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SENSITIVITY

ANALYSIS

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Prepared by

Air and Energy Engineering Research
Laboratory
Research Triangle Park NC 27711

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MOBILE4 SENSITIVITY ANALYSIS

FINAL REPORT

by

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ABSTRACT

The purpose of this analysis is to identify the MOBILE4 input variables that can have significant impacts on highway vehicle emissions inventories and to develop priorities for the development of improved guidance for specifying MOBILE4 inputs. Two major factors are considered: (1) the likelihood and potential range of variability in values for each MOBILE4 input; and (2) the potential magnitude of the effect of these variations, in terms of impact on typical mobile source inventories. This analysis updates previous work based on MOBILE3 by using MOBILE4 for the sensitivity analysis and by adding new MOBILE4 variables. The approach used in previous work is modified to address the specific concerns of this project (the State implementation plan [SIP] and National Emissions Data System [NEDS] inventory/guidance context). An additional level of detail is included for two critical variables (speed and temperature), and sensitivity to basic vehicle inspection/maintenance program specifications (waiver and compliance rate) is also considered.

The primary sensitivity analysis is structured around two base cases representing ozone and carbon monoxide season conditions. Ranges around the base cases are usually specified, but in some instances, other types of alternate values are specified. In general, the base cases and primary ranges were chosen to parallel the previous sensitivity analysis and to relate to specific cities or national averages available from the EPA Office of Mobile Sources. The pollutants, regions and calendar years were chosen to cover the areas, periods and pollutants of interest in SIP inventories and other typical inventory applications. The sections of the report describe: (1) MOBILE4 input variable values for the ozone and CO base cases; (2) the variables and ranges or alternate values applied in the sensitivity analysis; (3) the results of the sensitivity analysis, and (4) conclusions.

ACKNOWLEDGEMENTS

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METRIC CONVERSIONS

Readers more familiar with metric units may use the following factors to convert to that system.

Nonmetric	Times	Yields Metric
°F	0.556 (T – 32)	°C
gm / mi	1.609	gm / kg
lb	0.454	kg
mph	1.609	km / h
psi	6.895	kPa

SECTION 1

BACKGROUND

The purpose of this analysis is to identify the MOBILE4 input variables that can have significant impacts on highway vehicle emissions inventories, and to develop priorities for the development of improved guidance for specifying MOBILE4 inputs. Two major factors are considered: (1) the likelihood and potential range of variability in values for each MOBILE4 input; and (2) the potential magnitude of the effect of these variations, in terms of impact on typical mobile source inventories.

Although it is not possible to derive specific numeric ranges of MOBILE4 inputs associated with probabilities of error or mis-specification, this exercise attempts to use ranges that illustrate the following cases: misinterpretation of guidance; use of MOBILE4 defaults where local conditions are significantly different; and use of assumptions about local conditions which may not accurately reflect actual conditions.

MOBILE4 has internal data validity checks which prevent input of values beyond the range of its internal algorithms, which constitute a natural set of limits representing the logical boundaries of conditions expected in the inventory context, and which also serve to reject gross input errors. This protocol does not explicitly attempt to address input errors such as miscoding.

A previous sensitivity assessment for MOBILE3 is documented in *Procedures for Emission Inventory Preparation -- Volume IV: Mobile Sources*.[1] The purposes of the current analysis are to update the previous work to a MOBILE4 basis (using MOBILE4 as the basis for the sensitivity analysis as well as adding new MOBILE4 variables to the analysis), and to modify the approach to the extent possible to address the specific concerns of this project, which include guidance for use of MOBILE4 in State implementation plan [SIP] inventories as well as methods and data for national-scale inventories. An additional level of detail is included for two critical variables (speed and temperature), and sensitivity to basic inspection/maintenance (I/M) program specifications (waiver and compliance rate) is also considered. It should be noted that the figures presented in the *Volume IV* sensitivity analysis as published in July 1989 do not match the text in that volume.

The primary sensitivity analysis presented here is structured around two base cases representing ozone and carbon monoxide season conditions. Ranges around the base cases are usually specified, but in some instances, other types of alternate values are specified. Table 1 summarizes the protocol for the primary sensitivity analysis, including all relevant MOBILE4 input variables. In general, the base cases and primary ranges were chosen to be parallel to the previous sensitivity analysis, and to relate to specific cities or national averages from available work by the EPA Office of Mobile Sources (OMS). The pollutants, regions and calendar years were chosen to cover the areas, periods and pollutants of interest in SIP inventories and other typical inventory applications. Table 1 also specifies input value labels which correspond to the labels in the Figures in Section 4. It should be noted that the "high" and "low" labels are related to the input values, and do not necessarily correlate to higher and lower emissions. Derivation of the input values in the protocol is discussed in Sections 2 and 3. Additional information concerning the importance of accuracy in estimating key variables is provided by testing the effects of secondary sensitivity ranges around the base cases as well as around the primary speed and temperature ranges specified in the protocol.

The following sections describe: (1) MOBILE4 input variable values for the ozone and CO base cases, (2) the variables and ranges or alternate values applied in the sensitivity analysis, (3) the results of the sensitivity analysis, and (4) conclusions.

TABLE 1. PROTOCOL FOR MOBILE4 SENSITIVITY ANALYSIS

	Base Case 1: Ozone Season	Base Case 2: CO Season	Ozone Season Ranges[a]	CO Season Ranges[a]
Pollutant	HC, CO, NO_x	CO only	–	–
Region	Low + high altitude	Low + high altitude	–	–
Calendar Year	1990, 2005	1990, 2005	–	–
Avg. Speed (mph)[b]	19.6	19.6	7.1(low) - 35(high)	7.1(low) - 35(high)
Avg. Temperature(°F)[c]	78.1	43.2, no diurnal	86.0(low) - 91.7(high)[d]	11.3(low) - 66.1(high)
Hot/Cold Start[e]	20.6/27.3/20.6	20.6/27.3/20.6	5.0/5.0/5.0 (low) - 5.0/55.0/5.0 (high)	57.0/0/57.0 (low) - 5.0/5.0/5.0 (high)
VMT Mix and Mileage Accumulation	MOBILE4 Default	MOBILE4 Default	Fairbanks - California	Fairbanks - California
Vehicle Age Distrib.	MOBILE4 Default	MOBILE4 Default	Fairbanks - Phoenix	Fairbanks - Phoenix
ASTM Class	C	E	C or B[c]	–
Diurnal Temp.(°F)	60-84°F	No diurnal	72-90; 62-102[d]	No diurnal
Base RVP (psi)	10.5	13.7	10.5; 9.0[d]	–
In-use RVP (psi)	9.0 in 1992	13.7	9.0; 7.8[d]	–
I/M Program[f]	Basic I/M	Basic I/M		
Compliance	95%	95%	90 - 100%[g]	90 - 100%[g]
Waivers	8%	8%	0 - 16%[g]	0 - 16%[g]

[a] In addition, secondary ranges of 5 mph and 5°F around the base cases and ranges for speeds and temperatures were simulated.
[b] Readers more familiar with metric units may use the factors listed at the end of the front matter to convert to that system.
[c] These are trip- and emission-weighted average temperatures as calculated by MOBILE4.
[d] Temperature, ASTM class, diurnal range and RVPs varied jointly for Muskegon and Sacramento cases (see Section 3).
[e] Percent of VMT accumulated by: Non-catalyst vehicles in cold start mode/Catalyst vehicles in hot-start mode/Catalyst vehicles in cold start mode -- other fractions calculated by MOBILE4.
[f] See Table 2 for listing of I/M program characteristics used
[g] Ranges for I/M combined into two cases: 100% compliance with 0% waivers (high); 90% compliance with 16% waivers (low).

SECTION 2

MOBILE4 INPUT VALUES FOR THE BASE CASES

Emissions of hydrocarbons, nitrogen oxides and carbon monoxide (HC, NO_x and CO) were all analyzed for summer ozone season conditions, although CO is a relatively minor participant in ozone photochemistry. Only CO was considered for the winter CO season base case, since the other mobile source pollutants are not implicated in urban CO problems. Both low and high altitude situations were included, although only a few counties in the western United States are actually modeled as high altitude. The years 1990 and 2005 were selected as typical base and projection years for SIP submittals, to provide some perspective on the relative importance of the individual variables over time. Table 1 lists the input values used for the MOBILE4 ozone and CO season base cases. The combination of low and high altitude with 1990 and 2005 results in four altitude/year scenarios under the ozone and CO season base cases.

The base case speed of 19.6 mph is the Federal Test Procedure (FTP) average speed, developed as a typical urban driving cycle. For the ozone season base case, the average temperature and diurnal temperature range are based on the typical conditions simulated in the FTP. It should be noted that the "average" temperatures cited here and elsewhere are trip- and emission-weighted average temperatures as calculated by MOBILE4, which are used in the estimation of several MOBILE4 emission factors.

The 10.5 psi Reid vapor pressure (RVP) chosen for the ozone season base case for 1990 is the "Phase I" volatility standard specified for most of the country beginning in 1989.[2] For 2005, the ozone season RVP of 9.0 psi reflects the effect of Phase II summertime RVP limits.[3]

For the CO base case, the 43.2°F average daily temperature and 13.7 psi RVP are national averages for cold temperature CO exceedance situations, taken from a recent draft Office of Mobile Sources (OMS) analysis entitled "Use of Cold Temperature CO Air Quality Analysis for Clean Air Act Amendment Evaluation."[4] Diurnal temperature ranges do not affect CO.

For both ozone and CO season base cases, MOBILE4 default values were used for VMT mix, mileage accumulation and vehicle age distributions. For hot/cold start percentages, typical values recommended in the MOBILE4 guidance were used.[5]

Both base cases and all sensitivity runs tests assume the typical basic inspection and maintenance (I/M) program specified in Table 2. Since this is intended as an example, the individual program specifications were selected to be typical of current programs. The base case compliance and waiver rates are values selected as typical of I/M programs nationwide. Generally, the other I/M characteristics are known program variables and are less subject to variation and error than the waiver and compliance rates.

TABLE 2. "BASIC" I/M PROGRAM CHARACTERISTICS

I/M PROGRAM:	
START YEAR (JANUARY 1):	1983
PRE-1981 MYR STRINGENCY RATE:	20%
MECHANIC TRAINING PROGRAM?:	NO
FIRST MODEL YEAR COVERED:	1970
LAST MODEL YEAR COVERED:	2020
VEHICLE TYPES COVERED:	LDGV, LDGT1, LDGT2
1981+ MYR TEST TYPE:	IDLE ONLY
1981+ MYR TEST CUTPOINTS:	1.2% CO, 220 PPM HC
ANTI-TAMPERING PROGRAM SELECTED:	NONE
ADDITIONAL MOBILE4 I/M INPUTS:	
WAIVER RATES:	8% (ALL YEARS)
COMPLIANCE RATE:	95%
INSPECTION TYPE:	CENTRALIZED
INSPECTION FREQUENCY:	ANNUAL

SECTION 3

MOBILE4 INPUT VALUES FOR SENSITIVITY ANALYSIS

Table 1 lists the MOBILE4 input values for the ozone and CO season ranges used in the primary sensitivity analysis, which are described below.

Speed

The low speed of 7.1 mph is from the New York City cycle, a testing protocol that represents driving in highly-congested urban traffic. The high speed of 35 mph is based on the highest-speed urban driving cycle used by OMS.

Temperature/Reid Vapor Pressure

Since temperature and RVP are interrelated, two cases based on recent OMS analyses for Muskegon and Sacramento were used to create two logical joint scenarios for the ozone and CO season primary sensitivity analyses. Muskegon represents a case in which the diurnal temperature range is 18°F rather than the 24°F of the Federal Test Procedure (FTP) (with corresponding trip- and emission-weighted MOBILE4 average temperature of 86.0°F rather than the FTP average of 78.1°F). The RVP-related parameters for Muskegon are unchanged from the base case (10.5 psi in 1990). Sacramento is in a different ASTM region, and has incrementally lower RVPs (9.0 in 1990), as well as a larger diurnal range and higher trip- and emission-weighted average temperature.

Hot/Cold Start Fractions

Variations in the hot/cold start fractions were selected to be parallel to the previous MOBILE3 sensitivity analysis. For the ozone season, the set of input fractions labeled as "low" represents low levels of both cold and hot starts (5 percent), resulting in a high level of stabilized emissions. The set labeled "high" represents a high level of hot starts (55 percent) and low levels of cold starts. For CO season, the "low" input set includes 57 percent cold starts and the "high" set has a minimum level of hot and cold starts (5 percent), resulting in a high percentage of stabilized emissions. These designations were used to be consistent with the previous MOBILE3 analysis and the "high" and "low" terms do not refer to the resulting emissions levels.

VMT Mix, Mileage Accumulation and Vehicle Age

Ranges for VMT mix, mileage accumulation and vehicle age distribution were based on input variable sets used in the previous MOBILE3 analysis to represent significant variations from the MOBILE3 defaults. Fairbanks, Alaska was selected for its high proportion of light duty trucks, low mileage accumulation, and relatively low numbers of older vehicles. The VMT mix and mileage accumulation for California were chosen for the relatively high proportion of cars in the California fleet and the higher levels of mileage accumulation reported. The vehicle age distribution for Phoenix was used as an example of an area where vehicles have relatively long lives. For the California and Phoenix cases, each of these variable sets was used individually. The unique character of the local fleet in Fairbanks (e.g., no motorcycles) made it inadvisable to use the default VMT mix for that case, so the local VMT mix was also used in the mileage accumulation and vehicle age distribution runs for Fairbanks. This causes the results of the

latter runs to be a combination of the effects of the two input sets, as discussed in the following section.

Appendix A provides the values used for each of the VMT mix, mileage accumulation and vehicle age distribution cases, and the relative changes from the MOBILE4 default values.

I/M Program Compliance and Waiver Rate

Sensitivity of MOBILE4 to I/M program parameters was limited to joint variation of compliance and waiver rates from the base case (95 percent compliance, 8 percent waivers). The "low" case used 16 percent waivers and 90 percent compliance, and the "high" case used 100 percent compliance and 0 percent waivers (an ideal program with respect to these variables). These two variables were chosen because they each have a direct impact on the overall I/M effectiveness, and are key program design and assessment parameters. The other local I/M program characteristics are generally more static and less susceptible to mis-specification in inventory work.

Secondary Sensitivity Runs for Speed and Temperature

In addition to the primary ozone and CO season ranges discussed above, which were chosen to represent reasonable limits to the conditions that might be expected in actual inventory applications, a second set of sensitivity runs was made to illustrate the effects of smaller changes in speed or temperature. These secondary sensitivity runs were made to illustrate the potential effects of inaccuracies in these two critical variables across their potential ranges. These analyses were made by varying temperature and speed for each of the primary sensitivity analysis cases in Table 1 by 5°F and 5 mph, respectively. In the ozone season temperature runs, this was done by raising or lowering the appropriate minimum and maximum temperatures, resulting in time- and emission-weighted average temperature differences which were not exactly 5°F. Variables other than speed or temperature remained at the values used for the base case or range in question.

SECTION 4

SENSITIVITY ANALYSIS RESULTS

Figure 1 presents the results of the sensitivity analysis for the primary ozone and CO season cases for 1990 at low altitude. Figure 2 presents the results of the secondary sensitivity runs for speed and temperature, also for 1990 and low altitude. Appendix B provides additional figures for 2005 and high altitude cases, as well as tables of the fleet composite emission factors on which the figures are based. These results are discussed below.

Results for Low Altitude in 1990

Results for the low altitude base case in 1990 will be discussed in some depth since the low altitude case applies to most of the United States, and the current task is directed at implications for base year State implementation plan inventories. The following discussions for the year 2005 and high altitude concentrate on the ways in which sensitivities for these cases vary from the 1990/low altitude case.

Ozone Season

The first three graphs in Figure 1 show the variation of hydrocarbon (HC), CO and NO_x fleet composite emission factors from the ozone season base case inputs to the ozone season ranges shown in Table 1. In general, these graphs indicate that speed and the combination of RVP and temperature have the largest and most consistent effects. The dramatic results for speed follow the basic relationships shown in the figures in Appendix C,[6] which consist of relatively low emissions at high speeds and progressive emission increases at lower speeds. CO is the pollutant most affected by speed, followed by HC and then NO_x. The joint variation of temperature and RVP to simulate Muskegon and Sacramento resulted in very significant increases in HC and CO for both cases, with NO_x being reduced slightly. This overall effect is due primarily to the differences in temperature, with the HC and CO results for Sacramento being tempered by the lower RVP.

Both of the alternate ozone season hot/cold start ratios reduced emissions for all pollutants, with the "low" input set causing reductions of over 10 percent for all pollutants and smaller changes for the "high" set. Changes in the I/M program waiver and compliance rates have a relatively small effect on HC emissions, a slightly larger effect on CO emissions, and no effect on NO_x emissions (typical I/M programs are not intended to reduce NO_x).

The three variables associated with local vehicle fleet characteristics (VMT mix, mileage accumulation, and vehicle age distribution) show relatively little effect on overall emissions in 1990. The major exception is the effect of the Fairbanks VMT mix on NO_x emissions, which is mainly due to an increase in heavy duty diesel VMT of 130 percent over the base case. Since heavy duty diesels emit about ten times as much NO_x per mile as the other vehicle types, this single VMT increase has a dramatic effect on fleet composite NO_x emissions. The Fairbanks VMT mix was also used in conjunction with the Fairbanks vehicle age and mileage accumulation cases, so the NO_x results for these cases are affected in a similar manner. The net result is that the Fairbanks mileage accumulation appears to have no effect and the Fairbanks vehicle age distribution has about 9 percent additional effect on NO_x emissions. Of the other fleet-related variable cases, the only results over five percent are the effect of the Fairbanks vehicle age distribution on HC and CO emissions and the effect of the California

mileage accumulation on NO_x emissions.

The effects of the fleet-related variables can vary among pollutants. For example, the California mileage accumulation reduces HC by 3 percent, increases NO_x by 8 percent, and has no effect on CO (relative to the MOBILE4 default mileage accumulation, holding the other fleet variables at MOBILE4 default values).

