBILE4 is provided in Appendix 2A. Further guidance on developing the information required to model the emissions impact of an ATP can be obtained by contacting the Office of Mobile Sources (Technical Support Staff, 313/668-4367 or FTS 382-8367).

### 2.2.7 REFUELING EMISSIONS

#### 2.2.7.1 Description

The refueling of gasoline-fueled vehicles results in the displacement of fuel vapor from the vehicle fuel tank to the atmosphere. There are two basic approaches to the control of vehicle refueling emissions, generally referred to as "Stage II" (at the pump) and "onboard" (on the vehicle) vapor recovery systems (VRS). MOBILE4.1 has the ability to model uncontrolled levels of refueling emissions (i.e., assuming no requirements for Stage II or onboard VRS systems), as well the impacts of the implementation of either or both of the major types of VRS.

### 2.2.7.2 Options

There are five approaches available in MOBILE4.1 for the modeling of vehicle refueling emissions, depending on the value assigned to RLFLAG:

| Value | Action |
|---|---|
| 1 | Model uncontrolled refueling emissions for all gasoline-fueled vehicle types |
| 2 | Model refueling emissions assuming a Stage II VRS requirement |
| 3 | Model refueling emissions assuming an onboard VRS requirement |
| 4 | Model refueling emissions assuming both Stage II and onboard VRS requirements |
| 5 | Account for refueling emissions elsewhere in the inventory; no refueling emission factors calculated by MOBILE4.1 |

There are no additional input requirements for the first or last approaches. If you wish to include the effects of either or both VRS requirements on refueling emissions, you must supply certain information to be assumed about the program.

### 2.2.7.3 Refueling Emissions in MOBILE4.1

The uncontrolled refueling emission factors in MOBILE4.1 are based on vehicle test results which were used to develop a regression equation expressing refueling emissions as a function of fuel RVP, temperature of dispensed fuel, and difference in temperatures of dispensed and residual tank fuel. Each of these values is supplied by the model user, either directly (fuel RVP) or indirectly (the temperature of the dispensed fuel is a function of the input minimum and maximum temperatures, while the "delta T" temperature term is a function of the dispensed temperature). This equation yields refueling EFs in terms of grams of vapor emitted per gallon of fuel dispensed (g/gal). To this value is added an estimate of spillage losses, also in g/gal. Combining this total g/gal emission factor with vehicle fuel economy data (mi/gal) yields refueling emission factors in grams per mile (g/mi).

If you wish to model the effect of a Stage II VRS requirement on these emissions, its in-use control efficiencies (for LDGVs and LDGTs, and for HDGVs) must be entered as input. There are no national average values for Stage II efficiency in MOBILE4.1. In modeling an an onboard VRS requirement, MOBILE4.1 assumes a 96 percent reduction from uncontrolled levels in refueling emissions from onboard-equipped vehicles.

### 2.2.7.4 Required Information

To model the effect of a Stage II VRS requirement, you must provide four inputs: the start year (calendar year in which the requirement takes effect), the phase-in period (number of years for Stage II VRS installation to be completed), and the system efficiency (in percent) at controlling refueling emissions from light-duty vehicles and trucks, and from heavy-duty vehicles.

Modeling the effect of an onboard VRS requirement requires the user to provide only the starting model year and which of the four possible vehicle types (LDGV, LDGT1, LDGT2, HDGV) are subject to the requirement. The effects of the EPA reproposal for a national onboard VRS requirement, as mandated by the CAA, can be modeled if necessary by verifying the specifics of the program with EPA (see section 2.2.7.6).

All of the above information must be supplied if both VRS requirements are assumed.

The format of the Stage II VRS descriptive record is:

```
I2,1X,I1,2(1X,I3).
```

The format of the onboard VRS descriptive record is:

```
I2,1X,4I1.
```

If both records are to be supplied, the Stage II descriptive record precedes the onboard descriptive record. Table 2.2-4 summarizes both of these possible records, including the variable names, codes, and allowable values for each field.

### 2.2.7.5 Changes Since MOBILE4

There have been no revisions to the information required to model the effects of either type of VRS on refueling emissions, or to the format requirements of that information, since the release of MOBILE4.

### 2.2.7.6 Guidance

EPA recommends that States and others use MOBILE4.1 to model refueling emissions for highway vehicle emission inventory development. The refueling emission factors can be calculated in grams per gallon of dispensed fuel (g/gal) or in grams per mile (g/mi). The preferred approach is to calculate g/gal refueling emission factors using MOBILE4.1, reflecting Stage II and/or onboard VRS requirements as applicable, then multiplying the g/gal emission factor by total gasoline sales. This is the most

accurate method of estimating the contribution of refueling emissions to the inventory, particularly for areas with good data on gasoline sales (e.g., through tax records). This method also accounts for refueling emissions generated when gasoline is purchased in an area, but consumed largely outside of the area, and does not include refueling emissions for through traffic that does not refuel in the area. When good data on gasoline sales is not available, the use of the g/mi refueling emission factor is more convenient and, while also more approximate, acceptable for SIP inventory development.

The overall effectiveness of Stage II VRS at controlling refueling emissions depends on a number of factors, including the baseline efficiency of the system used, the portion of total area gasoline consumption handled by service stations exempt from Stage II requirements, and the frequency and stringency of enforcement programs. In general, the effectiveness of Stage II VRS at controlling refueling emissions will be greater for light-duty vehicles and trucks than for heavy-duty vehicles, since HDGVs are more likely to be refueled at service stations (or other fuel dispensing locations, such as private refueling depots) that will be exempted from Stage II requirements. For assistance in developing such information, contact EPA's Office of Air Quality Planning and Standards (919/541-5397 or FTS 629-5397).

Since any onboard requirement would be a national control program, the only issues are what model year the program will be implemented and whether or not all gasoline-fueled vehicles will be covered. The Clean Air Act Amendments of 1990 provide the manufacturers with a three-year phase-in period when EPA issues onboard VRS regulations. This phase-in is not reflected in MOBILE4.1; it will be included in the next model update.

If the user chooses not to model refueling emissions using MOBILE4 (by setting RLFLAG = 5), then these emissions must be accounted for in the stationary source portion of the inventory in the development of the base and projected emission inventories. The effects of an onboard VRS system requirement cannot be modeled if this approach is taken. EPA recommends that States and others use MOBILE4.1 to model refueling emissions for highway vehicle emission inventory development.

## 2.2.8 LOCAL AREA PARAMETER RECORD

### 2.2.8.1 Description

The local area parameter (LAP) record consists of six, seven, or eight locality-specific input variables. This record must be included at least once in every MOBILE4.1 run.

#### 2.2.8.2 Options

You can choose to use one LAP for all scenarios of the run (by setting LOCFLG = 2) or a different LAP for each scenario (by setting LOCFLG = 1). With the possible exception of the scenario name (see section 2.2.9), the same LAP generally should be used for all scenarios (e.g., different evaluation years) for the same locality.

#### 2.2.8.3 Content of the LAP

The following variables comprise the LAP record:

1) Scenario name
2) Minimum daily temperature
3) Maximum daily temperature
4) Base (pre-control) RVP
5) In-use (controlled) RVP
6) In-use RVP start year
7) * OXYFLG
8) * DSFLAG

The last two variables, indicated by asterisks, are optional. Each variable is discussed in sections 2.2.9 through 2.2.15 below. Table 2.2-5 summarizes the LAP record, including the content, variable name, codes, and allowable values for each field of the record.

#### 2.2.8.4 Changes Since MOBILE4

There have been three revisions to the LAP records since the release of MOBILE4. First, the ASTM volatility class, which used to be the second variable specified on the LAP record, is no longer used in MOBILE4.1 and is no longer required as input (see section 2.2.10). The second and third changes are the addition of two optional flag values at the end of the LAP record. These flags indicate whether the user wishes to model the effects on exhaust CO emissions of oxygenated fuels, and whether the user wishes to supply alternate diesel sales fractions for LDVs and LDTs as input data. These flags are discussed in sections 2.2.14 and 2.2.15 respectively.

### 2.2.9 SCENARIO NAME

#### 2.2.9.1 Description

A field of 16 character spaces is available for entering an identifying label for each scenario within a run. This label is echoed as part of the output. Nothing about the scenario name and its use has been revised since the release of MOBILE4.

2.2.9.2 Guidance

If no scenario name is desired, a blank field must be entered here. This field is typically used to define the most important characteristics distinguishing the scenario from others within the same MOBILE4.1 run (e.g., calendar year of evaluation, with or without an operating I/M program).

## 2.2.10 ASTM VOLATILITY CLASS

2.2.10.1 Description

This variable, which represented the gasoline volatility class assigned to a given area for a given month by the American Society for Testing and Materials, is no longer used in MOBILE4.1. In order to minimize the need for reformatting of input data files prepared for use with MOBILE4, the space within the LAP record that formerly contained the ASTM class remains, but it can be left blank. If a letter representing ASTM class is present, MOBILE4.1 will not read the letter and it will have no impact on the execution of the program.

2.2.10.2 Options

Either a value (e.g., from a MOBILE4 input file) or a blank space must appear in order to maintain the positions of the remaining variables on the LAP record. In any case, it will have no impact on the execution of the program or its results.

## 2.2.11 MINIMUM and MAXIMUM DAILY TEMPERATURE

2.2.11.1 Description

The minimum and maximum daily temperatures are used directly in MOBILE4.1 in the calculation of the diurnal portion of evaporative HC emissions, and in estimating the temperature of dispensed fuel for use in the calculation of refueling emissions. The temperatures used in calculating the temperature corrections to exhaust HC, CO, and NOx emissions, the hot soak portion of evaporative emissions, and resting loss and running loss HC emissions are calculated by MOBILE4.1 based on the minimum and maximum temperatures input here, unless overridden by the user (see sections 2.1.14 and 2.3.4).

2.2.11.2 Options

The user must input values for the minimum and maximum ambient temperatures. The minimum temperature must be between 0°F and 100°F (-18° to 38°C), and the maximum temperature must be

between 10°F and 120°F (-12° to 49°C) inclusive. The maximum temperature must be greater than or equal to the minimum temperature.

2.2.11.3 Use in MOBILE4.1

Diurnal emissions are most frequently measured for the Federal Test Procedure (FTP) temperature range of 60°F (16°C) to 84°F (29°C), but diurnal emissions in MOBILE4.1 are adjusted for the minimum and maximum temperatures provided as input based on testing over other temperature ranges. The basic exhaust emission rates for HC, CO, and NOx are based on the standard test temperature of 75°F. MOBILE4.1 can calculate a temperature for each pollutant representing average emissions over the course of the day (based on the input minimum and maximum daily temperatures and a representative curve of temperature as a function of time of day), and adjusts the exhaust emission factors for temperature effects accordingly.

Hot soak emissions at FTP conditions are based on a temperature of 82°F (28°C). MOBILE4.1 can calculate a temperature for the hot soak emissions, based on the minimum and maximum temperatures input here, and adjust the basic hot soak emission rates for temperature effects accordingly. Resting loss and running loss HC emissions are also dependent on temperature. As in the cases of exhaust and hot soak emissions, MOBILE4.1 can calculate appropriate average temperatures for use in estimating resting loss and running loss emissions, weighted to account for differing emission levels at different temperatures in the range of the minimum and maximum daily temperatures.

The model should be operated in this mode if the desired result is total daily emissions (emission factors representing entire days). The algorithm used in MOBILE4.1 to determine temperatures for correction of the above types of emissions on the basis of the input minimum and maximum temperatures takes into account both the typical 24-hour diurnal temperature profile for a day having the specified minimum and maximum, and the typical distribution of travel over the course of 24 hours. Thus the emission factors calculated in this way are appropriately weighted for both trips and emissions at different temperatures, resulting in factors that can be multiplied by daily vehicle miles travelled (VMT) when total daily emissions are the desired result.

The input value of ambient temperature can also be used to determine the temperature corrections for exhaust HC, CO, and NOx emissions, hot soak evaporative emissions, dispensed fuel temperature in the refueling emissions calculations, and resting loss and running loss emissions, through the use of the control flag TEMFLG (see section 2.1.14). This is not recommended unless

the modeling of a short time period, such as an hour, is being performed. Refueling emissions should always be modeled using the "full day" approach, not with hourly temperatures. Diurnal emissions can only be modeled by the "full day" approach, as the algorithm used is inaccurate over the very small temperature rises (1 to 5 F°) typical of a single hour.

If the input minimum temperature or calculated hot soak temperature is < 40°F (4°C), evaporative emission factors will not be calculated. EPA does not have sufficient data to estimate evaporative emissions at low temperatures, and there is reason to believe that such emissions approach zero when temperatures are sufficiently low. The MOBILE4.1 output will include a warning message noting the lack of evaporative emission factor calculations if either of these temperature conditions occur. If the calculated running loss temperature is $\leq$ 40°F, no running loss emission factors will be calculated for similar reasons. Refueling emissions will be calculated for any valid input temperatures. Finally, if the calculated exhaust emission correction temperature is $\leq$ 45°F (7°C), the exhaust emission factors will not be corrected for the effects of fuel volatility (RVP).

#### 2.2.11.4 Required Information

Minimum and maximum daily temperatures (°F).

#### 2.2.11.5 Changes Since MOBILE4

There have been no revisions to the temperature input data requirements since the release of MOBILE4.

#### 2.2.11.6 Guidance

The temperatures to be used here depend on the intended application of the results. Restrictions on these temperatures are: the maximum temperature must be greater than or equal to the minimum temperature, and the ambient temperature should be between the minimum and maximum (minimum $\leq$ ambient $\leq$ maximum). Guidance on the determination of appropriate temperatures for use in development of emission inventories for nonattainment areas appears in "Procedures for Emission Inventory Preparation, Vol. IV: Mobile Sources," EPA-450/4-81-026d (revised), July 1991.

### 2.2.12 "PERIOD 1" RVP

#### 2.2.12.1 Description

Evaporative and refueling emissions (and exhaust emissions, to a lesser extent) vary with fuel volatility. EPA's vehicle

certification program and much of its emission factor testing use gasoline with volatility (as measured by Reid vapor pressure (RVP)) of 9.0 psi. MOBILE4.1 adjusts the emission factors to account for the effects of fuel with other than 9.0 psi RVP.

The value to be used for "period 1" RVP is the average in-use RVP of gasoline in the area to be modeled in the time before a volatility control program takes effect, or the years preceding a change in the controlled RVP level (such as will occur in most areas in 1992, when EPA's Phase I volatility control program is superceded by Phase II volatility control limits). The major function of having two RVP values as input, "period 1" ("base" in MOBILE4) and "period 2" ("in-use" in MOBILE4), is to allow the user to define a step change in fuel volatility at a specific calendar year.

2.2.12.2 Options

The value used for "period 1" RVP can be anywhere between 7.0 psi and 15.2 psi inclusive. However, for accurate and meaningful results, the guidance provided below should be followed.

2.2.12.3 Use in MOBILE4.1

The "period 1" RVP is used in MOBILE4.1, for calendar years of evaluation prior to the user-specified "period 2" start year, to account for the effects of fuel volatility on emissions. Thus, the use of the appropriate value of RVP allows the construction of more accurate emission factors and a more accurate emission inventory. If the calendar year of evaluation is the same or later than the specified "period 2" start year, then the "period 1" RVP input is ignored (in the sense that it will not have any impact on the emission factors for the evaluation year).

2.2.12.4 Required Information

A value of RVP (in psi) representing the prevailing average fuel volatility for the geographic area of interest, either in the absence of volatility control requirements or before more stringent control requirements takes effect.

2.2.12.5 Changes Since MOBILE4

The name of this variable has been changed from "base RVP" to "period 1 RVP." There have been no revisions since the release of MOBILE4 to the definition or input requirements for this variable.

2.2.12.6 Guidance

As with the temperature inputs discussed above, the intended use of the MOBILE4.1 run determines the season for which the

average RVP should be ascertained. For ozone-related (summer season) modeling, use summer (July) RVP. For CO (winter season) modeling, use winter (January) RVP. Note that MOBILE4.1 does not model effects of RVP on exhaust emissions at temperatures of less than 45°F (7°C), and that no effects of fuel volatility greater than an RVP of 11.7 psi are modeled. If modeling of emission factors is being performed on a month-by-month basis, the value of RVP appropriate to each of the specific months being modeled should be used. It is not correct to average RVP values from different months or seasons together, or to use RVP from a season other than that used to determine the temperatures used in the emission factor modeling.

Further guidance on the determination of the appropriate values to use as input for fuel RVP is provided in "Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources," EPA-450/4-81-026d (revised), July 1991.

## 2.2.13 "PERIOD 2" RVP and "PERIOD 2" START YEAR

### 2.2.13.1 Description

EPA has issued rules requiring that fuel RVP during the ozone season be limited to 10.5 psi RVP in most parts of the country (roughly corresponding to ASTM Class C areas) during the summer ozone-season months in 1989-91 (Phase I volatility control), and to 9.0 psi RVP during the summer ozone-season months in 1992 and later (Phase II control), with generally proportional reductions in summer fuel maximum RVP in other States (roughly corresponding to ASTM Class A and B areas). MOBILE4.1 provides the ability to model the effects of an RVP control program through specification of the "Period 2" RVP limit and the calendar year in which the requirement is effective.

### 2.2.13.2 Options

The user must input values for the "period 2" RVP and "period 2" start year. The RVP value can be between 6.5 and 15.2 psi inclusive. The earliest allowed in-use start year is 1989.

### 2.2.13.3 Required Information

The RVP level to be assumed (psi) for "period 2" and the calendar year in which the control program is first effective.

### 2.2.13.4 Changes Since MOBILE4

The names of the variables have been changed from "in-use RVP" and "in-use start year" in MOBILE4 to "period 2 RVP" and "period 2 start year." There have been no revisions in the input or formatting of these two variables since the release of MOBILE4.

### 2.2.13.5 Guidance

To model the effects of the Federal volatility control program issued by EPA, in which volatility is limited in the summer months (May through September), see the relevant Federal Register notices (54 FR 11868, March 22, 1989; 55 FR 23658, June 11, 1990), or contact your EPA Regional Office to determine the applicable RVP limits for a specific State and month. The interim (Phase I) controls were in effect during 1989 and 1990, and the final (Phase II) controls take effect beginning in the summer of 1992.

EPA will accept the use of the Federal RVP limits for a given area as the fuel RVP for the highway vehicle emission factors and inventory. However, greater accuracy is possible by using the results of local fuel survey RVP measurements, or by adjusting the regulated RVP limit to reflect the degree to which typical fuel RVP fall below the limits effective for areas and months with fuel survey data. For areas without fuel survey data, typical commercial fuel subject to an RVP limit of 9.0 psi can be assumed to have 8.7 psi RVP. For RVP limits of 7.8 psi or lower, no "margin of safety" should be assumed, since the cost of creating a safety margin is greater. The margin can be estimated through interpolation for RVP limits between 7.8 and 9.0 psi. It is not correct to use the actual RVP limit in the base year and then to include a safety margin in modeling the projection years.

The effects of local (State, regional) fuel volatility control programs, which may be more stringent and/or take effect sooner than Federal controls, can be modeled by appropriate selection of values for "period 2" RVP and start year. To model the effect of a fuel volatility control program, use the proposed RVP limit as the value of "period 2" RVP, and the year in which the program takes effect as the "period 2" start year.

If no changes in fuel volatility are to be assumed, then the value of "Period 1" RVP should be used for "Period 2" RVP as well. In this case, with no change in RVP between "period 1" and "period 2," the period 2 start year should be set at 2020.

## 2.2.14 OXYFLG

### 2.2.14.1 Description

There are two optional flag settings that appear as the last two variables of the LAP record. The first of these is OXYFLG, a flag that tells MOBILE4.1 whether or not the user intends to model the impact of oxygenated fuels on exhaust CO emissions. If this flag is missing, MOBILE4.1 will interpret its value as "1" and will not expect to see additional input data on oxygenated fuels.

2.2.14.2 Options

This flag has two possible values, 1 and 2. If OXYFLG = 2, then the user must supply an additional input record containing data on the average oxygen content of two types of oxygenated fuels (gasoline/alcohol and gasoline/ether blends), the market penetration of each type of oxygenated fuel, and whether or not a an RVP allowance (+1.0 psi) for alcohol-based oxygenated fuels is in effect in the area being modeled. See section 2.3.9 for information on the placement and content of this record.

If OXYFLG = 1, then the model assumes that no oxygenated fuel information will be included in the remainder of the input data file, and no effects of fuel oxygen content on emissions will be modeled. If this flag is missing, it will be interpreted as "1."

2.2.14.3 Required Information

No information is required; as noted above, if this flag is not present at the end of the LAP record (following the in-use RVP control start year), it will be interpreted as being set to 1. If the effects of an oxygenated fuels program on exhaust CO emissions are to be included in the modeling, this flag must be present and set to 2.

2.2.14.4 Use in MOBILE4.1

The use of oxygenates in gasoline, whether in the form of alcohols or ethers, leads to reductions in carbon monoxide emissions. MOBILE4.1 incorporates the effects of fuel oxygen content, as specified by the modeler, on CO emissions. If an RVP waiver is in effect for alcohol-based oxygenated fuels, such that the volatility limit for such fuels is higher than that for straight gasoline, then this "RVP boost" will also result in slight increases in exhaust HC, CO, and NOx emissions relative to the case where no waiver is in effect.

2.2.14.5 Guidance

If oxygenated fuels are known to have significant market penetration in the area being modeled, then this should be reflected in the highway vehicle emission factors and emission inventories prepared by States (or local or regional entities) in response to the requirements of the 1990 CAA amendments.

## 2.2.15 DSFLAG

### 2.2.15.1 Description

The other optional flag at the end of the LAP record is DSFLAG, which instructs MOBILE4.1 as to whether the user is supplying alternate diesel sales fractions by model year for LDVs and LDTs. As in the case of OXYFLG, if this flag is missing it will be interpreted as having a value of 1, and the model will not expect to find alternate diesel sales fractions as part of the model input data).

### 2.2.15.2 Options

This flag has two possible values, 1 and 2. If DSFLAG = 2, then the user must supply 50 diesel sales fractions (25 each for LDVs and LDTs, for model years from the calendar year of evaluation back to 25 model years ago) for each scenario of the run. The placement of these fractions, format requirements, and additional information appear in section 2.3.10.

NOTE: If the user wishes to supply alternate diesel sales fractions by model year for LDVs and LDTs, then the entire LAP record must appear in the Scenario data section for each scenario of the run. In other words, if DSFLAG = 2 is chosen, LOCFLG = 1 MUST be chosen. The reasons for this are discussed in section 2.3.10. If the input file violates this condition by including DSFLAG = 2 on the LAP record, but contains only one LAP record for all scenarios, an error message will be produced and the run will not be executed.

### 2.2.15.3 Required Information

No information is required; as noted above, if this flag is not present at the end of the LAP record (following the in-use RVP control start year and the value of OXYFLG), it will be interpreted as being set to 1. If alternate diesel sales fractions by model year for LDVs and LDTs are to be included in the modeling, this flag must be present and set to 2, and the entire LAP record must appear in the Scenario data section.

### 2.2.15.4 Guidance

Sales of diesel powered light-duty vehicles and trucks underwent a surge in the late 1970s and early 1980s, peaking at 5.9 percent of nationwide LDV sales in the 1981 model year, and at 9.3 percent of nationwide LDT sales in the 1982 model year. Since then diesel sales have fallen precipitously, to virtually zero for LDVs (less than 0.05 percent of all LDV sales in model years 1988 through 1990) and to about 0.2 percent of LDTs since the 1988 model year.

MOBILE4.1, like earlier versions of the model, uses a single set of registration distributions by age and annual mileage accumulation rates to describe all LDVs, and another set to describe all LDTs. The use of model-year-specific diesel sales fractions allows MOBILE4.1 to internally split the LDVs and LDTs into gas and diesel sub-categories, which have distinctly different emission rates and behaviors.

To assist those areas having access to vehicle registration data that distinguishes between gas and diesel LDVs and LDTs, provisions have been made in MOBILE4.1 to allow the user to input alternate (locality-specific) diesel sales fractions by model year. These data must be supplied for every calendar year of evaluation: Since they apply to vehicles of ages 1, 2, 3, ..., to 25-and-older, different sets of fractions are required for each calendar year.

The input of alternate diesel sales fractions is discussed in section 2.3.10. Areas having the necessary information for development of these sales fractions by model year are encouraged to incorporate their own diesel sales fractions by model year for use in the construction of the base year inventories. EPA will accept the use of the built-in national average diesel sales fractions in modeling emission factors for use in constructing the mobile source portion of the base and projection year emission inventories. Additional guidance on diesel sales fractions to be used in projection year modeling will be provided at a later date.

## 2.2.16 BY MODEL YEAR INCLUSION VECTOR

### 2.2.16.1 Description

If the user chooses to have MOBILE4.1 provide additional output tables showing the relative contribution of vehicles of each model year to the average fleet emission factor, for each vehicle type, then an additional input record that tells MOBILE4.1 which vehicle types the additional output is requested for and what additional information is requested must appear in the One-Time Data section of the input. This option is available by setting OUTFMT = 5 (see sections 1.1.14 and 2.1.15). This record is essentialy a string of "yes/no" flags, as described below. If used, it appears as the last One-Time Data section input record.

### 2.2.16.2 Options

If the "by model year" option has been selected, then the modeler must specify for which vehicle types the additional output information is desired. (Since running MOBILE4.1 in the "by model year" mode slows program execution dramatically, it is suggested

that the modeler carefully consider the need for the information provided before electing this option, and only select only those vehicle types for which the information is necessary.)

The user can also choose three kinds of "by model year" output: One consisting only of the model year-specific emission factors, one which also provides the model year-specific I/M credits (assuming that an I/M program has been included in the modeling), and one which also provides information on tampering rates and offsets on a model year-specific basis.

2.2.16.3 Required Information

If by model year output is requested, then the last record in the One-Time Data section consists of ten integer flags, each having a value of "1" or "2." The first eight instruct MOBILE4.1 whether by model year emission factor output is desired (2) or not necessary (1) for each vehicle type, in this order: LDGV, LDGT1, LDGT2, HDGV, LDDV, LDDT, HDDV, and MC. The last two flags instruct MOBILE4.1 whether the by model year output for I/M program effects and tampering rates and offsets are desired; each of these is coded such that 1 = "No" and 2 = "Yes."

The format of this record is:

```
8I1,2(1X,I1)
```

An example is shown below:

```
22211111 2 1
```

In this example, by model year emission factors and I/M credit information are requested for light-duty gas vehicles and both classes of light-duty gas trucks; no by model year information is requested for the other five vehicle types, and no by model year tampering information is requested.

2.2.16.4 Guidance

This option is provided for special modeling purposes. There is no need for this option to be exercised in the development of mobile source emission factors and inventories. Due to the memory required to exercise this option, selecting it results in a dramatic increase in the time necessary to execute MOBILE4.1 runs. Modelers with a need for such information, and desiring further information than is provided in this section, are advised to contact EPA for assistance.

This concludes the One-time data section.

## 2.3 SCENARIO SECTION

The Scenario data follow the One-time data in the MOBILE4.1 input stream, and are used to assign values to those variables that specifically define each of the scenarios to be evaluated. It consists of one to six records, depending on the values assigned to the flags in the Control section and to the two optional flags on the LAP record.

The user can calculate emissions for one or more scenarios. Each scenario is associated with one group of Scenario section records. The program terminates execution upon detecting an end-of-file condition.

The first record, consisting of those variables discussed in sections 2.3.1 through 2.3.5, must be included for every scenario of every MOBILE4 run. The second possible record, required only if LOCFLG = 1, consists of local area parameters to be applied for this scenario only (see sections 2.1.13, 2.2.8 through 2.2.13). The third possible record is required only if the user has elected to model the effects on exhaust CO emissions of an oxygenated fuel program (and the associated volatility impact on all exhaust emissions if an RVP waiver for oxygenated fuels is in effect) by setting OXYFLG = 2 on the LAP record. This record would then be the oxygenated fuel descriptive record, discussed in section 2.3.9. The fourth through sixth possible records are required only if the user has chosen to input diesel sales fraction data for LDVs and LDTs by setting DSFLAG = 2 on the LAP record. These records would then contain the alternate diesel sales fractions, as discussed in section 2.3.10. The seventh possible record, required only if VMFLAG = 3, consists of the VMT mix to be applied for this scenario only (see sections 2.1.6 and 2.2.2). The eighth and last possible record, required only if ALHFLG = 2 or 3, consists of either six or ten additional input values used to correct certain exhaust emission factors (see sections 2.1.10 and 2.3.7).

Table 2.3-1 summarizes the Scenario section input record(s), including the variable names, codes, and allowable values for each field.

### 2.3.1 REGION

#### 2.3.1.1 Description

The first specification required in the first record of the Scenario data section is the region for which emission factors are to be calculated.

#### 2.3.1.2 Options

MOBILE4.1 provides two options for region: low-altitude and high-altitude. Low-altitude emission factors are based on conditions representative of approximately 500 feet above mean sea level (+500 ft MSL), and high-altitude factors are based on conditions representative of approximately +5500 ft MSL. MOBILE4.1, like MOBILE4, does not calculate California emission factors.

#### 2.3.1.3 Use in MOBILE4.1

The region selected determines whether the MOBILE4.1 emission factor calculations will be based on low-altitude or high-altitude basic emission rates, and if applicable whether low-altitude or high-altitude I/M credits will be used. (If high-altitude I/m credits are to be used, they must be supplied as a separate input file of alternate credits. See section 2.2.5.)

#### 2.3.1.4 Required Information

A value of either 1 (low-altitude) or 2 (high-altitude) must be entered for the region.

#### 2.3.1.5 Changes Since MOBILE4

There have been no revisions to this variable or how it is input to the model since the release of MOBILE4.

#### 2.3.1.6 Guidance

For the majority of MOBILE4.1 applications, low-altitude is the appropriate choice. For those areas designated as high-altitude by EPA for mobile source regulatory purposes, generally those counties that lie "substantially" above +4000 ft MSL, high-altitude should be selected. A list of those counties EPA has designated as high-altitude appears in §86.088-30, paragraphs (a)(5) (ii) and (iv), Code of Federal Regulations.

### 2.3.2 CALENDAR YEAR

#### 2.3.2.1 Description

The value used for calendar year in MOBILE4.1 defines the year for which emission factors are to be calculated (as of January 1). It is frequently referred to as the calendar year of evaluation.

#### 2.3.2.2 Options

MOBILE4.1 has the ability to model emission factors for the years 1960 through 2020 inclusive.

#### 2.3.2.3 Required Information

You must enter a value for the last 2 digits of the calendar year of evaluation (range 60-99 and 00-20).

#### 2.3.2.4 Changes Since MOBILE4

There have been no revisions to this variable or how it is input to the model since the release of MOBILE4.

#### 2.3.2.5 Guidance

Different uses of the emission factors calculated by MOBILE4.1 require special treatment. The base year (1990) inventories are supposed to be based on a typical day in the pollutant season, most commonly summer for ozone and winter for CO. Thus the base year HC inventories should be based on interpolation of the calendar year 1990 and 1991 MOBILE4.1 emission factors. CO inventories generally should be based on emission factors from a single calendar year of evaluation. For example, if the three-month period for which CO emissions are being modeled was December 1989 and January and February 1990, the use of 1990 for calendar year would be appropriate. If that three-month period is instead November 1990 - January 1991, then calendar year 1991 emission factors would be more appropriate. Questions regarding the best calendar year to use for CO modeling, if not addressed by the examples above, should be addressed to the EPA Regional Office.

Similar instuctions apply to the development of reasonable further progress (RFP) inventories. For modeling of specific episode days, the best results will be obtained by interpolating exactly to the day being modeled. In attainment demonstrations, it is acceptable to account for fleet turnover through November 15 of the year being modeled.

### 2.3.3 SPEED

#### 2.3.3.1 Description

Emission factors vary considerably with the average speed assumed. The value(s) input for speed in MOBILE4.1 will have a significant impact on the resulting emission factors for exhaust and running loss emissions. The speed correction factors have

been extensively revised since MOBILE4. In general, it is still the case that exhaust emissions are at a minimum at approximately the average speed of the Highway Fuel Economy (HFET) test cycle, or about 48 mph. The general curve describing all emission rates (HC, CO, NOx) as functions of speed displays very high emissions at very low speeds, with emissions decreasing (sharply at first, then more slowly) as average speed increases, until minimum emissions are reached at around 48 mph. Above 48 mph, further increases in speed result in increased emissions.

#### 2.3.3.2 Options

You have the option of using one average speed for all vehicles (by setting SPDFLG = 1) or of using eight average speeds, one for each vehicle type (by setting SPDFLG = 2). MOBILE4.1 will calculate emission factors for average speeds of 2.5 to 65.0 mph, in increments of 0.1 mph. If a speed below 2.5 mph is input, a warning message will be issued by MOBILE4.1 and 2.5 mph will be used in the calculations.

Similarly, if a speed above 65 mph is input, a warning message will be issued and 65.0 mph will be used in the calculations. Note that the maximum speed of 65 mph is an increase from the maximum 55 mph average speed allowed by MOBILE4.

#### 2.3.3.3 Use of Average Speed in MOBILE4

The data base on which all emission factor calculations are based is developed from vehicle test results at based on FTP conditions, including the average speed of 19.6 mph. MOBILE4 adjusts the emission factors for speeds other than 19.6 mph (20 mph for HDGVs and HDDVs) through the use of speed correction factors. Running loss HC emissions also vary with average speed, and that variation is reflected in the running loss emission factors produced by MOBILE4.1.

#### 2.3.3.4 Required Information

You must supply either a single value which is assumed to apply to all vehicles (if SPDFLG = 1, 3, or 4), or eight values (one for each regulated vehicle class, if SPDFLG = 2) in the following order: LDGV, LDGT1, LDGT2, HDGV, LDDV, LDDT, HDDV, MC.

#### 2.3.3.5 Changes Since MOBILE4

The choices available (one average speed or eight vehicle-specific average speeds) and the associated data format requirements are unchanged from MOBILE4. In MOBILE4.1, the maximum average speed for which emission factors can be calculated has been increased to 65 mph.

#### 2.3.3.6 Guidance

The FTP driving cycle was originally intended to be representative of driving conditions typical of a standard commute in an urban area. Thus the use of 19.6 mph as the average speed applicable to all vehicle types is appropriate for approximate analysis of emissions from traffic in urban areas as a whole. However, such an approach is not suitable for SIP inventory preparation. Instead, vehicle miles travelled (VMT) should be consolidated into at least three speed categories, and MOBILE4.1 used to estimate emission factors for eachy of them.

The average speed of the transient test cycle used for heavy-duty engine certification is 20 mph, which is representative of urban driving overall for these vehicles. Use of 19.6 mph as the average speed for all vehicles therefore leads to application of a small speed correction factor to the HDGV and HDDV emission factors.

For some applications of MOBILE4.1, you might assume a single value other than 19.6 mph. For example, to model emission factors typical of a stretch of limited access highway, the use of a speed in the 55 to 65 mph range for all vehicle types would be appropriate.

When, as in SIP inventory preparation, MOBILE4.1 runs are required using speed(s) representative of certain areas (e.g., subsets of urban areas, specific highway links) or of certain times of day, there are often speed data available from local, regional, or state transportation planning agencies. The prediction of average speeds in the future is difficult, and may be a critical factor in some areas' ability to project compliance with SIP commitments and air quality standards. A discussion of how average speeds can be estimated from available data sources and additional guidance on the determination of average speeds for use in highway vehicle emission inventory development is provided in "Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources," EPA-450/4-81-026d (revised), July 1991.

### 2.3.4 AMBIENT TEMPERATURE

#### 2.3.4.1 Description

Emissions vary considerably with ambient temperature. The value of temperature used to calculate the temperature correction factors for exhaust emissions, hot soak evaporative emissions, refueling emissions, and resting loss and and running loss emissions will significantly affect the resulting emission factors.

If TEMFLG = 1, the temperature used to adjust the exhaust emission factors for all three exhaust pollutants, the hot soak component of evaporative emissions, the displacement component of refueling emissions, and resting loss and and running loss emission factors will be calculated by MOBILE4.1 on the basis of the input minimum and maximum daily temperatures. The ambient temperature specified here will not be used.

If TEMFLG = 2, the value of ambient temperature specified here will be used as the basis of the temperature correction factors for all exhaust emissions, hot soak evaporative emissions, refueling emissions, and resting loss and running loss emissions. The input values for minimum and maximum daily temperatures will still be used in calculating the diurnal component of evaporative emissions. The use of TEMFLG = 2 causes the input value of ambient temperature to be used to correct the exhaust emission factors in the same way as was done in MOBILE3. If the specified ambient temperature is inconsistent with the minimum and maximum daily temperatures (e.g., 20°F ambient with 60°-84°F minimum and maximum), an error message will result and processing of the current scenario will be stopped.

2.3.4.2 Options

The ambient temperature specified can range from 0°F (-18°C) to 110°F (43°C). If a temperature less than 0°F is input, a warning message will be issued, and 0°F will be used in the calculations (if TEMFLG = 2). Similarly, if a temperature greater than 110°F is input, a warning is issued, and 110°F is used in the calculations (if TEMFLG = 2).

2.3.4.3 Use of Ambient Temperature in MOBILE4.1

The basic emission rates that underlie the emission factor calculations are developed from emission data from vehicles tested at FTP conditions, at a nominal test temperature of 75°F (24°C). MOBILE4.1 uses temperature correction factors to correct exhaust emission factors to temperatures other than 75°F. Temperature corrections are also applied to the hot soak component of evaporative HC emissions. Refueling, resting loss, and running loss emissions are all functions of temperature. If TEMFLG = 2, the value input here for ambient temperature is used to determine these correction factors.

2.3.4.4 Required Information

A value of ambient temperature in degrees Fahrenheit (°F).

2.3.4.5 Changes Since MOBILE4

There have been no revisions to this variable's use or input data format requirements since the release of MOBILE4.

#### 2.3.4.6 Guidance

EPA generally recommends that the minimum and maximum daily temperatures be used to determine the temperatures for corrections to the emission factors if daily average emissions are to be estimated, rather than hour-by-hour emissions.

If this ambient temperature is used instead, the value specified depends in large measure on the purpose for which MOBILE4.1 is being used. Additional information and guidance on the determination of appropriate ambient temperture values appears in "Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources," EPA-450/4-81-026d (revised), July 1991.

The ambient temperature logically must be between the minimum and maximum temperatures. This is particularly important when HC emission factors are being modeled, since minimum and maximum temperatures are used in the evaporative emission component of those calculations, and the evaporative and exhaust components of the emission factor should be estimated on a consistent basis. Modeling of CO emission factors is more likely to focus on times with cooler temperatures, when most violations of the National Ambient Air Quality Standard (NAAQS) for CO occur.

### 2.3.5 OPERATING MODES (PCCN, PCHC, PCCC)

#### 2.3.5.1 Description

One important determinant of emissions performance is the mode of operation. EPA's emission factors are based on testing over the FTP cycle, which is divided into three segments (referred to as "bags"), each with differing associated emissions performance. The bags correspond to operating modes:

| Bag | Operating Mode |
|---|---|
| 1 | Cold start |
| 2 | Stabilized |
| 3 | Hot start |

Emission data from each of these bags reflect the fact that emissions generally are highest when a vehicle is in cold-start mode: the vehicle, engine, and emission control equipment (particularly the catalytic converter) are all at ambient temperature and thus not performing at optimum levels. Emissions are generally somewhat lower in hot start mode, when the vehicle is not yet completely warmed up but was not sitting idle for sufficient time to have cooled completely to ambient temperatures. Finally, emissions generally are lowest when the vehicle is operating in stabilized mode, and has been in continuous operation

long enough for all systems to have attained relatively stable, fully "warmed-up" operating temperatures.

The three variables PCCN, PCHC, PCCC are sufficient to completely define the percent VMT accumulated in each of the three operating modes by vehicles in each of two basic emission control configurations, non-catalyst and catalyst-equipped. Thus the input of values for percent VMT accumulated in hot start mode by non-catalyst vehicles, or in stabilized mode by non-catalyst or catalyst-equipped vehicles, is not required as input. MOBILE4.1 calculates these quantities from the three values entered.

The definitions of the three variables and how together they define six vehicle type/operating mode combinations are shown below:

| Vehicle Type | Operating Mode | Defined in MOBILE4.1 as: |
|---|---|---|
| Non-catalyst | Cold-start | PCCN |
| Catalyst | Hot-start | PCHC |
| Catalyst | Cold-start | PCCC |
| Catalyst | Stabilized | 1.0 - PCCC - PCHC |
| Non-catalyst | Stabilized | 1.0 - PCCC - PCHC (assumed equal to the stabilized VMT fraction for catalyst-equipped vehicles) |
| Non-catalyst | Hot-start | PCCC - PCCN + PCHC |

The user should not expect the sum of PCCN + PCHC + PCCC to be 100 percent. While it is true that (percent VMT in cold-start mode) + (percent VMT in hot-start mode) + (percent VMT in hot stabilized mode) always equals 100 percent, for both catalyst-equipped and non-catalyst vehicles separately, the variables PCCN, PCHC, and PCCC are not equivalent to these variables.

The values of PCHC, PCCC, and PCCN are used in the calculation of the bag-dependent correction factors (such as temperature and volatility) for LDV, LDT, and MC emission factors. It is assumed that all diesel vehicles and all motorcycles are always non-catalyst.

#### 2.3.5.2 Options

The three specified values must all be expressed as percentages (not as fractions). Each value must lie between 0.0 and 100.0. The sum of PCHC + PCCC must not exceed 100 percent. The value of PCCN logically should be less than that of PCCC, for the reasons discussed above.

### 2.3.5.3 MOBILE4 Standard (FTP) Operating Mode Fractions

The values of the three variables corresponding to the conditions of the FTP cycle are:

| | |
|---|---|
| PCCN | 20.6 % |
| PCHC | 27.3 % |
| PCCC | 20.6 % |

These values reflect the same assumptions and conditions that are reflected in other aspects of the Federal Test Procedure.

### 2.3.5.4 Required Information

Three percentage values, reflecting the percentage of **VMT** (not the percentage of vehicles) accumulated by non-catalyst vehicles in cold-start mode (PCCN), by catalyst-equipped vehicles in hot-start mode (PCHC), and by catalyst-equipped vehicles in cold-start mode (PCCC).

### 2.3.5.5 Changes Since MOBILE4

There have been no revisions in the definitions or in the use or format requirements of these variables since the release of MOBILE4.

### 2.3.5.6 Guidance

EPA historically has defined cold starts to be any start that occurs at least four hours after the end of the preceding trip for non-catalyst vehicles and at least one hour after the end of the preceding trip for catalyst-equipped vehicles. Hot starts are those starts that occur less than four hours after the end of the preceding trip for non-catalyst vehicles and less than one hour after the end of the preceding trip for catalyst-equipped vehicles. The shorter time interval associated with the cold/hot start definition for catalyst-equipped vehicles reflects the fact that catalytic converters do not operate at intended efficiency until they are fully warmed up (to operating temperatures in the 600°F (316°C) range); thus catalyst-equipped vehicles reflect "cold-start" emissions performance after a much shorter off time than do non-catalyst vehicles, which do not depend on attainment of such high temperatures for stabilization of emissions performance.

In the absence of supporting data for values other than those listed above, EPA believes that the values reflecting FTP conditions are appropriate in many cases. This is particularly true when the emission factors being modeled are intended to represent a broad geographic area (Metropolitan Statistical Area,

entire state) and/or a wide time period (days, months). When the modeling is intended to represent highly localized conditions (specific highway links) or very limited periods of time (as single hours), it may be possible to develop more representative values for these variables. Areas known to have average trip lengths significantly shorter or longer than 7.5 miles may also merit the use of alternate values.

Thus for SIP-related modeling, EPA will accept the use of the FTP operating mode values except for small scale scenarios where their use would clearly be inappropriate. EPA will not accept SIP-related modeling that includes different operating mode fractions for the base and projection years without adequate quantitative written justification.

There are several ways of approximating the percentage of VMT accumulated in each mode for each type of vehicle, although highly accurate determinations are not readily obtainable. Guidance on three possible methods for determining the cold-start/hot-start VMT fractions for non-catalyst and catalyst-equipped vehicles, including references to generally available data sources, appears in Chapter 8 of the report "Techniques for Estimating MOBILE2 Variables."

