

FC_{NG} = cubic feet of natural gas fuel consumed per mile

$$= \frac{(0.749)CH_4 + (CWF_{NMHC})NMHC + (0.429)CO + (0.273)(CO_2)}{CWF_{NG}D_{NG}}$$

where:

CWF_{NG}=the carbon weight fraction of the natural gas fuel as calculated in paragraph (d) of this section.

WF_{CO₂}=weight fraction carbon dioxide of the natural gas fuel calculated using the mole fractions and molecular weights of the natural gas fuel constituents per ASTM D 1945.

[59 FR 39654, Aug. 3, 1994; 59 FR 44795, Aug. 30, 1994, as amended at 59 FR 48537, Sept. 21, 1994; 64 FR 23975, May 4, 1999; 69 FR 18803, Apr. 9, 2004]

§ 600.114-08 Vehicle-specific 5-cycle fuel economy calculations.

This section applies to data used for fuel economy labeling under Subpart D of this part.

(a) *City fuel economy.* For each vehicle tested under §600.010-08(c)(i) and (ii), determine the 5-cycle city fuel economy using the following equation:

$$(1) \text{ City FE} = 0.905 \times \frac{1}{(\text{Start FC} + \text{Running FC})}$$

Where:

$$(i) \text{ Start FC (gallons per mile)} = 0.33 \times \left(\frac{(0.76 \times \text{Start Fuel}_{75} + 0.24 \times \text{Start Fuel}_{20})}{4.1} \right)$$

Where:

$$\text{Start Fuel}_x = 3.6 \times \left(\frac{1}{\text{Bag 1 FE}_x} - \frac{1}{\text{Bag 3 FE}_x} \right)$$

Where:

Bag Y FE_x = the fuel economy in miles per gallon of fuel during the specified bag of

the FTP test conducted at an ambient temperature of 75 °F or 20 °F,

and,

$$(ii) \text{ Running FC} = 0.82 \times \left[\frac{0.48}{\text{Bag } 2_{75} \text{ FE}} + \frac{0.41}{\text{Bag } 3_{75} \text{ FE}} + \frac{0.11}{\text{US06 City FE}} \right] + 0.18 \times \left[\frac{0.5}{\text{Bag } 2_{20} \text{ FE}} + \frac{0.5}{\text{Bag } 3_{20} \text{ FE}} \right] + 0.133 \times 1.083 \times \left[\frac{1}{\text{SC03 FE}} - \left(\frac{0.61}{\text{Bag } 3_{75} \text{ FE}} + \frac{0.39}{\text{Bag } 2_{75} \text{ FE}} \right) \right]$$

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Where:

US06 City FE = fuel economy in miles per gallon over the “city” portion of the US06 test.

HFET FE = fuel economy in miles per gallon over the HFET test.

SC03 FE = fuel economy in miles per gallon over the SC03 test.

(b) *Highway fuel economy.* (1) For each vehicle tested under §§ 600.010-08(a) and (c)(1)(ii)(B), determine the 5-cycle highway fuel economy using the following equation:

$$\text{Highway FE} = 0.905 \times \frac{1}{\text{Start FC} + \text{Running FC}}$$

Where:

$$(i) \text{ Start FC} = 0.33 \times \left(\frac{(0.76 \times \text{Start Fuel}_{75}) + (0.24 \times \text{Start Fuel}_{20})}{60} \right)$$

Where:

$$\text{Start Fuel}_x = 3.6 \times \left(\frac{1}{\text{Bag 1 FE}_x} - \frac{1}{\text{Bag 3 FE}_x} \right)$$

and,

$$(ii) \text{ Running FC} = 1.007 \times \left[\frac{0.79}{\text{US06 Highway FE}} + \frac{0.21}{\text{HFET FE}} \right] + 0.133 \times 0.377 \times \left[\frac{1}{\text{SC03 FE}} - \left(\frac{0.61}{\text{Bag 3}_{75}\text{FE}} + \frac{0.39}{\text{Bag 2}_{75}\text{FE}} \right) \right]$$

Where:

US06 Highway FE = fuel economy in mile per gallon over the highway portion of the US06 test.

HFET FE = fuel economy in mile per gallon over the HFET test.

SC03 FE = fuel economy in mile per gallon over the SC03 test.

