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MOBILE5 Information Sheet #8

Tier 2 Benefits Using MOBILE5

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Assessment and Standards Division
Office of Air Transportation and Air Quality
U.S. Environmental Protection Agency

NOTICE

This technical report does not necessarily represent final EPA decisions or positions. It is intended to present technical analysis of issues using data which are currently available. The purpose in the release of such reports is to facilitate the exchange of technical information and to inform the public of technical developments which may form the basis for a final EPA decision, position, or regulatory action.

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Tier 2 Benefits Using MOBILE5

April 2000

US EPA, NVFEL, ASD, 2000 Traverwood, Ann Arbor, Michigan 48105 (734) 214-4902

I. Introduction

MOBILE5 Information sheets are a series of documents intended to give users detailed information about techniques that can be used to more accurately model highway mobile source emissions and avoid potential errors or resolve limitations to modeling capabilities. When referring to MOBILE5 in this and other Information Sheets, we will mean the latest officially released version of the MOBILE model, unless otherwise specifically noted. At the time of this Information Sheet, two versions of the model were actively being used. The most current version of the model, MOBILE5b, was released in October of 1996 while the other version, MOBILE5a, was released in March of 1993.

All of the MOBILE5 Information Sheets will be made available on the EPA Office of Transportation and Air Quality site on the World Wide Web (WWW). The WWW site is available to users 24 hours a day, 7 days a week, and may be reached at "http://www.epa.gov/oms/m5.htm".

If you would like to be added to our mailing list, please follow the instructions included in the last section of the Information Sheet. This only need be done once. You do not need to send in this information if you are already on our mailing list.

II. Problem Description

The final rule on Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements ("Tier 2 standards") for passenger cars, light trucks, and larger passenger vehicles was published on February 10, 2000 (65 FR 6698). The program is designed to focus on reducing the emissions most responsible for the ozone and particulate matter (PM) impact from these vehicles -- nitrogen oxides (NOx) and non-methane organic gases (NMOG), consisting primarily of hydrocarbons (HC) and contributing to ambient volatile organic compounds (VOC).

The program will also, for the first time, apply the same set of federal standards to all passenger cars, light trucks, and medium-duty passenger vehicles. Light trucks include “light light-duty trucks” (or LLDTs), rated at less than 6000 pounds gross vehicle weight and “heavy light-duty trucks” (or HLDTs), rated at more than 6000 pounds gross vehicle weight). “Medium-duty passenger vehicles” (or MDPVs) form a new class of vehicles introduced by this rule that includes SUVs and passenger vans rated at between 8,500 and 10,000 GVWR. The program thus ensures that essentially all vehicles designed for passenger use in the future will be clean vehicles. More information about this rule is available on the EPA web site:

http://www.epa.gov/oms/tr2home.htm

MOBILE5a and MOBILE5b were released in 1993 and 1996, respectively, before the Tier 2 rules were proposed. As a result, MOBILE5a and MOBILE5b did not address the effects of Tier 2 exhaust and evaporative emission certification requirements on emissions for motor vehicles starting in 2004. These effects will be addressed in the MOBILE6 on-road emissions model, planned for release at the end of 2000. However, there are many areas which wish to include the effects of the Tier 2 standards in SIPs and conformity analyses before MOBILE6 is available.

III. Remedy

Background

The effect of Tier 2 on emission inventories was estimated for 1-hour ozone attainment demonstration areas in a memorandum, "1-Hour Ozone Attainment Demonstrations and Tier 2/Sulfur Rulemaking" from Lydia N. Wegman, Director, Air Quality Standards and Standards Division of the Office of Air Quality Planning and Standards and Merrylin Zaw-Mon, Director, Fuels and Energy Division of the (then) Office of Mobile Sources to the Air Directors of EPA Regions 1-6, dated November 8, 1999. The purpose of the memo was to advise the EPA Regional offices of the relationship between 1-hour ozone attainment demonstrations and the emissions reductions that will be achieved by the Tier 2/sulfur (Tier 2) rule and to provide emissions data related to that rule. This information assist the Regions in their work with States on issues related to the 1-hour ozone attainment demonstrations and the benefits of the Tier 2 rule for certain serious and severe ozone nonattainment areas in those Regions. A copy of this memo and the associated spreadsheet is available on the EPA web site at:

http://www.epa.gov/ttncaaa1/t1/meta/m10433.html

EPA stated in the November 8, 1999 memorandum that an official MOBILE information sheet would be released to provide guidance on crediting Tier 2 standards in SIPs and conformity. This information sheet provides that guidance.