Carbon Monoxide Season

The last graph in Figure 1 shows the variation of CO fleet composite emission factors from the CO season base case inputs to the CO season ranges shown in Table 1. For the cooler CO season temperatures, speed remains a major variable, and the temperature and hot/cold start ranges selected for the CO season also have dramatic effects on CO emissions. Effects are especially pronounced for low speed (7.1 mph), low temperature (11.3°F) and the cold-start-dominated hot/cold start mix. The I/M program ranges have slightly less effect at CO season temperatures than they do at ozone season temperatures. The vehicle fleet-related variables also have less effect at CO season temperatures.

Secondary Sensitivity Runs for Speed and Temperature

Figure 2 shows the results of further variation of speed and temperature around the base case and ranges described in Table 1. Secondary ranges of five degrees Fahrenheit and five miles per hour were used around both the ozone and CO season base cases and the cited primary ranges. This exercise illustrates the sensitivity of MOBILE4 results to small potential errors in these key variables. The "high," "low" and "base" designations for the individual results in Figure 2 refer to the protocol in Table 1. For example, the first three sets of bars in the graph for HC illustrate the effect of raising or lowering the maximum and minimum temperatures by 5°F from the FTP-based base case and the "low" and "high" ranges which represent Muskegon and Sacramento (with corresponding changes in the trip- and emission-weighted averages).

In general, the results in Figure 2 indicate that relatively small differences in average speed and temperature can have significant effects on the MOBILE4 composite fleet emission factors for ozone season HC and for CO in both seasons. NO_x is much less sensitive to speed and temperature. As the examples of MOBILE4 emissions/speed functions in Appendix C show, the effects are particularly pronounced for the low speed case. It should be noted that the very dramatic results of lowering the low speed range (7.1 mph) to 2.1 mph ("Low-5" on Figure 2) would not be expected to occur in most typical inventory development situations. That is, it is not likely that an error of 5 mph would be made in this speed range. In fact, 2.1 mph is beyond the valid range of MOBILE4 input for light duty vehicle speed, and light duty vehicle speeds were actually set at 2.5 mph in this set of runs. Excluding this extreme case, it is still clear that accurate specification of the average speed and temperature for an area is essential to the accuracy of the resulting mobile source inventory. For example, a 5 mph inaccuracy in speed in the 20 mph range can cause an 11 to 18 percent error in ozone season HC emissions and a 20 to 29 percent error in CO emissions for ozone or CO season conditions. Relative changes in CO with speed are essentially the same for the ozone and CO seasons since they are based on the same MOBILE4 speed correction factors, although the absolute emissions are different (see the last worksheet in Appendix B). Temperature sensitivity runs show ozone season HC most highly affected, with CO somewhat sensitive as well.

Results for 2005 and for High Altitude

Appendix B includes graphs showing the results of applying the entire Table 1 primary sensitivity analysis protocol for 2005 and for high altitude. The main purpose of these runs was to identify any situations in which the basic conclusions obtained for low altitude in 1990 might change in the future or in the few areas considered high altitude for MOBILE4 modeling.

For all future year and high altitude cases, the effect of changing I/M program compliance and waiver rates is marginally less than for low altitude in 1990.

For 2005 at low altitude, the following ozone season parameters showed some significant variation from the 1990 base year:

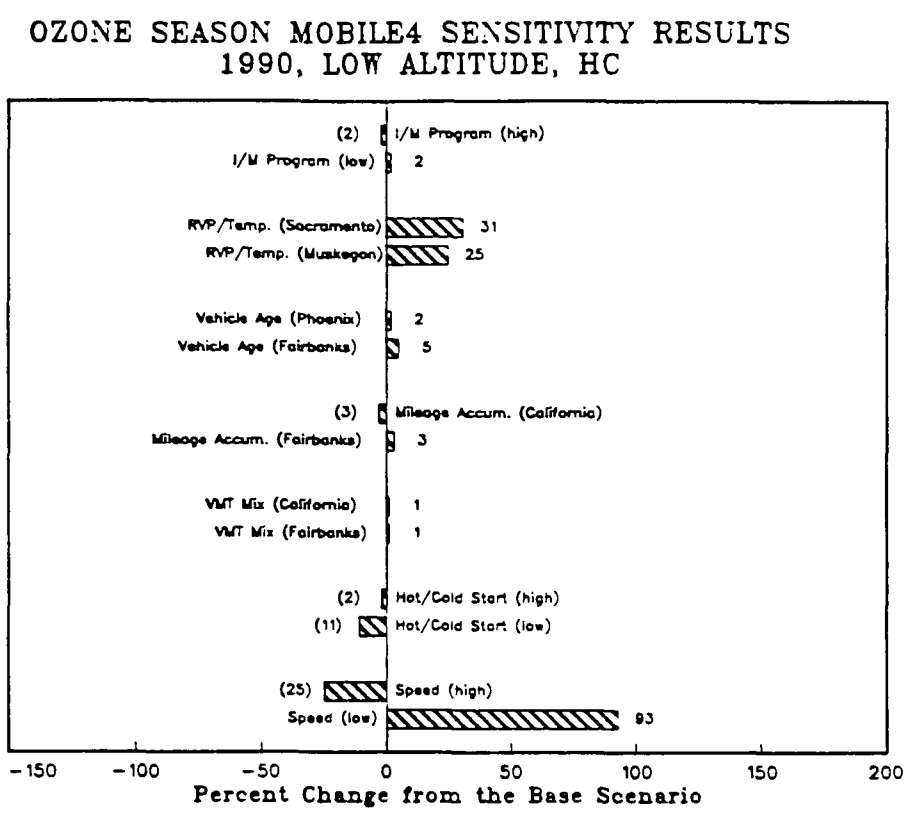
Effect of the specified RVP/temperature combinations is somewhat smaller for HC and their slightly negative effects for NO_x in the base year become slightly positive for 2005.

Effects of vehicle fleet parameters and hot/cold start ratios are marginally larger for HC and CO, and are mixed for NO_x.

Effects of the speed range become a little larger for HC and NO_x, but are reduced for CO.

For the CO season, the results of the specified variations in vehicle fleet parameters are mixed, and results for hot/cold start mix, temperature and speed are marginally smaller than in 1990.

Going from low to high altitude for the two analysis years results in only a few noticeable changes. The general effects of the vehicle fleet characteristics on ozone season HC and CO at high altitude are somewhat greater for 1990 and are considerably greater in 2005. The Fairbanks VMT mix appears to be responsible for the biggest changes, resulting in roughly double the changes seen for HC at low altitude. Sensitivity to speed is slightly lower in 2005, for ozone season HC and CO emissions as well as for CO emissions in the CO season.



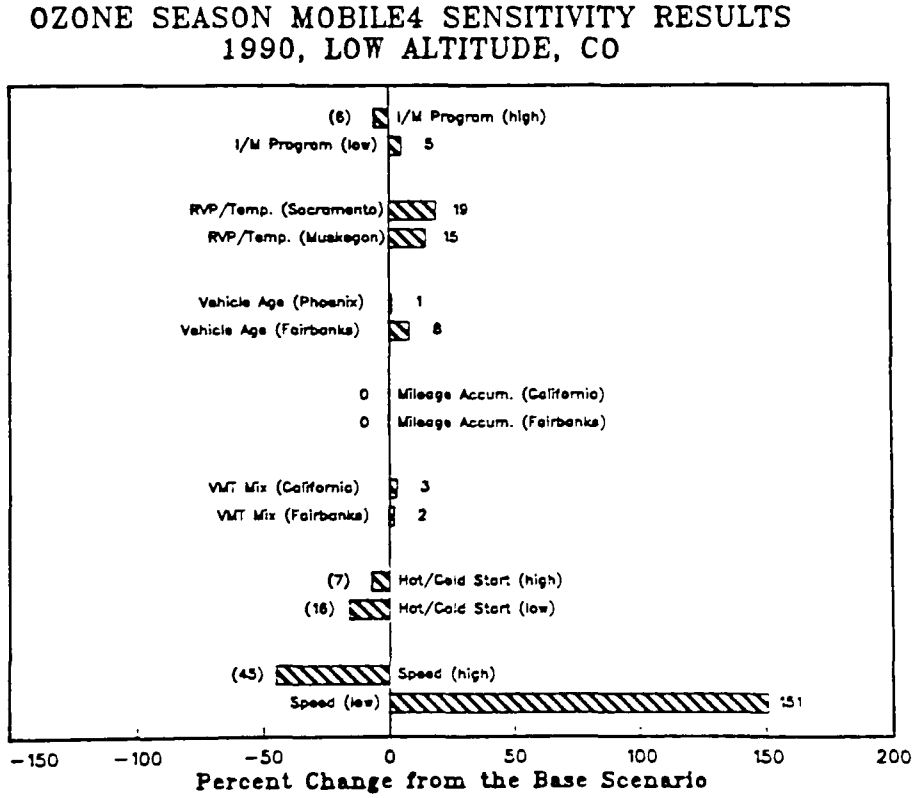
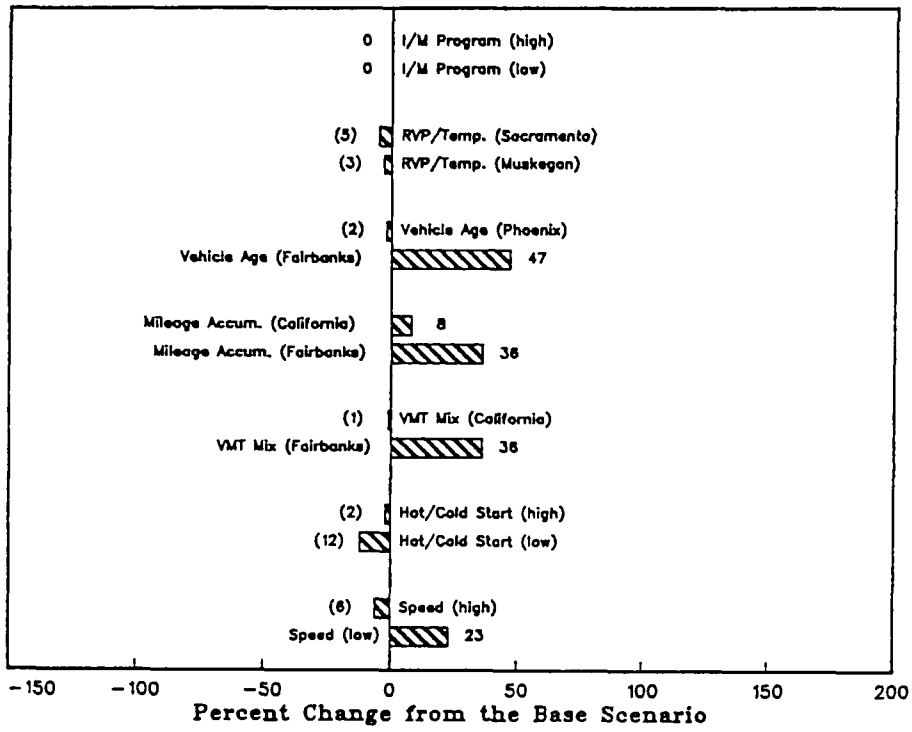


Figure 1. Primary MOBILE4 Sensitivity Analysis Results (Low Altitude-1990)

(continued)

OZONE SEASON MOBILE4 SENSITIVITY RESULTS
1990, LOW ALTITUDE, NOx



CO SEASON MOBILE4 SENSITIVITY RESULTS
1990, LOW ALTITUDE, CO

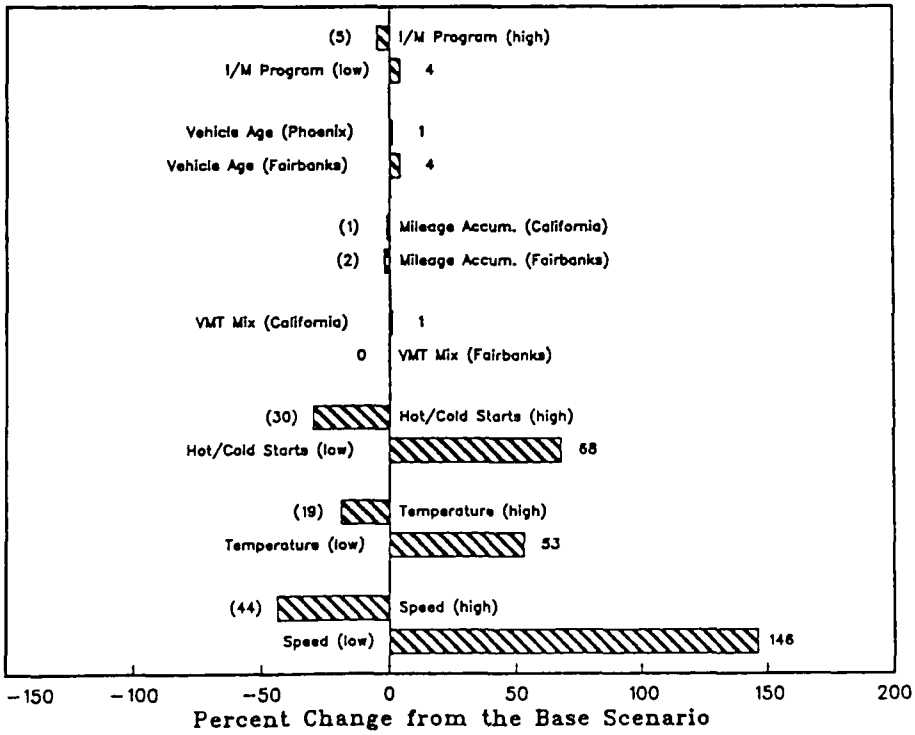
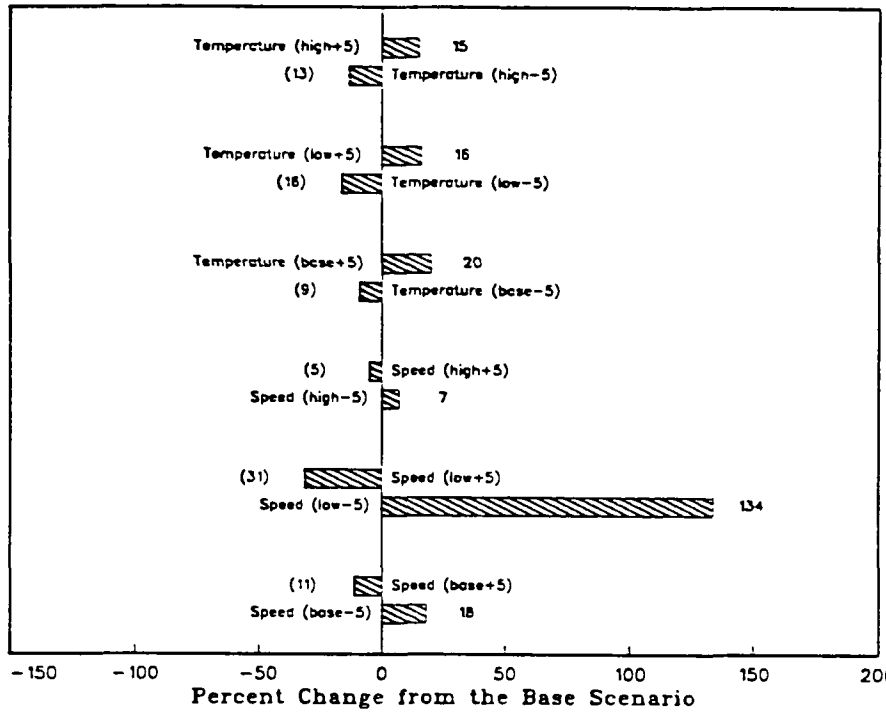


Figure 1. Primary MOBILE4 Sensitivity Analysis Results (Low Altitude-1990) (Continued)

OZONE SEASON MOBILE4 SENSITIVITY RESULTS
SECONDARY TEMPERATURE AND SPEED RANGES FOR HC



OZONE SEASON MOBILE4 SENSITIVITY RESULTS
SECONDARY TEMPERATURE AND SPEED RANGES FOR CO

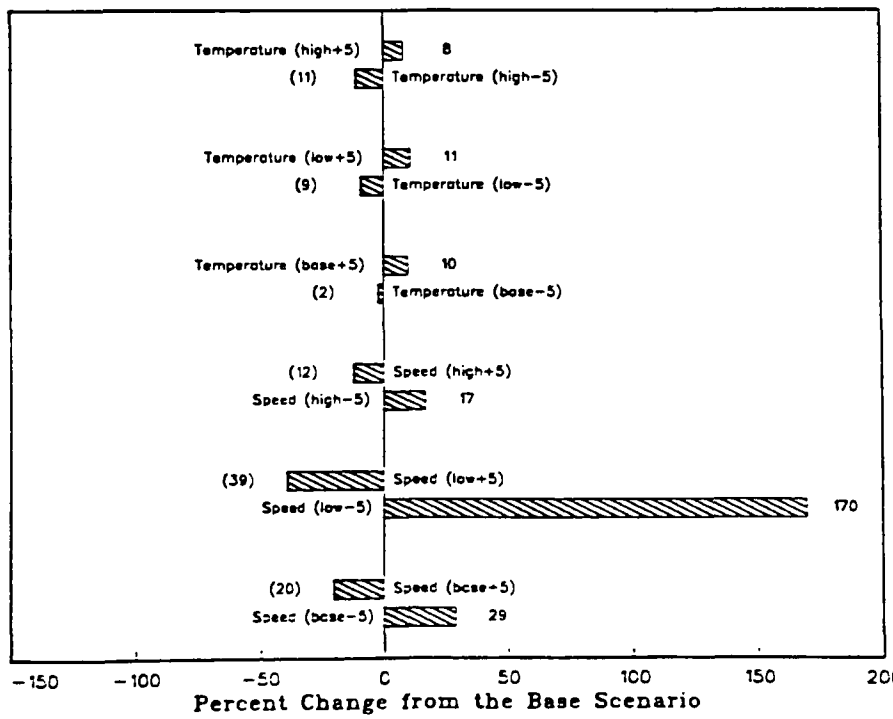
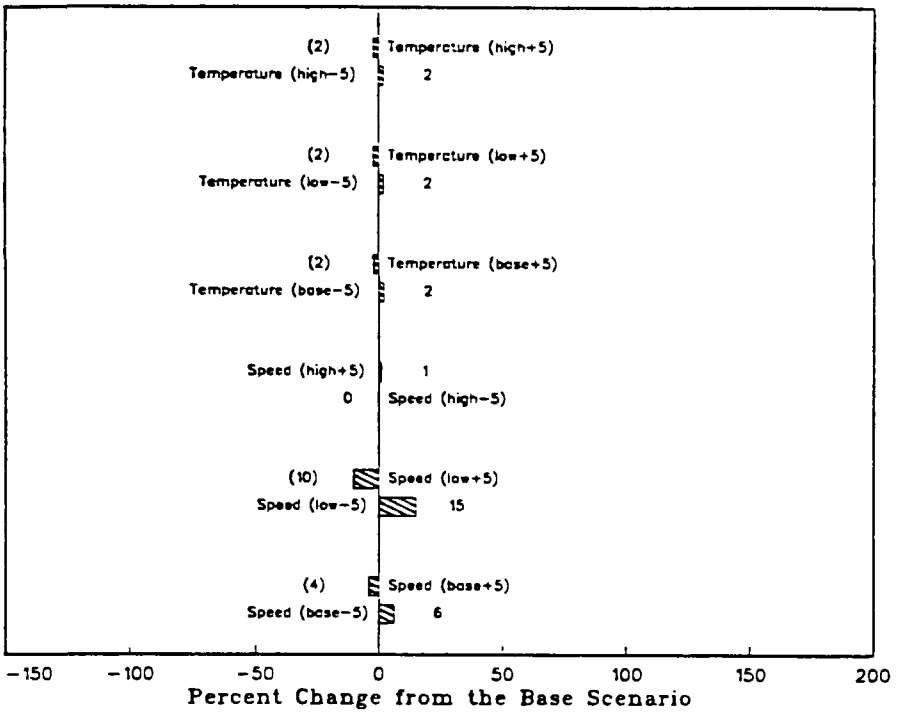


