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OFFICE OF  
AIR AND RADIATION

May 26, 2005

CCD-05-10 (LDV/LDT/MDPV/HDV/ICI/LD-AFC)

Dear Manufacturer:

Subject: Assigned Deterioration Factors

This letter provides revised EPA assigned deterioration factors (ADFs) for determining compliance with chassis-based exhaust and evaporative emission standards. These assigned deterioration factors may be used for small volume manufacturers under the provisions of 40 CFR 86.1826-01, and are applicable for chassis tested vehicles using petroleum based fuels (gasoline and diesel), alcohol fuels (ethanol and methanol) and gaseous fuels (natural gas and liquified petroleum gas). ADFs are provided for current vehicle standards and, because aftermarket alternative fuels converters and Independent Commercial Importers (ICIs) may convert or modify older model year vehicles, ADFs are also listed for previous model year standards. These ADFs must be used by qualifying small volume manufacturers and ICIs who certify new test groups after October 15, 2005. Small volume manufacturers and ICIs may optionally use these ADFs immediately.

### **Applicability**

EPA's regulations at 40 CFR 86.1826-01(a) define the applicability of ADFs.

These revised deterioration factors (DFs) supercede previous assigned deterioration factors presented in EPA Advisory Circular 51C<sup>1</sup>, guidance letters CCD-00-12 dated August 24, 2000 and CD-95-14 dated September 27, 1995, and the ADFs presented in the most recent version of a template letter sent to prospective new small volume manufacturers and Independent Commercial Importers (ICIs).<sup>2</sup>

Guidance letter CCD-00-12 continues to be the appropriate source for determining EPA ADFs for aftermarket conversions of heavy-duty engines for operation on alternative fuels.

The new ADFs do not necessarily apply to vehicles certified to comply with California emission standards. Manufacturers who desire to certify vehicles in California by using ADFs will need to satisfy the current requirements from the California Air Resources Board (CARB). The CARB contact is Duc Nguyen (e-mail: [dnguyen@arb.ca.gov](mailto:dnguyen@arb.ca.gov)).

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<sup>1</sup>The assigned deterioration factors contained in Advisory Circular 51C are still applicable for ICI Tier 0 vehicles.

<sup>2</sup> The assigned exhaust and evaporative emission deterioration factors used by new small volume manufacturers and ICIs are based on California Air Resources Board Manufacturer Advisory Correspondence documents No. 91-04 and 97-01, respectively.

## **Background**

The EPA authority to develop and provide vehicle and engine manufacturers with ADFs is based on Section 206(a)(1) of the Clean Air Act. EPA subsequently enacted regulations which allowed manufacturers to use ADFs. These provisions were described in §86.084-14 and §86.085-24(e)(2), and ADFs were published in Office of Mobile Sources (OMS) Advisory Circular (A/C) letter No. 51C, dated December 4, 1986.<sup>3</sup>

Effective with the Tier 1 emission standards, EPA accepted the use of the deterioration factors contained in the California Air Resources Board (CARB) Manufacturers Advisory Correspondence (MAC) letter No. 91-04. EPA also accepted use of the evaporative emission assigned deterioration factors in CARB MAC letter No. 97-01. These CARB developed ADFs were used in lieu of EPA supplied industry-wide ADFs for Tier 1 exhaust emissions and enhanced (Tier 1) evaporative emission standards. These same ADFs were also used by manufacturers for determining compliance with the NLEV emission standards, and were also used as EPA ADFs to meet interim non-Tier 2 standards and final Tier 2 emission standards.

In the September 21, 1994 Federal Register, EPA published emission standards and test procedures for gaseous fueled vehicles and engines. In a separate rulemaking action on September 30, 1994, EPA published emission standards for Clean-Fuel Vehicles (CFVs) and Engines. These regulations prompted EPA to publish ADFs for the Clean-Fuel Vehicle program in EPA guidance letter CD-95-14 in 1995, and to re-issue this as guidance letter CCD-00-12, in 2000. The ADFs in these guidance letters are identical. The ADFs for gaseous vehicles were not based on data, but instead they were based on an analysis of emission standards values.