Some transportation emissions modeling approaches are based on the concepts of trip-start emissions and running emissions, rather than the method described above. MOBILE4.1 does not directly mesh well with this approach, but can be manipulated to do so. Modelers should contact EPA to discuss the suitability of this approach and for assistance in using MOBILE4.1 to develop the appropriate emission factors.

### 2.3.6 VEHICLE MILES TRAVELLED MIX by vehicle type

The VMT mix was discussed in section 2.2.2. This record must appear in the Scenario data section if different VMT mixes are to be applied to each scenario (VMFLAG = 2), and must appear in the One-time data section if the same VMT mix is to be applied to all scenarios (VMFLAG = 3). The information provided in section 2.2.2 is applicable in either case. This record is not required if the MOBILE4 VMT mix is to be used (VMFLAG = 1).

### 2.3.7 LOCAL AREA PARAMETER RECORD

The local area parameter (LAP) record was discussed in sections 2.2.8 through 2.2.13, and is summarized in Table 2.2-5. It must appear in the Scenario data section if a different LAP record is to be applied to each scenario (LOCFLG = 1), and must

appear in the One-time data section if the same LAP record is to be applied for all scenarios (LOCFLG = 2). If the user elects to supply diesel sales fractions by model year as input data by setting DSFLAG = 2 on the LAP record, then the LAP record must be included for each scenario. The information provided in sections 2.2.8 through 2.2.13 is applicable in either case. This record must be supplied, in either the One-time data section or the Scenario data section, for every MOBILE4.1 run.

## 2.3.8 Additional Correction Factors for Light-Duty Gasoline-Fueled Vehicle Types

### 2.3.8.1 General Description

MOBILE4.1 provides the capability of applying four additional correction factors to the exhaust emission factors for LDGVs, LDGT1s, and LDGT2s. These factors are used to represent unique conditions not typically assumed in MOBILE4.1 runs, which is why they are segregated from other correction factors (such as speed and temperature).

These factors allow for exhaust emission factors only to be adjusted to account for the emissions impact of air conditioning (A/C) usage, extra loading, and trailer towing. There is also a humidity correction factor, which applies only to exhaust NOx emissions and is also applied to motorcycles.

### 2.3.8.2 Options

Depending on the value assigned to the ALHFLG flag controlling the application of these additional correction factors, six or ten input values may be required.

When ALHFLG = 2, six values are required:

1) One A/C usage fraction (for all LDGVs and LDGTs)
2-4) Three extra load usage fractions (for LDGVs, LDGT1s, LDGT2s)
5) One trailer towing fraction (for all LDGVs and LDGTs)
6) One humidity level (for all LDGVs and LDGTs plus motorcycles)

When ALHFLG = 3, ten values are required:

1) One A/C usage fraction (for all LDGVs and LDGTs)
2-4) Three extra load usage fractions (for LDGVs, LDGT1s, LDGT2s)
5-7) Three trailer towing fractions (for LDGVs, LDGT1s, LDGT2s)
8) One humidity level (for all LDGVs and LDGTs plus motorcycles)
9-10) Dry bulb and wet bulb temperatures (used to calculate an A/C usage fraction for LDGVs and LDGTs).

Each of these five types of input (A/C, extra load, trailer towing, humidity, and temperature) are discussed below.

### 2.3.8.3 A/C Usage Fraction

#### 2.3.8.3.1 Description

If you wish to include the effect on the exhaust emission factors of A/C usage, enter a nonzero value for this variable and appropriate dry and wet bulb temperatures, as explained below.

#### 2.3.8.3.2 Options

This fractional value must be between zero and one ($0.0 \leq AC \leq 1.0$).

In the six value option (ALHFLG = 2), no correction factor for A/C usage will be applied, regardless of the value that is entered. Entering 0.0 as the value is recommended in this case.

In the ten value option (ALHFLG = 3), the variable acts as a flag, and the A/C usage fraction will be calculated on the basis of the dry bulb and wet bulb temperatures (see section 2.3.8.7). If 0.0 is entered, no correction factor will be applied, although values of dry and wet bulb temperature must still be provided. To have a correction factor for A/C usage calculated and applied, enter a nonzero value ($0.0 < AC \leq 1.0$) and appropriate values for dry and wet bulb temperatures.

### 2.3.8.4 Extra Load Usage Fractions

#### 2.3.8.4.1 Description

These values are used to model the exhaust emissions impact of vehicles carrying an extra 500 lb (227 kg) load. If you wish to include this effect, three fractional values are entered (one each for LDGVs, LDGT1s, and LDGT2s), representing the fraction of all vehicles of the given type carrying such an extra load.

#### 2.3.8.4.2 Options

These values must all lie between zero and one. If the value entered is zero, no correction for the effects of extra load is applied.

### 2.3.8.5 Trailer Towing Usage Fraction

#### 2.3.8.5.1 Description

These values are used to model the impact on exhaust emissions of vehicles towing trailers. If you wish to include this effect in your modeling, one or three fractions are entered

representing the fraction of vehicles of a given type that are to be assumed to be towing trailers.

2.3.8.5.2 Options

Any value for this fraction must lie between zero and one. If the value entered is zero, no correction for the effect of trailer towing is applied.

In the six value option (ALHFLG = 2), one value is entered and is applied to LDGVs, LDGT1s, and LDGT2s.

In the ten value option (ALHFLG = 3), three values are entered, and one each is applied to LDGVs, LDGT1s, and LDGT2s.

### 2.3.8.6 NOx Humidity Correction

2.3.8.6.1 Description

This value is used to correct exhaust NOx emission factors for absolute humidity. The value entered is the absolute (specific) humidity, expressed as grains water per pound of dry air.

2.3.8.6.2 Options

The value entered for absolute humidity must lie between 20 and 140. If the value entered is 75, corresponding to the absolute humidity condition of the FTP, then no correction will be applied.

### 2.3.8.7 Dry and Wet Bulb Temperatures

2.3.8.7.1 Description

MOBILE4.1 will calculate the fraction of A/C-equipped vehicles actually using their air conditioning on the basis of a "discomfort index," which in turn is calculated from the dry bulb and wet bulb temperatures.

2.3.8.7.2 Options

The values of each of these temperatures must be between 0° and 110°F (-18° and 43°C), inclusive. In addition, the wet bulb temperature must be less than or equal to the dry bulb temperature. If any of these three conditions are not met, an error message will be issued by MOBILE4.1.

These values (in °F) will be used to calculate the A/C usage fraction on the basis of the discomfort index only if the ten

value option is selected (ALHFLG = 3) and a nonzero value is entered for the variable AC. If used, this calculated value overrides the value read in for AC as part of the input.

#### 2.3.8.8 Changes Since MOBILE4

There have been no revisions to any of the variables discussed in this section, or to how they are supplied to the model as input data, since the release of MOBILE4.

#### 2.3.8.9 Guidance

In most cases, ozone pollution episodes occur during summer months and very warm to hot temperatures. It is reasonable to assume that vehicle air conditioning usage is high under such conditions. The air conditioning correction factors that are calculated in MOBILE4.1 are of uncertain accuracy. The emissions impact for late model year vehicles of operating the air conditioner is not well quantified, and the fraction of vehicles equipped with air conditioning is substantially higher for the vehicle fleet of the late 1980s than it was for the fleet of the late 1970s. Thus the use of the air conditioning corrections to the emission factors is acceptable, but is not required, in the development of SIP inventories. EPA will accept SIP inventories that do not attempt to explicitly account for vehicle air conditioning use. The same approach that is taken in developing the base year inventory must also be used for projection inventories.

The humidity correction for NOx emissions accounts for the fact that when "excess" water vapor in present, some of the heat of combustion heats water vapor rather than enhancing NOx formation. As with the air conditioning correction, EPA will accept SIP inventories that do not attempt to account for local humidity. If the humidity correction is applied in the base year, it's derivation must be detailed in the emission inventory supporting documentation, and it must also be used in any projection inventories.

If you believe that conditions applying to a specific application of MOBILE4.1 warrant the use of one or more of the correction factors described in this section, and desire guidance beyond that provided above, contact EPA for additional information (Test and Evaluation Branch, 313/668-4325 or FTS 374-8325).

## 2.3.9 OXYGENATED FUELS DESCRIPTIVE RECORD

### 2.3.9.1 Description

If the user elects to model the effects of the use of oxygenated fuels on exhaust carbon monoxide (CO) emissions, then the value of OXYFLG on the LAP record must be 2 (section 2.2.14). If this option is chosen, then a record describing the market penetration and usage of oxygenated fuels in the time and area being modeled must be provided. This record must immediately follow the LAP record. Thus if the user is applying a single LAP record for all scenarios (by setting LOCFLG = 2), this record will appear immediately after the LAP record and before any other One-Time data that may also be included. If the user is applying a distinct LAP record for each scenario (by setting LOCFLG = 1), then the LAP record is the second scenario record for each scenario, and this record immediately follows as the third scenario record for each scenario.

### 2.3.9.2 Options

The user has the choice of not accounting for the effects of oxygenated fuel use (by setting OXYFLG = 1 or leaving the space for OXYFLG blank), or of accounting for the effects of such fuels on exhaust CO emission rates (by setting OXYFLG = 2).

### 2.3.9.3 Use in MOBILE4.1

If the user chooses to model the effects on exhaust CO emissions of the use of oxygenated fuels, the information detailed below is supplied and MOBILE4.1 uses it to estimate the reductions in exhaust CO emissions that result for gasoline-fueled vehicle types (LDGV, LDGT1, LDGT2, HDGV, and MC). The effects on exhaust HC and NOx emission factors and on evaporative HC emissions, are estimated only with respect to the impact of volatility (if the oxygenated fuels have been granted a waiver allowing higher RVP than base gasoline in the modeled area).

### 2.3.9.4 Required Information

If the user has set OXYFLG = 2, then the record containing this information must immediately follow the LAP record in the input data file. If the LAP record is in the One-Time data section, then this record immediately follows it and precedes any other One-Time data records that are being supplied. If the LAP records are in the Scenario data section, then this record immediately follows each LAP record as the third Scenario data record for each scenario.

The record consists of the following five variables:

- Ether blend market share (as a fraction)
- Alcohol blend market share (as a fraction)
- Average oxygen content of ether blend fuels (percent weight, expressed as a fraction)
- Average oxygen content of alcohol blend fuels (percent weight, expressed as a fraction)
- RVP waiver switch
  [integer value indicating whether alcohol-based oxygenated fuels must meet the same RVP limit as straight gasoline (value = 1), or have been granted a 1.0 psi waiver (value = 2)]

The format of this record is:

```
4(F4.3,1X),1X,I1.
```

To illustrate, the following oxygenated fuel input data record states that 3.5 percent of the fuel sold in the area is ether blends having an average oxygen content of 2.7 percent weight, that 12.9 percent of the fuel sold in the area is alcohol blends having 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 that the limit applicable to straight gasoline:

| Column: | 12345678901234567890 |
|---|---|
| Input record: | .035 .129 .027 .031 2 |

2.3.9.5 Guidance

Areas that are known to have significant market penetration of ether blends and/or alcohol blends should attempt to accurately characterize the relative market shares and oxygen content of these fuel blends, and account for it in their emission factor modeling. Areas having insignificant market penetration of both types of oxygenated fuels may safely disregard oxygenated fuels in their modeling.

EPA should be contacted for assistance in modeling the effects of oxygenated fuels if any of the following situations apply: (i) the fuels available in an area include blends containing both ether(s) and alcohol(s) in the same fuel, or (ii) an RVP waiver greater than 1.0 psi is applicable to oxygenated fuels in an area, or (iii) no RVP waiver is in effect but the volatility of base gasoline is currently below the regulated limit, or (iv) if two or more types of alcohol blends are marketed under different RVP waiver treatment. Additional guidance may be obtained through contacting the appropriate EPA Regional Office or the Office of Mobile Sources.

## 2.3.10 DIESEL SALES FRACTIONS

### 2.3.10.1 Description

In section 2.2.15, the use of diesel sales fractions by model year for LDVs and LDTs in MOBILE4.1 is discussed. These fractions represent the share of all LDV (LDT) sales in a given model year which are diesel-powered, rather than gasoline-fueled, vehicles.

### 2.3.10.2 Options

The user can choose to supply sets of diesel sales fractions by model year for both LDVs and LDTs that are locality-specific (and different from the national sales fractions that are included in MOBILE4.1), or to use the national sales fractions. The options are exercised through the value assigned to DSFLAG, the final variable on the LAP record. As noted previously, if the user is supplying diesel sales fraction data, it must be included in the Scenario data section and the LAP record(s) must also appear in the Scenario data section.

### 2.3.10.3 Use in MOBILE4.1

MOBILE4.1, like earlier versions of the model, uses a single set of registration distributions by age and annual mileage accumulation rates to describe all LDVs, and another set to describe all LDTs. This is due in part to the fact that it is nearly impossible to develop such information for gas and diesel vehicles separately, and in part since there is little evidence to suggest that typical use patterns, mileage accumulation rates, and so forth are different for gas and diesel vehicles. The use of model-year-specific diesel sales fractions allows MOBILE4.1 to internally split the LDVs and LDTs into gas and diesel sub-categories, which have distinctly different emission rates and behaviors.

MOBILE4 contained forecasts of increasing diesel sales. MOBILE4.1 essentially assumes that diesel sales after 1990 will show no increase from current very low levels.

### 2.3.10.4 Required Information

If the user is supplying alternate diesel sales fractions as input to the model, then the information immediately follows the LAP record and the oxygenated fuels descriptive record (if the oxygenated fuels record is present).

For each scenario, the user must supply the fractions of LDV and of LDT sales that were diesel for each model year from the calendar year of evaluation back to 24+ model years ago. For

example, if the calendar year of evaluation is 1990, then diesel sales fractions for model year 1990, 1989, 1988, ..., 1967, and 1966-and-older LDVs and LDTs must be provided. If two different scenarios are being run, both for the same calendar year but with other differences, then the same set of diesel fractions would have to be supplied again as part of the second scenario. If a scenario with calendar year 1995 was also being run, then the diesel sales fractions would represent model year 1995, 1994, ..., 1972, and 1971-and-older vehicles. The same values would be used for the model years in common to the two sets of sales fractions, but the five oldest model year values would "drop off the end" of the sequence and be replaced by sales fractions for the five most recent model years.

The 50 diesel sales fractions, 25 each for LDVs and LDTs, will constitute the next three records. The format of these records is:

```
20F4.3
20F4.3
10F4.3
```

The values are entered in pairs: The first two values on the first record are the diesel sales fractions for LDVs and LDTs of age 1 (model year = calendar year of evaluation), the second two values are the sales fractions for LDVs and LDTs of age 2 (model year = one year before calendar year of evaluation), and so on, with the last two values on the third record being the sales fractions for age 25+ LDVs and LDTs (model year = 24+ years before calendar year of evaluation).

Note that there are no leading zeros or spaces in these input records. The fractions should be listed to three decimal places, one after another, with the values paired to represent cars then light trucks of each age. The MOBILE4.1 diesel fractions, formatted according to the requirements above, appear below (these fractions are for calendar year 1990, and represent model years 1990 through 1976-and-older).

```
.000.002.000.002.000.002.003.003.003.007.009.011.017.023.021.047.047.093.059.056
.044.035.021.018.009.008.005.000.003.000.002.000.003.000.002.000.002.000.001.000
.000.000.000.000.000.000.000.000.000.000
```

### 2.3.10.5 Guidance

This option has been provided in MOBILE4.1 for two reasons. First, some users performing highway vehicle emission factor modeling may have access to vehicle registration data, or data from other sources, enabling them to characterize diesel sales of LDVs and LDTs in the area being modeled. Particularly if these sales fractions differ significantly from those included in MOBILE4.1, it will enhance the accuracy of the emission factors and inventory to use those sales fractions as model input. Second, as can be seen by the sharp rise and equally sharp fall of diesel sales in the late 1970s and early 1980s, it is extremely difficult to forecast diesel sales fractions for future model years. This provision will allow modelers to account for future increases in diesel sales, if such increases occur.

## 2.3.11 TRIP LENGTH DISTRIBUTION

### 2.3.11.1 Description

EPA has determined through its running loss emission test programs that the level of running loss emissions depends on several variables: the average speed of the travel, the ambient temperature, the volatility (RVP) of the fuel, and the length of the trip. "Trip length" as used here refers to the duration of the trip (how long the vehicle has been travelling), not on the distance travelled in the trip (how far the vehicle has been driven). Test data show that for any given set of conditions (average speed, ambient temperature, and fuel volatility), running loss emissions are zero to negligible at first, but increase significantly as the duration of the trip is extended and the fuel tank, fuel lines, and engine become heated.

In MOBILE4, the test data available for the modeling of running loss emissions were only adequate to allow these emissions to be modeled as direct functions of the user-input temperature and volatility; average speed and trip length were accounted for internally to the model, using values representative of typical urban area traffic patterns. MOBILE4.1 contains significantly revised estimates of running loss emissions.

The additional data obtained since the development of MOBILE4 allows running loss emissions to be modeled as a direct function of the input temperature, fuel volatility, and average speed. While an internal weighting of trip length (duration) is included in the model and is used to estimate the running loss emission factors, the user now has the option of supplying an alternate trip length distribution for use in estimating running loss emissions. If this option of specifying trip length distributions

is not selected, then MOBILE4.1 will calculate the running loss emission factors on the basis of an internal assumed trip length distribution.

2.3.11.2 Options

The user can let MOBILE4.1 estimate running loss emission factors using the internal trip length distributions (by setting SPDFLG to 1 or 2), or can supply a set of trip length distributions (by setting SPDFLG to 3 or 4).

2.3.11.3 Use in MOBILE4.1

For each combination of vehicle type and trip length category (see below), a value representing running loss emissions at the standard test speed, temperature, and volatility is contained in the coded data. This information, if supplied, is used in weighting these factors together to derive the fleet average emission factor, which then is corrected for average speed, temperature, and fuel volatility.

2.3.11.4 Required Information

If a modeler has the necessary information, a separate input data record of trip length distribution can be supplied as input and used in the calculation of running loss emission factors. This record must list the percentage of all travel (VMT) being accumulated over the time period that the emission factors apply for, in trips of the following lengths (durations):

Under 10 minutes
11 to 20 minutes
21 to 30 minutes
31 to 40 minutes
41 to 50 minutes
51 minutes and longer

The format of this record is:

6(1X,F4.1)

The record may appear in the One-Time data section or in each Scenario data section, depending on value of SPDFLG specified by the user.

2.3.11.5 Guidance

Solid data on trip length distributions is not likely to be available in most cases. Thus for base year emission inventory development by States and others, EPA will accept the use of the

internal trip length distributions for the estimation of running loss HC emission factors. The use of trip length distributions other than that included in MOBILE4.1 in the development of required base year emission estimates must be adequately documented for acceptance by EPA. Where the transportation modeling process can produce reliable inputs for trip length distribution, it will allow more accurate estimates of the benefits attributable to SIP measures which shorten average trip lengths without eliminating entire trips.

This completes the Scenario data section.

## 2.4 SUMMARY OF MOBILE4.1 INPUT SEQUENCE

Table 2.4-1 summarizes the input sequence required for a MOBILE4.1 run, in the order required by the program. Records listed in parentheses are optional, and are only required if certain flags have been assigned specific values in the Control section.

## 2.5 OBTAINING REFERENCED DOCUMENTS

Two of the reports specifically mentioned in the guidance subsections of this document, "Techniques for Estimating MOBILE2 Variables" and "Additional Techniques for Estimating MOBILE2 Variables," can be obtained through the National Technical Information Service (NTIS). These reports were prepared by Energy and Environmental Analyses, Inc., for EPA under contract (Contract No. 68-03-2888). The NTIS number is:

| Report Title | NTIS Number |
|---|---|
| "Techniques for Estimating MOBILE2 Variables" and "Additional Techniques for Estimating MOBILE2 Variables" (both reports come as one order) | PB 83 183277 |

For price information and to order, contact

National Technical Information Service
U. S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161
Attention: Sales

Phone: (703) 487-4650

The User's Guides to the earlier versions of the emission factor model (MOBILE2, MOBILE3, and MOBILE4) are also available through NTIS at the above address, for those who might wish to obtain them:

| | |
|---|---|
| Title: | User's Guide to MOBILE2 |
| NTIS Ref: | PB 81 205619 |
| Estimated Costs: (as of 7/1/91) | Paper - $53.00<br>Microfiche - $10.00 |

| | |
|---|---|
| Title: | User's Guide to MOBILE3 |
| NTIS Ref: | PB 84 213974 |
| Estimated Costs: (as of 1/1/89) | Paper - $53.00<br>Microfiche - $10.00 |

| | |
|---|---|
| Title: | User's Guide to MOBILE4 |
| NTIS Ref: | PB 89 164271 |
| Estimated Costs: | Paper - $23.00 |
| (as of 1/1/89) | Microfiche - $ 8.00 |

The report referenced in section 1.0, "Guidance on Estimating Motor Vehicle Emission Reductions From the Use of Alternative Fuels and Fuel Blends," is also available through NTIS:

| | |
|---|---|
| Title: | Guidance on Estimating Motor Vehicle Emission Reductions From the Use of Alternative Fuels and Fuel Blends |
| NTIS Ref: | PB 88 169594/AS |
| Estimated Cost: | Paper - $19.95 |
| (as of 7/1/91) | |

The report "Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources," (revised), EPA-450-4-81-026d (revised), July 1991, should be available to State and local air quality planning officials by contacting their respective EPA Regional Offices.

Table 2.1-1

FLAGS CONTROLLING INPUT TO AND EXECUTION OF MOBILE4.1

| Record Number | Variable Name | Content and Codes | Format | Refer to Section |
|---|---|---|---|---|
| 1 | **PROMPT** | Flag for prompting of remaining Control section data<br><br>1 = No prompting, vertical format<br>2 = Prompting, vertical format<br>3 = No prompting, horizontal format<br>4 = Prompting, horizontal format | I1,3A1 | 2.1.1 |
| | **IOUNEW** | Values for output units:<br><br>(1) Formatted reports unit<br>(2) Diagnostic messages unit<br>(3) Prompting messages unit<br><br>(Allowable values for each unit are 1, 2, 3, 6, 7, or 8. The default value for all three output units is 6.) | | 2.1.2 |
| 2 | **PROJID** | 80 characters for title | 20A4 | 2.1.3 |
| 3 | **TAMFLG** | Flag for optional input of tampering rates<br><br>1 = Use MOBILE4 rates<br>2 = Input alternate rates[1] | I1 | 2.1.4 |
| 4 | **SPDFLG** | Selects speed for each vehicle type; also flag indicating whether alternate trip length distribution data are supplied as input<br><br>1 = One speed for all vehicle types[2]<br>2 = Eight speeds, one for each vehicle type[2]<br>3 = One speed for all vehicle types, plus one alternate set of trip length distribution data per scenario[3]<br>4 = One speed for all vehicle types, plus one set of trip length distribution data for all scenarios[4] | I1 | 2.1.5 |

Table 2.1-1 (continued)

FLAGS CONTROLLING INPUT TO AND EXECUTION OF MOBILE4.1

| Record Number | Variable Name | Content and Codes | Format | Refer to Section |
|---|---|---|---|---|
| 5 | **VMFLAG** | Selects optional use of user-supplied VMT mix among vehicle types<br><br>1 = Use MOBILE4 VMT mix<br>2 = Input one VMT mix for each scenario[2]<br>3 = Input one VMT mix for all scenarios[1] | I1 | 2.1.6 |
| 6 | **MYMRFG** | Flag for optional input of annual mileage accumulation rates and/or registration distributions by age<br><br>1 = Use MOBILE4 values<br>2 = Input annual mileage accumulation rates[1]<br>3 = Input registration distributions by age[1]<br>4 = Input both annual mileage accumulation rates and registration distributions[1] | I1 | 2.1.7 |
| 7 | **NEWFLG** | Flag for optional input of modified basic exhaust emission rates (BERs)<br><br>1 = Use MOBILE4 BERs<br>2 = Input one or more alternate BERs[1] | I1 | 2.1.8 |
| 8 | **IMFLAG** | Flag to include impact of operating I/M program in emission factor calculations<br><br>1 = No I/M program modeled<br>2 = I/M program modeled[1] | I1 | 2.1.9 |

Table 2.1-1 (continued)

FLAGS CONTROLLING INPUT TO AND EXECUTION OF MOBILE4.1

| Record Number | Variable Name | Content and Codes | Format | Refer to Section |
|---|---|---|---|---|
| 9 | **ALHFLG** | Flag to correct exhaust emission factors (gasoline vehicles only) for:<br>(a) air conditioning usage<br>(b) extra vehicle load<br>(c) trailer towing<br>(d) humidity (NOx only)<br><br>1 = No corrections<br>2 = Input six values[2]<br>3 = Input ten values[2] | I1 | 2.1.10 |
| 10 | **ATPFLG** | Flag to include impact of of anti-tampering program (ATP) on emission rates<br><br>1 = No ATP modeled<br>2 = ATP modeled[1] | I1 | 2.1.11 |
| 11 | **RLFLAG** | Flag for control of whether and how refueling emission factors are calculated<br><br>1 = Uncontrolled rates<br>2 = Stage II VRS assumed[1]<br>3 = Onboard VRS assumed[1]<br>4 = Stage II and onboard VRS assumed[1]<br>5 = No refueling emission factors calculated | I1 | 2.1.12 |
| 12 | **LOCFLG** | Flag for control of user input of local area parameter (LAP) record<br><br>1 = One LAP record input for <u>each</u> scenario[2]<br>2 = One LAP record input for <u>all</u> scenarios[1] | I1 | 2.1.13 |

Table 2.1-1 (continued)

FLAGS CONTROLLING INPUT TO AND EXECUTION OF MOBILE4.1

| Record Number | Variable Name | Content and Codes | Format | Refer to Section |
|---|---|---|---|---|
| 13 | TEMFLG | Flag for control of values of temperature to be used for correcting emission factors for effects of temperature<br><br>1 = MOBILE4 calculates temperatures to be used in correction of emission factors from input values of minimum and maximum daily temperature; value read as input for ambient temperature is overridden by calculated values.<br><br>2 = Use input value of ambient temperature to correct emission factors for temperature | I1 | 2.1.14 |

1 Record(s) must appear in One-time data section.
2 Record(s) must appear in Scenario data section.
3 Speed value(s) appear in usual location(s) on first Scenario data record; alternate trip length distributions appear as additional Scenario section data records.
4 Speed value(s) appear in usual location(s) on first Scenario data record; alternate trip length distribution appears as additional One-Time data section record.

Table 2.1-2

FLAGS CONTROLLING OUTPUT OF MOBILE4.1

| Record Number | Variable Name | Content and Codes | Format | Refer to Section |
|---|---|---|---|---|
| 14 | **OUTFMT** | Selects the structure of formatted output report<br><br>1 = 222-column numerical<br>2 = 140-column numerical<br>3 = 112-column descriptive<br>4 = 80-column descriptive<br>5 = 112-column descriptive plus "by model year" tables | I1 | 2.1.15 |
| 15 | **PRTFLG** | Selects pollutants for which emission factors are to be calculated and included in output<br><br>1 = HC only<br>2 = CO only<br>3 = NOx only<br>4 = All three pollutants | I1 | 2.1.16 |
| 16 | **IDLFLG** | Controls calculation and output of idle emission factors<br><br>1 = No idle EFs<br>2 = Include idle EFs | I1 | 2.1.17 |
| 17 | **NMHFLG** | Selects composition of "HC" emission factors<br><br>1 = Total hydrocarbons (THC)<br>2 = Non-methane hydrocarbons (NMHC)<br>3 = Volatile organic compounds (VOC)<br>4 = Total organic gasses (TOG)<br>5 = Non-methane organic gasses (NMOG) | I1 | 2.1.18 |

Table 2.1-2 (continued)

FLAGS CONTROLLING OUTPUT OF MOBILE4.1

| Record Number | Variable Name | Content and Codes | Format | Refer to Section |
|---|---|---|---|---|
| 18 | **HCFLAG** | Selects how HC emission factors are output<br><br>1 = No component EFs printed (sum of HC emissions only)<br>2 = Component and total EFs printed<br>3 = Component and total EFs printed, with detailed evaporative emissions breakdown in grams | I1 | 2.1.19 |

Table 2.2-1

SUMMARY OF ALTERNATE BER RECORDS (required if NEWFLG = 2)

| Record | Field | Content, Description, and Codes | Format | Allowable Values |
|---|---|---|---|---|
| 1 | 1 | Number of BER records to follow | I3,/ | 1 to 100 |
| 2 thru N+1 | 1 | Code for region new BER applies to:<br><br>1 = low-altitude<br>2 = high-altitude | I1,1X | 1 or 2 |
| | 2 | Code for vehicle type new BER applies to:<br><br>1 = LDGV 5 = LDDV<br>2 = LDGT1 6 = LDDT<br>3 = LDGT2 7 = HDDV<br>4 = HDGV 8 = MC | I1,1X | 1 to 8 |
| | 3 | Code for pollutant new BER applies to:<br><br>1 = HC 2 = CO 3 = NOx | I1,1X | 1 to 3 |
| | 4 | First model year new BER applies to (last 2 digits) | I2,1X | 60-99, 00-20 |
| | 5 | Last model year new BER applies to (last 2 digits) | I2,1X | 60-99, 00-20 |
| | 6 | New Zero-mile level | F6.2,1X | $\geq$ 0.0 |
| | 7 | New Deterioration rate (or DR1*) | F6.2,1X | $\geq$ 0.0 |
| | 8 | New DR2* | F6.2,/ | $\geq$ 0.0 |

* DR2 for model year 1981 and later LDGV HC and CO BERs only. Field 8 blank for LDGV NOx BERs and for all pollutant BERs for other vehicle types.

Table 2.2-2

SUMMARY OF I/M PROGRAM DESCRIPTIVE INPUT RECORD
(required if IMFLAG = 2)

| Field | Content, Description, Codes | Format | Allowable Values | Refer to Section |
|---|---|---|---|---|
| 1 | Program start year | I2,1X | 60-99, 00-20 | 2A.1.2 |
| | (Last 2 digits of first calendar year of program operation) | | | |
| 2 | Stringency level (percent) | I2,1X | 10 to 50 | 2A.1.3 |
| 3 | First model year | I2,1X | 41-99, 00-20 | 2A.1.4 |
| | (Last 2 digits of oldest model year of vehicles included in program) | | | |
| 4 | Last model year | I2,1X | 41-99, 00-20 | 2A.1.5 |
| | (Last 2 digits of latest model year of vehicles included in program) | | | |
| 5 | Waiver rate for pre-1981 model year vehicles (percent) | F2.0,1X | 0 to 50 | 2A.1.6 |
| 6 | Waiver rate for 1981 and later model year vehicles (percent) | F2.0,1X | 0 to 50 | 2A.1.6 |
| 7 | Compliance rate (percent) | F3.0,1X | 0 to 100 | 2A.1.7 |
| 8 | Program type | I1,1X | 1 to 3 | |
| | 1 = Centralized | | | 2A.1.12 |
| | 2 = Decentralized/Computerized | | | 2A.1.13 |
| | 3 = Decentralized/Manual | | | 2A.1.14 |

Table 2.2-2 (continued)

SUMMARY OF I/M PROGRAM DESCRIPTIVE INPUT RECORD
(required if IMFLAG = 2)

| Field | Content, Description, Codes | Format | Allowable Values | Refer to Section |
|---|---|---|---|---|
| 9 | Inspection frequency<br><br>1 = annual<br>2 = biennial | I1,1X | 1 or 2 | 2A.1.8 |
| 10 | Vehicle types subject to inspections<br><br>Enter 1 (not subject to inspection) or 2 (subject to inspection) for each vehicle type, in this order: LDGV, LDGT1, LDGT2, HDGV | 4I1,1X | 1 or 2 (in each column) | 2A.1.9 |
| 11 | Test type<br><br>1 = Idle test<br>2 = 2500/Idle test<br>3 = Loaded Idle test | I1,1X | 1, 2, 3 | 2A.1.10 |
| 12 | Flags to indicate whether alternate I/M credits are to be input by user<br><br>Enter 1 (use MOBILE4.1 I/M credits) or 2 (read in alternate I/M credits on logical I/O device unit 4, for Tech I-II and Tech IV+ vehicles respectively | 2I1 | 1 or 2 | 2A.1.11<br>2A.1.15 |

Table 2.2-3

SUMMARY OF ATP DESCRIPTIVE INPUT RECORD
(required if ATPFLG = 2)

| Field | Content, Description, Codes | Format | Allowable Values | Refer to Section |
|---|---|---|---|---|
| 1 | Program start year<br>(Last 2 digits of first calendar year of ATP operation) | I2,1X | 60-99, 00-20 | 2A.1.2 |
| 2 | First model year<br>(Last 2 digits of oldest model year of vehicles included in ATP) | I2,1X | 41-99, 00-20 | 2A.1.4 |
| 3 | Last model year<br>(Last 2 digits of latest model year of vehicles included in ATP) | I2,1X | 41-99 or 00-20 | 2A.1.5 |
| 4 | Vehicle types subject to inspections<br>Enter 1 (not subject to inspection) or 2 (subject to inspection) for each vehicle type, in this order: LDGV, LDGT1, LDGT2, HDGV | 4I1,1X | 1 or 2 (in each column) | 2A.1.9 |
| 5 | Program type<br>1 = Centralized<br>2 = Decentralized | I1 | 1 or 2 | 2A.1.12<br>2A.1.13 |
| 6 | Inspection frequency<br>1 = annual<br>2 = biennial | I1,1X | 1 or 2 | 2A.1.8 |

Table 2.2-3 (continued)

SUMMARY OF ATP DESCRIPTIVE INPUT RECORD
(required if ATPFLG = 2)

| Field | Content, Description, Codes | Format | Allowable Values | Refer to Section |
|---|---|---|---|---|
| 7 | Compliance rate (percent) | F4.0,1X | 0 to 100 | 2A.1.7 |
| 8 | Inspections performed | 8I1 | 1 or 2 (in each column) | |
| | Enter 1 (inspection is not performed) or 2 (inspection is performed) for each type of inspection, in this order: | | | |
| | Air pump system | | | 2A.2.3 |
| | Catalyst | | | 2A.2.4 |
| | Fuel inlet restrictor | | | 2A.2.5 |
| | Tailpipe lead deposit test | | | 2A.2.6 |
| | EGR system | | | 2A.2.7 |
| | Evaporative control system | | | 2A.2.8 |
| | PCV system | | | 2A.2.9 |
| | Gas cap | | | 2A.2.10 |

Table 2.2-4

SUMMARY OF STAGE II AND ONBOARD VRS DESCRIPTIVE INPUT RECORDS
(required if RLFLAG = 2, 3, or 4)

**Stage II VRS Input Record** (required if RLFLAG = 2 or 4)

| Field | Content, Description, Codes | Format | Allowable Values |
|---|---|---|---|
| 1 | Stage II start year<br>(Last 2 digits of calendar year in which Stage II requirement is first effective) | I2,1X | 89-99, 00-20 |
| 2 | Phase-in period<br>(Number of years allowed for all stations subject to Stage II requirement to complete installation) | I1 | 1 to 5 |
| 3 | Percent efficiency of Stage II VRS at controlling refueling emissions from LDGVs and LDGTs | 1X,I3 | 0 to 100 |
| 4 | Percent efficiency of Stage II VRS at controlling refueling emissions from HDGVs | 1X,I3 | 0 to 100 |

**Onboard VRS Input Record** (required if RLFLAG = 3 or 4)

| Field | Content, Variable Name, Codes | Format | Allowable Values |
|---|---|---|---|
| 1 | Onboard start year<br>(Last 2 digits of first model year vehicles are subject to onboard VRS requirement) | I2,1X | 89-99, 00-20 |
| 2 | Vehicle types covered<br>Enter 1 (not covered) or 2 (covered) for each vehicle type, in this order: LDGV, LDGT1, LDGT2, HDGV | 4I1 | 1 or 2 (in each column) |

Table 2.2-5

SUMMARY OF THE LOCAL AREA PARAMETER RECORD

| Field | Content, Description, Codes | Format | Allowable Values | Refer to Section |
|---|---|---|---|---|
| 1 | Scenario name | 4A4,2X | | 2.2.9 |
| 2 | Minimum daily temperature (°F) | F5.0 | 0.-100. | 2.2.11 |
| 3 | Maximum daily temperature (°F) | F5.0 | 10.-120. | 2.2.11 |
| | (These temperatures are used in calculation of the diurnal index for evaporative HC emissions. If TEMFLG = 1, they are also used to calculate temperatures for correction of exhaust HC, CO, and NOx, hot soak evaporative, refueling, resting loss, and running loss emissions.) | | | |
| 4 | "Period 1" RVP (psi) | F5.1 | 7.0-16.0 | 2.2.12 |
| | (Average fuel volatility for the area being modeled, applied to years of evaluation prior to the "Period 2" start year) | | | |
| 5 | "Period 2" RVP (psi) | F5.1,1X | 7.0-16.0 | 2.2.13 |
| | (Average fuel volatility for the area being modeled, applied to years of evaluation at or after "Period 2" start year) | | | |
| 6 | "Period 2" start year | I2 | 89-99,00-20 | 2.2.13 |
| | (Last 2 digits of first calendar year for which "Period 2" RVP is assumed; base RVP applies for years of evaluation prior to the year specified) | | | |
| 7 | Oxygenated fuel flag | 1X,I1 | 1 or 2 | 2.2.14 |
| | (Flag indicates whether effect of oxygenated fuels on exhaust CO is to be modeled; if missing, assumed to be "1") | | | |
| 8 | Diesel sales fraction flag | 1X,I1 | 1 or 2 | 2.2.15 |
| | (Flag indicates whether user is supplying alternate LDV and LDT diesel sales fractions; if missing, assumed to be "1") | | | |

Table 2.3-1

SUMMARY OF THE SCENARIO RECORD(S)

**Record 1: Scenario Descriptive Record (MANDATORY)**

| Field | Content, Description, Codes | Format | Allowable Values | Refer to Section |
|---|---|---|---|---|
| 1 | Region for which emission factors are to be calculated<br><br>1 = low-altitude<br>2 = high-altitude | I1,1X | 1 or 2 | 2.3.1 |
| 2 | Calendar year of evaluation | I2,1X | 60-99, 00-20 | 2.3.2 |
| | (Last 2 digits of calendar year for which emission factors are to be calculated, as of January 1) | | | |
| 3 | Average speed to be used in emission factor calculations | | 2.5-65.0 | 2.3.3 |
| | If SPDFLG = 1, one speed is used for all vehicle types | F4.1 | | |
| | | or | | |
| | If SPDFLG = 2, eight speeds are used, one for each vehicle type, in this order: LDGV, LDGT1, LDGT2, HDGV, LDDV, LDDT, HDDV, MC | 8(F4.1,1X) | | |
| 4 | Ambient temperature (°F) | 1X,F4.1 | 0.0-110.0 | 2.3.4 |
| | (If TEMFLG = 2, ambient temperature is used to correct exhaust, hot soak evaporative, resting loss, and running loss emission factors fortemperatures other than 75°F) | | | |

Table 2.3-1 (continued)

SUMMARY OF THE SCENARIO RECORD(S)

**Record 1: Scenario Descriptive Record (MANDATORY)**[1] (continued)

| Field | Content, Description, Codes | Format | Allowable Values | Refer to Section |
|---|---|---|---|---|
| 5 | Operating mode fractions | 3(1X,F4.1) | 0.0-100.0 | 2.3.5 |
| | [Percent of VMT accumulated by (1) non-catalyst vehicles in cold-start mode (PCCN), (2) catalyst-equipped vehicles in hot-start mode (PCHC), and (3) catalyst-equipped vehicles in cold-start mode (PCCC)] | | | |

**Record 2: LAP record for this scenario only (OPTIONAL)**
(required only if LOCFLG = 1)

See Table 2.2-5

**Record 3: Oxygenated fuels descriptive record (OPTIONAL)**
(Required only if OXYFLG = 2 on LAP record, and LOCFLG = 1)

| Field | Content, Description, Codes | Format | Allowable Values | Refer to Section |
|---|---|---|---|---|
| 1 | Ether blends market share | F4.3,1X | 0.0-1.0 | 2.3.9 |
| 2 | Alcohol blends market share | F4.3,1X | 0.0-1.0 | 2.3.9 |
| 3 | Average oxygen content of ether blend fuels (by wgt) | F4.3,1X | 0.0-0.027 | 2.3.9 |
| 4 | Average oxygen content of alcohol blend fuels (by wgt) | F4.3,1X | 0.0-0.035 | 2.3.9 |
| 5 | RVP waiver switch (indicating whether oxygenated fuels are allowed to exceed regulated RVP limit by 1.0 psi) | 1X,I1 | 1 or 2 | 2.3.9 |

1 **NOTE**: Values MUST be entered for all fields in the scenario descriptive record; there are NO DEFAULT VALUES for these variables.

Table 2.3-1 (continued)

SUMMARY OF THE SCENARIO RECORD(S)

**Records 4-6: Diesel sales fractions (OPTIONAL)**
(Required only if DSFLAG = 2 on LAP record **and** LOCFLG = 1)

| Field | Content, Description, Codes | Format | Allowable Values | Refer to Section |
|---|---|---|---|---|
| | Three records listing fraction of LDV/LDT sales by model year that were diesel, starting with model year = calendar year of evaluation | 20F4.3<br>20F4.3<br>10F4.3 | 0.0-1.0<br>0.0-1.0<br>0.0-1.0 | 2.3.10 |

**Record 7: VMT mix by vehicle type record (OPTIONAL)**
(Required only if VMFLAG = 2)

| Field | Content, Description, Codes | Format | Allowable Values | Refer to Section |
|---|---|---|---|---|
| 1-8 | VMT fraction accumulated by each of eight vehicle types, in this order: LDGV, LDGT1, LDGT2, HDGV, LDDV, LDDT, HDDV, MC | 8F4.3 | 0.0-1.0 | 2.2.2 and 2.3.6 |

**Record 8: Additional Correction Factor record (OPTIONAL)**
(Required only if ALHFLG = 2 or 3)

| Field | Content, Description, Codes | Format | Allowable Values | Refer to Section |
|---|---|---|---|---|
| 1 | Air conditioning use fraction (Percent of AC-equipped vehicles actually using AC) | F4.2 | 0.0-1.0 | 2.3.8.3 and 2.3.8.7 |

Note: If ALHFLG = 2, no AC usage correction factor will be applied, and the input value of this variable should be 0.0.

If ALHFLG = 3, the input value is overridden by calculated value (see 2.3.8.7); however, a nonzero value must be entered here in order to have the correction factor calculated and applied.