The November 8, 1999 memorandum was meant originally to address only the immediate needs of certain ozone nonattainment areas and only addresses the impact of Tier 2 on SIP

inventories. This MOBILE information sheet is intended to make this information more widely available to other areas that may have a need for this information. States that have already submitted SIP revisions based on the November 8, 1999 memorandum do not need to revise those SIPs with this information sheet. SIP and conformity implementers must use this information sheet to assess the emission reductions associated from the Tier 2 program in future emissions analyses.

Users of the information given here and in the November 8, 1999 memorandum need to be aware of the serious limitations of this information in certain situations. The model used to derive these estimates of Tier 2 reductions incorporates changes proposed for MOBILE6 that are unrelated to the Tier 2 program and, as a result, produces baseline emissions estimates that are different from those produced by MOBILE5. In the absence of MOBILE6, users will apply these reductions to baseline emissions calculated using versions of MOBILE5. As a result, the final inventories estimated using this method may be substantially different from what will be estimated once MOBILE6 becomes available.

After applying the reduction estimates given here and in the November 8, 1999 memo, areas using some combinations of local inputs may derive inventory estimates that are unreasonable, because of the differences in the model used to derive these reduction estimates and the MOBILE5 model used to derive baseline emissions in local areas. These areas should contact Gary Dolce at (734) 214-4414 or dolce.gary@epa.gov for further guidance.

The final rule on Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements does not claim or estimate specific benefits from the rule for CO emissions. As a result, this User Information Sheet will not present an estimate of the effect of the Tier 2 standards on CO emissions. The effect of the Tier 2 rule on all emissions (including CO emissions) will be included in the MOBILE6 version of the model when it becomes available.

Method

Tables 1 through 6 for VOC and NOx reductions in this information sheet were distributed with the November 8, 1999 memorandum (referred to in that memorandum as Tables 8 and 9). These tables give differences in base case and control case emission factors for VOC and NOx for six different combinations of inspection/maintenance [I/M] program and gasoline formulation for calendar years from 2004 to 2030. Reductions are shown for gasoline fueled passenger cars (LDGV), light-duty trucks (LDGT) and heavy duty vehicles (>8500 lbs GVWR) and for diesel fueled light-duty trucks (LDDT). The estimate for reductions for diesel fueled passenger vehicles, heavy duty trucks and for motorcycles are negligible and are not shown.

The differences were derived from the special version of MOBILE called “Modified MOBILE5b/Version2," prepared for the Tier 2 rulemaking. Full documentation of the methods used to develop the estimates for VOC and NOx are available in the Tier 2 Docket. To briefly summarize here, highway vehicle emissions were first estimated using MOBILE5b with input files that described specific conditions (I/M program, temperatures, fuel parameters, registration

distribution). The resulting emission factors were then multiplied by correction factors in order to simulate emission factors that would result from proposed changes in MOBILE to be incorporated in MOBILE6. Correction factors were developed for both a base case (without Tier 2 control) and a Tier 2 control case. Because the factors used were based on default national MOBILE inputs and for the reasons described above, the results should be viewed as interim approximations which may change substantially when MOBILE6 becomes available. The accuracy of the resulting estimated emission reductions for specific areas is further limited by the lack of local area specificity in the MOBILE inputs used to develop the emission factors for these tables. For example, the emission reductions would be greater in an area that has greater fleet turnover (i.e., the fleet age distribution has a higher percentage of newer vehicles) than the default, national average distribution used in MOBILE.

The differences in grams per mile shown in the tables can be multiplied by the appropriate local VMT to develop rough estimates of Tier 2 reductions in any area in any year starting in 2004. These Tier 2 reductions would then be subtracted from the total motor vehicle emissions that were calculated using MOBILE5a or MOBILE5b and existing MOBILE information sheets. Areas wishing to use the tables must choose the table that best fits their own local conditions. Table 7 shows some detail regarding the specific inputs used to define the I/M program and other important parameters used to derive the reductions. Further detail about the inputs used can be found in the Tier 2 docket. Areas may wish to consult with their EPA Regional office for advice on which tables to use.

