State of California
AIR RESOURCES BOARD

CALIFORNIA EVAPORATIVE EMISSION STANDARDS AND TEST PROCEDURES FOR 2001 AND SUBSEQUENT MODEL MOTOR VEHICLES

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Amended: [INSERT DATE OF AMENDMENT]

Note: ACC II Draft CARB staff proposed changes for public discussion, December 2021, Subject to change before issuance of Notice of Proposed Rulemaking. The proposed amendments to this document are shown in underline to indicate additions and ~~strikeout~~ to indicate deletions compared to the test procedures as adopted September 2, 2015. [No change] indicates proposed federal provisions that are also proposed for incorporation herein without change. Existing intervening text that is not amended in this rulemaking is indicated by "* * * *".

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PART I. GENERAL CERTIFICATION REQUIREMENTS FOR EVAPORATIVE EMISSIONS

A. 40 CFR §86.1801-01 Applicability.

1.1. These evaporative standards and test procedures are applicable to all new 2001 and subsequent model gasoline-, liquefied petroleum- and alcohol-fueled passenger cars, light-duty trucks, medium-duty vehicles, heavy-duty vehicles, hybrid electric vehicles (including fuel-flexible, dual fuel and bi-fuel vehicles, and 2012 and subsequent model-year off-vehicle charge capable hybrid electric vehicles), and motorcycles. <u>Unless otherwise indicated,</u> ~~T~~<u>t</u>hese standards and test procedures do not apply to motor vehicles that are exempt from exhaust emission certification, dedicated petroleum-fueled diesel vehicles, <u>or</u> dedicated compressed natural gas-fueled vehicles~~, or hybrid electric vehicles that have sealed fuel systems which can be demonstrated to have no evaporative emissions~~. A manufacturer may elect to certify 2009 through 2011 model-year off-vehicle charge capable hybrid electric vehicles using these provisions. In cases where a provision applies only to a certain vehicle group based on its model year, vehicle class, motor fuel, engine type, or other distinguishing characteristics, the limited applicability is cited in the appropriate section.

D. General Standards; increase in emissions; unsafe conditions; waivers

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3. Auxiliary engines and fuel systems

3.1. §86.1813-17 (e) ~~(February 19, 2015)~~ <u>June 29, 2021</u> [No change]

3.2. Except for 2017 model vehicles >6,000 lbs. GVWR and 2021 and previous model vehicles certified by a small volume manufacturer, 2017 and subsequent model vehicles equipped with an auxiliary engine shall be subject to these requirements.

<u>3.3. For 2026 and subsequent model year motor vehicles, these requirements apply to any auxiliary fuel system, including a fuel fired heater</u>

<u>3.4. These requirements also apply to motor vehicles that are exempt from exhaust emission certification, dedicated petroleum-fueled diesel vehicles, and dedicated compressed natural gas-fueled vehicles.</u>

E. Emission Standards

1. Evaporative Emission Standards for 2001 and Subsequent Model Year Vehicles Other Than Motorcycles.

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(e) For 2015 and subsequent model motor vehicles, the following evaporative emission requirements apply:

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(f) For 2026 and subsequent model year motor vehicles, the following evaporative emission requirements apply in addition to the requirements in section I.E.1.(e):

(i) Running loss hydrocarbon emission standard: Running loss emissions shall not exceed 0.01 grams per mile for all vehicle types.

Phase-in schedule for running loss:

For each model year, a manufacturer shall certify, at a minimum, the specified percentage of its vehicle fleet to these standards according to the implementation schedule set forth below. For this calculation, the manufacturer's vehicle fleet is defined as the total vehicles produced and delivered for sale by the manufacturer in California that are subject to this standard.

Model Year	*Minimum Percentage of Vehicle Fleet*[1]
2026	30
2027	60
2028 and subsequent	100

[1] Small volume manufacturers are not required to comply with the phase-in schedule set forth in this table. Instead, they shall certify 100 percent of their 2028 and subsequent model year vehicle fleet to the standards.

(ii) 2028 and subsequent model year vehicles must meet the minimum canister size requirement for vehicles that have a tank pressure which exceeds 10 inches of water during the running loss test.

