## Section 4.9 METHODOLOGY USED IN ESTIMATING EMISSION RATES FOR VEHICLES CERTIFIED TO THE LEV_II STANDARDS

This section details how the basic emission rates in grams per mile were estimated for vehicles certifying to the Low Emission Vehicle phase II (LEV_II) emission standards. The LEV_II regulation requires that these vehicles be phased in beginning with the 2004 model year.

### 4.9.1 Introduction

In November 1998 the California Air Resources Board (CARB) adopted a proposal that requires manufacturers to produce vehicles, beginning with the 2004 model year, that meet the LEV II standards. Table 4.9-1 shows the LEV II standards for vehicles tested using the Federal Test Procedure (FTP).

**Table 4.9-1 LEV_I and LEV_II FTP Standards (grams per mile)**

| | HC | CO | NOx | Durability |
|---|---|---|---|---|
| LEV_I | 0.075 | 3.40 | 0.20 | 50K |
| LEV_II | 0.090 | 4.20 | 0.07 | 120K |
| ULEV_I | 0.040 | 1.70 | 0.20 | 50K |
| ULEV_II | 0.055 | 2.10 | 0.07 | 120K |
| SULEV | 0.010 | 1.00 | 0.02 | 120K |

The notation used in this memorandum is:

LEV_I = Vehicles certified to the Low Emission Vehicle (LEV) standard as defined in CARB's 1990 LEV regulation.

LEV_II = Vehicles certified to the LEV 120,000 mile durability standards as defined in the 1998 LEV II regulation.

ULEV_I = Vehicles certified to the Ultra Low Emission Vehicle (ULEV) standard as defined in CARB's 1990 LEV regulation.

ULEV_II = Vehicles certified to the ULEV 120,000 mile durability standards as defined in the 1998 LEV II regulation.

SULEV = Vehicles certified to the Super Ultra Low Emission Vehicle (SULEV) 120,000 mile durability standards as defined in the LEV II regulation.

Table 4.9-2 shows the suggested implementation schedules for vehicles certified to both the LEV_I and LEV_II standards. The implementation schedules vary by vehicle class. As an example, the schedule requires that 47 percent of the 2010 model year passenger cars and light-duty trucks (with inertia weights less than 3,500 lbs.) meet the ULEV_II standards. Similarly, 62

percent of the 2010 model year light- and medium-duty trucks should meet the ULEV_II standards.

**Table 4.9-2 Implementation Schedules – Percent of Vehicles by Model Year Certifying to the LEV II Emission Standards**

| PCs and LDTs < 3501 lbs | | | | | | |
|---|---|---|---|---|---|---|
| **C Year** | **LEV I** | **LEV II** | **ULEV I** | **ULEV II** | **SULEV** | **ZEV** |
| **2004** | 39.0 | 13.0 | 25.0 | 8.0 | 5.0 | 10.0 |
| **2005** | 23.0 | 23.0 | 17.0 | 17.0 | 10.0 | 10.0 |
| **2006** | 9.0 | 27.0 | 11.0 | 33.0 | 10.0 | 10.0 |
| **2007** | 0.0 | 31.0 | 0.0 | 45.0 | 14.0 | 10.0 |
| **2008** | 0.0 | 28.0 | 0.0 | 42.0 | 20.0 | 10.0 |
| **2009** | 0.0 | 22.0 | 0.0 | 48.0 | 20.0 | 10.0 |
| **2010** | 0.0 | 18.0 | 0.0 | 47.0 | 25.0 | 10.0 |
| **LDTs > 3501 and MDTs < 8500 lbs** | | | | | | |
| **C Year** | **LEV I** | **LEV II** | **ULEV I** | **ULEV II** | **SULEV** | **ZEV** |
| **2004** | 61.0 | 20.0 | 14.0 | 5.0 | 0.0 | 0.0 |
| **2005** | 37.0 | 37.0 | 13.0 | 13.0 | 0.0 | 0.0 |
| **2006** | 13.5 | 40.5 | 10.5 | 31.5 | 4.0 | 0.0 |
| **2007** | 0.0 | 47.0 | 0.0 | 48.0 | 5.0 | 0.0 |
| **2008** | 0.0 | 36.0 | 0.0 | 54.0 | 10.0 | 0.0 |
| **2009** | 0.0 | 28.0 | 0.0 | 62.0 | 10.0 | 0.0 |
| **2010** | 0.0 | 21.0 | 0.0 | 64.0 | 15.0 | 0.0 |