Table 2.3-1 (continued)

SUMMARY OF THE SCENARIO RECORD(S)

**Record 8: Additional Correction Factor record (OPTIONAL)**
(Required only if ALHFLG = 2 or 3) (continued)

| Field | Content, Description, Codes | Format | Allowable Values | Refer to Section |
|---|---|---|---|---|
| 2-4 | Extra load fractions<br>(Percent of vehicles assumed to be carrying additional 500 lb; fractions apply to LDGVs, LDGT1s, and LDGT2s, in that order) | 3F4.2 | 0.0-1.0 | 2.3.8.4 |
| 5 or 5-7 | Trailer towing fraction(s)<br>(Percent of vehicles assumed to be towing trailers) | F4.2 or 3F4.2 | 0.0-1.0 | 2.3.8.5 |
| Note: | If ALHFLG = 2, one value is required and is used to calculate correction factor for all three vehicle types.<br>If ALHFLG = 3, three values are required and are used to calculate correction factors for LDGVs, LDGT1s, and LDGT2s, in that order | | | |
| 6 or 8 | Absolute humidity level<br>(Grains water per pound dry air, used to correct exhaust NOx emission factors) | F4.0 | 20.-140. | 2.3.8.6 |
| 9, 10 | Dry and wet bulb temperatures in °F<br>If ALHFLG = 3 only, these temperatures are used to calculate a "discomfort index," which in turn is used to estimate an A/C usage fraction (which then overrides the value input in Field 1 of this record). | 2F4.0 | 0.-110. | 2.3.8.7 |

Table 2.4-1

SUMMARY OF THE MOBILE4.1 INPUT RECORD SEQUENCE

| Input Record Sequence | Input Section | Refer to Section |
|---|---|---|
| 1 PROMPT flag record | CONTROL | 2.1.1 |
| (1-3 IOUNEW values)* | CONTROL | 2.1.2 |
| 1 PROJID record | CONTROL | 2.1.3 |
| 1 TAMFLG flag record[1] | CONTROL | 2.1.4 |
| 1 SPDFLG flag record[1] | CONTROL | 2.1.5 |
| 1 VMFLAG flag record[1] | CONTROL | 2.1.6 |
| 1 MYMRFG flag record[1] | CONTROL | 2.1.7 |
| 1 NEWFLG flag record[1] | CONTROL | 2.1.8 |
| 1 IMFLAG flag record[1] | CONTROL | 2.1.9 |
| 1 ALHFLG flag record[1] | CONTROL | 2.1.10 |
| 1 ATPFLG flag record[1] | CONTROL | 2.1.11 |
| 1 RLFLAG flag record[1] | CONTROL | 2.1.12 |
| 1 LOCFLG flag record[1] | CONTROL | 2.1.13 |
| 1 TEMFLG flag record[1] | CONTROL | 2.1.14 |
| 1 OUTFMT flag record[1] | CONTROL | 2.1.15 |
| 1 PRTFLG flag record[1] | CONTROL | 2.1.16 |
| 1 IDLFLG flag record[1] | CONTROL | 2.1.17 |
| 1 NMHFLG flag record[1] | CONTROL | 2.1.18 |
| 1 HCFLAG flag record[1] | CONTROL | 2.1.19 |
| (24 or 48 tampering records)[2] if TAMFLG = 2 | ONE-TIME | 2.2.1 |
| (1 VMT mix record) if VMFLAG = 3 | ONE-TIME | 2.2.2 |
| (24 mileage accumulation rate by age records) if MYMRFG = 2 or 4 | ONE-TIME | 2.2.3 |
| (24 registration distribution by age records) if MYMRFG = 3 or 4 | ONE-TIME | 2.2.3 |
| (1 to 100 basic emission rate records) if NEWFLG = 2 | ONE-TIME | 2.2.4 |
| (1 I/M program descriptive record) if IMFLAG = 2 | ONE-TIME | 2.2.5 |
| (1 ATP descriptive record) if ATPFLG = 2 | ONE-TIME | 2.2.6 |
| (1 or 2 refueling VRS descriptive records)[3] if RLFLAG = 2, 3, or 4 | ONE-TIME | 2.2.7 |
| (1 Local Area Parameter record)[4] if LOCFLG = 2 | ONE-TIME | 2.2.8 |
| (1 oxygenated fuel descriptive record) if LOCFLG = 2 and OXYFLG = 2 | ONE-TIME | 2.3.9 |
| (1 trip length distribution record) if SPDFLG = 4 | ONE-TIME | 2.3.11 |
| (1 by model year inclusion vector record) if OUTFMT = 5 | ONE-TIME | 2.2.16 |

Table 2.4-1 (continued)

SUMMARY OF THE MOBILE4.1 INPUT RECORD SEQUENCE

| Input Record Sequence | Input Section | Refer to Section |
|---|---|---|
| 1 Scenario descriptive record | SCENARIO | 2.3.1 |
| (1 Local Aera Parameter record)[4] | | |
| if LOCFLG = 1 | SCENARIO | 2.2.8 |
| (1 oxygenated fuel descriptive record) | | |
| if LOCFLG = 1 and OXYFLG = 2 | SCENARIO | 2.3.9 |
| (3 diesel sales fraction by model year records) | | |
| if LOCFLG = 1 and DSFLAG = 2 | SCENARIO | 2.3.10 |
| (1 VMT mix record) | | |
| if VMFLAG = 2 | SCENARIO | 2.2.2 |
| (1 trip length distribution record) | | |
| if SPDFLG = 3 | SCENARIO | 2.3.11 |
| (1 additional correction factor record) | | |
| if ALHFLG = 2 or 3 | SCENARIO | 2.3.8 |

* Required only if reassignment of output device numbers is desired.

[1] These 16 flags are entered on one record (format I1, 15(1X,I1)) if PROMPT = 3 or 4.

[2] 24 records if IMFLAG = 1; 48 records if IMFLAG = 2.

[3] Stage II record if RLFLAG = 2; onboard record if RLFLAG = 3; both records if RLFLAG = 4.

[4] The Local Area Parameter record must appear in either the One-Time or the Scenario data section.

# Appendix 2A

## INSPECTION/MAINTENANCE AND ANTI-TAMPERING PROGRAM TERMINOLOGY DEFINITIONS

This appendix discusses the terminology used to describe inspection and maintenance (I/M) and anti-tampering (ATP) programs for purposes of modeling the emission benefits of such programs using MOBILE4.1. In general, MOBILE4.1 assumes that the I/M program is mandatory, periodic, and covers a well-defined group of vehicles. There are many details (e.g., instrument specifications) which are beyond the scope of this document. Program planners should consult with EPA (Technical Support Staff, 313/668-4367 or FTS 374-8367) if there are questions regarding I/M program requirements.

### 2A.1 I/M PROGRAM TERMINOLOGY

#### 2A.1.1 I/M

I/M refers to "inspection and maintenance" programs, which are inspections of vehicles using a measurement of tailpipe emissions and which require that all vehicles with tailpipe emissions higher than the program cutpoints be repaired to pass a tailpipe emission retest. Inspections that are aimed at verifying the presence and proper connection of emission control devices and components are termed anti-tampering programs (ATPs). For convenience, such tailpipe I/M and ATPs are sometimes referred to collectively simply as "I/M programs" in other EPA documents.

#### 2A.1.2 Start Year

The year in which the periodic inspection program begins to require both inspection and repairs is called the start year. MOBILE4.1 only provides for a January 1st start date. Other start dates will require interpolation between two MOBILE4.1 runs to give accurate estimates of benefits. Separate and different start dates may be specified for a tailpipe I/M program and an ATP.

#### 2A.1.3 Stringency

Stringency refers to the tailpipe emission test failure rate expected in an I/M program among pre-1981 model year passenger cars or pre-1984 light-duty trucks, based on the short test emission cutpoints. The expected failure rate can be determined by applying the program cutpoints to a representative sample of

vehicles tested in a survey. Actual failure rates reported by a program can also be used to determine stringency, but only when there is no possibility of significant testing or data reporting errors. MOBILE4.1 assumes that the failure rate remains fixed at the stringency level for each evaluation year. MOBILE4.1 does not allow a stringency less than 10% or greater than 50%.

### 2A.1.4 First Model Year

The first model year refers to the oldest model year vehicle which is always included in the inspection program. MOBILE4.1 assumes that all vehicle classes have the same model year coverage and does not allow for a separate coverage period for each vehicle class. Some programs do not fix the model years covered by the program, and instead use a coverage "window" to define which vehicles must be inspected. For example, such a program may cover only vehicles 15 years old or younger. Such programs cannot be modeled accurately using MOBILE4.1 without special assistance.

### 2A.1.5 Last Model Year

The last model year refers to the youngest (newest) model year vehicle which is always subject to the inspection program. This allows for a program to cover only particular model years. Most programs routinely include new model year vehicles in the program as they reach one year of age. It is recommended that the maximum allowable last model year (2020) be input as the last model year, unless a special case requires some other input. MOBILE4.1's calculation of I/M credits already assumes that vehicles less than one year old are exempt from inspection, so input of the maximum last model year allows for maximum flexibility.

### 2A.1.6 Waiver Rates

Many I/M programs waive the requirement to pass a retest if certain defined criteria are met. Waivers are often granted in I/M programs for vehicles whose owners have spent over a set dollar limit in attempting to comply with the program retest requirement.

The waiver rate inputs to MOBILE4.1 reduce the estimated benefit of the I/M program design. The waiver rates are always calculated as a percent of non-duplicate initial test failures. Waiver rates must be provided for pre-1981 and for 1981 and later model year light-duty vehicles. MOBILE4.1 assumes that tampered or misfueled vehicles cannot receive waivers, and so does not reduce the ATP benefit based on the waiver rate.

## 2A.1.7 Compliance Rate

Compliance rate refers to the level of compliance with the inspection program. For example, assume a program required that all passenger cars be inspected each year, and that 100,000 passenger cars were registered in the area covered by the program. If in a given year only 95,000 passenger cars completed the inspection process to the point of receiving a final certificate of compliance or waiver, it could be assumed that the remaining 5,000 vehicles had avoided the inspection requirement. The compliance rate for this program would then be 95%. The number of initial inspections should not be used to calculate the compliance rate, since some cars may drop out after failing one or more tests. The compliance rate input is also used to account for vehicles which are waived from compliance without any testing (e.g., vehicles with special testing problems or vehicles owned by certain types of owners).

MOBILE4.1 uses a single compliance rate to reduce both the I/M and ATP portions of the program benefits. The reduction in benefit is not linear. The benefit loss per vehicle assumes that the failure rate among non-complying vehicles will be larger than the expected failure rate in the fleet. As the rate of non-compliance increases, the non-complying failure rate will approach and finally equal the expected failure rate.

The following table shows the loss of benefit assumed for the enforcement fraction:

| Compliance Rate | Non-Compliance Rate | Non-Complier Failure Rate Adjustment | Fraction Benefit Loss | Fraction Benefit Remaining |
|---|---|---|---|---|
| 100% | 0% | 2.0 | .000 | 1.000 |
| 99% | 1% | 2.0 | .020 | .980 |
| 98% | 2% | 2.0 | .040 | .960 |
| 97% | 3% | 2.0 | .060 | .940 |
| 96% | 4% | 2.0 | .080 | .920 |
| 95% | 5% | 1.5 | .095 | .905 |
| 90% | 10% | 1.4 | .169 | .831 |
| 85% | 15% | 1.3 | .238 | .762 |
| 80% | 20% | 1.2 | .302 | .698 |
| 75% | 25% | 1.1 | .361 | .639 |
| 70% | 30% | 1.0 | .415 | .585 |
| 50% | 50% | 1.0 | .615 | .385 |

## 2A.1.8 Inspection Frequency

MOBILE4.1 allows for two inspection frequencies. "Annual" means that all covered vehicles must be inspected once each year.

"Biennial" means that each vehicle is inspected once every two years, such that half of the vehicles of each model year are inspected each calendar year. Any other inspection frequency would require alternate I/M credits provided by EPA.

### 2A.1.9 Vehicle Classes

MOBILE4.1 program benefits are calculated separately for each gasoline-fueled vehicle class. No emission benefits are estimated for diesel vehicles or motorcycles. The vehicle class designations are based on the certification standard definitions:

**LDGV** - light-duty gasoline-fueled vehicles (passenger cars).

**LDGT1** - light-duty gasoline-fueled trucks less than 6,000 lbs gross vehicle weight (lighter pick-up trucks and vans).

**LDGT2** - light-duty gasoline-fueled trucks greater than 6,000 lbs but less than 8,500 lbs GVW (heavier pick-up trucks and vans and many commercial trucks).

**HDGV** - heavy-duty gasoline-fueled vehicles greater than 8,500 lbs GVW (heavier commercial trucks, including highway hauling trucks).

Many areas do not use the same vehicle class designations in their vehicle registration data as are used in MOBILE4. In these cases care must be taken not to claim coverage for too many vehicles.

### 2A.1.10 I/M Test Types

There are three I/M test types allowed in MOBILE4.1. These test types only apply to the inspection of 1981 and newer model year passenger cars and 1984 and newer light-duty trucks. (The concept of stringency already takes into account the effect of the test type on the benefits from older vehicles.) The chosen test type is assumed to be applied to all 1981 and newer passenger cars and 1984 and newer light-duty trucks both at the initial inspection and the retest. It is assumed that the cutpoints used for the inspections are 1.2 percent CO and 220 ppm HC in all cases.

**Idle Test** refers to a measurement of HC and CO emission concentrations of a fully warmed vehicle as it idles in neutral or park.

**2500/Idle Test** refers to a measurement of HC and CO emission concentrations of a fully warmed vehicle at 2500 rpm in neutral or park and again at idle. The vehicle must pass both at idle and at 2500 rpm in order to pass the test.

**Loaded/Idle Test** refers to a measurement of HC and CO emission concentrations of a fully warmed vehicle on a chassis dynamometer at a constant load, and again at idle in neutral or park. The vehicle must pass both at idle and at load in order to pass the test.

### 2A.1.11 Alternate I/M Credits

In special cases where the design of the I/M program to be modeled does not fit into any of the categories defined in MOBILE4 (e.g., semi-annual or tri-annual inspection frequency), the model allows the user to supply a set of factors that will be used to determine the I/M program benefits. Normally these factors will be supplied by EPA at the request of the program manager or air quality planner.

### 2A.1.12 Centralized Programs

Centralized inspection programs refer to those programs which completely separate the inspection of vehicles from the repairs. Usually high-volume inspection stations, run either by the local agency itself or by a contractor, will perform all initial tests and retests after repair. Garages and other repair facilities are not allowed to perform official tests. Independent, centralized programs are the standard used to determine the emission benefits for I/M and ATP program designs.

### 2A.1.13 Decentralized Programs (Manual)

Decentralized inspection programs refer to those programs where the local program agency licenses service stations and garages to perform official inspections and reinspections. These licensed inspection stations are allowed to perform repairs on the vehicles they inspect. The number of licensed inspections stations in decentralized programs is larger and the volume per station is smaller than for centralized programs.

Decentralized programs have been found to be less effective than centralized programs. As a result, MOBILE4.1 reduces the emission benefits, relative to a centralized program design, by 50 percent for the I/M (tailpipe test) portion and 50 percent for the ATP portion of the program if a decentralized design is chosen. The 50 percent reduction in benefits from the tailpipe portion of the test includes the loss due to waivers, if any. Areas which can demonstrate that a currently operating network achieves greater emission reductions should contact EPA for assistance.

### 2A.1.14 Computerized Inspection

Some decentralized I/M programs require the use of computerized emission analyzers. These analyzers contain small computers which keep track of all official inspection activity, automatically calibrate the instrumentation, and prompt the inspector during the inspection procedure. The computer also prepares a machine-readable record of all official inspections and calibrations, and will not allow inspections whenever it determines the instrumentation to be out of calibration.

MOBILE4.1 assumes that the I/M portion of a decentralized computerized inspection program will be 50 percent as effective as a centralized program of similar stringency (i.e., the benefits of the program are discounted by 50 percent). As noted above, this benefit reduction includes the impact of waivers, if any, and is not applied on top of a waiver-related loss potential benefits. Any area that has data to support the contention that a specific decentralized computerized program is more efficient than this (i.e., that the program should have its benefits discounted by less than 50 percent relative to the benefits of a centralized program) is encouraged to contact EPA for assistance in verifying that contention and in modeling the impact of that program on the in-use emission factors. Decentralized computerized inspection programs will also have the benefits from the ATP portion of the program reduced by 50 percent.

### 2A.1.15 Tech I-II and Tech IV+

The calculation of I/M benefits for MOBILE4 was done by technology group, which can roughly be determined by model year for each vehicle type. These technology groups have come to be referred to by numbers. Within the Tech IV group, I/M credits are developed separately for each model year of LDGVs, with model year mapping to LDGTs based on similarity of emission control technology used. The table below summarizes the technology groupings used in MOBILE4.1 and their respective application to gasoline-fueled passenger cars and light trucks.

| Technology Grouping | Model Years Covered | | |
|---|---|---|---|
| | LDGV | LDGT1 | LDGT2 |
| I | Pre-1975 | Pre-1975 | Pre-1979 |
| II | 1975-80 | 1975-83 | 1979-83 |
| IV+ | 1981+ | 1984+ | 1984+ |

Sets of alternate I/M credits may contain both Tech I and II credits, only Tech IV+ credits, or Tech I, II, and IV+ credits together. This is usually indicated in the header block of the alternate I/M credit deck.

## 2A.2 ATP TERMINOLOGY

This section discusses the terminology used to describe ATP inspections for purposes of modeling the emission benefits of such programs using MOBILE4.1. In general, it is assumed that the program is mandatory, periodic, and covers a well-defined group of vehicles. A program which inspects for tampering only when a vehicle has failed its tailpipe I/M inspection, or only when a vehicle owner requests a test waiver, is not considered as an ATP in MOBILE4.1.

It is also assumed that the inspections are primarily visual rather than functional, and involve no disassembly or disconnection to gain access to hidden components (other than removal of the gas cap to view the fuel inlet restrictor). However, program planners are encouraged to define failure in broad enough terms of visual damage and proper operating condition so that any emission control component determined by the inspector to be non-functional can be properly failed and repaired. There are many details (such as replacement catalyst specifications) which are beyond the scope of this discussion. Program planners should consult with EPA's Office of Mobile Sources (Technical Support Staff, 313/668-4367 or FTS 374-8467) if there are questions regarding the requirements of ATP inspections.

### 2A.2.1 ATP

Anti-tampering programs (ATPs) are periodic inspections of vehicles to detect damage to, disablement of, or removal of emission control components. Owners are required to restore the vehicle's emission control system and have the vehicle reinspected. Note that programs that inspect for tampering only those vehicles failing an I/M tailpipe test are not considered for MOBILE4.1 modeling purposes to have an ATP, and should not attempt to derive ATP emission reduction credits.

### 2A.2.2 Tampering and Misfueling

Any physical damage to, or disablement or removal of, an emission control component is considered tampering in MOBILE4.1. This does not limit tampering only to deliberate disablements or only to those disablements of which the vehicle owner is aware. As a result, tampering can often be a result of poor maintenance as opposed to some action by the vehicle owner or a service mechanic.

Misfueling is the use of leaded fuel in any vehicle which is equipped with a catalytic converter. This includes inadvertent use of leaded fuel without the knowledge of the vehicle owner.

### 2A.2.3 Air Pump Inspection

Air pump systems supply fresh air needed by the catalytic converter to reduce engine emissions before they leave the tailpipe. Inspectors should check for missing belts and hoses and proper connection at the exhaust manifold. Sometimes the entire pump and its plumbing are removed. A valve is sometimes used to route air away from the exhaust stream during certain operating modes. This valve should be checked for proper hose and wire connections. Often the air is injected directly into the catalytic converter underneath the vehicle. If so, this connection should be checked. Any missing, damaged or altered components of the air pump system should be replaced.

### 2A.2.4 Catalyst Inspection

The catalytic converter, sometimes referred to simply as the catalyst, oxidizes excess hydrocarbon and carbon monoxide from the engine exhaust into water and carbon dioxide. Newer catalysts also reduce oxides of nitrogen in the exhaust. The metals which accomplish this task are most commonly coated on a ceramic honeycomb inside the stainless steel shell of the catalyst. The catalyst resembles a muffler in some ways, but would not be confused with a muffler because it is farther forward on the vehicle, and its stainless steel shell will not rust.

Some cars will have more than one catalyst, so the number of catalysts expected should be determined before the inspection begins. Some catalysts are located very near the exhaust manifold, so the inspector should be sure to check the entire length of the exhaust piping from the exhaust manifold to the muffler before determining that the catalyst is not present.

Emission credit should not be claimed using MOBILE4.1 unless regulations provide a mechanism to assure that failed cars are correctly repaired with OEM or approved aftermarket replacements. Program planners should consult with EPA to avoid incorrectly claiming credit.

### 2A.2.5 Fuel Inlet Restrictor Inspection

Vehicles requiring the use of only unleaded gasoline have been equipped with fuel inlets that only allow use of narrow fuel nozzles. Leaded fuel is required to be dispensed only from pumps using wider nozzles. Any vehicle found to have a fuel inlet which allows a leaded fuel nozzle to be inserted, such as having the nozzle size restriction removed, is assumed to have used leaded fuel. Leaded fuel permanently reduces the ability of the catalytic converter to reduce emissions. Therefore, vehicles

found with a fuel inlet which allows insertion of a leaded fuel nozzle should be required to replace the catalytic converter. In addition, the vehicle's fuel inlet should be repaired to only allow the insertion of unleaded fuel nozzles.

Repair of the fuel inlet restrictor only is not considered a repair which will reduce the emissions of the vehicle. The damage to the emission control of the vehicle occurs in the catalyst. It is the catalyst which must be replaced to result in any substantial emission reduction. The inlet restrictor must be replaced simply as protection for the new catalyst.

MOBILE4.1 assumes that inspectors are not allowed to skip this inspection for such reasons as that the fuel inlet is concealed by a locked door.

### 2A.2.6 Tailpipe Lead Detection Test

Leaded fuel permanently reduces the ability of the catalytic converter to reduce engine emissions before they leave the tailpipe. Therefore, vehicles found to have used leaded fuel should be required to replace the catalytic converter. EPA has allowed for the use of a lead detection test in the vehicle tailpipe as a method to detect the use of leaded fuel. Since this is a chemical test, care must be taken to assure that the test is properly conducted and that the results are properly interpreted.

Vehicles with evidence of lead deposits in the tailpipe have used leaded fuel. The damage to the emission control of the vehicle occurs in the catalyst. It is the catalyst which must be replaced to result in any substantial emission reduction. (The tailpipe should also be replaced simply to avoid failing the test at the next inspection.) ATPs which require failure of both the fuel inlet restrictor inspection and the tailpipe lead detection test before requiring replacement of the catalyst get credit for neither in MOBILE4.1, and should not indicate either inspection on the input records.

### 2A.2.7 EGR Inspection

The exhaust gas recirculation (EGR) system reduces oxides of nitrogen by routing some of the exhaust back into the intake manifold. The primary component of the system is the valve which controls the flow between the exhaust and intake manifolds, however, most systems are quite complex with various sensors and valves which control the operation of the system. Hoses may be plugged, either deliberately or by neglect. Any system observed with missing or damaged components or misrouted or plugged hoses and wires should be failed and repaired.

### 2A.2.8 Evaporative Control System

The evaporative control system collects gasoline vapors from the gas tank and carburetor bowl and stores them in a charcoal canister. During certain engine operations, the canister purges, releasing the vapors which are routed to the engine to be burned. In addition to the evaporative canister itself, the system includes varying numbers of hoses, wires and control valves. Hoses may be plugged, either deliberately or by neglect. Any system observed with missing or damaged components or misrouted or plugged hoses and wires should be failed and repaired. This inspection flag is not used to indicate any functional purge or pressure testing of the evaporative emission control system. Emission reductions resulting from such testing must be calculated separately.

### 2A.2.9 PCV Inspection

The positive crankcase ventilation (PCV) system routes the vapors from the crankcase to the intake manifold where they can be burned by the engine. The PCV system has two major loops. The most critical connects the crankcase with the throttle or the intake manifold with a hose and usually contains a valve. Another hose connects the crankcase with the air cleaner to provide the crankcase with filtered fresh air. Any system observed with damaged or missing components or with hoses misrouted or plugged, should be failed and repaired.

### 2A.2.10 Gas Cap Inspection

Gas caps are actually part of the evaporative control system. Without a properly operating gas cap, fuel vapors from the gas tank would escape. On some vehicles, a missing gas cap will also cause the evaporative system canister to purge incorrectly. Inspectors should examine the fuel inlet area of each vehicle to determine that the gas cap is present. If not, the vehicle should be failed and the gas cap replaced. Inspectors should not be allowed to skip this inspection for such reasons as that the fuel inlet is concealed by a locked door.

# Chapter 3

# MOBILE4.1 OUTPUT

## 3.0 INTRODUCTION

MOBILE4.1 produces three types of output: prompting messages, diagnostic messages, and formatted reports.

Prompting messages are provided by MOBILE4.1 on tape (mainframe version) if the user sets PROMPT = 2 or 4 (section 2.1.1). These messages prompt the user to provide MOBILE4.1 input data in the proper sequence. There are two prompting formats: vertical input (PROMPT = 2) and horizontal input (PROMPT = 4). Otherwise the prompting messages are identical in both cases. Prompting messages are discussed in section 3.1.

Diagnostic messages are used to caution the user concerning user-supplied data. Three types of diagnostics exist: errors, warnings, and comments. An error will in all cases terminate processing of the current scenario, and in some cases will terminate processing of the entire run. Warnings and comments are included to assist users in the interpretation of the results if MOBILE4.1. Diagnostic messages are discussed in section 3.2.

Five types of formatted reports can be produced by MOBILE4.1. These reports include the information necessary to identify the scenario being studied and the calculated emission factors by vehicle type. The type of formatted report produced is controlled by the value assigned to the OUTFMT flag in the Control section (section 2.1.15). The structure of the formatted report formats are discussed in section 3.3, and each is illustrated in Chapter 5 (MOBILE4.1 Examples).

## 3.1 PROMPTING MESSAGES

If PROMPT = 2 or 4, the user is prompted for input data in the order required by MOBILE4.1. Prompting messages are written to logical I/O unit 6, unless the user reassigns the prompting message unit through the IOUNEW flag (section 2.1.2). MOBILE4.1 does not prompt for the first record (PROMPT flag and IOUNEW unit reassignment record), since the value of the PROMPT flag determines whether or not prompting will occur.

The prompt for each record is described below. The prompting messages are printed in **boldface** in this section. See the referenced sections of Chapter 2 for detailed discussion of the prompted values.

### 3.1.1 Control Section Prompts

#### 3.1.1.1 Title Record Prompt

The title record for the MOBILE4.1 run is prompted for by this message:

**Enter project id:**

#### 3.1.1.2 16 Remaining Flag Prompts

If PROMPT = 2 (vertical format), the 16 remaining Control section flags are prompted for individually, as follows:

**Enter TAMFLG:**
**Enter SPDFLG:**
**Enter VMFLAG:**
**Enter MYMRFG:**
**Enter NEWFLG:**
**Enter IMFLAG:**
**Enter ALHFLG:**
**Enter ATPFLG:**
**Enter RLFLAG:**
**Enter LOCFLG:**
**Enter TEMFLG:**
**Enter OUTFMT:**
**Enter PRTFLG:**
**Enter IDLFLG:**
**Enter NMHFLG:**
**Enter HCFLAG:**

If PROMPT = 4 (horizontal format), the 16 remaining Control section flags are prompted for on one record, with this message:

**Enter TAMFLG, SPDFLG, VMFLAG, MYMRFG, NEWFLG, IMFLAG, ALHFLG, ATPFLG, RLFLAG, LOCFLG, TEMFLG, OUTFMT, PRTFLG, IDLFLG, NMHFLG, & HCFLAG**

### 3.1.2 One-time Data Prompts

Prompts for One-time Data section inputs have been revised to correspond to MOBILE4.1 input requirements. All of the possible prompts for data in the One-time Data section are presented below.

#### 3.1.2.1 Tampering Rate Prompts

If TAMFLG=2, the replacement zero-mile tampering rates (ZMLTAM) and increases in tampering with accumulated mileage, or

tampering rate deterioration rates (DRTAM) are asked for by one of two possible pairs of prompts, depending on whether an inspection and maintenance (I/M) program is to be assumed (see section 2.1.9). The input requirements are discussed in section 2.2.1. If IMFLAG = 1, then these prompting messages are used:

**Enter tampering intercepts (zero-mile levels) for non-I/M case only:**

**Enter tampering slopes (deterioration rates) for non-I/M case only:**

If IMFLAG = 2, then these prompting messages are used:

**Enter tampering intercepts (zero-mile levels) for non-I/M and I/M cases:**

**Enter tampering slopes (deterioration rates) for non-I/M and I/M cases:**

#### 3.1.2.2 VMT Mix Record Prompt

If VMFLAG = 3, the user must supply one alternate vehicle miles travelled (VMT) mix record, which will be applied to all scenarios of the MOBILE4 run. The input required is discussed in section 2.2.2. This record is prompted for by the message:

**Enter VMT split:**

#### 3.1.2.3 Annual Mileage Accumulation Rates and/or Registration Distributions by Age Prompts

If MYMRFG = 2, the user must supply annual mileage accumulation rates by age for each of eight vehicle types. If MYMRFG = 3, the user must supply registration distributions by age for each of eight vehicle types. If MYMRFG = 4, the user must supply both, with the annual mileage accumulation rates preceding the registration distributions. The input requirements are discussed in section 2.2.3. These records are prompted for with the following messages (first block applicable to annual mileage accumulations, second block to registration distributions):

**Enter MYM ages 1-10 for LDGVS:**
**Enter MYM ages 11-20 for LDGVS:**
**Enter MYM ages 21-25 for LDGVS:**
**Enter MYM ages 1-10 for LDGT1s:**
**Enter MYM ages 11-20 for LDGT1s:**
**Enter MYM ages 21-25 for LDGT1s:**

```
Enter MYM ages  1-10 for LDGT2s:
Enter MYM ages 11-20 for LDGT2s:
Enter MYM ages 21-25 for LDGT2s:
Enter MYM ages  1-10 for HDGVs:
Enter MYM ages 11-20 for HDGVs:
Enter MYM ages 21-25 for HDGVs:
Enter MYM ages  1-10 for LDDVs:
Enter MYM ages 11-20 for LDDVs:
Enter MYM ages 21-25 for LDDVs:
Enter MYM ages  1-10 for LDDTs:
Enter MYM ages 11-20 for LDDTs:
Enter MYM ages 21-25 for LDDTs:
Enter MYM ages  1-10 for HDDVs:
Enter MYM ages 11-20 for HDDVs:
Enter MYM ages 21-25 for HDDVs:
Enter MYM ages  1-10 for MCs:
Enter MYM ages 11-20 for MCs:
Enter MYM ages 21-25 for MCs:

Enter MYR ages  1-10 for LDGVS:
Enter MYR ages 11-20 for LDGVS:
Enter MYR ages 21-25 for LDGVS:
Enter MYR ages  1-10 for LDGT1s:
Enter MYR ages 11-20 for LDGT1s:
Enter MYR ages 21-25 for LDGT1s:
Enter MYR ages  1-10 for LDGT2s:
Enter MYR ages 11-20 for LDGT2s:
Enter MYR ages 21-25 for LDGT2s:
Enter MYR ages  1-10 for HDGVs:
Enter MYR ages 11-20 for HDGVs:
Enter MYR ages 21-25 for HDGVs:
Enter MYR ages  1-10 for LDDVs:
Enter MYR ages 11-20 for LDDVs:
Enter MYR ages 21-25 for LDDVs:
Enter MYR ages  1-10 for LDDTs:
Enter MYR ages 11-20 for LDDTs:
Enter MYR ages 21-25 for LDDTs:
Enter MYR ages  1-10 for HDDVs:
Enter MYR ages 11-20 for HDDVs:
Enter MYR ages 21-25 for HDDVs:
Enter MYR ages  1-10 for MCs:
Enter MYR ages 11-20 for MCs:
Enter MYR ages 21-25 for MCs:
```

#### 3.1.2.4 Alternate BER Prompts

If NEWFLG = 2, the user must supply one or more alternate basic emission rate (BER) records. The input requirements are discussed in section 2.2.4, and are summarized in Table 2.2-1. These records are prompted for with the messages:

**Enter no. of new e.f. intercept/slope pairs:**

**Enter region, veh. type, pollutant, first my, last my, intercept, slope, & above 50K miles slope:**

The second message is repeated as many times as required, based on the number entered in response to the first prompt.

3.1.2.5 I/M Program Parameter Record Prompt

If IMFLAG = 2, the user must supply a record specifying the characteristics of the inspection and maintenance (I/M) program to be modeled. The input requirements are discussed in section 2.2.5 and are summarized in Table 2.2-2. The I/M parameters are prompted for by this message:

**Enter the I/M Program parameter record:**

**Program start year, stringency, first and last model year getting benefits, old tech waiver rate, new tech-waiver rate, compliance rate, frequency of inspection, vehicle classes covered, test type, flag for alternate I/M credits, Tech I & II and Tech IV+, the format is: (4(I2,1X),2(F2.0,1X),F3.0,1X,I1,1X,I1,1X,4I1,1X,I1,1X,2I1)**

If the value of either or both of the flags for alternate I/M credits (the last two items of the I/M program record) is 2, the user must also supply alternate I/M credits to be read from logical I/O unit 4. MOBILE4.1 does not issue prompting messages for the I/M credit data from unit 4.

3.1.2.6 ATP Parameter Record Prompt

If ATPFLG = 2, the user must supply a record specifying the characteristics of the anti-tampering program (ATP) to be modeled. The input requirements are discussed in section 2.2.6 and are summarized in Table 2.2-3. The ATP parameters are prompted for by this message:

**Enter ATP start year, first & last years included, vehicle types covered, inspection type & frequency, compliance rate, and inspections conducted (format = 3(I2,1X),4I1,1X,F4.0,1X,8I1):**

The user does not supply ATP emission reduction credit matrices as input. MOBILE4.1 contains a subroutine that generates these credit matrices on the basis of the information supplied characterizing the ATP.

### 3.1.2.7 VRS Descriptive Record Prompt

If RLFLAG = 2, 3, or 4, the user must supply one or two records describing the refueling vapor recovery system (VRS) requirements to be modeled. The Stage II VRS record is required if RLFLAG = 2. The onboard VRS record is required if RLFLAG = 3. Both records are required if RLFLAG = 4, with the Stage II record preceding the onboard record. The input requirements are discussed in section 2.2.7 and are summarized in Table 2.2-4. The required record(s) are prompted for by one or both of these messages:

**Enter Stage II VRS parameters - start year, # phase-in years, LDG & HDG % efficiency (I2,1X,I1,1X,I3,1X,I3):**

**Enter onboard VRS first model year & vehicle classes (I2,1X,4I1):**

### 3.1.2.8 LAP Record Prompt

If LOCFLG = 2, the user must supply the local area parameter (LAP) record as part of the One-time data section, and it will be applied to all scenarios of the MOBILE4.1 run. Sections 2.2.8 - 2.2.13 discuss the input requirements, which are summarized in Table 2.2-5. The LAP record is prompted for by this message:

**Enter scenario name, min & max daily temps, period 1 and 2 RVP, period 2 start year, and OXYFLG:**

### 3.1.2.9 Oxygenated Fuels Record Prompt

If the user has set OXYFLG = 2 on the LAP record, then a record describing oxygenated fuels in the area being modeled must be supplied. Section 2.3.9 discusses the input requirements for this record. The oxygenated fuel record is prompted for by this message:

**Enter MTBE/ETBE market share, gasohol market share, MTBE/ETBE oxygen content, gasohol oxygen content, gasohol waiver flag:**

### 3.1.2.10 Trip Length Distribution Record

If the user has set SPDFLG = 3 or 4, then a trip length distribution record must be entered for use in calculating running loss emission factors. The input requirements for this record are discussed in section 2.3.11. The trip length distribution record is prompted for by this message:

**Enter trip length VMT fractions (6(1X,F4.1)):**

#### 3.1.2.11 By Model Year Inclusion Vector

If the user has set OUTFMT = 5, then a record describing which vehicle classes the optional by-model year emission factor tables are requested for and whether special information on I/M credits and tampering rates and offsets are requested. The input requirements for this record are discussed in section 2.2.16. The by model year inclusion vector is prompted for by this message:

**Enter vehicle types and I/M and tampering flags, format 8I1,2(1X,I1)**

### 3.1.3 Scenario Section Data Prompts

As discussed in section 2.3, the Scenario section consists of one to seven records, depending on the values assigned to flags in the Control section. The first record, called the scenario descriptive record, is mandatory. The second through seventh records are optional. All of the possible data prompting messages for the Scenario data section are presented below.

#### 3.1.3.1 Scenario Descriptive Record Prompt

The scenario descriptive record specifies the region, calendar year of evaluation, average speed(s), ambient temperature, and operating mode fractions to be assumed for the current scenario. The input requirements are discussed in sections 2.3.1 - 2.3.5, and are summarized in Table 2.3-1.

If SPDFLG = 1, a single average speed is used for all vehicle types, and the record is prompted for by this message:

**Enter region, CY, SPD(1), AMBT, PCCN, PCHC, PCCC:**

If SPDFLG = 2, eight average speeds must be input, one for each of the eight modeled vehicle types. The record is prompted for with this message:

**Enter region, CY, SPD(8), AMBT, PCCN, PCHC, PCCC:**

#### 3.1.3.2 LAP Record Prompt

If LOCFLG = 1, a distinct local area parameter record must be supplied by the user for each scenario of the run. The input requirements are discussed in sections 2.2.8 - 2.2.13, and are summarized in Table 2.2-5. The LAP record for the current scenario is prompted for by this message:

**Enter scenario name, min & max daily temps, period 1 and 2 RVP, period 2 start year, and OXYFLG:**

### 3.1.3.3 Oxygenated Fuels Record Prompt

If the user has set OXYFLG = 2 on the LAP record, then a record describing oxygenated fuels in the area being modeled must be supplied. Section 2.3.9 discusses the input requirements for this record. The oxygenated fuel record is prompted for by this message:

**Enter MTBE/ETBE market share, gasohol market share, MTBE/ETBE oxygen content, gasohol oxygen content, gasohol waiver flag:**

### 3.1.3.4 Diesel Sales Fraction Prompt

If the user has set DSFLAG = 2 on the LAP record, then the sales fractions of LDVs and LDTs that were diesel for the 25 model years ending in the calendar year of evaluation must be supplied. The input requirements are discussed in section 2.3.10. This message is new in MOBILE4.1. The diesel sales fractions are prompted for by this message:

**Enter diesel sales fractions (LDV/LDT pairs):**

### 3.1.3.5 VMT Mix Record Prompt

If VMFLAG = 2, a distinct VMT mix record must be supplied by the user for each scenario of the run. The input requirements are discussed in section 2.2.2. The VMT mix for the current scenario is prompted for by this message:

**Enter VMT split:**

### 3.1.3.6 Trip Length Distribution Prompt

If the user has set SPDFLG = 3 or 4, then a trip length distribution record must be entered for use in calculating running loss emission factors. The input requirements for this record are discussed in section 2.3.11. The trip length distribution record is prompted for by this message:

**Enter trip length VMT fractions (6(1X,F4.1)):**

### 3.1.3.7 Additional Light-Duty Correction Factor Record Prompt

If ALHFLG = 2 or 3, the user must supply a record used to develop and apply up to four additional correction factors to the light-duty gasoline-fueled vehicle and truck emission factors.

The input requirements are discussed in section 2.3.8 and are summarized in Table 2.3-1.

If ALHFLG = 2, six input values are required, and are prompted for with this message:

**Enter AC, XLOAD(3), TRAILR(1), ABSHUM:**

If ALHFLG = 3, ten input values are required, and are prompted for with this message:

**Enter AC, XLOAD(3), TRAILR(3), ABSHUM, DB, WB:**

## 3.2 DIAGNOSTIC MESSAGES

### 3.2.1 Introduction

This section describes the MOBILE4.1 diagnostic messages. MOBILE4.1 issues three types of diagnostic messages: error messages, warning messages, and comments.

Error messages indicate either that invalid input data were entered into MOBILE4.1, or MOBILE4.1 attempted to perform invalid operations. All error messages are prefixed by ***** Error:**. If a number follows ***** Error:**, it is the value read by MOBILE4.1 for the variable in error (the variable name is also printed). If the error message is due to an input value that is out of bounds, the range of acceptable values is also printed. An error will stop a MOBILE4.1 run.

The following errors are considered to be "fatal" errors. If any of these errors occur, no further processing of the MOBILE4.1 input data will be performed:

M28, M53, M60, M61, M82, M89, M97, M107, M110, M121.

Warning messages indicate that MOBILE4.1 input data caused an operation not necessarily intended by the user, although the situation is not serious enough to be labeled an error. Nonetheless, users should examine the warning messages to ascertain the conditions that were modeled. Comments are a type of warning message that are printed for the user's information. Neither warning nor a comment will stop a MOBILE4.1 run.

The following is a list of the individual error, warning, and comment messages. In order to make the listing more useful to the MOBILE4.1 user, all of the messages are listed by message number (M## at the beginning of each message). MOBILE4.1 prints the message number as part of all diagnostic messages, allowing the user to quickly look up the message and its explanation in this section. The diagnostic messages are all printed in **boldface** in this section.

### 3.2.2 Explanation of Messages, Listed by Number (M##)

**M 0 *** Error: Message code <nnn> is unknown**

This message should only be printed when the message printing subroutine QUITER is passed an undefined message code value. The run is aborted at this point. This message was M88 in MOBILE4.

**M 1 *** Error: <value of flag> out of bounds for flag <flag name>**

This message may be printed one or more times preceding message M53 and program termination. It will appear for each of the 16 input/output control flags which is in error. The number appearing after "***Error:" is the value of the flag read by the program. Each of these messages indicates the value falls outside of the valid bounds for that flag. This single error message replaces messages M1 through M16 from MOBILE4. Allowable flag values are listed in Tables 2.1-1 and 2.1-2. See Section 2.1.

**M 2 *** Error: <n.nnn> out of bounds for ETBE/MTBE market share (0. to 1.)**

This message is printed if the input value of the market fraction of ether/gasoline blends is not between zero and one. See section 2.3.9. This message is new in MOBILE4.1.

**M 3 *** Error: <n.nnn> out of bounds for Gasohol market share (0. to 1.)**

This message is printed if the input value of the market fraction of alcohol/gasoline blends is not between zero and one. See section 2.3.9. This message is new in MOBILE4.1.

**M 4 *** Error: <n.nnn> out of bounds for Total Oxy Fuel market share (0. to 1.)**

This message is printed if the sum of the input values of the market fractions of ether/gasoline and alcohol/gasoline blends is not between zero and one. See section 2.3.9. This message is new in MOBILE4.1.

**M 5 *** Error: <n.nnn> out of bounds for ETBE/MTBE Oxygen Content (0. to 0.027)**

This message is printed if the input value of the average oxygen content of ether/gasoline blends is not between 0. and 0.027 (2.7 percent). See section 2.3.9. This message is new in MOBILE4.1.

**M 6 *** Error: <n.nnn> out of bounds for Gasohol Oxygen Content (0. to 0.035)**

This message is printed if the input value of the average oxygen content of ether/gasoline blends is not between zero and 0.035 (3.5 percent). See section 2.3.9. This message is new in MOBILE4.1.

**M 7 *** Error: <n> out of bounds for Gasohol RVP Waiver Switch (1 or 2)**

This message is printed if the input value of the oxygenated fuel RVP waiver switch is not 1 or 2. See section 2.3.9. This message is new in MOBILE4.1.

**M 8 *** Error: Inconsistent ETBE/MTBE input encountered**

**M 9 *** Error: Inconsistent Gasohol input encountered**

These messages are printed if the input values on the oxygenated fuels record have internal inconsistencies present. See section 2.3.9. These messages are new in MOBILE4.1.

**M 10 *** Error: RLFLAG = <n> and PRTFLG not = 1 or 4, so RLFLAG input records skipped**

This message is printed if RLFLAG is set to 1, 2, 3, or 4 (meaning that vehicle refueling emission factors are to be calculated), but PRTFLG is set to 2 or 3 (calculate CO or NOx emission factors only). See sections 2.1.16 and 2.2.7.

**M 11 *** Error: <nnnn> out of bounds for number of records to skip (1 to 999)**

This message is printed when the user responds to the prompt "Enter of number of MOBILE4.1 calls:" with a value not in the range 1 to 999. See Chapter 4 on the PC versions of MOBILE4.1.

**M12 *** Error: <n> out of bounds for number of cold CO standards (1 to 2)**

**M 13 *** Error: <yyyy> out of bounds for cold CO standard start MY (1980-2020)**

**M 14 *** Error: <nnnn> out of bounds for cold CO standard #n (2.0-15.0)**

**M 15 *** Error: Cold CO standard #1 must start before #2**

**M 16 *** Error: <nn.nnn> out of bounds for % IV under CCO std #n (0.0-100.0)**

Messages 12 - 16 are printed when the user models cold temperature CO emission standards and includes values that are outside of the allowable ranges. This feature is for EPA internal use and is not accessible through release MOBILE4.1.

**M 17 *** Error: <value of VMTMIX(IV)> out of bounds for VMTMIX (0. to 1.)**

This message is printed if a value of VMTMIX(IV) (vehicle miles travelled fraction for vehicle type IV) is not between 0. and 1. See Section 2.2.2.