Figure 2. Secondary MOBILE4 Sensitivity Analysis (Low Altitude-1990)

(continued)

OZONE SEASON MOBILE4 SENSITIVITY RESULTS
SECONDARY TEMPERATURE AND SPEED RANGES FOR NOx



CO SEASON MOBILE4 SENSITIVITY RESULTS
SECONDARY TEMPERATURE AND SPEED RANGES FOR CO

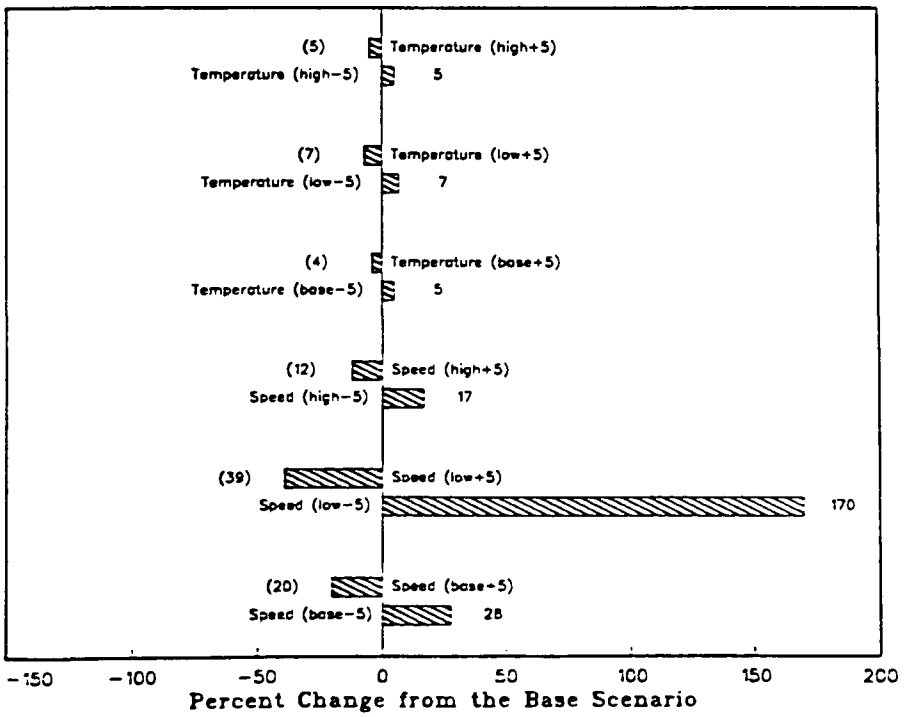


Figure 2. Secondary MOBILE4 Sensitivity Analysis (Low Altitude-1990) (Continued)

SECTION 5

CONCLUSIONS

The following is a summary of the general conclusions that can be drawn from this analysis.

The most consistently significant variables identified in this analysis are speed and the combination of Reid vapor pressure (RVP) and temperature (temperature alone for the CO season). This is true for current and future years, and for high and low altitude.

The primary speed ranges used in this analysis are wide enough that they should encompass the area-wide average speeds of all U.S. cities, but should not be taken as indicative of potential errors in any area-wide inventory. The increasing sensitivity of emissions at lower speeds indicates that methods of incorporating speeds in inventories should be oriented toward better reflection of the true distribution of speeds. For example, a VMT-weighted average speed for an area would not produce an appropriate average emission factor for the area since the speed/emission relationship is non-linear.

The combinations of RVP and temperature used for the ozone season sensitivity ranges represent realistic cases which both fall above the base case for the analysis. Results show that the combination of these two variables can cause significant variations between areas (about 20 to 30 percent difference in HC and CO). The effect of RVP is less pronounced in future years, due to Federal RVP control mandates.

For the cold temperature CO season case, there is high sensitivity to the average temperature in the lower part of the range tested. The effects of the hot/cold start percentage were also high, especially for the case with over 50 percent of the VMT in cold start mode. The overall results for the CO season point out the need for explicit consideration of speed, temperature and vehicle starts in analyses of CO exceedance situations, and for the development of better methods and more accurate data for these variables if possible.

Secondary sensitivity analyses around the base and primary ranges for temperature and speed indicate that relatively small differences in these variables can have significant effects on the MOBILE4 emission factors for ozone season HC and for CO in both seasons. Ozone season HC shows the highest sensitivity to temperature (9 to 20 percent change in emissions due to 5 degrees change in temperature), while a five mph variation in speed can have significant effects on ozone season HC and on CO in both ozone and CO seasons. The effects of speed changes are most pronounced at low speed, but a five mph difference can cause HC to vary by 11 to 18 percent and CO to vary by 20 to 29 percent even in the 20 mph range. These results further support the statements regarding the importance of accurate speed information which were made above regarding the primary sensitivity analysis.

Results for vehicle fleet characteristics and VMT mix were only significant in a few of the cases used in this analysis. The most dramatic result was a 36 percent increase in NO_x due to a 130 percent increase in heavy duty diesel VMT in the VMT mix for Fairbanks. The specific fleet-related variables were taken from a previous analysis and no independent attempts were made to determine whether they actually represent appropriate alternative cases for the 1990 and 2005 analysis years. More detailed study of this area could provide inventory managers a better perspective on the value of developing area-specific inputs for these variables, and on methods for their development.

SECTION 6

REFERENCES

1. *Procedures for Emission Inventory Preparation -- Volume IV: Mobile Sources.* EPA-450/4-81-026d (revised). U.S. Environmental Protection Agency, Research Triangle Park, NC. July 1989.

2. Volatility Regulations for Gasoline and Alcohol Blends Sold in Calendar Years 1989 and Beyond. (Notice of Final Rulemaking). 54 FR 11868, March 22, 1989.

3. Volatility Regulations for Gasoline and Alcohol Blends Sold in Calendar Years 1992 and Beyond. (Notice of Final Rulemaking). 55 FR 23658, June 11, 1990.

4. Wolcott, Mark A., and Dennis F. Kahlbaum. *Use of Cold Temperature CO Air Quality Analysis for Clean Air Act Amendment Evaluation.* U.S. Environmental Protection Agency, Office of Mobile Sources, Ann Arbor, MI. November 9, 1989.

5. *User's Guide to MOBILE4.* EPA-AA-TEB-89-01 (NTIS PB89-164271). U.S. Environmental Protection Agency, Office of Mobile Sources, Ann Arbor, MI. 1989.

6. *MOBILE3 and MOBILE4 Speed Correction Factors for 1985 Light Duty Vehicles.* EPA Office of Mobile Sources Briefing Materials. U.S. Environmental Protection Agency, Office of Mobile Sources, Ann Arbor, MI. 1989.

APPENDIX A

MOBILE INPUT VALUES FOR VEHICLE FLEET CHARACTERISTICS

This worksheet includes:

Values used for each of the VMT mix, mileage accumulation and vehicle age distribution cases. Marginal notes indicate cases where specific lines in the original Sierra input data were MOBILE3 default values rather than location-specific values, and cases in which MOBILE4 block data (or calculations based on MOBILE4 routines) were used.

Relative changes from the MOBILE4 default values.

TABLE A-1. MOBILE INPUT VALUES FOR VEHICLE FLEET CHARACTERISTICS

****MOBILE4 DEFAULT DATA****

**** VMT MIX for 1990 (DEFAULTS FROM MOBILE4)

LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC
0.710	0.127	0.086	0.015	0.013	0.004	0.034	0.010

**** MILEAGE ACCUMULATION RATES (DEFAULTS FROM MOBILE4 BLOCK DATA)

MY->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	FOOT-NOTE
LDGV	0.131	0.124	0.117	0.111	0.105	0.099	0.093	0.088	0.084	0.079	0.075	0.071	0.067	0.063	0.060	0.056	0.053	0.050	0.048	0.045	
LDGT1	0.156	0.145	0.136	0.126	0.118	0.110	0.103	0.096	0.089	0.083	0.078	0.072	0.067	0.063	0.059	0.055	0.051	0.047	0.044	0.041	
LDGT2	0.176	0.162	0.149	0.137	0.126	0.116	0.107	0.099	0.091	0.083	0.077	0.071	0.065	0.060	0.055	0.051	0.047	0.043	0.040	0.036	
HDGV	0.182	0.167	0.154	0.142	0.130	0.120	0.110	0.102	0.094	0.086	0.079	0.073	0.067	0.062	0.057	0.052	0.048	0.044	0.041	0.037	
LDDV	0.178	0.164	0.152	0.140	0.130	0.120	0.111	0.102	0.095	0.087	0.081	0.075	0.069	0.064	0.059	0.054	0.050	0.046	0.043	0.040	
LDDT	0.201	0.175	0.154	0.136	0.121	0.108	0.097	0.088	0.081	0.074	0.068	0.064	0.059	0.056	0.053	0.051	0.049	0.047	0.046	0.045	
HDDV	0.529	0.496	0.456	0.419	0.385	0.354	0.326	0.300	0.276	0.254	0.233	0.214	0.197	0.181	0.167	0.153	0.141	0.130	0.119	0.110	CALC
MC	0.047	0.044	0.041	0.038	0.035	0.032	0.029	0.026	0.023	0.019	0.016	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

**** VEHICLE REGISTRATION DISTRIBUTION (DEFAULTS FROM MOBILE4 BLOCK DATA)

MY->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
LDGV	0.062	0.082	0.079	0.075	0.071	0.067	0.063	0.060	0.056	0.052	0.048	0.045	0.041	0.037	0.033	0.029	0.026	0.022	0.018	0.034
LDGT1	0.070	0.092	0.088	0.083	0.077	0.072	0.067	0.062	0.057	0.051	0.047	0.041	0.036	0.031	0.026	0.021	0.016	0.011	0.007	0.044
LDGT2	0.070	0.092	0.088	0.083	0.077	0.072	0.067	0.062	0.057	0.051	0.047	0.041	0.036	0.031	0.026	0.021	0.016	0.011	0.007	0.044
HDGV	0.065	0.131	0.113	0.097	0.084	0.072	0.062	0.054	0.046	0.040	0.034	0.030	0.026	0.022	0.019	0.016	0.014	0.012	0.010	0.052
LDDV	0.062	0.082	0.079	0.075	0.071	0.067	0.063	0.060	0.056	0.052	0.048	0.045	0.041	0.037	0.033	0.029	0.026	0.022	0.018	0.034
LDDT	0.070	0.092	0.088	0.083	0.077	0.072	0.067	0.062	0.057	0.051	0.047	0.041	0.036	0.031	0.026	0.021	0.016	0.011	0.007	0.044
HDDV	0.082	0.165	0.135	0.111	0.091	0.075	0.061	0.050	0.041	0.034	0.028	0.023	0.019	0.015	0.013	0.010	0.009	0.007	0.006	0.024
MC	0.144	0.168	0.135	0.109	0.088	0.070	0.056	0.045	0.036	0.029	0.023	0.097	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

NOTE: Columns for vehicle registration and mileage accumulation represent the last 20 model years (MY) beginning with the most recent year (1).

LDGV = Light duty gas vehicle
LDGT1 = Light duty gas truck to 6000 lbs
LDGT2 = Light duty gas truck, 6000 to 8500 lbs
HDGV = Heavy duty gas vehicle
LDDV = Light duty diesel vehicle
LDDT = Light duty diesel truck
HDDV = Heavy duty diesel vehicle
MC = Motorcycle
CALC = Calculated from MOBILE4 equation
MOB3 = MOBILE3 default
MOB4 = MOBILE4 default

(continued)

TABLE A–1. MOBILE INPUT VALUES FOR VEHICLE FLEET CHARACTERISTICS (Continued)

****SIERRA DATA****

****VMT MIX - CALIF (M3-VMTMX.DATA FROM SIERRA)

LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC
0.716	0.144	0.048	0.031	0.021	0.004	0.030	0.006

****MILEAGE ACCUM. - CALIF (M3-MILAC.DAT FILE FROM SIERRA)

MY->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
LDGV	0.159	0.150	0.140	0.131	0.122	0.113	0.103	0.099	0.085	0.076	0.067	0.066	0.062	0.059	0.055	0.051	0.050	0.047	0.044	0.044
LDGT1	0.159	0.150	0.140	0.131	0.122	0.113	0.103	0.099	0.085	0.076	0.067	0.066	0.062	0.059	0.055	0.051	0.050	0.047	0.044	0.044
LDGT2	0.157	0.157	0.141	0.126	0.113	0.102	0.094	0.086	0.080	0.075	0.071	0.066	0.063	0.060	0.055	0.052	0.050	0.047	0.044	0.044
HDGV	0.197	0.197	0.180	0.180	0.151	0.151	0.115	0.115	0.100	0.100	0.074	0.074	0.074	0.074	0.074	0.074	0.074	0.074	0.074	0.074
LDDV	0.159	0.150	0.140	0.131	0.122	0.113	0.103	0.099	0.085	0.076	0.067	0.066	0.062	0.059	0.055	0.051	0.050	0.047	0.044	0.044
LDDT	0.159	0.150	0.140	0.131	0.122	0.113	0.103	0.099	0.085	0.076	0.067	0.066	0.062	0.059	0.055	0.051	0.050	0.047	0.044	0.044
HDDV	0.786	0.738	0.720	0.602	0.602	0.457	0.457	0.399	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294
MC	0.058	0.042	0.030	0.021	0.015	0.011	0.008	0.006	0.004	0.004	0.004	0.004	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000

****VMT MIX - FAIRBANKS (M4-FBNKS.DATA FROM SIERRA)

LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC
0.656	0.148	0.084	0.024	0.005	0.004	0.079	0.000

****MILEAGE ACCUM. - FAIRBANKS (M4-FBNKS.DATA FROM SIERRA)

MY->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	FOOT-NOTE
LDGV	0.128	0.095	0.086	0.081	0.077	0.074	0.071	0.070	0.068	0.066	0.065	0.064	0.063	0.062	0.061	0.060	0.060	0.059	0.058	0.058	
LDGT1	0.174	0.161	0.150	0.139	0.129	0.119	0.111	0.103	0.095	0.088	0.082	0.076	0.070	0.065	0.061	0.056	0.052	0.048	0.045	0.042	MOB3
LDGT2	0.184	0.169	0.156	0.144	0.133	0.123	0.114	0.105	0.097	0.090	0.083	0.076	0.071	0.065	0.060	0.056	0.051	0.047	0.044	0.040	MOB3
HDGV	0.200	0.181	0.164	0.148	0.134	0.121	0.110	0.100	0.090	0.082	0.074	0.067	0.061	0.055	0.050	0.045	0.041	0.037	0.033	0.030	MOB3
LDDV	0.128	0.095	0.086	0.081	0.077	0.074	0.071	0.070	0.068	0.066	0.065	0.064	0.063	0.062	0.061	0.060	0.060	0.059	0.058	0.058	
LDDT	0.176	0.163	0.151	0.140	0.130	0.120	0.111	0.103	0.095	0.088	0.082	0.076	0.070	0.065	0.060	0.056	0.052	0.048	0.044	0.041	MOB3
HDDV	0.529	0.496	0.456	0.419	0.385	0.354	0.326	0.300	0.276	0.254	0.233	0.214	0.197	0.181	0.167	0.153	0.141	0.130	0.119	0.110	CALC
MC	0.047	0.044	0.041	0.038	0.035	0.032	0.029	0.026	0.023	0.019	0.016	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	MOB4

****MILEAGE ACCUM. - FAIRBANKS (M4-FBNKS.DATA FROM SIERRA WITH MOBILE4 DEFAULTS FOR LDGT, HDGV, & LDDT) -- USED FOR COMPARISON ONLY

MY->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	FOOT-NOTE
LDGV	0.128	0.095	0.086	0.081	0.077	0.074	0.071	0.070	0.068	0.066	0.065	0.064	0.063	0.062	0.061	0.060	0.060	0.059	0.058	0.058	
LDGT1	0.156	0.145	0.136	0.126	0.118	0.110	0.103	0.096	0.089	0.083	0.078	0.072	0.067	0.063	0.059	0.055	0.051	0.047	0.044	0.041	MOB4
LDGT2	0.176	0.162	0.149	0.137	0.126	0.116	0.107	0.099	0.091	0.083	0.077	0.071	0.065	0.060	0.055	0.051	0.047	0.043	0.040	0.036	MOB4
HDGV	0.182	0.167	0.154	0.142	0.130	0.120	0.110	0.102	0.094	0.086	0.079	0.073	0.067	0.062	0.057	0.052	0.048	0.044	0.041	0.037	MOB4
LDDV	0.128	0.095	0.086	0.081	0.077	0.074	0.071	0.070	0.068	0.066	0.065	0.064	0.063	0.062	0.061	0.060	0.060	0.059	0.058	0.058	
LDDT	0.201	0.175	0.154	0.136	0.121	0.108	0.097	0.088	0.081	0.074	0.068	0.064	0.059	0.056	0.053	0.051	0.049	0.047	0.046	0.045	MOB4
HDDV	0.529	0.496	0.456	0.419	0.385	0.354	0.326	0.300	0.276	0.254	0.233	0.214	0.197	0.181	0.167	0.153	0.141	0.130	0.119	0.110	CALC
MC	0.047	0.044	0.041	0.038	0.035	0.032	0.029	0.026	0.023	0.019	0.016	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	MOB4

NOTE: Columns for vehicle registration and mileage accumulation represent the last 20 model years (MY) beginning with the most recent year (1).