MOBILE5 is an area-wide model and the results are best applied area-wide. However, once the area-wide benefits have been determined, a proportional reduction (i.e., area-wide percent reduction) can be determined and used for more detailed link-based analysis.

EPA understands the limitations of this information and the resulting inaccuracy in inventory estimates. However, a more detailed analysis will be possible when MOBILE6 becomes available. These tables should not be used with emission estimates based on versions of MOBILE which have already been modified to account for changes in the basic emission rates as the result of introduction of Tier 2 vehicles into the fleet.

IV. Additional Information/ Listserver Subscription

EPA Office of Transportation and Air Quality (OTAQ) sponsors a listserver named EPA-MOBILENEWS. A listserver is an electronic mailing list service that will send messages to the all of the persons with e-mail addresses who have "subscribed" to that particular listserver. This listserver has largely replaced physical mailings of information to parties interested in the MOBILE model, as well as others interested in general mobile source emission factor and inventory information (including particulate emissions and the PART emission factor model, and nonroad mobile sources).

To subscribe to the EPA-MOBILENEWS listserver send the following message:

subscribe EPA-MOBILENEWS FIRSTNAME LASTNAME

where FIRSTNAME and LASTNAME is your name (for example: Fred Flintstone) to the EPA List server address. The list server e-mail address is:

listserver@unixmail.rtpnc.epa.gov

Your e-mail address will then be added to the list of subscribers and a confirmation message will be sent to your e-mail address. Whenever a message is posted to the EPA-MOBILENEWS listserver by the listserver owner (The Assessment and Standards Division of the EPA's Office of Transportation and Air Quality), a copy of that message will be sent to every person who has subscribed.

You can remove yourself from the list by sending another message to the listserver address. This message must be sent from the same e-mail address that you used to subscribe, and must contain the message:

unsubscribe EPA-MOBILENEWS

If you are interested in highway vehicle emission factors, including particulate matter, the MOBILE and PART emission factor models, and non-road vehicle emission factors and modeling, as well as guidance issued from OTAQ on the use of these models and development of emission inventories for all mobile sources, the Assessment and Standards Division encourages you to take advantage of the EPA-MOBILENEWS listserver as the best and most efficient way to get up-to-date information about these issues.

We recognize that some parties interested in these topics may not be able to subscribe to the listserver, and we will continue to mail paper copies of information to those parties on request. If you cannot subscribe to the EPA-MOBILENEWS listserver at this time and wish to continue to receive paper copies of information by regular mail, please mail or fax your current information (name, company name, mailing address, phone and fax numbers) to us at the address below and clearly indicate that you wish to continue receiving paper copies of all information distributed over the listserver. Send this request to:

MOBILE/PART Mailing Lists
US EPA NVFEL
Assessment and Standards Division
2000 Traverwood
Ann Arbor, MI 48105

or fax the information to: 734/214-4939

and note "Attention: MOBILE/PART Mailing Lists" on the fax.

Table 1
Difference in Hydrocarbon Emissions (grams per mile) Due to Tier 2/Sulfur Program
with No I/M Programs