**M 18 *** Error: <value of VMTMIX> sum of VMTMIX is not equal to 1.**

This message is printed if the sum of VMTMIX(IV) over all vehicle types is not equal to 1. Since each VMTMIX(IV) represents the fraction of total miles that vehicle type IV contributes to the total vehicle miles traveled by the fleet, the sum of these fractions should equal 1. See Section 2.2.2.

**M 19 *** Error: <value of AMAR(JDX,IV)> negative model year mileage**

This message is printed if the user supplied mileage accrual data (annual mileage accumulation rate) for model year JDX and vehicle type IV is negative. All annual mileage accumulation rates must be $\geq$ 0.0. See Section 2.2.3.

**M 20 *** Error: <value of JULMYR(JDX,IV)> negative model year registration**

This message is printed if the model year registration fraction is negative. Since this number represents the fraction of all vehicles in the fleet of a given age, it must be between 0 and 1 inclusive. See Section 2.2.3.

**M 21 Warning: <value of JULMYR> registration with zero mileage**

**M 22 Warning: <value of AMAR> mileage with zero registration**

One of these messages is printed if, for a given vehicle age, vehicles either do not accumulate mileage yet make up a fraction of the fleet (M21), or do not make up a fraction of the fleet, but accumulate mileage (M22). All vehicle type/model year combinations assumed to exist in the fleet must accumulate some mileage annually. For a given vehicle type and vehicle age, if either the mileage accumulation rate or the registration fraction is zero, both should be zero. See Section 2.2.3.

**M 23 *** Error: <value of NEWCT> out of bounds for e.f. changes (1 to 100 pairs)**

This message is printed if the number of emission rate modifications is not between 1 and 100. MOBILE4.1 is limited to handling a maximum of 100 modifications. See Section 2.2.4.

**M 24 *** Error: <region code> out of bounds for region (1 or 2)**

This message is printed if the region chosen in the scenario record is not equal to 1 (low altitude) or 2 (high altitude). See Section 2.3.1.

**M 25 *** Error: <vehicle type code> out of bounds for vehicle type (1 to 8)**

This message is printed if the vehicle type in the emission rate modification section is not equal to 1, 2, 3, 4, 5, 6, 7, or 8. The eight vehicle types in MOBILE4 and their corresponding codes are:

1 = light-duty gasoline-fueled vehicles (LDGV)
2 = light-duty gasoline-fueled trucks I (0-6000 lb GVW) (LDGT1)
3 = light-duty gasoline-fueled trucks II (6001-8500 lb GVW) (LDGT2)
4 = heavy-duty gasoline-fueled vehicles (8501+ lb GVW) (HDGV)
5 = light-duty diesel-powered vehicles (LDDV)
6 = light-duty diesel-powered trucks (0-8500 lb GVW) (LDDT)
7 = heavy-duty diesel-powered vehicles (8501+ lb GVW) (HDDV)
8 = motorcycles (MC)

See Table 2.2-1 and section 2.2.4.

**M 26 *** Error: <pollutant code> out of bounds for pollutant (1 to 3)**

This message is printed if the code for pollutant on the emission rate modification input section is not equal to 1, 2, or 3. MOBILE4 calculates emission factors only for 1 = hydrocarbons, 2 = for carbon monoxide, and 3 = oxides of nitrogen. See Table 2.2-1 and section 2.2.4.

**M 27 *** Error: <value of MYFRST or MYLAST> out of bounds for year (1941 to 2020)**

This message is printed if the code corresponding to the first or last model year to have altered emission rates is not between 41 and 99 or 00 and 20 (corresponding to years 1941-1999 and 2000-2020). See Table 2.2-1 and section 2.2.4.

**M 28 *** Error: Excess data errors prevent further analysis**

This message is printed if the accumulated number of data input errors exceeds 50. The run is stopped at this point. All input data should be thoroughly checked and must be corrected before rerunning MOBILE4.1.

**M 29 *** Error: Last year cannot be less than first year**

This message is printed if the first model year to have its emission rates altered is less than (before) the last model year to be altered. See Table 2.2-1 and section 2.2.4.

**M 30 *** Error: <value of ZMLNEW> intercept must be positive**

This message is printed if a new zero-mile emission level is $\leq 0$. See Table 2.2-1 and section 2.2.4.

**M 31 Warning: <value of DRNEW> negative slope for ageing vehicle**

This message is printed if the value for the exhaust deterioration rate is negative. A negative deterioration rate implies improving emissions with increasing mileage accumulation. See Table 2.2-2 and section 2.2.4.

**M 32 *** Error: <value of ICYIM> out of bounds for year (1960 to 2020)**

This message is printed if the code indicating the year in which an I/M program is to begin does not fall between 60 and 99, or 00 and 20 (years 1960 to 2020). See Section 2.2.3, I/M program description, field 1.

**M 33 *** Error: <value of ISTRIN> out of bounds for stringency (10 to 50)**

This message is printed if the stringency of the I/M program for 1980 and earlier LDVs or 1984 and earlier LDTs is not between 10 and 50 (percent). See Table 2.2-2 and sections 2.2.5 and 2A.1.3.

**M 34 *** Error: <value of CRIM> out of bounds for I/M Program compliance rate (0 to 100%)**

This message is printed if the specified value for compliance rate of an I/M program is not between 0 and 100 (percent) inclusive. See Table 2.2-2 and sections 2.2.5 and 2A.1.7.

**M 35 *** Error: <value of MODYR1> out of bounds for MODYR1 (1941 to 2020)**

This message is printed if the code representing the first model year under an I/M program is not between 41 and 99, or 00 and 20 (years 1941 and 2020). These years are the limits set by MOBILE4. See Table 2.2-2 and sections 2.2.5 and 2A.1.4.

**M 36 *** Error: <value of MODYR2> out of bounds for MODYR2 (1941 to 2020)**

This message is printed if the code representing the last model year under an I/M program is not between 41 and 99, or 00 and 20 (years 1941-1999 or 2000-2020). See Table 2.2-2 and sections 2.2.5 and 2A.1.4.

**M 37 *** Error: MODYR1 cannot be greater than MODYR2**

This message is printed if the first model year in an I/M program is greater than the last model year in an I/M program. See Table 2.2-2 and sections 2.2.5, 2A.1.4, and 2A.1.5.

**M 38 *** Error: <value of CY> out of bounds for year (1960 to 2020)**

This message is printed if the calendar year to be evaluated is not between 1960 and 2020 (60 to 99 or 00 to 20) inclusive. These are the only years for which MOBILE4 evaluates emission factors. See Table 2.3-1 and section 2.3.2.

**M 39 *** Error: <value of SPD(I)> speed must be positive**

This message is printed if the value for average speed (if SPDFLG = 1) or any of the eight values of average speed (if SPDFLG = 2) is $\leq$ 0.0. See section 2.3.3.

**M 40 *** Error: <value of AMBT> valid ambient temperature is 0-110 deg (F)**

This message is printed if the specified value for ambient temperature value is not between 0° and 110°F (-23° and 43°C). These are the limits for application of temperature correction factors. See section 2.3.4.

**M 41 *** Error: <value of PCCN> out of bounds for PCCN (0. to 100.)**

This message is printed if the input value for percentage of miles traveled by non-catalyst vehicles in cold-start mode is not between 0 and 100 (percent). See section 2.3.5.

**M 42 *** Error: <value of PCHC> out of bounds for PCCN (0. to 100.)**

This message is printed if the input value for percentage of miles traveled by catalyst-equipped vehicles in hot-start mode is not in between 0 and 100 (percent). See section 2.3.5.

**M 43 *** Error: <value of PCCC> out of bounds for PCCC (0. to 100.)**

This message is printed if the input value for percentage of miles traveled by catalyst-equipped vehicles in cold-start mode is not between 0 and 100 (percent). See section 2.3.5.

**M 44 *** Error: <value of AC> out of bounds for AC (0. to 1.)**

This message is printed if the specified value of the fraction of air-conditioner-equipped vehicles using air conditioning is not between 0. and 1. inclusive. See section 2.3.8.3.

**M 45 *** Error: <value of XLOAD(I)> out of bounds for extra load (0. to 1.)**

This message is printed if the specified value for the fraction of vehicles assumed to be carrying an extra 500 lb load is not between 0. and 1. inclusive. See section 2.3.8.4.

**M 46 *** Error: <value of TRAILR(I)> out of bounds for trailers (0. to 1.)**

This message is printed if the specified fraction of vehicles assumed to be towing a trailer is not between 0. and 1. inclusive. See section 2.3.8.5.

**M 47 *** Error: <value of ABSHUM> out of bounds for humidity (20. to 140.)**

This message is printed if the specified value for absolute humidity is not between 20 and 140 inclusive. See section 2.3.8.6.

**M 48 *** Error: There are no sales for vehicle <vehicle name>**

MOBILE4.1 assumes that no significant number of LDDVs exist before 1975. Similarily, no significant number of LDDTs are assumed to exist prior to 1978. This message is printed if the user inputs a positive VMT fraction for LDDVs or LDDTs for calendar years in which they are assumed to be virtually nonexistent.

**M 49 *** Warning: <value of CHKMYR> MYR sum not = 1. (will normalize)**

This message is printed if the sum of registration fractions by model year for a given vehicle type do not sum to 1. If the model year age registration fractions do not sum to 1, MOBILE4.1 normalizes the fractions so that they do. See Section 2.2.3.

**M 50 *** Error: <value of ZEROML> out of bounds for tampering rate intercept (up to 1.0)**

The zero-mileage level of tampering cannot exceed 100% of the fleet (1.0 as a fraction) for any combination of tampering type and vehicle type. See section 2.2.1.

**M 51 *** Error: equation <equation number> causes more than 12 allowed for any 1 reg/veh/pol**

This message is printed if the user attempts to enter more than 12 modified basic emission rate equations for any single combination of region, vehicle type, or pollutant. See section 2.2.4.

**M 52 Warning: <value of SPD> speed increased to 2.5 mph minimum**

This message is printed if the average speed (if SPDFLG = 1) or one or more of the eight average speeds (if SPDFLG = 2) is less than 2.5 mph. MOBILE4 increases the value to 2.5 mph and continues execution. See section 2.3.3.

**M 53 Comment: All flags must be corrected before rerunning**

This message is printed if one or more errors occur in reading the Control section flags. It should appear after a list indicating which flags are in error (see **M 1**). The run is aborted at this point. All flags in error must be corrected before the program will continue.

**M 54 *** Error: End-of-file return on read of unit IOUIMD (new FTP I/M credits). Run aborted.**

**M 55 *** Error: Error return on read of unit IOUIMD (new FTP I/M credits). Run aborted.**

These messages are printed if the user specifies alternate I/M credits are to be read in from logical I/O device unit IOUIMD, and the user either fails to supply the alternate credit data (M54) or the alternate credit data contain errors (M55). Either of these errors must be corrected before attempting to rerun the program.

**M 56 Comment: A/C correction factor will be calculated. Value of inputted AC usage parameter is ignored.**

This message is printed if ALHFLG = 3 and a non-zero value for air conditioning usage fraction is entered. With ALHFLG = 3, the air conditioning usage fraction is calculated as a function of the input dry bulb and wet bulb temperatures. See sections 2.3.8.3 and 2.3.8.7.

**M 57 *** Error: WB temp cannot be greater than DB temp**

This message is printed if the input wet bulb temperature is greater than the input dry bulb temperature. The wet bulb temperature is always less than or equal to the corresponding dry bulb temperature. See section 2.3.8.7.

**M 58 Warning: Average miles/day is zero for vehicle class <IV> and model year <value of MY>**

This message is printed if BLOCK DATA Subprogram 14 has been incorrectly modified by the user.

**M 59 Warning: equation <equation number> zeroes all idle coefficients (and total) for IR = <region code>, IV = <vehicle code>, IP = <pollutant code>**

This message is printed when the user modifies the basic emission rate equations for the specified region, vehicle type, and pollutant. All alternative emission equations cause MOBILE4.1 to zero all idle emission equations corresponding to the region, vehicle type, and pollutant modified. See section 2.2.4.

**M 60 *** Error: <pointer value> exceeds ub of highest myg in <index function name>**

This message is printed to indicate that a default exit has been taken from an index function. This message is generated by an internal software error check, and should not occur unless the program code has been damaged. The run is halted at this point. The program must be corrected and recompiled before another run.

**M 61 *** Error: default used for <year> in index function <index function name>**

This message is printed to indicate that a default exit has been taken from an index function. This message is generated by an internal software error check, and should not occur unless the program code has been damaged. The run is aborted at this point. The program must be corrected and recompiled before another run.

**M 62 *** Error: <value of NEWREG> out of bounds for new e.f. region (1 or 2 only)**

This message is printed if the region to which a modified basic emission rate applies is specified to be other than 1 (low altitude) or 2 (high altitude). This specification of region is independent of the region specified in the Scenario descriptive record (see section 2.3.1). See Table 2.2-1 and section 2.2.4.

**M63 *** Error: <value of sum PCHC + PCCC - PCCN> out of bounds (0. ≤ PCHC + PCCC ≤ 100.)**

This message is printed if the sum of the cold-start and hot-start VMT percentages for catalyst-equipped vehicles is not between 0 and 100 percent inclusive. See section 2.3.5.

**M 64 *** Error: <value of sum PCHC + PCCC - PCCN> out of bounds (0. ≤ PCHC + PCCC - PCCN ≤ 100.)**

This message is printed if the sum of the cold-start and hot-start VMT percentages for catalyst-equipped vehicles less the cold-start VMT percentage for non-catalyst vehicles is not between 0 and 100 percent inclusive. See section 2.3.5.

**M 65 *** Error: MYR of LDDV not equal to LDGV for JDX = <value>**

**M 66 *** Error: MYR of LDDT not equal to LDGT1 for JDX = <value>**

One of both of these messages is printed if the user enters a different registration distribution by age for LDGVs than for LDDVs (M65) or for LDGT1s than for LDDTs (M66). The registration distribution by age for the total LDV (or LDT) fleet is to be input twice for the gasoline-fueled and diesel vehicles (or trucks). MOBILE4.1 apportions total registrations into the separate gasoline-fueled and diesel groups based on diesel sales fractions by model year. See section 2.2.3.4.

**M 67 *** Error: EFFTP = 0. and GSF = 0. for vehicle <vehicle name>**

This message will be printed if the named vehicle type has a positive basic emission rate and a zero fleet sales fraction. See section 2.2.3.

**M 68 *** Error: EFFTP ≤ 0. AND VMTMIX > 0. for vehicle <vehicle type>**

This message will be printed if no exhaust emission rates exist for the named vehicle type, but vehicles of that type have accumulated a nonzero fraction of the total vehicle fleet mileage.

**M 69 *** Error: EFIDLE < 0. for vehicle <vehicle type>**

This message is printed if the named vehicle type has a positive idle emission factor and a zero fleet sales fraction. See section 2.2.3.

**M 70 *** Error: EFIDLE ≤ 0. AND VMTMIX > 0. for vehicle <vehicle type>**

This message is printed if the named vehicle type has a positive idle emission rate and a zero fleet sales fraction. See section 2.2.3.

**M 71 Comment: Current output unit numbers are:**
**IOUREP = "formatted report unit"**
**IOUERR = "error/warning/comment unit"**
**IOUASK = "prompt message unit"**

This message is printed whenever any of the default output unit numbers are reassigned using the IOUNEW record in the Control section. See section 2.1.2.

**M 72 *** Error: <Value of ILDT(1)> out of bounds for short test type flag (1 to 3)**

This message is printed if the value of ILDT(I) is not 1 or 2 in the I/M program descriptive record. See Table 2.2-2.

**M 73 *** Error: <value of ITEST> out of bounds for short test type flag (1 to 3)**

This message is printed if the value of ITEST (Tech IV+ short test type) is not 1, 2 or 3. See Table 2.2-2.

**M 74 *** Error: <Value of NUDATA> out of bounds for I/M data flag (1 to 2)**

This message is printed if the value of the NUDATA flag (the flag from the I/M program descriptive record indicating whether or not new I/M credits are to be read from unit IOUIMD) is not 1 or 2. See Table 2.2-2.

**M 75 *** Error: <value of LAPSY> out of bounds for anti-tampering program start year**

This message is printed if the value of the start year for the selected anti-tampering program (ATP) is not in the range 1960 to 2020 (60-99, 00-20). See Table 2.2-3 and section 2A.1.2.

**M 76 *** Error: <value of LAP1ST> out of bounds for anti-tampering program 1st model year**

This message is printed if the value of the first model year included in the selected ATP is not in the range 1941 to 2020 (41-99, 00-20). See Table 2.2-3 and section 2A.1.4.

**M 77 *** Error: <value of LAPLST> out of bounds for anti-tampering program last model year**

This message is printed if the value of the first model year included in the selected ATP is not in the range 1941 to 2020 (41-99, 00-20). See Table 2.2-3 and section 2A.1.5.

**M 78 *** Error: <value of LVTFLG (IVTAM)> out of bounds for anti-tampering vehicle type (1 to 2)**

This message is printed if the value entered for the ATP vehicle class inclusion flag for vehicle type I is not either 1 (not covered) or 2 (covered). See Table 2.2-3.

**M 79 *** Error: <value of EVP> out of bounds for evap ATP effectiveness rate (0. to 1.)**

This message is printed if the value calculated for the evaporative ATP effectiveness rate in the ATP effectiveness rate matrices generated by MOBILE4 is not in the range 0.0 to 1.0. These rates act as percentage credits, and hence must be nonnegative and not exceed unity.

**M 80 *** Error: <value of RATE> out of bounds for exh ATP effectiveness rate (0. to 1.)**

This message is printed if the value calculated for the exhaust ATP effectiveness rate in the ATP effectiveness rate matrices generated by MOBILE4 is not in the range 0.0 to 1.0. These rates act as percentage credits, and hence must be nonnegative and not exceed unity.

**M 81 *** Error: <value of RATE> out of bounda for exh ATP effectiveness rate (0. to 1.)**

This message is printed if any column of each of the 4 exhaust ATP effectiveness rate matrices generated by MOBILE4 on the basis range 0.0 to 1.0. These rates act as percentage credits, and hence must be nonnegative and not exceed unity.

**M 82 *** Error: <value of INTYP> out of bounds for type of I/M inspection [1 (centralized) or 2 (computerized decentralized) or 3 (manual decentralized)]**

This message is printed if the value of the I/M program type specified in the I/M descriptive record is not 1, 2, or 3. The run is aborted at this point. See Table 2.2-2 and sections 2.2.5, 2A.1.12, 2A.1.13, and 2A.1.14.

**M 83 Comment: One or more evaporative temperatures (input daily maximum, input ambient, calculated hot soak, and/or calculated running loss) is 40F or less, or the input daily minimum is 25F or less; no evaporative emission factors (hot soak, diurnal, running loss, or resting loss) will be calculated**

This message is printed if (1) one or more temperatures calculated by MOBILE4.1 for correction of emissions (TEMFLG = 1), or (2) the input ambient temperature (TEMFLG = 2), is less than or equal to 40°F (4°C); or (3) the input daily minimum

temperature is less than or equal to 25°F (-4°C). See sections 2.1.13 and 2.2.11.5 for additional information. Crankcase emissions will still be calculated, resulting in a small non-zero evaporative emission factor representing crankcase emissions only.

**M 84 *** Error: <Value of IVOB(IV)> out of bounds for onboard VRS vehicle class flag (1 to 2)**

This message is printed if the value of the IVOB flag for vehicle type IV, indicating whether or not the vehicle type is subject to the requirements of an onboard VRS system, is not 1 or 2. See Table 2.2-4 and section 2.2.7.

**M 85** Message slot 85 is not assigned in MOBILE4.1

**M 86 *** Error: <value of NPHASE> out of bounds for no. of stage II phase-in years (1 to 5)**

This message is printed if the value of NPHASE in the Stage II VRS descriptive record is not between 1 and 5. See Table 2.2-4 and section 2.2.7.

**M 87 *** Error: <value of IS2SY or IOBMY or IUSESY> out of bounds for VRS or RVP controls start year**

This message is printed if any of the specified start years for Stage II VRS, onboard VRS, or "period 2" volatility (RVP) is not between 1989 and 2020 (89-99 and 00-20). See sections 2.2.7 and 2.2.13.

**M 88 *** Error: <n.nnn> out of bounds for diesel sales fraction (0. to 1.)**

This message is printed if the user has supplied diesel sales fractions by model year for LDVs and LDTs, and one or more of the fractions is not between zero and one. This message is new in MOBILE4.1. See section 2.3.10.

**M 89 *** Error: <value of PROMPT> out of bounds for flag PROMPT**

This message is printed if PROMPT does not equal 1, 2, 3, or 4. The run is stopped, and this correction must be made before the program will proceed. See section 2.1.1.

**M 90 Warning: <Value of RVP> RVP is reset to <new value>**

This message is printed if the input value for either "period 1" or "period 2" RVP, or the value of either of these after fuel weathering is accounted for, is outside the RVP limits of 7.0 to 15.2 psi inclusive; or, if the value of RVP to be used in the diurnal or hot soak evaporative emission factor calculation exceeds an upper limit for each that depends on the temperature to be used in that calculation. See Table 2.2-5 and sections 2.2.12 and 2.2.13. The value printed first is reset by MOBILE4.1 to <new value> before the emission factors are calculated.

**M 91 *** Error: <value of TEMMIN> out of bounds for minimum daily temperature**

**M 91 *** Error: <value of TEMMAX> out of bounds for maximum daily temperature**

One of these messages is printed if either the input minimum or maximum daily temperature is outside the limits set by MOBILE4.1 ($0 \leq$ minimum $\leq 100$, $10 \leq$ maximum $\leq 120$). See Table 2.2-5 and section 2.2.11.

**M 92 *** Error: Max daily temp = <value of TEMMAX> < min daily temp**

This message is printed if the minimum daily temperature is greater than the maximum daily temperature. See section 2.2.11.

**M 93 *** Error: <nnn.n> out of bounds for % TLVMT (0. to 1.)**

This message is printed if the user is supplying trip length distribution data to be used in calculating running loss emission factors, and one or more of the values is not between zero and one. This message is new in MOBILE4.1. See section 2.3.11.

**M 94 *** Error: <nnn.n> % TLVMT sum not = 100. (will normalize)**

This message is printed is the user is supplying trip length distribution data to be used in calculating running loss emission factors, and the sum of the six values is not 100 (percent). This message is new in MOBILE4.1. See section 2.3.11.

**M 95 *** Error: Ambient temperature = <value of AMBT> is < daily min temp or < daily max temp**

This message is printed if the ambient temperature (see section 2.3.4) is either less than the minimum daily temperature or greater than the maximum daily temperature (see section 2.2.11).

**M 96 Warning: <Value of SPD(i)> speed reduced to 65 mph maximum**

This message is printed if the average speed (SPDFLG = 1) or one or more of the eight average speeds (SPDFLG = 2) is greater than 65 mph. MOBILE4.1 reduces the value to 65 mph and continues execution. This is revised from MOBILE4, when the maximum speed was 55 mph. See section 2.3.3.

**M 97 *** Error: <Value of A> out of bounds for Wade Index calculation (CALUDI) of A, pass <value of JV>: must be $\geq$ 0.0.**

This message is printed if an unrealistic combination of very high fuel volatility (RVP) and temperature values are used in the calculation of diurnal evaporative emissions. The run is aborted at this point. Re-check all input RVP and temperature values. See sections 2.2.11 - 2.2.13.

**M 98 Warning: Diurnal temperature rise (max temp - min temp = <value>) is > 40F; diurnal evaporative emission factors will be calculated, but may be inaccurate.**

This message is printed if the difference in the input daily minimum and maximum temperatures is greater than 40°F (4°C). See section 2.2.11.5.

**M 99 *** Error: <Value of PCTEL> out of bounds for Stage II efficiency for LDGV (0 to 100%) or <Value of PCTEH> out of bounds for Stage II efficiency for HDGV (0 to 100%)**

This message is printed if the specified value for the efficiency of Stage II VRS at controlling refueling emissions from LDGVs and LDGTs, or from HDGVs, is not between 0 and 100 percent. See Table 2.2-4 and section 2.2.7.

**M 100 *** Error: <Value of WAIVER(1) or WAIVER(2)> out of bounds for I/M Program waiver rate 00 to 50%)**

This message is printed if the values specified for either waiver rate for I/M programs on the I/M program descriptive record is not between 0 and 50 percent inclusive. See Table 2.2-2 and sections 2.2.5 and 2A.1.6.

**M 101 *** Error: <Value of IFREQ> out of bounds for frequency of I/M inspection [1 (annual) or 2 (biennial)]**

This message is printed if the value of IFREQ specified on the I/M program descriptive record is not 1 or 2. See Table 2.2-2 and sections 2.2.5 and 2A.1.8.

**M 102 Warning: High altitude I/M scenario requires user to supply high altitude values for Tech 1&2 I/M credits arrays**

This message is printed if the user specifies high-altitude as the region for which emission factors are to be calculated and also specifies that an I/M program is to be assumed. The I/M credits contained in the MOBILE4 code are applicable only to low-altitude regions. The MOBILE4.1 tape and diskette include standard high-altitude region I/M credit matrices, which must be read in on logical I/O unit 3.

**M 103 *** Error: <Value of ATPPGM> out of bounds for type of ATP program [1 (centralized) or 2 (decentralized)]**

This message is printed if the value of the ATPPGM flag on the ATP descriptive record, indicating the type of ATP to be modeled, is not 1 or 2. See Table 2.2-3 and sections 2.2.6 and 2A.1.8.

**M 104 *** Error: <Value of ATPFQT> out of bounds for frequency of ATP inspection [1 (annual) or 2 (biennial)]**

This message is printed if the value of the ATPFQT flag on the ATP descriptive record, indicating the frequency of inspection in the ATP to be modeled, is not 1 or 2. See Table 2.2-3 and sections 2.2.6 and 2A.1.8.

**M 105 *** Error: <Value of CRATP> out of bounds for ATP compliance rate, must be in the range 0.% to 100.%, inclusive**

This message is printed if the specified ATP compliance rate is not between 0 and 100 percent inclusive. See Table 2.2-3 and sections 2.2.6 and 2A.1.7.

**M 106 *** Error: <Value of DISTYP(I)> out of bounds for ATP disablement inspections [1 (no) or 2 (yes)]**

This message is printed if the value of any of the eight DISTYP flags on the ATP decriptive record, indicating whether or not each of eight possible inspections is performed, is not 1 or 2.
See Table 2.2-3 and sections 2.2.6 and 2A.2.3 through 2A.2.10.

**M 107 *** Error: Error reading ATP program description in the ONE-TIME data section**

This message is printed if there is an error in reading the ATP descriptive record. The run is aborted at this point. Check the formats and all input values closely. See Table 2.2-3.

**M 108 Warning; The ATP compliance rate of <value of CRATP> is not equal to the I/M compliance rate of <value of CRIM>**

This message is printed if the specified ATP compliance rate is not equal to the specified I/M compliance rate. The program will continue execution, but since such programs are generally run in conjunction in a given area, the compliance rates generally should be equal for both programs. See sections 2.2.5.

**M 109 Warning: The ATP inspection frequency is <value of AT[FQT> and the I/M inspection frequency is <value of IFREQ>**

This message is printed if the ATP inspection frequency is not equal to the specified I/M inspection frequency. The program will continue execution, but since such programs are generally run in conjunction in a given area, the frequency of inspection generally should be the same for both programs. See sections 2.2.5, 2.2.6, and 2A.1.8.

**M 110 Warning: The ATP inspection type is <value of ATPPGM>, the I/M inspection type is <value of INTYP>**

This message is printed if the specified ATP program type (i.e., centralized or decentralized) is not the same as the specified I/M program type. The program will continue execution, but since such programs are generally run in conjunction in a given area, the program type generally should be the same for both programs. See sections 2.2.5, 2.2.6, 2A.1.12, and 2A.1.13.

**M 111 *** Error: <Value of exhaust correction temperature or not soak, running loss, or diurnal correction temperature> is < min daily temp or > max daily temp**

This message is printed if TEMFLG = 1 and one of the temperatures calculated for correction of exhaust, evaporative, running loss, or resting loss emissions is outside of the range of the specified minimum and maximum daily temperatures. Since these calculations use the input minimum and maximum daily temperatures to start with, this is an internal error check. If this message appears, and the minimum and maximum daily temperatures are correct and meet all of the necessary conditions, damage has occurred to either the source code or the compiled program. Recompile and attempt the run again.

**M 112 Warning: Purge/pressure entry (HCFLAG = 5) is for EPA in-house use only. There is no user application of this feature which would be acceptable for submission to EPA**

**M 113 Warning: MPD/TPD entry (HCFLAG = 6) is for EPA in-house use only. There is no user application of this feature which would be acceptable for submission to EPA**

**M 114 Warning: IPRGYR must be ≥ IM24YR in IM240 program**

**M 115 Warning: The alternate I/M credits necessary for determining the benefit of the IM240 test have not been provided**

**M 116 Warning: The I/M stringency input must be adjusted to account for the benefit of the IM240 test for model years prior to 1981**

Messages 112 through 116 are generated by inappropriate input data being used in conjunction with features of MOBILE4.1 intended for use by EPA only. These features are not fully implemented and users should not attempt to model emission factors using these features.

**M 117 *** Error: <n> out of bounds for by model year table pick (1 to 2)**

This message is printed if the values of the two flags at the end of the by model year inclusion vector are not 1 or 2. See section 2.2.16.

**M 118 *** Error: Input of diesel sales fractions not allowed in One-Time Data section**

This message is printed if the user sets DSFLAG = 2 on the LAP record and also sets LOCFLG = 2. See sections 2.2.15 and 2.3.10.

**M 119 Warning: Zero tampering is for EPA in-house use only. There is no user application of this feature that would be acceptable for submission to EPA**

This message is generated in conjunction with use of a feature of MOBILE4.1 intended for use by EPA only. Users should not attempt to model emission factors using this feature.

**M 120 Warning: MOBILE4.1 does not model most 1993 and later Clean Air Act requirements; emission factors for CY 1993 and later are affected**

This message is printed whenever MOBILE4.1 is used to calculate emission factors for calendar years 1993 or later.

**M 121 *** Error: ATP program including evaporative control system inspection MUST also include gas cap inspection**

This message is printed if an ATP is specified that includes evaporative emission control system inspection but does not include gas cap inspection. See section 2.2.6.4 and Table 2.2-3.

## 3.3 FORMATTED REPORT OUTPUT

There are five different types of formatted report output. The user specifies which of the five is to be generated through assignment of a value to the OUTFMT flag in the Control section (section 2.1.15). If OUTFMT = 1 or 2, MOBILE4.1 generates a formatted data set suitable for use as an input file for subsequent computer analysis ("numeric" output). If OUTFMT = 3 or 4, a report more suitable for visual inspection and analysis ("descriptive" format) is generated. These latter outputs are designed to provide a well-annotated record of the user's analysis. If OUTFMT = 5, the output produced by OUTFMT = 3 is produced, along with additional tables providing detailed by model year emission factor information.

### 3.3.1 221-Column Numeric Format (OUTFMT = 1)

If OUTFMT = 1, the longest numeric format report is generated. It consists of four heading records, which provide minimal column descriptions, followed by one to ten records per scenario evaluated. The number of records produced for each scenario is determined by the values assigned to the PRTFLG, IDLFLG, and HCFLAG flags in the Control section (see section 2.1).

Each record of this output format consists of 35 subject columns. (In the description that follows, the term "column" is used to refer to the subject columns, while the term "character" is used to refer to the number of individual, one-space columns spanned by the subject column.) Example 1 in Chapter 5 illustrates this output format. The subject columns and the value(s) shown in each are described below:

One other item to note with respect to the numeric output formatted report options is the "carriage control" characters used to control the placement of records. FORTRAN incorporates a character in column 1 of each output record which is used to indicate carriage control (such as "start new page," "double-space before printing next record," and similar instructions). If OUTFMT = 1 or 2 and the formatted report is directed to a line file, the first character space is reserved for this carriage control character. Thus, all of the columns that follow in each record are shifted one character space to the right:

| Format | Content |
|---|---|
| 1X | (carriage control character) |
| I1 | (Column 1: Region) |
| 1X,I2 | (Column 2: CY of evaluation), etc. |

The total record length is then 221 columns (OUTFMT = 1) or 140 columns (OUTFMT = 2).

If the numeric output formatted report is directed to a printer, such as was done in generating Examples 1 and 2 in section 5.1.1, the instructions provided by the carriage control characters are executed, but the characters are not printed and no space is reserved for them on the hard copy. Thus, the format of the printed version of OUTFMT = 1 or 2 reports does not begin with 1X (carriage control character), and the total length of each record is 220 columns (OUTFMT = 1) or 139 columns (OUTFMT = 2).

Column 1: Region. The column is one character wide (format I1). The column heading is "Reg" (printed vertically). The value shown is either 1 (low-altitude) or 2 (high-altitude). This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records.

Column 2: Calendar year of evaluation. The column is three characters wide (format 1X, I2). The column heading is "CY." The value shown is the last 2 digits of the calendar year of evaluation. Note that CY 2000-2009 will appear as 0, 1, ..., 9, not 00, 01, ..., 09. This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records. See section 2.3.2.

Columns 3-10: Vehicle Speeds. The column is 40 characters wide (format 8F5.1). The column heading is "Vehicle Speeds." The values shown are the average speeds used for each of the eight vehicle classes, in this order: LDGV, LDGT1, LDGT2, HDGV, LDDV, LDDT, HDDV, MC. If SPDFLG = 1, all eight speeds have the same value. In print, the values are separated by slashes (/). For example, if SPDFLG = 1 and speed = 19.6 mph, this line appears:

19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6

This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records.

Column 11: Ambient Temperature. The column is four characters wide (format 1X, I3). The column heading is "Amb Tem" on two lines. The value(s) that appear in this column depend on the value of TEMFLG: If TEMFLG = 1, the temperature(s) calculated by MOBILE4 based on the input minimum and maximum daily temperatures for the correction of exhaust HC, CO, AND NOx emission factors are printed on the applicable line. If

TEMFLG = 2, the input ambient temperature is echoed back on the exhaust emission factor records. This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records (exhaust, evaporative, refueling, running loss, and resting loss).

Columns 12-14: Operating Mode Fractions. The column is 18 characters wide (format 3F6.1). The column heading is "Cold/Hot Start." The values that appear are the input values for PCCN, PCHC, and PCCC, in that order. This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records.

Column 15: Altitude. The column is 7 characters wide (format F7.0). The column heading is "Alt. in Ft." on two lines. This feature is residual from earlier versions of the model. The value listed will be either 500 [if the input region is 1 (low- altitude)] or 5500 [if the input region is 2 (high-altitude)]. This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records.

Column 16: Pollutant. The column is two characters wide (format 1X,A1). The column heading is "Pol" printed vertically. The values and their corresponding identification of pollutants are:

| Value | Pollutant | Value | Pollutant |
|---|---|---|---|
| 1 | Total HC | X | Exhaust HC |
| 2 | Exhaust CO | V | Evaporative HC (includes crankcase) |
| 3 | Exhaust NOx | | |
| 4 | Idle HC | R | Refueling HC |
| 5 | Idle CO | T | Running loss HC |
| 6 | Idle NOx | S | Resting loss HC |

Columns 17-26: Composite Emission Factors. The next ten columns are each eight characters wide (format 10F8.3). The column headings are "Composite Emission Factors" centered over all 80 characters, with the individual columns headed in order by: "LDGV," "LDGT2," "LDGT," "HDGV," "LDDV," "LDDT," "HDDV," "MC," and "All Veh". These represent the emission factors for the pollutant identified in column 16, for the following vehicle classes in order: light-duty gasoline-fueled vehicles, light-duty gasoline- fueled trucks 1 (up to 6000 lb GVW), light-duty gasoline-fueled trucks 2 (6001-8500 lb GVW), all LDGTs together (weighted results for LDGT1s and LDGT2s), heavy-duty gasoline-fueled vehicles (over 8500 lb GVW), light-duty diesel vehicles, light-duty diesel trucks (up to 8500 lb GVW),

heavy-duty diesel vehicles (over 8500 lb GVW), motorcycles, and all vehicles combined (weighted by the VMT mix; see below). The emission factors are listed to 3 decimal places (0.001 g/mi) in this type of formatted report.

Columns 27-34: VMT Mix. The next eight columns are each six characters wide (format 8F6.3). The column headings are "Vehicle Mix" centered over all 48 columns, with the individual columns headed in order by: "LDGV," "LDGT1," "LDGT2," "HDGV," "LDDV," "LDDT," "HDDV," and "MC." The values are the VMT mix input by the user for the current scenario. This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records.

Column 35: Scenario Title. The column is 17 characters wide (format 1X,4A4). The heading is "Scenario Title." The value is the echo of the scenario title input as part of the Local Area Parameter record. See sections 2.2.8 and 2.2.9 and Table 2.2-5.

### 3.3.2 140-Column Numeric Format (OUTFMT = 2)

If OUTFMT = 2, a somewhat shorter numeric format report is generated. As in the case of the longer numeric format report, it consists of four heading records providing minimal column descriptions, followed by one to ten records per scenario evaluated. The number of records produced for each scenario is determined by the values assigned to the PRTFLG, IDLFLG, and HCFLAG flags in the Control section.

Each record of this output format consists of 25 subject columns. (In the description that follows, the term "column" is used to refer to the subject columns, while the term "character" is used to refer to the number of individual, one-space columns spanned by the subject column.) Example 2 in Chapter 5 illustrates this output format. Note that this output will be truncated after a maximum of 132 columns if printed in landscape format on standard 8.5x11 inch paper unless wrapped around. See the discussion of carriage control characters provided in section 3.1.1, which is also applicable in this case. The subject columns and the value(s) shown in each are described below:

Column 1: Region. The column is one character wide (format I1). The column heading is "Reg" (printed vertically). The value shown is either 1 (low-altitude) or 2 (high-altitude). This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records.

Column 2: Calendar year of evaluation. The column is three characters wide (format 1X,I2). The column heading is "CY." The value shown is the last 2 digits of the calendar year of evaluation. Note that CY 2000-2009 appear as 0, 1, ..., 9, not 00, 01, ..., 09. This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records (exhaust, evaporative, refueling, running loss, and resting loss).

Column 3: Ambient Temperature. The column is five characters wide (format 1X,I3). The column heading is "Amb Tem" on two lines. The value(s) that appear in this column depend on the value of TEMFLG: If TEMFLG = 1, the temperature(s) calculated by MOBILE4 based on the input minimum and maximum daily temperatures for the correction of exhaust HC, CO, and NOx emission factors are printed on the applicable lines. If TEMFLG = 2, the input ambient temperature is echoed back on the exhaust emission factor records. This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records.

Column 4-6: Operating Mode Fractions. The column is 18 characters wide (format 3F6.1). The column heading is "Cold/Hot Start." The values that appear are the input values for PCCN, PCHC, and PCC, in that order. This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records.

Column 7: Pollutant. The column is two characters wide (format 1X,A1). The column heading is "Pol" printed vertically. The values and their corresponding identification of pollutants are:

| Value | Pollutant | Value | Pollutant |
|---|---|---|---|
| 1 | Total HC | X | Exhaust HC |
| 2 | Exhaust CO | V | Evaporative HC (includes crankcase) |
| 3 | Exhaust $NO_x$ | | |
| 4 | Idle HC | R | Refueling HC |
| 5 | Idle CO | T | Running loss HC |
| 6 | Idle NOx | S | Resting loss HC |

Columns 8-17: Composite Emission Factors. The next ten columns are each eight characters wide (format 10F8.3). The column headings are "Composite Emission Factors" centered over all 80 characters, with the individual columns headed in order by: "LDGV:, "LDGT1", "LDGT2", "LDGT", "HDGV", "LDDV", "LDDT", "HDDV", "MC", and "All Veh." These represent the emission factors for the pollutant identified in column 7, for the following vehicle classes in order: light-duty gasoline-fueled vehicles, light-duty

gasoline-fueled trucks 1 (up to 6000 lb GVW), light-duty gasoline-fueled trucks 2 (6001-8500 lb GVW), all LDGTs together (weighted results for LDGT1s and LDGT2s), heavy-duty gasoline-fueled vehicles (over 8500 lb GVW), light-duty diesel vehicles, light-duty diesel trucks (up to 8500 lb GVW), heavy-duty diesel vehicles (over 8500 lb GVW), motorcycles, and all vehicles combined (weighted by the VMT mix; see columns 18-25 below). The emission factors are listed to two decimal places (0.01 g/mi) in this type of formatted report.

Columns 18-25: VMT Mix. The next eight columns are each six characters wide (format 8F6.3). The column headings are "Vehicle Mix" centered over all 48 columns, with the individual columns "LDGV," "LDGT1," "LDGT2," "HDGV," "LDDV," "LDDT," "HDDV," and "MC." The values are the VMT mix input by the user for the current scenario. This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records.

### 3.3.3 112-Column Descriptive Format (OUTFMT = 3)

If OUTFMT = 3, a well-annotated descriptive format output is produced. This format is designated for ease of visual inspection, with more complete labeling and heading information. The 112 column width allows this format to be printed in landscape format (sideways) on standard 8.5x11 paper.

The exact content of the report is determined by a number of flag settings. Information applicable to the entire run (all scenarios) is listed first, followed by a series of blocks, one per scenario evaluated. The scenario output blocks are separated by solid lines.

Each possible component of this output format is briefly described below. Example 3 in Chapter 5 is an illustration of this type of output.

The first line of the report is the project title input by the user (section 2.1.1). This is followed by a blank line, then by the following optional information if applicable:

If the output units have not been reassigned (section 2.1.2), then any diagnostic messages generated will follow the project title.

If an I/M program is to be modeled (IMFLAG = 2), a block echoing the descriptive information on the I/M program will be printed. This block consists of 16 lines. For example:

I/M program selected:

| | |
|---|---|
| Start year (January 1): | 1981 |
| Pre-1981 MYR stringency rate: | 20% |
| First model year covered: | 1965 |
| Last model year covered: | 2020 |
| Waiver rate (pre-1981); | 10.% |
| Waiver rate (1981 and newer): | 10.% |
| Compliance rate: | 80.% |
| Inspection type: | Centralized |
| Inspection frequency: | Annual |
| Vehicle types covered: | LDGV - Yes |
| | LDGT1 - Yes |
| | LDGT2 - Yes |
| | HDGV - No |
| 1981 & later MYR test type: | Idle |

If the user has supplied alternate I/M credits, then a message indicating this can be printed following this block. This message must be provided in the alternate I/M credit file to be read from logical I/O unit 4.

If the user has selected modeling of the effects of an anti-tampering program (ATP), the program description is echoed. This block consists of 19 lines. For example:

Anti-tampering program selected:

| | |
|---|---|
| Start year (January 1): | 1981 |
| First model year covered: | 1970 |
| Last model year covered: | 2020 |
| Vehicle types covered: | LDGV |
| Type: | Centralized |
| Frequency: | Annual |
| Compliance Rate:90.0% | |
| Air pump system disablements: | Yes |
| Catalyst removals:Yes | |
| Fuel inlet restrictor disablements: | Yes |
| Tailpipe lead deposit test: | No |
| EGR disablements: | Yes |
| Evaporative system disablements: | Yes |
| PCV system disablements: | Yes |
| Missing gas caps: | No |

If both I/M and anti-tampering programs are selected, the I/M block precedes the ATP block in the output.

If alternate basic emission rates are modeled (NEWFLG =2), message M59 (see section 3.2.2) will be printed, followed by a table summarizing the changes made to the BERs. For example:

Emission Factor Modification Profile

| Equation | Req | Veh | Pol | First MY | Last MY | Base | DR | 50K DR | Altered |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 1 | 2 | 1980 | 1986 | 30.05 | 3.01 | 3.44 | Yes |

If one one local area parameter record is to be applied to all scenarios (LOCFLG = 2), this information is printed on the next two lines. The first line lists the scenario name and the minimum and maximum daily temperatures. The second line lists the period 1 RVP, the period 2 RVP, and period 2 start year. Each is clearly indicated with a label.