(A) Compliance with minimum canister size requirement is demonstrated using the equation in Part III of these test procedures

PART II. DURABILITY DEMONSTRATION

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PART III. EVAPORATIVE EMISSION TEST PROCEDURES FOR LIGHT- AND MEDIUM-DUTY VEHICLES

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B. Calibrations

1. Evaporative emission enclosure calibrations are specified in 40 CFR §86.117-90. For the purposes of this section III.B, methanol shall mean ethanol when testing with ethanol-containing fuel. Methanol measurements may be omitted when methanol-fueled vehicles will not be tested in the evaporative enclosure. Amend 40 CFR §86.117-90 to include an additional section III.B.1.1., to read:

1.1. Diurnal evaporative emission enclosure. The diurnal evaporative emission measurement enclosure calibration consists of the following parts: initial and periodic determination of enclosure background emissions, initial determination of enclosure volume, and periodic hydrocarbon (HC) and methanol retention check and calibration. Calibration for HC and methanol may be conducted in the same test run or in sequential test runs.

1.1.1. The initial and periodic determination of enclosure background emissions shall be conducted according to the procedures specified in §86.117-90(a)(1) through (a)(6). The enclosure shall be maintained at a nominal temperature of 105.0°F throughout the four hour period. Variable volume enclosures may be operated in either the latched volume configuration, or with the variable volume feature active. Fixed volume enclosures shall be operated with inlet and outlet flow streams closed. The allowable enclosure background emissions of HC and/or methanol as calculated according to 40 CFR §86.117-90(a)(7) shall not be greater than 0.05 grams in 4 hours. The enclosure may be sealed and the mixing fan operated for a period of up to 12 hours before the initial HC concentration reading (C_{HCi}) and the initial methanol concentration reading (C_{CH3OHi}) is taken and the four hour background measurement period begins.

1.1.2. The initial determination of enclosure internal volume shall be performed according to the procedures specified in section III.A.1.3. If the enclosure will be used for hot soak determination, the determination of enclosure internal volume shall also be performed based on 105°F.

1.1.3. The HC and methanol measurement and retention checks shall evaluate the accuracy of enclosure HC and methanol mass measurements and the ability of the enclosure to retain trapped HC and methanol. The check shall be conducted over a 24-hour period with all of the normally functioning subsystems of the enclosure active. A known mass of propane and/or methanol shall be injected into the enclosure and an initial enclosure mass measurement(s) shall be made. The enclosure shall be subjected to the temperature cycling specified in section III.D.10.3.7. of these procedures (revising 40 CFR §86.13390(l)) for a 24 hour period. The temperature cycle shall begin at 105ºF (hour 11) and continue according to the schedule until a full 24-

hour cycle is completed. A final enclosure mass measurement(s) shall be made. The ~~following procedure~~ HC (propane) measurement and retention check shall be performed prior to the introduction of the enclosure into service and following any modifications or repairs to the enclosure that may impact the integrity of this enclosure; otherwise, the following procedure shall be performed on a monthly basis. (If six consecutive monthly HC retention checks are successfully completed without corrective action, the following procedure may be determined quarterly thereafter as long as no corrective action is required.) The methanol measurement and retention check shall be performed only upon initial SHED installation or after major maintenance which may impact methanol retention based on good engineering judgement.

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D. Test Procedure

The test sequence described in 40 CFR §86.130 through §86.140 shall be performed with the following modifications:

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3. Vehicle Preconditioning

3.1.1. For supplemental vehicle preconditioning requirements for 2001 through 2008 model-year hybrid electric vehicles, refer to the "California Exhaust Emission Standards and Test Procedures for 2005 – 2008 Model Zero-Emission Vehicles, and 2001 – 2008 Model Hybrid Electric Vehicles, in the Passenger Car, Light-Duty Truck, and Medium-Duty Vehicle Classes."

3.1.2. For supplemental vehicle preconditioning requirements for 2009 and subsequent model-year hybrid electric vehicles, refer to the “California Exhaust Emission Standards and Test Procedures for 2009 through 2017 Model Zero-Emission Vehicles and Hybrid Electric Vehicles, in the Passenger Car, Light-Duty Truck and Medium-Duty Vehicle Classes,” or the “California Exhaust Emission Standards and Test Procedures for 2018 and Subsequent Model Zero-Emission Vehicles and Hybrid Electric Vehicles, in the Passenger Car, Light-Duty Truck and Medium-Duty Vehicle Classes,” as applicable.

3.2. The following language shall be applicable in lieu of 40 CFR §86.132-90(a)(4) for 2001 through 2011 model-year vehicles; and, in lieu of 40 CFR §86.132-00(e) for 2012 and subsequent model-year vehicles.

The Executive Officer may also choose to conduct or require the performance of optional or additional preconditioning to ensure that the evaporative emission control system is subjected to conditions typical of normal driving. The optional preconditioning shall consist of no less than 20 and no more than 50 miles of on-road mileage accumulation under typical driving conditions.

3.3. The following language shall be applicable in lieu of 40 CFR §86.132-90(b) for 2001 through 2011 model-year vehicles. For 2012 and subsequent model-year vehicles, the vehicle preconditioning shall be performed in accordance with 40 CFR §86.132-00(f) through (j), except when amended by the following language.

