

**Environmental Protection Agency**

**§ 86.1243-96**

- (vii) T = Enclosure temperature, °R(°K).
- (viii) i = initial reading.
- (ix) f = final reading.
- (x) 1 = First impinger.
- (xi) 2 = Second impinger.
- (xii)(A) k = 0.208 (12 = H/C).

- (B) For SI units, k = 1.2 (12 = H/C).
- Where:
  - (xiii) H/C = hydrogen carbon ratio.
  - (A) H/C = 2.33 for diurnal emissions.
  - (B) H/C = 2.2 for hot soak emissions.
  - (3) For total evaporative emissions: Total Evaporative Emissions =

$$\left( M_{HC} + \frac{14.3594 \times 10^6}{32.042} M_{CH_3OH} \right) + \left( M_{HC} + \frac{14.2284 \times 10^6}{33.042} M_{CH_3OH} \right) \text{g.}$$

(b) The final reported results shall be computed by summing the individual evaporative emission results determined for the diurnal breathing-loss test, running-loss test and the hot-soak test.

[54 FR 14570, Apr. 11, 1989, as amended at 60 FR 34363, June 30, 1995]

**§ 86.1243-96 Calculations; evaporative emissions.**

(a) The following equations are used to calculate the evaporative emissions

$$M_{CH_3OH} = V_n \times \left[ \frac{(C_{MS1f} \times AV_{1f}) + (C_{MS2f} \times AV_{2f})}{V_{E_f}} \right] - \left[ \frac{(C_{MS1i} \times AV_{1i}) + (C_{MS2i} \times AV_{2i})}{V_{E_i}} \right] + (M_{CH_3OH,out} - M_{CH_3OH,in})$$

Where:

- (A) M<sub>CH<sub>2</sub>OH</sub>=Methanol mass change, μ g.
- (B) V<sub>F<sub>n</sub></sub>=Net enclosure volume, ft<sup>3</sup>, as determined by subtracting 50 ft<sup>3</sup> (1.42 m<sup>3</sup>) (volume of vehicle with trunk and windows open) from the enclosure volume. A manufacturer may use the measured volume of the vehicle (instead of the nominal 50 ft<sup>3</sup>) with advance approval by the Administrator: Provided, the measured volume is determined and used for all vehicles tested by that manufacturer.
- (C) [Reserved]
- (D) V<sub>E</sub>=Volume of sample withdrawn, ft<sup>3</sup>. Sample volumes must be corrected for differences in temperature to be consistent with determination of V<sub>n</sub>, prior to being used in the equation.

from gasoline- and methanol-fueled vehicles, and for gaseous-fueled vehicles.

(b) Use the measurements of initial and final concentrations to determine the mass of hydrocarbons and methanol emitted. For testing with pure gasoline, methanol emissions are assumed to be zero.

- (1) For enclosure testing of diurnal, hot soak, and running loss emissions:
  - (i) Methanol emissions:

- (E) [Reserved]
- (F) A<sub>C<sub>MS</sub></sub>=GC concentration of sample.
- (G) AV=Volume of absorbing reagent in impinger.
- (H) P<sub>B</sub>=Barometric pressure at time of sampling, in. Hg.
- (I) i=Initial sample.
- (J) f=Final sample.
- (K) 1=First impinger.
- (L) 2=Second impinger.
- (M) M<sub>CH<sub>3</sub>OH,out</sub>=mass of methanol exiting the enclosure, in the case of fixed volume enclosures for diurnal emission testing, μ g.
- (N) M<sub>CH<sub>3</sub>OH,in</sub>=mass of methanol entering the enclosure, in the case of fixed volume enclosures for diurnal emission testing, μ g.
- (ii) Hydrocarbon emissions:

$$M_{HC} = (kV_n \times 10^{-4}) \times \left( \frac{(C_{HCf} - rC_{CH_3OHf})P_{Bf}}{T_f} - \frac{(C_{HCi} - rC_{CH_3OH_i})P_{Bi}}{T_i} \right) + M_{HC,out} - M_{HC,in}$$

Where,

- (A)  $M_{HC}$ =Hydrocarbon mass change, g.
- (B)  $C_{HC}$ =FID hydrocarbon concentration as ppm carbon including FID re-

sponse to methanol (or methane, as applicable) in the sample.