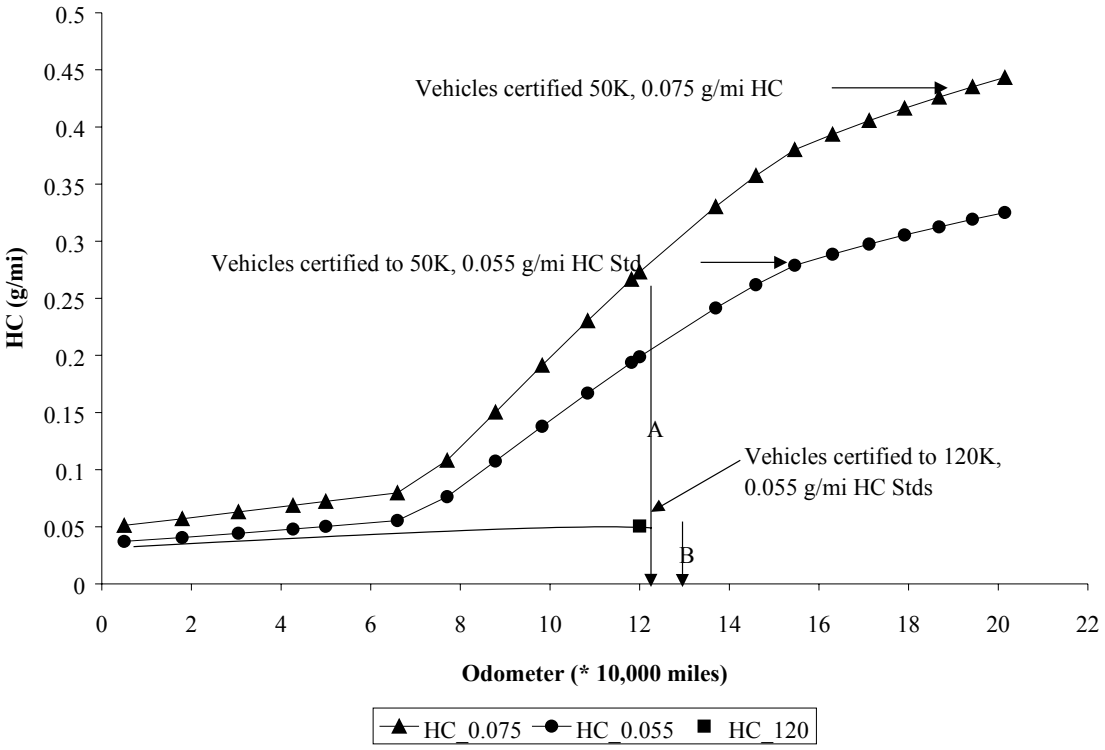
### 4.9.2 Methodology

In EMFAC2000, technology group 23 represents multi-point fuel injected vehicles certified to the LEV_I emission standards. The basic emission rates for this group were cloned from technology group 18 which represents multi-point fuel-injected vehicles certified to the 0.4 grams per mile (g/mi.) NOx standard. The zero mile emission rates for vehicles certified to the LEV_I standards are based on testing performed during CARB's Title 13 program. In this program, new vehicles are randomly selected and tested using the FTP test to ensure compliance with California's emission standards. In this memorandum, the regime growth rates for vehicles certified to the LEV_I standards are based on the behavior of technology group 18 vehicles. This assumes that the distribution of normal, moderate, high, very high and super emitters as a function of vehicle mileage is the same in both technology groups. This methodology assumes that vehicles with like technologies will exhibit similar malfunctions (as a function a vehicle mileage), and hence have similar regime growth and deterioration rates.

Figure 4.9-1 shows the basic emission rate curve for vehicles certified to the 50,000-mile (50K) 0.075 g/mi. LEV_I HC standard. If the ULEV_II standards were also 50K durability standards

then it would be relatively simple to calculate the ULEV_II emission rates by taking the ratio of the ULEV_II/LEV_I standards and applying this ratio to the technology group 23 emission rates. However, the ULEV_II emission standards are 120,000-mile (120K) durability standards. Further, the additional constraint or assumption is that the percentage difference between the emission rate and the standard at 50K should be the same at 120K for vehicles certified to the same numerical standards. That is, if vehicles certified to the 50K standards exceed them by ***x*** percent then it is assumed that vehicles certified to the 120K standards will also exceed this emission standard by ***x*** percent.

**Figure 4.9-1 Basic Emission Rate Curves for Vehicles Certified to 0.075, 0.055 g/mi. HC Standards**




Staff investigated two methodologies for developing LEV_II emissions rates. These were:

Method A: The first method requires calculating a ratio based on the emission rate for vehicles certified to 120K standard at 120K miles divided by the emission rate for vehicles certified to the 50K standard at 120K miles. This ratio (B/A) as shown in Figure 4.9-1 is then applied to LEV_I basic emission rates. This approach lowers the zero mile emission rates, and results in very low emission rates for LEV_II vehicles early in their useful life.

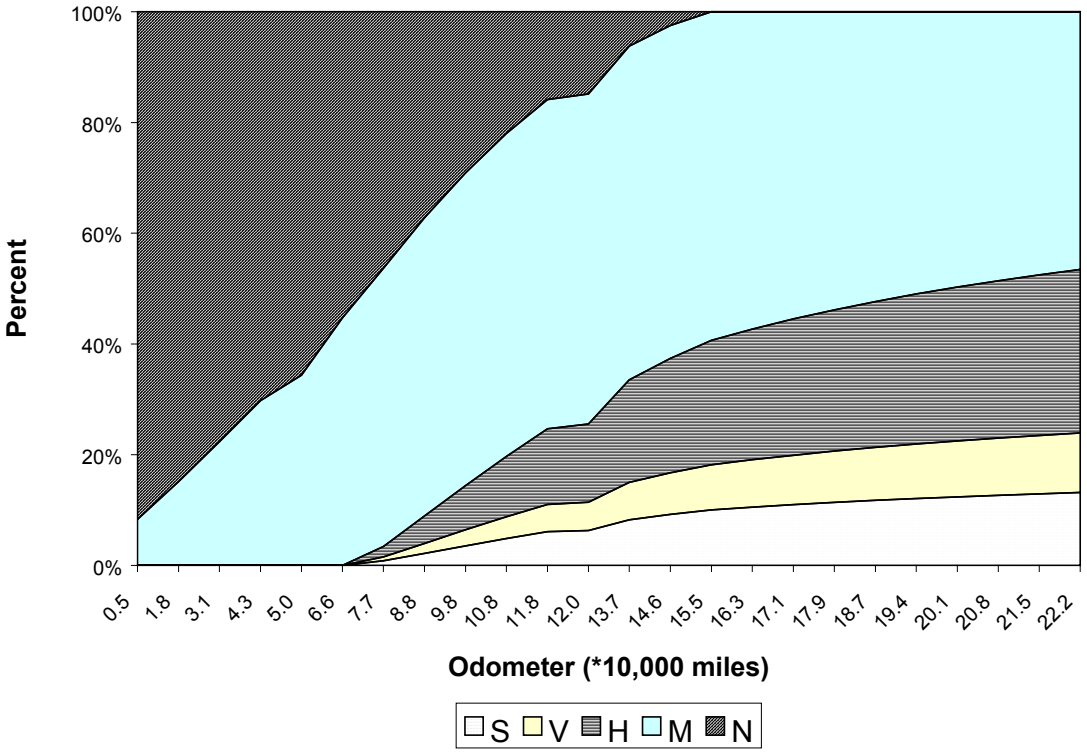
Method B: The second methodology requires manipulating the regime growth rates such that the standards are met at 120K. By changing the regime growth rates, one can be assured

that the zero mile emission levels, for vehicles certified to the same numerical emission standards, would remain the same. However, staff wanted to ensure that the new regime growth rates were not simply manufactured but were based on a sound methodology, and preserved most of regime growth rate and deterioration rate patterns from the technology group used in cloning the new emission rates. Figure 4.9-2 shows the regime growth rates for vehicles certified to the 0.075 g/mi. LEV_I HC standard. The following four methods were considered for modifying the regime growth rates:

1. Try all combinations of regime sizes such that the standards are met at 120K.
2. Increase the size of normal emitters until the standard is met at 120K.
3. Assume that there are no high, very high and super emitters for the first 120K miles, and maintain the same regime growth rates for normal and moderate emitters.
4. Assume that there are no high, very high and super emitters for the first 120K miles. Further the regime size of normal and moderate emitters at 120K in the cloned technology group are the same as those at 50K in the original technology group.

