

Environmental Protection Agency

§ 86.117-96

(c) At least monthly or after any maintenance which could alter calibration, the following calibrations and checks shall be performed:

(1) Calibrate the THC analyzers (both evaporative and exhaust instruments), methane analyzer, carbon dioxide analyzer, carbon monoxide analyzer, and oxides of nitrogen analyzer (certain analyzers may require more frequent calibration depending on particular equipment and uses).

(2) Calibrate the dynamometer. If the dynamometer receives a weekly performance check (and remains within calibration) the monthly calibration need not be performed.

(3) Perform an organic gas retention and calibration on the evaporative emissions enclosure (see § 86.117-90(c)).

(4) Calibrate the gas meters or flow instrumentation used for providing total flow measurement for particulate sampling.

(5) Check the oxides of nitrogen converter efficiency.

(d) At least weekly or after any maintenance which could alter calibration, the following calibrations and checks shall be performed:

(1) [Reserved]

(2) Perform a CVS system verification, and

(3) Run a performance check on the dynamometer. This check may be omitted if the dynamometer has been calibrated within the preceding month.

(e) The CVS positive displacement pump or Critical Flow Venturi shall be calibrated following initial installation, major maintenance, or as necessary when indicated by the CVS system verification (described in § 86.119).

(f) Sample conditioning columns, if used in the CO analyzer train, should be checked at a frequency consistent with observed column life or when the indicator of the column packing begins to show deterioration.

(g) The Administrator, upon request, may waive the requirement to comply with the specified methanol recovery tolerance (e.g., ± 2 percent in §§ 86.117-90 and 86.119-90), and/or the specified methanol retention tolerance (e.g., ± 4 percent in § 86.117-90), and instead require compliance with higher tolerances (not to exceed ± 6 percent for re-

coveries and ± 8 for retention), provided that:

(1) The Administrator determines that compliance with these specified tolerances is not practically feasible; and

(2) The manufacturer makes information available to the Administrator which indicates that the calibration tests and their results are consistent with good laboratory practice, and that the results are consistent with the results of calibration testing conducted by the Administrator.

[56 FR 25774, June 5, 1991, as amended at 58 FR 58422, Nov. 1, 1993; 59 FR 33913, July 1, 1994; 60 FR 34342, June 30, 1995]

§ 86.117-96 Evaporative emission enclosure calibrations.

The calibration of evaporative emission enclosures consists of three parts: initial and periodic determination of enclosure background emissions (hydrocarbons and methanol); initial determination of enclosure internal volume; and periodic hydrocarbon and methanol retention check and calibration. Methanol measurements may be omitted if methanol-fueled vehicles will not be tested in the evaporative enclosure. Alternate calibration methods may be used if shown to yield equivalent or superior results, and if approved in advance by the Administrator; specifically, more extreme temperatures may be used for determining calibration without affecting the validity of test results.

(a) *Initial and periodic determination of enclosure background emissions.* Prior to its introduction into service, annually thereafter, and after any repair that can affect the enclosure background emissions, the enclosure shall be checked to determine that it does not contain materials that will themselves emit hydrocarbons or methanol. When methanol as well as hydrocarbons are present in the evaporative enclosure, the HFID hydrocarbon concentration measurement includes the partial response of the HFID to methanol plus the hydrocarbons. Determination of the HFID response to methanol, § 86.121, prior to its being placed in service is required for the determination of hydrocarbons. Proceed as follows:

(1) Prepare the enclosure. (i) Variable-volume enclosures may be operated in either latched or unlatched volume configuration, as described in paragraph (b)(1) of this section. Ambient temperatures shall be maintained at 96 ± 3 °F throughout the 4-hour period.

(ii) Fixed-volume enclosures may be operated with inlet and outlet flow streams either closed or open; if inlet and outlet flow streams are open, the air flowing into and out of the enclosure must be monitored in accordance with §86.107-96(a)(1)(ii)(B). Ambient temperatures shall be maintained at 96 ± 3 °F throughout the 4-hour period.

(iii) For running loss enclosures ambient temperatures shall be maintained at 95 ± 3 °F throughout the 4-hour period. For running loss enclosures designed with a vent for makeup air, the enclosure shall be operated with the vent closed.