- (C)  $C_{CH_3OH}$ =Methanol concentration as ppm carbon.

$$= \frac{1.501 \times 10^{-3} \times T}{P_B \times V_E} \times [(C_{S1} \times AV_1) + (C_{S2} \times AV_2)]$$

(D)  $V_n$ =Net enclosure volume ft<sup>3</sup> (m<sup>3</sup>) as determined by subtracting 50 ft<sup>3</sup> (1.42 m<sup>3</sup>) (volume of vehicle with trunk and windows open) from the enclosure volume. A manufacturer may use the measured volume of the vehicle (instead of the nominal 50 ft<sup>3</sup>) with advance approval by the Administrator, provided the measured volume is determined and used for all vehicles tested by that manufacturer.

(E)  $r$ =FID response factor to methanol.

(F)  $P_B$ =Barometric pressure, in Hg (Kpa).

(G)  $T$ =Enclosure temperature, °R(°K).

(H)  $i$ =initial reading.

(I)  $f$ =final reading.

(J)  $1$ =First impinger.

(K)  $2$ =Second impinger.

(L) Assuming a hydrogen to carbon ratio of 2.3:

(1)  $k=2.97$ ; and

(2) For SI units,  $k=17.16$ .

(M)  $M_{HC,out}$ =mass of hydrocarbons exiting the enclosure, in the case of fixed-volume enclosures for diurnal emission testing, g.

(N)  $M_{HC,in}$ =mass of hydrocarbons entering the enclosure, in the case of fixed-volume enclosures for diurnal emission testing, g.

(iii) For variable-volume enclosures, defined in §86.1207(a)(1)(i), the following simplified form of the hydrocarbon mass change equation may be used:

$$M_{HC} = \left( \frac{kP_B V_n \times 10^{-4}}{T} \right) \times \left[ (C_{HCf} - rC_{CH_3OHf}) - (C_{HCi} - rC_{CH_3OH_i}) \right]$$

(2) For running loss testing by the point-source method, the mass emissions of each test phase are calculated below, then summed for a total mass emission for the running loss test. If

emissions are continuously sampled, the following equations can be used in integral form.

- (i) Methanol emissions:

$$M_{CH_3OH} = \rho_{CH_3OH} V_{mix} \times (C_{CH_3OH,rl} - C_{CH_3OH,d})$$

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Where,

(A)  $M_{CH_3OH}$ =methanol mass change,  $\mu$  g.

(B)  $\rho_{CH_3OH}$ = 37.71 g/ft<sup>3</sup>, density of pure vapor at 68 °F.

(C)  $V_{mix}$ =total dilute sample volume, in ft<sup>3</sup>, calculated as appropriate for the collection technique used.

(D)  $C_{CH_3OH,rl}$ =methanol concentration of diluted running loss sample, in ppm carbon equivalent.

(E)  $C_{CH_3OH,d}$ =methanol concentration of dilution air, in ppm carbon equivalent.

(ii) Hydrocarbon emissions:

$$M_{HC} = \rho_{HC} V_{mix} \times 10^{-6} (C_{CH,rl} - C_{HC,d})$$

Where,

(A)  $M_{HC}$ =hydrocarbon mass change, g.

(B)  $\rho_{HC}$ = 16.88 g/ft<sup>3</sup>, density of pure vapor at 68 °F (for hydrogen to carbon ratio of 2.3).

(C)  $V_{mix}$ =total dilute sample volume, in ft<sup>3</sup>, calculated as appropriate for the collection technique used.

(D)  $C_{HC,rl}$ =hydrocarbon concentration of diluted running loss sample, in ppm carbon equivalent.

(E)  $C_{HC,d}$ =hydrocarbon concentration of dilution air, in ppm carbon equivalent.

(c) Calculate the adjusted total mass emissions for each test segment.

$$(1) \quad M_{DI} = \left( M_{HC} + \frac{14.3594}{32.042} \times 10^{-6} M_{CH_3OH} \right)_{DI}$$

where  $M_{DI}$ =mass emissions from the diurnal emission test (see §86.1233), g.

$$(2) \quad M_{HS} = \left( M_{HC} + \frac{14.2284}{32.042} \times 10^{-6} M_{CH_3OH} \right)_{HS}$$

where  $M_{HS}$ =mass emissions from the hot soak test (see §86.1238), g.

$$(3) \quad M_{RL} = \left( M_{HC} + \frac{14.2284}{32.042} \times 10^{-6} M_{CH_3OH} \right)_{RL}$$

where  $M_{RL}$ =mass emissions from the running loss test (see §86.1234), g.