Finally, one of the following messages will be printed before the individual scenario results. If NMHFLG = 1: "Total HC emission factors include evaporative HC emission factors"; if NMHFLG =2: "Non-methane HC emission factors include evaporative HC emission factors"; if NMHFLG = 3: "Volatile organic compound emission factors include evaporative HC emission factors"; if NMHFLG = 4: "Total organic gasses emission factors include evaporative HC emission factors"; and if NMHFLG = 5: "Non-methane organic gasses emission factors include evaporative HC emission factors".

The above information is followed by a series of scenario output blocks, separated for each scenario by solid lines. Each of these blocks has the same format and structure.

After the line indicating the start of a scenario output block, the following one-line messages are printed if applicable to that scenario:

If TAMFLG = 2:

"User supplied tampering and misfueling rates"

If MYMRFG = 2:

"User supplied mileage accrual distributions"

If MYMRFG =3:

"User supplied vehicle registration distributions"

If MYMRFG = 4:

"User supplied mileage accrual distributions, vehicle registration distributions"

These messages are followed by two lines describing the scenario being modeled. The first line includes the calendar year of evaluation, whether or not an I/M program is modeled, the

ambient temperatures used to correct exhaust HC, CO, and NOx emissions, and the region (low- or high-altitude). The second line includes whether or not an ATP is modeled, the operating mode fractions, and the altitude (500 ft for low-altitude and 5500 ft for high-altitude). Each of these is clearly labeled. The three ambient temperatures apply in order to HC, CO, and NOx.

Two additional lines containing the local area parameter record information follow, if LOCFLG = 1 (separate local area parameter record for each scenario). The first line lists the scenario name and the minimum and maximum daily temperatures. The second line lists the period 1 RVP, the period 2 RVP, and the period 2 start year. Each is clearly indicated by a label.

The next line starts with "Veh. Type:" and continues across with ten column headings. In order, these are LDGV, LDGT1, LDGT2, LDGT, HDGV, LDDV, LDDT, HDDV, MC, and All Veh. The remaining lines in the output each consist of an identifier at left, with the values for that line, for each of the ten vehicle types or groups, following under the appropriate headings.

The next line is "Veh. Speeds" with values entered only in the eight columns for which vehicle average speed is used to correct the emission factors. The next line is "VMT Mix:" with VMT fractions by vehicle class entered in the appropriate columns. (No speed or VMT Mix values will appear under the combined LDGT1 and LDGT2 "LDGT" column or the "All Veh" column.)

The next line reads "Composite Emission Factors (Gm/Mile)." This line precedes a set of one to eight lines of emission factors, depending on the pollutants to be printed (PRTFLG) and whether component HC emission factors are to be printed (HCFLAG). If all eight lines appear, they are in the following order:

| Label | Content |
|---|---|
| Total HC: | Total or Non-methane HC emission factor (EF), including all components (whether or not they are listed individually) |
| Exhaust HC: | Exhaust HC component EF |
| Evaporative HC: | Evaporative HC component EF (includes crankcase emissions) |
| Refuel L HC: | Refueling loss HC component EF |
| Running L HC: | Running loss HC component EF |
| Rsting L HC: | Resting loss HC component EF |
| Exhaust CO: | Exhaust CO EF |
| Exhaust NOx: | Exhaust NOx EF |

Unless the idle emission factors have been requested, this completes the block for an individual scenario. If IDLFLG = 2, indicating that idle emission factors are to be printed, the following identifying line is printed: "Hot Stabilized Idle Emission Factors (Gm/Hr)". This is followed by one to three additional lines, depending on the pollutants to be listed. These lines are labeled "Idle HC:", "Idle CO:", and "Idle NOx:".

If the expanded evaporative output is selected, then the last block of output will contain the detailed evaporative HC emission factors by source, in units appropriate for each. This option is accessed by setting the HCFLAG in the Control Data section of the input to "3." The standard OUTFMT = 3 output discussed above is printed first, followed by the expanded evaporative emission factor output.

The identifying line "Evaporative Emissions by Component" is printed first, with the following additional information on the first two lines: Weathered RVP, Hot Soak Temp, Running Loss Temp, and units (Hot Soak: g/trip, Diurnals & Multiples: g, Refueling: g/gal, Running Loss: g/hr, Crankcase: g/mi). Six additional lines of emission factors are then printed, lined up under the column headings for vehicle type from the standard emission factor portion of the output. These are labeled in order: Hot Soak, Diurnal, Multiple, Refueling, Running Loss, and Crankcase. The use of these evaporative emission factors may be required for development of inventories that are spatially and temporally allocated, as required for input to many Airshed models.

### 3.3.4 80-Column Descriptive Format (OUTFMT = 4)

If OUTFMT = 4, a well-annotated descriptive format output similar to that described in section 3.3.3 is produced. This format is also designed for ease of visual inspection, with complete labeling and heading information. The 80-column width allows this format to be printed in portrait format (vertically) on standard 8.5 x 11 paper.

The exact content of the report is determined by a number of flag settings. Information applicable to the entire run (all scenarios) is listed first, followed by a series of blocks, one per scenario evaluated. The scenario output blocks are separated by solid lines. Example 4 in Chapter 5 is an illustration of this type of output.

This output follows the order of information presented in section 3.3.3 above, with additional lines and minor format changes required in some cases to accommodate all of the information in the narrower overall width. Refer to Example 4 in section 5.1.1 and the descriptions provided above.

### 3.3.5 By Model Year Output

The last form of formatted output report available through MOBILE4.1 is the by model year option. In this option, the 112-column descriptive output discussed in section 3.3.3 is produced, followed by additional tables providing information on the relative contributions of vehicles of each given model year in the calendar year fleet to the overall fleet emission factor for each vehicle type. The user can select which vehicle types the by model year tables are produced for through the values assigned to the by model year inclusion vector, discussed in section 2.2.16.

These tables (one table per vehicle type selected, per scenario) contain the following information:

First, the title of the MOBILE4.1 run (as entered by the user for "PROJID" in the Control section) and the Scenario title (as entered by the user on the Local Area Parameter record) are echoed back as identifiers. The next two lines give the vehicle type for which the table is applicable and the date of emission factor evaluation (January 1, CY, where CY is the calendar year of evaluation entered by the user). The rest of the table is 19 columns wide by 28 rows long, with the first two rows consisting of column headings and the last row containing sums for some of the column entries. The remaining 25 rows represent the 25 model years of vehicles, ending in the CY of evaluation, in reverse order (newest vehicles first).

The first three columns (L to R) are labeled "Model Year", "TF", and "Miles". Model Year is the model year to which the other values of the row apply. TF is the travel fraction. It combines the registration distribution by age and the annual mileage accumulation rates by age to determine the fraction of all vehicle miles travelled (VMT) by the given vehicle class accounted for by vehicles of that row's model year in the evaluated calendar year. The TFs serve as the weighting factors to combine the model year-specific emission factors into a specific vehicle type's fleetwide emission factor. Miles represents the average odometer mileage of vehicles of model year MY on January 1 of calendar year CY, based on the average annual mileage accumulation rates by age used in the model.

The next eight columns are all spanned by the heading "HC", followed by four columns each for "CO" and "NOx". The HC columns contain information on exhaust, evaporative, refueling, running loss, and resting loss emissions, while CO and NOx deal only with exhaust emissions. The columns common to all three pollutants have essentially the same descriptions.

"BEF4" contains the average exhaust emission factor (g/mi) for vehicles of model year MY on January 1 of calendar year CY. This emission factor already contains the following corrections to conditions specified by the user: temperature, fuel volatility (RVP), operating modes, and (if applicable) methane offset, inspection/maintenance program reduction, and open-loop technology. The column headed "Tamper" shows the tampering offset (emission factor increase due to tampering), also corrected for temperature, RVP, operating mode, and (if applicable) open-loop technology. The tampering offsets are only produced for vehicle types subject to tampering (LDGVs, LDGTs, and HDGVs).

The column headed "SALHCF" is the value of the combined correction factors for average speed and "optional" corrections (air conditioning use, extra loading, trailer towing, and NOx humidity correction). If none of the optional correction factors are used, then SALHCF is simply the speed correction factor.

For CO and NOx, the last column labeled "FER" is then the average contribution to the exhaust emission factor for vehicles of model year MY in calendar year CY. This is calculated as:

FER = (BEF4 + Tamper) * SALHCF * TF.

Thus the FERs can be summed to obtain the exhaust emission factor for that vehicle type as shown in the preceding portion of the output.

For HC, the remaining columns are model year-specific emission factors for the other components of HC emissions. The column "Evapor" represents the combined evaporative emission factor (hot soak, diurnals, multiple diurnals, and crankcase), including any offsets due to tampering. The column "Refuel," for gasoline vehicles only, is the model year-specific refueling emission factor, reflecting Stage II and/or onboard VRS control if applicable. "Runnin" and "Restin" are the running loss and resting loss model year-specific emission factors, respectively, for gasoline vehicles only. The FER for HC is then calculated as:

FER = ‹[(BEF4+Tamper)*SALHCF]+(Evapor+Refuel+Runnin+Restin)› * TF

Modelers who wish to use the by model year emission factors for some analyses and have additional questions not addressed above are encouraged to contact EPA for additional assistance.

# Chapter 4

# MOBILE4.1 IMPLEMENTATION

## 4.0 INTRODUCTION

This chapter contains information on the MOBILE4.1 program diskettes and tapes, and other information that may be useful to users interested in the computer resource requirements of MOBILE4.1, to users implementing MOBILE4.1 on their own computer systems, and to users who are considering making software changes. It also contains instructions on how to port the mainframe version of the code to personal computers (Macintosh, and IBM-style computers, such as PC-AT, PS-2, or clones).

## 4.1 MOBILE4.1 TAPE

The MOBILE4.1 tape released by EPA contains four files. The first file is the MOBILE4.1 source code in mixed-case lettering (upper and lower). The second file is exactly the same as the first file, except it is an uppercase-only lettering version. This second file has been provided in the event some systems have difficulty with lowercase characters. The mixed-case version is more easily read than the all-uppercase version.

The third file is a copy of the input files used to generate the User's Guide examples of Chapter 5, in uppercase. These examples can be used to verify that MOBILE4.1 is operating properly when installed on a new system.

The fourth file on the tape is set of standard parameter inspection and maintenance (I/M) program credits applicable to high-altitude areas. The I/M credits stored in the MOBILE4.1 code are applicable only to low-altitude areas. This file has the same structure as is used for the credits contained in the code, but for high-altitude areas. See section 2.2.5 and Appendix 2A.

Other characteristics of the MOBILE4.1 tape are presented in Table 4.1-1.

Table 4.1-1

MOBILE4.1 Tape Characteristics

| | | | |
|---|---|---|---|
| Density: | 1600 bpi | Character Set: | EBCDIC |
| Blocking: | 3500 | Total Length: | 504.11 feet |
| Record Length: | 140 | Unlabeled | |

| File Number | Description | Number of Records | Block Count | Tape Length (Feet) |
|---|---|---|---|---|
| 1 | MOBILE4.1 Source Code (Mixed-case letters) | 26,233 | 1050 | 248.62 |
| 2 | MOBILE4.1 Source Code (Uppercase) | 26,233 | 1050 | 248.62 |
| 3 | Input Files for User's Guide Examples | 240 | 10 | 2.64 |
| 4 | I/M Credit Matrices (for high-altitude areas) | 406 | 17 | 4.23 |

## 4.2 PROGRAM STORAGE REQUIREMENTS

The wide variety of computers and system configurations in use prohibits a precise statement of main storage requirements on each system. Nevertheless, the following should be representative of the requirements of MOBILE4.1 on most systems.

| | Kilobytes | 32-bit memory words |
|---|---|---|
| Source Code | 1108 | 283,648 |
| Object Code | 928 | 237,568 |

The standard convention of 1 kilobyte = 1024 bytes is used. The values were obtained from the implementation of MOBILE4.1 on the Michigan Terminal System at Wayne State University, based on an Amdahl 5890-180E computer.

## 4.3 PROGRAM EXECUTION TIME

MOBILE4.1 requires slightly more time to process scenario records than did MOBILE4. This was expected due to the extensive revisions made to the program, including the additions of new subroutines, the increased complexity of many of the computational algorithms used, and the added provisions for the user to supply additional types of input data. Since relatively few model users operate in a time-sharing environment, statistics on execution time and comparisons to MOBILE4 are not presented here.

## 4.4 DEVIATIONS FROM FORTRAN STANDARD ANSI X3.9-1978

MOBILE4.1 is based on the FORTRAN language standard ANSI X3.9-1978 published by the American National Standards Institute. No incompatibilities are known to exist between the MOBILE4.1 code and that standard.

## 4.5 TYPICAL JOB STRUCTURE

Since job control language (JCL) is highly system-dependent, this manual does not provide detailed examples. The general requirements for running a job are outlined here. Most users should have little difficulty implementing JCL to perform similar functions.

The simplest job structure for most systems is shown below:

```
JCL to sign on the computer system
JCL to compile MOBILE4.1 FORTRAN source code
                .
                .
                .
     (MOBILE4.1 FORTRAN source code)
                .
                .
                .
JCL to assign MOBILE4.1 I/O, catalog (link edit), and run
MOBILE4.1
                .
                .
                .
     (MOBILE4.1 input data)
                .
                .
                .
```

MOBILE4.1 uses I/O device numbers stored in common IOUCOM. MOBILE4.1 I/O device assignments are:

```
4 = user-supplied inspection/maintenance (I/M) credits (IOUIMD)
5 = general input data (IOUGEN)
6 = formatted reports (IOUREP)
6 = diagnostic messages (IOUERR)
6 = input prompting messages (IOUASK)
```

Users can change these device numbers by modifying source code data statements initalizing common IOUCOM in Block Data

Subprogram 16. Output devices only can also be changed by assigning replacement numbers to IOUNEW on line 1 of the Control data section, as discussed in section 2.1.2.

The job structure illustrated above does not read user-supplied I/M credits. Users can read I/M credits by entering the data from another I/O device, such as a disk file or magnetic tape. Alternately, users can merge the credits or rates with other input and change the I/M logical I/O device number from 4 to 5 by revising BLOCK DATA Subprogram 16:

change DATA IOUIMD,IOUGEN,IOUERR,IOUASK/**4**,5,6,2*9/

to DATA IOUIMD,IOUGEN,IOUERR,IOUASK/**5**,5,6,2*9/.

Another useful change (especially for OUTFMT = 1 or 2) might alter IOUREP from 6 to some other unused unit number via IOUNEW. Again, see section 2.1.2.

## 4.6 INSTALLATION AND EXECUTION OF MOBILE4.1 ON PERSONAL COMPUTER SYSTEMS

### 4.6.1 Introduction

Due to the increased utilization of personal computers (PCs) by many parties involved in emission factor modeling and air quality planning functions, EPA has developed MOBILE4.1 to be compatible to the greatest extent possible with the two most commonly used PC systems: Apple Macintosh and IBM PC-AT and PS-2 (and their clones). However, since the development of the program was performed entirely on mainframe time-sharing systems, some differences exist between the MOBILE4.1 program as developed and discussed in this User's Guide, and the program in a form that can be executed on PC systems. This section provides instructions for downloading the mainframe version of MOBILE4.1 (e.g., from MTS at Wayne State or from NCC) to the PCs mentioned, outlines the code changes required for the personal computer environment, and provides installation instructions for the use of diskettes obtained through EPA or NTIS.

### 4.6.2 Downloading the Mainframe Version of MOBILE4.1 to an Apple Macintosh or IBM-Style Desktop Computer

Due to the system dependency of some steps, these instructions may not cover every situation encountered in downloading MOBILE4.1. Users attempting this operation and encountering difficulties may contact EPA for assistance.

The directions provided in this section assume that the Macintosh being used has 1024K bytes of free memory (2048K is

recommended), a hard-disk drive, and ABSOFT Corporation's MacFORTRAN or MacFORTRAN/020 compiler. The assumptions made with respect to IBM-style computers are that 640K memory is available and that the LAHEY FORTRAN F77L compiler is present.

The first operation necessary is to port the MOBILE4.1 source code to the Macintosh or IBM-style unit. To accomplish this transfer, an error-checking protocol (such as KERMIT) should be used. The MOBILE4.1 code should be transmitted so that an ASCII text file, with no hidden characters (such as tabs), is created.

Once transferred, the code must be modified slightly to accommodate the Macintosh or IBM-style FORTRAN environment. These required modifications include file opening statements and screen/keyboard connections:

1. This instruction applicable to both types of computer.

   Insert the following lines controlling file I/O just before the statement **INERR=0** in the MOBILE4.1 **MAIN** program section:

   ```
   OPEN(5,FILE='M4INPUT',STATUS='OLD')
   OPEN(6,FILE='M4OUTPUT',STATUS='NEW')
   ```

   File names other that "M4INPUT" and "M4OUTPUT" may be used. If so, the names used should be substituted for "M4INPUT" and "M4OUTPUT" in reading the remainder of this section.

2. This instruction applicable to both types of computer.

   If alternate I/M credits are also to be read in (see section 2.2.5), then insert the following line immediately after the comment statement "**User supplies alternate FTP I/M credits**":

   ```
   OPEN(4,FILE='M4IMC',STATUS='OLD')
   ```

   A file name other that "M4IMC" may be used. If so, the name used should be substituted for "M4IMC" in reading the remainder of this section.

3. Finally, alter the initialization line for screen/keyboard I/O in **SUBROUTINE GETIOU**. This line currently reads:

   ```
   DATA IOUDEF/6,6,6/
   ```

This line should be altered to read:

For Macintosh: DATA IOUDEF/6,6,**9**/

For IBM-style computers: DATA IOUDEF/6,6,**0**/

If the user also wishes to have diagnostic (error and warning) messages appear on the computer screen, rather than being listed in the formatted output file, these lines should be altered to read:

For Macintosh: DATA IOUDEF/6,**9**,**9**/

For IBM-style computers: DATA IOUDEF/6,**0**,**0**/

These changes direct MOBILE4.1 to always read the program input from a file called M4INPUT and to always write the program output to a file called M4OUTPUT. If the alternate I/M credit data modification was made, then the alternate credits will always be read from a file called M4IMC. These changes direct all prompting (last digit change) and/or diagnostic (middle digit change) messages to the screen (logical I/O device unit 9 for Macintosh, unit 0 for IBM-style machines).

After these changes have been made, invoke the compiler. If your unit has a math coprocessor, select it using the OPTIONS menu (Macintosh) or by using the /E Lahey compiler option (IBM).

When the compilation has been completed, the heap space for the resulting MOBILE4.1 application must be adjusted. To do this on a Macintosh, select the MOBILE4.1 application icon, then select the GET INFO option from the Macintosh Finder's file menu (not the compiler's menu). Note the application size value in the lower right portion of the window. If it is less than 1024K, increase it to 1024K. No such adjustment is required for IBM-style computers. However, due to the size of MOBILE4.1, only DOS should reside in the 640K memory of the computer. The MOBILE4.1 application is now ready for use.

Before running the program, place the MOBILE4.1 input data in a file called M4INPUT. Next, check to be sure that the M4OUTPUT file is empty. (If M4OUTPUT contains data or information you wish to save, simply rename it so that it is not overwritten by the results of the pending MOBILE4.1 run.) To execute on Macintosh, launch the MOBILE4.1 application by double-clicking its icon. To execute on IBM-style, type "MOBILE41" at the DOS prompt. See section 4.6.3.

### 4.6.3 Installing and Executing MOBILE4.1 on Desktop Computers

These instructions are to be followed in loading the program from diskettes supplied by EPA or obtained through NTIS. With minor exceptions, they can also be followed by those running MOBILE4.1 as downloaded from a mainframe computer (as described in the preceding section).

**Note**: These instructions are nearly identical for both types of computer. Differences are noted when applicable. For IBM-style machines, DOS commands that the user types in are in **boldface**. Messages generated by the computer are in quotation marks.

1. In order to load the contents of the MOBILE4.1 diskette(s), you must have 2.4 MB (2.4 megabytes) of available disk space. Additionally, for IBM-style computers, memory of 640 KB RAM is required for program operating space. In most cases, this means that no other resident software (e.g., TOPS) can be present; only DOS should be loaded unless adequate memory is available.

2. After the contents of the diskette(s) have been copied into your computer, they must be decompressed. This is accomplished by typing **M41** (IBM-style machines), or by double-clicking on the M41.CPT icon (Macintosh).

   The following files will then reside in the MOBILE41 directory on an IBM-style computer:

| File Name | Contents |
|---|---|
| MOBILE41.FOR | Complete FORTRAN source code (including comments) |
| MOBILE41.EXE | Executable (object) code |
| COMPILE.BAT | LAHEY FORTRAN compiler instructions |
| IMCHI.DAT | Alternate high-altitude I/M credits file |
| EXINx.TXT | User Guide example input files (x = 1, 2, ..., 7) |
| EXOUTx.TXT | User Guide example output files (x = 1, 2, ..., 7) |

On a Macintosh, the following files will be available in the MOBILE4.1 folder:

| Name | Contents |
|---|---|
| Mobile4.1.FOR | Complete FORTRAN source code (including comments) |
| Read Me M41.FOR | Read file concerning the source code file |
| Mobile4.1 | Executable (object) code |
| Read Me | Read file concerning the Mobile4.1 object code file |
| Mobile4.1/020 | Executable (object) code, for use with a math co-processor (faster execution times) |
| Read Me /020 | Read file concerning the Mobile4.1/020 object code file |
| f77.rl | Library file required for use of Mobile4.1 and Mobile4.1/020 |
| m81.rl | Library file required for use of Mobile4.1/020 |
| IMCHI.DAT | Alternate high-altitude I/M credit file |
| M41 Examples | Folder containing seven example input and output files (EXIN<x>.TXT and EXOUT<x>.TXT, x = 1, 2, ..., 7) |

It is recommended that the files **f77.rl** and **m81.rl** be relocated from the MOBILE4.1 folder to the system folder on your hard disk. They must be present for the object code to run properly.

3. In order to execute a MOBILE4.1 run:

   On a Macintosh, launch the MOBILE4.1 application by double-clicking the icon (Mobile4.1 or Mobile4.1/020).

   On an IBM-style machine, when prompted by DOS ("C:>" or similar), type

   **MOBILE41**

   and return.

4. If enough memory is available for the program to operate, the program will respond:

   "Interactive input mode (Y/N)?"

   If you wish to enter the input data in an interactive mode, type "yes" or "Y" and return, then follow steps 9 - 15. If you have the input data in a file (recommended), type "no" or "N" and return, then follow steps 5 - 8.

Steps 5 - 8: Not using interactive data entry:

5. The program will respond with:

   "********** MOBILE4.1 DRIVER **********"

   "Enter number of MOBILE4.1 calls:"

   Type in the number of MOBILE4.1 runs that you intend to execute, then return. Allowable values are 1 to 999. Each run can consist of any number of scenarios.

6. The program will respond:

   "Please enter the MOBILE4.1 input filename:"

   For IBM-style machines, respond with any valid DOS file name [1 to 8 characters (file name), followed by optional period and 1 to 3 characters (file name extension); for example, M4INPUT.A], then return. For Macintosh, respond with any valid file name. The input data does not have to be in a file called M4INPUT. The file can contain up to 999 complete MOBILE4.1 input data files. If more than one input data set is in the file, the data sets must be separated by a line of zeroes:
   0000000000000000000000000000000000000000000000000000000000000000

7. The program will respond:

   "Please enter the MOBILE4.1 output filename:"

   Respond with any valid file name (any valid DOS file name for IBM-style machines), then return. The output does not have to be directed to a file named M4OUTPUT. The file named must not exist prior to the execution of this MOBILE4.1 run. MOBILE4.1 will create, open, name, and write to this file in executing. No appending to existing files is permitted.

8. The program will then execute. No messages will be generated until execution is completed. Depending on the number of scenarios and the speed of the computer, this may take 30 seconds or longer. The program will signal completion of the run by issuing this message:

   "Run #<n> INERR = <x>"
   "DRIVER calls completed."

where <n> = the number of the run (entered at step 5), and <x> = the number of errors detected in the input data set. Error messages will be in the file named to receive the output in step 7. If x $\geq$ 1, the program may not have generated the desired emission factors. See Chapter 3 for discussion of error messages.

Steps 9 - 15: Using interactive mode of data entry:

9. The program will respond with:

   "**********  MOBILE4.1 DRIVER  **********"

   "Enter number of MOBILE4.1 calls:"

   Type in the number of MOBILE4.1 runs that you intend to execute, then return. Allowable values are 1 to 999. Each run can consist of any number of scenarios.

10. The program will respond:

    "Please enter the MOBILE4.1 output filename:"

    Respond with any valid file name (any valid DOS file name for IBM-style machines), then return. The output data does not have to go to a file named M4OUTPUT. The file named must not exist prior to the execution of this MOBILE4.1 run. MOBILE4.1 will create, open, name, and write to this file in execution. No appending to existing files is permitted.

11. The program then will expect you to enter the value of the PROMPT flag (see section 2.1.1). You will not be prompted for this value; you should enter either "2" or "4," then return. (The value of PROMPT must be either 2 or 4, as you have chosen interactive data entry.)

12. Whether "2" (vertical data entry) or "4" (horizontal data entry) is chosen for PROMPT, the program may respond with

    "1"

    which serves as a FORTRAN control character, or the program may "jump" to a new screen. The reaction to the control character is system-dependant.

13. The program will then prompt you for the remaining input. (Prompting messages are discussed in section 3.1.) Enter the appropriate input data in response to each prompt then return.

14. After you have entered all of the Scenario section input data, the program will respond by prompting for the first record of the next scenario (calendar year, region, etc.). Enter a zero ("0") to indicate that you have finished entering new data.

15. The program will then execute. No messages will be generated until execution is completed. Depending on the number of scenarios and the speed of the computer, this may take 30 seconds or longer. The program will signal completion of the run by issuing this message:

    "Run #<n> INERR = <x>"
    "DRIVER calls completed."

    where <n> = the number of the run (entered at step 5), and <x> = the number of errors detected in the input data set. Error messages will be in the file named to receive the output in step 10. If $x \geq 1$, the program may not have generated the desired emission factors. See Chapter 3 for discussion of error messages.

## 4.7 MOBILE4.1 ON THE NCC SYSTEM

For those users with access to the National Computing Center (NCC), MOBILE4.1 has been installed there. This is the mainframe version of the program, and is operated as described through the rest of this document. File names and contents are given below:

| File Name | Contents |
|---|---|
| KADSAME.M41(M41) | MOBILE4.1 Source code |
| KADSAME.LOAD(M41) | MOBILE4.1 Object code |
| KADSAME.M41(EXUG) | MOBILE4.1 Example runs (I/O files) |
| KADSAME.M4B(IMCHI) | High-altitude area I/M credits |

## 4.8 MOBILE4.1 ON THE MTS SYSTEM

For those users with access to the Michigan Terminal System (MTS), MOBILE4.1 can be accessed there. This is the mainframe version of the program, and is operated as described through the rest of this document. File names and contents are given below:

| File Name | Contents |
|---|---|
| SFUT:M4.1.S | MOBILE4.1 Source code |
| SFUT:M4.1.L | MOBILE4.1 Object code |
| SFUT:M4.1.C | Command file to run the model |
| SFUT:M4.1.D-UG | Input file for example runs |
| SFUT:M4.1.R-UG | Output file for example runs |
| SFUT:M4.1.D-HI | High-altitude area I/M credits |

## 4.9 PROGRAM UPDATE INFORMATION

EPA expects MOBILE4.1 to undergo future revision to correct possible errors, improve program performance, and incorporate changes in the methodology. Users who wish to submit changes or corrections can mail these to the EPA Motor Vehicle Emission Laboratory in Ann Arbor, at the address given at the end of this section.

A list of program errors and User's Guide corrections will be compiled, if necessary, and distributed to EPA Regional Offices. EPA does not currently intend to support a user mailing list for automatic distribution of these corrections. Users should contact their Regional Offices from time to time. Users who wish to do so may submit the following Update Request form. In the event a complete mailing list is assembled, they will be included and sent any published changes to MOBILE4.1.

## MOBILE4.1 UPDATE REQUEST

Mail to: MOBILE4.1 Emission Factor Project
U.S. EPA Motor Vehicle Emission Laboratory
Emission Control Technology Division
Test and Evaluation Branch
2565 Plymouth Road
Ann Arbor, Michigan 48105

Name and Address of User:

_____

_____

_____

_____

CITY _____ STATE _____

ZIP _____

Name(s) and telephone number(s) of individual(s) we may need to reach to respond to questions:

_____

_____

_____

_____

_____

## MOBILE4.1 UPDATE REQUEST

Mail to:

MOBILE4.1 Emission Factor Project
U.S. EPA Motor Vehicle Emission Laboratory
Emission Control Technology Division
Test and Evaluation Branch
2565 Plymouth Road
Ann Arbor, Michigan 48105

Name and Address of User:

_____

_____

_____

_____

CITY _____ STATE _____

ZIP _____

Name(s) and telephone number(s) of individual(s) we may need to reach to respond to questions:

_____

_____

_____

_____

_____

# Chapter 5

# MOBILE4.1 EXAMPLES

## 5.0 INTRODUCTION

Seven examples are provided to illustrate various aspects of MOBILE4.1. The user is encouraged to try two or more of these examples to ensure that the model as compiled is running properly.

## 5.1 EXAMPLES

The MOBILE4.1 examples are summarized in Table 5.1-1.

Table 5.1-1

Summary Description of MOBILE4.1 Examples

| Example | Title | Content |
|---|---|---|
| 1 - 5 | Output choices | Emission rates evaluated on January 1 of 1980, 1988, 1990 (1-4 only), and 2000 (1-4 only); onboard VRS for light-duty gas vehicles and trucks starting in MY 1989. |
| 1 | | OUTFMT = 1 (221-column numeric) |
| 2 | | OUTFMT = 2 (140-column numeric) |
| 3 | | OUTFMT = 3 (112-column descriptive) |
| 4 | | OUTFMT = 4 ( 80-column descriptive) |
| 5 | | OUTFMT = 5 (by model year tables plus 112-column output) |
| 6 | Replacement of MOBILE4.1 data | Emission rates evaluated on January 1 of 1980, 1988, 1990, and 2000; user-supplied alternate registration distributions and annual mileage accumulation rates by age. |
| 7 | Anti-tampering program | Emission rates evaluated on January 1 of 1980, 1988, 1990, and 2000, with an anti-tampering program implemented January 1, 1984. |

### 5.1.1 Output Choices

Examples 1 through 5 illustrate the five choices of output formats available from MOBILE4.1. Each of these examples models emission factors for 1/1/80, 1/1/88, 1/1/90, and 1/1/00 using:

default tampering rates (TAMFLG=1)
one average speed for all vehicle types (SPDFLG=1)
default VMT mix (VMFLAG=1)
default registration distributions and annual mileage accumulation rates (MYMRFG=1)
no new basic emission rate equations (NEWFLG=1)
no inspection/maintenance program (IMFLAG=1)
no additional correction factors for light-duty gas vehicles and trucks (ALHFLG=1)
no anti-tampering program (ATPFLG=1)
refueling emissions (from LDGVs, LDGT1s, LDGT2s only) controlled by onboard VRS starting with model year 1989 vehicles (RLFLAG=3)
local area parameter (LAP) record provided for each scenario (LOCFLG=1)
MOBILE4.1 calculated temperatures for correction of emission factors, based on user-supplied minimum and maximum temperatures (TEMFLG=1)
emission factors for all pollutants (PRTFLG=4)
no idle emission factors (IDLFLG=1)
total hydrocarbon emission factors (NMHFLG=1)
separate listing of the components of HC emissions: exhaust, evaporative, refueling, running loss, and resting loss (HCFLAG=2)
FTP temperatures: 75°F (24°C), diurnal temperature range 60° to 84°F (11° to 29°C)
FTP operating mode fractions: 20.6/27.3/20.6
Fuel volatility of 11.5 psi RVP for all years (period 1 RVP = period 2 RVP)

The output from example 1 is shown on two pages; if this output is directed to a file, each line is 220 columns wide. Only the first two calendar years (1980 and 1988) are included with Example 5 due to the length of the output produced. Each of the five choices of formatted output report is discussed in Chapter 3.

Note that the calendar year 2000 emission factors are preceded by a warning message regardless of the output format chosen. Users may wish to reassign the logical I/O device for messages to a different file than is designated to receive the emission factors, particularly if one of the numeric output options has been chosen and the results are to be used as input for another program, in order to avoid the need for examining and editing the output file. See section 2.1.2.

```
1           PROMPT
MOBILE4.1 UG EXAMPLE 1: OUTFMT = 1 (LONG (220 COLUMN) NUMERIC OUTPUT FORMAT)
1           TAMFLG
1           SPDFLG
1           VMFLAG
1           MYMRFG
1           NEWFLG
1           IMFLAG
1           ALHFLG
1           ATPFLG
3           RLFLAG
1           LOCFLG  -  READ IN LOCAL AREA PARAMETERS AS 2ND REQ SC REC
1           TEMFLG  -  CALCULATE EXHAUST TEMPERATURES
1           OUTFMT  -  MOBILE4 210 COLUMN 3 DP NUMERIC OUTPUT FORMAT
4           PRTFLG
1           IDLFLG
1           NMHFLG
2           HCFLAG  -  PRINT HC COMPONENTS
89 2221       IOBMY, IVOB
1 80 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 88 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 90 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 00 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
```

MOBILE4.1 UG EXAMPLE 1: OUTFMT = 1 (LONG (220 COLUMN) NUMERIC OUTPUT FORMAT)

| Reg | CY | Vehicle Speeds | Amb. Tmp | Cold/Hot Start | | | Alt. in Ft. | Pol | Composite Emission Factors LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | LDDT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 80 | 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6 | 78 | 20.6 | 27.3 | 20.6 | 500. | 1 | 8.394 | 9.670 | 16.642 | 11.979 | 29.666 | 0.661 | 0.991 |
| | | | | | | | | X | 4.342 | 5.161 | 7.844 | 6.049 | 14.079 | 0.661 | 0.991 |
| | | | | | | | | V | 2.438 | 2.842 | 6.058 | 3.907 | 12.288 | | |
| | | | | | | | | R | 0.368 | 0.433 | 0.440 | 0.436 | 0.615 | | |
| | | | | | | | | T | 1.126 | 1.131 | 2.199 | 1.485 | 2.521 | | |
| | | | | | | | | S | 0.120 | 0.103 | 0.102 | 0.102 | 0.163 | | |
| 1 | 80 | 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6 | 78 | 20.6 | 27.3 | 20.6 | 500. | 2 | 54.957 | 62.885 | 82.036 | 69.229 | 226.273 | 1.557 | 2.134 |
| 1 | 80 | 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6 | 78 | 20.6 | 27.3 | 20.6 | 500. | 3 | 3.111 | 3.257 | 4.682 | 3.729 | 7.387 | 1.514 | 1.961 |
| 1 | 88 | 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6 | 78 | 20.6 | 27.3 | 20.6 | 500. | 1 | 4.684 | 6.166 | 8.484 | 6.938 | 18.129 | 0.615 | 0.794 |
| | | | | | | | | X | 2.275 | 3.383 | 4.182 | 3.649 | 6.954 | 0.615 | 0.794 |
| | | | | | | | | V | 1.247 | 1.571 | 2.823 | 1.988 | 8.602 | | |
| | | | | | | | | R | 0.262 | 0.331 | 0.335 | 0.332 | 0.537 | | |
| | | | | | | | | T | 0.784 | 0.780 | 1.044 | 0.868 | 1.890 | | |
| | | | | | | | | S | 0.116 | 0.101 | 0.101 | 0.101 | 0.147 | | |
| 1 | 88 | 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6 | 78 | 20.6 | 27.3 | 20.6 | 500. | 2 | 29.070 | 40.562 | 47.979 | 43.031 | 128.803 | 1.567 | 1.725 |
| 1 | 88 | 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6 | 78 | 20.6 | 27.3 | 20.6 | 500. | 3 | 1.700 | 2.145 | 2.670 | 2.320 | 5.963 | 1.565 | 1.769 |
| 1 | 90 | 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6 | 78 | 20.6 | 27.3 | 20.6 | 500. | 1 | 4.087 | 5.216 | 7.141 | 5.831 | 15.208 | 0.692 | 0.932 |
| | | | | | | | | X | 1.909 | 2.867 | 3.564 | 3.090 | 5.670 | 0.692 | 0.932 |
| | | | | | | | | V | 1.097 | 1.294 | 2.291 | 1.613 | 7.254 | | |
| | | | | | | | | R | 0.217 | 0.274 | 0.281 | 0.276 | 0.525 | | |
| | | | | | | | | T | 0.752 | 0.683 | 0.907 | 0.755 | 1.623 | | |
| | | | | | | | | S | 0.111 | 0.097 | 0.098 | 0.097 | 0.136 | | |
| 1 | 90 | 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6 | 78 | 20.6 | 27.3 | 20.6 | 500. | 2 | 25.229 | 34.050 | 40.327 | 36.056 | 105.695 | 1.666 | 1.898 |
| 1 | 90 | 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6 | 78 | 20.6 | 27.3 | 20.6 | 500. | 3 | 1.439 | 1.892 | 2.277 | 2.015 | 5.781 | 1.633 | 1.866 |

M120 Warning: MOBILE4.1 does not model most 1993 and later Clean Air Act requirements; Emission Factors for CY 1993 or later are affected.

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6 | 78 | 20.6 | 27.3 | 20.6 | 500. | 1 | 2.741 | 3.383 | 3.726 | 3.484 | 9.032 | 0.629 | 0.924 |
| | | | | | | | | X | 1.002 | 1.738 | 1.855 | 1.773 | 2.882 | 0.629 | 0.924 |
| | | | | | | | | V | 0.885 | 0.874 | 1.037 | 0.922 | 4.458 | | |
| | | | | | | | | R | 0.041 | 0.070 | 0.073 | 0.071 | 0.488 | | |
| | | | | | | | | T | 0.726 | 0.617 | 0.679 | 0.635 | 1.108 | | |
| | | | | | | | | S | 0.087 | 0.084 | 0.083 | 0.083 | 0.095 | | |
| 1 | 0 | 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6 | 78 | 20.6 | 27.3 | 20.6 | 500. | 2 | 15.394 | 18.908 | 21.011 | 19.530 | 44.891 | 1.596 | 1.835 |
| 1 | 0 | 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6 | 78 | 20.6 | 27.3 | 20.6 | 500. | 3 | 0.779 | 1.240 | 1.286 | 1.254 | 4.662 | 1.367 | 1.681 |

| | | | Vehicle Mix | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HDDV | MC | All Veh | LDGV | LDGT1 | LDGT2 | HDGV | LDDV | LDDT | HDDV | MC | Scenario Title |
| 5.483 | 9.709 | 9.626 | 0.688 | 0.142 | 0.070 | 0.031 | 0.005 | 0.001 | 0.052 | 0.011 | SAN FRANCISCO CA |
| 5.483 | 6.979 | 5.070 | | | | | | | | | |
| | 2.290 | 2.910 | | | | | | | | | |
| | | 0.364 | | | | | | | | | |
| | | 1.167 | | | | | | | | | |
| | 0.440 | 0.114 | | | | | | | | | |
| 16.236 | 33.627 | 60.699 | 0.688 | 0.142 | 0.070 | 0.031 | 0.005 | 0.001 | 0.052 | 0.011 | SAN FRANCISCO CA |
| 30.064 | 0.470 | 4.745 | 0.688 | 0.142 | 0.070 | 0.031 | 0.005 | 0.001 | 0.052 | 0.011 | SAN FRANCISCO CA |
| 3.405 | 6.363 | 5.547 | 0.639 | 0.152 | 0.076 | 0.036 | 0.013 | 0.003 | 0.072 | 0.009 | SAN FRANCISCO CA |
| 3.405 | 3.069 | 2.822 | | | | | | | | | |
| | 2.854 | 1.588 | | | | | | | | | |
| | | 0.263 | | | | | | | | | |
| | | 0.768 | | | | | | | | | |
| | 0.440 | 0.106 | | | | | | | | | |
| 13.951 | 22.715 | 34.312 | 0.639 | 0.152 | 0.076 | 0.036 | 0.013 | 0.003 | 0.072 | 0.009 | SAN FRANCISCO CA |
| 21.520 | 0.800 | 3.415 | 0.639 | 0.152 | 0.076 | 0.036 | 0.013 | 0.003 | 0.072 | 0.009 | SAN FRANCISCO CA |
| 3.031 | 5.926 | 4.816 | 0.628 | 0.163 | 0.077 | 0.037 | 0.009 | 0.002 | 0.076 | 0.008 | SAN FRANCISCO CA |
| 3.031 | 2.572 | 2.410 | | | | | | | | | |
| | 2.914 | 1.369 | | | | | | | | | |
| | | 0.222 | | | | | | | | | |
| | | 0.714 | | | | | | | | | |
| | 0.440 | 0.102 | | | | | | | | | |
| 13.296 | 21.953 | 29.616 | 0.628 | 0.163 | 0.077 | 0.037 | 0.009 | 0.002 | 0.076 | 0.008 | SAN FRANCISCO CA |
| 20.069 | 0.821 | 3.154 | 0.628 | 0.163 | 0.077 | 0.037 | 0.009 | 0.002 | 0.076 | 0.008 | SAN FRANCISCO CA |
| 2.209 | 5.479 | 3.141 | 0.589 | 0.191 | 0.080 | 0.038 | 0.002 | 0.002 | 0.092 | 0.007 | SAN FRANCISCO CA |
| 2.209 | 2.099 | 1.399 | | | | | | | | | |
| | 2.940 | 0.958 | | | | | | | | | |
| | | 0.062 | | | | | | | | | |
| | | 0.641 | | | | | | | | | |
| | 0.440 | 0.080 | | | | | | | | | |
| 11.385 | 21.437 | 17.244 | 0.589 | 0.191 | 0.080 | 0.038 | 0.002 | 0.002 | 0.092 | 0.007 | SAN FRANCISCO CA |
| 9.697 | 0.830 | 1.880 | 0.589 | 0.191 | 0.080 | 0.038 | 0.002 | 0.002 | 0.092 | 0.007 | SAN FRANCISCO CA |

```
1           PROMPT
MOBILE4.1 UG EXAMPLE 2: OUTFMT = 2 (SHORT (139 COLUMN) NUMERIC OUTPUT FORMAT)
1           TAMFLG
1           SPDFLG
1           VMFLAG
1           MYMRFG
1           NEWFLG
1           IMFLAG
1           ALHFLG
1           ATPFLG
3           RLFLAG
1           LOCFLG  -  READ IN LOCAL AREA PARAMETERS AS 2ND REQ SC REC
1           TEMFLG  -  CALCULATE EXHAUST TEMPERATURES
2           OUTFMT
4           PRTFLG
1           IDLFLG
1           NMHFLG
2           HCFLAG  -  PRINT HC COMPONENTS
89 2221       IOBMY, IVOB
1 80 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 88 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 90 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 00 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
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MOBILE4.1 UG EXAMPLE 2: OUTFMT = 2 (SHORT (139 COLUMN) NUMERIC OUTPUT FORMAT)

| Reg | CY | Amb. Tmp | Cold/Hot Start | | | Pol | Composite Emission Factors | | | | | | | | | Vehicle Mix | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | AllVeh | LDGV | LDGT1 | LDGT2 | HDGV | LDDV | LDDT | HDDV | MC |
| 1 | 80 | 78 | 20.6 | 27.3 | 20.6 | 1 | 8.39 | 9.67 | 16.64 | 11.98 | 29.67 | 0.66 | 0.99 | 5.48 | 9.71 | 9.63 | .688 | .142 | .070 | .031 | .005 | .001 | .052 | .011 |
| | | | | | | X | 4.34 | 5.16 | 7.84 | 6.05 | 14.08 | 0.66 | 0.99 | 5.48 | 6.98 | 5.07 | | | | | | | | |
| | | | | | | V | 2.44 | 2.84 | 6.06 | 3.91 | 12.29 | | | | 2.29 | 2.91 | | | | | | | | |
| | | | | | | R | 0.37 | 0.43 | 0.44 | 0.44 | 0.61 | | | | | 0.36 | | | | | | | | |
| | | | | | | T | 1.13 | 1.13 | 2.20 | 1.48 | 2.52 | | | | | 1.17 | | | | | | | | |
| | | | | | | S | 0.12 | 0.10 | 0.10 | 0.10 | 0.16 | | | | 0.44 | 0.11 | | | | | | | | |
| 1 | 80 | 78 | 20.6 | 27.3 | 20.6 | 2 | 54.96 | 62.89 | 82.04 | 69.23 | 226.27 | 1.56 | 2.13 | 16.24 | 33.63 | 60.70 | .688 | .142 | .070 | .031 | .005 | .001 | .052 | .011 |
| 1 | 80 | 78 | 20.6 | 27.3 | 20.6 | 3 | 3.11 | 3.26 | 4.68 | 3.73 | 7.39 | 1.51 | 1.96 | 30.06 | 0.47 | 4.74 | .688 | .142 | .070 | .031 | .005 | .001 | .052 | .011 |
| 1 | 88 | 78 | 20.6 | 27.3 | 20.6 | 1 | 4.68 | 6.17 | 8.48 | 6.94 | 18.13 | 0.62 | 0.79 | 3.40 | 6.36 | 5.55 | .639 | .152 | .076 | .036 | .013 | .003 | .072 | .009 |
| | | | | | | X | 2.27 | 3.38 | 4.18 | 3.65 | 6.95 | 0.62 | 0.79 | 3.40 | 3.07 | 2.82 | | | | | | | | |
| | | | | | | V | 1.25 | 1.57 | 2.82 | 1.99 | 8.60 | | | | 2.85 | 1.59 | | | | | | | | |
| | | | | | | R | 0.26 | 0.33 | 0.33 | 0.33 | 0.54 | | | | | 0.26 | | | | | | | | |
| | | | | | | T | 0.78 | 0.78 | 1.04 | 0.87 | 1.89 | | | | | 0.77 | | | | | | | | |
| | | | | | | S | 0.12 | 0.10 | 0.10 | 0.10 | 0.15 | | | | 0.44 | 0.11 | | | | | | | | |
| 1 | 88 | 78 | 20.6 | 27.3 | 20.6 | 2 | 29.07 | 40.56 | 47.98 | 43.03 | 128.80 | 1.57 | 1.72 | 13.95 | 22.71 | 34.31 | .639 | .152 | .076 | .036 | .013 | .003 | .072 | .009 |
| 1 | 88 | 78 | 20.6 | 27.3 | 20.6 | 3 | 1.70 | 2.14 | 2.67 | 2.32 | 5.96 | 1.57 | 1.77 | 21.52 | 0.80 | 3.41 | .639 | .152 | .076 | .036 | .013 | .003 | .072 | .009 |
| 1 | 90 | 78 | 20.6 | 27.3 | 20.6 | 1 | 4.09 | 5.22 | 7.14 | 5.83 | 15.21 | 0.69 | 0.93 | 3.03 | 5.93 | 4.82 | .628 | .163 | .077 | .037 | .009 | .002 | .076 | .008 |
| | | | | | | X | 1.91 | 2.87 | 3.56 | 3.09 | 5.67 | 0.69 | 0.93 | 3.03 | 2.57 | 2.41 | | | | | | | | |
| | | | | | | V | 1.10 | 1.29 | 2.29 | 1.61 | 7.25 | | | | 2.91 | 1.37 | | | | | | | | |
| | | | | | | R | 0.22 | 0.27 | 0.28 | 0.28 | 0.53 | | | | | 0.22 | | | | | | | | |
| | | | | | | T | 0.75 | 0.68 | 0.91 | 0.75 | 1.62 | | | | | 0.71 | | | | | | | | |
| | | | | | | S | 0.11 | 0.10 | 0.10 | 0.10 | 0.14 | | | | 0.44 | 0.10 | | | | | | | | |
| 1 | 90 | 78 | 20.6 | 27.3 | 20.6 | 2 | 25.23 | 34.05 | 40.33 | 36.06 | 105.70 | 1.67 | 1.90 | 13.30 | 21.95 | 29.62 | .628 | .163 | .077 | .037 | .009 | .002 | .076 | .008 |
| 1 | 90 | 78 | 20.6 | 27.3 | 20.6 | 3 | 1.44 | 1.89 | 2.28 | 2.01 | 5.78 | 1.63 | 1.87 | 20.07 | 0.82 | 3.15 | .628 | .163 | .077 | .037 | .009 | .002 | .076 | .008 |

M120 Warning: MOBILE4.1 does not model most 1993 and later Clean Air Act requirements; Emission Factors for CY 1993 or later are affected.

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 78 | 20.6 | 27.3 | 20.6 | 1 | 2.74 | 3.38 | 3.73 | 3.48 | 9.03 | 0.63 | 0.92 | 2.21 | 5.48 | 3.14 | .589 | .191 | .080 | .038 | .002 | .002 | .092 | .007 |
| | | | | | | X | 1.00 | 1.74 | 1.86 | 1.77 | 2.88 | 0.63 | 0.92 | 2.21 | 2.10 | 1.40 | | | | | | | | |
| | | | | | | V | 0.88 | 0.87 | 1.04 | 0.92 | 4.46 | | | | 2.94 | 0.96 | | | | | | | | |
| | | | | | | R | 0.04 | 0.07 | 0.07 | 0.07 | 0.49 | | | | | 0.06 | | | | | | | | |
| | | | | | | T | 0.73 | 0.62 | 0.68 | 0.64 | 1.11 | | | | | 0.64 | | | | | | | | |
| | | | | | | S | 0.09 | 0.08 | 0.08 | 0.08 | 0.09 | | | | 0.44 | 0.08 | | | | | | | | |
| 1 | 0 | 78 | 20.6 | 27.3 | 20.6 | 2 | 15.39 | 18.91 | 21.01 | 19.53 | 44.89 | 1.60 | 1.84 | 11.39 | 21.44 | 17.24 | .589 | .191 | .080 | .038 | .002 | .002 | .092 | .007 |
| 1 | 0 | 78 | 20.6 | 27.3 | 20.6 | 3 | 0.78 | 1.24 | 1.29 | 1.25 | 4.66 | 1.37 | 1.68 | 9.70 | 0.83 | 1.88 | .589 | .191 | .080 | .038 | .002 | .002 | .092 | .007 |