The first method was considered but not used since there were many combinations of regime sizes that could be used to meet the standards. With the second approach, the standards could only be met by increasing the normal regime growth rate by the large factor. This assumption resulted in more normal emitters at 120,000 miles than at zero miles. This approach was also dropped from further consideration. The standards could not be met using the third approach. The fourth approach yielded the closest results to the standards, however, in order to meet the LEV_II standards one had to assume that the emissions from normal emitters would also be reduced. Staff considered this to be a reasonable assumption, given that the 120K durability standard will require manufacturers to develop more durable vehicles with lower deterioration rates.

**Figure 4.9-2 Regime Growth Rates for Vehicles Certified to the 0.075 g/mi., 50K LEV_1 Hydrocarbon Standard**




The following calculation illustrates how the HC emission rate was estimated for vehicles certified to the 120K LEV_II HC standard of 0.09 g/mi.

1. Determine the percentage by which the LEV_I vehicles are below or above the standard at 50K miles. For example, if the LEV_I vehicle HC emission rate is 3.733 percent below the 0.075 g/mi. HC standard at 50K miles. Then one can estimate the LEV_II HC emission rate 120K miles by assuming that this rate will be 3.733 percent below the 120K mile standard. This results in a LEV_II HC rate of 0.0866 g/mi. at 120K. This is a pseudo standard that LEV_II vehicles must meet in order to maintain their emissions below the standard by 3.733 percent.
2. Calculate a ratio of the LEV_II / LEV_I HC emission standards or (0.09/0.075).
3. Modify the existing regime growth rate coefficients such that the size of super, very high and highs are zero at 120,000 miles. Further, modify the regime growth rate coefficients for moderate and normal emitters such that the normal and moderate regime sizes at zero miles and 120,000 miles in the cloned technology group are the same as the normal and moderate regime sizes at zero and 50,000-miles in the LEV_I technology group.
4. In EMFAC2000, emissions of normal vehicles deteriorate with vehicle mileage. This deterioration rate is lowered until the LEV_II vehicles meet the pseudo standards.

### 4.9.3 Results

Table 4.9-3 shows the basic emission rates for LEV_II, ULEV_II and SULEV vehicles developed using Method A. The modes 1, 2 and 3 represent emissions from bags 1, 2 and 3 of the FTP. Modes 4 and 5 represent emissions from bags 1 and 2 of the Unified Cycle. Figures 4.9-3, 4.9-4 and 4.9-5 show the resulting FTP composite HC, CO and NOx emission rates, respectively.

**Table 4.9-3 Basic Emission Rates for Vehicles Certified to the LEV II Standards Developed using Method A**

LEV certified to Stds of HC=0.09 g/mi, C0=4.2 g/mi, NOx=0.07 g/mi stds 120K

Tech Gp28 Normals

| Mode | HC | CO | NOx |
|---|---|---|---|
| 1 | 0.04540 | 0.50513 | 0.00959 |
| 2 | 0.00445 | 0.20350 | 0.00325 |
| 3 | 0.00953 | 0.21234 | 0.00797 |
| 4 | 0.17524 | 2.16833 | 0.02649 |
| 5 | 0.01860 | 0.68058 | 0.02952 |

c

Tech Gp28 Deterioration of Normals

| Mode | HC | CO | NOx |
|---|---|---|---|
| 1 | 0.00187 | 0.04152 | 0.00000 |
| 2 | 0.00000 | 0.02278 | 0.00000 |
| 3 | 0.00000 | 0.00000 | 0.00000 |
| 4 | 0.00187 | 0.04152 | 0.00000 |
| 5 | 0.00000 | 0.02278 | 0.00000 |

c

Tech Gp28 Moderates

| Mode | HC | CO | NOx |
|---|---|---|---|
| 1 | 0.09938 | 2.51557 | 0.09073 |
| 2 | 0.01651 | 1.21693 | 0.02780 |
| 3 | 0.02477 | 1.46997 | 0.04992 |
| 4 | 0.35504 | 8.52032 | 0.23629 |
| 5 | 0.03675 | 1.99083 | 0.09854 |

c

Tech Gp28 High

| Mode | HC | CO | NOx |
|---|---|---|---|
| 1 | 0.15748 | 4.02781 | 0.12048 |
| 2 | 0.08890 | 3.29741 | 0.05918 |
| 3 | 0.09081 | 2.73169 | 0.09154 |
| 4 | 0.53765 | 12.72677 | 0.31146 |
| 5 | 0.08800 | 3.62122 | 0.15062 |

c

Tech Gp28 V_Highs

| Mode | HC | CO | NOx |
|---|---|---|---|
| 1 | 0.30385 | 8.55350 | 0.19007 |
| 2 | 0.20543 | 9.60384 | 0.09821 |
| 3 | 0.15177 | 7.60003 | 0.14373 |
| 4 | 0.97226 | 24.18367 | 0.48555 |
| 5 | 0.13589 | 6.87861 | 0.20017 |

c

Tech Gp28 Super

| Mode | HC | CO | NOx |
|---|---|---|---|
| 1 | 0.64517 | 18.05007 | 0.26975 |
| 2 | 0.63120 | 19.18843 | 0.17853 |
| 3 | 0.46229 | 13.87049 | 0.25804 |
| 4 | 1.91666 | 45.70784 | 0.68280 |
| 5 | 0.24326 | 10.42104 | 0.28002 |

ULEV certified to Stds of HC=0.055 g/mi, C0=2.1 g/mi, NOx=0.07 g/mi stds 120K

Tech Gp29 Normals

| Mode | HC | CO | NOx |
|---|---|---|---|
| 1 | 0.02775 | 0.25257 | 0.00959 |
| 2 | 0.00272 | 0.10175 | 0.00325 |
| 3 | 0.00582 | 0.10617 | 0.00797 |
| 4 | 0.11242 | 1.20094 | 0.02649 |
| 5 | 0.01441 | 0.44896 | 0.02952 |

c

Tech Gp29 Deterioration of Normals

| Mode | HC | CO | NOx |
|---|---|---|---|
| 1 | 0.00114 | 0.02076 | 0.00000 |
| 2 | 0.00000 | 0.01139 | 0.00000 |
| 3 | 0.00000 | 0.00000 | 0.00000 |
| 4 | 0.00114 | 0.02076 | 0.00000 |
| 5 | 0.00000 | 0.01139 | 0.00000 |

c

Tech Gp29 Moderates

| Mode | HC | CO | NOx |
|---|---|---|---|
| 1 | 0.06073 | 1.25779 | 0.09073 |
| 2 | 0.01009 | 0.60846 | 0.02780 |
| 3 | 0.01513 | 0.73499 | 0.04992 |
| 4 | 0.22777 | 4.71904 | 0.23629 |
| 5 | 0.02846 | 1.31330 | 0.09854 |