3.3.4. For the three-day diurnal sequence, the evaporative emissions storage canister(s) shall be preloaded with an amount of butane equivalent to 1.5 times the nominal working capacity. For vehicles with multiple canisters in a series configuration, the set of canisters must be preconditioned as a unit. For vehicles with multiple canisters in a parallel configuration, each canister shall be preconditioned separately. For vehicles equipped with a non-integrated refueling emission control system, the non-integrated canisters shall be preconditioned for the three-day diurnal test sequence according to the procedure in section III.D.3.3.5.1. All 2012 and subsequent model-year off-vehicle charge capable hybrid electric vehicles equipped with non-integrated refueling canister-only systems shall be preconditioned for the three-day diurnal test sequence according to the procedure specified in section III.D.3.3.6., unless a manufacturer is conducting only an exhaust emission test sequence, in which case the optional canister preconditioning and loading method allowed by section III.D.1.7.10. may apply. If a vehicle is designed to actively control evaporative or refueling emissions without a canister, the manufacturer shall devise an appropriate preconditioning procedure subject to the approval of the Executive Officer. If canisters on both certification and production vehicles are equipped with purge and load service ports, the service port shall be used for the canister preconditioning. The nominal working capacity of a carbon canister shall be established by determining the mass of butane required to load a stabilized canister to a 2-gram breakthrough. The 2-gram breakthrough is defined as the point at which the cumulative quantity of hydrocarbons emitted is equal to 2 grams, as defined in section I.B.1.3. The determination of nominal capacity shall be based on the average capacity of no less than five canisters which are in a stabilized condition. For stabilization, each canister must be cycled no less than 10 times and no more than 100 times to a 2-gram breakthrough with a 50/50 mixture by volume of butane and nitrogen, at a rate of 15 ± 2 grams butane per hour. Each canister loading step must be preceded by canister purging with 300 canister bed volume exchanges at 48 SCFH. The following procedure shall be used to preload the canister:

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3.3.6. After the soak period specified in section III.D.1.7.5., is completed, the canister for a 2012 and subsequent model-year off-vehicle charge capable hybrid electric vehicle equipped with a non-integrated refueling canister-only system shall be preconditioned and loaded according to the following steps. Prior to conducting the applicable test sequence, the canister shall have already achieved a stabilized state, such as is accomplished using the stabilization method described in section III.D.3.3.4. Good engineering practice and safety considerations, such as, but not limited to, adequate ventilation and appropriate electrical groundings, shall apply.

3.3.6.1. Ambient temperature levels encountered by the test vehicle throughout these steps shall not be less than 68ºF (20ºC) or more than 86ºF (30ºC).

3.3.6.2. The test vehicle shall be approximately level, during the performance of these steps, to prevent abnormal fuel distribution.

3.3.6.3. In order to be moved, the test vehicle shall be pushed, as necessary, without starting its engine, throughout the performance of these steps.

3.3.6.4. The test vehicle shall be allowed to soak for a minimum of 6 hours and a maximum of 24 hours, at 80ºF ±3ºF (27ºC ±1.7ºC), prior to starting the fuel-tank-fill canister-loading step. It is optional for the manufacturer to isolate the refueling canister ~~The refueling canister shall remain isolated~~ from its system during this soak period, in order to prevent any abnormal purging or loading of it during this soak period. During certification, the manufacturer shall report whether the canister was isolated or not, and the same method shall be used for compliance testing.

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3.3.6.11. It is optional for the manufacturer to isolate the refueling canister ~~The refueling canister shall be isolated~~ from its system as soon as possible after completing the refilling step. During certification, the manufacturer shall report whether the canister was isolated or not, and the same method shall be used for compliance testing.

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8. Running Loss Test

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8.1. If running loss testing is conducted using an enclosure which incorporates atmospheric sampling equipment, the manufacturer shall perform the following steps for each test:

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8.1.7. When the ambient temperature is 105ºF ± 5ºF, the running loss test shall begin. Analyze enclosure atmosphere for hydrocarbons and alcohol ~~at the beginning of each phase of the test (i.e., each UDDS and 120 second idle; the two NYCCs and 120 second idle)~~ and record. This is the initial (time = 0 minutes) hydrocarbon concentration, herein denoted as C_{HCe1}, and initial ethanol concentration, herein denoted as $C_{C2H5OHe1}$. ~~This is the background hydrocarbon concentration, herein denoted as $C_{HCa(n)}$ for each phase of the test and the background methanol concentration, herein denoted as $C_{CH3OHa(n)}$ for each phase of the test.~~ The methanol sampling must start simultaneously with the initiation of the hydrocarbon analysis and continue for 4.0 ± 0.5 minutes. Record the time elapsed during this analysis. If the 4 minute sample period is inadequate to collect a sample of sufficient concentration to allow accurate Gas Chromatography analysis, rapidly collect the methanol sample in a bag and then bubble the bag sample through the impingers at the specified flow rate. The time elapsed between collection of the bag sample and flow through the impingers should be minimized to prevent any losses.