(2) The enclosure may be sealed and the mixing fan operated for a period of up to 12 hours before the 4-hour background sampling period begins.

(3) Zero and span (calibrate if required) the hydrocarbon analyzer.

(4) Prior to the background determination, purge the enclosure until a stable background hydrocarbon reading is obtained.

(5) Turn on the mixing blower (if not already on).

(6) Seal enclosure and measure background hydrocarbon concentration, background methanol, temperature, and barometric pressure.

These are the initial readings C_{HCl} , $C_{\text{CH}_3\text{OH}_i}$, and P_{Bi} , T_i for the enclosure background determination.

(7) Allow the enclosure to stand undisturbed for four hours.

(8) Measure the hydrocarbon concentration on the same FID and the methanol level. These are the final concentrations, C_{HCl_f} and $C_{\text{CH}_3\text{OH}_f}$. Also measure final temperature and barometric pressure.

(9) Calculate the mass change of methanol, hydrocarbons, and hydrocarbons plus methanol in the enclosure according to the equations in paragraph (d) of this section.

(i) *Diurnal enclosures.* The enclosure background emissions (hydrocarbons

plus methanol) shall not be greater than 0.05g for the 4 hours.

(ii) *Running loss enclosures.* The enclosure background emissions (hydrocarbons plus methanol) shall not be greater than 0.2 grams for the 4 hours.

(b) *Initial determination of enclosure internal volume.* Prior to its introduction into service the enclosure internal volume shall be determined by the following procedure:

(1) Carefully measure the internal length, width and height of the enclosure, accounting for irregularities (such as braces) and calculate the internal volume. For variable-volume enclosures, latch the enclosure to a fixed volume when the enclosure is held at a constant temperature; this nominal volume shall be repeatable within ± 0.5 percent of the reported value.

(2)-(3) [Reserved]

(c) *Hydrocarbon and methanol (organic gas) retention check and calibration.* The hydrocarbon and methanol (if the enclosure is used for methanol-fueled vehicles) retention check provides a check upon the calculated volume and also measures the leak rate. The enclosure leak rate shall be determined prior to its introduction into service, following any modifications or repairs to the enclosure that may affect the integrity of the enclosure, and at least monthly thereafter. (The methanol check can be performed less frequently, provided it is performed at least twice annually.) If six consecutive monthly retention checks are successfully completed without corrective action, the enclosure leak rate may be determined quarterly thereafter as long as no corrective action is required.

(1) An enclosure to be used for the diurnal emission test (see §86.133-96) shall be calibrated according to the following procedure. Calibration for hydrocarbon and methanol may be conducted simultaneously or in sequential test runs.

(i) Zero and span (calibrate if required) the hydrocarbon analyzer.

(ii) Purge the enclosure until a stable background hydrocarbon reading is obtained.

(iii) Turn on the mixing blowers (if not already on).

(iv) [Reserved]

(v) Turn on the ambient temperature control system (if not already on) and adjust it for an initial temperature of 96 °F (36 °C). On variable-volume enclosures, latch the enclosure to the appropriate volume position for the set temperature. On fixed-volume enclosures close the outlet and inlet flow streams.

(vi) When the enclosure stabilizes at 96 ± 3 °F (36 ± 2 °C), seal the enclosure and measure background hydrocarbon concentration, background methanol, temperature, and barometric pressure. These are the initial readings C_{HC} , $C_{\text{CH}_3\text{OH}}$, T_i , and P_{B_i} for the enclosure calibration.

(vii) For evaporative emission enclosures which will be used to measure evaporative emissions from vehicles meeting evaporative standards equal to or above 2.0 grams, inject into the enclosure 0.5 to 6 grams of pure methanol at a temperature of at least 150 °F (65 °C) and/or 0.5 to 6 grams of pure propane at lab ambient temperatures. For evaporative emission enclosures which will be used to measure evaporative emissions from vehicles meeting evaporative standards below 2.0 grams, inject into the enclosure 0.5 to 1.0 grams of pure methanol at a temperature of at least 150 °F (65 °C) and/or 0.5 to 1.0 grams of pure propane at lab ambient temperature. The injected quantity may be measured by volume flow or by mass measurement. The method used to measure the quantity of methanol and propane shall have an accuracy of ± 0.2 percent of measured value (less accurate methods may be used with the advance approval of the Administrator).

(viii) After a minimum of 5 minutes of mixing, analyze the enclosure atmosphere for hydrocarbon and methanol content, also record temperature and pressure. These measurements are the final readings for the enclosure calibration as well as the initial readings for the retention check.

(ix) To verify the enclosure calibration, calculate the mass of propane and the mass of methanol using the measurements taken in paragraphs (c)(1)(vi) and (viii) of this section. See paragraph (d) of this section. This quantity must be within ± 2 percent of that measured

in paragraph (c)(1)(vii) of this section. (For 1991-1995 calendar years, the difference may exceed ± 2 percent for methanol, provided it does not exceed ± 6 percent.)

(x) For variable-volume enclosures, unlatch the enclosure from the nominal volume configuration. For fixed-volume enclosures, open the outlet and inlet flow streams.

(xi) Start cycling the ambient temperature from 96 °F to 72 °F and back to 96 °F over a 24-hour period, according to the profile specified in § 86.133-96 and appendix II of this part, within 15 minutes of sealing the enclosure.

(xii) At the completion of the 24-hour cycling period, analyze the enclosure atmosphere for hydrocarbon and methanol content; determine the net withdrawn methanol (in the case of diurnal emission testing with fixed volume enclosures); record temperature and barometric pressure. These are the final readings for the hydrocarbon and methanol retention check. The final hydrocarbon and methanol mass, calculated in paragraph (d) of this section, shall be within three percent of that determined in paragraph (c)(1)(viii) of this section. (For 1991-1995 calendar years, the difference may exceed ± 3 percent for methanol, provided it does not exceed ± 6 percent.)

(2) An enclosure to be used for the running loss test (see § 86.134-96) shall meet the calibration and retention requirements of § 86.117-90(c).

(3) Enclosures calibrated according to the procedures specified in either paragraph (c)(1) or (c)(2) of this section may be used for hot soak testing (see § 86.138).

(d) *Calculations.* (1) The calculation of net methanol and hydrocarbon mass change is used to determine enclosure background and leak rate. It is also used to check the enclosure volume measurements. The methanol mass change is calculated from the initial and final methanol samples, the net withdrawn methanol (in the case of diurnal emission testing with fixed-volume enclosures), and initial and final temperature and pressure according to the following equation:

$$M_{\text{CH}_3\text{OH}} = V_n \times \left[\frac{(C_{\text{MS1f}} \times AV_{\text{1f}}) + (C_{\text{MS2f}} \times AV_{\text{2f}})}{V_{\text{E_f}}} \right] - \left[\frac{(C_{\text{MS1i}} \times AV_{\text{1i}}) + (C_{\text{MS2i}} \times AV_{\text{2i}})}{V_{\text{E_i}}} \right] + (M_{\text{CH}_3\text{OH,out}} - M_{\text{CH}_3\text{OH,in}})$$

Where:

- (i) $M_{\text{CH}_3\text{OH}}$ =Methanol mass change, μg .
- (ii) V =Enclosure volume, ft^3 , as measured in paragraph (b)(1) of this section.
- (iii)-(iv) [Reserved]
- (v) V_E =Volume of sample withdrawn, ft^3 . Sample volumes must be corrected for differences in temperature to be consistent with determination of V_n , prior to being used in the equation.
- (vi) P_B =Barometric pressure at time of sampling, in. Hg.
- (vii) C_{MS} =GC concentration of test sample.
- (viii) AV =Volume of absorbing reagent in impinger (ml).
- (ix) i =Initial sample.
- (x) f =Final sample.
- (xii) 1 =First impinger.

- (xiii) 2 =Second impinger.
- (xiv) $M_{\text{CH}_3\text{OH,out}}$ =mass of methanol exiting the enclosure, in the case of fixed volume enclosures for diurnal emission testing, μg .
- (xv) $M_{\text{CH}_3\text{OH,in}}$ =mass of methanol exiting the enclosure, in the case of fixed volume enclosures for diurnal emission testing, μg .
- (2) The hydrocarbon mass change is calculated from the initial and final FID readings of hydrocarbon concentration, methanol concentration with FID response to methanol, the net withdrawn hydrocarbon and methanol (in the case of diurnal emission testing with fixed-volume enclosures), and initial and final temperature and pressure according to the following equation:

$$M_{\text{HC}} = (kV_n \times 10^{-4}) \times \left(\frac{(C_{\text{HC}_f} - rC_{\text{CH}_3\text{OH}_f})}{T_f} - \frac{(C_{\text{HC}_i} - rC_{\text{CH}_3\text{OH}_i})P_{B_i}}{T_i} \right) + M_{\text{HC,out}} - M_{\text{HC,in}}$$

Where,

- (i) M_{HC} =Hydrocarbon mass change, g.
- (ii) C_{HC} =FID hydrocarbon concentration as ppm carbon, that is, ppm pro-

- pane $\times 3$, including FID response to methanol in the sample.
- (iii) $C_{\text{CH}_3\text{OH}}$ =Methanol concentration as ppm carbon

$$= \frac{1.501 \times 10^{-3} \times T_E}{P_B \times V_E} \left[(C_{\text{S1}} \times AV_1) + (C_2 \times AV_2) \right]$$

- (iv) V =Enclosure volume ft^3 (m^3), as measured in paragraph (b)(1) of this section.
- (v) r =FID response factor to methanol.
- (vi) P_B =Barometric pressure, in. Hg. (kPa).
- (vii) T =Enclosure ambient temperature, R(K).
- (viii) i =Indicates initial reading.
- (ix) f =Indicates final reading.
- (x)(A) $k=3.05$.
- (B) For SI units, $k=17.60$.

- (xi) $M_{\text{HC,out}}$ =mass of hydrocarbon exiting the enclosure, in the case of fixed-volume enclosures for diurnal emission testing, g.
- (xii) $M_{\text{HC,in}}$ =mass of hydrocarbon entering the enclosure, in the case of fixed-volume enclosures for diurnal emission testing, g.
- (3) For variable-volume enclosures, defined in § 86.107(a)(1)(i), the following simplified form of the hydrocarbon mass change equation may be used:

$$M_{HC} = \left(\frac{kP_B V_n \times 10^{-4}}{T} \right) \times \left[(C_{HC_f} - rC_{CH_3OH_f}) - (C_{HC_i} - rC_{CH_3OH_i}) \right]$$

(e) *Calibration of equipment for point-source testing of running losses.* For the point-source method, the running loss fuel vapor sampling system shall be calibrated as a CVS system, as specified in §86.119, with the additional specification that the vapor sampling system verification be conducted as follows:

(1) The following “gravimetric” technique can be used to verify that the vapor sampling system and analytical instruments can accurately measure a mass of gas that has been injected into the system. If the vapor sampling system will be used only in the testing of petroleum-fueled engines, the system verification may be performed using propane. If the vapor sampling system will be used with methanol-fueled vehicles as well as petroleum-fueled vehicles, the system verification performance check must include a methanol check in addition to the propane check. (Verification can also be accomplished by constant flow metering using critical flow orifice devices.)

(i) Obtain a small cylinder that has been charged with pure propane gas. Obtain another small cylinder that has been charged with pure methanol if the system will be used for methanol-fueled vehicle testing. Since this cylinder will be heated to 150–155 °F, care must be taken to ensure that the liquid volume of methanol placed in the cylinder does not exceed approximately one-half of the total volume of the cylinder.

(ii) Determine a reference cylinder weight to the nearest 0.01 grams.

(iii) Operate the vapor sampling system in the normal manner and release a known quantity of pure propane into the most frequently used fuel vapor collector during the sampling period (approximately 5 minutes).

(iv) Continue to operate the vapor sampling system in the normal manner and release a known quantity of pure methanol into the system during the

sampling period (approximately 5 minutes).