LDGV = Light duty gas vehicle
LDGT1 = Light duty gas truck to 6000 lbs
LDGT2 = Light duty gas truck, 6000 to 8500 lbs
HDGV = Heavy duty gas vehicle
LDDV = Light duty diesel vehicle
LDDT = Light duty diesel truck
HDDV = Heavy duty diesel vehicle
MC = Motorcycle
CALC = Calculated from MOBILE4 equation
MOB3 = MOBILE3 default
MOB4 = MOBILE4 default

(continued)

TABLE A–1. MOBILE INPUT VALUES FOR VEHICLE FLEET CHARACTERISTICS (Continued)

****SIERRA DATA (CONTINUED)****

****VEHICLE REGISTRATION - FAIRBANKS (M4-FBNKS.DATA FROM SIERRA DATA)

MY->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	FOOT-NOTE
LDGV	0.041	0.100	0.078	0.075	0.075	0.065	0.064	0.071	0.067	0.062	0.049	0.051	0.042	0.036	0.026	0.021	0.019	0.019	0.019	0.019	
LDGT1	0.036	0.089	0.086	0.068	0.064	0.048	0.065	0.070	0.073	0.069	0.055	0.046	0.042	0.039	0.026	0.024	0.026	0.026	0.026	0.026	
LDGT2	0.036	0.089	0.086	0.068	0.064	0.048	0.065	0.070	0.073	0.069	0.055	0.046	0.042	0.039	0.026	0.024	0.026	0.026	0.026	0.026	
HDGV	0.019	0.058	0.047	0.057	0.075	0.035	0.061	0.069	0.049	0.051	0.066	0.050	0.046	0.035	0.024	0.046	0.053	0.053	0.053	0.053	
LDDV	0.041	0.100	0.078	0.075	0.075	0.065	0.064	0.071	0.067	0.062	0.049	0.051	0.042	0.036	0.026	0.021	0.019	0.019	0.019	0.019	
LDDT	0.036	0.089	0.086	0.068	0.064	0.048	0.065	0.070	0.073	0.069	0.055	0.046	0.042	0.039	0.026	0.024	0.026	0.026	0.026	0.026	
HDDV	0.022	0.047	0.030	0.044	0.069	0.062	0.073	0.080	0.059	0.047	0.102	0.058	0.049	0.043	0.031	0.031	0.038	0.038	0.038	0.038	
MC	0.144	0.168	0.135	0.109	0.088	0.070	0.056	0.045	0.036	0.029	0.023	0.097	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	MOB3

****VEHICLE REGISTRATION - PHOENIX (M4-PHNX.DATA FROM SIERRA) -- USED AS REVISED BELOW

MY->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
LDGV	0.063	0.076	0.068	0.074	0.076	0.080	0.079	0.069	0.065	0.054	0.047	0.045	0.041	0.032	0.025	0.019	0.017	0.014	0.011	0.045
LDGT1	0.065	0.076	0.061	0.067	0.062	0.067	0.068	0.057	0.055	0.046	0.042	0.043	0.042	0.036	0.031	0.023	0.023	0.022	0.016	0.098
LDGT2	0.074	0.083	0.060	0.072	0.068	0.077	0.081	0.070	0.063	0.050	0.043	0.043	0.039	0.032	0.025	0.019	0.018	0.017	0.012	0.054
HDGV	0.049	0.057	0.050	0.071	0.059	0.073	0.072	0.060	0.051	0.050	0.053	0.050	0.050	0.042	0.037	0.025	0.028	0.022	0.018	0.083
LDDV	0.010	0.017	0.058	0.083	0.091	0.018	0.199	0.157	0.104	0.042	0.013	0.012	0.008	0.005	0.003	0.003	0.002	0.001	0.001	0.007
LDDT	0.016	0.079	0.108	0.154	0.151	0.244	0.134	0.050	0.029	0.021	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.000	0.001	0.004
HDDV	0.044	0.106	0.105	0.088	0.040	0.050	0.052	0.067	0.088	0.062	0.044	0.022	0.025	0.040	0.041	0.037	0.021	0.015	0.013	0.039
MC	0.050	0.104	0.126	0.123	0.122	0.080	0.073	0.069	0.046	0.047	0.039	0.030	0.022	0.015	0.011	0.010	0.007	0.004	0.003	0.019

****VEHICLE REGISTRATION - PHOENIX (M4-PHNX.DATA FROM SIERRA WITH LDDV AND LDDT SET EQUAL TO LDGV AND LDGT1)

MY->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
LDGV	0.063	0.076	0.068	0.074	0.076	0.080	0.079	0.069	0.065	0.054	0.047	0.045	0.041	0.032	0.025	0.019	0.017	0.014	0.011	0.045
LDGT1	0.065	0.076	0.061	0.067	0.062	0.067	0.068	0.057	0.055	0.046	0.042	0.043	0.042	0.036	0.031	0.023	0.023	0.022	0.016	0.098
LDGT2	0.074	0.083	0.060	0.072	0.068	0.077	0.081	0.070	0.063	0.050	0.043	0.043	0.039	0.032	0.025	0.019	0.018	0.017	0.012	0.054
HDGV	0.049	0.057	0.050	0.071	0.059	0.073	0.072	0.060	0.051	0.050	0.053	0.050	0.050	0.042	0.037	0.025	0.028	0.022	0.018	0.083
LDDV	0.063	0.076	0.068	0.074	0.076	0.080	0.079	0.069	0.065	0.054	0.047	0.045	0.041	0.032	0.025	0.019	0.017	0.014	0.011	0.045
LDDT	0.065	0.076	0.061	0.067	0.062	0.067	0.068	0.057	0.055	0.046	0.042	0.043	0.042	0.036	0.031	0.023	0.023	0.022	0.016	0.098
HDDV	0.044	0.106	0.105	0.088	0.040	0.050	0.052	0.067	0.088	0.062	0.044	0.022	0.025	0.040	0.041	0.037	0.021	0.015	0.013	0.039
MC	0.050	0.104	0.126	0.123	0.122	0.080	0.073	0.069	0.046	0.047	0.039	0.030	0.022	0.015	0.011	0.010	0.007	0.004	0.003	0.019

NOTE: Columns for vehicle registration and mileage accumulation represent the last 20 model years (MY) beginning with the most recent year (1).

LDGV = Light duty gas vehicle
LDGT1 = Light duty gas truck to 6000 lbs
LDGT2 = Light duty gas truck, 6000 to 8500 lbs
HDGV = Heavy duty gas vehicle
LDDV = Light duty diesel vehicle
LDDT = Light duty diesel truck
HDDV = Heavy duty diesel vehicle
MC = Motorcycle
CALC = Calculated from MOBILE4 equation
MOB3 = MOBILE3 default
MOB4 = MOBILE4 default

(continued)

TABLE A–1. MOBILE INPUT VALUES FOR VEHICLE FLEET CHARACTERISTICS (Continued)

****PERCENT DIFFERENCE OF SIERRA DATA TO MOBILE4 DEFAULT DATA (MOBILE4 – BASE SCENARIO))****
(((SIERRA–MOBILE4)/MOBILE4)*100)

****VMT MIX - CALIF

LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC
0.8	13.4	-44.2	106.7	61.5	0.0	-11.8	-40.0

****MILEAGE ACCUM. - CALIF

MY->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
LDGV	21.4	21.0	19.7	18.0	16.2	14.1	10.8	12.5	1.2	-3.8	-10.7	-7.0	-7.5	-6.3	-8.3	-8.9	-5.7	-6.0	-8.3	-2.2
LDGT1	1.9	9.7	10.3	11.1	11.0	10.9	9.7	7.3	11.2	2.4	-2.6	-6.9	-1.5	-1.6	0.0	0.0	0.0	6.4	6.8	7.3
LDGT2	-10.8	-3.1	5.4	2.9	0.0	-2.6	-4.7	-5.1	-5.5	-3.6	-2.6	0.0	1.5	5.0	9.1	7.8	10.6	16.3	17.5	22.2
HDGV	8.2	18.0	16.9	26.8	16.2	25.8	4.5	12.7	6.4	16.3	-6.3	1.4	10.4	19.4	29.8	42.3	54.2	68.2	80.5	100.0
LDDV	-10.7	-8.5	-7.9	-6.4	-6.2	-5.8	-7.2	-2.9	-10.5	-12.6	-17.3	-12.0	-10.1	-7.8	-6.8	-5.6	0.0	2.2	2.3	10.0
LDDT	-20.9	-14.3	-9.1	-3.7	0.8	4.6	6.2	12.5	4.9	2.7	-1.5	3.1	5.1	5.4	3.8	0.0	2.0	0.0	-4.3	-2.2
HDDV	48.6	48.8	57.9	43.7	56.4	29.1	40.2	33.0	6.5	15.7	26.2	37.4	49.2	62.4	76.0	92.2	108.5	126.2	147.1	167.3
MC	23.4	-4.5	-26.8	-44.7	-57.1	-65.6	-72.4	-76.9	-82.6	-78.9	-75.0	-69.2	--	--	--	--	--	--	--	--

****VMT MIX - FAIRBANKS (M4-FBNKS.DATA FROM SIERRA)

LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC
-7.6	16.5	-2.3	60.0	-61.5	0.0	132.4	-100.0

****MILEAGE ACCUM. - FAIRBANKS

MY->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
LDGV	-2.3	-23.4	-26.5	-27.0	-26.7	-25.3	-23.7	-20.5	-19.0	-16.5	-13.3	-9.9	-6.0	-1.6	1.7	7.1	13.2	18.0	20.8	28.9
LDGT1	11.5	20.0	18.4	19.0	17.8	17.3	15.5	15.6	15.7	14.5	12.8	13.9	13.4	11.1	10.2	10.9	9.8	10.6	9.1	9.8
LDGT2	4.5	13.6	13.4	13.9	14.3	14.7	15.0	15.2	15.4	16.9	16.9	16.9	16.9	18.3	18.2	17.6	19.1	18.6	17.5	22.2
HDGV	9.9	8.4	6.5	4.2	3.1	0.8	0.0	-2.0	-4.3	-4.7	-6.3	-8.2	-9.0	-11.3	-12.3	-13.5	-14.6	-15.9	-19.5	-18.9
LDDV	-28.1	-42.1	-43.4	-42.1	-40.8	-38.3	-36.0	-31.4	-28.4	-24.1	-19.8	-14.7	-8.7	-3.1	3.4	11.1	20.0	28.3	34.9	45.0
LDDT	-12.4	-6.9	-1.9	2.9	7.4	11.1	14.4	17.0	17.3	18.9	20.6	18.7	18.6	16.1	13.2	9.8	6.1	2.1	-4.3	-8.9
HDDV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--	--	--	--	--

****MILEAGE ACCUM. - FAIRBANKS (M4-FBNKS.DATA FROM SIERRA WITH MOBILE4 DEFAULTS FOR LDGT, HDGV, & LDDT)

MY->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
LDGV	-2.3	-23.4	-26.5	-27.0	-26.7	-25.3	-23.7	-20.5	-19.0	-16.5	-13.3	-9.9	-6.0	-1.6	1.7	7.1	13.2	18.0	20.8	28.9
LDGT1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LDGT2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HDGV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LDDV	-28.1	-42.1	-43.4	-42.1	-40.8	-38.3	-36.0	-31.4	-28.4	-24.1	-19.8	-14.7	-8.7	-3.1	3.4	11.1	20.0	28.3	34.9	45.0
LDDT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HDDV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--	--	--	--	--

NOTE: Columns for vehicle registration and mileage accumulation represent the last 20 model years (MY) beginning with the most recent year (1).

LDGV = Light duty gas vehicle
LDGT1 = Light duty gas truck to 6000 lbs
LDGT2 = Light duty gas truck, 6000 to 8500 lbs
HDGV = Heavy duty gas vehicle
LDDV = Light duty diesel vehicle
LDDT = Light duty diesel truck
HDDV = Heavy duty diesel vehicle
MC = Motorcycle
CALC = Calculated from MOBILE4 equation
MOB3 = MOBILE3 default
MOB4 = MOBILE4 default

(continued)

TABLE A–1. MOBILE INPUT VALUES FOR VEHICLE FLEET CHARACTERISTICS (Continued)

****PERCENT DIFFERENCE OF SIERRA DATA TO MOBILE4 DEFAULTS (MOB4 – BASE SCENARIO) (CONT'D)****
(((SIERRA–MOB4)/MOB4)*100)

****VEHICLE REGISTRATION - FAIRBANKS

MY->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
LDGV	-33.9	22.0	-1.3	0.0	5.6	-3.0	1.6	18.3	19.6	19.2	2.1	13.3	2.4	-2.7	-21.2	-27.6	-26.9	-13.6	5.6	-44.1
LDGT1	-48.6	-60.9	1.1	3.6	-11.7	-11.1	-28.4	4.8	22.8	43.1	46.8	34.1	27.8	35.5	50.0	23.8	50.0	136.4	271.4	-40.9
LDGT2	-48.6	-60.9	1.1	3.6	-11.7	-11.1	-28.4	4.8	22.8	43.1	46.8	34.1	27.8	35.5	50.0	23.8	50.0	136.4	271.4	-40.9
HDGV	-70.8	-55.7	-58.4	-41.2	-10.7	-51.4	-1.6	27.8	6.5	27.5	94.1	66.7	76.9	59.1	26.3	187.5	278.6	341.7	430.0	1.9
LDDV	-33.9	22.0	-1.3	0.0	5.6	-3.0	1.6	18.3	19.6	19.2	2.1	13.3	2.4	-2.7	-21.2	-27.6	-26.9	-13.6	5.6	-44.1
LDDT	-48.6	-3.3	-2.3	-18.1	-16.9	-33.3	-3.0	12.9	28.1	35.3	17.0	12.2	16.7	25.8	0.0	14.3	62.5	136.4	271.4	-40.9
HDDV	-73.2	-71.5	-77.8	-60.4	-24.2	-17.3	19.7	60.0	43.9	38.2	264.3	152.2	157.9	186.7	138.5	210.0	322.2	442.9	533.3	58.3
MC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--	--	--	--	--

****VEHICLE REGISTRATION - PHOENIX (M4-PHNX.DATA FROM SIERRA)

MY->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
LDGV	1.6	-7.3	-13.9	-1.3	7.0	19.4	25.4	15.0	16.1	3.8	-2.1	0.0	0.0	-13.5	-24.2	-34.5	-34.6	-36.4	-38.9	32.4
LDGT1	-7.1	-17.4	-30.7	-19.3	-19.5	-6.9	1.5	-8.1	-3.5	-9.8	-10.6	4.9	16.7	16.1	19.2	9.5	43.7	100.0	128.6	122.7
LDGT2	5.7	-9.8	-31.8	-13.3	-11.7	6.9	20.9	12.9	10.5	-2.0	-8.5	4.9	8.3	3.2	-3.8	-9.5	12.5	54.5	71.4	22.7
HDGV	-24.6	-56.5	-55.8	-26.8	-29.8	1.4	16.1	11.1	10.9	25.0	55.9	66.7	92.3	90.9	94.7	56.3	100.0	83.3	80.0	59.6
LDDV	-83.9	-79.3	-26.6	10.7	28.2	-72.7	215.9	161.7	85.7	-19.2	-72.9	-73.3	-80.5	-86.5	-90.9	-89.7	-92.3	-95.5	-94.4	-79.4
LDDT	-77.1	-14.1	22.7	85.5	96.1	238.9	100.0	-19.4	-49.1	-58.8	-97.9	-97.6	-97.2	-96.8	-92.3	-95.2	-93.8	-100.0	-85.7	-90.9
HDDV	-46.3	-35.8	-22.2	-20.7	-56.0	-33.3	-14.8	34.0	114.6	82.4	57.1	-4.3	31.6	166.7	215.4	270.0	133.3	114.3	116.7	62.5
MC	-65.3	-38.1	-6.7	12.8	38.6	14.3	30.4	53.3	27.8	62.1	69.6	-69.1	--	--	--	--	--	--	--	--

****VEHICLE REGISTRATION - PHOENIX (M4-PHNX.DATA FROM SIERRA WITH LDDV AND LDDT SET EQUAL TO LDGV AND LDGT1)

MY->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
LDGV	1.6	-7.3	-13.9	-1.3	7.0	19.4	25.4	15.0	16.1	3.8	-2.1	0.0	0.0	-13.5	-24.2	-34.5	-34.6	-36.4	-38.9	32.4
LDGT1	-7.1	-17.4	-30.7	-19.3	-19.5	-6.9	1.5	-8.1	-3.5	-9.8	-10.6	4.9	16.7	16.1	19.2	9.5	43.7	100.0	128.6	122.7
LDGT2	5.7	-9.8	-31.8	-13.3	-11.7	6.9	20.9	12.9	10.5	-2.0	-8.5	4.9	8.3	3.2	-3.8	-9.5	12.5	54.5	71.4	22.7
HDGV	-24.6	-56.5	-55.8	-26.8	-29.8	1.4	16.1	11.1	10.9	25.0	55.9	66.7	92.3	90.9	94.7	56.3	100.0	83.3	80.0	59.6
LDDV	1.6	-7.3	-13.9	-1.3	7.0	19.4	25.4	15.0	16.1	3.8	-2.1	0.0	0.0	-13.5	-24.2	-34.5	-34.6	-36.4	-38.9	32.4
LDDT	-7.1	-17.4	-30.7	-19.3	-19.5	-6.9	1.5	-8.1	-3.5	-9.8	-10.6	4.9	16.7	16.1	19.2	9.5	43.7	100.0	128.6	122.7
HDDV	-46.3	-35.8	-22.2	-20.7	-56.0	-33.3	-14.8	34.0	114.6	82.4	57.1	-4.3	31.6	166.7	215.4	270.0	133.3	114.3	116.7	62.5
MC	-65.3	-38.1	-6.7	12.8	38.6	14.3	30.4	53.3	27.8	62.1	69.6	-69.1	--	--	--	--	--	--	--	--

NOTE: Columns for vehicle registration and mileage accumulation represent the last 20 model years (MY) beginning with the most recent year (1).