8.1.10. Allowable tank pressure during the running loss test:

If vehicle's tank pressure during running loss test:	Then follow this requirement:
Does not exceed 10 inches of water	Transitory incidents of the pressure exceeding 10 inches of water, not greater than 10 percent of the total driving time, shall be acceptable during the running loss test if the manufacturer can demonstrate that the tank pressure does not exceed 10 inches of water during in-use operation.
Exceeds 10 inches of water	Manufacturer shall demonstrate in a separate test or an engineering evaluation that vapor would not be vented to the atmosphere if the fuel fill pipe cap was removed at the end of the test.

~~Tank pressure shall not exceed 10 inches of water during the running loss test unless a pressurized system is used and the manufacturer demonstrates in a separate test that vapor would not be vented to the atmosphere if the fuel fill pipe cap was removed at the end of the test. For 2012 and subsequent model-year off-vehicle charge capable hybrid electric vehicles that are equipped with non-integrated refueling canister-only systems, a manufacturer shall demonstrate in either a separate test or an engineering evaluation, that vapor would not be vented to the atmosphere if the fuel fill pipe cap was removed at the end of the test. Transitory incidents of the pressure exceeding 10 inches of water, not greater than 10 percent of the total driving time, shall be acceptable during the running loss test if the manufacturer can demonstrate that the tank pressure does not exceed 10 inches of water during in-use operation.~~ No pressure checks of the evaporative system shall be allowed. If the manufacturer suspects faulty or malfunctioning instrumentation, a repair of the test instrumentation may be performed. Under no circumstances will any changes/repairs to the evaporative emissions control system be allowed.

8.1.11. The FID hydrocarbon analyzer shall be zeroed and spanned immediately prior to the end ~~of each phase~~ of the test.

8.1.12. The running loss test ends with completion of the final 120 second idle and occurs 72 ± 2 minutes after the test begins. Analyze the enclosure atmosphere for hydrocarbons and for alcohol ~~following each phase~~ at the end of the running loss test. This is the sample hydrocarbon concentration, herein denoted as C_{HCe2} ~~$C_{HCs(n)}$ for each phase~~ at the end of the test and the sample alcohol concentration, herein denoted as $C_{C2H5OHe2}$ ~~$C_{CH3OHs\ (n)}$ for each phase~~ at the end of the test. ~~The sample hydrocarbon~~

~~and alcohol concentration for a particular phase of the test shall serve as the background concentration for the next phase of the test. The running loss test ends with completion of the final 120 second idle and occurs 72 ± 2 minutes after the test begins.~~ The elapsed time of this analysis shall be recorded.

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8.2. If running loss testing is conducted using a cell which incorporates point source sampling equipment, the manufacturer shall perform the following steps for each test:

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8.2.5. Allowable tank pressure during the running loss test:

If vehicle's tank pressure during running loss test:	Then follow this requirement:
Does not exceed 10 inches of water	Transitory incidents of the pressure exceeding 10 inches of water, not greater than 10 percent of the total driving time, shall be acceptable during the running loss test if the manufacturer can demonstrate that the tank pressure does not exceed 10 inches of water during in-use operation.
Exceeds 10 inches of water	Manufacturer shall demonstrate in a separate test or an engineering evaluation that vapor would not be vented to the atmosphere if the fuel fill pipe cap was removed at the end of the test.

~~Tank pressure shall not exceed 10 inches of water during the running loss test unless a pressurized system is used and the manufacturer demonstrates in a separate test that vapor would not be vented to the atmosphere if the fuel fill pipe cap was removed at the end of the test. For 2012 and subsequent model-year off-vehicle charge capable hybrid electric vehicles that are equipped with non-integrated refueling canister-only systems, a manufacturer shall demonstrate in either a separate test or an engineering evaluation, that vapor would not be vented to the atmosphere if the fuel fill pipe cap was removed at the end of the test. Transitory incidents of the pressure exceeding 10 inches of water, not greater than 10 percent of the total driving time, shall be acceptable during the running loss test if the manufacturer can demonstrate that the tank pressure does not exceed 10 inches of water during in-use operation.~~ No pressure checks of the evaporative system shall be allowed. If the manufacturer suspects faulty or malfunctioning instrumentation, a repair of the test instrumentation may be performed. Under no circumstances will any changes/repairs to the evaporative emissions control system be allowed.