(2) If the condition specified in § 600.115-08(b)(2)(iii)(B) is met, in lieu of using the calculation in paragraph (b)(1) of this section, the manufacturer

may optionally determine the highway fuel economy using the following modified 5-cycle equation which utilizes data from FTP, HFET, and US06 tests, and applies mathematic adjustments for Cold FTP and SC03 conditions:

(i) Perform a US06 test in addition to the FTP and HFET tests.

(ii) Determine the 5-cycle highway fuel economy according to the following formula:

$$\text{Highway FE} = 0.905 \times \frac{1}{\text{Start FC} + \text{Running FC}}$$

Where:

$$(A) \text{ Start FC} = 0.33 \times \left(\frac{(0.0055155 + 1.13637 \times \text{Start Fuel}_{75})}{60.0} \right)$$

Where:

$$\text{Start Fuel}_{75} = 3.6 \times \left(\frac{1}{\text{Bag 1 FE}_{75}} - \frac{1}{\text{Bag 3 FE}_{75}} \right)$$

Bag y FE₇₅ = the fuel economy in miles per gallon of fuel during the specified bag of

the FTP test conducted at an ambient temperature of 75 °F.

$$(B) \text{ Running FC} = 1.007 \times \left[\frac{0.79}{\text{US06 Highway FE}} + \frac{0.21}{\text{HFET FE}} \right] + \left[0.377 \times 0.133 \times \left(0.00540 + \frac{0.1357}{\text{US06 FE}} \right) \right]$$

Where:

US06 Highway FE = fuel economy in miles per gallon over the highway portion of the US06 test.

HFET FE = fuel economy in miles per gallon over the HFET test.

US06 FE = fuel economy in miles per gallon over the entire US06 test.

(c) *Fuel economy calculations for hybrid electric vehicles.* Under the requirements of §86.1811-04(n), hybrid electric vehicles are subject to California test methods which require FTP emission sampling for the 75 °F FTP test over four phases (bags) of the UDDS (cold-start, transient, warm-start, transient). Optionally, these four phases

may be combined into two phases (phases 1 + 2 and phases 3 + 4). Calculations for these sampling methods follow.

(1) *Four-bag FTP equations.* If the 4-bag sampling method is used, manufacturers may use the equations in paragraphs (a) and (b) of this section to determine city and highway fuel economy estimates. If this method is chosen, it must be used to determine both city and highway fuel economy. Optionally, the following calculations may be used, provided that they are used to determine both city and highway fuel economy:

(i) *City fuel economy.*

$$\text{City FE} = 0.905 \times \frac{1}{(\text{Start FC} + \text{Running FC})}$$

Where:

$$(A) \text{ Start FC (gallons per mile)} = 0.33 \times \left(\frac{(0.76 \times \text{Start Fuel}_{75} + 0.24 \times \text{Start Fuel}_{20})}{4.1} \right)$$

Where:

$$(1) \text{ Start Fuel}_{75} = 3.6 \times \left[\frac{1}{\text{Bag 1 FE}_{75}} - \frac{1}{\text{Bag 3 FE}_{75}} \right] + 3.9 \times \left[\frac{1}{\text{Bag 2 FE}_{75}} - \frac{1}{\text{Bag 4 FE}_{75}} \right]$$

and

$$(2) \text{ Start Fuel}_{20} = 3.6 \times \left[\frac{1}{\text{Bag 1 FE}_{20}} - \frac{1}{\text{Bag 3 FE}_{20}} \right]$$

(B) Running FC (gallons per mile) =

$$0.82 \times \left[\frac{0.48}{\text{Bag 4}_{75} \text{ FE}} + \frac{0.41}{\text{Bag 3}_{75} \text{ FE}} + \frac{0.11}{\text{US06 City FE}} \right] + 0.18 \times \left[\frac{0.5}{\text{Bag 2}_{20} \text{ FE}} + \frac{0.5}{\text{Bag 3}_{20} \text{ FE}} \right] \\ + 0.133 \times 1.083 \times \left[\frac{1}{\text{SC03 FE}} - \left(\frac{0.61}{\text{Bag 3}_{75} \text{ FE}} + \frac{0.39}{\text{Bag 4}_{75} \text{ FE}} \right) \right]$$

Where:

US06 Highway FE = fuel economy in miles per gallon over the city portion of the US06 test.