c

Tech Gp29 High

| Mode | HC | CO | NOx |
|---|---|---|---|
| 1 | 0.09624 | 2.01391 | 0.12048 |
| 2 | 0.05433 | 1.64871 | 0.05918 |
| 3 | 0.05549 | 1.36585 | 0.09154 |
| 4 | 0.34492 | 7.04882 | 0.31146 |
| 5 | 0.06816 | 2.38883 | 0.15062 |

c

Tech Gp29 V_Highs

| Mode | HC | CO | NOx |
|---|---|---|---|
| 1 | 0.18569 | 4.27677 | 0.19007 |
| 2 | 0.12554 | 4.80193 | 0.09821 |
| 3 | 0.09275 | 3.80003 | 0.14373 |
| 4 | 0.62373 | 13.39431 | 0.48555 |
| 5 | 0.10525 | 4.53764 | 0.20017 |

c

Tech Gp29 Super

| Mode | HC | CO | NOx |
|---|---|---|---|
| 1 | 0.39427 | 9.02506 | 0.26975 |
| 2 | 0.38573 | 9.59425 | 0.17853 |
| 3 | 0.28251 | 6.93527 | 0.25804 |
| 4 | 1.22958 | 25.31563 | 0.68280 |
| 5 | 0.18842 | 6.87449 | 0.28002 |

SULEV certified to Stds of HC=0.01 g/mi, C0=1.0 g/mi, NOx=0.02 g/mi stds 120K

Tech Gp30 Normals

| Mode | HC | CO | NOx |
|---|---|---|---|
| 1 | 0.00504 | 0.12027 | 0.00274 |
| 2 | 0.00049 | 0.04845 | 0.00093 |
| 3 | 0.00106 | 0.05056 | 0.00228 |
| 4 | 0.02418 | 0.63806 | 0.00782 |
| 5 | 0.00595 | 0.28762 | 0.01461 |

c

Tech Gp30 Deterioration of Normals

| Mode | HC | CO | NOx |
|---|---|---|---|
| 1 | 0.00021 | 0.00989 | 0.00000 |
| 2 | 0.00000 | 0.00542 | 0.00000 |
| 3 | 0.00000 | 0.00000 | 0.00000 |
| 4 | 0.00021 | 0.00989 | 0.00000 |
| 5 | 0.00000 | 0.00542 | 0.00000 |

c

Tech Gp30 Moderates

| Mode | HC | CO | NOx |
|---|---|---|---|
| 1 | 0.01104 | 0.59895 | 0.02592 |
| 2 | 0.00183 | 0.28975 | 0.00794 |
| 3 | 0.00275 | 0.34999 | 0.01426 |
| 4 | 0.04899 | 2.50720 | 0.06975 |
| 5 | 0.01175 | 0.84135 | 0.04876 |

c

Tech Gp30 High

| Mode | HC | CO | NOx |
|---|---|---|---|
| 1 | 0.01750 | 0.95901 | 0.03442 |
| 2 | 0.00988 | 0.78510 | 0.01691 |
| 3 | 0.01009 | 0.65041 | 0.02615 |
| 4 | 0.07419 | 3.74500 | 0.09195 |
| 5 | 0.02815 | 1.53037 | 0.07453 |

c

Tech Gp30 V_Highs

| Mode | HC | CO | NOx |
|---|---|---|---|
| 1 | 0.03376 | 2.03656 | 0.05431 |
| 2 | 0.02282 | 2.28664 | 0.02806 |
| 3 | 0.01686 | 1.80954 | 0.04107 |
| 4 | 0.13417 | 7.11632 | 0.14334 |
| 5 | 0.04347 | 2.90698 | 0.09904 |

c

Tech Gp30 Super

| Mode | HC | CO | NOx |
|---|---|---|---|
| 1 | 0.07168 | 4.29765 | 0.07707 |
| 2 | 0.07013 | 4.56869 | 0.05101 |
| 3 | 0.05136 | 3.30251 | 0.07373 |
| 4 | 0.26449 | 13.45005 | 0.20157 |
| 5 | 0.07781 | 4.40405 | 0.13855 |