	Conventional Gasoline					Reformulated Gasoline				
Calendar Year	LDGV	LDGT <6001 lbs.	LDGT >6000 lbs.	LDDT	HDGV	LDGV	LDGT <6001 lbs.	LDGT >6000 lbs.	LDDT	HDGV
2004	0.047	0.063	0.086	0.052	0.110	0.020	0.022	0.031	0.055	0.040
2005	0.046	0.059	0.096	0.124	0.100	0.020	0.023	0.040	0.130	0.038
2006	0.046	0.056	0.108	0.190	0.090	0.020	0.024	0.051	0.200	0.036
2007	0.046	0.060	0.139	0.250	0.082	0.021	0.026	0.065	0.265	0.034
2008	0.047	0.059	0.150	0.301	0.071	0.023	0.029	0.080	0.321	0.030
2009	0.047	0.052	0.147	0.345	0.060	0.025	0.032	0.095	0.368	0.027
2010	0.048	0.053	0.165	0.381	0.055	0.026	0.035	0.111	0.408	0.025
2011	0.048	0.056	0.183	0.412	0.050	0.029	0.038	0.125	0.442	0.023
2012	0.048	0.058	0.199	0.437	0.045	0.030	0.041	0.139	0.469	0.021
2013	0.050	0.057	0.214	0.459	0.042	0.032	0.044	0.153	0.492	0.020
2014	0.051	0.058	0.228	0.475	0.039	0.033	0.046	0.165	0.510	0.020
2015	0.051	0.059	0.241	0.488	0.038	0.035	0.049	0.176	0.524	0.020
2016	0.053	0.061	0.252	0.499	0.037	0.036	0.051	0.186	0.536	0.019
2017	0.054	0.062	0.264	0.508	0.035	0.038	0.052	0.195	0.545	0.020
2018	0.055	0.062	0.273	0.515	0.034	0.039	0.054	0.203	0.553	0.019
2019	0.056	0.063	0.282	0.520	0.033	0.040	0.054	0.210	0.559	0.019
2020	0.057	0.063	0.290	0.524	0.032	0.041	0.054	0.217	0.564	0.019
2021	0.058	0.064	0.297	0.527	0.030	0.042	0.055	0.222	0.567	0.018
2022	0.058	0.065	0.302	0.529	0.026	0.042	0.056	0.228	0.569	0.016
2023	0.058	0.064	0.308	0.530	0.023	0.042	0.056	0.233	0.571	0.014
2024	0.058	0.064	0.313	0.532	0.021	0.044	0.056	0.236	0.573	0.013
2025	0.059	0.065	0.317	0.533	0.018	0.044	0.056	0.240	0.575	0.012
2026	0.060	0.065	0.319	0.534	0.016	0.044	0.057	0.243	0.576	0.011
2027	0.059	0.065	0.326	0.535	0.013	0.044	0.057	0.249	0.578	0.010
2028	0.059	0.066	0.331	0.536	0.011	0.044	0.057	0.253	0.579	0.008
2029	0.059	0.066	0.333	0.537	0.010	0.045	0.058	0.255	0.580	0.008
2030	0.060	0.065	0.334	0.532	0.009	0.044	0.058	0.255	0.575	0.007

Table 2
Difference in Hydrocarbon Emissions (grams per mile) Due to Tier 2/Sulfur Program
with Phase-In I/M Programs

	Conventional Gasoline					Reformulated Gasoline				
Calendar Year	LDGV	LDGT <6001 lbs.	LDGT >6000 lbs.	LDDT	HDGV	LDGV	LDGT <6001 lbs.	LDGT >6000 lbs.	LDDT	HDGV
2004	0.044	0.054	0.066	0.053	0.110	0.019	0.022	0.024	0.055	0.040
2005	0.044	0.054	0.079	0.127	0.100	0.020	0.023	0.034	0.133	0.038
2006	0.044	0.054	0.094	0.199	0.090	0.021	0.025	0.046	0.208	0.036
2007	0.045	0.053	0.109	0.269	0.082	0.022	0.028	0.059	0.281	0.034
2008	0.046	0.053	0.127	0.334	0.071	0.024	0.030	0.073	0.348	0.030
2009	0.046	0.054	0.145	0.390	0.060	0.027	0.033	0.089	0.406	0.027
2010	0.048	0.054	0.164	0.440	0.055	0.029	0.036	0.105	0.458	0.025
2011	0.049	0.055	0.183	0.482	0.050	0.031	0.039	0.121	0.502	0.023
2012	0.050	0.056	0.199	0.517	0.045	0.033	0.042	0.134	0.538	0.021
2013	0.051	0.056	0.213	0.547	0.042	0.035	0.044	0.148	0.569	0.020
2014	0.052	0.057	0.228	0.570	0.039	0.037	0.046	0.161	0.593	0.020
2015	0.054	0.058	0.240	0.588	0.038	0.039	0.048	0.172	0.612	0.020
2016	0.055	0.059	0.252	0.604	0.037	0.040	0.050	0.182	0.628	0.019
2017	0.057	0.060	0.262	0.618	0.035	0.042	0.051	0.191	0.642	0.020
2018	0.057	0.061	0.272	0.629	0.034	0.043	0.052	0.200	0.654	0.019
2019	0.058	0.061	0.280	0.639	0.033	0.044	0.053	0.207	0.664	0.019
2020	0.059	0.062	0.288	0.646	0.032	0.044	0.054	0.214	0.671	0.019
2021	0.060	0.062	0.295	0.651	0.030	0.045	0.054	0.219	0.677	0.018
2022	0.060	0.063	0.300	0.656	0.026	0.046	0.054	0.224	0.682	0.016
2023	0.060	0.062	0.305	0.660	0.023	0.046	0.055	0.229	0.686	0.014
2024	0.061	0.063	0.310	0.664	0.021	0.046	0.055	0.233	0.690	0.013
2025	0.060	0.062	0.313	0.666	0.018	0.047	0.056	0.237	0.693	0.012
2026	0.061	0.063	0.316	0.668	0.016	0.047	0.055	0.240	0.695	0.011
2027	0.061	0.063	0.322	0.672	0.013	0.047	0.056	0.245	0.699	0.010
2028	0.061	0.063	0.327	0.675	0.011	0.047	0.056	0.250	0.702	0.008
2029	0.061	0.063	0.329	0.675	0.010	0.047	0.057	0.251	0.703	0.008
2030	0.061	0.064	0.328	0.672	0.009	0.047	0.057	0.251	0.699	0.007

Table 3
Difference in Hydrocarbon Emissions (grams per mile) Due to Tier 2/Sulfur Program
with Final I/M Programs

	Conventional Gasoline					Reformulated Gasoline				
Calendar Year	LDGV	LDGT <6001 lbs.	LDGT >6000 lbs.	LDDT	HDGV	LDGV	LDGT <6001 lbs.	LDGT >6000 lbs.	LDDT	HDGV
2004	0.042	0.053	0.064	0.053	0.110	0.018	0.021	0.023	0.055	0.040
2005	0.042	0.053	0.077	0.127	0.100	0.018	0.023	0.033	0.133	0.038
2006	0.043	0.053	0.092	0.199	0.090	0.020	0.024	0.044	0.208	0.036
2007	0.044	0.053	0.108	0.269	0.082	0.022	0.027	0.058	0.281	0.034
2008	0.045	0.053	0.125	0.334	0.071	0.024	0.030	0.073	0.348	0.030
2009	0.046	0.053	0.145	0.390	0.060	0.026	0.033	0.089	0.406	0.027
2010	0.047	0.054	0.164	0.440	0.055	0.029	0.035	0.105	0.458	0.025
2011	0.049	0.055	0.181	0.482	0.050	0.030	0.038	0.120	0.502	0.023
2012	0.050	0.056	0.199	0.517	0.045	0.033	0.041	0.135	0.538	0.021
2013	0.051	0.056	0.214	0.547	0.042	0.035	0.044	0.147	0.569	0.020
2014	0.052	0.057	0.227	0.570	0.039	0.036	0.046	0.161	0.593	0.020
2015	0.054	0.058	0.240	0.588	0.038	0.039	0.048	0.172	0.612	0.020
2016	0.055	0.058	0.252	0.604	0.037	0.040	0.050	0.181	0.628	0.019
2017	0.056	0.060	0.262	0.618	0.035	0.042	0.051	0.190	0.642	0.020
2018	0.058	0.060	0.271	0.629	0.034	0.043	0.052	0.199	0.654	0.019
2019	0.059	0.061	0.280	0.639	0.033	0.044	0.053	0.207	0.664	0.019
2020	0.059	0.062	0.288	0.646	0.032	0.044	0.054	0.214	0.671	0.019
2021	0.060	0.062	0.295	0.651	0.030	0.045	0.054	0.219	0.677	0.018
2022	0.060	0.063	0.300	0.656	0.026	0.046	0.054	0.224	0.682	0.016
2023	0.060	0.062	0.305	0.660	0.023	0.046	0.055	0.229	0.686	0.014
2024	0.061	0.063	0.310	0.664	0.021	0.046	0.055	0.233	0.690	0.013
2025	0.060	0.062	0.313	0.666	0.018	0.047	0.056	0.237	0.693	0.012
2026	0.061	0.063	0.316	0.668	0.016	0.047	0.055	0.240	0.695	0.011
2027	0.061	0.063	0.322	0.672	0.013	0.047	0.056	0.245	0.699	0.010
2028	0.061	0.063	0.327	0.675	0.011	0.047	0.056	0.250	0.702	0.008
2029	0.061	0.063	0.329	0.675	0.010	0.047	0.057	0.251	0.703	0.008
2030	0.061	0.064	0.328	0.672	0.009	0.047	0.057	0.251	0.699	0.007

Table 4
Difference in Oxides of Nitrogen Emissions (grams per mile) Due to Tier 2/Sulfur Program with No I/M Programs

	Conventional Gasoline					Reformulated Gasoline				
Calendar Year	LDGV	LDGT <6001 lbs.	LDGT >6000 lbs.	LDDT	HDGV	LDGV	LDGT <6001 lbs.	LDGT >6000 lbs.	LDDT	HDGV
2004	0.215	0.190	0.170	0.093	0.491	0.116	0.108	0.094	0.094	0.207
2005	0.241	0.220	0.227	0.220	0.468	0.133	0.133	0.151	0.223	0.204
2006	0.270	0.252	0.295	0.342	0.448	0.155	0.161	0.218	0.347	0.203
2007	0.303	0.290	0.366	0.456	0.431	0.178	0.195	0.288	0.460	0.202
2008	0.338	0.330	0.439	0.554	0.415	0.204	0.232	0.360	0.559	0.200
2009	0.371	0.371	0.512	0.638	0.401	0.229	0.268	0.431	0.644	0.200
2010	0.405	0.409	0.581	0.709	0.389	0.254	0.303	0.499	0.716	0.199
2011	0.437	0.445	0.645	0.767	0.380	0.278	0.335	0.561	0.774	0.199
2012	0.466	0.476	0.702	0.813	0.373	0.299	0.364	0.618	0.821	0.199
2013	0.490	0.504	0.753	0.850	0.363	0.318	0.390	0.668	0.859	0.197
2014	0.510	0.528	0.800	0.879	0.355	0.334	0.412	0.714	0.889	0.197
2015	0.526	0.548	0.841	0.903	0.350	0.348	0.430	0.755	0.912	0.197
2016	0.540	0.564	0.878	0.920	0.346	0.358	0.445	0.791	0.930	0.197
2017	0.551	0.577	0.910	0.932	0.341	0.368	0.457	0.822	0.943	0.197
2018	0.560	0.586	0.939	0.940	0.339	0.375	0.465	0.850	0.951	0.197
2019	0.567	0.593	0.965	0.946	0.335	0.381	0.473	0.876	0.957	0.197
2020	0.572	0.599	0.986	0.949	0.333	0.385	0.478	0.897	0.960	0.197
2021	0.576	0.603	1.006	0.952	0.330	0.389	0.482	0.916	0.963	0.197
2022	0.580	0.607	1.024	0.952	0.328	0.391	0.485	0.933	0.963	0.197
2023	0.582	0.609	1.039	0.952	0.326	0.393	0.487	0.949	0.963	0.197
2024	0.586	0.613	1.052	0.952	0.325	0.395	0.490	0.961	0.964	0.197
2025	0.588	0.616	1.064	0.952	0.324	0.398	0.493	0.973	0.963	0.197
2026	0.588	0.617	1.075	0.952	0.323	0.398	0.494	0.983	0.964	0.198
2027	0.588	0.619	1.092	0.952	0.321	0.399	0.495	1.001	0.964	0.198
2028	0.589	0.620	1.109	0.952	0.319	0.398	0.496	1.018	0.964	0.198
2029	0.589	0.620	1.116	0.953	0.319	0.399	0.497	1.024	0.965	0.198
2030	0.586	0.618	1.113	0.942	0.319	0.398	0.495	1.021	0.954	0.198

Table 5
Difference in Oxides of Nitrogen Emissions (grams per mile) Due to Tier 2/Sulfur Program with Phase In I/M Programs

	Conventional Gasoline					Reformulated Gasoline				
Calendar Year	LDGV	LDGT <6001 lbs.	LDGT >6000 lbs.	LDDT	HDGV	LDGV	LDGT <6001 lbs.	LDGT >6000 lbs.	LDDT	HDGV
2004	0.204	0.184	0.162	0.095	0.491	0.127	0.106	0.090	0.097	0.207
2005	0.228	0.210	0.218	0.229	0.468	0.143	0.129	0.144	0.233	0.204
2006	0.255	0.239	0.283	0.361	0.448	0.162	0.154	0.209	0.366	0.203
2007	0.283	0.273	0.352	0.486	0.431	0.183	0.185	0.275	0.492	0.202
2008	0.313	0.309	0.420	0.599	0.415	0.204	0.219	0.344	0.605	0.200
2009	0.341	0.343	0.490	0.699	0.401	0.224	0.252	0.411	0.705	0.200
2010	0.368	0.377	0.556	0.785	0.389	0.242	0.284	0.475	0.791	0.199
2011	0.392	0.408	0.617	0.857	0.380	0.261	0.314	0.535	0.863	0.199
2012	0.415	0.435	0.674	0.916	0.373	0.277	0.340	0.589	0.922	0.199
2013	0.434	0.460	0.726	0.965	0.363	0.291	0.364	0.640	0.970	0.197
2014	0.450	0.480	0.772	1.005	0.355	0.303	0.385	0.686	1.009	0.197
2015	0.462	0.498	0.815	1.036	0.350	0.313	0.402	0.726	1.040	0.197
2016	0.473	0.512	0.853	1.060	0.346	0.322	0.417	0.764	1.063	0.197
2017	0.481	0.523	0.887	1.079	0.341	0.329	0.428	0.796	1.082	0.197
2018	0.488	0.532	0.917	1.093	0.339	0.335	0.436	0.824	1.096	0.197
2019	0.493	0.539	0.942	1.104	0.335	0.339	0.442	0.850	1.106	0.197
2020	0.497	0.543	0.965	1.111	0.333	0.342	0.448	0.872	1.114	0.197
2021	0.500	0.547	0.985	1.118	0.330	0.344	0.451	0.892	1.120	0.197
2022	0.503	0.550	1.003	1.121	0.328	0.347	0.454	0.908	1.124	0.197
2023	0.505	0.552	1.018	1.124	0.326	0.349	0.457	0.923	1.127	0.197
2024	0.507	0.555	1.031	1.127	0.325	0.351	0.459	0.936	1.129	0.197
2025	0.509	0.558	1.041	1.128	0.324	0.351	0.461	0.947	1.131	0.197
2026	0.508	0.558	1.052	1.130	0.323	0.351	0.461	0.957	1.133	0.198
2027	0.509	0.559	1.069	1.132	0.321	0.351	0.462	0.974	1.134	0.198
2028	0.509	0.560	1.086	1.134	0.319	0.352	0.464	0.991	1.136	0.198
2029	0.509	0.561	1.092	1.135	0.319	0.352	0.465	0.997	1.138	0.198
2030	0.507	0.558	1.088	1.125	0.319	0.351	0.462	0.994	1.127	0.198

Table 6
Difference in Oxides of Nitrogen Emissions (grams per mile) Due to Tier 2/Sulfur Program with Final I/M Programs

	Conventional Gasoline					Reformulated Gasoline				
Calendar Year	LDGV	LDGT <6001 lbs.	LDGT >6000 lbs.	LDDT	HDGV	LDGV	LDGT <6001 lbs.	LDGT >6000 lbs.	LDDT	HDGV
2004	0.178	0.182	0.158	0.095	0.491	0.088	0.093	0.089	0.097	0.207
2005	0.205	0.208	0.215	0.229	0.468	0.106	0.118	0.144	0.233	0.204
2006	0.233	0.238	0.280	0.361	0.448	0.126	0.144	0.208	0.366	0.203
2007	0.264	0.272	0.349	0.486	0.431	0.149	0.176	0.274	0.492	0.202
2008	0.294	0.308	0.417	0.599	0.415	0.172	0.211	0.343	0.605	0.200
2009	0.324	0.343	0.487	0.699	0.401	0.195	0.246	0.411	0.705	0.200
2010	0.353	0.376	0.554	0.785	0.389	0.218	0.278	0.475	0.791	0.199
2011	0.380	0.406	0.616	0.857	0.380	0.240	0.310	0.535	0.863	0.199
2012	0.406	0.434	0.673	0.916	0.373	0.261	0.337	0.590	0.922	0.199
2013	0.427	0.459	0.724	0.965	0.363	0.278	0.362	0.640	0.970	0.197
2014	0.444	0.480	0.772	1.005	0.355	0.293	0.384	0.686	1.009	0.197
2015	0.458	0.497	0.814	1.036	0.350	0.306	0.402	0.726	1.040	0.197
2016	0.470	0.512	0.852	1.060	0.346	0.317	0.416	0.764	1.063	0.197
2017	0.478	0.523	0.886	1.079	0.341	0.325	0.427	0.796	1.082	0.197
2018	0.486	0.531	0.915	1.093	0.339	0.332	0.436	0.825	1.096	0.197
2019	0.492	0.538	0.942	1.104	0.335	0.336	0.442	0.850	1.106	0.197
2020	0.496	0.543	0.965	1.111	0.333	0.341	0.447	0.872	1.114	0.197
2021	0.499	0.547	0.985	1.118	0.330	0.344	0.451	0.892	1.120	0.197
2022	0.502	0.550	1.003	1.121	0.328	0.345	0.453	0.908	1.124	0.197
2023	0.504	0.552	1.018	1.124	0.326	0.347	0.455	0.923	1.127	0.197
2024	0.507	0.555	1.031	1.127	0.325	0.349	0.458	0.936	1.129	0.197
2025	0.509	0.558	1.041	1.128	0.324	0.351	0.461	0.947	1.131	0.197
2026	0.508	0.558	1.052	1.130	0.323	0.351	0.461	0.957	1.133	0.198
2027	0.509	0.559	1.069	1.132	0.321	0.351	0.462	0.974	1.134	0.198
2028	0.509	0.560	1.086	1.134	0.319	0.352	0.464	0.991	1.136	0.198
2029	0.509	0.561	1.092	1.135	0.319	0.352	0.465	0.997	1.138	0.198
2030	0.507	0.558	1.088	1.125	0.319	0.351	0.462	0.994	1.127	0.198

Table 7
Parameters Used in Modeling

Temperature:	All results are calculated at 72 and 96 degrees Fahrenheit, minimum and maximum temperatures for VOC and NOx emissions and at 75 and 20 degrees Fahrenheit for CO emissions.
Fuel:	"Conventional" gasoline is 9.0 lbs. RVP with industry average 339 ppm sulfur content. Reformulated Gasoline (RFG) is the federal final rule program for Region 2 areas as defined for MOBILE5 in AP-42. Tier 2 fuel sulfur control is assumed beginning in the 2004 calendar year.
Altitude:	All results are for low altitude areas.
Month:	All HC and NOx results are calculated for July 1st and all CO results are calculated for January 1st of the calendar year.
Speed:	All results are calculated for an areawide average trip speed of 24.6 miles per hour.
Fleet:	Fleet descriptors (registration distributions, mileage accumulations, etc.) are national averages as proposed for MOBILE6.
I/M:	Phase in Inspection and Maintenance (I/M) includes: January 1986 start year, 20% stringency, 1968 and newer model year coverage, 10% waivers, 85% compliance, test only, biennial frequency, covering LDGV, LDGT1 and LDGT2, IM240 test procedure with 1.2/30./3.0 gram per mile HC/CO/NOx cutpoints for 1981 and newer model year vehicles. 1996 and newer model years include both an evaporative pressure check and a purge system check with 96% compliance. Tier 1 vehicles include an onboard diagnostic (OBD) systems check. Final I/M includes: January 1986 start year, 20% stringency, 1968 and newer model year coverage, 3% waivers, 96% compliance, test only, biennial frequency, covering LDGV, LDGT1 and LDGT2, IM240 test procedure with 0.8/15./2.0 gram per mile HC/CO/NOx cutpoints for 1981 and newer model year vehicles. 1996 and newer model years include both an evaporative pressure check and a purge system check with 96% compliance. Tier 1 vehicles include an OBD check.
Op. Mode	Default (20.6/27.3/20.6) operating modes were used.