(d)(1) For the full three-diurnal test sequence, there are two final results to report:

(i) The sum of the adjusted total mass emissions for the diurnal and hot soak tests ( $M_{DI}+M_{HS}$ ); and

(ii) The adjusted total mass emissions for the running loss test, on a grams per mile basis= $M_{RL}/D_{RL}$ , where  $D_{RL}$ =miles driven for the running loss test (see §86.1234-96(c)(6)).

(2) For the supplemental two-diurnal test sequence, there is one final result to report: the sum of the adjusted total

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mass emissions for the diurnal and hot soak tests ( $M_{DI}+M_{HS}$ ), described in §§ 86.1233-96(p) and 86.1238-96(k), respectively.

[58 FR 16062, Mar. 24, 1993, as amended at 59 FR 48525, Sept. 21, 1994; 60 FR 34364, June 30, 1995; 60 FR 43906, Aug. 23, 1995]

**§ 86.1246-96 Fuel dispensing spitback procedure.**

(a) The vehicle is fueled at a rate of 10 gal/min to test for fuel spitback emissions. All liquid fuel spitback emissions that occur during the test are collected in a bag made of a material impermeable to hydrocarbons or methanol. The bag shall be designed and used so that liquid fuel does not spit back onto the vehicle body, adjacent floor, etc., and it must not impede the free flow of displaced gasoline vapor from the orifice of the filler pipe. The bag must be designed to permit passage of the dispensing nozzle through the bag. If the bag has been used for previous testing, sufficient time shall be allowed for the bag to dry out. The dispensing nozzle shall be a commercial model, not equipped with vapor recovery hardware.

(b) Ambient temperature levels encountered by the test vehicle shall be not less than 68 °F nor more than 86 °F. The temperatures monitored during testing must be representative of those experienced by the test vehicle. The vehicle shall be approximately level during all phases of the test sequence to prevent abnormal fuel distribution.

(c) Measure and record the mass of the bag to be used for collecting spitback emissions to the nearest 0.01 gram.

(d) Drain the fuel tank(s) and fill with test fuel, as specified in § 86.1213, to 10 percent of the reported nominal fuel tank capacity. The fuel cap(s) shall be installed immediately after refueling.

(e) The vehicle shall be soaked at  $80\pm 6$  °F ( $27\pm 3$  °C) for a minimum of six hours, then placed, either by being driven or pushed, on a dynamometer and operated through one Heavy-Duty Vehicle Urban Dynamometer Driving Schedule (specified in § 86.1215 and appendix I of this part). The test vehicle may not be used to set dynamometer horsepower.

(f) Following the preconditioning drive, the vehicle shall be moved or driven at minimum throttle to the refueling area.

(g) All areas in proximity to the vehicle fuel fill orifice and the dispenser nozzle itself shall be completely dry of liquid fuel.

(h) The fuel filler neck shall be snugly fitted with the vented bag to capture any fuel emissions. The fuel nozzle shall be inserted through the bag into the filler neck of the test vehicle to its maximum penetration. The plane of the nozzle's handle shall be perpendicular to the floor of the laboratory.

(i) The fueling procedure consists of dispensing fuel through a nozzle, interrupted by a series of automatic shutoffs. A minimum of 3 seconds shall elapse between any automatic shutoff and subsequent resumption of dispensing. Dispensing may not be manually terminated, unless the test vehicle has already clearly failed the test. The vehicle shall be fueled according to the following procedure:

(1) The fueling operation shall be started within 4 minutes after the vehicle is turned off and within 8 minutes after completion of the preconditioning drive. The average temperature of the dispensed fuel shall be  $65\pm 5$  °F ( $18\pm 3$  °C).

(2) The fuel shall be dispensed at a rate of  $9.8\pm 0.3$  gallons/minute ( $37.1\pm 1.1$  l/min) until the automatic shutoff is activated.

(3) If the automatic shutoff is activated before the nozzle has dispensed an amount of fuel equal to 70 percent of the tank's nominal capacity, the dispensing may be resumed at a reduced rate. Repeat as necessary until the nozzle has dispensed an amount of fuel equal to at least 70 percent of the tank's nominal capacity.

(4) Once the automatic shutoff is activated after the nozzle has dispensed an amount of fuel equal to 70 percent of the tank's nominal capacity, the fuel shall be dispensed at a rate of  $5\pm 1$  gallons/minute ( $19\pm 4$  l/min) for all subsequent dispensing. Dispensing shall be restarted two additional times.

(5) If the nozzle has dispensed an amount of fuel less than 85 percent of the tank's nominal capacity after the two additional dispensing restarts, dispensing shall be resumed, and shall