**Figure 4.9-3 FTP Composite HC Emission Rates Developed Using Method A**

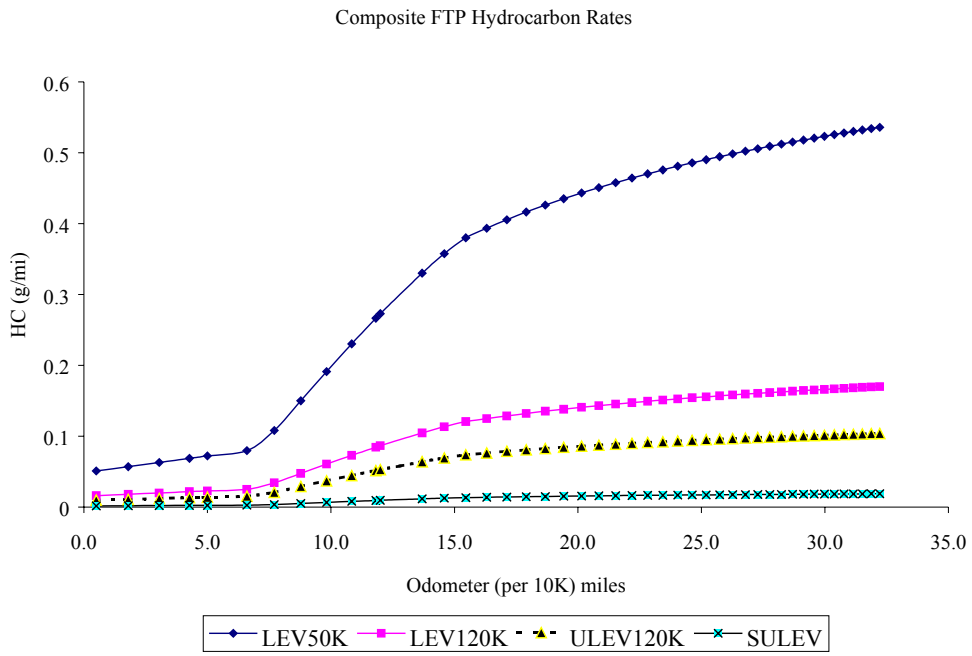



**Figure 4.9-4 FTP Composite CO Emission Rates Developed Using Method A**

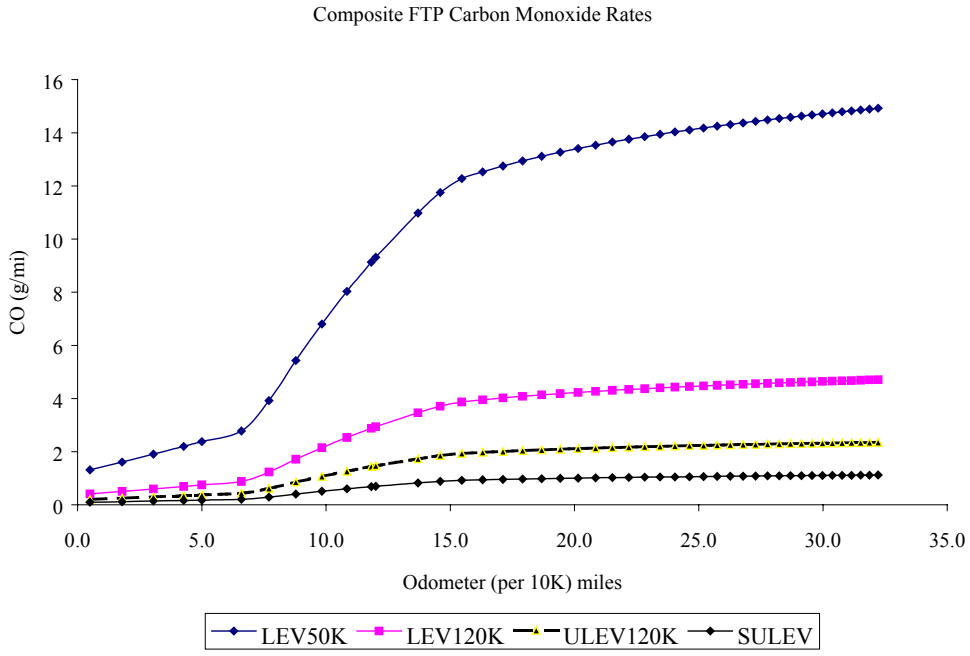


**Figure 4.9-5 FTP Composite NOx Emission Rates Developed Using Method A**

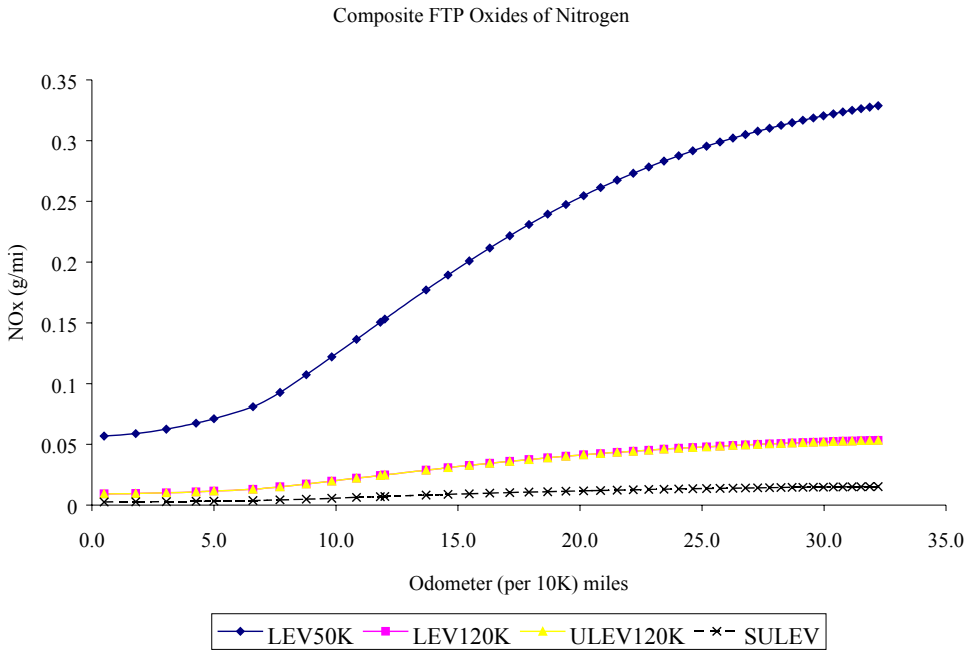



Table 4.9-4 shows the basic emission rates for LEV_II vehicles developed using Method B that requires manipulating the regime growth rates. Table 4.9-5 shows the corresponding regime growth rate coefficients applicable to technology groups 28, 29, 30 (vehicles certified to 120K standards).

## Table 4.9-4 Basic Emission Rates For Vehicles Certified to the LEV II Standards Developed using Method B

| LEV_II | LEV_II | LEV_II | LEV_II |
|---|---|---|---|
| Tech Gp28 | | Normals | |
| Mode | HC | CO | NOx |
| 1 | 0.17160 | 1.97771 | 0.02065 |
| 2 | 0.01680 | 0.79676 | 0.00700 |
| 3 | 0.03600 | 0.83135 | 0.01715 |
| 4 | 0.58091 | 6.94065 | 0.05590 |
| 5 | 0.03708 | 1.54398 | 0.04541 |
| c | | | |
| Tech Gp28 | Deterioration of Normals | | |
| Mode | HC | CO | NOx |
| 1 | 0.00290 | 0.06826 | 0.00000 |
| 2 | 0.00000 | 0.03745 | 0.00000 |
| 3 | 0.00000 | 0.00000 | 0.00000 |
| 4 | 0.00290 | 0.06826 | 0.00000 |
| 5 | 0.00000 | 0.03745 | 0.00000 |
| c | | | |
| Tech Gp28 | | Moderates | |
| Mode | HC | CO | NOx |
| 1 | 0.37560 | 9.84900 | 0.19530 |
| 2 | 0.06240 | 4.76453 | 0.05985 |
| 3 | 0.09360 | 5.75524 | 0.10745 |
| 4 | 1.17697 | 27.27289 | 0.49855 |
| 5 | 0.07324 | 4.51640 | 0.15157 |
| c | | | |
| Tech Gp28 | | High | |
| Mode | HC | CO | NOx |
| 1 | 0.59520 | 15.76976 | 0.25935 |
| 2 | 0.33600 | 12.91006 | 0.12740 |
| 3 | 0.34320 | 10.69518 | 0.19705 |
| 4 | 1.78232 | 40.73740 | 0.65716 |
| 5 | 0.17540 | 8.21512 | 0.23168 |
| c | | | |
| Tech Gp28 | | V_Highs | |
| Mode | HC | CO | NOx |
| 1 | 1.14840 | 33.48882 | 0.40915 |
| 2 | 0.77640 | 37.60112 | 0.21140 |
| 3 | 0.57360 | 29.75576 | 0.30940 |
| 4 | 3.22305 | 77.41005 | 1.02448 |
| 5 | 0.27084 | 15.60484 | 0.30791 |
| c | | | |
| Tech Gp28 | | Super | |
| Mode | HC | CO | NOx |
| 1 | 2.43840 | 70.66994 | 0.58065 |
| 2 | 2.38560 | 75.12688 | 0.38430 |
| 3 | 1.74720 | 54.30600 | 0.55545 |
| 4 | 6.35374 | 146.30726 | 1.44067 |
| 5 | 0.48485 | 23.64119 | 0.43073 |