US06 Highway FE = fuel economy in miles per gallon over the Highway portion of the US06 test.

HFET FE = fuel economy in miles per gallon over the HFET test.

SC03 FE = fuel economy in miles per gallon over the SC03 test.

(ii) *Highway fuel economy.*

$$\text{Highway FE} = 0.905 \times \frac{1}{\text{Start FC} + \text{Running FC}}$$

Where:

$$(A) \text{ Start FC} = 0.33 \times \frac{(0.76 \times \text{Start Fuel}_{75} + 0.24 \times \text{Start Fuel}_{20})}{60}$$

Where:

$$\text{Start Fuel}_{75} = 3.6 \times \left[\frac{1}{\text{Bag 1 FE}_{75}} - \frac{1}{\text{Bag 3 FE}_{75}} \right] + 3.9 \times \left[\frac{1}{\text{Bag 2 FE}_{75}} - \frac{1}{\text{Bag 4 FE}_{75}} \right]$$

$$\text{Start Fuel}_{20} = 3.6 \times \left[\frac{1}{\text{Bag 1 FE}_{20}} - \frac{1}{\text{Bag 3 FE}_{20}} \right]$$

$$\text{(B) Running FC} = 1.007 \times \left[\frac{0.79}{\text{US06 Highway FE}} + \frac{0.21}{\text{HFET FE}} \right] + 0.133 \times 0.377 \times \left[\frac{1}{\text{SC03 FE}} - \left(\frac{0.61}{\text{Bag 3}_{75} \text{ FE}} + \frac{0.39}{\text{Bag 4}_{75} \text{ FE}} \right) \right]$$

Where:

US06 Highway FE = fuel economy in miles per gallon over the Highway portion of the US06 test,

HFET FE = fuel economy in miles per gallon over the HFET test,

SC03 FE = fuel economy in miles per gallon over the SC03 test.

(2) *Two-bag FTP equations.* If the 2-bag sampling method is used for the 75 °F FTP test, it must be used to determine both city and highway fuel economy. The following calculations must be used to determine both city and highway fuel economy:

(i) *City fuel economy.*

$$\text{City FE} = 0.905 \times \frac{1}{\text{Start FC} + \text{Running FC}}$$

Where:

$$\text{(A) Start FC} = 0.33 \times \frac{(0.76 \times \text{Start Fuel}_{75} + 0.24 \times \text{Start Fuel}_{20})}{4.1}$$

Where:

$$\text{Start Fuel}_{75} = 7.5 \times \left[\frac{1}{\text{Bag 1/2 FE}_{75}} - \frac{1}{\text{Bag 3/4 FE}_{75}} \right]$$

$$\text{Start Fuel}_{20} = 3.6 \times \left[\frac{1}{\text{Bag 1 FE}_{20}} - \frac{1}{\text{Bag 3 FE}_{20}} \right]$$

Where:

Bag y FE₂₀ = the fuel economy in miles per gallon of fuel during Bag 1 or Bag 3 of the 20 °F FTP test.

Bag x/y FE_x = fuel economy in miles per gallon of fuel during combined phases 1 and 2 or phases 3 and 4 of the FTP test conducted at an ambient temperature of 75 °F.

$$(B) \text{ Running FC} = 0.82 \times \left[\frac{0.90}{\text{Bag } 3/4_{75} \text{ FE}} + \frac{0.10}{\text{US06 City FE}} \right] + 0.18 \times \left[\frac{0.5}{\text{Bag } 2_{20} \text{ FE}} + \frac{0.5}{\text{Bag } 3_{20} \text{ FE}} \right] + 0.133 \times 1.083 \times \left[\frac{1}{\text{SC03 FE}} - \left(\frac{1.0}{\text{Bag } 3/4_{75} \text{ FE}} \right) \right]$$

Where:

US06 City FE = fuel economy in miles per gallon over the city portion of the US06 test,

SC03 FE = fuel economy in miles per gallon over the SC03 test.

Bag x/y FE_x = fuel economy in miles per gallon of fuel during combined phases 1 and 2 or phases 3 and 4 of the FTP test conducted at an ambient temperature of 75 °F.

