



MOBILE6 Estimates of Exhaust Emissions for 1994-and-later Light Duty Diesel Cars and Trucks

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M6.EXH.001

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INTRODUCTION

Light duty diesel cars and trucks form a very small part of the highway vehicle fleet, and emissions data on these vehicles is extremely limited. For these reasons, in developing MOBILE6, EPA chose not to update all the light duty diesel (LDD) emission factors. MOBILE6 will generally use the same LDD emission factors as used in MOBILE5. The MOBILE5 emission factors are separated into start and running emission factors (diesel vehicles have negligible evaporative emissions) as described in MOBILE6 report M6.EXH.005.

However, in the time since MOBILE5 was developed, several new standards for light duty diesels have come into effect. This makes it necessary to update the MOBILE emission rates for 1994-and-later light duty vehicles. The new standards includes Tier 1 standards that came into effect in 1994, and Low Emission Vehicle (LEV) standards that came into effect in 2001. Additional factors will be phased in starting in 2004 (Tier 2). This paper explains how emission factors for light duty diesel vehicles meeting these new standards will be modeled in MOBILE6.

APPROACH

Only a small amount of in-use data is available on emission rates from Tier 1 and newer diesel vehicles and trucks^{1,2}. And, unfortunately, much of this data was gathered under non-Federal Test Procedure conditions or on vehicles that are classified in MOBILE6 as light heavy-duty diesel vehicles. Thus, we have used the simple approach of applying ratios of the appropriate standards to the Tier 0 estimates of emission rates for these classes of vehicles in MOBILE5.

Table 1 summarizes the relevant Tier 1 and LEV standards for Light Duty Diesel vehicles and trucks. In general, these standards apply to both diesel and gasoline powered vehicles.

While MOBILE6 has four light duty gasoline truck classes to correspond to the four truck classes in the vehicle standards, MOBILE6 will have only two light-duty diesel truck classes (light light-duty trucks (LDDT12) which includes diesel LDT1 and LDT2, and heavier light-duty trucks (LDDT34) which includes diesel LDT3 and LDT4) . Diesel fleet sales data³ indicates that there have not been (and are not projected to be) any significant LDDT1, LDDT2, or LDDT3 sales since model year 1988. Therefore, for simplicity, the LDT2 emission standard will be used to compute emissions for the MOBILE6 LDDT12 vehicle class and the LDT4 emission standard will be use to calculate emissions for the MOBILE6 LDDT34 vehicle class.

Not all Tier2 vehicles are required to meet the same emission standard. Instead, Tier 2 emission standards are phased in by bin, that is, each bin has a specific emission standard, and

each year, manufacturers must assure that a certain fraction of the fleet falls into that bin. In MOBILE6, the base emission rate is calculated using the weighted average emission standard for a specific model year.

In MOBILE6, the basic emission rate for Tier 1 and later vehicles will be calculated using a ratio of the listed standards and the MOBILE5-based emission factor for Tier 0 vehicles. The ratio will be applied as follows:

$$\text{Tier "X" BERs} = \text{Tier 0 BER} * \left[\frac{\text{Tier "X" Standard}}{\text{Tier 0 Standard}} \right]$$

Where:

Tier "X" BER = the basic emission rate for start or running emissions for a given vehicle class, standard and pollutant. It is a function of vehicle mileage.

Tier 0 BER = the basic emission rate for start or running emissions for a given pollutant for vehicles of a given class meeting the "Tier 0" standard. It is a function of vehicle mileage.

Tier "X" Standard = the emission level for a given standard, vehicle class and pollutant as listed in Tables 1, or the average Tier 2 standard applying to the model year, vehicle class and pollutant.

Tier 0 Standard = the Tier 0 standard for a given vehicle class and pollutant, as listed in Table 1.

As a simplification, in cases where the standard is listed in non-methane organic gases rather than non-methane hydrocarbons (organic gases include aldehydes), the speciation is ignored for the purpose of calculating base emissions; this may slightly overestimate hydrocarbon emissions for LEVs. Also, for Tier 2 LDDTs, the model ratios "50K" and "full useful life" standards, which also may lead to a slight underestimate of Tier 2 emissions for these vehicles. We believe these approximations are appropriate for the MOBILE6 model because these vehicles make up such a small fraction of the total highway vehicle fleet. However, in future highway vehicle models, we hope to replace these estimates with estimates based on emissions data from these advanced light duty diesel vehicles.

Table 1
Light-Duty Exhaust Emissions Standards⁴

| Vehicle Type | Emission Standard | NMHC g/mi | CO g/mi | NOx g/mi | Vehicle Age |
|---------------------|--------------------------|------------------|----------------|-----------------|---------------------|
| LDDV | Tier 0 | 0.34 (a) | 3.40 | 1.00 | 50k Standards |
| | Tier 1 | 0.25 | 3.40 | 1.00 (d) | 50k Standards |
| | TLEV | 0.125 (b) | 3.40 | 0.40 | 50k Standards |
| | LEV | 0.075 (b) | 3.40 | 0.20 | 50k Standards |
| | ULEV | 0.040 (b) | 1.70 | 0.20 | 50k Standards |
| | Tier 2 (e) | | | | 50k Standards |
| | | | | | |
| LDDT12 (c) | Tier 0 | 0.67 | 10.00 | 1.70 | Full Life Standards |
| | Tier 1 | 0.40 | 5.50 | 0.97 | Full Life Standards |
| | TLEV | 0.20 (b) | 5.50 | 0.90 | Full Life Standards |
| | LEV | 0.13 (b) | 5.50 | 0.50 | Full Life Standards |
| | ULEV | 0.07 (b) | 2.80 | 0.50 | Full Life Standards |
| | Tier 2 (e) | | | | 50k Standards |
| | | | | | |
| LDDT34 (c) | Tier 0 | 0.67 | 10.00 | 1.70 | Full Life Standards |
| | Tier 1 | 0.56 | 7.30 | 1.53 | Full Life Standards |
| | TLEV | 0.28 (b) | 7.30 | 1.50 | Full Life Standards |
| | LEV | 0.28 (b) | 7.30 | 1.50 | Full Life Standards |
| | ULEV | 0.167 (b) | 3.70 | 0.80 | Full Life Standards |
| | Tier 2 (e) | | | | 50k Standards |
| | | | | | |

Notes: (a) Standard is in THC, but NMHC equivalent is used for these computations.

(b) NMOG

(c) LDT2 standards used for LDDT12; LDT4 used for LDDT34

(d) The Tier 1 NOx standard listed here applies to diesel vehicles only.

(e) Tier 2 standards are described in M6.EXH.004.⁵

REFERENCES

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2. "Investigation of Exhaust Emissions from Light Heavy-Duty Vehicles as a Function of Payload," Prepared for U.S. EPA by Center for Environmental Research and Technology, Quarterly Progress Report Number 1, September 1999.
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4. "Exhaust Emission Certification Standards." U.S. EPA Office of Mobile Sources, EPA420-B-98-001. March 24, 1998.
5. "Accounting for the Tier 2 and Heavy-Duty 2005/2007 requirements in MOBILE6" John Koupal, MOBILE6 Report M6.EXH.004. June 2001.