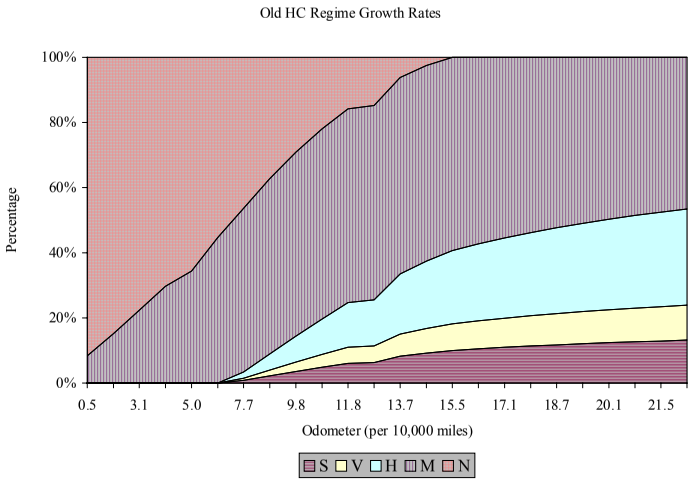
| ULEV_II | ULEV_II | ULEV_II | ULEV_II |
|---|---|---|---|
| Tech Gp29 | | Normals | |
| Mode | HC | CO | NOx |
| 1 | 0.10487 | 0.98885 | 0.02065 |
| 2 | 0.01027 | 0.39838 | 0.00700 |
| 3 | 0.02200 | 0.41568 | 0.01715 |
| 4 | 0.37267 | 3.84412 | 0.05590 |
| 5 | 0.02872 | 1.01852 | 0.04541 |
| c | | | |
| Tech Gp29 | Deterioration of Normals | | |
| Mode | HC | CO | NOx |
| 1 | 0.00177 | 0.03333 | 0.00000 |
| 2 | 0.00000 | 0.01828 | 0.00000 |
| 3 | 0.00000 | 0.00000 | 0.00000 |
| 4 | 0.00177 | 0.03333 | 0.00000 |
| 5 | 0.00000 | 0.01828 | 0.00000 |
| c | | | |
| Tech Gp29 | | Moderates | |
| Mode | HC | CO | NOx |
| 1 | 0.22953 | 4.92450 | 0.19530 |
| 2 | 0.03813 | 2.38226 | 0.05985 |
| 3 | 0.05720 | 2.87762 | 0.10745 |
| 4 | 0.75506 | 15.10525 | 0.49855 |
| 5 | 0.05673 | 2.97935 | 0.15157 |
| c | | | |
| Tech Gp29 | | High | |
| Mode | HC | CO | NOx |
| 1 | 0.36373 | 7.88488 | 0.25935 |
| 2 | 0.20533 | 6.45503 | 0.12740 |
| 3 | 0.20973 | 5.34759 | 0.19705 |
| 4 | 1.14340 | 22.56266 | 0.65716 |
| 5 | 0.13585 | 5.41929 | 0.23168 |
| c | | | |
| Tech Gp29 | | V_Highs | |
| Mode | HC | CO | NOx |
| 1 | 0.70180 | 16.74441 | 0.40915 |
| 2 | 0.47447 | 18.80056 | 0.21140 |
| 3 | 0.35053 | 14.87788 | 0.30940 |
| 4 | 2.06766 | 42.87402 | 1.02448 |
| 5 | 0.20978 | 10.29409 | 0.30791 |
| c | | | |
| Tech Gp29 | | Super | |
| Mode | HC | CO | NOx |
| 1 | 1.49013 | 35.33497 | 0.58065 |
| 2 | 1.45787 | 37.56344 | 0.38430 |
| 3 | 1.06773 | 27.15300 | 0.55545 |
| 4 | 4.07608 | 81.03316 | 1.44067 |
| 5 | 0.37554 | 15.59546 | 0.43073 |

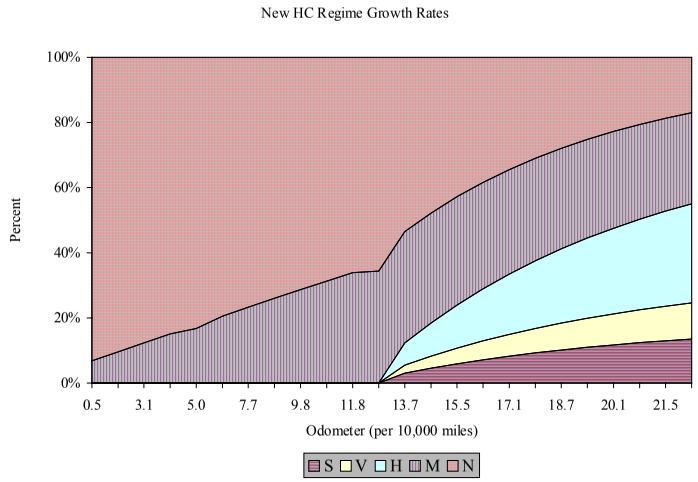
| SULEV | SULEV | SULEV | SULEV |
|---|---|---|---|
| Tech Gp30 | | Normals | |
| Mode | HC | CO | NOx |
| 1 | 0.01907 | 0.47088 | 0.00590 |
| 2 | 0.00187 | 0.18971 | 0.00200 |
| 3 | 0.00400 | 0.19794 | 0.00490 |
| 4 | 0.08016 | 2.04236 | 0.01650 |
| 5 | 0.01186 | 0.65250 | 0.02247 |
| c | | | |
| Tech Gp30 | Deterioration of Normals | | |
| Mode | HC | CO | NOx |
| 1 | 0.00032 | 0.01548 | 0.00000 |
| 2 | 0.00000 | 0.00849 | 0.00000 |
| 3 | 0.00000 | 0.00000 | 0.00000 |
| 4 | 0.00032 | 0.01548 | 0.00000 |
| 5 | 0.00000 | 0.00849 | 0.00000 |
| c | | | |
| Tech Gp30 | | Moderates | |
| Mode | HC | CO | NOx |
| 1 | 0.04173 | 2.34500 | 0.05580 |
| 2 | 0.00693 | 1.13441 | 0.01710 |
| 3 | 0.01040 | 1.37029 | 0.03070 |
| 4 | 0.16242 | 8.02533 | 0.14718 |
| 5 | 0.02343 | 1.90868 | 0.07499 |
| c | | | |
| Tech Gp30 | | High | |
| Mode | HC | CO | NOx |
| 1 | 0.06613 | 3.75471 | 0.07410 |
| 2 | 0.03733 | 3.07382 | 0.03640 |
| 3 | 0.03813 | 2.54647 | 0.05630 |
| 4 | 0.24595 | 11.98740 | 0.19400 |
| 5 | 0.05611 | 3.47179 | 0.11463 |
| c | | | |
| Tech Gp30 | | V_Highs | |
| Mode | HC | CO | NOx |
| 1 | 0.12760 | 7.97353 | 0.11690 |
| 2 | 0.08627 | 8.95265 | 0.06040 |
| 3 | 0.06373 | 7.08471 | 0.08840 |
| 4 | 0.44477 | 22.77871 | 0.30244 |
| 5 | 0.08664 | 6.59477 | 0.15235 |
| c | | | |
| Tech Gp30 | | Super | |
| Mode | HC | CO | NOx |
| 1 | 0.27093 | 16.82618 | 0.16590 |
| 2 | 0.26507 | 17.88735 | 0.10980 |
| 3 | 0.19413 | 12.93000 | 0.15870 |
| 4 | 0.87679 | 43.05242 | 0.42530 |
| 5 | 0.15510 | 9.99101 | 0.21312 |