The current EPA policy regarding ADFs is found in 40 CFR §86.1826-01(b)(1)(i). This CFR section discusses using a 70<sup>th</sup> percentile analysis of industry-wide data to determine ADFs for manufacturers with sales volumes less than 300 vehicles, while §86.1826-01(b)(2)(i)(A) discusses using either a 70<sup>th</sup> percentile or arithmetic average of a manufacturer's deterioration factor data, whichever is less, to determine ADFs for a manufacturer with sales volumes of 301-14,999 vehicles. In §86.1826-01(b)(1)(ii) and in §86.1826-01(b)(2)(i)(C) the CFR authorizes the use of "alternative methods" to calculate ADFs. It is this flexibility in §86-1826-01 which was exercised in developing the revised EPA ADFs in Tables 1 and 2.

## **Summary**

Small volume manufacturers of light-duty vehicles, light-duty trucks, medium-duty passenger vehicles, and heavy-duty chassis tested vehicles should use the ADFs presented in this letter. Aftermarket alternative fuels converters for these same vehicle classes should use the same ADFs, or alternatively, fuels converters may use OEM DFs as optionally permitted in EPA guidance document CCD-04-20. Aftermarket alternative fuels converters of heavy-duty engines should continue to use EPA guidance document CCD-00-12.

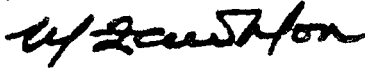
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<sup>3</sup>A/C 51C superceded A/C Nos. 51B and 51-1 and was effective beginning with the 1988 model year.

**Revised ADFs**

Tables 1 and 2 present the new ADFs. Attachment 3 describes the analysis methodology used to develop Tables 1 and 2. Questions concerning the derivation or usage of these factors may be directed to Martin Reineman, 734-214-4430, or [reineman.martin@epa.gov](mailto:reineman.martin@epa.gov)

Sincerely,



Merrylin Zaw-Mon, Director  
Certification and Compliance Division  
Office of Transportation and Air Quality

Attachments: Tables 1 and 2  
Attachment 3

Table 1 to CCD-05-10

**Exhaust Emission ADFs for Gasoline, Methanol, Ethanol, Compressed Natural Gas and Liquefied Petroleum Gas<sup>1</sup> - 50,000 and 120,000 Mile Multiplicative ADFs<sup>2,3</sup>**

Standards	NMOG/ NMHC		CO		NO <sub>x</sub>		HCHO	
	50K	120K	50K	120K	50K	120K	50K	120K
<b>Tier 2</b>	1.14	1.37	1.22	1.62	1.27	1.73	1.63	2.34
<b>NLEV/ Interim non-Tier 2</b>	1.14	1.36	1.32	1.78	1.30	1.90	1.54	2.31
<b>Tier 1</b>	1.09	1.23	1.11	1.27	1.13	1.32	N/A	N/A
<b>HDV</b>	N/A	1.37	N/A	1.62	N/A	1.73	N/A	2.34 <sup>4</sup>

Notes:

- 1) This table does not apply to diesel vehicles. Diesel ADFs will be assigned on a case-by-case basis based on latest industry wide-information.
- 2) Some Tier 1, NLEV, and Interim non-Tier 2 vehicle classes have a useful life of 100K. Use the following equation to convert 120K ADFs to 100K ADFs:

$$100K \text{ ADF} = 1 + (120K \text{ ADF} - 1) * (96K/116K)$$

Where: 100K ADF = The converted 120,000 mile multiplicative ADF  
 120K ADF = The 120,000 mile multiplicative ADF  
 96K, 116K = 96,000 and 116,000 miles, respectively

- 3) Tier 2 standards have an optional useful life of 150K. Use the following equation to convert 120K ADFs to 150K ADFs:

$$150K \text{ ADF} = 1 + (120K \text{ ADF} - 1) * (146K/116K)$$

Where: 150K ADF = The converted 120,000 mile multiplicative ADF  
 120K ADF = The 120,000 mile multiplicative ADF  
 146K, 116K = 146,000 and 116,000 miles, respectively

- 4) HCHO standards apply to HDVs effective with the 2008 MY.

