UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL VEHICLE AND FUEL EMISSIONS LABORATORY
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OFFICE OF
AIR AND RADIATION

June 22, 2015

CD-15-15 (LDV/LDT/ICI/LIMO)

SUBJECT: Derived 5-cycle Coefficients for 2017 and Later Model Years

Dear Manufacturer:

This guidance updates the slopes and intercepts for the "derived 5-cycle" calculation methodology in 40 CFR Part 600.

Under the regulations, EPA "will periodically update the slopes and intercepts through guidance and will determine the model year that the new coefficients must take effect" and "will issue guidance no later than six months prior to the earliest starting date of the effective model year." The coefficients listed in the regulation must be used "unless and until superseded by written guidance." See 40 CFR 600.210-12(a)(2)(iii)-(iv).

New Coefficients

The table below shows the new coefficients that manufacturers must use for 2017 and later model year vehicles. For comparison, the coefficients applicable to model years prior to 2017 are also shown. Enclosure 1 describes the methodology and the data used to determine the new coefficients.

	Existing Coefficients (for 2008-2016 model years)	**New Coefficients (for 2017 and later model years)**
City Intercept	0.003259	**0.004091**
City Slope	1.1805	**1.1601**
Highway Intercept	0.001376	**0.003191**
Highway Slope	1.3466	**1.2945**

These new coefficients supersede the coefficients in 600.210-12(a)(2)(iii), and must be used wherever referenced in 40 CFR Part 600, including sections 600.115-11 and 600.210-12, whether applicable to fuel economy or CO_2 values for labeling.

Model Year Applicability

The new coefficients are applicable starting with the 2017 model year. They may optionally be used for 2016 model year vehicles.

Carry-over Vehicles

It is possible that a vehicle test group that previously met the criteria described in 40 CFR 600.115-11 using the 2008-2016 coefficients could fail to meet those criteria using the new coefficients. For test groups where these criteria were evaluated and met using pre-2017 coefficients and test data, and where the pre-2017 test results used for this evaluation are being carried over into the 2017 or later model years, a reevaluation of the criteria in 40 CFR 600.115-11 is not required, and the prior evaluation of those criteria may also be carried forward. In these cases, EPA will allow the continued use of the derived 5-cycle method for determining label values, as long as all the test results supporting the original determination remain unchanged. However, in using the derived 5-cycle method, the new coefficients specified for the 2017 and later model years shall be used to determine label values.

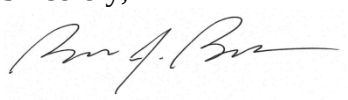
As provided in 40 CFR 600.210-12(a), however, manufacturers may choose to use the vehicle-specific 5-cycle method, even if the test group covering the model type met the criteria in 40 CFR 600.115-11.

Use of 0.7 Factor Described in 40 CFR 600.115-11

The introductory text of 40 CFR 600.115-11 states that manufacturers may alternatively use a factor of 0.7 in lieu of applying the derived 5-cycle equations. However, 0.7 is based on, and a direct mathematical result of, the pre-2017 slopes and intercepts and the now-outdated data that were used to develop those values, and its use should be discontinued for new gasoline and diesel vehicles. The new data used to generate the new slopes and intercepts is far more representative of today's new gasoline and diesel vehicles, and the resulting slopes and intercepts (and the statistical strength of those coefficients) demonstrate that 0.7 is an inappropriate value to apply to new gasoline and diesel vehicles, in lieu of the derived 5-cycle equations. Use of the 0.7 factor would likely result in misleading label values for new gasoline and diesel vehicles. Thus, for the 2017 and later gasoline and diesel vehicles, it would not be appropriate to use the 0.7 factor. Rather than using the 0.7 factor, manufacturers should use either the derived 5-cycle equations with the new slope and intercept values or the vehicle-specific 5-cycle method. Because the updated data and regression equations do not inform EPA any further regarding advanced technology vehicles, the use of the 0.7 factor remains appropriate for certain vehicles and may continue to be used for electric vehicles, plug-in hybrid electric vehicles (charge-depleting operation only, based on an evaluation of cycle-by-cycle fuel efficiency), and other advanced technology vehicles, such as fuel cell vehicles.