```
1           PROMPT
MOBILE4.1 UG EXAMPLE 3: OUTFMT = 3 (LANDSCAPE (112 COLUMN) DESCRIPTIVE OUTPUT FORMAT)
1           TAMFLG
1           SPDFLG
1           VMFLAG
1           MYMRFG
1           NEWFLG
1           IMFLAG
1           ALHFLG
1           ATPFLG
3           RLFLAG
1           LOCFLG  -  READ IN LOCAL AREA PARAMETERS AS 2ND REQ SC REC
1           TEMFLG  -  CALCULATE EXHAUST TEMPERATURES
3           OUTFMT
4           PRTFLG
1           IDLFLG
1           NMHFLG
2           HCFLAG  -  PRINT HC COMPONENTS
89 2221       IOBMY, IVOB
1 80 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 88 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 90 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 00 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
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MOBILE4.1 UG EXAMPLE 3: OUTFMT = 3 (LANDSCAPE (112 COLUMN) DESCRIPTIVE OUTPUT FO

Total HC emission factors include evaporative HC emission factors.

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Cal. Year: 1980 I/M Program: No Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.

SAN FRANCISCO CA Minimum Temp: 60. (F) Maximum Temp: 84. (F)
Period 1 RVP: 11.5 Period 2 RVP: 11.5 Period 2 Start Yr: 1988

| Veh. Type: | LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | All Veh |
|---|---|---|---|---|---|---|---|---|---|---|
| Veh. Speeds: | 19.6 | 19.6 | 19.6 | | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | |
| VMT Mix: | 0.688 | 0.142 | 0.070 | | 0.031 | 0.005 | 0.001 | 0.052 | 0.011 | |
| Composite Emission Factors (Gm/Mile) | | | | | | | | | | |
| Total HC: | 8.39 | 9.67 | 16.64 | 11.98 | 29.67 | 0.66 | 0.99 | 5.48 | 9.71 | 9.626 |
| Exhaust HC: | 4.34 | 5.16 | 7.84 | 6.05 | 14.08 | 0.66 | 0.99 | 5.48 | 6.98 | 5.070 |
| Evaporat HC: | 2.44 | 2.84 | 6.06 | 3.91 | 12.29 | | | | 2.29 | 2.910 |
| Refuel L HC: | 0.37 | 0.43 | 0.44 | 0.44 | 0.61 | | | | | 0.364 |
| Runing L HC: | 1.13 | 1.13 | 2.20 | 1.48 | 2.52 | | | | | 1.167 |
| Rsting L HC: | 0.12 | 0.10 | 0.10 | 0.10 | 0.16 | | | | 0.44 | 0.114 |
| Exhaust CO: | 54.96 | 62.89 | 82.04 | 69.23 | 226.27 | 1.56 | 2.13 | 16.24 | 33.63 | 60.699 |
| Exhaust NOX: | 3.11 | 3.26 | 4.68 | 3.73 | 7.39 | 1.51 | 1.96 | 30.06 | 0.47 | 4.745 |

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Cal. Year: 1988 I/M Program: No Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.

SAN FRANCISCO CA Minimum Temp: 60. (F) Maximum Temp: 84. (F)
Period 1 RVP: 11.5 Period 2 RVP: 11.5 Period 2 Start Yr: 1988

| Veh. Type: | LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | All Veh |
|---|---|---|---|---|---|---|---|---|---|---|
| Veh. Speeds: | 19.6 | 19.6 | 19.6 | | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | |
| VMT Mix: | 0.639 | 0.152 | 0.076 | | 0.036 | 0.013 | 0.003 | 0.072 | 0.009 | |
| Composite Emission Factors (Gm/Mile) | | | | | | | | | | |
| Total HC: | 4.68 | 6.17 | 8.48 | 6.94 | 18.13 | 0.62 | 0.79 | 3.40 | 6.36 | 5.547 |
| Exhaust HC: | 2.27 | 3.38 | 4.18 | 3.65 | 6.95 | 0.62 | 0.79 | 3.40 | 3.07 | 2.822 |
| Evaporat HC: | 1.25 | 1.57 | 2.82 | 1.99 | 8.60 | | | | 2.85 | 1.588 |
| Refuel L HC: | 0.26 | 0.33 | 0.33 | 0.33 | 0.54 | | | | | 0.263 |
| Runing L HC: | 0.78 | 0.78 | 1.04 | 0.87 | 1.89 | | | | | 0.768 |
| Rsting L HC: | 0.12 | 0.10 | 0.10 | 0.10 | 0.15 | | | | 0.44 | 0.106 |
| Exhaust CO: | 29.07 | 40.56 | 47.98 | 43.03 | 128.80 | 1.57 | 1.72 | 13.95 | 22.71 | 34.312 |
| Exhaust NOX: | 1.70 | 2.14 | 2.67 | 2.32 | 5.96 | 1.57 | 1.77 | 21.52 | 0.80 | 3.415 |

---

Cal. Year: 1990 I/M Program: No Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.

SAN FRANCISCO CA Minimum Temp: 60. (F) Maximum Temp: 84. (F)
Period 1 RVP: 11.5 Period 2 RVP: 11.5 Period 2 Start Yr: 1988

| Veh. Type: | LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | All Veh |
|---|---|---|---|---|---|---|---|---|---|---|
| Veh. Speeds: | 19.6 | 19.6 | 19.6 | | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | |
| VMT Mix: | 0.628 | 0.163 | 0.077 | | 0.037 | 0.009 | 0.002 | 0.076 | 0.008 | |
| Composite Emission Factors (Gm/Mile) | | | | | | | | | | |
| Total HC: | 4.09 | 5.22 | 7.14 | 5.83 | 15.21 | 0.69 | 0.93 | 3.03 | 5.93 | 4.816 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Exhaust HC: | 1.91 | 2.87 | 3.56 | 3.09 | 5.67 | 0.69 | 0.93 | 3.03 | 2.57 | 2.410 |
| Evaporat HC: | 1.10 | 1.29 | 2.29 | 1.61 | 7.25 | | | | 2.91 | 1.369 |
| Refuel L HC: | 0.22 | 0.27 | 0.28 | 0.28 | 0.53 | | | | | 0.222 |
| Runing L HC: | 0.75 | 0.68 | 0.91 | 0.75 | 1.62 | | | | | 0.714 |
| Rsting L HC: | 0.11 | 0.10 | 0.10 | 0.10 | 0.14 | | | | 0.44 | 0.102 |
| Exhaust CO: | 25.23 | 34.05 | 40.33 | 36.06 | 105.70 | 1.67 | 1.90 | 13.30 | 21.95 | 29.616 |
| Exhaust NOX: | 1.44 | 1.89 | 2.28 | 2.01 | 5.78 | 1.63 | 1.87 | 20.07 | 0.82 | 3.154 |

M120 Warning: MOBILE4.1 does not model most 1993 and later Clean Air Act requirements; Emission Factors for CY 1993 or later are affected.

Cal. Year: 2000 I/M Program: No Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.

SAN FRANCISCO CA Minimum Temp: 60. (F) Maximum Temp: 84. (F)
Period 1 RVP: 11.5 Period 2 RVP: 11.5 Period 2 Start Yr: 1988

| Veh. Type: | LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | All Veh |
|---|---|---|---|---|---|---|---|---|---|---|
| Veh. Speeds: | 19.6 | 19.6 | 19.6 | | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | |
| VMT Mix: | 0.589 | 0.191 | 0.080 | | 0.038 | 0.002 | 0.002 | 0.092 | 0.007 | |
| Composite Emission Factors (Gm/Mile) | | | | | | | | | | |
| Total HC: | 2.74 | 3.38 | 3.73 | 3.48 | 9.03 | 0.63 | 0.92 | 2.21 | 5.48 | 3.141 |
| Exhaust HC: | 1.00 | 1.74 | 1.86 | 1.77 | 2.88 | 0.63 | 0.92 | 2.21 | 2.10 | 1.399 |
| Evaporat HC: | 0.88 | 0.87 | 1.04 | 0.92 | 4.46 | | | | 2.94 | 0.958 |
| Refuel L HC: | 0.04 | 0.07 | 0.07 | 0.07 | 0.49 | | | | | 0.062 |
| Runing L HC: | 0.73 | 0.62 | 0.68 | 0.64 | 1.11 | | | | | 0.641 |
| Rsting L HC: | 0.09 | 0.08 | 0.08 | 0.08 | 0.09 | | | | 0.44 | 0.080 |
| Exhaust CO: | 15.39 | 18.91 | 21.01 | 19.53 | 44.89 | 1.60 | 1.84 | 11.39 | 21.44 | 17.244 |
| Exhaust NOX: | 0.78 | 1.24 | 1.29 | 1.25 | 4.66 | 1.37 | 1.68 | 9.70 | 0.83 | 1.880 |

```
1           PROMPT
MOBILE4.1 UG EXAMPLE 4: OUTFMT = 4 (PORTRAIT (80 COLUMN) DESCRIPTIVE OUTPUT FORMAT)
1           TAMFLG
1           SPDFLG
1           VMFLAG
1           MYMRFG
1           NEWFLG
1           IMFLAG
1           ALHFLG
1           ATPFLG
3           RLFLAG
1           LOCFLG  -  READ IN LOCAL AREA PARAMETERS AS 2ND REQ SC REC
1           TEMFLG  -  CALCULATE EXHAUST TEMPERATURES
4           OUTFMT
4           PRTFLG
1           IDLFLG
1           NMHFLG
2           HCFLAG  -  PRINT HC COMPONENTS
89 2221       IOBMY, IVOB
1 80 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESV
1 88 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESV
1 90 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESV
1 00 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESV
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
```

MOBILE4.1 UG EXAMPLE 4: OUTFMT = 4 (PORTRAIT (80 COLUMN) DESCRIPTIVE OUTPUT FORM

Total HC emission factors include evaporative HC emission factors.

---

Cal. Year: 1980 Region: Low Altitude: 500. Ft.
I/M Program: No Ambient Temp: 78.1 / 78.1 / 78.1 F
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6

SAN FRANCISCO CA
Minimum Temp: 60. (F) Maximum Temp: 84. (F)
Period 1 RVP: 11.5 Period 2 RVP: 11.5 Period 2 Yr: 1988

| Veh. Type: | LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | All Veh |
|---|---|---|---|---|---|---|---|---|---|---|
| Veh. Spd.: | 19.6 | 19.6 | 19.6 | | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | |
| VMT Mix: | 0.688 | 0.142 | 0.070 | | 0.031 | 0.005 | 0.001 | 0.052 | 0.011 | |
| Composite Emission Factors (Gm/Mile) | | | | | | | | | | |
| Total HC: | 8.39 | 9.67 | 16.64 | 11.98 | 29.67 | 0.66 | 0.99 | 5.48 | 9.71 | 9.63 |
| Exhst HC: | 4.34 | 5.16 | 7.84 | 6.05 | 14.08 | 0.66 | 0.99 | 5.48 | 6.98 | 5.07 |
| Evap. HC: | 2.44 | 2.84 | 6.06 | 3.91 | 12.29 | | | | 2.29 | 2.91 |
| Refuel HC: | 0.37 | 0.43 | 0.44 | 0.44 | 0.61 | | | | | 0.36 |
| Runing HC: | 1.13 | 1.13 | 2.20 | 1.48 | 2.52 | | | | | 1.17 |
| Rsting HC: | 0.12 | 0.10 | 0.10 | 0.10 | 0.16 | | | | 0.44 | 0.11 |
| Exhst CO: | 54.96 | 62.89 | 82.04 | 69.23 | 226.27 | 1.56 | 2.13 | 16.24 | 33.63 | 60.70 |
| Exhst NOX: | 3.11 | 3.26 | 4.68 | 3.73 | 7.39 | 1.51 | 1.96 | 30.06 | 0.47 | 4.74 |

---

Cal. Year: 1988 Region: Low Altitude: 500. Ft.
I/M Program: No Ambient Temp: 78.1 / 78.1 / 78.1 F
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6

SAN FRANCISCO CA
Minimum Temp: 60. (F) Maximum Temp: 84. (F)
Period 1 RVP: 11.5 Period 2 RVP: 11.5 Period 2 Yr: 1988

| Veh. Type: | LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | All Veh |
|---|---|---|---|---|---|---|---|---|---|---|
| Veh. Spd.: | 19.6 | 19.6 | 19.6 | | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | |
| VMT Mix: | 0.639 | 0.152 | 0.076 | | 0.036 | 0.013 | 0.003 | 0.072 | 0.009 | |
| Composite Emission Factors (Gm/Mile) | | | | | | | | | | |
| Total HC: | 4.68 | 6.17 | 8.48 | 6.94 | 18.13 | 0.62 | 0.79 | 3.40 | 6.36 | 5.55 |
| Exhst HC: | 2.27 | 3.38 | 4.18 | 3.65 | 6.95 | 0.62 | 0.79 | 3.40 | 3.07 | 2.82 |
| Evap. HC: | 1.25 | 1.57 | 2.82 | 1.99 | 8.60 | | | | 2.85 | 1.59 |
| Refuel HC: | 0.26 | 0.33 | 0.33 | 0.33 | 0.54 | | | | | 0.26 |
| Runing HC: | 0.78 | 0.78 | 1.04 | 0.87 | 1.89 | | | | | 0.77 |
| Rsting HC: | 0.12 | 0.10 | 0.10 | 0.10 | 0.15 | | | | 0.44 | 0.11 |
| Exhst CO: | 29.07 | 40.56 | 47.98 | 43.03 | 128.80 | 1.57 | 1.72 | 13.95 | 22.71 | 34.31 |
| Exhst NOX: | 1.70 | 2.14 | 2.67 | 2.32 | 5.96 | 1.57 | 1.77 | 21.52 | 0.80 | 3.41 |

---

Cal. Year: 1990 Region: Low Altitude: 500. Ft.
I/M Program: No Ambient Temp: 78.1 / 78.1 / 78.1 F
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6

SAN FRANCISCO CA
Minimum Temp: 60. (F) Maximum Temp: 84. (F)
Period 1 RVP: 11.5 Period 2 RVP: 11.5 Period 2 Yr: 1988

| Veh. Type: | LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | All Veh |
|---|---|---|---|---|---|---|---|---|---|---|
| Veh. Spd.: | 19.6 | 19.6 | 19.6 | | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | |
| VMT Mix: | 0.628 | 0.163 | 0.077 | | 0.037 | 0.009 | 0.002 | 0.076 | 0.008 | |
| Composite Emission Factors (Gm/Mile) | | | | | | | | | | |
| Total HC: | 4.09 | 5.22 | 7.14 | 5.83 | 15.21 | 0.69 | 0.93 | 3.03 | 5.93 | 4.82 |
| Exhst HC: | 1.91 | 2.87 | 3.56 | 3.09 | 5.67 | 0.69 | 0.93 | 3.03 | 2.57 | 2.41 |
| Evap. HC: | 1.10 | 1.29 | 2.29 | 1.61 | 7.25 | | | | 2.91 | 1.37 |
| Refuel HC: | 0.22 | 0.27 | 0.28 | 0.28 | 0.53 | | | | | 0.22 |
| Runing HC: | 0.75 | 0.68 | 0.91 | 0.75 | 1.62 | | | | | 0.71 |
| Rsting HC: | 0.11 | 0.10 | 0.10 | 0.10 | 0.14 | | | | 0.44 | 0.10 |
| Exhst CO: | 25.23 | 34.05 | 40.33 | 36.06 | 105.70 | 1.67 | 1.90 | 13.30 | 21.95 | 29.62 |
| Exhst NOX: | 1.44 | 1.89 | 2.28 | 2.01 | 5.78 | 1.63 | 1.87 | 20.07 | 0.82 | 3.15 |

M120 Warning: MOBILE4.1 does not model most 1993 and later Clean Air Act requirements; Emission Factors for CY 1993 or later are affected.

Cal. Year: 2000 Region: Low Altitude: 500. Ft.
I/M Program: No Ambient Temp: 78.1 / 78.1 / 78.1 F
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6

SAN FRANCISCO CA
Minimum Temp: 60. (F) Maximum Temp: 84. (F)
Period 1 RVP: 11.5 Period 2 RVP: 11.5 Period 2 Yr: 1988

| Veh. Type: | LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | All Veh |
|---|---|---|---|---|---|---|---|---|---|---|
| Veh. Spd.: | 19.6 | 19.6 | 19.6 | | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | |
| VMT Mix: | 0.589 | 0.191 | 0.080 | | 0.038 | 0.002 | 0.002 | 0.092 | 0.007 | |
| Composite Emission Factors (Gm/Mile) | | | | | | | | | | |
| Total HC: | 2.74 | 3.38 | 3.73 | 3.48 | 9.03 | 0.63 | 0.92 | 2.21 | 5.48 | 3.14 |
| Exhst HC: | 1.00 | 1.74 | 1.86 | 1.77 | 2.88 | 0.63 | 0.92 | 2.21 | 2.10 | 1.40 |
| Evap. HC: | 0.88 | 0.87 | 1.04 | 0.92 | 4.46 | | | | 2.94 | 0.96 |
| Refuel HC: | 0.04 | 0.07 | 0.07 | 0.07 | 0.49 | | | | | 0.06 |
| Runing HC: | 0.73 | 0.62 | 0.68 | 0.64 | 1.11 | | | | | 0.64 |
| Rsting HC: | 0.09 | 0.08 | 0.08 | 0.08 | 0.09 | | | | 0.44 | 0.08 |
| Exhst CO: | 15.39 | 18.91 | 21.01 | 19.53 | 44.89 | 1.60 | 1.84 | 11.39 | 21.44 | 17.24 |
| Exhst NOX: | 0.78 | 1.24 | 1.29 | 1.25 | 4.66 | 1.37 | 1.68 | 9.70 | 0.83 | 1.88 |

```
1           PROMPT
MOBILE4.1 UG EXAMPLE 5: OUTFMT = 5 (= OUTFMT=3 + BYMY TABLES, TERSE VERSION)
1           TAMFLG
1           SPDFLG
1           VMFLAG
1           MYMRFG
1           NEWFLG
1           IMFLAG
1           ALHFLG
1           ATPFLG
3           RLFLAG
1           LOCFLG  -  READ IN LOCAL AREA PARAMETERS AS 2ND REQ SC REC
1           TEMFLG  -  CALCULATE EXHAUST TEMPERATURES
5           OUTFMT
4           PRTFLG
1           IDLFLG
1           NMHFLG
2           HCFLAG  -  PRINT HC COMPONENTS
89 2221        IOBMY, IVOB
22222222 1 1           BY MODEL YEAR TABLE PICKS
1 80 19.6 75.0 20.6 27.3 20.6                      1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88       LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 88 19.6 75.0 20.6 27.3 20.6                      1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88       LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
```

MOBILE4.1 UG EXAMPLE 5: OUTFMT = 5 (= OUTFMT=3 + BYMY TABLES, TERSE VERSION)

Total HC emission factors include evaporative HC emission factors.

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MOBILE4.1 UG EXAMPLE 5: OUTFMT = 5 (= OUTFMT=3 + BYMY TABLES, TERSE VERSION)

Cal. Year: 1980 I/M Program: No Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.

SAN FRANCISCO CA Minimum Temp: 60. (F) Maximum Temp: 84. (F)
Period 1 RVP: 11.5 Period 2 RVP: 11.5 Period 2 Start Yr: 1988

| Veh. Type: | LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | / LDDT | HDDV | MC | All Veh |
|---|---|---|---|---|---|---|---|---|---|---|
| Veh. Speeds: | 19.6 | 19.6 | 19.6 | | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | |
| VMT Mix: | 0.688 | 0.142 | 0.070 | | 0.031 | 0.005 | 0.001 | 0.052 | 0.011 | |
| Composite Emission Factors (Gm/Mile) | | | | | | | | | | |
| Total HC: | 8.39 | 9.67 | 16.64 | 11.98 | 29.67 | 0.66 | 0.99 | 5.48 | 9.71 | 9.626 |
| Exhaust HC: | 4.34 | 5.16 | 7.84 | 6.05 | 14.08 | 0.66 | 0.99 | 5.48 | 6.98 | 5.070 |
| Evaporat HC: | 2.44 | 2.84 | 6.06 | 3.91 | 12.29 | | | | 2.29 | 2.910 |
| Refuel L HC: | 0.37 | 0.43 | 0.44 | 0.44 | 0.61 | | | | | 0.364 |
| Runing L HC: | 1.13 | 1.13 | 2.20 | 1.48 | 2.52 | | | | | 1.167 |
| Rsting L HC: | 0.12 | 0.10 | 0.10 | 0.10 | 0.16 | | | | 0.44 | 0.114 |
| Exhaust CO: | 54.96 | 62.89 | 82.04 | 69.23 | 226.27 | 1.56 | 2.13 | 16.24 | 33.63 | 60.699 |
| Exhaust NOX: | 3.11 | 3.26 | 4.68 | 3.73 | 7.39 | 1.51 | 1.96 | 30.06 | 0.47 | 4.745 |

MOBILE4.1 UG EXAMPLE 5: OUTFMT = 5 (= OUTFMT=3 + BYMY TABLES, TERSE VERSION)
SAN FRANCISCO CA

Light Duty Gas Vehicles
Jan 1, 1980

| Model | | | HC | | | | | | | | CO | | | | NOX | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | TF | Miles | BEF4 | Tamper | SALHCF | Evapor | Refuel | Runnin | Restin | FER | BEF4 | Tamper | SALHCF | FER | BEF4 | Tamper | SALHCF | FER |
| 1980 | .0227 | 1640. | 0.461 | 0.043 | 1.000 | 0.643 | 0.261 | 0.482 | 0.086 | 0.045 | 8.357 | 0.529 | 1.000 | 0.201 | 1.458 | 0.153 | 1.000 | 0.037 |
| 1979 | .1107 | 9816. | 1.445 | 0.092 | 1.000 | 0.651 | 0.301 | 0.491 | 0.087 | 0.340 | 23.315 | 1.007 | 1.000 | 2.693 | 1.776 | 0.221 | 1.000 | 0.221 |
| 1978 | .1114 | 22403. | 1.832 | 0.208 | 1.000 | 0.693 | 0.306 | 0.504 | 0.092 | 0.405 | 26.999 | 2.171 | 1.000 | 3.249 | 1.906 | 0.349 | 1.000 | 0.251 |
| 1977 | .1045 | 34309. | 2.197 | 0.319 | 1.000 | 1.519 | 0.330 | 0.528 | 0.098 | 0.522 | 30.484 | 3.361 | 1.000 | 3.537 | 2.029 | 0.470 | 1.000 | 0.261 |
| 1976 | .1015 | 45571. | 2.544 | 0.427 | 1.000 | 1.607 | 0.347 | 0.572 | 0.103 | 0.568 | 33.780 | 4.552 | 1.000 | 3.890 | 2.559 | 0.579 | 1.000 | 0.318 |
| 1975 | .0927 | 56225. | 2.871 | 0.516 | 1.000 | 1.720 | 0.384 | 0.648 | 0.109 | 0.579 | 36.898 | 5.747 | 1.000 | 3.952 | 2.601 | 0.644 | 1.000 | 0.301 |
| 1974 | .0832 | 66303. | 4.674 | 0.088 | 1.000 | 1.855 | 0.424 | 0.753 | 0.115 | 0.658 | 63.959 | 2.137 | 1.000 | 5.502 | 3.045 | 0.242 | 1.000 | 0.274 |
| 1973 | .0573 | 75837. | 4.835 | 0.105 | 1.000 | 2.018 | 0.424 | 0.828 | 0.122 | 0.478 | 66.513 | 2.547 | 1.000 | 3.959 | 3.090 | 0.225 | 1.000 | 0.190 |
| 1972 | .0484 | 84854. | 4.987 | 0.040 | 1.000 | 2.196 | 0.417 | 0.954 | 0.129 | 0.422 | 68.929 | 0.978 | 1.000 | 3.384 | 4.248 | 0.000 | 1.000 | 0.206 |
| 1971 | .0468 | 93383. | 6.711 | 0.023 | 1.000 | 3.170 | 0.420 | 2.521 | 0.136 | 0.607 | 79.743 | 0.547 | 1.000 | 3.754 | 4.248 | 0.000 | 1.000 | 0.199 |
| 1970 | .0434 | 101452. | 6.721 | 0.024 | 1.000 | 4.627 | 0.406 | 2.521 | 0.144 | 0.627 | 76.518 | 0.560 | 1.000 | 3.346 | 4.248 | 0.000 | 1.000 | 0.184 |
| 1969 | .0443 | 109084. | 7.167 | 0.026 | 1.000 | 4.765 | 0.406 | 2.521 | 0.152 | 0.667 | 83.679 | 0.586 | 1.000 | 3.736 | 4.248 | 0.000 | 1.000 | 0.188 |
| 1968 | .0365 | 116303. | 7.348 | 0.028 | 1.000 | 4.906 | 0.406 | 2.521 | 0.161 | 0.561 | 85.507 | 0.632 | 1.000 | 3.145 | 4.248 | 0.000 | 1.000 | 0.155 |
| 1967 | .0272 | 123133. | 9.409 | 0.000 | 1.000 | 5.801 | 0.406 | 2.521 | 0.170 | 0.498 | 106.231 | 0.000 | 1.000 | 2.888 | 3.376 | 0.000 | 1.000 | 0.092 |
| 1966 | .0167 | 129593. | 9.525 | 0.000 | 1.000 | 5.947 | 0.406 | 2.521 | 0.180 | 0.310 | 107.692 | 0.000 | 1.000 | 1.796 | 3.376 | 0.000 | 1.000 | 0.056 |
| 1965 | .0125 | 135704. | 9.635 | 0.000 | 1.000 | 6.097 | 0.406 | 2.521 | 0.190 | 0.235 | 109.074 | 0.000 | 1.000 | 1.362 | 3.376 | 0.000 | 1.000 | 0.042 |
| 1964 | .0087 | 141484. | 9.738 | 0.000 | 1.000 | 6.250 | 0.406 | 2.521 | 0.201 | 0.166 | 110.381 | 0.000 | 1.000 | 0.961 | 3.376 | 0.000 | 1.000 | 0.029 |
| 1963 | .0088 | 146951. | 9.836 | 0.000 | 1.000 | 6.406 | 0.406 | 2.521 | 0.213 | 0.171 | 111.617 | 0.000 | 1.000 | 0.985 | 3.376 | 0.000 | 1.000 | 0.030 |
| 1962 | .0061 | 152124. | 9.929 | 0.000 | 1.000 | 9.865 | 0.406 | 2.521 | 0.225 | 0.140 | 112.787 | 0.000 | 1.000 | 0.690 | 3.377 | 0.000 | 1.000 | 0.021 |
| 1961 | .0042 | 157016. | 10.017 | 0.000 | 1.000 | 10.030 | 0.406 | 2.521 | 0.237 | 0.098 | 113.893 | 0.000 | 1.000 | 0.480 | 3.377 | 0.000 | 1.000 | 0.014 |
| 1960 | .0030 | 161644. | 10.100 | 0.000 | 1.000 | 10.198 | 0.406 | 2.521 | 0.251 | 0.070 | 114.939 | 0.000 | 1.000 | 0.343 | 3.377 | 0.000 | 1.000 | 0.010 |
| 1959 | .0024 | 166022. | 10.179 | 0.000 | 1.000 | 10.370 | 0.406 | 2.521 | 0.265 | 0.056 | 115.929 | 0.000 | 1.000 | 0.273 | 3.377 | 0.000 | 1.000 | 0.008 |
| 1958 | .0018 | 170162. | 10.253 | 0.000 | 1.000 | 10.547 | 0.406 | 2.521 | 0.281 | 0.043 | 116.866 | 0.000 | 1.000 | 0.208 | 3.377 | 0.000 | 1.000 | 0.006 |
| 1957 | .0013 | 174080. | 10.323 | 0.000 | 1.000 | 10.727 | 0.406 | 2.521 | 0.297 | 0.031 | 117.751 | 0.000 | 1.000 | 0.149 | 3.377 | 0.000 | 1.000 | 0.004 |
| 1956 | .0040 | 177785. | 10.390 | 0.000 | 1.000 | 10.914 | 0.406 | 2.521 | 0.314 | 0.098 | 118.589 | 0.000 | 1.000 | 0.473 | 3.378 | 0.000 | 1.000 | 0.013 |
| | | | | | | 2.438 | 0.368 | 1.126 | 0.120 | 8.394 | | | | 54.957 | | | | 3.111 |

Light Duty Gas Trucks 1
Jan 1, 1980

| Model | | | HC | | | | | | | | CO | | | | NOX | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | TF | Miles | BEF4 | Tamper | SALHCF | Evapor | Refuel | Runnin | Restin | FER | BEF4 | Tamper | SALHCF | FER | BEF4 | Tamper | SALHCF | FER |
| 1980 | .0266 | 1955. | 0.994 | 0.457 | 1.000 | 0.566 | 0.331 | 0.337 | 0.065 | 0.073 | 14.524 | 4.360 | 1.000 | 0.501 | 1.667 | 0.000 | 1.000 | 0.044 |
| 1979 | .1435 | 11697. | 1.293 | 0.595 | 1.000 | 0.574 | 0.411 | 0.337 | 0.066 | 0.470 | 17.284 | 6.027 | 1.000 | 3.344 | 1.721 | 0.000 | 1.000 | 0.247 |
| 1978 | .1338 | 26552. | 2.732 | 0.750 | 1.000 | 0.645 | 0.396 | 0.368 | 0.071 | 0.664 | 36.426 | 7.919 | 1.000 | 5.935 | 2.713 | 0.217 | 1.000 | 0.392 |
| 1977 | .1181 | 40409. | 3.142 | 0.935 | 1.000 | 1.647 | 0.387 | 0.615 | 0.076 | 0.804 | 40.690 | 10.159 | 1.000 | 6.008 | 2.753 | 0.699 | 1.000 | 0.408 |
| 1976 | .1162 | 53335. | 3.524 | 1.205 | 1.000 | 1.914 | 0.420 | 0.835 | 0.082 | 0.927 | 44.664 | 13.403 | 1.000 | 6.748 | 2.791 | 1.033 | 1.000 | 0.444 |
| 1975 | .0816 | 65393. | 3.881 | 1.237 | 1.000 | 2.066 | 0.442 | 0.918 | 0.088 | 0.704 | 48.369 | 13.657 | 1.000 | 5.060 | 2.827 | 1.036 | 1.000 | 0.315 |
| 1974 | .0646 | 76642. | 4.909 | 0.199 | 1.000 | 2.231 | 0.484 | 1.023 | 0.094 | 0.578 | 67.192 | 4.804 | 1.000 | 4.653 | 3.029 | 0.371 | 1.000 | 0.220 |
| 1973 | .0321 | 87135. | 5.097 | 0.207 | 1.000 | 2.367 | 0.484 | 1.032 | 0.101 | 0.298 | 70.115 | 4.989 | 1.000 | 2.410 | 3.068 | 0.331 | 1.000 | 0.109 |
| 1972 | .0245 | 96923. | 5.272 | 0.071 | 1.000 | 2.541 | 0.476 | 1.124 | 0.108 | 0.235 | 72.841 | 1.721 | 1.000 | 1.826 | 4.248 | 0.000 | 1.000 | 0.104 |
| 1971 | .0245 | 106054. | 7.198 | 0.036 | 1.000 | 3.609 | 0.476 | 2.521 | 0.116 | 0.342 | 84.175 | 0.882 | 1.000 | 2.087 | 4.248 | 0.000 | 1.000 | 0.104 |
| 1970 | .0245 | 114572. | 7.204 | 0.036 | 1.000 | 4.695 | 0.476 | 2.521 | 0.124 | 0.368 | 80.771 | 0.841 | 1.000 | 1.997 | 4.248 | 0.000 | 1.000 | 0.104 |
| 1969 | .0346 | 122517. | 7.503 | 0.037 | 1.000 | 4.912 | 0.476 | 2.521 | 0.133 | 0.539 | 87.080 | 0.827 | 1.000 | 3.042 | 4.248 | 0.000 | 1.000 | 0.147 |
| 1968 | .0302 | 129929. | 7.689 | 0.038 | 1.000 | 5.138 | 0.476 | 2.521 | 0.143 | 0.484 | 88.957 | 0.847 | 1.000 | 2.714 | 4.247 | 0.000 | 1.000 | 0.128 |
| 1967 | .0237 | 136843. | 9.655 | 0.000 | 1.000 | 6.044 | 0.476 | 2.521 | 0.153 | 0.447 | 109.332 | 0.000 | 1.000 | 2.592 | 3.376 | 0.000 | 1.000 | 0.080 |
| 1966 | .0167 | 143293. | 9.771 | 0.000 | 1.000 | 6.283 | 0.476 | 2.521 | 0.164 | 0.322 | 110.790 | 0.000 | 1.000 | 1.854 | 3.376 | 0.000 | 1.000 | 0.057 |
| 1965 | .0095 | 149310. | 9.879 | 0.000 | 1.000 | 6.531 | 0.476 | 2.521 | 0.176 | 0.186 | 112.150 | 0.000 | 1.000 | 1.063 | 3.377 | 0.000 | 1.000 | 0.032 |
| 1964 | .0120 | 154922. | 9.979 | 0.000 | 1.000 | 6.791 | 0.476 | 2.521 | 0.188 | 0.239 | 113.419 | 0.000 | 1.000 | 1.357 | 3.377 | 0.000 | 1.000 | 0.040 |
| 1963 | .0112 | 160157. | 10.073 | 0.000 | 1.000 | 7.061 | 0.476 | 2.521 | 0.202 | 0.227 | 114.603 | 0.000 | 1.000 | 1.279 | 3.377 | 0.000 | 1.000 | 0.038 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1962 | .0493 | 165041. | 10.161 | 0.000 | 1.000 | 10.643 | 0.476 | 2.521 | 0.216 | 1.185 | 115.708 | 0.000 | 1.000 | 5.709 | 3.377 | 0.000 | 1.000 | 0.167 |
| 1961 | .0055 | 169597. | 10.243 | 0.000 | 1.000 | 10.937 | 0.476 | 2.521 | 0.232 | 0.134 | 116.738 | 0.000 | 1.000 | 0.641 | 3.377 | 0.000 | 1.000 | 0.019 |
| 1960 | .0039 | 173847. | 10.319 | 0.000 | 1.000 | 11.246 | 0.476 | 2.521 | 0.249 | 0.098 | 117.699 | 0.000 | 1.000 | 0.464 | 3.377 | 0.000 | 1.000 | 0.013 |
| 1959 | .0033 | 177811. | 10.390 | 0.000 | 1.000 | 11.567 | 0.476 | 2.521 | 0.266 | 0.083 | 118.595 | 0.000 | 1.000 | 0.392 | 3.378 | 0.000 | 1.000 | 0.011 |
| 1958 | .0027 | 181509. | 10.456 | 0.000 | 1.000 | 11.904 | 0.476 | 2.521 | 0.286 | 0.070 | 119.431 | 0.000 | 1.000 | 0.327 | 3.378 | 0.000 | 1.000 | 0.009 |
| 1957 | .0019 | 184959. | 10.518 | 0.000 | 1.000 | 12.255 | 0.476 | 2.521 | 0.306 | 0.050 | 120.211 | 0.000 | 1.000 | 0.231 | 3.378 | 0.000 | 1.000 | 0.006 |
| 1956 | .0054 | 188177. | 10.576 | 0.000 | 1.000 | 12.621 | 0.476 | 2.521 | 0.328 | 0.142 | 120.939 | 0.000 | 1.000 | 0.649 | 3.378 | 0.000 | 1.000 | 0.018 |
| | | | | | | 2.842 | 0.433 | 1.131 | 0.103 | 9.670 | | | | 62.885 | | | | 3.257 |