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11. Calculations: Evaporative Emissions

11.0. Revise 40 CFR §86.143-~~90~~ 96 as amended Oct. 25, 2016, as follows:

11.1. Revise subparagraph (a) and (b) to read: The calculation of the net hydrocarbon plus ethanol (or methanol) mass change in the enclosure is used to determine the diurnal, hot soak, and running loss mass emissions. If the emissions also include alcohol components other than methanol and ethanol, the manufacturer shall determine an appropriate calculation(s) which reflect characteristics of the alcohol component similar to the equations below, subject to the Executive Officer approval. The mass changes are calculated from initial and final hydrocarbon and ethanol concentrations in ppm carbon, initial and final enclosure ambient temperatures, initial and final barometric pressures, and net enclosure volume using the equations of this section III.D.11. Diurnal, hot soak, and running loss mass emissions for methanol-fueled vehicles shall be conducted according to 40 CFR §86.143-96~~, as amended August 23, 1995~~.

11.2. Revise subparagraph (~~a~~b)(1)(i) to read:

For ethanol in an enclosure:

$$M_{C2H5OH} = (V_n - 50) \times \left[\frac{(C_{S1f} \times AV_{1f}) + (C_{S2f} \times AV_{2f})}{V_{Ef}}\right] - \left[\frac{(C_{S1i} \times AV_{1i}) + (C_{S2i} \times AV_{2i})}{V_{Ei}}\right] + (M_{C2H5OHout} - M_{C2H5OHin})$$

where:

M_{C2H5OH} is the ethanol mass emissions (μg)

V_n is the enclosure nominal volume. (ft^3)

C_S is the GC concentration of sample (μg/ml)

AV is the volume of absorbing reagent in impinger (ml)

V_E is the 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.

i = initial sample

f = final sample

1 is the first impinger

2 is the second impinger

$M_{C2H5OH,\ out}$ is the mass of ethanol exiting the enclosure from the beginning of the cycle to the end of the cycle; this only applies to diurnal testing in fixed-volume enclosures (µg); For variable-volume enclosures, $M_{C2H5OH,\ out}$ is zero

$M_{C2H5OH,\ in}$ is the mass of ethanol entering the enclosure from the beginning of the cycle to the end of the cycle; this only applies to diurnal testing in fixed-volume enclosures (µg); For variable-volume enclosures, $M_{C2H5OH,\ in}$ is zero

The enclosure ethanol mass (M_{C2H5OH}) determined from the equation above goes into the equations of subsequent sections to calculate the total mass emissions, where $M_{C2H5OHhs}$ is the ethanol mass emissions from the hot soak test, $M_{C2H5OHdi}$ is the ethanol mass emissions from the diurnal test, and $M_{C2H5OHrl}$~~(n)~~ is the total ethanol mass emissions from the running loss test ~~for phase n of the test~~. For diurnal testing, this calculation shall be made for each 24-hour diurnal period.

11.3. Revise subparagraph ~~(a)(2)~~(b)(1)(ii) to read:

11.3.1. For hydrocarbons in an enclosure:

(a) Hot soak and diurnal testing in an enclosure: For fixed volume enclosures, the enclosure hydrocarbon mass is determined as:

$$M_{HC} = [2.97x\ (V_n - 50)\ x10^{-4}\ x\ \{P_f\ (C_{HCe2} - rC_{C2H5OHe2})/T_f - P_i\ (C_{HCe1} - rC_{C2H5OHe1})/T_i\}] + M_{HC,\ out} - M_{HC,\ in}$$

where:

M_{HC} is the HC mass emissions (grams)

V_n is the enclosure nominal volume. (ft^3)

P_i is the initial barometric pressure (inches Hg)

P_f is the final barometric pressure (inches Hg)

C_{HCe2} is the final enclosure hydrocarbon concentration including FID response to ethanol in the sample (ppm C)

C_{HCe1} is the initial enclosure hydrocarbon concentration including FID response to ethanol in the sample (ppm C)

$C_{C2H5OHe2}$ is the final ethanol concentration (ppm C equivalent)

$$= \frac{2.088 \times 10^{-3} \times T_f}{P_f \times V_E} \times [(C_{S1f} \times AV_{1f}) + (C_{S2f} \times AV_{2f})]$$

$C_{C2H5OHe1}$ is the initial ethanol concentration (ppm C equivalent)

$$= \frac{2.088 \times 10^{-3} \times T_i}{P_i \times V_E} \times [(C_{S1i} \times AV_{1i}) + (C_{S2i} \times AV_{2i})]$$

r is the FID response factor to ethanol

T_i is the initial enclosure temperature (°R)

T_f is the final enclosure temperature (°R)

V_E is the 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.