If you have any questions about these instructions, please contact your certification team representative.

Sincerely,



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

Enclosure

Enclosure to CD-15-15

Description of Data and Methodology for Determining Derived 5-Cycle Coefficients

1. The Data

The data is from EPA's database of test results and is comprised of the official data used to perform the "litmus test" to determine whether or not the models covered by a given test group are eligible for using the derived 5-cycle method or whether they must perform complete 5-cycle testing. The data contains 847 unique sets of fuel economy test results from 2011 to 2016 model year vehicles.

Note that the data used to determine the original derived 5-cycle coefficients had a number of necessary technical limitations, none of which exist in the current dataset:

1. Complete bag data was not always available, requiring estimates of bag values for some vehicles;
2. The heater/defroster impact on the cold FTP had to be estimated because no test results were available that included that impact; and
3. The US06 city and highway values had to be estimated because no tests were available with separate US06 city and highway phases.

Further, the original dataset contained a limited number of vehicles with very high fuel economy (very low fuel consumption), lending some uncertainty to the prediction of 5-cycle values for vehicles with low fuel consumption. In contrast, the current dataset has the advantage of having more vehicles with low fuel consumption and better reflecting the technologies expected in the model year 2017 and later fleet.

2. The Analysis

The analysis is a simple regression analysis, done separately for city and highway, to determine the best-fit relationship between "2-cycle" fuel consumption and 5-cycle fuel consumption. The regressions are performed on fuel consumption values, and the resulting regression equations are translated into fuel economy terms for the purpose of determining label values. The resulting equations are as follows:

5-Cycle City MPG = 1/ (0.004091 + 1.1601/FTP MPG)

5-Cycle Highway MPG = 1/ (0.003191 + 1.2945/HFET MPG)

All measures of statistical accuracy are improved relative to the analysis conducted in 2006. The confidence intervals around the slopes and intercepts are extremely tight, reflecting a high degree of precision. Further, a Z-test of the new slope and intercept values indicates with a high level of probability (>99%) that the new values are in fact different from the old values. The complete regression results are shown in the tables below.

SUMMARY OUTPUT - CITY

Regression Statistics	
Multiple R	0.996079
R Square	0.9921734
Adjusted R Square	0.9921641
Standard Error	0.0013294
Observations	847

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.189314987	0.189315	107119.9	0
Residual	845	0.001493384	1.77E-06		
Total	846	0.190808371			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.0040914	0.000161688	25.30414	1.3E-105	0.003774007	0.004408719	0.003774007	0.004408719
CITYFC_2C	1.1600886	0.003544508	327.2918	0	1.153131479	1.167045626	1.153131479	1.167045626

SUMMARY OUTPUT - HIGHWAY

Regression Statistics	
Multiple R	0.979161332
R Square	0.958756915
Adjusted R Square	0.958708107
Standard Error	0.001940192
Observations	847