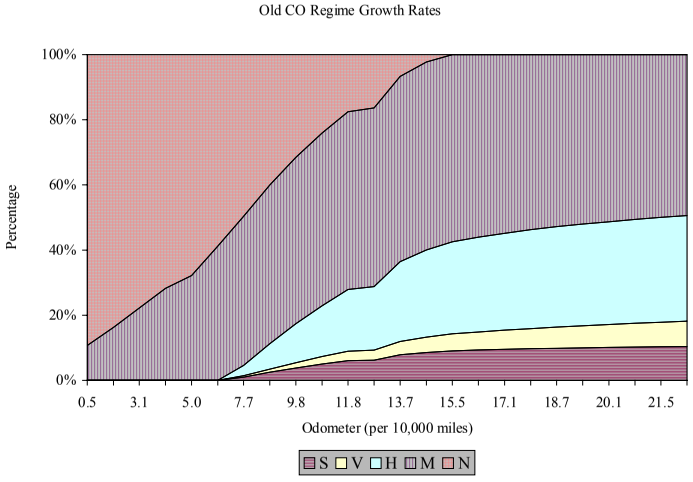
**Table 4.9-5 Regime Growth Rates for Emission Rates Developed Using Method B**

| Tech groups=28, 29, 30 | | | | |
|---|---|---|---|---|
| HC | A | B | C | D |
| S | -9.81936 | 0.00000 | 0.06819 | 0.00000 |
| V | -7.99632 | 0.00000 | 0.05553 | 0.00000 |
| H | -22.00896 | 0.00000 | 0.15284 | 0.00000 |
| M | 7.73600 | 1.85833 | 0.00000 | 0.00000 |
| N | 134.04700 | 0.00000 | 0.00000 | -22.14167 |
| CO | | | | |
| S | -13.06560 | 1.08880 | 0.00000 | 0.00000 |
| V | -4.01760 | 0.00000 | 0.02790 | 0.00000 |
| H | -40.76520 | 3.39710 | 0.00000 | 0.00000 |
| M | 11.41800 | 1.26321 | 0.00000 | 0.00000 |
| N | 131.96200 | 0.00000 | 0.00000 | -21.93012 |
| NOx | | | | |
| S | -1.41432 | 0.11786 | 0.00000 | 0.00000 |
| V | -3.17880 | 0.26490 | 0.00000 | 0.00000 |
| H | -4.21344 | 0.00000 | 0.02926 | 0.00000 |
| M | 8.53500 | 0.00000 | 0.03364 | 0.00000 |
| N | 95.85200 | -1.13367 | 0.00000 | 0.00000 |

Figure 4.9-6 shows a comparison of the old and new regime growth rates for HC and CO. These figures show that the non-linear nature of the new regime growth rates was maintained in the development of the new technology groups. Further, it is evident from these figures that with the advent of the 120K durability standards, normal and moderate emitters are projected to dominate future vehicle fleets. Figures 4.9-7, 4.9-8 and 4.9-9 show the HC, CO and NOx composite FTP emission rates, respectively, for various LEV vehicles.