MOBILE4.1 UG EXAMPLE 5: OUTFMT = 5 (= OUTFMT=3 + BYMY TABLES, TERSE VERSION)
SAN FRANCISCO CA

Light Duty Gas Trucks 2
Jan 1, 1980

| Model | | | HC | | | | | | | | CO | | | | NOX | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | TF | Miles | BEF4 | Tamper | SALHCF | Evapor | Refuel | Runnin | Restin | FER | BEF4 | Tamper | SALHCF | FER | BEF4 | Tamper | SALHCF | FER |
| 1980 | .0221 | 2201. | 1.002 | 0.566 | 1.000 | 0.529 | 0.331 | 0.337 | 0.058 | 0.062 | 14.594 | 5.278 | 1.000 | 0.439 | 1.668 | 0.000 | 1.000 | 0.037 |
| 1979 | .1254 | 13163. | 1.338 | 0.747 | 1.000 | 0.539 | 0.410 | 0.337 | 0.059 | 0.430 | 17.699 | 7.289 | 1.000 | 3.134 | 1.729 | 0.000 | 1.000 | 0.217 |
| 1978 | .1151 | 29731. | 6.757 | 0.000 | 1.000 | 4.334 | 0.396 | 2.521 | 0.064 | 1.619 | 69.823 | 0.000 | 1.000 | 8.034 | 4.510 | 0.039 | 1.000 | 0.523 |
| 1977 | .0888 | 44991. | 7.016 | 0.000 | 1.000 | 4.606 | 0.386 | 2.521 | 0.070 | 1.296 | 73.763 | 0.000 | 1.000 | 6.548 | 4.568 | 0.102 | 1.000 | 0.415 |
| 1976 | .0887 | 59047. | 7.254 | 0.000 | 1.000 | 4.890 | 0.420 | 2.521 | 0.076 | 1.345 | 77.389 | 0.000 | 1.000 | 6.864 | 4.621 | 0.123 | 1.000 | 0.421 |
| 1975 | .0893 | 71992. | 7.474 | 0.000 | 1.000 | 5.189 | 0.442 | 2.521 | 0.082 | 1.403 | 80.728 | 0.000 | 1.000 | 7.213 | 4.670 | 0.124 | 1.000 | 0.428 |
| 1974 | .0788 | 83915. | 7.676 | 0.000 | 1.000 | 5.503 | 0.484 | 2.521 | 0.089 | 1.282 | 83.801 | 0.000 | 1.000 | 6.601 | 4.715 | 0.124 | 1.000 | 0.381 |
| 1973 | .0606 | 94897. | 8.664 | 0.000 | 1.000 | 5.833 | 0.484 | 2.521 | 0.097 | 1.067 | 83.807 | 0.000 | 1.000 | 5.082 | 6.299 | 0.127 | 1.000 | 0.390 |
| 1972 | .0459 | 105012. | 8.917 | 0.000 | 1.000 | 6.179 | 0.475 | 2.521 | 0.105 | 0.835 | 86.367 | 0.000 | 1.000 | 3.962 | 6.299 | 0.000 | 1.000 | 0.289 |
| 1971 | .0358 | 114329. | 9.151 | 0.000 | 1.000 | 6.545 | 0.475 | 2.521 | 0.114 | 0.674 | 88.726 | 0.000 | 1.000 | 3.179 | 6.298 | 0.000 | 1.000 | 0.226 |
| 1970 | .0245 | 122909. | 9.366 | 0.000 | 1.000 | 6.917 | 0.475 | 2.521 | 0.124 | 0.476 | 90.898 | 0.000 | 1.000 | 2.230 | 6.298 | 0.000 | 1.000 | 0.155 |
| 1969 | .0538 | 130812. | 11.853 | 0.000 | 1.000 | 7.318 | 0.475 | 2.521 | 0.135 | 1.199 | 123.717 | 0.000 | 1.000 | 6.652 | 5.339 | 0.000 | 1.000 | 0.287 |
| 1968 | .0431 | 138092. | 11.984 | 0.000 | 1.000 | 7.736 | 0.475 | 2.521 | 0.146 | 0.984 | 125.363 | 0.000 | 1.000 | 5.398 | 5.339 | 0.000 | 1.000 | 0.230 |
| 1967 | .0337 | 144796. | 12.104 | 0.000 | 1.000 | 13.754 | 0.475 | 2.521 | 0.159 | 0.978 | 126.880 | 0.000 | 1.000 | 4.277 | 5.339 | 0.000 | 1.000 | 0.180 |
| 1966 | .0237 | 150970. | 12.215 | 0.000 | 1.000 | 14.218 | 0.475 | 2.521 | 0.172 | 0.703 | 128.276 | 0.000 | 1.000 | 3.046 | 5.340 | 0.000 | 1.000 | 0.127 |
| 1965 | .0140 | 156658. | 12.317 | 0.000 | 1.000 | 14.708 | 0.475 | 2.521 | 0.187 | 0.423 | 129.563 | 0.000 | 1.000 | 1.816 | 5.340 | 0.000 | 1.000 | 0.075 |
| 1964 | .0119 | 161896. | 12.411 | 0.000 | 1.000 | 15.225 | 0.475 | 2.521 | 0.203 | 0.366 | 130.747 | 0.000 | 1.000 | 1.553 | 5.340 | 0.000 | 1.000 | 0.063 |
| 1963 | .0119 | 166721. | 12.498 | 0.000 | 1.000 | 15.770 | 0.475 | 2.521 | 0.220 | 0.374 | 131.839 | 0.000 | 1.000 | 1.568 | 5.341 | 0.000 | 1.000 | 0.064 |
| 1962 | .0079 | 171165. | 12.577 | 0.000 | 1.000 | 16.346 | 0.475 | 2.521 | 0.239 | 0.254 | 132.844 | 0.000 | 1.000 | 1.048 | 5.341 | 0.000 | 1.000 | 0.042 |
| 1961 | .0056 | 175257. | 12.651 | 0.000 | 1.000 | 16.954 | 0.475 | 2.521 | 0.260 | 0.186 | 133.770 | 0.000 | 1.000 | 0.756 | 5.341 | 0.000 | 1.000 | 0.030 |
| 1960 | .0037 | 179027. | 12.718 | 0.000 | 1.000 | 17.595 | 0.475 | 2.521 | 0.282 | 0.125 | 134.622 | 0.000 | 1.000 | 0.500 | 5.341 | 0.000 | 1.000 | 0.020 |
| 1959 | .0038 | 182499. | 12.781 | 0.000 | 1.000 | 18.272 | 0.475 | 2.521 | 0.306 | 0.129 | 135.408 | 0.000 | 1.000 | 0.510 | 5.342 | 0.000 | 1.000 | 0.020 |
| 1958 | .0032 | 185697. | 12.838 | 0.000 | 1.000 | 18.989 | 0.475 | 2.521 | 0.332 | 0.111 | 136.131 | 0.000 | 1.000 | 0.429 | 5.342 | 0.000 | 1.000 | 0.017 |
| 1957 | .0020 | 188643. | 12.891 | 0.000 | 1.000 | 19.745 | 0.475 | 2.521 | 0.361 | 0.073 | 136.797 | 0.000 | 1.000 | 0.278 | 5.342 | 0.000 | 1.000 | 0.011 |
| 1956 | .0067 | 191355. | 12.940 | 0.000 | 1.000 | 20.545 | 0.475 | 2.521 | 0.392 | 0.247 | 137.411 | 0.000 | 1.000 | 0.919 | 5.342 | 0.000 | 1.000 | 0.036 |
| | | | | | | 6.058 | 0.440 | 2.199 | 0.102 | 16.642 | | | | 82.036 | | | | 4.682 |

Heavy Duty Gas Vehicles
Jan 1, 1980

| Model | | | HC | | | | | | | | CO | | | | NOX | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | TF | Miles | BEF4 | Tamper | SALHCF | Evapor | Refuel | Runnin | Restin | FER | BEF4 | Tamper | SALHCF | FER | BEF4 | Tamper | SALHCF | FER |
| 1980 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1979 | .1188 | 9105. | 3.956 | 0.000 | 1.026 | 11.308 | 0.562 | 2.521 | 0.088 | 2.203 | 65.898 | 0.000 | 1.022 | 8.003 | 5.867 | 0.000 | 0.996 | 0.695 |
| 1978 | .1112 | 26595. | 7.837 | 0.000 | 1.026 | 11.325 | 0.571 | 2.521 | 0.096 | 2.507 | 146.908 | 0.000 | 1.022 | 16.692 | 5.181 | 0.000 | 0.996 | 0.574 |
| 1977 | .0910 | 42696. | 8.148 | 0.000 | 1.026 | 11.341 | 0.583 | 2.521 | 0.104 | 2.084 | 155.566 | 0.000 | 1.022 | 14.465 | 5.272 | 0.000 | 0.996 | 0.478 |
| 1976 | .0868 | 57522. | 9.841 | 0.000 | 1.026 | 11.355 | 0.598 | 2.521 | 0.113 | 2.142 | 191.032 | 0.000 | 1.022 | 16.939 | 6.262 | 0.000 | 0.996 | 0.541 |
| 1975 | .0868 | 71171. | 10.769 | 0.000 | 1.026 | 11.368 | 0.616 | 2.521 | 0.123 | 2.228 | 210.727 | 0.000 | 1.022 | 18.687 | 6.741 | 0.000 | 0.996 | 0.583 |
| 1974 | .0786 | 83738. | 11.989 | 0.000 | 1.026 | 11.381 | 0.628 | 2.521 | 0.134 | 2.120 | 237.251 | 0.000 | 1.022 | 19.062 | 7.435 | 0.000 | 0.996 | 0.582 |
| 1973 | .0572 | 95308. | 13.667 | 0.000 | 1.026 | 11.392 | 0.641 | 2.521 | 0.145 | 1.643 | 248.591 | 0.000 | 1.022 | 14.534 | 9.608 | 0.000 | 0.996 | 0.548 |
| 1972 | .0451 | 105961. | 14.089 | 0.000 | 1.026 | 11.402 | 0.642 | 2.521 | 0.158 | 1.317 | 256.588 | 0.000 | 1.022 | 11.839 | 9.608 | 0.000 | 0.996 | 0.432 |
| 1971 | .0346 | 115769. | 14.478 | 0.000 | 1.026 | 11.412 | 0.642 | 2.521 | 0.171 | 1.025 | 263.951 | 0.000 | 1.022 | 9.344 | 9.608 | 0.000 | 0.996 | 0.332 |
| 1970 | .0282 | 124799. | 14.836 | 0.000 | 1.026 | 11.421 | 0.642 | 2.521 | 0.186 | 0.847 | 270.730 | 0.000 | 1.022 | 7.815 | 9.608 | 0.000 | 0.996 | 0.270 |
| 1969 | .0545 | 133113. | 24.203 | 0.000 | 1.026 | 11.426 | 0.652 | 2.521 | 0.202 | 2.161 | 318.288 | 0.000 | 1.022 | 17.738 | 8.983 | 0.000 | 0.996 | 0.488 |
| 1968 | .0433 | 140768. | 24.480 | 0.000 | 1.026 | 11.426 | 0.652 | 2.521 | 0.219 | 1.727 | 322.716 | 0.000 | 1.022 | 14.266 | 8.983 | 0.000 | 0.996 | 0.387 |
| 1967 | .0356 | 147816. | 24.734 | 0.000 | 1.026 | 16.999 | 0.652 | 2.521 | 0.238 | 1.628 | 326.793 | 0.000 | 1.022 | 11.876 | 8.983 | 0.000 | 0.996 | 0.318 |
| 1966 | .0255 | 154305. | 24.969 | 0.000 | 1.026 | 16.999 | 0.652 | 2.521 | 0.259 | 1.176 | 330.546 | 0.000 | 1.022 | 8.626 | 8.983 | 0.000 | 0.996 | 0.229 |
| 1965 | .0193 | 160279. | 25.185 | 0.000 | 1.026 | 16.999 | 0.652 | 2.521 | 0.281 | 0.893 | 334.002 | 0.000 | 1.022 | 6.585 | 8.983 | 0.000 | 0.996 | 0.173 |
| 1964 | .0161 | 165780. | 25.384 | 0.000 | 1.026 | 16.999 | 0.652 | 2.521 | 0.305 | 0.749 | 337.184 | 0.000 | 1.022 | 5.546 | 8.983 | 0.000 | 0.996 | 0.144 |
| 1963 | .0169 | 170844. | 25.567 | 0.000 | 1.026 | 16.999 | 0.652 | 2.521 | 0.331 | 0.788 | 340.114 | 0.000 | 1.022 | 5.861 | 8.983 | 0.000 | 0.996 | 0.151 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1962 | .0113 | 175506. | 26.323 | 0.000 | 1.026 | 16.999 | 0.652 | 2.521 | 0.360 | 0.537 | 350.068 | 0.000 | 1.022 | 4.040 | 9.168 | 0.000 | 0.996 | 0.103 |
| 1961 | .0078 | 179799. | 26.483 | 0.000 | 1.026 | 16.999 | 0.652 | 2.521 | 0.391 | 0.372 | 352.604 | 0.000 | 1.022 | 2.810 | 9.168 | 0.000 | 0.996 | 0.071 |
| 1960 | .0064 | 183752. | 26.630 | 0.000 | 1.026 | 16.999 | 0.652 | 2.521 | 0.425 | 0.306 | 354.939 | 0.000 | 1.022 | 2.315 | 9.168 | 0.000 | 0.996 | 0.058 |
| 1959 | .0059 | 187390. | 26.765 | 0.000 | 1.026 | 16.999 | 0.652 | 2.521 | 0.461 | 0.283 | 357.089 | 0.000 | 1.022 | 2.144 | 9.168 | 0.000 | 0.996 | 0.054 |
| 1958 | .0037 | 190741. | 26.889 | 0.000 | 1.026 | 16.999 | 0.652 | 2.521 | 0.501 | 0.179 | 359.069 | 0.000 | 1.022 | 1.365 | 9.168 | 0.000 | 0.996 | 0.034 |
| 1957 | .0034 | 193825. | 27.004 | 0.000 | 1.026 | 16.999 | 0.652 | 2.521 | 0.544 | 0.166 | 360.891 | 0.000 | 1.022 | 1.263 | 9.168 | 0.000 | 0.996 | 0.031 |
| 1956 | .0120 | 196665. | 27.109 | 0.000 | 1.026 | 16.999 | 0.652 | 2.521 | 0.591 | 0.585 | 362.569 | 0.000 | 1.022 | 4.460 | 9.168 | 0.000 | 0.996 | 0.110 |
| | | | | | | 12.288 | 0.615 | 2.521 | 0.163 | 29.666 | | | | 226.273 | | | | 7.387 |

MOBILE4.1 UG EXAMPLE 5: OUTFMT = 5 (= OUTFMT=3 + BYMY TABLES, TERSE VERSION)
SAN FRANCISCO CA

Light Duty Diesel Vehicles
Jan 1, 1980

| Model | | | HC | | | CO | | | NOX | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | TF | Miles | BEF4 | SALHCF | FER | BEF4 | SALHCF | FER | BEF4 | SALHCF | FER |
| 1980 | .1804 | 2228. | 0.297 | 1.000 | 0.054 | 1.159 | 1.000 | 0.209 | 1.409 | 1.000 | 0.254 |
| 1979 | .4086 | 13327. | 0.513 | 1.000 | 0.210 | 1.290 | 1.000 | 0.527 | 1.453 | 1.000 | 0.594 |
| 1978 | .1701 | 30145. | 0.631 | 1.000 | 0.107 | 1.441 | 1.000 | 0.245 | 1.520 | 1.000 | 0.259 |
| 1977 | .0863 | 45692. | 0.740 | 1.000 | 0.064 | 1.581 | 1.000 | 0.136 | 1.583 | 1.000 | 0.137 |
| 1976 | .0490 | 60063. | 0.841 | 1.000 | 0.041 | 1.710 | 1.000 | 0.084 | 1.640 | 1.000 | 0.080 |
| 1975 | .0291 | 73349. | 0.934 | 1.000 | 0.027 | 1.830 | 1.000 | 0.053 | 1.693 | 1.000 | 0.049 |
| 1974 | .0384 | 85630. | 1.995 | 1.000 | 0.077 | 3.822 | 1.000 | 0.147 | 1.802 | 1.000 | 0.069 |
| 1973 | .0172 | 96984. | 2.086 | 1.000 | 0.036 | 3.970 | 1.000 | 0.068 | 1.847 | 1.000 | 0.032 |
| 1972 | .0142 | 107479. | 2.169 | 1.000 | 0.031 | 4.106 | 1.000 | 0.058 | 1.889 | 1.000 | 0.027 |
| 1971 | .0067 | 117181. | 2.247 | 1.000 | 0.015 | 4.232 | 1.000 | 0.028 | 1.928 | 1.000 | 0.013 |
| 1970 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1969 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1968 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1967 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1966 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1965 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1964 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1963 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1962 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1961 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1960 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1959 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1958 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1957 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1956 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | | 0.661 | | | 1.557 | | | 1.514 |

Light Duty Diesel Trucks
Jan 1, 1980

| Model | | | HC | | | CO | | | NOX | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | TF | Miles | BEF4 | SALHCF | FER | BEF4 | SALHCF | FER | BEF4 | SALHCF | FER |
| 1980 | .2118 | 2517. | 0.880 | 1.000 | 0.186 | 1.995 | 1.000 | 0.423 | 1.850 | 1.000 | 0.392 |
| 1979 | .5694 | 15025. | 0.980 | 1.000 | 0.558 | 2.120 | 1.000 | 1.207 | 1.950 | 1.000 | 1.110 |
| 1978 | .2189 | 33252. | 1.126 | 1.000 | 0.246 | 2.302 | 1.000 | 0.504 | 2.096 | 1.000 | 0.459 |
| 1977 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1976 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1975 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1974 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1973 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1972 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1971 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1970 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1969 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1968 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1967 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1966 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1965 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1964 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1963 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1962 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1961 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1960 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1959 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1958 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1957 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1956 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | | 0.991 | | | 2.134 | | | 1.961 |

MOBILE4.1 UG EXAMPLE 5: OUTFMT = 5 (= OUTFMT=3 + BYMY TABLES, TERSE VERSION)
SAN FRANCISCO CA

Heavy Duty Diesel Vehicles
Jan 1, 1980

| Model | | | HC | | | CO | | | NOX | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | TF | Miles | BEF4 | SALHCF | FER | BEF4 | SALHCF | FER | BEF4 | SALHCF | FER |
| 1980 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1979 | .1650 | 35671. | 3.510 | 1.015 | 0.588 | 14.468 | 1.021 | 2.437 | 23.780 | 1.008 | 3.955 |
| 1978 | .1461 | 104163. | 4.545 | 1.015 | 0.674 | 13.107 | 1.021 | 1.955 | 27.479 | 1.008 | 4.047 |
| 1977 | .0979 | 167179. | 4.993 | 1.015 | 0.496 | 14.325 | 1.021 | 1.432 | 29.146 | 1.008 | 2.876 |
| 1976 | .0961 | 225158. | 5.261 | 1.015 | 0.513 | 15.023 | 1.021 | 1.474 | 29.718 | 1.008 | 2.878 |
| 1975 | .1072 | 278502. | 5.581 | 1.015 | 0.607 | 15.876 | 1.021 | 1.737 | 30.732 | 1.008 | 3.320 |
| 1974 | .0905 | 327582. | 5.875 | 1.015 | 0.540 | 16.661 | 1.021 | 1.539 | 31.664 | 1.008 | 2.888 |
| 1973 | .0486 | 372739. | 6.146 | 1.015 | 0.303 | 17.384 | 1.021 | 0.863 | 32.542 | 1.008 | 1.595 |
| 1972 | .0396 | 414287. | 6.396 | 1.015 | 0.257 | 18.049 | 1.021 | 0.729 | 33.331 | 1.008 | 1.330 |
| 1971 | .0277 | 452513. | 6.625 | 1.015 | 0.186 | 18.660 | 1.021 | 0.528 | 34.058 | 1.008 | 0.951 |
| 1970 | .0306 | 487684. | 6.736 | 1.015 | 0.209 | 18.445 | 1.021 | 0.576 | 34.066 | 1.008 | 1.051 |
| 1969 | .0315 | 520044. | 6.900 | 1.015 | 0.221 | 18.841 | 1.021 | 0.606 | 33.951 | 1.008 | 1.078 |
| 1968 | .0210 | 549817. | 6.959 | 1.015 | 0.148 | 18.937 | 1.021 | 0.405 | 33.727 | 1.008 | 0.713 |
| 1967 | .0159 | 577211. | 7.123 | 1.015 | 0.115 | 19.348 | 1.021 | 0.314 | 34.220 | 1.008 | 0.548 |
| 1966 | .0063 | 602415. | 7.154 | 1.015 | 0.046 | 18.754 | 1.021 | 0.120 | 33.231 | 1.008 | 0.210 |
| 1965 | .0067 | 625605. | 7.294 | 1.015 | 0.050 | 19.078 | 1.021 | 0.131 | 33.625 | 1.008 | 0.228 |
| 1964 | .0473 | 646942. | 7.422 | 1.015 | 0.356 | 19.377 | 1.021 | 0.936 | 33.988 | 1.008 | 1.620 |
| 1963 | .0077 | 666573. | 7.539 | 1.015 | 0.059 | 19.652 | 1.021 | 0.155 | 34.322 | 1.008 | 0.267 |
| 1962 | .0045 | 684636. | 7.648 | 1.015 | 0.035 | 19.905 | 1.021 | 0.091 | 34.629 | 1.008 | 0.157 |
| 1961 | .0031 | 701254. | 7.748 | 1.015 | 0.024 | 20.138 | 1.021 | 0.064 | 34.911 | 1.008 | 0.109 |
| 1960 | .0019 | 716545. | 7.839 | 1.015 | 0.015 | 20.352 | 1.021 | 0.039 | 35.171 | 1.008 | 0.067 |
| 1959 | .0015 | 730614. | 7.924 | 1.015 | 0.012 | 20.549 | 1.021 | 0.031 | 35.410 | 1.008 | 0.052 |
| 1958 | .0013 | 743558. | 8.001 | 1.015 | 0.011 | 20.730 | 1.021 | 0.028 | 35.630 | 1.008 | 0.048 |
| 1957 | .0005 | 755468. | 8.073 | 1.015 | 0.004 | 20.897 | 1.021 | 0.011 | 35.833 | 1.008 | 0.018 |
| 1956 | .0016 | 766426. | 8.139 | 1.015 | 0.013 | 21.050 | 1.021 | 0.034 | 36.019 | 1.008 | 0.058 |
| | | | | | 5.483 | | | 16.236 | | | 30.064 |

Motorcycles
Jan 1, 1980

| Model | | | HC | | | | | CO | | | NOX | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | TF | Miles | BEF4 | SALHCF | Evapor | Restin | FER | BEF4 | SALHCF | FER | BEF4 | SALHCF | FER |
| 1980 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1979 | .2568 | 2393. | 2.750 | 1.000 | 2.710 | 0.336 | 1.489 | 25.262 | 1.000 | 6.488 | 0.664 | 1.000 | 0.171 |
| 1978 | .1930 | 7023. | 3.419 | 1.000 | 2.710 | 0.359 | 1.252 | 26.898 | 1.000 | 5.190 | 0.664 | 1.000 | 0.128 |
| 1977 | .1450 | 11343. | 9.562 | 1.000 | 1.947 | 0.386 | 1.724 | 37.125 | 1.000 | 5.382 | 0.283 | 1.000 | 0.041 |
| 1976 | .1083 | 15351. | 9.860 | 1.000 | 1.947 | 0.418 | 1.324 | 38.414 | 1.000 | 4.160 | 0.296 | 1.000 | 0.032 |
| 1975 | .0792 | 19049. | 10.135 | 1.000 | 1.947 | 0.454 | 0.993 | 39.604 | 1.000 | 3.137 | 0.309 | 1.000 | 0.024 |
| 1974 | .0578 | 22437. | 10.386 | 1.000 | 1.947 | 0.498 | 0.742 | 40.694 | 1.000 | 2.353 | 0.320 | 1.000 | 0.019 |
| 1973 | .0420 | 25513. | 10.615 | 1.000 | 1.947 | 0.551 | 0.551 | 41.684 | 1.000 | 1.750 | 0.331 | 1.000 | 0.014 |
| 1972 | .0300 | 28279. | 10.821 | 1.000 | 1.947 | 0.616 | 0.402 | 42.573 | 1.000 | 1.278 | 0.340 | 1.000 | 0.010 |
| 1971 | .0213 | 30735. | 11.003 | 1.000 | 1.947 | 0.699 | 0.291 | 43.363 | 1.000 | 0.924 | 0.348 | 1.000 | 0.007 |
| 1970 | .0146 | 32879. | 11.162 | 1.000 | 1.947 | 0.809 | 0.203 | 44.053 | 1.000 | 0.644 | 0.355 | 1.000 | 0.005 |
| 1969 | .0520 | 34713. | 11.299 | 1.000 | 1.947 | 0.959 | 0.738 | 44.643 | 1.000 | 2.321 | 0.361 | 1.000 | 0.019 |
| 1968 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1967 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1966 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1965 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1964 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1963 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1962 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1961 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1960 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1959 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1958 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1957 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1956 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | | 2.290 | 0.440 | 9.709 | | | 33.627 | | | 0.470 |

MOBILE4.1 UG EXAMPLE 5: OUTFMT = 5 (= OUTFMT=3 + BYMY TABLES, TERSE VERSION)

Cal. Year: 1988 I/M Program: No Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.

SAN FRANCISCO CA Minimum Temp: 60. (F) Maximum Temp: 84. (F)
Period 1 RVP: 11.5 Period 2 RVP: 11.5 Period 2 Start Yr: 1988

| Veh. Type: | LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | All Veh |
|---|---|---|---|---|---|---|---|---|---|---|
| Veh. Speeds: | 19.6 | 19.6 | 19.6 | | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | |
| VMT Mix: | 0.639 | 0.152 | 0.076 | | 0.036 | 0.013 | 0.003 | 0.072 | 0.009 | |
| Composite Emission Factors (Gm/Mile) | | | | | | | | | | |
| Total HC: | 4.68 | 6.17 | 8.48 | 6.94 | 18.13 | 0.62 | 0.79 | 3.40 | 6.36 | 5.547 |
| Exhaust HC: | 2.27 | 3.38 | 4.18 | 3.65 | 6.95 | 0.62 | 0.79 | 3.40 | 3.07 | 2.822 |
| Evaporat HC: | 1.25 | 1.57 | 2.82 | 1.99 | 8.60 | | | | 2.85 | 1.588 |
| Refuel L HC: | 0.26 | 0.33 | 0.33 | 0.33 | 0.54 | | | | | 0.263 |
| Runing L HC: | 0.78 | 0.78 | 1.04 | 0.87 | 1.89 | | | | | 0.768 |
| Rsting L HC: | 0.12 | 0.10 | 0.10 | 0.10 | 0.15 | | | | 0.44 | 0.106 |
| Exhaust CO: | 29.07 | 40.56 | 47.98 | 43.03 | 128.80 | 1.57 | 1.72 | 13.95 | 22.71 | 34.312 |
| Exhaust NOX: | 1.70 | 2.14 | 2.67 | 2.32 | 5.96 | 1.57 | 1.77 | 21.52 | 0.80 | 3.415 |

MOBILE4.1 UG EXAMPLE 5: OUTFMT = 5 (= OUTFMT=3 + BYMY TABLES, TERSE VERSION)
SAN FRANCISCO CA

Light Duty Gas Vehicles
Jan 1, 1988

| Model | | | HC | | | | | | | | CO | | | | NOX | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | TF | Miles | BEF4 | Tamper | SALHCF | Evapor | Refuel | Runnin | Restin | FER | BEF4 | Tamper | SALHCF | FER | BEF4 | Tamper | SALHCF | FER |
| 1988 | .0240 | 1640. | 0.321 | 0.001 | 1.000 | 0.422 | 0.213 | 0.456 | 0.068 | 0.036 | 4.269 | 0.015 | 1.000 | 0.103 | 0.465 | 0.008 | 1.000 | 0.011 |
| 1987 | .1140 | 9816. | 0.396 | 0.007 | 1.000 | 0.435 | 0.216 | 0.456 | 0.071 | 0.180 | 5.691 | 0.067 | 1.000 | 0.656 | 0.499 | 0.012 | 1.000 | 0.058 |
| 1986 | .1133 | 22403. | 0.510 | 0.019 | 1.000 | 0.460 | 0.218 | 0.456 | 0.086 | 0.198 | 7.837 | 0.176 | 1.000 | 0.908 | 0.565 | 0.020 | 1.000 | 0.066 |
| 1985 | .1052 | 34309. | 0.620 | 0.031 | 1.000 | 0.532 | 0.225 | 0.492 | 0.093 | 0.210 | 9.938 | 0.316 | 1.000 | 1.079 | 0.832 | 0.026 | 1.000 | 0.090 |
| 1984 | .1011 | 45571. | 0.750 | 0.041 | 1.000 | 0.575 | 0.232 | 0.512 | 0.102 | 0.224 | 12.838 | 0.418 | 1.000 | 1.341 | 0.910 | 0.033 | 1.000 | 0.095 |
| 1983 | .0919 | 56225. | 0.827 | 0.132 | 1.000 | 0.690 | 0.235 | 0.589 | 0.106 | 0.237 | 13.939 | 1.566 | 1.000 | 1.425 | 0.956 | 0.105 | 1.000 | 0.097 |
| 1982 | .0804 | 66303. | 1.223 | 0.174 | 1.000 | 0.796 | 0.235 | 0.668 | 0.113 | 0.258 | 18.968 | 2.218 | 1.000 | 1.704 | 1.072 | 0.124 | 1.000 | 0.096 |
| 1981 | .0546 | 75837. | 1.407 | 0.231 | 1.000 | 0.951 | 0.244 | 0.747 | 0.122 | 0.202 | 22.211 | 3.134 | 1.000 | 1.385 | 1.121 | 0.150 | 1.000 | 0.069 |
| 1980 | .0469 | 84854. | 1.475 | 0.986 | 1.000 | 1.386 | 0.261 | 0.954 | 0.129 | 0.243 | 16.514 | 11.992 | 1.000 | 1.336 | 2.021 | 0.825 | 1.000 | 0.133 |
| 1979 | .0463 | 93383. | 4.013 | 0.920 | 1.000 | 1.520 | 0.301 | 1.063 | 0.136 | 0.368 | 47.774 | 9.721 | 1.000 | 2.663 | 2.638 | 0.773 | 1.000 | 0.158 |
| 1978 | .0435 | 101452. | 4.261 | 1.002 | 1.000 | 1.781 | 0.306 | 1.212 | 0.144 | 0.378 | 50.136 | 10.626 | 1.000 | 2.642 | 2.721 | 0.799 | 1.000 | 0.153 |
| 1977 | .0446 | 109084. | 4.496 | 1.039 | 1.000 | 2.811 | 0.330 | 1.269 | 0.152 | 0.450 | 52.370 | 11.330 | 1.000 | 2.841 | 2.800 | 0.825 | 1.000 | 0.162 |
| 1976 | .0368 | 116303. | 4.718 | 1.144 | 1.000 | 2.911 | 0.347 | 1.292 | 0.161 | 0.389 | 54.483 | 12.867 | 1.000 | 2.478 | 2.836 | 0.840 | 1.000 | 0.135 |
| 1975 | .0274 | 123133. | 4.927 | 1.186 | 1.000 | 3.022 | 0.384 | 1.309 | 0.170 | 0.302 | 56.482 | 13.907 | 1.000 | 1.931 | 2.863 | 0.862 | 1.000 | 0.102 |
| 1974 | .0168 | 129593. | 5.741 | 0.201 | 1.000 | 3.135 | 0.424 | 1.326 | 0.180 | 0.185 | 80.915 | 4.858 | 1.000 | 1.442 | 3.346 | 0.316 | 1.000 | 0.062 |
| 1973 | .0126 | 135704. | 5.844 | 0.202 | 1.000 | 3.228 | 0.424 | 1.327 | 0.190 | 0.141 | 82.552 | 4.876 | 1.000 | 1.102 | 3.375 | 0.281 | 1.000 | 0.046 |
| 1972 | .0088 | 141484. | 5.941 | 0.067 | 1.000 | 3.322 | 0.417 | 1.327 | 0.201 | 0.099 | 84.100 | 1.625 | 1.000 | 0.753 | 4.248 | 0.000 | 1.000 | 0.037 |
| 1971 | .0089 | 146951. | 8.770 | 0.033 | 1.000 | 4.574 | 0.420 | 2.521 | 0.213 | 0.147 | 98.481 | 0.808 | 1.000 | 0.885 | 4.248 | 0.000 | 1.000 | 0.038 |
| 1970 | .0062 | 152124. | 8.586 | 0.032 | 1.000 | 5.816 | 0.406 | 2.521 | 0.225 | 0.109 | 92.945 | 0.749 | 1.000 | 0.580 | 4.248 | 0.000 | 1.000 | 0.026 |
| 1969 | .0043 | 157016. | 8.367 | 0.032 | 1.000 | 5.980 | 0.406 | 2.521 | 0.237 | 0.075 | 95.814 | 0.719 | 1.000 | 0.411 | 4.248 | 0.000 | 1.000 | 0.018 |
| 1968 | .0030 | 161644. | 8.483 | 0.032 | 1.000 | 6.148 | 0.406 | 2.521 | 0.251 | 0.054 | 96.986 | 0.719 | 1.000 | 0.295 | 4.248 | 0.000 | 1.000 | 0.013 |
| 1967 | .0024 | 166022. | 10.179 | 0.000 | 1.000 | 7.070 | 0.406 | 2.521 | 0.265 | 0.049 | 115.929 | 0.000 | 1.000 | 0.276 | 3.377 | 0.000 | 1.000 | 0.008 |
| 1966 | .0018 | 170162. | 10.253 | 0.000 | 1.000 | 7.247 | 0.406 | 2.521 | 0.281 | 0.037 | 116.866 | 0.000 | 1.000 | 0.211 | 3.377 | 0.000 | 1.000 | 0.006 |
| 1965 | .0013 | 174080. | 10.323 | 0.000 | 1.000 | 7.427 | 0.406 | 2.521 | 0.297 | 0.027 | 117.751 | 0.000 | 1.000 | 0.150 | 3.377 | 0.000 | 1.000 | 0.004 |
| 1964 | .0040 | 177785. | 10.390 | 0.000 | 1.000 | 7.614 | 0.406 | 2.521 | 0.314 | 0.086 | 118.589 | 0.000 | 1.000 | 0.478 | 3.378 | 0.000 | 1.000 | 0.014 |
| | | | | | | 1.247 | 0.262 | 0.784 | 0.116 | 4.684 | | | | 29.070 | | | | 1.700 |

Light Duty Gas Trucks 1
Jan 1, 1988

| Model | | | HC | | | | | | | | CO | | | | NOX | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | TF | Miles | BEF4 | Tamper | SALHCF | Evapor | Refuel | Runnin | Restin | FER | BEF4 | Tamper | SALHCF | FER | BEF4 | Tamper | SALHCF | FER |
| 1988 | .0278 | 1955. | 0.603 | 0.010 | 1.000 | 0.339 | 0.288 | 0.337 | 0.056 | 0.045 | 2.771 | 0.084 | 1.000 | 0.080 | 0.795 | 0.005 | 1.000 | 0.022 |
| 1987 | .1477 | 11697. | 0.774 | 0.033 | 1.000 | 0.383 | 0.280 | 0.340 | 0.058 | 0.276 | 8.243 | 0.312 | 1.000 | 1.264 | 0.916 | 0.027 | 1.000 | 0.139 |
| 1986 | .1359 | 26552. | 0.922 | 0.084 | 1.000 | 0.445 | 0.283 | 0.348 | 0.068 | 0.292 | 12.528 | 0.968 | 1.000 | 1.833 | 1.077 | 0.050 | 1.000 | 0.153 |
| 1985 | .1185 | 40409. | 1.048 | 0.120 | 1.000 | 0.525 | 0.295 | 0.375 | 0.077 | 0.289 | 15.570 | 1.451 | 1.000 | 2.017 | 1.181 | 0.071 | 1.000 | 0.148 |
| 1984 | .1151 | 53335. | 1.795 | 0.174 | 1.000 | 0.599 | 0.297 | 0.413 | 0.080 | 0.387 | 23.501 | 2.155 | 1.000 | 2.954 | 1.429 | 0.099 | 1.000 | 0.176 |
| 1983 | .0788 | 65393. | 2.173 | 0.693 | 1.000 | 0.772 | 0.292 | 0.546 | 0.088 | 0.360 | 30.105 | 8.129 | 1.000 | 3.014 | 1.761 | 0.444 | 1.000 | 0.174 |
| 1982 | .0594 | 76642. | 2.373 | 0.814 | 1.000 | 0.898 | 0.302 | 0.651 | 0.097 | 0.305 | 32.382 | 9.889 | 1.000 | 2.513 | 1.791 | 0.495 | 1.000 | 0.136 |
| 1981 | .0307 | 87135. | 2.559 | 0.897 | 1.000 | 1.045 | 0.308 | 0.725 | 0.101 | 0.173 | 34.506 | 10.871 | 1.000 | 1.394 | 1.820 | 0.545 | 1.000 | 0.073 |
| 1980 | .0240 | 96923. | 3.908 | 1.907 | 1.000 | 1.753 | 0.331 | 1.124 | 0.108 | 0.219 | 41.430 | 20.115 | 1.000 | 1.475 | 2.191 | 1.171 | 1.000 | 0.081 |
| 1979 | .0244 | 106054. | 4.188 | 2.049 | 1.000 | 1.957 | 0.411 | 1.266 | 0.116 | 0.244 | 44.016 | 21.395 | 1.000 | 1.598 | 2.241 | 1.174 | 1.000 | 0.083 |
| 1978 | .0246 | 114572. | 5.333 | 2.022 | 1.000 | 2.093 | 0.396 | 1.300 | 0.124 | 0.277 | 63.464 | 20.681 | 1.000 | 2.071 | 2.971 | 1.048 | 1.000 | 0.099 |
| 1977 | .0351 | 122517. | 5.568 | 2.140 | 1.000 | 3.139 | 0.387 | 1.313 | 0.133 | 0.445 | 65.902 | 21.785 | 1.000 | 3.078 | 2.994 | 1.050 | 1.000 | 0.142 |
| 1976 | .0307 | 129929. | 5.787 | 2.409 | 1.000 | 3.337 | 0.420 | 1.369 | 0.143 | 0.413 | 68.176 | 24.540 | 1.000 | 2.842 | 3.016 | 1.052 | 1.000 | 0.125 |
| 1975 | .0240 | 136843. | 5.991 | 2.125 | 1.000 | 3.484 | 0.442 | 1.369 | 0.153 | 0.326 | 70.296 | 21.851 | 1.000 | 2.216 | 3.036 | 1.052 | 1.000 | 0.098 |
| 1974 | .0170 | 143293. | 6.102 | 0.238 | 1.000 | 3.637 | 0.484 | 1.369 | 0.164 | 0.204 | 85.759 | 5.746 | 1.000 | 1.553 | 3.281 | 0.376 | 1.000 | 0.062 |
| 1973 | .0096 | 149310. | 6.210 | 0.238 | 1.000 | 3.797 | 0.484 | 1.369 | 0.176 | 0.118 | 87.435 | 5.746 | 1.000 | 0.896 | 3.304 | 0.334 | 1.000 | 0.035 |
| 1972 | .0121 | 154922. | 6.310 | 0.079 | 1.000 | 3.965 | 0.476 | 1.369 | 0.188 | 0.150 | 88.998 | 1.915 | 1.000 | 1.103 | 4.247 | 0.000 | 1.000 | 0.052 |
| 1971 | .0113 | 160157. | 9.278 | 0.039 | 1.000 | 5.524 | 0.476 | 2.521 | 0.202 | 0.204 | 103.100 | 0.952 | 1.000 | 1.178 | 4.247 | 0.000 | 1.000 | 0.048 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1970 | .0500 | 165041. | 9.061 | 0.038 | 1.000 | 6.664 | 0.476 | 2.521 | 0.216 | 0.949 | 97.132 | 0.882 | 1.000 | 4.904 | 4.247 | 0.000 | 1.000 | 0.212 |
| 1969 | .0056 | 169597. | 8.682 | 0.038 | 1.000 | 6.959 | 0.476 | 2.521 | 0.232 | 0.105 | 99.000 | 0.847 | 1.000 | 0.556 | 4.247 | 0.000 | 1.000 | 0.024 |
| 1968 | .0040 | 173847. | 8.788 | 0.038 | 1.000 | 7.267 | 0.476 | 2.521 | 0.249 | 0.077 | 100.076 | 0.847 | 1.000 | 0.403 | 4.246 | 0.000 | 1.000 | 0.017 |
| 1967 | .0034 | 177811. | 10.390 | 0.000 | 1.000 | 8.267 | 0.476 | 2.521 | 0.266 | 0.074 | 118.595 | 0.000 | 1.000 | 0.398 | 3.378 | 0.000 | 1.000 | 0.011 |
| 1966 | .0028 | 181509. | 10.456 | 0.000 | 1.000 | 8.604 | 0.476 | 2.521 | 0.286 | 0.062 | 119.431 | 0.000 | 1.000 | 0.332 | 3.378 | 0.000 | 1.000 | 0.009 |
| 1965 | .0019 | 184959. | 10.518 | 0.000 | 1.000 | 8.955 | 0.476 | 2.521 | 0.306 | 0.044 | 120.211 | 0.000 | 1.000 | 0.234 | 3.378 | 0.000 | 1.000 | 0.007 |
| 1964 | .0054 | 188177. | 10.576 | 0.000 | 1.000 | 9.321 | 0.476 | 2.521 | 0.328 | 0.126 | 120.939 | 0.000 | 1.000 | 0.658 | 3.378 | 0.000 | 1.000 | 0.018 |
| | | | | | | 1.571 | 0.331 | 0.780 | 0.101 | 6.166 | | | | 40.562 | | | | 2.145 |

MOBILE4.1 UG EXAMPLE 5: OUTFMT = 5 (= OUTFMT=3 + BYMY TABLES, TERSE VERSION)
SAN FRANCISCO CA

Light Duty Gas Trucks 2
Jan 1, 1988

| Model | | | HC | | | | | | | | CO | | | | NOX | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | TF | Miles | BEF4 | Tamper | SALHCF | Evapor | Refuel | Runnin | Restin | FER | BEF4 | Tamper | SALHCF | FER | BEF4 | Tamper | SALHCF | FER |
| 1988 | .0233 | 2201. | 0.606 | 0.011 | 1.000 | 0.302 | 0.289 | 0.337 | 0.050 | 0.037 | 2.817 | 0.097 | 1.000 | 0.068 | 0.796 | 0.004 | 1.000 | 0.019 |
| 1987 | .1296 | 13163. | 0.789 | 0.038 | 1.000 | 0.342 | 0.281 | 0.341 | 0.052 | 0.239 | 8.502 | 0.387 | 1.000 | 1.152 | 0.922 | 0.029 | 1.000 | 0.123 |
| 1986 | .1172 | 29731. | 0.948 | 0.093 | 1.000 | 0.404 | 0.284 | 0.350 | 0.061 | 0.251 | 12.948 | 1.083 | 1.000 | 1.645 | 1.092 | 0.057 | 1.000 | 0.135 |
| 1985 | .0894 | 44991. | 1.076 | 0.133 | 1.000 | 0.481 | 0.295 | 0.375 | 0.070 | 0.217 | 16.036 | 1.618 | 1.000 | 1.578 | 1.291 | 0.079 | 1.000 | 0.122 |
| 1984 | .0882 | 59047. | 1.896 | 0.209 | 1.000 | 0.565 | 0.298 | 0.423 | 0.074 | 0.306 | 24.657 | 2.575 | 1.000 | 2.402 | 1.467 | 0.121 | 1.000 | 0.140 |
| 1983 | .0867 | 71992. | 2.290 | 0.775 | 1.000 | 0.749 | 0.294 | 0.569 | 0.083 | 0.413 | 31.441 | 9.343 | 1.000 | 3.535 | 1.779 | 0.472 | 1.000 | 0.195 |
| 1982 | .0727 | 83915. | 2.502 | 0.907 | 1.000 | 0.884 | 0.304 | 0.679 | 0.092 | 0.390 | 33.855 | 11.283 | 1.000 | 3.282 | 1.811 | 0.530 | 1.000 | 0.170 |
| 1981 | .0583 | 94897. | 2.697 | 0.978 | 1.000 | 1.023 | 0.309 | 0.740 | 0.097 | 0.341 | 36.078 | 12.024 | 1.000 | 2.803 | 1.841 | 0.583 | 1.000 | 0.141 |
| 1980 | .0451 | 105012. | 4.156 | 2.446 | 1.000 | 1.856 | 0.331 | 1.154 | 0.105 | 0.453 | 43.721 | 24.252 | 1.000 | 3.063 | 2.236 | 1.173 | 1.000 | 0.154 |
| 1979 | .0358 | 114329. | 4.442 | 2.623 | 1.000 | 2.096 | 0.410 | 1.296 | 0.114 | 0.393 | 46.361 | 25.814 | 1.000 | 2.585 | 2.287 | 1.176 | 1.000 | 0.124 |
| 1978 | .0248 | 122909. | 8.337 | 0.000 | 1.000 | 6.929 | 0.396 | 2.521 | 0.124 | 0.454 | 93.845 | 0.000 | 1.000 | 2.325 | 4.862 | 0.125 | 1.000 | 0.124 |
| 1977 | .0547 | 130812. | 8.471 | 0.000 | 1.000 | 7.333 | 0.386 | 2.521 | 0.135 | 1.031 | 95.879 | 0.000 | 1.000 | 5.248 | 4.892 | 0.125 | 1.000 | 0.275 |
| 1976 | .0438 | 138092. | 8.594 | 0.000 | 1.000 | 7.752 | 0.420 | 2.521 | 0.146 | 0.852 | 97.753 | 0.000 | 1.000 | 4.285 | 4.920 | 0.125 | 1.000 | 0.221 |
| 1975 | .0343 | 144796. | 8.707 | 0.000 | 1.000 | 8.195 | 0.442 | 2.521 | 0.159 | 0.687 | 99.478 | 0.000 | 1.000 | 3.414 | 4.945 | 0.125 | 1.000 | 0.174 |
| 1974 | .0242 | 150970. | 8.812 | 0.000 | 1.000 | 8.661 | 0.484 | 2.521 | 0.172 | 0.499 | 101.068 | 0.000 | 1.000 | 2.443 | 4.969 | 0.125 | 1.000 | 0.123 |
| 1973 | .0143 | 156658. | 10.211 | 0.000 | 1.000 | 9.153 | 0.484 | 2.521 | 0.187 | 0.322 | 99.442 | 0.000 | 1.000 | 1.419 | 6.297 | 0.128 | 1.000 | 0.092 |
| 1972 | .0121 | 161896. | 10.342 | 0.000 | 1.000 | 9.674 | 0.475 | 2.521 | 0.203 | 0.281 | 100.768 | 0.000 | 1.000 | 1.218 | 6.297 | 0.000 | 1.000 | 0.076 |
| 1971 | .0121 | 166721. | 10.463 | 0.000 | 1.000 | 10.221 | 0.475 | 2.521 | 0.220 | 0.289 | 101.989 | 0.000 | 1.000 | 1.235 | 6.297 | 0.000 | 1.000 | 0.076 |
| 1970 | .0080 | 171165. | 10.574 | 0.000 | 1.000 | 10.767 | 0.475 | 2.521 | 0.239 | 0.197 | 103.114 | 0.000 | 1.000 | 0.828 | 6.296 | 0.000 | 1.000 | 0.051 |
| 1969 | .0058 | 175257. | 12.651 | 0.000 | 1.000 | 11.376 | 0.475 | 2.521 | 0.260 | 0.157 | 133.770 | 0.000 | 1.000 | 0.769 | 5.341 | 0.000 | 1.000 | 0.031 |
| 1968 | .0038 | 179027. | 12.718 | 0.000 | 1.000 | 12.016 | 0.475 | 2.521 | 0.282 | 0.106 | 134.622 | 0.000 | 1.000 | 0.509 | 5.341 | 0.000 | 1.000 | 0.020 |
| 1967 | .0038 | 182499. | 12.781 | 0.000 | 1.000 | 18.272 | 0.475 | 2.521 | 0.306 | 0.132 | 135.408 | 0.000 | 1.000 | 0.519 | 5.342 | 0.000 | 1.000 | 0.020 |
| 1966 | .0032 | 185697. | 12.838 | 0.000 | 1.000 | 18.989 | 0.475 | 2.521 | 0.332 | 0.113 | 136.131 | 0.000 | 1.000 | 0.437 | 5.342 | 0.000 | 1.000 | 0.017 |
| 1965 | .0021 | 188643. | 12.891 | 0.000 | 1.000 | 19.745 | 0.475 | 2.521 | 0.361 | 0.074 | 136.797 | 0.000 | 1.000 | 0.283 | 5.342 | 0.000 | 1.000 | 0.011 |
| 1964 | .0068 | 191355. | 12.940 | 0.000 | 1.000 | 20.545 | 0.475 | 2.521 | 0.392 | 0.251 | 137.411 | 0.000 | 1.000 | 0.935 | 5.342 | 0.000 | 1.000 | 0.036 |
| | | | | | | 2.823 | 0.335 | 1.044 | 0.101 | 8.484 | | | | 47.979 | | | | 2.670 |