Table 2 to CCD-05-10

**Evaporative Emission ADFs<sup>1,2,3</sup> - 120,000 Mile Additive ADFs<sup>4,5</sup>**

Standards	Vehicle Class	3 Day (High 24D + HS), g	2 Day (High 24D + HS), g <sup>6</sup>	Running Loss, g/mi <sup>7</sup>	ORVR, g/gal <sup>8</sup>
Tier 2 <sup>9</sup>	LDV, LDT1, LDT2	0.04	0.05	0.004	0.022
Tier 1	LDV, LDT1, LDT2	0.29	0.33	0.006	0.041
	LDT3 <sup>10</sup> , LDT4 <sup>10</sup> , HDV, Heavy-as-Light <sup>11</sup>	0.47	0.56	0.005	0.026

Notes:

- 1) This table does not apply to diesel vehicles.
- 2) This table does not apply to alcohol fueled vehicles. ADFs for alcohol fueled vehicles will be assigned on a case-by-case basis based on latest industry wide-information.
- 3) Evaporative emission test waivers may apply to aftermarket fuels conversions to CNG or LPG if approved in advance by EPA. See EPA guidance letter CCD-04-20 dated October 1, 2004.
- 4) Some Tier 1 and Interim non-Tier 2 evaporative emission standards have a useful life of 100K miles. Use the following equation to convert 120K additive ADFs to 100K additive ADFs:

$$100K \text{ ADF} = (120K \text{ ADF}) * (96K/116K)$$

Where: 100K ADF = The converted 120,000 mile additive ADF

120K ADF = The 120,000 mile additive ADF

96K, 116K = 96,000 and 116,000 miles, respectively

- 5) Tier 2 evaporative emission standards have an optional useful life of 150K miles. Use the following equation to convert 120K additive ADFs to 150K additive ADFs:

$$150K \text{ ADF} = (120K \text{ ADF}) * (146K/116K)$$

Where: 150K ADF = The converted 120,000 mile additive ADF

120K ADF = The 120,000 mile additive ADF

146K, 116K = 146,000 and 116,000 miles, respectively

- 6) No 2-day standards for dedicated CNG or dedicated LPG vehicles.
- 7) No running loss standards for dedicated CNG or dedicated LPG vehicles.
- 8) No ORVR standards for dedicated CNG vehicles.
- 9) ADFs for Tier 2 LDT3, LDT4, MDPV, and HDV evaporative standards will be provided after phase-in starts in the 2008 MY.
- 10) ADFs apply to Tier 1 LDT3 and LDT4 vehicles regardless of fuel tank capacity.
- 11) Heavy duty vehicles optionally certified under light-duty provisions.

## Development of Revised EPA Assigned Deterioration Factors

### Data Base

This analysis was based on 2001 - 2005 model year vehicle data contained in EPA's Certification and Fuel Economy Information data base, CFEIS. The certification data include information from passenger cars, light-duty vehicle trucks (LDT1 through LDT4), medium-duty passenger vehicles, and optionally chassis certified heavy-duty vehicles.

### Analysis Approach - General

In addition to needing revised ADFs for the Tier 2 and HDV standards, because ICIs and aftermarket alternative fuels converters may certify older model year vehicles, revised exhaust emission ADFs were also developed for manufacturers certifying to Tier 1 and NLEV standards.<sup>4</sup>

The development of revised ADFs for exhaust emissions were based on a number of compromises which met an objective based on simplicity, applicability and good judgment. To satisfy those objectives the following criteria were developed and employed:

- Simplicity - Provide sets of multiplicative ADFs which can be applied across multiple levels of program specific emission standards.
- Applicability - Develop ADFs for all applicable EPA emission control "program types," i.e. vehicles certified to Tier 1 standards, NLEV standards (includes Clean Fuel Vehicle (CFV) standards), Tier 2 standards, and HDV standards.<sup>5</sup> Provide multiplicative ADFs for petroleum fuels (gasoline and diesel), alcohol fuels (ethanol and methanol), and gaseous fuels (compressed natural gas and liquified petroleum gas) for intermediate and full useful life standards. Provide multiplicative ADFs at a common full useful life, and provide a means to scale them to a longer or shorter full useful life as necessary.<sup>6</sup>
- Good Judgment - Exercise other options than using a 70<sup>th</sup> percentile value, such as

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<sup>4</sup> Tier 1 standards were in effect starting with 1994 model year passenger cars and light trucks under 6000 lbs GVW, and were phased-in for 100% of 1999 model year light trucks with GVW over 6000 lbs. NLEV standards became effective with 1999 model year passenger cars and LDT1s, and were phased-in for 100% of 2001 model year LDT2s.

<sup>5</sup> In this analysis, the CFV program is assumed to be an extension of the NLEV program. The standards are similar for passenger cars, LDT1 and LDT2. The LDT3 and LDT 4 standards in the CFV program were used for determining compliance with Federal standards under the NLEV program, as there are no specific LDT3 and LDT4 standards under the EPA NLEV program.

<sup>6</sup> For EPA emission purposes, Useful Life is defined as 100K miles for passenger cars and light light-duty trucks but 120K miles for the heavy light-duty vehicles under the Tier 1, NLEV, and Clean Fuel Vehicle programs. Useful life is 120K, with an optional useful life of 150K for all classes of vehicles under the Tier 2 program.

calculating an average value, to develop ADFs when sample sizes are very small. The resulting ADFs should not be unrepresentatively high or low relative to the CFEIS deterioration factor (DF) data from all manufacturers.

Multiplicative ADFs were developed because they can be applied across a range of standards for a particular program type with many exhaust emission categories (for example, the 11 bins of the Tier 2 program). Providing additive ADFs has the disadvantage that they should be unique across different emission standards. Providing additive ADFs would yield an undesirable number of ADFs per program type (for example, four sets per pollutant type for Tier 1 vehicles, six sets per pollutant type for NLEV vehicles, 14 sets per pollutant type for Clean Fuel Vehicles, 11 sets per pollutant for Tier 2 vehicles, and two sets per pollutant for Heavy-Duty Vehicles, for a total of 37 ADFs for a particular exhaust pollutant). Such a large set of ADFs was judged to be too complex, and stratifying the DF data into so many unique groups would result in sample sizes too small to provide either representative 70<sup>th</sup> percentiles or averages.

Providing a reduced number of multiplicative ADFs does not imply that the technology across a particular set of emission standards is the same. For example, the technology to achieve Bin 2 standards vs. Bin 10 standards under the Tier 2 program may be considerably different, but using multiplicative ADFs assumes the rate of deterioration across the Tier 2 program type is the same. The same reasoning holds for the other EPA program types: Tier 1, NLEV, and HDV where there are multiple sets of standards. By using multiplicative ADFs, a much reduced number of exhaust emission ADFs may be applied across different levels of standards. This is the approach taken in Table 1, where ADFs are presented on a program specific basis.

The methodology used to analyze and develop evaporative emission ADFs is similar to that described above with the exception that because the vast majority of manufacturer submitted evaporative emission DFs are additive, only additive DFs were analyzed. Instead of the four program types described above for exhaust emissions, there are two evaporative emission program types - the Enhanced Evaporative Emission Standards (Tier 1), which has four unique sets of standards, and the Tier 2 Evaporative Emission Standards, also containing four unique sets of standards when heavy duty vehicles are included. Because an additive ADF cannot be applied across different standards, Table 2 provides unique additive ADFs across the different evaporative emission standard levels.

### **Exhaust Emission Analysis Approach**

A query was constructed to extract the DF data from of the Oracle based EPA CFEIS data system. The CFR requires an analysis using unique DFs.<sup>7</sup> Data fields in the CFEIS relational data base which were used to conduct this analysis included the following:

Model Year - Identifies the model year of interest, or 2001 - 2005 model year data for this

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<sup>7</sup> Unique DFs are associated with a "durability group," a basic classification used for grouping vehicles.

analysis

Manufacturer - Identifies specific LDV, LDT, MDPV, or HDV vehicle manufacturers through unique manufacturer codes

Sales Area - Represents different standards (program types), such as Federal vs. California

Vehicle Class Code - Distinguishes passenger cars from four categories of light trucks. Differences in class vehicle codes also identify different emission standards.

DF Type Code - Distinguishes type of aging process used in a manufacturer's durability demonstration

Fuel Type - Identifies the fuels which were analyzed, which include gasoline, diesel, ethanol, and CNG

Individual test groups within a durability group were analyzed to extract the following data fields:

Emission Name - Identifies the exhaust or evaporative emission pollutants of interest

Useful Life - 50K or 120K miles (or 100K or 150K), specific to the standard and pollutant of interest

Result - The low mileage (4K) test result

Additive DF - The quantity in g/mi (exhaust) or g (evap) added to the low mileage test result to show the effect of deterioration, if any, at 50K or 120K miles<sup>8</sup>

Multiplicative DF - Dimensionless multiplier applied to the low mileage test result to show the effect of deterioration, if any, at 50K or 120K miles<sup>9</sup>

Certification Level - The emission result after either (but not both) the additive DF or the multiplicative DF is applied to the low mileage test result and compared to the appropriate standards.

Emission Standard - Standards in g/mi (exhaust) or g (evap) at 50K or 120K miles

Tier - The specific emission program (or standard) of interest, for example, T1 (Tier 1), LEV (NLEV), B5 (Tier 2, Bin 5), or HDV

The query results were sorted using the relational and filtering capabilities of Microsoft Access and reduced using the statistical analysis capabilities of Microsoft Excel. The exhaust emission query results were filtered for:

Usable DFs - Unusable entries included DFs representing durability demonstrations using aged components, which by definition, cannot be used for developing quantitative

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<sup>8</sup> By definition, an additive emission DF equals the useful life emission value minus the 4K emission result.

<sup>9</sup> By definition, a multiplicative DF is the ratio of emissions at 50K or 120K miles divided by the emissions at low mileage, nominally 4K miles.



ADFs.<sup>10</sup>

DF Type Code/DF Type - The records filtered out in this step included DF Types described as: Aged Components, EPA ADFs, and MFR ADFs.

Vehicle Class Code - This code was used for obtaining DFs from the vehicles of interest, which included passenger cars, light trucks of the categories LDT1 - LDT4, medium-duty passenger vehicles, and optionally chassis certified heavy-duty vehicles.

Vehicle Manufacturer - The DF data from 23 large volume vehicle manufacturers were selected for analysis.

Emission Name - This step filtered for the pollutants of interest. They included: HC-NM (non-methane hydrocarbon), OMHCE (alcohol fuel organic material hydrocarbon equivalent), OMNMHCE (alcohol fuel organic material non-methane hydrocarbon equivalent), NMOG (non-methane organic gas), HCHO (formaldehyde), CO (carbon monoxide), NOx (nitrogen oxides), and PM (particulate matter). OMHCE and OMNMHCE DFs are associated with emission tests on ethanol flex-fueled vehicles and their sample sizes after all screening criteria were applied were extremely small.

OMHCE, OMNMHCE, and HC-NM data were combined to calculate "NMOG" DFs.

Sales Area - The data were filtered to exclude vehicles sold in California due to their unique program requirements and standards.

Duplicate Records - §86.1826-01(a)(2)(ii)(A) requires unique records be used for developing ADFs. This filtering step removed duplicate DF values which occur because, by definition, multiple test groups may use the DFs developed for a unique durability group.

EPA emission standards for Tier 1 and NLEV programs have useful life standards for some vehicle classes of 100K miles, while the Tier 2 program have optional useful life standards of 150K miles. To avoid presenting multiple tables of ADFs based on various useful lives, the analysis converted 100K and 150K multiplicative DFs (MultDFs) to 120K MultDFs. The objective was to create a larger sample size for developing 120K ADFs while avoiding inaccurate results from analyzing small samples of DFs at 100K or 150K miles. The resulting 120K ADFs developed from 70<sup>th</sup> percentiles were then scaled by applying adjustment factors that yielded 100K and 150K ADFs.

The conversion of 100K MultDFs to 120K MultDFs assumes a linear deterioration rate from 4K to 120K miles, and uses the known emission results at 4K and 100K miles. Knowing the slope of the line relating emission level vs. mileage, one can calculate an assumed value for emissions at 120K miles. Using the definition of a MultDF as 120K emission value divided by 4K emission value, the equation for converting a 100K MultDF to a 120K MultDF becomes:

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<sup>10</sup> In the CFEIS data system, manufacturers that used aged components in lieu of submitting additive or multiplicative DFs, often coded the entries differently. For example, manufacturers selecting this durability option sometimes submitted multiplicative DFs of 1 and an additive DF of 0.0, others simply left the multiplicative and additive DF fields blank, others have combinations of multiplicative DFs of 1, additive DFs or 0.0, and blank entries.

$$\text{Eq 1: } 120\text{K MultDF} = 1 + (100\text{K MultDF} - 1) * (116\text{K}/96\text{K})^{11}$$

Where: 120K MultDF = The converted 100,000 mile multiplicative DF

100K MultDF = The 100,000 mile multiplicative DF from the CFEIS data base

116K, 96K = 116,000 and 96,000 miles, respectively

Similar to equation 1, the equation for converting 150K MultDFs to 120K MultDFs is:

$$\text{Eq 2: } 120\text{K MultDF} = 1 + (150\text{K MultDF} - 1) * (116\text{K}/146\text{K})$$

Given the substantial number of additive DFs in the data base, the initial analysis approach created “equivalent” multiplicative DFs from the additive DFs using the low mileage test result (Result) and the 50K or 120K result (Certification Level). The objective was to be able to use the additive DFs in order to develop a larger sample size to find the 70<sup>th</sup> percentile values. An equivalent multiplicative DF was calculated by dividing individual CFEIS Certification Level values by the corresponding CFEIS Result values. The resulting equivalent multiplicative DFs were then combined with manufacturer reported multiplicative DFs in the CFEIS data base (the actual multiplicative DFs) and the combined values ranked from lowest to highest DF, with the 70<sup>th</sup> percentile value selected as a new ADF.

Unfortunately, the viability of using additive DFs converted to equivalent multiplicative DFs breaks down when the 4K test result is very low. The resulting multiplicative DF becomes very large, which is why manufacturers were given the option of using additive DFs in lieu of multiplicative DFs. Various options were considered in order to include “reasonable” converted additive DFs in the analysis. These options included: 1) using converted DFs capped at selected subjective levels (for example those below 3.0); 2) capping the converted DFs at the maximum value of the actual multiplicative DFs; and 3) calculating an average DF based on using the actual multiplicative DFs together with the converted additive DFs. None of these options were determined to be satisfactory due to their arbitrary nature in the case of the first two options, or the unrepresentatively high ADFs resulting from using the third option.

By process of elimination, the approach selected was to analyze only the actual multiplicative DFs and ignore the additive DFs. This solution was deemed acceptable as long as there were sufficient data for a particular combination of emission control program, pollutant, and fuel type. This is the analysis approach used for developing the gasoline fueled vehicle ADFs in Table 1.

Because the ADFs in Table 1 are based on 120K multiplicative DFs, manufacturers who wish to use the multiplicative ADFs in Table 1 for vehicle classes with full useful life of 100K miles may use the following equation:

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<sup>11</sup> This equation assumes the low mileage test is conducted at 4K miles. In actuality, the 4K test is conducted at a mileage not exactly equal to 4K miles.

$$\text{Eq 3: } 100\text{K ADF} = 1 + (120\text{K ADF} - 1) * (96\text{K}/116\text{K})$$

Similarly, the following equation allows a manufacturer to use Table 1 to calculate an exhaust ADF appropriate for a useful life of 150K miles:

$$\text{Eq 4: } 150\text{K ADF} = 1 + (120\text{K ADF} - 1) * (146\text{K}/116\text{K})$$