(v) The calculations of §86.144 are performed in the normal way, except in the case of propane. The density of propane (17.30 g/ft³/carbon atom (0.6109 kg/m³/carbon atom)) is used in place of the density of exhaust hydrocarbons. In the case of methanol, the density of 37.71 g/ft³ (1.332 kg/m³) is used.

(vi) The gravimetric mass is subtracted from the vapor sampling system measured mass and then divided by the gravimetric mass to determine the percent accuracy of the system.

(vii) The cause for any discrepancy greater than ±2 percent must be found and corrected.

(2) This procedure shall be conducted in the point-source running loss test environment with the collector installed in a vehicle in the normal test configuration. The fuel of the test vehicle shall either be diesel, or it shall be kept under 100 °F (38 °C). Two to six grams of pure propane and two to six grams of pure methanol shall be injected into the collector while the vehicle is operated over one Urban Dynamometer Driving Schedule (UDDS), as described in §86.115 and appendix I of this part. The propane and methanol injections shall be conducted at the ambient temperature of 95±5 °F (35±3 °C).

[58 FR 16030, Mar. 24, 1993, as amended at 60 FR 34343, June 30, 1995; 60 FR 43890, Aug. 23, 1995; 70 FR 72927, Dec. 8, 2005]

EFFECTIVE DATE NOTE: At 73 FR 37192, June 30, 2008, §86.117-96 was amended by revising the first equation in paragraph (d)(2) and at 73 FR 38293, July 3, 2008, this equation was corrected, effective July 7, 2008. For the convenience of the user, the revised text, as corrected, is set forth as follows:

§ 86.117-96 Evaporative emission enclosure calibrations.

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(d) * * *
(2) * * *

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

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§ 86.118-00 Dynamometer calibrations.

(a) The dynamometer shall be calibrated at least once each month or performance verified at least once each week and then calibrated as required.

(b) For large single roll electric dynamometers or equivalent dynamometer configurations, the dynamometer adjustment settings for each vehicle's emission test sequence shall be verified by comparing the force imposed during dynamometer operation with actual road load force.

[61 FR 54891, Oct. 22, 1996]

§ 86.118-78 Dynamometer calibration.

(a) The dynamometer shall be calibrated at least once each month or performance verified at least once each week and then calibrated as required. The calibration shall consist of the manufacturer's recommended calibration procedure plus a determination of the dynamometer frictional power absorption at 50.0 mph (80.5 km/h). One method for determining dynamometer frictional power absorption at 50.0 mph (80.5 km/h) is described below, other methods may be used if shown to yield equivalent results. The measured absorbed road power includes the dynamometer friction as well as the power absorbed by the power absorption unit. The dynamometer is driven above the test speed range. The device used to drive the dynamometer is then disengaged from the dynamometer and the roll(s) is (are) allowed to coast down. The kinetic energy of the system is dissipated by the dynamometer. This

method neglects the variations in roll bearing friction due to the drive axle weight of the vehicle. The inertia of the free (rear) roll may be neglected in the case of dynamometers with paired rolls.

(1) Devise a method to determine the speed of the drive roll if it is not already measured. A fifth wheel, revolution pickup, or other suitable means may be used.

(2) Place a vehicle on the dynamometer or devise another method of driving the dynamometer.

(3) Engage the inertial flywheel or other inertial simulation system for the most common vehicle mass category for which the dynamometer is used. In addition other vehicle mass categories may be calibrated, if desired.

(4) Drive the dynamometer up to 50.0 mph (80.5 km/h).

(5) Record indicated road power.

(6) Drive the dynamometer up to 60.0 mph (96.9 km/h).

(7) Disengage the device used to drive the dynamometer.

(8) Record the time for the dynamometer drive roll to coastdown from 55.0 mph (88.5 km/h) to 45 mph (72.4 km/h).

(9) Adjust the power absorption unit to a different level.

(10) Repeat steps (4) to (9) above sufficient times to cover the range of road power used.

(11) Calculate absorbed road power (HP_d). See paragraph (c) of this section.

(12) Plot indicated road load power at 50 mph (80.5 km/h) versus road load power at 50 mph (80.5 km/h) as shown in Figure B78-5.