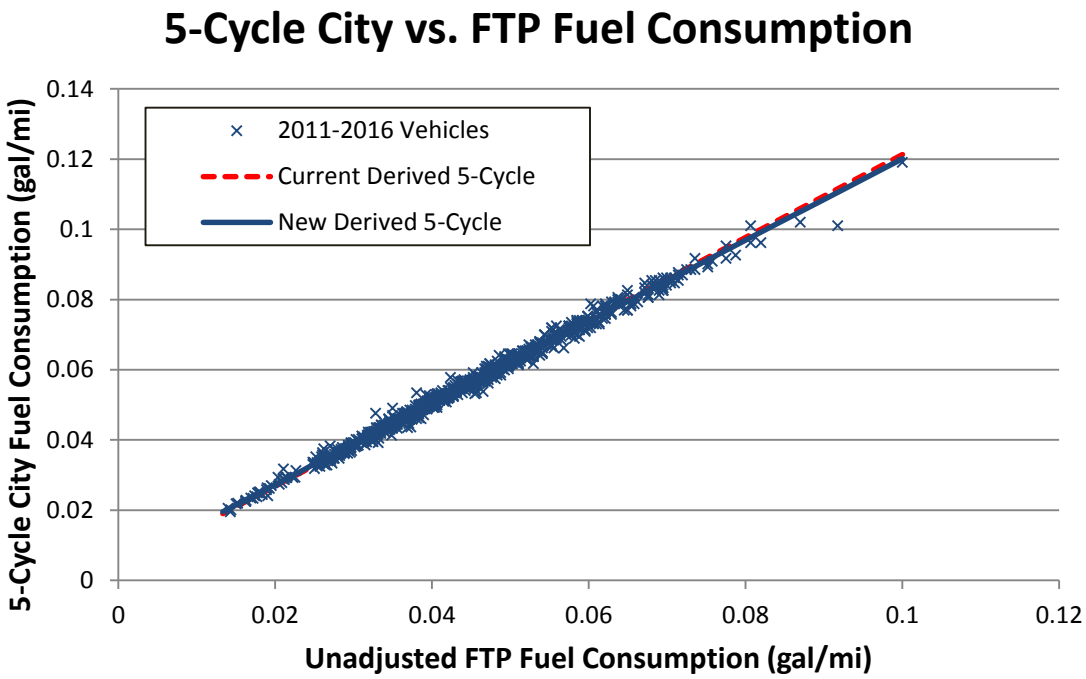
ANOVA

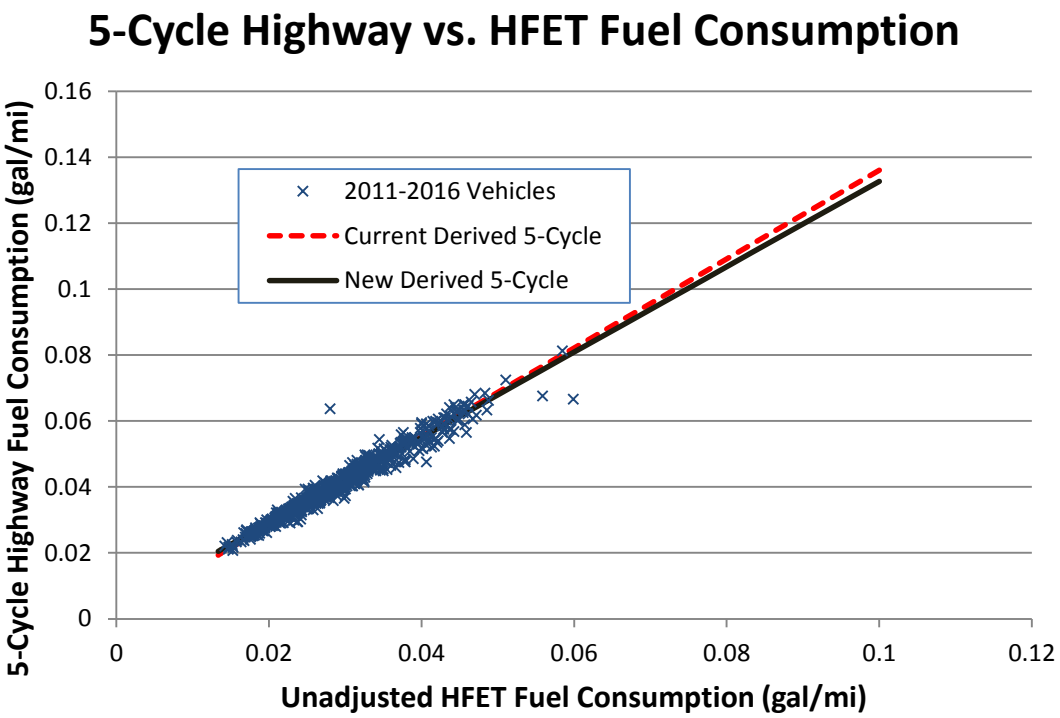
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.07394409	0.07394409	19643.283	0
Residual	845	0.00318087	3.7643E-06		
Total	846	0.07712496			

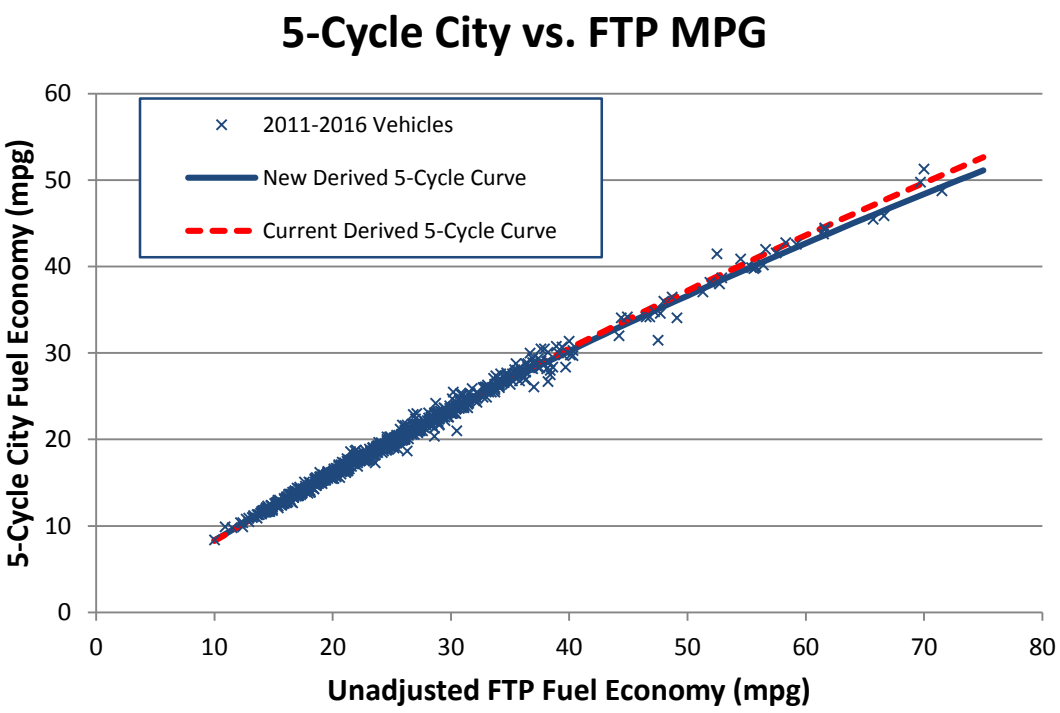
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.003191445	0.00027188	11.7384936	1.3925E-29	0.00265781	0.00372508	0.00265781	0.00372508
HWYFC_2C	1.294543688	0.00923655	140.154497	0	1.27641442	1.31267296	1.27641442	1.31267296

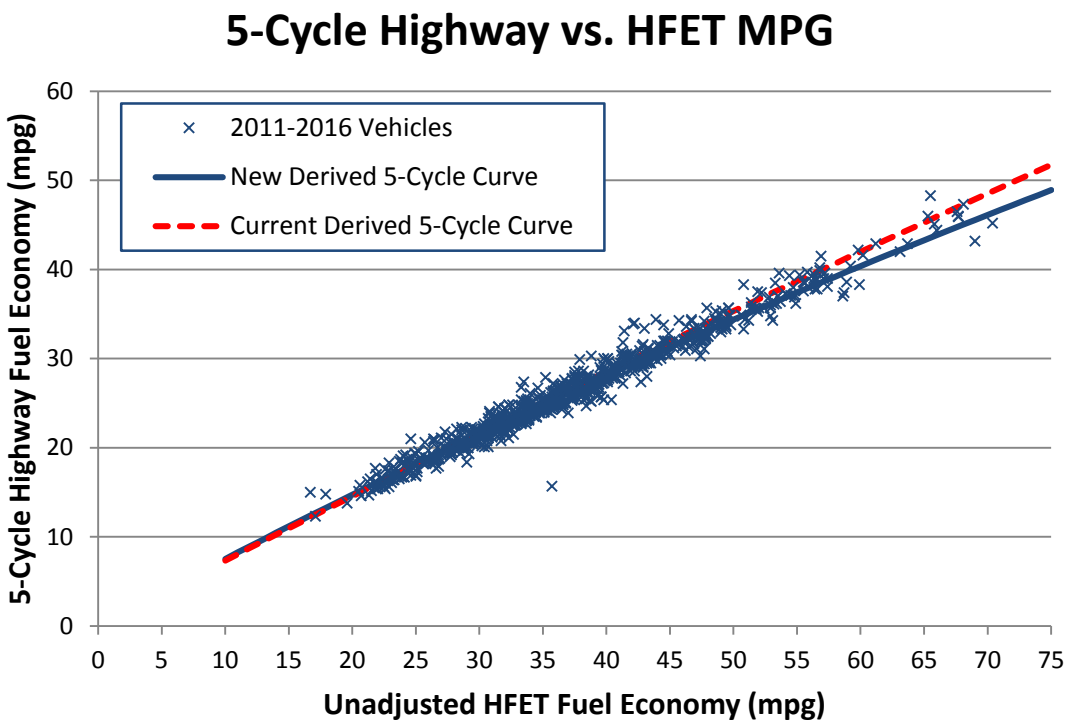
3. The Results

In fuel consumption terms, the new regression line tilts relative to the previous analysis. Most label values are likely to be unaffected except those with higher MPG values, where the difference is most pronounced. Some high MPG vehicles may see a decrease in label values if they continue to use the derived 5-cycle values, but of course the actual impact will depend upon the results achieved with complete 5-cycle testing and whether a manufacturer opts for derived 5-cycle methods for determining label values. The difference relative to the previous equation is more pronounced for the highway derived 5-cycle value. Some low MPG vehicles may actually see an increase in label values, but the difference relative to current values is so small and subtle that any change would simply be the result of changes due to rounding of MPG values. The following figures illustrate the new versus old equations, both in terms of fuel consumption and MPG. Further, as a result of the equations providing a better fit with current vehicles, we expect a decrease in the volume of failures of the "litmus test" with a corresponding increase in the number of vehicles eligible to use the derived 5-cycle values.




5-Cycle Highway vs. HFET Fuel Consumption
5-Cycle Highway Fuel Consumption (gal/mi)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
2011-2016 Vehicles
Current Derived 5-Cycle
New Derived 5-Cycle
0
0.02
0.04
0.06
0.08
0.1
0.12
Unadjusted HFET Fuel Consumption (gal/mi)


5-Cycle City vs. FTP MPG
5-Cycle City Fuel Economy (mpg)
60
50
40
30
20
10
0
2011-2016 Vehicles
New Derived 5-Cycle Curve
Current Derived 5-Cycle Curve
0
10
20
30
40
50
60
70
80
Unadjusted FTP Fuel Economy (mpg)


5-Cycle Highway vs. HFET MPG
2011-2016 Vehicles
New Derived 5-Cycle Curve
Current Derived 5-Cycle Curve
5-Cycle Highway Fuel Economy (mpg)
Unadjusted HFET Fuel Economy (mpg)
0
10
20
30
40
50
60
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75