C_S is the GC concentration of sample (µg/ml)

AV is the Volume of absorbing reagent in impinger (ml)

1 is the first impinger

2 is the second impinger

i = initial sample

f = final sample

$M_{HC, out}$ is the mass of hydrocarbon exiting the enclosure from the beginning of the cycle to the end of the cycle; this only applies to diurnal testing in fixed-volume enclosures (grams)

$M_{HC, in}$ is the mass of hydrocarbon entering the enclosure from the beginning of the cycle to the end of the cycle; this only applies to diurnal testing in fixed-volume enclosures (grams)

For vehicles tested in an enclosure with gasoline containing 10 percent ethanol by volume only, measured ethanol values can be omitted so long as the resultant M_{HC} is multiplied by 1.08. If this option is used, then all terms accounting for ethanol in the applicable equations of this section III.D.11 (including ethanol concentration values of the above equation) shall equal zero.

The enclosure HC mass (M_{HC}) determined from the equation above goes into the equations of subsequent sections to calculate the total mass emissions, where M_{HChs} is the HC mass emissions from the hot soak test, M_{HCdi} is the HC mass emissions from the diurnal test, and M_{HCrl}~~(n)~~ is the total HC mass emissions from the running loss test ~~for~~

~~phase n of the test~~ if the enclosure method is used for running loss testing. For diurnal testing, this calculation shall be made for each 24-hour diurnal period.

<u>Revise subparagraph (b)(1)(iii) to read:</u>
For variable volume enclosures, calculate the enclosure HC mass (M_{HC}) according to the equation used above except that P_f and T_f shall equal P_i and T_i and $M_{HC, out}$ and $M_{HC, in}$ shall equal zero.

(b) <u>Revise subparagraph (b)(2) to read:</u>

<u>For the point source method:</u>

Running loss mass.

The running loss HC mass per distance traveled is defined as:

$$M_{HCrlt} = (M_{HCrl(1)} + M_{HCrl(2)} + M_{HCrl(3)})/(D_{rl(1)} + D_{rl(2)} + D_{rl(3)})$$

where: M_{HCrlt} is the total running loss HC mass per distance traveled (grams HC per mile)

$M_{HCrl(n)}$ is the running loss HC mass for phase n of the test (grams HC)

$D_{rl(n)}$ is the actual distance traveled over the driving cycle for phase n of the test (miles)

The running loss ethanol mass per distance traveled is defined as:

$$M_{C2H5OHrlt} = (M_{C2H5OHrl(1)} + M_{C2H5OHrl(2)} + M_{C2H5OHrl(3)})/(D_{rl(1)} + D_{rl(2)} + D_{rl(3)})$$

where: $M_{C2H5OHrlt}$ is the total running loss ethanol mass per distance traveled (grams ethanol per mile)

$M_{C2H5OHrl(n)}$ is the running loss ethanol mass for phase n of the test (grams ethanol)

~~For the point source method:~~

Hydrocarbon emissions:
<u>For running loss testing by the point-source method, the mass emissions of each test phase are calculated below.</u>
<u>If emissions are continuously sampled, the following equations can be used in integral form.</u>

$$M_{HCrl(n)} = (C_{HCs(n)} - C_{HCa(n)}) \times 16.88 \times V_{mix} \times 10^{-6}$$

where: $C_{HCs(n)}$ is the sample bag HC concentration for phase n of the test (ppm C)

$C_{HCa(n)}$ is the background bag concentration for phase n of the test (ppm C)

16.88 is the density of pure vapor at 68°F (grams/ft^3)

V_{mix} is the total dilute CVS volume (std. ft^3)

and: V_{mix} is calculated per 40 CFR §86.144-~~90~~94

Ethanol emissions:

$M_{C2H5OHrl(n)} = (C_{C2H5OHs(n)} - C_{C2H5OHa(n)}) \times 54.25 \times V_{mix}$

where: $C_{C2H5OHs(n)}$ is the sample bag ethanol concentration for phase n of the test (ppm C equivalent)

$C_{C2H5OHa(n)}$ is the background bag concentration for phase n of the test (ppm C equivalent)

54.25 is the density of pure vapor at 68°F (grams/ft^3)

V_{mix} is the total dilute CVS volume (std. ft^3)

and: V_{mix} is calculated per 40 CFR §86.144-~~90~~94

For vehicles tested for running loss using the point source method with gasoline containing 10 percent ethanol by volume only, measured ethanol values can be omitted so long as the resultant $M_{HCrl(n)}$ is multiplied by 1.08. If this option is used, then all terms accounting for ethanol in the applicable equations of this section III.D.11 shall equal zero and both $C_{HCs(n)}$ and $C_{HCa(n)}$ in the above equation shall include the FID response to ethanol (the FID response to ethanol shall not be subtracted).

For the enclosure method:

~~$M_{HCrl(n)}$ is the running loss HC mass for phase n of the test (grams HC) and shall be determined by the method specified in section III.D.11.3.1.(a).~~

The running loss HC mass per distance traveled is defined as:

$M_{HCrlt} = (M_{HCrl})/(D_{rl})$

where: M_{HCrlt} is the total running loss HC mass per distance traveled (grams HC per mile)

M_{HCrl} is the running loss HC mass for the entire test, and shall be determined by the method specified in section III.D.11.3.1.(a) (grams HC)

D_{rl} is the actual distance traveled driving the entire test (miles)

$M_{C2H5OHrlt} = (M_{C2H5OHrl})/(D_{rl})$

where: $M_{C2H5OHrlt}$ is the total running loss ethanol mass per distance traveled (grams ethanol per mile)

$M_{C2H5OHrl}$ is the running loss ethanol mass for the entire test, and shall be determined by the method specified in section III.D.11.2 (grams ethanol)

D_{rl} is the actual distance traveled driving the entire test (miles)

11.3.2 Subparagraph (c): no changes

11.3.~~2.~~3. ~~Revise subparagraph (a)(3) to read:~~

The total mass emissions shall be adjusted as follows:

(1) $M_{hs} = M_{HChs} + (14.2284/23.034) \times 10^{-6} M_{C2H5OHhs}$

(2) $M_{di} = M_{HCdi} + (14.3594/23.034) \times 10^{-6} M_{C2H5OHdi}$

(3) $M_{rl} = M_{HCrlt} + (14.2284/23.034) \times 10^{-6} M_{C2H5OHrlt}$

11.3.~~3~~4. Revise subparagraph ~~(b)~~(d) to read: The final evaporative emission test results reported shall be computed by summing the adjusted evaporative emission result determined for the hot soak test (M_{hs}) and the highest 24-hour result determined for the diurnal breathing loss test (M_{di}). The final reported result for the running loss test shall be the adjusted emission result (M_{rl}), expressed on a grams per mile basis.

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14. Minimum canister size calculation for selected vehicles:

14.1 Applies to vehicles that have a tank pressure which exceeds 10 inches of water during the running loss test.

14.2 Min Canister nominal working capacity (grams) =

$$1.3 \times [5.8 \times 14.7/P_{tvs} \times ((P_{tvs} \times V_{tvs})/14.7 - V_{tvs}) + G_{refuel} \times 0.86 \times V_{fuelcap}]$$

where:

- Nominal working capacity as defined in III.D.3.3.4
- V_{tvs} is vapor space volume. This is 90% of the total geometric volume of the fuel tank. Geometric volume is the sum of the fuel tank capacity and vapor space. (gallons)
- $V_{fuelcap}$ is the nominal fuel tank capacity, which means the volume of the fuel tank(s), specified by the manufacturer to the nearest tenth of a U.S. gallon, which may be filled with fuel from the fuel tank filler inlet. (gallons)
- G_{refuel} is the vapor generation during refueling (grams/gallon)
  - Use 5 grams/gallon as default
  - Manufacturer has the option to use a custom value for G_{refuel} which represents the refueling vapor generation in the fuel tank of their particular vehicle.
- P_{tvs} is fuel tank's maximum pressure in-use (absolute pressure in psi) Pressure to use for P_{tvs};
  A default value of 19 psia is presumed to be a typical maximum tank pressure and shall be used for this calculation except as follows:

  A) If the actual maximum pressure in the tank is higher than the default value at any time during charge-sustaining operation (for off-board charge capable vehicles) or during normal operation (for hybrid or conventional vehicles), the actual maximum pressure shall be used in the calculation.

  B) If the manufacturer demonstrates that the actual maximum pressure in the tank is lower than default value, under all operating conditions (e.g., charge-depleting and charge-sustaining operation for off-board charge capable vehicles), the actual maximum pressure may be used in the calculation in lieu of the default value.

  For purposes of this requirement to determine actual maximum pressure, manufacturers shall only be required to verify the maximum pressure that occurs when conducting the running loss fuel tank temperature profile sequence in accordance with section III.C (e.g., 105°F fuel and ambient temperature, UDDS and NYCC driving cycles), except reference this section III.D.14 for determining state of charge.