(ii) *Highway fuel economy.*

$$\text{Highway FE} = 0.905 \times \frac{1}{\text{Start FC} + \text{Running FC}}$$

Where:

$$(A) \text{ Start FC} = 0.33 \times \frac{(0.76 \times \text{Start Fuel}_{75} + 0.24 \times \text{Start Fuel}_{20})}{60}$$

Where:

$$\text{Start Fuel}_{75} = 7.5 \times \left[\frac{1}{\text{Bag } 1/2 \text{ FE}_{75}} - \frac{1}{\text{Bag } 3/4 \text{ FE}_{75}} \right]$$

and

$$\text{Start Fuel}_{20} = 3.6 \times \left[\frac{1}{\text{Bag } 1 \text{ FE}_{20}} - \frac{1}{\text{Bag } 3 \text{ FE}_{20}} \right]$$

and

$$(B) \text{ Running FC} = 1.007 \times \left[\frac{0.79}{\text{US06 Highway FE}} + \frac{0.21}{\text{HFET FE}} \right] + 0.133 \times 0.377 \times \left[\frac{1}{\text{SC03 FE}} - \left(\frac{1.0}{\text{Bag } 3/4_{75} \text{ FE}} \right) \right]$$

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Where:

US06 Highway FE = fuel economy in miles per gallon over the city portion of the US06 test.

SC03 FE = fuel economy in miles per gallon over the SC03 test.

Bag y FE₂₀ = the fuel economy in miles per gallon of fuel during Bag 1 or Bag 3 of the 20 °F FTP test.

Bag x/y FE_x = fuel economy in miles per gallon of fuel during phases 1 and 2 or phases 3 and 4 of the FTP test conducted at an ambient temperature of 75 °F.

(3) For hybrid electric vehicles using the modified 5-cycle highway calculation in paragraph (b)(2) of this section, the equation in paragraph (b)(2)(ii)(A) of this section, applies except that the equation for Start Fuel₇₅ will be replaced with one of the following:

(i) The equation for Start Fuel₇₅ for hybrids tested according to the 4-bag FTP is:

$$\text{Start Fuel}_{75} = 3.6 \times \left[\frac{1}{\text{Bag 1 FE}_{75}} - \frac{1}{\text{Bag 3 FE}_{75}} \right] + 3.9 \times \left[\frac{1}{\text{Bag 2 FE}_{75}} - \frac{1}{\text{Bag 4 FE}_{75}} \right]$$

(ii) The equation for Start Fuel₇₅ for hybrids tested according to the 2-bag FTP is:

$$\text{Start Fuel}_{75} = 7.5 \left[\frac{1}{\text{Bag 1/2 FE}_{75}} - \frac{1}{\text{Bag 3/4 FE}_{75}} \right]$$

[71 FR 77938, Dec. 27, 2006; 72 FR 20403, Apr. 24, 2007]

§ 600.115-08 Criteria for determining the fuel economy label calculation method for 2011 and later model year vehicles.

This section provides the criteria to determine if the derived 5-cycle method for determining fuel economy label values, as specified in § 600.210-08 (a)(2) or (b)(2), as applicable, may be used to determine label values for 2011 and later model year vehicles. Separate criteria apply to city and highway fuel economy for each test group. The provisions of this section are optional. If this option is not chosen, or if the criteria provided in this section are not met, fuel economy label values for 2011 and later model year vehicles must be determined according to the vehicle-specific 5-cycle method specified in § 600.210-08(a)(1) or (b)(1), as applicable.

(a) *City fuel economy criterion.* (1) For each test group certified for emission compliance under § 86.1848-01 of this chapter, the FTP, HFET, US06, SC03 and Cold FTP tests determined to be official under § 86.1835-01 of this chapter are used to calculate the vehicle-specific 5-cycle city fuel economy which is then compared to the derived 5-cycle city fuel economy, as follows:

(i) The vehicle-specific 5-cycle city fuel economy from the official FTP, HFET, US06, SC03 and Cold FTP tests for the test group is determined according to the provisions of § 600.114-08(a) and rounded to the nearest one tenth of a mile per gallon.

(ii) Using the same FTP data as used in paragraph (a)(i) of this section, the corresponding derived 5-cycle city fuel economy is calculated according to the following equation: