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NATIONAL VEHICLE AND FUEL EMISSIONS LABORATORY
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OFFICE OF
AIR AND RADIATION

January 30, 2023

CD-2023-01 (LDV/LDT/ICI/LIMO/HD 2b/3)

SUBJECT: Tier 3 Assigned Deterioration Factors

Dear Manufacturer:

The purpose of this letter is to provide updated EPA assigned deterioration factors (ADFs) for determining compliance with certain chassis-based exhaust, evaporative, and GHG emission standards. These revised ADFs apply to vehicles that are required to meet a Tier 3 light-duty (LD) or heavy-duty (HD) chassis-based standard. The ADFs are presented in Tables 1-3 attached to this letter. The values displayed in this guidance letter supersede the ADFs in EPA guidance CD-12-07 for Tier 2 vehicles and are effective immediately.

Applicability

The new ADFs must be used by original equipment manufacturers (OEMs) electing to use EPA ADFs for demonstrating compliance under Tier 3 LD and HD chassis certified emission standards. Utilization of ADFs is contingent on OEMs qualifying under the small volume manufacturer and small volume test group provisions of 40 CFR § 86.1826-01 as provided in 40 CFR paragraphs 86.1838-01(b)(1) and 86.1838-01(b)(2).

Qualifying small volume alternative fuel converters and independent commercial importers (ICIs) also use ADFs to demonstrate compliance with emission standards. Fuel converters modify previously certified OEM products and demonstrate compliance with emission standards under EPA regulations in 40 CFR Part 85 subpart F. ICIs bring previously uncertified vehicles into compliance with applicable EPA standards. Thus, both alternative fuel converters and ICIs that have need for ADFs must follow the guidance provided in this letter.

Given that OEM deterioration factors from model years (MY) 2014-2018 from EPA's EV-CIS databased were used for the exhaust analysis, the exhaust emission ADFs apply to only MY14 and newer vehicles that are required to meet Tier 3 emission standards. Similarly, the new evaporative ADFs were developed using data from 2022 MY Tier 3 vehicles. Therefore, these new evaporative ADFs apply to newer vehicles that are required to meet Tier 3 emission standards. For vehicles that are required to meet different standards, please consult with your certification engineer.

Authority

EPA is issuing these new ADFs under the regulatory authority in CFR § 86.1826-01, in particular the authority for the Agency to assign deterioration factors, and to periodically update and publish these in a guidance document or advisory circular. The objective is to provide representative ADFs for all applicable vehicles.

Methodology

A recent assessment of the ADFs contained in EPA guidance letter CD-12-07 contains rationale that additive DFs were more representative than multiplicative DFs of OEM vehicles for Tier 2 standards and this explanation will be upheld for Tier 3 ADFs. A large majority of OEMs have exclusively used additive DFs since the beginning of emission compliance under Tier 3 standards.

Exhaust ADFs

The ADFs in Tables 1 and 2 are based on an analysis that ranked certification OEM additive DFs from lowest to highest, then found the 70th percentile value as contemplated under §86.1826(b)(1)(i). In order to overcome the problem of insufficient gasoline OEM DFs for Tier 3 LD BINs 20, 50 and 160, it was determined that a linear fit to the significant ADF values was reasonable. EPA vehicle certification regulations are structured such that the DFs associated with a durability group may be used across a number of test groups. Prior to finding the 70th percentile values, duplicate data was removed for combinations of test group and durability group over multiple model years.

The OEM data used for developing the new exhaust ADFs was derived from the EPA EV-CIS database. Records from MY 2014-2018 were used for analysis of OEM exhaust and GHG emission DFs. These model years represent phased in Tier 3 LD and HD chassis certified vehicles. Only test groups that adhere to Tier 3 or LEV-III emissions standards were evaluated. Analyzing OEM additive DFs provided a more robust sample size compared to the population of OEM multiplicative DFs.

Evaporative ADFs

The Compliance Division (CD) of EPA's Office of Transportation Air Quality (OTAQ), contacted nearly all large manufacturers of light-duty and heavy-duty chassis certified vehicles. We asked the various manufacturers to provide the original evaporative DFs used for each family for the 2022 model year. We asked for only one model year of data to ensure that we did not "double count" any data sets because they were used in multiple years. This data was limited to actual DF test data, and each set of DFs was only counted once in the list. It is important to note that evaporative DF data is very often carried over to other evaporative families. These other evaporative families may have different evaporative standards, and they may contain vehicles from different weight classes than those of the data vehicle. This is allowed by the regulations. This "overlap" of data resulted in similarities in the data even when the data was combined by certain features such as weight class. Furthermore, because Tier 3 evaporative emission

standards are very low, the DFs for vehicles that meet Tier 3 evaporative emission standards are necessarily quite low. For example, the EPA looked at many ways to categorize DFs for each evaporative test. The highest assigned DF for any test with any categorization the EPA looked at was 9.6mg (0.0096 g/test). So, the worst-case an assigned DF could be from our data set was about 3.2% of the fleet average FEL for an LDV/LDT1 vehicle.