Heavy Duty Gas Vehicles
Jan 1, 1988

| Model | | | HC | | | | | | | | CO | | | | NOX | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | TF | Miles | BEF4 | Tamper | SALHCF | Evapor | Refuel | Runnin | Restin | FER | BEF4 | Tamper | SALHCF | FER | BEF4 | Tamper | SALHCF | FER |
| 1988 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1987 | .1188 | 9105. | 1.004 | 0.180 | 1.026 | 1.866 | 0.494 | 0.456 | 0.042 | 0.484 | 16.693 | 2.104 | 1.022 | 2.283 | 4.800 | 0.016 | 0.996 | 0.570 |
| 1986 | .1112 | 26595. | 2.373 | 0.046 | 1.026 | 1.997 | 0.495 | 0.486 | 0.045 | 0.612 | 43.317 | 0.529 | 1.022 | 4.982 | 4.839 | 0.083 | 0.996 | 0.545 |
| 1985 | .0910 | 42696. | 2.774 | 0.058 | 1.026 | 3.071 | 0.504 | 0.762 | 0.049 | 0.663 | 56.050 | 0.667 | 1.022 | 5.274 | 4.892 | 0.282 | 0.996 | 0.469 |
| 1984 | .0868 | 57522. | 4.455 | 0.068 | 1.026 | 11.353 | 0.499 | 2.521 | 0.113 | 1.659 | 81.766 | 0.625 | 1.022 | 7.306 | 5.207 | 0.000 | 0.996 | 0.450 |
| 1983 | .0868 | 71171. | 4.549 | 0.078 | 1.026 | 11.366 | 0.500 | 2.521 | 0.123 | 1.671 | 87.055 | 0.734 | 1.022 | 7.785 | 5.526 | 0.000 | 0.996 | 0.478 |
| 1982 | .0786 | 83738. | 4.756 | 0.090 | 1.026 | 11.378 | 0.503 | 2.521 | 0.134 | 1.534 | 92.800 | 0.842 | 1.022 | 7.524 | 5.587 | 0.000 | 0.996 | 0.438 |
| 1981 | .0572 | 95308. | 4.947 | 0.000 | 1.026 | 11.389 | 0.520 | 2.521 | 0.145 | 1.124 | 98.091 | 0.000 | 1.022 | 5.735 | 5.644 | 0.000 | 0.996 | 0.322 |
| 1980 | .0451 | 105961. | 5.418 | 0.000 | 1.026 | 11.402 | 0.530 | 2.521 | 0.158 | 0.911 | 108.747 | 0.000 | 1.022 | 5.017 | 6.083 | 0.000 | 0.996 | 0.274 |
| 1979 | .0346 | 115769. | 5.937 | 0.000 | 1.026 | 11.412 | 0.562 | 2.521 | 0.171 | 0.719 | 120.606 | 0.000 | 1.022 | 4.269 | 6.492 | 0.000 | 0.996 | 0.224 |
| 1978 | .0282 | 124799. | 9.735 | 0.000 | 1.026 | 11.421 | 0.571 | 2.521 | 0.186 | 0.697 | 199.717 | 0.000 | 1.022 | 5.765 | 5.738 | 0.000 | 0.996 | 0.161 |
| 1977 | .0545 | 133113. | 9.895 | 0.000 | 1.026 | 11.426 | 0.583 | 2.521 | 0.202 | 1.357 | 204.188 | 0.000 | 1.022 | 11.379 | 5.785 | 0.000 | 0.996 | 0.314 |
| 1976 | .0433 | 140768. | 11.704 | 0.000 | 1.026 | 11.426 | 0.598 | 2.521 | 0.219 | 1.158 | 243.334 | 0.000 | 1.022 | 10.757 | 6.813 | 0.000 | 0.996 | 0.294 |
| 1975 | .0356 | 147816. | 12.640 | 0.000 | 1.026 | 11.426 | 0.616 | 2.521 | 0.238 | 0.987 | 261.607 | 0.000 | 1.022 | 9.507 | 7.321 | 0.000 | 0.996 | 0.259 |
| 1974 | .0255 | 154305. | 13.855 | 0.000 | 1.026 | 11.426 | 0.628 | 2.521 | 0.259 | 0.742 | 287.974 | 0.000 | 1.022 | 7.515 | 8.036 | 0.000 | 0.996 | 0.204 |
| 1973 | .0193 | 160279. | 16.242 | 0.000 | 1.026 | 11.426 | 0.641 | 2.521 | 0.281 | 0.608 | 297.365 | 0.000 | 1.022 | 5.863 | 9.608 | 0.000 | 0.996 | 0.185 |
| 1972 | .0161 | 165780. | 16.460 | 0.000 | 1.026 | 11.426 | 0.642 | 2.521 | 0.305 | 0.512 | 301.495 | 0.000 | 1.022 | 4.959 | 9.608 | 0.000 | 0.996 | 0.154 |
| 1971 | .0169 | 170844. | 16.661 | 0.000 | 1.026 | 11.426 | 0.642 | 2.521 | 0.331 | 0.540 | 305.296 | 0.000 | 1.022 | 5.261 | 9.608 | 0.000 | 0.996 | 0.161 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1970 | .0113 | 175506. | 16.846 | 0.000 | 1.026 | 11.426 | 0.642 | 2.521 | 0.360 | 0.364 | 308.796 | 0.000 | 1.022 | 3.563 | 9.608 | 0.000 | 0.996 | 0.108 |
| 1969 | .0078 | 179799. | 25.891 | 0.000 | 1.026 | 11.426 | 0.652 | 2.521 | 0.391 | 0.324 | 345.294 | 0.000 | 1.022 | 2.752 | 8.983 | 0.000 | 0.996 | 0.070 |
| 1968 | .0064 | 183752. | 26.033 | 0.000 | 1.026 | 11.426 | 0.652 | 2.521 | 0.425 | 0.266 | 347.580 | 0.000 | 1.022 | 2.267 | 8.983 | 0.000 | 0.996 | 0.057 |
| 1967 | .0059 | 187390. | 26.165 | 0.000 | 1.026 | 16.999 | 0.652 | 2.521 | 0.461 | 0.279 | 349.685 | 0.000 | 1.022 | 2.100 | 8.983 | 0.000 | 0.996 | 0.053 |
| 1966 | .0037 | 190741. | 26.286 | 0.000 | 1.026 | 16.999 | 0.652 | 2.521 | 0.501 | 0.177 | 351.623 | 0.000 | 1.022 | 1.336 | 8.983 | 0.000 | 0.996 | 0.033 |
| 1965 | .0034 | 193825. | 26.398 | 0.000 | 1.026 | 16.999 | 0.652 | 2.521 | 0.544 | 0.164 | 353.408 | 0.000 | 1.022 | 1.236 | 8.983 | 0.000 | 0.996 | 0.031 |
| 1964 | .0120 | 196665. | 26.500 | 0.000 | 1.026 | 16.999 | 0.652 | 2.521 | 0.591 | 0.577 | 355.050 | 0.000 | 1.022 | 4.368 | 8.983 | 0.000 | 0.996 | 0.108 |
| | | | | | | 8.602 | 0.537 | 1.890 | 0.147 | 18.129 | | | | 128.803 | | | | 5.963 |

MOBILE4.1 UG EXAMPLE 5: OUTFMT = 5 (= OUTFMT=3 + BYMY TABLES, TERSE VERSION)
SAN FRANCISCO CA

Light Duty Diesel Vehicles
Jan 1, 1988

| Model Year | TF | Miles | HC BEF4 | HC SALHCF | HC FER | CO BEF4 | CO SALHCF | CO FER | NOX BEF4 | NOX SALHCF | NOX FER |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1988 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1987 | .0230 | 13327. | 0.330 | 1.000 | 0.008 | 1.203 | 1.000 | 0.028 | 0.910 | 1.000 | 0.021 |
| 1986 | .0224 | 30145. | 0.380 | 1.000 | 0.009 | 1.271 | 1.000 | 0.028 | 0.961 | 1.000 | 0.021 |
| 1985 | .0612 | 45692. | 0.427 | 1.000 | 0.026 | 1.333 | 1.000 | 0.082 | 1.007 | 1.000 | 0.062 |
| 1984 | .1095 | 60063. | 0.470 | 1.000 | 0.052 | 1.390 | 1.000 | 0.152 | 1.491 | 1.000 | 0.163 |
| 1983 | .1206 | 73349. | 0.510 | 1.000 | 0.062 | 1.443 | 1.000 | 0.174 | 1.531 | 1.000 | 0.185 |
| 1982 | .2372 | 85630. | 0.547 | 1.000 | 0.130 | 1.492 | 1.000 | 0.354 | 1.568 | 1.000 | 0.372 |
| 1981 | .2002 | 96984. | 0.581 | 1.000 | 0.116 | 1.538 | 1.000 | 0.308 | 1.602 | 1.000 | 0.321 |
| 1980 | .1232 | 107479. | 0.613 | 1.000 | 0.075 | 1.580 | 1.000 | 0.195 | 1.831 | 1.000 | 0.226 |
| 1979 | .0555 | 117181. | 1.240 | 1.000 | 0.069 | 2.224 | 1.000 | 0.123 | 1.868 | 1.000 | 0.104 |
| 1978 | .0215 | 126150. | 1.303 | 1.000 | 0.028 | 2.305 | 1.000 | 0.050 | 1.904 | 1.000 | 0.041 |
| 1977 | .0119 | 134440. | 1.361 | 1.000 | 0.016 | 2.379 | 1.000 | 0.028 | 1.937 | 1.000 | 0.023 |
| 1976 | .0058 | 142104. | 1.415 | 1.000 | 0.008 | 2.448 | 1.000 | 0.014 | 1.968 | 1.000 | 0.011 |
| 1975 | .0028 | 149189. | 1.464 | 1.000 | 0.004 | 2.512 | 1.000 | 0.007 | 1.996 | 1.000 | 0.006 |
| 1974 | .0025 | 155739. | 2.555 | 1.000 | 0.006 | 4.733 | 1.000 | 0.012 | 2.082 | 1.000 | 0.005 |
| 1973 | .0012 | 161793. | 2.604 | 1.000 | 0.003 | 4.812 | 1.000 | 0.006 | 2.106 | 1.000 | 0.003 |
| 1972 | .0008 | 167390. | 2.649 | 1.000 | 0.002 | 4.885 | 1.000 | 0.004 | 2.129 | 1.000 | 0.002 |
| 1971 | .0004 | 172564. | 2.690 | 1.000 | 0.001 | 4.952 | 1.000 | 0.002 | 2.149 | 1.000 | 0.001 |
| 1970 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1969 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1968 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1967 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1966 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1965 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1964 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | | 0.615 | | | 1.567 | | | 1.565 |

Light Duty Diesel Trucks
Jan 1, 1988

| Model Year | TF | Miles | HC BEF4 | HC SALHCF | HC FER | CO BEF4 | CO SALHCF | CO FER | NOX BEF4 | NOX SALHCF | NOX FER |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1988 | .0038 | 2517. | 0.440 | 1.000 | 0.002 | 1.340 | 1.000 | 0.005 | 1.078 | 1.000 | 0.004 |
| 1987 | .0295 | 15025. | 0.490 | 1.000 | 0.014 | 1.390 | 1.000 | 0.041 | 1.525 | 1.000 | 0.045 |
| 1986 | .0595 | 33252. | 0.563 | 1.000 | 0.033 | 1.463 | 1.000 | 0.087 | 1.580 | 1.000 | 0.094 |
| 1985 | .0772 | 49230. | 0.627 | 1.000 | 0.048 | 1.527 | 1.000 | 0.118 | 1.628 | 1.000 | 0.126 |
| 1984 | .1506 | 63326. | 0.683 | 1.000 | 0.103 | 1.583 | 1.000 | 0.238 | 1.670 | 1.000 | 0.252 |
| 1983 | .2064 | 75843. | 0.733 | 1.000 | 0.151 | 1.633 | 1.000 | 0.337 | 1.707 | 1.000 | 0.352 |
| 1982 | .3110 | 87030. | 0.778 | 1.000 | 0.242 | 1.678 | 1.000 | 0.522 | 1.741 | 1.000 | 0.541 |
| 1981 | .0899 | 97091. | 0.819 | 1.000 | 0.074 | 1.718 | 1.000 | 0.155 | 1.771 | 1.000 | 0.159 |
| 1980 | .0418 | 106200. | 1.710 | 1.000 | 0.071 | 3.032 | 1.000 | 0.127 | 2.679 | 1.000 | 0.112 |
| 1979 | .0211 | 114500. | 1.776 | 1.000 | 0.037 | 3.115 | 1.000 | 0.066 | 2.745 | 1.000 | 0.058 |
| 1978 | .0092 | 122112. | 1.837 | 1.000 | 0.017 | 3.190 | 1.000 | 0.029 | 2.807 | 1.000 | 0.026 |
| 1977 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1976 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1975 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1974 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1973 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1972 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1971 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1970 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1969 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1968 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1967 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1966 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1965 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1964 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | | 0.794 | | | 1.725 | | | 1.769 |

MOBILE4.1 UG EXAMPLE 5: OUTFMT = 5 (= OUTFMT=3 + BYMY TABLES, TERSE VERSION)
SAN FRANCISCO CA

Heavy Duty Diesel Vehicles
Jan 1, 1988

| Model Year | TF | Miles | HC BEF4 | HC SALHCF | HC FER | CO BEF4 | CO SALHCF | CO FER | NOX BEF4 | NOX SALHCF | NOX FER |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1988 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1987 | .1652 | 28495. | 2.230 | 1.015 | 0.374 | 10.396 | 1.021 | 1.753 | 17.180 | 1.008 | 2.860 |
| 1986 | .1462 | 83199. | 2.280 | 1.015 | 0.338 | 11.109 | 1.021 | 1.659 | 17.560 | 1.008 | 2.589 |
| 1985 | .0979 | 133514. | 2.590 | 1.015 | 0.258 | 11.552 | 1.021 | 1.155 | 17.530 | 1.008 | 1.731 |
| 1984 | .0961 | 179795. | 2.820 | 1.015 | 0.275 | 13.058 | 1.021 | 1.281 | 19.080 | 1.008 | 1.848 |
| 1983 | .1072 | 222364. | 2.660 | 1.015 | 0.289 | 12.661 | 1.021 | 1.386 | 18.060 | 1.008 | 1.951 |
| 1982 | .0905 | 261521. | 2.780 | 1.015 | 0.255 | 13.735 | 1.021 | 1.269 | 18.840 | 1.008 | 1.718 |
| 1981 | .0486 | 297538. | 3.170 | 1.015 | 0.156 | 15.943 | 1.021 | 0.791 | 21.470 | 1.008 | 1.052 |
| 1980 | .0396 | 330670. | 3.170 | 1.015 | 0.127 | 16.307 | 1.021 | 0.659 | 21.470 | 1.008 | 0.856 |
| 1979 | .0277 | 361147. | 3.510 | 1.015 | 0.099 | 18.374 | 1.021 | 0.519 | 23.780 | 1.008 | 0.664 |
| 1978 | .0306 | 389182. | 6.255 | 1.015 | 0.194 | 17.667 | 1.021 | 0.551 | 32.894 | 1.008 | 1.013 |
| 1977 | .0315 | 414971. | 6.480 | 1.015 | 0.207 | 18.290 | 1.021 | 0.588 | 33.854 | 1.008 | 1.074 |
| 1976 | .0209 | 438695. | 6.542 | 1.015 | 0.139 | 18.439 | 1.021 | 0.394 | 33.775 | 1.008 | 0.713 |
| 1975 | .0159 | 460519. | 6.673 | 1.015 | 0.107 | 18.788 | 1.021 | 0.304 | 34.190 | 1.008 | 0.547 |
| 1974 | .0063 | 480596. | 6.794 | 1.015 | 0.043 | 19.110 | 1.021 | 0.122 | 34.571 | 1.008 | 0.218 |
| 1973 | .0067 | 499065. | 6.904 | 1.015 | 0.047 | 19.405 | 1.021 | 0.133 | 34.942 | 1.008 | 0.236 |
| 1972 | .0472 | 516057. | 7.006 | 1.015 | 0.336 | 19.677 | 1.021 | 0.948 | 35.265 | 1.008 | 1.678 |
| 1971 | .0077 | 531688. | 7.100 | 1.015 | 0.056 | 19.927 | 1.021 | 0.157 | 35.562 | 1.008 | 0.276 |
| 1970 | .0045 | 546069. | 7.086 | 1.015 | 0.032 | 19.321 | 1.021 | 0.088 | 35.175 | 1.008 | 0.159 |
| 1969 | .0031 | 559298. | 7.136 | 1.015 | 0.022 | 19.429 | 1.021 | 0.061 | 34.657 | 1.008 | 0.108 |
| 1968 | .0019 | 571470. | 7.089 | 1.015 | 0.014 | 19.262 | 1.021 | 0.037 | 34.116 | 1.008 | 0.065 |
| 1967 | .0015 | 582668. | 7.156 | 1.015 | 0.011 | 19.430 | 1.021 | 0.029 | 34.318 | 1.008 | 0.050 |
| 1966 | .0013 | 592970. | 7.098 | 1.015 | 0.010 | 18.622 | 1.021 | 0.025 | 33.070 | 1.008 | 0.045 |
| 1965 | .0005 | 602448. | 7.155 | 1.015 | 0.004 | 18.754 | 1.021 | 0.009 | 33.232 | 1.008 | 0.016 |
| 1964 | .0016 | 611168. | 7.207 | 1.015 | 0.012 | 18.876 | 1.021 | 0.031 | 33.380 | 1.008 | 0.053 |
| | | | | | 3.405 | | | 13.951 | | | 21.520 |

Motorcycles
Jan 1, 1988

| Model Year | TF | Miles | HC BEF4 | HC SALHCF | HC Evapor | HC Restin | HC FER | CO BEF4 | CO SALHCF | CO FER | NOX BEF4 | NOX SALHCF | NOX FER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1988 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1987 | .2568 | 2393. | 1.484 | 1.000 | 2.940 | 0.336 | 1.223 | 18.751 | 1.000 | 4.816 | 0.830 | 1.000 | 0.213 |
| 1986 | .1930 | 7023. | 1.830 | 1.000 | 2.940 | 0.359 | 0.990 | 19.930 | 1.000 | 3.846 | 0.830 | 1.000 | 0.160 |
| 1985 | .1450 | 11343. | 2.153 | 1.000 | 2.940 | 0.386 | 0.794 | 21.029 | 1.000 | 3.049 | 0.830 | 1.000 | 0.120 |
| 1984 | .1083 | 15351. | 3.098 | 1.000 | 2.853 | 0.418 | 0.690 | 22.050 | 1.000 | 2.388 | 0.830 | 1.000 | 0.090 |
| 1983 | .0792 | 19049. | 3.448 | 1.000 | 2.853 | 0.454 | 0.535 | 22.991 | 1.000 | 1.821 | 0.830 | 1.000 | 0.066 |
| 1982 | .0578 | 22437. | 3.769 | 1.000 | 2.853 | 0.498 | 0.412 | 23.854 | 1.000 | 1.379 | 0.830 | 1.000 | 0.048 |
| 1981 | .0420 | 25513. | 4.849 | 1.000 | 2.865 | 0.551 | 0.347 | 24.937 | 1.000 | 1.047 | 0.830 | 1.000 | 0.035 |
| 1980 | .0300 | 28279. | 5.166 | 1.000 | 2.865 | 0.616 | 0.260 | 25.662 | 1.000 | 0.770 | 0.830 | 1.000 | 0.025 |
| 1979 | .0213 | 30735. | 6.841 | 1.000 | 2.710 | 0.699 | 0.218 | 35.275 | 1.000 | 0.752 | 0.664 | 1.000 | 0.014 |
| 1978 | .0146 | 32879. | 7.151 | 1.000 | 2.710 | 0.809 | 0.156 | 36.033 | 1.000 | 0.527 | 0.664 | 1.000 | 0.010 |
| 1977 | .0520 | 34713. | 11.299 | 1.000 | 1.947 | 0.959 | 0.738 | 44.643 | 1.000 | 2.321 | 0.361 | 1.000 | 0.019 |
| 1976 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1975 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1974 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1973 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1972 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1971 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1970 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1969 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1968 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1967 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1966 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1965 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1964 | .0000 | 0. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | | 2.854 | 0.440 | 6.363 | | | 22.715 | | | 0.800 |

### 5.1.2 User-Supplied Registration Distributions and Annual Mileage Accumulation Rates by Age

Example 6 illustrates the use of the options for supplying alternate registration distributions and annual mileage accumulation rates. In the example, the registration fractions for vehicles of ages 21 to 25+ have been set to zero. This necessitates the zero mileage accumulation rates for vehicles of these ages (since vehicles of a given age that exist in the fleet must accumulate mileage). The same calendar years as in examples 1 through 5 are modeled (1980, 1988, 1990, and 2000). The only other difference between the first five examples and this example is that refueling HC emission factors are not calculated (RLFLAG=5). The 112-column descriptive output is used (OUTFMT=3).

Note the warning messages that precede the emission factors in the output. The message M 49 is frequently generated when the sum of the registration fractions for a given vehicle type is not exactly 1.000; even if the values entered do add to 1.000, the representation of decimal numbers in the computer will often result in round-off errors large enough to trigger this message. A user entering registration distributions by age as input data and finding this message in the output should recheck the input data for errors; if none are found, then it can be assumed that the message was generated due to internal representation of the input values as described above.

```
1           PROMPT
MOBILE4.1 UG EXAMPLE 6: MYMRFG = 4 (NEW MILEAGE ACCRUAL RATES & REGISTRATION DISTRIBU.)
1           TAMFLG
1           SPDFLG
1           VMFLAG
4           MYMRFG
1           NEWFLG
1           IMFLAG
1           ALHFLG
1           ATPFLG
5           RLFLAG
1           LOCFLG   -  READ IN LOCAL AREA PARAMETERS AS 2ND REQ SC REC
1           TEMFLG   -  CALCULATE EXHAUST TEMPERATURES
3           OUTFMT
4           PRTFLG
1           IDLFLG
1           NMHFLG
1           HCFLAG   -  DO NOT PRINT HC COMPONENTS
 .12800 .12100 .11400 .10800 .10200 .09600 .09100 .08600 .08100 .07600   AMAR.LDGV..MY AGES 1-10
 .07200 .06800 .06400 .06100 .05700 .05400 .05100 .04800 .04600 .04300        .LDGV..MY AGES 11-20
 0.0    0.0    0.0    0.0    0.0                                             .LDGV..MY AGES 21-25
 .17400 .16100 .15000 .13900 .12900 .11900 .11100 .10300 .09500 .08800        .LDGT1.MY AGES 1-10
 .08200 .07600 .07000 .06500 .06100 .05600 .05200 .04800 .04500 .04200        .LDGT1.MY AGES 11-20
 0.0    0.0    0.0    0.0    0.0                                             .LDGT1.MY AGES 21-25
 .18400 .16900 .15600 .14400 .13300 .12300 .11400 .10500 .09700 .09000        .LDGT2.MY AGES 1-10
 .08300 .07600 .07100 .06500 .06000 .05600 .05100 .04700 .04400 .04000        .LDGT2.MY AGES 11-20
 0.0    0.0    0.0    0.0    0.0                                             .LDGT2.MY AGES 21-25
 .19900 .18100 .16400 .14800 .13400 .12100 .11000 .10000 .09000 .08200        .HDGV..MY AGES 1-10
 .07400 .06700 .06100 .05500 .05000 .04500 .04100 .03700 .03300 .03000        .HDGV..MY AGES 11-20
 0.0    0.0    0.0    0.0    0.0                                             .HDGV..MY AGES 21-25
 .12800 .12100 .11400 .10800 .10200 .09600 .09100 .08600 .08100 .07600        .LDDV..MY AGES 1-10
 .07200 .06800 .06400 .06100 .05700 .05400 .05100 .04800 .04600 .04300        .LDDV..MY AGES 11-20
 0.0    0.0    0.0    0.0    0.0                                             .LDDV..MY AGES 21-25
 .17500 .16300 .15100 .14000 .12900 .12000 .11100 .10300 .09500 .08800        .LDDT..MY AGES 1-10
 .08200 .07600 .07000 .06500 .06000 .05600 .05200 .04800 .04400 .04100        .LDDT..MY AGES 11-20
 0.0    0.0    0.0    0.0    0.0                                             .LDDT..MY AGES 21-25
 .19900 .18100 .16400 .14800 .13400 .12100 .11000 .10000 .09000 .08200        .HDDV..MY AGES 1-10
 .07400 .06700 .06100 .05500 .05000 .04500 .04100 .03700 .03300 .03000        .HDDV..MY AGES 11-20
 0.0    0.0    0.0    0.0    0.0                                             .HDDV..MY AGES 21-25
 .04100 .02800 .02100 .01600 .01200 .00800 .00600 .00400 .00200 .00200        .MC....MY AGES 1-10
 .00200 .00000 .00000 .00000 .00000 .00000 .00000 .00000 .00000 .00000        .MC....MY AGES 11-20
 0.0    0.0    0.0    0.0    0.0                                             .MC....MY AGES 21-25
 .075 .107 .107 .106 .100 .092 .085 .077 .066 .052                  JULMYR.LDGV..MY AGES 1-10
 .039 .027 .018 .014 .009 .006 .005 .005 .005 .004                        .LDGV..MY AGES 11-20
 0.0    0.0    0.0    0.0    0.0                                          .LDGV..MY AGES 21-25
 .061 .095 .094 .103 .083 .076 .076 .063 .054 .043                        .LDGT1.MY AGES 1-10
 .036 .024 .030 .028 .026 .024 .022 .020 .018 .016                        .LDGT1.MY AGES 11-20
 0.0    0.0    0.0    0.0    0.0                                          .LDGT1.MY AGES 21-25
 .037 .070 .078 .086 .075 .075 .075 .068 .059 .053                        .LDGT2.MY AGES 1-10
 .044 .032 .038 .036 .034 .032 .030 .028 .026 .024                        .LDGT2.MY AGES 11-20
 0.0    0.0    0.0    0.0    0.0                                          .LDGT2.MY AGES 21-25
 .037 .070 .078 .086 .075 .075 .075 .068 .059 .053                        .HDGV..MY AGES 1-10
 .044 .032 .038 .036 .034 .032 .030 .028 .026 .024                        .HDGV..MY AGES 11-20
 0.0    0.0    0.0    0.0    0.0                                          .HDGV..MY AGES 21-25
 .075 .107 .107 .106 .100 .092 .085 .077 .066 .052                        .LDDV..MY AGES 1-10
 .039 .027 .018 .014 .009 .006 .005 .005 .005 .004                        .LDDV..MY AGES 11-20
 0.0    0.0    0.0    0.0    0.0                                          .LDDV..MY AGES 21-25
 .061 .095 .094 .103 .083 .076 .076 .063 .054 .043                        .LDDT..MY AGES 1-10
 .036 .024 .030 .028 .026 .024 .022 .020 .018 .016                        .LDDT..MY AGES 11-20
 0.0    0.0    0.0    0.0    0.0                                          .LDDT..MY AGES 21-25
```

```
 .077 .135 .134 .131 .099 .090 .082 .062 .045 .033                    .HDDV..MY AGES 1-10
 .025 .015 .013 .011 .010 .008 .007 .006 .005 .004                    .HDDV..MY AGES 11-20
 0.0    0.0    0.0    0.0    0.0                                      .HDDV..MY AGES 21-25
 .105 .225 .206 .149 .097 .062 .046 .033 .029 .023                    .MC....MY AGES 1-10
 .008 .005 .013 .000 .000 .000 .000 .000 .000 .000                    .MC....MY AGES 11-20
 0.0    0.0    0.0    0.0    0.0                                      .MC....MY AGES 21-25
1 80 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 88 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 90 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 00 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
```

M 49 Warning: 0.999 MYR sum not = 1. (will normalize)

M 49 Warning: 0.992 MYR sum not = 1. (will normalize)

M 49 Warning: 0.999 MYR sum not = 1. (will normalize)

M 49 Warning: 0.992 MYR sum not = 1. (will normalize)

M 49 Warning: 0.992 MYR sum not = 1. (will normalize)

M 49 Warning: 1.00 MYR sum not = 1. (will normalize)

M 21 Warning: 0.500E-02 registration with zero mileage

M 21 Warning: 0.130E-01 registration with zero mileage

Total HC emission factors include evaporative HC emission factors.

---

User supplied mileage accrual distributions, veh registration distributions.

Cal. Year: 1980 I/M Program: No Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.

SAN FRANCISCO CA Minimum Temp: 60. (F) Maximum Temp: 84. (F)
Period 1 RVP: 11.5 Period 2 RVP: 11.5 Period 2 Start Yr: 1988

| Veh. Type: | LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | All Veh |
|---|---|---|---|---|---|---|---|---|---|---|
| Veh. Speeds: | 19.6 | 19.6 | 19.6 | | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | |
| VMT Mix: | 0.700 | 0.161 | 0.076 | | 0.034 | 0.005 | 0.001 | 0.016 | 0.007 | |
| Composite Emission Factors (Gm/Mile) | | | | | | | | | | |
| Total HC: | 6.40 | 8.22 | 15.56 | 10.57 | 25.29 | 0.60 | 0.97 | 4.21 | 9.27 | 7.986 |
| Exhaust CO: | 46.69 | 61.52 | 80.70 | 67.67 | 209.39 | 1.48 | 2.11 | 13.10 | 28.79 | 56.281 |
| Exhaust NOX: | 2.95 | 3.31 | 4.75 | 3.77 | 7.12 | 1.48 | 1.94 | 26.33 | 0.55 | 3.633 |

---

User supplied mileage accrual distributions, veh registration distributions.

Cal. Year: 1988 I/M Program: No Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.

SAN FRANCISCO CA Minimum Temp: 60. (F) Maximum Temp: 84. (F)
Period 1 RVP: 11.5 Period 2 RVP: 11.5 Period 2 Start Yr: 1988

| Veh. Type: | LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | All Veh |
|---|---|---|---|---|---|---|---|---|---|---|
| Veh. Speeds: | 19.6 | 19.6 | 19.6 | | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| VMT Mix: | 0.654 | 0.174 | 0.083 | | 0.040 | 0.012 | 0.004 | 0.028 | 0.005 | |
| Composite Emission Factors (Gm/Mile) | | | | | | | | | | |
| Total HC: | 3.18 | 4.95 | 7.11 | 5.65 | 14.28 | 0.52 | 0.84 | 2.73 | 6.99 | 4.224 |
| Exhaust CO: | 20.12 | 37.55 | 45.42 | 40.10 | 104.66 | 1.45 | 1.79 | 11.66 | 19.48 | 28.118 |
| Exhaust NOX: | 1.32 | 2.04 | 2.55 | 2.21 | 5.71 | 1.49 | 1.81 | 18.96 | 0.83 | 2.215 |

User supplied mileage accrual distributions, veh registration distributions.

Cal. Year: 1990 I/M Program: No Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.

SAN FRANCISCO CA Minimum Temp: 60. (F) Maximum Temp: 84. (F)
Period 1 RVP: 11.5 Period 2 RVP: 11.5 Period 2 Start Yr: 1988

| Veh. Type: | LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | All Veh |
|---|---|---|---|---|---|---|---|---|---|---|
| Veh. Speeds: | 19.6 | 19.6 | 19.6 | | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | |
| VMT Mix: | 0.643 | 0.185 | 0.083 | | 0.041 | 0.008 | 0.003 | 0.031 | 0.005 | |
| Composite Emission Factors (Gm/Mile) | | | | | | | | | | |
| Total HC: | 2.74 | 4.23 | 5.92 | 4.75 | 11.61 | 0.56 | 0.90 | 2.49 | 6.84 | 3.638 |
| Exhaust CO: | 17.10 | 30.76 | 37.58 | 32.87 | 83.10 | 1.50 | 1.85 | 11.17 | 19.45 | 23.711 |
| Exhaust NOX: | 1.05 | 1.76 | 2.15 | 1.88 | 5.55 | 1.52 | 1.84 | 18.00 | 0.83 | 1.988 |

M120 Warning: MOBILE4.1 does not model most 1993 and later Clean Air Act requirements; Emission Factors for CY 1993 or later are affected.

User supplied mileage accrual distributions, veh registration distributions.

Cal. Year: 2000 I/M Program: No Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
Anti-tam. Program: No Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.

SAN FRANCISCO CA Minimum Temp: 60. (F) Maximum Temp: 84. (F)
Period 1 RVP: 11.5 Period 2 RVP: 11.5 Period 2 Start Yr: 1988

| Veh. Type: | LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | All Veh |
|---|---|---|---|---|---|---|---|---|---|---|
| Veh. Speeds: | 19.6 | 19.6 | 19.6 | | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | |
| VMT Mix: | 0.602 | 0.219 | 0.087 | | 0.041 | 0.001 | 0.001 | 0.045 | 0.004 | |
| Composite Emission Factors (Gm/Mile) | | | | | | | | | | |
| Total HC: | 2.23 | 2.88 | 3.23 | 2.98 | 7.14 | 0.47 | 0.79 | 2.14 | 6.78 | 2.670 |
| Exhaust CO: | 12.12 | 16.86 | 20.00 | 17.75 | 36.89 | 1.39 | 1.69 | 10.21 | 19.45 | 14.787 |
| Exhaust NOX: | 0.68 | 1.15 | 1.23 | 1.18 | 4.50 | 1.13 | 1.46 | 8.43 | 0.83 | 1.339 |

### 5.1.3 Anti-Tampering Program

Example 7 provides an example of the modeling of an anti-tampering program to reduce emissions. All of the other settings are the same as were used in Example 6. The anti-tampering program modeled has the following characteristics: Start data 1984, oldest model year vehicles subject to the ATP requirements of 1975, newest model year vehicles subject to the ATP requirements of 2020 (meaning that all vehicles of model years 1975 and later are covered), light-duty gas vehicles are the only vehicle type subject to the ATP requirements (light-duty gas trucks and heavy-duty gas vehicles are exempt), centralized program, annual frequency of inspection, 50 percent compliance rate, and inspections are performed for air pump system, catalyst, fuel inlet restrictor, evaporative control system, PCV system, and gas cap. No tailpipe lead detection test or EGR system inspection is included in this program. Note that the evaporative emission control system inspection and gas cap inspection are both required; as discussed in section 2.2.6, credit is provided for evaporative emission system inspections only if a gas cap inspection is also given.

The ATP described by this example is for illustrative purposes only, and does not reflect the situation in San Francisco, CA.

```
1           PROMPT
MOBILE4.1 UG EXAMPLE 7: ATPFLG = 2 (ANTI-TAMPERING PROGRAM), LAPSY = 1984, NO I/M
1           TAMFLG
1           SPDFLG
1           VMFLAG
1           MYMRFG
1           NEWFLG
1           IMFLAG
1           ALHFLG
2           ATPFLG: 2 = READ ATP PARAMETER CARD.
5           RLFLAG
1           LOCFLG  -  READ IN LOCAL AREA PARAMETERS AS 2ND REQ SC REC
1           TEMFLG  -  CALCULATE EXHAUST TEMPERATURES
3           OUTFMT
4           PRTFLG
1           IDLFLG
1           NMHFLG
1           HCFLAG  -  DO NOT PRINT HC COMPONENTS
84 75 20 2111 11 050. 22211222        ATP PARAMETERS: START, 1ST MYR, LAST MYR, VEH TYPES, INSP PGM TYPE & FREQ, COMPLIANCE, DISABLE
1 80 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 88 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 90 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 00 19.6 75.0 20.6 27.3 20.6                    1ST REQ SC REC: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
SAN FRANCISCO CA C  60.  84. 11.5 11.5 88      LAP REC: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
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MOBILE4.1 UG EXAMPLE 7: ATPFLG = 2 (ANTI-TAMPERING PROGRAM), LAPSY = 1984, NO I/

Anti-tampering program selected:

| | |
|---|---|
| Start year (January 1): | 1984 |
| First model year covered: | 1975 |
| Last model year covered: | 2020 |
| Vehicle types covered: | LDGV |
| Type: | Centralized |
| Frequency: | Annual |
| Compliance Rate: | 50.0% |
| Air pump system disablements: | Yes |
| Catalyst removals: | Yes |
| Fuel inlet restrictor disablements: | Yes |
| Tailpipe lead deposit test: | No |
| EGR disablement: | No |
| Evaporative system disablements: | Yes |
| PCV system disablements: | Yes |
| Missing gas caps: | Yes |

Total HC emission factors include evaporative HC emission factors.

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Cal. Year: 1980 I/M Program: No Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
Anti-tam. Program: Yes Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.

SAN FRANCISCO CA Minimum Temp: 60. (F) Maximum Temp: 84. (F)
Period 1 RVP: 11.5 Period 2 RVP: 11.5 Period 2 Start Yr: 1988

| Veh. Type: | LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | All Veh |
|---|---|---|---|---|---|---|---|---|---|---|
| Veh. Speeds: | 19.6 | 19.6 | 19.6 | | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | |
| VMT Mix: | 0.688 | 0.142 | 0.070 | | 0.031 | 0.005 | 0.001 | 0.052 | 0.011 | |
| Composite Emission Factors (Gm/Mile) | | | | | | | | | | |
| Total HC: | 8.22 | 9.38 | 16.20 | 11.64 | 29.05 | 0.66 | 0.99 | 5.48 | 9.71 | 9.415 |
| Exhaust CO: | 54.96 | 62.89 | 82.04 | 69.23 | 226.27 | 1.56 | 2.13 | 16.24 | 33.63 | 60.699 |
| Exhaust NOX: | 3.11 | 3.26 | 4.68 | 3.73 | 7.39 | 1.51 | 1.96 | 30.06 | 0.47 | 4.745 |

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Cal. Year: 1988 I/M Program: No Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
Anti-tam. Program: Yes Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.

SAN FRANCISCO CA Minimum Temp: 60. (F) Maximum Temp: 84. (F)
Period 1 RVP: 11.5 Period 2 RVP: 11.5 Period 2 Start Yr: 1988

| Veh. Type: | LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | All Veh |
|---|---|---|---|---|---|---|---|---|---|---|
| Veh. Speeds: | 19.6 | 19.6 | 19.6 | | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | |
| VMT Mix: | 0.639 | 0.152 | 0.076 | | 0.036 | 0.013 | 0.003 | 0.072 | 0.009 | |
| Composite Emission Factors (Gm/Mile) | | | | | | | | | | |
| Total HC: | 4.33 | 6.20 | 8.33 | 6.91 | 17.68 | 0.62 | 0.79 | 3.40 | 6.36 | 5.300 |
| Exhaust CO: | 28.34 | 40.56 | 47.98 | 43.03 | 128.80 | 1.57 | 1.72 | 13.95 | 22.71 | 33.846 |
| Exhaust NOX: | 1.70 | 2.14 | 2.67 | 2.32 | 5.96 | 1.57 | 1.77 | 21.52 | 0.80 | 3.412 |

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Cal. Year: 1990 I/M Program: No Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
Anti-tam. Program: Yes Operating Mode: 20.6 / 27.3 / 20.6 Altitude: 500. Ft.

SAN FRANCISCO CA  Minimum Temp: 60. (F)  Maximum Temp: 84. (F)
Period 1 RVP: 11.5  Period 2 RVP: 11.5  Period 2 Start Yr: 1988

| Veh. Type: | LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | All Veh |
|---|---|---|---|---|---|---|---|---|---|---|
| Veh. Speeds: | 19.6 | 19.6 | 19.6 | | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | |
| VMT Mix: | 0.628 | 0.163 | 0.077 | | 0.037 | 0.009 | 0.002 | 0.076 | 0.008 | |
| Composite Emission Factors (Gm/Mile) | | | | | | | | | | |
| Total HC: | 3.77 | 5.39 | 7.14 | 5.95 | 14.87 | 0.69 | 0.93 | 3.03 | 5.93 | 4.632 |
| Exhaust CO: | 24.55 | 34.05 | 40.33 | 36.06 | 105.70 | 1.67 | 1.90 | 13.30 | 21.95 | 29.188 |
| Exhaust NOX: | 1.43 | 1.89 | 2.28 | 2.01 | 5.78 | 1.63 | 1.87 | 20.07 | 0.82 | 3.151 |

M120 Warning: MOBILE4.1 does not model most 1993 and later Clean Air Act requirements; Emission Factors for CY 1993 or later are affected.

Cal. Year: 2000  I/M Program: No  Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
Anti-tam. Program: Yes  Operating Mode: 20.6 / 27.3 / 20.6  Altitude: 500. Ft.

SAN FRANCISCO CA  Minimum Temp: 60. (F)  Maximum Temp: 84. (F)
Period 1 RVP: 11.5  Period 2 RVP: 11.5  Period 2 Start Yr: 1988

| Veh. Type: | LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | All Veh |
|---|---|---|---|---|---|---|---|---|---|---|
| Veh. Speeds: | 19.6 | 19.6 | 19.6 | | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | |
| VMT Mix: | 0.589 | 0.191 | 0.080 | | 0.038 | 0.002 | 0.002 | 0.092 | 0.007 | |
| Composite Emission Factors (Gm/Mile) | | | | | | | | | | |
| Total HC: | 2.65 | 3.66 | 4.03 | 3.77 | 9.62 | 0.63 | 0.92 | 2.21 | 5.48 | 3.188 |
| Exhaust CO: | 15.20 | 18.91 | 21.01 | 19.53 | 44.89 | 1.60 | 1.84 | 11.39 | 21.44 | 17.128 |
| Exhaust NOX: | 0.77 | 1.24 | 1.29 | 1.25 | 4.66 | 1.37 | 1.68 | 9.70 | 0.83 | 1.877 |