Reporting requirements for manufacturer at certification:

- Indicate how V_{tvs}, P_{tvs}, and G_{refuel} were determined. If a custom value was used for any of these, then provide supporting data demonstrating the appropriateness of the value(s) selected.
- A clear description of what conditions trigger the fuel tank pressure to be relieved.

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Part IV. Figures illustrating the evaporative emission test procedures

The figures in this Part IV are for illustrative purposes only. If any discrepancies exist between the language in Part III and the figures in this Part IV, the requirements in Part III shall apply.

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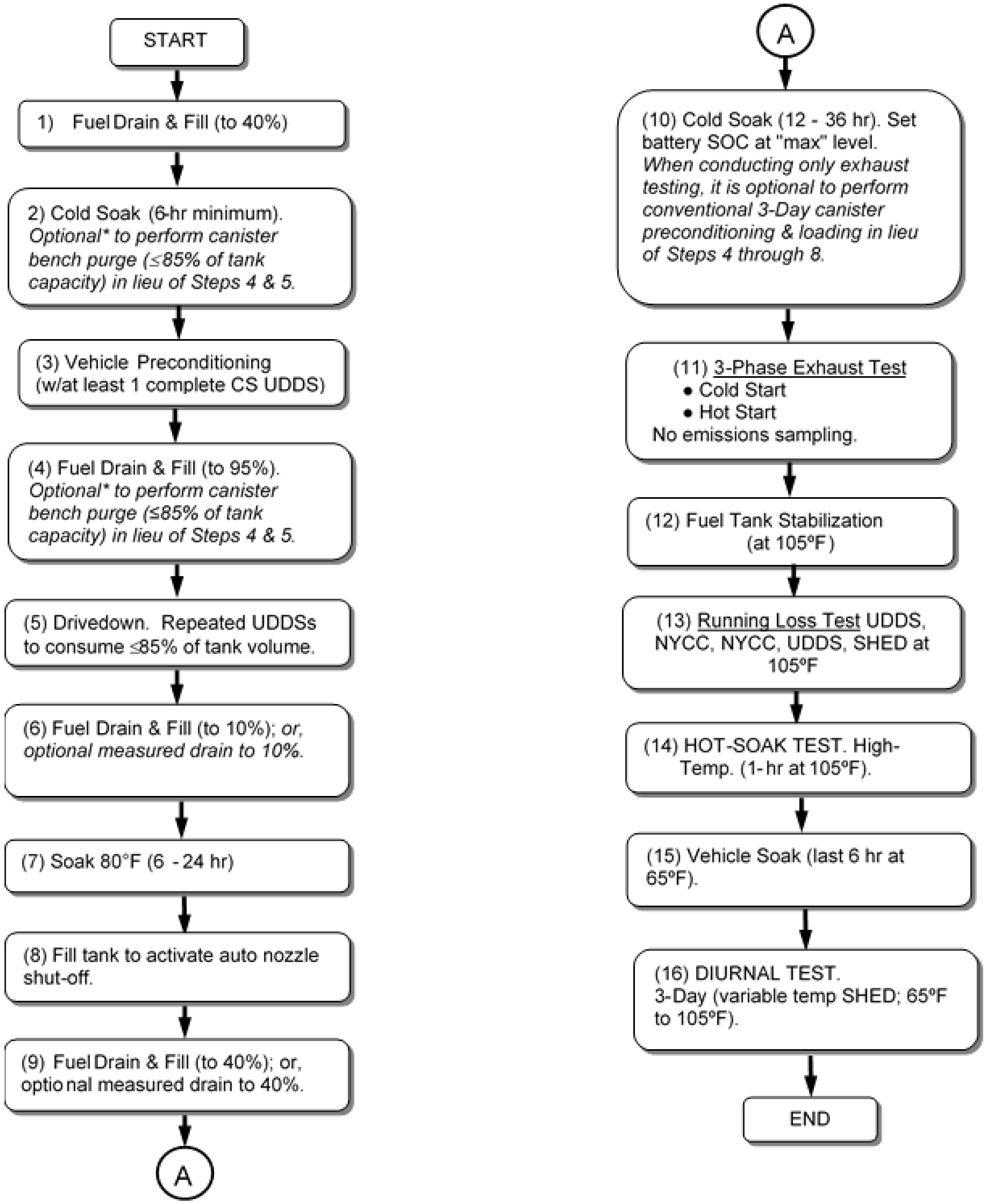

Figure 4: 3-day Test Procedure for Off-vehicle Charge Capable Hybrid Electric Vehicles with Non-Integrated Refueling Canister-Only System