LDGV = Light duty gas vehicle
LDGT1 = Light duty gas truck to 6000 lbs
LDGT2 = Light duty gas truck, 6000 to 8500 lbs
HDGV = Heavy duty gas vehicle
LDDV = Light duty diesel vehicle
LDDT = Light duty diesel truck
HDDV = Heavy duty diesel vehicle
MC = Motorcycle
CALC = Calculated from MOBILE4 equation
MOB3 = MOBILE3 default
MOB4 = MOBILE4 default

APPENDIX B

RESULTS OF PRIMARY AND SECONDARY MOBILE4 SENSITIVITY ANALYSES

BAR GRAPHS

Low Altitude for 1990

Low Altitude for 2005

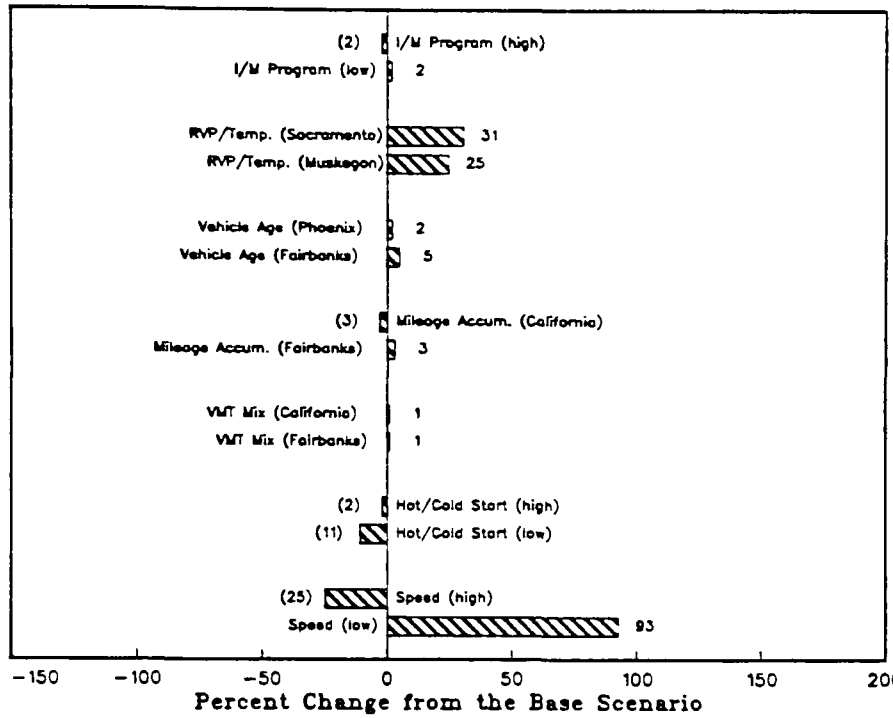
High Altitude for 1990

High Altitude for 2005

Secondary Sensitivity Analysis

WORKSHEETS FOR SENSITIVITY ANALYSIS

OZONE SEASON MOBILE4 SENSITIVITY RESULTS
1990, LOW ALTITUDE, HC



OZONE SEASON MOBILE4 SENSITIVITY RESULTS
1990, LOW ALTITUDE, CO

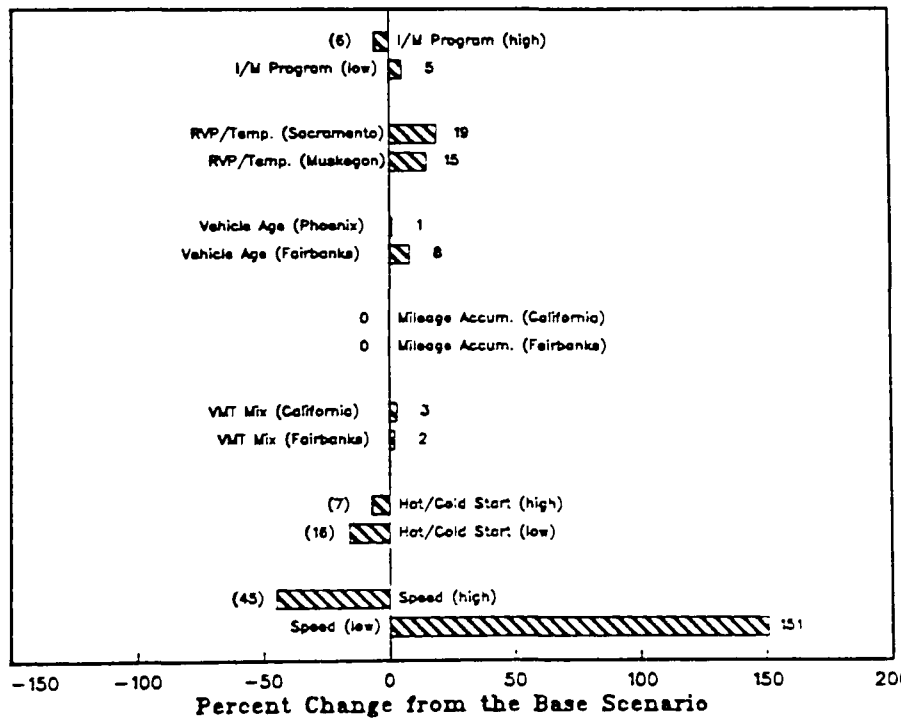
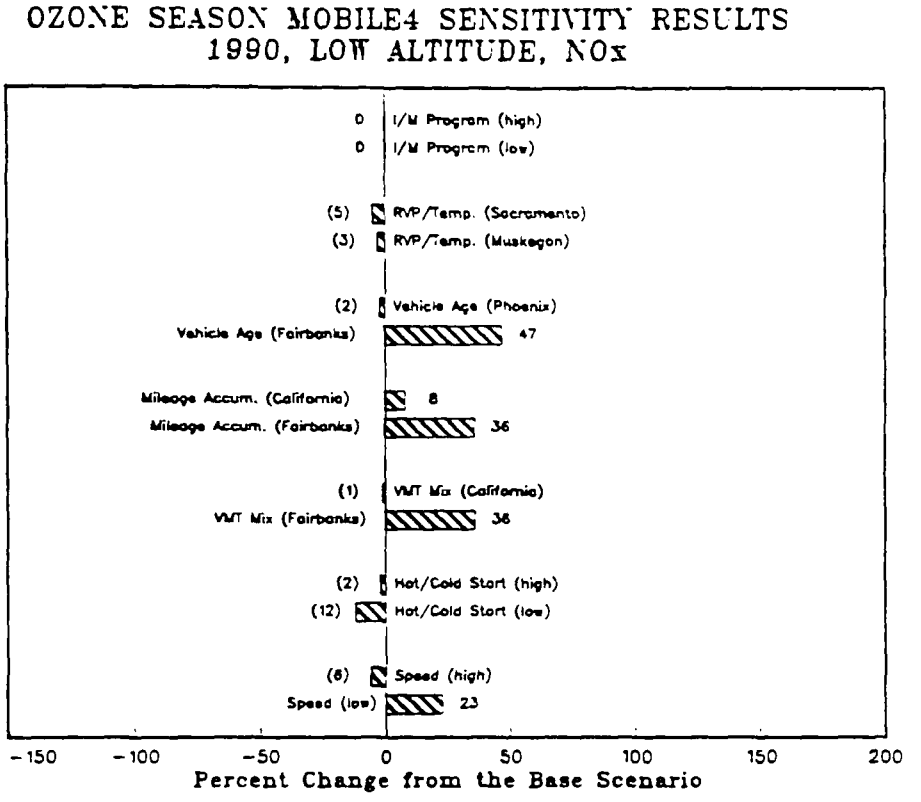


Figure B-1. Primary MOBILE4 Sensitivity Analysis Results (Low Altitude-1990)

(continued)



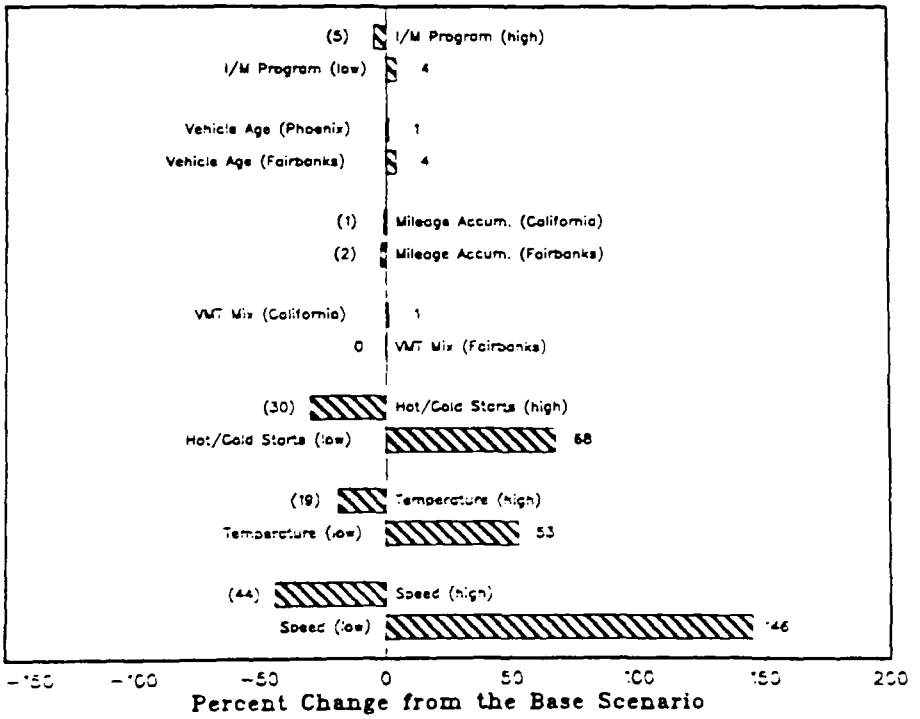
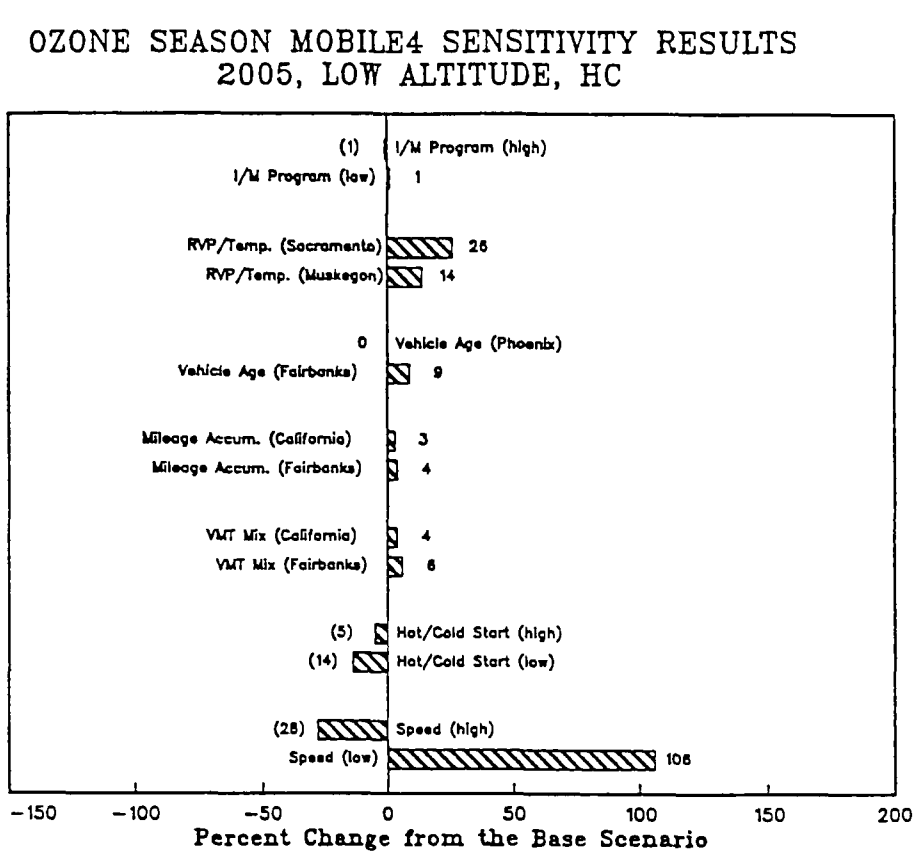


Figure B-1. Primary MOBILE4 Sensitivity Analysis Results (Low Altitude-1990) (Continued)



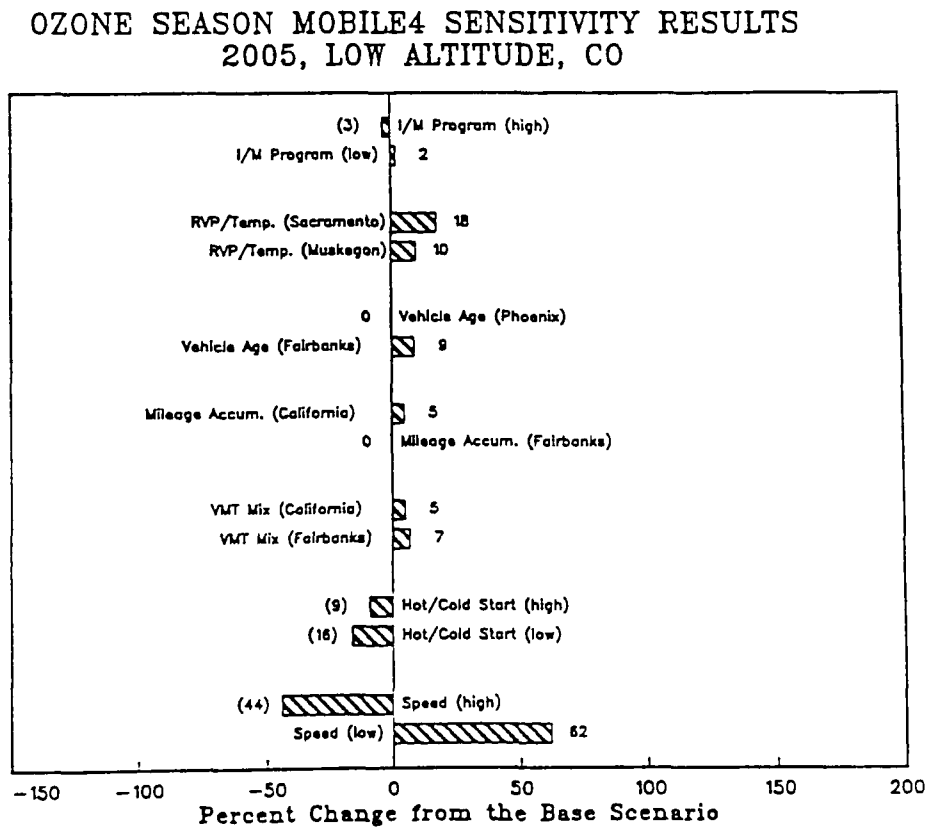
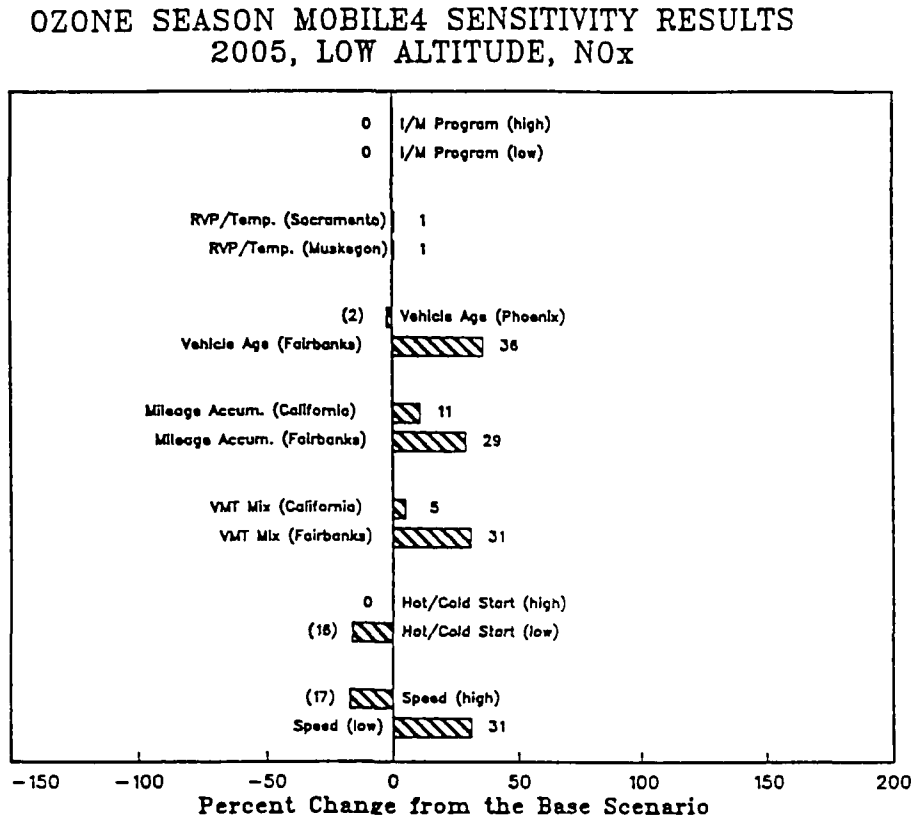


Figure B-2. MOBILE 4 Sensitivity Analysis (Low Altitude for 2005)

(continued)



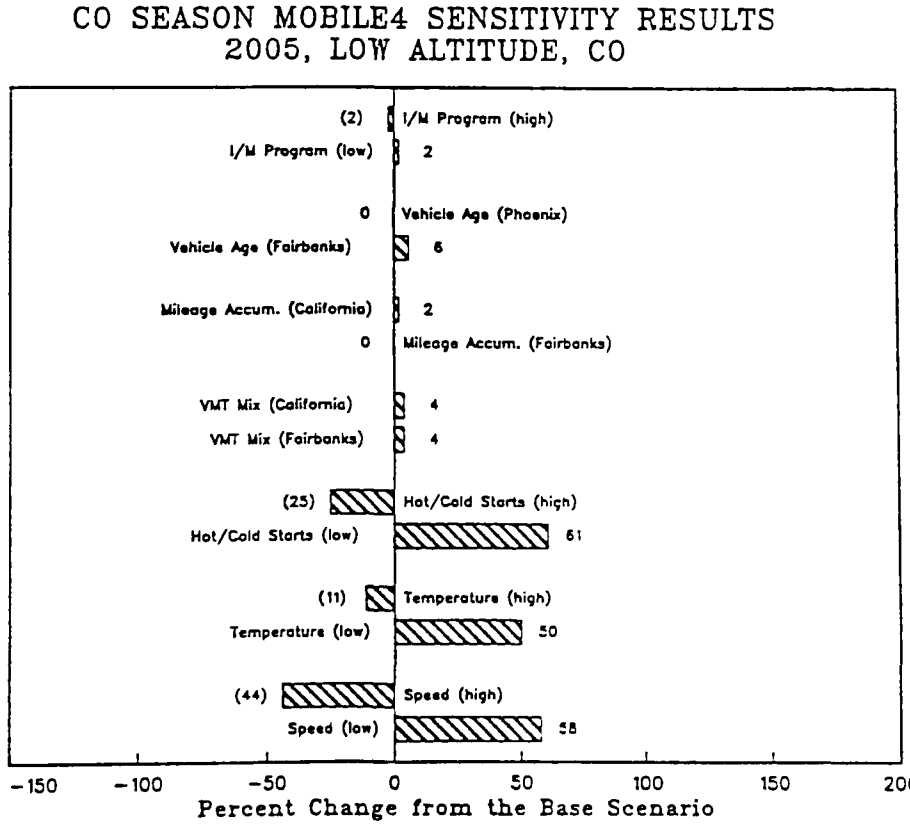
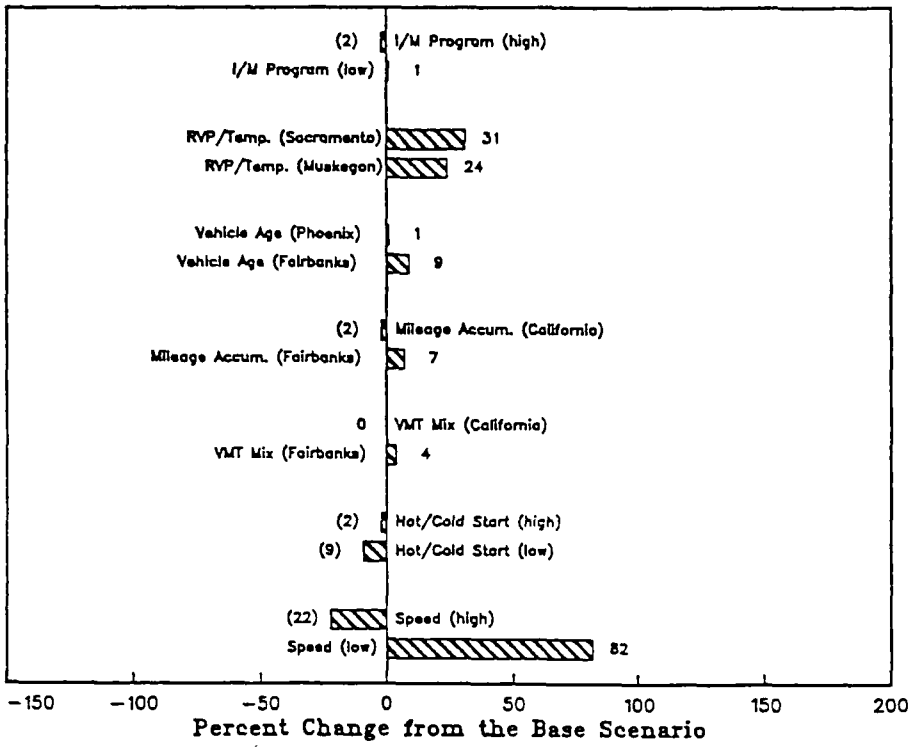


Figure B-2. MOBILE 4 Sensitivity Analysis (Low Altitude for 2005) (Continued)

OZONE SEASON MOBILE4 SENSITIVITY RESULTS
1990, HIGH ALTITUDE, HC



OZONE SEASON MOBILE4 SENSITIVITY RESULTS
1990, HIGH ALTITUDE, CO

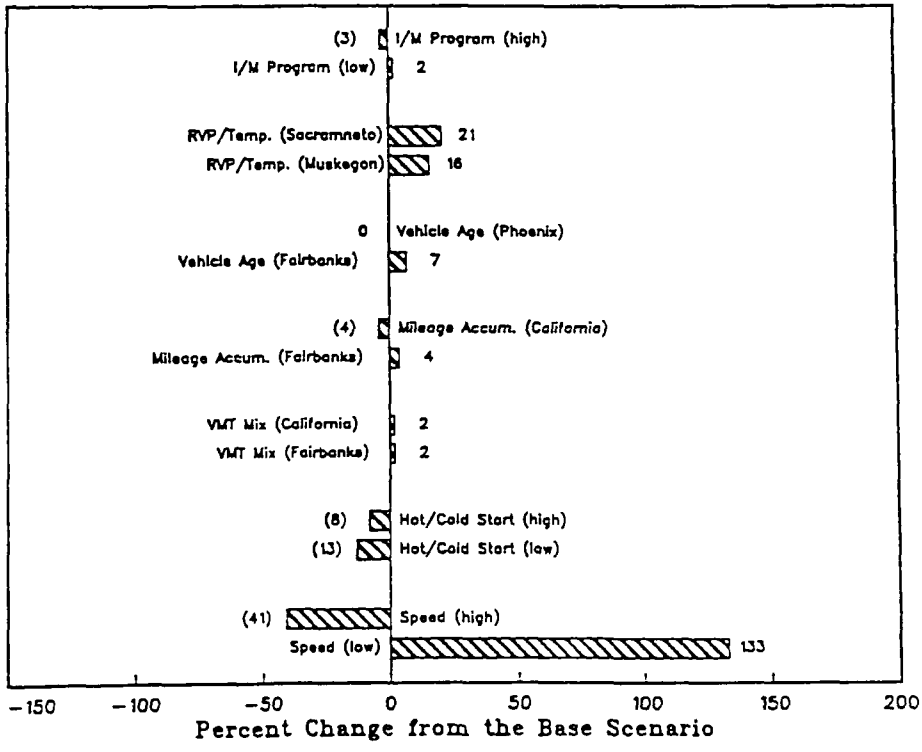
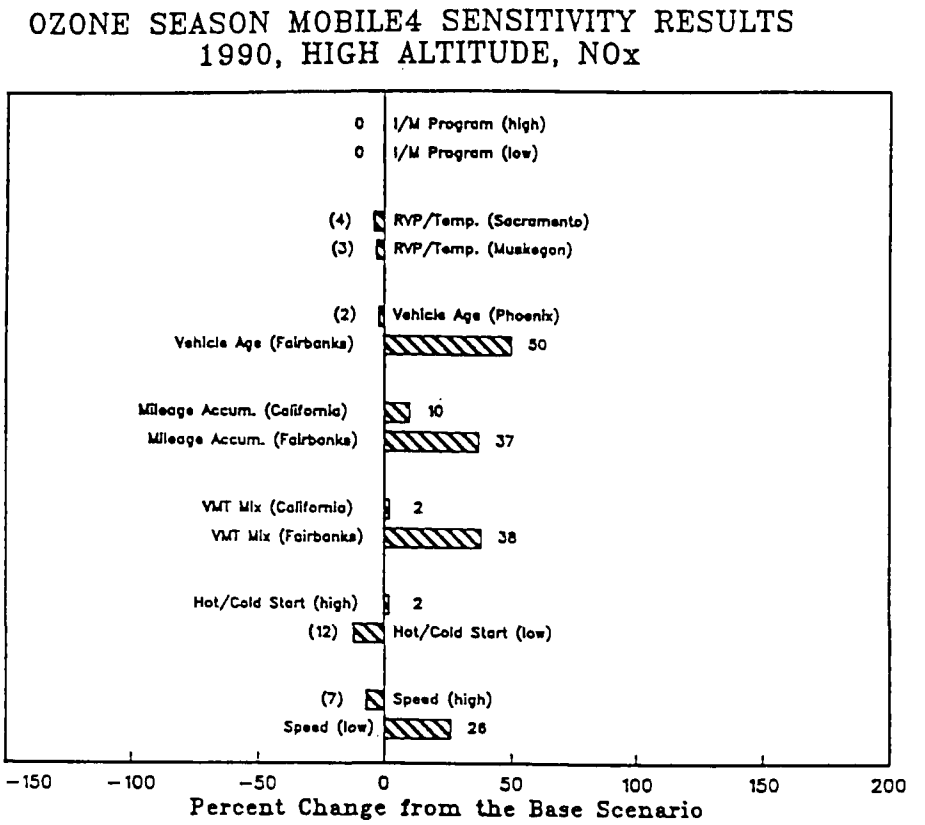


Figure B-3. MOBILE 4 Sensitivity Analysis (High Altitude for 1990)

(continued)



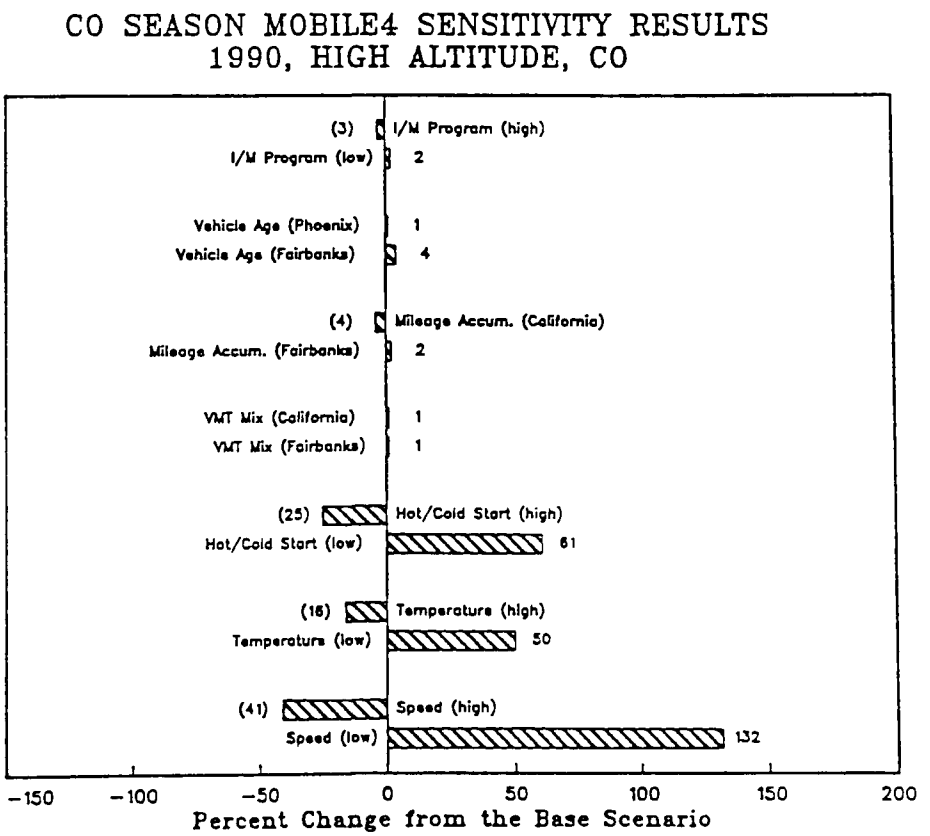
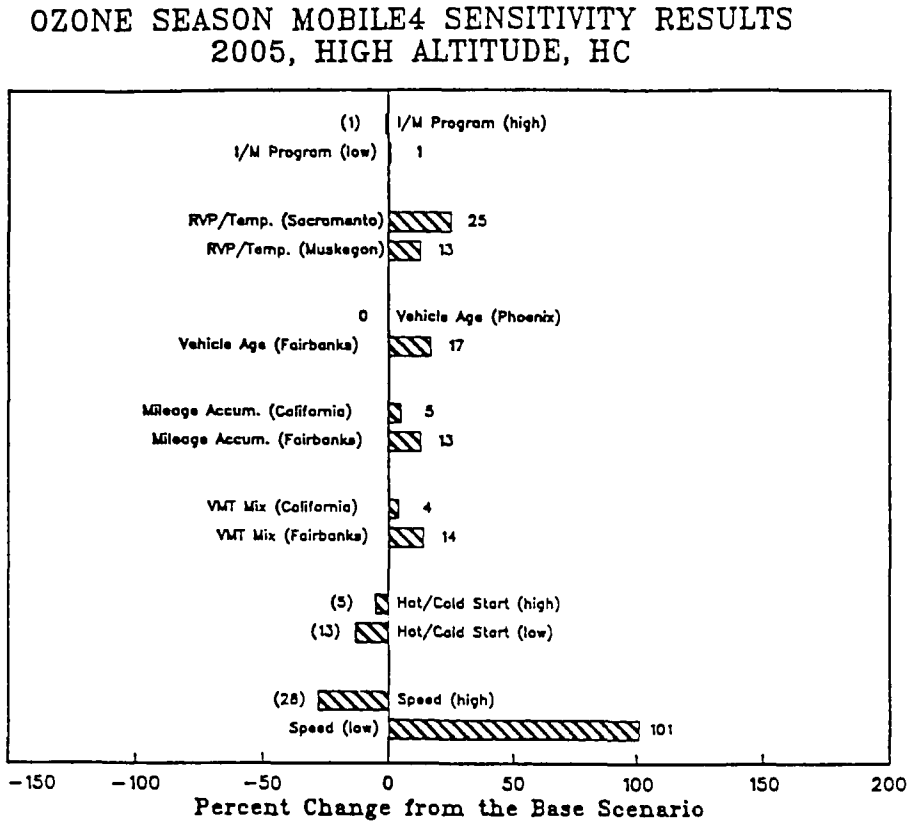


Figure B-3. MOBILE 4 Sensitivity Analysis (High Altitude for 1990) (Continued)



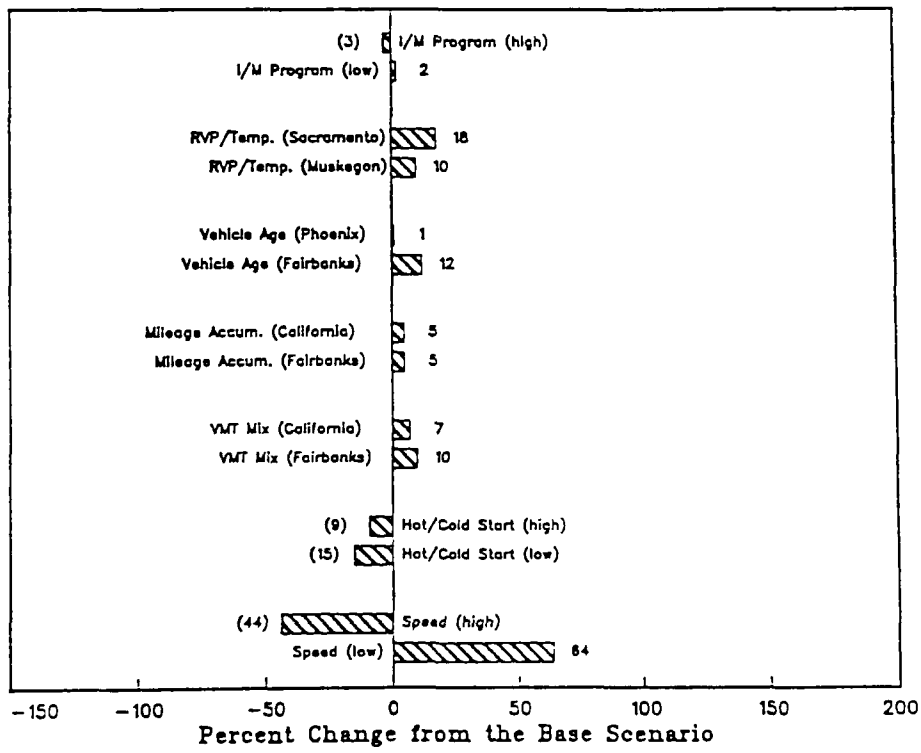
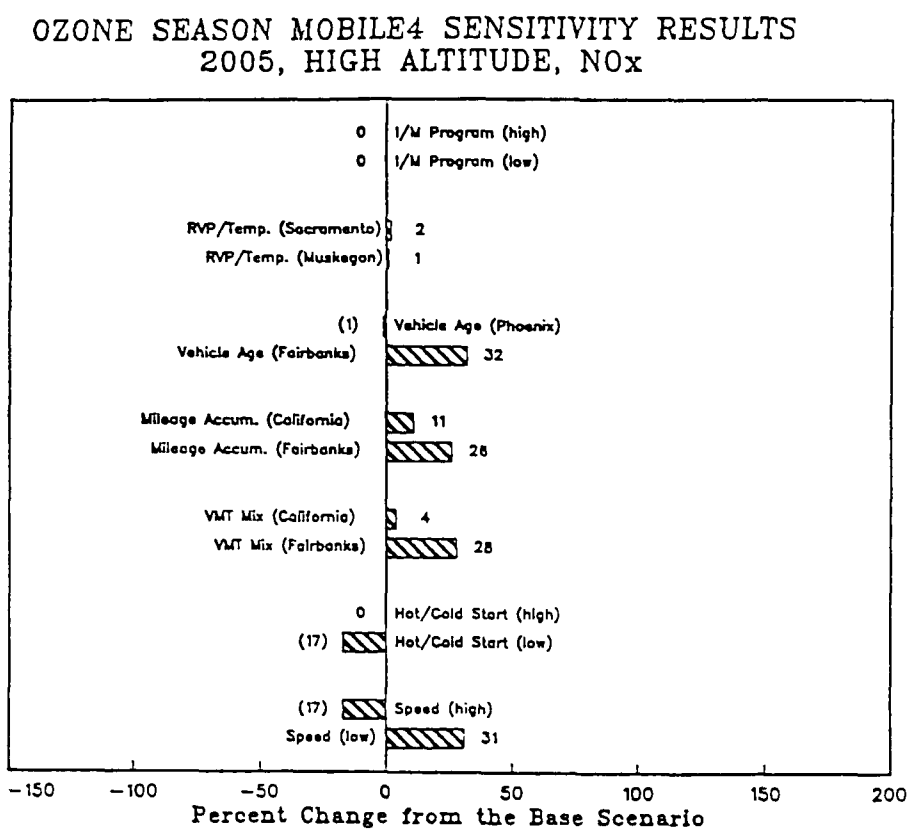


Figure B-4. MOBILE 4 Sensitivity Analysis (High Altitude for 2005)

(continued)



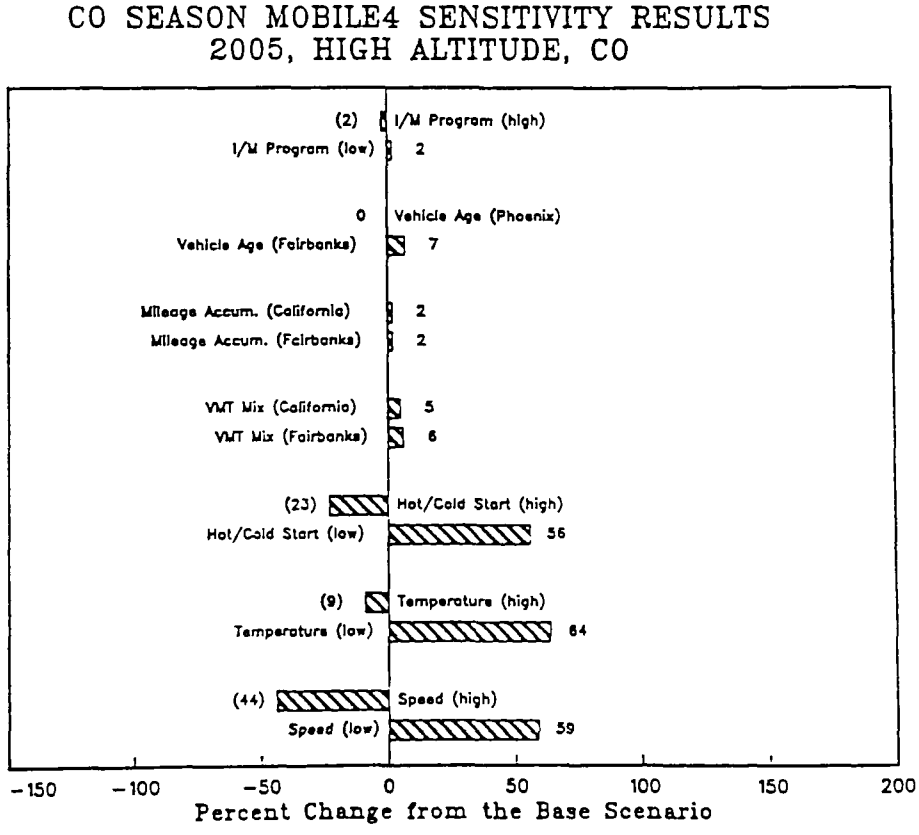
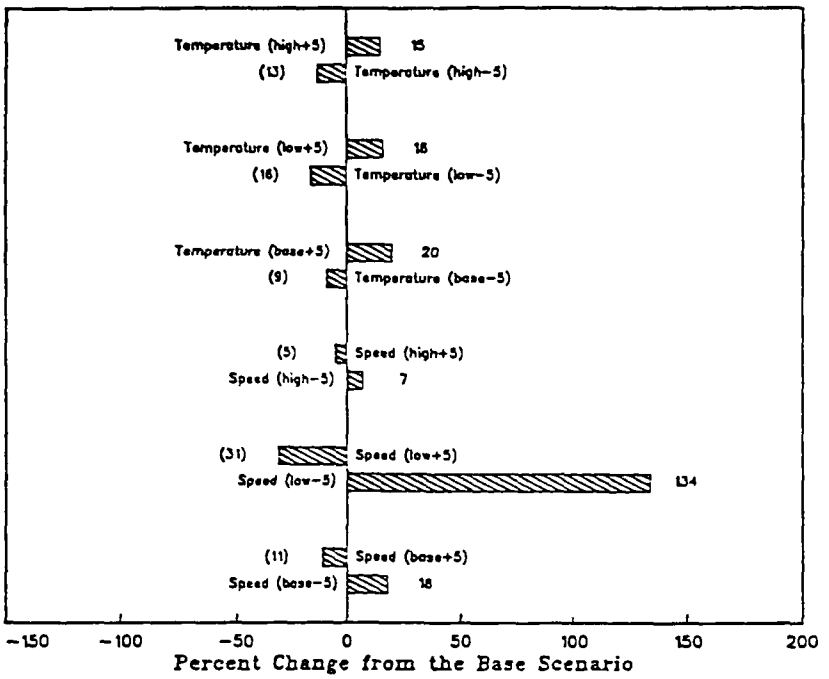


Figure B-4. MOBILE 4 Sensitivity Analysis (High Altitude for 2005) (Continued)

OZONE SEASON MOBILE4 SENSITIVITY RESULTS
SECONDARY TEMPERATURE AND SPEED RANGES FOR HC



OZONE SEASON MOBILE4 SENSITIVITY RESULTS
SECONDARY TEMPERATURE AND SPEED RANGES FOR CO

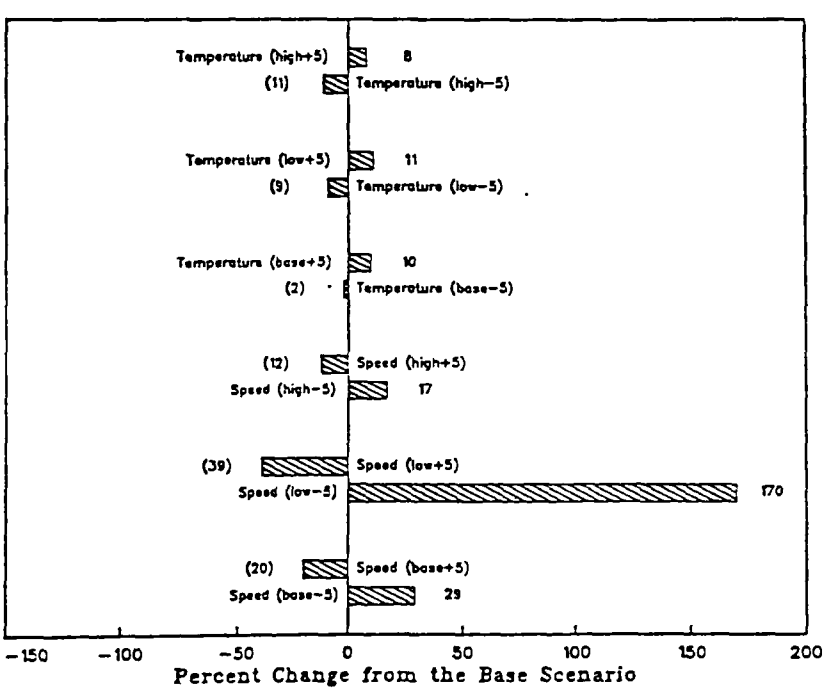
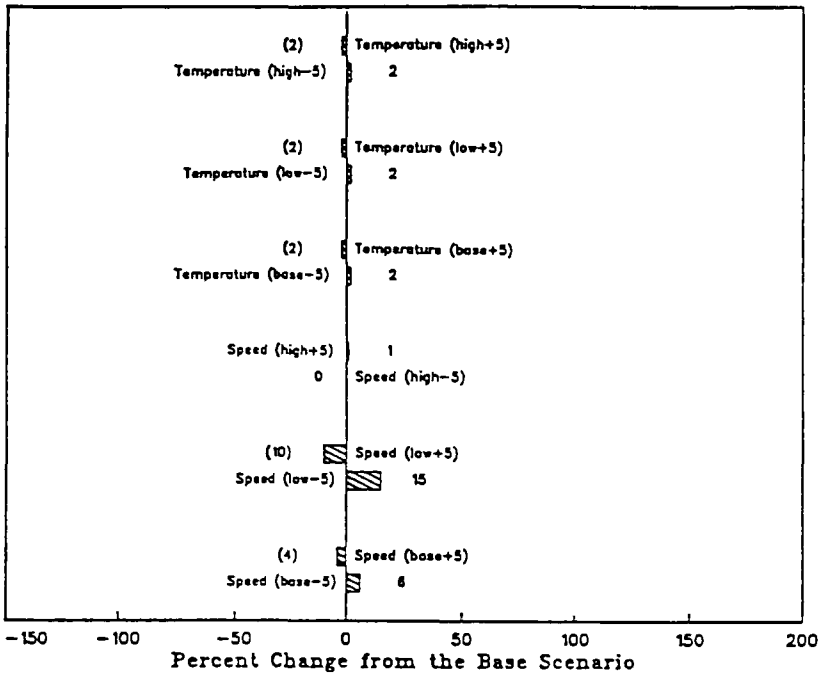


Figure B-5. Secondary MOBILE4 Sensitivity Analysis (Low Altitude-1990)

(continued)

OZONE SEASON MOBILE4 SENSITIVITY RESULTS
SECONDARY TEMPERATURE AND SPEED RANGES FOR NOx



CO SEASON MOBILE4 SENSITIVITY RESULTS
SECONDARY TEMPERATURE AND SPEED RANGES FOR CO

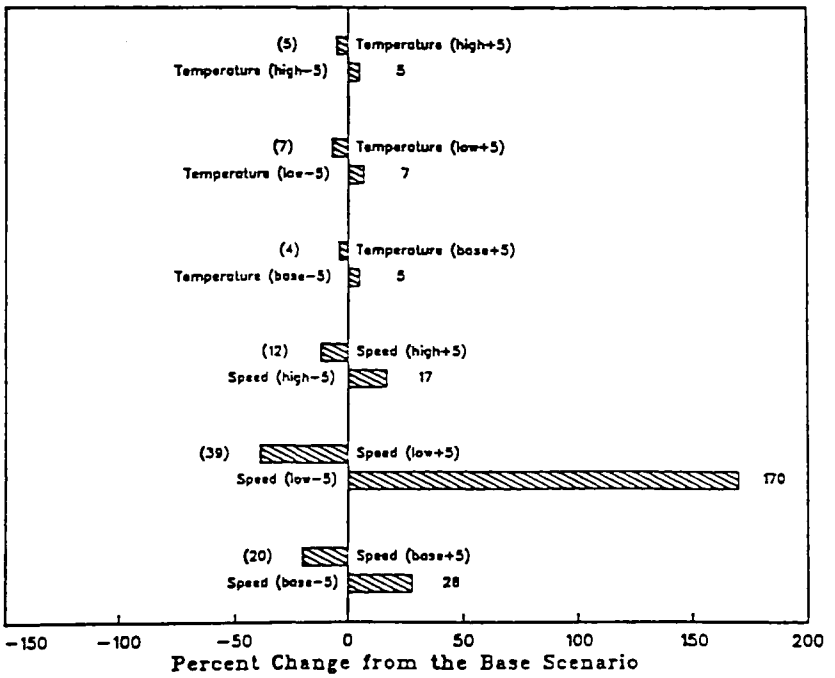


Figure B-5. Secondary MOBILE4 Sensitivity Analysis (Low Altitude-1990) (Continued)

TABLE B-1. WORKSHEETS FOR MOBILE4 SENSITIVITY ANALYSIS

PRIMARY SENSITIVITY ANALYSIS -- MOBILE4 COMPOSITE EMISSION FACTORS (gm/mile)

ANALYSIS PARAMETERS	LOW ALTITUDE 1990			LOW ALTITUDE 2005			HIGH ALTITUDE 1990			HIGH ALTITUDE 2005		
	NON-METHANE HC	EXHAUST CO	EXHAUST NOx	NON-METHANE HC	EXHAUST CO	EXHAUST NOx	NON-METHANE HC	EXHAUST CO	EXHAUST NOx	NON-METHANE HC	EXHAUST CO	EXHAUST NOx
CO BASE CASE	2.908	27.415	2.588	1.645	16.567	1.497	4.565	40.319	2.422	2.486	18.227	1.611
O3 BASE CASE	2.957	19.008	2.256	1.262	8.734	1.296	3.649	29.743	2.112	1.412	10.046	1.389
CO AVG. SPEED-LOW		67.397			26.158			93.562			28.969	
CO AVG. SPEED-HIGH		15.234			9.266			23.774			10.247	
O3 AVG. SPEED-LOW	5.704	47.754	2.781	2.601	14.160	1.694	6.641	69.387	2.669	2.845	16.431	1.821
O3 AVG. SPEED-HIGH	2.227	10.546	2.113	0.911	4.881	1.077	2.834	17.675	1.971	1.021	5.655	1.146
CO TEMPERATURE-LOW		41.898			24.821			60.410			29.906	
CO TEMPERATURE-HIGH		22.325			14.715			33.817			16.500	
CO HOT/COLD STARTS-LOW		46.019			26.639			64.848			28.488	
CO HOT/COLD STARTS-HIGH		19.265			12.386			30.170			13.985	
O3 HOT/COLD STARTS-LOW	2.638	15.985	1.978	1.080	7.296	1.085	3.304	25.803	1.854	1.225	8.495	1.152
O3 HOT/COLD STARTS-HIGH	2.890	17.693	2.305	1.198	7.938	1.301	3.563	27.422	2.147	1.347	9.187	1.394
O3 RVP/TEMP - MUSKEGON	3.709	21.944	2.184	1.436	9.620	1.307	4.526	34.392	2.058	1.595	11.057	1.401
O3 RVP/TEMP - SACRAMENTO	3.882	22.661	2.138	1.586	10.338	1.314	4.780	35.962	2.021	1.767	11.877	1.410
CO I/M PROGRAM-LOW		28.523			16.862			41.197			18.544	
CO I/M PROGRAM-HIGH		26.003			16.191			39.201			17.824	
O3 I/M PROGRAM-LOW	3.002	19.912	2.256	1.274	8.948	1.296	3.698	30.465	2.112	1.424	10.276	1.389
O3 I/M PROGRAM-HIGH	2.900	17.856	2.256	1.247	8.460	1.296	3.586	28.822	2.112	1.397	9.753	1.389
CO VMT MIX - FBNKS		27.487			17.233			40.579			19.324	
CO VMT MIX - CALIF		27.810			17.188			40.827			19.145	
O3 VMT MIX - FBNKS	2.981	19.422	3.066	1.338	9.319	1.698	3.790	30.441	2.912	1.615	11.052	1.782
O3 VMT MIX - CALIF	2.972	19.534	2.240	1.307	9.147	1.356	3.654	30.462	2.076	1.464	10.710	1.443
CO MILEAGE ACCUM.-FBNKS		26.843			16.491			41.091			18.582	
CO MILEAGE ACCUM.-CALIF		27.213			16.964			38.796			18.671	
O3 MILEAGE ACCUM.-FBNKS	3.035	18.946	3.077	1.311	8.777	1.667	3.909	30.892	2.896	1.590	10.511	1.751
O3 MILEAGE ACCUM.-CALIF	2.883	18.950	2.444	1.294	9.134	1.445	3.558	28.650	2.330	1.484	10.517	1.540
CO VEHICLE AGE-FBNKS		28.640			17.482			41.980			19.570	
CO VEHICLE AGE-PHNX		27.799			16.612			40.657			18.148	
O3 VEHICLE AGE-FBNKS	3.114	20.572	3.312	1.372	9.530	1.758	3.986	31.891	3.160	1.654	11.261	1.840
O3 VEHICLE AGE-PHNX	3.007	19.210	2.206	1.268	8.736	1.272	3.692	29.850	2.070	1.407	9.945	1.369

(Continued)

TABLE B-1. WORKSHEETS FOR MOBILE4 SENSITIVITY ANALYSIS (Continued)

PRIMARY SENSITIVITY ANALYSIS -- PERCENT CHANGE FROM BASE CASE

ANALYSIS PARAMETERS	LOW ALTITUDE 1990			LOW ALTITUDE 2005			HIGH ALTITUDE 1990			HIGH ALTITUDE 2005		
	NON-METHANE HC	EXHAUST CO	EXHAUST NOx	NON-METHANE HC	EXHAUST CO	EXHAUST NOx	NON-METHANE HC	EXHAUST CO	EXHAUST NOx	NON-METHANE HC	EXHAUST CO	EXHAUST NOx
CO AVG. SPEED-LOW		146			58			132			59	
CO AVG. SPEED-HIGH		-44			-44			-41			-44	
O3 AVG. SPEED-LOW	93	151	23	106	62	31	82	133	26	101	64	31
O3 AVG. SPEED-HIGH	-25	-45	-6	-28	-44	-17	-22	-41	-7	-28	-44	-17
CO TEMPERATURE-LOW		53			50			50			64	
CO TEMPERATURE-HIGH		-19			-11			-16			-9	
CO HOT/COLD STARTS-LOW		68			61			61			56	
CO HOT/COLD STARTS-HIGH		-30			-25			-25			-23	
O3 HOT/COLD STARTS-LOW	-11	-16	-12	-14	-16	-16	-9	-13	-12	-13	-15	-17
O3 HOT/COLD STARTS-HIGH	-2	-7	2	-5	-9	0	-2	-8	2	-5	-9	0
O3 RVP/TEMP - MUSKEGON	25	15	-3	14	10	1	24	16	-3	13	10	1
O3 RVP/TEMP - SACRAMENTO	31	19	-5	26	18	1	31	21	-4	25	18	2
CO I/M PROGRAM-LOW		4			2			2			2	
CO I/M PROGRAM-HIGH		-5			-2			-3			-2	
O3 I/M PROGRAM-LOW	2	5	0	1	2	0	1	2	0	1	2	0
O3 I/M PROGRAM-HIGH	-2	-6	0	-1	-3	0	-2	-3	0	-1	-3	0
CO VMT MIX - FBNKS		0			4			1			6	
CO VMT MIX - CALIF		1			4			1			5	
O3 VMT MIX - FBNKS	1	2	36	6	7	31	4	2	38	14	10	28
O3 VMT MIX - CALIF	1	3	-1	4	5	5	0	2	-2	4	7	4
CO MILEAGE ACCUM.-FBNKS		-2			0			2			2	
CO MILEAGE ACCUM.-CALIF		-1			2			-4			2	
O3 MILEAGE ACCUM.-FBNKS	3	0	36	4	0	29	7	4	37	13	5	26
O3 MILEAGE ACCUM.-CALIF	-3	0	8	3	5	11	-2	-4	10	5	5	11
CO VEHICLE AGE-FBNKS		4			6			4			7	
CO VEHICLE AGE-PHNX		1			0			1			0	
O3 VEHICLE AGE-FBNKS	5	8	47	9	9	36	9	7	50	17	12	32
O3 VEHICLE AGE-PHNX	2	1	-2	0	0	-2	1	0	-2	0	-1	-1

(Continued)

TABLE B-1. WORKSHEETS FOR MOBILE4 SENSITIVITY ANALYSIS (Continued)

SECONDARY SENSITIVITY ANALYSIS -- TEMPERATURE AND SPEED RANGES
(EMISSION FACTORS [GM/MILE] and PERCENT CHANGE FROM BASE CASE)

CO TEMPERATURE	BASE RUN CO	-5 RUN CO	+5 RUN CO	Percent Difference -5 CO	Percent Difference +5 CO
BASE	27.42	28.87	26.29	5	-4
LOW	41.90	44.87	39.12	7	-7
HIGH	22.33	23.42	21.24	5	-5

CO SPEED	BASE RUN CO	-5 RUN CO	+5 RUN CO	Percent Difference -5 CO	Percent Difference +5 CO
BASE	27.42	35.11	21.94	28	-20
LOW	67.40	182.16	41.35	170	-39
HIGH	15.23	17.89	13.36	17	-12

O3 TEMPERATURE	BASE RUN HC	-5 RUN HC	+5 RUN HC	Percent Difference -5 HC	Percent Difference +5 HC
BASE	2.96	2.70	3.56	-9	20
LOW	3.71	3.13	4.29	-16	16
HIGH	3.88	3.36	4.46	-13	15

O3 SPEED	BASE RUN HC	-5 RUN HC	+5 RUN HC	Percent Difference -5 HC	Percent Difference +5 HC
BASE	2.96	3.50	2.63	18	-11
LOW	5.70	13.34	3.93	134	-31
HIGH	2.23	2.39	2.11	7	-5

O3 TEMPERATURE	BASE RUN CO	-5 RUN CO	+5 RUN CO	Percent Difference -5 CO	Percent Difference +5 CO
BASE	19.01	18.72	20.82	-2	10
LOW	21.94	19.99	24.27	-9	11
HIGH	22.66	20.10	24.56	-11	8

O3 SPEED	BASE RUN CO	-5 RUN CO	+5 RUN CO	Percent Difference -5 CO	Percent Difference +5 CO
BASE	19.01	24.56	15.21	29	-20
LOW	47.75	128.97	29.05	170	-39
HIGH	10.55	12.39	9.26	17	-12

O3 TEMPERATURE	BASE RUN NOx	-5 RUN NOx	+5 RUN NOx	Percent Difference -5 NOx	Percent Difference +5 NOx
BASE	2.26	2.31	2.21	2	-2
LOW	2.18	2.23	2.14	2	-2
HIGH	2.14	2.18	2.10	2	-2

O3 SPEED	BASE RUN NOx	-5 RUN NOx	+5 RUN NOx	Percent Difference -5 NOx	Percent Difference +5 NOx
BASE	2.26	2.40	2.17	6	-4
LOW	2.78	3.19	2.50	15	-10
HIGH	2.11	2.12	2.14	0	1

APPENDIX C

EXAMPLES OF SPEED VERSUS EMISSIONS GRAPHS
(MOBILE3 AND MOBILE4 Speed Correction Factors for 1985 Light Duty Vehicles)[6]

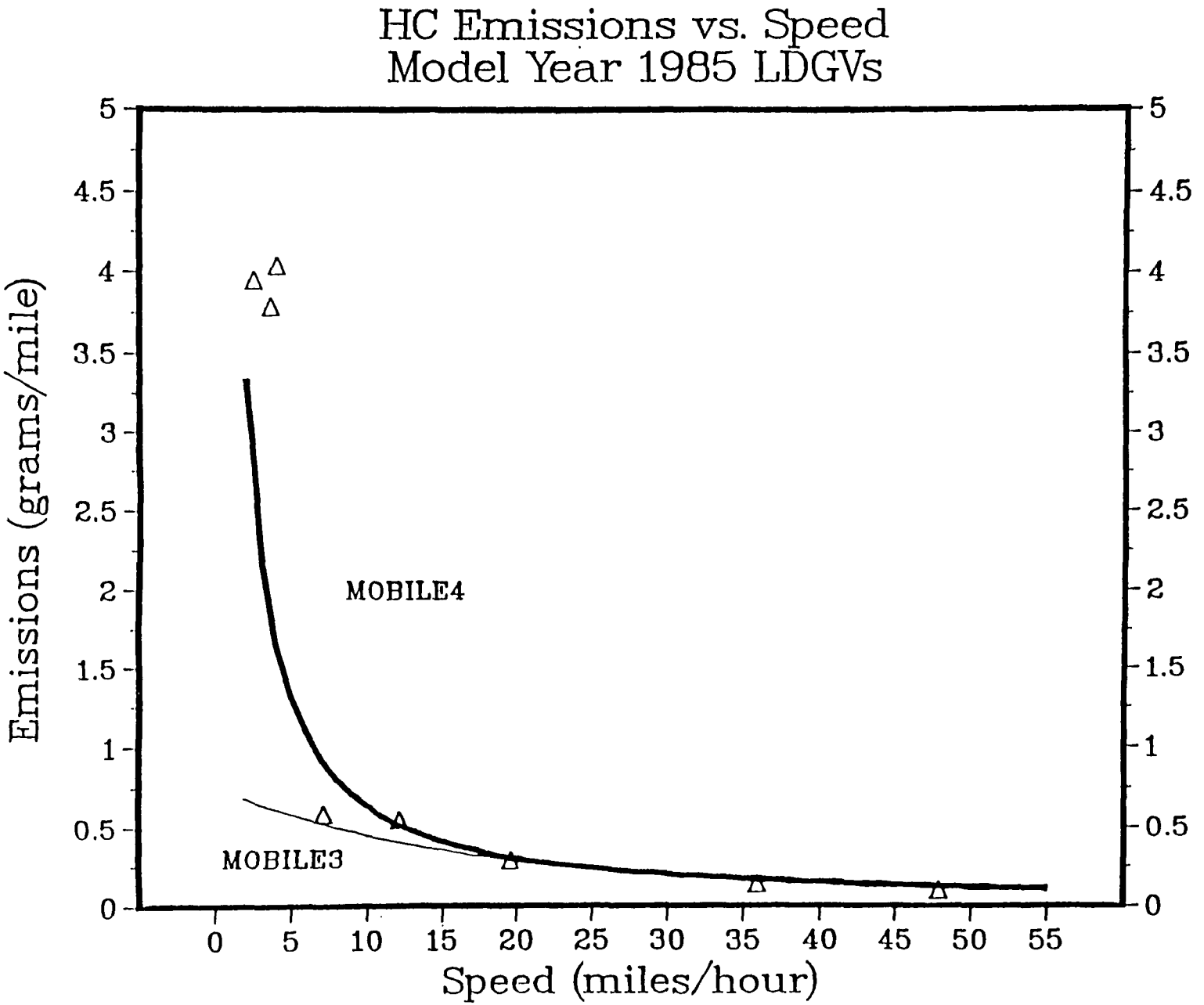


Figure C-1. Example of Speed versus HC Emissions for MOBILE3 and MOBILE4

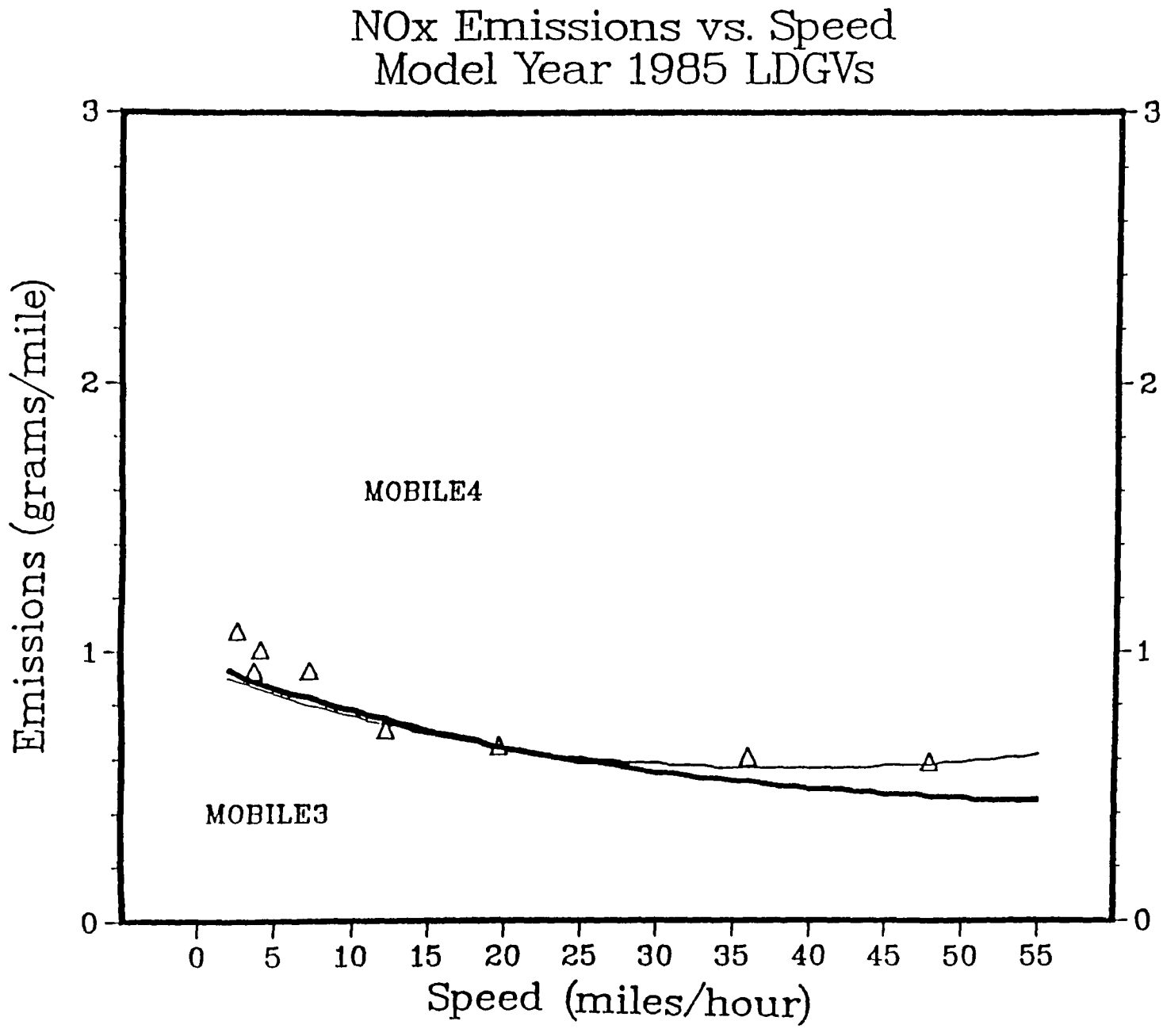


Figure C-2. Example of Speed versus NO_x Emissions for MOBILE3 and MOBILE4

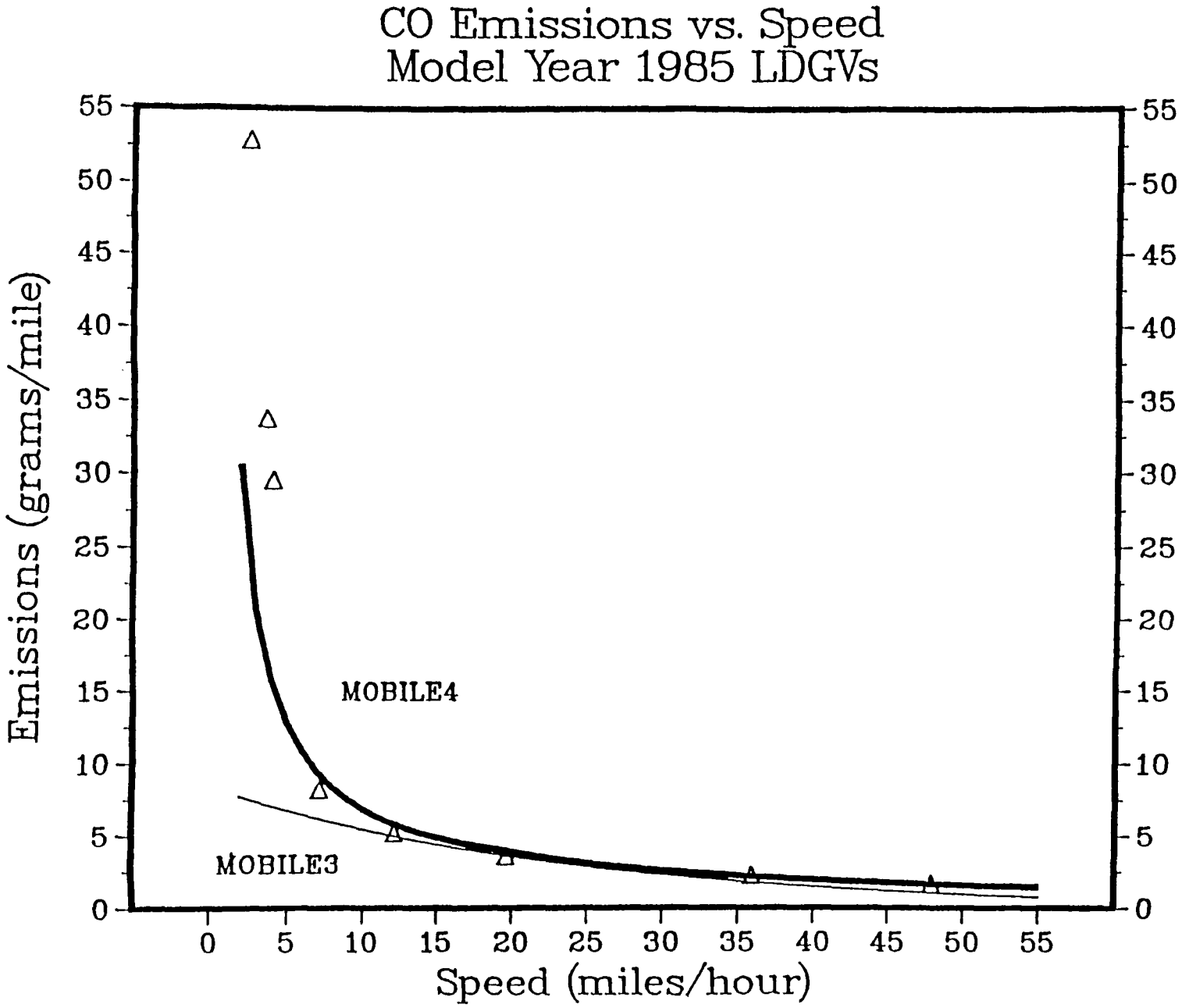


Figure C-3. Example of Speed versus CO Emissions for MOBILE3 and MOBILE4

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(Please read Instructions on the reverse before completing)

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16. ABSTRACT The report identifies the MOBILE4 input variables that can have significant impacts on highway vehicle emissions inventories and gives priorities for the development of improved guidance for specifying MOBILE4 inputs. Two major factors are considered: (1) the likelihood and potential range of variability in values for each MOBILE4 input; and (2) the potential magnitude of the effect of these variations, in terms of impact on typical mobile source inventories. The analysis updates previous work based on MOBILE3 by using MOBILE4 for the sensitivity analysis and by adding new MOBILE4 variables. The approach used in previous work is modified to address the specific concerns of this project--the State Implementation Plan (SIP) and National Emissions Data System (NEDS) inventory/guidance context. An additional level of detail is included for two critical variables (speed and temperature). Sensitivity to basic vehicle inspection/maintenance program specifications (waiver and compliance rate) is also considered. The primary sensitivity analysis is structured around two base cases representing ozone and carbon monoxide (C) season conditions. The report describes: (1) MOBILE4 input variable values for the ozone and CO base cases, (2) the variables and ranges or alternate values applied in the sensitivity analysis, (3) sensitivity analysis results, and (4) conclusions.

17. KEY WORDS AND DOCUMENT ANALYSIS

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