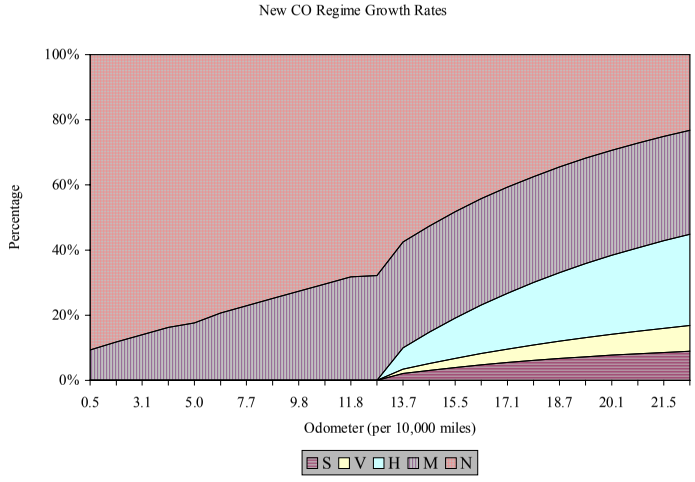




**Figure 4.9-6 Comparison of the Old and New Regime Growth Rates**

**Figure 4.9-7 Composite FTP HC Emission Rates Developed Using Method B**

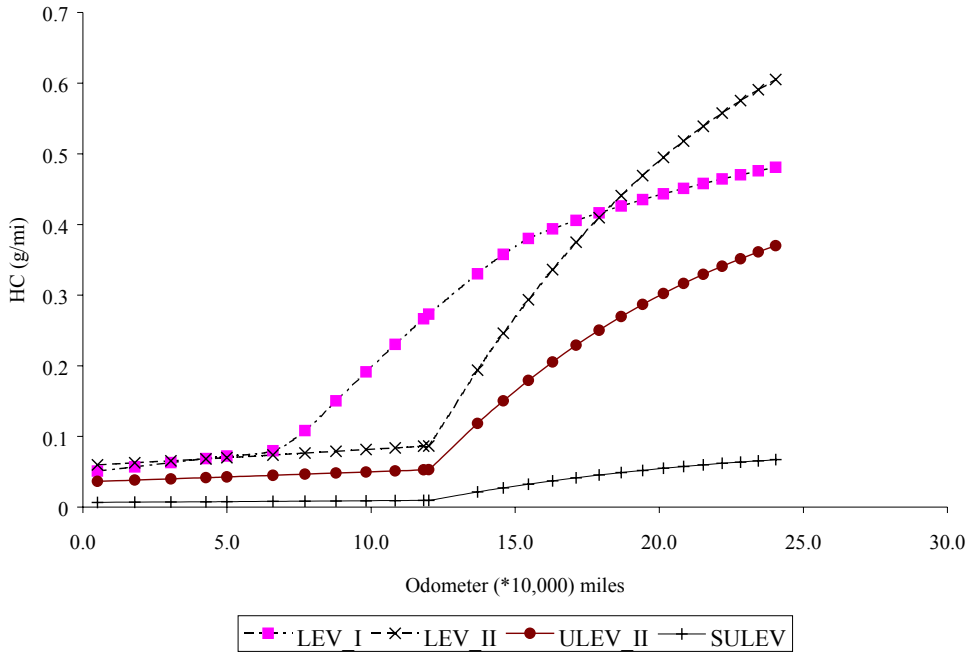



**Figure 4.9-8 Composite FTP CO Emission Rates Developed Using Method B**

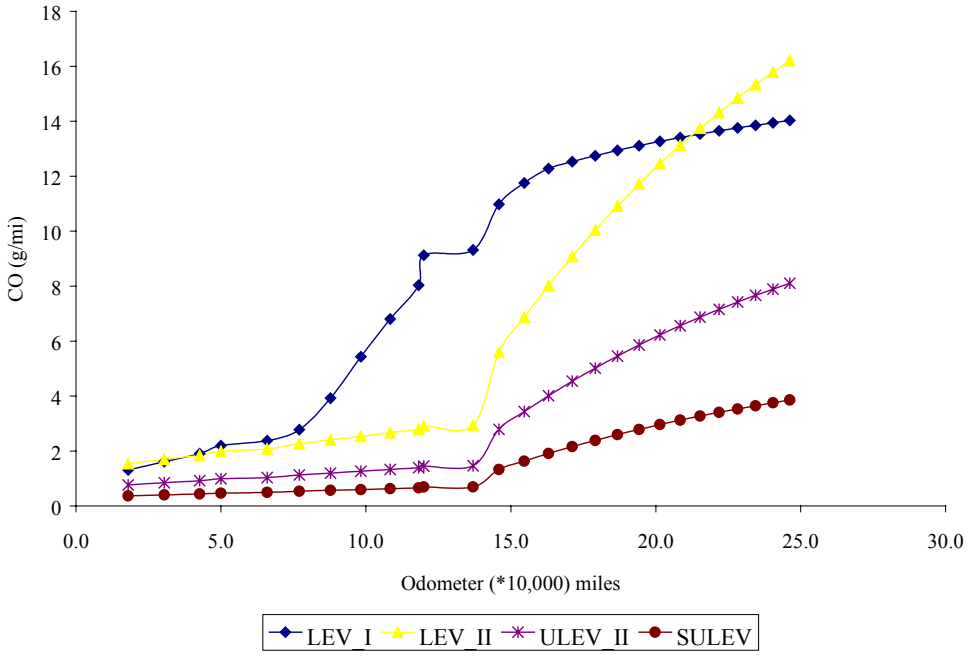
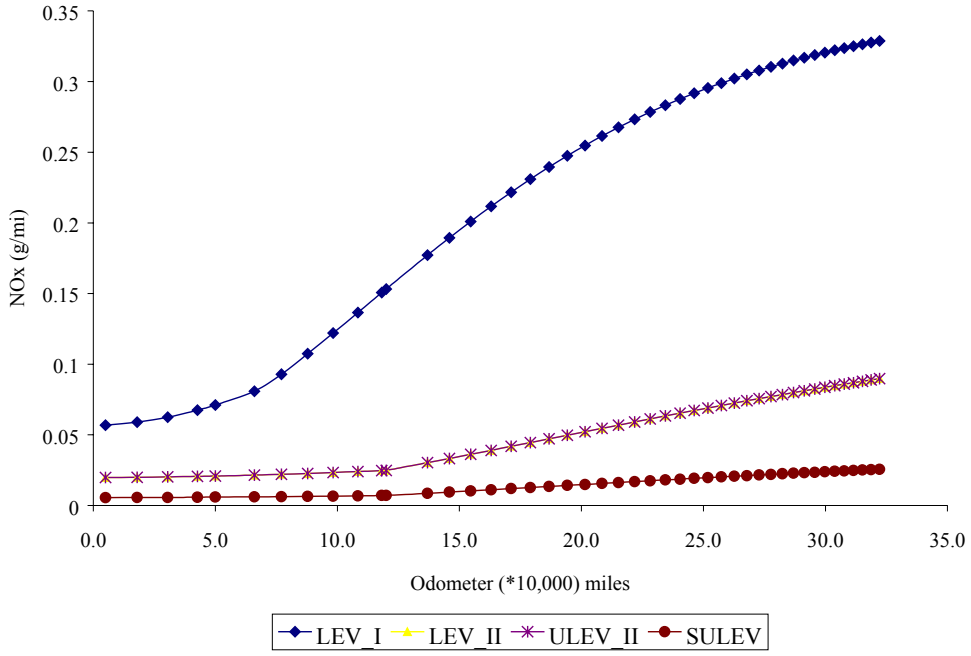


**Figure 4.9-9 Composite FTP NOx Emission Rates Developed Using Method B**




## 4.9.4 Recommendations

Staff recommends that Method A be used in estimating the emission rates for vehicles certified to the LEVII standards. The emission rates generated using Method A will meet the 120K durability standards. However, these rates will have proportionately lower zero mile rates resulting from the ratios of the LEVII/LEVI standards. Method B though elegant produces composite rates that are contrary to engineering judgement. For example it results in LEVII vehicles having higher emission rates, at mileage's above 170K, than LEVI vehicles. This results from the constraints placed on the regime growth rates in order to meet the standards at 120K and maintaining the same zero mile rates as vehicles certified to the same numerical standards.