### **Evaporative Emission Analysis Approach**

The analysis of evaporative emission data required an analysis of additive DFs, but the general approach to developing the evaporative emissions ADFs was similar to the methodology used in the development of the exhaust emission ADFs. Specifically, the same 2001 - 2005 MY CFEIS data source was used, the same 23 largest manufacturers, the same vehicle classes (LDV, LDT1-4, MDPVs, HDVs), the same sales area (no California data), and duplicate DFs were excluded. For sample sizes of 10 or less the additive ADF was calculated using the average of the DFs. This occurred only once during the analysis of the Tier 2 running loss data.

Similar to exhaust emission DFs, evaporative emission DFs are based on full useful life mileage. To account for differences in mileage, an assumption of linear deterioration was used to convert 100K DFs to 120K DFs. Due to the difference in definition of additive DF (AddDF) vs. multiplicative DF, the equation used to convert 100K additive DFs to 120K additive DFs becomes the following:

$$\text{Eq 5: } 120\text{K AddDF} = (100\text{K AddDF}) * (116\text{K}/96\text{K})$$

Where: 120K AddDF = The converted 100,000 mile additive DF  
100K AddDF = The 100,000 mile additive DF from the CFEIS data base  
116K, 96K = 116,000 and 96,000 miles, respectively

Similarly, any 150K additive DFs were converted to 120K additive DFs using the equation:

$$\text{Eq 6: } 120\text{K AddDF} = (150\text{K AddDF}) * (116\text{K}/146\text{K})$$

Because the ADFs in Table 2 are based on additive DFs, manufacturers may use the following equation to convert 120K evaporative emission ADFs to 100K ADFs:

$$\text{Eq. 7: } 100\text{K ADF} = (120\text{K ADF}) * (96\text{K}/116\text{K})$$

Similarly, manufacturers may use the following equation to convert 120K evaporative emission ADFs to 150K ADFs:

$$\text{Eq. 8: } 150\text{K ADF} = (120\text{K ADF}) * (146\text{K}/116\text{K})$$

### **Discussion of Tables 1 and 2**

Table 1 - Table 1 presents multiplicative ADFs at 50K and 120K miles for four exhaust emission types (NMOG/NMHC, CO, NOx, HCHO) as a function of program type, or standards.

The results presented in Table 1 are based on a ranking of multiplicative DFs from lowest to highest and then selecting the 70<sup>th</sup> percentile value. The sample sizes used in developing the values in Table 1 varied from 30 unique DF values for Tier 1 vehicles, to 110 values for NLEV vehicles, to 85 values for Tier 2 vehicles. Owing to the very small sample sizes for fuel types other than gasoline, the ethanol, methanol, CNG, and LPG fuel types will use the DFs derived from analysis of gasoline DFs. This is based on the conservative assumption that multiplicative ADFs for vehicles fueled on other fuel types should be no worse than the DFs for vehicles operating on gasoline.

An exception is diesel vehicles where it may be unreasonable to use gasoline ADFs as a surrogate for diesel ADFs. EPA will address manufacturers' needs for diesel ADFs on a case-by-case basis using knowledge of the vehicle control system and current industry wide data to assign representative ADFs.

Inadequate sample sizes prevent use of a statistical approach to determine representative DFs from heavy-duty vehicles. Until more data are available and a revised set of ADFs are published, EPA will permit manufacturers to use the Tier 2 ADFs in Table 1 in absence of HDV ADFs based on actual data.

Table 2 - Table 2 presents evaporative emission ADFs for three types of evaporative emission tests (3 Day, 2 Day, Running Loss), and the onboard refueling vapor recovery test (ORVR). The ADFs are presented as a function of vehicle class. The Tier 1 sample sizes from which the 70<sup>th</sup> percentile values were selected varied from a high of 165 3 Day DFs to a low of 85 running loss DFs. Tier 2 sample sizes ranged from a high of 46 ORVR DFs to a low of 2 running loss DFs.