After looking at different ways to combine the data to come up with representative and fair assigned DFs, we decided to calculate assigned DFs for the following categories:

1. Assigned DF for vehicles with Non-Integrated Refueling Canister-Only System (NIRCOS evap systems)
2. Assigned DF for vehicles with 2-day/3-day diurnal test FELs of below 0.325g/test
3. Assigned DF for vehicles with 2-day/3-day diurnal test FELs of 0.325g/test or above

We split NIRCOS vehicles into their own category because the only fuel system degradation with respect to diurnal testing in a NIRCOS system is a change in permeation of the materials. Integrated systems have two deterioration paths with respect to diurnal testing, permeation of the materials, and degradation of the canister media.

We split the integrated evaporative emission systems into two categories, a lower FEL group and a higher FEL group. The data suggests that overall vehicles with low diurnal FELs have higher DFs than those of vehicles with high diurnal FELs. We believe this has to do with the vehicle “background” emissions, or the hydrocarbon emissions from the vehicle that are not associated with fuel evaporation or permeation. Vehicle background emissions are expected to be highest when the vehicle is green and decrease with time. Conversely, we expect that fuel system hydrocarbon emissions will be lowest when the vehicle is green and increase with time. On a vehicle with high background emissions (typically a vehicle that contains more plastic and rubber than an ‘average’ vehicle), the results of a DF test would often produce a DF of zero, as the relatively high vehicle background emissions would dissipate, and the lower fuel evaporative emissions would not rise as much. On a vehicle with low background emissions, the effects of evaporative system would be relatively larger due to the low level of the background emissions, thus making the DF more likely to be non-zero. This was discussed in the preamble to the Tier 3 rule on pp. 23493 and 23494 of the Federal Register announcement.¹

Alternate Fuel Vehicles and ICI’s

Based on the lack of sufficient OEM additive DFs samples for alternative fuels, no unique ADFs were determined for these vehicles. However, based on knowledge of exhaust temperature development data at the catalyst inlet, it is reasonable to conclude that, in general, OEM DFs developed on gasoline would represent a worst-case DF relative to DFs developed using CNG, LNG, LPG and ethanol fuel types. As a result, OEMs, fuel converters and ICIs wishing to use

¹ Control of Air Pollution From Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Standards, 79 Fed. Reg. 23493 (April 28, 2014) (to be codified at 40 C.F.R. pts. 79, 80, 85, 86, 600, 1036, 1037, 1039, 1042, 1048, 1054, 1065 and 1066).

ADFs on vehicles that will use those alternative fuels listed above, may use the OEM exhaust, evaporative and GHG DFs with EPA approval.

OEMs, fuel converters, and ICIs that desire to use an EPA ADF for new fuel types and advanced vehicle and emissions control technologies must contact EPA for guidance. If you have any questions, please contact your certification engineer.

Sincerely,

A handwritten signature in black ink, appearing to read "Byron Bunker". The signature is fluid and cursive, with a long horizontal stroke at the end.

Byron Bunker, Director
Compliance Division
Office of Transportation and Air Quality

Tables 1 and 2
Criteria Pollutant Assigned DF's and CHC Assigned DF's

Criteria Pollutant Assigned DFs							
Tier 3 BIN	Useful Life	CO (g/mile)	HCHO (g/mile)	NMOG (g/mile)	NOx (g/mile)	NMOG+NOx (g/mile)*	PM (g/mile)
0	150,000 miles	0.00	0.0000	0.0000	0.0000	0.0000	0.0000
20	150,000 miles	0.06	0.0001	0.0025	0.0019	0.0043	0.0000
30	150,000 miles	0.11	0.0001	0.0034	0.0024	0.0058	0.0000
50	150,000 miles	0.16	0.0002	0.0062	0.0047	0.0109	0.0000
70	150,000 miles	0.24	0.0003	0.0098	0.0070	0.0168	0.0000
125	150,000 miles	0.38	0.0005	0.0149	0.0115	0.0264	0.0000
160	150,000 miles	0.50	0.0006	0.0198	0.0149	0.0347	0.0000

GHG Assigned DFs			
Tier 3 BIN	Useful Life	N2O (g/mile)	CH4 (g/mile)
0	120,000 miles	0.0000	0.0000
20	120,000 miles	0.0004	0.0010
30	120,000 miles	0.0007	0.0020
50	120,000 miles	0.0011	0.0026
70	120,000 miles	0.0012	0.0027
125	120,000 miles	0.0028	0.0069
160	120,000 miles	0.0034	0.0083

Table 3
Assigned Evaporative DF's

	Hot Soak + 2-day Diurnal DF	Hot Soak + 3-day Diurnal DF	Running Loss DF	ORVR DF
NIRCOS All FEL	0.0030	0.0067	0.000	0.005
Integrated system with FEL lower than 0.325	0.0000	0.0021	0.000	0.006
0.325 FEL or higher, integrated system	0.0000	0.0000	0.000	0.006